ANTHROPOLOGICA ET PRAEHISTORICA

Bulletin de la
Société royale belge d'Anthropologie
et de Préhistoire

Bulletin van de
Koninklijke Belgische Vereniging
voor Antropologie en Prehistorie

131 / 2020

Ce volume a été publié
grâce à l'appui de
et grâce au soutien financier de

Deze bundel werd gepubliceerd
met de steun van
en met de financiële steun van

l'Institut royal des Sciences naturelles de Belgique • het Koninklijk Belgisch Instituut voor Natuurwetenschappen

et

l'Association pour la Diffusion de l'Information archéologique

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TABLE DES MATIÈRES / INHOUDSTAFEL

Anthropologica et Præhistorica, 131/2020 (2022) : 29-78
https://doi.org/10.57937/ap.2022.003

Scrapers and bifacial pieces. Technological characteristics of Yabrudian industries at Yabroud, Tabun and Adlun (Central Levant): a comparative study

Amjad AL QADI & Marie BESSE

Abstract

Here we present a technological analysis of Yabrudian lithic assemblages from three major sites in the Levant: the eponymous site of Yabroud (shelter I), located in a steppe region, and the sites of Tabun and Adlun (Bezez Cave), both located in coastal zones. Our research focuses on the definition of the Yabrudian in the Levantine region, on the one hand, and its origin and chronological aspects on the other. We focus particular attention on whether the Yabrudian represents an individual facies or forms part of a larger techno-complex of Middle Palaeolithic industries.

***Keywords*:** Levant, Middle Palaeolithic, Yabrudian, lithic techno-complex.

Résumé

Nous présentons ici une analyse technologique de séries lithiques du Yabroudien provenant de trois sites majeurs du Levant : le site éponyme de Yabroud (abri I), situé dans une région steppique, et les sites de Tabun et Adlun (grotte Bezez), tous deux situés en zone côtière. Notre recherche est centrée sur la définition du Yabroudien dans la région Levantine, sur ses origines et sa position chronologique. La question de savoir si le Yabroudien représente un faciès unique ou fait partie d'un techno-complexe du Paléolithique moyen plus vaste a sous-entendu le propos de cette contribution.

Mots-clés : Levant, Paléolithique moyen, Yabroudien, techno-complexe lithique.

1. INTRODUCTION

The Yabrudian is a local Levantine Palaeolithic industry that is now known from several archaeological sites (Fig. 1) and dates to around 387-215 ka (RINK *et al.,* 2004; BARKAI *et al.,* 2009; MERCIER *et al.,* 2013; FALGUÈRES *et al.,* 2015; HERSHKOVITZ *et al.,* 2016). The Yabrudian is found over diverse and relatively widespread geographical areas and varied natural environments: a steppe zone (Yabroud, the regions of El Kowm and Palmyra, Azraq basin), a mountainous forest zone (Dederiyeh) and coastal areas (from south to north: Qesem, Tabun, Masilya, Adlun, Masloukh).

Initially defined by A. Rust during his excavations in Syria between 1930 and 1933 of a rock shelter at Yabroud, 60 km north of Damascus (RUST, 1950), the Yabrudian was considered as a transitional industry between the Lower and Middle Palaeolithic (HOURS *et al.*, 1973; COPELAND, 1978; VINCENT, 1985; LE TENSORER, 2005). At the time of its discovery, Yabrudian industries presented a typology hitherto unknown in the Levant. For A. Rust, the Yabrudian is defined by the presence of a large number of offset and transverse scrapers with scaled-stepped retouch, made on short, thick flakes, with plain or dihedral platforms, from a non-Levallois reduction sequence (Fig. 2). These industries without a biface component are found at the base of the Shelter I stratigraphic sequence. However, Rust referred to Yabrudian industries with bifaces from the lowest part of the Shelter I sequence as "Acheuleo-Yabrudian" (RUST, 1950).

This "Acheuleo-Yabrudian Complex" has been identified at several sites: Yabroud (RUST, 1950), Tabun (GARROD, 1956; JELINEK, 1990; TSATSKIN, 2000; GISIS & RONEN, 2006; SHIMELMITZ

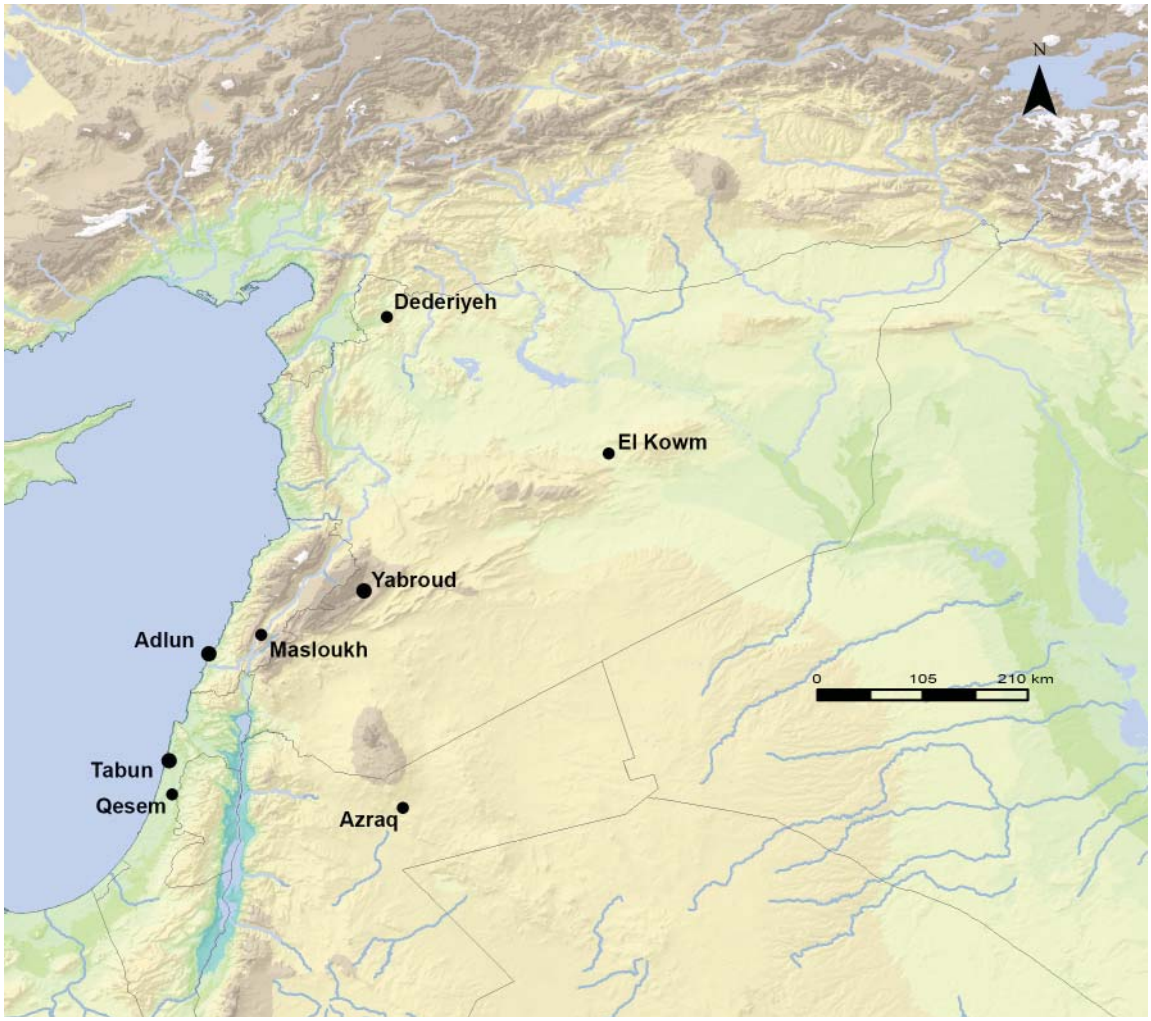


Fig. 1 – Geographic distribution of the main Yabrudian sites known for the Levant.

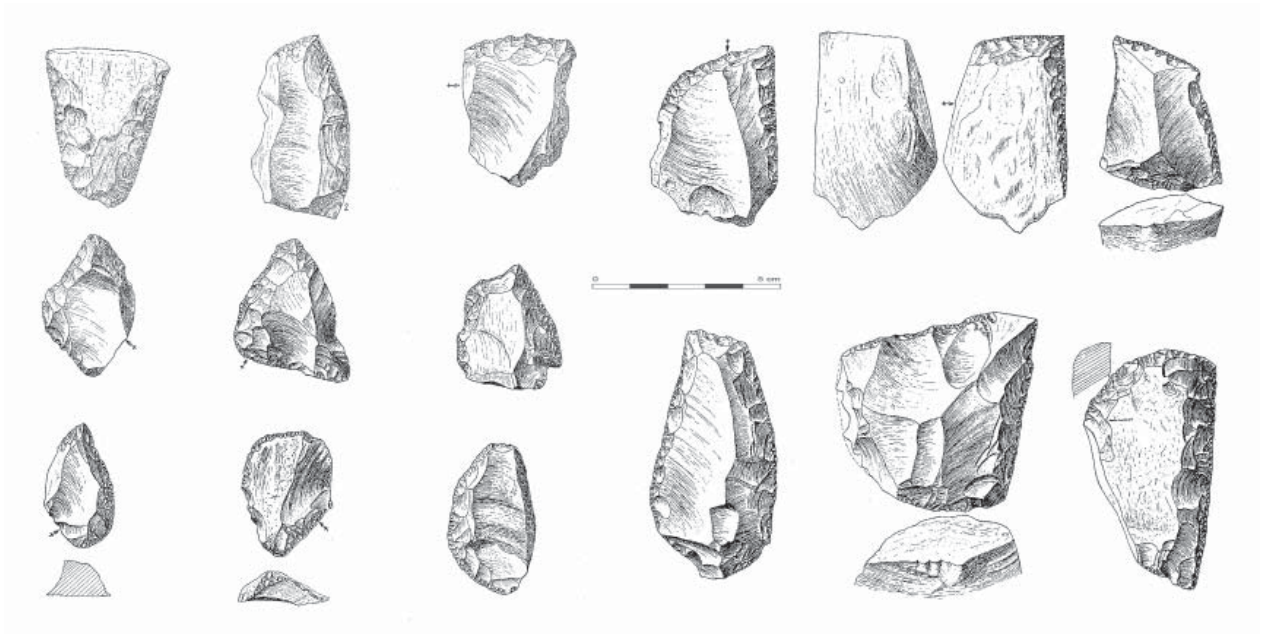


Fig. 2 – Yabrudian scrapers from Rust's excavations (1930-1933) at the site of Yabroud. After RUST, 1950.

et al., 2014), Bezez Cave in Adlun (GARROD, 1966; COPELAND & HOURS, 1983) and Qesem Cave (BARKAI *et al.* 2009; BARKAI & GOPHER, 2016; ASSAF, 2014; ASSAF *et al.*, 2016; AGAM, 2019; AGAM *et al.,* 2019; AGAM & ZUPANCICH, 2020), Misliya (ZAIDNER *et al.* 2006; ZAIDNER & WEINSTEIN-EVRON, 2016, WEINSTEIN-EVRON & ZAIDNER, 2017) and Hayonim (MEIGNEN & BAR YOSEF, 2020) This association of the Acheulean and Yabrudian raises issues concerning the relationship between these two industries as well as the status of the Yabrudian itself.

In Tabun layer E, Jelinek described a "Wadi Mughara" culture (Mugharan Tradition) which, according to him, is composed of the "Acheuleo-Yabrudian", the Yabrudian and the Amudian/"Pre-Aurignacian" (JELINEK, 1982a). The term "Yabrudian" was initially used by A. Rush in 1930 when he first defined this industry. Several subsequent studies of material recovered from sites across the Levant were also attributed to the "Yabrudian", starting with F. Bordes then L. Bourguignon's analyses of assemblages from Yabroud (BORDES, 1955, 1977, 1984; BOURGUIGNON, 1997), and the work of J. Besançon, L. Copeland, F. Hours, P. Sanlavillem, G. Henning, J. M. Le Tensorer, S. Muhesen, Al Qadi, D. Wojtczak, or R. Jagher in the El Kowm region of central Syria (BESANÇON *et al.,* 1981; COPELAND & HOURS, 1983; HOURS, 1982; HOURS *et al.,* 1983; HENNING *et al.,* 1982; LE TENSORER & HOURS, 1989; LE TENSORER *et al.*,1997, 2001, 2011, 2018; LE TENSORER, 2004, 2005; WOJTCZAK 2015; JAGHER *et al.*, 2016). Y. Nishiaki and T. Akazawa (NISHIAKI *et al.,* 2011, 2017; AKAZAWA & NISHIAKI, 2017) also attributed assemblages from Dederiyeh (northern Syria) to the Yabrudian, as did A. Vincent for several Levantine sites (VINCENT, 1985). The bifaces or bifacial pieces which are found alongside Yabrudian scrapers differ in terms of technology from Upper Acheulean bifaces in the Levant. This was noted by A. Rust himself (RUST, 1950) and several other researchers (BORDES, 1977; LE TENSORER *et al.,* 1997; LE TENSORER, 2005; ZAIDNER *et al., 2006*; AL QADI, 2008, 2011). The term "Yabudian" thus represents the accumulated work of multiple researchers and is still applied to several sites, including the eponymous site of Yabroud. In this sense, the original definition of the "Yabudian" still remains the most pertinent.

Several researchers have noted technological similarities between the Yabrudian and the Quina Mousterian of south-west France (BORDES & BOURGON, 1951; LENOIR, 1973; LE TENSORER, 1976; VERJUX & ROUSSEAU, 1986; TURQ, 1985; MEIGNEN, 1988; VERJUX, 1988; ROLLAND & DIBBLE, 1990; BOURGUIGNON, 1997). In his study of the Yabrudian industries from Yabroud, F. Bordes concluded that this facies is very close in both typology and technology to the Quina Mousterian (BORDES, 1955). Le Tensorer also saw similarities in these two types of industries (LE TENSORER, 2005). Subsequently, L. Bourguignon, who carried out a technological analysis of the Yabrudian industries from layers 25, 22 and 21 of Yabroud shelter I, compared Yabrudian and Quina Mousterian assemblages from a technological standpoint. Generally speaking, she suggests that the Yabrudian has thick, short and wide blanks with plain or dihedral platforms, demonstrating the alternating exploitation of two surfaces of the block; asymmetrical blanks are well represented and the Yabrudian is technically similar to the Quina Mousterian (BOURGUIGNON, 1997).

In order to better define and understand Yabrudian industries, we have applied a tried and tested approach to lithic analysis. As mentioned above, a technological relationship between the Yabrudian and the Quina Mousterian has been suggested. This has led to the use of specific terms traditionally used to describe the Quina Mousterian, such as "Yabrudian scrapers with Quina retouch" or even "Quina debitage", being applied to the Yabrudian. A. Rust first identified and described Yabrudian debitage in terms of blank and retouch types in 1930 (and published in 1950) before F. Bordes had defined the Quina Mousterian. In our investigation of the variability of the Yabrudian industries in the Levantine region, we have opted for the terms of Yabrudian debitage and "typical stepped-scaled retouch" rather than "Quina or Yabrudian retouch", and "atypical stepped -scaled retouch" in place of "semi-Quina or semi-Yabrudian". We prefer to remain descriptive rather than use a charged term for particular preparation processes of stepped-scaled retouch typical of certain Quina or Yabrudian scrapers as well as more recent industries such as those found in Patagonia (ESTELA *et al.,* 1987).

2. MATERIALS AND METHODS

The sites selected for the present study all contain long stratigraphic sequences in the central Levant. We chose the sites of Yabroud, in the semi-arid northern Levant, and Tabun, in the coastal zone, because of their historical importance and accessibility. Having been the subject of qualitative and quantitative studies, these sites constitute the main sources of data for our analysis. Qualitative studies from Adlun, which is located in a coastal zone by the shore of the northern part of southern Levant, were integrated for comparative purposes.

2.1. The site of Yabroud

The first excavations at Yabroud were carried out between 1930 and 1933 (RUST, 1950). Further excavations were directed from 1963 to 1965 by a Columbia University team (New York, USA) led by the Soleckis (SOLECKI & SOLECKI, 1966, 1987-1988; SOLECKI, 1968, 1970). The site of Yabroud comprises four rockshelters with multiple Palaeolithic occupations:

- Shelter I, the largest, contains occupations dating to the final Lower Palaeolithic and Middle Palaeolithic.
- Shelter II, about 380 metres to the east, produced Middle and Upper Palaeolithic occupations (RUST, 1950; SOLECKI & SOLECKI, 1966).
- Shelter III, roughly 200 metres from Shelter I, is dated to the Upper Palaeolithic and Epipalaeolithic (Rust, 1950, Solecki and Solecki, 1966).
- Shelter IV (about 150 m north of Shelter I), is attributed to the Tayacian (Lower Palaeolithic) by Solecki and Solecki (1966) and Solecki (1968).

Located in a basin with a large water table and springs fed by Wadi al Majarre to the south, the site of Yabroud supported the development of tree-lined areas forming an oasis with a microclimate favourable to human settlement.

Shelter I, the object of our study, is a rockshelter developed on the eastern slope of the Qalamoun massif, in the Anti-Lebanon Mountains (Fig. 3). The site lies in the Skifta Valley, at the edge of the steppe. Its 11 m thick fill was subdivided by Rust into 25 archaeological layers (Fig. 4) and produced several cultures, including Acheulean, Yabrudian, Micoquian, Mousterian and pre-Aurignacian. According to Rust, 11 of these contain Yabrudian material (layers 25, 24, 22, 21, 20, 19, 16, 14, 11, 8, 2).

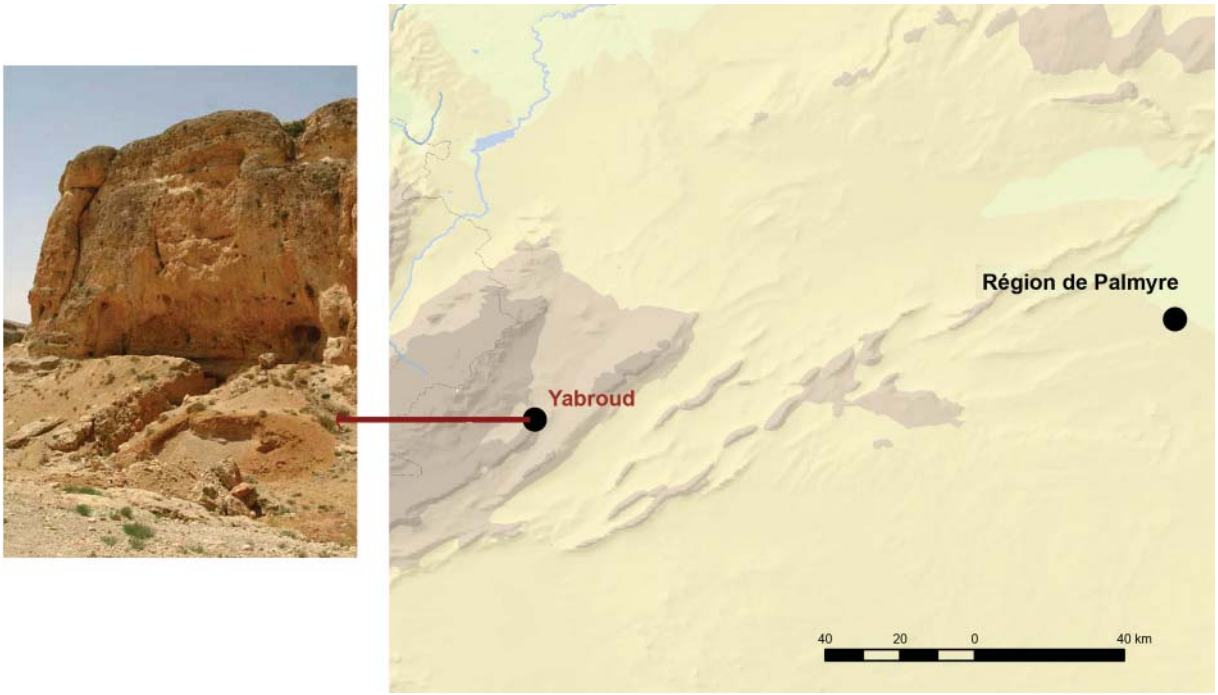


Fig. 3 – Location of the site of Yabroud in the Qalamoun mountainous region.

2.2. The site of Tabun

The site of Tabun is located on the western slope of Mount Carmel, about 20 km south of Haifa, near Wadi Mughara (Fig. 1). The cave has been the subject of several archaeological excavations since the 1920s (GARROD & BATE, 1937; JELINEK, 1981; JELINEK *et al.,* 1973; WEINSTEIN-EVRON & TSATSKIN, 1994). At an elevation of 45 m, it opens onto the plain of Ein

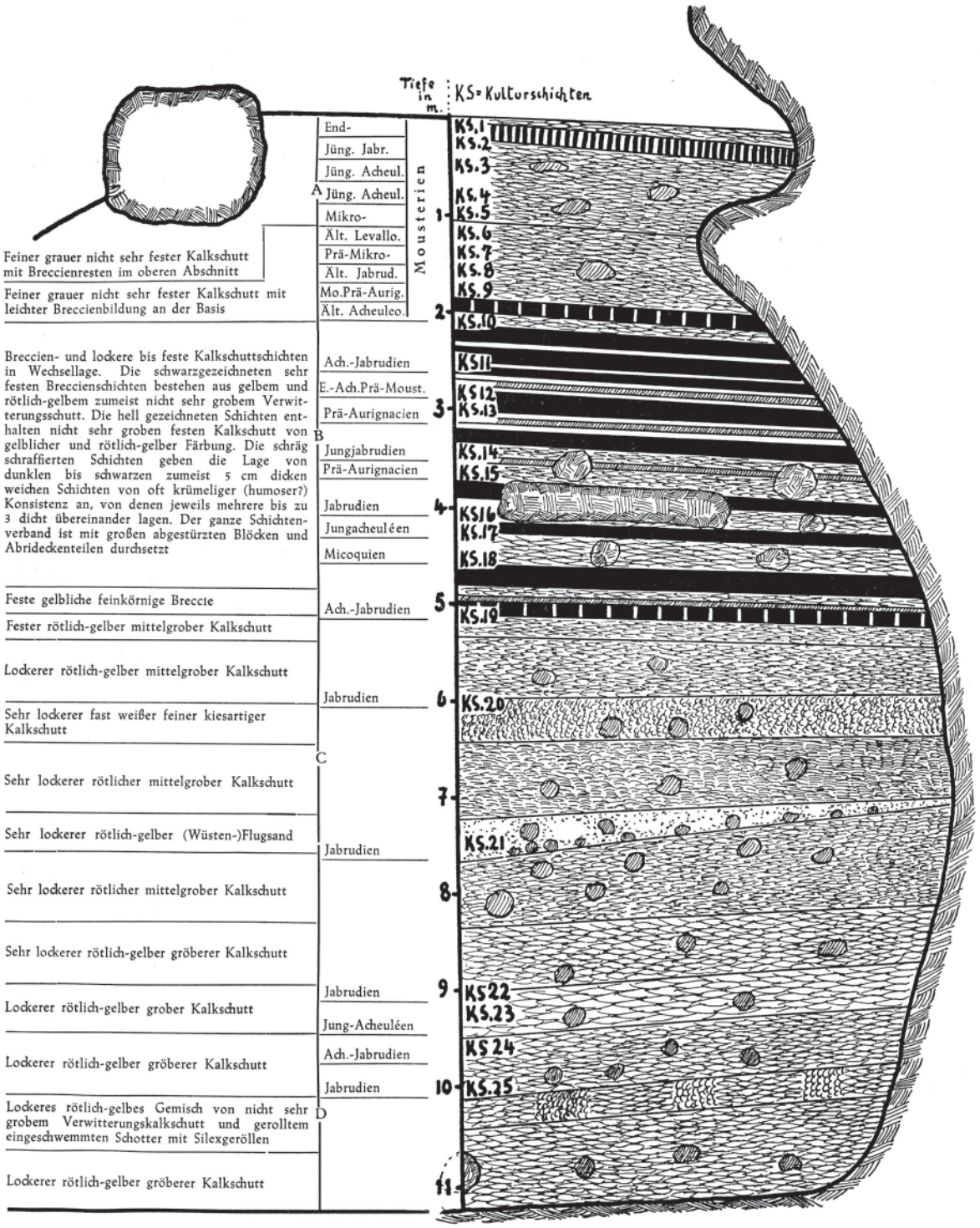


Fig. 4 – Alfred Rust's stratigraphic divisions of Shelter I at Yabroud. After RUST, 1950.

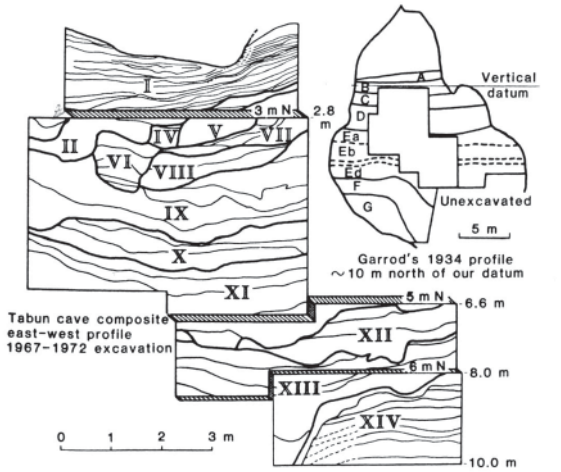


Fig. 5 – Stratigraphy from D. Garrod's excavations (1929-1934) and A. Jelinek's excavations (1967-1972). After GARROD & BATE, 1937 and JELINEK, 1982.

Carmel, which borders the Mediterranean. The site consists of a large open chamber and a small intermediate chamber which communicates with a third open chamber, whose missing roof is due to the collapse of a chimney during prehistoric times.

Tabun was the subject of three different excavation campaigns. During the first, between 1929 and 1934, D. A. E. Garrod divided the cultural sequence of the Early, Middle and Upper Palaeolithic into seven layers, attributed to the Tayacian (layer G), the Final Acheulean (layer F), the Micoquian (layer E), the Early Levallois-Mousterian (layers D and C), and the Upper Levallois-Mousterian (layer B). A second phase of excavations, carried out by A. J. Jelinek from 1967 to 1972, made it possible to refine the stratigraphic sequence by reorganising it into 14 units (I to XIV), all of which were divided into sub-layers, which were themselves subdivided into small groups based on associated artefacts (Fig. 5). According to Jelinek (1982), Unit XIV corresponds to the Final Acheulean, Unit XIII to the Acheuleo-Yabrudian, Unit XII to the Acheulean, Unit XI to the Yabrudian-Amudian, Unit X is a transitional phase between industries comprising blades and points, Unit IX is Mousterian, Units VIII-III also contain mixed material (all Mousterian), Unit II may represent a transitional industry between Garrod's Mousterian C and D and is characterised by large flakes and scrapers, and finally Unit I is assigned to the Mousterian. This finer stratigraphic division also aimed to correlate geological evidence of the Pleistocene environmental conditions with the presence of different lithic industries. The breakdown suggested by A.J. Jelinek allowed the characterisation of more than 85 layers over 10 metres of stratigraphy. Within this sequence, more than 300 contextual associations of artefacts could be determined, for a total of 44,000 recorded objects, including flakes. A third excavation campaign was carried out between 1975 and 2003 by A. Ronen and focused on the lower part of the Garrod's section (GISIS & RONEN, 2006; RONEN & TSATSKIN, 1995). For Gisis and Ronen, layer G belongs to the "Tayacian" cultural group (GISIS & RONEN, 2006).

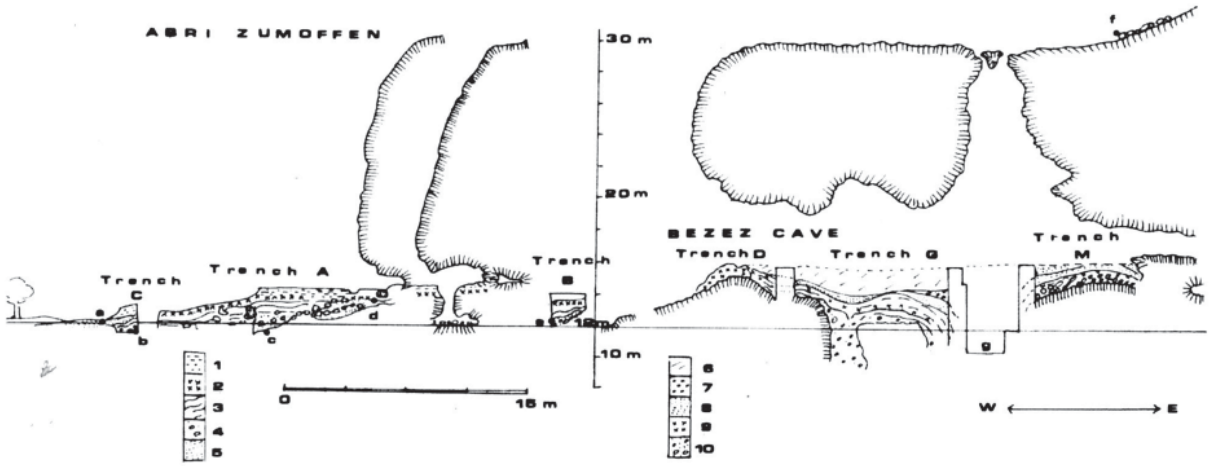
2.3. The site of Adlun

The site of Adlun is located 66 km south of Beirut, on the Lebanese coast, and comprises two locations : Zumofen rockshelter and Bezez Cave. The former was excavated in 1958 by Garrod and Kirkbride (GARROD & KIRKBRIDE, 1961) and produced both a Yabrudian and an Amudian level. The latter is more extensive and was excavated in 1963 (GARROD, 1966a; GARROD & HENRI-MARTIN, 1961; Fig. 6). Six trenches were sunk in both deposits.

Bezez Cave, whose Yabrudian material we studied at the University of Cambridge, yielded 25 geological layers, grouped by Garrod into three distinct cultural units: level C, at the base, about 30 cm thick with Acheuleo-Yabrudian material ; level B, of similar thickness, with Levallois-Mousterian material and level A, represented by small sedimentary lenses, which is dated to the Upper Palaeolithic (GARROD, 1966; COPELAND, 1983).

2.4. Methods

Our technological approach consists in applying the concept of chaîne opératoire used in prehistoric archaeology by A. Leroi-Gourhan (LEROI-GOURHAN, 1964), and then by numerous authors to highlight several types of Lower and Middle Palaeolithic reduction sequences (BORDES, 1950, 1961; BOËDA, 1986, 1988, 1991, 1993, 1995; MEIGNEN, 1988;



– Schematic cross section of the exposures at Adlun, arranged at random along a line 12 m. above sea-level. After the published sections of Garrod (1966) and Garrod and Kirkbride (1961).

1, Acheuleo-Yabrudian ; 2, Yabrudian ; 3, Amudian ; 4, Beach Industry ; 5, Pink sandstone beach ; 6, Neolithic ; 7. Level A (Aurignacian) ; 8, Level B (Levalloiso-Mousterian) ; 9, Level C (Acheuleo-Yabrudian); 10, Beach material. Points marking elevation above sea-level : a, 12 m. ; b, 11.51 m. ; c, 11.65 m. ; d, 13.65. ; 3, 12.48 m. ; f, the 33 m. beach above the cave ; g, swallowhole in Trench S.

Fig. 6 – Archaeological levels in Zumofen Rockshelter and Bezez Cave at Adlun. After COPELAND, 1978.

ASHTON, 1992; DELPECH *et al.,* 1995; GENESTE *et al.,* 1990; BOURGUIGNON, 1997). This analytical approach incorporates all elements of a lithic assemblage, independent of their size, in order to reconstruct all the stages in the manufacture of an artefact. Yabrudian industries are classified by technological categories following the various identified phases of the reduction sequence. These include retouched products, bifacial pieces, shaping flakes and cores. In order to illustrate our data and support our interpretations, we provide illustrations and graphic representation of the lithic material.

Studying several Yabrudian lithic assemblages from sites located over a vast and diverse geographic area, sheds new light on Yabrudian reduction sequences. This technological approach offers the possibility to document the diversity and variability of Yabrudian industries. The initial aim of these analyses is therefore to re-establish the Yabrudian 'chaîne opératoire', to define the Yabrudian in the Levantine region, and, finally, to attempt to understand the origin and subsequent evolution of this facies. These technological studies also provide an opportunity to clarify the potential technological homogeneity or diversity of the Yabrudian between the southern and northern Levant.

For this purpose, we analysed three assemblages: (1) Yabroud (Shelter I), (University of Cologne collection, Germany, under the supervision of Prof J. Richter, layers with a Yabrudian component, Rust excavations 1930-1933), (2) Tabun (Unit XIII, University of Arizona collections, USA, under the supervision of Prof S. Kuhn, Jelinek excavations 1967-1972) and (3) Adlun (level C of Bezez Cave, University of Cambridge collections, UK). These are the largest Yabrudian collections available (especially Yabroud and Tabun) and come from contexts whose stratigraphic position is well documented. As far as Yabroud is concerned, all lithic assemblages were examined and every industry assigned to the Yabrudian was laid out for analysis, comprising all layers of shelter I, which we refer to here as layers with a Yabrudian component (25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 14, 12, 11, 10, 8), amounting to 554 pieces.

For Tabun, we focused on the material from Unit XIII as it is the most abundant in terms of Yabrudian industries, which were studied in greater depth during our analyses. In total, 8722 artefacts were divided into 4 categories: 358 bifacial pieces, 1230 cores, 2408 scrapers and 4726 flakes. We sampled 1000 pieces from these

4 categories in equal proportions. We occasionally incorporated elements from other Units (XIV, XII, XI) in the analysis for better comparison.

Before moving on to the detailed comparisons of all three Yabrudian assemblages mentioned above (Yabroud, Tabun and Adlun), we present a qualitative analysis of the so-called 'Tayacian' level from Unit XIV at Tabun. This choice is based on the presence of Yabrudian-type elements (scrapers on thick blanks, re-sharpening flakes, similar Quina-type cores) while also maintaining the chronological order of the various facies discussed in this work. For Adlun, we studied all industries from level C of Bezez Cave (Cambridge University collections), numbering 204 pieces. Here we discuss technological classes, production goals, tool transformation, modalities of flake production and retouch before exploring diachronic and synchronic assemblage variability. Finally, we conclude with a chronological, environmental and geographical approach, and perspectives concerning population movements.

3. RESULTS

3.1. Analysis of the 'Tayacian' level of Tabun Unit XIV

Referred to as Unit XIV by A. Jelinek, this level corresponds to layer G of D. Garrod's stratigraphic profile, which she attributed to the

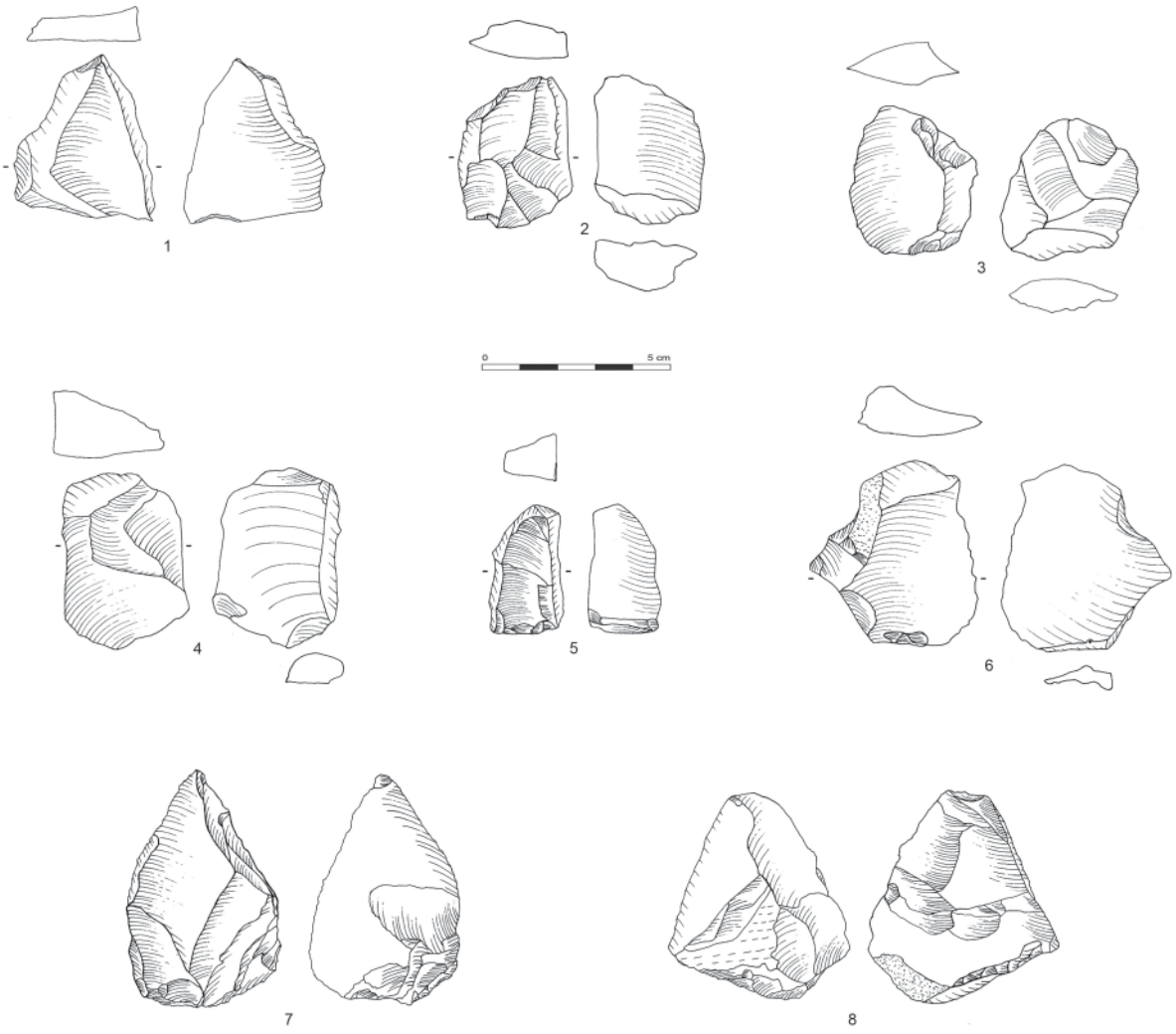


Fig. 7 – 'Tayacian' flakes, Tabun (Unit XIV). Drawings A. Al Qadi.

'Tayacian' (GARROD & BATE, 1937) based on a comparison with the material identified by Peyrony from layer C of La Micoque (Les Eyzies de Tayac) in southern France, and attributed to the Tayacian by Abbé Breuil (PEYRONY, 1938). This term is tied to a series of levels at La Micoque, below what was described as Micoquian, which included Clactonian debitage and Mousterian-like sidescrapers (PEYRONY, 1938). Unit XIV was later attributed by A. Jelinek to the Final Acheulean due to the presence of bifacial pieces.

Our analysis of the material from this unit documents the presence of flakes associated with scrapers made on thick blanks with typical scaled-stepped retouch, as well as cores and bifacial pieces. Flakes are thick, Clactonian in type, and removed by hard hammer percussion (Fig. 7). This production of short, thick flakes, is also evident on some of the cores (removal negatives) and on the dorsal surfaces of certain flakes. Most of these flakes have more or less extensive abrupt backs (Fig. 7:4-5, 8), while platforms are

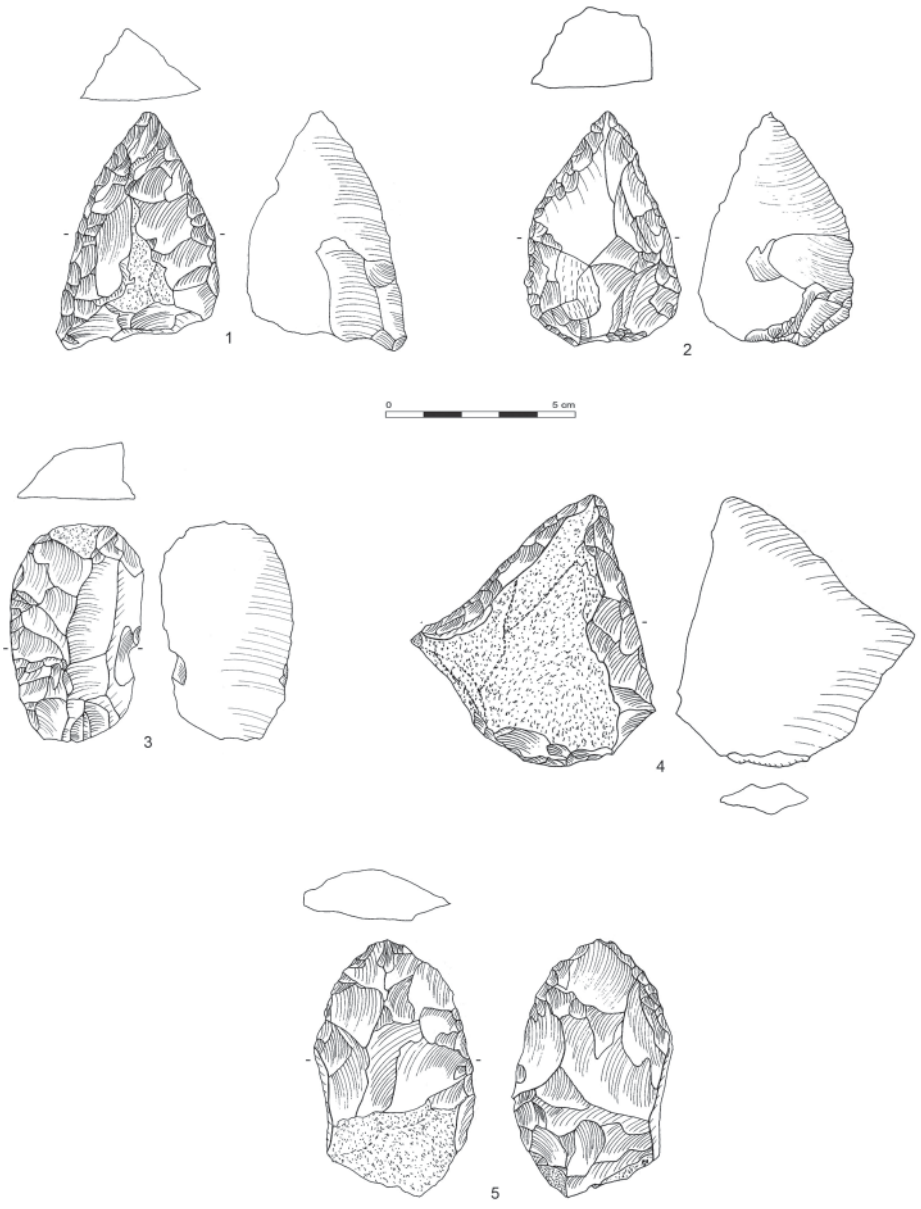


Fig. 8 – 1-4. Scrapers with typical and atypical scaled-stepped retouch.
5. Bifacial piece, Tabun (Unit XIV). Drawings A. Al Qadi.

often plain and wide (Fig. 7:2-4). Dorsal surfaces bear several, often unipolar flake negatives. Kombewa flakes are also present (Fig. 7:3-4). These flakes are technologically similar to those from unit G at Hummal, referred to as 'Oldowan' (LE TENSORER *et al.,* 2011; WEGMÜLLER, 2015; LE TENSORER *et al.,* 2018). Flakes from unit XIV also present similarities with 'Tayacian' flakes from level C of Bezez Cave (COPELAND, 1983).

3.1.1. Retouched products

Scrapers

Some flakes from Unit XIV were transformed into scrapers, with typical and atypical scaled stepped retouch. Single (Fig. 8:3), offset and convergent scrapers (Fig. 8:1-2, 4), made on cortical and non-cortical blanks with plain striking platforms (Fig. 8:4). Scraper dimensions, which are larger than those of the 'Tayacian' flakes described above, suggest that large flakes may have been preferentially selected to be transformed into scrapers (Fig. 9). These scraper forms are similar to those from Yabrudian industries where we observe similar technical features: scrapers made on thick blanks with scaled-stepped retouch, often associated with plain and wide striking platforms.

Bifacial pieces

Unit XIV was attributed by A. Jelinek to the Final Acheulean due to the presence of bifaces or bifacial pieces in the assemblage. The association of bifaces with 'Tayacian' reduction sequences seems entirely consistent, as can be seen at other Levantine sites and further afield (see below). The bifaces from this level exhibit

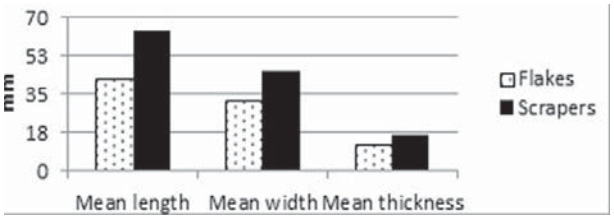


Fig. 9 – Mean length, width and thickness of flakes and scrapers from Unit XIV, Tabun.

little symmetry, and are partially backed with irregular edges (Fig. 10). These thick pieces are made on blanks detached by hard-hammer percussion from blocks and often bear rough basal extremities.

Cortical zones, partially preserved on edges or at the base, show that blows do not remove material from the entire surface of the piece nor the entire length of the edge. Bifacial pieces from Tabun's 'Tayacian' Level of Unit XIV bear similarities to thick, irregular-edged bifaces with scaled retouch from Umm Qatafa level E, described by R. Neuville as 'Middle Acheulean' (Fig. 11). This latter level also produced an assemblage geared towards obtaining 'Tayacian' flakes. We also encounter these types of pieces with bifaces in the 'Oldowan' level at Hummal (WEGMÜLLER, 2015; Fig. 12).

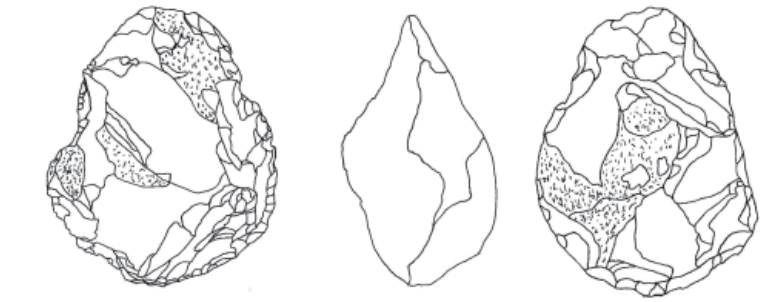
3.1.2. Re-sharpening and recycling flakes

We identified two re-sharpening flakes, both of which removed part of the biface's active edge. The first one is fan-shaped, removed with a hard hammer and exhibits negatives from a scraper with atypical scaled-stepped retouch at its proximo-dorsal end. This flake was subsequently reworked into a small transverse scraper (Fig. 13:1) and corresponds to type IV of the typology applied to Yabrudian industries, based on the classification established by Laurence Bourguignon for the Quina Mousterian (BOURGUIGNON, 1997, 2001). The second piece is a core edge flake (*éclat débordant*), removed from the extremity of a lateral cutting edge (Fig. 13:2). It could be classed as type 'VI atypical', considering the initial cutting edge does not bear scaled stepped-scaled retouch and therefore does not precisely correspond to a type IV flake (BOURGUIGNON, 1997, 2001).

3.1.3. Cores

The assemblage contains cores with either a prismatic (Fig. 15:4) or discoidal volume, where removals were detached in a similar manner on two opposed surfaces. These cores are heavily

Fig. 10 – (opposite page) Bifacial pieces. Tabun (Unit XIV). Drawings A. Al Qadi.



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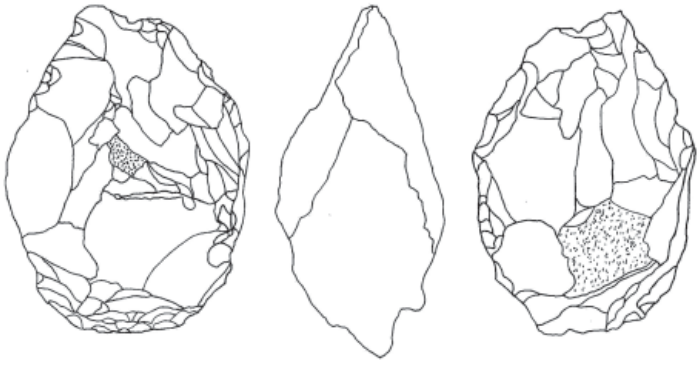

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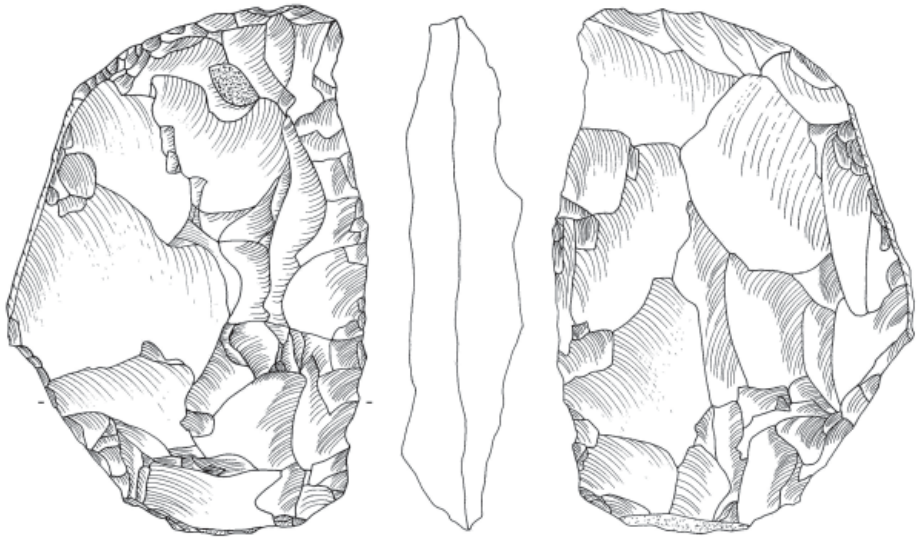


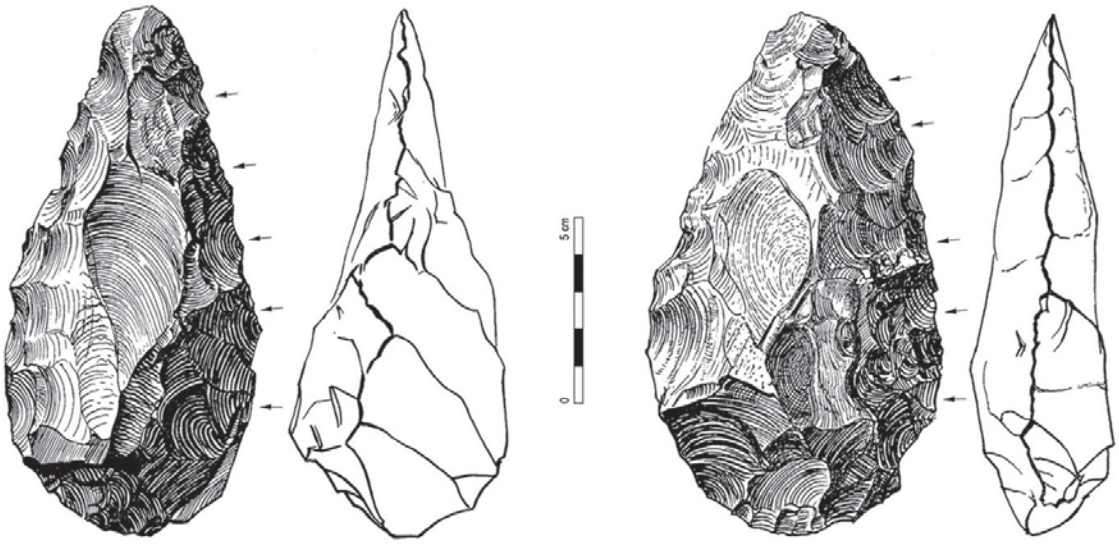


Fig. 11 – Bifaces with scaled retouch from level E at Oumm Qatafa. After NEUVILLE *et al.*, 1951.

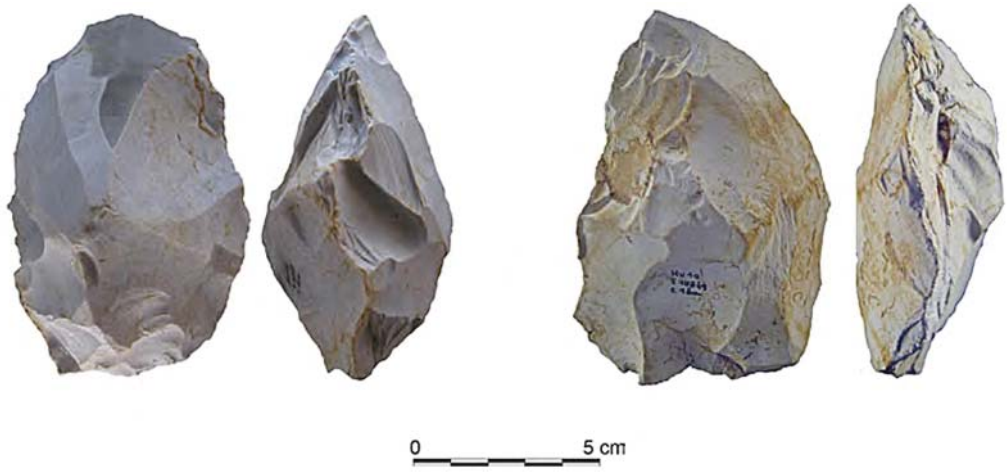


Fig. 12 – Bifaces from the "Oldowan" level, unit G in Hummal. After WEGMÜLLER, 2015.

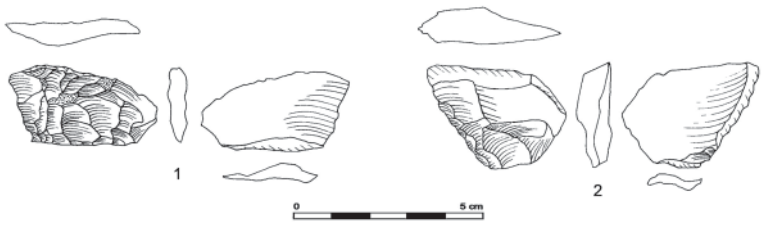


Fig. 13 – 1. Type IV re-sharpening flake,
2. Type VI re-sharpening flake recycled into a transverse scraper, Tabun (Unit XIV). Drawings A. Al Qadi.

exploited and present varied morphologies: sub-circular (Fig. 14:3), sub-quadrangular (Fig. 14:1, 5) and sub-triangular (Fig. 14:2, 4; Fig. 15:1, 3), with multi-directional removals and opportunistic flake production devoid of any preparation or hierarchy. Some of the cores are of a similar design to Yabrudian ones, sharing the same volumetric structure : a sub-parallel surface opposite a secant surface (Fig. 14:2-4, Fig. 15:1, 3). We also note the presence of a heavily reduced core-on-flake, where the dorsal surface of the flake is debited (Fig. 15:2).

Very few illustrated or described cores from Tayacian levels are available in the literature. Two cores from Umm Qatafa are described as 'Tayacian' (Fig. 16), which is a core on pebble with a sub-circular morphology. Two other cores from Hummal are attributed to the 'Oldowan' (Fig. 17). Both of these show a similar reduction pattern to the cores from Unit XIV. These cores are more or less prismatic in structure and produced a large

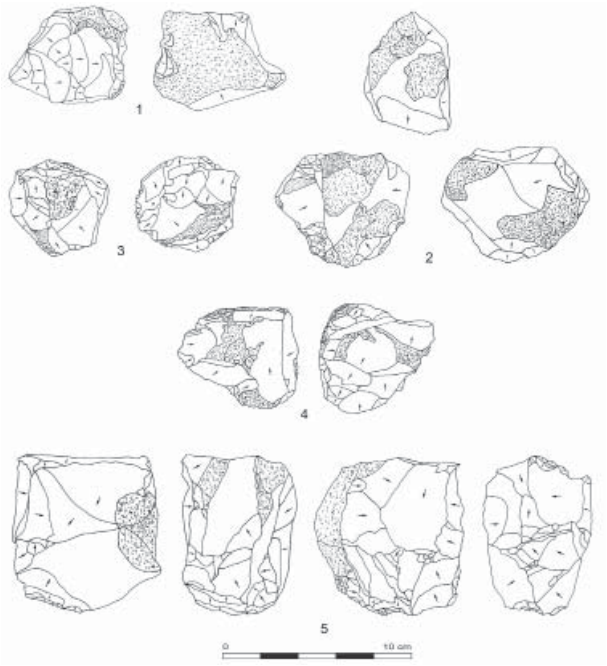


Fig. 14 – Cores from "Tayacian" level, Unit XIV, Tabun. Drawings A. Al Qadi.

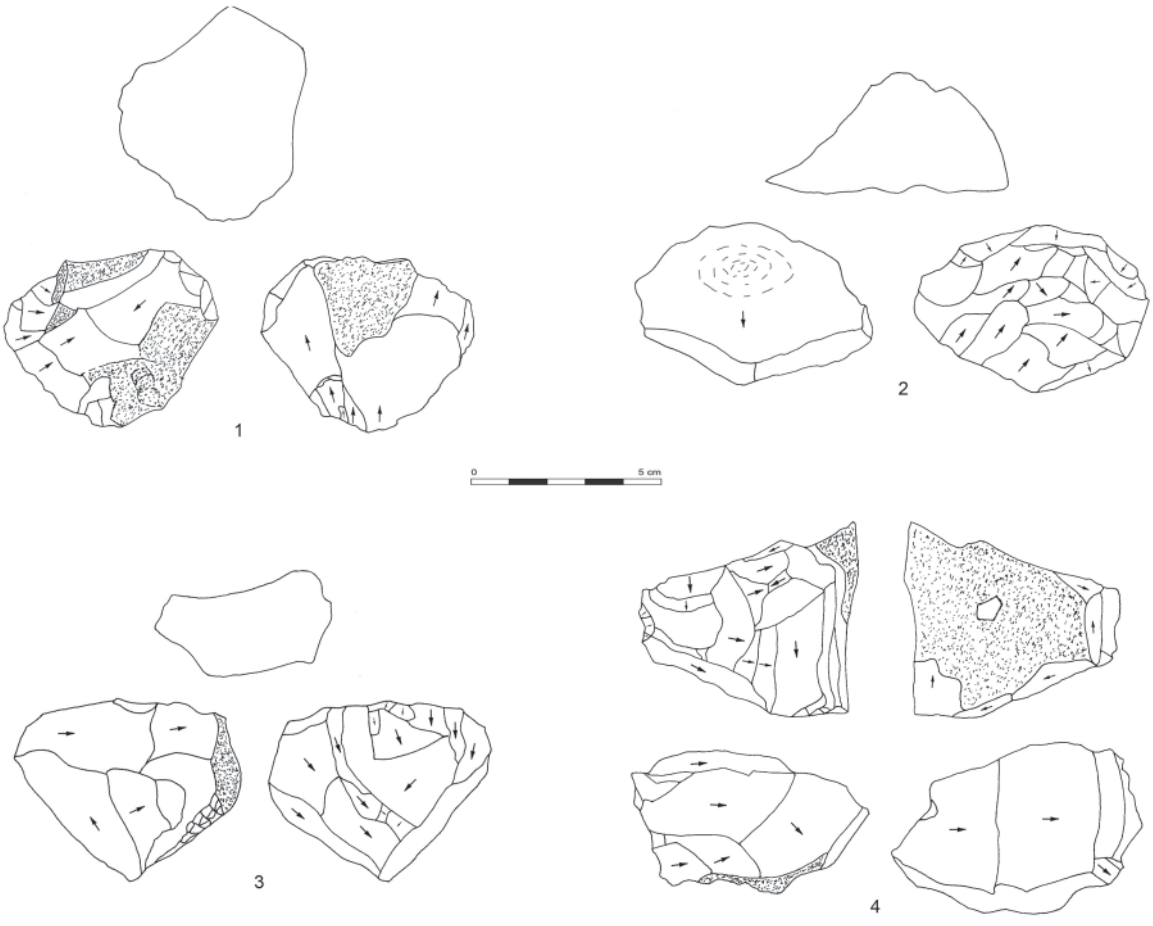


Fig. 15 – Cores from "Tayacian" level, Unit XIV, Tabun. Drawings A. Al Qadi.

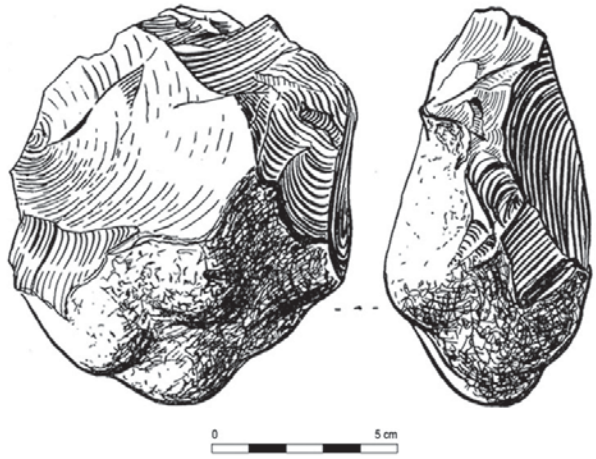


Fig. 16 – Cores from Oumm Qatafa. After NEUVILLE *et al.*, 1951.

number of flakes from bipolar surfaces (Fig. 14). Found in the 'Oldowan' level, these cores fit perfectly with 'Tayacian' industries.

3.2. Comparative analyses of Yabroud, Tabun and Adlun

We based our comparisons on the Yabrudian industries from three assemblages: Yabroud (layers with Yabrudian components, Rust excavations), Tabun (Unit XIII sample, University of Arizona collections) and Adlun (Bezez Cave Level C, Cambridge University collections).

3.2.1. Types of cortical and non-cortical blanks

Proportions of cortical blanks at Yabroud vary between layers. Layers 25, which contains most of the Yabrudian material from shelter I, contains 42% of all Yabrudian cortical blanks (n=220), and 17% of the total Yabrudian material.

Within Yabrudian component layers (layers 25, 24, 23, 22, 21, 20, 19, 16, 14, 12, 11, 10, 8), cortical blanks (Fig. 18:1-4, 7-8; Fig. 19:3-5; Fig. 20:2-4, 7) represent 39% of pieces overall (Tab. 1). Tabun Unit XIII produced more cortical than non-cortical blanks, contrarily to Yabroud (Fig. 21:1, 4, 6, 9; Fig. 22:1-2, 5-7). At Adlun, cortical blanks account for 22% of the total Yabrudian industries in Level C of Bezez Cave (Cambridge Collection; Fig. 23:1-4) and are less numerous than non-cortical blanks (Tab. 1). Retouched blanks (cortical and non-cortical) are well represented in all three assemblages, and blanks with asymmetrical sections are out numbered by symmetrical ones overall (Tab. 2).

3.2.2. Striking platforms

Plain platforms dominate in all three assemblages (Yabroud, Tabun, Adlun). They account for 58% of all platforms in the Yabrudian

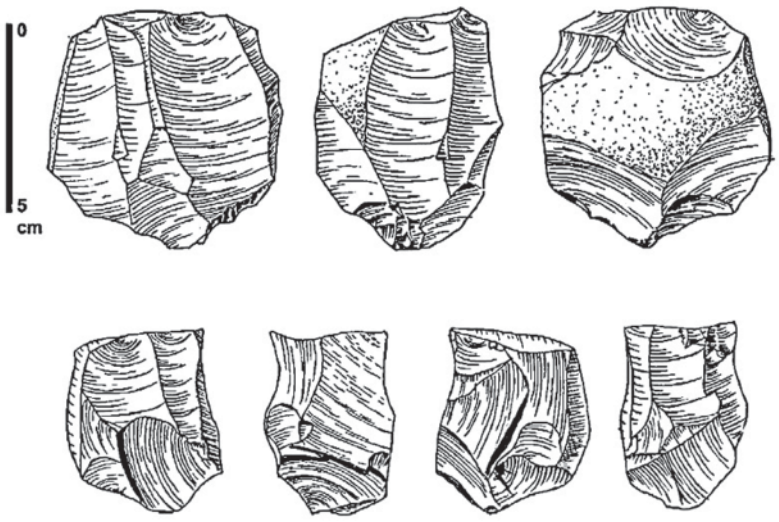


Fig. 17 – Cores from the "Oldowan" level at Hummal. After Le Tensorer *et al.*, 2011b.

material of shelter I of Yabroud (Fig. 18:4, 5, 7; Fig. 19:1; Fig. 20:1, 2, 5, 7).

Cortical and facetted platforms are less numerous, followed by asymmetrical dihedral platforms (Fig 18:2, 6) and symmetrical dihedral platforms (Tab. 3).

In Tabun Unit XIII, like Yabroud, platforms are mainly plain (56%, Fig. 21:1, 4, 8; Fig. 22:5,

Yabroud		*Tabun (XIII)*		*Adlun (Bezez Cave)*	
Total cortical blanks for Yabrudian industries of Yabroud I level 25	38%	Total cortical blanks from Unit XIII	58%	Total cortical blanks	22%
Including retouch	29%	Including retouch	41%	Including retouch	14%
Total objects	*554*	*Total objects*	*1000 piece sample*	*Total objects*	*204*
Total non-cortical blanks for Yabrudian industries of Yabroud I level 25	45%	Total non-cortical blanks from Unit XIII	26%	Total non-cortical blanks	40%
Including retouch	33%	Including retouch	16%	Including retouch	25%
Total objects	*554*	*Total objects*	*1000 piece sample*	*Total objects*	*204*

Tab. 1 – Proportions of cortical and non-cortical blanks in assemblages from Yabroud I, Tabun and Adlun.

Yabroud		*Tabun XIII*		*Adlun (Bezez Cave)*	
Total blanks	*Percentage of blanks with an asymmetrical section*	*Total blanks*	*Percentage of blanks with an asymmetrical section*	*Total blanks*	*Percentage of blanks with an asymmetrical section*
100%	24%	100%	29%	100%	15%
Type of back	Percentage	Type of back	Percentage	Type of back	Percentage
Cortical	36%	Cortical	36%	Cortical	63%
Unworked	34%	Unworked	33%	Unworked	27%
Worked	25%	Worked	25%	Worked	10%
Natural	5%	Natural	6%	Natural	0%
Total objects	*554*	*Total objects*	*1000 piece sample*	*Total objects*	*204*

Tab. 2 – Proportions of blanks with an asymmetrical section for assemblages from Yabroud I, Tabun and Adlun.

Yabroud		*Tabun XIII*		*Adlun (Bezez Cave)*	
Type of platform	*Percentage*	*Type of platform*	*Percentage*	*Type of platform*	*Percentage*
Plain	58%	Plain	56%	Plain	67%
Cortical	20%	Cortical	11%	Cortical	16%
Asymmetric dihedral	6%	Asymmetric dihedral	7%	Asymmetric dihedral	3%
Symmetric dihedral	2%	Symmetric dihedral	3%	Symmetric dihedral	0%
Facetted	14%	Facetted	5%	Facetted	5%
Total objects	*554*	*Total objects*	*1000 piece sample*	*Total objects*	*204*

Tab. 3 – Proportion of different types of striking platforms for assemblages from Yabroud I, Tabun and Adlun.

7, 8), followed by cortical, dihedral (Fig. 21:3, 5, 7) and facetted types (Tab. 3). At Adlun, plain striking platforms also dominate (Fig. 23:3-4).

3.2.3. Retouched products

Two types of retouched products are present in the Yabrudian assemblages : scrapers and bifacial pieces. Scrapers are well represented at Yabroud and Tabun (Unit XIII). At Adlun, Bezez Cave level C (Cambridge Collection), retouched pieces are less numerous than at both Yabroud and Tabun (Tab. 4).

Scrapers are more numerous than bifacial pieces overall (Tab. 5) and comprise several types.

Fig. 18 – Single scrapers, Yabroud (layers 25, 16, 14). Drawings A. Al Qadi.

Single scrapers are the most numerous in all three assemblages. At Yabroud, this type dominates in all layers with a Yabrudian component (Fig. 18), followed by offset (Fig. 19) and transverse scrapers (Fig. 20). At Tabun, Unit XIII, single scrapers also dominate (Fig. 21), with offset and transverse types in equal proportions (Figs 21-22). At Adlun, single scrapers are in the majority for Level C

Yabroud		*Tabun (XIII)*		*Adlun (Bezez Cave)*	
Retouched blanks	62%	Retouched blanks	57%	Retouched blanks	39%
Total objects	*554*	*Total objects*	*1000 piece sample*	*Total objects*	*204*

Tab. 4 – Proportion of retouched blanks assemblages from Yabroud I, Tabun and Adlun.

Yabroud		*Tabun (XIII)*		*Adlun (Bezez Cave)*	
Single scrapers	37%	Single scrapers s	51%	Single scrapers	54%
Offset scrapers	19%	Offset scrapers	16%	Offset scrapers	5%
Transverse scrapers	11%	Transverse scrapers	16%	Transverse scrapers	28%
Total scrapers	*318*	*Total scrapers*	*1000 piece sample*	*Total scrapers*	*204*

Tab. 5 – Scraper proportions for assemblages from Yabroud I, Tabun and Adlun.

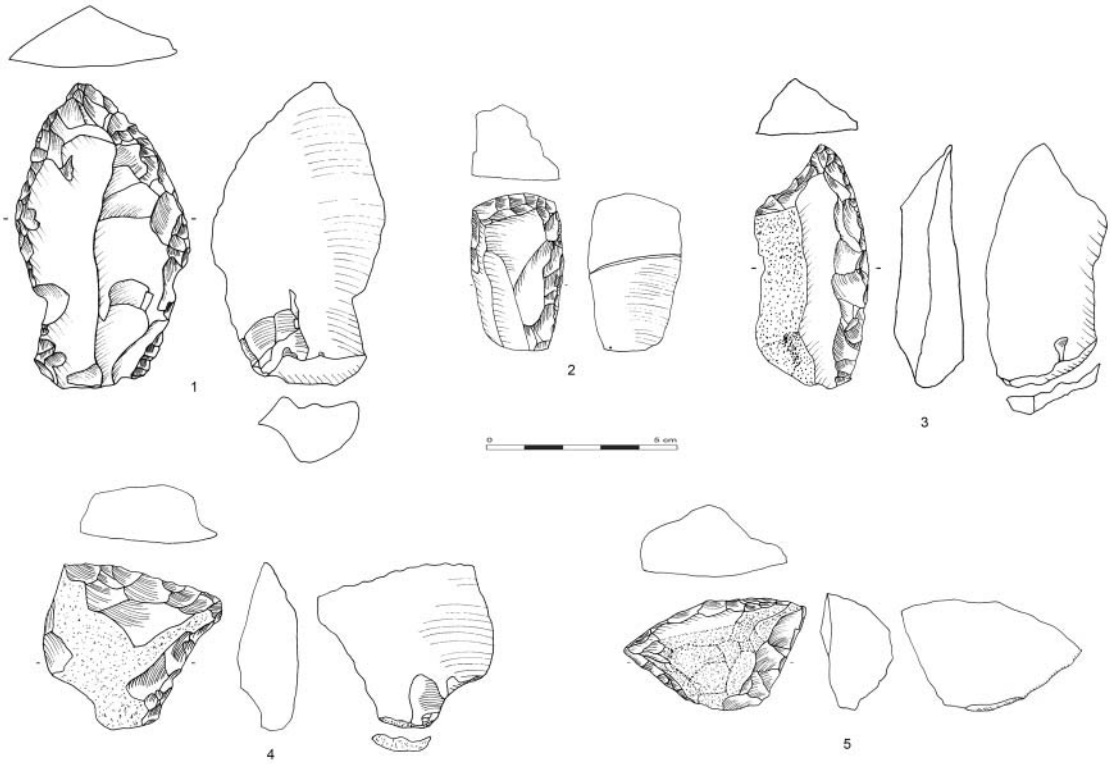


Fig. 19 – Offset scrapers, Yabroud (layers 25, 22, 16, 14). Drawings A. Al Qadi.

of Bezez Cave (Fig. 23) followed by transverse scrapers (Fig. 24).

In addition to single scrapers, double and convergent scrapers are present in modest numbers in all three assemblages.

At Yabroud, shelter I, bifacial pieces account for 5% of all Yabrudian material (Fig. 25), which is similar to Tabun with 7% (Fig. 26). At Adlun, the number of bifacial pieces is more important than at Yabroud and Tabun (Fig. 27), and close to that of scrapers (Tab. 6).

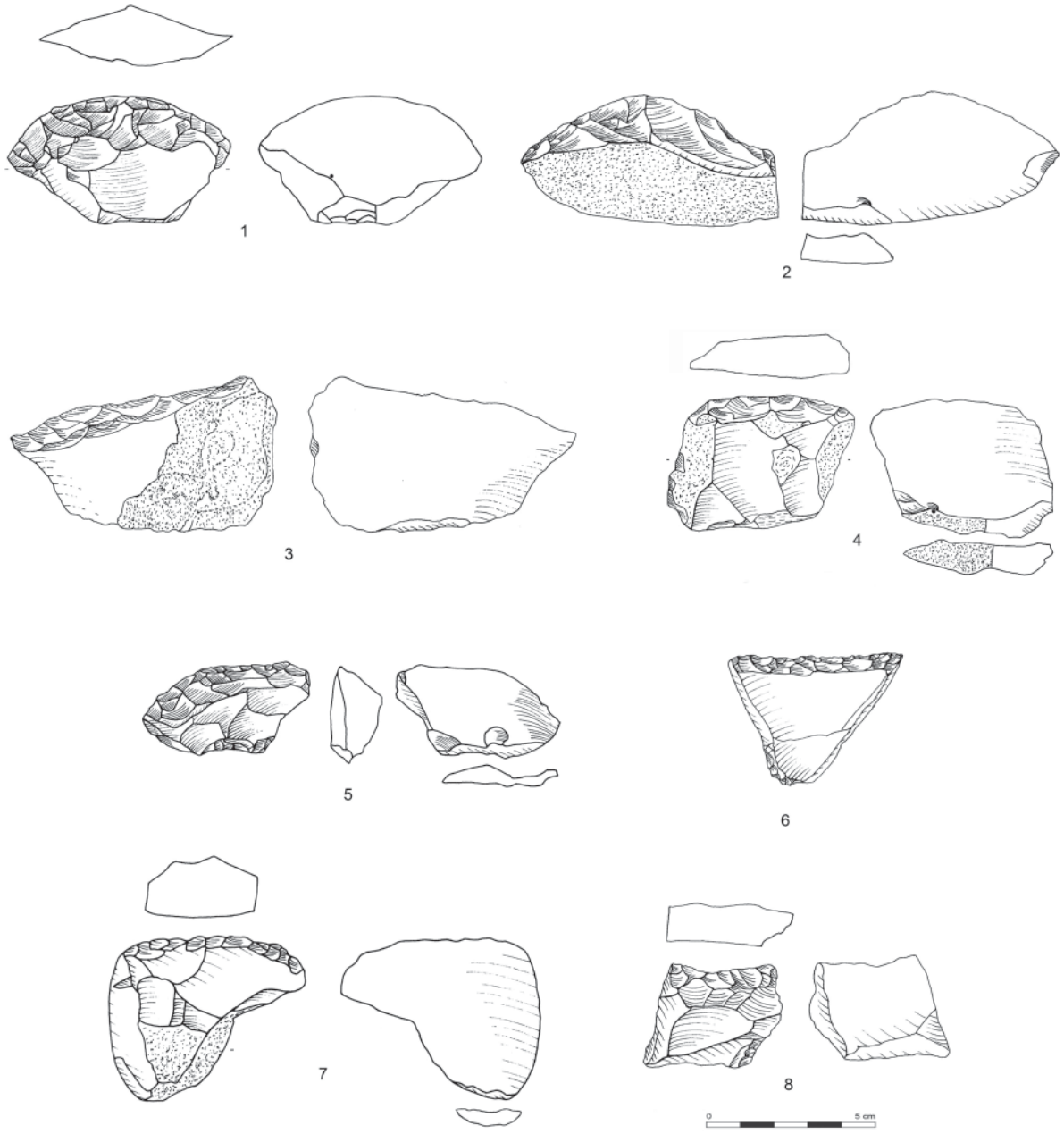


Fig. 20 – Transverse scrapers,Yabroud (layers 24, 22, 19, 16, 14, 10). Drawings A. Al Qadi.

Yabroud		*Tabun (XIII)*		*Adlun (Bezez Cave)*	
Bifacial pieces	5%	Bifacial pieces	7%	Bifacial pieces	33%
Total objects	*554*	*Total objects*	*1000 piece sample*	*Total objects*	*204*

Tab. 6 – Proportion of bifacial pieces for assemblages from Yabroud I, Tabun and Adlun.

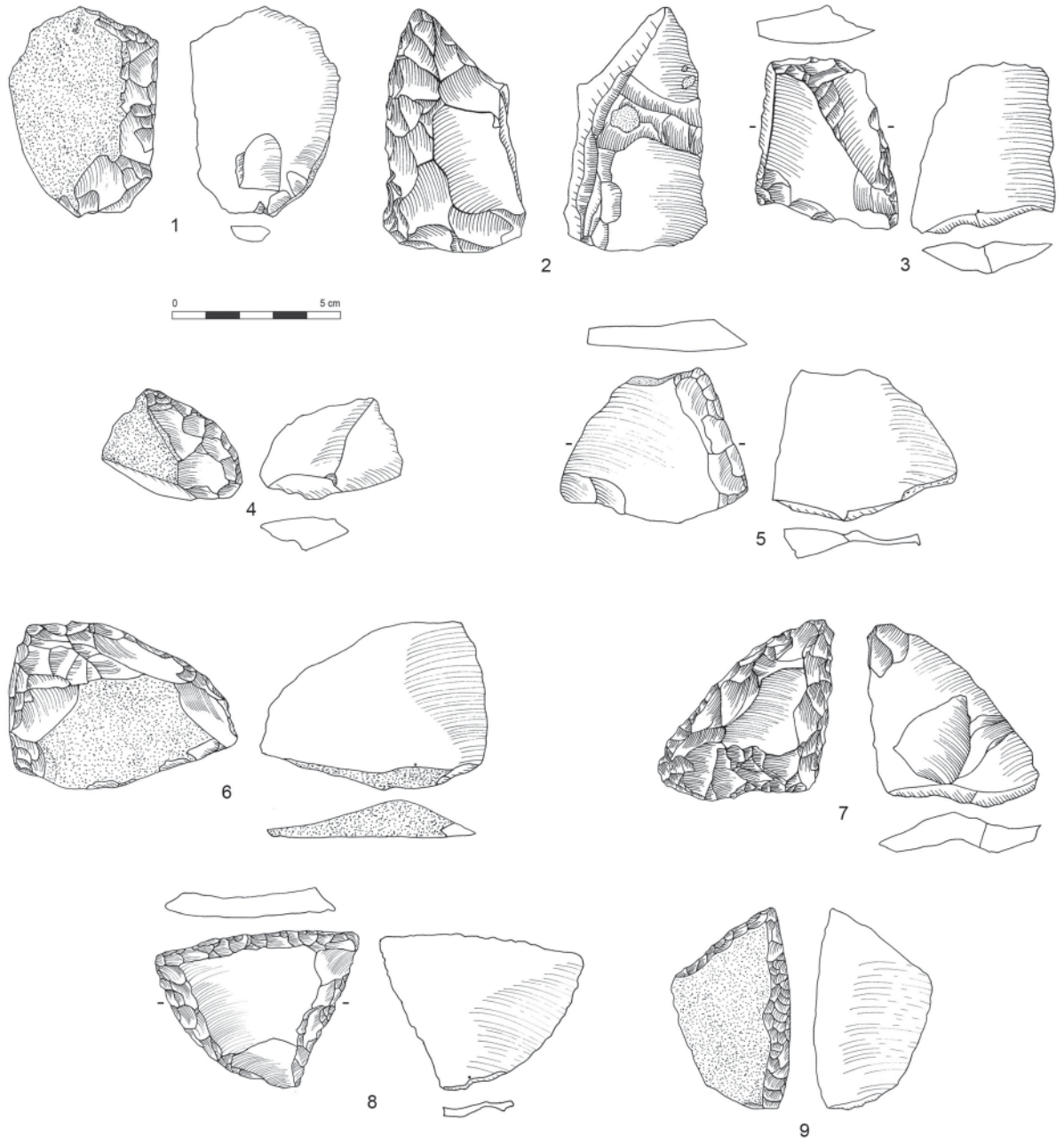


Fig. 21 – Single and offset scrapers, Tabun (Unit XIII). Drawings A. Al Qadi.

3.2.4. Management, re-sharpening and re-cycling flakes

Re-sharpening and bifacial thinning flakes are present in the Yabroud and Tabun assemblages, whereas they are absent in Level C of Bezez Cave (Cambridge Collection). At Yabroud, management, re-sharpening and recycling flakes account for 11% (n=59) of the total Yabrudian material from Shelter I (Tab. 7). Type IV flakes in

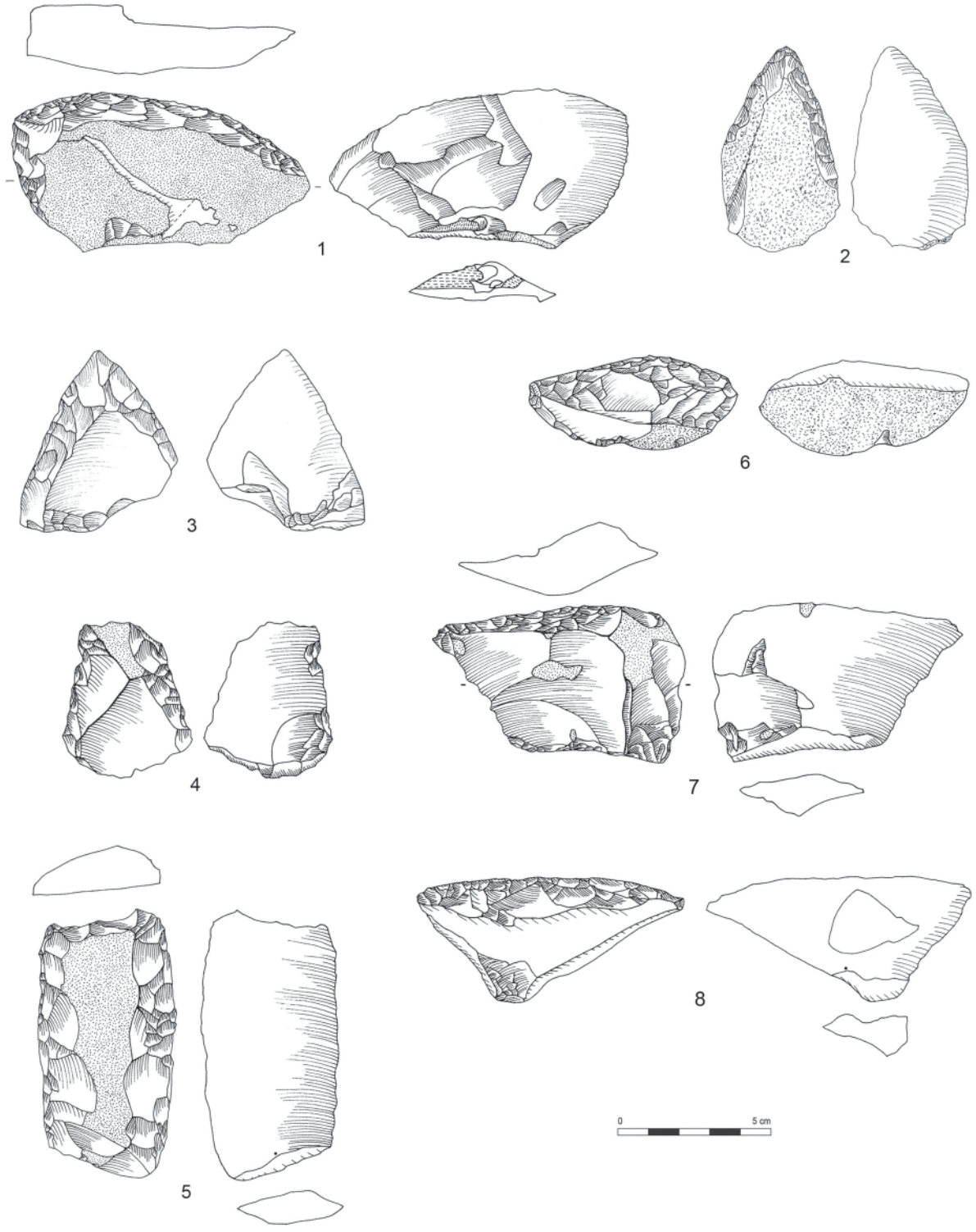


Fig. 22 – Offset and transverse scrapers, Tabun (Unit XIII). Drawings A. Al Qadi.

the Quina Mousterian typology (BOURGUIGNON, 1997) are the most frequent, accounting for 25% of flakes from this group. This type represents re-sharpening elements with convex profiles that carry negatives in their proximal portion. These flakes have thick cross-section which results from

Yabroud		*Tabun (XIII)*		*Adlun (Bezez Cave)*	
Retouch flakes	11%	Retouch flakes	1%	Retouch flakes	0%
Total objects	*554*	*Total objects*	*1000 piece sample*	*Total objects*	*204*

Tab. 7 – Proportion of retouch flakes for assemblages from Yabroud I, Tabun and Adlun.

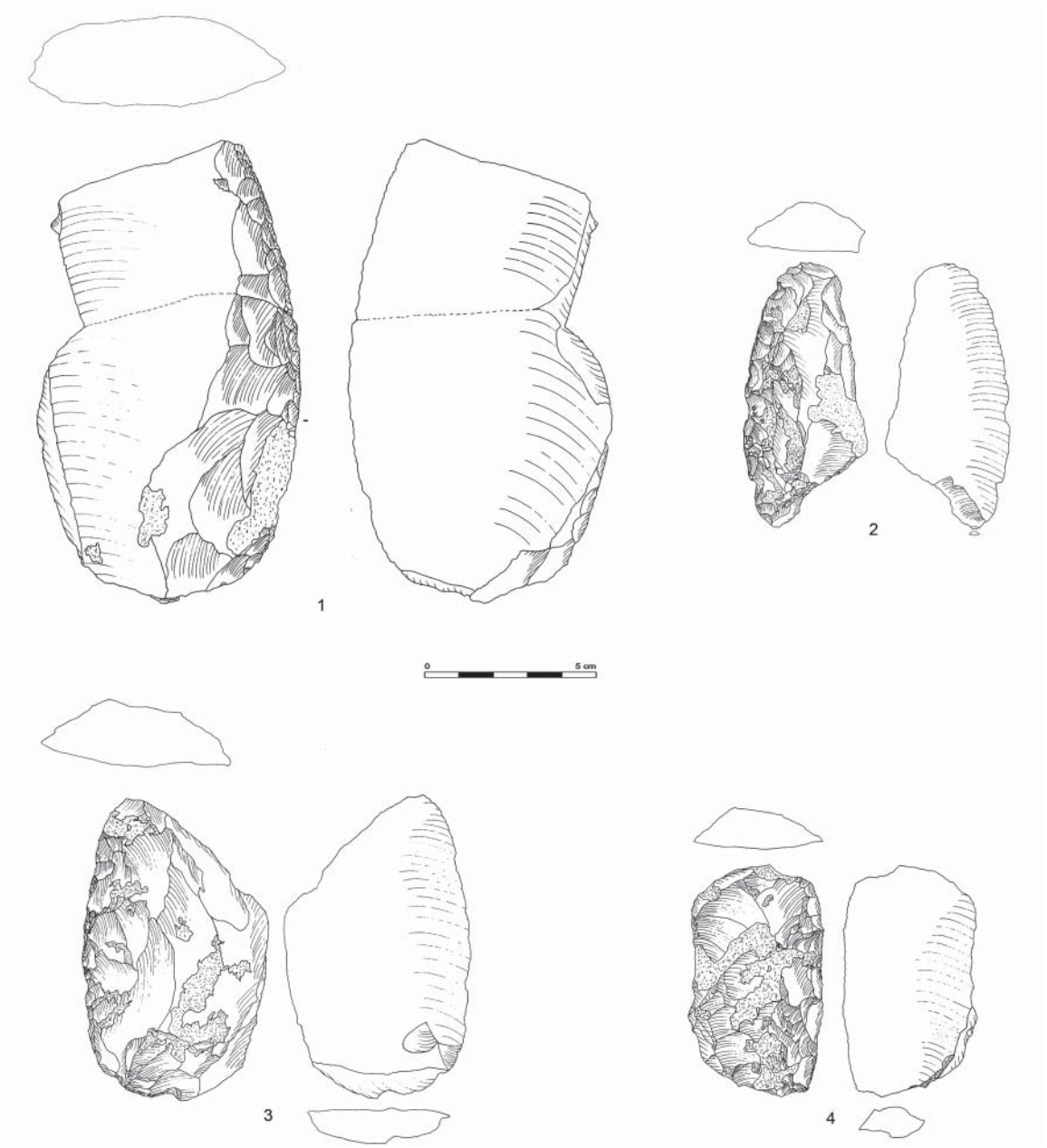


Fig. 23 – Single scrapers, Adlun, (level C, Bezez Cave). Drawings A. Al Qadi.

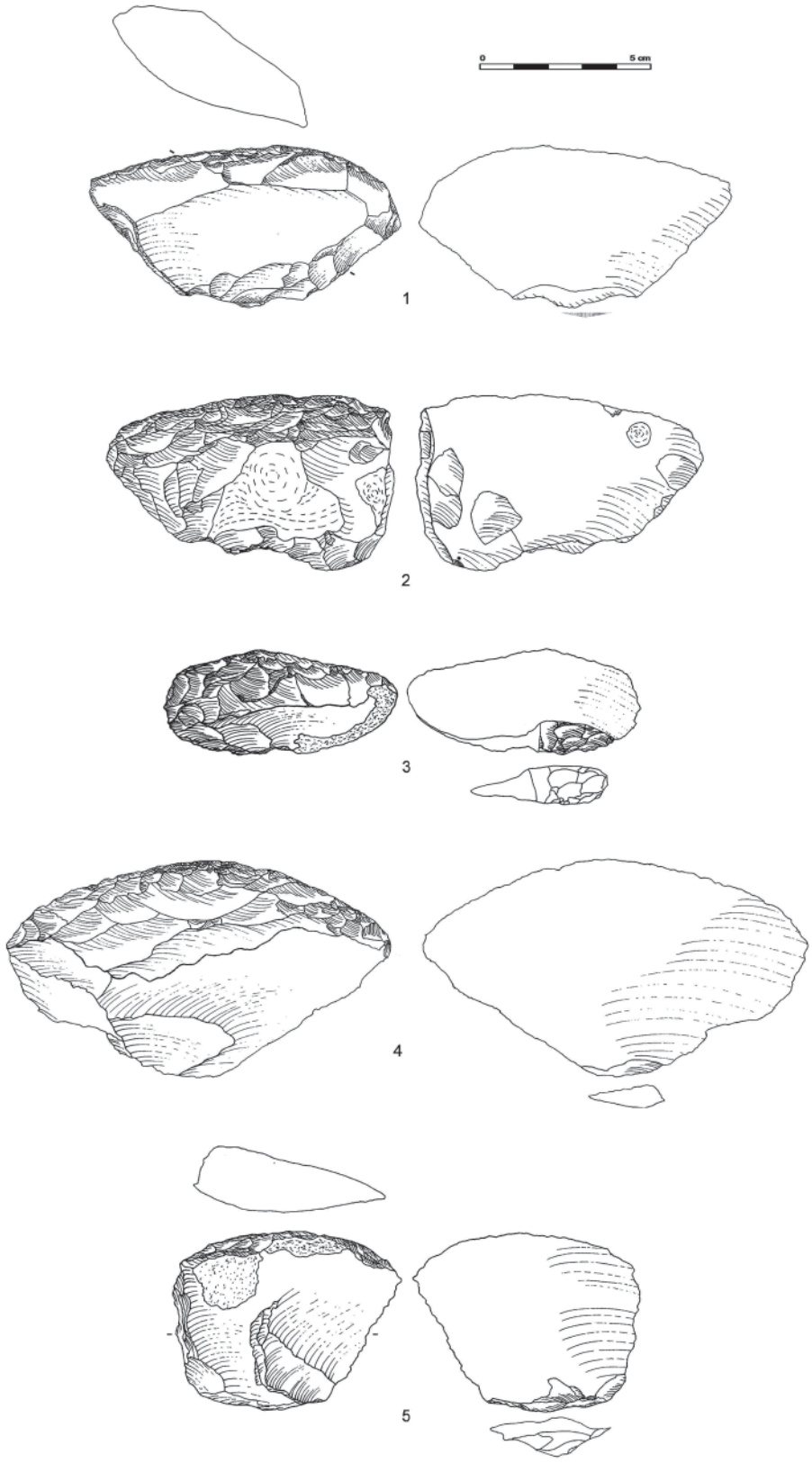


Fig. 24 – Transverse scrapers, Adlun, (Level C, Bezez Cave). Drawings A. Al Qadi.

the use of a hard hammer, and have a plain, wide platform reflecting direct percussion (Fig. 28:12-17). Type III flakes (BOURGUIGNON, 1997) have thin platforms and convex profiles resulting from soft-hammer percussion. They are relatively thick and wider than they are long. This group of flakes have plain, thin platforms, indicating the use of a soft hammer and a tangential blow to create a new scraper edge (Fig. 28:8-11).

Type 0 accounts for 5% of all management flakes. These flakes do not bear previous flake negatives and are removed with a soft hammer, as demonstrated by their thin plain, facetted or cortical platforms (Fig. 28:1-3). Type I flakes are rare (3%) and are characterized by small, convex flakes with negatives on the entire dorsal surface (Fig. 28:4-5). Types 0 and I are detached during the installation of the first row of retouch on the scraper's edge (BOURGUIGNON, 1997). Type II flakes are present in equal proportion to Type I. These fan-shaped flakes with thin platforms (lip) and plain thin platforms are detached with a soft hammer and bear flake negatives at their proximal ends (Fig. 28:6-7). In addition to these two flake types, we can note the presence of a large, considerably thicker (26x45x19 mm) flake. This flake, transformed into a scraper, has a convex and slightly overshot profile and is wider than it is long. Its morphology is consistent with a type VII flake (Fig. 28:18), which is rare in Quina assemblages, and is the only example of this type in all the material from Yabroud.

Retouch flakes from Yabroud reflect several stages in the management of Yabrudian scrapers, similar to that identified for the Quina Mousterian by L. Bourguignon (1997). Type 0 is associated with the initial preparation of the first row of scraper retouch which produces Type I elements. Type II flakes represent the second stage of scraper management and are used to re-shape the profile of the scraper's cutting edge. Type III flakes correspond to scraper edge re-sharpening. Type IV flakes reflect a change in hammer type (from soft to hard) as well as the type of blow applied (from tangential to perpendicular). These changes equally reflect a change of intention, as they destroy the scraper's Quina profile and create a notched edge. Type VII flake represents a fourth stage which serves to highlight previous series of abrupt, concave flake negatives by detaching a flake that overshoots the scraper's cutting edge, producing a new convex cutting edge. This type of flake can be a form of recycling, transforming an active edge into an active surface.

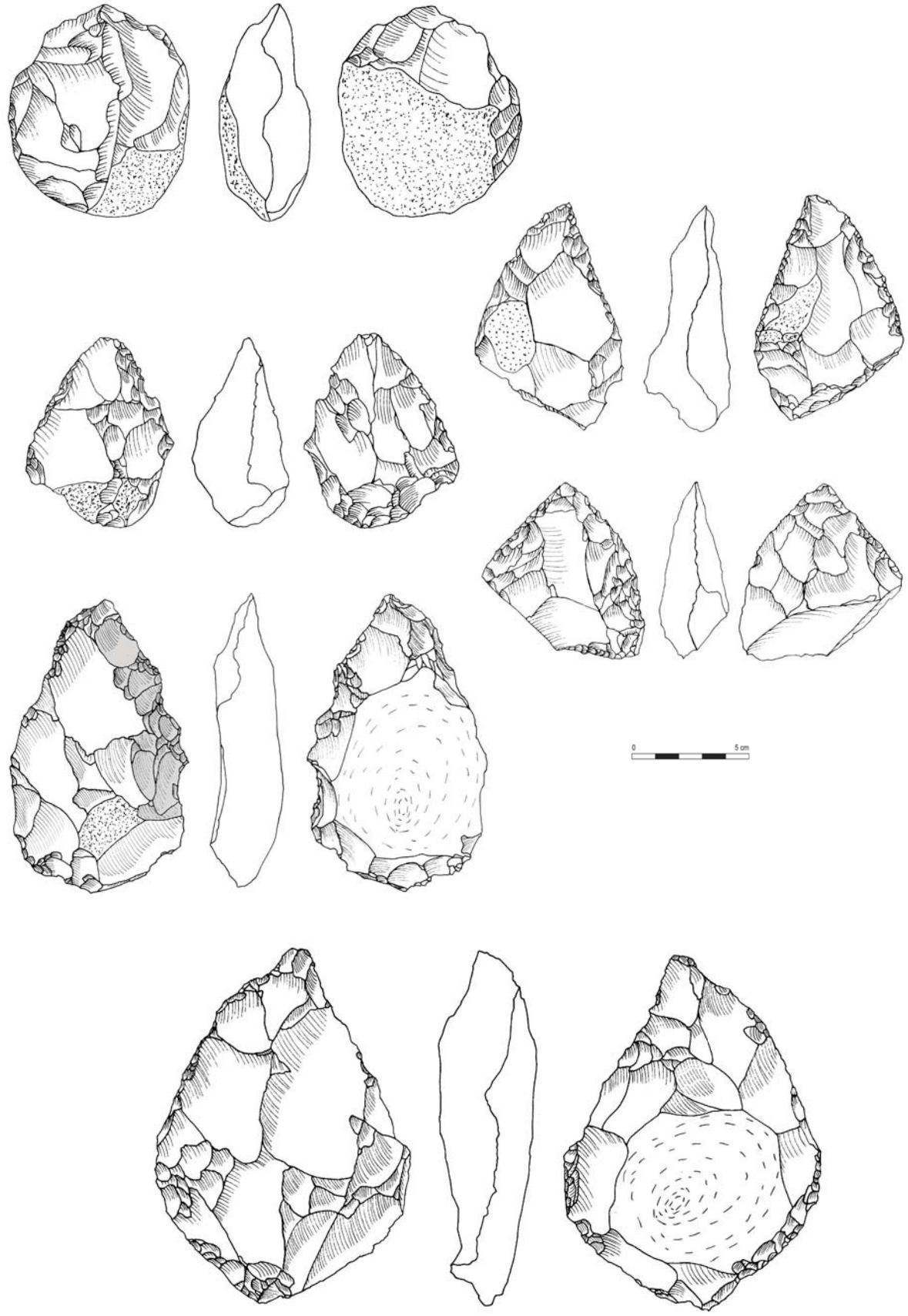
At Tabun, re-sharpening and recycling flakes make up 1% of the total sample from Unit XIII (n=13; Tab. 8). Type IV flakes remain the most abundant, accounting for 46% of all re-sharpening flakes (Fig. 29:3-8). Only one recycling flake (BOURGUIGNON, 1997) was identified and can be described as a Clactonian notch corresponding to type Vb (Fig. 29:9). Amongst the flakes from Unit XIII, one was transformed into a transverse scraper (Fig. 29:8). Its facetted platform indicates an anticipated preparation of the striking platform and the use of a hard hammer.

Bifacial-thinning flakes are also present in the Tabun assemblage and account for 31% of all management flakes (Fig. 29:10-13).

Re-sharpening flakes are absent in the Level C of Bezez Cave (Cambridge Collection).

3.2.5. Retouch types

Typical scaled-stepped retouch is most frequent in Yabroud assemblages (Tab. 8; Figs 18-19), while atypical scaled-stepped retouch is much less well represented (Fig. 20:6-7). At Tabun, the percentage of typical scaled-stepped retouch is the greatest in Unit XIII (Tab. 8; Fig. 21:1-7; Fig. 22), and co-occurs with atypical scaled-stepped retouch (Fig. 21:8-9). In contrast to Unit XIII, atypical stepped-scaled retouch dominates Unit XI, present on 56% of all retouched blanks (Fig. 30). This is however a unique case in the assemblages studied. Typical scaled stepped-retouch dominates the assemblage from Level C of Bezez Cave (Cambridge collection; Tab. 8).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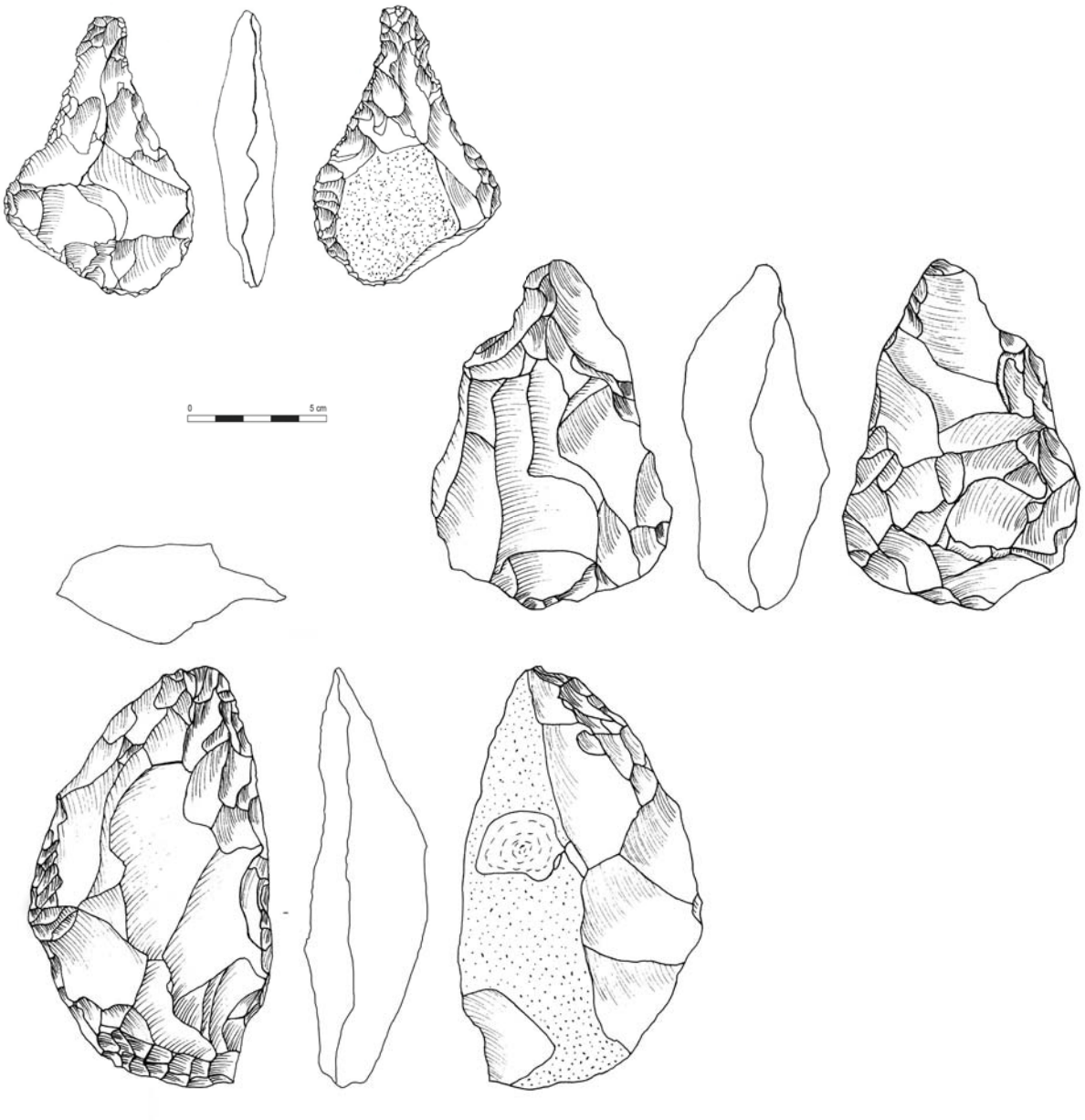


Fig. 25 – (previous page and this page) Bifacial pieces, Yabroud (layers 24, 19, 14, 11, 10). Drawings A. Al Qadi.

Yabroud		*Tabun (XIII)*		*Adlun (Bezez Cave)*	
Typical scaled-stepped retouch	62%	Typical scaled-stepped retouch	47%	Typical scaled-stepped retouch	86%
Atypical scaled-stepped retouch	10%	Atypical scaled-stepped retouch	9%	Atypical scaled-stepped retouch	1%
Total objects	*554*	*Total objects*	*1000 piece sample*	*Total objects*	*204*

Tab. 8 – Proportion of typical and atypical scaled-stepped retouch for assemblages from Yabroud I, Tabun and Adlun.

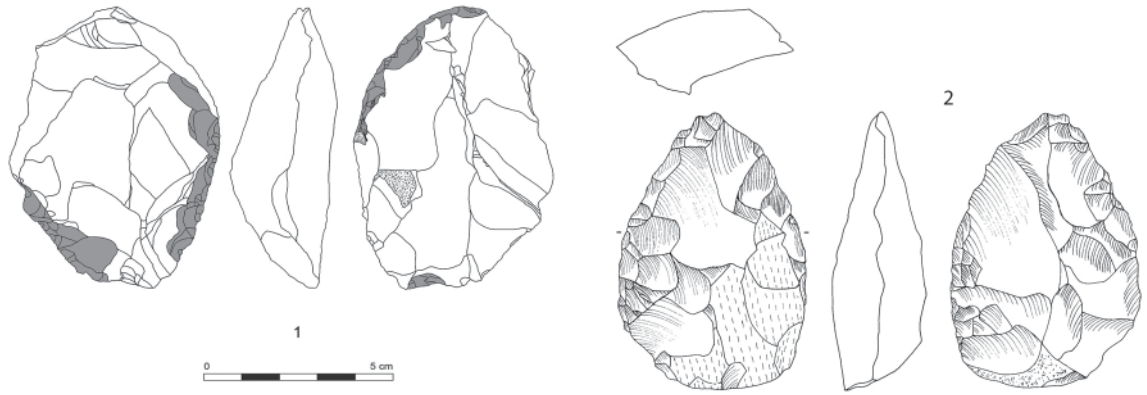


Fig. 26 – Bifacial pieces, Tabun (Unit XIII). Drawings A. Al Qadi.

3.2.6. Cores

Cores are present in small proportions in all three assemblages. At Yabroud, cores make up 5% of the total Yabrudian material from the layers studied (Tab. 9). Layer 25 produced the most cores (n=11) of all levels with a Yabrudian component and can be grouped into six categories. The first is composed of 5 small sub-quadrangular cores-on-flakes with centripetal removals on both surfaces (A and B). Fracture planes are secant on the dorsal surface, (surface B), and sub-parallel on the ventral face (surface A), resulting in a secant surface opposite a flat surface from which a series of flakes were removed. These cores bear some cortical surfaces, with the final flakes removing part of the core's edge on surface B and being centripetal on surface A (Fig. 31:2, 4, 5, 8).

The second category comprises 2 cores which are larger than those previously described and exploited on three sides. One of them is sub-triangular in shape and knapped from a block (Fig. 31:8). The fracture planes are sub-parallel on surface A, and secant on surface B. Removals are orthogonal on surface A and centripetal on surface B. The 3 surfaces are exploited in a continuous alternating manner, resulting in between 10 to 17 flake negatives on each surface. The third category comprises a single triangular core on an undetermined blank

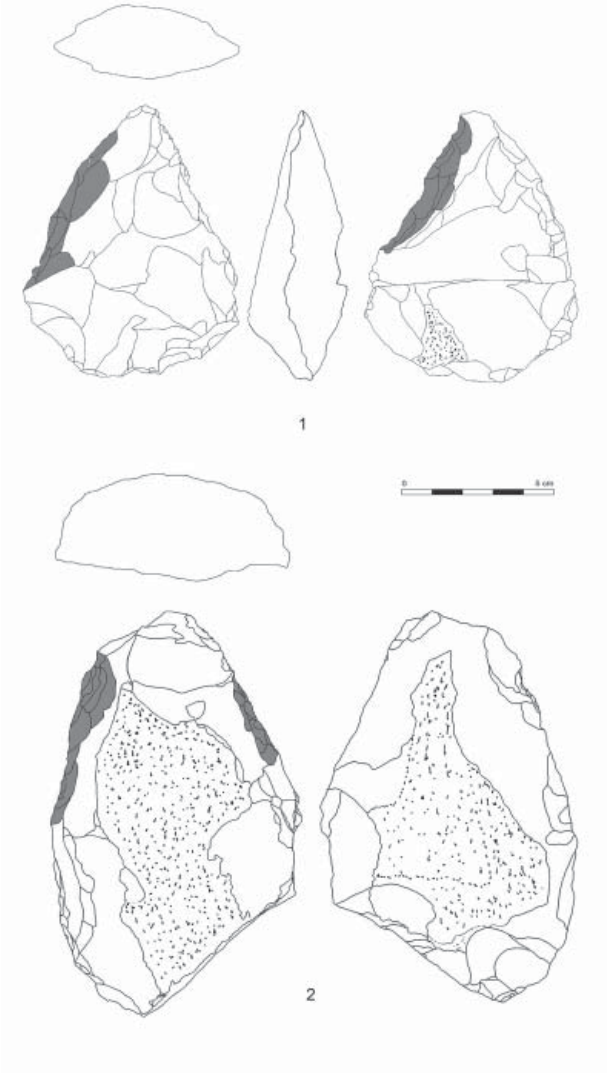
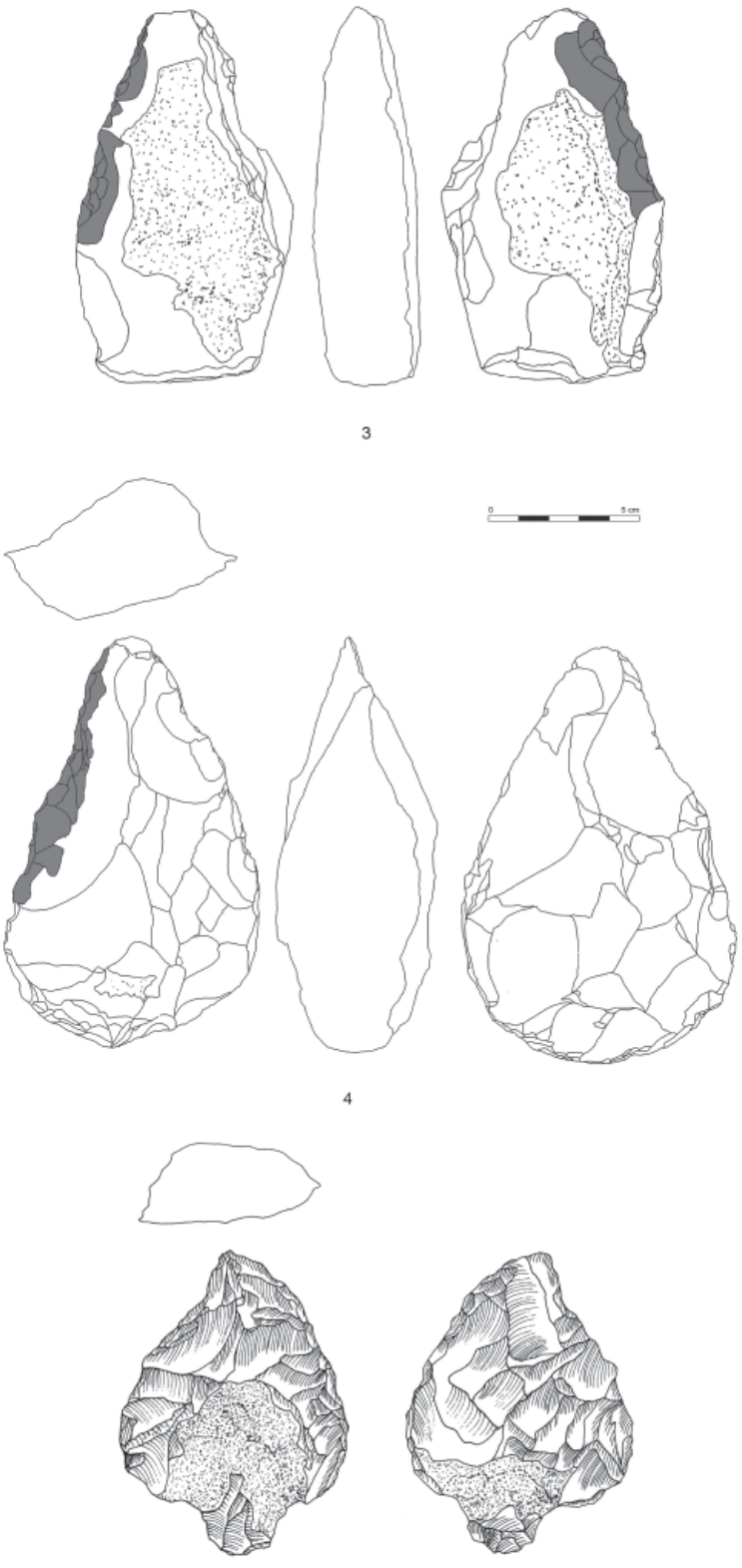


Fig. 27– (this page and opposite page) Bifacial pieces, Adlun (Level C, Bezez Cave). Drawings A. Al Qadi.

(Fig. 31:1) with flakes removed from 4 surfaces. The fracture planes are sub-parallel on surfaces A, B, D and secant on surface C. The directions of the removals are variable on all 4 surfaces; orthogonal on surface A, unipolar on surfaces B and D, and bipolar on C.



The fourth category also consists of a single core exhibiting a shift to a Yabrudian debitage concept after the initial production of blades (Fig. 31:14). This is evidenced by two removals, one of which was refit to the core by L. Bourguignon (BOURGUIGNON, 1997). The two flakes were alternately removed from the lateral edges of the core following secant fracture planes, in contrast to

Yabroud		*Tabun (XIII)*		*Adlun (Bezez Cave)*	
Cores	5%	Cores	10%	Cores	1%
Total objects	*554*	*Total objects*	*1000 piece sample*	*Total objects*	*204*

Tab. 9 – Core proportions for assemblages from Yabroud I, Tabun and Adlun.

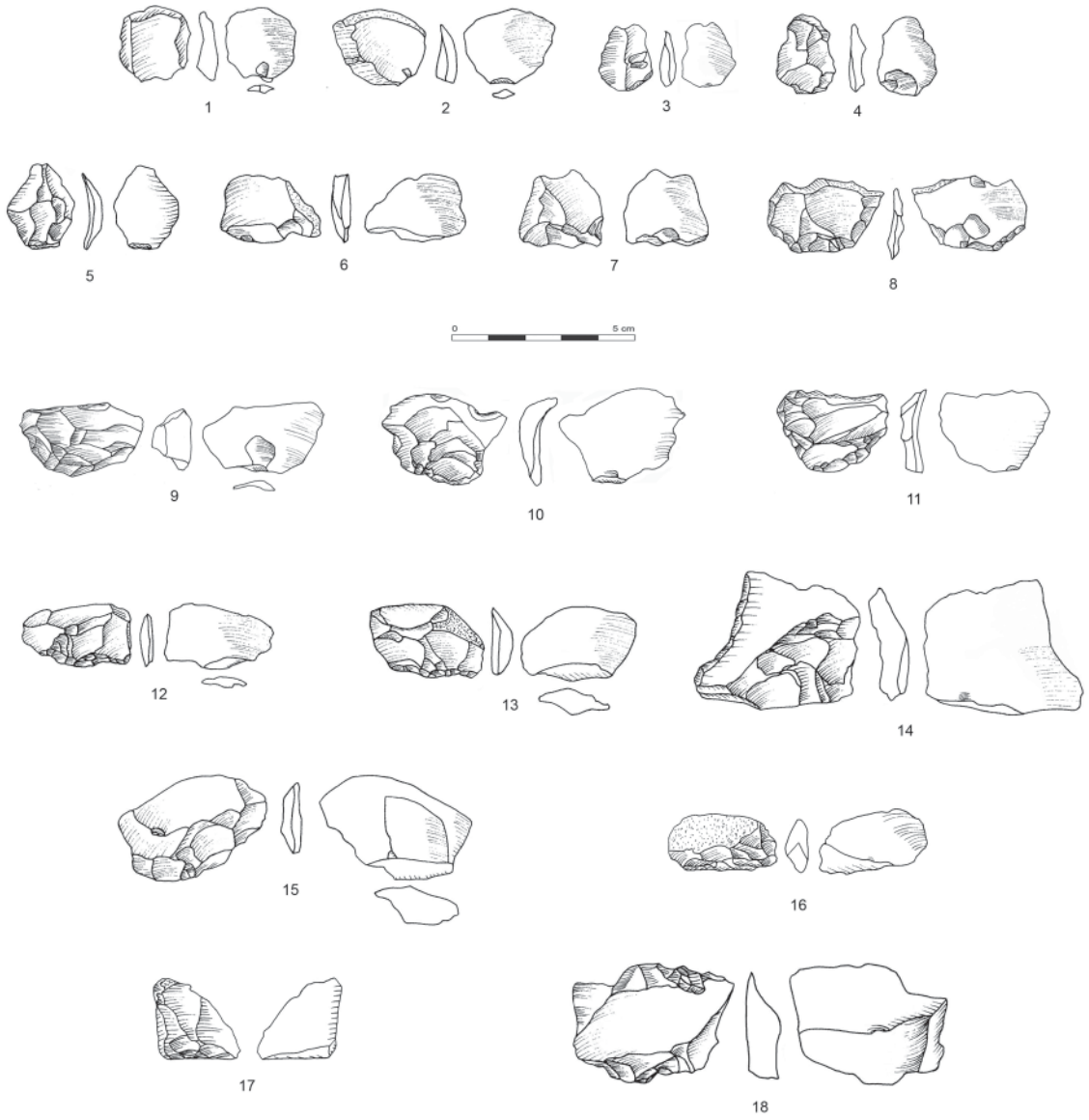


Fig. 28 – Management, re-sharpening and recycling flakes, Yabroud (layers 25, 24, 22, 16). Drawings A. Al Qadi.

the earlier recurrent, sub-parallel removals on the same surface. This core therefore exhibits the co-occurrence of two reduction methods, Yabrudian and blade debitage, in the same layer.

The fifth category consists of a single core with biconvex volumetric structure that can be tied to the Levallois concept (Fig. 31:15). For L. Bourguignon, this core exhibits several

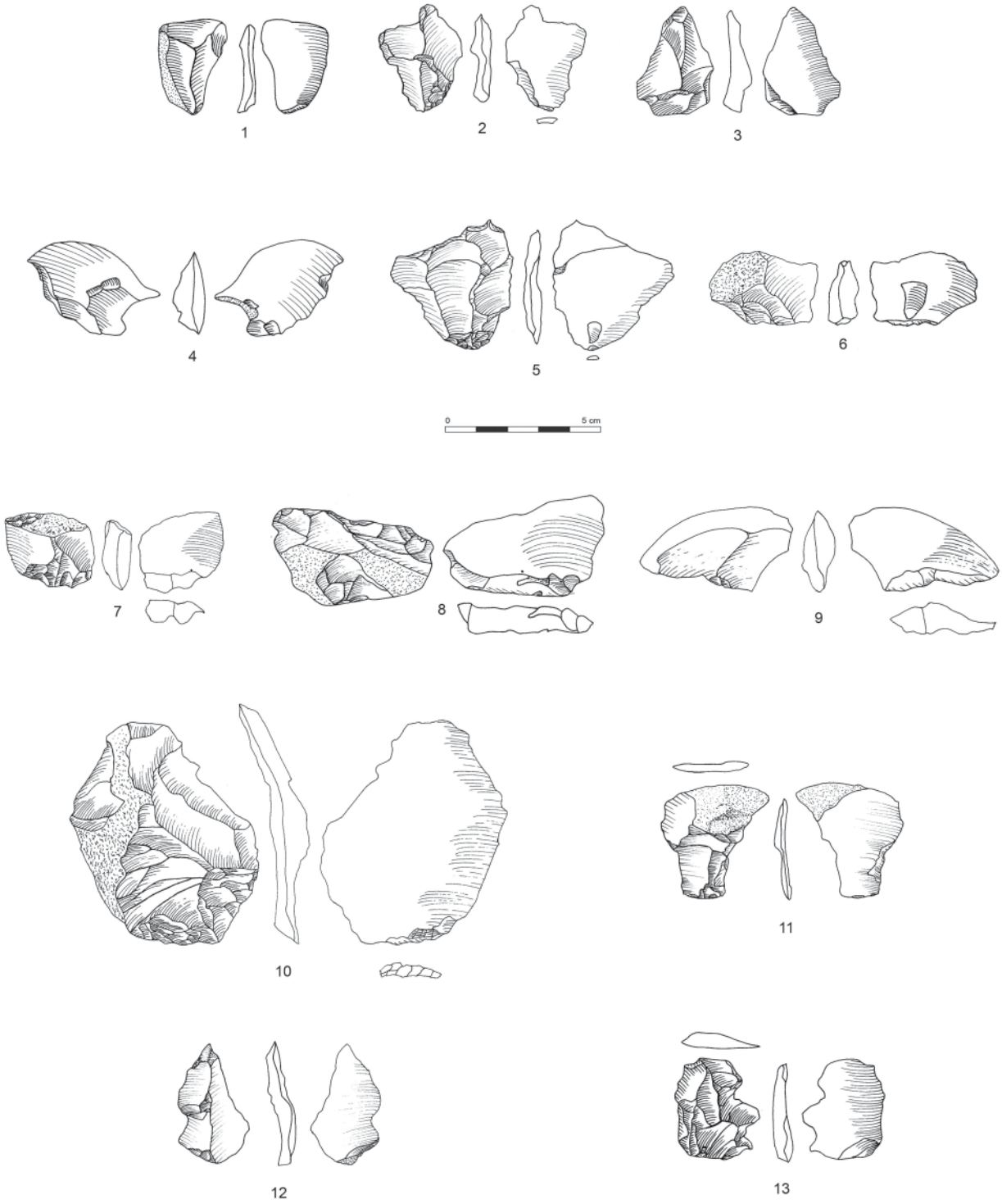


Fig. 29 – Management, re-sharpening, recycling and bifacial thinning flakes, Tabun (Unit XIII). Drawings A. Al Qadi.

criteria similar to those defined by E. Boëda in relation to the Levallois concept (BOËDA, 1986, 1988; BOËDA & VINCENT, 1990). The volumetric design is conceived as two convex, intersecting surfaces. The hierarchy of both surfaces and the management of the core's lateral convexities serve to predetermine the shape of the Levallois blanks (BOURGUIGNON, 1997).

The final category consists of a small, sub-triangular, unipolar core-on-flake with sub-parallel removals detached solely from the dorsal surface.

In the Yabrudian layers, sub-quadrangular cores are the most frequent and represent 37% of all cores (Fig. 31:1-6). Cores with a sub-triangular morphology are also numerous and comprise 30% of all cores (Fig. 31:7, 9, 10-13). Sub-circular cores represent 13% (Fig. 31:16-17). A pyramidal core is present in the Yabroud assemblage (Fig. 31:8). At Tabun, cores represent 11% of our sample, of which we selected a group of 10, five sub-quadrangular (Fig. 32:1-5) and 5 sub-triangular (Fig. 32:6-10), all of which were exploited on 2, 3 or 4 debitage surfaces. The removals can be centripetal (Fig. 32:1-3, 6-8) or

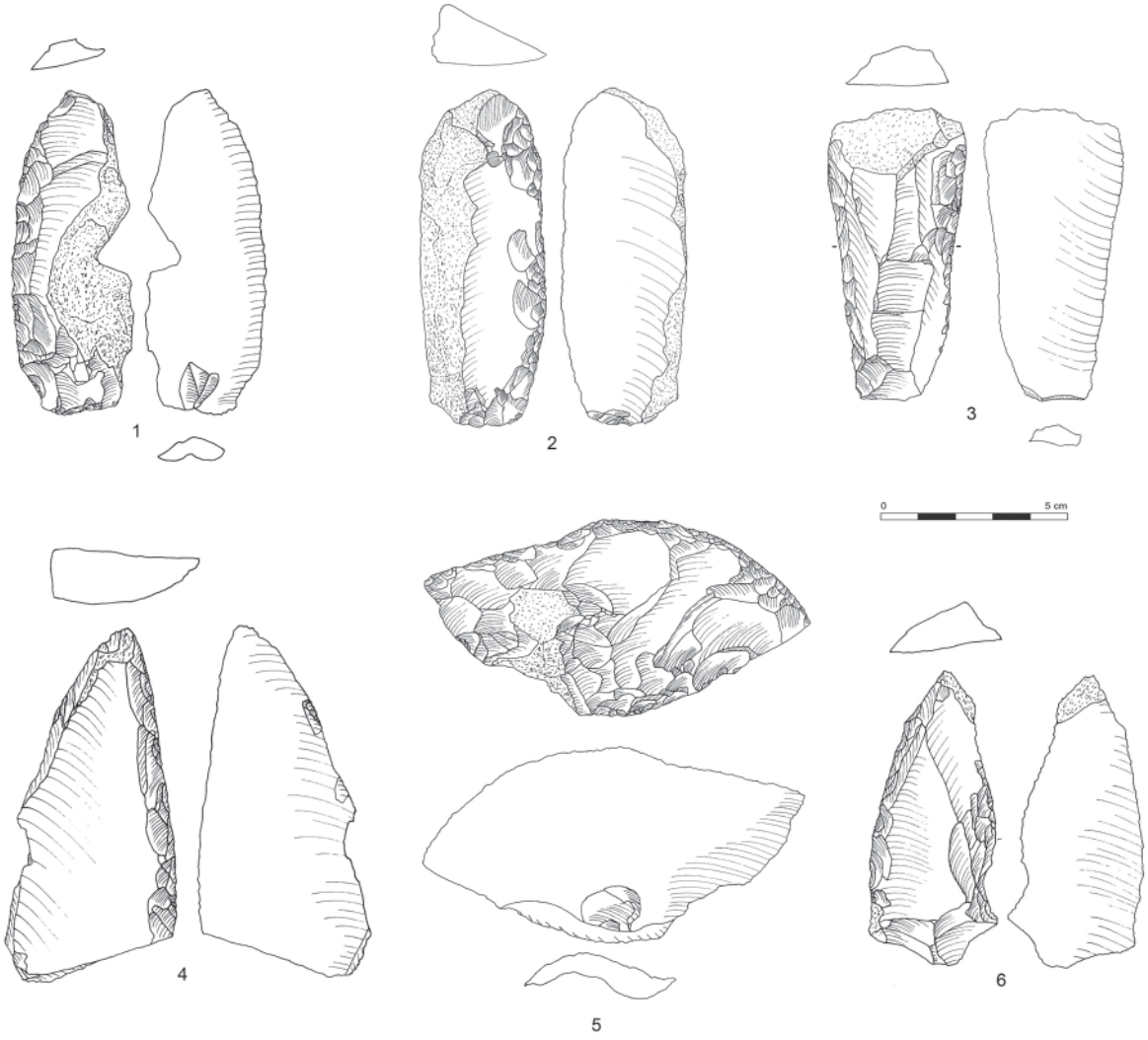


Fig. 30 – Scrapers with atypical scaled-stepped retouch, Tabun (Unit XI). Drawings A. Al Qadi.

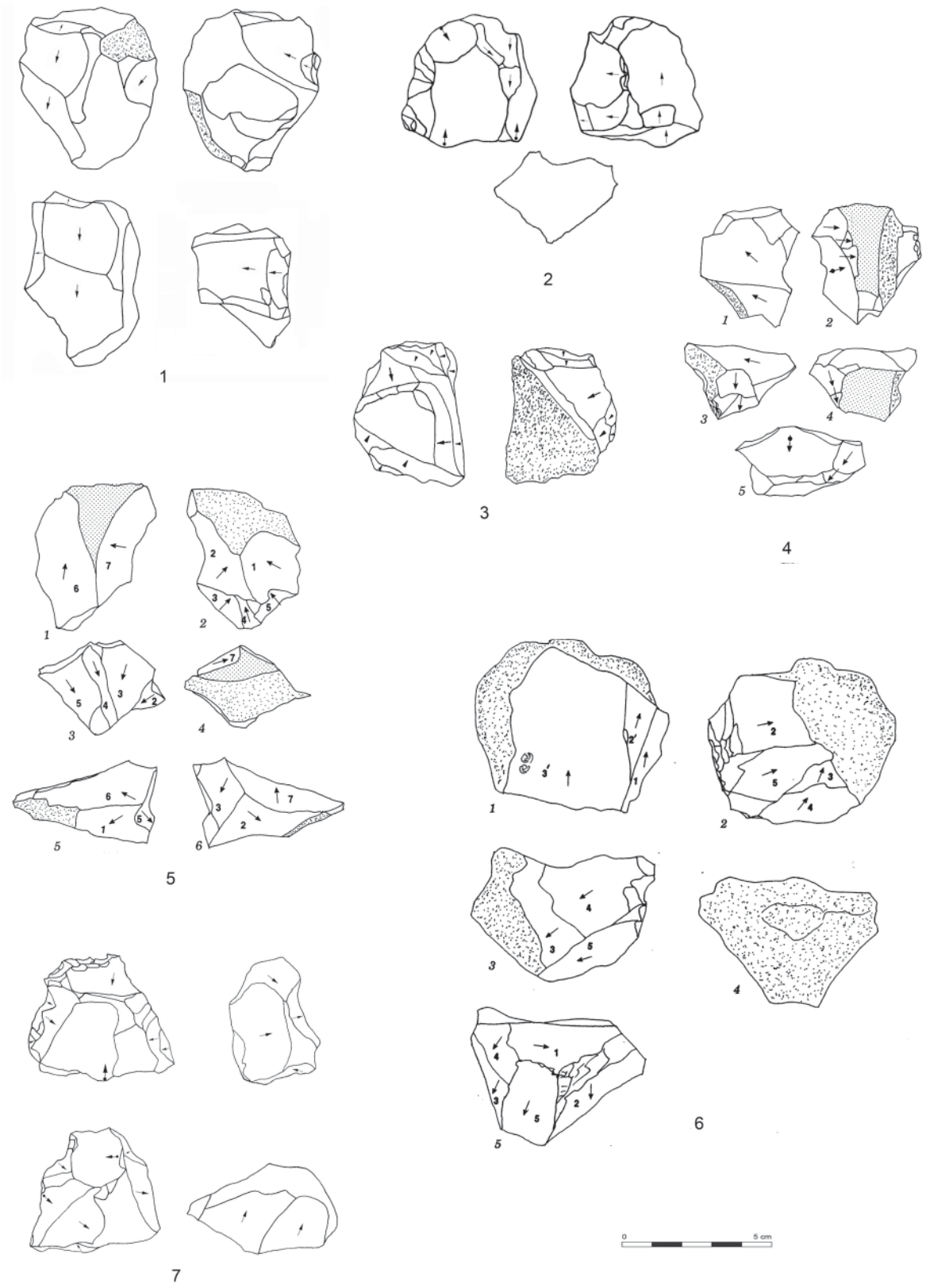
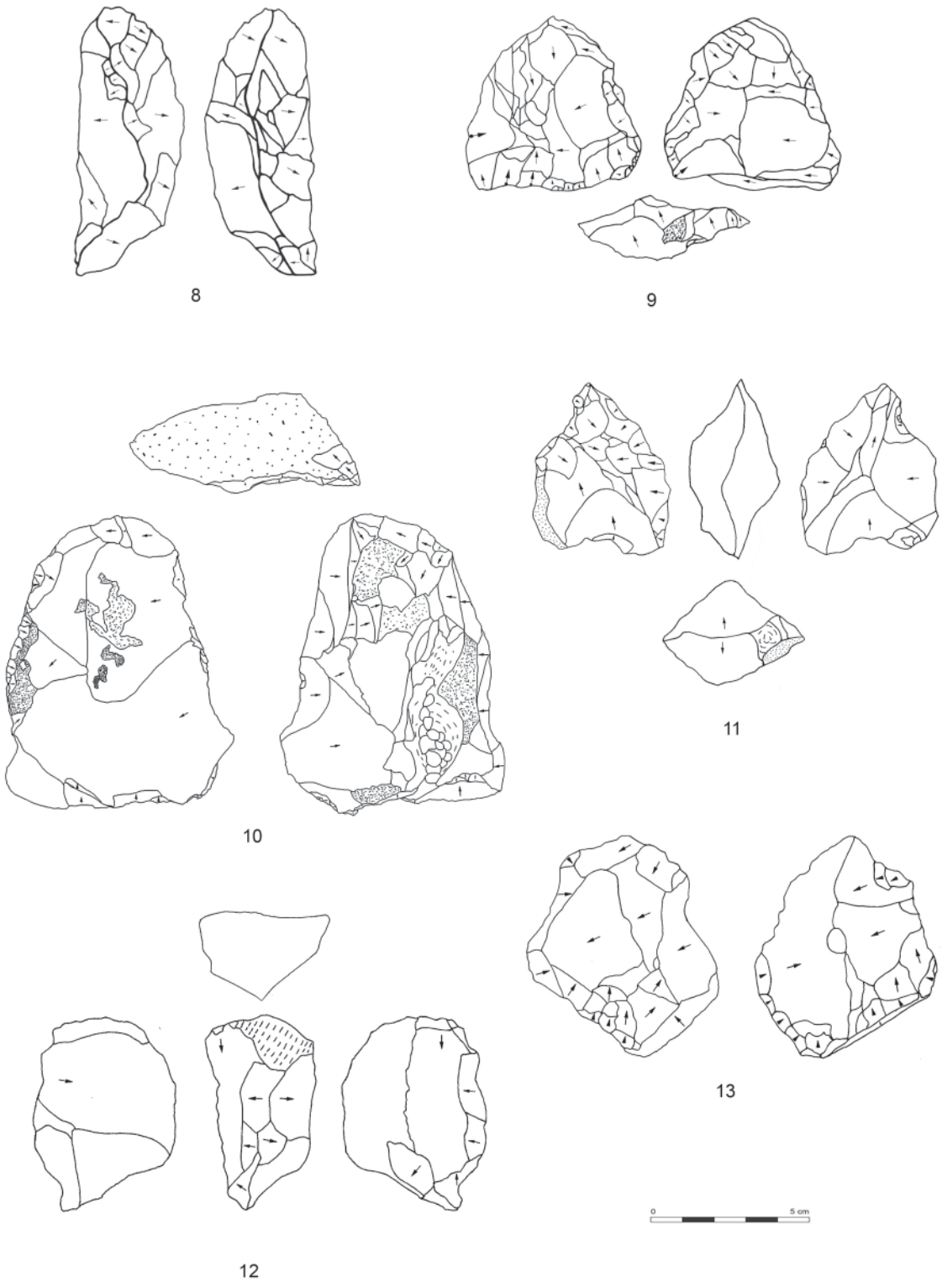
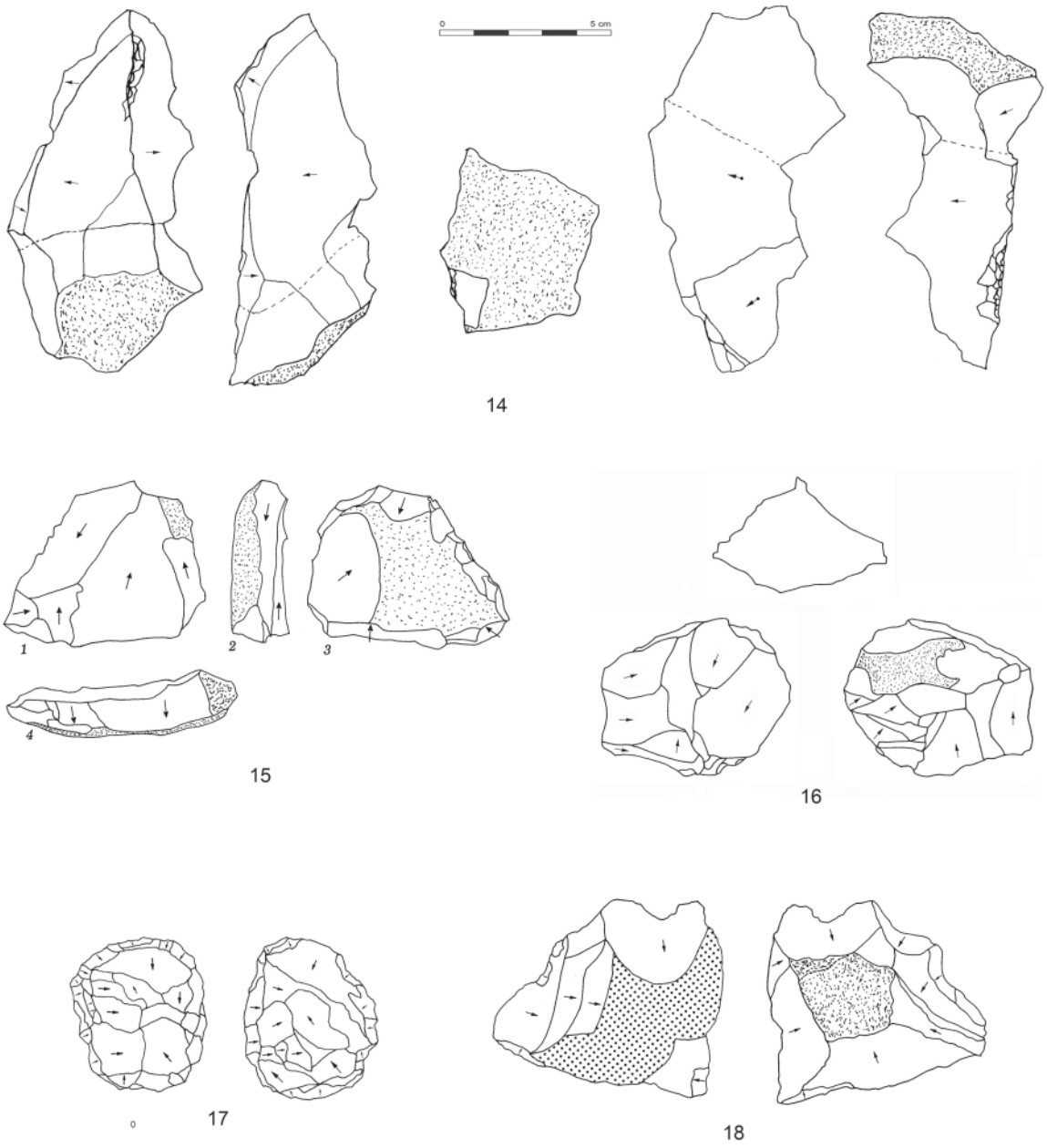


Fig. 31 – (this page and pages 60-61). Yabrudian cores, Yabroud (layers 25, 24, 22, 21, 19, 11, 10, 8); Number 4, 5, 6, 14, 15 in BOURGUIGNON 1997, other drawings A. Al Qadi.



orthogonal (Fig. 32:4-5) and are removed along fracture planes that are secant on one side, and sub-parallel on the other.

The cores are of various sizes, the largest being 81 mm long, 67 mm wide, 18 mm thick and the smallest 40 mm long, 52 mm wide, 12 mm thick, and all are knapped from blocks. Cortical surfaces are present on 8 of the 10 cores (Fig. 32, No. 1, 2, 3, 4, 5, 6, 8, 9), indicating early stages of reduction for some, non-maximal for others, but generally speaking the cores are heavily



exploited (5 of which are very heavily exploited). These cores are similar in terms of shape and technology to Unit XIV, but are more heavily exploited, with flakes sometimes removed from 2, 3 or 4 surfaces. The products from these cores are longer and larger than those obtained from the Unit XIV cores.

The order of removals for the Unit XIII cores shows a more elaborate reduction sequence. The cores show similarities with the Yabrudian ones from Yabroud. We observe the same Quina volumetric concept, the same morphologies and the same reduction management. These Yabrudian levels produced a typical Quina reduction sequence identical to the one from the eponymous site. At Adlun, the assemblage from level C of Bezez Cave (Cambridge collection) includes only two cores, both made on blocks. The first is sub-triangular (Fig. 33:1), the second sub-rectangular (Fig. 33:2). Both cores are exploited on three sides, with sub-parallel fracture planes on one surface and secant fracture planes on the other, with centripetal removals on the surfaces of both cores. The latter are exploited by continuous alternating removals and are consistent with the volumetric conception typical of Quina reduction. Cortical surfaces are present on both cores.

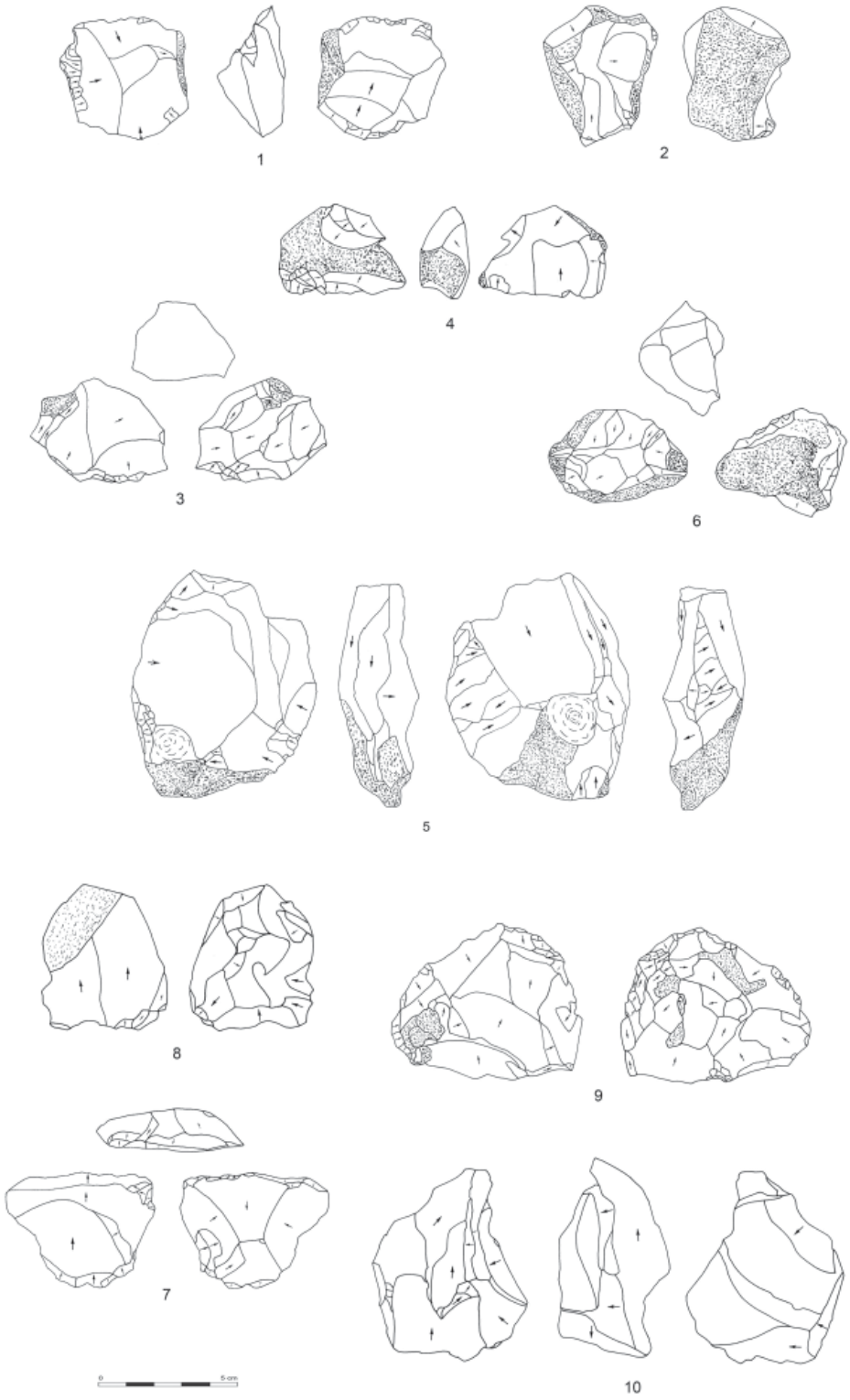


Fig. 32 – Yabrudian cores, Tabun (Unit XIII). Drawings A. Al Qadi.

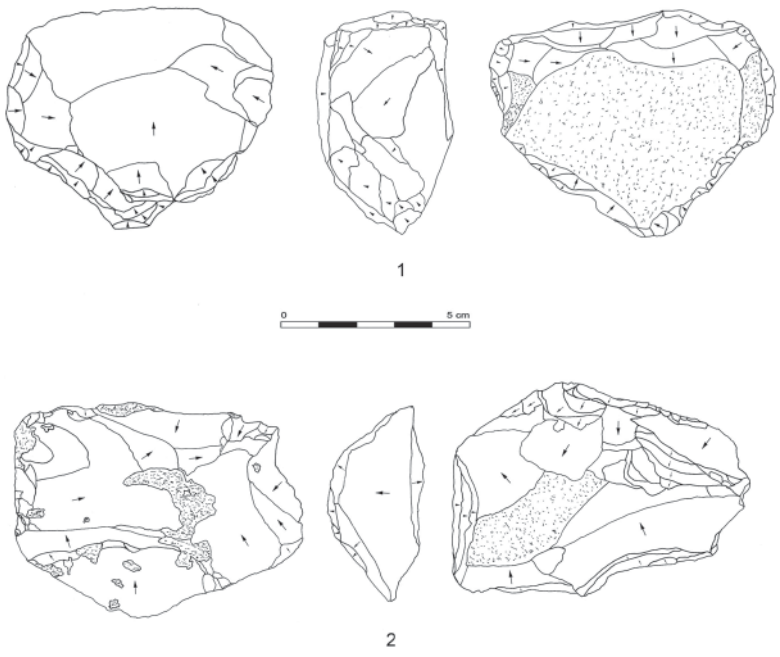


Fig. 33 – Yabrudian cores, Adlun (Level C, Bezez Cave). Drawings A. Al Qadi.

4. DISCUSSION

4.1. Production intentions

Our analyses of the Yabrudian assemblages from Yabroud, Tabun and Adlun in the central Levant provids new insights into the characteristics of Yabrudian debitage. Several of these features have been identified in previous studies (RUST, 1950; BORDES, 1955, 1977, 1984; GARROD, 1956, 1966; COPELAND & HOURS, 1983; SKINNER, 1970; HOURS *et al.* 1973; COPELAND, 1978; JELINEK, 1981, 1982; VINCENT, 1985; BOURGUIGNON, 1997; LE TENSORER, *et al.,* 1997; LE TENSORER, 2005; TSATSKIN, 2000; GOPHER *et al.,* 2005; GISIS & RONEN, 2011; ZAIDNER *et al.,* 2006, ZAIDNER & WEINSTEIN-EVRON 2016; AL QADI, 2008, 2011, 2014, 2016; NISHIAKI *et al.,* 2011; RONEN *et al.,* 2011; ASSAF, 2014; ASSAF *et al.;* 2016; SHIMELMITZ *et al.,* 2014; WEINSTEIN-EVRON *et al.,* 2017; AGAM, 2019; AGAM *et al.,* 2019; AGAM & ZUPANCICH, 2020; MEIGNEN *et al.,* 2020).

The Yabrudian reduction sequence is geared towards the production of thick and wide, short or sometimes long blanks, often associated with a plain and wide striking platform. They may also be linked to an asymmetrical or symmetrical dihedral or cortical striking platforms. Non-cortical blanks are more numerous than cortical ones in several assemblages, notably at Yabroud and Adlun. Plain striking platforms indicate the detachment of flakes from unprepared surfaces, while a cortical butt indicates flakes struck from a cortical platform. Asymmetrical dihedral striking platforms are indicative of a recurrent alternating series of removals from both surfaces of the block. Blanks with asymmetrical sections have cortical, unworked or modified backs. These backs are consistent with the alternation between two or more surfaces and the lateralization of removals on one of the core's sides.

Scrapers are predominant in all assemblages, represented by simple, offset and trans-

verse forms. Single scrapers are the most frequent types at Yabroud, Tabun and Adlun, while transverse and offset scrapers share similar proportions. The predominance of single scrapers is also attested in the Yabrudian assemblages from sites in the El Kowm region of central Syria (COPELAND & HOURS, 1983; LE TENSORER, 2005; AL QADI, 2008, 2011; AL QADI *et al.,* 2015), at Dederiyeh in northern Syria (NISHIAKI *et al.,* 2011, 2017; AKAZAWA *et al.,* 2017) and at Misliya, Qesem and Hayonim (ZAIDNER & WEINSTEIN-EVRON, 2016; WEINSTEIN-EVRON *et al.,* 2017; MEIGNEN *et al.,* 2020; AGAM & ZUPANCICH, 2020). Although in smaller numbers, double, limace or even convergent scrapers are also present in these assemblages and indicate some variation in blank transformation.

Alongside these various scraper types, Yabrudian assemblages equally contain bifacial pieces that occasionally bear scaled-stepped retouch. These often thick pieces are made on blocks or large flakes. Relatively asymmetrical, they have irregular edges and partial, sometimes cortical backs. These pieces demonstrate bifacial shaping to co-exist with flake production and the two concepts can be observed on the same piece.

Cores primarily reflect a typical Quina volumetric conception — a sub-parallel surface opposite a secant surface — and exist in several morphologies, although sub-quadrangular and sub-triangular forms are the most frequent. Sub-circular or pyramidal cores on blocks and flakes are also typical of Yabrudian industries, and are often exploited on two or more surfaces. The alternation between debitage surfaces is indicated by the presence of backed blanks, asymmetrical dihedral striking platforms or contra-bulbs on core surfaces, the latter indicating the direction of flakes removed from the opposite surface. Removals are centripetal, unipolar or orthogonal. Fracture planes are subparallel on one side and secant on the other, or secant on both surfaces. Most cores are heavily reduced while still preserving their original volumetric conception.

4.2. Tool transformation

Blanks are transformed into scrapers via typical and atypical scaled-stepped retouch, which is also occasionally observed on bifacial pieces. Scraper retouch and reduction follows different stages. Re-sharpening, recycling and management flakes found in the Yabroud and Tabun assemblages are of varied morphology and dimensions, and correspond to the different types described for the Quina Mousterian (BOURGUIGNON, 1997). These flakes reflect several stages of retouch; a first row of retouch is followed by a second installed by tangential blows with a soft hammer. A third phase re-sharpens the scraper, with the subsequent perpendicular blow by a hard hammer leaving a deep negative. Retouch concerns a large proportion of the assemblage, including both flake blanks and bifacial pieces. In all of the assemblages, retouched pieces are in the majority and exceed 50% of the total assemblage. The presence of re-sharpening flakes, especially types III and IV, demonstrates the regular re-sharpening of scrapers on-site.

Typical scaled-stepped retouch dominate Yabrudian assemblages, as at Yabroud (RUST, 1950; BORDES, 1955, 1977, 1984; BOURGUIGNON, 1997; AL QADI, 2016), Tabun (GARROD, 1956; JELINEK, 1982), Adlun (GARROD, *et al.*, 1961; COPELAND, 1978), Masloukh (SKINNER, 1970), the Yabrudian sites from El Kowm region (COPELAND & HOURS, 1983; LE TENSORER, 2005; LE TENSORER *et al.,* 1997; AL QADI, 2008, 2011), Dederiyeh (NISHIAKI *et al.,* 2011) and Qesem Cave (GOPHER *et al.*, 2005).

Atypical scaled-stepped retouch is less frequent, with the exception of the Yabrudian assemblage from Unit XI at Tabun (Jelinek excavations). As mentioned earlier, the high percentage for this type of retouch may be related to thinner blanks which are more elongated than those from other assemblages. As our analysis was based on a sample, this latter aspect cannot be extended to all Yabrudian debitage. In addition to management and re-sharpening flakes, the Tabun assemblage equally produced

bifacial-thinning flakes that are most likely tied to the on-site production of bifacial pieces.

4.3. Flake production and retouch techniques

The thickness of the blanks and their plain and wide striking platforms is consistent with the use of hard hammers and a perpendicular blow throughout the reduction sequence. Bifacial preforms are also produced using hard-hammer percussion, as demonstrated by the thickness of the pieces and notched negatives on their edges.

In addition to hard hammers, soft hammers in antler or wood were also used in the initial stages of scraper retouch, as can clearly be seen by the presence of thin striking platforms (punctiform with lips) and type 0-III management flakes. The bifacial-thinning flakes in the Yabrudian of Tabun Unit XIII also indicate the use of a soft hammer in the shaping of certain bifacial pieces. This likely involved antler or wood soft-hammers, which is consistent with our experiments, and particularly well documented experimentally for the Quina Mousterian (BOURGUIGNON, 1997, 2001).

4.4. Technological variability

The Yabrudian material from the three studied assemblages generally shows a convergence in both terms of technology and typology. Nevertheless, some variations and preferences in the choices made by knappers are discernable. The layers with a Yabrudian component in shelter 1 at Yabroud share numerous technological similarities (layers 25, 24, 23, 22, 21, 20, 19, 16, 14, 12, 11, 10, 8); however, differences between layers are observable in the dominant blank types. In the richest layers (layers 25-22), cortical blanks are more frequent than non-cortical ones, whereas in the other Yabrudian layers the percentage of non-cortical blanks is higher. Retouched blanks outnumber non-retouched ones, with scrapers being the dominant tool type, most often single forms.

Cores displaying a Quina volumetric conception predominate in the Yabrudian material of Shelter I. Type III and IV re-sharpening flakes from are most frequent amongst retouch flakes, and typical scaled-stepped retouch is most common in all layers with a Yabrudian component of Shelter I.

Non-cortical blanks at Yabroud (all layers with a Yabrudian component) and at Adlun (Bezez Cave, Cambridge Collection) outnumber cortical blanks, whereas at Tabun (Unit XIII), cortical blanks outnumber non-cortical ones. In the latter assemblage, cores are also relatively numerous compared to Yabroud. This could be related to the increased intensity of on-site debitage activities and perhaps to raw material accessibility. Blanks with asymmetrical cross-sections are fewer than those with symmetrical ones in all three assemblages. They occur in similar proportions and cortically-backed blanks are most frequent amongst blanks with asymmetrical cross-sections. Blanks with a non-worked back are less frequent than cortically-backed blanks followed by those with worked backs.

The presence of blanks with an asymmetrical section testifies to the regular lateralization of removals from the side of the core. Striking platforms generally share similar representations at all three sites. Plain striking platforms are clearly the most represented type, followed by cortical and asymmetric dihedral ones at Tabun and Adlun, while at Yabroud, facetted platforms are less common than cortical ones, but more frequent than asymmetric dihedral striking platforms. Facetted platforms are more common, amongst the Yabrudian material from Shelter I than at both Tabun or Adlun, which would be consistent with the co-occurrence of Yabrudian and Levallois reduction methods at the site. This phenomenon was previously highlighted by F. Bordes during his final study of the Yabrudian material from Yabrud, published in 1984 (BORDES, 1984), and confirmed by our study of these industries, especially those from layer 8, which is dominated by a Levallois reduction sequence alongside

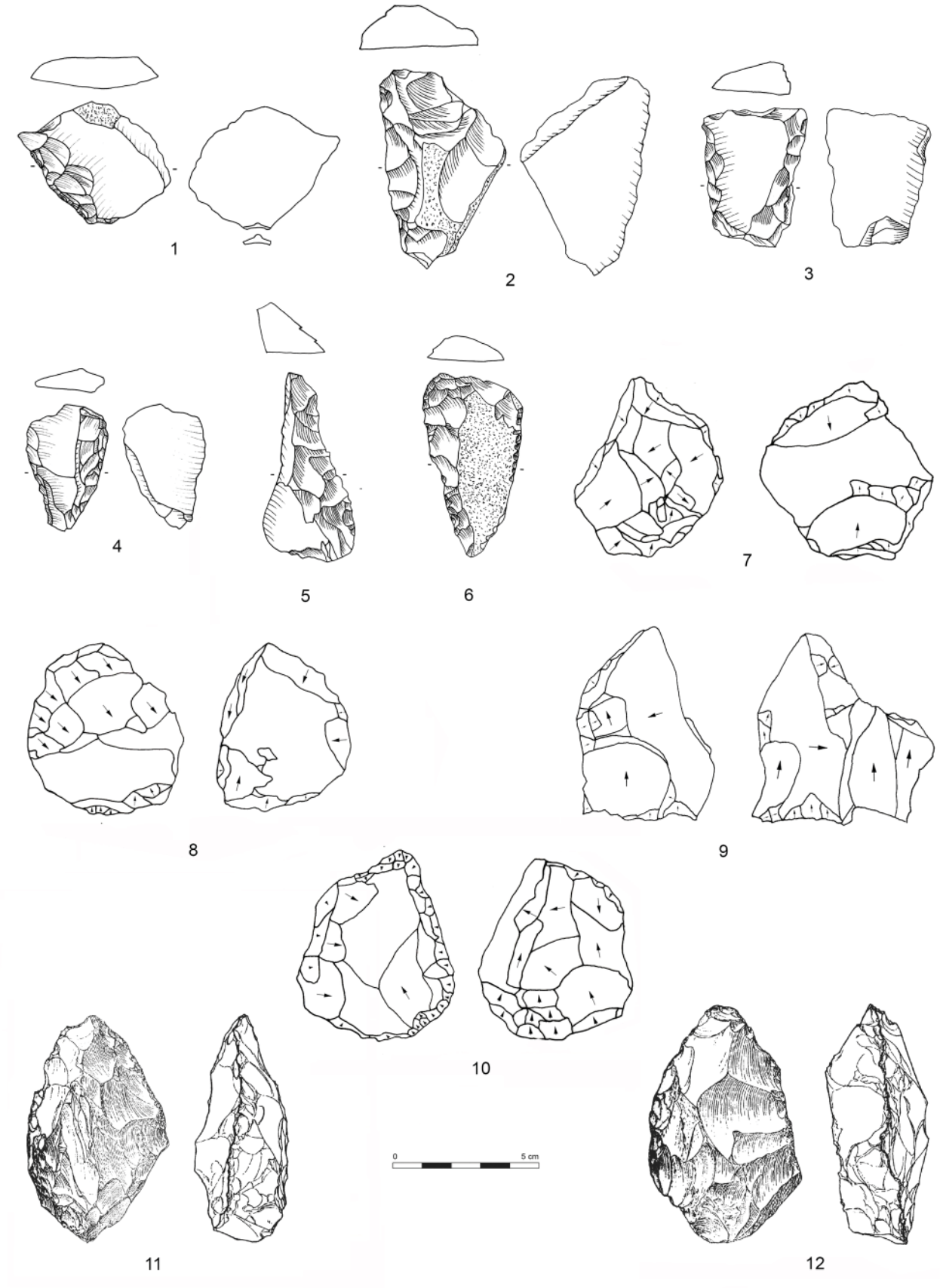


Fig. 34 – 1-6. Yabrudian scrapers, 7-10. Yabrudian cores, 11-12. Bifacial Pieces. Yabroud (layer 8). Nr 11-12 after RUST, 1950, other drawings A. Al Qadi.

Yabrudian-type scrapers, cores and even bifacial pieces (Figs 34-35). The presence of Levallois elements in Yabrudian assemblages is also noted in level C of Bezez Cave at Adlun (COPELAND & HOURS, 1983), and more generally by several authors (SHIMELMITZ *et al.*, 2014). At Misliya, a few criteria linking both reduction methods were observed throughout the sequence (ZAIDNER & WEINSTEIN-EVRON, 2016).

Tools are dominated by scrapers, primarily single forms, in all three assemblages. In addition to the predominance of plain striking platforms, the greater frequency of single scrapers is one of the main defining features of Yabrudian industries for a large portion of the Levantine sites. Offset scrapers follow single scrapers in the Yabroud assemblages, and transverse scrapers occur in smaller proportions to both single and offset forms. In the Tabun assemblage, offset and transverse scrapers occur in identical proportion, while at Adlun transverse scrapers are less numerous than single forms but outnumber offset scrapers.

Overall, single scrapers always form the majority in the tool component, followed by transverse and offset scrapers in equal measures. While other scraper types occur, including double, limace and convergent forms, they are always few in number.

Bifacial pieces are present in different proportions in all three assemblages from Yabroud,

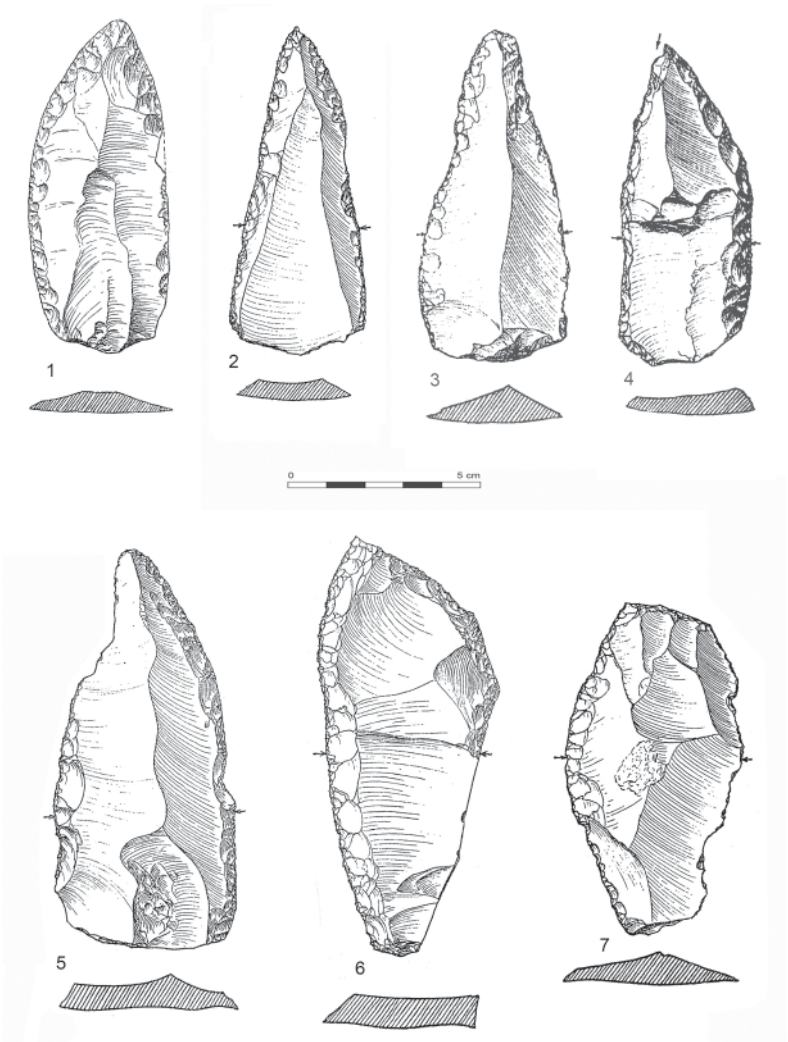


Fig. 35 – Levallois-Mousterian points and scrapers, Yabroud (layer 8). After RUST, 1950.

Tabun and Adlun. Always less well represented compared to scrapers, they occur in roughly equal proportions at Yabroud and Tabun (between 5 and 7%) and are considerably more frequent in the Cambridge Collection from Bezez Cave (33%). Amongst Yabrudian bifacial pieces, those with thick, partial backs and irregular edges often bearing scaled-stepped retouch differ from typical Acheulean bifaces of the Levant. This distinction has already been emphasized by Copland for the Yabrudian industries of level C at Bezez Cave (COPELAND, 1978), and by Le Tensorer for the Yabrudian material of Nadaouiyeh Aïn Askar (LE TENSORER *et al.,* 1997) and Hummal (LE TENSORER, 2005). Differences between the Yabrudian and Acheulean with respect to bifaces/bifacial pieces was reinforced in our analysis of Yabrudian material from Hummal and Nadaouiyeh Aïn Askar (AL QADI, 2008).

A bifacial piece with scaled-stepped retouch and a sort of tanged based was identified amongst the bifacial pieces from Level C of Bezez Cave (Cambridge Collection; Fig. 27:5), a morphology that has no known equivalent in Yabrudian assemblages from the entire Levant. This tool form is also unique in the Bezez Cave Level C assemblage.

Bifacial pieces (or Yabrudian bifaces) have been reported under different names. Copeland referred to them as 'bifaces' for Bezez Cave Level C material (COPELAND, 1978). Later, Copeland and Hours switched to the term 'Yabrudian biface' (COPELAND & HOURS, 1983). In his study of Yabrudian material from Nadaouiyeh Aïn Askar and Hummal, Le Tensorer preferred 'biface' and used the term 'bifacial object' to describe this type of industry (LE TENSORER, 2005). Regardless the name given to industries with bifaces in the Yabrudian, these pieces are clearly distinguishable from Acheulean bifaces of the Upper and Middle Acheulean in that the associated technological concept differs considerably from what can be seen in the Yabrudian. Furthermore, at Hummal, the Yabrudian level does not overlie a clear Acheulean level (WEGMÜLLER, 2015). At Umm el Tlel, the Yabrudian sequence dates to around 120 000 years and is situated higher up in the Mousterian sequence, without any contact with Acheulean levels (BOËDA, 2014). The association between the Yabrudian and Acheulean as embodied by the term 'Acheuleo-Yabrudian' therefore appears problematic, reflecting a degree of subjectivity that is both confusing and imprecise.

Management and re-sharpening flakes are present in Yabrudian layers of the eponymous site and at Tabun (Unit XIII) but are absent in Level C at Bezez Cave (Cambridge Collection). Types III and IV are most frequent in the Yabroud assemblage, and Type IV at Tabun. Bifacial-thinning flakes are present at Tabun and absent at both other sites.

Retouch on scraper edges and bifacial pieces is mostly scaled-stepped, a pattern typical of Yabrudian assemblages from the Levant. At Yabroud, the predominance of scaled-stepped retouch had already been mentioned by Rust (RUST, 1950), Bordes (BORDES, 1955, 1977, 1984) and Bourguignon (BOURGUIGNON, 1997). At Tabun and Adlun (Bezez Cave and Zumoffen rockshelter), scaled-stepped retouch was also previously reported as being the most frequent (GARROD, 1956, GARROD *et al.*, 1961; COPELAND, 1978; JELINEK, 1982).

Atypical scaled-stepped retouch is generally present in smaller proportions than the typical form. One example from Unit XI of Tabun, where Yabrudian scrapers are clearly elongated and sometimes thinner (Fig. 30:1-4, 6), bears atypical scaled-stepped retouch. The thickness of these pieces and their striking platforms are characteristic of Yabrudian debitage. The association of this type of retouch with elongated blanks can be connected to different technological choices that vary according to the morphological structure of the blank, a pattern that reflects the internal variability of Yabrudian technology.

Generally poorly represented overall, cores from all three assemblages show varying morphologies. At Yabroud, a previous analysis suggested similarities with the Quina Mousterian and described how cores were managed (BOURGUIGNON, 1997). Cores exhibiting a Quina volumetric conception are present in several layers with a Yabrudian component at Yabroud (layers 25, 22, 21, 19, 12, 11, 10, 8), in Unit XIV and Unit XIII of Tabun, and at Adlun (Bezez

Cave, Cambridge Collection). Sub-quadrangular core are most numerous at Yabroud and Tabun (Units XIV, XIII).

Sub-circular cores are present at both Tabun (Unit XIII) and Bezez Cave (Level C). In addition to cores on blocks, the Yabroud assemblage also yielded cores-on-flakes where both surfaces were exploited. In Yabrudian industries, cores are generally of varied shape and exploited on at least 2 or more surfaces and sometimes exhibit a Quina volumetric conception. Quina-type cores are more common in all the studied assemblages but regularly co-occur with other forms. Cores on blocks or flakes were reduced in an opportunistic manner, producing thick blanks without any preparation or a hierarchy of removals.

4.5. Diachronic approach

Dates from multiple Yabrudian levels demonstrate Yabrudian traditions to be concentrated in a 170 ka period between roughly 387-215 ka (RINK *et al.*, 2004; BARKAI *et al.,* 2009; MERCIER *et al.*, 2013; FALGUÈRES *et al.,* 2015; HERSHKOVITZ *et al.*, 2016). The Yabrudian has classically been described as a thick, short-blank industry with scaled-stepped retouch. Our results, however, reveal certain changes within the Yabrudian chaîne opératoire over time.

The Unit XIV assemblage from Tabun, which corresponds to Garrod's layer G, first described as 'Tayacian' (GARROD & BATE, 1937) and then as Final Acheulean by Jelinek (JELINEK, 1982), presents reduction sequences very similar to those documented for the Yabrudian. Occasionally, the same assemblage types occur in levels assigned to both the 'Tayacian' and Yabrudian. Several cores from the 'Tayacian' level at Tabun have a geometric structure similar to that of cores from the Yabrudian levels and a close, perhaps less elaborate, patterns of exploitation. Similarly, cores with a Quina volumetric conception are also present in the 'Tayacian' level.

Blanks from this level are thick and short, some of which were transformed into scrapers by scaled-stepped retouch. Scrapers are less common in this unit than in later Yabrudian levels (Units XIII-XI), and are also characterized by more heavily retouched pieces. Bifacial pieces, management and re-sharpening flakes similar to those found in Yabrudian levels also occur in the 'Tayacian' level. These aspects potentially suggest the 'Tayacian' to represent an early phase of the Yabrudian 'chaîne opératoire', and are reminiscent of H. de Lumley's hypothesis, whereby the 'Tayacian' would be the origin of the Quina Mousterian (DE LUMLEY-WOODYEAR, 1971), and that of Le Tensorer, who considered the Yabrudian to have its origins in the 'Tayacian' levels of Hummal (LE TENSORER, 2005).

Yabrudian levels from the more recent units at Tabun (XIII-XI) have a higher percentage of Quina-type cores and retouched products. We also note the presence within Unit XI of Yabrudian scrapers made on elongated blanks with atypical scaled-stepped retouch. These scrapers are associated within this unit with a laminar industry called Amudian (JELINEK, 1990). Similar associations between Yabrudian scrapers and a laminar industry are observed at Yabroud in layers 10 and 11, and at Qesem Cave (GOPHER *et al.,* 2005).

Taken together, these elements potentially reflect the evolution of Yabrudian technological traditions over time and across several generations of knappers. The 'Tayacian', which could be seen as a sort of 'archaic Yabrudian', remains a problematic term, although a suitable replacement requires an examination of additional assemblages and a larger comparative dataset.

4.6. Chronological aspects

The Yabrudian has been considered as a transitional facies between the Lower and Middle Palaeolithic due to its stratigraphic position between the Acheulean and Levallois-Mousterian, or the Acheulean and Hummalian at Hummal in the El Kowm region of central Syria (COPELAND & HOURS, 1983; LE TENSORER, 2005). The association of the Yabrudian with the Acheulean has led some researchers to consider it as a Lower Palaeolithic facies (SHIMELMITZ *et al.,* 2014). The Yabrudian, whose 'chaîne opératoire' is essentially based on flake production, remains

closer to Levallois concepts, typical of the Middle Palaeolithic, than to Lower Palaeolithic biface and pebble industries. The technological convergence between Yabrudian and the Quina Mousterian has led to proposals of chronological ties between the two industries.

The Yabrudian is usually considered to predate the Quina Mousterian; however, we cannot ignore the fact that some Quina industries have yielded dates similar to those obtained for the Yabrudian, such as at Petit-Bost, located in the Isle Valley of the Dordogne, France. Dates from Level 2, which includes Quina industries among others, dates to about 320 ka (BOURGUIGNON *et al.,* 2006). Another date from Baume Bonne cave in Haute Provence, France places the site in isotopic stages 8 to 10, sometime between 400 and 300 ka (GAGNEPAIN & GAGAILLARD, 2005). Given its chronology and technology, the Yabrudian is, in our view, an early phase of the Middle Palaeolithic.

4.7. Environmental aspects

The assemblages studied here come from three sites separated by a considerable distance and located in two different environments: steppe zone for Yabroud, and coastal areas for Tabun and Adlun. Several factors explain the differences observed between the steppe and coastal occupations: the nature of the sites, climatic setting or access to raw materials. Each natural environment impacts hunter-gather lifeways, especially in terms of subsistence strategies, such as hunting or fishing, as well as habitation structures. Based on the notion that behavioural diversity and change can be provoked by different adaptations to local environmental conditions, we examined lithic material from different environmental settings to assess their impact on technological traditions.

Technological characteristics identified in the Yabrudian assemblages from several Levantine sites do not demonstrate any fundamental differences in technological behaviour among populations in these diverse regions. Despite some technological variability between assemblages, this does not appear to be primarily impacted by environmental conditions. Although environmental factors undoubtedly played a role in the technological behaviour of prehistoric groups, they were not the primary driving force. Our analyses show that Yabrudian groups in both distinct geographical areas and different natural environments shared the same technological traditions and the same know-how. Technological similarities between the Yabrudian of the Levant and the Quina Mousterian in Western Europe demonstrates that populations separated by considerable distance can share technological knowledge.

4.8. Cultural and anthropological approach

The recurrent presence of Yabrudian in several Levantine sites has lead some to recognize a Levantine specific industry. However, is the Yabrudian truly limited to this region? The Levant in its strictest sense is delimited to the west by the Mediterranean Sea, to the north by the Taurus foreland and southern Turkey, to the east by the fertile crescent that runs from the plains of the Nile to the Persian Gulf, and to the south by the Arabian Desert. A Yabrudian level was recently reported from Dederiyeh, in the northern most limits of the Levant (NISHIAKI *et al.,* 2011). Similarly, Yabrudian cores and blanks were identified towards the eastern limits of the northern Levant, at the site of Kulayb el Hemah in the Deir Ez-Zor area, which forms part of the Mesopotamian zone (AL QADI, in press).

Thus the presence of the Yabrudian outside the Levant seems entirely coherent. In Turkey, north of the Levant, Lower, Middle and Upper Palaeolithic are distributed in different geographic areas (KUHN, 2002). An industry technologically similar to the Yabrudian is present at the site of Karain in south-western Turkey, although it is referred to as an industry with 'Quina scrapers' (YALÇINKAYA *et al.,* 1992) or Charentian-type industry (OTTE *et al.,* 1996). Available data for Palaeolithic facies in the eastern Levant, in the heart of Mesopotamia, remains limited. Surveys and new excavations in this area will undoubtedly produce additional evidence for both the Yabrudian and other Palaeolithic facies. The Yabrudian may be much more widespread than current data suggests. The Yabrudian seems to be just as present in the Near East as both the Mousterian or Acheulean.

Its presence in several areas of the Levant region could relate to the exchange of ideas linked to mobility patterns or could result from an emergence from the same technological substrate without any contact or exchange between areas, as is likely reflected in the technological convergence between the Yabrudian and Quina Mousterian. While we now have a better understanding of the character of Yabrudian lithic assemblages, very few human remains have been discovered in Yabrudian levels. Moreover, these older finds often come from levels lacking a reliable chrono-cultural attribution. The recent discovery of a tooth in a Yabrudian level at Qesem Cave exhibits morphological features close to both archaic Homo sapiens as well as Neanderthals. Despite the fact that this tooth bears more features tying it to an archaic Homo sapiens, the available data makes it impossible to reliably attribute to either population (HERSHKOVITZ *et al.,* 2016).

5. CONCLUSION

Our analysis of Yabrudian assemblages from Yabroud I, Tabun and Adlun provides insights into several aspects of Yabrudian lithic technology, namely the production of thick blanks with plain wide striking platforms by hard-hammer percussion, associated with a predominance of multiple scraper forms. Single scrapers are the most frequent type in all assemblages. In addition to wide plain striking platforms, the presence of asymmetrical dihedral platforms reflects the alternation of a recurrent series of flakes detached from two surfaces of the block. Yabrudian assemblages also produced several types of flakes (BOURGUIGNON, 1997) that can be connected to the management and successive phases in the re-sharpening cycle of Yabrudian scrapers. Bifacial pieces, while present in Yabrudian assemblage, differ from typical Upper Acheulean bifaces in their technology. Yabrudian bifacial pieces are thick, with irregular edges and scaled-stepped retouch. Cores, although infrequent in Yabrudian assemblages, are predominantly Quina in conception, show an alternating use of several surfaces, and are most frequently sub-quadrangular, sub-triangular and sub-circular in shape. Narrow striking platforms (lips) associated with management, re-sharpening and bifacial-thinning flakes provide evidence for the use of soft hammers. Typical scaled-stepped retouch is most frequent and can be atypical, as in Unit XI at Tabun, which produced Yabrudian scrapers on elongated blanks. This also indicates that, in addition to thick and short flakes, Yabrudian scraper retouch can be applied to other types of blanks.

The comparison between assemblages from both steppe (Yabroud) and coastal zones (Tabun and Adlun) reveals a high degree of techno-typological similarity. These assemblages share the main characteristics of Yabrudian industries, including an abundance of retouched blanks, a preference for scrapers, especially the single forms, the dominance of plain striking platforms, the frequent use of cortically-backed blanks amongst flakes with asymmetrical cross-sections, small numbers of cores, including frequent Quina-types, few bifaces compared to scrapers, and a limited number of re-sharpening or management flakes.

Despite these technological and typological similarities, some variation between assemblages does exist, such as the prevalence of cortical blanks over non-cortical blanks in the Tabun Unit XIII assemblage (Jelinek excavations), which contrasts with the proportions observed in the two other assemblages. These differences may relate to several factors: distances between sites and raw material sources, site function, or duration of occupation. Our study has shown that Yabrudian technology co-occurs with the Levallois method in the majority of layers with a Yabrudian component in Yabroud Shelter I (layers 25, 24, 23, 22, 21, 19, 16, 14, 12, 11, 10, 8). The coexistence of Yabrudian and Levallois technology could be interpreted as the co-existence of human groups with different know-how during specific periods.

Atypical scaled stepped retouch is by far the best represented in the material of Unit XI of Tabun and layer 8 of Yabroud. Bifacial pieces are more frequent in level C of Bezez than at Tabun, and even more so at Yabroud, demonstrating the consistent coexistence of bifacial shaping with flake production. Despite this high percentage of

bifacial pieces, this pattern cannot be generalized to all of level C, as we were unable to access the entire collection from the site. A comparison of the assemblages from all three sites nevertheless show Yabrudian groups to have shared similar ideas and technological knowledge in both steppe and coastal areas of the Levant.

At the same time, each group expressed its technological know-how in a different ways, under the influence of internal factors specific to each environmental and social context, resulting in intra-assemblage variability. This variability is also evident in Yabrudian assemblages within each environmental zone and between sites as a function of differing mobility patterns or population movements introducing new technological innovations or subsistence strategies. The Yabrudian 'chaîne opératoire' is essentially based around flake production, and coexists with typical Middle Palaeolithic industries, such as the Levallois-Mousterian. The Yabrudian appears technologically more similar to the Middle Palaeolithic than to the Lower Palaeolithic, and can therefore be considered an early phase of the Levantine Middle Palaeolithic.

The Yabrudian also shows technological similarities with 'Tayacian' assemblages, which are found chrono-stratigraphically below the Yabrudian in several Levantine sites (Tabun, Hummal, Umm Qatafa). As evident in our analysis of the Tabun material, technological links between the Yabrudian and 'Tayacian' industries suggest the former finds its origins in the latter, a hypothesis already put forward by Le Tensorer for the site of Hummal (LE TENSORER, 2005). Technological similarities between Yabrudian and Quina Mousterian industries seem to be linked to the presence of two similar technological concepts in widely distant regions.

In the absence of any evidence of Yabrudian occupations in the geographic space between the Levant and Western Europe, it is currently difficult to establish causal links between the Yabrudian and the Quina Mousterian. New data from this intermediate zone combined with a re-examination of industries presenting characteristics similar to Yabrudian industries, such as those currently known from the site of Karain in south-west Turkey, may provide important insights for this question. This resemblance between the Yabrudian and Quina Mousterian is comparable to Palaeolithic facies assigned to the same techno-complex in the Levant and in Europe, such as the Acheulean and the Mousterian.

Acknowledgments

The authors would like to thank all the people who contributed to the ideas presented in this article, in particular Dr. Laurence Bourguignon, for her advice throughout this research. Several researchers not only welcomed us to their institutes to study the collections, but participated in discussions that helped improve the research presented here. We would like to thank Jürgen Richter of the *Institut für Ur-und Frühgeschichte* at the University of Cologne, Germany, Steven Kuhn, Department of Anthropology at the University of Arizona, USA, Maya Haidar-Boustani, curator at the Lebanese Prehistory Museum of the University of Saint Joseph in Beirut, Imogen Gunn, Museum of Archeology and Anthropology at the University of Cambridge, UK.

This research would not have been possible without the financial support of the Swiss National Science Foundation (SNSF grant 143415, PI M. Besse), the Ernst & Lucie Schmidheiny Foundation, Switzerland (PI M. Besse), the Augustin Lombard Fellowship of the Society of Physics and Natural History, Switzerland (PI A. Al Qadi), and the Deutscher Akademischer Austauschdienst DAAD, France branch (PI A. Al Qadi).

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