TEL AVIV UNIVERSITY
THE LESTER AND SALLY ENTIN FACULTY OF HUMANITIS
THE CHAIM ROSENBERG SCHOOL OF JEWISH STUDIES

LITHIC BLADE PRODUCTION IN THE MIDDLE PLEISTOCENE OF THE LEVANT

Volume I: Text

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RON SHIMELMITZ

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Abstract

The Acheulo-Yabrudian cultural complex of the late Lower Paleolithic period, dating from 400,000 to 220,000 years ago, has been studied thus far only briefly. This phase is of great importance since it marks the shift from the Acheulian culture of the Lower Paleolithic period, attributed to Homo erectus, to the Middle Paleolithic Mousterian culture, attributed to Homo sapiens and Neanderthals. In general, the Mousterian culture was characterized by more complex human behaviour than the preceding Acheulian culture, exhibiting rapid changes and high regional diversity. These traits of the Middle Paleolithic, along with other traits within that period which are not of the lithic arena, are generally assumed to represent the onset of Modern Human Behaviour – the beginning of a gradual process of our ability to think and interact symbolically. The exact role of the Acheulo-Yabrudian complex in this fundamental shift is yet unclear and this is the query which my thesis endeavoured to answer by studying the blade technology. In this study I examined blades from the three main sites in which they were found – the caves of Qesem and Tabun in Israel and the rockshelter of Yabrud I in Syria.

The Acheulo-Yabrudian complex consists of three facies characterized by different industries: Acheulian (also referred to as Acheulo-Yabrudian), Yabrudian and Amudian (also referred to as Pre-Aurignacian). The Amudian facies which is characterized by intensive blade production was the focus of my study. However I also studied the blade production which appeared at a lower intensity in the Acheulian and Yabrudian facies. The intent in examining the blade production from the two other facies was to provide another perspective regarding the relationship between the facies of the Acheulo-Yabrudian complex which is still not fully clear.

My method entailed analyzing the characteristics of the lithic implements and the waste from their production into sets of attributes, from which I could extract recurring patterns that, when put together, can be used to reconstruct the reduction sequence – i.e. the technique by which the blades were made. Using this method I succeeded in reconstructing the technology practiced at the three sites. The detailed reconstruction, which was not available prior to my work, served as the basis for the conclusions of my thesis.

One of the main conclusions reached is that the production of blades was not only systematic but also serial – i.e. enabling the manufacture of similar end-products, with a predetermined shape, one after another. These sophisticated technologies are an indication of the high cognitive abilities of the hominids of the late Lower Paleolithic.

Another important conclusion was that, while the end-products are rather similar among the three sites, the technologies used to achieve them were different. Each of the sites had its own tradition for making blades, which was practiced for a long time and probably reflects a distinct regional group. Such variability between sites in close proximity to one another prior to the Middle Paleolithic has not been identified up to now.

Another contribution of my work is that it illustrates that the laminar reduction was not restricted to the Amudian facies and that the three facies shared the same technological knowledge. This supports the argument that the three facies of the Acheulo-Yabrudian complex represent different behavioral patterns within a single culture.

As a whole, the results of my study demonstrate that a major shift in human behaviour occurred within the time span of the Acheulo-Yabrudian complex, showing traits that have thus far been thought of as appearing in such intensity only at the beginning of the Middle Paleolithic (220,000 years ago). This conclusion is of great significance since it pushes the roots of modern human behaviour even further back in time – to ca. 400,000 years ago.

Chapter 1
Introduction

Blades have been the focus of many studies since the rise of systematic lithic analysis, mostly in reviewing Upper Paleolithic and Neolithic industries (e.g. Bordes and Crabtree 1969; Ferring 1980; Mortensen 1970; Pelegrin 1991). Although blade industries from earlier periods have been recognized for a long time in the Levant, as well as in other regions of the old world, until recently they were only briefly studied (e.g. Rust 1933; Garrod and Bate 1937). The importance of researching these early blade industries in order to uncover the complexity of the Lower and Middle Paleolithic periods was recognized at the end of the last century. The studies focused on the Levant (e.g. Meignen 1998, 2000, 2007a,b; Monigal 2001, 2002; Nishiaky 1989; Wiseman 1993; Vishnyatsky 1994, 2000) and on other regions of the old world (e.g. Meignen and Tushabramishvili 2006; Moncel 2001; Révillion and Tuffreau 1994; Soriano *et al.* 2007).

In past studies blade industries were frequently used as one of the indications of the superiority of *Homo sapiens* over other hominids (e.g. Arambourg 1956). This view however is no longer accepted by most scholars, especially since blades appear in earlier contexts that predate the presence of *Homo sapiens* (Bar-Yosef and Kuhn 1999; Johnson and McBrearty 2009; Meignen 1998). At the current state of research the presence of blades in itself does not indicate complex behaviors. In order to use blades as an indication of sophisticated capabilities, it is necessary to demonstrate that it is characterized by systematic, serial, and standardized production of predetermined blanks.

My study examines the blade technology of the Amudian industry, which is part of the Acheulo-Yabrudian complex of the late Lower Paleolithic period in the Levant (Copeland 2000). The Acheulo-Yabrudian complex is dated to 400-230/210 kyr BP (Barkai *et al*. 2003), thus placing the Amudian blade technology as one of the earliest. It is placed between the Acheulian culture of the Lower Paleolithic period, which is generally attributed to *Homo erectus*, and the Mousterian culture of the Middle Paleolithic period, which is attributed to *Homo sapiens* and Neandertals. The Acheulo-Yabrudian complex consists of three facies characterized by different industries: (1) Acheulian (also referred to as Acheulo-Yabrudian), dominated by flake production and the common appearance of handaxes and side-scrapers, (2) Yabrudian, dominated by flake production and by side-scrapers made on heavy flakes with Quina retouch, and (3) Amudian/Pre-Aurignacian, which includes blade production and 'Upper Paleolithic tool types' (Copeland 2000; Jelinek 1990).

Although our knowledge of the Acheulo-Yabrudian complex is generally limited, its place between the Lower Paleolithic Acheulian culture and the Middle Paleolithic Mousterian culture, which are very different from each other, implies that there is great potential in further exploring this phase. In general, the lithic industries of the Middle Paleolithic were more complex than those of the Lower Paleolithic Acheulian, as evident by prepared core technologies and predetermined blanks being highly common in Middle Paleolithic industries and rare in the Lower Paleolithic Acheulian (e.g. Lahr and Foley 2001; Madsen and Goren-Inbar 2004). In addition, the Middle Paleolithic industries show a high variability within sites and especially between sites, in comparison to those of the Lower Paleolithic Acheulian (e.g. Henry 1998). These traits have been cited to manifest the high capabilities of the hominids of the Middle Paleolithic period (e.g. Karlin and Julien 1994; Pelegrin 2005). How these traits appear in the Acheulo-Yabrudian complex, which constitutes the gap between the Acheulian and the Mousterian cultures, is yet unclear and my thesis will endeavor to clarify this issue.

The present study will reconstruct the Amudian blade technology from the three main sites where it was uncovered: Qesem Cave (Gopher *et al.* 2005), Tabun Cave (henceforth Tabun) (Garrod and Bate 1937; Jelinek *et al.* 1973; Jelinek 1990) and the rockshelter of Yabrud I (Rust 1950) (Fig. 1). The finds from Qesem Cave constitute the main base of the study and were examined at Tel Aviv University as part of the Qesem Cave Project directed by Prof. A. Gopher and Dr. R. Barkai. The examined finds from Tabun were retrieved from Jelinek's excavations Unit XI (Jelinek *et al.* 1973; Jelinek 1990). The majority of this assemblage is at the University of Arizona and only a small part of it is stored at the Israel Antiquities Authority. I examined both of these collections with the courtesy of Prof. A. Jelinek and Prof. S.L. Kuhn. The material from Yabrud I was examined at the *Institut für Ur- und Frühgeschichte der Universität zu Köln*, with the courtesy of Prof. J. Richter and Prof. A. Zimmermann. My study of the Yabrud I material includes the Amudian/Pre-Aurignacian facies of Layers 13 and 15 and the Acheulian facies (Acheulo-Yabrudian) of Layers 11-12 (Rust 1950).

My study will endeavor to reconstruct the blade production from each of the aforementioned sites. Our preliminary work on one of the samples from Qesem Cave showed that when dealing with the Amudian facies using the term ‘blade’ can be misleading, since it includes different types of blades, all appearing in large numbers. These types include "central/common" blades (blades), primary element blades (PE blades) and naturally backed knives (NBKs). In order to unify them into one category we use the term ‘laminar items’ (Barkai *et al.* 2005). The technological reconstruction will be based on an attribute analysis which will focus mainly on the three laminar types (blades, PE blades and NBKs), but will also include core trimming elements (CTEs) and cores. I hope the results of this study will also shed light on the abilities of the hominids of the late Lower Paleolithic and on the meaning of the relationship between the three facies that composed the Acheulo-Yabrudian complex.

The Acheulo-Yabrudian Complex

The Acheulo-Yabrudian complex ('Mugharan Tradition' according to Jelinek 1990) is part of the late Lower Paleolithic period of the Levant (Bar-Yosef 1995a; Goren-Inbar 1995). It is generally considered to consist of three facies – Acheulian (also referred to as Acheulo-Yabrudian or ‘Acheulian of Yabrudian facies’), Yabrudian and Amudian/Pre-Aurignacian (e.g.; Copeland 2000; Garrod and kirkbride 1961; Jelinek 1990; Rust 1950). The Acheulo-Yabrudian complex is stratigraphically placed on top of the Lower Paleolithic late Acheulian layers at the sites of Tabun, Nadaouiyeh Aïn Askar and Hummal, and underlying Middle Paleolithic Mousterian layers at the sites of Tabun, Yabrud I, Bezez Cave, Misliya and Hayonim Cave (Bar-Yosef *et al.* 2005:24; Garrod and Bate 1937; Kirkbride 1983; Le Tensorer *et al.* 2007; Rust 1950; Weinstein-Evron *et al.* 1999, 2003). The main sites at which all three facies of the Acheulo-Yabrudian complex were found are Tabun (Garrod and Bate 1937; Gisis and Ronen 2006; Jelinek *et al.* 1973, Jelinek 1982a,b, 1990), Yabrud I (Rust 1950) and Adlun (the adjoining sites of Bezez Cave and Abri-Zumoffen; Garrod and Kirkbride 1962; Copeland 1983a). Other sites with occupations from the Acheulo-Yabrudian complex are El Kowm (a series of sites;

Copeland and Hours 1983; Le Tensorer *et al.* 2007), Jamal Cave (Weinstein-Evron *et al.* 1999; Zaidner *et al*. 2005), Jerf Ajla (Copeland 1975:327; Schroeder 1969), Maslukh (Skinner 1970), Qesem Cave (Gopher *et al.* 2005) and Zuttiyeh (Gisis and Bar-Yosef 1974; Turville-Petre 1927). In sites where two or three facies are present, the facies may appear in a different order along the stratigraphy, sometimes even appearing several times, without a repeated pattern among the sites (Copeland 2000).

The Acheulo-Yabrudian complex appears throughout only part of the Levant and it is still unknown in the Negev and southern Jordan (Bar-Yosef 1995a). In the latter regions, the late Acheulian probably coexisted with the Acheulo-Yabrudian complex (Bar-Yosef 1998:49; Bar-Yosef and Vandermeersch 2007).

The three facies of the Acheulo-Yabrudian complex are defined according to their lithic assemblages. Although it is highly likely that the three facies differ in aspects beyond lithics as well, such as in faunal assemblages or spatial distribution of artifacts, no such data is yet available. In this chapter I will present their main characteristics, while a more thorough description and the course of events leading to the current state of research will be provided in the following chapter addressing the history of research.

The Acheulian Facies (Acheulo-Yabrudian Facies)

The industry of the Acheulian facies is mainly flake-oriented and the shaped items are primarily typified by handaxes and side-scrapers. In fact, it is this combination of handaxes and side-scrapers that led Rust (1950:128-129) to suggests the name ‘Acheulo-Yabrudian’ for the layers containing them at Yabrud I. In his line of thought, the handaxes represent the Acheulian and the side-scrapers – the Yabrudian (Rust actually argued for four facies: Acheulian, Acheulo-Yabrudian, Yabrudian and Pre-Aurignacian).

The Acheulian facies was discovered at Tabun in sub-layer Ec from Garrod’s Excavations (Garrod and Bate 1937), in Unit XI-XII from Jelinek's excavations, and in Layers 220-290 from Ronen’s excavations (Gisis and Ronen 2006). It was also found in Yabrud I Layers 14, 16, 20-22 and 25 (Rust 1950), Bezez Layer C (Copeland 1983a), Zuttiyeh (Gisis and Bar-Yosef 1974; Turville-Petre 1927), Misliya (Weinstein Evron *et al*. 2003), and Jamal Cave (Zaidner *et al.* 2005). It might also be present in Hayonim Cave (Bar-Yosef *et al.* 2005:24), and the Lion spring (Copeland 1989a).

The handaxes, which are the hallmark of the Acheulian facies vary in size, shape and character of modification (e.g. Bordes 1984:16-20; Copeland 1983a; Garrod and Kirkbride 1961; Gilead 1970a,b; Rollefson 1978; Rust 1950; Saragusti 2002; Zaidner *et al.* 2006). The more thorough technological and typological descriptions of the handaxes of this facies are based on the material from Tabun. There it was found that many of the handaxes have an unprepared butt, a flat retouch that mostly concentrates at the distal end, and a relatively broad tip (e.g. Gisis and Ronen 2006; McPherron 2003; Rollefson 1978). These features were also found at Misliya and it was suggested that they may characterize the Acheulian facies of Mount Carmel (Zaidner *et al.* 2006).

The Yabrudian Facies

The industry of the Yabrudian facies is mainly flake-oriented and is characterized by the prevalence of side-scrapers. Rust (1950:125-127), who suggested the term Yabrudian, argued that the difference between the 'Acheulo-Yabrudian' and 'Yabrudian' is the lack of handaxes in the latter. Rust’s line of thought was later presented by Jelinek (1982b:63) – "Yabrudian *sensu strictu* without bifaces". Other scholars however do not accept this view and argue that the Yabrudian facies can contain a small portion of handaxes, although there are no references to exact amount (e.g. Copeland 1975:322; Garrod and Kirkbride 1961:21; Jelinek 1977:88, 1990; Skinner 1970). Still, the fact that terms such as "pure Yabrudian" were still in use (Copeland 1983a:159) implies that the presence of handaxes in the Yabrudian is not taken for granted.

The Yabrudian facies was recovered in Tabun sub-layers Ea, Eb and Ed from Garrod’s Excavations, Unit XI and XIII from Jelinek’s excavations (Jelinek *et al.* 1973, Jelinek 1982a), and Layers 230-290 from Ronen’s excavations (Gisis and Ronen 2006). It was also recovered at Yabrud I, Layers 11-12, 17-19 and 23-24 (Rust 1950), Abri-Zumoffen (Copeland 1983a), Masloukh (Skinner 1970; Shmookler 1983), El Kowm (Copeland and Hours 1983; Le Tensorer *et al.* 2007) and Qesem Cave (Barkai *et al.* in press).

The side-scrapers of the Yabrudian facies were commonly made on thick flakes with a plain butt and by a Quina or demi Quina retouch (Bar-Yosef 1995a:252; Garrod and Kirkbride 1961:21; Skinner 1970). They appear in various types, of which dejéte and transversal side-scrapers are reported to be more common in the Yabrudian facies than in the others (e.g. Bordes 1955; Skinner 1970). This observation however was not statistically significant in Jelinek's (1981:269-270) examination of Tabun Units XI- XIII.

The Amudian/Pre-Aurignacian Facies

The Pre-Aurignacian was defined by Rust (1950:30-36) for Layers 13 and 15 from Yabrud I. Its main features are the production of laminar items and a large representation of 'Upper Paleolithic tool types' – i.e. burins, end-scrapers and retouched laminar items. The term 'Amudian' was later introduced by Garrod and Kirkbride (1961) in order to replace the previous term – 'Pre-Aurignacian'. The two terms remained in the literature, sometimes as synonyms and other times as variants of the blade dominated facies. Copeland (2000:101), for example, argues that a distinction between the Pre-Aurignacian and the Amudian is valid. She emphasizes that, while in the Pre-Aurignacian there are end-scrapers of Aurignacian type and dihedral burins, in the Amudian there are more backed knives, some with a tip resembling ' Chatelperron points'. 'Adlun burins' are also suggested by her to better represent the Amudian. The latter type was defined following the excavations of Abri-Zumoffen (Garrod and Kirkbride 1961:23).

This facies was found at Tabun sub-layers Ea-Eb from Garrod's excavations (Garrod and Bate 1937; Garrod 1956) and Unit XI from Jelinek's (1990) excavations. It was also found at Yabrud I Layers 13 and 15 (Rust 1950), Masloukh (Skinner 1970; Shmookler 1983), Abri-Zumoffen (Garrod and Kirkbride 1961; Copeland 1983a) and Qesem Cave (Barkai *et al*. 2005; Gopher *et al.* 2005). A possible other Pre-Aurignacian occurrence was reported at El-Kowm (Le Tensorer *et al.* 2007). Zuttiyeh (Turville-Petre 1927) is not included here – for a reason to be explained in the following chapter. Haua Fteah, Libya (McBurney 1967; Moyer 2003) is not included as well, due to its later dating and the different geographic setting. In this study I will use the term Amudian to represent this facies and the term Pre-Aurignacian will be used only in the case of Yabrud I, in accordance with Rust's terminology.

The laminar items of the Amudian facies include blades, PE blades and NBKs, which are all assumed to be desired end-products that result from a single reduction sequence (Barkai *et al*. 2005). The blades of the Amudian facies are generally thick and have a triangular or trapezoidal cross-section (Monigal 2002; Wiseman 1993).

Other Lithic Characteristics of the Acheulo-Yabrudian Complex

Alongside the presence of the aforementioned lithic characteristics there are some additional traits which are of note. Choppers, denticulates, notches and retouched flakes are found in almost all the sites and facies in varying frequencies (Bordes 1955; Copeland 1983a, 2000; Gopher *et al*. 2005). Another feature common to most Acheulo-Yabrudian sites is the presence of a few Levallois products (e.g. Bordes 1984, Rollefson *et al.* 2006:68; Skinner 1970). This may however be misleading. Copeland (1995) argued that some of the items defined as Levallois might originate from handaxes or discoidal cores. In addition, the presence of Mousterian layers on top of the Acheulo-Yabrudian layers at many of the sites raises the possibility that they are intrusive. The absence of Levallois products in Qesem Cave, where no Mousterian layers are found, supports the general absence of this technology in the Acheulo-Yabrudian complex. If so, it will be in sharp contrast to the Lower Paleolithic late Acheulian, where it constituted a small but a constant portion of the assemblages (e.g. Bar-Yosef 1994; Goren-Inbar 1995).

Relation between the Three Facies and its Implications

The distinction between the three facies is not always clear and there are many cases in which the traits of these facies blend into each other (e.g. Garrod and Kirkbride 1961; Jelinek 1990; Shmookler 1983). The relatively clear differences among the layers of Yabrud I (Rust 1950) is the exception, but the fact that the retrieved material was not systematically collected (Solecki and Solecki 1966) raises doubts as to its validity. Although the later excavations at Yabrud I by Solecki and Solecki (1986) indicated that Rust simplified his documentation of the stratigraphy, it did not reveal any new data on the character of the assemblages themselves.

At most sites of the Acheulo-Yabrudian complex side-scrapers, handaxes and blades are found in all facies and the difference between the facies is signified by their percentages (Copeland 1983a; Garrod 1956; Jelinek *et al.* 1973, Jelinek 1990; Skinner 1970). Jelinek (1982a,b, 1990), who demonstrated this variability following his results from the Tabun excavations, promoted the idea that these facies should better be treated as one and he referred to it as the 'Mugharan Tradition'.

Although side-scrapers, handaxes and blades can be found in all three facies, they were observed in some cases to differ, not only in percentage but also in character. Since this issue has been only briefly examined, I will note just a few examples. In the case of laminar items, the blades found at Tabun sub-layers Ec-Ed (Yabrudian and Acheulian facies) were reported to be rougher than the blades of Tabun sub-layers Ea-Eb (Amudian facies) (Garrod and Bate 1937:86). Differences in the character of side-scrapers were discussed in relation to the finds from Abri-Zumoffen. At this site most of the side-scrapers found in the Amudian facies were not recorded as a 'Yabrudian type', but instead were described as being smaller and rougher (Garrod and Kirkbride 1961:23). They were reported to mostly lack Quina retouch and transversal and dejete types (e.g. Copeland 1983a:229, 244). Differences in handaxes are less clear, but McPherron (2003), who studied the material from Tabun, argued that in beds where handaxes were prevalent and side-scrapers were few (Yabrudian facies) the handaxes were mostly broader, rounded and shorter. In contrast, in beds where side-scrapers were prevalent and handaxes were few (Acheulian facies) the handaxes were more elongated, pointed and longer. Rust (1950:127-129) also noted that the handaxes differ among the layers of Yabrud I.

Various explanations have been suggested for the differences among the three facies which will be discussed in the following chapter. The three facies have been suggested to represent different groups or cultures (Bordes 1955; Rust 1950; Garrod 1956), climatic changes (Jelinek *et al*. 1973; Wiseman 1990:313), or specific activity zones (Copeland 1983a, 2000). The debate on the meaning of these differences is still ongoing, mostly because fine data for examining these hypotheses are generally lacking. The fact that many of the variations between the three facies described above are reflected in different percentages rather than in more fundamental differences is a major key in exploring this issue further. This is in light of the fact that their presence among the three facies is an indication of a common ground, possibly signifying that they are part of a single entity (Jelinek 1990). At the current state of research, however, the studies of the Yabrud I finds (Bordes 1955; Rust 1950), which argue for clear differences between the facies, do no enable a single explanation. I hope that my study on the laminar technology can help in illuminating this problem.

The Environment

The sites of the Acheulo-Yabrudian complex appear in different environments. While some, like Tabun and Adlun, appear near the current Mediterranean shoreline, others, such as Qesem Cave, Zuttiyeh and El-Kowm appear inland (Garrod and Bate 1937; Garrod and Kirkbride 1961; Gopher *et al.* 2005; Le Tensorer *et al.* 2007; Turville-Petre 1927). The site of Yabrud I, located at 1400 m a.s.l. (Rust 1950), further emphasizes the different environments occupied. It is of note that the three facies of the Acheulo-Yabrudian complex are found in all of these environments.

The climate in the Acheulo-Yabrudian complex changed several times and it consists of several glacial cycles (e.g. Almogi-Labin *et al.* 2004). Reconstructing the environment of the Acheulo-Yabrudian complex has included several methods during the last century, mostly using microgeological studies (e.g. Farrand 1970; Goldberg 1973; Jelinek *et al*. 1973; Tsatskin 2000). Other attempts include the ratio of gazelle/dama (Garrod and Bate 1937:141, Fig. 1) and the changing elevations of the Mediterranean sea (Copeland 2000; Sanlaville 1998 and references therein). Most past observations however need to be calibrated with new data about the antiquity of this phase and the several glacial cycles within its time span. This is due to the fact that before the results of the radiometric dating have been obtained, this phase was assumed to be shorter and more recent (e.g. Jelinek 1990:83). Despite these studies we still do not know enough about the environment of the Acheulo-Yabrudian complex. Although it may play a role in explaining some of the variability within this complex, the lack of details prevents further advancement in this direction.

Human Remains

Very few human remains were found at sites of the Acheulo-Yabrudian complex. These include a few bones from Tabun (Garrod and Bate 1937:67; McCown and Keith 1939:60, 195, Fig. 29) and the Galilee skull from Zuttiyeh (Keith 1927). The latter has been a subject of many studies and was ascribed to various types of hominids (e.g.

Trinkaus 1982; Vandermeersch 1982; Zeitoun 2001). From the previous phase of the Lower Paleolithic late Acheulian, there is a leg bone from Nadouiyeh Aïn Askar attributed to *Homo erectus* and retrieved from sediments estimated to be 450 kyr old (Jagher *et al.* 1997; Le Tensorer *et al*. 2007). *Homo sapiens* and Neandertals are known to have existed in the following period of the Levantine Middle Paleolithic, but only from its middle and late phases (Klein 1999; Kramer *et al*. 2001 and references therein). In the absence of clear data, not only from sites of the Acheulo-Yabrudian complex, but also from the sites of the earlier late Acheulian or the later early Mousterian, the hominid type related to the Acheulo-Yabrudian complex is still unknown. Several scholars have raised the possibility that an archaic *Homo sapiens* was the hominid that produced some of the assemblages of the Acheulo-Yabrudian complex (e.g. Bar-Yosef 1994:247; Mercier *et al*. 1995:507; Perrot 1968:340).

Dating

The radiometric dating of the Acheulo-Yabrudian complex is still debated, since different results were obtained by various methods (for an overview of these methods see Schwarcz and Rink 2001). Primarily the ESR dating method usually provides younger dates than the TL method (e.g. Bar-Yosef 1998). It is also of note that ESR and TL are relatively new and in some cases the analyzed teeth and burnt flints were stored for many years in various universities or museums before being examined (for example Jelinek's excavations ended in 1971 whereas the items were examined in the 1990's). Despite these difficulties most samples of the Acheulo-Yabrudian complex yielded a general range of 400-200 kyr. These dates are mainly derived from the sites of Tabun (Grün and Stringer 2000; Mercier and Valladas 2003; Rink *et al*. 2004), Qesem Cave (Barkai *et al*. 2003) and Yabrud I (Porat *et al*. 2002) and will be presented in detail in the relevant chapters. Another contribution to the chronology of the Acheulo-Yabrudian complex was obtained by a U-series of a flowstone from Jamal Cave, which gave a minimum age of 220 kyr (Weinstein *et al.* 1999).

The few dates from the Lower Paleolithic late Acheulian and the early Middle Paleolithic are of importance as well. The dating of the basalt flow overlying the Lower Paleolithic late Acheulian site of Berekhat Ram yielded a date of 233±3 kyr using

$^{40}Ar/^{39}Ar$ (Feraud *et al*. 1983). The ESR date of 204±16 kyr from Holon (Porat *et al*. 2002) is problematic since the dating was conducted long after the excavation ended and did not directly examine the excavated layers. Two TL dates of 315±20 and 324±22 kyr, obtained from Ronen's excavations at Tabun from sediments that he correlated with Garrod's Layer F (Mercier and Valladas 2003: Table 2), contrast with the lower boundary of 400 kyr for the Acheulo-Yabrudian complex. These dates of Layer F are problematic however, since teeth from sediments equivalent to the following layer (Garrod's sub-layer Ed) yielded a date of 387+49/-36 kyr by a combined model of ESR and U-series (Rink *et al*. 2004).

Some of the dates of the early Middle Paleolithic are in the range of 200 kyr and earlier and therefore can aid in framing the upper boundary of the Acheulo-Yabrudian complex. Some of these dates are very early, around 250 kyr. These include the mean TL date of 256±26 kyr retrieved from Jelinek's Unit IX of Tabun (Mercier and Valladas 2003), and the dates of 241±11 and 257±6 kyr by a combined model of U-series and ESR from the lower part of Hayonim Layer E (Schwarcz and Rink 1998). A large series of TL dates from Layers E and F of Hayonim Cave gave dates of 210±28 and 221±21 kyr (Mercier *et al*. 2007).

The overlap between the earliest dates of the Middle Paleolithic period and the later dates of the Acheulo-Yabrudian complex remains a problem to solve. I prefer viewing the range of the Acheulo-Yabrudian complex from 400-220 kyr by following the TL dates from Qesem Cave and Hayonim Cave, which were obtained from large sets of samples from well controlled current excavations (Barkai *et al.* 2003; Mercier *et al*. 2007).

Fauna

Fauna from the sites of the Acheulo-Yabrudian complex was not well studied and available reports are short and partial. The data on the fauna from the sites of Qesem Cave (Gopher *et. al.* 2005), Tabun E (Garrod and bate 1937) and Yabrud I (Lehmann 1970; Perkins 1968) is presented in the following chapters. Faunal finds were also reported from Masloukh (Gautier 1970), the Adlun sites (Garrard 1983) and Zuttiyeh (Bate 1927a, b). These studies show a range of species including tortoise, birds, equids, rhinoceros (*Dicerorhinus hemitoechus*), boar (sus), fallow deer (*Dama mesopotamia*), red deer (*Cervus elaphus*), roe dear (*Capreolus capreolus*) and wild goat (*Capra aegagrus*). Fallow deer are common in many of the sites of the Acheulo-Yabrudian complex and so are equids (Garrard 1983; Gautier 1970). Of the above studies, only that of Garrard's (1983) enables comparing the faunal finds from the three facies as they appear at a single locality – the Adlun sites. The samples of the three facies he examined show that fallow deer dominates the Yabrudian and Amudian samples (56.7% and 68.8% respectively), but is almost completely lacking in the Acheulian (Acheulo-Yabrudian) sample (4.1%). Furthermore, while in the Amudian sample both leg bones and teeth are present, the Yabrudian sample contained only teeth (Garrard 1983:408, Fig. F.3). Although the above variation might be affected by a difference in preservation factors and by the small size of the samples, it urges us to consider the possibility that the three facies were also characterized by a different exploitation of animals.

Modern Human Behavior

Although the term 'modern human behavior' is long in use in archeological literature, its exact definition is still debated (e.g. Deacon and Wurz 2001; d'Errico 2003; Henshilwood and Marean 2003; Mellars 2005; Wadley 2001). The main concept it conveys, according to most of these studies, is the hominids' abilities to think and interact symbolically. One of the main problems in this debate is interpreting the archeological material and specifying what exactly signifies modern human behavior. The various models suggested for the onset of modern human behavior can be divided into three groups: (1) around 40-50 kyr ago and in relation to Anatomically Modern Humans (e.g. Klein 1995, 1999, 2000; Wadley 2001); (2) prior to 40-50 kyr ago , but still relating to Anatomically Modern Humans (e.g. Deacon and Wurz 2001; James and Petraglia 2005); and (3) around 200-300 kyr ago, or possibly earlier, and not necessarily shared by a single species (e.g. d'Errico 2003; Hovers and Belfer-Cohen 2006; Taçon 2006). It is of note that the first group emphasizes clear cases of external storage of symbolic information and argues for a symbolic explosion. In contrast, the two other groups generally see it as a gradual process (e.g. d'Errico 2003). Those who argue for a gradual process criticize the emphasis on artistic elements as an indicator of external storage of symbolic information and claim that it reflects a western line of thought that is far from suitable to all cultures (Henshilwood and Marean 2003).

Most studies arguing for the early appearance of modern human behavior refer to the Middle Paleolithic and not to the Acheulo-Yabrudian complex or to the Lower Paleolithic Acheulian (e.g. Foley and Lahr 1997, 2003). It will not be surprising however, if the more common features interpreted as representing symbolic behavior found in the Middle Paleolithic period (for a summary see Shea 2006a) are not only the result of their younger date, but also of the larger number of sites excavated from this period as compared to earlier periods.

One example of features signifying modern human behavior is the use and control of fire, which gave humans new advantages in several fields, including diet, heating and protection, and is considered by some to signify modern human behavior (e.g. McBrearty and Brooks 2000). While evidences for the use of fire has been found at some Levantine Lower Paleolithic sites (e.g. Alperson-Afil *et al*. 2007; Goren-Inbar *et al*. 2004), it has become a more constant feature only from the Middle Paleolithic period (e.g. Bar-Yosef *et al.* 1992). Hearth remains however are common in the sites of the Acheulo-Yabrudian complex. The constant and controlled use of fire was best evidenced at the site of Qesem Cave, where ash originating from wood burning was consistently found in the sediments of the upper half of the stratigraphy (Karkanas *et al*. 2007). Traces of ash were also found to be more common in the upper half of the stratigraphy in the case of Yabrud I (de Heinzelin 1966). The geoarchaeological study of the layers of the Acheulo-Yabrudian complex from Ronen's excavations at Tabun found ash traces as well (Ronen and Tsatskin 1995; Tsatskin 2000:135). Visual hearth features were reported in the sites of Yabrud I (Farrand 1965), Bezez Level C (Copleand 1983a:158) and Abri-Zumoffen (Copeland 1975:322), all from the Acheulo-Yabrudian complex. Although the two latter sites were not examined by geological methods I presume that the use of fire was common in the Acheulo-Yabrudian complex and that the conception of domestic space (Karkanas *et al*. 2007; McBrearty and Brooks 2000) was inherent in their behavior, not much differently from the Middle Paleolithic.

Another trait that was suggested to reflect modern human behavior is the effort to extract raw materials, including mining (e.g. d'Errico 2003:200). Extraction of flint from buried sediment in order to attain fresh raw material was identified at Qesem Cave and Tabun Layer E (Verri *et al.* 2004). It is of note that several quarry sites attributed to the Lower Paleolithic late Acheulian are familiar as well (e.g. Barkai *et al*. 2006).

A differential use of space within sites, as represented by the distribution of finds or other features, is also considered an indicator of modern human behavior (e.g. Wadley 2001). If we can confirm the suggestions that the different facies of the Acheulo-Yabrudian complex are coeval at some sites representing zones of different activities (Barkai *et al.* in press; Copeland 1983a), it would mean that this feature too appeared already in the Acheulo-Yabrudian complex.

Another issue is the presence of complex lithic technologies (e.g. Lahr and Foley 2001; Pelegrin 2005). While in the past blade production was automatically considered to be an indication of high cognitive capabilities (e.g. Clark 1969), this in no longer the case (Bar-Yosef and Kuhn 1999:324; Davidson 2003; d'Ericco 2003:192). Although not substantially demonstrated, the laminar technology of the Amudian facies was tentatively suggested to mark modern human behavior (Ronen 1992, 1998b; Vishnyatsky 1994).

All of the above features not only support the models that argue for a gradual process in the formation of modern human behavior, but indicate as well that major advances in this direction were already made in the Acheulo-Yabrudian complex.

Laminar Items and Their Study

Many of the studies of laminar items are concerned with their manufacturing technology and the implications of their use. It is assumed that the use of a specific technology does not merely reflect functional utilitarian aspects, but also the cultural background of its users (Dobres 2000; Ingold 1993; Lemonnier 1993; Pfaffenberger 1988, 1992). In trying to understand the reason behind the technological choice for producing laminar items it is important to note that in almost all regions of the old world it occurred in several periods, first appearing in the late Lower Paleolithic or early Middle Paleolithic (Bar-Yosef and Kuhn 1999; Révillion and Tuffreau 1994 and references therein). The exact factor that stimulated the production of laminar items is still debatable. Among the more common explanations are those concerned with efficiency (e.g. Bleed 1986; Myers 1989; Torrence 1989) and mobility (e.g. Henry 1995:432-434;

Belfer-Cohen and Goring-Morris 2002; Marks 1983). While these studies promoted our understanding of this issue, many of their conclusions were criticized (e.g. Andrefski 1994; Lurie 1989; Bamforth 1991). One of the main problems is that the production and use of laminar items have advantages as well as disadvantages. One of the advantages is the potential to produce a greater amount of sharp edges out of a given mass of flint (e.g. Mackay 2008; Sheets and Muto 1972). Although this conclusion was recently criticized in a study by Eren *et al*. (2008), their different results were obtained due to the exclusion of side-products which in many cases are actually useful blanks. The other advantages include the ability to form long and relatively straight sharp edges (Whittiker 1994:33), and standardization of the products. The last aspect made the laminar items highly efficient as inserts within complex hafted tools (Bar-Yosef and Kuhn 1999) and it is assumed to have had an enormous impact on the maintenance and reliability of hunting tools from the Upper Paleolithic and later periods (e.g. Bleed 1986; Myers 1989; Torrence 1989). The disadvantages of laminar items include the need for a specific raw material of a good quality which is harder to obtain, a high risk of failure while knapping, and a greater need for preliminary shaping of the core which may cause a loss of raw material. Furthermore, laminar items are more fragile due to their elongated form (Bar-Yosef and Kuhn 1999) and have less potential to be resharpened (Eren *et al*. 2008).

Bar-Yosef and Kuhn (1999) emphasized the fact that laminar items have advantages and disadvantages, and thus no simple answer is at hand. They further argued that the fact that laminar items did not appear consistently along the periods, but rather in cycles, is in itself an indication that producing laminar items is only one possible solution, out of many, for solving specific problems. They consequently suggested that the most reasonable explanation for the production of laminar items is the creation of standardized inserts for complex hafted tools. This explanation however excludes the production of laminar items of the Lower Paleolithic and most industries of the Middle Paleolithic which lack evidence of complex hafting (i.e. several inserts in the same haft). They suggested that in these early cases the production of laminar items was probably related to mobility, raw material and function.

I, on the other hand, contend that we do not yet fully understand the logic behind the production of laminar items. Not only have we still not found a convincing solution in the case of the early laminar industries, but also in the case of the later laminar industries the situation is not clear. This is best exemplified by the fact that we find several industries that managed well with using flakes as inserts for complex hafting (e.g. Gopher *et al.* 2001; Goring-Morris *et al.* 1998). In other words, even the use of inserts does not necessarily require laminar items. An additional factor, thus far only briefly explored, is the possibility that laminar items not only played a functional role, but a social role as well (e.g. Goring-Morris & Belfer-Cohen 2001; Eren *et al*. 2008; Knutsson 2001) and it would not be surprising if this element had a significant impact on the technological choice of making laminar items.

The fact that most of the above studies based their conclusions on Upper-Paleolithic or later industries emphasizes how little we know about the earlier laminar industries and consequently the reasons that led to their flowering. The present research will hopefully aid in taking this riddle one step further to solution.

Research Goals

The first goal of the present study is to portray the laminar technology of the Amudian. This will be performed by examining the lithic assemblages from the three main sites where the Amudian facies was found: Qesem Cave, Tabun and Yabrud I. My method for reconstructing the reduction sequence entails analyzing the characteristics of the laminar items and of their production waste (CTEs and cores) by observing sets of attributes from which I can extract recurring patterns. The attribute analysis I use in this study is presented in detail in Chapter 3, and applied in Chapters 4-6 for each of the examined sites. The building of this new set of data will provide a wider perspective regarding the enquiry of the complexity of the late Lower Paleolithic. The importance of creating a wide data base is emphasized by several scholars, stating that a lack of data is one of the major obstacles in the debate on the intricacy of the Acheulo-Yabrudian complex (Goren-Inbar 1995:99; Copeland 2000).

The results of the technological reconstruction will be summarized in Chapter 8, following a short review, in Chapter 7, of the laminar technology from other sites of the Acheulo-Yabrudian complex. In Chapter 8 I will also endeavor to present the implications of my results for our understanding of the Acheulo-Yabrudian complex.

First I will discuss the question whether the Amudian laminar technology represents a sophisticated systematic lithic technology or an improvised version of manufacturing. This point is of importance since it potentially reflects the abilities of the hominids of the late Lower Paleolithic (e.g. Belfer-Cohen and Goren-Inbar 1994; Karlin and Julien 1994; Lahr and Foley 2001; Pelegrin 2005).

By studying the material from these three sites I also wish to establish whether the Amudian laminar technology in the various sites was similar or different and in what aspects. This is important since variability in the production potentially reflects a complex human behavior (e.g. Van Peer 1998; Wurz 2002). Since each of the examined sites includes several layers or beds with Amudian laminar production, the analysis will also be used to examine how the laminar production differs within the sites. The mot suitable candidate for examining such variability in Amudian laminar production at a single site is Qesem Cave. This is due to the long stratigraphic sequence of 7.5 m of Amudian layers, from which I extracted five samples from different localities. The two Pre-Aurignacian layers of Yabrud I can reflect variability as well.

Another goal is to characterize the laminar technology that appears in the Yabrudian and Acheulian facies of the Acheulo-Yabrudian complex and to compare it to that of the Amudian. In order to achieve this I will examine the laminar items and the related waste from the Yabrudian and Acheulian facies of Tabun XI and from Yabrud I Layers 11-12. The presence of similar or dissimilar technologies may provide another perspective for uncovering the relationship between the three facies of the Acheulo-Yabrudian complex. It may aid in understanding weather the three facies represent variability within a single entity (possibly related to function), as promoted mainly by Copeland (1983a, 2000), or various independent entities (cultures) as promoted mainly by Rust (1950). This inquiry, which is particularly familiar from the study of Middle Paleolithic industries and the attendant "cultural" versus "functional" debate, promoted mainly by Binford and Bordes (Binford and Binford 1966; Binford 1973; Bordes and Sonneville-Bordes 1970) is relevant here as well.

Finally, by integrating the various results of my study I will deliberate whether the Amudian laminar technology can be added to other features of the Acheulo-Yabrudian complex that hint at modern human behavior (see above Pp. 12-14). This will follow the literature on this subject (e.g. Deacon and Wurz 2001; d'Errico 2003; Henshilwood and Marean 2003; Mellars 2005; Wadley 2001) and will attempt to promote a statement on the appearance of modern human behavior at this early stage in human evolution.

Chapter 2

History of Research of the Amudian Facies and the Acheulo-Yabrudian Complex

While several papers have discussed the history of research of the Levantine Lower Paleolithic (e.g. Bar-Yosef 1994, 1995a; Hours *et al.* 1973; Perrot 1968; Goren Inbar 1995), only a few have addressed the history of research of the Acheulo-Yabrudian complex in detail (e.g. Copeland 2000; Jelinek 1990:81-83; Monigal 2002:102-106). Thus, my discussion will only regard the research of the Acheulo-Yabrudian complex and will especially concentrate on the Amudian facies.

Three Phases in the History of Research of the Acheulo-Yabrudian Complex

Upon reviewing the Acheulo-Yabrudian history of research three phases can be distinguished. The first consists of the preliminary observations regarding the complexity of the late Lower Paleolithic (years 1933-1950); the second is comprised of ensuing debates regarding the construct and chronology of the phase later termed 'Acheulo-Yabrudian complex' (years 1952-1962); and the third consists of a re-examination of the variability of the Acheulo-Yabrudian complex by means of controlled systematic excavations (years 1963- present).

Phase I: The Complexity of the Late Lower Paleolithic Revealed (1933-1950)

Although the prehistoric research of the Levant already began in the late 19th century, mostly via the investigation of surface collections, it is only between the two World Wars that the prehistoric research of the Levant crystallized into a scientific endeavor (Bar-Yosef 1994:222). The excavation of cave sites from which multi-cultural stratigraphic sequences could be obtained characterized this stage of research (Goren-Inbar 1995:96). The major excavations of this time were conducted by Turville-Petre (1927), Garrod and Bate (1937), Neuville (1951) and Rust (1950). The recovery of the 'Galilee Skull' from Zuttiyeh (Keith 1927; Turville-Petre 1927), which confirmed the presence early human remains, was argued to have been one of the main incentives for the proliferation of excavations at the time (Jelinek 1990).

Sites with layers belonging to the Acheulo-Yabrudian complex were excavated already in the late 19th century and early 20th century although not recognized as such. The first of these is 'Abri-Zumoffen' (Garrod and Kirkbride 1961; Zumoffen 1900), but the most famous is Zuttiyeh, excavated by Turville-Petre (1927).

Rust's (1933) preliminary report on Yabrud I marked the first step towards an appreciation of the variability of the late Lower Paleolithic in the Levant. In his report he briefly presented the 25 layers from Yabrud I and suggested that the Paleolithic period of the Levant differed from that of Europe. He argued that several different cultures appear along Layers 11-25 attributed to the Lower Paleolithic. In this early publication he divided these layers into three entities: Acheulian, Yabrudian (*Jabrudien*) and Pre-Aurignacian. Each of these entities was represented by more than one layer and they were placed indiscriminately along the sequence. Rust especially emphasized the presence of the Yabrudian which he defined by the lack of handaxes and by the abundance of side-scrapers; he also noted that the flakes of this industry are generally thick with a plain striking platform. The Pre-Aurignacian was found in Layers 13 and 15 and was also referred to as '*Prä-Antelien*'. Blades and 'Upper Paleolithic tool types', including burins, end-scrapers and retouched blades characterized the Pre-Aurignacian layers.

Garrod's early publications of her work in Wadi el Mughara further revealed the complexity of the late Lower Paleolithic period. Garrod (1934, 1935) recognized that while Tabun Layer E differed from the late Acheulian, it was still pre-Mousterian and thus preliminarily termed it 'Acheulio-Mousterian'. In these early publications of Garrod's one can find all aspects of the Acheulo-Yabrudian complex as we know them toady. She noted that the assemblages of Layer E are dominated by side-scrapers and handaxes, and that the former were made on thick flakes with plain butts that are clearly different from those of the Mousterian. Garrod also pointed out the presence of 'Upper Paleolithic tool types', including blades and retouched blades which were made by a different technology than the other items in Layer E. In her brief description she noted the variability within Layer E, which included parts with more blades and 'Upper Paleolithic tool' types', and parts with more handaxes. These features varied both within and between the sub-layers (Garrod 1934, 1935). Once convinced of the Lower Paleolithic origin of the above mentioned side-scrapers, Garrod proposed the name 'Upper Acheulian/Micoquian' for this entity (Garrod 1936; Garrod and Bate 1937) and later 'Final Acheulian' (Garrod 1938). It is of note that in

Garrod's early reports, no reference was made to Rust's (1933) preliminary publication of Yabrud I. Garrod (1970:224) later mentioned that she met Rust and saw the material from Yabrud I only after her final publication of Tabun was already in press.

Although the variability among the sub-layers of Tabun Layer E was well presented in Garrod's final report, the gradual change was only mentioned briefly and the spatial difference was almost completely neglected (Garrod and Bate 1937). The simplification of the data in the final report might be the reason that the picture presented in the early publications, which well exemplified the Acheulo-Yabrudian complex as it is known today, did not echo in the scientific community of the time.

In 1938, after learning about the Pre-Aurignacian of Yabrud I, Garrod noted the existence of a "well-defined zone, one metre in thickness, which yielded a relatively small but constant proportion of well-made Chatelperron points, end-scrapers and blades with delicate edge-retouch." within Tabun Layer E. She emphasized that "This observation (was) borne out by excavations in rock-shelters at Yabrud…" (Garrod 1938:14).

A better representation of the variability of the late Lower Paleolithic was offered by Rust's (1950) final report of Yabrud I, whose publication was delayed due to World War II. In this report Rust ascribed the 15 layers of the late Lower Paleolithic at the site to four cultures: Acheulian, Yabrudian, Acheulo-Yabrudian and Pre-Aurignacian. The latter three terms were coined by him and became an integral part of the terminology of the Levantine prehistory. Rust (1950:141-154), who had the opportunity to compare his material to that of Garrod's, argued that Yabrud I and Tabun represent the same cultures. The difference between the two being that in Yabrud I the assemblages were reported as distinct, while in Tabun they blend into one anther (Rust 1950). Rust argued that the absence of clear divisions in Tabun resulted from a lack of control over the stratigraphic sequence.

The significance of the presence of blades in these early contexts was well recognized. In one of Garrod's (1934:9) early reports she noted that the blades from Tabun Layer E were made by a different technology than the flakes and that they reflect a "…contact with a very early Aurignacian…". Later she suggested that it "…should be explained by contact between the Micoquian and a very early *blade-culture* (my emphasis), possibly ancestral to the Chatelperron stage of Europe, whose centre of dispersion theoretically lies somewhere in southern Central Asia." (Garrod 1937:18). It is interesting that Rust (1950:28) also defined Yabrud I, Layer 15 as a blade culture (*Klingenkultur*) and that the name he gave – the Pre-Aurignacian – is similar to the first suggestion for the blades' origin

(Aurignacian) suggested by Garrod (1934). The appearance of the Pre-Aurignacian in the eastern Mediterranean was argued by Rust (1950:129-130) to result from climatic changes. Although naming Levantine Paleolithic industries after western European entities was common in the early 20th century, the case of the Pre-Aurignacian is still exceptional. At the time that the term was proposed and the possibility raised that it represents people related to Upper Paleolithic cultures, the temporal gap between the Upper Paleolithic period of Europe and the Acheulo-Yabrudian complex was not properly evaluated and was considered to be much shorter (Jelinek 1990). Garrod (1934) for example, argued that the entire sequence of Tabun (Layers A-G) represents only 100,000 years. Erroneous statements asserting the blades to be identical to those of the Upper Paleolithic had an important role in underestimating the temporal distance. For example, I quote Garrod (1938:14): "If these implements are isolated from the hand-axes and thick racloirs with which they were associated in the deposits, they form a group which no typologist would hesitate to classify as Upper Palaeolithic."

In summarizing the state of research at the end of Phase I the variability in the late Lower Paleolithic was well observed but far from being clearly defined and understood. In general, both Garrod and Rust regarded the variability as representing different groups/cultures. However, while Rust argued for four different groups as represented by Yabrud I, Garrod argued for only two groups: one represented by most of the Tabun Layer E sequence and a second represented by the blades (Garrod and Bate 1937:18).

Phase II: Debating the Construct and Chronology of the Acheulo-Yabrudian Complex (1952-1962)

Although both Rust and Garrod laid the foundation for the study of the Acheulo-Yabrudian complex, it was Rust (1950) in his report of Yabrud I that took the understanding of the variability in the late Lower Paleolithic a crucial step forward. This is because his publication prompted discussion of two important issues: (1) the validity of the different independent entities he presented, and (2) the meaning of the presence of blades in this early stage of human evolution.

Waecther (1952) was the first to grapple with these questions, but it was Bordes' (1955) study of the finds of Yabrud I that stimulated a fertile discussion. Bordes analyzed the finds according to his typological method which enabled a more refined comparison between assemblages. In his study he found that the Pre-Aurignacian of Yabrud I Layer 15 showed a high resemblance only to the

Aurignacian Upper Paleolithic from Yabrud II Layers 6-7 and suggested accordingly that the Lower Paleolithic assignment to the former was wrong. He consequently argued that the Pre-Aurignacian should be placed in Würm II, a phase considered close in time to the earliest Upper Paleolithic industries of Europe. Although Bordes' suggestion was basically erroneous it triggered a set of articles by him and Garrod debating this issue (Bordes 1958, 1960, 1961a, 1977; Garrod 1956, 1958, 1961, 1962). Bordes (1961a) criticized the validity of the different entities described by Rust and did not accept the existence of the early blade industry of the Pre-Aurignacian at such an early stage. One of his main arguments was a lack of stratigraphic control in Rust's (1950) and Garrod's excavations (Garrod and Bate 1937). Garrod responded by trying to emphasize the impossibility of Bordes' suggestion: "Bordes…, unable to accept that a typical blade industry should appear earlier in the Middle East than in Europe, suggests that the Pre-Aurignacian is contemporary with the Chatelperronian and that the last stage of the Yabrudian and the whole of the Levalloiso-Mousterian correspond in time with the French Aurignacian Perigordian complex." (Garrod 1962:236). It is of note that incorrect statements repeatedly made by Garrod (1962:234) that the Amudian "…blades and blades tools (are) practically indistinguishable from those of the Upper Palaeolithic…" did not help in convincing the academic community of the validity of these early industries.

This debate stimulated Garrod (1956) to offer new sets of data on Tabun Layer E, presenting a refined stratigraphy and a more detailed understanding of the sequence and its lithic industries. She stated the presence of three levels with Pre-Aurignacian material and placed her results in better correlation to Rust's in order to confirm its antiquity. She also adopted his terminology, referring to Tabun Layer E as Acheulo-Jabrudian, i.e. containing both handaxes and side-scrapers and presented a test case which demonstrated how the percentages of handaxes, side-scrapers and Pre-Aurignacian elements fluctuate along Tabun sub-layers Ea-Ed.

Despite their disagreements, Garrod, Bordes and Rust shared the view that the Pre-Aurignacian represents a foreign culture that immigrated to this region. This is in contrast to the Yabrudian and Acheulo-Yabrudian (Acheulian facies in my terminology) which were assumed to be local culture/s, representing a clear continuation from the Acheulian culture (e.g. Garrod 1962:234). It is of note that migration was commonly used to explain cultural differences in the mid 20th century (Trigger 1989). Another interesting suggestion in this direction was made by Rust (1958) and Howell (1959:37) who argued that the Pre-Aurignacian ought to be attributed to *Homo sapiens*, while the other facies to Neanderthals.

The expedition to the Adlun sites, and particularly Abri Zumoffen, which were conducted at this time (Garrod and Kirkbride 1961), were employed by Garrod (1961) as another response to Bordes' skepticism of the antiquity of the Pre-Aurignacian. These excavations were performed according to more accurate methods than those employed at Tabun and Yabrud I and thus undermined Bordes' arguments for a lack of straitigraphic control when a similar sequence was found. Even more conclusive evidence however was offered by the recovery of Pre-Aurignacian layers deposited on a fossil beach located 12-13 m above the current sea level, indicating its antiquity. Moreover, the presence of an undisturbed blade industry spread throughout seven layers was used to support Rust's argument that the Pre-Aurignacian was an 'independent industry' (Garrod 1961). The variability of the assemblages of this phase was demonstrated by the presence of three Yabrudian layers with a blade component in them, varying from 15.8% to 50.2%. It was also demonstrated that handaxes can appear within Yabrudian assemblages. The layers including both Yabrudian and Pre-Aurignacian elements were suggested by Garrod (1961:72) to represent a "Jabrudian-Pre-Aurignacian symbiosis". In another paper Garrod and Kirkbride (1961:42) suggested that "a possible explanation may (be) that the two peoples continued to live side by side for some time, perhaps as the result of inter-marriage".

It was also suggested that the 'Pre-Aurignacian' layers were fairly contemporaneous at the known sites and that the main difference in this aspect was attributed to the duration of the 'Acheulo-Yabrudian' layers (i.e. Yabrudian and Acheulian facies) which overlie and underlie them in each of the sites (Garrod 1962:248; Garrod and Kirkbride 1961:44).

Following the Adlun project, a new name, the 'Amudian', was proposed by Garrod and Kirkbride (1961) for the laminar industry of the Acheulo-Yabrudian complex instead of the 'Pre-Aurignacian'. The origin of the name followed the false assumption (Chapter 7, Pp 301-302) that the blade industry of that complex was first discovered, although not recognized as such, in the cave of Zuttiyeh at Wadi Amud in the Galilee (Turville-Petre 1927). The idea was to use a name that is not associated with European Upper Paleolithic nomenclature, since they are not related in time or space (Garrod 1970). Garrod and Kirkbride (1961:11) further noted that even if we do look for a similarity to the European industries the Aurignacian is not a good example.

Garrod was inconsistent however, in her terminology and although she and Kirkbride noted that the Amudian is equivalent to Rust's Pre-Aurignacian, she used both terms in her later studies (Garrod 1962, 1970). As a result of this ambiguity both terms are still in use even today. In some cases they are synonymous and in others they represent different characteristics (see above, Pp: 6).

In summarizing the state of research at the end of Phase II one may say that the complexity of the late Lower Paleolithic was acknowledged, including the chrono-stratigraphical position of the Amudian within it. Nevertheless, it is of note that Bordes' (1955) suggestion of a Middle Paleolithic assignment was accepted by some researches (e.g. Perrot 1968). A name for the Acheulo-Yabrudian complex however was still not accepted; a situation that caused some terminological ambiguity and confusion. Howell (1959:16), for example, referred to Layers 11-25 of Yabrud I as 'Yabrudian facies' and to the equivalent material from Tabun Layer E as 'Final Acheulian of Yabrudian facies'. For the Amudian he suggested the term 'Upper Paleolithic Stage Ø' (Howell 1959: 25). Nonetheless, Garrod's (1962:247-8) suggestion of terming it as a 'Yabrudian complex' was well echoed in the Levantine prehistoric terminology of the 1970's onwards. The additional data presented by Garrod (1956) concerning Tabun Layer E and the excavations at Adlun confirmed that the variability in the Acheulo-Yabrudian complex was not only between the Acheulian, Yabrudian and Amudian facies but also in the exact character of each. For example, the lower layers from Abri-Zumoffen were argued to represent a "coastal facies of the Amudian" (Garrod 1962:241) which was termed the 'Beach Industry' (Garrod and Kirkbride 1961:37).

Phase III: Re-examining the Variability of the Acheulo-Yabrudian Complex (1963-present)

In the 1960's many of the major prehistoric sites excavated in the early 20th century were re-excavated equipped with new and improved field methods, in an attempt to retrieve refined data (e.g. Schroeder 1969; Tixier 1974; Vandermeerch 1966). Tabun (Jelinek *et al*. 1973), Yabrud I (Solecki 1970) and Zuttiyeh (Gisis and Bar-Yosef 1974) were included in these renewed excavations.

The excavations at Yabrud I were renewed in 1963-1965 by Solecki and Solecki (1966). However, since they published only preliminarily reports they had limited impact on our understanding of the Acheulo-Yabrudian complex. Re-examination of the old sections from Rust's excavations demonstrated that the stratigraphical sequence of the Acheulo-Yabrudian complex at the site was more complicated than originally presented (de Heinzelin 1966:166, Fig. 4). The renewed excavations at Zuttiyeh (Gisis and Bar-Yosef 1974) were limited yet confirmed the presence of the Acheulian facies and Yabrudian facies at this site.

The renewed excavations at Tabun by Jelinek (Jelinek *et al*. 1973), on the other hand, had a key role in re-examining the variability of the Acheulo-Yabrudian complex. The greater impact of these excavations came to light in the early 1980's when a number of detailed reports were published (their contributions are summarized in Chapter 5).

A new site of the Acheulo-Yabrudian complex was discovered in 1969 – the site of Masloukh north of Beirut, Lebanon. This site was excavated by Skinner (1970) and was found to include both Yabrudian and Amudian layers (Shmookler 1983). Skinner documented a gradual increase in the presence of blades throughout the excavated layers and noted that they were not equally distributed within the upper layer. He argued however, that only Yabrudian is present and that the variability in blade frequency (vertical and horizontal) indicates that they are mostly intrusive, originating from the cave’s chimney. Despite this contention, no site was found above Masloukh (Shmookler 1983:22). Although Skinner (1970) did not address the Amudian, he did discuss the nature of the Yabrudian trying to better characterize its lithic assemblages. The Amudian facies from the site was later presented by Shmookler (1983) who had reanalyzed the excavation and its finds.

The concept of a single complex comprising the Acheulian (Acheulo-Yabrudian), Yabrudian and Amudian/Pre-Aurignacian, as already suggested by Garrod in 1962, finally crystallized in the 1970’s. Following her suggestion, most scholars in the 1970's referred to the Acheulo-Yabrudian complex as 'Yabrudian' (e.g. Copeland 1975; Ronen 1975). According to Ronen (1979:301) the 'Yabrudian' forms one of the 'groups' that constitute the Upper Acheulian. However, most studies of the 1970’s assigned it to the Middle Paleolithic period (e.g. Bordes 1977; Copeland 1975, 1978; Farrand 1965, 1979). Jelinek (1982b:68) argued that it can “…be considered as the earliest known manifestation of the Middle Paleolithic in the southern Levant. This suggestion is based on the composition of the Yabrudian Facies which, typologically, is strikingly similar to the Quina Mousterian of the Middle Paleolithic of Western Europe”.

While the presence of the complex itself was well established, the definition and meaning of the different facies was a subject of considerable controversy.

Skinner's (1965:175-176) study of the material from Tabun Layer E and Yabrud I-15 led him to suggest that the Pre-Aurignacian/Amudian is the manifestation of specialized activity rather than an independent industry. Soon after, this possibility was also stated by Hours *et al.* (1973).

Jelinek, following stratigraphic observations from the new excavations at Tabun promoted a similar opinion that the Amudian is "simply a specialized aspect of the Yabrudian" (Jelinek *et al*. 1973:174). According to this line of thought, he referred to the Yabrudian as a culture and to the Amudian as an industry. He suggested that the observed variability is not a matter of cultural affiliation but an adaptive respond to a changing environment and that the fluctuations between the facies in Tabun are correlated with climatic changes as indicated by the assumed retreat of the sea level (Jelinek 1981). In his proposed sequence, the Yabrudian facies was associated with warmer climate, the Acheulian facies with a cooler climate and the Amudian facies with the coolest climate. Soon after, Jelinek suggested the term 'Mugharan Tradition' for integrating all the facies into one entity, following the idea that the elements of the three facies actually blend into each other (Jelinek 1981; this is described in greater detail in Chapter 5). In a later paper Jelinek (1990:84) explained that the name 'Mugharan Tradition' was proposed instead of 'Acheulo-Yabrudian' since it actually includes an "Acheulo-Jabrudian-Amudian" blend. The term 'Mugharan Tradition' was offered since at that time there was a conviction that the sites of this complex are only located in caves (Gilead 1970a:334; Jelinek 1981:271; Ronen 1975). However, while proposing this term Jelinek mentioned the possibility of an open air site from the Azraq basin in Jordan which might be related to this complex (Zeuner *et al.* 1957:23-25). It is not surprising therefore that the clear identification of open air sites in El-Kowm (Copeland and Hours 1983; Le Tensorer *et al.* 2007) did not lead Jelinek (1990) to withdraw the term he suggested.

Another explanation for the variability within the Acheulo-Yabrudian complex was suggested by Copeland following her study of the material from Adlun. Copeland (1975:321-322) argued that the different facies of the Acheulo-Yabrudian complex of Bezez Cave do not vary vertically between levels but laterally, thus indicating that the cause for differentiation is more likely to lie in activity zones than in "alternating tribes". It was stated by her as follows: "The variation of facies is seen in the proportion of certain tool types vis-a-vis others (e.g. the biface/side-scraper ratio), while the techniques of debitage, style of retouch, flake morphology, etc., are similar throughout. On statistical bases, these three variants resemble facies which occur *vertically* at Yabrud I, and which have been interpreted as different industries…This author… (suggests) that these variations in Bezez reflect activities zones…" (Copeland 1975:319-321). She furthermore wrote that "(Bezez) Level C contains three variants of an Acheulo-Yabrudian industry…These variants are distributed *laterally* in the deposits running from front to back of the cave." (Copeland 1975:319). As for the Amudian in particular, Copeland contended that its elements increased throughout the sub layers of Abri-Zumoffen and Bezez Cave and that it did not contain any implements unknown from the other two facies of the Acheulo-Yabrudian complex (Copeland 1975:322).

In the final report on the lithics from Adlun it was suggested that the Amudian facies of Abri-Zumoffen and the Acheulian facies of the nearby cave of Bezez represent in fact a single site, in which Bezez constituted the main habitation and Abri-Zumoffen served as an activity zone (Copeland 1983a:243; Kirkbride *et al.* 1983). The fact that the Amudian in Abri-Zumoffen did not appear as one block but as sediment episodes separated by several sterile intervals led Copeland to further suggest that the Amudian in this site represents seasonal activity. Copeland also observed that while in the Yabrudian layers at the site all of the lithic elements of the Acheulo-Yabrudian complex (side-scrapers, bifacials and blades) are present, in the Amudian some were lacking, mainly the 'Yabrudian side-scrapers' and bifacials. She accordingly argued that the Yabrudian is "…the parent industry, and the Amudian…a specialized variant of it, a concentration of small tools made to enable some particular activities to be carried out." (Copeland 1983a:244).

Solecki and Solecki's (1986) study on the section of Yabrud I supported Copeland's argument. It demonstrated that Rust's (1950) Layers 12-18 of Yabrud I are partly overlapping and differ in horizontal location. The main horizontal overlap was in the case of Layer 12 (Acheulian facies) and Layer 13 (Pre-Aurignacian facies), and in the case of Layer 16 (Yabrudian facies) and Layer 17 (Acheulian facies).

It is of note that both Copeland (1983a) and Jelinek (1982a:1373) argued that the variability resulted from different activities. The blades of the Amudian were suggested by both to represent cutting and slicing activities (Copeland 1975:322, 2000:104; Jelinek 1990:88). The difference between these two researches is that while Jelinek emphasized an adaptive correlation with climatic changes (especially in the case of the Amudian), Copeland promoted the idea of spatial arrangement and activity zones. Both Jelinek's and Copeland's suggestions which emerged in the 1970's accorded well with the scientific approach of the time as represented by the 'New Archaeology' (Trigger 1989). Although Jelinek's suggestion was slightly modified later by Wiseman (1990:313), who argued that the blades of the Amudian correlate with "aridity rather then cold per se", Bar-Yosef criticized this explanation arguing that it does not correspond to the oldest dates obtained in the 1990's. He further added that "despite several efforts, correlations between changes of environmental conditions and the emergence of different kinds of stone tool assemblages have never been demonstrated to be real." (Bar-Yosef 1994:254).

In the following years additional sites of the Acheulo-Yabrudian complex were found and published including El Kowm (Copeland and Hours 1983; Le Tensorer *et al.* 2007), Jamal Cave (Weinstein-Evron *et al.* 1999), Misliya (Weinstein-Evron *et al.* 2003), Hayonim Cave (Bar-Yosef *et al.* 2005:24) and Qesem Cave (Gopher *et al.* 2005). Of these sites, El Kowm and Qesem Cave have had the greatest impact. The sites of El-Kowm clearly demonstrated that the Acheulo-Yabrudian complex can be found in open air sites. Qesem Cave demonstrated that the Amudian facies does not necessarily constitute a late part of the Acheulo-Yabrudian complex nor a minor part of it, but is rather an integral part appearing all along the sequence from its very beginning. This eliminates past assumptions that the Amudian/Pre-Aurignacian of Yabrud and Tabun represent a single cultural horizon, which can be correlated and dated using the shoreline of Adlun (Farrand 1965, 1970). Additional contributions of the Qesem Cave Project such as those concerning the habitual use of fire, and the use of stone tools are presented in Chapter 4.

The new radiometric dating retrieved from the 1990's onwards which preceded 220 kyr (Barkai *et al.* 2003; Mercier and Valladas 2003), confirmed the original assignment of the Acheulo-Yabrudian complex to the Lower Paleolithic period (e.g. Bar-Yosef 1995a,b; Goren-Inbar 1995:96) and today only few still regard it as part of the Middle Paleolithic (Le Tensorer *et al.* 2007).

Previous Studies of the Amudian Laminar Technology

Although the blades and their presence in the Acheulo-Yabrudian complex were much discussed, very little systematic study of their character and technology was conducted. An important step in this direction was made by Skinner (1965:175) who clearly stated that the blades of the Amudian do not resemble those of the Levantine Upper Paleolithic as Garrod (1938, 1962) argued. This was later demonstrated in more detail by Copeland (1983a:224). Until recently the blade reduction sequence itself was generally considered to be unsophisticated. According to Copeland (1983a:228) "The number of unsuccessful and atypical blades present could mean that the Amudian blade-makers had not yet perfected or stabilized their technique…". Additional studies on the Amudian laminar technology conducted from the early 1990's, emphasizing various aspects (Meginen 1994, Monigal 2001, 2002; Vishnyatsky 2000; Wiseman 1990, 1993) did not change this perspective. Nevertheless, Vishnyatsky (1994), who found their appearance highly unique, offered that the blades in the Amudian present a window as to the high capabilities of the early hominids and he described this phenomenon as "running ahead of time". A recent work on the finds from Qesem Cave (Barkai *et al.* 2005) regarding the nature of the blade reduction, suggested that although it was indeed a simple production, the simplicity should be considered as a technological advantage.

Concluding Remarks

Despite 80 years of research, the debate on the definition of the Acheulo-Yabrudian complex and its facies has not subsided. One example is the lack of consensus regarding the name of this phase. While most scholars refer to it as Acheulo-Yabrudian (e.g. Bar-Yosef 1995a:252; Barkai *et al*. 2005), few continue to use the term Yabrudian (e.g. Gisis and Ronen 2006; Ronen and Tsastkin 1995). The relations between the three facies (or four facies if one follows Rust; 1950) of the Acheulo-Yabrudian complex are still unclear as well. This is due to the fact that the variability is not only between the facies but also within each of the facies. One of the major differences is between Yabrud I, where the three facies are reported to be clearly separated, and Tabun and Adlun, where the facies blend into each other. Whether this reflects a difference in the perspective of scholars – between 'lumpers' and 'splitters' as Copeland (2000:102) and Kirbride *et al.* (1983:422) argued or a real archaeological variability is hard to estimate since many of the past publications are not detailed enough. It is this lack of fine data regarding the patterns of similarities or differences among the three facies that prevents us from taking this study forward and refining our explanations. I hope that the following study, focusing on the laminar production, will contribute in this endeavor as well as provide new insight regarding aspects still unexplored of the Acheulo-Yabrudian complex.

Chapter 3

Methodology

Initial Remarks

In this study I employ Jelinek's (1990) terminology regarding the Acheulo-Yabrudian complex ('Mugharan tradition') which is composed of three facies referred to as Acheulian, Yabrudian and Amudian. It is of note that this division correlates with Rust's (1933) preliminary suggestion of dividing the layers of Yabrud I. In order to avoid the confusion of the 'Acheulian facies' with the 'Acheulian culture' which predates the Acheulo-Yabrudian complex I use the term 'Lower Paleolithic Acheulian' in referring to the latter.

The technological analysis will explore the laminar production from the three main sites where the Amudian facies was found: Qesem Cave, Tabun (Unit XI) and Yabrud I (Layers 13, 15). The laminar production from other facies of the Acheulo-Yabrudian complex found at Tabun Unit XI and Yabrud I will be examined as well. The Yabrudian facies from Qesem Cave will not be examined since it has only been recently discovered.

Although reconstructing the *chaîn opératoire* (e.g. Lemonnier 1986; Pelegrin *et al*. 1988; Sellet 1993) can be performed by various approaches, my method entails disassembling the characteristics of the laminar items and the waste of their production (CTEs and cores) into sets of attributes from which I can extract recurring patterns. The employment of an attribute analysis for a technological reconstruction was conducted on several Paleolithic industries (e.g. Soriano *et al.* 2007) including the Levant (e.g. Ferring 1980; Sarel 2002), yet with only a modest examination of the Amudian (Monigal 2002; Wiseman 1993).

The key site of my study is Qesem Cave from which I will examine several assemblages in full and not only the laminar component. As for the other sites, I will examine *all* the laminar items and related waste (i.e. CTEs and cores). The technological analysis of these sites reviews many aspects which comprise a large bulk of data. The examination of each site will follow the same pattern – a scheme that will enable a comparison between the assemblages. The method and definitions used for this technological analysis are presented below[1].

[1]The statistical analysis presented in this study was carried out using SPSS and Statview. Certain figures with three or more variables are provided in color for clarity.

Laminar Items

The term ‘laminar item’ is used in this study since the Amudian assemblages are not merely characterized by an abundance of "central/common" blades, but by three types of laminar items, including blades, PE blades and NBKs (Fig. 2), all appearing in high frequencies. These items, which are at the center of this study, will be referred to as the 'three laminar types'. Other laminar types, which generally appear in smaller frequencies, include PE bladelets, bladelets, burin spalls, crested blades, overpass items and 'double bulb' items (the two latter appear in flake form as well). The laminar items of the various types are characterized by a length/width ratio that exceeds 2/1. Although some researches suggest that the definition of laminar items should be restricted to items bearing clear previous blade scars (e.g. Parry 1994:87; Ulrix-Closset 1975:21), in this study I do not use such a limited definition since we are dealing with an early and what may have been the first systematic laminar production entailing a unique character. It is of note that also Bordes and Crabtree (1969) felt that in examining early blade industries we should not use the more restricted definitions. Nevertheless, the number of laminar items that do not bear previous laminar scars are recorded and presented in the text and can be omitted if one wishes. The laminar types include not only whole and proximal items, but medial and distal fragments as well. One should take into consideration that this causes a bias in favor of the laminar component within the assemblage since in the case of the flakes and PE flakes only whole items and proximal fragments were included. Nevertheless, for the purpose of my study, the inclusion of fragments has an advantage since it increases the number of specimens for the attribute analysis which in some cases can be observed on broken pieces as well (e.g. butt type or distal end shape).

Order of Categories

In general, techno-typological analyses are conducted using a method which places each item in only one category although its character might be more complex and suited to several categories. The logic in placing the items in specific categories is in following with ground rules that are accepted by most of the research community (e.g. Bordes 1961b [referring to the general scheme and not to the validity of specific types]; Debénath and Dibble 1994; Inizan *et al*. 1992). In this study, which aimed at investigating the laminar technology, it was essential to examine the entire population of the produced laminar items regardless of their being recorded among the debitage or shaped items. The same is true for the examination of CTEs.

One of the major problems with regard to the assemblages of the Acheulo-Yabrudian complex is the assignment of NBKs. Although in technological terms they are first of all a type of blank, they are also a 'technologically defined tool' (Bordes 1961b; Debénath and Dibble 1994:53-54). Despite of the fact that use-wear analysis from Qesem Cave confirmed the assumption that many of the NBKs were used as tools without secondary modification (Lemorini *et al*. 2006), the NBKs as a whole include both used and unused items. Copeland (1983a:233) had a similar problem in her study of the material from Abri Zumoffen and assigned such items to 'tools' only when visible use signs appeared on the sharp edge. In order to overcome this problem, in the lithic study of Qesem Cave we used the term 'shaped items' for the various types that have a secondary modification. The term 'tool' refers only to items that show signs of use-wear (Lemorini *et al*. 2006). NBKs that lack secondary modification were recorded within the debitage. Referring to them as a blank and not as a "tool" type caused some problems in calculating the entire category of NBKs. This is due to the fact that the same items with secondary modification are assigned to the shaped items and because some items that could have been defined as NBKs but either have a bold overpassing end termination (overpass items) or a flaked ridge (crested blades) were recorded among the CTEs. It is of note that while in the case of Qesem Cave I documented their presence among the CTEs, at the other sites the documentation was not as thorough.

General Stages of the Technological Analysis

1: The General Character of the Assemblages

The first stage evaluates the techno-typological character of the assemblage. Since I did not study all the assemblages in full, the assignment of the assemblages to one of the three facies of the Acheulo-Yabrudian complex is in following with Jelinek (1990) in the case of Tabun and Rust (1950) and Vishnyatsky (2000) in the case of Yabrud I. The studied samples from Qesem Cave are all attributed to the Amudian (e.g. Barkai *et al.* 2005; Gopher *et al*. 2005). In the case of Qesem Cave, which is the key site in this study, I will present the assemblages in their entirety as an example of the Amudian industry's general character. Although I reviewed all of the items from the relevant assemblages at Tabun and Yabrud I, the presentation of the general character of these assemblages will be according to the literature (e.g. Bordes 1955, 1984; Garrod and Bate 1937; Jelinek 1975, 1981, 1982a, 1982b; 1990; Jelinek *et al*. 1973; Rust 1950; Vishnyatsky 2000).

Identifying the selected raw material used for the production of laminar items can be performed in this stage of the analysis. The importance of this aspect is not the quality of flint, which is high in all the studied samples, but rather the shape and size of the used raw material since these affected the reduction sequence (Dibble 1989; Dibble and Rolland 1992). The types of the used raw material (Pp. 56) are indicated in cases where raw material was left unworked at the site and in cases where the cores still bear some of the original nodule's contour. Handaxes found in some of the studied samples can aid in reconstructing the available raw material types as well since they were shaped on relatively large pieces of flint.

The relative amount of laminar items in the assemblage is of importance since it may indicate the intensity of the laminar production. In the case of Qesem Cave the percentage of the laminar items out of the total of debitage and shaped items was calculated. This percentage includes blades, PE blades, NBKs (laminar), bladelets, PE bladelets, burin spalls, crested blades, overpass items and double bulb items (in the latter two only items with a length/width ratio higher than 2/1), referring both to the items found in the debitage and items that were secondarily modified and recorded as shaped items. It is of note that this calculation is different from the laminar index (Ilam) suggested by Bordes, which calculates the number of complete laminar items divided by the number of complete laminar items and flakes (Debénath and Dibble 1994:176).

In the case of Tabun and Yabrud I, which I did not examine in full, only the published Ilam and other observations regarding the laminar items will be used.

The percentage of laminar items within the shaped items is of importance as well. Again, in the case of Qesem Cave the data will be fully presented, while for Tabun and Yabrud I, only general estimations following publications of the sites will be presented. An examination will also be conducted of which shaped item types were made on the various laminar types in order to identify whether different shaped laminar types required blanks with different characteristics. A detailed study of the Amudian typology is clearly needed, however it is not within the scope of this study, thus typological observations will be minimal.

Another important question is whether the studied assemblages indeed represent at least most of the stages of the reduction sequence, including production, use and discard. The importance lies in that a successful technological analysis requires that all these aspects will be present to an extent that enables comparison. A paucity of cores, for example, might indicate that the production mainly occurred outside the excavated area. If such a case arises it is then necessary to examine how it affects the analysis results.

The recovery methods of the archeological assemblages also affected the studied samples. In the case of Qesem Cave the material was sieved and all the finds stored at Tel-Aviv University. The assemblage of Tabun is currently stored at the University of Arizona and at the Israel Antiquities Authority. The lithic items under 2.5 cm were excluded from the assemblage and stored separately. As a result I did not examine these small items. It is possible that it contained several fragments of laminar items and CTEs that I would have chosen to include in my analysis. The Yabrud I material is currently stored at the University of Köln. The assemblages of Yabrud I were not systematically collected and the possible effect will be mentioned in the relevant chapter.

2. Attribute Analysis of the Three Laminar Types

Analyzing the blades, PE blades and NBKs is the key to characterizing the laminar production, not only because they are the end-products but also because they appear in large numbers. The primary assumption is that their specific attributes can help reconstruct the reduction sequence and its character. The analysis includes a set of attribute observations described and defined below. In the first step of the attribute analysis I will examine each of the three laminar types including both blanks and shaped items in order to evaluate *all* end-products of the laminar production disregarding selection. Following that, a comparison between the laminar blanks and the laminar shaped items will be performed in order to identify attributes which were significant in blank selection for secondary modification and to better reconstruct the technology used to produce the desired laminar types. The fact that specific blanks, mainly NBKs, were used for different activities without secondary modification (e.g. Lemorini *et al.* 2006) makes this aspect difficult to examine. Nevertheless, the attribute analysis may be of help in understanding what made the NBKs suitable for use without additional modification.

Following the presentation of this attribute analysis I will summarize and discuss its results. This will be conducted in four sections: (1) a brief description of the three laminar types, (2) preliminary observations regarding the laminar technology, (3) the desired characteristics of laminar items as reflected in the comparison between blanks and shaped items, and (4) NBKs as 'technologically defined tools' and their suitability as hand-held knives. In the case of Qesem Cave the differences among the samples will be discussed as well.

3. Analyzing the Core Trimming Elements (CTEs)

CTEs will be studied in detail since they have the potential to reveal stages of the reduction sequence which are mostly invisible to us. The CTEs were first divided into types and sub-types. The goal is not only to evaluate different shaping procedures, but to also identify what shaping and maintenance procedures were most commonly used in the different stages of the reduction. For this purpose the overpass items and the crested blades were further separated into categories that represent the initial knapping of the core and those that represent the general course of reduction. Overpass items and crested blades will also be analyzed according to a set of attributes (definitions are presented below) in an attempt to better reconstruct the reduction sequence.

4. Analyzing the Laminar Core Class

Although different methods have been suggested for dividing cores into types (e.g. Brézillon 1968; Conard *et al*. 2004), I chose to divide the cores according to end-products into three classes: flake cores, laminar cores and tested raw material (Fig. 17). This separation enables comparing the results from the analysis of the three laminar types to the relevant specific cores. Although some of the flake cores might have been previously used for laminar production, they were excluded if no visible evidence of this was available. The laminar core class was further divided into three groups; (1) cores with a domination of laminar scars that are referred to as 'laminar cores', (2) cores with a mixture of laminar and flake scars which are referred to as 'laminar and flake cores', and (3) bladelet cores. Each of these groups includes several types which specify the number of striking platforms. The various types within the laminar core class will be carefully examined using an attribute analysis in order to reconstruct the core reduction (definitions of core types and attributes are presented below).

5: Experimental Knapping

In order to widen the scope of the technological analysis experimental knapping was performed. The contribution of experimental knapping to reconstructing different aspects of the reduction was demonstrated in several studies (e.g. Madsen and Goren-Inbar 2004; Pelegrin 2006; Wilke and Quintero 1994). The experimental study is in following with the analysis of Qesem Cave, of which I have the best background and relatively easy access to the local types of raw material and hammerstones used at the site. In the case of Tabun, the raw material sources used in the Amudian beds are still unknown, and in the case of Yabrud I, I have no access to potential sources. Nevertheless, I assume that the results of the experimental knapping based on the Qesem Cave material will be of significance to the study of the Amudian as a whole.

6. The Laminar Technology: Conclusion and Discussion

This stage will summarize and integrate the previous stages of the technological analysis; the general character of the assemblages, the analysis of the three laminar types, the CTEs, the cores, and the experimental knapping (the latter only in the case of Qesem Cave).

The description of the above six stages refers to the study of each site separately. Following the analysis of the laminar technology from the three sites a comparison between the sites will be conducted. In this comparison I will also use the calculation of various ratios by addressing cores, CTEs and laminar items – a method frequently used for reconstructing and comparing reduction sequences (e.g. Bar-Yosef 1991; Goring Morris 1987:372-386).

General Definitions

Natural Surfaces

A distinctive characteristic of the Amudian assemblages is the frequent presence of cortex on blanks and shaped items (e.g. Barkai *et al.* 2005; Monigal 2002:241). Since my goal is to reconstruct the reduction sequence/s, I consider as a natural surface not only calcareous surfaces but also old patinated surfaces that appear on the dorsal face and predate the knapping of the item (some refer to it as 'double patina'). This is because both types of surfaces can teach us about the placement of the items along the reduction sequence. Since the presence of items with patinated surfaces might also signify recycling old knapped items, their numbers are noted. In order to avoid redundancy in the description, the term cortex will include both calcareous cortical surfaces and old patinated ones (unless stated otherwise). In the drawings old patinated surfaces are marked by a gray raster (Fig. 3).

Primary Element Blades (PE blades)

PE blades are one of the three laminar types and they are characterized by at least 30% cortex on the dorsal face (Fig. 2). Many of the PE blades are similar to NBKs in that they have one lateral edge covered with cortex and another edge that is sharp and can be used for cutting. Such items were recorded as PE blades as long as the angle of their cortical edge did not exceed 55º; a more obtuse angle of the cortical edge is considered a back in accordance with the terminology used in the Qesem Cave study based on the first sample examined (sample G/19-20; Barkai *et al*. 2005).

Naturally Backed Knives (NBKs)

NBKs are one of the three laminar types. In my study the few NBKs with flake dimensions that are also found in Amudian assemblages, are treated separately and referred to as 'NBK-flakes'. Such a separation was not conducted in many previous studies and NBKs with either laminar or flake proportions were usually grouped together. The basic definition of NBK, by Bordes (1961b:33) states as follows: *“Les couteaux à dos naturel sont des éclats ou lames présentant un tranchant d’un côté et de l’anture une surface de cortex jouant le role du dos…Ce cortex doit être perpendiculaire ou relativement peu oblique sur le plan d’aplatissement”*. The term ‘basic definition’ is used because there are a few additional aspects involved, such as the possibility of including other (non-cortical) naturally backed items or the appearance of use marks on the sharp edge (*e.g*. Bordes 1961b:33). Debénath and Dibble (1994:53-54) emphasized the problematic nature of some of these aspects, focusing on the question of when these items should be added to the 'tool' category (mainly referring to the presence of additional traces of utilization). In this study the ‘basic definition’ was chosen because the NBK is considered first of all as a laminar type/blank for the purpose of the technological analysis. Although Debénath and Dibble (1994:54) suggested that the angle of the cortical edge should be 75º-105º, I recorded items with an angle of 60º or more as NBKs (as long as they have a sharp edge as well) in accordance with the results of the first assemblage studied from Qesem Cave (Barkai *et al*. 2005). The validity of this choice for other Amudian assemblages will be examined.

Blades

Blades are also one of the three laminar types and they can bear cortex up to 20% on their dorsal face. In terms of size they are at least 12 mm wide.

Primary Element Bladelets (PE bladelets)

PE bladelets are laminar items with a dorsal face covered by at least 30% cortex or patina and less than 12 mm wide. No length criteria were used since they rarely exceed 3-4 cm. While among the larger laminar items there was a division of items with a cortical edge and an opposed sharp edge into different types according to the angle of the cortical edge (i.e. PE blade vs. NBKs), I made no such separation among the PE bladelets due to their small numbers.

Bladelets

Bladelets are laminar items with up to 20% cortex on their dorsal face and less than 12 mm wide.

Blade-Flakes

‘Blade-flakes’ are elongated items with a length/width ratio slightly smaller or equal to 2/1 with scars of previous laminar reduction on their dorsal face. According to Debénath and Dibble (1994:12) they should have a length/width ratio of 1.5-2.0. Although these items are flakes in principle, their presence is significant for the technological analysis of the laminar production (e.g. Vishnyatsky 2000:145). These items were referred to as 'pseudo blades' in the publication of sample G/19-20 from Qesem Cave (Barkai *et al*. 2005:42).

Definitions for the Attribute Analysis of the Three Laminar Types

Sample size might vary for each attribute examined due to the fact that some items are broken or covered by cemented sediments. The number of specimens examined in each specific case is stated in the graphs or text.

State of Preservation

The state of preservation includes the following cases: whole, proximal, medial and distal. Whole items include fully intact or only slightly damaged pieces. In the case of fragmented items (proximal, medial, distal) no size limitations were made (minimum or maximum). It is a prerequisite though that the broken fragments have fairly parallel lateral edges and remnants of laminar scars on their dorsal face.

Amount of Cortex

The analysis of this attribute will only include whole items. The presence of cortex on the dorsal face (including the lateral edges) was recorded in cohorts of 10% (i.e. 10%, 20%, 30% etc.), except for the case of blades in which a cohort of 5% was also recorded in order to account for a minute appearance of cortex.

Cortex Configurations

Cortex configuration on the dorsal face relates only to blades and PE blades. NBKs are not included since a specific cortex configuration is part of their definition. The cortex configurations were cataloged as follows (Fig. 4): (1) whole: spreading along more than ¾ of the dorsal surface, (2) full edge: spreading along more than a half of the lateral edge's length, (3) partial edge: spreading along up to a half of the lateral edge's length, (4) two edges: spreading along both lateral edges, (5) medial: a stripe of cortex that does not engage with any of the lateral edges, (6) distal and (7) irregular (Fig. 4).

Another attribute regards the side of the cortex (left/right) in cases where it appears on one edge only (partly or complete). The left/right position was recorded while looking at the item's dorsal face with the proximal end downward.

Angles of the Lateral Edges

One of the main goals of examining the angles of the lateral edges (and especially cortical edges) is to characterize the difference between PE blades and

NBKs. This is of importance since many of the PE blades resemble NBKs and have a uniform strip of cortex on one edge while the other edge is sharp and can serve as a cutting edge. Therefore, for this attribute I examined only these specific PE blades. This examination will demonstrate whether the PE blades and NBKs are two different populations, as was found in the case study of sample G/19-20 from Qesem Cave (Barkai *et al*. 2005), or whether they are one population and the division into PE blades and NBKs is superficial. If the PE blades and NBKs are indeed two different populations, the measured angle may aid in defining the "boundary" between the two and whether it was correctly placed at 60°. Although a boundary is necessary for conducting the analysis, the two populations probably merge into each other.

The angle of the sharp edge was examined as well since it is assumed to effect the item's utility (e.g. Lemorini *et al*. 2006). In addition, the results might provide another perspective to the technological analysis. In the case of blades the angles of the lateral edges were recorded as left and right.

Angles of the lateral edges were only measured when they were fairly constant along the bulk of the item’s length. Measurements were taken by a goniometer and for the convenience of the study they were recorded at intervals of five degrees (i.e. 25º, 30º, 35º, etc.). Although more accurate measurement methods were suggested (Dibble and Bernard 1980), they are not required here, especially due to the fact that the angle slightly varies along the edge. In cases where the angle severely varies along the edge it was recorded as 'non-uniform'. Only whole items were examined for this attribute. In cases where the secondary modification of the shaped items obscured the original angle it was recorded as 'missing'. The percentage of non-uniform cortical angles might aid in reconstructing the character of the used raw materials. It is assumed that the exploitation of rounded or amorphous nodules will result in a more common removal of items with a non-uniform angle of the cortical edge.

Blade Shapes and Lateral Edges of PE Blades and NBKs

Blade shapes were defined by the outlines of their lateral edges and divided as follows (Fig. 5): parallel, straight-curved, pointed, fan, leaf (curved-curved), curved-irregular, straight-irregular and irregular (entailing two irregular edges).

An attempt to divide the shapes of PE blades and NBKs in the same manner turned out to be too complex since the categories 'straight-curved', 'straight-irregular' and 'curved-irregular' would have been doubled due to the importance of cataloging the outline of the cortical and sharp edges. For example, in the case of 'straight-curved' it is of importance to distinguish which is the curved edge and which is the straight edge. A preliminary attempt to use multiple categories in order to present this complexity was not affective and therefore an alternative method was used for characterizing the cortical edge and the sharp edge separately. The goal is to characterize the differences between NBKs and PE blades that have a cortical edge and an opposed sharp edge. PE blades that are not characterized as such were excluded from the analysis of this specific attribute. Each of the edges was recorded as ‘straight’, ‘curved’ or ‘irregular’ (Fig. 6). It is of note that the different outlines of the cortical edges may aid in reconstructing the shapes of the raw materials used. To that end I grouped together the PE blades and NBKs.

Butt Types

The butt represents the portion of the core's striking platform that was detached with the item. Five butt types were recorded (Fig. 7):

1. Thin plain: these butts appear as a thin plain strip (1-2 mm thick). Inizan *et al.* (1992:80) refer to similar butts as 'linear'.
2. Thick plain: these butts are characterized by a relatively wide and thick plain surface. The plain butts are at least 3 mm thick and were divided in some samples into medium plain (3-5 mm thick) and large plain (6 mm or more) butts.
3. Modified: these butts include any striking platform modification (except plain). Debénath and Dibble (1994:13) refer to such butts as 'prepared'. In general, it includes butts that are usually referred to as faceted, dihedral or irregular (e.g. Wiseman 1993). A division into various modification types was not performed since different kinds of faceting are clearly dominant.
4. Punctiform: these butts are pointed and small, both in thickness and width.
5. Natural: these butts are covered with cortex or patina and are generally quite thick.

Another aspect that goes hand in hand with the butt characteristics is the occasional presence of a light nibbling or crushing on the butt's exterior (towards the item’s dorsal face; Fig. 3), which I refer to as micro flaking. In many cases the micro flaking appears only on part of the edge, covering just a few millimeters. Its presence might be planned in order to blunt the edge of the striking platform and to reduce the possibility of it collapsing while knapping (e.g. Andrefsky 2005:96; Inizan *et al*. 1992:75-76), or accidental as a result of using a hard hammer. A key for reconstructing its role in the reduction sequence is correlating it with butt types.

The Bulb of Percussion and its Location along the Butt

The bulb of percussion is not necessarily located in the middle of the item's butt and can appear in different places. In the case of PE blades and NBKs I note whether they appear near the cortical edge, the sharp edge or in the middle (Fig. 8). This refers to all NBKs and to PE blades that have one cortical edge and one sharp edge. PE blades lacking this characteristic were not examined for this attribute.

The location of the bulb was also examined among blades. In this case I recorded whether it appears near the left or right edge or in the middle. Recording the left/right position was conducted while observing the items from the ventral face with the proximal end downward (Fig. 8).

Cross-Sections

The laminar items' cross-sections were divided into triangular, right-angle triangular, trapezoidal, right-angle trapezoidal and ‘other’ (Fig. 9). All but the last must have a continuous homogenous cross-section along most of its length. The cross-sections do not need to be perfect geometric shapes, only general outlines. The 'other' cross-section is differently represented among the three laminar types. Among blades and NBKs it generally refers to an irregular cross-section, while among PE blades it includes both irregular and rounded or partly rounded cross-sections, the latter resulting from "opening" rounded nodules.

End Terminations

The end terminations were divided into feather, overpassing and hinge (Fig. 10) (Debénath and Dibble 1994:17). I opted to follow Odell's (2003:56-58) suggestion and did not include a forth type of end termination, known as a step fracture (Andrefsky 2005:20-21) since it is difficult to identify on blanks (compared to a simple break). Overpassing end terminations require some clarification; first, with regard to why items with this feature were assigned to blanks and not to CTEs, and second, with regard to what differentiates these from the other items recorded as overpass items within the

CTEs. The answer to the former question lies in the fact that one of the main features of the Amudian industry was the reduction of fairly robust laminar items which had followed-through the entire debitage surface and occasionally led to the removal of a small portion of the core base (Barkai *et al*. 2005). The answer to the latter question is more complex since the difference between laminar items with an overpassing end termination and overpass items recorded as CTEs is reflected in two conjoined aspects: (1) Generally, if the part removed from the core base is only a few millimeters thick it is recorded as a laminar item with an overpassing end termination and if it is thicker it is recorded as an overpass item (CTE). (2) In cases where a greater thickness was removed from the core base, the item's classification will be in accordance with its general thickness. In cases where the distal end thickness is fairly equal to the item's general thickness it is recorded as a laminar item with an overpassing end termination and in cases where the distal end is significantly thicker than the item's general thickness it is recorded as an overpass item. Laminar items which led to the removal of parts of a modification surface from the cores' bases are recorded as CTEs regardless of the thickness of the distal end.

Distal End Shapes

Six shapes of the distal end were recorded: oblique, pointed, pointed-rounded, rounded, straight and irregular (Fig. 11).

Profiles

The profile refers to the outline of the ventral face from a lateral view and it was examined solely on whole items. The profiles were divided as follows: semi-straight, curved, convex, twisted and irregular. The semi-straight profile refers to items characterized by a minor curvature or twist (completely straight items were added to the semi-straight category). I use the term 'semi-straight' since items with a perfectly straight profile are rare in the Amudian assemblages. This is due in part to the frequently large and protruding bulb of percussions which can sometimes extend over a quarter of the item's length.

Number of Laminar Scars

Only whole items were examined for the number of laminar scars on the laminar item's dorsal face (Fig. 13). Although some studies, mostly referring to Middle

Paleolithic assemblages, examined the scar patterns on the dorsal face, (e.g. Bisson 2000; Monigal 2002), I made no such documentation for the Amudian. This is since in contrast to the Middle Paleolithic items where scars can originate from different directions, in the Amudian almost all blanks were detached from a single striking platform and thus all scars generally share the same direction (e.g. Monigal 2002:242; Wiseman 1993).

Metrics

Lithic artifacts can be measured in several methods (e.g. Debénath and Dibble 1994:17-19), however the measurement of laminar items is quite simple since the results of the different methods do not vary greatly as they do with flakes. The method chosen here therefore includes maximum measurements of length, width and thickness solely of whole items.

Measuring shaped items raised some difficulties. Whole shaped items, in which the secondary modification has taken off a portion of the original blank, are the main problem since the purpose of measuring is to examine the population of the selected blanks and not to a typological study. Fortunately, the majority of the Amudian shaped laminar items are characterized by a minimal change in the original size of the used blanks. The backed knives and side-scrapers, which are few in the examined samples, are good examples of shaped items whose original width might no longer be visible. Another difficulty is the presence of whole shaped items made on broken laminar blanks. This is especially common among the end-scrapers and burins. The latter were recorded as they are for possible future typological analysis, but were excluded from the metric analysis performed here. The same is true of whole shaped items in which the original size of the selected blanks was greatly changed. In this case however, only the specific measurements not valid for the original size were excluded (for example, the width of a heavily retouched backed knife was put aside, while its length, if still in its original state, was included). Methods for evaluating the original measurements before the secondary modification were suggested (e.g. Shott and Weedman 2007), but they were not used here since the samples are large enough even with the exclusion of these specific measurements.

An additional difficulty is the presence of shaped items with dimensions that are laminar (length/width ratio exceeding 2/1), although it is most likely that they were shaped on flakes and the “misleading” ratio is a result of secondary modification. These items were recorded in my data base but were excluded from the analysis of laminar technology.

The ratios of length/width and width/thickness of whole items were examined as well. In the following chapters there will be cases where the length/width ratio will be presented as 2.0. These cases however also have a ratio larger than 2/1 and this is the result of using rounded numbers.

Number of Hinge Scars

The number of hinge scars on the laminar item’s dorsal face was only examined on whole items and recorded as: (1) absent, (2) one scar, (3) two scars or (4) three or more scars. Though a differentiation between hinge scars and step fractures might be helpful in reconstructing the performance of the knappers (Andrefsky 2005:20-21) such a differentiation was not made.

Definitions of Core Trimming Elements

The CTEs were divided into five types: core tablets, overpass items, radial overpass items (see below), crested blades and CTE-varia. The overpass items and the crested blades are assumed to be the products of the laminar production. The core tablets and the CTE-varia may be the result of laminar production or flake production. Core tablets are more likely to represent laminar production and CTE-varia are more likely to represent flake production. The radial overpass items are assumed to represent a radial flake production.

Core Tablets

The core tablets found in the assemblages of the Acheulo-Yabrudian complex include both "classical" core tablets, as they are known from Upper Paleolithic industries, which led to the removal of the entire striking platform (e.g. Inizan *et al.* 1992:95; Ferring 1976), and similar items, which led to the removal of only a portion of it (e.g. Debénath and Dibble 1994:13).

Overpass Items

Overpass items, also known as plunging items (Inizan *et al*. 1992:93; Mortensen 1970:16), are characterized by the removal of a considerable mass of the core base. The items defined in this category can be in flake or laminar dimension and both are part of the laminar production. The profile of their ventral face is usually curved, especially near the distal end.

Overpass items were divided into three categories according to their place in the reduction sequence – 'initial', 'correction' and 'regular'. 'Initial' overpass items were removed at the beginning of the reduction and they were part of "opening" the cores' debitage surfaces. The term 'initial' does not necessarily mean that it was the first item detached from the debitage surface but rather that it was detached as part of a series of items that together formed the debitage surface. In order to define an overpass item as 'initial' it must bear on the front of its dorsal face a considerable amount of cortex, patina or an irregular scar pattern that was not part of previous laminar production. Single laminar scars on the dorsal face can appear as well, since opening and defining the debitage surface could have included the removal of several items. 'Correction' and 'regular' overpass items, on the other hand, are characterized by well defined laminar scars which indicate they were removed during the course of a laminar reduction. The difference among these two is that 'correction' overpass items bear hinge scars, raw material impurities, irregular surfaces or other reasons that led to their removal in an attempt to correct the disturbed debitage surface. 'Regular' overpass items include items that might have been unintentionally reduced or that had served some unidentified correction or maintenance action.

Crested Blades

The following crested blade sub-types were defined (Fig. 14):

1. *Primary crested blades*. These items are characterized by a triangular cross-section and a well shaped ridge, usually bifacially knapped which runs along the entire length of the item (e.g. Mortensen 1970:17-18). The ridge does not need to be perfectly shaped as in some of the later blade industries, only to be constant.
2. *Rough crested blades*. These items are characterized by an irregular ridge, usually composed of only a few blows. Some of them may be unifacial.
3. *Patinated crested blades*. These items are characterized by an old prepared ridge that was already present on the selected raw material or recycled item. The presence of patina which covers the ridge and pre-dates the knapping of the crest is the key aspect here. The old ridge can be the result of knapping or a natural formation (rare) if the raw material was collected from the surface. Additional small adjustments of the old ridge, overlying the patinated surface, are common. The type of recycled item is hard to evaluate. The use of discarded handaxes at Yabrud (Rust: 1950:28-29) represents only one example of this aspect.
4. *Second-primary crested blades*: These items are characterized by a ridge which may be similar to each of the former sub-types, however they bear a laminar scar parallel to the ridge which does not have direct contact with it. The ‘second-primary’ crested blades usually have a right-angle trapezoidal cross-section. They seem to be related to the use of flat slabs or other angular raw material with two parallel carinated edges. The use of such raw material which enables "opening" the debitage surface from two points is different from most other blade industries characterized by initiating the reduction with a single crest (e.g. Inizan *et al*. 1992:60). It is of note that although the term 'second-primary' implies that a previous crested blade was detached, this is not

necessarily the case, rather it can be a simple blank (these crested blades should not be confused with 'secondary crested blades'; Mortensen 1970:18).

5. *Unifacial crested blades*: These items are characterized by a triangular cross-section with the scars shaping the ridge appearing on only one of its sides. The other side is characterized by a large flat scar/s whose exact nature is not clear. The placement of these crested blades in the reduction sequence varies in correlation with the nature of the flat plain scar/s. In general, three options are suggested: (a) Initial crested blades detached from a core made on a split nodule or flake, on which the plain surface is part of a previous ventral surface. (b) ‘Ridge straightening blades’ on which the plain surface is part of a previous large laminar scar. (c) It reflects a change in core production orientation, whereby the plain surface is part of the lateral edge of the previous striking platform.
6. *Rejuvenation crested blades*: These items are characterized by a shaped ridge overlying previous laminar scars. It is assumed that the shaping of the ridge was performed in order to modify the debitage surface by straightening the ridges (e.g. Wilke and Quintero 1994).

A seventh sub-type was identified in the study of the Yabrud I material and it was defined as *Faustkeilklingen* according to Rust (1950:28-29). Since it appears only in Yabrud I it will be described separately in Chapter 6 where the Yabrud I material is analyzed.

Crested blades in which the shaped ridge was already partly removed by a previous reduction are referred to in the literature as 'secondary crested blades' (Mortensen 1970:18). Only a few such crested blades were found in my study samples and they were therefore recorded within the previous sub-types (i.e. primary, rough, patinated etc.) according to the characteristics of the shaped ridge. Their presence however is noted.

The seven sub-types of crested blades were divided into three categories in order to make better use of them in reconstructing different stages in the reduction sequence and in evaluating the different methods applied. The first category includes the primary, rough, second-primary, patinated and *Faustkeilklingen* sub-types, which I call 'initial' crested blades and were reduced at the beginning of the laminar production. The second category includes the rejuvenation crested blades that were reduced in the course of laminar production. The third category includes the unifacial crested blades which can not be ascribed to either of the previous categories since they could have been reduced at the beginning of the reduction or at some point along its course.

Radial Overpass Items

These items are relatively wide and flat, bearing on their dorsal face either flake scars originating from various directions and/or a cortical surface. Their distal end has either a part of the circumference “striking platform” or a cortical angular segment of the used raw material. In both cases its detachment is assumed to have caused the removal of the opposite portion of the plane of detachment (*plan sécant*) which characterized radial/discoidal cores (Boëda 1993). In some cases its detachment led to the removal of part of the lateral edge as well, wearing a shape of *débordant* (Beyries and Boëda 1983). Although the items with extensive cortical surfaces assigned to this type do not bear radial scar patterns, I include them here since I presume that they mark the beginning of such a reduction which utilized the flat surface of the raw material. The radial overpass items share many similarities with the discoidal core technique (e.g. Boëda 1993; Cook and Jacobi 1998). Learning more about their characteristics however deserves a separate study which is beyond the scope of this research.

Definitions for the Attribute Analysis of Core Trimming Elements

Many of the attributes which are to be examined regarding the CTEs are similar to those used for the analysis of the three laminar types. The specific additional attributes relating to the overpass items and crested blades are presented below.

Additional Attributes for the Overpass Item Analysis

Indications for the Use of Cores with Cortex on Both Lateral Edges

The reduction of overpass items usually caused the removal of considerable parts not only of the core base, but of the debitage surface as well. On some overpass items, traces of two cortical surfaces, one on each lateral edge, can be observed. The cortical edges can be flat or rounded and their presence can be a further indication of the type of raw material used.

Changes in Debitage Surface Length

The removal of overpass items occasionally changed the core debitage surface. This attribute is used to examine the change in length by comparing the reconstructed length of the core debitage surface before and after the overpass item was removed. The length of the debitage surface *after* the removal is represented by the length of the overpass items' ventral face. The length of the debitage surface *before* the removal is represented by the length of the previous laminar scars on the dorsal face (Fig. 15). Three possibilities were recorded in order to represent the change in length: (1) longer; in cases where the "new" debitage surface is longer than the previous one, (2) equal; in cases where no major change occurred in the debitage surface length (no more than a few millimeters) and (3) shorter; in cases where the "new" debitage surface is shorter than the previous one.

Remnants of Base Modifications

Remnants of core base modification can be observed on the distal end of overpass items. Base modifications were divided as follows: (1) the reduction of single blades or bladelets from the core base in order to maintain the laminar production from the end opposing the striking platform. (2) The removal of flakes either towards the debitage surface or towards the base, probably performed in order to overcome obstacles at the distal end of the debitage surface. (3) The deliberate shaping of the core base into a pointed/sharp outline, and (4) the blunting of sharp edges at the base, in all probability in order to enable a firm grip while knapping.

The Presence of Shaped Ridges

Shaped ridges are found on some of the overpass items. In these cases not only their presence was noted but also their location along the length of the overpass item (recorded as whole, proximal, medial or distal).

Additional Attributes for the Crested Blade Analysis

Intensity of the Shaped Ridge

This attribute refers to the extent of the shaped ridge along the length of the crested blade and it includes four possibilities: (1) complete, (2) half (3) quarter, and (4) touch.

Location of the Shaped Ridge along the Length of the Item

This attribute refers to the location of the shaped ridge along the item's length. It includes four possibilities: whole, proximal, medial and distal.

Location of the Shaped Ridge along the Width of the item

This attribute refers to the location of the shaped ridge along the width axis of the crested blades. Four different possibilities for the ridge location were defined: left, right, middle and irregular (Fig. 16).

Ridge Profiles

This attribute refers to the profile of the crest on the dorsal face and takes into account not only the shaped ridge but also how it conjoins with the unshaped part in cases where it is a partial ridge (this observation is different from the profile taken for the laminar types which refers to the ventral face). Four crest profiles were recorded: straight, curved, angular and irregular. The angular refers to cases in which the general character of the dorsal face is fairly straight and the shaped ridge is obliquely placed at the distal end. In most cases the oblique portion is fairly short, ca. 1 cm in length.

Defining the Laminar Core Class

The study of cores is particularly challenging since as long as the cores were still being used for reducing items they were dynamic and could have changed in size and shape (Bordes and Crabtree 1969; Conard *et al*. 2004; Inizan *et al*. 1992:45). It is this changeability which complicates the study of cores since irregular removals at the end of the core's life might camouflage the "original" pattern we wish to explore. The possibility that the dynamic character is the key feature should not be overlooked as well. In order to display the dynamics of the core reduction as well as the original patterns as much as they exist, the cores were divided into types following the scar patterns and general shapes.

The specimens in the laminar core class all fit the definition by Conard *et al.* (2004) of ‘platform’ cores. The production of these cores was generally performed from a striking platform located on the narrow face of the cores, although in some cases it was performed on the broad face. The removal of the products could have run along the striking platform’s circumference or concentrate on part of it. Although according to Conard *et al.* (2004) the ‘platform’ cores were used for the production of either laminar items or flakes, I assigned the latter to a different class. Conard *et al*. further note that this basic definition needs further classification according to the cores’ different characteristics. In my analysis the laminar core class was separated into groups according to specific end-products, then into types according to the number of striking platforms and finally according to shape (Fig. 17).

The division into two groups was made according to end-product scars on the core’s debitage surface. In the first group the reduction was dominated by laminar items and in the second group a combined reduction of flakes and laminar items took place. These groups are referred to as 'laminar cores' and 'laminar and flake cores' respectively. The difference between them is that in the former, laminar items could have been reduced from the debitage surface without almost any flakes unless mistakes were made, while in the latter, the reduction of flakes seems to have been systematically combined with the reduction of laminar items. Many of the produced flakes from these cores were probably 'blade-flakes’. The 'laminar and flake cores' were added to the laminar core class since it is assumed that if the primary intention was to create flakes and not laminar items, the cores would be much simpler in form, as are most of the flake cores in the examined samples.

The technological significance of the 'laminar and flake cores' is not clear and they can represent three options: (1) A systematic production in which laminar items and flakes were simultaneously detached – both as desired end-products and/or as a means to complete and improve the laminar reduction. (2) Laminar cores that were slightly deformed due to obstacles at the final stage of reduction. (3) A secondary or continuous use of discarded or exhausted laminar cores.

Shapes of Cores with a Single Striking Platform

The single striking platform cores of the laminar core class were divided into five shapes (Fig. 18).

1. *Amorphous front*: These cores lack a defined shape and they are generally characterized by a debitage surface covering only a small portion of the core circumference located in a carinated part. In the case of the 'laminar and flake cores' the laminar scars are usually concentrated on the carinated part of the debitage surface and the flake scars on its flat part. It is possible that in some cases flake removal was used to modify the carinated part for the laminar production.
2. *Parallel edges*: These cores are generally characterized by a flat debitage surface which follows the concept of a prismatic production, yet they are also characterized by the presence of a well defined form of the debitage surface which is constricted by two fairly uniform core sides. Uniform *sides* and not *edges* are emphasized since the uniformity should appear not only from a frontal view (looking at the debitage surface), but also from a top view (looking at the core's striking platform). In the latter case the sides, as also reflected by the two lateral edges of the striking platform, should be fairly parallel. The debitage surface is mostly rectangular and elongated, but can be U-shaped or triangular. The importance lies in the fact that the form of debitage surface can remain for the most part unchanged during the course of the reduction. Although the presence of two cortical sides is not a part of the definition, it is an additional common characteristic of these cores.
3. *Prismatic*: Prismatic cores are usually defined by having parallel scars (e.g. Brézillon 1968:92; de Heinzelin 1962:9; Sonneville-Bordes 1960:20). For the purpose of my study, I further added, that these cores have a relatively flat debitage surface. The main difference from the cores with the 'parallel edges'

shape is that there is no evidence that the contour of the debitage surface was constant along the reduction, rather it seems to have changed during its course. In this core shape there is a clear difference between the 'laminar cores' and the 'laminar and flake cores'. In the latter group the laminar scars mostly appear near one of the lateral edges, sometimes even slightly using the core’s lateral edge itself, thereby improving the convexity of the debitage surface.

4. *Pyramidal*: These cores are characterized by a curved debitage surface (from a top view, looking at the striking platform) that covers more than half of the core's circumference and by a pointed base (e.g. Brézillon 1968:92; de Heinzelin 1962:9; Sonneville-Bordes 1960:20).
5. *Narrowed Prismatic*: These cores are characterized by a narrow shape and by a debitage surface that spreads along the core’s front and one or two of its sides. The scars on the front of the debitage surface are laminar, while those on the sides are mostly flakes. The narrow shape is not natural but is a result of the removal of flakes from its sides. The base of these cores is pointed/sharp in many of the cases. These cores are all of the ‘laminar and flake’ group.

Definitions for the Attribute Analysis of Cores

Raw Material Shapes

The following raw material types were recorded: (1) flat slabs or nodules with cortex on both lateral edges, (2) nodules or split nodules, which are rounded or amorphous, (3) large flakes, (4) old knapped patinated items, and (5) unidentified.

Percentage of Cortex on Core Surface

This percentage is determined by the portion of cortex out of the entire surface of the core. Old patinated surfaces are regarded as cortex as well. The percentage is recorded in cohorts of 10% (i.e. 10%, 20%, 30%...).

Cortex Cover and the Potential for Removing Cortical Items

The cover of cortex on the cores differs and its precise location is of importance since it indicates the potential for removing cortical laminar items (PE blades and NBKs). Hence, I recorded whether cortex appears on the back, side/s, base and/or striking platform. Various combinations of these options can appear on the cores. Of these combinations, the one with cortex covering the entire core surface except for the striking platform and debitage surface best represents the potential for removing laminar items.

The potential for removing cortical laminar items is examined according to the presence of cortex along the cores' sides and it includes the following categories: (1) In cases where at least one side is cortical and regular in outline it is assumed that cortical laminar items were reduced until the end of production; (2) In cases where cortex appears sporadically on the core sides it is assumed that cortical laminar items were reduced sometime in the course of the production but not at the end; (3) In cases where there is no cortex on the core's sides it is assumed that the possibility that regular cortical laminar items were produced from such cores is small and if so it probably occurred at an early stage of reduction.

Striking Platforms

The striking platforms of the cores were defined as follows: (1) flat scar, (2) faceting, (3) flat scar with an adjustment by faceting, and (4) natural, either cortical, patinated or an old breakage scar. I use the term 'flat scar' and not 'core tablet removal' since although many of them could have resulted from a core tablet removal it could have been performed by other actions as well.

The presence of micro flaking along the edge of the striking platform was documented as well. Since this micro flaking is not constant it is not automatically referred to as blunting or edge trimming. Comparing this phenomenon to other attributes of the cores might help in understanding its presence.

Debitage Surface Shapes

This attribute refers to the shape of the debitage surface and not to the general core shape. It includes the following shapes: (1) rectangular, (2) U-shaped, (3) triangular and (4) irregular.

Core Bases

The shape of the base is inspected from a frontal view and it includes the following shapes: (1) pointed, (2) flat, (3) rounded, (4) oblique, and (5) irregular.

Modification and Maintenance Surfaces

Since no complex modification or maintenance surfaces were observed on the cores in the analyzed samples, only basic data regarding the location of these surfaces was recorded. They can appear on the core base, back or debitage surface.

Metrics

Metrics included maximum measurements of length (from striking platform to base), width (from one side to another) and thickness (from core face to back). I also recorded the width and length of the debitage surface in order to compare them to the maximum width and length of the cores (Fig. 19).

Number of Laminar Scars

The number of laminar scars was recorded using two methods: (1) including all traces of laminar scars on the debitage surface and (2) including the number of parallel laminar scars along the debitage surface (Fig. 20). Flake scars that mainly appear on the 'laminar and flake cores' were not recorded.

Number of Hinge and Overpass Scars

The number of hinge and overpass scars recorded includes only those appearing on the debitage surface. Hinge scars and step fractures (Andrefsky 2005:18-19) were counted together without differentiation.

Assumed Reasons for Discard

Although the discard of the cores is not necessarily the result of a single factor, for the sake of this study I tried to identify the main reason that led to core discard. The following causes were recorded:

1. *Hinge scars*: While hinge scars are common on most cores, in this case their presence did not enable the removal of further laminar items. In some cases it can appear as a single large hinge and in others as a series of adjoined hinge fractures.
2. *Large overpass removal*: While overpass scars are found on many of the cores, this case refers to an overpass detachment that led to the removal of a large mass of the core and obliterated the debitage surface.
3. *Raw material problem*s: In some cases raw material impurities were met during the reduction. These could have been concealed at the beginning of knapping or identified from the start of the reduction. Nevertheless, what might have had little or no affect on the reduction in the initial phases may have become more crucial in the course of knapping, thus leading to abandonment.
4. *Exhaustion*: A core is exhausted when it cannot produce useful laminar blanks any more, not as a result of some obstacle, but simply because the core mass has diminished.
5. *False striking platform*: This refers to cores in which the striking platform was no longer suitable for laminar reduction. This can be the result of (1) an unfit angle, (2) a complete reduction of the shaped striking platform, or (3) an attempt to maintain or renew the striking platform that had accidentally deformed it.
6. *Unknown*: In these cores no apparent reason for core abandonment can be identified and it seems that several laminar items of good quality could have been further reduced.

Chapter 4

The Amudian Laminar Production from Qesem Cave

The Site of Qesem Cave

Qesem Cave is located 12 km east of Tel Aviv, Israel (Fig. 1) and was discovered in the year 2000 during the course of road construction. In 2001 two salvage excavation seasons were conducted at the site (Gopher *et al*. 2005), later developed into a long-term project directed by Avi Gopher and Ran Barkai on behalf of the Institute of Archaeology, Tel Aviv University. So far, four more seasons of excavations were conducted in 2004-2008.

The site is situated at 90 m a.s.l. in the western foothills of the Samaria Mountains. The surroundings are characterized by shallow limestone hills and a few small caves (Frumkin *et al*. 2009). The stream of Wadi Rabah lies ca. 200 m to the south.

The cave lost its ceiling, but nevertheless, large parts of the interior are still intact. The archaeological sediments are ca. 7.5 m deep with a stratigraphic sequence entirely attributed to the Acheulo-Yabrudian complex. Although most excavated parts were found to be of the Amudian facies (Gopher *et al*. 2005), a new area opened in 2006 reveled the presence of a Yabrudian facies in the cave as well (Barkai *et al*. in press).

Speleothems from the upper part of the site were dated by U/Th to ca. 380-210 Kyr (Barkai *et al.* 2003). The stratigraphical sequence is generally divided into two parts – lower (ca. 3 m. thick), consisting of sediments with clastic content and gravel, and upper (ca. 4.5 m. thick), mostly consisting of cemented sediment with a large ashy component. The lower part was deposited in a time the cave was a closed karstic environment, while the upper part was deposited when the cave was more open as indicated by the presence of calcified rootlets (Frumkin *et al*. 2009; Karkanas *et al*. 2007).

The use of fire at the site is apparent by the burnt bones and flints (Lemorini *et al*. 2006), and by the traces of ash in the sediments. The geomorphological study indicates that the use of fire was highly common in the upper part of the sequence but also used in the lower part. Ash remnants originating from burnt wood indicate controlled habitual use of fire (Karkanas *et al*. 2007).

A recent study attempting to evaluate the possibility of flint mining in the Paleolithic period by examining the amount of the cosmogenic isotope ^{10}Be in archaeological lithic artifacts focused on Qesem Cave (Verri *et al*. 2004, 2005). This study suggests that some of the flint items from Qesem Cave were obtained from flint outcrops located in buried sediments, probably by shallow mining.

The faunal assemblage of the site is rich and in a good state of preservation. Fallow deer (*Dama mesopotamica*) dominate the assemblage, constituting 70-89% of the analyzed material 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 outside of the site and only selected parts were brought to the cave. Cut marks and marrow extraction were recognized (Gopher *et al*. 2005; Lemorini *et al*. 2006).

A use-wear study of a complete sample was performed on the material retrieved from square K/10 where diagnostic traces were found on 74 artifacts including 37 shaped items and 37 unshaped items (Lemorini *et al*. 2006). In the case of the former, the wear traces were mostly found on the unshaped (non-retouched) part of the items. The most prominent activity identified 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 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 use. The results also demonstrate the efficiency of NBKs as cutting tools.

The Analyzed Samples

Five Amudian lithic samples from Qesem Cave constitute the center of this research. A brief introduction of these samples is presented in order to provide a general picture of the Amudian lithic industry as a whole and not only of the laminar component. The five samples were retrieved from different areas of the cave (Fig. 21) located at different parts of the stratigaphic sequence and they are schematically ordered from lower to upper, presumably early to late:

1. Unit V includes squares E/22, F/22, G/21 and G/22 in elevations 745-850 cm below datum (the analysis of this sample was chiefly performed by Lior Landenberg, yet the analysis of the laminar component was performed by the author). It represents the oldest excavated sample at the site and includes several spheroids.
2. Sample G-I/19-22 includes squares G/20, G/21, G/22, H/19, H/20, H/21, H/22 and I/20 from elevations 600-670 cm below datum. This sample was retrieved from the southern part of the cave which was destroyed by the newly built road. Several spheroids were retrieved from this sample as well.
3. Sample G/19-20 includes squares G/19 and G/20 from elevations 525-600 cm below datum. The lithic analysis of this sample was recently published (Barkai *et al*. 2005).
4. Sample F-H/13-15 includes squares F/13, F/14, F/15, G/13, G/14, G/15, H/13, H/14, H/15 and squares I/15 and I/16. The two latter squares were recorded according to the grid used in the salvage excavations. This sample includes elevations 553-670 cm below datum and it represents the upper part of the test pit that was excavated in the center of the cave.
5. Sample K/10 includes only one excavated square (K/10) at elevations 300-420 cm below datum. This square was also recorded according to the grid used in the salvage excavation. A use-wear analysis of this sample was recently published (Lemorini *et al*. 2006). This is the only analyzed sample here that originated from the upper part of the stratigraphic sequence. It was retrieved from soft sediments that were covered by cemented sediments.

The five samples include 19,166 items (Table 1). The state of preservation is rather good as indicated by the presence of wear traces (Lemorini *et al*. 2006).

Debitage and shaped items (n=8,914) constitute 46.7-64.1% of the studied samples, except for sample K/10 where they constitute 27.1%. The difference is most probably due to the fact that the K/10 sediments were wet-sieved in contrast to the others that were dry-sieved and thus half of its total number of items is chips. Debri includes 10,252 items divided into three categories: chunks (n=5,164), chips (n=4,578) and micro flakes (n=510). The latter are small flakes with a bulb of percussion still intact whose size does not exceed 1.5 cm.

Although some of the results had already been published, including sample G/19-20 (Barkai *et al.* 2005) and several notes on sample K/10 (Lemorini *et al.* 2006), in this study several changes were performed. In the case of G/19-20 (Barkai *et al.* 2005) four items that were classified as cores were reclassified in the 'core on flake' category. In addition, following changes in our typological classification, several shaped item types were grouped together. The 'curved backed laminar items' were added to the 'backed knives', and the 'curved retouched laminar items' and 'pointed laminar items' were added to the 'retouched laminar items'. Two items previously classified as side-scrapers were also reclassified – one as a backed knives and one as a retouched flakes. In the detailed attribute analysis, slightly different results were obtained due to the fact that for certain specific examinations I used only whole items and did not include broken items as was previously done. The differences appear in the percentage of cortex, number of laminar scars and hinge scars. In the case of K/10 (Lemorini *et al.* 2006) there was a mistake in the publication and the number of chips is not 2,556 but 2,329 and therefore the sample is slightly smaller. In addition, minor changes were made in the categories and the revised number of shaped items is 178. None of the selected items studied for use-wear was reclassified.

Raw Material

Various raw material types were used at the site and a preliminary survey around Qesem Cave revealed that some of these were derived from sources in the close vicinity (Barkai *et al*. 2005). Many of the raw material types are highly siliceous and homogenous enabling systematic laminar production. Some appear as flat slabs with cortex on both sides (Fig. 184). This characteristic, of two parallel flat cortical surfaces, can be seen on overpass items, cores and even on some of the laminar items (e.g. Figs. 29:1, 30:1,4,7, 31:1, 32:4-6; 37:1, 39:3, 40:1, 51:2). The use of rounded nodules, mostly fist size, also occurred at the site as indicated by some of the cores (e.g. Fig. 43:5; 45:2) as well as by the NBKs with the curved cortical back (e.g. Fig. 22:3, 24:7-8). The cortex in all cases is rather thin and varies from 1-5 mm. Indications of using exceptionally large raw material are rare (e.g. Barkai *et al*. 2005:49, Fig. 8), as is the splitting of large raw material into smaller pieces for cores (not including the 'core on flake' phenomenon). It seems that selected raw material pieces were used for shaping a single core in most cases (at least for the laminar core class). An attempt to divide the five assemblages into raw material types by color and texture was highly problematic due to the nature of the flint and the large variety.

In the studied samples nine unworked raw material pieces were retrieved (they were not recorded in Table 1 since they were not knapped). Four of them were retrieved from sample G-I/19-22, three from sample F-H/13-15 and two from sample K/10. Seven of the raw material pieces are rounded nodules and two are flat slabs. Five of the rounded nodules and the two slabs are characterized by rolled surfaces. The rounded nodules are rather small (the largest is 78x59x42 mm) and the two flint slabs, which are in a good size for knapping (112x65x58 mm; 117x95x41 mm) are cracked and are of low quality. Five of the rounded nodules bear crushing marks which might indicate they were used as hammerstones.

Primary Element Flakes

PE flakes (n=935) constitute 6.3-14.4% of the debitage and shaped items. They include items with the bulb of percussion still intact and with a dorsal face that is covered by at least 30% cortex. Base modification is not common among the PE flakes and appears in 9.5-26.1% of them. The most common base modification is irregular faceting. In general, the PE flakes show no clear pattern, except for some which are elongated and can be referred to as ‘blade-flakes’ and are probably by-products of the laminar production. Old patinated surfaces were observed on several items, constituting 14.4%, 15.3% and 10.7% in samples Unit V, G/19-20 and F-H/13-15 respectively.

Primary Element Blades (PE blades)

PE blades (n=595) constitute 5.4-8.5% of the debitage and the shaped items (Figs. 22:1, 23:5, 24:1, 25:1-2). They are presented in detail in the following analysis of the laminar items.

Primary Element Bladelets

PE bladelets (n=69; 0.6-1.1% of the debitage and shaped items) are mostly robust and seem to be by-products of the laminar production. The majority of these items are whole (n=35), however proximal (n=17), medial (n=5) and distal (n=12) fragments appear as well. Most PE bladelets are similar to PE blades and NBKs in that they have one uniform cortical lateral edge and an opposite sharp edge. The fact that the angle of the cortical edge is in some cases sharp and in others steep, forming a cortical back, implies that their reduction correlates to the general reduction scheme of the PE blades and NBKs. The bladelets might have been intentionally reduced in order to enhance the ridges or spontaneously reduced as a result of using hard hammer percussion.

Flakes

Two different flake types were recorded, both with the bulb of percussion intact. Non-modified base flakes (N=2,108, 14.3-32.8% of the debitage and shaped items) and flakes with different types of base modification performed before detachment (N=620, 4.3-8.6% of the debitage and shaped items), mostly with irregular faceting. Some of the flakes of both types are elongated (with a length/width ratio near 2/1) and they bear scars of previous laminar reduction. Most of these ‘blade-flakes’ were probably reduced during or after laminar production.

Blades

The assemblages include 645 blades (4.3-10.5% of the debitage and shaped items) (Figs. 23:6, 24:2-3, 25:3-5). They are presented in detail in the following analysis of the laminar items.

Bladelets

Bladelets appear in small numbers in most samples (n=116; 0.5-1.5% of the debitage and shaped items). They appear in a relatively high percentage (3.1%) only in sample K/10. They include 80 whole items, 15 proximal, 4 medial and 17 distal fragments. The bladelets are mostly robust and lack scars of previous bladelets removal. It is thus concluded that they are not part of systematic bladelet reduction but are by-products of the laminar production. The few bladelets cores (n=5), which might indicate a different mode, can not explain the bladelet reduction as a whole.

Many of the bladelets have remnants of cortex. The bladelets are characterized by straight, curved, twisted or irregular profiles without a clear pattern.

Naturally Backed Knives (NBK)

Altogether 696 NBKs (laminar) were found (5.3-12.1% of the debitage and shaped items) and 246 'NBK-flakes' (1.1-3.7% of the debitage and shaped items). The laminar NBKs (Figs. 22:3-4, 23:1-4, 24:4-11, 26) are presented in detail in the following analysis and the data provided here concerns only the 'NBK-flakes' (Fig. 27). The presence of butt modification among the 'NBK-flakes' is highly variable and it is the highest in Unit V (50.0%) and the lowest in sample G/19-20 (18.6%). Faceting is the most common butt modification. The presence of old patinated surfaces was examined in Unit V and sample F-H/13-15 showing 4.3% and 6.9% respectively. The cortical back of the 'NBK-flakes' is less uniform than that of the laminar NBKs. Many of the 'NBK-flakes' bear previous scars of laminar reduction (e.g. Fig. 27:1, 3, 5, 7) and they were probably reduced as part of the laminar production.

Core Trimming Elements (CTE)

CTEs (n=726) constitute 6.3.-9.4% of the debitage and shaped items. They include 43 core tablets (Fig. 28), 224 overpass items (Figs. 29-32), 26 radial overpass items, 199 crested blades (Figs. 33-35) and 234 CTE-varia. A detailed description of CTEs is presented below.

Cores

The cores (n=317; 1.7-4.3% of the debitage and shaped items) include various types classified into three classes: laminar cores (n=121; 38.2% of the cores; Figs. 37-46), flake cores (n=192; 60.6%) and tested raw material (n=4; 1.3%). Additional 61 core fragments (0.2-1.0% of the debitage and shaped items) that could not be assigned to a specific type were recorded separately.

The different cores within the laminar core class will be presented in detail below while here I will only elaborate on the two other classes. Flake cores include those with a single striking platform (n=88; 27.8%), two striking platform (n=82; 25.9%) and radial reduction (n=22; 6.9% of all cores). The flake cores as a group show no clear pattern. The majority seem to be opportunistic in nature with no uniformity in size or shape. Exploitation to exhaustion characterized most of these cores. Large cores are rare and the one found in sample G/19-20 (Barkai *et al*. 2005:49, Fig. 8) is the exception. The radial cores represent an organized flake production. In general they produced wide and thin flakes representing an opposing concept to that of the laminar technology. They intentionally focused on the wide part of the raw material and not on the narrow part as was often the case in the laminar production.

The four tested raw material items are another indication of the use of both flat flint slabs and small nodules. These items include one rolled nodule with an amorphous shape (70x66x48 mm), a large chunk (71x49x23 mm) and two flat flint slabs with cortex on both sides (72x63x22 mm; 81x50x37 mm). All these items are of low quality that might explain their discard.

'Cores on Flakes'

'Cores on flakes' (n=127) constitute 0.9-1.9% of the debitage and shaped items (Barkai *et al*. 2005). These items represent what was termed the 'Nahr Ibrahim technique' and were mostly found in Lower and Middle Paleolithic industries (Goren 1979; Goren-Inbar 1988a; Hovers 2007; Newcomer and Hivernel-Guerre 1974; Shea and Bar-Yosef 1999; Solecki and Solecki 1970).

Double Bulb Items

The ‘double bulb’ items (n=67, 0.2-1.1% of the debitage and shaped items) are characterized by two bulbs of percussion, each on a different face of the item (Barkai *et al*. 2005). This category probably resulted from more than one specific technological procedure (e.g. Brézillon 1968:101-102; Inizan *et al.* 1992:57-58; Newcomer and Hivernel-Guerre 1974). The attribute that bounds these items together is that they all removed the bulb of the item they were detached from. In general they represent both secondary modification of shaped items and the use of flakes as cores. Some of these are overpasses or in the shape of a ‘burin spall’, while others have traces of retouch and seem to indicate shaped item rejuvenation. Some of these items might be related to the 'Tabun snap' which is considered a characteristic of Acheulo-Yabrudian industries (Shifroni and Ronen 2000).

Burin Spalls

Burin spalls (n=157) constitute 1.3-2.0% of the debitage and shaped items. Some of the burin spalls demonstrate scars of previous burin spalls removal. In addition, some are characterized by a perfectly shaped ridge – a meticulous shaping that is rarely found among the items recorded as crested blades. Among the burin spalls there are several items with a unique cross-section that is characterized by one lateral edge of ca. 100 degrees or more. It is assumed that these burin spalls were reduced from the 'Adlun burins' (see below). The possibility that some ‘burin spalls’ are a specific type of a laminar blank removed during early stages of core reduction is valid, but it cannot be confirmed without refitting. This possibility was raised in the analysis of several other Amudian assemblages (e.g. Jelinek *et al*. 1973:174). Wear traces were found on several of the burin spalls from sample K/10 (Lemorini *et al*. 2006).

Special Waste

Thirty two items were recorded as special waste (0.0-0.9% of the debitage and shaped items). They all bear traces of retouch and are assumed to represent detached parts of shaped items. They are different from the items cataloged as 'retouched fragments' (in the shaped items) in that they were detached from the shaped item by a clear blow. Although it is assumed that most of these represent resharpening and recycling activities, some are probably the result of shaping mistakes. Identifying the type of shaped item they were detached from is not easy, yet the scaled and semi abrupt retouch that appears on some of them indicates that many were removed from scrapers.

Shaped Items

A total of 1,397 shaped items (11.7-24.2% of the debitage and shaped items) was found (Table 2) and divided into three technological classes: shaped flakes (n=733; 52.5% of the shaped items), shaped laminar items (n=657; 47.0% of the shaped items) and bifacials/core tools (n=7; 0.5% of the shaped items). The third class has only a minor representation as expected in Amudian assemblages (Copeland 2000; Jelinek 1990). The composition of laminar blanks of each of the shaped item types is presented below (Figs. 64-65). The shaped items include the following types:

Retouched laminar items

'Retouched laminar items' (n=400) constitute the most commonly shaped item type in the studied samples (18.6-44.5% of the shaped items). Most of these bear fine or semi-abrupt retouch (Figs. 46:1-2, 47-48, 51:1-2, 52). Inverse retouch appears in small numbers and a few items are characterized by invasive flat retouch. The retouch appears mostly on one lateral edge, but in some cases on both edges (Fig. 48:4). The retouch can cover an entire or partial edge. Although straight and curved outlines of the retouched edge are highly common, irregular outlines appear as well. The PE blades and NBKs in this category are mostly retouched along the cortical edge (Fig. 47:3-4), but a few are retouched along the sharp edge or both edges.

Backed knives

The backed knives (n=100; 1.3-8.2% of the shaped items) were shaped on laminar items (n=58) and flakes (n=42). They have a steep back shaped by abrupt retouch and an opposite sharp edge. While in some the back is straight, in others it is curved (Figs. 46:4, 49, 53:1). In some of the latter the curved back forms a tip at the distal end resembling a point. The resemblance of these items to 'Chatelperron points' was mentioned by several scholars (Garrod and Bate 1937:79-89; Copeland 2000:101). The items shaped on flakes were commonly shaped on 'blade-flakes'.

Distally retouched laminar items

'Distally retouched laminar items' (n=90; 4.1-10.3% of the shaped items) are characterized by a fine or semi abrupt retouch at the distal end (Fig. 50:1, 51:3). Although this retouch resembles a truncation in some cases, it is not abrupt and in many cases covers only part of the distal end's width. The retouch outline can be straight, oblique, or slightly arched. In some of these items the lateral edge was partially retouched as well.

End-scrapers

End-scrapers (n=104; 2.5-8.4% of the shaped items) were more commonly shaped on laminar items (n=60) (Fig. 50:3, 51:6, 53:4) than on flakes (n=44). The presence of retouch along the lateral edge is also common in many of the end-scrapers. A unique characteristic of the end-scrapers is that in many of them the abrupt retouch of the potential "active" edge has an oblique shape (Fig. 46:6, 50:4, 51:5, 53:2-3). Some of the latter might be a specific type of a shaped knife in which the oblique part served as a back.

Side-scrapers

Side-scrapers (n=69; 0.8%-8.9%) include various sub-types (or types according to the Bordes' type-list) of which convex and straight are the most common. Other sub-types include transverse, interior surface, double and convergent side-scarpers which appear in small numbers. It is of note that many of the side-scrapers are broken and their classification into specific sub-types is impossible. The side-scrapers were mostly shaped on thick flakes (n=62) rather than laminar items (n=7). In some cases, the blanks used for side-scraper are slightly larger than the common blanks at the site. A demi-Quina retouch appears on some of the side-scrapers (the side-scrapers from the site are currently the topic of a Master Thesis by Zohar Lev).

Burins

Burins (n=141; 4.2-13.3%) were mostly shaped on flakes (n=115), but some were shaped on laminar items as well (n=26) (Fig. 53:5). The burins are mostly simple, however burins on truncations and dihedral burins are found in small numbers. 'Adlun burins', which are a specific sub-type characteristic of Amudian assemblages (Garrod & Kirkbride 1961:23-25), are present as well. These burins are characterized by a burin spall scar that is not perpendicular to the axis of the item but diagonal (Barkai *et al*. 2005:54-56).

Retouched flakes

Retouched flakes (n=242; 11.8-32.9%) is the second most common type in all samples except for Unit V and sample G-I/19-22 where it is the most common. The retouched flakes lack clear patterns in the shape of blanks or secondary modification.

Notches and denticulates

Notches and denticulates (n=53; 0.5-7.9% of the shaped items) were mostly shaped on flakes (n=47) and rarely on laminar items (n=6). These shaped items lack any clear pattern.

Bifacials

Seven bifacials tools were found. They include two handaxes (one from Unit V and one from sample F-H/13-15), two choppers (one from Unit V and one from sample F-H/13-15), two 'other' bifacials (from sample F-H/13-15) and one broken piece (from sample G-I/19-22). The handaxe from Unit V was roughly shaped and might represent an unfinished specimen (Gopher *et al*. 2005:72, Fig. 4). The handaxe from sample F-H/13-15 was well shaped (Gopher *et al*. 2005:72, Fig. 3). Another handaxe was found in this sample, however it was recycled into a laminar core and recorded as such (Fig. 39:1). The choppers were made on small pebbles. The two 'other' bifacials include one small item (31x24x11 mm) and one thick nodule with bifacial knapping that might represent a rough handaxe.

Varia

The varia (n=38; 1.1-4.4%) include shaped items that were not assigned to the previous types. Most of them were shaped on flakes (n=28) but laminar items appear as well (n=10).

Retouched fragments

This category included 153 fragments of shaped items (6.7-13.9% of the shaped items) that could not be assigned to a specific type.

The composition of the shaped item types in the various samples

The composition of shaped items in the different samples demonstrates some similarity providing a general picture of the Amudian characteristic typology (at least as it appears in Qesem Cave). Differences between the five samples on the other hand, demonstrate that some inter Amudian variability exists as well.

A high percentage of ‘retouched laminar items‘ is the first characteristic and they are the most common in most samples. Backed knives which appear in rather similar percentages of 7.1-8.2% in most samples (Unit V is an anomaly with 1.3%) is another characteristic. ‘Distally retouched laminar items’ appear at varying percentages, yet their presence is an important marker since such items are hardly known from other industries. Burins and end-scrapers are well represented, the latter constituting rather similar percentages of 7.0-8.4% throughout the samples (again with Unit V differing – 2.5%). Side-scrapers are meager in most samples except for sample F-H/13-15 where they constitute 8.9%. Bifacials are extremely rare, except for Unit V where they constitute 2.5%.

In short, the high frequencies of ‘retouched laminar items’ along with the common presence of backed knives, ‘distally retouched laminar items’, end-scrapers and burins account for the Amudian character. The rarity of bifacials and the paucity of side-scrapers in these samples complete the picture (e.g. Copeland 2000; Jelinek 1990). Although the presence of bifacials and side-scrapers in general is more common in other facies of the Acheulo-Yabrudian complex, none of the samples demonstrate sufficient amounts to justify a different assignment than Amudian. As for the variability among the Amudian samples of Qesem Cave, two major differences are of note: (1) the especially high percentage of ‘retouched laminar items’ in samples G/19-20 and K/10 (44.5% and 34.3% respectively), and (2) the fact that Unit V repeatedly demonstrates a slightly different pattern than that of the other samples. The fact that Unit V is the oldest sample examined from Qesem Cave might account for this pattern.

The Laminar Component in the Studied Samples

The percentage of the laminar items out of the debitage and shaped items (Table 1; Fig. 55) varies among the different samples. Sample G/19-20 and K/10 has the largest laminar component (58.2% and 38.9% respectively). Samples G-I/19-22 and F-H/13-15 have a laminar component of 33.1% and 31.5% respectively and Unit V, the oldest sample excavated at the cave so far, has the smallest laminar component (24.5%). Fluctuations in the laminar component can be observed within each of the samples as well. Examining each sample spit by spit (except for Unit V where this was not tested) shows the following: Samples G-I/19-22 and K/10 (Figs. 55, 58) demonstrates a "cyclicality" in the laminar percentages which change from ca. 30% to 40% and vice-versa. In samples G/19-20 and F-H/13-15 a constant increase was observed through the spits (Fig. 56-57), a pattern that was found to be statistically significant in the case of sample G/19-20 ($Y=331.908-0.479$; $R^2=0.709$). Another variation in the presence of laminar items was observed in their spatial distribution within each sample, however this aspect was not examined here.

The percentages of laminar items out of the shaped items demonstrate a correlation to the general percentages of all laminar items in the assemblages (Fig. 54). In the samples of Unit V, G-I/19-22 and F-H/13-15, where the general laminar component is low, so are the percentages of the shaped laminar items. In samples G/19-20 and K/10, where the general percentages of laminar items are high, so are the percentages of the shaped laminar items. In all the samples the percentage of laminar items out of the entire shaped items population exceeds the percentage of the laminar items within the general assemblage. In samples G/19-20 and K/10 this pattern is especially clear.

The variations in the component of laminar items can also be observed in the blanks on which the backed knives were shaped. In samples G/19-20 and K/10, where the laminar component is high, they were dominantly shaped on laminar items. In contrast, in the other samples, where the laminar component is not as high, they were less often shaped on laminar items and in some cases they were more commonly shaped on flakes (Table 2). The general correlation between the general assemblages' composition and that of the shaped items is an important indication that the studied samples are indeed complete assemblages that represent well both the production and use of the items at the site.

The composition of the three laminar types (blades, PE blades and NBKs), including both blanks and shaped items, slightly varies among the samples (Fig. 59). While in Unit V, samples G-I/19-22 and F-H/13-15 blades, PE blades and NBKs were produced in relatively equal numbers, in samples G/19-20 and K/10 a larger production of blades occurred constituting 43.6% in both cases. The composition of the laminar types within the blanks shows a clear difference than that of the shaped items. While among blanks the three laminar types appear in fairly equal percentages (blade: 33.3%; PE blade: 30.7%; NBK 36.0%; n=1,936 [all samples]), among the shaped items, blades are dominant while NBKs are few (blade: 57.5%; PE blade: 26.6%; NBK: 15.9%; n=616 [all samples]). Although the percentage of items with secondary modification varies in the different samples, a general pattern can be seen (Fig. 60). Blades were the main laminar type chosen for secondary modification and 35.4% of the entire blade population was secondarily modified (Fig. 61). PE blades show a lower percentage (21.6%) of secondary modification and NBKs show an especially low percentage of secondary modification (12.3%; 98 out of 794 items). The NBKs percentage is even lower than that of the overpass items with secondary modification. This fact further supports the argument that considering only the retouched items in this industry is not satisfying, since some of the blanks were used as tools without secondary modification as the use-wear study confirmed (Lemorini *et al*. 2006). In the case of the NBK, secondary modification seems to be marginal. Their potential as non-modified cutting implements seems to be the main target of their production.

Since NBKs are important items that can be considered as 'technologically defined tools' it is important to examine their relation to 'NBK-flakes'. The NBKs (laminar) and 'NBK-flakes' (blanks and shaped) appear in different percentages in the five samples (% calculated out of the debitage and shaped items) but they show some correlation. First, in cases the percentage of laminar NBKs increases, the percentage of ‘NBK-flakes’ decreases and vice versa. Second, if they are counted together they show a higher homogeneity in percentage throughout the studied samples (Fig. 62). In the latter case they constitute 10.2-12.1% of the debitage and shaped items, with a single exception in sample G/19-20 where they constitute 16.5%. This similarity might imply that NBKs (laminar) and 'NBK-flakes' are indeed the same 'type', as previously suggested (e.g. Bordes 1961b:33) and that they represent two different choices for achieving the same goal. The amount of ‘NBK-flakes’ produced correlates with the general percentage of flakes in the assemblages (Fig. 63).

Another perspective that may help in understanding the technological choices for producing specific end-products lies in the frequencies of the different shaped laminar item types in the five samples (Table 2). The high percentages of 'retouched laminar items' (51.1-82.6% of the shaped *laminar* items) in contrast to the other types that appear in lower frequencies (up to 18.2% of the shaped *laminar* items) is of great significance. Since most ‘retouched laminar items’ have one or two sharp edges, it is assumed that potential cutting edges were a major target of the production. The paucity of end-scrapers, burins and side-scrapers made on laminar items, for which there might have been a slightly different blank preference, did not originated from a different reduction sequence since they could have been shaped on sporadic blanks from a reduction focusing on producing cutting implements. It is of note that NBKs were selected in relatively high percentages for making end-scrapers and 'distally retouched laminar items', and relatively low percentage for 'retouched laminar items' (Fig. 64). The fact that the general distribution of shaped items made on NBKs is clearly different from that of blades and PE blades and that even the overpass items and crested blades show more similarity to the latter two than the NBKs further supports the unique character of NBKs and the suggestion that their main purpose did not involve secondary modification.

Since use-wear analysis is still on-going and results are available only for sample K/10 (Lemorini *et al*. 2006), we can only assume the functions of the shaped items. It seems that the majority of the shaped laminar items required a sharp cutting edge and only a small portion required items with relatively obtuse edge angles for scarping activities. This pattern can be seen in the composition of the selected blanks for each shaped item type as presented in Fig. 65. Blades form the largest group in all types except for the 'distally retouched laminar items'. NBKs constitute a relatively high percentage in types that seemingly did not require a cutting edge, including the ‘distally retouched laminar items’, end-scrapers, burins and notches. This indicates a clear contrast between the assumed "original" purpose of NBKs as cutting implements and their use as shaped items – a point which further supports the argument that they were not primary intended to be modified into shaped items.

In all, the selection of blanks for various shaped items shows some clear preferences. Most of the shaped item types were made on blades and a lesser amount on PE blades. NBKs, overpass items and crested blades were sporadically selected and burin spalls were only rarely selected (it is of note that use-wear resulting from cutting activities was found on several burin spalls from sample K/10; Lemorini *et al*. 2006). Of the latter, all but the NBKs are CTEs or other modification items (i.e. burin spalls) and their use for secondary modification seems to be opportunistic. This is not the case of the NBKs that were produced in large numbers. It is thus assumed that the NBKs were used without secondary modification as the preliminary use-wear study confirms (Lemorini *et al*. 2006).

Attribute Analysis of the Three Laminar Types

The Analyzed Sample

The analysis of the three laminar types from Qesem Cave included 2,551 blades, PE blades and NBKs, both blanks and shaped items. The blanks (n=1,936) include 645 blades, 595 PE blades and 696 NBKs. The shaped items (n=615) include 353 blades, 164 PE blades and 98 NBKs (Table 3).

State of Preservation

The laminar items have been well preserved as indicated by the fact that in all the samples whole items are the most common (Fig. 66). A sole exception is the case of blades from sample F-H/13-15 in which proximal parts slightly outnumber whole items. Nevertheless, the precise state of preservation varies among the samples; Unit V and sample K/10 contain the best preserved items, while the most fragmented items are found in sample F-H/13-15. A repeated pattern observed in all samples (except for sample G-I/19-22) is that the percentage of whole items is highest among NBKs, followed by PE blades and then by blades. This pattern indicates the durability of the three laminar types and it seems that blades which are also thinner (see below) were the most fragile. When all the samples are grouped together, whole items are statistically less common among the blades than among the PE blades ($X^2=9.76$, df=1, $p<0.05$) or the NBKs ($X^2=15.68$, df=1, $p<0.05$). The paucity of medial fragments is probably due to the fact that the three laminar types are rather robust and were usually broken into two – proximal and distal fragments.

In general, the percentage of whole shaped items is higher than that of the blanks (Fig. 67) (with the exception of PE blades in Unit V and blades in K/10). This pattern which is statistically significant ($X^2=14.93$, df=1, $p<0.05$) may indicate that more durable laminar items were chosen for secondary modification. It may further indicate that shaped items were discarded not because they were intensively used and broken, but due to other reasons such as a dull edge and/or a short use life. The latter option is supported by the use-wear analysis (Lemorini *et al.* 2006)

Amount of Cortex

The percentage of cortex on the dorsal face of the three laminar types (Fig. 68) shows a similar distribution pattern in the various samples. It is of note, that NBKs demonstrate the most uniform pattern, with a clear peak at 30% cortex on the dorsal face (43.7% of all NBKs). The fact that 41.1-57.7% of the blades (blanks and shaped) bear remnants of cortex indicates that cortex was reduced almost all along the reduction sequence and was not removed from the cores before blank detachment. If the three laminar types are grouped together (blanks and shaped), cortex appears on 80.7% of them. Thus, only a fifth of the laminar types were reduced from the inner mass of the nodule without any contact with the cortical exterior.

Patinated surfaces on laminar items (blanks and shaped) appear at the highest percentages on blades (9.9% of all blades with natural surfaces). They appear at slightly lower percentages on PE blades (8.9%) and at even lower percentages on NBKs (3.0%). Cases in which both calcareous cortex and patina are present on the same item constitute 0.9% of the blades that bear natural surfaces, 6.2% of the PE blades and 5.2% of the NBK. It is thus concluded that in the case of NBKs, the tendency was to remove them with a clear calcareous cortical back and not with patinated surface.

When examining the presence of patinated surfaces on the three laminar types together (including the cases in which they appear alongside calcareous cortex), it is found that in Unit V they appear in the highest percentage (16.3%) and in sample G/19-20 in the lowest percentage (8.5%). Since their presence either reflects the use of recycled knapped flint or the collection of flint from the surface (patintaed surfaces can represent old breakage plains), it bears on the quality of the used raw material in the different samples. According to this argument, Unit V shows the lowest quality of flint and sample G/19-20 the highest. In addition, since there is no reason to assume that the landscape dramatically changed during the time frame that the samples represent, the differences are presumed to be a matter of choice.

An attempt to identify the effect of cortex on the selection of laminar items for secondary modification shows an almost complete match in the distribution pattern of both blanks and shaped items (Fig. 69). It is thus assumed that the precise amount of cortex did not play a major role in the selection of blanks for secondary modification. This is the case not only for the PE blades and NBKs but also for the blades.

Cortex Configurations

Cortex configuration of PE blades demonstrates a high similarity to that of NBKs with 83.9% of the PE blades (blanks and shaped) having one cortical lateral edge and an opposite sharp edge (an additional 2% have the same cortex configuration but the plain edge is not sharp). The percentage of PE blades with one cortical edge and one sharp edge varies among the samples from 80.0-91.8%. These PE blades were the ones mainly selected for secondary modification as indicated by the fact that while the other cortex configurations constitute 19.1% of the PE blade blanks, they constitute only 6.7% of the shaped PE blades. On items which the cortex does not cover the entire lateral edge, the plain part mostly appears near the proximal end.

Among the whole blades which bear cortex (n=330; blanks and shaped), the cortex mostly appears on the distal end (40.9%), but is also quite common on the lateral edge where it spreads along a part (36.7%) or all of it (14.8%). Less common configurations of cortex on blades include cortex along the proximal end (5.8%), along the middle of the dorsal face (1.5%) or along both lateral edges (0.3%).

The side of the cortex (left/right) on PE blades and NBKs (blanks and shaped) is fairly equal in samples G/19-20 and F-H/13-15, with small differences in sample K/10 and with larger differences ranging from 40-60% in Unit V and sample G/I-19-22 (Fig. 70). In all, the differences between left and right are small (each constituting 50%±10).

The differences in the side of cortex among the blades (blanks and shaped) in the various samples (Fig. 71) fluctuates around 50%±12%. A small tendency for a left position of the cortex is present in all of the samples but Unit V.

Examining as one group the blades, PE blades and NBKs (Fig. 72) demonstrates that in all samples the left/right position of the cortex tends to be equal (50%±4.3%). This supports the assumption that the three laminar types were commonly produced by a single reduction sequence which commonly used raw material with two cortical sides (either slabs or fist size nodules).

The fairly even distribution of the cortical side among PE blades and NBKs in samples G/19-20, F-H/13-15 and K/10 demonstrates that in these samples there was no repeatedly preferred side for the production of a specific laminar type and that they were reduced from both sides of the core. The larger differences in Unit V and sample G-I/19-23 might indicate a tendency to reduce more NBKs from one side of the core and more PE blades from another (although the precise choice of sides is different in the two samples). It is interesting that in both these samples the differences in the left/right position between PE blades and NBKs are complementary – if PE blades demonstrate a higher tendency for a right position of the cortex than NBKs demonstrate a higher tendency for a left position.

Angles of the Lateral Edges

The distribution of the angle of the cortical edge of PE blade and NBKs (Fig. 73) shows a bi-modal pattern, indicating that NBKs and PE blades are indeed two different types. The peak of NBKs clusters around 75°-90° and the peak of PE blades clusters around 45°-55°. Although the "boundary" between the two types might vary slightly in the different samples (Fig. 74), it is best placed on 60° for the Qesem Cave samples. Nevertheless, it is of note that these two laminar types merge into each other and that their precise distribution patterns among the various samples vary. The different peaks of the PE blades are in correlation with the different peaks of the NBKs. For examples, in samples F-H/13-15 and K-10 where the peak of the NBKs is at a relatively "small" angle (75° in both; small in comparison to NBKs), the peaks of the PE blades are also at relatively small angles (35°-50° and 40° respectively). This correlation indicates that the PE blades and NBKs were generally part of a single reduction sequence in which the character of each blank produced affected the character of the others.

Non-uniform angles of the cortical edge were observed in 22.6% of the PE blades and 13.9% of the NBKs. Their presence in the different samples varies, however in all but sample K/10 the NBKs are characterized by a lower percentage of non-uniform angles of the cortical edge than PE blades (Fig. 75).

Comparing blanks to shaped items (Figs. 76-77) demonstrates that there was a general selection of PE blades and NBKs with more acute angles of the cortical edge for secondary modification. This was found to be statistically significant in the case of PE blades ($t[228]=2.83$, $p<0.05$). The percentages of blanks and shaped items with a non-uniform angle of the cortical edge vary as well. In the case of PE blades they constitute 22.8% of the blanks and 19.5% of the shaped items. In the case of NBKs they constitute 13.3% of the blanks and 15.2% of the shaped NBKs.

The angles of the sharp edges were examined as well (Fig. 78) and showed acuter angles than the angles of the cortical edges among both PE blades and NBKs, although among the PE blades the difference is small. Both types demonstrate a rather similar distribution pattern with peaks at 40°. However, while the peak of the PE blades is clearly emphasized, the peak of the NBKs clusters on a larger range of 40°-50°. Furthermore, the distribution pattern of the NBKs demonstrates almost a perfect bell shape, while the PE blades have a less organized pattern. The presence of items with a non-uniform angle of the sharp edge varies among the samples (Fig. 79), whereby NBKs are characterized by more uniform angles than PE blades. While a sharp edge with a non-uniform angle appears on 8.8% of the PE blades, it appears on only 2.9% of the NBKs. This difference is statistically significant (X^2=12.18, df=1, $p<0.05$).

The selection of items for secondary modification (Figs. 80-81) demonstrates slightly different preferences concerning the angles of the sharp edge. In the case of PE blades, items with more acute angles were preferred, while in the case of NBKs, items with a more obtuse angles were preferred. In addition, while a non-uniform angle of the sharp edge appears on 8.9% of the PE blade blanks and 3.4% of the NBK blanks, it appears on 8.4% of the shaped PE blades and on none of the shaped NBKs.

The results demonstrate that the PE blades and NBKs not only differ in the angle of the cortical edge but also in that of the sharp edge. The sharp edge of NBKs is characterized by angles that are more uniform and slightly less acute than those of the PE blades. This is evident not only in the blanks but also in the selection for secondary modification, a fact that might indicate a different use. The use-wear study of sample K/10 (Lemorini *et al.* 2006) indicated that edges with acute angles (up to 40°) were more often used for cutting soft material, while edges with angles of 40° and up were more often used for cutting materials of medium hardness and for scraping. Using these results for a statement on the general assemblage we can argue that the PE blades are more suitable for fine cutting, while the NBKs are more suitable for dismembering carcasses – a task that includes cutting, scraping and frequent contact with bones.

The angles of the lateral edges of blades were also examined (Fig. 82) showing that NBKs and PE blades differ from blades not only in the lesser presence (or absence) of cortex but in other aspects as well. Both angles of the lateral edges of blades tend to be more acute than those of the cortical items. While the distribution pattern of the sharp edge of the cortical laminar blanks peak at 40° with a tendency towards more obtuse angles and a general distribution from 35°-55°, that of the blades peak at 40° but with a tendency towards more acute angles and a general distribution from 30°-50°. Furthermore, it appears that in the production of blades, items with two sharp lateral edges were preferred.

The presence of blades with lateral edges with non-uniform angles varies among the samples (Fig. 84). Samples G/19-20 and K/10 show the highest percentages of blades with two edges characterized by uniform angles and accordingly the lowest percentages of two edges with non-uniform angles. Unit V shows the highest percentage of non-uniform angles.

The comparison between blade blanks and shaped blades (Fig. 83) demonstrates that there was a selection of items with more acute edge angles – a difference that was found to be statistically significant ($t[1019.00]=4.65$, $p<0.05$). The effect of lateral edges with non-uniform angles on the selection of blades for secondary modification is presented in Fig. 85. Blades with two lateral edges with uniform angles are slightly more common among the shaped items (65.5%) than among the blanks (61.9%). Blades with one lateral edge with a uniform angle and one lateral edge with a non-uniform angle are also slightly more common among the shaped items (33.1%) than among the blanks (27.4%). This might be explained by the fact that one potential cutting edge is enough for their intended purpose. In contrast, blades with two lateral edges with non-uniform angles were rarely selected for secondary modification; while they form 10.7% of the blade blanks, they form only 1.4% of the shaped blades. This difference is statistically significant ($X^2=11.54$, $df=1$, $p<0.05$). This point emphasizes the importance of producing items with a regular cutting edge.

Blade Shapes and Lateral Edges of PE Blades and NBKs

Various shapes of blades (blanks and shaped) appear in each of the studied samples (Fig. 86) – a variability that probably characterized the production. Nevertheless, the dominance of blades with parallel edges in most samples except for Unit V and F-H/13-15 is of note. Their relatively high percentage in sample G/19-20 and their paucity in Unit V is also of importance. The high frequencies of 'straight-irregular', 'curved-irregular' and 'irregular' shapes of blades in Unit V are in accordance with this pattern.

The comparison between blanks and shaped blades (Fig. 87) indicates that blades with parallel and pointed shapes were favored for secondary modification. The other shapes are more common among the blanks than among the shaped blades and were probably less desired.

When uniting the PE blades and NBKs, the distribution pattern of the outline of the cortical edge (Fig. 88) demonstrates a high similarity among the samples (except for Unit V) and reflects the use of similar raw material. The dominance of straight outlines reflects the common use of flat flint slabs. When each of the cortical laminar types is examined separately, this similarity is slightly less obvious among the

PE blades than among the NBKs (Fig. 89). It thus seems that there was a higher emphasis on achieving a straight cortical edge in the case of NBKs than in that of PE blades. This aspect is also evident in the case of irregular cortical edges that are more common among the PE blades when all samples are examined together (Fig. 90).

The outline of the sharp edge of the PE blades and NBKs is most commonly straight (Fig. 91). The fact that PE blades with a straight outline appear in the highest percentage in sample G/19-20 and NBKs with a straight outline appear in the highest percentage in samples G/19-20 and K/10 is of note. Among the five samples, Unit V demonstrates the most different pattern of dispersion in the case of the NBKs. The comparison between blanks and shaped items, for both PE blades and NBKs (Fig. 92), shows that items with a straight sharp edge were favored, while items with an irregular sharp edge were mostly rejected. The latter indicates the importance of the cutting potential of the shaped items. Comparing the sharp edge of NBKs to that of PE blades demonstrates that the main difference lies not in the presence of irregular edges which appear in an equal amount, but in higher percentages of curved edges and less straight edges among the NBKs (Fig. 91:C).

Butt Types

Among the various types of butts the most common is the thick plain butt, slightly outnumbered by modified butts only in one case – the NBKs from sample F-H/13-15 (Fig. 93). Looking at the five samples, including both blanks and shaped items, the thick plain butts constitute 45.1% of the blades, 46.9% of the PE blades and 49.6% of the NBKs (Fig. 94). The plain thick butts from sample F-H/13-15 were further divided into medium (3-5 mm thickness) and large (6 mm or more), and it was found that the thickness varies among the three laminar types (Fig. 95). In the blades the medium thickness was the most common while in the NBKs the large thickness was the most common. The fact that thin plain butts appear in the smallest amount in NBKs (Fig. 94) correlates with this observation.

The modified butts are for the most part quite thick, with faceting being most common. Although well shaped faceted butts do appear, irregular faceting is more frequent. Other modified butts are mostly surfaces composed of several scars from different directions, probably the traces of previous faceting. Some of the latter are dihedral. In all samples PE blades have the smallest amount of modified butts (Fig. 93). It is assumed that faceting implies that more attention was given to the reduction, indicating that greater effort was put into controlling the shape of the specific end-product. The fact that NBKs and blades show a higher frequency of modified butts than PE blades seems to indicate that controlling the shape of the latter was less important than that of the formers.

Punctiform butts appear in small numbers, indicating that they do not represent a systematic production which concentrated on hitting at a precise point on the striking platform edge as in several later blade industries (e.g. Coinmann 2003; Wiseman 1993). In general punctiform butts are less common among the NBKs (Fig. 94).

Natural butts are covered by cortex or patina and are generally quite thick. The paucity of natural butts (5.1-22.2% among the blanks and the shaped items in the various samples) indicates that although meticulous preparation of the striking platforms was minor at Qesem Cave, it should not be interpreted as neglecting striking platform shaping. In most cases some preparation of the striking platform was performed by at least removing cortex. Blades usually show the lowest percentage of natural butts (5.3%), followed by NBKs (9.7%). The fact that PE blades (13.9%) show the highest percentage of natural butts (Fig. 94) is another indication that the butts of the PE blades were the least treated.

The comparison of butt types between blanks and shaped items (Fig. 96) demonstrates that items with thin plain butts, puncitform butts and natural butts were usually less selected for secondary modification. In uniting all three laminar types a statistically significant difference was found in case of the thin plain butts (X^2=5.39, df=1, $p<0.05$). Another important pattern is that in the case of PE blades there was a clear preference for items with a modified butt.

Micro flaking of the exterior of the butt is found on many of the laminar items (Fig. 97) and it either appears as light retouch or crushing. In general it is most common among blades (ca. 30%), lesser among PE blades (ca. 25%) and even lesser among NBKs (ca. 20%). This pattern characterized samples G-I/19-22, G/19-20 and F-H/13-15. In Unit V micro flaking was slightly more common, nevertheless it shows a similar pattern with a highest frequency among blades, a lower frequency among PE blades and lowest frequency among NBKs. Sample K/10 demonstrates a slightly different pattern. When all samples are grouped together, the presence of micro flaking on the butts of blades was found to be statistically different from both PE blades (X^2=7.01, df=1, $p<0.05$) and NBKs (X^2=15.97, df=1, $p<0.05$).

Examining the presence of micro flaking on the various types of butts (Fig. 98) revealed that it appears in different frequencies. One can thus conclude that the presence of this micro flaking is not arbitrary, but whether it is intentional or a by-product of using hard hammer percussion is still in question. The fact that micro flaking appears in the lowest frequency on modified butts is important and has two possible explanations: (1) The modified butts, which by definition represent the most complex striking platform preparation, in general did not require further treatment such as micro flaking/blunting. (2) The meticulous shaping of the butts enabled a precise impact point for the hammerstone and therefore no micro flaking was formed as by-product. It should be noted however, that both explanations indicate the benefit of modifying the butts. Another clue for understanding the presence of this micro flaking is that it appears differently on the butt types of each of the laminar types (Fig. 99). In the case of blades for example, not only thin and thick butts are characterized by a relatively high percentage of micro flaking but also natural butts. This pattern indicates that micro flaking is not only related to the type of butt but also to the type of blank produced. Comparing the presence of micro flaking on butts of blanks and shaped items did not reveal clear patterns (they are thus not presented) and it seems that its role in the selection of items for secondary modification was minor.

Although a clear cut answer regarding the presence of micro flaking was not found, the variation in its presence on different butt types and on different laminar types supports its having been an intentionally planned act rather than simply a by-product of using hard hammer percussion. The fact that no support for this view was found in the comparison between blanks and shaped items should not out rule this possibility, since even in the case of the modified butts (where the intentional shaping is not in question) there was no major difference between the blanks and shaped items in blades and NBKs. It can be concluded that while the butt type represents the technological choices made in shaping the striking platform, the micro flaking of the edge represents a possible supplementary treatment. If so, these two methods and their combinations represent the varied choices that were available to the Amudian knapper before removing blanks.

The Bulb of Percussion and its Location along the Butt

The bulb of percussion on most laminar items is protruding, indicating the use of powerful blows, most probably by hard hammer direct percussion. Although the presence of laminar items with two adjoining bulbs, usually referred to as 'double impact' is rare (including three blades and two NBKs), it further indicates the use of hard hammer percussion. The bulb of percussion on PE blades and NBKs is most commonly in the middle of the butt. The main difference between the PE blades and NBKs is that among the latter a higher percentage is near the cortical edge (19.8-36.7% and 41.1-49.0% respectively). This difference is statistically significant ($X^2=30.71$, $df=1$, $p<0.05$). In two samples (G/19-20 and K/10) the percentages of NBKs with the bulb of percussion located near the cortical edge is even higher than the 'middle' category. A point of impact near the sharp edge was rare as indicated by the low frequencies of bulb location on this edge. This repeated pattern implies that the placement of the bulb is not accidental. A point of impact near the cortical edge probably affected the angle of this edge making it fairly obtuse and the opposite edge angle acute. The same logic explains the minor frequency of a point of impact near the sharp edge since it would probably create items with a steep edge not useable for cutting. The selection of items for secondary modification (Fig. 101) shows a preference for items with the bulb of percussion in the middle. Items with the bulb near the sharp edge were rarely selected for secondary modification.

The seemingly contradiction between a repeating pattern of hitting near the cortical edge, but not necessarily choosing these items for secondary modification requires an explanation. It is possible that the properties that make these artifacts good cutting implements without secondary modification was not an advantage when secondary modification was considered. This is especially relevant for NBKs, assuming that they were primarily intended to be used as cutting implements without secondary modification. In this case it is possible that the less desirable items were chosen for secondary modification for other purposes. In the case of PE blades, the lack of correlation between the reduction method and their quality as desirable end-products is more complex since they are less suitable to be used as knives without secondary modification. It is thus possible that the reduction of PE blades was not only aimed towards the manufacturing of end-products, but also towards creating the needed contour of the debitage surface for the production of blades and NBKs.

The bulb of percussion on blades (Fig. 102) is in the middle of the butt in 65.6-80.0% of the cases, usually following a central ridge. In the cases where it is not in the middle, no preference for a specific side was noticed. The benefit of an impact blow in the middle is probably in an increased symmetry of the produced blades.

Comparing blanks and shaped items indicates a selection pattern in favor of blades with the bulb located in the middle for secondary modification.

Cross-Sections

The cross-sections of the three laminar types demonstrate different patterns which generally repeat in the five samples (Fig. 103). Blades (blanks and shaped) are dominated by a triangular cross section in all samples. The relatively high percentage of blades with an 'other' cross-section in Unit V may relate to the fact that it is the earliest laminar production from Qesem Cave. The fact that an 'other' cross-section appears in the lowest amount in samples G/19-20 and K/10 might relate to the fact that these samples represent the most intensive laminar production. The relatively high percentages of a trapezoidal cross-section in these samples and in sample F-H/13-15 might also indicate a more regular and continuous laminar production.

PE blades are characterized by the highest percentage of a triangular cross-section of all the laminar types (60.2-68.1%; Fig. 103). The percentage of PE blades with an 'other' cross-section in the five samples probably correlates with regularity of the reduction and the use of raw materials with amorphous shapes.

NBKs demonstrate a domination of a right-angle trapezoidal cross-section in all samples, yet the presence of a relatively high percentage of NBKs with a right-angular triangular cross-section is of importance as well. In Unit V and sample G-I/19-22 the difference between these two cross-sections is small and it might be another indication that the Amudian laminar production of these early stages was slightly less organized. The clear dominance of a right-angle trapezoidal cross-section in samples G/19-20, F-H/13-15 and K/10 is very important, indicating the intention of achieving not only a steep cortical back, but also a form in which a large portion of the dorsal face is generally parallel to the ventral face. This form might have an advantage in using the NBKs, enabling a firmer hand grip.

Comparing the cross-sections of blanks and shaped items (Fig. 104) shows a rather similar pattern for blades and PE blades. In both there was a preference for items with a triangular cross-section and a rejection of most items with a right-angle triangular or 'other' cross-section. Among blades the difference between blanks and shaped items is statistically significant both in the case of the triangular cross-section ($X^2=15.01$, $DF=1$, $p<0.05$) and the ‘other’ cross-section ($X^2=8.95$, $DF=1$, $p<0.05$). The major difference between the blades and the PE blades is that items with a trapezoidal cross-section were preferred in the case of blades but not in the case of PE blades. The selection of NBKs shows a preference for items with a right-angle trapezoidal cross-section. Such items are more common among the shaped items than among the blanks with a statistically significant difference ($X^2=4.27$, $df=1$, $p<0.05$). This demonstrates that NBKs chosen for secondary modification were not those similar to blades or to PE blades but those of a different character. This fact correlates with the pattern of often using them for specific shaped item types (i.e. 'distally retouched laminar items' and end-scrapers). Another difference in the selection for secondary modification among blades, PE blades and NBKs is that while in the case of the former two types, items with an 'other' cross-section were mostly rejected, in the case of NBKs they were not rejected.

End Terminations

Feather end terminations are the most common on all laminar types, including blanks and shaped items (except for the NBKs of sample K/10) (Fig. 105). In all the samples NBKs demonstrate a different pattern than blades and PE blades, and are characterized by lower frequencies of feather and hinge end terminations and higher frequencies of overpassing end terminations. This indicates that the force used in the knapping of these laminar types was different and that the NBKs were reduced by relatively heavier blows than the blades and PE blades.

Comparing the blanks to the shaped items (Fig. 106) reveals that items of the three laminar types with a hinge end termination were rarely selected. Their smaller presence among the shaped items was found to be statistically significant in the case of blades ($X^2=5.85$, $df=1$, $p<0.05$) and PE blades ($X^2=9.77$, $df=1$, $p<0.05$). Laminar items with a feather end termination dominate the blanks and shaped items and they appear in almost equal amounts among both. Overpassing end terminations are more common among the shaped items than among the blanks in the case of the blades and the PE blades – a difference that is statistically significant ($X^2=17.26$, $df=1$, $p<0.05$; $X^2=6.33$, $df=1$, $p<0.05$ respectively). Among the NBKs they appear in relatively equal numbers. The selection of items with an overpassing end termination indicates that the heavy blows which occasionally lead to items with an overpassing end termination were not a disadvantage for their use (shaped or not) and might even have been an advantage.

Distal End Shapes

The shape of the distal end is characterized by a high variability among each of the three laminar types (Fig. 107). The most common end shapes of blades are oblique and pointed and of PE blades oblique, pointed and rounded. NBKs are characterized by a higher representation of wide distal end shapes as reflected by the most common oblique, rounded and straight end shapes. In addition, a pointed distal end shape appears in the lowest percentage among NBKs. It is of note that a high variation in distal end shapes was also observed among the five samples but without a clear pattern (thus not presented). The high variation of the distal end shapes, both within and among samples, probably indicates the absence of a systematic base modification of cores (see below) and the possible minor importance of achieving a specific distal end shape.

The selection pattern for secondarily modification is presented in Fig. 108. Among the blades there was a slight preference for selecting items with a pointed, oblique or rounded end shapes rather than with pointed/rounded, straight or irregular end shapes. The differences between the blanks and shaped items in the cases of the oblique ($X^2=5.68$, df=1, $p<0.05$), straight ($X^2=5.92$, df=1, $p<0.05$) and ‘irregular’ distal end shapes ($X^2=7.58$, df=1, $p<0.05$) are statistically significant. Among PE blades and NBKs the difference between blanks and shaped items is smaller and only a preference for a rounded distal end shape is noticed. This high similarity may indicate that the distal end shape was not of importance in PE blades and NBKs.

Profiles

The distribution patterns of the profiles of the three laminar types (Fig. 109) demonstrate a similar pattern. In all three types, items with a semi-straight profile are the most common and the main difference is in the percentages of items with curved and twisted profiles. Curved profiles show the lowest percentage among the blades and the highest among the NBKs. The twisted profiles, on the other hand, show the highest percentage among the blades and the lowest among the NBKs. The higher percentage of a curved profile among the NBKs might indicate that they were knapped by more powerful blows than the PE blades and the blades. The lighter force used for knapping blades might also be indicated by the higher frequency of convex profiles.

The influence of the bulb of percussion's size on the profiles of the laminar items is considerable and it accounts for the deformation of many of the items with the semi-straight profile and some of the items with the other profiles. The location of the bulb of percussion on the item's butt also affected the profile. This is especially clear on items where the two lateral edges show different curvatures in profile – usually one edge is fairly straight while the second is curved. These items which have a "semi-twisted" profile were added to the twisted or semi-straight profiles, depending on the influence of the curved edge. In order to examine this phenomenon I reviewed items from sample F-H/13-15 with one straight edge and one curved edge. As part of this examination I recorded the correlation between the side of the curved edge and the location of the bulb of percussion on the butt. The results (Fig. 110) clearly demonstrate that the curved edge tends to be the one close to the bulb of percussion, while the straight edge tends to be the one far from it. This was found to be statistically significant ($X^2=35.19$, $df=1$, $p<0.05$).

The differences in profiles among the five samples are only presented in the case of blades (Fig. 111). Unit V demonstrates a lower percentage of semi-straight profiles and a higher percentage of twisted and irregular profiles compared to the other samples.

The comparison of profiles between blanks and shaped items is presented in Fig. 112. The distribution patterns of the shaped blades and shaped PE blades are quite similar and in both cases items with semi-straight and curved profiles were preferred for secondary modification, while items with convex, twisted or irregular profiles were mostly rejected. A statistically significant difference between blank blades and shaped blades was found in the case of the curved ($X^2=22.24$, $df=1$, $p<0.05$), convex ($X^2=7.56$, $df=1$, $p<0.05$), and twisted ($X^2=8.27$, $df=1$, $p<0.05$) profiles. A statistically significant difference was also found between blank PE blades and shaped PE blades in the case of curved ($X^2=3.93$, $df=1$, $p<0.05$) and twisted ($X^2=8.57$, $df=1$, $p<0.05$) profiles. The selection pattern of the NBKs differs from that of the former two types in that items with a semi-straight profile are more common among the blanks. The fact that convex and irregular profiles appear in similar percentages among both blank NBKs and shaped NBKs is of significance as well. A characteristic shared by NBKs as well as the former two types is that items with a curved profile are more common among the shaped items than among the blanks, a difference that is statistically significant in the case of NBKs as well ($X^2=5.43$, $df=1$, $p<0.05$). The selection of items with a curved profile in all cases reinforces the assumption that laminar items were not hafted, since the curved profile makes hafting difficult.

Number of Laminar Scars

The number of laminar scars on the dorsal face varies among the three laminar types (blanks and shaped; Fig. 113). Among the blades, the peak of the distribution pattern is at two laminar scars in all samples, except for sample G/19-20 where it is at three laminar scars. Among the PE blades, the peak is at one laminar scar in all samples and among the NBKs the peak is at two laminar scars except for sample G-I/19-22 where it is at one laminar scar. The minor presence of blades with no laminar scars is of note (n=blanks – Unit V: 2; G-I/19-22: 5; F-H/13-15: 2; shaped items – Unit V: 2; F-H/13-15: 1). The mean number of laminar scars is 2.5 (s.d. 1.1) for blades, 1.3 (s.d. 0.8) for PE blades and 1.8 (s.d. 0.8) for NBKs.

The small number of scars on most of the laminar items indicates that the debitage surfaces of the cores generally did not bear a large number of laminar scars. The possibility that the number of laminar scars correlates to the intensity of the reduction of laminar items is suggested by the fact that the blades from sample G/19-20, which is characterized by the highest percentage of laminar items, has the highest peak – three laminar scars. Unit V, on the other hand, which is characterized by the lowest percentage of laminar items, has the lowest range of laminar scars as apparent from the highest percentage of blades with no laminar scars. The fact that the PE blades and NBKs of Unit V also have the highest percentage of items with no laminar scars further indicates the less systematic laminar production of this sample.

Comparing the blanks to the shaped items (Fig. 114) revealed only small differences. This is also observed in the mean number of laminar scars (blade blanks: 2.5 [s.d. 1.1] – shaped blades: 2.6 [s.d. 1.0]; blank PE blades: 1.3 [s.d. 0.8] – shaped PE blades: 1.2 [s.d. 0.6]; blank NBKs: 1.8 [s.d. 0.8] – shaped NBKs: 1.8 [s.d. 0.6]).

Metrics

The distribution patterns of length of the three laminar types (blanks and shaped) are quite similar (Fig. 115). This similarity is also observed in the mean length which stands on 51.2 mm (s.d. 12.7) for blades, 53.7 mm (s.d. 12.0) for PE blades, and 52.5 mm (s.d. 10.9) for NBKs (Table 4). PE blades and NBKs are slightly longer than blades in most samples – a difference that probably results from the fact that while the former were reduced from the outer mass of the nodules, blades were reduced from the inner mass. In terms of ranges, the majority of the laminar items are

41-60 mm long. The similarity in length is one of the indications that the blades, PE blades and NBKs were usually the product of a single reduction sequence.

In examining the three laminar types together, the five samples demonstrate a difference in the distribution patterns of length (Fig. 116). In samples G-I/19-22 and K/10 the peak is at 41-45 mm, in sample G/19-20 it is at 46-50 mm and in sample F-H/13-15 and Unit V it is at 51-55 mm. Nevertheless, these differences become obsolete when the means come into play, only varying from 50.1 to 53.7 mm (Table 4).

The distribution of the width of the three laminar types (blanks and shaped) demonstrates a similar pattern (Fig. 117), again indicating that they are part of a single reduction sequence. The peaks are at 16-20 mm and most of the laminar items are 16-25 mm in width. Their similarity is also observed in the mean width that varies only 0.7 mm among the three laminar types; the mean width of blades is 20.9 mm (s.d. 5.5), of PE blades 21.5 mm (s.d. 5.6) and of NBKs 20.8 mm (s.d. 5.3). Nevertheless, the width shows a larger variation among the samples (Fig. 118). While in most samples the peak is at 16-20 mm, in Unit V it is at 21-25 mm. When examining the distribution pattern of each laminar type in the various samples (Fig. 119), the variations are more pronounce among the blades and the PE blades than among the NBKs which demonstrate the most uniform pattern (except for Unit V with wide NBKs). The variation in the mean width is presented in Table 5.

In contrast to the relatively homogeneous distribution patterns of length and width among the three laminar types, the thickness demonstrates a clear difference (Fig. 120). The blades are thinner than the PE blades which are thinner than the NBKs. While in the former the peak is at 7 mm, in the latter two it is at 10-11 mm. The means are: 8.6 mm (s.d. 3.1) for blades, 9.9 mm (s.d. 3.1) for PE blades, and 10.8 mm (s.d. 3.6) for NBKs. A statistically significant difference was found between blades and PE blades ($t[821]=5.75$, $p<0.05$), blades and NBKs ($t[854]=9.58$, $p<0.05$) and PE blades and NBKs ($t[804.41]=4.11$, $p<0.05$). This pattern is repeated in each of the samples as observed in the means (Fig. 121). For example, in Unit V, where blades are relatively thick (9.6 mm [s.d. 4.1]), PE blades and NBKs are also thicker (10.6 mm [s.d. 3.3] and 13.2 mm [s.d. 4.9] respectively).

The length/width ratio of the majority of the laminar items (blanks and shaped) is between 2.0-2.5 among all three laminar types (Fig. 122). In general, the longer the laminar item the greater its width, keeping a length/width ratio of 2.0-2.5 (Fig. 123). However, the exact distribution pattern of this ratio varies among the samples, while most of them show a peak at 2.1, samples K/10 and G/19-20 peak at 2.4-2.5 (Fig. 124). The mean length/width ratio of all samples is 2.5 (s.d. 0.4) for blades, 2.6 (s.d. 0.5) for PE blades, and 2.6 (s.d. 0.5) for NBKs (Table 7).

The distribution pattern of the width/thickness ratio shows a clear difference among the three laminar types (blanks and shaped; Fig. 125). Blades have the highest width/thickness ratio with a peak at 2.1-2.5 and NBKs have the lowest ratio with a peak at 1.6-2.0. This difference is also observed in the mean width/thickness ratio (Table 8). A statistically significant difference was found between blades and PE blades ($t[792.47]=6.34$, $p<0.05$), blades and NBKs ($t[806.84]=11.59$, $p<0.05$) and PE blades and NBKs ($t[803]=5.81$, $p<0.05$). This ratio indicates that out of the three laminar types blades tend to have the thinnest cross-section and NBKs tend to have the thickest cross-section. The width/thickness ratio of each of the laminar types shows a high variation among the five samples with only the NBKs demonstrating the same peak of 1.6-2.0 in all samples (Fig. 126). This uniformity might indicate that such a ratio is one of the characteristics of NBKs in general.

Comparing blanks to shaped items shows that generally, longer, wider and thicker items were selected for secondary modification as demonstrated by the distributions patterns and means (Tables 4-6; Figs: 127-129). A statistically significant difference was found in the cases of length and width for all three laminar types (Length – blades: $t[431]=6.25$, $p<0.05$; PE blades: $t[383]=3.79$, $p<0.05$; NBKs: $t[416]=4.93$, $p<0.05$) (Width – blades: $t[427]=4.58$, $p<0.05$; PE blades: $t[383]=3.47$, $p<0.05$; NBKs: $t[418]=4.72$, $p<0.05$). In the case of thickness a statistically significance difference was found only in the case of the PE blades ($t[387]=2.70$, $p<0.05$). The selection of larger items is of importance in evaluating the efficiency of the technology. It indicates that the laminar items of this industry, which are relatively robust compared to later blade industries (e.g. Coinman 2003), does not demonstrate low knapping capabilities (unachieved delicate blades) rather that they were intentionally produced this way.

The affect of the length/width ratio in the selection of items for secondary modification is presented in Fig. 130. Among all three laminar types there was a tendency for selecting items with a slightly larger length/width ratio. This is evident from the fact that the peaks that characterized the blanks of the three laminar types are at 2.1, while the shaped items show slightly higher peaks of 2.2-2.5. In terms of the means of length/width ratio the differences are minor and only the blades show a repeated pattern of selecting more elongated items. The blades were also the only type to show a significant statistical difference regarding this aspect ($t[420]=2.62$, $p<0.05$). The small difference between the blanks and shaped items indicates that the desire for elongated items had its limit and especially elongated items were not required.

The comparison of width/thickness ratio between the blanks and the shaped items (Fig. 131) shows a high similarity both among blades and PE blades and it is thus apparent that it did not play a major role in the selection for secondary modification in their case. A small difference is observed only in the case of NBKs where a slightly higher width/thickness ratio characterizes the shaped items. It may indicate that in the selection of NBKs for secondary modification, items with a thinner cross-section were preferred as in blades and PE blades.

Hinge Scars

Hinge scars were found on 34.7% of the blades, 22.6% of the PE blades and 18.0% of the NBKs, including both blanks and shaped items (n=430, 389 and 422 respectively). The presence of more hinge scars on blades, which is statistically significant compared to the PE blades ($X^2=14.37$, df=1, $p<0.05$) and the NBKs ($X^2=30.35$, df=1, $p<0.05$), is not surprising, since they also have more laminar scars on the dorsal face. It is interesting that NBKs, which are generally characterized by more laminar scars than PE blades, are characterized by less hinge scars than PE blades. A comparison of the three laminar types as one shows a high similarity among the five samples (Fig. 132).

The distribution patterns of hinge scars on the blanks and the shaped items are shown in Fig. 133. Items without hinge scars are more common among the shaped items than among the blanks of each laminar type. A statistically significant difference however was found only in the case of the blades ($X^2=7.16$, df=1, $p<0.05$). While items with multiple hinge scars are rare in the blanks, they are completely absent from the shaped items.

Summarizing the Attribute Analysis of the Three Laminar Types

The attribute analysis of the three laminar types revealed many aspects that help in reconstructing the laminar technology practiced at Qesem Cave. They are summarized and discussed as follows:

1) *Description of the three laminar types*

The following description refers to the results of examining both blanks and shaped items.

Blades

The blades from Qesem Cave frequently bear remnants of cortex, mostly spread along their distal end (44.7% of them have up to 20% cortex on their dorsal face). Their shapes vary, however parallel edges are the most common. The butts are most frequently plain, however modified butts are common as well. The bulb of percussion is generally located in the middle of the butt. Triangular cross-sections are dominant (47.2%), but trapezoidal cross-sections are common as well (26.4%). Semi-straight profiles are the most common and so is the presence of two laminar scars on the dorsal face. The blades range in length between 27-130 mm, but most of them are between 41-60 mm. Their width ranges between 12-46 mm, but most of them are between 16-25 mm. Their thickness ranges between 3-24 mm, but most of them are between 5-11 mm. The mean dimensions for blades are 51.2 mm (s.d. 12.7) long, 20.9 mm (s.d. 5.5) wide and 8.6 mm (s.d. 3.1) thick. Their length/width ratio ranges from 2.0-4.6 with most falling between 2.1-.2.5. Their width/thickness ratio ranges from 0.8-5.5 with most falling between 1.6-3.0. Hinge scars appear on about one third of them.

Primary element blades (PE blades)

The PE blades have extensive cortical surfaces that generally cover 50% of their dorsal face. In all, 83.9% of them have a strip of cortex along one edge while the other edge is sharp and can be used as a cutting edge. The angle of the cortical edge ranges from 25º-55º but most items are characterized by 45º-55º. The cortical and the sharp edges are most commonly straight. The butts are mostly of the thick plain type, however modified butts are common as well. The bulb of percussion is usually in the middle of the butt, however some are near the cortical edge. The dominant cross-section is triangular (64.9%). PE blades usually have a single laminar scar on their dorsal face and their most common profile is semi-straight. They range in length between 27-99 mm, but most of them are between 41-60 mm. Their width ranges between 12-41 mm, but most of them are between 16-25 mm. Their thickness ranges between 4-20 mm, but most of them are between 6-13 mm. The mean dimensions for PE blades are 53.7 mm (s.d. 12.0) long, 21.5 mm (s.d. 5.6) wide and 9.9 mm (s.d. 3.1) thick. Their length/width ratio ranges from 2.0-4.2 but most of them are between 2.1-

2.5. Their width/thickness ratio ranges from 1.0-5.0 but most of them are between 1.6-2.5. Hinge scars appear on about one quarter of the PE blades.

Naturally backed knives (NBKs)

The NBKs have a strip of cortex along all or most of one of the lateral edges that generally constitutes ca. 30% of the dorsal face. The other edge is a potential cutting edge. The angle of the cortical edge ranges from 60º-110 º but most of them are between 75º-90º. The cortical and sharp edges are generally straight but a curved sharp edge is common as well. The most prevalent butt type is thick plain, however a modified butts are also common. Although the bulb of percussion is usually in the middle of the butt, it is also often found near the cortical edge. The most prevalent cross-section is right-angle trapezoidal (50.6%), but right-angle triangular is common as well (29.1%). A considerable portion of the NBKs (36.9%) is characterized by an overpassing end termination. They are most commonly characterized by a semi-straight profile (41.5%), but a curved profile is also common (31.0%). NBKs are usually characterized by two laminar scars on their dorsal face. They range in length between 27-92 mm, but most of them are between 41-60 mm. Their width ranges between 12-45 mm, but most of them are between 16-25 mm. Their thickness ranges between 4-28 mm, but most of them are between 6-13 mm. The mean dimensions for NBKs are 52.5 mm (s.d. 10.9) long, 20.8 mm (s.d. 5.3) wide and 10.8 mm (s.d. 3.6) thick. Their length/width ratio ranges from 2.0-5.6 but mostly falls between 2.1-.2.5. Their width/thickness ratio ranges from 0.8-4.7 but mostly falls between 1.1-2.5. Hinge scars appear on about one fifth of the NBKs.

2) *Preliminary observations regarding the laminar technology*

The presence of cortex on most of the laminar items (80.7%) indicates that cortex was not removed prior to the reduction of laminar items. The common appearance of cortex, even on blades, indicates that very few laminar items were reduced from the inner parts of the raw material without peeling parts of its exterior. It is thus concluded that not only blades were target end-products, but also laminar items bearing cortex. In the latter case, there was a focus towards the production of items with one uniform cortical edge and an opposite sharp edge (mainly NBKs, but also PE blades). The number of cases in which the cortex appears on the right or left edges are either equal or with small variations which become equal when the three laminar types are examined together (Fig. 70-72). This is an indication of the use of raw material with cortex on both faces (flat slabs or fist size nodules), but more importantly that the three laminar types are complementary in terms of the reduction. The relations between them indicates that the removal of one laminar type prepared the outline of the other as also attests by the distribution patterns of the cortical edge angles of PE blades and NBKs (Fig. 74).

The relatively high percentages of PE blades and NBKs with a straight cortical edge (Fig. 88) point to the common use of flat flint slabs. Its common use not only contributed to the complementary removal of a series of blades, PE blades and NBKs, but also to the laminar production in general. This is best observed when examining the correlation between the length/width ratio and the outline of the cortical edge of both PE blades and NBKs as one population. The results (Fig. 134) demonstrate that items with a straight cortical edge have a higher length/width ratio than those with the curved or irregular cortical edge.

The reduction of laminar items was conducted by hard hammer and relatively powerful blows as evidenced by the common presence of a protruding bulb of percussion and an overpassing end termination. The fact that most laminar items are characterized by thick butt types indicates hitting deep inside the striking platform. This enabled producing relatively long, wide and thick laminar items as Dibble (1981) and Pelcin (1997) demonstrated. A correlation between the presence of a thick butt type and length is exemplified in the case of the blades (Fig. 135). Another examination is of the correlation between the butt thickness and the type of end termination, which is an indication of the "relative" length in relation to the debitage surface (Fig. 136). Placing the impact blow near the striking platform edge, as attested to by the thin butts, was more likely to result in items with a feather or a hinge end termination thus indicating that their removal did not necessarily follow through the entire length of the debitage surface. In contrast, placing the impact blow inside the striking platform, as attested to by the thick butts, had greater potential for removing items that have an overpassing end termination and following through the entire debitage surface. The difference between these types of butts and the presence of overpassing end terminations was found to be statistically significant (X^2=5.63, df=1, $p<0.05$). The removal of items that followed through the entire debitage surface seems to have been intentional and among its benefits was a better preservation of the debitage surface with less hinge scars and a convenient curvature for production.

The various butt types usually attest to little effort invested in shaping the striking platform. This includes the case of the modified butts which generally demonstrate simple faceting. The technological choice of hitting deep inside the striking platform probably enabled this simplicity. Nevertheless, the common presence of micro flaking along the exterior of the butts, which might have been a complementary preparation before reducing a laminar item, further demonstrates that striking platform maintenance was not neglected, but in most cases only required minimal actions.

The high variability in the shapes of the distal end indicates that there was no defined core base treatment that dictated the shape of the distal end. It is also an indication that the shape of the distal end probably did not play an important role in this industry. This aspect is also suggested by the pattern of selection for secondary modification which does not demonstrate clear cut preferences in the case of PE blades and NBKs. The fact that there was no major emphasis on achieving a pointed end shape may imply that the laminar items were intended to be used for a range of activities involved with cutting and the main goal was the lateral sharp edges.

Although in general the three laminar types were reduced in a single reduction sequence, the nature of reduction of each of the laminar types within that sequence slightly varies. For example, the habit of powerful blows and follow-through reduction was more common among the NBKs than among the blades. The location of the bulb of percussion on the items' butts also varies. While on all laminar items it tends to be in the middle, in the case of NBKs and PE blades it appears near the cortical edge as well. This was probably intentional in order to make the cortical edge of these laminar types more pronounced. In the case of the blades, on the other hand, there was a clear preference for placing the impact point in the middle of the items, enhancing the possibility of having two potential cutting edges and greater symmetry. The fact that modified butts appear in the lowest percentages among the PE blades might indicate that they are laminar items whose precise outline was the least important. It is even possible that it is an indication that the blades and NBKs were the main end products while the PE blades were less desired. Nevertheless, PE blade production could not be avoided since as noted the three laminar types are complementary.

3) *Differences between the samples*

Although the five samples demonstrate some differences regarding the examined attributes of the three laminar types, the high similarity should be noted first. This similarity is pronounced in the mean metrics showing minor variations (Tables 4-6) in many of the cases. Nevertheless, the small differences are of importance and there seems to be a repeated pattern in which samples G/19-20 and K/10, with the highest percentage of laminar items, represent the most uniform production. In contrast, Unit V, the oldest studied sample from Qesem Cave with the smallest laminar component, represents the least uniform production. Samples G-I/19-22 and F-H/13-15 fall in between these extremes.

This pattern can be observed in the angles of the lateral edges of blades in which uniform angles are the most common in samples G/19-20 and K/10, while non-uniform angles are the most common in Unit V (Fig. 84). The fact that Unit V also presents the highest percentage of sharp edges with a non-uniform angle in the case of PE blades and NBKs (Fig. 79) is of note as well. In addition, the blades from Unit V are characterized by the highest percentage of irregular profiles. In the case of the number of laminar scars, Unit V shows the smallest number and G/19-20 the highest (Fig. 113). A similar pattern is observed in the items’ cross-sections. The blades from samples G/19-20 and K/10 have the lowest percentage of an 'other' cross-section, while the blades from Unit V have the highest percentage of items with an 'other' cross-section. The presence of a relatively high percentage of a trapezoidal cross-section in samples G/19-20, F-H/13-15 and K/10 might also correlate to a more regular laminar production (Fig. 103). The cross-sections of NBKs show variation between the samples as well. In Unit V and G-I/19-22 the difference between the right-angle triangular and the right-angle trapezoidal is small, while in samples G/19-20, F-H/13-15 and K/10 the right-angle trapezoidal cross-section is more common (Fig. 103). Another aspect that demonstrates this difference is that the length/width ratio is the lowest in Unit V and the highest in samples G/19-20 and K/10 (Table 7; Fig. 124).

4) *The characteristics of the items selected for secondary modification*

The comparison between blanks and shaped items revealed several aspects that may shed light on the desired character of the end products. While certain aspects were shared by all the three laminar types, some only appeared on the blades and PE blades, whereas the NBKs displayed other patterns. Following the assumption that

NBKs were primarily intended to be used without secondary modification, the patterns of selection that characterized them have less potential to reflect the character of the desired NBKs.

The metrics demonstrate one of the major relevant aspects. The comparison between the blanks and shaped items indicated that longer, wider and thicker items were mainly selected for secondary modification (Tables: 4-6; Figs. 127-129). This aspect is also reflected in the state of preservation whereby the shaped items are characterized by higher percentages of whole items than the blanks (Fig. 67) – a fact indicating that the more durable items were selected. This repeated pattern is of importance since it indicates that the Amudian knappers intentionally removed relatively large laminar items and they did not seek delicate blades as in later industries. The small differences in the length/width ratio among the blanks and shaped items (Table 7; Fig. 130) indicate that especially elongated items were not a major target. It seems that although laminar items (with a ratio higher than 2/1) were the target, there was a limit to the desired length/width ratio that might have been affected by the need to create items with a high durability rather than technological barriers.

Sharp edges were required, as is apparent by a set of attributes. In the case of blades, the angles of the lateral edges of the shaped blades are in general more acute than those of the blanks (Fig. 83). Furthermore, blades with two non-uniform angles of the edges were rarely selected (Fig. 85). In the case of PE blades items without a sharp edge were mostly rejected. In addition, the shaped PE blades are characterized by a more acute angle of the sharp edge than blanks PE blades (Fig. 80). PE blades with an irregular outline of the sharp edge were also less selected (Fig. 92). The fact that preferences for a specific distal end shape were found only in the case of blades and that even in this case they were not accentuated (Fig. 108) reinforces the assumption that it was the sharp lateral edges that were of importance. Other evidence of the importance of the sharp edge can be found in the fact that items with a semi-straight profile were commonly selected and that items with convex, twisted or irregular profiles were mostly rejected in the case of blades and PE blades (Fig. 112). The fact that items with hinge scars were usually avoided, especially in the case of blades (Fig. 133), further supports the importance of using fine sharp edges.

In the case of the NBKs the situation is a little more complex. The distributions of the angle of the sharp edge of the blanks and shaped NBKs indicate that the ones with the more obtuse angles were generally selected (Fig. 81). The fact that the peak of the distribution of shaped NBKs is at 50º might indicate that the items selected were intended for scraping activities. Whatever their purpose was, the importance of having a sharp edge with a uniform angle was noticed here as well. While 3.4% of the blank NBKs have a sharp edge with a non-uniform angle, none of the shaped NBKs do. The fact that the results concerning the NBKs contrast those of the blades and PE blades correlates to their assumed principal use as 'technologically defined tools' without secondary modification.

Several additional preferences were observed in the selection for secondary modification. In the case of blades they include a parallel or a pointed shape, a bulb of percussion in the middle of the butt, a triangular cross-section, two laminar scars on the dorsal face, and a feather or overpassing end termination. In the case of PE blades they include a bulb of percussion in the middle of the butt, a triangular cross-section, and one laminar scar on the dorsal face. In the case of NBKs they include a bulb of percussion in the middle of the butt, a right-angle trapezoidal cross-section, two laminar scars on the dorsal face, and a feather or overpassing end termination.

The preferences described above attest to the generally desired characteristics of the end products, however when each of the items was separately evaluated by the knappers, it was an overall look that guided the choices made. It is my assumption that a relatively large size and a good sharp edge were the first factors considered.

5) *NBKs as 'technologically defined tools' and their suitability as hand-held knives*

NBKs are usually regarded as 'technologically defined tools' (Debénath and Dibble 1994:53-54) and the results of the attribute analysis of the laminar items support this view. First, in their morphology that fits a hand-held cutting tool. Second, in the relative homogeneity of their characteristics, which is frequently higher than the homogeneity of blades and PE blades. The fact that in some cases the NBKs with a seemingly lower quality were selected for secondary modification also advocates that their primary goal was to be used as is.

In terms of the morphology, the main characteristics reviewed here are the sharp edge and the opposed steep back. Since their sole presence is part of the NBK's definition (e.g. Debénath and Dibble 1994:53-54), the emphasis here is on their character. The angle of the sharp edge of the NBKs is not very acute and mostly ranges between 40º-50º. Such angles are suitable for cutting medium-hard materials/tissues and are highly efficient in dismembering carcasses (Lemorini *et al*.

2006). The curved outline which characterized some of the sharp edges might have had an advantage for cutting activities by enabling more flexible movement of the wrist while cutting. Although the profile of the NBKs is rarely perfectly straight and many are semi-straight or curved, it seems that fairly straight sharp edges were the goal since they are more efficient for cutting (e.g. Lemorini *et al*. 2006). It is probably the reduction technology, characterized by relatively powerful blows that did not enable the exclusive production of straight sharp edges. Nevertheless, in most cases with a twisted profile the specific sharp edge profile tends to be straighter than that of the cortical edge. Even in the case of the curved profile, the sharp edge in many cases tends to be slightly less curved. The habit of frequently placing the impact blow near the cortical edge contributed to the forming of a straight sharp edge (Fig. 110).

The fact that NBKs exhibit the highest durability as seen in the high percentage of whole items (Fig. 66) indicates that they are suited to be hand-held knives – i.e. enduring the pressures involved while using them. The intention of forming a *steep* cortical edge can be seen in the comparison of the angle of their cortical edge to that of PE blades (Fig. 74) showing two different populations. The cortical back of the NBKs, potentially used as a holding surface, is uniform in most cases, with an either straight or curved outline. This uniformity along the steep angle enabled applying pressure while cutting. The overpassing end termination frequently found on NBKs was another advantage enabling the application of pressure at the distal end. The right-angle trapezoidal cross-section of many of the NBKs, which is characterized by fairly parallel ventral and dorsal faces, further enhanced their suitability for use as hand-held cutting implements. While the former aspects are related to the use of force downward (into the carcass), the latter enabled a good grip for the vertical movement needed for cutting. The fact that out of the three laminar types NBKs are characterized by the lowest percentage of patinated surfaces indicates that in the production of NBKs there was a focus on using the calcareous cortex for forming the back. Calcareous cortex enables a firmer grip than a patinated back since it causes greater friction. The absence of a clear preferred distal end shape further emphasizes that the lateral sharp edge was of importance.

In terms of the relative homogeneity, the higher uniformity of the cortical edge of NBKs compared to PE blades is of importance. This uniformity is reflected in the relative amount of cortex on of the dorsal face (NBKs have the most uniform distribution pattern with a peak at 30% in each of the samples [Fig. 68]), in a lower percentage of non-uniform cortical edge angles (Fig. 75), and in the greater presence of straight cortical edges and less irregular edges (Fig. 90). In the case of the latter, when each sample is examined separately, all but Unit V show almost an identical distribution pattern of the cortical back outline – ca. 60% straight, ca. 25% curved and ca. 15% irregular (Fig. 89).

The higher homogeneity of NBKs compared to PE blades is also characterized by a lower percentage of sharp edges with non-uniform angles (Fig. 79) and less hinge scars. Greater attention paid in preparing the core before knapping NBKs is indicated by the fact that they generally have the highest percentage of modified butts (Fig. 94). The width of NBKs exhibits the most uniform distribution pattern of all the three laminar types with a peak at 16-20 mm (Fig. 119). In addition, while the width/thickness ratio of each of the laminar types varies among the samples, only the NBKs have the same peak at 1.6-2.0 (Fig. 126).

The last point refers to the several repeated patterns in the selection of NBKs for secondary modification that are clearly different from those of blades and PE blades. It seems that while among blades and PE blades the better blanks were selected for secondary modification, among NBKs the opposite pattern frequently appears. The most important of these patterns is that while the blades and PE blades with the more acute sharp angles were generally selected (Figs. 80, 83), it was the NBKs with the less acute sharp edge that were generally selected (Fig. 81). Another such pattern is in the case of hinge scars. While blades with hinge scars on their dorsal face were clearly less selected for secondary modification, in the case of NBKs it is less obvious (Fig. 133). The last aspect here refers to the angle of the cortical back. In this case, PE blades and NBKs demonstrate the same pattern, with more acute angles of the cortical edge largely preferred for secondary modification (Figs. 76-77). This is in accordance with the previous observations since it indicates that the “less backed” NBKs were selected.

In all, the morphology, the homogeneity and the patterns of selection not only support the assumption that NBKs were mainly intended to be used as 'technologically defined tools' but also evince their potential efficiency as hand-held cutting implements.

Analysis of Core Trimming Elements

The presented analysis includes CTEs found in the debitage (n=726) and CTEs that were secondarily modified and recorded in the shaped items (n=74). All together the CTEs constitute 800 items and their division into types is presented in Table 9.

Core Tablets

Core tablets include 43 items (5.4% of the CTEs) with only a few "classic" core tablets (Fig. 28:1-3). As a group, they lack any uniformity in size or shape and their reduction usually led to the removal of only a portion of the striking platform (Fig. 28: 4-5). In the latter case they are often characterized by a right-angle triangular cross-section. Removing such core tablets probably resulted in creating a curved and angular striking platform.

The scarcity of core tablets stands in contrast to the frequent plain butts on the laminar items. This contrast led to the assumption that in many cases the striking platforms were initially shaped by the removal of simple cortical flakes that in technological terms served as 'primary core tablets'. However, these items are rarely identified as such without a refitting study. The renewal of striking platforms was possibly more commonly preformed by faceting and not by removing a core tablet. It is of note that none of the core tablet was selected for secondary modification.

Overpass Items

The analyzed sample

Overpass items constitute the most common CTE type (n=268; 33.5% of the CTEs) and they are the main characteristic of core maintenance and control in the studied samples. They include 224 overpass item blanks and 44 overpass items that were secondarily modified. The majority of the overpass items (n=171; 63.8%) are laminar and the rest (n=97; 36.2%) are flakes (<2/1 in length/width ratio). About one quarter (24.3%) of the overpass items are broken and are represented by distal fragments. The types of shaped items modified on CTEs are presented in Table 10.

The division of overpass items into sub-types as defined in the methodology section includes 68 'initial', 79 'correction' and 71 'regular'. Additional 50 overpass items were recorded as 'unidentified' (18.7%) due to their fragmentary nature.

Excluding the 'unidentified' cases, 'initial' constitutes 31.2%, 'correction' 36.2% and 'regular' 32.6%. Their percentages in the five samples are presented in Fig. 137. It is concluded that only a third of the overpass items were removed in the primary knapping stages while the majority, as represented by the 'correction' and 'regular' overpass items, were knapped during the production of laminar items.

Some of the overpass items (n=58; 21.6%) are similar to NBKs in that they have a natural back and an opposed sharp edge (Figs. 29:2-3,5, 30:7, 31:2,5, 32:4-5). Of these items, 40 are laminar (23.4% of the laminar overpass items) and 18 are flakes (18.6% of the flake overpass items). Their frequencies vary among the three categories of the overpass items. They are common among the 'initial' overpass items (33.8%) and less common among the 'correction' and 'regular' overpass items (17.9% and 19.2% respectively). There is also a morphological difference among these NBK-like items in the three categories; eight of the 23 NBK-like of the 'initial' overpass items have an angular cortex that covers not only the back but also a portion of the frontal dorsal face. The other NBK-like, although more similar to the common NBKs, are less standardized than the formal NBKs and tend to have a curved profile and incomplete sharp edge and back. These overpass items and other overpass items with sharp edges indicate that many of these items could have been used as cutting tools even without secondary modification. This potential and the fact that 16.4% of the overpass items were secondarily modified into shaped items demonstrate that although in general these items were part of the core maintenance, they were still useful blanks.

The presence of cortex

Cortex appears on 87.4% of the overpass items and its amount varies, mainly in accordance to their place in the reduction sequence (Fig. 138). 'Initial' overpass items, reduced at the "opening" of the debitage surface, tend to bear larger cortical surfaces. In contrast, overpass items reduced during the production of laminar items (the 'correction' and 'regular') tend to have less cortex.

The presence of cortex on both lateral edges (14.3% of the overpass items) (Figs. 29:1, 30:1, 4, 7, 31:1, 32:4-6) indicates a frequent use of flint slabs and flat nodules as cores. Such overpass items however were mostly unsuitable for secondary modification as indicated by the fact that while they constitute 16.1% of the blank overpass items, they constitute only 4.8% of the shaped overpass items. This is probably since they lack a whole sharp edge.

Butt types

Most common butt types of overpass items are thick plain and modified (Fig. 139). No major differences were observed among the three categories; however the fact that thin plain butts are more common among the 'initial' overpass items is intriguing. The slightly higher percentage of natural butts among the 'initial' overpass items correlates with the fact they were reduced at the beginning of the knapping process.

The presence of overpass items with thin or punctiform butts supports the assumption that knapping was performed with relatively powerful blows. This is due to the fact that there is a general correlation between the butt size and the general size of the items (Dibble and Whittaker 1981; Pelcin 1997), and the fact that these items still overpassed the debitage surface can only be explained by heavy blows.

The presence of micro flaking along the butts' exterior varies according to the type of butt (Fig. 140) and it is most common on thin plain butts. Although in most cases the micro flaking is sporadic, the difference among butt types is another indication of various pre-treatments conducted before knapping and it indicates that the difference between the thin and large plain butts is not accidental but pre-planned.

Distal end shapes

The distal end of the overpass items (n=259) is mostly characterized by various broad shapes (oblique: 17.8%; rounded: 31.3%; straight: 23.6%; and irregular: 18.9%), while pointed and pointed/rounded shapes (e.g. Fig. 31:3) constitute only 8.5% of the cases (3.9% and 4.6% respectively). This indicates that core bases were not modified into sharp pointed shapes as in many other blade industries which used single striking platform cores (e.g. Ferring 1976; Goring-Morris and Davidzon 2006), but rather left unshaped and wide.

Profiles

The profile of overpass items (n=199) is mostly curved (52.3%). This is expected following the assumption that they were reduced by heavy blows. Twisted profiles also constitute a large part (22.6%) of the overpass items. About half of them have one straight edge and one curved edge thus creating a "semi-twisted" profile. The other profiles include semi-straight (13.1%) and irregular (12.1%).

Number of laminar scars

The number of laminar scars on the overpass items varies from none to six (Fig. 141). By definition 'initial' overpass items tend to bear less laminar scars on their dorsal face. Nevertheless, the presence of one or more laminar scars on them indicates that preparing the debitage surface required in many cases not only the removal of a single item but a series of two to three overlapping items (of which none must be an overpass item).

Among the 'correction' and 'regular' overpass items, two laminar scars are the most common (42.6% and 32.8% respectively). Since the detachment of overpass items in general tends to remove a large portion of the debitage surface, the number of scars on them may attest to the number of laminar scars on the cores' debitage surface during the reduction. The small number of laminar scars in the 'correction' and 'regular' overpass item categories, which represent the course of the reduction of laminar items, is an indication that most cores had a small number of laminar scars all along the reduction sequence.

Metrics

The overpass items' length varies from 32-100 mm, the distribution patterns between the samples being different (Fig. 142). The majority are between 41-60 mm and their mean length is 53.6 mm (s.d. 10.5). It is of note that the length of the overpass items correlates with the general distributions and means of the length of blades, PE blades and NBKs (Table 4; Fig. 115). Since overpass items, by definition reduced the entire length of the core's debitage surface, this similarity in length indicates that the three laminar types were reduced mostly by following through the entire debitage surface length. The comparison between the length of the 'initial' overpass items and the 'correction' and 'regular' overpass items (Fig. 143) shows no major differences and demonstrates that the length of the debitage surface usually did not change much throughout the main course of the laminar reduction (it apparently did change near core exhaustion according to the recovered cores). The mean length of the 'initial' is 53.0 mm (s.d. 10.5), of the 'correction' is 54.3 mm (s.d. 10.5), and of the 'regular' is 53.5 mm (s.d. 10.6).

The width of overpass items varies from 13-50 mm, with a large difference among the samples (Fig. 144). The mean width is 26.5 mm (s.d. 7.6). The fact that the majority of the overpass items range from 16-35 mm is a major difference from the three laminar types of which the majority range from 16-25 mm (Fig. 117). This difference reflects the tendency of the overpass items detachment to remove large parts of the debitage surface, as further indicated in some cases by the presence of cortex on both lateral edges. Comparing the 'initial', 'correction' and 'regular' overpass items indicates that the 'initial' tend to be narrower with a peak at 16-25 mm, while the 'correction' and 'regular' overpass items tend to be wider with a peak at 21-35 mm (Fig. 145). The mean width of the 'initial' is 24.9 mm (s.d. 7.3), of the 'correction' is 27.5 mm (s.d. 7.3) and of the 'regular' is 27.2 (s.d. 7.9). This difference reflects the various purposes of removing these overpass items. The 'initial' overpass items probably did not remove wide parts of the future debitage surface intentionally, probably in order to create the outline for the following item that will be most likely in the shape of a NBK. This possibility is supported by the presence of previous laminar scars on the dorsal face of many of the 'initial' overpass items and by the fact that this sub-type is characterized by the highest frequency of NBK-like items. On the other hand, the detachment of 'correction' overpass items probably caused the intentional peeling of large parts of the debitage surface in an attempt to remove problems the knapper faced. Two possible explanations for the relatively large width of the 'regular' overpasses can be offered: (1) they had a correction purpose although I could not identify it, and/or (2) the morphology of the core during the production of laminar items did not enable the common reduction of thin overpass items (intentionally or not).

The thickness of overpass items ranges from 7-30 mm and it varies among the samples (Fig. 146). The mean thickness is 14.8 mm (s.d. 4.5). Comparing the thickness between the overpass items categories (Fig. 147) demonstrates that the 'initial' overpass items are generally thicker. The mean thickness of the 'initial' is 15.9 mm (s.d. 4.7), of the 'correction' is 15.2 mm (s.d. 5.0) and of the 'regular' is 13.7 (s.d. 4.0). It can thus be concluded that overpass items detached in the initial steps of the reduction caused the removal of relatively thick bulks of the core mass in contrast to overpass items removed in the course of the reduction which caused the removal of thinner parts.

Examining the difference between overpass items included in the debitage and those with secondary modification demonstrates that in general the selection was in favor of the larger overpass items. This is apparent in their means – debitage overpass items are 53.0 mm (s.d. 10.0) long, 25.9 mm (s.d. 7.3) wide and 14.7 mm (s.d. 4.5) thick, while overpass items with secondary modification are 57.5 mm (s.d. 12.2) long, 29.2 mm (s.d. 8.7) wide and 15.1 mm (s.d. 4.4) thick.

The length/width ratio (Fig. 148) demonstrates the same pattern observed among the three laminar types in which samples G/19-20 and K/10 have a higher ratio. No discernable difference was found between the three overpass item categories. The width/thickness ratio of overpass items (Fig. 149) varies among the five samples. The difference of this ratio among the three overpass item categories (Fig. 150) shows that the 'initial' overpass items have the most thick cross-section with a peak at 1.1-1.5, followed by the 'correction' with a peak at 1.6-2.0 and the 'regular' overpass items which are the most thin with a peak at 2.1-2.5. An interesting pattern in the selection of items for secondary modification is that there was a preference for items with a thinner cross-section, as indicated by the higher ratio characterizing the secondarily modified overpass items (Fig. 151).

Hinge scars

The number of hinge scars on the overpass items (n=200) vary; 53.5% have no hinge scars, 34.0% have one hinge scar, 12.0% have two hinge scars and only 0.5% have three hinge scars. This demonstrates that the reduction of overpass items is not merely the result of hinge fractures on the dorsal face or initial knapping, but also due to other aspects such as raw material problems and an irregular structure of the debitage surface that probably resulted from unsuccessful previous reduction. This observation also supports the possibility that some overpass items are knapping mistakes.

Changes in debitage surface length

Examining the relationship between the length of the debitage surface before and after the reduction of each overpass item (see methodological chapter) is presented in Fig. 152. In all, the reduction of overpass items led to a longer debitage surface in 49.0% of the cases, made no change in the length of the debitage surface in 41.9%, and shortened the debitage surface in 9.0%. The 'initial' overpass items had the highest percentage of cases leading to a longer debitage surface (60.5%) and the lowest percentage of shortening it (2.6%). Among the 'correction' overpass items 51.5% led to a longer debitage surface while among the 'regular' overpass items only 33.8% led to a longer debitage surface. The latter also include the highest percentage of shortening the debitage surface (17.6%), thus implying that this category has the largest amount of knapping mistakes. Nevertheless, it should be noted that only a few overpass items could be called ‘death shots’ – *i.e.* overpass items that caused the removal of a large mass of the core leading to its abandonment. The small amount of cases in which the debitage surface was shortened is important since it indicates that although knapping was based on powerful blows, they were well controlled.

Remnants of core base modification

Base modification appears on 32.2% of the overpass items including base blunting (3.0% of all overpass items), flake removal at various directions (26.9%; Fig. 29:3, 5; 31:5), and single blades or bladelets removal from the core base (2.3%; Fig. 30:3). Some of the latter might be an indication of an irregular bipolar reduction or the occasional use of the bipolar concept in order to modify the core from its base as in several later blade industries (e.g. Goring-Morris *et al*. 1998:163). The frequency of base modification is the highest among the 'correction' overpass items ('correction' [n=72]: 38.9%; 'initial' [n=74]: 32.4%; 'regular' [n=71]: 26.8%). This might indicate that correcting a knapping obstacle sometimes required several sequential steps – in this case, first a small correction from the base and then clearing the surface entirely by removing an overpass item. This method might have been less costly in raw material than detaching a large thick overpass item that could have removed the obstacle in one strike but also reduced a large flint mass.

Presence of shaped ridges

Shaped ridges appear on 13.6% of the overpass items (Fig. 31:5). They appear on 29.4% of the 'initial’, 12.7% of the 'correction' and 4.2% of the 'regular' overpass items. Their relatively high frequency among the 'initial' overpass items correlates with the fact that 'crested blade' removal in general is more common in the initial reduction (see below) and that shaped ridges are more easily performed on items with an angular outline rather than flat. Their paucity among the 'correction' and 'regular' overpass items indicates that shaped ridges were not commonly made during the reduction of the laminar items. The intensity of the shaped ridges and their location on the overpass items of the three categories (Fig. 153) correlate with the above pattern. Among the 'initial' overpass items, where the shaped ridges appear in the highest percentage, a complete ridge that cover the overpass items' entire length appears in the highest percentage (15% of all crests in this category of overpass items). In the 'correction' and 'regular' overpass items, where a shaped ridge is less common, the ridge is generally partial. In the latter cases the shaped ridges were probably made to correct knapping failures of previous items. As in the case of the base modification surfaces, the shaping of the ridge might have been a complementary action to the overpass item removal.

Summarizing the attribute analysis of the overpass items

The results of the overpass items analysis revealed several aspects concerning the reduction sequence/s applied at Qesem Cave and of the character of the cores during the course of removing laminar items. While about one third of the overpass items were used for "opening" and shaping the debitage surface, the majority were removed in the course of the laminar reduction probably as maintenance. Although overpass items were primarily used for shaping and maintaining the cores, the fact that they had the potential for being cutting implements or to be modified into shaped items is an indication of the efficiency of the reduction, making even "by-products" useful.

Before summarizing the insights derived from the overpass items analysis I wish to address the issue of knapping mistakes. Of the three overpass item categories it is the 'regular' category that probably includes the largest number of cases of knapping mistakes since, in contrast to the two other overpass item categories, I could not ascribed to them any clear knapping purpose. The reduction method which is characterized by the intentional removal of items that followed through the entire debitage surface probably led to these knapping errors. In addition, it is of note that even if the overpass items were deliberately detached, they might have caused the removal of a larger mass than originally intended. Nevertheless, the fact that the majority of the overpass items from Qesem Cave are of the 'initial' and 'correction' categories indicates that most overpass items were deliberately removed. It is likely that even among the 'regular' overpass items, which constitute about one third of the overpass items, many had a maintenance purpose that was not identified. This is important since it is an indication that the removal of laminar items by follow-through blows was well controlled and only seldom led to an overpass item reduction.

The following points regard the cores and the general production during the course of the laminar reduction derived from the analysis of the overpass items:

1. The common use of flat flint slabs and possibly small flat nodules is indicated by the presence of overpass items with cortex on both lateral edges.
2. Core bases were not heavily shaped if at all and they were usually left in their "natural" state as indicated by the wide distal end that characterizes many of the overpass items.

3. The remnants of base modification on overpass items for the most part do not represent a systematic modification surface, but a simple one. They were probably conducted *ad hoc* in order to fix specific problems that occurred during reduction. It is highly possible that they were complementary to the reduction of the overpass items.
4. The core debitage surfaces were mostly covered with a small number of laminar scars all along the reduction as indicated by the fact that most overpass items bear only two laminar scars.
5. Knapping was made by relatively powerful blows as indicated by the many overpass items and especially those with thin plain and punctiform butts. The presence of overpass items that are the results of knapping mistakes (whatever be their precise amount) supports the use of powerful blows as well.
6. The debitage surface length did not change much during the course of the laminar reduction as indicated by the fact that the distribution pattern of the length of the 'initial' overpass items is similar to that of the 'correction' and 'regular' overpass items.
7. The debitage surface was commonly maintained by the removal of overpass items. It helped in forming the required curvature as indicated by the fact that most overpass items have curved profiles. While some overpass items dealt with a specific part of the debitage surface, overpass items with two cortical edges completely renewed the debitage surface. The latter created a new debitage surface free from previous flaws and constraints. Similar spalls are referred to as *flanc de nucleus* (Brézillon 1968:97).

Crested Blades

<u>*The analyzed sample*</u>

Crested blades are the third largest group of the CTEs (n=215; 26.9% of the CTEs). They include 199 debitage CTEs and 16 CTEs that were secondarily modified. The crested blade sub-types of Qesem Cave (Table 11) are characterized as follow:

1. *Primary* (n=8; 3.7%). These are characterized by a shaped ridge that is mostly bifacial and runs along the entire item’s length (Fig. 34:5). These items are rare and do not seem to characterize the reduction.

2. *Rough* (n=37; 17.2%). These are irregular in shape and have a roughly shaped ridge composed of a few blows (Figs. 33:1; 35:1).
3. *Patinated* (n=51; 23.7%). The majority have a crest that is part of an old knapped surface (Figs. 33:2, 4-5; 34:3-4, 6; 35:2), however a portion of these crests are probably natural and were formed on the edges of the broken flint slabs that were commonly used as raw material for laminar production. Additional small adjustments to the old crest that overlies the patinated surfaces was performed on 21 of these items. The types of items that were recycled are hard to evaluate by the crests alone. The presence of a single laminar core shaped on a discarded handaxe (Fig. 39:1) is the exception in Qesem Cave since handaxes are rare at the site.
4. *Second-primary* (n=13; 6.0%). Although these are few, they are an indication for the use of flat flint slabs and other raw materials whose narrowed part is not pointed, but thick and flat so that it has two carinated edges. The ridge on these crested blades is generally roughly knapped (Fig. 33:6).
5. *Unifacial* (n=48; 22.3%; Figs. 34:2; 35:3). Three general possibilities for their placement in the reduction sequence were suggested in the methodology section. The first possibility, that the plain edge is part of a ventral face or a breakage plain, is highly likely. "Opening" the debitage surface by taking advantage of a breakage plain of a flint slab by performing minor shaping could lead to such crested blades. The second possibility that the plain surface is part of a previous large laminar scar – i.e. rejuvenation action – is possible as well since many of the cores are characterized by wide laminar scars. The fact that unifacial crested blades are the smallest in length and width (see below) strengthens this option. The third possibility, that is a result of a change in the core reduction orientation, seems invalid since this phenomenon is rare in Qesem Cave (see below).
6. *Rejuvenation* (n=58; 27.0%). These items form the most common crested blade sub-type in the Qesem Cave samples (Figs. 33:3; 34:1; 35:4-6). The shaped ridges are mostly partial and focus on the distal end.

Dividing the various sub-types into the three categories ('initial' [including primary, rough, patinated and second-primary], unifacial and rejuvenation) (Fig. 154) shows that 'initial' crested blades constitute the largest category, 50.7% of all samples.

Since a part of the unifacial crested blades relate to the initial knapping of the cores as well, it can be conclude that the majority of the crested blades were reduced in the initial stage of the reduction.

The selection rate of crested blades for secondary modification is low, constituting only 7.4%. However, the percentage varies among the various sub-types (Table 11). It is higher among rejuvenation crested blades (15.5%) and lower among the rest (0.0%-7.7%). This is probably a result of the former being reduced in the course of the laminar reduction and of being similar in character to the three laminar types. The most common shaped item type made on crested blade is the 'retouched laminar item' (56.3% of the shaped crested blades; Table 10).

In the following attribute analysis the results relating the primary and second-primary sub-types should be taken with caution due to their sparse representation in the studied samples. The rest of the sub-types have larger samples and more solid results.

Intensity of the shaped ridge

The shaped ridges of the crested blades usually show a minor effort in preparations as indicated by their intensity. Only 32.9% of the crested blades have a complete knapped ridge. The rest include 25.0% with a ridge along half of the length, 24.3% with a ridge along a quarter of the length and 17.9% with a limited crest on a small part of the length (touch). The intensity of the shaped ridge along the crested blades is highly variable among the various sub-types (Fig. 155). Primary crested blades have by definition a complete ridge in all cases. The rough crested blades which form a major part of the 'initial' crested blades demonstrate that a complete ridge was not a necessity for initiating the reduction and partial ridges were sufficient. The complete ridges that appear on 57.1% of the patinated crested blades should not be seen as an example for an effort in shaping ridges since the bulk of these ridges are old and in some cases it is a combination of old and new. The paucity of complete and half complete shaped ridges among rejuvenation crested blades indicates that correction actions were quite simple.

Location of the shaped ridge along the length of the item

The location of the shaped ridges along the crested blades also varies among the different sub-types (Fig. 156) (cases where the ridge was shaped all along the item's length correlate to the previous examination; Fig. 155). The important observation here is that most crested blades lack a clear pattern, not only in the intensity of the shaped ridges but also in their location. The sole exception is in the case of rejuvenation crested blades in which 63.2% were treated near the distal end. This was probably performed in order to correct small hinges and other obstacles resulting from the reduction of laminar items that did not follow through the entire length of the debitage surface.

Location of the shaped ridge along the width of the item

In all (n=135), only on 41.5% of the crested blades the ridge is located in the middle, while on 26.7% it runs near the left edge, on 29.6% its run near the right edge and on 2.2% it is irregularly spread along the item. Among the different sub-types the second-primary items posses the highest percentage of ridges found near the lateral edges (88.9%). The common appearance of ridges near the lateral edges probably resulted from the core's shape which is commonly characterized by sides that are clearly separate from the debitage surface. This separation is occasionally characterized by a sharp angle which enabled easy access from to perform the correction.

Ridge profiles

The profile of the shaped ridge along the dorsal face discloses that only a small effort was placed in making the crested blades (Fig. 157). Among the different sub-types, rough crested blades show the highest percentage of irregular profiles. A curved profile is most common among the other sub-types, especially among the patinated, second-primary and unifacial crested blades.

Butt types

The crested blade sub-types show differences in shaping the butts. Shaping the butt of crested blades seems to have been more carefully done than with the three laminar types (blades, PE blades and NBKs) as indicated by the fact that 46.3% of them have a modified butt, usually by faceting. Modified butts were especially common among rejuvenation, unifacial and second-primary crested blade sub-types (Fig. 158). There is also a difference in the presence of micro flaking along the exterior of the butts (Fig. 159).

Metrics

The length of the crested blades shows clear differences among the samples, with those from samples G/19-20 and K/10 being the longest (Fig 160). Examining the length of crested blades according to the three categories (Fig. 161) demonstrates that 'initial' have a similar distribution pattern to that of rejuvenation crested blades.

This similarity might indicate that the length of the debitage surface did not change much until approaching exhaustion of the cores. This indication should be taken with caution however since crested blades did not necessarily led to the removal of the entire length of the debitage surface. Unifacial crested blades have the shortest length.

No major differences were observed in width among the samples, but rather among the different sub-types (Fig. 162). The distribution pattern shows that unifacial crested blades tend to be narrowest with a peak at 11-15 mm; patinated and rejuvenation crested blades have a peak at 16-20 mm, while rough and second-primary crested blades tend to be the widest with peaks at 21-25 mm. These differences may indicate the different purposes of the reduction of these items. The rough and second-primary, which are the widest, were probably removed in order to clear a wide area for creating the debitage surface. The relatively narrow patinated crested blades were probably removed in cases where the debitage surface width could have been gradually increased during laminar production and there was no need to initiate it by removing a large bulk. The reduction of rejuvenation crested blades led to the removal of only a small portion of the debitage surface and were most likely detached in order to maintain a specific and limited area in the course of reduction.

The thickness of crested blades (Fig. 163) is most commonly 6-15 mm. Patinated, second-primary, unifacial and rejuvenation crested blades mostly clustered around 6-10 mm and rough crested blades around 11-15 mm.

Summarizing the attribute analysis of the crested blades

The results of the crested blade analysis revealed several aspects concerning the reduction sequence/s from Qesem Cave.

1. The crested blades were mostly shaped and reduced in the "opening" of the debitage surfaces. This is well indicted by the fact that the 'initial' crested blades constitute 50.7% of all crested blades, as well as by the suggestion that some of the unifacial crested blades were also reduced for this purpose. Only 27.0% of the crested blades (the rejuvenation sub-types) were clearly removed during the laminar reduction itself for rejuvenation purposes.
2. The crested blades are characterized by simplicity. The best manifestation is in the second most common sub-type – the patinated crested blades – showing almost no effort in shaping. The rough crested blades characterized by irregular and simple shaping are another indication. The simplicity of their

shaping is further illustrated by the fact that the shaped ridges on the crested blades are generally partial, nonsymmetrical and irregular in profile.

3. Attention given to shaping the striking platform before the crested blades reduction exceeded that of the three laminar types (blades, PE blades and NBKs) as indicated by the relatively high percentages of modified butts.
4. The different sub-types of 'initial' crested blades are indicative of the variety of options feasible for initiating the reduction. This demonstrates that although their shaping was simple, their use was sophisticated. The differences in width among the rough, second-primary and patinated crested blades illustrate this well. While in some cases a relatively wide debitage surface was "opened" (the case of rough and second-primary crested blades) in others a narrower one was "opened" (the case of patinated crested blades). This difference further indicates that the "opening" of recycled items was different from that of the regular raw material.
5. Only small differences were observed among the samples. The most pronounced difference is reflected in the longer crested blades from samples G/19-20 and K/10.

Radial Overpass Items

The radial overpass items (n=29; 3.6% of the CTEs) all relate to flake production. They are characterized by a flat and wide dorsal surface either covered by large flake scars or cortex. The outline of the radial overpass items indicates that they were removed from the flat part of the used raw material/core and it is thus assumed that they were mostly the products or 'by-products' of radial cores.

CTE-Varia

The CTE-varia (n=245; 30.6% of the CTEs) consist of various items that can not be assigned to the previous types. They include 234 debitage CTEs and only 11 items (4.5%) that were secondarily modified. An attempt to divide the debitage CTE-varia into several sub-types did not reveal any pattern and the majority (n=158; 67.5%) are still highly variable. The other debitage CTE-varia include (1) items with a remnant of a striking platform located in a different direction than the one from which they were detached (n=26; 11.1%); (2) flat items with a crest (n=11; 4.7%); and broken unidentified CTEs (n=39; 16.7%). Although some CTE-varia can be related to the less planned core shaping and maintenance of the laminar production, the majority are most likely the result of flake reduction that took place on-site.

A General Assessment of the CTEs

The CTEs reflect all the reduction strategies at the site and not only the laminar production. The ones directly related to the laminar production are the overpass items and crested blades. Although most core tablets originated from the laminar production as well (especially the "classic" ones), some of the other core tablets could have been reduced from flake cores. The CTE-varia on the other hand, originated mostly from flake production and only a small portion from laminar production. The radial overpass items represent the only CTE type that is directly connected to flake production.

A correlation between CTE types and laminar or flake production can be seen in the case of crested blades. They constitute the highest percentage (36.4%) in sample G/19-20 where the laminar production was the most intensive and the lowest percentage (17.9%) in Unit V where the laminar production was the less intensive. The percentages of the CTE-varia complete this picture. They appear in the lowest percentages in samples G/19-20 and K/10 where the flake production was least intensive. In addition, radial overpass items, which originated from flake production, show the highest percentage in Unit V.

The CTEs teach us about of the different areas of the cores that were treated. For example, while the core tablets demonstrate the treatment of the striking platform, the crested blades and the overpass items (including the radial overpass items in the case of flake cores) demonstrate the treatment of the debitage surface. In the case of the laminar production, CTE-varia can originate from treating the core base or back. In the case of flake production, their origin is more complex and needs further study.

The CTE types differ in the mass of flint removed from the core as well. The clearest example is in the case of overpass items and crested blades. While both run along the length of the debitage surface, the reduction of overpass items removed a wide part of it and the reduction of crested blades a narrow part. The significance of this difference varies according to the reduction stages. Opening a wide debitage surface in initiating the reduction was not necessarily required and a gradual increase in its width was sometimes preferred (if the raw material shape enabled it). This aspect is apparent due to the fact that the majority of the crested blades were reduced at the beginning of the reduction and only a third of the overpass items were reduced at this stage. The fact that 'initial' overpass items are narrower than the other overpass items further supports this observation. In the case of the reduction of CTEs during the course of laminar reduction, the crested blades and the overpass items represent two completely different approaches. The detachment of rejuvenation crested blades caused the removal of only a small portion of the debitage surface which retained most of its previous contour. In contrast, the detachment of overpass items caused the removal of a larger portion of the debitage surface and cleaned most of the previous scars. The removal of overpass items that have two cortical edges exemplified this aspect most clearly. The result of such a removal is starting anew without the constraints or benefits of the previous structure of the scars.

The division of the overpass items and crested blades into sub-types and categories demonstrated that the maintenance of the core debitage surface was mostly conducted by overpass item removal. A possible reason for the minor role of ridge correction at Qesem Cave is the use of powerful blows and the detachment of items that followed through the entire length of the debitage surface which minimized the number of hinge scars. The fact that the overpass items have a high potential to be useful blanks (as evidenced by the fact that they are the most common CTE type selected for secondary modification and by the resemblance of some to NBKs) might have also contributed to the choice to maintain the cores by the removal of overpass items and not crested blades.

Analysis of the Laminar Core Class

The laminar core class (n=121) is represented in all the samples yet it is outnumbered by flake cores in all cases except for sample G/19-20 (Fig. 164). The laminar core class was divided into the following types (Table 12): (1) ‘single striking platform laminar core' (n=60; 18.9% of all cores), (2) ‘two striking platforms laminar core' (n=9; 2.8% of all cores), (3) ‘single striking platform laminar and flake core' (n=34; 10.7% of all cores); (4) ‘two striking platforms laminar and flake core' (n=13; 4.1% of all cores) and (5) bladelet core (n=5; 1.6% of all cores). The rest (n=196; 61.8% of all cores) are flake cores of different types and a few tested raw material pieces. Due to the small number of cores of the laminar core class in the various samples they were grouped together. As a result the 'single striking platform laminar cores' and the 'single striking platform laminar and flake cores' have sufficient numbers and will be quantitatively analyzed. The other types of the laminar core class represented by only small numbers will be described in qualitative terms.

‘Single Striking Platform Laminar Cores'

The ‘single striking platform laminar cores’ (n=60) include 48 whole cores, six slightly damaged cores and six broken cores with large portions missing (one was excluded from the analysis).

Core shapes

The ‘single striking platform laminar cores' are characterized by different shapes, of which 'parallel edges' (n=28; 47.5%; Figs. 36:2, 37:1, 39:2-3; 40:1) is the most common. The other core shapes include 'amorphous front’ (n=10; 16.9%; Fig. 36:1), prismatic (n=14; 23.7%; Figs. 36:4, 38:2-4; 40:3-4) and pyramidal (n=7; 11.9%; Fig. 37:2). It is of note that one of the pyramidal shape cores (Fig. 36:3) has some common characteristics with the 'narrowed prismatic' shape.

Raw material

The high exploitation of cores made the identification of the raw material shapes difficult. Nevertheless, 23.7% still bear evidences of using flat slabs with cortex on both sides. Additional 15.3% were shaped on fist size nodules. A large number of cores (32.2%) bear a portion of cortical surface which indicates they were shaped of nodules of some sort. It is assumed that some originated from flat slabs but were too heavily worked for identification. The fact that 10.2% of the cores were shaped on flakes is significant, but it seems that in general, splitting the raw material into several parts was not common and in most cases it was used as a single block. The exploitation of old patinated items (6.8%) is important in evaluating recycling. Additional 11.9% of the cores were recorded as unidentified.

Cortex

Cortex is still present to some extent on 94.7% of these cores (Fig. 165). In 43.1% of them it covers the entire surface of the core except for the debitage surface and striking platform. In the rest it covers smaller parts with different configurations, mostly spread along the core's back and one of the lateral edges.

The common presence of cortex on the outer surface of these cores demonstrates that no pre-peeling of cortex was performed; rather it was gradually removed by the laminar production. In 71.2% of these cores cortical laminar items were reduced up to the point of discard, in 5.1% the possibility of removing cortical laminar items ceased slightly before core abandonment and in 23.7% the possibility of removing cortical laminar items ceased long before core abandonment.

Striking platforms

The striking platforms of these cores were mostly shaped by faceting (39.3%) or by forming a flat scar (39.2%). A combination of a flat scar with faceting appears on 8.9% and a natural surface appears on 12.5%. Although some of the flat scars were made by a core tablet removal as indicated by the CTEs, others were probably made by simple flake removal. Irregular micro flaking on the edge of the striking platform appears on 47.3% of these cores. It is of note that while it appears on 72.2% of the striking platforms shaped by a flat scar, it appears on only 36.4% of the striking platforms shaped by faceting. Although in a few cases the striking platform is rounded or rectangular in shape, in most cases it is amorphous.

Debitage surface shapes

The most common debitage surface shape is rectangular, usually elongated (41.5%; Fig. 40:1). Other debitage surface shapes are U-shaped (22.6%; Fig. 38:1, 3), triangular (11.3%; Fig. 36:4) and irregular (24.5%; Fig. 36:3). The shapes of the debitage surface however vary greatly among the different shapes of the cores (Fig. 166).

Core bases

The core base is not characterized by a specific form and it seems that no effort was made in shaping it. Only 22.2% of core bases are pointed in the frontal view and the rest show various wide shapes. Nonetheless, pointed bases are common among the prismatic and pyramidal cores when they are presented separately (Fig. 167). In the latter case it is mostly a result of removing overpass items and not of shaping.

Modification and maintenance surfaces

Modification and maintenance surfaces were noticed on 42.6% of these cores. These are mostly simple, spreading along small areas and constitute only a small number of flakings. In 24.1% of the cores some maintenance at the base was noticed, generally including the removal of small flakes towards the debitage surface. In a few cases it includes the removal of a single blade/bladelet. In additional 3.7% of the cores (all with an 'amorphous front' shape) the base was intentionally narrowed into a pointed shape. In other cores a modification on the core back was noticed (3.7%) or on the back and base (9.3%). The purpose of back modification is not clear, but it might have served to remove obstacles in order to enable a comfortable grip of the core. One of the cores in the latter group also shows traces of hinge repair. In summary, the majority of these treatments are not modification surfaces aimed at controlling the core shape, but rather maintenance procedures performed sporadically in order to deal with specific problems that occurred during the reduction.

Metrics

The maximum core length and the debitage surface length are fairly similar (Table 13; Fig. 168). The distribution patterns in both cases demonstrate a peak at 41-45 mm. No significant differences were observed among the four core shapes. The width, on the other hand, is highly varied (Fig. 169). A major difference between the maximum core width and the debitage surface width was observed only in the 'amorphous front' shape (Fig. 170). The high similarity among the other core shapes is exemplified by the cores with the 'parallel edges' shape where the maximum width and the debitage surface width show similar distribution patterns (Fig. 171). The cores' thickness (Fig. 172) demonstrates large differences among the four core shapes. While the prismatic shape cores tend to be the thinnest, with a peak at 16-20 mm, the other core shapes demonstrate a large range of thickness with clear peaks at 26-30 mm.

The above metrics indicate intensive use of cores, mostly abandoned when reaching a relatively small size. Laminar items were rarely removed after the cores reached a length of 41-45 mm and it seems that in that size cores were no longer considered useful for laminar production. The small thickness of the cores also indicates that only a small mass of flint was left, insufficient for removing another series of laminar items. The width does not necessarily indicate the degree of utilization, since in many cases it did not change significantly during reduction, especially in the case of cores with the 'parallel edges' shape.

Number of laminar scars

The total number of laminar scars on the debitage surface of these cores ranges from one to seven and the number of parallel laminar scars ranges from one to five (Fig. 173). The fact that these two measurements are similar indicates that in general the laminar items followed through the entire length of the debitage surface. The cores with the 'parallel edges' and 'amorphous front' shapes show the smallest number of laminar scars peaking at two scars, the prismatic shape cores peak at 2-3 laminar scars and the pyramidal shape cores at four laminar scars. The small number of laminar scars on the debitage surface correlates to the high percentage of items with cortex. This indicates that only a small number of laminar items were directly reduced from the center of the debitage surface of these cores without peeling part of their sides. This is especially relevant to the 'parallel edges', which is the most common core shape at Qesem Cave, peaking at two laminar scars.

Number of hinge and overpass scars

Hinge scars are frequently found on the core’s debitage surface (66.1% of the cores). In most cases it includes only one (27.1%) or two hinge scars (23.7%) and their presence does not necessarily indicate that they are the reason for core abandonment. Overpass scars are quite common on these cores and appear on 64.8% of them. In 48.1% of these cores only one overpass scar appears, in 11.1% two overpass scars and in 5.6% there are 3-4 overpass scars. Most core shapes show similarity in the frequency of overpass scars except for the pyramidal which has a larger number of scars (Fig. 174).

Assumed reasons for discard

The main reason for core abandonment is an exhaustion of the core mass (40.6%) (Figs. 36:3; 38:4; 40:2-3). It should be noted that even among the other cases of abandonment not much flint mass was left and that only seven cores of this type are characterized by a large mass that could enable the reduction of several more laminar items. The second most common abandonment reason is the presence of hinge scars which prevented the continuation of laminar reduction (21.4%; Fig. 37:1). This factor is especially relevant for a reduction that utilized only a limited part of the core perimeter. Although one bold hinge scar might stop the reduction, in most cases only when several hinge scars were formed the debitage surface potential was blocked. Another abandonment reason is the detachment of a large overpass item which caused the removal of the entire debitage surface and did not leave much mass for further reduction (8.9%; Fig. 38:1-2). Other abandonment reasons include an absence of a suitable striking platform (7.1%) and raw material problems (7.1%). Among 10.7% of these cores no visible reason for core abandonment was detected (Fig. 40:1).

Summarizing the attributes analysis of the 'single striking platform laminar cores'

The variations in the analyzed attributes of the 'single striking platform laminar cores' mostly correlate with the four core shapes. In order to better illustrate the character of the core shapes and the relationship between them I will summarize each core shape separately.

'Parallel edges'

The cores with the 'parallel edges' shape (n=28) received their form not by preliminary knapping but from the used raw material. In these cores the raw material was fairly flat with two relatively parallel sides. Flat flint slabs were most commonly used (50.0%), but fist size nodules or parts of nodules (28.6%), flakes (17.9%) and unidentified raw material pieces (3.6%) were used as well. The fact that the length and width of the debitage surface are almost equal to the core's maximum length and width (Table 13; Fig 171) indicates that the full potential of the raw material was utilized in these cores. The flint slabs and the fist size nodules have another advantage being extensively covered by cortical surfaces that enable the continuous production of blades, PE blades and NBKs. In all, 59.3% of the cores of this shape are fully covered by cortex (except for the debitage surface and striking platform). In additional 25.9%, the cortex is spread along one of the lateral edges.

The striking platform was made by a flat scar (40.7%), faceting (33.3%) or a combination of both (3.7%). In 22.2% of these cores the striking platform was left in its natural state. The relatively high representation of the latter probably accounts for the use of flint slabs with natural breakage plains which are suitable to be used as striking platforms. The debitage surface of these cores was located at the narrow part of the raw material so it was constricted by the two sides. The debitage surface was usually elongated, having a rectangular shape (75.0%; Fig. 166). The base of these cores is usually wide (Fig. 167), indicating that only minor effort, if at all, was invested in its shaping. The debitage surface that was determined by the raw material sides is assumed to have remained in the same shape along the reduction only gradually receding.

The debitage surface was mostly narrow (26.2 mm [s.d. 7.4] in mean) and covered by two laminar scars (Fig. 173). The fact that the total number of laminar scars is similar to that of the parallel laminar scars indicates that the reduced items generally followed through the entire debitage surface. The small number of laminar scars indicates that only a few laminar items were reduced from the inner mass of the raw material without peeling parts of its exterior.

Maintenance surfaces are simple and appear on 45.8% of these cores. They are usually found at the core’s base, but in 8.4% several maintenance surfaces were noted on the same core, on the back and on the debitage surface. None of the modification surfaces significantly contributed to forming the 'parallel edge' shape. Rather they seemed to be the result of minor corrections of the distal end of the debitage surface, or the result of blunting that improved the core’s grip during the reduction.

These cores were mostly discarded due to core exhaustion (42.3%). Other reasons include cases in which hinge scars blocked the potential for further knapping (15.4%), a large overpass item’s removal diminished the debitage surface (11.5%), the striking platform was no longer suitable for further reduction (7.7%), or raw material problems were faced (7.7%). For 15.4% of the cores no reason for abandonment was recognized.

<u>‘Amorphous front’</u>

These cores (n=10) were most commonly made on nodules or nodule parts (60.0%) with rounded or amorphous shapes (the other cases were made on recycled patinated artifacts and unidentified raw material types). The debitage surface was usually “opened” on an angular part of the raw material and its shape was predominantly irregular or U-shaped (Fig. 166). Since preliminary shaping was not conducted, the shape of the debitage surface was affected by the character of the raw material. The difference between the maximum core width and the debitage surface width (Table 13; Fig. 170) indicates that the shape of the debitage surface was not constant, rather it was highly dynamic during the reduction. Although cortex appears to some extent on all of these cores, only three are fully covered by cortex (except for the debitage surface and striking platform).

The debitage surface has a mean width of 32.0 mm (s.d. 8.3) and it is usually covered by two parallel laminar scars. Hinge scars and overpass scars are common as well (each appearing on seven cores). Modification and maintenance surfaces appear on half of these cores, mostly on the base but in some along the back or side as well. In two cases, the base modification made the distal end of these cores pointed. Eight of the cores were abandoned due to hinge scars, problems with the striking platform or raw material impurity. Only one core was discarded due to exhaustion. For one additional core no reason for discard was identified.

Prismatic

These cores (n=14) were mostly made on nodules or nodule parts (78.5%) with rounded or amorphous shapes. The debitage surface of these cores does not have a dominant shape (Fig. 166). The most common core bases are rounded and pointed (Fig. 167). Cortex appears on all the cores (Fig. 165); on 28.5% it covers the entire core (except for the debitage surface and striking platform) and on another 50.0% it is covers one side. The mean maximum width of these cores is 30.4 mm (s.d. 6.3) and is identical to the width of the debitage surface (Table 13). The debitage surface bears 2-4 laminar scars. Hinge and overpass scars are common and appear on half of them. Modification surfaces appear on 30.8% of these cores, usually at the base. The majority of the prismatic cores were abandoned due to exhaustion (69.2%). Other reasons for abandonment include hinge scars (15.4%) and large overpass removal (15.4%).

Pyramidal

The circumferential reduction that characterized these cores (n=7) camouflaged the ability to identify the shapes of the used raw material in three of the cases. The others were made on rounded nodules or parts of nodules with rounded or amorphous shapes. The circumferential reduction is also the cause for the relatively limited cortex cover on these cores (Fig. 165). The most common shapes of the debitage surface of these cores are irregular and U-shaped (Fig. 166). Core base is usually pointed (Fig. 167). The 3-7 laminar scars on these cores tend to converge into this pointed base. Hinge scars as well as overpass scars appear on all of these cores. The latter contributed for forming the pointed base. Modification surfaces appear on the base and back of three of these cores. Four of these cores were abandoned due to exhaustion.

Based on the above description of the cores I suggest that the 'parallel edges' shape represents one reduction strategy, while the prismatic, pyramidal and 'amorphous front' core shapes represent a second reduction strategy which was more flexible. The reduction strategy that characterized the cores with the ‘parallel edges’ shape will be elaborated on in the following experimental knapping study. First though, I wish to elaborate on the strategy that characterized the three other core shapes.

The cores with the prismatic and pyramidal shapes most probably had a different shape at the beginning of reduction as evidenced by the following data: (1) The prismatic and pyramidal shapes are characterized by the least amount of cortex (Fig. 165). (2) The prismatic shape cores are the least thick (Fig. 172), and (3) the pyramidal shape cores are characterized by the highest number of overpass scars (Fig. 174). The fact that the maximum width of the cores of the prismatic and pyramidal shape exceeds that of the 'parallel edges' shape (Fig. 169) supports the assumption that they represent a different strategy. In this strategy the cores probably started out by having an 'amorphous front' shape – the widest core shape of the ‘single striking platform laminar cores’. The fact that only one of the ten cores recorded as ‘amorphous front’ was discarded due to exhaustion supports the assumption that they generally represent an initial shape of the cores. These cores started out with a relatively limited debitage surface compared to their circumference and from this point onwards they took on different shapes depending on the course of reduction. One possibility is that during the reduction the debitage surface gradually shifted towards the core back, consequently becoming wider and flat, thus bearing a prismatic core shape. Another possibility is that the removal of items from the core sides was enhanced at some point during the reduction resulting in a pyramidal core shape.

It is of note that in some cases cores that began with a 'parallel edges' shape might also have ended up having a prismatic or pyramidal shape. This might be reflected by the thinner specimens among these shapes or by the shifting of the production from the narrow face to the core’s side in order to increase the debitage surface width. Such cases however lost all the benefits of the strategy that characterized the ‘parallel edges’ shape cores.

‘Two Striking Platforms Laminar Cores’

The nine cores of this type have two striking platforms which used two different debitage surfaces; both of which exploited the narrow part of the raw material. None of the cases seem to show a simultaneous use of the two debitage surfaces; but rather, the second striking platform was created only after the first was abandoned. This shift could have taken place after the first striking platform had encountered major difficulties or subsequent to a notion that utilizing a different part of the core might produce better results. These cores were shaped on flat flint slabs with cortex on both sides, although in two cases it is not fully clear. In general, each of the used striking platforms followed the concept of the 'parallel edges' shape, however four different relationships between the striking platforms were observed:

1. The two striking platforms are in the same orientation (n=3). Each of them is located on a different face of the core – one in the front and one in the back. Although the two striking platforms seemingly conjoined, the debitage surfaces are completely separated. The size of the largest of these cores is 78x50x29 mm.
2. The two striking platforms are alternating (n=3) (Fig. 41:2). Each of them is located on a different face of the core – one at the front and one at the back, but in contrast to the former case they were knapped in opposing directions. The size of the largest of these cores is 57x30x27 mm in size.
3. The two striking platforms are at a 90° to each other (n=2) (Fig. 41:1). On these cores the debitage surface of the first striking platform was used as a striking platform for the new debitage surface. The size of the largest of these cores is 61x60x35 mm.
4. A core with multiple striking platforms (n=1). This core has two clear striking platforms and three debitage surfaces. One of the old striking platforms was removed in the course of the reduction. The core is triangular in shape and its size is 42x33x18 mm.

‘Single Striking Platform Laminar and Flake Cores'

The 34 cores of this type appear in the following shapes: 'amorphous front' (n=6; 17.6%), prismatic (n=25; 73.5%) (Figs. 42:2, 43, 44:2) and pyramidal (n=3; 8.8%) (Figs. 42:1; 44:1). In the following presentation I will describe the 'single striking platform laminar and flake cores' as a whole, yet since the prismatic shape cores indicate a specific and repeated discard pattern I will also describe them separately. I have added to the graphic presentation of these cores the data of the 'single striking platform laminar cores' in order to provide a comparison between the two.

Raw materials used for this type are different in frequencies than those of the 'single striking platform laminar cores'. Flat flint slabs constitute only 11.8%, while the majority are made on round nodules and nodule fragments (58.8%). Other raw material types include patinated items (2.9%) and unidentified (17.6%).

The presence of extensive cortical surfaces is an integral characteristic of these cores and especially of the prismatic shape (Fig. 175). The cortex on 55.9% of the cores of this type appears on the entire outer surface excluding the debitage surface and the striking platform. In the case of the prismatic shape this is even more pronounced, constituting 72.0%. The presence of cortex is a good indication of the potential for reducing cortical laminar items.

The striking platforms of these cores were shaped by forming a flat scar (35.5%), faceting (29.0%), a combination of a flat scar and faceting (32.3%) or natural (3.2%). In the case of the prismatic shape there was a larger tendency towards making the striking platform by a flat scar (40.9%) (other striking platforms of the prismatic shape cores were made by faceting: 18.2%; flat scar and faceting: 36.4%; natural: 4.5%). Micro flaking of the striking platform edge appears on 43.3% of these cores (43.5% in the prismatic shape).

The shapes of the debitage surface of this core type are fairly equally divided between U-shaped (32.4%), irregular (32.4%) and rectangular (29.4%). Triangular debitage surfaces are rare (5.9%). In the case of the prismatic shape, a more uniform debitage surface appears; U-shaped (44.0%) and rectangular (40.0%) are dominant, while triangular (4.0%) and irregular (12.0%) are few. In general, the debitage surface tends to be relatively wide and not elongated as with the 'single striking platform laminar cores'. The base of these cores is either oblique (8.8%), flat (38.2%), pointed (2.9%), rounded (35.3%) or irregular (14.7%). The paucity of pointed bases and the variety of wide bases are important. The prismatic cores demonstrate a similar pattern.

The total number of laminar scars on this core type is small and a single laminar scar is the most common (1 scar: 44.1%; 2 scars: 29.4%; 3 scars: 20.6%; 4-7 scars: 5.9%). Their mean is 2.0 (s.d. 1.3). The number of parallel laminar scars is not very different (1 scar: 44.1%; 2 scars: 38.2%; 3 scars: 11.8%; 4-7 scars: 5.9%) with a mean of 1.8 (s.d. 0.8). The total number of laminar scars on the prismatic shape cores is even smaller (1 scar: 48.0%; 2 scars: 32.0%; 3 scars: 20.0%) and so is the number of the parallel laminar scars (1 scar: 48.0%; 2 scars: 40.0%; 3 scars 12.0%). These cores however, are also characterized by flake scars on the debitage surface, whereby the laminar scars are almost exclusively near the lateral edges of the debitage surface. Among 40.9% of these cores the laminar scars are near the left edge, among 50.0 they are near the right edge and among 4.5% they appear near both edges. Only among 4.5% of these cores they are in the middle of the debitage surface.

The distribution pattern of the number of hinge scars on these cores (Fig. 176) peaks at two. This is clearly different from the case of the 'single striking platform laminar cores' where the peak is at zero hinge scars. The number of overpass scars on the debitage surface shows the same pattern (Fig. 177) with 'single striking platform laminar and flake cores' showing more overpass scars than the 'single striking platform laminar cores'. It is assumed that the higher number of hinge and overpassing scars on these cores reflects the limitations of this technological choice.

The distribution pattern of the maximum length of this core type (Fig. 178) peaks at 41-45 mm (mean: 43.0 mm [s.d. 8.0]; Table 13) and in general it is not far from that of the ‘single striking platform laminar cores’. The major difference in metrics is in width (Fig. 179). The distribution pattern of the 'single striking platform laminar and flake cores’ has a clear peak at 41-45 mm (the prismatic shape show a similar pattern), while that of the ‘single striking platform laminar cores’ is at 21-25 mm. In the case of the prismatic cores there is almost a compete match between the maximum width and the width of the debitage surface (Table 13). The thickness of the ‘single striking platform laminar and flake cores’ (Fig. 180) is much smaller than that of the ‘single striking platform laminar cores’. While in the former the distribution peaks at 16-20 mm in the latter it peaks at 26-30 mm. The prismatic cores, which have an even higher peak at 16-20 mm, represent a very good exploitation of the core mass if we consider the flakes as desirable products.

Simple modification and maintenance surfaces appear on 44.1% of these cores. They are fairly equally placed on the core base (20.0%) or back (17.6%). Additional 5.8% appear on the debitage surface, probably in order to maintain hinge fractures.

These cores were mostly discarded due to exhaustion (60.0%), however hinge scars (11.4%), raw material problems (17.1%), and large overpass removal (8.6%)

had also led to core abandonment. Only in 2.9% of these cores no abandonment reason was identified. It is of note that among the prismatic shape the amount of cores that were exploited to exhaustion is high (69.2%).

‘Two Striking Platform Laminar and Flake Cores'

The 13 cores of this type show much variation and only five demonstrate a repeated pattern. The latter cores have one striking platform used for laminar production along the narrow part of the raw material, and another striking platform used for flake production on its flat face. In four of these cores, the striking platform of the flake production is on the base-side of the core as seen from the laminar production perspective. There is a possibility that the two striking platforms are in fact complementary in a manner that the flake removal from the base served in making the debitage surface of the laminar production more pointed. These cores are generally small with the largest measuring 49x32x48 mm.

The other cores vary and will not be described in detail. It is noteworthy though that one of the cores is very small (Fig. 45:1) and demonstrates that creating a second striking platform was efficient in exploiting the core mass. A second core, which is relatively large (65x68x71 mm; Fig. 45:2) and was rejected due to raw material problems, shows that a second striking platform could be created at an early stage of the production.

Summary of the Laminar Core Class

The attribute analysis of the cores revealed several patterns contributing to the reconstruction of the reduction sequence. It shows that controlling the core’s general shape was rarely conducted by preliminary knapping procedures, but rather by the selection of specific raw material shapes and by initiating the reduction from specific parts of the raw material. The debitage surface was usually located in a manner that it was framed by one or two cortical sides.

In general, I observed two main core strategies which were highly affected by the selection of raw material. One is represented by the cores with the 'parallel edges' shape, and the other is more flexible and represented by the cores with the 'amorphous front', prismatic and pyramidal shape. The latter strategy includes both ‘laminar cores’ and 'laminar and flake cores'. The cores with a 'parallel edges' shape mainly utilized flat flint slabs, but small nodules or other raw material pieces which have two relatively uniform sides (with cortex or not) could have been used as well. In the case of the cores with a 'parallel edges' shape the reduction focused on the narrow part of the raw material and the debitage surface framed by the core sides gradually receded retaining its size and shape.

In contrast, wider raw material with a rounded or amorphous shape cannot be reduced in that manner. Since major pre-shaping of the core was not practiced, the solution was to start the knapping from an angular part of the raw material so the removal of items would gradually improve the core's contour thus enabling a more controlled reduction. In many cases however, the constant removal of laminar items was impossible due to the raw material's shape and there was a need to combine the laminar production with flake production in order to improve the contour of the debitage surface. Such was the case with the laminar and flake cores. Utilizing this strategy most of the cores started out by having an 'amorphous front' shape and the more refined prismatic and pyramidal shapes materialized through the course of the reduction (Fig. 181). It is of note that the cores with an 'amorphous front' or prismatic shape could have shifted from producing only laminar items to producing a combination of laminar items and flakes or vice versa at any stage of the reduction.

Both strategies led to a high exploitation of core mass. In the case of the 'parallel edges' shape it is best seen by the fact that the debitage surface spread over the maximum length and width of the raw material. In the case of the other strategy the small size of many of the prismatic shape cores demonstrates its efficiency.

Experimental Knapping

The observations originating from the analysis presented in the previous sections are the base of the technological reconstruction of the laminar production at Qesem Cave. The validity of some of these observations can be examined from another vantage point by experimental knapping. Assuming the experimental knapping supports the results, it can be further used to improve our understanding of several aspects of the reduction. The experimental knapping was conducted according to the main characteristics of the Amudian laminar technology from Qesem Cave summarized below:

1. Several raw material types were exploited at Qesem Cave, yet the use of flat flint slabs with cortex on both sides was the most pronounced.
2. The selected raw material was transformed into laminar cores with minimal preparation and cortex was not removed prior to laminar production. Striking platforms were shaped by either a single removal or by light faceting. Removing the first items from the debitage surface included, if any, only minor shaping. The debitage surface usually exploited the entire length and width of the used raw material.
3. Knapping was performed by direct percussion, hitting deep inside the striking platform using hard hammer and relatively follow-through, heavy blows. The detached items sometimes led to the removal of a small mass from the core base (i.e. overpassing end termination).
4. Producing laminar items that have one sharp edge and one cortical edge (PE blades and NBKs) was a major goal and not only blades.
5. Blades, PE blades and NBKs were all part of a single reduction sequence.
6. Maintenance was minimal and simple, with overpass items reduction being the main procedure used.
7. The applied reduction sequence led to a high percentage of laminar items in the assemblage.

Since the utilization of flint slabs was the most pronounced in the Qesem Cave samples, the experimental knapping focused on this raw material type. Although some of the results of the experimental knapping are probably relevant for the exploitation of other raw material types/shapes, this was not studied in detail. A single example using a rounded nodule will be presented in order to illustrate this point. The conclusions of the experimental knapping presented below were obtained after many knapping sessions and the reduction of dozens of cores according to the guidelines presented above.

Raw Material

In order to make the experimental knapping as close as possible to the reduction sequence recorded at Qesem Cave I used a flint slab source from the vicinity of Qesem Cave. The selected raw material source is located at Ya'ar Horashim, approximately four km north of Qesem Cave. The flint outcrops of Ya'ar Horashim include relatively flat and large nodules, some reaching one m in diameter and their width rarely exceeding five cm. The nodules which are partly exposed on the surface tend to crack and split into small orthogonal slabs (Figs. 182-183). The fragmentation pattern is characterized by fairly uniform lines and the breakage plains (occasionally patinated) are generally perpendicular to the cortical surface (Fig. 184). Since these flint slabs originated from surface outcrops, some of them are too damaged and fractured to meet the demands for laminar production. During the visits to Ya'ar Horashim I noticed several archaeological raw material fragments tested by a single blow that removed a laminar item (testing raw material is noted in ethnography, e.g. Binford and O'Connell 1984). A few cores that resemble the Amudian laminar technology were found as well. These cores and the tested raw material pieces might indicate that the outcrops of Ya'ar Horashim were exploited in the late Lower Paleolithic.

Hammerstones Used in the Experiment

The hammerstones used in the experimental knapping were collected from the wadi of Nahal Qana that runs through Ya'ar Horashim. This wadi contains many limestone pebbles and a few basalt pebbles of varying hardness. For the experiment I chose hard limestone pebbles, mostly fist size (Fig. 185). For knapping large cores I used slightly larger hammerstones and for small cores slightly smaller hammerstones. In general, small hammerstones were easier to control, but in the case of the large cores it was necessary to use heavy hammerstones for the massive blows. In these cases a basalt hammerstone was preferable (several fragments of possible basalt hammerstone were found in the archaeological material at Qesem Cave). Since the knapping was conducted in a manner that the point of impact between the hammerstone and the striking platform is deep within the striking platform I preferred to use a slightly carinated hammerstone. Hitting on a specific point of the striking platform is easier using the carinated edge of a hammerstone rather than a rounded one.

Primary Shaping of Cores and Initial Knapping

Transforming the selected raw material into laminar cores using only minimal preparations was quite simple. This was done by using the uniform breakage plains of the flint slabs as a striking platform and debitage surface. The angles between the breakage plains usually provide several options suitable for laminar production. The specific spot utilized for laminar production was chosen in considering the presence of a potential striking platform, a potential debitage surface and a suitable angle between them.

In some cases the breakage plains were highly uniform and with an angle of ca. 60º-80º to the potential debitage surface so that no preparation of the striking platform was needed. In others, only small adjustments by faceting were required. In most cases, removing a large piece (*i.e.* a primary core tablet) from the potential striking platform was not necessary.

The use of flint slabs makes it possible to easily form a debitage surface framed by two cortical sides. The "opening" of the debitage surface was fairly simple following one of the two natural crests on each of the edges of the potential debitage surface. The outline of these crests sometimes required a small adjustment by preparing a ridge. These crests could have been reduced as PE blades or NBKs (if no further preparation was performed), as crested blades if a knapped ridge was added, or as an overpass item if it had been removed by a powerful blow that removed a part of the core base. The small adjustment of a shaped ridge that was often needed to initiate the reduction resulted in crested blades of the 'rough' sub-type. Since the cores shaped on these flint slabs were characterized by two natural crests and not only one, it was possible to initiate the knapping from these two corners in a manner that they would together form the entire debitage surface. In cases where the raw material was not too wide and the removal from the two corners was partly overlapping, the second detached item had a laminar scar on the dorsal face and a sharp edge. Such items are NBKs or NBKs-like since they have a clear sharp edge and a cortical back (NBKs-like refer to those recorded as overpass items or crested blades). The NBKs removed at this early stage have a clear character; cortex or patinated surfaces appear not only along their back, but also along part of their frontal dorsal face (Fig. 186). In case the second removed item bears a ridge that is not in contact with the laminar scar of the previous detachment from the other corner, it will be similar in shape to the 'second-primary' crested blade. All of these options emphasize the efficiency of this reduction sequence enabling the reduction of uniform sharp laminar items already in the initial stage of reduction.

However, when the raw material is relatively wide, it is possible that the scars of the items removed from the corners will not meet and a strip of cortex/patina will be left in the middle of the debitage surface. This can explain the few archaeological laminar items found with a strip of cortex in the middle of their dorsal face. Nevertheless, since these are very few, it is my assumption that either the utilization of especially wide raw material was avoided or that in such cases wider items were removed so that a set of two such large items could have completely formed the debitage surface.

The Course of Laminar Reduction and the Affect of Raw Material Width and Length

The raw material width and length directly affect the reduction sequence of the laminar items. The effect of the length is obvious – a longer debitage surface enables the reduction of longer laminar items. However, the longer the debitage surface, the harder it is to maintain a continuous reduction of laminar items. While removing several laminar items from a relatively long debitage surface (ca. 8-10 cm) is easily done, removing a series of long laminar items without any mistakes is difficult. On the other hand, removing series of laminar items is much easier with a debitage surface that is ca. 5-6 cm long. It is of note that the archaeological laminar items from Qesem Cave are mostly in the range of 4-6 cm in length although the raw material sources enabled the shaping of cores with larger debitage surfaces which could have produced longer items. It seems that focusing on the production of laminar items ca. 5 cm long was specifically chosen by the Amudian knappers of Qesem Cave. Since we have no data on hafting (e.g. Lemorini *et al.* 2006), I presume that achieving a controllable reduction sequence of a series of laminar items was the main cause for this technological choice.

The effect of raw material width is more complex. Following the experimental knapping I tentatively divided the cores into three groups of width. The effect of width however is also in correlation with length:

1. *Raw material/cores narrower than 3 cm in width*: A reduction from such thin cores resulted in the production of many cortical laminar items (Fig. 187). Blades were few, and those that were detached usually had traces of cortex. The narrow outline also led to accidental removals of laminar items with cortex on both lateral edges. These laminar items appear in the archaeological assemblage of Qesem Cave but they do not seem to have been desired end-products since they are not suitable for cutting activities – a major goal of this industry (Lemorini *et al*. 2006). In order to avoid producing items with two cortical edges it was preferable to choose flint slabs ca. 5 cm long in which case it was easier to control the reduction throughout the length of the debitage surface.
2. *Raw material/cores ca. 3-4 cm in width*: The reduction of these cores enables a comfortable continuous production of laminar items that include blades, PE blades and NBKs (Fig. 188). Laminar items with cortex on both lateral edges are few. The few cases are usually characterized by one edge that is fully covered with cortex and another that is only partly covered with cortex, thus not entirely excluding the cutting potential of the item. It is possible to control the amount of NBKs and blades reduced from this raw material. If the intention is to increase the number of blades, a small shift in the reduction sequence is needed which will reduce the amount of NBKs produced. Exploiting raw material fragments exceeding 5 cm in length is preferable for these cores. Nevertheless, debitage surfaces ca. 8-10 cm in length are hard to control and items with cortex on both edges will reappear (since the reduced items will also be wider).
3. *Raw material/cores 4-6 cm in width*: While in the two former cases the removal from the debitage surface width was mostly performed in sub-sequences of two laminar items, the removal from a wider debitage surface is mostly conducted by sub-sequences of three laminar items (Fig. 189). The items removed from the center of such sequences are blades with no cortex. The items removed from the side of the cores are cortex-bearing – PE blades and NBKs. Production from relatively wide debitage surfaces also leads to the

reduction of 'blade-flakes'. Among these are ‘NBK-flakes’ which are common in the archaeological samples. The removal of the debitage surface by a series of three items makes the production of laminar NBKs difficult, since the required angular surface (for forming a thin right angle trapezoidal cross-section) is hard to achieve. As a result, less NBKs are produced from cores with such a wide debitage surface than from the former cores (3-4 cm wide). The utilized raw material of these cores is relatively long (ca. 6 cm and more); such a length is required in order to enable the production of laminar items. As noted, the items produced from these cores tend to be wider, so that in order to reduce blanks with a ratio exceeding 2:1 a longer debitage surface is needed. It is of note that in contrast to the two previous cases in which the cores are of the 'single striking platform laminar core' type, the cores in this case are of the 'single striking platform laminar and flake core’ type.

Reshaping the Striking Platforms

Reshaping the striking platform was usually conducted by faceting and only rarely by core tablet removal. The benefit of using faceting is that it allows adjusting a local area and not the entire surface. Although in some industries it was preferred to adjust the entire striking platform by one strike (*i.e.* removing a “classic” core tablet), in the reduction sequence used here a local adjustment was best fitting (*i.e.* faceting and the removal of a core tablet that reduced only a part of the striking platform), since there are slightly different needs at the various points of the utilized debitage surface. The need for local modification especially arose in light of the fact that these cores have two flat cortical sides perpendicular to the striking platform and the desire to utilize a part of them for the production of PE blades and NBKs. Although the reduction from the center of the debitage surface might have a suitable angle of 60º-80º, the reduction from the debitage surface edges (adjoining the core sides) might have confronted angles near 90º not suitable for direct percussion. Therefore the need for a local adjustment of the striking platform increases as the production reaches the core sides.

Another advantage of using faceting and not core tablet removal is the possibility of forming a specific point slightly raised from the surrounding area. The advantage here is that it enables accuracy while using hard hammer direct percussion aimed at hitting deep within the striking platform.

The use of faceting, however, has some disadvantages as well. The first is that the faceting scars usually reach further than the specific adjusted area and the remnants of these removals affect the surface of the following detachments. The presence of this multi-scarred surface might cause a continuous need for faceting. Another disadvantage, although not very different from the use of core tablet removal is that faceting gradually shortens the debitage surface.

Knapping Mistakes and their Repair

As long as the knapping succeeded in removing items that followed through the debitage surface (occasionally by removing a small mass from the core base) usually no need for any repair arose. In some cases the attempt to reduce the laminar items in that way resulted in unintentional removal of overpass items. These cases however generally did not harm the uniformity of the debitage surface and the continuity of reduction. The major problem emerged when the reduced items did not succeed in following through the entire debitage surface. Deformations of the debitage surface can be overcome by several methods. One method is by forming a small ridge from the core side and removing the hinge scar. The item detached after this will usually be categorized as a 'rejuvenation crested blade'. A second method is by detaching an overpass item that will remove the hinge scar. This option also improves the convexity of the debitage surface. A third method is by removing the hinge scar from the core base. All these methods are seen in the archaeological assemblage from Qesem Cave.

The Shapes of the Core at the End of the Reduction

The shape of a discarded core is affected not only by its primary form but also by the reduction sequence. Not all cores that started out with cortex on both sides and a relatively narrow debitage surface ended up having these features. In cores from the experimental knapping, which still exhibit these features, I did not reduce the cores to full exhaustion but stopped when the removal of good laminar items was no longer possible. In the archeological samples the situation was different. Most of the cores were highly utilized and it seems that although there was not any further potential for removing good laminar items a production of smaller laminar items and even flakes sometimes continued. It is assumed that this is the reason why cores that resemble the ones from the experimental study are not the majority in the archaeological samples.

Nevertheless, several cases are of noteworthy. A good knapping procedure that did not shift into the core sides generally ended up having the 'parallel edges' shape. An attempt to utilize the core's sides as a last step of production (ordinarily after the potential to remove items from the front diminished) occasionally led to discarding the core with a pyramidal shape although the major course of the reduction was not circumferential. The use of relatively wide raw material ended up in some cases as a prismatic core shape bearing both laminar and flakes scars. With all of the core strategies, detachment of a large overpass item that might have reduced the entire debitage surface occasionally occurred. The core after this accident was relatively short with a flat large scar. All of the cases described here appear in the archaeological samples.

A Short Note on the Affect of Raw Material with a Rounded or Amorphous Shape

In the described experimental study I used flat nodules with cortex on both sides, however other raw material types can be used as well. An attempt to produce laminar items from large globular nodules resulted in the removal of many flakes and 'blade-flakes' alongside the laminar items. The use of non-flat raw material led to the removal of laminar items that had curved cortical lateral edges in the case of globular nodules and irregular cortical lateral edges in the case of amorphous nodules. During the reduction, the length and especially the width of the debitage surface usually gradually enlarged. Keeping a constant and repeated rhythm in the removal of laminar items was thus difficult, especially in the beginning of the reduction, until the debitage surface was set in a specific shape.

Conclusions of the Experimental Knapping

The experimental study demonstrated that the technological reconstruction based on the archeological material can indeed be performed. The exploitation of flat flint slabs was the main key here. Nevertheless, many of the observations are relevant for the other raw material shapes used at the site as well. The principal observations are summarized below:

1. Selection of raw material played a major role. The central features of the raw material are uniformity in shape and cortex on both sides. The uniformity enables the simple continuous reduction of laminar items with no major need for pre-shaping the core or a complex maintenance while knapping. The cortex

exterior enables the continuous systematic production of blades, PE blades and NBKs through a single reduction sequence as reconstruct from the archaeological material.

2. The use of follow-through blows, occasionally leading to items with an overpassing end termination, was found to be highly efficient in maintaining the production. It does not require however that each item will be removed in such a manner. It is enough that only a portion of the items will follow through the entire debitage surface, yet they need to be removed all along the reduction and not only at the beginning or end.
3. The width of the raw material affected the relative amount of each of the three laminar types produced. Relatively narrow raw material (up to 3 cm) produced mainly NBKs and PE blades, or mainly blades and PE blades. A constant combination of the three in similar numbers is actually impossible. A raw material that is 3-4 cm wide can produce fairly similar quantities of the three laminar types. Wider raw material (4 cm and up) can produce the three laminar types but their relative amount is not constant since the production is combined with flake production.
4. The reduction enables control of the number of blades and NBKs produced, whereby decreasing the number of produced blades will consequently increase the number of NBKs or vice versa. There is no way however to diminish the number of reduced PE blades as long as cortex was not peeled prior to the reduction. The fact that the production enables controlling the reduction of NBKs and blades but not PE blades might indicate that the two former types are the primary target end-products and PE blades are actually "side-products" of the reduction sequence.
5. The production procedure affected the amount of laminar items in the assemblage as a whole. A production from narrow raw material produced almost no flake at all, while the production from wider raw material produced a considerable portion of flakes alongside the laminar items.
6. Faceting was found to be very useful for reduction, especially due to the fact that producing items from the lateral edges of the debitage surface requires a different treatment than from its center.
7. It is a simple reduction sequence, yet a sophisticated technological choice that enables the continuous systematic reduction of laminar items.

The Laminar Technology from Qesem Cave:
Summary and Conclusion

The previous sections explored the laminar production in the studied samples of Qesem Cave. A brief summary of the results was presented at the end of each of these sections. Here I wish to integrate these results in order to reconstruct the desired end products, the reduction sequence, and the significance of this technology.

The Three Laminar Types

The three laminar types – blades, PE blades and NBKs were the major laminar items produced. These three types have some common features, such as a high percentage of thick plain and modified butts and a semi-straight profile. In terms of the metrics, they are generally 41-60 mm long, 16-25 mm wide and with a length/width ratio between 2.1-.2.5. Many additional traits characterize each of the laminar types and are summarized above (Pp: 93-94).

Identifying patterns in the selection of items for secondary modification contributed in discerning some of the aspects which guided the production of the three laminar types. The main laminar type chosen for secondary modification was the blade; 35.4% of all blades were transformed into shaped items. A much lower percentage of PE blades (21.6%) and NBKs (12.3%) were selected for secondary modification. The low percentage of shaped NBKs, which is even lower than that of the overpasses items, supports the argument that in the case of NBKs secondary modification was marginal and not the main purpose. Their potential to be used as cutting implements without any further modification seems to have been the main goal.

The analysis of laminar items helped identify attributes that were of importance in the selection. The metrics demonstrate that longer, wider and thicker items were mainly selected for secondary modification. The fact that length/width ratio is quite low even among shaped items indicates that especially long items were not a major goal. This in turn indicates that the Amudian knappers intentionally removed relatively large and rough laminar items. Although elongated items were desired, there was a limit to the length, not due to technological constraints, but rather due to the need to create durable items.

The presence of sharp edge/s was another major goal according to the observed selection patterns. This is indicated by the fact that blades and PE blades with a more acute angle of the sharp edge were selected for secondary modification. In addition, items without a good sharp edge were rarely selected as best indicated by blades with two edges with non-uniform angles and PE blades without a sharp edge that were usually rejected.

The Reduction Sequence

The raw material used for the laminar production varies and mainly includes flat flint slabs and fist size nodules. Examples of both cases are found among the unworked or tested raw material pieces, but more clearly among the cores. Additional indications of the used raw material are observed among the blanks and overpass items. The use of flat flint slabs is seen among some of the overpass items that bear cortex on both lateral edges and among PE blades and NBKs dominated by a straight cortical edge. The use of rounded nodules is seen among the PE blades and NBKs that have a curved cortical edge. The selection of raw material played a major role. Of importance here is the use of uniform raw material with parallel sides, either flint slabs or flat nodules, which enables the simple continuous reduction of laminar items with no major need for pre-shaping or complex maintenance while knapping. The cortex exterior enables the continuous systematic production of blades, PE blades and NBKs using a single reduction sequence. Other raw materials with a rounded or amorphous shape demanded a slightly different reduction sequence.

Cortex was not peeled prior to the production of laminar items as indicated by the fact that 80.7% of all laminar items bear cortex to some extent. The majority of the flint slabs and flat nodules were transformed into cores by placing the debitage surface between the two uniform cortical sides so that they will bear the 'parallel edges' shape. In the case of the rounded and amorphous nodules the debitage surface was generally formed in one of the carinated areas of the raw material. The latter were mostly of the 'amorphous front' shape at the initial stage. The base of the cores was usually left unshaped. Only a few examples of bases that were narrowed into a pointed shape were noticed, all on cores with an 'amorphous front' shape.

The first item detached from the front of the core while "opening" the debitage surface could have been a PE blade, an overpass item or a crested blade. However, the "opening" of the debitage surface was incorporated with a removal of a series of two to three laminar items that together formed its shape. The crested blade sub-types used at this stage were simple. They mainly include the 'rough' crested blades characterized by a ridge that was shaped by only a few blows, and the 'patianted' crested blades which actually took advantage of old ridges that were already present on the used raw material. The striking platform was either shaped by forming a flat scar, by faceting or a combination of both.

The reduction of the laminar items was conducted by hard hammer and relatively powerful blows as indicated by the common presence of protruding bulbs of percussion and overpassing end terminations. The place of impact of the hammerstone was deep inside the striking platform as indicated by the dominance of thick plain and modified butts. The benefit is that it produces relatively long, wide and thick laminar items which mostly followed through the entire debitage surface. Hitting deep inside the striking platform probably enabled a low investment in shaping the striking platform. Nevertheless, the common presence of micro flaking on the exterior of the butts which correlates to specific butt types raised the possibility that it had served as a complementary shaping before the reduction of many laminar items. This correlation, which indicated that the micro flaking was more common among plain butts than among modified butts, was also observed among the cores, especially those with a striking platform shaped by core tablet removal rather than faceting. This correlation points out that striking platform maintenance was not neglected, only that minimal steps were enough in most cases.

The length of the debitage surface did not significantly change during most of the reduction sequence. This is evident from the fact that overpass items removed at the initial stage of the reduction are similar in length to those reduced during the course of laminar reduction, as well as from the length of the overpass items as a whole which is not much different from that of the three laminar types. In the case of the cores with a 'parallel edges' shape the width of the debitage surface remained constant during the reduction as well. In contrast, in the case of the reduction strategy represented by the ‘amorphous front’, prismatic and pyramidal shape cores, the debitage surface outline continuously changed during the reduction. In some of the latter cores flakes and laminar items were reduced from the debitage surface.

The three laminar types that were found in fairly similar amounts were mostly produced through a single reduction sequence. The reduction of each laminar item created the configuration for knapping the other. The fact that the three laminar types are complementary in terms of the reduction can be seen in the distribution pattern of the left/right position of their cortical edge which is either equal on both sides or with small variations that become equal when the three laminar types are examined as a single group. The distribution patterns of the angle of the cortical edge of PE blades and NBKs showed some correlation as well.

The experimental study demonstrated that the width of the raw material affects the relative amount of the three laminar types produced. Relatively narrow raw material (up to 3 cm) will produce mainly PE blades and NBKs, or mainly PE blades and blades. In this case a constant production of the three in relatively equal amounts is generally impossible. In contrast, raw material that is 3-4 cm wide can produce fairly similar amounts of the three laminar types. In the case of wider raw material (4 cm and up) the relative amount of the three laminar types produced will not be constant since the reduction sequence is combined with flake removal. The differences in width also affected the amount of laminar items in the assemblage as a whole. The use of narrow raw material produced almost no flakes at all, while a wide raw material produced a considerable portion of flakes alongside laminar items.

The way in which each of the laminar types within that sequence was knapped varies slightly (beyond the fact that blades came from the inner mass of raw material and PE blades and NBKs from its sides). In general, more powerful blows were used while removing the NBKs as indicated by the fact they are thicker than the two other laminar types and by their common overpassing end termination. Both of these qualities testify to the fact that NBKs had a larger mass which needed greater force to be removed (e.g. Dibble and Whittaker 1981; Pelcin 1997). Another difference among the laminar types is in the hammerstone's point of impact in relation to the produced blank. While among all the three laminar types, and especially among blades, it is mostly in the middle of the butt, among NBKs and PE blades it commonly tends to appear near the cortical edge as well.

Modifications were occasionally required during the laminar reduction. The renewal of the striking platform was commonly conducted by faceting, but core tablet removals were performed as well. Most core tablets actually led to the removal of only a portion of the striking platform and not all of it. The several "classic" core tablets that were found in the samples indicate that the Amudian knappers were familiar with this possibility but in general they did not find it advantageous to their needs.

Renewing the debitage surface was conducted by either crested blades or overpass items. The use of powerful blows that followed-through the entire length of the debitage surface reduced the number of knapping failures such as hinge fractures. One of the differences between overpass items and crested blades is reflected in the amount of mass removed from the core. While the detachment of overpass items removed a wide part of the debitage surface, the detachment of crested blades removed only a particularly narrow part. The removal of overpass items that have two cortical edges represents this aspect most clearly. The consequence of such an overpass items removal is a new start without the constraints or benefits of the previous structure of the scars.

Indications of modifying the core from its base appear on a considerable amount of the cores and overpass items. These modification surfaces are usually simple and probably represent *ad hoc* actions.

Cores were most commonly abandoned after reaching exhaustion and very few cores had potential for further removal of good quality laminar items. The discarded cores have the shapes of 'amorphous front', 'parallel edges', prismatic and pyramidal. The experimental study demonstrated that cores that were formed in the 'parallel edges' shape had the highest potential to be discarded in a state that still resembles their original shape. The fact that they are not so numerous in the studied samples indicates that many of them were probably recycled or transformed into flake cores and lost their original character. This is supported by the large number of laminar items with a straight cortical edge found in the samples. The cores with the prismatic or pyramidal shape are assumed, for the most part, to have started out by applying the concept of the 'amorphous front' shape.

Variations among the Samples

On the whole, the five samples demonstrate a high similarity in the attributes of the laminar items. The best example is the metrics showing only minor variations in means (a matter of a few millimeters). Yet, alongside this similarity there is some variability. It is primarily observed in the composition of the shaped item types and in the general percentage of the laminar items. The five samples can be roughly divided into three groups; one including samples G/19-20 and K/10 that demonstrate the highest laminar percentages (58.2% and 38.9% respectively); the second including Unit V with the lowest laminar percentage of 24.5%; and the third including samples

G-I/19-22 and F-H/13-15 with a laminar component ranging between the two former groups (33.1% and 31.5% respectively). The results of the laminar attribute analysis repeatedly demonstrated a pattern that correlates to this division. Samples G/19-20 and K/10 represent the most uniform production, while, Unit V, the oldest studied sample from Qesem Cave, represents the least uniform production. Samples G-I/19-22 and F-H/13-15 are generally in between these two ends. This pattern is best observed in attributes that include 'irregular', ‘non-uniform’ or 'other' categories such as the angles of the lateral edges of blades, the sharp edges of PE blades and NBKs, the profile and cross-section. In these attributes the highest rate of 'irregular'/’non-uniform’/'other' is mostly found in Unit V and the lowest rate in samples G/19-20 and K/10.

Other indications for this pattern are found in the number of laminar scars on the items and in the length/width-ratio. In the case of the laminar scars Unit V shows the smallest number and G/19-20 the largest. In the case of the length/width ratio distribution pattern, samples Unit V, G-I/19-22 and F-H/13-15 peak at 2.1, while samples G/19-20 and K/10 peak at 2.4-2.5. The relative amount of the three laminar types produced demonstrates another aspect of variation. While in samples Unit V, G-I/19-22 and F-H/13-15 blades, PE blades and NBKs were produced in relatively equal amounts, in samples G/19-20 and K/10 a larger production of blades occurred. In all, this repeated pattern demonstrates a clear correlation between the intensity of laminar production and its character – the more intense the laminar production, the higher its quality.

The Laminar Technology of Qesem Cave and its Significance

The laminar production in Qesem Cave not only varied in its intensity and quality among the samples, but within most of the sub-units of the samples as well. These variations in the laminar production indicate that this technological choice was practiced in different manners during the time span that the archaeological samples represent. An example that might demonstrate the technological choice is the relationship between NBKs (laminar) and ‘NBK-flakes’. These two show different percentages in the different samples, which are diminished if they are examined together. The difference in the amount of laminar or flake NBKs produced was in correlation to the general percentages of laminar items and flakes in the samples. This pattern indicates that the NBKs (laminar) and the ‘NBK-flakes’ are indeed the same as suggested by their definition (Bordes 1961b:33) and that they represent two different choices for achieving these required end-products. The same pattern was found in the case of the blanks used for shaping backed knives. In samples where the general percentage of laminar items was high, backed knives were mostly shaped on laminar items and in samples where the general laminar percentage was low, they were less shaped on laminar items. In other words, it illustrates that at least in some cases, the laminar items are one technological solution out of a larger pool of possibilities.

The laminar production from Qesem Cave had several advantages. The most important is that it enabled a continuous and systematic reduction of relatively standardized blanks that were highly suitable for their purpose. This is best observed in the case of blades which were the main laminar type chosen for secondary modification, mostly having only light retouch. NBKs, which required no further shaping, further support this. The idea that NBKs are 'technologically defined tools' (Debénath and Dibble 1994:53-54) was confirmed at Qesem Cave by the use-wear analysis which found that they were commonly used for cutting activities (Lemorini *et al*. 2006). The experimental knapping further emphasized this by showing that their reduction could have been avoided and that the choice to reduce them came at the expense of reducing more blades. Their consistent reduction and their rarity among the shaped items can only be explained if they were intended to be 'technologically defined tools'. Furthermore, the NBKs display a high homogeneity in their character and a unique morphology which made them highly suitable as hand-held cutting tools (this is described in detail in Pp: 99-101).

In concluding this section I wish to emphasize that although the laminar production from Qesem Cave was rather simple, it was a sophisticated technological choice which enabled the continuous systematic reduction of relatively standardized laminar items. This technology achieved high quality laminar items that are more common in later periods when 'prepared-core' technologies were in use (e.g. Debénath and dibble 1994:23). The Amudian of Qesem Cave achieved this goal but without great investment in complex preparations and maintenance procedures.

Chapter 5

The Laminar Production from Tabun XI

My analysis of the laminar production of the Acheulo-Yabrudian complex from Tabun Cave is based on Jelinek's excavations, Unit XI (henceforth Tabun XI). The examination of the material includes only laminar items and related waste. In Tabun XI the three facies of the Acheulo-Yabrudian complex appear – the Acheulian, Yabrudian and Amudian. Although the laminar production is mostly found within the Amudian facies and it is the focus of my study, it is also found within the Acheulian and Yabrudian facies of Tabun XI. In this chapter I will examine all three facies and compare them. However, before that I will shortly review the site and the relevant history of research regarding the Acheulo-Yabrudian complex. Published results regarding the relevant lithic assemblages of Tabun are presented as well.

The Site of Tabun

Tabun Cave lies at the opening of Nahal Me'arot (Wady el-Mughara), facing the coastal plain ca. 20 km south of Haifa. In its close vicinity lie the caves of el-Wad, el-Jamal and Skhul (e.g. Garrod and Bate 1937; Jelinek *et al*. 1973; Weinstein-Evron and Tsatskin 1994; Weinstein-Evron *et al.* 2007). Excavations at the Nahal Me'arot caves began following plans to exploit this section of Mount Carmel as a stone quarry for the construction of the Haifa Harbor in 1928. Preliminary excavations at el-Wad led to the Excavation Project of Wady el-Mughara conducted in 1929-1934 directed by D.A.E. Garrod on behalf of the Joint Expedition of the American School of Prehistoric Research and the British School of Archaeology in Jerusalem (Garrod and Bate 1937:1-2). Excavations at Tabun were later renewed in 1967-1971 by A. Jelinek from the University of Arizona (Jelinek *et al*. 1973) and between 1975-2003 by A. Ronen on behalf of Haifa University (Gisis and Ronen 2006).

Although in the current landscape the large opening of Tabun is the most visible of the four caves of Nahal Me'arot, prior to the excavation its entrance, which was at 63.1 m a.s.l., had been much smaller since it was full of sediments. Tabun cave includes an inner chamber with a chimney, an outer chamber which has no roof and a third small intermediate chamber. A terrace of sediments ('talus' in Garrod's description) runs along the open part of the cave. A considerable part of the cave ceiling collapsed prior to the first human occupation at the site (Garrod and Bate 1937:57-58).

The Stratigraphic Sequence

Garrod excavated a large portion of the cave, exposing a total depth of sediments of 24.50 m. She excavated ca. 2000 m³ (Rollefson 1978:19) leaving a stepped section that begun at the inner chamber and ended at bedrock in the outer chamber where a swallow-hole was uncovered. Bedrock was exposed in ca. 100 m² of her excavation. The stratigraphic sequence was divided by Garrod into seven layers and an additional unit termed ‘Chimney’ (Garrod and Bate 1937). Although the new excavations had better control over the stratigraphy, Garrod’s division of the sequence is still most commonly used in the literature. The stratigraphy of the three excavations cannot be fully correlated; not only due to the long gap between Garrod's excavation and the 1960’s-2000’s seasons, but also because the stratigraphic sequence varies in different parts of the cave (Garrod 1956; Garrod and Bate 1937; Jelinek *et al*. 1973; Tsatskin 2000).

Jelinek’s excavations at Tabun focused on achieving a refined stratigraphic sequence based on purely geological and sedimentological aspects and free of typological consideration as was partly performed by Garrod. The controlled data retrieved from Jelinek's excavation was used to examine changes in climate, environment and the lithic industries. Jelinek’s excavations concentrated on Garrod’s stepped section in the intermediate chamber. The new section was 10 m high, five to six m wide and it penetrated two m into Garrod’s section. The lower part of the new section shifted a little westward from the main section due to the loose sediments caused by the ‘spring’ activity found below (Jelinek *et al*. 1973). The exposed sequence was divided into 14 'Major Stratigraphic Units', each composed of several geological beds that were further divided into 'stratigraphic contexts' (Jelinek 1982b, 1990).

Ronen’s excavation focused on the lower part of Garrod’s section in sediments that correlate with layers E and G (Gisis and Ronen 2006; Ronen 1995; Ronen and Tsatskin 1995).

The following stratigraphic description is mainly based on Garrod’s excavations, but includes the preliminary results of the later excavations as well.

Layer G was ascribed by Garrod to the Tayacian and its maximum thickness was 3.80 m. It lies on bedrock. No animal bones were found and flint artifacts were few (Garrod and Bate 1937:69-70). Due to the inclinations of the sediments and the scarcity of artifacts, a correlation between Jelinek's Unit XIV and Garrod's Layer G was suggested with caution (Jelinek 1981). Ronen correlates his ‘Layer 410’, which overlies the bedrock, to Garrod’s Layer G (Gisis and Ronen 2006). The cultural affinity of Layer G is still debated. While Jelinek (1981) ascribed it to the Late Acheulian, Gisis and Ronen (2006) ascribed it to the Tayacian.

Layer F was ascribed by Garrod to the 'Upper Acheulian' and its maximum thickness was 3.60 m. It is composed of whitish to yellow sediments, clearly different from the overlying sediments of Layer E (Garrod and Bate 1937:68). This layer was deformed by the swallow-hole. The deformation and the cementation of its upper part occurred before Layer E accumulated (Ronen and Tsatskin 1995). Animal remains were scarce in this layer (Garrod and Bate 1937:68). Ronen’s ‘Layers 310-390’ were correlated with Garrod’s Layer F (Gisis and Ronen 2006). Layer F is currently ascribed to the late Acheulian (e.g. Bar-Yosef 1995a; Gisis and Ronen 2006).

Layer E was ascribed by Garrod in the excavation report to the 'Upper Acheulian' or Micoquian and its maximum thickness was 7.10 m. The layer consists of various sediments of which some are cemented (Garrod and Bate 1937:65-67). Layers E and D are actually composed of the same eolian sediments differing in proportions of sand and silt. While sand is more common at the bottom, silt is more common at the upper part. Traces of fire and water activity were noticed within the sediments (Goldberg 1973:92-106; Jelinek *et al*. 1973). Layer E was divided by Garrod into four sub-layers (Ea-Ed), mostly based on lithic typology. Faunal remains were found within the cemented sediments, while in other parts of Layer E they were rare to absent. Few human remains were found within this layer (Garrod and Bate 1937:67; McCown and Keith 1939:60, 195, Fig. 29). According to Garrod (1956) there were three levels with ‘Upper Paleolithic tools’ at the bottom of sub-layer Ea and the upper part of sub-layer Eb. Jelinek (1981) reports that his Units X-XIII are equivalent to Garrod's Layer E. Although a full correlation between the two excavations was not achieved, Jelinek correlates sub-layer Ea to Units X-XI, sub-layer Eb to Unit XII and sub-layer Ed to Unit XIII. A correlation to the very thin sub-layer Ec was not identified. Though Jelinek views Unit X as an intermediate phase between Layers D and E (Jelinek 1981), it will not be included in the following description of Layer E since this unit might represents a mixture of material from both layers (Bar-Yosef 1994). Garrod also observed a level with a mixture of Layers E and D artifacts, yet in her report this level is assigned to Layer D (Garrod and Bate 1937:65). Ronen reports that his ‘Layers 210-290’ are equivalent to Garrod’s Eb-Ed (Gisis and Ronen 2006). My study focused on Jelinek’s Unit XI including Beds 73-77 which were further divided into 16 ‘stratigraphic contexts’. The Amudian was found within Bed 75 (Jelinek 1990). Layer E was later described by Garrod (1956) as Acheulo-Yabrudian, by Jelinek (1981) as the 'Mugharan Tradition' and by Ronen as Yabrudian (Gisis and Ronen 206).

Layer D was ascribed by Garrod to the 'Lower Levalloiso-Mousterian' and its maximum thickness was 2.70 m. The layer is generally horizontal (Garrod and Bate 1937:65). The upper part of Layer D bears erosion channels that seem to indicate a discontinuity and a gap in the deposits between Layers D and C. The sediments of Layer D include sand and silt (Jelinek *et al*. 1973). Jelinek’s Units II-IX correlate to Garrod's Layer D (Jelinek 1981). In the current state of research the industry of this layer is mostly referred to as 'Early Levantine Mousterian' or ‘Tabun D-Type' (Bar-Yosef 1995a; Copeland 1998; Shea 2003 and references therein).

Layer C was ascribed by Garrod to the 'Lower Levalloiso-Mousterian' and its maximum thickness was 2.20 m. It is characterized by black to white sediments that include remnants of ashes, representing the repeated occurrence of fire. The presence of large limestones blocks and *terra rossa* within Layer C indicates that the chimney was formed at this stage. Before the opening of the chimney the cave was a closed roofed shelter. Several human remains were found within this layer (Garrod and Bate 1937:63-65; McCown and Keith 1939). Jelinek’s Unit I, Beds 17-26 correlate with Garrod's Layer C (Jelinek 1981). In the current state of research the industry of this layer is mostly referred to as 'middle Levantine Mousterian' or ‘Tabun C-Type' (Bar-Yosef 1995a; Copeland 1998; Shea 2003 and references therein).

Layer B was ascribed by Garrod to the 'Upper Levalloiso-Mousterian' and its maximum thickness was 3.40 m. Sediments include *terra rossa* with large limestone blocks in the inner chamber and 'whitish clay' at the outer part. Several human remains were retrieved from the inner chamber (Garrod and Bate 1937:62-63; McCown and Keith 1939). Jelinek (1981) correlates his Unit I, Beds 1-16 with Garrod's Layer B. In the current state of research the industry of this layer is mostly referred to as 'late Levantine Mousterian' or 'Tabun B-Type' (Bar-Yosef 1995a; Copeland 1998; Shea 2003 and references therein).

The *'Chimney'* was ascribed by Garrod to the 'Upper Levalloiso-Mousterian' and it was six m in depth. Sediments were mainly *terra rossa* (Garrod and Bate 1937:60-62; McCown and Keith 1939).

Layer A included material from the Early Bronze Age to modern times and it was up to 1.30 m in depth. In the inner chamber it was composed of *terra rossa*, while along the outer chamber it was composed of darker material and stones (Garrod and Bate 1937:59-60).

Faunal Remains of Tabun Layer E

Faunal remains were scarce in Jelinek's Units XI-XIII and of the finds retrieved from Garrod's Layer E only a small portion was identified. *Gazella*, *Dama* and *Bos* constitute the majority of the finds, while the other 32 identified species are represented by only few specimens. Additional large mammals include *Alcelapus*, *Elephas, Equus, Hippopotamus*, *Rhinoceros* and *Sus*. Gazzela was not well represented in the lower part of Layer E and its quantity increased towards the upper part of this layer (Garrod and Bate 1937:145-146).

The Dating of Tabun E

The dates for the Tabun layers have constantly changed during the last 40 years in correlation with the new and refined dating methods. Nevertheless, the dates are still not clear due to different results from different dating methods.

ESR and U-series dates were retrieved from teeth taken from museum collections of Garrod's excavations (Grün *et al*. 1991). The results were recently revised following new calculation methods. The refined result for sub-layer Ea as presented by a combined model of ESR and U-series is 208+102/-44 kyr (Grün and Stringer 2000). In 1995 several teeth were retrieved from sediments equivalent to Garrod's sub-layer Ed. The combined model of ESR and U-series gave a date of 387+49/-36 kyr for this sample (Rink *et al*. 2004).

TL dates of the Tabun sequence were obtained from 37 burnt flint items from Jelinek's excavations (Mercier *et al*. 1995). These results were recently refined following methodological improvements. The means of the recent results are 264±28 kyr for Unit XI, 324±31 kyr for Unit XII and 302±27 kyr for Unit XIII (Mercier and Valladas 2003).

Raw Material Sources

Mount Carmel is rich in flint outcrops of varying quality, color, size and shape, some of which are in the vicinity of Tabun. Druck (2004) recently examined the raw material sources of Mount Carmel and their correlation to the assemblages from the Tabun Sequence. The results showed that although the same sources formed the main bulk of raw material in the different assemblages, their relative amounts varied. The presence of 'Source no. 3', characterized by flint slabs with cortex on both flat sides, in the vicinity of Tabun is of note although it was not commonly exploited (Fig. 201). The study of the cosmogenic ^{10}Be by Verii *et al.* (2004) indicated that some of the raw material from the lower part of Layer E might have been quarried.

Lithic Industries from the Tabun Sequence

The lithic industries of Tabun were first presented by Garrod and Bate (1937). From the later excavations of Jelinek and Ronen only preliminary reports were published (Gisis and Ronen 2006; Jelinek 1975, 1977, 1981, 1982a, 1982b, 1990; Jelinek *et al*. 1973; Ronen and Tsatskin 1995). In addition to these, many more studies were conducted on various shaped item types or technological aspects of the Tabun lithics (e.g. Dibble 1981; Druck 2004; Gilead 1970a, 1970b, 1977; Matskevich 2006; Matskevich *et al*. 2001; McPherron 2003, 2006; Monigal 2002; Rollefson 1978; Rollefson *et al*. 2006; Saragusti 2002; Shifroni 1997; Shifroni and Ronen 2000; Skinner 1965; Wiseman 1990; Wright 1966). It is of note that while the collection of lithic material in Garrod's excavations was not systematic, Jelinek documented the exact coordinates of each piece over to 2.5 cm in size. While only brief notes concerning the Tabun industries will be presented here, the material from Layer E / Units XI-XIII will be thoroughly reviewed in the following section.

The lithic assemblage of Layer G is characterized by an abundance of retouched flakes and a scarcity of bifacials. Side-scrapers are the only additional shaped item type that appears in large numbers (Garrod and Bate 1937:90-91). Jelinek also noted the meager presence of bifacials in his Unit XIV which he correlates to Layer G (Jelinek 1981; Jelinek *et al*. 1973). Gisis and Ronen (2006) note that the side-scrapers from ‘Layer 410’ which they consider equivalent to Layer G are different from the 'Yabrudian types'. Blades were well represented in their ‘Layer 410 ‘(Ilam: 27).

The lithic assemblage of Layer F is dominated by handaxes, constituting about one third of the shaped items. Side-scrapers and choppers are noted as well. Among the debitage, blades and ‘NBK-flakes’ were found as well (Garrod and Bate 1937:87-89; Gisis and Ronen 2006; Shifroni 1997).

The lithic industry of Layer D is characterized by elongated Levallois points and blades which are not all of Levallois technology (Jelinek 1977:88; Meignen 2007a). An especially high laminar index characterized this layer. The Ilam of Bed 39, for example, is 57.2 (Jelinek 1975:306, Table 4).

The lithic industry of Tabun C is characterized by relatively large thin and broad Levallois flakes radially prepared. Triangular points are few in Tabun C. The Tabun B industry is characterized by triangular Levallois points and Levallois flakes produced by radial and unidirectional reduction (Jelinek 1982b; Jelinek *et al*. 1973; Mericer *et al*. 1995:497).

The Lithic Industries of Tabun Layer E/Units XI-XIII

In this section I will summarize the published results of the lithic industries from Garrod's Layer E and its equivalent material from Jelinek's Units XI-XIII and Ronen's 'Layers 210-290'. Since only the material from Garrod's excavations was presented in a final report I will first describe it separately. The description of the character of the main blanks and shaped items will be according to studies performed on finds from all the excavations. Trends within Layer E and its equivalent units based on all the excavations will conclude this section. The published data regarding the lithic assemblages of Jelinek's Unit XI, from which my studied material was taken, will be presented separately.

The Assemblages of Garrod's Excavations

The inventory of lithic finds from Garrod's Layer E was presented by numbers (Garrod and Bate 1937:79-89). I did not convert it into percentages since the collection was biased.

Sub-layer Ed

The lithics of sub-layer Ed include 18,783 items. Debitage flakes are generally smaller and have less base modification than those of the following sub-layers. Blades are present, however they are described as "large and clumsy" (Garrod and Bate 1937:86). Of the 270 cores, only three are 'blade cores'. Several Levallois cores were found as well. Among the shaped items, side-scrapers are by large the most common (n=11,741). Although Garrod's description used different terms, it seems that the most common sub-types are the 'single straight' or 'single convex'. Déjeté side-scrapers however are also well represented. Handaxes (n=3,618) are generally roughly knapped and are 70-110 mm long. Although most have a pear shape, Micoquian types are present as well. The base of many handaxes is natural or only slightly modified and the tip is usually blunt. Choppers (n=1,643) constitute a large part as well. Other shaped item types appear in smaller numbers. Worth noting is that end-scrapers (n=79) were made on thicker blades than in the following sub-layers.

Sub-layer Ec

Although the lithics of sub-layer Ec include 5,019 items, its description is limited. Among the shaped items, side-scrapers (n=3,513), handaxes (n=616) and choppers (n=379) are the most dominant. Other shaped item types are present in smaller numbers.

Sub-layer Eb

The lithics of sub-layer Eb include 14,164 items. Among the debitage the presence of blades is noted. Of the 178 cores, no ‘blade cores’ are mentioned. Among the shaped items, side-scrapers are the most common (n=9,344), although handaxes (n=1,866) and choppers (n=1,057) are also well represented. Other types appear in smaller numbers. ‘Nibbled blades’ (n=174), end-scrapers (n=67), burins (n=97) and ‘Chatelperron points’ (n=76) appear in this sub-layer but they were mostly found near the contact of sub-layers Eb and Ea. Garrod’s use of the European term 'Chatelperron point' described items with a slightly curved retouched back that extends into the distal end forming a tip. In my opinion they should be described as backed knives.

Sub-layer Ea

The lithics of sub-layer Ea include 6,668 items. Blades are found within the debitage, although it is stated that most of them were not kept. The cores include many items described as ‘Calctonian type’ and some Levallois cores that are probably intrusive. Only seven blade cores are mentioned. The shaped items are dominated by side-scrapers (n=4,260) mostly shaped on large flakes. According to Garrod’s description of the side-scrapers, single-convex seem to be the most common although transversal side-scrapers are common as well. Handaxes are well represented (n=1,003). Other shaped item types appear in much smaller numbers, including choppers (n=320), ‘nibbled blades’ (n=61), end-scrapers (n=21; all on blades), burins (n=59) and ‘Chatelperron points’ (n=51).

The Character of Main Blanks and Shaped Item Types from Layer E/Units XI-XIII

The finds from Tabun were the focus of many studies by different scholars, concentrating on four topics: flakes, blades, handaxes and side-scrapers. In this section I will summarize these four topics using the results of these studies. Indexes of side-scrapers, handaxes and laminar items are given in Table 14.

Flakes and blades:

Blanks (flakes and blades) from several beds along the Tabun sequence, including samples from Units XI-XIII, were studied by Jelinek (1977) and Dibble (1981). Dibble found a clear correlation between the size of the striking platform and the size of the blanks. In addition, he found that the thickness and width of the striking platform affect the thickness and width of the produced blanks. The blades were the focus of several studies (e.g. Monigal 2002; Wiseman 1990), however I will address their results following the presentation of my own analysis.

<u>*Handaxes:*</u>

Among the handaxes of Layer E Garrod notes that pear shaped are the most common. She also noted the presence of Micoquian type handaxes (Garrod and Bate 1937:79-89). The main handaxe types from Jelinek's excavations are amygdaloid, thick ovate and thick disc (Rollefson 1978). In Ronen's excavations the amygdaloid type was the most common, but many other types appear as well (Gisis and Ronen 2006:149, Table 10). Some of the bifacials were defined as cleavers (e.g. Matskevich 2006; Rollefson *et al*. 2006).

Within Layer Ea few handaxes that are familiar from European assemblages were retrieved. Jelinek (1975:306) was the first to observe this phenomenon by identifying a 'prodnik' within his material. Matskevich *et al*. (2001) examined this aspect in samples from Jelinek’s and Garrod’s excavations and recognized bifacials defined as *'Faustkeilblätter'*. These handaxes were shaped on flat 'tabular' flint with cortex on both faces. They are characterized as thin and flat with cortex at the proximal end. Their point is extremely thin and sharp. The lateral edges are mostly concave and their retouch is occasionally similar to that of side-scrapers. These handaxes appear in sub-layers Ed and Ea.

The handaxes from the Layer E bear more cortex than the ones from the late Acheulian at the site (Gisis and Ronen 2006). In the sample examined by Saragusti from Jelinek’s Beds 76 and 79 (2002:142, Tables 77, 79) 92.4% of the handaxes bear cortex, of which 16.4% bear cortex on both faces.

Jelinek *et al*. (1973:173) described the shaping of handaxes and noted the "frequent appearance of keen-edged bifaces, sharpened by broad, flat, intersecting flake scars". The occasional sharpening by a tranchet removal was observed as well.

Their relatively small size in comparison to those of most Lower Paleolithic Acheulian sites is of note. In mean length the handaxes from sub-layer Ec are the shortest (84.3 mm) and those from sub-layers Ea-Eb are the longest (87.6 mm). Handaxes from sub-layer Ed have a mean length of 85.0 mm (Gilead 1970a:330, 1970b:8, Fig. 2).

Saragusti (2002) examined patterns of symmetry and regularity among handaxes from five Lower Paleolithic samples. The sample from Tabun Layer E, including Jelinek's Beds 76 and 79, was found to be the crudest. McPherron (2003) argued that there are cyclical changes in the handaxes from Tabun that correlate to other changes observed by Jelinek. McPherron demonstrated that in beds where handaxes were prevalent and side-scrapers were few the handaxes were mostly broader, rounded and shorter. In contrast, in beds where side-scrapers were prevalent and handaxes were few the handaxes were more elongated, pointed and longer. He concluded that in beds where more handaxes were made, they were also more intensely used and resharpened before being discarded. The heavy resharpening of handaxes and their occasional recycling into flake cores was noted by Rollefson *et al*. (2006).

A similarity between some of the handaxes and bifacial-scrapers was noted by Jelinek (1975:306) and Wright (1966). An interesting contextual feature is the presence of a cache of 29 handaxes (Garrod and Bate 1937:67).

Side-scrapers:

The majority of side-scrapers were shaped on thick flakes. A sample of 250 side-scrapers from Layer E examined by Gilead (1970a:127-131, Table 17) gave a mean thickness of 16.0 mm. Cortex was very common in this sample – 40% bear cortex on more than a half of their dorsal face, 42% bear cortex on less than a half of their dorsal face and only 18% bear no cortex. Some of the side-scrapers were made on laminar items. In the sample examined by Wright (1966) they were more common in sub-layers Ea-Eb than in the other parts of Layer E. Wright described one of the side-scraper types of Layer E as a ‘backed scraper’ characterized by a natural back (probably shaped on large cortical laminar items). Quina or demi-Quina retouch is found on many of the side-scrapers (Jelinek 1975; Wright 1966).

Garrod’s terminology for side-scrapers typology is no longer in use today. A division of the side-scrapers from her excavations following the ‘Bordes type list’ was performed by Wright (1966) and Skinner (1965). Although they worked on some of the same museum samples, they reached different results (Jelinek 1975). The common ground of both studies point to the following side-scraper types as the most frequent in Layer E: single-straight, single-convex, convergent, angular and transversal. These types are also well represented in Jelinek's excavations (Dibble 1981:40-47, Tables 7-13; Jelinek 1975:309, Table 6).

Trends within the Lithics of Layer E/Units XI-XIII

The lithic assemblages from the different parts of Layer E demonstrate a high similarity in types of artifacts but in different frequencies. Garrod focused on this variation and accordingly divided Layer E into four sub-layers. Although trends within Layer E were first identified by her (Garrod 1956; Garrod and Bate 1937:78-87), the biased collection of artifacts and the division of the assemblages that was not necessarily based on sedimentoligcal grounds undermined the validity of these observations. Jelinek's (1981, 1990) studies completed this void, since his preliminary results showed several trends in the material from Units XI-XIII paralleling Layer E.

Jelinek *et al*. (1973:173) found that Units XI-XIII are characterized by a relatively high density of flint items and by a high ratio of shaped items to blanks. These aspects led them to suggest that the manufacturing of blanks was not entirely performed in some of the beds from the lower parts of this sequence (Beds 53-59 of the preliminary division). Jelinek (1977) later suggested that it might have also occurred in some of the beds from the upper part of this sequence.

In all of the sub-layers of Garrod's Layer E, side-scrapers and handaxes are the most common. Although Garrod (1956) observed gradual changes in the frequency of these artifacts, she assigned Layer E as a whole to the 'Acheulo-Yabrudian'. Jelinek (1982b:65) noted that along the sequence of Units XI-XIII there are two main "industries" – one poor in handaxes and rich in side-scrapers which he ascribed as Yabrudian facies, and one poor in side-scrapers and rich in handaxes which he ascribed to Acheulian facies. He strongly asserts however, that there are no clear divisions between the two facies; but rather that they demonstrate a "cyclical pattern" which is best represented by the fluctuations of the bifacials/side-scrapers ratio (Jelinek 1981:270, Fig. 2, 1982a:1373), indicating "...gradual changes in a single industry" (Jelinek 1981:271). In general, Jelinek (1981:374, Fig. 3) ascribed Unit XIII to the Yabrudian facies, Unit XII to the Acheulian facies and Unit XI as containing Amudian, Yabrudian and Acheulian facies. These facies are all part of the 'Mugharan Tradition' (Jelinek 1990).

Garrod argued that there is a difference in the types of side-scrapers along Layer E (Garrod and Bate 1937:79-89). Wright (1966:420) supports this view and in his examination of the Michigan and Chicago collections from Garrod's excavations the percentages of Quina and demi-Quina retouch gradually increased (in sub-layer Eb it constitutes 44.1% and in sub-layer Ea 56.1%). Jelinek (1981:269-270), on the other hand, argued that Quina retouch and specific side-scraper types, such as déjeté, appear all along Units XI-XIII with no statistically significant differences.

The Amudian constitutes a much smaller part of the Layer E stratigraphy. In the 1930’s when Garrod's excavation report was published, the existence of the Pre-Aurignacian and the work of Rust (1933, 1950) at Yabrud I was still unfamiliar to her. In her report therefore, Garrod only noted the presence of blades and Upper Paleolithic types in high quantities within the upper part of sub-layer Eb and in sub-layer Ea. It was reported however that blades, end-scrapers and burins were found in smaller numbers all along Layer E and that only the ‘Chatelperron points’ (backed knives) were more restricted to the upper part of sub-layer Eb and to sub-layer Ea. The presence of blades in sub-layers Eb-Ea was not only a matter of quantity, but also of quality – the blades from the lowest part of Layer E were more robust (Garrod and Bate 1937:79-89).

It was only when Garrod (1956) re-examined her notes following Rust (1950) that she noted the presence of three Amudian “zones”. This new observation was criticized by Wright (1966:421) following his examination of Garrod’s finds and he argued that the presence of blades all along Layer E indicates that "...the separation between the Pre-Aurignacian and the Acheulo-Jabrudian may not be as great as Garrod… indicated". Jelinek (1981:273) argued, based on his own material, that sporadic Amudian traits appear all along Units XI-XIII and that they gradually increase. He even suggested a possible "Acheulian-Amudian continuity" (Jelinek 1982b:72).

As a result of having no clear divisions among the traits of the three facies, but rather fluctuations and even cyclicality, Jelinek suggested the following:

"I would propose that we are dealing with a single, but highly variable industry, within which two extreme facies can be distinguished. These facies correspond to industries that have been previously designated as Acheulian and Yabrudian. I would suggest that the complex of industries as a whole be designated as the "Mugharan Tradition", and that within this tradition we can distinguish several variants of facies, including a "Yabrudian Facies" and Acheulian Facies". (Jelinek 1981:271)

Although Jelinek in the above description left the Amudian aside, in his view (1990) it is still an integral part of the 'Mugharan Tradition'. Jelinek (1981:271) suggested that this variability represents "specialized facies" and further argued that "...the typological variability in these industries was the result of task-specific shifts in the technology" (Jelinek 1982a:1373).

The Lithic Industries from Tabun XI

This section summarizes the published results of the lithic finds from Tabun XI. As noted, this unit best represents the three facies of the ‘Mugharan Tradition’ (the Acheulo-Yabrudian complex) in Tabun. In fact, it is the only unit from Jelinek’s excavations where the Amudian facies is represented. Jelinek (1990) did not recover in Tabun XI evidences of the three levels of blade industry that Garrod (1956) mentioned within sub-layers Eb-Ea. Instead, he found that the 'Amudian features' fluctuate within this unit. They gradually increased from Bed 77 to Bed 75, where they reached their highest peak, and then declined toward Bed 73 (Jelinek 1990:86, Fig. 4.2) (Fig. 190). In order to evaluate how the three facies of the ‘Mugharan Tradition’ of Tabun XI are interrelated Jelinek (1990) examined the relations between the three aspects that best represent the facies in his view: handaxes for the Acheulian, side-scrapers for the Yabrudian and backed knives for the Amudian. The results, presented on a triangular coordinate diagram, demonstrated three clusters (Jelinek 1990:85, Fig. 4.1) (Fig. 191). Although Jelinek does not promote the notion of a clear division between the facies but rather the idea that they are interrelated and represent fluctuations within the ‘Mugharan Tradition’, he did note that the beds of Tabun XI demonstrate a relation to different facies. He attributed Beds 75I1, 75I2 and 75S to the Amudian facies; Beds 73, 74, 75S1, 75S2, 75X and 77 to the Yabrudian facies and Bed 76 to the Acheulian facies[2].

The results of Jelinek's latest publication (1990) are used in my study for examining the three facies. It is of note that several beds were previously assigned differently: (1) Bed 75S was previously attributed to the Yabrudian facies and not to the Amudian facies (Jelinek 1977:88, 1982b:64). This Amudian bed is however the closest to the Yabrudian facies in Jelinek's triangular coordinate diagram (Jelinek 1990:85, Fig. 4.1). (2) In an early paper, Jelinek (1982b:61, Fig. 2) noted that the Acheulian facies appeared in the upper and lower parts of Tabun XI, probably in Beds 73 and 77, while in his latest analysis he ascribed these beds to the Yabrudian facies. The Yabrudian Bed 77 is however, the closest to the Acheulian facies in Jelinek's triangular coordinate diagram (Jelinek 1990:85, Fig. 4.1).

The general inventory of the assemblages of several beds from Tabun XI was presented by Jelinek (1975:306, Table 5) and Dibble (1981:38-47, Tables 5, 8, 11)

[2] Jelinek used the term 'Bed' both for describing general beds, for example Bed 75, and for describing specific parts within it, for example Bed 75S2. I did not change this method

(Table 15). A classification of 'tools' from these beds following Bordes’ type list was presented as well (Dibble 1981:38, 47, Tables 5, 8, 11; Jelinek 1975:309, Table 6) (Table 16). The descriptions provided by Jelinek do not however refer to these specific beds but are more general.

The Three Facies of Tabun XI

A summary of published notes concerning each of the three facies from Tabun XI is presented below.

Acheulian

The Acheulian is characterized by high percentages of handaxes reaching up to 15% of the assemblage. Other shaped item types including side-scrapers are represented by various percentages, constituting about 15%-20% of the inventory (Jelinek 1981:269). The general inventory and the shaped items from Beds 76I1 and 76I2b were presented according to the Bordes’ type list (Dibble 1981:38, 40, Tables 5, 7) (Tables 15-16). The mean dimensions of blanks from Bed 76 are 54.6 mm in length, 38.2 mm in width and 9.3 mm in thickness (Dibble 1981:114, Table 40).

Yabrudian

The Yabrudian is mainly characterized by the abundance of side-scrapers as well as by a high percentage of shaped items, reaching 40%-50% in some of the samples (Jelinek 1981:269). The presence of handaxes within the Yabrudian beds is of note (Jelinek 1977:88). The general composition of the assemblage of Bed 75S1 and its inventory of 'tools' according to the Bordes’ type list was presented by Dibble (1981:41, 43, Tables 8-9) (Tables 15-16). The mean dimensions of blanks from Bed 75S1 are 56.8 mm in length, 40.8 mm in width and 11.2 mm in thickness (Dibble 1981:114, table 40).

Amudian

Jelinek (1977:90) notes that the Amudian beds of Tabun XI are characterized by a high percentage of whole items and he suggested that it is partially a result of selection performed by the inhabitants of the cave. Cores are few in these beds (Jelinek 1981:272). Among the blanks he emphasized the presence of blades, generally characterized as thick and prismatic. He noted however that some resemble large burin spalls (Jelinek *et al*. 1973:174). NBKs are highly common in the Amudian beds and he correlated their appearance to a specific reduction sequence that utilized cortical nodules (Jelinek 1975:304). The NBK index of Bed 75S (earlier assigned as

48A) is 22.7 and of Bed 75I (earlier assigned as 48B) is 23.3 (Jelinek 1975:306, Table 4). A general inventory of the assemblages of Beds 75S, 75I and 75I1 was presented by Jelinek (1975:306, Table 5) and Dibble (1981:44, Table 11) (Table 15). The mean dimensions of blanks (flakes and blades) from Beds 75I and 75I1 are 65.0 mm long, 31.9 mm wide, and 9.0 mm thick (Dibble 1981:114, Table 40).

The ‘tools’ from Beds 75S, 75I and 75I1 were classified according to the Bordes type list (Dibble 1981:47, Table 13; Jelinek 1975:309, Table 6) (Table 16). Retouched blades, characterized as 'lightly backed' or 'nibble blades', and 'backed points' that are similar to ‘Chatelperron points’ are noted in the Amudian beds (Jelinek *et al*. 1973:174). Handaxes, on the other hand, are rare (Jelinek 1981:272). In all, the character of the blanks and shaped items led Jelinek (1975:311) to suggest that the Amudian was highly engaged with the slicing and cutting of soft materials.

Summering the above, the following features characterized the three facies: (1) Handaxes and a simple flake reduction are most common in the Acheulian beds. (2) Side-scrapers and wide flakes are most common in the Yabrudian beds, and (3) prismatic blades, backed knives and NBKs are most common in the Amudian beds.

The Laminar Component in the Studied Samples

When referring to the relative portion of laminar items in the assemblages, one should take into account that Jelinek (1977:87) defined blades/laminar items by measuring the width at the mid-point and not the maximal width. This may result in items with a 2/1 length/width ratio that reach no such ratio when measured at the maximal width. This method leads to a higher number of laminar items and thus to a higher Ilam. Jelinek (1975:304) was aware of the implications of his measuring method but he argued that the difference is marginal.

The Ilam of only two Amudian beds from Tabun XI was presented – that of Bed 75S (20.3) and that of Bed 75I (49.6) (Jelinek 1975:306, Table 4). These indexes (Ilam) demonstrated that the laminar component is highly variable, not only among the three facies but also within the Amudian. In the absence of reported Ilam from all faices I can only provide a general estimation. Jelinek’s (1990:86, Fig. 4.2.) diagram of the changing frequencies of Amudian features, which also presented fluctuation in blade percentages (including burin spalls) (Fig. 190), is the source of this estimation. Although the precise calculation of these percentages is not clear from the text, I use it as a relative measure. The diagram indicates that only in Beds 75 blades are especially common, while in other beds they are relatively few. The Amudian facies, found in Bed 75 only, is characterized by relatively high percentages of blades (up to 30% according to Jelinek's diagram). The Acheulian facies, which appears only in Bed 76, is characterized by a low frequency of blades (5%-10% according to Jelinek's diagram). The Yabrudian facies, found in all beds except for Bed 76, shows a high variability of the blade percentages. While Beds 73-74 and 77 are similar in this aspect to the Acheulian beds, the Yabrudian within Bed 75 is more similar to the Amudian (ca. 15% for Bed 75S2 according to Jelinek's diagram).

Another issue is the extent to which the use of laminar items represents a technological choice for which we can identify alternative options. Jelinek notes that game butchering was one of the main activities conducted all along layer E and he correlates the role of blades and handaxes as follows:

"The presence of many slicing implements among the bifaces... suggests that the butchering of game may have been a primary concern during this period of occupation. In the light of this functional aspect of many of the bifaces, the apparent mutually exclusive distribution of bifaces and Amudian tools may provide a clue to the significance of the Amudian industry. The dominant element in the Amudian at Tabun is the backed blades. These blades and backed points of the Amudian also appear to be cutting tools. It would seem that when they were in use in the cave they replaced the bifacial slicing that otherwise occur in Layer E." (Jelinek *et al*. 1973:177)

The Samples from Tabun XI Analyzed for this Study

My study examined all the laminar items and related waste found in Tabun XI. It include 364 blades, 166 PE blades, 166 NBKs, 176 overpass items, 100 crested blades and 37 laminar cores (except for the latter all contain both blanks and shaped items). Other components of the assemblage were not examined, although I did review all cores and divided the CTEs into types. The material, currently stored at the University of Arizona, Tucson, and in the Israel Antiquities Authority, was examined with the courtesy of Prof. Arthur Jelinek. The classification of the lithic items into blank types and shaped item types was made by me (see methodological section) and does not necessarily reflect Jelinek's classification. It is of note that I did not study the artifacts smaller than 2.5 cm since these were divided from the general assemblage and stored elsewhere.

The beds of Tabun XI were divided into three groups that represent the three facies of the Acheulo-Yabrudian complex/'Mugharan Tradition' following the results of Jelinek's (1990) study. The decision to follow Jelinek's results in ascribing the different beds to facies was made in an understanding that the character of the assemblages is not only affected by the presence of laminar items, but by the presence of other features as well, mainly side-scrapers and handaxes which I did not examine.

The subdivision of Tabun XI includes some small beds that represent particular locations in relation to the section which are not specifically assigned to any of the facies in Jelinek's (1990) analysis. I assigned these beds to a specific facies in correlation to the larger beds that they are part of and are mentioned in Jelinek's text. The uniting of small beds was also performed by Jelinek (1990:86) and Dibble (1981:38, Table 11). Nonetheless, five beds could not be assigned to any of the larger beds (Table 17). The benefit in ascribing the material into the three facies is in forming larger samples that will enable separating and examining the Amudian facies and its relation to the other facies in terms of the laminar production.

Examining the laminar production from the Amudian beds is the main focus of my study. Therefore, in the first step, the three laminar types (blades, PE blades and NBKs) from the Amudian beds were analyzed separately and are described in details. The three laminar types from the Acheulian and Yabrudian beds are not presented separately, but rather reviewed together with the Amudian by means of comparison.

The analysis of the CTEs discussed the three facies together, but specifically addresses the differences among them whenever present. The relatively small size of the laminar core class on the other hand, did not enable to treat each facies separately and therefore I united the material.

In integrating the results of the analysis of laminar items, CTEs and cores I will focus again on the Amudian, but I will also refer to the Acheulian and Yabrudian facies and will attempt to describe the laminar reduction sequence that characterized the 'Mugharan Tradition'. The order of the three facies in my analysis follows the focus of my interest – the laminar component. The Amudian facies is thus first in line. Since the Yabrudian facies of Tabun XI constitutes a large sample of laminar items and the Acheulian facies only a few, they are placed second and third respectively in my analysis. It is of note that this order could have been different if all components of the 'Mugharan Tradition' (side-scrapers and handaxes) were taken into account.

In general, the technological reconstruction as performed here is based on the assumption that the studied assemblage is fairly “complete” including an authentic representation of most stages of the reduction sequence. The presence of blanks, shaped items, CTEs and cores in this unit enable such a reconstruction. Jelinek’s (1977) suggestion that in some of the excavated beds from Tabun XI not all blanks were produced at the site should not be overlooked. Nonetheless, since the assumption that some of the reduction occurred outside of the cave was not confirmed, I will review the material as is. However, I will utilize my results to reexamine this assumption.

A different note concerns the illustrated lithic items that were drawn by the kind permission of Prof. A. Jelinek (Figs. 192-200). These were retrieved from the small and limited sample stored in the Israel Antiquities Authority only and not from the larger and more varied sample in The University of Arizona.

Raw Material

The used raw material is mostly highly siliceous and homogenous, yet varying in color, size and shape. Alongside the use of fist size rounded nodules, the use of larger raw material was observed. The original shapes of the larger raw material are unknown. The cortex of the raw material also varies in thickness, ranging from a few mm to 15 mm. The abundant handaxes in Tabun XI provide a glance on some of the available raw material shapes. Many of them bear cortex on both faces and were shaped on thin nodules (McPherron 2003; Rollefson 1978). It is of note however, that the use of these flat thin nodules for laminar production in Tabun XI seems to be minimal. Material from Tabun XI was not included in Druck's (2004) study.

Preliminary Observations on the Laminar Items from the Three Facies of Tabun XI

The relative amount of each of the three laminar types out of their total is rather similar in the three facies (Fig. 202). Blades are by far the most common constituting ca. 60%, while PE blades and NBKs constitute ca. 20% each (in the Amudian beds blades constitute 57.9%, PE blades 20.0% and NBKs 22.1%). This resemblance in relative amount of end-products implies a technological similarity in the three facies.

The population of the laminar types among the blanks and shaped items varies. In the Amudian beds blades are more frequent among the shaped items (69.0%) than among the blanks (51.5%). PE blades and NBKs, on the other hand, are less common among the shaped items (blanks 21.1% and 26.5%; shaped items 16.5% and 14.6% respectively).

The rate of secondary modification was relatively high as indicated by the percentages of the shaped items out of the total of blanks and shaped items of each laminar type (Fig. 203). This aspect also shows a difference among the three facies. Secondary modification is the most intense in the Yabrudian beds followed by the Amudian beds. The Acheulian beds are characterized by the lowest intensity of secondary modification of laminar items. There are also differences in the secondary modification of the different types of blanks. Only in the Yabrudian beds the percentage of secondary modification is fairly similar among all the laminar, ranging from 45.1%-52.6% (except for crested blades; 28.9%). In the Amudian beds blades were the main laminar type secondarily modified – 43.8% of all blades were transformed into shaped items. The percentages of secondary modification of the other laminar types in the Amudian beds is 30.2% for PE blades, 24.2% for NBKs, 34.3% for laminar overpass items, and 27.9% for crested blades. In the Acheulian beds the percentages of secondary modification of laminar items are the lowest excluding the NBKs and overpass items. In all, the variability in the percentages of secondary modification in the three facies indicates a major difference in the selection pattern of laminar items.

Another perspective is the division of shaped laminar item types. The division deals only with the *laminar* shaped items because I did not examine the entire shaped item population. In the Amudian beds the most common shaped laminar item type is 'retouched laminar item' (54.2%). It is followed by backed knives (15.1%), 'distally retouched laminar items' (12.3%) and end-scrapers (10.1%) (Fig. 405).

The shaped item types made on each of the laminar types shows different patterns among the three facies (Fig. 204). Blades in all facies were mainly shaped into 'retouched laminar items' (68.8% of all shaped blades in the Amudian). Other types shaped on blades are represented by low percentages and only the backed knives constitute more than 10% in the Amudian and Yabrudian beds. As for the other laminar blank types, only the Amudian and Yabrudian beds constitute a relatively large number of items which can represent some patterns. The variety of shaped items types made on the other laminar items indicates that these blanks were not meant to become specific shaped item types. A clear difference in the selection of laminar items for secondary modification is seen between the Amudian and Yabrudian beds. This is mainly reflected in a higher selection rate of PE blades, NBKs and overpass items for shaping side-scrapers in the Yabrudian beds (constituting 31.3%-39.1% of these laminar items). In order to better illustrate the relation between the shaped item types and specific laminar types I have divided each of the shaped items types from the Amudian beds into the various laminar types it was made on (Fig. 205). The results demonstrate that 'retouched laminar items' and backed knives were mainly made on blades (77.3% and 63.0% respectively). In the case of the 'distally retouched laminar items', end-scraper and side-scrapers there was no clear preference for specific laminar type.

Attribute Analysis of the Three Laminar Types from the Amudian Beds of Tabun XI

The Analyzed Sample

The analysis of the laminar types from the Amudian beds of Tabun XI examined 437 blades, PE blades and NBKs, including both blanks and shaped items. The blanks (n=272) include 140 blades, 60 PE blades and 72 NBKs. The shaped items (n=165) include 113 blades, 27 PE blades and 25 NBKs (Figs. 192, 195; Tables 17-18).

State of Preservation

The laminar items' preservation is exceptionally good. Altogether, including both blanks and shaped items, 82.7% of the blades, 76.7% of the PE blades and 86.3% of the NBKs are whole (Fig. 206). Medial segments are few in all cases. The low percentages of broken items (13.7%-24.3%) might be affected by the fact that I did not study the small lithic finds (less than 2.5 cm).

The comparison of blanks to shaped items (Fig. 207) demonstrates almost an identical pattern. The high percentages of whole shaped items indicate that their utilization was not intensive and did not lead to a high breakage rate.

Amount of Cortex

The percentage of cortex on the dorsal face of the three laminar types, including both blanks and shaped items (Fig. 208) is the most uniform for NBKs with a clear peak at 30% (40.7% of all NBKs). The fact that 43.2% of the blades bear remnants of cortex indicates that cortex was reduced along almost the entire reduction sequence. If the three laminar types are looked at together, cortex appears on 66.9% of them. It is thus concluded that only about one third of the laminar items were fully reduced from the inner non-cortical mass of the nodule.

Patinated surfaces appear on 5.9% of the three laminar types (blanks and shaped) and on an additional 3.3%, the patianted surface appears along a calcareous cortical surface. Among the blades that bear cortex, patinated surfaces constitute 6.7%, among the PE blades it constitutes 8.1% and among the NBKs it constitutes only 3.2%. Cases in which both calcareous cortex and patina are present on the same item constitute 1.1% of the blades that bear cortex, 7.0% of the PE blades and 2.1% of the NBK. No major differences were observed among blanks and shaped items in this aspect.

The presence of cortical surfaces was found to be statistically different between blanks and shaped items ($t[351]=3.16$, $p<0.05$). Items selected to be secondarily modified bear smaller cortical surfaces (Fig. 209).

Cortex Configurations

The cortex configuration of most PE blades demonstrates a high similarity to that of NBKs. In all, 86.3% of the PE blades (blanks and shaped) have one cortical lateral edge and an opposite sharp edge. It is this kind of PE blade which was usually selected for secondary modification as indicated by the fact that while they constitute 82.2% of the PE blade blanks, they constitute 95.2% of the shaped PE blades.

In the case of blades (blanks and shaped) the little cortex, if present at all, mostly appears at the distal end (58.4%). Also common is the appearance of cortex on one lateral edge, spreading along part (22.5%) or all of it (4.5%). Less common configurations of cortex on blades include its presence along the middle of the dorsal face (10.1%) or ‘irregular’ (4.5%).

The side of cortex on PE blades and NBKs (blanks and shaped) demonstrates opposite patterns (Fig. 210). While among PE blades the cortical edge is more commonly on the right (54.9%), among NBKs it is more commonly on the left (55.3%). When uniting blades, PE blades and NBKs into one group the left/right position of the cortex is completely equal (Fig. 210). This implies that the laminar items were commonly reduced from cores shaped on nodules on which the debitage surface was framed by two cortical edges and that the three laminar types were the products of a single reduction sequence.

Angles of the Lateral Edges

The distribution pattern of the angles of the cortical edge of NBKs and PE blades (Fig. 211) shows a bi-modal pattern, indicating that the two types are indeed two different populations. While the NBKs’ peak is around 70°, the PE blades’ peak clustered around 45°. The “boundary” between the two types is at 55°-60°. This shows that the division of items that have one cortical edge and an opposite sharp edge into NBKs and PE blades according to the study at Qesem Cave, where items with an angle >60° are defined as NBKs (Barkai *et al*. 2005) holds true for the Tabun XI material as well.

Non-uniform angles of the cortical edge were observed among 23.2% of the PE blades and 29.6% of the NBKs. This relatively high percentage reflects the common use of nodules with amorphous shapes.

Comparing the blanks to the shaped items demonstrates that there was a general preference for PE blades with more acute angles of the cortical edge (Fig. 212) and of NBKs with more obtuse angles of the cortical edge (Fig. 213). The percentages of shaped items with a non-uniform angle of the cortical edge are also different. In the case of PE blades they constitute 24.3% of the blanks and 21.1% of the shaped items. In the case of NBKs they constitute 32.3% of the blanks and 21.1% of the shaped NBKs.

The distribution pattern of the angle of the sharp edge of PE blades and NBKs (blanks and shaped) demonstrates that PE blades are characterized by a more acute angle with a peak at 30°-40° (Fig. 214). The distribution of the NBKs demonstrates a more uniform pattern of a rough bell shape with a peak at 40°-45°. The higher homogeneity of the NBKs' is also reflected in the frequency of a sharp edge with non-uniform angle (including both blanks and shaped items) which is higher among the PE blades (7.1%) than among the NBKs (1.3%).

The angle of the sharp edge did not reveal any clear pattern of selection for secondary modification in the case of PE blades. In the case of NBKs however, a tendency for selecting NBKs with 40°-45° was observed (Fig. 215). Items with a non-uniform angle of the sharp edge were less selected in both cases. While they constitute 8.3% of the PE blade blanks and 1.6% of the NBK blanks, they constitute 5.0% of the shaped PE blades and none of the shaped NBKs.

The distribution patterns of the angles of the blades' lateral edges (blanks and shaped) show a clear peak at 35° (Fig. 216). The sharp edges of the blades are characterized by more acute angles than the sharp edges of the PE blades ($t[104.18]=2.83$, $p<0.05$) and NBKs with a statistical significance ($t[244.75]=2.13$, $p<0.05$). Blades with non-uniform angles at both lateral edges constitute 4.8% and blades with one lateral edge bearing non-uniform angle constitute 27.4%. The comparison between blank blades and shaped blades demonstrates that there was a selection of items with more acute edge angles that is statistically significant ($t[320]=3.48$, $p<0.05$). It was found that items with one or two lateral edge angles exceeding 55° were rarely selected and there was a general preference for items with 35° (Fig. 217). The role of non-uniform angles of the lateral edges in the selection of blades for secondary modification is also of note. Blades with two uniform edge angles are more common among the shaped items (73.0%) than among the blanks (64.3%). This difference is best reflected among the items with two lateral edges bearing non-uniform angles which constitute 8.0% of the blanks and are totally absent in the shaped items – a difference that was found to be statistically significant ($X^2=6.36$, df=1, $p<0.05$). Blades with one edge bearing a uniform angle and one edge bearing a non-uniform angle are equally common among the blanks (27.7%) and the shaped items (27.0%).

Blade Shapes and Lateral Edge Shapes of PE blades and NBKs

The following shapes of blades (blanks and shaped) appear in the Amudian beds of Tabun XI: parallel (19.6%), straight-curved (23.5%), pointed (6.5%), fan (1.3%), leaf (0.7%), straight-irregular (24.2%), curved-irregular (13.1%) and irregular (11.1%). The shapes that were most commonly selected for secondary modification are parallel, straight-curved and straight-irregular (Fig. 218). The fact that blades with an irregular shape were less selected suggests that among the desired qualities of the blade a uniform lateral edge was important. The fact that pointed shapes were less favored might further emphasize that the important feature was the lateral edges.

When PE blades and NBKs are grouped together (blanks and shaped), a straight outline of the cortical edge is the most common (41.6%), yet curved and irregular outlines are common as well and together they outnumber the straight outline (Fig. 219). The frequent appearance of a cortical edge with a straight outline on the laminar types is in contrast to other observations of the raw material (of CTEs and cores) which did not indicate a common use of flint slabs or flat nodules. It is therefore suggested that although rounded and amorphous nodules were most commonly utilized it was possible to obtain relatively straight cortical surfaces from specific parts on them. The fact that NBKs are characterized by a higher percentage of straight cortical edges than the PE blades suggests that the flat/straight surfaces on the amorphous or rounded nodules were more commonly used for the production of NBKs.

The division of the outline of the sharp edge of PE blades and NBKs (blanks and shaped) demonstrates that a straight outline was the most common (Fig. 220). No major differences were observed between the NBKs and PE blades. Although no statistical significance between the blanks and shaped items was found, the following points are of note. Items with a straight sharp edge were favored in the case of PE blades, while items with a curved sharp edge were preferred in the case of both PE blades and NBKs. Items with an irregular sharp edge were usually rejected, especially in the case of PE blades (Fig. 221).

Butt Types

Modified and thick plain butts are the most common among the laminar items from the Amudian beds (Fig. 222). Dividing the thick plain butts into medium (3-5 mm thick) or large (6 mm or more thick) shows that those over six mm in thickness are most common among NBKs (Fig. 223). This is correlated by the fact that thin plain butts appear in the lowest percentage among the NBKs (Fig. 222). The modified butts are generally quite thick and the most common method of modification is faceting. Although the faceting is for the most part irregular, well shaped faceted butts are found as well. Other modified butts are mostly with a surface composed of several scars from different directions, probably traces of previous faceting. Some of the latter are dihedral. PE blades have the smallest amount of modified butts. Punctiform butts appear in small numbers and they do not represent a systematic production concentrating on hitting a precise location on the striking platform edge. They appear in the highest percentage among the blades and in the lowest percentage among the NBKs. Natural butts are mostly quite thick and they appear in the largest frequency among the PE blades (Fig. 222).

Micro flaking along the exterior of the butt appears at the highest frequency (35.3%) on blades (n=221). On PE blades (n=68) it constitutes 30.9% and on NBKs (n=81) it constitutes 29.6%. The presence of micro flaking varies according to the various types of butts as well. It appears on 56.6% of the thin plain butts (n=53), on 37.7% of the thick plain butts (n=122), on 20.1% of the modified butts (n=154), on 21.4% of the punctiform butts (n=14) and on 40.0% of the natural butts (n=20). These two observations indicate that this is not accidental, but rather the result of performing different procedures while knapping different blank types with different butt types.

The Bulb of Percussion and its Location along the Butt

The bulb of percussion in many laminar items is protruding indicating the use of powerful blows, most probably by hard hammer direct percussion. The bulb of percussion tends to be more commonly located in the middle of the butts among PE blades and less so among NBKs (including both blanks and shaped items; Fig. 224). Accordingly, the percentage of items with the bulb near the cortical edge is higher among NBKs than among PE blades (32.9% vs. 23.8%). In both cases, only rarely is the bulb found near the sharp edge.

The comparison between blanks and shaped items shows that items on which the bulb is in the middle of the butt were preferred in the case of NBKs (54.2% of the blanks [n=59] vs. 70% of the shaped items [n=20]) and less preferred in the case of PE blades (69.8% of the blanks [n=43] vs. 55.0% of the shaped items [n=20]).

In the case of blades (blanks and shaped), the bulb of percussion is in the middle of the butt in 78.6% of the cases (Fig. 225). Among items where it was placed near the sides, there is a slight preference for the right. Comparing the blanks and the shaped items indicates that there was a preference for blades with the bulb in the middle of the butt (74.2% and 84.6% respectively).

Cross-Sections

The cross-sections of blades (blanks and shaped) is most commonly triangular (42.3%) but a trapezoidal cross-section (31.8%) is common as well (Fig. 226). The PE blades are characterized by the highest frequency of a triangular cross-section (67.9%). The NBKs demonstrate a domination of a right-angle trapezoidal cross-section (42.6%). The fact that among NBKs the second most common cross-section is not the right-angle triangular is of note.

The comparison between blanks and shaped items shows that the cross-sections of all the three laminar blanks are statistically different from those of all three laminar shaped items ($X^2=38.55$, df=13, $p<0.05$). The blades and PE blades are characterized by a higher selection of items with a triangular or trapezoidal cross-section and a rejection of most items with a right-angle triangular or ‘other’ cross-section (Fig. 226). These differences however were only found to be statistically significant in the case of triangular ($X^2=5.18$, df=1, $p<0.05$) and irregular ($X^2=11.31$, df=1, $p<0.05$) cross-sections of blades. The selection of NBKs shows a preference for items with a right-angle trapezoidal cross-section and a general rejection of items with a right-angle triangular cross-section. Another difference in the selection among the blades, PE blades and NBKs is that while among the former two there was a general rejection of items with an ‘other’ cross-section, in the case of the NBKs they are more numerous among the shaped items.

End Terminations

Feather end terminations are the most common among all the three laminar types (including blanks and shaped items) (Fig. 227). While the blades and PE blades demonstrate a fairly similar pattern, the NBKs are different. They include a lower frequency of feather end termination and higher frequencies of overpassing and hinge end terminations.

The end-terminations of all the three laminar types are significantly different among the blanks and the shaped items ($X^2=19.17$, $df=8$, $p<0.05$). In the case of blades and PE blades, items with a feather end termination were favored as indicated by the fact that they are more common among the shaped items. Among the NBKs, on the other hand, items with a feather end termination were less selected and items with an overpassing end termination were favored.

Distal End Shapes

The three laminar types (blanks and shaped) are characterized by a high variation of the distal end shape (Fig. 228). Nevertheless, the following observations are of note. Only the PE blades demonstrate a dominant end shape which is rounded. Among the blades, pointed and rounded end shapes are slightly more common and among the NBKs oblique and rounded end shapes are the most common.

The distal end shapes of all the three laminar types were found to have a statistically significant difference among the blanks and the shaped items ($X^2=30.67$, $df=17$, $p<0.05$). The selection pattern for secondary modification (Fig. 228) shows that a rounded end shape is more common among the shaped items than among the blanks. This pattern is especially characteristic of the PE blades and NBKs. Items with a pointed end shape were not selected among the NBKs and were mostly rejected in the case of the PE blades. In the case of the blades they are slightly less common among the shaped items than among the blanks indicating that they were not usually favored. The absence of a preference for a pointed end shape supports the assumption that among the Amudian laminar items the important feature was the lateral edges.

Profiles

Blades and PE blades (blanks and shaped) are most commonly characterized by a semi-straight profile while NBKs are most commonly characterized by a curved profile (Fig. 229). The higher percentage of curved profiles among NBKs might indicate that they were removed by relatively heavier blows than the two other laminar types.

The profiles of all three laminar types are significantly different among the blanks and the shaped items ($X^2=28.34$, df=14, $p<0.05$). A comparison of profiles between blanks and shaped items (Fig. 229) shows that in the case of blades there was a higher selection of items with a semi-straight or curved profile. The latter was found to be statistically significant ($X^2=4.24$, df=1, $p<0.05$). In the case of PE blades, there was a higher selection of items with only a semi-straight profile. Although among both blades and PE blades items with an irregular profile were less selected, this was found to be statistically significant only among the blades ($X^2=8.33$, df=1, $p<0.05$). In the case of NBKs there was a preference for items with a curved or convex profile and a general rejection of items with a twisted profile. It is interesting that only among the NBKs items with an irregular profile were not rejected.

Number of Laminar Scars

The number of laminar scars on the dorsal face (Fig. 230) varies among the laminar types (blanks and shaped). Among the blades the distribution pattern peaks at 2-3 laminar scars, among the PE blades at one laminar scar and among the NBKs at two laminar scars. The mean number of laminar scars is 2.6 (s.d. 1.1) for blades, 1.2 (s.d. 0.7) for PE blades and 1.7 (s.d. 0.8) for NBKs. Only seven of the blades have no laminar scars (3.4%). The relatively small number of laminar scars on all types indicates that during laminar reduction the laminar items usually followed through the entire length of the debitage surface thus not leaving many scars along its length.

Comparing the blanks to the shaped items (Fig. 231) shows that in the cases of blades and NBKs there was preference for items with two laminar scars. In the case of PE blades the peaks stand at one laminar scar among both blanks and shaped items, but with a higher tendency for two laminar scars in the case of the shaped items.

Metrics

The distribution patterns of the length of the three laminar types (blanks and shaped) are generally similar and most items fall between 46-70 mm (Fig. 232). This similarity is also observed in the mean length which is 62.6 mm (s.d. 13.7) for blades, 64.4 mm (s.d. 15.3) for PE blades, and 65.6 mm (s.d. 13.9) for NBKs (Table 19). The similarity in length fits the assumption that the blades, PE blades and NBKs were usually the product of a single reduction sequence.

The distribution pattern of the width of the three laminar types demonstrates that they generally range between 16-30 mm (Fig. 233). The peaks of the blades and PE blades are both at 21-25 mm, but the distribution pattern of the PE blades demonstrates that they are slightly wider. The peak of the NBKs is at 16-20 mm. The means width however is very similar and varies only by 1.4 mm among the three laminar types. The mean width of blades is 23.5 mm (s.d. 6.3), of PE blades is 24.9 mm (s.d. 6.1) and of NBKs is 23.6 mm (s.d. 6.3).

The thickness demonstrates a clear difference among the three laminar types (Fig. 234). The blades tend to be thinner than the PE blades, which tend to be thinner than the NBKs. Statistically significant differences were found between the blades and NBKs ($t[286]=2.26$, $p<0.05$) and between the PE blades and NBKs ($t[144]=3.30$, $p<0.05$). The mean thickness is 8.9 mm (s.d. 3.4) for blades, 9.8 mm (s.d. 3.5) for PE blades, and 11.8 mm (s.d. 3.6) for NBKs.

The distribution patterns of the length/width ratio indicates that the majority of the three laminar types (blanks and shaped) fall between 2.0-3.0 (Fig. 235). Blades and PE blades peak at 2.2-2.3 while NBKs peak at 2.4-2.5. The mean length/width ratio of blades is 2.8 (s.d. 0.6), of PE blades is 2.7 (s.d. 0.5) and of NBKs is 2.9 (s.d. 0.7).

The width/thickness ratio of the three laminar types (blanks and shaped) presents a distinct difference in their distribution patterns. The peak of the blades and PE blades is at 2.1-2.5 while that of the NBKs at 1.6-2.0 (Fig. 236). It is of note that the NBKs demonstrate the most clear and uniform peak. The width/thickness ratio of NBKs is statistically different from that of blades ($t[240.98]=7.22$, $p<0.05$) and PE blades ($t[143]=4.43$, $p<0.05$). The mean width/thickness of blades is 2.9 (s.d. 1.1), of PE blades is 2.6 (s.d. 0.7) and of NBKs is 2.1 (s.d. 0.6).

The comparison between the blanks and shaped items of each laminar type shows different results. In terms of length and width, usually longer and wider items were selected for secondary modification with the exception of blades in the case of width (Figs. 237-238). These patterns are also apparent in the means (Tables 19-20). Statistically significant differences between blanks and shaped items were found in the case of length ($t[348]=4.08$, $p<0.05$) and width ($t[343]=2.54$, $p<0.05$) when the three laminar types were examined together, and in the case of length of blades (t[203]=3.65, $p<0.05$) and PE blades (t[63]=2.14, $p<0.05$) alone. In terms of thickness, none of the laminar types demonstrate an evident pattern of selection visible in the distribution graphs (Fig. 239). Nonetheless, the means indicate that slightly thicker items were preferred for secondary modification (Table 21). A significant difference was only found in the case of NBKs (t[23.88]=2.52, $p<0.05$).

The role of the length/width ratio in the selection of items for secondary modification (Fig. 240) demonstrates different patterns among the three laminar types. While in general, the more elongated PE blades were preferred, the opposite pattern was observed among the NBKs. Among the blades no major difference was noticed between the blanks and the shaped items. These patterns are observed in the means as well (Table 22).

Comparing the width/thickness ratio of blanks and shaped items (Fig. 241) shows that relatively thinner blades (items with a higher width/thickness ratio) were selected. In the case of PE blades the pattern is not clear and in the case of NBKs, items with a lower width/thickness ratio were usually selected. The patterns observed among blades and NBKs are strengthened by the means (Table 23).

Hinge Scars

Hinge scars were found on 26.7% of the blades, 20.3% of the PE blades and 29.3% of the NBKs, including both blanks and shaped items. The high similarity in the precise number of hinge scars among the laminar types is of note (Fig. 242).

Comparing the number of hinge scars on blanks and shaped items (Fig. 243) teaches that in all cases the differences are small and lack statistical significance. It is noteworthy that among blades and NBKs the number of items without any hinge scars is higher among the shaped items, while among PE blades it is lower.

Summary of the Attribute Analysis of the Three Laminar Types

The attribute analysis of the three laminar types revealed several patterns that form a major part in reconstructing the laminar technology of the Amudian beds at Tabun XI. They are summarized and discussed as follows:

1) Description of the three laminar types

The following description refers to the results regarding both blanks and shaped items.

Blades

The blades from the Amudian beds of Tabun XI are frequently covered by traces of cortex, mostly spreading along their distal end (43.2% of them have up to 20% cortex). The most common blade shapes are parallel, straight-curved and straight-irregular. The butts are mostly faceted or thick plain. The bulb is usually in the middle of the butt. A triangular cross-section is the most common, but a trapezoidal cross-section is common as well. The end termination is mostly feathered. The distal end shape varies, with pointed and rounded distal end shapes slightly more common. A semi-straight profile is the most common, although a curved profile is also well represented. Two to three laminar scars on the dorsal face characterize most of the blades. The blades range in length between 35-104 mm, but most are between 51-70 mm. Their width ranges between 12-47 mm, but most are between 16-25 mm. Their thickness ranges between 2-20 mm, but most are between 5-12 mm. Mean dimensions are 62.6 mm (s.d. 13.7) long, 23.5 mm (s.d. 6.3) wide and 8.9 mm (s.d. 3.4) thick. Their length/width ratio ranges from 2.0-5.5, mostly falling between 2.0-.3.0. Their width/thickness ratio ranges from 1.0-7.7, mostly falling between 1.6-3.5. The mean length/width ratio is 2.8 (s.d. 0.6) and the mean width/thickness ratio is 2.9 (s.d. 1.1). Hinge scars appear on about one quarter of the blades.

Primary element blades (PE blades)

The PE blades are characterized by extensive cortical surfaces that generally cover 30%-50% of their dorsal face. In all, 86.3% of them have a strip of cortex along one edge while the other is sharp and can be used as a cutting edge. The angle of the cortical edge is mostly between 45º-50º. The outline of the cortical edge is either straight (34.1%), curved (36.6%) or irregular (29.3%). The sharp edge is generally straight. The butts of the PE blades are most commonly thick plain or modified. The bulb is usually in the middle of the butt, however on some it is near the cortical edge. Their cross-sections are mostly triangular and they are usually characterized by a feather end termination. The most common distal end shape is rounded. Their predominant profile is semi-straight, and they generally have a single laminar scar on their dorsal face. They range in length between 35-106 mm, with a majority between 46-70 mm. Their width ranges between 13-40 mm, but most of them are between 16-

30 mm. Their thickness ranges between 4-20 mm, but most of them are between 5-12 mm. In means, the PE blades are 64.4 mm (s.d. 15.3) long, 24.4 mm (s.d. 6.7) wide and 9.0 mm (s.d. 3.8) thick. Their length/width ratio ranges from 2.0-4.2, but most fall between 2.0-2.9. Their width/thickness ratio ranges from 1.5-4.7, but most fall between 1.6-3.5. The mean length/width ratio is 2.7 (s.d. 0.5) and the mean width/thickness ratio is 2.6 (s.d. 0.7). Hinge scars appear on about one fifth of the PE blades.

Naturally backed knives (NBKs)

The NBKs have a strip of cortex that runs along all or most of one of the lateral edges and usually covers 30% of the dorsal face. The other edge is a potential cutting edge. The angle of the cortical edge ranges from 60º-110º, the most prevalent angle being 70º. The sharp edge angle mostly ranges from 40º-45º. The cortical edge is most commonly straight (46.7%), but curved (21.7%) and irregular (31.7%) outlines are also well represented. The sharp edge is usually straight. The butts are mostly modified. Although the bulb is generally in the middle of the butt, it is often near the cortical edge. The most common cross-section is right-angle trapezoidal. Although the majority of the NBKs have a feather end termination, a considerable portion (30.1%) has an overpassing end termination. NBKs are frequently characterized by a curved profile, but a semi-straight profile is common as well. Most NBKs are characterized by one to two laminar scars on their dorsal face. They range in length between 40-107 mm, but most of them are between 46-70 mm. Their width ranges between 13-41 mm, with a clear peak at 16-20 mm. Their thickness ranges between 5-22 mm, but most of them are between 8-15 mm. In means they are 65.6 mm (s.d. 13.9) long, 23.6 mm (s.d. 6.3) wide and 11.8 mm (s.d. 3.6) thick. Their length/width ratio ranges from 2.0-5.0, but most of them fall between 2.0-.3.3. Their width/thickness ratio ranges from 1.0-4.0, but most fall between 1.0-3.0. The mean length/width ratio is 2.9 (s.d. 0.7) and the mean width/thickness ratio is 2.1 (s.d. 0.6). Hinge scars appear on about one quarter of the NBKs.

2) *Preliminary observations regarding the laminar technology*

The results of the attribute analysis of the three laminar types provide some insights concerning the reconstruction of the laminar technology from the Amudian beds of Tabun XI. The used raw material is assumed to be mostly fist size nodules with a rounded or amorphous shape. This is discerned from the outline of the cortical edges of PE blades and NBKs, many of which are rounded or irregular (Fig. 219). The presence of a straight outline among the PE blades and NBKs indicates however that some of the nodules with the amorphous shape had one flat edge that could produce straight cortical edges. A minor use of flint slabs or flat nodules should not be overlooked as well. The size of the raw material is discerned by the general length of the laminar items (ca. 60-70 mm) of which some bear an overpassing end termination – a feature indicating that their reduction exploited the whole length of the debitage surface. The fact that the side of cortex (left/right) on the laminar items appears differently on NBKs and PE blades but becomes equal when the three laminar types examined together (Fig. 210) supports the assumption that the debitage surface was commonly framed by two cortical edges and therefore the raw material width was not exceptionally large.

The reduction of the laminar items was conducted by hard hammer and relatively powerful blows as indicated by the common presence of a protruding bulb of percussion and the occasional overpassing end termination. The fact that most laminar items are characterized by butt types that are predominantly thick (plain or modified) indicates hitting deep inside the striking platform. The various butts indicate that usually little effort was put into shaping the striking platform, including the modified butts which generally show simple faceting. The habit of hitting deep inside the striking platform probably enabled this simplicity. Nevertheless, the common presence of micro flaking along the exterior of the butts, which might have served as complementary shaping before the reduction of laminar items, demonstrates that striking platform maintenance was not neglected, but rather that in most cases minimal actions were sufficient.

The presence of cortex, which characterized most laminar items (66.9%) indicates that cortex was not removed prior to the reduction of laminar items. The presence of some PE blades that are almost completely covered by cortex (80%-100% of the dorsal face; 6% of the PE blades) indicates that the initiation of the reduction could have been performed from an angular corner of the raw material with no complex preparations. The presence of PE blades and blades with a strip of cortex along the middle of the dorsal face (6.1% and 10.1% respectively) indicates that it was possible to initiate the reduction from two angular corners close to each other yet far enough to leave a strip of cortex in the center of the debitage surface that was just formed.

When examining the possibility that the three laminar types are the products of a single reduction sequence, the side of cortex on the laminar items provides a major clue (Fig. 210). Although the cortex tends to appear on differing sides (left/right) among the three laminar types, when they are united it appears equally on both sides. This demonstrates that the three laminar types are complementary to each other in terms of the reduction. The relations between them indicate that the removal of one laminar type prepared the outline of the other. This is further supports by the high resemblance in the length and width of the laminar types (Tables 19-20; Figs. 232-233).

The high variability in the shapes of the distal end (Fig. 228) indicates that there was no defined core base treatment that led to a constant shape. It is also an indication that the core bases were generally quite wide.

Although it is assumed that the three laminar types were mostly reduced by a single reduction sequence, the reduction of each of the laminar types within that sequence slightly varied. For example, powerful blows and follow-through reduction was more commonly practiced in the removal of NBKs than of blades as indicated by their more prevalent overpassing end termination (Fig. 227). The location of the bulb of percussion on the items' butts also varies. While on all laminar types it tends to be in the middle, in the case of NBKs and PE blades it tends to appear near the cortical edge as well (Figs. 224-225).

3) The characteristics of the selected items for secondary modification

The comparison between the blanks and the shaped items provided several aspects that may reveal the desired character of the end products. The metrics include some of the clearest identified patterns. The comparison between the blanks and shaped items indicated that in general longer, wider and thicker laminar items were preferred (Tables 19-21; Figs. 237-239). The length/width and width/thickness ratios show different preferences in the case of the three laminar types. In the case of the length/width ratio, blades and PE blades with a slightly higher length/width ratio were preferred while NBKs with a lower length/width ratio were favored (Table 22). In the case of the width/thickness ratio, while items with a thinner cross-section (higher width/thickness ratio) were generally desired in the case of blades, an opposite pattern was observed in the case of NBKs (Table 23; Fig. 241).

Achieving sharp edges was a major target among all three laminar items. In the case of blades items with lateral edge with more acute angles were generally preferred (Fig. 217). In addition, blades with both lateral edges with non-uniform angles were rarely selected and PE blades without a sharp edge were mostly neglected. In the case of NBKs there was general selection of items with 40°-45° out of a larger range (Fig. 215).

In reference to the shape of the blades, items with parallel, straight-curved and straight-irregular shapes were preferred (Fig. 218). Pointed shape blades were less desired and irregular shape blades were largely left aside. In the case of PE blades, items with straight or curved sharp edges were preferred and items with an irregular sharp edge were less selected. Among the NBKs, the difference between blanks and shaped items is not as evident, but items with a curved sharp edge were favored (Fig. 221).

Among all three laminar types there was a preference of selecting items on which the bulb of percussion is in the middle of the butt (Figs. 224-225). Regarding cross-sections, there was a preference for triangular and trapezoidal cross-sections in the case of the blades and PE blades, and a preference for a right-angle trapezoidal cross-section in the case of the NBKs. Items with an 'other' cross-section were generally not chosen in the case of blades and PE blades but were favored in the case of NBKs (Fig. 226). These preferred cross-sections correlate with the number of the laminar scars on the dorsal face. Among blades and NBKs there was a preference for items with two laminar scars and among PE blades for items with 1-2 laminar scars (Fig. 231). In the case of the PE blades and NBKs the cortical edge completes the cross-section outline.

A feather end termination is slightly more prevalent among the shaped items than among the blanks in the case of blades and PE blades. In the case of NBKs a different pattern emerges and items with an overpassing end termination were favored. Hinge end terminations were generally rejected in the case of PE blades (Fig. 227). Items with a rounded distal end shape were the most commonly selected for secondary modification. However, while in the case of blades this trend is not emphasized, in the case of PE blades and NBKs it is more apparent (Fig. 228).

In terms of the profile (Fig. 229) there was a preference for blades with semi-straight and curved profiles, PE blades with a semi-straight profile and NBKs with a curved profile. It is of note that while in the case of blades and PE blades items with irregular profiles were generally avoided, in the case of NBKs they are even slightly more common among the shaped items. Items with a twisted profile appear in fairly similar frequencies among the blanks and shaped items in the case of blades and PE blades, and in much smaller numbers among the shaped NBKs than the blank NBKs.

Items with hinge scars on the dorsal face are less common among the shaped blades and NBKs than among the blank blades and NBKs. In contrast, hinge scars are more common among the shaped PE blades than among the blank PE blades (Fig. 243).

The attributes described above provide a general character of the characteristics of the end products, however when each of the items was separately evaluated by the prehistoric knapper, the attributes were probably considered as a whole. I estimate that a relatively large size and a good potential cutting edge were the primary factors at play.

Among the three laminar types, the differences between the characteristics of the blanks and the shaped items tend to be the smallest in the case of the blades. This is evident in the state of preservation (Fig. 207), the presence of cortex on the dorsal face (Fig. 209), the distal end shape (Fig. 228), the width (Fig. 238), thickness (Fig. 239) and the number of hinge scars (Fig. 243). The observed patterns of selection also demonstrate that in general there was a high similarity in the preferences of specific qualities in the case of the blades and PE blades and that the preferences in the case of the NBKs were different. This is expressed in the length/width ratio (Table 22), width/thickness ratio (Table 23), cross-section (Fig. 226), end termination (Fig. 227) and the profile (Fig. 229).

4) *NBKs as 'technologically defined tools' and their suitability as hand-held knives*

In this section I will examine whether the results of the analysis of the laminar items supports the idea that the NBKs from the Amudian beds of Tabun XI are 'technologically defined tools' (Debénath and Dibble 1994:53-54). Three aspects will be reviewed: (1) the suitability of their morphology to be used as hand-held cutting tools, (2) homogeneity in their characteristics, and (3) a pattern showing that the more "perfect" NBKs were less selected for secondary modification.

The examination of the morphology is in following with the definition of NBKs and regards the quality of the sharp edge and the cortical back. The angle of their sharp edge, which is most commonly between 40º to 45º (Fig. 214), is efficient in dismembering carcasses (Lemorini *et al.* 2006). However, the relatively high percentage of a sharp edge with an irregular outline (25.4%) did not contribute to the efficiency of the NBKs as cutting tools. The intention of forming a *steep* cortical lateral edge/back, and not just any cortical lateral edge, can be seen in the comparison between the NBKs and PE blades (Fig. 211) showing that they represent two different populations. The NBKs' cortical back is mostly uniform as evident by the straight (46.7%) and curved (21.7%) outlines that characterized most of them. The uniformity of the back outline probably enabled an easier grip for applying pressure while cutting. Nonetheless, the fact that 31.7% of the NBKs have an irregular cortical edge outline demonstrates that a considerable portion of the NBKs did not have this advantage. It is also of note that 29.6% of the NBKs are characterized by an irregular angle of the cortical edge which does not contribute to the uniformity. Another attribute, indirectly referring to the back, is the common presence of NBKs with an overpassing end termination (Fig. 227). On such items, the lateral edge near the distal end tends to be thicker and thus can serve as a holding point. The right-angle trapezoidal cross-section of many of the NBKs indicates of that the ventral face is fairly parallel to the dorsal face – a cross-section which might further enhance their suitability to be used as hand-held cutting implements. While the former aspects refer to the ability to apply force downward (into the carcass), the latter enabled a good grip for the complementary horizontal motion needed for cutting.

NBKs are characterized by a high durability as reflected by the high percentages of whole items (Fig. 206). The fact that NBKs are the thickest of all three laminar types further supports this. This durability attests to their potential to endure the pressure applied while using them as hand-held knives.

High homogeneity characterized only some of the NBKs attributes. The percentage of cortex on the dorsal face is one of them. Out of the three laminar types, the NBKs have the clearest distribution pattern with a peak at 30% (Fig. 208). The angle of the sharp edge also demonstrates the highest homogeneity out of the three laminar types in its distribution pattern (Figs. 214, 216). Furthermore, the sharp edge of the NBKs is characterized by less non-uniform angles than the blades and PE blades (NBKs: 1.3%; blades: 4.8% have two edges with non-uniform angles and 27.4% have one edge with a non-uniform angle; PE blades: 7.1%). As for metrics, the NBKs demonstrate the clearest distribution pattern of all the three laminar types in their width with a peak at 16-20 mm (Fig. 233), and in their width/thickness ratio, with a peak at 1.6-2.0 (Fig. 236).

It is of note however that some attributes of the NBKs do not show homogeneity. These include the presence of cortical edges with a non-uniform angle that is lower among the PE blades (23.2%) than among the NBKs (29.6%). In addition, although the NBKs are characterized by more straight cortical edges, the PE blades and NBKs are characterized by fairly equal percentages of cortical edges with an irregular outline (Fig. 219).

The last point refers to several cases in which the selection of NBKs for secondary modification demonstrated an opposite situation than that of blades and PE blades. It seems that in contrast to the case of blades and PE blades, where the more “perfect” blanks were selected for secondary modification, the selected NBKs were the less “perfect” ones. The most important of these patterns is that while in the case of blades, items with the more acute sharp angles were generally selected, in the case of NBKs items with a more obtuse sharp edge were usually selected (Figs. 215, 217). In addition, while in the case of PE blades items with an irregular outline of the sharp edge were generally not selected, in the case of NBKs they appear in almost identical percentages among the blanks and shaped items (Fig. 221). The fact that only in the case of the NBKs the 'other' cross-section is more common among the shaped items than among the blanks, and that NBKs constitute the only laminar type of which items with an irregular profile were not commonly rejected supports this contention (Figs. 226, 229).

The above reviewed characteristics of the NBKs support their potential to be used as hand-held cutting implements despite the lack of homogeneity in some of their qualities. A regularity of the cortical back is one of the features that were expected to be more homogenous. Although it is affected by the character of the raw material, the absence of a selection of a more suitable raw material indicates that it was a calculated procedure. It is also worth noting here that my experimental study (Chapter 4) demonstrated that in general, the reduction of NBKs minimizes the potential to remove a larger number of blades from the core mass. It was also found that if the NBKs were not a desired product but rather a result of peeling cortex, it would have been better, for the sake of blade production, to remove PE blades which could have enabled the preservation of a greater volume of the inner core mass. It is thus assumed that the significant presence of NBKs in the Amudian beds of Tabun XI (22.1% of the three laminar types) cannot be seen as by-products. The observed patterns in the selection for secondary modification support the assumption that the more “perfect” NBKs were probably used as ‘technologically defined tools’ without further shaping.

Attribute Analysis of the Three Laminar Types from the Three Facies of Tabun XI

In this section I will present the results of the attribute analysis of the three laminar types (blades, PE blades and NBKs) from the Yabrudian and Acheulian beds of Tabun XI and I will compare them to the results from the Amudian beds. The material from the Yabrudian and Acheulian beds was analyzed using the same method, of which here I will present only some of the attributes which are relevant for comparison. Although one of the major differences among the facies is the intensity of laminar production, in this section I will examine the laminar items' characteristics without considering their relative frequencies in the assemblages.

The Analyzed Sample

The analyzed population is divided into the three facies (Tables 17-18). The sample from the Yabrudian beds constitutes 256 artifacts, including both blanks and shaped items. The blanks (n=132) include 72 blades, 32 PE blades and 28 NBKs. The shaped items (n=124) include 76 blades, 27 PE blades and 21 NBKs (Figs. 193-197).

The sample from the Acheulian beds constitutes 68 artifacts, including both blanks and shaped items. The blanks (n=48) include 32 blades, 9 PE blades and 7 NBKs. The shaped items (n=20) include 12 blades, two PE blades and six NBKs. The small sample from the Acheulian beds makes some of the comparisons problematic, especially with regard to PE blades and NBKs.

Reviewing the Attributes

The state of preservation of the laminar items (blanks and shaped) from the Yabrudian and Acheulian beds is very good and highly similar to that of the Amudian beds with more than 70% of the items being whole (Figs. 207, 244).

The distribution patterns of the percentages of cortex on the dorsal face of the three laminar types (blanks and shaped) from all facies are similar (Figs. 208, 245). The only major difference is in the PE blades from the Acheulian beds which might be due to the small sample size (n=9). In all cases NBKs are characterized by a peak at 30%. The affect of the percentage of cortex on the dorsal face on the selection is also similar among the three facies. In the Yabrudian beds, where the samples are large enough, it is clear that items with a lower percentage of cortex on the dorsal face were preferred for secondary modification (Fig. 246). In the Acheulian beds only the blades enable such a comparison and the results demonstrate the same pattern (Fig. 247).

The cortex configuration on PE blades (blanks and shaped) is not very different among the three facies (n=Amudian: 66; Yabrudian: 50; Acheulian: 9). A configuration that includes one cortical edge and one sharp edge constitutes 81.8% in the Amudian beds, 82.0% in the Yabrudian beds and 77.8% in the Acheulian beds. PE blades fully covered by cortex constitute 6.1% in the Amudian beds and 8.0% in the Yabrudian beds. No such cases were present in the Acheulian beds. Another cortex configuration of the PE blades that can contribute to our technological reconstruction is the presence of a line of cortex along the middle of the dorsal face. These items constitute 6.1% in the Amudian beds, 4.0% in the Yabrudian beds and 11.1% in the Acheulian beds. This cortex configuration, which also appears on blades, indicates the use of relatively wide debitage surfaces that could have been "opened" from two different corners.

The cortex configuration of blades (blanks and shaped) is also of importance (including only blades with cortex: n=Amudian: 89; Yabrudian: 50; Acheulian: 11). Worth mentioning here are the cases where cortex appears along the distal end (58.4% in the Amudian beds, 64.0% in the Yabrudian beds and 90.9% in the Acheulian beds; the difference between the Amudian and Acheulian is of statistically significance: $X^2=4.38$, df=1, $p<0.05$) and the cases where it appears along the middle of the dorsal face (10.1% in the Amudian beds, 6.0% in the Yabrudian beds and none in the Acheulian beds). Blades with cortex spreading along the distal end can reflect the standardization of the reduction sequence. It is assumed that blades with a distal end completely covered with cortex indicate that the former detached blades were shorter (this is especially relevant for items ending in a feather end termination). In other words, it is assumed that in samples where such blades are common, the length of the debitage surface was not constant throughout the reduction sequence (e.g. Soriano *et al*. 2007:687, Fig. 9). However, cortex on the distal end does not always cover it completely, but can be partial and actually be a result of removing parts of the core's cortical lateral edges. In order to contend with this possibility I further examined the intensity of cortex on the distal end when present. It appears on the entire distal end in 44.3% of these blades (n=79) from the Amudian beds, on 62.7% of these blades (n=51) from the Yabrudian beds and on 50.0% of these blades (n=12) from the

Acheulian beds. The difference between the Amudian and Yabrudian beds is statistically significant ($X^2=4.22$, df=1, $p<0.05$). Since the blades from the Amudian are characterized by the lowest appearance of cortex on the distal end and by the lowest percentage of cases where it covers the entire distal end, it can be concluded that the Amudian reduction represents the highest standardization concerning the debitage surface length.

The side of cortex on the laminar items (blanks and shaped) from the Yabrudian beds demonstrates a different pattern than that of the Amudian beds; the PE blades and the NBKs do not peak on different sides (Figs. 210, 248). Nevertheless, when all laminar items from the Yabrudian beds are grouped together, the different sides are equal (49.6% and 50.4%) as in the case of the Amudian. In the Acheulian beds the numbers are too small and therefore are not presented.

The division into PE blades and NBKs (blanks and shaped), which is based not only on the presence of a sharp edge but also on the presence of a steep cortical back with an angle of 60° or more for NBKs, was found to be relevant for the Yabrudian (Fig. 249) and Acheulian beds as well (the latter, constituting a small sample, is not presented here). Non-uniform angles of the cortical edge (including both PE blades and NBKs) demonstrate a clear difference among the facies, although a statistically significant difference was only found between the Amudian and Yabrudian beds ($X^2=16.16$, df=1, $p<0.05$). While they constitute 23.2%-29.6% of the PE blades and NBKs from the Amudian beds, they constitute 45.5%-57.5% of the PE blades and NBKs from the Yabrudian and Acheulian beds (Fig. 250). This difference might not only reflect a technological difference but also a difference in the selection of the raw material.

The angles of the sharp edge of PE blades and NBKs (blanks and shaped) from the Yabrudian beds do not show a clear difference between the two laminar types, except for that NBKs show a more uniform distribution pattern (a bell shape) (Fig. 251). Although in the case of the items from the Amudian beds the difference was not large as well, there was a general trend of more obtuse angles for the NBKs (Fig. 214). As for the presence of a sharp edge with of a non-uniform angle, in the Yabrudian beds it constitutes 17.1% of the PE blades (n=41) and 12.1% of the NBKs (n=33). A lower percentage of a sharp edge with a non-uniform angle among the NBKs (in comparison to the PE blades) was the case in the Amudian beds as well.

In the case of blades (blanks and shaped) there were some differences between the three facies in the angles of the lateral edges which were found to be statistically significant between the Amudian and the Yabrudian beds ($t[328.19]=2.31$, $p<0.05$). While the distribution pattern of the angles of blades from the Amudian beds show a clear peak at 35° (Fig. 216), the blades from the Yabrudian and Acheulian beds did not present a clear peak (30°-40° in the case of the Yabrudian beds and 25°-45° in the case of the Acheulian beds; Fig. 252). The blades from the three facies also differ in the presence of lateral edges with non-uniform angles (Fig. 253). In this aspect the blades from the Amudian beds demonstrate the highest uniformity and the fewest cases with one or two non-uniform angles of the lateral edges (the difference between the Amudian and Yabrudian beds is statistically significant: $X^2=4.29$, df=1, $p<0.05$). The blades from the Acheulian beds are less regular with the highest percentage of cases with one or two non-uniform angles of the lateral edges (the difference between the Acheulian and Amudian beds is statistically significant: $X^2=5.96$, df=1, $p<0.05$). The difference is not only reflected in the production of blades, but also in the selection for secondary modification. In the Amudian beds blades with two non-uniform edge angles were not used for shaped items; in the Yabrudian beds this kind of blade was selected in a few cases; and in the Acheulian beds it is even more common among the shaped items than among the blanks.

The shapes of blades (blanks and shaped) vary highly among the facies (Fig. 254). Nevertheless, the relatively high percentage of an irregular shape in the Yabrudian and Acheulian beds (26.3% and 31.0% respectively) is in contrast to the Amudian beds (11.1%). Its lower percentage in the Amudian beds is statistically different than in the Yabrudian ($X^2=9.63$, df=1, $p<0.05$) and Acheulian beds ($X^2=7.90$, df=1, $p<0.05$). The relatively low percentage of parallel shape in the Acheulian beds (13.8%) compared to the Amudian (19.6%) and Yabrudian beds (26.3%) is of note as well. In terms of the selection for secondary modification, only the Yabrudian beds provided a suitable sample (n=blank: 56; shaped items: 39), showing a preference for parallel (33.3% vs. 21.4%), straight-curved (17.9% vs. 8.9%) and straight-irregular (25.6% vs. 23.2%) shapes – similar to the Amudian beds (Fig. 218).

The outline of the cortical edge of PE blades and NBKs (blanks and shaped) among the three facies (Fig. 255) shows that the Yabrudian beds are characterized by the highest percentage of an irregular outline – probably indicating a higher use of flint nodules with amorphous shapes. Among all the facies, NBKs were more commonly produced while focusing on the straight surfaces of the used raw material (Figs. 219, 256). Nevertheless, while in the Amudian beds there is no major difference between the PE blades and NBKs, in the Yabrudian beds the NBKs are characterized by higher percentages of straight and curved outlines and a lower percentage of an irregular outline than the PE blades.

The distribution pattern of the butt types of each of the three laminar types (blanks and shaped) demonstrates some variation between the three facies (Fig. 257). The laminar items from the Acheulian beds are different from those of the other beds, showing a paucity of thick plain butts. This difference is clearer when all three laminar types are united and represented by larger numbers (Fig. 258). The difference in thick plain butts between the Yabrudian and the Acheulian beds was found to be statistically significant ($X^2=3.93$, df=1, $p<0.05$). The percentage of micro flaking on the butts differs between the three facies (Fig. 259) and in the Amudian beds it is the lowest. The fact that the micro flaking does not show the same pattern on the three laminar types in each of the samples indicates that the cause for its appearance among the samples might differ. In other words, while on some it might mainly be an intentional act of shaping, on others it might be a ‘by-product’ of hard hammer percussion. Unfortunately, the small samples from the Yabrudian and Acheulian beds do not enable further exploration of this issue

The location of the bulb of percussion on PE blades and NBKs (blanks and shaped) demonstrates the same pattern among both the Amudian and Yabrudian beds (Fig. 260). The location of the bulb along the butt of the blades tends to be in the middle in all cases, nevertheless it is most common in the Amudian beds and less common in the Acheulian beds (Fig. 261).

The most common cross-section of blades (blanks and shaped) among all facies is triangular (Fig. 262) and the major differences between the facies is in the trapezoidal and 'other' cross-sections. Trapezoidal cross-section claims the highest percentage in the Amudian beds and the lowest in the Acheulian beds – a difference that is statistically significant ($X^2=6.19$, df=1, $p<0.05$). The ‘other’ cross-section presents the lowest percentage in the Amudian beds and the highest in the Acheulian beds. In this case the Acheulian beds were found to be statistically different both from the Amudian beds ($X^2=14.53$, df=1, $p<0.05$) and the Yabrudian beds ($X^2=5.27$, df=1, $p<0.05$). The cross-sections of PE blades (blanks and shaped) also demonstrate a difference among the three facies. In the Amudian beds a triangular cross-section appears at the highest rate and in the Acheulian beds the lowest rate – a difference that is statistically significant (X^2=4.20, df=1, p<0.05). In contrast, the 'other' cross-section demonstrates the opposite trend within the PE blades – they are most common in the Acheulian beds and less common in the Amudian beds. In this case the Amudian beds were found to be statistically different from the Yabrudian beds (X^2=7.10, df=1, p<0.05) as well as the Acheulian beds (X^2=3.96, df=1, p<0.05). The cross-sections of the NBKs (blanks and shaped) demonstrate the same opposed trends among the facies as the PE blades but instead of the triangular cross-section it is the right-angle trapezoidal cross-section that appears at the highest rate in the Amudian beds and the lowest in the Acheulian beds. Among the NBKs, the 'other' cross-section appears at the highest rate in the Acheulian beds and the lowest in the Amudian beds.

Differences between the facies are also reflected in the selection for secondary modification. While in the Amudian beds blades with an 'other' cross-section were generally not selected (blank [n=134]: 17.9%; shaped blade [n=105]: 3.8%), in the Yabrudian beds they were usually selected (blank [n=67]: 17.9%; shaped item [n= 67]: 17.9%). The PE blades demonstrate the same pattern, while items with an 'other' cross-section were generally not selected in the Amudian beds (blank [n=59]: 16.9%; shaped item [n=25]: 4.0%) they were selected in the Yabrudian beds (blank [n=32]: 25.0%; shaped item [n=25]: 40.0%). In other words, while in the Amudian beds items with an 'other' cross-section were usually regarded as less suitable for secondary modification, in the Yabrudian beds it did not pose a problem.

In comparing the end termination of the three laminar types (blanks and shaped) from the three facies, the blades demonstrate the highest similarity (Fig. 263). Nonetheless, blades with hinge end terminations are fewest in the Amudian beds and most common in the Acheulian beds – a difference that is statistically significant (X^2=5.50, df=1, p<0.05). In the case of PE blades, hinge end terminations have a higher percentage in the Yabrudian beds than in the Amudian beds. In the case of NBKs, overpassing end terminations are more common in the Amudian beds than in the Yabrudian beds. A difference in the selection of blades for secondary modification between the three facies was observed as well. While in the Amudian beds hinge terminations appear in the same percentage among the blanks and the shaped items (blanks [n=121]: 10.7%; shaped items [n=92]: 10.9%), in the Yabrudian and

Acheulian beds hinge termination are more numerous among the shaped items (Yabrudian – blanks [n=61]: 13.1%; shaped items [n=58]: 20.7%) (Acheulian – blanks [n=21]: 23.8%; shaped items [n=10]: 30.0%).

The shapes of the distal end show a large variability not only within each of the laminar types, but also between the facies. Here I will only present the blades (blanks and shaped) (Fig. 264). The variability in the distal end shape indicates an absence of a systematic core base treatment in all facies. Nonetheless, a high percentage of an 'irregular' end shape, which may be an indication of an extreme irregularity of the core base, appears in the lowest percentage in the Amudian beds and the highest in the Acheulian beds.

A comparison of the profiles of the three laminar types (blanks and shaped) from the three facies (Fig. 265) shows that Amudian and Yabrudian beds are highly similar in the case of the blades and PE blades. Blades with a semi-straight profile are the most common in all facies and their percentages are fairly similar (38.0%-39.5%). In examining the three laminar types as one, it was found that twisted and irregular profiles are more common in the Acheulian beds than in the Amudian beds ($X^2=6.67$, $df=1$, $p<0.05$) and Yabrudian beds ($X^2=6.24$, $df=1$, $p<0.05$) with a statistically significant difference.

The number of laminar scars on the blades (blanks and shaped) demonstrates a clear difference between the three facies (Fig. 266). In the Acheulian beds the peak is at one laminar scar, in the Amudian beds it is at 2-3 laminar scars and in the Yabrudian beds at three laminar scars. The differences between the Amudian and the Acheulian beds ($t[233]=2.67$, $p<0.05$) and between the Yabrudian and the Acheulian beds ($t[144]=2.67$, $p<0.05$) were found to be statistically significant. The PE blades and NBKs (blanks and shaped) from the Amudian and Yabrudian beds show a similar distribution pattern with a peak at one laminar scar in the case of the PE blades and a peak at 1-2 laminar scars in the case of NBKs. The similarity between the Amudian and Yabrudian beds is also reflected in the selection pattern. In both, a preference of blades with two laminar scars for secondary modification was observed, although items with three laminar scars were present as well (Figs. 231, 267).

The mean length of the three laminar types (blanks and shaped) from the three facies demonstrate a difference when they are united (Amudian: 63.4 mm [s.d. 14.0]; Yabrudian: 67.8 mm [s.d. 14.7]; Acheulian: 63.6 mm [s.d. 19.6]). The greater length in the Yabrudian beds is also reflected in the distribution patterns. While most laminar items from the Yabrudian beds range between 46-80 mm, most laminar items from the Amudian beds range between 46-70 mm (Figs. 232, 268). The difference in length between the Amudian and Yabrudian beds is statistically significant ($t[552]=3.39$, $p<0.05$). The blades from the Acheulian beds generally range between 46-60 mm and they are also statistically different from that of the Yabrudian beds ($t[143]=2.08$, $p<0.05$). Although PE blades are few in the Acheulian beds, the fact that most are exceptionally long (71-145 mm) is of note. Comparing the lengths of blades, PE blades and NBKs within each of the three facies however, presented a larger difference. While the distribution patterns of the three laminar types from the Amudian beds demonstrate a high similarity (Fig. 232), that of the Yabrudian beds show a lower similarity and that of the Acheulian beds show no similarity (Fig. 268). This is also observed in the mean length (Table 19; Fig. 271) where the difference between the three laminar types in the Amudian beds is 3.0 mm, in the Yabrudian beds 7.2 mm and in the Acheulian beds 24.0 mm.

The width of the three laminar types (blanks and shaped) from the Yabrudian and Acheulian beds is generally greater than that of the Amudian beds (Figs. 233, 269). The width of the three laminar types from the Amudian beds is statistically different from that of the Yabrudian ($t[538]=4.88$, $p<0.05$) and Acheulian beds ($t[396]=2.53$, $p<0.05$). The mean width of the three laminar types in the Yabrudian beds is 26.6 mm (s.d. 6.7), in the Acheulian beds 26.2 mm (s.d. 7.9) and in the Amudian beds 23.8 mm (s.d. 6.2). While the difference in width between the three laminar types within the Amudian beds is small, in the Yabrudian and Acheulian beds it is much larger (Table 20; Fig. 272). The presence of exceptionally wide PE blades in the Acheulian facies is of note.

The thickness of the three laminar types (blanks and shaped) from the three facies demonstrates a repeated pattern in which blades are the thinnest, PE blades are slightly thicker and NBKs are the thickest (Table 21, Figs. 234, 270, 273). When grouped together, the three laminar types from the Yabrudian beds are thicker than those of the Amudian Beds with a statistically significant difference ($t[560]=2.27$, $p<0.05$).

The affect of the metrics on the selection for secondary modification is witnessed in all three facies. In general, longer, wider and thicker laminar items were transformed into shaped items (Tables 19-21). The sole exception is in the case of the thickness of the PE blades in the Yabrudian beds. The difference between blanks and shaped items was found to be statistically significant for length in the cases of the Amudian beds ($t[348]=4.08$, $p<0.05$) and the Yabrudian beds ($t[202]=3.02$, $p<0.05$), and for width in the cases of the Amudian beds ($t[343]=2.54$, $p<0.05$) and the Yabrudian beds ($t[193]=2.04$, $p<0.05$). The difference in thickness was found to be statistically significant only in the case of the NBKs from the Amudian beds ($t[23.89]=2.52$, $p<0.05$).

The distribution patterns of the length/width ratio of the three laminar types (blanks and shaped) from the Yabrudian and Amudian beds are characterized by peaks ranging between 2.2-2.5. In contrast, the length/width ratio of the laminar types from the Acheulian beds demonstrates a different pattern, best represented by the low ratio of the blades with a peak at 2.0-2.1 (Figs. 235, 274). The mean length/width ratio demonstrates that the blades from the Amudian beds have the highest length/width ratio and those from the Acheulian beds the lowest ratio (Table 22, Fig. 276). The length/width ratio of the Amudian is statistically different from that of the Yabrudian beds ($t[459.12]=3.53$, $p<0.05$) and the Acheulian beds ($t[92.41]=4.94$, $p<0.05$). In terms of the selection for secondary modification, PE blades with a higher length/width ratio and NBKs with a lower length/width ratio were selected both in the Amudian and Yabrudian facies (Fig. 276). The blades show a different pattern within each of the facies. In the Amudian beds, items with a higher ratio were selected, in the Yabrudian beds there is no difference and in the Acheulian beds items with a lower ratio were selected. However, none of these differences is statistically significant.

The width/thickness ratio of the three laminar types (blanks and shaped) is very similar in its distribution pattern in the Amudian and Yabrudian beds (Figs. 236, 275). In terms of the means, it is clear that the Acheulian beds demonstrate the largest difference and that the width/thickness of the PE blades is the main difference among the facies (Table 23, Fig. 277). The PE blades from the Acheulian were found to be statistically different from those of the Amudian beds ($t[72]=3.52$, $p<0.05$).

The percentage of hinge scars on the three laminar types varies between the three facies. Their presence on the blades (blanks and shaped; n=Amudian: 206; Yabrudian: 115; Acheulian: 32) is the lowest in the Amudian beds (26.7%) and the highest in the Acheulian beds (40.6%). In the Yabrudian beds hinge scars appear on 33.0% of the blades.

Evaluating the Reduction Method and Patterns of Selection for Secondary Modification According to the Attribute Analysis of the Three Laminar Types

The Amudian and Yabrudian beds include relatively large samples that enabled comparing the three laminar types. The Acheulian beds however include a much smaller number of laminar items and therefore its comparison to the other facies was only based on the blades which included a reasonable sized sample. The fact that the blades from the Acheulian beds represent a repeated pattern supports the validity of the results.

Before summarizing the differences between the three facies, it is important to note that almost none of the differences are fundamental and that the laminar items generally present the same character. Nonetheless, five major points can be deduced from the above comparison of laminar items from the three facies: (1) The laminar production from the Amudian beds is of the highest quality. (2) Patterns observed in the Amudian beds are generally similar to those of the Yabrudian beds and less so to those of the Acheulian beds. (3) Some attributes show a decline or an increase in frequency when the three facies are regarded in the following order: Amudian, Yabrudian, Acheulian. (4) The differences among blades are smaller than the differences among PE blades and NBKs, and (5) the selection of items for secondary modification varies among the facies.

The higher quality of the Amudian laminar production

The higher quality of the Amudian laminar production is portrayed in many aspects. The first is already apparent in the selection of raw material; in the Amudian beds a uniform raw material suitable for continuous laminar production was more commonly selected than in the Yabrudian and Acheulian beds. This is indicated by the cortical edges of PE blades and NBKs which show much fewer non-uniform angles in the Amudian beds than in the other facies (Fig. 250). In addition, an irregular outline of the cortical edges of PE blades and NBKs appears in the Amudian (and Acheulian beds) in lower percentages than in the Yabrudian beds (Fig. 255).

The presence of cortex on the distal end of blades indicates that the debitage surface length was the most constant along the reduction in the Amudian beds where it is found in the lowest frequency.

The character of the sharp edge is another important aspect in evaluating the quality of the laminar production since it seems to be of major significance. It is worth noting that out of the three facies, the blades from the Amudian beds show the most clear distribution pattern of their sharp edge angles (Figs. 216, 252). Furthermore, non-uniform angles on one or two of the lateral edges of the blades appear in the lowest percentages in the Amudian beds (Fig. 253).

The shapes of the blades constitute more evidence of the higher quality of the Amudian laminar production. This is portrayed by the fact that irregular shapes are found in the Amudian beds in the lowest percentage of all three facies (Fig. 254). The fact that the blades from the Amudian beds show the highest frequency of cases where the bulb is in the middle of the butt (Fig. 261) correlates with the production of blades with more regular shapes.

A few other indications of the Amudian higher quality laminar production are of note. Among each of the three laminar types from the three facies, 'other' cross-sections appear in the lowest percentage in the Amudian beds (Fig. 262). Irregular end shapes and irregular profiles appear among the blades from the Amudian beds in the lowest percentage (Figs. 264-265). The length/width ratio is higher in the Amudian beds (Fig. 276).

The similarity between the Amudian and Yabrudian laminar production

Although the Amudian beds represent the highest quality of laminar production in Tabun XI, its character is not much different from that of the Yabrudian beds. In fact, the laminar types of the Amudian and Yabrudian beds generally demonstrate much similarity in their attributes and a clear difference from that of the Acheulian beds. This pattern is portrayed by a number of aspects, including the cover of cortex on the dorsal face (Figs. 208, 245), the angels of the sharp edges of blades (Figs. 216, 252, 253), butt types (Fig. 257), the location of the bulb along the butt (Figs. 260-261), cross-sections (Fig. 264), end terminations (Fig. 263), profiles of blades and PE blades (Fig. 265), number of laminar scars (Fig. 266), the resemblance between the three laminar types within each of the facies with reference to length and width (Figs. 232-233, 268-272), length/width ratio (Fig. 276), width/thickness ratio (Fig. 277) and the number of hinge scars.

Increasing and decreasing patterns among the three facies

When the three facies are put in an order of Amudian, Yabrudian and Acheulian (according to the intensity of the laminar production) the results of the attribute analysis frequently show increasing or decreasing patterns. Decreasing patterns are observed in the uniform angles on blades (Fig. 253) and in the location of the bulb in the middle of the butt (Fig. 261). Increasing patterns are observed among blades with two lateral edges with non-uniform angles (Fig. 253), irregular cross-sections (Fig. 262), irregular distal end shape of blades (Fig. 264), irregular profiles of blades (Fig. 265), and length/width ratio (Fig. 276).

The similarity of blades between the three facies

When comparing each of the laminar types from the three facies separately, blades demonstrate having the most similarity and in some cases almost identical patterns. This is seen in the butt types (Fig. 257), cross-sections (Figs. 262), end terminations (Fig. 263), profiles (Fig. 265), number of laminar scars (Fig. 266), mean length, width and thickness (Figs. 271-273) and mean width/thickness ratio (Fig. 277). NBKs also demonstrate some similarity, especially in metrics. Comparing the mean length, mean width and mean width/thickness ratio (Figs. 271-273, 277) clearly shows that PE blades entail the greatest difference which is mainly affected by the dissimilarity of PE blades from the Acheulian beds.

In according with the above comparisons it is now possible to present a preliminary evaluation of the reduction method of the three facies. It is my contention that in the Amudian beds the laminar items were mostly the products of a single reduction sequence, in which the three laminar types were complementary to each other. One piece of evidence supporting this argument is that the length and width of the three laminar types are similar. A second regards the side of cortex (left/right) which appears in different amounts among each of the laminar types, yet appears in equal amounts when they are united. These two patterns also appear in the Yabrudian beds. Although the number of PE blades and NBKs is small in the Acheulian beds, I assume that the general similarity in blades to the two other facies indicates that the same reduction sequence was performed in all facies. The main cause for differences between the three facies lies in the presence of an additional reduction sequence which was characterized by the production of exceptionally large cortical laminar items. It mainly includes PE blades which were commonly shaped into side-scrapers. This reduction sequence is represented at the site solely by the presence of large cortical laminar items and was probably performed outside of the cave. These items are present in the Acheulian and Yabrudian beds, however percentage-wise they are more common in the Acheulian.

The differences among the facies in the main reduction sequence applied to laminar production are not pronounced. Although the small differences in the raw materials used might have affected the reduction and caused these observed variations, they were more commonly the result of a more meticulous production in the Amudian beds. For example, while the shape of the raw material might have affected the blank shapes, it is unlikely that it affected their profiles. Another difference is the change of the debitage surface length. This was detected by examining the presence of cortex on the distal end of blades which demonstrated that the debitage surface length in the Amudian beds was the most constant, followed by the Yabrudian beds and then the Acheulian beds. Such a pattern can explain the higher uniformity of the laminar items from the Amudian beds.

Comparing the patterns of selection for secondary modification demonstrated that while some attributes were preferable in all facies, others were not. Similar trends in the selection are found for example in the presence of cortex on laminar items, where items with less cortical surface were usually preferred for secondary modification (Figs. 209, 246-247). Another similar pattern is in the selection of longer, wider and thicker laminar items for secondary modification (Figs. 271-273). In addition, PE blades with a higher length/width ratio and NBKs with a lower length/width ratio were preferred in all facies (Fig. 276). Different patterns of selection between the facies can be identified. For example, blades with two lateral edges with non-uniform angles were entirely rejected in the Amudian beds, but were preferred in the Yabrudian and Acheulian beds (Fig. 253). Another case is the lesser selection of blades and PE blades with an irregular cross-section for secondary modification in the Amudian beds than in the Yabrudian beds. Blades with a higher length/width ratio were preferred only in the Amudian beds (Fig. 276). The difference in the selection is of importance, since it indicates that not only the reduction sequence was slightly different, but also the demands. The more meticulous blank selection witnessed in the Amudian beds goes hand in hand with the more carefully conducted reduction sequence.

Analysis of Core Trimming Elements

During my examination of the finds from Tabun XI I reviewed the debitage CTEs (n=447) and the CTEs that were secondarily modified into shaped items (n=135). Altogether the CTEs entail 582 items and their division into types is presented in Table 24. The overpass items and the crested blades were the subject of an attribute analysis. Although the attribute analysis originally examined each of the facies separately, the results did not show substantial differences in many of the cases. Therefore, in the following description the CTEs from the three facies will be presented together. Nonetheless, a division into the three facies will be made in cases where a clear difference was noted.

Core Tablets

Core tablets include 21 items, constituting 4.7% of the CTE in the Amudian beds, 3.3% in the Yabrudian beds and 2.1% in the Acheulian beds. The detachment of these core tablets generally led to the removal of only a part of the core's striking platform and in only a few cases the entire striking platform had been removed. None of the core tablets were selected for secondary modification.

Overpass items

The analyzed sample

The analyzed sample include 111 debitage overpass items and 65 overpass items that were secondarily modified (Table 24; Fig. 198). In the Amudian beds, overpass items constitute the largest group of the CTEs (37.9%), while in the Yabrudian and Acheulian beds they form the second largest group after the 'CTE-varia'. The overpass items are either laminar (n=77; 43.8%) or flake (n=99; 56.3%) (<2/1 in length/width ratio). Laminar overpass items are most common among the Amudian beds, constituting 48.6% (in the Yabrudian beds they constitute 44.2% and in the Acheulian beds 28.6%). Most of the overpass items are whole and only 11.4% are distal fragments. Only two of the overpass items seem to have been 'death shots' that diminished the core's mass to an unusable size.

A large portion (36.9%) of the overpass items was secondarily modified into shaped items; most common are backed knives, end-scrapers, side-scrapers, 'retouched laminar items' and retouched flakes (Fig. 204). Although some of the overpass items resemble NBKs, having a cortical back and an opposed sharp edge, no documentation of this aspect was performed. The division of the overpass items into categories as defined in the methodology section includes 41 'initial' overpass items (25.3%), 70 'correction' overpass items (43.2%) and 51 'regular' overpass items (31.5%). Although the percentage of the 'initial' overpass items varies between the three facies (22.9%-42.9%), it is clear that the majority of the overpass items were knapped during the production of laminar items and not in the initial steps of the core reduction (Fig. 278).

The presence of cortex

Cortex appears on 85.5% of the overpass items, whose amount on the dorsal faces varies, mainly in accordance to their place in the reduction sequence (Fig. 279). 'Initial' overpass items, reduced at the "opening" of the debitage surface, tend to bear larger cortical surfaces. In contrast, overpass items reduced during the laminar production (the 'correction' and 'regular') tend to have less cortex.

Remnants of cortex on both lateral edges appear on 4.0% of the overpass items (in the Amudian beds it is slightly higher – 5.6%). These overpass items attest to the use of fist size nodules, mostly rounded in shape. Their relative paucity might indicate that the use of such raw material was limited or that the core’s width was usually greater than that of the overpass items – *i.e*. the overpass items only rarely led to the removal of the entire debitage surfaces.

Butt types

Thick plain and modified butts are the most common types found on the overpass items. An especially high percentage of modified butts characterize the Amudian beds (Fig. 280). Among the three categories, the highest percentage of thick plain butts is found among the 'initial' overpass items and the highest percentages of modified butts among the 'correction' overpass items (Fig. 281).

Shapes of the distal ends

The distal end of overpass items (n=124) is characterized by the following shapes: oblique (31.7%), pointed (0.8%), pointed-rounded (2.4%), rounded (25.2%), straight (17.9%) and irregular (22.0%). All the distal end shapes are broad except for the pointed and pointed/rounded shapes that constitute 3.2%. This feature indicates that cores bases were usually left unshaped and relatively wide.

Profiles

The overpass items (n=153) are mostly characterized by a curved profile (63.4%). Other profiles include semi-straight (7.8%), twisted (13.1%) and irregular (15.7%). The percentage of the less uniform profiles, including both the twisted and irregular, varies among the three facies. In the Amudian beds (n=65) they constitute the lowest percentage (23.1%), while in the Yabrudian (n=61) and Acheulian beds (n=21) they are slightly higher in percentage (36.1% and 28.6% respectively).

Number of laminar scars

The number of laminar scars on the dorsal face of overpass items varies from zero to six (Figs. 282-283) with a mean of 2.3 (s.d. 1.3). The distribution patterns of overpass items from the Amudian and Yabrudian beds show a peak at three laminar scars and from the Acheulian beds at one laminar scar. The mean number of laminar scars of the Amudian beds is 2.5 (s.d. 1.5), of the Yabrudian beds is 2.2. (s.d. 1.2) and of the Acheulian beds is 1.5 (s.d. 1.1). When the overpass items are divided into categories, the peaks of the 'correction' and 'regular' categories, which represent the face of the cores along the course of laminar reduction, are at three laminar scars. The mean of the 'correction' and 'regular' overpass items together is 3.1 (s.d. 1.2) for the Amudian beds, 2.6 (s.d. 0.9) for the Yabrudian beds and 2.0 (s.d. 1.0) for the Acheulian beds. The differences between the Amudian and Yabrudian beds ($t[95]=2.12$, $p<0.05$) and between the Amudian and Acheulian beds ($t[59]=2.83$, $p<0.05$) are statistically significant.

Metrics

The length of the overpass items varies from 43-112 mm with different distribution patterns among the three facies (Fig. 284). In the Amudian beds the majority are between 46-70 mm and in the Yabrudian beds the majority are between 51-80 mm. The mean length in the Amudian beds is 65.0 mm (s.d. 15.1), in the Yabrudian beds 66.4 mm (s.d. 11.0) and in the Acheulian beds 69.0 mm (s.d. 16.6). The difference in length between the Amudian and Yabrudian beds correlates to the general distributions and the mean length of blades, PE blades and NBKs from each of these facies (Table 19, 25, Figs. 232, 268). Since overpass items, by definition represent the reduction of the entire length of the core's debitage surface, their similarity to the three laminar types indicates that the latter were reduced in a manner which generally followed through the entire debitage surface length. The comparison between the length of 'initial' overpass items to that of 'correction' and 'regular' overpass items from the Amudian and Yabrudian beds (Fig. 285) shows no major differences and demonstrates that the length of the debitage surface usually did not change much during the course of the laminar reduction. The mean length of the 'initial' is 64.8 mm (s.d. 14.9) and of the 'correction' and 'regular' is 66.7 mm (s.d. 13.8). However, in the Amudian beds the means are almost identical among the three overpass items categories and in the Yabrudian and Acheulian beds they are slightly different (Table 25). This indicates that the debitage surface of the laminar cores from the Amudian beds was characterized by a more constant length during the reduction than that of the other two facies.

The width of the overpass items varies from 13-64 mm. Although the three facies demonstrate approximately the same distribution patterns (Fig. 286), their means are different (Amudian: 33.2 mm [s.d. 9.7]; Yabrudian: 34.0 mm [s.d. 8.4]; Acheulian: 36.7 mm [s.d. 10.6]) (Table 25). Comparing the 'initial', 'correction' and 'regular' overpass items also demonstrates a general similarity (Fig. 287) with differences in means. The mean width of the 'initial' is 32.8 mm (s.d. 8.4), of the 'correction' is 36.0 mm (s.d. 6.3) and of the 'regular' is 32.4 (s.d. 9.3). The ‘correction’ overpass items are the widest in mean among each of the facies (Table 25).

The thickness of the overpass items ranges between 7-30 mm and its distribution pattern is almost identical among all three facies (Fig. 288). The mean thickness is 17.0 mm (s.d. 5.3). Comparing the overpass items categories (Fig. 289) demonstrates that although the peaks of all the categories are at 16-20 mm, the ‘regular’ overpass items are the thinnest. This pattern is also seen in the means (Table 25).

The distribution patterns of the length/width ratio (Fig. 290) from the Amudian and Yabrudian beds are different from that of the Acheulian beds. An examination of the difference between the three overpass items categories did not reveal any clear pattern. The width/thickness ratio of the overpass items varies between the facies and between the three categories (Figs. 291-292).

An examination of the difference between the debitage overpass items and those which were secondarily modified demonstrated that in general, longer and wider overpass items were selected (Table 25). It is of note that this pattern is not reflected in the thickness and it might indicate that there was a limit to the desired thickness which the overpass items had occasionally exceeded. In the case of width/thickness ratio, there was a preference for items with a flatter cross-section for secondary modification as indicated by the higher ratio that characterized the shaped overpass items (Fig. 293).

Hinge scars

One to four hinge scars appear on 55.1% of the overpass items (n=156), among which a single hinge scar is the most common (34.6% of all overpass items). No major differences were observed among the three facies.

Changes in debitage surface length

The relations between the length of the debitage surface before and after the reduction are presented in Fig. 294 (see methodological chapter for details). When examining all overpass items together, their reduction led to a longer debitage surface in 51.5% of the cases, did not change its length in 35.5% and shortened it in 15.0%. Among all three facies the 'initial' overpass items are characterized by the highest percentage of cases that led to longer debitage surfaces. The 'correction' overpass items commonly led to a longer debitage surface in the Amudian beds (65.6%) and in the Yabrudian beds (51.9%), but not in the Acheulian beds (12.5%). Both the Amudian (X^2=7.30, df=1, p<0,05) and the Yabrudian beds (X^2=3.90, df=1, p<0,05) are statistically different from the Acheulian beds in this aspect. The ''regular' overpass items demonstrate the largest difference among the facies: in the Amudian beds the cases where the debitage surface was shortened are relatively few (20.0%), in the Yabrudian beds slightly higher (39.3%) and in the Acheulian beds they are the most common (50.0%). Since cases in which the debitage surface was shortened surely include knapping mistakes, it can be stated that in the Amudian beds the laminar knapping was the most meticulous and in the Acheulian beds the least.

Remnants of core base modification

Remnants of core base modification appear on 33.1% of the overpass items as a whole. They appear on 33.8%% of the overpass items in the Amudian beds, on 28.6% in the Yabrudian beds and on 42.9% in the Acheulian beds. Their higher percentage in the Acheulian beds does not represent a more meticulous reduction since these modifications were for the most part very simple and probably conducted *ad hoc* in order to repair specific problems. In other words, they might represent a higher need for modification due to a lesser refined knapping. The modifications usually appear in the form of flake removals from various directions of the base (26.3% of all overpass items), in a more organized removal forming a pointed base (3.4%), and as blade or bladelet removal from the core base (3.4%). The frequency of base modification is the highest among the 'initial' overpass items (Fig. 295) and it indicates that initiating the reduction was often accompanied by some treatment of the core base. Nevertheless, modifying the core from the base was practiced all along the reduction sequence.

The presence of shaped ridges

Shaped ridges appear on 7.4% of the overpass items and their presence varies among the facies (Amudian: 10.8% [n=72]; Yabrudian: 1.4% [n=75]; Acheulian: 16.7% [n=21]). The shaped ridges along the overpass items are mostly partial and located near the distal end. They appear on 16.2% of the 'initial' overpass items, 7.4% of the 'correction' overpass items and 1.8% of the 'regular' overpass items. Their presence on the ‘initial’ overpass items also varies among the facies. While in the Amudian beds (n=17) they are common (30.8%), in the Yabrudian beds (n=16) they are entirely absent. The paucity of shaped ridges among the 'correction' and 'regular' overpass items indicates that it was not a common procedure to prepare a ridge during the course of the laminar production.

Summarizing the attribute analysis of the overpass items

The analysis of the overpass items shows several patterns regarding the reduction sequence/s applied at Tabun XI and the character of the cores.

1. The used raw material was relatively wide as indicated by the paucity of overpass items with cortex on both lateral edges (only 4.0%). This assumption is based on experimental knapping (see Chapter 4) demonstrating that such overpass items are more commonly detached while using thin raw material. The width of the overpass items that ranges from 13-64 mm, with the majority between 21-45 mm, can be used to estimate the cores’ minimal width.
2. The base of the cores was usually not modified but left in its “natural” state – generally wide in character. Modification, if present, was simple and did not alter the base shape. Only in 3.4% of the overpass items the modification had shaped the base into a sharp/pointed form – a modification that probably remained along most of the reduction sequence.
3. The base modification on the overpass items was usually performed by a few blows and does not represent a systematic modification surface. They were probably *ad hoc* in character, conducted in order to fix a specific problem that occurred during reduction. It is quite possible that they were complementary to the reduction of the overpass items.

4. The debitage surfaces of the cores were covered by a series of at least two to six laminar scars along the reduction of laminar items as indicated by the number of laminar scars on the overpass items.
5. Knapping with relatively powerful blows is indicated by the 'regular' overpass items, of which at least some are the result of knapping mistakes.
6. The length of the debitage surface did not change much during the course of the laminar reduction. This is indicated by the distribution pattern of the length of the 'initial' overpasses items that is similar to that of the 'correction' and 'regular' overpass items. Nonetheless, while in the Amudian beds their lengths are almost identical, in the Yabrudian and Acheulian beds the debitage surface became slightly longer in the course of the laminar reduction.
7. The overpass items were mostly removed along the course of the laminar reduction and only one quarter of them was reduced while "opening" and shaping the core debitage surface.
8. The core debitage surface was commonly maintained by the removal of overpass items. They cleared obstacles on the debitage surface and helped in forming the required curvature of the debitage surface as indicated by the fact that most overpass items have a curved profile.
9. Although the overpass items from the three facies are generally similar, some differences are of note. One of these is that their length differs and in the case of the Amudian and Yabrudian beds it correlates to the length of the three laminar types. Another important difference is that although the overpass items from the Amudian beds are the narrowest and those from the Acheulian beds are the widest, the number of laminar scars on the Acheulian overpass items is lower compared to that of the Amudian. The changing length of the debitage surface as apparent by the overpass items indicates that the knapping represented in the Amudian beds was performed with the most control over its length and the knapping in the Acheulian beds with the least control. The fact that overpass items with a twisted or irregular profile appear in the lowest percentage in the Amudian beds further supports this. Base modification appears in the highest percentage on overpass items from the Acheulian beds and may reflect a need for more maintenance actions due to a less controlled reduction.

Crested Blades

The analyzed sample

Crested blades are the third largest group of CTEs from Tabun XI (n=100, 17.2% of the CTEs). They include 74 debitage CTEs and 26 CTEs that were secondarily modified. Their percentage out of the total number of CTEs varies greatly between the facies: in the Amudian beds they constitute 23.7%, in the Yabrudian beds 14.1% and in the Acheulian beds 10.3%. The crested blades (Table 26; Fig. 199) include the following sub-types: primary (n=5; 5.0%), rough (n=26; 26.0%), patinated (n=12; 12.0%), second-primary (n=4; 4.0%), unifacial (n=7; 7.0%) and rejuvenation (n=46; 46.0%). It is of note that seven of the crested blades have a length/width ratio that is slightly less than 2/1. Five of the crested blades are 'secondary crested blades' from which the ridge was already partly removed by a previous removal (Fig. 199:4). These were recorded as sub-types according to their original character (n= primary: 1; rough: 1; patinated: 1; rejuvenation: 2).

Dividing the various sub-types into the three categories ('initial' [including primary, rough, patinated and second-primary], unifacial and rejuvenation) demonstrates a large difference among the facies (Fig. 296). In the Amudian beds 'initial' crested blades constitute the largest category (55.6%) and rejuvenation crested blades constitute a smaller part (40.0%). In contrast, in the Yabrudian beds rejuvenation crested blades constitute the largest category (52.6%) and ‘initial’ crested blades form a smaller part of 36.8%. In all the facies unifacial crested blades are few. The attribute analysis focused on the categories and not on specific sub-types due to the small samples. In fact, the comparison will mainly deal with the 'initial' and rejuvenation crested blades since the unifacial crested blades are too few.

The selection of crested blades for secondary modification is relatively high (26.0%) and characterized most of the sub-types, except for the patinated crested blades (8.3%; Table 26). The most common shaped items made on crested blades are 'retouched laminar items', but backed knives, 'distally retouched laminar items' and end-scrapers are also well represented.

Differences between the facies regarding the crested blades were observed in only a few cases in reference to the Amudian and Yabrudian beds. The number of items from the Acheulian beds is too small for any comparison.

Intensity of the shaped ridge:

The shaped ridges of the crested blades (n=90) were usually made with a little effort as indicated by their intensity. Only 25.6% of the crested blades have a completely knapped ridge. The rest include 17.8% with a ridge that runs along half of length, 28.9% with a ridge along a quarter of the length and 27.8% with a ridge along only a small part (‘touch’). The intensity of the shaped ridge along the crested blades varies among the sub-types. Due to the small sample only the rough and rejuvenation crested blades are worth further description. Among the rough crested blades the intensity is divided as follows: whole: 32.0%, half: 28.0%, quarter: 36.0% and touch: 4.0%. Among the rejuvenation crested blades the intensity division is: whole: 6.7%, half: 15.6%, quarter: 31.1% and touch: 46.7%.

Location of the shaped ridge along the length of the item

The location of the shaped ridges along the length of the crested blades categories varies (Fig. 297). While in many of the 'initial' crested blades the shaped ridge spreads along the whole length, in most of the rejuvenation crested blades it is located near the distal end.

Location of the shaped ridge along the width of the item

The shaped ridge (n=94) appears near the left edge (26.6%), in the middle (34.0%), near the right edge (30.9%) or irregularly (8.5%). One can assume that the high percentage of ridges that are found on either of the lateral edges is the result of the core’s debitage surface contour. A debitage surface that is clearly separated from the core sides probably enabled an easy location from which to perform the correction.

Shaped ridge profiles

The profiles of the shaped ridge along the dorsal face (Fig. 298) demonstrate the use of little effort in making the crested blades. The dominant irregular profile among the 'initial' crested blades is a good example.

Butt types

The following butt types appear on the crested blades: thin plain: 10.6%, thick plain: 38.3%, modified: 39.4%, punctiform: 3.2% and natural: 8.5%. The percentages however vary among the three categories (Fig. 299). While among the 'initial' crested blades modified butts are the most common (44.2%), among the rejuvenation crested blades thick plain butts are the most common (46.7%). There is also a difference in the presence of micro flaking along the exterior of the butts on the 'initial' (n=43) and rejuvenation crested blades (n=45) – it is more common on the latter (23.3% and 42.2% respectively).

Metrics

The crested blades from the Yabrudian beds tend to be longer and wider than those of the Amudian beds (Figs. 300-301). In addition, there is also a difference between the categories in which ‘initial’ crested blades tend to be relatively narrow and thick, while the rejuvenation crested blades tend to be relatively wide and thin (Figs. 302-303).

Summarizing the attribute analysis of the crested blades

The results of the attribute analysis of the crested blades and their relevance to the reconstruction of the laminar reduction sequence/s applied at Tabun XI are summarized as follows:

1. The composition of the crested blade sub-types indicates that crested blades were used equally for initiating the reduction (as represented by the 'initial' crested blades which form 46.0%) and for maintaining the laminar production (as represented by the rejuvenation crested blades which form 47.0%).
2. Simplicity characterized most of the crested blades. A manifestation of it can be seen in the prevalence of rough crested blades. It is also reflected in the fact that the shaped ridges on the crested blades are often partial, asymmetrical and with an irregular profile.
3. The simplicity however is not an indication of a lack of planning. The different sub-types of 'initial' crested blades, for example, indicate the presence of several options for initiating the reduction. In addition, the difference in butt types among the 'initial' and rejuvenation crested blades indicates that the procedures conducted before the reduction of a crest were more complex than the forming the ridge itself. In other wards, the simplicity reflects a sophisticated laminar technology that found a way to initiate production and maintain the core without complex procedures.
4. Although there are some differences among the facies, the high similarity among them indicates that a technological background or 'know-how' was shared by the knappers of these facies. Of the differences it is worth noting that while in the Amudian beds ‘initial’ crested blades are the most common, in the Yabrudian beds rejuvenation crested blades are the most common.

Another difference is that the crested blades from the Yabrudian beds are longer and wider than those of the Amudian.

Radial Overpass Items and CTE-Varia

The radial overpass items (n=49; 10.4% of the CTEs) are linked to flake production (for their definition see methodological section Pp: 50). In the Amudian beds they appear in the lowest frequency (5.8%) and in the Yabrudian beds in the highest frequency (10.7%). In the Acheulian beds they form 9.3%. A large portion (28.6%) of the radial overpass items was secondarily modified. Side-scrapers were one of the major types shaped on them.

The CTE-varia constitute the most common CTE type in Tabun XI (n=236, 40.5% of the CTEs). They include 206 debitage CTEs and 30 CTEs that were secondarily modified (constituting 12.7% of the CTE-varia). Although some of the CTE-varia can be related to the less planned core shaping and maintenance of the laminar production, the majority are more likely to result from flake reduction.

A General Assessment of CTEs

The CTEs were the result of all the reduction strategies represented at the site and not only from the laminar production. The composition of CTE types (Table 24) correlates to the assumed intensity of laminar or flake production in the three facies. Overpass items and crested blades, which are the most obvious CTEs types related to laminar production, were found to be the most common in the Amudian beds. Their frequencies are lower in the Yabrudian beds and especially low in the Acheulian beds where the laminar production is also low. In contrast, CTE-varia, which are mostly related to flake production, show the lowest frequency in the Amudian beds, a higher frequency in the Yabrudian beds, and an especially high frequency in the Acheulian beds. In addition, radial overpass items, which are related to a specific trajectory of flake production, are few in the Amudian beds and slightly more common in the Yabrudian and Acheulian beds.

In all facies the overpass items are more common than the crested blades, thus indicating that they were the major means of controlling and maintaining the laminar reduction. Nevertheless, initiating the reduction was more commonly performed using crested blades and maintaining the reduction while removing laminar items was more commonly performed using overpassing items.

The division of types and sub-types as well as the results of the attribute analysis shows that in general the same know-how concerning laminar production was shared by the knappers from the three facies. The differences however are of importance as well. It is interesting that the attribute analysis shows a larger difference between the overpass items from the Amudian and Acheulian beds than between the Amudian and Yabrudian beds. The fact that in the case of the attribute analysis of the crested blades only minor differences between the Amudian and Yabrudian beds were observed further supports the general similarity between the Amudian and Yabrudian facies.

Analysis of the Laminar Core Class

The laminar core class of Tabun XI includes only 37 items. In contrast, flake cores are found in larger numbers in all facies and especially in the Acheulian beds (Table 27). The laminar core class was divided into the following types: (1) ‘single striking platform laminar cores’ (n=16; 3.3% of all cores), 'single striking platform laminar and flake cores' (n=12; 2.5% of all cores) and (3) 'two striking platforms laminar and flake cores' (n=9; 1.9% of all cores). Due to their small numbers I united the cores from the three facies for the following description. Nevertheless, the percentage of the laminar core class out of the total number of cores demonstrates a clear pattern that correlates to the general laminar component within the facies. While in the Amudian beds they constitute the highest percentage (15.6%), in the Yabrudian beds they form a lower percentage (9.0%) and in the Acheulian beds the lowest percentage (3.8%). Many cores of all types are broken or damaged. An attribute analysis of cores was problematic not only due to the small numbers but also due to the missing data that resulted from their fragmentation. The following description is therefore short.

Two items that are not of the laminar core class were illustrated in order to demonstrate some of the available raw material shapes. One is recorded as a rough-out (Fig. 200:3) and demonstrates a nodule with an amorphous shape. The second (Fig. 200:1) is recorded as a flake core but most likely represents an attempt to produce laminar items. It was made on a thick flint slab with cortex on both sides. In the laminar core class the former shape seems to have been more in use (for example, Fig. 200:2) while the latter was rare.

‘Single Striking Platform Laminar Cores’

The 16 ‘single striking platform laminar cores’ are fairly equally divided into ‘parallel edges’ (n=5), ‘amorphous front’ (n=6) and prismatic (n=5) shapes. The used raw material includes nodules or nodule fragments and it seems that in general a single core was made from a single nodule. Only two of the cores were made on large flakes. The used nodules were mostly rounded or amorphous in shape and only four were flat with cortex on both sides. Cortex remained on all the cores. On seven of them (43.8%) it covers the entire core except for the debitage surface and the striking platform, while on the rest it covers smaller parts with different configurations, mostly spreading along the core’s back and one of the lateral edges.

The presence of cortex demonstrates that no pre-peeling of cortex was performed, rather it was gradually removed by the laminar production. In 75% of these cores cortex covers at least one whole side, indicating that a potential for removing cortical laminar items usually remained until core abandonment.

The striking platforms of these cores (n=15) were mostly shaped by faceting (60.0%), forming a flat scar (26.7%) or a combination of a flat scar with faceting (13.3). No use of natural surfaces was noticed. Micro flaking of the edge of the striking platform was generally irregular and appears on 50.0% of the cores (n=14).

The shape of the debitage surfaces (n=13) varies, with irregular being the most common (46.2%). Of the regular shapes, only the U-shaped appears in more than one specimen (30.8%).

The base of the cores (n=15) is not characterized by a specific form and it is most commonly irregular (40.0%). The other cases are straight (13.3%), rounded (33.3%) or pointed (13.3%). Modification surfaces were noticed on only 25.0% of the cores (n=16) and they appear on the core's back or base. The modification procedures are simple and include only a small number of flakings, thus suggesting that these should not be regard as true modification surfaces but as modification points.

The maximum length of the cores is generally similar to that of the debitage surface length (Fig. 304). Among both, the peak of the distribution pattern is at 46-50 mm. The mean maximum length of the cores is 61.4 mm (s.d. 13.5) and the mean length of the debitage surfaces is 59.3 mm (s.d. 11.5). The maximum width of the cores however is significantly larger than that of the debitage surface (Fig. 305). While the peak of the distribution pattern of the maximum width is at 36-40 mm, that of the debitage surface is at 21-25 mm. The mean maximum width is 37.2 mm (s.d. 8.5) and the mean debitage surface width is 34.5 mm (s.d. 9.9). The thickness ranges from 17-85 mm (Fig. 306) and its mean is 33.9 mm (s.d. 18.5).

The total number of laminar scars ranges from one to eight and the number of parallel laminar scars ranges from one to six (Fig. 307). Two to three parallel laminar scars are most common. The mean total number of laminar scars is 2.9 (s.d. 1.8) and the mean parallel laminar scars is 2.5 (s.d. 1.3).

Hinge scars are found on 73.3% of the cores’ debitage surfaces (n=15) and in most cases they include only one hinge scar (53.3% of the cores). Overpass scars appear on 93.3% of these cores (n=15) and are mostly represented (80.0%) by a single overpass scar (the remainder 13.3% has two overpass scars).

The main reason for core abandonment (n=15) is exhaustion (53.3%). It is of note that even among the other cases of abandonment not much flint mass was left and only three cores retained a large mass that could enable further reduction of laminar items. Other abandonment reasons are hinge scars that disenabled the continuation of laminar reduction (6.7%), the absence of a suitable striking platform (6.7%) and a raw material problem (6.7%). An additional 26.7% of these cores do not present a clear reason of abandonment.

'Single Striking Platform Laminar and Flake Cores’

The 12 cores of this type appear in the following shapes: ‘amorphous front’ (n=2; 16.7%), prismatic (n=8; 66.7%) and ‘narrowed prismatic’ (n=2; 6.7%). Due to the small number, they are all addressed together and their description is brief, focusing only on several aspects.

These cores were mostly shaped on nodules or nodule fragments (58.8%). Extensive cortex cover characterizes these cores and many are entirely covered except for the debitage surface and the striking platform. The extensive cortex cover indicates the potential for reducing cortical laminar items. The striking platform of these cores (n=12) was mostly shaped by faceting (41.7%); a flat scar appears on 25.0% and a flat scar with additional faceting appears on 33.3%. Natural striking platforms are not found.

The debitage surface of this core type is generally U-shaped. The bases of these cores are rounded except one which has a pointed base. Hinge scars are highly common on the debitage surface and usually include several hinges on each core. The mean maximum length is 57.2 mm (s.d. 17.8), the mean maximum width is 52.4 mm (s.d. 11.8) and the mean maximum thickness is 35.0 (s.d. 13.2). Simple modification surfaces appear on some of these cores (41.7%). These cores were discarded due to core exhaustion, hinge fractures or raw material problems.

'Two Striking Platforms Laminar and Flake Cores’

In all but one of the cores of this type the striking platforms were not simultaneously used, and even in that single case their simultaneous use is only a possibility. In most cases the flake production clearly post dates the laminar production.

Seven of the nine cores of this type show a similar pattern – they have one striking platform for flake reduction and one striking platform for laminar reduction, whereby the laminar production generally used the more angular or narrow parts of the core. The size of the largest of these cores is 71x58x41 mm. Another one of these cores has platforms that are perpendicular to each other and might have been complementary (its size is 39x40x33 mm).

Each of the remainder two cores of this type represents a unique combination. The first has one striking platform for laminar and flake production and another for flake production (size: 66x44x60 mm). The second has two striking platforms and three debitage surfaces of which one was used for laminar production and the other two for flake production. The laminar production is the oldest platform used and was cut by the latter two surfaces (size: 86x70x73 mm).

A Summary of the Laminar Core Class

The retrieved data from the cores analysis is partial due to their paucity and fragmentation state. The 'two striking platform laminar and flake cores' indicate that shifting the goal of the production from laminar items to flakes did occur, thus implying that the small number of cores within the laminar core class was affected by this high exploitation. Nevertheless, it can be concluded that cores were mostly shaped on fist size nodules with rounded or amorphous shapes. Using flat nodules or slabs was not common. The cortex, which was not peeled prior to the laminar reduction, enabled the reduction of cortical laminar items.

A Comparison of the Results to Previous Studies

Before integrating the former sections I wish to compare my results to the studies of Wiseman (1991, 1993) and Monigal (2002) and to some observations by Jelinek and by Garrod of the industries of Tabun XI/sub-layers Ea-Eb. Unfortunately, this comparison can only be partial because these studies were performed on different samples and there are differences in terminology. Monigal (2002) and Wiseman (1993) studied a smaller number of artifacts which were selected randomly. Monigal (2002:234-275) examined 178 items from beds 73-75 and although she referred to her sample as Amudian, it included material from Yabrudian and Amudian beds. Weisman (1993) examined 134 laminar items from Tabun XI, representing a mixture of the three facies. On the other hand, I examined the entire population of the laminar items and related waste including a sum of 1072 items. The difference in terminology is in the division of the laminar items into types and in the attributes examined (compare Chapter 3 to Monigal [2002:139-199] and Wiesman [1993:15-22]). Due to the above difficulties I will mainly compare the results referring to the laminar items in general.

Cortex appears on 70% of the laminar items from Monigal's (2002:241) sample. She found that among laminar items with a cortex cover of 11%-49% the cortex most commonly spread along a lateral edge, and among laminar items with less than 10% cortex it is mostly concentrated along the distal end. The common presence of cortex and its configuration on the items is highly similar to my results.

Monigal (2002:249) noted that laminar items with pointed shapes are few, just as in my results. The butt types are differently represented in the various studies. In Monigal's (2002:247) sample the butts are described as generally thick, of which 'unfaceted' are the most common (49.2%). Other well represented butt types are 'multiple faceted' (17.2%) and 'cortical' (15.6%). Wiseman (1993:26) described 'smooth butts' as the most common in her sample and 'faceted butts' as less common. In Garrod's sub-layer Ea about half of the recorded blades have a prepared striking platform (Garrod and Bate 1937:81). In my study, modified butts are dominant and although the use of different samples probably affected the results, I presume that the main difference is due to the definition what exactly each type includes. The presence of abrasion on 16% of the laminar item butts was noted by Monigal (2002:247). She further observed that it more commonly appears on ‘unprepared’ butts (18.1%) than on ‘prepared’ butts (11.9%). These observations are similar to mine.

A triangular cross-section is the most prevalent (47.4%), although trapezoidal cross sections (22.6 %) are also well represented in Monigal’s (2002:251-2) sample. Jelinek's description of the blades as generally prismatic, but also including items resembling burin spalls (Jelinek *et al*. 1973:174) emphasizes the presence of these two cross-sections. These results and observations correlate with mine.

According to Monigal (2002:253) overpassing end terminations constitute 31% of the laminar items. This percentage is slightly higher than my findings. Among the profiles, Monigal (2002:250) stated that there is a dominance of twisted ones. This result is different than mine. It is possible that since she compared her material with later blade industries, in which the profiles are by far more refined, she was strict about its character. On the other hand, I defined the semi-straight category as including profiles that are nearly straight bearing a minor twist or curvature.

The mean dimensions of the laminar items from Monigal’s (2002:245, Table 8-3) sample show a length of 71.5 mm (s.d. 14.0), a width of 22.3 mm (s.d. 6.9) and a thickness of 8.4 mm (s.d. 3.1). The mean dimensions of Wiseman’s (1993:57, 59, charts 2-3) sample are 64.5 mm (s.d. 16.6) long, 22.6 mm (s.d. 6.3) wide, and 8.3 mm (s.d. 3.0) thick. Most blades from Garrod's sub-layer Ea are 60-70 mm long (Garrod and Bate 1937:81). The small differences from my study (Tables 19-21) are partly the result of the different samples examined and in the case of the width and thickness also due to different measuring methods – maximum (mine) vs. mid-point by Monigal (2002) and Wiseman (1993). The length/width ratio is 3.4 and the width thickness ratio is 2.8 in Monigal’s (2002:250) sample. In Wiseman’s (1993:61, Chart 5) sample the length/width ratio is 2.9 (s.d. 0.7). These ratios are slightly higher than mine (Tables 22-23) and I presume that the difference is not only due to the examined samples but also the result of measuring width and thickness at mid-point.

In Monigal’s (2002:242) study the scars on the laminar items include a small occurrence of a bidirectional pattern. In my study I recognized only a few laminar items with a bidirectional scar pattern, but I did not examine this aspect. This is due to the fact that the reduction is unidirectional – an observation shared by Monigal (2002) and Wiseman (1993).

Comparing the cores is more complicated. It is worth noting Garrod’s study stating that blade cores are rare and flake cores are common (Garrod and Bate

1937:81-83) and that it is similar to my observation. Monigal (2002:236-249) examined all types of cores including flake cores and therefore I cannot compare the results. Nonetheless, she also stated that many of the cores are broken or unidentifiable. My observation on the presence of 'laminar and flake' cores for the production of both laminar items and flakes, can be compared to Monigal's suggestion that the blade production was not separated from the flake production at Tabun XI. A similar suggestion can be found in Jelinek's (1990:87) argument that the NBKs were reduced as part of a reduction sequence that also led to the reduction of elongated flakes.

Several more insights regarding the reduction sequence were noted. Monigal (2002:242) argued, just as I concluded, that cortex was not peeled prior to the laminar item removal and that it is one of the main characteristics of the reduction sequence applied. Jelinek's (1990:87) suggestion that NBKs were reduced as part of the prismatic blade production (and elongated flakes) correlates partly to my reconstruction that the blades, PE blades and NBKs were generally the products of a single reduction sequence. Monigal argued that various laminar types were reduced from a single sequence as well, but she presumed that the cortical laminar items were not necessarily desired end-products: "The great amount of cortex present on the Tabun XI material is entirely due then to the manner of core reduction and a lack of a formalized preparation/decortication stage…Tabun XI decorticaton strategies were fairly ad hoc and part of the actual blank production stage, rather than a separate preliminary stage of core management" (Monigal 2002:246)

The exact character of the reduction sequence however is not clearly presented and only a few points are suggested. The knapping is assumed to be performed by "simple" direct percussion as indicated by the presence of thick plain butts (Jelinek 1990:87). According to Jelinek (1981:272) the prismatic blades originated from prepared cores, although he did not specify as to their nature. Monigal (2002:253) on the other hand, emphasized the simplicity of the reduction sequence and demonstrated, for example, that the bases of the cores were not shaped. I agree to some extent with both points of view and will discuss it in the next section.

Finally, in regard to the selection pattern of blanks for secondary modification, both Monigal (2002:257) and Wiseman (1993:26) found that, in general, shaped items are larger than blanks. Monigal (2002:257) also observed that there was a preference for items with less cortex. Both observations accord with my results.

As noted, only some of the results from my analysis were comparable and these were found to be mostly rather similar to the former studies. It is of note that the major benefit of my analysis of Tabun XI was not in building a new data base, but in forming a list of attributes that will enable reconstructing the reduction sequence and compare it to that of other Amudian sites. This could not have been done with the results of the former studies.

The Laminar Technology from Tabun XI: Summary and Conclusion

In this section I will integrate the results from the previous sections in an attempt to provide a more comprehensive picture of the laminar Technology of Tabun XI. Since the results of the analysis demonstrated only small differences among the facies, I assume that a similar reduction sequence characterized all facies of Tabun XI. I will therefore, mainly describe the reduction sequence addressing all facies. This is also necessary, since cores were examined without any sub-division. Nonetheless, the observed differences among the facies are of importance and will be discussed.

Reconstructing the Reduction Sequence

The used raw material for the laminar production varied and mainly included fist size nodules with rounded or amorphous shapes, as indicated by the analysis of the cores. Flat nodules were only rarely used for laminar production. Indications for the used raw material were also concluded from the cortical edge outline of PE blades and NBKs, which are most commonly characterized by a straight outline but also by curved or irregular ones. The high representation of all outlines, and especially straight outlines, raises the possibility that although many of the nodules were amorphous in shape it was possible to exploit specific parts of them for removing straight or curved cortical edges. The original dimensions of the used raw material can be deduced from the size of the analyzed items. Its original length can be deduced from the mean lengths of the overpass items (66.2 mm [s.d. 13.8]) and NBKs (66.8 mm [s.d. 15.2]) whose reduction commonly followed through the entire debitage surface length. The width can be discerned from the cores ('single striking platform laminar cores': 37.2 mm [s.d. 8.5]; 'single striking platform laminar and flake cores': 52.4 mm [s.d. 11.8]). Furthermore, the fact that most overpass items led to the removal of only a portion of the debitage surface indicates that the nodules were wider than the width of the overpass (mean width of overpass items is 34.0 mm [s.d. 9.3]). The rarity of overpass items with two cortical lateral edges also indicates that the cores' width was usually larger. Although the use of flint slabs or flat nodules might have made the laminar reduction easier to control, they were not commonly exploited for this purpose. The fact that many handaxes were shaped on flat flint nodules and that there is a source of flint near by Tabun Cave which is characterized by flint slabs (Druck 2004) (Fig. 201), indicates that it was a conscious choice. I presume that they intentionally selected relatively wide raw material of ca. 4 cm and more, and as a result they needed to commonly work with raw material that had a rounded or amorphous shape.

The exploitation of cores did not include the peeling of cortex prior to the production of laminar items. This is indicated by the appearance of cortex on 67.0% of the three laminar types as a whole. The handaxes and thinning flakes (personal observation) found in many of the beds from Tabun XI, including the Amudian, indicate that the peeling of cortex and the shaping of a uniform narrow outline using bifacial reduction were well known procedures. Their absence in the case of the laminar core class is a choice that must have had advantages.

The debitage surface was probably shaped by using the more uniform parts of the raw material as the core’s sides, delineating its outline. Initiating the reduction took advantage of the presence of an angular or carinated part that required only minor preliminary shaping. The simplicity of “opening” the debitage surface is seen in the ‘initial’ overpass items and the ‘initial’ crested blades, which generally lack complex shaping. The few PE blades that are almost completely covered with cortex further support the possibility of “opening” the cores with no major effort. The "opening" of the debitage surface was achieved by the removal of a series of items that together formed its shape. The blades and PE blades that bear a strip of cortex along the middle of the debitage surface indicate that on some cores the debitage surface was "opened" from two different corners so that a strip of cortex still remained in the middle. The fact that such a strip remained supports the reconstruction that the debitage surfaces were relatively wide. In addition, the possibility to initiate the reduction from two close points indicates that some nodules were angular in a way that enabled clearly separating the debitage surface from the core’s sides.

The striking platform was shaped either by a removal of a flat blank that served as a 'primary core tablet', by faceting or a combination of both. The reduction of the laminar items was conducted by a hard hammer and relatively powerful blows as indicated by the common presence of a protruding bulb of percussion and overpassing end termination. The point of impact of the hammerstone was deep inside the striking platform as indicated by the dominance of thick plain and modified butts. Although the modification of the butts was mostly simple, such as rough faceting, the presence of complementary micro flaking indicates that there was a full awareness of the need to prepare a good point of impact.

There were only minor changes in the length of the debitage surface during most of the reduction sequence. The correlation in length between the laminar items and the overpass items is one indication for this. The difference between the ‘initial’ overpass items and the ‘correction’ and ‘regular’ overpass items, which were reduced during the course of the laminar reduction, indicates that the debitage surface became a little longer (a few mm on average) during the reduction (not including the stages near abandonment). This is also evident from the presence of blades with cortex that spreads all along the distal end – a configuration which indicates that the former detached blade/s were shorter. It is possible that the small elongation of the debitage surface at the beginning of the reduction is due to the use of rounded or amorphous raw material in which the maximum length is reached only after detaching several series of items (Soriano *et al.* 2007).

The width of the cores was probably less stable during the reduction due to the common use of nodules with rounded and amorphous shapes. Cases in which the raw material enabled to maintain a relatively constant debitage surface width were probably more aimed at forming 'single striking platform laminar cores'. The more variable shapes, on the other hand, were probably more of use for a combined reduction of laminar items and flakes. Some of the wide overpass items that have only a single laminar scar (as in the Acheulian facies) support the common reduction from 'laminar and flake' cores. No indications of an attempt to control and transform the shape of the debitage surface by meticulous modification were noticed. It rather seems that the possibilities were to either solely produce laminar items (if the core shape allowed it) or to use a combined reduction of laminar items and flakes in order to control the shapes of the products.

The cortex exterior enabled the continuous systematic production of blades, PE blades and NBKs in a single reduction sequence – a reduction that could also be engaged with the complementary reduction of flakes as noted. Of the three laminar types, blades constitute 58.3%, and PE blades and NBKs constitute 20.9% each. This implies that from the used sequence more blades were produced. The high portion of blades correlates with the expectation that relatively wide cores will enable the reduction of more laminar items from their inner mass. The equal proportion of PE blades and NBKs indicates that they are complementary. The fact that the left/right position is differently represented on each of them, but when they are united (with the blades) it becomes equal, supports the suggestion that they are complementary to each other. The almost identical mean length and width of the three laminar types in the Amudian and Yabrudian beds also support the reconstruction that they are all part of a single reduction sequence. The dissimilarity in the Acheulian beds is explained by the presence of additional exceptionally large laminar items originating from a different reduction sequence.

Although the laminar types are generally the result of a single reduction sequence, the procedures used while knapping each of the laminar types slightly varied. The clearest difference is in the more powerful blows applied while removing NBKs as indicated by their greater thickness and by their more frequent overpassing end terminations. Another difference is in the point of impact of the hammerstone in relation to the produced blank as observed by the location of the bulb of percussion on the butt. While among all laminar items, and especially among blades, it tends to be in the middle, among the NBKs and PE blades it tends to appear near the cortical edge as well.

A need for modifications occasionally arose during laminar reduction. The renewal of the striking platform was performed by faceting and/or core tablet removal and the renewing of the debitage surface was performed by crested blades or overpass items removal. In the latter case, the use of powerful blows and the removal of laminar items that had followed through the entire length of the debitage surface reduced the need for repairs. One possible consideration in choosing whether to repair the debitage surface with the aid of an overpass item or a crested blade is the portion of flint mass removed from the core. The practice of modifying the core from its base is evident on some of the overpass items and cores. This modification however, is mostly *ad hoc* in nature and does not represent a systematic modification surface.

The reduction of laminar items was intense as evident from the cores of which almost none were capable of producing further laminar items. The shapes of the cores probably became deformed at this stage.

It is of note that several aspects indicate the presence of a separate reduction sequence that produced exceptionally long and wide cortical laminar items. Its products were mainly large PE blades that are represented better in the Yabrudian and Acheulian beds. The items recorded by Wright (1966) as 'backed scrapers' were probably made on these blanks as well. Although clearly defining them is difficult due to their small numbers, it can be stated that they are at least 100 mm in length and showing a length/width ratio near 2/1. These large laminar items do not seem to be the result of initiating the main laminar reduction sequence presented above. This is due to the fact that the removal of such items would clearly cause the removal of the cortex from the cores, which is a key feature of the main reduction sequence. Furthermore, since they do not tend to have an overpassing end termination, they could not have led to the reduction of the core length and thus cannot represent a procedure of cortex peeling before a reduction aimed for the manufacture of blades alone (such large blades were not found). I presume it was primarily aimed at cutting tools and blanks for side-scrapers. We lack evidence for their production on site, and their presence is minor in relation to the main reduction sequence described above.

Variations in Laminar Production among the Amudian, Yabrudian and Acheulian Facies

The three facies show a general similarity in the various attributes examined. This indicates that a similar reduction sequence for producing laminar items was practiced among the three facies although with varying intensity. The slight variations are probably due to the selection of raw material and the care taken while knapping. The variations which arose from the comparison of the three laminar types within the three facies remain the main source of data on this issue. I assembled them into five inclusive points of interest.

The first point is that the laminar production from the Amudian facies is of a higher quality in comparison to the other facies. The selection of raw material marks the first difference. It appears that in the Amudian beds more uniform nodules were selected which were more suited for laminar production. The main evidence for this difference is that non-uniform angles of the cortical edge of PE blades and NBKs constitute in the Amudian beds about half of the percentage found in the other two facies. In addition, the differences in width of overpass items indicate that in the Amudian beds there was a tendency for selecting narrower raw material than in the other two facies.

The higher quality of the blades from the Amudian beds is reflected in the higher uniformity of their sharp edges, in their shapes, in the central position of the bulb of percussion, in the paucity of irregular end shapes and in the paucity of irregular profiles compared to the other two facies. The higher quality of laminar production in the Amudian is also reflected in the CTEs. This can be seen in the fact that overpass items with laminar dimensions (>2/1 length/width ratio) are the most common in the Amudian beds. In addition, overpass items from the Amudian beds bear the highest number of laminar scars. The fact that the change in length of the debitage surface, as concluded from the overpass items, showed that in the Amudian beds it remained the most constant along the course of the reduction supports this as well.

The second point argues that although the Amudian beds represent the highest quality of laminar production in Tabun XI, its character is not very different from that of the Yabrudian beds. These two facies demonstrate a high similarity to one another, and a clear difference from the Acheulian facies in many of the examined attributes (see Pp. 196).

The third point argues that despite the above mentioned similarities, some of the attributes show a pattern of increasing or decreasing in frequency when the facies are ordered as follows – Amudian, Yabrudian and Acheulian (for examples see Pp. 196-197). This pattern is witnessed among the CTEs in the case of the assumed knapping mistakes as reflected by the overpass items.

The forth point is that out of the three laminar types, the blades demonstrate the greatest similarity among the three facies and in some cases almost identical patterns (for examples see Pp. 197). The PE blades on the other hand, present the greatest difference.

The fifth point regards patterns of selection for secondary modification. It was found that while some attributes were preferable in all cases, others are differently represented within each of the three facies (for details see page 198). The difference in the selection patterns is important since it indicates that not only the reduction sequence was slightly different, but also the demands. It is interesting that the more meticulous reduction performed in the Amudian beds correlates to a selection pattern aimed at using more uniform laminar items.

Addressing the Possibility of Reduction Occurring Outside the Cave

The supposition that some of the reduction took place elsewhere and its products went through some selection before reaching the cave was raised by Jelinek based on the high proportion of shaped items and some differences in attributes (1977:93; personal communication, 2006). Garrod's (Garrod and Bate 1937:79-89) observation concerning the paucity of "blade cores" in her excavations supports this possibility. Using the results of my analysis I further examined this point.

The relatively high percentage of secondary modification of the examined laminar items and CTEs (Table 24) supports Jelinek's suggestion. This point is emphasized when compared to the lower percentages of secondary modification from Qesem Cave and Yabrud I (Tables 9, 34).

The particularly good state of preservation is another point that might support this possibility. It is unlikely that such a high preservation state represents the spontaneous breakage during reduction, the human impact of using the items and the post depositional processes. This observation is somewhat problematic however since I did not study the small finds (less than 2.5 cm) which might include small fragments of laminar items which could diminish the high percentages of whole items.

In my study of the laminar core class I also identified relatively few cores and this too might support Jelinek's suggestion. Nevertheless, the fact that many of the laminar cores are damaged and some recycled and used as flake cores makes this evidence less pronounced, since it implies that the identified cores are actually a portion of the original population.

In conclusion, although the conjecture that some of the laminar production occurred outside of the cave seems probable, it cannot be fully confirmed. I presume that it was not repeatedly performed and thus affected only a small portion of the Tabun XI assemblages.

The Laminar Production from Tabun XI and its Significance

My analysis of the Tabun XI material indicated that the laminar production not only varied in intensity between the facies, but also in its character. These differences seem to be due to the care taken while knapping and not to a difference in know-how or capability. In the Amudian beds, where the laminar items were the most prevalent, they were meticulously made, while in the Acheulian beds, where the laminar items were the fewest, they were coarsely produced. The fact that among the examined attributes from the three facies the similarities outnumber the differences highly correlates with Jelinek’s (1990) observation that the three facies are all part of a single industry – the ‘Mugharan Tradition’.

To conclude this section I wish to review again the different perspectives concerning the reduction of laminar items as presented by Jelinek and Monigal. While

Jelinek (1981:272) suggested that the prismatic blades originated from prepared cores, Monigal (2002:246) argued that the reduction and the cores were very simple. I agree with both. While Monigal is right when saying that there are no indications for core shaping and the reduction was simple, Jelinek is correct in saying that the uniformity of the blanks and especially the blades, which he called prismatic, indicates that their shape was preplanned and controlled as expected from prepared cores (Tixier *et al*. 1980:44). One must appreciate the ability of the Acheulo-Yabrudian knappers from Tabun XI to achieve this goal without complex preparations.

Chapter 6

The Laminar Production from Yabrud I Layers 11-15

The Site of Yabrud I

Yabrud I rockshelter is located in the Skifta Valley, near the town of Yabrud, ca. 60 km north of Damascus, Syria. It lies at a relatively high altitude, 1400 m a.s.l. and to its west are the upland plains, leading to the Anti-Lebanon Mountains (20 km westwards). The Skifta Valley includes several more rockshelters and caves with Paleolithic and Epi-Paleolithic layers (Farand 1965; Rust 1950; Solecki and Solecki 1966). Yabrud I is located at the base of a limestone cliff in the northern part of the Skifta Valley facing east. The rockshelter is 35 m long and eight m deep (Farrand 1965:38). Near by the site are two large springs. Rust (1950) discovered the site while on a bicycle trip from Germany to Egypt. He excavated rockshelters I, II and III in the years 1932-1933. Excavations at Yabrud I and other rockshelters in the valley were renewed in 1963-1965 by the Columbia University expedition directed by R.S. Solecki and R.L. Solecki (Solecki and Solecki 1966, 1986).

The Stratigraphic Sequence

Rust excavated a 23 m long trench with a width of up to five m along the rockshelter wall in a series of four units which he termed *kammern* ('chambers'). These *kammern* were excavated one after another and the sediments were dumped in the former excavated *kammern*. In '*kammer I*' 24 m² were excavated to bedrock showing a total depth of 11.25 m from top soil to bedrock. Rust identified four geological horizons and 25 cultural layers within this sequence. The top geological horizon is from the surface to a depth of 2.0 m comprising Layers 1-9. The second horizon is 2-5 m below surface comprising Layers 10-18. The third horizon is 5-9 m below surface, comprising Layers 19-21 and the fourth horizon is 9-11.25 m below surface comprising Layers 22-25. Layers 1-10 include Mousterian finds and were all attributed by Rust to the Middle Paleolithic period, while Layers 11-25 were all attributed by him to various cultural entities from the late Lower Paleolithic period. Rust (1950: Tafel 4) presented only a schematic section of his excavations in Yabrud I showing the succession of all layers. The actual complexity of the stratigraphy is partly documented in a later drawing presented by de Heinzelin (1966:166, Fig. 4).

During the new excavations at Yabrud I the eastern section of *kammer I* was cleaned and enabled a refined picture of Rust's stratigraphy. Farrand (1965:39-43, Fig. 2) identified seven geological horizons in this sequence: (1) 0.0-2.3 m below surface: sediments were light gray in color and partly cemented. They included small limestones, probably cave debris. (2) 2.3-3.3 m below surface: sediments were as above but not cemented and included several hearths. (3) 3.3-5.0 m below surface: sediments were mostly cemented and included cave debris in larger sizes than the former. An earth "layer" ca. 10 cm thick was noticed at 4.5 m depth. (4) 5.0-6.8 m below surface: sediments were mostly composed of small particles with a reddish brown color. (5) 6.8-9.0 m below surface: reddish brown sediments with rubble and a sandy component. (6) 9.0-9.7 m below surface: sediments were reddish brown in color, including sand, loam and pebbles. (7) 9.7-10.5 m below surface: sediments included coarse cave debris. Farrand noted that although he suggested a different sequence compared to Rust, the differences in details are small.

Integrating the above sedimentological data with Rust's (1950) publication Solecki and Solecki (1986) suggested a slightly revised cultural stratigraphy of Yabrud I. Their refinements focused on the upper part of the sequence – Layers 1-18. The most variable composition of cultural layers was observed in a depth of three to five m below datum, including Layers 12-18. They emphasized that while Rusts' (1950:26-38, Tafel 4) written documentation notes the same elevation for some layers and their concentration in specific parts of the excavated area, he did not present it as such in the schematic section. The main ambiguity is in the relations between Layers 12 and 13, and between Layers 16 and 17.

The following is an elaboration on Layers 11-18 which are relevant to my research. Layer 18 is 20 cm thick at elevations of 4.4-4.6 m and it was ascribed by Rust to the Micoquian. According to Rust, it was disturbed by the inhabitants of Layer 15 who dug into it, passing through Layer 16, for the purpose of retrieving raw material. As a result, 9 m² in the center of the excavated area in Layer 15 included a mixture of

Micoquian and Pre-Aurignacian finds. Layers 16 and 17 are thin and appeared at an elevation of 4.2 m. The difference between them is that Layer 17 is south of the Micoquian/Pre-Aurignacian disturbance and was found only under a large stone that fell from the rockshelter's roof. Layer 16 lay north of the same disturbance. Layer 15 is at elevations of 3.8-4.0 m except for the southern part where it reached an elevation of 3.6 m. This small difference is assumed to be the result of collapsed debris from the cave's roof. Layer 14 is at elevations of 3.4-3.7 m and includes burnt material and several hearths. Layer 13 is at elevations of 2.9-3.0 m and it was only found in the southern part of the rockshelter in a limited area of 3 m². Layer 12 appears at the same elevations – ca. 3 m, however its exact relation to Layer 13 is not noted. Layer 11 is at elevations of 2.5-2.7 m (Rust 1950; Solecki and Solecki 1986). Although the stratigraphy is not fully clear, it is obvious that the 'cultural layers' did not necessarily overlay each other but were in some cases at similar elevations.

The new excavations of Solecki and Solecki opened an area perpendicular to the rockshelter wall and thus the correlation between this and Rust's excavations, who opened a trench along the wall is limited (Solecki 1970:203, Abb. 40). It is of note that Rust was present at the new excavations and helped to locate his original grid and datum. In the new excavations non-Levallois industries, which they termed as Yabrudian, started to appear at a depth of 1.35 m below datum. At a depth of 4 m traces of hearths were found. Solecki and Solecki (1966:130) note that "associated with the hearths at about 4 meters depth were collections of stones which must have been laid in place by the hand of man…Several of the stones appeared to encircle what were probably hearths…". The hearths as well as the finds were more concentrated near the rockshelter wall (Solecki and Solecki 1966:130).

Three teeth from Solecki and Solecki's excavations Levels 18-19, ascribed to the Acheulo-Yabrudian complex, gave an ESR date of 226±15 kyr. A burnt flint from Yabrud I Level 18 gave a date of 224±17 kyr (Porat *et al*. 2002).

Geological Studies

The sequence and sediments of the Yabrud rockshelters were the subject of several geological studies (e.g. Brunnacker 1970; Farrand 1965; de Heinzelin 1966). These studies mostly endeavored to reconstruct the paleoenvironment, climate as well as chronology. Although their chronological suggestions seem to be invalid due to the current accepted chronology, the raw data base is still of value. It is of note for example, that de Heinzelin (1966) found that the upper 4.5 m include eolian sediments and that traces of fire were present in the upper five meters but not in the lower part.

Faunal Remains

The fauna from Rust's excavations (Lehmann 1970) and from Solecki and Solecki's excavations (Perkins 1968) includes only a small number of identified bones, most of which are teeth of two equid species (*Heminous* and *Asinus*). Other species, represented by only a few bones, include *Lepus*, *Canis lupaster*, *Vulpes vulpes*, *Felis silvestris*, *Cervus elaphus*, *Dama*, *Gazella* and *Capra ibex*.

Raw Material Sources

Raw material sources in the vicinity of Yabrud I are highly common, varying in size and quality. Some of the sources are characterized by different colors and texture of flint that hampered the possibility of relating the archeological material from the site to specific outcrops. 'Tabular raw material' is highly common in the region, but usually of a low quality (Bakdach 1982, 2000; Solecki and Solecki 2007).

Other Finds

The other finds from the levels of the Acheulo-Yabrudian complex from Solecki and Solecki's excavations include a piece of red ochre 0.5 cm in size retrieved from a depth of 3.2 m. Solecki (1970:205) consequently discussed the symbolic implications of this find within its early context.

The Acheulo-Yabrudian Lithic Assemblages of Yabrud I Layers 11-25

The collection of lithic finds in Rust's excavations was not systematic and the sediments were not sieved. Solecki and Solecki (1966:126-127, Figs. 6-9) report that while preparing the area for their excavations at Yabrud I they encountered roughly 4,000 flint items within the backfilling left by Rust. They also note that Rust confirmed during his visit to the new excavations that his collection of lithic items was not complete. Solecki and Solecki examined the material found in the cleaning of the 1964 season (n=1804) and argued that it was mainly debitage items, especially flakes, that were rejected by Rust. Nonetheless, some cores of various types (n=203), NBKs (n=44; laminar and flake in proportion) and even some blades were rejected as well. Although this demonstrates that all categories of the assemblages of Rust's excavations were affected by the unsystematic collection, it seems that the laminar component was only slightly distorted and laminar items were usually collected.

The retrieved lithic items from Solecki and Solecki's excavations have the potential to reflect the real character of the assemblages along the sequence without the bias of unsystematic collection, but the material was not presented in details. The few notes provided mention variations along the sequence with several levels richer in Quina retouched side-scarpers. Other shaped items mentioned are denticulates and burins (Solecki 1970).

The description of the lithic assemblages from Yabrud I Layers 11-25 is according to Rust (1950) and Bordes (1955, 1984) and only addresses the main technological and typological traits. The material from Layers 11-13 and 15, from which I have examined the laminar items, is presented separately in more detail. In order to simplify the text the layers are referred to as Yabrud I-11, Yabrud I-12 etc.

Yabrud I-25: This layer was defined as Yabrudian and is mainly characterized by side-scrapers made on thick, large flakes with thick plain butts. No handaxes are present (Rust 1950:13-16). Bordes (1984:35-37) notes the dominance of shaped items on flakes and that faceting of the butts is not common (IF: 27.5%). The presence of Levallois items is small (IL: 4.2). Side-scrapers are highly common and their index is 65.8. Among the side-scrapers, Quina retouch is highly common and *déjeté* and transversal types are well represented.

Yabrud I-24: This layer was defined as Acheulo-Yabrudian and the lithic items include both handaxes and side-scrapers. The handaxes are relatively small, 4-6.5 cm in length (Rust 1950:16-18). Bordes (1984:16) notes that the side-scraper index is 51.3 and that 13.9% of the side-scrapers are *déjeté*. The Ilam is 5.7. Several Levallois items were found as well.

Yabrud I-23: This layer was defined as middle-late Acheulian. The lithic items include both handaxes and side-scrapers. The handaxes include large and small specimens. The butt of the handaxes is generally unshaped (Rust 1950:18-20). Side-scraper index is relatively low (27.9) with no *déjeté*. Denticulates are highly common in this layer (Bordes 1984:16).

Yabrud I-22: This layer was defined as Yabrudian and the lithic items include numerous side-scrapers and zero handaxes (Rust 1950:20-22). Among the technological traits which Bordes (1984:37) noted are, a common presence of faceting (IF: 35.7), and a small presence of Levallois (IL: 6.7) and laminar items (Ilam: 7.1). The index of side-scrapers is high (79.3) and many of the side-scrapers are *déjeté*. Quina retouch is well represented.

Yabrud I 19-21: These layers are poor in finds. The several retrieved side-scrapers and handaxes led Rust (1950:23-24) to define Layers 20-21 as Yabrudian and Layer 19 as Acheulo-Yabrudian.

Yabrud I-18: This layer was defined as Micoquian and the lithic finds include handaxes and side-scrapers. The handaxes are 7-15 cm long (Rust 1950:25-26). The side-scraper index is 24.3 and no *déjeté* are noted. Denticulates are highly common in this layer (20.8%). Among the other shaped items, backed knives are present. Levallois items (IL: 24.3) are common in this layer (Bordes 1984:16).

Yabrud I-17: This layer was defined as late Acheulian and the lithic finds include handaxes and side-scrapers. Cores are dominated by discoidal shapes (Rust 1950:26-27) and the assemblage includes Levallois items (IL: 32.8) and several blades (Ilam: 13.6). The faceting index is especially high (IF: 57.4). Side-scrapers index is 42.8 and no *déjeté* are noted. Backed knives are relatively common and their index is 11.9 (Bordes 1984:16-20).

Yabrud I-16: This layer was defined as Yabrudian and its lithic material is poor. Side-scrapers are the most common shaped item (Rust 1950:27-28). Bordes notes the high index of faceting (IF: 47.2) and the small presence of Levallois (IL: 3.6) and laminar items (Ilam: 3.6). Side-scrapers are highly common (IR: 71.7) and include *déjeté* and transversal types (Bordes 1984:37).

Yabrud I-14: This layer was defined as late Yabrudian and the lithic finds are characterized by side-scrapers. Bordes (1984:37) notes the presence of faceting (IF: 32.6), Levallois (IL: 3) and laminar items (Ilam: 6). The index of side-scrapers is high – 79.1.

The Pre-Aurignacian Lithic Assemblage of Yabrud I Layer 15

Yabrud I-15 was defined by Rust as Pre-Aurignacian and it is mainly characterized by blades. The 975 lithic items from Yabrud I-15 were defined by Rust (1950:30-33) as 17 end-scrapers, three end-scrapers/burins, 56 burins, three borers, 13 thick scrapers, seven Chatelperron points, 45 retouched blades, 10 saws, 12 small tools, 178 blades, 89 cores, 145 retouched flakes and 395 flakes. Two hammerstones were also found in this layer but they are not included in the count. This assemblage was later studied by Bordes (1955, 1984) and Vishnyatsky (2000). According to Bordes (1955) the Ilam is 37.3 and the index of the 'Upper Paleolithic tools' is 45. Vishnyatsky divided the 927 items he studied into 192 'unretouched blades' (whole or broken), 484 'unretouched flakes' (including blanks, chips, 'resharpening spalls' and CTEs) and 134 'tools'.

One of the unique characters of Yabrud I-15 is the common recycling of old lithic artifacts as indicated by the 108 items with double patina and by the 38 items that were detached from handaxes. Rust suggested that the recycled lithic artifacts, especially handaxes, were dug from the Micoquian of Yabrud I-18 and that they were selected for that purpose since they were suitable for the production of blades. He further argued that the presence of double patina and the general absence of blades in Yabrud I-18 ruled out the possibility that these procedures were performed by the inhabitants of the Micoquian layer (Rust 1950:28-29). It is of note that while Bordes (1984:40) did not accept this view and argued that the items detached from handaxes more likely represent resharpening of handaxes, others like Vishnyatsky (2000:145-146) and Soelcki and Solecki (2007) excepted Rust's view, especially in light of absence of whole or nearly whole handaxes in the assemblage of Yabrud I-15. Vishnyatsky (2000:146) further argued that this feature, along with the high exploitation of cores, indicates "…some shortage of raw material."

Although blades are well represented within the debitage, they are outnumbered by flakes (Rust 1950:30). Vishnyatsky (2000:145) notes that about four fifths of the flakes are elongated and that their size is usually smaller than five cm.

The cores were differently divided by the researches. Among the 89 cores observed by Rust (1950:33) he noted the utilization of three large flakes as blade cores, several 'cylindrical' cores, discoidal cores and two bipolar cores. Bordes (1984: 40) divided the cores he identified into 12 discoidal, 17 'divers', 24 'formless', 14 prismatic with a single striking platform, three prismatic with two striking platforms, 35 globular and one pyramidal.

The typological division of shaped items is better presented by Bordes (1955) and Vishnyatsky (2000). Bordes (1984:40) noted among the shaped items 16 end-scrapers, 37 burins, two backed knives, nine truncated blades, 22 retouched blades, six notches, 10 denticulates, three side-scrapers and three retouched flakes. Vishnyatsky (2000:145, Table 1) divided the shaped items into eight distal parts of handaxes, four side-scrapers, 43 burins, 17 end-scrapers, three burins/end-scrapers, three 'retouched truncated blades', 19 retouched blades, one backed blade, six notches, four 'chisel-like tools' and 26 'retouched flakes and indeterminate tool fragments'.

According to Rust the domination of blades is apparent among the shaped items (90% of them are on blades). For this calculation he removed items with double patina. This high percentage clearly did not include the 145 items he recorded as retouched flakes. It is of note however, that Bordes (1984:37-40) mentioned only three retouched flakes and Vishnyatsky (2000:145, Table 1) noted only 26 items under the category of 'retouched flakes and indeterminate tool fragments'.

Retouched blades are usually characterized by light retouch (Rust 1950:33), which can appear along all or part of one edge, or both edges (Bordes 1984:40; Vishnyatsky 2000:146). More intrusive heavy retouch appears on some of the blades and Vishnyatsky (2000:146) argued that these specific items can also be defined as side-scrapers. Bakdach (1982: Tafeln 76-79) also identified several shaped blades as side-scrapers. Rust (1950:32) noted that the six items he recorded as Chatelperron points have a retouched back that ended with a sharp point.

The end-scrapers include different sub-types. Bordes (1984:37) divided the 16 end-scrapers he identified into four on blades, five ‘atypical’, two on flakes, three carinated and two nosed. Vishnyatsky (2000:146) divided the 17 end-scrapers he identified into more general groups including six high end-scrapers, six items made on blades and five made on flakes. The carinated and nosed end-scrapers mentioned by Bordes correlate to the high end-scrapers mentioned by Vishnyatsky and the thick scrapers noted by Rust. Both Vishnyatsky and Rust discussed the similarity of these end-scrapers to cores. While Rust (1950:32) argued that some were made on rejected cores, Vishnyatsky (2000:146) argued that "some can equally be defined as cores". It is of note that all three researches found that only a small portion of the end-scrapers were made on blades.

Burins are one of the dominant types in this assemblage and their diversity had already been observed by Rust (1950:31). Bordes (1984:37) divided the 37 burins he identified into dihedrals, on a break, on truncations, transversal and multiple. Vishnyatsky (2000:146) noted that among the 43 burins which he identified, many were simply made on broken blades and flakes. Side-scrapers are rare in this assemblage and only one of the four items identified by Vishnyatsky (2000:146) is whole.

Specific observations concerning the laminar technology and CTEs from this and the following layer will be presented and discussed in a different section (Pp: 292-294) which will compare my results to previous studies.

The Pre-Aurignacian Lithic Assemblage of Yabrud I Layer 13

The lithic assemblage from Yabrud I-13 is very small and includes 113 items. It was ascribed by Rust to the Pre-Aurignacian. The material was divided by Rust (1950:36) into six end-scrapers, six burins, one borer, four thick end-scrapers, two Chatelperron points, eight retouched blades, five saws, 41 blades, five cores and 35 flakes. Vishnyatsky (2000:146) noted that only 95 items from Yabrud I-13 were present when he examined the material and he divided them as follows: five ‘secondary cores and core fragments’, 31 ‘unretouched flakes’, 51 ‘unretouched blades’ and eight shaped items. The latter include three burins, three end-scrapers and two retouched flakes.

Rust (1950:36) noted that the assemblage from Yabrud I-13 is different from that of Yabrud I-15, mainly in the smaller size of blades.

The Lithic Assemblage of Yabrud I Layer 12

Yabrud I-12 was ascribed by Rust (1950:37) to the 'Terminal Acheulian' (Pre-Mousterian) and he divided the retrieved 395 lithic items into 22 handaxes, 10 'points', 14 side-scrapers, 12 burins, one borer, 36 cores and over 300 flakes. This assemblage is clearly dominated by flakes and the Ilam is 15 (Bordes 1984:20). Other technological comments by Bordes included the relatively high faceting index (IF: 56.3) and the presence of Levallois debitage. As for cores, most were defined by Rust (1950:37) as discoidal. Bordes noted that many of the 'tools' (n=93) from Yabrud I-12 were shaped on flakes. The index of side-scrapers is not high (24.1) and no *déjeté* are found. Denticulates are reported to constitute 16% and burins 18.5%. The handaxes include the following types: lanceolate (n=3), triangular (n=1), cordiform (n=1), amygdaloid (n=4), sub-cordiform (n=2), ovate (n=2), core-like (n=3), divers (n=3) and broken (n=4) (Bordes 1984:20). Rust (1950:38) reported that the handaxes of this layer are relatively small.

The Lithic Assemblage of Yabrud I Layer 11

Yabrud I-11 was ascribed by Rust to the 'Acheulo-Yabrudian' and the 435 retrieved lithic items were divided by him into three handaxes, 11 end-scrapers, 82 side-scrapers, nine 'points', three burins, five 'small tools', 22 cores and over 300 flakes. This assemblage is also dominated by flakes and the Ilam (16.7) is similar to that of Yabrud I-12 (Bordes 1984:20). Other technological traits marked by Bordes include the presence of Levallois items (IL: 8.1) and a relatively high index of faceting (IF: 48.1). Bordes noted in his division of the Yabrud I-11 assemblage that many of the 'tools' were shaped on flakes (n=140). The tools are dominated by side-scrapers as evident by their high index (70.7). *Déjeté* side-scrapers are well represented forming 6.8%. Other types he mentions are backed knives (0.9%), denticulates (11.6%) and burins (1%). Bordes notes seven handaxes, four of which are broken (Bordes 1984:20).

The Three Facies of the Acheulo-Yabrudian Complex of Yabrud I

Although Rust originally ascribed Layers 11-25 from Yabrud I to various cultural entities, in his summary he united these layers into four frameworks – Yabrudian, Acheulian, Acheulo-Yabrudian and Pre-Aurignacian (Rust 1950:125-130). I suggest that the difference between the layers described as Acheulian and Acheulo-Yabrudian is minor and the two can be united. It is of note that Bordes (1984:14-20) united them as well. In all, the 15 relevant layers from Yabrud I can be divided into the three facies of the Acheulo-Yabrudian complex and their character is here shortly summarized.

Pre-Aurignacian

The Pre-Aurignacian of Layers 13 and 15 is characterized by blades. The Ilam of Yabrud I-15 is 37.3 (Bordes 1960). The character of these blades was described by Rust (1950) and Vishnyatsky (2000) and their observations will be discussed following my analysis of the laminar items. The shaped items are characterized by a high index of 'Upper Paleolithic tool', including retouched blades, end-scrapers and burins.

Yabrudian

The Yabrudian of Layers 14, 16, 20-22 and 25 is mainly characterized by an abundance of side-scrapers and the absence of handaxes. This facies is dominated by flakes and shaped items made on flakes. The flakes are relatively large and their butts are described by Rust (1950:125-127) as mostly thick and plain. Bordes (1984:35-37) noted that the faceting index of these layers ranges from 25.7 to 47.2. The production of flakes in the Yabrudian layers had a unique character reflected by the common location of the bulb of percussion along the sides of the butts and with a skew from the axis of reduction. Rust (1950:39) noted that this is the case in 35% of the shaped items from Layers 22 and 25, and 30% of the shaped items from Layers 14 and 16. Laminar items appear, but are relatively few as reflected by the low Ilam, varying from 3.6 to 7.3. Levallois items were found within all of these layers (Bordes 1984:35-37).

The dominant shaped item in these layers is the side-scraper with an index of 65.8-79.3 (Bordes 1984:35-37). The typical Yabrudian side-scrapers were described by Rust (1950:125) as thick and with an angular retouch. These are better defined as Quina retouched side-scrapers, commonly appearing as *déjeté* or transversal types (Bordes 1984:37).

Acheulian

The Acheulian facies is represented by Layers 11-12, 17-19 and 23-24. Rust gave a different name to almost every one of these layers (including Acheulo-Yabrudian, Acheulian and Micoquian). The main characteristic uniting them is the presence of both handaxes and side-scrapers.

Flakes and flake tools dominate this facies. Rust (1950:39) notes that the production of flakes in the Acheulian layers was different from that of the Yabrudian (see above) in that they were removed close to the axis of production. In Yabrud I-11 he notes that only 5% of the shaped items have a bulb of percussion that appears near the side. The butt of the blanks was commonly modified as indicated by the relatively high faceting index (IF: 48.1-57.4). Rust (1950:28) notes that some of the blades found within these layers are especially large compared to the Pre-Aurignacian. Levallois items appear in all layers, especially in Layers 17-18 where their index is relatively high (24.3 and 32.8 respectively). The Ilam ranges from 5.7 to 16.7 (Bordes 1984:16-20).

Handaxes are the main type characterizing this facies, although they sometimes appear in small numbers. Their index varies from 4 to 31.6 in the different layers (Bordes 1984:16-20). Rust (1950:127-129) argued that the handaxes highly vary in shape, size and quality between the layers. Small handaxes were retrieved from Layers 24 and 12, while large handaxes were retrieved from Layers 17-18. Retaining the handaxes' butt unshaped is a common feature. Side-scrapers constitute a major portion of these assemblages as well, as indicated by the high index varying from 24.1 to 70.7 (Bordes 1984:16-20). Bordes (1984:42, Tableau II) also compared the percentages of backed knives and burins in the Acheulian layers to those of the Yabrudian layers and found that they are nearly absent in the latter and present in almost all of the former.

The Analyzed Material from Yabrud I Layers 11-15

The previous sections presented the material from Yabrud I according to the published data. From this section onwards the results of my own examination of the material from Rust's excavations, currently stored at Köln University, Germany, are presented. The finds from the Columbia University expedition are stored in Syria (Solecki 1970) and are unavailable. My prime goal is to examine the laminar production from the Pre-Aurignacian layers – Yabrud I-13 and Yabrud I-15, however I also studied the laminar production from the other facies of the Acheulo-Yabrudian complex of Yabrud I. In my review of Layers 11-12, 14 and 16-25, I encountered only a small number of laminar items in each assemblage and thus a systematic study was impractical. I chose to unite the laminar items and their related waste from Layers 11-12, where relatively larger numbers were found into a single unit which I termed Yabrud I-11/12. This unit will be used to uncover the character of the laminar production as it appears in the Acheulian facies of Yabrud I.

Rust's excavations did not meet the standards of modern excavations and the collection of lithic items was not systematic. Yet as noted, the collection of laminar items suffered less distortions and thus can be examined by a thorough attribute analysis. Although these are not ideal circumstances, due to the uniqueness of the Pre-Aurignacian layers of Yabrud I it is of great importance to examine them despite the difficulties.

Raw Material

The raw materials used for the laminar production are usually highly siliceous varying in colors and texture. The utilization of old patinated items and handaxes in Yabrud I-15 was described by Rust and was summarized above. The cortical contour of the various flint items indicates that the used nodules were flat, rounded or amorphous in shape. The handaxes from Layers 11-25 also provide some insight concerning the available raw material shapes and sizes. Some of these handaxes which are exceptionally large (ca. 20 cm) and lack cortex (Rust 1950: Taflen 19:1; 18:1) indicate that large nodules were available. In addition, the presence of handaxes with cortex on both faces (Rust 1950: Taflen 20:7; 41:2) indicates that flat nodules or flint slabs were used to some extent.

Hammerstones

Two hammerstones were found in Yabrud I-15 (Rust 1950:33). They are both of hard limestone and are relatively heavy for their size. The first is small (50x50x37 mm) and rounded in shape. The second is larger (80x67x47 mm) and although it is generally rounded in shape it has two carinated corners. These carinated corners could enable locating the impact blow at a specific point inside the striking platform (see Pp: 131-139). The fact that one of the carinated corners of the hammerstone is covered by many pecking scars supports this possibility.

Preliminary Observations on the Laminar Items from Yabrud I Layers 11-15

Blades are the most dominant laminar type in the analyzed sample, constituting 66.2%-72.6% of the three laminar types (including blanks and shaped items) in the different layers (Figs. 308-309, 317). PE blades and NBKs appear in smaller numbers (Fig. 310), constituting 9.6%-19.2%. In Yabrud I-11/12 and Yabrud I-15 PE blades and NBKs are fairly equally represented, while in Yabrud I-13 NBKs are clearly more common than PE blades (Fig. 317). Despite the unsystematic collection, the small difference among the layers in the relative frequency of laminar end-products implies a technological similarity. It can be stated that the reduction sequence/s used for the production of laminar items resulted in a small number of cortical items and blades were the main end-product.

The different population of the three laminar types in the blanks and shaped items was examined only in Yabrud I-15 where blades are most frequent among the blanks and shaped items constituting 66.0% and 66.7% respectively. PE blades are slightly less common among the blanks (17.3%) than among the shaped items (21.7%), and NBKs are more common among the blanks (16.7%) than among the shaped items (11.7%).

The relative frequency of shaped items out of the total of blanks and shaped items of each laminar type (Fig. 318) shows different percentages of secondary modification. Blades are characterized by a relatively low percentage of secondary modification ranging from 10.8% to 27.2% with Yabrud I-15 showing the highest percentage and Yabrud I-13 the lowest. The other laminar types appear in small numbers, especially in

Yabrud I-11/12 and Yabrud I-13. Nonetheless, it is of note that PE blades show a relatively high percentage of secondary modification and NBKs a low percentage. In Yabrud I-15 31.7% of the PE blades and 20.6% of the NBKs were secondarily modified.

The types of shaped items made on each laminar type are presented for Yabrud I-15 only where a relatively large sample was retrieved (Fig. 319). However, even in this layer only the blades are well represented. The most common shaped laminar item type made on blades is the ‘retouched laminar item’ (57.5%). The two other shaped item types commonly made on blades are ‘distally retouched laminar item’ (15.0%) and burins (15.0%).

Cross cutting the above results by examining whether specific laminar types were selected for making different shaped item types is presented in Fig. 320 (this includes laminar shaped items only and not the entire shaped items population which was not examined by me). Although only the ‘retouched laminar item’ type consists of a considerable number of artifacts (n=34), the repeating pattern shows that blades dominate some shaped item types and are never outnumbered by the other laminar types.

Attribute Analysis of the Three Laminar Types from Yabrud I-15

The Analyzed Sample

The analysis of the three laminar types from Yabrud I-15 is comprised of 222 blades, PE blades and NBKs, including both blanks and shaped items (Figs. 308-310). The blanks (n=162) include 107 blades, 28 PE blades and 27 NBKs. The shaped items (n=60) include 40 blades, 13 PE blades and 7 NBKs. They include whole items and fragments (Table 28). Due to the small number of shaped PE blades and NBKs the comparison between blanks and shaped items will focus only on the blades.

State of Preservation

The laminar items' state of preservation (including blanks and shaped items) is good and whole items dominate all types, constituting 81.6% of the blades, 80.5% of the PE blades and 76.5% of the NBKs (Fig. 321). The relatively high percentage of whole items is probably affected by the unsystematic collection of lithic artifacts as indicated by the absence of medial fragments. The fact that blades show the highest percentage of whole items and NBKs the lowest is of note. Comparing blanks to shaped items shows that whole blades appear in a similar frequency in both cases (81.3% and 82.5% respectively). In contrast, whole PE blades are more common among the blanks than among the shaped items (85.7% vs. 69.2%) and whole NBKs are less common among the blanks (74.1% vs. 85.9%).

Amount of Cortex

Of the three laminar types (blanks and shaped), NBKs show the most uniform distribution pattern of cortex cover on the dorsal face (Fig. 322), with a clear peak at 20% (50.0% of all NBKs). The common appearance of cortex on blades (40.7%) indicates that cortex was commonly reduced all along the reduction sequence. Uniting the three laminar types into one group shows that 60.1% bear cortex. Although this percentage is high, it is of note that nearly 40% of the three laminar types were reduced from the nodule's inner mass having no contact with its exterior.

Patinated surfaces appear on 11.7% of the three laminar types (blanks and shaped) and on an additional 8.6%, where the patination appears along calcareous cortical surfaces. Patinated surfaces appear on 15.1% of blades (bearing cortex), 9.8% of PE blades and 8.8% of NBKs. Combined calcareous cortex and patina appear on 1.9% of the blades (bearing cortex), 14.6% of the PE blades and 8.6% of the NBKs. Altogether, patinated surfaces (with or without calcareous cortex) appear on 20.3%-24.4% of the items with cortex. This relatively high percentage support's Rust's (1950:28-29) argument that old knapped items were commonly recycled into cores for laminar production.

Comparing the amount of cortex on blank blades and shaped blades did not show major differences (Fig. 323).

Cortex Configuration

Most PE blades (78.1%), including blanks and shaped items, show the same cortex configuration as NBKs having a cortical edge and an opposed sharp edge. Other cortex configurations of PE blades include the presence of a strip of cortex on both lateral edges (2.4%), along the middle of the item (7.3%) and over the entire item (12.2%).

The occasional presence of cortex on blades (blanks and shaped) is mostly at the distal end (49.1%). It also commonly appears on one lateral edge, along a part of it (29.1%) or all of it (9.1%). Less common configurations of cortex on blades are along the middle (3.6%), on both lateral edges (3.6%) and irregular (3.5%).

The side of cortex on the three laminar types (blanks and shaped) shows a tendency for producing laminar items with cortex on the left edge (Fig. 324). While the difference between sides is small among PE blades and NBKs, it is large among blades. The fact that even when uniting the blades, PE blades and NBKs they still show a clear inclination to the left indicates one of two options: (1) cores were not necessarily characterized by a debitage surface confined by two cortical edges and/or (2) in the case of a combined reduction of laminar items and flakes, the laminar items were more commonly reduced from the right side of the debitage surface.

Angles of the Lateral Edges

Examining the angle of the cortical lateral edge of NBKs and PE blades did not show a clear distribution pattern – neither a bi-modal pattern nor a unimodal bell pattern

(Fig. 325). In the absence of any clear evidence for separating PE blades from NBKs in Yabrud I-15 the division between these laminar types remained as in Qesem Cave and Tabun XI, where items with an angle of ≥60° are defined as NBKs. A none-uniform angle of the cortical edge appears on 14.8% of the PE blades (n=27) and 33.3% of the NBKs (n=27). These relatively high percentages might indicate the common use of raw material with amorphous shapes.

The distribution patterns of the angles of the sharp edges of PE blades and NBKs (blanks and shaped) show a peak at 40° for PE blades and a peak at 35°-45° for NBKs (Fig. 326). A non-uniform angle of the sharp edge appears less among NBKs (n=25) than among PE blades (n=26), constituting 8.0% and 26.9% respectively – a difference that demonstrates a higher uniformity of the angle of the sharp edge of NBKs.

The angles of the lateral edges of blades (blanks and shaped) mostly range between 25°-50°, peaking at 30° (Fig. 327). Non-uniform angles on both lateral edges appear on 10.6% and one lateral edge with non-uniform angle appears on 38.9% of the blades (n=113). Comparing blank blades and shaped blades shows that there was a preference for items with an angle of 30° for secondary modification (Fig. 328). Nonetheless, the presence of a lateral edge with a non-uniform angles did not harm the potential for being used as a shaped item as indicated by the fact they are more common among shaped items than among blanks. One lateral edge with a non-uniform angle is found on 35.6% of the blank blades (n=87) and on 38.9% of the shaped blades (n=26). Two lateral edges with non-uniform angels are found on 9.2% of the blank blades and on 10.6% of the shaped blades.

Blade Shapes and Lateral Edges of PE Blades and NBKs

The shapes of blades (blanks and shaped) include parallel (20.4%), straight-curved (19.5%), pointed (2.7%), enlarged (3.5%), leaf (5.5%), straight-irregular (19.5%), curved-irregular (22.1%) and irregular (8.8%). The most common shape selected for secondary modification is the parallel (Fig. 329). It is of note that none of the blades with a pointed shape was selected for secondary modification.

When uniting the PE blades and NBKs (blanks and shaped) in order to examine the outlines of the cortical edge (Fig. 330) it was found that a straight outline is the most common (44.2%), while curved and irregular outlines appear in a smaller amount (28.8% and 26.9% respectively). A straight cortical edge equally appears on PE blades and NBKs. The difference between the two is that NBKs have a higher percentage of a curved cortical outline while PE blades have a higher percentage of an irregular cortical outline.

The sharp edges of PE blades and NBKs (blanks and shaped) show a dominance of straight edges (Fig. 331). Sharp edges with curved and irregular outlines appear in smaller amounts. While among PE blades, curved and irregular sharp edges are equally represented, among NBKs curved outlines are slightly more common than irregular ones.

Butt Types

Modified and thick plain butts are the most common among all three laminar types (Fig. 332). Thick plain butts are highly common among PE blades (54.3%) and less common among blades (34.2%) and NBKs (37.5%). Modified butts are most common among blades (50.0%) and less common among PE blades (22.9%). The modified butts are mostly characterized by irregular faceting. Dividing the thick plain and modified butts into size categories (medium [3-5 mm thick] and large [6 mm thick or more] for thick plain butts, and small [1-2 mm thick], medium and large for modified butts) show that the large thickness is most common among NBKs in both cases (Figs. 333-334).

Comparing blank blades to shaped blades shows that there was a clear preference for blades with modified butts (Fig. 335). The difference in modified butts between blanks and shaped items is statistically significant ($X^2=15.09$, $df=1$, $p<0.05$). Curiously, even blades with a thick plain butt were rarely selected for secondary modification. The lower presence of thick plain butts among the shaped items is statistically significant ($X^2=6.42$, $df=1$, $p<0.05$).

Micro flaking of the butt's exterior appears on 26.9% of the blades (n=119), 31.4% of the PE blades (n=35) and 32.3% of the NBKs (n=31), including blanks and shaped items. It appears differently on the various butt types (including all laminar types), constituting 30.4% of the thin plain butts (n=23), 45.8% of the thick plain butts (n=72) and 12.7% of the modified butts (n=79) (other butt types are represented by low numbers). The results of both examinations indicate that the presence of the micro flaking is not arbitrary, thus supporting the possibility that it served as blunting. It might represent different procedures undertaken while treating different butt types and removing different blank types.

The Bulb of Percussion and its Location along the Butt

The bulb of percussion on the laminar items is not always protruding and can be relatively small. Double impact was observed on three blades and one NBK. The bulb of percussion is located differently on the butts of PE blades and NBKs (blanks and shaped; Fig. 336) with a statistical significance ($X^2=10.55$, $df=1$, $p<0.05$). On the PE blades it is mostly in the middle (85.7%), while on the NBKs it is mostly near the cortical edge (54.8%). In the case of blades (blanks and shaped), the bulb is in the middle of the butt in 69.6%. Among specimens where the bulb is near one of the sides, the left side is more common. Blanks and shaped items show an almost identical pattern (Fig. 337).

Cross-Sections

The most common cross-sections of blades (blanks and shaped) are triangular (40.4%) and trapezoidal (25.5%) (Fig. 338). The most common cross-sections of PE blades are triangular (50.0%) and ‘other’ (36.8%). Right-angle trapezoidal (50.0%) and right-angle triangular (25.0%) are the most common cross-sections of NBKs.

Cross-sections of blank blades and shaped blades (Fig. 339) show almost identical patterns.

End Terminations

Feather end terminations dominate all three laminar types (blanks and shaped), constituting 68.2%-73.3% (Fig. 340). While among blades and PE blades hinge and overpassing end terminations are fairly equally represented (13.2%-14.9%), among NBKs hinge end terminations are rare (4.5%) and overpassing end termination are common (27.3%). When all three laminar types are grouped together, overpassing end termination constitute 16.2%. Comparing blank blades and shaped blades (Fig. 341) shows that while a feather end termination is dominant among both, its percentage is slightly lower among the blanks. Alternately, overpassing end terminations are more common among the shaped blades with a statistical significance ($X^2=3.93$, df=1, $p<0.05$).

Distal End Shapes

A high variation characterizes the distal end shapes of the three laminar types (blanks and shaped; Fig. 342). The most common distal end shapes found among blades are oblique and rounded. Among PE blades, only the rounded are clearly more common, and among NBKs the most common distal end shapes are rounded, straight and irregular.

Comparing blank blades and shaped blades (Fig. 343) shows a preference for items with oblique, rounded and irregular distal end shapes. It is of note that items with a pointed distal end shape were rarely selected for secondary modification. Nevertheless, none of these differences is statistically significant.

Profiles

Semi-straight profiles are the most common among the three laminar types (blanks and shaped; Fig. 344), constituting 38.5%-45.5%. Curved profiles constitute 23.5%-30.8%; blades with the lowest percentage and NBKs with the highest. Twisted profiles constitute 11.5%-27.3%, with NBKs appearing in the lowest percentage and PE blades the highest. Irregular profiles are well represented only within the NBKs, constituting 19.2%.

Comparing blank blades and shaped blades (Fig. 345) shows that although items with a semi-straight profile are the most common in both cases, they are less common among the shaped items where items with curved and twisted profiles were preferred. However, none of these differences are statistically significant.

Number of Laminar Scars and a Bipolar Scar Pattern

The distribution patterns of the number of laminar scars on the dorsal face (Fig. 346) vary among the three laminar types (blanks and shaped). While the peak of blades is at 2-3 laminar scars, the peaks of PE blades and NBKs are at two laminar scars. The minor presence of blades with no laminar scars is of note (5.9%; n=7). The mean number of laminar scars on blades is 2.3 (s.d. 1.4), on PE blades is 1.4 (s.d. 0.9) and on NBKs is

1.7 (s.d. 0.9). The small number of laminar scars indicates that laminar items generally followed through the entire length of the debitage surface, thus leaving very few scars along its length. Comparing blank blades to shaped blades (Fig. 347) showed that there was a preference for blades with two laminar scars. The means however, show a minor difference (blade blanks: 2.3 [s.d. 1.4]; shaped blades: 2.4 [s.d. 1.5]).

A bipolar scar pattern is a consistent feature of the laminar items (blanks and shaped). It is found on 9.5% of the blades (n=147), 9.8% of the PE blades (n=41) and 2.9% of the NBKs (n=34).

Metrics

The length of the three laminar types (blanks and shaped) shows relatively similar distribution patterns, mainly ranging from 46-70 mm (Fig. 348). This similarity, which is also observed in the mean length (blades: 58.2 mm [s.d. 13.2]; PE blades: 61.5 mm [s.d. 12.7]; and NBKs 61.9 mm [s.d. 11.0]; Table 29), supports the possibility that blades, PE blades and NBKs were usually the products of a single reduction sequence.

The width of the three laminar types (blanks and shaped) also demonstrates a fairly similar distribution pattern with most of them between 16-30 mm (Fig. 349). The peaks of all laminar types are at 21-25 mm. The mean width of blades is 21.9 mm (s.d. 5.0), of PE blades is 23.8 mm (s.d. 4.6) and of NBKs is 24.6 mm (s.d. 5.3).

The thickness demonstrates a clear difference between the three laminar types (blanks and shaped), with blades being the thinnest (Fig. 350). The mean thickness of blades is 8.0 mm (s.d. 2.7), of PE blades is 10.8 mm (s.d. 3.3) and of NBKs 11.5 mm (s.d. 2.9).

The length/width ratio of the majority of the three laminar types (blanks and shaped) falls between 2.0-3.0 with fairly similar distribution patterns (Fig. 351). Nevertheless, while blades and PE blades peak at 2.4-2.5, most NBKs range between 2.0-2.9 with no clear peak. The mean length/width ratio of blades is 2.7 (s.d. 0.5), of PE blades is 2.6 (s.d. 0.4) and of NBKs is 2.7 (s.d. 0.5) (Table 32).

The width/thickness ratio, on the other hand, shows a clear difference in the distribution patterns of the three laminar types (blanks and shaped). The peak of blades is at 2.6-3.0, of PE blades at 2.1-2.5 and of NBKs is at 1.6-2.0 (Fig. 352). Of the three laminar types, NBKs demonstrate the most uniform distribution pattern. The mean width/thickness ratio of blades is 3.0 (s.d. 1.0), of PE blades is 2.4 (s.d. 0.7) and of NBKs is 2.2 (s.d. 0.8).

Comparing blank blades and shaped blades by distribution patterns and means shows that longer, wider and thicker items were usually preferred for secondary modification (Tables 29-31; Figs. 353-355). This was found to be statistically significant in the case of length ($t[113]=2.39$, $p<0.05$) and width ($t[117]=2.35$, $p<0.05$). Comparing the length/width and width/thickness ratios of blank blades and shaped blades did not show major differences in distribution patterns (therefore not presented) or means (Tables 32-33).

Hinge Scars

Hinge scars were found on 27.7% of the blades, 33.3% of the PE blades and 30.8% of the NBKs, including blanks and shaped items (Fig. 356). Comparing blank blades and shaped blades (Fig. 357) shows that blades with a smaller number of hinge scars were generally preferred for secondary modification – hinge scars appear on 32.2% of the blank blades but only on 15.6% of the shaped blades.

Summary of the Attribute Analysis of the Three Laminar Types

The above attribute analysis revealed several patterns that may be of help in reconstructing the laminar technology from Yabrud I-15. They are summarized and described in the following four sections.

1) Description of the three laminar types

The following description of the three laminar types from Yabrud I-15 refers to the results of analyzing blanks and shaped items.

Blades

Blades frequently bear traces of cortex, which are often spread along their distal end (40.7% of them have up to 20% cortex on their dorsal face). The most common blade shapes are parallel, straight-curved and curved-irregular. Many of the butts are modified, however thick plain butts are common as well. The bulb of percussion is usually located in the middle of the butt and a triangular cross-section is the most common. A feather end termination is dominant and the most common distal end shapes are oblique and rounded. A semi-straight profile is the most common. Most of the blades are characterized by two or three laminar scars on the dorsal face. Their length ranges between 33-98 mm, but most are 46-65 mm long. Their width is between 12-35 mm, but most are 16-30 mm wide. Their thickness ranges between 3-16 mm, but most are between 5-8 mm. The mean dimensions are 58.2 mm (s.d. 13.2) long, 21.9 mm (s.d. 5.0) wide and 8.0 mm (s.d. 2.7) thick. Their length/width ratio ranges from 2.0-4.3, with most of them between 2.2-2.9. Their width/thickness ratio ranges from 1.1-7.3, with most of them between 1.6-4.0. The mean length/width ratio is 2.7 (s.d. 0.5) and the mean width/thickness ratio is 3.0 (s.d. 1.0). About one quarter of the blades have hinge scars.

Primary element blades (PE blades)

PE blades are covered by extensive cortical surfaces, consisting of 30%-60% of the dorsal face. About four-fifths of the PE blades have a strip of cortex along one edge, while the other edge is sharp. The cortical and the sharp edges are generally straight. The butts are mostly 'thick plain' and the bulb of percussion is usually in the middle of the butt. The most common cross-section is triangular, however an 'other' cross-section is well represented as well. Semi-straight profiles are dominant and two laminar scars are usually found on the dorsal face. The length of the PE blades is 40-92 mm, but most are 46-70 mm long. Their width is 13-34 mm, but most are 16-30 mm wide. Their thickness is 5-17 mm, but most range between 7-12 mm. The mean metrics are 61.5 mm (s.d. 12.7) long, 23.8 mm (s.d. 4.6) wide and 10.8 mm (s.d. 3.3) thick. Their length/width ratio is 2.1-3.6 but most range between 2.1-3.0. Their width/thickness ratio is 1.0-4.4 but most of them range between 1.6-3.0. Hinge scars appear on roughly one third of them.

Naturally backed knives (NBK)

The NBKs have a strip of cortex along all or most of one of the lateral edges, most commonly covering 20% of the dorsal face. The other lateral edge is sharp. The angle of the cortical edge ranges from 60º-110 º with no clear pattern. The cortical and the sharp edges are generally straight. Thick plain or modified butts characterize most of the NBKs. The bulb of percussion is mostly near the cortical edge and their cross-section is usually right-angle trapezoidal. They are dominated by semi-straight and curved profiles. Most NBKs have two laminar scars on their dorsal face. Their length is 42-86 mm, with most ranging between 46-70 mm. Their width is 13-35 mm, with most ranging between 21-30 mm. Their thickness is 5-16 mm, with most ranging between 9-16 mm. Their mean metrics are 61.9 mm (s.d. 11.0) long, 24.6 mm (s.d. 5.3) wide and 11.5 mm (s.d. 2.9) thick. Their length/width ratio is 2.0-4.0 but mostly falls between 2.0-2.9. Their width/thickness ratio is 1.0-7.3 but mostly falls between 1.1-3.0. Hinge scars appear on ca. one third of them.

2) *Preliminary observations regarding the laminar technology*

The shapes of the raw material/nodules were commonly rounded or amorphous as indicated by the prevalent rounded and irregular outlines of the cortical edges of PE blades and NBKs (28.8% and 26.9% respectively). Although the common presence of PE blades and NBKs with straight cortical edges (44.2%) may indicate the use of raw material with two flat faces, they more likely originated from specific flat parts on amorphous and rounded nodules.

Cortex was usually present on cores all along the reduction sequence as indicated by its appearance on 60.1% of all three laminar types. The fact that cortex is more often found on the left edge than on the right edge suggests that many of the laminar cores did not have a debitage surface constricted by two cortical edges, and that in the case of a combined reduction of laminar items and flakes, the laminar items were more commonly reduced from the right side of the debitage surface.

The variability in the shapes of the distal end indicates that the bases of cores did not have a constant shape and that probably little effort was placed in controlling its shape. It also implies that achieving a specific distal end shape was not of importance.

Laminar items were produced by hard hammer and by usually hitting deep inside the striking platform as indicated by the common thick butts, plain or modified. The relatively high percentage of modified butts, especially among blades, indicates an effort invested in shaping the striking platform. The common presence of micro flaking along the exterior of the butts, especially on thick plain butts, probably served as a complementary preparation before reducing laminar items.

The length and width of the three laminar types are generally similar, thus suggesting that they were the products of a single reduction sequence. Nonetheless, the reduction of each laminar type within that sequence slightly varied. For example, more powerful blows were used in the reduction of NBKs as indicated by the more common overpassing end terminations and their larger size (Tables 29-31). The hammerstone's point of impact in relation to the produced item also varies as indicated by the location of the bulb of percussion on the butts. While on blades and PE blades it is mostly in the middle, on NBKs it mostly near the cortical edge. The fact that modified butts appear in the lowest percentages on PE blades might indicate that controlling their precise outline was the least important out of the three laminar types.

3) *The characteristics of blades selected for secondary modification*

A comparison of blanks and shaped items in order to observe aspects regarding the character of desired end products was only conducted with blades since PE blade and NBK samples were too small.

Longer, wider and thicker blades were generally selected for secondary modification (Figs. 353-355; Tables: 29-31), thus indicating that the robust character of blades was intentional. Sharp edges were desired as apparent by the fact that the angles of the lateral edges of shaped blades are generally more acute than those of blank blades (Fig. 328). Nonetheless, the higher percentage of blades with one or two lateral edges with a non-uniform angle among the shaped blades demonstrates that perfect sharp edges were not always the most important feature.

The shapes indicate a clear preference of blades with parallel edges for secondary modification (Fig. 329). The rejection of blades with a pointed shape for secondary modification is of importance. The rejection of items with a pointed end shape as well (Fig. 343), instruct that the desired features of blades relate more to the lateral edges and less to the distal end. This is supported by the fact that feather end terminations are slightly less common among the shaped blades than among the blanks blades, as well as by the fact that overpassing end terminations, characterized by a thick and non-pointed contour, are more common among the shaped blades (Fig. 341).

Another indication of a preference for fine lateral edges is the lower presence of hinge scars on shaped blades than on blank blades (Fig. 357). The common selection of blades with two laminar scars over blades with more laminar scars (Fig. 347) may further reflect a desire for fine lateral edges.

The profile does not seem to have been a major issue in selection. This is reflected by the fact that although a semi-straight profile is the most prevalent among blank blades and shaped blades (Fig. 345), its percentage is slightly lower among the latter. A preference was observed only in the case of the curved and twisted profiles which appear in higher percentages among the shaped items.

The clear selection of blades with modified butts for secondary modification (82.1% of all shaped blades; Fig. 335) does not indicate that it was a desired feature of blades. It is more likely that investing more effort on pre-shaping the striking platform led to blades with qualities more suitable for secondary modification.

The preferences described above indicate two clear aspects regarding the qualities of selected blades. One concerns size and the second concerns the character of the lateral edges. In terms of size, achieving larger blades and not delicate blades is prominent. The desired character of the lateral edges is more complex. Although the attributes of shape, distal shape and end termination all indicate that it is the lateral edge that was of importance and not the distal end its precise desired character is not clear. Even the importance of achieving a good sharp edge is limited due to the fact that blades with two non-uniform sharp edge angles were favored in some cases.

4) *NBKs as 'technologically defined tools' and their suitability as hand-held knives*

Although NBKs are not well represented in Yabrud I-15, it is worth examining their potential as 'technologically defined tools' as reflected in the results of the above attribute analysis. The aspects examined include the suitability of their morphology as hand-held cutting tools and their homogeneity which may indicate their potential for use without secondary modification.

In reference to the morphology, the main features reviewed here are according to the NBK's definition – the character of the sharp edge and the opposed back (e.g. Debénath and Dibble 1994:53-54). The angle of the sharp edge of the NBKs usually ranges between 35º-45º and suitable for cutting both soft and medium-hard materials (Lemorini *et al.* 2006). The outline of the sharp edge is either straight or curved. Irregular outline which could decrease the cutting potential constitute only 16.0%. Although the most common profile of NBKs is semi-straight (38.5%) which is highly suitable for cutting, the presence of NBKs with curved, twisted or irregular profiles shows that not all were highly efficient for cutting. However, among many of the NBKs with a non-straight profile, the sharp edge tends to be straighter than the cortical edge. This is probably a result of placing the impact blow near the cortical edge as demonstrated in Chapter 4 (Pp: 87-88).

The intentional shaping of the *steep* cortical edge is best indicated by the common presence of the bulb of percussion near the cortical edge (Fig. 336) – a procedure that enables controlling the item's cross-section so that it will have a steep cortical back. Comparing the angle of the cortical edge of PE blades and NBKs did not show however a bi-modal pattern (Fig. 325). The outline of the NBKs' cortical back is either straight or curved in 73.1% of the cases. These uniform outlines provided a comfortable hold for applying pressure while cutting. The overpassing end termination, found on roughly one third of the NBKs, enables placing pressure at the distal end as well. The right-angle trapezoidal cross-section of most NBKs, characterized by relatively parallel ventral and dorsal faces, further enhanced their suitability as hand-held cutting implements. While the character of the back relates to the ability to apply force downward (into the carcass), the cross-section enabled a good grip for the vertical motion needed for cutting. The absence of a clear distal end shape (Fig. 342) further emphasizes that in NBKs the lateral sharp edge was of importance.

The homogeneity of NBKs is reflected in the cortical edge, preliminarily by that the cover of cortex on the dorsal face which is relatively constant – in 80.8% of them cortex covers 20%-30% of the dorsal face (Fig. 322). Additionally, NBKs are characterized by a lower percentage of items with an irregular cortical edge outline than PE blades (Fig. 330). However, this aspect is not entirely clear, since NBKs are also characterized by a higher percentage of a non-uniform angle of the cortical edge than PE blades (33.3% vs. 14.8%) – a point which does not contribute to their uniformity. The homogeneity is more apparent in the case of the sharp edge. NBKs have a lower percentage of a non-uniform angle of the sharp edge than PE blades (8.0% vs. 26.9%).

The fact that NBKs have a higher percentage of modified butts than PE blades might be an indicator for greater attention in preparing the striking platform prior to their knapping. In addition, the width/thickness ratio of NBKs shows the most distinct peak of all three laminar types (1.6-2.0; Fig. 352).

An additional quality is the potential of NBKs to endure pressure. Their greater thickness in comparison to the other two laminar types attests to their durability. The fact that 74.1% of them are whole further supports this. However, the fact that the percentage of whole items is slightly lower than that of blades and PE blades (Fig. 321) is of note.

In conclusion, while NBKs from Yabrud I-15 show some evidence supporting their suitability as hand-held cutting tools, other features do not. This opposing evidence does not contradict their use as a 'technologically defined tools', but rather indicates that they were not perfectly planned.

Attribute Analysis of the Three Laminar Types from Yabrud I-13

The Analyzed Sample

The Pre-Aurignacian of Yabrud I-13 provides a small sample of 37 blades, five PE blades and ten NBKs, including both blanks and shaped items (Fig. 311:1-6; Table 28). The following analysis therefore examines only blades and refers to blanks and shaped items together. A comparison between blanks and shaped items will not be conducted due to the small number of shaped blades. The results of each of the attributes are compared to those of Yabrud I-15 in order to demonstrate the variability of the Pre-Aurignacian facies within Yabrud I.

Attribute Analysis of Blades

The state of preservation of blades from Yabrud I-13 is as follows: 67.6% whole, 13.5% proximal and 18.9% distal. One difference in comparison to Yabrud I-15 (Fig. 321) is the lower percentage of whole blades in Yabrud I-13.

Cortex is not common on blades from Yabrud I-13 with 84.0% not bearing any cortex at all (Fig. 322). Out of the seven blades bearing cortex two (28.6%) are covered by patinated surface. The presence of cortex on blades from Yabrud I-15 was higher with statistical significance ($t[48.25]=2.76$, $p<0.05$).

The angles of the lateral edges of blades from Yabrud I-13 show differences between left and right (Fig. 359). While the angles of the left edge peak at 35°, the angles of the right edge mainly spread from 25° to 40° with no clear peak. Blades with two uniform edge angles constitute 68.0%, blades with one edge with non-uniform angle 28.0%, and blades with two edges with non-uniform angles 4.0% (Fig. 360). Blades from Yabrud I-15 are different in that the distribution patterns of the angles of both lateral edges show a peak at 30° (Fig. 327). In addition, blades from Yabrud I-15 show higher percentages of non-uniform edge angles, but yet with no statistical difference.

The most dominant blade shape is straight-irregular (32.0%); other blade shapes are parallel (16.0%), straight-curved (16.0%), pointed (8.0%), fan (4.0%), leaf (4.0%) and curved-irregular (12.0%). The distribution pattern of blade shapes is different from that of Yabrud I-15, yet without a statistical significance (Fig. 361).

The butts of blades from Yabrud I-13 are most commonly modified (36.7%). Other butt types are thin plain (26.7%), thick plain (26.7%) and punctiform (10.0%) (Fig. 362). Micro flaking appears on 43.3% of the blades' butts (n=30). The bulbs of percussion do not tend to protrude and they are mostly small. No double impact was observed. The bulb of percussion is usually in the middle of the butts (72.4%). The distribution pattern of the butts of blades from Yabrud I-13 is statistically different from that of Yabrud I-15 ($X^2=10.75$, df=4, $p<0.05$). The main difference between them is that the blades from Yabrud I-13 show a lower frequency of modified and thick plain butts ($X^2=6.51$, df=1, $p<0.05$) and a higher frequency of thin plain and punctiform butts ($X^2=8.85$, df=1, $p<0.05$). Micro flaking of the butts' exterior is less common in Yabrud I-15. Yet, since micro flaking was found to be more common on plain butts than on modified ones, their lower percentage in Yabrud I-15 can be correlated to the higher percentage of modified butts. In reference to the location of the bulb of percussion, a fairly similar percentage is located in the middle in Yabrud I-15 (Fig. 363).

The predominant cross-section of blades is triangular (55.9%). Other cross-sections include right-angle triangular (8.8%), trapezoidal (14.7%), right-angle trapezoidal (5.9%) and 'other' (14.7%). Although statistical significance was not found, this is different from the blades of Yabrud I-15 where a triangular cross-section appears in a lower percentage and a trapezoidal cross-section in a higher percentage (Fig. 364).

Feather end terminations dominate the blades from Yabrud I-13 (78.1%); overpassing and hinge end terminations are few (6.3% and 15.6% respectively). The main difference from Yabrud I-15 is in the lower percentage of overpassing end terminations in Yabrud I-13 (Fig. 365).

The most common distal end shape is oblique (36.7%). Other distal end shapes are pointed (13.3%), pointed-rounded (13.3%), rounded (16.7%), straight (16.7) and irregular (3.3%). The blades of Yabrud I-15 on the other hand present two dominant end shapes: oblique and pointed rounded (Fig. 366).

Many of the blades profiles are semi-straight (42.3%); the other profiles are curved (19.2%), convex (3.8), twisted (23.1%) and irregular (11.5%). These results are similar to those of Yabrud I-15 (Fig. 367).

The number of laminar scars on the dorsal face varies from zero (one blade) to seven, with two laminar scars being the most common (40.0%). Yabrud I-13 shows a higher peak at two scars than Yabrud I-15 (Fig. 368). The mean number of laminar scars on blades from Yabrud I-13 is 2.6 (s.d. 1.7). A bipolar scar pattern was observed on one blade (2.7%). This is much lower than the case of Yabrud I-15.

The metrics (Figs. 369-371) show that blades from Yabrud I-13 are relatively short, narrow and thin. Their mean dimensions are 48.3 mm (s.d. 9.1) in length, 18.0 mm (s.d. 3.7) in width and 6.2 mm (s.d. 2.2) in thickness. These dimensions are smaller than in Yabrud I-15 with a statistically significant difference (Tables 29-31) (length: $t[138]=3.56$, $p<0.05$; width: $t[56.95]=5.75$, $p<0.05$; thickness: $t[143]=3.19$, $p<0.05$). The distribution of length/width ratio shows that most blades range between 2.2-3.3 (Fig. 372). The distribution of width/thickness ratio shows a clear peak at 2.6-3.0 (Fig. 373). The mean length/width ratio is 2.8 (s.d. 0.4) and the mean width/thickness ratio is 3.2 (s.d. 1.2). It is of note that although the length, width and thickness show a clear difference between Yabrud I-13 and Yabrud I-15 the length/width and width/thickness ratios are quite similar (Tables 32-33).

Hinge scars appear on 40% of the blades, 32% of which have one hinge scar and 8.0% two hinge scars. The percentage of blades with hinge scars is lower in Yabrud I-15 (Fig. 374).

Notes on the Characteristics of the Three Laminar Types

Before summarizing the above attributes I wish to present several observations regarding blades, PE blades and NBKs as a group and for PE blades and NBKs as a group (blanks and shaped items). This grouping is necessary due to the small number of laminar items in Yabrud I-13 and in order to retrieve more data for the technological reconstruction.

For evaluating the appearance of old patinated surfaces (double patina) in comparison to calcareous cortical surfaces I united the blades with a natural surface, PE blades and NBKs (n=22). Patinated surfaces are found on 22.7% of the items and a combined surface of patina and calcareous cortex is found on 9.1%. Patinated surfaces (including those combined with calcareous cortex) are more common on laminar items from Yabrud I-13 than from Yabrud I-15 (31.8% vs. 20.3%).

The side on which cortex appears is equally divided into left and right if all three laminar types are examined as one (n=18). It is of note that PE blades and NBKs show opposite trends in the side of cortex when examined separately.

More than a half of the cortical edges of PE blades and NBKs (n=11) have an irregular outline (63.6%). The rest of the cortical edges have a straight (27.3%) or curved (9.1%) outline. This is different from Yabrud I-15 where a straight outline is more common and an irregular outline is fewer. The latter is statistically significant ($X^2=5.50$, df=1, $p<0.05$) despite the small sample.

PE blades and NBKs from Yabrud I-13 (n=11) are generally longer than the blades from this layer. This is best reflected by their mean length; while that of PE blades and NBKs is 54.5 mm (s.d. 10.2) that of blades is 48.3 mm (s.d. 9.1). The mean width of PE blades and NBKs, on the other hand, is similar to that of blades (18.9 mm [s.d. 4.6] and 18.0 mm [s.d. 3.7] respectively).

The Character of the Laminar Production from Yabrud I-13

The above results do not enable a solid reconstruction of the laminar technology. Nonetheless, they can demonstrate that the laminar production in Yabrud I-13 differed from that of Yabrud I-15.

The difference in blades between the two layers can be observed in the amount of cortex, angles of the lateral edges, shapes, butt types, cross-sections, metrics, number of laminar scars and number of hinge scars. The results obtained from the PE blades and NBKs also attest to this difference. The cortical edges of PE blades and NBKs, mainly characterized by irregular outlines, indicate the use of nodules with amorphous shapes. This is in contrast to Yabrud I-15 where the raw material was probably more regular in shape. The higher percentage of laminar items with patinated surfaces and the significantly shorter laminar items in Yabrud I-13 further indicate a difference in the used raw material.

Although the difference in the used raw material probably affected some of the examined attributes, there is some dissimilarity indicating that the laminar item reduction from Yabrud I-13 was slightly different than that of Yabrud I-15. The larger length of PE blades and NBKs compared to blades is one aspect – a difference that may indicate two options: First that blades, PE blades and NBKs were not necessarily the products of the same reduction sequence; Second that PE blades and NBKs were more frequently removed in the initial stages of the reduction, while blades were more commonly removed after the core was slightly shortened. The fact that blades are rarely characterized by cortex supports the second option. Other features that are less likely to be explained by a difference in raw material include the varied distribution of butt types. In Yabrud I-13 thin plain and punctiform butts together form 36.7% of all blades, indicating that placing the impact blow deep inside the striking platform was not as common as in Yabrud I-15. Since there is a correlation between the size of butt and the produced blank (Dibble and Whittaker 1981), it may indicate that the shorter blades were actually intentional and not constrained by the raw material. Another difference not explained by raw material is the angles of the lateral edges of blades. The blades from Yabrud I-13 show a unique case in which the left edge has a clear distribution pattern (peaking at 35º), while the right edge lacks a clear pattern. The lower percentage of blades with a bipolar scar pattern compared to Yabrud I-15 also reflects a difference in the reduction.

Features hinting that the laminar production of Yabrud I-13 was slightly less organized than in Yabrud I-15 are the cross-section and number of hinge scars. Since I assume that a trapezoidal cross-section of blades, which is usually composed of three well defined scars, indicates a well organized removal of laminar items, their low percentage in Yabrud I-13 indicates the opposite. The relatively high percentage of hinge scars on blades, representing knapping mistakes, is another indication.

Summarizing the above, the laminar production from Yabrud I-13 is different from that of Yabrud I-15. Although a different selection of raw material might have affected the character of the entire reduction sequence, there are indications for a slightly different reduction sequence and a lesser degree of attention paid while knapping.

Attribute Analysis of the Three Laminar Types from Yabrud I-11/12

The Analyzed Sample

The Acheulian facies of Yabrud I-11/12 ('Acheulo-Yabrudian' and 'terminal Acheulian' according to Rust) provides a small sample of 62 laminar items (blanks and shaped; Table 28). The blades, which constitute the majority of this sample (n=45), were studied in detail. Due to the small sample, blanks and shaped items are treated together. PE blades and NBKs are briefly reviewed.

Attribute Analysis of Blades

The state of preservation of the 45 blades is as follows: 60% are whole, 15.6% are proximal, 2.2% are medial and 22.2% are distal fragments. It is of note that the laminar items from Yabrud I-11/12 are the most fragmented of all layers examined, with a statistically significant difference from that of Yabrud I-15 ($X^2=6.06$, df=1, $p<0.05$).

Cortex is present on 40.7% of the whole blades (Fig. 358). The configuration of cortex on these blades (n=19) is divided into the following categories: distal (36.8%), middle (10.5%), partial lateral edge (36.8%) and 'other' (15.8%). This is different from Yabrud I-15 mainly in the higher percentages of the 'middle' and 'other' configurations.

Although the distribution of angles of the blades' lateral edges lacks a clear pattern (Fig. 375), there is some differentiation between the left and right angles with peaks at 30° vs. 40° and with a more uniform distribution of the right edge angle. Blades having two lateral edges with uniform angles (40.0%) are outnumbered by blades having one edge with a non-uniform angle (44.0%). Blades with two edges with non-uniform angles constitute a relatively high percentage (16.0%). The angles of the lateral edges of blades from Yabrud I-13 and Yabrud I-15 demonstrate higher uniformity in the distribution patterns (Figs. 327, 359). The presence of non-uniform angles of the lateral edges (Fig. 360) is also higher in Yabrud I-11/12 with a statistical significance in comparison to Yabrud I-13 ($X^2=3.95$, df=1, $p<0.05$).

The four most common shapes are parallel, straight-curved, straight-irregular and curved-irregular (each constituting 16.7%-20.8%; Fig. 361). This is not particularly different from the two other layers examined. Of note is the higher frequency of pointed shape blades in Yabrud I-11/12 as compared to Yabrud I-15 which is statistically significant ($X^2=4.58$, df=1, $p<0.05$).

The butt types of blades are thin plain (6.7%), thick plain (40.0%), modified (46.7%), punctiform (3.3%) or natural (3.3%). The modified butts are mostly characterized by simple faceting and only one by meticulous faceting. The composition of the different butt types is not very different from the case of Yabrud I-15 (Fig. 362). The butts of blades from Yabrud I-13 represent a completely different character. Micro flaking on the blade's butt (n=28) appears on 32.1%, slightly higher than in Yabrud I-15.

The bulb of percussion is protruding on some blades and is relatively flat on others. Only one blade with double impact was observed. The bulb of percussion is usually in the middle of the butt (Fig. 363), however in a third of the blades it is near one of the lateral edges with a clear difference between left and right (left: 10.0%; right 23.3%). Blades with the bulb in the middle of the butt constitute similar percentages in Yabrud I-15 and Yabrud I-13, yet the largest difference between the left/right position of the bulb is in Yabrud I/11-12.

The blades' cross-sections (Fig. 364) are often trapezoidal (35.7%) or triangular (31.0%). This is different from Yabrud I-13 and Yabrud I-15 where a triangular cross-section predominates. A statistical difference was found between Yabrud I/11-12 and Yabrud I-13 in the case of triangular ($X^2=4.79$, df=1, $p<0.05$) and trapezoidal ($X^2=5.70$, df=1, $p<0.05$) cross-sections.

Feather end terminations are most common, while overpassing and hinge end terminations are few (Fig. 365). The distribution pattern is very similar to that of Yabrud I-15.

The most common distal end shape found among blades is pointed (31.0%), followed by oblique (24.1%). Other distal end shapes are less common, constituting 10.3%-13.8% (Fig. 366). The main difference between Yabrud I-11/12 and Yabrud I-13 or Yabrud I-15 is the higher percentage of pointed end shapes. In the latter case it was found to be statistically significant ($X^2=6.02$, df=1, $p<0.05$).

The dominant profile of blades is semi-straight (53.8%), followed by curved (23.1%) (Fig. 367). Other blade profiles constitute 3.8%-11.5%. This is different from

Yabrud I-13 and Yabrud I-15 in having a higher percentage of semi-straight profiles and a lower percentage of twisted profiles.

The distribution pattern of the number of laminar scars on blades shows a peak at two laminar scars (34.6%), yet three and four laminar scars are also common (30.8% and 23.1% respectively). Only two blades were found with zero laminar scars (7.7%). The mean number of laminar scars is 2.5 (s.d. 1.2). While in the distribution pattern the number of laminar scars is more similar to Yabrud I-15 (Fig. 368), the mean is more similar to Yabrud I-13. A bipolar scar pattern was observed on 6.7% of the blades.

The length of the blades is 36-105 mm with most ranging between 56-70 mm (Fig. 369). The mean length is 65.2 mm (s.d. 18.1). The width of the blade is 14-45 mm and although its distribution pattern peaks at 21-25 mm, most blades range from 16-40 mm without a clear pattern (Fig. 370). The mean width is 27.8 mm (s.d. 10.4). the thickness of the blades range from 3-17 mm with a peak at 11-15 mm. The mean thickness is 8.4 mm (s.d. 4.0). The length, width and thickness of Yabrud I-11/12 (Figs. 369-371; Tables 29-31) are greater with a statistically significant difference from those of Yabrud I-13 ($t[37.26]=4.21$, $p<0.05$; $t[34.36]=6.16$, $p<0.05$; $t[41.01]=4.77$, $p<0.05$ respectively) and those of Yabrud I-15 ($t[139]=2.25$, $p<0.05$; $t[31.35]=3.52$, $p<0.05$; $t[31.36]=2.99$, $p<0.05$ respectively).

The length/width ratio ranges from 2.1-3.3 with a peak at 2.4-2.5 (Fig. 372). The mean length/width ratio is 2.4 (s.d. 0.3). The width/thickness ratio ranges from 1.2-5.7 with a peak at 2.1-2.5 (Fig. 373). Its mean is 2.9 (s.d. 1.0). Comparing the length/width ratio to Yabrud I-13 and Yabrud I-15 shows the same peak at 2.1-2.5 (Fig. 372), yet the latter two clearly differ from that of Yabrud I-11/12 with a statistical significance ($t[49]=3.27$, $p<0.05$; $t[67.53]=3.86$, $p<0.05$ respectively). This difference is reflected in the mean length/width ratio which is higher in Yabrud I-13 and Yabrud I-15 (2.8 [s.d. 0.4] and 2.7 [s.d. 0.5] respectively). Comparing the width/thickness ratio of blades to that of Yabrud I-13 and Yabrud I-15 shows different peaks and different distribution patterns (Fig. 373). Of the three samples examined Yabrud I-11/12 has the lowest width/thickness ratio.

Hinge scars on blades are highly common, appearing on 59.3%. This percentage is much higher than in Yabrud I-13 and Yabrud I-15 (Fig. 374), in which the diefference between Yabrud I-11/12 and Yabrud I-15 is statistically significant (X^2=9.81, df=1, $p<0.05$).

Notes on the Characteristics of the Three Laminar Types

Patinated surfaces on blades with natural surfaces, PE blades and NBKs together (n=31) are rare, constituting 3.2% only in Yabrud I-11/12. Other indications of the used raw material can be found in the outline of the cortical edges of PE blades and NBKs. Although the number of items examined for this attribute is extremely small (n=6), the fact that all are irregular in shape may indicate that raw material with amorphous shapes was commonly used in these layers. The side of cortex on all three laminar types (n=22), is equally divided into left (50%) and right (50%) position. In accounting all three laminar types, items with an overpassing end termination constitute 16.7%. Four of the seven PE blades in Yabrud I-11/12 are extremely large – 86-125 mm long, 41-45 mm wide and 10-19 mm thick (Fig. 311:7). All four are at the margin or beyond the ranges measured for blades (Figs. 369-371). As a result, the PE blades are completely different from the blades and the NBKs from Yabrud I-11/12 in mean metrics (Tables 29-31). It is most likely that the expectantly large PE blades represent a different reduction sequence than the one represented by the blades, the other PE blades and the NBKs in the assemblage.

The Character of the Laminar Production from Yabrud I-11/12

The laminar production from Yabrud I-11/12, in light of the above attribute analysis, has a different character than that of Yabrud I-13 and Yabrud I-15. It is of note that in Yabrud I-11/12 two different reduction sequences were probably present – one that reduced large PE blades and it is only minimally represented, and another that constitutes the major source of laminar items, mainly reducing blades but some PE blades and NBKs as well. Since the character of the former is obscure, the second one will be elaborated on here.

One of the major characteristics of the main reduction sequence of Yabrud I-11/12 is the relatively large size of the end products as reflected in the distribution patterns and mean dimensions (Figs. 369-371; Tables 29-31). This was the result of the selection of relatively large raw material. The presence of blades with cortex in the middle of the dorsal face supports this possibility since it demonstrates that the debitage surface was wide enough to enable its “opening” from two edges leaving a strip of cortex in the middle.

Even if the selection of raw material had an affect on the different character of the reduction in Yabrud I-11/12, attributes from the blade analysis indicate that a different concept of reduction was involved as well. These include a relatively high percentage of a pointed shape and the dominance of a pointed end shape. Both are fewer in the other layers and indicate different core shapes. Another difference is that the reduction of blades does not show a symmetrical orientation, but rather tendency to a specific side. This is observed in the location of the bulb of percussion along the butt which is often found more to the right than to the left side. The dominant trapezoidal cross-section among blades is unique within the assemblages of the Acheulo-Yabrudian complex, even outside Yabrud I. While on the one hand it demonstrates the different character of the reduction from Yabrud I-11/12, on the other it is indicative of its well organized nature. This can also be observed in the mean number of laminar scars (2.5) on blades. The semi-straight profile which dominates the blades is another indication of the well organized and controlled reduction. Only the relatively high percentage of hinge scars is suggestive of some flaws in this systematic reduction.

Analysis of Core Trimming Elements

All types of CTEs from the examined layers were recorded (n=196), including debitage CTEs (n=171) and CTEs that were secondarily modified (n=25). Their division into layers and types is presented in Table 34. The attribute analysis of overpass items and crested blades will describe separately the finds from Yabrud I-11/12, Yabrud I-13 and Yabrud I-15 according to the results of the laminar items analysis that shows that each of them has a different character. CTEs from Yabrud I-11/12 and Yabrud I-15 are the focus of this analysis, while CTEs from Yabrud I-13 will be briefly discussed due to the small number of items.

Core Tablets

Core tablets include 17 items, constituting 9.3% in Yabrud I-11/12 and 9.3% in Yabrud I-15. None were retrieved from Yabrud I-13. Most core tablets caused the removal of only a part of the striking platform and only a few led to the removal of the whole striking platform. One of the latter, originating from Yabrud I-15 (Fig. 312: 1), shows the removal of blanks from a wide and angular debitage surface – an outline that fits some of the cores of the 'single striking platform laminar and flake' type (see below). This illustrated core tablet also demonstrates a case in which the striking platform was previously shaped by faceting. Only one core tablet (from Yabrud I-15) was secondarily modified.

Overpass Items

Overpass items include 38 specimens: 16 from Yabrud I-11/12, one from Yabrud I-13 and 21 from Yabrud I-15, constituting 18.6%, 9.1% and 21.2% of the CTEs of each layer respectively (Fig. 312:2-5). In all, 32 are debitage items and six were secondarily modified (Table 29). The overpass items are either laminar or flakes (<2/1 in length/width ratio). Laminar overpass items constitute 62.5% in Yabrud I-11/12 and 33.3% in Yabrud I-15. Only two overpass items, one from Yabrud I-11/12 and one from Yabrud I-15 are similar to NBKs showing a steep cortical back and an opposed sharp edge.

Two exceptional overpass items from Yabrud I-15 were reduced from handaxes. One of them was detached from the lateral edge of a handaxe removing its entire distal end. It is 103 mm long, 18 mm wide and bears a previous laminar scar (Fig. 312:4). The second is a distal fragment which was detached from the centre of a flat face of a handaxe and removed its tip. It is 68 mm long, 32 mm wide and has two laminar scars (Fig. 312:5). The presence of laminar scars on these two items indicates that they are not knapping mistakes made while attempting to rejuvenate handaxes but rather their systematic recycling into laminar cores.

The analyzed sample

The attribute analysis will focus on the items from Yabrud I-11/12 (n=16) and Yabrud I-15 (n=19). The two overpass items demonstrating the recycling of handaxes into laminar cores are not included due to their clear difference from the rest of the population. Most of the examined overpass items are whole (Yabrud I-11/12: 87.5%; Yabrud I-15: 89.5%) while the reminder are distal segments.

The majority of overpass items are of the 'correction' category (see methodology section), especially in Yabrud I-15 where they constitute 64.7% (Fig. 376). Although examining overpass items according to the three categories (initial, correction and regular) was found to be useful for reconstructing the laminar technology (see Chapters 4-5), it is not done here due to the small samples.

The presence of cortex

Cortex appears on 64.3% of the overpass items from Yabrud I-11/12 and on 80.0% of the overpass items from Yabrud I-15. In most cases it covers only a small portion of the items’ dorsal face (Fig. 377). Overpass items with cortex on both lateral edges were not found. Patinated surfaces are present on only one overpass item from Yabrud I-11/12 and it is mixed with calcareous cortex.

Butt types

Thick plain and modified butts are the most common. Thin plain butts are more common in Yabrud I-11/12 and thick plain butts are more common in Yabrud I-15 (Fig. 378).

Distal end shapes

Overpass items from Yabrud I-15 are most commonly characterized by rounded and straight distal end shape and those from Yabrud I-11/12 are most commonly characterized by oblique and rounded distal end shapes (Fig. 379). Pointed end shape is meagerly represented and appears only in Yabrud-11/12.

Profiles

Overpass items from Yabrud I-11/12 (n=14) and Yabrud I-15 (n=17) mostly have a curved profile (64.3% and 52.9% respectively). Other profiles from Yabrud I-11/12 are semi-straight (7.1%), twisted (14.3%) and irregular (14.3%). The same profiles appear in Yabrud I-15, slightly differing in percentages – semi-straight (23.5%), twisted (11.8%) and irregular (11.8%).

Number of laminar scars

The number of laminar scars on the overpass items varies from zero to five (Fig. 380). Their distribution patterns show peaks at two laminar scars both in Yabrud I-11/12 and Yabrud I-15. However, overpass items from Yabrud I-15 are characterized by slightly more laminar scars as indicated by the mean – 2.8 (s.d. 1.4) in Yabrud I-15 and 2.4 (s.d. 1.3) in Yabrud I-11/12.

Metrics

The length of the overpass items varies from 37-112 mm in Yabrud I-11/12 and from 42-70 mm in Yabrud I-15. The peak of their distribution pattern in Yabrud I-11/12 is at 46-50 mm and in Yabrud I-15 is at 66-70 mm (Fig. 381). Their mean length is 62.3 mm (s.d. 19.3) for Yabrud I-11/12 and 58.0 mm (s.d. 9.5) for Yabrud I-15. The presence of longer overpass items in Yabrud I-11/12 is in correlation with the longer blades found there (Table 29; Fig. 369).

The width of the overpass items varies from 16-52 mm in Yabrud I-11/12 and from 17-45 mm in Yabrud I-15. The peak of the distribution pattern (Fig. 382) is at 36-40 mm in Yabrud I-11/12 and at 26-30 mm in Yabrud I-15. The mean width is 33.1 mm (s.d. 10.0) for Yabrud I-11/12 and 31.5 mm (s.d. 7.8) for Yabrud I-15.

The thickness of the overpass items ranges from 7-27 mm in Yabrud I-11/12 and from 8-22 mm in Yabrud I-15. The distribution pattern of overpass items from Yabrud I-11/12 shows a peak at 11-20 mm and that of Yabrud I-15 at 11-15 mm (Fig. 383). The mean thickness from Yabrud I-11/12 is 16.0 mm (s.d. 5.9) and from Yabrud I-15 is 14.0 mm (s.d. 3.6).

The distribution patterns of length/width ratio show a peak at 1.6-2.0, with overpass items from Yabrud I-11/12 having a slightly higher ratio than that of Yabrud I-15 (Fig. 384). The width/thickness ratio of overpass items (Fig. 385) is higher in Yabrud I-15, peaking at 2.1-2.5. In Yabrud I-11/12 it peaks at 1.6-2.0.

Hinge scars

Overpass items from Yabrud I-11/12 (n=14) and Yabrud I-15 (n=17) commonly bear hinge scars (64.3% and 64.7% respectively). The main difference between the layers is in their number. While in Yabrud I-11/12 one and two hinge scars are equally represented (each constituting 28.6%), in Yabrud I-15 one hinge scar constitutes 41.2% and the rest are poorly represented.

Changes in debitage surface length

The affect of the overpass items reduction on the length of the debitage surface (see methodological section; Pp: 51) is different in the examined layers (Fig. 386) with a statistical significance (X^2=7.36, df=2, $p<0.05$). While in Yabrud I-11/12 cases in which the debitage surface became longer are the most common (46.7%), in Yabrud I-15 cases without any major changes in the debitage surface length are dominant (72.%). In addition, in Yabrud I-15 cases in which the debitage surface became longer are extremely few with a statistical difference from Yabrud I-11/12 (X^2=7.53, df=1, $p<0.05$). These differences indicate that overpass items served a different role in the reduction sequence of each layer.

Remnants of core base modification

Remnants of core base modification are common and appear on 56.3% of the overpass items from Yabrud I-11/12 (n=16) and on 57.9% in Yabrud I-15 (n=19). They mostly appear in the form of flake removal in various directions (Yabrud I-11/12: 31.3%; Yabrud I-15: 36.8%). Modification that formed a sharp/pointed base appears on 12.5% of the overpass items from Yabrud I-11/12 and none on that from Yabrud I-15. Single blades or bladelets removal from the core base is found on 6.3% of the overpass items from Yabrud I-11/12 and on 21.1% of those from Yabrud I-15. In addition, blunting of the core base was observed on 6.3% of the overpass items from Yabrud I-11/12.

The presence of shaped ridges

Shaped ridges on overpass items constitute 18.8% in Yabrud I-11/12 and 21.1% in Yabrud I-15. The ridges are usually partial, concentrating along the middle of the item's length or near the distal end.

Summarizing the attribute analysis of the overpass items

The above examination of overpass items provides several insights concerning the characteristics of the cores and the reduction sequence/s applied at Yabrud I-11/12 and Yabrud I-15:

1. The presence of cortex on overpass items is relatively low and none have cortex on both lateral edges. This indicates that the debitage surfaces were not commonly framed by two cortical sides. The fact that overpass items 40 mm and up in width also lack this feature further supports this assumption. The paucity of cortex can be the result of three factors: (a) the debitage surfaces were relatively wide and the detached overpass items did not necessarily cause the removal of the cortical edge/s, (b) using split nodules led to a smaller portion of cortex on the core's exterior, and (c) cortex was partly removed before the laminar reduction was initiated. All of these factors probably had an affect on the overpass items from Yabrud I. It is of note that while the first factor relates to size, the latter two demonstrate preplanning in shaping the cores.
2. The commonly found traces of core modification on the distal end of overpass items indicate that the bases of cores were often modified. These modifications were generally simple, but more complex ones were also found, including (a) the removal of blades/bladelets from the base in an opposed direction to that of the main knapping, and (b) the narrowing of the base into a sharp/pointed form. The simple base modification and opposed blade/bladelet removal were probably conducted *ad hoc* in order to fix specific problems that occurred during the reduction and they were possibly complementary to the reduction of the overpass items. The narrowing of the core base into a sharp/pointed form demonstrates a more constant procedure that affected the core shape and probably remained fairly constant along the reduction.

3. The number of laminar scars on overpass items indicates that the debitage surfaces of the cores were frequently covered by a series of at least two laminar scars along the reduction of laminar items.
4. Overpass items were most commonly removed in the course of the laminar reduction and only one quarter or less of them were reduced while "opening" and shaping the core debitage surface.
5. Overpass items from Yabrud I-11/12 and Yabrud I-15 show some differences. Overpass items from Yabrud I-11/12 are longer and wider compared to those from Yabrud I-15, indicating the use of larger cores with wider debitage surfaces. It is interesting that while the debitage surfaces of cores from Yabrud I-15 were narrower than those of Yabrud I-11/12, they are characterized by a larger mean number of laminar scars. This indicates that the relatively wide debitage surfaces of Yabrud I-11/12 were more commonly used for a combined reduction of laminar items and flakes. Another difference is in the base modification. Narrowing the base into a sharp/pointed form was only observed on overpass items from Yabrud I-11/12 and blade/bladelet removal from the core's base was more common on overpass items from Yabrud I-15.

Crested Blades

<u>*The analyzed sample*</u>

Crested blades are the largest group of CTEs in Yabrud I-13 and Yabrud I-15 and the second largest group alongside overpass items in Yabrud I-11/12 (Table 34). They include 62 debitage CTEs and nine CTEs that were secondarily modified (the selection of crested blades for secondary modification is differently represented in the various layers, varying from 0.0% to 22.2 %; Table 35). Their division into sub-types is presented in Table 35 and only the *Faustkeilklingen* sub-type is described in detail since this unique crested blade which appears solely in Yabrud I was not described in the methodological section.

1. *Primary* (n=4; 0.0-8.7%). This sub-type is rare and found only in Yabrud I-15.
2. *Faustkeilklingen* (n=14; 0.0-28.3%; Fig. 313:3-5). These items highly resemble *tranchet* renewal spalls removed from handaxes (e.g. Inizan *et al*. 1992:72; Jöris

2006:299). Most are found in Yabrud I-15 and only one in Yabrud I-13. Their presence in Yabrud I-15 is statistically different than in Yabrud I-11/12 (X^2=5.72, df=1, $p<0.05$). They are recorded as crested blades since they are assumed to represent the recycling of handaxes into cores – a suggestion already made by Rust (1950:28-29) and accepted here. The complete absence of handaxes in Yabrud I-15 where *Faustkeilklingen* are abundant, and their absence in Yabrud I-11/12 where handaxes are found, supports the idea that they are not related to handaxe maintenance but rather to recycling. They are characterized by a well shaped bifacial ridge that runs all along the item's length. The flaking is scaled and includes scars that deeply penetrate the item's mass, as expected from thinning flake removals that characterized bifacials. One of the lateral edges of these items has an angle of ca. 100°, while the other is sharp. None of them is characterized by old patinated surfaces. Cortex is rare on these items, appearing in only two cases.

3. *Rough* (n=13; 0.0-31.3%; Fig. 313:2). These are found only in Yabrud I-11/12 and Yabrud I-15 and are especially common in the former. Many of them bear extensive cortical surfaces.
4. *Patinated* (n=6; 4.3-18.8%). These appear in all layers, constituting the largest percentage in Yabrud I-11/12. In five of these crested blades the patinated shaped ridge was slightly modified as apparent by small flaking that overlies it.
5. *Second-primary* (n=2; 0.0-4.3%). The two crested blades of this sub-type are covered by extensive cortical surfaces constituting 40-50% of the dorsal face. Both items are from Yabrud I-15.
6. *Unifacial* (n=6; 4.3-22.2%). Although in the methodological section several options for their place in the reduction sequence were suggested, their small number does not enable reaching any conclusions.
7. *Rejuvenation* (n=26; 32.6-55.6%). This crested blade sub-type is the most common in all the examined layers. Many of their morphological characteristics are highly similar to those of blades.

Only three secondary crested blades (of which the proximal part of the shaped ridge had already been removed) were found. Two of these were included in the patinated sub-type (one from Yabrud I-11/12 and one from Yabrud I-13) and one (Yabrud I-11/12) in the rough sub-type. Rust (1950:29; Tafeln 34:8, 36:1, 5) noted the presence of 13 items similar to the *Faustkeilklingen* sub-type that bear the same cross-section and do not have a shaped ridge, but only partial scars (Fig. 308:5). He accordingly argued that these items were reduced "secondarily" or even "thirdly" from handaxes. Although I agree with this observation, these items do not fall under the 'secondary crested blades' as it is used here and they were mostly recorded as blades.

Dividing the various sub-types into the three categories ('initial' [including primary, *Faustkeilklingen*, rough, patinated and second-primary], unifacial and rejuvenation) (Fig. 387) shows a different pattern in the examined layers. While 'initial' crested blades constitute the largest category in Yabrud I-11/12 (50.0%) and Yabrud I-15 (63.0%), rejuvenation crested blades constitute the largest category in Yabrud I-13.

The attribute analysis will address crested blades from each layer separately due to the results of the laminar items that demonstrated differences among the layers. Yabrud I-11/12 and Yabrud I-15 will be the focus of this analysis. Although crested blades from Yabrud I-13 are represented in the attached figures, they will not be discussed in the text due to their small numbers.

Intensity of the shaped ridges

The intensity of the shaped ridge demonstrates a rather similar pattern in Yabrud I-11/12 (n=10) and Yabrud I-15 (n=37) with cases where it is spread along the entire length are the most common constituting 40.0% in Yabrud I-11/12 and 40.5% in Yabrud I-15. In the other cases of Yabrud I-15 it spreads along half the item's length (24.3%), along a quarter of its length (21.6%) or along only a minute amount of its length ('touch') (13.5%).

Location of the shaped ridge along the length of the item

Crested blades on which the shaped ridges run along the entire item's length or along the distal end are the most common, both in Yabrud I-11/12 and in Yabrud I-15 (Fig. 388). Examining the 'initial' and rejuvenation crested blades from Yabrud I-15 (Fig.

388) indicates that shaped ridges on 'initial' crested blades tend to be extensive, while on rejuvenation crested blades they tend to be at the distal end.

__Location of the shaped ridge along the width of the item__

The location of the shaped ridge along the items' width is statistically different in Yabrud I-11/12 and Yabrud I-15 (X^2=13.42, df=3, p<0.05). While in both Yabrud I-11/12 (n=15) and Yabrud I-15 (n=46) the ridge is symmetrically placed in the middle of the item in a third of the cases (33.3% and 28.3% respectively), in the other cases it shows a clear proclivity towards different sides. In Yabrud I-11/12 20.0% favor the left while 46.7% favor the right. In Yabrud I-15 52.2% favor the left, while only 8.7% favor the right. It is of note that all 13 *Faustkeilklingen* crested blades from Yabrud I-15 tend to the left (Fig. 313:3-5). In Yabrud I-15 an additional 10.9% are irregularly placed.

__Crest profiles__

The profiles of the shaped ridge on the dorsal face of crested blades from Yabrud I-15 are mostly curved (Fig. 389) demonstrating an effort in planning and making the crested blades. The profiles of the shaped ridges from Yabrud I-11/12 lack a clear character.

__Butt types__

The crested blade butts from Yabrud I-11/12 and Yabrud I-15 are farily similar, mainly including thick plain and modified types (Fig. 390). It is of note that the percentage of modified butts on crested blades is smaller than on blades, both in Yabrud I-11/12 and in Yabrud I-15 (Fig. 362). Micro flaking along the exterior of the butts appears in 10.0% of the cases from Yabrud I-11/12 (n=10) and in 21.6% of the cases from Yabrud I-15 (n=37).

__Metrics__

The length of crested blades from Yabrud I-11/12 (n=10) is 36-83 mm and that of Yabrud I-15 (n=36) is 28-85 mm with no clear distribution pattern. The mean length of crested blades from Yabrud I-15 is 57.9 mm (s.d. 15.3) and from Yabrud I-11/12 it is 56.6 mm (s.d. 16.8). Examining the 'initial' (n=22) and rejuvenation (n=11) crested blades from Yabrud I-15 shows a mean length of 62.4 mm (s.d. 13.0) for the 'initial' and of 51.8 mm (s.d. 15.7) for the rejuvenation. Although this difference which is statistically significant (t[31]=2.06, p<0.05) might indicate that the length of cores from Yabrud I-15 gradually decreased along the course of the laminar reduction, it should be remember that there is no indication that the reduction of crested blades caused the removal of the entire length of the debitage surface.

The width of the crested blades is 15-39 mm in Yabrud I-11/12 and 12-37 mm in Yabrud I-15. The distribution of width shows clear peaks at 16-20 mm in both cases (Fig. 391). The mean width in Yabrud I-11/12 is 25.6 mm (s.d. 8.6) and in Yabrud I-15 is 22.8 mm (s.d. 8.0). Examining ‘initial’ (n=22) and rejuvenation (n=11) crested blades from Yabrud I-15 showed a mean width of 24.0 mm (s.d. 8.6) for the ‘initial’ and of 21.2 mm (s.d. 6.4) for the rejuvenation. The difference between the two latter indicates that rejuvenation crested blades led to the removal of a smaller mass from the cores than did the ‘initial’, probably indicating a precise removal of a specific point.

The thickness of the crested blades (Fig. 392) from Yabrud I-11/12 is 6-18 mm and from Yabrud I-15 is 5-20 mm. The distribution pattern of the thickness shows that those from Yabrud I-11/12 tend to be thicker. While the peak of those from Yabrud I-15 at on 6-10 mm that of Yabrud I-11/12 is at 11-15 mm. This observation is reflected in the mean thickness as well (Yabrud I-11/12: 12.6 mm [s.d. 4.2]; Yabrud I-15: 10.4 mm [s.d. 3.9]). The mean thickness of ‘initial’ (n=24) and rejuvenation crested blades (n=11) from Yabrud I-15 is 11.3 mm (s.d. 4.1) and 8.9 mm (s.d. 3.0) respectively. This further supports the notion that rejuvenation crested blades led to the removal of a smaller and more precise portion of the cores than did ‘initial’ crested blades.

Summarizing the attribute analysis of the crested blades

The results of the crested blade analysis revealed several aspects regarding the reduction sequence/s applied in the examined layers from Yabrud I.

1. Some of the crested blades indicate the occasional recycling of "old" knapped flint items. This is concluded from the patinated crested blade sub-type as well as from the *Faustkeilklingen* sub-type in Yabrud I-15 originating from recycled handaxes. The latter demonstrates a systematic procedure as attested to by their relatively large number.
2. Crested blades in Yabrud I-11/12 and Yabrud I-15 were more commonly used for "opening" the debitage surface than for maintaining it while reducing laminar

items. This is indicated by the dominance of 'initial' crested blades in these layers. The rejuvenation sub-type forms only a third of the crested blades in these layers.

3. Simplicity in using crested blades is reflected in the rough crested blades characterized by irregular shaping, but more importantly by the patinated and *Faustkeilklingen* sub-types where the selection of a former existing outline was the main key.
4. The different sub-types of 'initial' crested blades present a variety of options for initiating the reduction and demonstrate that although the shaping of crested blades was simple their use was sophisticated.
5. The propensity of the ridges to be near one of the lateral edges and not necessarily in the middle does not seem to be accidental. This is indicated by a tendency towards one side in Yabrud I-11/12 and towards the other in Yabrud I-15. This is further indicated by the fact that all 13 items of the *Faustkeilklingen* sub-type tend to the left. The affect of this procedure on the reduction sequence will be reviewed below.
6. The crested blades were slightly more carefully made in Yabrud I-15 than in Yabrud I-11/12. This is indicated by a more homogeneous profile of the ridge on the dorsal face, a greater appearance of micro flaking on the butts and a smaller width and thickness. The two latter measurements indicate a more precise removal of mass from the core while detaching crested blades.
7. The crested blades from Yabrud I-11/12 and Yabrud I-15 are different not only in the division into sub-types but also in metrics, as well as in the tendency to specific sides. This is indicative of a slightly different use of crested blades, probably reflecting differences in the reduction sequence as a whole.

Radial Overpass Items and CTE-Varia

Radial overpass items are not common in the examined layers from Yabrud I (Table 34). The 12 items retrieved include eight debitage CTEs and four items that were secondarily modified. They constitute 8.1% in Yabrud I-11/12, 5.2% in Yabrud I-15 and in Yabrud I-13 they are entirely absent. They are the products of a radial flake reduction, probably aimed at the reduction of large and wide flakes. The percentage of radial overpass items is in accordance with Rust's (1950:37) observation that disocidal cores were common in Yabrud I-12

CTE-varia include 58 items (Table 34), 53 of which are debitage and five of which were secondarily modified. They are more common in Yabrud I-11/12 than in Yabrud I-13 ($X^2=5.97$, df=1, $p<0.05$) or Yabrud I-15 ($X^2=6.58$, df=1, $p<0.05$) with a statistically significant difference. Their percentage out of the CTEs is 45.3% in Yabrud I-11/12, 9.1% in Yabrud I-13 and 18.6% in Yabrud I-15.

A General Assessment of the CTEs

The retrieved CTEs originated from all reduction strategies conducted at the site and not only from the laminar production. The ones that are clearly related to the laminar production are the overpass items and crested blades. The high percentage of crested blades in the Pre-Aurignacian of Yabrud I-13 and Yabrud I-15 as opposed to their low percentage in the Acheulian facies of Yabrud I-11/12 is not surprising. Most core tablets probably originated from the laminar production as well, although some might have been reduced from flake cores. The CTE-varia mainly originated from flake production and only a small portion may be related to the laminar production. The fact that CTE-varia are more common in Yabrud I-11/12 correlates with its more intense flake production. Radial overpass items not only correlate with flake production, but also to a specific trajectory characterized by a radial reduction. These too are more common in Yabrud I-11/12.

Analysis of the Laminar Core Class

The laminar core class includes 38 items in Yabrud I-15, ten items in Yabrud I-11/12 and only two items in Yabrud I-13. The percentage of the laminar core class out of the total number of cores (Table 36) is 45.8% in Yabrud I-15 and 13.2% in Yabrud I-11/12. The difference between the two is statistically significant ($X^2=20.04$, df=1, $p<0.05$). Layer 13 is excluded from the following analyses since it has only three cores. The division of the laminar core class into types is presented in Table 36. The cores from the examined layers were not grouped into one sample due to the differences observed between the layers. The attribute analysis includes only the 'single striking platform laminar cores' and the 'single striking platform laminar and flake cores' from Yabrud I-15. Other core types within the laminar core class of Yabrud I-15 will be described in qualitative terms as will the cores from Yabrud I-11/12.

'Single Striking Platform Laminar Cores' – Yabrud I-15

Yabrud I-15 includes 14 'single striking platform laminar cores'. Two of these cores are damaged and therefore only limited data was retrieved from them. In the attribute description the number of examined cores will be stated only when it is smaller than 14.

Core shapes

These cores are divided into the following shapes: 'amorphous front' (n=3; 21.4%), 'parallel edges' (n=3; 21.4%) and prismatic (n=8; 57.1%; Fig. 314:1). Since the prismatic shape cores are the most common, their precise character will be described separately.

Raw material

Although identifying the used raw material shapes is difficult due to the intensive utilization of cores that characterized the Yabrud I material, some notes can be made. More than half (n=8; 57.2%) were shaped on rounded or amorphous nodules or parts of nodules. Three cores were shaped on flakes and in three cases they were unidentifiable. The absence of flat flint slabs or flat nodules for the shaping of this core type is of note. In the case of the prismatic shape cores, seven of the eight were shaped on rounded or amorphous nodules.

Cortex

Cortex is present on 92.3% of the cores (n=13) usually constituting only a small portion of the cores' surfaces (Fig. 393). One of these cores bears an old patinated surface, covering some 10% of the core's exterior. Only among 21.4% of these cores, cortex covers the entire surface of the core except for the debitage surface and striking platform. Among 35.7% cortex is spread along the core's back, sometimes extending towards the core base. Among 28.6% of these cores cortex covers only the right side and among 14.3% cortex is entirely lacking. The presence of cortex is slightly more common when the prismatic shape cores are examined separately ranging from 20%-60% of their outer surface; on three cores it covers the entire surface except for the debitage surface and striking platform.

The small cortex cover on these cores does not indicate pre-peeling of cortex before reduction, but more likely the exhaustion of cores and the occasional use of parts of nodules. In such a case, cortex would have been present on a limited portion of the core's exterior even before the reduction began and with no association to pre-peeling of cortex. The potential for removing cortical laminar items from the cores in their discarded state (n=13) is not high. While among 46.2% of the cores it seems that cortical laminar items were reduced until the end of the reduction, with another 46.2% the potential for reducing cortical laminar items diminished long before the cores were abandoned. Among the remaining 7.6% no evidence of the removal of cortical laminar items at any stage of the reduction was found.

Striking platforms

The striking platforms of these cores were most frequently shaped by forming a flat surface by a single removal (42.9%). Faceting appears on 28.6% of these cores and a combination of a flat surface with faceting appears on 28.6%. Micro flaking of the edge of the striking platform appears on 50.0% of these cores, and is equally represented among cores with faceting or a flat scar surface.

Debitage surface shapes

The shape of the core's debitage surface (n=13) is often either rectangular (30.8%) or U-shaped (30.8%). Triangular (23.1%) and irregular (15.4%) debitage surface shapes are less common. Out of the eight prismatic cores, rectangular (n=3) and U-shaped (n=3) debitage surfaces are most common.

Core bases

The bases of these cores (n=13) are most commonly rounded (38.5%) or pointed (30.8%) in shape. Other base shapes include flat (23.1%) and irregular (7.7%). Cores with a prismatic shape are characterized by wide bases.

Modification surfaces

Modification surfaces were found on 71.4% of these cores, almost all of them at the base. They include blunting the base's sharp edges (7.1%), flake removal in various directions (42.8%) and a more organized flaking that created a sharp/pointed base (21.4%). One of the cores with a simple base modification also has a modification surface along the back. In the case of the prismatic cores, modification surfaces appear on five of the eight specimens.

Metrics

The cores maximum length varies from 29 to 68 mm and the peak of the distribution patterns is at 46-50 mm (Fig. 394). The debitage surface length is only slightly lower, as is best reflected by the fact that the mean maximum length is 48.7 mm (s.d. 10.0) and the mean debitage surface length is 44.1 mm (s.d. 7.5). The width of these cores is 23-45 mm, with most measuring between 23-35 mm (Fig. 395). On all these cores the debitage surface spanned the entire width of the core (i.e. maximum width equals debitage surface width). The mean width is 30.8 mm (s.d. 7.4). The thickness of these cores is 11-42 mm, with most measuring between 11-35 mm (Fig. 396). The mean thickness is 25.5 mm (s.d. 7.4). The mean dimensions of the prismatic cores are 46.3 mm (s.d. 11.5) long, 34.5 mm (s.d. 6.9) wide and 23.1 mm (s.d. 10.7) thick.

The metrics indicate the intensive use of cores as attested to by the fact that the mean maximum length is much smaller than that of the laminar items from the same layer (48.7 mm [s.d. 10.0] vs. 59.3 mm [s.d. 12.8]). It seems that when cores reached this length they were no longer considered useful for laminar production. The thickness of these cores also indicates that only a small mass of flint was left, insufficient for removing another series of laminar items.

Number of laminar scars

While the total number of laminar scars on the debitage surfaces of these cores ranges from two to nine (Fig. 397), the number of parallel laminar scars ranges from two to four. The mean of the former is 3.8 (s.d. 2.2) and of the latter 2.9 (s.d. 0.8). The difference between the two indicates that many of the reduced laminar items did not follow through the entire length of the debitage surface and thus left multiple laminar scars. The fact that the most common number of parallel laminar scars on the debitage surface is three also explains the low percentage of items with cortex. This is resultant of a portion of the laminar items having been reduced from the center of these cores and having had no contact with their sides.

Number of hinge and overpass scars

Hinge scars are found on 51.7% of the cores' debitage surfaces. These cases include cores with one (21.4%), two (14.3%) or three (21.4%) hinge scars. Overpass scars are found on 50.0% of these cores. On 28.6% of these cores there is only one overpass scar and on 21.4% there are two overpass scars.

Assumed reasons for discard

Half of the cores were abandoned due to exhaustion. It is noteworthy that most of the other cores were near exhaustion when abandoned as well. This may explain why among cores with an identified discard reason of hinge fractures (35.7%) or striking platform deformation (7.1%) no attempt was made to correct these flaws. Another identified reason for discard is raw material problems (7.1%).

Summarizing the attribute analysis of the 'single striking platform laminar cores'

The 14 cores of this type provide only a general picture due to the small sample. The paucity of 'parallel edges' shape cores is important and is an indication that the shapes of the 'single striking platform laminar cores' from Yabrud I-15 were highly dynamic during the reduction.

The used nodules were mostly rounded or amorphous in shape, some with partially straight edges. It seems however that some cores were shaped on nodule parts and thus the percentage of cortex on their exterior was limited even before the reduction. The small cortical surfaces on the cores decrease the potential for removing PE blades and NBKs and increase the potential for removing blades. Control of the core shapes is best indicated by the fact that a third of the cores have a sharp/pointed base and that 71.1% of the cores have a modified base. The debitage surface of these cores is usually wide and in a rectangular or U-shape. Many laminar scars cover the debitage surface and the relatively large difference between the total number of laminar scars and parallel laminar scars indicates that the reduction was not usually performed by follow-through blows but by more delicate blows.

The prismatic cores which are the most common call for a separate description. These were mostly made on rounded or amorphous shape nodules. The shape of their debitage surface is generally rectangular or U-shaped and their bases are wide. A simple base modification surface appears on many of them. Their mean dimensions are 46.3 mm (s.d. 11.5) long, 34.5 mm (s.d. 6.9) and 23.1 mm (s.d. 10.7) thick. The mean number of total laminar scars on them is 3.9 (s.d. 1.6). They were most commonly discarded due to exhaustion.

'Two Striking Platforms Laminar Cores'– Yabrud I-15

The single core of this type was shaped on a flat nodule and has two debitage surfaces at 90º to each other (Fig. 316:1). Both debitage surfaces are framed by the same two cortical sides. The striking platform of the older debitage surface was removed by the later debitage surface overlying it. The striking platform of the latter was shaped by core tablet removal. The reason for abandoning the older debitage surface is not clear. The core was slightly narrowed by the removal of flakes and its size is 55x32x75 mm.

'Single Striking Platform Laminar and Flake Cores' – Yabrud I-15

The 21 cores of this type appear in the following shapes: prismatic (n=10; 47.6%; Fig. 314:2-3), 'narrowed prismatic' (n=10; 47.6%; Fig. 315) and 'amorphous front' (n=1; 4.8%). The following attribute analysis will address these cores in two manners; (1) describing them as a single group and (2) describing the cores with the prismatic and 'narrowed prismatic' shapes separately.

Raw material

The most common raw materials used for this type are round or amorphous nodules, whole or split (71.4%). The other raw materials include a flake in a single case (4.8%) and unidentified cases (23.8%).

Cortex

Cortex appears on 85.7% of these cores, with no clear pattern of the percentage of cover (Fig. 393). Cores with the entire exterior surface covered by cortex, excluding the debitage surface and striking platform, constitute 19.0%. In the other cases cortex appears on the back (14.3%), on the right side (28.5%) or left side (23.8). The described configurations of cortex are very different among the cores with the prismatic and ‘narrowed prismatic' shapes. While cases with the entire exterior covered by cortex are common among the prismatic shape cores (40%), they are absent among the 'narrowed prismatic' cores. A difference also exists in cases where cortex appears on only one side. While the five relevant specimens of the prismatic shape cores all bear cortex on the right side, of the six relevant specimen of the 'narrowed prismatic' shape cores, five bear cortex on the left side and only one on the right. Cores with no cortex at all are found only among the 'narrowed prismatic' shape cores.

Striking platforms

The striking platforms of these cores most commonly appear as a flat scar (52.4%). Faceting appears on 23.8% of the cores, a combination of a flat scar and faceting on 14.3% and the use of an old scar as a striking platform on 9.5% of these cores. Micro flaking of the edge of the striking platform appears on 57.1% of these cores. It is less common on cores with faceting or a combination of faceting and a flat scar than on the others. No major differences were observed among the different core shapes.

Debitage surface shapes

The debitage surfaces of this core type (n=20) are dominated by a U shaped (55.0%). Rectangular (20.0%) and triangular (25.0%) shapes also appear. The major difference between the prismatic and 'narrowed prismatic' shape cores is that triangular debitage surfaces are only present in the latter, constituting half of them.

Core bases

The bases of these cores are either flat (23.8%), oblique (14.3%), pointed (38.1%), rounded (19.0%) or irregular (4.8%). The main difference between the two discussed core shapes is that sharp/pointed bases are found only among the 'narrowed prismatic', constituting eight of the ten cores of this type. The prismatic cores on the other hand, are characterized by wide bases.

Modification surfaces

Modification surfaces appear on 65% of these cores (n=20), often on the base (50%). Core base modification is most commonly represented by its narrowing into a sharp/pointed form (30%). One of the cores with a narrowed base modification also shows back modification. An additional 15% of the base modifications are simple and composed of several flake removals from different directions (among these specific cores, the base modification was also accompanied by a back modification). The last core (5%) shows blunting at the base. It is of note that one of the cores with a narrowed base modification also bears a hinge modification surface.

The difference between the two aforementioned core shapes is that among the ‘narrowed prismatic’ shape cores, base modification forms an integral part (nine out of ten), while among the prismatic shape cores they are less common (four out of nine). In addition, cores with a narrowed base modification are all of the ‘narrowed prismatic’ shape.

Metrics

The distribution patterns of the maximum length show a peak at 46-50 mm (Fig. 394). The debitage surface length is very similar to the maximum length, indicating that the core’s mass was generally well utilized. The mean maximum length is 47.3 mm (s.d. 10.1) and that of the debitage surface is 46.6 mm (s.d. 9.9). The maximum width of these cores is 17-53 mm and its distribution pattern shows a peak at 26-30 mm (Fig. 395). No major differences were observed between the maximum width and debitage surface width as demonstrated by the means (max. width: 33.5 mm [s.d. 9.0]; debitage surface width: 32.1 mm [s.d. 8.6]). The few cases in which the debitage surface is slightly smaller than the maximum width are all of the prismatic shape cores. The thickness of the cores is 16-71 mm, with most between 16-20 mm (Fig. 396). The mean thickness is 33.9 mm (s.d. 15.8).

Number of laminar scars

The total number of laminar scars on this core type ranges from one to six, with three scars being the most common (Fig. 397). The number of parallel laminar scars is smaller, as best witnessed by the means (total of laminar scars: 3.1 [s.d. 1.4]; parallel laminar scars: 2.6 [s.d. 0.7]). In this aspect the difference among the two discussed core shapes is small.

The laminar scars on the debitage surfaces of these cores are mixed with flake scars in different compositions. In the prismatic shape cores the laminar scars are usually near one of the lateral edges constituting about a third of the debitage surface while the rest is covered by flake scars. In the 'narrowed prismatic' shape cores the laminar scars are on the narrowed front and the flake scars on the side/s.

Number of hinges and overpass scars

Hinge scars are common on the debitage surfaces of these cores and appear on 76.2% of them. One or two hinge scars are the most common (each constituting 28.6%). Three or four hinge scars are less common (14.3% and 4.8% respectively). No major differences were observed among the core shapes.

Overpass scars appear on 76.2% of the debitage surfaces of this core type. One overpass scar is the most common (47.6%), while two or three overpass scars are less so (23.8% and 4.8% respectively). The core shapes show a difference in this aspect. While they appear on all of the prismatic cores, they appear on only half of the 'narrowed prismatic'. In both cases, they are mostly represented by a single overpass scar.

Overpass reduction seems to have had a unique character in the 'narrowed prismatic' cores. With these cores the reduction of flakes from the sides was commonly preformed as an overpassing. This procedure resulted in the creation of a sharp/pointed base (Fig. 315:3).

Assumed reasons for discard

Most cores were discarded due to exhaustion (61.9%). The other reasons of discard are hinge scars (19.0%) and raw material problems (9.6%). Among an additional 9.5% the reason for discard was not detected. The key difference between the prismatic and 'narrowed prismatic' core shapes is not in different percentages of reasons for discard but in the character of the exhausted cores. While among the 'narrowed prismatic' the debitage surface usually became too small for further laminar reduction, among the prismatic the cores' the thickness was diminished to a small size impractical for further reduction.

Summarizing the attribute analysis of ‘single striking platform laminar and flake cores’

The 21 cores of this type are represented by two shapes – prismatic and 'narrowed prismatic'. Only one core has a different shape and it is the 'amorphous front'. Since the prismatic and 'narrowed prismatic' demonstrate a clear difference I will summarize each of them separately.

Prismatic ('single striking platform laminar and flake cores')

The cores of this shape were mostly made on rounded or amorphous shape nodules. Many have cortex covering 10% to 50 % of their surface, with 50% cover being the most common. In almost half of them the cortex covers the entire core exterior except for the debitage surface and striking platform. The striking platform was made by forming a flat scar in half of them. The debitage surface is in either a rectangular or U-shape and the base is wide. Modification surfaces appear on four of these ten cores and they are mostly on the base or back. Overpassing scars are found on all of these cores. Their mean dimensions are 51.4 mm (s.d. 10.8) long, 41.0 mm (s.d. 6.1) wide and 21.6 mm (s.d. 5.4) thick. The debitage surface consists of both flake and laminar scars, with the latter usually located near one of the lateral edges. The mean number of laminar scars on the debitage surface is 3.1 (s.d. 1.6). These cores were usually discarded due to exhaustion.

'Narrowed prismatic' ('single striking platform laminar and flake cores')

The used raw material includes rounded or amorphous nodules, however with half of these cores the raw material was not identified. Cortex is present on seven of the ten cores, spreading over, up to 30% of the cores' exterior. The limited cortical surfaces commonly cover one side of the core. The striking platform was shaped by forming a flat scar among half of them. Regardless of the shape of the debitage surface, which is mostly triangular, the core base is sharp and pointed from a frontal view. Modification surfaces are an integral feature of these cores and they usually contributed to thinning the base. Overpass scars are found on half of these cores. Their mean dimensions are 44.6 mm (s.d. 7.6) long, 26.3 mm (s.d. 4.7) wide and 47.4 mm (s.d. 11.8) thick. The debitage surface of these cores includes both flake and laminar scars with the laminar scars on the narrow part and the flake scars on one or two of the lateral edges. The flake scars on the sides occasionally ended with an overpassing end termination thus contributing to making the core base narrow and sharp. The mean of the total number of laminar scars on these cores is 3.3 (s.d. 1.2). The cores were mostly abandoned due to exhaustion as reflected by their relatively short length. These cores demonstrate sophistication in controlling core shape and focusing on the production of specific end products. This is reflected in the reduction of flakes from the core sides which fashioned a narrow area for laminar reduction and in the narrowing of the core base into a sharp/pointed form. While among some cores the flake scars along the sides are clearly mixed with the laminar scars from the core's front and seem to indicate that their removal was fairly simultaneous, in other cases it is not so clear. In the latter cases there is a possibility that the flake removal from the core sides was actually part of pre-shaping the core. The same ambiguity regards the narrowing of the base; while in some cases it seems to be conducted during the reduction, in others it might have been part of a pre-shaping stage.

'Two Striking Platform Laminar and Flake Cores' – Yabrud I-15

Only two cores of this type were found. The first has one striking platform for laminar production and one striking platform for flake production (Fig. 316:2). The two debitage surfaces are located at different faces of the core and the two striking platforms are perpendicular to each other. It bears cortex on one of the sides and its size is 46x47x20 mm. The possibility that the striking platform used for flake production is actually a modification surface shaping the core's back was rejected since the scars are intrusive and large and are not any different than scars on flake cores.

The second core has one striking platform for laminar and flake production and another striking platform for flake production. The orientations of the debitage surfaces and striking platforms are the same as in the previous core. This core lacks any cortex and it size is 47x39x20 mm.

The Laminar Core Class from Yabrud I-13

Only two cores of the laminar core class were identified in this layer. The first has two striking platforms, both for laminar production. Although the striking platforms are opposed, the debitage surfaces are parallel and not overlapping. The striking platforms were shaped by forming a flat scar. While one of the debitage surfaces seems to have been well used, the other seems to have been an unsuccessful attempt from which only two small blades (up to 40 mm) were detached. The core bears no cortex and its size is 55x23x20 mm. It was discarded due its short length and hinge scars.

The second core has two striking platforms – one for laminar production, concentrating on the narrow part and one for flake production. The striking platform used for flake reduction is at the base. This raises the possibility that the flake reduction was originally used as base modification from which the core base was narrowed. Old patinated surfaces cover 30% of the core exterior. The striking platform of the laminar production is faceted and the one for flake production is shaped by a single flake removal. Its size from the laminar production perspective is 55x27x30 mm, but it is of note that the debitage surface is much shorter (42 mm). The assumed discard reason is exhaustion as reflected in the small length.

The Laminar Core Class from Yabrud I-11/12

The laminar core class from Yabrud I-11/12 consists of ten cores of various types (Table 36). Only three 'single striking platform laminar cores', each with a different shape were found. The 'amorphous front' shape core is 45x35x20 mm in size, the 'parallel edges' shape core is 37x24x25 mm and the prismatic shape core is 76x50x51 mm. They bear 20%-70% of cortex on their surface, with the 'amorphous front' and prismatic shape cores entirely covered except for the debitage surface and striking platform. A modification surface was noticed only in the 'parallel edges' shape core. While the discard reason of the prismatic shape core was not identified, the two others were discarded due to exhaustion.

Four of the five 'single striking platform laminar and flake cores’ have a prismatic shape. They are 41-48 mm long, 28-48 mm wide and 15-20 mm thick. The single core of this type with a 'narrowed prismatic' shape is 43x29x45 mm in size. Cortex covers 0%-50% of the outer surface of these cores and in two cases it covers the entire surface except the debitage surface and striking platform. Modification surfaces appear on four of them and all were abandoned due to exhaustion.

'Two striking platforms laminar and flake cores’ include two items. In both cases one striking platform was used for a combined reduction of laminar items and flakes while the second striking platform was used for flakes only. Cortex covers 20%-30% of their outer surfaces. Their size is 52x40x15 mm and 75x64x19 mm. Both were discarded due to core exhaustion.

A Summary of the Laminar Core Class

The previous discussion focused on cores from Yabrud I-15 solely due to the small sample of the laminar core class in the other layers. For this same reason, the comparison between the layers is limited. It is of note that in Yabrud I-11/12 no major differences were noticed in the types of cores and almost all the core shapes and types found in Yabrud I-15 are present.

The analysis of the laminar cores class indicates that two shapes dominate the single striking platform cores from Yabrud I-15 – prismatic and 'narrowed prismatic'. The prismatic shape cores appear both as 'laminar cores' and 'laminar and flake' cores. Cores with 'amorphous front' and 'parallel edges' shapes are not well represented. In this section I will attempt to evaluate whether the different core shapes and types represent a single concept of reduction or distinct trajectories that were predetermined. For this purpose I will review all the 35 items of the laminar core class that have a single striking platform in Yabrud I-15.

The first aspect refers to the effect of the used raw material on this variability. The most common used raw materials were rounded or amorphous nodules (n=23). The fact that the core's cortical surfaces are usually not extensive indicates that the raw material was often large and that the cores represent only a small portion of it. While some of these cores were made on a single nodule that was heavily reduced and thus lost its cortex, others were made on split nodules. However in addition to these cases, some cores bear rather extensive cortical surfaces that cover their entire exterior except for the debitage surface and striking platform. The latter were probably made on slightly smaller, fist size nodules. The four cores made on flakes and the eight cores of which the raw material was not identified support the notion that splitting large nodules was common.

I conjecture that the raw material shapes had an affect on the reduction or at least on the way it was initiated (Fig. 398). The clearest case is in the flakes, three of which were transformed into cores with a ‘parallel edges’ shape. In these cores the debitage surface was on one of the flakes' narrow parts in such a manner that it was framed by the fairly parallel dorsal and ventral faces. Due to this configuration the debitage surface receded backwards during the reduction while retaining a similar shape. The possibility of using flat nodules for reaching the same results can be exemplified by the laminar core with two striking platforms that is not discussed here (Fig. 316:1).

When using rounded or amorphous raw material the reduction of the cores could have started out by having an ‘amorphous front’ or prismatic shape, whereby the products could have been laminar items or a combination of laminar items and flakes. Although the cores started out with a specific shape, it is not obligatory that the same shape remained all along the reduction sequence. Various possible changes are suggested in the schematic flowchart (Fig. 398). Here I wish to elaborate on a few cases. The possibility that a core with an ‘amorphous front’ shape will be transformed into a prismatic or ‘narrowed prismatic’ shape is high. In contrast, the possibility that any kind of shape will be transformed into an ‘amorphous front’ shape is low. This is resultant of the limited part used for the debitage surface in the ‘amorphous front’ shape cores having gradually become wider during the reduction – i.e. it became less characterized by an accentuated limited debitage surface. In addition, the reduction usually makes the core shape more regular by removing the irregular parts from it. It is of note that the items removed from the debitage surface can change from solely laminar items to laminar items and flakes and vice versa. This could have taken place while retaining the same shape or by changing it.

The exploitation of raw material with a width of approximately three cm enabled a serial and systematic production of laminar items with only a few flakes (i.e. ‘laminar cores’). On the other hand, in exploiting relatively wide raw material, the reduction of laminar items and flakes was more likely to have occurred since the combination of the two enabled better control over the production. In terms of the shapes, the two main possibilities were prismatic and 'narrowed prismatic'; both of these could have begun with the ‘amorphous front’ shape. With the prismatic shape cores, flakes and laminar items were reduced from a fairly flat surface, from which the laminar items were commonly detached near one of the lateral edges (Fig. 315:2-3). With the 'narrowed prismatic' cores, flakes and laminar items were reduced from an angular surface whereby the flakes were removed from the sides and the laminar items from the narrow part which was accentuated by the flake removals (Fig. 315). Although there is a hypothetical possibility that the removal of flakes from the sides was made in the pre-shaping of the core and that these cores were actually of the 'parallel edges' shape (i.e. "Upper Paleolithic style"), there is no data supporting this idea. Choosing whether to reduce cores of a prismatic shape or a 'narrowed prismatic' shape had an affect on the potential for removing cortical laminar items. A review of the discarded cores of the 'laminar and flake' type shows that in eight of the ten prismatic shape cores the potential for removing cortical laminar items remained until the end. In contrast, only three of the ten 'narrowed prismatic' shape cores retained the same potential. In other words, while the prismatic cores increased the potential for removing cortical laminar items (since among these cores the laminar items tend to be removed near the sides), the 'narrowed prismatic' cores increased the potential for removing non-cortical blades.

The shapes of the discarded cores represent the final stage of the production dynamics. The paucity of cores with an 'amorphous front' shape indicates that this shape mostly represents the initial stages of the reduction and is likely to change as the reduction continues. The paucity of 'parallel edges' shape cores, assumed to generally remain in their original shape, indicates that this shape was not commonly used in Yabrud I-15. Prismatic on the other hand, is the most commonly discarded shape, including 18 cases out of a total of 35 cores. In many of them the core thickness is small indicating that these cores were utilized to exhaustion. It is interesting that the size of the prismatic shape cores (of the laminar and flake type) is similar to that of the 'narrowed prismatic' shape cores only with alternating width with thickness. The mean dimensions of the prismatic cores are 51.4x41.0x21.6 mm and of the 'narrowed prismatic' cores are 44.6x26.3x47.4 mm.

The 'two striking platform laminar core' from Yabrud I-15 demonstrates another possibility in the dynamic of core reduction. With this core the used debitage surface was rejected in favor of "opening" a new one at a different location which might have had better potential for removing the desired end-products.

A Comparison of the Results to Previous Studies

The results of my study on the lithics from Yabrud I-13 and Yabrud I-15 are slightly different compared to Rust (1950) and Vishnyatsky (2000). The main reason for the difference is probably the different methods used. For example, nor Rust, nor Vishnyatsky noted the presence of PE blades or NBKs and they probably treated some, or all of them, as ‘blades’. As for the entire sample size, Vishnyatsky (2000:145) recorded in his study 192 ‘unretouched blades’ (including fragments) and at least 29 more ‘blades’ among the shaped items. Although the total number (n=221) is similar to my sample of the three laminar types (n=222), it is not clear where did he include the items which I defined as crested blades. In addition, it is not clear if the shaped items are included in his attributes description. Despite these difficulties, the following comparison regarding Yabrud I-15 is presented. As for the material from Yabrud I-11/12, no comparable data was found.

Rust (1950:30-33) reported that the blank ‘blades’ (the inverted commas indicate the possible mixture of various laminar items) are 40-95 mm long and that the shaped ‘blades’ are 50-60 mm long with a mean width of 20 mm and a mean thickness of 5 mm. The mean metrics according to Vishnyatsky (2000:146; Table 3) are 60.0 mm long, 23.4 mm wide and 9.2 mm thick. Vishnyatsky also observed that the shaped ‘blades’ are larger than the blank ‘blades’, as in my study. Although the above means differ from my results (Tables 29-31), the differences are relatively minor. The main dissimilarity is in the smaller thickness Rust described which I cannot explain.

The cross-section of ‘blades’ was reported by Rust (1950:30) to be ‘prismatic’ in 45% of the cases and trapezoidal in 20%. As for the rest of the population, he did not provide details. Since I found that 25.5% of the blades have a trapezoidal cross-section, I can only presume that Rust's ‘prismatic’ is a triangular cross-section which constitutes 40.4% in my study of the blades.

Cortex was reported by Vishnyatsky (2000:146) to be present on 23% of the ‘blades’, while my results show cortex on 40.7% of the blades and on 60.1% of all the three laminar types. This difference might result from the fact that I included for this examination only whole items.

Vishnyatsky (2000:147; Table 4) divided the butts of ‘blades’ (n=111) into 'smooth' (65%), faceted/dihedral (18%), punctiform/linear (15.2) and natural (1.8%). Rust (1950:34) noted only a minor presence of modified butts on ‘blades’ (10%-15%). Both these results differ from mine with modified butts dominating (Fig. 332). This dissimilarity is probably affected by the different samples (the total sum of the three laminar types in my analysis is 187) and the different terminologies used. My definitions of the 'thick plain' and modified butt types do not correlate to Vishnyatsky's 'smooth' and 'faceted/dihedral' butts. As for Rust, I assume he included under the modified butts only items with clear faceting. Despite the described differences, the trend of modified butts being more common on shaped ‘blades’ than on blank ‘blades’ was observed by Rust (1950:34) as well as myself.

An Additional difference is in the bipolar scar pattern on laminar items. Vishnyatsky (2000:146) noted that it is present on 15% of the ‘blades’. This is in contrast to my results showing only 9.8%. The accuracy of this observation however is problematic due to the occasional fragmentation of the finds and the light patination that covers many of the items and camouflages the direction of every scar on the items.

As for cores, they were described by Vishnyatsky (2000:145) to be used until exhaustion and to be shorter in length than the blades. Both of these observations are similar to mine. The slightly smaller number of cores recorded in my analysis (n=83) compared to Rust's (1950:30) and Bordes' (1984:40) reports (n=89) might result from my exclusion of unidentified broken cores (at least five such items were noticed). The division of the cores into types was conducted differently by Bordes (1984:40), but since he did not separate the cores according to end-products, as I did, a comparison is not possible. Another difference is that Rust (1950:33) noted the presence of three bipolar cores, while I recognized cores with base modification, but no true bipolar cores. I did however note that some of these base modifications show blades and bladelets removal that might give the impression of seemingly bipolar cores. Another difference is in some of the cores which I defined as laminar and flake cores of the 'narrowed prismatic' shape and Rust (1950:32; Tafeln 35:2-3) (Fig. 315:1-2) recoded as high end-scrapers. Nevertheless, even he had noted their similarity to cores and that some were actually shaped on cores. Vishnyatsky, (2000:146) who also recorded some of these items as high end-scrapers, noted that they "…can equally be defined as cores". I presume that although some of these cores might be misleading such as the cores presented in Fig. 315:1-2, the fact that other similar cores (Fig. 315:3-4) are clearly not end-scrapers, supports my decision to classify them as cores.

In reference to Yabrud I-13, only minor comparisons are possible. Vishnyatsky (2000:146, Table 3) noted that the ‘blades’ means are 49.1 mm long, 18.5 mm wide and 6.9 mm thick. These metrics are very similar to mine (Tables 29-31). Cortex appears on 14% of the ‘blades’ according to Vishnyatsky (2000:147) and this too is close to my result concerning blades solely (16.0%), however it is different if all the three laminar types are included (43.2%). Vishnyatsky also reports that 20% of the ‘blades’ have a bipolar scar pattern, while I observed a bipolar pattern on only 6.7% of the blades. The butt types (n=32) were divided by Vishnyatsky (2000:147, table 4) into 'smooth' (53%), faceted/dihedral (22%) and punctiform/linear (25%). These results are different from mine and the possible reasons for the above differences are the same as in the case of Yabrud I-15. It is of note however, that both of us recognized that the portion of punctiform/linear butts is higher in Yabrud I-13.

Although there are some variations between the studies, they are mostly minor and probably result from different samples and slightly different terminologies. It is of importance that similar patterns and trends were observed.

The Laminar Technology from Yabrud I Layers 11-15: Summary and Conclusion

The focus of the analysis was the Pre-Aurignacian of Yabrud I-15 which provided a relatively large sample. Although the analyzed material from the Pre-Aurignacian of Yabrud I-13 and the Acheulian facies of Yabrud I-11/12 were sufficient for identifying a different character of production, they are too small for a complete technological reconstruction. In this section therefore, I will mainly discuss Yabrud I-15, while the other layers will be used to illustrate the variability in laminar production.

Unfortunately, the material from Rust's excavations was not systematically collected and although the laminar items seem to have been less affected they still were. However for now, there is no replacement for the Yabrud I assemblages which are at the heart of the discussion regarding the meaning of the variability in the Acheulo-Yabrudian complex and the place of the Pre-Aurignacian/Amudian within it (e.g. Bordes 1977; Copeland 2000; Garrod 1956). The fact that the conclusions from the study of the three laminar types, CTEs and cores are similar, even though each was conducted separately, indicates the validity of the results despite the nonsystematic collection. For example, cortex is meager not only on blades, but also on overpass items and cores – i.e. there was no bias in the collection of less cortical items and the dominance of blades in the assemblages is real. That is also the case with size. The length of overpass items and blades correlates within each layer. In other words, although the precise calculated percentages of the various attributes are affected by the nonsystematic collection, the general picture is reliable.

Reconstructing the Reduction Sequence of Yabrud I-15

The most commonly used raw material for laminar production is assumed to have been rounded and amorphous nodules with partial straight edges. This observation is primarily concluded from the cortical outlines of PE blades and NBKs and supported by the character of the laminar core class. The latter also indicated that the raw material could have been fist size or larger as deduced from the small presence of cortex. When large raw material (whose exact size is unknown) was used, two options were at hand. One was transforming it into a large core that was gradually reduced in size leaving little cortex, the second was splitting the raw material into relatively large flakes or fragments (probably fist size). The original length of the cores before the reduction can be reconstructed by the overpass items' length ranging from 37-112 mm with a mean of 62.3 mm (s.d. 19.3).

Alongside the exploitation of nodules, old knapped items were recycled, as indicated by laminar items with double patinated surfaces. Additional items indicate the systematic recycling of handaxes into laminar cores. These include crested blades that are described by Rust (1950:36) as *Faustkeilklingen*, two overpass items with the tip of the handaxe still intact at their distal end, and several blades with cross-sections and scar patterns indicating that they are "secondary" items removed from handaxes. It is of note however, that while evidence of recycling handaxes was found among the CTEs and blanks, no cores were identified as originally having been a handaxe.

Although the relative paucity of cortex on cores and laminar items partly resulted from splitting large raw material into smaller workable size flakes or fragments, there is a possibility that a few of the cores were pre-shaped – a procedure during which some of the cortex was peeled. This refers to some cores within the laminar and flake type that have the 'narrowed prismatic' shape.

The debitage surface of the cores was "opened" by using various methods. The simplest method was using a carinated part of the nodule and removing a completely cortical PE blade. Few such PE blades are found within the assemblage. Since it is assumed that nodule parts were used alongside whole nodules, the same goal could have been achieved by removing laminar items that were only partly covered by cortex but had no laminar scars on them. Few such PE blades and blades were found. Another method used to "open" the debitage surface was an overpass item reduction. This possibility was not very common however, as indicated by the fact that only 17.6% of the overpass items were recorded as 'initial'. In contrast, the most common method for "opening" the debitage surface was probably by shaping a ridge or selecting an already existing ridge (when utilizing recycled items) and removing a crested blade. The five different sub-types of 'initial' crested blades, constituting 63.0% of all crested blades, indicate that also in this case there were several options.

Forming the debitage surface occasionally involved the removal of several items. The two crested blades of the 'second primary' sub-type are one indication for this. The few PE blades and blades with a strip of cortex along the middle of the items is another. The various cores from Yabrud I-15 demonstrate however that while in some cases wide debitage surfaces were "opened", in others narrow ones were preferred.

The striking platforms of the cores were predominantly shaped by forming a flat scar, possibly by a core tablet removal. Nevertheless, faceting, or a combination of a flat scar and faceting, were also common. The removal of the laminar items was performed by using a hard hammer. This is attested to by the prevalence of thick plain or modified butts, and by the finding of two hard limestone hammers in this layer. The presence of micro flaking on the edge of the striking platform of some of the cores and the laminar item may be an indication for supplementary treatment of the striking platform.

Blades, PE blades and NBKs are assumed to have been reduced from the same sequence. Their similarity in length and width is one indication. The lack of evidence for a sequence aimed at the production of only PE blades and/or NBKs is another. However, the relative amount of each of the three laminar types produced probably varied in correlation with the type and shape of core they were reduced from. Blades were the main products, constituting two thirds of the three laminar types. This is not surprising since as noted, many of the cores were only partly covered by cortex. It is worth mentioning that in many of the cases not only laminar items were removed, but rather a combination of flakes and laminar items.

The cores, and their debitage surfaces in particular, had commonly changed in size and shape. A schematic representation of this was presented in Fig. 398. The length of cores was reduced during the production. However, since the mean length of overpass items is similar to that of the three laminar types (62.3 mm [s.d. 19.3] and 59.3 mm [s.d. 12.8] respectively) and both are different from the mean length of the rejected cores (single striking platform laminar cores: 48.7 mm [s.d.10.0]; single striking platform laminar and flake cores: 47.3 [10.1]) I can only assume that during the main course of laminar reduction a major decrease in length did not occur. The more substantial change probably took place just before discard. As for width, it is clear that it did change, but it is hard to determine to what extent.

Modification surfaces are highly common on the cores from Yabrud I-15 and mostly appear at the base. While in some cases they are relatively simple and might have served only *ad hoc* purposes, in other cases they are more complex and had a major affect on the debitage surface shape. This refers to cases in which the base was transformed by flake removal into a pointed/sharp shape. The latter modification was also a more constant feature which remained along most of the reduction sequence. It is even possible that in some cases it was performed before the laminar production began. Among the simple base modifications the common reduction of single blades/bladelets from the base is of note. This procedure demonstrates much control in knapping and took advantage of the same logic applied in a bipolar technology. The use of this procedure is also evident on the laminar items bearing a bipolar scar pattern.

The reduction of laminar items usually continued until cores were exhausted. At this stage the cores not only had a short length but also a small thickness in general, both indicating full utilization of the flint mass.

Variations in the Yabrud I Laminar Production

The limited sample of Yabrud I-13 shows a difference in the production of laminar items as compared to that of Yabrud I-15. Although the same range of raw materials seems to have been exploited in Yabrud I-13, it is assumed that the portion of amorphous nodules and recycled old knapped items was larger. The different character of the reduction in Yabrud I-13 is best witnessed in the shorter length of the produced blades and the paucity of cortex. The butts of the blades from Yabrud I-13 are characterized by higher percentages of punctiform and thin plain types, attesting to an intentional removal of smaller/shorter items. Several additional features indicate that the reduction in Yabrud I-13 was not only different but also less organized. This is expressed by the lower percentage of a trapezoidal cross-section and the relatively high percentage of hinge scars on blades. The differences between Yabrud I-15 and Yabrud I-13 demonstrate that the Pre-Aurignacian included varying strategies for laminar production.

The laminar production from the Acheulian facies of Yabrud I-11/12 shows an even larger variability within the Acheulo-Yabrudian complex of Yabrud I. Again, the same range of raw materials were probably used but in differing proportions. It seems that larger nodules or nodule fragments were exploited as cores. The laminar items are also relatively larger than in Yabrud I-15. Yet, the differences in the production cannot be explained as resulting solely from raw material variability. The main difference is the higher percentages of blades with a pointed shape and with a pointed end shape. A pointed end shape is also more common among the overpass items. Another difference is that this is the only sample in which the blades are characterized by a dominance of trapezoidal cross-sections. The conspicuous presence of blades with a pointed shape and trapezoidal cross-section in Yabrud I-11/12, at the end of the sequence of the Acheulo-Yabrudian complex of Yabrud I, just below the Mousterian layers, raised the possibility that some of the material is intrusive. The fact that the index of Levallois items in Yabrud I-11/12 is not much higher than that of most other layers of the Acheulo-Yabrudian complex of Yabrud I (Bordes 1984:16-40) indicates that even if there is an intrusive element its affect is not significantly different than in the other layers. This is further supported by the fact that only one of the butts of these blades shows a meticulous faceting as is common in the Mousterian (e.g. Meignen 1998).

Nevertheless, the reduction of laminar items from Yabrud I-11/12 and Yabrud I-15 share some characteristics which attest to a similar background. These include a frequent use of base modification for maintaining the debitage surface, the appearance of cores with the 'narrowed prismatic shape', and a reduction that has a propensity to be partly asymmetrical and to tend towards either of the sides. The latter is mainly expressed in the location of the bulb of percussion on the butt of blades and by the location of the ridge on crested blades.

It is of note that in Yabrud I-11/12 two trajectories of laminar production were recognized. While the main one was described above, the second is marginal and characterized by the production of large PE blades.

The Laminar Production from Yabrud I and its Significance

The results obtained from the examination of the three samples of Yabrud I show that the laminar production was diverse and could have been conducted in a variety of ways. The most intense laminar production occurred in Yabrud I-15, yet even in this layer many flakes were found. Vishnyatsky (2000:148) suggested that "…it will not be an exaggeration to say that in Layers 15 and 13 of Yabrud blades actually represent almost the only type of blank. The overwhelming majority of flakes are, judging by their size and shape, by-products and waste."

Although some of the flakes were the products of designated flake cores, many of the flakes are indeed by-products or waste of shaping and controlling the core shape. This aspect, along with the observation of the different core modifications and the well defined and controlled shapes of the end-products, indicate that we are dealing with a sophisticated core technology.

Chapter 7

A Review of the Laminar Production from Other Sites of the Acheulo-Yabrudian Complex

This section summarizes the literature regarding the laminar production from sites of the Acheulo-Yabrudian complex which were not examined in this study. Of these sites, Zuttiyeh (Turville-Petre's excavations) is the only exception where I observed the assemblage myself. Although there are quite a few sites of the Acheulo-Yabrudian complex, many were only briefly explored (e.g. Bar-Yosef *et al.* 2005:24; Copeland 1975:327; Copeland and Hours 1983; Schroeder 1969). The sites where the Amudian facies was found are relatively well studied, with the sole exception of Nadaouiyeh Aïn Askar and Hummal where Amudian/Pre-Aurignacian levels were reported (Le Tensorer *et al*. 2007). The purpose of this chapter it to enable a wider perspective which will not only include the three sites I worked on, but other sites of the Acheulo-Yabrudian complex as well. In this section I used the term 'blade' as used in the addressed publications.

The Reviewed Sites

Zuttiyeh (Acheulian and Yabrudian Facies)

The cave of Zuttiyeh is located in Nahal Amud in the Upper Galilee, Israel and it was excavated in 1925-1926 by Turville-Petre (1927). The excavated sediments included a mixture of Lower Paleolithic and Middle Paleolithic finds (and probably layers) that were not distinguished by the excavator. The lithic material includes small handaxes (8-12.7 cm long) and side-scrapers made on thick flakes with Quina retouch. Several blades were found as well.

The blades found in Zuttiyeh led Garrod and Kirkbride (1961:42-43) to suggest the name 'Amudian' in order to replace the previous term 'Pre-Aurignacian'. Since the blades were not numerous at the site they argued that the assemblage represents a 'Yabrudian-Amudian symbiosis'. Some scholars, including myself (Gopher *et al.* 2005), were misled by the term 'Amudian' provided by Garrod and Kirkbride (1961) and referred to Zuttiyeh as containing Amudian (Gilead 1970a:333; Jelinek 1982a:1375, 1990:81-82). Others noted the Amudian presence with caution (Ronen 1979:302; Vishnyatsky 2000). A recent examination of the material from Zuttiyeh (currently stored at the Rockefeller Museum, Jerusalem) by A. Gopher, R. Barkai and myself revealed that this site was mistakenly referred to as including a blade industry of the Acheulo-Yabrudian complex. The blades in this collection are significantly longer than the Amudian blades, have a trapezoidal cross- section, a pointed shape and a meticulous faceted butt characteristic of Mousterian blades (e.g. Meignen 2000; Monigal 2002). In other words, these blades are most likely from the Middle Paleolithic material and their presence among the Lower Paleolithic finds is probably the result of the mixture of the finds or layers mentioned above. This however will be the subject of a different paper where it will be elaborated upon.

Excavations at the site of Zuttiyeh were renewed by Bar-Yosef and Gisis in 1973. The new excavations, although limited, uncovered the presence of a complex stratigraphy that was overlooked by Turville-Petre. The excavators recognized layers attributed to the Mousterian Middle Paleolithic and to the Yabrudian and Acheulian facies of the Acheulo-Yabrudian complex (Gisis and Bar-Yosef 1974).

Azraq Oasis

At the Azraq oasis in Jordan several sites, which were disturbed by a human agency, were found to include heavy Quina side-scrapers and handaxes. These sites were suggested to represent an Acheulian facies (Acheulo-Yabrudian) (Copeland 1989a; 2000). At the 'Lion Spring' site and 'Site C' several blade cores were also found of which a few were made on recycled handaxes (Copeland 1989b:317, 317, Fig. 7.1).

Masloukh (Amudian and Yabrudian facies)

P. Sanlaville discovered in 1969 the site of Masloukh north of Beirut, Lebanon, at an elevation of 38 m a.s.l. It was excavated in the same year by Skinner (1970). The site includes a terrace and a small cave with a chimney. The cave's sediments were divided into three layers (Layers A-C), all attributed by Skinner to the Yabrudian. During excavation he recognized a decrease in blades towards the lower part of the sequence as well as that the blades are not equally spread along the upper layer. Although Skinner tentatively argued that all the layers were slightly disturbed (trying to explain the presence of blades in them), re-examining his field notes teaches that only Layer C (the lowest of the sequence) was disturbed and that this occurred before Layers A-B were deposited. Following this observation, alongside a new analysis of the site's material, Shmookler (1983) suggested that Layers A-B are in fact Amudian.

Shmookler (1983) examined a sample of 5,339 lithic items, representing the three layers (n=Layer A: 552; Layer B: 2,178; and Layer C: 2,609). His results show that the three main features of the Acheulo-Yabrudian complex (side-scrapers, handaxes and laminar items) fluctuate among the three layers. Side-scrapers shaped by Quina or regular retouch were especially prevalent in Layer C. The side-scrapers were commonly made on thick flakes with cortical surfaces. Shmookler assumes that most of the side-scrapers were heavily resharpened. The side-scrapers index (IR) is especially high in Layer C (84.0) and then dramatically declines – IR of Layer B is 33.2 and of Layer A it is 28.1. The bifacial index (IB) is 3.5 in Layer C, 0.03 in Layer B and 0.0 in Layer A (Shmookler 1983:18, Table 6).

The percentage of 'blades' (calculated out of the entire assemblage) increased throughout the layers, constituting 1.2% in Layer C, 11.2% in Layer B and 16.3% in Layer A. The percentage of "tools on blades" shows the same pattern: 1.9% in Layer C, 20.2% in Layer B and 34.4% in Layer A. The Ilam is 4.1 in Layer C, 32.8 in Layer B and 38.4% in Layer A (Shmookler 1983:17-18, Table 3-5).

Backed knifes (including those made on flakes and laminar items) are highly common in this site yet, according to Shmookler's (1983:15) description these also include specimens with semi-abrupt and nibble retouch, which in my opinion should be defined as retouched laminar items. The presence of a few Levallois items in each of the layers is of note.

A general statement on the cores is provided by Skinner (1970:158) who noted that the laminar cores were "simple" and were made without much preparation.

Shmookler argued that the changes between Layers A-C were gradual and were not accompanied by a major technological shift. He also argued that the assemblages from Layers A-B represent a variant of the Amudian and that these assemblages ”occupy an intermediary typological position between the Amudian and Yabrudian” (Shmookler 1983:31).

Abri Zumoffen (Amudian and Yabrudian Facies)

This site at Adlun, Lebanon was briefly examined at the end of the 19th century by Père Zumoffen (1900). It was systematically excavated in 1958 by Garrod and Kirkbride (1961) and was found to consist of several layers attributed to the Yabrudian facies and to two variants of the Amudian facies. The site’s stratigraphy is complex and differs in the various trenches and squares excavated (Copeland 1983b; Garrod and Kirkbride 1961).

Differences within each of the facies were already noticed by Garrod and Kirkbride (1961:23), especially in the case of blades that appear all along the sequence but decline in frequency. Parts of the lithic industries of this site were later studied by Copeland (1983a). Her research focused mainly on the 'Beach Industry' (an Amudian variant), referring to the level overlying the fossil beach. While some other Amudian samples (referred to as ‘Amudian) were also included in her research, Yabrudian samples were almost completely neglected. In the case of the Yabrudian layers, her observation that they contain some Amudian elements is of importance (Copeland 1983a:243). Copeland’s study includes a total sum of 963 items.

The raw material types used in the Beach Industry and the Amudian are similar but with different frequencies. While in the Beach Industry a local raw material with mollusk fossils appearing as rounded pebbles or tabular slabs was preferred, in the Amudian, pebbles of a different origin with a thick calcareous cortex were favored. The cores from the Beach Industry and the Amudian were divided into prismatic (n=29), Levallois (n=4), discoidal (n=4), ‘back to back' (n=7), and amorphous (n=4). The prismatic cores (n=29), which are the most common, were further divided into three types: I: 'Acheulian' (n=10), II: 'intermediate' (n=8) and III: core resembling those from the Upper Paleolithic (n=11). Type I cores are more common in the Beach Industry and type III cores are more common in the Amudian. Copeland (1983a:217) noted that "the later (*type III*) are no more than miniaturized versions of the former (*type I*)". The prismatic cores of all types are described as "not well prepared" and their striking platform is either plain or faceted (Copeland 1983a:216). The presence of thinning flakes originating from bifacial manufacturing indicates that the technique of narrowing the raw material was well controlled by the site's knappers although not used for cores. The illustrated prismatic cores (Copeland 1983a: 250, 255-257, Pls: Z.2:4, Z.7:4, Z.8:7, 9, Z.9:1, 7) indicate that cortex is still present on many of them, that core bases were mostly unshaped and wide, and that some were used for the combined production of laminar items and flakes.

Cortex is highly common on the blanks, appearing on 69.0% of them (Copeland 1983a:219, Table Z.4). The presence of ‘cortex backed blades’ among the blanks is important. These were not recorded as NBKs by Copeland (1983a:218) since according to her classification, NBKs are part of the ‘tool’ category and need to bear retouch or use wear. She referred to these and other cortical items as part of peeling the cortex from cores.

Crested blades are present in the sites’ assemblages but are not described in detail. The single illustrated item (Copeland 1983a: 255, Pl. Z.7:6) indicates that they probably fall under my type of 'rough' crested blades. The simplicity of their character led Copeland (1983a:221) to the conclusion that they were "…seemingly struck from unprepared cores and are not true crested blades".

Many of the blades are broken and Copeland (1983a:220) consequently suggested that "The number of 'failed blades' is therefore rather high (an indication of inadequately-prepared cores, or of underdeveloped technological skill?)".

In the Beach Industry plain butts constitute 77.8% and in the Amudian 40.9%. In contrast, modified butts, mostly roughly faceted, constitute 47.0% in the Amudian and 19.4% in the Beach Industry. Linear butts constitute 12.1% in the Amudian and 2.8% in the Beach Industry. Punctiform butts are reported to be rare or absent. Trapezoidal cross-sections dominate the blades, although triangular cross-sections are found as well. Pointed end shapes of blades are rare (Copeland 1983a:220-222, Table Z.5). As for length/width ratio, no specific numbers are given, yet the data presented by Copeland (1983a:225-226, Figs. Z.3-4) shows that the items from the Amudian sample are characterized by a higher ratio than that of the Beach Industry.

Copeland summarized that the main difference between the Amudian and the Beach Industry is the higher frequency of blades in the Amudian and the lower presence of heavy tools. Nonetheless, they are both variants of the Amudian.

Bezez Cave, Level C (Acheulian Facies)

Bezez Cave in Adlun, Lebanon is located near by the site of Abri Zumoffen and was excavated by Garrod and Kirkbride in 1963 (Garrod 1965). With regard to the similarity and the small distance between these two sites it was suggested that they in fact represent a single site (Copeland 1983a:243; Kirkbride *et al.* 1983). The following description however is only of Bezez Cave.

Bezez Level C, the lowest at the site, was attributed to the Acheulo-Yabrudian complex and was assigned to the Acheulian (Acheulo-Yabrudian) facies (Kirkbride 1983). A sample of the lithic industry (n=1,220) studied by Copeland (1983a) showed that Level C is dominated by handaxes (n=142) and side-scrapers (n=487).

Various raw material types were used in Level C and they were divided into rounded pebbles (50%), tabular nodules (1.4-3.0 cm thick, with cortex on both sides; 24%), irregular nodules (17%) and unidentified (9%) (Copeland 1983a:96).

Among the 94 cores, 19 are prismatic cores, but not all of them were used for laminar production. Only five of these are reported to resemble the prismatic cores of the Amudian of Abri Zumoffen. Other core types are Levallios (n=23), ‘back to back cores’ (n=5), radial (n=34), and other (n=14) (Copeland (1983a:98-101). The illustrated laminar cores (Copeland 1983a:193-194, Pls. C.25:11, C.26:3) show that cortex was not peeled prior to reduction and that cortical laminar items could have been produced until core discard. Some of these cores also show a modification on their back.

In this level a sum of 114 ‘non-Levallois blades’ was retrieved, constituting 9.3% of the debitage and shaped items. NBKs are scarce (n=18; 1.5% of the debitage and shaped items) since only items with retouch or use wear were included (Copeland 1983a:93, Table C.2.).

Plain butts are the most common among the blanks (including blades and flakes). Copeland (1983a:103, Fig. C.3) examined the length/width ratio of flakes and blades as one population. Since the graph did not show a bell pattern but rather three peaks, she suggested that it represents more then one population of blanks. The peak of the items with a length/width ratio higher than 2/1, concentrates around 2.25.

Examining the differences among the nine major layers that composed Level C demonstrated clear fluctuations in almost all aspects. The index of side-scrapers (IR) varies from 24%-71%; Quina retouch varies randomly; bifacial index varies from 13%-20% and Ilam index varies from 5.7%-26.2%. Differences in the spatial distribution were detected as well. Side-scrapers were more common at the entrance of the cave, bifacials were more common at its centre and Levallois items were more commonly found in the cave's rear. No spatial distribution pattern was noticed among the blades (Copeland 1983a:148-157).

A Comparison to My Study

The study of the above sites demonstrates well that some of the patterns observed in my analysis are not distinctive to the three sites I examined but are found within other sites of the Acheulo-Yabrudian Complex as well. This includes some similarities in the attributes of the laminar items, as for example, the common presence of plain thick butts and a relatively low length/width ratio not much larger than 2/1.

Although the studies of the Adlun sites and Masloukh provided a good data base for some comparison, the description is not detailed enough to enable a comparison of the reduction sequence between these sites and the three sites I examined. Nevertheless, several points are noteworthy.

A difference in the selection of raw material was observed between the different facies of Adlun, a pattern also observed in my study of Tabun XI. The use of small pebbles or tabular flint in the Adlun sites is also of importance since both represent the ability to frame the debitage surface between two cortical edges and to enable the production of PE blades and NBKs. This feature was found to be important among all three sites I examined.

Another important similarity to my results is that the laminar reduction from Abri-Zumoffen was characterized by a simple preparation of the cores and by the retaining the cortex on them. The presence of crested blades which were roughly made, and of cores used for a combined reduction of laminar items and flakes, is also familiar among the three sites I studied.

Variability within the Amudian facies is also apparent in the above sites. The reported difference between the Amudian and the ‘Beach industry’ of Abri Zumoffen seems to be large, just as in the case of Yabrud I-13 and Yabrud I-15 as reflected in my work. This is in contrast however, to the lower variability in the case of the laminar technology from the samples of Qesem Cave and the various beds constituting the Amudian of Tabun XI. The difference between Layers A and B from Masloukh (Shmookler 1983) seems to be small as well, but a lack of data does not enable making a clear statement.

The various sites show that the laminar production appears not only in the Amudian facies, but in the other facies of the Acheulo-Yabrudian complex as well, although these are mostly characterized by a low Ilam. This was also found to be the case in a cluster of surface sites of the Acheulo-Yabrudian complex from El- Kowm examined by Copeland and Hours (1983). Despite the fact that the intensity of the laminar production varied greatly between the facies, it was found that the technology of how to produce them was similar in cases where the facies appeared at the same site. This similarity, which was observed in my study of Tabun XI and Yabrud I, was also found at the Adlun sites (Copeland 1975, 1983b; Roe 1983) and probably at Masloukh although regarding the latter the details are less clear.

Chapter 8

Summary and Conclusions

This chapter begins with a characterization of the laminar technology of the Amudian facies, based on the results of the three sites which I examined, Qesem Cave, Tabun XI and Yabrud I. This will be followed by a characterization of the laminar technology practiced within the other facies of the Acheulo-Yabrudian complex based on the material from Yabrud I-11/12 and the Yabrudian and Acheulian beds of Tabun XI which I examined as well. The subsequent discussion of the significance of several patterns which emerged from my study of the laminar technology constitutes a major part of this chapter.

The Laminar Technology of the Amudian Facies from the Three Analyzed Sites

The description of the Amudian laminar technology will be combined with a comparison of the results from the three examined sites. In this comparison I will not repeat the data from the previous chapters, but rather present patterns of similarities and differences. The comparison will focus on three topics: (1) end-products, (2) reduction sequences, and (3) patterns of selection for secondary modification. For Qesem Cave I will use the results of the five samples grouped together. The results from Yabrud I-15 and Yabrud I-13 however, will be treated separately since they have a considerable difference between them (see Chapter 6), yet Yabrud I-13, being a small sample, will be only briefly noted. In the case of Tabun XI, some of the results relating to cores refer to all facies of Tabun XI and not only to the Amudian facies due to their small amount.

Characteristics of the End-Products

A meticulous description of the end-products – blades, PE blades and NBKs (blanks and shaped) from the three sites was provided in the previous chapters. Although some fluctuations were found in each of the attributes examined, here I wish to mention only the main characteristics of each laminar type and the major similarities and differences between the sites.

The main difference in end-products among the three sites is in the frequency of each of the three laminar types. While in Tabun XI and Yabrud I blades are dominant, in Qesem Cave blades, PE blades and NBKs appear in relatively equal numbers (Fig. 399). Here though, I wish to compare the characteristics of each of the three laminar types separately. For ease of comparison some of the major attributes are presented in Table 37.

Blades

Blade mean size is similar among the three sites, ranging from 51-63 mm in length, 21-23 mm in width and 8-9 mm in thickness. This similarity is also reflected in the mean length/width ratio which ranges between 2.5-2.7, and the mean width/thickness ratio whose range is 2.6-3.0. Minute cortical surfaces are highly common on blades and appear on about half of them. A triangular cross-section dominates the blades from all samples, generally appearing among nearly half of all blades. A trapezoidal cross-section is common as well, generally appearing among a quarter of the blades. The mean number of laminar scars is low, varying from 2.3-2.6. The sharp edges are usually characterized by acute angles of 30°-40°. A feather end termination constitutes about two thirds of the blades in all samples. The four major blade shapes in the examined samples are parallel, straight-curved, curved-irregular and straight-irregular. While in Tabun XI and Yabrud I-15 all of these shapes appear in a relatively equal amount, in Qesem Cave the parallel shape is the most common. In short, the Amudian knappers usually produced blades with two sharp edges, a triangular or trapezoidal cross-section and a fairly specific size. The only exception is the case of Yabrud I-13, where blades are smaller and rarely covered with cortex (Chapter six).

Primary element blades (PE blades)

The mean size of PE blades is similar among the three sites, ranging between 54-64 mm in length, 21-25 mm in width and 10-11 mm in thickness. The similarity is also reflected in the length/width ratio which ranges in mean between 2.6-2.7 and in the width/thickness ratio which ranges in mean between 2.3-2.6. Cortex mostly covers half of their dorsal face. Almost all PE blades have a strip of cortex which covers one lateral edge while the other edge is clean of cortex and sharp. The angle of the sharp edge is generally at 40°. Most PE blades have a triangular cross-section and a feather end termination. They bear very few laminar scars, with a mean of 1.2-1.4.

Naturally backed knives (NBKs)

NBKs are similar in mean size among the three sites, ranging between 52-66 mm in length, 21-25 mm in width, and 11-12 mm in thickness. This is also reflected in the mean length/width ratio, whose range is 2.6-2.9, and the mean width/thickness ratio whose range is 2.0-2.2. The strip of cortex along the back generally covers 20-30% of the NBKs' dorsal face. The distribution of the angle of the sharp edge differs slightly between the three sites, but its peak is around 45° in all three sites. The dominant cross-section is right-angle trapezoidal in all samples, generally constituting nearly half of all NBKs. A feather end termination appears on about half of the NBKs in all samples and an overpassing end termination characterizes about a third of the NBKs. It is of note however that the latter is slightly more common in Qesem Cave. The mean number of laminar scars is 1.7-1.8.

As seen above, the characteristics of each of the three laminar types are highly similar among the three sites. This similarity however should not be mistaken to represent an identical pattern, since there is variation when looking at the fine details, as presented in the chapters studying each of the sites individually. I will elaborate on some of these variations in the reconstruction of the reduction sequence. The study of Qesem Cave, where I had full control over all aspects of the assemblages, demonstrated that variability in the Amudian facies can also appear in a single site and provide additional insight into this phenomenon. With regard to Qesem Cave I demonstrated that some attributes fluctuate in correlation with the intensity of laminar production in the various samples. In samples with a more intense laminar production the characteristics of the laminar items were found to be more regular. This is reflected in the lower percentages of items with non-uniform angles of the lateral edges, irregular profiles and 'other' cross-sections. In addition, the laminar items in these samples have a higher number of laminar scars and a higher length/width ratio. I suggest that in the case of Qesem Cave this variation reflects small differences in the reduction sequence as well as in the attention given to details while knapping.

The Reduction Sequence

The reduction sequence at the three studied sites was described in detail. Here I will not repeat the reconstruction of the reduction sequence of each site, but rather illustrate in what aspects they are similar and different. This will be done step by step throughout the reduction sequence. A method frequently used in reconstructing and comparing reduction sequences is the calculation of various ratios (e.g. Bar-Yosef 1991; Goring-Morris 1987:372-386). Using a ratio of end-products to cores ([blades + PE blades + NBKs]/laminar core class) was found to be unhelpful in the case of the studied samples since the number of end-products per core is too high, especially at Tabun XI but also at Qesem Cave (26 and 15 respectively; Table 38). This is demonstrated by the results of the experimental knapping study, which show a ratio of 8-11 (Figs. 187-189). The relatively high ratios in the archeological assemblages probably resulted from the high degree of exploitation, in which some of the cores were heavily reduced or recycled and therefore not identified as part of the laminar core class. Due to these differences I used ratios relating to laminar items and specific CTE types and not to cores.

Raw material selection

Although siliceous homogenous raw material was preferred among all the studied sites, there was a major difference in the shapes of the used raw material. These were grouped into four types: (1) flint slabs with two cortical surfaces or flat thin nodules, (2) rounded/amorphous fist size nodules, (3) larger nodules, with rounded or amorphous shapes that were split into smaller pieces (no data is available on the technique of splitting; the use of large flakes is minor), and (4) recycled old knapped items. Although the four raw material types were exploited among all the sites, there are differences in their appearance.

While flint slabs with two flat cortical surfaces were commonly used at Qesem Cave, they were rarely used at the other sites. This is exemplified by overpass items with cortex on both lateral edges, which appear with the highest percentage at Qesem Cave (14.3%), with a lesser percentage at Tabun XI (5.6%), and are completely absent at Yabrud I-15 (the percentage is out of all overpass items; n=Qesem Cave: 266; Tabun XI: 72; Yabrud I-15: 21). The difference between Qesem Cave and Yabrud I-15 in this case is statistically significant ($X^2=3.97$, df=1, $p<0.05$).

In Tabun XI and Yabrud I-15 fist size or larger nodules with rounded or amorphous shapes were usually exploited. This is indicated within these sites by the higher percentage of PE blades and NBKs having a cortical edge with a rounded or irregular outline (Tabun XI: 58.4%; Yabrud I-15: 55.8%; Qesem Cave: 44.6%) (data from Figs. 88, 219, 330). The difference between Tabun XI and Qesem Cave in this case is statistically significant ($X^2=6.97$, df=1, $p<0.05$).

It is more difficult to evaluate how many of the cores were made of whole nodules and how many were made of split nodules. Using flakes for such an evaluation was found to be insufficient, since it was identified in only a few cases. The data I draw on for this estimation comes from the cases in which the discarded cores are still entirely covered by cortex except for the debitage surface and the striking platform, thus indicating that a whole nodule was used for each such core. Although the character of discarded cores is the result of the reduction sequence, this can still be used as a base for estimation, since most of the cores in all the sites were not characterized by a circumferential reduction which should have removed the cortex. In all, these cases constitute 20% in Yabrud I-15, 30.8 % in Tabun XI and 47.8% in Qesem Cave (including ‘laminar cores’ and ‘laminar and flake cores’ with a single striking platform; n= Qesem Cave: 92; Tabun XI: 26; Yabrud I: 35). The difference between Yabrud I-15 and Qesem Cave is statistically significant (X^2=8.17, df=1, p<0.05). This pattern suggests that, while the cores from Qesem Cave usually exploited whole pieces of raw material (nodule or flint slab), the cores from Yabrud I-15 were mostly made of split raw material.

In order to estimate the recycling of old patinated items for laminar production I used the percentage of the laminar items bearing old patinated surfaces out of the sum of all laminar items bearing natural surfaces (n= Qesem Cave: 1882; Tabun XI: 270; Yabrud I: 128). It was found that laminar items with patinated surfaces appear with the highest percentage at Yabrud I-15 (20.3%) and with lower percentages in Qesem Cave (11.4%) and Tabun XI (9.3%). The differences between Yabrud I-15 and Qesem Cave (X^2=8.97, df=1, p<0.05) and between Yabrud I-15 and Tabun XI (X^2=9.50, df=1, p<0.05) are statistically significant. Of special interest is the recycling of handaxes, especially as seen in Yabrud I-15, but also in a single case from Qesem Cave.

Another difference is in the dimensions of the piece (whole or split) of the raw material used for cores, as reflected by the size of the end-products, overpass items and cores. Since the technological reconstruction found that the debitage surface was placed in a manner which exploits the entire length of the raw material, the differences in the length of the used pieces of raw material at the three sites can be traced by the differences in the length of the end-products (Table 37) and overpass items (Qesem Cave: 53.34 mm [s.d. 9.9]; Tabun XI: 65.0 mm [s.d. 15.14]; Yabrud I-15: 58.0 mm [s.d. 2.3]). Although the variations in length are usually small, a statistical difference was found in the case of end-products between Tabun XI and Qesem Cave and between Tabun XI and Yabrud I-15 ($t[258.43]=10.03$, $p<0.05$; $t[374]=2.35$, $p<0.05$ respectively), and in the case of overpass items between Tabun XI and Qesem Cave ($t[85.13]=5.78$, $p<0.05$). According to these measurements the used raw material from Tabun XI is characterized by the longest size and that of Qesem Cave by the shortest. The width of the used piece of raw material is estimated by the core's maximum width. According to this, in Tabun XI the pieces of the used raw material were wider (Table 39), with a statistically significant difference, than those of Qesem Cave ($t[116]=4.68$, $p<0.05$) and Yabrud I-15 ($t[58]=4.32$, $p<0.05$).

The difference in the used raw materials between the sites is important, since the material affects the entire course of the reduction. It is therefore a central question whether this difference represents a choice out of larger variety of options, or whether it reflects constraints of the environment. The landscapes of Tabun and Qesem Cave both have a variety of raw materials, appearing in different shape, size and quality. Druk’s (2004) study of the raw material sources of Mount Carmel well illustrates the richness of raw material sources in the vicinity of Tabun cave. The most important aspect of the raw material variety is the presence of flint slabs and rounded fist size nodules of high quality in both areas. The fact that numerous handaxes from Tabun XI-XIII were made on flat flint slabs or on thin nodules (McPherron 2003; Rollefson 1978) exemplifies that such raw material sources were indeed known and used in that period at Tabun. In the case of Yabrud I, Bakdach (2000) and Solecki and Solecki (2007) note that ‘tabular raw material’ is highly common in its region, although usually of a low quality. The presence of several items made of such raw material, including one core from Yabrud I-15 and several handaxes from the other layers of Yabrud I (Rust 1950: Taflen 20:7; 41:2) confirm that these sources were known and used.

It is of note that none of the examined sites lie specifically on a raw material source. This is important, since Marks *et al.* (1991) found that among sites that are located specifically on raw material outcrops there was a bias towards the collection from the specific outcrop. Accordingly, it is concluded that the differences in frequencies of the used raw material types between the three examined sites were not the consequence of what the environment had to offer but rather of a human choice.

Shaping the striking platform and the debitage surface

Transforming the raw material into cores usually required only minor preparations. This was possible by taking advantage of the raw material's natural shape – i.e. by locating the best potential area for a striking platform and a debitage surface with a good angle between them, suitable for knapping. The striking platform could have been a simple breakage plain of the raw material, if present. In other cases, the striking platform was shaped by removing a flake that formed a flat surface. The fact that we do not find in any of the sites items that could be recorded under 'primary core tablet' (Mortensen 1970) indicates that shaping the primary striking platforms was indeed simple.

The debitage surface was preferably placed on a narrow part of the raw material in a manner that it was framed by the core's sides, which were usually cortical. The advantage in placing it on the narrow part of the raw material is twofold: (1) The narrow part is characterized by a more angular contour, thus making the "opening" of the debitage surface simple. (2) The angular character increases the possibility that the items removed will be thin and elongated (Pelcin 1997).

However, a full exploitation of the narrow facet of the raw material for the removal of laminar items was not always the case. A good example is found in the discarded 'laminar and flake cores'. In many of these cores the thickness became smaller than the width in the later stage of the reduction and thus there was a potential for extending or shifting the debitage surface to the core side which now became the narrow facet. This however was not carried out and the laminar production at this stage was performed slightly diagonally to the main orientation of the debitage surface. This phenomenon is also observed in the recycling of handaxes into laminar cores, as evinced by the *Faustkeilklingen* crested blades all having a right-angle triangular cross-section while not even one has an equilateral triangular cross-section. This is also reflected by some of the blades removed from these recycled handaxes, and by the location of the debitage surface on the core made on a handaxe from Qesem Cave (Fig. 39:1). Exploiting either the narrow or wide part of the raw material led to the reduction of blanks with different characteristics. This is supported by Pelcin's (1997) experimental study, which found that items removed from angular surfaces are usually elongated and narrow, while items removed from flat surfaces are usually short and wide. According to this reasoning, I can only assume that in some cases it was intentionally performed in an oblique axis in order to find a balance between these two properties. Such a balance suits the Amudian industry, which is characterized by laminar items with a low length/width ratio.

Prior to the laminar reduction the cortex was not peeled but rather left intact. The presence of handaxes in some of the examined assemblages indicates that, although the possibility of narrowing and controlling the core outline by bifacial reduction was a feasible option, such an option was not chosen. I presume that the cortex was deliberately kept, in order to enable the reduction of NBKs and probably PE blades as well, alongside the reduction of blades. Only in Yabrud I-15 the possibility of a preliminary narrowing of the cores was noticed. Yet even in this case, it seems more likely that the narrowing occurred along the course of the laminar reduction, as an adjoining flake reduction, and not as pre-shaping. The presence of some cores with a base that was modified into a sharp/pointed shape by knapping raised the possibility that this procedure may have been conducted in a pre-shaping stage. This feature is especially common in Yabrud I-15, but again, identifying whether it was performed at this stage or in the following laminar reduction is not possible. Even if the two aforementioned possibilities of the pre-shaping of cores will be found to be valid, the majority of the cores in all three sites were still only slightly treated before initiating the laminar reduction.

The debitage surface itself could have been “opened” using various options. Those identified by indicative waste include the removal of PE blades fully covered with cortex, 'initial' crested blades and 'initial' overpass items (see methodology section for their definitions). These three options were practiced at all three sites but in different frequencies. In order to identify differences between the sites, I used the percentage of each of the three methods out of the sum (Fig. 400). The results show that in "opening" the debitage surface, 'initial' crested blades were the most common among all three sites. The second most prevalent option was the removal of 'initial' overpass items, while the option of removing PE blades completely covered by cortex appears at the lowest percentage in all sites. Despite this similarity, the sites also show a clear difference. While in Qesem Cave all three options are well represented, in Tabun XI only the crested blades and overpass items are well represented. Furthermore, in Yabrud I-15 crested blades dominate while the other options are only meagerly represented. The higher percentage of PE blades fully covered with cortex in Qesem Cave, which is statistically different from Tabun XI ($X^2=4.59$, df=1, $p<0.05$) and Yabrud I-15 ($X^2=5.29$, df=1, $p<0.05$), correlates to the more common use of flint slabs.

This is probably due to their reduction having taken advantage of the angular corners of this raw material type. The removal of overpass items to initiate the reduction was more common in Tabun XI and Qesem Cave than in Yabrud I-15. In this case Yabrud I-15 is statistically different from both Tabun XI (X^2=6.48, df=1, $p<0.05$) and Qesem Cave (X^2=7.58, df=1, $p<0.05$). The fact that overpass items appear in the highest percentage in Tabun XI may correlate with the use of rounded nodules, in which forming a crest was not always possible. The higher percentage of ‘initial’ crested blades in Yabrud I-15 was found to be statistically significant from that in Qesem Cave (X^2=17.06, df=1, $p<0.05$) and in Tabun XI (X^2=7.92, df=1, $p<0.05$). The extremely high percentage of ‘initial’ crested blades and the rarity of the other options in Yabrud I-15 cannot be explained merely by differences in raw material. It is more likely that in Yabrud I-15 shaping a crest before "opening" the debitage surface was inherent to the concept of the reduction sequence.

The removal of PE blades or overpass items for initiating the reduction was quite simple and did not require major pre-shaping, if any at all. The removal of crested blades was also rarely engaged with complex preparations; instead, the prepared ridge was usually made by using only several blows. This is illustrated by the 'rough' crested blade sub-type which is common in all samples. The frequent appearance of the 'patinated' crested blade sub-type is another indication of the simplicity in “opening” the debitage surface. The latter were made when old items were recycled by exploiting old prepared ridges, occasionally by slightly adjusting them. Another example is the *Faustkeilklingen* crested blade sub-type from Yabrud I-15. This sub-type was removed from handaxes, exploiting one of their lateral edges in order to initiate the reduction. The simplicity in preparing the 'initial' crested blades should not be mistaken as a lack of planning, but rather the contrary. The five different sub-types (primary, rough, patinated, *Faustkeilklingen* and second-primary) that constitute the 'initial' crested blade category not only represent different conceptual methods of "opening" the debitage surface, but also demonstrate how the Amudian knappers succeed in taking advantage of the pre-existing outline of the used raw materials by only slightly adjusting it.

In most cases “opening” the debitage surface was performed by the removal of two or three items, which together created the debitage surface outline. This was demonstrated by both the experimental knapping study and by the archeological material. Items indicative of this include 'initial' overpass items that bear previous laminar scars on the dorsal face, NBKs that bear a portion of cortex on the frontal dorsal face and not only on the lateral edge, as well as the second-primary crested blade sub-type. Blades and PE blades with a strip of cortex that runs along the middle of their dorsal face are indicative of such a practice as well, since they demonstrate cases where the debitage surface was “opened” from two different carinated parts of the raw material. This method, which was found to some extent at all three sites, is different from most other blade industries, which are characterized by initiating the reduction from a single locality (e.g. Inizan *et al*. 1992:60). The fact that many of the 'initial' overpass items and the second-primary crested blade sub-type found in the assemblages are similar to NBKs (i.e. have a cortical back and a sharp edge) indicates that already at the “opening” of the debitage surface useful cutting implements were produced – a point emphasizing the efficiency of this procedure.

The removal of laminar items and its rhythm

Removal of laminar items was performed by hard hammer percussion, usually by hitting deep inside the striking platform. This is manifested by the most common butt types of the laminar items in all samples being the thick plain and modified butts. A sole exception is in the case of Yabrud I-13, where thin plain and punctiform butts abound as well. Hard limestone hammers were recovered in Yabrud I-15 and in Qesem Cave (in the latter – from samples not analyzed here). Basalt fragments, probably originating from hard hammers, were found at several localities in Qesem Cave. It is worth noting that bifacial reduction, characterizing handaxes, and the Quina retouch, characterizing ‘Yabrudian side-scrapers’, were suggested to be partially made by soft hammer (e.g. Bourguignon 2001; Copeland 2000:101). Although it was claimed that such techniques do not necessarily reflect a difference in hammers but rather a specific method of using the hammer (Sharon and Goren-Inbar 1998), the finding of a worked antler of *Cervus* with battering marks on one of its ends in the lowest layer of Zuttiyeh (Bate 1927b:47, Plate XVII:6) supports the use of a soft hammer in the Acheulo-Yabrudian complex for some purposes. The above techniques indicate that the use of hard hammers for hitting deep inside the striking platform for laminar production was an intentional choice and not the result of a lack of know-how. The benefit of hitting deep inside the striking platform lies in the correlation between the butt size and the item’s measurements; in general, the larger the butt, the larger the item (Dibble and Whittaker 1981; Pelcin 1997; Pelegrin 2005). This choice fits the conclusion from the analysis of the laminar items, which showed that the Amudian knappers did not seek to create delicate blades. Another important advantage is that it enabled an easier reduction of items which followed through the entire length of the debitage surface.

Various blank types were produced in the reduction sequence. From some of the cores it was possible to produce almost exclusively blades, PE blades and NBKs, while from other cores the production of these three laminar types was accompanied by the production of flakes and NBKs with flake proportions (‘blade-flakes’). In my analysis I referred to the former as 'laminar cores' and to the latter as ‘laminar and flake cores’. In general, ‘laminar cores’ were made on relatively narrow raw material (ca. 3 cm) and ‘laminar and flake cores’ were made on wider raw material (Table 39).

The experimental knapping demonstrated that the reduction of blades, PE blades, NBKs, and even flakes and ‘NBK-flakes’, was complementary – each of these blank types helped shape the outline of the next detached blank. Removal of specific laminar types and its combination with flake reduction was in accordance with the core’s character. The experimental knapping demonstrated that the relative amount of produced blades, out of the three laminar types, generally increases in correlation with the debitage surface width. It was also found that when the width of the debitage surface exceeds approximately 4 cm, the reduction of laminar items is performed better with an adjoining flake removal. The amount of each of the three laminar types at the examined sites may contribute in demonstrating this aspect. While at Qesem Cave the three laminar types appear in approximately equal amounts with blades being only slightly more common, in Tabun XI and especially in Yabrud I-15 blades are clearly more numerous than the other two laminar types. The high representation of PE blades and NBKs at Qesem Cave correlates with the cores being relatively thin on average (Table 39) and with their having commonly been made of flat flint slabs with two cortical sides. The higher percentage of blades and the lower, but equal, percentage of PE blades and NBKs in Tabun XI correlate with the cores being wider on average but still characterized by a debitage surface framed by two cortical sides. In Yabrud I-15, where blades are highly common and PE blades and NBKs are few, their relative amount was affected less by the debitage surface width but rather by the more common use of split raw material for cores on which the debitage surfaces were not framed by two cortical sides.

The experimental knapping further demonstrated that not peeling the cortex prior to the reduction causes unavoidable removal of PE blades. Removal of NBKs, on the other hand, was found to be avoidable and thus assumed to be well controlled and intentionally produced. This is in contrast to some cases of the Middle Paleolithic industries where NBKs are reported to be *debordant* flakes (Marks and Monigal 1995; Meignen 1995). It was also found that if the purpose was to maximize the number of produced blades, than it was better to avoid producing NBKs, since their removal reduces more mass from the cores that could have been used for blades. This is also supported by some later laminar industries which used flat cortical nodules without peeling the cortex; in these assemblages one can find PE blades but only rarely items resembling NBKs (e.g. Futato 1996; Shimelmitz 2002).

In cases where the laminar production was combined with flake reduction, the removal of laminar items usually focused near one of the lateral edges, using its more angular outline. In some particular cases, flake removal focused on both lateral edges, accentuating the angularity of the debitage surface so that the laminar items could be reduced from its center.

The number of laminar items detached in each series of production (using the entire debitage surface width) can best be estimated by the number of parallel laminar scars on the ‘laminar cores’ which ranges in mean from 2.5 to 2.9 at all the sites (Table 39). The fact that the number of laminar scars on overpass items removed along the course of the laminar reduction is quite similar (Chapters 4-6) indicates that a low number of laminar scars characterized the cores not only in their discarded state, but rather all along the reduction. A major difference, with a statistical significance, between the 'laminar cores' and the 'laminar and flake cores', when examining all sites together, is that the former have more laminar scars ($t[141]=2.74$, $p<0.05$). The fact that both the maximum width and the debitage surface width of the 'laminar cores' are narrower, with a statistical significance, than that of the 'laminar and flake cores' ($t[150]=4.99$, $p<0.05$; $t[142]=4.57$, $p<0.05$ respectively) indicates that using a wide debitage surface did not necessarily lead to the reduction of more laminar items. This is due to the flake removal in the ‘laminar and flake cores’ which exploited an extensive portion of the debitage surface.

The precise character of the reduction of blades, PE blades and NBKs along this sequence was slightly different. There is a repeating pattern among all the samples, of blades being characterized by the highest percentage of modified butts and PE blades by the lowest. This signifies that out of the three laminar types, the effort in removing and controlling the shape of PE blades was the smallest. Abrasion was not performed as in later laminar industries, but the presence of micro flaking along the exterior of the butts in varied frequencies among the three laminar types and the different butt types raises the possibility that it was conducted as supplementary shaping before detaching laminar items. An important difference in the shaping of the butts, between the sites, is that while in Qesem Cave thick plain butts are the most common, in Tabun XI and Yabrud I modified butts are the most common (Table 37).

The hammerstone's point of impact on the butts shows some variation between the three laminar types. Among blades, the point of impact was mostly in the middle of the butt, probably contributing to achieving fairly symmetrical blades with a triangular cross-section and two sharp edges with acute angles. Although in the case of PE blades and NBKs the point of impact was also commonly placed in the middle, a considerable number, especially among NBKs, was placed near the cortical edge. The latter method contributed to accentuating their back and in making the profile of the sharp edge straighter (see Pp: 87-88).

The force applied in the removal of the three laminar types differed as well and in general more force was used for removing NBKs. This is concluded from their slightly larger mass (mainly reflected in their being thicker than blades and PE blades) and from their more common overpassing end termination.

Fluctuations and stability of the core shapes

In the beginning of the reduction the cores most commonly had an 'amorphous front', a prismatic or a 'parallel edges' shape. While the former two appeared both as 'laminar cores' and 'laminar and flake cores', the latter appeared only as 'laminar cores'. The cores with an 'amorphous front' shape lack a defined outline and they are mostly characterized by a debitage surface covering only a small portion of the core's circumference, usually located in a carinated part. Prismatic cores have a relatively flat debitage surface with parallel scars and the cores with a 'parallel edges' shape are characterized by a well defined form of the debitage surface which is constrained by the core's two fairly uniform sides.

In general, these shapes were affected by the character of the raw material, and therefore the different selection of raw material had crucial consequences. Cores with 'parallel edges' shapes were mostly made of flint slabs and flat flint nodules, exploiting their naturally narrow character. A few cores with this shape were made on large flakes and recycled flint items in cases where their contour provided two parallel edges between which the debitage surface could have been framed. In Qesem Cave the use of flint slabs was the most common and ‘parallel edges’ cores are the most prevalent (when counting ‘laminar cores’ and ‘laminar and flake cores’ [Table 39] a statistically significant difference was found between Qesem Cave and Yabrud I-15: $X^2=6.43$, $df=1$, $p<0.05$). In Tabun XI and Yabrud I-15, where rounded and amorphous nodules were more commonly used, cores with prismatic and ‘amorphous front’ shapes are more frequent when grouped together (Table 39).

One of the fundamental differences between these core shapes is that among cores with a 'parallel edges' shape the debitage surface could have retained its contour all along the reduction. This characteristic enabled the serial removal of laminar items in a way that each series highly resembled the former, following the same outline. In contrast, among cores of the 'amorphous front' and prismatic shapes the debitage surface was not constant in contour during the reduction. The shape of these, relatively wide cores, could have easily changed and alternated from 'amorphous front' to prismatic and occasionally even vice versa. With these cores the reduction could also have shifted from the removal of laminar items solely, to the combined removal of laminar items and flakes and vice versa (Figs. 181, 398).

While the width of the debitage surface was not constant during the reduction, except in the case of cores with the ‘parallel edges’ shape, its length was quite stable. This was concluded from the comparison between the length of the ‘initial’ overpass items to the ‘correction’ and ‘regular’ overpass items which were removed during the course of laminar reduction and show similar results. The ability to remove items with a similar length along the bulk of the reduction should be regarded as one of the industry’s innovations. The decrease in length as apparent by the shorter length of cores probably occurred only near the core’s abandonment.

Cores with prismatic or ‘amorphous front’ shapes could also alter into ‘pyramidal’ or ‘narrowed prismatic’ shapes in the course of the reduction. Both of these cases represent an extension of the production towards the core's sides by making the debitage surface arched or angular. The items reduced from the sides can be flakes or laminar and their removal usually conjoined into a roughly pointed/sharp base. In both cases there was no further potential for removing NBKs. Of these two shapes, it is the ‘narrow prismatic’ that shows more planning. With these cores, the reduction from the sides gave them a narrow and homogenous shape which provided all the advantages found in the ‘parallel edges’ shape. Of all the Amudian core shapes, it is the ‘narrowed prismatic' that are the most similar to the blade cores found in Upper Paleolithic assemblages. This core shape is prevalent only in Yabrud I-15, with a statistically significant difference from both Qesem Cave (X^2=28.82, df=1, $p<0.05$) and Tabun XI (X^2=4.63, df=1, $p<0.05$). The pyramidal core shape is found only at Qesem Cave and its presence was found to be different from Yabrud I-15 with a statistical significance (X^2=4.08, df=1, $p<0.05$).

<u>Maintaining the striking platforms</u>

During the course of laminar reduction the striking platform was most commonly maintained by faceting. This faceting was rarely heavily performed and usually consisted of few removals, as indicated by the laminar items' butts. Maintaining the striking platform using the removal of core tablets was less common, as indicated by their low percentage among the CTEs in all samples. It is of note that even in the few cases where core tablets were reduced, their detachment usually led to the removal of only a portion of the striking platform and not its entire circumference. In this they are not very different from faceting in that both strategies generally treated only a segment of the debitage surface.

<u>Maintaining the debitage surfaces</u>

One of the benefits of the Amudian laminar technology is the heavy blows of knapping and the removal of laminar items that followed through the entire debitage surface, which served as a maintenance action all along the reduction. This procedure usually kept the debitage surface clear of hinges and with the required curvature. The main evidence of this is the overpassing end termination found on the laminar items, mainly on NBKs. This practice differed however between the three sites (Fig. 401). While in Qesem Cave about one of every four laminar items (including blades, PE blades and NBKs) had an overpassing end termination, in Tabun XI it was one out of five and in Yabrud I-15 one out of six. It can be concluded that removal of items by follow-through blows was most commonly practiced in Qesem Cave and the least practiced in Yabrud I-15, the difference between them being statistically significant (X^2=5.20, df=1,$p<0.05$). Another reflection of its lesser use in Yabrud I-15 is that the cores from this sample are characterized by the largest difference between the number of parallel scars and the total number of laminar scars on the debitage surface (Table 39). This difference can only have resulted from laminar items that did not follow-through the entire length of the debitage surface and did not completely remove former scars.

The removal of overpass items (referring to the ‘correction’ and ‘regular’ categories) played a major role in maintaining the debitage surface. The reduction of rejuvenation crested blades is also well present in each of the samples. In these, the shaped ridge was usually minimal, covering only a small portion of the item's length, concentrating at the distal end. The removal of an overpass item or of a crested blade as a maintenance action affected the debitage surface differently. The detachment of overpass items not only removed the entire length of the debitage surface but also a large portion of its width. In all the sites the mean width of the overpass items is quite similar to that of the cores. In Qesem Cave the removal of several of the overpass items clearly peeled the entire debitage surface as indicated by the presence of cortical surfaces at both lateral edges. The detachment of rejuvenation crested blades, on the other hand, did not necessarily remove the entire length of the debitage surface and removed only a small portion of its width. In other words, while the removal of overpass items renewed a significant area of the debitage surface, rejuvenation crested blades renewed a precise and limited area. Viewing both of the CTE types as ‘by-products’, the crested blades are less expensive in terms of raw material mass. In order to find which method was more commonly used to maintain the cores along the course of laminar reduction, I united the overpass items (‘correction’ and ‘regular’) with the rejuvenation crested blades and examined their relative percentages (Fig. 402). The results show that overpass item removal was much less common for maintaining the debitage surface in Yabrud I-15 than in Qesem Cave ($X^2=6.69$, $df=1$, $p<0.05$) and Tabun XI ($X^2=6.0$, $df=1$, $p<0.05$) with a statistical significance.

Another examination of this aspect uses two sets of ratios, each relating to the three laminar types. The first set is their ratios to rejuvenation crested blades, and the second to 'correction' and 'regular' overpass items (Table 38). The first set of ratios shows that in Qesem Cave the systematic reduction of laminar items was performed while only rarely needing the removal of rejuvenation crested blade (44\1). In Tabun XI the use of rejuvenation crested blades was more common as indicated by the significantly lower ratio (23.9\1) and in Yabrud I-15 it was relatively common (15.9\1). In this aspect Qesem Cave is significantly different from both Tabun XI and Yabrud I-15 ($X^2=5.09$, $df=1$, $p<0.05$; $X^2=14.67$, $df=1$, $p<0.05$ respectively). The removal of overpass items during the course of the laminar reduction was also the less common in Qesem Cave (17/1). But in this case, Yabrud I-15 shows a rather similar ratio, while in Tabun XI overpass item removal was well practiced (8.4/1). The difference between Qesem Cave and Tabun XI is statistically significant (X^2=16.08, df=1, $p<0.05$). The fact that in Qesem Cave both rejuvenation crested blades and overpass items show the highest ratio of all three sites demonstrates that maintenance actions were not often necessary during the reduction, probably due to the more common reduction of laminar items with an overpassing end termination.

The debitage surface was also maintained from the core base, as observed by the overpass items and cores. In Qesem Cave and Tabun XI it appears on about a third of the overpass items, while in Yabrud I-15 it appears on more than a half of them. The difference between Qesem Cave and Yabrud I-15 is statistically significant (X^2=5.22, df=1, $p<0.05$). Their presence on the cores themselves (including only single striking platform cores; Table 39) also varies. In Tabun they appear in the lowest percentage (14.3%), in Qesem Cave they appear on about one third of the cores (31.8%) and in Yabrud I-15 they appear on more than a half (58.8%). In this case Yabrud I-15 is statistically different from Qesem Cave (X^2=7.49, df=1, $p<0.05$) and from Tabun XI (X^2=12.84, df=1, $p<0.05$). Another major difference is in the character of the base modification. While in Qesem Cave and Tabun XI most of the base modifications are in the form of small flake removals, in Yabrud I-15 one fifth of all of the overpass items show the removal of single blades or bladelets from the base. In this case Yabrud I-15 is statistically different from Qesem Cave (X^2=24.63, df=1, $p<0.05$) and Tabun XI (X^2=5.92, df=1, $p<0.05$). Another indication of this type of base modification is in the laminar items with a bipolar scar pattern which were found in substantial numbers only in Yabrud I-15.

During the reduction several maintenance methods could have been performed on the same core in order to sustain the systematic production of laminar items. In some cases several maintenance methods were conducted simultaneously in order to correct a specific problem. This sophisticated performance is expressed by the presence of the overpass items with shaped ridges or base modifications found in all the samples. In these cases the problem was first dealt with by correcting it from the base or by forming a ridge and than later by removing an overpass item which concealed all traces of earlier treatments.

Another method of maintaining the reduction was by accepting that the reduction from a specific area of the core had lost its potential and a better way to keep exploiting the core was to abandon the debitage surface in favor of opening a new one. Although this choice was practiced to some extent in all the samples as indicated by the cores with two striking platforms, it was more frequently used in Qesem Cave (19.0%) and Tabun XI (24.3%) than in Yabrud I-15 (7.9%) (the percentage is out of all ‘laminar cores’ and ‘laminar and flake cores’).

Core discard

Several reasons for discard were documented at the various sites. In general, only few cores were not utilized to exhaustion. The reduction of laminar items had usually stopped at a fairly similar point – a few mm below the mean length of the laminar items. Other reasons for core discard include hinge scars, extremely large overpass removals, raw material impurities and striking platform complications. It is of note that in most of the latter cases the cores were near exhaustion and thus correcting these problems was ineffective.

Summarizing the variability within the reduction sequence

The above reconstruction shows that the reduction sequence was dynamic and that each step was comprised of technological choices made out of a large pool of possibilities. The dynamicity of the production can be seen as a “dialogue” between the knapper and the raw material. In this metaphor the dialogue's subject are the end-products planned by the knapper. The dialogue itself is expressed by the interaction between the different reduction methods known to the knapper and the properties of the raw material. This is supported by the fact that an end-product can usually be achieved by more than one mode of production (e.g. Boëda 1995; Débenath and Dibble 1994:12; Marks and Volkman 1983; Meignen 1995) and the knapper chooses according to the quality and shape of the raw material one of the techniques that he/she has mastered . The “dialogue” further continues with each reduction strategy possibly being characterized by specific knapping errors which the knapper needs to overcome using his particular chosen methods.

The trajectories of the reduction sequence from the three sites are illustrated in Figs. 403-404. My analysis found that almost all of the different methods (technological choices) used at each step of the reduction sequence appear at all three sites, thus indicating that the knappers shared the same 'know-how' (e.g. Annet 1996; Parker and Milbrath 1993) regarding laminar production. There were however, substantial differences between the three sites in the frequencies of the specific technological choices made along the reduction sequence.

These differences are already reflected in the raw material selection. While in Qesem Cave flat flint slabs were commonly favored, in Tabun XI and Yabrud I there was a preference for rounded or amorphous nodules, mostly fist size or larger. As noted above, the difference in raw material is the result of preference and not the lack of certain types of raw materials in the site's surroundings. A varied selection of raw material by different groups that are part of the same cultural complex was observed in other cases as well (e.g. Kuhn 1995:108; Van-Peer 1991:138). Although choosing a specific raw material led to a smaller range of technological choices for controlling the reduction (e.g. Kuhn 1995:105), my analysis shows that different choices were made even when working with similar raw material types. One piece of evidence for this is the utilization of rounded and amorphous nodules which were treated differently for the production of laminar items. Although among all sites they were often shaped into prismatic or 'amorphous front' cores, there was a difference in the use of the other options. In Yabrud I-15 there was a common trajectory for making them in the shape of 'narrowed prismatic' which was rarely the case at the other sites. Another difference is in the pyramidal cores. The technological choices leading to this specific shape were only conducted at Qesem Cave.

Another major difference is in the maintenance of the cores along the reduction. At Qesem Cave the production was engaged with the frequent removal of laminar items which followed through the entire length of the debitage surface. The constant removal of such items during the entire reduction preserved the convexity necessary for knapping and reduced the need for core maintenance by removing overpass items or crested blades. At Tabun XI and Yabrud I-15, where follow-through blows were less pronounced, the removal of overpass items and crested blades for maintenance was higher than at Qesem Cave. The production from Yabrud I-15 is also characterized by a higher frequency of base modification. Here as well, these differences do not seem to be related to the used raw material.

Patterns of Selection for Secondary Modification

Selection patterns were deduced from comparing blanks and shaped items and by identifying which attributes are more common among the latter. While selection patterns of blades were possible to observe among all the three sites, PE blade and

NBK patterns of selection could only be examined at Qesem Cave and Tabun XI and not in Yabrud I-15 due to its small samples. The results from the three studied sites show that while some attributes are characterized by the same patterns of selection for secondary modification, others are not. Before addressing each of the three laminar types separately it is important to note that the selection of longer, wider and thicker laminar items for secondary modification characterized them all and it is repeated at the three sites. This pattern indicates that the Amudian knappers did not seek out delicate laminar items, but rather more robust items that could be easily held by hand.

Among blades the following attributes were favored in all the samples: more acute edge angles, a parallel shape, a curved profile, two laminar scars on the dorsal face, less hinge scars and a modified butt. The common rejection of items with an irregular shape, an irregular or a convex profile, and a thin plain butt also characterized the blade selection at the three sites. It is also worth noting cases where the same selection pattern was observed at two sites, while at the third site the specific pattern was not positively or negatively represented (Table 40). These include the selection of blades with triangular or trapezoidal cross-sections and with the bulb of percussion in the middle of the butt. It also includes the common rejection of items with irregular or right-angle trapezoidal cross-sections.

Among the PE blades from Qesem Cave and Tabun XI the following attributes characterized the selection pattern: a more acute angle of the cortical edge, the presence of a sharp edge and an opposed cortical edge, a straight sharp edge, a triangular cross-section, one laminar scar on the dorsal face, a bulb of percussion in the middle of the butt and less hinge scars. The common rejection of items with an irregular outline of the sharp edge, irregular cross-section, and twisted or irregular profiles also characterized the PE blades' selection for secondary modification.

In the case of NBKs from Qesem Cave and Tabun XI the following attributes were preferred: a right-angle trapezoidal cross-section, a curved profile, a modified butt, a bulb of percussion in the middle of the butt, two laminar scars on the dorsal face and less hinge scars. The selection is also characterized by the common rejection of items with an irregular outline of the sharp edge, a semi-straight or twisted profile and a thin plain butt. The selection patterns of NBKs show a number of striking dissimilarities to the selection patterns of blades and PE blades. These include the fact that items with an irregular cross-section and irregular profile that were generally rejected in the case of blades and PE blades were not rejected in the case of NBKs.

This aspect suggests that the NBKs were in fact primarily intended to be used as hand-held knives without further treatment, as was found in the use wear analysis of Qesem Cave (Lemorini *et al.* 2006), and that the items that were secondarily modified were not necessarily the best blanks produced but rather the ones that were less alike the 'ideal' end-product.

While the above attributes attest to a common ground in the case of the selection patterns from the three sites, other attributes presented in Table 40 show a difference. It is of note that the examination of each of the five samples from Qesem Cave separately shows that some variations in selection patterns can even appear at the same site (see Chapter 4; Pp: 97).

The possibility that the differences in the selection pattern at the three sites contributed to diminishing differences that might occur due to the variability in the reduction sequence or used raw materials was investigated. The question behind this inquiry is whether the different selection patterns might have calibrated the small differences observed in the end-products into a more uniform representation. In such a case the shaped items from the various sites should be more similar in character than the blanks. The simplest examination for this is the differentiation in size. While in Tabun XI the produced laminar items are larger than in Qesem Cave and Yabrud I-15, the selection was still in favor of the larger items. If the purpose was to calibrate the difference, smaller blanks should have been selected. Also in the case of the other attributes which show different selection patterns, I did not observe situations in which the selection actually diminished the difference between the sites. In other words, this possibility was found to be invalid.

Another factor which might have affected the selection patterns (and the production itself) is a correlation to the specific types of shaped items made on the laminar items. This option demands an examination especially due to the typological difference between Tabun Ea-Eb/Unit XI and Yabrud I-15 – a difference that was used by some scholars to distinguish the Amudian from the Pre-Aurignacian (e.g. Garrod 1970; Jelinek *et al*. 1973:174; Vishnyatsky 2000). This difference is mainly reflected in the more common appearance of backed knives in the Amudian and the more frequent appearance of end-scrapers and burins in the Pre-Aurignacian. These typological differences however address not only the laminar items but all shaped items. For example, many of the burins and end-scrapers of Yabrud I-15 were made on flakes (Rust 1950; Vishnyatsky 2000). My typological division which focused only on the shaped items made on laminar types also shows that burins appear in exceptionally high percentage in Yabrud I-15 and backed knives appear at the highest percentage at Tabun XI. Nonetheless, in examining the entire distribution of shaped items made on laminar types the difference between the sites is not large (Fig. 405). In other words, the possibility that the difference in the selection pattern between the three sites correlates to a difference in the intended tools seems small.

Several other aspects from my study demonstrate that the use of specific laminar types for secondary modification did not vary greatly between the sites. First is the similar composition of the three laminar types among the shaped items – in all three sites blades constitute 57.5-69.0%, PE blades 16.5-26.6% and NBKs 11.5-15.9% (overpass items, crested blades and burins are not included). Second, the blades, which were most often secondarily modified out of the three laminar types, show the highest similarity among the three sites. In all three sites the majority of the blades (58.8-70.3%) were shaped into 'retouched laminar items' (i.e. retouched blades), while each of the other shaped types usually constitutes only a small percentage. PE blades and NBKs show a more diverse use as secondarily modified items among the three sites. In all three sites however, the percentages of PE blades and NBKs shaped into 'distally retouched laminar items', end-scrapers and burins are higher than in the case of blades. Crosscutting these results by examining the composition of each of the shaped types shows that in all three sites 'retouched laminar items' as well as backed knives were most commonly made of blades. The other types, including 'distally retouched laminar items', end-scrapers, side-scrapers, burins and notches, some of which appear in only limited numbers, did not show any repeated pattern, but rather a diverse use of various laminar types.

In conclusion, there is a high similarity in the selection patterns for secondary modification among the three sites. However, the fact that the selection patterns are not identical is of importance, since this is indicative of some differences between the sites.

Summarizing the Differences and Similarities among the Three Sites

The comparison between the Amudian facies from Qesem Cave, Tabun XI and Yabrud I-15 regarding end-products, reduction sequence and patterns of selection shared some similarities as well as differences; here I wish to summarize them.

End-products

1. The relative amount of the three laminar types differs – while in Qesem Cave, blades, PE blades and NBKs are fairly equally represented, in Tabun XI and Yabrud I-15 blades dominate.
2. When each of the three laminar types – blades, PE blades and NBKs are examined separately, a high similarity is observed. Nonetheless, there are differences and the items are not completely identical at the three sites.

Reduction sequence

1. Although the surrounding of each of the sites contains a variety of raw material types, including both nodules and flint slabs, the selection of raw material differed. While at Qesem Cave flint slabs were highly favored, at the other two sites rounded or amorphous nodules, mostly fist sized were preferred.
2. The reduction sequence included various technological choices made along its course. The results demonstrate that almost all the procedures appear at all the sites, whereby the major difference is in the intensity with which they were practiced. While some of these different choices can be explained by the selection of raw material, others cannot.

Patterns of selection of blanks for secondary modification

1. The various patterns of selection demonstrate that the character of the sharp edge was one of the major aspects desired.
2. The composition of the shaped types made on the laminar items is fairly similar among the three sites.
3. Blades constitute the main laminar item selected for secondary modification among all three sites.
4. NBKs were the least selected for secondary modification and since the technological reconstruction demonstrated that they are desired end-products and not ‘by-products’ it is assumed that their major use was without secondary modification.
5. In terms of the various attributes examined there are some major similarities among the sites. Nevertheless, there are some differences as well, indicating that the pattern of selection was not completely identical.

In the above section I elaborated on the variation in the Amudian facies between the sites, yet the variation as it appears within the sites (discussed in Chapters 4-6) is also of importance. In general, the difference in the laminar technology between the sites is greater than the difference found within each of the sites. This is best demonstrated by Qesem Cave from which I examined five samples, all of which show a preference for flat flint slabs and a reduction sequence characterized by many items which followed through the entire debitage surface. None of the many beds that composed the Amudian of Tabun XI showed this preference and neither did the two Yabrud I Pre-Aurignacian samples. However, while Qesem Cave showed a high resemblance between the five samples with only minor variations, a larger difference was observed in the case of Yabrud I-13 and Yabrud I-15.

The Laminar Production within the Acheulian and Yabrudian Facies

Characterizing the laminar production from the Yabrudian and Acheulian faceis of the Acheulo-Yabrudian complex is not an easy task since it usually constitutes only a small component of the assemblages. My study explored this aspect by examining the Acheulian and Yabrudian facies from Tabun XI and Yabrud I-11/12. These specific cases include a relatively higher percentage of laminar items than in the other Acheulian and Yabrudian layers within these sites (Bordes 1955:507, Tableau 1; Jelinek *et al*. 1973). In the case of the Yabrudian facies of Tabun XI a good representation of all three laminar types as well as CTEs was retrieved. In the other cases the number of laminar items is small and only blades are well represented. The difference between these facies and the Amudian facies as it appears in Tabun XI and Yabrud I was discussed in Chapters 5 and 6 and here I will only provide a brief summary.

A repeated pattern found at both Tabun XI and Yabrud I is that the laminar items from the Yabrudian and Acheulian facies are more robust than those of the Amudian facies as attested to by their larger size (a sole exception is in the length of blades from the Acheulian of Tabun XI; Table 37). In addition, the laminar items from the Yabrudian and Acheulian facies have a lower length/width ratio and a higher width/thickness ratio than that of the Amudian facies. As for the other attributes the picture is more complex and each of these sites shows a different pattern.

The Three Facies of Tabun XI

The laminar production of the three facies from Tabun XI generally presents the same character entailing five major differential aspects:

1. In reconstructing the reduction sequence it was found that out of the three facies of Tabun XI, the laminar production from the Amudian facies shows the highest quality of knapping. Examples of the less controlled reduction from the Yabrudian and Acheulian facies can be seen in attributes including 'irregular' or 'non-uniform' categories, which appear in higher percentages (Table 41).
2. The analysis of the three laminar types and the CTEs shows that the patterns identified in the Amudian facies are generally more similar to those of the Yabrudian facies and more remote from those of the Acheulian facies.

3. Several of the attributes examined show a pattern of increase or decrease in frequency when the facies are ordered as follows – Amudian, Yabrudian and Acheulian. This pattern, along with the presence of other attributes which show a complete resemblance among the three facies, indicates that the same reduction sequence with small variations was conducted within them.
4. The differences among blades, which are the most common laminar type in Tabun XI, are smaller than the differences among PE blades or NBKs.
5. The selection of items for secondary modification differs between the facies. These differences are important since they indicate that not only the reduction sequence was slightly varied, but also the demands. It was found that the more meticulous reduction performed in the Amudian facies correlates to a selection pattern aimed at using more uniform laminar items.

The Acheulian and Amudian (Pre-Aurignacian) Facies of Yabrud I

The laminar production from the Amudian facies of Yabrud I-15 and the Acheulian facies of Yabrud I-11/12 are characterized by a number of similar traits alongside a number of pronounced differences.

1. The similarities include a high use of base modification for maintaining the debitage surface, the appearance of cores with a 'narrowed prismatic' shape, a relatively low use of follow-through blows, and a reduction that has a propensity not to be fully symmetrical but rather tend towards one side or the other.
2. The differences are characterized by the fact that the blades from Yabrud I-11/12 have a higher percentage of pointed shapes, pointed end shapes and trapezoidal cross-sections. It is of note that the percentages of these attributes are even higher in comparison to other Amudian samples (Table 37).
3. The laminar production of Yabrud I-11/12 does not seem to have been less meticulously performed than that of Yabrud I-15, as indicated by the attributes including ‘irregular’/’non-uniform’ categories which are fairly similar in frequency among both (Table 41). This is further indicated by the common production of blades with a trapezoidal cross-section.
4. The larger difference between Yabrud I-15 and Yabrud I-11/12 in comparison to the case of the three facies of Tabun XI is intriguing. Since the possibility of intrusive material from the overlying Mousterian does not seem to be the

cause for the different character of Yabrud I-11/12 (see Pp. 298-299), it is possible that it represents a shift in the laminar technology which occurred at the very end of the Acheulo-Yabrudian complex.

An Additional Reduction Sequence for Manufacturing Massive Cortical Laminar Items

While most of the laminar production in the Yabrudian and Acheulian facies followed the main guidelines of the Amudian facies, another reduction sequence within these facies was aimed toward the production of massive cortical laminar items. These items appear in small numbers and are mainly recorded as PE blades. Their size exceeds 10 cm in length and four cm in width and their length/width ratio is only slightly higher than 2/1. Some were shaped into side-scrapers. There were no clear indications however of their reduction sequence at the examined sites.

These massive cortical laminar items are present in small numbers at other sites of the Acheulo-Yabrudian complex as well. For example, Copeland (1975:324-325, Fig. 3:11) notes the presence of "Bezez type racloir" which has a natural cortical back and was shaped on a massive cortical laminar item. Another possibility is in the site of Ras Beirut II, where Hours (1975) mentioned the presence of large blades, some of which are cortical. Although the site was tentatively ascribed to the Tayacian due to the absence of bifacials, there is a possibility that it is part of the Acheulo-Yabrudian complex (Hours mentioned that it is does not resemble Tabun G). Large laminar items, some of which are cortical, were also found at the Lion Spring (Azraq, Jordan) within an Acheulian assemblage with Yabrudian elements (Copeland 1989a:228, 233, Figs. 3:1, 3; 8:2).

The Contribution of the Laminar Technology Investigation to the Understanding of the Acheulo-Yabrudian Complex and the Late Lower Paleolithic

The above account described the Amudian laminar technology and its appearance in the other facies of the Acheulo-Yabrudian complex within the sites of Qesem Cave, Tabun and Yabrud I. In this section I will endeavor to illustrate how the study of the laminar technology leads to a better understanding of the Acheulo-Yabrudian complex and the Late Lower Paleolithic.

Predetermined Blanks and Prepared Technologies

The high degree of similarity between the Amudian laminar items from the three sites implies that their character was controlled. It further indicates that the knappers at the three sites shared the same general concept of the desired end-product. In broader perspectives, it suggests the presence of a mutual *mental template* (e.g. Deetz 1967:45-47; Monnier 2006) of how these end-products should be. Technologies intended to guide the production of specific blanks are referred to as 'predetermined debitage' and appear even earlier in the Lower Paleolithic, as represented by the Kombewa technique and the Levallois technology (Inizan *et al.* 1992:47; Rolland 1995; Tyron *et al.* 2006). Both of these examples are found in the Lower Paleolithic Acheulian of the Levant (Belfer-Cohen and Goren-Inbar 1994). Handaxes are argued to reflect the same notion as well, since their shapes are presumed to be predetermined according to a mental template (e.g. Pelegrin 2005).

Predetermined debitage techniques usually go hand in hand with prepared core technologies. This is especially the case with the Levallois technology (e.g. Boëda 1995; Boëda *et al.* 1990; Dibble and Bar-Yosef 1995 and references therein). The procedure of *façonnage*, a preparation stage before the reduction of the end-products, which involved reducing the nodule into a specific shape using flaking (e.g. Boëda 1995), rarely occurred in the Amudian (with some exceptions in Yabrud I-15). The Amudian technology filled this need by focusing on selecting perfectly fitting raw material or by a combined reduction of laminar items and flakes.

Pelegrin (2005:28) in reference to predetermined debitage techniques emphasizes that "the results of elaborated knapping procedures include standardized products, the formal features of which are completely independent of the initial morphology of the raw material". In the case of the Amudian technology the laminar items are not independent of the raw material morphology, but this was not always the case in the Middle Paleolithic Levallois technology as well (e.g. Kuhn 1995). I suggest that the importance in this aspect is that raw material morphology did not play a major role and that the elaborate technology enabled to overcome most of the raw material constraints. The Amudian laminar production demonstrates this quality in that the similar end-products from the three examined sites were achieved when reduced not only from flat flint slabs, but also from rounded and amorphous nodules of various sizes. The similar and predetermined blanks were obtained by following a set of procedures along the reduction. The systematic reduction of laminar items is argued to manifest a predetermined blank production, in which the removal of each laminar item defines the contour of the following detached item (e.g. Boëda 1995; Clark 1985). This is clearly exemplified in my study of the Amudian by the cores described as the 'laminar core' group.

When exploiting rounded or amorphous nodules, as was especially common in Tabun XI and Yabrud I-15, flakes were also frequently reduced from the debitage surface alongside the laminar items. This reduction trajectory shows a high sophistication as well, since in these cores the exact outline for the reduction of laminar items was prepared and guided by the adjoined flake reduction. The importance of such a procedure was emphasized by Pelegrin (2005:30): "When intimately combined in an elaborated core-reduction process, there is a clear hierarchy in the production of predetermin*ed* flakes – intended as products – and predetermin*ing* (or shaping) flakes within that same *chaîne opératoire*. I see this as evidence of a wholly new – and a decidedly 'modern' – cognitive dimension in stone knapping". Although in terms of the technology the hierarchy is clear, some of the reduced flakes were useful blanks. The use of 'by-products', or perhaps more correctly 'side-products', was an early human habit, as has been recently argued (Goren-Inbar *et al*. 2008). The fact that a significant portion of the overpass items and crested blades from the examined Amudian assemblages were secondarily modified supports this argument.

Although prepared core technologies are found in some Lower Paleolithic Acheulian sites (e.g. Belfer-Cohen and Goren-Inbar 1994; Madsen and Goren-Inbar 2004), they became a major component only in the Middle Paleolithic assemblages. Lahr and Foley (2001) argued that the main feature of 'Technological Mode 3' (Middle Paleolithic) is prepared core technologies and that this concept marks the rise of new capabilities of the hominids. It is assumed that such a complex knapping procedure, which involved a variety of technological choices along each step of the reduction, attests to high cognitive capabilities (Karlin and Julien 1994). Lahr and Foley (2001) are aware of the few cases where laminar production was found in Lower Paleolithic contexts but did not regard them as suited to this concept. The Amudian laminar production, although showing only a small degree of preliminary core preparation, pushes the heart of this concept – the ability to produce predetermined blanks – backward in time into the Acheulo-Yabrudian complex. The importance is that in contrast to the Lower Paleolithic Acheulian, where production of predetermined blanks appeared occasionally, in the Amudian it became the major feature of the reduction.

The possibility of standardization is also raised due to the high degree of similarity among the Amudian laminar items. Standardization of Paleolithic stone tools (e.g. Ashkenazi 2005; Monnier 2006) is still a controversial issue and its presence or absence is highly affected by the characteristics we choose to examine (Marks *et al.* 2001). In general, standardization of lithic items may be reflected in blanks and secondary modification (Monnier 2006). In following with the same logic, Marks *et al.* (2001) differentiated between standardization in *process* and standardization in *form*. They argued that the latter is more important by assuming that the intentional act is more visible in a form made by secondary modification (preferably not one that has been resharpened) than in cases where it is the result of a specific reduction sequence, in which it is possibly a by-product of the process.

In the case of the laminar items from the three Amudian sites, I did not explore the secondary modification but rather focused on the characteristics of the laminar types. It is of note however that in most cases the secondary modification was light and did not dramatically alter the blanks. There is no doubt that the homogeneity within the Amudian laminar items is at least partly a result of a process. However, I argue that the similarity of the laminar items among the three sites cannot be explained only by process. As noted, the fact that the reduction sequence by which they were produced was slightly different within the various sites indicates that the similarity in end-products was predetermined. Such an ability to follow a mental template was argued to indicate planning depth and was suggested by McBrearty and Brooks (2000) to be an indicator of modern human behavior. Although it was recently argued that we lack evidence indicating standardization related to a 'mental template' prior to the Upper Paleolithic (Monnier 2006), the case of the Amudian laminar production may support a rather different scenario.

Naturally Backed Knives and Ergonometrics

NBKs characterize all the examined samples, although at different frequencies. In my technological reconstruction, which is supported by experimental knapping, I demonstrated that the reduction of NBKs must be intentional and planned. Since the NBKs were the least selected for secondary modification out of the three laminar types in all the examined sites, it is assumed that they were designed to be used without secondary modification. This is further evidenced by the use wear study (Lemorini *et al.* 2006).

The morphology of these items is what made them suitable to be used as hand-held knives. The sharp edge of the NBKs is characterized by angles that are slightly more obtuse that those of blades and PE blades. This is evident in their distribution pattern, where NBKs peak at 40°-50°, while blades and PE blades peak at 30°-40°. The more obtuse angles of the NBKs are useful for cutting medium-hard material and for scraping (Lemorini *et al.* 2006). Both of these qualities indicate that these items could have been highly efficient in dismembering carcasses, an activity that needs a comfortable and stable grip, which is reflected in the other characteristics of the NBKs. These characteristics include the frequently uniform outline of the NBK’s back (straight or curved) and its steep angle, both of which improve the ability to apply force downward while cutting. By comparing the angle of the cortical edge of PE blades and NBKs it was found that these two types indeed represent two different populations and thus the steep back that characterizes the NBKs can be regarded as a planned feature.

Another important characteristic of NBKs is the right-angle trapezoidal cross-section, found on many of them. This feature enables a good grip for a slicing motion while cutting. Moreover, the very presence of a cortical back may contribute to a firmer grip due to increased friction.

Combining the facts that the NBKs were well suited to be used as hand-held knives and that their character was predetermined, it is concluded that the NBKs can be regarded as ergonometric well-planned tools. It is of note that the concept of ergonometrics lies not only in the comfort of using the items, but also and mainly in achieving better results while using them (Tytyk 2004). Keeping this in mind, the

NBKs provide another indication of the high cognitive abilities of the hominids of the late Lower Paleolithic.

Serial Production and the 'Receding Debitage Surface Technique'

The reconstruction of the laminar production from the three sites demonstrated that the production was not only systematic but also serial. The serial production is best observed in the cores bearing the 'parallel edges' shape, which are especially prevalent in Qesem Cave. In this specific trajectory the debitage surface was well framed between the two core sides, so that in the course of the laminar reduction it kept a similar contour, only gradually regressing towards the core's back. Using this method, the continuous reduction of laminar items maintained the same pattern with the same constraints and benefits guiding each series. The reconstruction of this trajectory is based not only on the attribute analysis of the archaeological material but also on experimental knapping (Chapter 4). I suggest referring to this trajectory as the 'receding debitage surface technique' (Fig. 403) and that it is probably marking the first appearance of a technique that characterized many later blade industries world wide (e.g. Andrefsky 1987; Callahan 1984; Desrosiers 2007). In the southern Levant this technique is found in blade industries from the Upper Paleolithic to the Early Bronze Age (Bar-Yosef 1991; Goring-Morris and Davidzon 2006; Marder 2002; Shimelmitz 2002; Shimelmitz *et al.* 2000; Wilke and Quintero 1994). Although this technique has received several titles, including the '*débitage frontal*' of Pigeot (1987:50-51), the 'volumetric conception of the Upper Paleolithic' of Boëda (1995:50, Fig. 4.12) and the 'narrow cores' of Bar-Yosef (1991), I suggest that addressing it as the 'receding debitage surface technique' best emphasizes its essence. The presence of the 'receding debitage surface technique' demonstrates that the Amudian laminar production was not inferior to later blade industries. The fact that in the Amudian laminar production the 'parallel edges' shape of the cores was achieved by the selection of narrow raw material, rather than by preliminary knapping, does not detract from the importance of this trajectory. In fact, many of the later blade industries using this concept also took advantage of the narrow natural shape of the raw material, though usually with some further adjustments (e.g. Goring-Morris *et al*. 1998; Shimelmitz 2002; Wilke and Quintero 1994).

It is of note that some former Paleolithic studies emphasized pyramidal cores as the best manifestation of an improved blade production (e.g. Monigal 2001). This notion probably follows Boëda's (1990, 1995) argument that the main difference of the Upper Paleolithic blade production from that of the Mousterian lies in that its volumetric concept covers three dimensions and not two as in the Levallois. It was argued that this volumetric concept enables a serial production of blades which maximizes utilization of the core's mass for blades (Boëda *et al.* 1990). I, on the other hand, argue that the 'receding debitage surface technique' is generally more efficient than a pyramidal, or other circumferential reduction, since when using the latter two methods, the core's diameter gradually diminishes with each series removed and thus the character of the detached blades is less constant (e.g. Clark 1985). In contrast, in the 'receding debitage surface technique' the debitage surface remains the same, enabling a serial and consistent production of similar blanks. Another advantage is that applying this technique on narrow raw material did not require preliminary shaping and thus enabled transforming a larger mass of the raw material into laminar items. This can be seen in one of the samples from Qesem Cave where the laminar items in it constitute 58.2% of the debitage and shaped items.

Although the *recurrent* method of the Levallois technology is characterized by some degree of serial production (Boëda 1995), the latter is not found among the few occurrences of the Levallois technology in the Lower Paleolithic late Acheulian (Copeland 1995). Therefore, the described serial production of the Amudian is of high importance, signifying a new approach to the utilization of flint.

Variability in the Amudian Laminar Production

My technological reconstruction showed that the difference in end- products between the three sites is relatively small and that a greater difference is found in the reduction sequence – a difference that demands an explanation. White and Dibble (1986) argued that when searching for the reason behind variability in lithic assemblages, five major aspects must be considered: raw material, function, mental template, technology and skill. A diachronic difference should also be added to these factors. In the case of my study the difference in the technology has already been noted, and the question is whether it was affected by some of the other variables and to what extent.

The possibility that diachronic differences affected the observed variability seems irrelevant, since the dates of Qesem Cave span from ca. 380-210 kyr (Barkai *et al.* 2003) and the dates from Tabun XI (Mercier and Valladas 2003) and Yabrud I

(Porat *et al*. 2002) fall within this range, although near its upper part. This however, does not contradict the possibility of small diachronic changes within each of the sites.

A difference was observed in raw material between the three sites, as well as its effect on the reduction sequence. In the above account I emphasized that the difference in raw material was a result of intentional selection and that the surroundings of each of the three sites had a variety of raw material types. Since the end-products are similar I can only assume that the selection of raw material reflects preferences by different groups. This possibility is strengthened by anthropological studies teaching us that the acquisition of raw material can be a social event and that the raw material sources constitute a special feature in the cultural and physical landscape, sometimes even possessing mythical powers (e.g. Binford and O'Connell 1984; Gould 1980:139-159; Paton 1994; Stout 2002).

The fact that that the three laminar types from the Amudian samples from the three sites are quite similar, demonstrates that a different mental template regarding the end-products is not the case here as well. Difference in skill also seems irrelevant to my results since I examined complete assemblages, whereas most studies emphasizing the skill factor discussed variability within a single assemblage/site (e.g. Davidzon and Goring-Morris 2007; Karlin and Julien 1994; Karlin *et al.* 1993; Shea 2006b).

The possibility of functional differences for the observed variability also seems small. This is due to the fact that not only the end-products are quite similar, but also the shaped types made from them. The only clear exception is in the higher percentage of NBKs at Qesem Cave, which could indicate some difference in the functions performed at the examined sites.

In summarizing the above, we have the clear effect of raw material and the possible effect of function (more NBKs in Qesem Cave) on the observed differences in technology between the sites. Nevertheless, as a whole, there are differences between the sites that cannot be explained by these two factors. These differences mainly include the intensity of using of follow-through blows, crested blades and base modification (Pp: 343-344). Keeping in mind that the end-products are quite similar I can only assume that there was a mental template of how the items should look and that each site had it own tradition for achieving this goal.

The described variability in the Amudian was not necessarily a new phenomenon, since such variability may have characterized the Lower Paleolithic

Acheulian as well. It is possible that we do not recognize it earlier due to a scarcity of meticulous studies and a paucity of sites (Ashton and White 2003; Gowlett 1998). It is of note however, that most of the observed patterns of variability from the Lower Paleolithic Acheulian demonstrate the differences across vast areas (e.g. Clark 2001; Gamble and Marshal 2001; Gowlett 1998; Sharon 2007). Variability in Middle Paleolithic industries, on the other hand, has been repeatedly discussed in the literature ever since the "cultural" versus "functional" debate, mainly promoted by Binford and Bordes (Binford and Binford 1966; Binford 1973; Bordes and Sonneville-Bordes 1970). In fact, variability has become one of the characteristics of the Middle Paleolithic/Middle Stone Age lithic industries (e.g. Barton 1988; Delagnes and Meignen 2006; McBrearty *et al*. 1996; McBrearty and Tryon 2006; Munday 1976, 1979; Skinner 1965; Van Peer 1998; Wurz 2002). Clark (1988), in his study of the Middle Stone Age of Africa, argued that it may represent the rise of regional identity.

The observed variability between the sites of the Amudian seems to bear a character more similar to the case of the Middle Paleolithic, where it is characteristic of even small regions. Variability in the Amudian was already noted in the literature, especially in the case of the difference between the 'Pre-Aurignacian' and the 'Amudian' (Copeland 2000), but also by the 'Beach Industry' (Copeland 1983a) and the work of Shmookler (1983) on Masloukh. Although primary notes regarding technological difference between Tabun XI and Yabrud I-15 have already been made (Meignen 2007a,b; Monigal 2002: 269-271), the results presented in my research are more detailed and instructive. This enables a better understanding of the variability and its essence. My study indicates that in the case of the Amudian there was a general 'know-how' concerning laminar production which was present at the three examined sites and most likely in the other Amudian sites as well. The main difference between the sites is in the specific choices made along the reduction sequence. In order to better understand the meaning of this difference, the relationship between the Amudian and the other two facies of the Acheulo-Yabrudian complex should be considered as well.

The Laminar Production of the Acheulo-Yabrudian Complex and the Relationship between the Three Facies

The results of my technological analysis also enable to re-examine the relationship between the three facies of the Acheulo-Yabrudian complex in order to better understand their essence. It was found that the laminar production at Tabun XI and Yabrud I show different patterns within the three facies of the Acheulo-Yabrudian complex. In the case of Tabun XI the technology of the laminar production was quite similar in all three facies and the main difference lies in the craftsmanship of the reduction. Although such a situation tentatively raises the possibility of a difference in skill among the knappers, it is not the case here. This is due to the fact that the major difference between the three facies is not in the character of the laminar items, but rather in the presence of other features, including handaxes and side-scrapers (Copeland 2000; Jelinek 1990). Yabrud I, on the other hand, demonstrates a more pronounced difference between the Pre-Aurignacian of Yabrud I-15 and the Acheulian facies of Yabrud I-11/12. Nevertheless, out of the examined samples from all three sites, the latter two share a resemblance (see below). It is interesting to note that the greater difference found among the facies of Yabrud I, as compared to that of the Tabun XI facies, correlates with past arguments that Yabrud I presents a clear distinction between the facies while Tabun presents continuity (Garrod 1956; Jelinek 1990; Rust 1950). The fact that my results, grounded on various sets of attribute analyses (end-products, CTEs and cores) that are not interrelated, provided the same patterns, confirms that this picture is not an outcome of field methodology or biased selection, but rather represents a true situation.

Despite all these differences, both Tabun XI and Yabrud I demonstrate that the three facies shared not only the ability to produce laminar items but also the same concept of how to produce them. This indicates that in general the knappers of each of the Acheulo-Yabrudian facies could have made laminar items, however they chose to do so only when it was required, probably according to some specific activity. This further indicates that the three facies represent variability within a single culture as already suggested by others (Copeland 1975, 1983a; Jelinek 1981, 1990; Roe 1983:438; Skinner 1965:175-176). In Chapters 1 and 2, I summarized the possibility that the three facies represent different activities, which in some cases are spread throughout a single site, such as in Tabun (Garrod 1956), Adlun (Copeland 1983a,b) and Yabrud I (Rust 1950; Solecki and Solecki 1986). The identified technological similarity among the facies in Tabun XI and Yabrud I supports the premise that the three facies are affiliated with the same population and thus also supports the notion of spatial variability at the mentioned sites. The appearance of this feature is important, since it has been suggested as one of the markers of modern human behavior and it has thus far been almost exclusively recognized within the Middle Paleolithic period onwards (e.g. Alperson-Afil and Hovers 2005; Henry 1998; Wadley 2001, 2006).

The reason or reasons for the various conducted activities is still unknown. The possibility that they are seasonal seems less likely since all facies are found in Yabrud I, which is situated at 1400 m a.s.l., where I assume the possibility of a winter occupation to be low. Although the fauna may be a key in uncovering the logic behind differences between the facies, so far there are no studies which enable a comparison of the facies within a single site. The only exception is in the case of the Adlun sites, where some difference was observed but the studied samples are relatively small for a clear pattern (Garrard 1983).

An interesting difference among the assemblages of the three facies is that, while side-scrapers and handaxes, which characterized the Acheulian and Yabrudian facies, were heavily shaped and resharpened, laminar items were generally only lightly retouched (Dibble 1988; McPherron 2006; Shmookler 1983:13-14). In theory, if the degree of reduction by secondary modification is a measure of curation (Shott and Weedman 2007:1017) then most of the laminar items were only slightly used. Although this might be a clue to understanding the difference between the facies, slight retouching of blades is common to many blade industries. Jeske (1989:37) suggested that "…blades may not be used economically because they are relatively inexpensive to produce once the core has been prepared. The economizing behavior is in the production of blades, not in a heavy use of them once they are produced. However, the blade cores should be reused until they become too small to be functional.". If the use of laminar items is equal in that perspective to curated tools then a difference in the mobility pattern, which is one of the main explanations for the use of curated tools (Andrefsky 1994; Bamforth 1991; Kuhn 1996; Morrow 1996; Odell 1996), is probably as well, not the cause for differences between the facies.

The results of my analysis contributed in another perspective. In reviewing the different sites and facies within them it is clear that the resemblance in the laminar technology between the Amudian facies of Qesem Cave, Yabrud I-15 and Tabun XI is smaller than the resemblance between the different facies when found at a single site. For example, the habit of selecting flat flint slabs and repeatedly using follow-through blows, which is evident in each of the samples from Qesem Cave, was not found at any of the other sites. In the case of Yabrud I, the Pre-Aurignacian of Yabrud I-15 and the Acheulian facies of Yabrud I-11/12 share several traits that appear differently at the other sites: This includes the ‘narrowed prismatic’ core shape, which was found in these two samples and is rare in the others. It also includes an especially high use of base modification and a meager reduction of laminar items that followed through the entire debitage surface (one out of six items in both). In the case of Tabun XI, the similarity between the three facies and especially between the Amudian and Yabrudian facies demonstrate this point. This complex situation conforms with Skinner’s (1965:170) prediction that the variability among “… layers in a given site would produce industries more nearly alike than layers of the same group from separate sites”.

Hovers (2001), in her study of the lithic assemblages of the Levantine Middle Paleolithic argued that there is a greater resemblance along the sequence of a single specific site than among sites. She suggested that it indicates that there was a pattern of return to the same sites by the same groups of people, especially in the late Middle Paleolithic. In following with my results, this pattern can be pushed backwards to the Acheulo-Yabrudian complex. Although only in the site of Qesem Cave I clearly demonstrated the presence of a repeated tradition of making laminar items along a long sequence, generally ranging from 380-220 kyr (Barkai *et al.* 2003), the same seems to be true of the other sites as well. This is supported by the pattern of similarity I identified in the laminar production among the three facies when they appear at the same site. In other words, although the Amudian/Pre-Aurignacian facies constitutes only a small part of the sequences of Tabun and Yabrud I, the fact that in both cases the laminar technology shows the highest resemblance to that of the Acheulian and Yabrudian facies from the same sites (though appearing in lower intensity) supports the suggestion that these sites represent the return of specific groups with their own traditions.

With regard to the above, Bar-Yosef’s (1995a:253) insight regarding the Acheulo-Yabrudian complex, in which its “…distribution is probably related to social rather than ecological boundaries”, is even more thought-provoking. My results demonstrated that this unique cultural complex that spread throughout a part of the Levant was composed of smaller units. Bearing in mind that technology is not merely a means to an end but also a reflection of the social sphere of its users (e.g. Dobres 2000; Ingold 1993; Lemonnier 1993; Pfaffenberger 1988, 1992), this implies that the groups that constituted the Acheulo-Yabrudian complex shared some mutual knowledge and a way of life, though with some small differences. As Ingold (1993:285) advocated, “In human societies…learning to do things in a certain way is also a matter of learning to do them *differently* from other people. Technical proficiency, then, is an aspect of social placement of belonging.”. This feature aligns well with the argument that modern human behavior was embedded within the Acheulo-Yabrudian complex.

Knapping as a Social Phenomenon

Variability in end-products has been interpreted in many cases as representing style (e.g. Mellars 1989). In the case of the Amudian, the small differences in end-products between the sites indicate that their potential for conveying differences between groups – i.e. 'emblemic style' in Wiessner's terminology – is minor. This of course does not contradict the possibility that each artifact may embrace an 'assertive style' – a reflection of the specific person who made it (Wiessner 1983). The fact that in the case of the Amudian the differences in end-products are small and that there are larger differences in the reduction sequences for achieving them, raises the possibility that the process of reduction itself was of major importance. In a way, this follows Davidson and McGrew’s (2005:812) suggestion that “For an early hominin returning to the remnants of the knapping of a previous time there is a possibility that the repetition of motor actions (of knapping) at the same place with the same rocks and with the same acoustic and physical consequences might have an effect, particularly if the separation of tool-making from the specific tool function brought attention to the making rather than the use”. In this section I wish to follow this path and further explore the implications of the existence of several traditions for achieving similar end-products within the Amudian. In order to do so I will use ethnographic studies. The use of ethnographic studies for uncovering behavioral patterns of early hominids should not be rejected, but dealt with while employing caution (Kuhn 1995:18; Steele and Shennan 1996:4-5).

The anthropological literature which discusses knapping exhibits that although in most cases there was a range of technologies used and items produced, it was usually the production of one or more particular type of item which received greater attention, not only by the anthropologists, but also by the kanppers themselves. (e.g. Binford 1986; Jones and White 1988; Moore 2003; Pope 1918:117 [after Shackley 2001]; Strathern 1969; Stout 2002; Waston 1995). The knapping of these specific items had occasionally been performed in groups and usually by men (e.g. Binford 1986; Moore 2003; Stout 2002; Taçon 1991). The main aspect of this phenomenon is that the making of these items and not only their use, had great social meaning with regard to the identity of the participants, their social relations with the community's members, and their natural surrounding (e.g. Binford 1986; Stout 2002, 2005). 'Costly signaling' (Bliege Bird and Smith 2005; Zahavi and Zahavi 1997) is embedded in the production of many of these items whereby it is expressed as a large effort invested in their making which exceeds the merely functional needs – an extra effort which plays its part in the social sphere.

In the southern Levantine prehistory we find in each of the periods a variety of blanks, shaped items and techniques, some of which were more elaborate, demonstrating greater effort in their production and a character that could have served as a medium for social transmissions. In the Lower Paleolithic Acheulian these were the handaxes, in the Middle Paleolithic the Levallois technology, and in the Ahmarian Upper Paleolithic – the blades. The case of the handaxes is the most often discussed of these examples (Gamble 1998; Kohn and Mithen 1999; Wynn 2002:399), but the case of the Levallois was promoted as well (e.g. White and Ashton 2003). In the case of the Acheulo-Yabrudian complex, the production of handaxes was probably at play in the Acheulian facies, Quina side-scrapers in the Yabrudian facies and laminar items in the Amudian facies.

According to the above pattern which was observed in anthropological studies, it is reasonable to assume that laminar production within the Acheulo-Yabrudian complex was occasionally conducted as an 'event', with the presence of several participants. The fact that each of the three examined sites demonstrates a specific tradition for producing laminar items which spans several layers/beds supports this assumption, since the passing on of these traditions resulted from such knapping sessions where the making of flint items by specific methods was learned (Karlin and Julien 1994; Shott and Weedman 2007).

At the same time, knapping sessions served as a fertile ground for building and reflecting the identity of the individuals in the community. As Voss and Young (1995:78) presented it: "The self exists at the intersection of the individual and the group and emerges as a result of social interaction". It is assumed that the displaying of knapping capabilities for social gains concentrated not only in end-products but also in the technique by which they were made, since the presentation of knapping abilities reflected the knapper's general skills (e.g. Kohn and Mithen 1999; Roe 1994:207; Sinclair 1995, 1998). The anthropological record of knapping sessions helps understand the dynamics in which these processes occurred. For example, Stout in his study of the Langda of Irian Jaya noticed that the knapping sessions were highly vivid and entailed a display of the participants' expertise. He further noted that "…craftsmen often call out in excitement after successful flake removals" (2005:334) and that "Sometimes the flakes (*ya-tokol)* produced are held aloft in display or passed along the line for examination. It is also common for knappers to observe and comment on the work of their neighbors…" (2002:698).

The advantage of the laminar technology in this sphere of human interaction lies in its serial production. First, the serial laminar reduction has a rhythm (Clark 1987:268) combined with sound of the successful blows (e.g. Davidson and McGrew's 2005:810), which can easily catch the attention of the observers. Second, the ability to perform a serial production of laminar items conveys a clear statement regarding its knapper, since "during core reduction, continued blade removal depends upon a high success rate and, also, upon a high recovery rate of any errors that one might make." (Clark 1987:267). It is therefore a decisive candidate for evaluating the knapper's capabilities (e.g. Finlay 2008) and the implications drawn from his performance.

Since 'showing-off' patterns are not foreign to hunter-gatherer societies (e.g. Hawkes 1991; Wood and Hill 2000), it would not be surprising if some technological choices made along the reduction at the three examined sites were aimed more toward impressing the viewers, rather than making a real difference in the end-products. In such knapping sessions, where the focus is not only on the end-products but also on the technique of production, the interaction among the workers might be engaged with the examination of the 'by-products' (overpass items, crested blades and cores) as well. Stout's (2002) study emphasized that 'by-products' of the reduction do capture the attention of the knappers and that each has a specific term. Esthetics in lithics is not foreign to hunter-gatherers (e.g. Taçon 1991) and was probably at play already in the Lower Paleolithic Acheulian (e.g. Kohn and Mithen and 1999). With regard to the Amudian laminar reduction, the question is not whether it affected the character of the end-products, but whether it affected the character of the cores and the core reduction as a whole. This point takes us back to the suggestion that the technological choices made along each step of the reduction may have been engaged not only with the practical but also with the visual effect while knapping within a group.

What Can an Extensive Investment in Cutting Implements Tell Us?

The minor presence of pointed shapes or pointed end shapes among the laminar items indicates that they were not used as projectiles. This is further supported by the absence of impact damage characteristics of projectiles (e.g. Knecht 1997 and references therein). The attribute analysis indicates that the emphasis in the Amudian laminar technology was on the production of fine sharp edges. It has already been suggested in the past, that the Amudian facies is characterized by slicing tools (e.g. Copeland 2000; Jelinek *et al.* 1973). The use wear study from Qesem Cave not only supported the importance of achieving sharp edges but also showed that the cutting of soft and medium hard tissues was one of their main goals (Lemorini *et al.* 2006). This evidence teaches us that, while the laminar items probably did not play a major role in hunting, they did have a central role in consuming the hunted meat (for the argument that hunting occurred in the Paleolithic and scavenging was minor see: Domínguez-Rodrigo 2002; Stiner 2005).

Meat consumption is not only a major theme in the social sphere of modern societies but also among apes (e.g. Mitani and Watts 2001; Stanford 2001). In modern hunter-gatherer societies it takes on the form of sharing (e.g. Hawkes *et al*. 2001; Lee 1979; Marshall 1976; Patton 2005). Kuhn and Stiner (1998) argued that sharing had an enormous impact on the tools used for achieving and processing food. I contend that although we do not have evidence for the concept of sharing in its full sense in the Acheulo-Yabrudian complex, there might have been a new arrangement in the consumption of meat as evident by the laminar items. Since meat is highly valued, its butchering can be part of a social interaction. The fact that in most societies butchering is conducted by men (Murdock 1973) indicates that it is not an arbitrary action but it has a pattern that could have worn a certain form also in the Lower Paleolithic.

Laminar items are certainly efficient for butchering, but there are other possibilities as well – simple flakes, for example (e.g. Jones 1980; Walker 1978). It is possible that the choice of making laminar items for this goal combined practical needs with social transmissions. The elaboration in their production, described above, may be of importance here. This can be illustrated in Pacey's (1999:18) argument that "…if we wish to understand what technology means to those who invent, tinker with, build, or just use its products, we must investigate how the esthetic is intertwined with the practical…". It is of note that in the earlier Lower Paleolithic Acheulian, handaxes may have been used for this purpose (e.g. Villa 1990). Both handaxes and laminar items carry alongside their practical use some 'social baggage'. With regard to this aspect, it is not surprising that laminar items may have taken on the role of handaxes in some situations, as already suggested by Jelinek *et al.* (1973:177). I suggest that it is more likely that the major difference between the Amudian and former industries is in the attachment of a new significance to the act of cutting, rather than in a more intensive cutting activity.

A Comparison to the Laminar Production of the Early Middle Paleolithic

The Levantine early Middle Paleolithic industries included an intensive laminar production whose exact character has been the subject of many studies (e.g. Lindly and Clark 1987; Marks and Monigal 1995; Meignen 1998, 2000, 2007a,b; Monigal 2002). Meignen (1998, 2000) recently emphasized the variability of laminar production in the early Middle Paleolithic, and identified two laminar technologies – one is Levallois in nature and the other is not. The first technology usually utilized a wide flat surface of the raw material while the second tended to use a greater portion of the circumference of the raw material. The Hummalian of El-Kowm, Syria constitutes another variant (Bergman and Ohnuma 1983; Boëda *et al.* 1998; Copeland 1985).

There is no doubt that the laminar items of the early Middle Paleolithic are different from those of the Amudian, mainly by being larger and having a common trapezoidal cross-section, a pointed shape and a well faceted butt (e.g. Meignen 2000; Monigal 2002). Another difference is that the use of some of the Middle Paleolithic items involved hafting (Boëda *et al.* 1998; Friedman *et al*. 1994). The use of Levallois points as projectiles is of note as well (e.g. Meignen *et al.* 1998; Villa *et al.* 2009), though this still needs conformation regarding the early Middle Paleolithic.

The possible continuity between the Amudian and the early Middle Paleolithic is of importance. So far the researches are divided in their view on this subject. While some argue that a line of continuity does exist (e.g. Klein 1999:430; Nishiaki 1989), others dispute this possibility. The latter argue that the Amudian shares a greater similarity with the Upper Paleolithic industries (e.g. Bordes 1955; Lamdan and Ronen 1989; Monigal 2002; Vishnyatsky 2000). Jelinek, who promoted the notion of continuity among the industries, based his argument on Tabun Unit X (Jelinek *et al.* 1973). This unit however was argued to represent a mixture of the two industries and thus – a false impression of a transition (Bar-Yosef 1995a).

The results of my analysis of the material from Yabrud I-11/12 may contribute to this subject. In the assemblage of Yabrud I-11/12 a larger portion of the laminar items were larger, flatter and pointed – features that are more characteristic of the early Middle Paleolithic blades (e.g. Meignen 2000) and support a continuation of technological traditions from the Lower to the Middle Paleolithic. If such a continuation is the case, it is more likely to be correlated to the non-Levallois technology of the early Middle Paleolithic (Meignen 1998, 2000). A similarity of some of the pyramidal cores from the early Middle Paleolithic of Misliya (Weinstein-Evron *et al.* 2003: 40, Fig. 6:1-2) to those of the Amudian supports this possibility. Pursuing this significant question, however, deserves a major study of its own and thus is outside the scope of the present dissertation. Here I only briefly mentioned several guidelines emerging from my study, which generally support the view of some continuity between the two periods.

Epilogue

In this study I investigated the Amudian laminar technology as it appears in the sites of Qesem Cave, Tabun and Yabrud I. The examination was conducted by an attribute analysis which focused on the laminar items and their related waste. The results are composed of numerous small pieces of data which are essential for the technological reconstruction and its implications. My analysis not only reconstructs the reduction sequence of the laminar production and its variability, but also serves as a base from which several conclusions are drawn regarding the capabilities and behavior of the hominids of the Acheulo-Yabrudian complex.

One of the major contributions of my work with regard to the reduction sequence is that it demonstrated that this was not an industry that lacked sophistication as previously argued (e.g. Copeland 2000:100; Monigal 2002). I found that although it was quite simple in concept, it included a well planned reduction sequence which led to the production of predetermined blanks requiring, if any, only minor secondary modification. In this perspective, the Amudian laminar production did not fall short of later blade industries and its simplicity should be appreciated and regarded as a technological advantage.

The advanced cognitive abilities of the kanppers of the Lower Paleolithic Acheulian have already been demonstrated in several cases (e.g. Belfer-Cohen and Goren-Inbar 1994; Goren-Inbar Goren-Inbar 1988b; Goren-Inbar *et al.* 2008; Madsen and Goren-Inbar 2004). Whether my results add just another piece to this accumulative data, or actually present even more advanced cognitive capabilities is hard to fully evaluate. I maintain that the new formation of a serial production of predetermined blanks hints at some advancement in the capabilities of hominids at the end of the Lower Paleolithic.

Another contribution of my work is that the results showed that the laminar reduction was not restricted to the Amudian facies and that the three facies shared the same technological knowledge. This supports the argument that the three facies of the Acheulo-Yabrudian complex represent different behavioral patterns within a single culture. My analysis also found that each of the examined sites had a specific technological tradition of how to produce laminar items.

In the introduction of this dissertation I presented several indications for the possibility that modern human behavior has it roots in the Acheulo-Yabrudian complex if not earlier; a contention already suggested by several studies (Goren-Inbar *et al.* 2008; Ronen 1992, 1998a,b). In this last chapter I endeavored to show how the results of my analysis are reflective of several complex behavioral patterns. These new insights strengthen the possibility that modern human behavior was already apparent in the Acheulo-Yabrudian complex although not yet in its full form. It is argued by some (e.g. Coolidge and Wynn 2005; Ingold 2000:36) that human evolution was controlled for a long time by biological evolution and only lately, about 50 kyr ago, by cultural evolution. The results of my study imply that this process began to accelerate long before that, emphasizing the importance of studying further the Acheulo-Yabrudian complex.

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אוניברסיטת תל אביב
הפקולטה למדעי הרוח ע״ש לסטר וסאלי אנטין
בית הספר למדעי היהדות ע״ש חיים רוזנברג

ייצור להבי צור בפלייסטוקן התיכון בלבאנט

חלק א׳: טקסט

חיבור לשם קבלת תואר דוקטור לפילוסופיה

מאת: רון שימלמיץ

מנחה: פרופ׳ אבי גופר

הוגש לסנאט של אוניברסיטת תל אביב

תשס״ט

תקציר

חקר תעשיות הלהבים הוא רחב היקף ורובו עוסק בתעשיות הפליאולית העליון והנאולית. בחינתן של תעשיות להבים מהתקופה הפליאולית התחתונה והתקופה הפליאוליתית התיכונה מועטה יותר. המחקר המוצג כאן מתמקד בייצור הלהבים השיטתי הקדום ביותר בלבאנט המשויך לקומפלקס האשלו-יברודי – קומפלקס שהתקיים בשלהי התקופה הפליאוליתית התחתונה ומתוארך ל- 380,000-220,000 שנים לפני זמננו. מרכז הכובד של עבודת מחקר זו הוא שחזור מלא של טכנולוגיית ייצור הלהבים משלושת האתרים המרכזיים של הקומפלקס האשלו-יברודי – מערת קסם, מערת טאבון ומחסה הסלע יברוד I. תוצאות הניתוח הטכנולוגי מהוות צוהר לחקר המורכבות של הקומפלקס האשלו-יברודי ושלהי התקופה הפלאוליתית התחתונה.

הקומפלקס האשלו-יברודי ממוקם בין התרבות האשלית של התקופה הפליאוליתית התחתונה המיוחסת להומו ארקטוס ובין התרבות המוסטרית של התקופה הפליאוליתית התיכונה המיוחסת לנאנדרטלים והומו-ספייאנס. משערים כי התרבות המוסטרית התאפיינה בהתנהגות מורכבת יותר מהתרבות האשלית, כפי שמתבטא בדגמי שינוי מהירים יותר ושונות אזורית ברורה יותר. מאפיינים אלו לצד מאפיינים אחרים הובילו חוקרים רבים לטעון כי במהלך התקופה הפלאוליתית התיכונה הופיעה לראשונה התנהגות מורכבת לה אנו קוראים 'התנהגות אדם מודרני' (modern human behavior) – היכולת שלנו לחשוב ולהתבטא באופן סימבולי. כיצד הקומפלקס האשלו-יברודי משתלב בשינוי מרכזי זה היא נקודה מרכזית שטרם נחקרה. תוצאות הניתוח של הפקת הלהבים מהקומפלקס האשלו-יברודי מסייעות בהבנת נושא זה.

הקומפלקס האשלו-יברודי מורכב משלוש תעשיות המכונות 'עמודית' (פרה-אורניאקית), 'יברודית' ו'אשלית' ('אשלו-יברודי') המופרדות זו מזו ומוגדרות על בסיס השונות של מכלולי הצור. העמודית מתאפיינת בייצור להבים וכלי להבים, היברודית בייצור נתזים ומקרצפים, והאשלית בייצור נתזים, מקרצפים ואבני-יד. בגוף העבודה אני מתייחס לשלוש התעשיות כפרצופים (פציאס; facies). שלוש תעשיות אלו נמצאו במספר מקרים באותם האתרים וללא סדר קבוע במיקומם לאורך הרצף הסטרטיגרפי. מהות הקשר בין שלוש התעשיות עדיין נדונה ואת דעות החוקרים ניתן לחלק לשתי קבוצות: האחת הטוענת כי הן מייצגות תרבויות שונות, והשנייה הטוענת כי הן יוצרו על ידי אותם האנשים (תרבות אחת) והן מייצגות התנהגות שונה בהתאם לסיבות שטרם הובררו.

תעשיית הלהבים העמודית שונה מתעשיות להבים מאוחרות ממנה בכך שהיא מדגישה ייצור פריטים להביים נושאי קליפה ולא רק ייצור של להבים מרכזיים (נקיים מקליפה). למעשה, בתעשייה זו מופיעים שלושה טיפוסי 'להבים': להבים (central blade) להבים ראשוניים, וסכינים בעלי גב טבעי. שלושת הטיפוסים האלו יוצרו בכמות נכרת לאורך כל רצף ההפחתה ומשום כך בחרתי במינוח 'פריטים למינריים' במטרה לכלול את שלושתם תחת כותרת אחת.

שיטת המחקר כללה ניתוח מאפיינים של תוצרי המטרה – שלושת הטיפוסים הלמיניריים – והפסולות של הכנתם – פסולות עיצוב הגרעין (core trimming elements) והגרעינים. לצורך המחקר בחנתי את כל הממצא מהשכבות או המפלסים הנבחרים. כמו כן ביצעתי סיתות ניסיוני במטרה לאפשר נקודת מבט נוספת על שחזור התעשייה. הסיתות הניסיוני נעשה בהתאם לתוצאות הניתוח הטכנולוגי של מערת קסם.

מערת קסם, השוכנת במרכז הארץ (12 ק"מ מזרחית לתל אביב), כוללת 7.5 מטר של סדימנטים עמוסי ממצא אנתרופוגני שרובו משויך לתעשייה העמודית. המערה נחפרת החל משנת 2001 על ידי אוניברסיטת תל-אביב, בראשות פרופ' א. גופר וד"ר ר. ברקאי, והממצא נבחן במעבדות אוניברסיטת תל-אביב. לצורך מחקרי נבחרו חמישה מכלולים מאזורים שונים באתר ומחלקים שונים של הרצף הסטריטגרפי. בסך הכל נבחנו בעזרת ניתוח מאפיינים 2552 להבים, להבים ראשוניים, וסכינים בעלי גב טבעי, הכוללים גם את הבלנקס (blanks) וגם את הפריטים המעוצבים (כלים). ניתוח מאפיינים נערך גם על 268 פריטי הסרת-יתר (overpass items), 215 להבים בעלי רכס, ו-94 גרעינים בעלי שטח נקישה אחד.

מערת טאבון נמצאת בפתח נחל מערות שברכס הכרמל והיא פונה אל מישור החוף. המערה כוללת רצף סטריטגרפי בעוצמה של 25 מטר, רצף הכולל שכבות החל מהתרבות האשלית של התקופה הפליאוליתית התחתונה ועד התרבות המוסטרית של התקופה הפליאוליתית התיכונה. הממצא הנחקר ממערת טאבון הוא מיחידה XI מחפירות פרופ' א. ג'לניק (1967-1971) – ממצא שנבחן באוניברסיטת אריזונה בארה"ב וברשות העתיקות בבית שמש. יחידה XI מקבילה לחלקה העליון של שכבה E מחפירות גרוד המייצגת את הקומפלקס האשלו-יברודי באתר. יחידה זו מורכבת ממספר מפלסים (beds) המשויכים לתעשיות השונות של הקומפלקס האשלו-יברודי. התעשייה העמודית נמצאה במפלס 75, התעשייה היברודית נמצאה במפלסים 73-75 ובמפלס 77, והתעשייה האשלית במפלס 76. בסך הכל נבחנו בעזרת ניתוח מאפיינים 796 להבים, להבים ראשוניים, וסכינים בעלי גב טבעי, הכוללים גם את הבלנקס וגם את הפריטים המעוצבים. ניתוח

מאפיינים נערך גם על 176 פריטי הסרת-יתר ומאה להבים בעלי רכס. הגרעינים היו מועטים מידי לניתוח מאפיינים כמותי. רוב החומר הנחקר הוא מהמפלסים העמודיים (n=554). במפלסים היברודיים נמצאה כמות פחותה (n=371) אך עדיין מתאימה למחקר כמותי, ואילו במפלסים האשליים הכמות היתה קטנה במיוחד (n=99) ואפשרה מחקר כמותי רק לגבי הלהבים והתזות-היתר.

מחסה הסלע יברוד I ממוקם 60 ק״מ צפונית לדמשק, סוריה, בגובה 1400 מ׳ מעל פני הים. האתר כולל 25 שכבות, מתוכן שכבות 11-25 משויכות לקומפלקס האשלו-יברודי. החומר הנבחן מיברוד I כלל את שכבות 11 עד 15 מחפירות א. רוסט (1932-1933) – חומר שנבחן באוניברסיטת קלן בגרמניה. שכבות 15 ו-13 מיוחסות לעמודית (פרה-אורניאקית) ואילו שכבות 11-12 לתעשייה האשלית (אשלו-יברודי). שכבה 14 התאפיינה בממצא מועט והיא לא נכללה כאן. בסך הכל נבחנו בעזרת ניתוח מאפיינים 336 להבים, להבים ראשוניים וסכינים בעלי גב טבעי, הכוללים בלנקס ופריטים מעוצבים. ניתוח מאפיינים נערך גם על 38 פריטי הסרת-יתר, 71 להבים בעלי רכס, ו-35 גרעינים בעלי שטח נקישה אחד. רוב החומר הוא משכבה 15 (n=325). שכבה 13 (n=62) ושכבות 11-12 (n=94) כללו ממצא מועט יותר.

המחקר התמקד כאמור בייצור הלהבים מן התעשייה העמודית: מערת קסם, טאבון XI מפלס 75, ויברוד I שכבות 13, 15. אולם, במקביל לכך, נבחן גם ייצור הלהבים בתעשיות האחרות של הקומפלקס האשלו-יברודי על פי ניתוח הממצא מיתר המפלסים של טאבון XI ומיברוד I שכבות 11-12.

תוצרי-המטרה של התעשייה העמודית – שלושת הטיפוסים הלמינריים

המאפיינים של תוצרי המטרה – שלושת הטיפוסים הלמינריים (להבים, להבים ראשונים וסכינים בעלי גב טבעי) – תוארו בפרוט רב בפרקים 4-6 בהם הממצא מכל אתר טופל בנפרד. השוואת תוצרי-המטרה משלושת האתרים הנחקרים הראתה כי הם בעלי מאפיינים דומים. ההבדל העיקרי שזוהה הוא בכמות היחסית של כל אחד מהטיפוסים: בעוד במערת קסם שלושת הטיפוסים מופיעים בשכיחות דומה יחסית, בטאבון XI וביברוד I להבים מופיעים בשכיחות גבוהה ולהבים ראשוניים וסכינים בעלי גב טבעי מופיעים בשכיחות נמוכה.

הלהבים משלושת האתרים הנבחנים מתאפיינים באורך ממוצע של 51-63 מ״מ, רוחב ממוצע של 21-23 מ״מ ועובי ממוצע של 8-9 מ״מ. יחס האורך\רוחב נע בממוצע בין 2.5-2.7 ויחס הרוחב\עובי נע בממוצע בין 2.6-3.0. קליפה המכסה עד 20% מהפן הדורסלי מופיעה על כמחצית מהלהבים. חתך-רוחב משולש מאפיין כמחצית מהלהבים וחתך רוחב טרפזי כרבע מהלהבים. הלהבים הם בעלי קצוות לטרלים חדים המתאימים לחיתוך.

הלהבים הראשוניים משלושת האתרים הנבחנים מתאפיינים באורך ממוצע של 54-64 מ״מ, רוחב ממוצע של 21-25 מ״מ ועובי ממוצע של 10-11 מ״מ. יחס האורך\רוחב נע בממוצע בין 2.6-2.7 ויחס הרוחב\עובי נע בממוצע בין 2.3-2.6. קליפה מכסה לרוב כמחצית מהפן הדורסלי והיא מתפרשת לאורך אחד מצידי הפריט, צדו השני של הפריט מתאפיין בקצה חד. חתך-הרוחב הדומיננטי של הלהבים הראשוניים הוא משולש.

הסכינים בעלי הגב הטבעי משלושת האתרים הנבחנים מתאפיינים באורך ממוצע של 52-66 מ״מ, רוחב ממוצע של 21-25 מ״מ ועובי ממוצע של 11-12 מ״מ. יחס האורך\רוחב נע בממוצע בין 2.6-2.9 ויחס הרוחב\עובי נע בממוצע בין 2.0-2.2. רצועת הקליפה לאורך אחד מצידי הפריט מכסה בדרך כלל 20-30% משטח הפן הדורסלי של הפריט. הזווית של הקצה החותך כהה במעט מזו של הלהבים והלהבים הראשוניים. חתך-הרוחב הדומיננטי הוא טרפז ישר זווית. סיומת קצה של התזת-יתר מאפיינת כשליש מהסכינים בעלי הגב הטבעי.

רצף ההפחתה

המחקר תיאר בפרוט את רצף ההפחתה של התעשייה העמודית מכל אחד משלושת האתרים הנבחנים בנפרד (פרקים 4-6). בתקציר זה אתאר את רצף ההפחתה באופן כללי בלבד ואדגיש תוך כדי התיאור במה שונה כל אחד מן האתרים.

חומרי הגלם שנבחרו לייצור הפריטים הלמינריים מתאפיינים בצורות שונות. שימוש בלוחות צור נמצא דומיננטי במיוחד במערת קסם. בטאבון XI וביברוד I הועדפו בולבוסים בעלי צורה עגולה או אמורפית. חשוב לציין, כי בסביבת שלושת האתרים ניתן היה למצוא את כל סוגי חומר הגלם הללו והבחירה מציינת את העדפתם של הסתתים. שונות נוספת בחומר הגלם היא כי ביברוד I נמצא השימוש הנפוץ ביותר בבולבוסים גדולים יחסית שפוצלו למספר חלקים שכל אחד מהם שימש להכנת גרעין בנפרד. בשני האתרים האחרים גוש חומר גלם אחד שימש לרוב לגרעין אחד.

הפיכתו של חומר הגלם לגרעין היתה פשוטה לרוב והתאפיינה בניצול תכונות חומר הגלם. עיצוב שטח הנקישה היה פשוט בדרך כלל ונעשה בהתזה בודדת. בחלק מהמקרים צלקת שבר שימשה כשטח הנקישה. משטח ההפקה מוקם לרוב בפן הצר של חומר הגלם כאשר הוא נתחם על ידי שני צדדים קליפתיים. הנוכחות של אבני-יד בחלק מהמדגמים מלמדת כי עיקרון הצרת חומר הגלם והסרת הקליפה בעזרת סיתות דו-פני היה ידוע לסתתים, אך לא נבחר במודע. ניתן להסיק כי הקליפה נשמרה במתכוון במטרה לאפשר ייצור של להבים ראשוניים וסכינים בעלי גב טבעי.

"פתיחת" משטח ההפקה עצמו נעשתה במספר שיטות. אלו המזוהות בפסולות כוללות הסרה של להב ראשוני שכולו מכוסה קליפה, להב מרוכס או התזת-יתר. בשלושת האתרים שימוש בעיצוב רכס והסרתו היה הדומיננטי ביותר, הסרת התזת-יתר הופיעה בשכיחות נמוכה יותר, והסרת להב ראשוני המכוסה קליפה במלואו הופיעה בשכיחות הנמוכה ביותר. למרות דמיון זה, שכיחות הניצול המדויקת של כל אחת משלוש השיטות היתה שונה בשלושת האתרים. במערת קסם אובחן השימוש הגבוה ביותר בהסרת להבים ראשוניים הנושאים קליפה במלואם. עניין זה תואם לניצול לוחות צור עם פינות המאפשרות להתחיל את ההפקה ללא צורך בעיצוב מקדים. בטאבון XI היה השימוש הגבוה ביותר בהתזת-יתר, עניין שיתכן ותואם לניצול בולבוסים עגולים ואמורפים. ביברוד I השימוש בהסרת להבים מרוכסים היה הנפוץ ביותר.

"פתיחת" משטח ההפקה בעזרת הסרת להב ראשוני המכוסה קליפה כולו או בעזרת התזת-יתר היתה פשוטה יחסית ולא נדרשו הכנות מקדימות. גם הסרת הרכסים היתה פשוטה ורוב הרכסים עוצבו במספר מועט של הכאות. חלקם אף ניצלו רכסים קדומים במקרים בהם היה מחזור של פריטים ישנים. "פתיחת" משטח ההפקה היתה כרוכה לרוב בהסרתם של מספר פריטים יחד. הסיתות הניסיוני הדגים כי כבר בשלב ראשוני זה של הסיתות ניתן היה להפיק פריטים יעילים לחיתוך.

הסרת הפריטים הלמינריים נעשתה במקבת קשה ובהכאה בעומק שטח הנקישה. שיטה זו הובילה לייצור פריטים גדולים יחסית ולהסרתם באופן שהם חלפו את כל אורכו של משטח ההפקה. במהלך ההפקה הוסרו שלושת הטיפוסים הלמינריים, אם כי לא בהכרח בכמויות שוות. בחלק מהמקרים הפחתת הפריטים הלמינריים היתה מלווה בהסרת נתזים. תוצאות ניתוח המאפיינים והסיתות הניסיוני הראו כי הפחתה של להבים, להבים ראשונים וסכינים בעלי גב טבעי נערכה כך שהסרתו של כל אחד מהם הכינה את המתאר להפחתת הפריט הבא. הסיתות הניסיוני הראה גם כי רוחב הגרעינים השפיע על הכמות היחסית של הפריטים המופקים, ובאופן כללי, ככל שהגרעינים רחבים יותר שכיחות הלהבים המופקים עולה. בגרעינים שרוחבם עולה על

4 ס״מ עדיף היה לשלב את הפחתת הפריטים הלמינריים עם הפחתת נתזים. בגרעינים צרים יחסית הפחתה של להבים ראשונים וסכינים בעלי גב טבעי היתה בעלת שכיחות גבוהה יחסית. ההסרה של סכינים בעלי גב טבעי היתה מכוונת ומתוכננת.

צורות הגרעינים השתנו במהלך ההפקה. בראשית ההפקה הצורות הנפוצות היו 'אמורפי', 'פריזמטי', ו'צלעות מקבילות'. הגרעינים בעלי הצורה ה'אמורפית' חסרים צורה מוגדרת ומתאפיינים במשטח הפקה הממוקם באחת הפנים המזוותות של הגרעין. משטח ההפקה בגרעינים אלו משתרע בדרך כלל רק על חלק קטן משטח הפנים של הגרעין. הגרעינים ה'פריזמטיים' הם בעלי משטח הפקה שטוח יחסית וצלקות מקבילות, והגרעינים בעלי 'הצלעות המקבילות' נושאים משטח הפקה שטוח יחסית ותחום היטב על ידי שני צידי הגרעין.

אופיים של הגרעינים מושפע מצורת חומר הגלם ולכן הבחירה של חומר הגלם היתה כבדת משקל. גרעינים בעלי 'צלעות מקבילות' נעשו לרוב על לוחות צור או בולבוסים שטוחים. במערת קסם, שבה השימוש בלוחות צור היה הנפוץ ביותר, נמצא גם השימוש הדומיננטי ביותר בגרעינים בעלי 'צלעות מקבילות'. בטאבון XI ויברוד I, שבהם היה שימוש נפוץ יותר בבולבסים אמורפים ועגולים, צורות גרעין 'אמורפיות' ו'פריזמטיות' היו נפוצות יותר.

אחד ההבדלים המהותיים ביותר בין צורות גרעין אלו הוא כי צורת הגרעין בעלת 'הצלעות המקבילות' יכלה לשמור על מתאר זהה של משטח ההפקה לאורך כך מהלך הפחתת הפריטים הלמינריים. בצורות הגרעין ה'אמורפיות' וה'פריזמטית', לעומת זאת, משטח ההפקה לא היה קבוע והשתנה בהדרגה. באחרונים, ההפחתה יכולה היתה להשתנות בין הפקה בלעדית של פריטים למינריים להפחתה משולבת של פריטים למינריים ונתזים.

בעוד ברוב המקרים רוחב הגרעינים לא היה קבוע לאורך רצף ההפחתה, מלבד הגרעינים בעלי צורת 'הצלעות המקבילות', האורך היה אחיד יותר והשתנה רק במעט לאורך ההפקה.

הגרעינים בעלי הצורות ה'אמורפית' וה'פריזמטית' יכלו גם להשתנות לגרעינים בעלי צורות 'פריזמטי מוצר' או 'פירמידלי'. שתי צורות אלו כוללות את הרחבת משטח ההפקה, כך שהוא הקיף חלק רחב יותר מהגרעין והתאפיין במתאר קשתי או מזוות. הגרעינים בעלי הצורה ה'פריזמטית המוצרת' מדגימים תכנון ושליטה ברצף ההפחתה. בגרעינים אלו ההפחתה מהצד הדגישה והצרה את חזית הגרעין כך שהתאימה להפקת להבים. ראוי לציין כי גרעינים בעלי צורה 'פריזמטית מוצרת' נפוצים במיוחד ביברוד I וכי גרעינים בעלי צורה 'פרמידלית' נמצאו רק במערת קסם.

תחזוק הגרעין נעשה במגוון שיטות. ראוי לציין כי שיטת ההפקה של הפריטים הלמינריים שהתבססה על הפחתת פריטים שחלפו את כל אורכו של משטח ההפקה שימשה כמרכיב חשוב בשמירת משטח הפקה נקי מצלקות הינג׳ ובעל קמירות רצויה. אולם, השכיחות של הפחתת פריטים שחלפו את משטח הפקה במלואו שונה בין האתרים. בעוד במערת קסם אחד מכל ארבעה פריטים הופק בשיטה זו, בטאבון XI אחד מכל חמישה פריטים וביברוד I אחד מכל שישה פריטים.

חידוש שטח ההפקה נעשה לעיתים תכופות בעזרת הסרת התזת-יתר או להב מרוכס. תיקון בעזרת התזת-יתר היה נפוץ יותר במערת קסם וטאבון XI ואילו תיקון בעזרת להב מרוכס היה נפוץ יותר ביברוד I. דרך תיקון נוספת התמקדה בבסיס הגרעין וכללה הסרת נתזים ולהבים בכיוון ההפוך לזה של משטח ההפקה. שיטה זו היתה נפוצה במיוחד ביברוד I והדבר מתבטא גם באופי הצלקות על הלהבים מהאתר – חלק מהם נושאים דגם צלקות בי-פולרי. בכמה מהמקרים תיקון שטח ההפקה כלל מספר מהלכים. מקרים אלו כוללים תיקון ראשוני בעזרת רכס והסרתו בעזרת התזת-יתר, או תיקון ראשוני מבסיס הגרעין והסרת שרידי תיקון זה בעזרת התזת-יתר. דרך התמודדות נוספת עם תיקון הגרעין היתה בנטישת שטח הנקישה הפעיל לטובת פתיחת שטח נקישה חדש במקום אחר בגרעין בו ניתן יהיה להפיק פריטים למינריים ביעילות גבוהה יותר. תופעה זו המשתקפת בגרעינים בעלי מספר שטחי נקישה זוהתה בכל האתרים, אך היא היתה נפוצה יותר במערת קסם וטאבון XI.

הגרעינים ננטשו ברובם לאחר שנוצלו עד כלות, כך שלא התאפשרה הפקת פריטים למינריים נוספים. אורכם הממוצע של הגרעינים הנטושים קטן מאורכם הממוצע של הפריטים הלמינריים. בחלק מהמקרים הגרעינים ניטשו עקב בעיות חומר גלם, צלקות הינג׳ או התזת-יתר גדולה מדי. אולם, גם במקרים אלו הגרעינים היו קרובים לניצול מירבי ולא ניתן היה להפיק פריטים למינריים רבים גם עם הבעיות הללו היו מתוקנות.

הניתוח הטכנולוגי מלמד כי רצף ההפחתה היה דינמי וכי כל שלב בו היה מלווה בבחירות טכנולוגיות מתוך מגוון רחב של אפשרויות. המחקר מצא כי כמעט כל הטכניקות המיוצגות על ידי הבחירות הטכנולוגיות השונות מופיעות בכל האתרים, עניין המעיד כי הסתתים משלושת האתרים חלקו ידע טכנולוגי זהה. יחד עם זאת, נמצא הבדל מהותי בין האתרים בשכיחות של הבחירות הטכנולוגיות לאורך רצף ההפחתה. ההבדל בבחירות הטכנולוגיות מתחיל בהעדפה שונה של חומרי גלם. אף על פי שבחירה זו ודאי השפיעה על מסלול ההפקה כולו, יש הבדלים רבים

נוספים שאינם תלויים בבחירת חומר הגלם. לדוגמא, בעוד ההעדפה לשיטות שונות ל״פתיחת״ הגרעינים כן הושפעה בחלקה מאופיו של חומר הגלם, ההעדפה של דרכים שונות לטיפול ותיקון הגרעינים במהלך ההפקה היתה קשורה יותר למסורת הסיתות.

עיצוב כלים ומאפיינים רצויים של הפריטים הלמינריים

השוואה בין הפריטים הלמינריים המצויים בבלנקס ואלו המצויים בין הפריטים המעוצבים (כלים) הובילה לזיהוי מספר תבניות לגבי התכונות המעודפות של פריטי-המטרה. התכונות הבאות נמצאו בשלושת האתרים שנבחנו.

1. אופיו של הקצה החד היה מרכיב מרכזי בבחירת הפריטים המתאימים לעיצוב ופריטים בעלי קצה חד אחיד יותר הועדפו.
2. הבחירה של פריטים ארוכים, רחבים ועבים יותר היא אחת התבניות הדומיננטיות והיא מלמדת כי הסתתים יצרו במתכוון פריטים גדולים יחסית.
3. הרכב טיפוסי הפריטים המעוצבים שהוכנו על הפריטים הלמינריים זהה למדי בשלושת האתרים ו׳פריטים למינריים משוברים׳ מהווים את הטיפוס הנפוץ ביותר.
4. להבים הם הטיפוס השכיח ביותר שנבחר לעיצוב והם מהווים 57-69% מסך הפריטים הלמינריים שעוצבו.
5. מבין שלושת הטיפוסים הלמינריים, סכינים בעלי גב טבעי נבחרו במידה הנמוכה ביותר. בעקבות הניתוח הטכנולוגי שהראה כי גם אלו פריטי-מטרה מכוונים ולא תוצרי לוואי, משוער כי מטרתם הראשונית היתה לשמש ככלים ללא עיצוב נוסף. הסכינים בעלי הגב הטבעי מראים בכמה מהמאפיינים שנבחנו דגם שונה לגמרי מזה של הלהבים והלהבים הראשוניים – דגם המרמז כי מטרתם הראשונית היתה לשמש ככלי חיתוך ללא צורך בעיצוב נוסף וכי הסכינים בעלי הגב הטבעי שנבחרו לעיצוב היו הפריטים ה״פחות טובים״.

ייצור פריטים למינריים בשלוש התעשיות של הקומפלקס האשלו-יברודי

אפיון ייצור הפריטים הלמינריים מן התעשייה היברודית ומן התעשייה האשלית של הקומפלקס האשלו-יברודי נעשה בעזרת בחינת המפלסים היברודיים והאשליים מטאבון XI ומשכבות 11-12 מיברוד I. בשני מקרים אלו נמצא ייצוג של שלושת הטיפוסים הלמינריים, של

פסולות עיצוב הגרעין והגרעינים שאפשרו את שחזור הטכנולוגיה. יחד עם זאת, ראוי לציין, כי השכיחות שלהם נמוכה בהרבה מזו המופיעה בתעשייה העמודית. התוצאות שהתקבלו הושוו לתוצאות הניתוח הטכנולוגי של התעשייה העמודית מאותם האתרים.

בבחינת שלוש התעשיות של טאבון XI נמצא כי העמודית מתאפיינת באיכות הסיתות הגבוהה ביותר. נמצא גם כי מאפייני סיתות הפריטים הלמינריים של התעשייה העמודית קרובים יותר לאלו של התעשייה היברודית ורחוקים יותר מאלו של התעשייה האשלית. בנוסף נמצא כי השונות בין התעשיות מתאפיינת במידתיות וכאשר בוחנים את שלוש התעשיות בסדר רציף (עמודית, יברודית, אשלית), חלק ניכר מהמאפיינים שנחקרו מראים מגמה של התעצמות או דעיכה בשכיחותם. זוהה כי בין שלושת הטיפוסים הלמינריים המופיעים בשלוש התעשיות, הדמיון הרב ביותר הוא בין הלהבים. בחירת הפריטים המתאימים לעיצוב מראה מאפיינים דומים בין התעשיות של טאבון XI, אך נמצא כי דגש על בחירת פריטים איכותיים יותר הופיע בעמודית בה הייצור היה דקדקני יותר. נראה כי בתעשייה האשלית החשיבות של איכות הפריטים היתה מועטה יותר, עניין המתבטא גם באופן ייצורם וגם בבחירת הפריטים לעיצוב.

בין התעשיות השונות של יברוד I נמצאה שונות רבה יותר באופן סיתות הפריטים הלמינריים מאשר השונות שזוהתה בטאבון XI. שונות זאת מתבטאת בכך שבתעשייה האשלית מיברוד I (שכבות 11-12) הופיע ייצור תדיר של פריטים למינריים בעלי צורה כללית מחודדת ובעלי צורת קצה חדה. בנוסף, הפריטים המיוצרים התאפיינו בשכיחות גבוהה יחסית של חתך-רוחב טרפזי. מאפיינים אלו מופיעים בשכיחות נמוכה באופן משמעותי בתעשייה העמודית מיברוד I שכבות 13 ו- 15. למרות השונות, נמצאו מספר מאפיינים המשותפים לשתי התעשיות הנבחנות מיברוד I ונדירים באתרים האחרים. מאפיינים אלו כוללים את הבחירה הטכנולוגית העקבית לתקן את משטח ההפקה מבסיס הגרעין והבחירה במסלול סיתות המוביל לגרעינים בעלי צורה 'פרמידלית מוצרת'.

מסקנות הניתוח

הדמיון הרב בין הטיפוסים הלמינריים משלושת האתרים מעיד כי צורתם היתה נשלטת וכי הסתתים משלושת האתרים חלקו תפיסה דומה לגבי צורתם המבוקשת של הפריטים (mental template). טכנולוגיות המתוכננות להפיק פריטים בעלי צורה קבועה מראש (predetermined (debitage technique) לרוב הופיעו יחד עם טכנולוגיות גרעין שכללו עיצוב מקדים ותכנון (prepared core technologies). בייצור הלהבים העמודי לא נערך עיצוב אינטנסיבי מקדים של הגרעין, והשליטה בהפקה התמקדה באיסוף חומר גלם שהתאים היטב לצורת הגרעין המבוקשת או בעזרת הפחתה משולבת של פריטים למינריים ונתזים. יחד עם זאת, העובדה כי בשלושת האתרים הטיפוסים הלמינריים דומים אף על פי שהיה בהם ניצול חומרי גלם שונים, מעידה כי הסתתים השכילו לעקוף את מגבלות השפעת חומר הגלם.

הייצור השיטתי מגרעינים מהם הופקו רק פריטים למינריים מעיד היטב כיצד הסרה של כל פריט למינרי הכינה את המתאר הדרוש להפחתת הפריט הבא. בעת ניצול בולבוסים רחבים יחסית נבחרה הפחתה משולבת של פריטים למינריים ונתזים. השילוב של הנתזים בהפקה מעיד גם כן על תחכום, שכן יש לפנינו במקרה זה הפרדה בין פריטים בעלי צורה קבועה מראש (predetermined blanks) ופריטים שהפחתתם תרמה לקביעת הצורה של הפריטים העוקבים (predetermining blanks). למרות שטכנולוגיות גרעין המובילות לייצור פריטים בעלי צורה ידועה מראש הופיעו עוד קודם במהלך התרבות האשלית של התקופה הפליאוליתית התחתונה, הן נפוצות רק במהלך התקופה הפליאוליתית התיכונה. הנחה זו שימשה חלק מהחוקרים לטעון כי ההומנידים מהתקופה הפליאוליתית התיכונה היו בעלי יכולות קוגניטיביות גבוהות יותר. מציאת מאפיינים אלו בעמודית בעוצמה שלא נופלת מזו של תעשיות הפליאולית התיכון מעידה על יכולתם הקוגניטיביות הגבוהות של ההומינידים של שלהי התקופה הפליאוליתית התחתונה.

העובדה כי הפריטים הלמינריים שעוצבו לכלים התאפיינו בשברור קל בלבד לרוב מלמדת כי צורת הפריטים אכן היתה מתוכננת היטב וכי לא נדרש עיצוב מסיבי לשינוי צורתם. הסכינים בעלי הגב הטבעי מהווים את העדות הטובה ביותר ליכולת השליטה בתוצרי-המטרה. פריטים אלו היו מתוכננים היטב כך שיכלו לשמש כסכינים ללא עיצוב נוסף כפי שמעידות תוצאות מחקר סימני השימוש. התכונות של הסכינים בעלי הגב הטבעי אפשרו אחיזה ביד בצורה שהקנתה יכולת להפעיל לחץ כלפי החומר הנחתך (בעל-חי) ותפיסה נוחה לתנועות האופקיות הדרושות לביצוע החיתוך. תכונות אלו כוללות את מתאר הגב הזקוף והאחיד לרוב, סיומת הקצה העבה שאפשרה אחיזה גם בקצה הדיסטלי, וחתך-הרוחב הטרפזי שאפשר תפיסה יציבה והעדפה לגב קליפתי גירני שהעצים את החיכוך בין היד והכלי. שלל תכונות אלו מלמד כי ניתן לראות בסכינים בעלי הגב הטבעי כלים ארגונומטרים. חשוב לציין, כי עקרון המפתח בכלים ארגונומטרים איננו היכולת לאחיזה נוחה יותר, אלא היכולת להשיג בעזרת האחיזה הנוחה תוצאות טובות יותר. עניין זה

מצביע גם כן על היכולות הקוגניטיביות הגבוהות של ההומונידים של שלהי התקופה הפליאוליתית התחתונה.

שחזור רצף ההפחתה הדגים כי ייצור הפריטים הלמינריים לא היה רק שיטתי אלא גם סדרתי. היצור הסדרתי ברור במיוחד בגרעינים בעלי הצורה 'צלעות מקבילות'. בגרעינים אלו משטח ההפקה היה תחום היטב בין שני צידי הגרעין כך שהוא שמר על מתאר זהה לאורך רוב רצף ההפחתה והשינוי היחידי בגרעין היה שמשטח ההפקה נסוג בהדרגה. בשיטה זו היתרונות של אופי משטח ההפקה, וגם החסרונות, נשארו זהים לאורך כל הרצף. במהלך ההפקה הוסרו סדרות של פריטים, שכל סדרה כיסתה את משטח ההפקה במלואו. משום שמתאר משטח ההפקה לא השתנה בגרעינים אלו, הפריטים שהופקו ברצף הסדרות היו דומים יחסית. לטכניקה זו אני קורא 'שיטת משטח ההפקה הנסוג'. שיטה זו אפיינה תעשיות להבים מאוחרות רבות ונקראה בשמות שונים על ידי חוקרים שונים. הנוכחות של שיטה זו כבר בעמודית מעידה כי יכולת סיתות הלהבים שלהם לא נפלה מזו של תעשיות מאוחרות. ההופעה הראשונית של ייצור סידרתי של פריטי צור היא חשובה ומלמדת על גישה חדשה לניצול חומר הגלם ועל יכולת תכנון.

ייצור הפריטים הלמינריים בעמודית מראה שונות ברצף ההפחתה בין שלושת האתרים. בהתחשב בכך שהתוצרים דומים, ניתן להסיק כי כל אחד מהאתרים התאפיין במסורת סיתות משלו. טענה זו נתמכת גם בכך שבכל אחד משלושת האתרים נמצאה אותה מסורת סיתות לאורך מספר שכבות או מפלסים וכי הדמיון בין מפלסים אלו גבוה מזה שבין האתרים. שונות אזורית המופיעה במרחב מצומם כמו זה הנבחן כאן לא תועדה קודם. תבניות דומות אובחנו רק מהתקופה הפליאוליתית התיכונה והילך.

השוואת ייצור הפריטים הלמינריים מהשכבות והמפלסים השונים של טאבון XI ויברוד I לימדה כי הסתתים משלוש התעשיות של הקומפלקס האשלו-יברודי ידעו לייצר פריטים למינריים, אם כי לא בהכרח בחרו לעשות זאת. נמצא כי ההבדל בין התעשיות איננו מייצג תרבויות שונות, אלא את אותה אוכלוסייה אשר יצרה מכלולי צור שונים בהתאם לנסיבות שונות. בכמה מן האתרים תעשיות אלו נמצאו כך שהן מופיעות באותן המפלסים, אם כי באזורים שונים באתר. תופעה זו נמצאה במערת טאבון, יברוד I, אתרי עדלון (חוף לבנון) ומערת קסם. כיוון שתוצאות ניתוח הפריטים הלמינריים מלמדת על ייצור התעשיות על ידי אותה האוכלוסייה, השונות במקרים אלו מעידה על קיומם של אזורי פעילות שונים. עובדה זו חשובה, שכן קיומם של אזורי פעילות נחשב לאחד ממאפייני 'התנהגות אדם מודרני'.

מעבר לכך, נמצא כי הדמיון במאפייני סיתות הפריטים הלמינריים רב יותר כאשר משווים תעשיות שונות מהקומפלקס האשלו-יברודי מאותו אתר מאשר בין מפלסי התעשייה העמודית בין האתרים. לדוגמא, הבחירה לנצל לוחות צור לייצור פריטים למינריים דומיננטית בכל אחד מהמדגמים שנבחנו ממערת קסם, אך נדירה בכל אחד מהמדגמים האחרים שנבחנו (עמודי או אחר) למרות שניתן היה למצוא אותם בסביבת כל אחד מן האתרים הנדונים. הבחירה להפיק את הפריטים הלמינריים באופן שהסרתם חלפה את כל אורכו של משטח ההפקה היתה נפוצה בכל אחד ממדגמי מערת קסם, אך נמצאה בשימוש מועט יותר בכל אחד מהאתרים האחרים. במקרה של יברוד I נמצאו מספר מאפיינים המשותפים לתעשייה העמודית של שכבה 15 ולתעשייה האשלית של שכבות 11-12 ושאינם מופיעים באופן דומה באתרים האחרים. מאפיינים אלו כוללים הופעת גרעינים בעלי צורה 'פריזמטית מוצרת', הפחתה מועטה יחסית של פריטים שחלפו את משטח הפקה במלואו, ושימוש גבוה בטיפולי בסיס על מנת לתחזק את הגרעין במהלך ההפקה. במקרה של טאבון XI הדמיון הרב בין היברודית והעמודית שזוהה בניתוח המאפיינים תומך בכך. תמונה זו מחזקת את הטענה כי כל אחד מהאתרים התאפיין במסורת סיתות פריטים למינריים משלו וכי מסורת זו התקיימה לאורך פרק זמן ניכר. עניין זה בולט במיוחד במערת קסם בה השכבות מתוארכות ל- 380,000-220,000 שנה והמדגמים המפוזרים לאורך רצף זה מדגימים מסורת זהה של ייצור פריטים למינריים. תופעה זו מלמדת כי שלושת האתרים הנדונים מייצגים שלוש קבוצות שונות במרחב שלכל אחת מהן היתה מסורת סיתות משלה. תופעה זו היתה ידועה עד כה מהתקופה הפליאולתית התיכונה בה נמצאו מספר מקרים של חזרות של אותן קבוצות לאתרים קבועים. ראוי לציין, כי כל אחת מהקבוצות ידעה להפיק את שלוש התעשיות המאפיינות את הקומפלקס האשלו-יברודי בהתאם לנסיבות שטרם הובררו.

העובדה כי השונות בין הפריטים הלמינריים משלושת האתרים קטנה יחסית וכי ההבדלים הברורים יותר הם ברצף ההפחתה מרמזת על חשיבותו של מהלך הסיתות עצמו בקרב החברות של שלהי התקופה הפליאוליתית התחתונה. מחקרים אנתרופולוגים וארכיאולוגים מלמדים כי למרות שברוב החברות היו מספר מסלולי סיתות לייצור מגוון כלים, בדרך כלל ניתנה משמעות רבה למסלול בודד אחד או יותר לא רק על ידי החוקרים אלא גם על ידי הסתתים עצמם. החשיבות במקרים אלו התמקדה לא רק בתוצר המוגמר, אלא ברצף ההפחתה כולו. במכלולים הארכיאולוגים, תופעה זו זכתה לתשומת לב רבה במקרה של אבני-היד של התרבות האשלית. העובדה כי שלושת האתרים מציגים מסורות שונות לייצור פריטים למינריים לאורך רצף של שכבות מרמזת כי בקומפלקס האשלו-יברודי פריטים אלו נשאו משמעות דומה. מסורת הסיתות

כנראה נלמדה בעתות בהן נערך סיתות בצוותא. מחקרים אנתרופולוגים מלמדים כי סיתות בצוותא היא תופעה שכיחה והיא משמשת בנוסף להכנת הכלים ללכד את חברי הקהילה. סיתות בצוותא שימש גם כמצע נוח להפגנת יכולות הסתתים. היתרון של ייצור הפריטים הלמינריים במקרה זה הוא בייצור הסדרתי שלהם. היכולת להפיק סדרה של פריטים אחד אחר השני ללא טעויות היא הפגנת מיומנות רבה והיא ניתנת לאבחנה רק במהלך הסיתות עצמו ולא בתוצרים המוגמרים. ביצוע הסיתות בצוותא העלה גם אפשרות כי חלק מפעולות הסיתות לא כוונו רק להפקת תוצרי-מטרה טובים יותר, אלא גם ליצירת רושם רב יותר על הצופים. ההנחה היא כי אסטטיקה עשויה היתה לשחק תפקיד לא רק לגבי חזותם של פריטי המטרה אלא גם לגבי תהליך ההפקה כולו.

תוצאות המחקר תרמו גם נקודת מבט נוספת להבנת המעבר בין התקופה הפליאוליתית התחתונה והתקופה הפליאוליתית התיכונה. מאפייני הלהבים מיברוד I שכבות 11-12 דומים במעט לאלו של הלהבים מתעשיות ראשית הפליאולית התיכון. מאפיינים אלו כוללים להבים בעלי צורה מחודדת, קצה מחודד וחתך-רוחב טרפזי. מיעוט עיצוב שטחי נקישה ב-faceting מסודר ורציף פוסל את האפשרות כי להבים אלו אינם באתרם. הייצור שלהם בשלב זה של סוף הקומפלקס האשלו-יברודי עשויה ללמד כי קיימת המשכיות מסוימת בין תעשיית הלהבים העמודית לזו של ראשית הפליאולית התיכון. משום שבתעשיות הפליאולית התיכון הופיע גם ייצור להבים בעל אופי לבלואזי וגם ייצור להבים שאיננו לבלואזי, אני מניח כי ההמשכיות האפשרית קשורה יותר לסוג השני.

לסיכום, ניתוח ייצור הפריטים הלמינריים מהקומפלקס האשלו-יברודי הראה כי טכנולוגיית ייצורם היתה אמנם פשוטה יחסית, אך מתוחכמת. למרות שהיא לא כללה מהלכי סיתות מורכבים, היא כן כללה מהלכים מחושבים היטב שמטרתם היתה להוביל להפקתם של התוצרים הדרושים. בפני הסתתים עמד מגוון אפשרויות והם בחרו מתוכן בהתאם לנסיבות הסיתות ומסורת המלאכה שלהם. בהתאם לכך, התעשייה העמודית למעשה, איננה נופלת מתעשיות להבים מאוחרות והפשטות של התעשייה למעשה צריכה להיחשב כיתרון ולא כחסרון. היכולת לתכנן את מהלכי הסיתות מעידה כי ההומנידים של שלהי התקופה הפליאוליתית התחתונה היו בעלי יכולות קוגניטביות גבוהות, כאשר ההופעה הראשונית של ייצור סדרתי מהווה עדות נוספת לכך.

העובדה ששלוש התעשיות של הקומפלקס האשלו-יברודי הם מעשי ידיה של אוכלוסיה אחת שאמנם היתה מחולקת למספר קבוצות, כפי שמסורות הסיתות מעידות, מלמדת על

התנהגות מורכבת ביותר הכוללת זהות קבוצתית והתנהגות שונה במרחב. נקודות אלו תומכות בכך שאף על פי שיתכן כי שורשי 'התנהגות האדם המודרני' מקורם עוד קודם לקומפלקס האשלו-יברודי, תפנית ניכרת בעוצמתה החלה בשלהי התקופה הפליאוליתית התחתונה.

TEL AVIV UNIVERSITY
THE LESTER AND SALLY ENTIN FACULTY OF HUMANITIS
THE CHAIM ROSENBERG SCHOOL OF JEWISH STUDIES

LITHIC BLADE PRODUCTION IN THE MIDDLE PLEISTOCENE OF THE LEVANT

Volume II: Tables and Figures

THESIS SUBMITTED FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

BY

RON SHIMELMITZ

UNDER THE SUPERVISION OF PROF. AVI GOPHER

SUBMITTED TO THE SENAT OF TEL AVIV UNIVERSITY

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	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

Table 1: The lithic assemblages of Qesem.

Composition of the laminar and flake component (data for the laminar percentages of Table 1):

Laminar items include: PE blades, PE bladelets, blade, bladelets, NBK, CTE (laminar), double bulb (laminar), burin spalls, and shaped items (laminar).

Flake items include: primary element flakes, flakes, modified base flakes, NBKs-flake, CTEs (flakes), double bulb (flakes), shaped items (flakes) and special waste.

Core items include: cores, core fragments, cores on flake, and shaped items ('core tools').

Division of mixed categories into laminar, flake and core items:

	CTEs		Double bulbs		Shaped items		
	laminar	flake	laminar	flake	laminar	flake	core
Unit V	17	31	1	3	23	54	2
G-I/19-22	84	111	6	13	89	152	1
G/19-20	89	43	9	8	263	117	
F-H/13-15	108	163	13	11	182	332	4
K/10	45	35	2	1	100	78	

	Unit V						
type	flake	% out of total shaped flakes	laminar items	% out of total shaped laminar	core tool	total	% of total shaped items
retouched laminar item			19	82.6		19	24.1
backed knife	1	1.9				1	1.3
distally retouched lam.			4	17.4		4	5.1
end-scraper	2	3.7				2	2.5
side-scraper	2	3.7				2	2.5
burin	5	9.3				5	6.3
retouched flake	26	48.1				26	32.9
notch/denticulate	6	11.1				6	7.6
biface					2	2	2.5
varia	1	1.9				1	1.3
retouched fragment	11	20.4				11	13.9
sum	54	100	23	100	2	79	100
% of class	68.4		29.1		2.5	100	

	G-I/19-22						
type	flake	% out of total shaped flakes	laminar items	% out of total shaped laminar	core tool	total	% of total shaped items
retouched laminar item			45	50.6		45	18.6
backed knife	7	4.6	11	12.4		18	7.4
distally retouched lam.			16	18.0		16	6.6
end-scraper	9	5.9	8	9.0		17	7.0
side-scraper	8	5.3	1	1.1		9	3.7
burin	26	17.1	5	5.6		31	12.8
retouched flake	46	30.3				46	19.0
notch/denticulate	17	11.2	2	2.2		19	7.9
biface					1	1	0.4
varia	6	3.9	1	1.1		7	2.9
retouched fragment	33	21.7				33	13.6
sum	152	100	89	100	1	242	100
% of class	62.8		36.8		0.4	100	100

	G/19-20						
type	flake	% out of total shaped flakes	laminar items	% out of total shaped laminar	core tool	total	% of total shaped items
retouched laminar item			169	64.3		169	44.5
backed knife	5	4.3	26	9.9		31	8.2
distally retouched lam.			39	14.8		39	10.3
end-scraper	7	6.0	23	8.7		30	7.9
side-scraper	3	2.6		0.0		3	0.8
burin	12	10.3	4	1.5		16	4.2
retouched flake	45	38.5				45	11.8
notch/denticulate	1	0.9	1	0.4		2	0.5
biface							0.0
varia	4	3.4	1	0.4		5	1.3
retouched fragment	40	34.2				40	10.5
sum	117	293	263	100		380	100
% of class	30.8		69.2			100	

	F-H/13-15						
type	flake	% out of total shaped flakes	laminar items	% out of total shaped laminar	core tool	total	% of total shaped items
retouched laminar item			106	58.2		106	20.5
backed knife	26	7.8	11	6.0		37	7.1
distally retouched lam.			21	11.5		21	4.1
end-scraper	18	5.4	22	12.1		40	7.7
side-scraper	43	13.0	3	1.6		46	8.9
burin	59	17.8	10	5.5		69	13.3
retouched flake	94	28.3				94	18.1
notch/denticulate	19	5.7	2	1.1		21	4.1
biface					4	4	0.8
varia	16	4.8	7	3.8		23	4.4
retouched fragment	57	17.2				57	11.0
sum	332	100	182	100	4	518	100
% of class	64.1		35.1		0.8	100	

	K/10						
type	flake	% out of total shaped flakes	laminar items	% out of total shaped laminar	core tool	total	% of total shaped items
retouched laminar item			61	61.0		61	34.3
backed knife	3	3.8	10	10.0		13	7.3
distally retouched lam.			10	10.0		10	5.6
end-scraper	8	10.3	7	7.0		15	8.4
side-scraper	6	7.7	3	3.0		9	5.1
burin	13	16.7	7	7.0		20	11.2
retouched flake	31	39.7				31	17.4
notch/denticulate	4	5.1	1			5	2.8
biface							
varia	1	1.3	1	1.0		2	1.1
retouched fragment	12	15.4				12	6.7
sum	78	100	100	99		178	100
% of class	43.8		56.2			100	

	Sum of all samples						
type	flake	% out of total shaped flakes	laminar items	% out of total shaped laminar	core tool	total	% of total shaped items
retouched laminar item			400	60.9		400	28.6
backed knife	42	5.7	58	8.8		100	7.2
distally retouched lam.			90	13.7		90	6.4
end-scraper	44	6.0	60	9.1		104	7.4
side-scraper	62	8.5	7	1.1		69	4.9
burin	115	15.7	26	4.0		141	10.1
retouched flake	242	33.0				242	17.3
notch/denticulate	47	6.4	6	0.9		53	3.8
biface					7	7	0.5
varia	28	3.8	10	1.5		38	2.7
retouched fragment	153	20.9				153	11.0
sum	733	100	657	100	7	1397	100
% of class	52.5		47.0		0.5	100	

Table 2: Shaped items from Qesem Cave.

		whole	proximal	medial	distal	sum
Unit V	blade	17	6	1	3	27
Unit V	PE blade	25	6	0	3	34
Unit V	NBK	24	5	1	3	33
G-I/19-22	blade	66	50	7	23	146
G-I/19-22	PE blade	67	23	13	28	131
G-I/19-22	NBK	68	46	8	18	140
G/19-20	blade	50	62	19	34	165
G/19-20	PE blade	62	39	7	25	133
G/19-20	NBK	95	44	15	36	190
F-H/13-15	blade	71	88	24	31	214
F-H/13-15	PE blade	84	60	21	44	209
F-H/13-15	NBK	108	73	17	48	246
K/10	blade	53	26	10	4	93
K/10	PE blade	57	11	6	14	88
K/10	NBK	58	16	7	6	87

A: Blanks

		whole	proximal	medial	distal	sum
Unit V	blade	10	2	0	1	13
Unit V	PE blade	4	0	0	2	6
Unit V	NBK	3	0	0	0	3
G-I/19-22	blade	28	5	4	8	45
G-I/19-22	PE blade	15	4	0	6	25
G-I/19-22	NBK	8	1	0	0	9
G/19-20	blade	79	34	17	26	156
G/19-20	PE blade	36	6	4	11	57
G/19-20	NBK	26	2	1	6	35
F-H/13-15	blade	31	20	4	21	76
F-H/13-15	PE blade	24	15	4	11	54
F-H/13-15	NBK	27	5	3	9	44
K/10	blade	32	10	5	17	64
K/10	PE blade	15	2	1	4	22
K/10	NBK	5	0	0	2	7

B: Shaped items

		whole	proximal	medial	distal	sum
Unit V	blade	27	8	1	4	40
Unit V	PE blade	29	6	0	5	40
Unit V	NBK	27	5	1	3	36
G-I/19-22	blade	94	55	11	31	191
G-I/19-22	PE blade	82	27	13	34	156
G-I/19-22	NBK	76	47	8	18	149
G/19-20	blade	129	96	36	60	321
G/19-20	PE blade	98	45	11	36	190
G/19-20	NBK	121	46	16	42	225
F-H/13-15	blade	102	108	28	52	290
F-H/13-15	PE blade	108	75	25	55	263
F-H/13-15	NBK	135	78	20	57	290
K/10	blade	85	36	15	21	157
K/10	PE blade	72	13	7	18	110
K/10	NBK	63	16	7	8	94

C: Blanks and shaped items

Table 3: The three analyzed laminar types from Qesem Cave and their state of preservation.

sample	laminar item type	Blanks					Shaped items					Blanks and shaped items				
		n=	smallest size	largest size	mean	standard deviation	n=	smallest size	largest size	mean	standard deviation	n=	smallest size	largest size	mean	standard deviation
Unit V	blade	17	32	63	49.2	10.5	10	40	85	58.3	11.9	27	32	85	52.6	11.7
G-I/19-22	blade	66	27	72	45.1	11.2	27	33	79	53.4	11.3	93	27	79	47.5	11.8
G/19-20	blade	49	29	77	49.4	10.0	79	39	83	54.3	9.7	128	29	83	52.5	10.1
F-H/13-15	blade	70	28	86	49.3	12.3	31	32	130	54.8	15.9	101	28	130	51.0	13.7
K/10	blade	52	30	110	48.7	14.6	32	28	96	60.2	14.0	84	28	110	53.0	15.5
all	blade	254	27	110	48.1	12.1	179	28	130	55.5	12.2	433	27	130	51.2	12.7
Unit V	PE blade	24	31	80	51.5	12.8	4	58	83	68.2	11.3	28	31	83	53.9	13.8
G-I/19-22	PE blade	66	31	99	51.6	12.6	15	45	71	58.9	9.1	81	31	99	53.0	12.3
G/19-20	PE blade	62	27	97	53.4	11.9	36	37	87	56.4	10.9	98	27	97	54.5	11.6
F-H/13-15	PE blade	82	30	86	53.6	12.3	24	38	81	57.2	11.0	106	30	86	54.4	12.1
K/10	PE blade	57	33	90	50.9	11.9	15	37	81	57.9	9.9	72	33	90	52.3	11.8
all	PE blade	291	27	99	52.4	12.2	94	37	87	57.7	10.6	385	27	99	53.7	12.0
Unit V	NBK	24	31	75	54.2	11.1	3	55	60	58.0	2.6	27	31	75	54.6	10.5
G-I/19-22	NBK	68	31	90	49.9	10.6	8	42	62	54.8	7.2	76	31	90	50.4	10.4
G/19-20	NBK	94	33	92	52.0	11.5	26	44	87	57.2	10.3	120	33	92	53.1	11.4
F-H/13-15	NBK	106	27	80	51.8	10.0	26	45	92	61.8	12.4	132	27	92	53.8	11.2
K/10	NBK	58	35	85	50.1	9.1	5	39	63	51.4	11.3	63	35	85	50.2	9.2
all	NBK	350	27	92	51.4	10.5	68	39	92	58.3	11.0	418	27	92	52.5	10.9
Unit V	all	65	31	80	51.9	11.6	17	40	85	60.6	11.1	82	31	85	53.7	12.0
G-I/19-22	all	200	27	99	48.9	11.8	50	33	79	55.3	10.2	250	27	99	50.1	11.8
G/19-20	all	205	27	97	51.8	11.4	141	37	87	55.4	10.2	346	27	97	53.3	11.0
F-H/13-15	all	258	27	86	51.7	11.5	81	32	130	57.8	13.7	339	27	130	53.2	12.3
K/10	all	166	30	110	49.9	12.0	52	28	96	58.7	12.8	218	28	110	52.0	12.8
all	all	895	27	110	50.8	11.7	341	28	130	56.7	11.6	1236	27	130	52.4	11.9

Table 4: Mean length of the three laminar types from Qesem Cave (in mm).

sample	laminar item type	Blanks					Shaped items					Blanks and shaped items				
		n=	smallest size	largest size	mean	standard deviation	n=	smallest size	largest size	mean	standard deviation	n=	smallest size	largest size	mean	standard deviation
Unit V	blade	17	12	27	20.7	3.9	10	15	35	24.0	6.5	27	12	35	21.9	5.2
G-I/19-22	blade	65	12	34	18.9	4.9	27	13	31	21.9	5.2	92	12	34	19.8	5.1
G/19-20	blade	49	13	31	19.6	4.3	79	12	39	21.7	4.9	128	12	39	20.9	4.8
F-H/13-15	blade	70	12	42	20.8	5.5	28	14	46	22.2	6.4	98	12	46	21.2	5.8
K/10	blade	53	12	45	19.8	6.6	31	14	39	23.8	5.9	84	12	45	21.2	6.6
all	blade	254	12	45	19.9	5.3	175	12	46	22.3	5.5	429	12	46	20.9	5.5
Unit V	PE blade	25	13	35	22.3	6.0	4	18	37	29.8	8.3	29	13	37	23.3	6.7
G-I/19-22	PE blade	67	12	40	20.8	6.2	15	17	29	24.4	4.1	82	12	40	21.5	6.0
G/19-20	PE blade	62	12	39	20.0	5.2	36	13	30	21.9	4.4	98	12	39	20.7	5.0
F-H/13-15	PE blade	84	13	41	21.7	5.7	22	15	28	23.5	4.0	104	13	41	22.5	5.4
K/10	PE blade	53	12	32	19.9	5.4	15	15	32	23.4	4.5	72	12	32	20.7	5.4
all	PE blade	293	12	41	21.0	5.7	92	13	37	23.3	4.7	385	12	41	21.5	5.6
Unit V	NBK	24	12	35	23.0	7.0	3	20	25	22.7	2.5	27	12	35	23.0	6.6
G-I/19-22	NBK	67	12	42	19.8	5.5	8	16	27	21.4	4.8	75	12	42	20.0	5.4
G/19-20	NBK	95	12	38	19.6	5.0	26	15	35	22.4	5.1	121	12	38	20.2	5.1
F-H/13-15	NBK	107	12	35	20.9	4.6	27	16	45	25.4	6.4	134	12	45	21.8	5.4
K/10	NBK	58	12	33	19.5	4.1	5	16	30	21.8	5.1	63	12	33	19.7	4.2
all	NBK	351	12	42	20.2	5.1	69	15	45	23.4	5.7	420	12	45	20.8	5.3
Unit V	all	66	12	35	22.2	5.9	17	15	37	25.1	6.7	83	12	37	22.8	6.2
G-I/19-22	all	199	12	42	19.9	5.6	50	13	31	22.5	4.9	249	12	42	20.4	5.5
G/19-20	all	206	12	39	19.7	4.8	141	12	39	21.9	4.8	347	12	39	20.6	4.9
F-H/13-15	all	259	12	42	21.0	4.7	77	14	46	23.7	5.9	336	12	46	21.8	5.5
K/10	all	168	12	45	19.7	5.4	51	14	39	23.5	5.4	219	12	45	20.0	5.6
all	all	898	12	45	20.3	5.1	336	12	46	22.8	5.3	1234	12	46	21.0	5.5

Table 5: Mean width of the three laminar types from Qesem Cave (in mm).

sample	laminar item type	Blanks n=	Blanks smallest size	Blanks largest size	Blanks mean	Blanks standard deviation	Shaped items n=	Shaped items smallest size	Shaped items largest size	Shaped items mean	Shaped items standard deviation	Blanks and shaped items n=	Blanks and shaped items smallest size	Blanks and shaped items largest size	Blanks and shaped items mean	Blanks and shaped items standard deviation
Unit V	blade	17	4	16	8.1	3.1	10	6	20	12.2	4.5	27	4	20	9.6	4.1
G-I/19-232	blade	66	4	21	8.7	3.4	27	5	13	9.0	2.6	93	4	21	8.8	3.2
G/19-20	blade	50	3	18	8.0	3.4	79	4	15	8.5	2.2	129	3	18	8.3	2.7
F-H/13-15	blade	70	4	21	9.1	3.1	30	5	12	8.4	2.0	100	4	21	8.9	2.8
K/10	blade	53	3	16	7.6	3.3	32	4	24	9.2	3.9	85	3	24	8.2	3.6
all	blade	256	3	16	8.4	3.3	178	4	24	8.9	2.9	434	3	24	8.6	3.1
Unit V	PE blade	25	5	18	10.0	3.1	4	13	17	14.5	1.7	29	5	18	10.6	3.3
G-I/19-22	PE blade	67	4	20	9.8	3.0	15	8	13	11.1	2.0	82	4	20	10.0	2.8
G/19-20	PE blade	62	5	14	8.7	2.4	36	5	18	9.5	2.8	98	5	18	9.0	2.5
F-H/13-15	PE blade	84	4	20	10.6	3.5	24	7	15	11.3	2.6	108	4	20	10.8	3.4
K/10	PE blade	57	4	19	8.8	2.8	15	6	20	10.5	3.4	72	4	20	9.2	3.0
all	PE blade	295	4	20	9.6	3.1	94	5	20	10.6	2.9	389	4	20	9.9	3.1
Unit V	NBK	24	4	25	13.5	5.1	3	7	13	10.7	3.2	27	4	25	13.2	4.9
G-I/19-22	NBK	68	5	22	10.4	3.1	8	9	14	11.3	1.8	76	5	22	10.5	3.0
G/19-20	NBK	95	5	18	9.8	3.0	26	7	21	10.7	3.6	121	5	21	10.0	3.2
F-H/13-15	NBK	108	5	28	11.5	3.9	27	8	19	12.9	2.9	135	5	28	11.8	3.8
K/10	NBK	58	5	18	9.7	2.2	5	5	15	9.0	3.7	63	5	18	9.7	3.0
all	NBK	353	4	28	10.7	3.6	69	5	21	11.5	3.3	422	4	28	10.8	3.6
Unit V	all	66	4	25	10.8	4.5	17	6	20	12.5	3.9	83	4	25	11.1	4.4
G-I/19-22	all	201	4	22	9.6	3.2	50	5	14	10.0	2.5	251	4	22	9.7	3.1
G/19-20	all	207	3	18	9.0	3.0	141	4	21	9.1	2.8	348	3	21	9.1	2.9
F-H/13-15	all	262	4	28	10.6	3.7	81	5	19	10.8	3.1	343	4	28	10.6	3.6
K/10	all	168	3	19	8.8	3.1	52	4	24	9.6	3.7	220	3	24	9.0	3.3
all	all	904	3	28	9.7	3.5	341	4	24	9.9	3.2	1245	3	28	9.7	3.4

Table 6: Mean thickness of the three laminar types from Qesem Cave (in mm).

sample	laminar item type	Blanks n=	Blanks mean	Blanks standard deviation	Shaped items n=	Shaped items mean	Shaped items standard deviation	Blanks and shaped items n=	Blanks and shaped items mean	Blanks and shaped items standard deviation
Unit V	blade	17	2.4	0.3	10	2.5	0.4	27	2.4	0.3
G-I/19-232	blade	65	2.4	0.3	27	2.5	0.3	92	2.4	0.3
G/19-20	blade	48	2.6	0.5	75	2.6	0.5	123	2.6	0.5
F-H/13-15	blade	69	2.4	0.3	28	2.5	0.4	97	2.4	0.4
K/10	blade	52	2.5	0.4	31	2.6	0.4	83	2.6	0.4
all	blade	251	2.5	0.4	171	2.6	0.4	422	2.5	0.4
Unit V	PE blade	24	2.4	0.3	4	2.4	0.6	28	2.4	0.3
G-I/19-22	PE blade	66	2.6	0.5	15	2.4	0.3	81	2.6	0.5
G/19-20	PE blade	62	2.7	0.5	35	2.6	0.5	97	2.7	0.5
F-H/13-15	PE blade	80	2.4	0.3	22	2.4	0.4	102	2.4	0.3
K/10	PE blade	57	2.6	0.5	15	2.5	0.3	72	2.6	0.4
all	PE blade	289	2.6	0.5	91	2.5	0.4	380	2.6	0.5
Unit V	NBK	24	2.5	0.6	3	2.6	0.4	27	2.5	0.6
G-I/19-22	NBK	67	2.6	0.5	8	2.7	0.6	75	2.6	0.5
G/19-20	NBK	94	2.8	0.7	25	2.7	0.6	119	2.7	0.6
F-H/13-15	NBK	105	2.5	0.4	26	2.5	0.5	131	2.5	0.4
K/10	NBK	58	2.6	0.6	5	2.5	0.8	63	2.6	0.6
all	NBK	348	2.6	0.5	67	2.6	0.5	415	2.6	0.5
Unit V	all	65	2.4	0.4	17	2.5	0.4	82	2.4	0.4
G-I/19-22	all	198	2.5	0.5	50	2.5	0.4	248	2.5	0.4
G/19-20	all	204	2.7	0.6	135	2.6	0.5	339	2.7	0.6
F-H/13-15	all	254	2.5	0.4	76	2.5	0.4	330	2.5	0.4
K/10	all	167	2.6	0.5	51	2.5	0.4	218	2.6	0.5
all	all	888	2.6	0.5	329	2.6	0.5	1217	2.6	0.5

Table 7: Mean length/width ratio of the three laminar types from Qesem Cave (in mm).

sample	laminar item type	Blanks n=	Blanks mean	Blanks standard deviation	Shaped items n=	Shaped items mean	Shaped items standard deviation	Blanks and shaped items n=	Blanks and shaped items mean	Blanks and shaped items standard deviation
Unit V	blade	17	2.8	0.7	10	2.1	0.6	27	2.5	0.7
G-I/19-232	blade	65	2.4	0.7	27	2.5	0.5	92	2.4	0.7
G/19-20	blade	49	2.8	1.0	79	2.7	0.8	128	2.7	0.8
F-H/13-15	blade	69	2.4	0.7	27	2.7	0.7	96	2.5	0.7
K/10	blade	53	2.9	0.9	31	2.8	0.8	84	2.8	0.9
all	blade	253	2.6	0.8	174	2.6	0.7	427	2.6	0.8
Unit V	PE blade	25	2.4	0.8	4	2.1	0.6	29	2.3	0.7
G-I/19-22	PE blade	67	2.2	0.6	15	2.2	0.4	82	2.2	0.5
G/19-20	PE blade	62	2.4	0.6	36	2.4	0.5	98	2.4	0.5
F-H/13-15	PE blade	82	2.2	0.6	22	2.1	0.5	104	2.2	0.6
K/10	PE blade	57	2.4	0.8	15	2.3	0.6	72	2.4	0.7
all	PE blade	293	2.3	0.6	92	2.3	0.5	385	2.3	0.6
Unit V	NBK	24	1.8	0.6	3	2.3	0.9	27	1.9	0.6
G-I/19-22	NBK	67	2.0	0.6	8	1.9	0.4	75	2.0	0.6
G/19-20	NBK	95	2.1	0.7	26	2.3	0.7	121	2.2	0.7
F-H/13-15	NBK	107	1.9	0.5	27	2.0	0.5	134	1.9	0.5
K/10	NBK	58	2.1	0.6	5	2.6	0.9	63	2.2	0.7
all	NBK	351	2.0	0.6	69	2.2	0.6	420	2.0	0.6
Unit V	all	42	2.3	0.8	14	2.1	0.6	56	2.2	0.7
G-I/19-22	all	132	2.2	0.6	42	2.3	0.5	174	2.2	0.6
G/19-20	all	111	2.4	0.8	115	2.5	0.7	226	2.4	0.8
F-H/13-15	all	151	2.2	0.6	49	2.3	0.6	200	2.2	0.6
K/10	all	110	2.5	0.8	46	2.6	0.8	156	2.5	0.8
all	all	546	2.3	0.7	266	2.4	0.7	812	2.3	0.7

Table 8: Mean width/thickness ratio of the three laminar types from Qesem Cave (in mm).

n=		core tablet	overpass item	radial overpass item	crested blade	varia	sum
Unit V	blanks	5	15	4	10	14	48
Unit V	shaped items	0	4	3	0	1	8
Unit V	total	5	19	7	10	15	56
G-I/19-22	blanks	8	56	7	51	73	195
G-I/19-22	shaped items	0	12	0	3	6	21
G-I/19-22	total	8	68	7	54	79	216
G/19-20	blanks	8	51	5	50	18	132
G/19-20	shaped items	0	13	0	5	1	19
G/19-20	total	8	64	5	55	19	151
F-H/13-15	blanks	12	71	10	68	110	271
F-H/13-15	shaped items	0	9	0	5	3	17
F-H/13-15	total	12	80	10	73	113	288
K/10	blanks	10	31	0	20	19	80
K/10	shaped items	0	6	0	3	0	9
K/10	total	10	37	0	23	19	89
sum	blanks	43	224	26	199	234	726
sum	shaped items	0	44	3	16	11	74
sum	total	43	268	29	215	245	800

%		core tablet	overpass item	radial overpass item	crested blade	varia	sum
Unit V	blanks	10.4	31.3	8.3	20.8	29.2	100
Unit V	shaped items	0.0	50.0	37.5	0.0	12.5	100
Unit V	total	8.9	33.9	12.5	17.9	26.8	100
G-I/19-22	blanks	4.1	28.7	3.6	26.2	37.4	100
G-I/19-22	shaped items	0.0	57.1	0.0	14.3	28.6	100
G-I/19-22	total	3.7	31.5	3.2	25.0	36.6	100
G/19-20	blanks	6.1	38.6	3.8	37.9	13.6	100
G/19-20	shaped items	0.0	68.4	0.0	26.3	5.3	100
G/19-20	total	5.3	42.4	3.3	36.4	12.6	100
F-H/13-15	blanks	4.4	26.2	3.7	25.1	40.6	100
F-H/13-15	shaped items	0.0	52.9	0.0	29.4	17.6	100
F-H/13-15	total	4.2	27.8	3.5	25.3	39.2	100
K/10	blanks	12.5	38.8	0.0	25.0	23.8	100
K/10	shaped items	0.0	66.7	0.0	33.3	0.0	100
K/10	total	11.2	41.6	0.0	25.8	21.3	100
sum	blanks	5.9	30.9	3.6	27.4	32.2	100
sum	shaped items	0.0	59.5	4.1	21.6	14.9	100
sum	total	5.4	33.5	3.6	26.9	30.6	100

total % of shaped items		0.0	16.4	10.3	7.4	4.5	9.3

Table 9: Core trimming elements from Qesem Cave.

		retouched laminar item	backed knife	distally retouched laminar item	end-scraper	side-scraper	burin	retouched flake	notch/ denticulate	varia	fragment	sum
Unit V	laminar	1										1
Unit V	flake						1	2				3
Unit V	total	1	0	0	0	0	1	2	0	0	0	4
G-I/19-22	laminar	2	1	1	2		1					7
G-I/19-22	flake							2	2	1		5
G-I/19-22	total	2	1	1	2	0	1	2	2	1	0	12
G19/20	laminar	6		1	1					1		9
G19/20	flake							3			1	4
G19/20	total	6	0	1	1	0	0	3	0	1	1	13
F-H/13-15	laminar	3										3
F-H/13-15	flake						3	3				6
F-H/13-15	total	3	0	0	0	0	3	3	0	0	0	9
K10	laminar	4										4
K10	flake							1			1	2
K10	total	4	0	0	0	0	0	1	0	0	1	6
sum	laminar	16	1	2	3	0	1	0	0	1	0	24
sum	flake	0	0	0	0	0	4	11	2	1	2	20
sum	total	16	1	2	3	0	5	11	2	2	2	44
sum %	laminar	66.7	4.2	8.3	12.5	0.0	4.2	0.0	0.0	4.2	0.0	100
sum %	flake	0.0	0.0	0.0	0.0	0.0	20.0	55.0	10.0	5.0	10.0	100
sum %	total	36.4	2.3	4.5	6.8	0.0	11.4	25.0	4.5	4.5	4.5	100

A: Overpass items

		retouched laminar item	backed knife	distally retouched laminar item	end-scraper	side-scraper	burin	retouched flake	notch/ denticulate	varia	fragment	sum
Unit V												0
G-I/19-22		1					1		1			3
G/19-20		4		1								5
F-H/13-15		4					1					5
K/10			1	1	1							3
sum		9	1	2	1	0	2	0	1	0	0	16
sum		56.3	6.3	12.5	6.3	0.0	12.5	0.0	6.3	0.0	0.0	100

B: Crested blades

Table 10: Overpass items (A) and crested blades (B) from Qesem Cave that were secondarily modified and their types.

		primary	rough	patinated	second-primary	unifacial	rejuvenation	sum
Unit V	blanks and shaped	1	1	2	2	1	3	10
Unit V	%	10.0	10.0	20.0	20.0	10.0	30.0	100
G-I/19-22	blanks and shaped	0	11	17	1	12	13	54
G-I/19-22	%	0.0	20.4	31.5	1.9	22.2	24.1	100
G/19-20	blanks and shaped	1	3	14	6	15	16	55
G/19-20	%	1.8	5.5	25.5	10.9	27.3	29.1	100
F-H/13-15	blanks and shaped	4	19	12	3	15	20	73
F-H/13-15	%	5.5	26.0	16.4	4.1	20.5	27.4	100
K/10	blanks and shaped	2	3	6	1	5	6	23
K/10	%	8.7	13.0	26.1	4.3	21.7	26.1	100
sum	blanks and shaped	8	37	51	13	48	58	215
sum	%	3.7	17.2	23.7	6.0	22.3	27.0	100
sum	blanks	8	35	49	12	46	49	199
sum	%	4.0	17.6	24.6	6.0	23.1	24.6	100
sum	shaped items	0	2	2	1	2	9	16
sum	%	0.0	12.5	12.5	6.3	12.5	56.3	100
sum	blanks and shaped	8	37	51	13	48	58	215
sum	%	3.7	17.2	23.7	6.0	22.3	27.0	100
Total % of shaped items		0.0	5.4	3.9	7.7	4.2	15.5	7.4

Table 11: Crested blades from Qesem Cave.

	Laminar core class					Flake core class				
	single striking platform laminar core	two striking platforms laminar core	single striking platform lamianr and flake core	two striking platforms laminar and flake core	single striking platform bladelet core	single striking platform flake core	multy striking platforms flake core	radial flake core	tested raw material	sum
Unit V	1	1	2			7	7	2		20
%	5.0	5.0	10.0	0.0	0.0	35.0	35.0	10.0	0.0	100
G-I/19-22	19	3	9	3	0	22	23	10	1	90
%	21.1	3.3	10.0	3.3	0.0	24.4	25.6	11.1	1.1	100
G/19-20	13	1	9	2	3	6	7		1	42
%	31.0	2.4	21.4	4.8	7.1	14.3	16.7	0.0	2.4	100
F-H/13-15	23	4	10	6	2	48	40	8	2	143
%	16.1	2.8	7.0	4.2	1.4	33.6	28.0	5.6	1.4	100
K/10	4	0	4	2	0	5	5	2		22
%	18.2	0.0	18.2	9.1	0.0	22.7	22.7	9.1	0.0	100
Sum	60	9	34	13	5	88	82	22	4	317
%	18.9	2.8	10.7	4.1	1.6	27.8	25.9	6.9	1.3	100

Laminar core class:	121	38.2%
Flake core class:	192	60.6%
Tested raw material:	4	1.3%
Total cores:	317	

Table 12: Cores from Qesem Cave.

shape		n=	mean	s.d.
amorphous front	max. length	10	51.9	11.7
	debitage surface length	10	48.5	8.5
	max. width	10	38.1	11.8
	debitage surface width	10	32.0	9.0
	max. thickness	10	36.0	13.5
parallel edges	max. length	23	52.3	15.3
	debitage surface length	23	49.3	12.9
	max. width	27	26.2	7.4
	debitage surface width	27	25.8	7.2
	max. thickness	27	35.8	13.3
prismatic	max. length	13	46.5	8.6
	debitage surface length	13	45.9	8.5
	max. width	14	30.4	6.3
	debitage surface width	14	30.4	6.3
	max. thickness	14	22.4	7.2
pyramidal	max. length	7	47.1	6.5
	debitage surface length	7	47.1	6.5
	max. width	7	30.4	8.4
	debitage surface width	7	30.4	8.4
	max. thickness	7	30.9	5.5
all	max. length	53	50.1	12.3
	debitage surface length	53	48.0	10.3
	max. width	58	29.8	9.0
	debitage surface width	58	28.5	7.4
	max. thickness	58	32.0	12.5

A: 'Single striking platform laminar cores'

shape		n=	mean	s.d.
amorphous front	max. length	6	41.3	7.7
	debitage surface length	6	41.2	7.4
	max. width	6	38.8	10.8
	debitage surface width	6	38.8	10.8
	max. thickness	6	32.5	11.6
prismatic	max. length	25	43.3	8.4
	debitage surface length	25	42.3	8.5
	max. width	25	38.8	9.5
	debitage surface width	25	38.5	9.2
	max. thickness	25	21.4	6.1
pyramidal	max. length	3	43.7	7.0
	debitage surface length	3	43.7	7.0
	max. width	3	38.0	12.5
	debitage surface width	3	38.0	12.5
	max. thickness	3	32.3	6.0
all	max. length	34	43.0	8.0
	debitage surface length	34	42.7	8.0
	max. width	34	38.7	9.6
	debitage surface width	34	38.5	9.4
	max. thickness	34	24.3	8.6

B: 'Single striking platform laminar and flake cores'

Table 13: Mean measurements of single striking platform cores from Qesem Cave.

	side-scraper index	bifaces index	laminar index	source
	(IR)	(IB)	(Ilam)	
Sub-layer Ed	81.4	19.1	3.4	Skinner 1965:77-83
Sub-layer Ec	81.0	12.1	2.9	Skinner 1965:77-83
Sub-layer Eb	84.1	12.3	2.8	Skinner 1965:77-83
Sub-layer Ea	83.7	9.7	16.5	Skinner 1965:77-83

A: Garrod's excavations

		side-scraper index	bifaces index	laminar index	source
		(IR)	(IB)	(Ilam)	
Unit XIII		70.2			Bordes 1984:32
Unit XIII		ca. 67	ca. 8		Rollefson *et al.* 2006:67
Unit XII		59.7			Bordes 1984:32
Unit XII		ca. 60	ca. 29		Rollefson *et al.* 2006:67
Unit XI		58.5			Bordes 1984:32
Unit XI		ca. 58	ca. 24		Rollefson *et al.* 2006:67

B: Jelinek's excavations

Table 14: Indexes from Tabun Layer E and Units XI-XIII.

	Unit	Bed	'retouched tool'	complete flake	broken flake	flake fragment	core	biface	biface fragment	sum
Acheulian	XI	76I1+76I2b	**202**	**170**	**500**	**144**	**243**	**217**	**90**	**1566**
%			12.9	10.9	31.9	9.2	15.5	13.9	5.7	100
Yabrudian	XI	75S1	**227**	**102**	**129**	**39**	**51**	**16**	**4**	**568**
%			40.0	18.0	22.7	6.9	9.0	2.8	0.7	100
Amudian	XI	75I1	**216**	**198**	**208**	**51**	**44**	**9**	**4**	**730**
~~%~~			29.6	27.1	28.5	7.0	6.0	1.2	0.5	100

A

	Unit	Bed	'tool' %	blank %	core %	sum n=
Amudian	XI	75S [48A]	47.1	48.0	4.9	452
Amudian	XI	75I [48b]	25.7	65.9	8.4	428

B

Table 15: Inventory data of several beds from Tabun XI, facies affiliation follows Jelinek's division (1990).

A: Data retreived from Dibble (1981: 38-47, Tables: 5, 8, 11).

B: Data retreived from Jelinek (1975: 306, Table: 5).

Type		Tabun XI Acheulian 76I1+76I2b	Tabun XI Yabrudian 75S1	Tabun XI Amudian 75I1	Tabun XI Amudian 75S (48A)	Tabun XI Amudian 75I (48B)
1	Atypical Levallois flake				4	3
3	Levallois point				1	
5	Pseudo Levallois point	1				
9	Simple straight side scraper	11	25	11	23	10
10	Simple convex side scraper	35	60	34	70	8
11	Simple concave side scraper	5	4	2	5	1
12	Double straight side scraper		5		4	
13	Double straight-convex side scraper	6	5	2	2	
14	Double straight-concave side scraper	1	3			
15	Double biconvex side scraper	3	4	3	8	
16	Double biconcave side scraper		1			
17	Double convex-concave side scraper	2	2			
18	Striaght convergent side scraper	2	1	1	2	
19	Convex convergent side scraper	6	7	3	10	2
20	Concave convergent side scraper	1	1			
21	*Dejete c*onvergent side scraper	10	34	14	15	1
22	Straight transverse side scraper		3	1	4	
23	Convex transverse side scraper	14	24	16	23	3
24	Concave transverse side scraper	1				
25	Side scraper on interior face	5	4	1		
26	Steep side scraper	3		2		
27	Thinned backed side scrpaer	1	2	1		
28	Bifacially retouched side scraper	2	1		3	1
29	Alternate retouched side scraper				1	
30	End scraper	1	3	2	2	2
31	Atypical end scraper	2				2
32	Burin	7	3	10	1	4
33	Atypical burin	4	5	1	4	1
34	Reamer				1	
35	Atypical reamer				1	1
36	Backed knife		3	42	1	18
37	Atypical backed knife	1	6	41	5	33
38	Naturally backed knife	82	25	67	29	47
40	Truncated flake and blade	10	1	2	2	9
42	Notch	20	3	6		1
43	Denticulate	34	10	5	14	3
45	Retouch on interior face	18	1	1	1	
46-47	Flake with heavy retouch					1
48-49	Flake with light retouch				4	1
51	Tayac point		1	1	1	
54	End notch flake			1		1
59	Chopper	2		1		
61	Chopping tool	18	1	2		3
62	Diverse	25	14	15	5	1
sum		**333**	**262**	**288**	**246**	**157**

Table 16: The 'tool' counts as presented by Jelinek (1975) and Dibble (1981).
Beds 75S (48A) and 75I (48B) are from Jelinek (1975:309, Table 6).
Beds 75I1, 75S1 and 76I1+76I2b are from Dibble (1981:40, 43, 47, Tables 7, 9, 13).

		Laminar blanks				Laminar shaped items				sub-total	Overpass items			Crested blades			Total
facies / Jelinek	Bed	blade	PE blade	NBK	sum	blade	PE blade	NBK	sum		blank	shaped item	sum	blank	shaped item	sum	
Yabrudian	73I	6	1	2	9	6	3	2	11	20	4		4	2	1	3	27
Yabrudian	73S	10	2	2	14	1		1	2	16	7	4	11	1	1	2	29
Yabrudian	73S2b	1			1				0	1			0			0	1
	sum	17	3	4	24	7	3	3	13	37	11	4	15	3	2	5	57
Yabrudian	74I	2	2	4	8	1	1	1	3	11	4	5	9	1		1	21
Yabrudian	74S	3	2	1	6	4		1	5	11	1		1	1		1	13
Yabrudian	74S1	4	3		7	5	1		6	13	3	1	4			0	17
Yabrudian	74S1e				0	2			2	2		1	1			0	3
Yabrudian	74S1i				0	1	1		2	2		1	1			0	3
Yabrudian	74SI2			1	1				0	1			0			0	1
Yabrudian	74S2	3	4	4	11	8	4	2	14	25	1		1	5		5	31
Yabrudian	74S2b				0		1		1	1			0			0	1
Yabrudian	74S2c				0				0	0	2	4	6		1	1	7
Yabrudian	74S2i		1		1				0	1			0	1		1	2
	sum	12	12	10	34	21	8	4	33	67	11	12	23	8	1	9	99
Amudian	75I	6		1	7	5	2		7	14	1	1	2	1	1	2	18
Amudian	75Iq	1			1				0	1			0			0	1
Amudian	75I1	24	17	11	52	28	5	5	38	90	8	5	13	5	2	7	110
Amudian	75I1a	31	6	11	48	21	5	5	31	79	7	4	11	2	2	4	94
Amudian	75I1b	14	1	8	23	14	4		18	41	1		1	2		2	44
Amudian	75I1c				0	4	1	2	7	7			0			0	7
Amudian	75I1q			1	1				0	1			0			0	1
Amudian	75I2	39	20	18	77	26	3	5	34	111	20	12	32	9	3	12	155
Amudian	75I2a	4	3	8	15	3	2		5	20	1		1	4		4	25
Amudian	75I2b	6		4	10	3	3		6	16	1	1	2	1	1	2	20
Amudian	75S	15	13	10	38	9	2	8	19	57	9	1	10	8	4	12	79
Yabrudian	75S1	2	5	3	10	3	4	2	9	19		2	2	4	2	6	27
Yabrudian	75S1a	1			1				0	1	1	2	3	1		1	5
Yabrudian	75S1b	1			1	4	1		5	6		3	3			0	9
Yabrudian	75S1c	1			1				0	1	1		1			0	2
Yabrudian	75S2	21	5	4	30	11	5	8	24	54	7	1	8	4	4	8	70
Yabrudian	75S2a	5	1	1	7	9	1	3	13	20	2	4	6			0	26
Yabrudian	75S2b	7	4	5	16	20	5	1	26	42	6	2	8	2	1	3	53
?	75S3a	2	3	1	6	3	2	1	6	12	2		2	3		3	17
?	75S3b	5	2	5	12	5			5	17	3	1	4	3	1	4	25
?	75S4	2	1		3				0	3			0			0	3
?	75X3b	1			1	1			1	2			0			0	2
?	75X4				0		1		1	1			0			0	1
	sum	188	81	91	360	169	46	40	255	615	70	39	109	49	21	70	794
Acheulian	76	3	1	1	5	1			1	6	3		3			0	9
Acheulian	76I1	4	4	2	10	6	1	2	9	19	1	1	2	2		2	23
Acheulian	76I1c			1	1				0	1			0			0	1
Acheulian	76I2b	5	3		8	2	1	1	4	12	4	1	5	2	1	3	20
Acheulian	76I2c	1			1	1			1	2			0			0	2
Acheulian	76I3	4			4	1			1	5	2	1	3	2		2	10
Acheulian	76S1a			1	1				0	1			0			0	1
Acheulian	76S1b	7			7			3	3	10	2		2			0	12
Acheulian	76S1c				0				0	0		1	1	1		1	2
Acheulian	76S2	5	1	2	8	1			1	9	1	3	4	2		2	15
Acheulian	76E	3			3				0	3	1		1			0	4
	sum	32	9	7	48	12	2	6	20	68	14	7	21	9	1	10	99
Yabrudian	77b	5	2	1	8	1			1	9	5	2	7	5	1	6	22
Yabrudian	77b1				0				0	0		1	1			0	1
	sum	5	2	1	8	1	0	0	1	9	5	3	8	5	1	6	23
Acheulian	sum	32	9	7	48	12	2	6	20	68	14	7	21	9	1	10	99
Yabrudian	sum	72	32	28	132	76	27	21	124	256	44	33	77	27	11	38	371
Amudian	sum	140	60	72	272	113	27	25	165	437	48	24	72	32	13	45	554
?	sum	10	6	6	22	9	3	1	13	35	5	1	6	6	1	7	48
Total	sum	254	107	113	474	210	59	53	322	796	111	65	176	74	26	100	1072

Table 17: The examined items from Tabun XI and their assignment to the three facies.

The material examined is stored at the University of Arizona and in the Israel Antiquities Authority.

		whole	proximal	medial	distal	sum
Amudian	blade	116	14	3	7	140
Amudian	PE blade	45	4	2	9	60
Amudian	NBK	62	4	1	5	72
Yabrudian	blade	58	5	3	7	73
Yabrudian	PE blade	29	0	0	3	32
Yabrudian	NBK	20	3	0	5	28
Acheulian	blade	24	6	0	2	32
Acheulian	PE blade	7	2	0	0	9
Acheulian	NBK	7	0	0	0	7
?	blade	8	0	0	1	9
?	PE blade	5	0	0	1	6
?	NBK	5	1	0	0	6

A: Blanks

		whole	proximal	medial	distal	sum
Amudian	blade	90	11	1	7	109
Amudian	PE blade	21	2	0	3	26
Amudian	NBK	20	1	1	1	23
Yabrudian	blade	58	13	1	9	81
Yabrudian	PE blade	25	1	0	3	29
Yabrudian	NBK	21	1	0	1	23
Acheulian	blade	9	2	0	1	12
Acheulian	PE blade	2	0	0	0	2
Acheulian	NBK	6	0	0	0	6
?	blade	7	1	0	0	8
?	PE blade	1	0	0	1	2
?	NBK	1	0	0	0	1

B: Shaped items

		whole	proximal	medial	distal	sum
Amudian	blade	206	25	4	14	249
Amudian	PE blade	66	6	2	12	86
Amudian	NBK	82	5	2	6	95
Yabrudian	blade	116	18	4	16	154
Yabrudian	PE blade	54	1	0	6	61
Yabrudian	NBK	41	4	0	6	51
Acheulian	blade	33	8	0	3	44
Acheulian	PE blade	9	2	0	0	11
Acheulian	NBK	13	0	0	0	13
?	blade	15	1	0	1	17
?	PE blade	6	0	0	2	8
?	NBK	6	1	0	0	7

C: Blanks and shaped items

Table 18: The three analyzed laminar types from Tabun XI and their state of preservation.

	laminar type	Blanks n=	smallest size	largest size	mean	standard deviation	Shaped items n=	smallest size	largest size	mean	standard deviation	Blanks and shaped items n=	smallest size	largest size	mean	standard deviation
Amudian	blade	115	35	90	59.6	12.1	90	35	104	63.4	14.6	205	35	104	62.6	13.7
Yabrudian	blade	57	36	94	62.2	12.7	55	41	95	67.3	11.8	112	36	95	64.7	12.5
Acheulian	blade	24	37	90	55.8	14.8	9	42	77	58.3	12.4	33	37	90	59.4	14.0
all	blade	196	35	94	60.4	12.6	154	35	104	66.2	13.6	350	35	104	62.9	13.4
Amudian	PE blade	45	35	100	61.8	14.8	20	49	106	70.3	15.0	65	35	106	64.4	15.3
Yabrudian	PE blade	29	49	98	70.1	11.9	25	51	123	74.0	17.8	54	49	123	71.9	14.9
Acheulian	PE blade	7	45	114	76.4	24.3	2	73	143	108.0	49.5	9	45	143	83.4	30.7
all	PE blade	81	35	114	66.0	15.5	47	49	143	73.9	19.2	128	35	143	68.9	17.3
Amudian	NBK	61	40	107	64.2	13.7	19	47	103	69.8	14.2	80	40	107	65.6	13.9
Yabrudian	NBK	19	39	105	65.3	17.7	19	53	115	77.4	14.7	38	39	115	71.3	17.2
Acheulian	NBK	7	39	63	52.9	9.0	5	58	88	71.0	14.7	12	39	88	60.4	14.5
all	NBK	87	39	107	63.5	14.6	43	44	115	73.3	14.6	130	39	115	66.8	15.2
Amudian	all	221	35	107	61.3	13.2	129	35	106	67.5	14.6	350	35	107	63.4	14.0
Yabrudian	all	105	36	105	64.9	13.8	99	41	123	70.9	14.6	204	36	123	67.8	14.7
Acheulian	all	38	37	114	61.6	17.4	16	42	143	68.5	24.0	54	37	143	63.6	19.6
all	all	364	35	114	62.4	13.9	244	35	143	69.0	15.3	608	35	143	65.0	14.9

Table 19: Mean length of the three laminar types from Tabun XI (in mm).

"All" includes the finds from the three facies and the finds from the small beds that were not assigned to any facies.

	laminar type	Blanks n=	smallest size	largest size	mean	standard deviation	Shaped items n=	smallest size	largest size	mean	standard deviation	Blanks and shaped items n=	smallest size	largest size	mean	standard deviation
Amudian	blade	114	12	38	22.7	5.9	86	15	47	24.4	6.7	200	12	47	23.5	6.3
Yabrudian	blade	57	12	42	24.8	5.5	54	14	41	26.3	6.4	111	12	42	25.5	6.0
Acheulian	blade	24	12	40	24.2	5.9	9	15	38	25.7	6.9	33	12	40	24.6	6.1
all	blade	195	12	42	23.5	5.8	149	14	47	25.2	6.6	344	12	47	24.2	6.2
Amudian	PE blade	44	13	40	24.2	5.8	21	11	37	26.3	6.4	65	11	40	24.9	6.1
Yabrudian	PE blade	29	20	40	28.6	5.0	19	16	53	29.4	9.3	48	16	53	29.0	7.0
Acheulian	PE blade	7	22	55	32.9	12.5	2	32	45	38.5	9.2	9	22	55	34.1	11.6
all	PE blade	82	13	55	26.5	6.9	42	11	55	28.3	8.2	122	11	55	27.1	7.4
Amudian	NBK	62	13	41	23.1	6.4	18	16	38	25.4	5.7	80	13	41	23.6	6.3
Yabrudian	NBK	20	12	35	24.0	6.8	16	21	53	29.8	7.6	36	12	53	26.6	7.7
Acheulian	NBK	7	17	29	22.0	3.7	4	22	35	28.8	5.4	11	17	35	24.5	5.4
all	NBK	89	12	41	23.2	6.3	38	16	53	27.6	6.7	127	12	53	24.5	6.7
Amudian	all	223	12	41	23.1	6.0	125	11	47	24.9	6.5	345	11	47	23.8	6.2
Yabrudian	all	106	12	42	25.7	5.9	89	14	53	27.6	7.4	195	12	53	26.6	6.7
Acheulian	all	38	12	55	25.4	7.9	15	15	45	28.2	7.6	53	12	55	26.1	7.9
all	all	364	12	55	24.1	6.3	229	11	53	26.1	7.0	593	12	55	24.9	6.7

Table 20: Mean width of the three laminar types from Tabun XI (in mm).

"All" includes the finds from the three facies and the finds from the small beds that were not assigned to any facies.

	laminar type	Blanks n=	smallest size	largest size	mean	standard deviation	Shaped items n=	smallest size	largest size	mean	standard deviation	Blanks and shaped items n=	smallest size	largest size	mean	standard deviation
Amudian	blade	116	2	17	8.9	3.1	90	3	20	9.0	3.8	206	2	20	8.9	3.4
Yabrudian	blade	57	5	15	8.9	2.9	58	4	16	9.5	2.9	115	4	16	9.2	2.9
Acheulian	blade	24	4	15	8.6	3.4	9	4	14	10.0	4.2	33	4	15	9.0	3.6
all	blade	197	2	17	8.8	3.0	157	3	20	9.3	3.5	354	2	20	9.0	3.3
Amudian	PE blade	45	4	19	9.7	3.3	19	6	20	10.2	3.9	64	4	20	9.8	3.5
Yabrudian	PE blade	29	4	19	11.2	3.8	25	5	19	10.4	3.5	54	4	19	10.8	3.6
Acheulian	PE blade	7	5	13	9.3	2.9	2	10	13	11.5	2.1	9	5	13	9.8	2.8
all	PE blade	81	4	19	10.2	3.5	46	5	20	10.4	3.5	127	4	20	10.2	3.5
Amudian	NBK	62	6	18	11.1	2.9	20	5	22	13.9	4.7	82	5	22	11.8	3.6
Yabrudian	NBK	20	6	21	12.5	3.8	22	5	28	14.6	5.3	42	5	28	13.6	4.7
Acheulian	NBK	7	8	18	12.1	3.7	6	10	17	13.5	2.9	13	8	18	12.8	3.3
all	NBK	89	6	21	11.4	3.2	48	5	28	14.2	4.8	137	5	28	12.4	4.0
Amudian	all	223	2	19	9.6	3.2	129	3	22	10.0	4.3	352	2	22	9.8	3.6
Yabrudian	all	106	4	21	10.2	3.6	105	4	28	10.8	4.1	211	4	28	10.5	3.9
Acheulian	all	38	4	18	9.4	3.6	17	4	17	11.4	3.8	55	4	18	10.0	3.7
all	all	367	2	21	9.8	3.4	251	3	28	10.4	4.2	618	2	28	10.0	3.7

Table 21: Mean thickness of the three laminar types from Tabun XI (in mm).

"All" includes the finds from the three facies and the finds from the small beds that were not assigned to any facies.

sample	laminar type	Blanks n=	Blanks mean	Blanks standard deviation	Shaped items n=	Shaped items mean	Shaped items standard deviation	Blanks and shaped items n=	Blanks and shaped items mean	Blanks and shaped items standard deviation
Amudian	blade	113	2.7	0.7	86	2.8	0.6	199	2.8	0.6
Yabrudian	blade	56	2.6	0.5	52	2.6	0.5	109	2.6	0.5
Acheulian	blade	24	2.5	0.5	9	2.3	0.5	33	2.5	0.5
all	blade	201	2.6	0.6	154	2.7	0.6	354	2.7	0.6
Amudian	PE blade	44	2.6	0.4	20	2.8	0.7	64	2.7	0.5
Yabrudian	PE blade	29	2.5	0.3	19	2.6	0.4	48	2.5	0.4
Acheulian	PE blade	7	2.4	0.4	2	2.7	0.6	9	2.5	0.4
all	PE blade	85	2.5	0.4	42	2.7	0.6	127	2.6	0.5
Amudian	NBK	61	2.9	0.7	18	2.8	0.6	79	2.9	0.7
Yabrudian	NBK	19	2.9	0.8	15	2.5	0.3	34	2.7	0.7
Acheulian	NBK	7	2.4	0.3	3	2.3	0.3	10	2.4	0.3
all	NBK	92	2.9	0.7	36	2.7	0.5	128	2.8	0.7
Amudian	all	218	2.8	0.6	124	2.8	0.6	342	2.8	0.6
Yabrudian	all	104	2.6	0.6	86	2.6	0.5	190	2.6	0.5
Acheulian	all	38	2.5	0.4	14	2.4	0.4	52	2.4	0.4
all	all	377	2.7	0.6	233	2.7	0.6	609	2.7	0.6

Table 22: Mean length/width ratio of the three laminar types from Tabun XI (in mm).

"All" includes the finds from the three facies and the finds from the small beds that were not assigned to any facies.

sample	laminar type	Blanks n=	Blanks mean	Blanks standard deviation	Shaped items n=	Shaped items mean	Shaped items standard deviation	Blanks and shaped items n=	Blanks and shaped items mean	Blanks and shaped items standard deviation
Amudian	blade	114	2.8	1.0	86	3.0	1.1	200	2.9	1.1
Yabrudian	blade	57	3.0	0.9	54	2.9	0.9	111	2.9	0.9
Acheulian	blade	24	3.1	1.0	9	2.9	0.9	33	3.1	1.0
all	blade	203	2.9	0.9	156	3.0	1.0	359	2.9	1.0
Amudian	PE blade	44	2.7	0.7	21	2.6	0.8	65	2.6	0.7
Yabrudian	PE blade	29	2.8	0.9	19	3.1	1.1	48	2.9	1.0
Acheulian	PE blade	7	3.6	0.9	2	3.3	0.2	9	3.6	0.8
all	PE blade	85	2.8	0.8	43	2.9	0.9	128	2.8	0.9
Amudian	NBK	62	2.2	0.6	18	2.1	0.7	80	2.1	0.6
Yabrudian	NBK	20	2.0	0.4	16	2.4	0.8	36	2.2	0.7
Acheulian	NBK	7	1.9	0.4	4	2.1	0.6	11	2.0	0.4
all	NBK	94	2.1	0.6	38	2.2	0.7	132	2.1	0.6
Amudian	all	220	2.6	0.9	125	2.8	1.1	345	2.7	1.0
Yabrudian	all	106	2.7	0.9	89	2.9	1.0	195	2.8	0.9
Acheulian	all	38	3.0	1.1	15	2.7	0.9	53	2.9	1.0
all	all	382	2.7	0.9	237	2.8	1.0	619	2.7	1.0

Table 23: Mean width/thickness ratio of the three laminar types from Tabun XI (in mm).

"All" includes the finds from the three facies and the finds from the small beds that were not assigned to any facies.

n=		core tablet	overpass item	radial overpass item	crested blade	varia	sum
Amudian	blank	9	48	11	32	48	148
Amudian	shaped item		24		13	5	42
Amudian	**total**	**9**	**72**	**11**	**45**	**53**	**190**
Yabrudian	blank	9	44	17	27	103	200
Yabrudian	shaped item		33	12	11	14	70
Yabrudian	**total**	**9**	**77**	**29**	**38**	**117**	**270**
Acheulian	blank	2	14	7	9	47	79
Acheulian	shaped item		7	2	1	8	18
Acheulian	**total**	**2**	**21**	**9**	**10**	**55**	**97**
?	blank	1	5	0	6	8	20
?	shaped item		1		1	3	5
?	total	1	6	0	7	11	25
sum	blank	21	111	35	74	206	447
sum	shaped item	0	65	14	26	30	135
sum	**total**	**21**	**176**	**49**	**100**	**236**	**582**

%		core tablet	overpass item	radial overpass item	crested blade	varia	sum
Amudian	blank	6.1	32.4	7.4	21.6	32.4	100
Amudian	shaped item	0.0	57.1	0.0	31.0	11.9	100
Amudian	**total**	**4.7**	**37.9**	**5.8**	**23.7**	**27.9**	**100**
Yabrudian	blank	4.5	22.0	8.5	13.5	51.5	100
Yabrudian	shaped item	0.0	47.1	17.1	15.7	20.0	100
Yabrudian	**total**	**3.3**	**28.5**	**10.7**	**14.1**	**43.3**	**100**
Acheulian	blank	2.5	17.7	8.9	11.4	59.5	100
Acheulian	shaped item	0.0	38.9	11.1	5.6	44.4	100
Acheulian	**total**	**2.1**	**21.6**	**9.3**	**10.3**	**56.7**	**100**
?	blank	5.0	25.0	0.0	30.0	40.0	100
?	shaped item	0.0	20.0	0.0	20.0	60.0	100
?	total	4.0	24.0	0.0	28.0	44.0	100
sum	blank	4.7	24.8	7.8	16.6	46.1	100
sum	shaped item	0.0	48.1	10.4	19.3	22.2	100
sum	**total**	**3.6**	**30.2**	**8.4**	**17.2**	**40.5**	**100**

% of shaped items	0.0	36.9	28.6	26.0	12.7	23.2

Table 24: Core trimming elements from Tabun XI.

	Amudian			Yabrudian			Acheulian			all		
	n=	mean	s.d.	n=	mean	s.d.	n=	mean	s.d.	n=	mean	s.d.
initial	15	64.1	17.3	15	64.4	10.7	9	67.6	18.7	40	64.8	14.9
correction and regular	50	65.3	14.6	46	67.1	11.1	12	70.1	15.6	113	66.7	13.2
all	65	65.0	15.1	61	66.4	11.0	21	69.0	16.6	147	66.2	13.8
all blanks										99	65.7	14.0
all shaped										54	67.1	13.0

A: Length (in mm)

	Amudian			Yabrudian			Acheulian			all		
	n	mean	s.d.	n	mean	s.d.	n	mean	s.d.	n	mean	s.d.
initial	16	32.2	9.4	15	33.9	8.4	9	32.3	7.7	41	32.8	8.4
correction	32	34.8	10.2	39	36.7	8.3	8	38.0	9.5	65	36.0	9.3
regular	17	31.4	9.2	39	31.5	7.9	9	32.3	7.7	46	32.4	9.6
all	65	33.2	9.7	61	34.0	8.4	20	36.7	10.6	146	34.0	9.3
all blanks										100	33.9	9.3
all shaped										52	34.3	9.2

B: Width (in mm)

	Amudian			Yabrudian			Acheulian			all		
	n	mean	s.d.	n	mean	s.d.	n	mean	s.d.	n	mean	s.d.
initial										41	16.9	5.4
correction										67	17.3	4.8
regular										48	15.6	5.6
all	66	16.5	5.0	63	16.1	5.5	21	19.0	5.4	150	17.0	5.3
all blanks										101	16.9	5.3
all shaped										55	16.3	5.1

C: Thickness (in mm)

Table 25: Mean measurements of overpass items from the three facies of Tabun XI.

"All" includes the finds from the three facies and the finds from the beds that were not assigned to any facies.

n=		primary	rough	patinated	second primary	unifacial	rejuvenation	sum
Amudian	blanks	1	9	8	1	1	12	32
Amudian	shaped items	0	5	1	0	1	6	13
Amudian	total	1	14	9	1	2	18	45
Yabrudian	blanks	1	9	1	1	3	12	27
Yabrudian	shaped items	1	0	0	1	1	8	11
Yabrudian	total	2	9	1	2	4	20	38
Acheulian	blanks	1	1	1	1	1	4	9
Acheulian	shaped items	0	1	0	0	0	0	1
Acheulian	total	1	2	1	1	1	4	10
?	blanks	1	1	1	0	0	3	6
?	shaped items	0	0	0	0	0	1	1
?	total	1	1	1	0	0	4	7
Total	blanks	4	20	11	3	5	31	74
Total	shaped items	1	6	1	1	2	15	26
Total	total	5	26	12	4	7	46	100

%		primary	rough	patinated	second primary	unifacial	rejuvenation	sum
Amudian	blanks	3.1	28.1	25.0	3.1	3.1	37.5	100
Amudian	shaped items	0.0	38.5	7.7	0.0	7.7	46.2	100
Amudian	total	2.2	31.1	20.0	2.2	4.4	40.0	100
Yabrudian	blanks	3.7	33.3	3.7	3.7	11.1	44.4	100
Yabrudian	shaped items	9.1	0.0	0.0	9.1	9.1	72.7	100
Yabrudian	total	5.3	23.7	2.6	5.3	10.5	52.6	100
Acheulian	blanks	11.1	11.1	11.1	11.1	11.1	44.4	100
Acheulian	shaped items	0.0	100.0	0.0	0.0	0.0	0.0	100
Acheulian	total	10.0	20.0	10.0	10.0	10.0	40.0	100
?	blanks	16.7	16.7	16.7	0.0	0.0	50.0	100
?	shaped items	0.0	0.0	0.0	0.0	0.0	100.0	100
?	total	14.3	14.3	14.3	0.0	0.0	57.1	100
Total	blanks	5.4	27.0	14.9	4.1	6.8	41.9	100
Total	shaped items	3.8	23.1	3.8	3.8	7.7	57.7	100
Total	total	5.0	26.0	12.0	4.0	7.0	46.0	100

% of shaped items	20.0	23.1	8.3	25.0	28.6	32.6	26.0

Table 26: Crested blades from Tabun XI.

	Laminar core class					Flake core class	Tested pebbles	
	single striking platform laminar core	two striking platforms laminar core	single striking platform laminar and flake core	two striking platforms laminar and flake core	bladelet core	flake core	tested pebbles	sum
Amudian	4		7	4		77	4	96
%	4.2		7.3	4.2		80.2	4.2	100
Yabrudian	8		1	3		119	2	133
%	6.0		0.8	2.3		89.5	1.5	100
Acheulian	3		4	2		229		238
%	1.3		1.7	0.8		96.2		100
?	1					12	2	15
%	6.7					80.0	13.3	100
total	16	0	12	9	0	437	8	482
%	3.3		2.5	1.9	0.0	90.7	1.7	100

Total of laminar core class: n=37; 7.7%

Table 27: Cores from Tabun XI.

layer		whole	proximal	medial	distal	sum
11-12	blade	22	5	1	8	36
11-12	PE blade	4	0	0	2	6
11-12	NBK	3	0	1	2	6
11-12	sum	29	5	2	12	48
13	blade	22	5	0	6	33
13	PE blade	1	0	0	1	2
13	NBK	8	0	0	0	8
13	sum	31	5	0	7	43
15	blade	87	13	0	7	107
15	PE blade	24	3	0	1	28
15	NBK	20	5	0	2	27
15	sum	131	21	0	10	162

A: Blanks

layer		whole	proximal	medial	distal	sum
11-12	blade	5	2	0	2	9
11-12	PE blade	3	0	0	1	4
11-12	NBK	1	0	0	0	1
11-12	sum	9	2	0	3	14
13	blade	3	0	0	1	4
13	PE blade	2	0	0	1	3
13	NBK	1	0	0	1	2
13	sum	6	0	0	3	9
15	blade	33	2	0	5	40
15	PE blade	9	3	0	1	13
15	NBK	6	1	0	0	7
15	sum	48	6	0	6	60

B: Shaped items

layer		whole	proximal	medial	distal	sum
11-12	blade	27	7	1	10	45
11-12	PE blade	7	0	0	3	10
11-12	NBK	4	0	1	2	7
11-12	sum	38	7	2	15	62
13	blade	25	5	0	7	37
13	PE blade	3	0	0	2	5
13	NBK	9	0	0	1	10
13	sum	37	5	0	10	52
15	blade	120	15	0	12	147
15	PE blade	33	6	0	2	41
15	NBK	26	6	0	2	34
15	sum	179	27	0	16	222

C: Blanks and shaped items.

Table 28: The three analyzed laminar types from Yabrud I and their state of preservation.

		Blanks					Shaped items					Blanks and shaped items				
Layer	laminar type	n=	smallest size	largest size	mean	standard deviation	n=	smallest size	largest size	mean	standard deviation	n=	smallest size	largest size	mean	standard deviation
11-12	blade											26	36	105	65.2	18.1
13	blade											25	31	63	48.3	9.1
15	blade	85	33	94	56.5	13.1	30	38	98	63.1	12.3	115	33	98	58.2	13.2
11-12	PE blade											7	55	124	91.0	29.2
13	PE blade											3	53	63	57.3	5.1
15	PE blade	23	40	92	60.5	13.9	8	53	76	64.1	8.3	31	40	92	61.5	12.7
11-12	NBK											4	41	91	63.0	21.1
13	NBK											8	37	73	53.4	11.7
15	NBK	19	47	86	62.4	11.6	6	42	67	60.3	9.3	25	42	86	61.9	11.0
11-12	all	28	36	105	64.6	20.0	9	65	124	86.1	24.0	37	36	124	69.8	22.7
13	all	30	31	73	49.4	9.9	6	40	63	54.3	8.6	36	31	73	50.2	9.8
15	all	127	33	94	58.1	13.2	44	38	98	62.9	11.2	171	33	98	59.3	12.8

Table 29: Mean length of the three laminar types from Yabrud I (in mm).

		Blanks					Shaped items					Blanks and shaped items				
Layer	laminar type	n=	smallest size	largest size	mean	standard deviation	n=	smallest size	largest size	mean	standard deviation	n=	smallest size	largest size	mean	standard deviation
11-12	blade											34	14	45	27.8	8.4
13	blade											34	12	25	18.0	3.7
15	blade	87	12	33	21.3	4.9	32	14	35	23.7	4.9	119	12	35	21.9	5.0
11-12	PE blade											6	24	44	35.5	9.3
13	PE blade											3	13	23	19.0	3.5
15	PE blade	24	13	34	24.0	5.1	8	15	26	23.1	2.1	32	13	34	23.8	4.6
11-12	NBK											4	14	45	25.5	13.5
13	NBK											9	12	25	18.9	5.1
15	NBK	20	13	35	24.4	5.9	5	23	28	25.4	1.8	25	13	35	24.6	5.3
11-12	all	29	14	45	27.7	8.9	8	20	44	31.1	9.0	37	14	45	28.5	8.9
13	all	31	12	25	17.9	3.8	6	13	21	18.5	1.8	37	12	25	18.0	3.6
15	all	131	12	35	22.3	5.3	45	14	35	23.8	4.3	176	12	35	22.6	5.1

Table 30: Mean width of the three laminar types from Yabrud I (in mm).

		Blanks					Shaped items					Blanks and shaped items				
Layer	laminar type	n=	smallest size	largest size	mean	standard deviation	n=	smallest size	largest size	mean	standard deviation	n=	smallest size	largest size	mean	standard deviation
11-12	blade											27	3	17	10.4	4.0
13	blade											25	2	13	6.2	2.2
15	blade	87	3	15	7.6	2.4	33	5	16	8.9	3.2	120	3	16	8.0	2.7
11-12	PE blade											7	10	19	13.6	3.9
13	PE blade											3	6	10	7.7	2.1
15	PE blade	24	5	17	11.0	3.5	9	7	15	10.1	2.8	33	5	17	10.8	3.3
11-12	NBK											4	7	12	9.5	2.1
13	NBK											9	5	12	7.6	2.8
15	NBK	20	7	16	11.6	2.7	6	5	16	11.0	3.8	26	5	16	11.5	2.9
11-12	all	29	3	19	10.1	4.0	9	9	17	13.3	3.0	38	3	19	10.9	4.0
13	all	31	2	13	6.6	2.6	6	6	13	6.7	0.5	37	2	13	6.6	2.4
15	all	131	3	17	8.9	3.2	48	5	16	9.4	3.2	179	3	17	9.0	3.2

Table 31: Mean thickness of the three laminar types from Yabrud I (in mm).

Layer	laminar type	Blanks n=	Blanks mean	Blanks standard deviation	Shaped items n=	Shaped items mean	Shaped items standard deviation	Blanks and shaped items n=	Blanks and shaped items mean	Blanks and shaped items standard deviation
11-12	blade								2.4	0.3
13	blade								2.8	0.4
15	blade		2.7	0.5		2.8	0.5		2.7	0.5
11-12	PE blade								2.4	0.3
13	PE blade								3.1	0.7
15	PE blade		2.6	0.3		2.8	0.4		2.6	0.4
11-12	NBK								2.6	0.5
13	NBK								3.0	0.6
15	NBK		2.7	0.5		2.5	0.3		2.6	0.5
11-12	all		2.4	0.2		2.7	0.4		2.5	0.3
13	all		2.8	0.5		3.0	0.6		2.9	0.5
15	all		2.7	0.5		2.7	0.5		2.7	0.5

Table 32: Mean length/width of the three laminar types from Yabrud I (in mm).

Layer	laminar type	Blanks n=	Blanks mean	Blanks standard deviation	Shaped items n=	Shaped items mean	Shaped items standard deviation	Blanks and shaped items n=	Blanks and shaped items mean	Blanks and shaped items standard deviation
11-12	blade								2.9	1.0
13	blade								3.2	1.2
15	blade		3.0	1.0		2.9	0.9		3.0	1.0
11-12	PE blade								2.8	0.8
13	PE blade								2.5	0.3
15	PE blade		2.4	0.8		2.5	0.4		2.4	0.7
11-12	NBK								2.7	1.3
13	NBK								2.7	0.7
15	NBK		2.2	0.9		2.2	0.4		2.2	0.8
11-12	all		3.0	1.0		2.5	1.0		2.9	1.0
13	all		3.1	1.2		2.8	0.3		3.0	1.1
15	all		2.8	1.0		2.8	0.8		2.8	1.0

Table 33: Mean width/thickness of the three laminar types from Yabrud I (in mm).

Layer (n=)		core tablet	overpass item	radial overpass item	crested blade	varia	sum
11	blank	6	6	1	4	11	28
11	shaped item		2	1		2	5
11	**total**	**6**	**8**	**2**	**4**	**13**	**33**
12	blank	2	7	5	12	26	52
12	shaped item		1				1
12	**total**	**2**	**8**	**5**	**12**	**26**	**53**
11-12	blank	8	13	6	16	37	80
11-12	shaped item		3	1	0	2	6
11-12	**total**	**8**	**16**	**7**	**16**	**39**	**86**
13	blank				7	1	8
13	shaped item		1		2		3
13	**total**	**0**	**1**	**0**	**9**	**1**	**11**
15	blank	8	19	2	39	15	83
15	shaped item	1	2	3	7	3	16
15	**total**	**9**	**21**	**5**	**46**	**18**	**99**
sum	blank	16	32	8	62	53	171
sum	shaped item	1	6	4	9	5	25
sum	**total**	**17**	**38**	**12**	**71**	**58**	**196**
Layer (%)		**core tablet**	**overpass item**	**radial overpass item**	**crested blade**	**varia**	**sum**
11-12	blank	10.0	16.3	7.5	20.0	46.3	100
11-12	shaped item		50.0	16.7		33.3	100
11-12	**total**	**9.3**	**18.6**	**8.1**	**18.6**	**45.3**	**100**
13	blank				87.5	12.5	100
13	shaped item		33.3		66.7		100
13	**total**		**9.1**		**81.8**	**9.1**	**100**
15	blank	9.6	22.9	2.4	47.0	18.1	100
15	shaped item	6.3	12.5	18.8	43.8	18.8	100
15	**total**	**9.1**	**21.2**	**5.1**	**46.5**	**18.2**	**100**
sum	blank	9.4	18.7	4.7	36.3	31.0	100
sum	shaped item	4.0	24.0	16.0	36.0	20.0	100
sum	**total**	**8.7**	**19.4**	**6.1**	**36.2**	**29.6**	**100**
11-12	% of shaped items		18.8	14.3		5.1	7.0
13			100.0		22.2		27.3
15		11.1	9.5	60.0	15.2	16.7	16.2
sum		5.9	15.8	33.3	12.7	8.6	12.8

Table 34: Core trimming elements from Yabrud I.

Layer		primary	*Faustkeil-klingen*	rough	patinated	second primary	unifacial	rejuvenation	sum
11-12	blank			5	3		2	6	16
11-12	shaped item								0
11-12	total			5	3		2	6	16
13	blank		1		1		2	3	7
13	shaped item							2	2
13	total		1		1		2	5	9
15	blank	3	13	7	1	1	1	13	39
15	shaped item	1		1	1	1	1	2	7
15	total	4	13	8	2	2	2	15	46
11-12	total %			31.3	18.8		12.5	37.5	100
13	total %		11.1		11.1		22.2	55.6	100
15	total %	8.7	28.3	17.4	4.3	4.3	4.3	32.6	100
11-12	% of shaped items								0.0
13								40.0	22.2
15		25.0		12.5	50.0	50.0	50.0	13.3	15.2

Table 35: Crested blades from Yabrud I.

	Laminar core class					Flake core class	tested raw material class	
layer	sinlge striking platform laminar core	two striking platforms laminar core	sinlge striking platform laminar and flake core	two striking platforms laminar and flake core	single striking platform bladelet core	flake core (various types)	tested raw material	sum
11	3		3	1		24		31
12			2	1		42		45
11-12	3	0	5	2	0	66	0	76
%	3.9	0.0	6.6	2.6	0.0	86.8	0.0	100
13		1		1		1		3
%								
15	14	1	21	2		45		83
%	16.9	1.2	25.3	2.4	0.0	54.2	0.0	100
sum	17	2	26	5	0	112	0	162

Table 36: Cores from Yabrud I.

	Amudian Blade			Amudian PE blade			Amudian NBK			Other facies Blade			Yabrudian PE blade	Yabrudian NBK
	Qesem Cave	Tabun Amudian	Yabrud I-15	Qesem Cave	Tabun Amudian	Yabrud I-15	Qesem Cave	Tabun Amudian	Yabrud I-15	Tabun Yabrudian	Tabun Acheulian	Yabrud I-11/12	Tabun Yabrudian	Tabun Yabrudian
number of specimens														
n=	999	249	147	759	86	41	794	95	34	155	44	45	61	51
metric														
mean length	51.2	62.6	58.2	53.7	64.4	61.5	52.5	65.6	61.9	64.7	59.4	65.2	71.9	71.3
mean width	20.9	23.5	21.9	21.5	24.9	23.8	20.8	23.6	24.6	25.5	24.6	27.8	29.0	26.6
mean thickness	8.6	8.9	8.0	9.9	9.8	10.8	10.8	11.8	11.5	9.2	9.0	10.4	10.8	13.6
mean length/width ratio	2.5	2.8	2.7	2.6	2.7	2.6	2.6	2.9	2.6	2.6	2.5	2.4	2.5	2.7
mean width/thickness ratio	2.6	2.9	3.0	2.3	2.6	2.4	2.0	2.1	2.2	2.9	3.1	2.9	2.9	2.2
cortex														
% of cortex on blades	44.7%	43.2%	40.8%							43.5%	33.3%	40.7%		
% on dorsal face				50%	30-50%	50%	30%	30%	20%				30-60%	30%
edge angles														
sharp edge angle (peak)	40º	35°	30°	40º	40°	40°	40º-50º	40°-45°	35°-45°	30º-40º	25º-40º	30º-40º	40°-45°	40°
shapes														
parallel shape	29.9	19.6	20.4							26.3	13.8	16.7		
pointed shape	6.9	6.5	2.7							1.1	0.0	16.7		
cross-section														
% of triangular (blades and PE blades)	47.2	42.3	40.4	64.9	67.9	50.0				47.0	45.0	31.0	59.6	
% of trapezoidal (blades)	26.4	31.8	25.5							23.9	12.5	35.7		
% of right-angle trapeziodal (NBKs)							50.6	50.0	50.0					32.6
other attributes														
feather end termination	68.6	72.3	71.9	67.8	74.3	73.3	52.5	53.0	68.2	73.9	61.3	73.3	68.5	65.8
overpassing end termination	15.5	16.9	14.9	20.2	13.5	13.5	36.9	30.1	27.3	9.2	12.9	16.7	9.3	21.1
number of laminar scars	2.5	2.6	2.3	1.3	1.2	1.4	1.8	1.7	1.7	2.6	2.0	2.5	1.1	1.6
butt, bulb and micro falking														
thick plain butt	49.2	30.9	34.2	47.7	38.8	54.3	44.0	37.0	37.5	32.3	22.9	40.0	34.7	45.2
modified butt	34.3	43.2	50.0	25.8	37.3	22.9	38.7	44.4	37.5	54.0	42.9	46.7	40.8	33.3
micro flaking	32.0	34.6	26.9	25.0	31.3	31.4	22.0	27.8	32.3	46.7	51.2	32.1	25.5	26.8

Table 37: Major features of the laminar types (including blanks and shaped items).
For precise description and number of specimens examined see chapters 4-6.
For standard deviation of means see Tables 4-8, 19-23, 29-33.

	the three laminar types* \ laminar core class	the three laminar types \ all overpass items and crested blades	the three laminar types \ rejuvenation crested blades, correction' and 'regular' overpass items	the three laminar types \ rejuvenation crested blades	the three laminar types \ 'correction' and 'regular' overpass items
Qesem Cave	15.8	5.3	12.3	44.0	17.0
Tabun XI (Amudian)	26.0	3.7	6.2	23.9	8.4
Tabun XI (Yabrudian)	19.5	2.3	3.6	13.3	4.9
Tabun XI (Acheulian)	7.2	2.2	4.3	17.0	5.7
Tabun XI (all)	19.4	4.3	4.8	17.3	6.6
Yabrud I-15	5.4	3.3	7.7	14.8	15.9
Yabrud I-13	21.0	5.2	10.4	10.4	\
Yabrud I-11/12	4.5	1.9	3.4	10.3	5.2

Table 38: Several ratios of the three laminar types (blades, PE blades and NBKs) to cores and CTEs.

*This ratio includes only whole and proximal items.

	'laminar cores'			'laminar and flake cores'		
	Qesem Cave	Tabun XI all	Yabrud I-15	Qesem Cave	Tabun XI all	Yabrud I-15
n*=	60	16	14	34	12	21
% out of 'laminar cores' and 'laminar and flake cores' with a single striking platform	59.5	57.1	40.0	40.5	42.9	60.0
core shapes (%)						
parallel edges	45.8	31.3	21.4	\	\	\
prismatic	20.3	31.3	57.1	73.5	66.7	47.6
pyramidal	10.2	0.0	0.0	8.8	0.0	0.0
narrowed prismatic	\	\	\	0.0	16.7	47.6
amorphous front	23.7	37.5	21.4	17.6	16.7	4.8
debitage surface shape (%)						
rectangle	41.5	15.4	30.8	29.4	\	20.0
U-shaped	22.6	30.8	30.8	32.4	\	55.0
triangular	11.3	7.7	23.1	5.9	\	25.0
irregular	24.5	46.2	15.4	32.4	\	0.0
Base shape (%)						
flat	33.3	13.3	23.1	38.2	\	23.8
oblique	13.0	0.0	0.0	8.8	\	14.3
pointed	22.2	13.3	30.8	2.9	\	38.1
rounded	27.8	33.3	38.5	35.3	\	19.0
irregular	3.7	40.0	7.7	14.7	\	4.8
mean size (mm)**						
maximum length	50.1	61.4	48.7	43.0	57.2	47.3
max. width	29.8	37.2	30.8	38.7	52.4	33.5
mean number of laminar scars**						
total scar no.	2.8	2.9	3.8	2.0	\	3.1
parallel scars	2.5	2.5	2.9	1.8	\	2.6
base modification						
% of base modification	27.8	12.5	71.4	20.6	8.3	50.0

Table 39: Major attributes of 'laminar cores' and 'laminar and flake cores'.

*in some cases the number of examined specimens is smaller due to fragmentation of the material.

For exact data see the relevant chapters.

*not including the bladelet cores

**For standard deviation see data in the relevant chapters.

	Amudian			Amudian		Amudian		Yabrudian		
	Blade			PE blade		NBK		Blade	PE blade	NBK
	Qesem Cave	Tabun XI Amudian	Yabrud I-15	Qesem Cave	Tabun XI Amudian	Qesem Cave	Tabun XI Amudian	Tabun XI Yabrudian	Tabun XI Yabrudian	Tabun XI Yabrudian
number of specimens										
n=blanks	645	140	107	595	60	696	72	73	32	28
n=shaped items	354	109	40	164	26	98	23	81	29	23
metric										
larger length	+	+	+	+	+	+	+	+	+	+
larger width	+	+	+	+	+	+	+	+	+	+
larger thickness	+	+	+	+	+	+	+	+	-	+
larger length/width ratio	+	+	+	=	+	=	-	=	+	-
larger width/thickness ratio	=	+	=	=	+	+	-	-	+	+
edge angles										
acuter angle of sharp edge	+	+	+	+	=	-	=			
acuter angle of cortical edge				+	+	+	-			
two edges with non-uniform angles (blades)	-	-	+					-		
non-uniform angle of sharp edge (PE blade; NBK)				=	-	-	-		-	-
Cortex										
higher % of cortex on dorsal face	=	-	=	=	-	=	-	-	-	-
PE blades with a sharp edge*				+	+					
Shape and outline										
parallel (blade)	+	+	+					+		
pointed (blade)	+	-	-					-		
irregular (blade)	-	-	-					-		
straight sharp edge (PE blade; NBK)				+	+	+	=		+	=
irregular sharp edge (PE blade; NBK)				-	-	-	-		-	-
cross-section										
triangular	+	+	=	+	+	=	=	-	-	-
trapezoidal	+	+	=	-	+	+	-	=	=	=
right-angle trapezoidal	-	-	=	=	=	+	+	+	=	+
'other'	-	-	=	-	-	=	+	=	+	-
end termination										
feather	=	+	-	=	+	+	-	=	+	+
overpassing	=	-	+	+	=	=	+	-	=	-
hinge	-	=	=	-	-	-	=	+	-	=
other attributes										
pointed distal end shape	+	-	-					+		
less hinge fractures	+	+	+	+	-	+	+			
number of laminar scars	2	2	2	1	1	2	2	2		
Profile										
semi-straight	=	=	-	=	+	-	-	-	=	+
curved	+	+	+	+	=	+	+	=	+	+
convex	-	-	-	-	+	=	+	+	-	-
twisted	-	=	+	-	-	-	-	=	-	-
irregular	-	-	-	-	-	=	=	=	=	-
butt and bulb of percussion										
thin plain butt	-	-	-	-	+	-	-	-	-	-
thick plain butt	=	=	-	-	+	+	-	-	-	+
modified butt	+	+	+	+	-	+	+	+	+	-
bulb of percussion in the butt's middle	+	+	=	+	+	+	+	=	+	+

(+) marks positive representation: more common in the shaped items than in blanks.
(-) marks an opposite pattern: less common among the shaped items.
(=) marks no major differences between blanks and shaped items.

Table 40: Selection patterns of the three laminar types.
The data takes into consideration both means and distribution patterns. For exact patterns see chapters 4-6.
*items similar to NBKs, but lacking a steep back.

	Amudian			Amudian			Amudian			Other facies			Yabrudian	Yabrudian
	Blade			PE blade			NBK			Blade			PE blade	NBK
	Qesem Cave	Tabun Amudian	Yabrud I-15	Qesem Cave	Tabun Amudian	Yabrud I-15	Qesem Cave	Tabun Amudian	Yabrud I-15	Tabun Yabrudian	Tabun Acheulian	Yabrud I-11/12	Tabun Yabrudian	Tabun Yabrudian
irregular cortical edge outline				23.4	29.3	29.6	13.6	31.7	24.0				47.5	33.3
irregular sharp edge outline				18.1	22.2	24.0	18.5	25.4	16.0				35.7	18.8
non-uniform cortical edge angle				22.6	23.2	14.8	13.9	29.6	33.3				57.5	51.3
non-uniform sharp edge angle				8.8	7.1	26.9	2.9	1.3	8.0				17.1	12.1
blades with two non-uniform edge angles	7.4	4.8	10.6							12.5	16.7	16.0		
irregular profile	7.6	10.2	7.6	6.5	10.6	0.0	7.4	14.8	19.2	14	16.1	7.7	11.3	14.6
irregular shape (blade)	11.7	11.1	8.8							26.3	31.0	8.3		
'other' cross-section	9.1	11.7	19.9	11.4	13.1	36.8	3.1	13.8	6.3	17.9	35.0	14.3	31.6	15.2

Table 41: Attributes indicative of less organized production.

Data retrieved from Chapters 5-6.

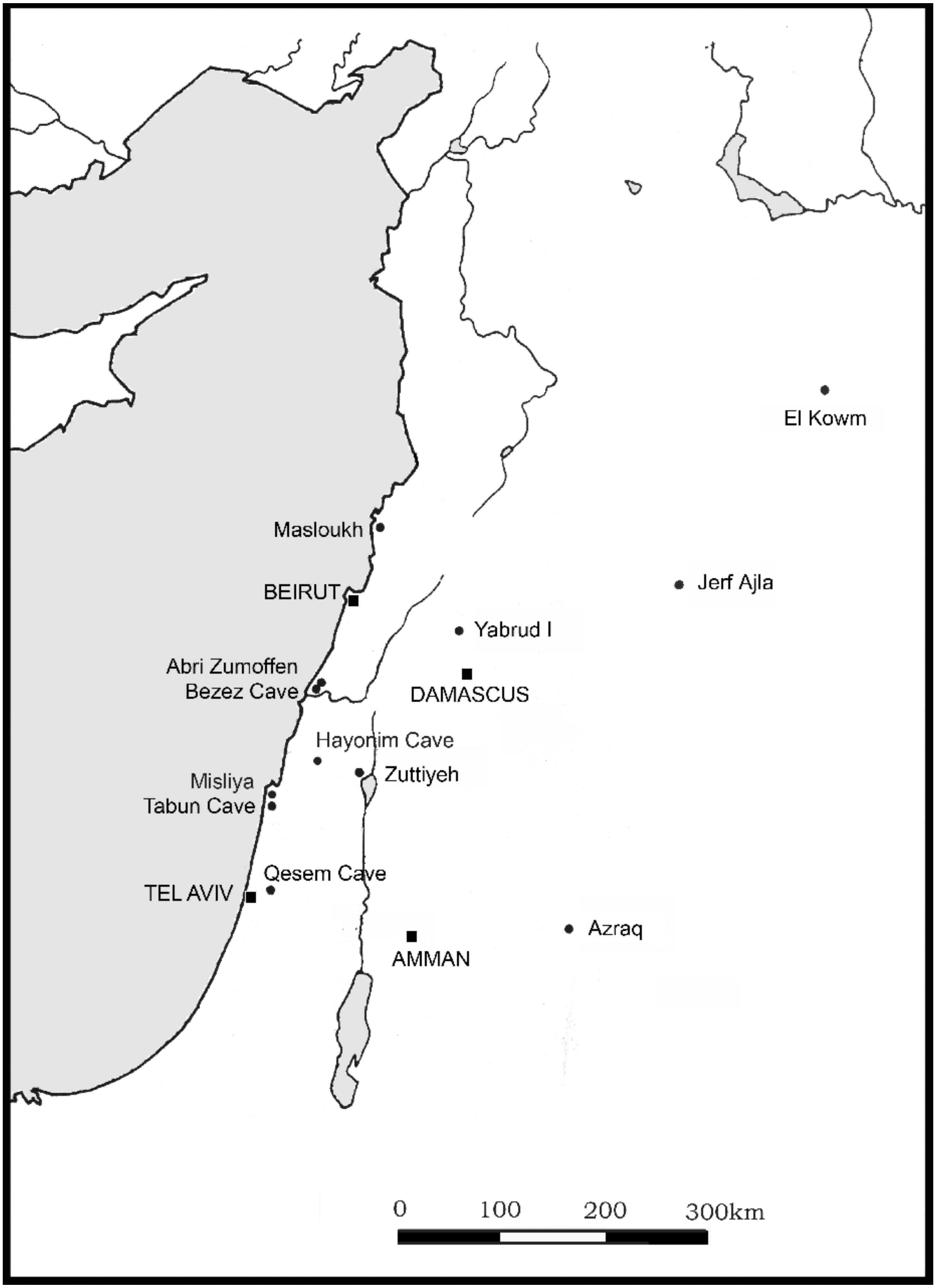


Fig. 1: Sites of the Acheulo-Yabrudian complex.

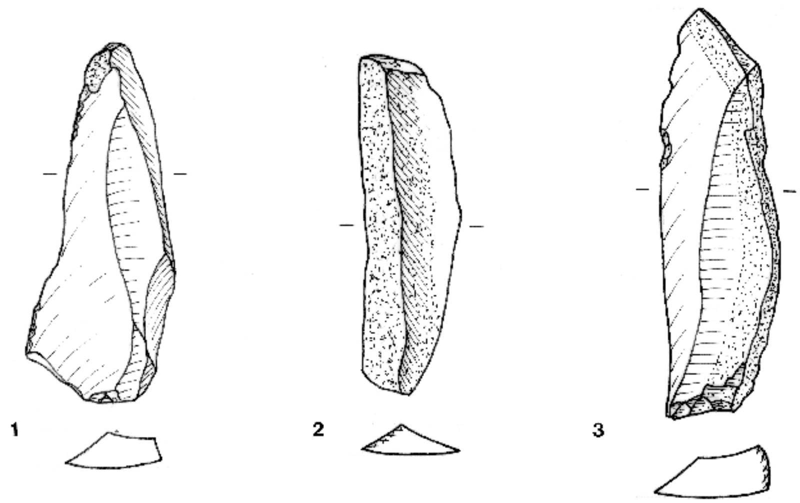


Fig. 2: The three laminar types: blade (1), PE blade (2) and NBK (3).

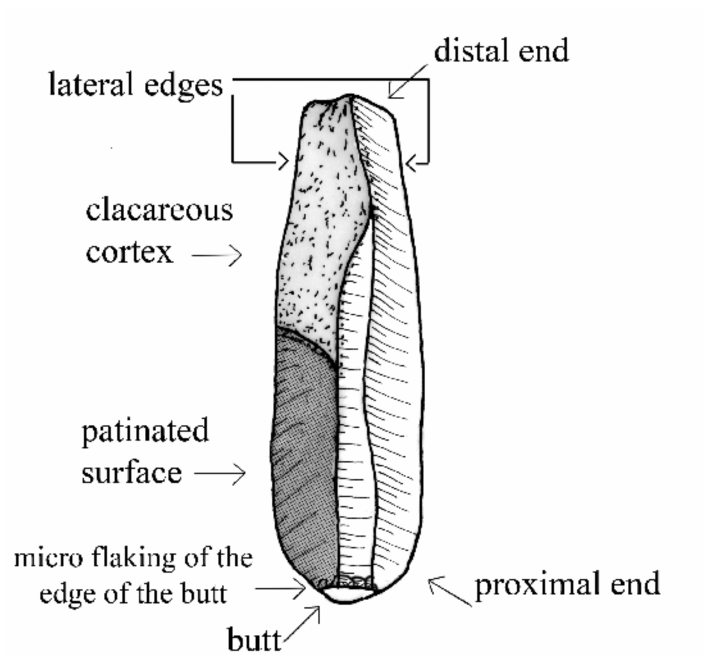


Fig. 3: General observations of laminar items, including the use of gray raster to mark patianted surface in the illustrated items.

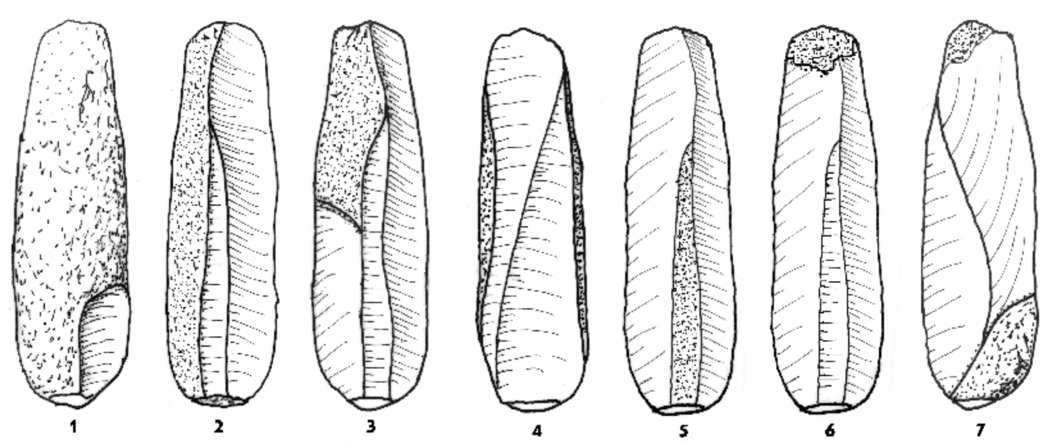


Fig. 4: Cortex configuration on laminar items: whole (1), full edge (2), partial edge (3), two edges (4), medial (5), distal (6), and irregular (7).

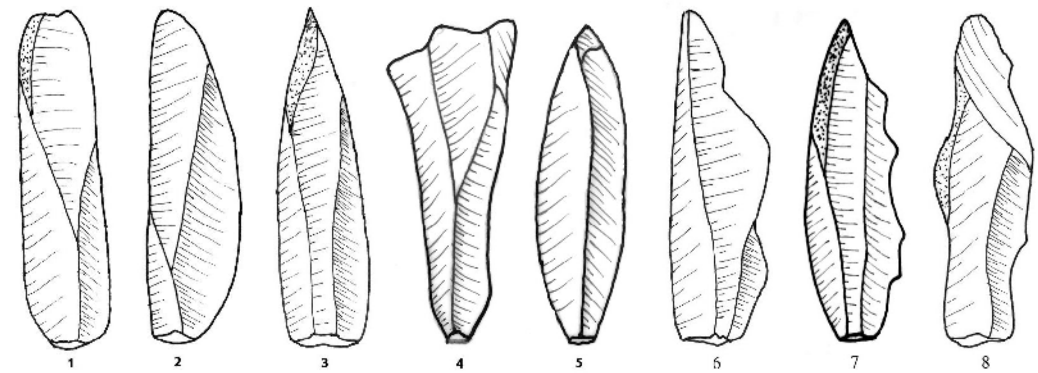
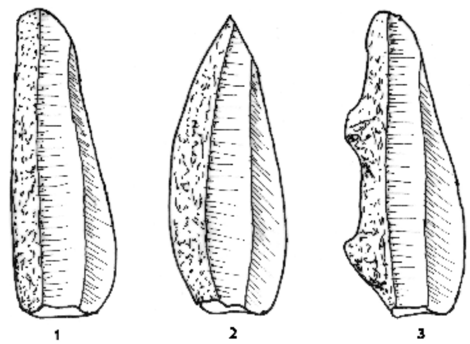
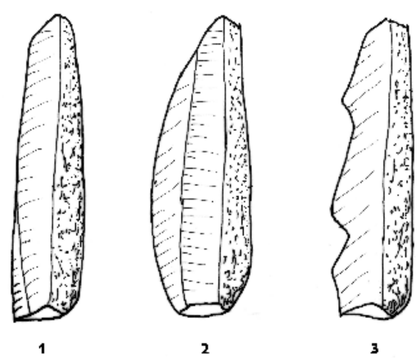


Fig. 5: Shapes of blades: parallel (1) straight-curved (2), pointed (3), fan (4), leaf (5), straight-irregular (6), curved-irregular (7), and irregular (8).



A: Cortical edge outline



B: Sharp edge outline

Fig. 6: Outlines of the cortical edge (A) and the sharp edge of PE blades and NBKs: straight (1), curved (2), and irregular (3).

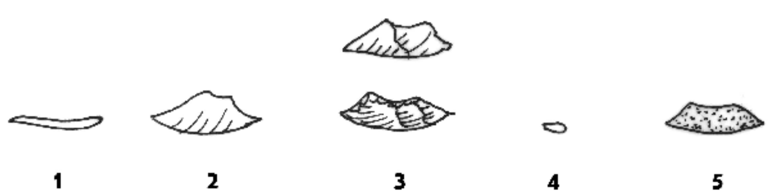


Fig. 7: Butt types: thin plain (1), thick plain (2), modified (3), punctiform (4), and natural (5).

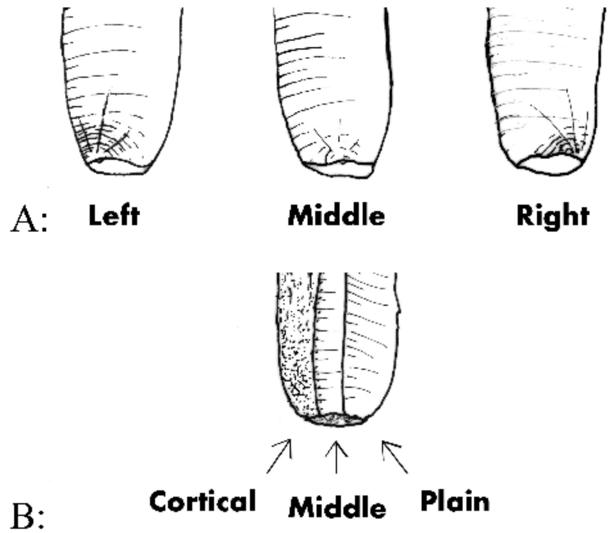


Fig. 8: Location of the bulb of percussion: (A) blades from ventral view, (B) PE blades and NBKs.

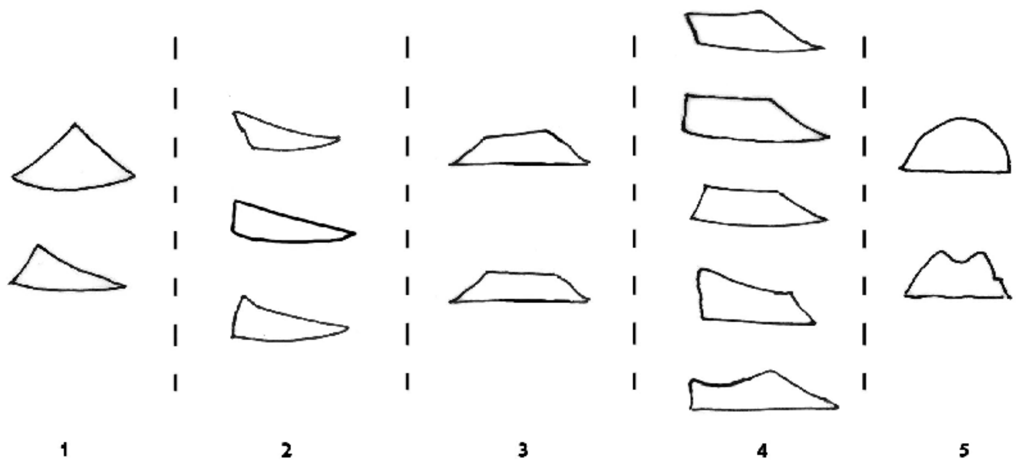


Fig. 9: Cross sections: triangular (1), right angle triangular (2), trapezoidal (3), right angle trapezoidal (4), and other (5).

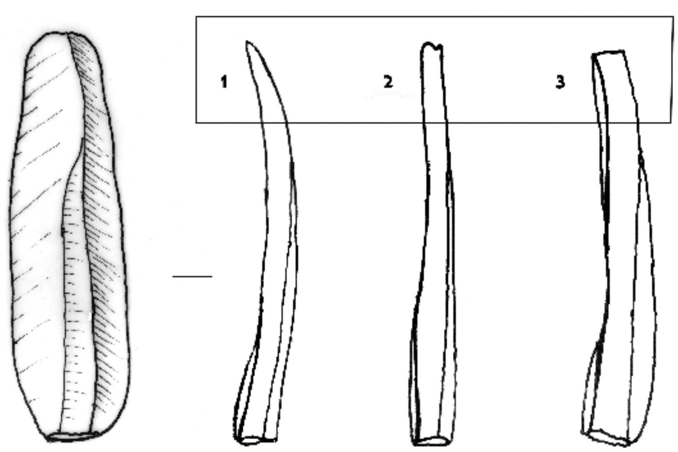


Fig. 10: End terminations: feather (1), hinge (2), overpassing (3).

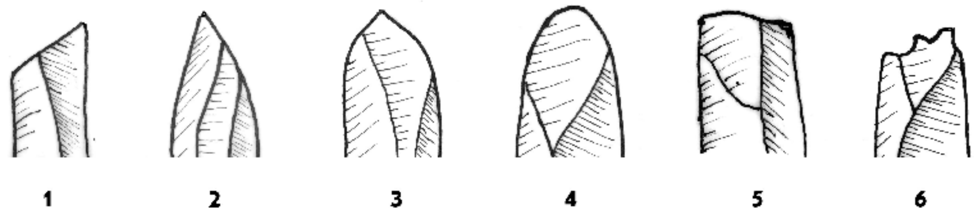


Fig. 11: Distal end shapes: oblique (1), pointed (2), pointed-rounded (3), rounded (4), straight (5), irregular (6).

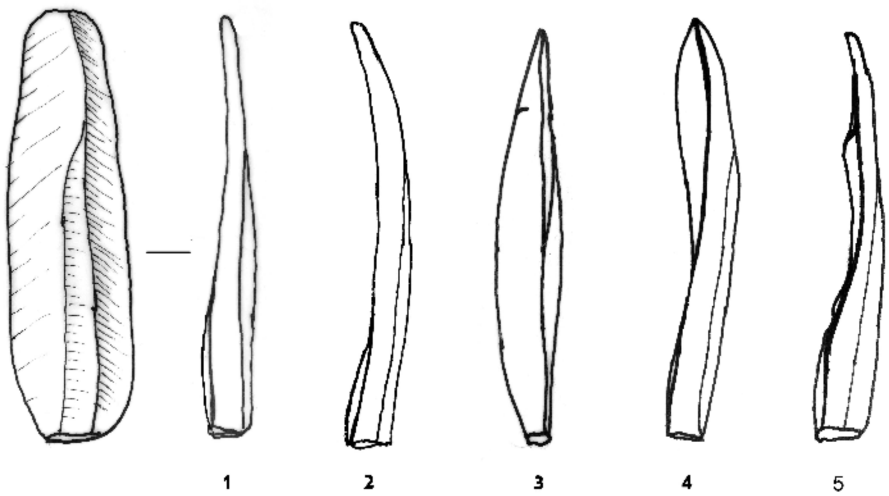


Fig. 12: Profiles: semi-straight (1), curved (2), convex (3), twisted (4), and irregular (5). Profile is referring to the ventral face only (left side in the example illustrations).

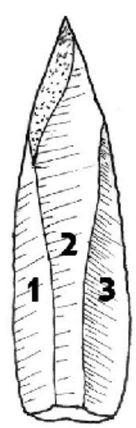


Fig. 13: An example of the number of laminar scars on dorsal face.

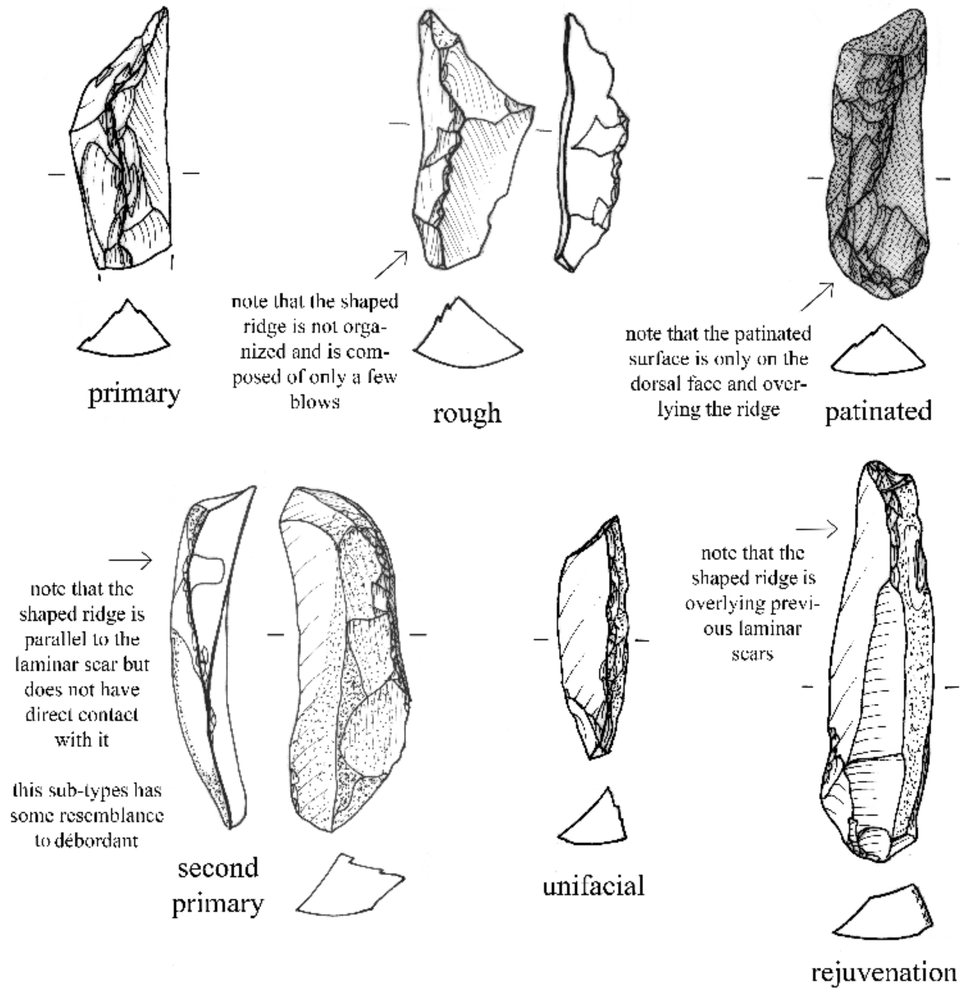


Fig. 14: Examples of crested blades sub-types.
The raster marks old patinated surface.

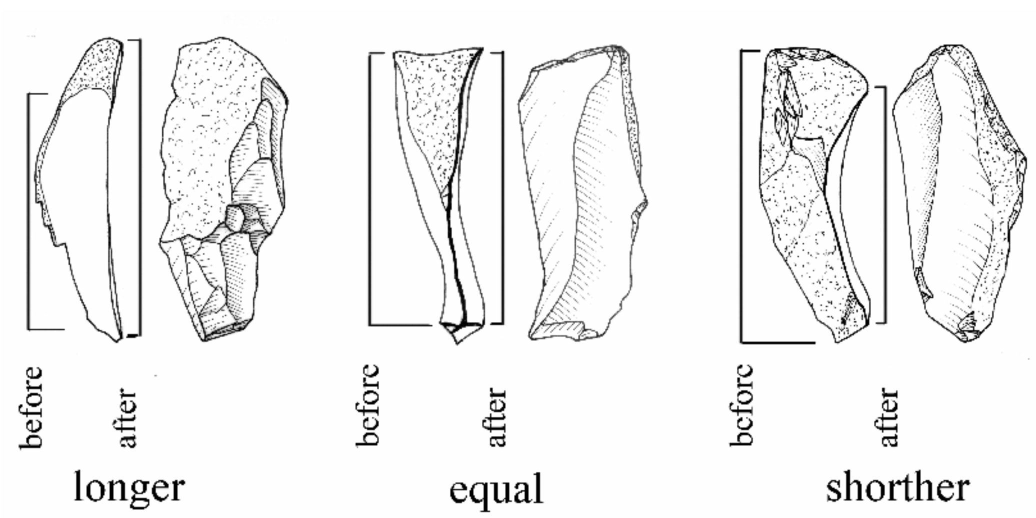


Fig. 15: Changes in the debitage surface length resulting from the removal of overpass items.

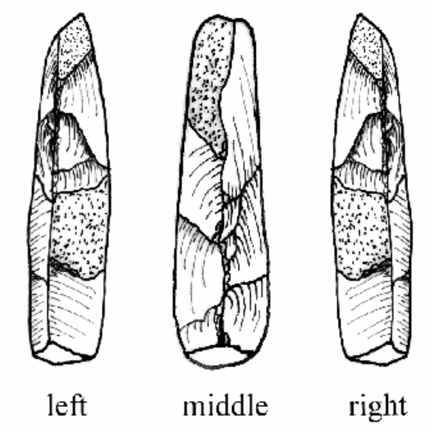


Fig: 16: Location of the shaped ridge along the width axis in crested blades.

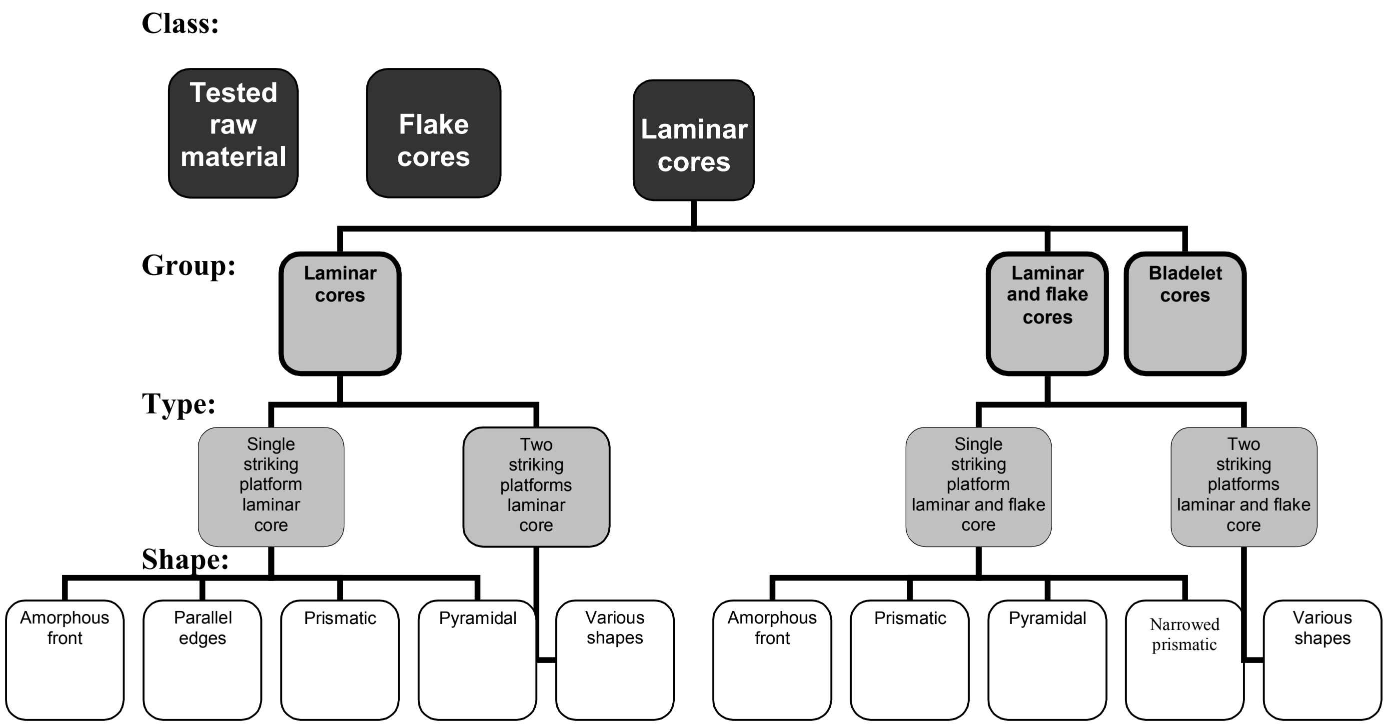


Fig. 17: Diagram of the hierarchy of the laminar cores class used in this is analysis.

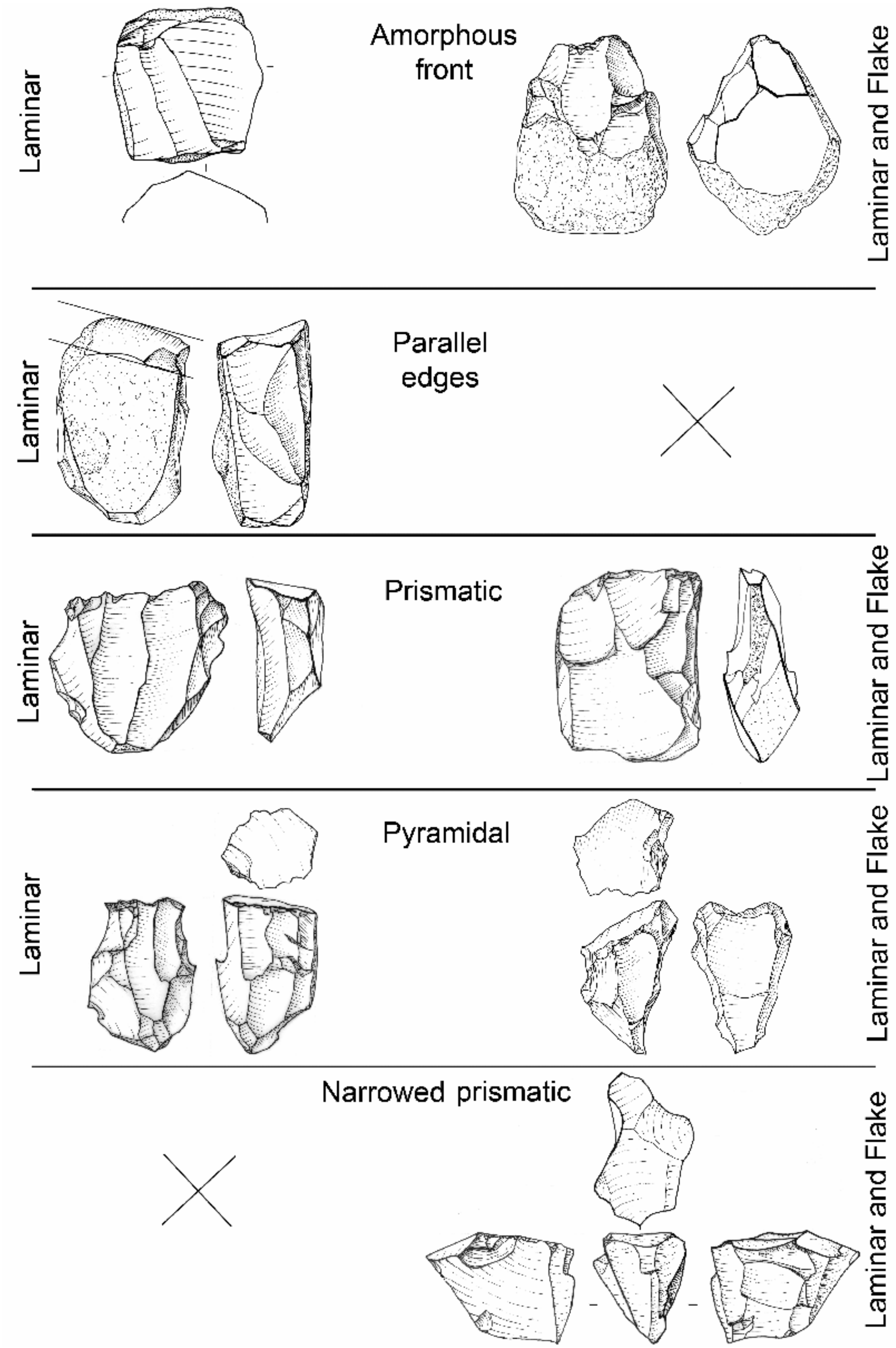


Fig. 18: Shapes of single striking platform cores of the laminar core class.
To the left are the shapes as appearing among ‘laminar cores’ and to the right as appearing among ‘laminar and flake cores’.

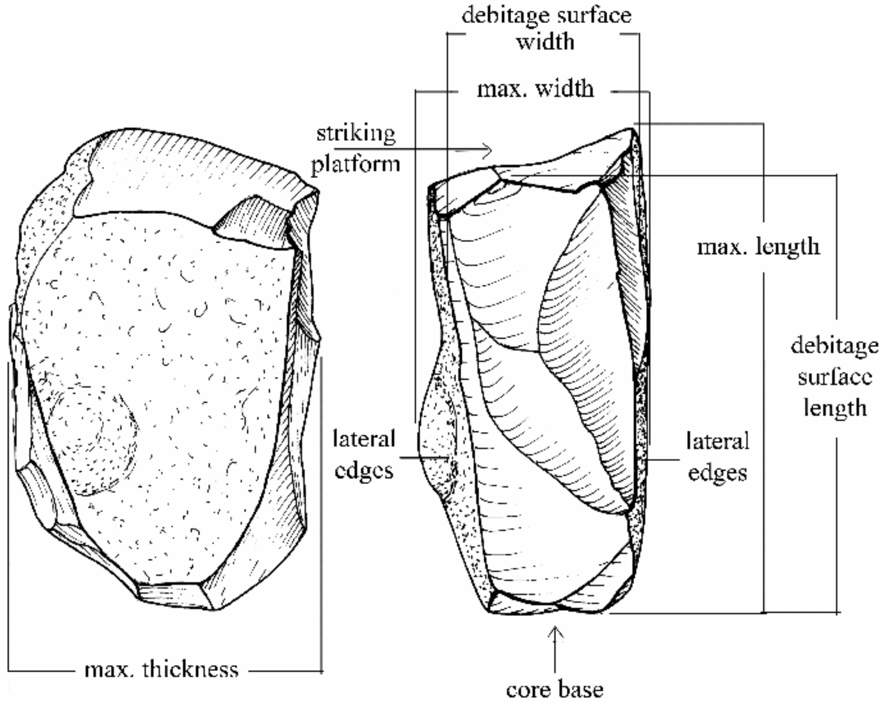


Fig. 19: General attributes of cores.

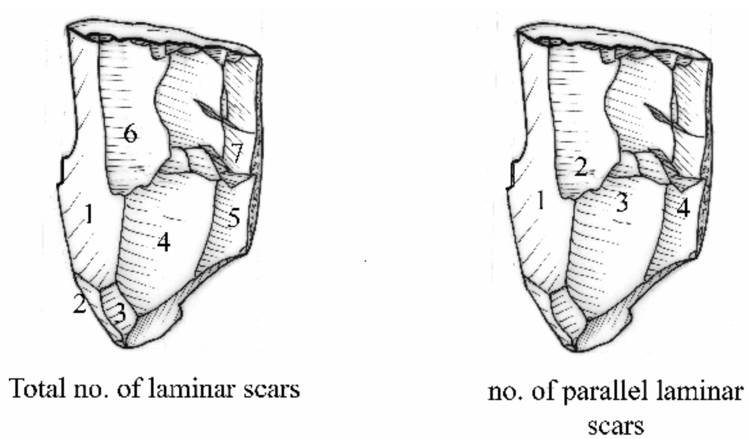


Fig. 20: Number of laminar scars on debitage surface.
While the total includes all remnants of laminar scars, the parallel count includes the maximum number of scars from one lateral edge to the other along a straight line.

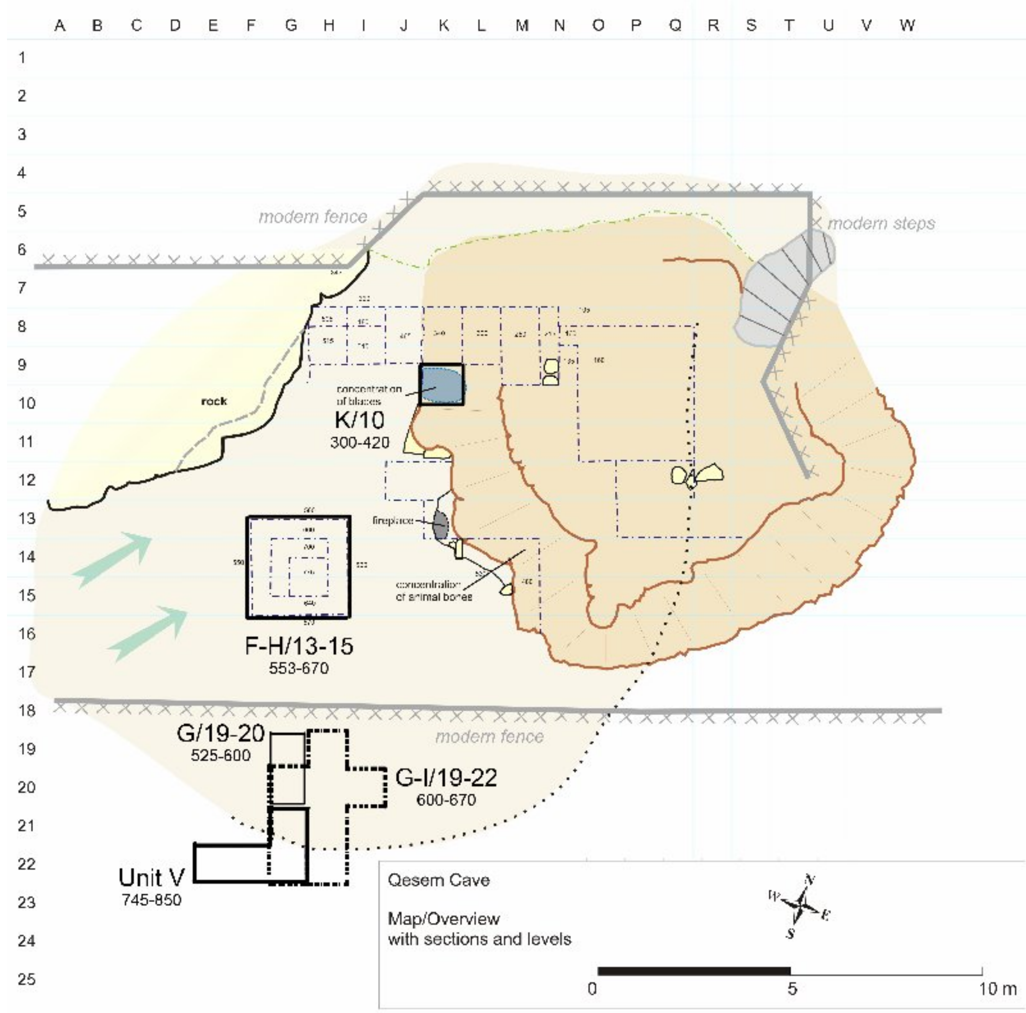


Fig. 21: Location of the studied samples from Qesem Cave.

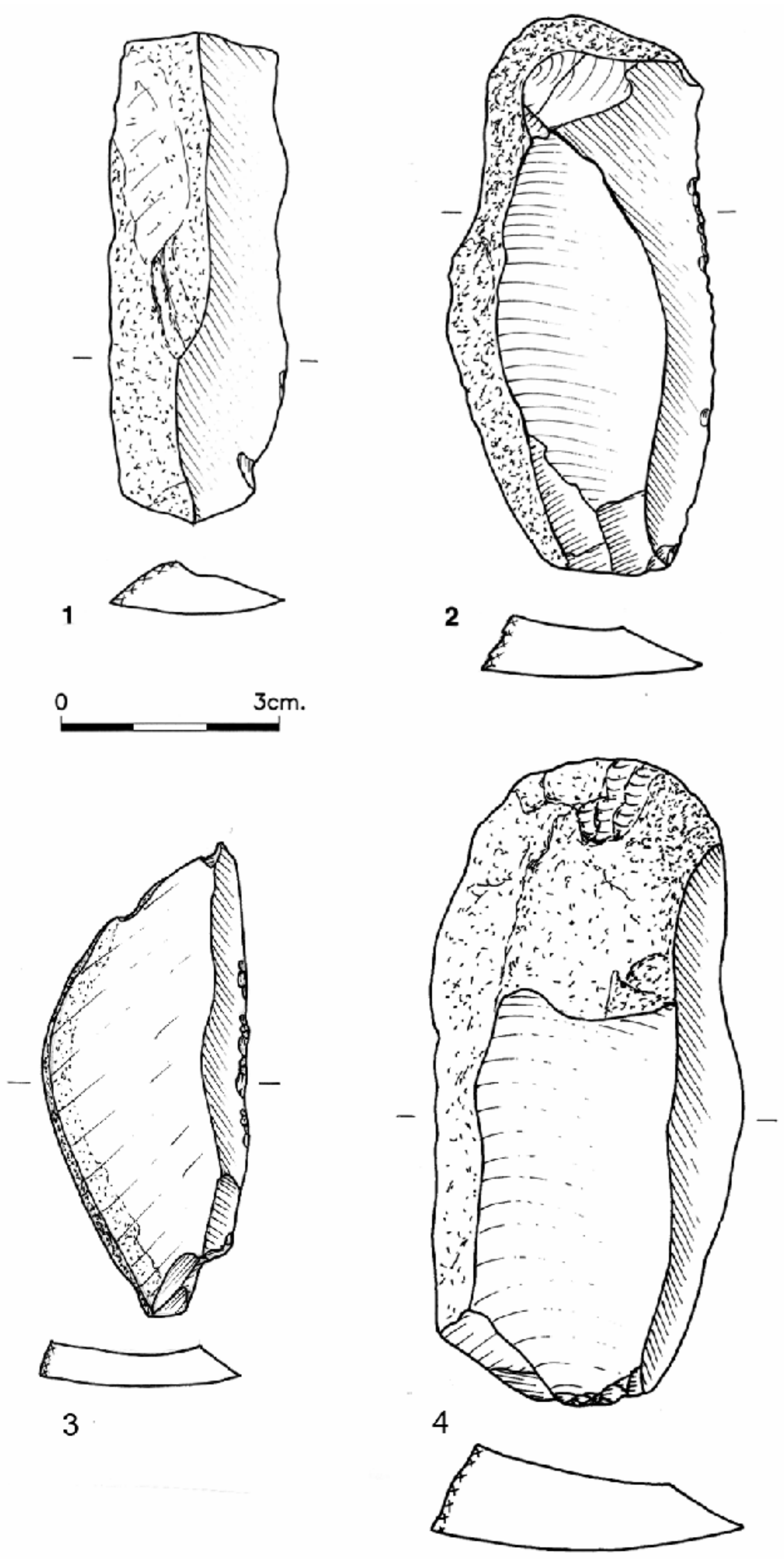


Fig. 22: Laminar blanks from Unit V (1-2) and sample G-I/19-23 (3-4), Qesem Cave. PE blades (1), NBK (2-4).

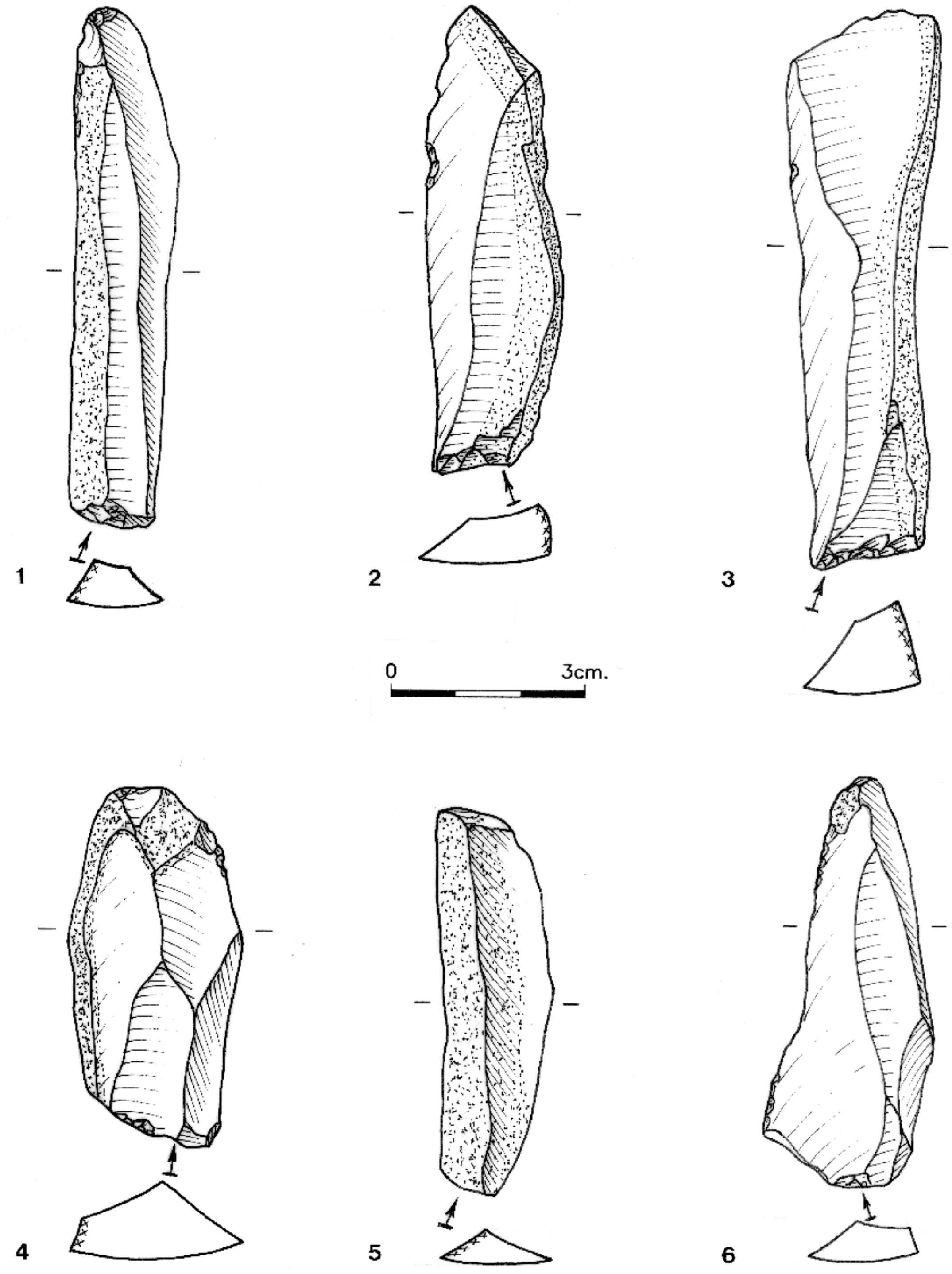


Fig. 23: Laminar blanks from sample G/19-20, Qesem Cave.
NBK (1-4), PE blade (5), blade (6).

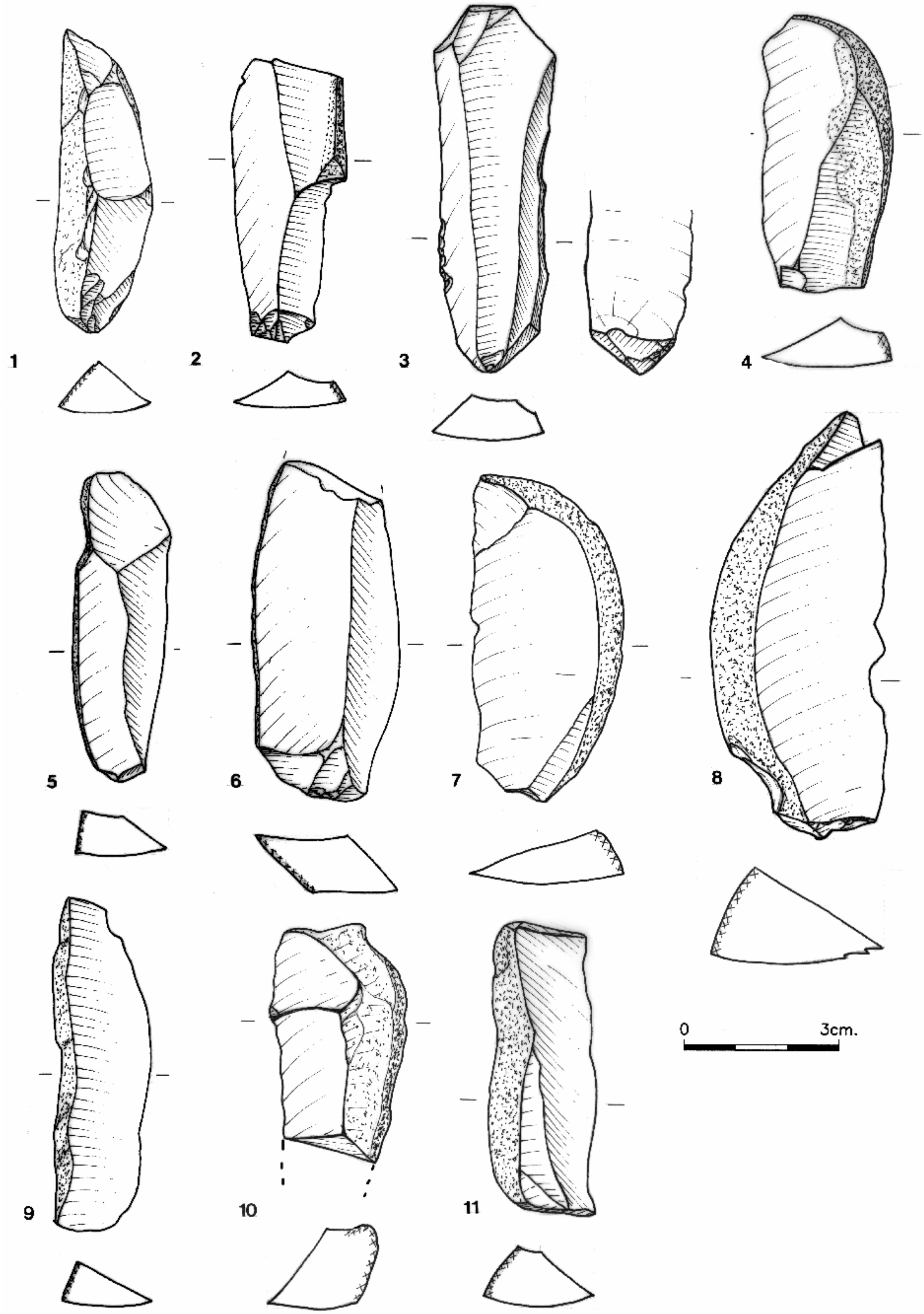


Fig. 24: Laminar blanks from sample F-H/13-15, Qesem Cave.
PE blades (1), blades (2-3), NBK (4-11).

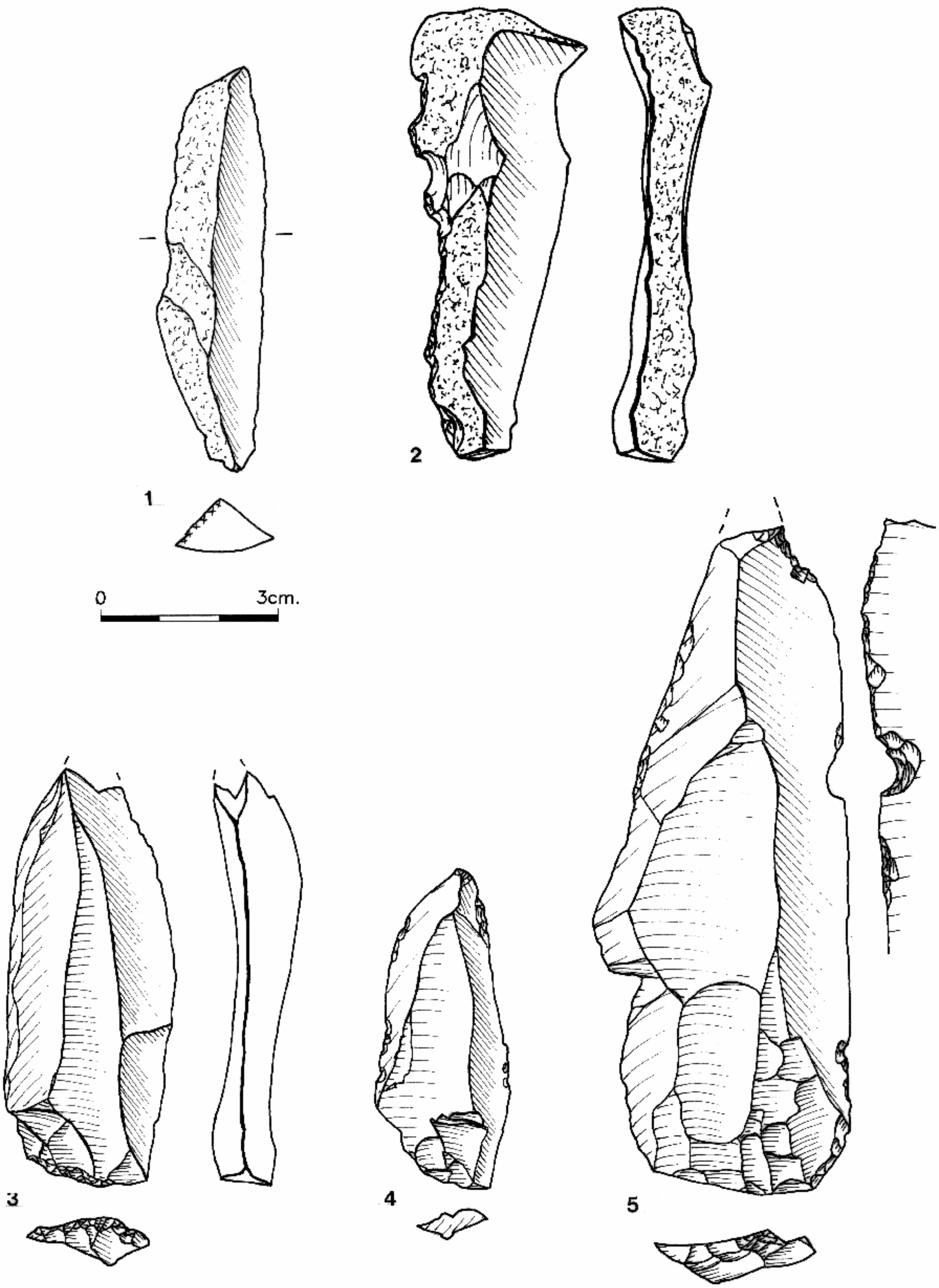


Fig. 25: Laminar blanks from sample K/10, Qesem Cave.
PE blade (1-2), blades (3-5).
Item no. 2 is a PE blade with an overpassing end termination.

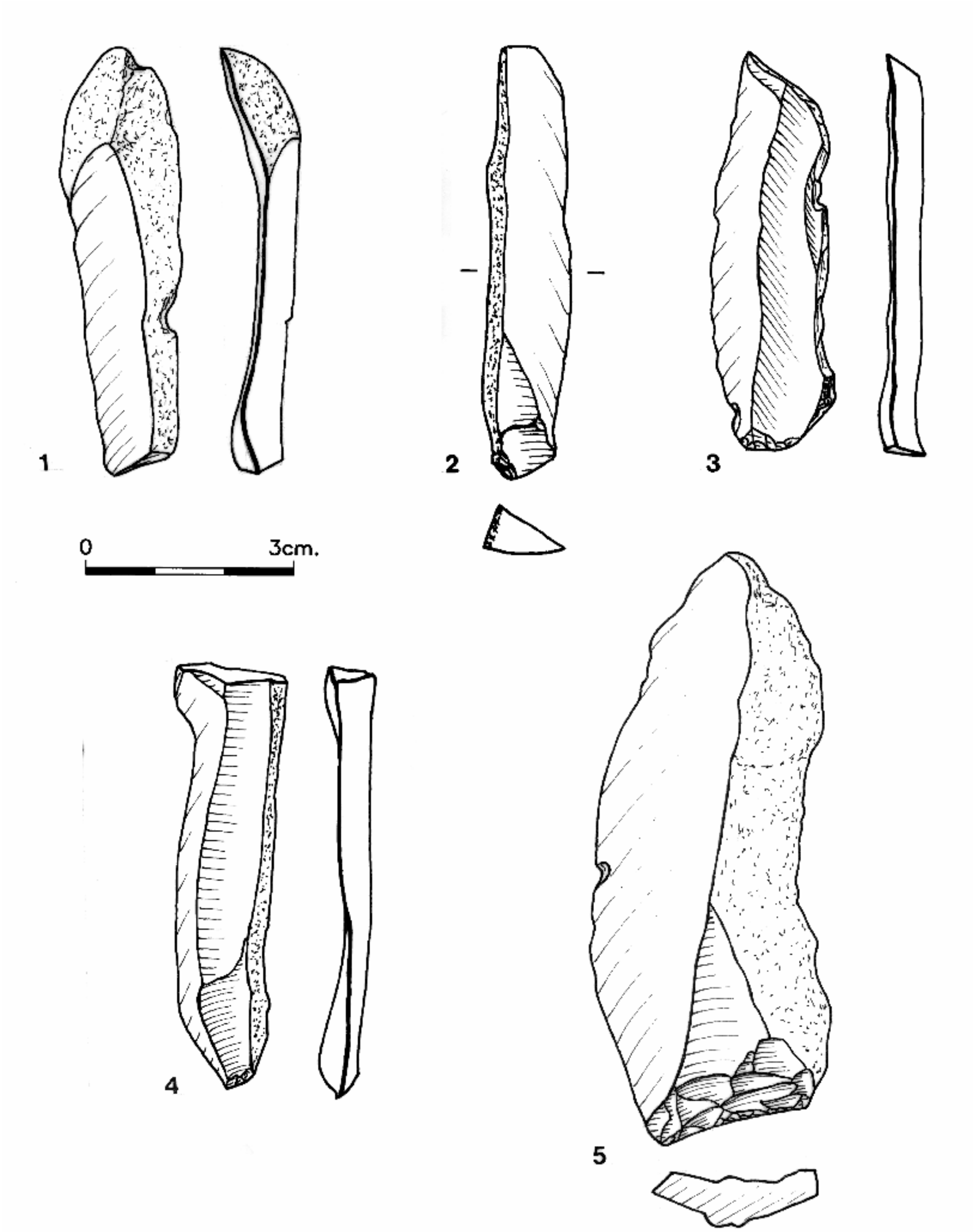


Fig. 26: NBKs from sample K/10, Qesem Cave. Item no. 4 is a NBK with an overpassing end termination.

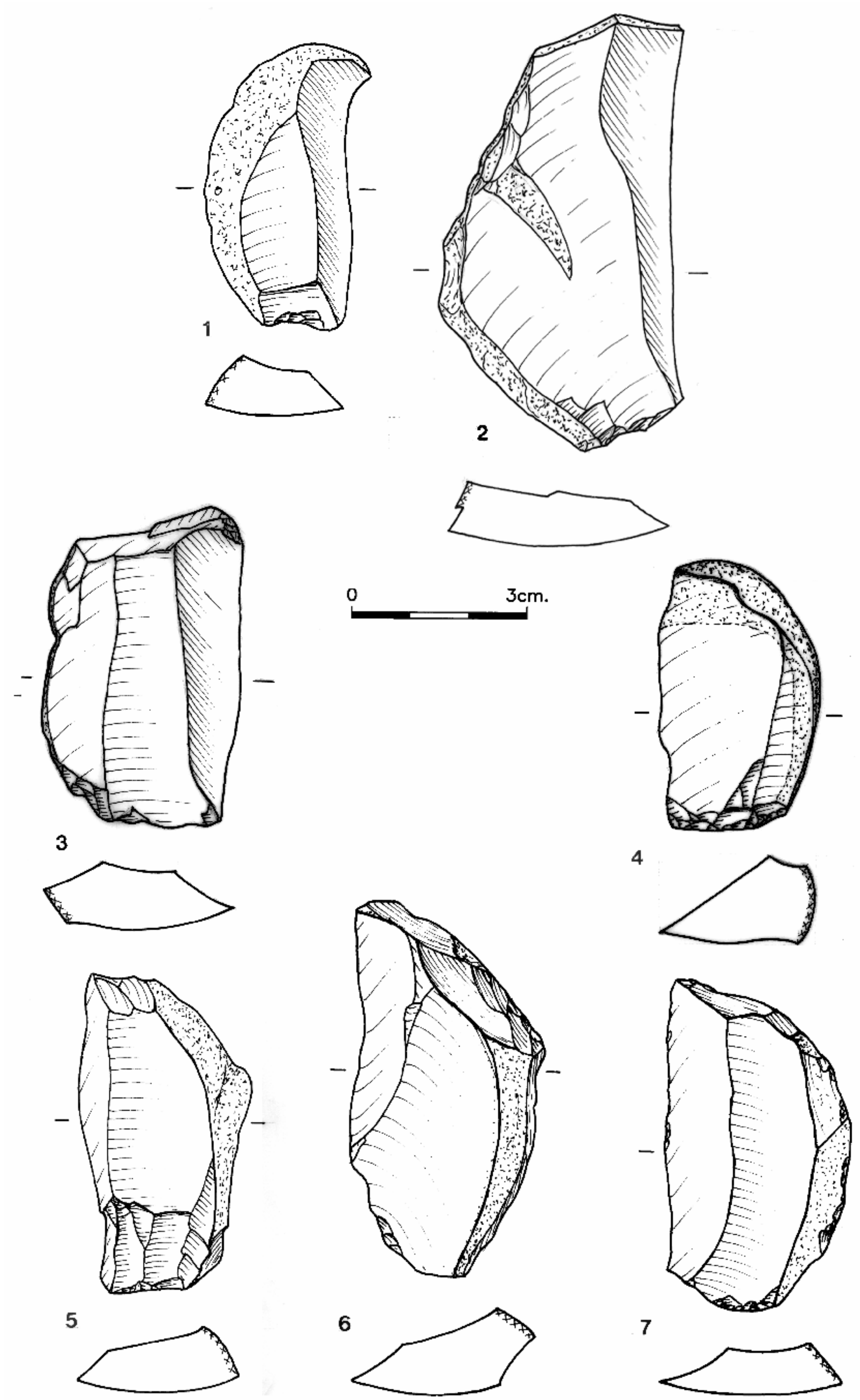


Fig. 27: NBKs-flake from Qesem Cave: Unit V (1), G-I/19-23 (2), F-H/13-15 (3-4), K/10 (5-7).

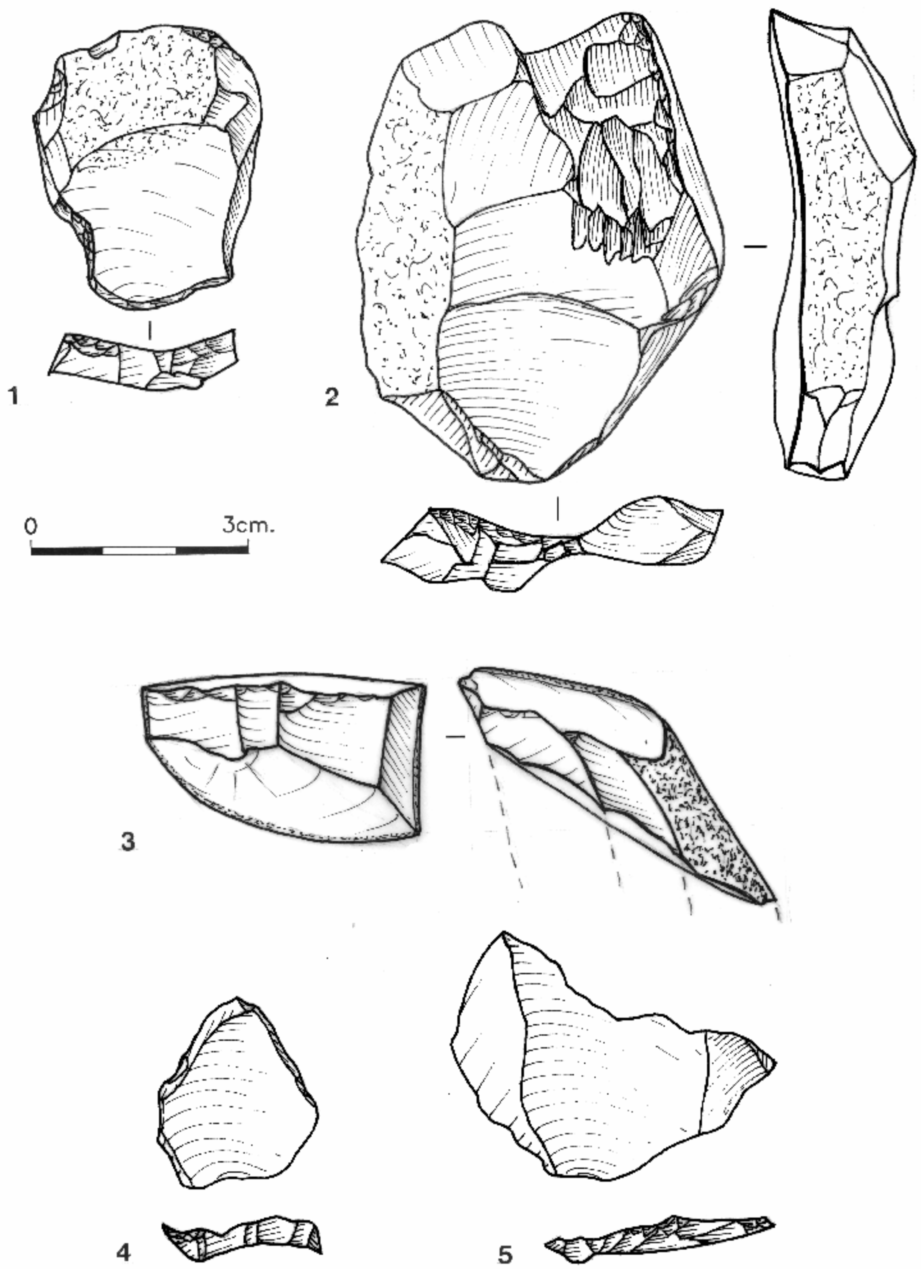


Fig. 28: Core tablets from Qesem Cave: G-I/19-23 (1), G/19-20 (2), F-H/13-15 (3), K/10 (4-5).

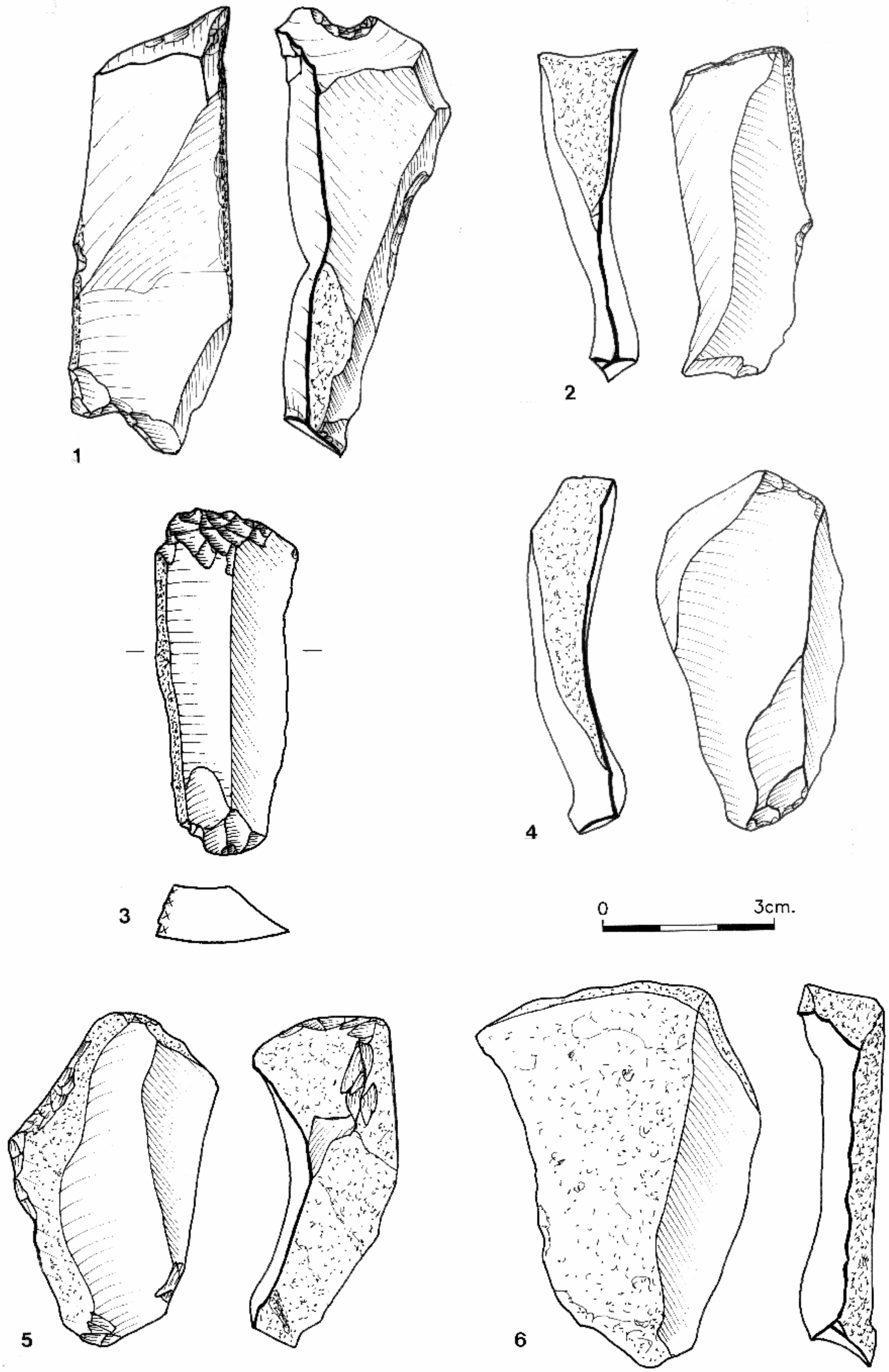


Fig. 29: Overpass items from Unit V, Qesem Cave.
Item no. 1 is characterized by two cortical lateral edges.

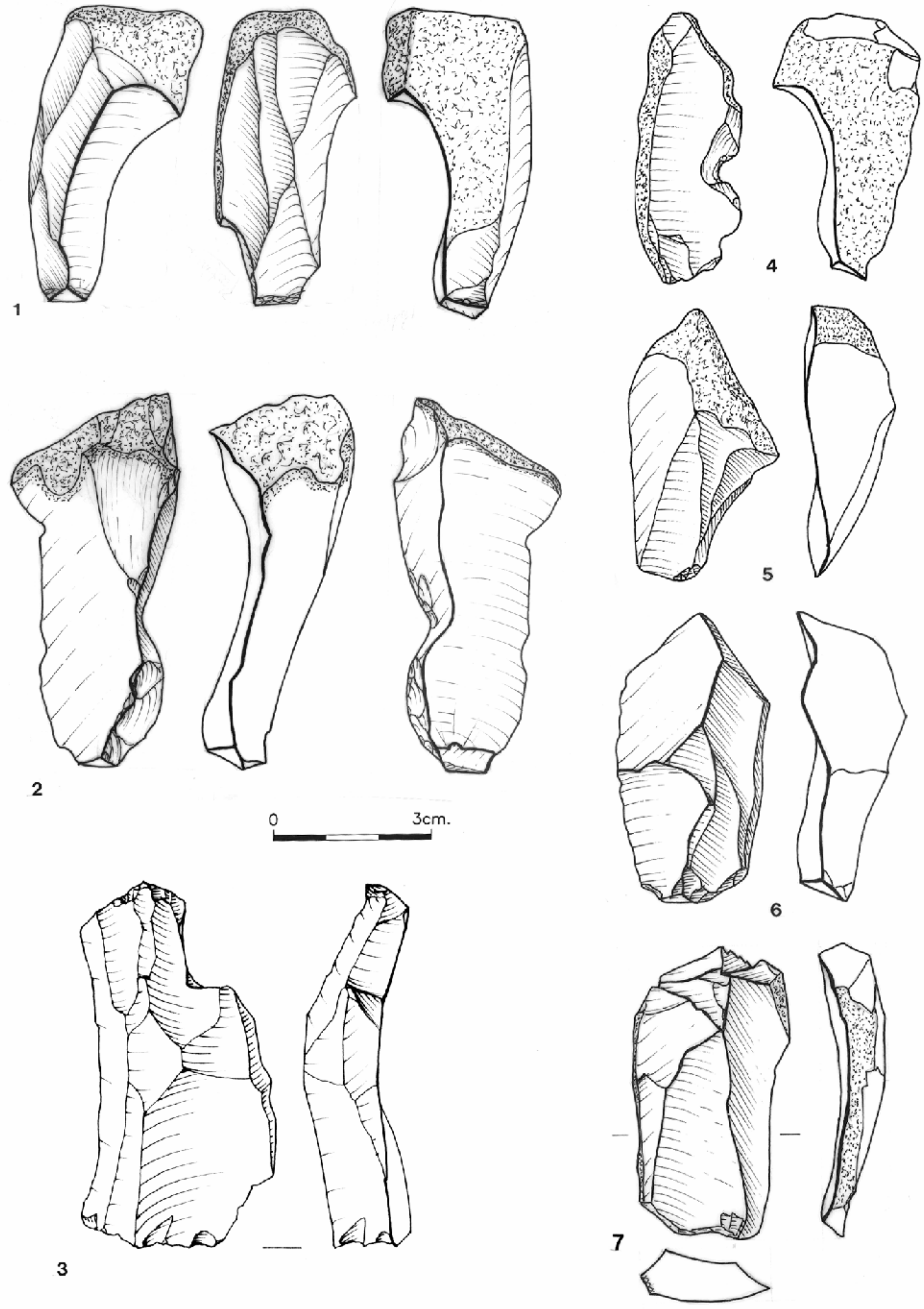


Fig. 30: Overpass items from sample G-I/19-22, Qesem Cave.
Items no. 1-2 and 7 have two cortical lateral edges.

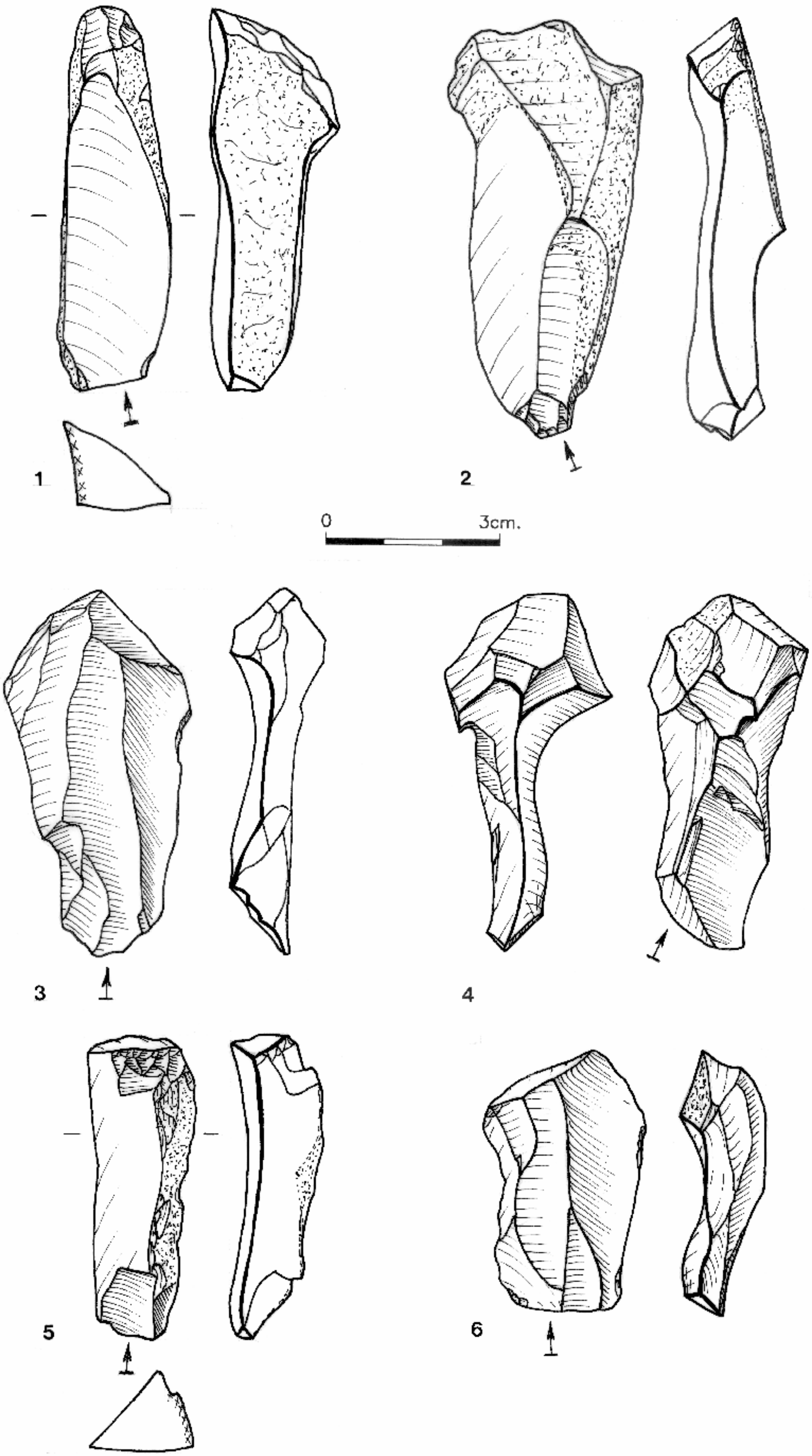


Fig. 31: Overpass items from sample G/19-20, Qesem Cave.
Item no. 1 has two cortical lateral edges and item no. 5 includes a shaped ridge.

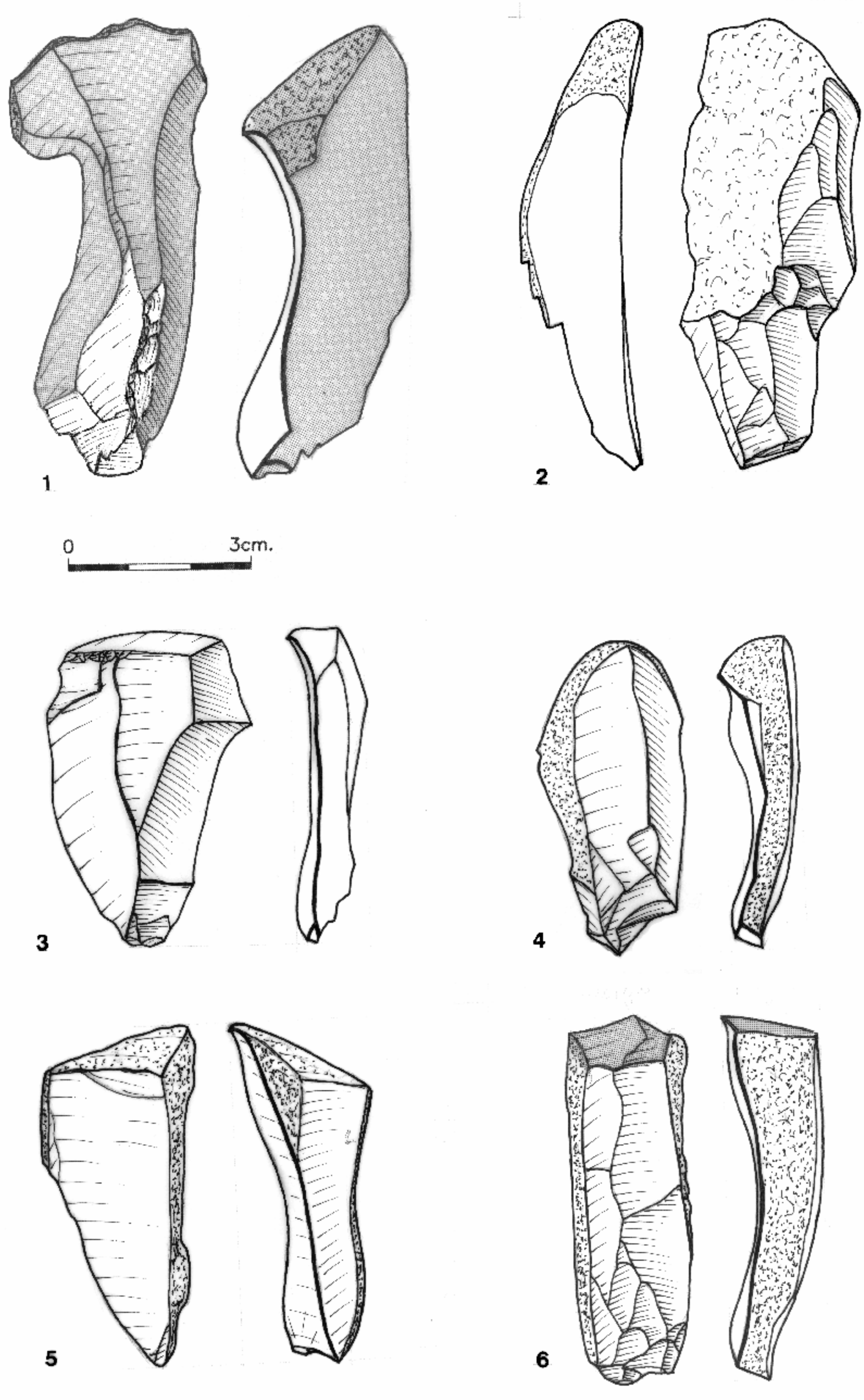


Fig. 32: Overpass items from sample F-H/13-15, Qesem Cave.
Raster marks patinated surface.
Items no. 4-6 have two cortical lateral edges.

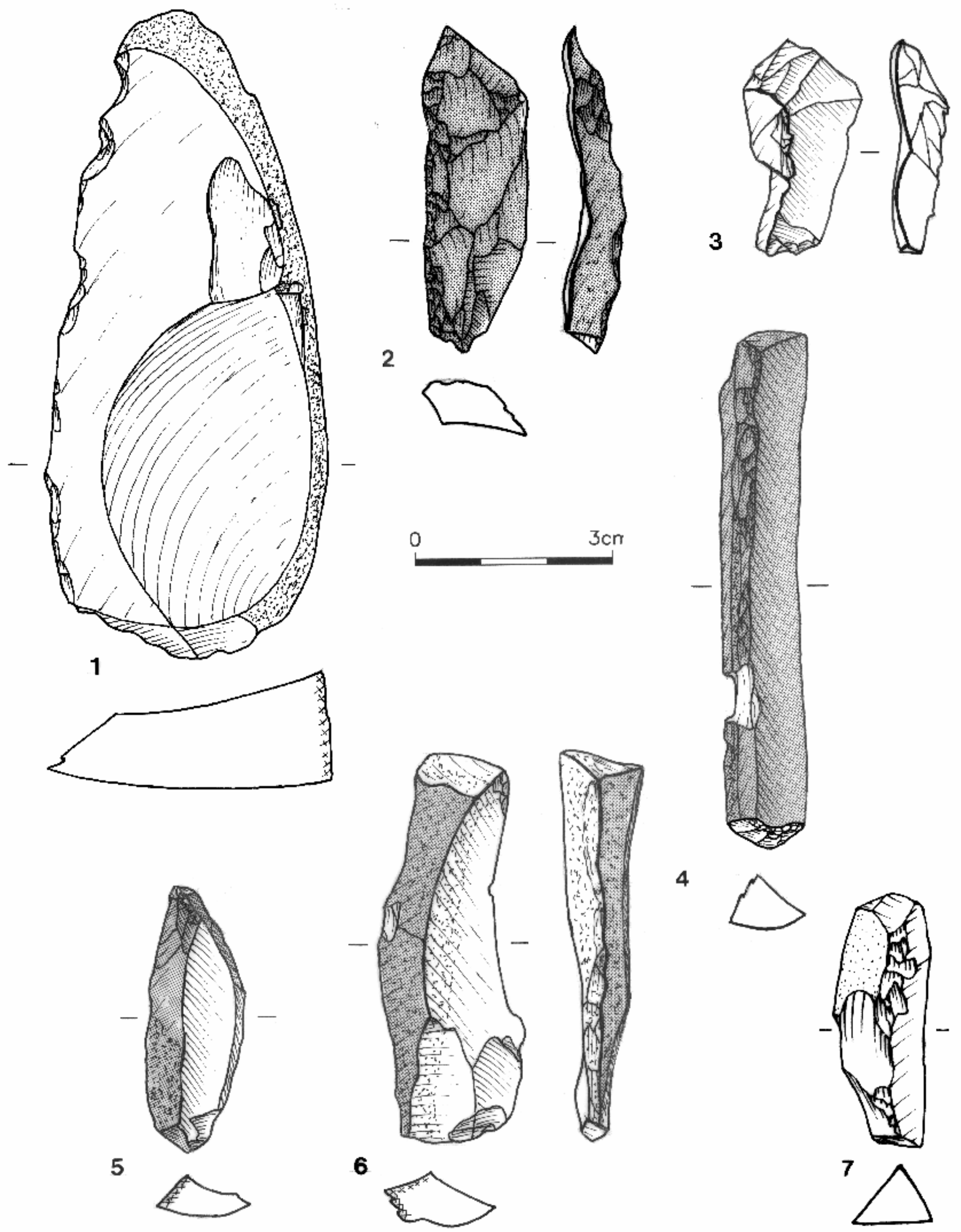


Fig. 33: Crested blades from Unit V (1-3) and sample G-I/19-22 (4-7), Qesem Cave.
Rough (1), patinated (2, 4-5), second-primary (6), rejuvenation (2, 7).
Raster marks patinated surface.
Note that the shaped ridge on the second-primary sub-type (6) is on the lateral edge (visible in the profile look) and completely do not come in contact with the previous reduction scars.

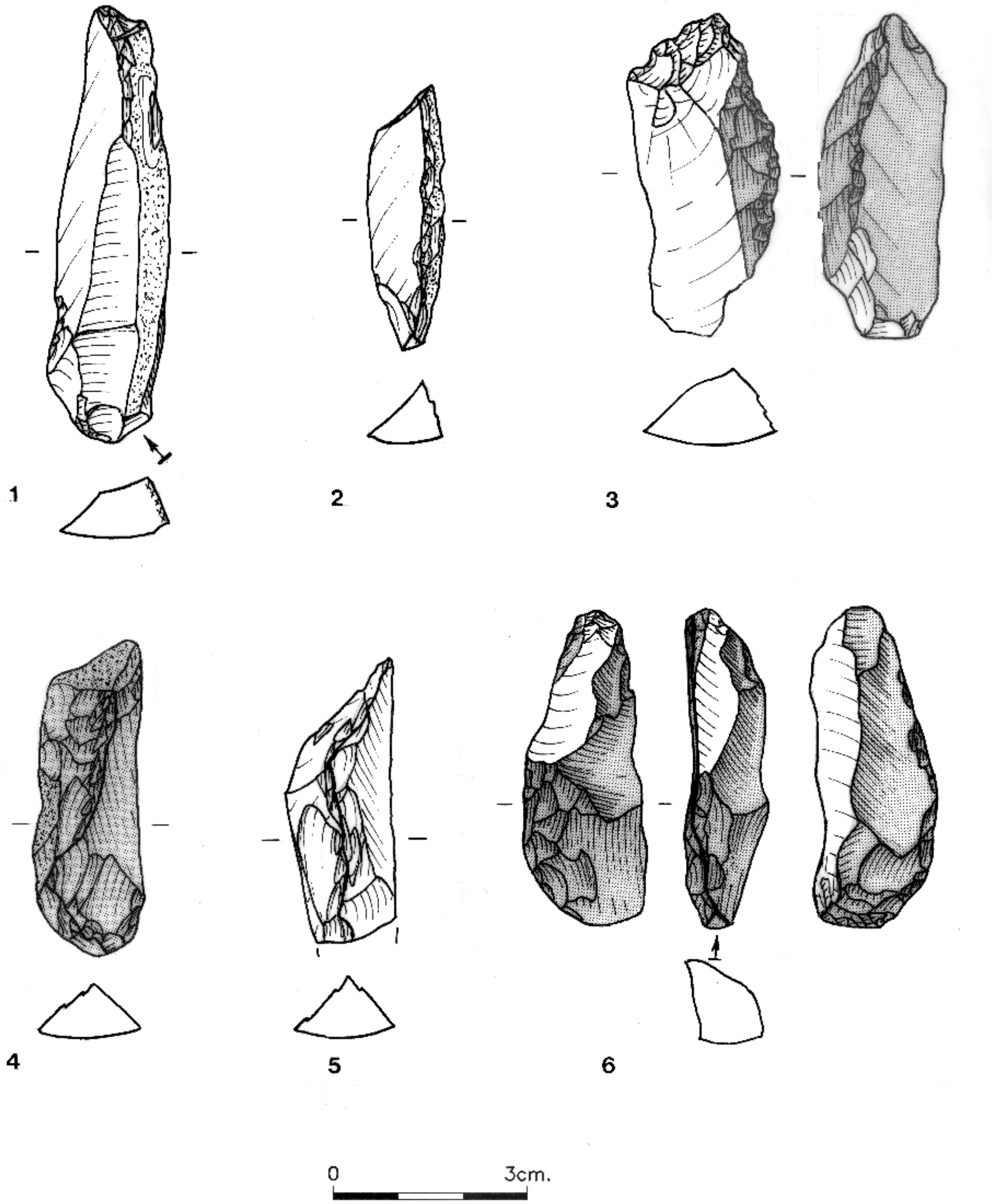


Fig. 34: Crested blades from sample G/19-20, Qesem Cave.
Rejuvenation (1), unifacial (2), patinated (3-4, 6), primary (5).
Raster marks patinated surface.

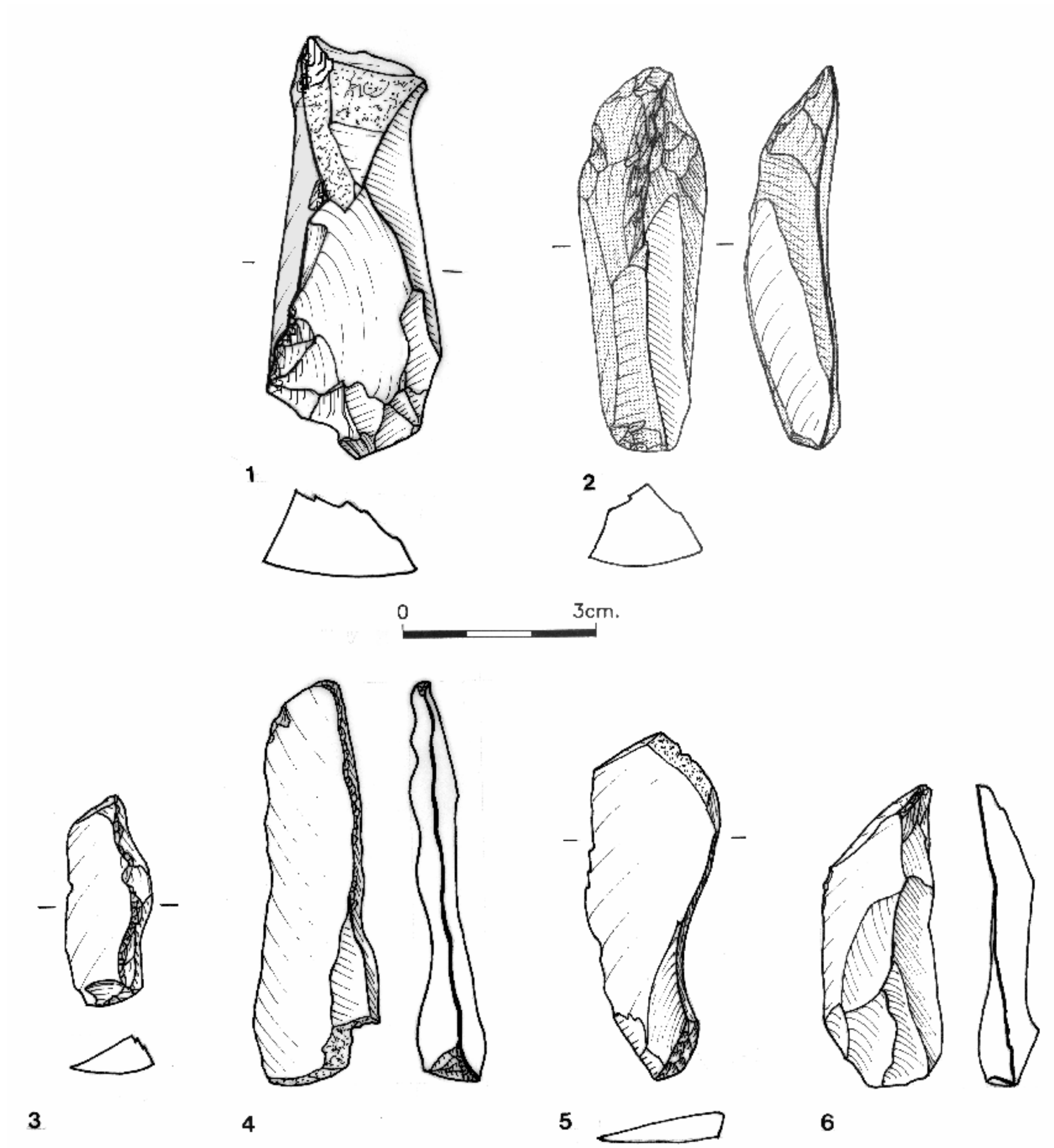


Fig. 35: Crested blades from samples F-H/13-15 (1-2) and K/10 (3-6), Qesem Cave.
Rough (1), patinated (2), unifacial (3), rejuvenation (4-6).
Raster marks patinated surfaces.

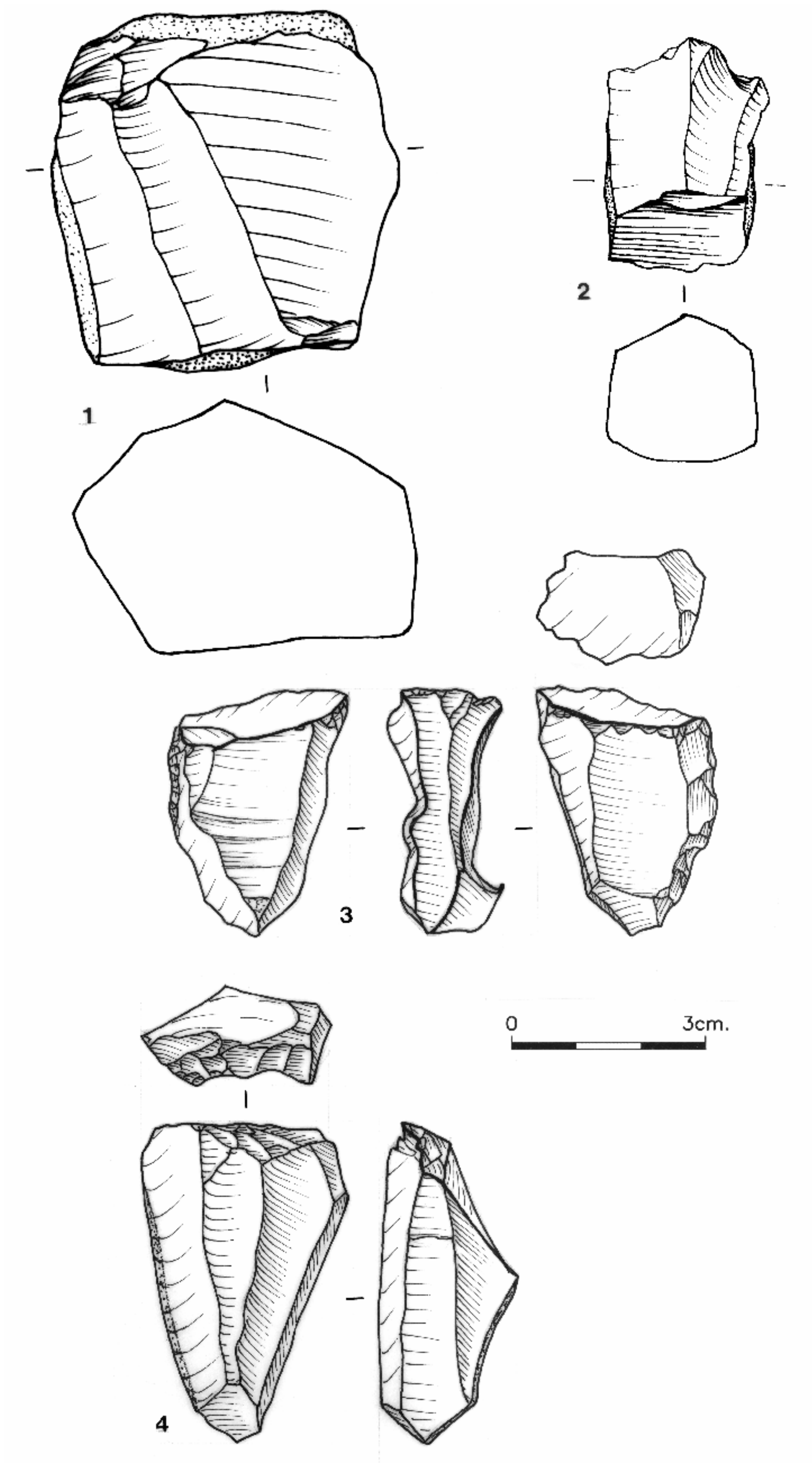


Fig. 36: 'Single striking platform laminar cores' from sample G-I/19-22, Qesem Cave.

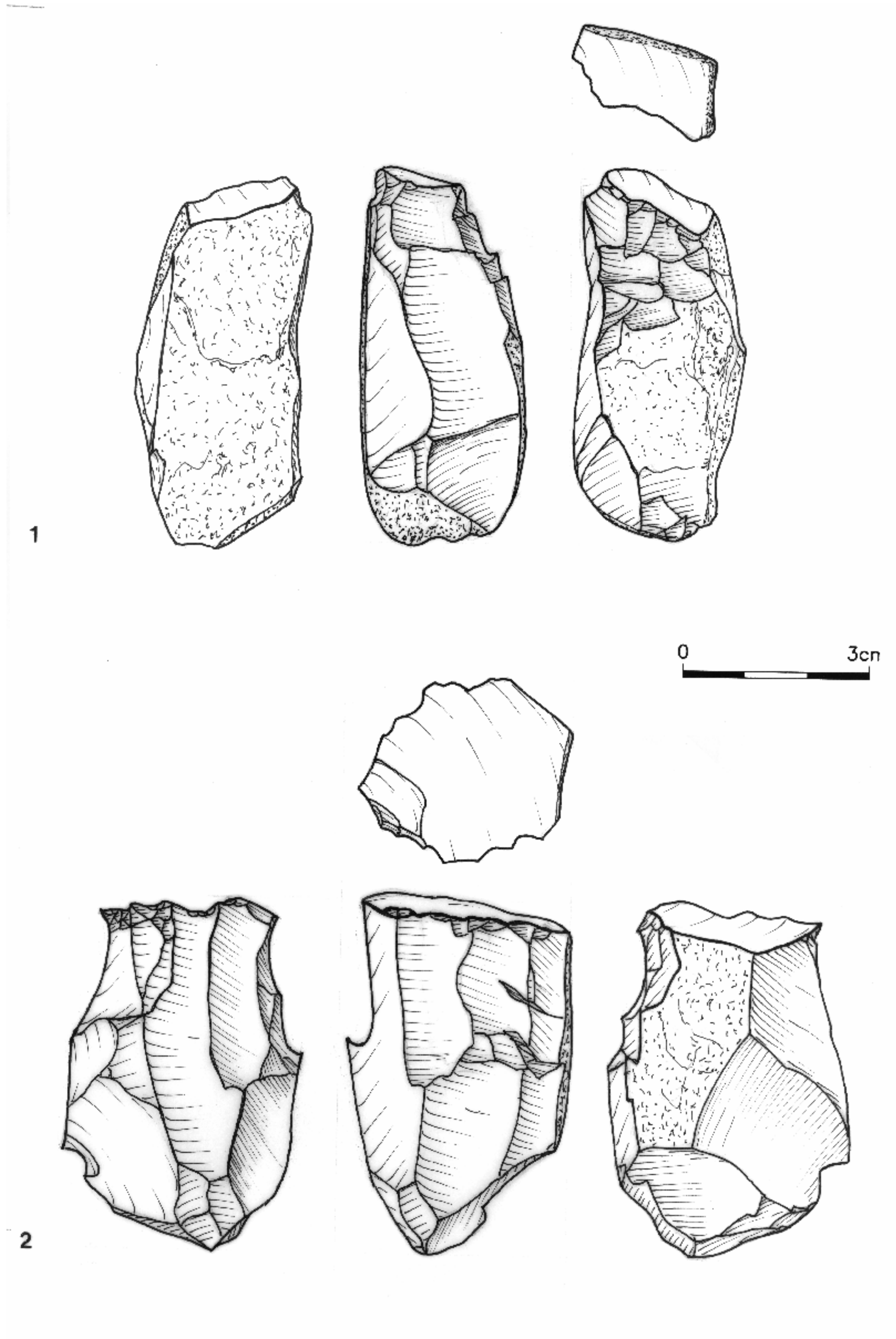


Fig. 37: 'Single striking platform laminar cores' from sample G-I/19-22, Qesem Cave.

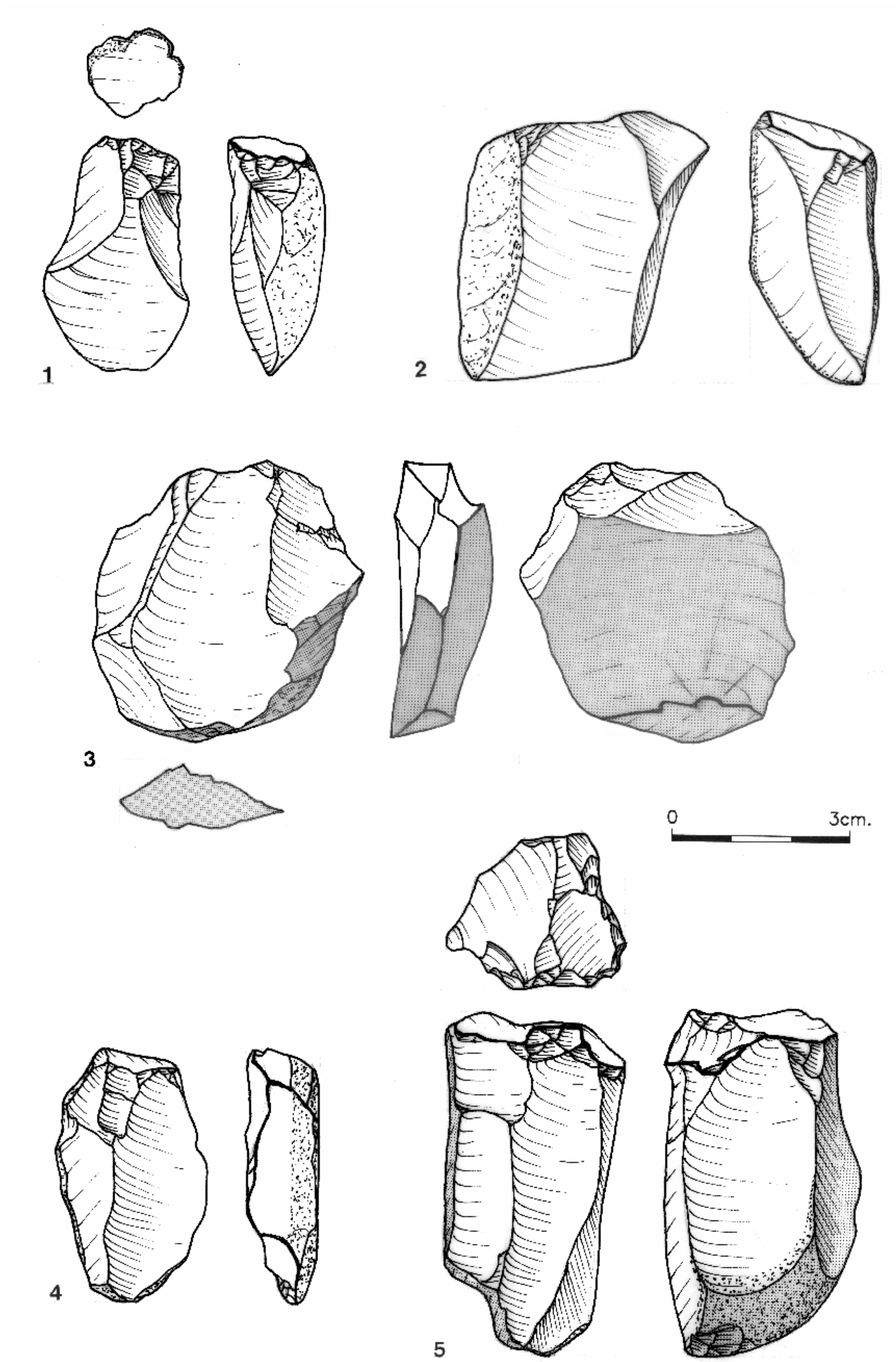


Fig. 38: 'Single striking platform laminar cores' from sample G/19-20, Qesem Cave. Item no. 3 was made on a thick flake from which a series of items were removed and it is thus different from the ‘core on flakes’.
Raster marks patinated surfaces.

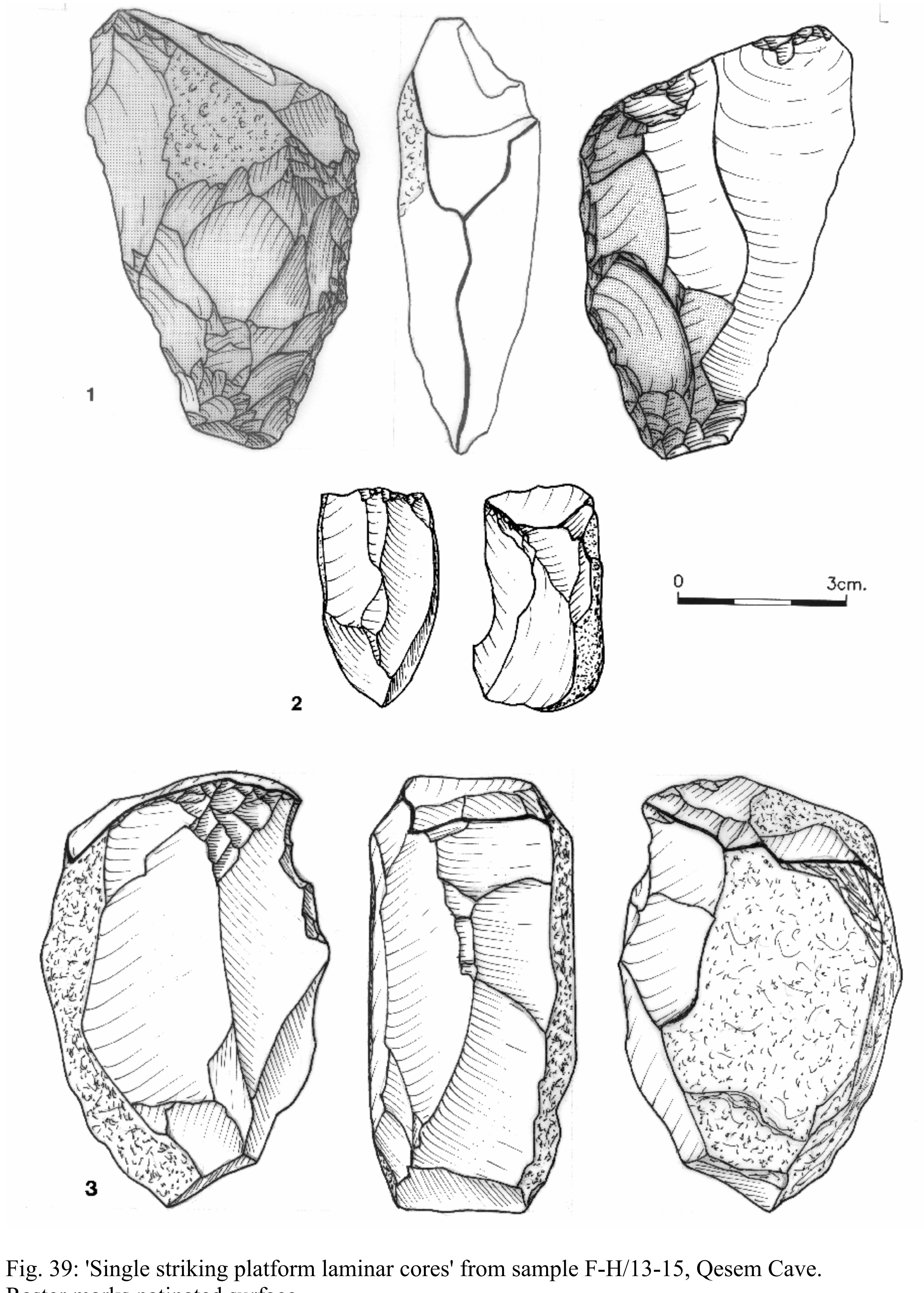


Fig. 39: 'Single striking platform laminar cores' from sample F-H/13-15, Qesem Cave.
Raster marks patinated surface.
Item no. 1 shows the recycling of a handaxe.

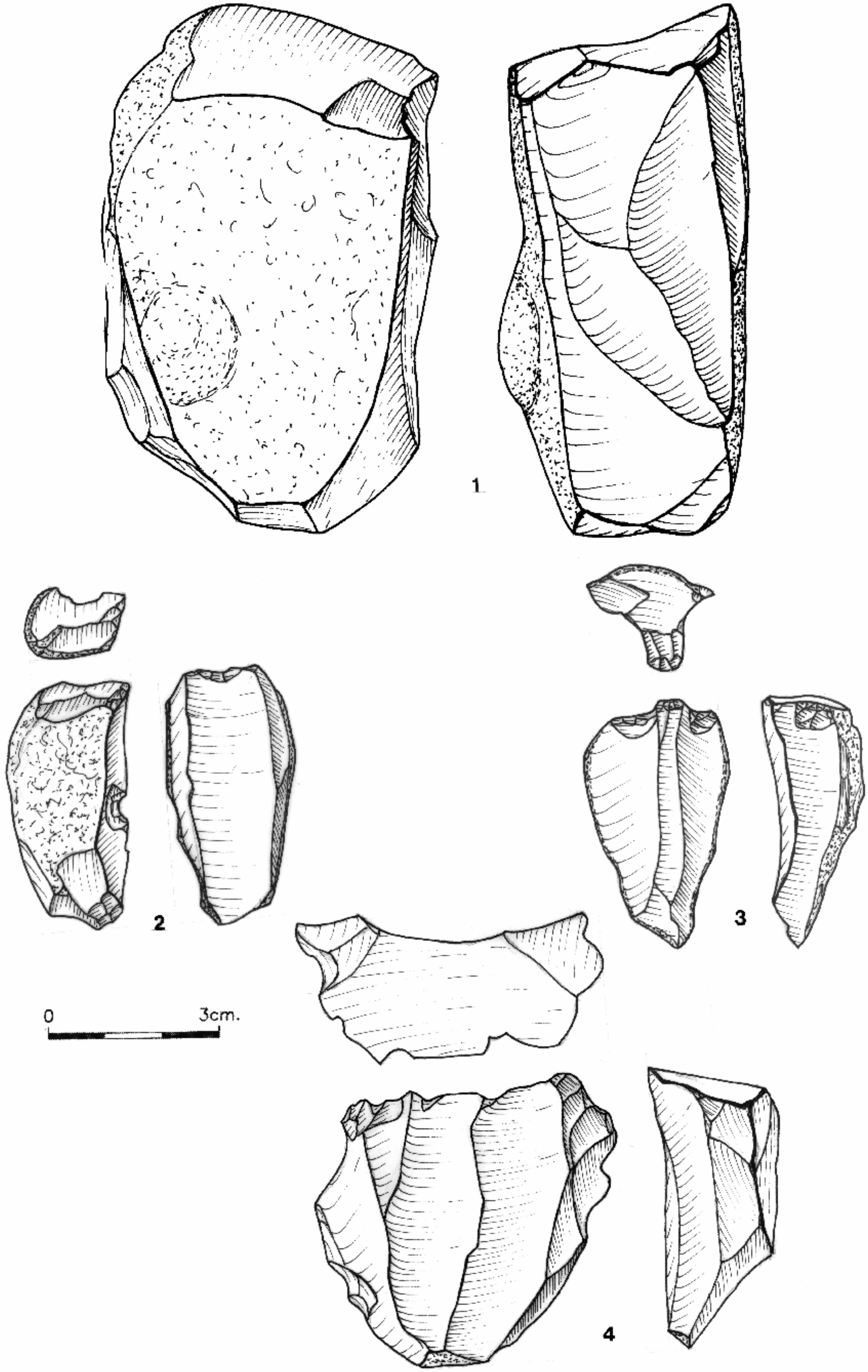


Fig. 40: 'Single striking platform laminar cores' from sample F-H/13-15, Qesem Cave.

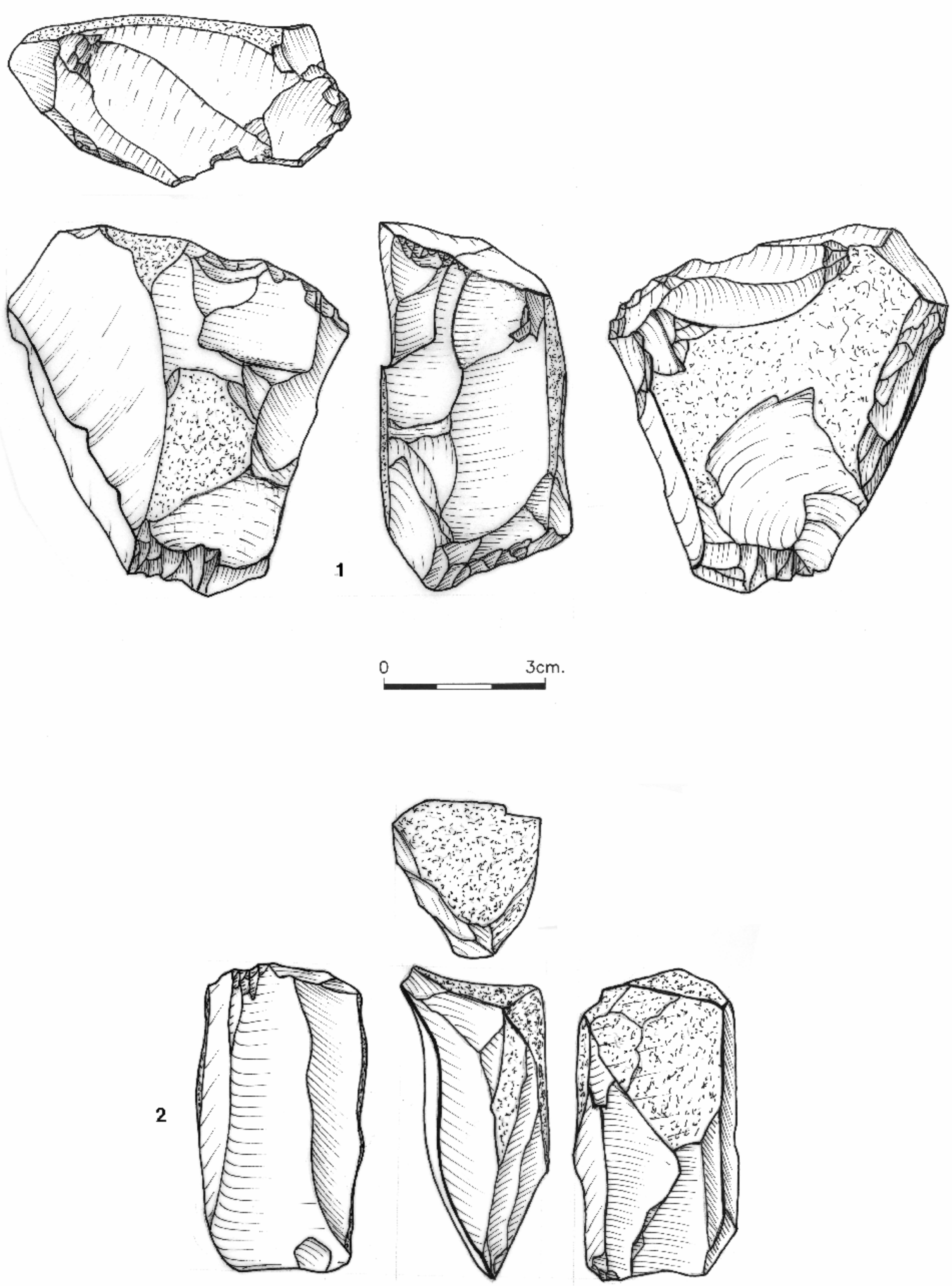


Fig. 41: 'Two striking platforms laminar cores' from samples G-I/19-22 (1)
and F-H/13-15 (2), Qesem Cave.

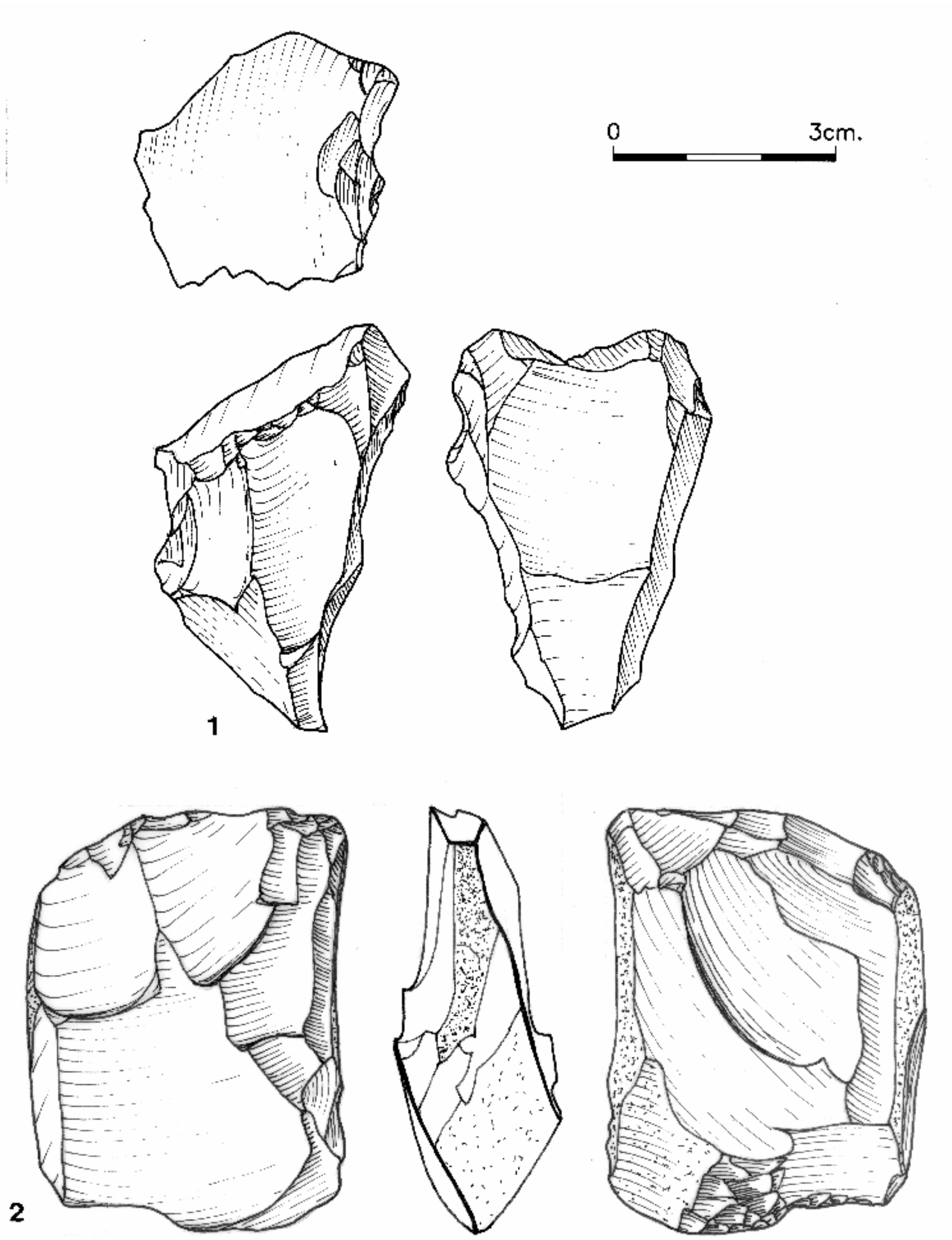


Fig. 42: 'Single striking platform laminar and flake cores' from Unit V (1) and sample G/19-20 (2), Qesem Cave.

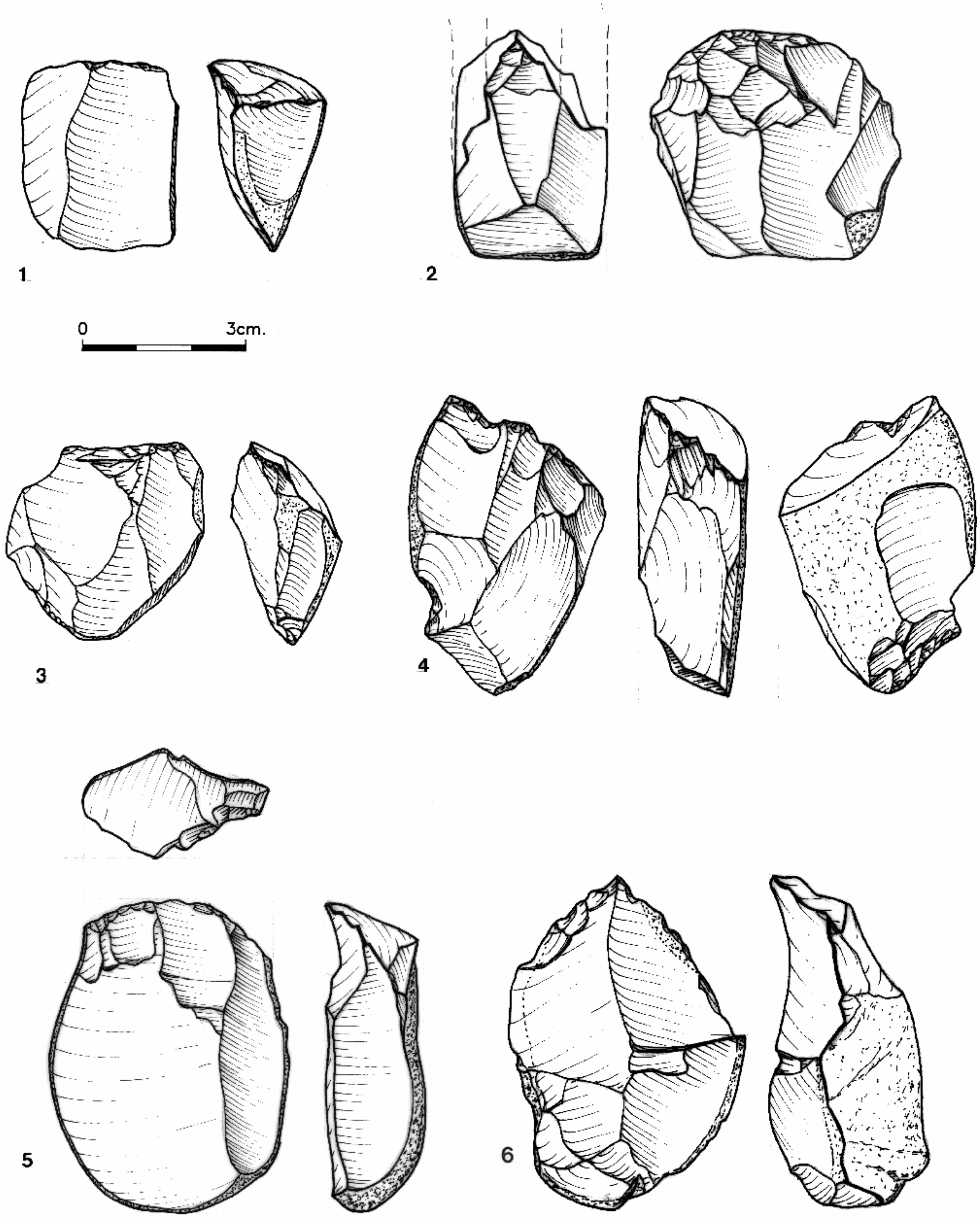


Fig. 43: 'Single striking platform laminar and flake cores' from sample F-H/13-15, Qesem Cave.

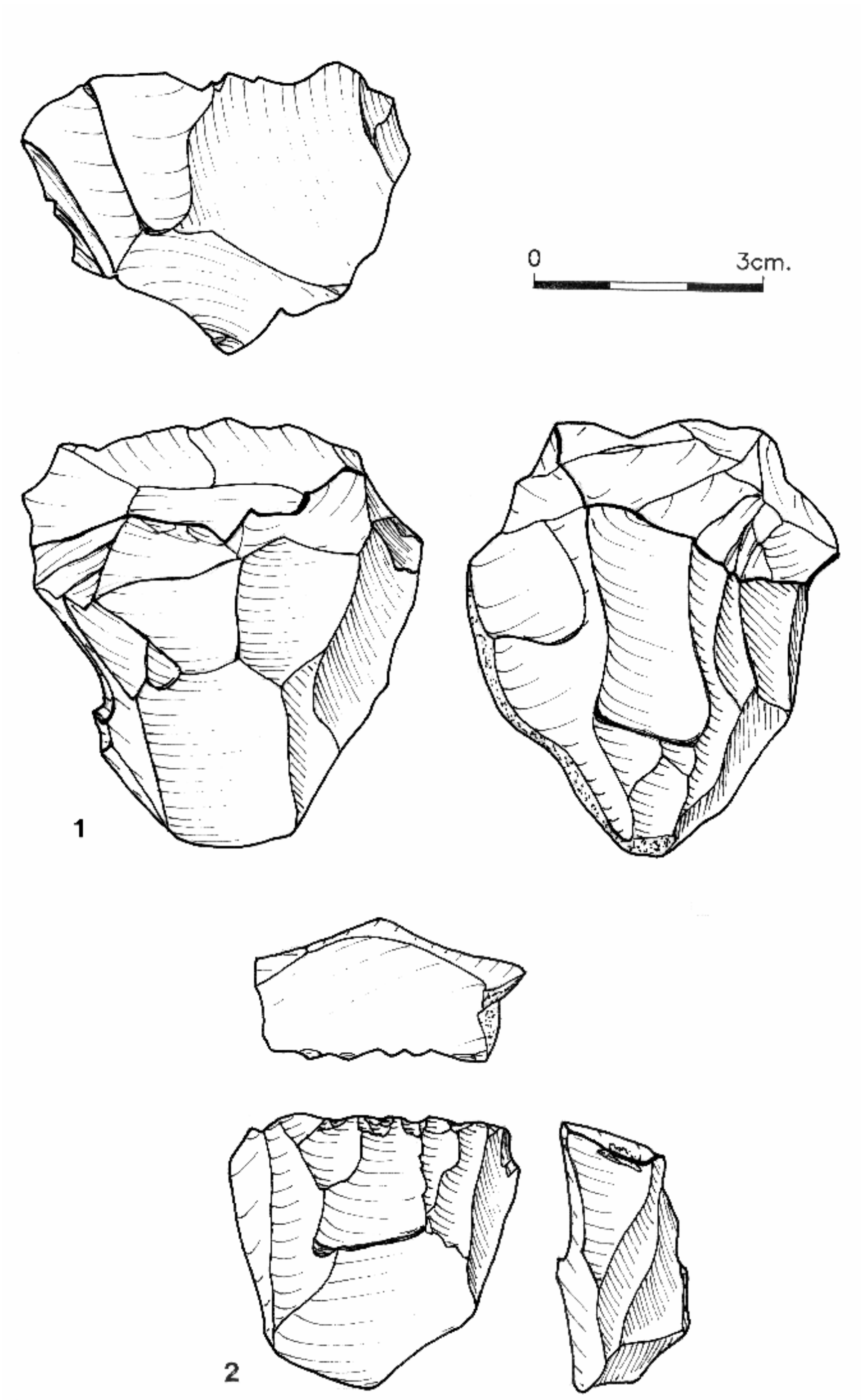


Fig. 44: 'Single striking platform laminar and flake cores' from sample K/10, Qesem Cave.

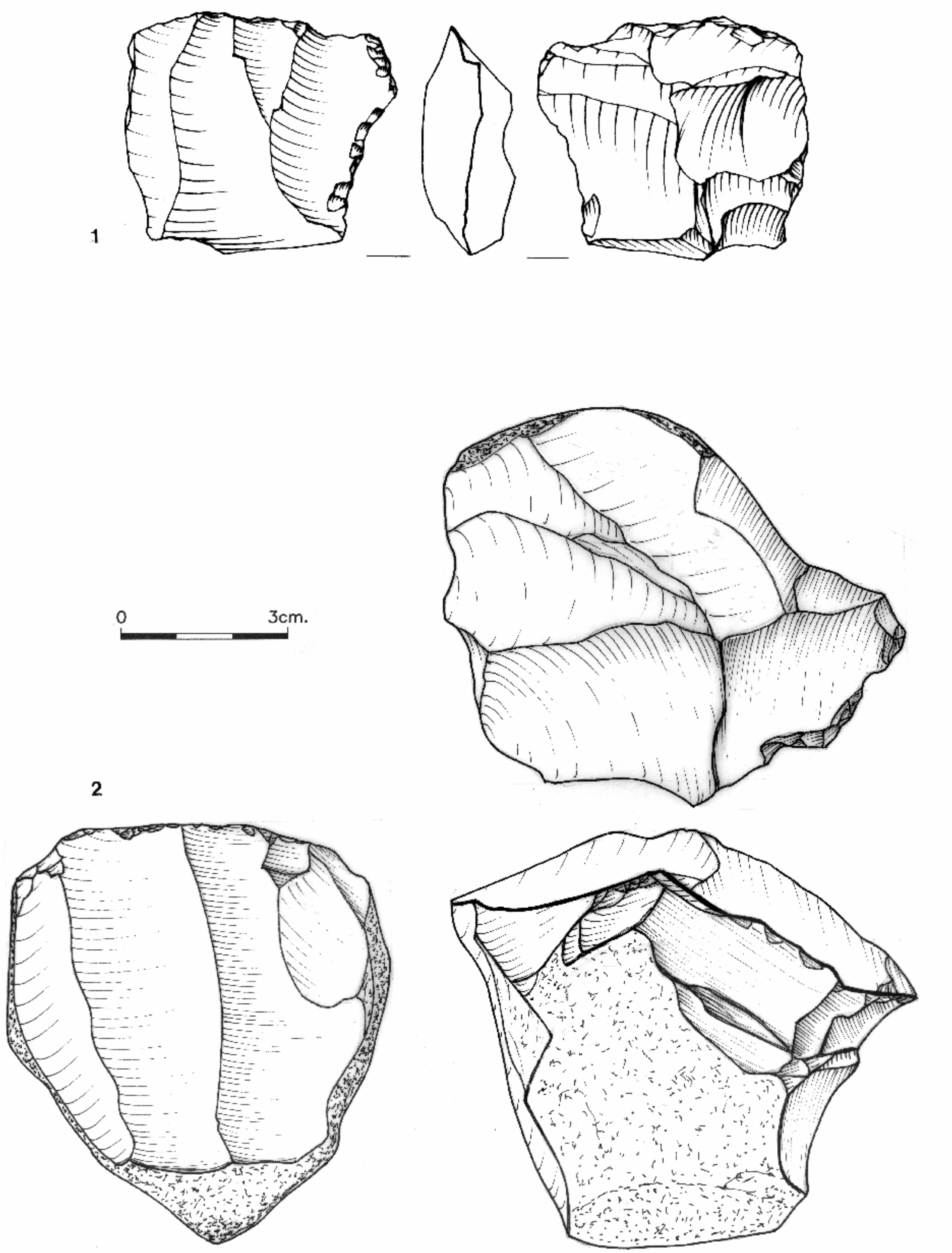


Fig. 45: 'Two striking platform laminar and flake cores' from samples G-I/19-22 (1) and F-H/13-15 (2), Qesem Cave.

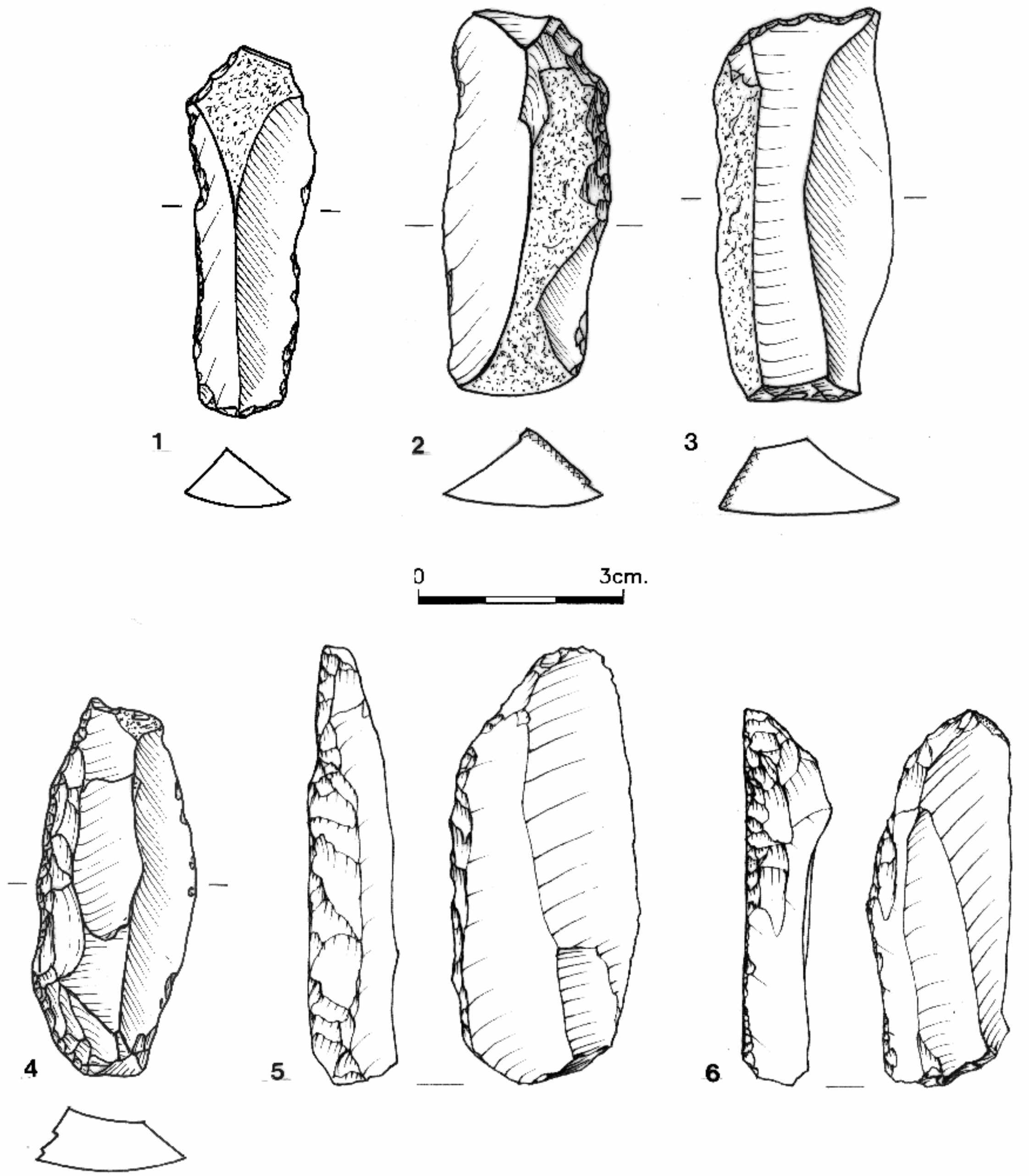


Fig. 46: Shaped laminar items from Unit V (1) and sample G-I/19-22 (2-6), Qesem Cave. ‘Retouched laminar items’ (1-2), ‘distally retouched laminar item’ (3), backed knives (4-5) and end-scraper (6).

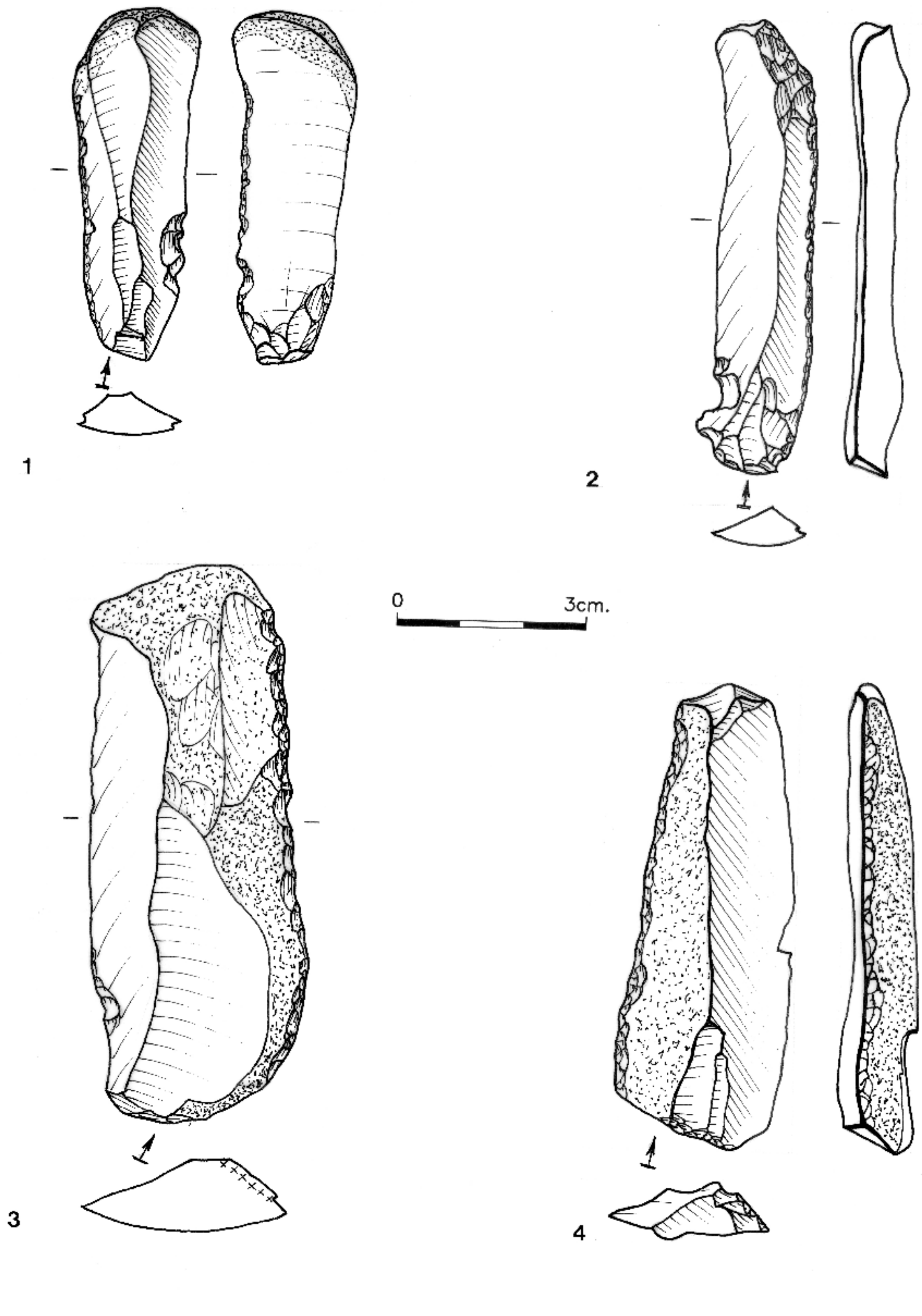


Fig. 47: ‘Retouched laminar items’ from sample G/19-20, Qesem Cave.

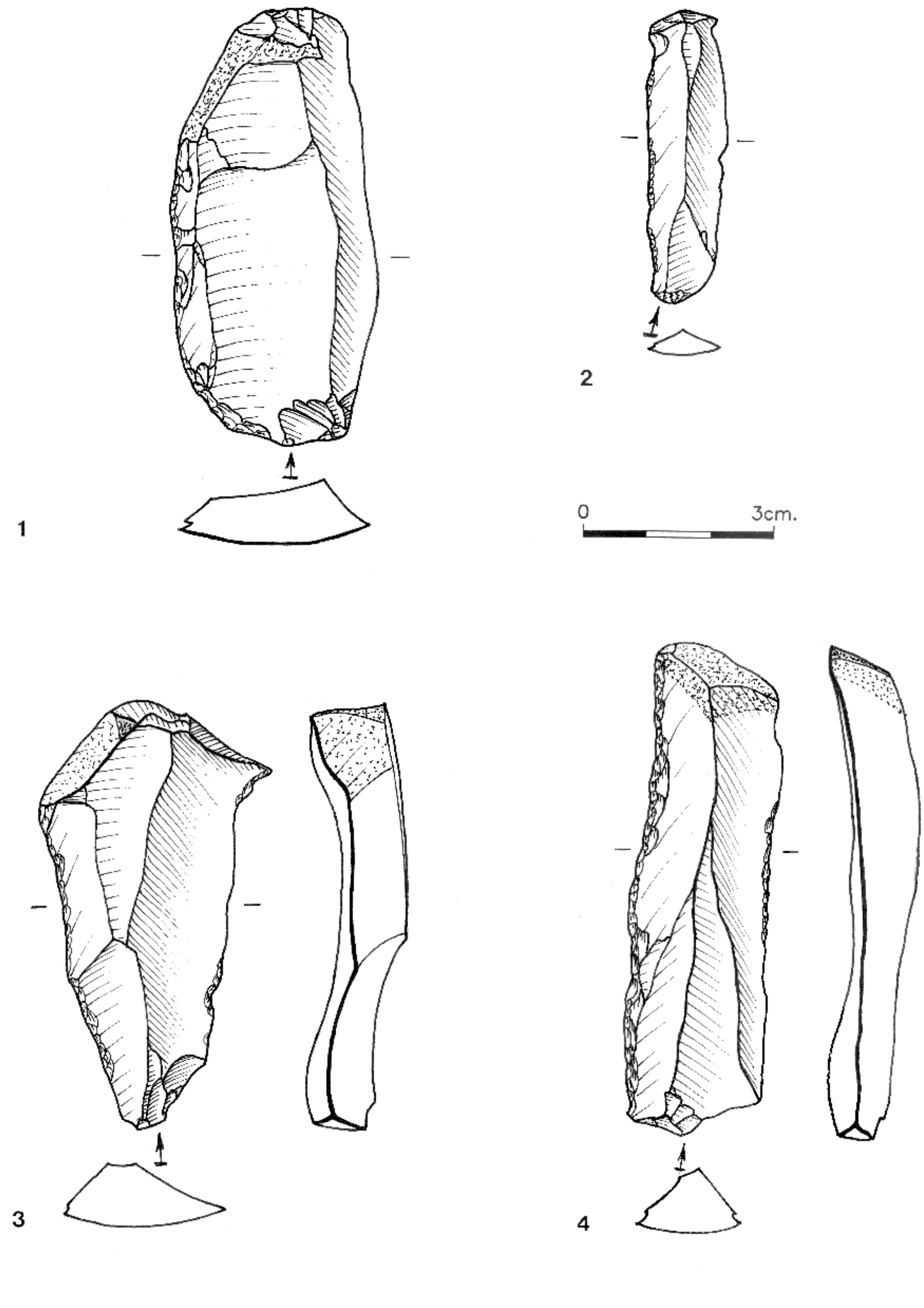


Fig. 48: 'Retouched laminar items' from sample G/19-20, Qesem Cave.

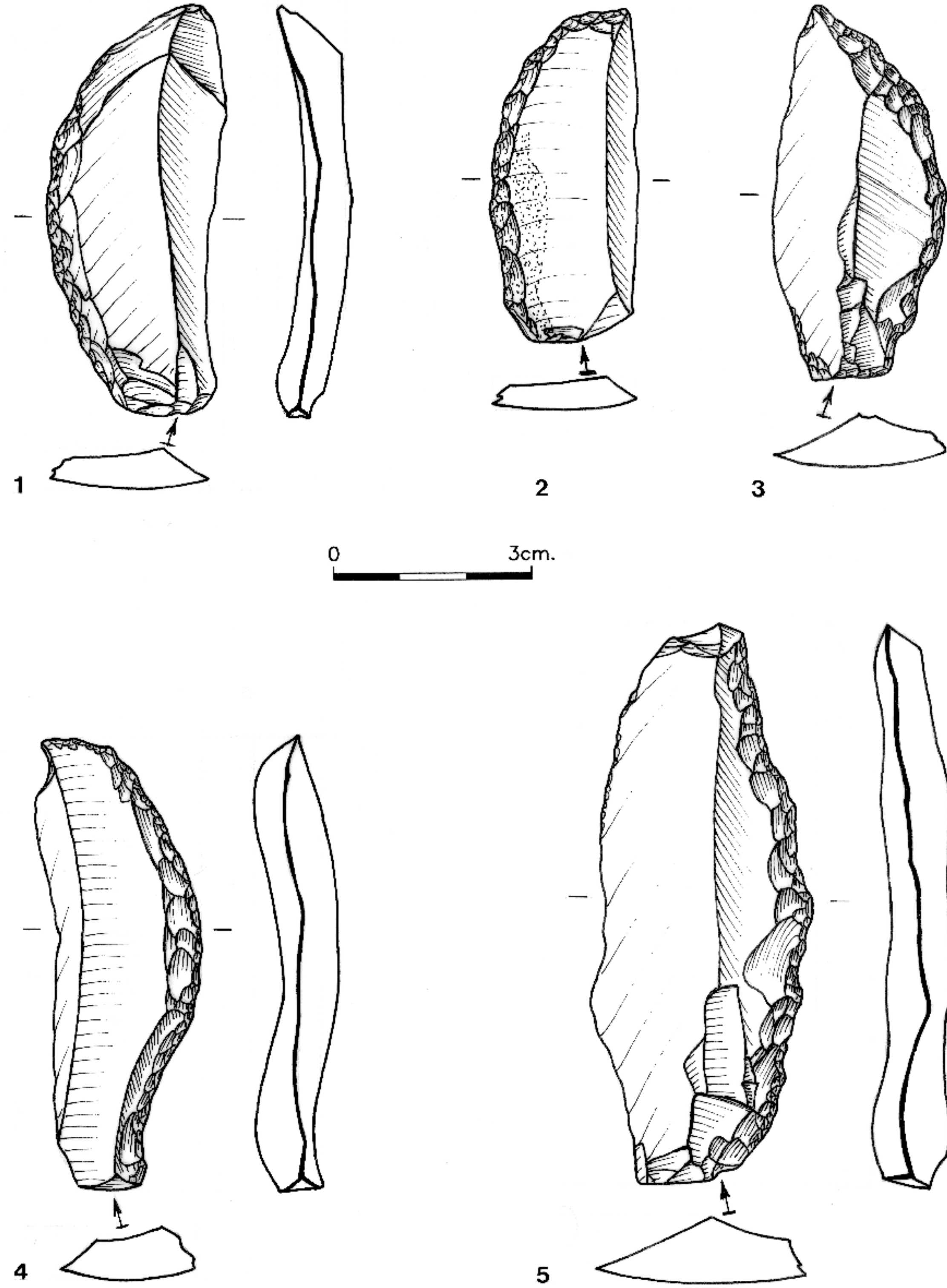


Fig. 49: Backed knives from sample G/19-20, Qesem Cave.

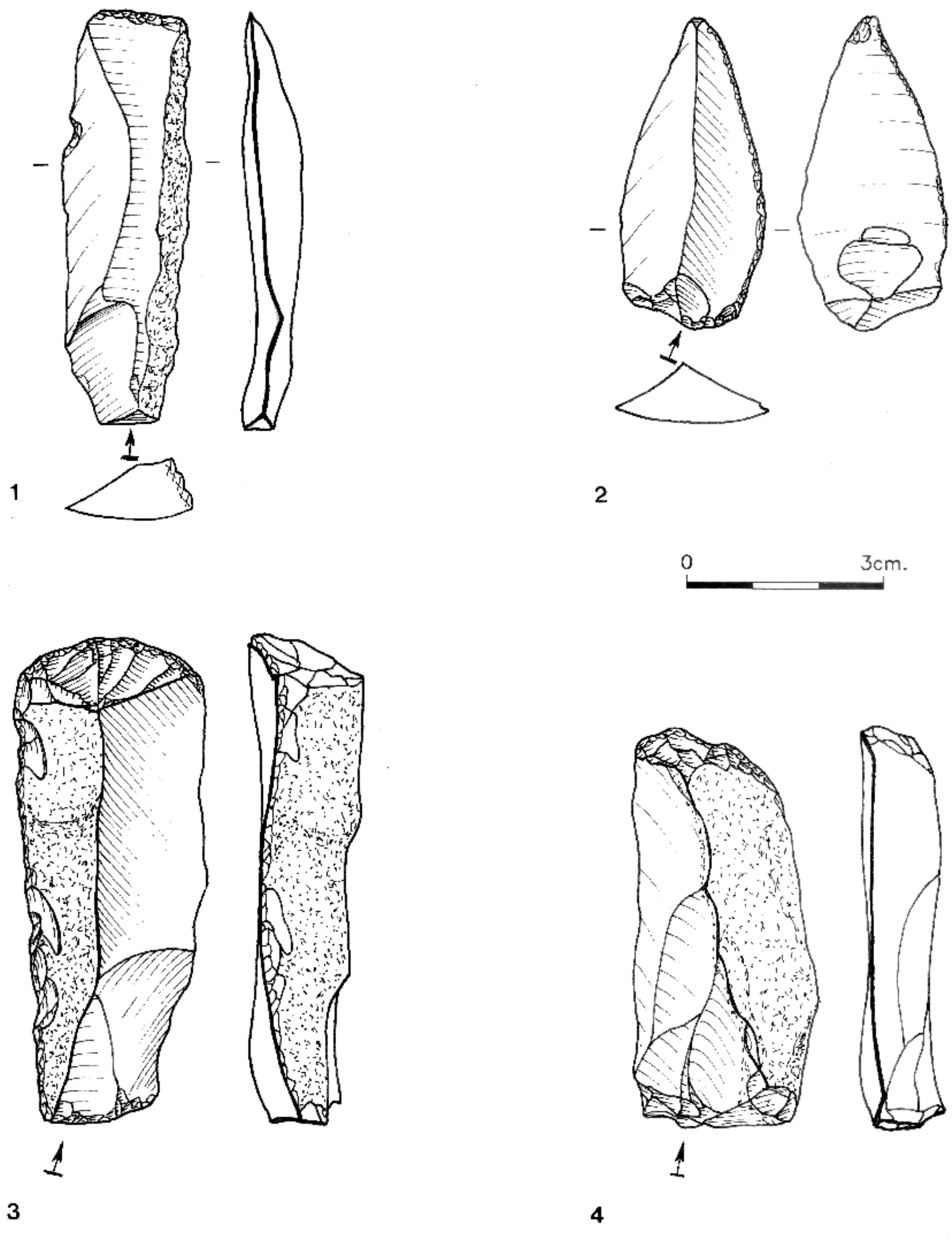


Fig. 50: Shaped laminar items from sample G/19-20, Qesem Cave.
'Distally retouched laminar item' (1), 'retouched laminar item' (2), end-scrapers (3-4).

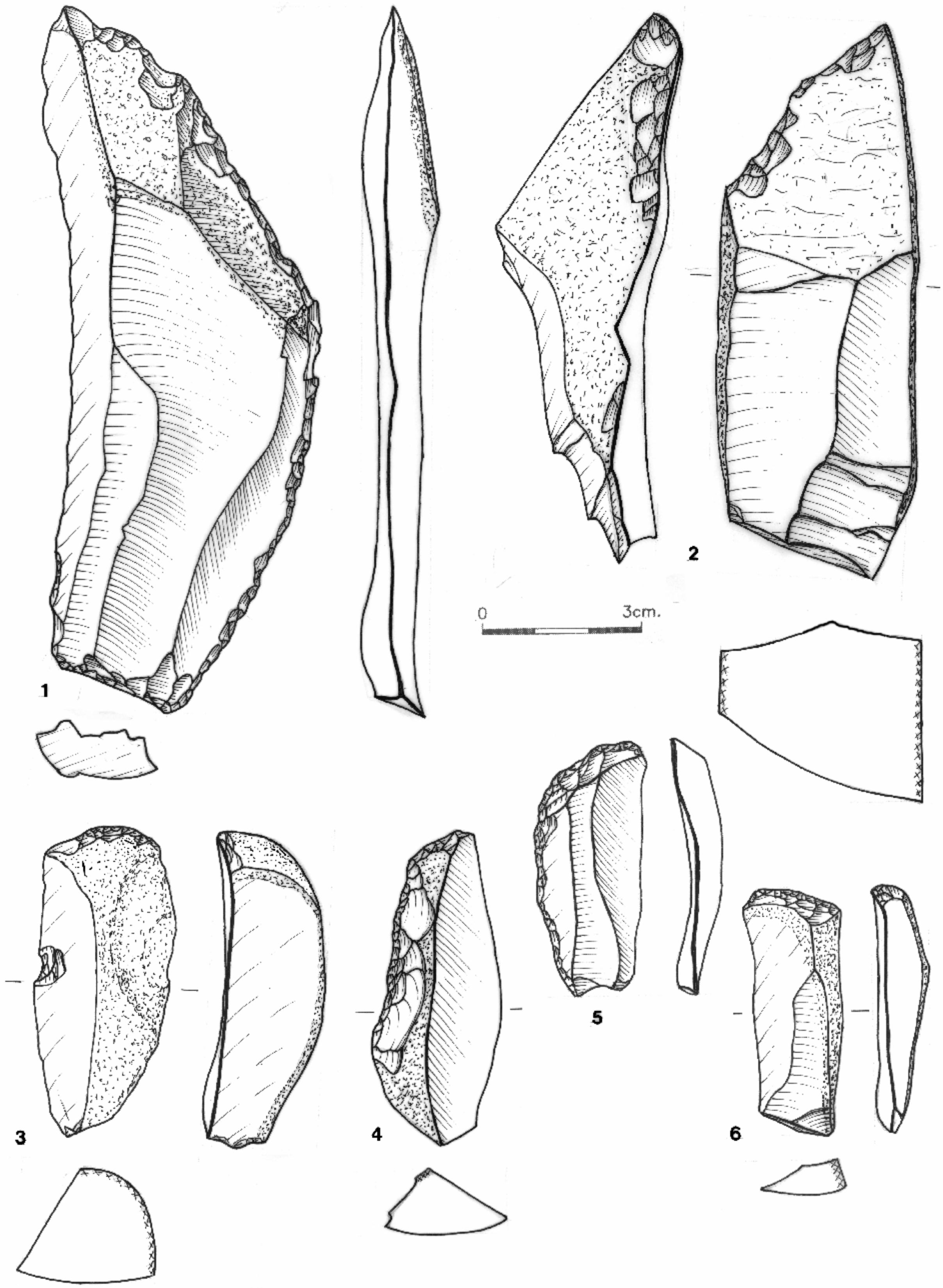


Fig. 51: Shaped laminar items from sample F-H/13-15, Qesem Cave:
'Retouched laminar items' (1-2), 'distally retouched laminar item' (3), backed knife (4), end-scrapers (5-6).
Item no. 2 is shaped on a massive overpass item with cortex on both lateral edges.

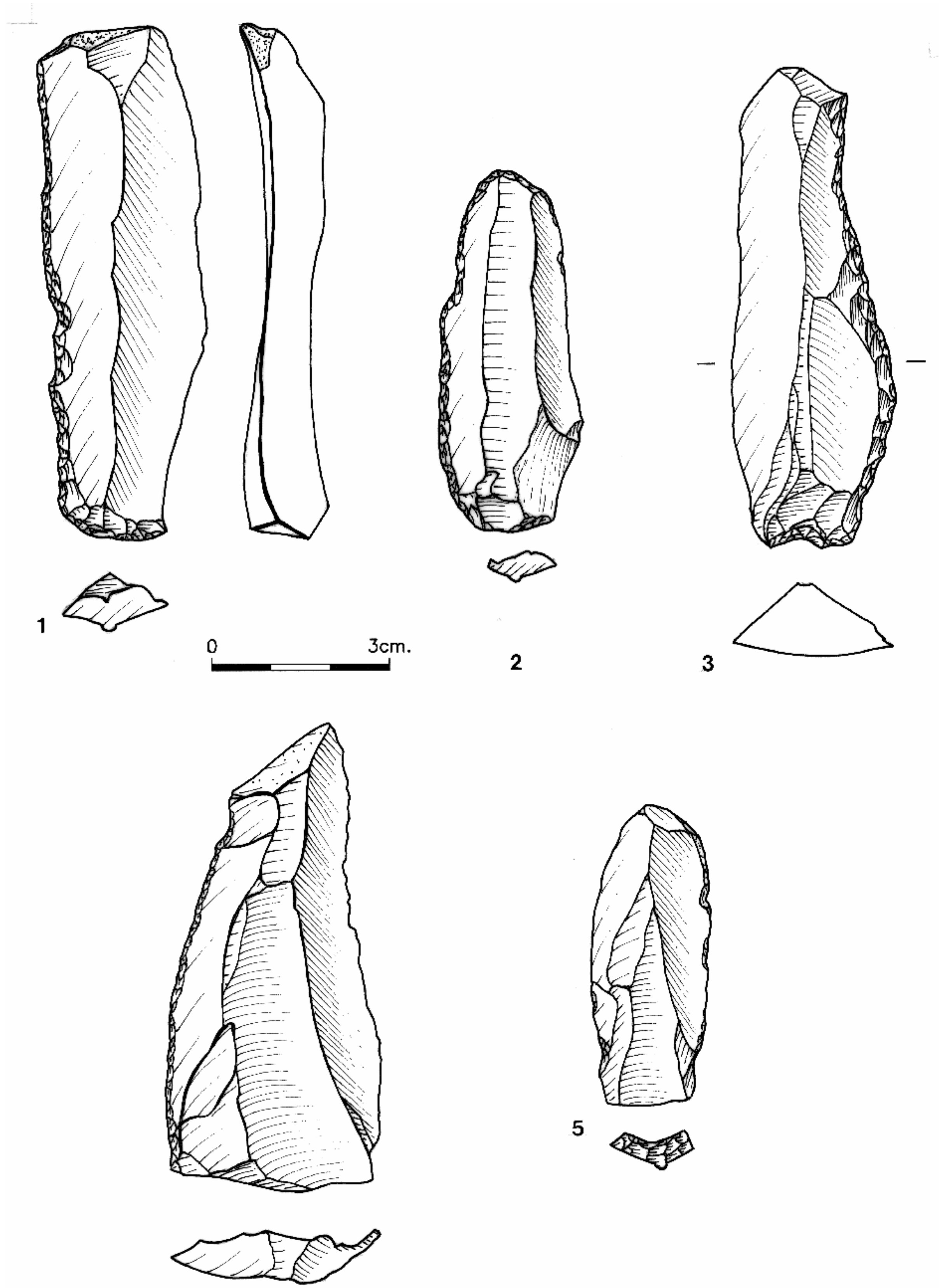


Fig. 52: 'Retouched laminar items' from sample K/10, Qesem Cave.

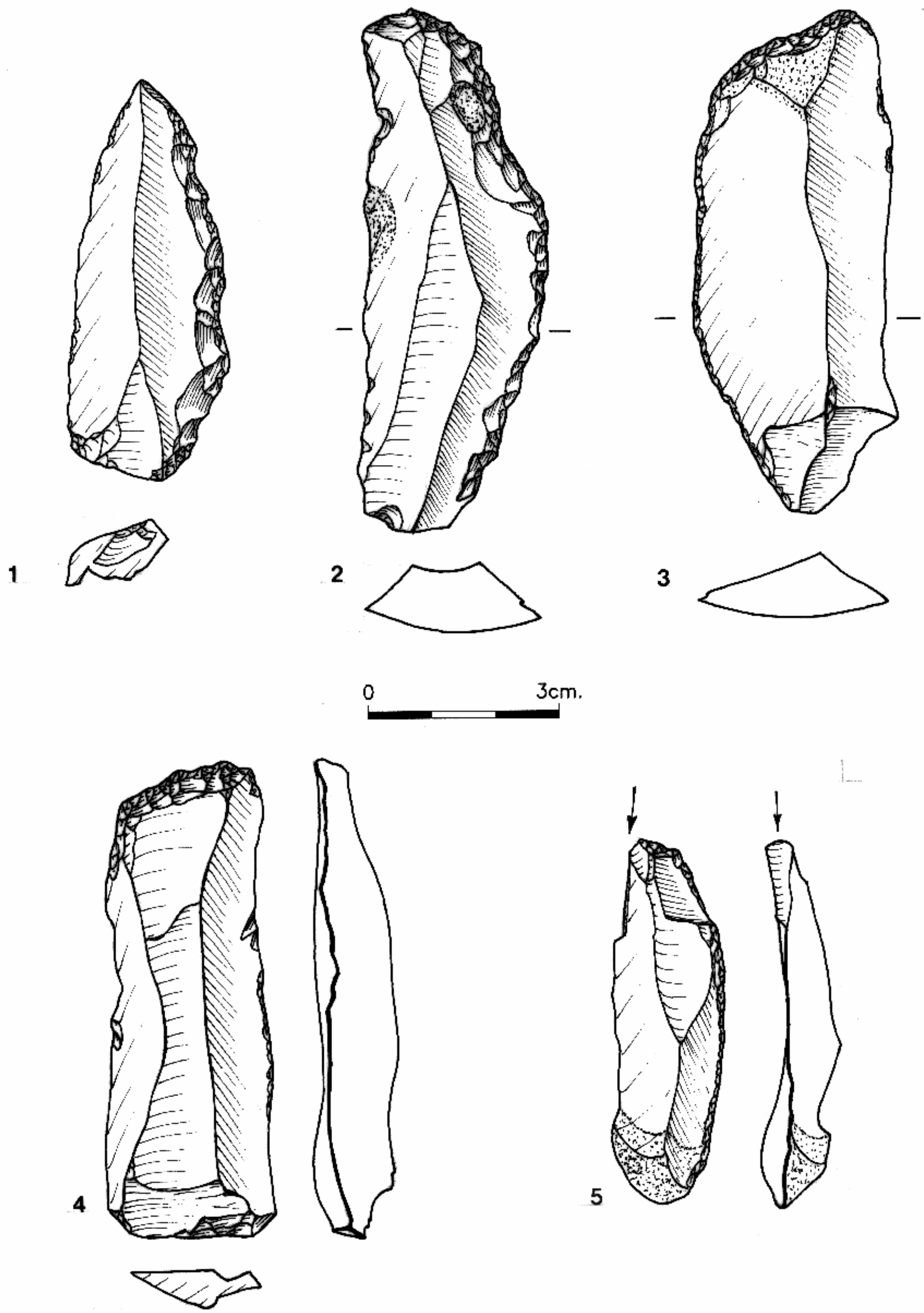


Fig. 53: Shaped laminar items from sample K/10, Qesem Cave.
Backed knife (1), end-scrapers (2-4), burin (5).

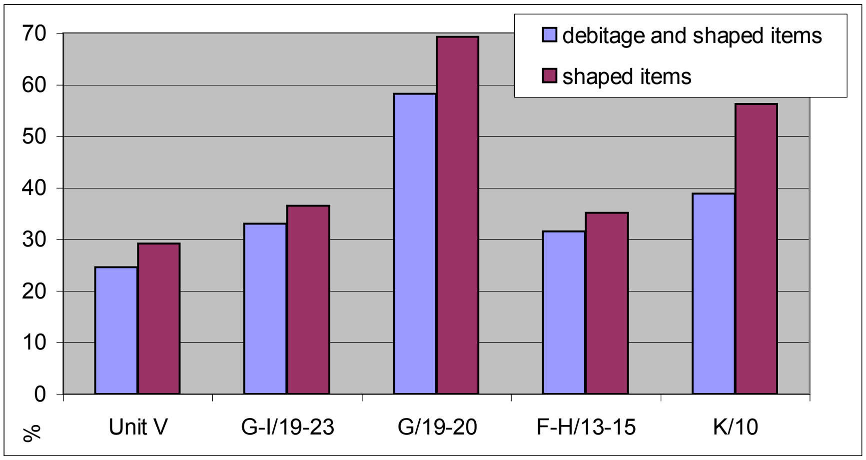


Fig. 54: Percentage of laminar items out of the shaped items
and out of the debitage and shaped items from Qesem Cave.
Data retrieved from Table 1.

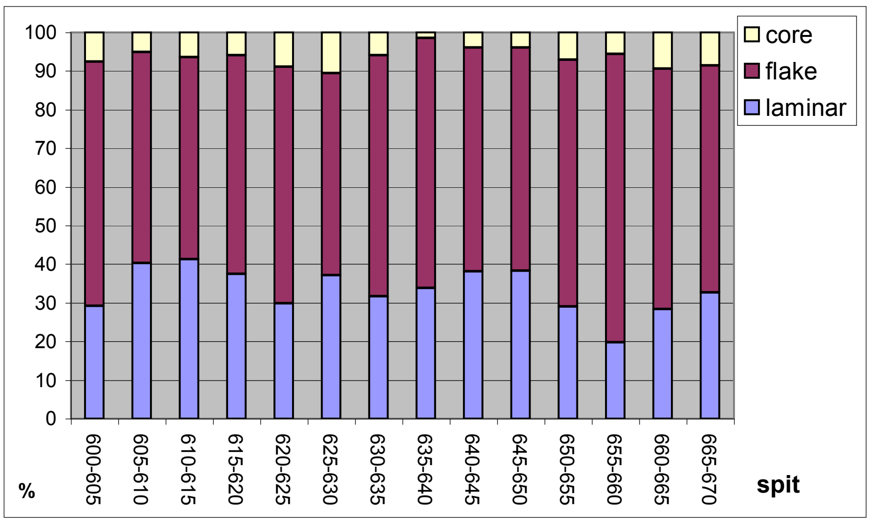


Fig. 55: Fluctuations in the laminar production throughout the excavated spits of sample G-I/19-22, Qesem Cave.
n=from left to right: 158, 98, 172, 184, 67, 132, 183, 68, 100, 154, 183, 158, 170, 245.

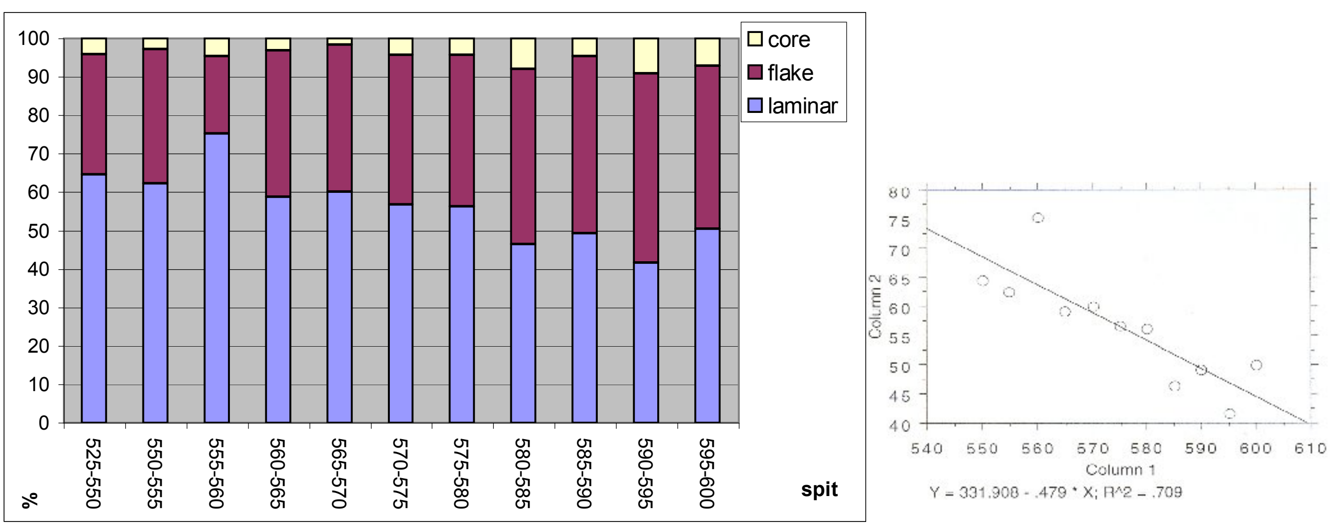


Fig. 56: Fluctuations in the laminar production throughout the excavated spits of sample G/19-20, Qesem Cave.
n=from left to right: 237, 214, 109, 194, 125, 162, 160, 112, 65, 65, 125.
To the right a regression plot of the data.

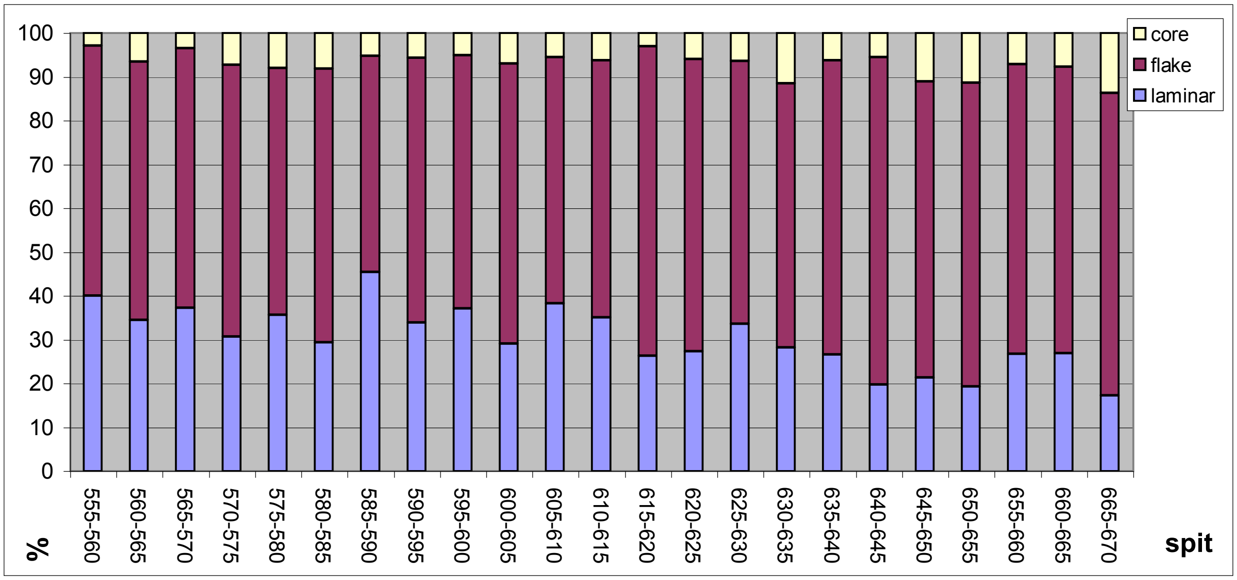


Fig. 57: Fluctuations in the laminar production throughout the excavated spits of sample F-H/13-15, Qesem Cave.
n=from left to right: 35, 61, 113, 137, 163, 160, 231, 227, 197, 158, 162, 160, 133, 150, 173, 156, 128, 91, 108, 114, 56, 26, 29.

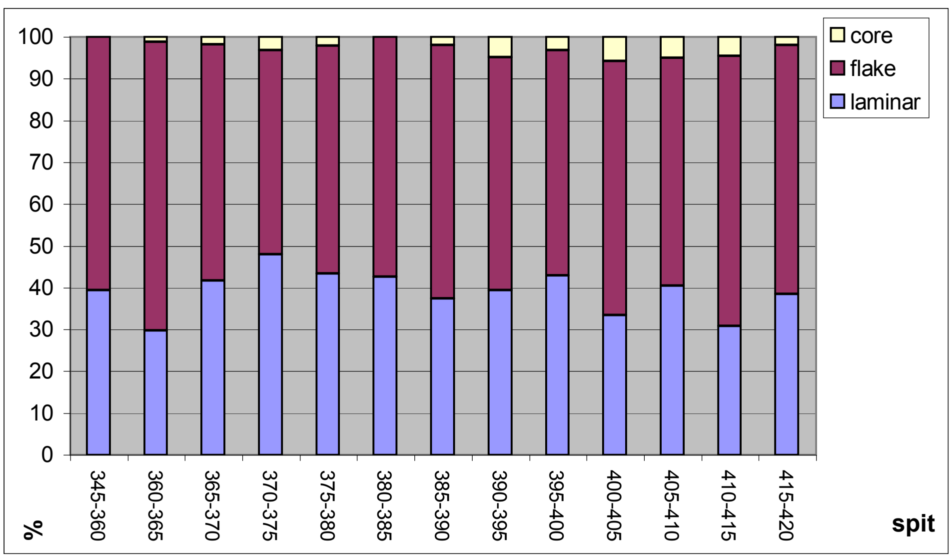


Fig. 58: Fluctuations in the laminar production throughout the excavated spits of sample K/10, Qesem Cave.
n=from left to right: 28, 84, 108, 125, 187, 101, 99, 61, 63, 87, 99, 130, 53, 32.

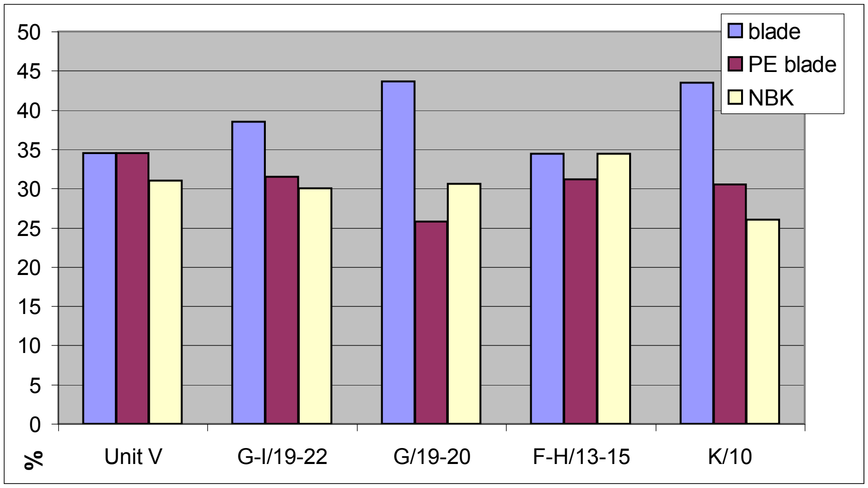


Fig. 59: Division of the three laminar types (blanks and shaped) from the Qesem Cave samples.
n=Unit V: 116; G-I/19-22: 496; G/19-20: 736; F-H/13-15: 843; and K/10: 361.

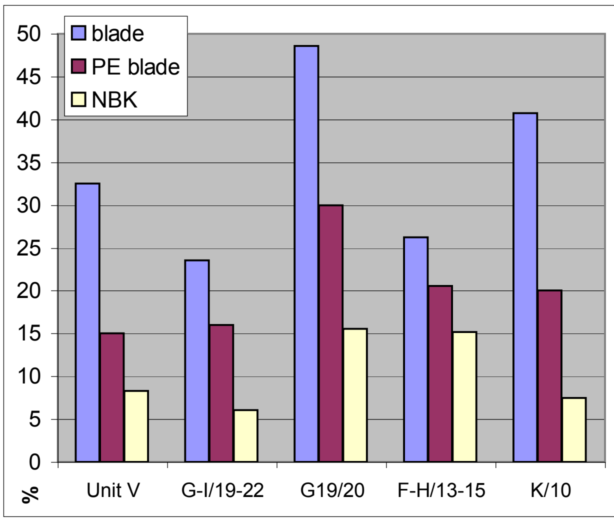


Fig. 60: Percentage of shaped items out of the sum of blanks and shaped items of each laminar type from the Qesem Cave samples.
n=Unit V - blade: 40; PE blade: 40; NBK: 36.
G-I/19-22 - blade: 191; PE blade: 156; NBK: 149.
G/19-20 - blade: 321; PE blade: 190; NBK: 225.
F-H/13-15 - blade: 290; PE blade: 263; NBK: 290.
K/10 - blade: 157; PE blade: 110; NBK: 94.

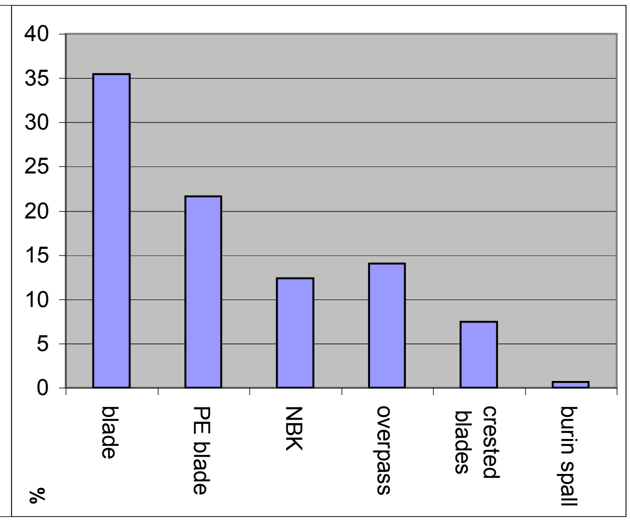


Fig. 61: Percentage of shaped laminar items out of the sum of blanks and shaped items from Qesem Cave.
n= blade: 999; PE blade: 759; NBK: 794;
overpass: 171 (laminar only); crested blade: 215;
burin spall: 158.

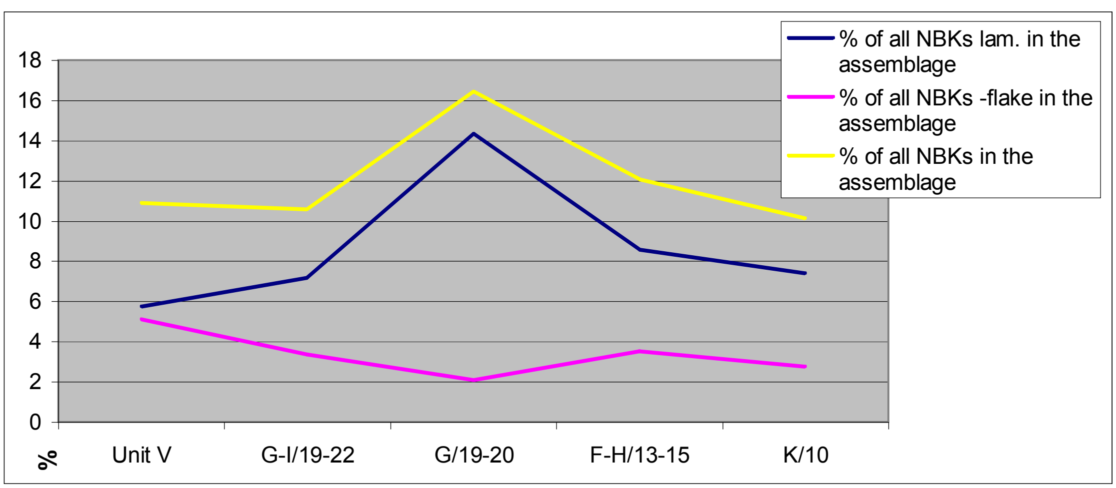


Fig. 62: Percentage of NBKs laminar and flakes (blanks and shaped) from the Qesem Cave samples.
Size of samples in Table 1.

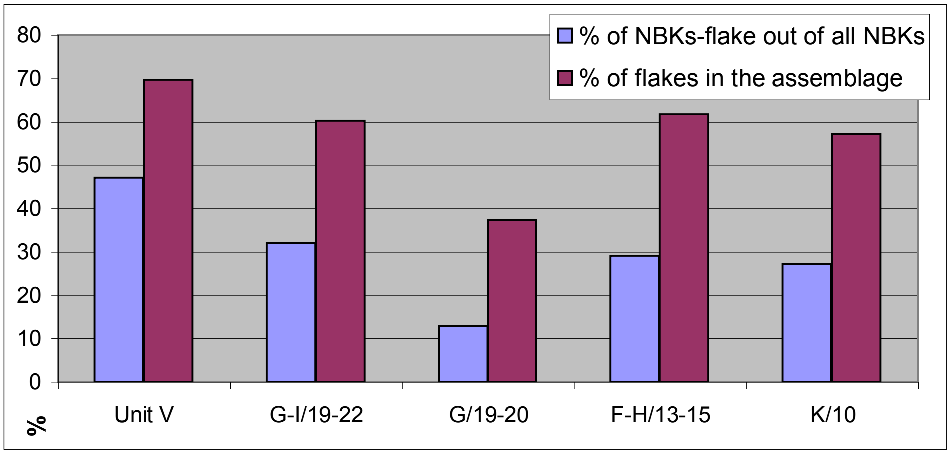


Fig. 63: Percentage of NBKs-flake out of all NBKs (blanks and shaped)
and in relation to the percentage of flakes from the Qesem Cave samples.
n=NBKs flakes - Unit V: 32; G-I/19-22: 70; G/19-20: 33; F-H/13-15: 119; K/10: 35.
NBK (laminar) - Unit V: 36; G-I/19-22: 149; G/19-20: 225; F-H/13-15: 290; K/10: 94.

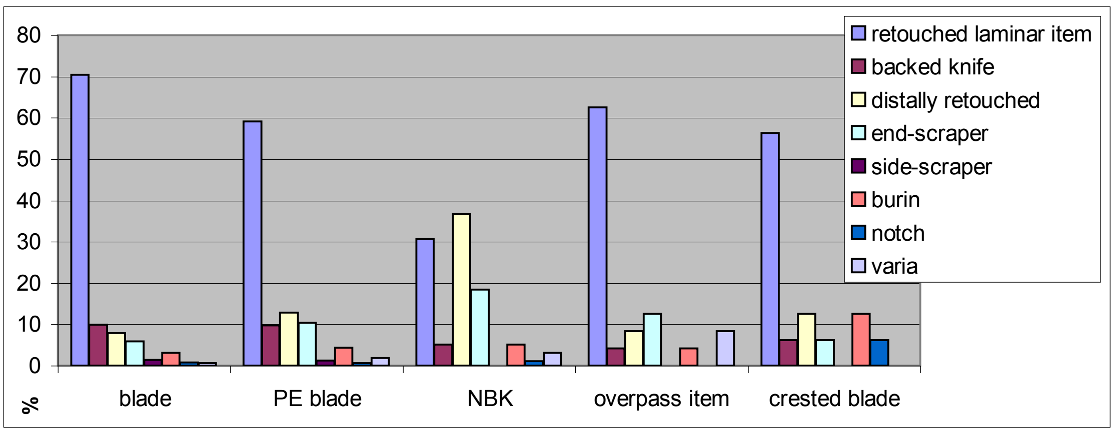


Fig. 64: Types of shaped items modified on each of the laminar types from Qesem Cave.
n=blade: 354; PE blade: 164; NBK: 98; overpass item: 24; and crested blade: 16.

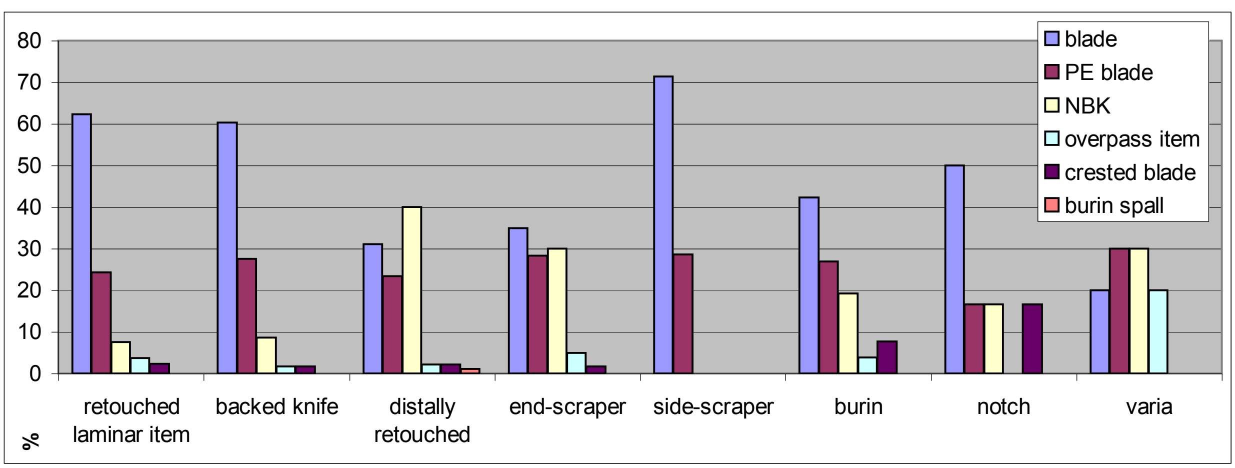


Fig. 65: Division of shaped item types into laminar types from Qesem Cave.
n= retouched laminar item: 400; backed knife: 58; distally retouched laminar item: 90; end-scraper: 60; side-scraper: 7;
burin: 26; notch/denticulate: 6; and varia 10.

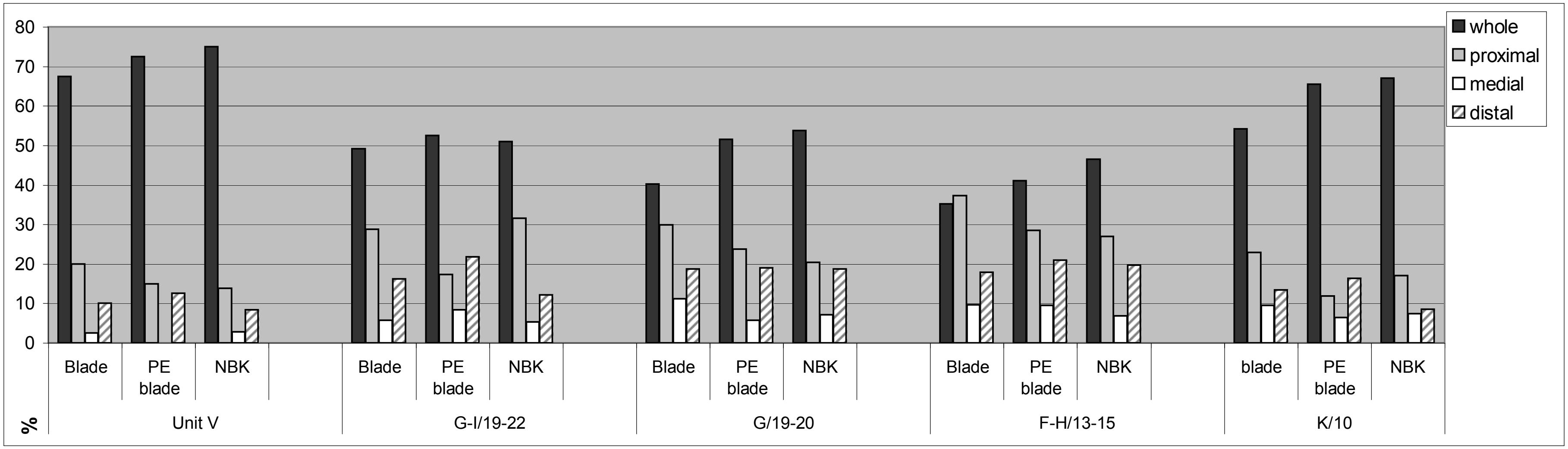
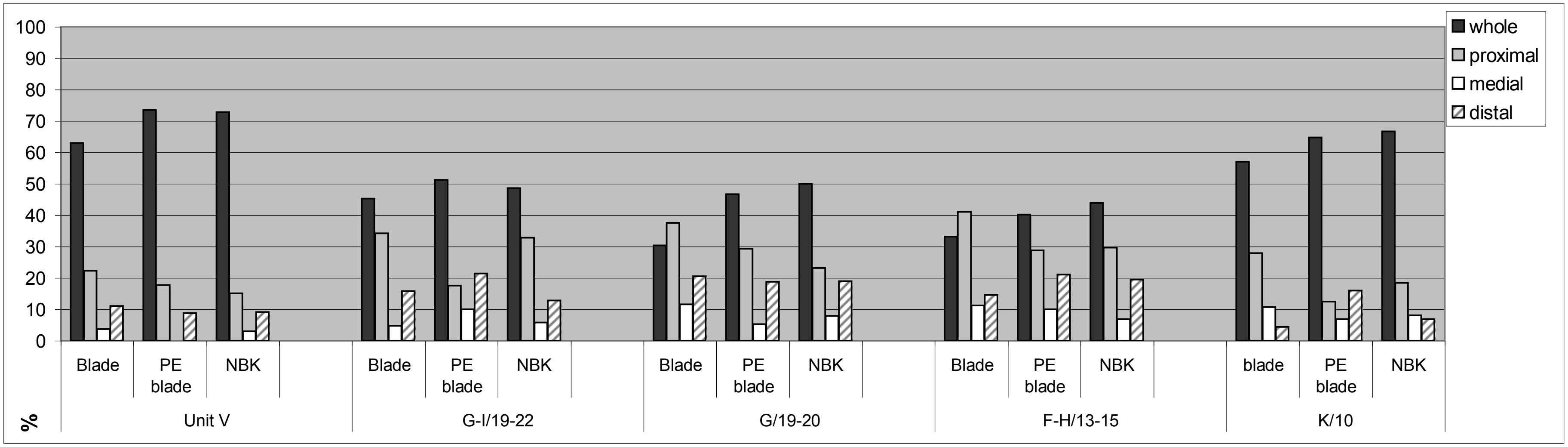


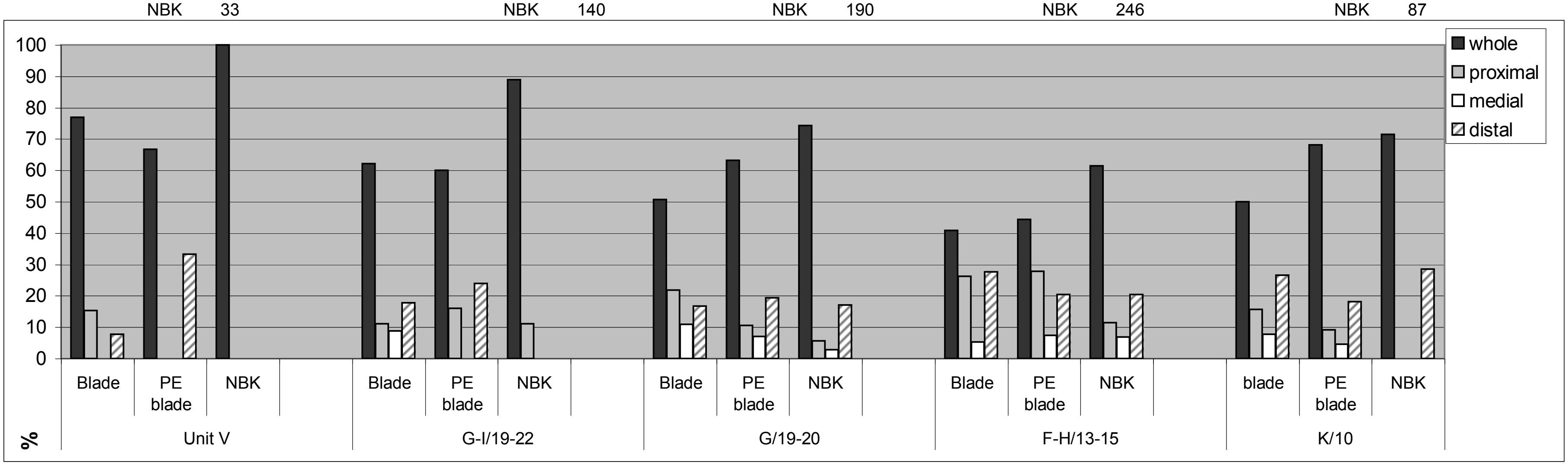
Fig. 66: State of preservation of laminar items (blanks and shaped) from Qesem Cave samples.

n=	Unit V:	Blade	40	G-I/1922:	Blade	191	G/19-20:	Blade	321	F-H/13-15:	Blade	290	K/10:	Blade	157
		PE blade	40		PE blade	156		PE blade	190		PE blade	263		PE blade	110
		NBK	36		NBK	149		NBK	225		NBK	290		NBK	94



A: Blanks

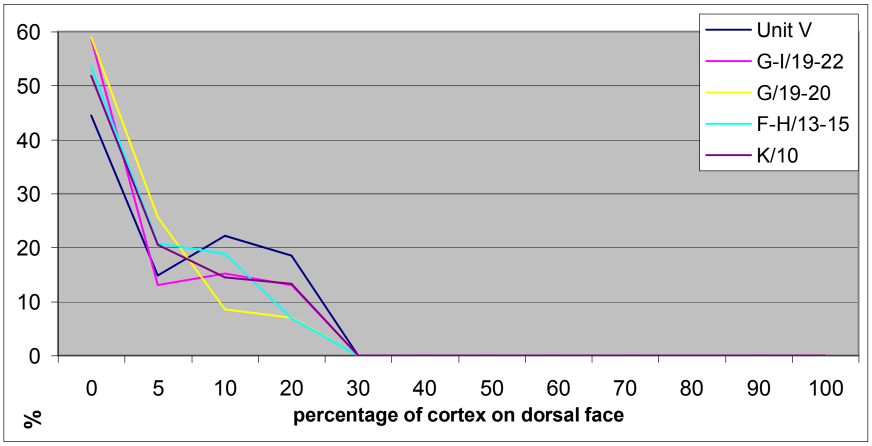
n=														
Unit V:	Blade	27	G-I/1922:	Blade	146	G/19-20:	Blade	165	F-H/13-15:	Blade	214	K/10:	Blade	93
	PE blade	34		PE blade	131		PE blade	133		PE blade	209		PE blade	88
	NBK	33		NBK	140		NBK	190		NBK	246		NBK	87



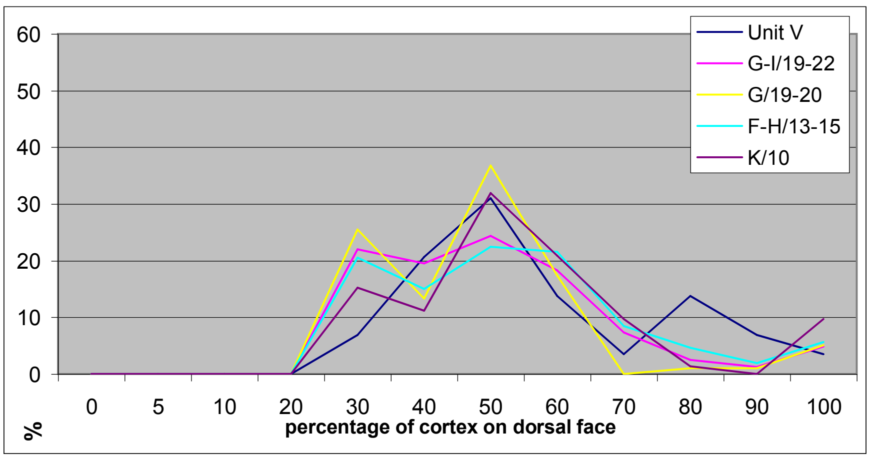
B: Shaped items

Fig. 67: State of preservation of laminar blanks and shaped laminar items from Qesem Cave samples.

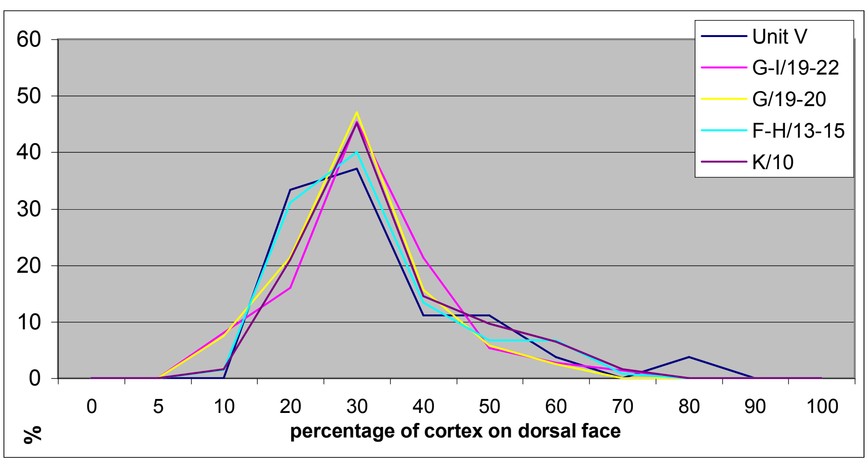
n=														
Unit V:	Blade	13	G-I/1922:	Blade	45	G/19-20:	Blade	156	F-H/13-15:	Blade	76	K/10:	Blade	64
	PE blade	6		PE blade	25		PE blade	57		PE blade	54		PE blade	22
	NBK	3		NBK	9		NBK	35		NBK	44		NBK	7



A: Blades (n=Unit V: 27; G-I/19-22: 92; G/19-20: 129; F-H/13-15: 101; and K/10: 83)

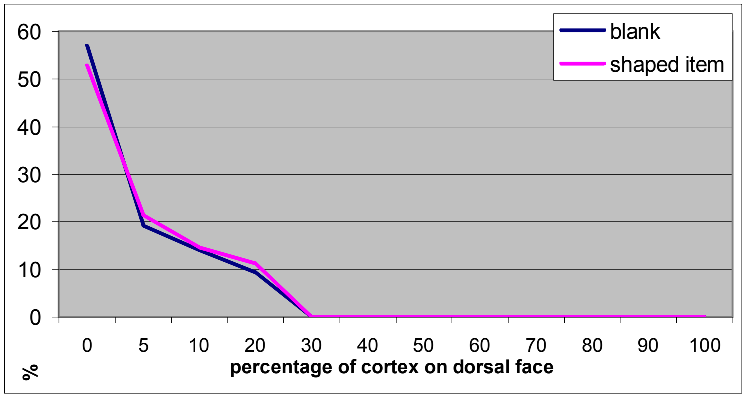


B: PE blades (n=Unit V: 29; G-I/19-22: 82; G/19-20: 98; F-H/13-15: 107; and K/10: 72)

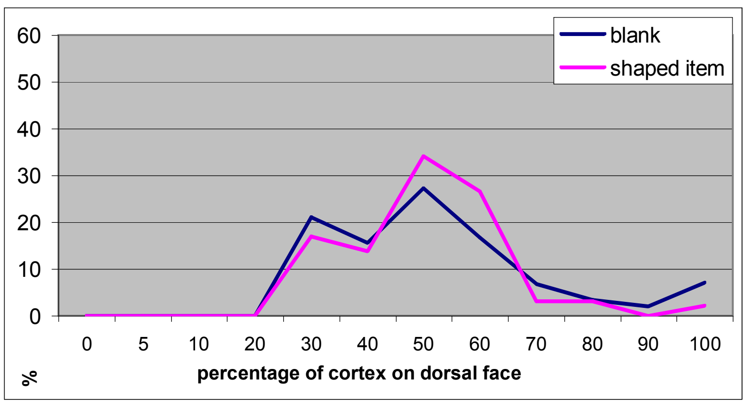


C: NBKs (n=Unit V: 27; G-I/19-22: 75; G/19-20: 121; F-H/13-15: 135; and K/10: 62)

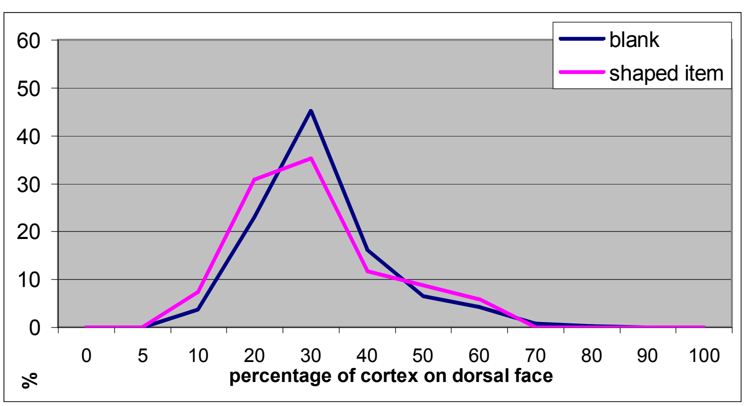
Fig. 68: Percentage of cortex on dorsal face of the three laminar types (blanks and shaped) from Qesem Cave.



A: Blades (n=blank: 254; shaped item: 178)



B: PE blades (n=blank: 294; shaped item: 94)



C: NBKs (n=blank: 352; shaped item: 68)

Fig. 69: Percentage of cortex on the dorsal face of blanks and shaped laminar items from Qesem Cave.

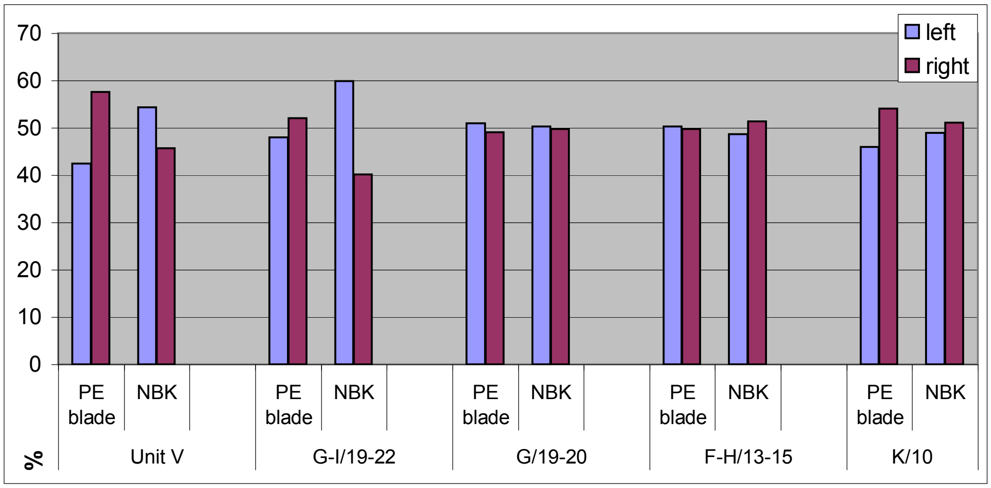


Fig. 70: The cortical side on PE blades and NBKs (blanks and shaped) from Qesem Cave samples.
*The PE blades here refer only to items in which left/right division was possible.
n=PE blade - Unit V: 33; G-I/19-22: 123; G/19-20: 169; F-H/13-15: 219; K/10: 85.
n=NBK - Unit V: 35; G-I/19-22: 142; G/19-20: 209; F-H/13-15: 282; K/10: 90.

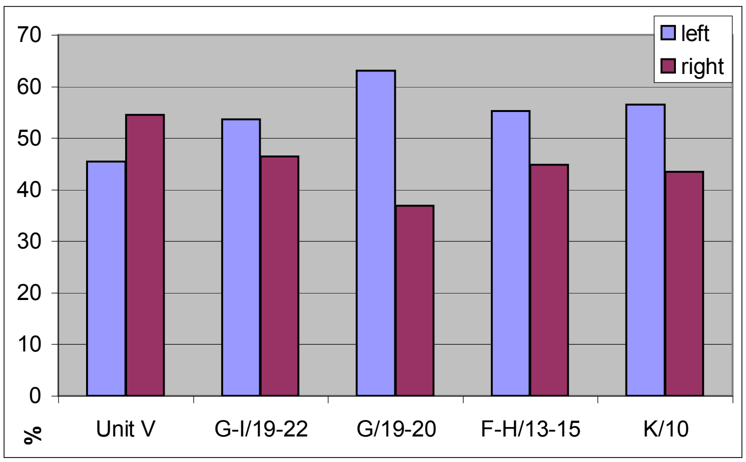


Fig. 71: The cortical side on blades (blanks and shaped) from Qesem Cave samples.
Includes only blades with cortex and with a clear left/right distinction.
n=Unit V: 11; G-I/19-22: 28; G/19-20: 65; F-H/13-15: 67; K/10: 23.

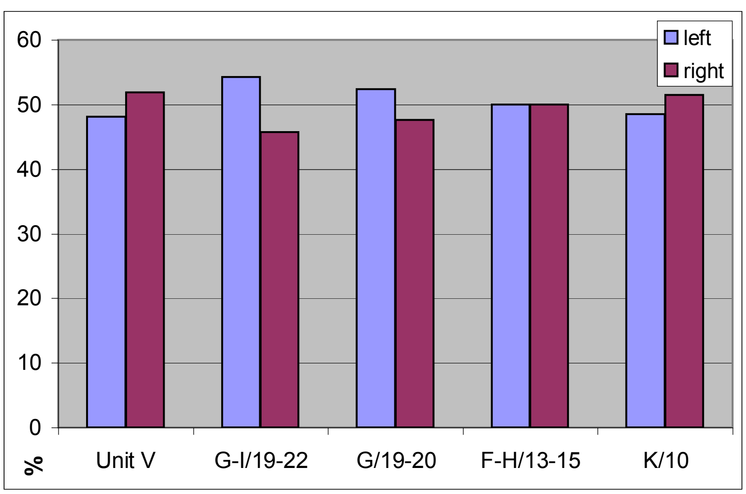


Fig. 72: The cortical side on all three laminar types from Qesem Cave samples.
n=Unit V: 79; G-I/19-22: 293; G/19-20: 443; F-H/13-15: 568; K/10: 198.

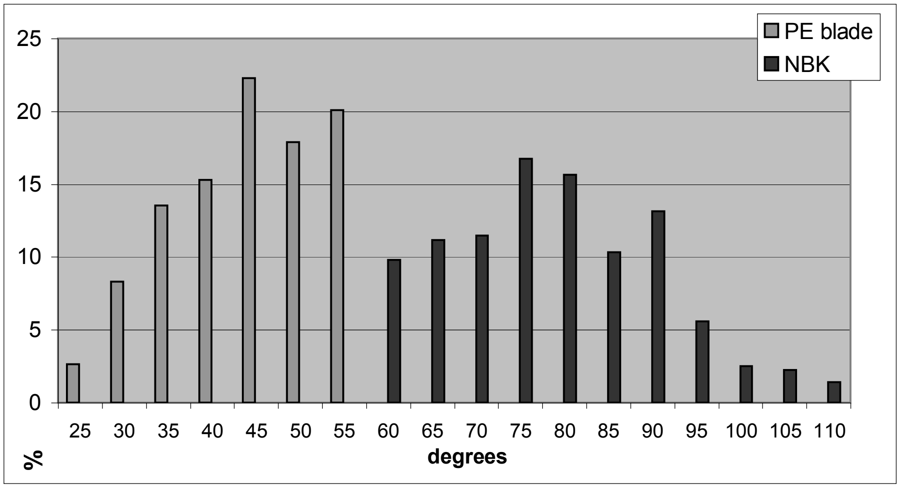
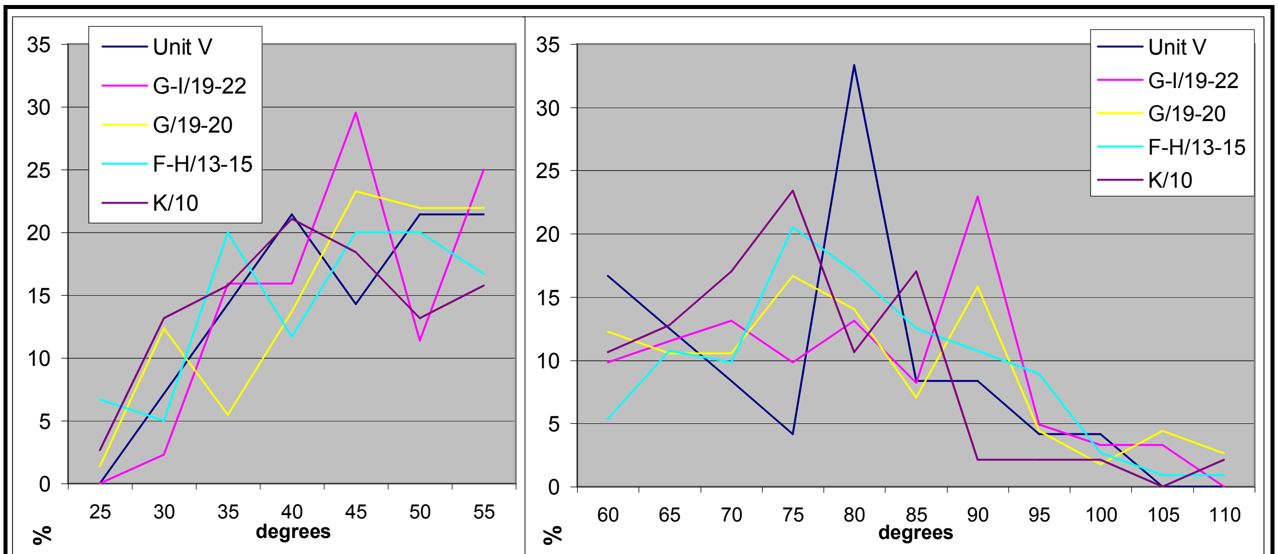


Fig. 73: Angle of the cortical edge of PE blades and NBKs (blanks and shaped) from Qesem Cave.
n=PE blade: 229; NBK: 358.



A: PE blades
n=Unit V: 14; G-I/19-22: 44; G/19-20: 73; F-H/13-15: 60; and K/10: 38.

B: NBKs
n=Unit V: 24; G-I/19-22: 61; G/19-20: 114; F-H/13-15: 112; and K/10: 47.

Fig. 74: Angle of the cortical edge of PE blades and NBKs (blanks and shaped) from Qesem Cave samples.

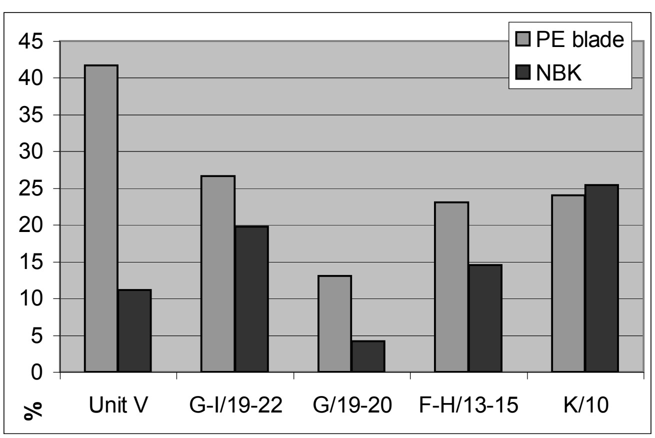


Fig. 75: Percentages of non-uniform angle of the cortical edge of PE blades and NBKs (blanks and shaped) from Qesem Cave samples.
n=PE blades - Unit V: 24; G-I/19-22: 60; G/19-20: 84; F-H/13-15: 78; and K/10: 50.
n=NBKs - Unit V: 27; G-I/19-22: 76; G/19-20: 119; F-H/13-15: 131; and K/10: 63.

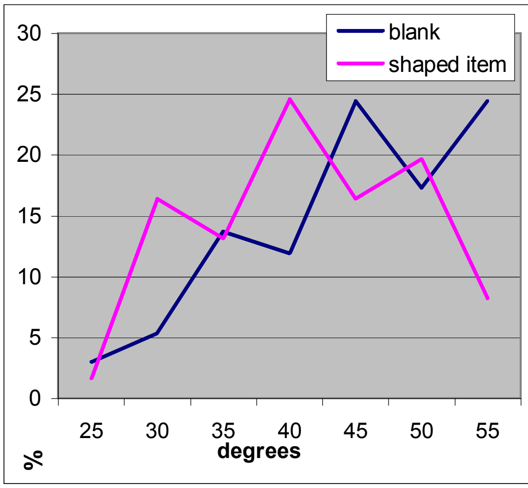


Fig. 76: Angle of the cortical edge of blank PE blades and shaped PE blades from Qesem Cave.
n=blank: 168; NBK: 61.

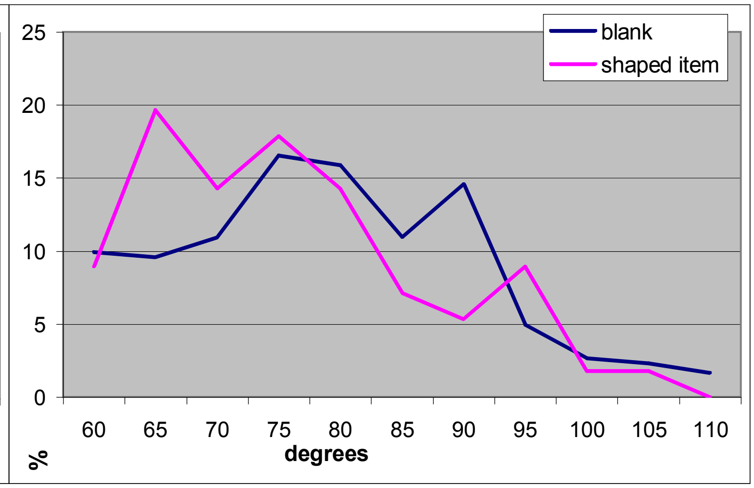


Fig. 77: Angle of the cortical edge of blank NBKs and shaped NBKs from Qesem Cave.
n=blank: 302; NBK: 56.

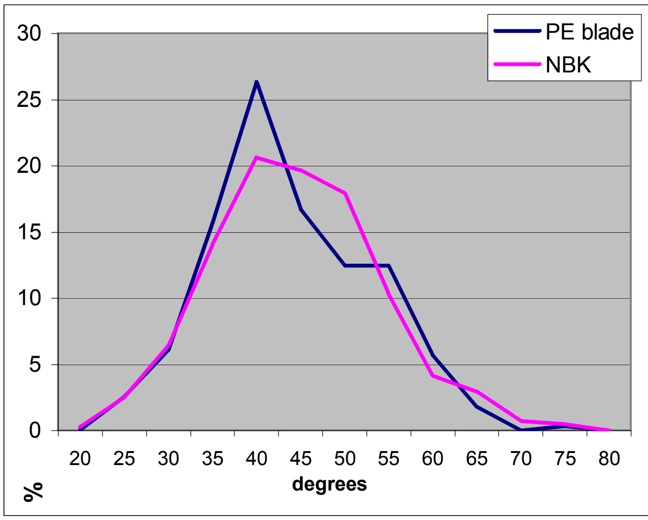


Fig. 78: Angle of the sharp edge of PE blades and NBKs (blanks and shaped) from Qesem Cave.
n=PE blades: 281; NBKs: 407.

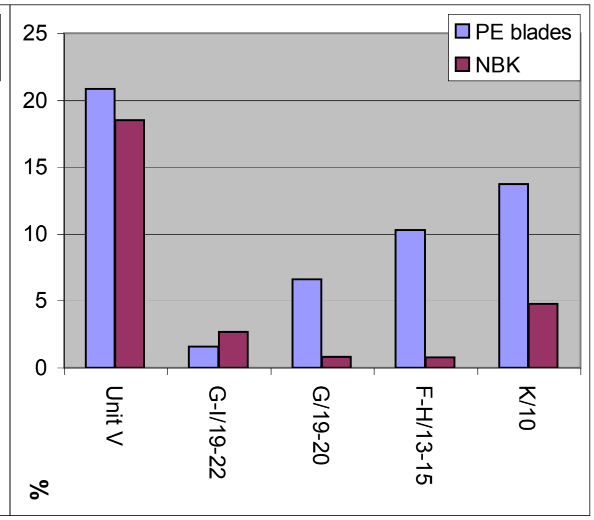


Fig. 79: Non-uniform angle of the sharp edge PE blades and NBKs (blanks and shaped) from Qesem Cave.
n=PE blade: Unit V: 24; G-I/19-22: 64; G/19-20: 91; F-H/13-15: 78; K/10: 51.
n=NBK: Unit V: 27; G-I/19-22: 75; G/19-20: 120; F-H/13-15: 134; K/10: 63.

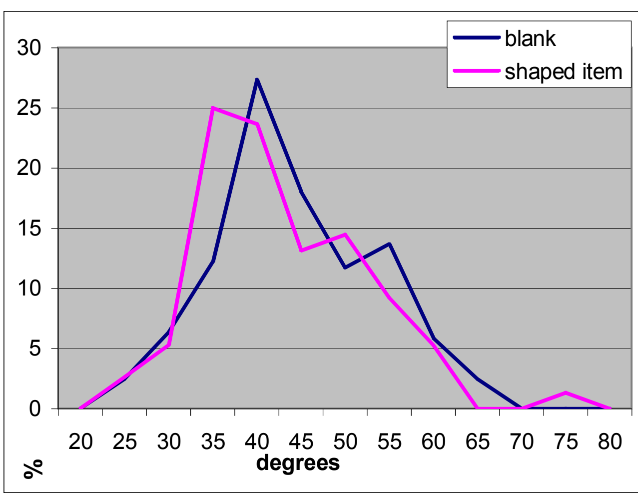


Fig. 80: Angle of the sharp edge of blank PE blades and shaped PE blades from Qesem Cave.
n=blank: 205; shaped item: 76.

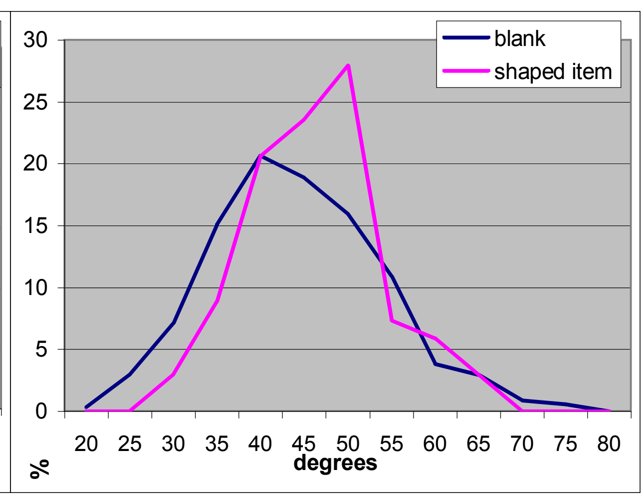


Fig. 81: Angle of the sharp edge of blank NBKs and shaped NBKs from Qesem.
n=blank: 339; shaped item: 68.

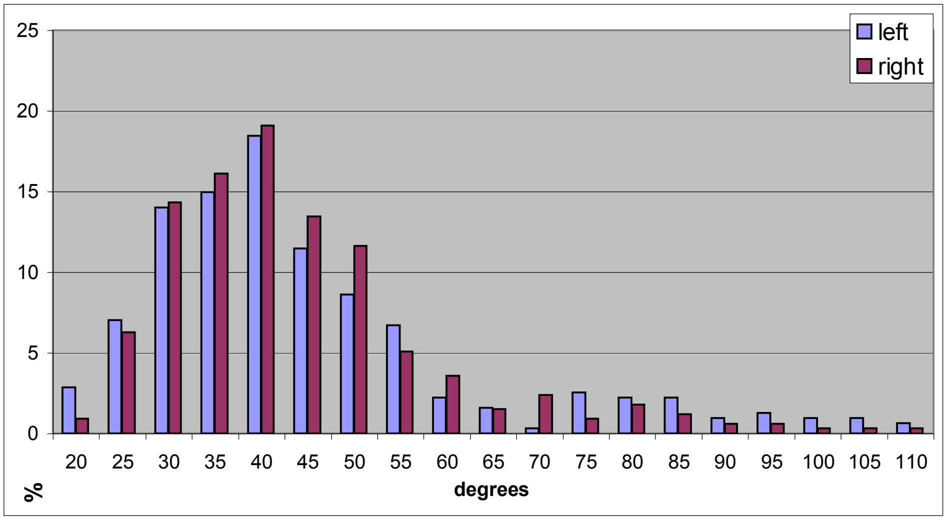


Fig. 82: Angles of the lateral edges of blades (blanks and shaped) from Qesem Cave.
n=left: 314; right: 335.

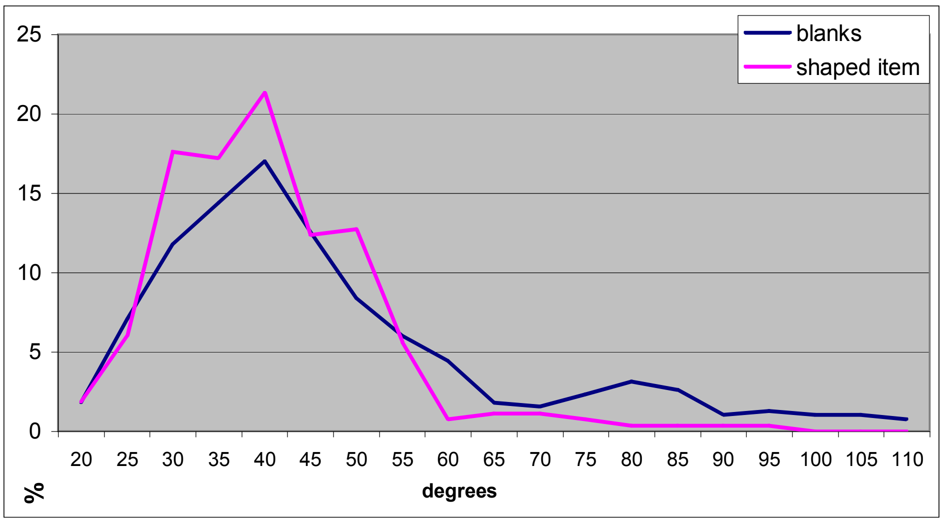


Fig. 83: Angles of the lateral edges of blanks blades and shaped blades from Qesem Cave (left/right united).
n=blank:382; shaped item: 267.

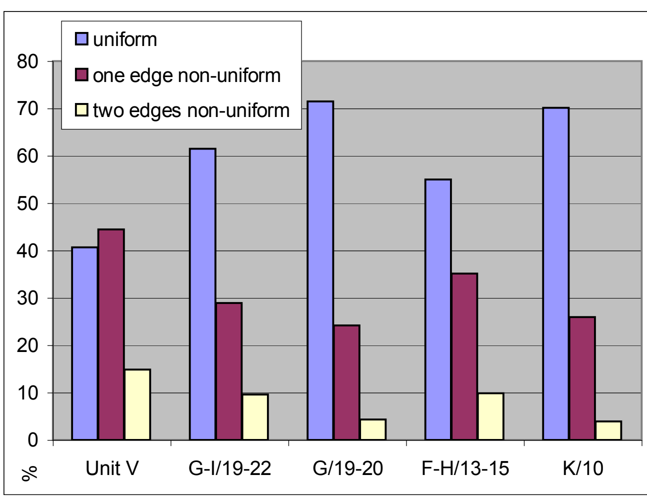


Fig. 84: Non-uniform angles of lateral edges of blades (blanks and shaped) from Qesem Cave samples.
n=Unit V: 27; G-I/19-22: 83; G/19-20: 116;
F-H/13-15: 91; and K/10: 77.

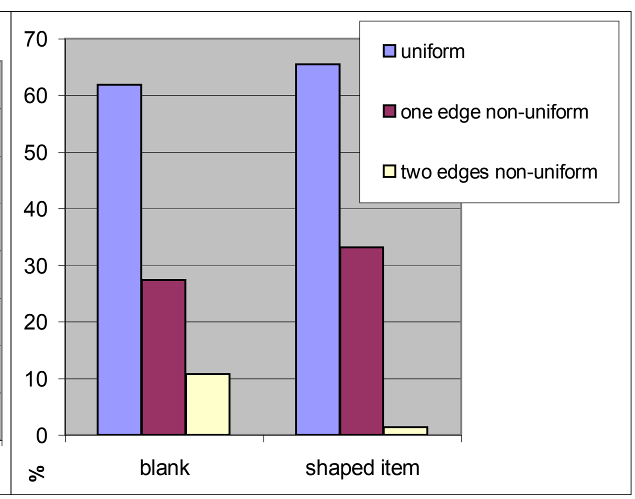


Fig. 85: Non-uniform angles of lateral edges of blank blades and shaped blades from Qesem Cave.
n=blank: 252; shaped item: 142.

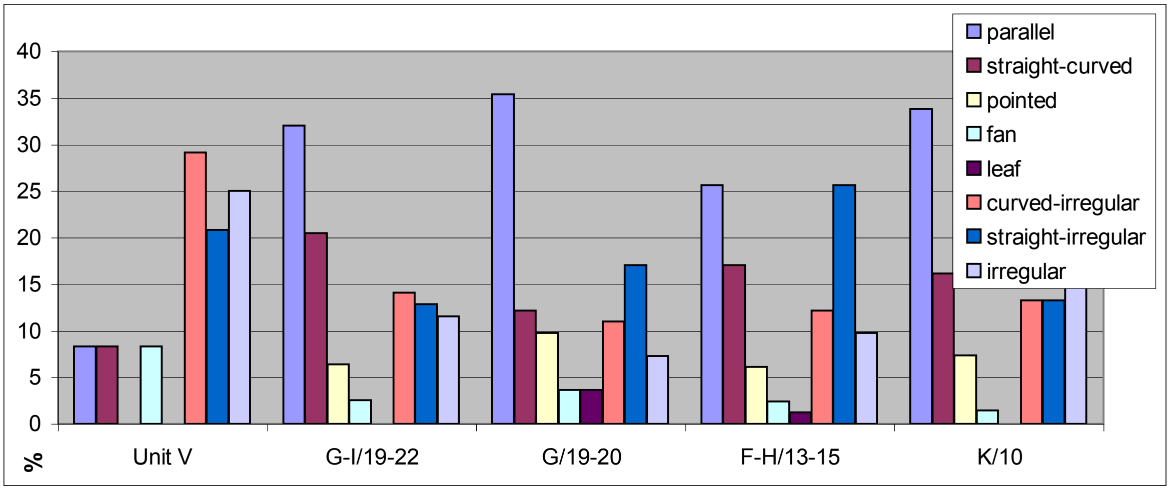


Fig. 86: Shape of blades (blanks and shaped) from the Qesem Cave samples.
n=Unit V: 24; G-I/19-22: 78; G/19-20: 82; F-H/13-15: 82; K/10: 68.

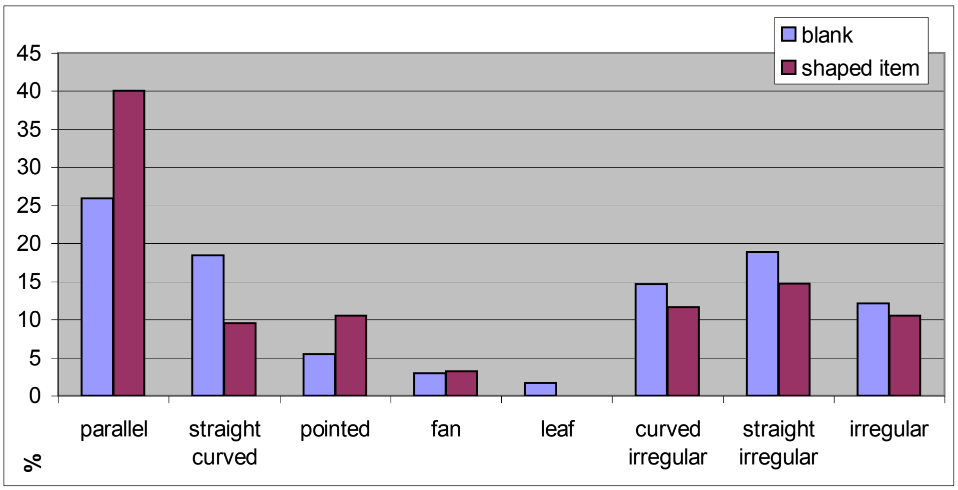


Fig. 87: Shape of blank blades and shaped blades from Qesem Cave.
n=blank: 239; shaped item: 95.

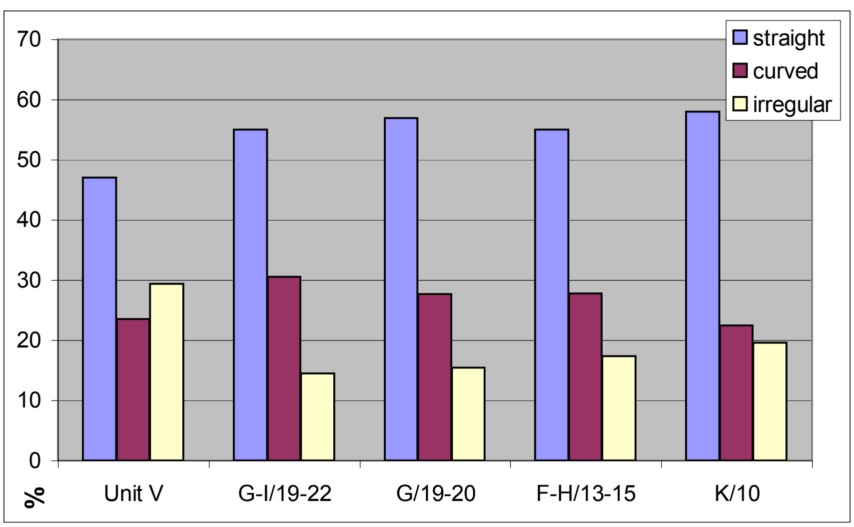
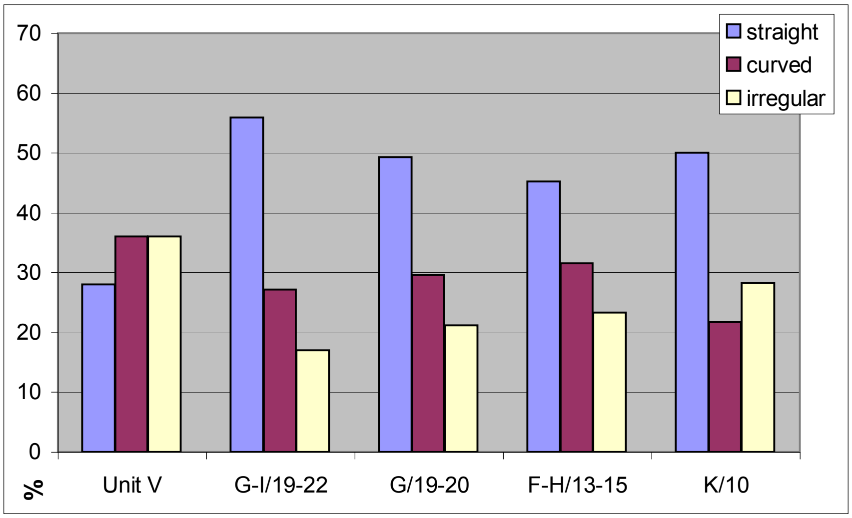
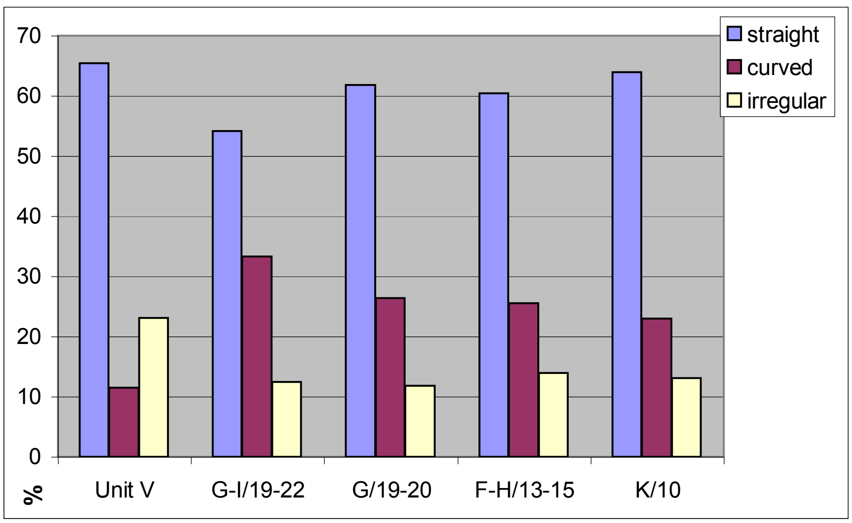


Fig. 88: Outline of the cortical edge of PE blades and NBKs (blanks and shaped) from the Qesem Cave samples (the two are united into one group).
n=Unit V: 51; G-I/19-22: 131; G/19-20: 181; F-H/13-15: 202; K/10: 107.



A: PE blades (n=Unit V: 25; G-I/19-22: 59; G/19-20: 71; F-H/13-15: 73; K/10: 46)



B: NBKs (n=Unit V: 26; G-I/19-22: 72; G/19-20: 110; F-H/13-15: 129; K/10: 61)

Fig. 89: Outline of the cortical edge of PE blades and NBKs (blanks and shaped) from Qesem Cave samples.

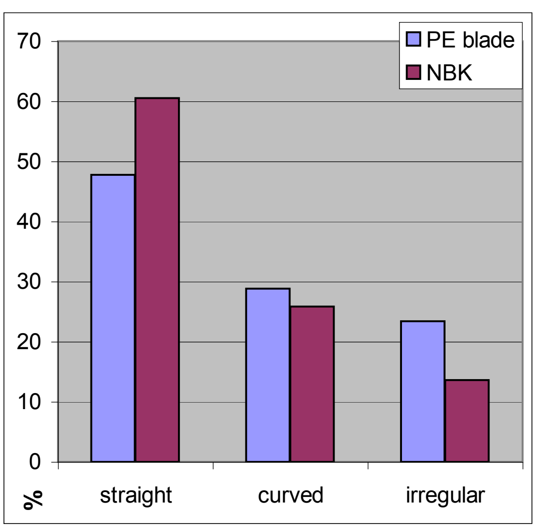
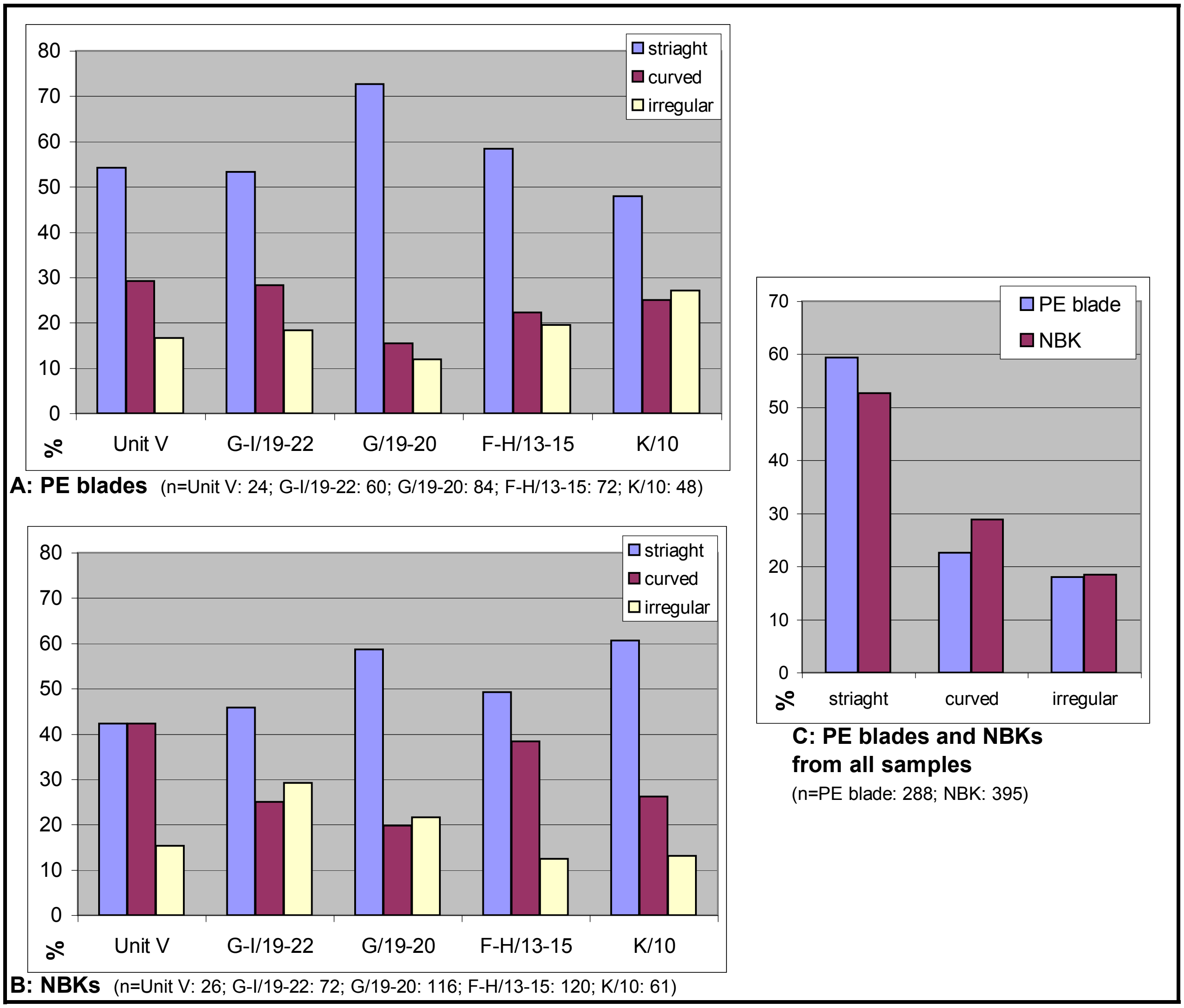


Fig. 90: Outline of the cortical edge of PE blades and NBKs from Qesem Cave.
n= PE blade: 274; NBK: 398.

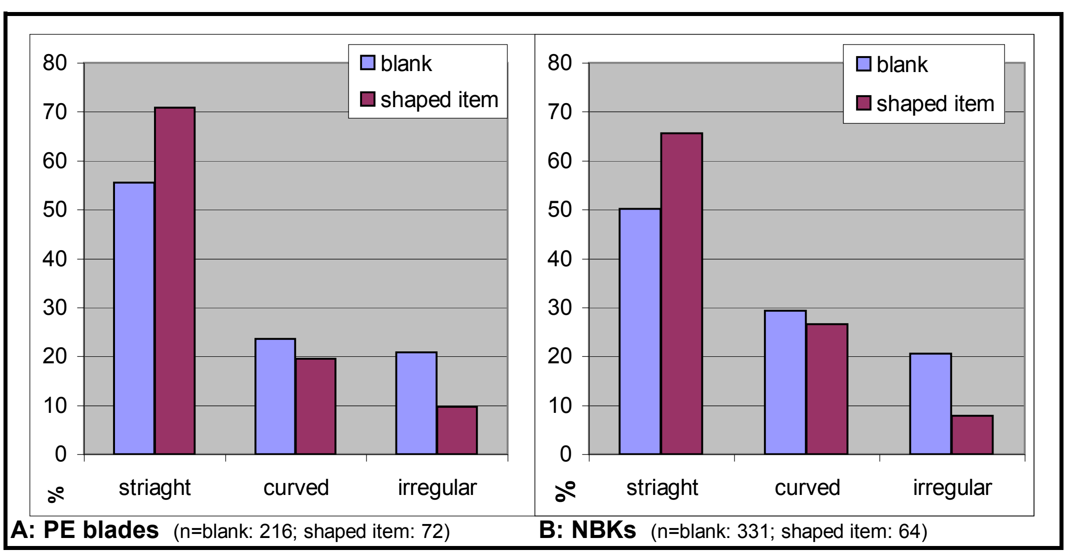


A: PE blades (n=Unit V: 24; G-I/19-22: 60; G/19-20: 84; F-H/13-15: 72; K/10: 48)

B: NBKs (n=Unit V: 26; G-I/19-22: 72; G/19-20: 116; F-H/13-15: 120; K/10: 61)

C: PE blades and NBKs from all samples (n=PE blade: 288; NBK: 395)

Fig. 91: Outline of the sharp edge of PE blades and NBKs (blanks and shaped) from Qesem Cave.



A: PE blades (n=blank: 216; shaped item: 72) **B: NBKs** (n=blank: 331; shaped item: 64)

Fig. 92: Outline of the sharp edge of blank PE blades and NBKs and of shaped PE blades and NBKs from Qesem Cave.

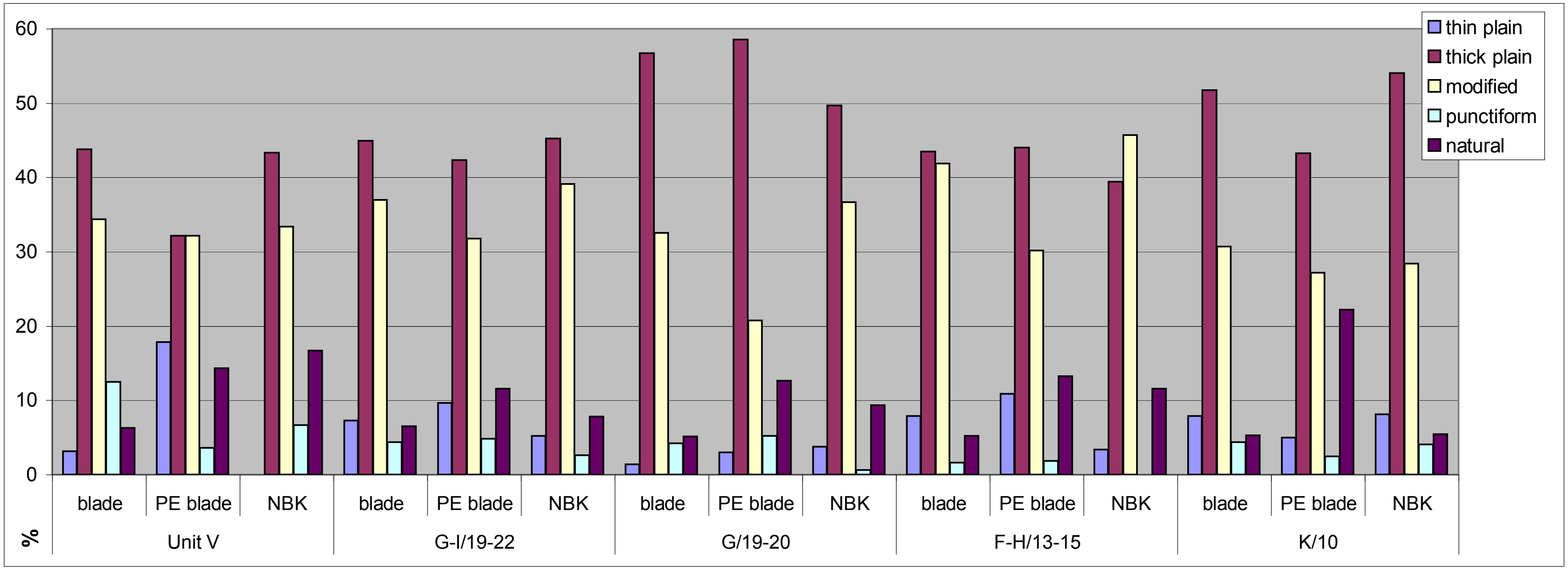


Fig. 93: Butt type of the three laminar types (blanks and shaped) from Qesem Cave samples.

n=	Unit V		G/I/19-22		G-19/20		F-H/13-15		K/10	
	blade:	32	blade:	138	blade:	215	blade:	191	blade:	114
	PE blade:	28	PE blade:	104	PE blade:	135	PE blade:	166	PE blade:	81
	NBK:	30	NBK:	115	NBK:	161	NBK:	208	NBK:	74

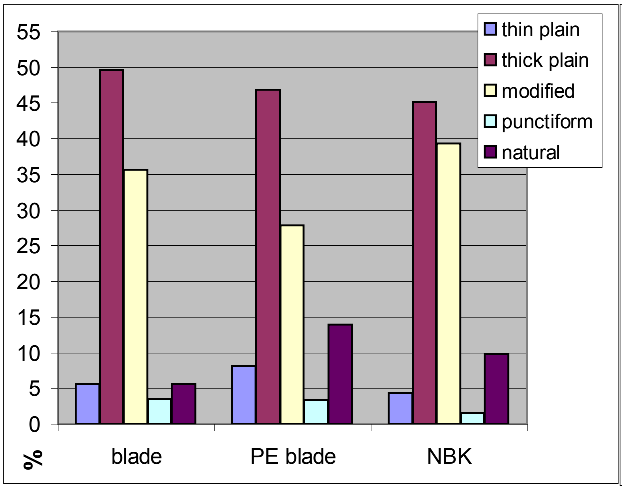


Fig. 94: Butt type of the three laminar types (blanks and shaped) from Qesem Cave.
n= blade: 679; PE blade: 510; NBK: 585.

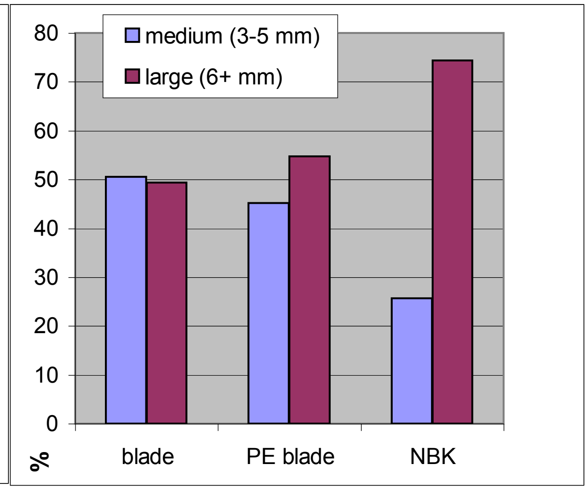
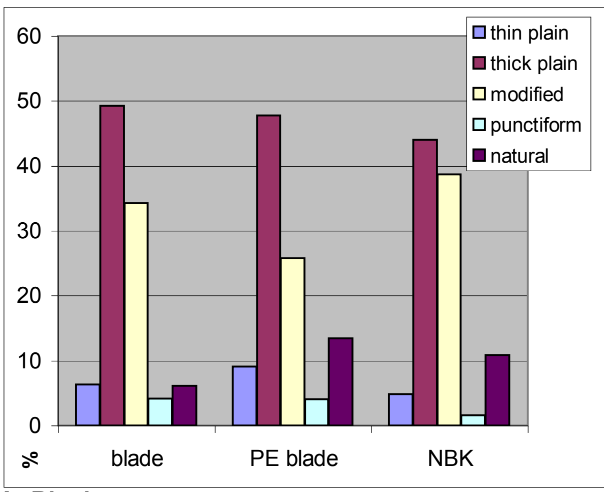
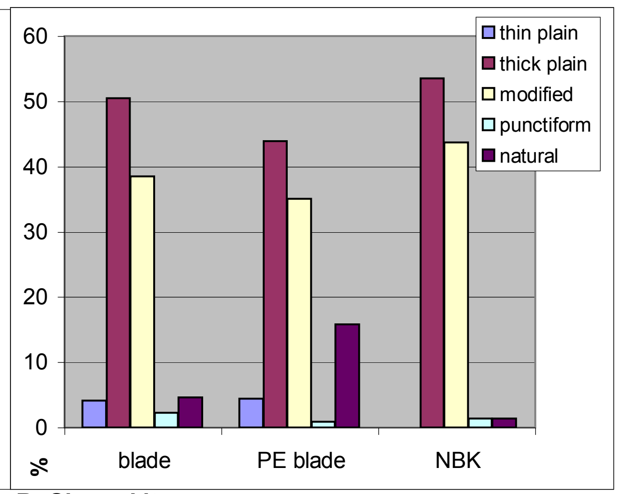


Fig. 95: Division of thick plain butts from sample F-H/13-15, Qesem Cave into medium and large thicknesses.
n= blade: 83; PE blade: 73; NBK: 82.



A: Blanks (n= blade:461; PE blade: 396; NBK: 514)



B: Shaped items (n= blade:218; PE blade:114; NBK:71)

Fig. 96: Butt type of laminar blanks and shaped laminar items from Qesem Cave.

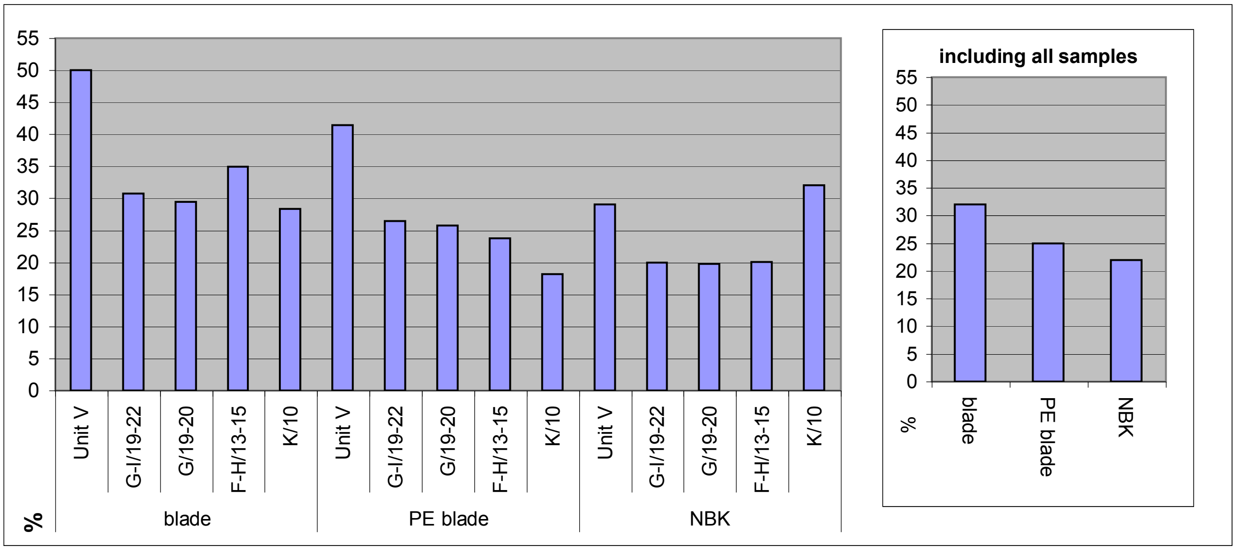


Fig. 97: Micro edge flaking on the butt of the three laminar types (blanks and shaped) from Qesem Cave. (in the right graph the samples are grouped together).

n=blade: Unit V: 34; G-I/19-22: 140; G/19-20: 217; F-H/13-15: 186; K/10: 113 (total: 690).

n=PE blade: Unit V: 29; G-I/19-22: 102; G/19-20: 136; F-H/13-15: 164; K/10: 77 (total: 508).

n=NBK: Unit V: 31; G-I/19-22: 115; G/19-20: 162; F-H/13-15: 199; K/10: 75 (total: 582).

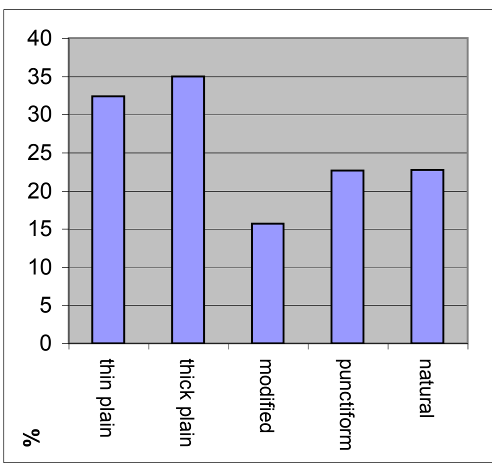


Fig. 98: The presence of micro edge flaking on the butt according to type of butt from Qesem Cave.

n=thin plain: 102; thick plain: 830; modified: 611; punctiform: 53; natural: 167.

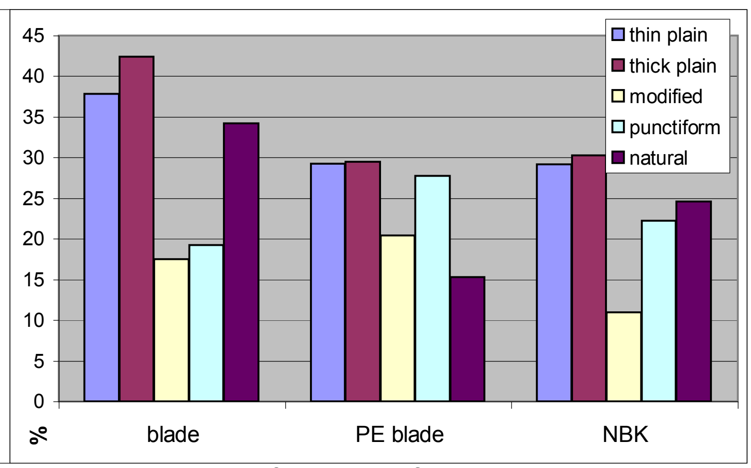


Fig. 99: The presence of micro edge flaking on the butt according to type of butt and the different laminar types from Qesem Cave.

n= blade - thin plain: 37; thick plain: 335; modified: 246; punctiform: 26; natural: 38.

n= PE blade - thin plain: 41; thick plain: 234; modified: 137; punctiform: 18; natural: 72.

n= NBK - thin plain: 24; thick plain: 261; modified: 228; punctiform: 9; natural: 57.

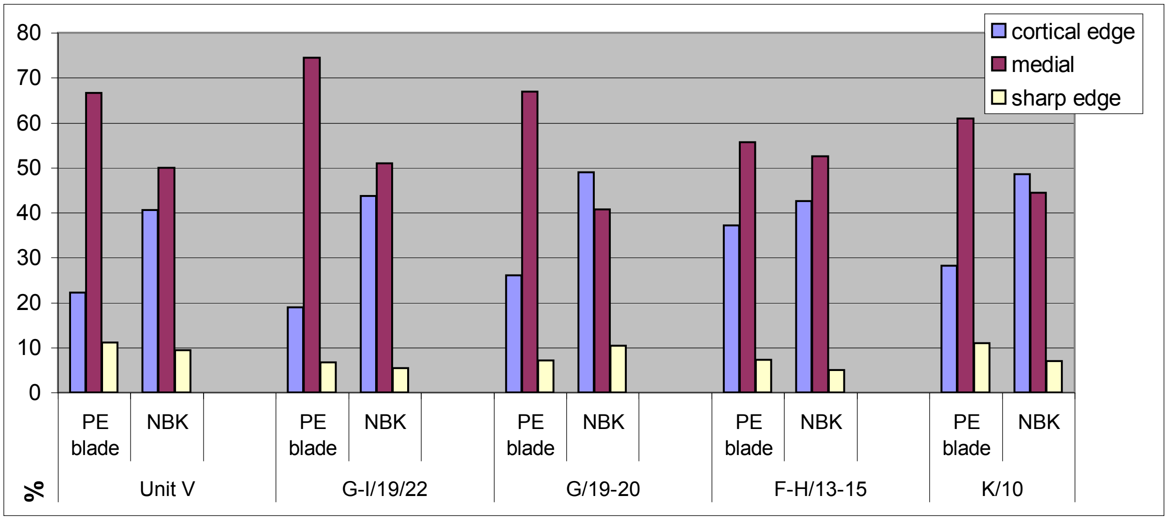


Fig. 100: Location of the bulb of percussion on PE blades and NBKs (blanks and shaped) from Qesem Cave.
n=PE blade - Unit V: 27; G-I/19-22: 90; G/19-20: 127; F-H/13-15: 151; K/10: 64.
n=NBK - Unit V: 32; G-I/19-22: 110; G/19-20: 155; F-H/13-15: 200; K/10: 72.

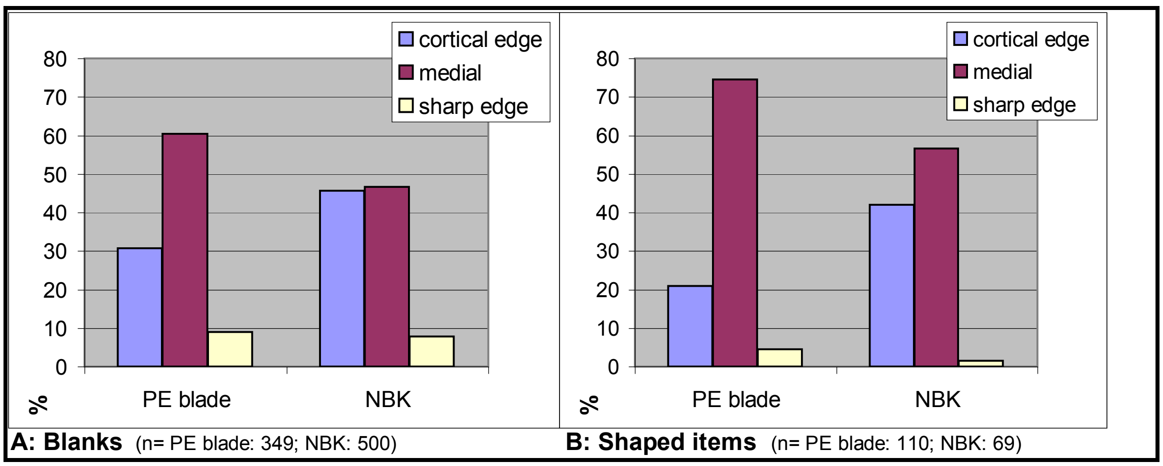


Fig. 101: Location of the bulb of percussion on PE blades and NBKs
among blanks (A) and shaped items (B) from Qesem Cave.

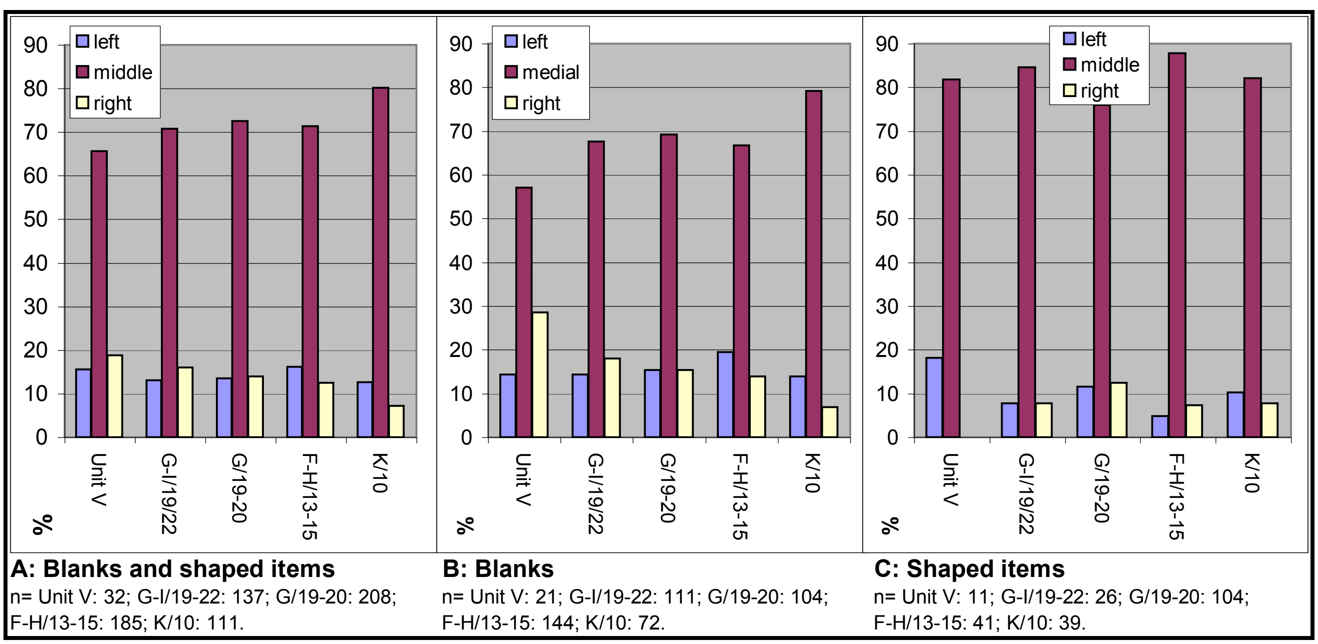
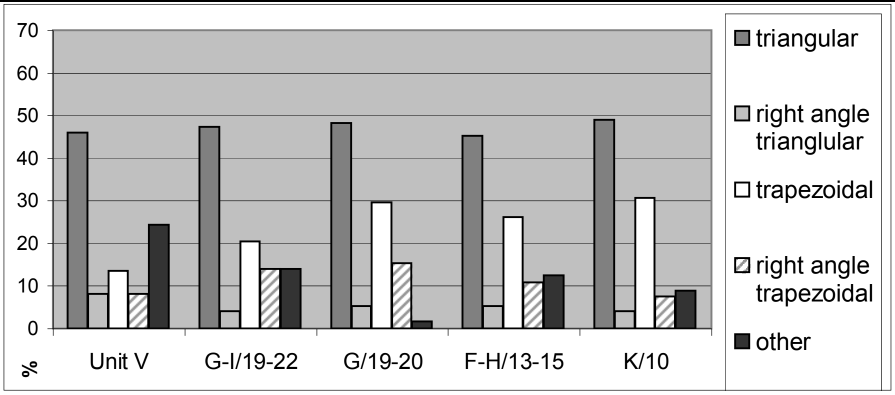
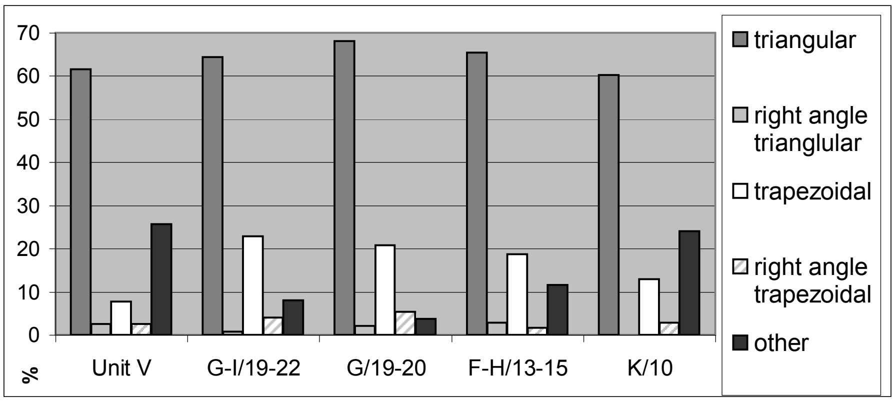


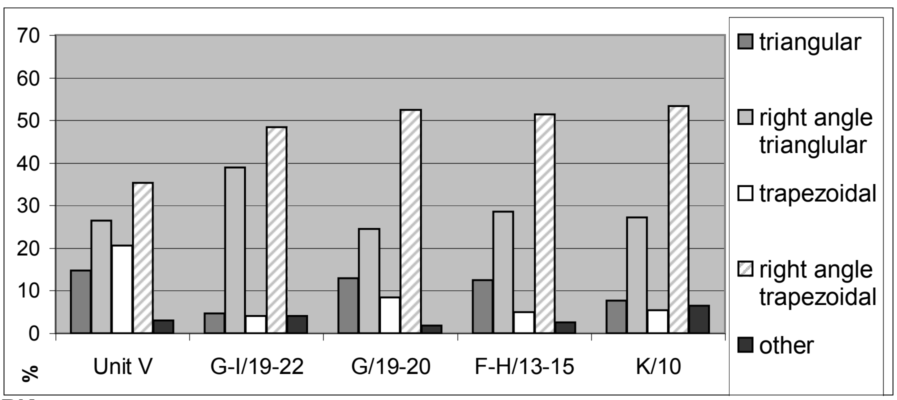
Fig. 102: Location of bulb of percussion on blades from Qesem Cave.



A: Blades (n=Unit V: 37; G-I/19-22: 171; G/19-20: 301; F-H/13-15: 248; K/10: 147)

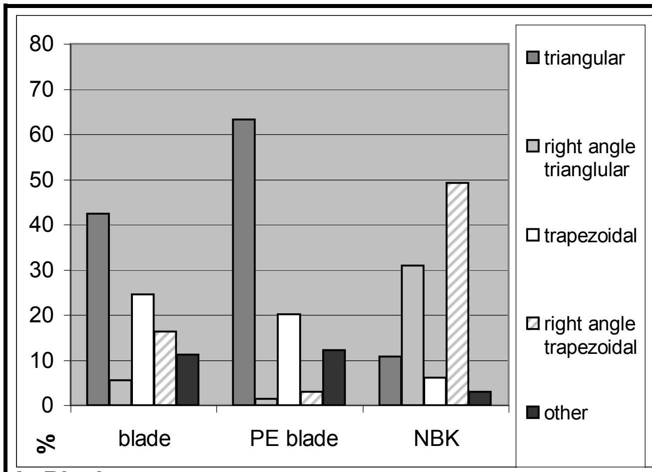


B: PE blades (n=Unit V: 39; G-I/19-22: 149; G/19-20: 188; F-H/13-15: 252; K/10: 108)

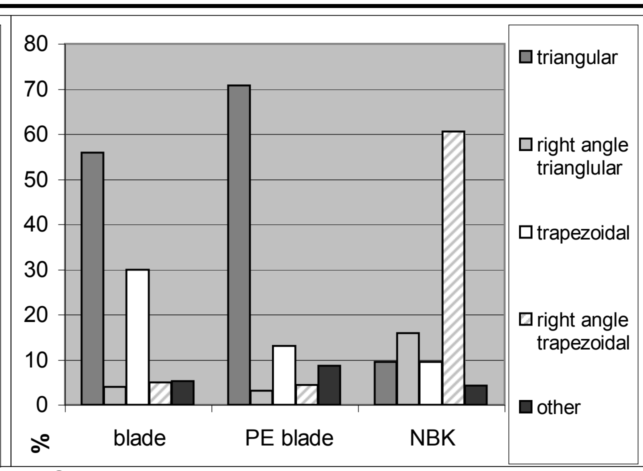


C: NBKs (n=Unit V: 34; G-I/19-22: 149; G/19-20: 225; F-H/13-15: 280; K/10: 92.)

Fig. 103: Cross-section of the three laminar types (blanks and shaped) from the Qesem Cave samples.



A: Blanks (n= blade: 580; PE blade: 575; NBKs: 686)



B: Shaped items (n= blade: 324; PE blade: 161; NBKs: 94)

Fig. 104: Cross-section of laminar blanks and shaped laminar items from Qesem Cave.

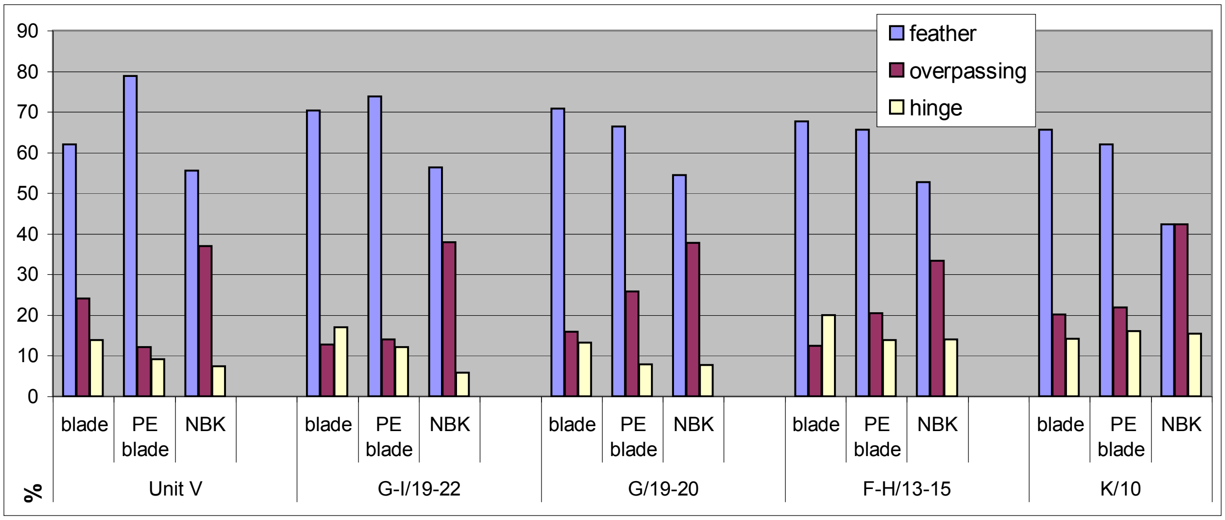
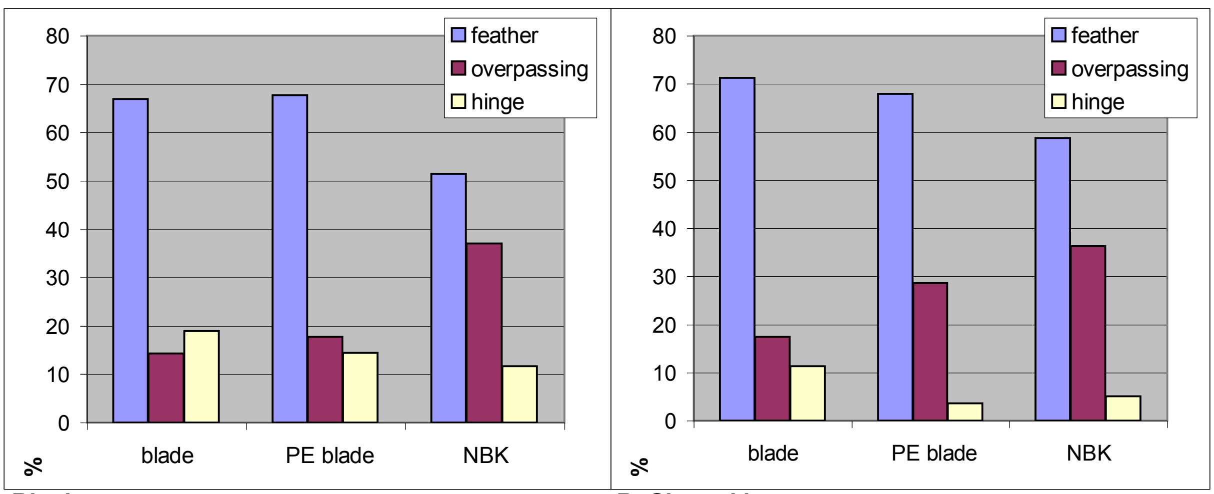


Fig. 105: End termination of the three laminar types (blanks and shaped) from Qesem Cave samples.

n=Unit V:		G-I/19-22:		G/19-20		F-H/13-15		K/10	
blades:	29	blades:	118	blades:	182	blades:	145	blades:	99
PE blades:	33	PE blades:	107	PE blades:	128	PE blades:	151	PE blades:	87
NBKs:	27	NBKs:	87	NBKs:	156	NBKs:	171	NBKs:	71



A: Blanks (n= blade: 344; PE blade: 394; NBK: 432) **B: Shaped items** (n= blade: 229; PE blade: 112; NBK: 80)

Fig. 106: End termination of laminar blanks and shaped laminar items from Qesem Cave.

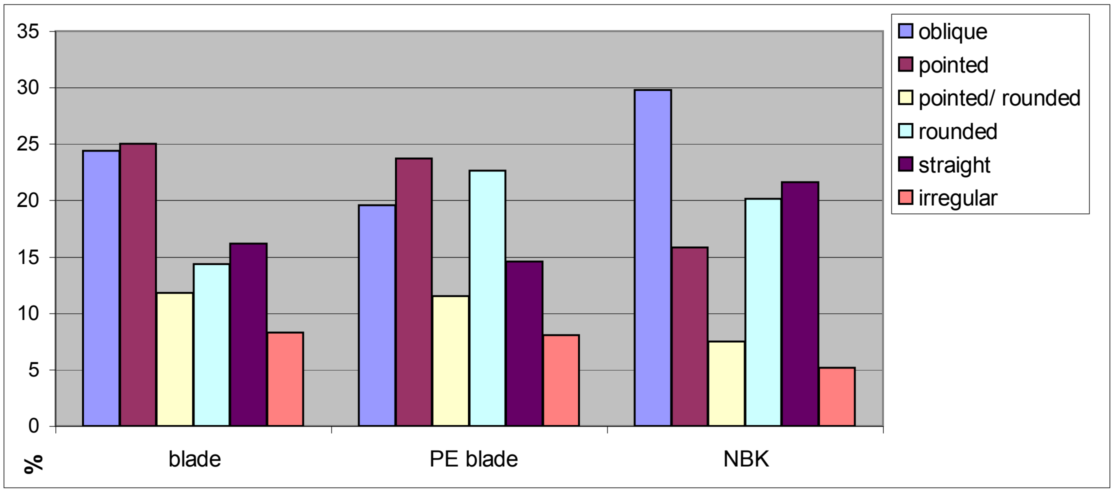
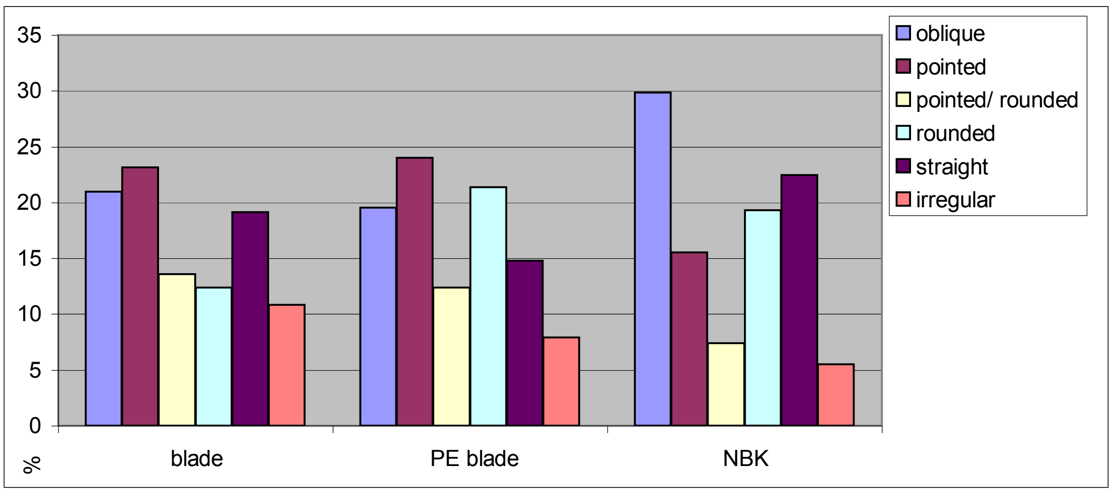
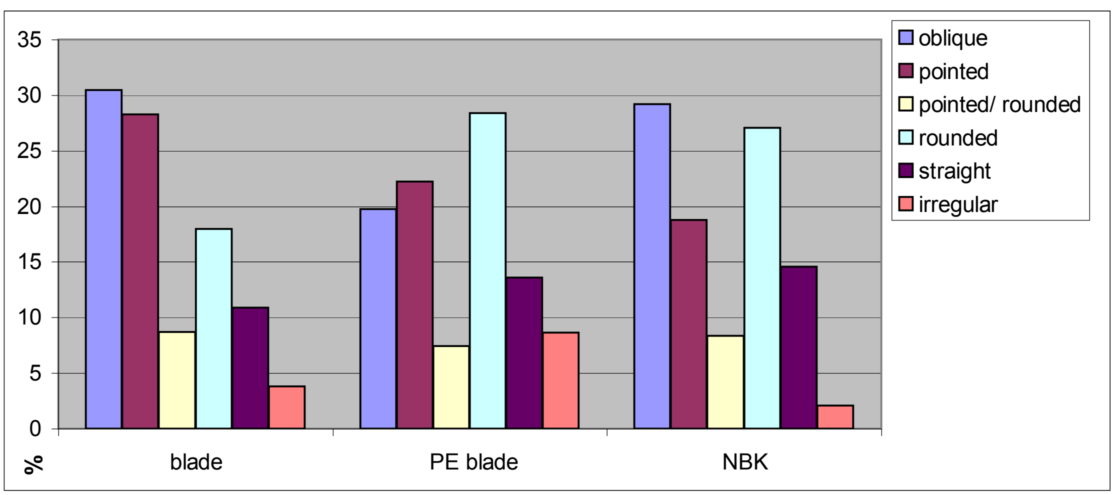


Fig. 107: Distal end shape of the three laminar types (blanks and shaped) from Qesem Cave.
n=blade: 508; PE blade: 460; NBK: 467.



A: Blanks (n=blade: 324; PE blade: 379; NBK: 419)



B: Shaped items (n=blade: 184; PE blade: 81; NBK: 48)

Fig. 108: Distal end shape of blanks and shaped laminar items from Qesem Cave.

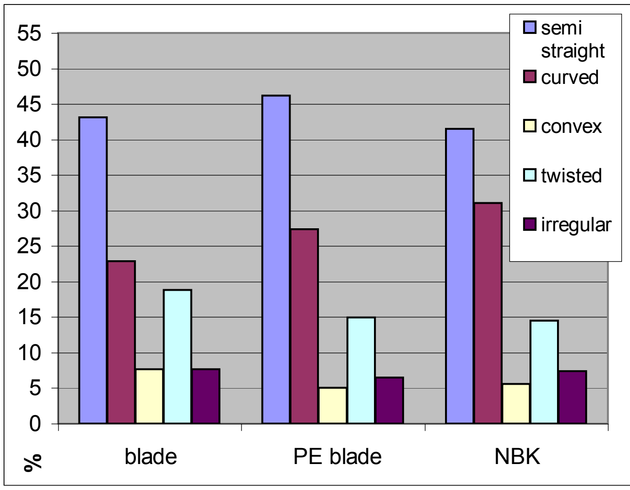


Fig. 109: Profile of the three laminar types (blanks and shaped) from Qesem Cave.
n=blade: 473; PE blade: 416; NBK: 448.

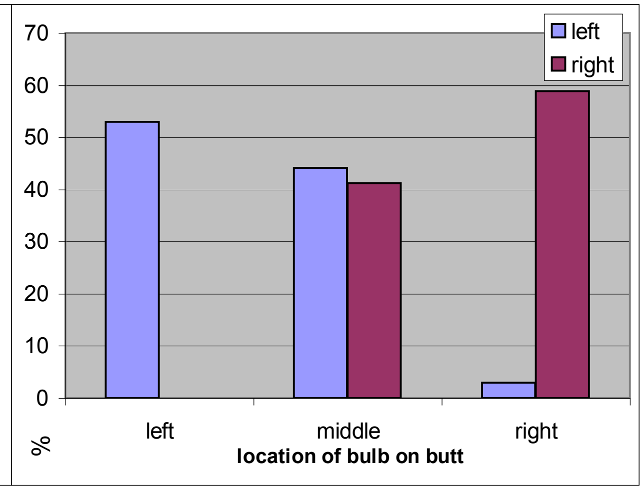


Fig. 110: Location of the curved side in comparison to the location of the bulb of percussion in "semi twisted" profiles from sample F-H/13-15, Qesem Cave.
n=left: 34; right: 34.

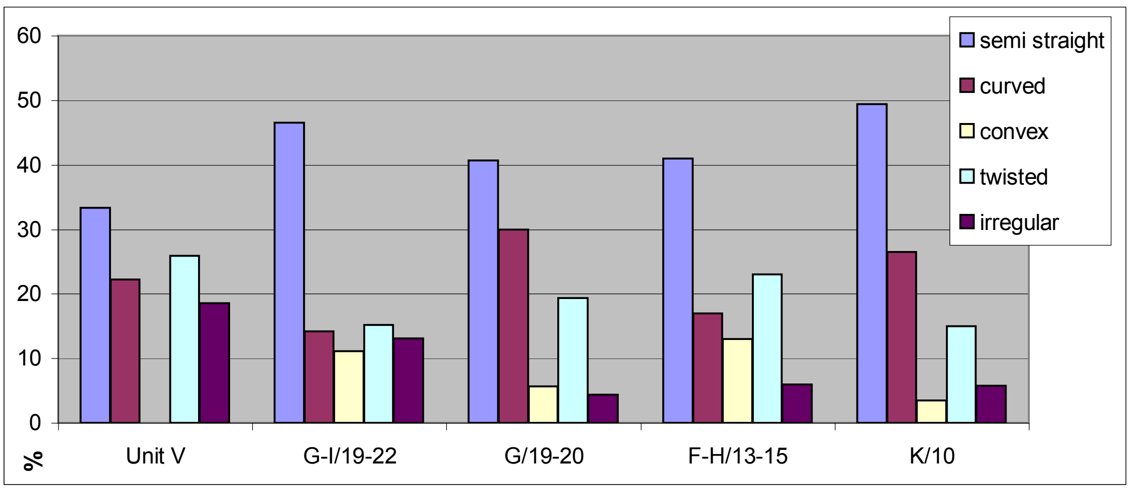
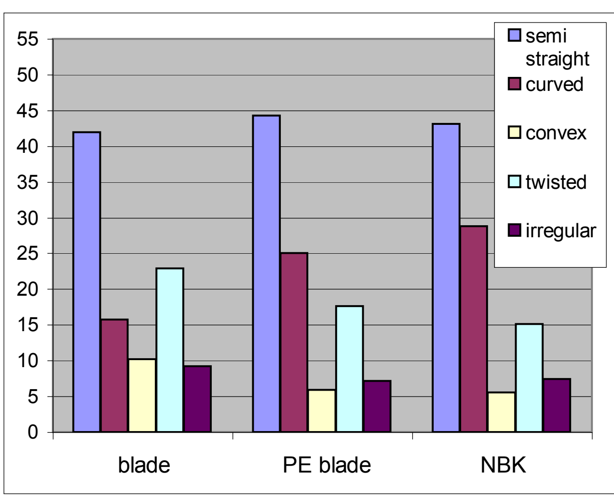
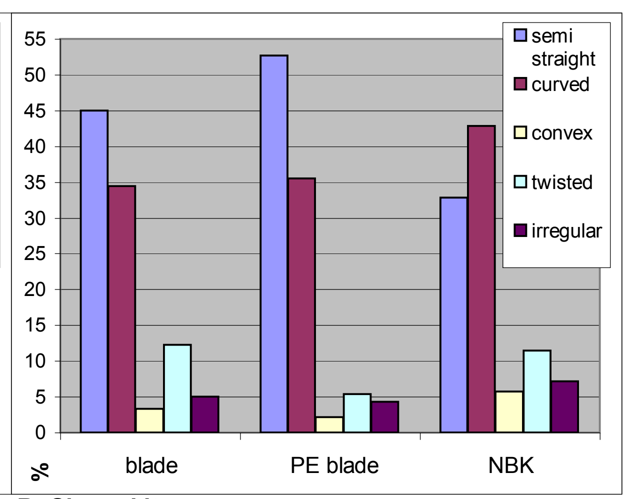


Fig. 111: Profile of blades (blanks and shaped) from Qesem Cave samples.
n=Unit V: 27; G-I/19-22: 99; G/19-20: 160; F-H/13-15: 100; K/10: 87.

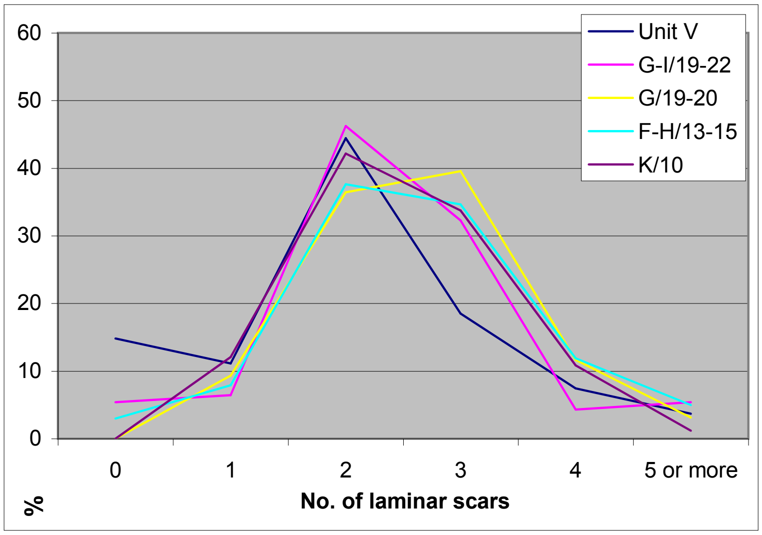


A: Blanks (n=blade: 293; PE blade: 323; NBK: 378)

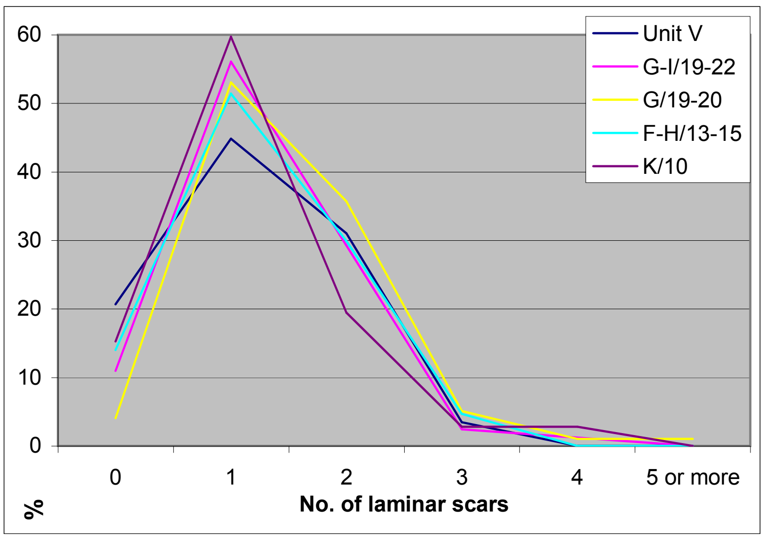


B: Shaped items (n=blade: 180; PE blade: 93; NBK: 70)

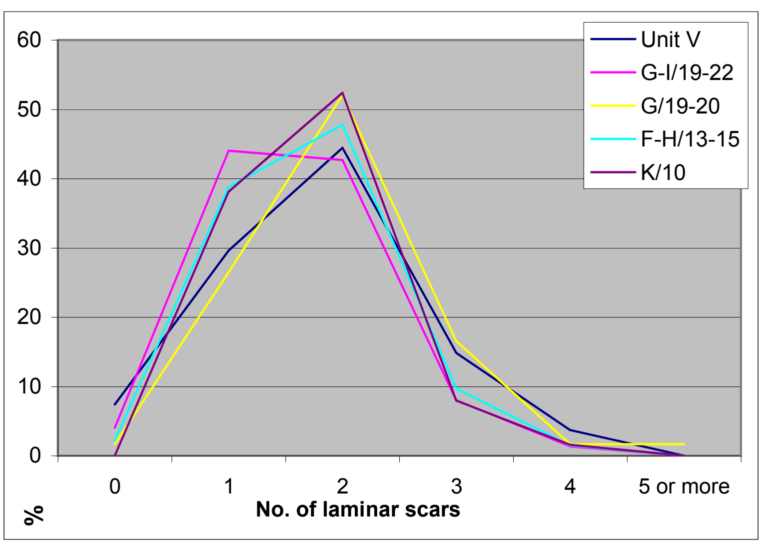
Fig. 112: Profile of laminar blanks and shaped laminar items from Qesem Cave.



A: Blades (n=Unit V: 27; G-I/19-22: 93; G/19-20: 129; F-H/13-15: 101; K/10: 83)

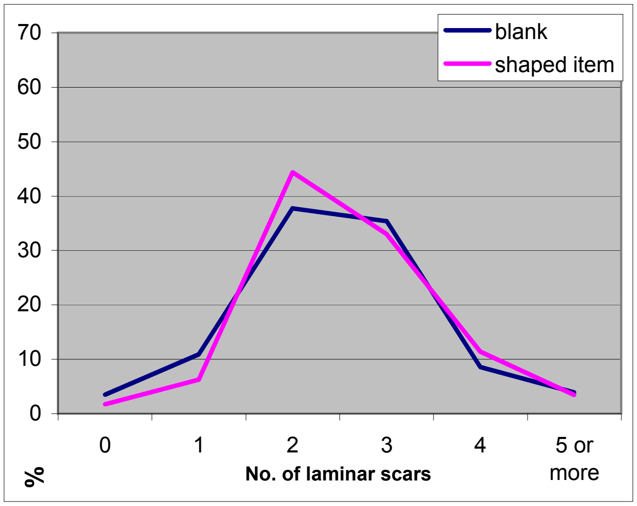


B: PE blades (n=Unit V: 29; G-I/19-22: 82; G/19-20: 98; F-H/13-15: 107; K/10: 72)

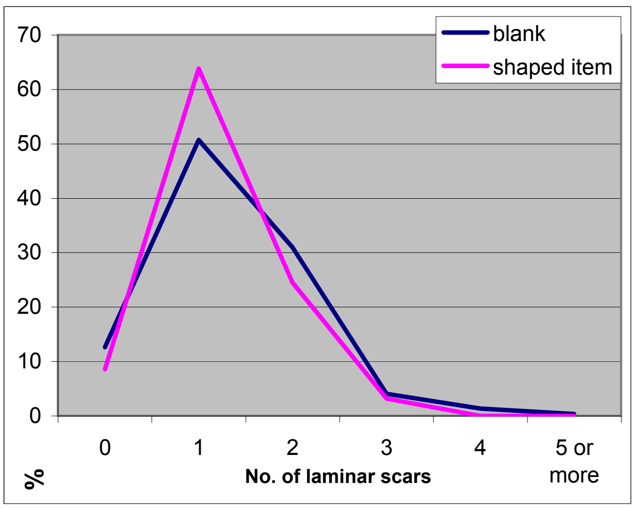


C: NBKs (n=Unit V: 27; G-I/19-22: 75; G/19-20: 121; F-H/13-15: 133; K/10: 63)

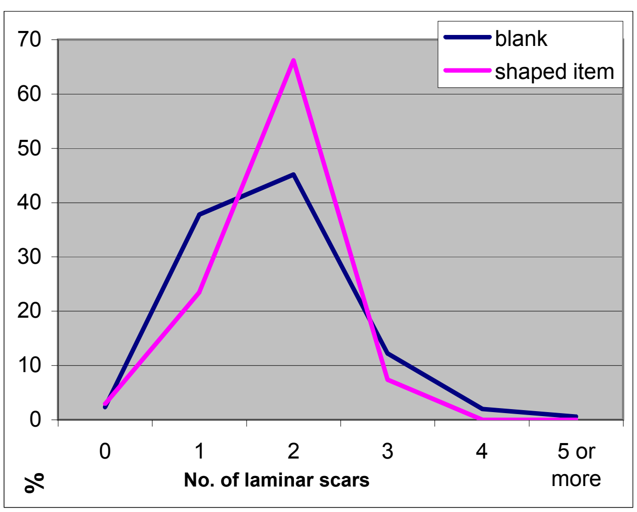
Fig. 113: Number of laminar scars on the three laminar types (blanks and shaped) from Qesem Cave samples.



A: Blades (n=blank: 257; shaped item: 176)



B: PE blades (n=blank: 294; shaped item: 94)



C: NBKs (n=blank: 351; shaped item: 68)

Fig. 114: Number of laminar scars on the three laminar types (blanks and shaped) from Qesem Cave.

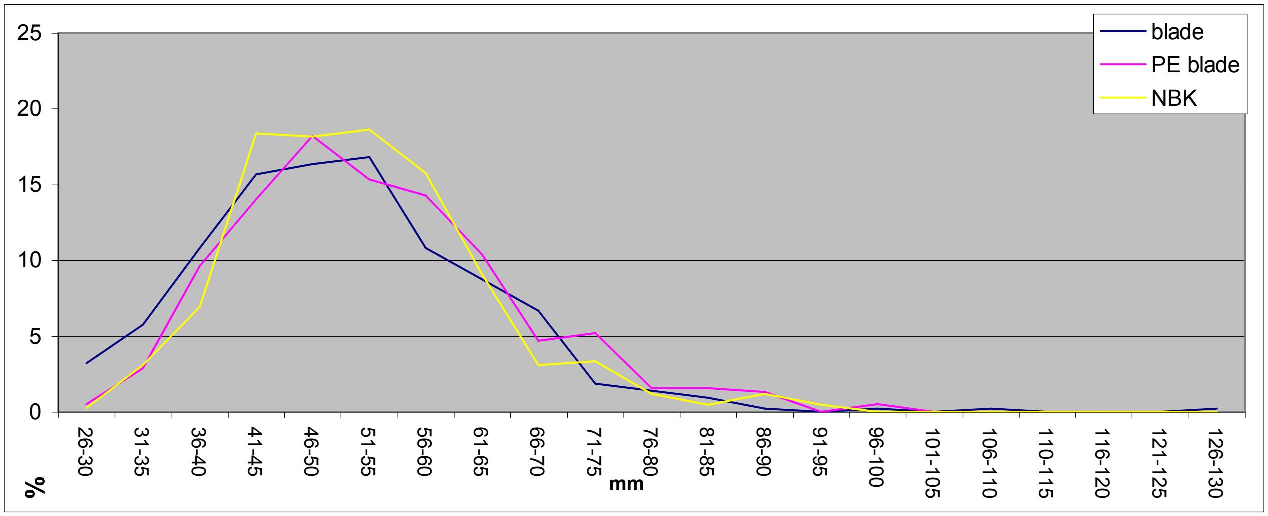


Fig. 115: Length of the three laminar types (blanks and shaped) from Qesem Cave.
n= blade: 483; PE blade: 382; NBK: 398.

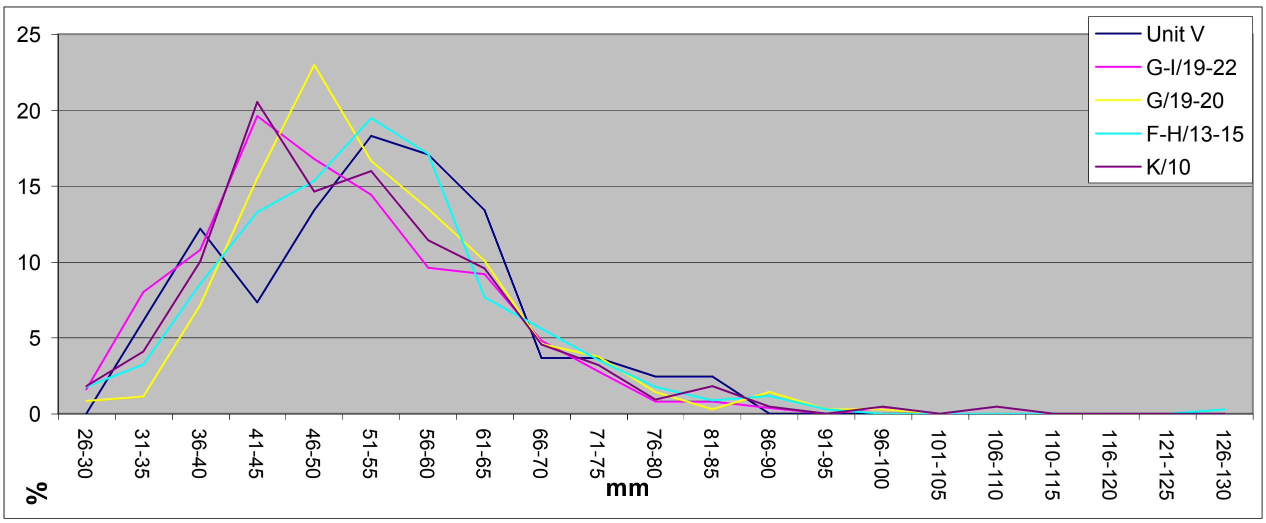


Fig. 116: Length of the three laminar types grouped together from the Qesem Cave samples.
n=Unit V: 81; F-H/13-15: 330; G-I/19-22: 237; G/19-20: 348; K/10: 217.

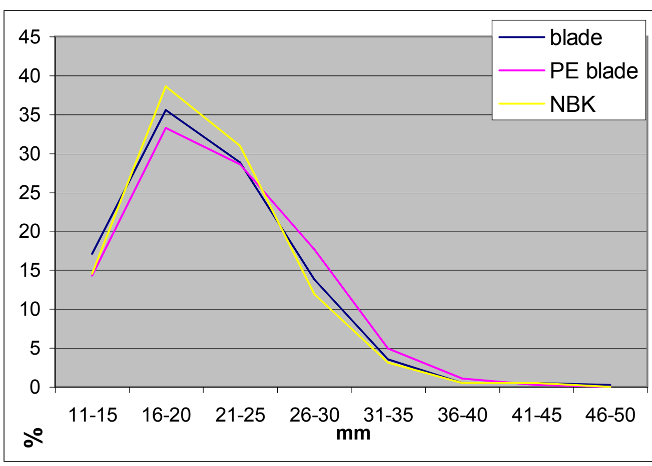


Fig. 117: Width of the three laminar types (blanks and shaped) from Qesem Cave.
n=blade: 438; PE blade: 386; NBK: 407.

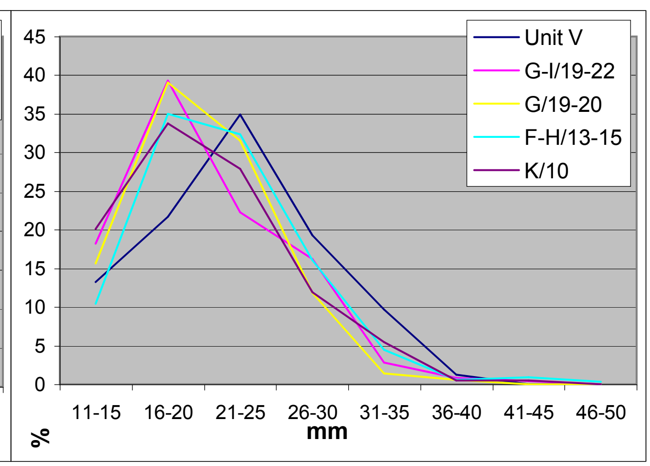
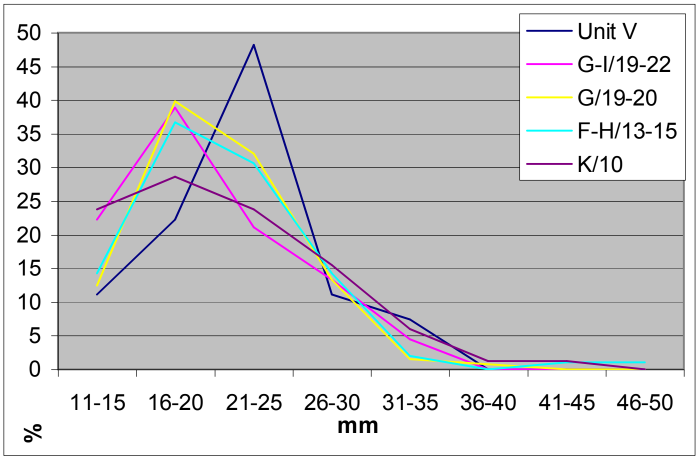
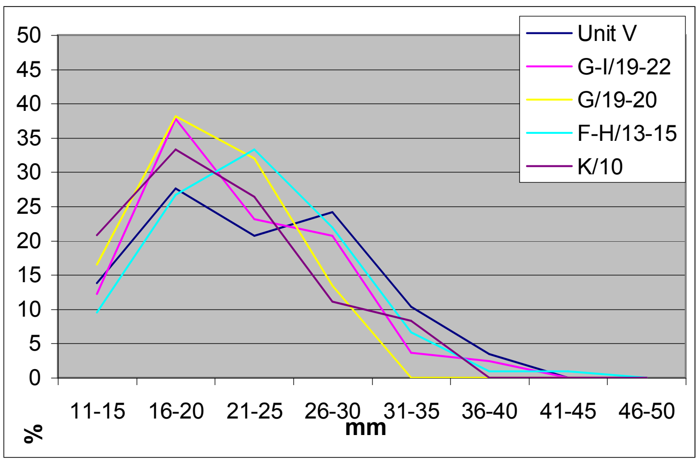


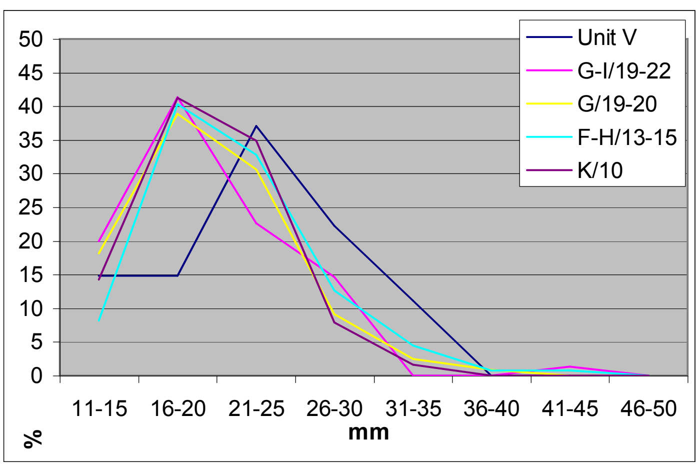
Fig. 118: Width of the three laminar types grouped together (blanks and shaped) from the Qesem Cave samples.
n=Unit V: 83; G-I/19-22: 247; G/19-20: 346; F-H/13-15: 337; K/10: 219.



A: Blades (n=Unit V: 27; G-I/19-22: 90; G/19-20: 128; F-H/13-15: 98; K/10: 84)



B: PE blades (n=Unit V: 29; G-I/19-22: 82; G/19-20: 97; F-H/13-15: 105; K/10: 72)



C: NBKs (n=Unit V: 27; G-I/19-22: 75; G/19-20: 121; F-H/13-15: 134; K/10: 63)

Fig. 119: Width of the three laminar types (blanks and shaped) from the Qesem Cave samples.

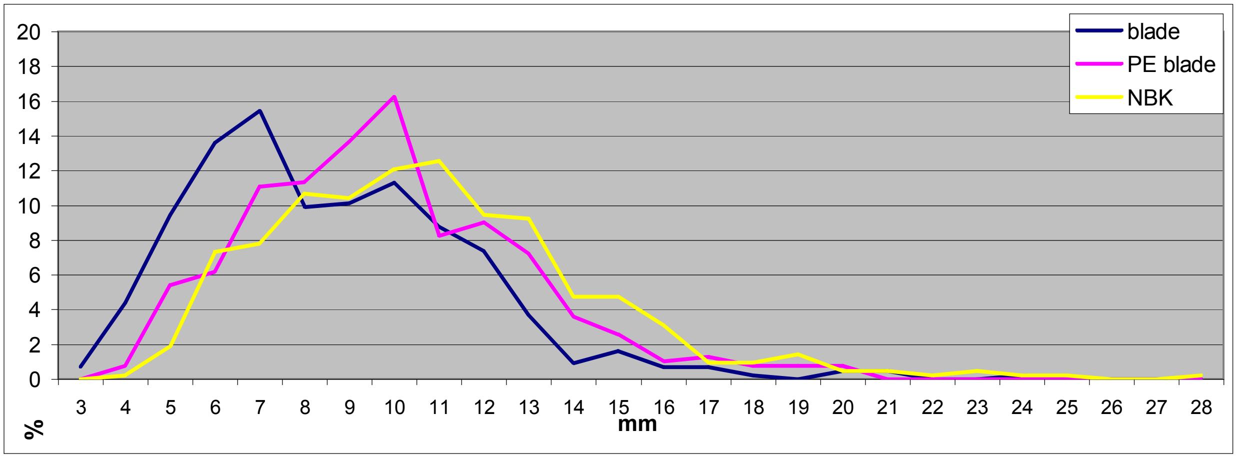


Fig. 120: Thickness of the three laminar types (blanks and shaped) from Qesem Cave.

n= blade: 403; PE blade: 353; NBK: 379.

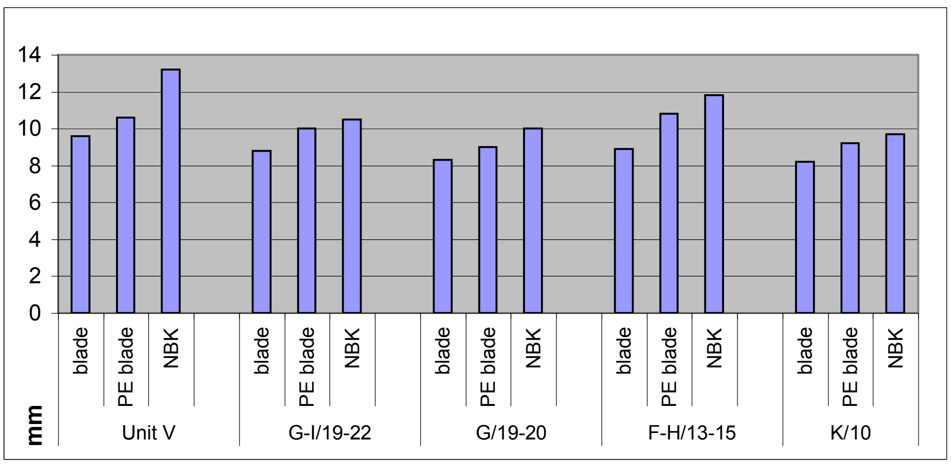


Fig. 121: Mean thickness of the three laminar types (blanks and shaped) from the Qesem Cave samples.

Data retrieved from Table 6.

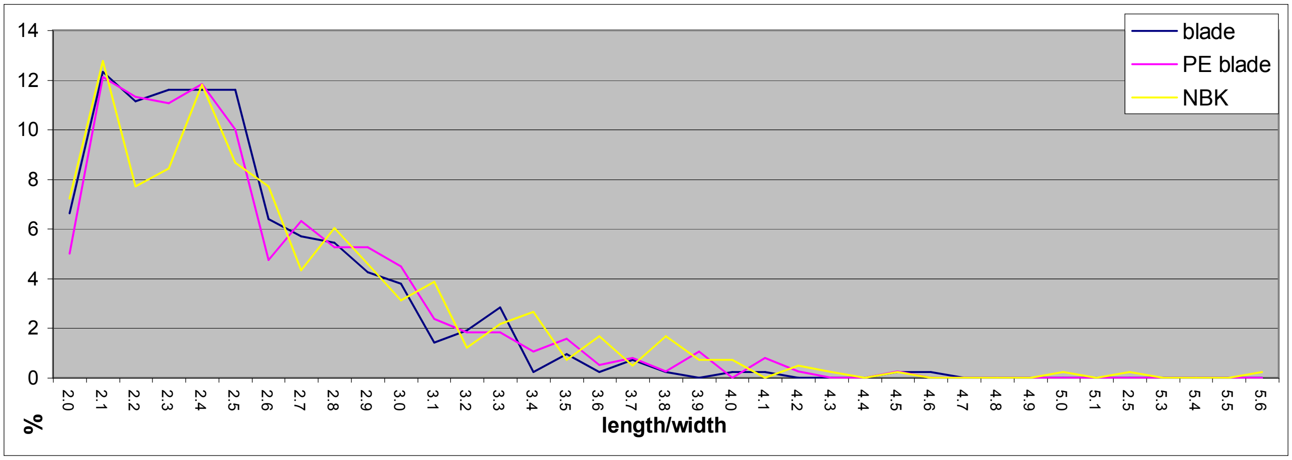


Fig. 122. Length/width ratio of the three laminar types (blanks and shaped) from Qesem Cave.
n= blade: 422; PE blade: 380; NBK: 415.

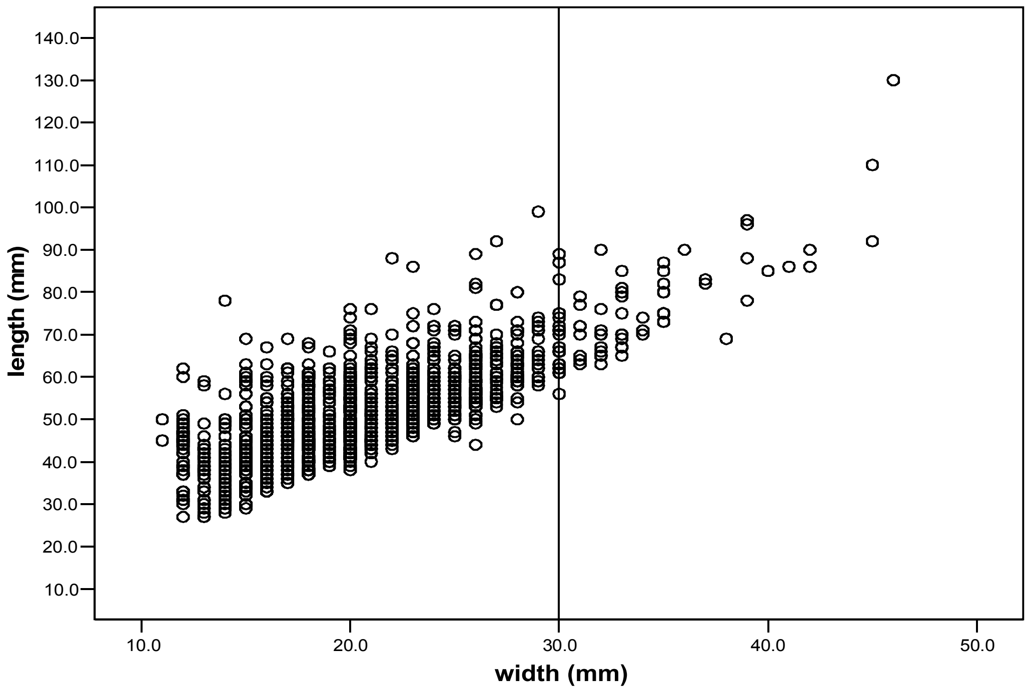


Fig. 123: Scatter pattern of length and width of the three laminar types from Qesem Cave.
n=1,223

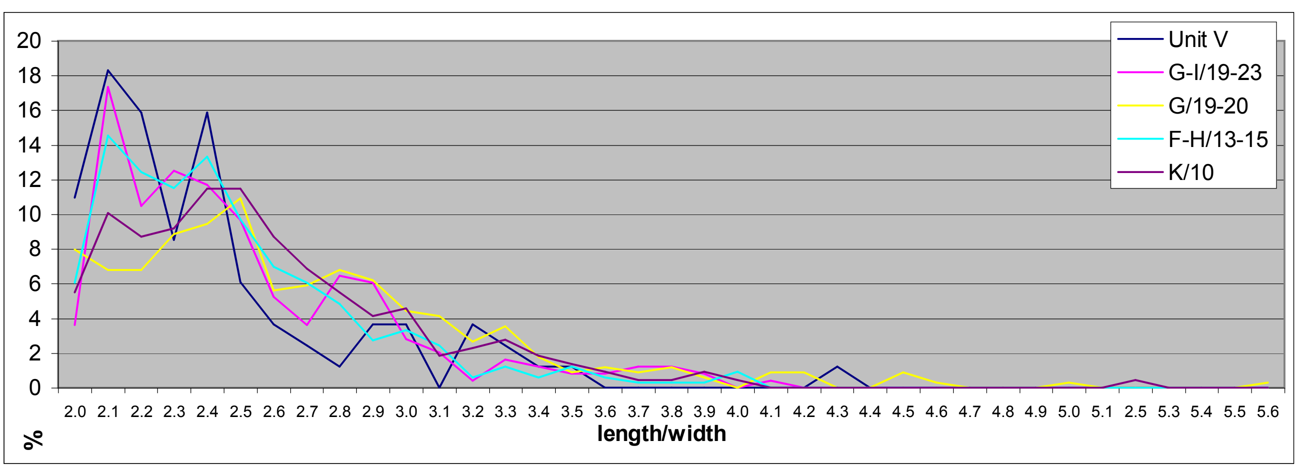


Fig. 124: Length/width ratio of the three laminar types (blanks and shaped) from Qesem Cave samples.
n=Unit V: 82; G-I/19-22: 248; G/19-20: 339; F-H/13-15: 330; K/10:218.

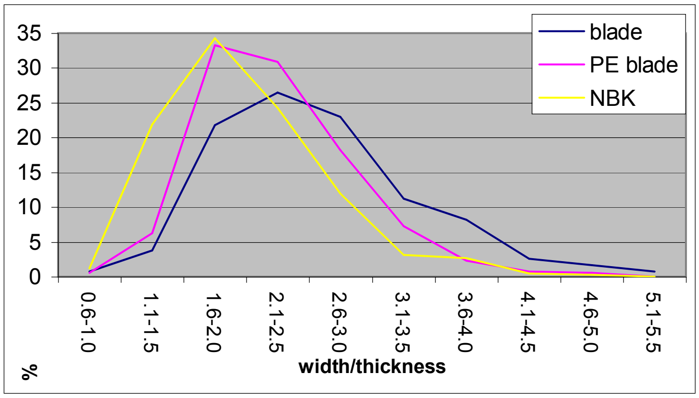
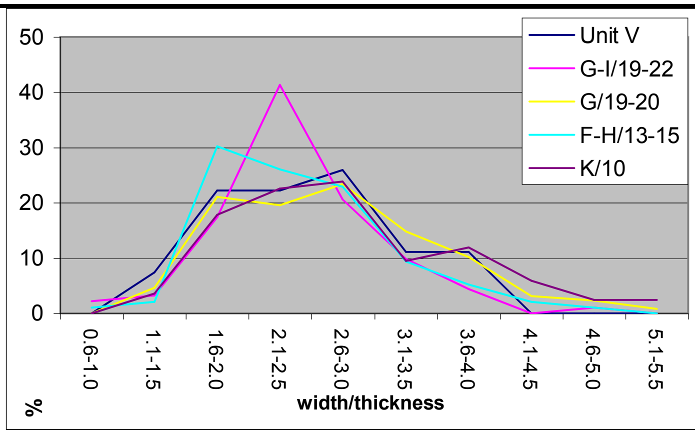
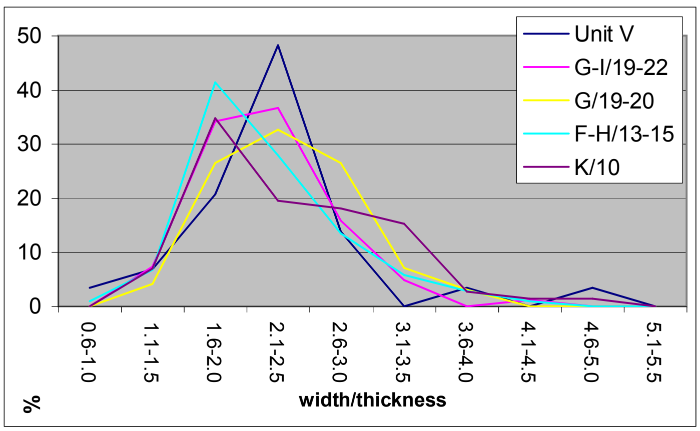


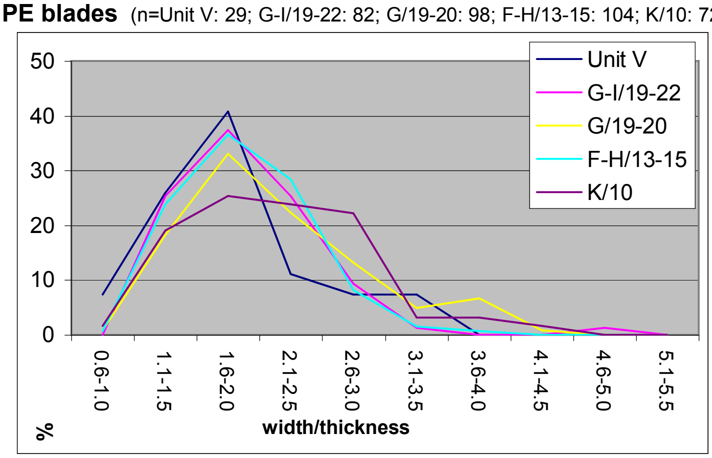
Fig. 125: Width/thickness ratio of the three laminar types (blanks and shaped) from Qesem Cave.
n=blade: 427; PE blade: 385; NBK: 420.



A: Blades (n=Unit V: 27; G-I/19-22: 92; G/19-20: 128; F-H/13-15: 96; K/10: 84)

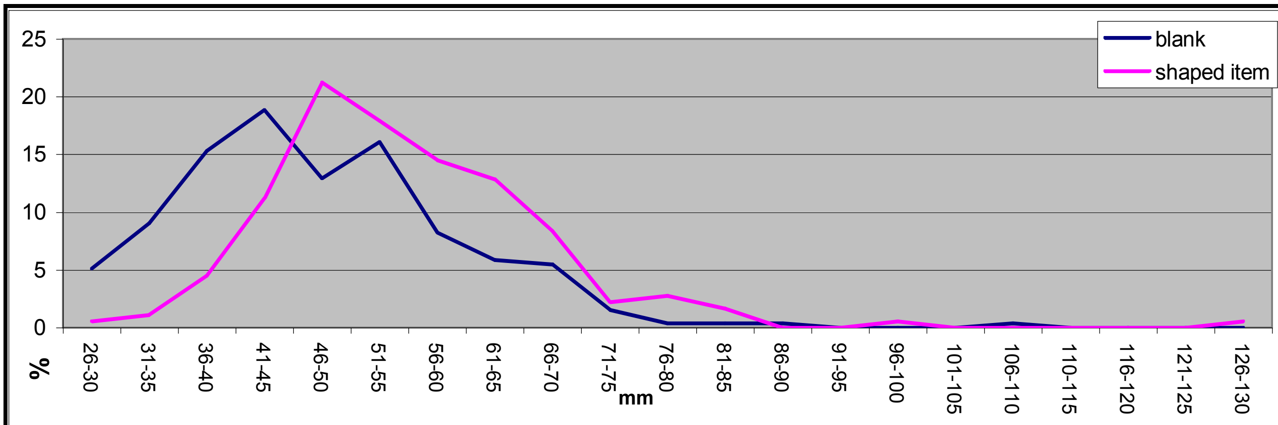


B: PE blades (n=Unit V: 29; G-I/19-22: 82; G/19-20: 98; F-H/13-15: 104; K/10: 72)

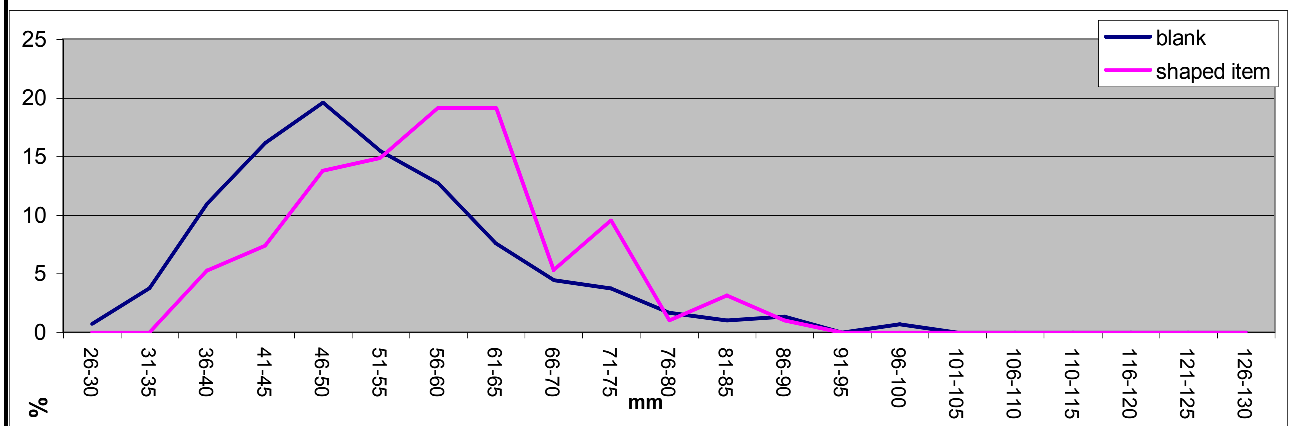


C: NBKs (n=Unit V: 27; G-I/19-22: 75; G/19-20: 121; F-H/13-15: 134; K/10: 63)

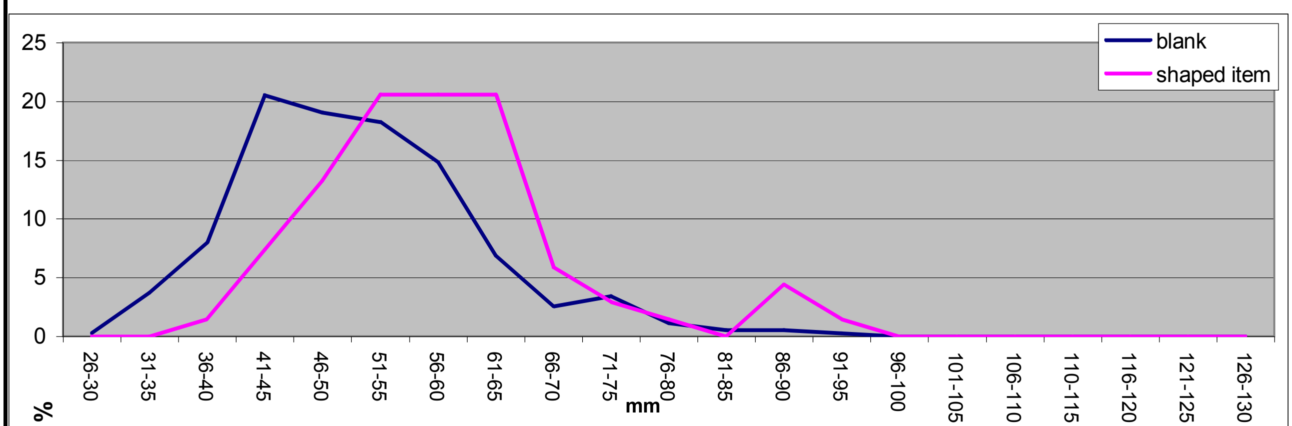
Fig. 126: Width/thickness ratio of the three laminar types (blanks and shaped) from the Qesem Cave samples.



A: Blades: (n= blank: 254; shaped item: 179)

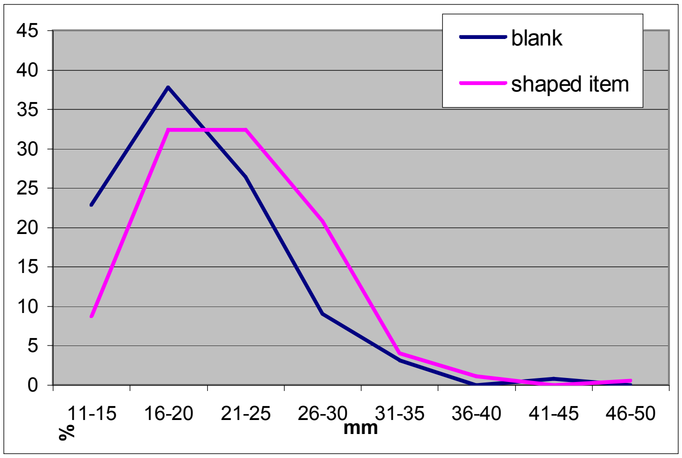


B: PE blades: (n= blank:291; shaped item: 91)

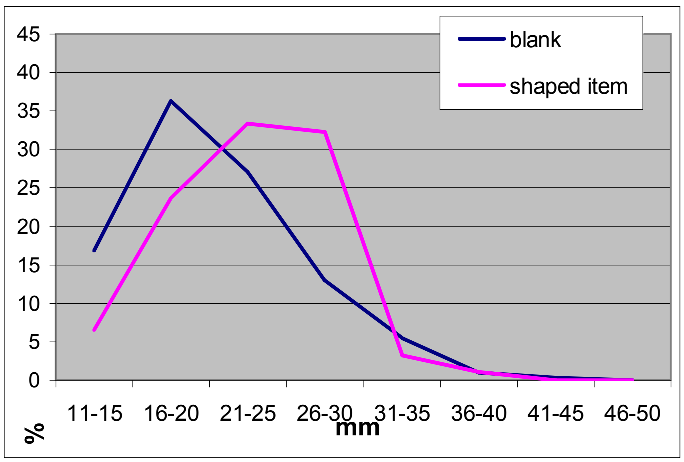


C: NBKs: (n= blank: 333; shaped item: 65)

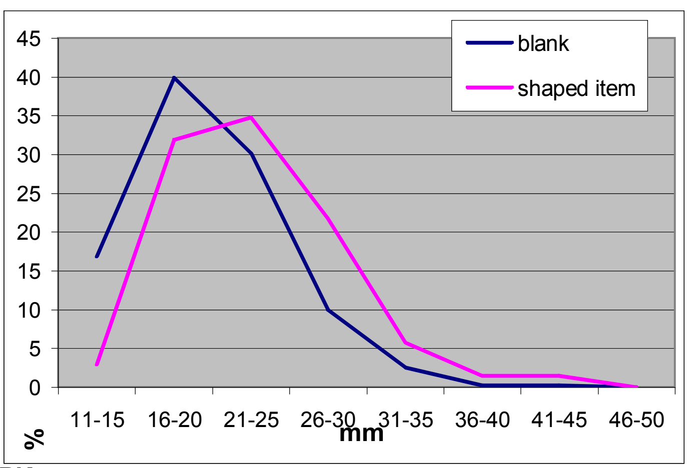
Fig. 127: Length of blanks and shaped laminar items from Qesem Cave.



A: Blades (n=blank: 261; shaped item: 177)

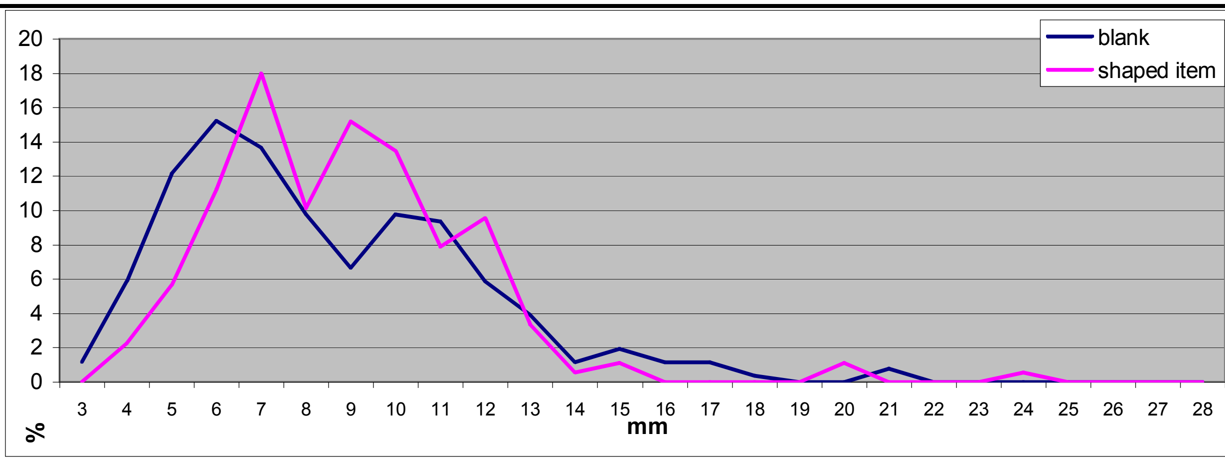


B: PE Blades (n=blank: 297; shaped item: 89)

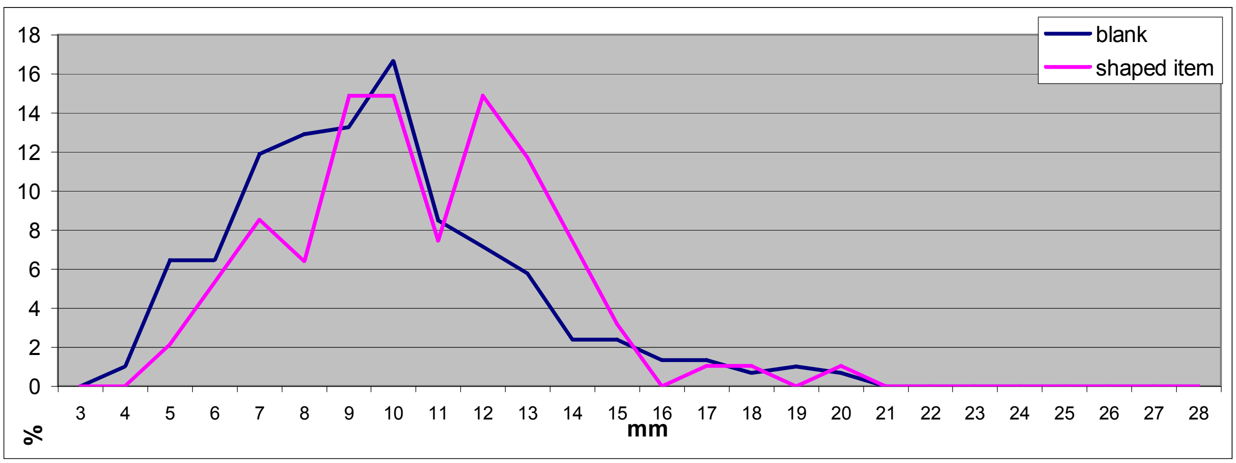


C: NBKs (n=blank: 342; shaped item: 65)

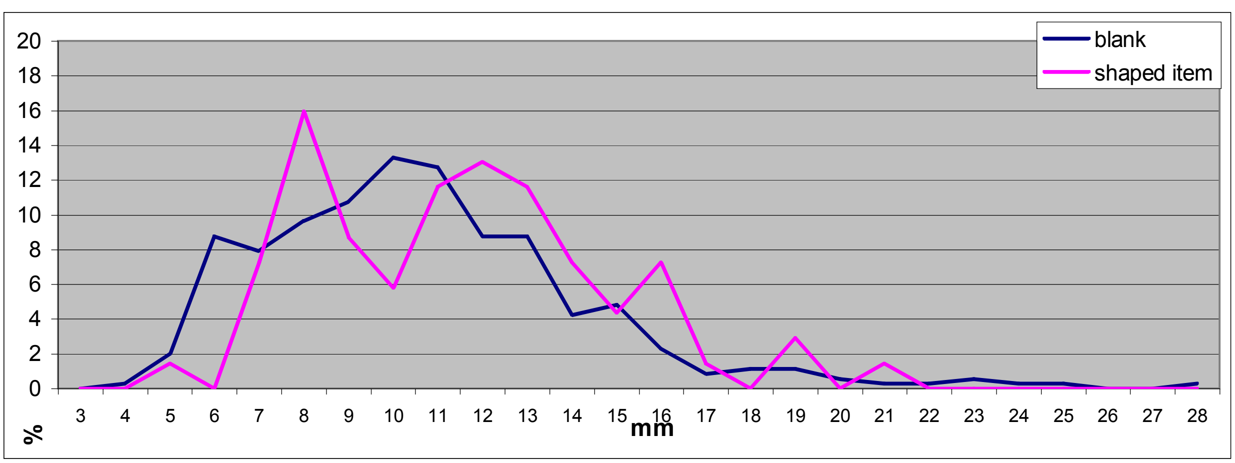
Fig. 128: Width of blanks and shaped laminar items from Qesem Cave.



A: Blades: (n=blank: 237; shaped item: 166)



B: PE blades: (n=blank: 262; shaped item: 91)



C: NBKs: (n=blank: 314; shaped item: 65)

Fig. 129: Thickness of blanks and shaped laminar items from Qesem Cave.

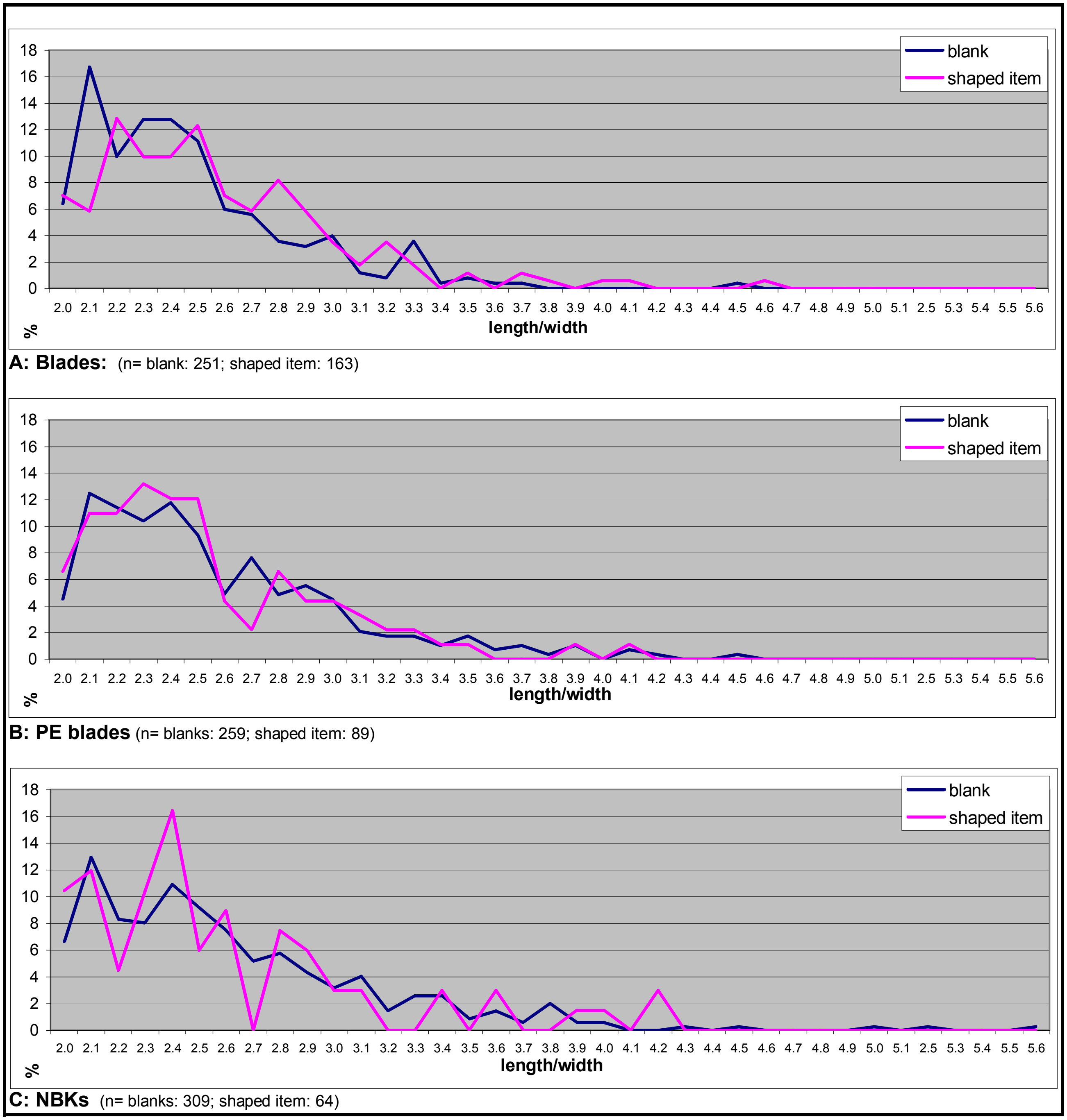
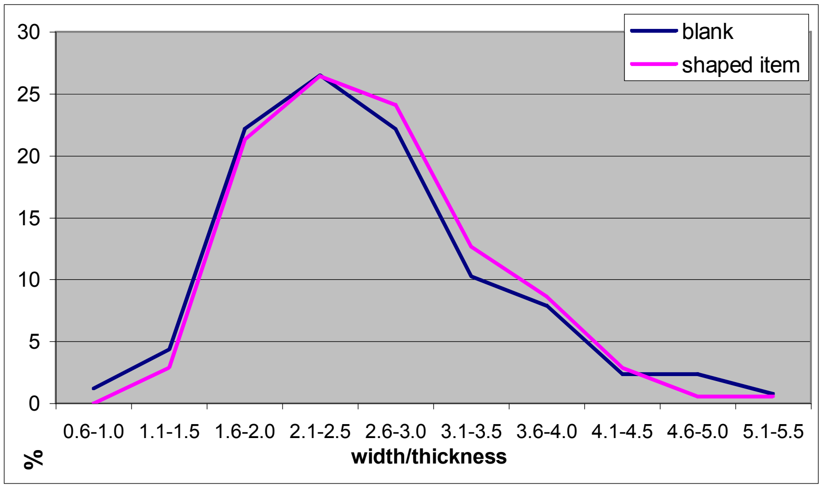
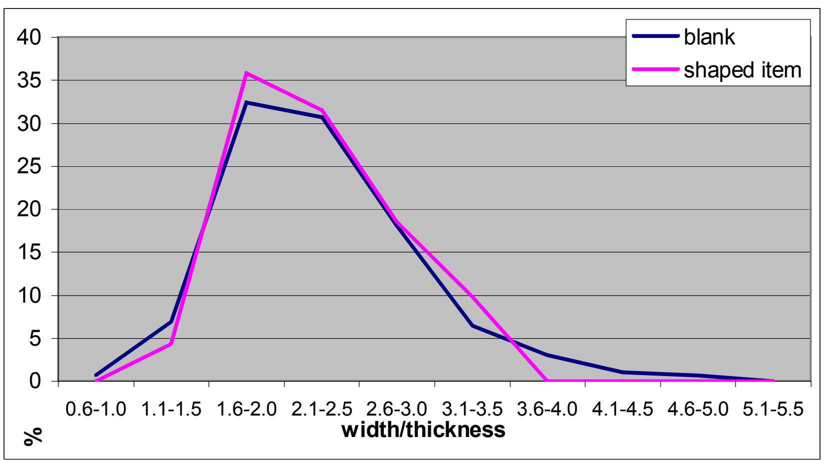


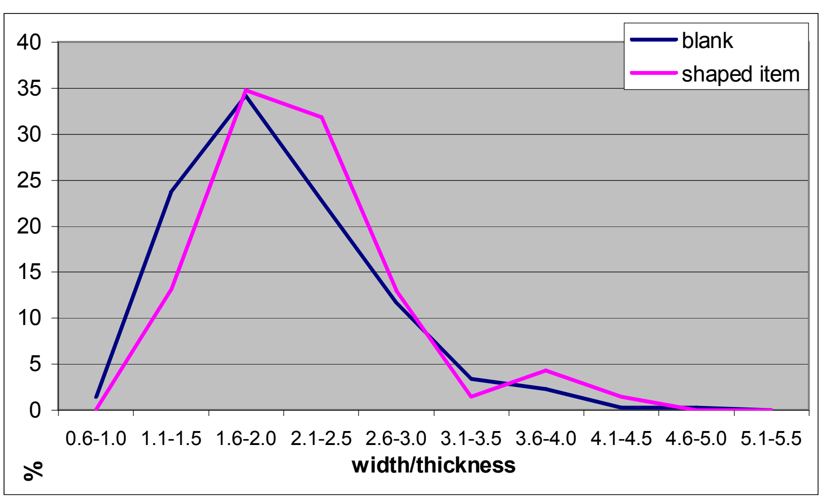
Fig. 130: Length/width ratio of blanks and shaped laminar items from Qesem Cave.



A: Blades (n=blank: 253; shaped item: 174)



B: PE blades (n=blank: 293; shaped item: 92)



C: NBKs (n=blank: 351; shaped item: 69)

Fig. 131: Width/thickness ratio of blanks and shaped laminar items from Qesem Cave.

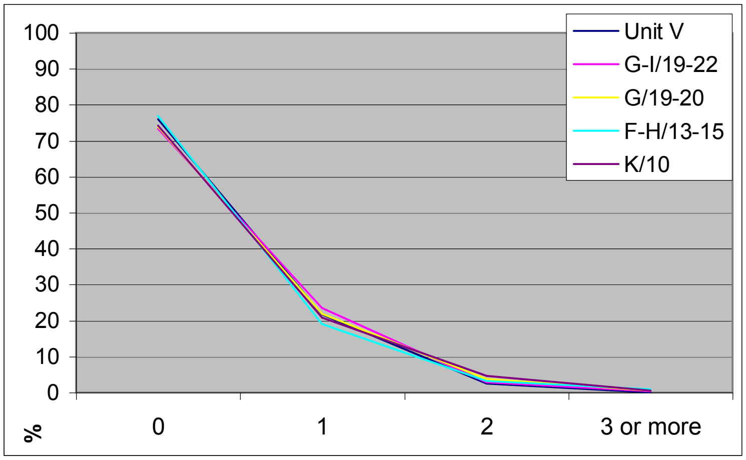


Fig. 132: Number of hinge scars on the three laminar types grouped together (blank and shaped) from the Qesem Cave samples.

n=Unit V: 83; G-I/19-22: 251; G/19-20: 348; F-H/13-15: 342; K/10: 217.

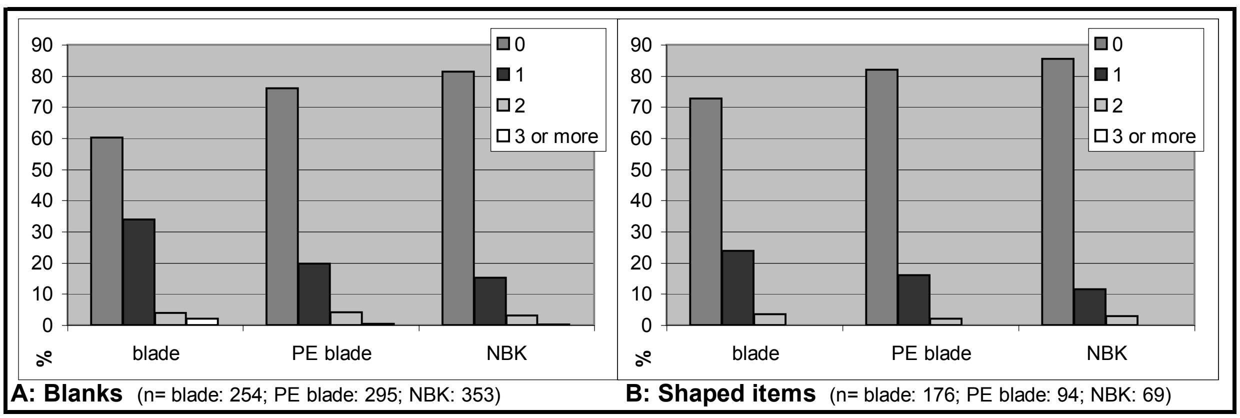


Fig. 133: Number of hinge scars on laminar blanks and shaped laminar items from Qesem Cave.

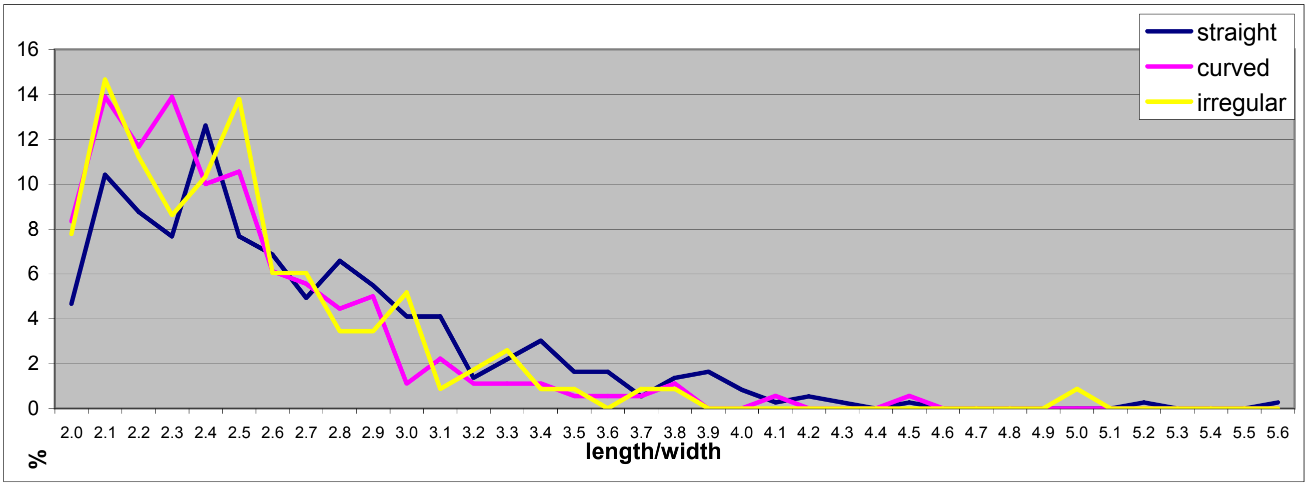


Fig. 134: Length/width ratio of PE blades and NBKs (blanks and shaped) from Qesem Cave in correlation to the outline of the cortical edge.

n=straight: 365; curved: 180; irregular: 116.

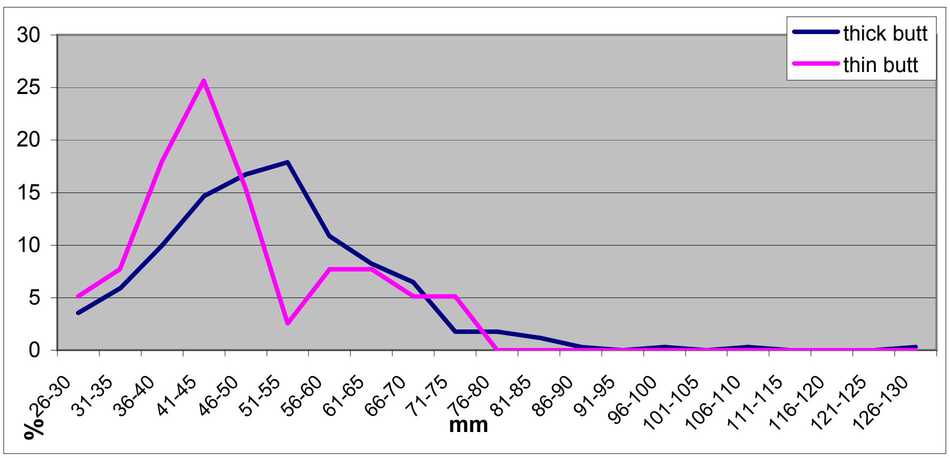


Fig. 135: Length of blades (blanks and shaped) from Qesem Cave in correlation to the thickness of the butt.

Thick butts include: large plain and modified (n=341).

Thin butts include: thin plain and punctiform (n=39).

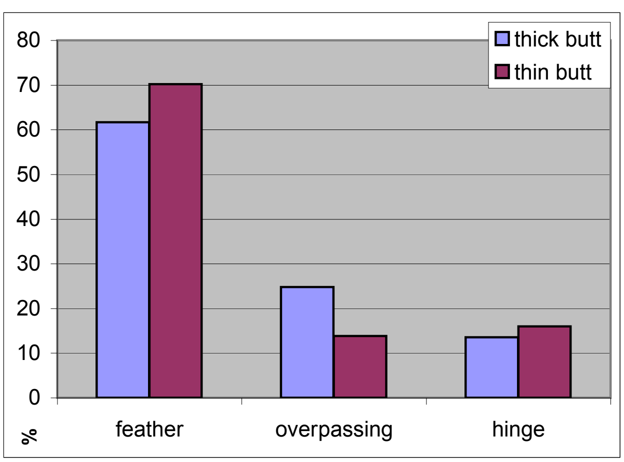


Fig. 136: Correlation between butt thickness and end termination of all three laminar types from Qesem Cave.

n=thick butt: 900; thin butt: 94.

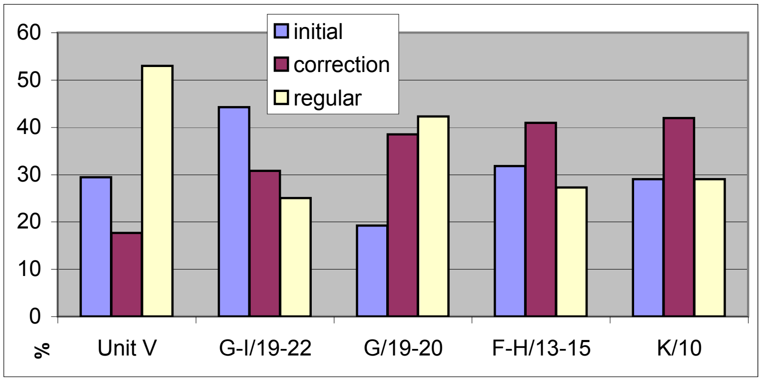


Fig. 137: Division of overpass items from Qesem Cave into categories.
n=Unit V: 17; G-I/19-22: 52; G/19-20: 52; F-H/13-15: 66; K/10:31.

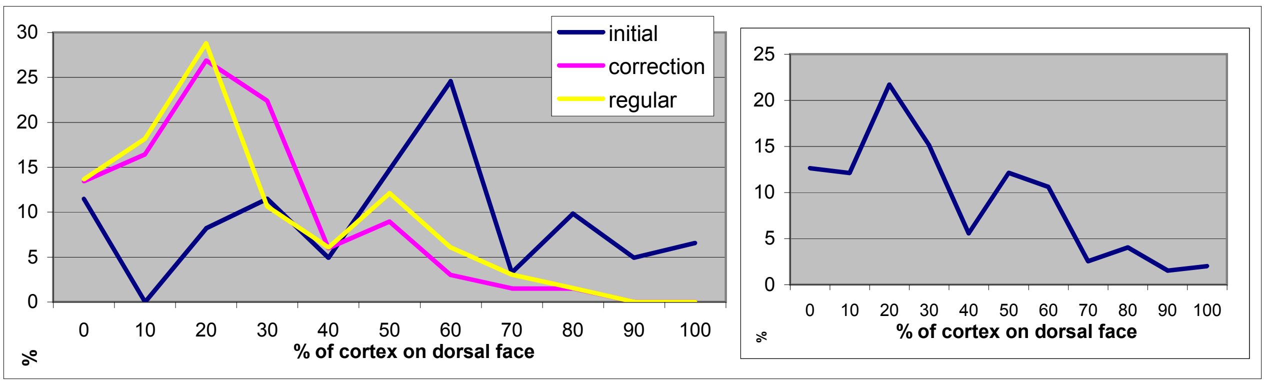


Fig. 138: Percentage of cortex on dorsal face of whole overpass items from Qesem Cave.
On the left it is according to categories, on the right as one.
n=initial: 61; correction: 67; regular: 66; all (including unidentified): 197.

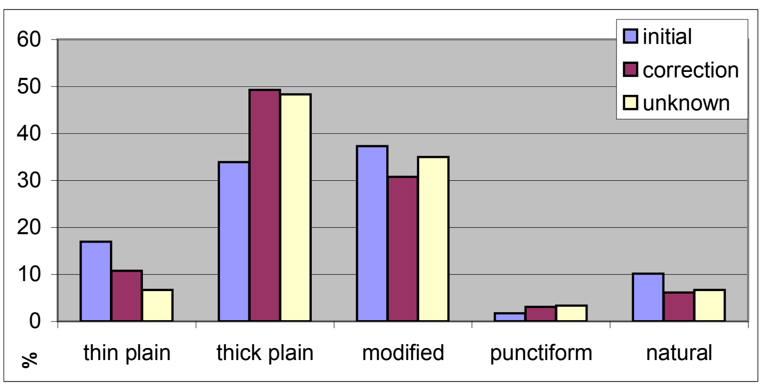


Fig. 139: Butt type of overpass items from Qesem Cave according to categories.
n=initial: 59; correction: 65; regular: 60.

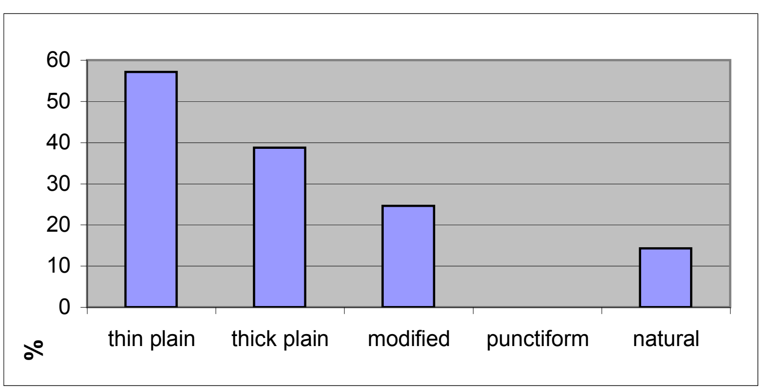


Fig. 140: Micro flaking of the edge of various butt types of overpass items from Qesem Cave.
n=thin plain: 21; thick plain: 80; modified:65; punctiform: 5; natural: 14.

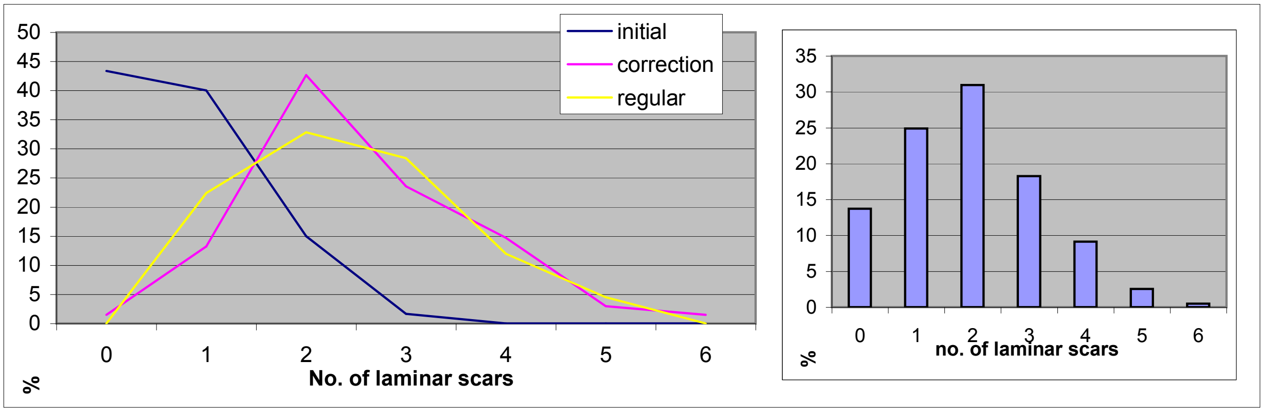


Fig. 141: Number of laminar scars on overpass items from Qesem Cave.

On the left a division according to different categories, to the right all overpass items as one.

n=initital: 60; correction: 68; regular: 67; all (including unidentified): 197.

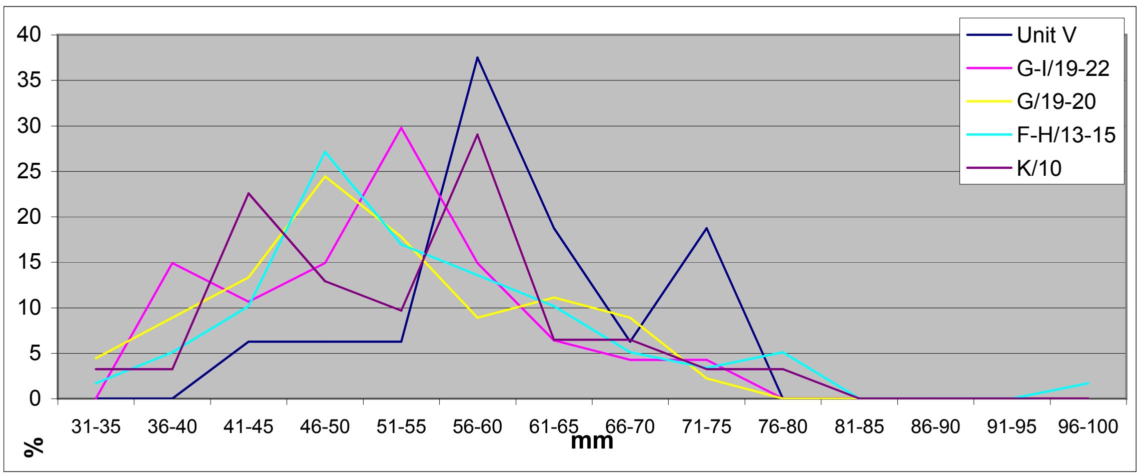


Fig. 142: Length of overpass items from Qesem Cave samples.

n=Unit V: 16; G-I/19-22: 47; G/19-20: 45; F-H/13-15: 59; K/10: 31.

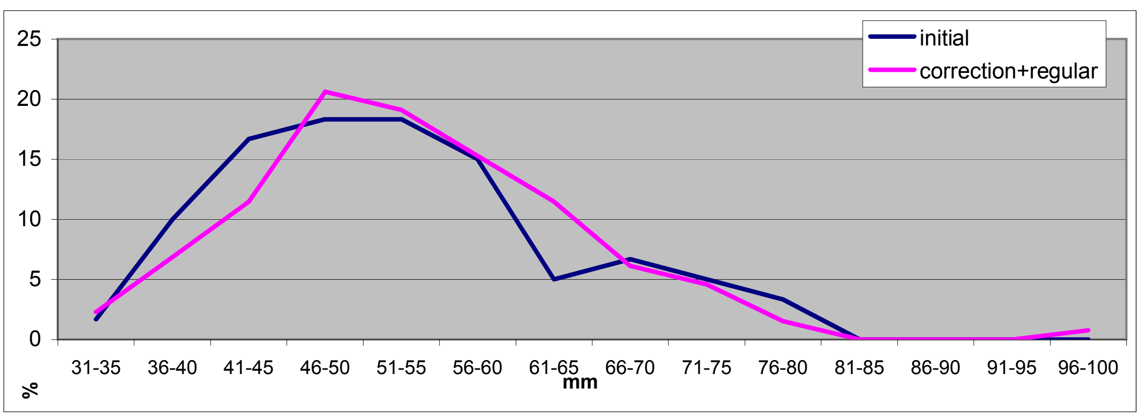


Fig. 143: Length of overpass items according to categories from Qesem Cave.

n=initial: 60; correction and regular: 131.

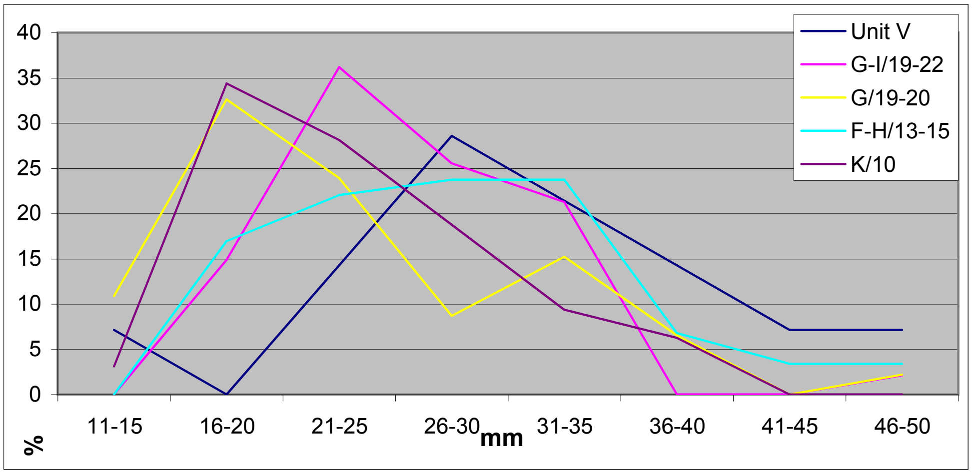


Fig. 144: Width of overpass items from Qesem Cave samples.
n=Unit V: 14; G-I/19-22: 47; G/19-20: 46; F-H/13-15: 59; K/10: 32.

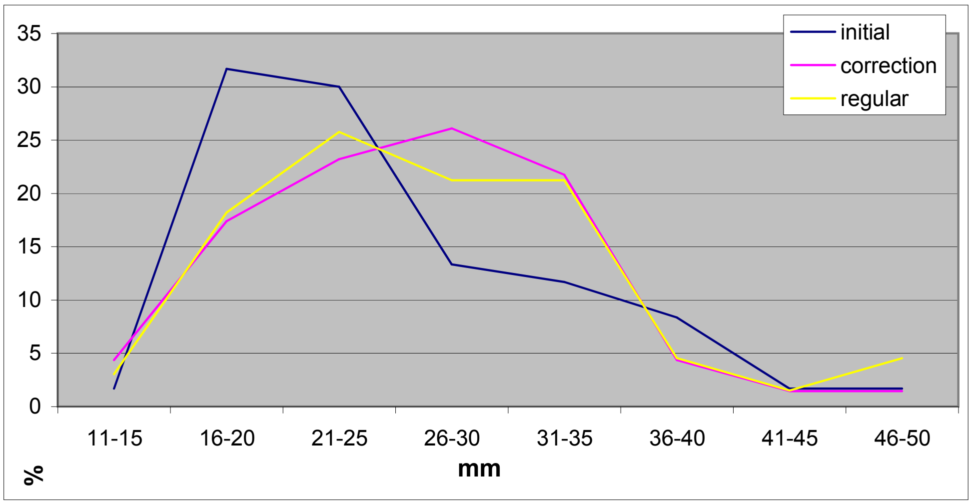


Fig. 145: Width of overpass items from Qesem Cave according to categories.
n=initial: 60; correction: 69; regular: 66.

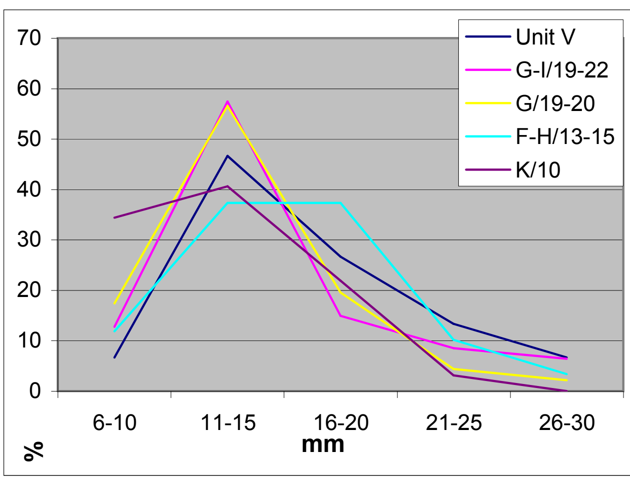


Fig. 146: Thickness of overpass items from Qesem Cave samples.
n=Unit V: 15; G-I/19-22: 47; G/19-20: 46; F-H/13-15: 59; K/10: 32.

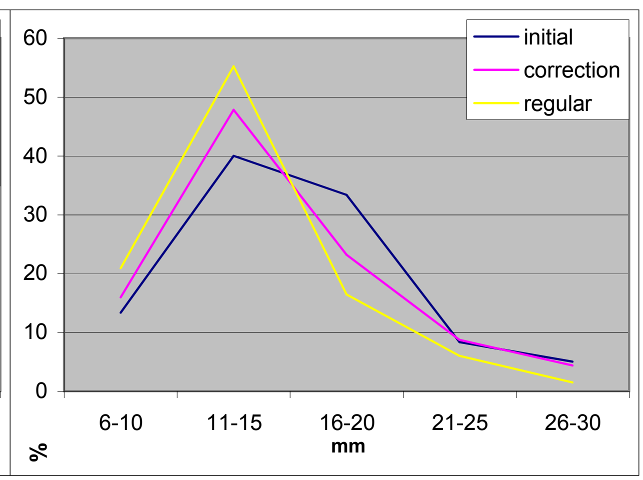


Fig. 147: Thickness of overpass items according to categories from Qesem Cave.
n=initial: 60; correction: 69; regular: 67.

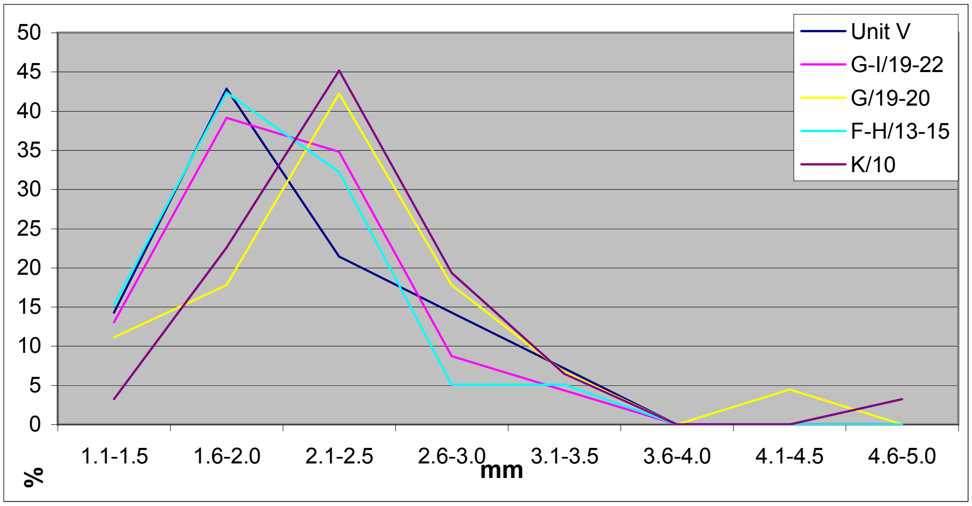


Fig. 148: Length/width ratio of overpass items from Qesem Cave samples.
n=Unit V: 14; G-I/19-22: 46; G/19-20: 45; F-H/13-15: 59; K/10: 31.

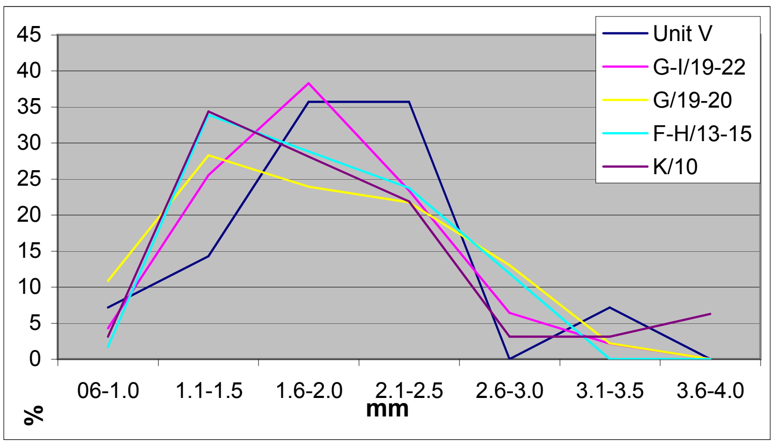


Fig. 149: Width//thickness ratio of overpass items from Qesem Cave samples.
n=Unit V: 14; G-I/19-22: 47; G/19-20: 46; F-H/13-15: 59; K/10: 32.

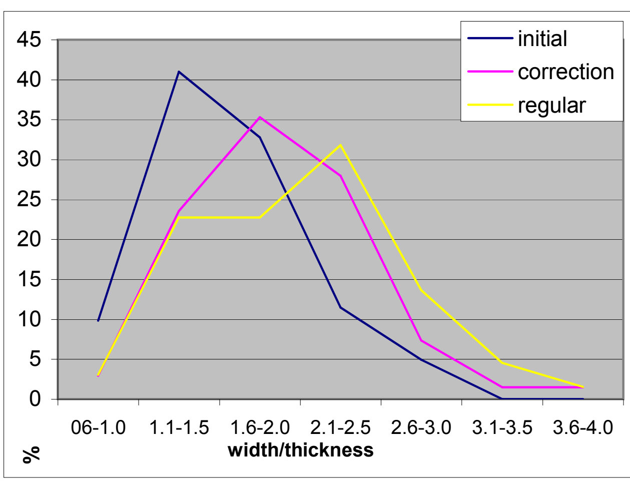


Fig. 150: width/thickness ratio of overpass items according to category from Qesem Cave.
n=initial: 60; correction: 69; regular: 66.

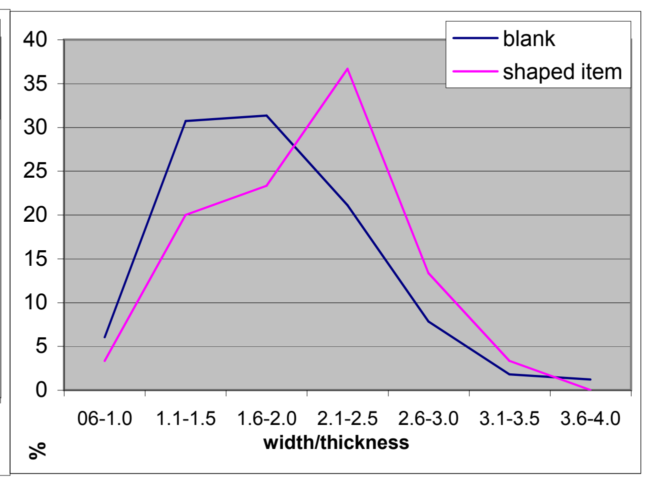


Fig. 151: Width/thickness ratio of blanks and shaped overpass items from Qesem Cave.
n=blank: 166; shaped item: 30.

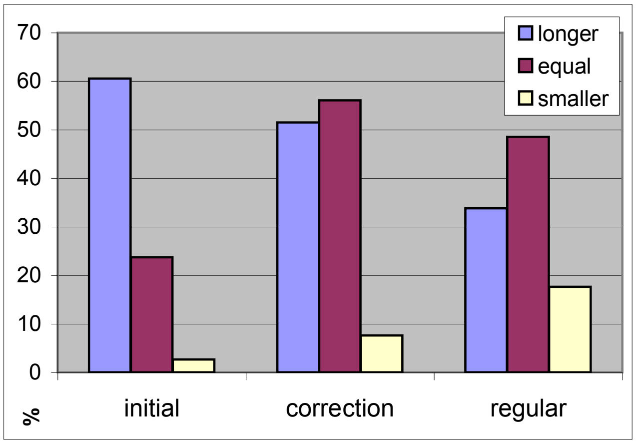


Fig. 152: Changes in the debitage surface length according to overpass items from Qesem Cave.
n=initial: 76; correction: 66; regular: 68.

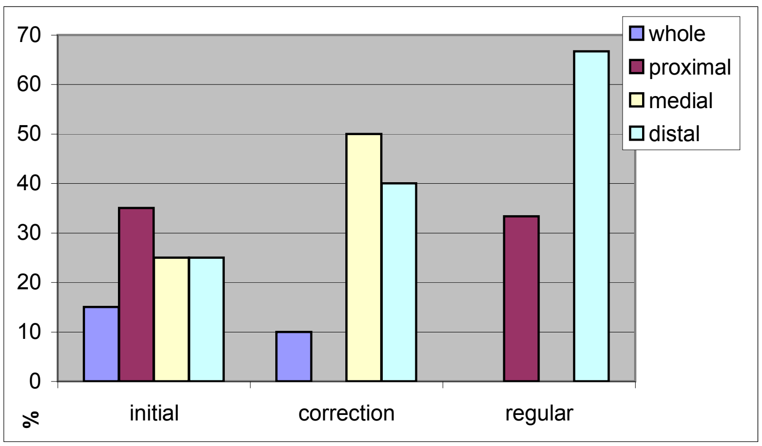


Fig. 153: Location of crest on overpass items from Qesem Cave.
n=initial: 20; correction: 10; regular: 3.

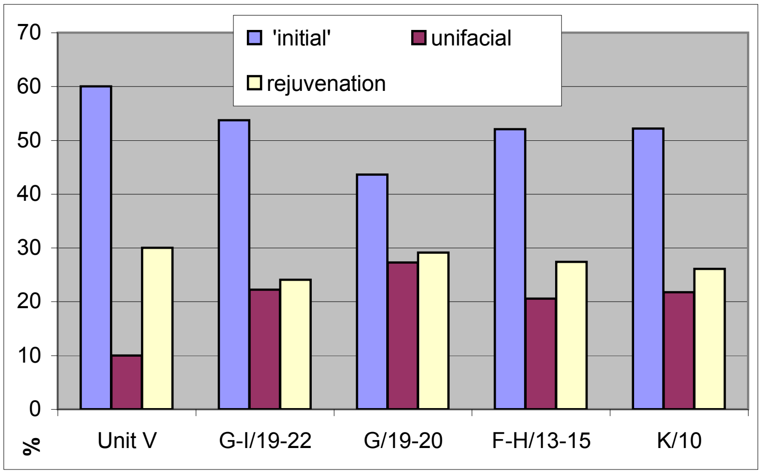


Fig. 154: Categories of crested blades from Qesem Cave samples.
n= Unit V: 10; G-I/19-23: 54; G/19-20: 55; F-H/13-15: 73; and K/10: 23.

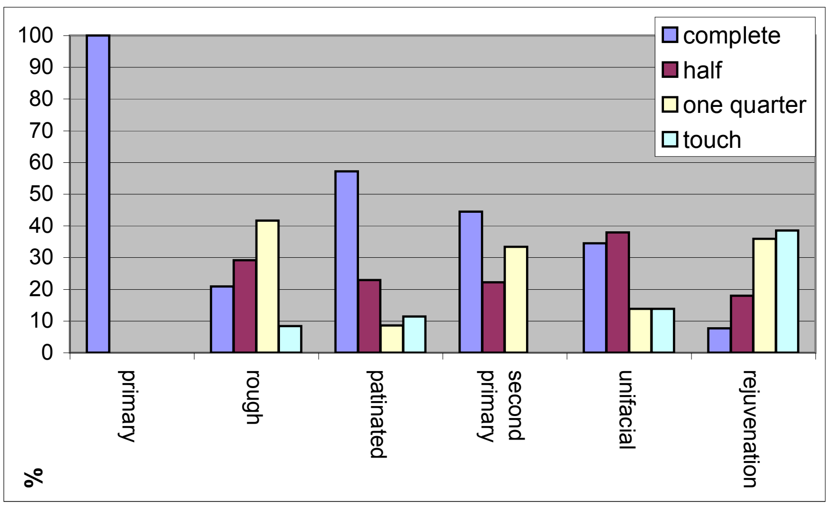


Fig. 155: Intensity of the shaped ridge along the length of the item from Qesem Cave.
n=primary: 4; rough: 24; patinated: 35; second primary: 9; unifacial: 29; rejuvenation: 39.

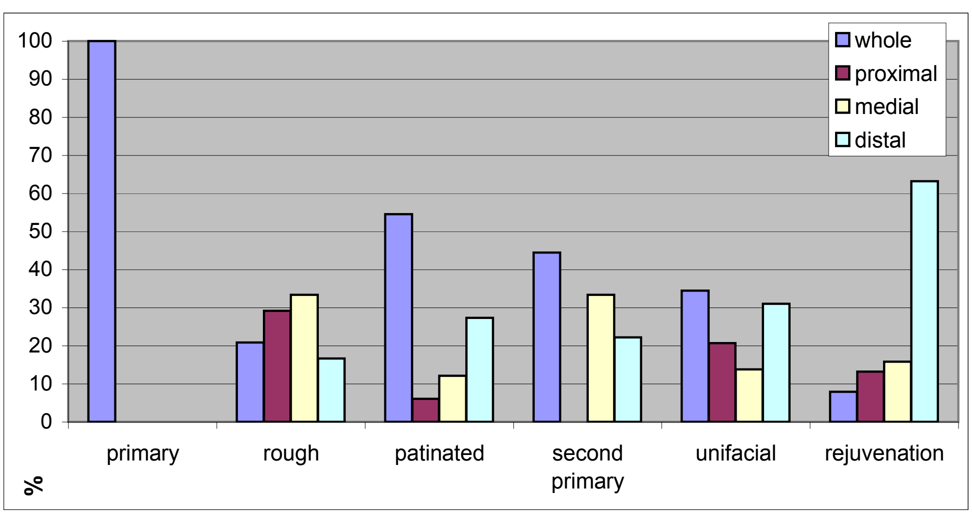


Fig. 156: Location of the shaped ridge along the crested blades length from Qesem Cave.
n=primary: 2; rough: 24; patinated: 33; second primary: 9; unifacial: 29; rejuvenation: 38.

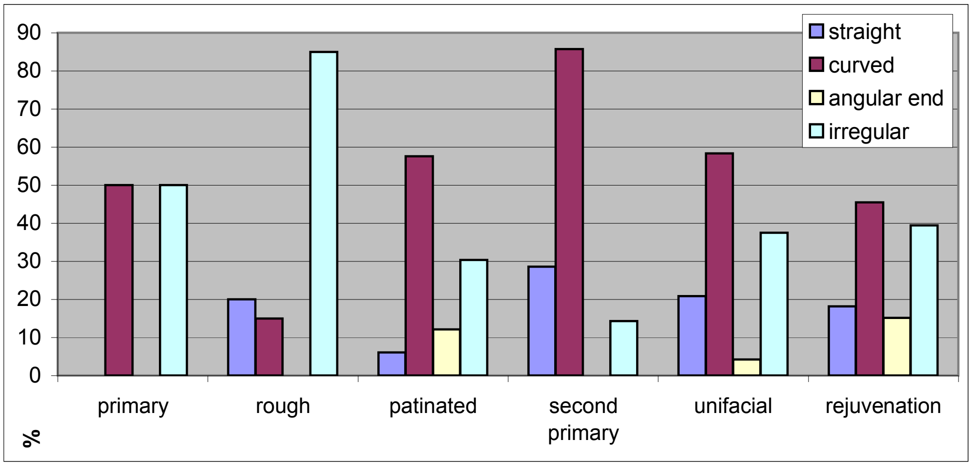


Fig. 157: Profile of the ridge shaped on the dorsal face of crested blades from Qesem Cave.
n=primary: 4; rough: 20; patinated: 33; second primary: 7; unifacial: 24; rejuvenation: 33.

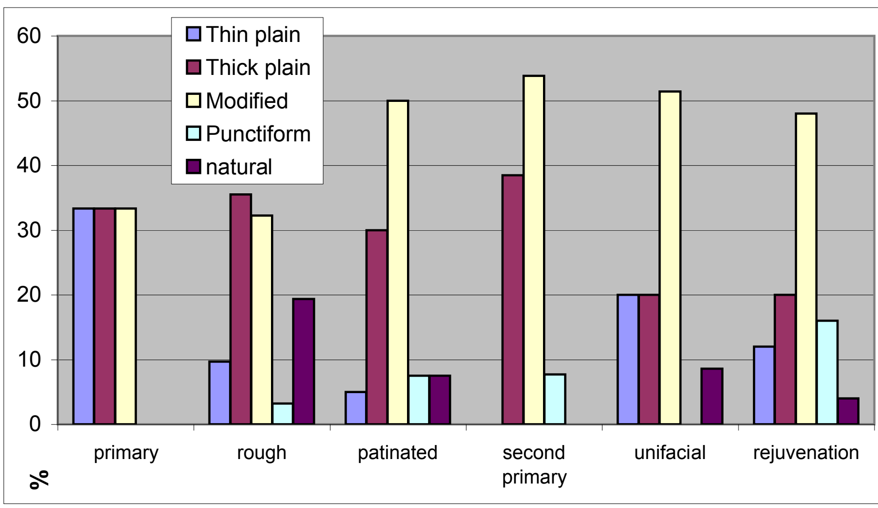


Fig. 158: Butt type on crested blade sub-types from Qesem Cave.
n=primary: 3; rough: 31; patinated: 40; second primary: 13; unifacial: 35; and rejuvenation: 25.

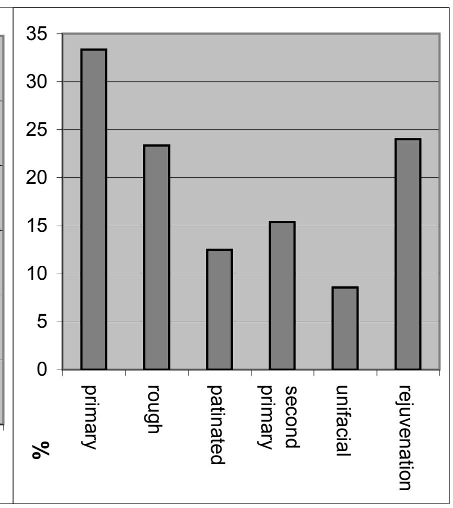


Fig. 159: micro edge flaking on the butt of crested blades from Qesem Cave.
n=primary: 3; rough: 30; patinated: 40; second primary: 13; unifacial: 35; rejuvenation: 25.

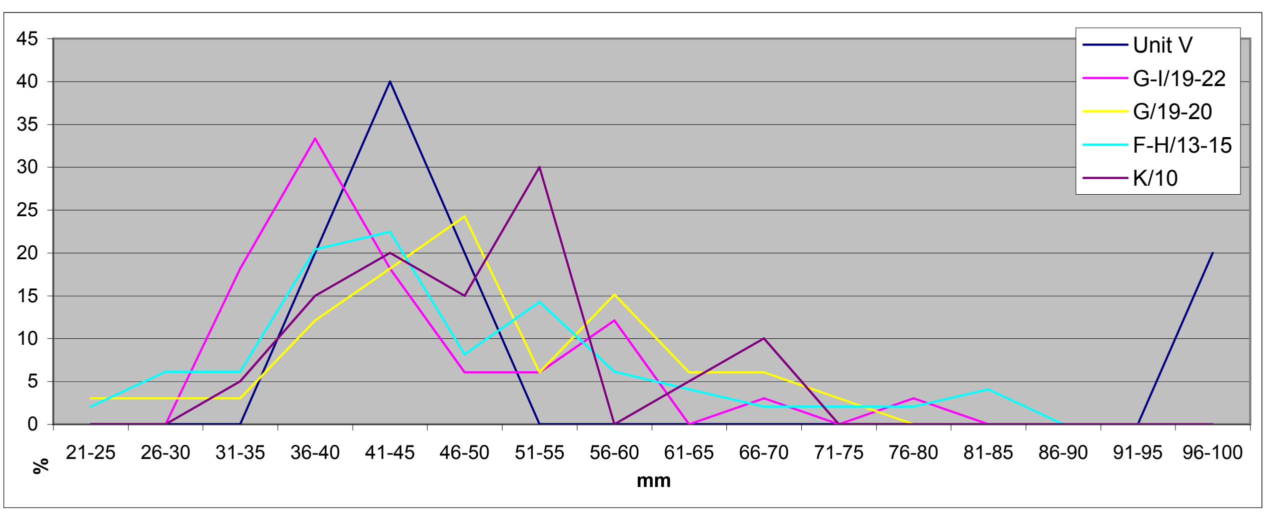


Fig. 160: Length of crested blades from Qesem Cave samples.
n=Unit V: 5; G-I/19-23: 49; G/19-20: 33; F-H/13-15: 33; K/10: 20.

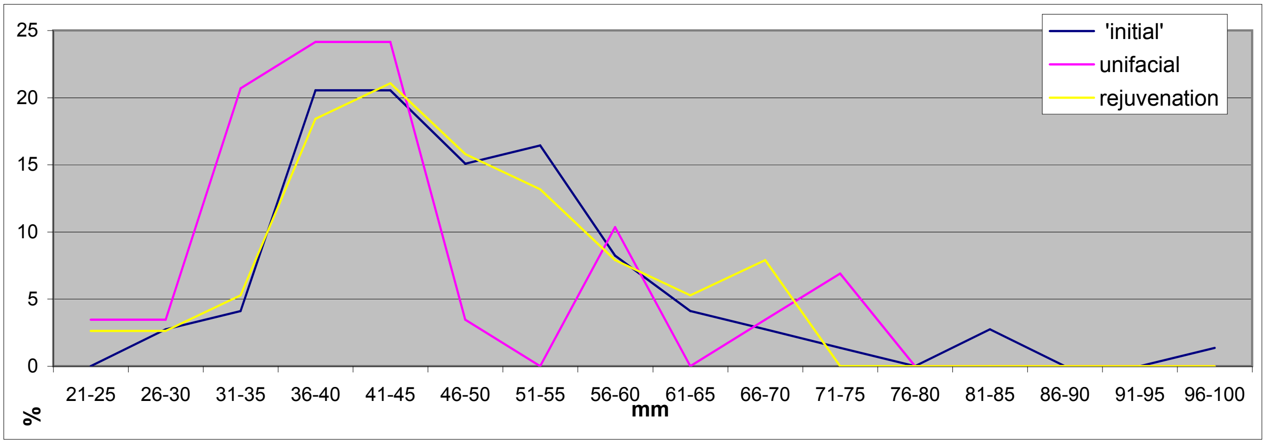


Fig. 161: Length of crested blades of the three categories from Qesem Cave.
n='initial': 73; unifacial: 29; rejuvenation: 38.

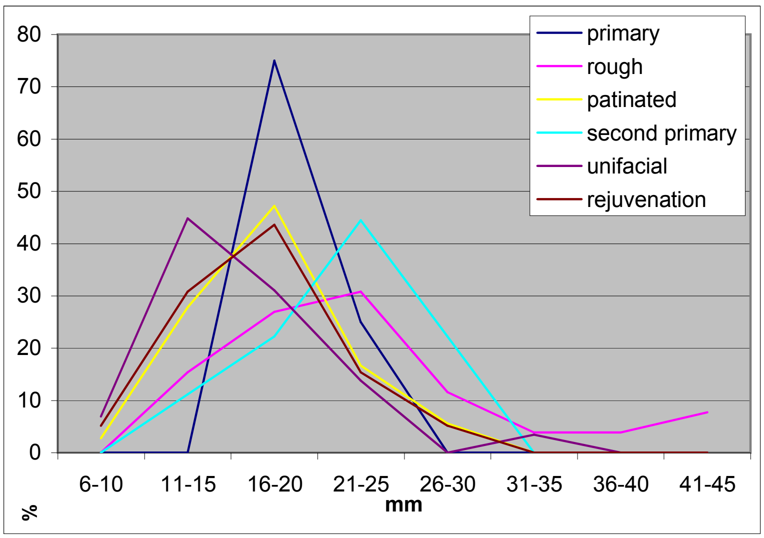


Fig. 162: Width of crested blades from Qesem Cave.
n=primary: 4; rough: 26; patinated: 36; second primary: 9; uni-facial: 29;
rejuvenation: 39.

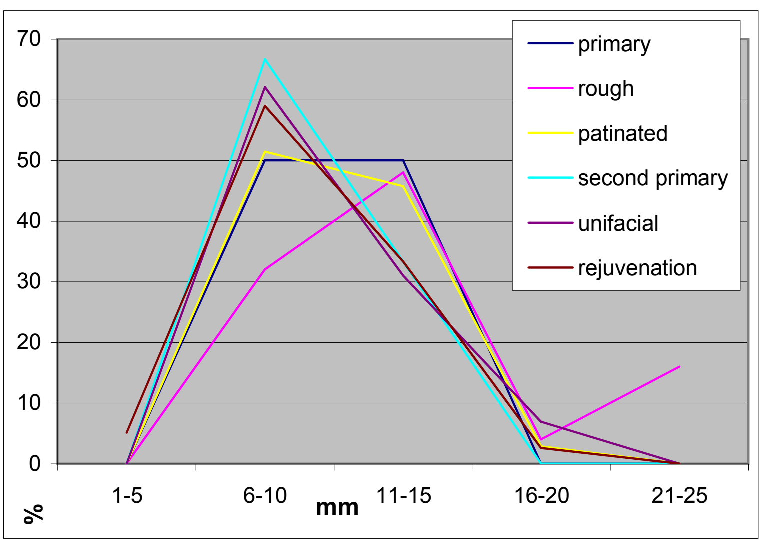


Fig. 163: Thickness of crested blades from Qesem Cave.
n=primary: 4; rough: 25; patinated: 35; second primary: 9;
uni-facial: 29; rejuvenation: 39.

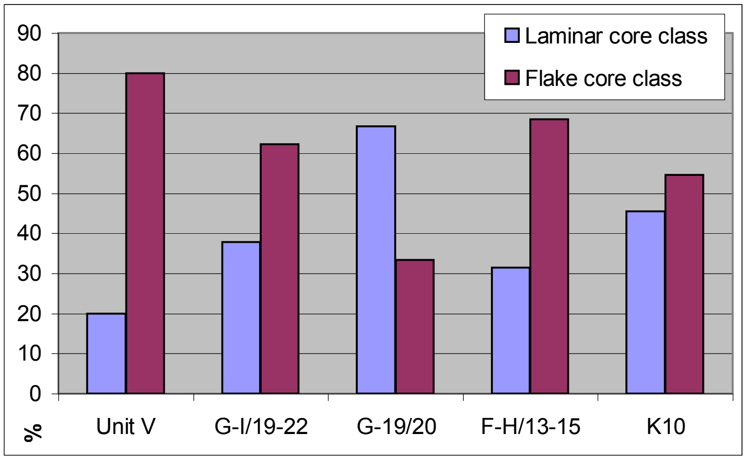


Fig. 164: The laminar and flake core classes from Qesem Cave samples.
n=Unit V: 20; G=I/19-22: 90; G/19-20: 42; F-H/13-15: 143; K/10: 22.

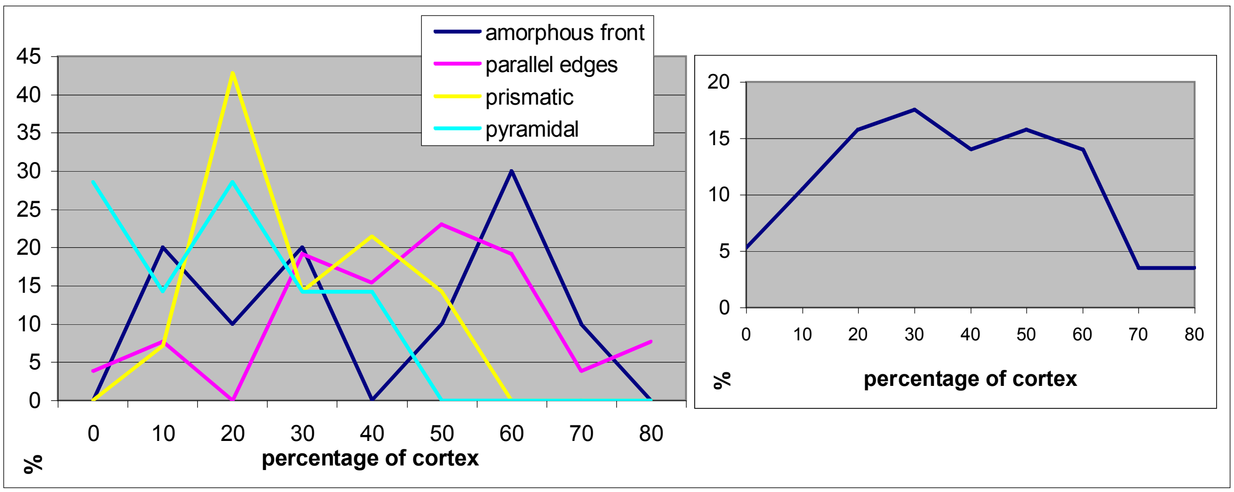


Fig. 165: Percentage of cortex on 'single striking platform laminar cores' from Qesem Cave.
To the left according to shape, to the right all as one group
n=amorphous front: 10; parallel edges: 26; prismatic: 14; pyramidal: 7; total: 57.

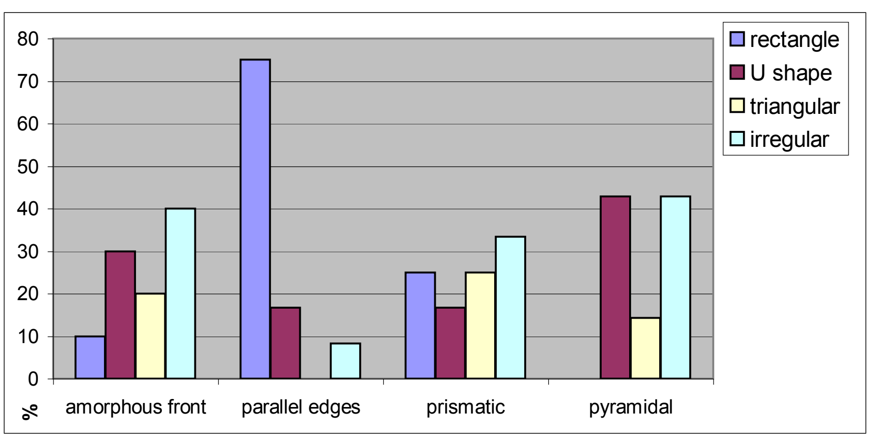


Fig. 166: Shape of the debitage surface of 'single striking platform laminar cores' from Qesem Cave.
n=amorphous front: 10; parallel edges: 24; prismatic: 12; pyramidal: 7.

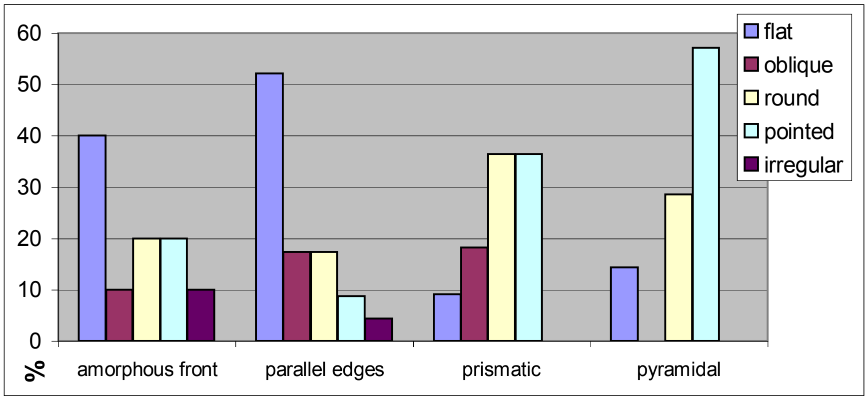


Fig. 167: Base shape of 'single striking platform laminar cores' from Qesem Cave.
n=amorphous front: 10; parallel edges: 23; prismatic: 11; pyramidal: 7.

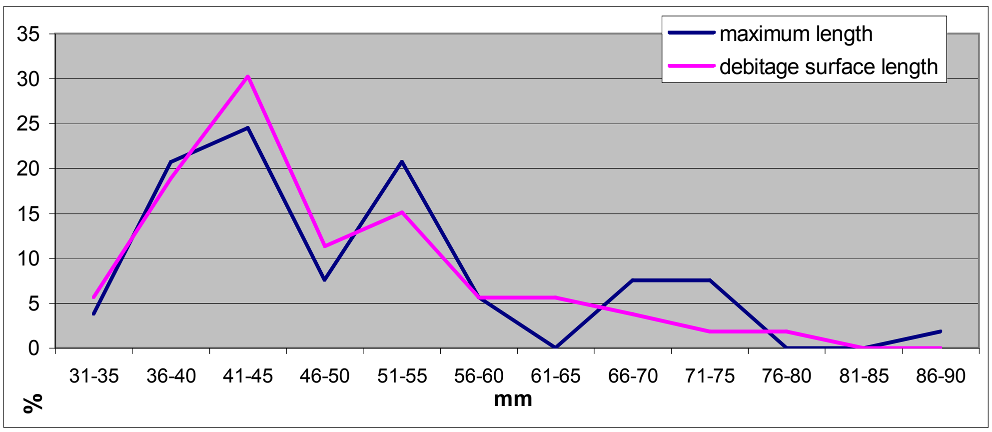


Fig. 168: Length of 'single striking platform laminar cores' from Qesem Cave.
n=53.

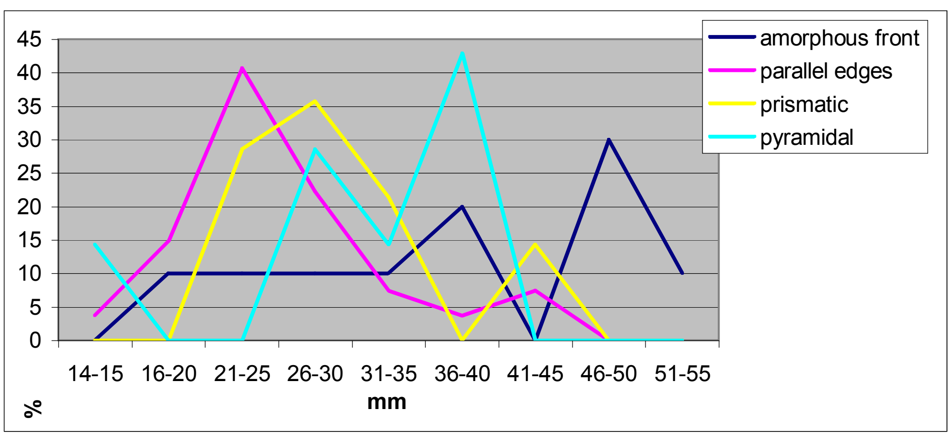


Fig. 169: Maximum width of 'single striking platform laminar cores' from Qesem Cave.
n=amorphous front: 10; parallel edges: 27; prismatic: 14; pyramidal: 7.

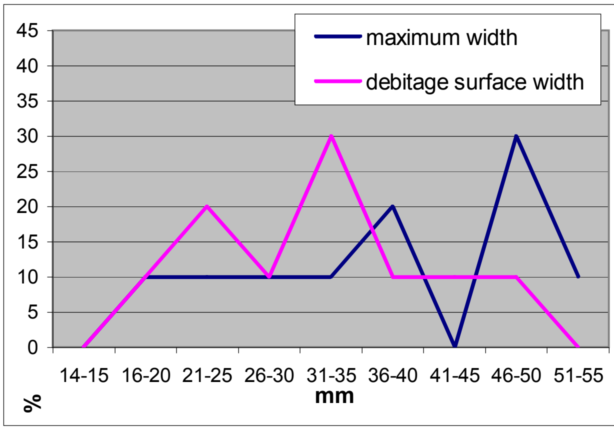


Fig. 170: Width of 'single striking platform laminar cores' with 'amorphous front' shape
from Qesem Cave.
n=10

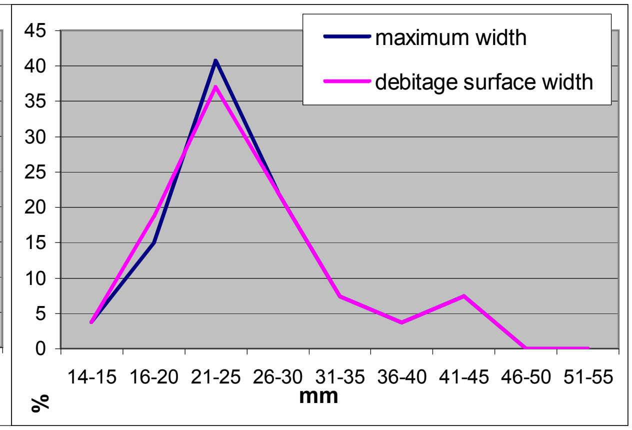


Fig. 171: Width of 'single striking platform laminar cores' with 'parallel edges' shape from Qesem Cave.
n=27

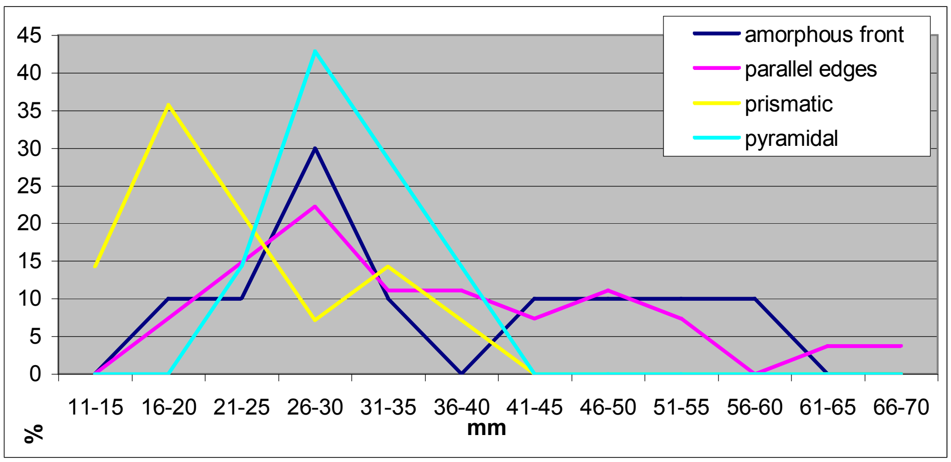
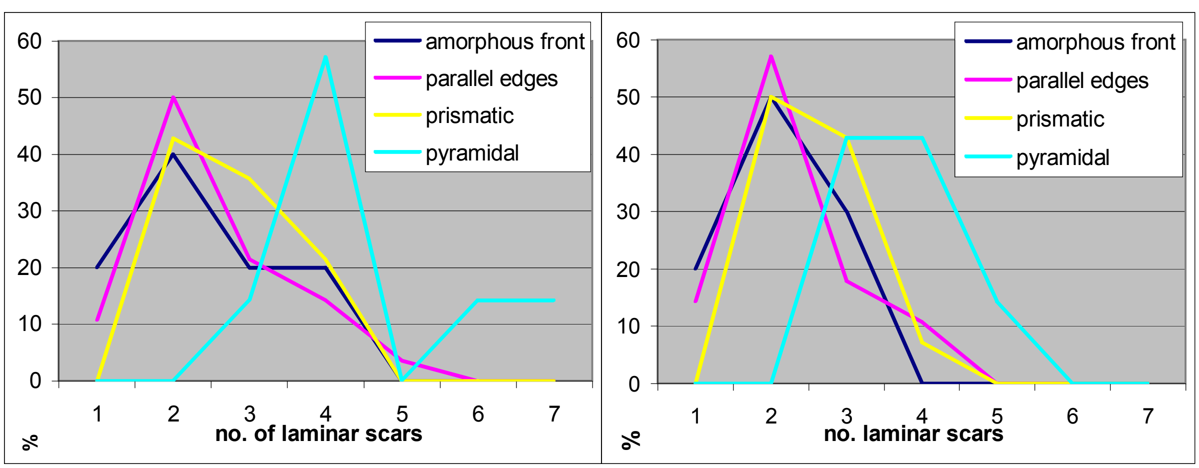


Fig. 172: Thickness of 'single striking platform laminar cores' from Qesem Cave.
n=amorphous front: 10; parallel edges: 27; prismatic: 14; pyramidal: 7.



A: Total number of laminar scars
n=amorphous front: 10; parallel edges: 28; prismatic: 14; pyramidal: 7.

B: Number of parallel laminar scars
n=amorphous front: 10; parallel edges: 28; prismatic: 14; pyramidal: 7.

Fig. 173: Total number of laminar scars and parallel number of laminar scars
on the debitage surface of 'single striking platform laminar cores' from Qesem Cave.

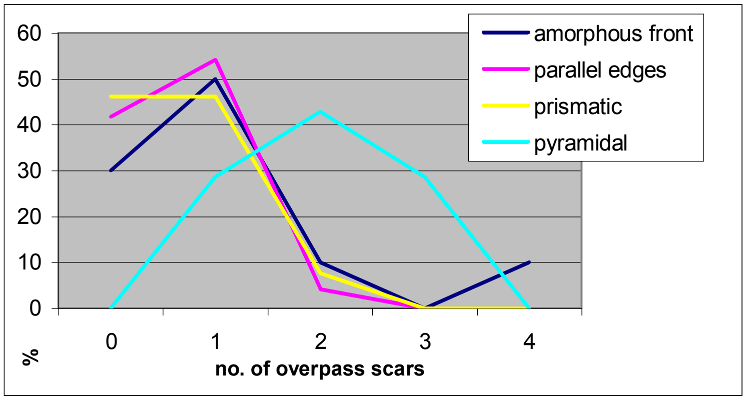


Fig. 174: Number of overpass scars on 'single striking platform laminar cores' from Qesem Cave.
n=amorphous front: 10; parallel edges: 24; prismatic: 13; pyramidal: 7.

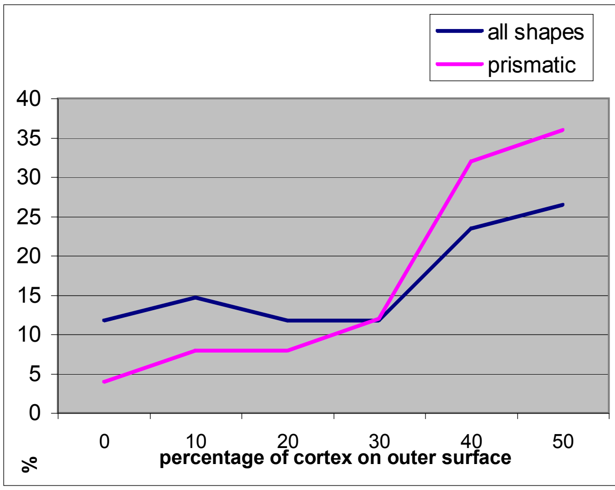


Fig. 175: Percentage of cortex on 'single striking platform laminar and flake cores' from Qesem Cave.
n=all shapes:33; prismatic: 24.

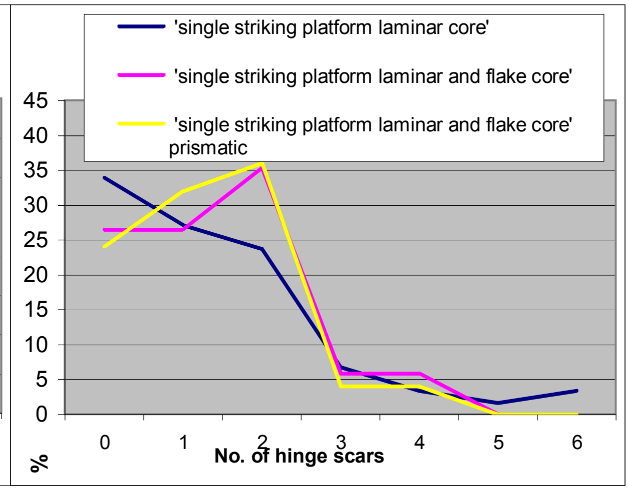


Fig. 176: Number of hinge scars on 'single striking platform laminar and flake cores' from Qesem Cave.
n='single striking platform laminar core': 59
'single striking platform laminar and flake core': 33
'single striking platform laminar and flake core' prismatic: 24

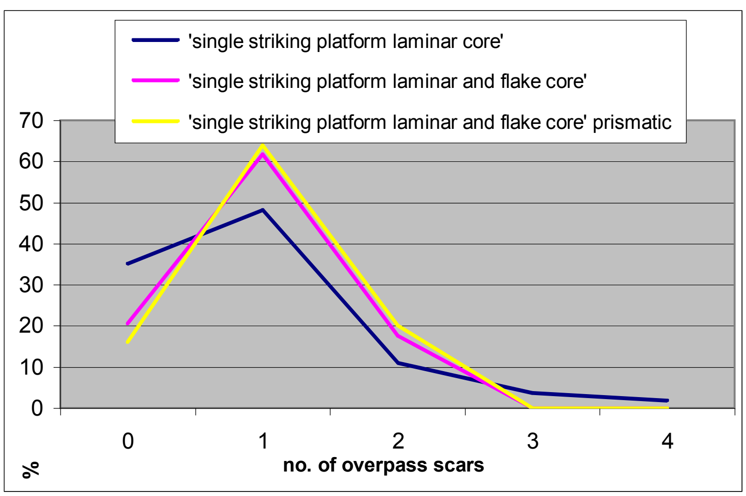


Fig. 177: Number of overpass scars on 'single striking platform laminar cores' and 'single striking platform laminar and flake cores' from Qesem Cave.
n='single striking platform laminar core': 54
'single striking platform laminar and flake core': 33
'single striking platform laminar and flake core' prismatic: 24

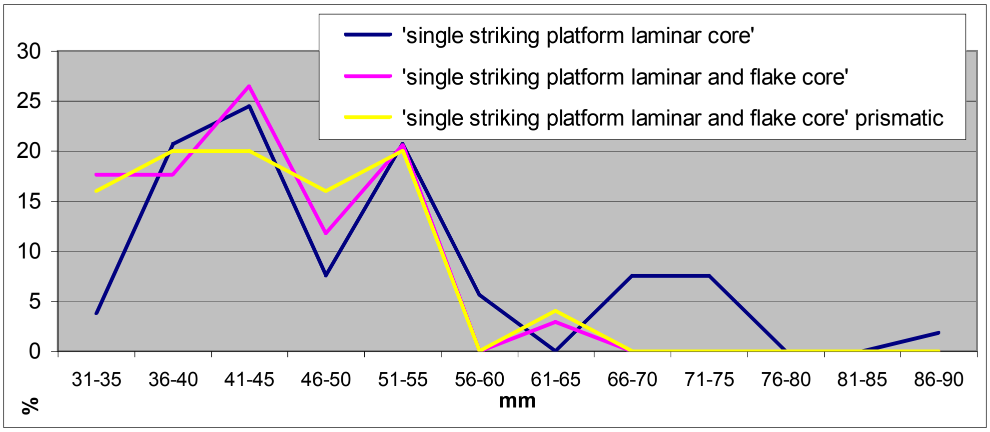


Fig. 178: Maximum length of 'single striking platform laminar cores',
and 'single striking platform laminar and flake cores' from Qesem Cave.

n='single striking platform laminar core': 53
'single striking platform laminar and flake core': 32
'single striking platform laminar and flake core' prismatic: 23

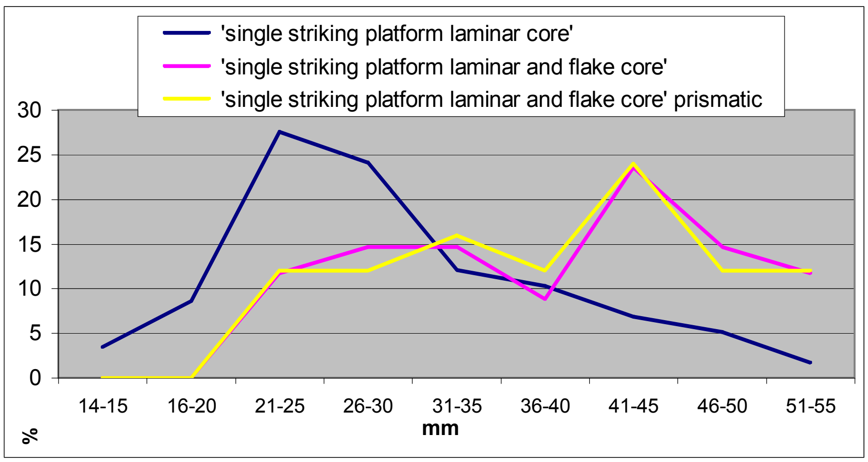


Fig. 179: Maximum width of 'single striking platform laminar cores',
and 'single striking platform laminar and flake cores' from Qesem Cave.

n='single striking platform laminar core': 58
'single striking platform laminar and flake core': 33
'single striking platform laminar and flake core' prismatic: 24

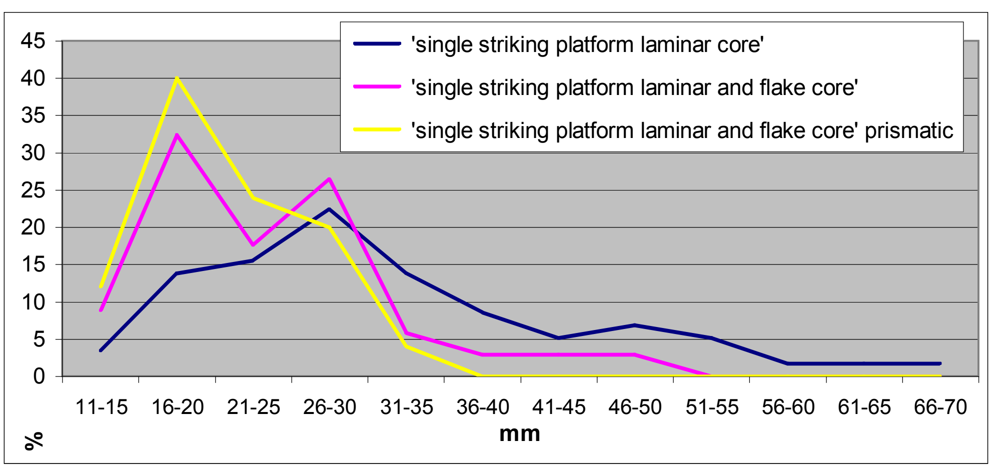


Fig. 180: Thickness of 'single striking platform laminar cores'
and 'single striking platform laminar and flake cores' from Qesem Cave.

n='single striking platform laminar core': 58
'single striking platform laminar and flake core': 34
'single striking platform laminar and flake core' prismatic: 25

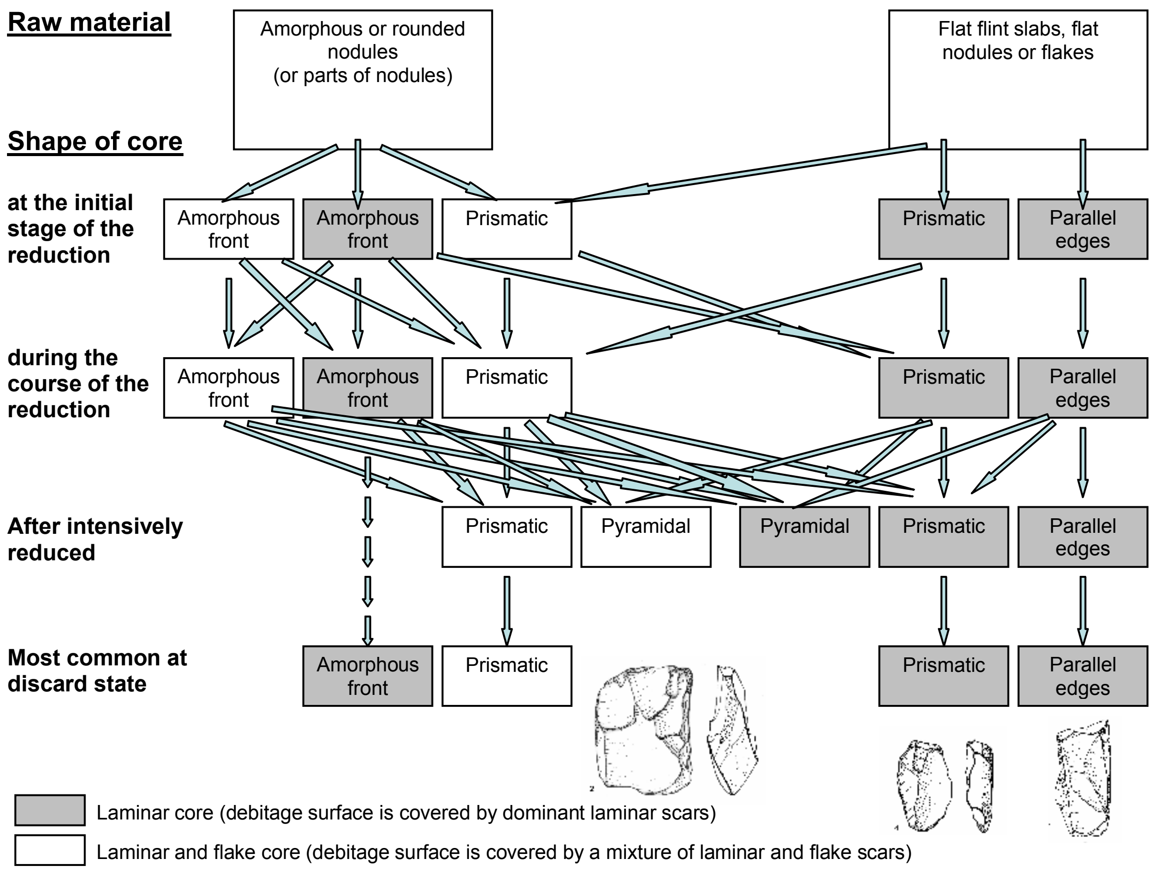


Fig. 181: A schematic flowchart of the dynamics in core shapes of the laminar core class. (The possibilities of creating a new debitage surface and/or alternating the core into a flake core are not included here).

This reconstruction demonstrates not only the shift from one shape to another, but also the possible shift from the laminar core type into the laminar and flake core type and vice versa. It also shows that the use of flat flint slabs or flat nodules have a larger potential to remain constant along the reduction.

Fig. 182: A flint outcrop from Ya'ar Horashim (4 KM north of Qesem Cave).

Fig. 183: A flint outcrop from Ya'ar Horashim (4 KM north of Qesem Cave).
Note how the flint cracks into orthogonal slabs.

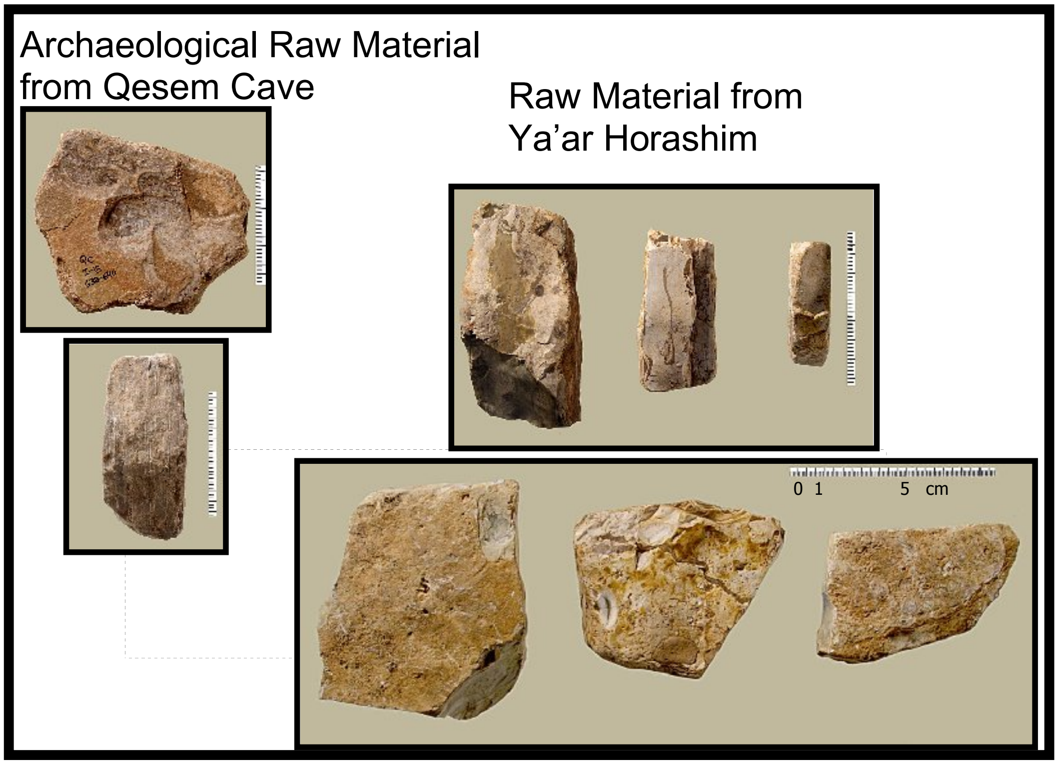


Fig. 184: Raw material from Qesem Cave and from Ya'ar Horashim.

Fig. 185: Hammerstones used for the experimental knapping from Nahal Qana in Ya'ar Horashim (5 KM north of Qesem Cave).

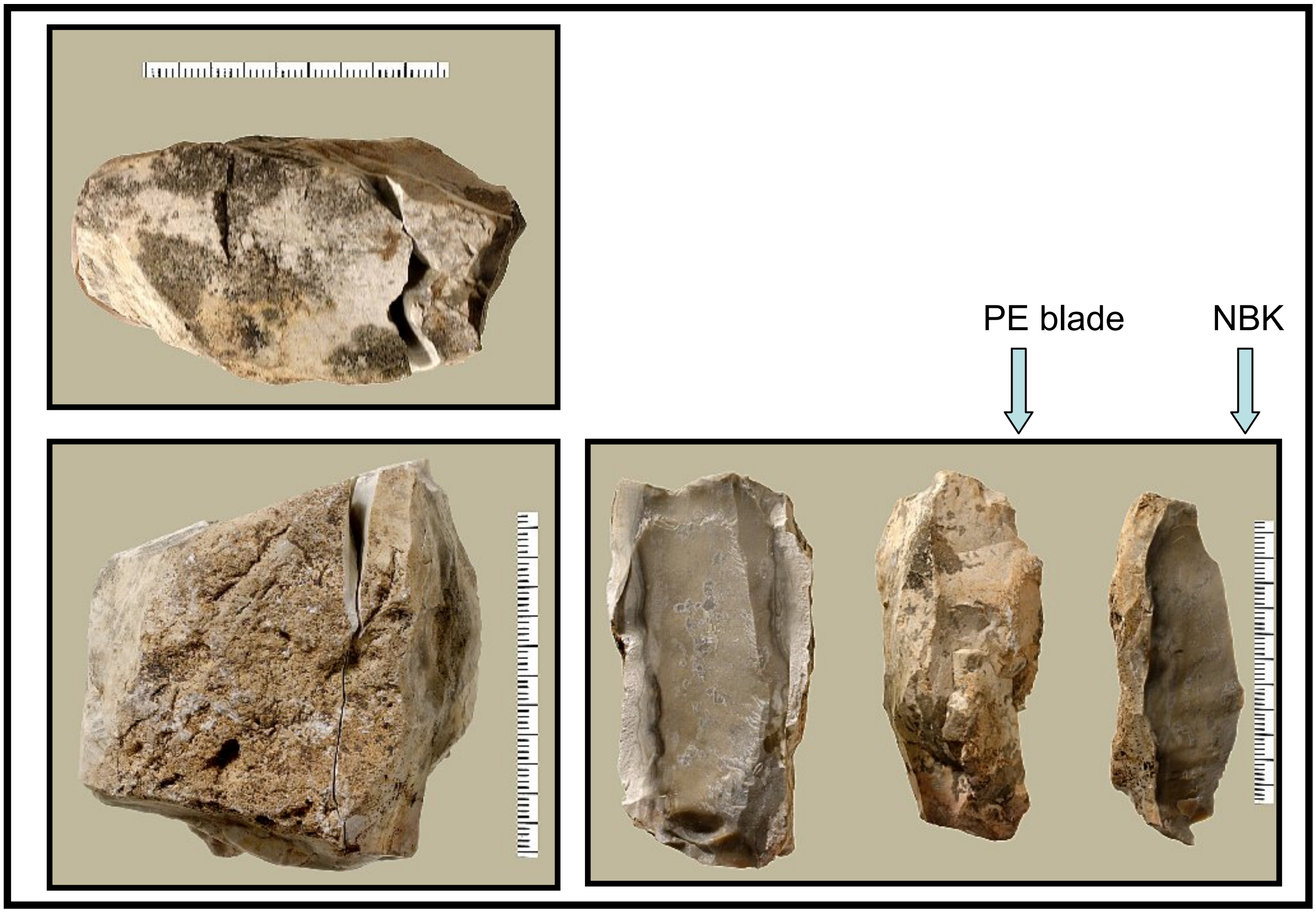


Fig. 186: An experimental example of reducing a NBK as the second item detached from a core.

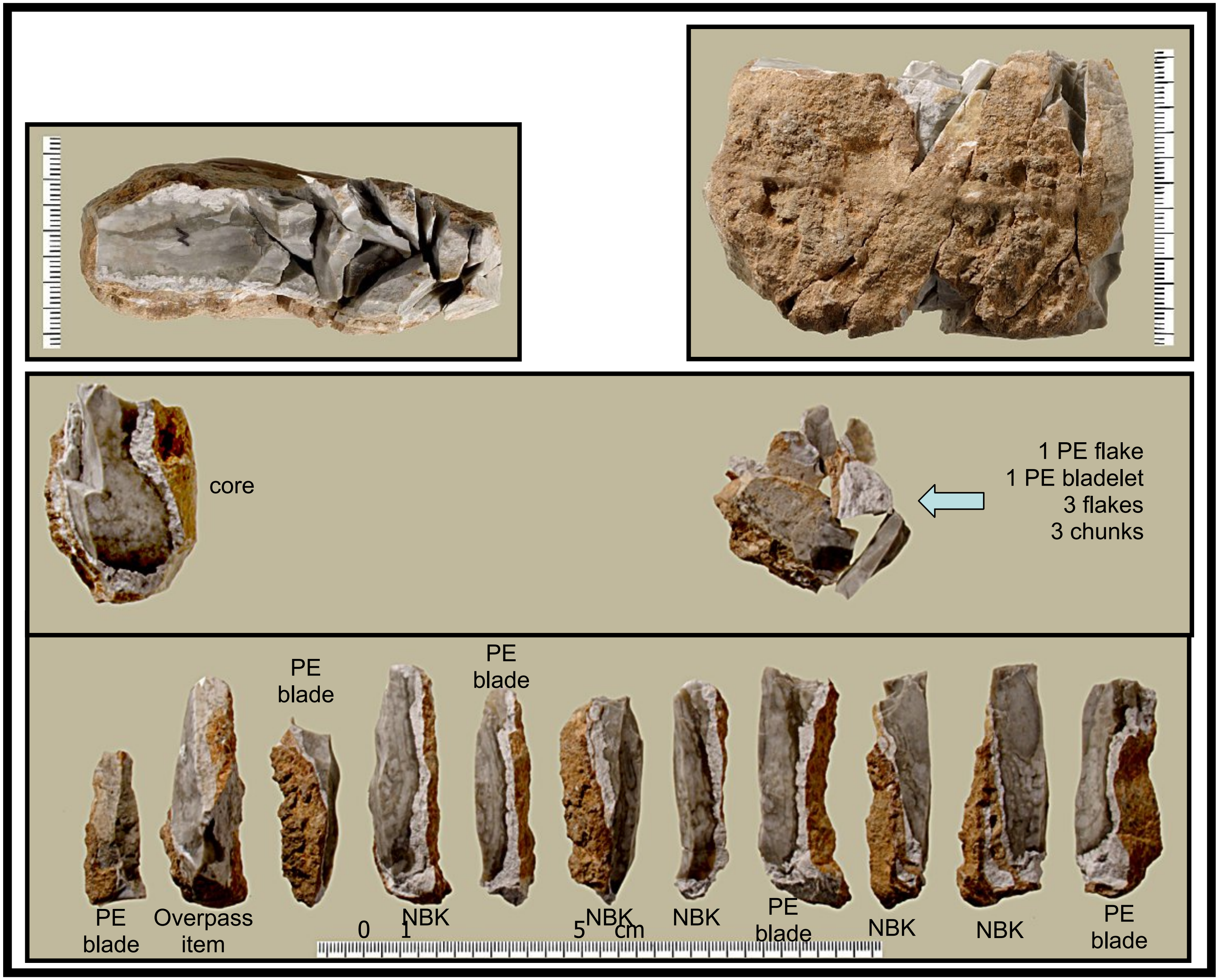


Fig. 187: An experimental example of reducing laminar items from a thin flint slab.

The blanks are ordered from left to right according to their reduction sequence.

*The division between PE blades and NBKs is in accordance to the angle of the cortical edge (NBKs ≥60º).

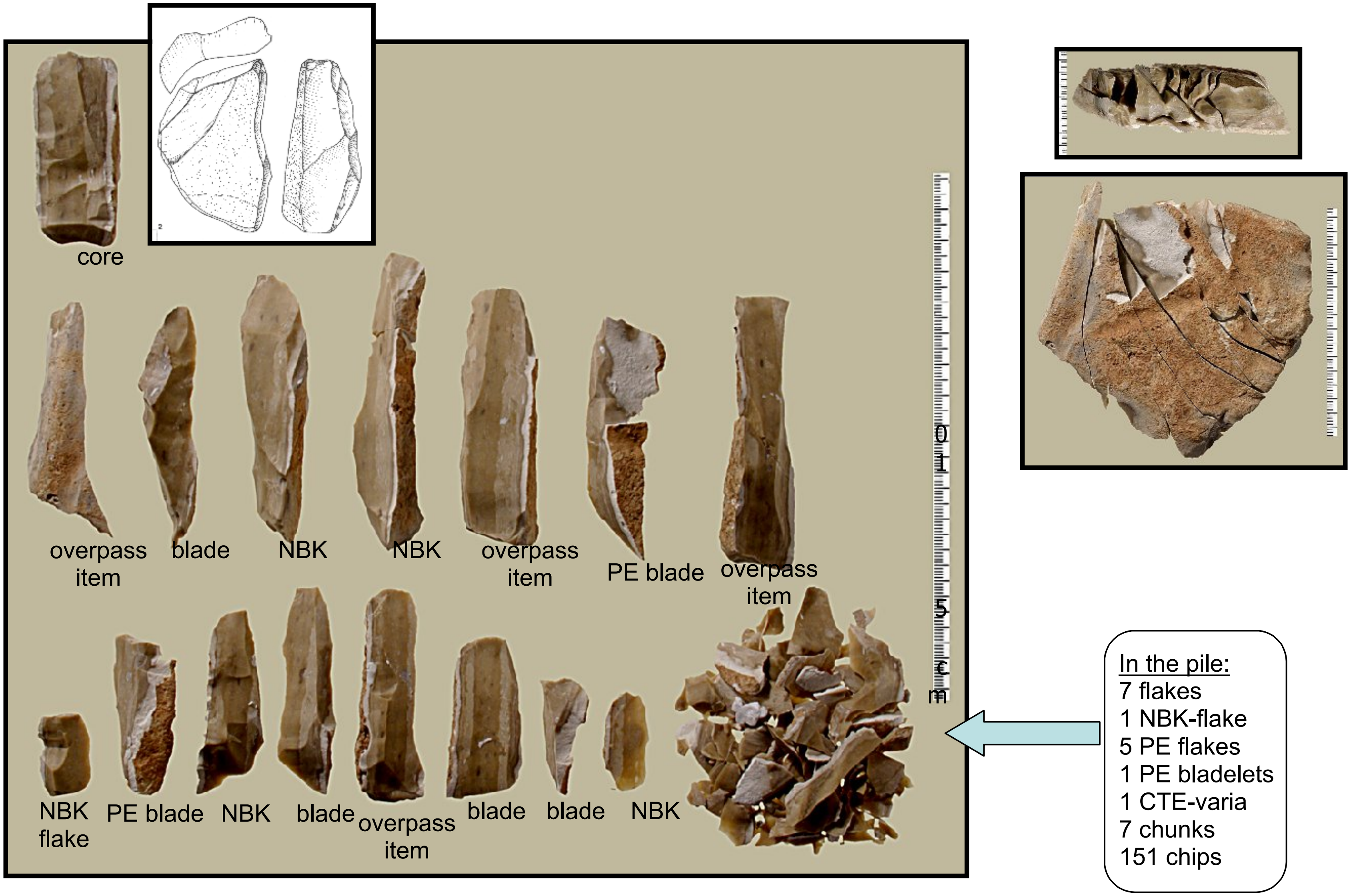


Fig. 188: An experimental example of reducing laminar items from a thin flint slab.
The illustrated item shows a similar archaeological specimen from Qesem Cave.
The blanks are ordered from left to right according to their reduction sequence.
*The division between PE blades and NBKs is in accordance to the angle of the cortical edge (NBKs ≥60º).

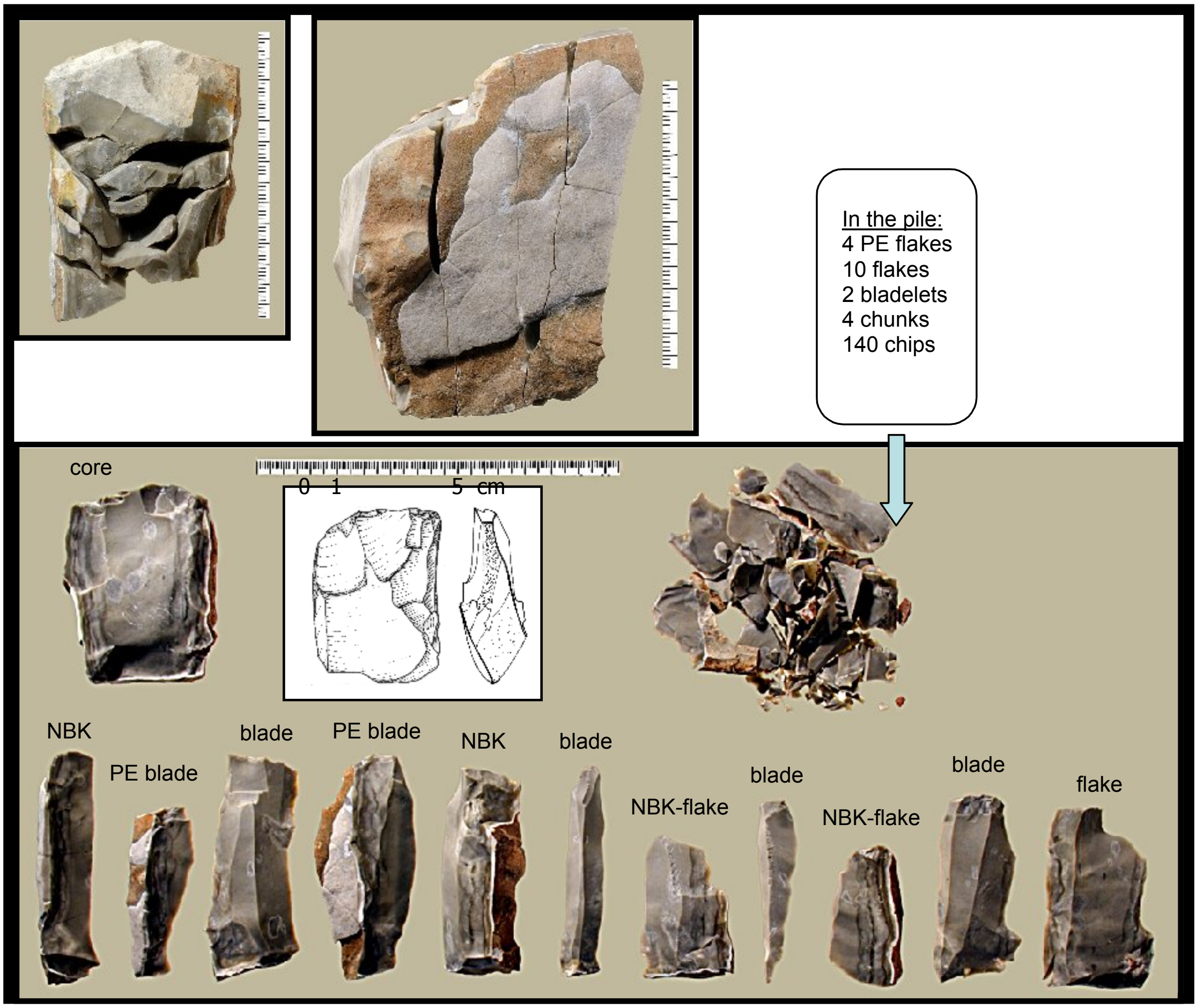


Fig. 189: An experimental example of reducing laminar items from a wide flint slab.
The illustrated item shows a similar archaeological specimen from Qesem Cave.
The blanks are ordered from left to right according to their reduction sequence.
*The division between PE blades and NBKs is in accordance to the angle of the cortical edge (NBKs $\geq 60^{o}$).

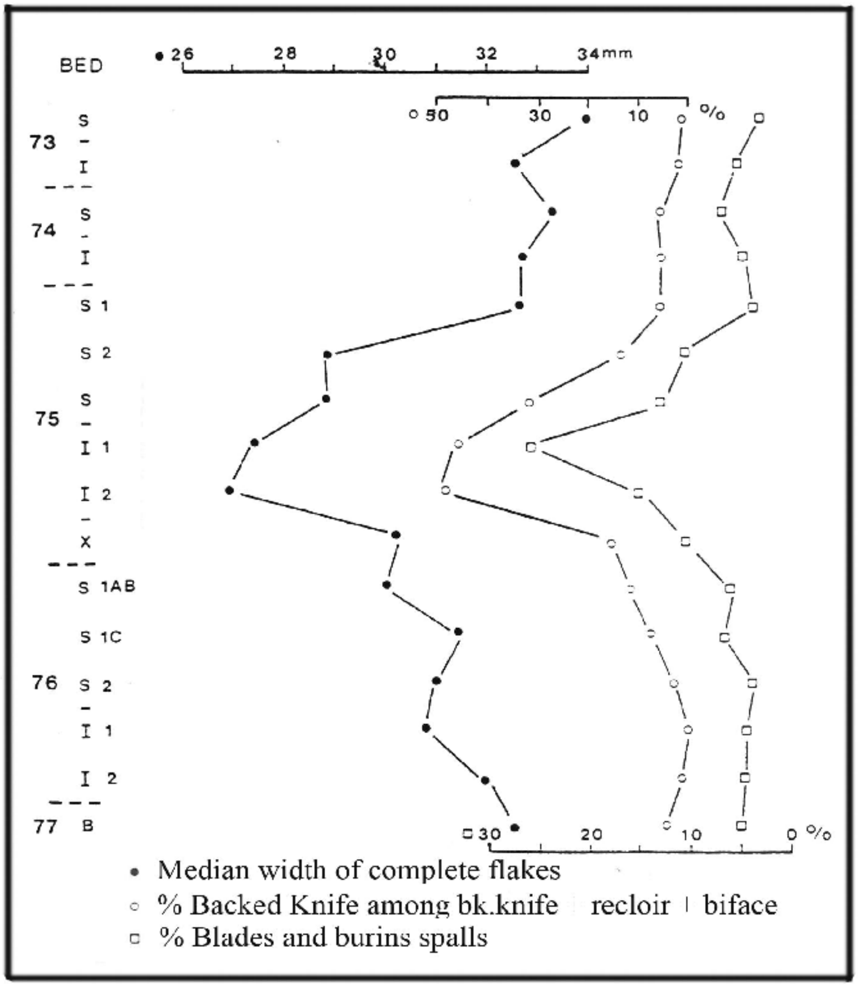


Fig. 190: Jelinek's diagram of the changing frequencies of backed knives and blades within Tabun XI. Reproduced from Jelinek 1990:86, Fig. 4.2.

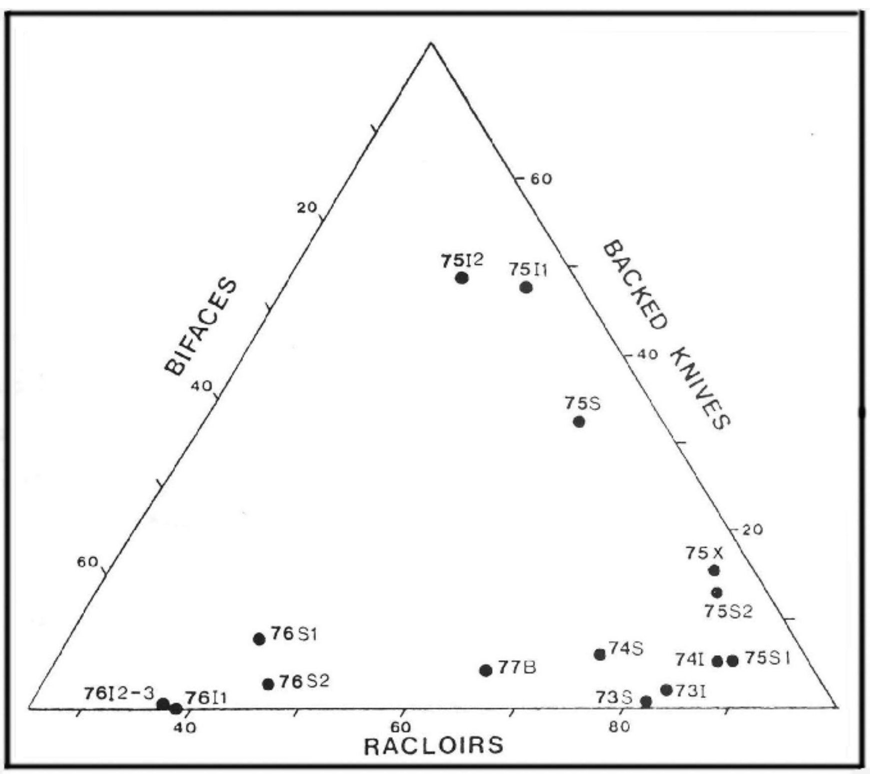


Fig. 191: Jelinek's triangular coordinate diagram which illustrates the relative frequencies of backed knives, bifaces and side-scrapers (racloirs) from the beds of Tabun XI.
Reproduced from Jelinek 1990:85, Fig. 4.1.

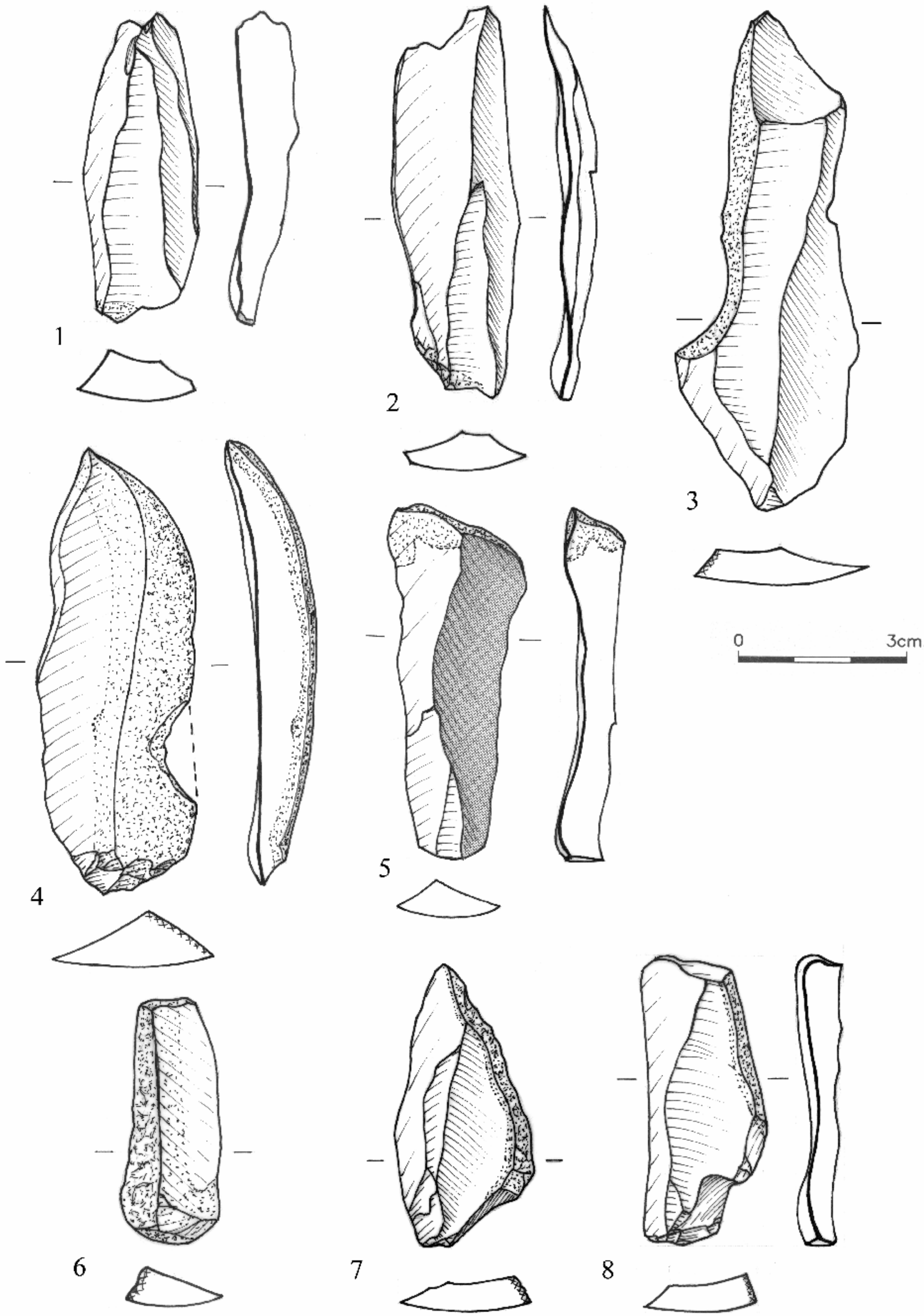


Fig. 192: Blades (1-3), PE blades (4-5), and NBKs (6-8) from the Amudian beds of Tabun XI.
Raster marks patinated surfaces.

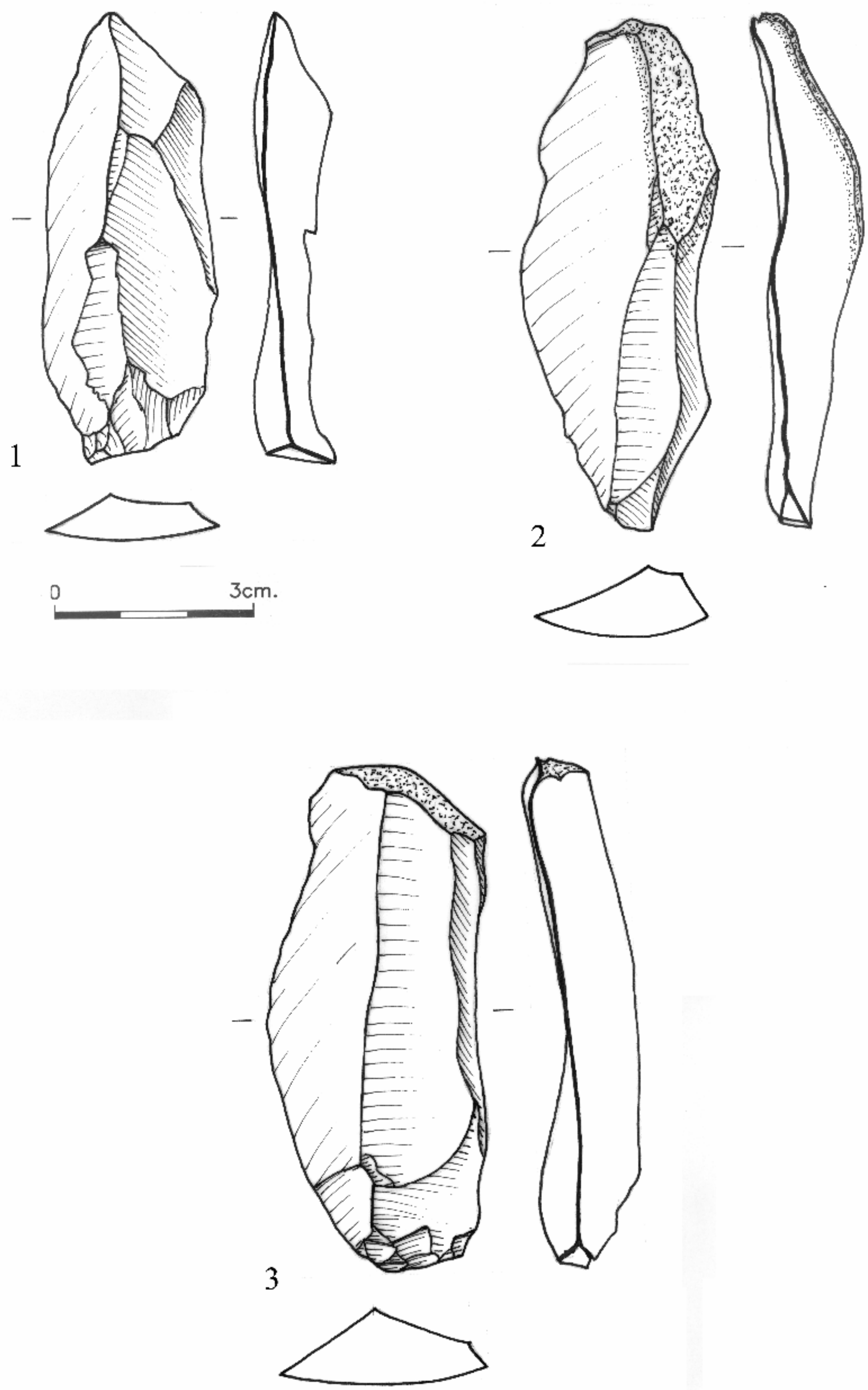


Fig. 193: Blades from the Yabrudian beds of Tabun XI.

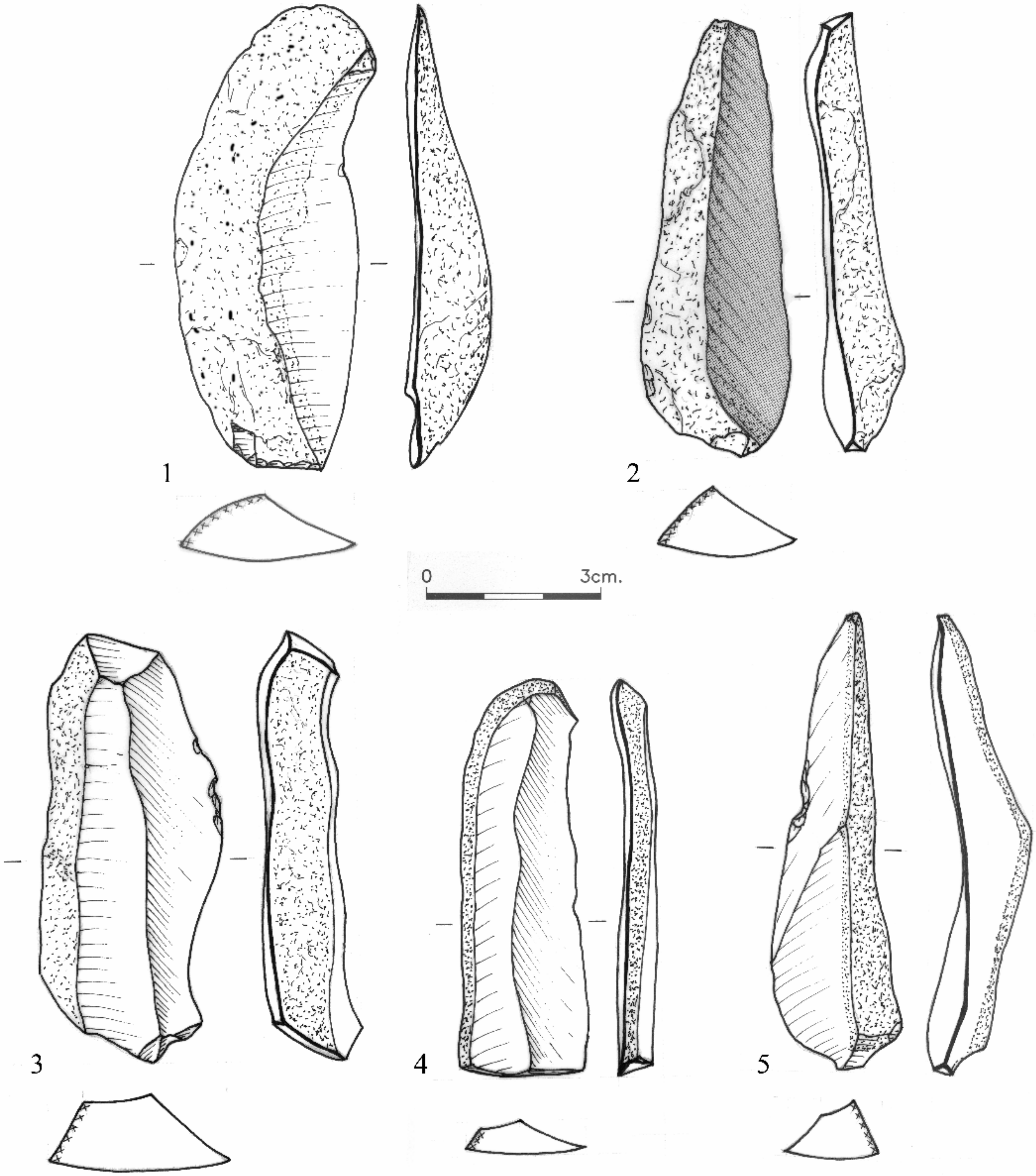


Fig. 194: PE blades (1-2) and NBKs (3-5) from the Yabrudian beds of Tabun XI.
Raster marks old patinated surfaces.

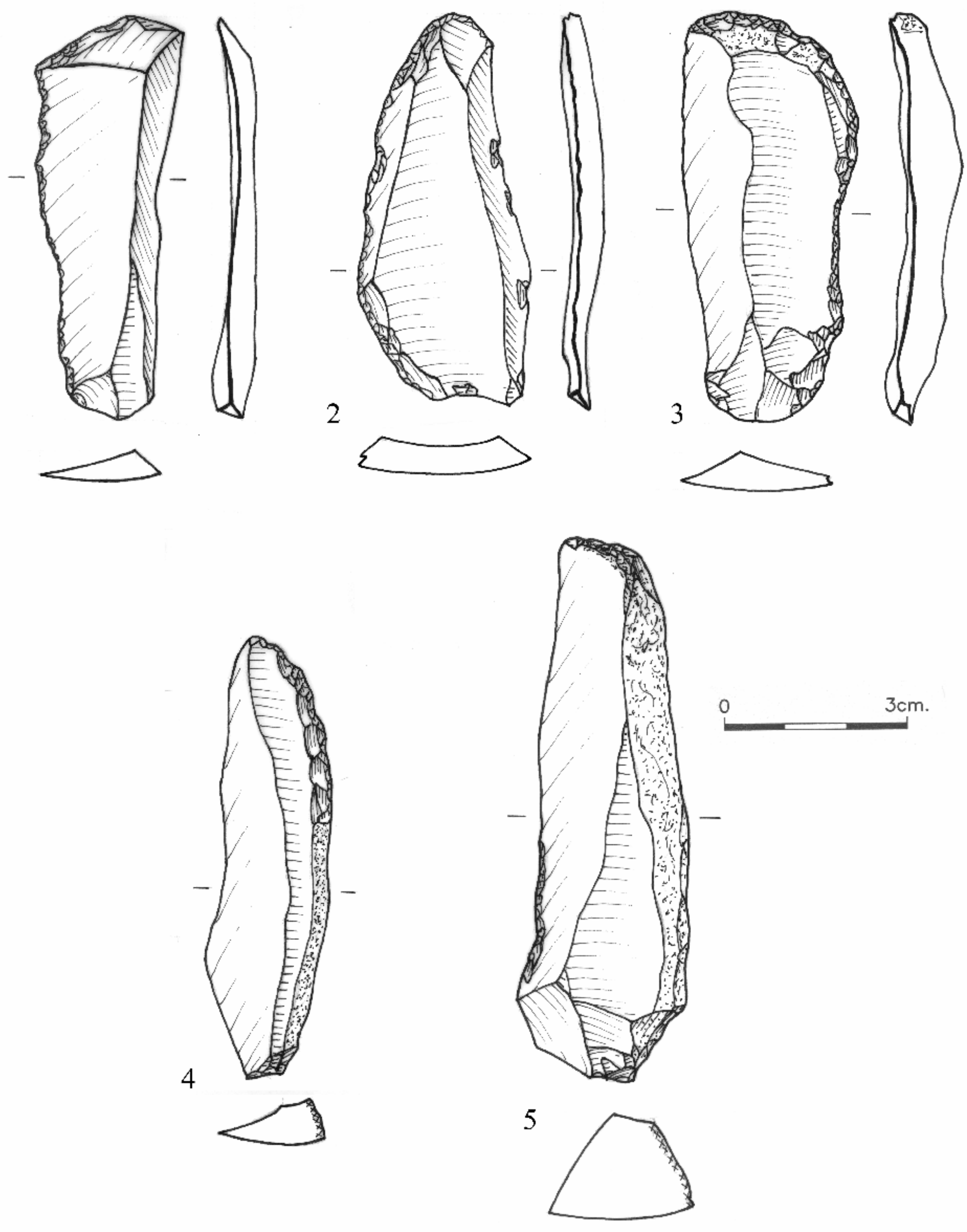


Fig. 195: Shaped items made on blades (1-3) and NBKs (4-5) from the Amudian beds of Tabun XI. 'Retouched laminar items' (1-2, 5), end-scraper (3), backed knife (4).

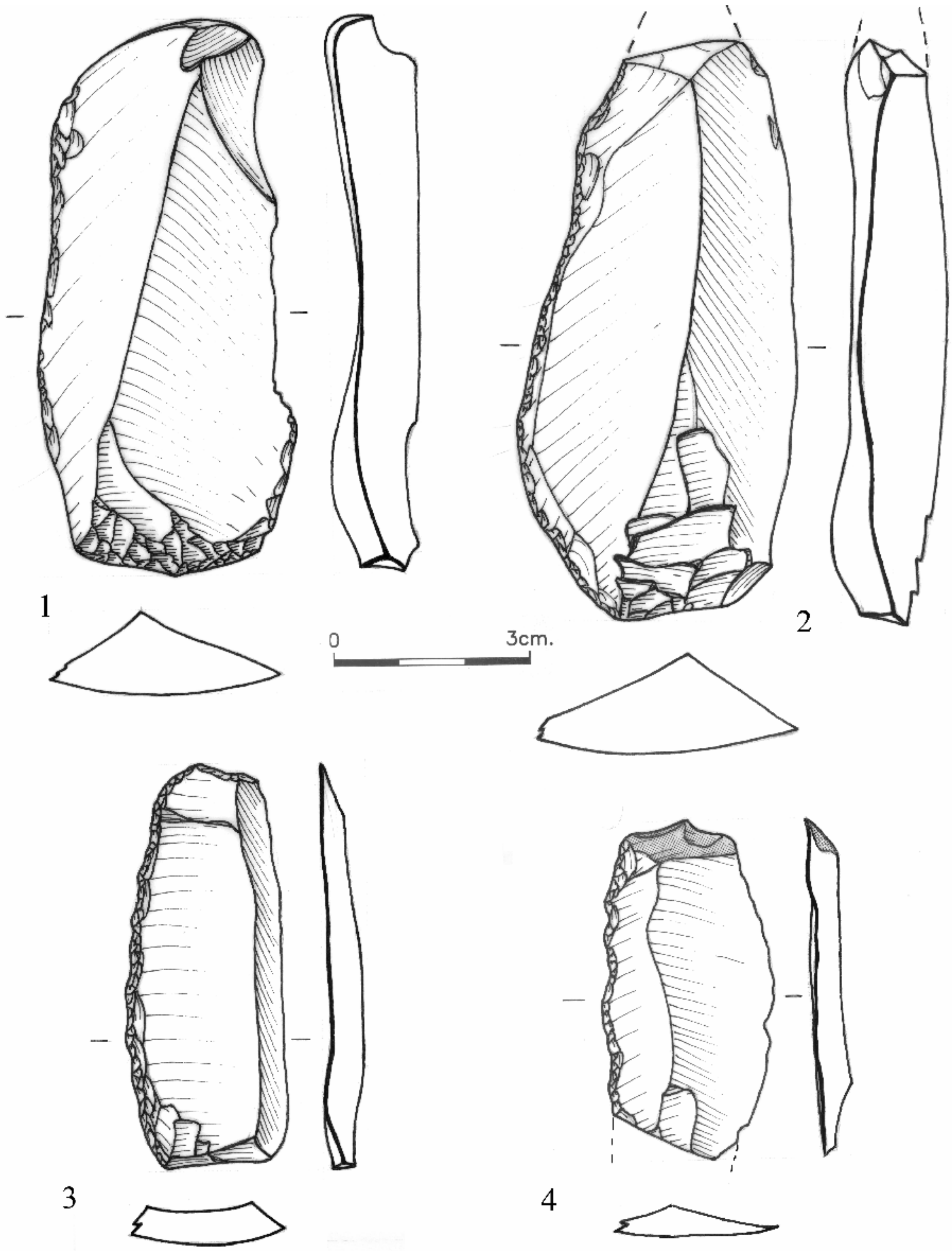


Fig. 196: Shaped items made on blades from the Yabrudian beds of Tabun XI.
'Retouched laminar items' (1-2, 4), backed knife (3).
Raster marks patinated surfaces.

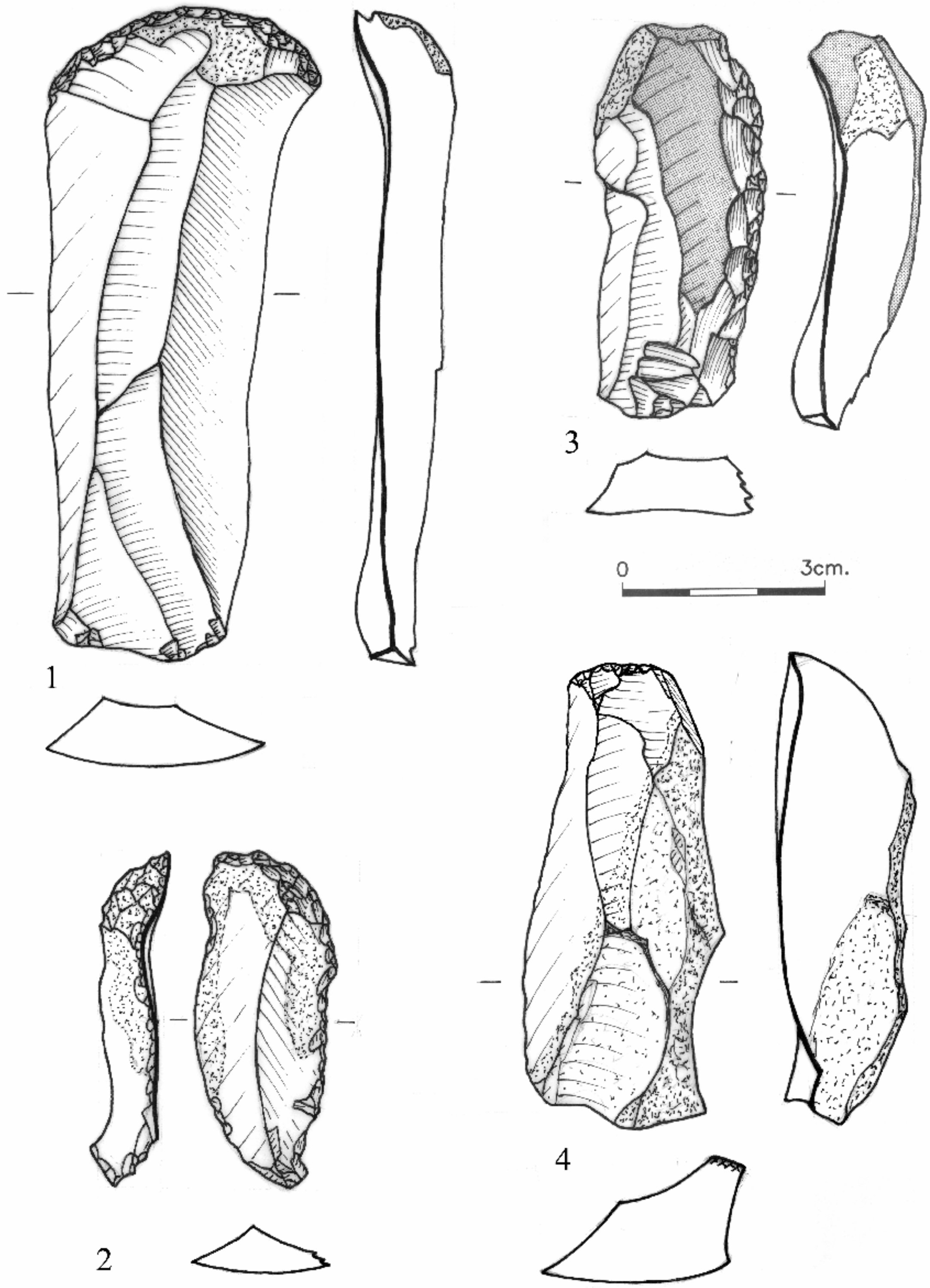


Fig. 197: Shaped items made on blades (1-2), PE blade (3) and NBK (4) from the Yabrudian beds of Tabun XI.
End-scrapers (1, 2), backed knife (3), ‘distally retouched laminar item (4).
Raster marks old patinated surfaces.

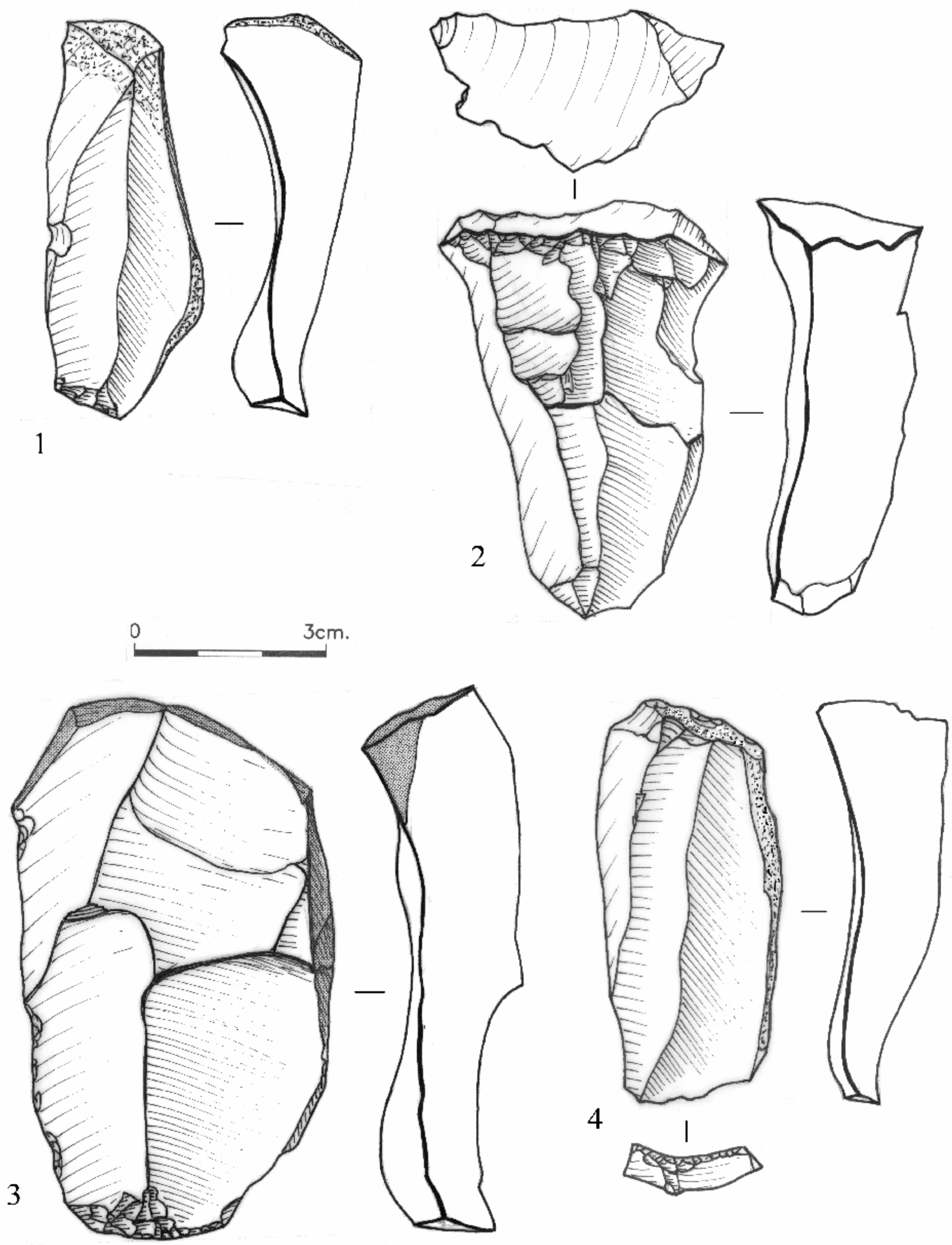


Fig. 198: Overpass items from the Amudian beds of Tabun XI.
Raster marks old patinated surfaces.

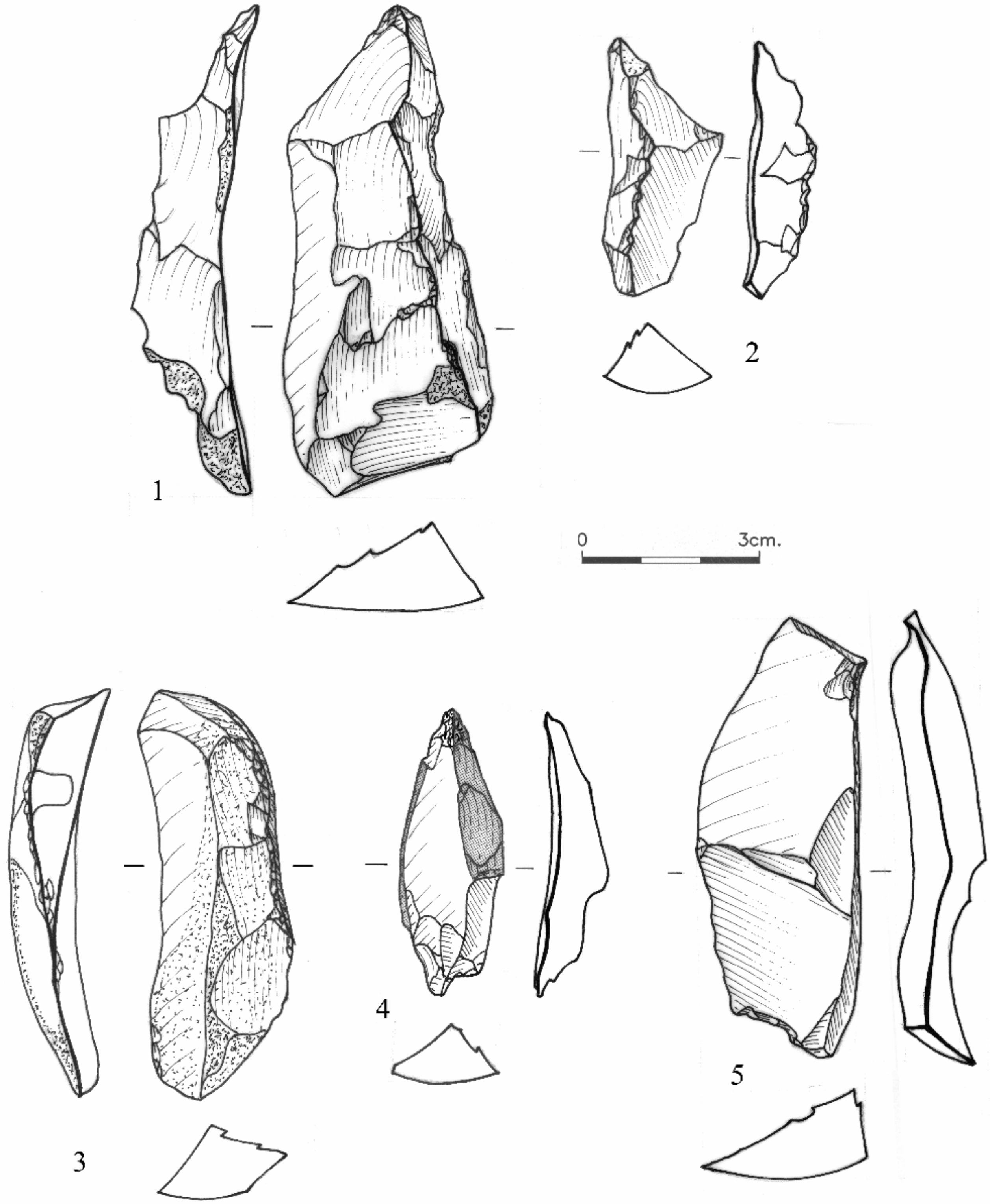


Fig. 199: Crested blades from the Amudian (1-2, 4-5) and Yabrudian (3) beds of Tabun XI. Rough crested blades (1-2), ‘primary-second crested blade (3), Patinated crested blade (4), rejuvenation crested blade (5).
Raster marks old patinated surfaces.

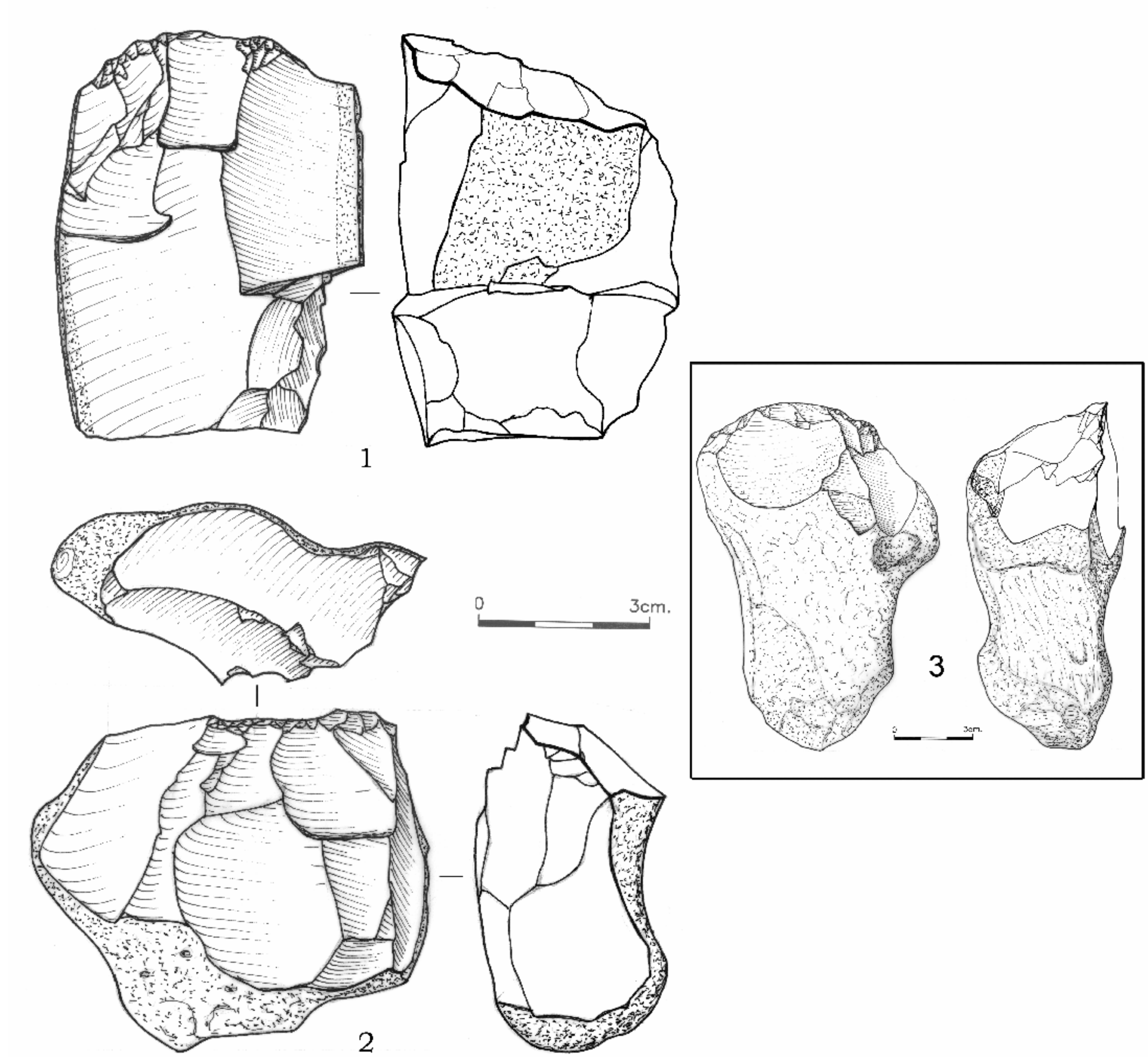
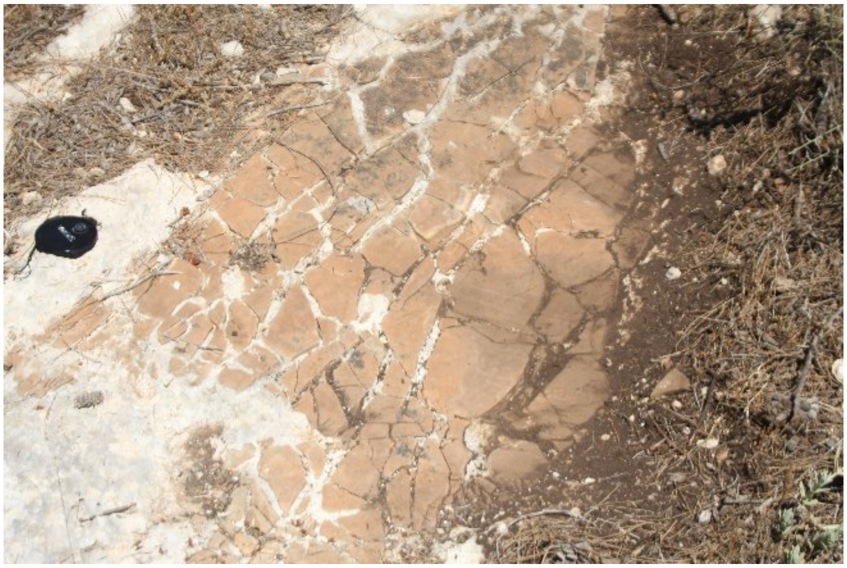


Fig. 200: Cores (1-2) from the Yabrudian beds, and a roughout (3) from the Amudian beds of Tabun XI.

The flake core (1) was made on a thick tabular flint and probably represents a false attempt for a laminar core. The ‘laminar and flake core’ (2) and the roughout (3) well exemplifying the use of nodules with amorphous shapes.



A: A raw material outcrop of flint slabs with cortex on both sides in the vicinity of Tabun, ca. 1.5 km south-east of the cave (‘Source 3’ in Druck’s [2004] survey; Israel map ref. 14850/22970).

B: Flint slabs with cortex on both sides which can be easily transformed into laminar cores from ‘Source 5’ in Druck’s [2004] survey; Israel map ref. 14815/22793. This raw material source is ca. 2.5 km south-east of Tabun Cave.

Fig. 201: Raw material outcrops of flint slabs with cortex on both sides in the vicinity of Tabun Cave.

Although only rarely used for laminar production, this type of raw material appears at several localities in the vicinity of Tabun Cave. This raw material is highly similar to that found in Ya’ar Horashim (Figs. 183-184) and suitable for laminar production. Nevertheless, it was not selected for that purpose in the case of Tabun XI.

Photographs by Zohar Lev

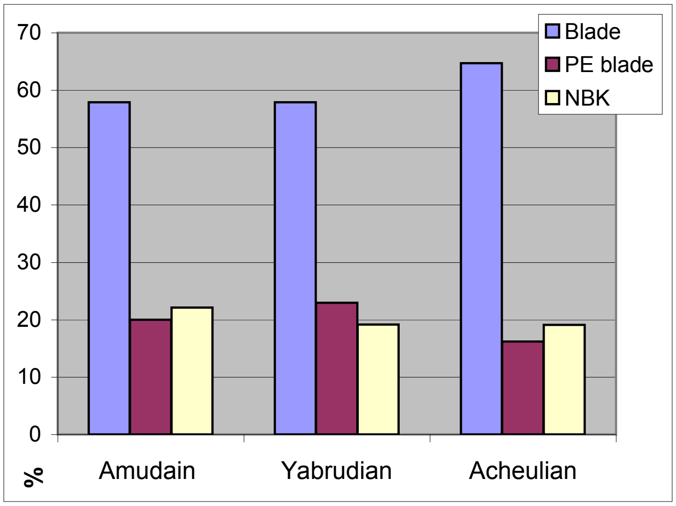


Fig. 202: Division of the three laminar types (blanks and shaped) from the three facies of Tabun XI.

n=Amudian: 430; Yabrudian: 266; Acheulian: 68.

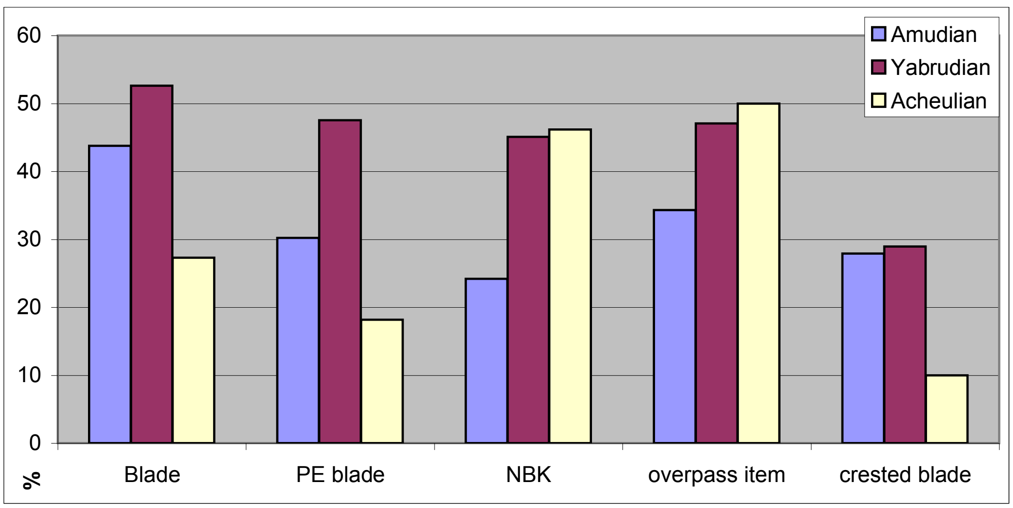
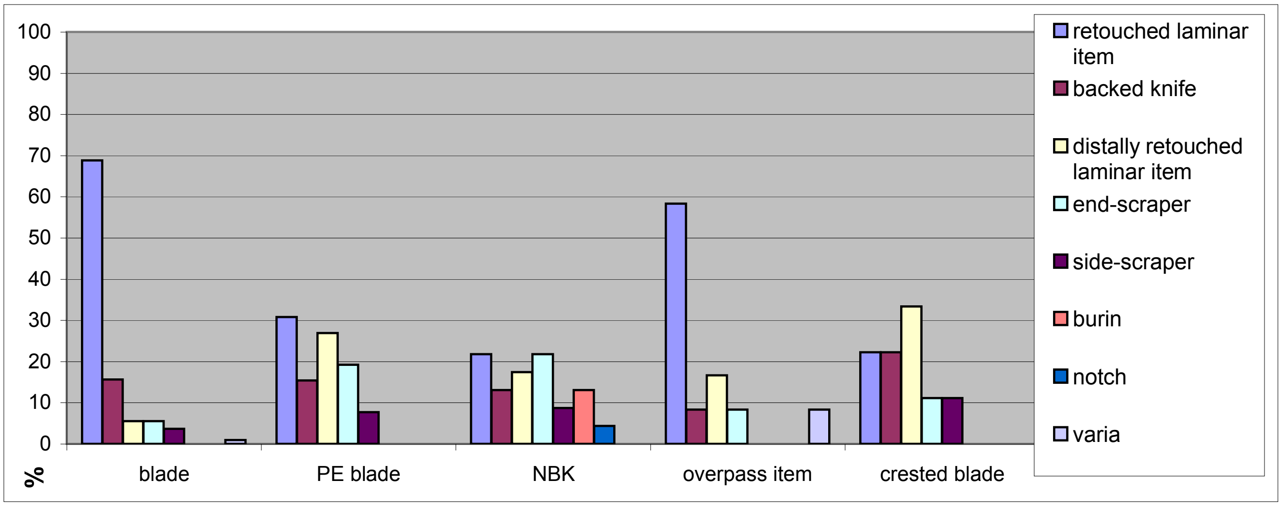


Fig. 203: Percentage of shaped items out of the sum of blanks and shaped items of each type from the three facies of Tabun XI.

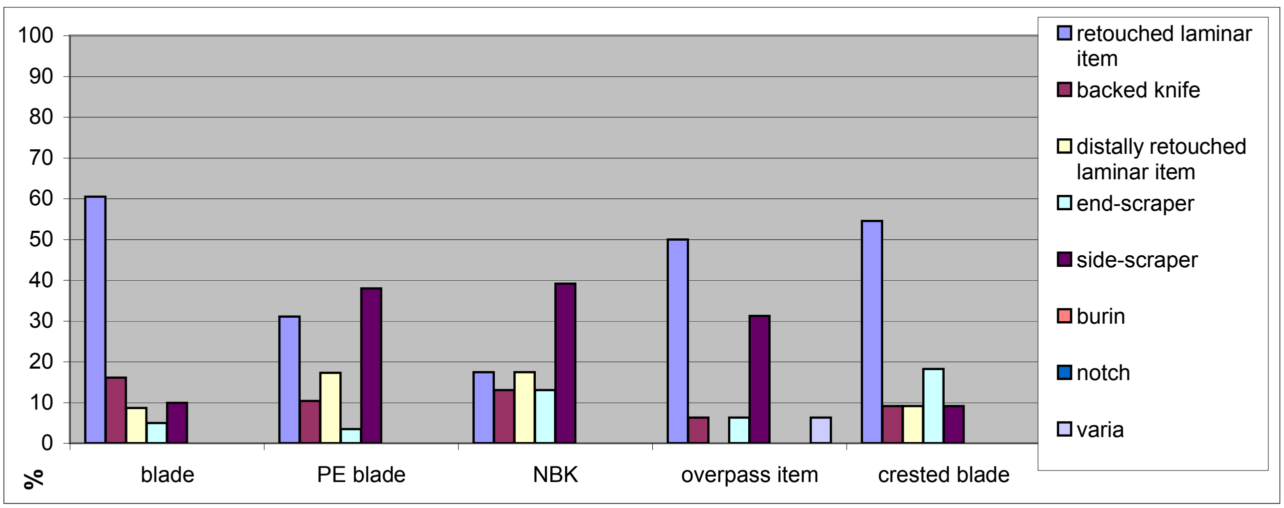
n=**Amudian** - blade: 249; PE blade: 86; NBK: 95; overpass item: 35; crested blade: 43.

Yabrudian - blade: 154; PE blade: 61; NBK: 51; overpass item: 34; crested blade: 38.

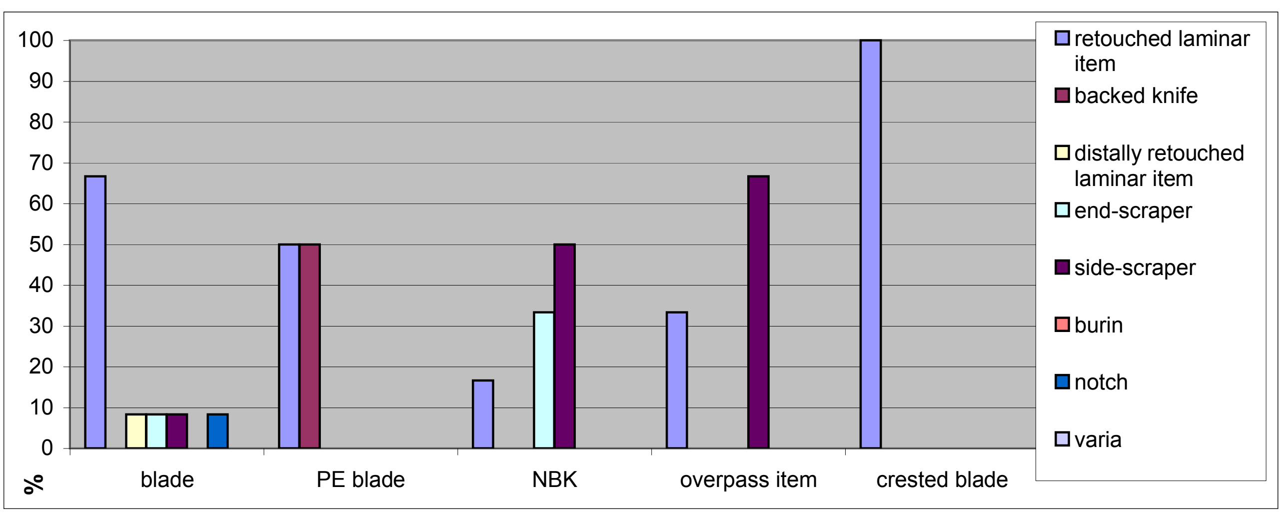
Acheulian - blade: 44; PE blade: 11; NBK: 13; overpass item: 6; crested blade: 10.



A: Amudian (n=blade: 107; PE blade: 26; NBK: 23; overpass item: 12; crested blade: 9)



B: Yabrudian (n=blade: 81; PE blade: 29; NBK: 23; overpass item: 16; crested blade: 11)



C: Acheulian (n=blade: 12; PE blade: 2; NBK: 6; overpass item: 3; crested blade: 1)

Fig. 204: Types of shaped items modified on each of the laminar types from the three facies of Tabun XI.

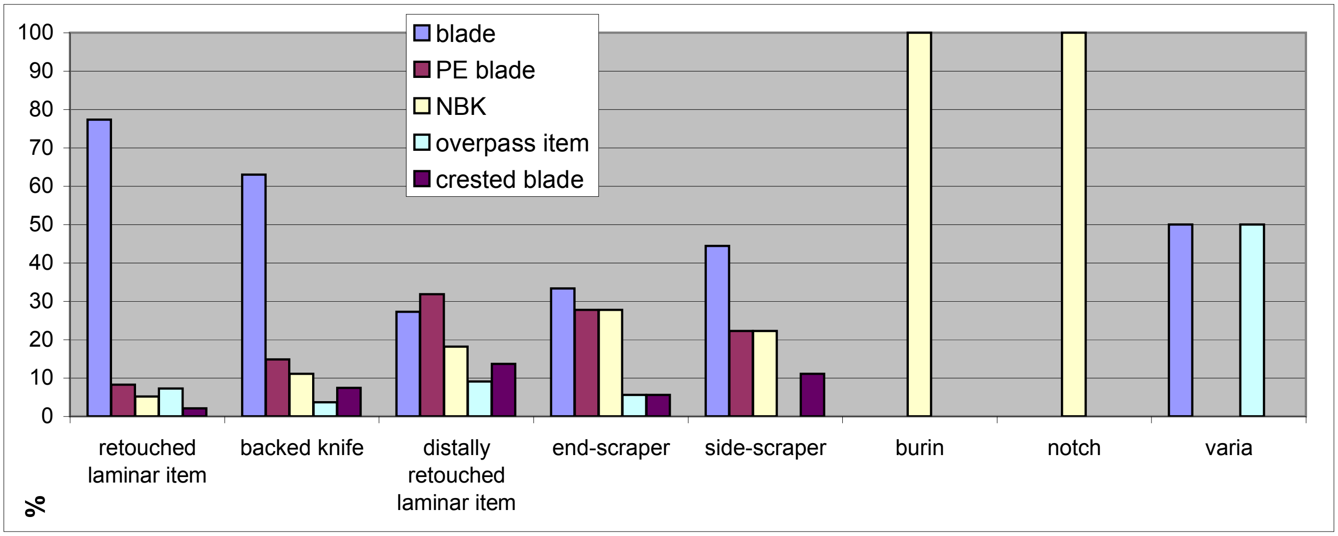


Fig. 205: Division of laminar shaped item types into laminar types from the Amudian beds of Tabun XI.
n=retouched laminar item: 97; backed knife: 27; distally retouched laminar item: 22; end-scraper: 18; side-scraper: 9; burin: 3; notch: 1; varia: 2.

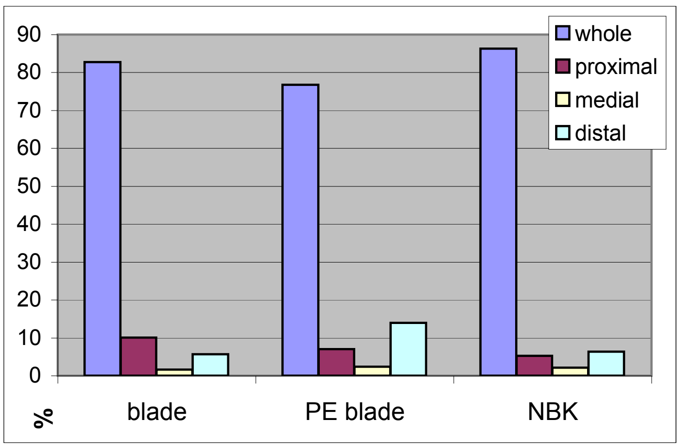


Fig. 206: State of preservation of the laminar items (blank and shaped) from the Amudian beds of Tabun XI.
n= blade:249; PE blade: 86; NBK: 95.

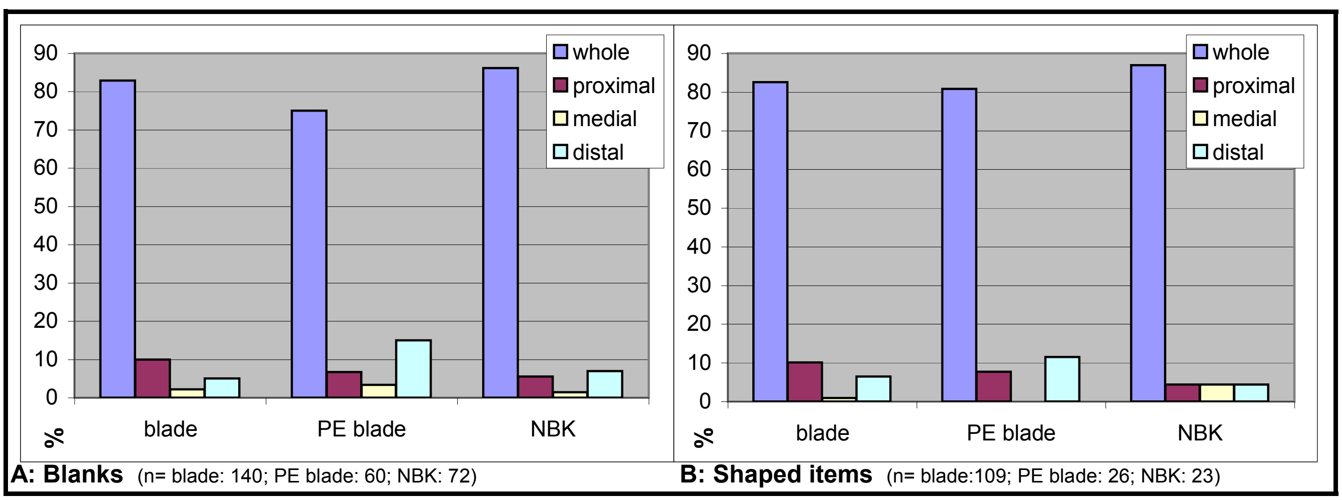


Fig. 207: State of preservation of laminar blanks and shaped laminar items from the Amudian beds of Tabun XI.

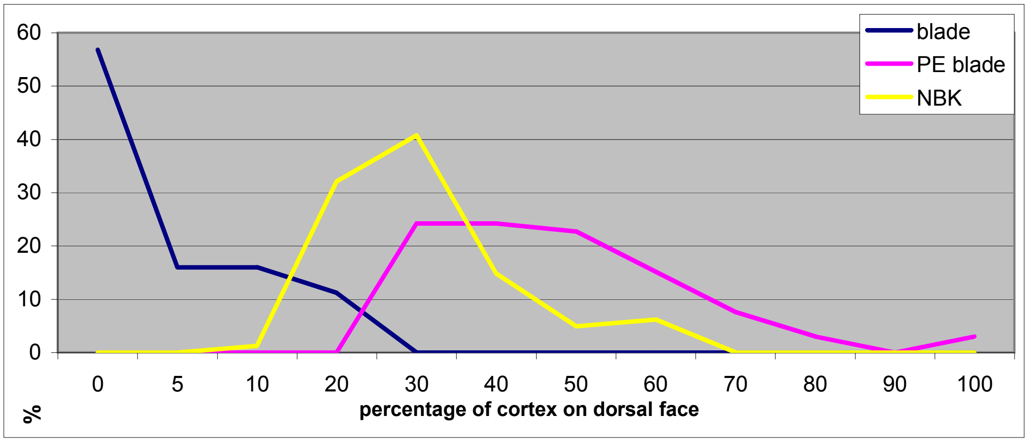
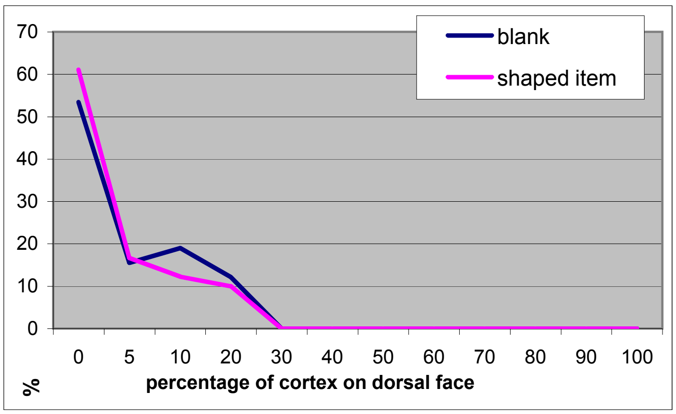
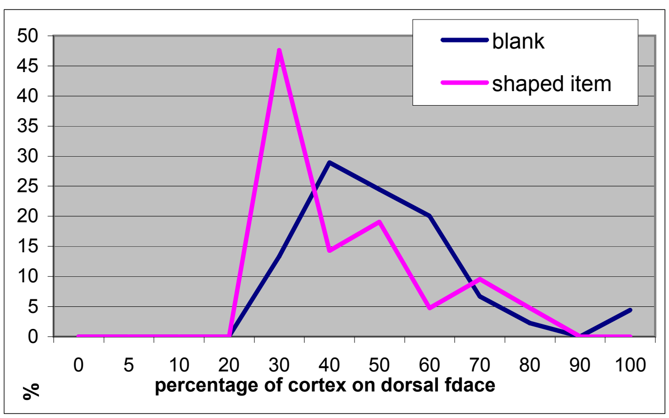


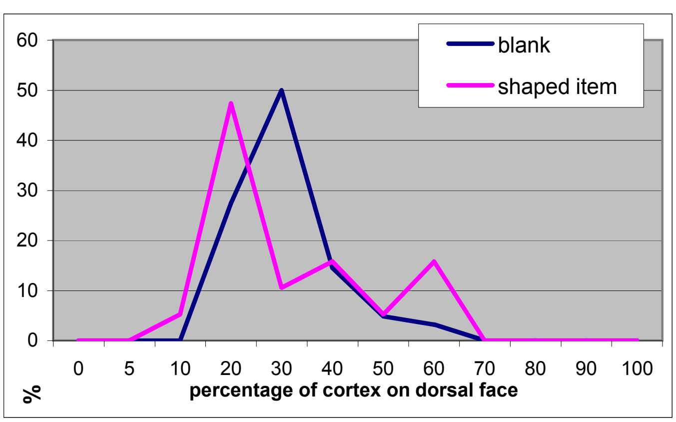
Fig. 208: Percentage of cortex on dorsal face of the three laminar types (blanks and shaped) from the Amudian beds of Tabun XI.
n=blade: 206; PE blade: 66; NBK: 81.



A: Blades (n=blank: 116; shaped item: 90)



B: PE blades (n=blank: 45; shaped item: 21)



C: NBKs (n=blank: 62; shaped item: 19)

Fig. 209: Percentage of cortex on dorsal face of laminar blanks and shaped laminar items from the Amudian beds of Tabun XI.

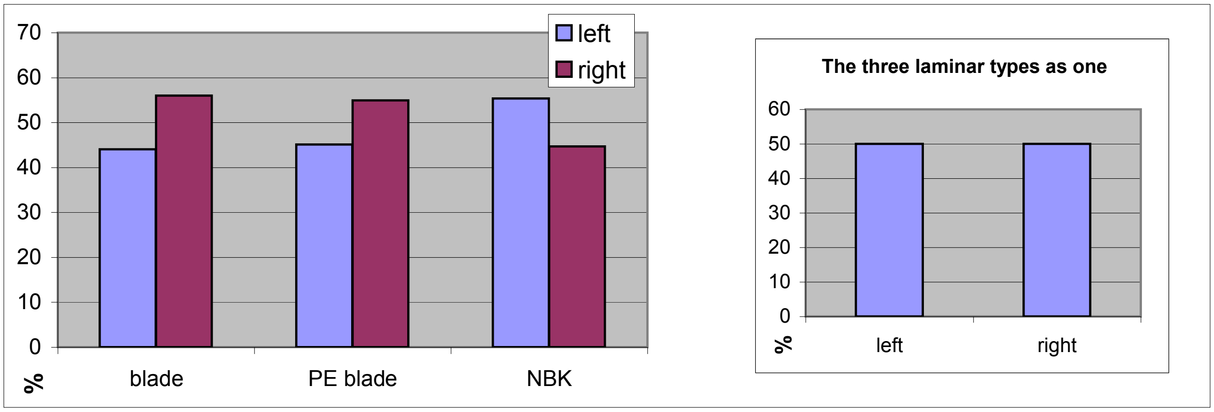


Fig. 210: Side of cortex on the three laminar types (blanks and shaped) from the Amudian beds of Tabun XI.
In the right graph all the three laminar types are united.
n=blade: 25; PE blade: 71; NBK: 94; total: 190.

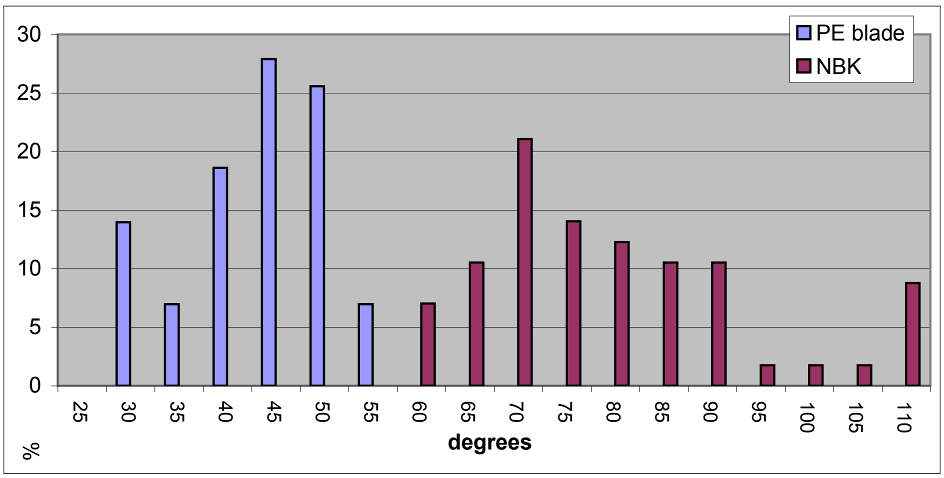


Fig. 211: Angle of cortical edge of PE blades and NBKs (blanks and shaped) from the Amudian beds of Tabun XI.
n=PE blade: 43; NBK: 57.

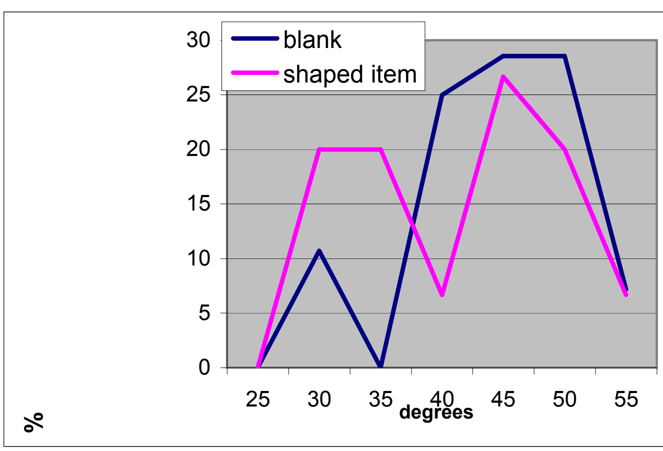


Fig. 212: Angle of the cortical edge of PE blade blanks and shaped PE blades from the Amudian beds of Tabun XI.
n= blank: 28; shaped item: 15.

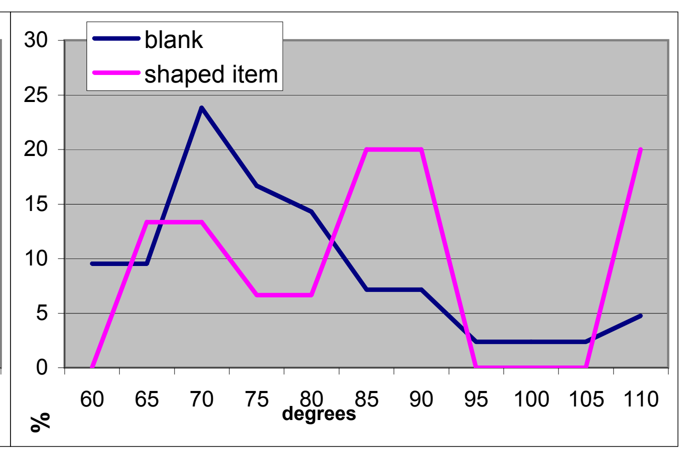


Fig. 213: Angle of the cortical edge of NBK blanks and shaped NBKs from the Amudian beds of Tabun XI.
n= blank: 42; shaped item: 15.

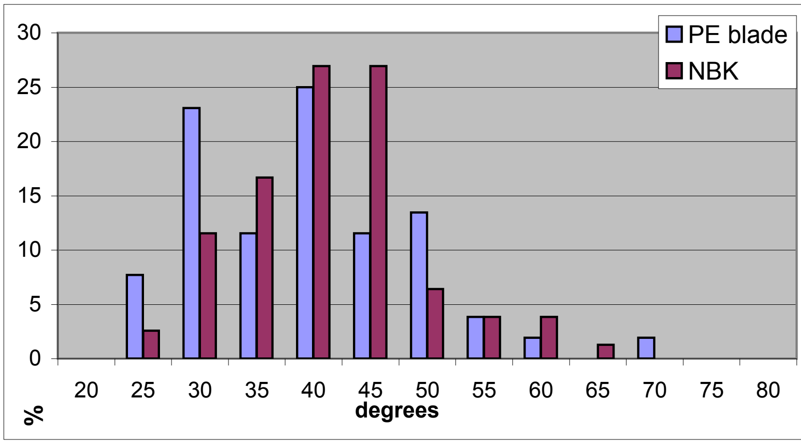


Fig. 214: Angle of the sharp edge of PE blades and NBKs (blanks and shaped) from the Amudian beds of Tabun XI.
n=PE blade: 52; NBK: 78.

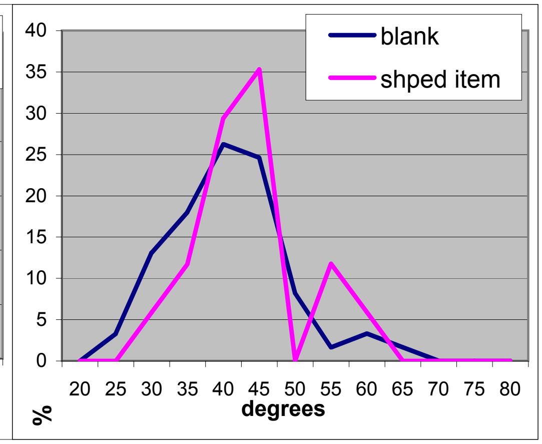


Fig. 215: Angle of the sharp edge of NBK blanks and shaped NBKs from the Amudian beds of Tabun XI.
n=blank: 61; shaped item: 17.

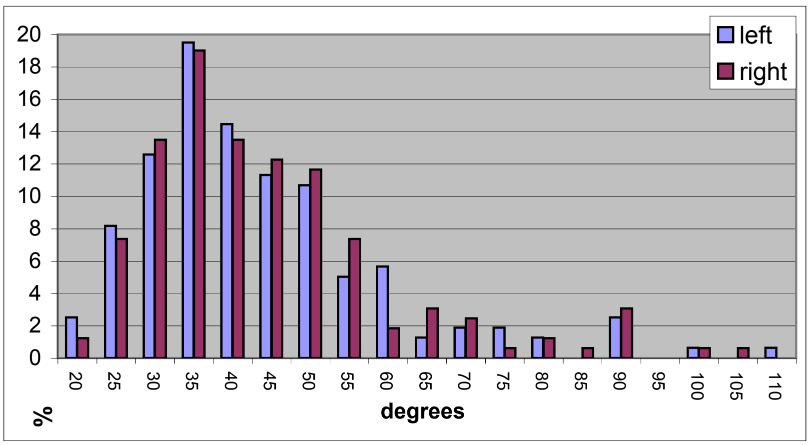


Fig. 216: Angles of the lateral edges of blades (blanks and shaped) from the Amudian beds of Tabun XI.
n=left: 159; right: 163.

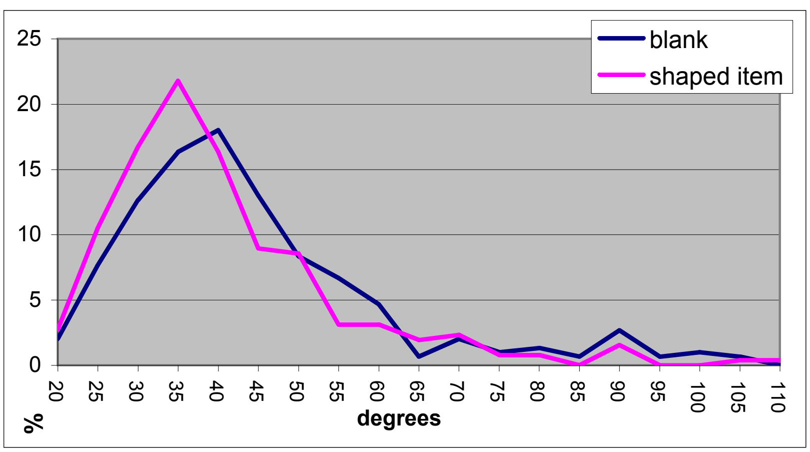


Fig. 217: Angles of the lateral edges of blank blades and shaped blades from the Amudian beds of Tabun XI.
The left and right angles were united into one population.
n=blank: 300; shaped item: 257.

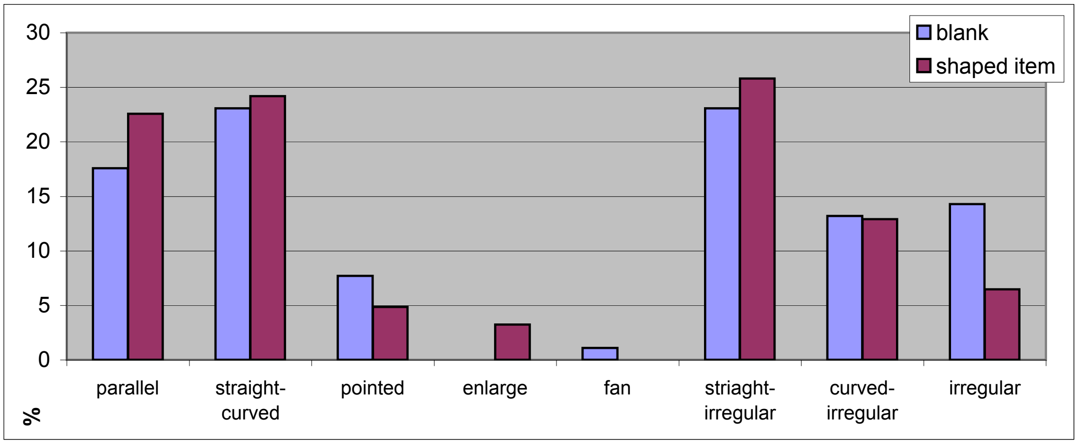


Fig. 218: Shape of blank blades and shaped blades from the Amudian beds of Tabun XI.
n=blank: 91; shaped item: 62.

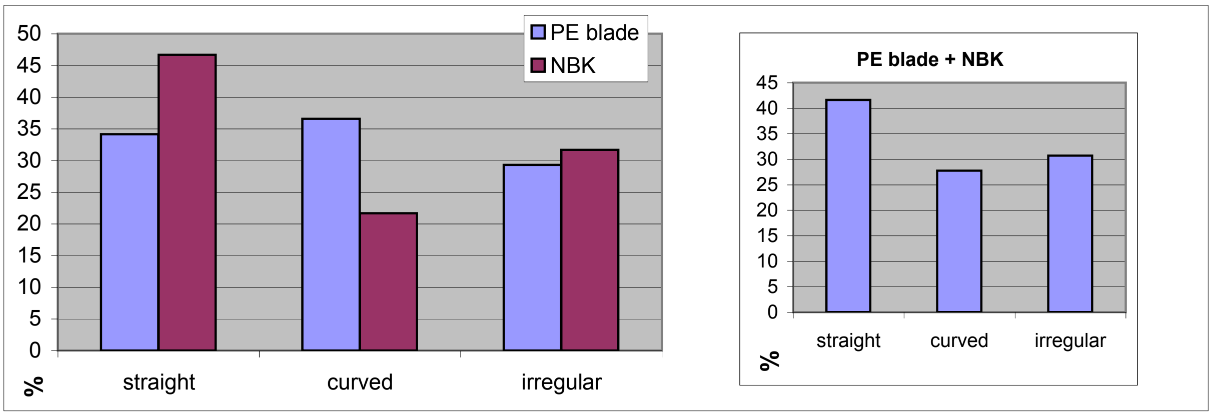


Fig. 219: Outline of the cortical edge of PE blades and NBKs (blank and shaped) from the Amudian beds of Tabun XI.
n= PE blade: 41; NBK: 60; total: 101.

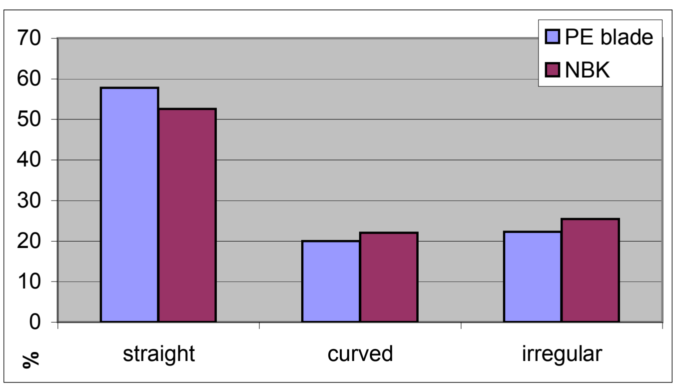


Fig. 220: Outline of the sharp edge of PE blades and NBKs (blanks and shaped) from the Amudian beds of Tabun XI.
n=PE blade: 45; NBK: 59.

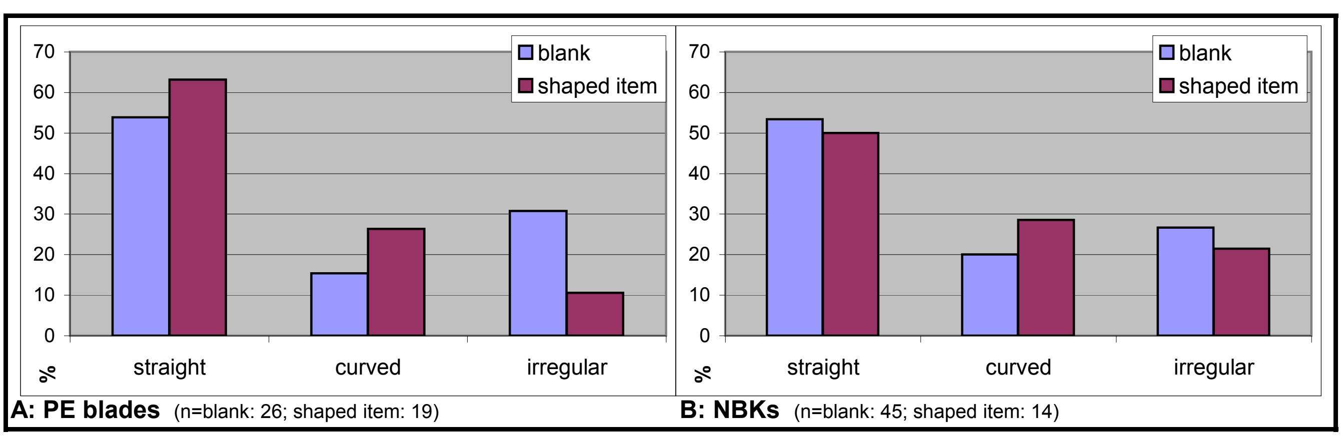


Fig. 221: Outline of the sharp edge of blank PE blades and NBKs and shaped PE blades and NBKs from the Amudian beds of Tabun XI.

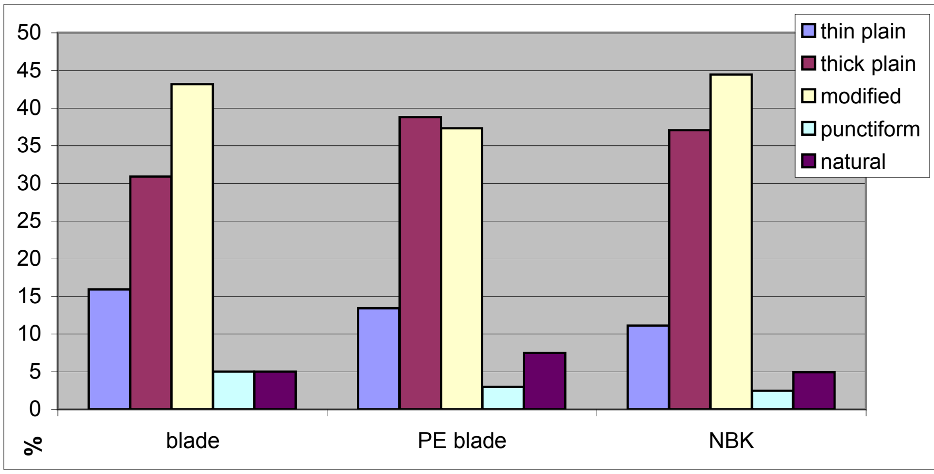


Fig. 222: Butt type of the three laminar types (blanks and shaped) from the Amudian beds of Tabun XI.
n=blade: 220; PE blade: 67; NBK: 81.

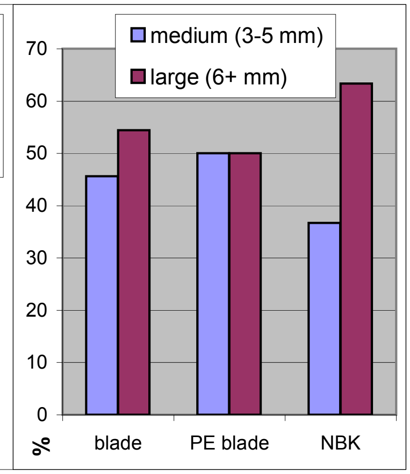


Fig. 223: Division of thick plain butts into medium and large thickness from the Amudian beds of Tabun XI.
n= blade: 68; PE blade: 26; NBK: 30.

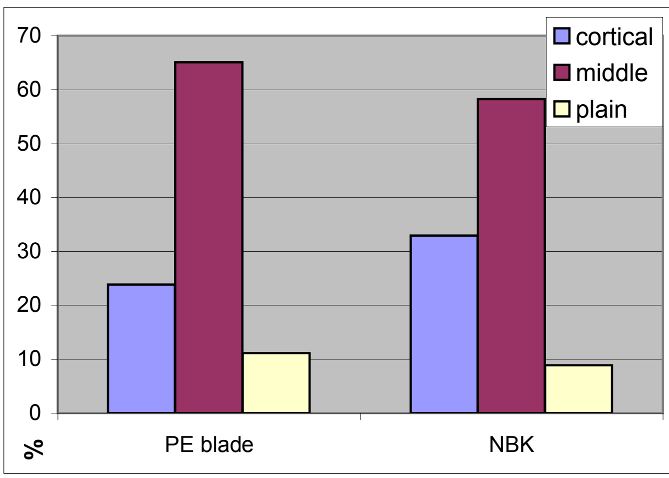


Fig. 224: Location of bulb of percussion on PE blades and NBKs (blanks and shaped) from the Amudian beds of Tabun XI.
n=PE blade: 63; NBK: 79.

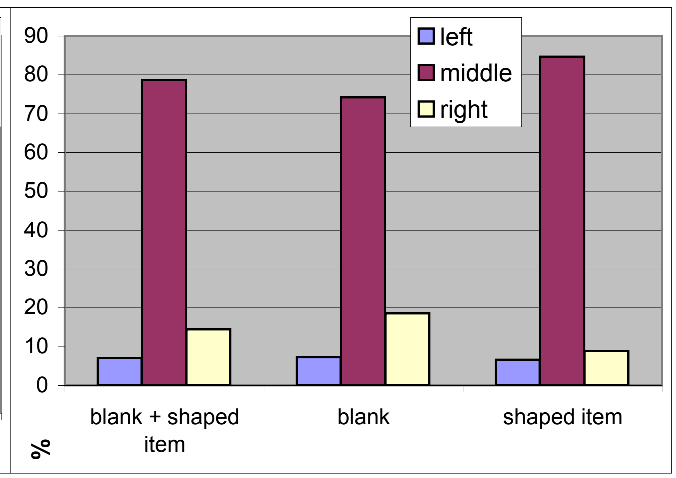
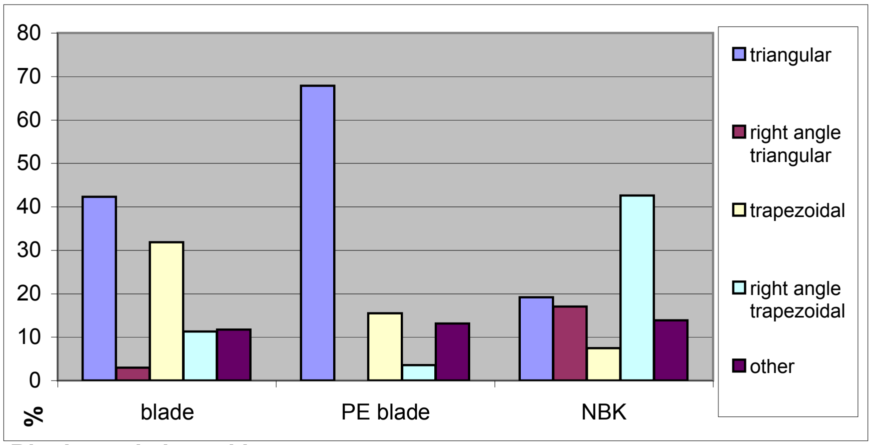
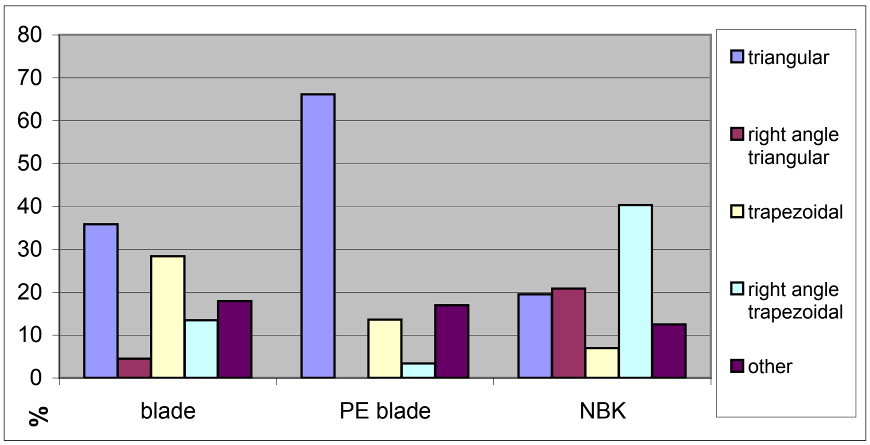


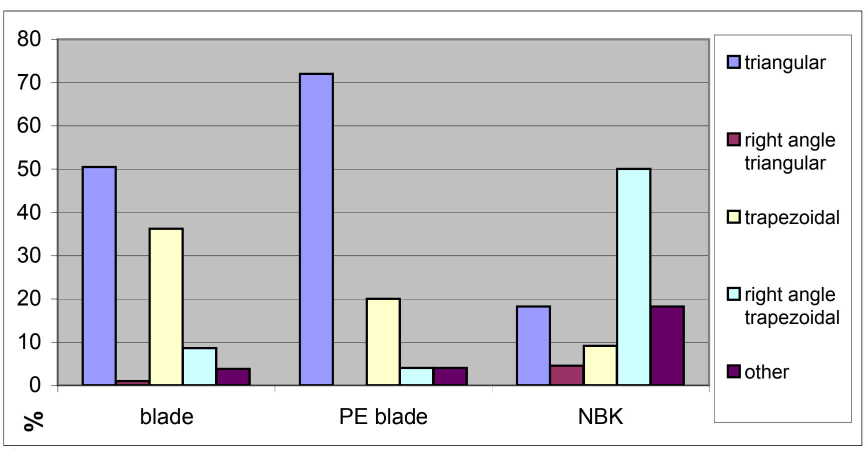
Fig. 225: Location of bulb of percussion on blades (blanks and shaped) from the Amudian beds of Tabun XI.
N=blank and shaped item: 215; blank: 124; shaped item: 91.



A: Blanks and shaped items (n=blade: 239; PE blade: 84; NBK: 94)

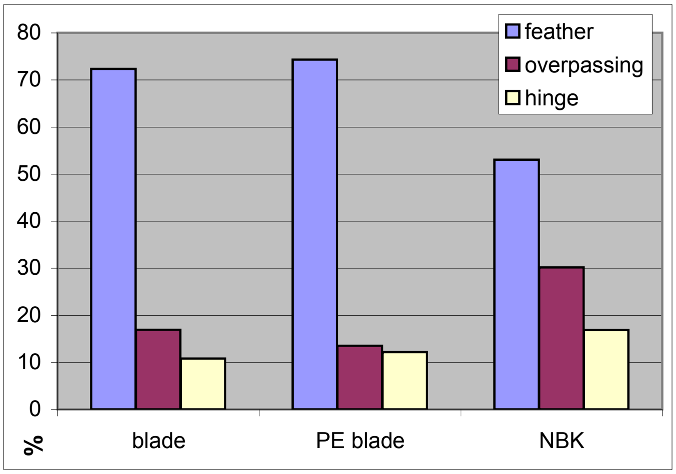


B: Blanks (n=blade: 134; PE blade: 59; NBK: 72)

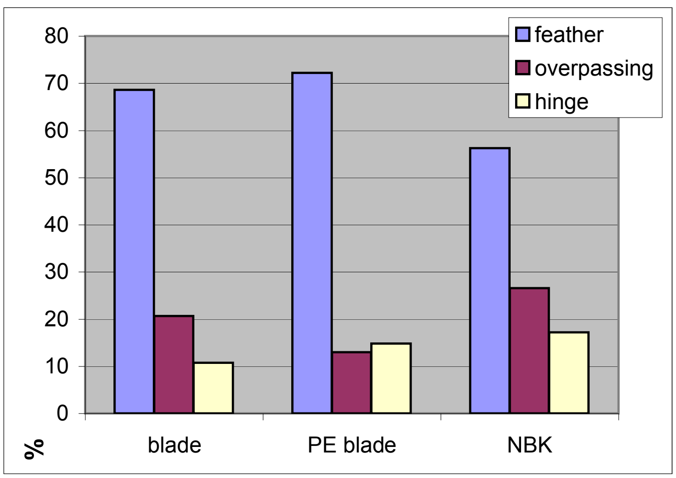


C: Shaped items (n=blade: 105; PE blade: 25; NBK: 22)

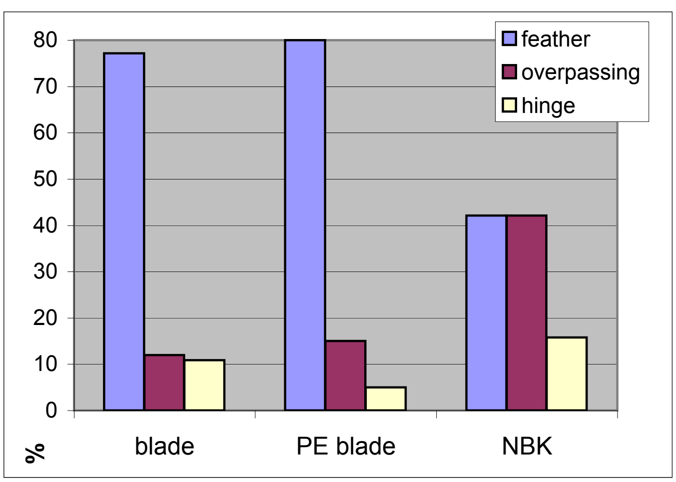
Fig. 226: Cross-section of laminar blanks and shaped laminar items from the Amudian beds of Tabun XI.



A: Blanks and shaped items (n=blade: 213; PE blade: 74; NBK: 83)

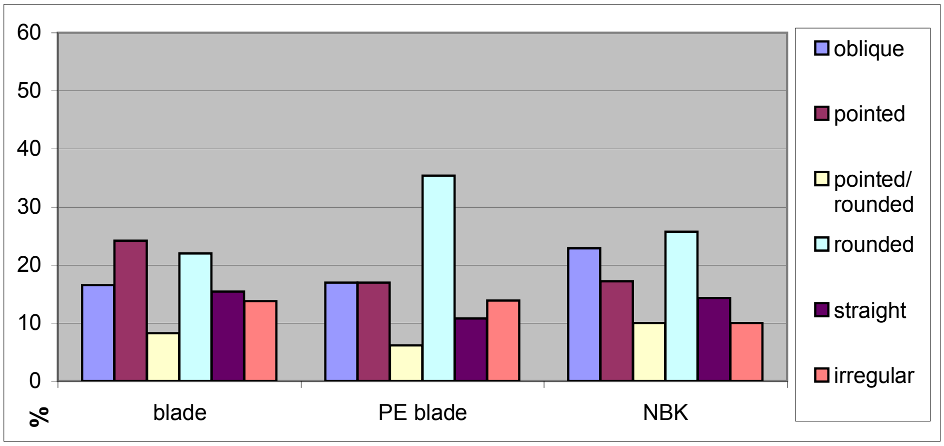


B: Blanks (n=blade: 121; PE blade: 54; NBK: 64)

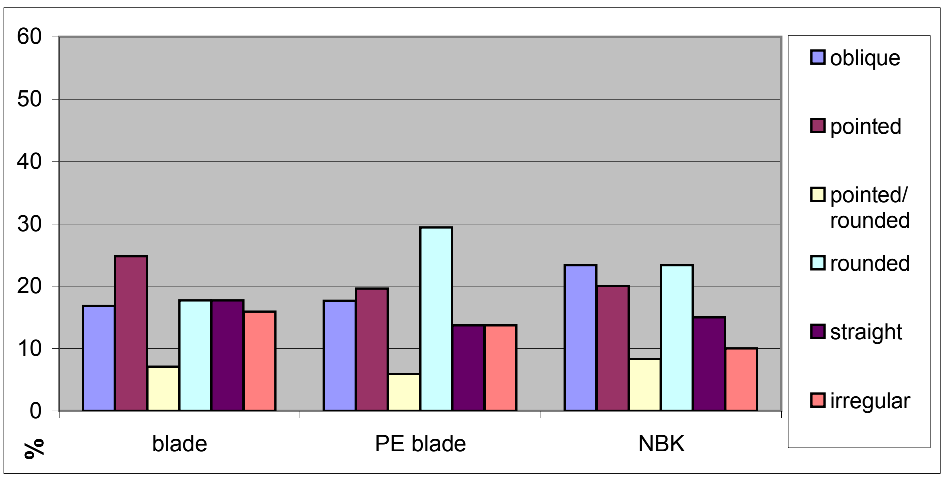


C: Shaped items (n=blade: 92; PE blade: 20; NBK: 19)

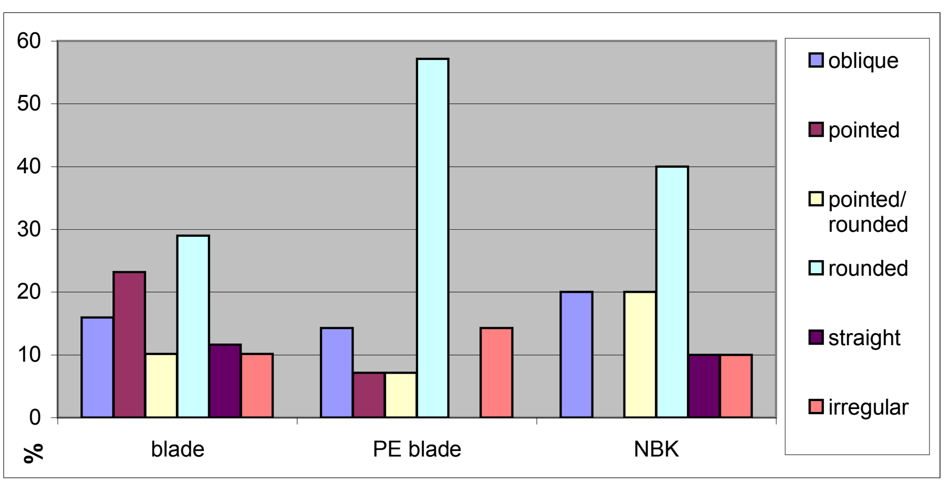
Fig. 227: End termination of laminar blanks and shaped laminar items from the Amudian beds of Tabun XI.



A: Blanks and shaped items (n=blade: 182; PE blade: 65; NBK: 70)

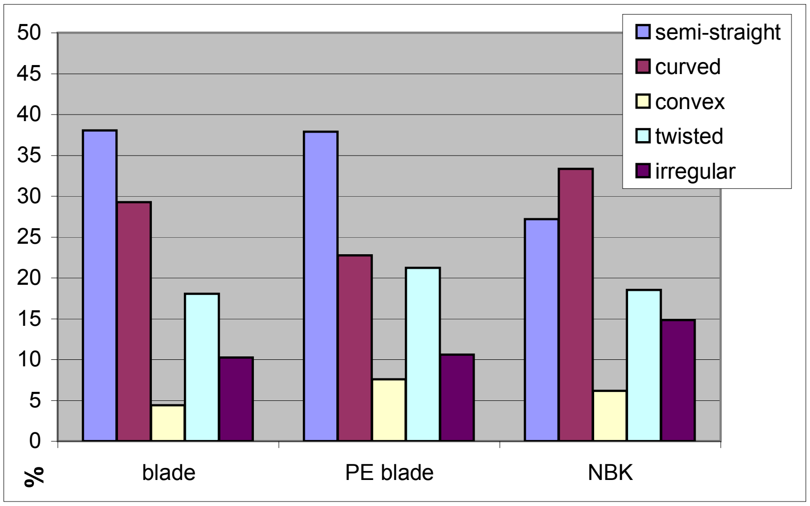


B: Blanks (n=blade: 113; PE blade: 51; NBK: 60)

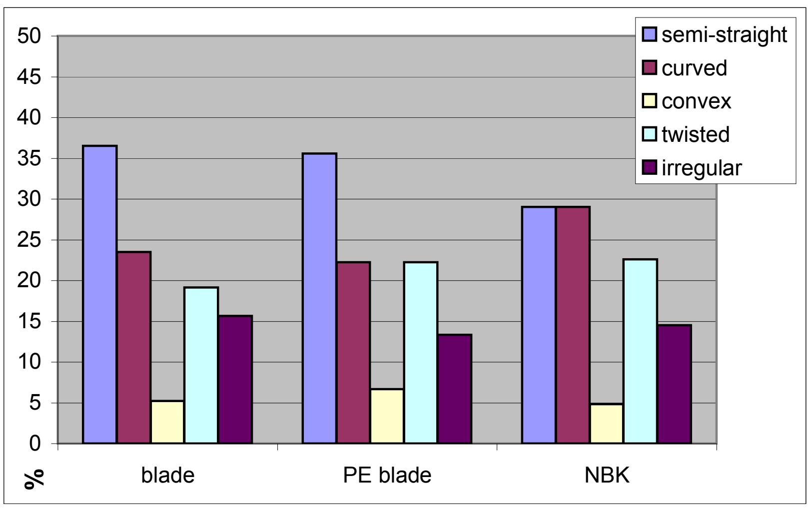


C: Shaped items (n=blade: 69; PE blade: 14; NBK: 10)

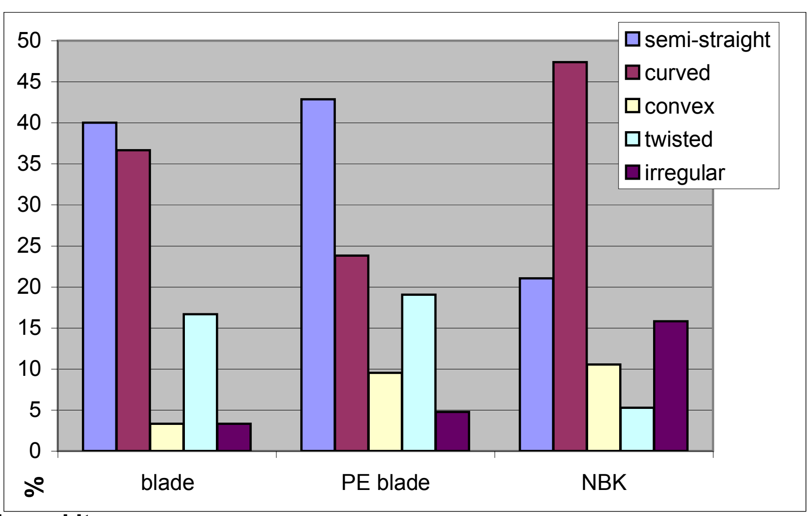
Fig. 228: Distal end shape of laminar blanks and shaped laminar items from the Amudian beds of Tabun XI.



A: Blanks and shaped items (n=blade: 205; PE blade: 66; NBK: 81)



B: Blanks (n=blade: 115; PE blade: 45; NBK: 62)



C: Shaped items (n=blade: 90; PE blade: 21; NBK: 19)

Fig. 229: Profile of the laminar blanks and shaped laminar items from the Amudian beds of Tabun XI.

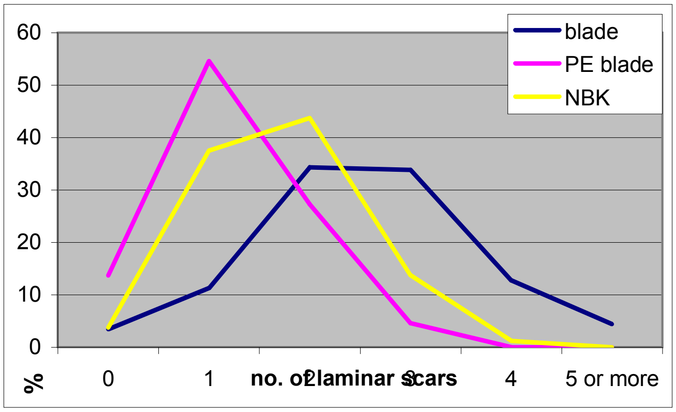
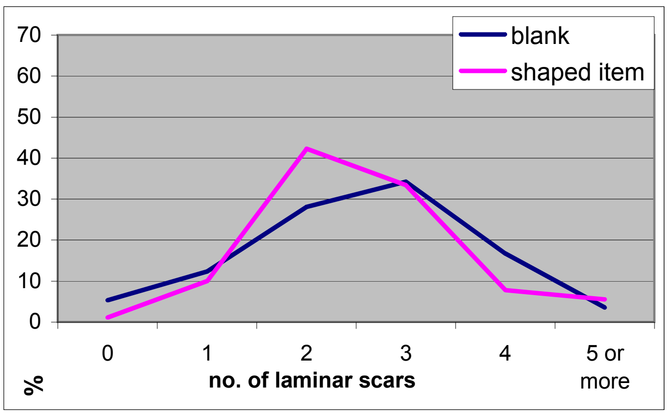
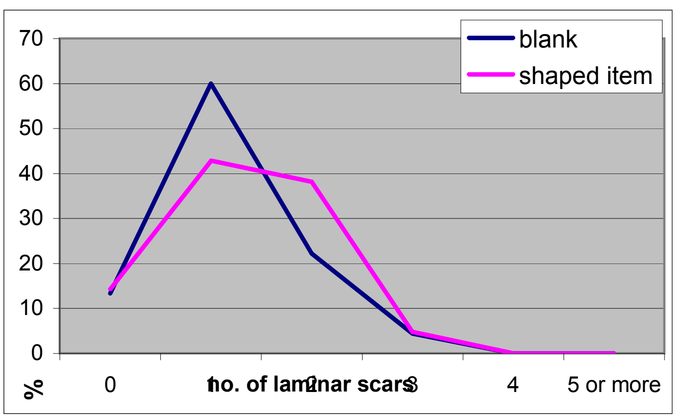


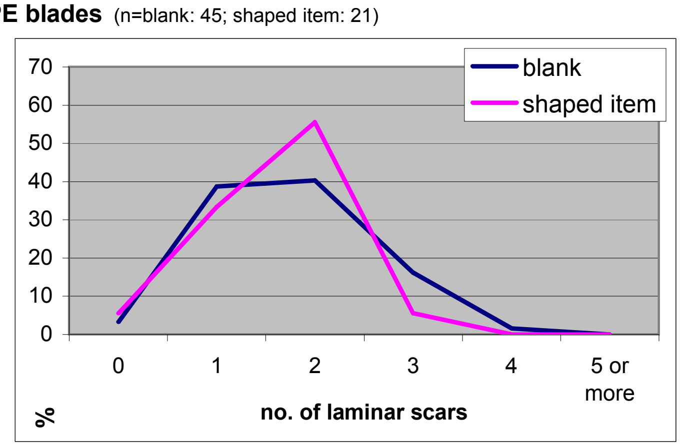
Fig. 230: Number of laminar scars on the three laminar types (blanks and shaped) from the Amudian beds of Tabun XI.
n=blade: 204; PE blade: 66; NBK: 80.



A: Blades (n=blank: 114; shaped item: 90)



B: PE blades (n=blank: 45; shaped item: 21)



C: NBKs (n=blank: 62; shaped item: 18)

Fig. 231: Number of laminar scars on laminar blanks and shaped laminar items from the Amudian beds of Tabun XI.

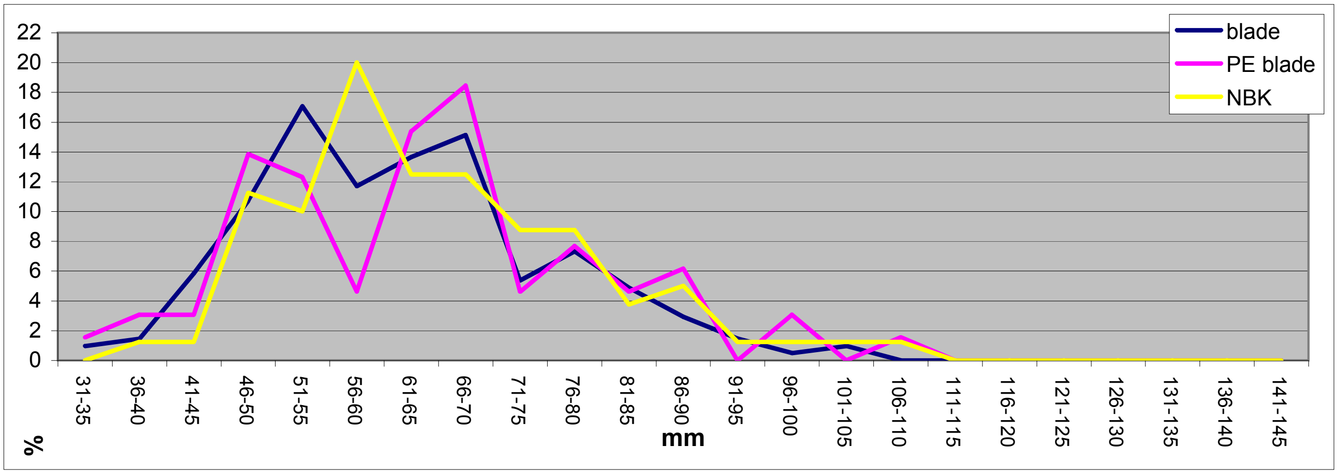


Fig. 232: Length of the three laminar types (blanks and shaped) from the Amudian beds of Tabun XI.
n=blade: 205; PE blade: 65; NBK: 80.

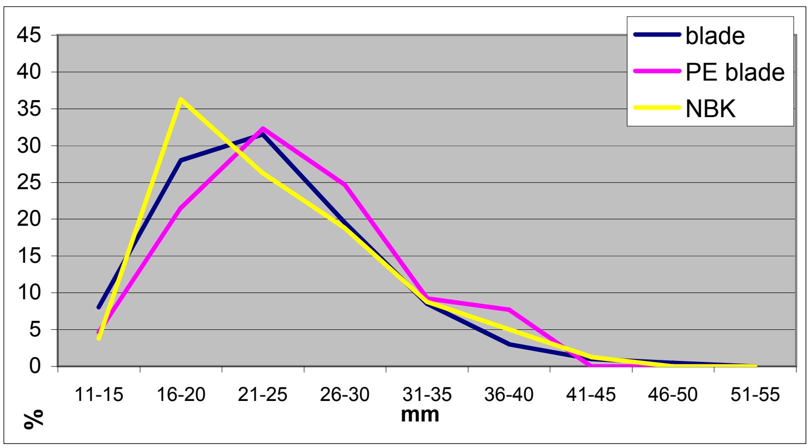


Fig. 233: Width of the three laminar types (blanks and shaped) from the Amudian beds of Tabun XI.
n= blade: 200; PE blade: 65; NBK: 80.

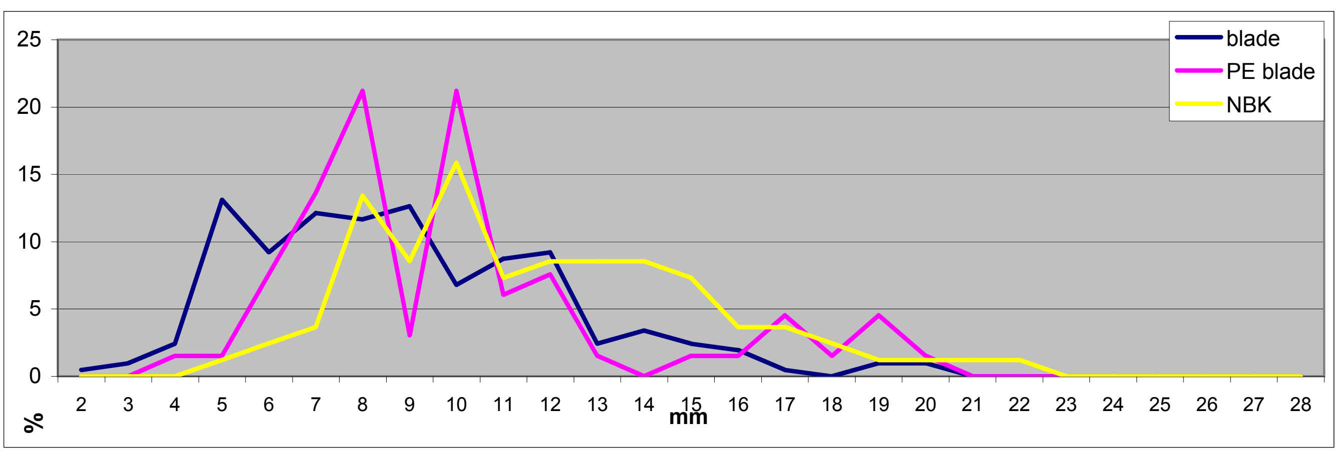


Fig. 234: Thickness of the three laminar types (blanks and shaped) from the Amudian beds of Tabun XI.
n=blade: 206; PE blade: 66; NBK: 82.

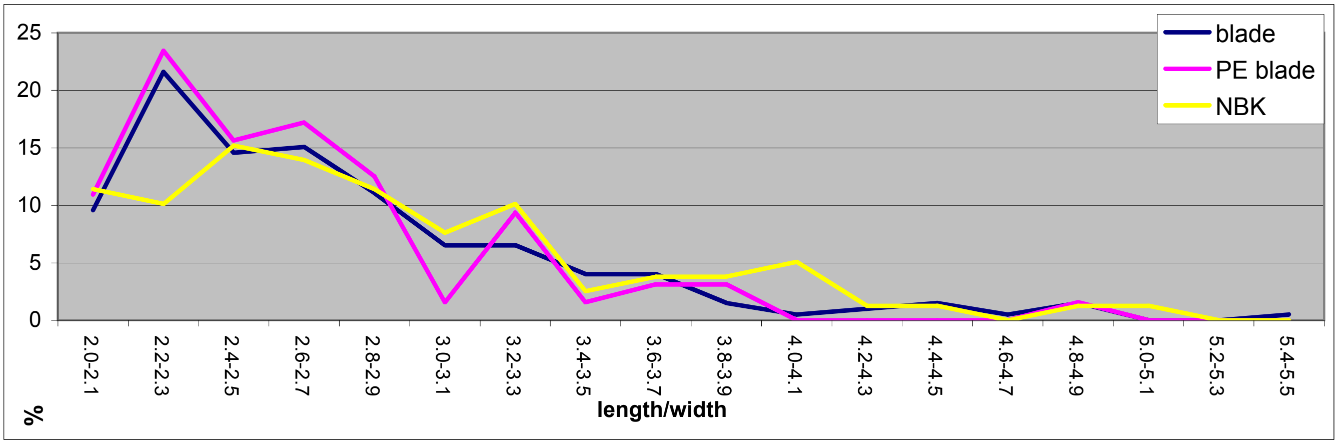


Fig. 235: Length/width ratio of the three laminar types (blanks and shaped) from the Amudian beds of Tabun XI.
n= blade: 199; PE blade: 64; NBK: 79.

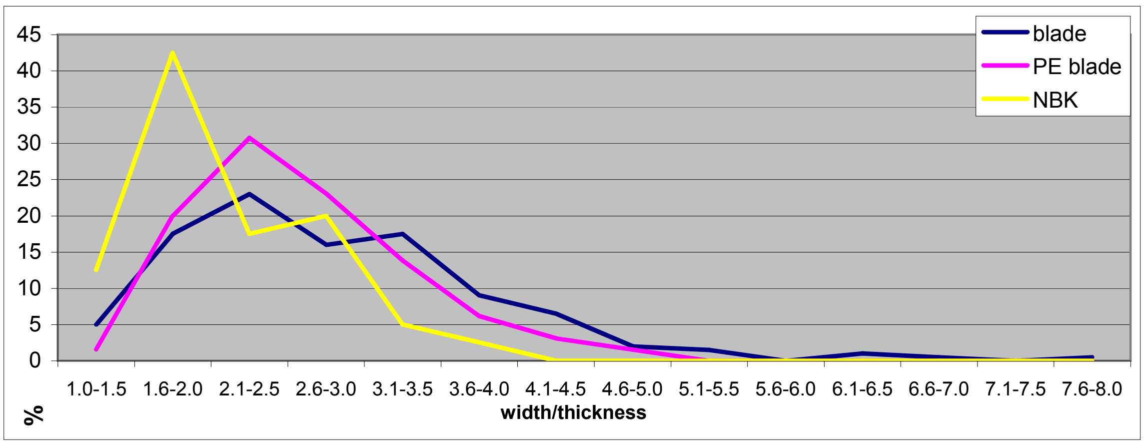
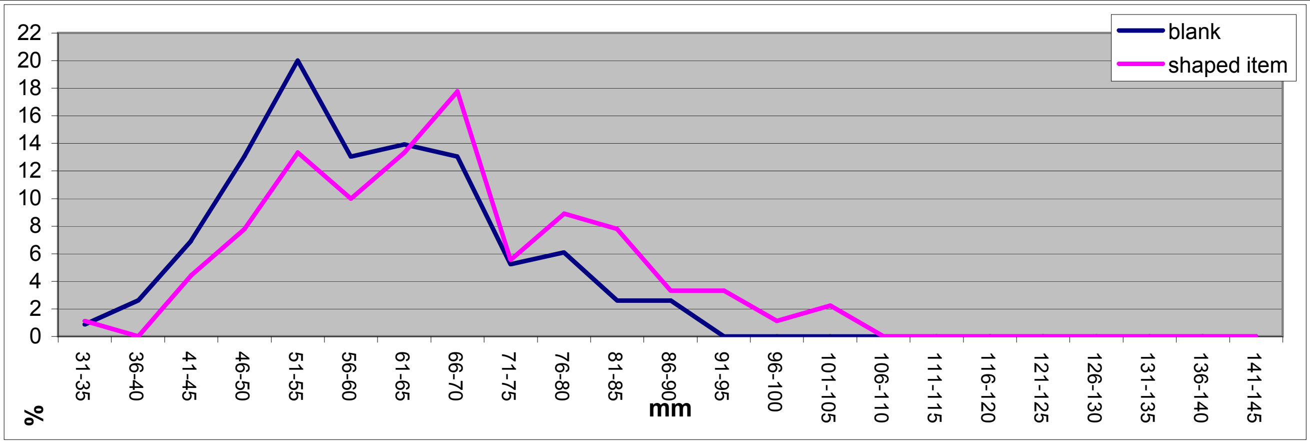
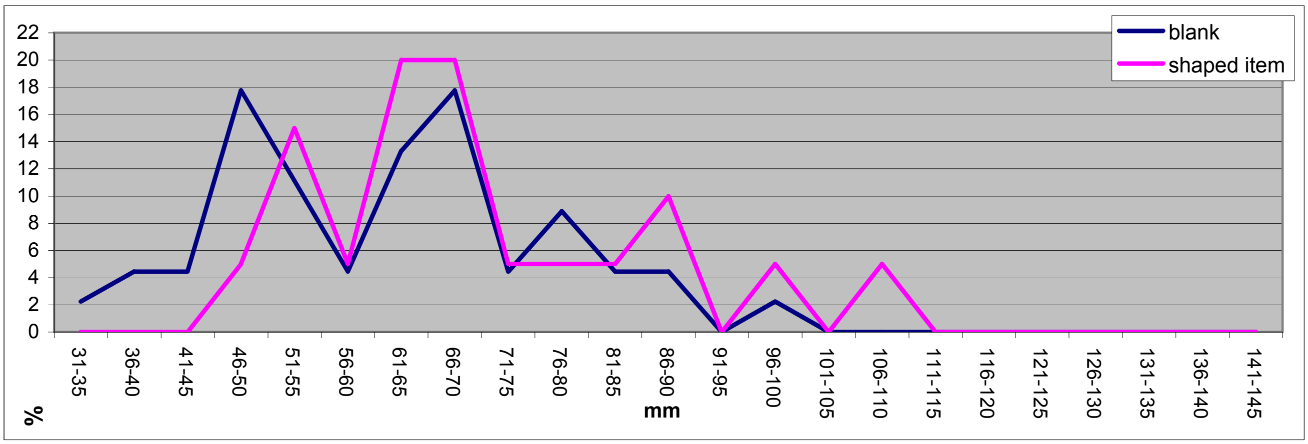


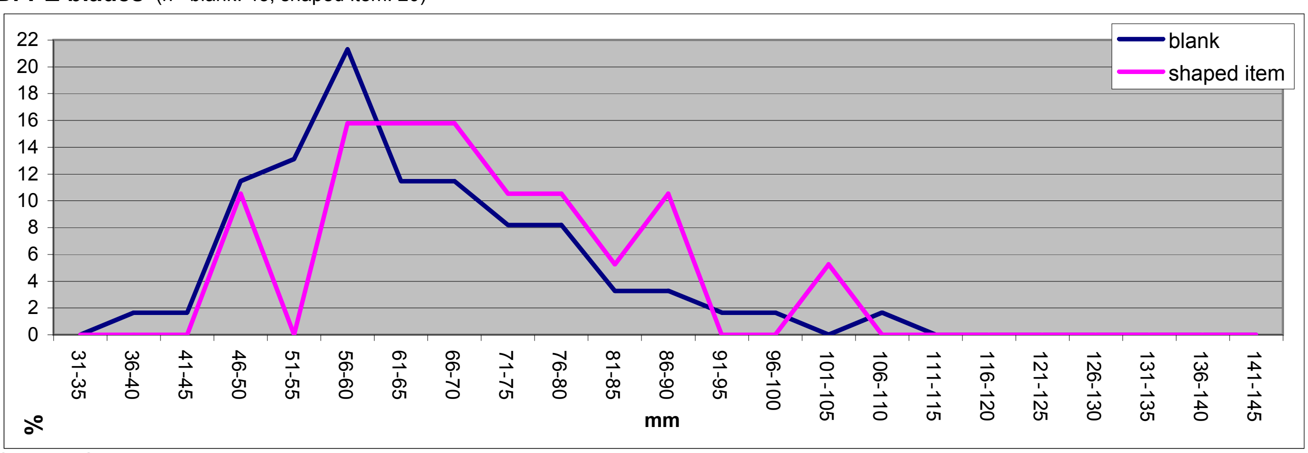
Fig. 236: Width/thickness ratio of the three laminar types (blanks and shaped) from the Amudian beds of Tabun XI.
n= blade: 200; PE blade: 65; NBK: 80.



A: Blades (n= blank: 115; shaped item: 90)

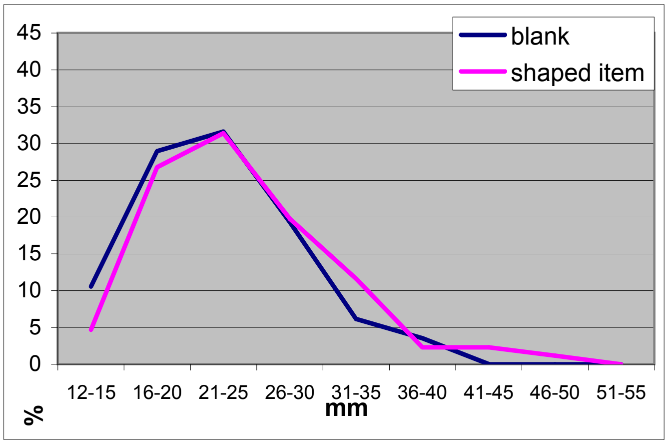


B: PE blades (n= blank: 45; shaped item: 20)

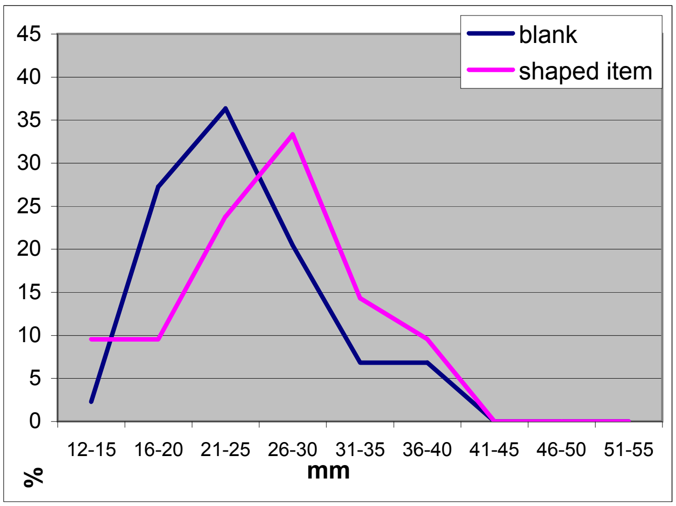


C: NBKS (n= blank: 61; shaped item: 19)

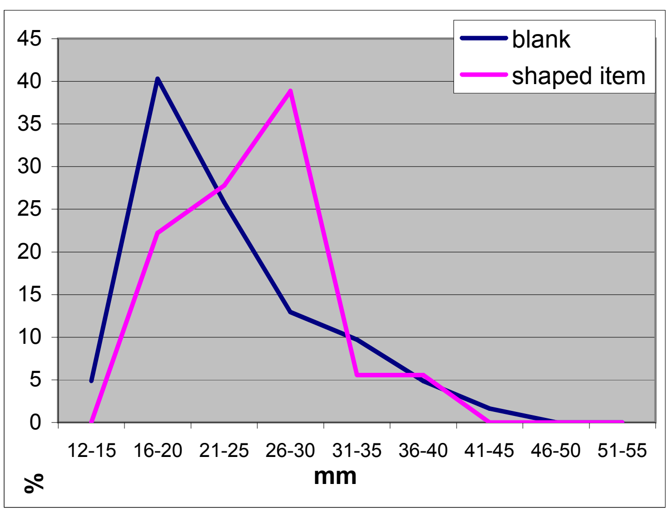
Fig. 237: Length of laminar blanks and shaped laminar items from the Amudian beds of Tabun XI.



A: Blades (n=blank: 114; shaped item: 86)

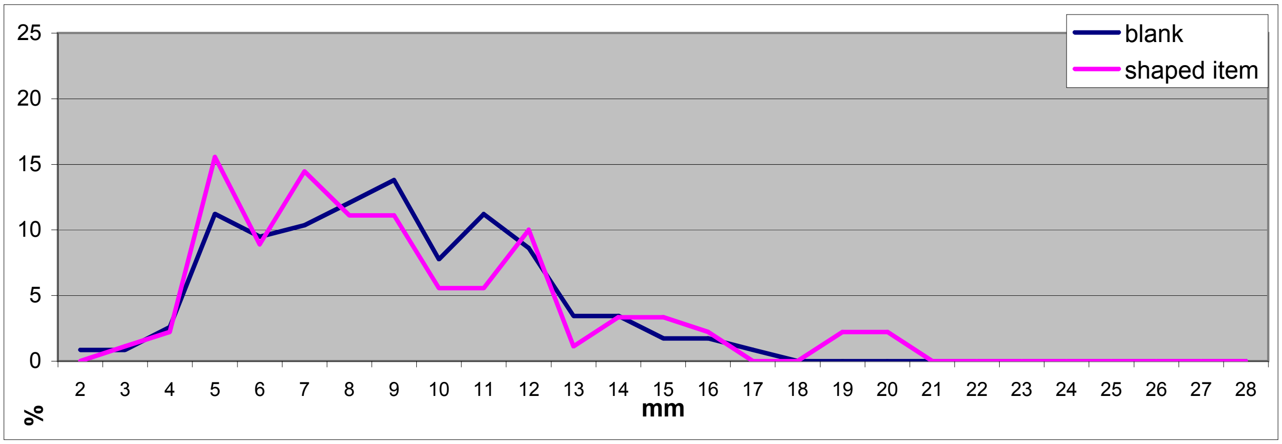


B: PE blades (n=blank: 44; shaped item: 21)

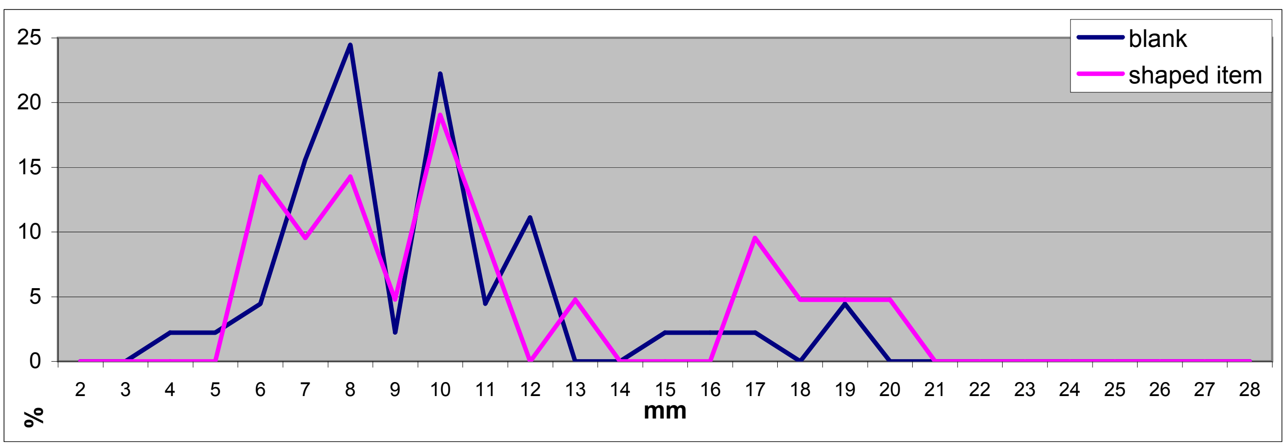


C: NBKs (n=blank: 62; shaped item: 18)

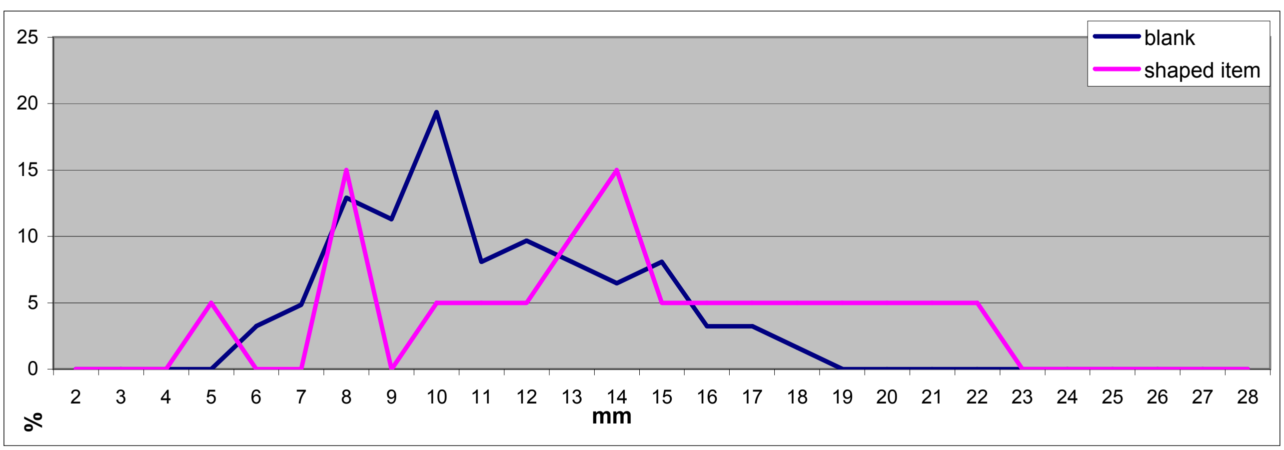
Fig. 238: Width of laminar blanks and shaped laminar items from the Amudian beds of Tabun XI



A: Blades (n=blank: 116; shaped item: 90)

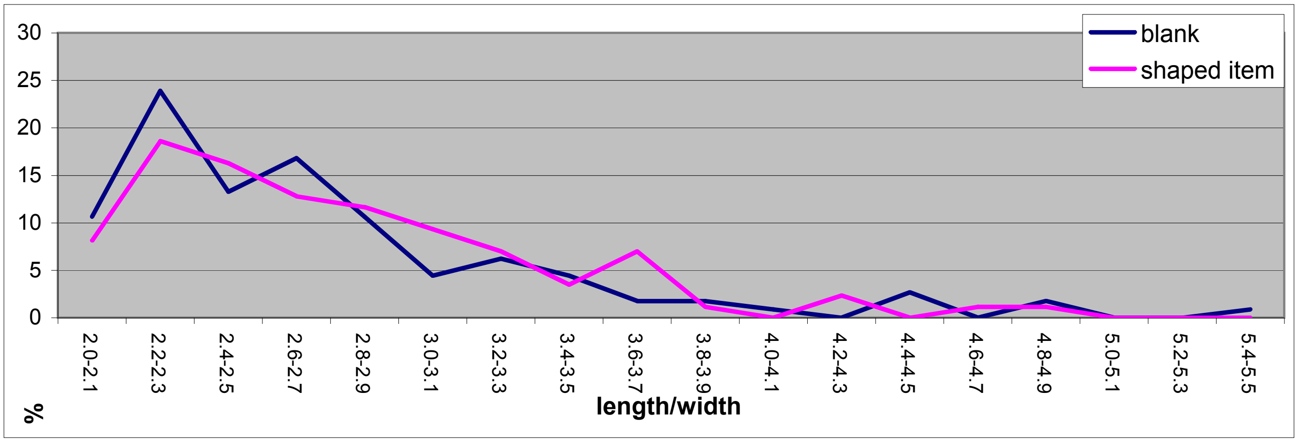


B: PE blades (n=blank: 45; shaped item: 21)

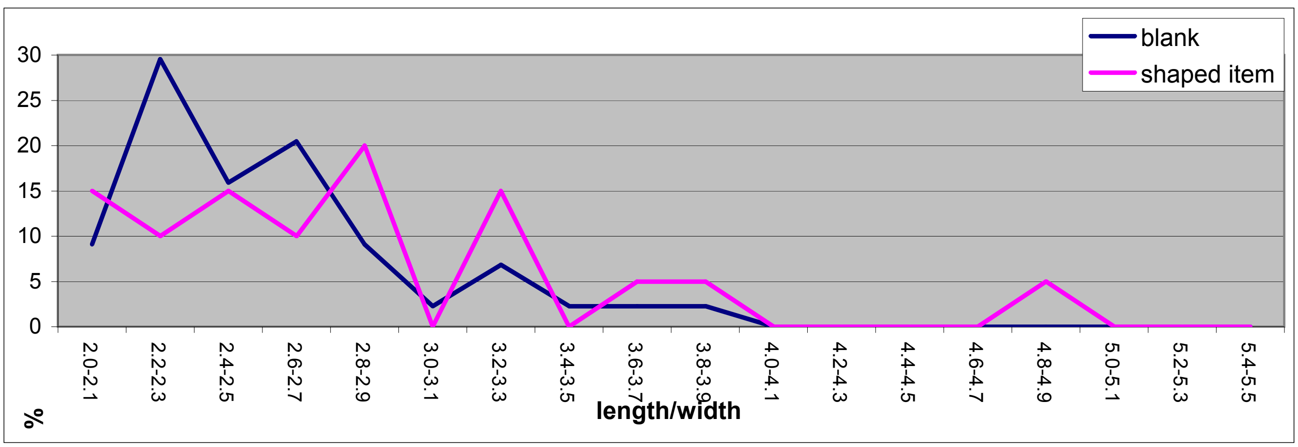


C: NBKs (n=blank:62; shaped item: 20)

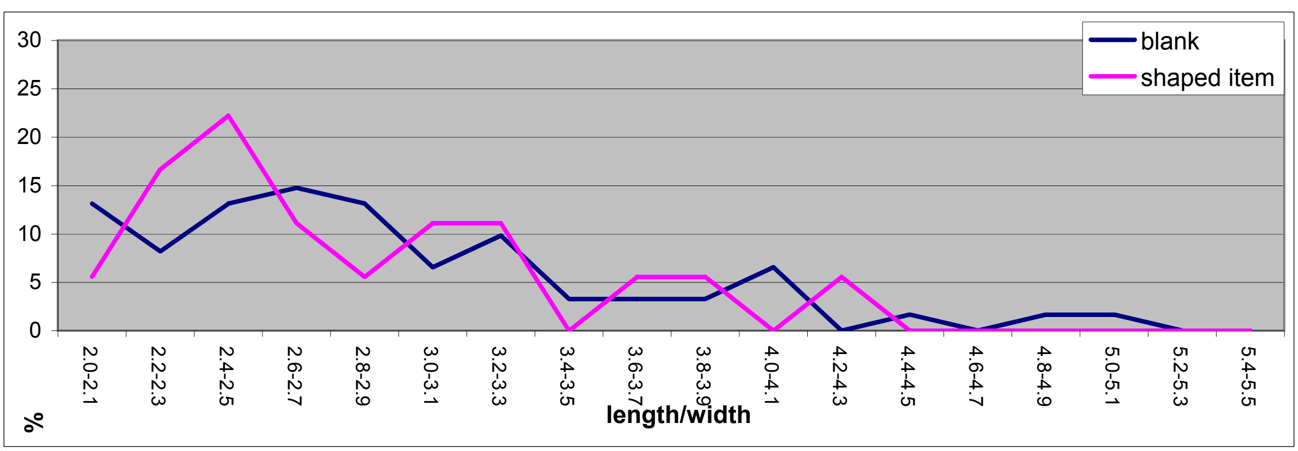
Fig. 239: Thickness of laminar blanks and shaped laminar items from the Amudian beds of Tabun XI.



A: Blades (n=blank: 113; shaped item: 86)

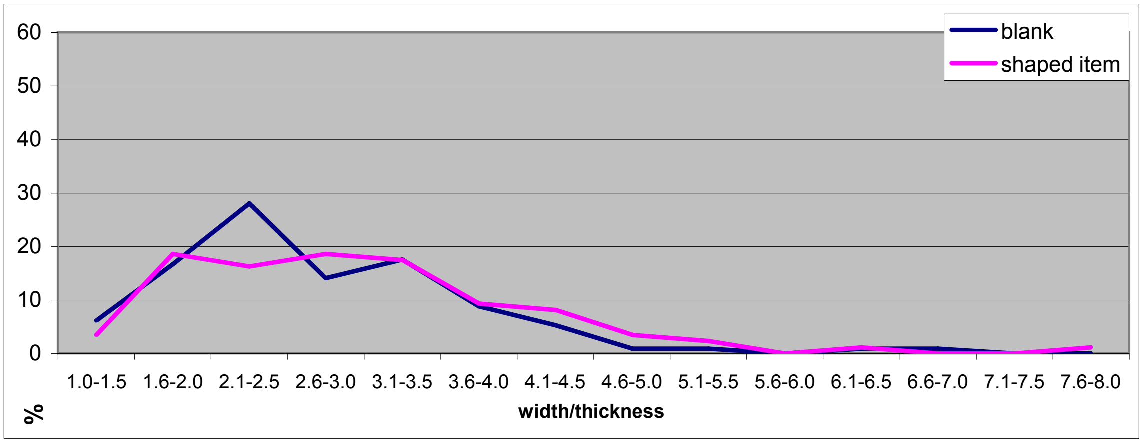


B: PE blades (n=blank: 44; shaped item: 20)

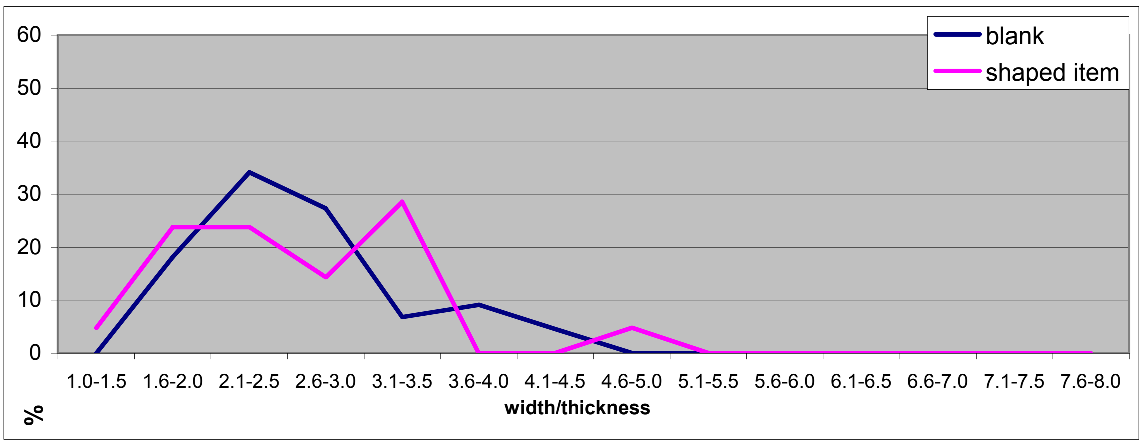


C: NBKs (n=blank: 61; shaped item: 18)

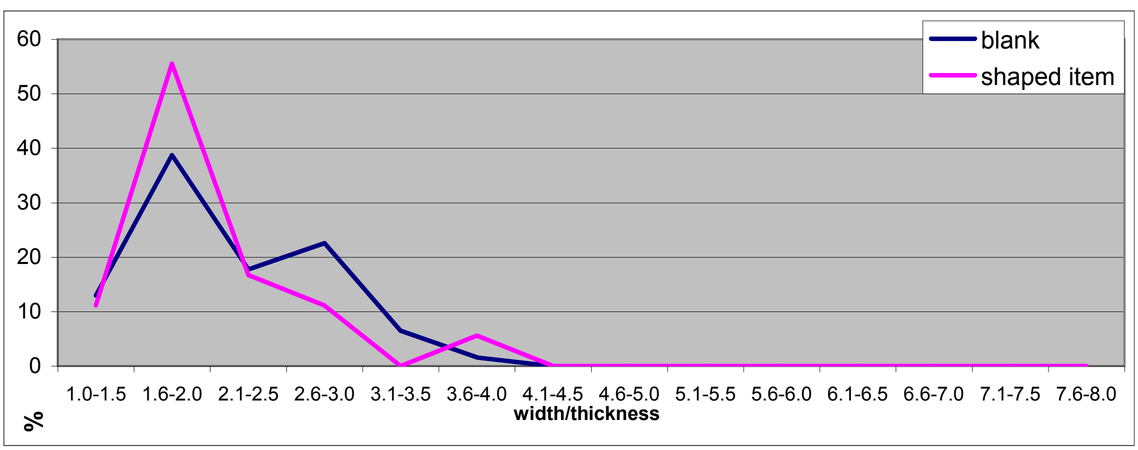
Fig. 240: Length/width ratio of laminar blanks and shaped laminar items from the Amudian beds of Tabun XI.



A: Blades (n=blank: 114; shaped item: 86)



B: PE blades (n=blank: 44; shaped item: 21)



C: NBKs (n=blank: 62; shaped item: 18)

Fig. 241: Width/thickness ratio of laminar blanks and shaped laminar items from the Amudian beds of Tabun XI.

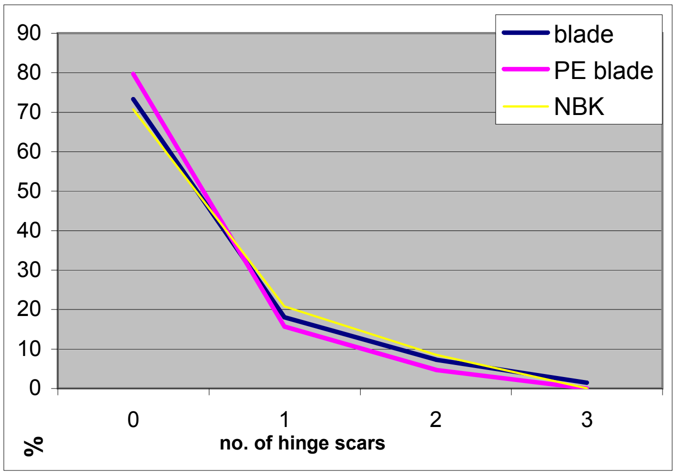


Fig. 242: Number of hinge scars on the three laminar types (blanks and shaped) from the Amudian beds of Tabun XI.
n=blade: 206; PE blade: 64; NBK: 82.

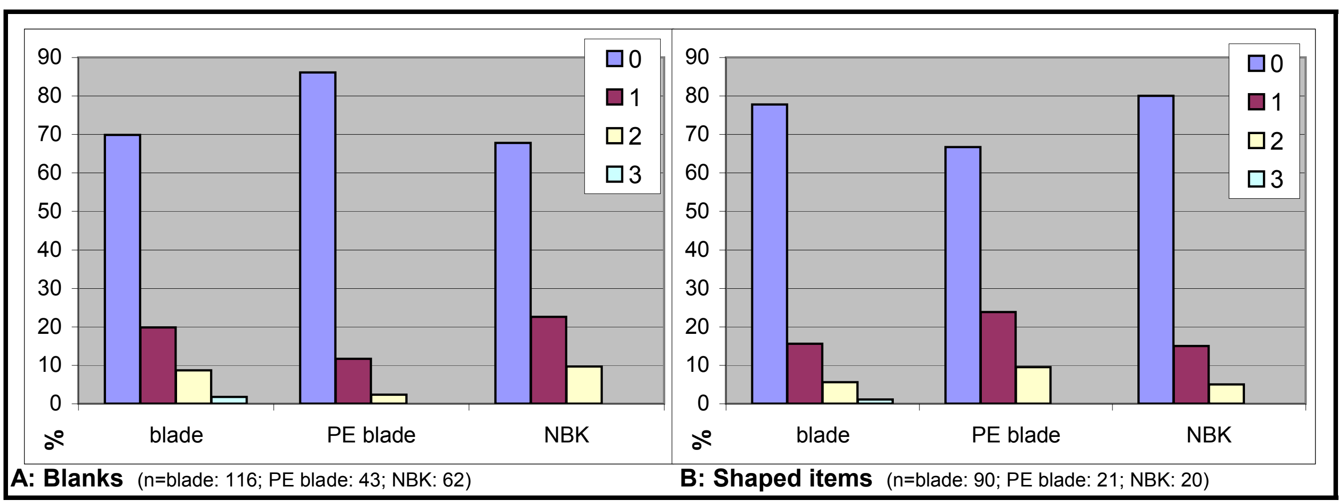


Fig. 243: Number of hinge scars on laminar blanks and shaped laminar items from the Amudian beds of Tabun XI.

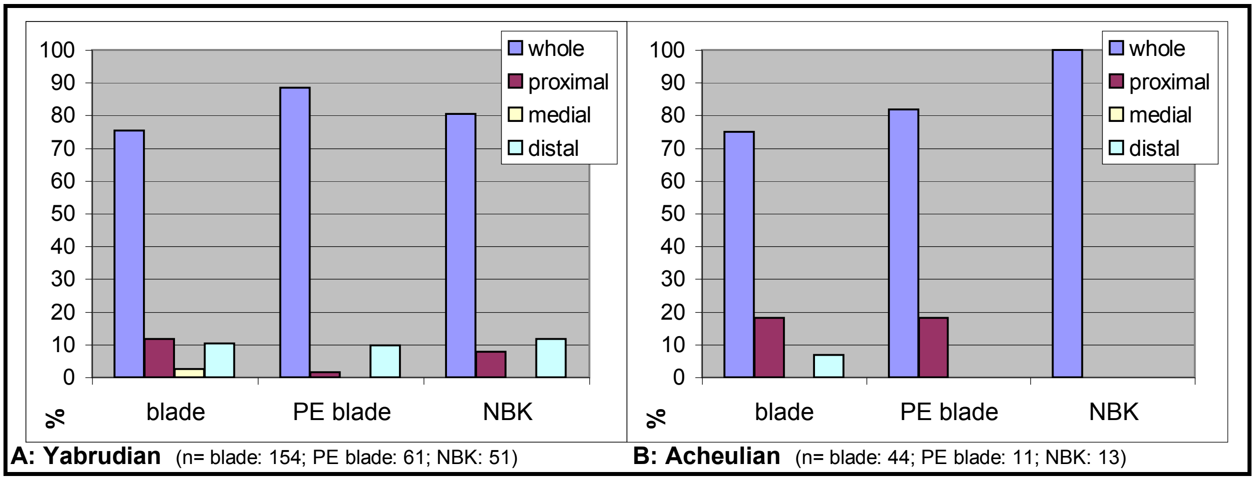


Fig. 244: State of preservation of the laminar items from the Yabrudian and Acheulian beds of Tabun XI.

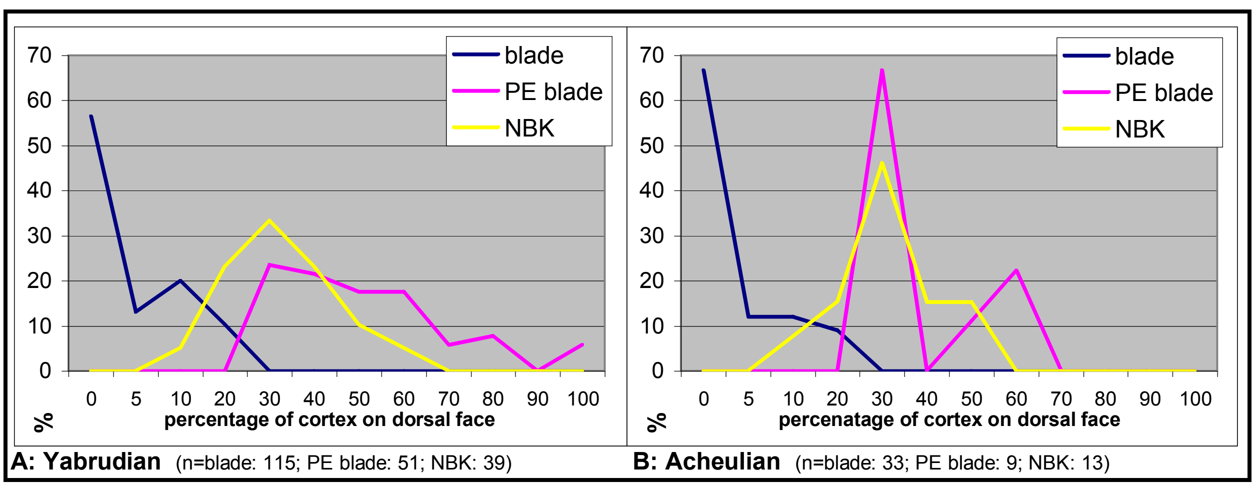
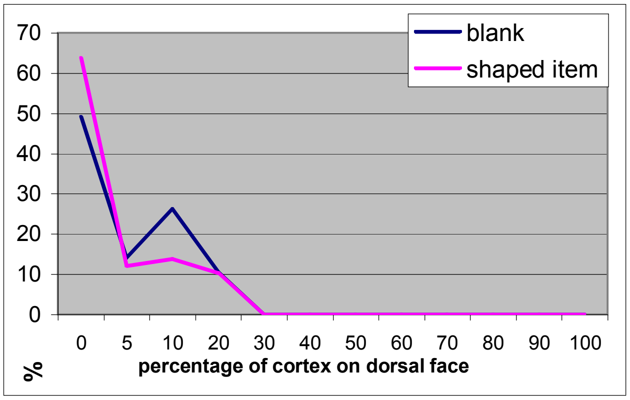
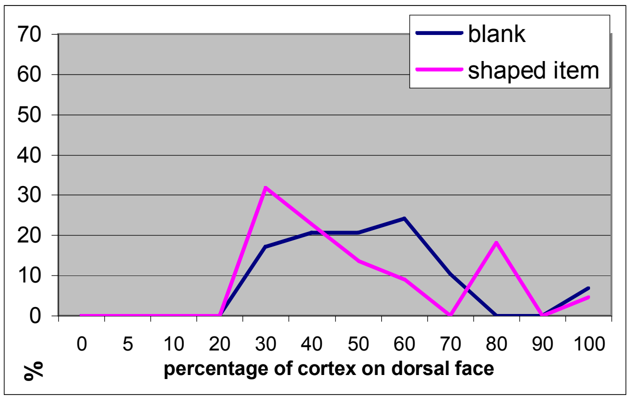


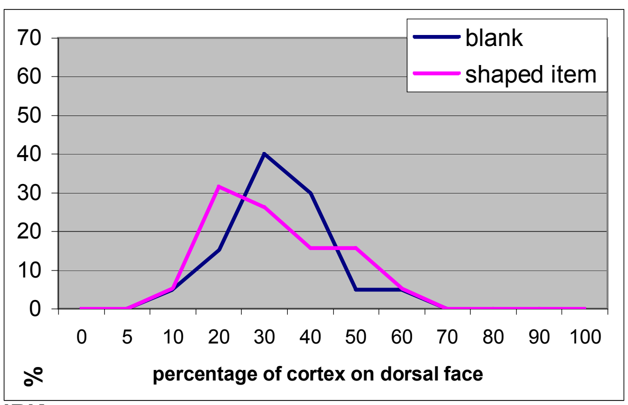
Fig. 245: Percentage of cortex on the dorsal face of the three laminar types (blanks and shaped) from the Yabrudian and Acheulian beds of Tabun XI.



A: Blades (n=blank: 57; shaped item: 58)



B: PE blades (n=blank: 29; shaped item: 22)



C: NBKs (n=blank: 20; shaped item: 19)

Fig. 246: Percentage of cortex on dorsal face of laminar blanks and shaped laminar items from the Yabrudian beds of Tabun XI.

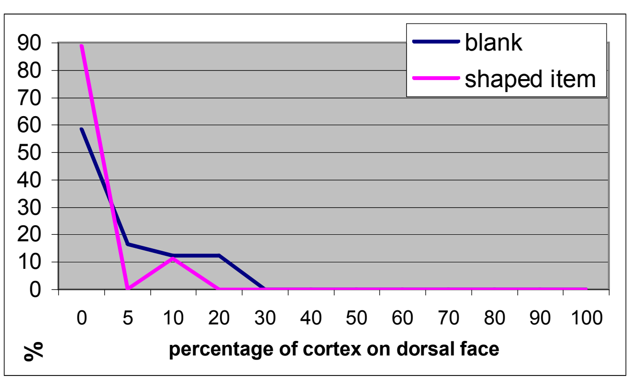


Fig. 247: Percentage of cortex on dorsal face of blank blades and shaped blades from the Acheulian beds of Tabun XI.
n=blank: 24; shaped item: 9.

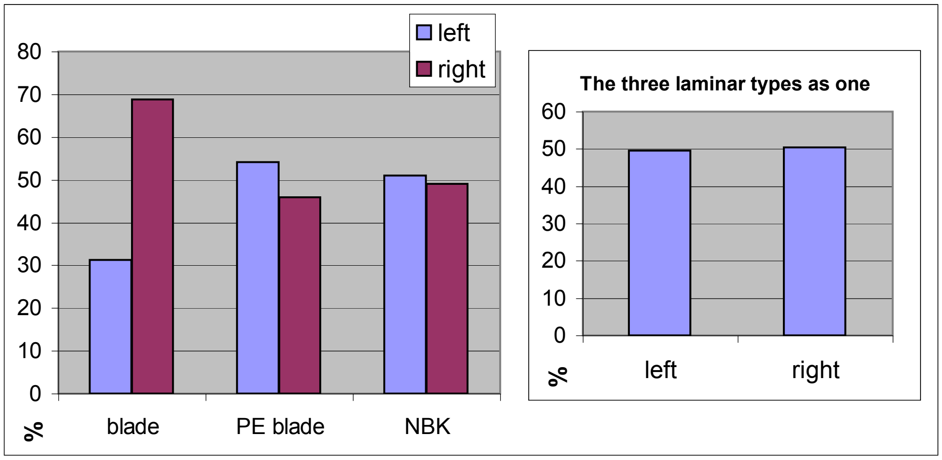


Fig. 248: Side of cortex on the three laminar types (blanks and shaped) from the Yabrudian beds of Tabun XI.
In the right graph all laminar types are united.
n=blade: 16; PE blade: 48; NBK: 51; total: 115.

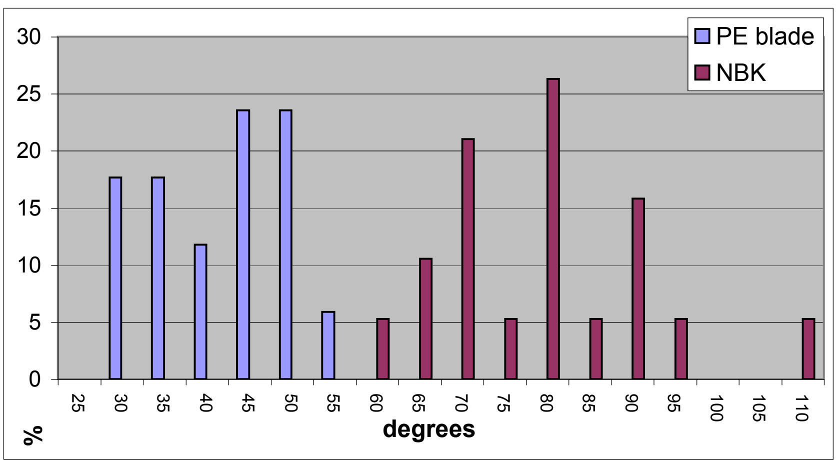


Fig. 249: Angle of the cortical edge of PE blades and NBKs (blanks and shaped)
from the Yabrudian beds of Tabun XI.
n=PE blade: 17; NBK: 19.

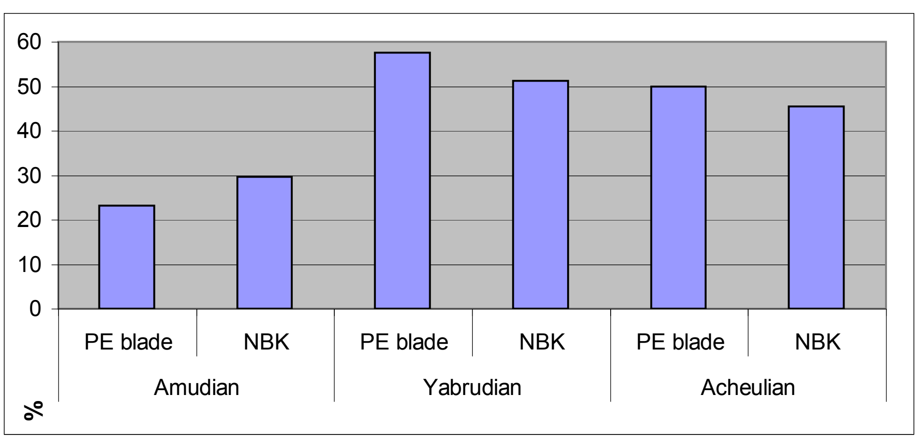


Fig. 250: The presence of a non-unifrom cortical angle on PE blades and NBKs (blanks and shaped)
from the three facies of Tabun XI.
n=**Amudian**: PE blade: 56; NBK: 81.
Yabrudian: PE blade: 40; NBK: 39.
Acheulian: PE blade: 6; NBK: 11.

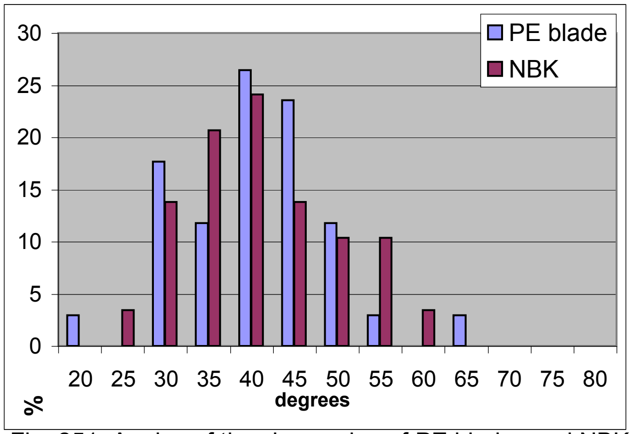
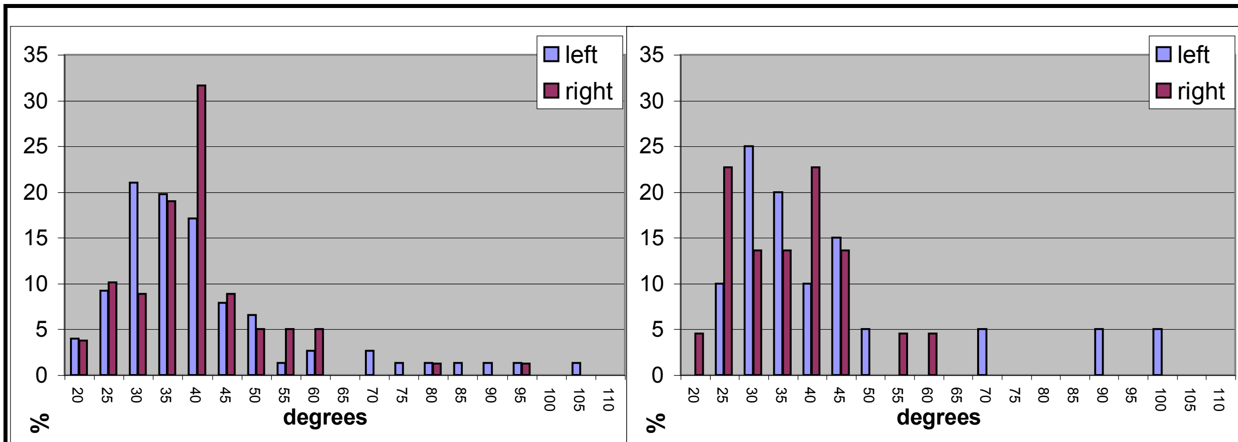
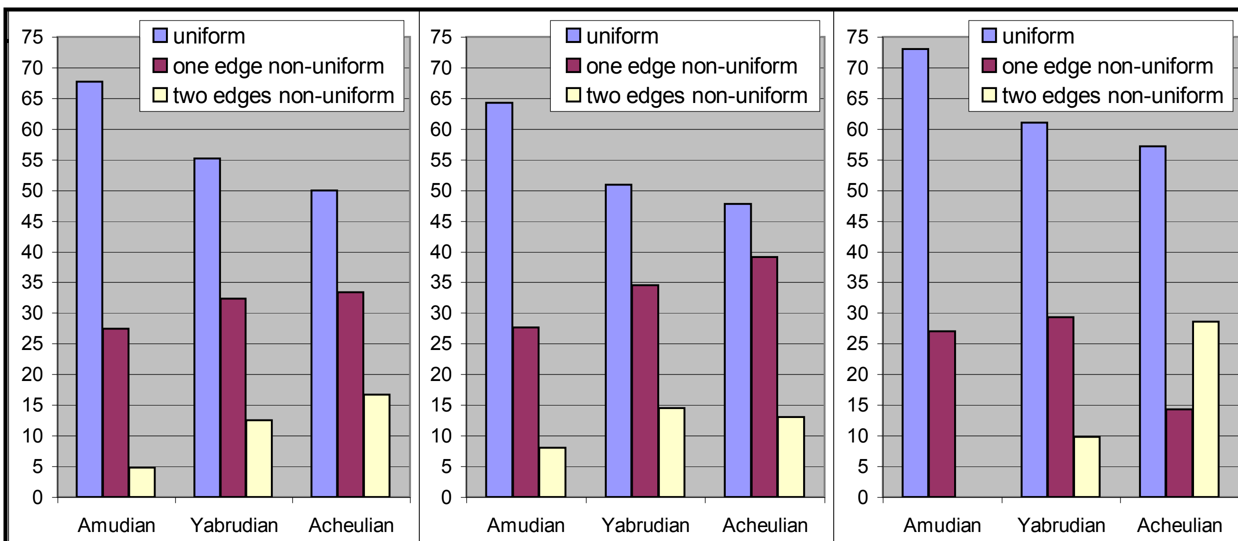


Fig. 251: Angles of the sharp edge of PE blades and NBKs (blanks and shaped) from the Yabrudian beds of Tabun XI.
n=PE blade: 34; NBK: 29.



A: Yabrudian (n=left: 76; right: 79) **B: Acheulian** (n=left: 20; right: 22)

Fig. 252: Angles of the lateral edges of blades (blanks and shaped) from the Yabrudian and Acheulian beds of Tabun XI.



A: Blanks and shaped items **B: Blanks** **C: Shaped items**

Fig. 253: Non-uniform angles of lateral edges of blades from the three facies of Tabun XI.
n=**blank and shaped item**: Amudian: 186; Yabrudian: 96; Acheulian: 30.
blank: Amudian: 112; Yabrudian: 55; Acheulian: 23.
shaped item: Amudian: 74; Yabrudian: 41; Acheulian: 7.

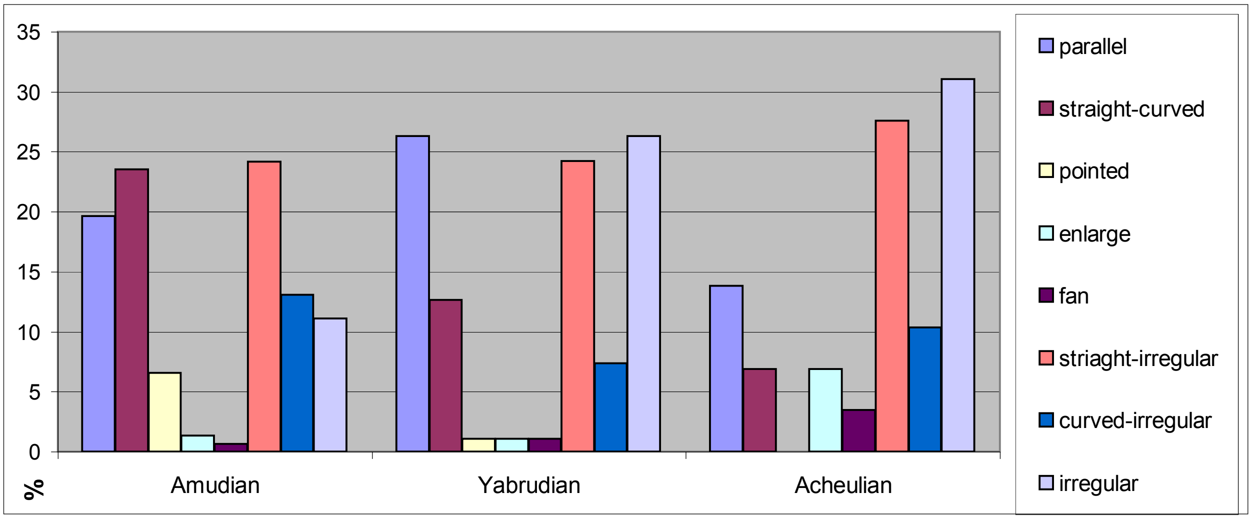


Fig. 254: Shape of blades (blanks and shaped) from the three facies of Tabun XI.
n=Amudian: 153; Yabrudian: 95; Acheulian: 29.

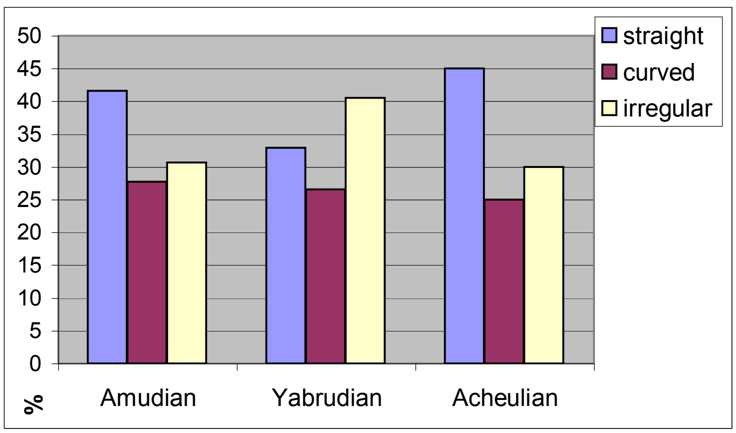


Fig. 255: Outline of the cortical edge of PE blades and NBKs (blanks and shaped) from the three facies of Tabun XI.
n=Amudian: 101; Yabrudian: 79; Acheulian: 20.

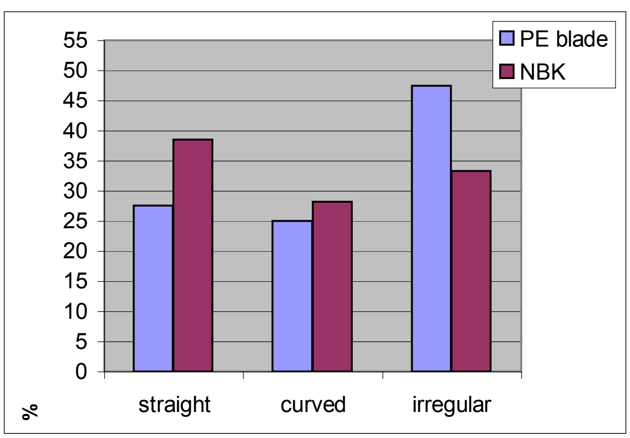


Fig. 256: Outline of the cortical edge of PE blades and NBKs (blanks and shaped) from the Yabrudian beds of Tabun XI.
n=PE blade: 40; NBK: 39.

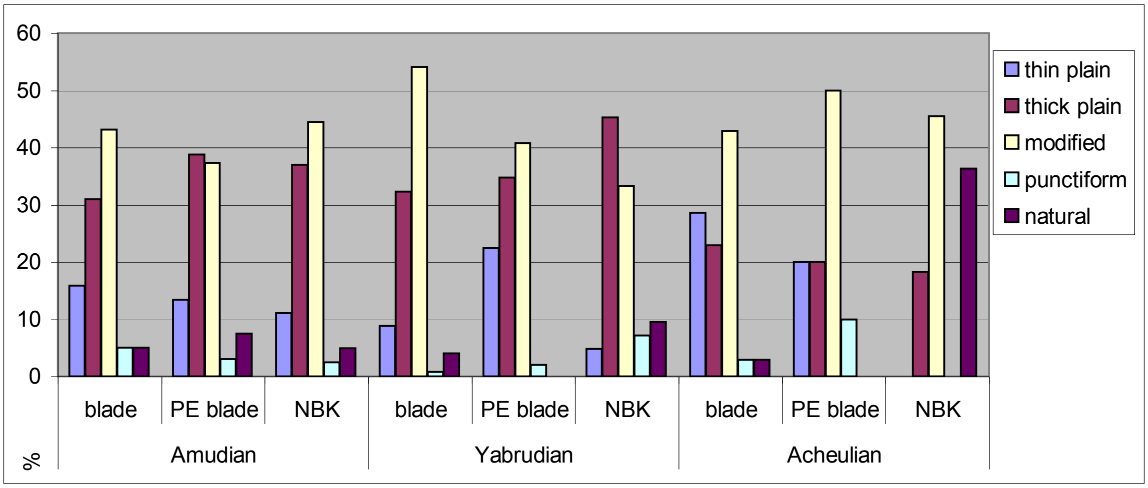


Fig. 257: Butt type of the three laminar types (blanks and shaped) from the three facies of Tabun XI.
n= **Amudian** - blade:220; PE blade: 67; NBK: 81.
Yabrudian - blade: 124; PE blade: 49; NBK: 42.
Acheulian - blade: 35; PE blade: 10; NBK: 11.

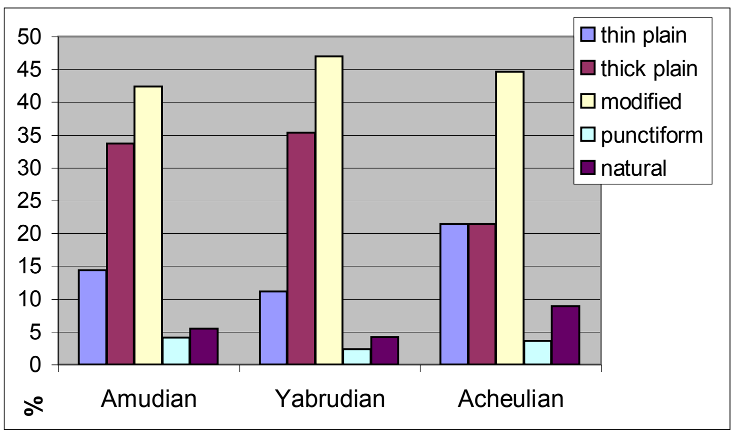


Fig. 258: Butt type of the three laminar types grouped together (blanks and shaped) from the three facies of Tabun XI.
n=Amudian: 368; Yabrudian: 215; Acheulian: 56.

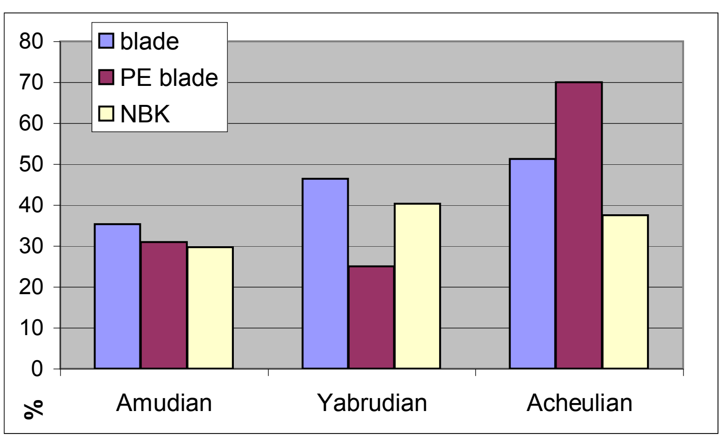


Fig. 259: Micro edge flaking on the butt of laminar types from the three facies of Tabun XI.
n=**Amudian** - blade: 221; PE blade: 68; NBKs: 81.
Yabrudian - blade: 123; PE blade: 48; NBK: 52.
Acheulian - blade: 41; PE blade: 10; NBK: 8.

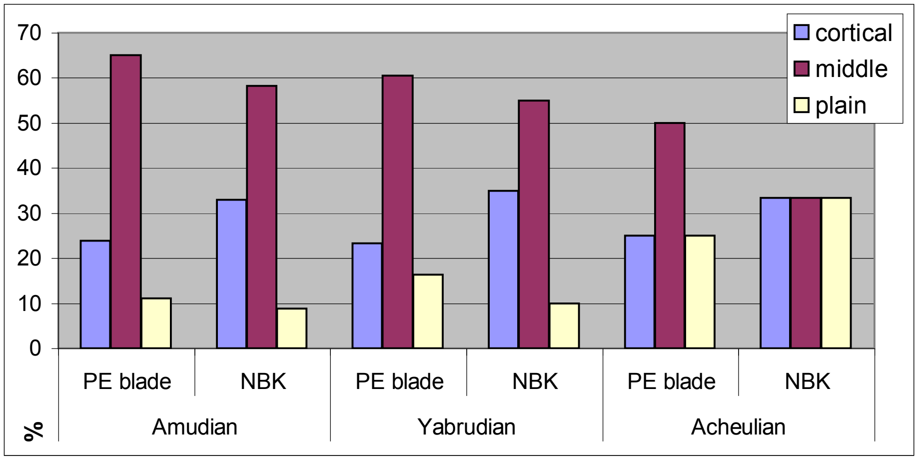


Fig. 260: Location of the bulb of percussion on PE blades and NBKs (blanks and shaped) from the three facies of Tabun XI.

n=Amudian: PE blade: 63; NBK: 79.

Yabrudian: PE blade: 43; NBK: 40.

Acheulian: PE blade: 8; NBK: 9.

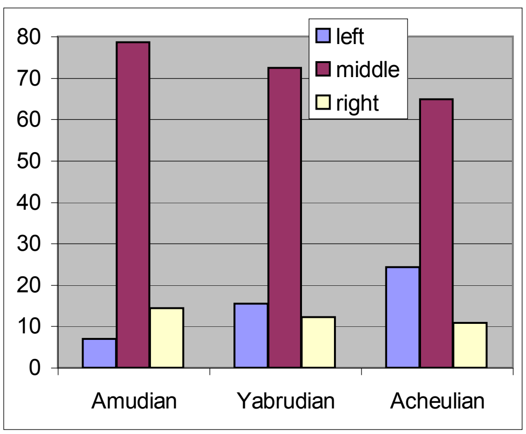
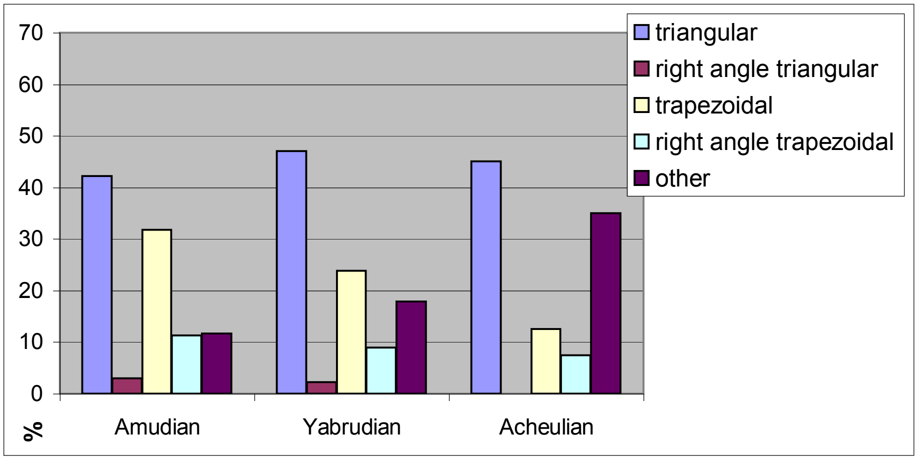
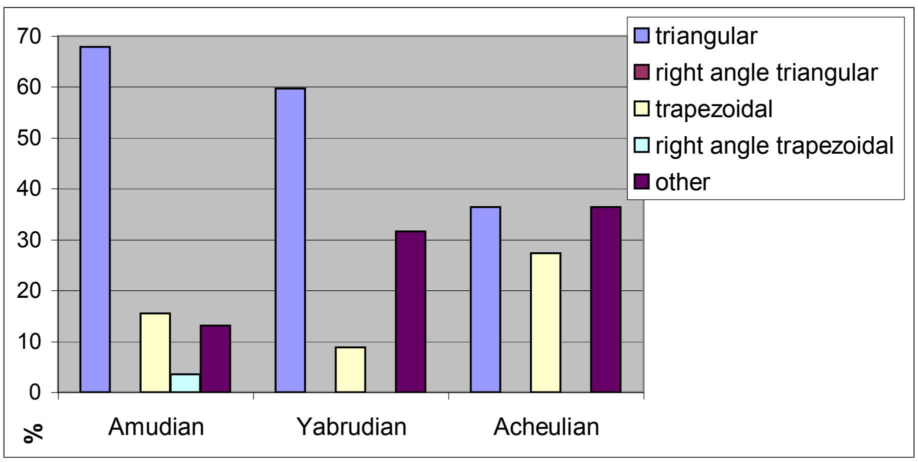


Fig. 261: Location of bulb of percussion on blades (blanks and shaped) from the three facies of Tabun XI.

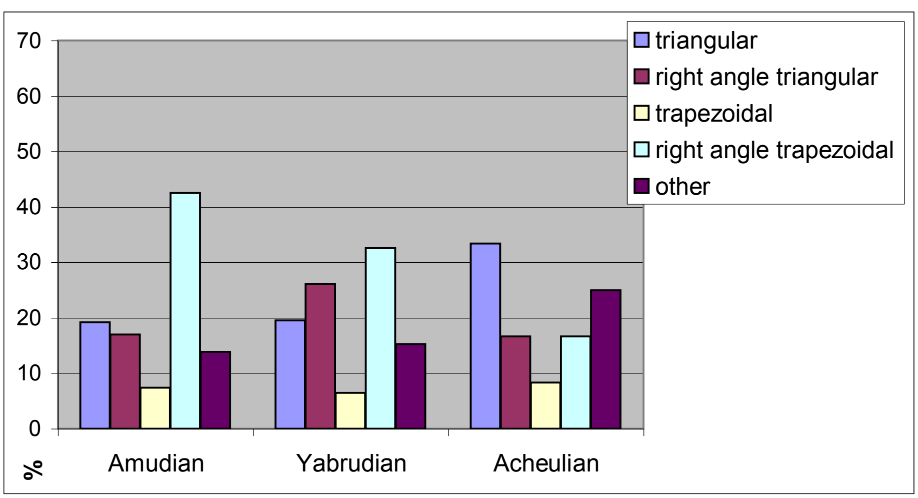
n=Amudian: 215; Yabrudian: 123; Acheulian: 37.



A: Blades (n=Amudian: 239; Yabrudian: 134; Acheulian: 40)



B: PE blades (n=Amudian: 84; Yabrudian: 57; Acheulian: 11)



C: NBKs (n=Amudian: 94; Yabrudian: 46; Acheulian: 12)

Fig. 262: Cross-section of the three laminar types (blanks and shaped) from the three facies of Tabun XI.

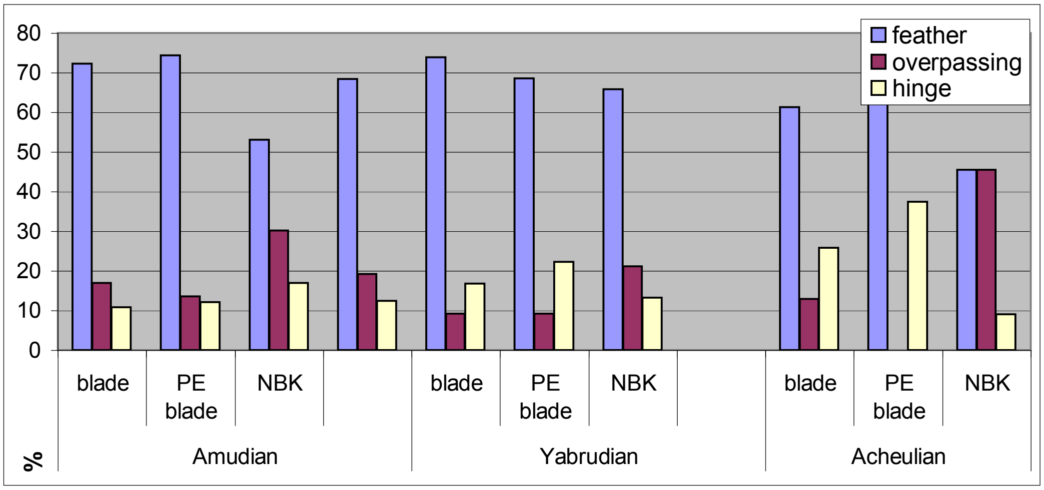


Fig. 263: End termination of the three laminar types (blanks and shaped) from the three facies of Tabun XI.

n= **Amudian** - blade: 213; PE blade: 74; NBK: 83.

Yabrudian - blade: 119; PE blade: 54; NBK: 38.

Acheulian - blade: 31; PE blade: 8; NBK: 11.

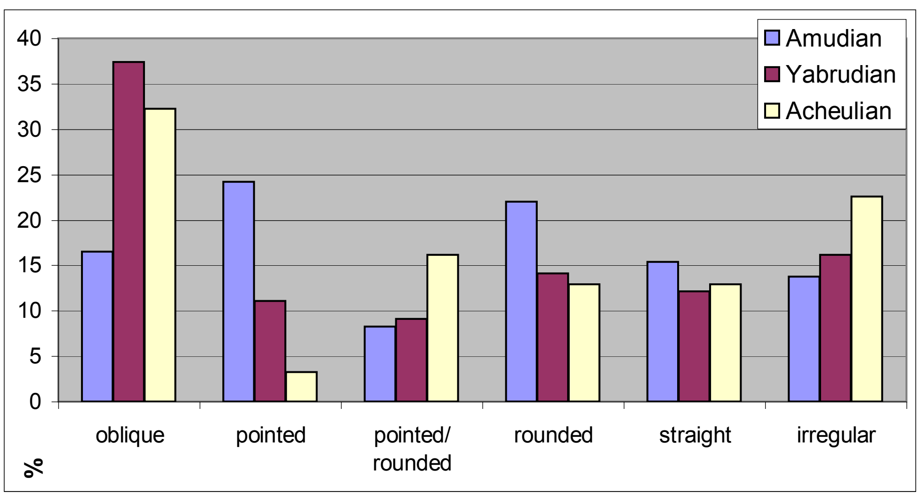
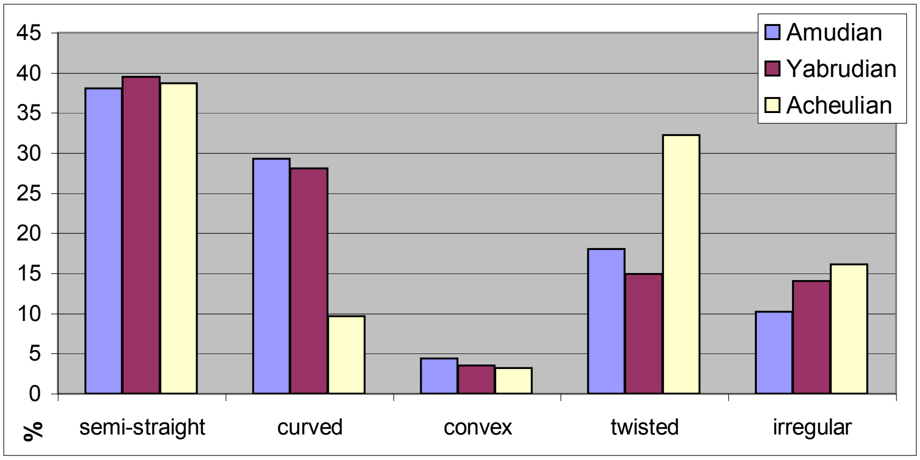
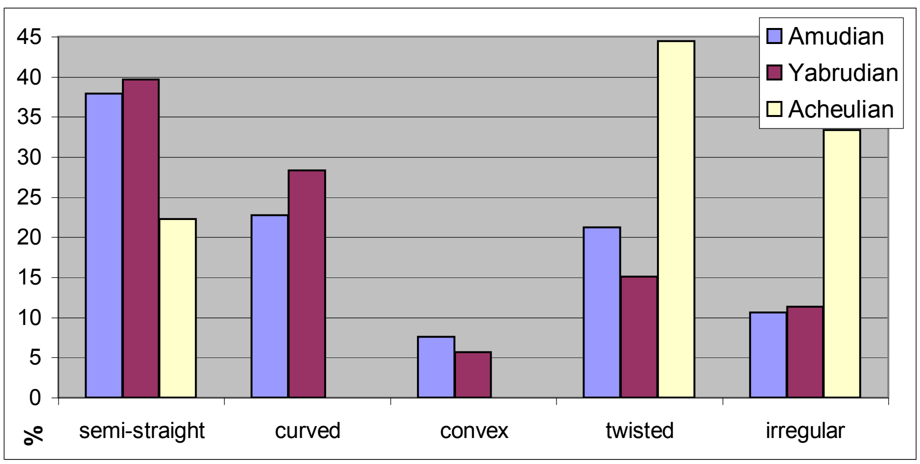


Fig. 264: Distal end shape of blades (blanks and shaped) from the three facies of Tabun XI.

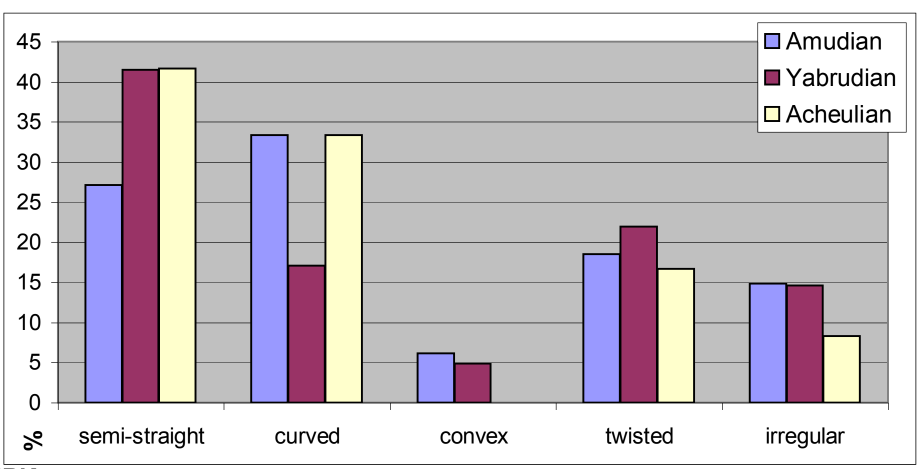
n=Amudian: 182; Yabrudian: 99; Acheulian: 31.



A: Blades (n=Amudian: 205; Yabrudian: 114; Acheulian: 31)

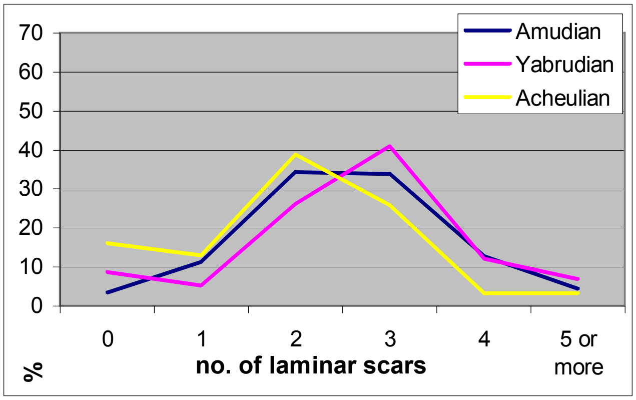


B: PE blades (n=Amudian: 66; Yabrudian: 53; Acheulian: 9)

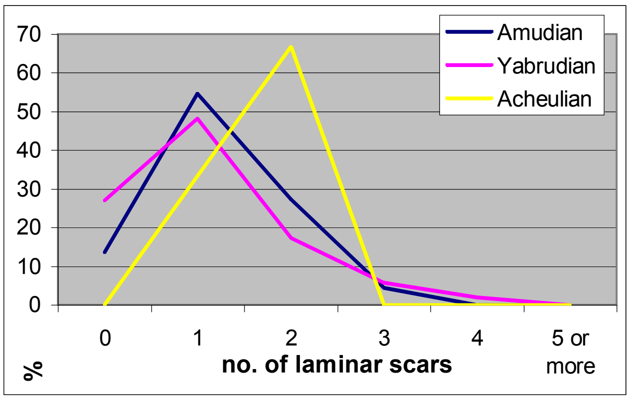


C: NBKs (n=Amudian: 81; Yabrudian: 41; Acheulian: 12)

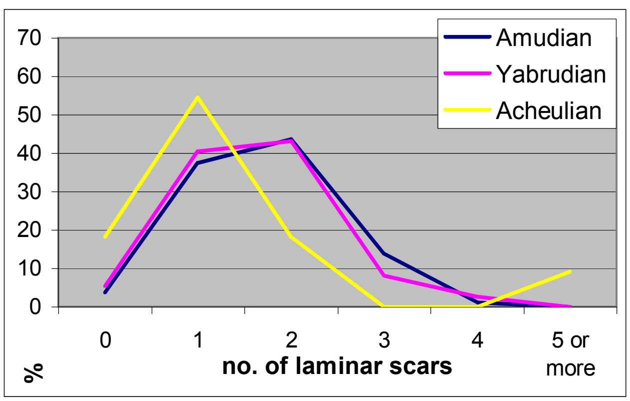
Fig. 265: Profile of the three laminar types (blanks and shaped) from the three facies of Tabun XI.



A: Blades (n=Amudian: 204; Yabrudian: 115; Acheulian: 31)



B: PE blades (n=Amudian: 66; Yabrudian: 52; Acheulian: 9)



C: NBKs (n=Amudian: 80; Yabrudian: 37; Acheulian: 11)

Fig. 266: Number of laminar scars on the three laminar types (blanks and shaped) from the three facies of Tabun XI.

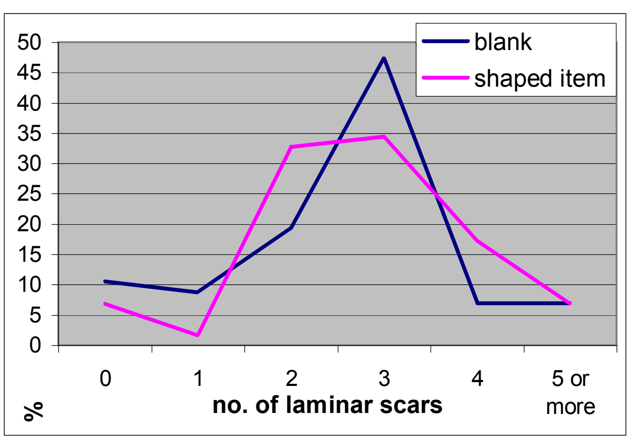
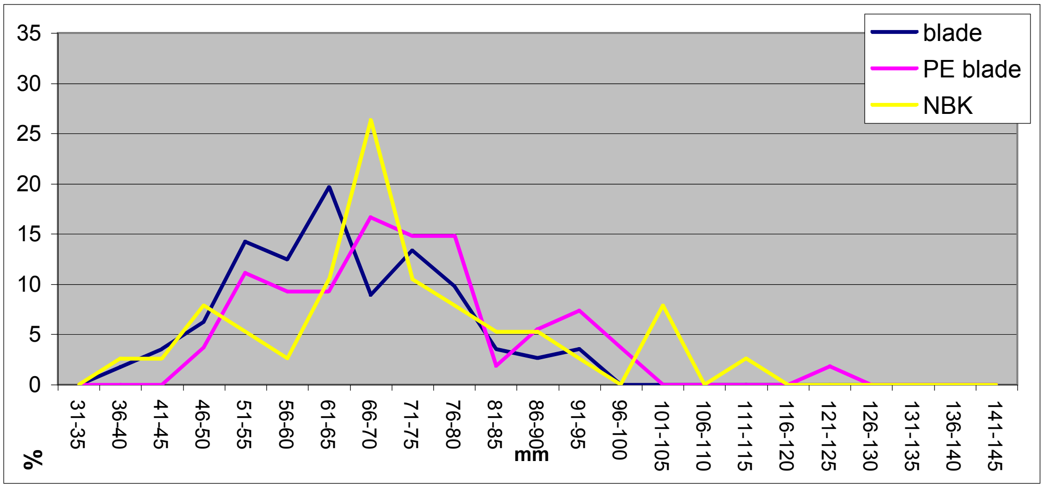
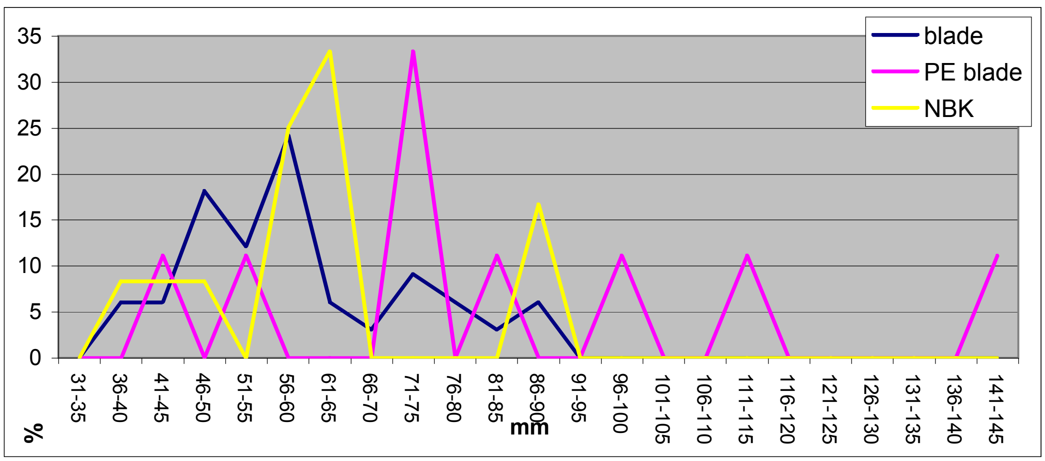


Fig. 267: Number of laminar scars on blade blanks and shaped blades from the Yabrudian beds of Tabun XI.
n=blank: 57; shaped item: 58.

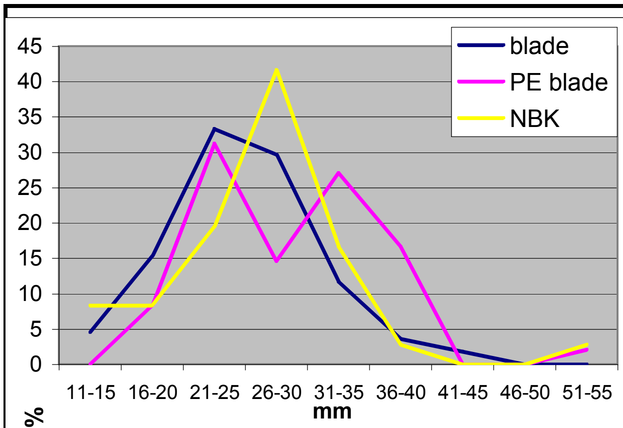


A: Yabrudian (n=blade: 112; PE blade: 54; NBKs: 38)

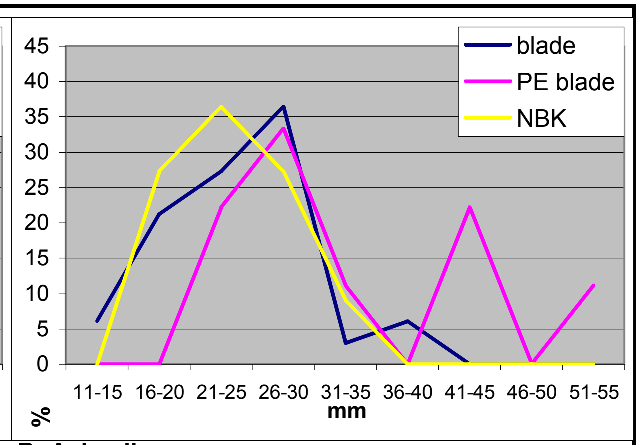


B: Acheulian (n=blade: 33; PE blade: 9; NBKs: 12)

Fig. 268: Length of the three laminar types (blanks and shaped)
from the Yabrudian and Acheulian beds of Tabun XI.



A: Yabrudian (n=blade: 111; PE blade: 48; NBK: 36)



B: Acheulian (n=blade: 33; PE blade: 9; NBK: 11)

Fig. 269: Width of the three laminar types (blanks and shaped)
from the Yabrudian and Acheulian beds of Tabun XI.

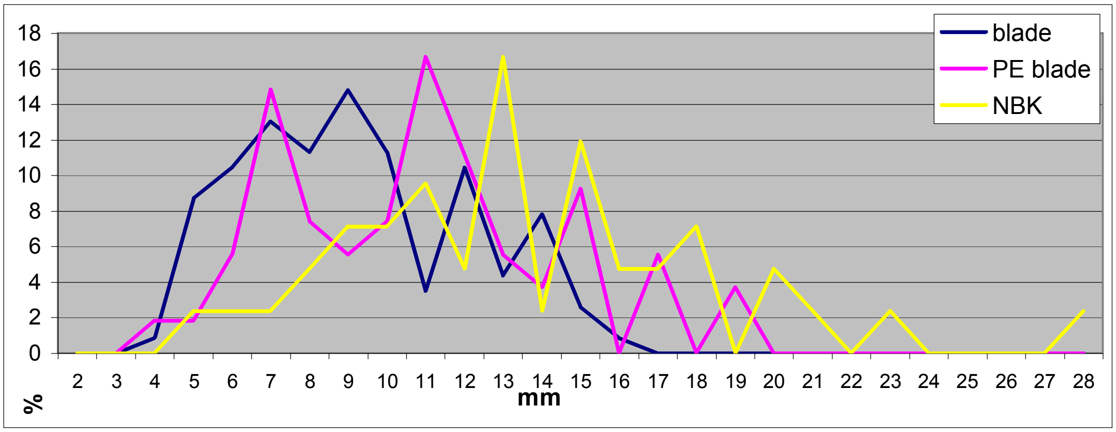


Fig. 270: Thickness of the three laminar types (blanks and shaped) from the Yabrudian beds of Tabun XI.
n=blade: 115; PE blade: 54; NBK: 42.

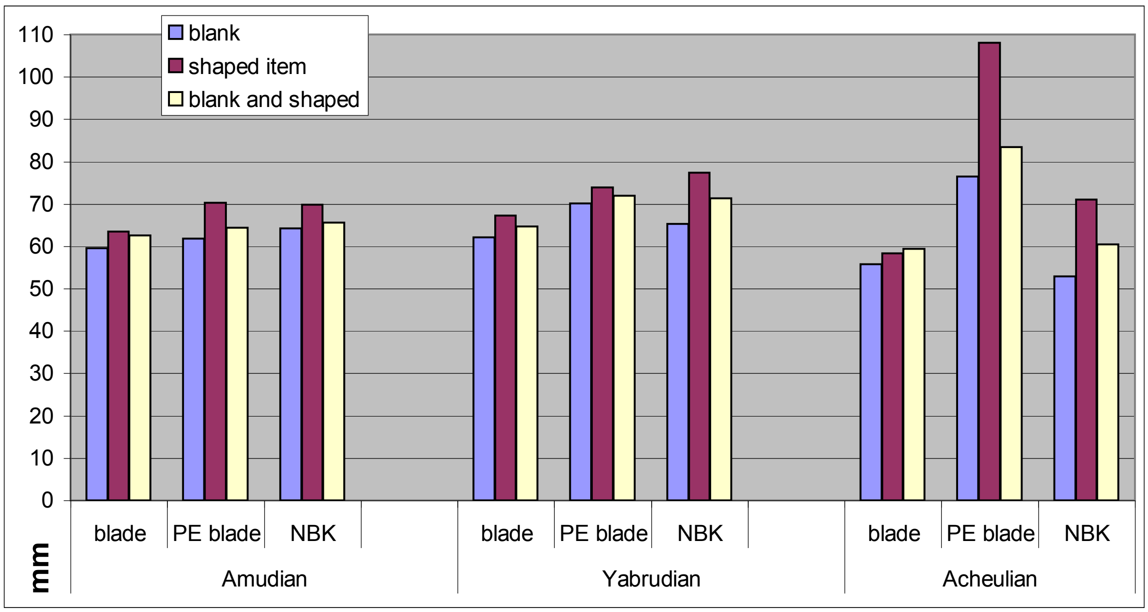


Fig. 271: Mean length of the three laminar types (blanks and shaped) from the three facies of Tabun XI.
Data retrieved from Table 19.

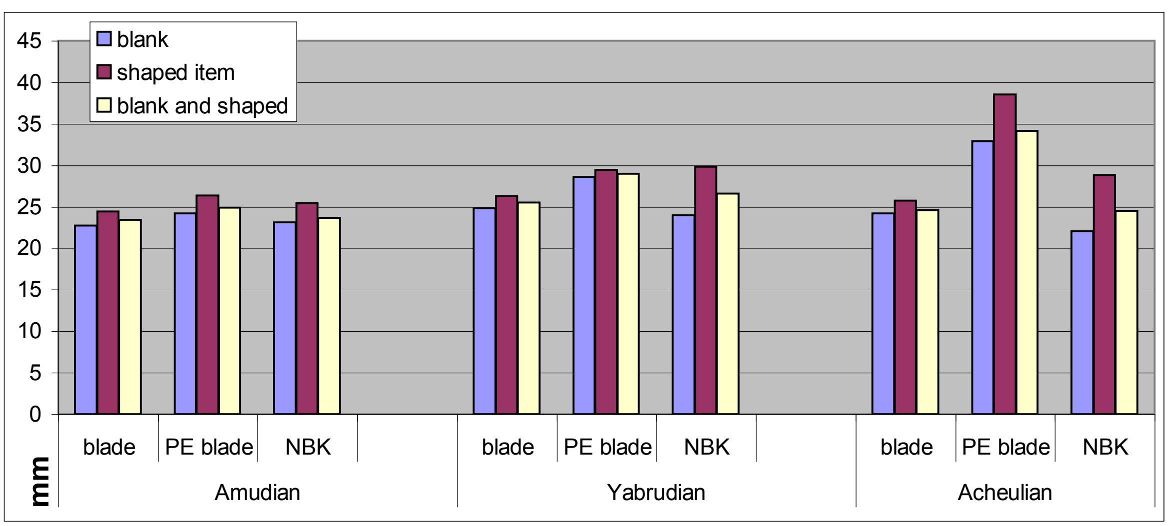


Fig. 272: Mean width of the three laminar types (blanks and shaped) from the three facies of Tabun XI.
Data retrieved from Table 20.

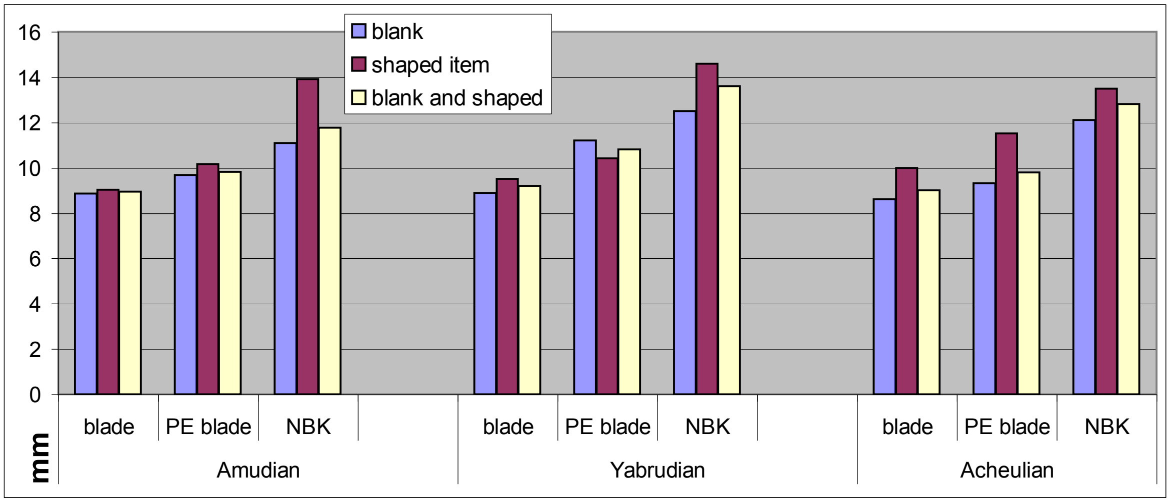
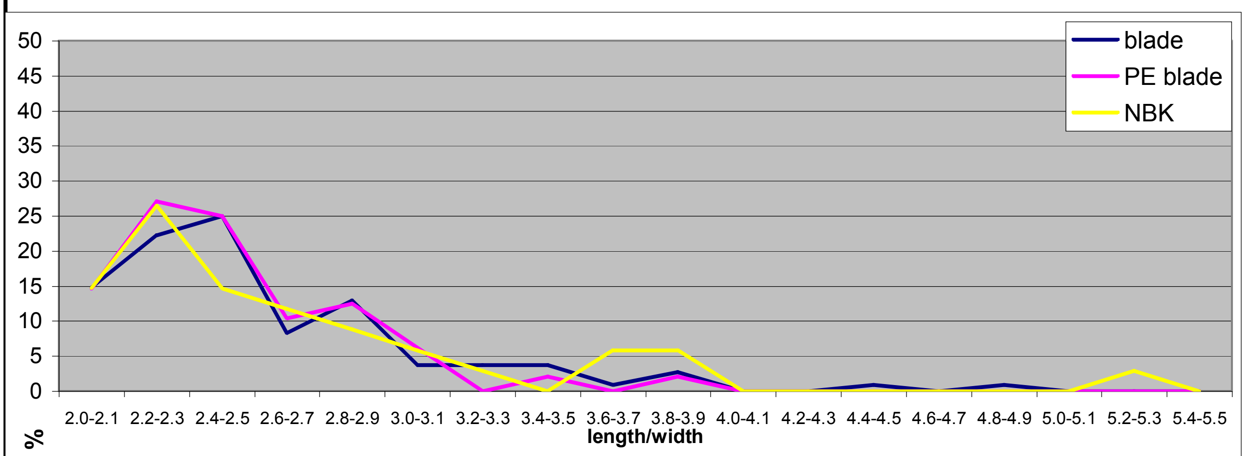
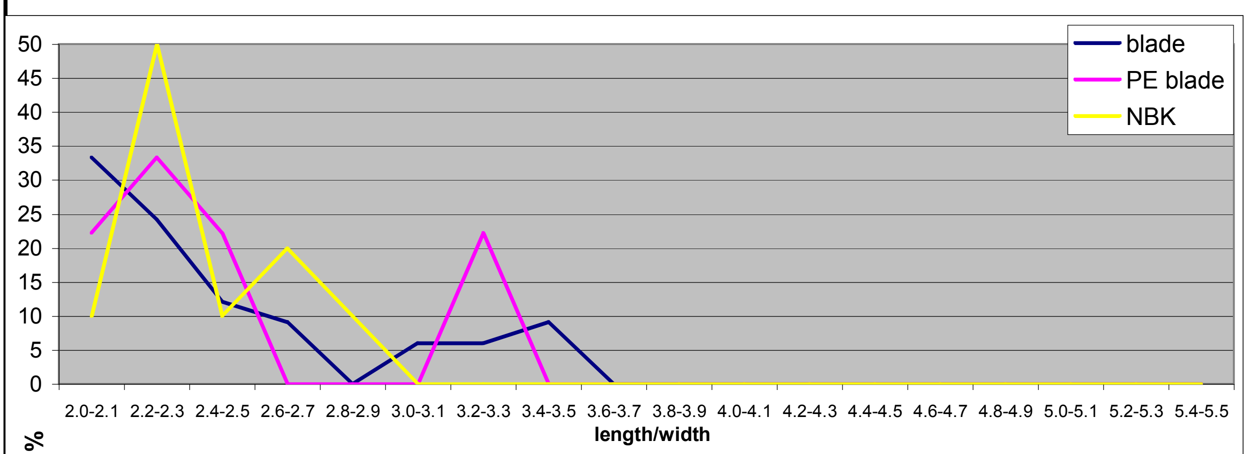


Fig. 273: Mean thickness of the three laminar types (blanks and shaped) from the three facies of Tabun XI.
Data retrieved from Table 21.



A: Yabrudian (n= blade: 108; PE blade: 48; NBK: 34)



B: Acheulian (n= blade: 33; PE blade: 9; NBK: 10)

Fig. 274: Length/width ratio of the three laminar types (blanks and shaped)
from the Yabrudian and Acheulian beds of Tabun XI.

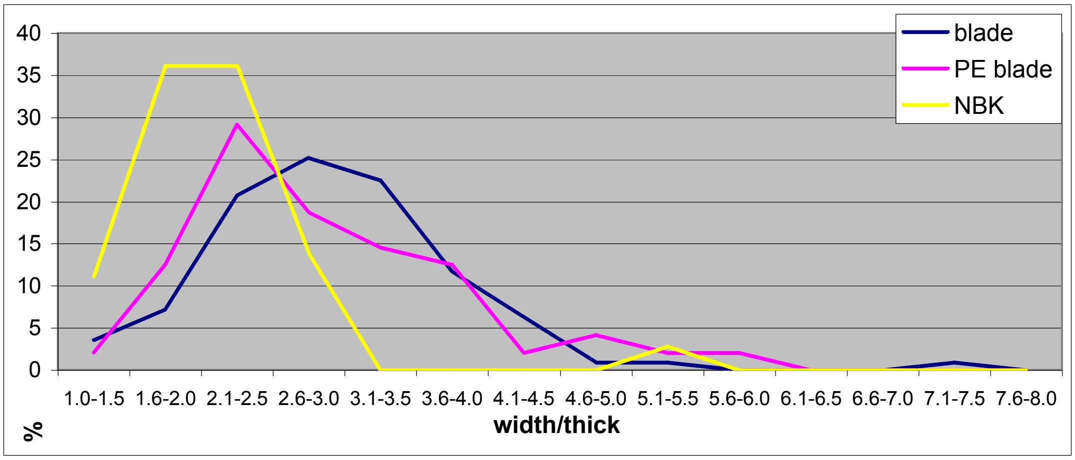


Fig. 275: Width/thickness ratio of the three laminar types from the Yabrudian beds of Tabun XI.
n= blade: 111; PE blade: 48; NBK: 36.

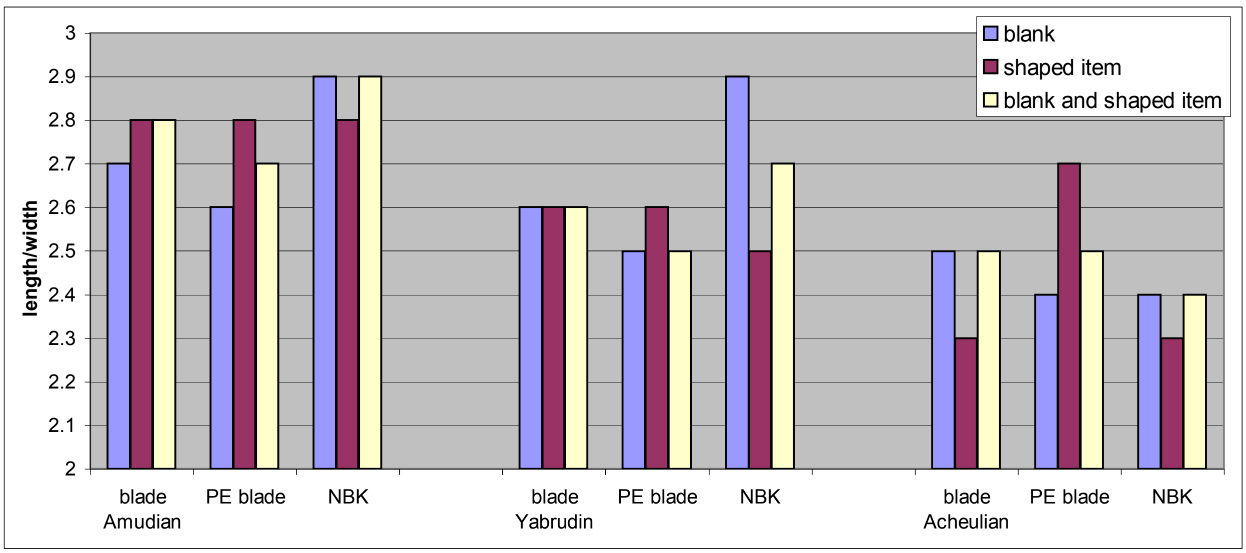


Fig. 276: Mean length/width ratio of the three laminar types (blanks and shaped)
from the three facies of Tabun XI.
Data retrieved from Table 22.

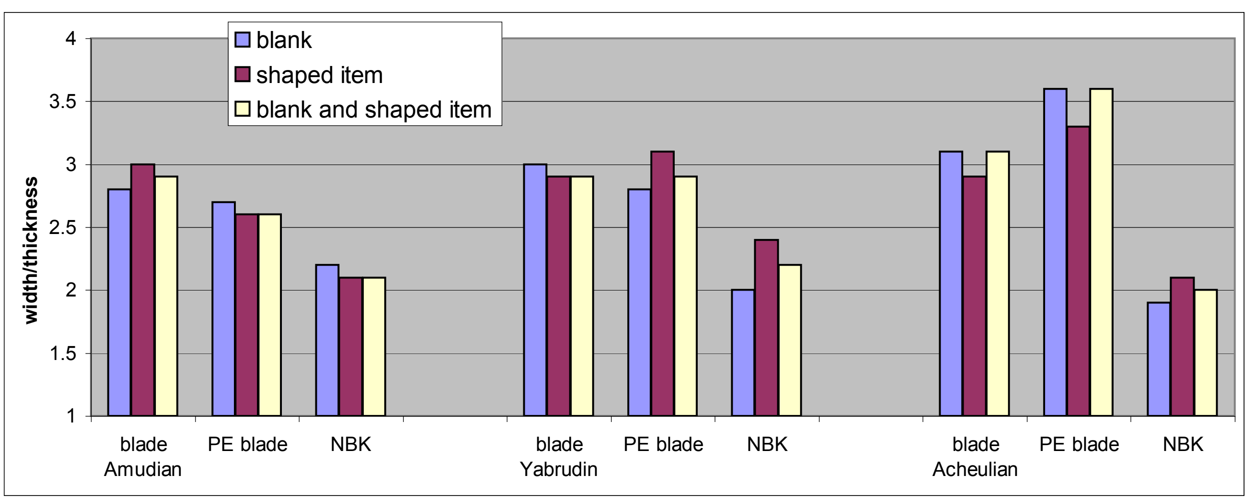


Fig. 277: Mean width/thickness ratio of the three laminar types (blanks and shaped)
from the three facies of Tabun XI.
Data retrieved from Table 23.

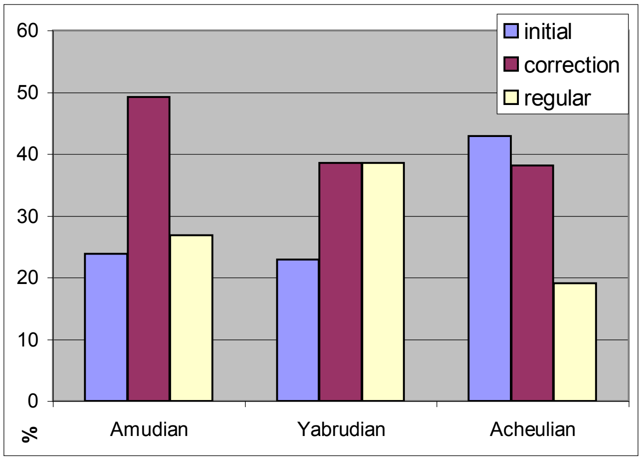


Fig. 278: Division of overpass items from the three facies of Tabun XI into categories.
n=Amudian: 67; Yabrudian: 70; Acheulian: 21.

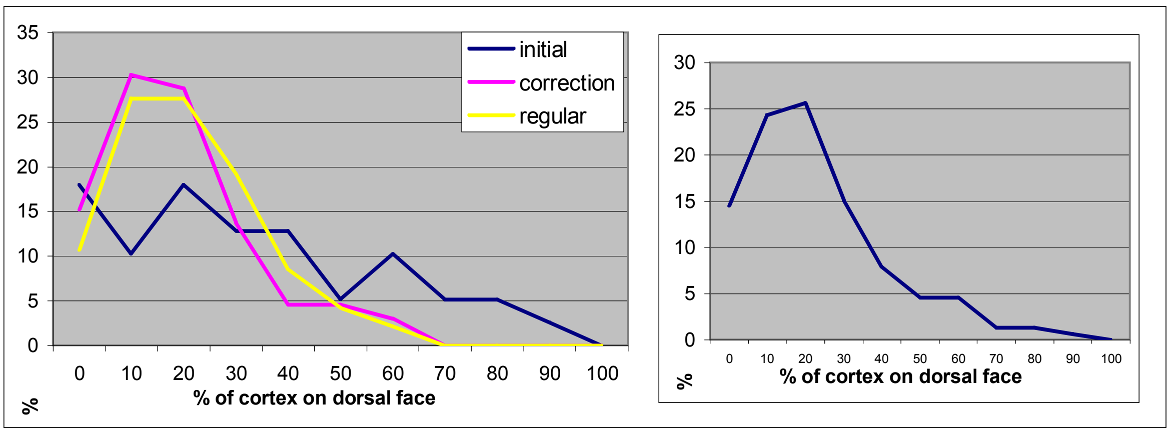


Fig. 279: Percentage of cortex on the dorsal face of overpass items from Tabun XI.
On the left according to categories, on the right as one.
n=initial: 40; correction: 65; regular: 47; total: 152.

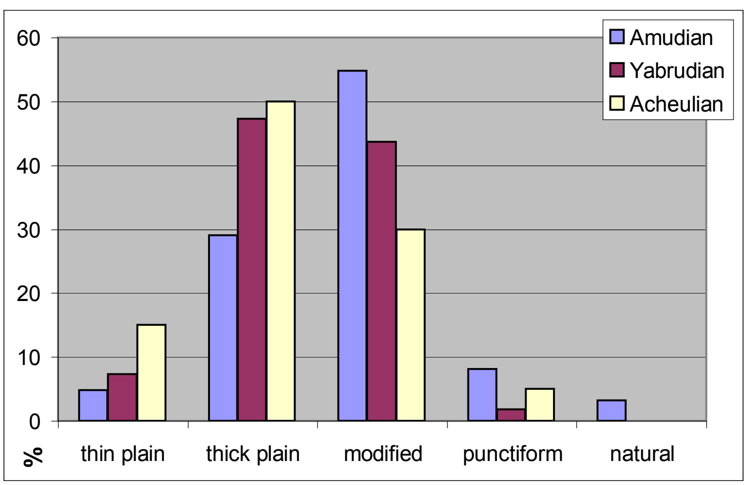


Fig. 280: Butt type of overpass items from the three facies of Tabun XI.
n=Amudian: 62; Yabrudian: 55; Acheulian: 20.

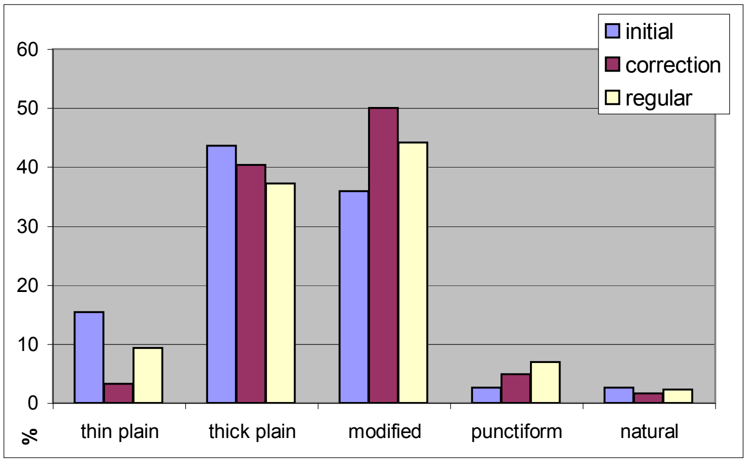


Fig. 281: Butt type of overpass items from Tabun XI according to categories.
n=initial:40; correction: 61; regular: 43.

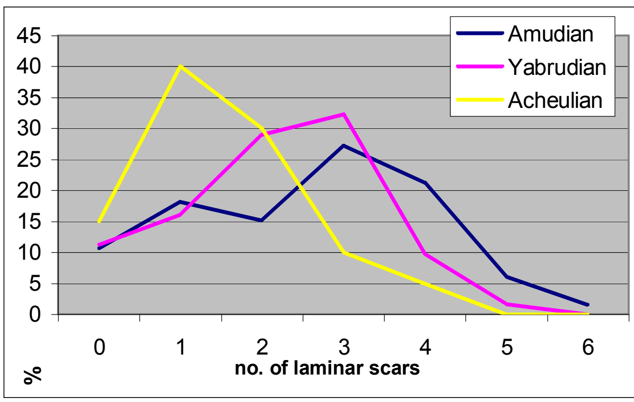


Fig. 282: Number of laminar scars on overpass items from the three facies of Tabun XI.
n=Amudian: 66; Yabrudian: 62; Acheulian: 20.

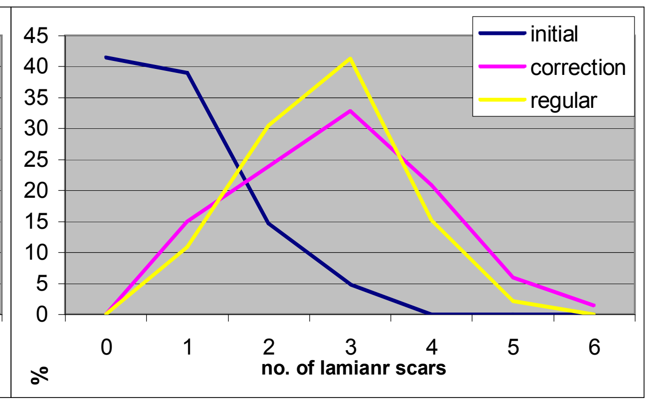


Fig. 283: Number of laminar scars on overpass items from Tabun XI according to categories.
n=initial:41; correction: 67; regular: 46.

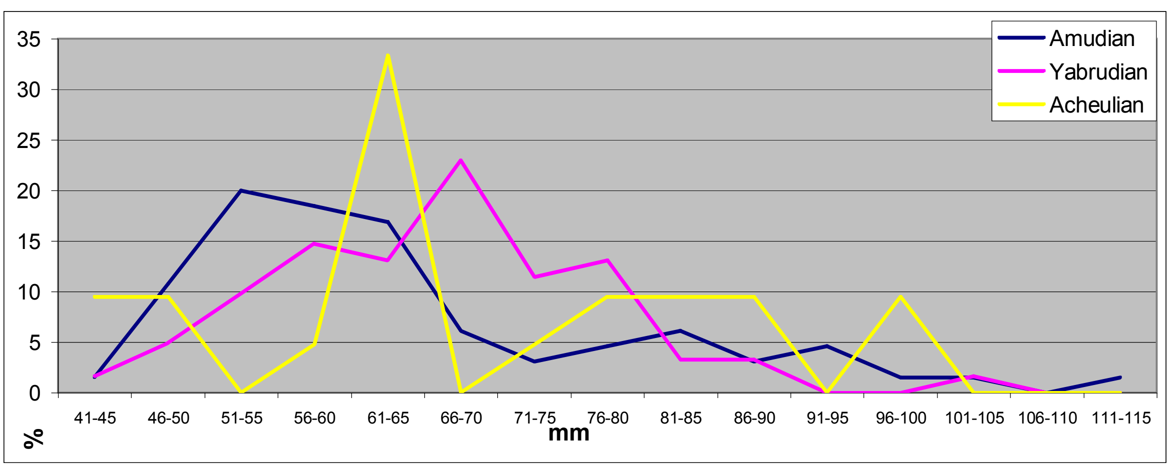


Fig. 284: Length of overpass items from the three facies of Tabun XI.
n=Amudian: 65; Yabrudian: 61; Acheulian: 21.

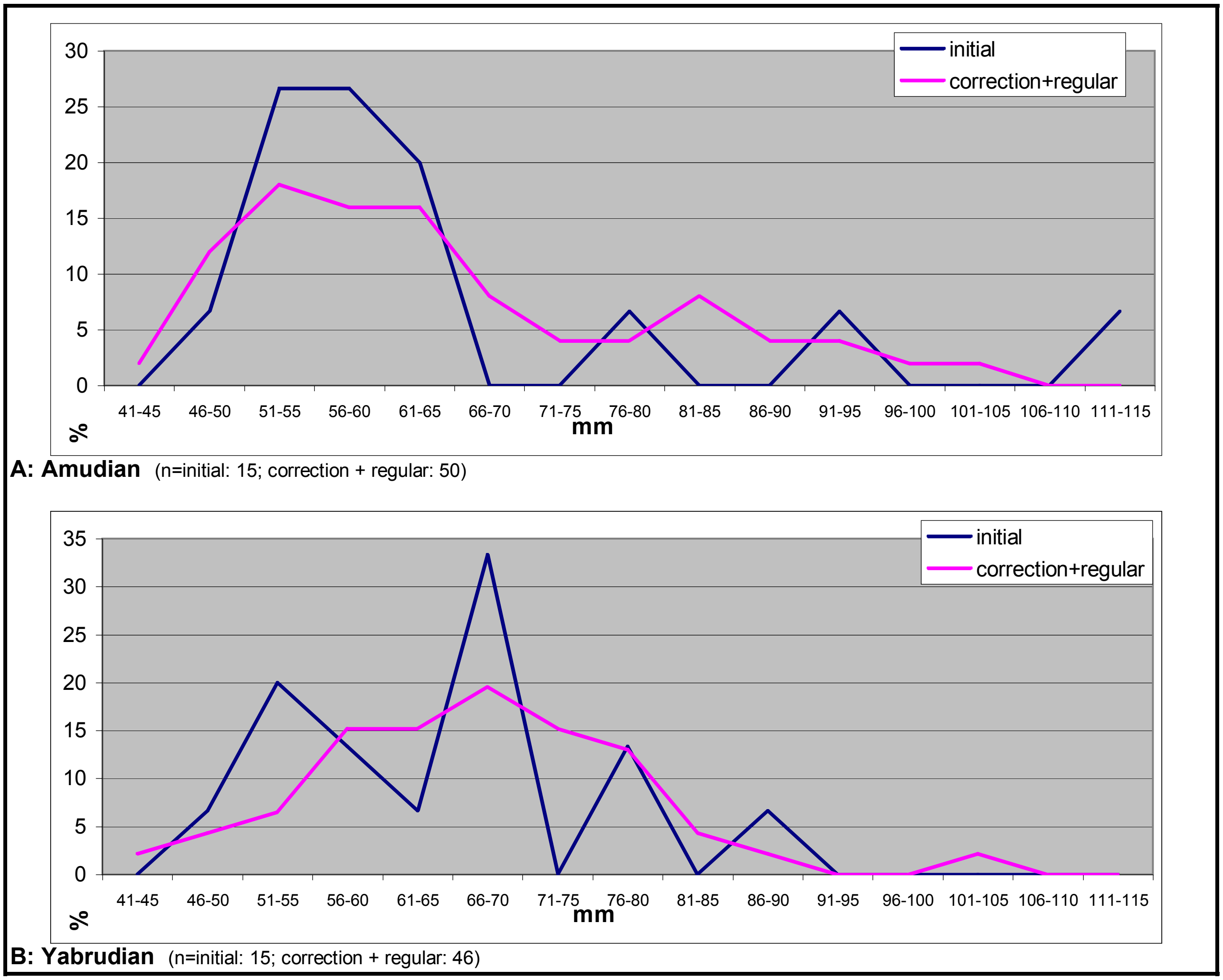


Fig. 285: Length of overpass items according to category from the Amudian and Yabrudian beds of Tabun XI.

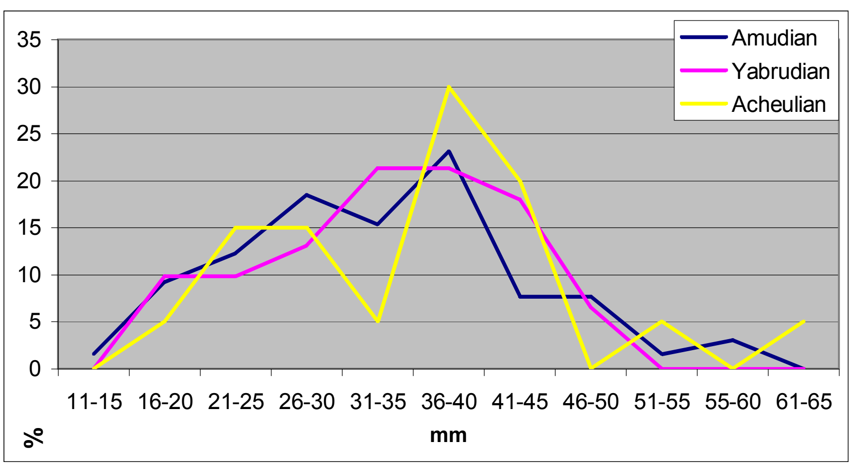


Fig. 286: Width of overpass items from the three facies of Tabun XI.
n=Amudian: 65; Yabrudian: 61; Acheulian: 20.

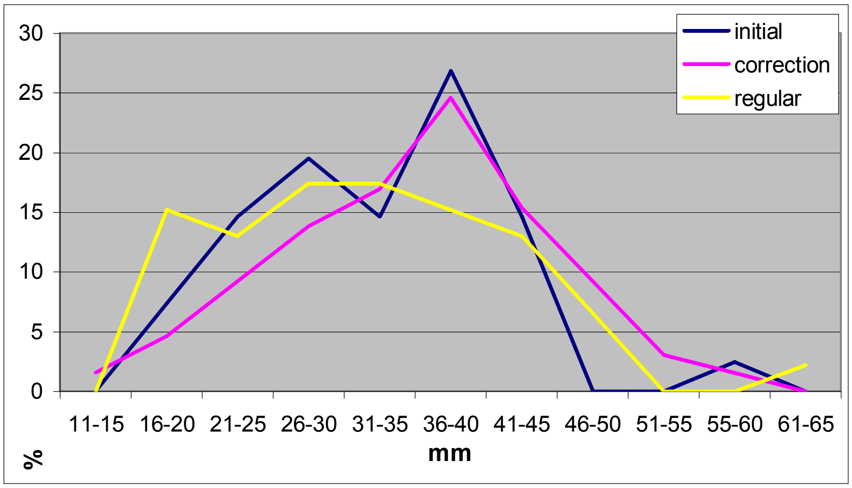


Fig. 287: Width of overpass items from Tabun XI according to categories.
n=initial:41; correction: 65; regular: 46.

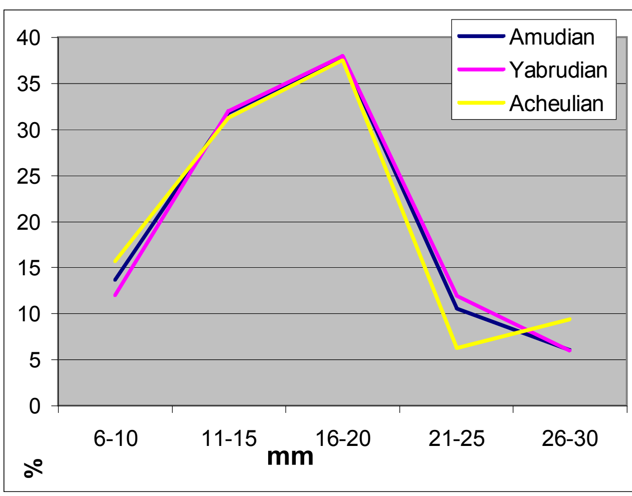


Fig. 288: Thickness of overpass items from the three facies of Tabun XI.
n=Amudian: 66; Yabrudian: 50; Acheulian: 32.

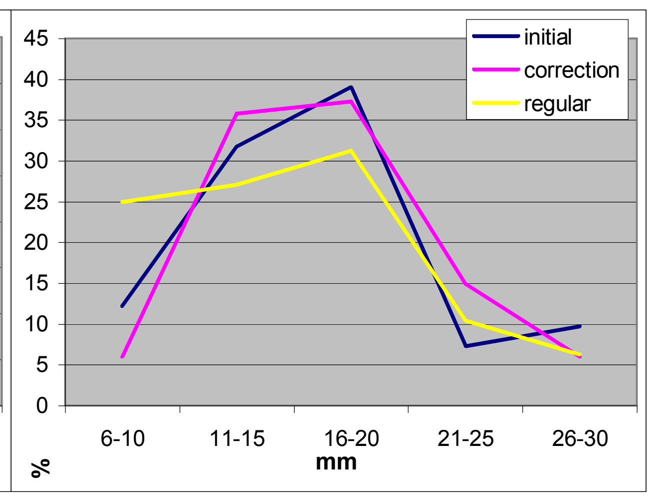


Fig. 289: Thickness of overpass items from Tabun XI according to categories.
n=initial:41; correction: 67; regular: 48.

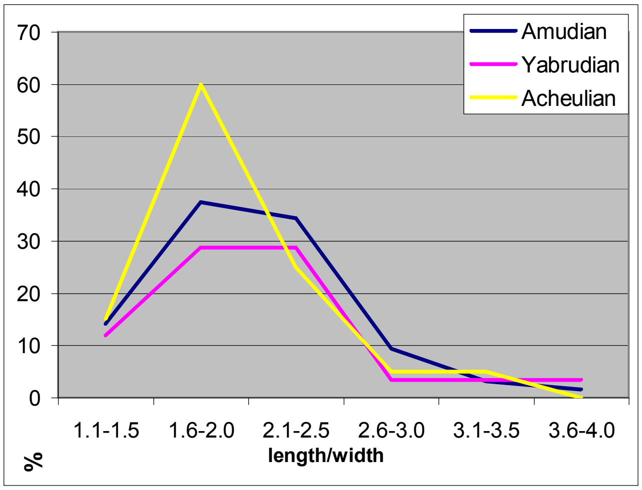


Fig. 290: Length/width ratio of overpass items
from the three facies of Tabun XI.
n=Amudian: 64; Yabrudian: 59; Acheulian: 20.

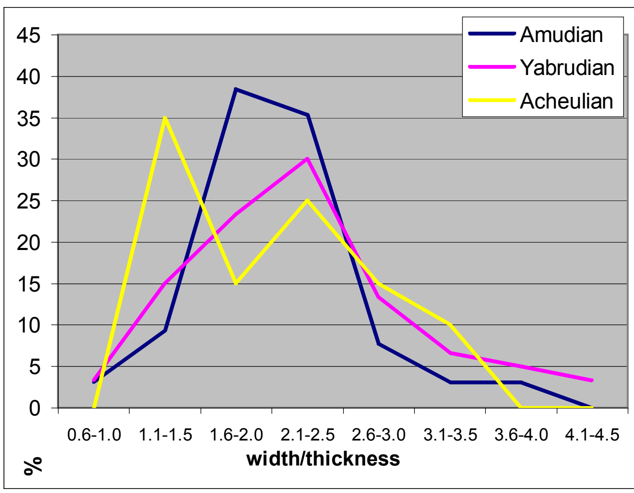


Fig. 291: Width/thickness ratio of overpass items
from the three facies of Tabun XI.
n=Amudian: 65; Yabrudian: 60; Acheulian: 20.

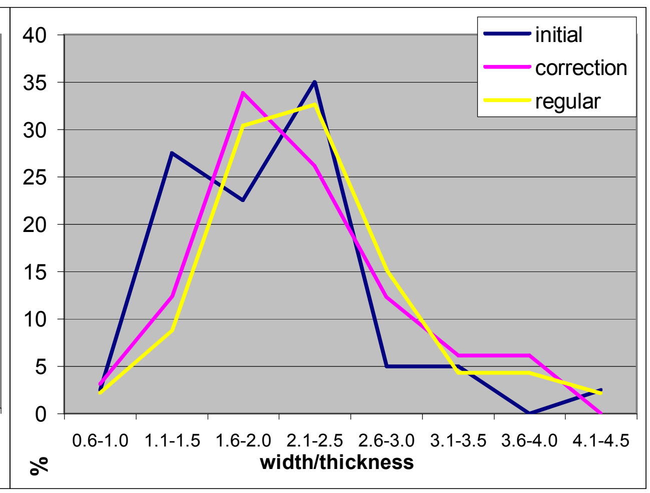


Fig. 292: Width/thickness ration of overpass items
from Tabun XI according to categories.
n=initial:40; correction: 65; regular: 46.

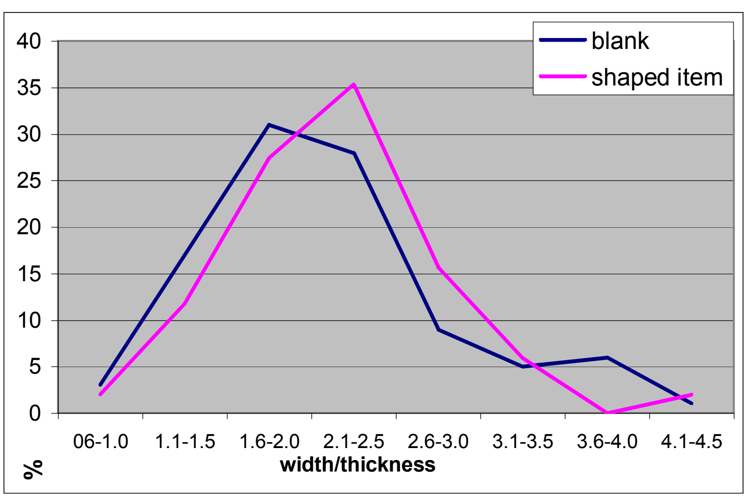


Fig. 293: Width/thickness ratio of overpass items, blanks and shaped from Tabun XI.
n=blank: 100; shaped item: 50.

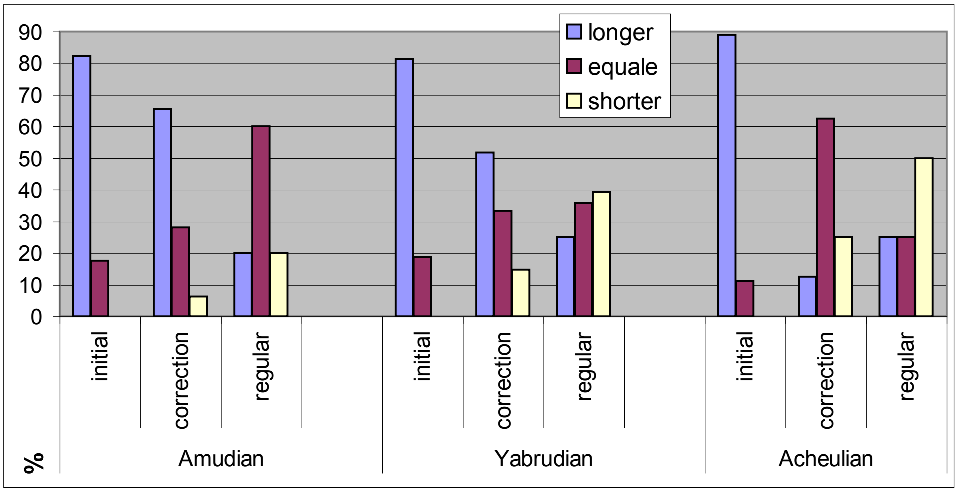


Fig. 294: Changes in the debitage surface length according to overpass items from the three facies of Tabun XI.
n=**Amudian** - initial: 17; correction: 32; regular: 20.
Yabrudian - initial: 16; correction: 27; regular: 28.
Acheulian - initial: 9; correction: 8; regular: 4.

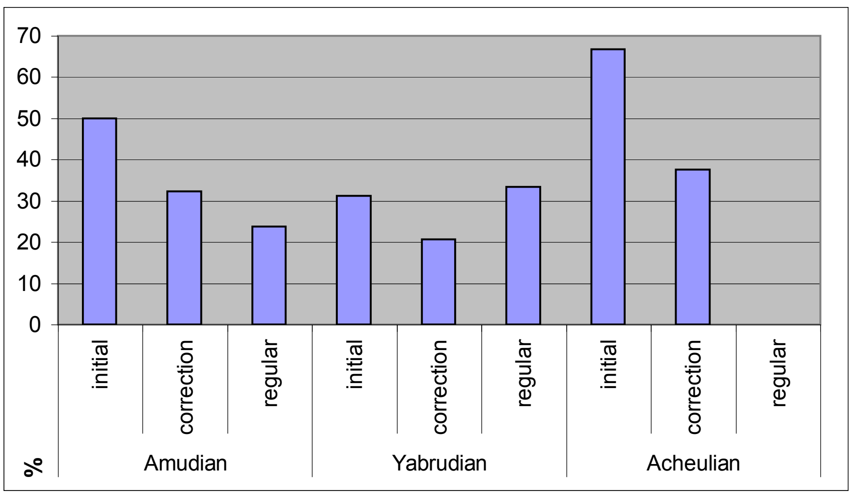


Fig. 295: Remnants of core base modification on overpass items from the three facies of Tabun XI.
n=**Amudian** - initial: 16; correction: 34; regular: 21.
Yabrudian - initial: 16; correction: 29; regular: 30.
Acheulian - initial: 9; correction: 8; regular: 4.

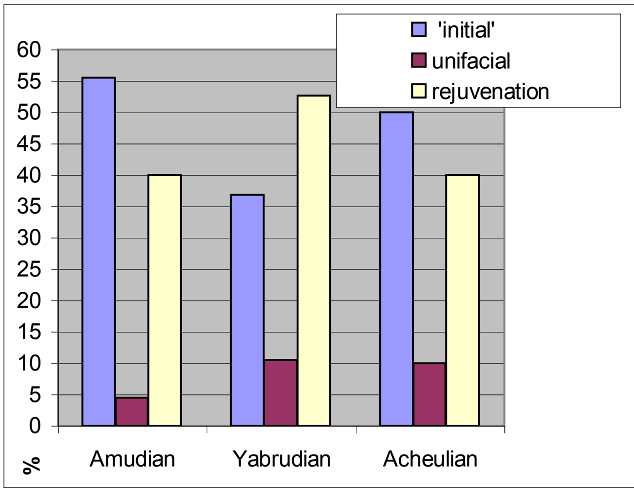


Fig. 296: Categories of crested blades from Tabun XI.
n=Amudian: 45; Yabrudian: 38; Acheulian: 10.

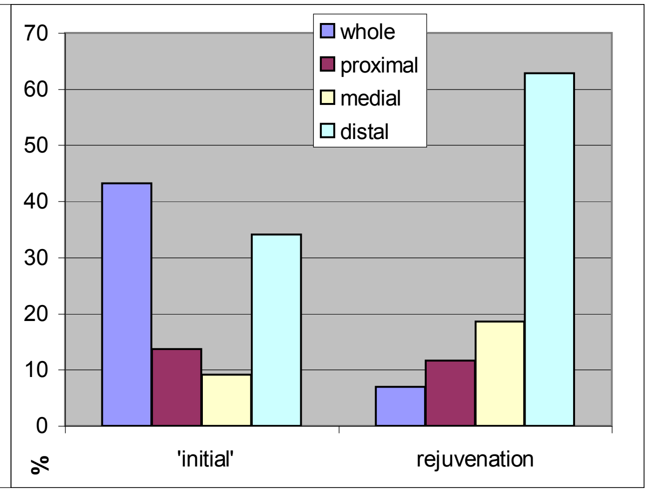


Fig. 297: Location of the shaped ridge along the crested blades from Tabun XI.
n='initial': 44; rejuvenation: 43.

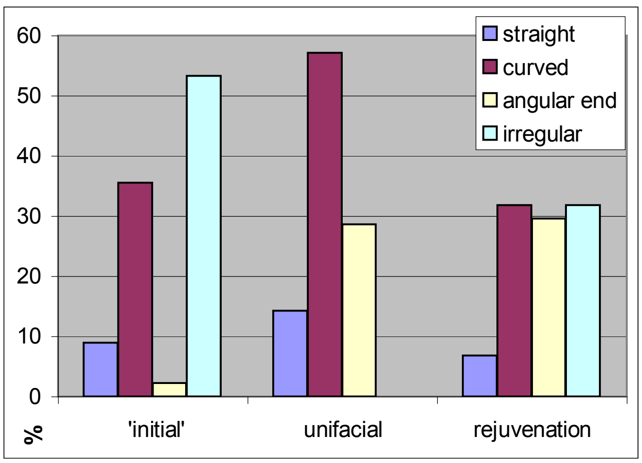


Fig. 298: Profile of the ridge shaped on the dorsal face of the crested blades from Tabun XI.
n='initial': 45; unifacial: 7; rejuvenation: 44.

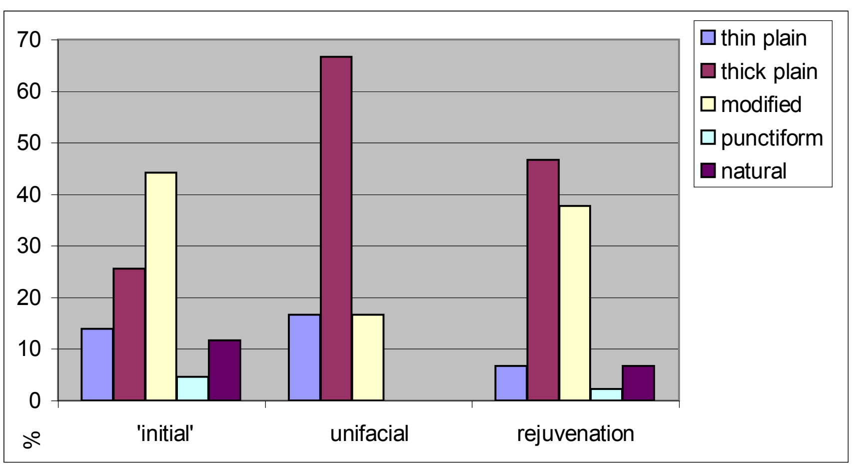


Fig. 299: Butt type on the crested blade categories from Tabun XI.
n='initial': 43; unifacial: 6; rejuvenation: 45.

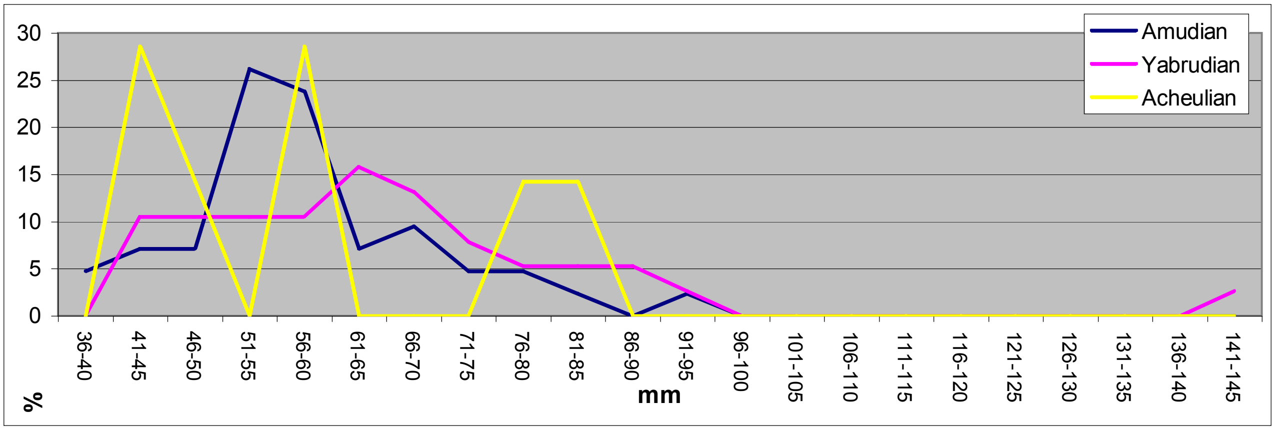


Fig. 300: Length of crested blades from the three facies of Tabun XI.
n=Amudian: 42; Yabrudian: 38; Acheulian: 7.

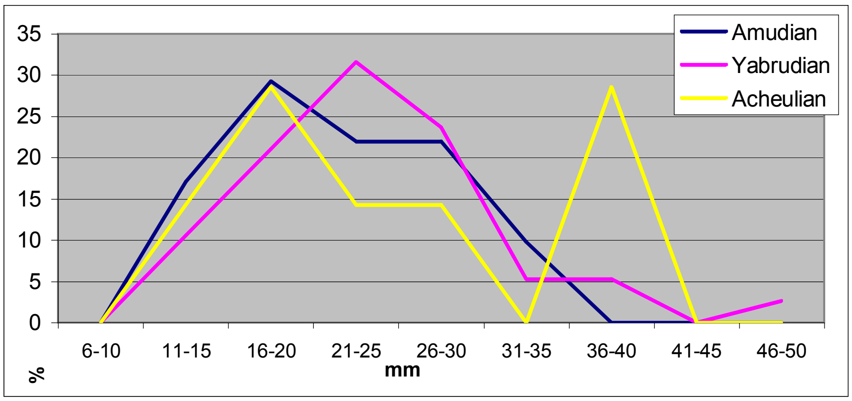


Fig. 301: Width of crested blades from the three facies of Tabun XI.
n=Amudian: 41; Yabrudian: 38; Acheulian: 7.

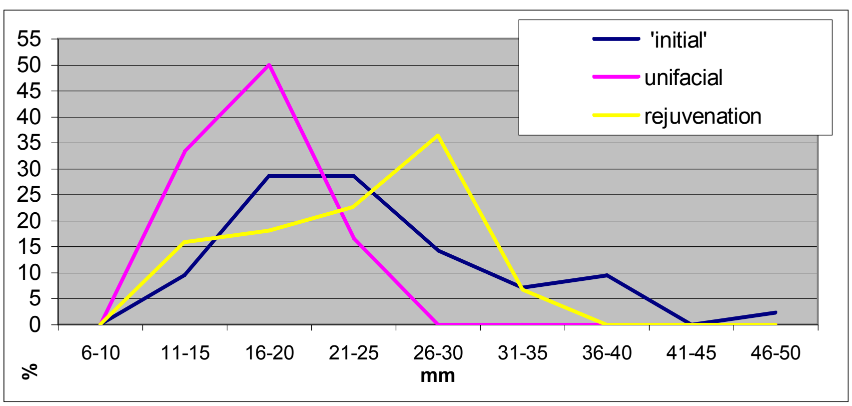


Fig. 302: Width of crested blades according to categories from Tabun XI.
n='initial': 42; unifacial: 6; rejuvenation: 44.

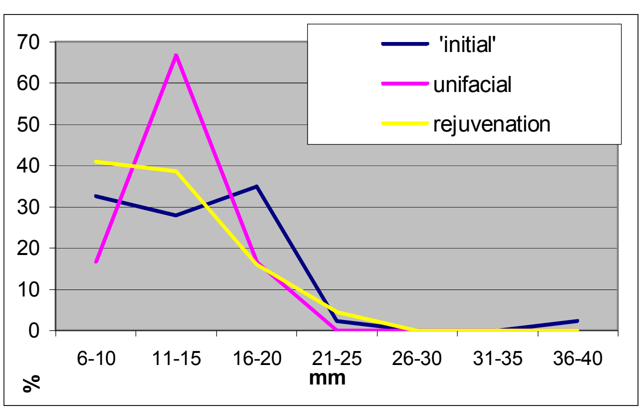


Fig. 303: Thickness of crested blades according to categories from Tabun XI.
n='initial': 43; unifacial: 6; rejuvenation: 44.

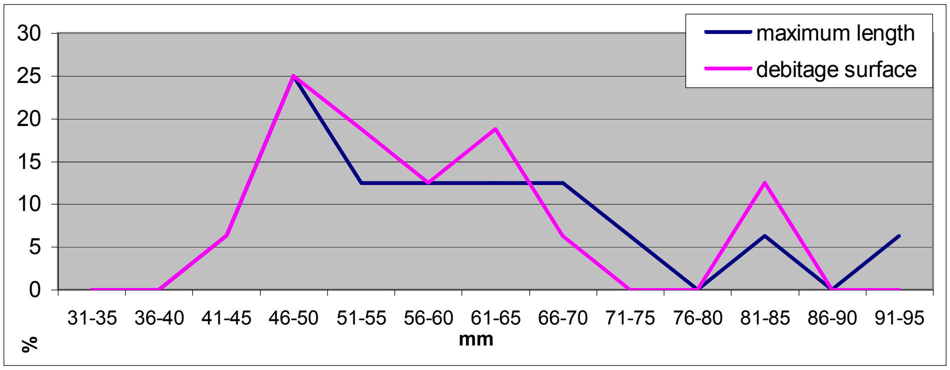


Fig. 304: 'Single striking platform laminar cores' maximum length and debitage surface length from Tabun XI.
n=maximum length: 16; debitage surface: 16.

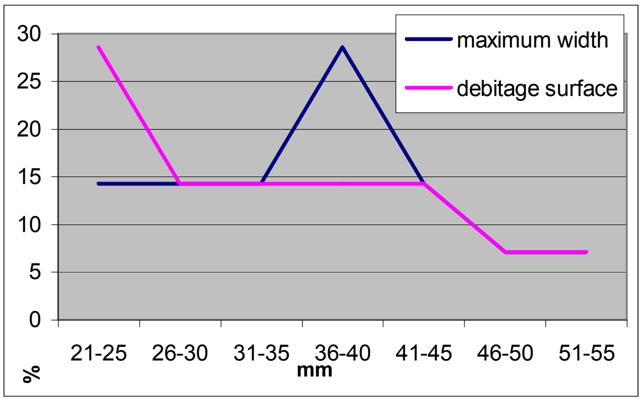


Fig. 305: 'Single striking platform laminar cores' maximum width and debitage surface width from Tabun XI.
n=maximum width 14; debitage surface width: 14.

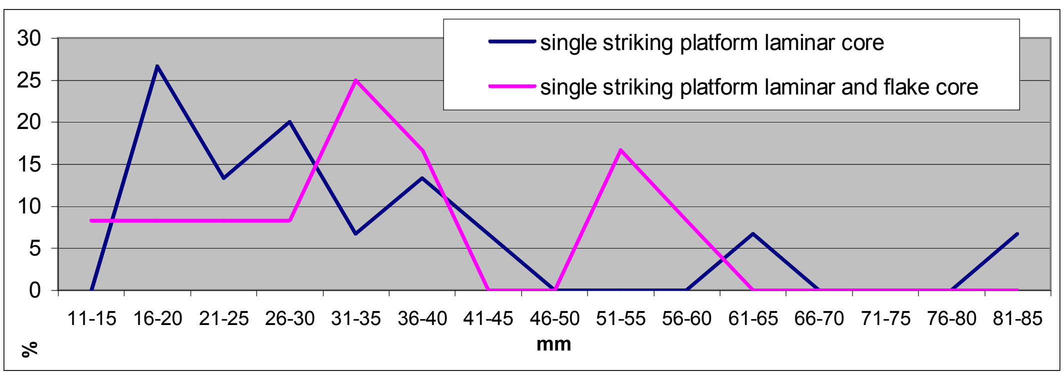


Fig. 306: Thickness of 'single striking platform laminar cores'
and 'single striking platform laminar and flake cores' from Tabun XI.
n='single striking platform laminar core': 15; 'single striking platform laminar and flake core': 12.

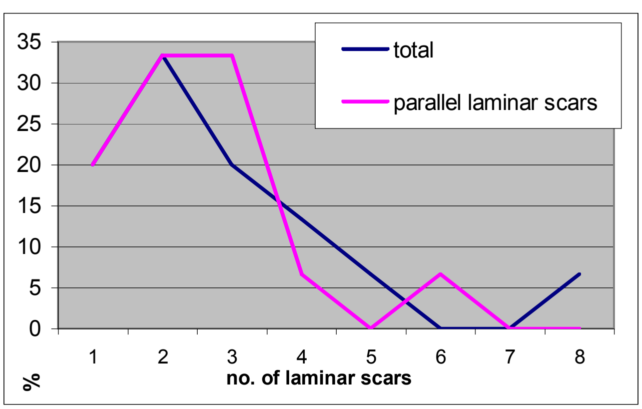


Fig. 307: Number of laminar scars on 'single striking platform laminar cores' from Tabun XI.
n=total: 15; parallel laminar scars: 15.

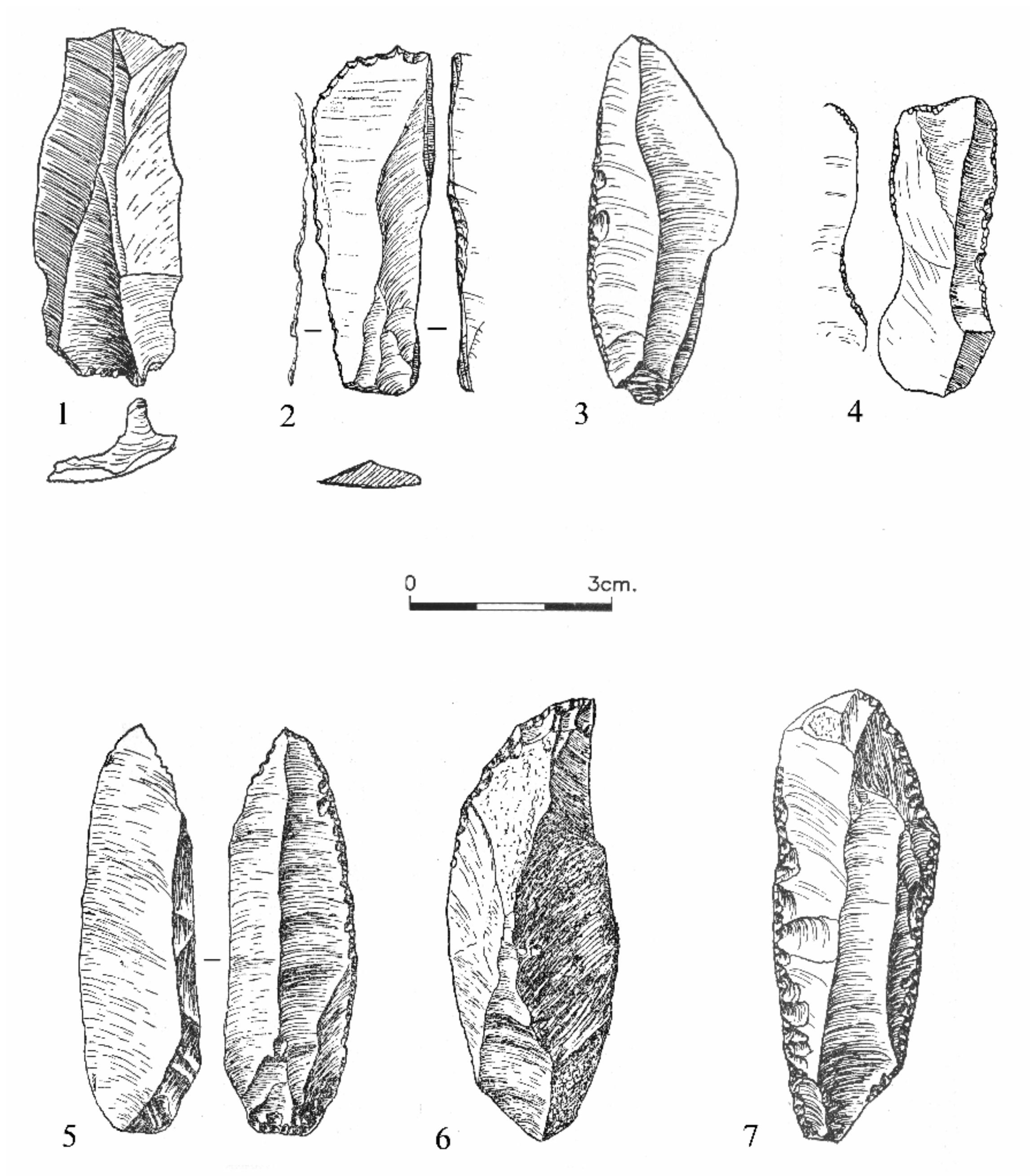


Fig. 308: Blade (1) and shaped items on blades (2-7) from Yabrud I-15.
After Rust 1950: Tafeln 32:1; 33: 10; 36: 1, 2, 8, 15; 37: 8.

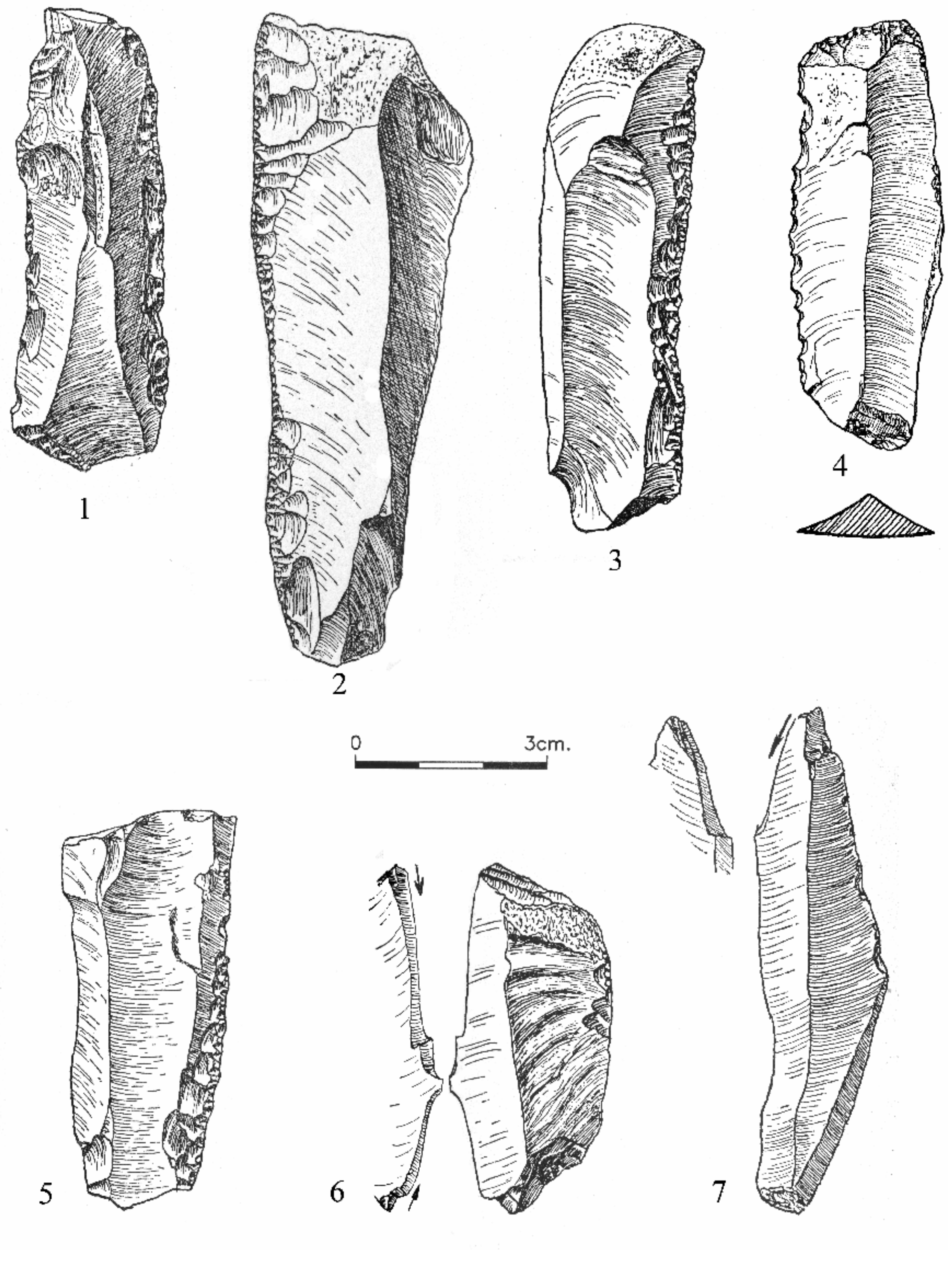


Fig. 309: Shaped items on blades from Yabrud I-15.
After Rust 1950: Tafeln 32: 2; 33: 1, 8; 36: 11-14,

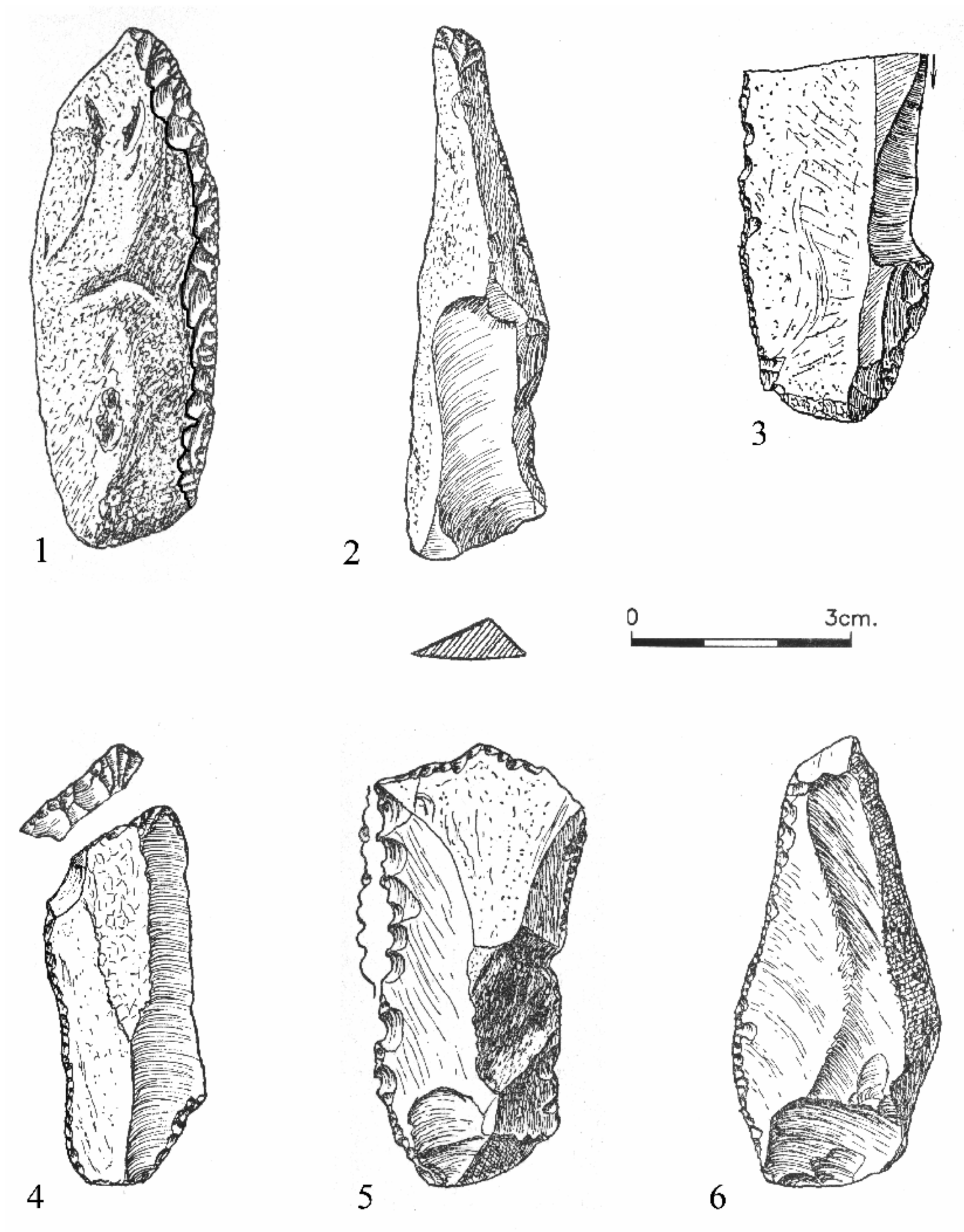


Fig. 310: Shaped items on PE blades (1-5) and NBK (6) from Yabrud I-15.
After Rust 1950: Tafeln 32: 4, 6; 33: 3; 36:3-4, 9.

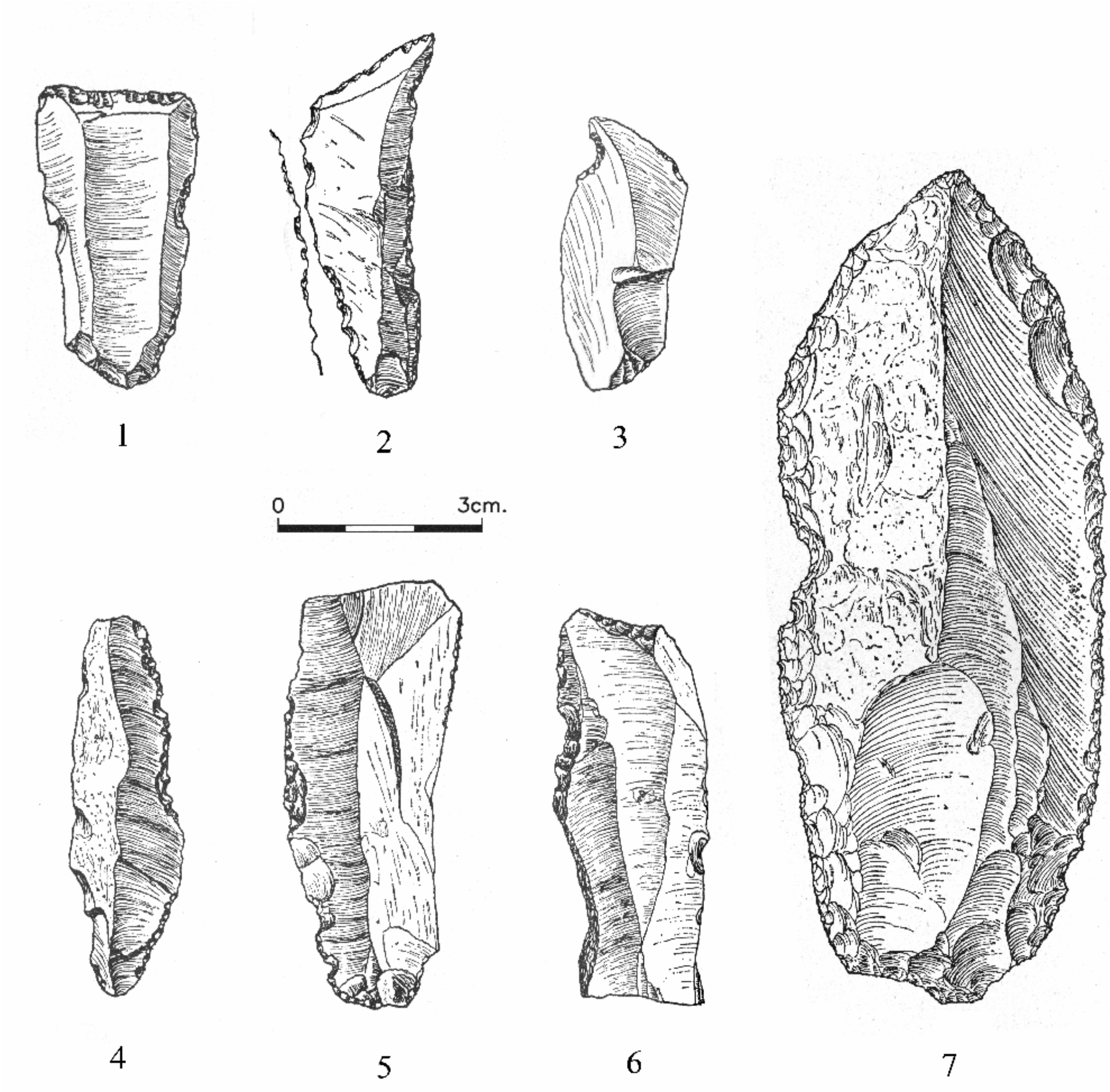


Fig. 311: Shaped items on blades (1-3), PE blades (4-5) and NBK (6) from Yabrud I-13, and a shaped item on a large PE blade from Yabrud I-11.
After Rust 1950, Tafeln 40:2, 5, 8-10, 12; 44:3.

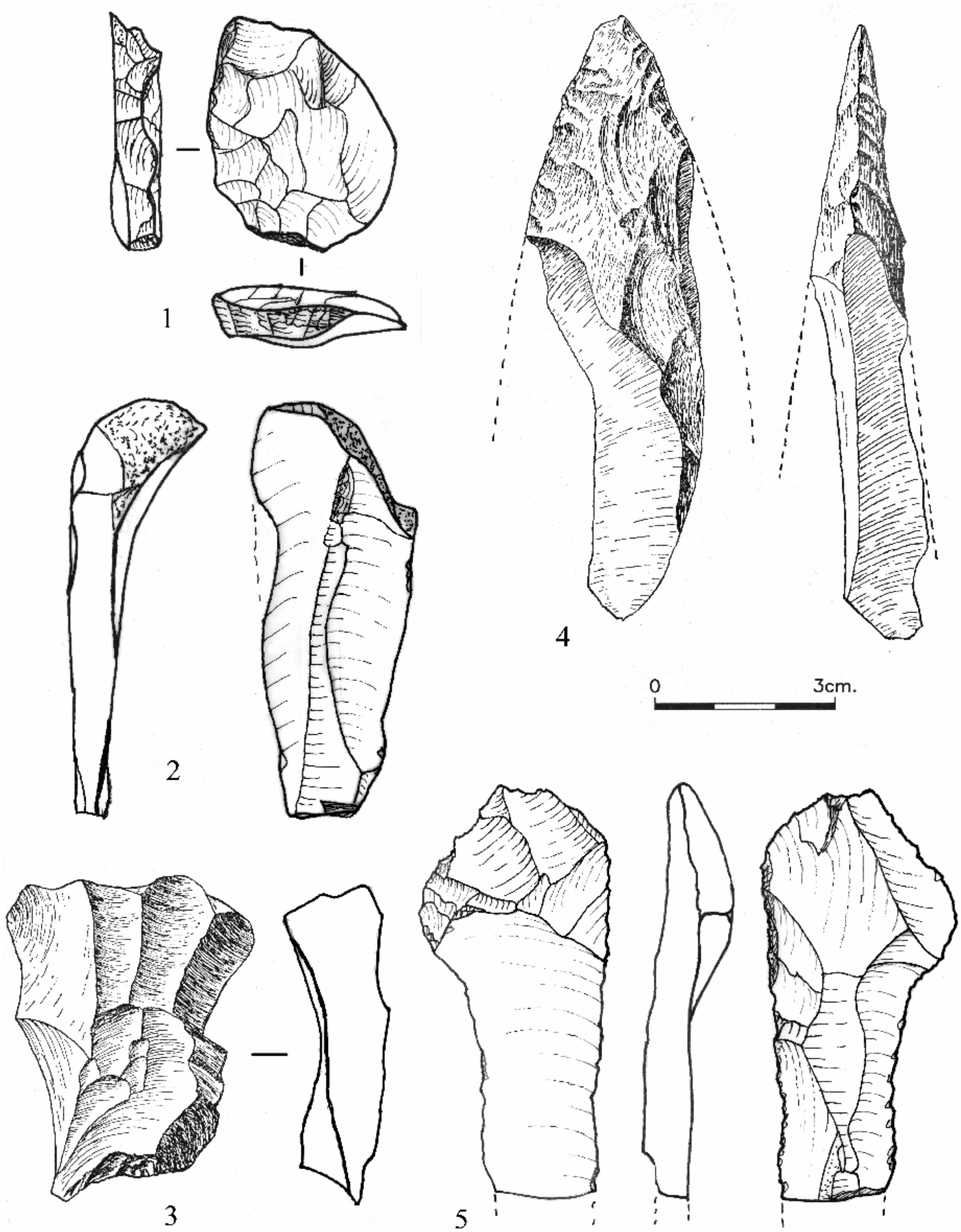


Fig. 312: Core tablet (1) and overpass items (2-5) from Yabrud I-15. Items 4-5 represent the recycling of handaxes for laminar cores. Drawings no. 3-4 are after Rust (1950, Tafeln 34:1, 37:11).

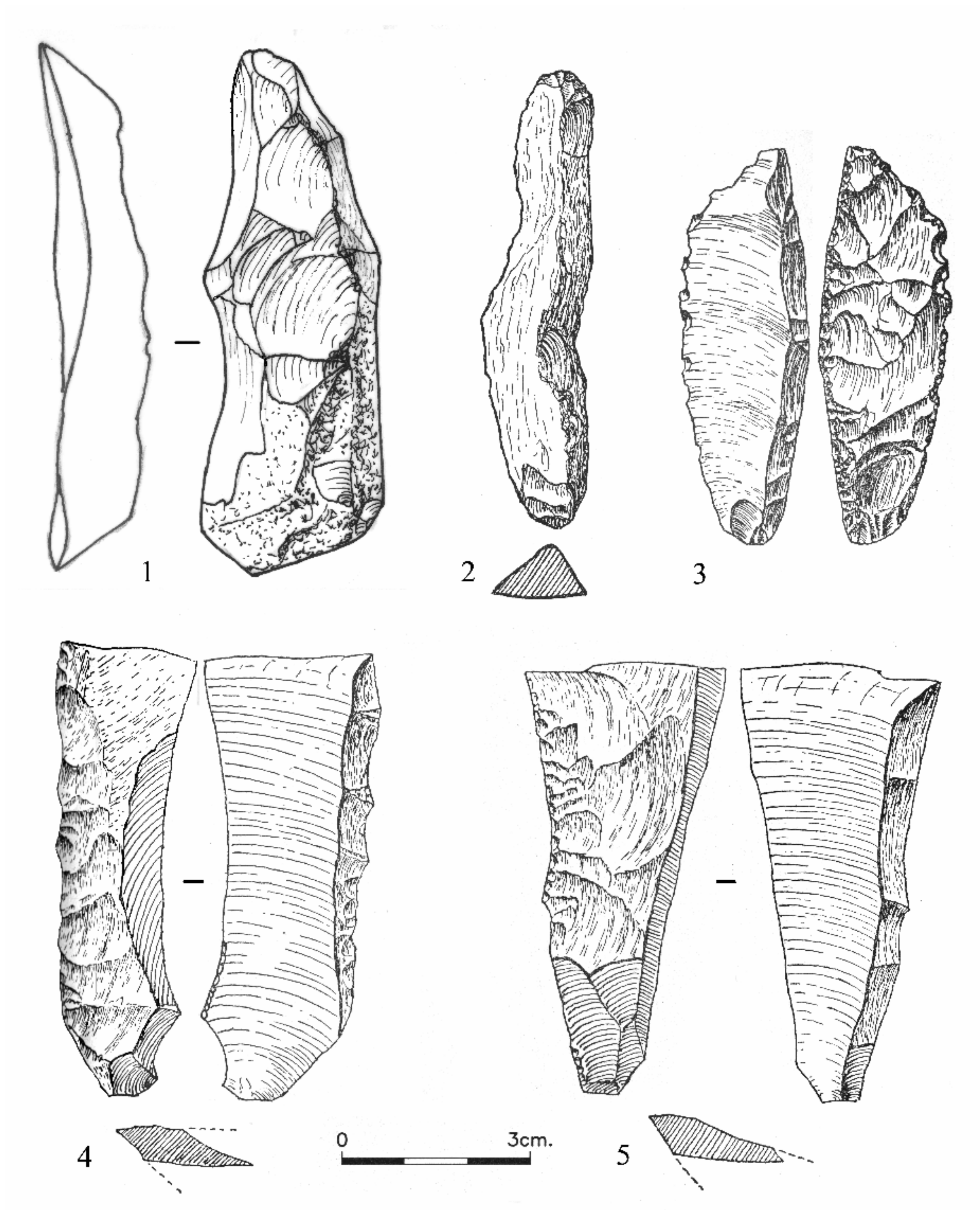


Fig. 313: Crested blades from Yabrud I-15: ‘rough’ crested blades (1-2), *faustkeil-klingen* (3-5).
Drawings no. 2-5 are after Rust 1950: Tafeln 34:6-7; 36: 5.

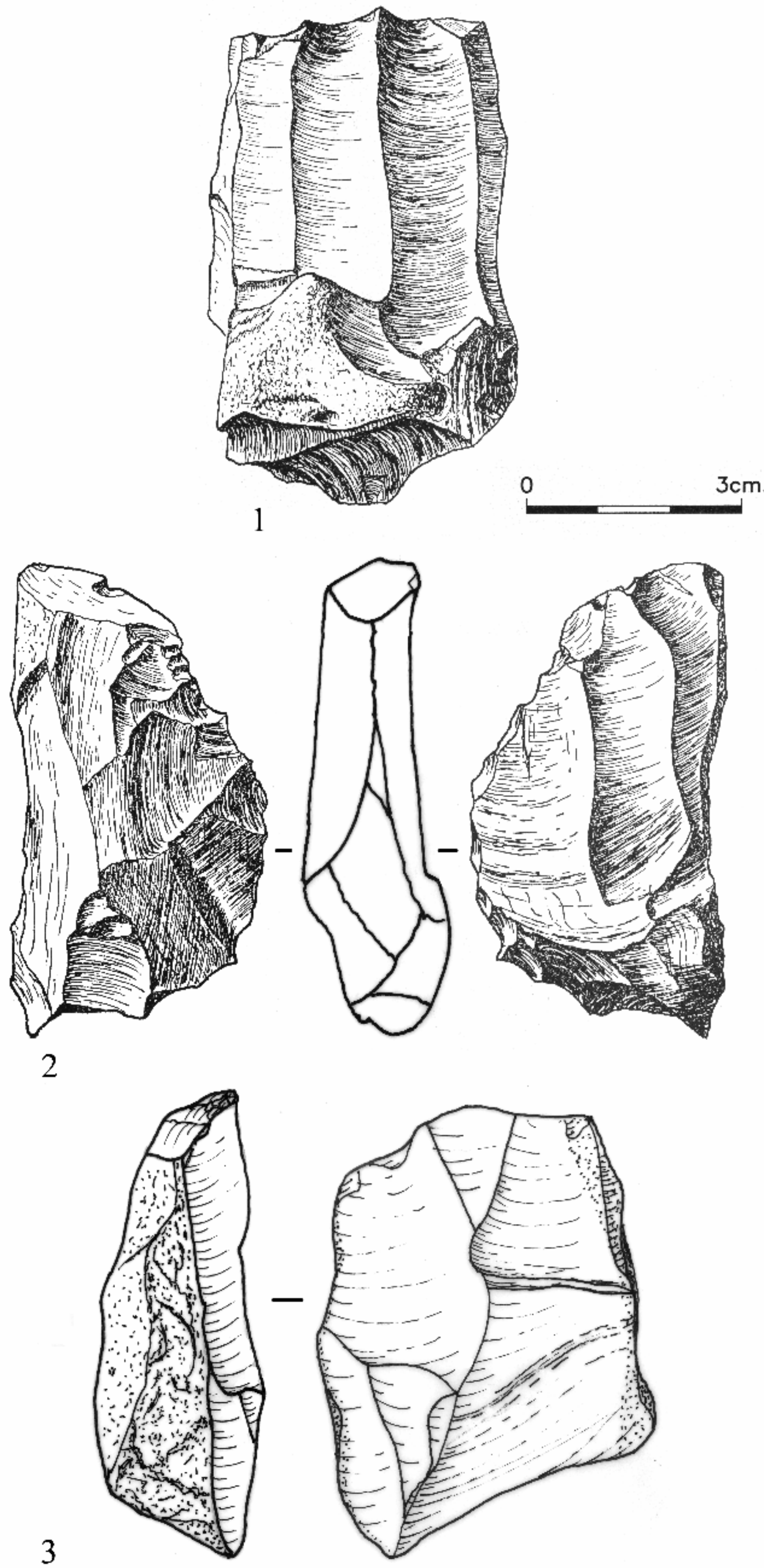


Fig. 314: 'Single striking platform laminar cores' (1) and 'single striking platform laminar and flake cores' (2-3) from Yabrud I-15.
Drawings 1-2 are after Rust 1950: Tafeln 37: 12-13, 15.

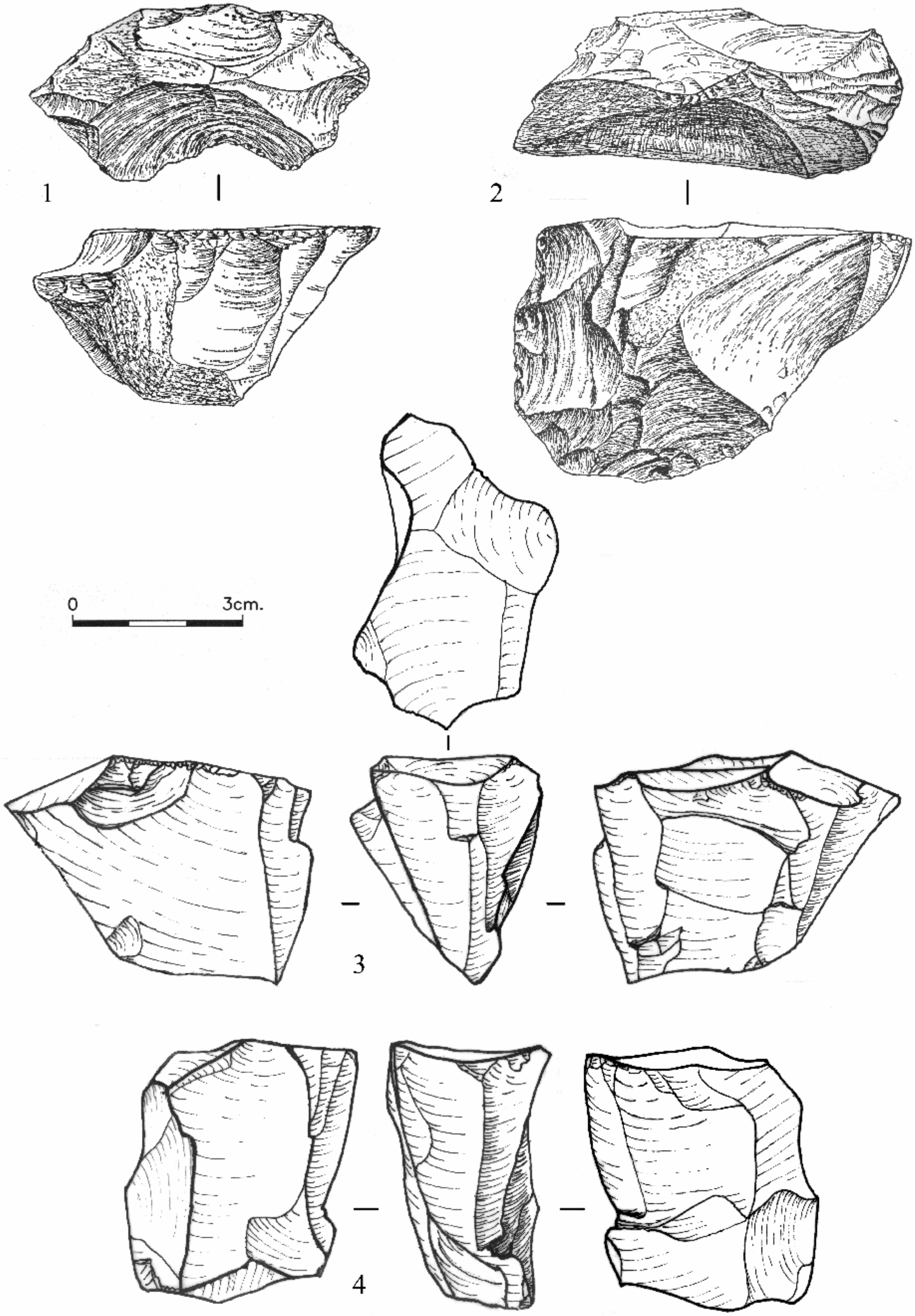


Fig. 315: 'Single striking platform laminar and flake cores' from Yabrud I-15.
Drawings no. 1-2 are after Rust 1950: Tafeln 35: 2-3.

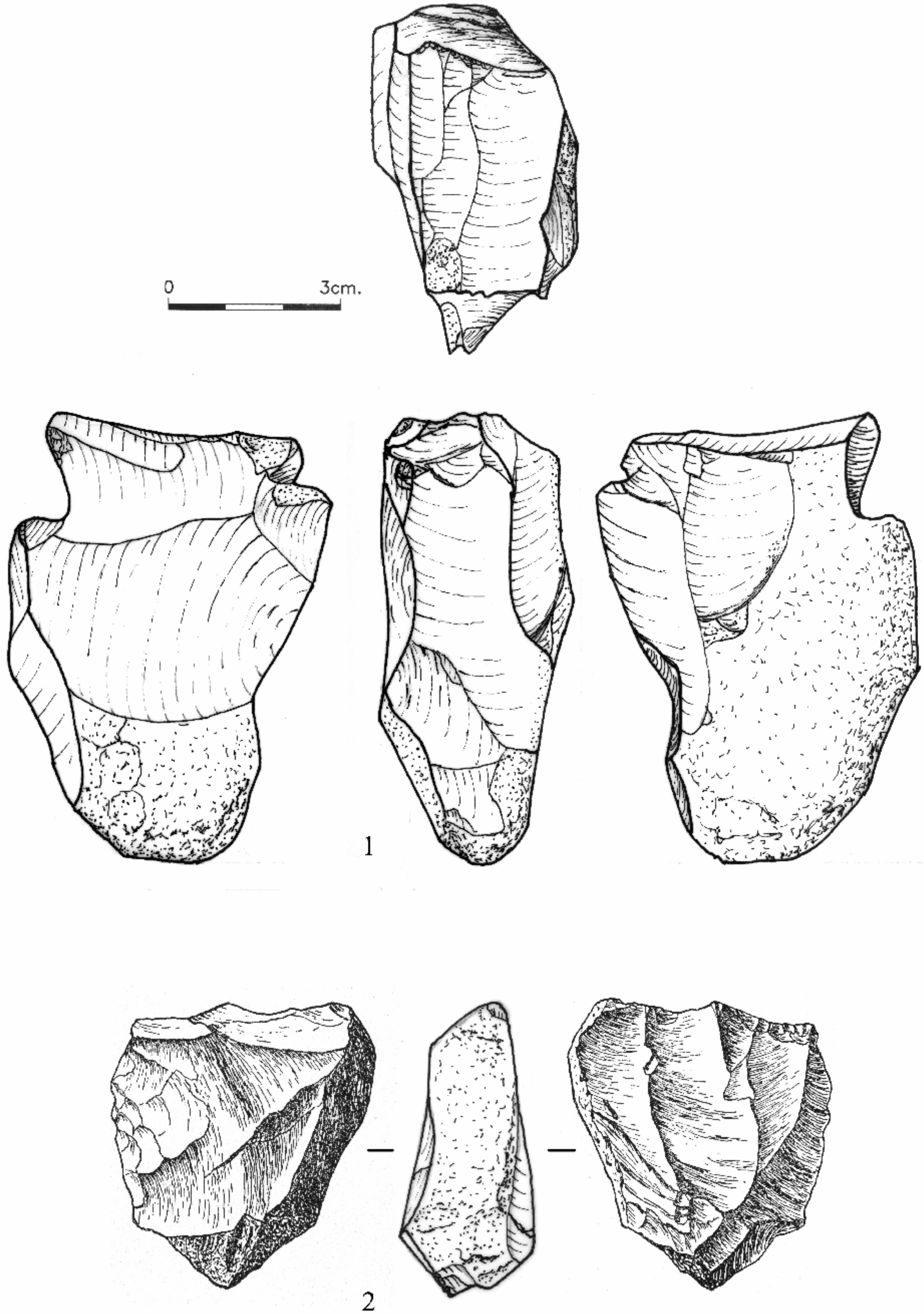


Fig. 316: 'Two striking platforms laminar core' (1) and a 'two striking platforms laminar and flake core' (2) from Yabrud I-15.
Drawing no. 2 is after Rust 1950: Tafeln 37:14.

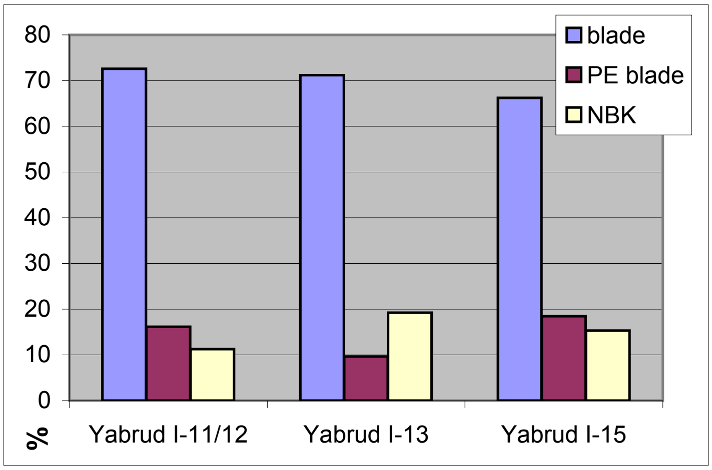


Fig. 317: Division of the three laminar types (blanks and shaped) from Yabrud I.
n=Yabrud I-11/12: 62; Yabrud I-13: 52; Yabrud I-15: 222.

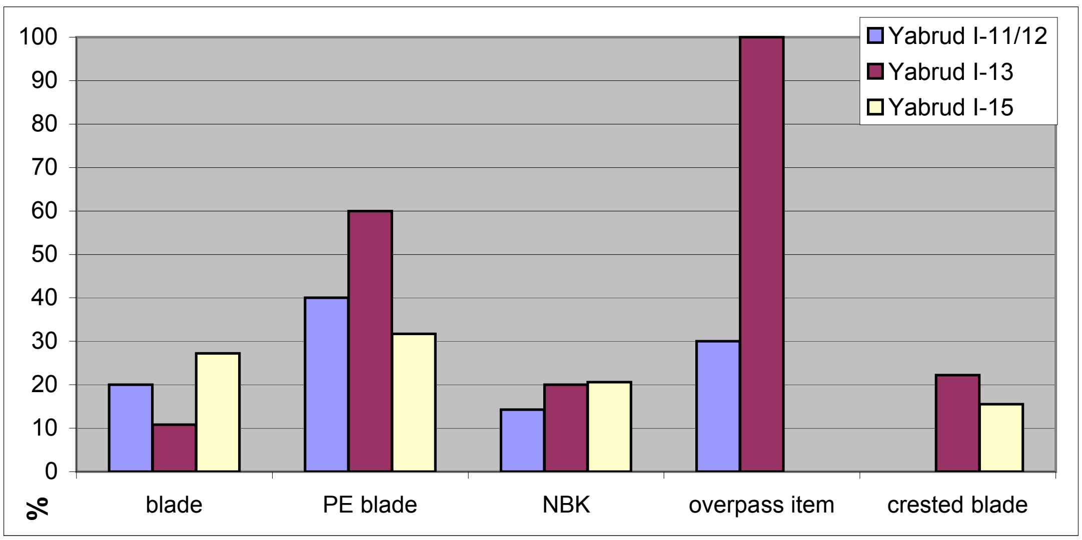


Fig. 318: Percentage of shaped items out of the sum of blanks and shaped items from Yabrud I.
n=**Yabrud I-11/12** - blade: 45; PE blade: 10; NBK: 7; overpass item (laminar only): 10; crested blade: 16.
Yabrud I-13 - blade: 37; PE blade: 5; NBK: 10; overpass item (laminar only): 1; crested blade: 9.
Yabrud I-15 - blade: 147; PE blade: 41; NBK: 34; overpass item (laminar only): 7; crested blade: 45.

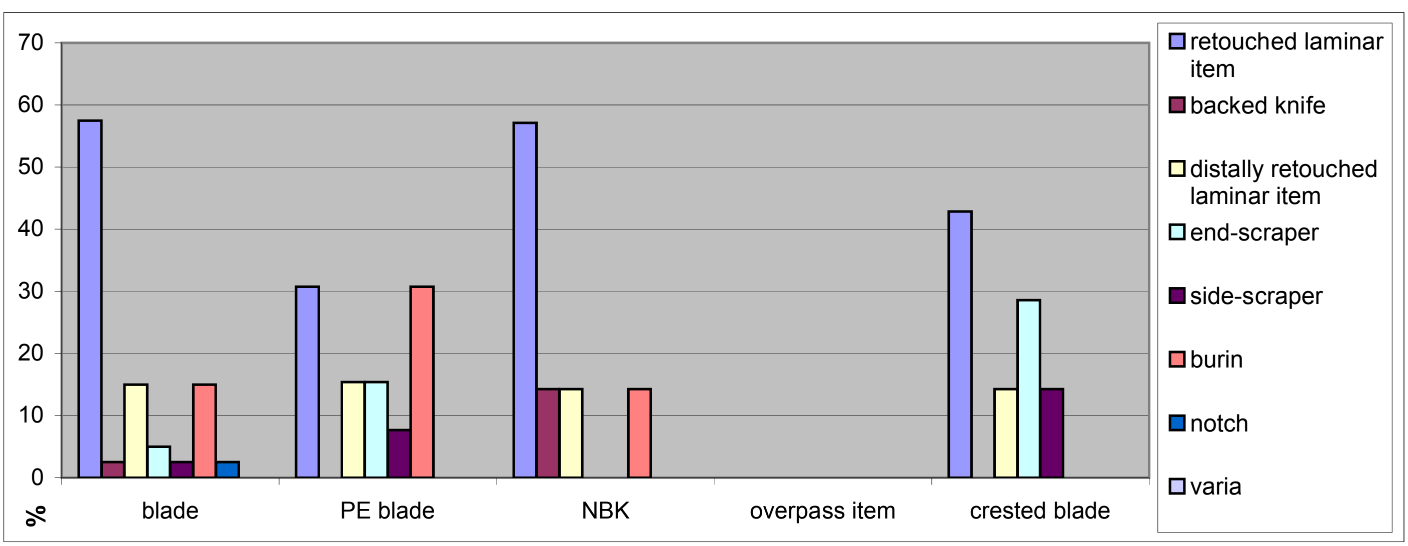


Fig. 319: Types of shaped items made on each of the laminar types from Yabrud I-15.
n=blade: 40; PE blade: 13; NBK: 7; crested blade: 7.

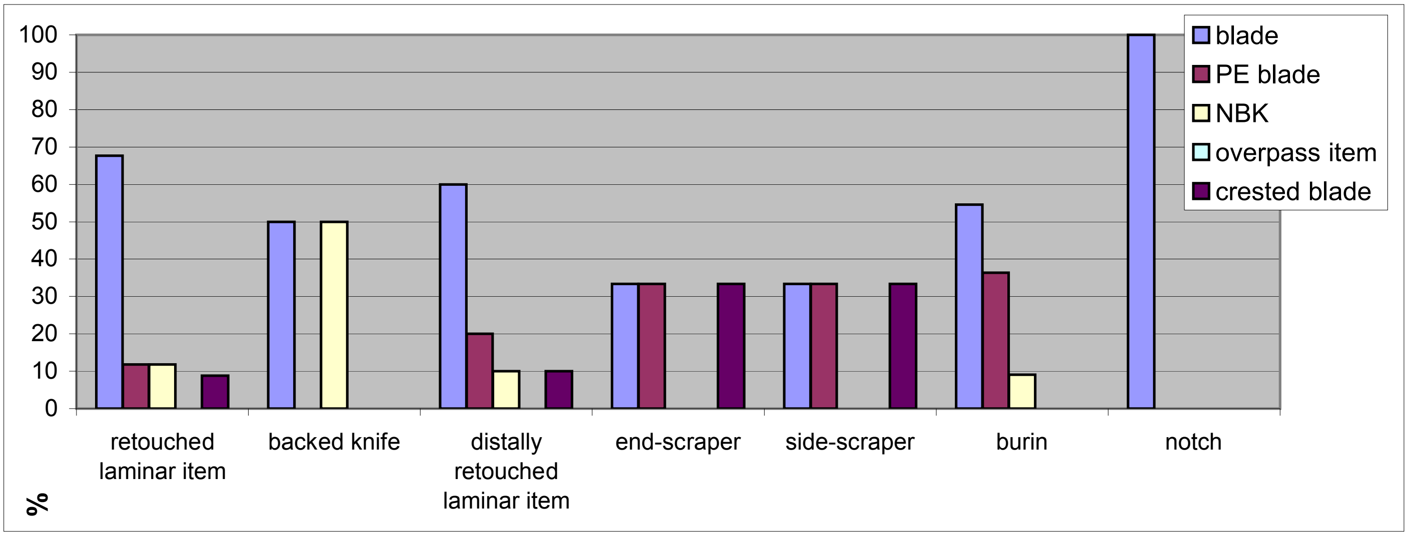


Fig. 320: Division of laminar shaped item types into laminar types from Yabrud I-15.
n=retouched laminar item: 34; backed knife: 2; distally retouched laminar item: 10; end-scraper: 6; side-scraper: 3; burin: 11; notch: 1.

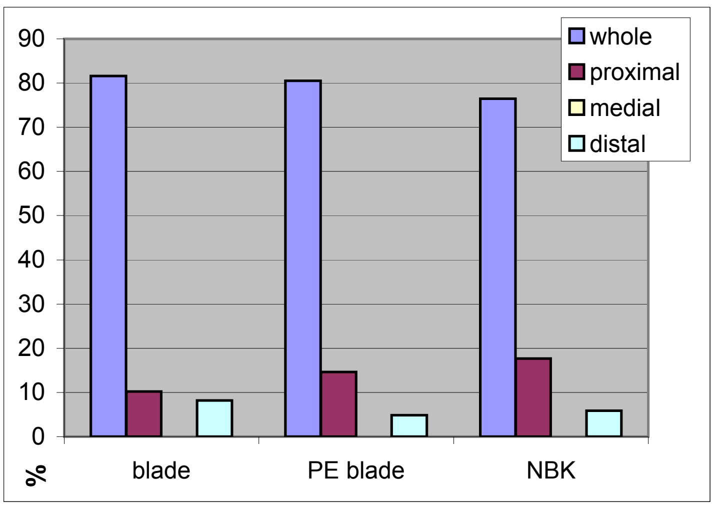


Fig. 321: State of preservation of the laminar items (blank and shaped) from Yabrud I-15.
n= blade: 147; PE blade: 41; NBK: 34.

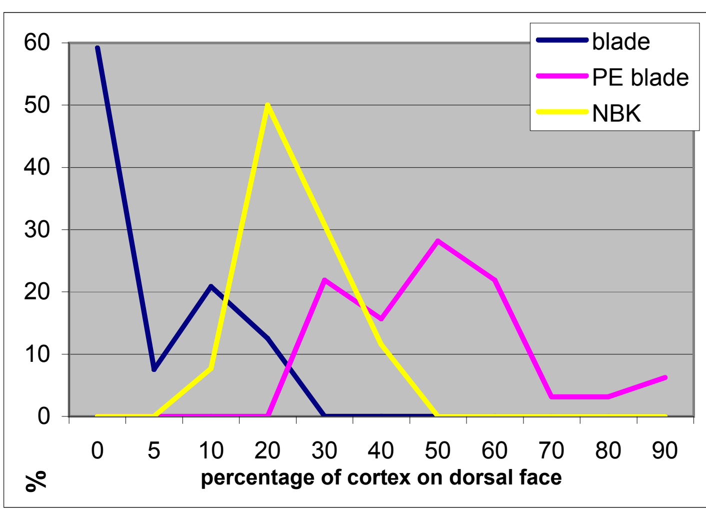


Fig. 322: Percentage of cortex on the dorsal face of the three laminar types (blanks and shaped) from Yabrud I-15.
n=blade: 120; PE blade: 32; NBK: 26.

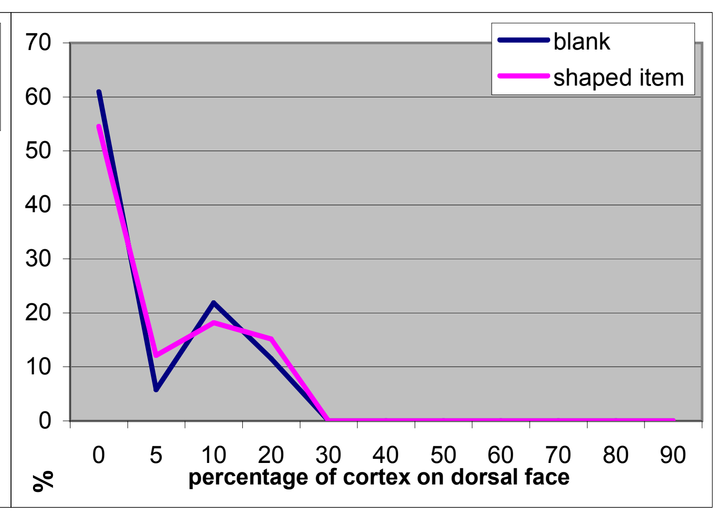


Fig. 323: Percentage of cortex on the dorsal face of blank blades and shaped blades from Yabrud I-15.
n=blank: 87; shaped item: 33.

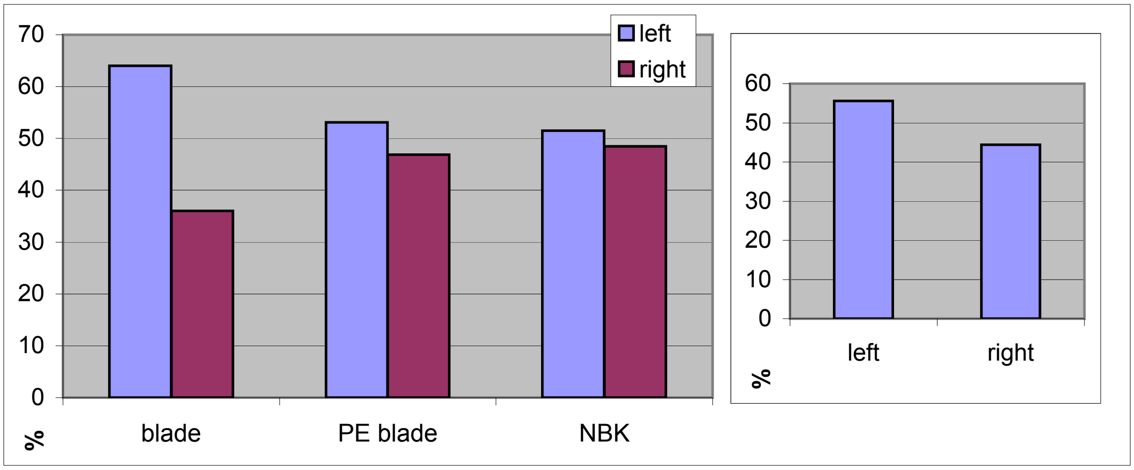


Fig. 324: Side of cortex on the three laminar types (blanks and shaped) from Yabrud I-15.
In the right graph the three laminar types are united.
n=blade: 25; PE blade: 32; NBK: 33; total: 90.

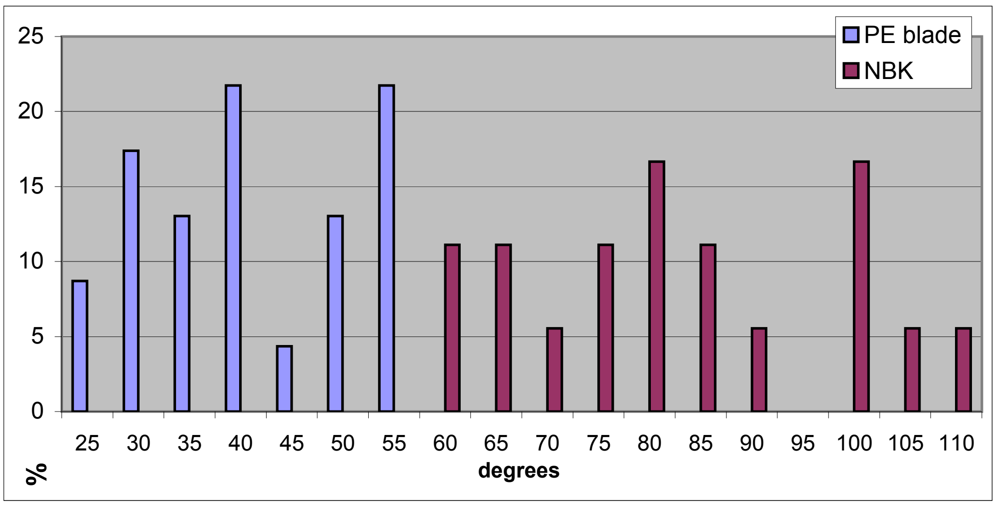


Fig. 325: Angle of the cortical edge of PE blades and NBKs (blanks and shaped) from Yabrud I-15.
n=PE blade: 23; NBK: 18.

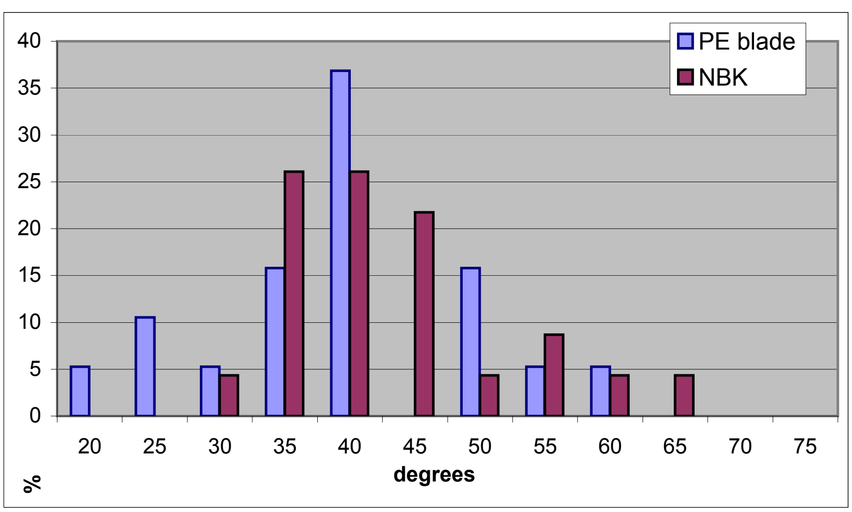


Fig. 326: Angle of the sharp edge of PE blades and NBKs
(blanks and shaped) from Yabrud I-15.
n=PE blade: 19; NBK: 23.

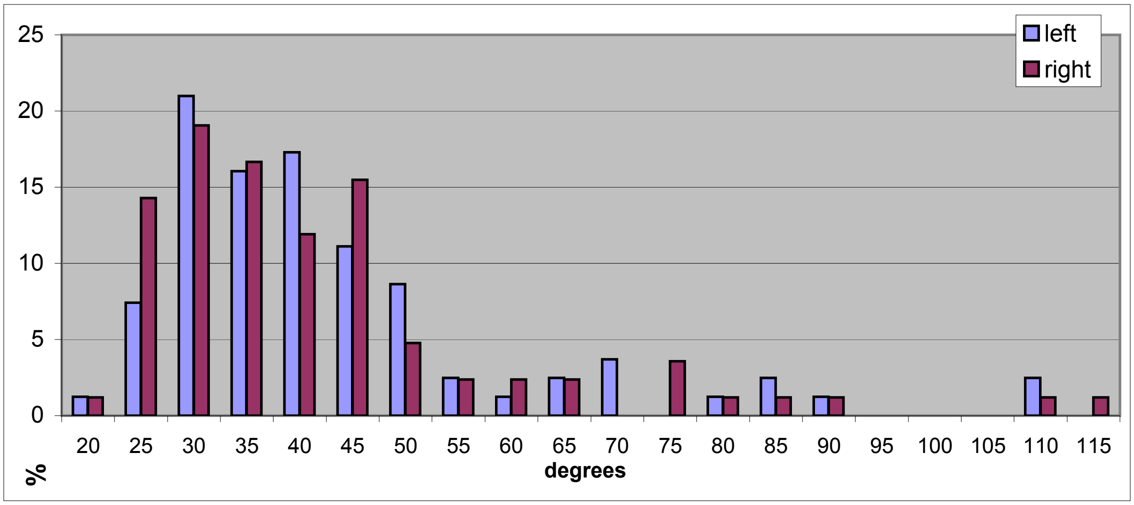


Fig. 327: Angles of the lateral edges of blades (blanks and shaped) from Yabrud I-15.

n=left: 81; right: 84.

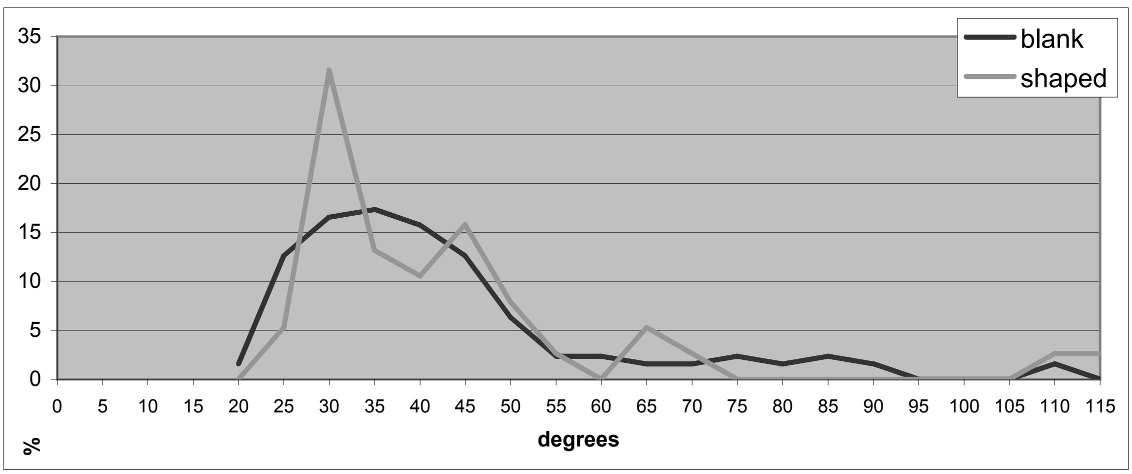


Fig. 328: Angles of the lateral edges of blank blades and shaped blades from Yabrud I-15.

The left and right angles were united into one population.

n=blank: 127; shaped item: 38.

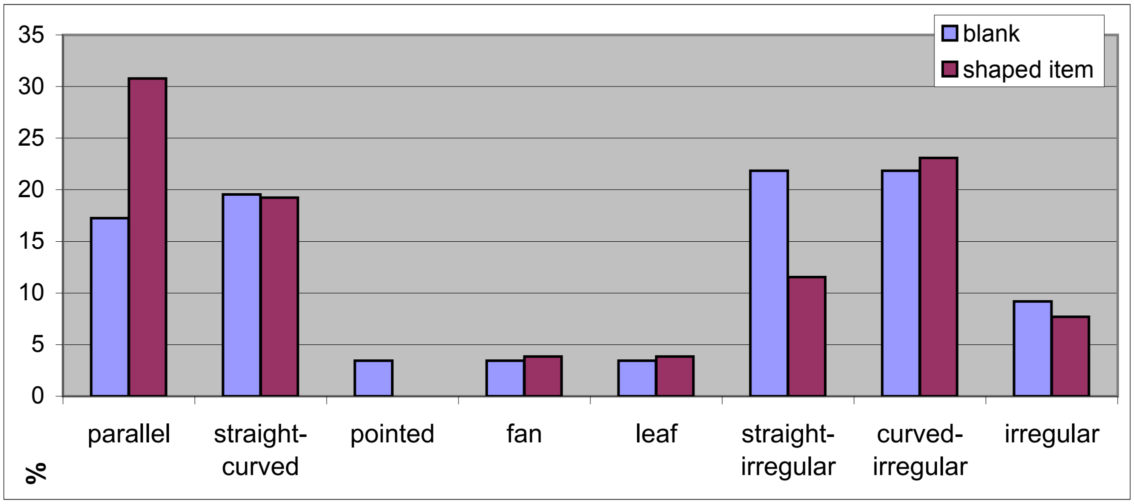


Fig. 329: Shape of blank blades and shaped blades from Yabrud I-15.
n=blank: 87; shaped item: 26.

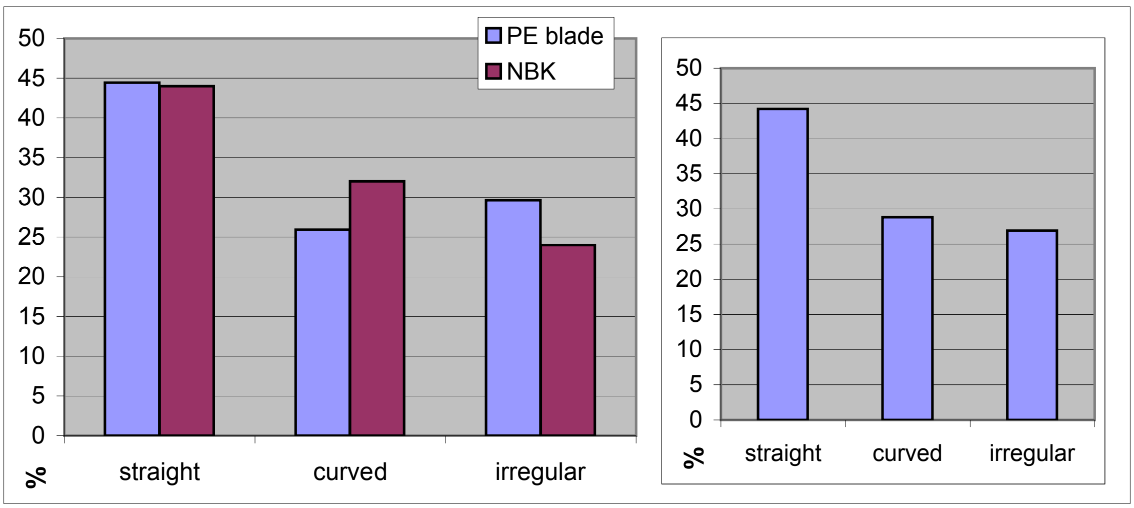


Fig. 330: Outline of the cortical edge of PE blades and NBKs (blank and shaped) from Yabrud I-15.
n= PE blade: 27; NBK: 25; total: 52.

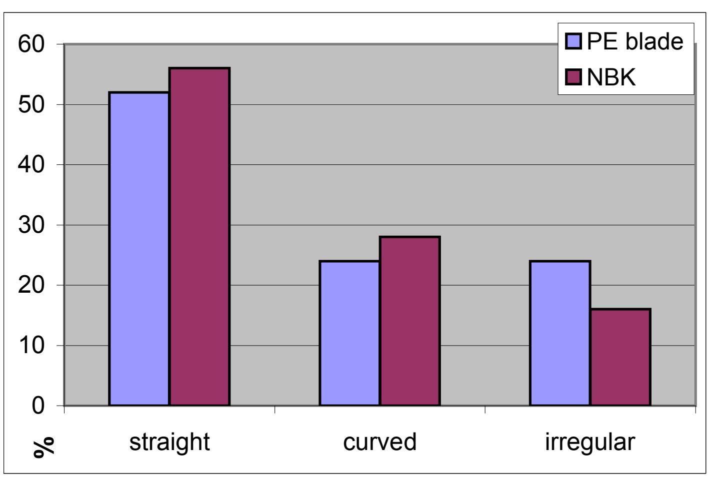


Fig. 331: Outline of the sharp edge of PE blades and NBKs (blanks and shaped) from Yabrud I-15.
n=PE blade: 25; NBK: 25.

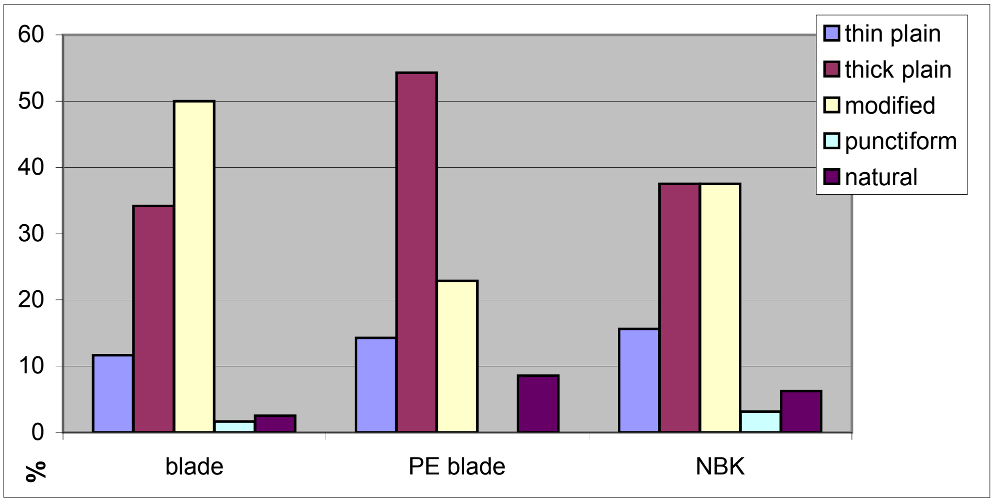


Fig. 332: Butt type of the three laminar types (blanks and shaped) from Yabrud I-15.
n=blade: 120; PE blade: 35; NBK: 32.

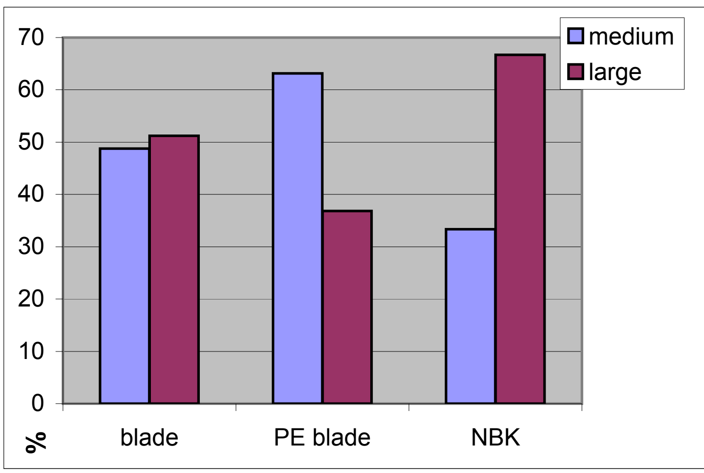


Fig. 333: Division of thick plain butts into medium and large thickness from Yabrud I-15.
n= blade: 41; PE blade: 19; NBK: 12.

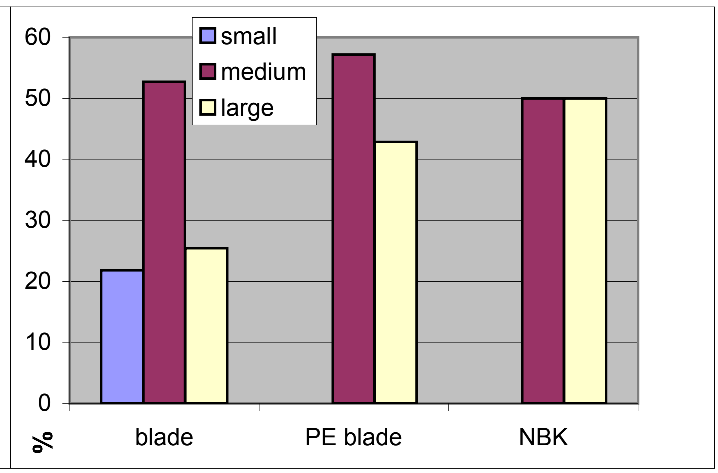


Fig. 334: Division of modified butts into small, medium and large thickness from Yabrud I-15.
n= blade: 55; PE blade: 7; NBK: 12.

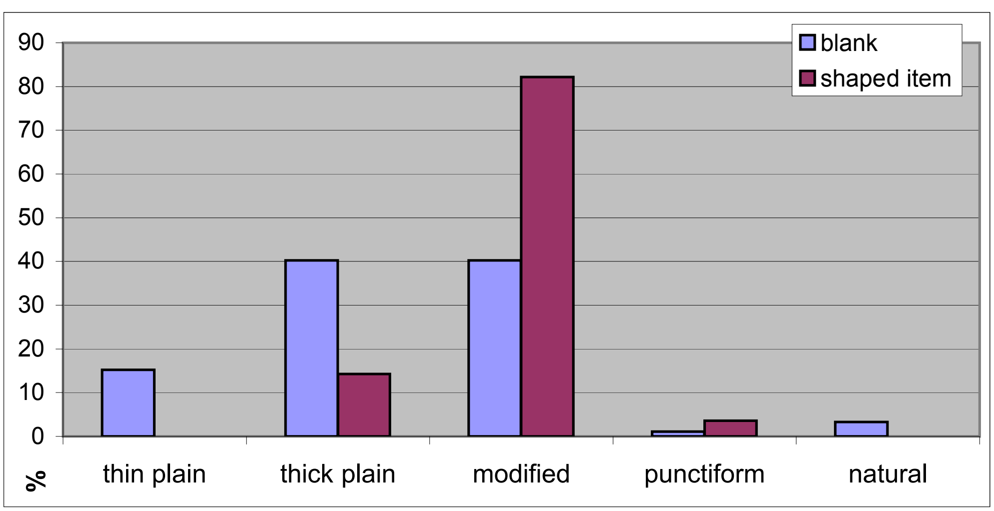


Fig. 335: Butt type of blank blades and shaped blades from Yabrud I-15.
n= blank: 92; shaped item: 28.

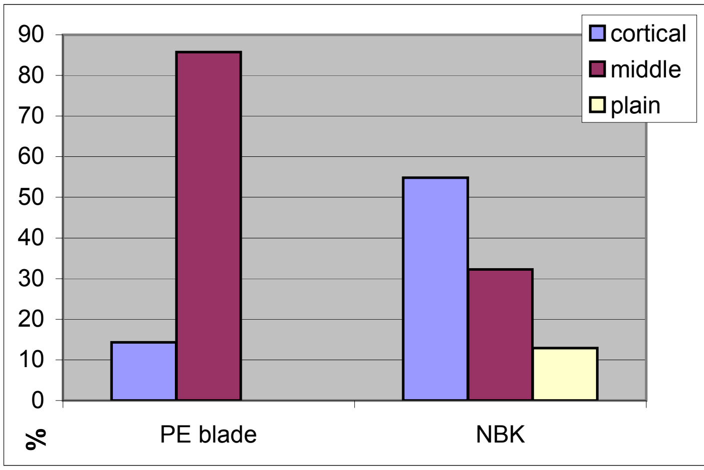


Fig. 336: Location of bulb of percussion on PE blades and NBKs (blanks and shaped) from Yabrud I-15.
n=PE blade: 28; NBK: 31.

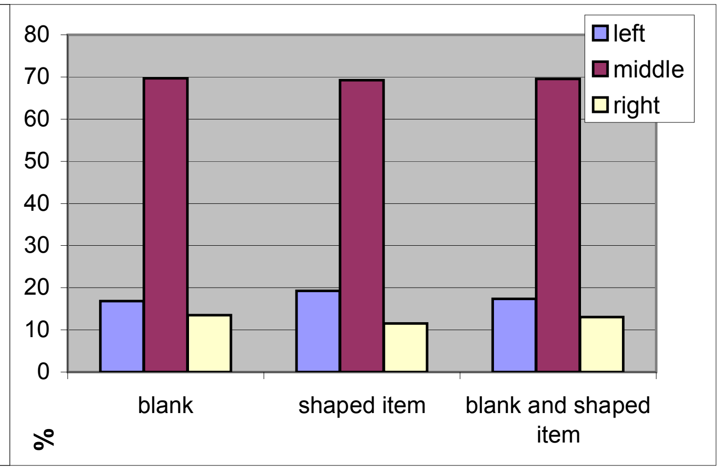


Fig. 337: Location of bulb of percussion on blades (blanks and shaped) from Yabrud I-15.
N=blank and shaped item: 89; blank: 26; shaped item: 115.

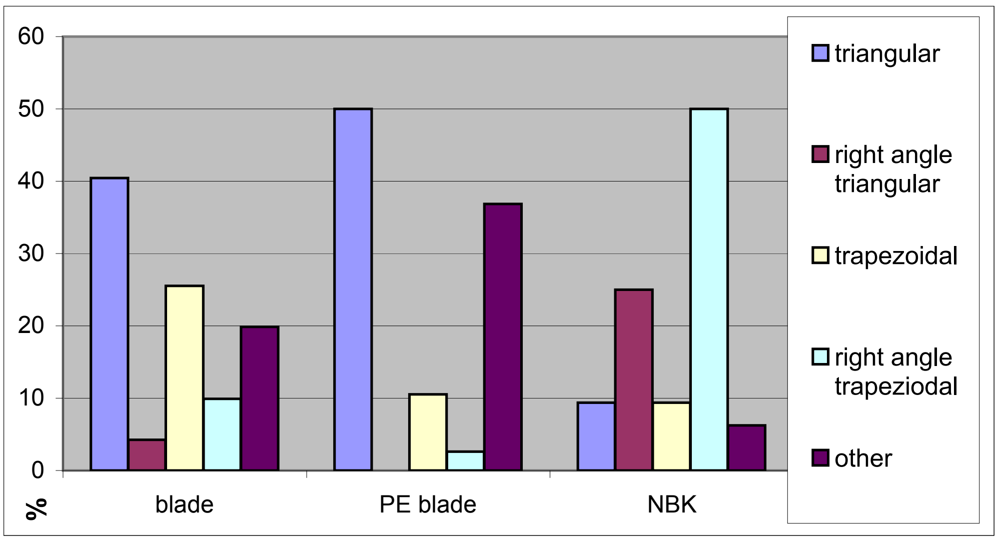


Fig. 338: Cross-section of the three laminar types (blanks and shaped) from Yabrud I-15.
n=blade: 141; PE blade: 38; NBK: 32.

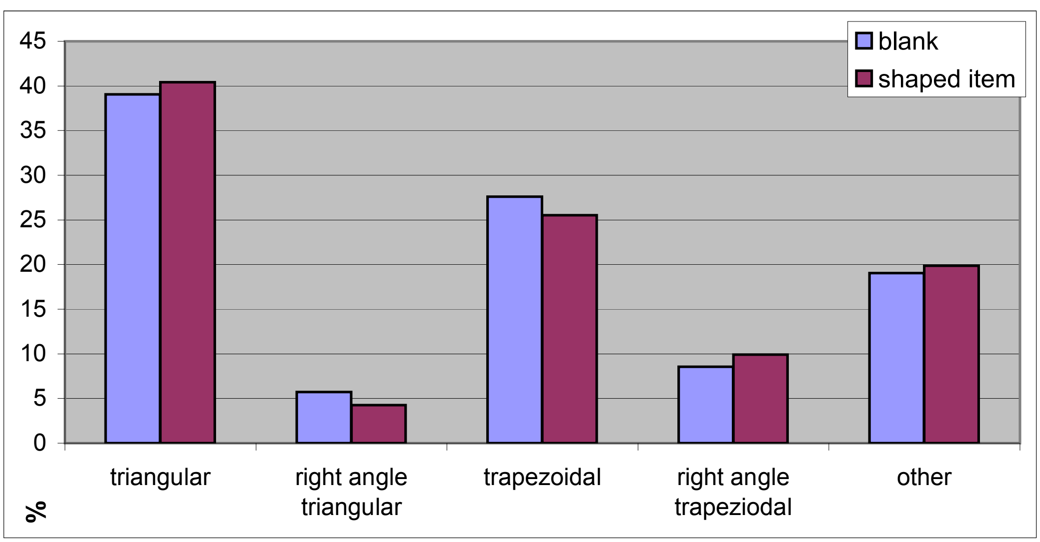


Fig. 339: Cross-section of blank blades and shaped blades from Yabrud I-15.
n= blank: 105; shaped item: 36.

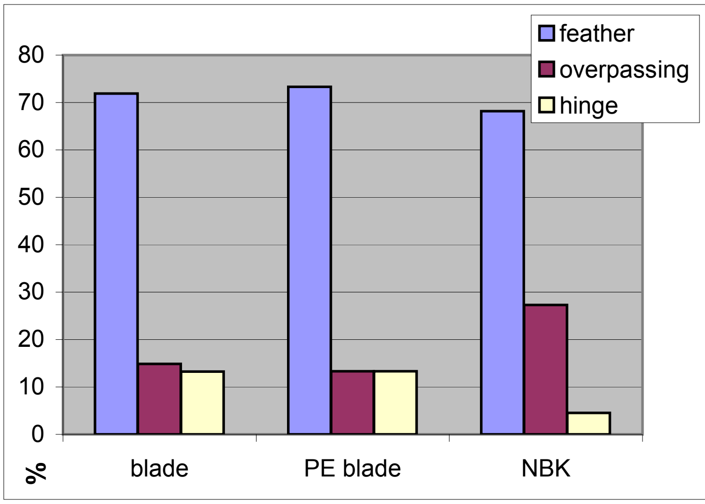


Fig. 340: End termination of the three laminar types (blanks and shaped) from Yabrud I-15.
n=blade: 121; PE blade: 30; NBK: 22.

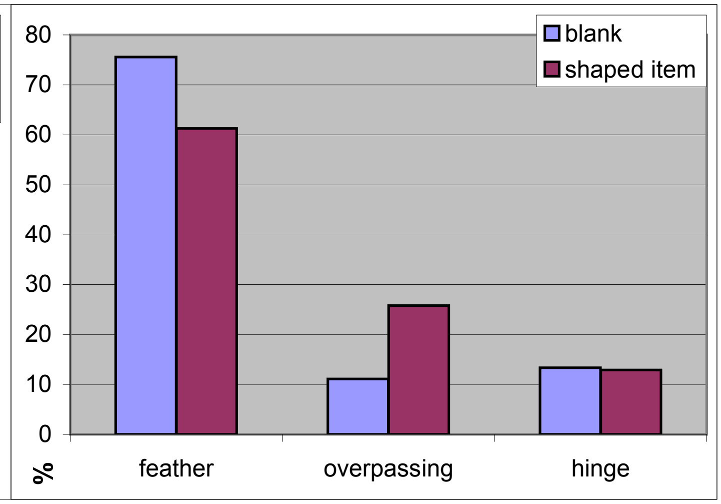


Fig. 341: End termination of blank blades and shaped blades from Yabrud I-15.
n=blank: 90; shaped item: 31.

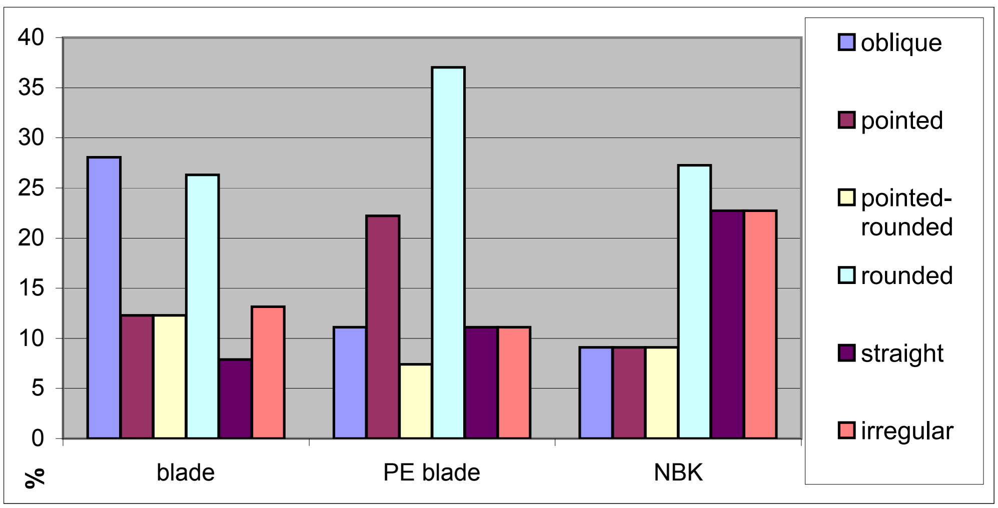


Fig. 342: Distal end shape of the three laminar types (blanks and shaped) from Yabrud I-15.
n=blade: 114; PE blade: 27; NBK: 22.

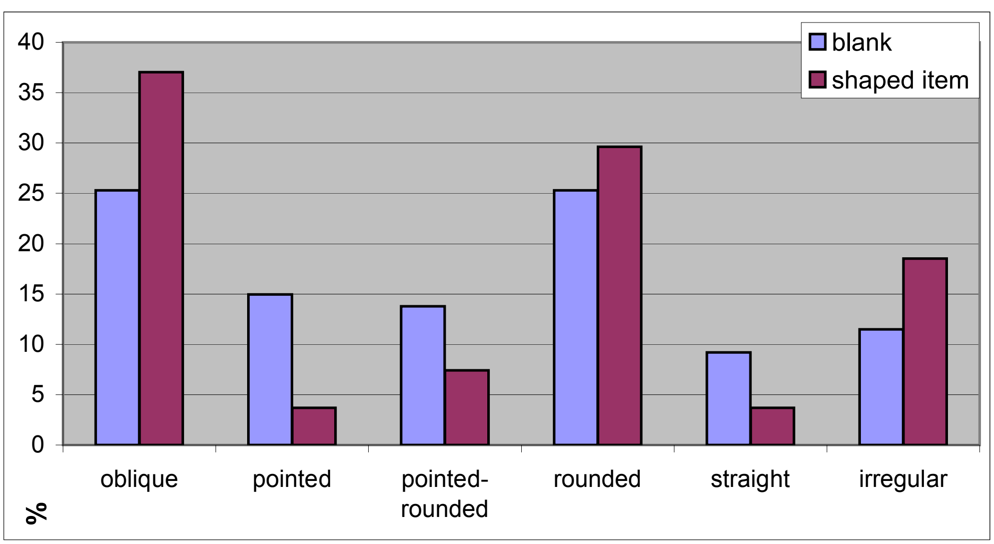


Fig. 343: Distal end shape of blank blades and shaped blades from Yabrud I-15.
n=blank: 87; shaped item: 27.

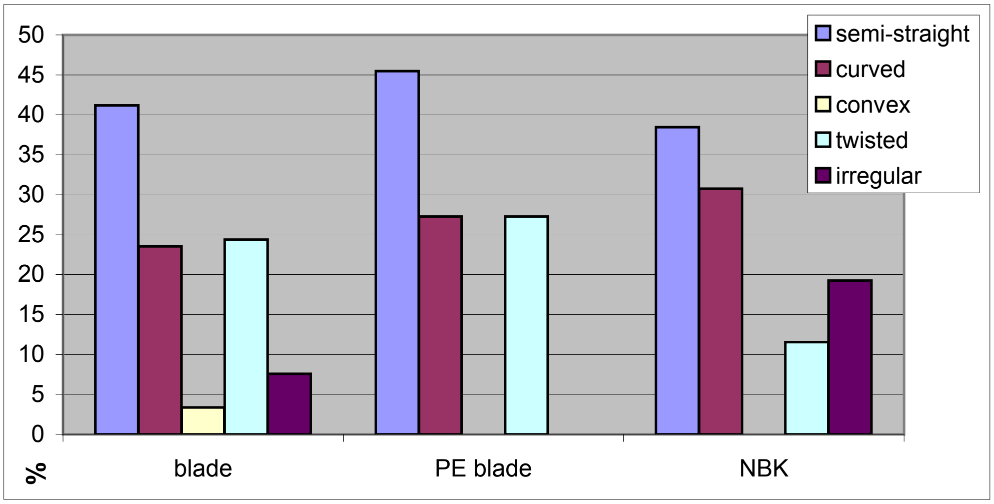


Fig. 344: Profile of the three laminar types (blanks and shaped) from Yabrud I-15.
n=blade: 199; PE blade: 33; NBK: 26.

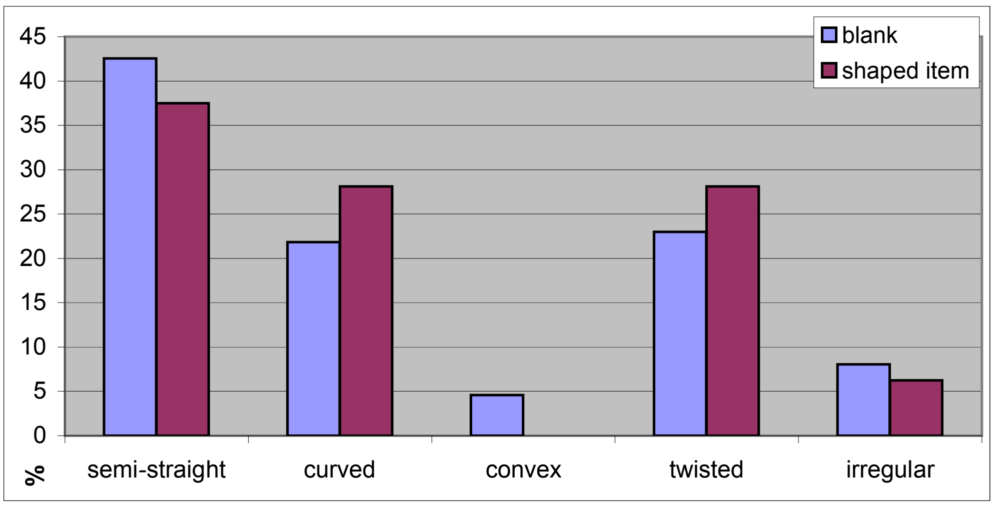


Fig. 345: Profile of blank blades and shaped blades from Yabrud I-15.
n=blank: 87; shaped item: 32.

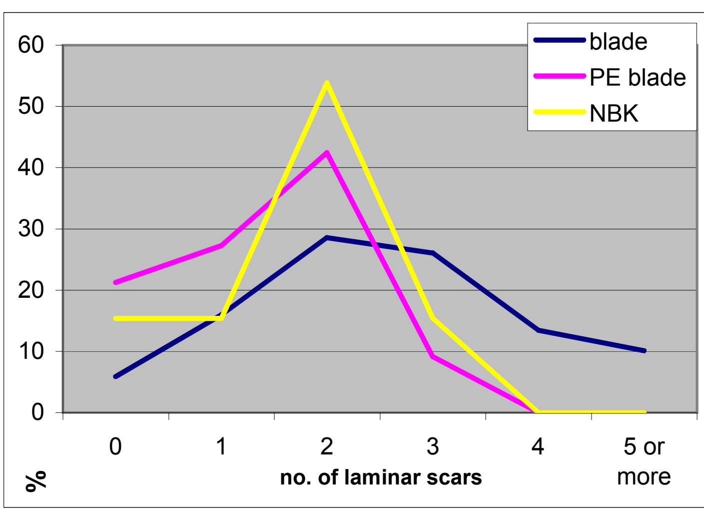


Fig. 346: Number of laminar scars on the three laminar types (blanks and shaped) from Yabrud I-15.
n=blade: 119; PE blade: 33; NBK: 26.

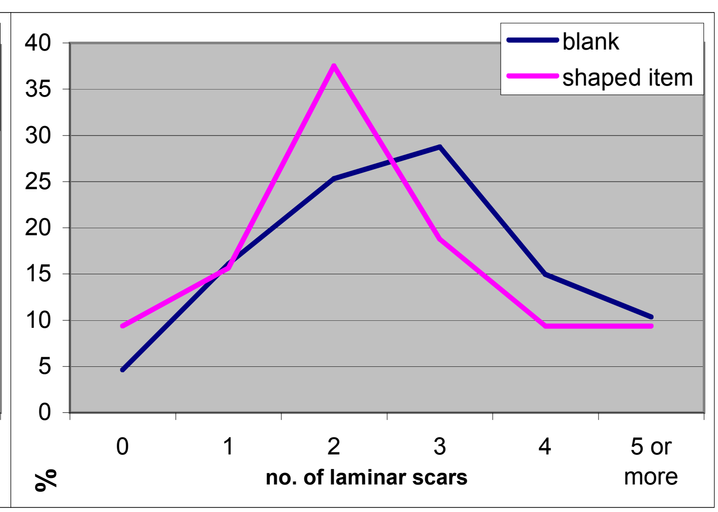


Fig. 347: Number of laminar scars on blade blanks and shaped blades from Yabrud I-15.
n=blank: 87; shaped item: 32.

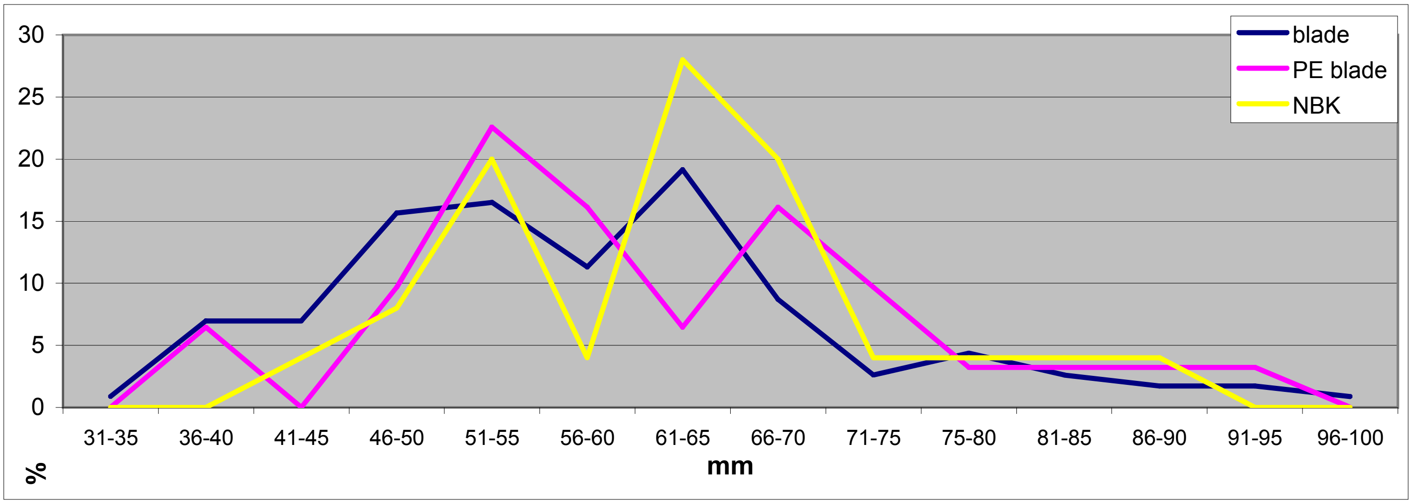


Fig. 348: Length of the three laminar types (blanks and shaped) from Yabrud I-15.
n=blade: 115; PE blade: 31; NBK: 25.

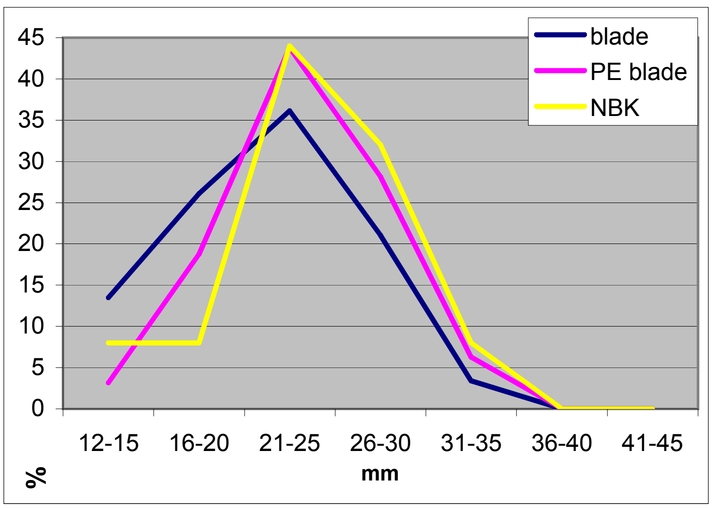


Fig. 349: Width of the three laminar types (blanks and shaped) from Yabrud I-15.
n= blade: 119; PE blade: 32; NBK: 25.

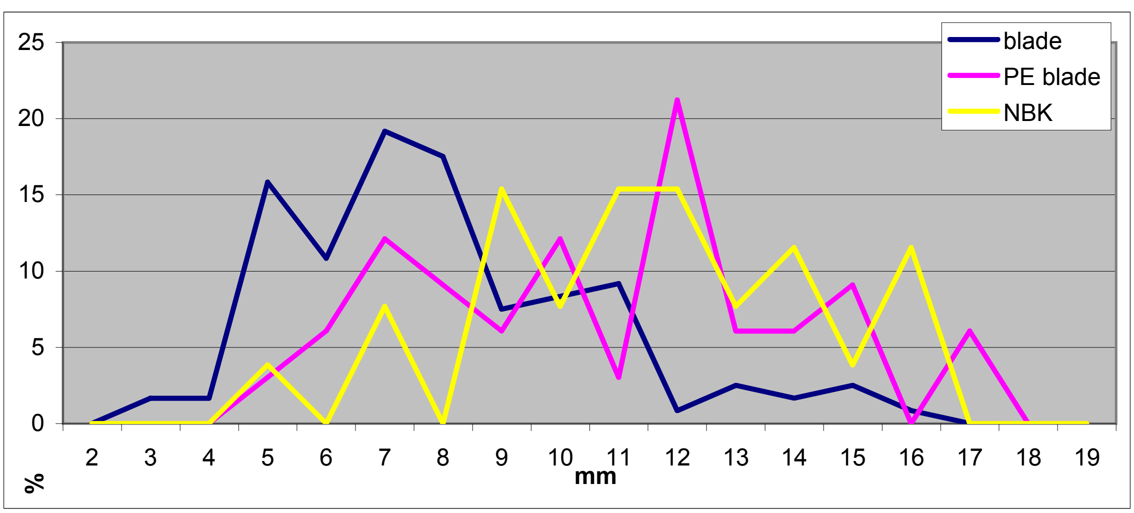


Fig. 350: Thickness of the three laminar types (blanks and shaped) from Yabrud I-15.
n=blade: 120; PE blade: 33; NBK: 26.

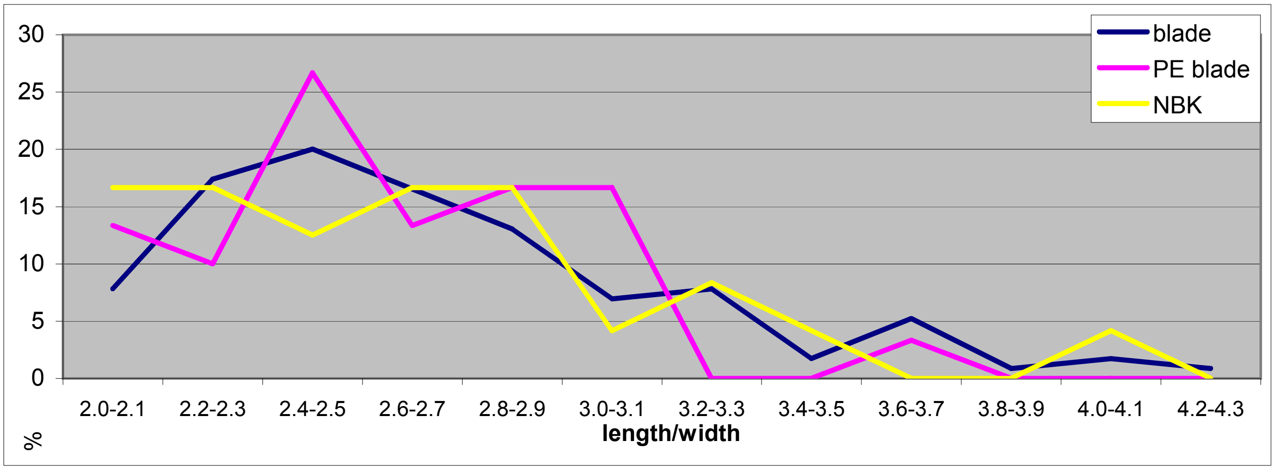


Fig. 351: Length/width ratio of the three laminar types (blanks and shaped) from Yabrud I-15.
n= blade: 115; PE blade: 30; NBK: 24.

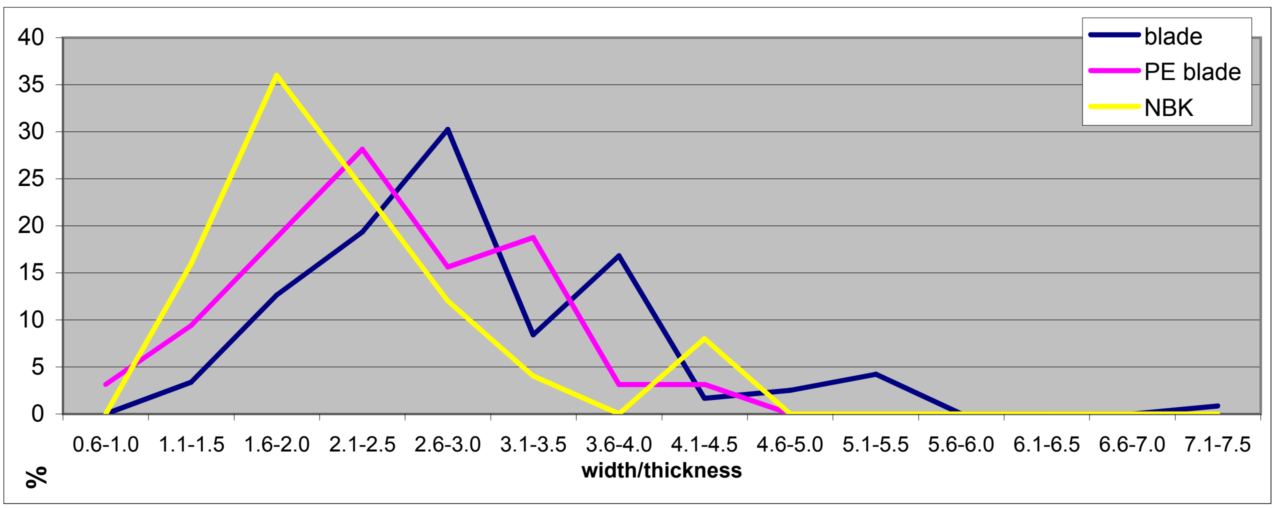


Fig. 352: Width/thickness ratio of the three laminar types (blanks and shaped) from Yabrud I-15.
n= blade: 119; PE blade: 32; NBK: 25.

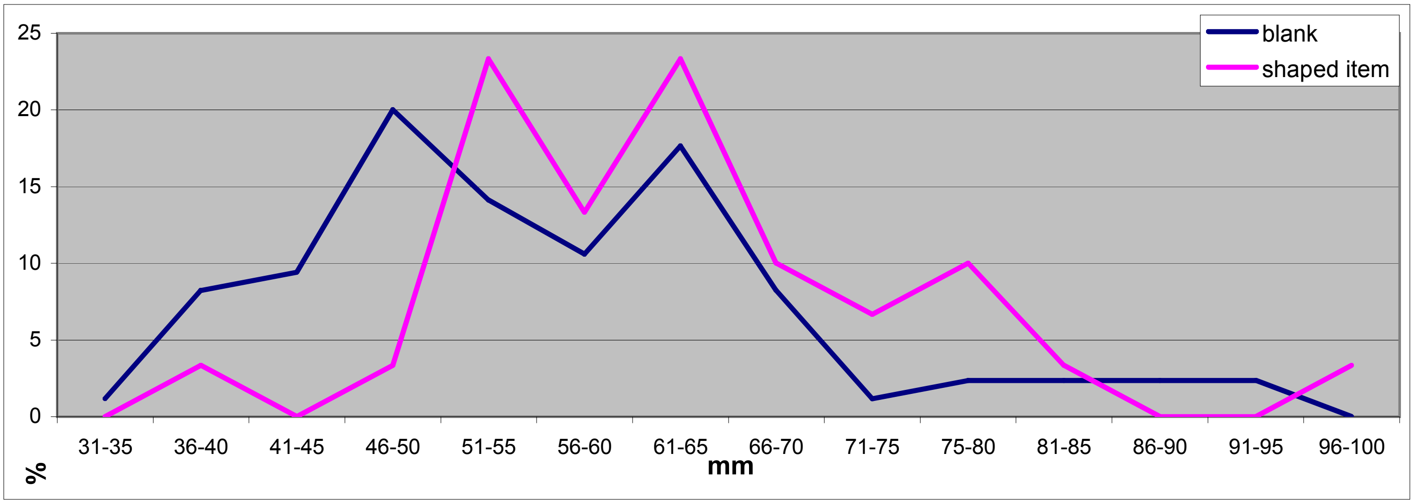


Fig. 353: Length of blade blanks and shaped blanks from Yabrud I-15.
n= blank: 85; shaped item: 30.

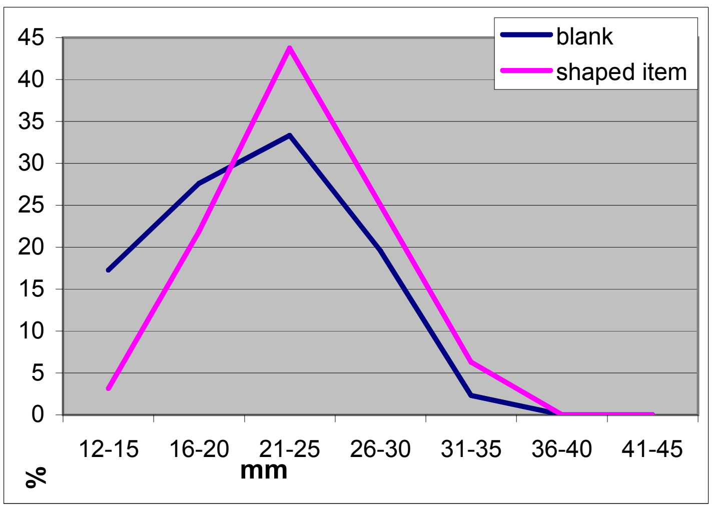


Fig. 354: Width of blade blanks and shaped blades from Yabrud I-15.
n=blank: 87; shaped item: 32.

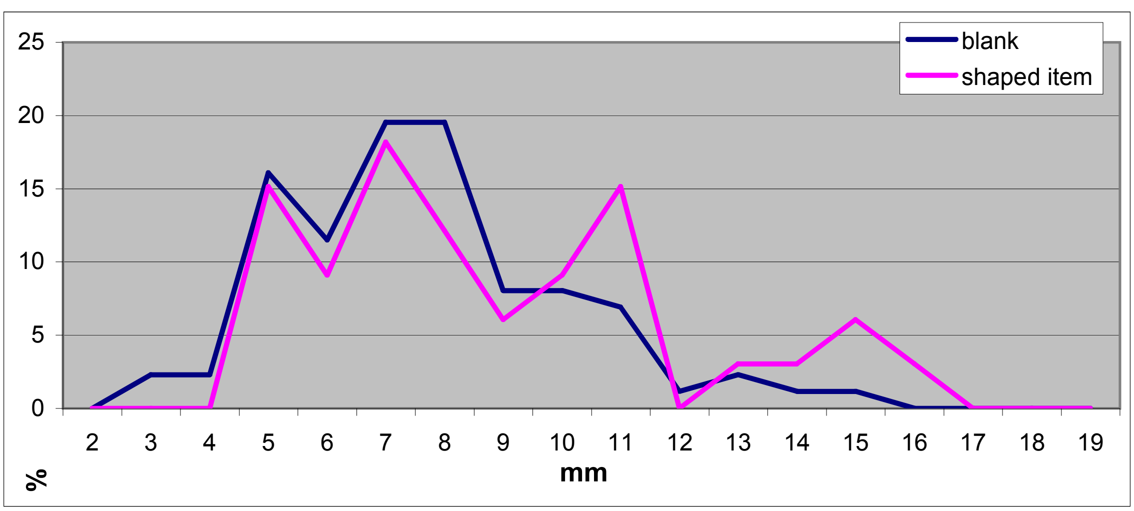


Fig. 355: Thickness of blade blanks and shaped blades from Yabrud I-15.
n=blank: 87; shaped item: 33.

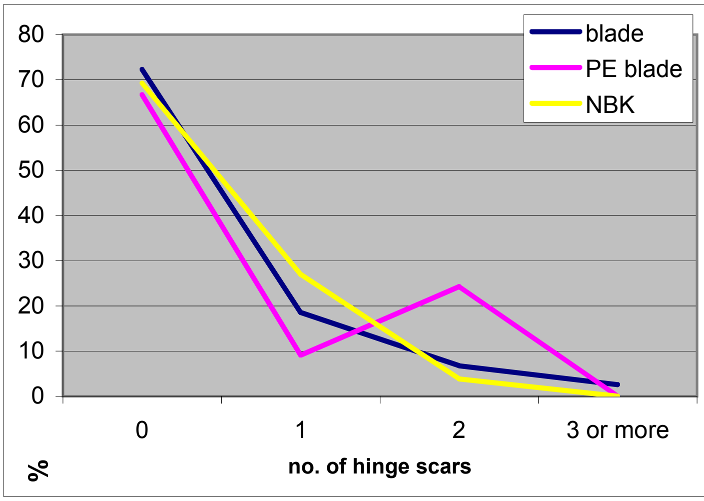


Fig. 356: Number of hinge scars on the three laminar types (blanks and shaped) from Yabrud I-15.
n=blade: 119; PE blade: 33; NBK: 26.

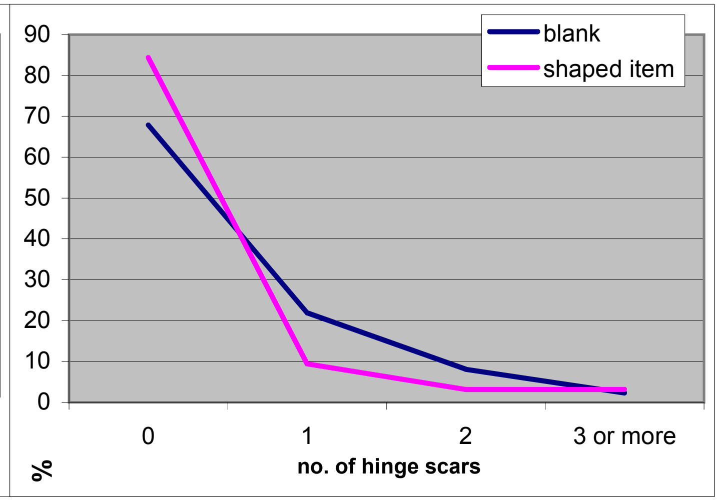


Fig. 357: Number of hinge scars on blade blanks and shaped blades from Yabrud I-15.
n=blank: 87; shaped item: 32.

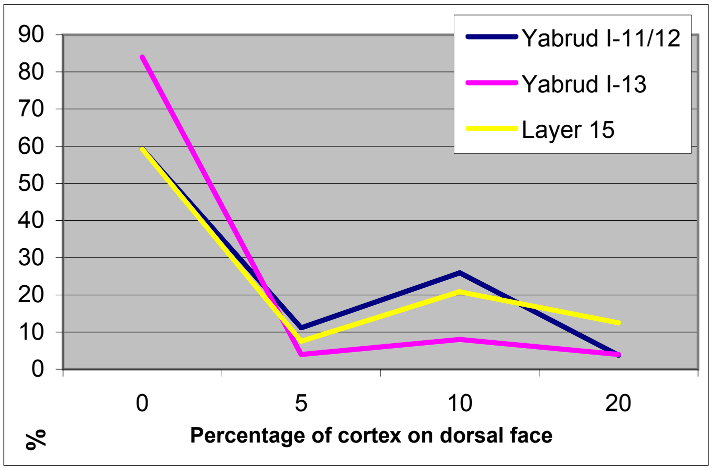


Fig. 358: Percentage of cortex on the dorsal face of blades (blanks and shaped) from Yabrud I.
n=Yabrud I-11/12: 27; Yabrud I-13: 25; Yabrud I-15: 120.

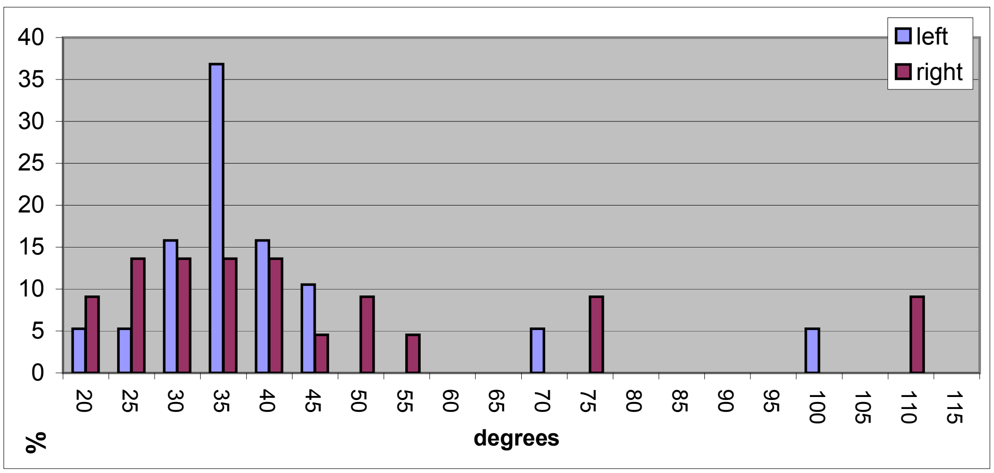


Fig. 359: Angles of the lateral edges of blades (blank and shaped) from Yabrud I-13.
n=left:19; right 22.

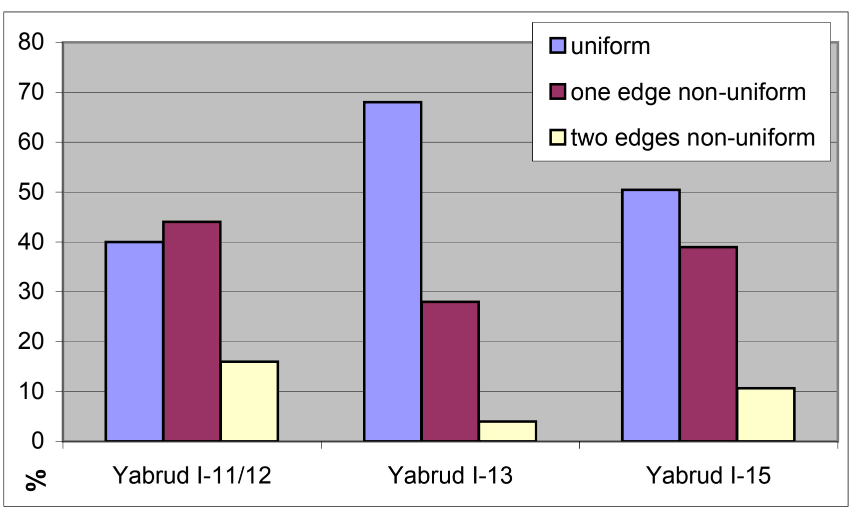


Fig. 360: Non-uniform angles of the lateral edges of blades (blanks and shaped) from Yabrud I.
n=Yabrud I-11/12: 25; Yabrud I-13: 25; Yabrud I-15: 115.

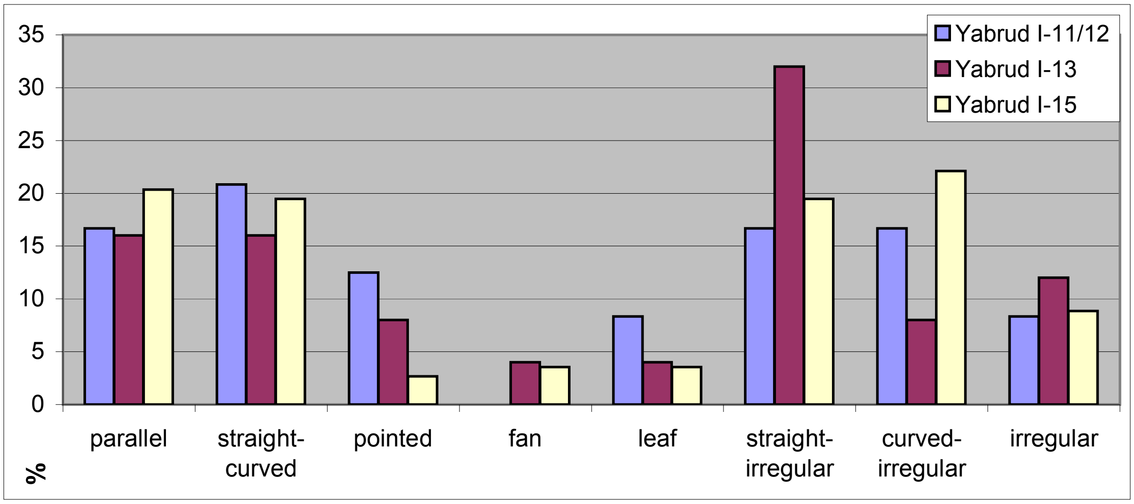


Fig. 361: Shape of blades (blanks and shaped) from Yabrud I.
n=Yabrud I-11/12: 24; Yabrud I-13: 25; Yabrud I-15: 113.

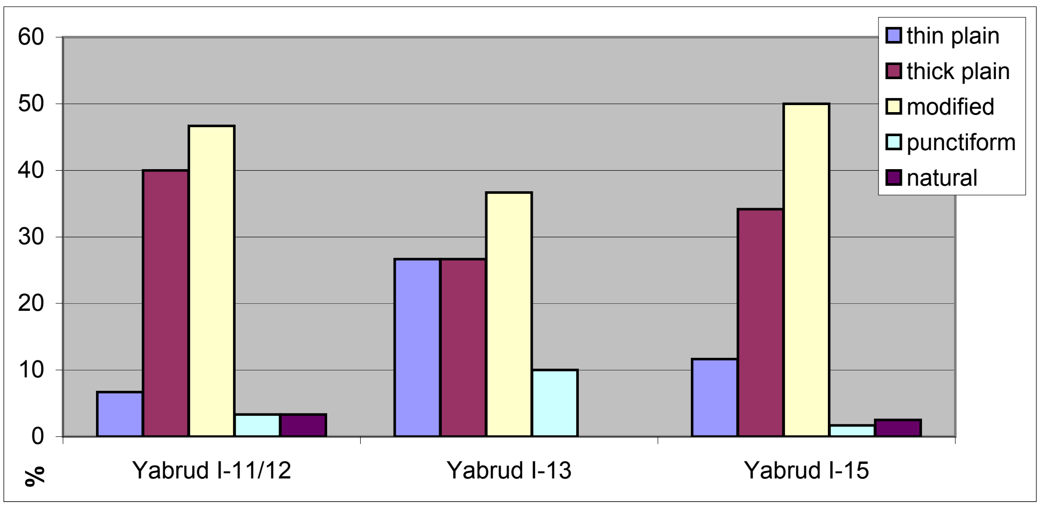


Fig. 362: Butt type of blades (blanks and shaped) from Yabrud I
n=Yabrud I-11/12: 30; Yabrud-13: 30; Yabrud-15: 120.

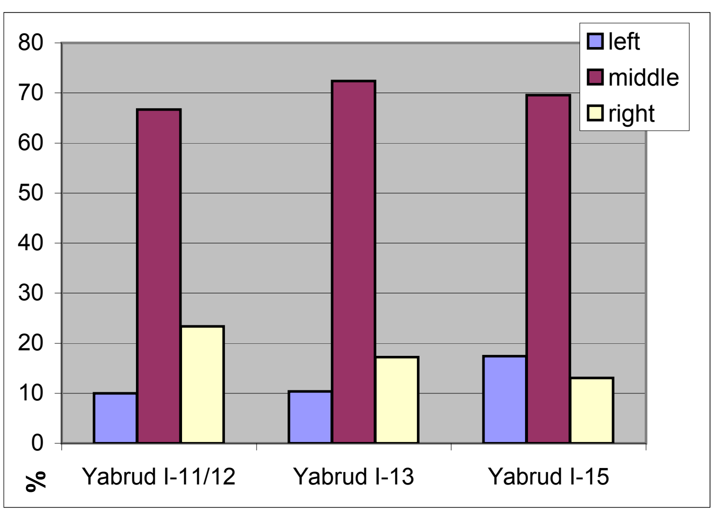


Fig. 363: Location of the bulb of percussion on blades (blanks and shaped) from Yabrud I.
n=Yabrud I-11/12: 30; Yabrud-13: 29; Yabrud I-15: 115.

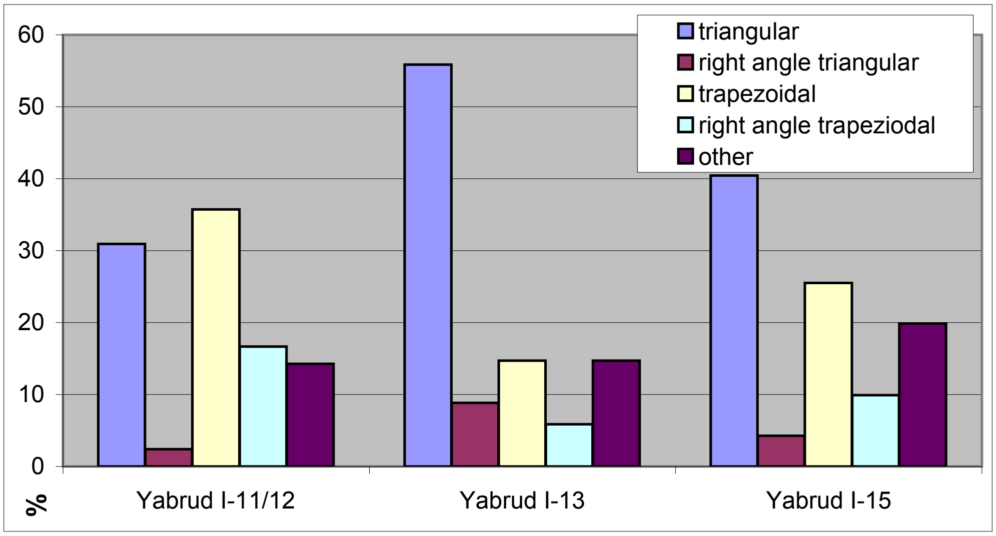


Fig. 364: Cross-section of blades (blanks and shaped) from Yabrud I.
n=Ybarud I-11/12: 42; Yabrud I-13: 34; Yabrud I-15: 141.

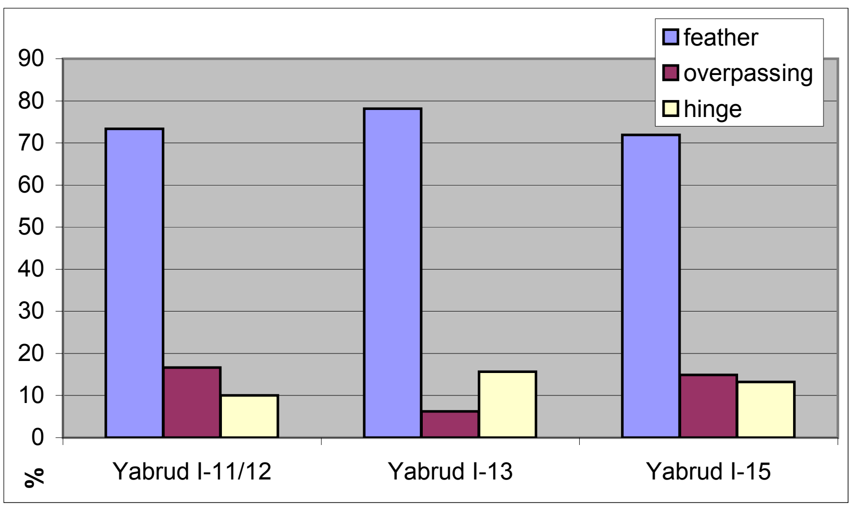


Fig. 365: End termination of blades (blanks and shaped) from Yabrud I.
n=Yabrud I-11/12: 30; Yabrud I-13: 32; Yabrud I-15: 121.

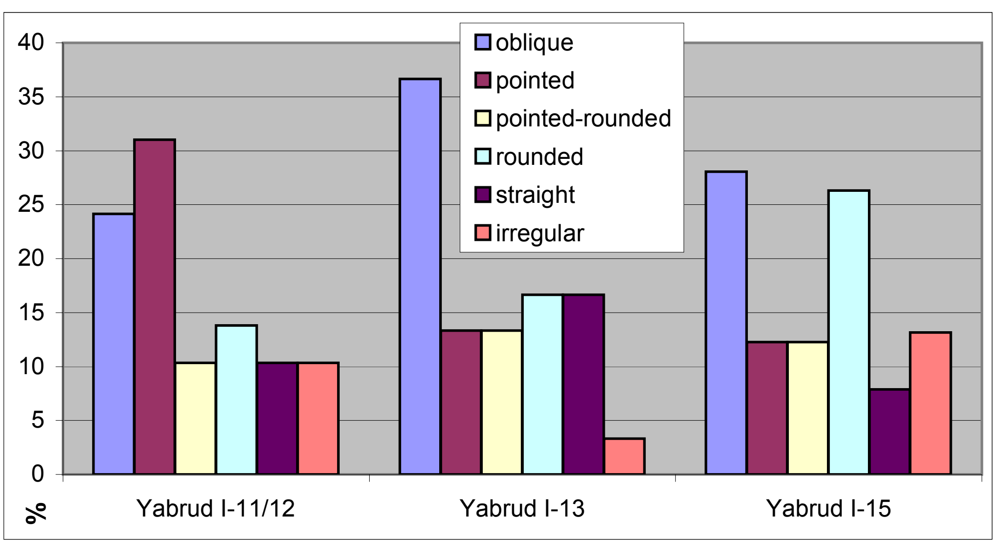


Fig. 366: Distal end shape of blades (blanks and shaped) from Yabrud I.
n=Yabrud I-11/12: 29; Yabrud I-13: 30; Yabrud I-15: 114.

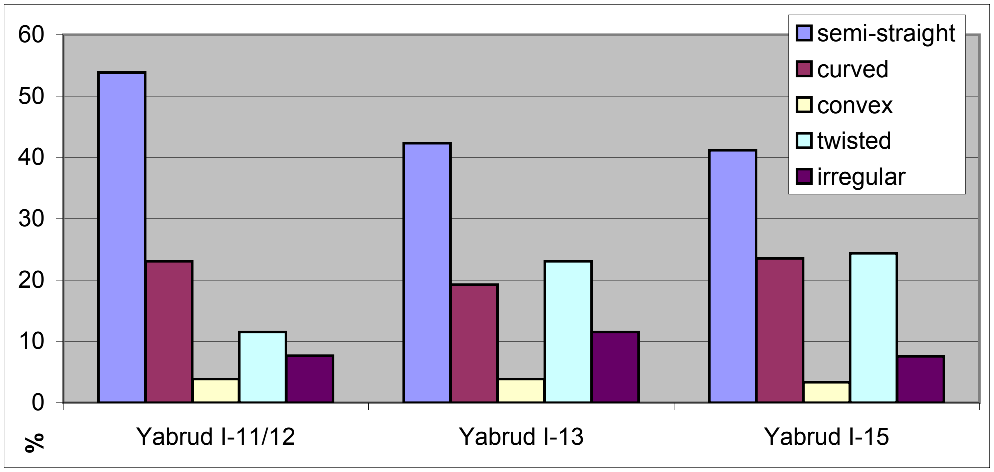


Fig. 367: Profile of blades (blanks and shaped) from Yabrud I.

n=Yabrud I-11/12: 26; Yabrud I-13: 26; Yabrud I-15: 119.

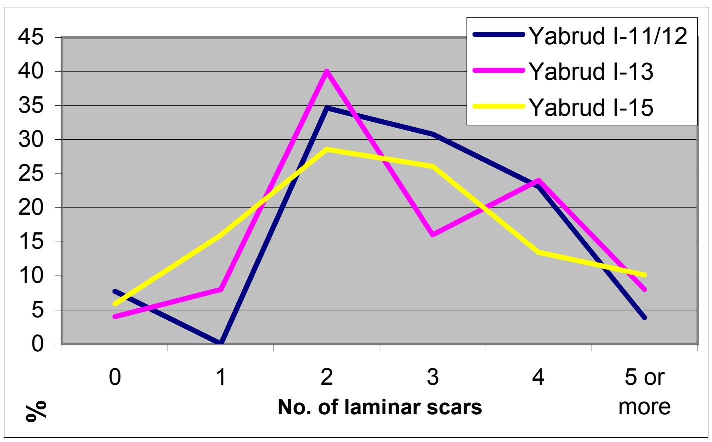


Fig. 368: Number of laminar scars on blades (blanks and shaped) from Yabrud I.

n=Yabrud I-11/12: 26; Yabrud I-13: 25; Yabrud I-15: 119.

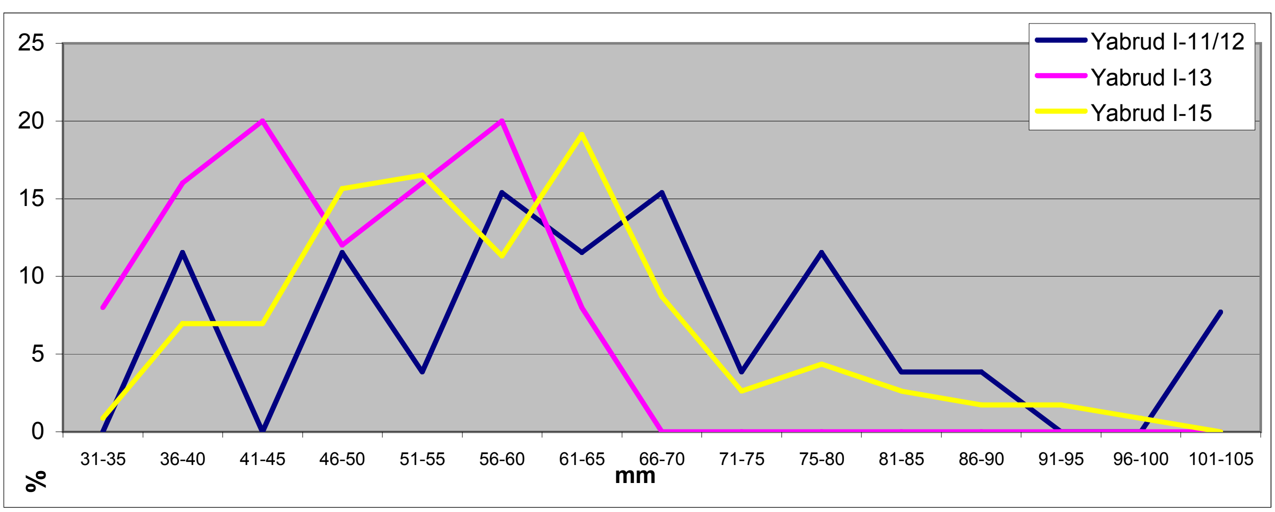
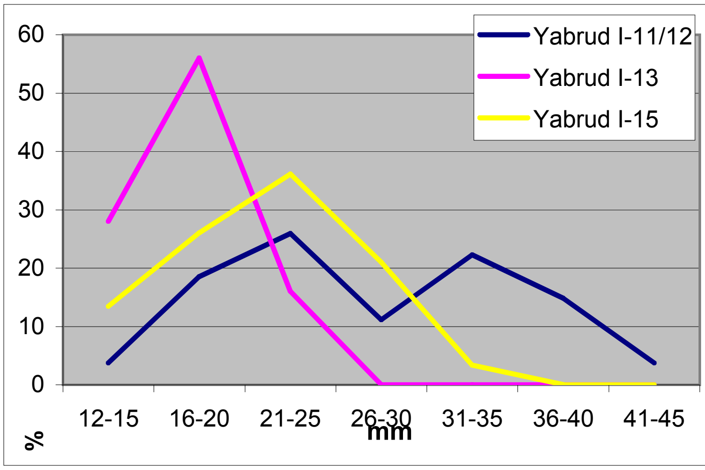


Fig. 369: Length of blades (blanks and shaped) from Yabrud I.

n=Yabrud I-11/12: 26; Yabrud I-13: 25; Yabrud I-15: 115.



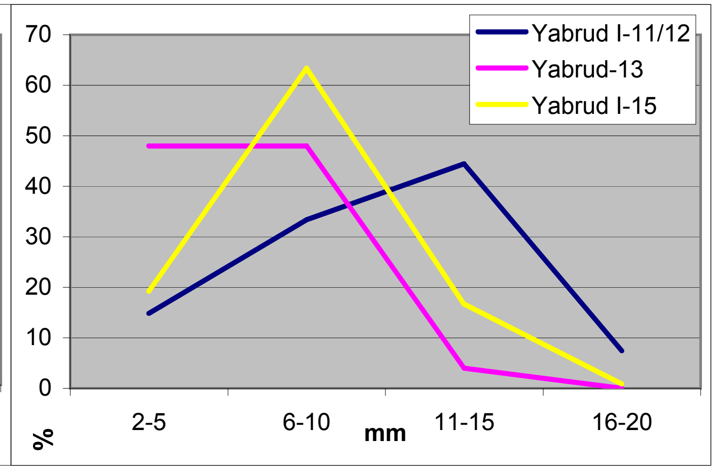


Fig. 370: Width of blades (blanks and shaped) from Yabrud I.
n=Yabrud I-11/12: 27; Yabrud I-13: 25; Yabrud I-15: 119.

Fig. 371: Thickness of blades (blanks and shaped) from Yabrud I.
n=Yabrud I-11/12: 27; Yabrud I-13: 25; Yabrud I-15: 120.

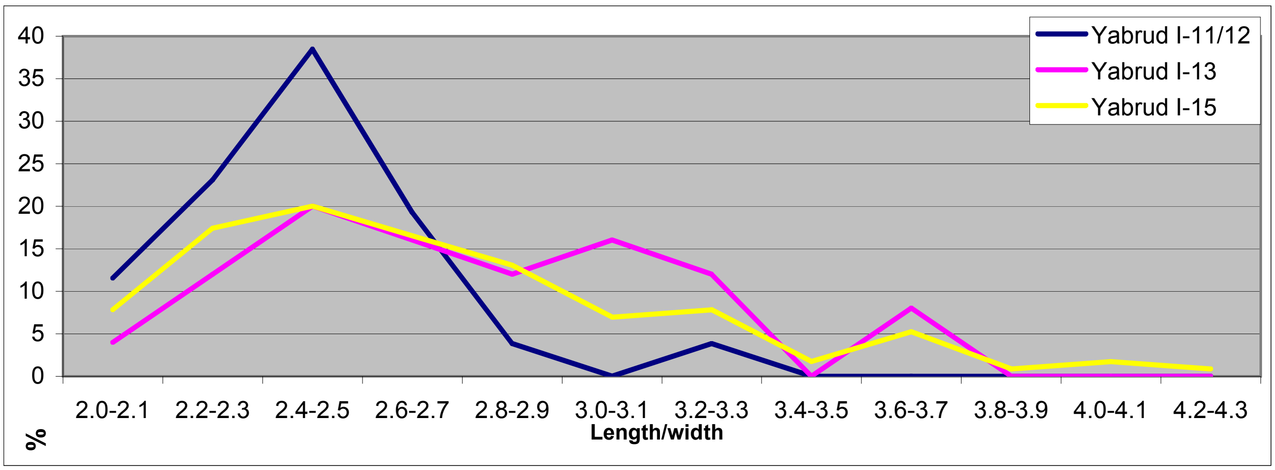


Fig. 372: Length/width ratio of blades (blanks and shaped) from Yabrud I.
n=Yabrud I-11/12: 26; Yabrud I-13: 25; Yabrud I-15: 115.

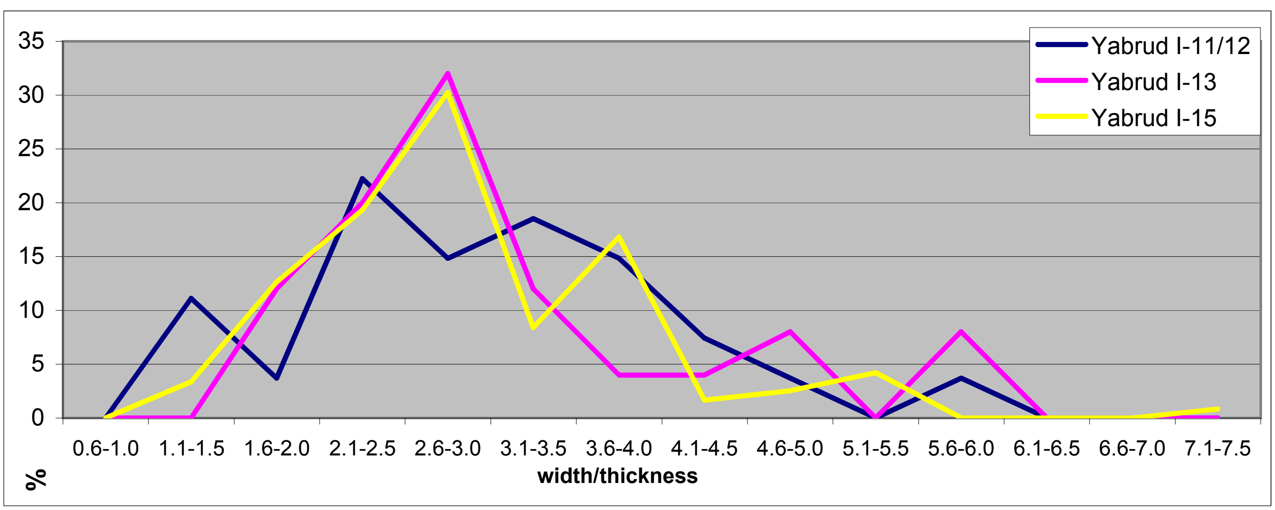


Fig. 373: Width/thickness ratio of blades (blanks and shaped) from Yabrud I.
n=Yabrud I-11/12: 27; Yabrud I-13: 25; Yabrud I-15: 119.

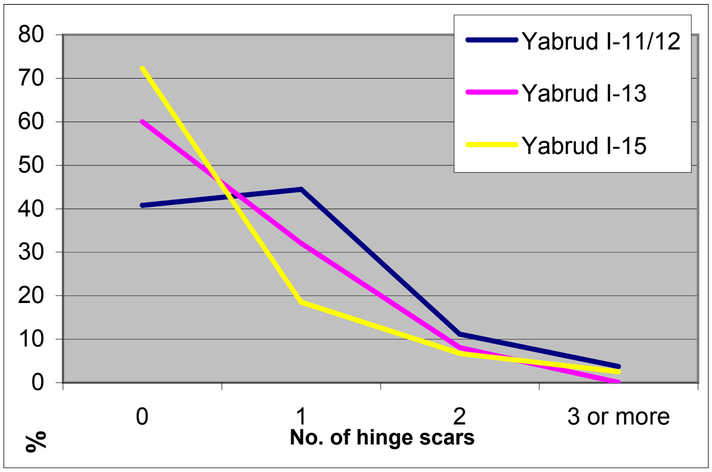


Fig. 374: Number of hinge scars on blades (blanks and shaped) from Yabrud I.
n=Yabrud I-11/12: 27; Yabrud I-13: 25; Yabrud I-15: 119.

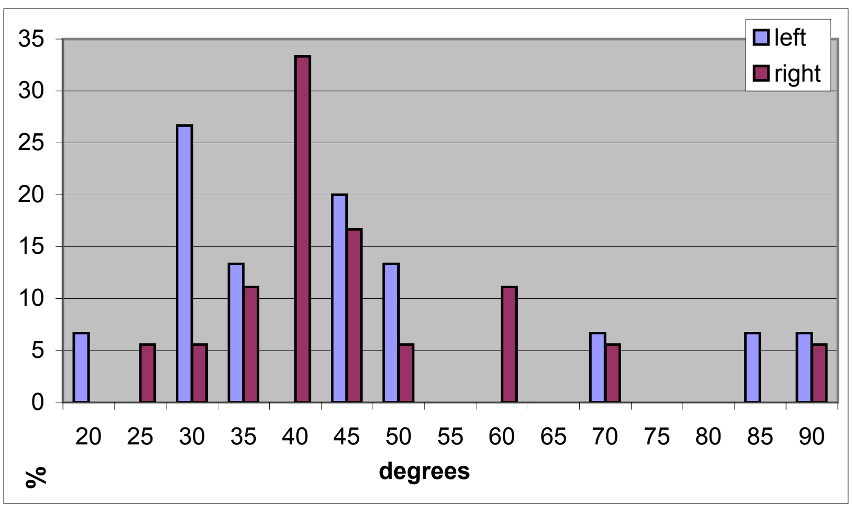


Fig. 375: Angles of the lateral edges of blades (blank and shaped) from Yabrud I-11/12.
n=left:15; right 28.

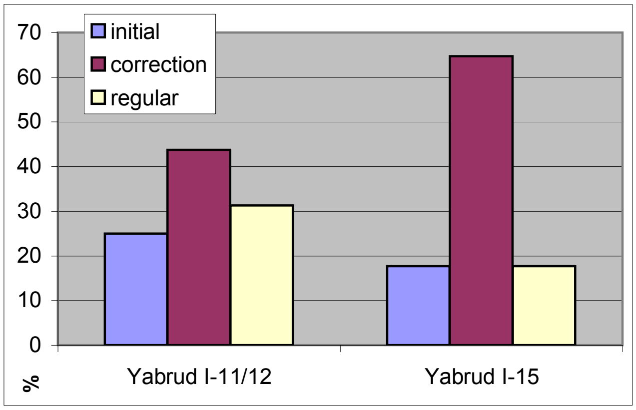


Fig. 376: Division of overpass items into categories from Yabrud I.
n=Yabrud I-11/12: 16; Yabrud I-15: 17.

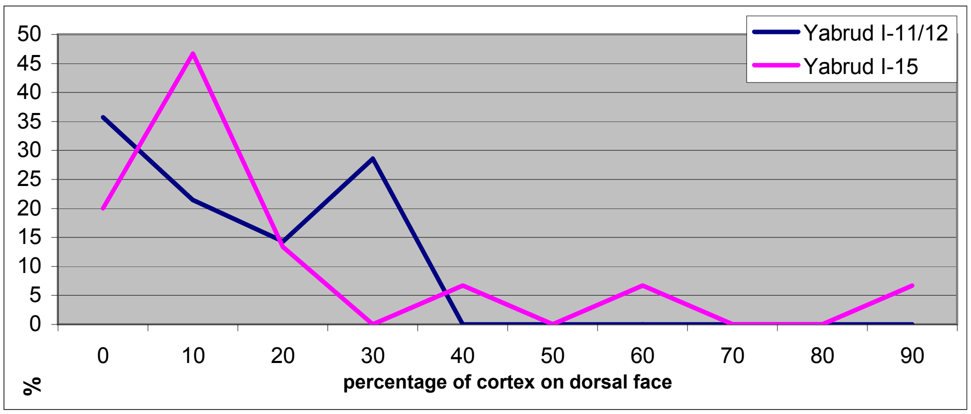


Fig. 377: Percentage of cortex on the dorsal face of overpass items from Yabrud I.
n=Yabrud I-11/12: 14; Yabrud I-15: 15.

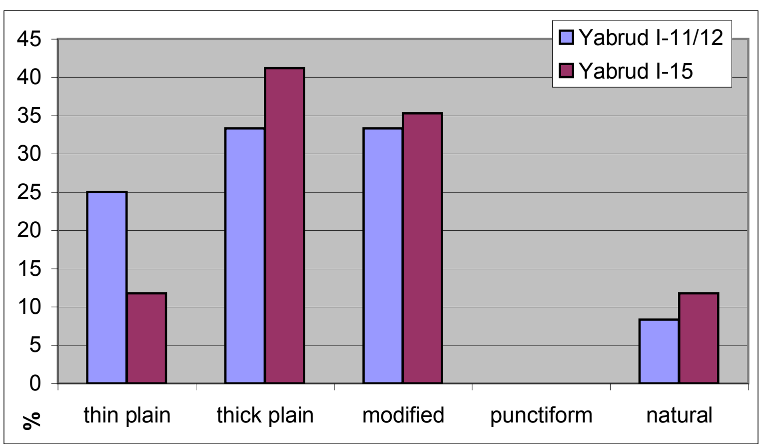


Fig. 378: Butt type of overpass items from Yabrud I.
n=Yabrud I-11/12: 12; Yabrud I-15: 17.

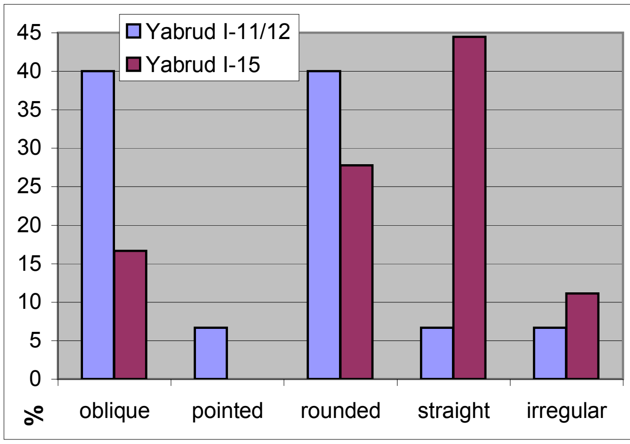


Fig. 379: Distal end shape of overpass items from Yabrud I.
n=Yabrud I-11/12: 15; Yabrud I-15: 18.

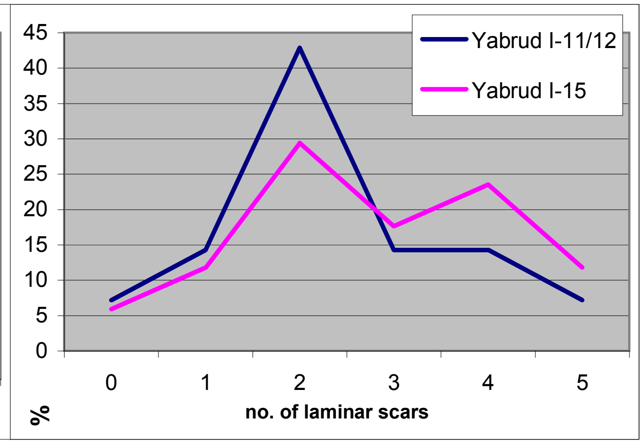


Fig. 380: Number of laminar scars on overpass items from Yabrud I.
n=Yabrud I-11/12: 15; Yabrud I-15: 18.

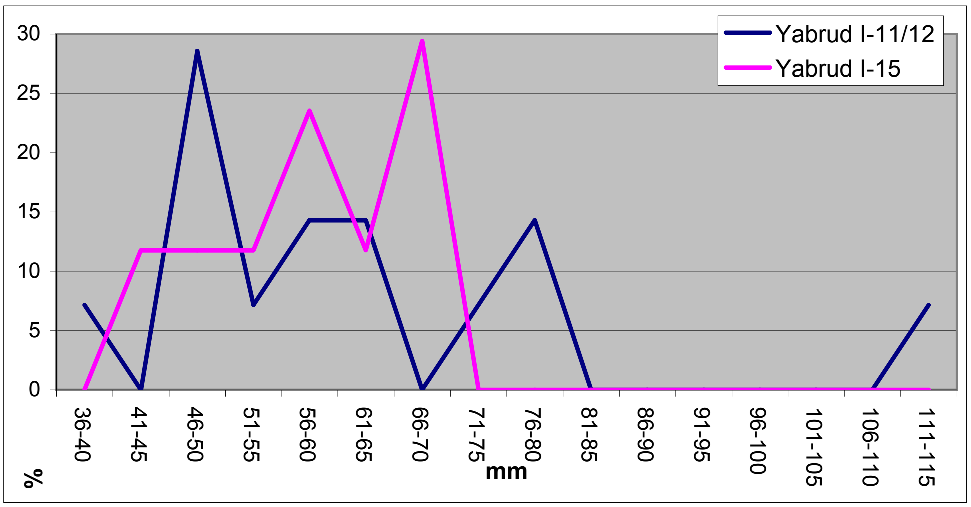


Fig. 381: Length of overpass items from Yabrud I.
n=Yabrud I-11/12: 14; Yabrud I-15: 17.

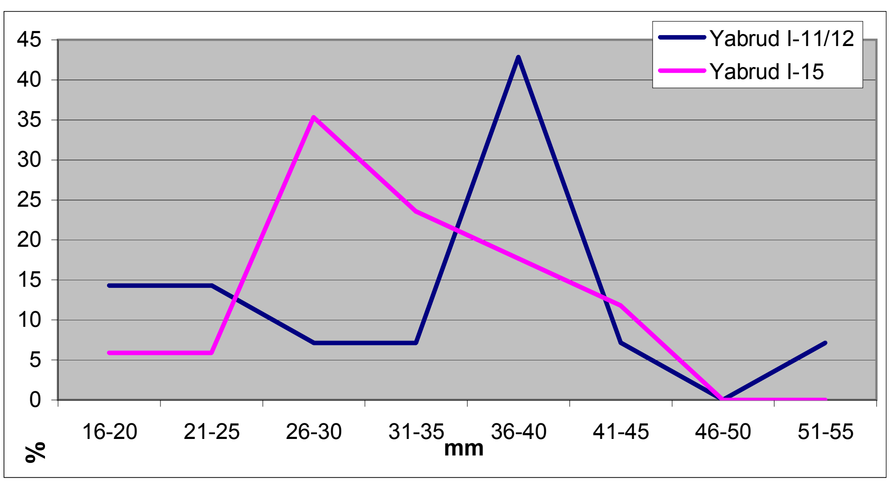


Fig. 382: Width of overpass items from Yabrud I.
n=Yabrud I-11/12: 14; Yabrud-15: 17.

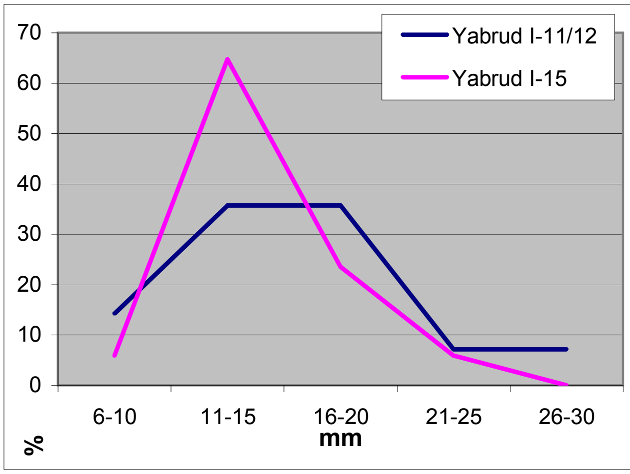


Fig. 383: Thickness of overpass items from Yabrud I.
n=Yabrud I-11/12: 14; Yabrud I-15: 17.

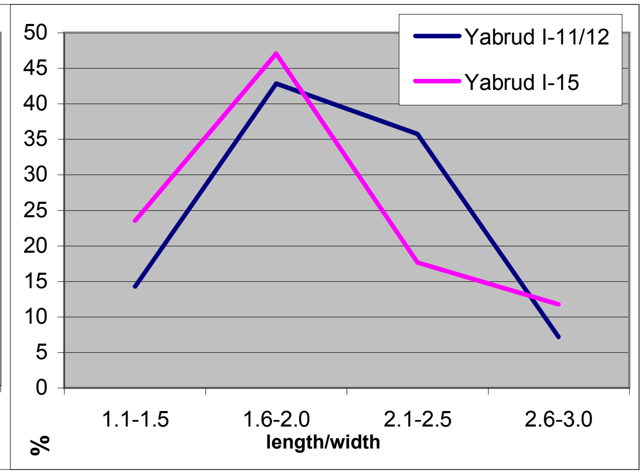


Fig. 384: Length/width ratio of overpass items from Yabrud I.
n=Yabrud I-11/12: 14; Yabrud I-15: 17.

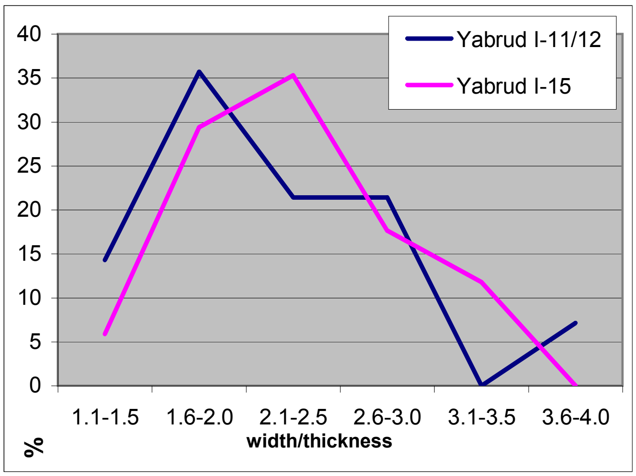


Fig. 385: Width/thickness ratio of overpass items from Yabrud I.
n=Yabrud I-11/12: 14; Yabrud I-15: 17.

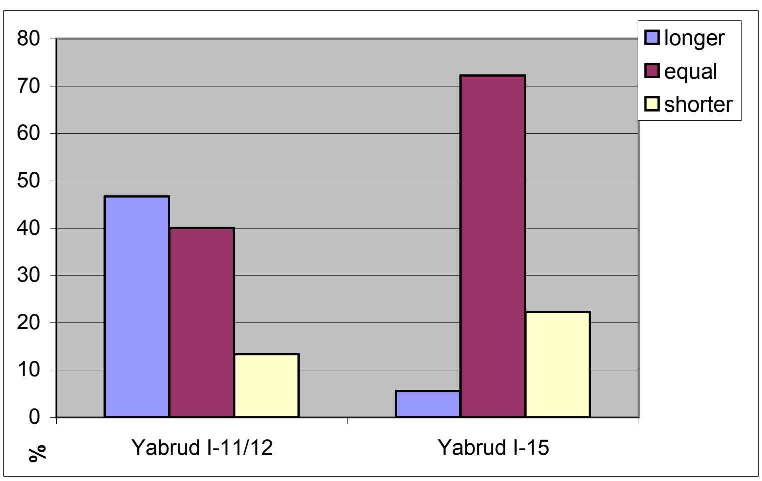


Fig. 386: Changes in debitage surface length according to overpass items from Yabrud I.
n=Yabrud I-11/12: 15; Yabrud I-15: 18.

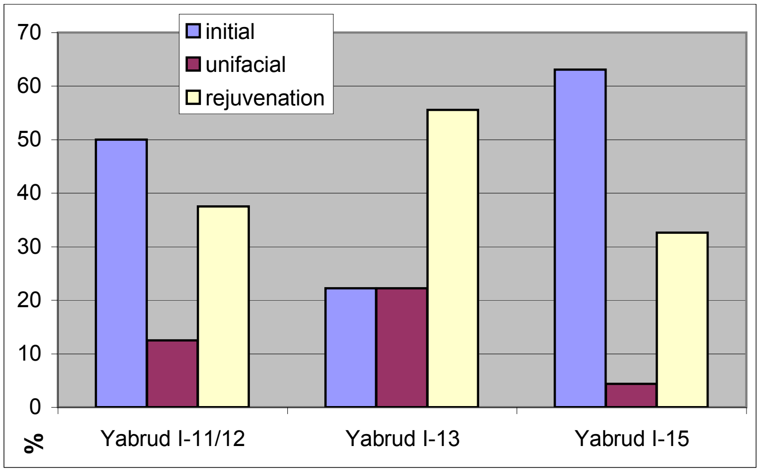


Fig. 387: Categories of crested blades from Yabrud I.
n=Yabrud I-11/12: 16; Yabrud I-13: 9; Yabrud I-15: 46.

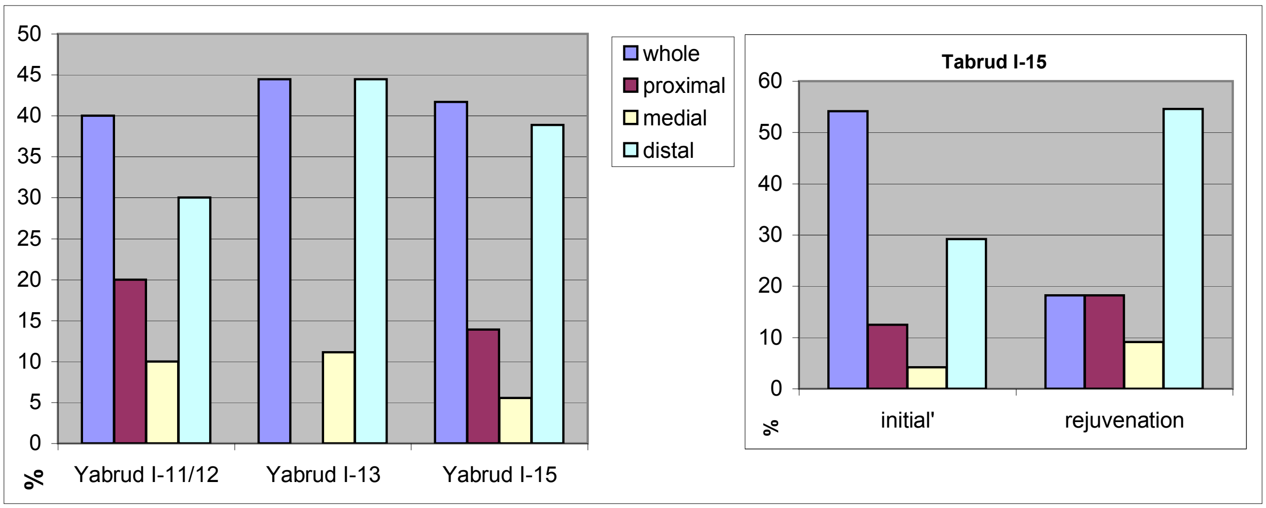


Fig. 388: Location of the shaped ridge along the crested blades from Yabrud I.
n=Yabrud I-11/12: 10; Yabrud I-13: 9; Yabrud I-15: 36.
To the right a division of crested blades from Yabrud I-15 into categories ('initial': 24; rejuvenation: 11).

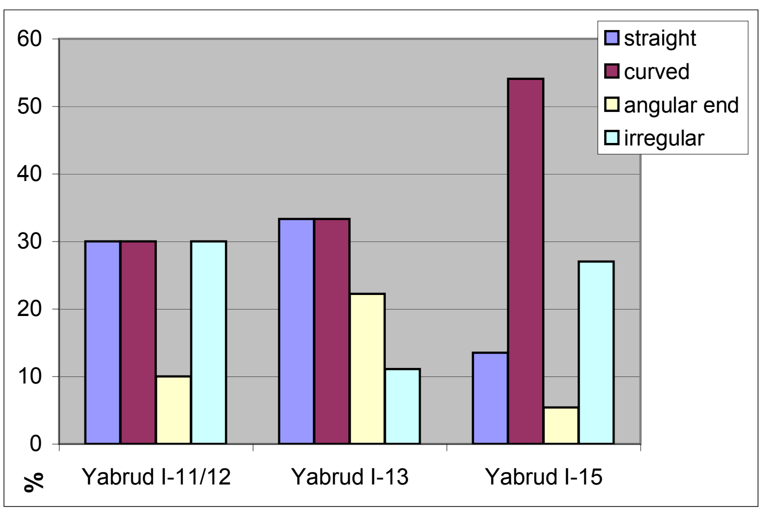


Fig. 389: Profile of the ridge shaped on the dorsal face
of the crested blades from Yabrud I.
n=Yabrud I-11/12: 10; Yabrud I-13: 9; Yabrud I-15: 37.

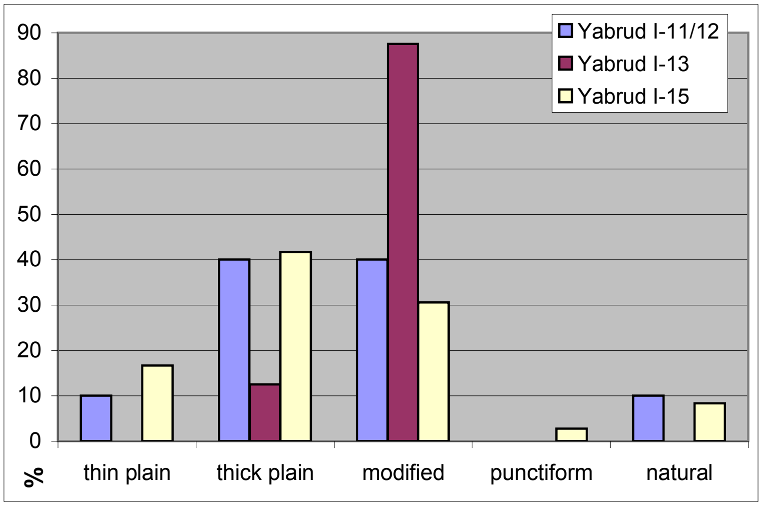


Fig. 390: Butt type on crested blade from Yabrud I.
n=Yabrud I-11/12: 10; Yabrud I-13: 8; Yabrud I-15: 36.

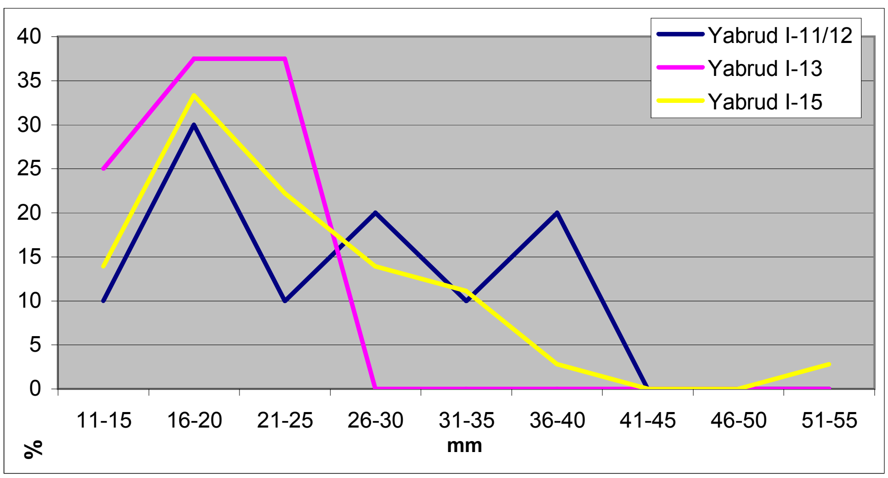


Fig. 391: Width of crested blades from Yabrud I.
n=Yabrud I-11/12: 10; Yabrud I-13: 8; Yabrud I-15: 36.

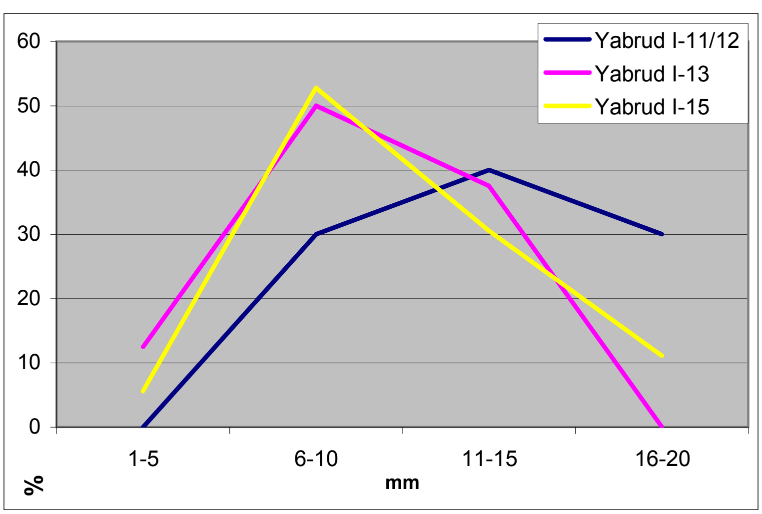


Fig. 392: Thickness of crested blades from Yabrud I.
n=Yabrud I-11/12: 10; Yabrud I-13: 8; Yabrud I-15: 36.

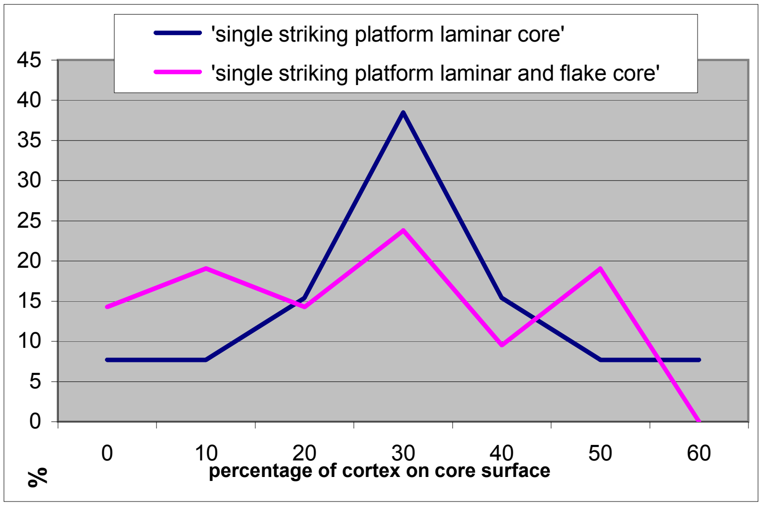


Fig. 393: Percentage of cortex on 'single striking platform laminar cores' and 'single striking platform laminar and flake cores' from Yabrud I.
n='single striking platform laminar core': 14; 'single striking platform laminar and flake core': 21.

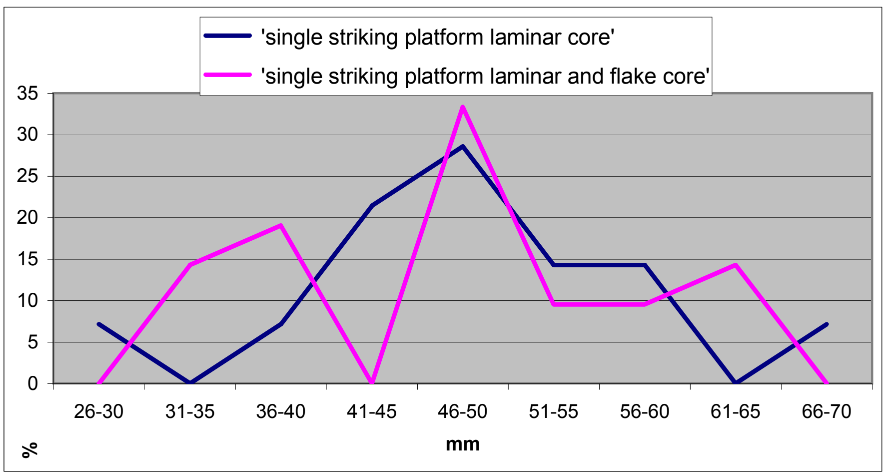


Fig. 394: Maximum length of 'single striking platform laminar cores' from Yabrud I-15.
n='single striking platform laminar core': 14; 'single striking platform laminar and flake core': 21.

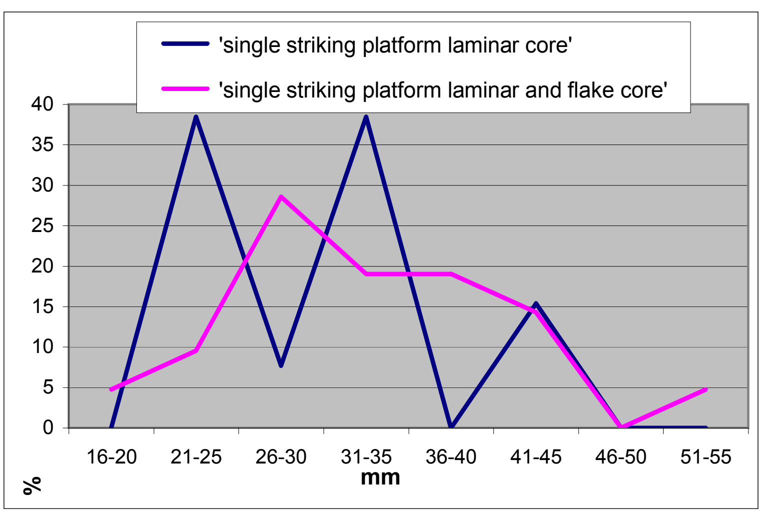


Fig. 395: Maximum width of 'single striking platform laminar cores' and 'single striking platform laminar and flake cores' from Yabrud I-15.
n='single striking platofrm laminar core': 13; 'single striking platform laminar and flake core': 21.

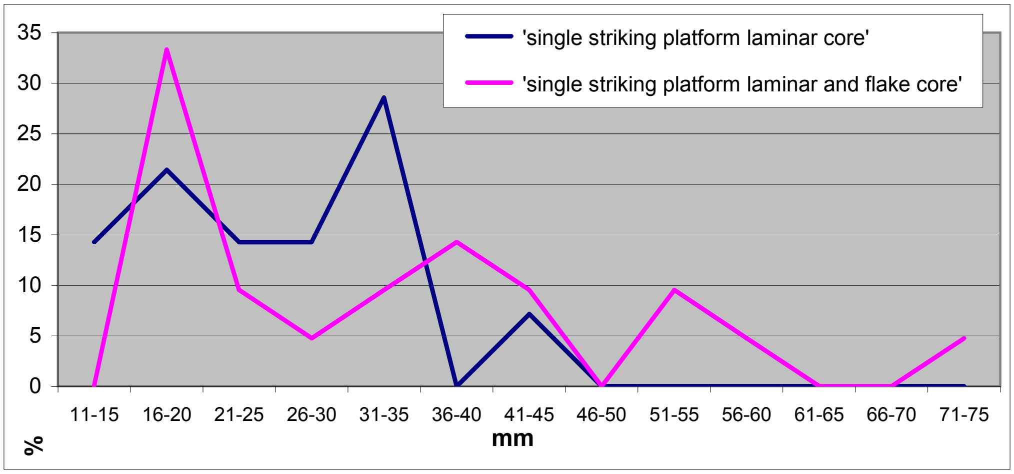


Fig. 396: Maximum thickness of 'single striking platform laminar cores' and 'single striking platform laminar and flake cores' from Yabrud I-15.

n='single striking platofrm laminar core': 13; 'single striking platform laminar and flake core': 21.

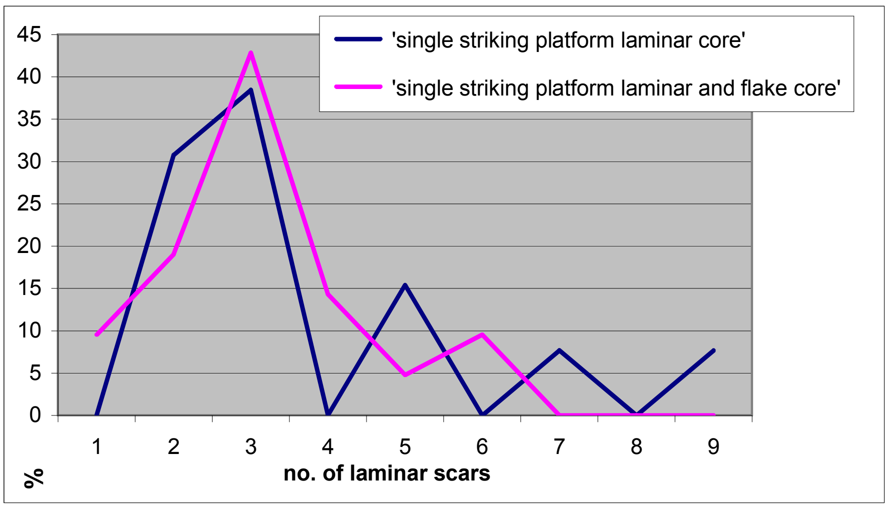


Fig. 397: Total number of laminar scars on 'single striking platform laminar cores' and on 'single striking platform laminar and flake cores' from Yabrud I-15.

n='single striking platofrm laminar core': 13; 'single striking platform laminar and flake core': 21.

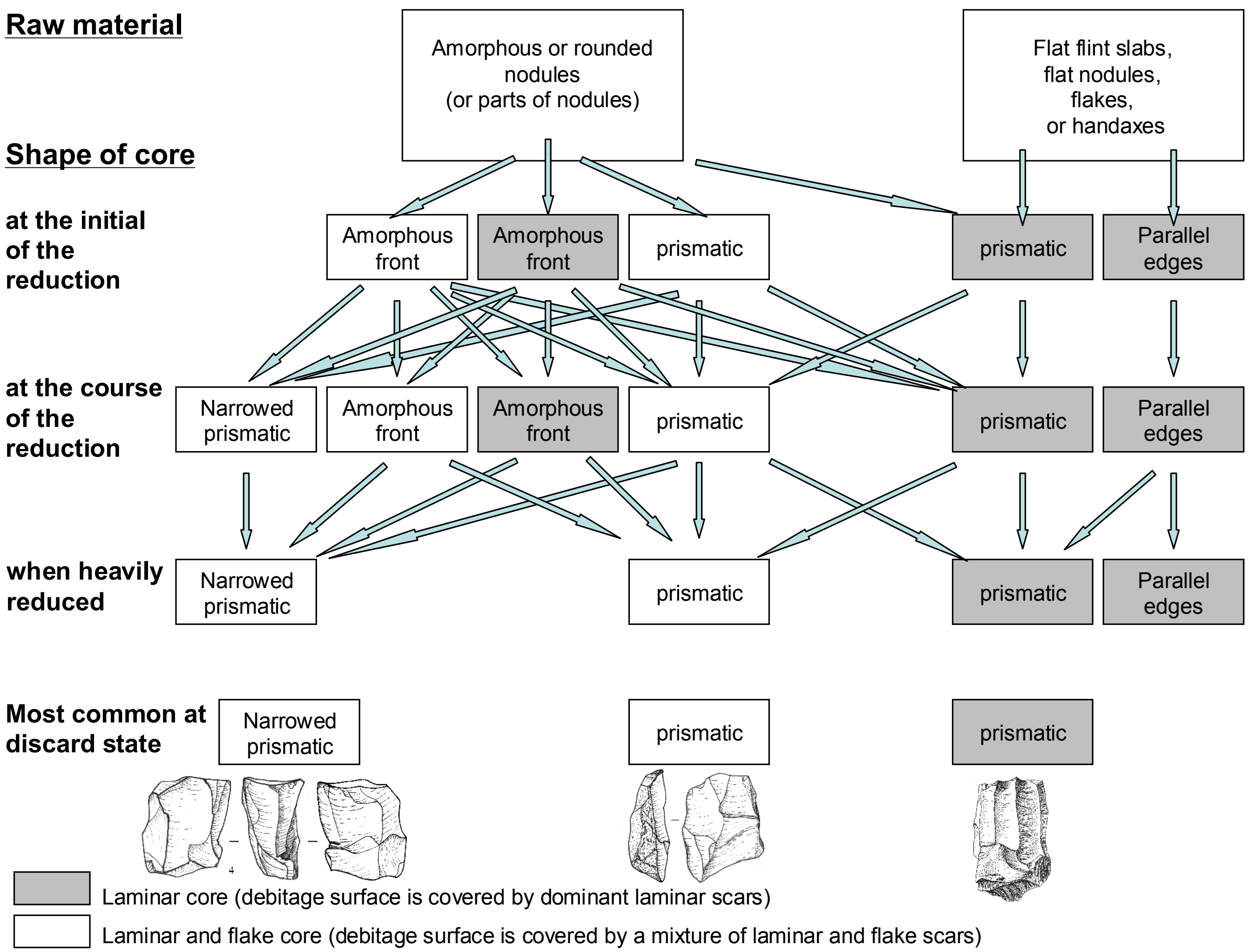


Fig. 398: A schematic flowchart of the dynamics in core shapes of the laminar core class.
(The possibilities of creating a new debitage surface and/or alternating the core into a flake core are not included here).

This reconstruction demonstrates not only the shift from one shape to another, but also the possible shift from the laminar core type into the laminar and flake core type and vice versa.

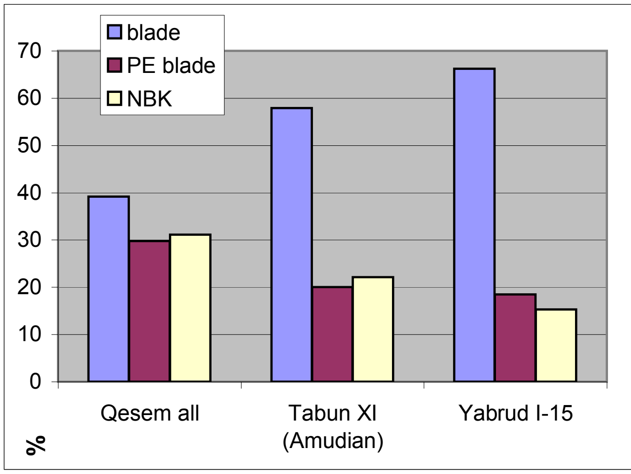


Fig. 399: Division of the three laminar types (blanks and shaped items) from the Amudian facies of the three sites.
n=Qesem Cave: 2552; Tabun XI (Amudian): 430; Yabrud I-15: 222.

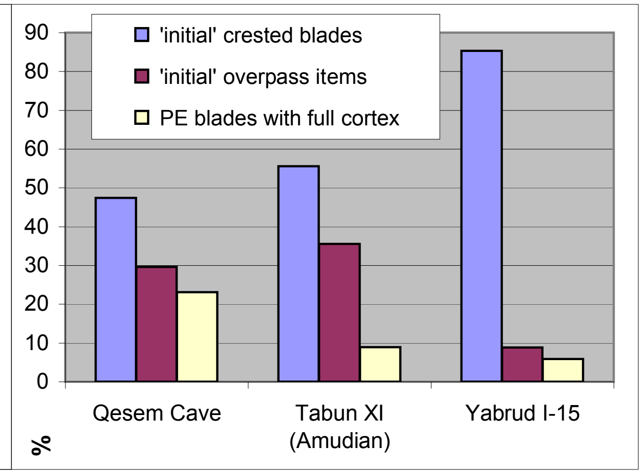


Fig. 400: Initiating options for "opening" the debitage surface from the Amudian facies of the three sites.
n=Qesem Cave: 230; Tabun XI (Amudian): 45; Yabrud I-15: 34.

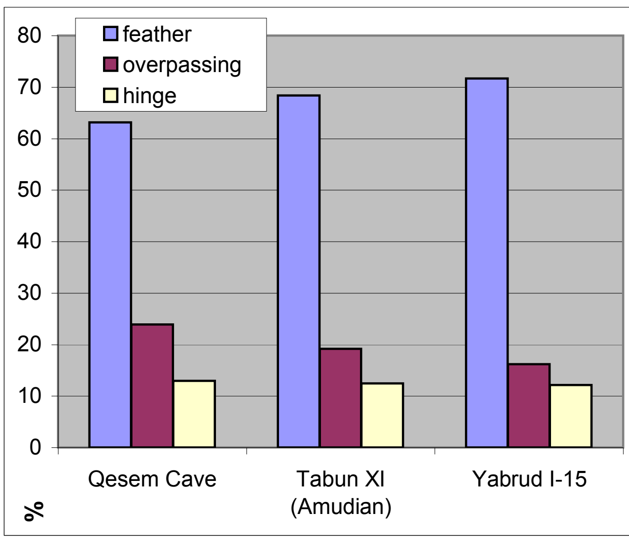


Fig. 401: End termination of all three laminar types from the Amudian facies of the three sites.
n=Qesem Cave: 1591; Tabun XI (Amudian): 370;
Yabrud I-15: 173.

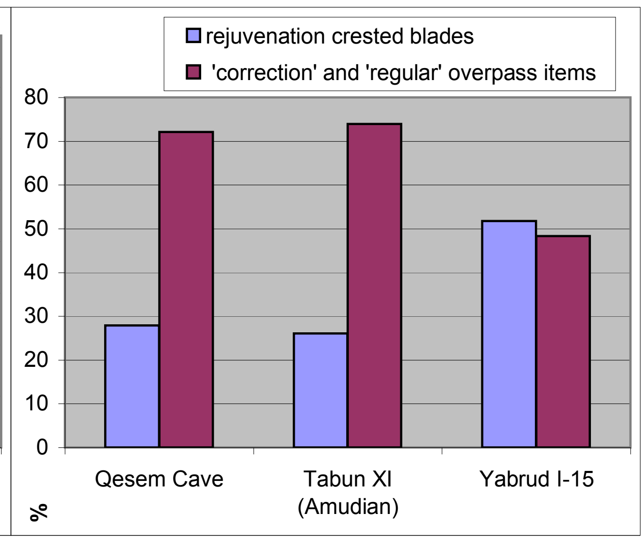


Fig. 402: Methods of maintaining the debitage surface in the course of laminar production by CTE removal from the Amudian facies of the three sites.
n=Qesem Cave: 208; Tabun XI (Amudian): 69; Yabrud I-15: 29.

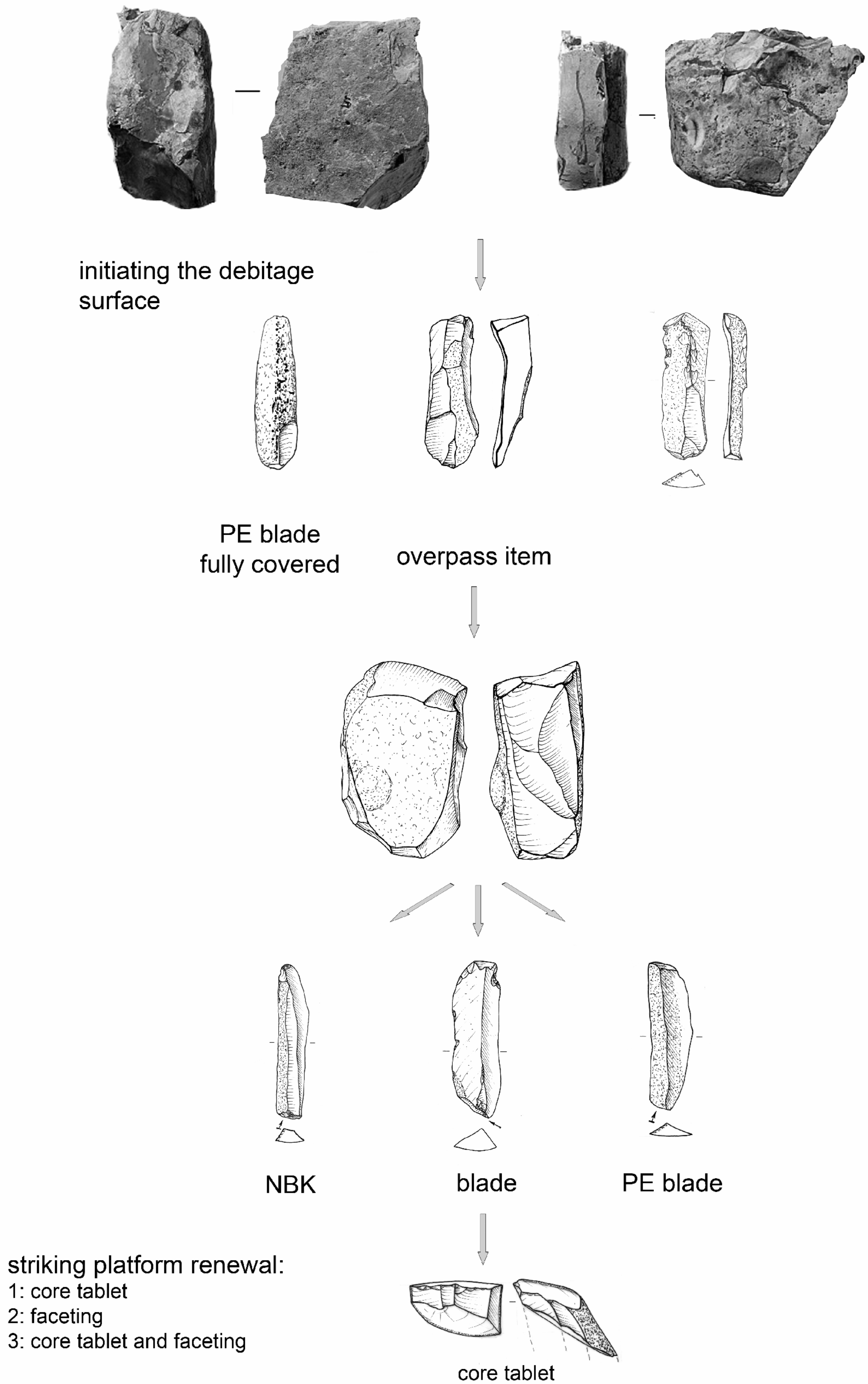


Fig. 403a: The reduction sequence characterizing the exploitation of flat flint slabs.

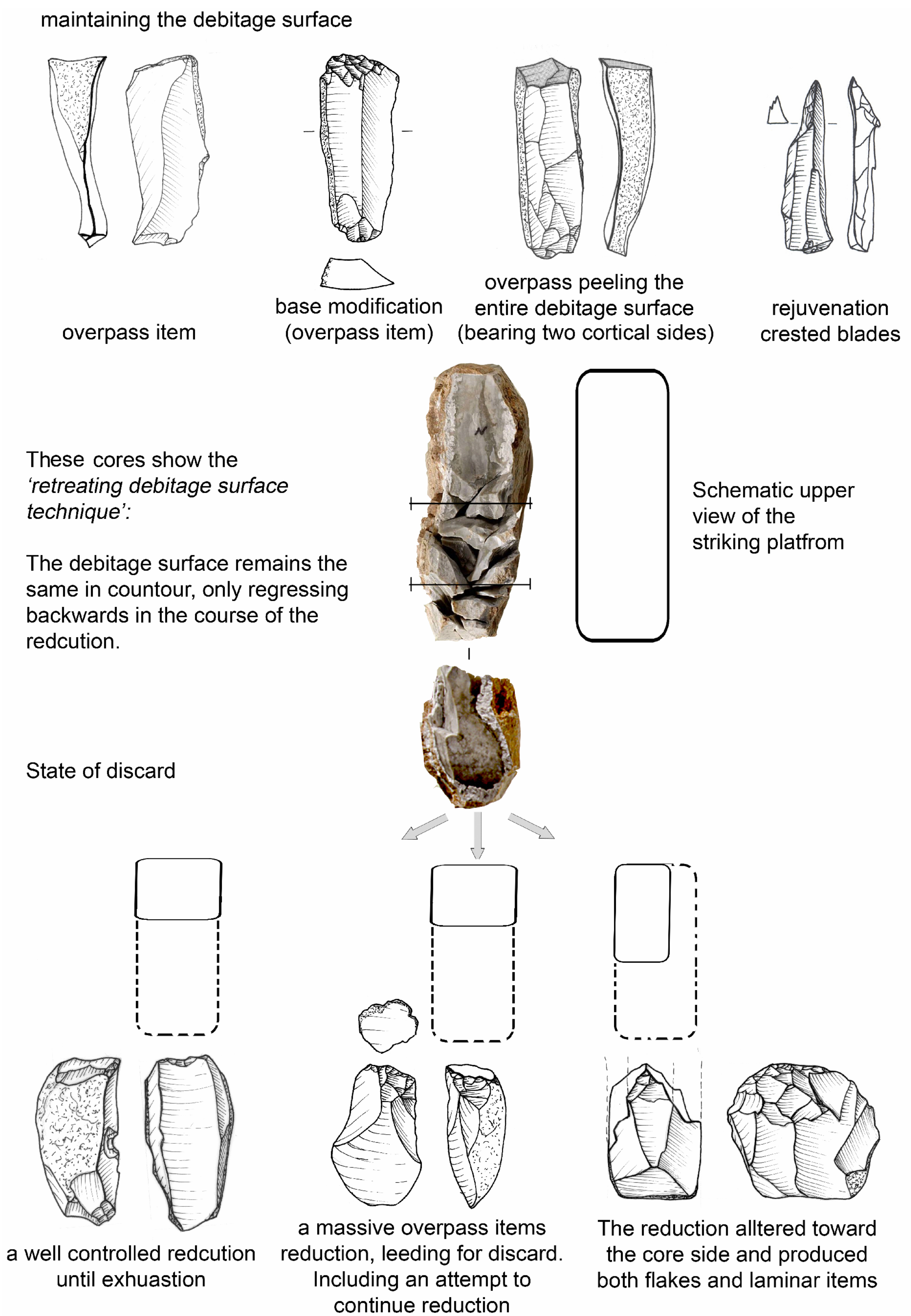


Fig. 403b: The reduction sequence characterizing the exploitation of flat flint slabs (continued).

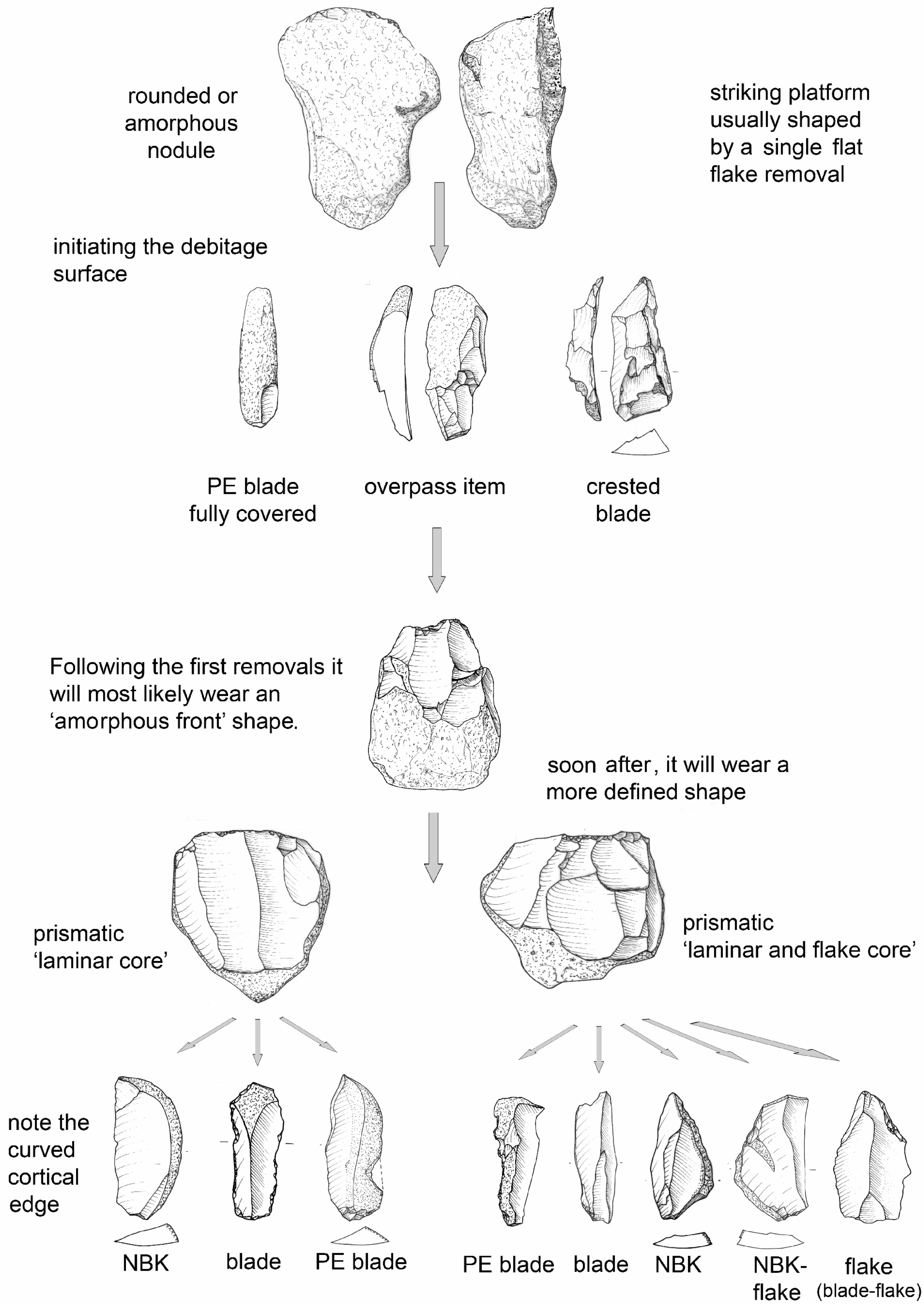


Fig. 404a: The reduction sequence characterizing the exploitation of rounded and amorphous nodules.

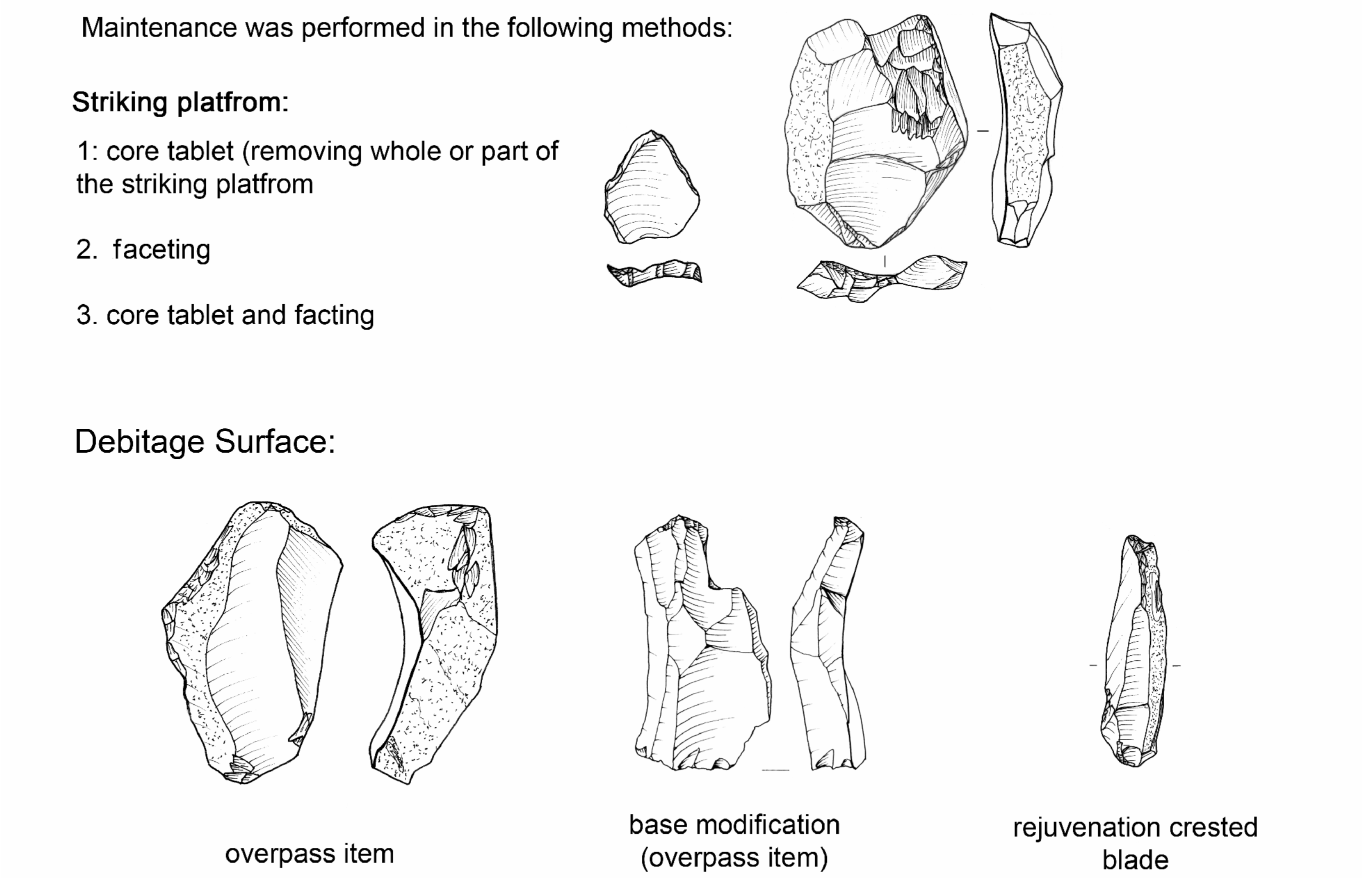


Fig. 404b: The reduction sequence characterizing the exploitation of rounded and amorphous nodules (continued).

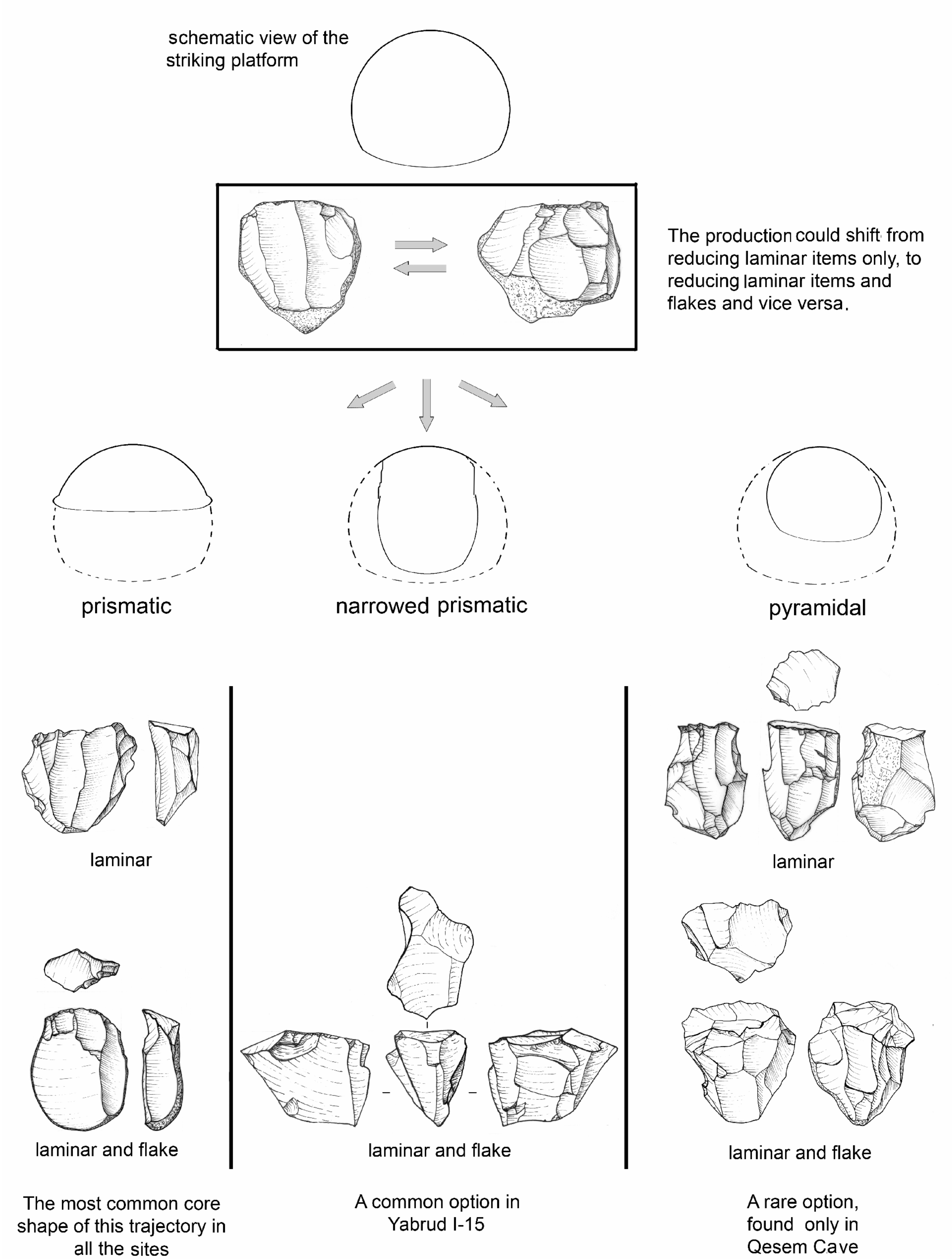


Fig. 404c: The reduction sequence characterizing the exploitation of rounded and amorphous nodules (continued).

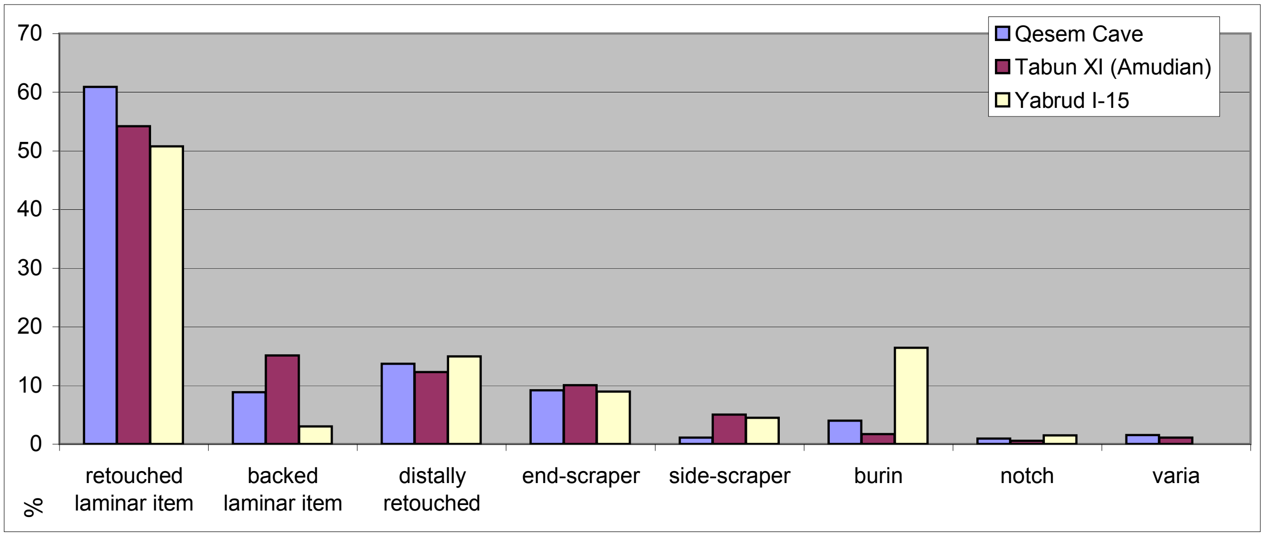


Fig. 405: Composition of the shaped items made on laminar items from the Amudian facies of the three sites.
n=Qesem Cave: 657; Tabun XI (Amudian): 179; Yabrud I-15: 67.

אוניברסיטת תל אביב
הפקולטה למדעי הרוח ע״ש לסטר וסאלי אנטין
בית הספר למדעי היהדות ע״ש חיים רוזנברג

ייצור להבי צור בפלייסטוקן התיכון בלבאנט

חלק ב׳: טבלאות ואיורים

חיבור לשם קבלת תואר דוקטור לפילוסופיה

מאת: רון שימלמיץ

מנחה: פרופ׳ אבי גופר

הוגש לסנאט של אוניברסיטת תל אביב

תשס״ט