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THE INTERMEDIATE PALEOLITHIC: THE FIRST BLADELET PRODUCTION 40,000 YEARS AGO

ABSTRACT: At Umm el Tlel (Syria), the Intermediate Paleolithic industries, rightly qualified as Transition Industry, are specific by new technical orientations. The bladelets flaking is one of those innovations. Among the four facies that characterize this Intermediate Paleolithic, only two yielded a great bladelets flaking, representing more than a third of the predetermined removals. The presence, on all types of bladelets, of micro use-wear corroborates the internationality of this production.

KEY WORDS: Intermediate Paleolithic – Micro use-wear – Bladelet – Umm el Tlel

INTRODUCTION

Across the Near East, between the last Middle Paleolithic industries and the first industries of the Upper Paleolithic, a number of lithic industries have been recognized that exhibit both vestiges of characteristics inherited from the Middle Paleolithic and from those found throughout the Upper Paleolithic. This combination of traits has awakened both interest and suspicion among investigators, and has resulted in a certain amount of confusion. Indeed, depending on the combination of characteristics, we find described transitional industries or industries that seem to be already part of the Upper Paleolithic, and are described as "Early Upper Paleolithic" or "Initial Upper Paleolithic"(Garrod 1951, 1955, Azoury 1986, Copeland 1970, 1975, Ohnuma 1988, Bar-Yosef, Belfer-Cohen 1988, Belfer-Cohen, Bar-Yosef 1999, Gilead 1991, Marks 1983, Kuhn *et al.* 1999).

However, in most cases, the choice of a cultural attribution seems to rely on *a priori* convictions that arbitrarily group an assortment of the dominant technical traits of the major cultural periods.

In addition, a number of archaeological levels are rejected, and never analyzed because it is assumed that the associations of certain artifact types are the result of disturbances mixing different cultural strata and do not represent a single archaeological culture. While in some cases these associations may be due to the contamination of strata, in other cases it is quite possible that conventional views of the Middle and Upper Paleolithic assemblages may prevent recognition of atypical assemblages reflecting particular facies or localized industries. This is particularly true in the cases where bladelets or bladelet cores are found in association with material supposed *a priori* to be a Transitional Industry. In fact, the appearance of bladelets is considered to define the beginning of the Upper Paleolithic, either the Ahmarian or the Aurignacian, depending on the region of the Near East considered.

Our team restarted excavation of the Umm el Tlel site (El Kowm Basin) in 1991 (Boëda, Muhesen 1993, Ploux, Soriano 2003), and uncovered five different archaeological assemblages. From these assemblages, and through surveying and examining collections from sites in the El Kowm basin and from Palmyra (*Figure 1*), we have been able to clearly identify ten archaeological assemblages positioned between the last Mousterian industries and the first industries that can be attributed to the Ahmarian. These assemblages can be regrouped into 4 facies or local types based on their similarities and differences**:** *Facies 1*: level III2b', Umm el Tlel; *Facies 2*: level IIIx, Umm el Tlel; *Facies 3*: levels III2a' and II base', Umm el Tlel and almost certainly the lowest level of the site of Cham (Ifpo

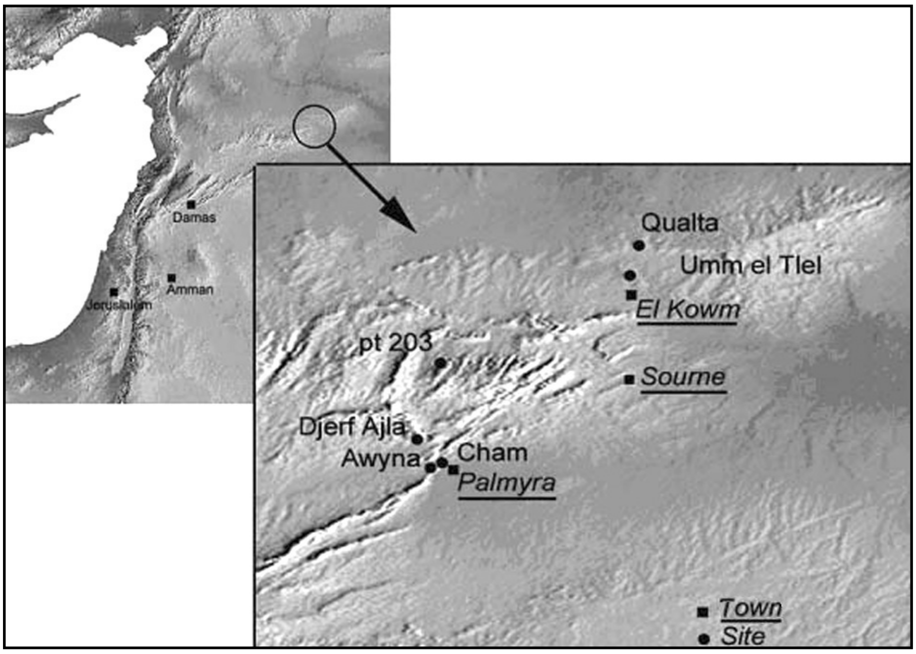


FIGURE 1. Geographic situation of sites.

Expedition 2004, dir. Boëda Eric); *Facies 4*, referred to as the Qualta type, present at the sites of Qualta (surface site) (Besançon *et al.* 1981), of Jerf Ajla (*in situ*) (Coon 1957, Schröeder 1969), of Awyna (*in situ*) (Ifpo Expedition 2004, dir. Boëda E.), point 203 (Ifpo Expedition 2004, dir. Boëda E.) and of Umm el Tlel (outside of the stratigraphy).

These four facies exhibit the following similarities: 1. the endscrapers and burins are the dominant types of retouched tools; 2. tools of these two categories are manufactured using laminar blanks; 3. blades are the primary predetermined product. At the same time, these facies differ in: 1. the nature of the blade production strategy, which differ from one facies to another; 2. the presence or absence of an associated Levallois reduction strategy; 3. the presence or absence of several Middle Paleolithic type tools; 4. the presence or absence of bladelet production; 5. the presence or absence of elongated Levallois points.

When the similarities and differences are considered, it is difficult to see in the assemblages a single culture that one might call the Transitional Industry. Indeed, are the similarities more pertinent characteristics than the differences? Or, can the different assemblage types or facies be considered to result from functional differences? This last explanation seems improbable when the technical differences are considered as a whole.

If one prefers to accept this vision of more complex reality in order to better understand it, it may help to avoid referring to the industries as Transitional or as Early Upper Paleolithic because these denominations refer to implicit paradigms. Would it not be preferable to create a new temporal space in which it would be possible to distinguish different facies or local industries, as it happens in the Middle or Upper Paleolithic? A new and neutral term, the Intermediate Paleolithic, makes it possible to distinguish and recognize a complex period which most certainly reflects the adoption by Paleolithic flintknappers of new paradigms, and also makes it possible to better isolate and analyse the mechanisms of these many and varied changes across time and space. In this article, the different facies of the Intermediate Paleolithic of the Near East are not all described in detail; rather attention is given to those industries which present, among their other characteristics, a bladelet reduction strategy.

Facies 2, 3 and 4, that is six out of seven assemblages from the El Kowm basin and Palmyra, produced bladelet materials in larger or smaller quantities. These products were not recovered in the assemblages of Facies 1, the earliest of the four. However, small numbers of bladelet cores were recovered from the most recent Mousterian layers underlying Facies 1.

All the facies were found in a clear and indisputable stratigraphic position in at least one instance. In addition, taphonomic studies carried out at the surface site of Qualta confirm incontrovertibly the integrity of the site. Even if each assemblage, from the surface or *in situ*, might represent a palimpsest of occupations, in the case of the *in situ* assemblages, there is no possible mixture of Mousterian, Aurignacian or Ahmarian industries as these intermediate facies were separated from the Middle Paleolithic and the Upper Paleolithic by 20 cm thick sterile horizons. These different facies were all dated to a period between 42,500 and 34,000 years ago by C^{14} dates mainly from the sites of Umm el Tlel and Qualta (Boëda *et al.* 1996).

In general these facies were characterized by the following: 1. primarily a dominance of blade production used for tool manufacture, specializing in endscrapers, burins and retouched blades; 2. blade debitage or reduction strategy that may be exclusively Levallois (Qualta or Facies 4) or mixed, with a Levallois blade reduction strategy used in association with non-Levallois blade production (Facies 3);

3. a nearly complete absence typical Middle Paleolithic characteristics such as side-scrapers or Nahr Ibrahim tools. When present, however, these tools were made from predetermining flakes (*prédéterminant*), necessary for the maintenance of a productive core as opposed to predetermined endproduct flakes (*prédéterminé*); 4. the presence of narrow-based, elongated Levallois points, which are not systematically produced through Levallois reduction strategies; 5. bladelet production through different modes of production, depending on the facies.

MODES OF BLADELET PRODUCTION

Facies 2

This facies is represented by a small assemblage composed of 155 artifacts including approximately fifteen bladelet products (*Figure 2*) and no cores. These artifacts are clearly bladelets, percussion struck well from the edge of smooth platforms, and they exhibit particular technical characteristics. The proximal end of these bladelets is characterized by a prominent central arris. This arris is formed by the intersection of two well-defined bulb scars that almost certainly correspond to removals larger than the bladelet itself.

This type of bladelet removal usually serves to level protruding areas in order to regularize the debitage surface before further products are detached. This does not seem to be the purpose of bladelet removals in this case; the proximal ends of the predetermined removals (Levallois or not) do not exhibit such bladelet negatives on the dorsal surface. Lastly, the curvature or twist present in some of the bladelets indicate preparation of a laterilized debitage surface that would have been more highly convex than a Levallois debitage surface. It appears that both the twisted and the straight bladelets may form a part of alternating production of the small blades also found in the collection.

It appears that the productions of blades and bladelets were not separate, but rather part of a single production mode, generating small blades and bladelets in alternation. This production mode is associated with a second, complementary reduction strategy producing elongated flakes.

Facies 3

This facies is well represented at Umm el Tlel by two successive layers, III 2a' et II base', which each yielded several hundred artifacts. These bladelets represent nearly 20% of the predetermined removals (*Table 1*). The bladelets result from two modes of production: a) the first, more productive mode, consists in alternating Levallois products and bladelets: in this case, the bladelets are narrow and elongated; b) the second mode utilizes a specific core for bladelet production: in this case the bladelets are shorter, thicker and less regular (*Table 2*).

Alternating production

Most of the predetermined Levallois products exhibit one or more bladelet removals along one or more arrises at the proximal end of the upper surface. These bladelets were removed before detaching the Levallois point (or blade etc.). In 1993, we suggested that these negatives served to thin or regularize the proximal part of elongated narrow Levallois points, possibly in relation to a specific mode of hafting. This idea was also pursued by Bourguignon (1996).

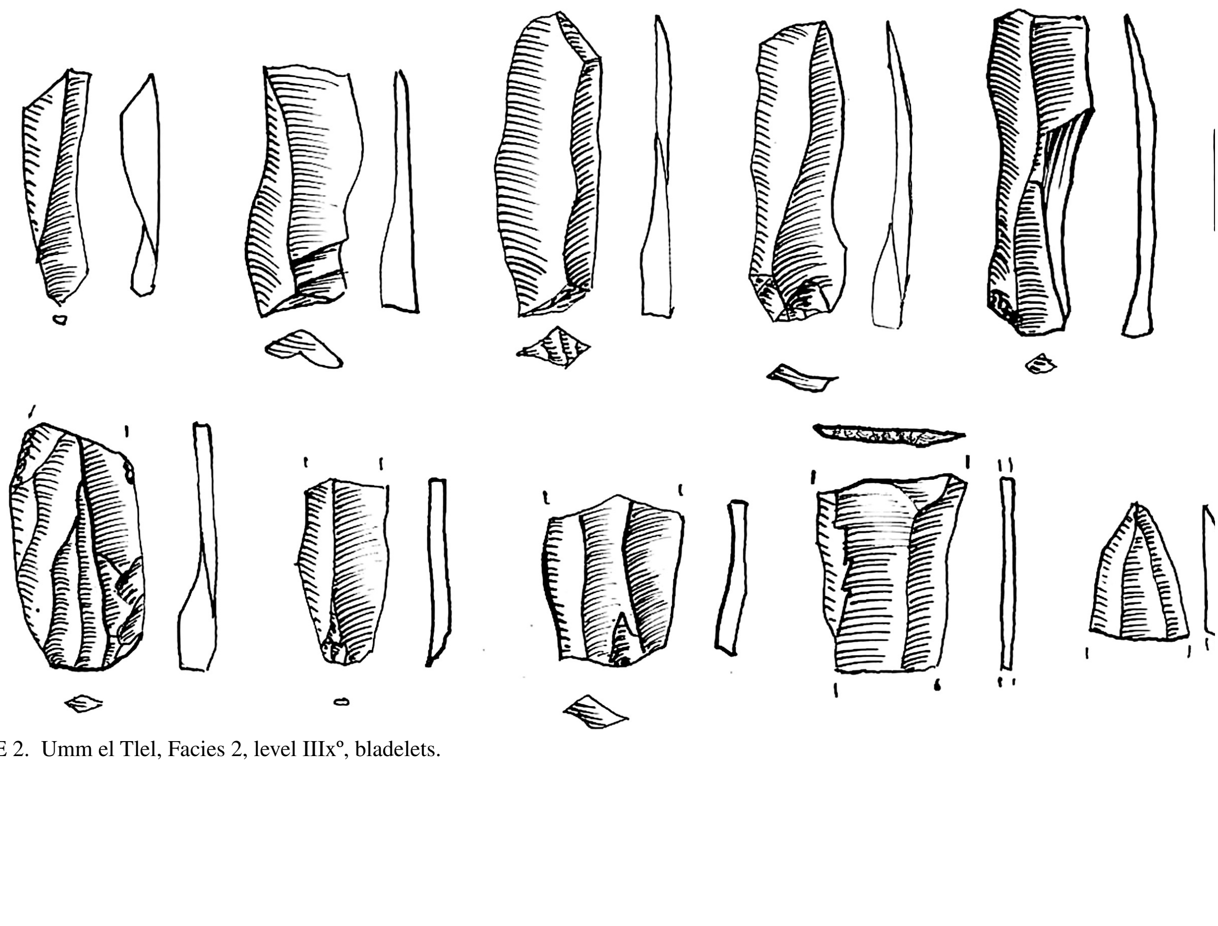


FIGURE 2. Umm el Tlel, Facies 2, level IIIx°, bladelets.

TABLE 1. Frequency of "prédéterminés" removals from Level III 2a' and II base'.

	III 2 a'	II base'
Umm el Tlel points	36 artifacts 1.8%	73 artifacts 2%
Triangular Levallois flakes	67 artifacts 3.3%	77 artifacts 2.1%
Levallois flakes	43 artifacts 2.1%	34 artifacts 0.9%
Blades	335 artifacts 17%	856 artifacts 23.7%
Bladelets	387 artifacts 19.6%	791 artifacts 21.9%
Diverse flakes	1111artifacts 56.1%	1785 artifacts 49.4%
Total	1979 artifacts	3607 artifacts

TABLE 2. Frequency of bladelets from level III 2a' and II base'.

Bladelets	III 2a'	II base'
Alternating reduction strategy	295 bladelets 80%	521 bladelets 72%
Specific reduction strategy	77 bladelets 20%	222 bladelets 28%
Total	387 bladelets	791 bladelets

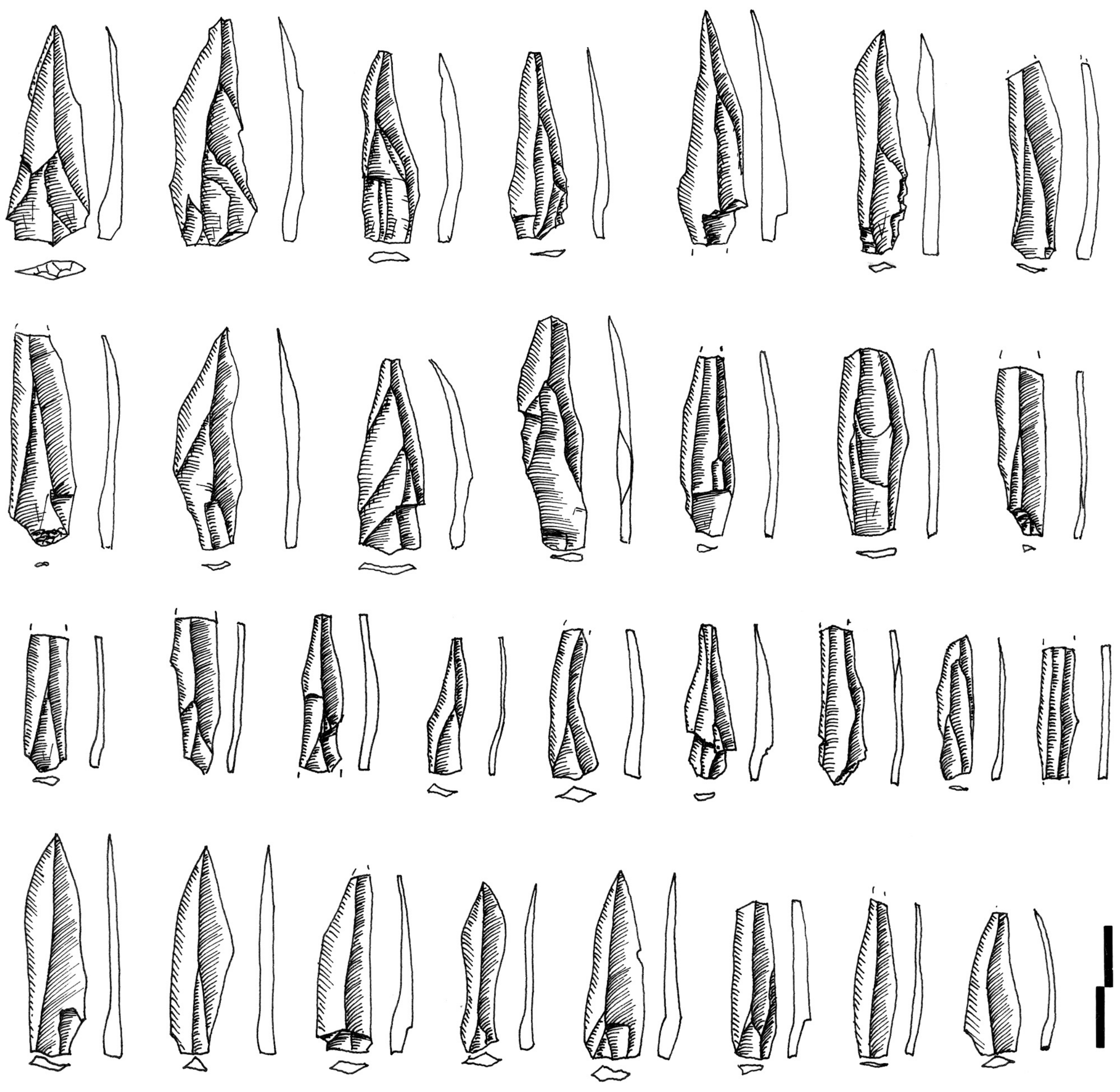


FIGURE 3. Umm el Tlel, Facies 3, levels II base and III 2a. Straight bladelets.

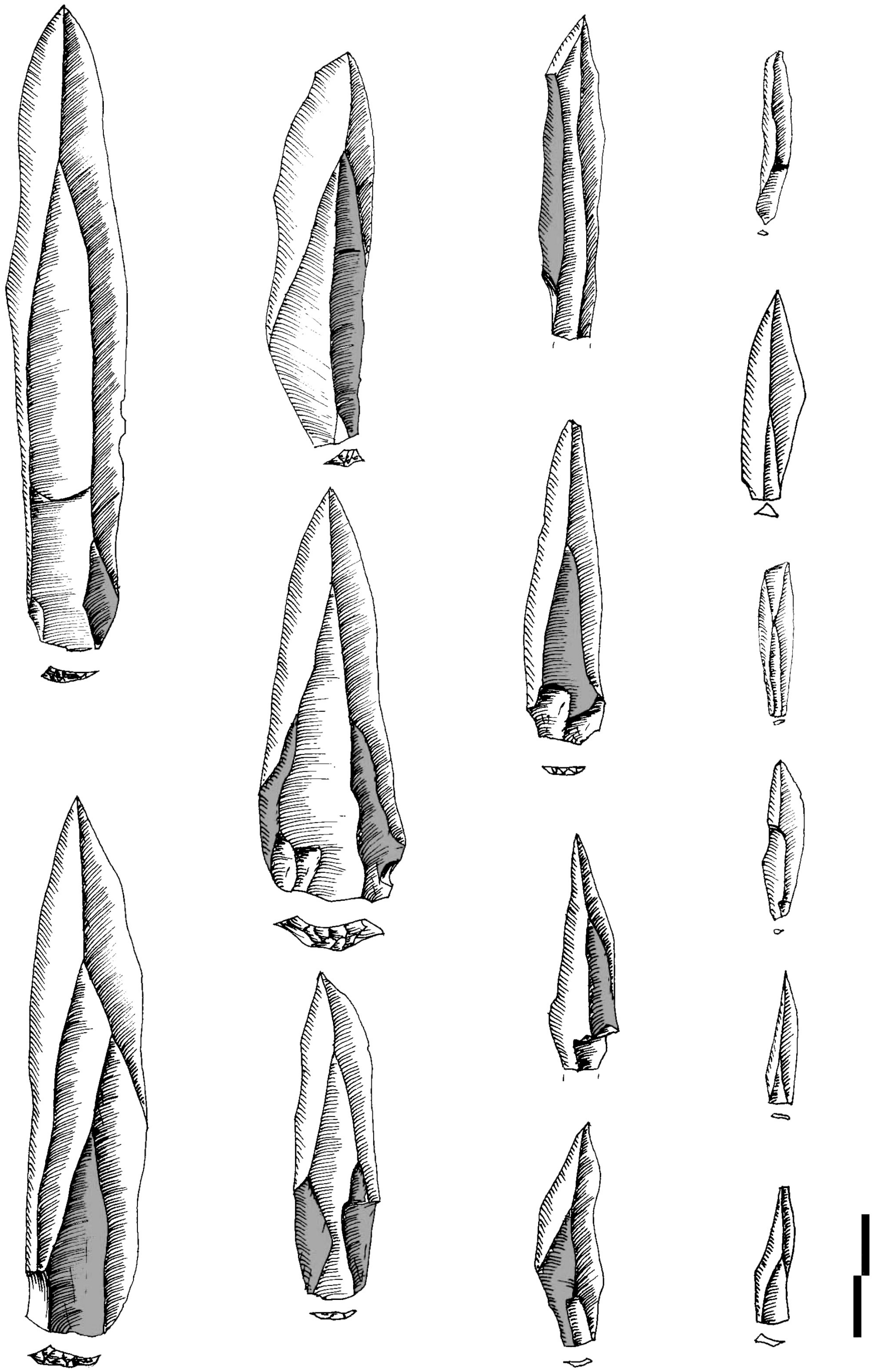


FIGURE 4. Production of bladelets alternating with the production of Levallois points and blades. Bladelet removals indicated in grey.

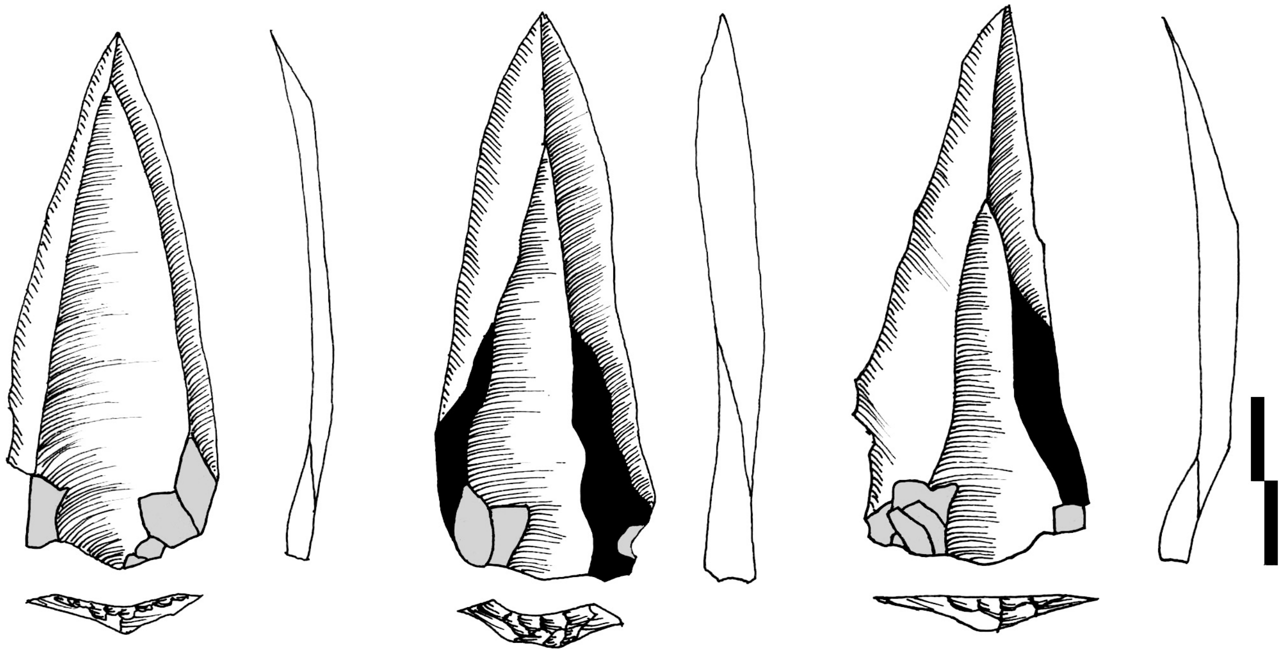


FIGURE 5. Point of sub-type 1 from the Umm el Tlel level II base. Bladelet removal scars are indicated in black; removal scars of hinged bladelets are in grey.

Following an exhaustive study of all the assemblages cited above, it appeared more logical, however, to admit that the bladelets themselves were end products, although the technical consequences of the bladelet production were also exploited in maintaining the productivity of the core. In this distinctive alternating production sequence, these bladelets are at once predetermined products, useful with or without retouch, and predetermining removals (*prédéterminants*), necessary for the maintenance of a productive core.

There are three arguments in favour of this hypothesis of alternating production:

1) The impressive quantity of bladelets recovered: 20% of the artifacts (387 bladelets from III 2a' and 791 from level II base' – *Figure 3*). Only whole artifacts or pieces with at least one third of the original length were tallied.
2) The presence of bladelet scars on all types of predetermined removals, or even several of the predetermining

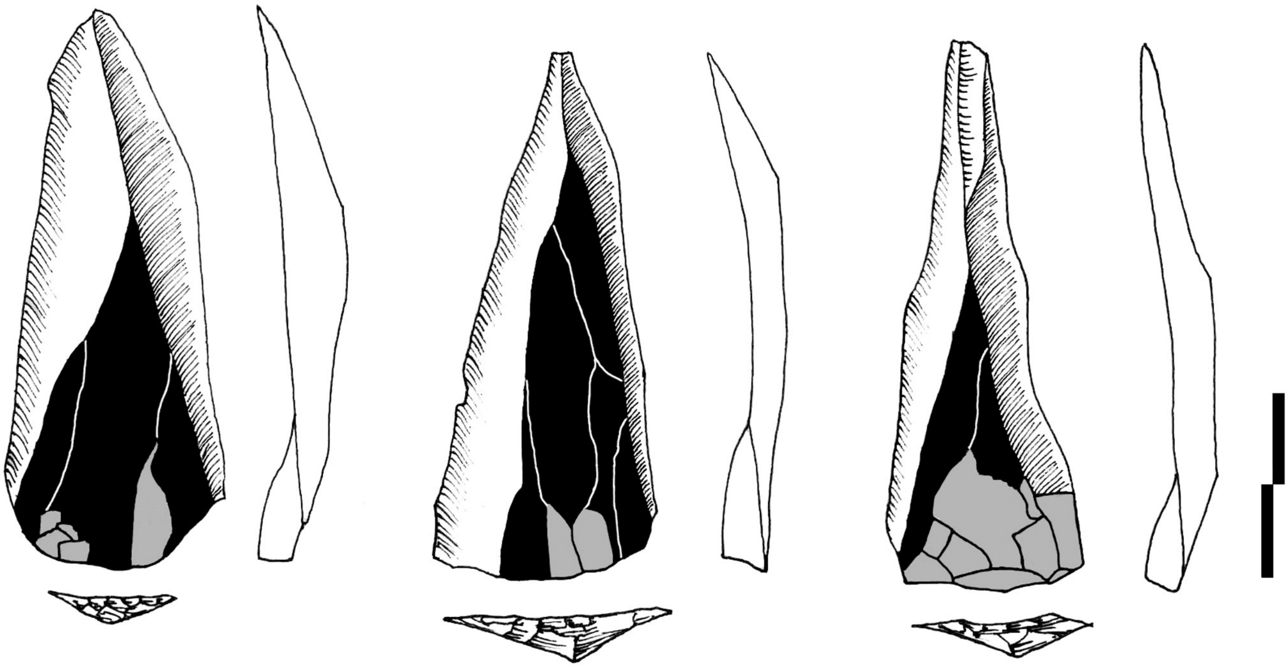


FIGURE 6. Point of sub-type 2 from Umm el Tlel, level II base. Bladelet removal scars are indicated in black; removal scars of hinged bladelets are in grey.

removals (*Figure 4*). The number of negatives varies from one single removal to several scars along one or more dorsal arrises.

3) Examining the proximal end of points from Umm el Tlel made possible the distinction of two categories of bladelet removals: elongated convergent scars or even hinged scars; or bladelet scars that are short because they are hinged. Examining the type known as Umm el Tlel points clarifies the importance of this distinction (Boëda, Muhesen 1993). Two technical subtypes can be distinguished in the Umm el Tlel points: a) The first subtype (1) is characterized by elongated triangular points with a narrow base and dorsal arrises that form a 'Y' inverted in comparison to classic Levallois points (*Figure 5*). When bladelet removals are present, they have been detached along one or both of the central dorsal arrises that form the central triangle. b) The second subtype (2) may be considered a 'constructed point.' A central triangle is constructed progressively through the removal of a series of bladelets that cluster along the central ridge of a triangular point removal (*Figure 6*).

When the two subtypes are closely examined, it becomes apparent that last bladelets detached are short and hinged. In first point sub-type these are the only type of removals present; if one considers also the fact that no other products exhibit this hinged termination, one may infer that this characteristic in bladelets is intentional, serving to prepare this type of artifact for hafting.

Bladelet production from specific bladelet cores

In Facies 3, there is also evidence of bladelet production using specialized bladelet cores. Quantitatively, only 20 to 28% of the bladelets are produced from specialized bladelet cores, and this production therefore appears to be of minor importance. In addition, these cores produce bladelets quite different from those discussed above: they are larger, considerably less regular and have a curved or even twisted profile (*Figure 7*). These bladelets come from at least two types of core (*Table 3*).

TABLE 3. Frequency of baldelet cor from the level III 2a' and II base'.

Bladelet core type	III 2 a'	II base'
Flake	3	5
Block	6	14
Total	9	19

Most of these cores utilize the natural form of the initial piece of raw material, on which the crest and the carination were simply reinforced (*Figure 8*). In cores on flake, the narrow face (thickness) is used for detachment of bladelets (*Figure 8*). Typologically, these cores might be classified as transverse plan burins. Small, former Levallois cores producing small elongated points are also reutilised. The bladelets obtained through these different modes vary in morphology and in size.

Summary of the bladelet production

Two major morphological categories of bladelets can be distinguished in Facies 3: straight bladelets from reduction strategy associated with alternating point and bladelet production, and twisted bladelets produced from dedicated bladelet cores of the transverse plan burin type.

The straight bladelets have variable morphology and represent 95% of the bladelet production. Two sub-categories can be distinguished: 1) bladelets with convergent margins and a pointed extremity or tip; 2) bladelets with parallel margins and rounded extremities.

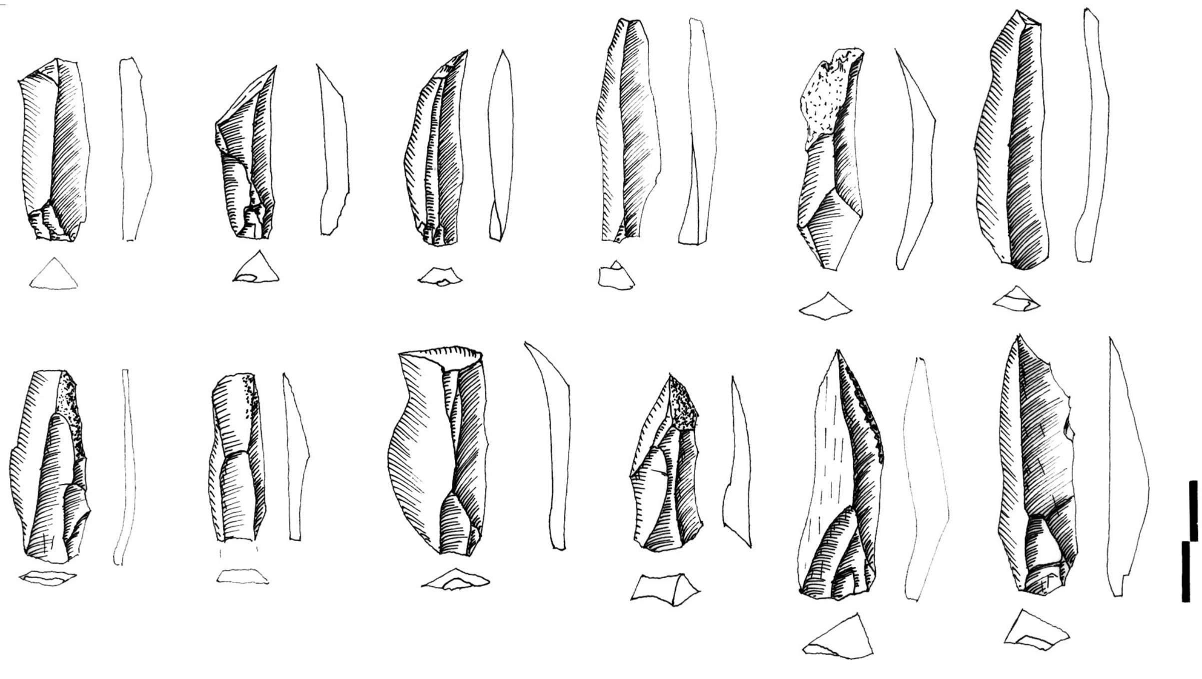


FIGURE 7. Umm el Tlel, Facies 3, level II base, bladelets from specific bladelet cores.

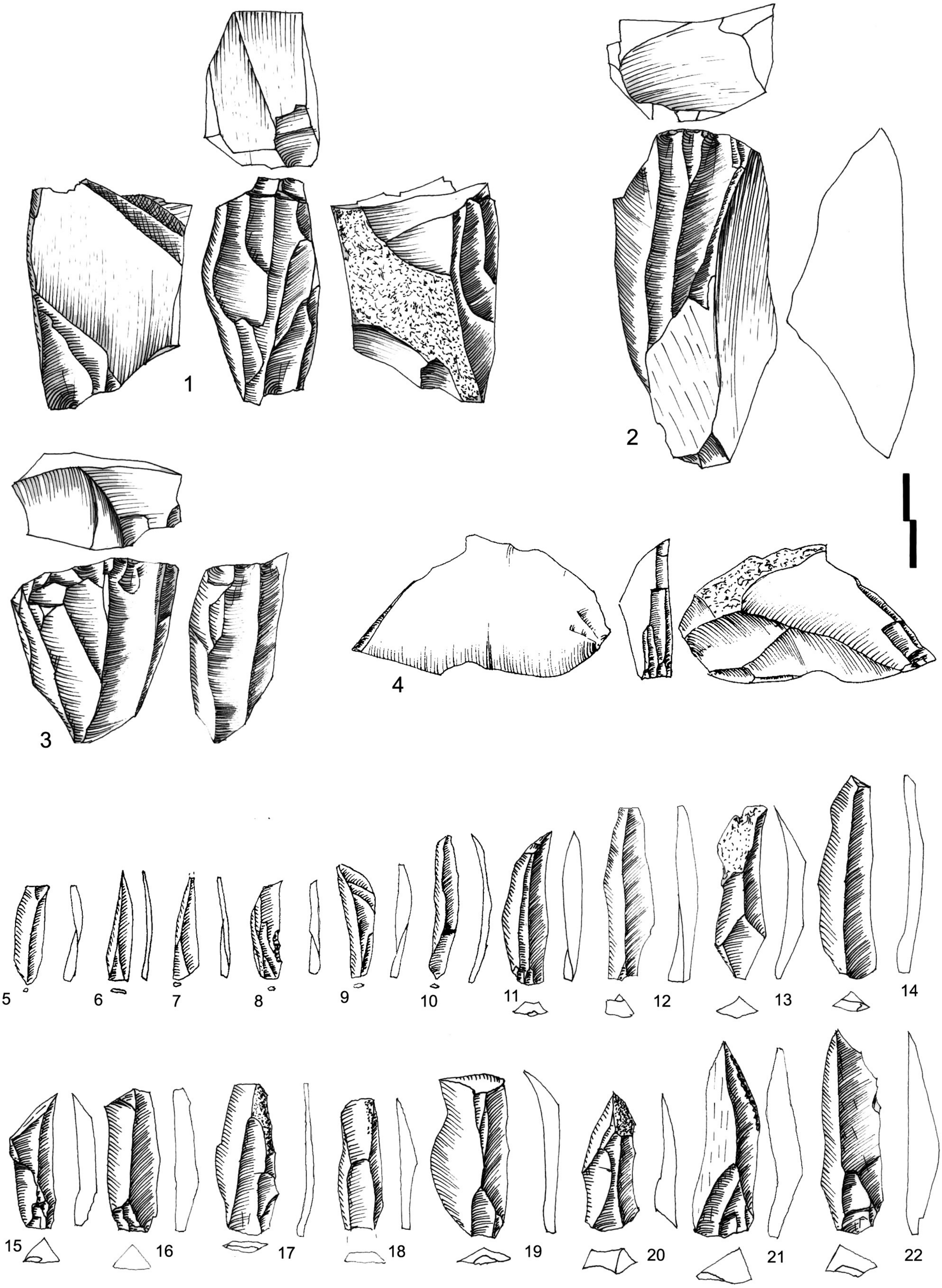


FIGURE 8. Umm el Tlel, Facies 3, level II base. Bladelet core on a block (1 to 3), and bladelet core on flake (4) used in the production of twisted (5 to 9 and 11), straight (12, 14, 17, 18, 22), and curved bladelets (10, 13, 15, 16, 19, 20, 21).

In both cases the size of product was quite variable, ranging from 1.5 to 5.0 cm. The bladelets with parallel margins measured up to 2.5 cm in length, while the other category of bladelets were found in all sizes up to 5 cm. The twisted bladelets were more uniformly sized, under 2 cm in length.

Facies 4

Bladelets are produced exclusively from cores in Facies 4. Due to erosion at the Qualta site only the cores were recovered, the smaller elements having been washed away (testing did however recover a few bladelets, *Figure 9*). There is a large diversity of core forms and sizes; the dimensions of the products obtained from some types of core may have been twice as long as those from other types of core. As indicated by the removal scars, the smallest bladelets measured 2 cm in length and 0.4 cm in width. They were produced from one specific type of core. The largest bladelets were up to 4 cm in length and 0.6–0.7 cm in width. Numerous intermediary sizes also exist.

Three categories of core can be described, each corresponding to the type of bladelets obtained: cores producing small straight or twisted bladelets; cores producing straight bladelets of varying dimensions, and cores producing large bladelets.

Cores producing small straight and twisted bladelets

Various types of flakes are most often used as cores (*Figure 10*). The bladelets produced are small in size and straight or more rarely twisted. However, this last characteristic does not seem to be systematically preferred in this case, in contrast to Aurignacian bladelet production.

Cores producing straight bladelets of dissimilar size

These cores are selected according to the natural shape of the raw material. The cores normally have a naturally-arched shape and a natural crest/cintre suitable for the removal of bladelets after a minimum of preparation. The debitage or reduction strategy entails removing a single series of adjacent bladelets. Most often these bladelets have a cortical, semi-cortical, or natural cleavage surface (when a naturally fractured rock is used as core) (*Figure 11*). Logically, the removal of this first series of bladelets should prepare a second surface suitable for the continued removal of bladelets, and these bladelets would be more regular than those of the first series. However, this second phase is not carried out here because of the frequent accidents that occur during the first series. The platform surface is re-prepared as needed. The debitage technique is tangential direct percussion using a soft stone. A small number of bladelets of differing sizes are produced.

Cores producing straight bladelets with regular tendencies

The cores in this category are residual cores, which produced about ten bladelets and can be re-prepared for continued production (*Figure 12*). There is considerably more preparation involved with these cores than with those discussed above. The control of the *cintrage* has two components. Taking advantage of the natural non-cortical surface, preparation is continued with the help of a partial anterior or posterior-lateral crest. The reduction is uni- or bidirectional.

The products are regular, with a length ranging from 2 to 4 cm and a width between 0.6 and 0.7 cm.

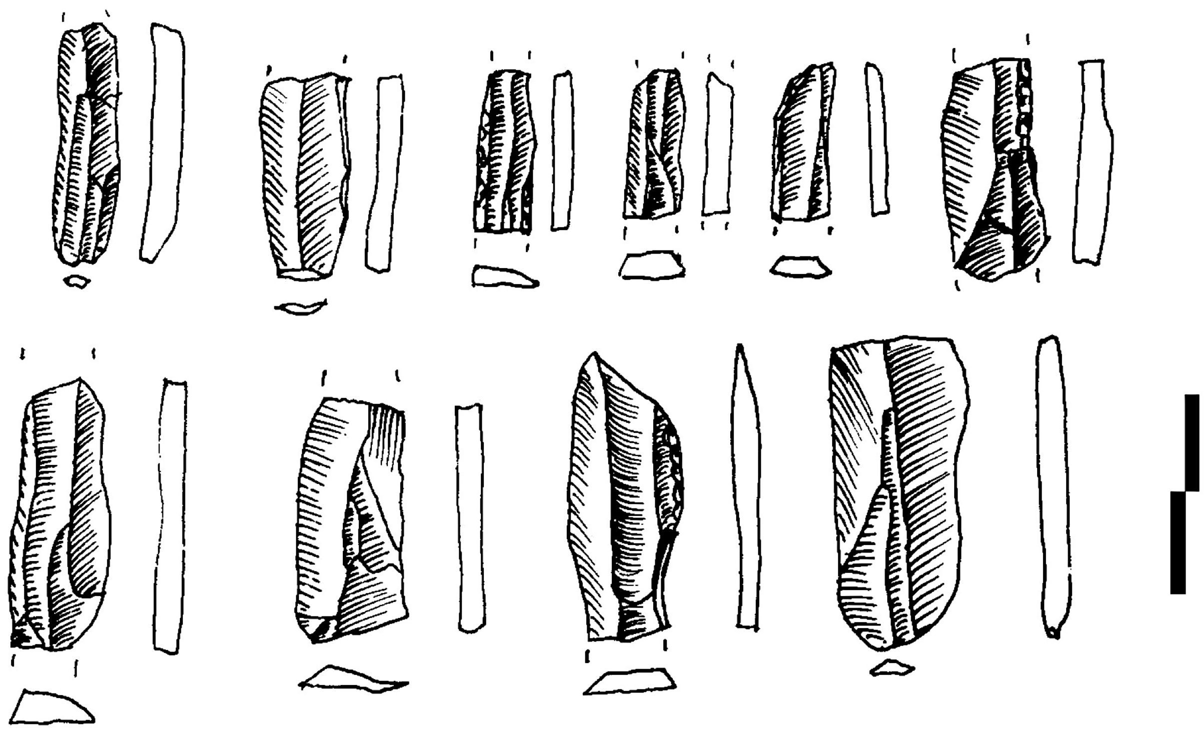


FIGURE 9. Qualta, Facies 4, bladelets.

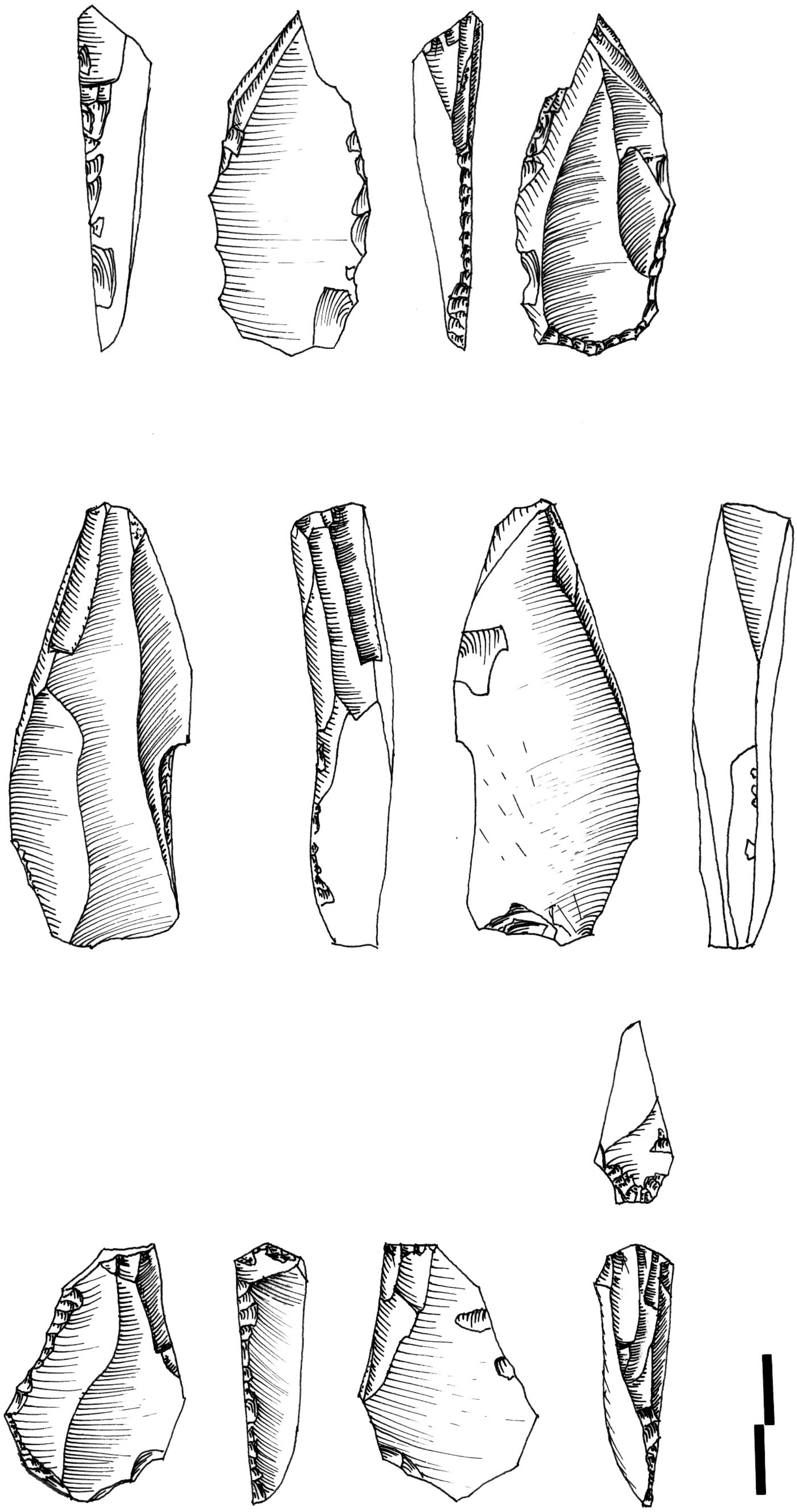


FIGURE 10. Qualta, Facies 4, cores reutilizing Levallois products and the resulting straight and twisted bladelets.

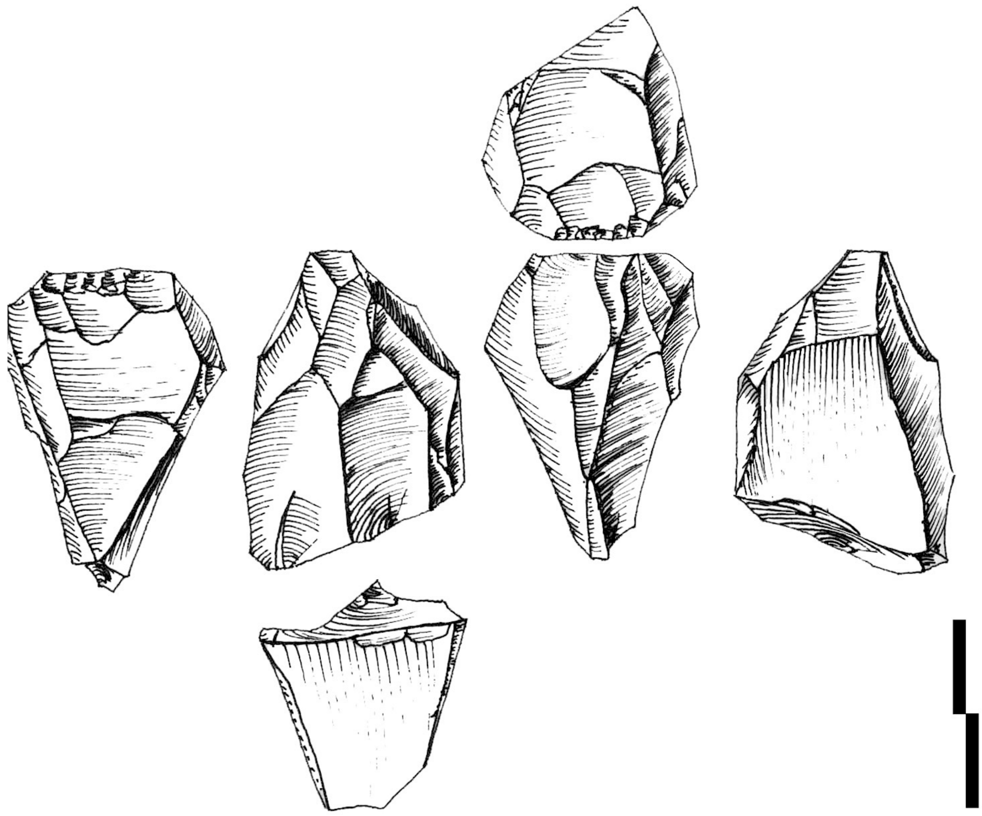


FIGURE 11. Qualta, Facies 4, Bladelet cores producing straight but dissimilar bladelets.

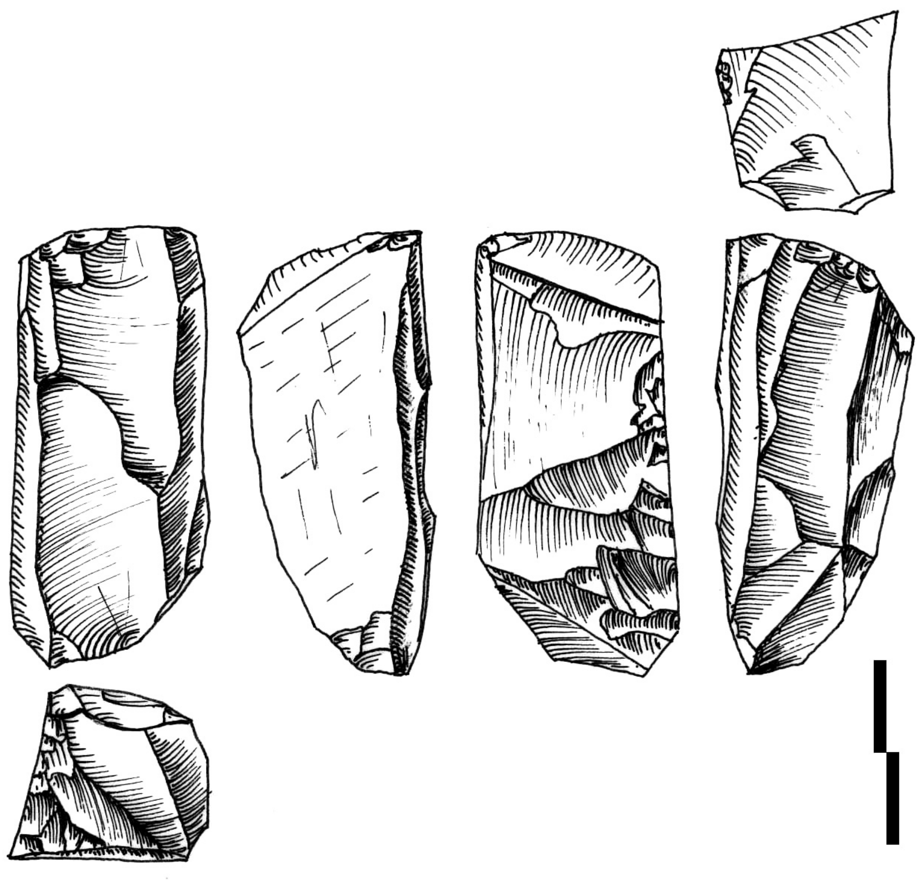


FIGURE 12. Qualta, Facies 4, prepared core producing straight, regular bladelets.

PRODUCTION SUMMARY

These three facies of Intermediate Paleolithic attest to the adoption of a new technical paradigm by Paleolithic toolmakers, which involved quasi-exclusive production of predetermined blades and bladelets.

The blades are retouched as burins, endscrapers and other tools. During the entire Middle Paleolithic, the same tools were generally made from predetermining flakes (*prédéterminant*).

The bladelets in the various Intermediate Paleolithic assemblages result from several modes of production. In some instances they are the only product of dedicated bladelet cores, but in other instances the production of bladelets alternated with that of blades. In Facies 2 bladelets were produced in alternation with a non-Levallois production of blades, while in Facies 3, they alternate with a Levallois reduction strategy.

Both quantitatively and qualitatively, it appears that the bladelets produced in alternation are more standardized and diversified. The dedicated bladelet cores, on the other hand, produce bladelets that are less regular and occasionally more robust.

In all facies the bladelets are rarely retouched. When they are, the retouch observed includes truncations as well as continuous or partial lateral retouch, either direct or indirect.

Because of the clearly intentional nature of the bladelet production, we have expanded the study of these bladelets to include a functional and technical analysis that attempts to find correspondences between the different techno-types of bladelets, their intended functions, and the way in which they were used.

TECHNO-FUNCTIONAL ANALYSIS – OBSERVATIONS AND TENDENCIES

The excellent conservation of the bladelet assemblage of Facies 3 made it possible to carry out a preliminary techno-functional analysis. The two methods of analysis used are linked and complementary. The assemblage was first subjected to a functional (use-wear) analysis and then to a technical analysis. This second analysis consists of identifying the various technical characteristics that were brought into play when the bladelets were used.

Ninety-nine artifacts from levels II base' and III2a' at Umm el Tlel were examined. This sample is representative of the different morpho-technical categories identified in the discussion of Facies 3 above. The bladelets can be divided into three groups.

The first group consists of 21 large bladelets, with or without convergent margins, and varying in length between 3.5 and 5.1 cm. Most of these bladelets were produced in alternation, within a Levallois reduction strategy. With one exception, these bladelets were not retouched.

The second group consists of 37 small twisted bladelets with parallel margins: in some cases the termination is hinged. These bladelets are produced through two reduction strategies: use of dedicated cores, or in alternation within a Levallois reduction strategy. The length of these bladelets varies between 1.5 and 2.5 cm and most have not been retouched.

The third group comprises 41 triangular bladelets, slightly retouched, varying in length between 2.1 and 4.5 cm. Most of these bladelets were produced in alternation, with a striking axis parallel or oblique to the morphological axis. In most cases, the point or tip has been fractured.

Use-wear analysis

All of the bladelets were examined with a binocular microscope (magnification from 16× to 40×) and with an optical reflecting microscope (magnification 200×).

Through a preliminary examination it was established that 73 of the 99 bladelets exhibited traces of use-wear. Thus far, 26 of these artifacts have been further studied and analysis of the remaining artifacts is ongoing.

The objective of this functional analysis is to study the zones of contact between the cutting edge and the worked material in order to characterize the types of materials worked and to define the gestures used and the way in which the artifacts functioned. In addition, much attention was paid to identifying traces of hafting.

The zones of the bladelets in contact with worked materials

Overall, the parts of the bladelet in contact with the worked material varied. The zones in contact included: a) the two margins of the artifact and the area of convergence or tip (7 triangular bladelets); b) the two margins of the artifact (7 artifacts from all types of production strategy, except the twisted bladelets); c) one single margin (12 artifacts from the three groups).

Motions of use

Striations and micro-chipping observed along the cutting edge and on the adjacent lateral surfaces, indicating longitudinal use motions, are the most common, and are found on all categories of bladelets. Less frequently, on the 6 triangular bladelets detached along an oblique axis to the morphological axis, the directional wear indicates both longitudinal and transversal actions.

Only the 7 artifacts with convergent margins had dulled tips or fractures probably indicating piercing actions as well as longitudinal and/or simultaneous transversal cutting actions.

Worked materials

For 19 artifacts it was possible to define the type of material that the piece had been in contact with or had worked. Five triangular (following the morphological axis) or medium-sized bladelets showed wear from contact with meat (butchery) that was more or less developed (*Figure 13*). Six bladelets had been in contact with meat and bone;

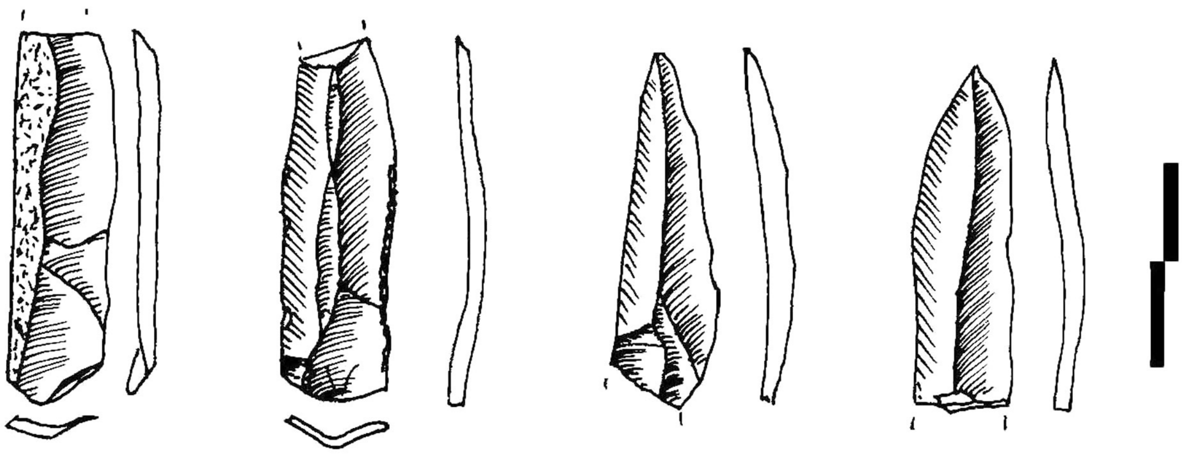


FIGURE 13. Bladelets in contact with meat.

these were principally bladelets detached on an oblique axis (*Figure 14a, b*). Seven bladelets of different types had been in contact with non-ligneous vegetal materials (*Figure 15a, b, c*) while a single artifact had been in contact with wood (*Figure 16a, b*).

Traces and types of hafting

The examination of the surfaces of the 26 artifacts analysed reveals that most exhibited one of three patterns of wear: a) The proximal and medial lower surfaces, and sometimes upper surfaces exhibit large, more-or-less longitudinally-oriented patches with a polish typical of wood. These patches are positioned obliquely or in parallel to the axis of debitage (*Figure 20c*). b) The proximal and medial upper surfaces exhibit striations that are oblique or parallel to the central arrises. These striations are in some cases associated with areas of wood polish. These striae may result from the presence of abrasive particles between the bladelet and a relatively hard material. c) The central arrises in the proximal and medial parts of the bladelet are frequently smeared and/or polished. d) The proximal edges are often smeared and/or polished (*Figure 19b*).

The association of these use-wear traces and their occurrence on 18 artifacts suggest that these bladelets were hafted.

The distribution of these traces of wear on the surfaces of the artifacts makes it possible to reconstruct the way in which these bladelets were hafted (principally using a wooden haft).

Three modes of hafting were revealed: 1) *An axial mode of hafting*: the traces of hafting are found on the proximal half or third of the artifacts. The distal extremity of the haft (in contact with the bladelet) was triangular and extended over the proximal end of the bladelet. This type of hafting has thus far been observed on three bladelets that are triangular in the axis of debitage (*Figure 17*).

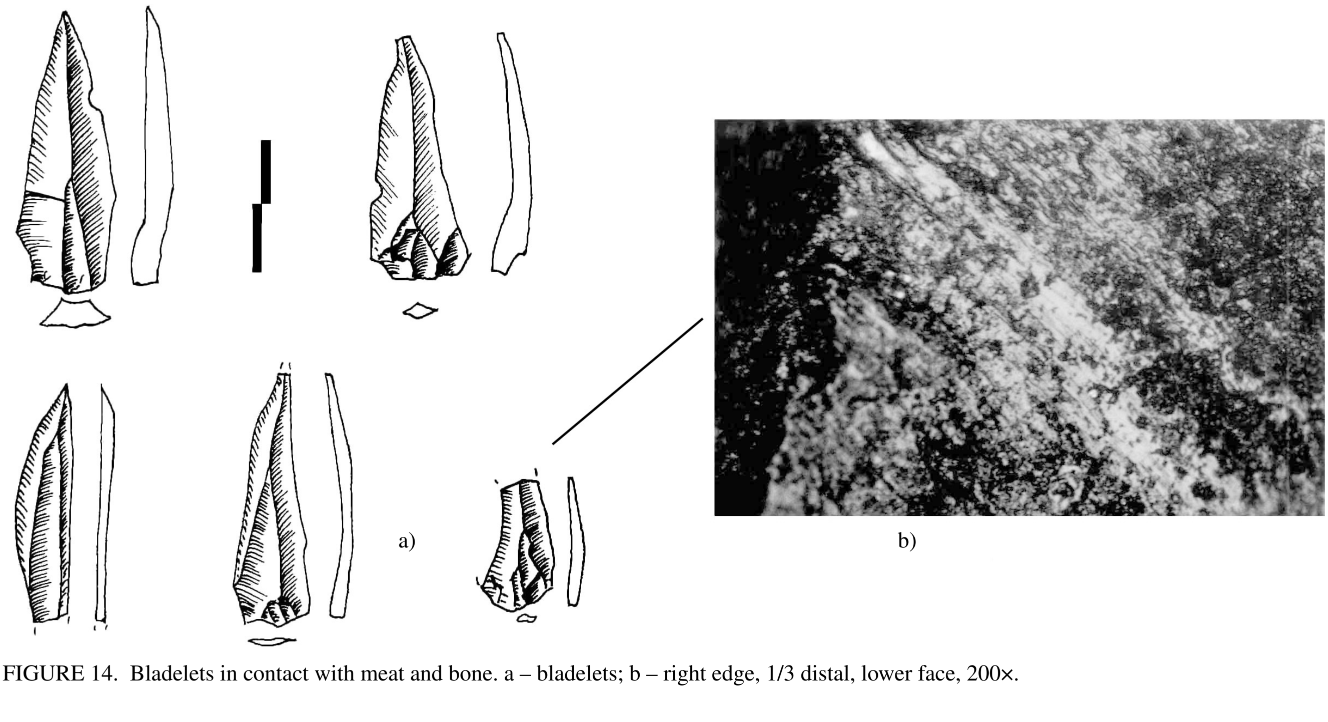


FIGURE 14. Bladelets in contact with meat and bone. a – bladelets; b – right edge, 1/3 distal, lower face, 200×.

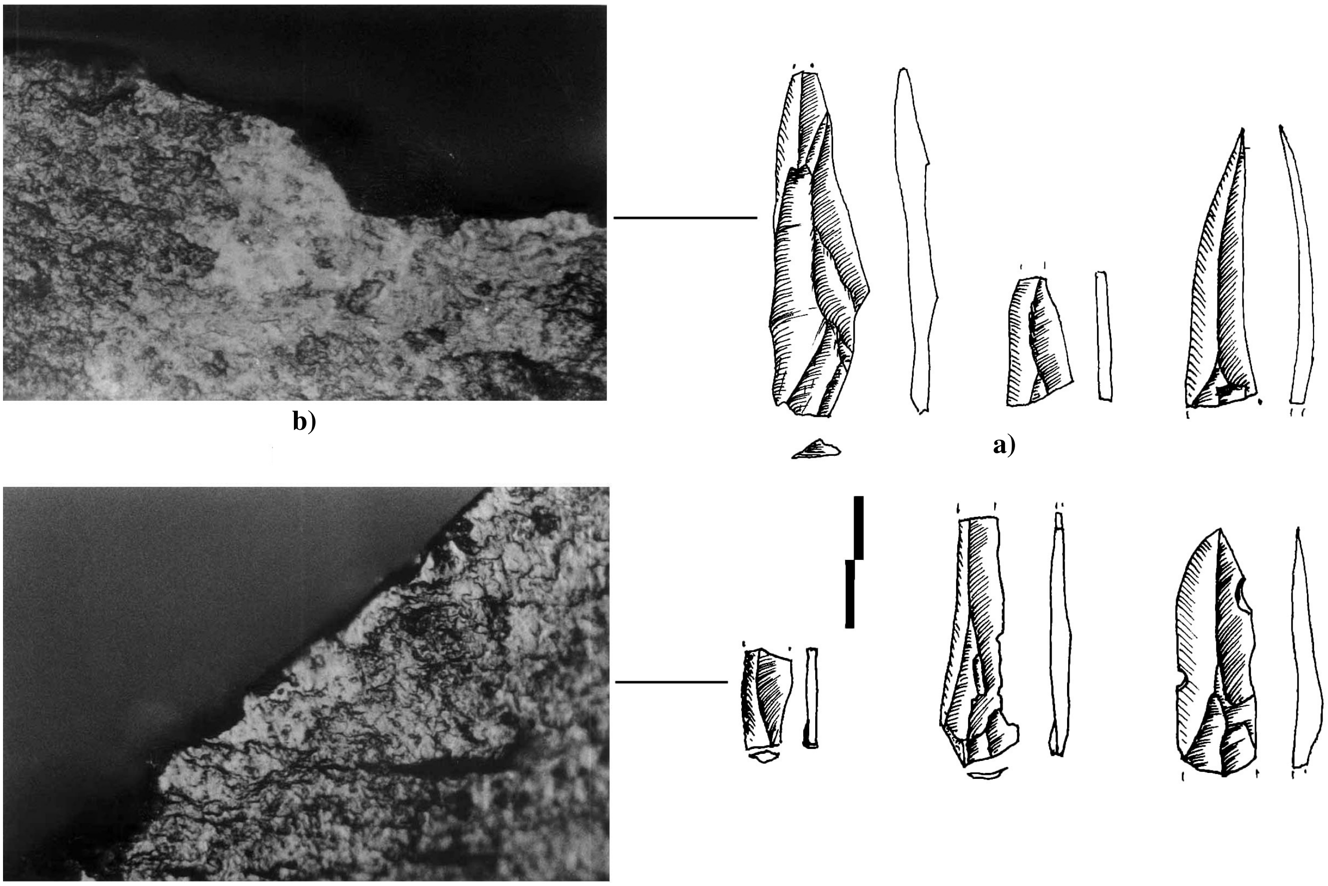


FIGURE 15. Bladelets in contact with non-ligneous vegetal materials. a – bladelets; b – left edge, 1/3 mesial, lower face, 200×; c – left edge, mesial, lower face, 200×.

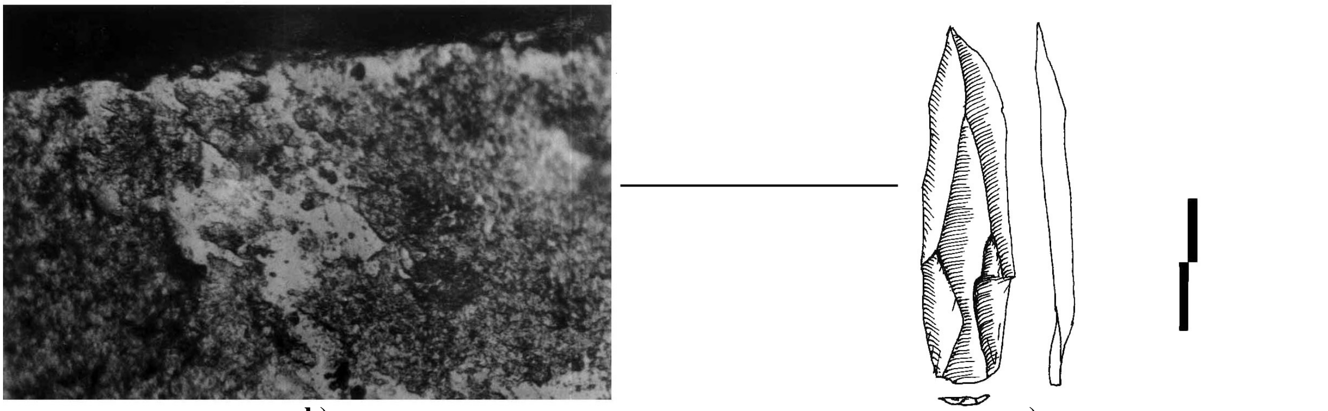


FIGURE 16. Bladelets in contact with wood. a – bladelets; b – left edge, distal, upper face, 200×.

2) *An oblique mode of hafting*: the use-wear traces follow a line that is oblique in relationship to the axis of debitage of the bladelets (*Figure 19a*). This limit-line may indicate two types of hafting: a) axial hafting with an asymmetrically-ending handle (*Figure 18: Scheme 1*); b) oblique hafting, with tool held at an angle to the morphological axis of the bladelet (*Figure 18: Scheme 2*). 3) *A lateral mode of hafting*: the use-wear traces are parallel to the axis of debitage of the artifact and are situated along the entire length of the bladelet margin (from the proximal end to the distal end). These tools were held laterally, leaving only one margin functionally free for cutting. This mode of hafting is principally found on small flat bladelets that are hinged or fractured at the extremities (5 bladelets, *Figure 20a, b*). On three bladelets, active, functioning edges as well as the hafting limits were observed on both margins. For these three artifacts, both lateral margins were probably used in alternation as active, functioning edges and hafting margins, implying that the hafting of one edge was dismantled and reassembled on the opposing side (*Figure 20a*).

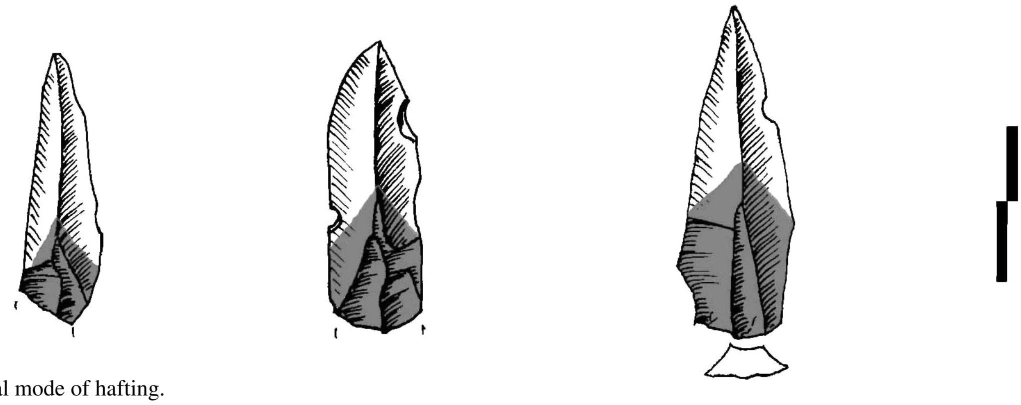
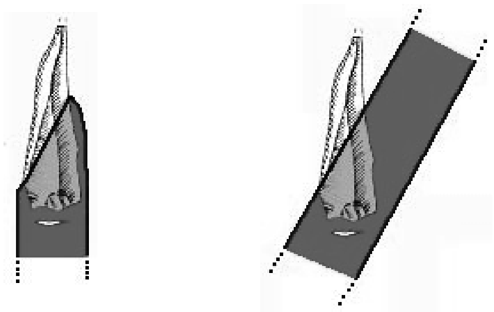


FIGURE 17. Axial mode of hafting.



SCHEME 1. SCHEME 2.

FIGURE 18. Scheme 1: Axial hafting with asymmetricallly anding handle. Scheme 2: oblique hafting.

Technical analysis

A morpho-technical analysis was used to complement the functional analysis of the 26 artifacts. The objective of the morpho-technical analysis was to determine the bladelet characteristics that were systematically favoured (and brought into play) in working each material type, and to determine the types of relationships linking the technical choices and intended functions. Four criteria were taken into account: 1) The global morphology of the bladelet, which took into account: a) the morphological axis of the tool, either oblique or parallel to the axis of bladelet removal; b) the delineation and morphology of the cutting edges of the two lateral margins of the artifacts. 2. a) The cross-sections of the active edges or profiles of the active cutting edges; b) the angles of the active cutting edges, both before and after retouch; c) the dimensions (lengths) of the artifacts.

The results presented below are considered to represent general tendencies that must still be confirmed or refined through additional study.

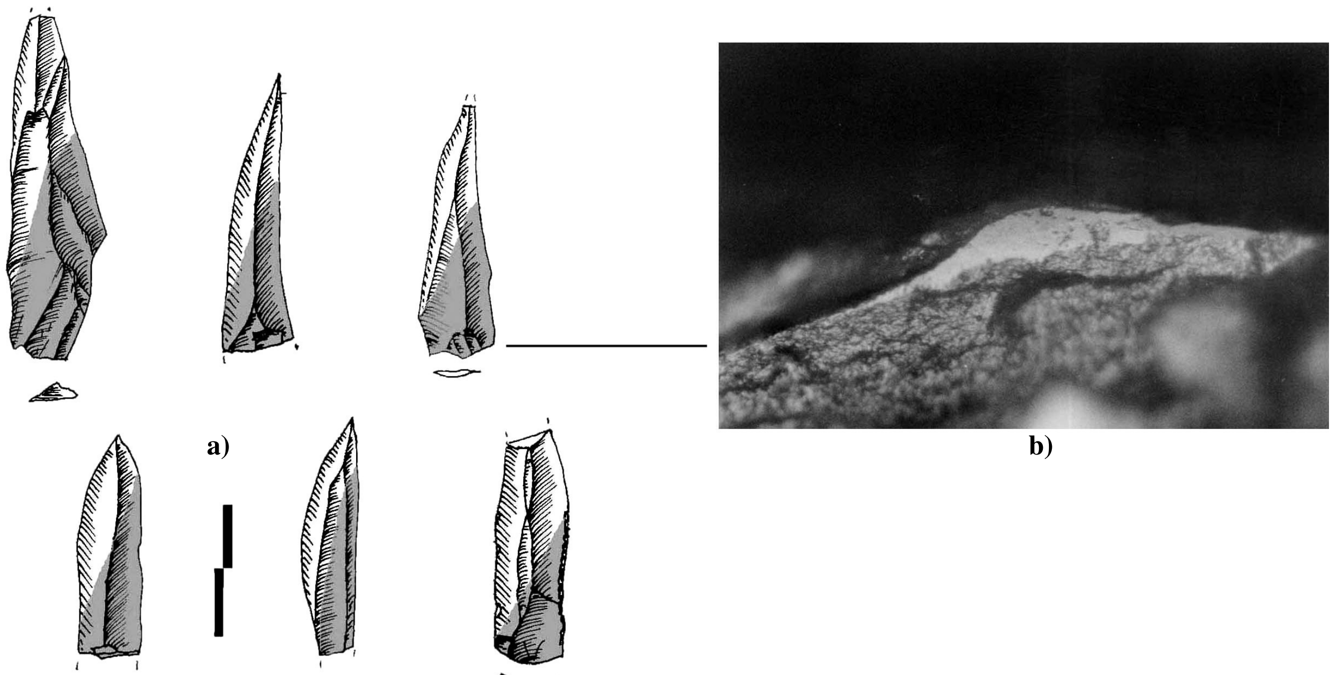


FIGURE 19. Oblique mode of hafting. a – bladelets; b – right edge, proximal, upper face, 200×.

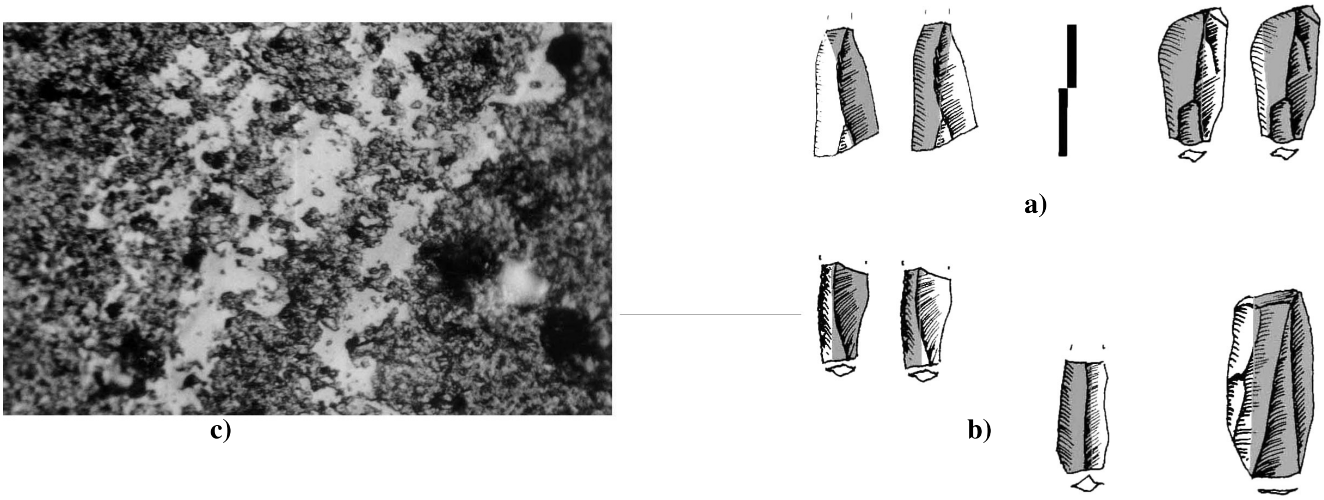


FIGURE 20. Lateral mode of hafting. a and b – bladelets; c – 1/3 mesial, lower face, 2000×.

Bladelets in contact with meat (butchery?)
These bladelets are either triangular bladelets, with the apex in the axis of debitage or else straight mid-sized bladelets (*Figure 13*). This group exhibits very little morphological variation; all the bladelets are oriented along the axis of debitage. Their margins are regular, convex-straight, straight-straight or convex-convex. In cross-section, the active portions are all bi-planar and the cutting-edge angle varies between 20 and 25 degrees. The length of the bladelets varies between 2.7 and 3.7 cm.

When they can be seen, the traces of the handles show that the blades were inserted axially or obliquely; it can be thus suggested that hafting was in the same axis or set obliquely to the axis of debitage.

Bladelets in contact with meat and bone
These triangular bladelets were struck obliquely to the morphological axis, and have relatively homogeneous morphology (*Figure 14a*). The margins are regular, either convex-straight or concave-straight. The technical characteristics of the active portions are a little more varied than those discussed above, but remain relatively homogeneous. The bladelets are bi-planar in cross-section and the cutting-edge angle ranges between 15/20 degrees and 30–35 degrees. The dimensions of these bladelets are a little more variable than those of the category discussed above, ranging between 2.1 and 4.2 cm. There is little variability in the use-wear traces, which reflect an oblique mode of hafting and an oblique or axial mode of prehension.

Overall the bladelets used for working meat and bone show relatively homogeneous technical characteristics and dimensions.

Bladelets in contact with vegetal materials
All of the morphological categories are represented in this diverse group. In addition to the categories of bladelets used above, large bladelets with or without convergent margins and small bladelets with parallel margins are also

TABLE 4. Techno-type and worked material.

Worked materials	**Morphological categories**	**Edge delineation**	**Cross-section profiles**	**Edge angle**	**Dimensions (length)**	**Position of hafting use-wear traces**	**Modes of hafting**
Soft meat tissues	-triangular apex in axis of the bladelet removal -"mid-sized" straight	-regular edges: convex-convex convex-straight straight-straight	bi-planar	20°–25°	between 2.7 and 3.7 cm	oblique and axial	oblique and/or axial
Meat and bone	-triangular with the apex in an oblique axis	-regular edges convex-straight concave-straight	bi-planar	15/20°–30/35°	between 2.1 and 4.2 cm	oblique	oblique and/or axial
Vegetal materials	- all categories	-regular edges straight-convex convex-convex convex-concave -irregular edges	bi-plans	20/25°–40/45°	between 1.5 and 5.1 cm	oblique, axial and lateral	oblique and/or axial and/or lateral

used (*Figures 15a, 16b*). In addition the margins can be regular, convex-convex, convex-concave or irregular. With the exception of the active portions of the margins, which are always bi-planar, the angles of the cutting-edges are also varied, ranging from 20/25 degrees to 40/45 degrees. The dimensions of the bladelets vary between 1.5 and 5.1 cm. The use-wear traces reflecting hafting (oblique, axial, or lateral) indicate varied modes of hafting.

It appears that the morpho-technical characteristics of the bladelets that were in contact with vegetal materials are much more variable than those that were in contact with animal materials (*Table 4*).

CONCLUSION

This study clearly demonstrates that bladelet production preceded the Ahmarian and Aurignacian industries of the Middle East. A few early examples of this production are clearly distinguished towards the end of the Mousterian industries of El Kowm, even before the systematized production of the Intermediate Paleolithic.

The findings of the use-wear[1] and technical analyses established that bladelets were also utilized during the Intermediate Paleolithic, reinforcing the recognition of the intentionality of the production. Quantitative confirmation was provided through the preliminary analysis of 73 ladelets which found that most of bladelets presented clear traces of use-wear, and most of the bladelets also showed traces of having been hafted. General techno-functional tendencies were also recognized; it appears that specific morphologies and technical characteristics were selected according to the type of material to be worked.

Comparison with other sites appears to be difficult, except for the comparison with Tor Sadaf (Fox, Coinman 2004) which also has evidence of clearly intentional bladelet production. Many other sites in the Levant probably also exhibit a similar production that passes unobserved because excavation techniques and present paradigms result in their being seen as mixed assemblages or palimpsest deposits.

Bladelet production is associated with the production of blades to such an extent that there appears to be a co-evolution of blade and bladelet. This association has already been remarked in the Hummalian industries (Hours 1982, Copeland 1985) in an unpublished collection that we have had the opportunity to examine. However, in that particular industry, although the bladelets were produced using specific bladelet cores, they were quantitatively unimportant. In the assemblages examined above, blades and bladelets were produced in the same proportions. The same is true of bladelet and blade production of the Ahmarian and Aurignacian periods, but during these latter periods there is a more rigorous standardization in the bladelet size and shape (usually straight in the Ahmarian and twisted in the Aurignacian). In addition there is a greater propensity to retouch tools in Ahmarian and Aurignacian assemblages than in the Intermediate Paleolithic.

[1] The only known traceological analyses known in bladelets flaking industries in the Palmyra region are related to the Epi-Paleolithic of Douara (Fujimoto 1988) and some Aurignacian levels of Umm el Tlel, carried out by J. J. Ibanez Esteves (unpublished). A quick comparison shows a certain similarity, yet to be confirmed, between bladelets flaking industries of the Intermediate Paleolithic and Aurignacian of Umm el Tlel.

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