

MIDDLE PLEISTOCENE BLADE PRODUCTION IN THE LEVANT: AN AMUDIAN ASSEMBLAGE FROM QESEM CAVE, ISRAEL

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Abstract

This paper describes an Amudian, laminar, lithic assemblage from Qesem Cave, Israel. The Amudian is part of the Acheulo-Yabrudian (Mugharan) complex of the Levant generally dated to 400–200 kyr ago.

We show that blade production dominates the assemblage. The technology looks simple with little core shaping or preparation and little, if at all, core maintenance. This is also reflected in the blanks that usually have thick plain butts.

Direct percussion heavy blows, deep inside the striking platform were practiced and thus overpassing items are abundant. Cortex was not removed since cortical laminar items were a desired end-product, especially Naturally Backed Knives.

Large, wide and thick laminar items were selected for secondary modification and the shaped items are dominated by retouched and backed laminar items with some end scrapers, burins and rare side scrapers.

In general, this appears to be a simple but an efficient laminar industry – a conscious technological choice of skilled flint knappers.

INTRODUCTION

Qesem Cave is a recently discovered Acheulo-Yabrudian¹ cave site, 12 km east of Tel Aviv, Israel (Fig. 1). The cave has lost its ceiling, but nevertheless large parts of the interior are still intact. Excavations in 2001 exposed a 7.5 m depth of archaeological sediments with a complex stratigraphy, including distinct artifact-bearing horizons. The stratigraphic sequence is attributed to the Acheulo-Yabrudian complex of the terminal Lower Paleolithic. The upper part of the section has been dated to *ca.* 380,000–210,000 kyr BP (Barkai *et al.*, 2003; Gopher *et al.*, 2005).

The Acheulo-Yabrudian complex is composed of different industries, one of which, the Amudian, is characterized by a systematic

production of laminar items (Copeland, 2000; Garrod, 1970). Detailed studies of Amudian lithic technology are few (*e.g.*, Copeland, 1983; Monigal, 2002:234–275; Wiseman, 1993; Vishnyatsky, 2000), although early laminar industries have received much attention recently (Bar-Yosef and Kuhn, 1999; Meignen, 1998, 2000; Monigal, 2001; Ronen, 1992; Vishnyatsky, 1994).

The Qesem Cave lithic assemblages are all Amudian (Gopher *et al.*, 2005) and this paper focuses on the lithic assemblage of one Amudian horizon in the Cave. Our primary intention is to characterize the Amudian lithic industry in Qesem Cave. This may be significant for better acquaintance with the Amudian and laminar late Lower Paleolithic industries as a whole. The

¹ The term Acheulo-Yabrudian refers to the cultural/lithic complex postdating the Acheulian and predating the Mousterian; Jelinek's 'Mugharan Tradition'.

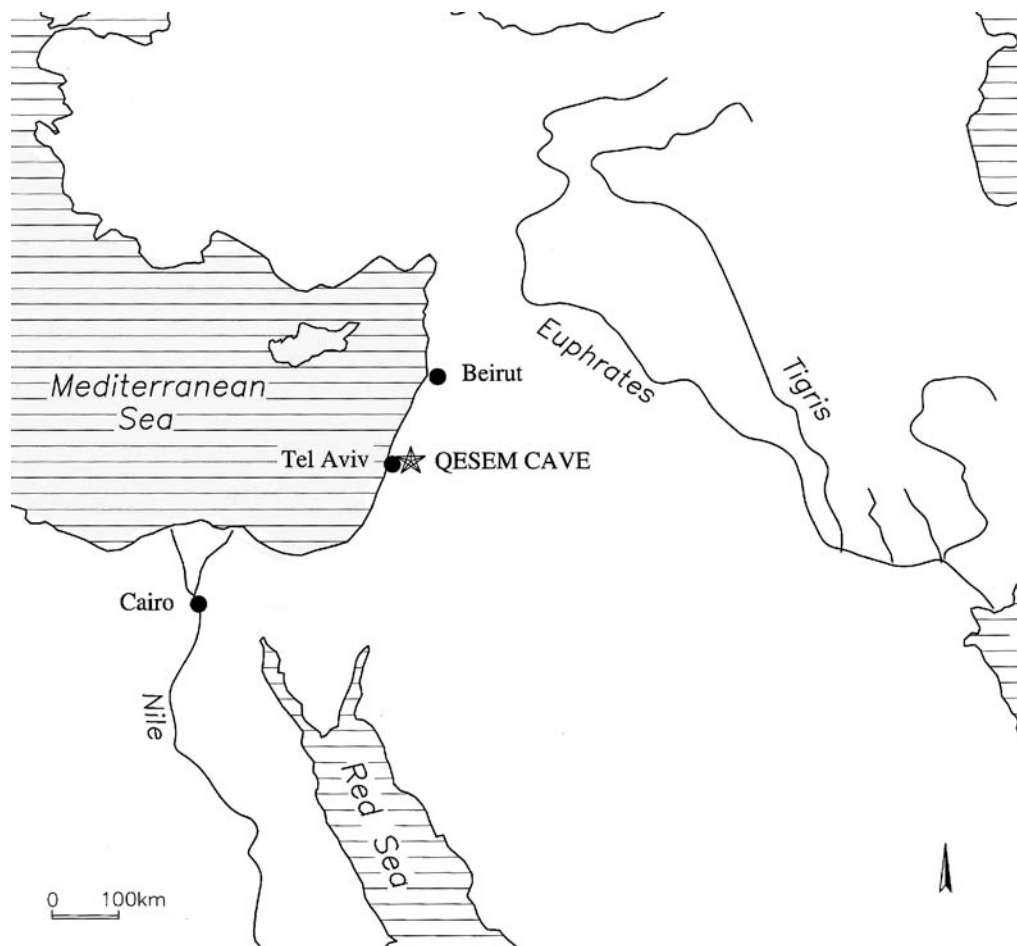


Fig. 1. Site location

assemblage analyzed originates from an area of two m^2 (G-19 and G-20 in the original Qesem Cave grid system), at an elevation of 525–600 cm below datum. The Amudian assemblage described here is some three meters below the flowstone dated to *ca.* 380,000–210,000 kyr BP (Barkai *et al.*, 2003).

The assemblage presented constitutes 2,560 items (Tables 1–2). The débitage and shaped items are predominantly laminar (58.2%). These include mainly blades, primary element blades (henceforth PE blades) and naturally-backed knives (henceforth NBK; Table 3). Our main objective is to characterize the laminar technology at the site through a detailed analysis of these items. A comparison between the laminar blanks and the

laminar shaped items was conducted in order to characterize the desired end-products, identify attributes that had a role in blank selection, and reconstruct the technology used to produce the desired blanks. We are aware of the fact that specific blanks were used for different activities without secondary modification like the NBKs (for an overview see Debénath and Dibble, 1994:53–54). However, without use-wear analysis of all the items in the assemblage, a clear-cut division between used items (tools) and unused blanks cannot be achieved. Preliminary results of a use-wear study at Qesem Cave revealed that both shaped and unshaped items were used as tools, especially in laminar-dominated assemblages (Lemorini *et al.*, 2006). In the case of this Amudian assem-

Table 1

Lithic assemblages from unit G19-20

	No.	% of débitage and shaped items	% of total assemblage
primary element flake	98	6.25	3.83
primary element blade (PE blade)	133	8.48	5.20
primary element bladelet (PE blt)	11	0.70	0.43
non-modified butt flake	225	14.35	8.79
modified butt flake	77	4.91	3.01
blade	165	10.52	6.45
bladelet	22	1.40	0.86
naturally backed knife (NBK)	190	12.12	7.42
naturally backed knife (flake; NBK flake)	17	1.08	0.66
core trimming element (CTE)	132	8.42	5.16
core	46	2.93	1.80
core fragment	6	0.38	0.23
core on flake	19	1.21	0.74
burin spall	30	1.91	1.17
double bulb (Tabun snap, Janus flake)	17	1.08	0.66
shaped items	380	24.23	14.84
sum of débitage and shaped items	1,568	99.97	61.25
chunk	810		31.64
chip	162		6.33
micro flake	20		0.78
Total	2,560		100

Note: The frequencies mentioned in the text are only of the débitage and shaped items.

blage we therefore consider all laminar items as desired end-products.

Table 2

Subdivision of débitage and shaped items into blank types and cores

THE ASSEMBLAGE

The assemblage comprises 2,560 items, most of which are débitage and shaped items, and the rest are debris (Table 1). This assemblage appears to represent the technological and typological characteristics of the Amudian industry at Qesem Cave (Gopher *et al.*, 2005). The chip category includes items smaller than 1.5 cm. Whole flakes smaller than 1.5 cm were also included in the debris, and are recorded as micro-flakes. We focused our analysis on the débitage and the shaped items. Lithic preservation state is good, and many items are in fresh condition.

	No.	%
laminar items	912	58.16
flakes	585	37.31
cores	71	4.53
total	1,568	100

Laminar items: PE blades, PE blt, blades, bladelets, NBK, burin spalls, CTE (laminar), double bulb (laminar) and laminar shaped items. Flakes: Primary element flakes, flakes with and without modified butt, NBK flakes, CTE (flake), double bulb (flake) and shaped items (flake). Of the CTEs, 43 are flakes and 89 are laminars. Of the double bulb, 8 are flakes and 9 are laminars. Of the shaped items, 117 are shaped on flakes and 263 shaped on laminar items.

Table 3

Glossary

Laminar item	All items with more than 2:1 length/width ratio, including blades, PE blades, NBKs, burin spalls and some of the overpassing items and 'double bulb' items.
Blade	The common laminar item, some covered by cortex up to 30% of the dorsal face.
Primary element blade (PE blade)	Laminar items covered by cortex of 30% or more of the dorsal face.
Naturally-backed knife* (NBK)	Laminar items that have a steep natural cortical back and an opposed sharp lateral edge.
Shaped item	A blank secondarily modified by retouch or burination.
Tool	An item (shaped or not) that shows signs of use or wear.

* NBKs mentioned in the text refer only to *laminar* NBKs unless stated otherwise.

Many of the raw material types are highly siliceous and homogenous, allowing systematic laminar production. Some appear as flat nodules (with flat cortical surfaces), suitable for laminar production without much preparation or modification. Cortex is rather thin (one to five mm.). There are indications that a portion of the raw material was quarried from deep subsurface sources (Verri *et al.*, 2004a–b).

Débitage

Primary elements (Table 1)

PE flakes (with at least a third of the dorsal face covered with cortex) constitute 6.2% of the débitage and shaped items. Butt modification (usually faceting) is rare in PE flakes (9.5%). PE blades (Fig. 2:5) constitute 8.48% of the débitage and the shaped items. This indicates that cortex was not usually removed before producing laminar items. Of the PE blades, 62 are whole, 39 are proximal fragments, seven are medial fragments, and 25 are distal fragments. Most of the PE blades have a uniform strip of cortex on one of the lateral edges, and only six are fully covered by cortex. Another category of primary elements is the PE bladelets ($n = 11$, 0.7% of the débitage and shaped items). A secondary use of old, patinated items for shaping cores was frequently observed. In technological terms, the peeling of old patinated surfaces is similar to removing cortex, and we therefore included artifacts with heavy patina on the dorsal face in the PE category. In all, 12 of the PE blades and four of the NBKs have patinated surfaces.

Three of the PE blades and one of the NBKs actually bear a mix of a patinated surface and cortex.

Flakes (Table 1)

Two different flake types were classified – non-modified butt flakes (cortical or plain butts), and flakes with different types of butt modification, mostly irregular faceting. Some of the flakes ($n = 26$) of both types are elongated (length to width ratio near two), and bear previous laminar scars. We refer to these as “pseudo-blades”, but they are also known as “blade-flakes” (e.g., Vishnyatsky, 2000:145).

Micro-flakes ($n = 20$, included in the debris). Micro-flakes are whole (or nearly whole) flakes smaller than 1.5 cm. Their separate count is in order to account for the very small flake production trajectory (“cores on flakes”, Nahr Ibrahim technique, see below).

Blades (Table 1)

The assemblage includes 165 blades, 50 of these being whole (Fig. 2:6), 62 proximal fragments, 19 medial fragments, and 34 distal fragments. The paucity of bladelets ($n = 22$) implies these were not a desired end-product, and that their detachment as by-products in the process of laminar production was meager.

Naturally-backed knives (NBK; Table 1)

Altogether 190 laminar NBKs were found and 17 NBKs with flake proportions (18.6% of the later have butt modification). Of the laminar NBKs, 95 are whole (Fig. 2:1–4), 44 are proximal

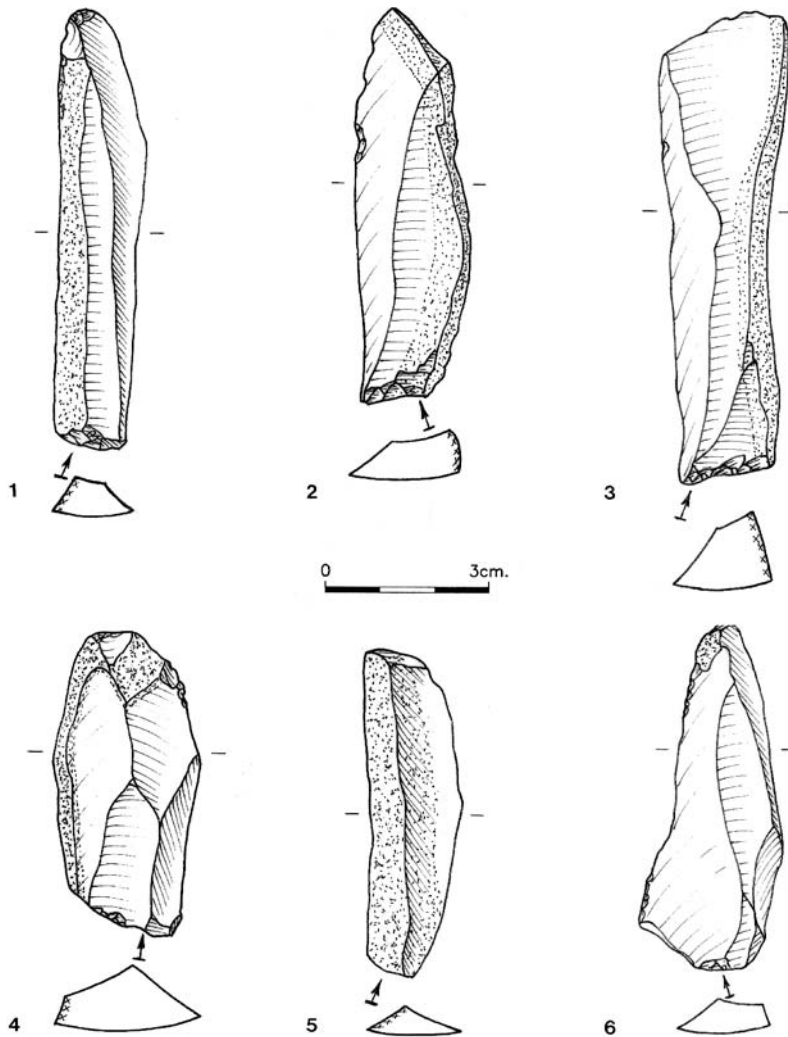


Fig. 2. Laminar Blanks: 1–4) NBKs; 5) PE blade; and 6) blade

fragments, 15 are medial fragments and 36 are distal fragments.

In the basic definition of the NBK, Bordes (1961:33) stated as follows: “Les couteaux à dos naturel sont des éclats ou des lames présentant un tranchant d’un côté et de l’autre une surface de cortex jouant le rôle du dos... Ce cortex doit être perpendiculaire ou relativement peu oblique sur le plan d’aplatissement”. We say “basic definition” because there are some other aspects involved, such as the possibility of including other (non-cortical) naturally-backed items, or the appearance of use marks on the cutting edge (e.g.,

Bordes, 1961:33). Debénath and Dibble (1994: 53–54) also emphasized the problematic nature of some of these aspects. We used the “basic definition” because we see NBK first of all as a blank type. We will review the technological characteristics of NBKs in the following technological analysis of laminar items.

Core trimming elements (CTE; Table 1)

Core tablets (tablettes de revivage). Core tablets are rare ($n = 8$), seven of which are rather small (three to five cm) with only a part of the original striking platform removed. Some of these

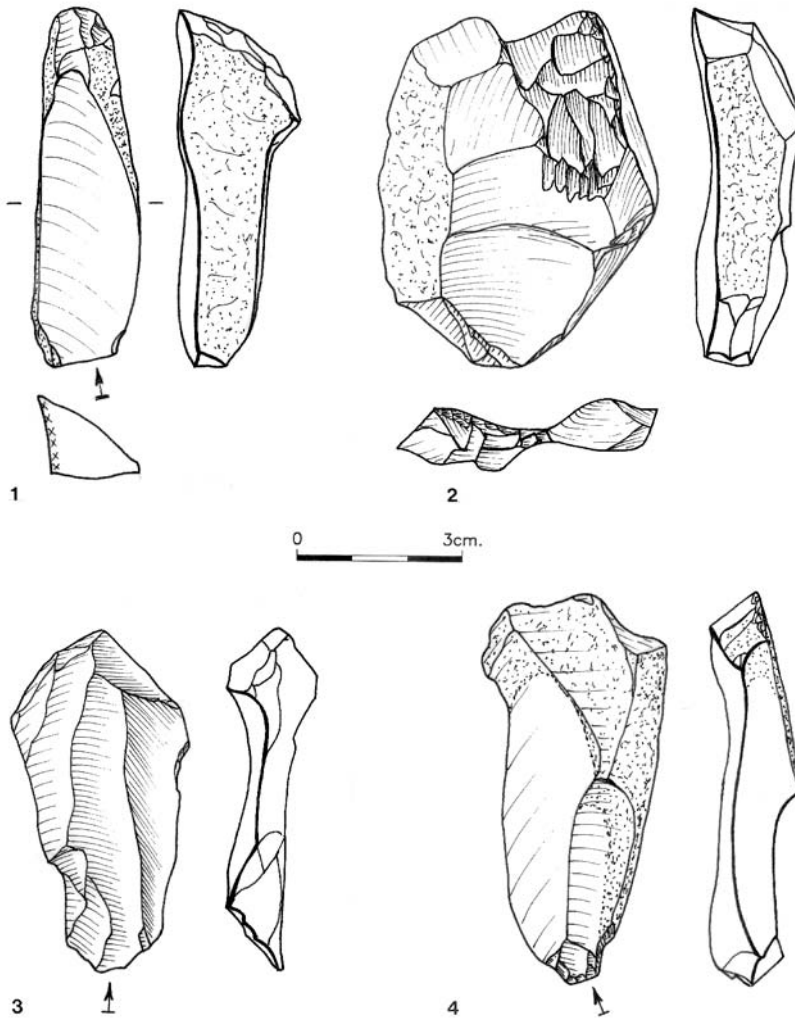


Fig. 3. CTE: 1, 3–4) overlapping items; and 2) core tablet

might be the result of faceting. One core tablet (Fig. 3:2) has removed the whole striking platform, and it appears that in this particular case the original striking platform was shaped by faceting, and later rejuvenated by the removal of a secondary core tablet. The paucity of core tablets indicates that the renewal of striking platforms, if needed, was mostly performed by faceting, and not by removal of a secondary core tablet.

Overpassing (outrepassé). Overpassing items constitute the largest group in the CTE ($n = 56$, 42.4% of the CTE), and are the main characteristic of core maintenance. Most of the overpassing

items bear dorsal laminar scars, implying their detachment during laminar production (Fig. 3:1, 3–4, Fig. 4). Thirteen of the overpassing items (23.2%) bear evidence of distal treatment (Fig. 3:4, Fig. 4:1). In many cases it is difficult to determine whether an overpassing item is the result of a deliberate correction of the core face, or a knapping error. In this assemblage it seems like a result of a unique reduction strategy using hard-hammer direct percussion, resulting in many overpassing laminar items. This reduction strategy has the advantages of detaching overpassing items, such as the removal of hinge scars, and the maintenance

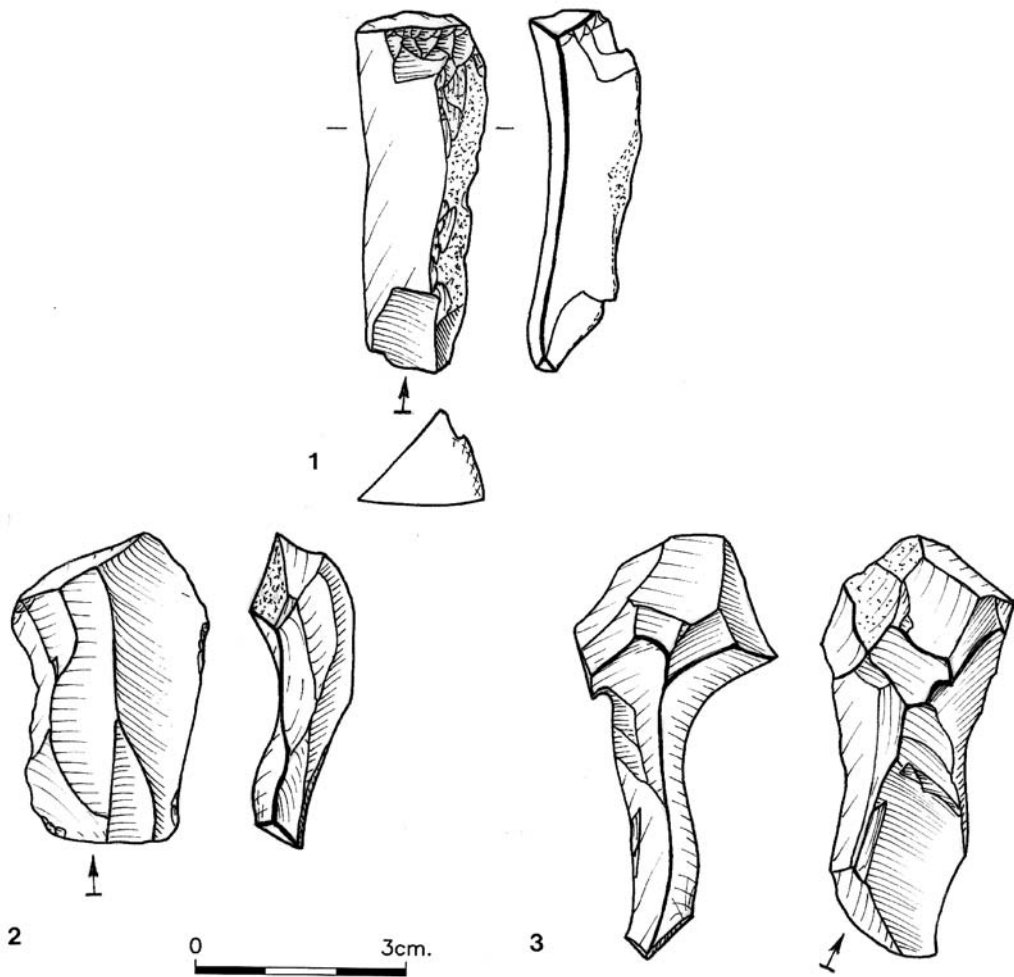


Fig. 4. Overpassing items

of the convexity of the débitage surface. Nevertheless, the items recorded as CTE have a bold overpassing termination that removed a considerable part of the distal end of the core. Only a few overpassing items could be called “death shots”, *i.e.*, items that had removed a large mass of the core causing its abandonment (Fig. 4:3). This is important, since it indicates a well-controlled removal of overpassing items.

Overpassing items are useful blanks, and 11.1% were secondarily modified. The selection of overpassing items for secondary modification is known from other, later, blade industries (*e.g.*, Goring-Morris *et al.*, 1998; Shimelmitz, 2002).

Crested blades (lame à crête). Crested blades ($n = 50$) constitute 37.9% of the CTE, and were divided into five different subtypes

Primary crested blades ($n = 1$). This item has a well-shaped bifacial ridge, probably preformed at the core preparation stage in order to shape the débitage surface outline and create the desired ridges (Fig. 5:5).

Rough crested blades ($n = 3$). These are irregular in shape and have a roughly shaped ridge made by a few blows, probably removed while preparing the core.

Patinated crested blades ($n = 20$). These are crested blades bearing patina on their dorsal face,

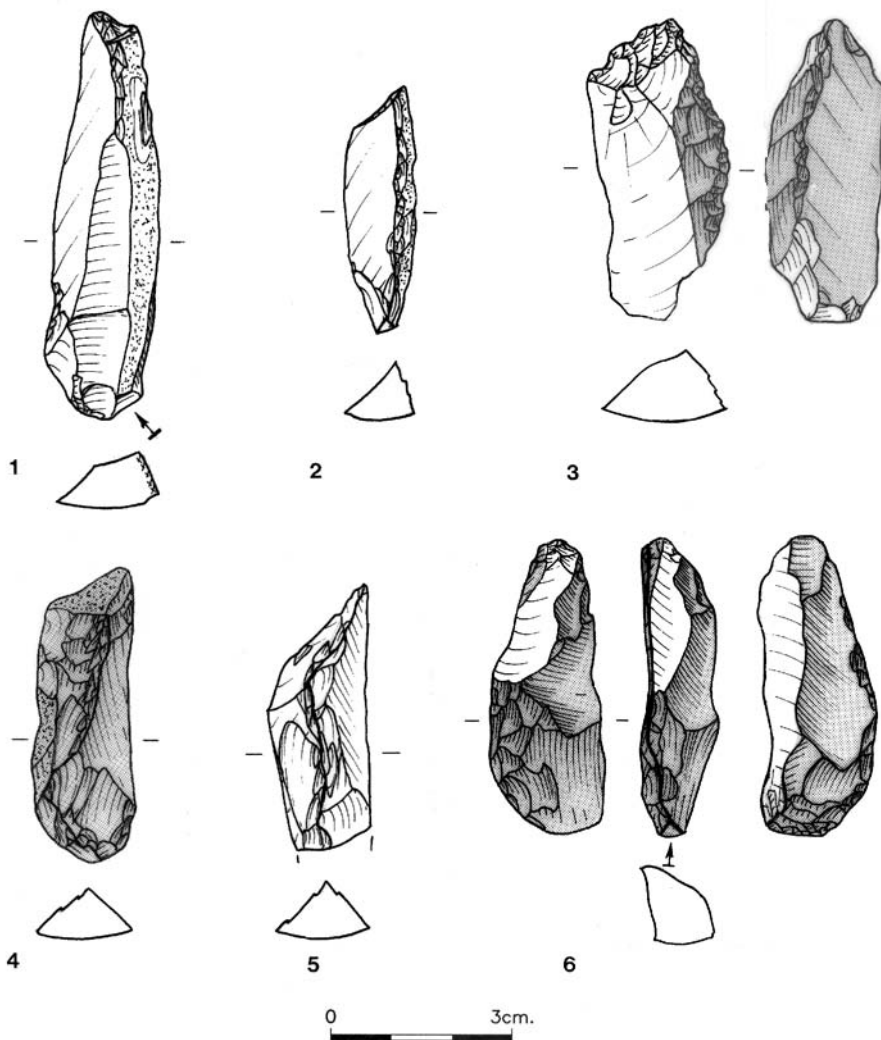


Fig. 5. Crested blades

indicating secondary use of old crests (Fig. 5:3–4, 6). The ridge itself was part of the original old item, but in some cases a few adjustments were made. The Amudian flint knappers chose old shaped items with a crest, enabling an immediate production of laminar items. Although these old ridges were not shaped by the blade makers, they indicate a unique trajectory of blank selection for laminar production and thus are included here. Re-used patinated items are common in the assemblage, but the patinated crested blades are unique in the use of a ready-shaped ridge. It seems

that these crested blades have been detached from relatively large items, probably old abandoned cores or even hand-axes (in another assemblage from Qesem Cave, a laminar core made on a discarded patinated hand-axe was found).

Rejuvenation crested blades ($n = 13$). The crested ridge is shaped on scars of previous laminar reduction; probably preformed in order to straighten and correct the ridges during laminar production. In eight of these it is placed at the distal end (Fig. 5:1).

Unifacial crested blades ($n = 13$; Fig. 5:2).

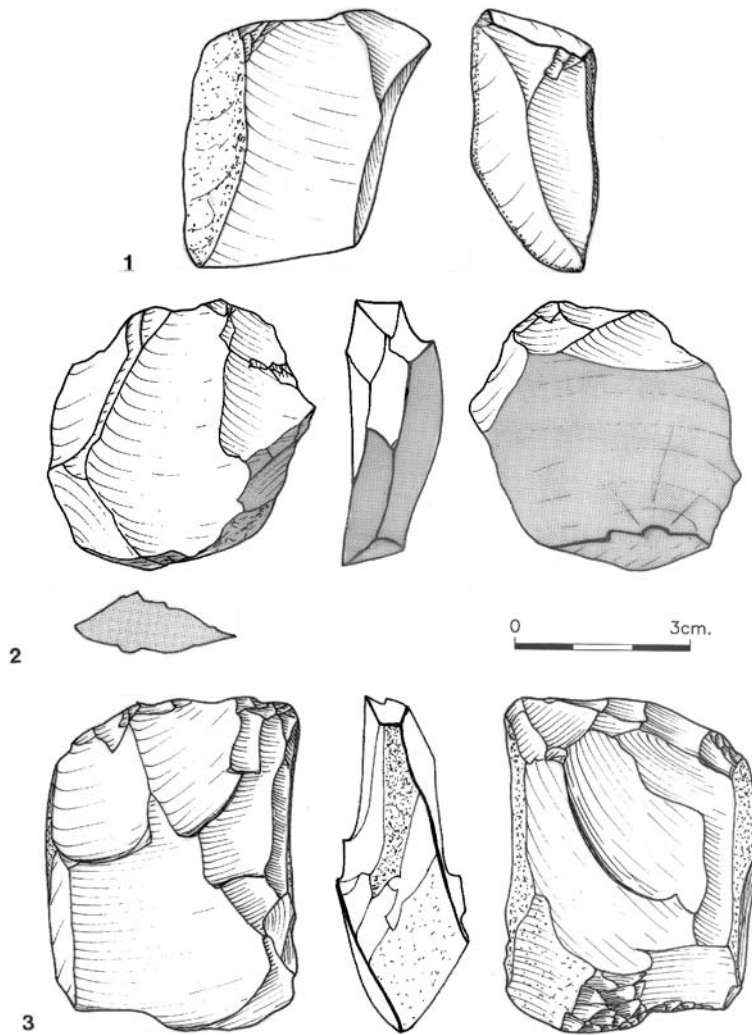


Fig. 6. Cores

Three options for placing these in the reduction sequence are suggested: 1) a primary crested blade detached from a core on a split nodule or a flake (the plain surface is part of a previous ventral surface); 2) a “ridge-straightening blade” (the plain surface is part of a previous large laminar scar); and c) it reflects a change in core orientation, a rather uncommon phenomenon in this assemblage.

Only a few crested blades show a fully-shaped ridge, while most are rather opportunistic in nature. The paucity of well-shaped primary

crested blades and the use of old patinated crested ridges best exemplifies this point. Most crested blades are related to the primary shaping of the cores’ débitage surface, and only a few are directly related to ridge maintenance – the rejuvenation crested blades. In short, the detachment of crested blades was more common during the primary stage of core reduction, and even in these cases little effort was invested in their shaping. This is in contrast to later laminar industries, in which major efforts were invested in rejuvenation crested blades detached in the course of blade/

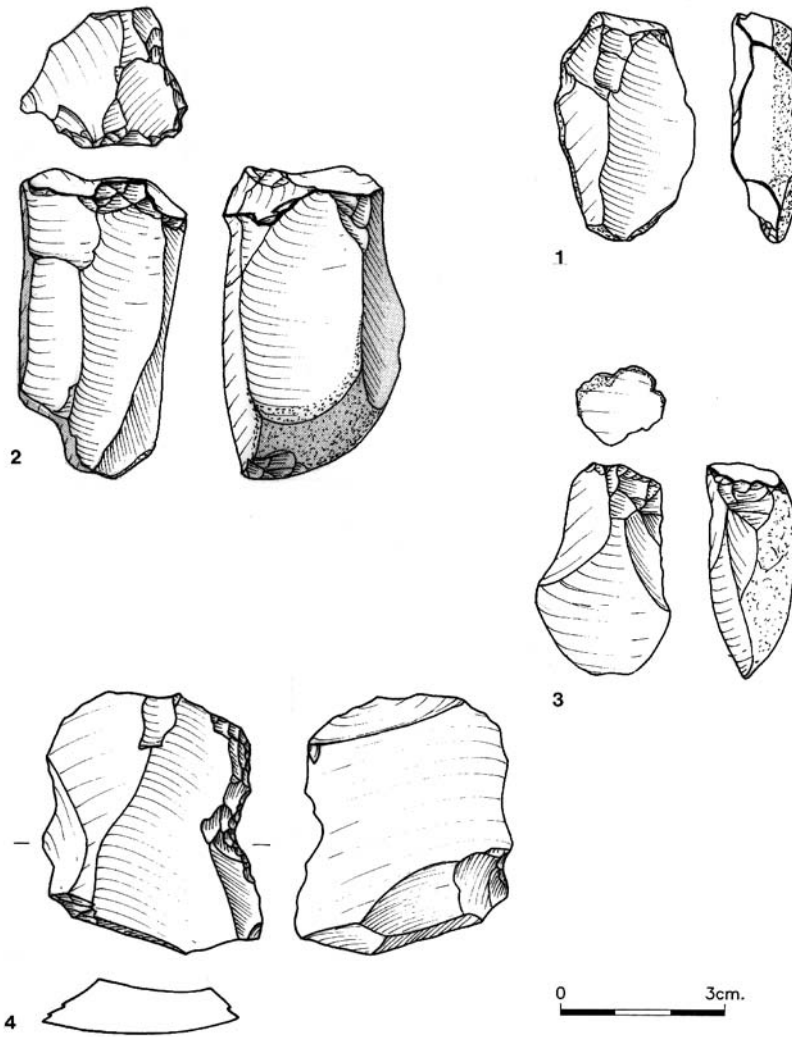


Fig. 7. 1–3) Cores; and 4) core on flake

bladelet production (*e.g.*, Shimelmitz, 2002). A possible reason for the minor importance of ridge correction was the use of powerful direct hard-hammer percussion blows that led to the detachment of overpassing items. This specific reduction strategy resulted in follow-through blows that not only reduced the number of knapping failures, such as hinge terminations and step fractures, but also allowed an easy correction of these errors by the detachment of an additional overpassing item.

Varia. The CTE varia ($n = 16$, 12.1% of the CTE) consist of various items, probably the result of less-planned core shaping and maintenance. It

should be remembered that flake production (also performed on-site) produced different non-standard CTEs.

Cores (Table 1)

A total of 46 cores was found, of which 16 are laminar cores, 13 are laminar and flake cores, three are bladelet cores and 13 are flake cores. Included here is a tested pebble or a core rough-out.

Single-platform laminar cores. Single striking platform laminar cores ($n = 13$) include cores with a rather flat débitage surface ($n = 6$; Fig. 6:1–2; Fig. 7:1) and cores in which a large part of

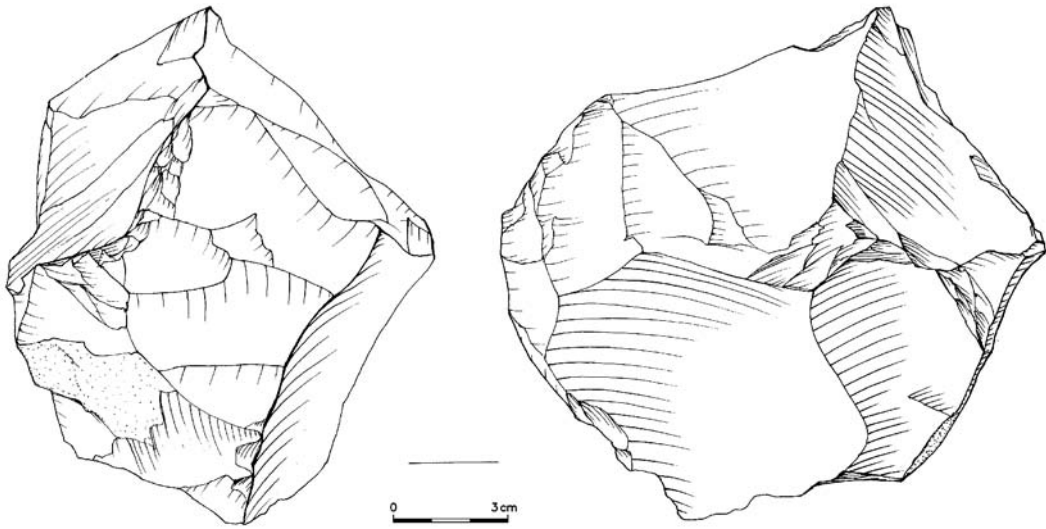


Fig. 8. A large flake core

the core perimeter was used for laminar production ($n = 7$; Fig. 7:2–3). The débitage surface of the discarded laminar cores is relatively short (37–55 mm, most being *ca.* 40 mm). The striking platforms of the cores were roughly shaped. In most cases striking platforms are irregular, shaped by core tablet removal and by a few unstandardized faceting blows. There are few complete homogenous striking platforms created by the removal of a core tablet. The fact that only three of these cores show other treatment besides the shaping of the striking platform, is surprising, since we observed base treatment on some of the overpassing items. Preparations and maintenance were rarely pre-planned, but rather ad hoc in nature and related to a specific problem. Many of the cores show hinge fractures and overpassing terminations (Fig. 6:1, Fig. 7:3). The reason for discarding most of the cores seems to be a combination of hinge fractures and a relatively short débitage surface.

Single-platform laminar and flake cores. These cores ($n = 9$) have one striking platform, and their débitage surface shows both laminar and flake scars (Fig. 6:3). In most, the débitage surface tends to be flatter and wider than that of the

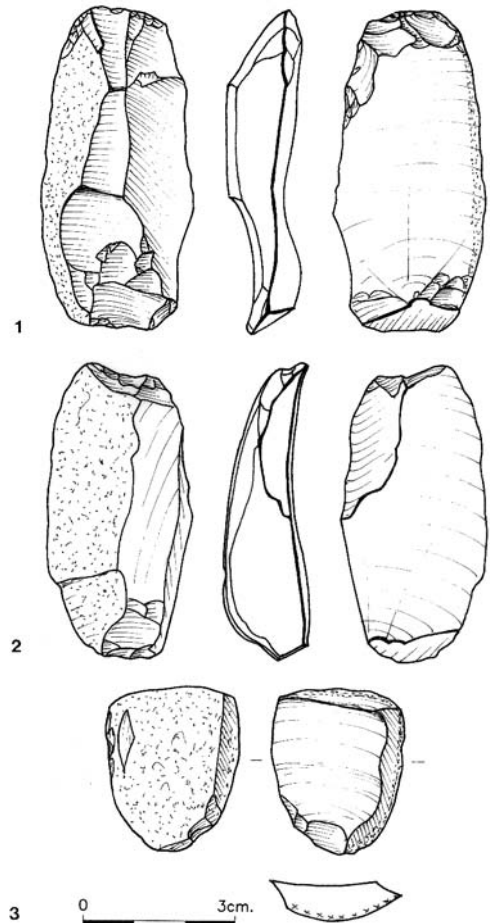


Fig. 9. 1, 3) Core on flakes; and 2) burin

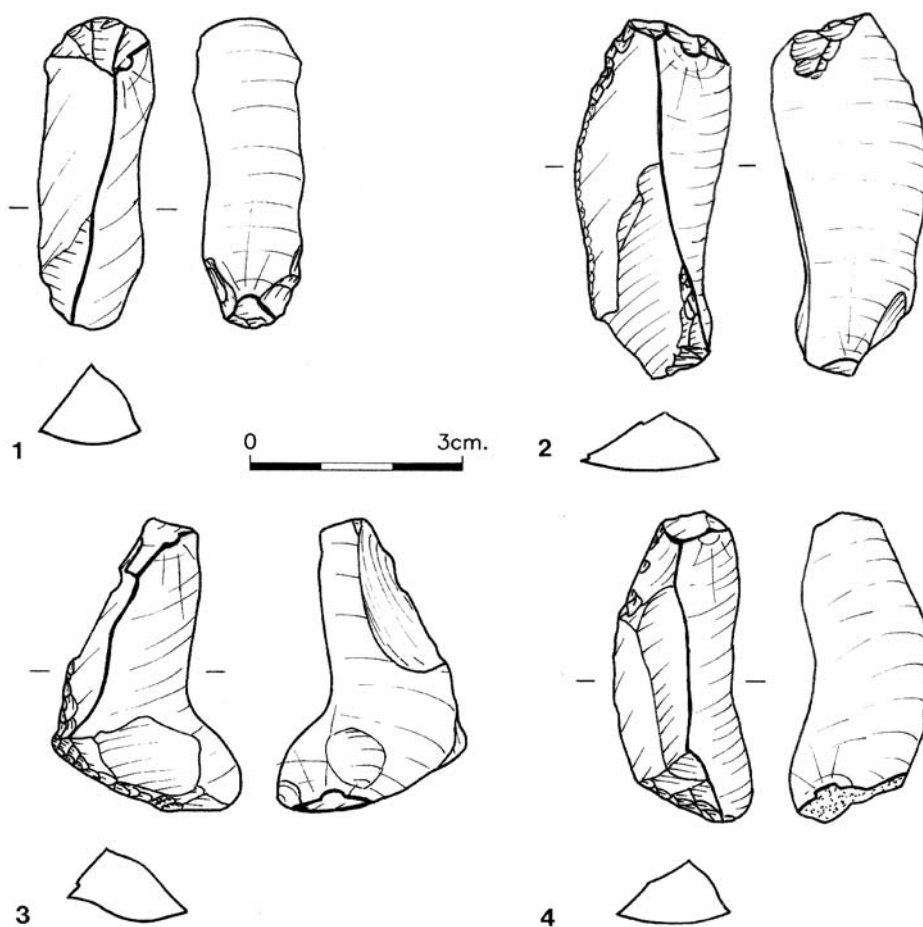


Fig. 10. Double bulb items

common laminar cores. Laminar scars mostly occur at the carinated part of the débitage surface. The technological significance of these cores is not clear, and three options are suggested: 1) they represent a systematic production in which laminar items and flakes were simultaneously detached; 2) they are laminar cores that were slightly deformed due to faults at the final stage of reduction; and; 3) they represent a secondary or continued use of discarded laminar cores.

Two-platform laminar cores

These three cores have two opposed striking platforms exploiting different débitage surfaces. Two of these cores are rather small (33 and 35 mm long) and one is slightly longer (52 mm).

Two-platform laminar and flake cores

These four cores have two striking platforms from which laminar items and flakes were detached. In three of them on platform produced flakes while the other produced flakes and laminar items.

Bladelet cores. Three bladelet cores with rather short bladelet scars (no longer than 30 mm) were found. These cores are very different from the bladelet cores of the Upper and Epi-Paleolithic industries that represent systematic bladelet production (e.g., Shimelmitz, 2002).

Flake cores. Thirteen flake cores were found, five with a single striking platform and seven with two or more striking platforms. Striking platforms are placed on natural surfaces or roughly shaped,

Table 4

Shaped items by blank type

Type	Flake	% Out of total shaped flakes	Laminar items	% Out of total shaped laminar items	Total	% of total shaped items
retouched laminar item			148	56.27	148	38.95
backed laminar item			8	3.04	8	2.11
backed flake	5	4.27			5	1.32
curved backed laminar item			17	6.46	17	4.47
curved retouched laminar item			9	3.42	9	2.37
distally retouched laminar item			39	14.83	39	10.26
pointed laminar item			12	4.56	12	3.16
end scraper	7	5.98	23	8.75	30	7.89
side scraper	4	3.42	1	0.38	5	1.32
burin	12	10.26	4	1.52	16	4.21
retouched flake	44	37.61			44	11.58
notch	1	0.85	1	0.38	2	0.53
varia	4	3.42	1	0.38	5	1.32
retouched fragment	40	34.19			40	10.53
Total	117	100	263	100	380	100
% of blank category	117	30.79	263	69.21	380	100

and both types seem to be rather opportunistic. A special large multi-platform flake core (Fig. 8) was also found. This core indicates radial production.

Cores on flakes (Table 1). Nineteen cores on flakes were found (Fig. 7:4, Fig. 9:1, 3). In many cases only one small flake was detached from each core. Some preliminary shaping was usually performed before flake detachment, creating a limited striking platform. These cores resemble the “Nahr Ibrahim technique”, and were mostly found in Middle and Lower Paleolithic industries (Goren, 1979; Goren-Inbar, 1988; Hovers, in press; Newcomer and Hivernel-Guerre, 1974; Nishiaky, 1985; Shea and Bar-Yosef, 1999; Solecki and Solecki, 1970).

Burin spalls (Table 1)

Altogether, 30 burin spalls were found. It

seems that some of these are not actually “burin spalls”, but a specific type of a laminar blank removed during early stages of core reduction. It is likely that when cores were shaped on flakes, a natural narrow/carinated edge was used for the primary shaping of the débitage surface. In these cases, the result would have been the detachment of “burin spall”-like items. These “false burin spalls” might represent a special type of crested blade intended to initiate laminar production. Jelinek observed a similar situation in Tabun beds 47–49 (Jelinek *et al.*, 1973:174).

Double bulb items (Tabun snap, Janus flake; Table 1)

A special category is the “double bulb” items ($n = 17$). These items have two bulbs of percussion, each on a different face of the item (Fig. 10). This category seems to indicate more than one

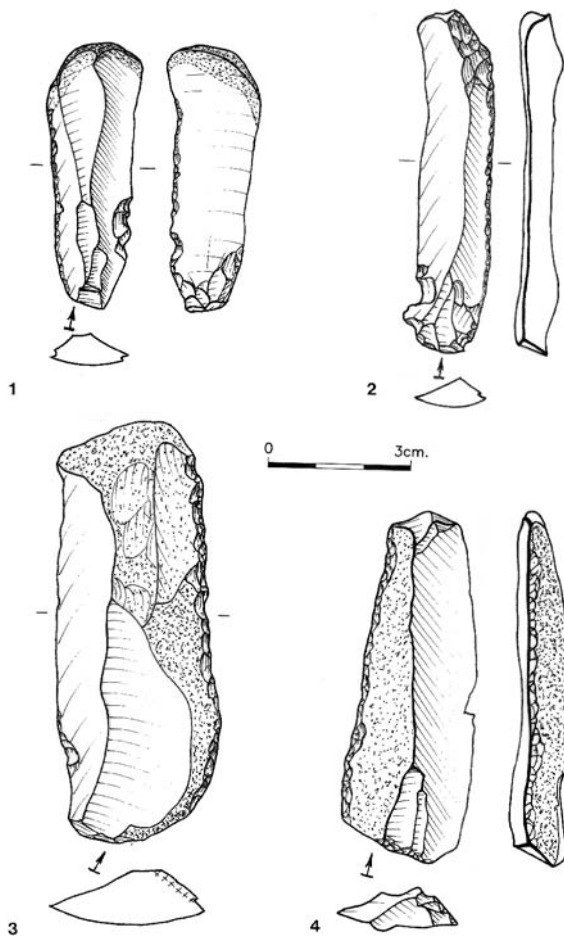


Fig. 11. Retouched laminar items

specific technological procedure. These items are characterized by the bulb being removed from the item they were detached from. In general, they represent both secondary modification of shaped items and the use of flakes for cores. Some of these are overpassing items (Fig. 10:3), or in the shape of a “burin spall”, while others have traces of retouch, and seem to indicate shaped items renewal. Some of these items might be related to the “Tabun snap” considered as a characteristic of Acheulo-Yabrudian industries (Shifroni and Ronen, 2000) and to the Janus flakes (Newcomer and Hivernel-Guerre, 1974). It seems to us that most of the “double bulb” items from Qesem Cave are part of a system of reusing or recycling previously flaked items by transforming them into cores or shaped items.

Shaped items (Table 4)

A total of 380 shaped items was found (Table 4), 69.2% were shaped on laminar blanks.

Retouched laminar items. A total of 148 retouched blades was found, the largest shaped item category in the assemblage. Most of these bear fine or semi-abrupt retouch (Figs. 11–12). The retouch mostly appears on one lateral edge, but in some on both edges (Fig. 12:4). In 63.3% of the cases, retouch covers a full lateral edge (mostly straight). However, many blades were partly retouched, and in these cases the retouch is less organized. Three items bear inverse retouch. Of the retouched laminar items, 110 are shaped on blades, 23 on PE blades, five on NBKs, six on overpassing items, and four on crested blades. Of the PE blades with a uniform cortex edge, 18 are

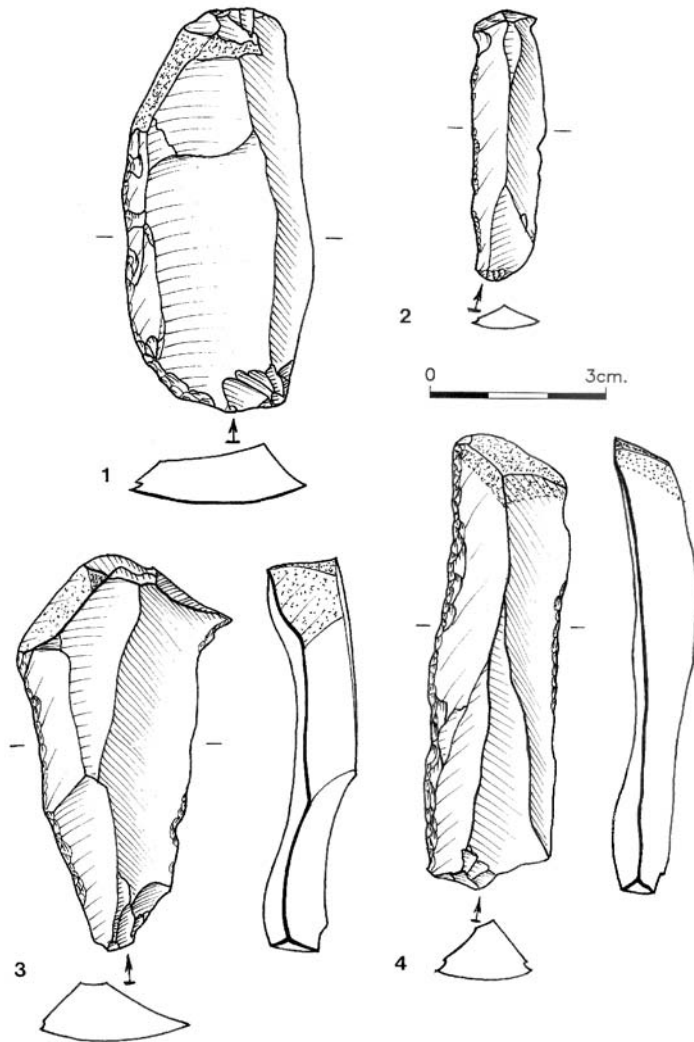


Fig. 12. Retouched laminar items

retouched along their cortical edge, and only three on the “cutting edge”. Of the NBKs, four are finely retouched along their cortical edge, and one on the cutting edge.

Backed laminar items. Eight backed laminar items were found with a steep straight back shaped by abrupt retouch. Three of these have a distal truncation.

Curved backed laminar items ($n = 17$; Fig. 13). Curved backed laminar items constitute 4.47% of the shaped items. Some of these items have a curved back forming a tip at the distal end resembling a point.

Curved retouched laminar items ($n = 9$). Most are shaped by semi-abrupt retouch.

Distally-retouched laminar items ($n = 39$). These items have a fine or semi-abrupt retouch at the distal end (Fig. 14:1) resembling a truncation, but the retouch is not abrupt, and in many cases it covers only *ca.* a half of the item’s width. The retouched distal end is straight, oblique, or slightly arched. In 15 items the lateral edge was also retouched; however, in most cases the retouch does not cover the whole edge.

Pointed laminar items ($n = 12$). These include laminar items with a retouched pointed tip (Fig.

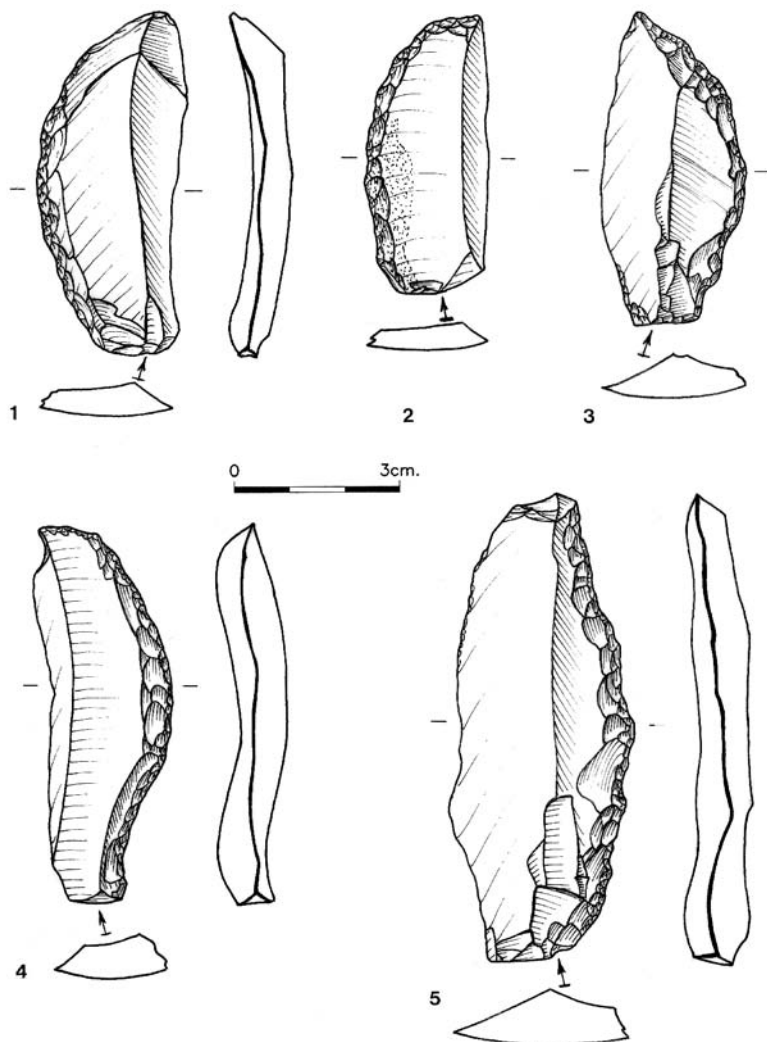


Fig. 13. Curved backed laminar items

14:2). Naturally-pointed tips were not included here.

End scrapers. Of the 30 end scrapers, 23 were shaped on laminar items (Fig. 14:3–4). Of 16 of the end scrapers shaped on laminar items, and of two of the end scrapers shaped on flakes, the retouch is oblique. A similar characteristic was noticed by Wright (1966:408) among the scrapers from Tabun E.

Side scrapers. Side scrapers (racloirs) are one of the characteristics of the Acheulo-Yabrudian complex, and especially of the Yabrudian industry (e.g., Copeland, 2000). In this sample of

Qesem Cave, only five side scrapers were found, one being made on a laminar blank. Three of the side scrapers are single-convex (one has demi-Quina retouch; Fig. 15:1), one is double-straight-convex, and one is “dejeté”. The relative paucity of side scrapers accords well with the Amudian characterization of this assemblage.

Burins. Of the 16 burins found (Fig. 9:2, Fig. 15:2–3), four were shaped on laminar blanks. The burin spall scar is usually not perpendicular to the axis of the item, but rather slightly oblique (Fig. 15:2). Some of these resemble the “Adlun burin” (Fig. 9:2; Garrod and Kirkbride, 1961:23–25).

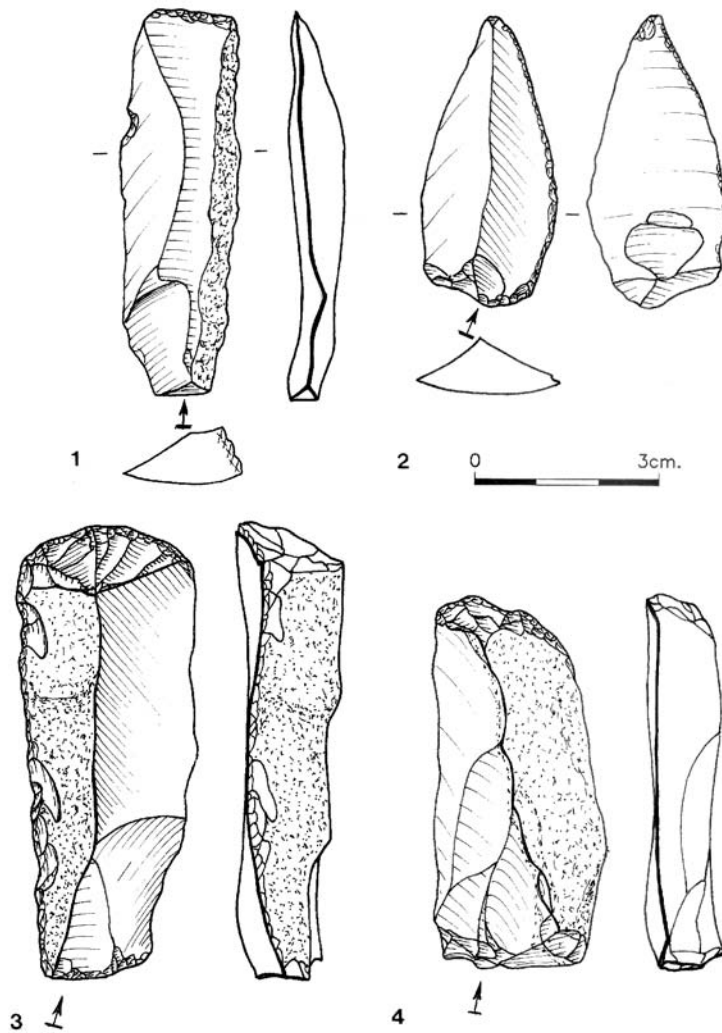


Fig. 14. 1) Distally retouched laminar item; 2) pointed laminar item; and 3–4) end scrapers

Retouched flakes. Of the flakes that had secondary modification, this is the largest category, including 44 items. Many of these have a modified butt (44.2%), mostly faceted. Eighteen are better defined as “pseudo-blades”.

Backed flakes. Five retouched backed flakes (knives) were found with a straight or curved back.

Notches. Two notches were found, one being shaped on a laminar item.

Varia. Of the five items, one was shaped on a laminar overpassing item and had two alternating retouched shoulders. The four others were shaped on “pseudo-blades”, three were shaped by an irregular abrupt retouch that formed a curved lateral edge, and one by irregular fine retouch forming a knob-like outline at the middle of the lateral edge.

Retouched fragments. This category includes 40 fragments of shaped items that we could not assign to any other category.

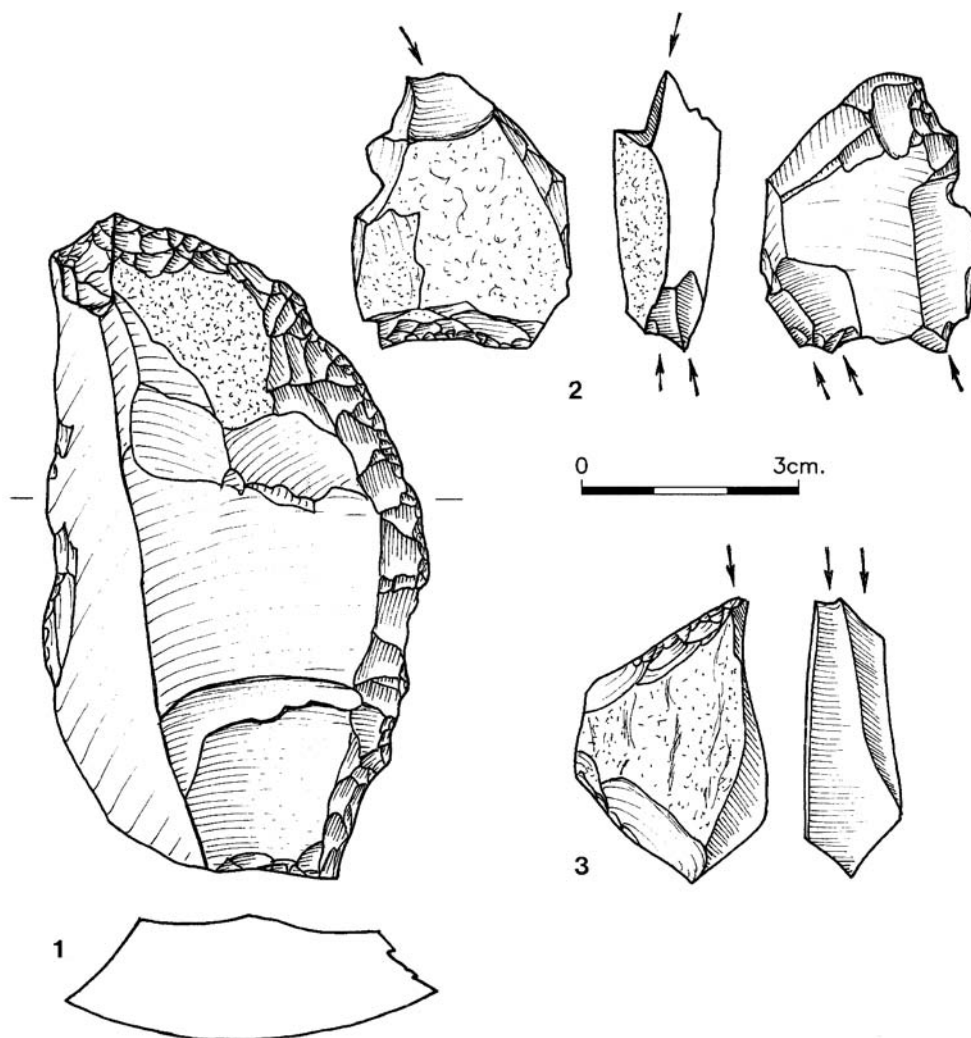


Fig. 15. 1) Side scraper; and 2–3) burins

TECHNOLOGICAL ANALYSES OF LAMINAR BLANKS AND SHAPED ITEMS

In order to achieve a better acquaintance with the Amudian laminar technology from Qesem Cave we analyzed the main laminar categories in detail: blades ($n = 165$), PE blades ($n = 133$), NBKs ($n = 190$), and various laminar-shaped items ($n = 263$). We examined the characteristics of the laminar blanks, and compared them to those of the laminar-shaped items. Each attribute

examined is separately presented for these two laminar populations. Sample size varies for each attribute due to the fact that some of the items are broken or covered by cemented sediments.

State of preservation. Whole PE blades and NBKs are more frequent than blades (Fig. 16). The reason might be that the latter are thinner and therefore more fragile. The paucity of medial fragments in all laminar categories is probably due to the fact that most laminar items are rather “robust” and usually split into two – proximal and distal parts. The distribution of laminar blank

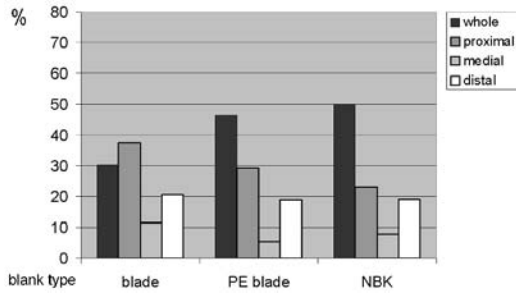


Fig. 16. Preservation state of the laminar debitage: $n =$ blade, 165, PE blade: 133, NBK: 190

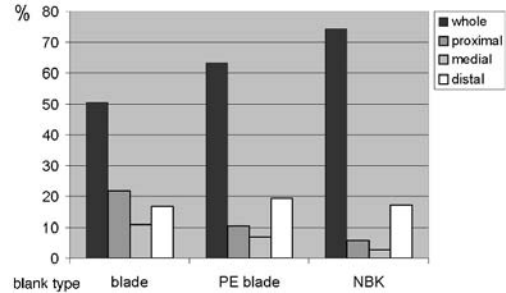


Fig. 17. Preservation state of the laminar shaped items: $n =$ blade: 156, PE blade: 57, NBK: 35

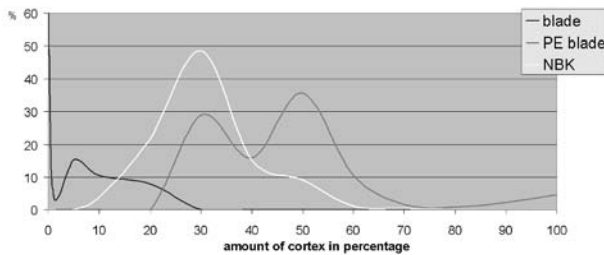


Fig. 18. Amount of cortex on the dorsal face of laminar blanks: $n =$ blade: 164, PE blade: 133, NBK: 188

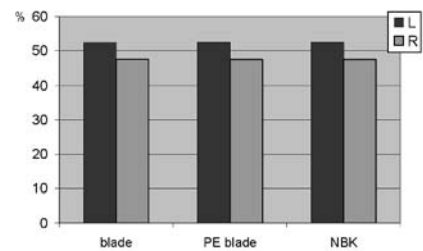


Fig. 19. Side of cortex on laminar blanks: $n =$ blade: 42, PE blade: 116, NBK: 175

state of preservation is statistically different than that of shaped items ($X^2 = 96.61$, $df = 11$, $p < 0.05$)². In general, the proportion of whole shaped items is higher than that of the blanks (Fig. 17), and this difference is statistically significant for blades ($X^2 = 13.78$, $df = 1$, $p < 0.05$) and PE blades ($X^2 = 4.37$, $df = 1$, $p < 0.05$). Maybe more durable laminar items were chosen for secondary modification.

Amount of cortex. Although the difference in the amount of cortex between the blades and the two other laminar categories (Fig. 18) is mostly a result of our categorization system, some points are worth mentioning. PE blades and the NBKs bear cortex – by definition and 38% of the common blades too. In all, 79% of all the laminar blanks bear cortex, demonstrating that cortex was not usually removed from core preforms. We assume that cortex was left intact since cortical laminar items were a desired end-product. This can be deduced from the fact that the cortex

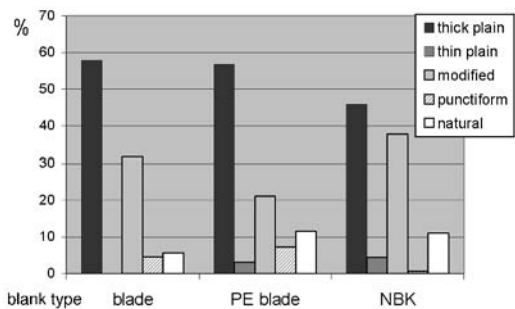


Fig. 20. Striking platform types of laminar blanks: $n =$ blade: 107, PE blade: 95, NBK: 135

appears as a uniform strip on one of the lateral edges of most of the PE blades and all the NBKs – most probably a result of pre-planning. Examining the amount of cortex on laminar shaped items reveals a similar distribution pattern to that observed for the blanks.

2 The statistical analysis of attributes of laminar blanks and shaped items was carried out by Statview.

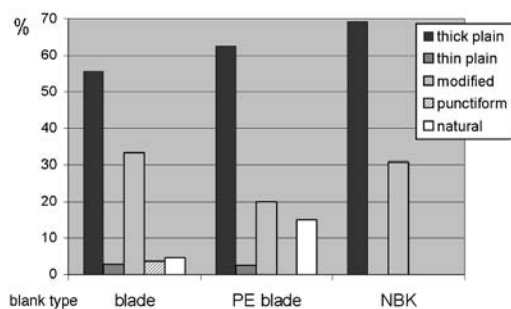


Fig. 21. Striking platform types of laminar shaped item: $n =$ blade: 108, PE blade: 40, NBK: 26

Cortex usually appears on one of the lateral edges. In some, it covers the whole edge (*e.g.*, NBK), while in others it is more complex; covering both sides, part of one side, etc. We examined the side of the cortex on the various laminar items (Fig. 19), and found no preference for a specific lateral edge. Nevertheless, in all the three laminar groups a cortical left edge is slightly more common.

Butt shape: five recorded butt types (Fig. 20)

Thick plain. These are characterized by a plain flat butt that removed a considerable part of the core's striking platform. It indicates that knapping was performed by hitting deep inside the striking platform, and not at its edge.

Thin plain. These butts resemble punctiform butts; however, here they are not pointed but appear as a thin plain strip.

Modified. These butts show evidence of modification, faceting being the most common. In some, only a few scars appear, and in others a well-shaped faceted butt was prepared. Very few of the modified butts are dihedral. Most of the modified butts are quite thick, and indicate that knapping had focused in hitting deep inside the striking platform.

Punctiform. These butts are very small and limited in number.

Natural. These butts are covered with cortex or patina, and are mostly quite thick.

The most common butts in the assemblage are thick plain butts. Modified butts appear in smaller numbers. Hitting deep inside the striking platform is one of the characteristics of the laminar technology practiced at the site. Only the thin

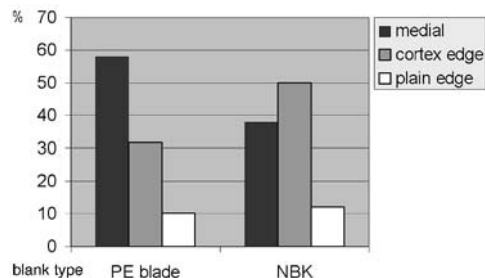


Fig. 22. Location of bulb of percussion in cortical blanks: $n =$ PE blade: 88, NBK: 132

plain butts and the punctiform butts are different in this respect, but they are rather few. Hitting deep inside the striking platform allows the detachment of relatively thick laminar items without much preparation, by using hard hammers and powerful direct percussion.

Although meticulous preparation of striking platforms is meager in this assemblage, striking platform shaping is present (as indicated by the paucity of natural butts, 5.6–11.6% among the blanks, and 4.6–15% among the shaped items). This indicates that preparation of the striking platform was performed in many cases, and cortex was removed at least from the striking platforms.

The distribution pattern of the different butt shapes varies among the laminar blanks. Since platform isolation is rare, we assume that faceting had a role in controlling the shape and character of the produced blanks. The fact that the NBKs and the blades show a higher frequency of modified butts than the PE blades, seems to indicate that the controlled shape of the latter was less important.

The butt shape distribution of all shaped laminar items was found to be significantly different ($\chi^2 = 60.22$, $df = 14$, $P < 0.05$) than that of all laminar blanks, mainly in the NBKs. Plain butts are more frequent than modified butts among the secondary modified NBKs (Fig. 21). This indicates that NBKs with unmodified butts were preferred for modification by retouch. The distribution of plain butts in blanks and shaped items for all three laminar categories indicates that only in the NBKs a selection of plain butts for secondary modification is statistically significant ($\chi^2 = 4.73$, $df = 1$, $P < 0.05$).

The bulb of percussion. The bulb of percussion in most of the laminar items is quite extensive, indicating the use of heavy blows, most probably using hard-hammer direct percussion. The bulb is not located at the middle of the butt in all items, and in many cases it tends towards one of the lateral edges. In the PE blades and NBKs the bulb location was checked to see whether it was near the cortical edge, near the plain edge, or in the middle (Fig. 22). The place of detachment mostly follows a chosen ridge on the dorsal face. The bulb was usually located in the middle or near the cortical edge, and that only rarely did it occur near the plain edge. An interesting difference between the PE blades and the NBKs is that in the latter, the bulb of percussion more commonly appears near the cortical edge. The benefit in striking (as indicated by the bulb) at that specific location is in controlling the cross-section of the laminar item produced. Placing the impact blow near the cortical edge resulted in an obtuse angle of this edge, while the opposite edge was sharp. As for the blades (Fig. 23), the bulb is more commonly in the middle (following a central ridge), rather than near one of the edges. This may indicate a preference of blades with a triangular cross-section (“central blades”).

Cross-section. Cross-sections of laminar items were divided as follows; triangular, right-angled triangular, trapezoidal, right-angled trapezoidal, and other (Fig. 24). Blades and PE blades mostly have a triangular cross-section, while NBKs are mostly characterized by a right-angled trapezoidal cross-section. The difference between the PE blades and the NBKs is in a way a result of the definition used (see below).

The cross-section distribution of all shaped laminar items was found to be significantly different and more homogenous (Fig. 25) than that of all laminar blanks ($\chi^2 = 104.74$, $df = 14$, $P < 0.05$). Among the shaped blades and PE blades, a triangular cross-section is more common than in the blanks. A right-angled trapezoidal cross-section is more common among the shaped NBKs than in the NBK blanks. A selection of blanks with a triangular cross-section for secondary modification was found to be statistically significant for blades only ($\chi^2 = 5.17$, $df = 1$, $P < 0.05$). A selection of blanks with a right-angled trapezoidal cross-section for secondary modification was found to

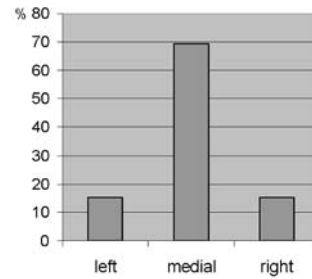


Fig. 23. Location of bulb in blade blanks: $n = 104$

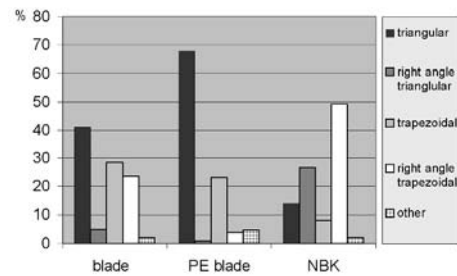


Fig. 24. Cross section of laminar blanks: $n =$ blade: 145, PE blade: 131, NBK: 190

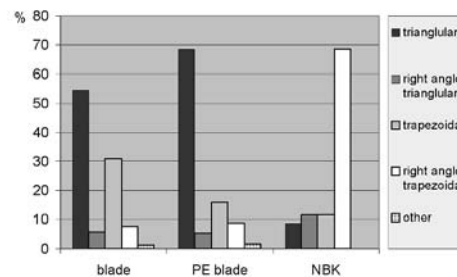


Fig. 25. Cross section of laminar shaped items: $n =$ blade: 156, PE blade: 57, NBK: 35

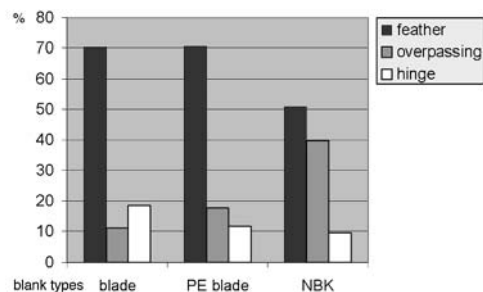


Fig. 26. End termination of laminar blanks: $n =$ blade: 81, PE blade: 85, NBK: 126

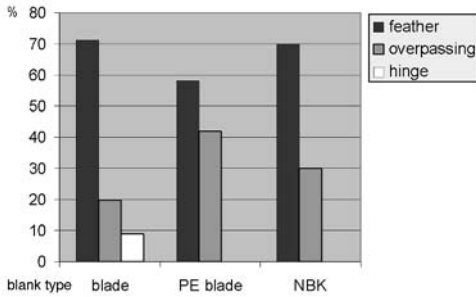


Fig. 27. End termination of laminar shaped items: $n =$ blade: 101, PE blade: 43, NBK: 30

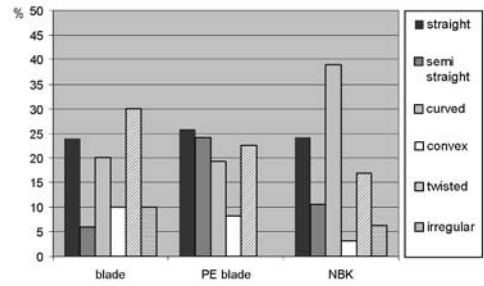


Fig. 30. Profile of laminar blanks: $n =$ blade: 50, PE blade: 62, NBK: 95

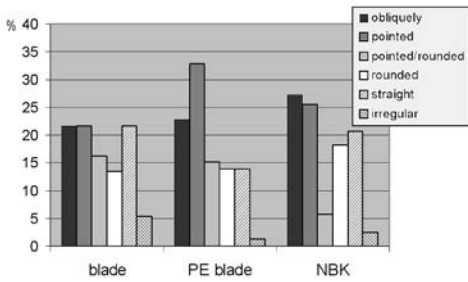


Fig. 28. Distal end shape of laminar blanks: $n =$ blade: 74, PE blade: 80, NBK: 123

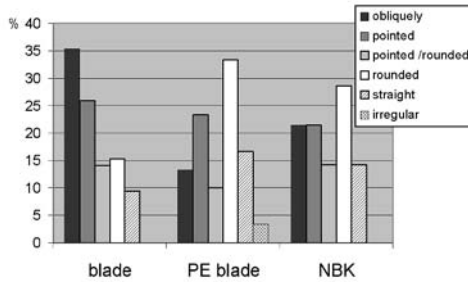


Fig. 29. Distal end shape (before modification) of laminar shaped items: $n =$ blade: 85, PE blade: 30, NBK: 14

be statistically significant for NBKs only ($X^2 = 4.32, df = 1, P < 0.05$). It appears that NBKs with a plain butt and a right-angled trapezoidal cross-section were selected to be modified by retouch.

End termination. End morphologies of laminar items include feather, hinge and overpassing terminations (Fig. 26). Feather terminations are

the most common in all laminar items. The NBKs were characterized by a high frequency of overpassing terminations. In the shaped laminar items, items characterized by a hinge termination were rare and overpassing termination was common among the PE blades and NBKs selected for secondary modification (Fig. 27). The distribution of end terminations of all shaped laminar items is significantly different ($X^2 = 68.82, df = 8, P < 0.05$) than that of all laminar blanks. The difference in the appearance of feather and overpassing end terminations in the blanks and the shaped items for all three laminar types, indicates a statistically significant ($X^2 = 8.75, df = 1, P < 0.05$) selection of PE blades with an overpassing end termination.

Shape of distal end. The shape of the laminar distal end comprises six types: oblique, pointed, pointed/rounded, rounded, straight and irregular. Among the blanks, oblique and pointed distal ends are the most common (Fig. 28). The distribution pattern of the distal end shape in laminar-shaped items (Fig. 29) shows a distinctive difference between the blades and the cortical laminar items. Among the shaped items, oblique or pointed distal ends are the most common for blades, while the PE blades and the NBKs do not have a characteristic distal end (although the most common is a rounded distal end). The shape of the distal end of all shaped laminar items is significantly different ($X^2 = 85.95, df = 17, P < 0.05$) than that of all laminar blanks. The difference in the appearance of pointed, oblique and rounded end shapes in the blanks, and shaped items for all three laminar types, indicates only a statistically significant ($X^2 = 5.42, df = 1, P < 0.05$) selection of

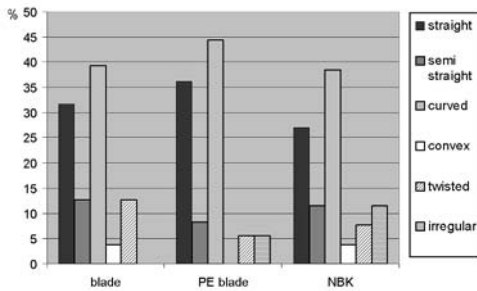


Fig. 31. Profile of laminar shaped items: $n =$ blade: 79, PE blade: 36, NBK: 26

PE blades with a rounded distal end shape. We presume that achieving a specific distal end shape was not a major issue in this sample from Qesem Cave.

Profile. Profiles of laminar blanks include six types: straight, semi-straight, curved, convex, twisted and irregular. In many items the large and bold bulb of percussion affected the profile, resulting in a curved profile when the bulb was located at the middle of the butt, and a twisted profile when the bulb was at one of the butt edges.

No clear pattern was observed among the blanks, and it seems that there was no preference between straight, curved and twisted blades (Fig. 30). The high frequency of curved profiles among the NBKs correlates well with the fact that many of these items have an overpassing termination. Among the laminar shaped items a slightly different picture emerged: straight and curved items were preferred (Fig. 31). The profile of all shaped laminar items is significantly different ($X^2 = 76.82$, $df = 17$, $P < 0.05$) than that of all laminar blanks. The difference in the appearance of straight, curved and twisted profiles in the blanks and shaped items for all three laminar categories indicates a) PE blades with a twisted profile are significantly less common in the shaped items; and b) blades with a curved profile are significantly more common in the shaped items ($X^2 = 6.4$, $df = 1$, $P < 0.05$). It thus seems that the laminar technology at Qesem Cave was not focused on producing straight laminar items.

Number of laminar scars. The number of laminar scars varies with the different laminar items (Fig. 32). The PE blade distribution peaks at one laminar scar, the NBK distribution peaks at



Fig. 32. Number of laminar scars on laminar blanks: $n =$ blade: 161, PE blade: 133, NBK: 188

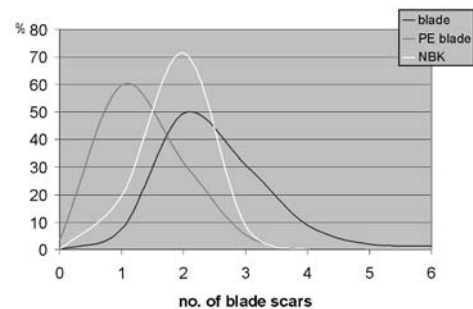


Fig. 33. Number of laminar scars on laminar shaped items: $n =$ blade: 156, PE blade: 57, NBK: 35

two laminar scars, and that of the blades peaks at three laminar scars.

The distribution pattern of laminar scars on laminar shaped items shows a difference between blank types (Fig. 33) with those shaped on common blades peaking at two scars, a fact that goes in-hand with the preference for a triangular cross-section. Among the NBKs, those chosen for secondary retouch usually have two laminar scars. The peak in the PE blades distribution is the same in both categories.

Metrics. The metric analysis (length, width and thickness) includes only whole items. The distribution range of length is quite similar in all three laminar categories (Fig. 34). An interesting point is that the NBKs show the most uniform distribution pattern. The average length of whole blades is 49.44 mm (s.d. 9.99), of PE blades 53.44 mm (s.d. 11.91), and of NBKs 52.02 mm (s.d. 11.54). The fact that the averages of PE blades and the NBKs are a little longer than in the blades

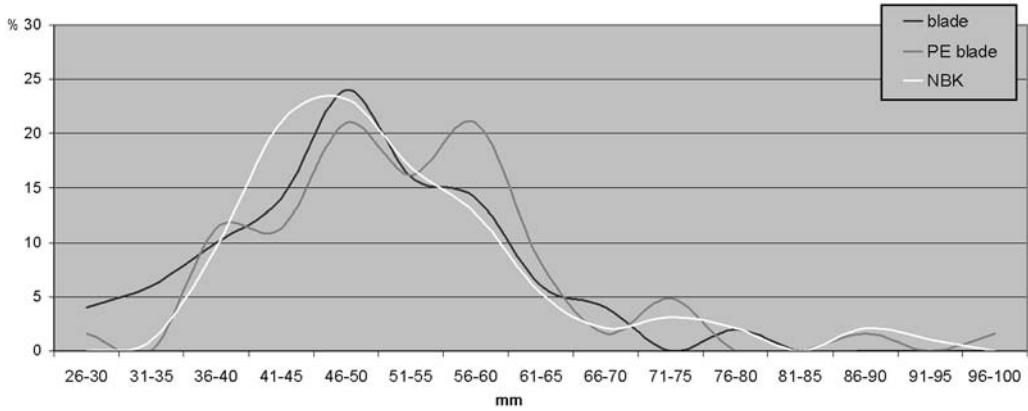


Fig. 34. Length of whole laminar blanks: $n =$ blade: 50, PE blade: 62, NBK: 95

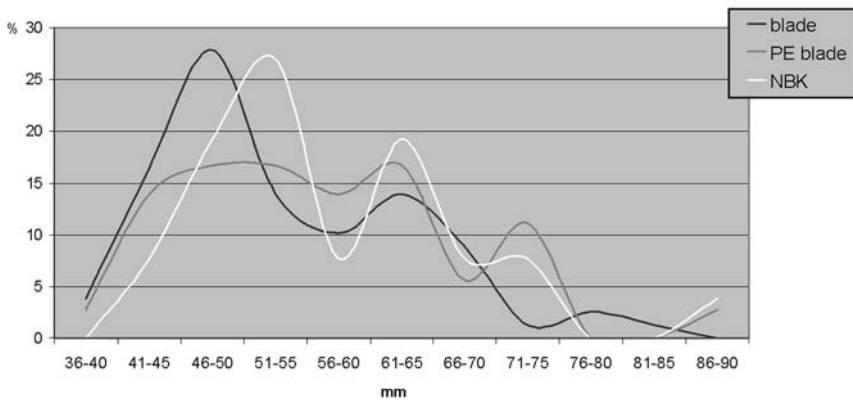


Fig. 35. Length of whole laminar shaped items according to their blanks: $n =$ blade: 79, PE blade: 35, NBK: 26

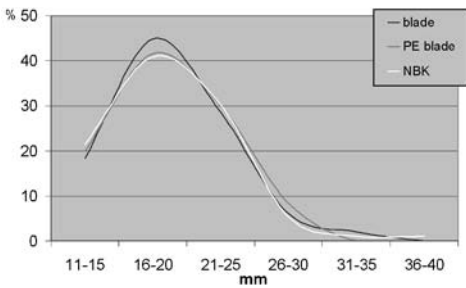


Fig. 36. Maximum width of whole laminar blanks: $n =$ blade: 49, PE blade: 61, NBK: 95

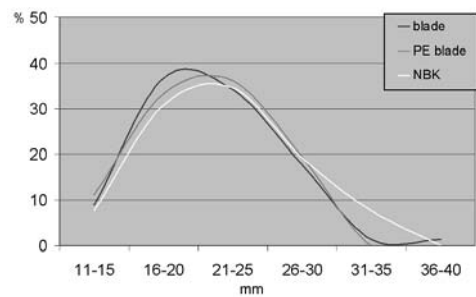


Fig. 37. Maximum width of whole laminar shaped items: $n =$ blade: 79, PE blade: 36, NBK: 26

is probably because they were reduced from the outer surface of the nodule, while the blades were reduced from the inner part. The laminar shaped items length was also examined (Fig. 35). The

blades show a sharp peak at 46–50 mm and the NBKs at 51–55 mm. The average length of whole laminar-shaped items is 54.30 mm (s.d. 9.72) for the blades, 56.39 mm (s.d. 10.95) for the PE

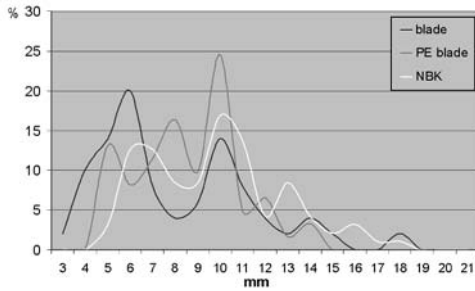


Fig. 38. Maximum thickness of whole laminar blanks: n = blade: 50, PE blade: 61, NBK: 95

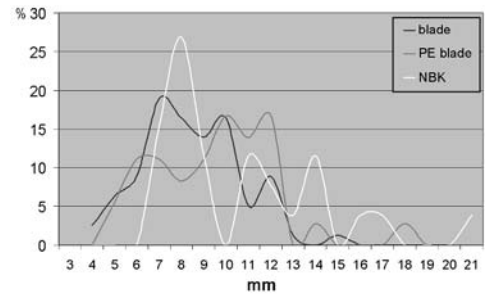


Fig. 39. Maximum thickness of whole laminar shaped items: n = blade: 79, PE blade: 36, NBK: 26

blades, and 57.19 mm (s.d. 10.33) for the NBKs. The only significant difference between the blanks and shaped items is in the blades (49.44 ± 9.99 vs. 54.30 ± 9.72 , $P < 0.017^3$).

The width of whole laminar items is also quite similar (Fig. 36). The average width of blades is 19.61 mm (s.d. 4.28), of PE blades 20.02 mm (s.d. 5.15), and of NBKs 19.63 mm (s.d. 4.96). Among the laminar-shaped items it seems that wider blanks were selected (Fig. 37), although it was found to be statistically significant in the blades (19.61 ± 4.28 vs. 21.68 ± 4.89 , $P < 0.017$) and NBKs (19.63 ± 4.96 vs. 22.42 ± 5.08 , $P < 0.017$) only. The average width of the shaped laminar items is 21.68 mm (s.d. 4.89) for the blades, 21.89 mm (s.d. 4.41) for the PE blades, and 22.42 mm (s.d. 5.08) for the NBKs.

The thickness shows a more complex picture (Fig. 38). The PE blades and the NBKs show a rather similar pattern, in which most are between five and 11 mm, with a peak at 10 mm. The blades on the other hand, are not as thick, and many of them are between four and seven mm, with a major peak at 6 mm. The average thickness of blades is 8.02 mm (s.d. 3.37), of PE blades 8.66 mm (s.d. 2.37), and of NBKs 9.80 mm (s.d. 3.00). The difference between blades and NBKs (8.02 ± 3.37 vs. 9.80 ± 3.00 , $P < 0.017$), and between PE blades and NBKs (8.66 ± 2.37 vs. 9.80 ± 3.00 , $P < 0.017$), was found to be significant. As for the laminar-shaped items, it seems that shaped blades

are a little thicker than blade blanks (Fig. 39). The preferable thickness for shaped blades is seven to 10 mm. PE blades and NBKs show no clear pattern. The average thickness of the shaped items is 8.47 mm (s.d. 2.23) for blades, 9.47 mm (s.d. 2.75) for PE blades, and 10.65 mm (s.d. 3.63) for NBKs. In this case only the NBKs were found to be significantly different from the blades (8.47 ± 2.23 vs. 10.65 ± 3.63 , $P < 0.017$).

We compared the three laminar blank categories as a group with the shaped items as a group. Only width was found to be significantly different (19.74 ± 4.84 vs. 21.87 ± 4.8 , $P < 0.017$). To conclude this part, we think that, although not all patterns were found to be statistically significant, it can be stated that in general terms relatively long, wide and thick laminar items were selected for secondary modification. One should also keep in mind that the original metrics of the shaped items were a little larger before secondary modification.

Angles of lateral edges. The main goal in this section is to characterize the difference between the PE blades and the NBKs by measuring the cortical lateral edge angle. This is important, since most of the PE blades (88.6%) have a uniform strip of cortex at one edge (Fig. 2:5). Items with a steep cortical edge of ca. 60–100° were assigned to the NBKs, and those with a rather acute angle (less than 60°) were assigned to the PE blades.

The cortical angles (Fig. 40) show a slightly bi-modal distribution. The first group, to which

3 The statistical analysis was carried out using SPSS 10. The test was carried out in order to investigate the relationships of the metric data among the various laminar blanks and shaped items. Since three metric parameters were examined the significant P is .05/3: $P.017$.

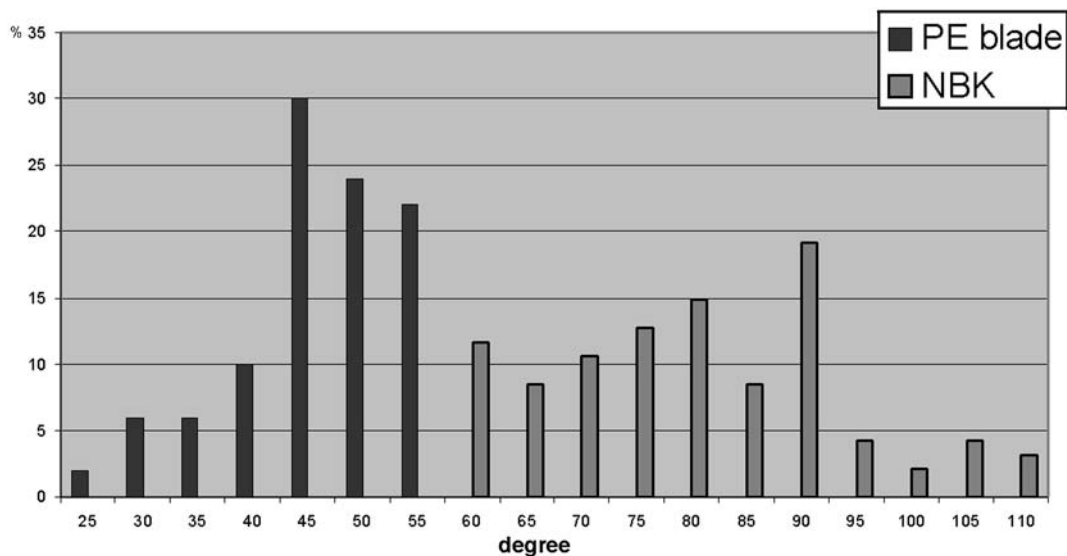


Fig. 40. Cortical edge angle of whole laminar blanks: $n =$ blade: PE blade: 50, NBK: 94

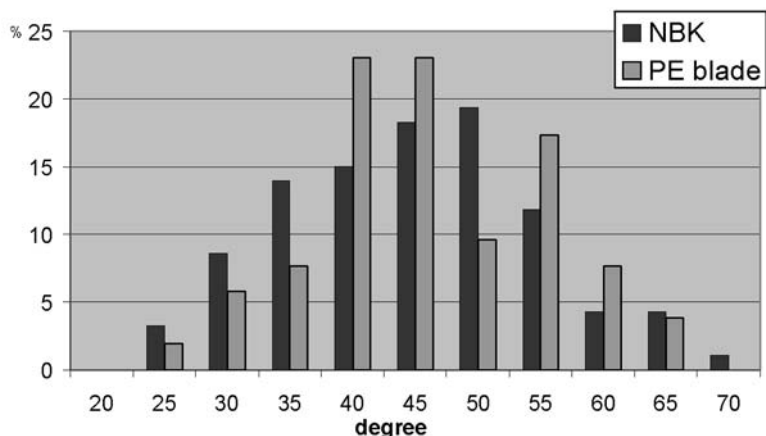


Fig. 41. Non-cortical edge angle of whole laminar blanks: $n =$ PE blade: 52, NBK: 93

we refer to as NBKs, has a peak around 80–90°, and the second, to which we refer to as PE blades, has a peak at 45–55°. The fact that the highest peak of the NBKs is at 90° is important, and may indicate that this is the preferable angle for NBKs. The border between the two groups is best placed around 60° nevertheless it should be noted that these two blank types merge into each other.

The non-cortical edge was also examined (Fig. 41). The distribution pattern of the NBKs is

more homogenous than that of the PE blades, but the difference is not pronounced.

The Amudian flint knappers at Qesem Cave produced large quantities of laminar items with one sharp lateral edge and one cortical edge. These items could be subdivided into steep and flat cortical edges; however, since these two types tend to merge into each other, we assumed that they belong to the same category of cortical knives. It seems that cutting implements with a

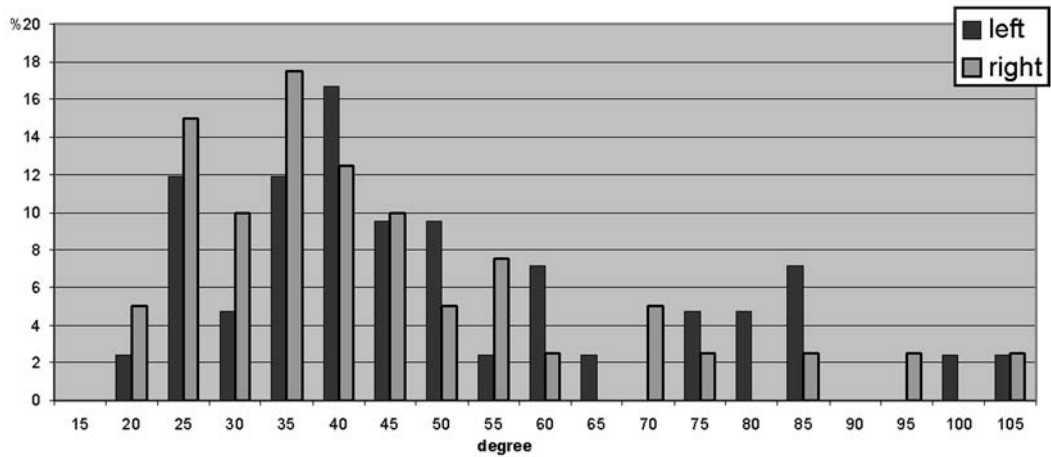


Fig. 42. Angles of common blade edges: n = left: 42, right 40

cortical lateral edge, providing a comfortable grip, were major end-products in this Qesem Cave assemblage, the most remarkable being the NBKs. Blades with a flat cortical lateral edge (usually defined as PE blades) are typical of many blade industries, and are usually regarded as items intended to initiate systematic blade production, and not a desired end-product. We suggest that this is not the case in the assemblage presented here, where cortical knives, both NBKs and PE blades, were desired end-products of the laminar industry. A recent use-wear study of another Amudian assemblage from Qesem Cave, indicating that both NBKs and PE blades were used as cutting tools (Lemorini *et al.*, 2006), supports this argument.

The lateral edges of the blades were also examined (Fig. 42), showing that the difference between these and the NBKs and PE blades is not only the absence of cortex. Both lateral edges of the blades are usually sharper than those of the cortical items. While the cortical laminar blank's peak is at 40–50° the blade's peak is at 35–40°. It appears that in the production of blades, items with two sharp lateral edges were preferred.

Hinge scars. Hinge scars were found on 20.7% of the blades, 21% of the PE blades, and 18.4% of the NBKs (Fig. 43). It is interesting that on the laminar-shaped items, hinge scars were found on 14.7% of the blades, 12.3% of the PE blades, and 25.7% of the NBKs. It seems that

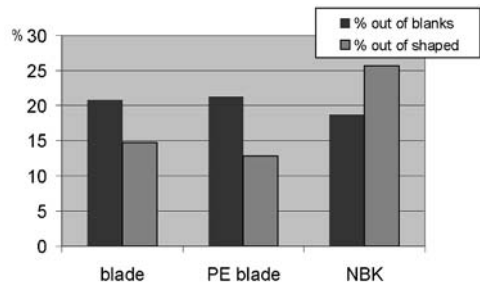


Fig. 43. Frequency of hinge fractures on laminar blanks: Blanks: n = blade: 164, PE blade: 133, NBK: 190; Shaped items: n = blade: 156, PE blade: 57, NBK: 35

blades and PE blades with fewer hinge scars were chosen for secondary modification, while NBKs chosen for secondary modification had more hinge scars. This might indicate that the qualities involved in the selection of blanks for secondary modification are somewhat different for the blades, PE blades and NBKs.

Laminar blank selection for secondary modification. The choice of blanks for shaped items shows some clear preferences (Fig. 44). Most of the shaped item types were made on blades. PE blades and NBKs were also chosen, but less frequently. Overpassing items, crested blades and burin spalls were only rarely used (Fig. 45). Only for endscrapers and the distally-retouched laminar items were the numbers of blades, PE blades

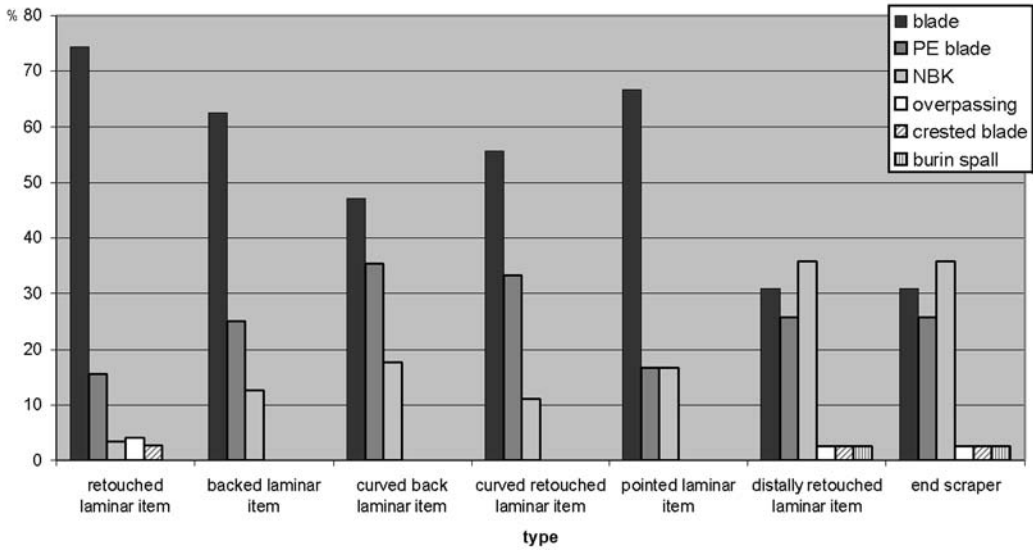


Fig. 44. Blanks of major laminar shaped items types (for size of samples see Table 3)

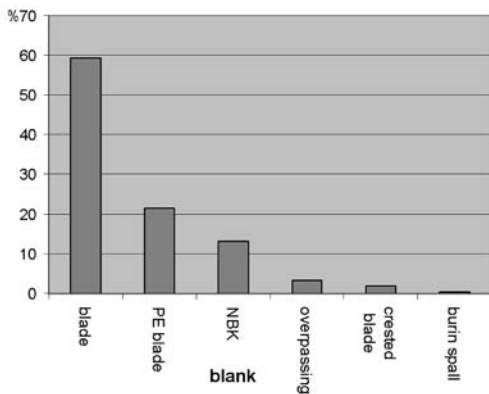


Fig. 45. Laminar shaped items blanks (n = 263)

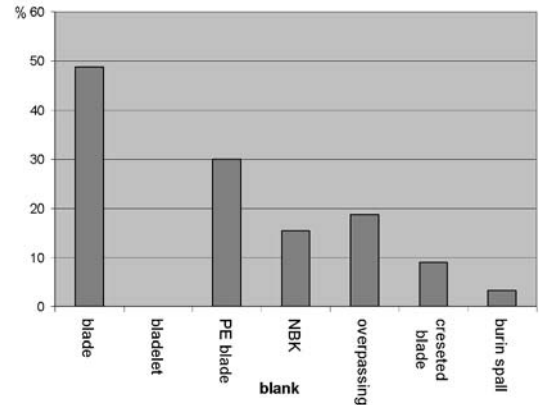


Fig. 46. Shaped laminar blanks out of the total blank produced: n = blade: 320, PE blade: 190, NBK: 225, overpassing (laminar): 48, crested blade: 55 and burin spall: 31

and NBKs comparable (Fig. 44). Among the retouched laminar items, blades were greatly preferred (most of these have a triangular cross-section).

The frequency of blanks selected for secondary modification is shown in Fig. 46. The fact that 49.8% of the blades produced were further retouched is noteworthy. This is even more emphasized considering that breakage (Figs. 16–17) is greater among the blanks – implying that the “original” proportion of blades selected for

secondary modification was even higher. Blades, no doubt, were the main blank type chosen for secondary modification. However, in this industry considering only the retouched items is not satisfactory, since it seems that many of the blanks were used as tools without secondary modification. The NBKs are a good example, and their secondary modification seems to be marginal, and not their main purpose.

DISCUSSION

The lithic analysis of an Amudian assemblage from Qesem Cave provided results for a better assessment of the Middle Pleistocene laminar technology practiced on site. We focused on the main laminar categories: blades, PE blades and NBKs. Comparing the blanks (*débitage*) to the shaped items (tools) raised the issue of how to approach the NBKs. Although in technological terms an NBK is considered a blank, some scholars view these items as technologically-defined tools (Debénath and Dibble, 1994:53–54). The use of these items as tools was previously recognized, following observation of use-wear signs on the cutting edges. A preliminary use-wear analysis at Qesem cave confirmed the assumption that many of the NBKs were used as tools without secondary modification (Lemorini *et al.*, 2006). Nevertheless, the NBKs category include both used and unused items. Copeland was well aware of this, and had assigned such items to the shaped tools only when visible use signs appeared on the cutting edge (Copeland, 1983:233).

Before summarizing the attribute analysis it is worth noting some aspects of the assemblage as a whole: a) the assemblage is characterized by a high proportion of laminar items (58.2% of the *débitage* and shaped items; Table 1), indicating that the production of flakes was relatively low, even as by-products; b) in many cases a natural narrow/carinated outline of raw material (mostly flat) was selected in order to shape the *débitage* surface and initiate laminar production; c) not much core maintenance was needed before laminar production, since the production was performed by heavy blows removing items with an overpassing termination, thus keeping the required outline and convexity; d) crested blades were occasionally shaped, but these are rather sporadic; e) the desired end products were laminar backed items with a sharp lateral edge; f) the laminar production system was simple but very efficient.

Analyzing the state of preservation of laminar items showed that blades are more fragile than the other two laminar blank types, and that the NBKs are the most durable. Examining the butts of laminar items indicated that knapping was performed by a hard hammer, hitting deep inside the striking

platform. The location of the bulb of percussion near the cortical edge was found to be one of the characteristics of the NBKs, and seems to be aimed at achieving the desired obtuse angle of the natural back. This was less common in the PE blades, and even less so among the blades.

Overpassing terminations are more common in the NBKs, and seem to be made on purpose. In general we can state that heavy blows were involved in knapping, and that overpassing terminations are a common result of this reduction strategy. The metric analysis showed that the length and width of the three main laminar blank types are rather similar. The length distribution of the NBKs was, however, more homogenous – another possible indication that they were end-products planned to be used without modification. The similarity in length indicates that the three laminar blank types originated from the same cores, all being part of the same reduction sequence. As for the thickness, blades are somewhat thinner than NBKs.

Comparing the laminar blanks to the laminar-shaped items reveals that whole items are more frequent among the shaped items. A high proportion of blanks were selected for secondary modification, with very few suitable blanks left in the *débitage*. A preference of blades with a triangular cross-section for secondary modification was also observed. The number of laminar scars shows that blades with two scars, usually with a triangular cross-section, were preferred. Laminar products with a twisted profile were less likely to be modified. The metric analysis shows that, in general, blanks chosen for secondary modification are not only longer, but also wider and thicker, than those found in the *débitage*.

Reviewing the shaped items indicated that blades constitute the preferred blank for secondary modification. The fact that *ca.* 50% of the blades produced were secondarily modified is of importance. In addition, the fact that only a small number of NBKs was chosen for secondary modification implies that this was a marginal objective, and not the main trend. The more homogenous distribution of length (Fig. 34), amount of cortex (Fig. 18), and angle of cutting edge (Fig. 41), characterizing the NBKs (compared to other laminar blanks), could indicate that much attention was given to achieving a specific blank shape that

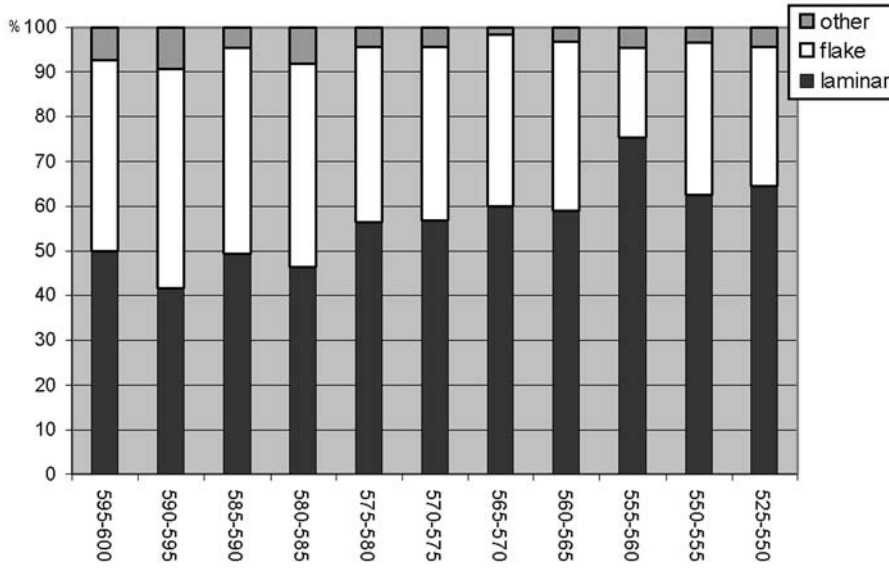


Fig. 47. Trends in laminar production in the G19/20 assemblage. For sample size and the composition of the three groups see Table 1-2.

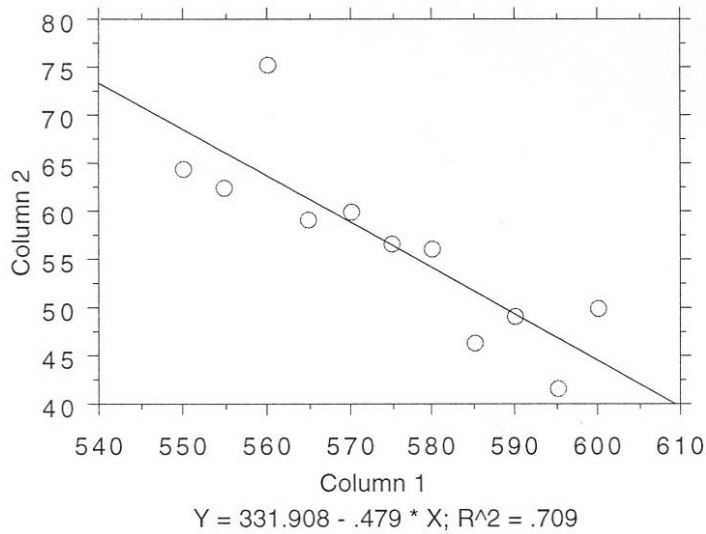


Fig. 48. Regression plot of percentage of laminar items per spit. Column 1: spit, Column 2: percentage

could be used with no further modification. It is also interesting that the NBK blank distribution pattern is more homogenous than that of the secondarily modified NBKs, for example in the length. The fact that hinge scars on the dorsal face are more common among the secondary modified

NBKs is in contrast to that observed for the other blank categories. While usually it was the “best” blanks that were shaped, it seems that the “best” NBKs were used with no further modification and that only the less “perfect” NBKs were shaped into end scrapers and backed laminar items.

To conclude, we wish to note that all three laminar blank categories: blades, PE blades, and NBKs, were manufactured simultaneously from the same cores, and are complementary.

Comparing the Qesem Cave results to Amudian industries from other sites is hampered by the scarcity of detailed technological studies. For now, we will concentrate on a comparison with Amudian assemblages, excluding other laminar industries, such as the Hummalian (Bergman and Ohnuma, 1983; Copeland, 1985). Variability is characteristic of the Amudian itself in different sites, and even within assemblages at a single site. A good example of such variation is Unit XI at Tabun (Jelinek, 1990). Some differences were also noticed between different Amudian assemblages at Qesem Cave (now under study). Even in the assemblage presented here an increase in the laminar component was noticed from the base to the top of the studied unit (Fig. 47), as confirmed by a regression test (Fig. 48).

The Amudian industry characterized by the production of laminar items requires suitable raw material. Preliminary studies of the Qesem raw materials indicate that some flints were obtained by mining from primary geological sources (Verri *et al.*, 2004, 2005). Future studies will concentrate on characterizing the raw material used in laminar production. Copeland (1983:210) remarks that the raw material used for laminar production in Abri Zumoffen is of better quality than that used for flake production. The use of old artifacts for the shaping of cores, as seen in Qesem Cave, is also known from other sites. The use of old hand-axes was noticed at Yabrud (Rust, 1950) and Tabun (Ronen, 1992:218). As for core shaping, it seems that minor preparation characterizes most Amudian assemblages (Copeland, 2000:100). The cores from Abri Zumoffen are roughly shaped, and so are the striking platforms (Copeland, 1983:216). Skinner (1970:158) states that laminar cores found in Masloukh are rather “simple” and are made without much preparation. The industry of Masloukh was later ascribed by Shmookler (1983) to the Amudian. Cores with a rather flat débitage surface are dominant in the Amudian assemblages of Abri Zumoffen (Copeland, 1983: 216). Recently, Monigal (2002:258) has performed a meticulous analysis of the Tabun XI Amudian industry, and she concludes that

“The reduction strategy in Unit Tabun XI appears to be quite simple...”.

The paucity of crested blades was also observed in other sites. For example, at Abri Zumoffen these are totally absent (Copeland, 1983:221). Irregularly prepared crested blades were also noted in Tabun XI by Monigal (2002:254), who chose to call them “pseudo-lames à crête”. In the analysis of the material of Yabrud I (layers 13 and 15), Vishnyatsky (2000:145) remarks that “the unretouched blades include 18 objects with high triangular cross-section, two of which can be defined as true (i.e., intentionally prepared) crested blades. The rest can be described as natural crested blades.” The technological reconstruction at Qesem Cave shows a similar pattern of exploiting the raw material’s natural outline.

Vishnyatsky (2000:147) observed that in Yabrud I (layers 13 and 15) knapping was performed by striking deep inside the striking platform, and the case is similar to Qesem Cave. In the Amudian industry of Tabun XI, large plain butts are also most common (Jelinek, 1990:86; Wiseman, 1993:26–27).

As for the size of cores; the average length in Abri Zumoffen is 60 mm (Copeland, 1983:216), longer than in the Amudian assemblage from Qesem Cave. The cores from the “Pre-Aurignacian” assemblage of Yabrud I are shorter than those of Abri Zumoffen, and their débitage surface is 30–40 mm long. Vishnyatsky (2000:145) also noted that the cores from Yabrud I are nearly exhausted. The latter are similar to those of Qesem Cave, not only in size, but also in their exhaustion.

The reduction sequence reconstructed at Qesem Cave involved the production of both cortical and non-cortical laminar items. Many of these cortical laminar items are actually NBKs. A differentiation between the types of laminar blanks, as we made here, was not done in most sites, and it is difficult to evaluate if such a reduction sequence characterized other Amudian assemblages as well. Wiseman (1993:26) notes that in a sample from Tabun XI, 43% of the “blades” and 55% of the shaped “blades” bear cortex. Monigal notes that in the sample from Tabun XI she studied, 70% of the laminar items are covered by some cortex, and cortex appears in many items along one of the lateral edges (Monigal 2002:241–242). Lamdan and Ronen (1989) observed that in a

sample from Ronen's excavation at Tabun, NBKs constitute 40% of the laminar blanks.

In spite of the limited comparative data, it seems that the production of laminar cortical items was also practiced in other Amudian assemblages. The NBK seem to be one of the main characteristics of the Amudian sample from Qesem Cave, as well as in other Amudian assemblages (*e.g.*, Jelinek, 1990:87; Wiseman, 1993:26). The common blades are mostly characterized by a triangular cross-section, not only at Qesem, but also at Tabun XI (Monigal, 2002:250).

Vishnyatsky (2000:145) mentions that not only blades characterize the Amudian assemblages, but also items that he calls "blade-flakes", which we referred to as "pseudo-blades". Jelinek (1975, 1990) had also noted that regarding length/width ratio, the flakes of the Amudian are relatively elongated. Comparing metric data of blanks from other sites should be made with caution since a clear division between blades, PE blades and NBKs was not made. In Yabrud I (layers 13 and 15) the average length of blade blanks is 59.4 mm, and that of the shaped blade is 66.0 mm. The average width of blade blanks is 23.2 mm, and that of the shaped blades is 26.3 mm (Vishnyatsky, 2000:146). These averages are a little higher than in the assemblage of Qesem Cave presented here, but are still rather close. The fact that the blanks chosen for secondary modification are longer and wider than the débitage blanks should be noted. This was also noted by Wiseman in her analysis of Tabun XI. In this sample the average blank length is 63.2 mm, width 22.6 mm and thickness 8.33 mm (Wiseman, 1993:26). In Garrod's analysis of Tabun, the blades and the secondary modified blades were measured together, and most of the items from layer Ea are *ca.* 60–70 mm in length, and from layer Eb *ca.* 50–60 mm (Garrod and Bate, 1937:81, 83). All of the above-average length measurements are a little higher than those characterizing Qesem Cave, but are still close.

Comparing the shaped items is also problematic because of the different terminologies used. Copeland, for example, included in the "backed blades" many items that we would have assigned as retouched laminar items. For example, she included items with a retouched "back" 1–2 mm thick (Copeland, 1983:232). Items that we have

defined as distally retouched laminar items or pointed laminar items, were included in most publications in the "retouched blade" category (*e.g.*, Garrod and Kirkbride, 1961:Fig. 4:3). Jelinek noted the appearance of a "truncated flake and blade" type in Tabun 48B, of which some might relate to the type we refer to as distally retouched laminar items. These items were found in lower numbers in the other samples he analyzed, which are not Amudian (Jelinek, 1975:309; Table 6). The most important observation for comparison is the domination of the retouched laminar items in Qesem Cave. This accords well with Garrod's observations, which chose to define the fine retouch or "nibbling" as one of the Amudian characteristics (Garrod and Kirkbride, 1961:23). The appearance of the curved backed laminar items in other Amudian assemblages (Garrod and Bate, 1937:81, 83; Copeland, 1983) should be noted.

A selection of a relatively high percentage of blanks for secondary modification was also noticed in Tabun XI (Jelinek *et al.*, 1973; Wiseman, 1993). Monigal (2002:251–258) confirmed this observation, and further added that mostly common blades were selected. She also remarks on a choice of blades with a triangular cross-section, in preference to blades with a twisted profile.

CONCLUSIONS

Although the comparative comments above are rather limited, they seem to indicate that the various Amudian assemblages show similar laminar technology in which simplicity is the key. We hope that further research in Qesem Cave and other Acheulo-Yabrudian sites will allow a better reconstruction of the Amudian industry and its place in the Acheulo-Yabrudian complex (*e.g.*, Gopher *et al.*, 2005). For now, we wish to emphasize the following points characterizing the Amudian industry at Qesem Cave as observed in the sample presented here.

A simple laminar technology was practiced with little core preparation and maintenance procedures. Platform isolation was not practiced before laminar production. Knapping was performed by a direct percussion, and characterized by striking deep inside the striking platform, as indicated by the thick butts. In most cases the butt is plain, but faceting appears as well, and when present it is not meticulous.

Knapping was characterized by heavy blows, which resulted in many overpassing items and laminar items with an overpassing termination. The powerful and follow-through blows were guided by pronounced ridges on the dorsal face, and the abundance of overpassing terminations indicates that the base of the core was not supported during laminar production.

The major aim of the laminar production was to create hand-held sharp cutting tools with a comfortable grip provided by the cortical back.

The laminar items produced were mainly blades, PE blades and NBKs, all part of a single reduction sequence; NBKs forming a large component of the assemblage.

The appearance of a uniform strip of cortex on one of the lateral edges in many of the laminar items characterizes the unique reduction sequence of the Amudian. Cortex was not removed prior to the laminar production, and cortical laminar items were desired end-products.

The Amudian assemblage is characterized by the production of laminar blanks that are well-suited to the desired end-product. The use of NBKs with no modification is of note. In many cases where secondary modification was performed, the change in the shape of the blanks was minor.

The shaped items are best characterized by the appearance of retouched laminar items, backed laminar items, curved backed laminar items, distally-retouched laminar items, end scrapers, and burins. It should be noted that side scrapers are rare. Another significant issue is the nature of this laminar technology in relation to other, later, laminar technologies. The choice of flat nodules, allowing an easy reduction without much preliminary shaping, characterized the Qesem Cave industry. Such a choice is also known from other industries of the southern Levant, such as the blade and bladelet industries of the Upper Paleolithic and the Early Epi-Paleolithic, and the Naviform blade industry of the Pre-Pottery Neolithic B. However the later industries are characterized by many core thinning and preparation procedures, and an investment in core shaping (e.g., Ferring, 1980; Quintero and Wilke, 1995; Goring-Morris *et al.*, 1998; Marder, 2003; Shmelmitz, 2002). In the Amudian industry, core shaping is rare. This is evident, not only in the

minor effort of shaping a meticulous preform, but also from the fact that cortex was not removed prior to laminar production. Retaining the cortex is different than in most later laminar industries. Not removing the cortex is assumed to be intentional, and aimed at creating a uniform strip of cortex on the back of the NBKs and the PE blades in order to provide a comfortable grip. We assumed that most of these items were not hafted (in contrast to many of the laminar blanks used in later periods), and the cortical edge provided a good grip for hand-held tools. No traces of hafting were found on cortical laminar items from Amudian assemblages at Qesem Cave, although the flint was in a good state of preservation (Lemorini *et al.*, 2006). Other technological differences between the Amudian and many later laminar industries are the total absence of platform isolation during the laminar production, and the dominant use of overpassing reduction in order to control the core débitage surface convexity in the Amudian.

The industry of Qesem Cave is also different from other laminar industries in that larger, wide and thick, rather than fine or delicate, laminar items were selected for secondary modification. This choice might relate to the use of items without hafting.

For now it seems that the Amudian is different than any of the later laminar industries. Meignen (1998, 2000) recently claimed that some laminar technologies previously thought to be related to the Tabun D are not truly Levalloisian, and suggested the coexistence of both volumetric Levallois and laminar technologies for blank production in the Early Levantine Mousterian. The presence of “common” laminar technologies, and not only Levalloisian, at this stage might connect the Amudian and these early Mousterian industries, as has already been suggested (e.g., Copeland, 1985; Jelinek, 1981; Nishiaky, 1989).

To conclude, we wish to state again that the industry presented here is rather simple. Rust (1950:33) chose to describe the laminar technology he found at Yabrud I as “primitive”. Copeland (1983:228) has also viewed the Amudian laminar technology in a similar way, and stated that “The number of unsuccessful and atypical blades presented could mean that the Amudian blade-makers had not yet perfected or stabilized

their technique...". Although we agree that this early laminar technology was simple, we think that this simplicity should be considered a technological advantage, enabling the production of desired laminar blanks from minimally prepared and maintained cores, rather than as a disadvantage or evidence of technological handicap. The Amudian knappers had produced laminar items without much preparation. Many of the items produced were chosen for secondary modification, and this modification had rarely changed much of the blanks' original shape. The blanks produced were well-suited to the desired end-products. This is clearly the case with the NBKs used without any modification. Such an industry should by no means be considered "primitive" or "undeveloped"; on the contrary, it should be looked upon as an efficient, conscious technological choice accomplished by skilled flint knappers.

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