The State of the Stone
Terminologies, Continuities and Contexts in Near Eastern Lithics

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and Osamu Maeda

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# Contents

<table>
<thead>
<tr>
<th>Introduction</th>
<th>ix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elizabeth Healey, Stuart Campbell &amp; Osamu Maeda</td>
<td></td>
</tr>
<tr>
<td>1  The PPN 1–6 Workshops: agendas, trends and the future</td>
<td>1</td>
</tr>
<tr>
<td>Hans Georg K. Gebel</td>
<td></td>
</tr>
<tr>
<td><strong>PPN predecessors</strong></td>
<td>23</td>
</tr>
<tr>
<td>2  PPN predecessors: current issues in Late Pleistocene chipped stone analyses in the southern Levant</td>
<td>25</td>
</tr>
<tr>
<td>Lisa A. Maher &amp; Tobias Richter</td>
<td></td>
</tr>
<tr>
<td>3  Nebekian, Qalkhan and Kebaran: variability, classification and interaction. New insights from the Azraq Oasis</td>
<td>33</td>
</tr>
<tr>
<td>Tobias Richter</td>
<td></td>
</tr>
<tr>
<td>4  Lithic “culture” issues: insights from the Wadi al-Hasa Epipalaeolithic</td>
<td>51</td>
</tr>
<tr>
<td>Deborah I. Olszewski</td>
<td></td>
</tr>
<tr>
<td>5  Technological rationality of core reduction and blank production in the Natufian lithic industries of the Galilee</td>
<td>67</td>
</tr>
<tr>
<td>Christophe Delage</td>
<td></td>
</tr>
<tr>
<td>6  Newly discovered Late Epipalaeolithic lithic assemblages from Dederiyeh Cave, the northern Levant</td>
<td>79</td>
</tr>
<tr>
<td>Yoshihiro Nishiaki, Yosef Kanjo, Sultan Muhesen &amp; Takeru Akazawa</td>
<td></td>
</tr>
<tr>
<td>7  The Epipalaeolithic chipped stone from Pınarbaşı, on the central Anatolian plateau</td>
<td>89</td>
</tr>
<tr>
<td>Anne Pirie</td>
<td></td>
</tr>
<tr>
<td><strong>Beyond chipped stone</strong></td>
<td>97</td>
</tr>
<tr>
<td>8  On floor level: PPNA indoor cupmarks and their Natufian forerunners</td>
<td>99</td>
</tr>
<tr>
<td>Danny Rosenberg &amp; Dani Nadel</td>
<td></td>
</tr>
<tr>
<td>9  Pestle sectioning at Dhra’: a chaîne opératoire for basalt pestles and their derivatives</td>
<td>109</td>
</tr>
<tr>
<td>Philipp M. Rassmann</td>
<td></td>
</tr>
<tr>
<td>10 Stone ring production in the Neolithic of the Near East and analogies from the American West</td>
<td>125</td>
</tr>
<tr>
<td>Marc W. Hintzman</td>
<td></td>
</tr>
<tr>
<td>11 Halaf bead, pendant and seal ‘workshops’ at Domuztepe: technological and reductive strategies</td>
<td>135</td>
</tr>
<tr>
<td>Ellen H. Belcher</td>
<td></td>
</tr>
<tr>
<td><strong>Change or continuity?</strong></td>
<td>145</td>
</tr>
<tr>
<td>12 Social and symbolic meanings of lithic technology during the PPN in the Middle Euphrates</td>
<td>147</td>
</tr>
<tr>
<td>Juan José Báñez &amp; Jesús González-Urquijo</td>
<td></td>
</tr>
<tr>
<td>13 Lunates as projectiles at the onset of the Neolithic period</td>
<td>157</td>
</tr>
<tr>
<td>Alla Yanoshchevich, Ofer Bar-Yosef &amp; Vladimir Zbenovich</td>
<td></td>
</tr>
<tr>
<td>14 Geometric from the Neolithic settlement of Tall i Mushki, south-west Iran</td>
<td>163</td>
</tr>
<tr>
<td>Masashi Abe</td>
<td></td>
</tr>
<tr>
<td>15 Did the diffusion of Levantine Helwan points to north-eastern Africa really take place? A study of side-notched and tanged projectile points in north-eastern Africa</td>
<td>171</td>
</tr>
<tr>
<td>Noriyuki Shinai</td>
<td></td>
</tr>
</tbody>
</table>
The lithic assemblage of Ayia Varvara Asprokremnos: a new perspective on the Early Neolithic of Cyprus
Carole McCartney

The PPNB site of Beisamoun (Hula Basin): present and past research
Fanny Bocquentin, Omry Barzilai, Hamoudi Khalaily & Liola Kolka Horwitz

Changes in chipped stone industries in south-eastern Anatolia: Akarçay Tepe (7,600–6,800 cal. BC)
Ferran Borrell

The lithic assemblage of Sha’ar Hagolan: PPN/PN continuity?
Zinovi Matskevich

Is the PPNC really different? The flint assemblages from three layers at Tel Roiim West, Hula Basin
Dani Nadel & Michal Nadler-Uziel

A note on the complexity of lithic assemblages
Laurence Astruc

Social contexts of production and use

Nahal Lavan 1021: a PPNB knapping site in the western Negev dunes
Omry Barzilai & Nigel Goring-Morris

A methodological approach, using GIS applications, to stratigraphy and spatial analysis at PPNB Kfar HaHoresh
Michal Birkenfeld & Nigel Goring-Morris

Knapping methods and techniques at Tell Halula (middle Euphrates valley), during the mid VIIIth millennium cal. BC
Ferran Borrell

Lithics in a ritual context at the PPNC site of Mishmar Ha’emeq: do they display special characteristics?
Omry Barzilai, Nimrod Getzov, Yaël Givol-Barzilai, Nimrod Marom & Ofer Marder

The social roles of the use of flint and obsidian artefacts at Salat Cami Yani in the upper Tigris valley
Osamu Maeda

Stones of the living and bones of the dead? Contextualising the lithics in the Death Pit at Domuztepe
Stuart Campbell & Elizabeth Healey

Side-blow blade-flakes from the Ghassulian sickle blade workshop of Beit Eshel: a Chalcolithic solution to a Neolithic riddle
Jacob Vardi & Isaac Gilead

On becoming a skilled flint knapper: practising flint knapping at the Chalcolithic sickle blade workshop of Beit Eshel, a preliminary refitting study
Angela Davidzon & Isaac Gilead

4th International Workshop on Chipped Lithic Industries (Niğde, Cappadocia, Turkey) 4th–8th June 2001

Introduction
Nur Balkan-Atlı

LPPNB blade caches at Tell Ain el-Kerkh, north-west Syria
Makoto Arimura

Flint and obsidian industry of Mezraa-Teleilat (Urfa, south-east Anatolia), PPN-PN
Güner Coşkunsu

An obsidian industry from Neolithic Hagoshtrim, Upper Galilee
Avi Gopher, Ofer Marder & Ran Barkai

Obsidian distribution and cultural contacts in the southern Levant during the 7th millennium cal. BC
Yosef Garfinkel

The typological analysis of Aşkılı arrowheads and problems
Semra Yıldırım Balcı
36 Preliminary results of the technological analyses of Musular obsidian – central Anatolia
Nurcan Kayacan & Mihriban Özbahadan

37 Parallel lives: Abu Ghosh and Yiftahel, economic strategies of two PPNB sites in the southern Levant
Ofer Marder, Hamoudi Khalaily & Ianir Milevski

38 Assessing lithic raw material availability, abundance and use in the Late Upper Palaeolithic, Epipalaeolithic and Neolithic of the Wadi al-Hasa, Transjordanian Plateau
Deborah I. Olszewski

39 PPNA stone and flint axes as cultural markers: technological, functional and symbolic aspects
Ran Barkai

40 The spatial distribution of arrowheads and microliths in the Near East (10,200–8,000 cal. BC)
Olivier Aurenche & Stefan K. Kozłowski

41 Preliminary notes on the Pre-Pottery and Pottery Neolithic lithics from Tell Seker al-Aheimar, the upper Khabur: the 2000–2001 seasons
Yoshihiro Nishiaki

42 Points and glossed pieces from Tell Sabi Abyad II and Tell Damishliyya I (Balikh Valley, Djezireh)
Laurence Astruc

43 Symbolic behaviour reflected in stone and bone objects from Nahal Hemar Cave, Judean Desert
Ofer Bar-Yosef

44 Stones in their symbolic context: Epipalaeolithic – Pre-Pottery Neolithic continuity in the Jordan Valley
Dani Nadel
Changes in chipped stone industries in south-eastern Anatolia: Akarçay Tepe (7,600–6,800 cal. BC)

Ferran Borrell

Abstract

The study of the chipped stone assemblage throughout the sequence of Akarçay Tepe has allowed us to characterise the different methods and techniques used to knap flint at this site. It has enabled us to establish changes between 7,600 and 6,800 cal. BC. Through this period of time, a divestment process in lithic tool production is clearly identified at Akarçay. This phenomenon affected the flint procurement strategies, the knapping techniques and methods, the retouching techniques, and the composition of the “tool kit”. These changes in stone tool production during the second half of the 8th millennium cal. BC, must be considered along with divestment in technology and simplification of the production of flint tools documented in the northern Levant. In addition strong similarities between the lithic industries of the sites located along the upper part of the middle Euphrates valley have been reported, suggesting a region with strong cultural links, specially through the lithic traditions and probably influences and exchanges with the sites located on the upper Euphrates.
each phase, but rather refer only to the changes in lithic production on flint at Akarçay.

The total amount of chipped flint recovered and studied in Akarçay Tepe is 8951 artefacts. This assemblage represents almost 90% of the material recovered during the 1999 to 2001 field seasons, mostly coming from exterior areas and the filling of the buildings. No specific sampling was done so all the categories are represented in the same way (cores, blades, flakes, debris, etc.). During the excavation no flint workshops or knapping areas were identified and during the study of the material no specific sampling was carried out. Thus, it can be assumed that all the categories are present (cores, flakes, blades, debris, etc.); the assemblage has not been sampled so, a priori, results should be comparable.

Raw materials and procurement strategies
In order to carry out a study of the procurement and selection strategies of flint throughout the occupation sequence of Akarçay Tepe, a specific methodology has been developed. The different flint varieties identified have been established according to a combination of macroscopic and microscopic features. Specific prospections have been carried out along the Euphrates terraces with the purpose of establishing the diversity and the proportion of the different varieties of flint available in the terraces.

Nine flint groups (group 0 to 8) have been defined at Akarçay. They have been described in detail in earlier publications (Borrell 2005; Borrell 2006; Borrell et al. 2006; Borrell 2010), so only a short explanation of their characteristic traits is given below

*Flint Group 1 to 3* are coarse-grained flint varieties transported by the river in large quantities. Colour ranges from white to light grey or cream. The nodules are medium-sized (15cm long) and mainly flat or globular.

*Flint Group 4* can be found in primary position outcrops in the limestone formation next to Akarçay, but are rarely found in the Euphrates terraces. The nodules of this fine/medium-grained reddish flint often have an irregular morphology.

*Flint Groups 5 and 6* are multi-coloured fine-grained flint varieties that can be easily found on the river terraces. Nodules are medium-sized and their morphology is mainly globular.

*Flint Group 7* is a characteristic dark brown fine-grained flint that can not be found in the Euphrates terraces. The nearest primary outcrops have been located 25km north of Akarçay, near Halfeti. On the basis of its macroscopic features, this flint group seems to have been reported in many sites in northern Syria and it has been described in many different ways (Cauvin 1994; Coqueugniot 1994; Molist et al. 2001; Cauvin et al. 2001; Abbès 2003; Nishiaki 2007).

*Flint Group 8* is a fine-grained grey flint that appears in thin (3cm thick) tabular sheets. It displays some impurities which makes it difficult to knap.

*Flint group 0* is a heterogeneous group of local fine and coarse-grained flints that are only represented in very low percentages, less than 1% of the total amount.

It has been possible to establish the relative importance of the flint varieties which come from the terraces of the Euphrates, as they account for 90% of the total assemblage. The terrace flints were preferred throughout the whole chronological sequence. Local coarse-grained flint (Flint Groups 1 to 3), which is very abundant in the terraces, occurs only in low percentages at the site. Correspondence Analysis (hereafter CA) (Fig. 1) shows that the flint from the Euphrates Terraces appear to be absolutely distinguished in all the Lithic Phases indicating that there was a clear selection of the available flint varieties.

<table>
<thead>
<tr>
<th>East Sector</th>
<th>C14 Dates</th>
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<th>C14 Dates</th>
<th>Chrono-cultural Phase</th>
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<tbody>
<tr>
<td>–</td>
<td>–</td>
<td>Lithic Phase 1</td>
<td>7,470±80 BP</td>
<td>Pottery Neolithic</td>
</tr>
<tr>
<td>Lithic Phase 2 (not studied)</td>
<td>–</td>
<td>Lithic Phase 2</td>
<td>7,860±40 BP</td>
<td>Early Pottery Neolithic</td>
</tr>
<tr>
<td>Lithic Phase 3 (not studied)</td>
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<td>Lithic Phase 3</td>
<td>8,390±110 BP</td>
<td>Late PPNB</td>
</tr>
<tr>
<td>Lithic Phase 4</td>
<td>8,260±40 BP</td>
<td>Lithic Phase 4</td>
<td>8,310±130 BP</td>
<td>Late PPNB</td>
</tr>
<tr>
<td>Lithic Phase 5</td>
<td>8,560±40 BP</td>
<td>–</td>
<td>–</td>
<td>Middle PPNB/Late PPNB</td>
</tr>
</tbody>
</table>

Table 1: Lithic Phases at Akarçay Tepe, absolute dates (Arimura et al. 2001 and M. Molist pers.comm.).
Changes in chipped stone industries in south-eastern Anatolia: Akarçay Tepe (7,600–6,800 cal. BC)

At the same time it has been possible to establish that there is some chronological change in the flint procurement strategies (Fig. 2), especially remarkable when considering that the local flint varieties come from the Euphrates terraces. As it can be observed in the CA analysis, the Lithic Phases appear following an order, from left to right, grouped into three different subgroups: AK-5 and 4, AK-3 and 2 and AK-1.

These results suggest that a chronological change in the flint procurement strategies can be documented throughout the sequence at Akarçay. During the earliest occupation the raw materials were more carefully selected. The degree of selection gradually decreases through time and Flint Groups less suitable for knapping are used more frequently. This suggests that there was a lesser investment in the selection of the locally available flint varieties. This gradual change is documented throughout the chronological sequence, although two specific points of change have been observed (between Lithic Phases 4 and 3 and between Lithic Phases 2 and 1) and three different flint procurement strategies can be established. This phenomenon developed during the Late PPNB, throughout the second half of the 8th millennium cal. BC and runs parallel to what seems to be a marked change in supply of obsidian (Maeda 2007).

The knapping process

At the end of the Middle PPNB and the beginning of the Late PPNB (Lithic Phase 5), blades represent about 50% of the total number of chipped stone artefacts whereas during the Late PPNB (Lithic Phase 4) that percentage gradually decreases to 25%. This phenomenon continues through the end of the Late PPNB (Lithic Phase 3) and into the Pottery Neolithic layers (Lithic Phases 2 and 1), where blades constitute no more than 10% of the total. The abandonment of blade knapping becomes evident and it seems to happen gradually throughout the sequence.

Besides this, there is a strong patterned use of flint in relation to flake and blade production (Fig. 3). The raw materials used to produce blades are mainly the fine-grained flint varieties procured from the Euphrates terraces (Flint Groups 5, 6 and 0) and the non-local flint (Flint Group 7). Flakes, on the other hand, are made of the coarse-grained local flint (Flint Groups 1, 2, 3 and 4 and 8).

Specific production of flakes seems only to be extensively documented at the very end of the Late PPNB and the Pottery Neolithic periods. During Lithic Phases 5 to 3 flake cores are very rare and flakes seem to have been obtained when preforming the blade cores and reusing the cores once exhausted. Blade production is the main manufacturing process. Nearly half of the 2,543 blades and bladelets show unidirectional removals on their dorsal face while the others have been knapped from bi-directional opposed-platform cores. There is also a deliberate selection of flint in relation to unidirectional and bi-directional blade production. Most of the unidirectional and bi-directional blades are made of fine-grained flint (Flint Group 5). Coarse-grained local flint (Flint Groups 1, 2 and 3) is mainly used to produce unidirectional blades, while fine-grained non-local flint (Flint Group 7) is mainly reserved for the production of bi-directional blades (Fig. 4). Different blade knapping methods have been attested in both the blades and the cores. The abundance of cores, blade products and some other blanks with technological information, allow us to propose that all kind of blade production...
knapping methods and techniques were developed by the neolithic community within the settlement.

**Single-platform blade/bladelet knapping**

Almost half of the blades from the earlier occupation of the tepe, at the end of the Middle PPNB (Lithic Phase 5), show uni-directional negative removals on their dorsal face. This percentage tends to increase gradually in a way that, at the beginning of the 7th millennium cal. BC, blades detached from single platform cores represent around 90% of the total number of blades. The technological attributes of the blades and the cores allow us to demonstrate that at Akarçay there are two knapping techniques used to detach uni-polar blades and bladelets (Borrell 2007b).

**Single-platform blade knapping by direct percussion**

Uni-directional blade production by direct percussion is extremely rare during the earliest occupation of the tepe but quickly becomes common during the Late PPNB layers (Lithic Phases 4 and 3). In particular, despite a decline in blade production, uni-directional blade production by percussion seems to replace bi-directional production and pressure/indirect percussion debitage, and at the very end of the Pre-Pottery Neolithic it represents almost the totality of the blade production, with the exception of a low percentage of bi-polar blades. Percussion is done with hard hammers and the products are robust blades with triangular cross-sections, marked bulbs and large butts.

**Single-platform blade/bladelet knapping by pressure/indirect percussion**

There is a high percentage of uni-directional blades which show specific features which suggest that pressure, and maybe indirect percussion, was used to detach blades (Borrell 2006; Borrell 2007b). The diffusion of this technique, probably from the upper Euphrates to the northern part of the middle Euphrates valley during the mid 8th millennium cal. BC (Borrell 2007b), does not seem to have been clearly identified in the contemporary sites located in the southern part of the middle Euphrates valley such as Halula (Borrell 2007b) where it is virtually absent (Borrell this volume).

These blades are quite long, thin and regular in size and shape, with a tiny linear or punctiform butt, parallel edges, a trapezoidal cross-section, and a slightly curved distal end. The presence of blades with these characteristics, together with the presence of some prismatic and flat cores with very regular negative removals, suggests the possibility that, at Akarçay, at the end of the Middle PPNB, a pressure technique was known and used to detach flint blades, mostly using local flint. No evidence of heat treatment has been observed. Most of the prismatic and flat single platform cores belong to the earliest occupations (Lithic Phase 5) (Fig. 5). They have some common typological features suggesting that the general concept of core reduction was the same. The shaping of the cores seems to affect most of the original surface and cortical surfaces are rare. The working face is nearly always restricted to the front of the core. They have an inclined single platform and, usually, prepared sides and backs. In addition to the evidence from these cores, it is possible to reconstruct the core reduction sequence by making use of evidence from the debitage associated with core reduction, such as platform-opening pieces, crested blades, lateral blades and plunging blades. The back of most of the cores was shaped by a crested ridge (dorsal or lateral) obtained either with uni-directional or bi-directional removals and the working surface was obtained after shaping and detaching a frontal crested ridge. The angle between the platform and the working face of the discarded cores is sometimes quite acute. The proximal end of working face was sometimes well prepared for blade detachment. Sometimes correction flakes were detached from the bottom or sides of the core. The shape of the distal end of the plunging blades, which have removed the bottom end of the core, is similar to the ends of the discarded cores.

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**Fig. 4: Percentage (left) and total number of uni-directional and bi-directional blades made with all types of flint**

<table>
<thead>
<tr>
<th>Flint Group</th>
<th>UNIDIRECTIONAL BLADE</th>
<th>BIDIRECTIONAL BLADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>1</td>
<td>25%</td>
<td>75%</td>
</tr>
<tr>
<td>2</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>3</td>
<td>75%</td>
<td>25%</td>
</tr>
<tr>
<td>4</td>
<td>100%</td>
<td>0%</td>
</tr>
</tbody>
</table>

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<tr>
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<td>1</td>
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<td>75%</td>
</tr>
<tr>
<td>2</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>3</td>
<td>75%</td>
<td>25%</td>
</tr>
<tr>
<td>4</td>
<td>100%</td>
<td>0%</td>
</tr>
</tbody>
</table>
The pressure technique used at Akarçay seems to have its origin in the upper Euphrates valley (Borrell 2007b). So, Akarçay Tepe represents the first evidence of the diffusion of this technique typical of eastern Anatolia, for example at Cafer Höyük (Calley 1985; Caneva et al. 1998) and Çayönü (Redman 1982; Binder 2008), to the northern part of the middle Euphrates valley during the mid 8th millennium cal. BC. Almost at the same time, the presence of pressure debitage at the sites of Hayaz Höyük, Gritille, Mezraa-Teleilat corroborates the diffusion of this technique in the region.

There is limited production of bladelets during the Lithic Phase 5, using fine-grained local flint varieties. The shaping of the cores has been carried out in various ways, showing some similarities with the single platform blade cores: shaping the back of the cores by a dorsal or postero-lateral crested ridge by means of uni-directional or bi-directional removals. One core (Fig. 5: 7) seems to have been preformed as a bifacial (asymmetric) piece and then the crested ridge was removed by means of one or more blade removals. The negative removals of those blades are used as the pressure platform from which bladelets were detached. The cross-section of the core is quite narrow and so it forms the working face. This method is very similar to the well-known method called “Yubetsu” or “Shirataki” (Tixier 1984; Inizan 1991; Inizan et al. 1992), which is a relatively simple method of knapping bladelets by pressure that can be carried out with the only help of a piece of bone (Inizan 1991).

The presence of the “cuneiform” or wedge-shaped core seems to corroborate the fact that pressure technique was used at Akarçay to detach blades and bladelets of flint during the earliest occupation of the site. This hypothesis does not exclude the possibility that indirect percussion could also have been used in some cases, maybe as part of the same production process. Some other data that strengthen our
The proposal is that during the same time period (Lithic Phase 5), pressure blade knapping, used to detach obsidian blades and bladelets at the settlement, is very well documented (Maeda 2007). Since the pressure technique was well known by the Neolithic community of Akarçay, it would not be strange to use it with raw materials other than obsidian. Moreover, there are great similarities in the method used for knapping flint and obsidian blades, both in the configuration of the core and the core reduction during the blade detachment process (Borrell 2007b).

Almost all the single-platform prismatic/pyramidal and flat cores belong to the earlier occupations of the site. Furthermore, the presence of bladelet production is restricted to the end of the Middle PPNB and the beginning of the Late PPNB (Lithic Phase 5), suggesting that pressure blade/bladelet knapping is a technique that becomes progressively abandoned during the third quarter of the 8th millennium cal. BC.

**Opposed-platform blade knapping**

Bi-directional technology is well documented at Akarçay, especially during the first occupation of the tell, where bi-directional blades represent nearly half of the blade production (Fig. 6). This percentage does not change significantly through the third quarter of the 8th millennium cal. BC (Lithic Phase 4) but starts to decrease at the very end of the Late PPNB (Lithic Phases 3 and 2). Finally, during the first quarter of the 7th millennium, bi-directional blades become very rare, even though a small percentage still is documented. Bi-directional blade production is mainly carried out using local fine-grained varieties of flint. On the other hand, non-local fine-grained flint (Group 7) is used only for a low percentage of the total assemblage of bi-directional blades, although it is clear that this raw material is especially reserved for this knapping method. The average measurements of the abandoned opposed-platform cores are 108 x 48 x 38mm. Considering that these are the dimensions of the

---

Fig. 6: Opposed-platform blade cores (1–2) and a crested blade (3) from Middle and Late PPNB layers (Lithic Phase 5), upsilon blades (4–5) from Lithic Phase 2 and a tested nodule shaped with a crested ridge (6) found in a mound located 500 meters from the site. The morphology of this coarse-grained local nodule seems highly suited to developing bi-directional blade reduction. The rest of the assemblage is made on fine-grained local flint.
exhausted and abandoned cores, we suggest that probably the original dimensions were bigger, perhaps up to 15cm in length and around 6cm wide. Some of the cores display cortical surfaces while some others have their back shaped with a lateral-dorsal crested ridge, which is roughly prepared with a few uni-directional removals. The cores were preformed by means of a single frontal ridge/crest and, only sometimes, with a dorsal crest.

Retouched tools
A total number of 1842 retouched pieces have been recovered (Borrell 2006; Borrell and Molist 2007; Borrell 2008). In almost all layers most of the retouched tools are made on flakes (40–60%), although some blades were reserved for the production of retouched pieces. The percentage of retouched tools suffers a gradual decrease throughout the chronological sequence. Retouched tools form around 20–30% of the total assemblage during the earlier two Lithic Phases but this percentage abruptly decreases to 5–10% during Lithic Phase 3 and later occupations. Almost at the same time (Lithic Phases 4 and 3), pressure retouch becomes widely used to shape projectile points.

A similar phenomenon is noted in the use of raw materials (Fig. 7). Most of the retouched tools are made from local fine-grained flint (Flint Group 5), although blades made on Flint Groups 6 and 7 are retouched in higher percentages than the other varieties. Flint Group 7 is mainly used to produce bi-directional blades that were retouched to produce projectile points. With Flint Group 5, all type of retouched tools are made, especially those on blades. The raw materials which are less suitable for knapping (Flint Groups 1, 2 and 3) are used to produce scrapers, side scrapers, denticulates and retouched flakes. Furthermore, there is a correlation between Flint Group 4 and the scrapers and notches. This flint group, of good knapping quality, appears in the form of irregular nodules near the site both in primary and secondary positions. The irregular morphology of the nodules is good for producing thick flakes which are suitable for scrapers.

The retouched tool kit comprises indeterminate arrowheads, Byblos points, Amuq points, Ugarit points, burins, truncations, scrapers, perforators/drills/borers, side scrapers, denticulates, glossed tools, notches, hoes, picks, pointed blades, retouched blades and retouched flakes. Nearly all these tools can be found, in different percentages, throughout the sequence of layers of Akarçay (Borrell 2006). Despite the apparently large range of retouched tools, most of the retouched assemblage is composed of projectile points, scrapers, denticulates, retouched blades, retouched flakes, sickle blades and burins. These categories are highly significant when trying to characterise the diachronic changes in the tool kit because they appear in high numbers and because these tools are related to important subsistence tasks such as hunting and harvesting and their proportions vary throughout the sequence (Fig. 8).

From the end of the Middle to the Late PPNB (Lithic Phases 5 to 3) Byblos and Ugarit points (made on Flint Group 7), glossed tools and retouched blades (made on Flint Groups 5 and 6) and scrapers (mainly made on Flint Group 4) predominate. The retouched equipment changes at the very end of the Late PPNB (between Lithic Phases 2 and 3) and Amuq points, burins, denticulates and retouched flakes become more common and are often made on coarse-grained local flint (Fig. 9). Finally, at the beginning of the 7th millennium cal. BC when pottery begins to appear, the tool kit changes completely as do the raw materials used to produce those tools. In general, there is destandardisation of the blanks used and of the shape of the retouched tools (Borrell 2006; Borrell 2007a).
Summary and contextualisation of the results
The study of the chipped stone industry at Akarçay Tepe has allowed us to characterise the production process of the stone tools and their change throughout almost 1800 years, covering an interesting period of time from the Middle PPNB to the PN. With the data obtained, two main aspects will be considered below: the change in the lithic assemblage at Akarçay within the framework of the northern Levant and, the strong similarities observed between Akarçay and some other contemporary sites located on the upper part of the middle Euphrates valley and further north.

During the second half of the 8th millennium cal. BC there is a phenomenon of technical divestment or simplification in the production of flint tools documented both at Akarçay Tepe and in some other settlements located along the middle Euphrates valley and the neighbouring regions, including Cyprus, although some slight chronological differences can be observed (Nishiaki 1993; Cauvin 1994; Caneva et al. 1994; Caneva et al. 1998; Nishiaki 2000; Molist et al. 2001; Abbès 2003; Borrell 2006; Guilaine and Brío 2006; Borrell 2007a; Nishiaki 2007). Despite this general trend, not all the complex technical processes are completely abandoned. The use of pressure retouch to produce elaborate and nicely-shaped projectile points (Amuq type) spreads throughout the Pottery Neolithic but in small proportions. Another example is the wide distribution during the Halaf period of a very specific tool type (and the raw material which is made on) namely the tile knife. Similarly with
regard to obsidian, although intra-site diachronical studies and data relating to obsidian production (technology/typology and provenance) are still scarce (Coşkunsoy 2007; Maeda 2007; Astruc this volume) for this time period (Late PPNB/ PN), pressure debitage is widely attested at many sites.

Actually, most of the transformation in flint technology occurred gradually before 7,000 cal. BC, prior to the appearance of the earliest pottery. What can be documented at the beginning of the 7th millennium cal. BC is the continuation of the major changes that started during the Late PPNB, suggesting continuity between PPNB and PN, not a drastic rupture. This continuity has been attested in other sites in the Euphrates valley, such as at Tell Halula (SAPPO 2007) and the upper Khabur valley (Nishiaki and Le Méire 2005). Changes also affected flint procurement strategies, knapping techniques and methods, the retouching techniques and the composition of the “tool kit”. Raw material procurement strategies changed and this process, affected the selection and use of both the local and non-local raw materials, would be better defined as decrease in investment in procurement of flint. A similar simplification of raw material procurement strategies has also been observed in Cyprus (Astruc 2004; Gualaine and Briois 2006). A second aspect that has been documented is that bidi-directional blade knapping was gradually abandoned at the end of the PPNB (Nishiaki 1993; Nishiaki 2000), although it can be documented, in lower percentages, at many sites like Tell Halula (Borrell 2006; Borrell 2007a; Borrell and Molist 2007), Akarçay Tepe (Borrell 2006; Borrell 2007a), Mezraa Teletat (Coskunsoy 2002), Tell el-Kerkh (Arinmusa 2003a; Arinmusa 2003b), Grithile (Davis 1988), Kumartepa (Roeddenberg 1989), Abu Hureyra (Moore 1979), Bouqras (Roeddenberg 1986) and Sabi Abyad I (Copeland 1996) during the PN. This phenomenon took place in the context of a marked decrease in blade production, defined as a change from “specialised blade to amorphous flake production” (Nishiaki 2000) or to an “expeditive and non-standardised” technology (Molist et al. 2001). In the northern zone of the middle Euphrates valley, especially at Akarçay Tepe, this transformation includes the abandonment of the pressure technique for detachng uni-directional blades (Borrell 2006; Borrell 2007a; Borrell 2007b). In other words, there seems to be a gradual abandonment of the more complex knapping methods and techniques such as bi-directional technology and pressure techniques during the Late PPNB. At the same time, the retouched stone tools changed, displaying a decrease in both morphological and functional standardisation. At Akarçay, projectile points, sickle blades, scrapers and some other tool types common during the PPNB loose their importance, while some other tools, such as notches, denticulates, side scrapers, and retouched flakes start to predominate. A similar change can be observed when comparing the retouched tool kit of some Middle/Late PPNB sites like Gürçütepe II (Belbe-Bohn et al. 1998), Sabi Abyad II (Copeland and Verhoeven 1996), Çayönü Cell Building sub-phase/Stage 3 (Caneva et al. 1994; Caneva et al. 2001), Çayönü Phase Receptive (Cauvin 1989), Hayaz Höyük (Roeddenberg 1984; Roeddenberg 1989) or Tell Halula Sector 4 (Molist et al. 2001; Borrell 2006) and some other sites contemporary with Akarçay Lithic Phases 3 to 1 (end of Late PPNB to PN) including Kumartepa (Roeddenberg 1989; Baykan 1998), Mezraa–Teletat (Coskunsoy 2002), Çayönü Large Room sub-phase/Stage 4 (Caneva et al. 1994; Caneva et al. 2001) and Pottery Layers (Ozdogan 1994), Tell Halula/sector SS7 (Ferrer 2000; Molist et al. 2001).}

The second point to be stressed, is that contextualisation of the flint assemblage of Akarçay has repeatedly suggested strong links with sites such as Hayaz Höyük, Grithile, Kumartepa and Mezraa–Teletat. Lithics from each one of these sites display strong parallels with some of the Lithic Phases established in Akarçay, so the changes in the production process of stone tools has been partially recognised in each of these assemblages providing a similar sequence to Akarçay. These similarities can be identified in both raw material procurement strategies and technological features, demarcating a region with high similarities in the lithic production (Fig. 10) (Borrell 2006). Similarities between Akarçay and both the upper part of the middle Euphrates Valley and the upper Euphrates seem not to be restricted to the flint assemblage (Borrell 2006; Borrell 2007b). The study of the obsidian assemblage seems to point in the same direction, and some links to the sites located in the upper Euphrates valley can also be established (Maeda 2007). The same phenomenon occurs with the rich architectural remains from the PPNB layers of Akarçay. The layout of the buildings with one-roomed buildings lying next to a multi-roomed building (Ozbasar and Molist 2006) show strong similarities with northern sites, especially the PPNB buildings from Çayönü (Ozdogan 1999). All these similarities seem to prove the existence of some common traditions between the new Middle and Late PPNB settlements located along the upper part of the middle Euphrates valley and the earlier sites from the upper Euphrates valley like Çayönü and Çafar, adding more data about the origin of the Pre-Pottery Neolithic settlement of the middle Euphrates valley. Contextualisation at a micro-regional scale allows us to propose that a certain variability and diversity in the lithic traditions of the middle Euphrates valley define a region, the upper part of the middle valley, which have certain common cultural traits that suggest links with and influence from the upper Euphrates valley.

Concluding remarks

Akarçay Tepe represents a good example of the continuity of the settlement between the Pre-Pottery and the Pottery Neolithic. This perception of continuity must be understood in a general framework of gradual, and sometimes quick, changes that may affect not only lithic production but many aspects of society, and that can not only be explained by a change in the availability of the raw materials at the very end of the 8th and the beginning of the 7th millennia cal. BC. Even though this goes beyond the purpose of this paper and needs a deeper and exclusive analysis, it is interesting to summarise the various proposals that have been made in
order to explain the important changes documented in flint production between the end of the PPNB and the PN. Some of these proposals have focused on explaining the causes of the abandonment of the bi-directional method due to a decrease in hunting activity (Nishiaki 1992; Nishiaki 2000; Abbès 2003) caused by a result of agricultural intensification so that as mobility decreased, non-local raw materials ceased to be acquired and there was a gradual abandonment of the bi-directional blade knapping method (Nishiaki 2000). Nevertheless, the intensification of agriculture would not automatically cause the abandonment of hunting, because agricultural and hunting activities are focused on obtaining different resources. Secondly, for example at Tell Halula, intensification of agriculture is a phenomenon attested before the decrease of the use of bi-directional technology at this site (Borrell 2007a; Borrell and Molist 2007; Borrell 2008), so that the decrease in bi-directional blade production cannot be the result of agriculture intensification. And, thirdly, bi-directional blade knapping is abandoned whether it is developed on local or non-local raw materials, so the abandonment of the method has nothing to do with a lesser availability of some non-local flint. Others suggest that hunting, at the end of the PPNB period, was not important for obtaining substantial resources, and that the role of hunting did not change at the beginning of the PN (Baird 2001; Astruc 2004). This view proposes that the abandonment of hunting activity happened before technical divestment is documented (Astruc 2004), and before the decline in the bi-directional blade knapping method. In this case, the abandonment of this method at the end of the 8th millennium cal. BC seems to be related to the end of the material conditions that permitted the appearance of specialised artisans (Nishiaki 2000; Astruc 2004) who developed a kind of technical specialisation (Abbès 2003, Astruc et al. 2003). When the particular conditions supporting the technical or artisanal specialisation disappeared, the opposed-platform blade knapping method gradually started to disappear too. Discussion of whether those methods of knapping are really the result of any kind of specialised work (Baird 2001; Borrell 2006; Borrell 2007b; Borrell this volume) is not the main purpose of the present paper. It does seem that according to this hypothesis, the abandonment of the bi-directional technology and any other specialised production, is the effect and not the cause of the divestment documented in the production of stone tools. This way, the questions are still not
answered. What makes the technical specialisation disappear? Does it really disappear? Was there technical specialisation?

The causes of the technical divestment and simplification in the production of stone tools still seem to be unclear. Probably there was more than one cause. The intensification of agriculture and animal husbandry probably played a major role because it meant that the organisation of communal tasks changed. Furthermore, the role played by hunting for the provision of meat during the Late PPNB should be also reconsidered and linked to the changes in the tool kits at every site. It is only by real interdisciplinary studies that the relationship between the decrease of hunting activity and changes reported in lithic manufacturing can be evaluated. In conclusion, it seems that during the Late PPNB, the adoption and consolidation of subsistence based fully on food production causes a series of transformations, not only in production processes but also in the social relations governing them (Borrell 2007a). These transformations could also imply an increase in social complexity and a change in the social value of some of the production processes. This might suggest, as others have proposed (Binder and Balkan-Atlı 2001; Abbès 2003), the appearance of certain activities with a prestigious value or social status and incipient social inequality. In addition the probable relationship between these major cultural changes and the 9.2ka BP dry/cold event must be considered. This abrupt planetary climate change was similar to and probably caused by the same phenomena that resulted in the better known and accepted 8.2ka BP dry/cold event (Fleitmann et al. 2008) which has been widely attested and accepted by many scholars (Alley et al. 1997; Von Grafenstein et al. 1999; Alley and Ágústsdóttir 2005; Rohling and Pälike 2005; Weninger et al. 2006; Stauberwasser and Weiss 2006; Berger and Guilaine 2009). Although this subject goes beyond the aim of this paper and deserves to be specifically researched, the importance of natural changes, that were much bigger than typical climate variability before and after the event, and the effect on agricultural potential of land has to be seriously considered as one of the potential factors that could have played a major role in the culture transformations during this time period.

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Knapping methods and techniques at Tell Halula (middle Euphrates valley), during the mid VIIIth millennium cal. BC

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Abstract

The study of the chipped stone industry at Tell Halula has allowed us to document the co-existence of different knapping methods during the middle 8th millennium cal. BC. There is also a patterned use of raw materials in relation to the different core reduction strategies. Furthermore, a detailed study of bi-directional blade production from opposed platformed cores has permitted the characterisation of a very specific reduction sequence at Tell Halula, based on a strict procedure oriented to the achievement of high productivity and a series of very standardised pointed blades, which show some highly diagnostic traits. The temporal and spatial distribution of this reduction strategy indicates that it is concentrated in the lower part of the middle Euphrates valley during the Middle PPNB. In conclusion, the wider diversity of bi-directional reduction strategies and the existence of macro-regions with common lithic traditions and cultural traits suggests high social diversity within the Neolithic settlement of the middle Euphrates valley during the PPNB period.

Introduction

Recent excavations carried out at Tell Halula during 2002 and 2004 have exposed a large domestic area belonging to the end of the Middle and Late PPNB period (occupational Phases 8 to 14) (Molist 1996; Molist 2000; SAPPO 2007; Molist et al. 2008; SAPPO 2008). The study of the chipped flint assemblage from Halula allows us to extend our previous knowledge (Molist et al. 2001) of the production process of lithic tools, including raw material procurement strategies, methods and techniques of knapping, the manufacture of retouched tools and the role played by this production process within the economy of Halula during the mid 8th millennium cal. BC. (Borrell 2006; Borrell 2007; Borrell 2008; Borrell and Molist 2007). This paper focuses on the technological aspects of lithic manufacture, both in respect of the techniques and of the methods of flint knapping, increasing our knowledge of opposed-platform bi-directional blade technology. Knapping methods and techniques identified at Tell Halula are defined, stressing a particular characteristic of the bi-directional opposed blade technology that has also been identified at some other contemporary sites of the lower part of the middle Euphrates valley and, later, in the inland desert region of central Syria. The widespread diffusion of this characteristic strategy indicates the great variability of opposed-platform bi-directional blade technology and defines a region that shares a common lithic tradition, suggesting the existence of a region with important common cultural traits and, maybe, a common origin.

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The State of the Stone: Terminologies, Continuities and Contexts in Near Eastern Lithics

The site and the raw materials available
The site of Tell Halula is located on the right bank of the Euphrates river and rests on an Upper Eocene formation. The total dimensions of the tell are about 300m from north-west to south-east by 150m north-east to south-west. The depth of the archaeological deposits is almost 8m. The chronological sequence includes a long series of occupational phases belonging to the Pre-Pottery Neolithic (Middle and Late PPNB) and to the Pottery Neolithic (Pre-Halaf and Halaf) (Molost 1996). The chipped stone assemblage presented in this paper belongs to Phases 8 to 14 (Sector 4, Squares 4D to 4J), which date from the third quarter of the 8th millennium cal. BC (7600–7300 cal. BC). The excavated area covers a surface of about 400m², where a series of domestic buildings and narrow paths in between them have been uncovered (Fig. 1). The total number of flint artefacts studied from these occupational phases is 6911.

Different varieties of flint have been found at Tell Halula which are confirmed by a combination of macroscopic and microscopic features (Borrell 2006; Borrell 2010). These groups are briefly defined below.

Flint Groups 1 to 3 are coarse-grained flint varieties transported by the river in large quantities. Colour ranges from white to light grey or cream. The nodules are middle sized (15cm long) and mainly flat or globular.

Flint Group 4 is rarely found in the Euphrates terraces. The nodules of this fine-grained reddish/pink flint which are found on the terraces are small in size and often display an irregular morphology. It is not possible to obtain large blades of the sort recovered at the site from these nodules, so non-local primary outcrops, as yet unlocated, should be considered.

Flint Groups 5 and 6 are multi-coloured fine-grained flint varieties that can be easily found on the river terraces. The nodules are medium-sized and their morphology is mainly globular and spherical.

Flint Group 7 is a characteristic dark brown fine-grained flint exhibiting excellent knapping qualities. It cannot be found on the nearby terraces. The nearest primary outcrops are in the Maksar formation, 25 to 30km south of Halula, where nodules appear in an Eocene limestone formation (Cauvin 1994; Abbès 2003). Due to its dark brown colour, this flint is often called “chocolate flint”, even though “chocolate flint” has been defined in many different ways (Cauvin 1994; Coqueugniot 1994; Cauvin et al. 2001; Molist et al. 2001; Abbès 2003; Nishiaki 2007).

Flint Group 8 is a dark brown fine-grained local flint that can be gathered only rarely from the Euphrates terraces. Flint group 0 is a heterogeneous group of local fine and coarse-grained flint varieties that are only represented in very low percentages, less than 1% of the total amount.

Methods and techniques of knapping at Tell Halula
Lithic production at Tell Halula is clearly blade-oriented even though specific flake production is also attested. The presence of flakes, blades, cores, hammers, some nodules, and some other technological blanks (crested blades, burin spalls, etc.), suggest a priori that both the production of blades and flakes was carried out within the settlement, as will be discussed below.

Flake production
Flakes constitute between 40 to 60% of the assemblage and 17 flake cores have been recovered of which two are blade cores which have been reused to detach some flakes. The cores are small (they rarely surpass 10cm in length) and all of them are made of the fine and coarse-grained flint which is widely available on the nearby Euphrates terraces. These cores are completely exhausted and it is difficult to
Knapping methods and techniques at Tell Halula (middle Euphrates valley), during the mid VIIth millennium cal. BC

identify how the exploitation of the nodules was organised.

The reduction technology for flake production seems to be very simple, with no clear evidence of core preparation. The cores indicate that there are three different strategies, 1) single-platform, 2) multiple-platform, resulting in polyhedral morphologies and 3) discoidal represented by flake debitage. Flaking is always done using direct percussion with a hard hammer and the variability of the size and morphology of the flakes is remarkable.

Almost all the flakes and flake cores (85%) are made of local fine grained flint (Flint Group 5). Only a small percentage of the flakes is made on non-local raw materials (Flint Groups 4 and 7). The presence of some refitting flakes, flake cores, and a high percentage of cortical flakes of all types, suggest that flaking was undertaken within the settlement, not far from the domestic buildings, in the exterior areas around them.

Blade production

A total of 3082 blades and 18 blade cores have been recovered. Only five bladelets, belonging to Occupational Phases 9 and 10, have been found. Single-platform blade production represents a constant but low percentage throughout the sequence, around 20% of the total assemblage, while bi-directional blades from opposed platform cores and the cores themselves predominate without significant chronological change, suggesting continuity in the lithic traditions in Tell Halula between the end of the Middle PPNB and Late PPNB (Fig. 2).

There is a clear pattern in the use of the raw materials for uni-directional and bi-directional opposed blade production. Almost all (70%) the uni-directional blades are made on local fine-grained flint (Flint Group 5). The rest of the raw materials available, local and non-local, are rarely used (Fig. 3). In contrast to this, non-local dark brown flint (Flint Group 7) is widely used (80%) for bi-directional opposed blade technology, even though fine-grained flint gathered on the Euphrates terraces (Flint Group 5) is also common.

Single-platform blade knapping

Uni-directional blade production is represented by a few core fragments and a small proportion of the blades. The uni-directional blades recovered are mostly robust, with triangular cross-sections, marked bulbs and flat and wide butts. Some of these blades have areas of cortex left on their distal end. These characteristics and the lack of standardisation
of the blanks suggest that the technique used for knapping these uni-directional blades at Tell Halula was direct percussion using a hard hammer.

The length of the complete uni-directional blades is between 5 and 9cm and the width between 1 and 3cm. The short length of these blades suggests that the original nodules were about 10cm long. With the few fragments of single-platform blade cores found (Fig. 9: 16 and 17), made of local raw materials, it is difficult to know the original volume of the nodules and the method of shaping the core, but most probably, the preparation of the core would have been minimal. No traces of a dorsal crest have been identified and the striking platform probably was obtained by the removal of a big flake. The flaking process would probably have been carried out in the settlement, in the exterior areas surrounding the domestic buildings.

Fig. 4: Correspondence analysis of a sample of 100 bi-directional blades. The variables taken are two fold. The first considers the presence/absence and the location of the proximal scar. The second variable reports on the longitudinal section of the blade: if it is straight or twisted towards the right or the left. The X axis explains 66% of the variance and the Y axis 31%.

Opposed-platform bi-directional blade knapping
Bi-directional blade production from opposed platform cores (hereafter bi-directional) predominates and it is geared to obtaining large central blades with a trapezoidal cross-section and straight longitudinal section. Most of the bi-directional blades from Halula measure between 4 and 12cm in length but larger ones can be up to 15cm. Width ranges between 1 and 3cm. Central blades, also known as lames pré-déterminées (Abbès 2003), represent almost the half of the recognisable blades, while the other half includes all kinds of lateral, upsilon and crested blades. This diversity within the blade blanks and the presence of opposed-platform bi-directional cores and some core rejuvenation flakes (Fig. 9: 5), suggest that bi-directional blade production from opposed platform cores was carried out in the settlement. A remarkably high percentage (around 70%) of central blades are made on non-local flint (Flint Group 7) although smaller proportion of cores and crested blades are made of this flint group. This proportion of central versus other type of blades and cores is completely different from those made of local fine-grained flint (Flint Group 5). In this case, the proportion of central and other blades tends to be balanced, and bi-directional cores with opposed platforms are much more frequent (Borrell 2006). This suggest that fine-grained local flint was knapped in the exterior areas adjacent to the domestic buildings, but that the non-local flint was not knapped in the area of the excavated domestic buildings, even though it was retouched and re-shaped within the settlement, as the presence of burin-like spalls and retouch flakes show. It seems that there is a temporal and spatial shift in the manufacture of bi-directional blades of non-local flint.

There are a number of questions which arise from this, some of which are difficult to answer but still need to be discussed. They include the location of bi-directional reduction of non-local fine-grained flint, whether the knappers are using different methods to reduce non-local and local raw materials, who is developing and carrying out the debitage process of both the local and non-local raw materials and whether the same community in Halula manages all the raw materials according to their needs or whether there is a group of outsiders who supply the community. Finally we need to ask if it was a specialised production process.

This paper will focus on the first two questions because the other ones go beyond the goals of this paper and need to be considered more specifically (Borrell in prep.), although some preliminary thoughts are given here.

To answer these questions the technological traits of opposed-platform bi-directional method at Halula were investigated by reconstructing the debitage process. This study has identified a series of specific traits on both the blades and the cores.

Bi-directional blades at Tell Halula
The blades display a series of traits that can be summarised as follows (Fig. 5).

1) A burin facet on the proximal end. A high percentage (around 50%) of bi-directional blades have a burin-like negative on the left side of the proximal end of the ventral face (Fig. 5: F). This scar resembles a burin, which is defined as a product of debitage made using the burin blow technique, in which “one blow is given on a prepared or unprepared striking platform...parallel to the faces of a blank, and removes a typically long, narrow sliver of flint called the burin spill” (Newcomer 1972). The burin scar is only rarely (1%) located on the right side of the ventral face. Sometimes the burin-like scar is obtained not by a single blow but by a series of blows or through inverse retouch. This proximal scar has been also defined as “a burin blow” (Cauvin 1972), “PPNB proximal scar” (Verhoeven 1994; Nishiaki 2000) or “burin-like scar” (Nishiaki 2007). The purpose of the negative removal is, as others have proposed (Nishiaki 2000; Nishiaki 2007), to facilitate the hafting of the tool. This proximal scar also eliminates the S-shaped profile...
Knapping methods and techniques at Tell Halula (middle Euphrates valley), during the mid VIIIth millennium cal. BC

on the proximal part of the right edge, as well as removing part of the bulb to make it thinner. The proximal scar is present on a wide range of blades that have been used as blanks for different tools such as Byblos points, glossed tools, borers, burins, non-retouched blades, etc. (Borrell 2006; Borrell 2008; Borrell and Molist 2007). It seems that this technical procedure was applied systematically to the blades before they were retouched and that it was carried out in the settlement because some burin-like spalls have been found.

2) A twisted longitudinal profile. Another specific trait of the bi-directional blades at Tell Halula is their twisted longitudinal section, giving the edge an S-shaped delineation. This trait is especially noticeable on the proximal part. 87% of the recognisable blades display a twisted longitudinal section towards the right, 6% are not twisted and 7% of the cases are unidentifiable (Fig. 5: C). This trait is statistically correlated with the proximal left scar because the ventral scar on the left side is made with the intention of removing the bulb and correcting the S-shaped profile of the right edge (Fig. 4).

3) The location of the burin facet. Most of the twisted blades with the burin-like scar have the butt and the impact point located on the right side of the proximal end indicating that the core was struck on the side of the striking platform so that the blade runs obliquely to the longitudinal axis of the core (Fig. 5: D; Fig. 8: 4; Fig. 9: 1–4).

4) Curvature to the left. Often, bi-directional central blades have their distal end curved to the left Fig 5: A; Fig. 8: 5).

5) An asymmetric cross-section. Most of the blades have an asymmetric trapezoidal cross-section. The right side of the trapeze is almost always the shortest one (Fig. 5: E; Fig. 8: 4 and 5; Fig. 9: 2–4). The left side of the trapeze is wider and descends gradually. Furthermore, there is a repetitive pattern in the distribution and direction of the dorsal scars. Often there are two opposed short removals on the right side (Fig. 5: B3/4) and only a large one coming from the opposite direction on the left side (Fig. 5: B2). That one is the negative removal of the previously detached central blade, while the negative removals on the right side are the scars left by lateral blades. In the middle of the dorsal face there is almost always the negative removal of the previous central blade detached from the same platform (Fig. 5: B1). It seems that the arrises left on the working surface by the last central blade, knapped from the opposing platform, are used to guide the direction of the next central blade.

6) Use of both local and non-local flint. Finally, it must be stressed that all these traits have been identified on blades made on both local and non-local fine-grained Flint Groups, indicating that exactly the same method is used whatever the type of flint. Furthermore, it is important to stress that these specific traits have been recorded not only on the large sized central blades, but on smaller sized ones and on some lateral blades, crested blades and even upsilon blades (Fig. 9: 12 and 19) suggesting that the same strategy of knapping with the same procedures and actions are being used without noticeable variations, from the beginning of the debitage process until the abandonment of the core.

Opposed-platform bi-directional blade cores at Tell Halula
Twelve cores and fragments of cores have been found (Fig. 8: 1–3), and all of them are exhausted. More cores with similar diagnostic traits have also been studied by the author but are not included in this paper as they belong to the earlier occupational phases of Halula. Dozens of the same kind of cores coming from an on-going survey and fieldwork in the Douara basin are also currently being studied. Even though both assemblages will not be detailed in this paper, their study has been of great help in understanding and defining the opposed-platform bi-directional method at Halula.

Most of the cores are made of local fine-grained flint (Flint Group 5) and only two on dark brown non-local flint. The length of the cores is around 7 to 9cm, and their width between 3 and 4.4cm. Most of them display cortical surfaces on their backs or lateral edges. The original dimensions of the cores are difficult to calculate but, as the largest bi-directional blades are 15cm long, it is suggested that the size of the nodules would have been around 20cm long.

The cores show a number of distinctive features:

1) The cores were shaped with a central frontal crested ridge and by one or two (dorsal or lateral) crested ridges on the back of the core. Most of the dorsal ridges have been roughly prepared with unifacial or bifacial removals. There are no certain naviform cores present. The working surface was obtained after shaping and
detaching the frontal crested ridge, using one or both striking platforms.

2) The striking platform is twisted and the impact point is often located on the right side the platform. Preparation of the striking platform includes a series of small removals and sometimes abrasion of the overhang.

3) The opposed platforms run parallel to one another but they are not perpendicular to the longitudinal axis of the core. The arrises on the working surface run obliquely to the longitudinal axis of the core. In other words, the platforms are opposed, rotated may be 15-20° from one another, and are slightly offset from one another along the axis of the core.

4) The working surface of the core is very narrow and the negative removals of two opposed central blades, one partially overlapping the other, can be identified (Fig. 6: dark shading). In this way the negative removal of the last central blade, knapped from the opposed platform, is used as guide for the next central blade and no left lateral blades need to be detached on this side. On the contrary, the right opposed side is arranged and reshaped by the removal of one or two lateral blades, sometimes detached from both platforms (Fig. 6: light shading). Upsilon blades/flakes are rare and small (Figs 9: 8, 10, 11 and 15).

5) This characteristic core reduction strategy produces a series of very standardised pointed central blades, with exactly the same features and morphology. The morphological homogeneity and the high productivity of the core seems to be the main reason for the use of this method of blade knapping, ensuring a high degree of standardisation of the pointed blades obtained.

The wider occurrence of bi-directional blade production

It seems clear that the opposed-platform bi-directional blade technology documented at Halula is almost the same as that identified and first described by Nishiaki at Douara Cave II (Nishiaki 1994; Nishiaki 2000) and previously in the region of Palmyra (Suzuki and Akazawa 1971), dated around the first half of the 7th millennium cal. BC and called “Naviform method of Douara type” (Nishiaki 2000, 84). This method of blade knapping was characterised by the following artefact classes (Nishiaki 2000, 86):

1) Cores with the main flaking surface slanting in relation to the longitudinal axis of the core, and a ridge on one side of the back.

2) Crested pieces with an asymmetrical transverse sections.

3) Presence of D-shaped blades.

4) Blades with a twisted profile and the percussion point situated at the right side of the butt.

5) Blades with their distal end curved to the right.

6) Blades with an IDB (Imitating Dihedral Burin) butt (Suzuki and Akazawa 1971) and flakes and blades with proximal scars and their retouch spalls.

Artefacts of these types with most of the diagnostic traits have been identified at Halula too, although the study of the exceptional assemblage from Halula permits a fuller understanding of the reduction sequence and allows us to add to and revise some of the diagnostic characteristics:

At Halula the distal part of the bi-directional central blades is curved to the left and the blades are twisted to the right; the proximal scar is almost always on the left side of the ventral face and the working surface of the cores is also twisted. The asymmetric trapezoid cross-section is present on the central blades and not only on the crested blades. On the working surface of the bi-directional opposed blade cores and on the dorsal face of the products, it is possible to observe the negative removals of the last two central blades, knapped from opposed platforms, one overlapping the other. The cores have one or two ridges on the back, often located on the side of it. The cross-section of the core is not naviform-like, as defined by Jacques Cauvin (1968).

Overall, and according to old and new data it is possible to demonstrate that despite these diagnostic traits, this method is characterised by the specific way in which the narrow working surface is managed in that the central blades are detached almost without removal of upsilon or lateral blades. The direction of flaking is slightly off-set and goes from the right side of the core platform to the opposite side of the distal end of the core, while the arrises of the last central blade are reused as if it was a lateral blade-scar. The negative removals of two central blades can be observed on the dorsal face of the bi-directional blades and on the working surface of the opposed-platform bi-directional cores.

Also, because the cores are knapped from two related and interacting opposed platforms it is clear that this is not a different method from that defined by others (Cauvin 1968; Inizan et al. 1992). However, it can be considered a different and very specific reduction strategy within the bi-directional blade method which is characterised by twisted blanks and cores and because the direction of debitage is slightly off-set. In this paper I refer to this specific reduction strategy as an ‘off-set bi-directional strategy’.

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Fig. 6: Three complete twisted opposed-platform bi-directional blade cores belonging to occupational Phases 8 to 12. The negative removals of the central blades are shaded dark grey and the lateral removals shaded grey.
Knapping methods and techniques at Tell Halula (middle Euphrates valley), during the mid VIIIth millennium cal. BC

The spatial and temporal distribution of the off-set bi-directional strategy

The spatial and temporal distribution of the off-set bi-directional strategy clearly identified at Halula is difficult to establish due to the lack of research at other sites, but considering the diagnostic traits that can be identified both on the blades and the cores, a proposal can be made. Blades and some cores with these characteristic traits have been reported in many sites at the Northern Levant dating from the third quarter of the 8th millennium cal. BC between the end of the Middle PPNB and the Late PPNB (7,600 cal. BC to 7,200 cal. BC), including Abu Hureyra (Moore 1975a: 59; Moore 1975b: 121; Moore 1978; Moore 1982, 12; Moss 1983, 148-159; Moore 1985, 27), Bouqras (de Contenson and Liere 1966, 191; Ackermans et al. 1983, 350; Roodenberg 1986, 45, 66, 88), Tell es Sinn (Roodenberg 1980), Gürçütepe II (Schmidt and Beile-Bohn 1996, 9-10; Beile-Bohn et al. 1998; Schmidt 2000, 10), Tell Assouad (Cauvin 1972, 103; Nishiaki 2000, 129), Hayaz Höyük (Roodenberg 1989, 95), Akarçay Tepe (Borrell 2006), Sabi Abyad II (Verhoeven 1994; Verhoeven 1998, 423), Seker al-Aheimar (Nishiaki 2007) and maybe Fakhariyya (Moore 1978, 183) and Magzala (Nishiaki 2000, 93). The use of this strategy is not limited to northern Syria. Cores and blades with the same traits have been found in some sites from inland Syria, dated from the beginning of the 7th millennium cal. BC, like Douara Cave II and Thaniziyet Wuker (Akazawa 1979; Fuji et al. 1987; Nishiaki 1992; Nishiaki 1994, 365; Nishiaki 2000: 95).

The presence of diagnostic blades and/or cores at all these sites does not automatically mean that production of twisted blades was developed at every settlement, but gives a general idea of the spread of the strategy and their products. As far as is known, this way of knapping opposed-platform blade cores appears during the Middle PPNB, and Tell Halula seems to be the earliest site where this method is well documented (blades, cores and by-products) and dated (8750±80 BP). Bi-directional opposed blade production reported at earlier sites of the northern Syria like Djade (Coqueugniot 2000), Mureybet, Cheikh Hassan (Aabbès 1994; Aabbès 2003), ‘Abr 3 (Yartah 2004) and Caramel (Mazurowski and Yartah 2001) shows no similarities with the bi-directional method reported later at Halula. From 7700 cal. BC onwards, this method expands quickly, and during the third quarter of the 8th millennium is reported at many of the large settlements in the lower part of the middle Euphrates valley and probably in the Balikh valley, while diagnostic products can be found in a wider region. At the very end of the 7th millennium opposed-platform bi-directional blade technology starts to

Fig. 7: Map of the Northern Levant with the location of Halula and other contemporary sites. The dark shaded area shows the heartland and the main key sites of the “offset bi-directional strategy” during the Middle and Late PPNB, while the light shaded area shows the region where it occurs at the end of the Late PPNB and the PN.
be abandoned throughout the Northern Levant (Nishiaki 2000; Abbès 2003; Borrell 2006; Borrell 2007; Nishiaki 2007) and this is also the case at Halula. Apart from this, it is during this period of time that this strategy is widely documented at many small sites in the inland regions of Syria, the Douara Basin and around the Palmyra oasis (Nishiaki 2000). Some blanks, but not cores, were observed when re-studying the neolithic chipped stone assemblage from Umm el-Tlel (Borrell et al. forthcoming) and at El Kowm II Caracol. But because the study of this material is still underway and the material from El Kowm is surface material, it is better not to include the data in the present interpretation. In the same region, at Qdeir 1, a preliminary study reported that almost 30% of the blades had a twisted profile but no more details were given (Calley 1986) while an on-going study by Frédéric Abbès seems to point in a different direction (Abbès pers. comm.). Up to now, data from this site is not conclusive enough to propose that the blades were the result of the off-set bi-directional strategy.

The main area using that particular reduction strategy seems to have been the lower part of the middle Euphrates valley, where cores and high percentages of blades with diagnostic traits have been reported at some large settlements like Halula, Abu Hureyra (Moore 1982, 12; Moss 1983; Nishiaki 2000, 87) and Bouqras (Roodenberg 1986). These three large settlements share striking similarities in lithic production (Nishiaki 2000; Borrell 2006) and seem to have been the heartland of the off-set bi-directional strategy at Halula and also known as the “naviform method of Douara type” (Fig. 7). The presence of some blanks in the upper part of the middle Euphrates valley, for example at Akarçay Tepe, should be carefully evaluated because the study of that lithic assemblage suggests that another bi-directional reduction sequence was used (Borrell this volume). The circulation and exchange of the blanks could be the reason why there are many sites located along the Euphrates, Balikh and Khabour valley and other regions, where diagnostic blades are common but not the cores.

Fig. 8: 1–4 are made on local fine-grained flint (Flint Group 5); 5 is made on non-local fine-grained flint (dark brown Flint Group 7).
Summary
The study of the chipped stone assemblage of Tell Halula has enabled us to characterise the production process of stone tools at the site during the mid 8th millennium cal. BC, suggesting that there is technological continuity between the Middle and Late PPNB. Lithic production is blade-oriented, although specific flake production is also present. The main method of producing blade blanks is through an opposed-platform bi-directional blade reduction while unidirectional production is marginal. A patterned use of raw materials according to the core reduction technology has been identified. The preparation and the subsequent flaking of the opposed-platform cores at Halula is organised and developed in a specific way in order to obtain highly standardised pointed blades and a high degree of productivity, demonstrating a higher variability of the opposed-platform bi-directional technology. This off-set bi-directional strategy leaves a series of diagnostic traits both on the blades and the cores, which can easily be recognised. These traits have been traced and identified at many sites of the Northern Levant and it has been possible to establish the spatial and temporal distribution of this variation of opposed-platform blade technology and to identify the region in which it first appeared during the Middle PPNB.

It has also enabled us to answer some of the questions raised earlier in terms of where the opposed-platform bi-directional blade production of non-local flint was carried out. Local fine-grained flint was knapped not far from the excavated area, while non-local dark brown flint was managed in a different way. It had been previously proposed that non-local flint was introduced into the settlement as blades or finished tools such as arrowheads (Molist et al. 2001), as in some other sites like Seker al-Aheimar (Nishiaki 2007). The lack of cores and flakes made of non-local flint at Halula

Fig. 9: 1–4, 13, 18 and 19 are made on non-local fine-grained flint (dark brown Flint Group 7); 5–12, 14–17 are made on local fine-grained flint (Flint Group 5).
only proves that not all the debitage process was carried out within the excavated area, but it could have been knapped at the sources, far from Halula, or just some metres away from the domestic buildings that have been exposed. This second possibility should be seriously considered because, as it has been stated before, the specific strategy used to detach bi-directional blades from non-local raw materials is exactly the same as that used to detach blades from the local varieties flint. The only difference is that local raw materials can be obtained daily, if necessary, and flaking episodes could be done often and in different areas, while dark brown flint was provided at a specific point of time and probably knapped in short episodes of intensive blade production which would produce a significant amount of waste material, so that these intensive episodes of blade production are likely to have been carried out away from domestic areas. It is also clear that the off-set bi-directional strategy was used when knapping both the local and non-local flint varieties so that the local and non-local blades and cores display the same diagnostic traits.

In order to determine who was carrying out the opposed-platform bi-directional blade production of the non-local flint and whether it was a specialised production process, it is necessary to consider a number of factors. To approach such questions, it is necessary to try to understand the social value of a technology, a tool or a blank, without over-valuing, a priori, the role played by non-local raw materials or technical complexity. This can never be done without considering the whole production process of stone tools and the role it played within the social and economical context of the settlement in which it was framed (Baird 2001). As mentioned above, some further studies are being undertaken but some considerations can be made at this point of the study. Bi-directional blades appear at Halula in huge proportions and, as far as can be seen, these blanks are not obtained using a different method, strategy or technique. The non-local and local bi-directional blades have exactly the same characteristics, shape and morphology. It seems reasonable to think that these blades were knapped by the same people who knapped the local flint. The fact that the blade production of non-local flint presents a temporal and maybe a spatial shift is not sufficient reason to prove that it was knapped by people who did not belong to the settlement. Furthermore, as has been shown, non-local bi-directional blades do not represent a different or new blank or technology, even though it seems probable that it was knapped in a specific debitage context. The existence, within the settlement or far away from it, of specific areas where non-local flint was knapped in short but intensive episodes, does not mean that there was a specialised production process at Halula. Specialised production in lithics must be evaluated within the whole lithic assemblage and the social context in which the lithic production is framed.

Conclusions

The lithic assemblage of Halula (Middle and Late PPNB) show striking similarities with Bouqras and Abu Hureyra, suggesting that that these important settlements, which seem to have played a major role in the neolithisation process of the region, had strong inter-site relationships, sharing some common cultural traditions (Borrell 2006). Lithic technology would be an important part of these common cultural traits which defined the lower part of the middle Euphrates valley during the mid 8th millennium cal. BC. The origin of these cultural traits, namely the off-set bi-directional strategy, is still problematic (Nishiaki 2000; Borrell 2006). As far as it is known, there is no evidence of this method at the earlier sites in the region like Mureybet, Cheikh Hassan or Dja’dé. This should not be a surprise because these sites seem to have been abandoned before the foundation of the new settlements like Halula, Abu Hureyra and Bouqras and suggests the possibility of some sort of discontinuity in the settlement of the lowest part of the middle Euphrates valley, that could initiate certain changes in lithic production and the appearance of new knapping techniques and methods. To find parallels to the production of straight and twisted blades produced from lateralised debitage surfaces we have to look at the Intermediate and Upper Paleolithic lithic assemblages from Umm el Tlel (Ploux and Soriano 2003; Boëda and Bonlauri 2006).

In conclusion, the study of the chipped stone assemblage of Halula and its contextualisation at a micro-regional scale allow us to propose that there is a certain variability and diversity in the lithic traditions of the middle Euphrates valley, even though it is senseless to deny certain common traits in what has been considered an homogeneous cultural region, called the “Levantine Province” (Kozłowski 1999), the “Euphratian” (Kozłowski and Aurenche 2005, 76) or “Moyen-Euphrate” (Cauvin and Cauvin 1993). This greater diversity in lithic traditions could suggest less homogeneous communities peopling the Euphrates valley during the Pre-Pottery Neolithic, as has been previously proposed (Kozłowski and Aurenche 2005). The integration of the results obtained by studying the lithic assemblages within inter-disciplinary projects developed at a micro-regional scale, will surely bring light to the neolithisation process of the Euphrates valley, arising from higher diversity both in the chronology and the process itself.

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Knapping methods and techniques at Tell Halula (middle Euphrates valley), during the mid VIIIth millennium cal. BC


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