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Lithic use-wear evidence for hunting in the Levantine Middle Paleolithic

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RÉSUMÉ

Des traces caractéristiques d'impact (lance ou pieu), de boucherie et d'emmanchement ont été observées sur des pointes provenant d'outillages moustériens du Levant. Le fait que ces « traces d'impact » apparaissent aussi bien dans les assemblages associés aux hommes modernes que dans ceux qui sont associés aux Néandertaliens suggère que ces deux hominidés pratiquaient les mêmes stratégies prédatoires.

ABSTRACT

Use-wear patterns characteristic of projectile impact, butchery and haft contact occur on pointed artifacts from Levantine Mousterian assemblages. That such « impact wear » appears in both the assemblages associated with early modern humans and those associated with Neandertals suggests these hominids practiced similar predatory strategies.

Introduction

The hunting of large animal prey has long been viewed as a key force in shaping the social and biological characteristics of modern humans. This paper explores the lithic evidence for the capture and processing of animal prey in the Levantine Mousterian and the implications of this evidence for understanding Upper Pleistocene hominid behavior and evolutionary ecology. Analysis of Levantine Mousterian collections indicates stone projectile armatures were employed both by Neandertals and by early anatomically-modern humans living in Southwest Asia between 45-100,00 BP.

Background

The use of stone armatures on wooden spears is a clear indication, not just of hunting, but also that such predatory activity occurred with sufficient regularity for there to have been an energetic « payoff » for enhancing the lethality of spear points beyond that which can be obtained by a sharpened wooden point. Recent interpretations of the Middle Paleolithic record have inferred that archaic/Neandertal populations lacked the ability or the incentive to devise such lithic projectile armatures (Binford, 1985 : 200 ; Gamble, 1986 ; 385 ; Dibble, 1987 : 187-189 ; Chase, 1989 : 332 ; Holdaway, 1989 ; Mellars, 1989 : 351). Instead, such lithic projectile armatures are thought to have appeared during or after the Middle-Upper Paleolithic transition about 35-40,00 BP with the appearance of anatomically-modern humans.

In the Levant, however, between 45-100,00 BP both archaic/Neandertal humans and early anatomically-modern humans are associated with the same Levantine Mousterian industry (Trinkaus, 1984 ; Vandermeersch, 1989 ; Bar-Yosef, 1989). Most Levantine Mousterian assemblages are executed on fine-grained and highly-siliceous flints that are eminently suitable for use-wear analysis (Shea, 1988, 1989a, 1989b, 1991). If, as recent interpretations of the European record have suggested, the use of stone-tipped projectile weapons in hunting was indeed a fundamental behavioral contrast between archaic/Neandertal humans and early modern humans, or one between Middle and Upper Paleolithic populations in general, then one should expect stone projectile points either (in the first case) to be associated only with early modern humans, or (in the second case) to be absent entirely from Levantine Mousterian contexts.

Experiments, microscopy, and pattern recognition

Many European Middle Paleolithic and African Middle Stone Age artifacts are described as « points » (Bordes, 1961). Because such artifacts are well-suited for a variety of cutting tasks, however, the morphology of pointed artifacts is not necessarily a reliable indicator of the acutal uses to which they were put. Only lithic use-wear analysis can provide a secure basis for inferring whether or not Middle Paleolithic « points » were used as projectile armatures.

In order to provide an empirical basis for the recognition and interpretation of Levantine Mousterian stone tool functions from patterned variation in use-wear traces, lithic artifacts replicating Middle Paleolithic forms were made and used by the author in 1279 experiments replicating projectile use, butchery, hide-working, carving bone and antler, cutting soft plant matter, woodworking and digging (Shea, 1991). In this experimental program, 98 flint artifacts were lashed to hafts and both thrust and thrown into animal targets, including domestic cow (*Bos familiarus*), horse (*Equus caballus*), donkey (*Equus asinus*), white-tailed deer (*Odocoilianus virginianus*) and gazelle (*Gazella gazella*). Most points were lashed to a foreshaft approximately 10-20 cm in length that was inserted into a hole in a main spear shaft about 2 m in length and 3-5 cm in diameter. Melted beeswax and pine pitch were applied to these lashing traces in order to make a durable bond. These experimental points were used until damage impaired their ability to penetrate the skin of target, the point at which it seems reasonable to suppose that prehistoric stone projectile points would have been discarded.

Following use, each worn experimental tool was scrubbed in soap and warm water then washed with acetone to remove animal fats and finger grease. All tools were examined for use-wear traces (polish, edge-rounding, striation, and microfractures) initially under direct lighting with an Olympus SZTR 4060 stereomicroscope (6-160x) and subsequently under incident lighting with an Olympus BHM metallurgical microscope (70-300x).

These experiments provided a comparative basis for interpreting use-wear patterns resulting from a wide range of activities. In general, the direction of tool motion can be identified from the alignment of microfractures and striations and from the distribution of edge-rounding and polish (Odell, 1981 ; Odell and Odell-Vereecken, 1980). The resistance characteristics of the worked material can be inferred from both the size and morphology of microfractures (larger = harder), and the extent to which abrasive wear extended over these microfractures (more extensive = soft, less extensive = hard). Matte-reflecting polishes resulted mainly from the incision of animal tissues ; bright polishes from the incision of wood ; and vitreous polishes from the incision of soil and highly-siliceous plant matter (Keeley, 1980 : 63).

« Impact damage » manifests itself primarily (or at least less ambiguously) in terms of microfracturing traces. The most diagnostic wear pattern resulting from projectile use that was also sufficient to terminate the use-life of a tool was a broad macro-fracture that extended from the tip of the projectile generally onto the ventral surface of the tool (fig. 1). Occasionally such fractures propagated obliquely, creating a scar similar to that resulting from a burin blow (fig. 2). Such large fractures did not occur in any of the other experimentally-replicated activities. Similar wear patterns have been observed on experimental projectile points by other use-wear analysts (Ahler, 1971 ; Bergman, Newcomer, 1983 ; Moss, 1983 ; Fischer *et al.*, 1984 ; Odell, Cowan, 1986). The results of these experiments suggest that such macrofractures were likely to be the most reliable criterion for identifying projectile impact among Levantine Mousterian archaeological collections.

Fig. 1. Experimental impact wear- ventral scar (width of field = 32 mm).

A second common result of stone projectile use was a lateral snap fracture that truncated the tool across the axis perpendicular to its trajectory at impact. Unfortunately, such lateral snaps also result from a wide range of processes, including trampling, laterally-directed force during use, « end-shock » in flintknapping, and soil pressure. This degree of equifinality suggests lateral snapping is not likely to be useful for identifying projectile impact in archaeological collections.

Worn projectiles were also inspected for such abrasive wear traces as striations and polish. Such striations as were observed usually trailed away from the distal tip of the projectile and were mainly visible on points that had missed the animal target

Fig. 2. Experimental impact wear- burination (width of field = 25 mm).

and had instead embedded themselves in soil. Polish was barely visible on the distal tips of impact-damaged projectiles. This absence probably reflects several factors, including the relatively slow loading speeds involved in spear use, the relatively brief duration of incision during impact, the yielding character of many of the materials, such as hide, muscle and viscera, against which projectile points make contact, and the loss of polished edges and surfaces near the distal tip when this fractures from dynamic contact with harder tissues, such as bone.

The results of these experiments suggest that, while polish and striation remain useful clues to many other stone tool uses (*e. g.* Keeley, 1980), microfractures are of equal or greater diagnostic value for identifying projectile impact.

The Levantine Mousterian samples

Twenty Levantine Mousterian assemblages from five sites were identified in which stone tool edges and surfaces were sufficiently well-preserved on a large percentage of implements (> 80 % of a random sample of 100 tools) for use-wear analysis to be conducted. These included Kebara Cave Units IX-XIII (1983-1986 excavations ; see

Bar-Yosef, *et al.*, 1986), Tabun Cave Units I, II, and IX (Jelinek, 1982), Hayonim Cave Level E (Bar-Yosef, 1979), Qafzeh Cave « Vestibule » Units XV, XVII-XXIV (Vandermeersch, 1981), all of which are located in Israel, and Level C of Tor Faraj Rockshelter, which is located in southern Jordan (Henry, 1986). All of the artifacts larger than 25 mm were examined for use-wear traces using the microscopic techniques previously described for the experimental program. Of the 29,206 artifacts examined, 2,309 (7.9 %) were identified as visibly worn from use (tab. 1).

	Artifacts	Use-Worn	Artifacts	EUs	EUs Referable Impact %
Assemblages	n	n	%	n	%
Kebara IX	2449	162	6.6	233	8.5
KebaraX	3258	433	13.3	676	10.1
Kebara XI	4169	363	8.7	537	9.1
Kebara XII	393	63	9.2	104	14.4
Kebara XIII	101	7	6.9	12	25.0
Tabun I-B	431	19	4.4	29	13.8
Tabun I-C	3985	139	3.4	184	2.2
Tabun II-D	1500*	59	3.9	90	13.3
Tabun IX-D	1642	209	12.7	338	6.3
Hayonim E	2185	271	12.4	414	6.8
Qafzeh XV	5872	334	5.7	486	12.8
Qafzeh XVII	1370	61	4.4	91	3.3
Qafzeh XVIII	82	11	13.4	17	0.0
Qafzeh XIX	397	40	10.1	44	2.2
Qafzeh XX	20	5	25.0	6	0.0
Qafzeh XXI	310	23	7.4	30	0.0
Qafzeh XXII	151	15	10.1	16	0.0
Qafzeh XXIIV	67	2	3.0	2	0.0
Tor Faraj C	824	93	11.2	169	16.0
Total	29,206	2309	7.9	3478	9.2

* estimate only, actual total not yet published.

Tab. 1. Sample sizes of Levantine Mousterian assemblages and frequencies of various functional indices related to hominid predatory activity.

Because almost one third of the use-worn tools in these assemblages exhibited more than one discrete concentration of use-wear traces on their perimeter, the occurrence of wear in these assemblages was quantified in terms of « employed units » (EUs), concentrations of wear whose morphological characteristics were referable to a single tool motion and worked material combination. 3478 EUs were identified in the Levantine Mousterian sample. Functional inferences/hypotheses about these EUs were made by systematically comparing the numerically-encoded values for nine use-wear variables recording aspects of edge-rounding, polishing, striation, and microfracturing for experimental reference collection with those for the archaeological databases.

Most EUs in the Levantine Mousterian sample were assessed as resulting from woodworking (1219 EUs or 35.1 %), an interpretation that replicates the results of several studies of European Mousterian assemblages (Beyries 1987b, Plisson 1988). Other frequently-represented activities included butchery (658 EUs or 18.9 %), haft contact (519 EUs or 14.9 %), hide-scraping (288 or 8.2 %), and « bone contact » – a category that could equally well include the results of heavy-duty butchery and/or the carving of bone/antler objects (257 EUs or 7.4 %). 319 EUs (9.2 %) replicated the wear patterns resulting from experimental projectile impact.

Such « impact wear » was identified in fifteen of the twenty assemblages, all except the relatively small collections from Qafzeh XVIII, XX-XXII, and XXIV. Wear traces referable to projectile impact occurred mainly on Levallois points, pointed blades, and triangular flakes that were generally less than 10 cm long (fig. 3), however, wear referable to impact was rarely the only EU on a tool (tab. 2).

Functional Parameters	n	%
Total Artifacts Examined	791	100.0
Use-worn Artifacts Identified	520	65.7
Total EUs	1098	100.0
Retouched EUs	177	16.1
Inferred Motions (EUs)		
cut	401	36.5
shave	25	2.3
scrape	58	5.3
pierce/impact	251	22.9
awl	29	2.4
haft contact	324	29.5
unknown/other	10	0.1
Inferred context of use (EUs)		
impact	251	22.9
butchery	283	25.8
hide-scraping	54	4.9
bone contact	47	4.3
soft plant processing	6	0.6
woodworking	115	10.5
haft contact	324	29.5
unknown/indeterminate	18	1.6
Total EUs referable to :		
prey capture and processing(1)	905	82.4
tool manufacture and repair(2)	169	15.4
indeterminate(3)	24	2.2

(1) Prey capture and processing = impact, butchery, bone contact, haft contact.
(2) Tool manufacture and repair = hide-scraping, woodworking.
(3) Indeterminate = soft plant processing, unknown.

Tab. 2. Functional parameters of pointed artifacts from Levantine Mousterian contexts.

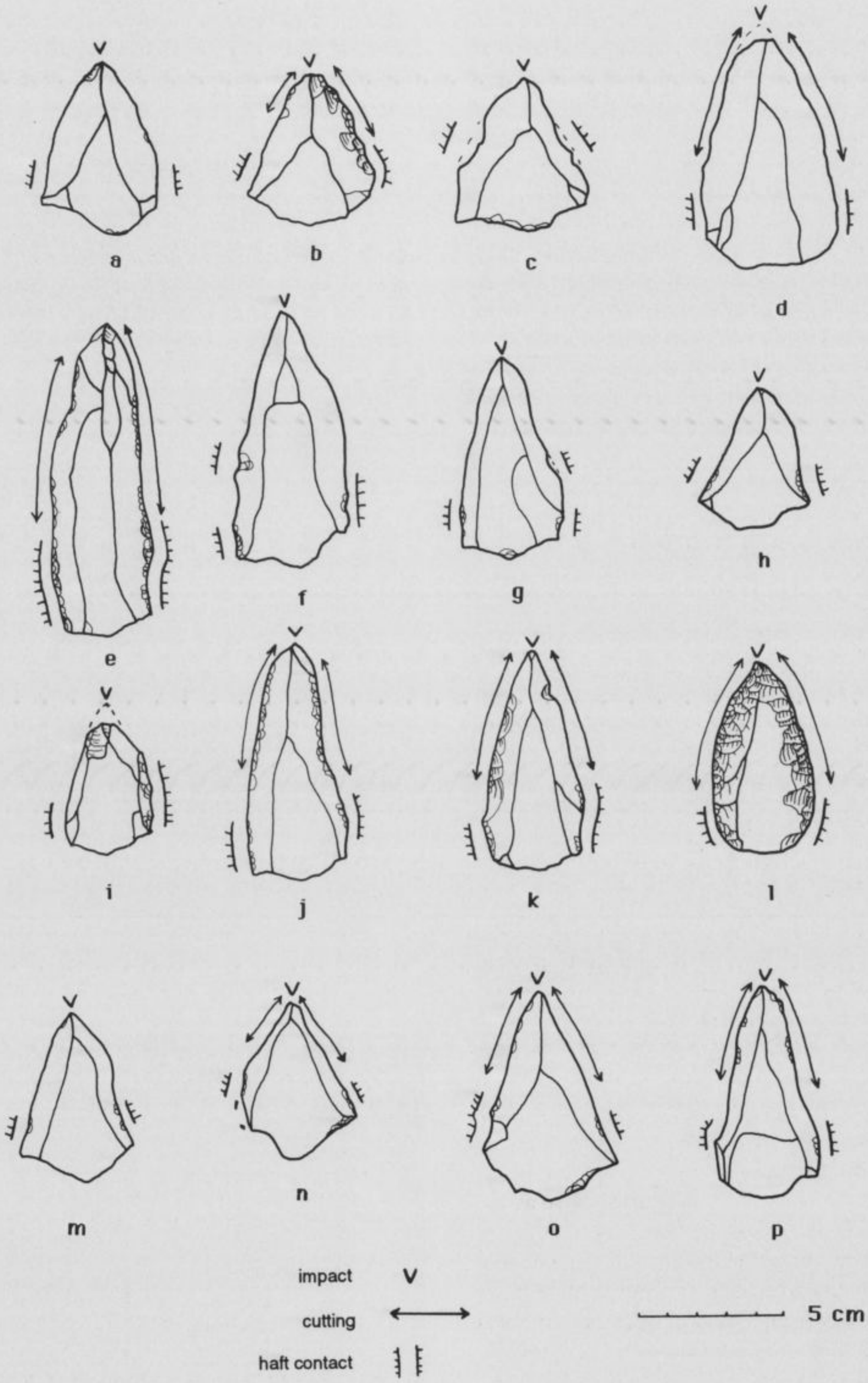

Fig. 3. Pointed Levantine Mousterian artifacts with notes on inferred uses (a-d : Kebara IX-XI ; e-g : Tabun IX ; h-l : Hayonim E ; m-n = Qafzeh XV ; o-p = Tor Faraj C).

The nature and distribution of associated wear traces (fig. 4) suggest the concavity near the proximal half of the point's dorsal surface was usually lashed to a notch cut into a wooden haft (or foreshaft) and possibly secured by some kind of mastic, perhaps bitumen or vegetal resin. Impact fractures replicated both kinds identified in the experimental program (fig. 5-6). The lateral edges trailing away from the distal tip often featured bifacially-distributed microfractures propagating obliquely to the edge covered by a matte-reflecting polish. In the experimental program, such wear results almost exclusively from edge-longitudinal cutting in butchery, hide-working, and bone carving (fig. 7-8). Small clusters of microfractures located near the proximal part of lateral edges (fig. 9) and localized abrasion of dorsal scar ridges near the proximal part of the tool (fig. 10) were interpreted as resulting from sliding contact between the tool and its handle and lashings (see also Beyries, 1987a ; Anderson-Gerfaud, Helmer, 1987). These observations suggest projectile weapons from Levantine Mousterian contexts were often multi-functional, having been used as combination projectiles and general-purpose butchery tools, much like the metal arrows and spears used by

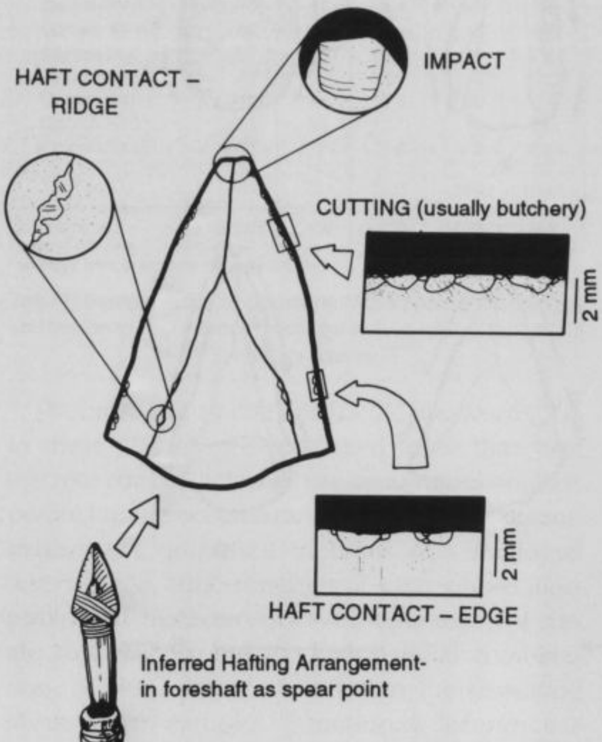

Fig. 4. Spatial relationship of wear traces on a model Levantine Mousterian Levallois point.

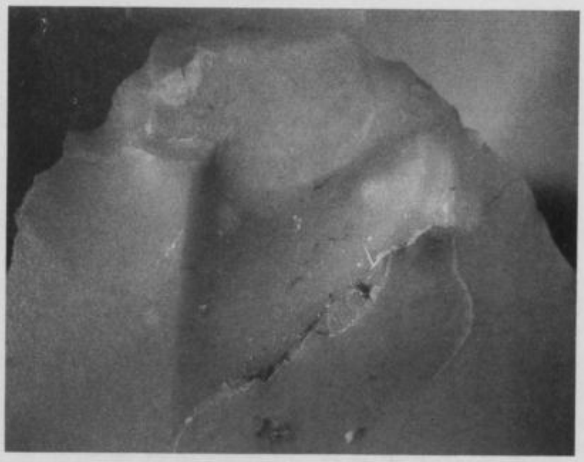

Fig. 5. Archaeological impact wear (ventral scar) on Levallois point from Kebara (see fig. 3 : d ; width of field = 32 mm).

Fig. 6. Archaeological impact wear (burin-like scar) on Levallois point from Hayonim E (width of field = 25 mm).

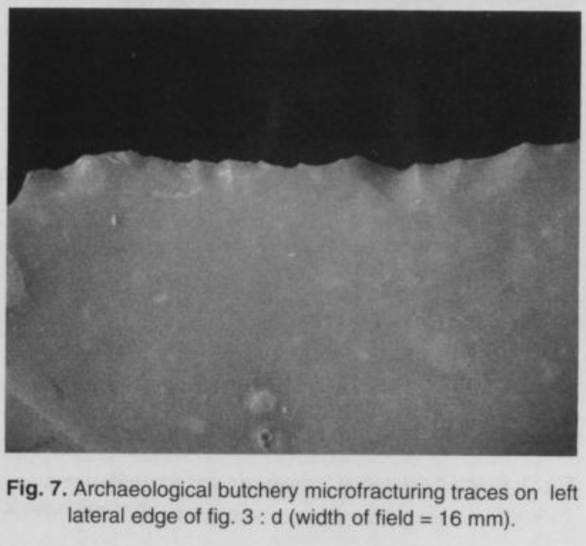

Fig. 7. Archaeological butchery microfracturing traces on left lateral edge of fig. 3 : d (width of field = 16 mm).

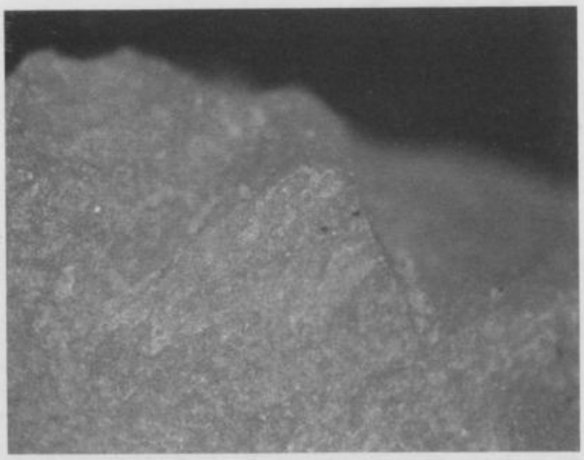

Fig. 8. Archaeological butchery abrasive traces on left lateral edge of fig. 3 : d (width of field = 2 mm).

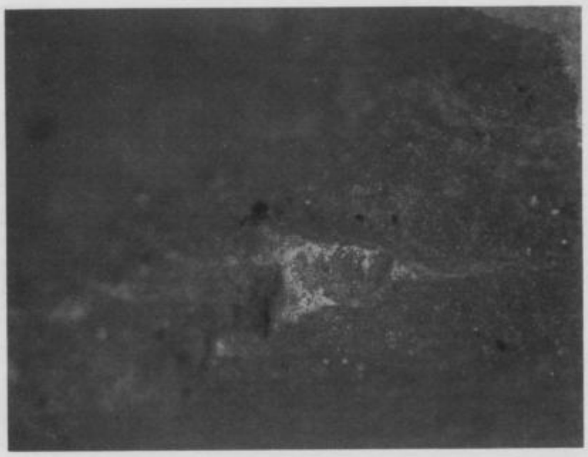

Fig. 10. Archaeological haft contact - abrasion on dorsal ridge of fig. 3 : d (width of field = 2 mm).

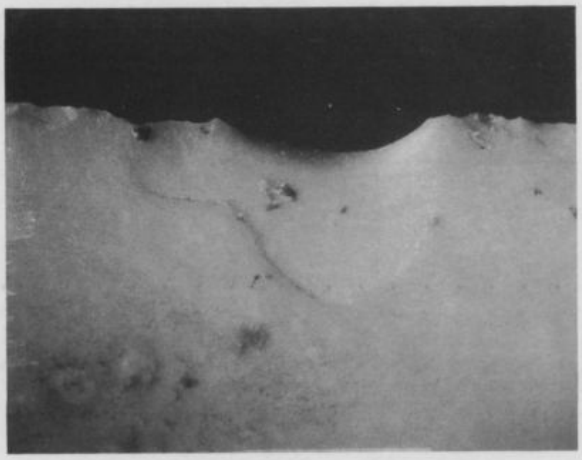

Fig. 9. Archaeological haft contact - microfractures on edge of fig. 3 : d (width of field = 16 mm).

living forager groups such as the !Kung San of the Kalahari Desert (Lee, 1979 : 139) and the Efe of the Ituri Forest in Zaire (Gregory T. Laden, pers. comm., 1990).

Not all use-worn pointed artifacts were worn from impact, but EUs referable to « prey capture and processing », that is, to impact, butchery, and bone contact (which, in the general absence of carved bone artifacts from Levantine Mousterian contexts, is most plausibly interpreted as resulting from heavy-duty butchery), together with haft contact, account for as much as 905/1098 or 82 % of the EUs on points. Wear traces referable to use in tool manufacture and repair, such as hide preparation and woodworking, are far less common among points (15.4 %) than they are in the Levantine Mousterian use-wear sample overall (45.9 %), suggesting that the number of points in an assemblage may be useful as a general indicator of Middle Paleolithic hominid predatory activity.

Discussion : hunting in the Levantine Mousterian

Clearly, use-wear traces are not the sole evidence, nor even perhaps the best evidence, for hominid predatory activity in the Middle Paleolithic. A more thorough assessment of the predatory strategies of Levantine Mousterian hominids will obviously require further study of the associated archaeofaunal assemblages. Nevertheless, the use-wear evidence can contribute answers to some important questions about prey capture and processing in the Levant between 45-100,00 BP and to the role of technologically-assisted hunting in Upper Pleistocene human evolution.

How were Levantine Mousterian stone projectile points delivered and what were their likely targets ?

The most likely scenario for the use of these points is for them to have been either thrust or thrown into their targets by hominids hunting from ambush, either solely or in groups. The presence of these points in cave deposits probably reflects the repair of damaged hunting equipment at sites where new tools were knapped.

Most of the large (> 20 kg) vertebrate faunal remains associated with Levantine Mousterian assemblages are those of smaller ungulates, such as *Dama mesopotamica*, *Gazella gazella*, and *Capra* *ibex* that were woodland or steppe-margin dwellers (Bar-Yosef, 1989). Spears tipped with broad Levallois points would have been advantageous to hominids hunting such animals because they inflict large slashing wounds that create a blood trail, allowing prey to be tracked through thick Mediterranean woodland vegetation. Animals such as *Dicerorhinus mercki, Dicerorhinus hemitoechus, Bos primigenius, Alcelaphus bucephalus, Equus asinus/hydruntinus, Cervus elaphus, Ursus arctos,* and *Sus scrofa,* were probably sufficiently large, dangerous, and thick-skinned as to require hominids to have used stone-tipped spears to hunt them effectively.

The difficulty of concealing oneself after thrusting or throwing a spear at a target suggests the use of these weapons on terrestrial carnivores and against other hominids is rather unlikely. The association of impact-damaged points and the remains of large carnivores such as *Felis leo, Felis pardus, Hyaena hyaena, Crocuta crocuta* and *Canis lupus,* at many Levantine Mousterian sites, probably reflects shifts in the occupation of the same caves and rockshelters by hominids and by carnivores.

The association of worn stone spear points with hominid remains probably reflects the burial, and, in some cases, subsequent disturbance by carnivores, of human remains in sediments containing the residues of previous human occupations. There is no direct evidence from the Levant that stone spear points were used by hominids in interpersonal combat. At Shanidar Cave in Iraq, however, a deep linear groove lined by exostic bone growth on the ninth left rib of Shanidar hominid 3 appears to be a partially-healed wound inflicted by an edged object (Trinkaus, 1983 : 414-415).

Did the use of stone projectile points differ between Neandertals and early modern humans ?

Impact-damaged points occur in the assemblages associated with early modern human fossils in Qafzeh Units XV, XVII, XIX, and in assemblages associated with archaic/Neandertal human fossils in Kebara Units IX-XII. If this stratigraphic association is a behaviorally-meaningful one, then the use-wear evidence suggests stone-tipped spears were employed both by robust modern humans and by Neandertal populations in the Levantine Mousterian. The ability to make and use complex projectile weapons, therefore, does not appear to have been a major behavioral contrast between these hominids.

What is the ecological and evolutionary significance of Middle Paleolithic stone projectile technology ?

Acquiring high-quality sources of protein and fats that are critical to brain growth during maturation would have been of vital importance to the relatively large-brained hominids of the Middle and Upper Pleistocene. Wooden spears from Clacton and Lehringen indicate that Middle Pleistocene hominids were familiar with the use of simple projectile weapons ; and stone artifacts worn from haft contact have now been identified in Middle Paleolithic assemblages from Europe (Anderson-Gerfaud, Helmer, 1987), Africa (Beyries, 1987a) and the Levant (Shea, 1988, 1989a, 1989b, 1991) ; indicating the assembly of compound tools was within the technical abilities of Middle Paleolithic hominids. Attaching stone armatures to projectile weapons would have been a logical extension of these pre-existing technological strategies and may have been one of many ways in which hominid groups attempted to increase their access to large animal meat and fat resources. Because foraging success is directly related to reproductive success, as has been repeatedly established by numerous socio-ecological studies both of recent human foragers and of non-human species, there would have been a powerful socio-biological incentive for hominids to devise and to use such weapons.

Conclusion

Without question, there were many bio-behavioral differences between Neandertals and early modern humans (Trinkaus, 1986). The association of both hominids with the same industry in the early Upper Pleistocene of the Levant provides a unique opportunity to assess their shared behavioral characteristics. While differences in hunting strategies may have played a key role in the origin of modern humans, or in the extinction of Neandertals, lithic use-wear analysis of Levantine Mousterian assemblages suggests the ability to make and use hafted stone projectile points was a common behavioral characteristic of both these hominids.

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