A blade for all seasons? Making and using Amudian blades at Qesem Cave, Israel.

Barkai R.[1]
Lemorini C.[2]
Shimelmitz R.[1]
Lev Z.[1]
Stiner M.C.[3]
Gopher A.[1]

[1]Department of Archaeology, Tel-Aviv University, Tel-Aviv, 69978 Israel.
[2] Dipartimento di Scienze Storiche, Archeologiche ed Antropologiche dell'Antichità, University of Rome "La Sapienza" P.le A. Moro 5, 00185 Rome, Italy.
[3] Department of Anthropology, P.O. Box 210030, University of Arizona, Tucson, AZ 85721-0030, U.S.A.
Email: barkaran@post.tau.ac.il

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The Qesem Cave prehistoric sequence consists of one dominant lithic industry – the Amudian, a part of the Acheulo-Yabrudian (late Lower Paleolithic) cultural complex. The Acheulo-Yabrudian complex comprises three major lithic industries – Acheulo-Yabrudian, Yabrudian and Pre-Aurignacian/Amudian. While the first two industries are dominated by typical Lower Paleolithic lithic traditions, namely flake production technologies, hand-axes and scrapers, the Amudian presents an innovative blade industry. This relatively poorly known industry is of importance being stratigraphically situated between the Lower Paleolithic Acheulian and the Middle Paleolithic Mousterian. The available radiometric dates for this entity indicate a range from ca. 400 to about 200 kyr. The Amudian in the Levant is characterized by systematic blade production and a major component of shaped blades. At Qesem Cave the majority of the lithic artefacts belong to the Amudian industry with distinctive blade-dominated assemblages throughout a stratigraphic sequence of 7.5 meters. During the 2006 excavation season a scraper-dominated Yabrudian assemblage was discovered, indicating variability and more complex human behaviour at the cave rather than specialized blade-related activities only. The Amudian at Qesem Cave is a very early blade production industry and it reflects technological choices of the artisans as well as specific modes of resource exploitation and subsistence activities.

This paper will summarize the current state of research on the Qesem cave lithic assemblages, focusing on the composition of the rich Amudian assemblages, the reconstruction of Amudian blade production and the functional interpretation of Amudian blades. A short survey of the new Yabrudian assemblage will be provided as well. We finally discuss interpretations of Acheulo-Yabrudian lithic variability and the meaning of late Lower Paleolithic blade production as a technological, functional and cultural phenomenon.

Introduction

With an age of 400-200 kyr Qesem Cave is part of the later Middle Pleistocene and it is assigned to the Acheulo-Yabrudian cultural complex of the late Lower Paleolithic period. The Acheulo-Yabrudian cultural complex postdates the Acheulian cultural complex of the Lower Palaeolithic period and predates the Mousterian cultural complex of the Middle Palaeolithic period, correlating to Jelinek's "Mugharan Tradition" (Jelinek 1990).

The Acheulo-Yabrudian complex defined by Rust (1950) included three major industries – Acheulo-Yabrudian (dominated by hand-axes and Quina scrapers); Yabrudian (dominated by Quina scrapers) and Pre-Aurignacian/Amudian (dominated by blades and shaped blades) (Bar-Yosef 1994; Copeland, 2000; Garrod, 1956, 1970; Goren-Inbar, 1995; Jelinek, 1982, 1990; Monigal, 2002; Ronen and Weinstein-Evron 2000). One of the most interesting aspects of this complex was an industry dominated by blade production (Garrod and Bate 1937; Rust 1950). This was a small component, hardly separated from overlying and underlying Yabrudian and Acheuleo-Yabrudian layers (Garrod 1970; Rust 1950: 28-34) and it was referred to as 'Pre-Aurignacian' (Rust 1950) and later termed 'Amudian' (Garrod and Kirkbride 1961). Amudian assemblages are scarce and have been recovered in only a few sites (Garrod and Bate 1937; Garrod and Kirkbride, 1961; Jelinek, 1990; Rust, 1950; Skinner, 1970).

The Amudian industry is characterized by systematic blade production and a major component of shaped blades, including backed and retouched blades, end scrapers, burins and Naturally Backed Knives (NBK's). Alongside blade production, a significant component of flakes also appears in the Amudian, and side scrapers and hand-axes appear in variable frequencies (Barkai *et al.,* 2005). Thorough studies of Amudian lithics have been undertaken for Tabun (Jelinek 1990; Monigal, 2001, 2002; Wiseman 1993), Yabrud I (Vishnyatsky 2000), Abri Zumoffen (Copeland 1983), and Masloukh (Shmookler 1983). Qesem Cave is a significant addition to this list with large Amudian assemblages. The analysis conducted thus far demonstrates that Qesem Cave is distinctive in that the lithic assemblages are blade-dominated throughout the thick stratigraphic sequence. The dating of Qesem Cave layers by Uranium series (Barkai *et al.,* 2003; Gopehr *et al.* ,Forthcomming) indicates a provisional time span of some 200 kyr (between ca. 400-200 kyr) for the Amudian. These dates suggest that the Amudian represents a major industry of the Acheuleo-Yabrudian complex, equivalent in time scale to other known facies and at least as long as the forthcoming Mousterian.

The Amudian is thus a remarkable archaeological entity of the close of the Levantine Lower Paleolithic sequence. Although poorly understood, it merits the independent status given to it.

Systematic blade production is considered an advanced technological skill that was once related only to Anatomically Modern Humans (e.g. Bar-Yosef and Kuhn, 1999). The analysis of Amudian blade production at Qesem Cave seems to provide an opportunity to

investigate the possibility that such technological capabilities were also demonstrated by Middle Pleistocene hominins. Amudian blade production and use may be related to specific modes of resource exploitation and subsistence, possibly quite different from those reflected by other late Lower Paleolithic industries of the Acheuleo-Yabrudian complex. We expect the lithic analysis to bear out the uniqueness of Amudian life-ways and its adaptation to the Middle Pleistocene environment.

Qesem Cave

Qesem Cave is a sediment-filled chamber cave located 12 km east of the Mediterranean. It was discovered in the year 2000 when road construction works cut through its southern and upper parts. The chamber was ~20X15 m in size and ~ten m high. The excavation has exposed ~7.5 meters of archaeological deposits containing rich faunal and lithic assemblages.

The Qesem Cave deposits contain a combination of natural and anthropogenic sediments. Subsidence, erosion, fracturing, deposition of various sediments and cementation were continuous or recurrent within Qesem Cave during the Middle Pleistocene, constantly changing the cave's landscape and conditions and finally acting as a post-depositional agent shaping the preset cave and its sediments (Frumkin *et al.,* 2008).

The stratigraphical sequence is generally divided into two parts – the lower (ca. 3m thick), consists of sediments with clastic content and gravel, and the upper (ca. 4.5 m. thick), mostly consists of cemented sediment with a large ashy component. The lower part was deposited in a closed karstic chamber cave, while the upper part was deposited when the cave was more open as indicated by the presence of calcified rootlets (Karkanas *et al*., 2007). The use of fire at the site is apparent not only by burnt bones and flints (Lemorini et al. 2006), but also by the traces of ash in the sediments. The micromorphological study indicates that fire was habitually used in the upper part of the sequence and present but less common in the lower part (Karkanas *et al.,* 2007).

$^{230}Th/^{234}U$ dates on speleothems suggest that the occupation of the cave began around 400 kyr and ended prior to 200 kyr (Barkai *et al.,* 2003, Gopher et al. Forthcomming). This is supported by unpublished TL dates.

The faunal assemblages of the site are rich and in a good state of preservation. Fallow deer dominate the assemblages from the 2001 excavations. Other species include aurochs (Bos), horse (Equus), wild pig (Sus), tortoise (Testudo) and red deer (Cervus). Not all body parts are present, indicating that carcasses were first processed out of the site and only selected parts were brought to the cave. Cut marks were found on some of the bones and indications of marrow extraction were recognized (Gopher et al. 2005; Lemorini et al. 2006).

Amudian lithic studies - remarks on raw material procurement, blade production technology and functional study of blades

Raw material

A study of raw material procurement strategies (quarrying versus surface collection) has been conducted using a method based on measuring the cosmogenic isotope ^{10}Be (Verri *et al.,* 2004; 2005). We sampled and analyzed flint artifacts from the Late Lower Paleolithic cave sites of Tabun and Qesem. The results have shown that deep mined flint was used already around 400,000 years ago as clearly seen for Tabun Cave and in a somewhat less definitive way for Qesem Cave. Both sites also show use of flint extracted from shallow mined sources and collected from the surface. The results show not only that some of the flint at Qesem Cave was quarried but that this quarried material was used for specific purposes (Boaretto *et al.,*2009). This indicates an intimate knowledge of the environment and the resources in the landscape around the cave. Preliminary surveys indicated the presence of potential raw material sources at the wadi slopes and wadi beds near Qesem Cave as well as *in situ* deposits of fractured flint blocks few km from the cave. Raw material appears as rounded, amorphous or flat small slabs. The later were preferred for blade production.

Blade production

The lithic industrial sequence of the cave is mostly blade-dominated (Barkai *et al*. ,2005; Gopher *et al*., 2005) and attributed, apart from one Yabrudian assemblage, to the Amudian industry. In this section we present a summary of several aspects of the Qesem Cave Amudian industry.

One of the Amudian lithic assemblages from Qesem cave was published recently (Barkai et al. 2005). This assemblage is presented here together with five additional assemblages studied recently and following insights from knapping experiments of Amudian blades conducted by one of us (RS). The basic concepts of Amudian blade production technology practiced at Qesem Cave are as follows:

- The Qesem Cave knappers preferred relatively small, flat and thin (ca. 10 cm long and up to 5cm thick) nodules with cortex on both faces for blade production. Blade cores and raw material blocks found within the cave's strata indicate frequent use of small and flat nodule fragments, most probably split by the elements from large flat nodules as reflected by the weathered and patinated breakage/cleavage plains characterizing the cores and the nodules found at Qesem Cave. These cleavage plains are usually in a ~90 degree angle to the intended production surface at the narrow side of the nodule and thus serve as readily available striking platforms. Similar nodules and nodule fragments were

found by one of us (RS) at the vicinity of Qesem Cave and were used in the knapping experiments.
- The technique used was direct hard-hammer percussion. Blades were removed by using powerful follow-through blows that occasionally removed parts of the distal end (base) of the core and resulted in an over-passing end termination. The blows were mostly delivered at the inside of the striking platform and not close to the edge of the core as indicated by thick platforms and large protruding bulbs of percussion.
- Cores were minimally prepared prior to blade production. Cortex was not removed in advance and many of the blades (especially the NBK's and primary blades but many of the "central" blades as well), carry a strip of cortex at one of the lateral edges or at the distal end. Striking platforms were mostly prepared by a single removal at the initial stage of preparation while the use of natural, unprepared (corticated or old cleavage surfaces) is common as well. Production surfaces were mostly created at an angular corner of the selected flat nodule thus enabling the removal of the first cortical blades following existing ridges with no investment in shaping the production surface and creating primary guiding ridges for blade production.
- Core maintenance during blade production was minimal. Core convexities were maintained by the removal of over-passing items that removed small parts of the core`s distal end (base) and maintained the desired angle between the striking platform and the production surface throughout systematic blade production. The fact that many blades bear a distal over-passing end termination seems to indicate that in the Amudian blade technology target blanks served as core maintenance elements as well. While the systematic, sequential removal of over-passing blades enabled continuous production with minimal maintenance, some of these blades removed a substantial part of the core's distal end and can thus be regarded items removed to control core convexities. It is indeed sometimes difficult to differentiate target blanks with a "minor" over-passing end termination from a true over-passing blades aimed at correcting the angle between the striking platform and the production surface, since in the Amudian technology practiced at Qesem Cave, blank production and core maintenance were achieved by a single blow. In some cases ridges were prepared and maintained and striking platforms were renewed by core tablets or faceting flakes, but this is rather uncommon.
- Laminar items (a general term for the three types of blades) produced included primary blades, NBK's and common/central blades, all part of a single continuous production sequence.
- Blades are characteristically short (mostly between 41-60mm) and thick (mostly between 6-13mm). Striking platforms are usually plain and thick, and bulbs of percussion are pronounced.
- Naturally Backed Knives and central blades are the most conspicuous blade categories in the Amudian industry at Qesem Cave.
- The Amudian blade reduction sequence led to a high percentage of laminar items in the assemblages with a minimal reduction of non-blade by products.

The use of blades

A use-wear study was performed on the lithics retrieved from square K/10 (Lemorini *et al.,* 2006). After selecting the best preserved pieces, 253 items were studied and diagnostic traces were found on 74 artifacts including 37 shaped items and 37 unshaped items. In the case of the former, the wear traces were mostly found on the unshaped (non-retouched) parts of the items. The major activity recognized was cutting (58% of the diagnostic items) followed by scraping activities (25% of the diagnostic items). The cutting is associated with the working of soft material, mainly fleshy tissues. The unshaped edges were used for the different cutting activities, while shaped edges were more often used for scraping. The use of these cutting tools was not intensive and items were discarded after a short time. The results demonstrate the efficiency of NBK's as cutting tools and can be summarized as follows:
1) Considering the age of the site, the state of preservation is outstandingly high and permits a detailed functional reconstruction.
2) The major use of blades in the studied assemblage was in butchering. The use wear is mainly related to cutting and defleshing of soft tissues. There is a correlation between working edge morphology (straight edge) and cutting activities.
3) The use of blades for cutting tasks seems to have been short, as indicated by the degree of development of wear traces and the general lack of resharpening.

New results of the Qesem Cave lithic studies – Assemblages composition

The excavated lithic assemblages of Qesem Cave from the 2001-2006 seasons includes over 50,000 artifacts. Here we present the composition of six distinct lithic assemblages, altogether 24,053 artifacts. Five of these lithic assemblages were studied in detail by RS in the course of a PhD thesis and one by ZL as part of an MA thesis focusing on the Yabrudian assemblage from Qesem Cave. We emphasize the centrality of blade production in the Amudian assemblages and the dominance of scraper production in the Yabrudian assemblage. The limited scope of this paper does not allow an elaboration on the lithic classification and a definition of each of the categories. A detailed attribute analysis of the blades and scrapers will be presented elsewhere.

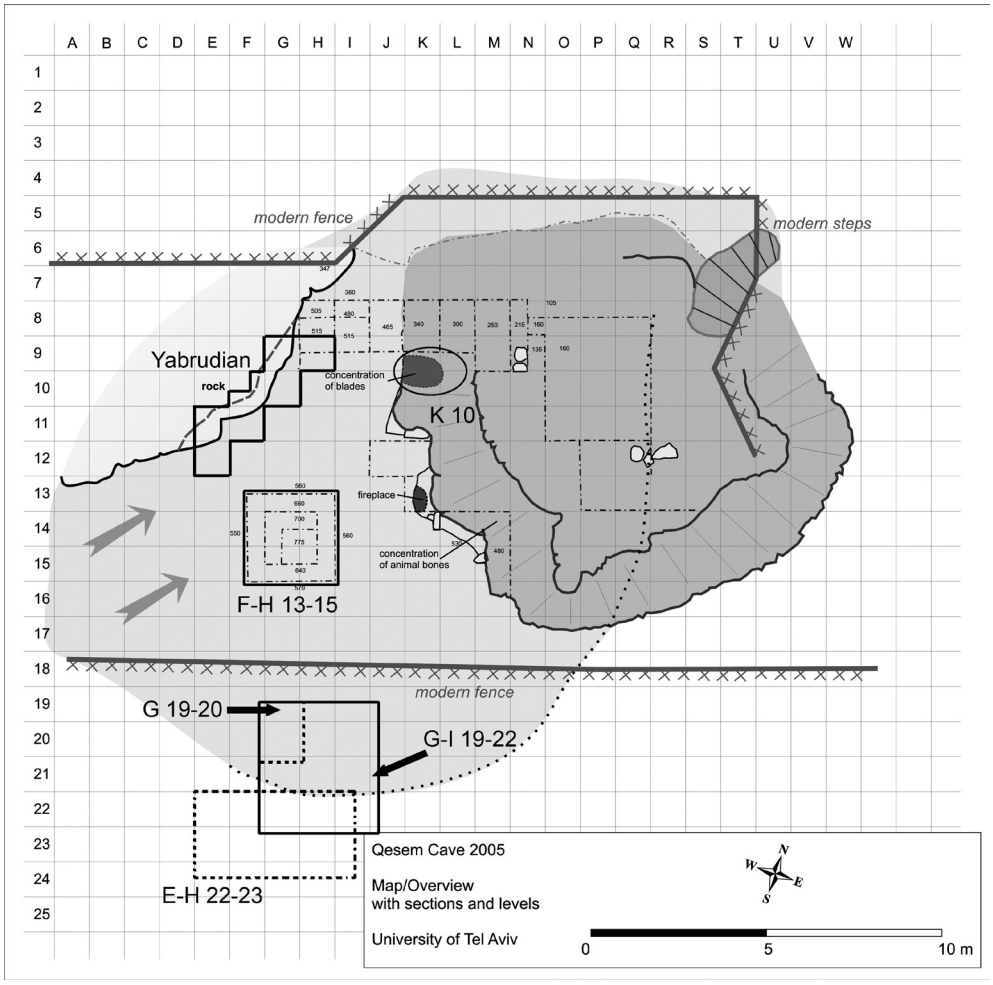

Figure 1. A plan view of Qesem Cave with indication of the spatial location of the six assemblages presented in the paper.

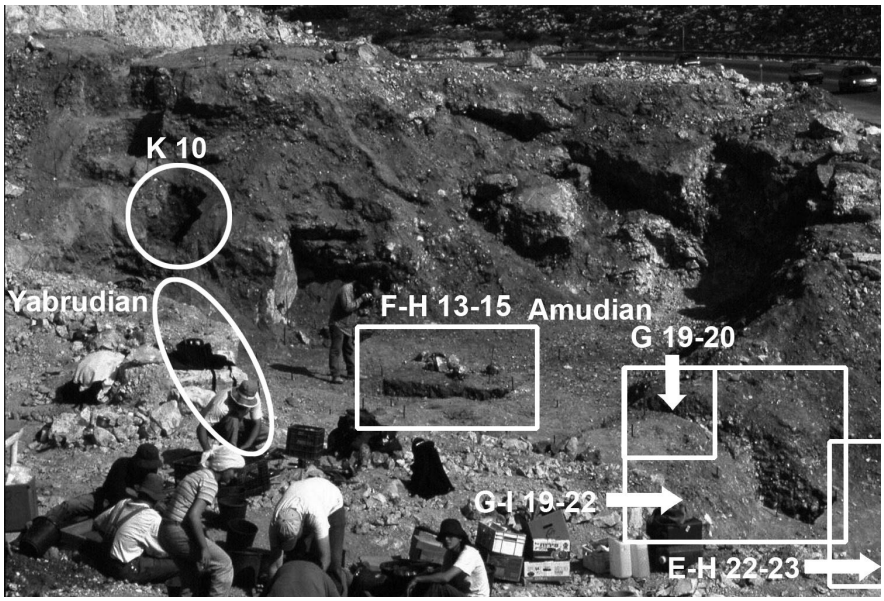

Figure 2. A picture of Qesem Cave taken during the 2001 salvage excavation with indication of the spatial location of the six assemblages presented in the paper.

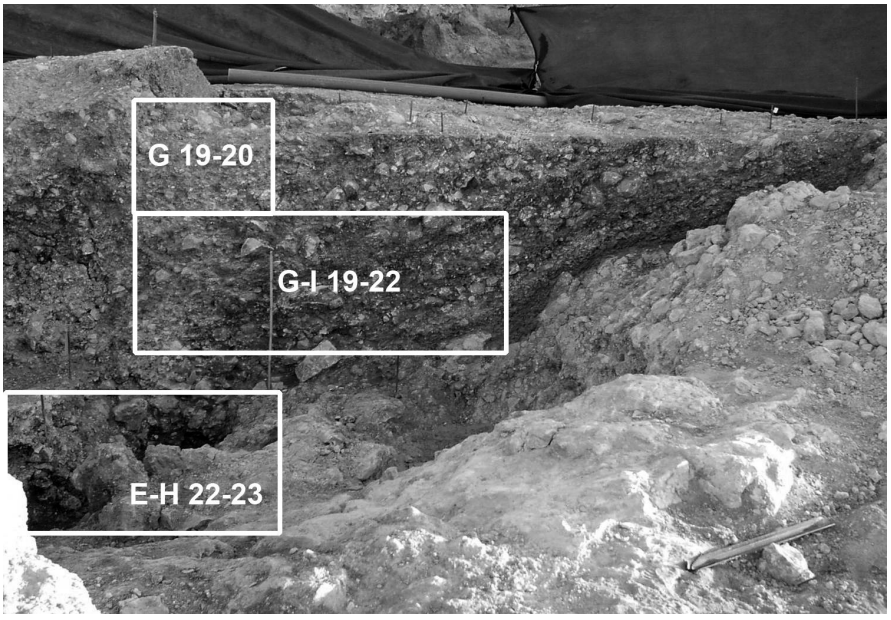

Figure 3. The lower part of the Qesem Cave stratigraphic sequence viewed from south to north as exposed during the 2001 salvage excavation. The approximate location of the three assemblages from the southern edge of the cave is indicated.

The Amudian assemblages

The five Amudian samples studied were retrieved from different areas of the cave (Figs 1-3) covering different parts of the stratigaphic sequence. The assemblages were schematically ordered, from lower to upper, presumably early to late:

1) The Unit V sample includes squares E22, F22, G21 and G22, elevations 745-850 cm below datum. It sits directly on bedrock at the bottom of the cave and represents the earliest excavated sample on- site.

2) Sample G-I/19-22 includes squares G20-22, H19-21, H22 and I20 from elevations 600-670 cm below datum. It is stratigraphicly distinct from Unit V and located 75 cm above it.

3) Sample G19-20 includes squares G19-20 at elevations 525-600 cm below datum. This very rich sample originated from a well defined stratigraphic horizon identified during the 2001 salvage excavation. It is located directly above sample G-I/19-22 at square G20. This assemblage was already published (Barkai *et al*. 2005).

4) Sample F-H/13-15 includes squares F13-15, G13-15, H13-15 and squares I15-16. The sample originates from elevations 553-670 cm below datum and it represents the upper part of the test pit excavated in the center of the cave. It is located over three meters to the north of the previous samples and is similar in elevation to samples G-I/19-22 and G19-20 (Figs. 1-3).

5) Sample K10 includes part of a single excavated square K10 at elevations 300-420 cm below datum. This is the only sample from the upper part of the stratigraphic sequence of Qesem Cave, the latermost sample in this study. It comes from a very special area of the cave characterized by a thick (~100cm) layer of very soft sediments extremely rich in lithic artifacts and fauna embedded between two very thick and hard layers of cemented archaeological sediments.

The five Amudian samples include 19,166 items (Table 1). Débitage and shaped items (n=8,914) constitute 46.7-64.1% of the studied samples, except for sample K10 where they constitute 27.1%. This difference can be attributed to the fact that sample K10 was wet-sieved while the others were dry-sieved. Debri includes 10,252 items divided into three categories: chunks (n=5164), chips (n=4578) and micro flakes (flakes smaller than 1.5 cm; n=510).

The general breakdown of the Amudian assemblages is presented in Fig 1 and reflects two basic insights: one is the central place of blades throughout the stratigraphy of the cave and the other is the range of variability between the different Amudian assemblages. We would like to emphasize the fact that the laminar component in each of the assemblages is conspicuous, ranging between 24.5-58.2% of the débitage and shaped items. Notwithstanding assemblage variability, a quarter to half of the identifiable blanks are blades of some sort (Fig. 4). This reinforces our contention, based on the technological reconstruction, that the Amudian should be characterized by its systematic

blade production (Barkai et al. 2005; Gopher et al. 2005). Among the blades produced we would like to draw attention to the special place of NBK's that appear in large numbers in all Amudian assemblages. It appears that this specific type of artifact is the major target of the Amudian blade industry. Although shaped items are not detailed here, we include some of the results of the shaped items analysis in our discussion. Surprisingly, the percentages of blades among the shaped items is very similar to the ratio of blades in the general assemblage accounting for 24.4%-61.4% of the shaped items. The meaning of this observation is twofold – firstly there was no selection in favor of blades in the shaped items, and secondly a quarter to two thirds of the shaped item were made on a blade blank. The distinctive Lower Paleolithic hand-axes are extremely rare in the assemblages presented here and some assemblages contain no bifacial tools at all. Talking in numbers, the analyzed Amudian assemblages include 657 shaped blades and only seven bifacial tools. Scrapers are not frequent as well in the Amudian assemblages and consist of between 0.8-8.9% of the shaped items, with a total number of 69 in all five assemblages. It should be noted that the NBK's are not classified as shaped items ("tools") but as blanks, regardless of the fact that many carry use-wear. Had we incorporated these typical Amudian items in the shaped items category, the amount of blades within the shaped items category would have increase significantly.

It goes without saying that simple flake production was practiced alongside blade production in the Amudian as two discrete core reduction strategies. A detailed account on the cores, Core Trimming Elements and the other categories is beyond the scope of this paper. The tendency of Amudian knappers to recycle "old" flint items, as reflected in the `cores on flake` category, items with double patina and double bulb items, should not be left unnoticed.

The Yabrudian assemblage

During the 2006 excavation season we opened a new area along the north-western edge of the cave, underneath a rock shelf (Figs.1-2). This shelf is located some four meters above the base of the occupational sediments and over three meters below the top of the occupational sediments – approximately at the middle of the cave's stratigraphic sequence. U-series dates indicate that the shelf was formed prior to 400 kyr and that human occupation on it ranges between 313 and 242 kyr (Gopher et al. Forthcomming). A single date obtained from a speleotheme below the shelf, within the orange sediments from which the Yabrudian assemblage was excavated, indicated human occupation in this part of the cave at ~297 kyr. Following sedimentlogical considerations, the sediments below the shelf were divided into two successive layers. The upper layer is directly underneath the shelf and composed of sediments that are orange in color and rather soft and loose. It was excavated in squares E11-12, F10-11, G9-10 and H9 to a depth of 30-100 cm (elevation ~420-520 below datum, depends on the inclination). It is of note that these orange

TABLE 1: The Amudian lithic assemblages of Qesem Cave plus a division into laminar and flake blanks.

	Unit V			G-I/19-22			G/19-20			F-H/13-15			K/10			All Smaples		
	No.	% out of debitage and shaped items	% out of the complete assemblage	No.	% out of debitage and shaped items	% out of the complete assemblage	No.	% out of debitage and shaped items	% out of the complete assemblage	No.	% out of debitage and shaped items	% out of the complete assemblage	No.	% out of debitage and shaped items	% out of the complete assemblage	No.	% out of debitage and shaped items	% out of the complete assemblage
primary element flake	90	14,4	9,2	217	10,5	5,9	98	6,3	3,8	403	11,9	5,6	127	10,0	2,7	935	10,5	4,9
primary element blade (PE blade)	34	5,4	3,5	131	6,3	3,5	133	8,5	5,2	209	6,2	2,9	88	6,9	1,9	595	6,7	3,1
primary element bladelet (PE blt)	7	1,1	0,7	18	0,9	0,5	11	0,7	0,4	19	0,6	0,3	14	1,1	0,3	69	0,8	0,4
non-modified base flake	183	29,3	18,8	495	23,9	13,4	225	14,3	8,8	789	23,3	10,9	416	32,8	8,9	2108	23,6	11,0
modified base flake	48	7,7	4,9	178	8,6	4,8	77	4,9	3,0	262	7,8	3,6	55	4,3	1,2	620	7,0	3,2
blade	27	4,3	2,8	146	7,0	4,0	165	10,5	6,4	214	6,3	3,0	93	7,3	2,0	645	7,2	3,4
bladelet	3	0,5	0,3	32	1,5	0,9	22	1,4	0,9	19	0,6	0,3	40	3,1	0,9	116	1,3	0,6
naturally backed knife (NBK)	33	5,3	3,4	140	6,8	3,8	190	12,1	7,4	246	7,3	3,4	87	6,9	1,9	696	7,8	3,6
NBK-flake	23	3,7	2,4	63	3,0	1,7	17	1,1	0,7	116	3,4	1,6	27	2,1	0,6	246	2,8	1,3
core trimming element (CTE)	48	7,7	4,9	195	9,4	5,3	132	8,4	5,2	271	8,0	3,7	80	6,3	1,7	726	8,1	3,8
core	20	3,2	2,1	90	4,3	2,4	42	2,7	1,6	143	4,2	2,0	22	1,7	0,5	317	3,6	1,7
core fragment	2	0,3	0,2	16	0,8	0,4	6	0,4	0,2	35	1,0	0,5	2	0,2	0,0	61	0,7	0,3
core on flake	12	1,9	1,2	33	1,6	0,9	23	1,5	0,9	47	1,4	0,6	12	0,9	0,3	127	1,4	0,7
double bulb	4	0,6	0,4	19	0,9	0,5	17	1,1	0,7	24	0,7	0,3	3	0,2	0,1	67	0,8	0,3
burin spall	8	1,3	0,8	39	1,9	1,1	30	1,9	1,2	55	1,6	0,8	25	2,0	0,5	157	1,8	0,8
special waste	3	0,5	0,3	18	0,9	0,5		0,0	0,0	10	0,3	0,1	1	0,1	0,02	32	0,4	0,17
shaped items	79	12,7	8,1	242	11,7	6,6	380	24,2	14,8	518	15,3	7,1	178	14,0	3,8	1397	15,7	7,3
debitage+shaped items sum	**624**	**100**	**64,1**	**2072**	**100**	**56,1**	**1568**	**100**	**61,3**	**3380**	**100**	**46,7**	**1270**	**100**	**27,1**	**8914**	**100**	**46,5**
chunk	229		23,5	1008		27,3	810		31,6	2284		31,5	833		17,7	5164		26,9
chip	112		11,5	528		14,3	162		6,3	1447		20,0	2329		49,6	4578		23,9
micro flake	9		0,9	86		2,3	20		0,8	134		1,8	261		5,6	510		2,7
total sum	974		100	3694		100	2560		100	7245		100	4693		100	19166		100

	No.	%		No.	%		No.	%		No.	%		No.	%		No.	%
laminar items	153	24,5		685	33,1		912	58,2		1065	31,5		494	38,9		3309	37,1
flake items	435	69,7		1247	60,2		585	37,3		2086	61,7		740	58,3		5093	57,1
cores	36	5,8		140	6,8		71	4,5		229	6,8		36	2,8		512	5,7
total	624	100		2072	100		1568	100		3380	100		1270	100		8914	100

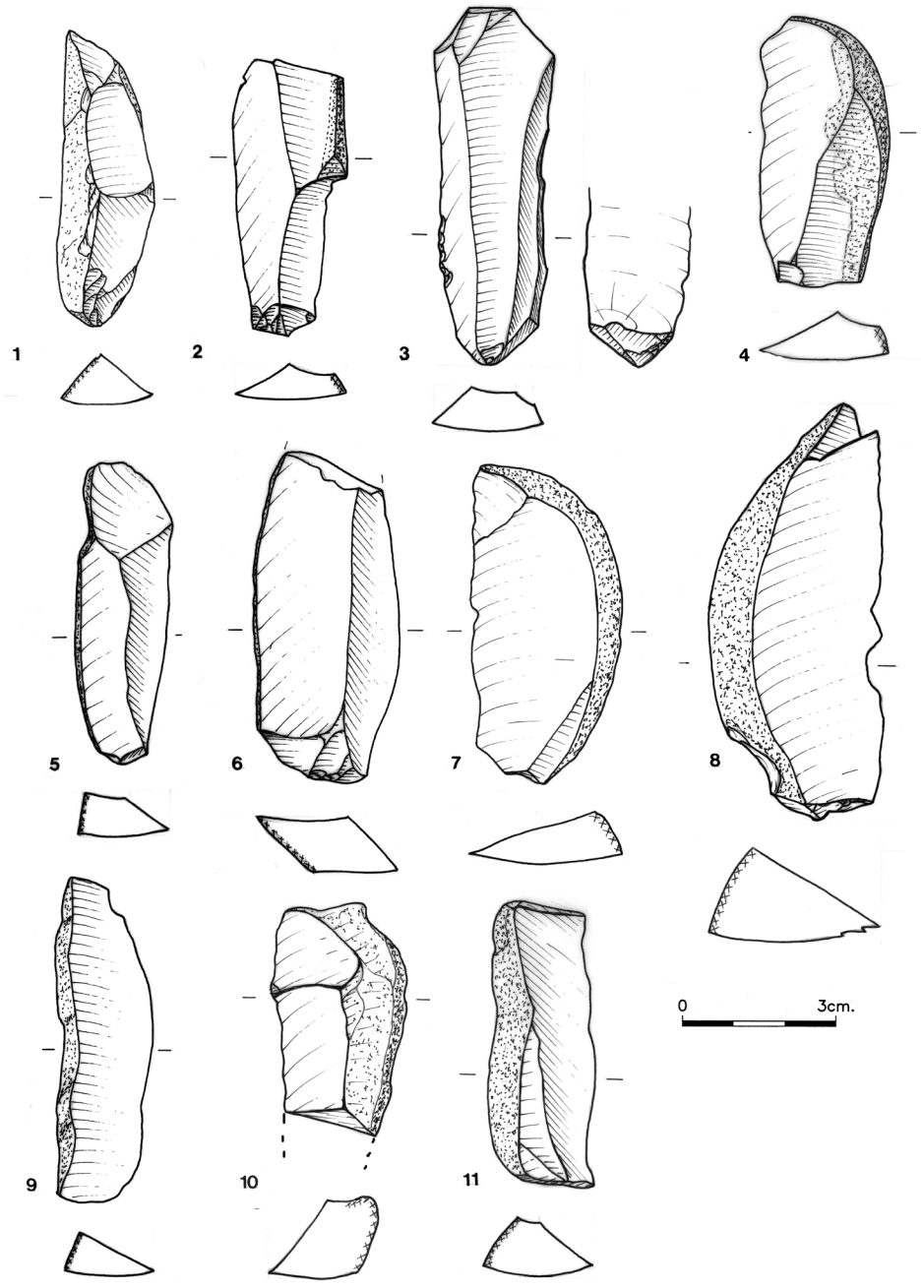

Figure 4. Naturally Backed knifes from sample F-H/13-15.

sediments are found only at the northern edge of the cave. The lower layer is directly below the orange layer and is composed of hard brown sediments. It was excavated in the same squares to a depth of 5-55cm (elevation ~520-590 below datum, depends on the inclination). We still have not excavated this layer completely while the orange layer was mostly removed from this area. The Yabrudian orange and brown assemblages were excavated from elevations similar to the elevations of the Amudian samples G19-20 and F-H/13-15 that are only two to six meters apart. It was already clear during excavation in the shelf area that these two layers are rich in scrapers and not so rich in blades and this impression was reinforced by the results of the analysis presented in Table 2. Blades constitute only 15% of the debitage and shaped items (Table 2), as opposed to 24.5%-58% in the Amudian assemblages. Only 18% of the shaped items are made on blade blanks. Bifacial tools are totally absent from these layers. The most conspicuous characteristic of these two layers is the prominent role of scrapers within the shaped items category where they account for 45% of the shaped items with a total number of 113 scrapers and 12 scraper resharpening flakes. The absolute number of scrapers from the shelf area is almost double than the number of scrapers from all Amudian assemblages taken together, where the total number of artifacts is five times larger than in the assemblage of the orange and brown layers at the shelf area. We assigned the lithic assemblages from the shelf area to the Yabrudian and treated them here as one assemblage. This issue is still under consideration and a detailed study of the scrapers is currently underway. It is clear that blade production took place during the Yabrudian occupation of this specific area of Qesem Cave and that blade production technologies were practiced following the Amudian technological standards detailed above. Nevertheless, this was done on a smaller scale than in the Amudian and the fact that every second shaped item in the Yabrudian assemblage is a scraper is the hallmark of this specific industry. Yabrudian scarpers are usually made on thick flakes, sometimes on transversal and dejete flakes and are shaped by Quina or demi-Quina retouch (Fig. 5). Unlike the blade industry, the initial stages of scraper blank production are absent and it seems that ready made blanks or shaped scrapers were imported to the shelf area of Qesem Cave. Scrapers were however maintained on-site as evidenced by scarper resharpening spalls.

TABLE 2: The Yabrudian assemblage of Qesem Cave plus a division into laminar and flake blanks

	no.	% of dé bitage and shaped items	% of total assemblage
primary element flake	68	6,59	1,39
primary element blade (PE blade)	18	1,74	0,37
primary element bladelet (PE blt)	3	0,29	0,06
non-modified base flake	435	42,15	8,90
modified base flake	76	7,36	1,56
blade	27	2,62	0,55
bladelet	4	0,39	0,08
naturally backed knife (NBK)	25	2,42	0,51
NBK flake	16	1,55	0,33
core trimming element (CTE)	41	3,97	0,84
core	7	0,68	0,14
core fragment	8	0,78	0,16
core on flake	8	0,78	0,16
burin spall	13	1,26	0,27
double bulb	2	0,19	0,04
shaped item	255	24,71	5,22
special waste	26	2,52	0,53
sum of débitage and shaped items	**1032**	**100,00**	**21,12**
chunk	1339		27,40
chip	2310		47,27
micro flake	206		4,22
Total	**4887**		**100,00**

	No.	%
laminar items	150	14,53
flakes	858	83,14
cores	24	2,33
total	**1032**	**100,00**

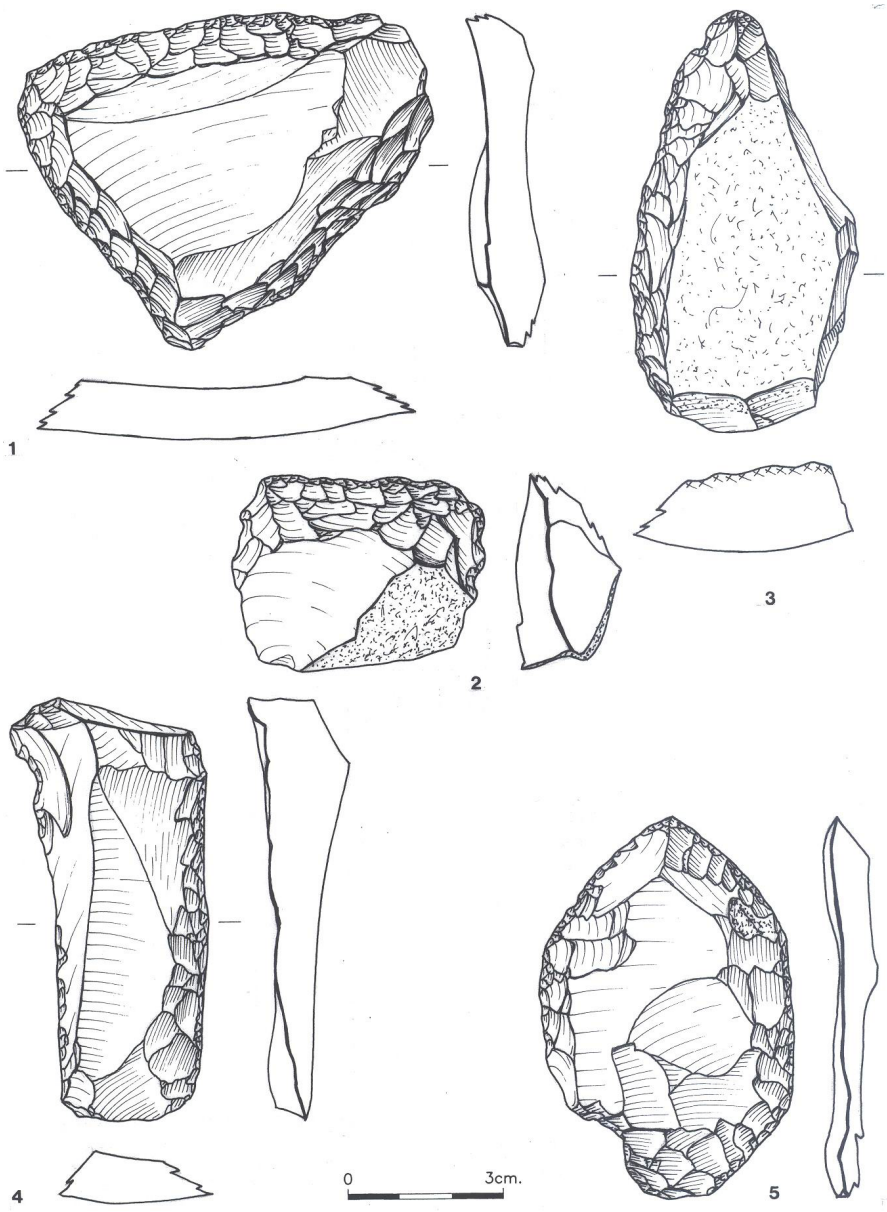

Figure 5. Scrapers from the Yabrudian assemblage.

Discussion and Conclusions

Qesem Cave was repeatedly visited by Hominins during the Middle Pleistocene, as early as 400 kyr ago when the cave was a large empty karstic chamber and until slightly prior to 200 kyr ago when anthropogenic sediments filled the cave almost completely. The human use of Qesem Cave is related to the Acheulo-Yabrudian cultural complex with no indication of earlier or later activities. The stratigraphic sequence of ca. 7.5 meters can be characterized by three major cultural traits repeatedly found from bottom to top: the first is systematic blade production, the second is the habitual use of fire and the third is the dominance of fallow deer within the fauna. The rich Amudian assemblages reflect strict standards of raw material procurement and an established and crystallized *Chaîne Opératoire* for blade production, use and discard at the dawn of the human use of blades. Amudian blades were reduced from specific flat nodule fragments and small nodules that were either collected or quarried from the sub-surface. These nodules enabled the implementation of the Amudian conception of blade production, i.e. serial production of cutting implements, preferably with one cortical, steep lateral edge and an opposed sharp edge, with very little effort invested in core preparation and maintenance. This sounds like mission impossible, but Amudian blade knappers developed a very efficient technology for the production of cutting tools which looks very simple at first glance, but is actually sophisticated and highly effective. Blank production and core convexities were achieved by follow-through blows and thus the Amudian blade technology supplied large numbers of cutting tools with relatively few by products. This is indeed a very early 'cutting edge' technology. Amudian blades were mostly used in cutting, butchering and defleshing activities on soft tissues and were practically conceived as disposable tools, cut and throw-away implements. This use and discard pattern was possible thanks to the constant supply of fresh cutting tools by the Amudian flint knappers. It is beyond the accidental that large numbers of blades appear together with large numbers of fallow deer body parts. It seems likely that Amudian blades at Qesem Cave were mostly used in butchering these prey animals. The habitual use of fire too might be connected to the consumption of meat at the site. Stray hand-axes and small numbers of scrapers found in Amudian assemblages might indicate a wider range of activities than blade-related tasks, but the dominance of blades reflects their centrality in the Amudian of Qesem. Acheulo-Yabrudian and Yabrudian assemblages in contemporaneous sites such as Tabun and Yabrud I are dominated by hand-axes and/or scrapers with few blades or no blades, and thus might reflect a different array of activities than the Amudian (e.g. Jelinek 1990). Another suggestion regarding this variability advocated the existence of different human groups in the Levant during Acheulo-Yabrudian times, each group characterized by one of the three lithic industries (Garrod, 1956; Rust, 1950).

While reflecting on Acheulo-Yabrudian variability following our work at Qesem Cave, and this study in particular, the traditional explanations caused unrest in some ways. On the one hand, it was very simple, perhaps too simple, and on the other hand

a sequence of ca. 7.5 m of Amudian only, as was the case at Qesem Cave until very recently, deserved attention and explanation in the Acheulo-Yabrudian context where blade dominated industries were usually marginal in scale and minor in the stratigraphy. Once we were certain about the presence of a Yabrudian, scraper-dominated assemblage, we had no way of saying that this Yarudian assemblage was not contemporaneous with some of Amudian ones at the cave.

This is not the common situation in Acheulo-Yabrudian sites and literature, although mentioned very briefly as an option in the sites of Tabun and Yabrud I and in a more pronounced manner at the site of Abri Zumoffen (Garod 1970; Garrod and Kirkbride 1961; Solekci and Solecki 1986). Excavations in Acheulo-Yabrudian sites mostly exposed vertical section documenting a succession of human occupations reported as stratigraphic layers or sub-layers containing successive alternating lithic industries appearing with no repeated order. These were thus interpreted as independent, interfingering units following the geological logic of such situations.

Although Garrod exposed a relatively large area of Layer E at Tabun cave, she emphasized the stratigraphy of the different Acheulo-Yabrudian (Layer E) industries present on-site as did Rust for Yabrud I (Garrod and Bate 1937, Garrod 1956; Rust 1950) Their followers and students of the Acheulo-Yabrudian until today have not invested too many efforts in discussing the meaning of this variability but the basic trends remained and Acheulo-Yabrudian industries have been presented as alternating entities with the general, large scale, embracing Acheulo-Yabrudian cultural complex.

The unique stratigraphic situation and the relatively large spatial exposure of the Qesem Cave deposits urged us to investigate other possibilities concerning the issue of Acheulo-Yabrudian industrial variability. While it is clear that the Amudian industry is central in the activities carried out at the cave throughout human occupation, the discovery of a Yabrudian assemblage in a specific location, but unequivocally in the same stratigraphic context as an Amudian assemblage might indicate a coexistence of Amudian and Yabrudian industries. This, in turn may support a spatially related interpretation to Acheulo-Yabrudian variability at Qesem Cave suggesting different activity areas at the cave.

This may bear far-reaching significance regarding our understanding of the Acheulo-Yabrudian cultural complex in general suggesting that the three typical lithic industries are indeed complementary and may be seen as components reflecting different coeval activities. Such a view would unequivocally shift the emphasis from attempts to explain cultural variability to an attempt of recognizing the complex adaptational and behavioral aspects of Middle Pleistocene hominins within a single, unique culture in the Levant between the Acheulian and the Mousterian.

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References

Bar-Yosef, O., 1994. The Lower Paleolithic in the Near East. *Journal World Prehistory*, 8:211-265.

Bar-Yosef, O. and Kuhn S. L., 1999. The big deal about blades: Laminar technologies and Human Evolution. *American Anthropologist*, 101/2: 322-338.

Barkai. R., Gopher, A., Lauritzen, S. E. and Frumkin, A., 2003. Uranium Series Dates from Qesem Cave, Israel, and the end of the Lower Palaeolithic. *Nature*, 423: 977-979.

Barkai, R.,Gopher, A. and Shimelmitz, R., 2005. Middle Pleistocene Blade Production in the Levant: An Amudian Assemblage from Qesem Cave, Israel. *Eurasian Prehistory*, 3: 39-74.

Boaretto E., Barkai R., Gopher A., Berna F., Kubik P.W., Weiner S., 2009. Specialized Flint Procurement Strategies for Hand Axes, Scrapers and Blades in the Late Lower Palaeolithic: A ^{10}BE Study at Qesem cave, Israel. In Longo L. (Ed.) Integrated methodological Aproaches to the Study of Lithic Technology, Human Evolution 24 (1).

Copeland, L., 1983 The Amudian Beach Industry at Abri Zumoffen. In, D. A. Roe (ed.), *Adlun in the Stone Age*, BAR International Series 159, Pp. 209-260.

Copeland, L., 2000. Yabrudian and related industries: The State of Research in 1996. In Ronen, A. and Weinstein-Evron, M. eds. *Toward Modern Humans: Yabrudian and Micoquian, 400-50 kyears ago*. BAR International Series 850. Pp. 97-117.

Frumkin, A. Karkanas, P.; Bar-Matthews, M.; Barkai, R.; Gopher, A.; Shahack-Gross, R. and Vaks, A., 2008. Gravitational deformations and fillings of aging caves: the example of Qesem karst system, Israel. *Geomorphology*,

Garrod, D.A.E., 1956. 'Acheuleo-Jabrudian' et 'Pre-Aurignacian' de la grotte du Taboun (Mont Carmel): étude stratigraphique et chronologique. *Quaternaria*, 3: 39-59.

Garrod, D. A. E., 1970. Pre-Aurignacian and Amudian: A Comparative Study of the Earliest Blade Industries of the Near East. In Gripp, K., Schütrumpf, R. and Schabedissen, H. eds. *Frühe Menschheit und Umwelt*. Böhlau Verlag, Köln. Pp. 224-229.

Garrod, D.A.E. and Bate, D.M.A., 1937. *The Stone Age of Mount Carmel, I*. Clarendon Press, Oxford.

Garrod, D.A.E. and Kirkbride, D., 1961. Excavation of the Abri Zumoffen, a Paleolithic rock-shelter near Adlun, South Lebanon. *Bulletin du Musée de Beyrouth*, 16:7-46.

Gissis, I. And Bar-Yosef,, O. 1974. New excavations in Zuttiyeh cave, Wadi Amud, Israel. *Paléorient*, 5: 175-180.

Gopher, A., Barkai, R., Shimelmitz, R., Khalaily, M., Lemorini, C., Hershkovitz, I. and Stiner, M., 2005. Qesem Cave: An Amudian site in central Israel. *Journal of the Israel Prehistoric Society*, 35: 69-92.

Gopher, A., Ayalon, A., Bar-Matthews, M. Barkai, R., Frumkin, A., Karkanas, P.,and Shahack-Gross, R., Forthcomming. A contribution to the chronology of the Late Lower Paleolithic in the Levant: U series dates of speleothems from the Middle Pleistocene Acheulo-Yabrudian Qesem cave, Israel

Goren-Inbar, N., 1995. The Lower Paleolithic of Israel. In: Levy, T. (ed.). *The Archaeology of Society in the Holy Land*. Leicester University Press, London. Pp. 93-109.

Jelinek, A. J., 1982. The Tabun Cave and Paleolithic Man in the Levant. *Science*, 216: 1369-1375.

Jelinek, A.J., 1990. The Amudian in the context of tha Mugharan tradition at the Tabun cave (Mt.

Carmel), Israel. In: Mellars, P. (ed.). *The Emergence of Modern Humans*. Edinburgh University Press, Edinburgh. Pp. 81-90.

Lemorini, C., Gopher, A, Shimelmitz, R., Stiner, M., and Barkai, R., 2006. Use-wear analysis of an Amudian laminar assemblage from Acheuleo-Yabrudian Qesem Cave, Israel. *Journal of Archaeological Science*, 33: 921-934.

Monigal, K., 2001. Lower and Middle Paleolithic blade industries and the dawn of the Upper Paleolithic in the Levant. *Archaeology, Ethnology and Anthropology of Eurasia*, 1: 11-24.

Monigal, K., 2002. *The Levantine Leptolithic: Blade Production from the Lower Paleolithic to the Dawn of the Upper Paleolithic*. Unpublished Ph.D. Dissertation, Southern Methodist University, Dallas.

Ronen, A. and Weinstein-Evron, M., eds.. 2000. *Towards Modern Humans: Yabrudian and Micoquian, 400-50 kyears ago*. BAR International Series 850.

Rust, A., 1950. Die Hohlenfunde von Jabrud (Syrien). Neumunster.

Shmookler, L., 1983. *Masloukh Revisited: The Amudian Layers of the Coastal Site in Lebanon*. Unpublished Manuscript, Department of Anthropology, Columbia University.

Skinner, J. H., 1970. El Masloukh: A Yabrudian Site in Lebanon. *Bulletin du Musée de Beyrouth*, XXIII: 143-172.

Solecki, R.L. and Solecki, R.S. 1986. A reappraisal of Rust's cultural stratigraphy of Yabrud shelter I. *Paléorient* 12: 53-59.

Turville Petre, F., 1927. *Research in Prehistoric Galilee 1925-1926 and a report on the Galilee Skull*. British School of Archaeology in Jerusalem, London.

Verri, G., Barkai, R., Bordeanu, C., Gopher, A., Hass, M., Kaufman, A., Kubik, P. Montanari, E., Paul, M., Ronen, A., Weiner, S., and Boaretto, E., 2004. Flint Mining in Prehistory Recorded by *in Situ* Produced Cosmogenic ^{10}Be. *Proceedings of the National Academy of Sciences U.S.A.,* 101(21):7880-7884.

Verri, G., Barkai, R., Gopher, A., Hass, M., Kubik, P., Paul, M., Ronen, A., Weiner, S., and Boaretto, E., 2005. Flint procurement strategies in the Late Lower Palaeolithic recordrd by in Situ produced Cosmogenic ^{10}Be in Tabun and Qesem Caves (Israel). *Journal of Archaeological Science,* 32:207-213.

Vishnyatsky, L. B., 2000. The Pre-Aurignacian and Amudian as Intra-Yabrudian-Episode. In Ronen, A. and Weinstein-Evron, M. eds. *Toward Modern Humans: Yabrudian and Micoquian, 400-50 kyears ago*. BAR International Series 850. Pp. 145-151.

Wiseman, M., 1993. Lithic Blade Elements from the Southern Levant: A Diachronic View of Changing Technology and Design Process. *Journal of the Israel Prehistoric Society,* 25: 13-102.