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Journal of Archaeological Science 33 (2006) 921–934

Journal of Archaeological SCIENCE

http://www.elsevier.com/locate/jas

Use-wear analysis of an Amudian laminar assemblage from the Acheuleo-Yabrudian of Qesem Cave, Israel

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Received 12 January 2005; received in revised form 14 September 2005; accepted 27 October 2005

Abstract

In this paper the results of use-wear analysis of an Amudian lithic assemblage recently discovered at Qesem Cave, Israel, are presented. Although very old, this assemblage maintains well-preserved traces of use that indicate that butchering activities and plants collecting were carried out at the site. Cut marks on faunal remains confirm the observations obtained by use-wear analysis.

Keywords: Use-wear analysis; Amudian laminar assemblage; Butchering activities; Faunal remains

1. Introduction

This paper presents the first results from a pilot study of use-wear carried out at Qesem Cave, a unique Acheuleo-Yabrudian site discovered in 2000. The ''fresh condition'' of the lithic industry permits the systematic application of this approach to the entire stratigraphy. As a starting point we have chosen an extremely well-preserved assemblage that is well defined stratigraphically and located in the middle of the archaeological sequence. The typological and technological characteristics define this assemblage as laminar Amudian [6].

The very good preservation of the Qesem faunal assemblage has also given us the opportunity to link use-wear data to faunal results, enriching the use-wear interpretation of activities related to the processing of prey.

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0305-4403/$ - see front matter
doi:10.1016/j.jas.2005.10.019

2. The site

Qesem Cave was discovered east of Tel-Aviv in October 2000 in the course of road construction [5]. The cave's ceiling was almost entirely removed, and by the time construction work was stopped, parts of the cave were already damaged. Abundant flint tools and faunal remains were collected prior to the salvage excavation. These included a single handaxe, demi-Quina scrapers, déjeté scrapers, blades, naturally backed knives (NBK), end-scrapers and burins. The lithic collection was tentatively assigned to the Acheuleo-Yabrudian complex of the terminal Lower Paleolithic as defined from other sites (e.g. [4,11,15,16,25]).

Two short salvage excavation seasons were conducted at Qesem Cave, exposing a stratigraphic sequence of ca. 7.5 m from bedrock to the uppermost part of the cave deposit. This stratigraphic sequence included overlying, distinct archaeological horizons, rich in lithics and well-preserved faunal remains. Flint edges are sharp, mostly unpatinated, and usually show no sign of post-depositional damage.

The different archaeological assemblages in Qesem Cave vary in technology and typology. Some of the assemblages are clearly dominated by laminar items (blades) and shaped laminar items (shaped/retouched blades), while in others laminar items are less common. In several of the assemblages the abundance of NBK is noteworthy. Our preliminary field observations also suggest that side-scrapers are present throughout the stratigraphic sequence. Single handaxes were recovered at the top and the bottom of the stratigraphic sequence (4.5 m apart in elevation), respectively, but not elsewhere. At the base of the cave deposit, just above bedrock, the lithic assemblages are flake-dominated and typical Acheuleo-Yabrudian tool-types are not abundant. Several polyhedrons, spheroids and chopping tools were found in these assemblages.

Samples for U/Th dating were extracted from speleothems in the eastern section within the archaeological horizons at the upper part of the cave. ^{230}Th/^{234}U dates were measured by thermal ionization mass spectrometry (TIMS) at the U-series laboratory of Bergen University [5]. The major Acheuleo-Yabrudian occupations of the cave began before 382 kyr, probably during oxygen isotope stage 11. Hominid occupations of the cave ceased before 152 kyr BP. Between ca. 382 and 207 kyr, hominid occupations could have taken place coeval with speleothem deposition, or during drier intervening periods.

The studied lithic assemblage comes from a stratigraphically well defined and distinct archaeological horizon located in square K-10 in the original Qesem grid system, roughly in the middle of the 7.5 m vertical section of Qesem Cave. This horizon was exposed and excavated in 2001 and is rich in lithic artefacts ($n = 4920$; 1270 *débitage* and shaped/retouched items and the rest are *débris*) and faunal remains. The lithic assemblage includes high proportions of laminar items: blades, primary blades (dorsal face with at least 30% cortex) and naturally backed knives. Laminar items constitute about 39% of the *débitage* and shaped items. Naturally backed knives are the most distinctive of the laminar items ($N = 87$, 6.9% of the *débitage* and shaped pieces). The majority (58%) of the 168 shaped pieces occur on laminar blanks (including retouched laminar pieces, end-scrapers, burins, and side-scrapers). Since square K-10 is partially covered by breccia, only the soft sediments were excavated in 2001. The assemblage presented here originates from a unit of about one-half square meter and 80 cm deep (elevation 340–420 below datum). The assemblage represents a sample of an Amudian lithic industry, one of the distinctive Acheuleo-Yabrudian lithic facies.

3. General introduction on use-wear analysis

Functional interpretation of stone tools has been an aspect of prehistoric studies since the end of XIX century [23]. Analysis of lithic surface modifications caused by the contact with worked material acquired a systematic methodological connotation in the end of 1950s [26]. S.A. Semenov observed, by means of optical equipment, use-wear on archaeological stone, bones, wood, and metal artefacts. The interpretation of wear-traces in terms of actions and worked materials was carried out by means of comparison with analogue wear-traces on experimental artefacts.

From the beginning of its diffusion into the western community of researchers, the methodology proposed by Semenov was applied to Paleolithic industries [2,17]. In particular, wear-trace analyses played an important role in the famous debate between Bordes and Binford concerning the meaning of the variability of Mousterian lithic industries. The study carried out on lithic industries from Southern France by Beyries [7] concluded that Mousterian types are not related to specific functions, supporting the Bordian thesis of cultural variation as the main cause of this variability.

From the end of 1980s, archaeological contexts rather than lithic types have become the main object of wear-traces research on Paleolithic industries. New approaches that integrate data from technology, zooarchaeology, and wear-traces have achieved interesting results on the function of Paleolithic sites and landscape use during the Paleolithic [8,9,12,13,19,21,24,27,33].

The interpretative potential of wear-trace analyses in prehistoric contexts may be hampered by taphonomic processes that cause alteration of the lithic surface that may sometimes limit or prevent a functional study. Lower Paleolithic sites usually give the poorest results [10], since their lithic assemblages frequently experience intensive alteration [3,17,18]. Nevertheless, recent studies [20] suggest that the detection potential of SEM (Scanning Electron Microscope) can improve the interpretation of use-wear altered by post-depositional processes.

4. Methodology

Since the flint artefacts from Qesem Cave are in a very good state of preservation, use-wear analysis employed both the traditional approaches, low-power (LPA) and high power (HPA), without resorting to SEM detection.

LPA [19,22,34] provides the basis for describing and interpreting macro-traces, edge-removals, macro-abrasions, and macro-rounding produced by contact of the lithic tool with the worked material or with a handle into which it may have been inserted. LPA makes possible detailed interpretations of the use action(s) carried out and more general interpretations of contact materials in terms of general categories of ‘‘hardness’’ (soft material, medium/hard material and hard material). Soft material includes fleshy tissues and herbaceous plants; medium hard material includes wood and hide, hard material includes stone and animal material as bone, ivory, antler, horn, teeth, shell. The definition ‘‘soft/medium hard material’’ will also be used in the following discussion of the results of traces analysis. This category describes macro-traces developed by the contemporary contact of the edge with materials of different hardness as, for example, bones, cartilage and fleshy tissues during butchering activity. Otherwise, this category describes single materials of intermediate hardness such as, for example, many types of plants, especially in their young state. Use-wear was observed at low magnification by a reflecting light stereomicroscope (a Nikon SMZ with a range of magnification from 0.74× to 70×).

HPA [14,17,19] allows a more detailed interpretation of worked material based on the observation of micro-traces, polishes, striations, micro-abrasions, and micro-rounding. Observations are made at high magnification by means of a reflecting light metallographic microscope (a Nikon Eclipse with a range of magnification from 100× to 500×).

Since only a preliminary survey for raw materials was carried out at the time of this analysis, local flint was not available to build a reference collection. The comparative experiments collection of Laboratory of Museo delle Origini in Rome was used as reference for wear-traces analysis of the Qesem Cave flint assemblage. In particular, experiments made of fine textured flint similar to Qesem raw material were employed.

5. The lithic sample

First, the complete array of *débitage* and shaped items ($n = 1270$) was examined with the naked eye and with the aid of a stereomicroscope to select pieces with one or more of the following attributes: no evident geogenic alterations, presence of retouches, presence of macro-traces of use, an evident functional morphology stressed by almost one edge with a regular morphology. A great number of fragments and *débitage*, especially flakes, were eliminated from consideration, as well as few pieces that displayed heavy patina. The sample selected for wear-traces analysis consisted of 253 artefacts.

6. State of preservation of the assemblage

Before conducting the wear-traces analysis, we evaluated the state of preservation of the artefacts. The risk of misunderstanding alterations that mimic wear-traces morphology can be avoided only by a survey of post-depositional phenomena that the archaeological artefacts may have suffered. The 253 artefacts from the K-10 assemblage were examined with the stereomicroscope to evaluate their state of preservation. The assemblage shows a high incidence of well-preserved artefact edges and surfaces (28%; 70 artefacts, Fig. 1).

The generally good preservation of the assemblage is further confirmed by the low percentage of very glossy surfaces, white patina, and thermal alteration – all of which change the structure of the flint surface drastically and, as a result, erase the traces of use by hominids. On the other hand, the high percentage of artefacts with a light glossy appearance (25%; 62 artefacts), followed by a lower percentage of medium glossy appearance (22%; 56 artefacts), indicates that the flint artefacts from square K-10 suffered some light post-depositional disturbances. This damage was sufficient to prevent the recognition of light wear-traces, although post-depositional disturbance of the ‘‘softest’’ wear-traces (which develop when working soft materials such as fleshy tissues and herbaceous plants) is very limited.

7. Functional interpretation

7.1. Materials and actions

Almost a third (29%) of the K-10 selected sample shows diagnostic traces of use (74 artefacts). The rest of the sample

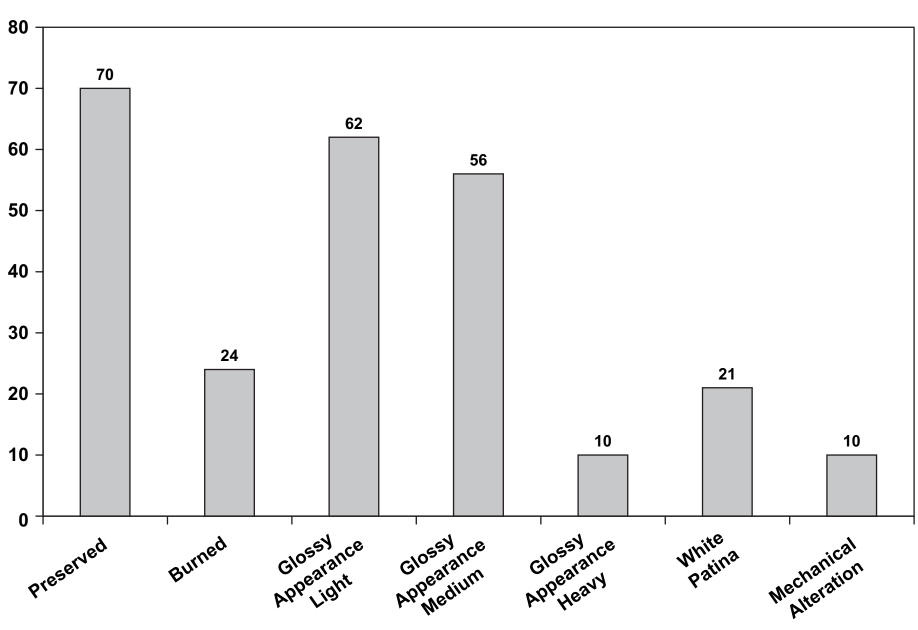


Fig. 1. State of conservation of K-10 lithic assemblage.

is not treated here because of the lack of clear or interpretable traces. Flint knapping produced many by-products that were very occasionally used, and this is especially true for *débitage*. Moreover, a fraction of the artefacts could have been so lightly used that no visible traces would have developed. The results thus take into account only 74 artefacts with diagnostic wear-traces. Although these under-represent the total amount of used artefacts in the K-10 assemblage, they are the pieces that permit a secure interpretation of use-wear patterns.

The 74 tools (37 shaped and 37 un-shaped artefacts, Table 1) with traces of use present 88 used edges (18 shaped and 70 un-shaped edges). Note that un-shaped (or un-retouched) and shaped (or retouched) artefacts with recognizable wear-traces here are all defined as "tools".

Fig. 2 summarizes the functional interpretation of these tools.

Soft materials were worked most often. This group of wear-traces consists of (1) traces from contact with unspecified soft materials (31%; 28 tools) that can be related to fleshy tissues

Table 1
Techno-typological definition of tools with use-wear and their functional interpretation, edge by edge

Tool	Used edge	Type	Action	Material
1	1	Retouched blade	Cutting	Soft material
2	1	Retouched blade	Cutting	Soft material
3	1	Core on blade	Cutting	Indeterminable
4	1	Retouched flake	Cutting	Soft/medium hard
5	1	Burin on blade	Scraping	Medium hard
6	1	Retouched primary blade	Cutting/ scraping	Soft/medium hard
7	1	Distally retouched blade	Cutting/ scraping	Tissues
8	1	Retouched blade	Cutting	Tissues
9	1	Curved retouched blade	Cutting	Tissues
9	2	Curved retouched blade	Cutting	Tissues
10	1	Retouched flake	Scraping	Tissues
10	2	Retouched flake	Cutting	Tissues
11	1	End scraper	Cutting	Soft material
12	1	Burin spall	Whittling	Soft material
13	1	Retouched blade	Cutting	Soft/medium hard
14	1	Natural backed knife	Engraving	Soft/medium hard
15	1	Natural backed knife	Cutting/ whittling	Vegetals/wood
16	1	Scraper fragment	Scraping	Medium hard
17	1	Blade	Cutting	Tissues
17	2	Blade	Scraping	Tissues/bone
18	1	Natural backed knife	Cutting	Tissues/hide
19	1	Primary element blade	Cutting/ scraping	Tissues/bone
20	1	Retouched blade (point)	Cutting	Soft material
21	1	Backed blade	Scraping	Tissues/hide
22	1	Backed blade	Cutting	Vegetals/wood
22	2	Backed blade	Scraping	Tissues
23	1	Retouched flake	Scraping	Medium hard
24	1	Retouched flake	Cutting	Soft/medium hard
25	1	Blade	Cutting/ scraping	Soft/medium hard
25	2	Blade	Scraping	Medium hard
26	1	Blade	Cutting	Indeterminable
27	1	Blade	Cutting	Medium hard
28	1	Blade	Scraping	Soft material
29	1	Natural backed knife	Cutting	Vegetals/wood
30	1	End scraper on blade	Scraping	Hide
31	1	Scraper fragment	Cutting	Soft material
31	2	Scraper fragment	Scraping	Soft material
32	1	Retouched blade	Cutting	Soft material
33	1	Retouched blade	Cutting	Soft material
34	1	Retouched blade	Cutting/ scraping	Vegetals/wood
35	1	Core on flake	Scraping	Medium hard
36	1	Primary blade	Cutting	Tissues
37	1	Blade	Cutting/ scraping	Tissues/hide
38	1	Blade	Cutting	Soft material
38	2	Blade	Cutting/ scraping	Medium hard
39	1	Primary element blade	Cutting	Soft material
39	2	Primary element blade	Cutting	Soft material
40	1	Natural backed knife	Cutting	Soft material
41	1	Natural backed knife	Cutting	Soft material
42	1	Natural backed knife	Cutting	Soft material
43	1	Retouched blade	Cutting	Tissues
44	1	Burin spall	Cutting/ scraping	Medium hard
45	1	Blade	Cutting	Soft material
46	1	Primary element blade	Cutting	Soft/medium hard
47	1	Retouched blade	Cutting	Soft/medium hard
48	1	Pseudo blade	Cutting/ whittling	Soft material
49	1	Natural backed knife flake	Cutting	Vegetals/wood
50	1	Natural backed knife flake	Cutting/ whittling	Soft/medium hard
51	1	End scraper	Scraping	Medium hard
52	1	Retouched blade	Scraping	Indeterminable
53	1	End scraper	Scraping	Tissues
54	1	Natural backed knife	Cutting	Tissues
54	2	Natural backed knife	Scraping	Tissues/bone
55	1	CTE overshot	Cutting	Vegetals/wood
56	1	End scraper	Scraping	Tissues/hide
56	2	End scraper	Cutting	Tissues/hide
57	1	Retouched blade	Cutting	Vegetals/wood
58	1	Retouched flake	Scraping	Soft/medium hard
59	1	Retouched blade	Cutting	Soft material
60	1	Retouched flake	Scraping	Medium hard
61	1	Primary blade	Cutting	Soft material
62	1	Natural backed knife	Cutting	Tissues
63	1	Natural backed knife	Cutting	Tissues
63	2	Natural backed knife	Cutting	Tissues
64	1	Burin spall	Cutting	Soft material
64	2	Burin spall	Cutting	Tissues
64	1	Burin spall	Scraping	Indeterminable
65	1	Blade/CTE	Engraving	Soft material
65	2	Blade/CTE	Cutting	Soft material
66	1	Retouched pseudo blade	Cutting	Indeterminable
67	1	Blade/levallois point	Cutting	Vegetals/wood
68	1	Overshot (natural backed knife)	Cutting/ scraping	Soft material
69	1	Retouched blade	Cutting	Soft material
70	1	Burin spall	Cutting	Soft material
71	1	Natural backed knife	Cutting	Soft material
72	1	Retouched baked blade	Cutting	Vegetals/wood
73	1	Scraper	Scraping	Medium hard
74	1	Simple concave scraper	Whittling	Soft material

and/or herbaceous plants; and (2) traces from contact with fleshy tissues with or without bone, or fresh hide contact (28%; 25 tools), suggesting butchering activities such as skinning, disarticulation and de-fleshing of carcasses (Figs. 3b, d–h, 4a–d, f, 6a–e, 7a–d).

A second group of wear-traces relates to soft/medium hard types of contact materials: (1) unspecified soft/medium hard materials (12%; 10 tools) and (2) herbaceous plants or wood (10%; 9 tools) (Figs. 3a, c, 4b, e, 5a–f). In this group, the tool edges were used on materials with variable degrees of hardness (i.e. a combination of fleshy tissues and hide, herbaceous plants/wood etc.).

The third and smallest group of wear-traces can be tied to medium/hard materials: (1) unspecified medium hard materials (13%; 11 tools), probably hide or wood, and (2) hide (1%) (Fig. 6f).

The use actions carried out with the tools were mainly cutting (58%; 52 tools) (Figs. 3a–d, f–h, 4b–f) followed by scraping motions (25%; 21 tools) (Figs. 3e, g, h, 4a, b). Cutting is strongly associated with fleshy tissues and, more generally, with soft materials. However, these kinds of wear-traces and actions can also be associated with herbaceous plants/wood, suggesting that the Qesem Cave inhabitants may have gathered such materials in addition to animal carcasses.

Both soft materials and medium/hard materials were scraped with stone tools at Qesem Cave. This observation implies that wood and hide probably were worked on-site. Scraping actions during butchering suggest not only skinning and cleaning of fresh hide on site but also of meat closest to the bone, and especially bone with large, relatively flat surfaces [1].

A third well represented group of tool actions is the "mixed actions group" (15%, 15 edges). These tool edges were used for either different actions on the same material or distinct actions on different materials.

Figs. 8 and 9 show the functional characteristics of shaped and un-shaped tool edges, respectively. Shaped tool edges were used especially for scraping both soft and medium/hard materials. Un-shaped tool edges were used to cut soft materials at first, and, later, to carry out a wider range of actions (engraving, whittling, mixed actions). Retouch increased the strength of the edges of the shaped tools, making them more useful for "heavier" activities such as scraping (Fig. 8).

Nevertheless, in the case of the studied sample from Qesem Cave, shaped edges were rarely used. Most of the used edges were un-shaped (70 as opposed to 18), and almost all the activities carried out on-site were performed with these un-shaped edges. Also important is the observation that these tools were discarded before exhaustion, suggesting only brief use, probably in the context of a single activity.

Use-wear data testify that NBKs were the most selected un-shaped tools and they were used almost exclusively for cutting activities (11 edges on a total of 13 with use-wear; see Table 1). These results suggest that NBKs' natural morphology was specifically adapted to this type of motion as opposed to blades, the second most large un-shaped category of tools, which were used to perform more varied actions (see Table 1: 5 edges used for cutting, 3 for cutting and scraping, 3 for scraping).

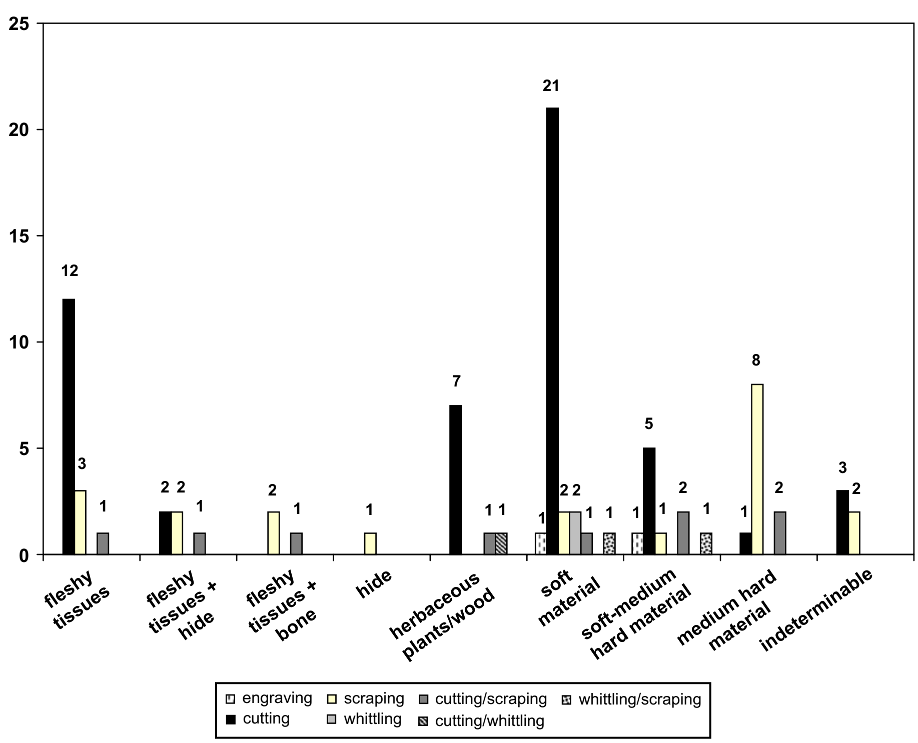
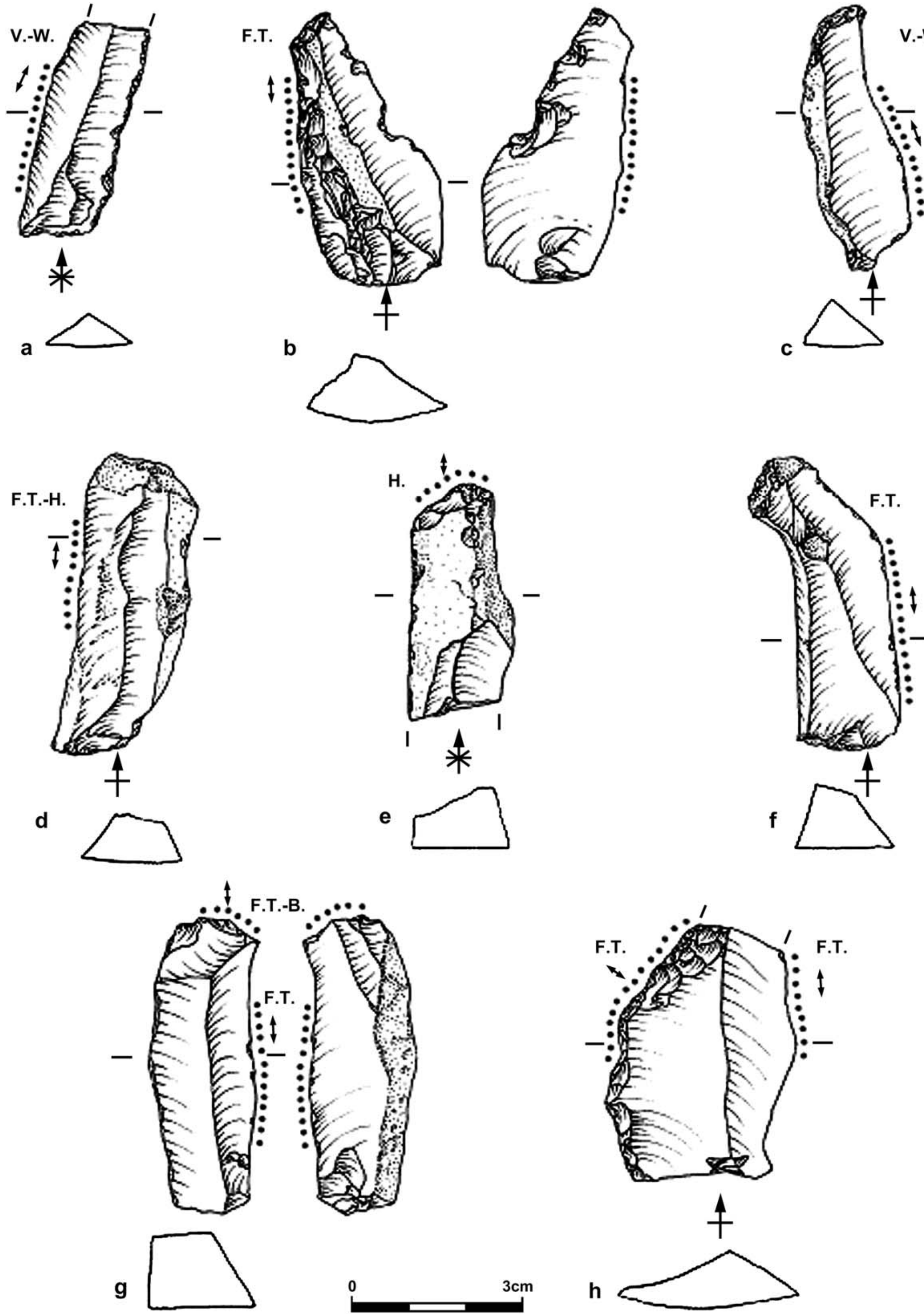
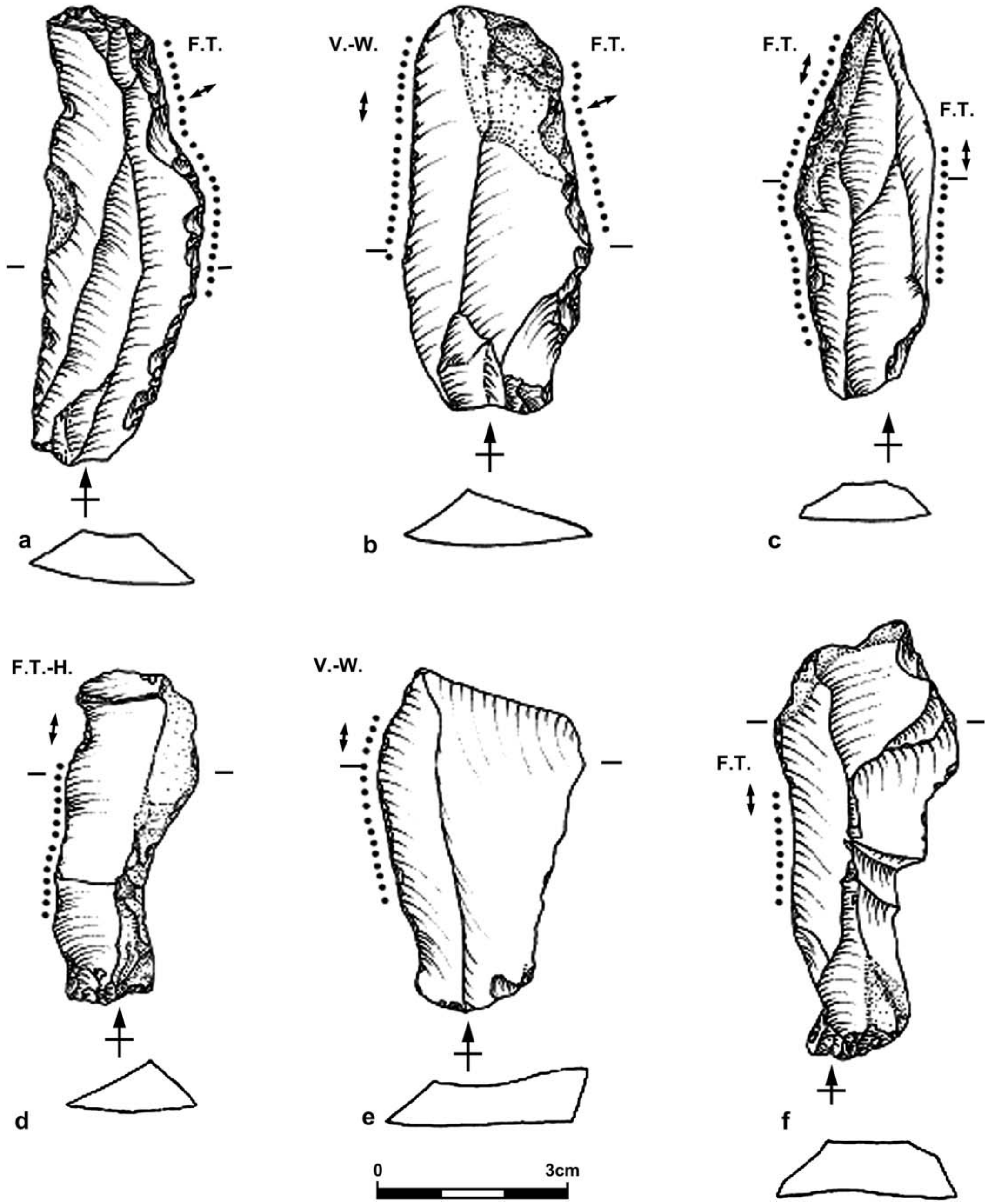


Fig. 2. Materials and actions interpreted by means of use-wear analysis.



Figs. 3 and 4. Examples of tools with use-wear; (· · ·) use-wear; (↔) cutting; (↑) scraping; (F.T.) fleshy tissues; (H.) hide; (B.) bone; (V.-W.) herbaceous plants/wood.



Figs. 3 and 4 (*continued*)

7.2. Aspects of the used edges

Morphological observations of edges with traces of use point out some of the criteria of selection that hominids of Qesem Cave may have emphasized in choosing their tools. In this study, we used four variables to describe the morphology of every tool edge: shape, profile, cross-section and edge-angle ([19: 14]). Figs. 10 and 11 present shape, profile and cross-section of the un-shaped used edges. The data indicate a consistent morphology: 81% (57 tools) of the edge shapes and 64% (45 tools) of the edge profiles are straight. Moreover, 81% (57 tools) of the edge cross-sections is straight on both the ventral and dorsal surfaces. Experiment data suggest that these morphological characteristics are suited to different kinds of tasks, but especially cutting, consistent with the way un-shaped edges of the K-10 sample appear to have been used.

Figs. 12 and 13 present the morphological characteristics of the shaped edges. The edge profiles are mostly straight (83%; 15 tools), as is true of the un-shaped edges. On the other hand, edge shape and edge cross-section are less homogeneous in this component of the sample: edge shape generally is characterized by convex (44%; 8 tools) or straight (33%; 6 tools) morphologies and the edge cross-section by both straight

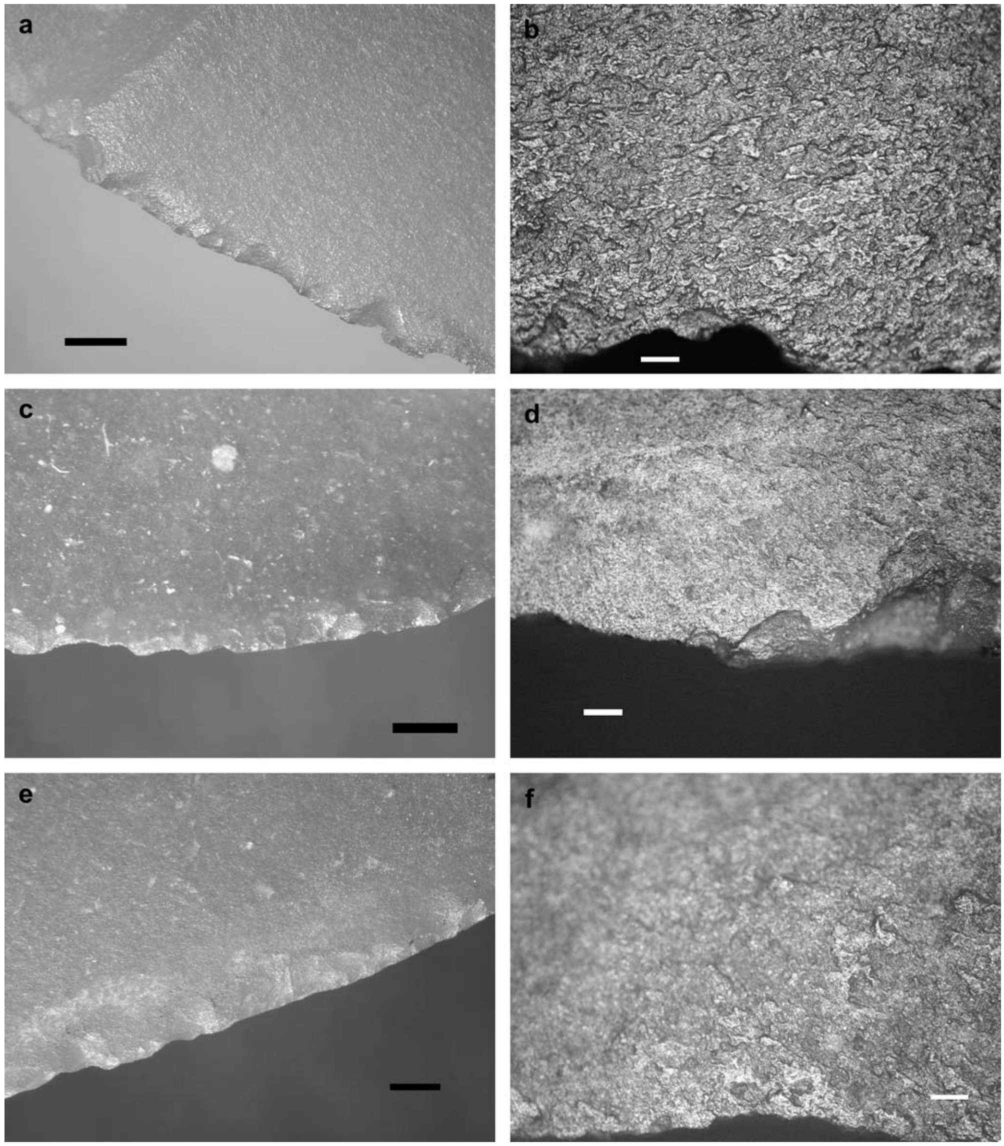


Fig. 5. Details of edge-removals (a, c, e) and polishes (b, f) interpreted as cutting herbaceous plants/wood; details of polishes (d) interpreted as scraping herbaceous plants/wood; traces a, b and e, f are related to the same used edge; (a, c, e) scale bars equal to 0.45 mm, (b, d, f) scale bars equal to 100 μm.

surfaces (38%; 7 tools), one straight and one convex surface (28%; 5 tools) and one straight and one concave surface (28%; 5 tools). Straight edges apparently were chosen for both cutting and scraping actions, whereas convex edge shape was chosen only for scraping actions. Straight–straight and straight–concave edge cross-sections were used for both scraping and cutting, while a straight–convex edge cross-section associates only with scraping activity. Experimental data confirm that a straight edge shape combined with a straight–straight or straight/–concave edge cross-section can be useful for a wide range of activities. On the other hand, the combination of a convex edge shape with a straight–convex edge cross-section is very efficient for scraping, especially of medium/hard and hard materials.

Finally, concerning the variable of the edge-angle (Fig. 14), the un-shaped edges are divided into two major groups: those with acute edge-angles from 21° to 40° (39%; 27 tools) that were used primarily to cutting soft materials, and those with medium edge-angles from 41° to 60°, (53%; 37 tools) that were used to both cutting and scraping soft and medium hard materials. On the other hand, the shaped edges show just one tool with an acute edge-angle. The other shaped edges have medium (33%; 6 tools) and thick (61%; 11 tools) edge-angles used primarily to scraping soft and medium hard materials. These results demonstrate that hominids of Qesem Cave could perform almost all their activities by un-shaped edges thanks to edge-angles that varied from very sharp, well adapted to cut soft materials, to medium also suitable for scraping harder materials.

In summary, the analysis of the edges showing use-wear indicates that the hominids focused their selection primarily on laminar items with regular and sharp edges (including NBKs, blades and primary blades), all similarly used to butcher animal carcasses. They also selected thicker un-shaped tools

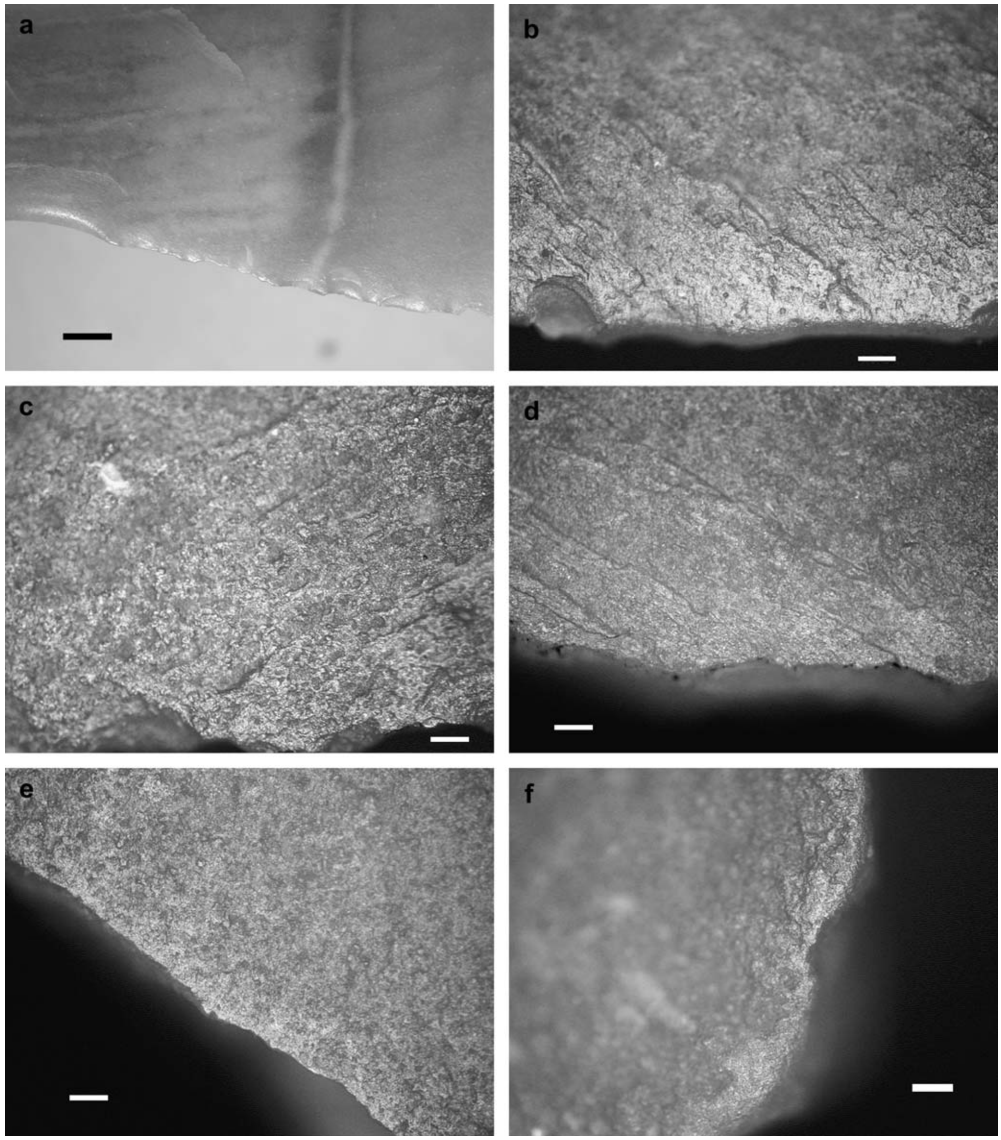


Fig. 6. Details of edge-removals (a) and polishes (b, c) interpreted as cutting fleshy tissues; details of polishes interpreted as scraping fleshy tissues and hide (d–f); traces a, b are related to the same used edge; (a) scale bar equal to 0.45 mm, (b–f) scale bars equal to 100 μm.

to cut and scrape diverse soft and medium materials. Apparently, they achieved by retouch a convex shape on some edges to carry out scraping activities. This behaviour of tools selection has also been observed in later lithic industries [12,19,21].

The specific tool shapes normally required for hide processing [32,33] are not present in this sample from Qesem Cave, and perhaps this is why the inhabitants made no particular efforts to alter the natural morphology of the blanks. The elongated and regular shape of this laminar assemblage fulfilled the full variety of functional demands of the tools used at the site.

8. Links to faunal results

A sample of 1780 identified specimens (NISP) obtained from the 2001 excavation of Qesem Cave indicates that the great majority of the faunal remains are from larger vertebrates, mainly fallow deer (*Dama*, large-bodied form), along with some remains of aurochs (*Bos*), horse (*Equus*, caballine type), wild pig (*Sus*), tortoise (*Testudo*), and rarely red deer (*Cervus*). These faunal remains bear many traces of hominid activity, ranging from cut marks and other kinds of tool damage to burning from fire. Burning damage occurs on 10–36% of NISP, but is most prevalent in square K-10 (36%), the source of the lithic sample presented in this paper. Such damage is even more common on unidentified bone fragments (11–84%), as is usually the case in Paleolithic cave sites [28,31], with highest frequencies occurring in square K-10 (48–84%). Only one possible case of carnivore gnawing damage was found. Weathering damage, associated with long surface exposure times, is rare (0–2% of NISP), suggesting consistent protection by the cave roof and/or relatively rapid burial.

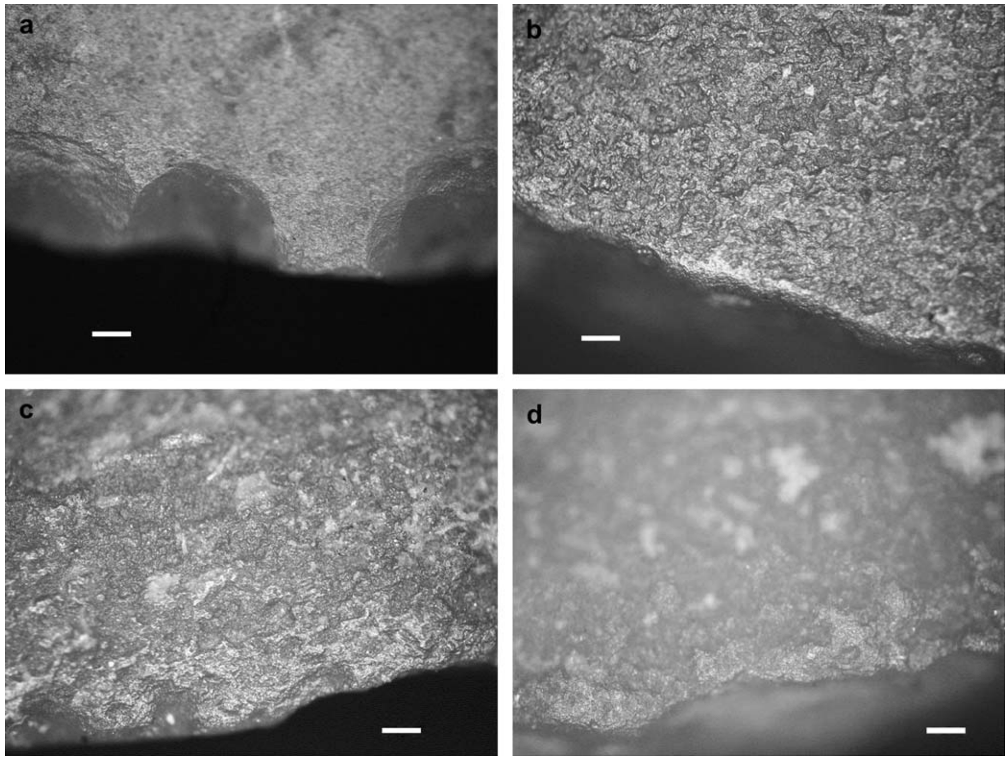


Fig. 7. Details of polishes interpreted as cutting and scraping fleshy tissues and hide (a), scraping fleshy tissues (b), cutting fleshy tissues (c, d); all scale bars equal 100 μm.

The orientations and anatomical placements of cut marks (mostly short, scattered, diagonal scars on bones associated with substantial muscle masses) indicate redundant, simple flesh cutting and removal activities. This pattern suggests a heavy emphasis on meat and connective tissue removal from bone surfaces, and probably also a lack of concern for the long-term performance of tool edges. Cut marks occur at between 10 and 19% of vertebrate NISP, and cone fractures indicative of marrow extraction from limb bones and mandibles occur at 23–38% of NISP. It is significant that cut marks and cone fractures are twice as or more abundant on the Qesem Cave ungulate remains than in later Mousterian and Upper

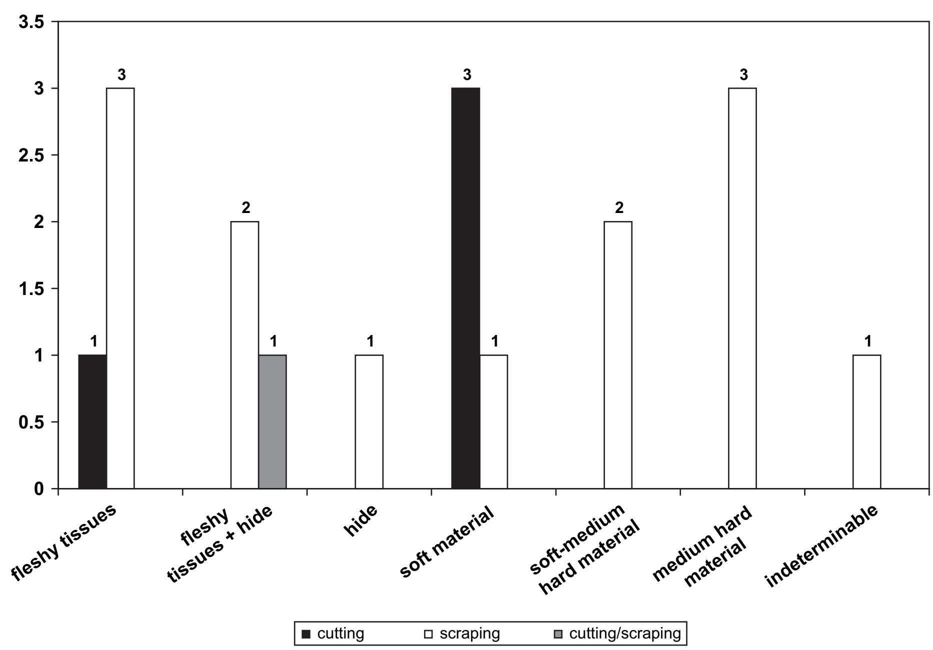


Fig. 8. Materials and actions related to the shaped edges.

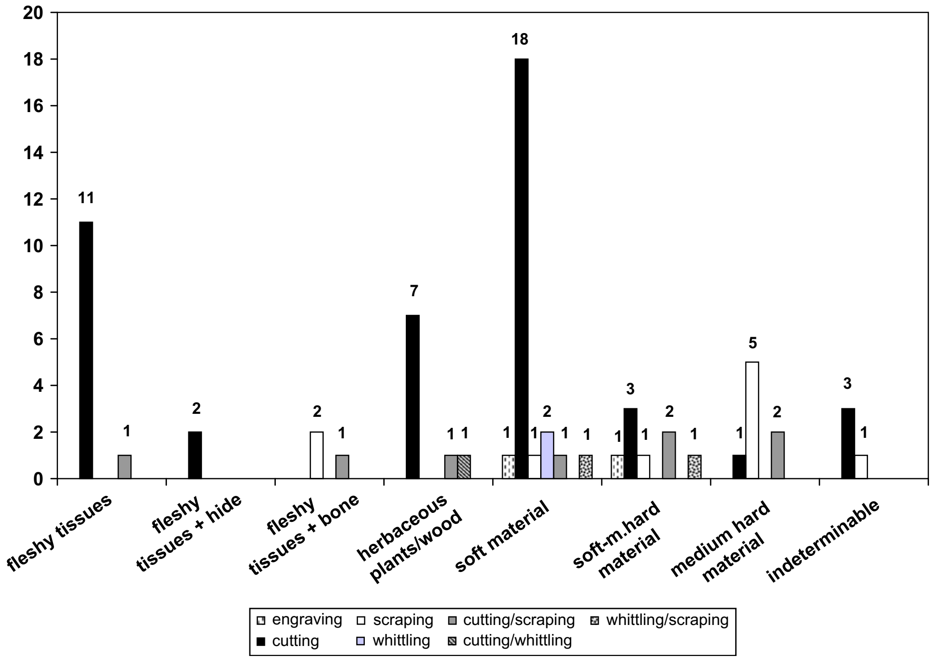


Fig. 9. Materials and actions related to the un-shaped edges.

Paleolithic faunas studied in the Levant [30]. The prevalence of cone fractures in this site is consistent with the high incidence of major limb bones. The high incidence of cut marks on long bone surfaces is consistent with the results from tool use-wear and technological analyses.

A related observation concerns the pattern of body part representation for common ungulate prey. Deer remains in the upper part of the Qesem sequence are confined to limb bones and head parts (without antlers) almost exclusively; there are almost no vertebrae, ribs, pelvis, or foot bones. In the lower part of the Qesem sequence the situation is somewhat different in that modest numbers of the latter suite of elements are represented, though still under-represented relative to head and limb segments. The dominance of head parts in particular is not explained by differential preservation of tooth enamel versus bone tissues, since the skeletal element counts for head parts are based on bony cranial features only. In light of the very good preservation of the Qesem faunal assemblages, and the use of methods designed to maximize element counts from highly fragmented material [28,29], the anatomical patterns observed for medium-sized ungulates in Qesem Cave indicate that hominids were quite

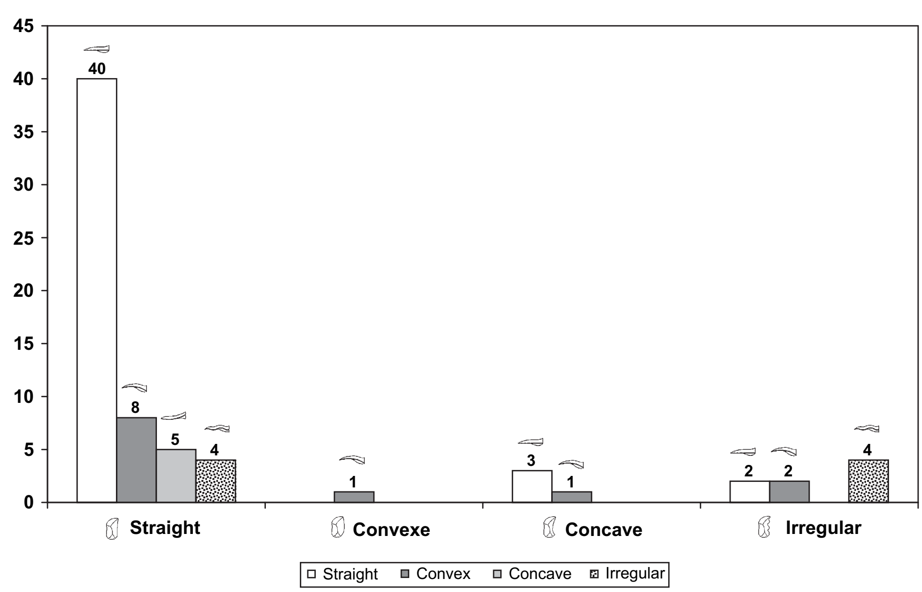


Fig. 10. Shape (*x*-axis) and profile (*y*-axis) of the un-shaped used edges.

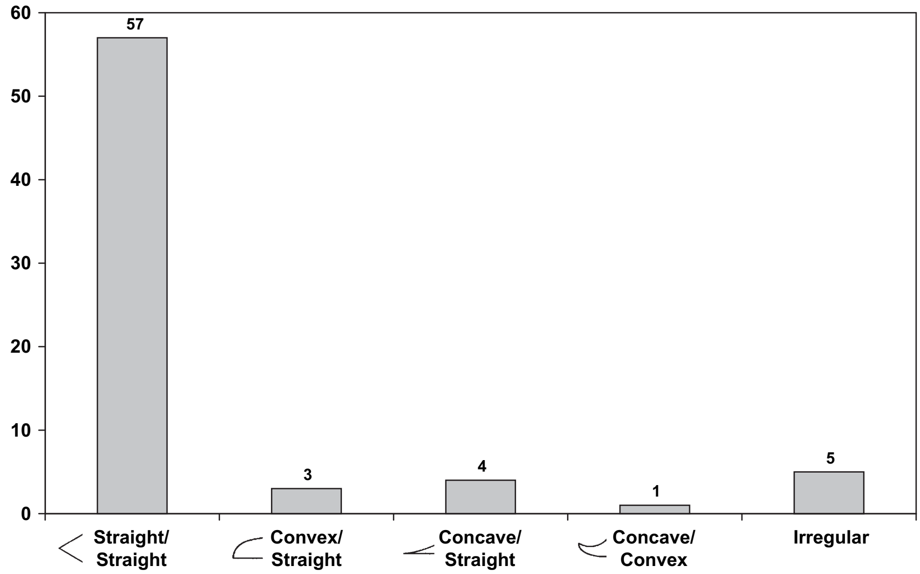


Fig. 11. Cross-section of the un-shaped used edges.

selective about the body parts they transported to the cave, presumably following initial field processing of the carcasses elsewhere.

9. Conclusions

Despite their antiquity, the Qesem Cave lithic assemblages are well-preserved and indicate a high potential for wear-trace analysis, an exceptional situation for Lower Paleolithic assemblages in general. This first functional study of an Amudian assemblage from square K-10 in Qesem Cave reveals that butchering was the main activity carried out by the terminal Lower Paleolithic inhabitants of the site. Portions of the carcasses of medium-sized and large ungulates, mainly heads and upper limbs, were brought to the cave for meat removal and marrow processing. Meat removal, especially that closest to bone surfaces, was accomplished mainly with un-shaped tools characterized by a regular morphology efficient for cutting fleshy tissues. The high rates of contact by blade edges with bones and hide, as well as with flesh, suggest that much skinning and disarticulation was carried out at the site, as well as cutting meat. Butchering actions included cutting and scraping actions and extensive removal of uncooked tissues from the surfaces of large bones. Less commonly, some flint tools may also have been used to gather herbaceous or woody plants.

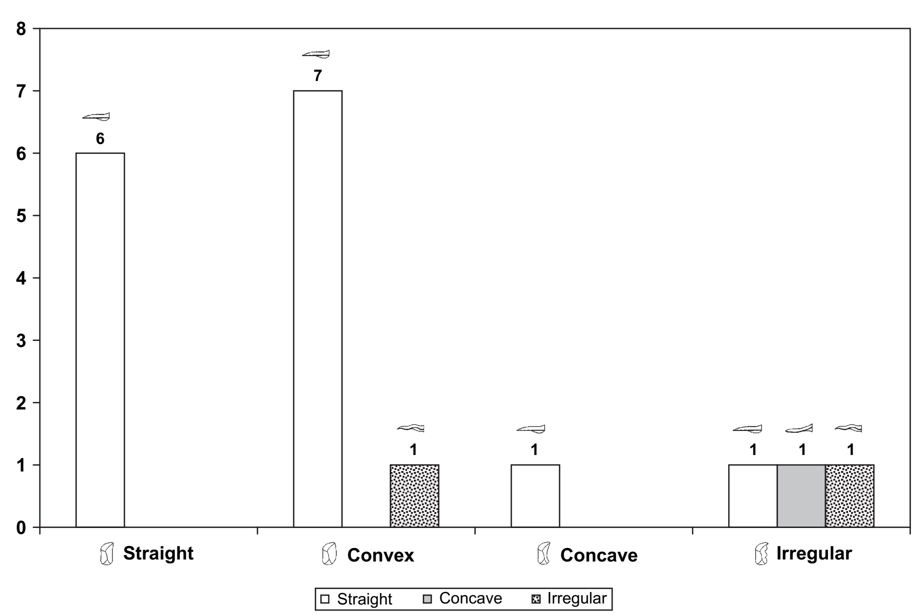


Fig. 12. Shape (*x*-axis) and profile (*y*-axis) of shaped used edges.

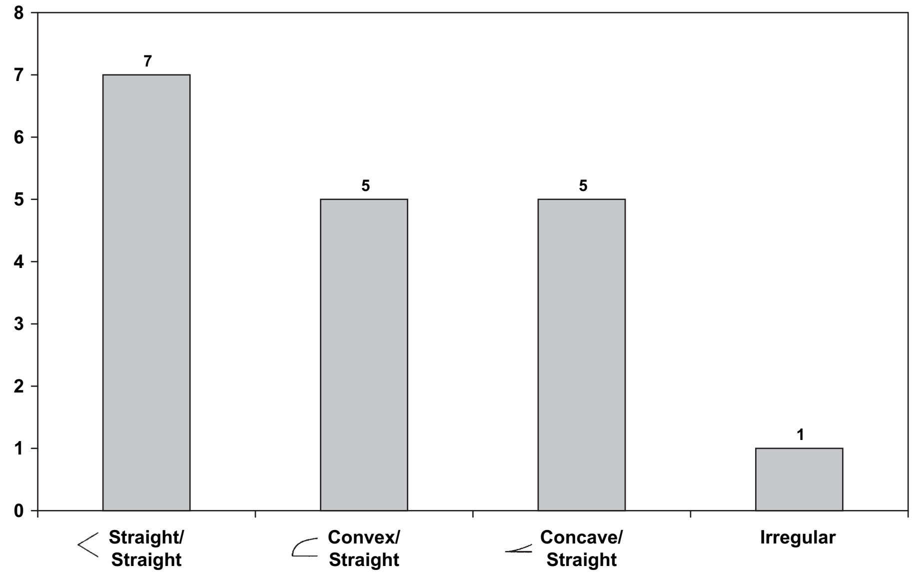


Fig. 13. Cross-section of the shaped used edges.

In summary, the Amudian assemblage of Qesem Cave indicates that shaped and un-shaped blades were discarded usually while they were still quite sharp. This could indicate a rich and constant supply of flint [6]. A preliminary survey for raw materials in the immediate vicinity of Qesem Cave supports this impression. The Amudian inhabitants of Qesem Cave seem to have had narrow applications for their cutting tools, with a strong emphasis on laminar production — the Amudian tool kit examined thus far served first and foremost as a source of butchering implements. However, the artefact sample from square K-10 is the first from Qesem Cave to be subjected to use-wear analysis, and thus we cannot generalize these results to other Acheuleo-Yabrudian facies at Qesem Cave or to other sites. Additional studies are needed to reveal how the variability in lithic technology and typology within the Acheuleo-Yabrudian complex is related to tool function and hominid activity patterns.

Acknowledgments

The Qesem Cave research project is supported by the Leakey Foundation, the Irene Levy-Sala CARE Archaeological Foundation and the Israel Science Foundation (Grant 820/02). We would like to thank R. Yerkes, H. Plisson, and L. Meignen for reading and improving earlier versions of the text.

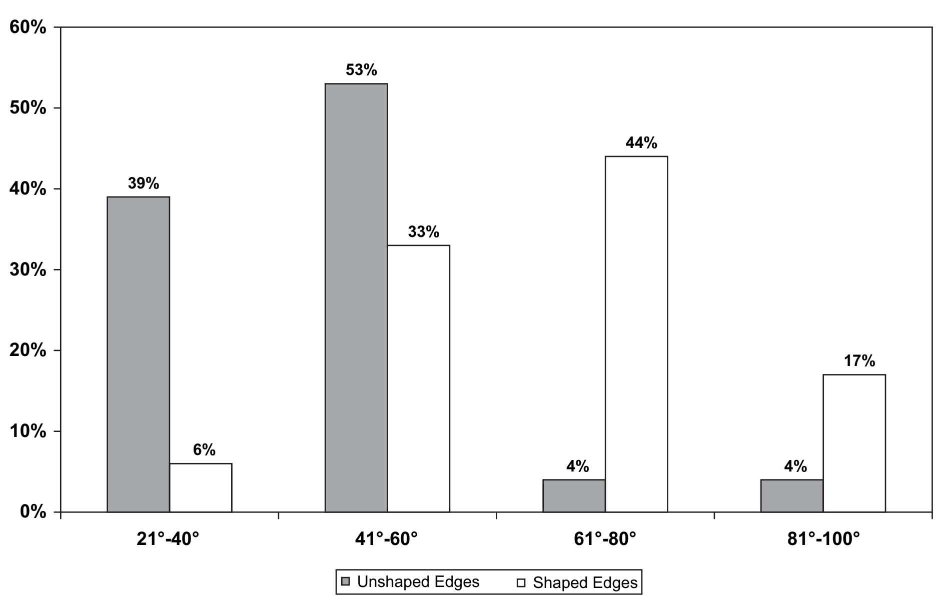


Fig. 14. Measures of the edge-angle of the un-shaped and shaped used edges.

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