Neolithic Chipped Stone Industries of the Fertile Crescent, and Their Contemporaries in Adjacent Regions

Proceedings of the *Second Workshop on PPN Chipped Lithic Industries*

Institute of Archaeology,
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edited by

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and
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Lorraine Copeland at Marouatte, celebrating the publication of *ASPRO*, 1995

Lorraine Copeland excavating at Jiita, 1974

Lorraine Copeland on a visit to Yabrud, 1965 (with Pères Hours and Fleisch; photo taken by Ralph Solecki)

To

Lorraine Copeland

in honour of her outstanding contributions to

prehistoric research in the Fertile Crescent

and the warmth of her friendship.

Contents

Dedication ....

Acknowledgements IV

Stefan K. Kozłowski and Hans Georg K. Gebel: Following Goals and Cooperation in Near Eastern Neolithic Chipped Stone Research. Preface 1

Adjacent Interaction Spheres and Taxa Discussions

Frank Hole: A Syrian Bridge Between the Levant and the Zagros? 5

Yosef Garfinkel: Critical Observations on the So-called Khiamian Flint Industry 15

Michał Kobusiewicz: Early Holocene Lithic Industries of Northeastern Africa 23

Galina F. Korobkova: The Djeitunian Industry, Southern Turkmenistan 37

Galina F. Korobkova: The Neolithic Chipped Stone Industries of the Southern Caucasus 57

Vadim Masson: The Cultural Zones and Variations of the Late Chipped Stone Industries in in Central Asia 91

Karol Szymczak and Tatiana Gretchkina: The Perspectives of the Studies on the Early Neolithic of the Kyzylkum Desert. Ayakagytma "The Site" and Other New Collections 105

Klaus Schmidt: Helwan in Egypt: A PPN Site? 127

Janusz Kozłowski: Techno-Morphological Changes in the Early Holocene Lithic Industries in Southeastern Europe 137

Karol Szymczak: PPN Flint Assemblages with Microliths: What Do We find, What Do We Lose? 145

EPPNB- Problems

Avi Gopher: What Happened to the Early PPNB? 151

Gary O. Rollefson: An EPPNB Settlement in the Wadi el-Hasa, Central Jordan 159

Pre-PPN Traditions

Stefan Karol Kozłowski: The Trialetian "Mesolithic" Industry of the Caucasus, Transcaspia, Eastern Anatolia, and the Iranian Plateau 161

Ivan Gatsov: Epipalaeolithic Sites from NW-Turkey 171

Stefan Karol Kozłowski: From Zawi Chemi to M'lefaat 175

Deborah Olszewski: The Lithic Transition to the Early Neolithic in the Zagros Region: Zarzian and M'lefatian Industries 183

Elisabeth Hildebrand: Changes in Methods and Techniques of Blade Production during the Epipalaeolithic and Early Neolithic in the Eastern Fertile Crescent 193

Ofer Bar-Yosef: Late Pleistocene Lithic Traditions in the Near East and Their Expression in Early Neolithic Assemblages 207

Anna Belfer-Cohen and Nigel Goring-Morris: The Late Epipalaeolithic as the Precursor of the Neolithic: the Lithic Evidence 217

Specializations in Raw Materials, Industries, and Tool Kits

Galina F. Korobkova: The Blades with "Mirror-Like" Polishing: Myth or Reality? 227

Leslie A. Quintero: Flint Mining in the Pre-Pottery Neolithic: Preliminary Report on the Exploitation of Flint at Neolithic 'Ain Ghazal in Highland Jordan 233

Philip J. Wilke and Leslie Quintero: Near Eastern Neolithic Millstone Production: Insights from Research in the Arid Southwestern United States 243

Hans Georg K. Gebel: Chipped Lithics in the Basta Craft System 261

Tamar Noy and Stefan K. Kozłowski: A Basket of Flint Artefacts from House 11 of Gilgal I, Locus 37/42 271

Phil J. Wilke: Bullet-Shaped Microblade Cores of the Near Eastern Neolithic: Experimental Replicative Studies 289

Yoshihiro Nishiyaki: Side-Blow Blade-Flakes from Tell Kashkashok II, Syria: a Technological Study 311

Lorraine Copeland and Marc Verhoeven: Bitumen-Coated Sickle-Blade Elements at Tell Sabi Abyad II, Northern Syria 327

Manuela Beile-Bohn: The Glossed Blades from Nevalı Çori: Preliminary Results 331

Patricia Anderson and François Valla: "Glossed Tools" from Hayonim Terrace: Blank Choice and Functional Tendencies 341

Klaus Schmidt: Nevalı Çori: Chronology and Intrasite Distribution of Lithic Tool Classes. Preliminary Results 363

Tamar Noy: Long Sickle Blades. A Case of Cultural Change in the PPN in the Southern Levant. Questions and Remarks 377

Industries Reconsidered/ New Industries

Isabella Caneva, Cristina Lemorini, and Daniela Zampetti: Lithic Technology and Functionality Through Time and Space at Çayönü 385

James Conolly: Synopsis of Recent Findings From the Analysis of Obsidian and Flint Artefacts from Çatalhöyük East *(Abstract)* 403

Jalal Rafifar: Remarques sur l'industrie lithique Néolithique de l'Iran (10.000-6.000 av. J.-C.) 405

Eric Coqueugniot et Patricia Anderson: L'industrie lithique d'El Aoui Safa, un nouveau site Khiamien à l'Est du Jebel el 'Arab (Désert Noir, Syrie du sud) 421

Miquel Molist and Arnau Ferrer: Industries lithiques pendant la période 8000-7500 B.P. à Tell Halula dans le cadre d' Euphrate moyen Syrien 431

Avi Gopher: A Preliminary Report on the Flints from 'Ain Darat, a PPNA Site in the Judean Desert 443

Summary Issues

Hans Georg K. Gebel and Stefan Karol Kozłowski: Remarks on Taxonomy and Related Questions of Neolithic Chipped Stone Industries of the Fertile Crescent, as Related to Their Contemporaries in the Adjacent Regions 453

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Following Goals and Cooperation in Near Eastern Neolithic Chipped Stone Research

Preface[1]

Stefan Karol Kozłowski and Hans Georg K. Gebel

On the Workshop

This volume assembles the proceedings of the *Second Workshop on Pre-Pottery Neolithic Chipped Lithic Industries* held at the Institute of Archaeology, Warsaw University, from 3 - 7 April, 1995. This gathering was initiated by the workshop held at the Seminar für Vorderasiatische Altertumskunde of the Freie Universität Berlin in spring 1993 (GEBEL and KOZLOWSKI, eds. 1994), which was the beginning for several efforts to improve cooperation and to coordinate goals in Near Eastern Neolithic chipped stone research. The Warsaw workshop continued in the same good spirits and fruitful atmosphere[2] that characterized the Berlin meeting. Altogether, 45 participants came to the workshop, of whom 34 presented 44 lectures in the following sections[3]:

Adjacent Interaction Spheres and Taxa Discussions
EPPNB- Problems
Pre- and Post-PPN Traditions
Specialization in Raw materials, Industries, and Tool Kits
Industries Reconsidered / New Industries[4]

On the Family[5]

It is remarkable that only two years since our first workshop so many colleagues gathered

---

[1] This introduction contains arguments also presented in the welcome addresses by Hans Georg K.Gebel and Stefan Karol Kozłowski to the workshop participants.

[2] This was accompanied by the hearty wishes for success received from colleagues who could not attend the meeting, e.g. from Robert Braidwood, Lorraine Copeland, Wolfgang Taute, and others.

[3] Regretfully, the workshop and the proceedings had to miss the following contributions:
Nikolai Bader (Moscow): The Industry of Magzaliya;
Nur Balkan Atlı (Istanbul): Bi-Directional (Naviform) Cores of Kaletepe, a Workshop in Central Anatolia;
Michael Forstadt (Harvard): The PPN Lithic Industry of Aq Kupruk, Northern Afghanistan;
Carole MacCartney (Edinburgh): Late Neolithic Technology in Transjordan;
Dani Nadel (Haifa): Axes and Their Spalls. Examples From PPNA Sites; and
Wolfgang Taute: Axe/Adze Manufacturing at the PPNB Workshops of Ramat Tamar and Mezad Mazzal, Israel.
However, we were happy to include the contributions of Lorraine Copeland and Marc Verhoeven, Ivan Gatsov, and of Miquel Molist and Arnau Ferrer, who could not join the meeting. In addition to those colleagues presenting lectures, the workshop discussions were strengthened by the presence of Alison Betts (Sydney), Michael Rosenberg (Delaware), and Shoh Yamada (Harvard).

[4] In addition to the lectures, reports from the co-ordinators on the work and developments in the working groups (established during the workshop 1993) were given (published in *Neo-Lithics* 1/95): Frank Hole: Microliths Sub-Group; Patricia Anderson: Glossed Elements Sub-Group; Eric Coqueugniot: Technology Sub-Group; Avi Gopher: Projectiles Sub-Group; and Gary Rollefson: Non-Formal-Tools Sub-Group.

[5] See also the Preface in GEBEL and KOZŁOWSKI (eds.) 1994.

again, presenting new and very interesting contributions. This indicates that our field of research is developing rapidly both in the sense of research intensity and the number of scholars devoting their efforts in PPN-PN lithic analysis. When proposing such a short interval between two workshops we followed the policy to maintain and to promote the enthusiasm and cooperative attitudes, which we felt characterized the atmosphere in Berlin. We were afraid that a longer interval would have been of disadvantage for the growing "family" feelings. It was not our primary intention to gather "big new results" coming from individual desks; it was more the aim to establish a permanent forum of cooperation in the form of bi- or triennial general meetings, assisted by sub-groups meetings between workshop gatherings. We considered then (and still do) that the research needs are considerable.

Progress in the working groups is stagnating, and we detect more than just logistical problems as a source of this. More initiatives need to be undertaken to find and define mutual goals beyond interest policies (see, *e.g.*, "Courage et Persévérance", a note on cooperation by the enlarged NFT Group at Marouatte (8 June 1996) in *Neo-Lithics* 1/96). We will not achieve satisfying results if the atmosphere of cooperative behavior becomes disturbed by segregational attitudes. Cooperation is still at its beginning, and we will fail to continue our new chances if there are, for example, preferences for national research environments and a clash of languages or analysis traditions. It was thought that international cooperation in sub-groups between the workshop meetings might help to overcome existing difficulties in respectful and friendly working milieus, and that growing "family" feelings would replace the problematic control of "schools". For the sake of our research, our energy should increasingly be devoted only to a controversial work on the subjects of our field that can bring us together, and not to the consideration of sociological research ingredients that force us farther apart.

On the Viewpoints

Studying the Near Eastern Neolithic chipped stone industries so far is often confined to specialization in certain Neolithic cultures, frequently discouraging the lithic specialist from looking much beyond the Fertile Crescent. This tends to isolate his/her research with regard to the techno-taxonomic framework in which these traditions developed. That is why we broadened the geographical scope of the workshop, at least for the second meeting, and hazarded glances beyond the Fertile Crescent into northeastern Africa, the Balkans, the Caucasus, and Central Asia. We are of the opinion that the techno-taxa of the neighboring regions of the Fertile Crescent have to be consulted in order to improve the understanding of the more progressive developments in the Early Holocene here. It was not expected that the colleagues working in these areas outside the Fertile Crescent would provide us preliminary determinations of techno-taxa relationships between, for example, Egypt and the southern Levant, or that we working in the Fertile Crescent could recognize such relationships at once from their presentations. The aim was more basic. Given the fact that we have mostly concentrated on research centering in the Fertile Crescent, we had to make the effort to expand our research sensitivity to outside developments. The adjacent techno-taxa, with their longer and more persistent Epipalaeolithic/Mesolithic traditions, would help to qualify the rapid and innovative nature of developing traditions in the Fertile Crescent. Such a consideration of adjacent developments would also help us to understand the possible patterns of interaction between areas still confined to Epipalaeolithic modes of exploitation, as well as those border zones into which Neolithic subsistence modes with their changed core technologies and tool kits penetrated (*cf.* Summary, this volume). It is especially these latter aspects that need more attention in the coming years.

The decision to extend the geographical scope made it apparent that similar industries or features in different regions were classified by different criteria. This derives from research centered on larger areas, when little or no exchange is practiced between the specialized scholars. A good example is the industry of Hallan Çemi on the one hand and that of the aceramic "Mesolithic" - ceramic "Neolithic" layers in Choch (Republic of Azerbaijan), both representing the Trialetian tradition. Other examples include an LPPNB tradition not completely understood yet -except for strong similarities- as a tradition reaching the lower Arabian-Persian Gulf (Qatar), and (Late) M'lefatian similarities as far east as the western fringes of the Dasht-e-Lut.

In this respect, it should be another concern of ours to remark on the use of the term "Neolithic" in the title of this volume. For us, it has a more symbolic significance than a meaning which deals with the reality of industries and cultures within the Early Holocene. When the term "Neolithic" was introduced for the Near East, it was widely considered as a synonym for food-producing economies, which meant in absolute chronology the prehistoric periods of the Early Holocene of the Near East dating between 8,200 -5,000 bc, or 9,900 - 5,800 cal. BC respectively. It is worth remembering that the proposed periodization (Proto-Neolithic - Pre-Pottery Neolithic A and B - Pottery Neolithic) cannot be confirmed for some regions (as in the case of Proto-Neolithic M'lefaat, PPN Jarmo, and Ceramic Jarmo; these sites exhibit the same or very similar industries). On the other hand, we know of examples when the same industry (PPNB of Sinai, Palestine, and Syria) was used by food-producing village populations as well as by contemporaneous hunters and gatherers. In many cases it is difficult to distinguish whether these hunter-gatherers are mobile groups of sedentary food-producing communities, or represent neighboring, economically independent groups of another population. This is why the use of the term "Neolithic industries" occurs problematic to us, and why it perhaps would be better to speak in future of "Early Holocene industries", which could be subdivided into "Aceramic" and "Early Ceramic" without always making judgments regarding their degree of "Neolithization". A "neutralization" of the terms would foster a better and independent understanding of the phenomena of contemporaneous industries existing in adjacent regions (Balkans, Caucasus, Central Asia, Egypt), which are generally classified as "Mesolithic" or "Epipalaeolithic", depending on the region and local traditions.

In fact, we are dealing with the same model of Early Holocene hunter-gatherer industries as those existing in those times all over in Europe and in the Maghreb. The aceramic industries of the Near East are very close to this model (local raw material exploitation, manufacture and use on the household level; different arrow points; dominance of scraping tools; microlithization of tools, except for PPNB industries). This is not astonishing when we understand that they reflect mostly hunter/gatherer activities, and that their "Neolithic" activities were limited in many cases.

On the Goals

A few more remarks should comment on research development (*cf.* also GEBEL and KOZŁOWSKI 1994). The field of primary production research has especially gained considerable prominence over the last years. This is not because debitage and cores are so attractive, but that primary production has increasingly been seen as providing strong indications of both regional and socio-economic specialization. Moreover, it may have become obvious that this field provides more relative chronological grounds than were anticipated. The level of morpho-typological approaches, a more conservative part of our research field, has recently been supplemented by new attempts to analyze such problematic classes as non-formal tools. Although not completely abandoning traditional paths, attribute analysis has developed as an additional -sometimes alternative- approach, improving our understanding of the tool kits beyond the type-lists.

More has to be done in future on the socio-economic aspects of flint production, because this is the means to make ourselves understandable to our non-lithic colleagues. Instead of masses of graphs and figures, they prefer the data to be transformed into patterns of human behavior and processes that can be interpreted as technology history. We should not be bureaucrats isolating ourselves with our own language; we should contribute to the explanation of the cognitive, social, and material economy processes and developments in the Neolithic. This certainly requires some steps outside the mainstream type of lithic analysis modes.

The techno-taxa approach, whereby each greater region is considered independently as its own area of development and interaction, has gained increased attention since Berlin, and we hope that this new, old thinking becomes a widespread research element in the Near Eastern Neolithic. We not only wanted to support this development by enlarging the geographical scope of this meeting, but we actively promote this trajectory as an independent lithic subject in the framework of Neolithic research.

On this Publication

It is our pleasure to devote this volume to Lorraine Copeland, an outstanding scholar of Near Eastern chipped lithics research. We, together with all the colleagues of this volume, admire her persistent, fruitful work. Time and again her common sense approach and plain talk has promoted our knowledge to an extent without which our discipline would not enjoy the standards and results it has. Thank you, Lorraine! We wish you many more years with small plastic bags on your table!

We the editors regret the delay of this publication. It was prepared with the utmost care possible. Considerable work was involved with translations, editing, re-editing, (re-)mounting figures, and other efforts (see acknowledgements on Page VIII). We deeply thank everybody who was envolved in this enormous task. We left the spellings of site names, terms etc. as authors used them. Corrected proofs were consulted to the extent that the authors provided information.

Commemoration

We sadly commemorate here on the passing away of our dear colleagues and friends Wolfgang Taute (late November 1995) and Tamar Noy (August 1997). Wolfgang Taute had intended to present to us during the Warsaw workshop a report on "Axe/Adze Manufacturing at PPNB Workshops Ramat Tamar and Mezad Mazzal, Israel," but he was unable to join us for reasons of health. Wolfgang Taute not only took part in the First Workshop with a brilliant report on the flint mining and primary manufacturing site at Mezzad Mazzal, we also benefit from his warm spirit, scholarly integrity, and friendship.

We saw Tamar Noy last when she joined and contributed to this workshop, illustrating that even after her retirement her constant and continuous interest was to contribute to the progress in lithics research, which developed during her work with late M. Stekelis. We all remember her warmly as a cordial, close and caring colleague.

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A Syrian Bridge Between the Levant and the Zagros?

Frank Hole

Abstract: *Distinctly different lithic traditions characterized the Levant and the Zagros from the Middle Paleolithic through the early Neolithic. The PPN is represented by Mureybet or Abu Hureyra in the west and Nemrik, Hallan Çemi or Karim Shahir in the east. Somewhere between the Tigris and Euphrates rivers there is a line dividing traditions that feature naviform cores and tanged arrowheads, from pyramidal cores, microliths and lozenge-shaped arrowheads. Any interaction between these regions was most likely across the steppe of northern Syria and Iraq, yet few archaeological sites have been found in this arid and open region. Recent discovery in the Khabur drainage of Nemrik-style points, and the presence at other sites of tanged arrowheads, implies overlapping distributions of some elements of these different cultural traditions.*

Introduction

In many respects the Khabur basin and the Jezireh of which it is a part, is a potential crossroads between the Euphrates and Tigris rivers and the lands beyond (Fig. 1). As a relatively open, flat land it has few impediments to travel except for a marked deficiency in surface water during the dry seasons. Accordingly, routes today normally follow the main river or the series of small springs that emanate from the flanking mountains. In recent times such routes have been across the northern, wetter part of the basin, leaving the region surrounding the Jebel Abd al-Aziz where our survey has been concentrated, relatively uninhabited. However, even today the Jebel traps moisture for the springs and provides oak, pistachio and figs, as well as abundant forage for livestock. As a consequence it was a center of pastoral life during the wet season. Recent virtual deforestation of the Jebel along with overgrazing, has severely depleted the land and contributed to denudation of the soil from the steeper slopes. In the past this region has seen a number of shifts in precipitation which have allowed permanent settlement as well as herding. It remains a question for investigation what kind of environments existed during the Epipaleolithic and early Neolithic. It is generally thought that conditions were markedly less seasonal toward the end of the Pleistocene, perhaps with rain that extended into the summer. However, this was interrupted by the Younger Dryas that plunged the region back into Ice Age conditions, particularly aridity. The Climatic Optimum followed abruptly on the Younger Dryas, raising temperatures several degrees Celsius during the summer and increasing the precipitation (COHMAP 1988, COURTY 1994). At this time much of the Jezireh may have been forested rather than open grassland steppe, and streams may have been perennial. This is the period when the PPNB spread to its maximum extent.

These changes in the environment clearly have much to do with the potential of the region for either agriculture or for hunting and collecting and they also affected where sites may have been. Therefore, the regions that are most suitable today were not necessarily as desirable at some periods in the past. Until there are adequate studies of local climate and environment we shall not know.

Perhaps because few early Neolithic or Epipaleolithic sites have been found in this semi-arid steppe, a unique lithic tradition has not been described for the region but it is questionable whether a unique tradition will be found. It has been observed repeatedly that the early Neolithic of the region west of the Euphrates is distinct from that found to the east of the river, and that a different lithic tradition existed in the central Zagros. In each of these other regions are locales that supported long-term occupations, usually at oases, riverine sites, or ecotones. These contrast with most of the Jezireh which is relatively open, flat and unvarying in resources.

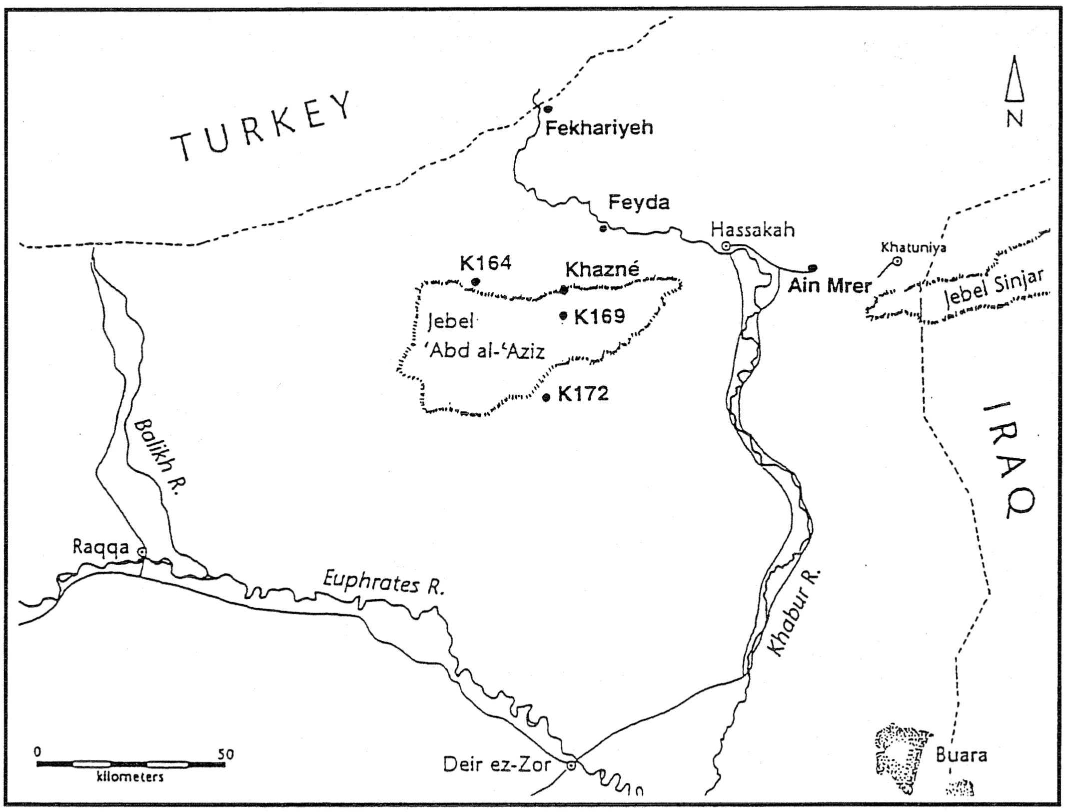

Fig. 1. Location of the Khabur Basin study area in northeastern Syria
<*The sites mentioned in the text are in boldface; base map after:* W.H.E. GREMMEN and S. BOTTEMA, Palynological investigations in the Syrian Gezira. In: H. KÜHNE (ed.), *Die rezente Umwelt von Tall Šeẖ Hamad und Daten zur Umweltrekonstruktion der assyrischen Stadt Dur Katlimmu:* Fig. 61 (1991). Berlin, D. Reimer>.

However, the lack of known sites may be more apparent than real. First, it is known that parts of the Jezireh were affected by alluviation during the fourth millennium B.C., and most of the land surfaces on which early Neolithic sites could lie may be buried (HOLE 1991b, 1994). Secondly, during the Climatic Optimum, immediately following the Younger Dryas, there was more precipitation throughout the region, including the warm months so that continuous occupation of the steppe may have been possible. In the absence of high terraces on which sites might lie untouched, as in other regions, or accidental exposure of buried sites during construction, there is little hope of finding most sites dating to the Pre-Pottery Neolithic. Another factor in the lack of sites is that the wettest parts of the Jezireh have been surveyed chiefly by investigators who are more familiar with ceramics than with lithics; therefore, some early sites may not have been observed. What seems certain, however, is that there are no PPN sites with enough depth of deposit so as not to have been buried by later alluviation. In sum, all signs point to ephermeral occupations during the early Neolithic, a condition that would militate against the development of a strong regional tradition.

Regional Traditions

Stefan Kozłowski has identified a cultural province spanning the Zagros and adjacent lowlands and piedmont, as well as a "Classical Levantine" tradition which extends into southeastern Turkey. He refers to these as the eastern and western wings of the Fertile Crescent.

The coherence of each region is denoted largely by different core reduction techniques (conical versus bidirectional naviform), the continued use of geometric microliths and the prevailing lack of arrowheads in the east which stands in sharp contrast with the western region where arrowheads are abundant and microliths absent after the Epipaleolithic. Moreover, in both areas there is increasing standardization of blades during the PPNB, but in both a later decline in technique, at least for artifacts produced on sites. Rather, a growing trade in well made blades, especially of obsidian, developed. The apogee of blade making, expressed in bullet cores, was reached belatedly in the Zagros and continued to be seen in early ceramic Neolithic sites both in the mountains and on the piedmont. Such cores are sometimes found in Anatolia but not in lowland Levant.

There would seem to be little relationship between the technique of core reduction and the presence or absence of arrowheads and microliths, for both techniques can yield good, flat blades or bladelets to use as blanks for tools, and microliths can be made on small, elongate flakes as well as on bladelets. Thus differences in their distribution implies differences in the technology of hunting - in the west, the single-headed arrow may have replaced the spear or javelin set with many small elements.

Conical blade cores are largely confined to the Tigris drainage and the Zagros region. They are ubiquitous in the Zagros (HOLE 1994) and some examples are found as far west as Çayönü (REDMAN 1982: Fig. 2.7:1-2). In general they seem to be confined to the mountainous regions rather than to the lowland steppe. This distribution, as well as the specific microlithic forms, fits with a region centered in the Caucasus, or the northern Zagros/Taurus, where these artifacts have a long tradition. Indeed, one can point to the existence of similar traditions and sequences in these regions as far back as the Mousterian (HOLE 1970), and especially well expressed in the Epipaleolithic (BADER 1984). In short, the counterpoise to the Levantine tradition may be the Caucasus/northeastern Anatolian-Zagros region. As for the conical blade cores, they seem to have their earliest manifestation in Asia, implying that the technique of pressure flaking may have moved from east to west across the central Asian steppe (INIZAN 1985).

If we examine the geographic regions more closely, we find that arrowheads extend across the Jezireh, all the way to the piedmont of the Zagros, but they do not intrude on the mountains themselves, nor do they extend south along the piedmont into Deh Luran. For whatever reason, arrowheads are artifacts of the open steppe and their distribution across the Near East is tied largely to the steppe. However, peoples using these implements also penetrated into the southeastern Anatolia, as known from surveys and excavations along the Euphrates and its tributaries. In general the sites in southern Anatolia lack geometric and backed microliths, in common with the Levantine sites from which they may have developed. Further, these sites lack El Khiam points, that might imply a later date, but they do have some Nemrik points that are known to be early. Geometric microliths are also missing from these sites. Although such tools occur at Nevalı Çori, they are attributed there not to the PPNB but to a preceeding Epipaleolithic (SCHMIDT 1993). More typical is Cafer Höyük where there are microlithic sized tools, but no geometrics (CAUVIN and BALKAN 1985).

A third system of core reduction is seen at Cafer Höyük, where obsidian was used primarily. The cores were single platform, but retained a ridged back resulting from the initial chipping. The preforms have no parallels outside this region but the final reduced cores with ridged backs are also seen in some of the early Neolithic sites of the Zagros, such as Karim Shahir, as well as in southeastern Anatolia.

Epipaleolithic

There are two possibilities for the emergence of these separate traditions, either the PPN cultures arose out of an indigenous Epipaleolithic background or they were introduced from outside. The former is clearly true in the southern Levant which has the only long and continuous sequence and it may also be true for the Zagros region although it has not yet been demonstrated archaeologically (HOLE 1987; HOLE, n.d.). An Epipaleolithic presence is probable in the Anatolia/Taurus region and in the north Mesopotamian steppe/Jezireh of Syria and Iraq, although in both cases it is probably only terminal Epipaleolithic (*cf.* late Natufian) and hence itself derived from one of the adjacent regions.

There are only minor hints, in the sparse finds in the Khabur basin, that Epipaleolithic peoples utilized the Jezireh. These finds are not adequate to demonstrate either a significant presence during these times, or what might be termed a local Epipaleolithic tradition. Rather it seems more likely that peoples out of either the Levantine or Zagros traditions occasionally made forays into the Jezireh and upper Euphrates for hunting.

Why might the Anatolian/Taurus region and the Jezireh have been effectively vacant during the earlier Epipaleolithic? The mountains were slow to rebound from glacial climates (ROBERTS and WRIGHT 1993) so that they may have been inhospitable to human occupation from the Late Glacial Maximum to essentially the time of the Younger Dryas, even though the southern Levant was much more favorable at this time. The Jezireh would have been affected similarly and perhaps not been suitable for year round occupation until the Climatic Optimum, immediately following the Younger Dryas. This is precisely the time when the first settlements occur, but in different locales and under different circumstances than during the preceeding Epipaleolithic. In general, the PPN sites are true settlements, whereas all the Epipaleolithic sites are seasonal or ephemeral. At least in the Khabur the Epipaleolithic sites are situated around fossil springs or caves and rock shelters, neither of which was occupied during the PPN. These are hunting locations, not agricultural sites.

Abu Hureyra and Mureybet, with late Epipaleolithic occupations, seemingly during the Younger Dryas, may be exceptions to the generalization that the area was abandoned (MOORE 1991, MOORE and HILLMAN 1992). However, we should recognize that if aridity was a determining factor in land use during the Younger Dryas, then the Euphrates would have been one of the most attractive locations.

Regional Economies

It is generally acknowledged that agriculture was first practiced in the southern Levant or even throughout the "Levantine Corridor" from Damascus to Petra. Wherever the precise locale may have been, it is also acknowledged that farmers began to spread into regions previously not settled. One of these certainly was the Jezireh. Inasmuch as agriculture arose out of the Levantine Epipaleolithic tradition, it is logical that peoples spread from west to east, bearing Levantine culture traits. Indeed, it is also clear that climates moved in the same way, gradually opening the regions to the east and allowing for the spread of native cereals and legumes, as well as people. While farmers were moving eastward, peoples of the Zagros arc were domesticating herds of goats and sheep and tending pigs (HOLE 1989, n.d.). In both cases, people depended for part of their subsistence on wild foods. Thus, in the west, where livestock had not been domesticated, hunting prevailed. In the east, after livestock were brought under control, wild plant foods provided the carbohydrate staples.

This regional alternation of subsistence strategies may underlie the distribution and movement of arrowheads *versus* microliths. After the use of domestic animals, arrowheads may not have been in great demand and we see their decline in the west too, when livestock were introduced. The Zagros stands apart, retaining its Epipaleolithic tradition of geometric microliths longer than any other region, and not participating at all in the spread of arrowheads: they did not move eastward beyond M'lefaat at the base of the Zagros and Qermez Dere near the Jebel Sinjar. Moreover, the making of pressure flaked blades from conical cores reached its finest development in the Zagros in the late PPN. The question is whether these Zagrosian elements stretched westward out into the steppe, or whether the Jezireh owes its character entirely to Levantine elements.

The Jezireh/upper Euphrates/southeastern Anatolia region comprises a coherent tradition, denoted primarily by the presence of lozenge-shaped arrowheads (*cf.* Nemrik points), but it also includes a significant number of geometric microliths. For example, at Qermez Dere there are scalene triangles and tiny backed and diagonally truncated bladelets, identical to those found in the Zagros tradition (WATKINS *et al.* 1989). Nemrik has a similar array with the significant addition of trapezoidal microliths, a form also found in the Zagros but later in time (KOZŁOWSKI and SZYMCZAK 1989). The lithics from Hallan Çemi are coarser and made on suitable flakes rather than bladelets, yet the forms are similar (ROSENBERG 1994). These sites would seem to offer evidence that the Zagros tradition extended a short distance out onto the Jezireh and even into the upper Tigris. However, we should remember that all of these sites had an economy based principally on wild foods, both hunted and collected. Therefore the dominance of Epipaleolithic elements is understandable. The hallmark of these elements is the geometric microlith which had essentially disappeared in the west. Thus, one can make a case that their presence in the Jezireh, along with PPNA or PPNB points would suggest a Zagrosian background.

In the Khabur we collected several sites located around small springs. Some of these, especially 'Ain Mrer, had numerous microlithics, many backed and truncated in the Zagros or Kebaran style but nothing that could be called an arrowhead. The microliths, like those from Karim Shahir, were made on suitable flakes rather than bladelets as became common later in the Zagros. We did not find any good conical blade or bladelet cores; rather the cores were generally from one direction, but flaked on only one face and rarely produced blades with parallel sides and one or more ridges. The site where we found Nemrik points, had no retouched microliths, nor did it have any evidence of tanged points. Neither is surprising in view of the very small collection that we made, but the fact is, when tanged points appear in this region, backed and geometric microliths are absent.

What does this sum to?

1. The area from the Euphrates eastward was visited infrequently shortly before the Younger Dryas by Epipaleolithic hunters with a Levantine toolkit, as seen at Abu Hureyra, Dibsi Faraj and Mureybet. Crescentic- or lunate-shaped microlithics in the Natufian tradition continued to be used at these sites (CAUVIN 1972: Fig. 1, WILKINSON and MOORE 1978), but this region lacks the bladelet tradition of the Zagros, as seen in the Zarzian.
2. Following the Younger Dryas, when climate ameliorated, hunters using notched and lozenge-shaped arrowheads spread throughout the Levant and up the Euphrates. By this time people in the west were using naviform cores. In northern Iraq, where the same arrowheads were being used, lithic reduction was based on one-directional cores, and bladelets formed a significant part of the lithic tool kit. This would seem to represent a merging of the lowland Zagros technology with new tool types derived from the west.
3. The lozenge-shaped arrowheads developed into tanged points, again spreading across the Jezireh and the bladelet tradition disappeared except in the Zagros. By this time the PPNB, in the form of agricultural villages, was established throughout the region, with local variants in lithics and other artifacts.

I interpret these facts to imply that the initial spread of arrowheads into the Jezireh was by hunters from the west who entered into newly rich grounds that had been essentially vacant. As the region became more attractive, hunters from the Zagros tradition also made forays into the steppe where they met with people from the west and adopted the bow and arrow. The center of development of early arrowhead technology may have been in upper Euphrates, as suggested by Cauvin (1988), Cauvin and Cauvin (1993), and Rollefson (1989). Eventually, however, farmers moved eastward across the steppe and dominated the local economy and apparently ended the Mesolithic holdovers. With the agricultural economy, the need for elaborate hunting equipment seems to have declined and the last vestige of it had disappeared by the late Neolithic. Only in the Zagros and Anatolia (with obsidian) did the tradition of using pressure-flaked microblades continue into the ceramic periods.

Sites in the Khabur Basin

General Remarks on Lithics

We have carried out surface surveys of large areas of the western part of the Khabur basin during several separate field seasons. Much of this survey has been directed toward finding ephemeral campsites of pastoralists so we have consistently attempted to find even small scatters of lithics. Despite the effort of ourselves and others, few sites pertinent to the Epipaleolithic or PPN have been found in the Jezireh, either in Syria or in Iraq. This is not to imply that such sites do not exist, either buried or in more favorable locales, but that they are very hard to find.

One problem is the ambiguity about dates of sites because some lithic types lasted longer than any archaeological culture. Using only surface finds and in the absence of excavation one must adopt some criteria other than just typology for establishing ages. One of these is patination, for there is a clear difference in age between pieces that are patinated and those that are "fresh". All pieces that are diagnostic of Epipaleolithic or Paleolithic are patinated, whereas all lithics that are diagnostic of the Neolithic and later lack patination. Further, all Neolithic flints are a fine grained dark brown stone, whereas the Epipaleolithic flints are gray to tan. The absence of obsidian is another indication of Epipaleolithic date, as is the absence of micro-borers/drills. Using these criteria one can find isolated lithics on third millennium sites that are clearly Paleolithic and Neolithic in age, denoted both by the patina and the typology.

Khazné Caves

There are three small caves directly above the modern village at Bir Khazné, on the north side of the Jebel, 47km southwest of Hasseke. The caves overlook the talus slope and are set into the steep face of the Jebel. Today this area is a campground for nomadic pastoralists, and agricultural fields have been cultivated to the base of the talus. The edge of the talus is deeply incised by wadis, in the beds and banks of which are numerous lithics, apparently mostly of middle Paleolithic age. We observed lithics buried by as much as two meters of coarse alluvium, but the ground surface also holds many similar lithics. We carefully searched the talus outside the shelters where we had recovered the geometrics in 1984, but we found no more lithics diagnostic of the Epipaleolithic. (see HOLE 1994 for illustrations of these lithics). Rather, we found numerous flat, unpatinated blades that may be ceramic Neolithic or later. They seem to go with the small chunk of obsidian and what may be the tang of a point (or the broken tip of a borer). The only cores recovered were amorphous flake cores.

The small caves and shelters along the rock face have been used recently as animal pens and their floors are covered with a layer of dung so that one cannot tell whether there is an archaeological deposit beneath.

Our general assessment of this locale is that the mountain side is slowly crumbling and the earth is slowly moving downslope, much like a glacier. Therefore, one would expect to find the oldest material on the bottom and spread farther down the wadis. To the extent that we could determine, this appears to be the case - at least the middle Paleolithic material is ubiquitous in the wadi beds, but not on the talus slopes.

K164

This site consists of several surface scatters of lithics on the eroded banks of a small wadi some 80km east of Hasseke. A small spring provides water for two stock troughs and supports a stand of reeds. The meandering wadi has a flat bottom that contained green vegetation until mid-June. The wadi banks are nearly barren and in the vicinity of the stock troughs bare bedrock is exposed. For the most part the land surrounding the site is flat, with only low occasional hills.

A general surface collection was made from both sides of the wadi and extending over a range of about 500 meters. Except in the two spots indicated, the scatter is very dispersed.

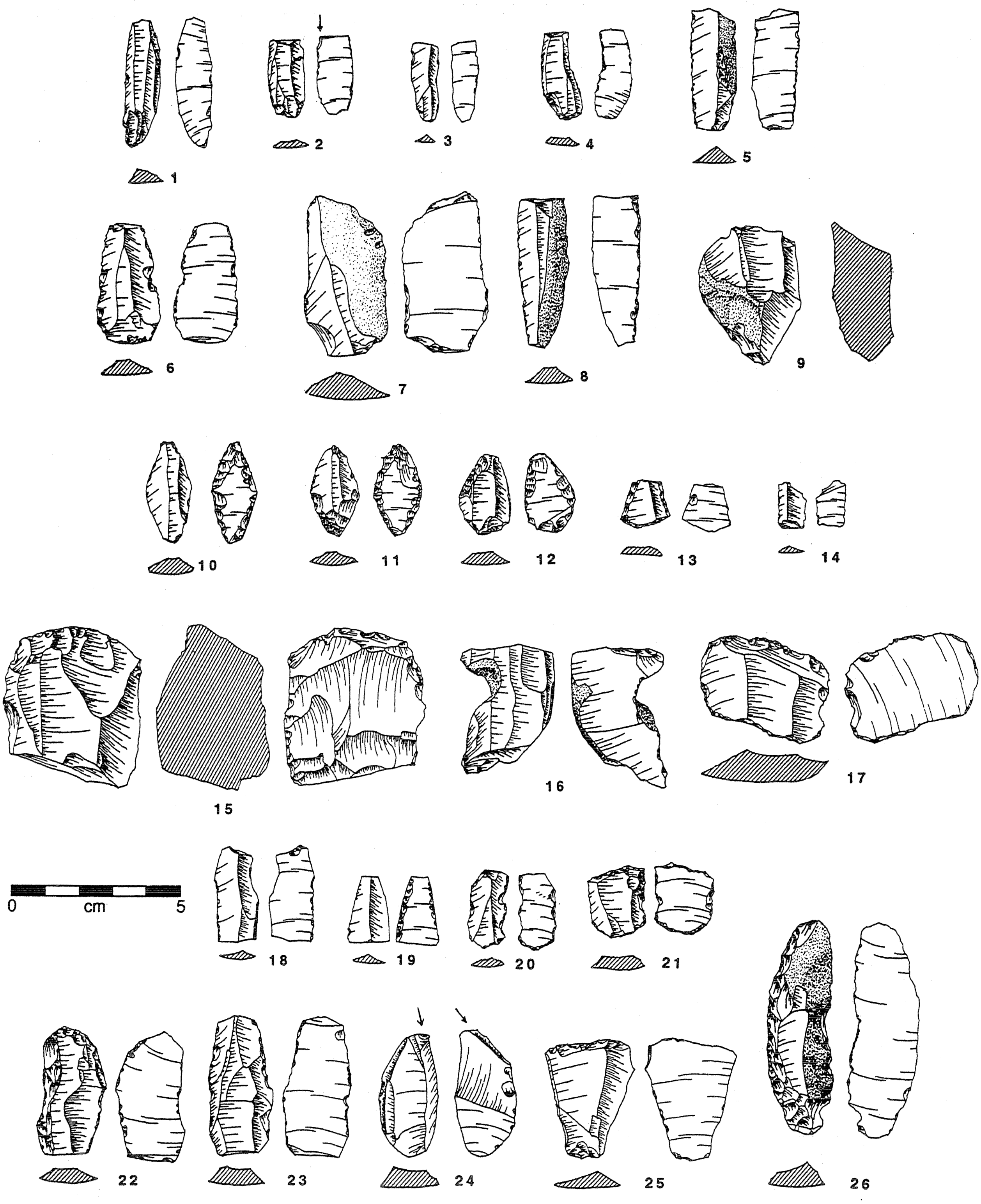

Fig. 2. Chipped stone artifacts from various sites in the Khabur Basin.

1 twisted blade (K164-1)
2 blade fragment (K164-1)
3 twisted bladelet (K164-1)
4 twisted bladelet (K164-1)
5 blade with cortex (K164-1)
6 blade with light edge chipping (K164-1)
7 flake with cortex and light chipping (K164-1)
8 blade with cortex (K164-1)
9 core (K164-1)
10 Nemrik point (K164-3)
11 Nemrik point (K164-3)
12 Nemrik point (K164-3)
12a blade/flake segment with edge retouch (K-164-3)
12b bladelet fragment (K-164-3)
13 core (K-164-2)
14 blade core fragment (K-164-2)
15 flake with edge retouch (K-164-2)
16 blade segment (K-164-2)
17 blade segment with inverse edge retouch (K-164-2)
18 blade with light edge chipping (K-164-2)
19 end scraper on blade segment (K-164-2)
20 flake with edge chipping (K-164-2)
21 flake with edge chipping (K-164-2)
22 dihedral burin (K-164-2)
23 end scrapers on flake (K-164-2)
24 steep edge scraper with cortex (K-164-2)

K164-1

This consists of a cluster of Epipaleolithic lithics recovered from a radius of not more than 5m.

The lithics are on lightly patinated flint from two or more cores. A true blade core was not found, but a segment of a blade core platform, as well as a number of blades and debitage indicate local chipping. The most diagnostic feature of the blades is their tendency to twist (Fig. 2:1-4). All were apparently produced by pressure and they often have more than one ridge. One bladelet has steep retouch along one edge (Fig. 2:4); another small blade is a dihedral burin (Fig. 2:2); and there are two larger flat blades (Fig. 2:5,8). A flake core on a small nodule has a sharply angled platform (Fig. 2:9). A rough nodule with a rounded platform from which two micro-blades were removed, may have been a steep scraper.

K164-3

A cluster of Proto-Neolithic lithics recovered from a radius of not more than 5m. The lithics from this cluster were sparse but contained three diagnostic Nemrik points, two with full, inverse flaking (Fig. 2:10-11), and one with shallower, less developed flaking (Fig. 2:12). The other lithics consisted of a backed bladelet (Fig. 2:13) and other bladelet fragments. According to Stefan Kozłowski, who examined these pieces at Yale, the lithics from K164-3 compare closely with those from Nemrik 9, but those from K164-1 are probably Epipaleolithic.

There is no apparent depth of deposit at this site although careful digging and sieving of the upper few centimeters of sediment might yield more material. This appears to have been a site visited only briefly on several occasions during prehistory, probably because of the available water and hunting possibilities.

K164-2

The general collection from the entire site produced material of various ages, from late Paleolithic through the third millennium. As is usual, the older lithics have the greatest amount of patina, which allows a rough separation by age: sites of aceramic Neolithic age and older invariably have patinated lithics, whereas those of younger age do not.

The general surface collection includes crude twisted, as well as flat, blades, larger than those from K164-1 (Fig. 2:18,20,22-23), There are end scrapers on a blade fragment (Fig. 2:21) and on a flake (Fig. 2:25); a dihedral burin (Fig. 2:24); a blade with inverse retouch (Fig. 2:19); retouched flakes (Fig. 2:6,17); a multi-platform flake core (Fig. 2:15); and a steeply retouched side scrapers on a crude blade (Fig. 2:26). None of these are specially diagnostic but all could fit into a late Paleolithic or early Neolithic range. The absence of obsidian is compatible with this assessment.

K169 (K36; no name known)

On the south side of the Jebel, in the foothill zone where there are still scattered pistachio trees, This is an area that is frequented by herders in the spring, as indicated by numerous visible campsites. In 1988 we collected from around a tree that stands just above the dirt road, finding little diagnostic material. The sparse lithics may have washed down from above. In 1994 we revisited the area and collected from a broader area 25m north of the pistachio trees, dissected by a wadi from which some of the lithics were taken. This site appears to date to the Epipaleolithic and earlier. The most diagnostic pieces are a steeply platformed core in Epipaleolithic style (Fig. 3:13), a twisted bladelet (Fig. 3:14), a small blade (Fig. 3:15), and a thumbnail scraper (Fig. 3:16).

K172 'Ain Kasebiyeh

South of the Jebel, intersected by the pipeline road, is the small spring/wadi at 'Ain Kasebiyeh, some 70km southwest of Hasseke. Surrounded by low hills, the spring is in a basin draining to the south, with pools of fresh water supporting a profusion of croaking frogs. At the spring, the wadi is incised some 6-8m into the gypsiferous sediments and has a relatively flat bottom. Below the spring the wadi becomes shallower, but upstream it becomes progressively more deeply incised, the bottom is filled with reeds, and the sides become canyon-like, collapsing as the wadi undercuts its banks. We carefully searched the surface for artifacts both above and below the spring, but both sherds and lithics were sparse. Both banks are barren of vegetation and we found nothing on the eastern side, but there were two small clusters of lithics on the west side.

K172-1

This cluster, which lay some 200m north of the road and about 75m north of the diesel pump,

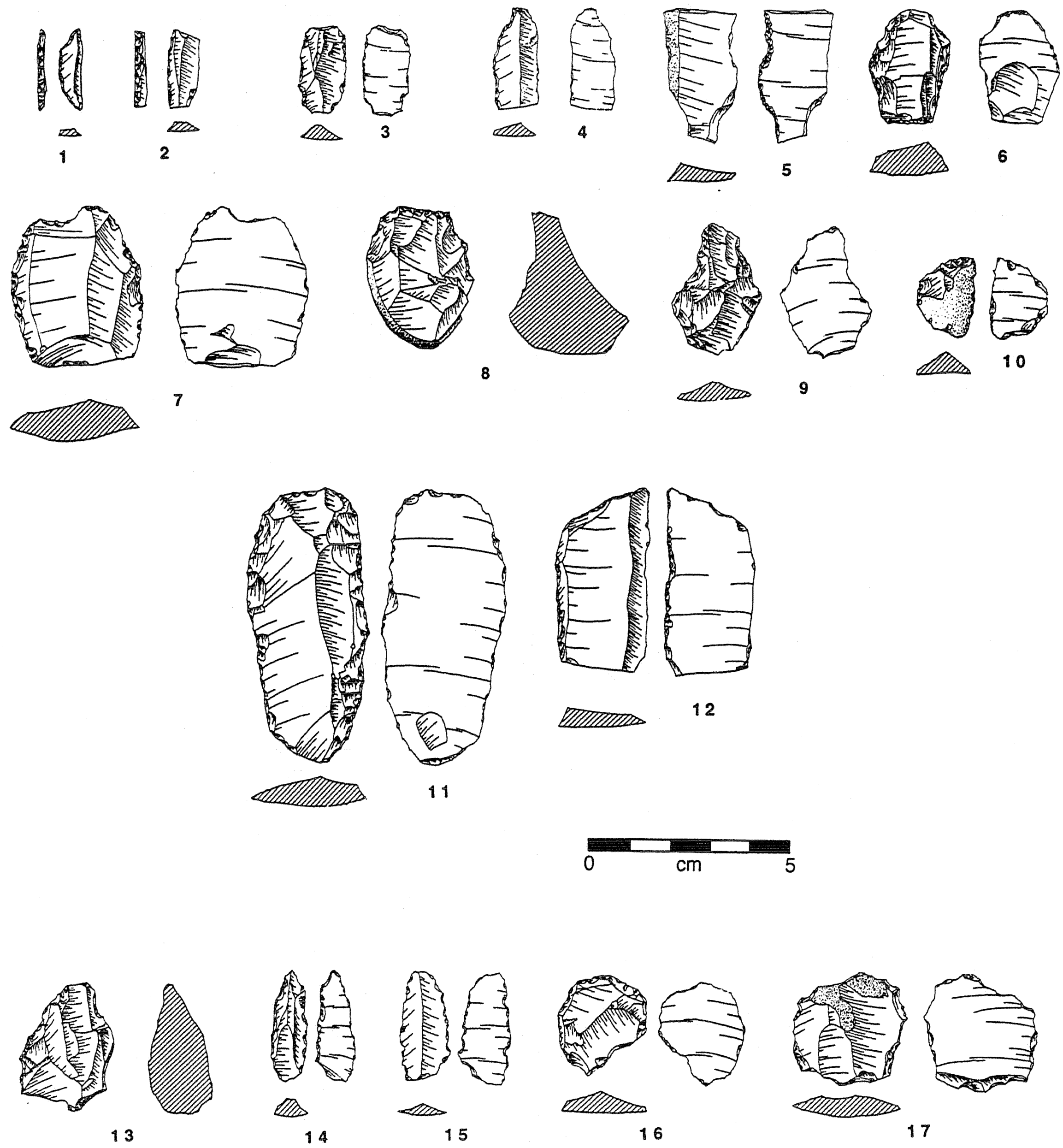

Fig. 3. Chipped stone artifacts from various sites in the Khabur Basin.

1 crescent on backed bladelet (K172-1)
2 backed bladelet (Kl172-1)
3 blade fragment with edge chipping (K172-1)
4 blade with backing retouch (K172-1) <*no patina*>
5 flake with edge retouch (K172-1)
6 flake with steep edge retouch (K172-1) <*no patina*>
7 flake with edge retouch (K172-1)
8 core (K172-1)
9 flake with edge chipping (K172-1)
10 flake end scraper (K172-1) <*no patina*>
11 large backed blade with edge retouch (K172-3)
12 large backed and truncated blade (K172-3)
13 small bladelet/flake core (K169)
14 twisted bladelet (K169)
15 bladelet (K169)
16 thumbnail scrapers (K169)
17 flake with some edge chipping (K169)

occurred in an area with a radius of not more than 5 meters. Also on the surface at this location, but unpatinated, were typical third millennium lithics. There were also some possible Neolithic lithics, none patinated, including one obsidian blade fragment, a blade with backing retouch, and a thick flake with steep retouch.

A possible Epipaleolithic component is suggested by a group of patinated lithics, including a perfectly flaked crescent (Fig. 3:1), a typical Epipaleolithic exhausted core (Fig. 3:8), and a number of small blades that do not have a twist (Fig. 3:3-4). Other lithics from the same surface cluster include Fig. 2:5-7,9-10.

A final group of four pieces has notably heavier patination, possibly suggesting a Paleolithic age, but none of these was diagnostic in other respects.

K172-2

Another small cluster of blades and debitage from a scatter near K171-1. We recovered five crude and apparently unused blades and three flakes, mostly of dark, banded flint. Because of the lack of soil cover on the wadi bank it seems unlikely that there is a deposit that could be excavated. This site, like K164, may have been just a transitory hunting site or camp.

K172-3

From the area where the road intersects the wadi, we collected third millennium sherds and lithics, as well as a few patinated pieces that are probably Paleolithic is age. One is a backed and truncated blade 2.2cm wide, with light inverse retouch opposite the backed edge (Fig. 3:12). This piece resembles a sickle, although because of patina any sheen would be impossible to discern. The other piece is a crude, thick flake/blade with full edge retouch (Fig. 3:11). This resembles pieces from the Middle or Upper Paleolithic.

Feyda and Fekhariyeh

These sites were described in my paper for the Berlin conference (HOLE 1994). Unlike the sites described above, these were both on the main Khabur river floodplain and were either long-term campsites or small villages.

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Critical Observations on the So-Called Khiamian Flint Industry

Yosef Garfinkel

Abstract: *The validity of the term "Khiamian Culture" is questioned. A re-examination of the relevant sites (el-Khiam, Mureybet, Nahal Oren, Salibiya IX, Hatula, and 'Iraq ed-Dubb) reveals a pattern which should be regarded with suspicion. Only sites with a Natufian layer below and a PPNA (Sultanian) layer above have produced "Khiamian" assemblages. I would thus argue that sometimes when a PPNA settlement existed above a Natufian layer, the topmost Natufian layer became mixed with the bottom-most PPNA deposit. The result of these site formation processes, deposits 10-20cm. thick, are the Khiamian assemblages.*

Introduction

It is now widely accepted that the Pre-Pottery Neolithic A (PPNA) period is divided into two phases:

a. an earlier phase, *c.* 8300-8000 B.C., known as the Khiamian.
b. a later phase, *c.* 8000-7500 B.C., known as the Sultanian.

By definition the Khiamian flint industry includes el-Khiam points (Neolithic tradition), lunates (Natufian tradition), and no bifacial tools. The Sultanian flint industry, on the other hand, includes el-Khiam points and bifacial tools but no lunates. Another interpretation suggests that the Khiamian and the Sultanian are not two separate archaeological entities, but that the Khiamian is a case of Sultanian intersite variability (NADEL 1990).

For almost a decade I have questioned the validity of the term Khiamian in lectures or personal discussions. Since more and more scholars are using this misleading term, it has now become imperative to present its problematic nature at some length. A re-examination of the relevant sites - el-Khiam, Mureybet, Nahal Oren, Salibiya IX, Hatula and 'Iraq ed-Dubb - reveals a pattern which should be regarded with suspicion.

The Khiamian Assemblages

El-Khiam Terrace

This site was first excavated by Neuville in the 1930s (PERROT 1951), and was investigated again in the early 1960s by ECHEGARAY (1964, 1966). Each of the excavators used a different terminology for the archaeological sequence and the cultural phases at the site. According to the common terminology the upper sequence includes Natufian, Khiamian, PPNA and PPNB. The stratigraphic phase following the Natufian and pre-dating the PPNA, *c.* 30-45cm. thick, was first designated as "Epi-Natufian" by Neuville and Perrot. Later, Echegaray dubbed this unit "Khiamian II", and this was the way in which it was introduced into the literature. Incidentally one should be aware that Echegaray uses the following terminology in his report: "Khiamian I" for Natufian (Layer 5), "Khiamian II" for Khiamian (Layer 4), "Proto-Tahunian" for PPNA (Layers 2-3) and "Tahunian" for PPNB (Layer 1).

It should be taken into consideration that the terrace of el-Khiam is situated on a rather steep slope where a natural process of erosion took place, with sediments and artefacts moving down the slope (Fig. 1). Crowfoot Payne has commented that "the stratification at el-Khiam is likely to be confused, and the true content of the industry will need revision" (1976: 134). The assemblages in each of the layers at el-Khiam include many re-deposited components which clearly came from earlier periods. For example, the "Khiamian II" assemblage presented here as Fig. 2 includes microliths, geometric microliths, lunates, el-Khiam points and truncations. The "Tahunian" assemblage presented here as Fig. 3, also includes microliths, geometric microliths, lunates, el-Khiam points and truncations. Note for example the typical truncated notched tool, which has been reported by Tamar Noy from PPNA Gilgal (Fig. 3:24). This contradicts Noy's observation that "In the Khiamian layer at El-Khiam or in any other layers of that site such tools were never presented". (NOY 1987: 159)

This distorted picture clearly indicates that one cannot consider Layer 4 at el-Khiam as a clean assemblage representing a meaningful archaeological unit.

Salibiya IX

A test pit measuring 2x2m, dug in the Salibiya region of the lower Jordan Valley, has been designated Salibiya IX (BAR-YOSEF 1981). The same spot received the name Gilgal IV from Noy (1987: 159, Note 1). Salibiya IX lies very near the PPNA site of Gilgal I and the Natufian site of Gilgal II. Since all these sites are so close to each other, it is quite possible that they should be considered as one site.

The report maintains that "during the survey both Late Natufian and Khiamian flints were found on the surface of Salibiya IX" (BAR-YOSEF 1981: 193). Here again, the so-called Khiamian assemblage was found in close proximity to both Natufian and PPNA settlements. Two radiocarbon dates fall within the Epi-Palaeolithic period (KUIJT and BAR-YOSEF 1994: 241), and cannot be considered as accurate.

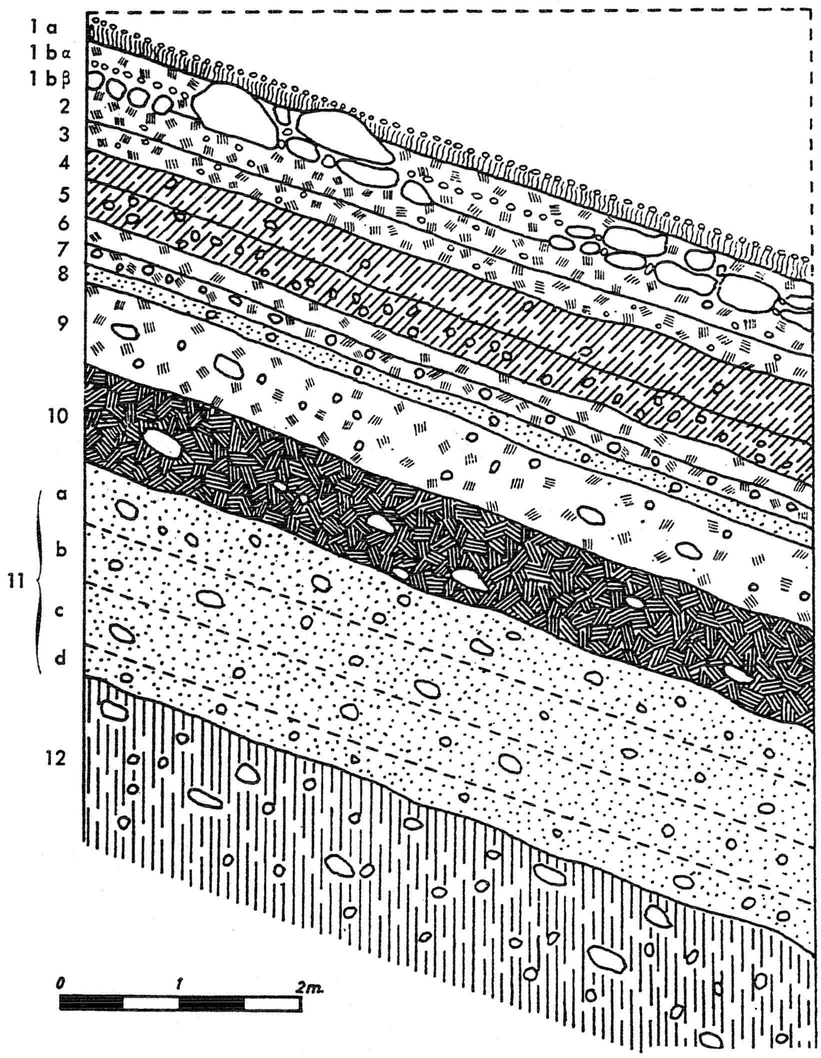

Fig. 1. The section published from the el-Khiam terrace (ECHEGARAY 1964: 22).

Mureybet

This site was first excavated by van Loon (1968), and later by Cauvin (1977). Each of them used a different numbering system for the archaeological layers. The sequence, as first presented by Cauvin, includes: Natufian (Phase Ia), Epi-Natufian (Phase Ib-II), PPNA (Phase III), and PPNB (Phase IVa-IVb). Later, the term Khiamian was suggested for Phases Ib-II (CAUVIN and CAUVIN 1983, M.C. CAUVIN 1991).

As can be seen in a section published recently by M.C. Cauvin (1991), the Khiamian Layer Ib is only 10cm. thick. It lies above the Natufian and below the PPNA strata.

The radiocarbon dates of the Natufian and the Khiamian layers at Mureybet cover the same time span, and thus do not indicate any specific time unit for the Khiamian. Waterbolk has recently summarized this situation: "I can only conclude that the PPNA started at *c.* 10,000 BP, and that the first Neolithic people used the same old wood as the Natufians." (1994: 361).

Hatula

This site lies on a gentle slope in the Judean foothills. In the early publications two layers were

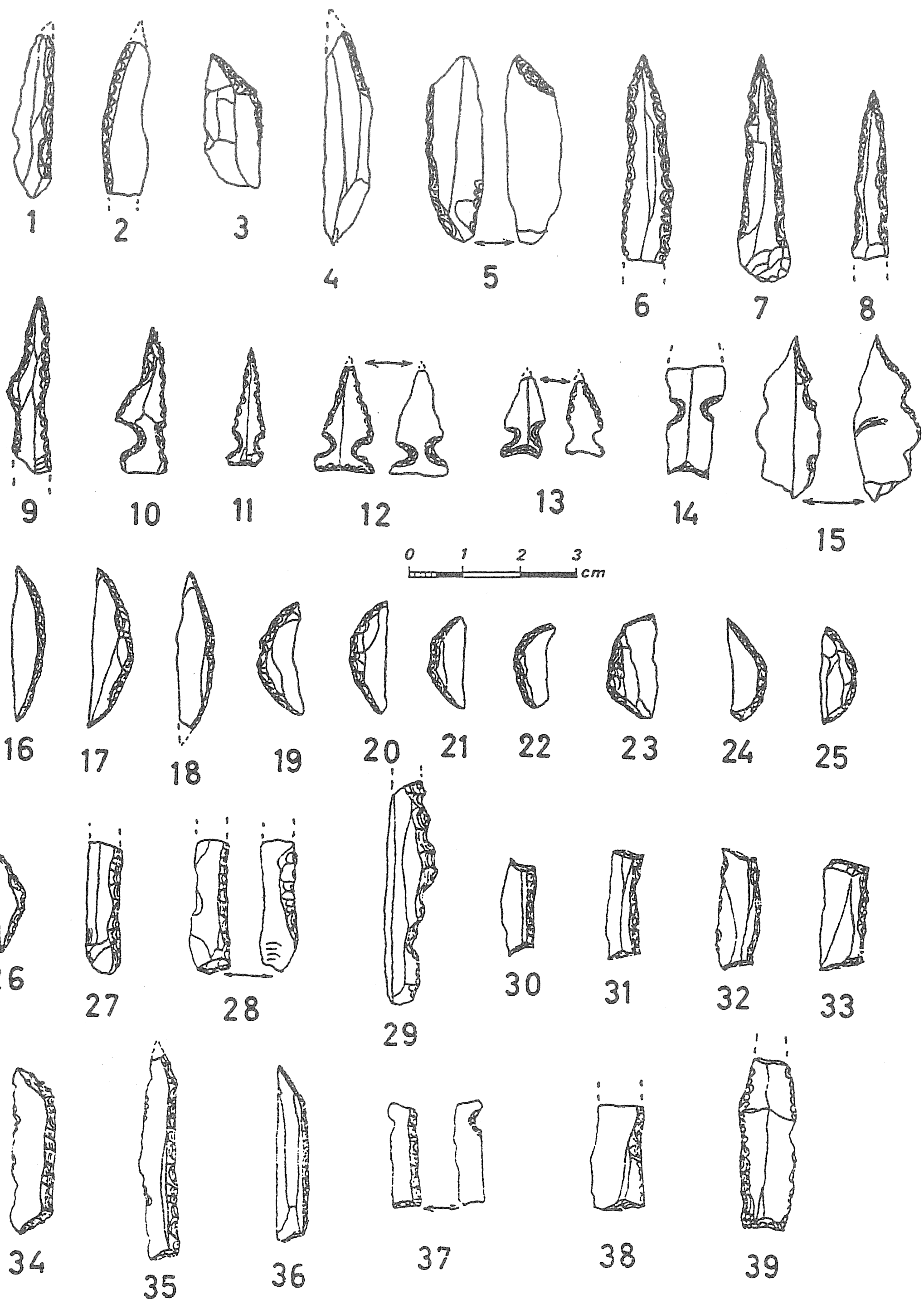

Fig. 2. "Khiamian II" flint artefacts at el-Khiam terrace (ECHEGARAY 1966: 54).

identified: Natufian and "Khiamian" (RONEN and LECHEVALLIER 1985). It has been suggested that "at the site of Hatula, the Khiamian may be defined as a late Natufian with El-Khiam points and needle-borers" (RONEN and LECHEVALLIER 1985: 162).

Further excavations revealed more PPNA remains, which were designated "Sultanian" (LECHEVALLIER *et al.* 1989). The best Khiamian layer was identified at Area A, inside a shallow depression; its depth does not exceed 25-30cm. at the most. Two factors should be taken into consideration when looking at the section of Area A (Fig. 4):

1. Natufian remains were found above the Khiamian.
2. The burial (Homo 1) was dug from the very top part of the Natufian layer. Is it possible that this grave was dug from the PPNA layer? If this is so, the digging must have brought earlier Natufian sediment into the PPNA structure, thus causing a mixture of earlier and later artefacts.

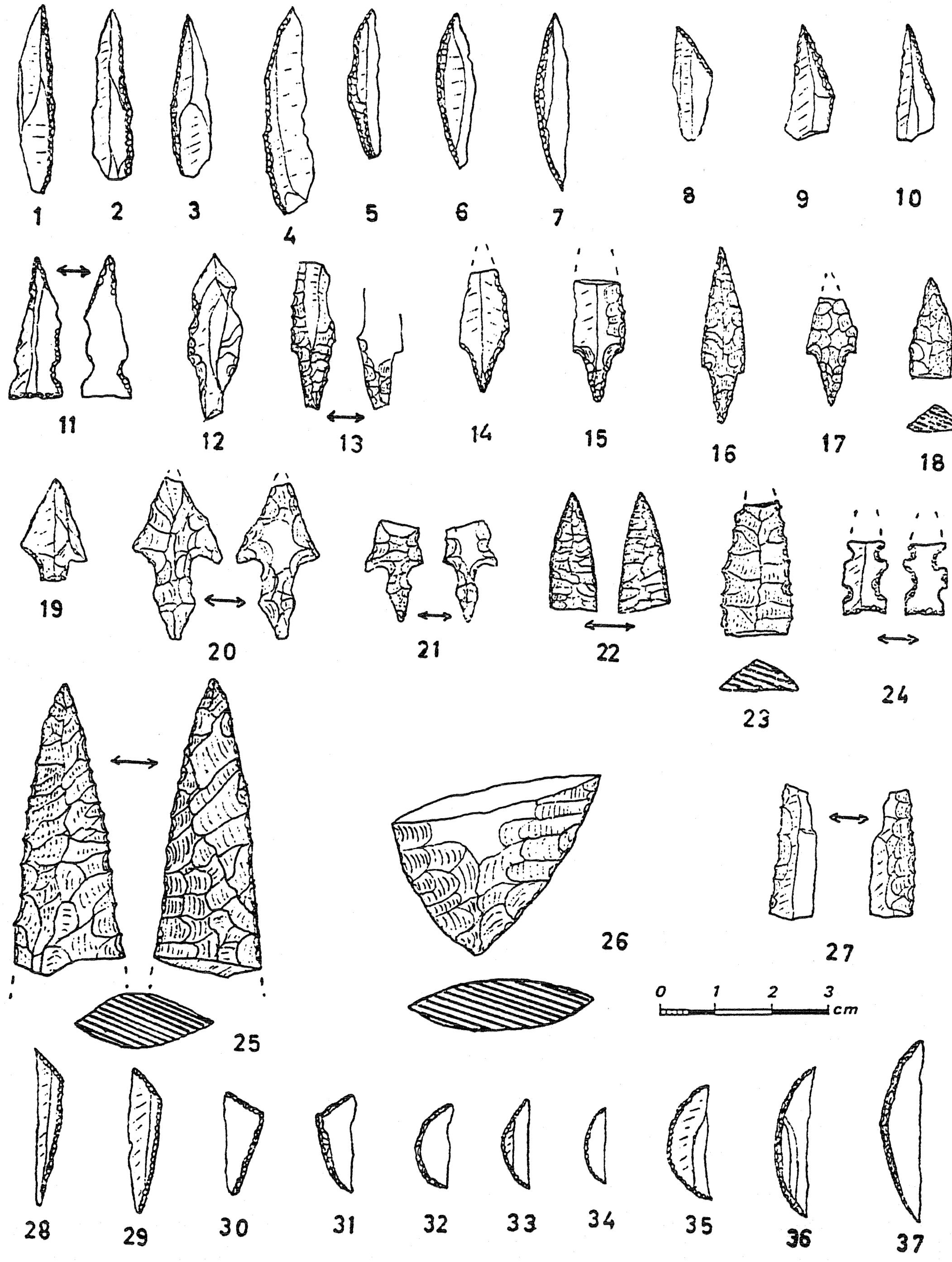

Fig. 3. "Tahunian" flint artefacts at el-Khiam terrace (ECHEGARAY 1966: 87).

The final excavation report on Hatula has recently been published (LECHEVALLIER and RONEN 1994). There seem to be no significant differences between the "Khiamian" or the "Sultanian" material remains. The post-Natufian remains at the site should probably all be classified as one cultural unit rather than two. The small quantities of bifacial tools (*c.* 0.5%) that have always been attributed to the Sultanian may represent different activity areas, as they seem to concentrate in Area F.

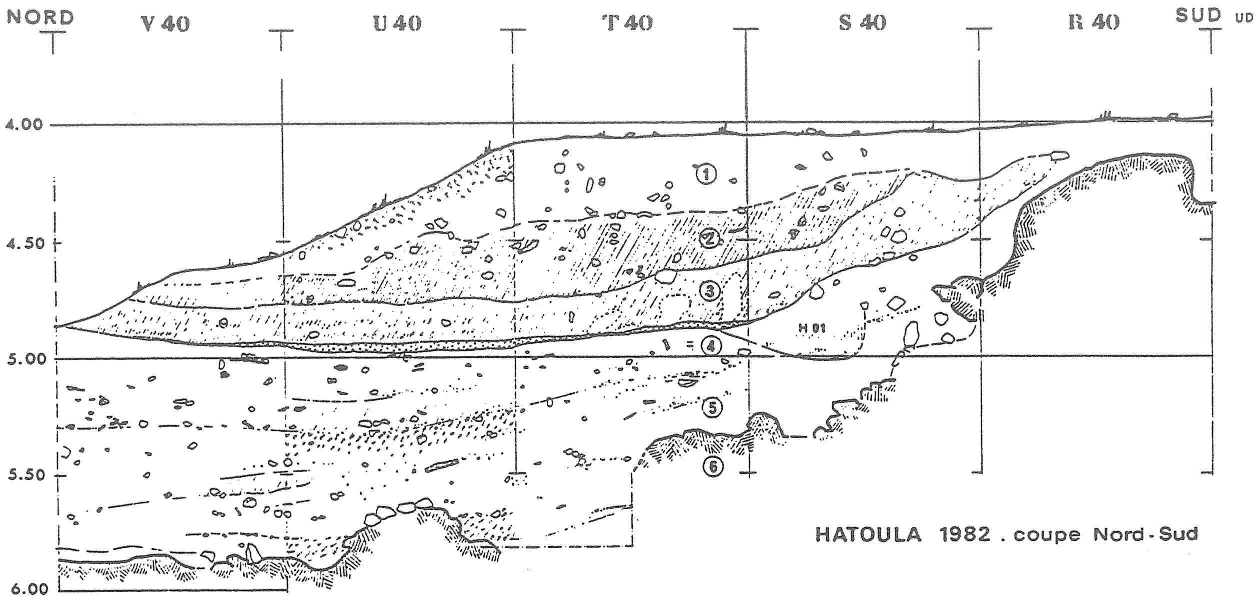

Fig. 4. The section published from Hatula, Area A (RONEN and LECHEVALLIER 1985: 149).

'Iraq ed-Dubb

This is a cave site in Jordan. In the early publications it was described as a single-layer site (PALUMBO *et al.* 1990, KUIJT *et al.* 1991). At this stage the following data were recovered: "The excavated flaked stone assemblage includes 13 el-Khiam points and point fragments, 13 small lunates, 10 Hagdud truncations, several microburins, awls, sickle knives, truncated blades, denticulates and a single triangle microlithic... Based on typological evidence alone, it is clear that 'Iraq ed-Dubb dates to the Khiamian period - a transitional phase between the final Natufian and Sultanian periods." (PALUMBO *et al.* 1990: 105).

Further field work and radiocarbon dates have revealed that the site has two layers: Natufian below and PPNA above. The new analysis concludes that "collectively, the radiocarbon dates, their stratigraphic contexts and the associated chipped stone materials from these loci and other areas clearly illustrate that the chipped stone assemblage from PPNA levels at 'Iraq ed-Dubb does not include lunates" (KUIJT 1994). Recently published radiocarbon dates from the site all fall within the eighth millennium B.C. and not in the last quarter of the ninth millennium B.C. as would be expected for the Khiamian.

Nahal Oren

This site lies on a steep slope in the foothills of Mount Carmel. Layer IV of this site has been described "Khiamian" in various publications (BAR-YOSEF 1981: 195, CAUVIN and CAUVIN 1983: 46-47). Only two sentences in the excavation report deal with this unit: "Layer IV is a small layer between the Natufian and the 'pre-Pottery Neolithic A' level. The small arrowheads with a hollow base may indicate that this is a late Natufian" (NOY *et al.* 1973: 83). Again, as in all the other examples, the so-called Khiamian is a very thin layer, squeezed between Natufian and PPNA layers. Furthermore Nahal Oren, like el-Khiam, is located on a steep slope and many earlier components have been eroded and redeposited into later levels.

Discussion

Four points should be emphasized regarding the Khiamian occurrence:

1. Only sites with a Natufian layer below and a PPNA (Sultanian) layer above have produced "Khiamian" assemblages. No single-layer Khiamian site has ever been excavated.
2. The Khiamian levels are very thin, usually 10 to 20cm. thick. This is notably different from Sultanian sites in which the archaeological levels can reach impressive depths, like the stratum of 8m at Jericho, at least 4m at Netiv Hagdud, at least 2m at Gilgal, and half a metre at the single layer site of Gesher.
3. Many of the sites are located on slopes on which natural erosion is more intensive than at regular sites.

4. The available radiocarbon dates from Khiamian sites do not fall within 8300-8000 B.C. as expected.

I would thus argue that sometimes when a PPNA settlement existed above a Natufian layer, the topmost Natufian layer became mixed with the lowest PPNA deposit. The result of this mixture, deposits 10-20cm. thick, are the Khiamian assemblages. The phenomenon of mixture at the point of contact between stratigraphic layers is familiar to every biblical archaeologist who has excavated multi-layered sites (tells) of the Bronze and Iron Ages. Thus the Khiamian assemblages do not reflect human activities but are the result of depositional processes, which take place at every archaeological site. In other words, there is no Khiamian industry at all. The so-called Khiamian assemblages are the result of our misinterpretation of site formation processes.

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Early Holocene Lithic Industries of Northeastern Africa

Michał Kobusiewicz

Abstract: *The paper presents lithic industries representing different Early Holocene cultures of northern Africa dating from c. 8000 to c. 5500 B.C. These cultures are described according to the main ecological zones. Five repeating typological traits, common for all the zones, characterize for Holocene lithic industries of the area considered.*

In this paper I would like to present briefly the lithic industries produced by flint-knappers who belonged to the different cultures of northeastern Africa during the Early Holocene Period, *c.* 8.000 to 5.500 years B.C. Such a narrow subject of my presentation was imposed by the general topic of our conference, strictly limited to the problems of chipped stone industries. As northeastern Africa I include here the territories of Egypt and Libya, and the very northern fringe of the Sudan. The regions situated further south or southwest belong entirely to a complex of subsaharan cultures that has nothing in common with the Middle East. Northeastern Africa is divided into three different ecological regions: the Nile Valley (in our case starting from the second cataract), present-day desert areas of the Eastern Sahara, and the Mediterranean Coast (Fig. 1). The sources presented below result of systematic work carried out mainly during the last thirty years by scholars from many scientific institutions.

Lithic Industries of the Nile Valley

The long tradition of microlithic Final Palaeolithic blade industries of the Nile Valley finishes with several units described below, dated to the Early Holocene period (VERMEERSCH 1970, KOBUSIEWICZ 1976).

Arkinian

This industry is known from one eponymic site Dibeira West 1 (DIW-1), situated on the western bank of the Nile, by Arkin village in the area of II Cataract by Wadi Halfa (SCHILD *et al.* 1968, WENDORF *et al.* 1979).

Chronology: Radiocarbon date 8.600 ± 150 B.C. (SMU-600).

Lithic assemblage: The lithics are mainly chert, but also use different raw materials such as agate, jasper and quartz. *Cores* are small or microlithic. They may be single-platform or change orientation, but are mainly for flakes or bladelets. *Retouched tools*: Small backed bladelets of different shape prevail (29%-53%), some with Ouchtata retouch. These are accompanied by numerous endscrapers on flakes, and rare perforators, notches and denticulates. *Geometric microliths* are mainly segments (2%-7%). Triangles and rectangles are very scarce (Fig. 2).

Elkabian

A few sites by El Kab in Upper Egypt, on the eastern bank of the Nile, make up this industry (VERMEERSCH 1970, 1978).

Chronology: Elkabian radiocarbon dates are from 6.400 ± 160 B.C. (Lv 393) to 5.980 ± 160 B.C (Lv 465).

Lithic assemblage: It is generally of small and microlithic character, based on high quality light

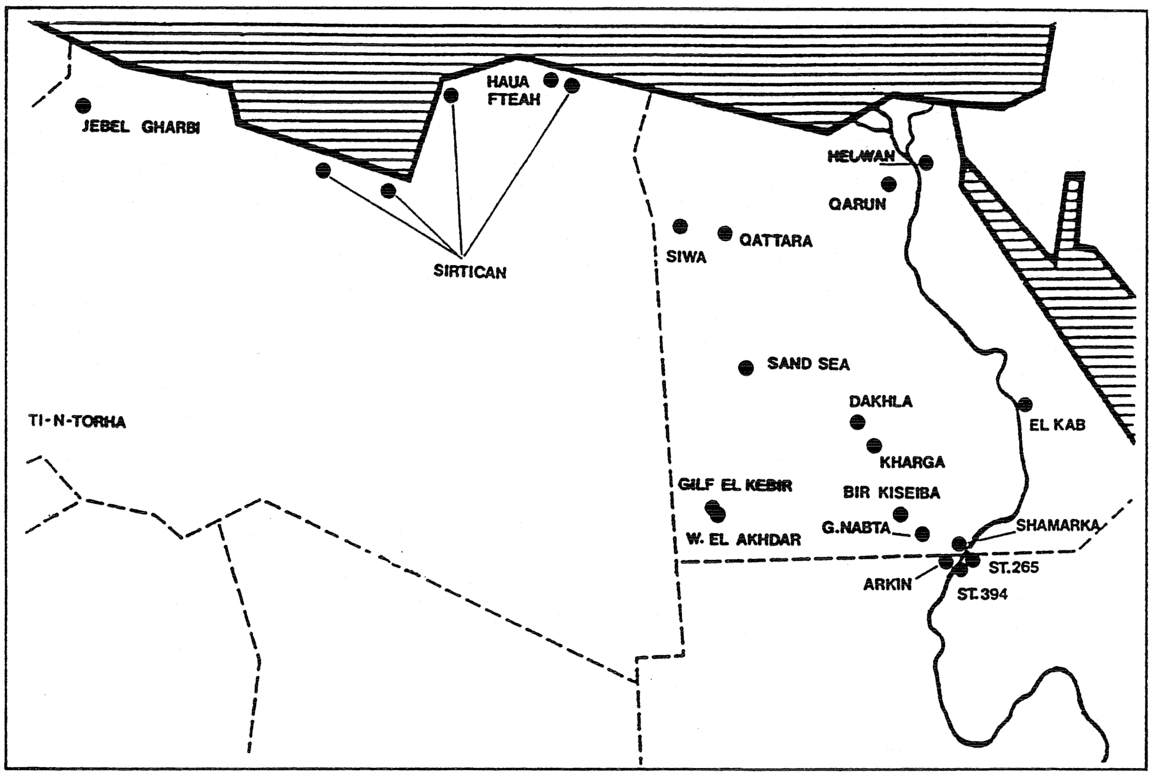

Fig. 1. General map of northeastern Africa with sites mentioned in the text.

brown local flint. *Cores* are well-prepared with single-platforms for the production of blades and bladelets. *Retouched tools*: Small backed bladelets prevail (30%-35%), sometimes with Ouchtata retouch. End-scrapers, perforators and retouched blades are rare. *Geometric microliths* consist of segments, trapezes and triangles. Microburins are very numerous (Fig. 3).

Qarunian

Four sites known from the northern part of Fayum Depression constitute this industry (SAID *et al.* 1972, WENDORF and SCHILD 1976).

Chronology: Radiocarbon dates are from 6150 ± 130 B.C. (I-4128) to 5.190 ± 120 B.C. (I-4129).

Lithic assemblage: Blade technology dominates. It is based almost exclusively on Eocene flint. *Cores* are mainly small with single-platforms for the production of blades. *Retouched tools*: Small arched, pointed bladelets prevail (18%-30%). Some of them also have a retouched base. Bladelets with straight backing are also numerous (14%-18%). Banal forms, such as notches and denticulates, are quite common. End-scrapers and perforators scarcely occur. *Geometric microliths* are very rare (Fig. 4).

Shamarkian

The Shamarkian is known from one site: Dibeira West-51 (DIW-51) situated on the western bank of the Nile by Wadi Halfa in the area of the second cataract (SCHILD *et al.* 1968, WENDORF *et al.* 1979).

Chronology: This industry has a radiocarbon date of 6.880 ± 90 B.C. (SMU-582).

The lithic assemblage is based on chert, some quartz, and agate. *Cores* are mainly of changed orientation, for the production of flakes and bladelets. *Retouched tools* include numerous backed bladelets with retouched bases, and truncated flakes. There are few burins, notches, denticulates and scaled pieces. *Geometric microliths* are rather scarce. They consist mainly of segments with few triangles and trapezes. Krukowski microburins are abundant (Fig. 5).

Sites 265 and 394

These sites, separated by a distance of 3 km, are typologically very similar. Both are located on the western bank of the Nile by the second cataract (MARKS 1970).

Chronology has been established by typology only - *c.* 5.700-5.300 years B.C.

Lithic assemblages are 90% based on chert, with addition of agate and quartz. *Cores* have single- and double-platforms for the production of blades and flakes. *Retouched tools* consist of small and microlithic backed bladelets (23%-37%), notches and denticulates (10%-21%), burins (8%-16%), retouched pieces (5%-12%), scaled pieces (2%-10%) and rare end-scrapers and perforators. *Geometric microliths* are totally absent (Fig. 6).

Helwan

There is one more Early Holocene site in the Nile Valley, especially interesting to the participants of this conference. Here I have in mind Helwan, south of Cairo. Its lithic assemblage contains strong Natufian elements, accompanied by characteristic adornments of sea shells, which are typical

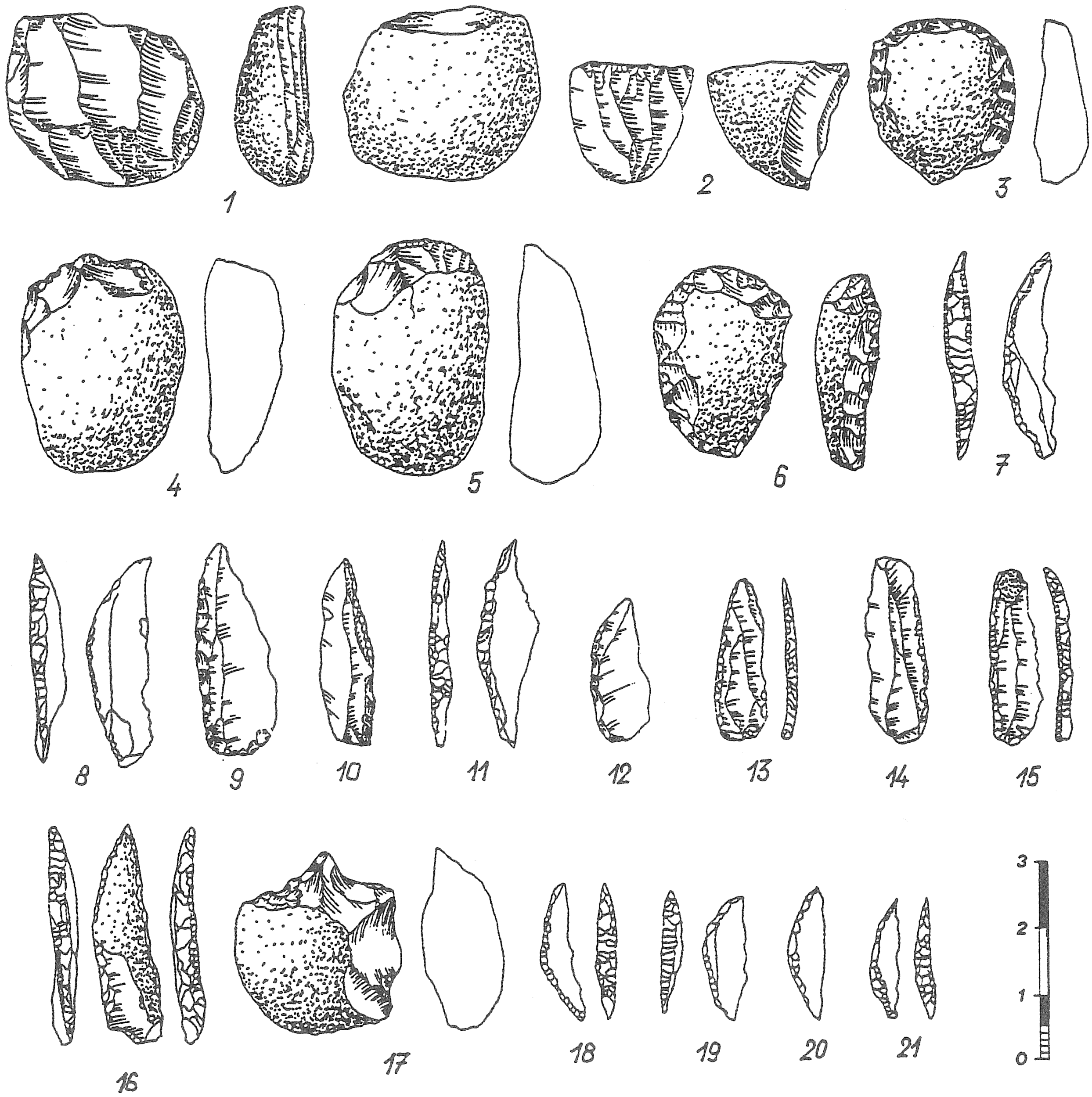

Fig. 2. Arkinian. 1-2 cores, 3-6 end-scrapers, 7-15 backed bladelets, 16-17 perforators, 18-21 segments (after SCHILD *et al.* 1968).

for this Middle-Eastern culture. Helwan site proves, I believe, the penetration of Natufian groups into the Nile Valley. Because this extremely interesting site is fortunately a subject of a separate paper at this symposium, I will not speak about it here.

Lithic Industries of the Eastern Sahara

In discussing desertic regions of northeastern Africa I will speak only about the Eastern Sahara, west of the Nile. The territory east of the river - the so-called Eastern Desert - has been examined only superficially, and has not delivered archeological materials that merit mentioning here. In the Eastern Sahara, in contrast, many new prehistoric sites of Early Holocene age were discovered and methodi-

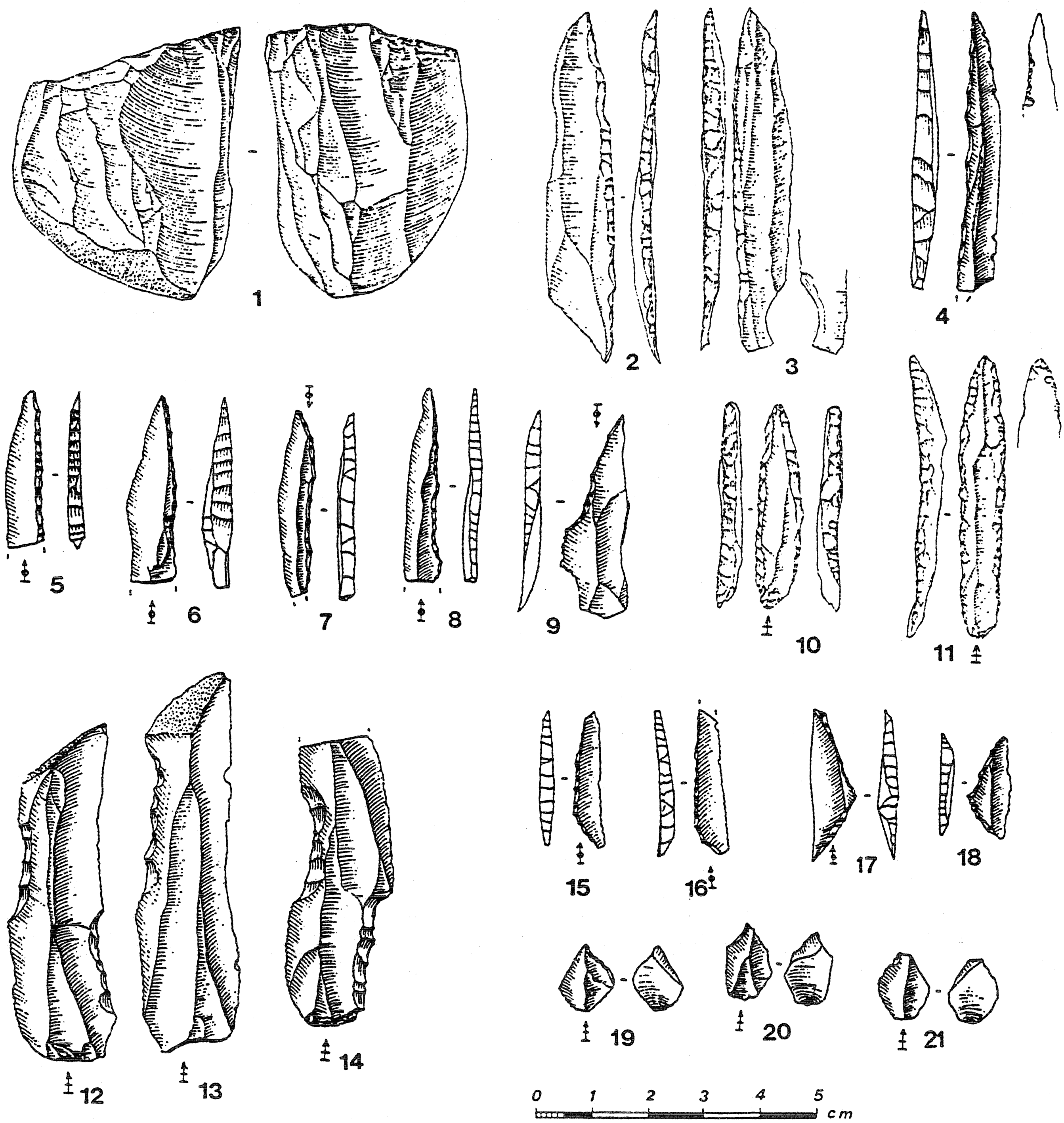

Fig. 3. Elkabian. 1 core, 2-9 backed bladelets, 10-11 perforators, 12-14 retouched blades, 15-18 triangles, 19-21 microburins (after VERMEERSCH 1970, 1992).

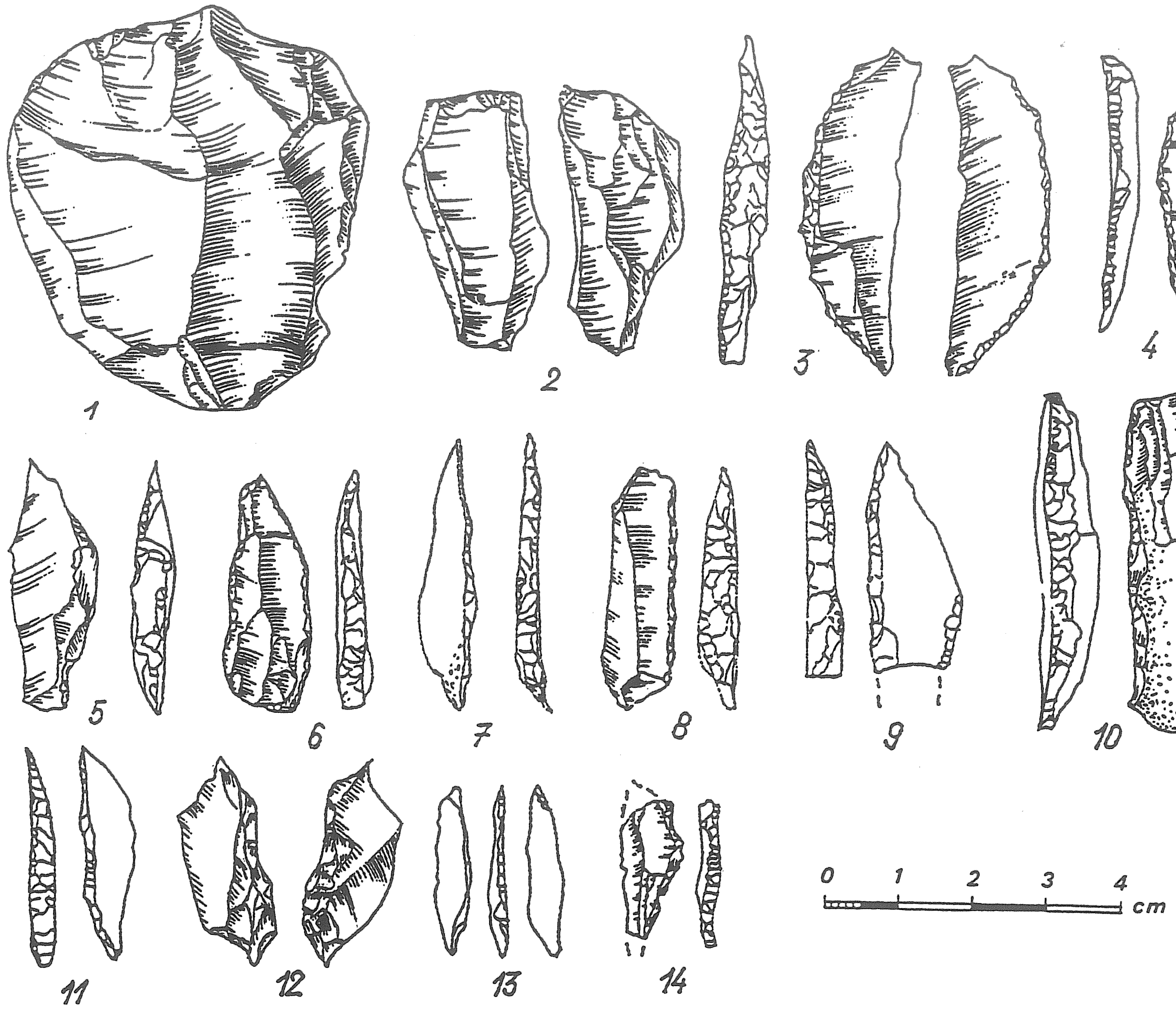

Fig. 4. Qarunian. 1-2 cores, 3-14 backed baladelets (after SAID *et al.* 1972).

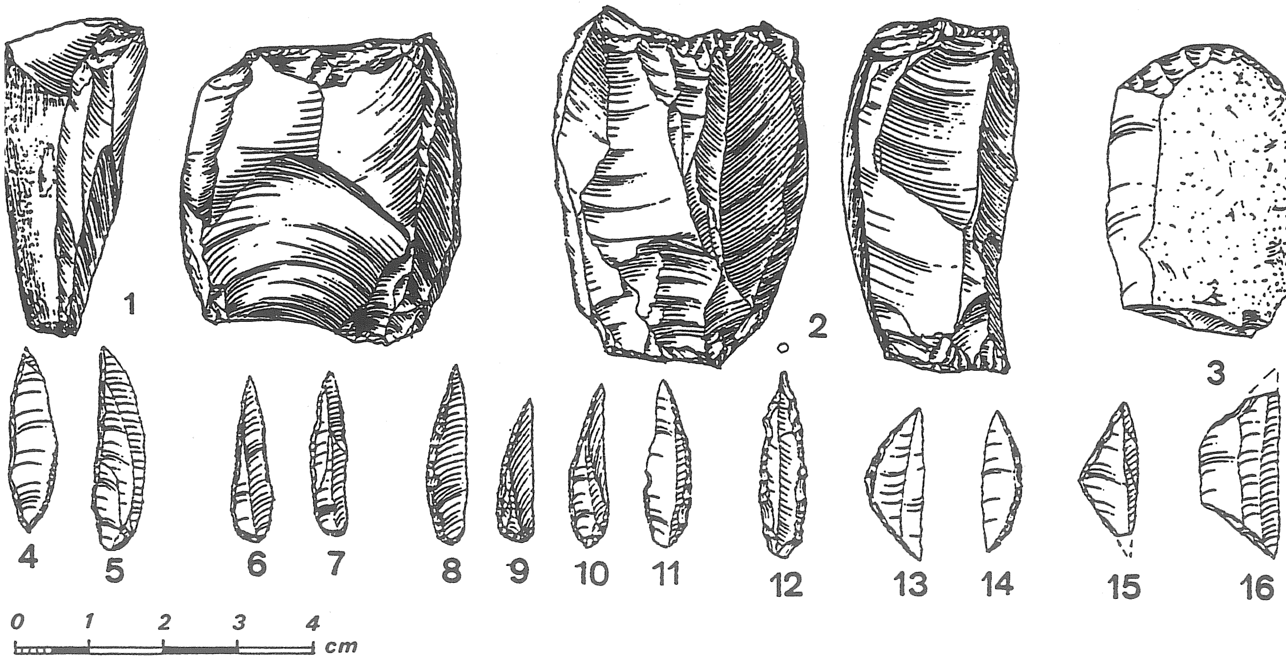

Fig. 5. Shamarkian. 1-2 cores, 3 end-scraper, 4-11 backed bladelets, 12 perforator, 13-14 segments, 15 triangle, 16 trapeze (after SCHILD *et al.* 1968).

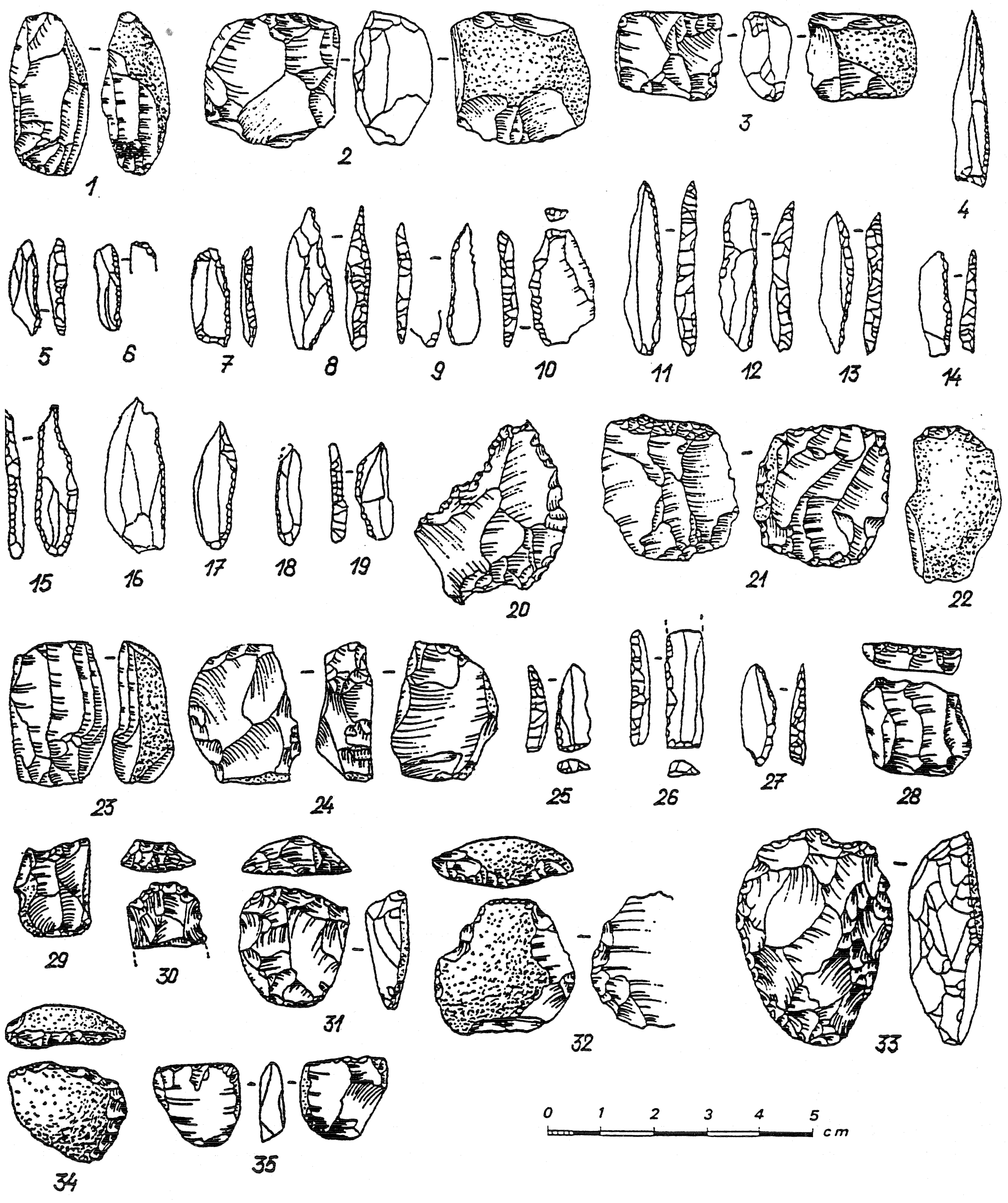

Fig. 6. Sites 265 (1-22) and 394 (23-35). 1-3,23-24 cores; 4 Bou Saada point; 5-14,25-27 backed bladelets; 15 perforator; 16-18 bladelets with Ouchtata retouch; 19 La Mouillah point; 20 denticulate; 21,35 scaled pieces; 22,30-32 end-scrapers; 28-29 retouched flakes; 33 proto-gouge; 34 scraper (after MARKS 1970).

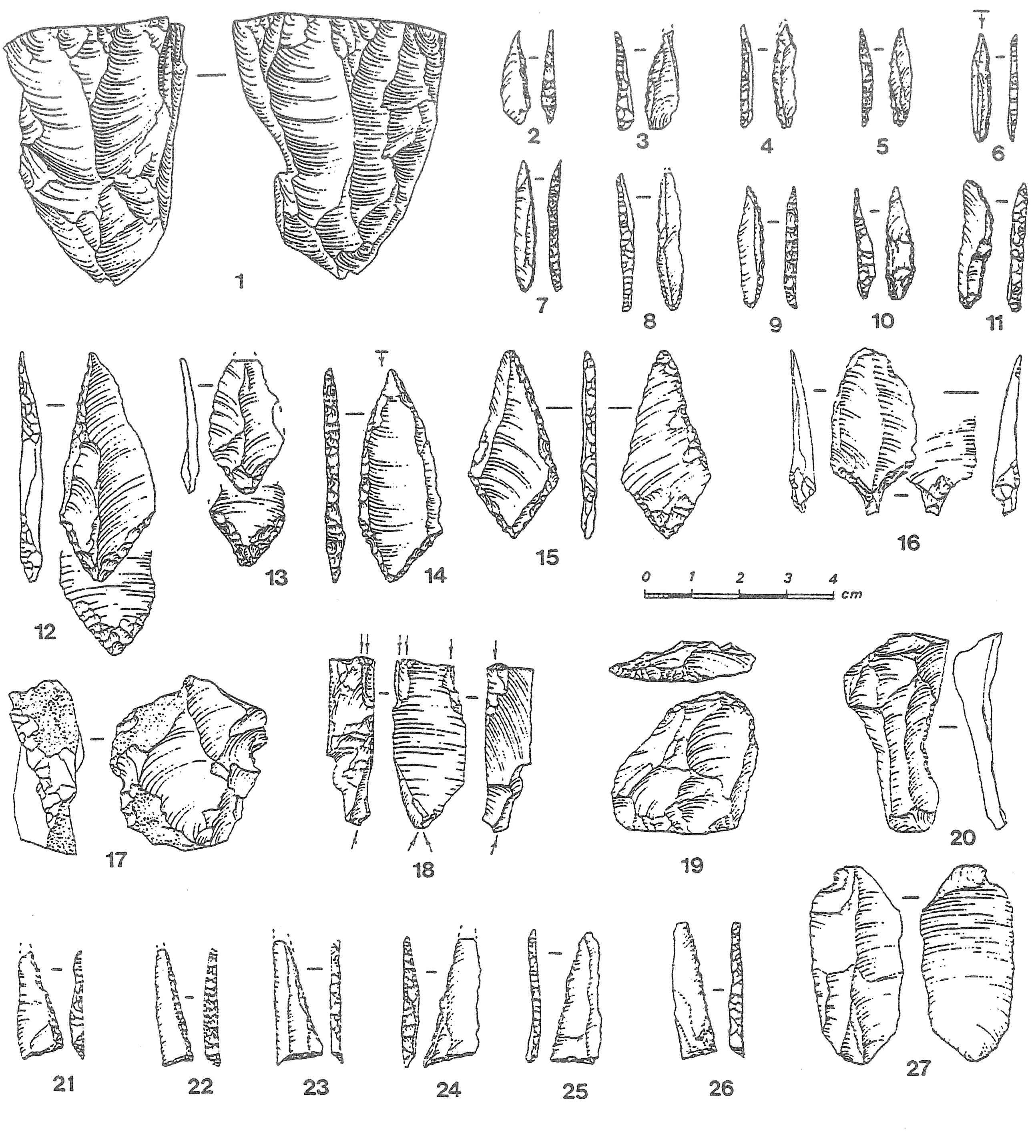

Fig. 7. Early Neolithic of Eastern Sahara. 1 core, 2-11 backed bladelets, 12-16 Ounan/Harif points, 17 denticulate, 18 burin, 19 end-scraper, 20 notch, 21-26 triangles, 27 microburin. (1,12-15 site E-85-1 near Bir Safsaf, after WENDORF *et al.* 1987; 2-11,17 site E-80-4 near Bir Kiseiba, after CLOSE 1992; 16,18-20 site E-79-1 near Bir Kiseiba, after WIECKOWSKA 1984).

cally excavated during the last quarter of a century. At first, these sites were classified as Final Palaeolithic. Lately, however, due to the new discoveries, they are recognized as Neolithic, and generally divided into three chronological phases: Early, Middle and Late Neolithic, two first of which fall into the Early Holocene (WENDORF and SCHILD 1984, CLOSE 1992).

Early Neolithic

This phase is known from numerous sites in the vicinity of Gebel Nabta, Bir Kiseiba, Bir Safsaf, Dyke Area, Kharga and Dakhla Oasis, and also from Gilf El Kebir, Wadi El Akhdar and Sand Sea

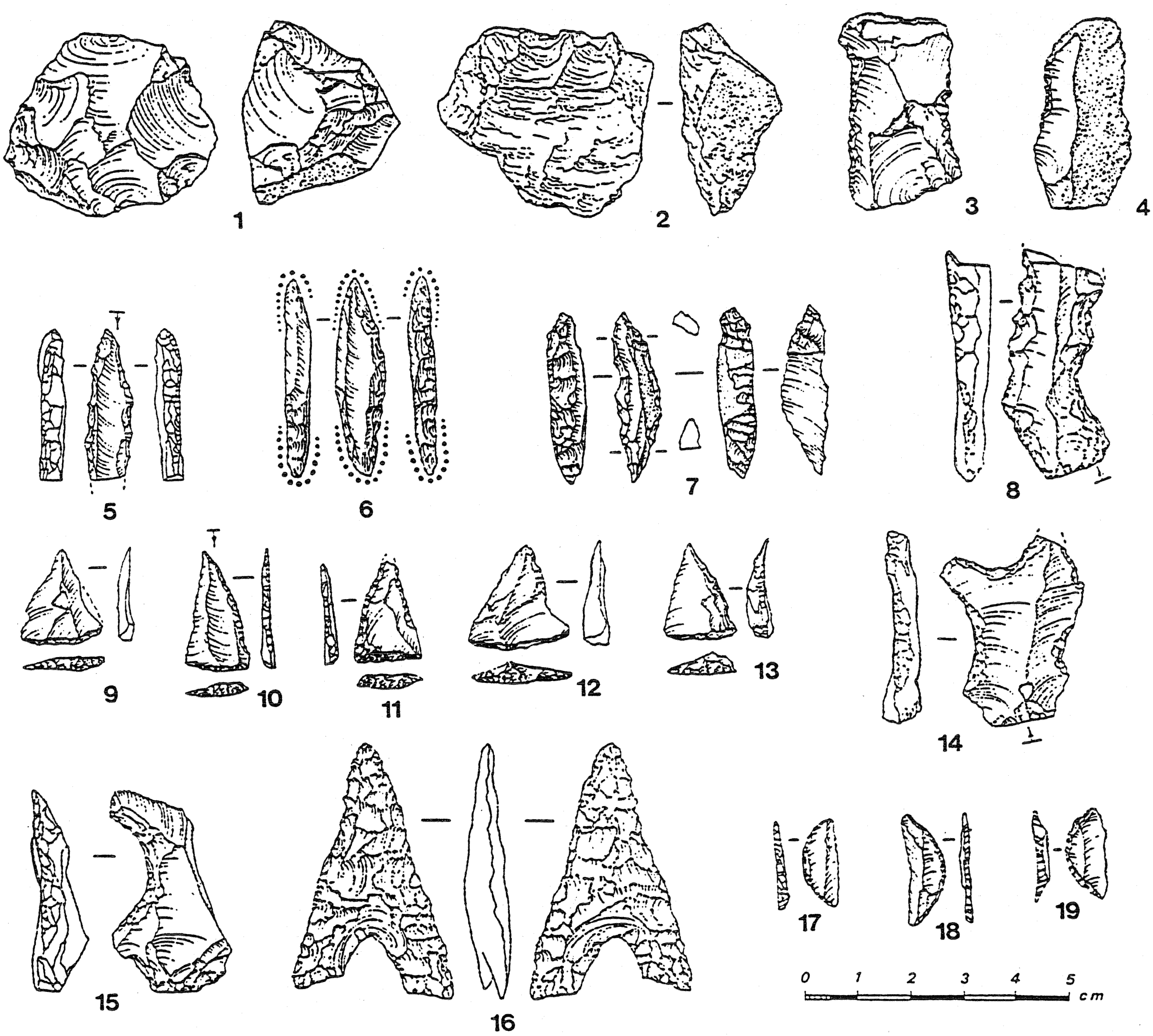

Fig. 8. Middle Neolithic of Eastern Sahara. 1-2 cores, 3-4 retouched pieces, 5-7 perforators, 8 denticulate, 9-13 points with retouched base, 14-15 notches, 16 bifacial arrowhead, 17-19 segments (site E-79-6 near Bir Kiseiba, after WENDORF and CLOSE 1984).

(WENDORF and SCHILD 1984; KUPER 1989; SCHÖN 1989; KLEES 1989; MCDONALD 1990, 1991; CLOSE 1992).

Chronology is based on many radiocarbon dates: *c.* 7.800-5.900 B.C. The Early Neolithic is divided by four chronological sub-phases: El Adam, El Kortein, El Ghorab and El Nabta, the first being the oldest.

Lithic assemblage: Generally, all Early Neolithic assemblages are typologically very close. The most common raw material by far in the Early Neolithic sites is imported Eocene flint of high quality. *Cores* have mainly single- and double-platforms for blades and bladelets. *Retouched tools* include numerous small or even microlithic backed bladelets, with different shapes and types of retouch. During the El Kortein phase only, backed bladelets are relatively poorly represented; they are partially replaced by stemmed points similar to the Harif points from Sinai or to the Ounan points of the Maghreb. End-scrapers, burins, notches, denticulates and double backed perforators are moderately represented. *Geometric microliths* are rather rare, except during the El Ghorab phase, in which elongated scalene triangles are quite numerous. During two earliest phases of El Adam and El Kortein, the microburin technique is commonly applied (Fig. 7).

Middle Neolithic

The Middle Neolithic assemblages from the Eastern Sahara can be divided into two groups. The southern one is known from numerous sites from Gebel Nabta, Bir Kiseiba, Dakhla Oasis and from Gilf El Kebir, Wadi El Akhdar and Sand Sea (WENDORF and SCHILD 1984; SCHÖN 1989; KUPER 1989; MACDONALD 1990, 1991; CLOSE 1992). The northern one is comprised of material from the oases Siwa, Qattara and Sitra (HASSAN and GROSS 1987, CZIESLA 1989).

Chronology is based on numerous radiocarbon dates of *c.* 5.700-4.200 years B.C.

Lithic assemblage of southern group: Here, if compared to Early Neolithic assemblages, a substantial change in lithic technology and procurement of raw material is observed. Flake technology is now dominant, and good-quality Eocene flint is replaced by local quartz, chert and even sandstone. *Cores* are mostly with changed orientation, for the production of flakes. *Retouched tools*: They are mainly retouched flakes, less numerous perforators, denticulates, and notches. Backed bladelets are rare. End-scrapers and burins are scarce. Stemmed points rarely occur, and are not of the Ounan/Harif type. Also occurring are characteristic flakes or blades with a retouched base naturally pointed or pointed by retouched truncation. Bifacial tools appear, including concave arrow-heads and polished celts. *Geometric microliths* are now almost exclusively segments (Fig. 8).

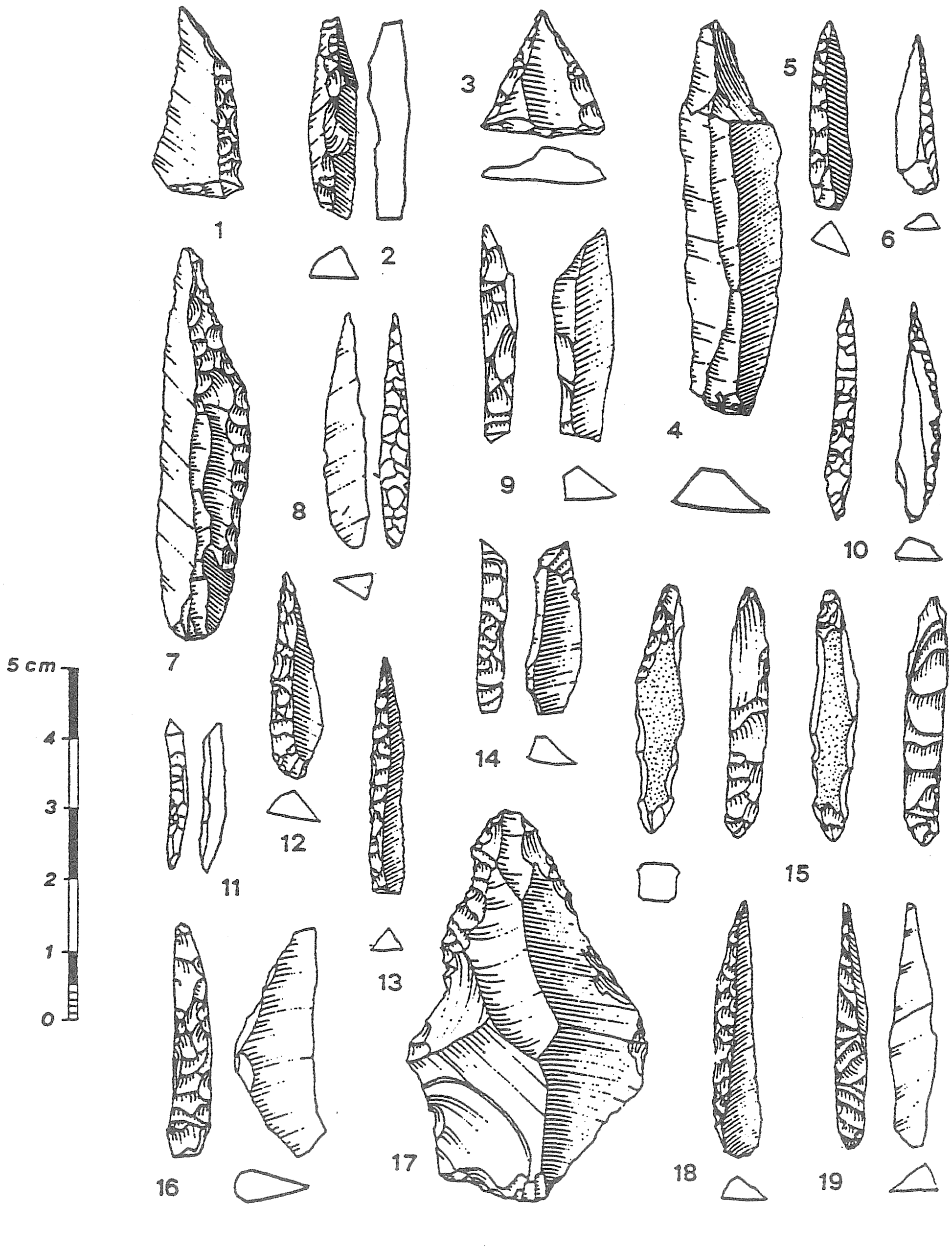

Fig. 9. Wadi Ti-n-Torha (after BARICH 1974).

Lithic assemblage of northern group are also based on local chert and silicified sandstone. *Cores* have single-, double- and multi-platforms, mainly for the production of flakes. *Retouched tools*: Backed bladelets are still quite numerous. Burins are abundant. Assemblages also contain some perforators, end-scrapers, notches, and denticulates. *Geometric microliths* are very rare.

The backed blade tradition also continues during the Early Holocene in Ti-n-Torha site excavated in the massif of Acacus in southwestern Libya (BARICH 1992). There, backed bladelets dominate markedly. End-scrapers, denticulates and perforators are rare. *Geometric microliths*, mainly segments, are very scarce (Fig. 9).

In sites excavated in Jebel Gharbi in northwestern Libya, backed elements are still numerous (BARICH 1992) (Fig. 10).

Lithic Industries of Mediterranean Coast

This region is still poorly recognized. Only a few sites can be ascribed to the Early Holocene period.

Libico-Capsian

This industry is known only from the Haua Fteah cave in Gebel Akhdar (Cyrenaica) (MACBURNEY 1960).

Chronology: *c.* 8.000-5.000 years B.C.

The lithic assemblage has much in common with the Capsian culture from the Maghreb. Microlithic as well as macrolithic elements occur. *Retouched tools*: Backed bladelets are the most numerous. End-scrapers and burins are also abundant. Scrapers, perforators and truncations are less common. Characteristic are notched blades made on large, thick blanks. *Geometric microliths* consist of segments, triangles and trapezes. Some microburins occur (Fig. 11).

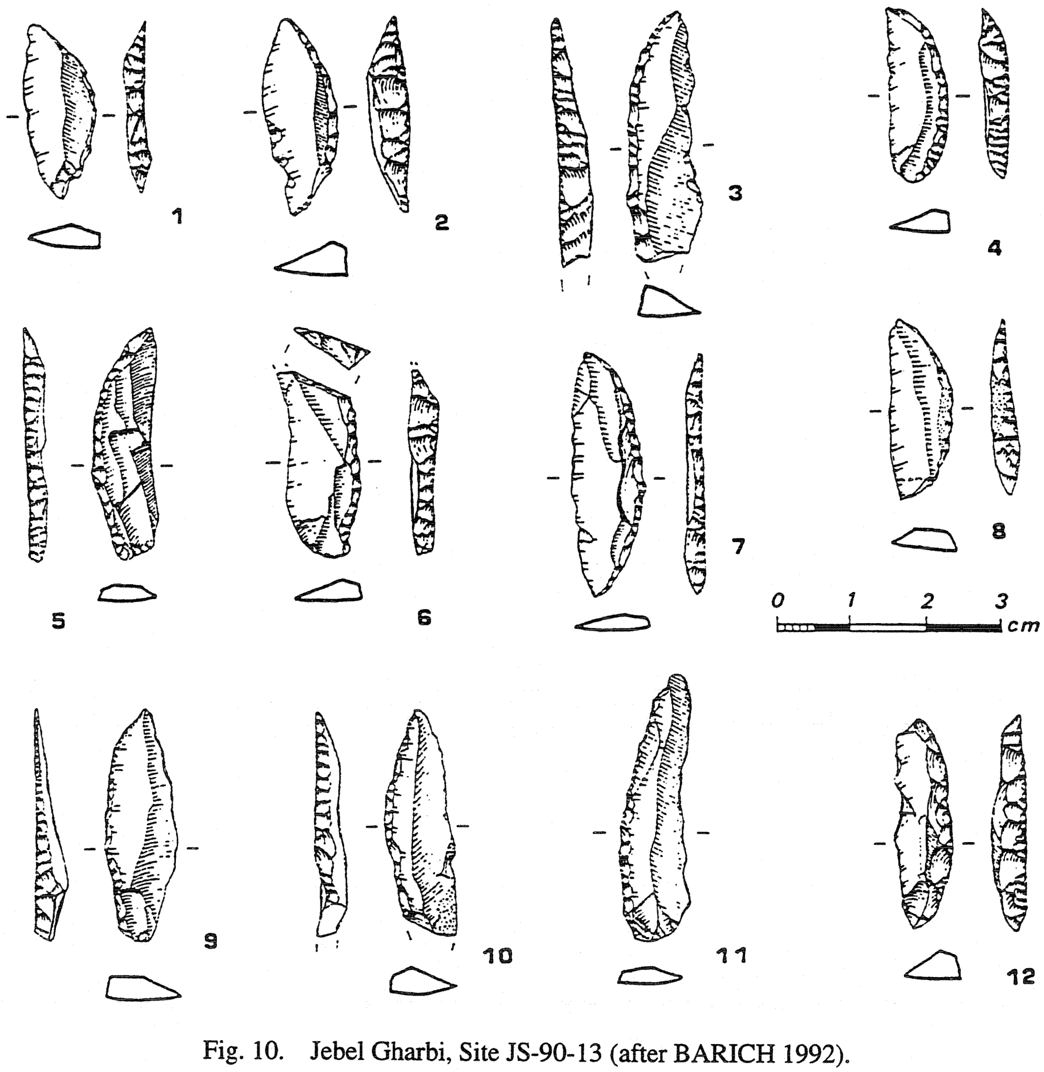

Fig. 10. Jebel Gharbi, Site JS-90-13 (after BARICH 1992).

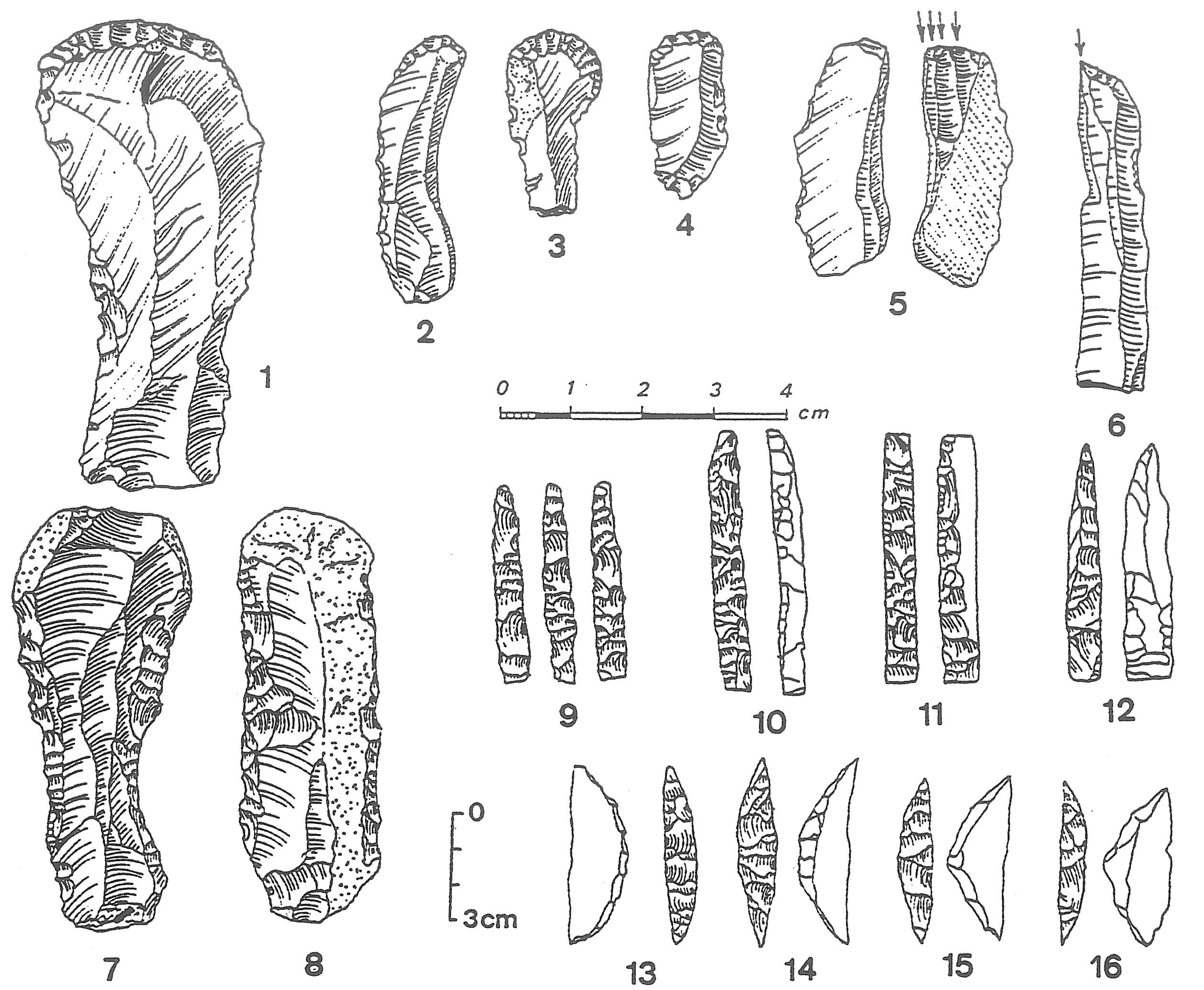

Fig. 11. Libico-Capsian. 1-4 end-scrapers, 5-6 burins, 7-8 retouched blades, 9-12 backed bladelets, 13-16 segments (after MCBURNEY 1967).

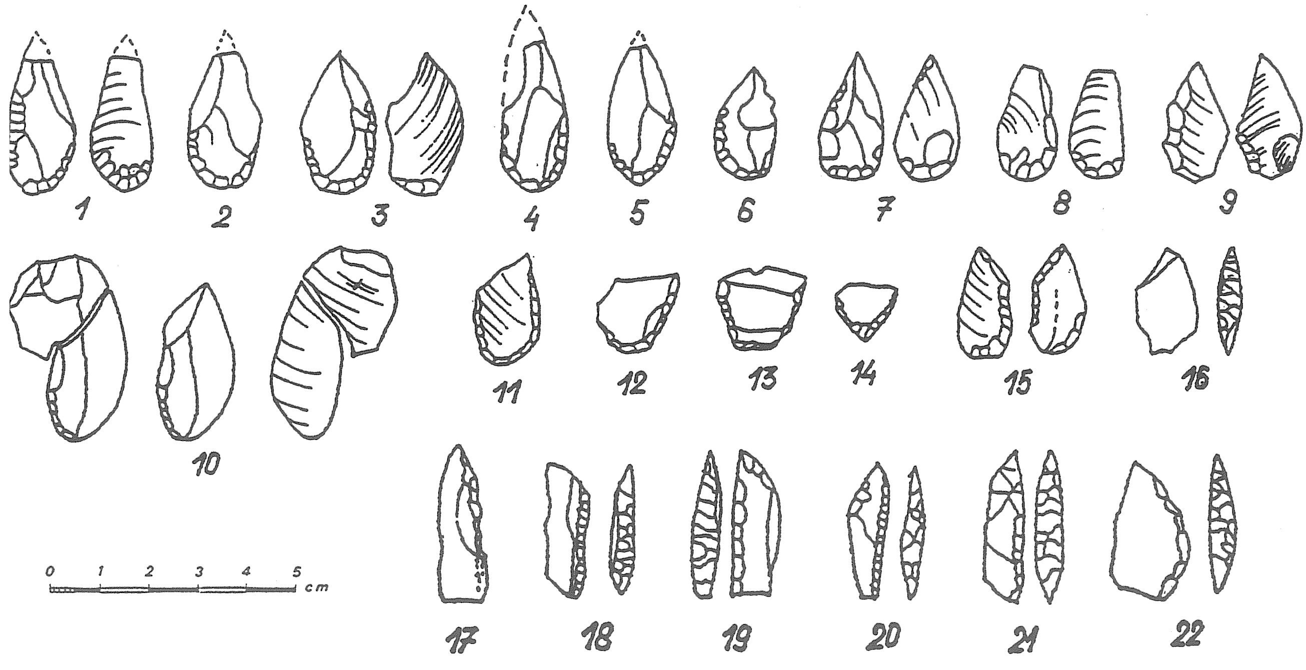

Fig. 12. Sirtican. 1-10 points retouched on the bulbus end, 11-14 trapez-like microliths, 15-22 backed microbladelets (after MCBURNEY 1947).

Sirtican

Four rather poor sites have been found along the Mediterranean coast of Libya (MACBURNEY 1947).

Chronology: Only by typology dated to *c.* 5.000 years B.C.

The lithic assemblage: is based on local flint. *Cores* are for production of blades and bladelets, but also for flakes. *Retouched tools*: The most common are microlithic points with a retouched rounded base, retouched ventral side, and tips sharpened by microburin technique. Backed bladelets are also numerous, accompanied by end-scrapers on flakes. *Geometric microliths* consist mainly of segments and rare trapezes (Fig. 12).

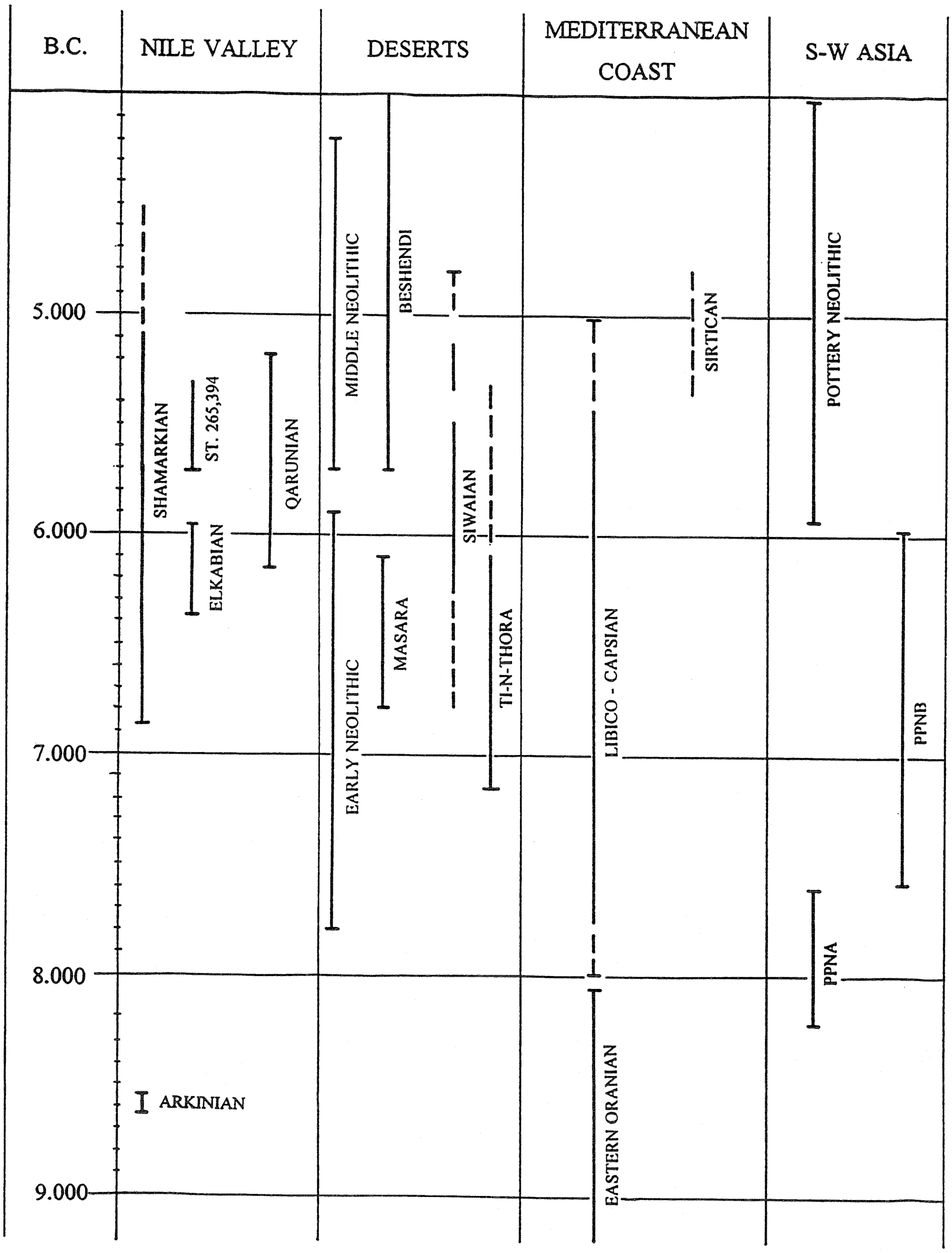

Fig. 13. Chronology of early Holocene lithic industries of northeastern Africa.

Summary

In summary, the Early Holocene lithic industries of northeastern Africa show a number of repeating common typological traits:

1. The supremacy of blade and bladelet technology.
2. The predominance, or at least a rich representation of backed bladelets.
3. A relatively scarce amount of geometric microliths. In early stage of Holocene these consist mainly of triangles and trapezes; beginning from the fourth millennium, they are segments.
4. Simple tool types like end-scrapers, burins, notches, perforators and denticulates are not numerous.
5. The common use of high-quality raw materials in earliest phase of the Holocene, and, at the beginning of sixth millennium, a sudden shift to "worse" local chert, quartz, sandstone and silicified limestone.

These common typological traits create the general lithic complex characteristic of the Early Holocene cultures of northeastern Africa (Fig. 13).

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The Djeitunian Industry, Southern Turkmenistan

Galina F. Korobkova

Abstract: *The Djeitunian Culture is considered as one of the earliest farmer-herder cultures of the Middle East. Chipped, stone and bone materials of all seventeen sites were studied by the present author; typological and microwear methods were used. The chipped industry is characterised by a well developed blade technology and microliths. This article reports on the analysed material and shows the similarities and variation across the Djeitun Culture region. When comparing the Djeitunian industry with contemporaneous industries of Anatolia and the Near East, we see several similarities, which are the result of intercultural contact and genetic ties.*

The Djeitun culture of southern Turkmenistan is one of the earliest agricultural and stock-breeding cultures of the Old World that is recorded using the systematics that describe ancient Near East farming cultures. It was defined by V.M. Masson on the basis of the broad horizontal exposure of the second building horizon at the Djeitun settlement. At the present time 17 sites are known. The sites of Chopan-depe, Togolok-depe, Mondjukly-depe and Bami, all of which have several stratigraphic layers, are among them. All Djeitunian sites are situated in the valleys of the Kopet-Dağ foot-hills on the banks of small rivers and streams (Fig. 1). There are three local groups of settlement: the west (Bami 1, 2 and the point located close to Ķzyl-Arvat), the central (Djeitun, Chopan-depe, Pessedjik-depe, Togolok-depe, Gievdjik-depe, New Nisa, Kelyata, Lepele, Jarty-Gumbez, Kentar) and the eastern (Chagylly-depe, Mondjukly-depe, and Gadymi-depe). The territory of the western and eastern groups was settled during the middle and late stages of Djeitun culture and the central territory during the early and middle stages.

The results of the Djeitun excavations and the main characteristics of the Djeitun culture were published in the monograph by V.M. Masson (1971). Comprehensive information concerning Chagylly-depe, Pessedjik-depe and Chopan-depe is also published (BERDYEV 1969). A number of publications are devoted to the stratigraphy of Djeitun culture settlements (BERDYEV 1963, 1964), problems of palaeogeography and agriculture (LISITZINA 1978), results of osteological studies (SHEVCHENKO 1960; ERMOLOVA 1970, 1972; KASPAROV 1992), technological, morphological and microwear analysis of the implements (KOROBKOVA 1969, 1987; KOROBKOVA, LOLLEKOVA, and SHAROVSKAYA 1992; LOLLEKOVA 1988), reconstructions of palaeoeconomy (KOROBKOVA 1980), and effectiveness of the reaping-tools (KOROBKOVA 1978, 1981).

Characteristics of the Djeitunian Culture

The *pisé*-walled (clay with the additional of straw) houses are the standard square or rectangular type of 16-30m^2 with a large oven placed close to the one of the walls, a ledge and a niche -situated close to the other one- and clay floors covered with plaster or red-ochre are characteristic for Djeitunian culture. A reed mat was sometimes placed on the floor. Black and red paint on floors occurs, for example, at Djeitun and Chagylly-depe. Subsidiary buildings and small yards adjoin the dwelling complexes. One curiosity is the sets of *pisé*-walled constructions that include several parallel sections of walls of the same length in the yards. These are believed to be the foundations of grain-storage platforms. The large scale of some houses is notable. House N4 at Djeitun, for example, is conspicuous for its large dimensions, double-size thickness of walls and remains of black, white and red paintings on the ledge of the southern wall. At Pessedjik-depe (House N12), a house of 64m^2 size was uncovered. The massive hearth measuring 1,8x1,1m was close to the north-eastern wall and to the right of the hearth there was a *pisé* bench. The surfaces of the two walls were decorated with polychrome painting. Pictured in black and red paint against a white background are animals, triangles, rhomboids, and trees. Similar motifs were also found in the frescoes of Chatal-Hüyük in southeastern

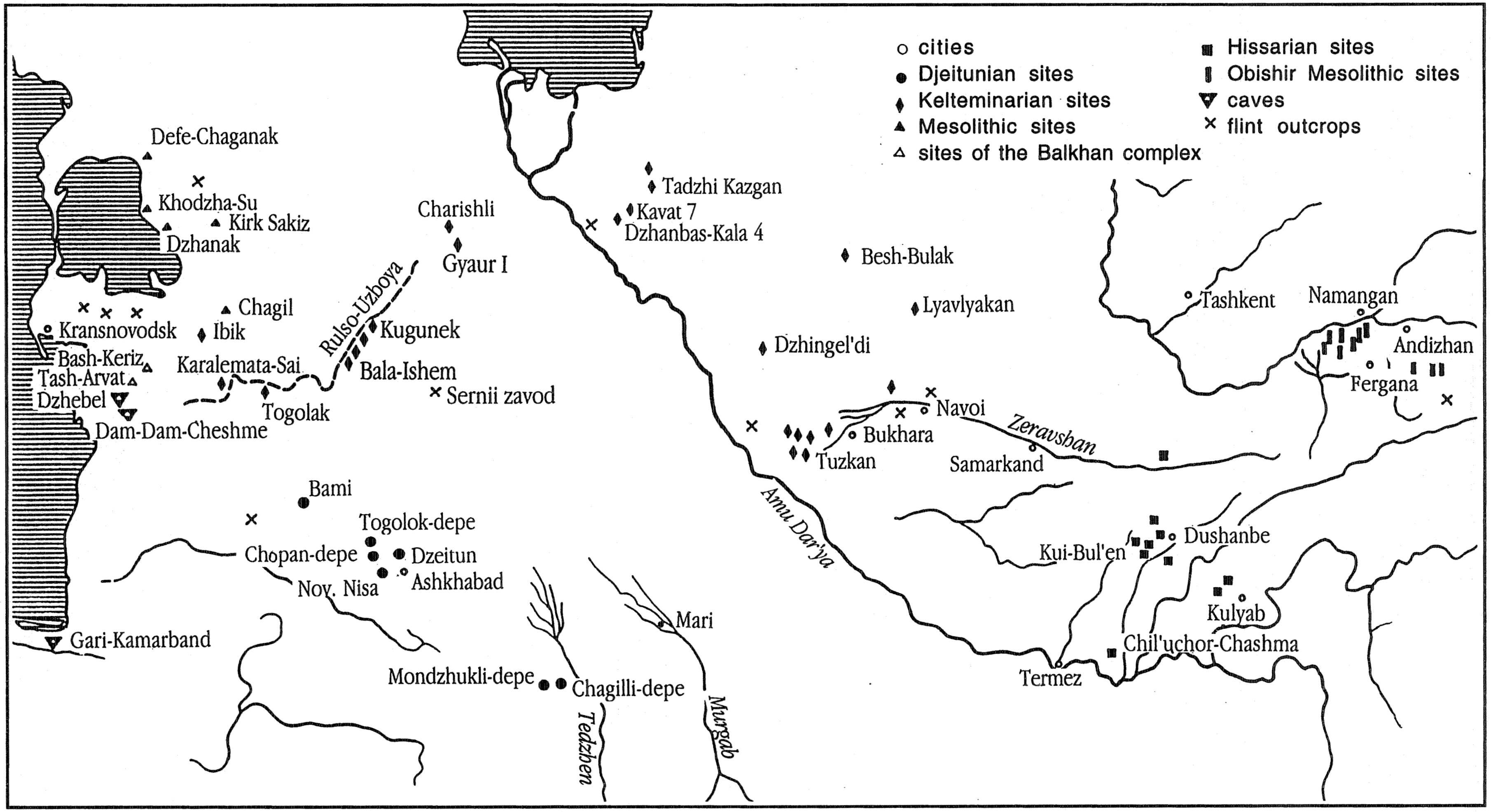

Fig. 1. Cultural zones in Central Asian Mesolithic/ Neolithic.

Turkey. However the designs of Pessedjik-depe look simpler and more archaic. According to O. Berdyev (1970), the building with the frescoes could be the "ancestral house" of the settlement. The size of the construction, the compactness of the walls and the wall-paintings, the plaster floor, and the small number of finds inside the house support this suggestion. It may have been a sanctuary where cult ceremonies were performed. It is noteworthy that under this sanctuary an earlier one was found (without paintings). It's position corresponded to the level of the lower three building horizons. The house-hold complex with its subsidiary constructions and storage areas adjoins the sanctuaries. The storage reserves and seeds for planting could be accumulated here. The complex could be considered the prototype of the Ancient East temple ensembles which served as religious and economic centers.

The increasing standardization of Djeitun culture settlement layout through time is marked. Early on, settlement planning is minimal, for example, the arrangement of houses at Djeitun. Later, houses are arranged in linear fashion. The clearest planning is present at the late settlements where the houses were separated by side-streets.

There are 12 burials known at Djeitun, Chopan-depe, and Chagylly-depe. They were situated under the floors of houses and in the yards. Flexed position is characteristic and supine position occurs more rarely.

Table 1. Djeitunian industries: technological and morphological analysis of the blank types. [1]

Категории	№№ групп	№№ типов	Наименования категорий, групп, типов	Ранний период: Джейтун	Ранний период: Теголок-депе (нижний слой)	Ранний период: Чопан-депе (нижний слой)	Средний период: Тоголок-депе (верхний слой)	Средний период: Чопан-депе (верхний слой)	Средний период: Песседжик-депе	Средний период: Гиевджик-депе	Средний период: Гадымы-депе	Поздний период: Чагыллы-депе
			Ядрища	▬	▬	▬	▥	▬	▬	●	●	▬
А	I		Призматические, с горизонтально подправленными площадками и снятыми карнизами	▬	▬	▬	▬	▬	▬		●	▬
		1	Однoплощадочные, с односторонним вертикальным скалыванием пластин	●		▬	▬	▬	▬			▬
		2	Одноплощадочные, с двусторонним вертикальным скалыванием пластин	●				●	●			●
		3	Двуплощадочные, с односторонним встречным скалыванием пластин	●		●	▬	▬	●			●
		4	Двуплощадочные, с двусторонним встречным скалыванием пластин	●								
		5	Двуплощадочные, с двусторонним вертикальным скалыванием пластин				▬	●				
		6	Двуплощадочные, со смежными площадками и двусторонним вертикальным и горизонтальным скалыванием пластин		▬		●		●			
		7	Трехплощадочные, со смежными площадками и трехсторонним вертикальным и горизонтальным скалыванием пластин								●	●
	II		Конусовидные, с горизонтально подправленными площадками и снятыми карнизами	●		●		●	●	●	●	●
		8	Одноплощадочные, с односторонним вертикальным скалыванием пластин	●		●						
		9	Одноплощадочные, с круговым вертикальным скалыванием пластин	●		●		●	●	●		●
		10	Двуплощадочные, со смежными площадками и двусторонним вертикальным и горизонтальным скалыванием пластин								●	
	III		Аморфные, без специально подготовленной площадки					●	●			●
		11	С бессистемным скалыванием отщепов					●	●			●
	IV		Подклиновидные, с подправленным боковым ребром, горизонтальной площадкой и снятыми карнизами				●					
		12	Одноплощадочные, с торцовым и односторонним вертикальным скалыванием пластин				●					
	V		Желваки с подправленными скошенными площадками и карнизами					●				
		13	Одноплощадочные, с начальным односторонним скалыванием пластин					●				
		14	Двуплощадочные, с начальным односторонним встречным скалыванием пластин					●				
	VI		Обломки ядрищ	●	▬			●	●		●	●
		15	Неопределенной формы	●	▬			●	●		●	●
			Заготовки и отходы	▨	▨	▨	▨	▨	▨	▨	▨	▨
Б	VII		Пластины призматической формы и сечения	▨	▨	▨	▨	▨	▨	▨	▨	▨
		16	Крупные, с прямым профилем	▥	▥	▥	▬	▬	▬	▬	▬	▬
		17	Крупные, с изогнутым профилем									●
		18	Средние, с прямым профилем	▨	▨	▨	▨	▨	▨	▨	▨	▩
		19	Средние, с изогнутым профилем	▬	▬	▬	▥	▥	▥	▥	▥	▨
		20	Микропластины	●			▥	▥	▥	▩	▩	▩
		21	Сечения	▩	▩	▩	▩	▩	▩	▩	▩	▩
	VIII		Отщепы	▬	▥	▥	▬	▬	▥	▩	▨	▨
		22	Крупные					●	●		▬	▬
		23	Средние	▬	▬	▬	▬	▬	▬	▬	▩	▩
		24	Мелкие	●	▬	▬	▬	●	▬	▩	▩	▩
		25	Чешуйки	●	▬	▬	▬	●	▬	▩	▩	▬
	IX		Осколки кремния	●				▬	▬		▥	
		26	Неопределенной формы	●				▬	▬		▥	
	X		Валуны, гальки, куски, плитки из мелкозернистых пород камня	▬	▬	▬	▩	▬	▬		▩	▩
		27	Целые, клиновидной формы	●	●	●	▬	●	●		▬	▬
		28	Целые, шаровидной формы		▬	▬	▬	●	●		▬	▬
		29	Гальки со сколами								●	
		30	Плитки, куски, обломки	●	●	▬	▥	●	●		▬	▬
	XI		Кости животных	▬	▬	▬	▬	▥	▬		●	▥
		31	Лопатки мелкого рогатого скота	▬	▬	▬		●				
		32	Продольно расчлененные отрезки трубчатых костей	●		▬	▬	▬	▬		●	▥
		33	Продольно и поперечно расчлененные ребра	●				●	●			●

▨ >20% ▩ >10%, но <20% ▥ >5%, но < 10% ▬ >1%, но <3% ● <1%

[1] Editorial comment: Tables 1-3 of this contribution had to be accepted for this publication in the form presented here.

The population was engaged in agriculture, stock-breeding and hunting and were sedentary. Macrobotanical analysis of seeds conducted recently by palaeobotanists from Great Britain has demonstrated the prevalence of the wheat *Triticum monococcum* L. among the domesticated cereals (CHARLES and HILLMAN 1992). It is one of the peculiarities of Djeitun and Djeitunian culture in general compared to the Near East where the wheat *Triticum dicoccum* (spelt) was the most popular. The farmers of the Iranian plateau preferred the soft or dwurf wheats which had spread into the valleys of the Kopet-Dağ foothills during the IVth-IIIrd mill. B.C. The wild ancestor of the wheat *Triticum monococum* was native to the area of Asia Minor, the Caucasus and the Near East. Probably the Djeitunian population borrowed the practice of agriculture from this area. The reaping of cereals was carried out using composite reaping-knives in two strokes. First the ears were cut off and then the straw. This is confirmed by finding only the central parts of the stalks inside mud-bricks. This reaping technique was another peculiarity of Djeitunian agriculture. The reaping technology, however, was practical. If the ears are cut off first, the grains are mixed as much with weed seeds which reach a lesser height as a rule than do the cereals. This technology is not known in any other area.

Stock-breeding was not well developed during the early stage of Djeitun culture when it was based mainly on goats and sheep. This is the third peculiarity of the culture. The bones of domesticated goats and sheep constitute somewhat more than 16% of the osteological assemblage (IIIrd horizon of the Djeitun settlement). Cattle appeared during the late stages, but the foundation of the herd was goats and sheep. Hunting played a major role in the acquisition of meat, as is documented by the correlation between wild and domestic animal bone. Hunting became less important only at the latest sites of Djeitun culture which were characterized by intensified stock-breeding.

Table 2. Djeitunian industries: technologies of secondary production.

Категории	№№ групп	№№ типов	Наименования категорий, групп, типов	Ранний период			Средний период					Поздний период
				Джейтун	Тоголок-депе (нижний слой)	Чопан-депе (нижний слой)	Тоголок-депе (верхний слой)	Чопан-депе (верхний слой)	Песседжик-депе	Гиеваджик-депе	Гадымин-депе	Чагыллы-депе
			Техника ретуширования	>20%	>20%	>20%	>20%	>20%	>20%	>20%	>20%	>20%
А	I		Затупливающая ретушь	>20%	>20%	>20%	>20%	>20%	>20%	>20%	>20%	>20%
		1	на одном конце со стороны спинки	>20%	>20%	>20%	>20%	>20%	>20%	>20%	>1%, но <5%	>1%, но <5%
		2	на двух концах со стороны спинки		>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>5%, но <10%	>5%, но <10%
		3	на 1 конце и 1 боковом крае со спинки					<1%	<1%		>1%, но <5%	>1%, но <5%
		4	на 1 конце и 2 боковых краях со спинки					<1%	<1%	>1%, но <5%	>5%, но <10%	>5%, но <10%
		5	на 1 конце со спинки и 1 боковом крае с брюшка								>1%, но <5%	
		6	на 1 конце со спинки и 2 боковых краях с брюшка								<1%	
		7	на 2 концах со спинки и 1 боковом крае с брюшка						<1%			
		8	на 2 концах и 1 боковом крае со спинки	>1%, но <5%	>1%, но <5%	>1%, но <5%						<1%
		9	на 1 конце со спинки и противоположн. на 2 боковых краях						<1%		>1%, но <5%	
		10	на 1 конце и 2 боковых краях с 2-х сторон				>1%, но <5%					
		11	на 1 конце и 1 боковом крае встречная						<1%			
		12	на 1 боковом крае встречная						<1%			
		13	на 1 боковом крае со стороны спинки	>5%, но <10%	>5%, но <10%	>5%, но <10%	>10%, но <20%	>10%, но <20%	>10%, но <20%	>5%, но <10%	>10%, но <20%	>10%, но <20%
		14	на 2 боковых краях со стороны спинки	>10%, но <20%	>10%, но <20%	>10%, но <20%	>10%, но <20%	>10%, но <20%	>10%, но <20%	>20%	>10%, но <20%	>10%, но <20%
		15	на 2 краях острия со спинки	>1%, но <5%		>1%, но <5%		<1%	<1%			<1%
		16	на 2 боковых краях с двух сторон					<1%	<1%	>1%, но <5%		<1%
		17	на 1 боковом крае со стороны брюшка		>1%, но <5%	>1%, но <5%		<1%	<1%		>1%, но <5%	>1%, но <5%
		18	на 2 боковых краях со стороны брюшка					<1%	<1%		<1%	<1%
		19	по периметру со стороны спинки	>10%, но <20%	>5%, но <10%	>5%, но <10%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>10%, но <20%	>5%, но <10%	>1%, но <5%
		20	противолежащая на 2 боковых краях	>1%, но <5%	>1%, но <5%	>5%, но <10%	>5%, но <10%	>5%, но <10%	>5%, но <10%	>5%, но <10%	>5%, но <10%	>5%, но <10%
	II		Заостряющая ретушь	>10%, но <20%	>10%, но <20%	>10%, но <20%	>20%	>20%	>20%	>20%	>10%, но <20%	>10%, но <20%
		21	на 1 боковом крае со стороны спинки	>5%, но <10%	>5%, но <10%	>5%, но <10%	>5%, но <10%	>10%, но <20%	>10%, но <20%	>1%, но <5%	>5%, но <10%	>5%, но <10%
		22	на 2 боковых краях со стороны спинки	>5%, но <10%	>5%, но <10%	>5%, но <10%	>10%, но <20%	>10%, но <20%	>10%, но <20%	>5%, но <10%	>10%, но <20%	>10%, но <20%
		23	на 1 боковом крае со стороны брюшка						<1%		<1%	<1%
		24	на 2 боковых краях со стороны брюшка					<1%	<1%		<1%	<1%
		25	противолежащая на 2 боковых краях	>1%, но <5%	>1%, но <5%	>1%, но <5%		<1%	<1%	>1%, но <5%	<1%	<1%
		26	зубчатая на 1 боковом крае						<1%	>1%, но <5%	<1%	<1%
		27	зубчатая на 2 боковых краях				>5%, но <10%	>5%, но <10%	>5%, но <10%	>5%, но <10%	<1%	<1%
		28	на конце со спинки и зубчатая на 2 боковых краях						<1%			
		29	на 1 конце и 1 боковом крае со спинки и зубчатая на другом боковом крае								<1%	
		30	на 1 боковом крае со спинки и зубчатая на другом боковом крае								<1%	
			Резцовая техника						>1%, но <5%			
Б	III		Обработка лезвий орудий						>1%, но <5%			
		31	вертикальная параллельными сколами на 1 боковом крае						<1%			
		32	вертикальная параллельными сколами на 1 боковом крае и затупл. ретушью со спинки на 1 конце						<1%			
			Техника подтески						<1%			
В	IV		Обработка лезвий орудий						<1%			
		33	1 конца с двух сторон крупными ступенчатыми фасами						<1%			
			Точечная техника	>1%, но <5%	>1%, но <5%	>1%, но <5%	>5%, но <10%	>1%, но <5%	>1%, но <5%		>5%, но <10%	>5%, но <10%
Г	V		Обработка орудий	>1%, но <5%	>1%, но <5%	>1%, но <5%	>5%, но <10%	>1%, но <5%	>1%, но <5%		>5%, но <10%	>5%, но <10%
		34	всей поверхности	>1%, но <5%	>1%, но <5%	>1%, но <5%	>5%, но <10%	<1%	<1%		>1%, но <5%	>5%, но <10%
		35	частичная	<1%				<1%	<1%		>1%, но <5%	>1%, но <5%
			Абразивная техника	>5%, но <10%	>5%, но <10%	>5%, но <10%	>10%, но <20%	>10%, но <20%	>10%, но <20%		>5%, но <10%	>20%
Д	VI		Обработка орудий	>5%, но <10%	>1%, но <5%	>5%, но <10%	>10%, но <20%	>10%, но <20%	>10%, но <20%		>5%, но <10%	>20%
		36	всей поверхности	>1%, но <5%	>1%, но <5%	>1%, но <5%	>5%, но <10%	>5%, но <10%	>5%, но <10%		>1%, но <5%	>10%, но <20%
		37	частичная	>1%, но <5%		>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%		>1%, но <5%	>5%, но <10%
	VII		Обработка украшений		>1%, но <5%		>1%, но <5%	>1%, но <5%	>1%, но <5%		<1%	<1%
		38	всей поверхности		>1%, но <5%		>1%, но <5%	<1%	<1%		<1%	<1%
		39	частичная		>1%, но <5%			<1%	<1%		<1%	<1%
			Сочетание точечной и абразивной техник									<1%
Е	VIII		Обработка каменных сосудов									<1%
		40	всей поверхности									<1%

>20%   >10%, но <20%   >5%, но <10%   >1%, но <5%   <1%

Table 3. Djeitunian industries: tool types.

Категории	№ № групп	№ № типов	Наименования категорий, групп, типов	Ранний период: Джейтун	Ранний период: Тоголок-депе (нижний слой)	Ранний период: Чопан-депе (нижний слой)	Средний период: Тоголок-депе (верхний слой)	Средний период: Чопан-депе (верхний слой)	Средний период: Песседжик-депе	Средний период: Гиевджик-депе	Средний период: Гадыми-депе	Поздний период: Чагыллы-депе
А			Геометрические микролиты	>10%, но <20%	>5%, но <10%	>5%, но <10%		>1%, но <5%	>1%, но <5%	>1%, но <5%	>5%, но <10%	>5%, но <10%
	I		Трапеции	>10%, но <20%	>5%, но <10%	>5%, но <10%		>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>5%, но <10%
		1	Симметричные, удлиненных пропорций	>5%, но <10%	>5%, но <10%	>5%, но <10%		<1%	<1%			<1%
		2	Симметричные, укороченных пропорций	>1%, но <5%				>1%, но <5%	>1%, но <5%		>1%, но <5%	>1%, но <5%
		3	Асимметричные, удлиненных пропорций	<1%								
		4	Асимметричные, укороченных пропорций					<1%	<1%	>1%, но <5%	>1%, но <5%	>1%, но <5%
	II		Сегменты	>1%, но <5%								<1%
		5	Высокие, укороченных пропорций	>1%, но <5%								<1%
	III		Треугольники	>1%, но <5%						>1%, но <5%		<1%
		6	Равнобедренные, укороченных пропорций	>1%, но <5%								<1%
		7	Разносторонние, укороченных пропорций	<1%						>1%, но <5%		<1%
	IV		Прямоугольники	<1%							<1%	
		8	Низкие, удлиненных пропорций	<1%							<1%	
		9	Высокие, укороченных пропорций	<1%								
Б			Скребки	>20%	>20%	>20%	>20%	>20%	>20%	>20%	>20%	>20%
	V		Боковые на пластинах	>10%, но <20%	>10%, но <20%	>10%, но <20%	>10%, но <20%	>10%, но <20%	>10%, но <20%	>1%, но <5%	>10%, но <20%	>10%, но <20%
		10	С ретушью на 1 боковом крае	>1%, но <5%	>1%, но <5%	>1%, но <5%	>5%, но <10%	>5%, но <10%	>5%, но <10%	>1%, но <5%	>5%, но <10%	>5%, но <10%
		11	С ретушью на 2 боковых краях	>5%, но <10%	>10%, но <20%	>10%, но <20%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%
	VI		Микролитические	>20%	>10%, но <20%	>10%, но <20%	>5%, но <10%	>5%, но <10%	>5%, но <10%	>1%, но <5%	>10%, но <20%	>1%, но <5%
		12	Подчетырехугольные	>10%, но <20%			>5%, но <10%	>5%, но <10%	>5%, но <10%	>5%, но <10%	>5%, но <10%	>1%, но <5%
		13	Округлые	>10%, но <20%	>5%, но <10%	>5%, но <10%			<1%	>1%, но <5%	>1%, но <5%	<1%
		14	Миндалевидные	>5%, но <10%	>5%, но <10%	>5%, но <10%	>1%, но <5%	<1%	<1%	>1%, но <5%	>10%, но <20%	>1%, но <5%
		15	Подтреугольные							>1%, но <5%		
	VII		Концевые на пластинах	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	<1%	>1%, но <5%
		16	Без ретуши на боковых краях	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	<1%	<1%
		17	С ретушью на 1 боковом крае					<1%				<1%
		18	С ретушью на 2 боковых краях	<1%	>1%, но <5%	>1%, но <5%			>1%, но <5%			<1%
	VIII		Концевые на отщепах	>1%, но <5%		>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%		<1%	>1%, но <5%
		19	Без ретуши на боковых краях	>1%, но <5%		>1%, но <5%		<1%	<1%			<1%
		20	С ретушью на 1 боковом крае				>1%, но <5%	>1%, но <5%			<1%	<1%
		21	С ретушью на 2 боковых краях						>1%, но <5%		<1%	<1%
	IX		Округлые на отщепах								<1%	
		22	С ретушью по круглому краю								<1%	
В			Пластины с вторичной обработкой	>20%	>20%	>20%	>20%	>20%	>20%	>20%	>20%	>20%
	X		С видимой зеркальной заполировкой	>20%	>20%	>20%	>20%	>20%	>20%	>20%	>20%	>20%
		23	Со скошенным ретушированным концом	>10%, но <20%	>20%	>20%	>10%, но <20%	>10%, но <20%	>10%, но <20%	>5%, но <10%	<1%	>1%, но <5%
		24	Со скошенным концом и заостренной ретушью на боковых краях				>5%, но <10%	>5%, но <10%	>5%, но <10%	>1%, но <5%	>5%, но <10%	>5%, но <10%
		25	Со скошенным концом и противолеж. ретушью на боковых краях						<1%	>1%, но <5%	>1%, но <5%	>1%, но <5%
		26	Со скошенным концом и зубчатой ретушью на боковых краях								<1%	<1%
		27	С заостренной ретушью на боковых краях				>10%, но <20%	>10%, но <20%	>10%, но <20%	>5%, но <10%	>10%, но <20%	>10%, но <20%
		28	С противолежащей ретушью на боковых краях					<1%	<1%		<1%	<1%
		29	С зубчатой ретушью на боковых краях				>1%, но <5%	>1%, но <5%	>1%, но <5%		<1%	<1%
		30	С выщербинами на боковых краях	>1%, но <5%	>1%, но <5%	>1%, но <5%		>5%, но <10%	>5%, но <10%	>5%, но <10%	>5%, но <10%	>5%, но <10%
	XI		С выемчатыми краями	>5%, но <10%	>5%, но <10%	>5%, но <10%	>10%, но <20%	>10%, но <20%	>10%, но <20%	>10%, но <20%	>10%, но <20%	>10%, но <20%
		31	С симметричными выемками на боковых краях	<1%							<1%	
		32	С 1 многовыемчатым краем	>1%, но <5%	>1%, но <5%	>1%, но <5%		>1%, но <5%	>1%, но <5%	>1%, но <5%	<1%	<1%
		33	С 2 многовыемчатыми краями	>1%, но <5%	>5%, но <10%	>5%, но <10%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%
		34	С вогнутыми краями	>1%, но <5%			>10%, но <20%	>10%, но <20%	>10%, но <20%	>10%, но <20%	>5%, но <10%	>10%, но <20%
	XII		С ретушированными краями	>10%, но <20%	>10%, но <20%	>10%, но <20%	>20%	>20%	>20%	>5%, но <10%	>20%	>20%
		35	С односторонней краевой ретушью по 1 краю	>1%, но <5%	>1%, но <5%	>1%, но <5%	>5%, но <10%	>5%, но <10%	>5%, но <10%	>1%, но <5%	>5%, но <10%	>5%, но <10%
		36	С односторонней краевой ретушью по 2 краям	>5%, но <10%	>5%, но <10%	>5%, но <10%	>10%, но <20%	>10%, но <20%	>10%, но <20%		>10%, но <20%	>10%, но <20%
		37	С односторонней краевой ретушью на 1 конце	<1%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	<1%	<1%
		38	С односторонней краевой ретушью на 1 конце и 1 боковом крае						<1%		<1%	<1%
		39	С односторонней краевой ретушью на 1 конце и 2 боковых краях								>1%, но <5%	>1%, но <5%
		40	С односторонней краевой ретушью на 1 конце и противолежащей на боковых краях								<1%	<1%
		41	С односторонней краевой ретушью на 1 конце и зубчаткой на 1 боковом крае								<1%	
		42	С односторонней краевой ретушью на 1 конце и зубчаткой на 2 боковых краях								<1%	
		43	С зубчатой ретушью на 1 боковом крае						<1%		<1%	<1%
		44	С зубчатой ретушью на 2 боковых краях				>1%, но <5%	>1%, но <5%	<1%	>1%, но <5%	<1%	<1%
		45	С противолежащей ретушью на боковых краях	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%
Г			Отщепы с обработанными краями		>1%, но <5%	>1%, но <5%		>1%, но <5%	<1%			
	XIII		С ретушированными краями		>1%, но <5%	>1%, но <5%		>1%, но <5%				
		46	С односторонней краевой ретушью на 1 боковом крае		>1%, но <5%	>1%, но <5%		<1%				
		47	С односторонней краевой ретушью на 2 боковых краях					<1%				
	XIV		С подтёской концов						<1%			
		48	1 конца с 2-х сторон крупными ступенчатыми фасками						<1%			
Д			Острия	>1%, но <5%	>1%, но <5%	>1%, но <5%	>5%, но <10%	>5%, но <10%	>5%, но <10%	>5%, но <10%	>1%, но <5%	>1%, но <5%
	XV		Симметричные	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%
		49	Стержневидные формы с ретушью по краям	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%
		50	Со специально выделенным остриём	<1%	>1%, но <5%	>1%, но <5%		<1%	<1%	>1%, но <5%	<1%	<1%
	XVI		Асимметричные	<1%			>1%, но <5%	>1%, но <5%	>1%, но <5%	>5%, но <10%	>1%, но <5%	>1%, но <5%
		51	Стержневидные формы с ретушью по краям	<1%			>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%
		52	Со специально выделенным остриём				>1%, но <5%	>1%, но <5%	>1%, но <5%	>1%, но <5%	<1%	<1%
Е			Наконечники стрел					<1%				
	XVII		На пластинах					<1%				
		53	С боковой выемкой					<1%				
Ж			Резцы						>1%, но <5%			
	XVIII		На углу сломанные пластины						<1%			
		54	Без ретуши на краях						<1%			
	XIX		Боковые на пластинах						<1%			
		55	Со скошенным ретушированным концом и вертикальными сколами на торце						<1%			
		56	Со скошенным ретушированным концом и 1 боковым краем						<1%			
			и вертикальными сколами на торце								<1%	
З			Галечные орудия								<1%	
	XX		С вторичной обработкой краев								<1%	
		57	Чопперы								<1%	
		58	Чоппинги								<1%	
		59	Гальки с единичными сколами									

Legend: >20% ; >10%, но <20% ; >5%, но <10% ; >1%, но <5% ; <1%

Pottery is the most important of the finds. It is hand-made, coiled and straw-tempered. The main shapes of the vessels are flat-bottomed cups, large pots, basins, beakers, and jars. Square shaped vessels are rare. The pottery can be divided into painted and unpainted wares, of which the latter was most common. Red paint was used. The exact colour depends on the firing temperature and shades vary from dark-brown to crimson or dark-chestnut. Designs include vertical flowing lines or horizontal stripes consisting of rows of vertical brackets. Net-designs, large dots, and silhouette triangles occur rarely.

Djeitun culture assemblages are supplemented by clay and stone artefacts including cones, truncated cones, and counters of semi-spherical and conoid-cylindrical shape. There are ornaments made from Cauri and Didacna shells, stone and tubular bone beads and stone amulets in the form of human and animal figurines. Clay bracelets were found at Chagylly-depe.

Examples of portable art are rare. They include a flattish head of a large anthropomorphic and the torso of a female figure with a cone-shaped breast. Zoomorphic figurines are made from fired and unfired clay. Figurines of goats and cattle are found. A figurine with a fragment of sharpened bone driven into it was found at Chagylly-depe.

The equal distribution of tools throughout the dwelling complexes at Djeitun and at other sites indicates decentralization of home production activities. It means that each family owned not only the house but also had in its possession a set of necessary tools.

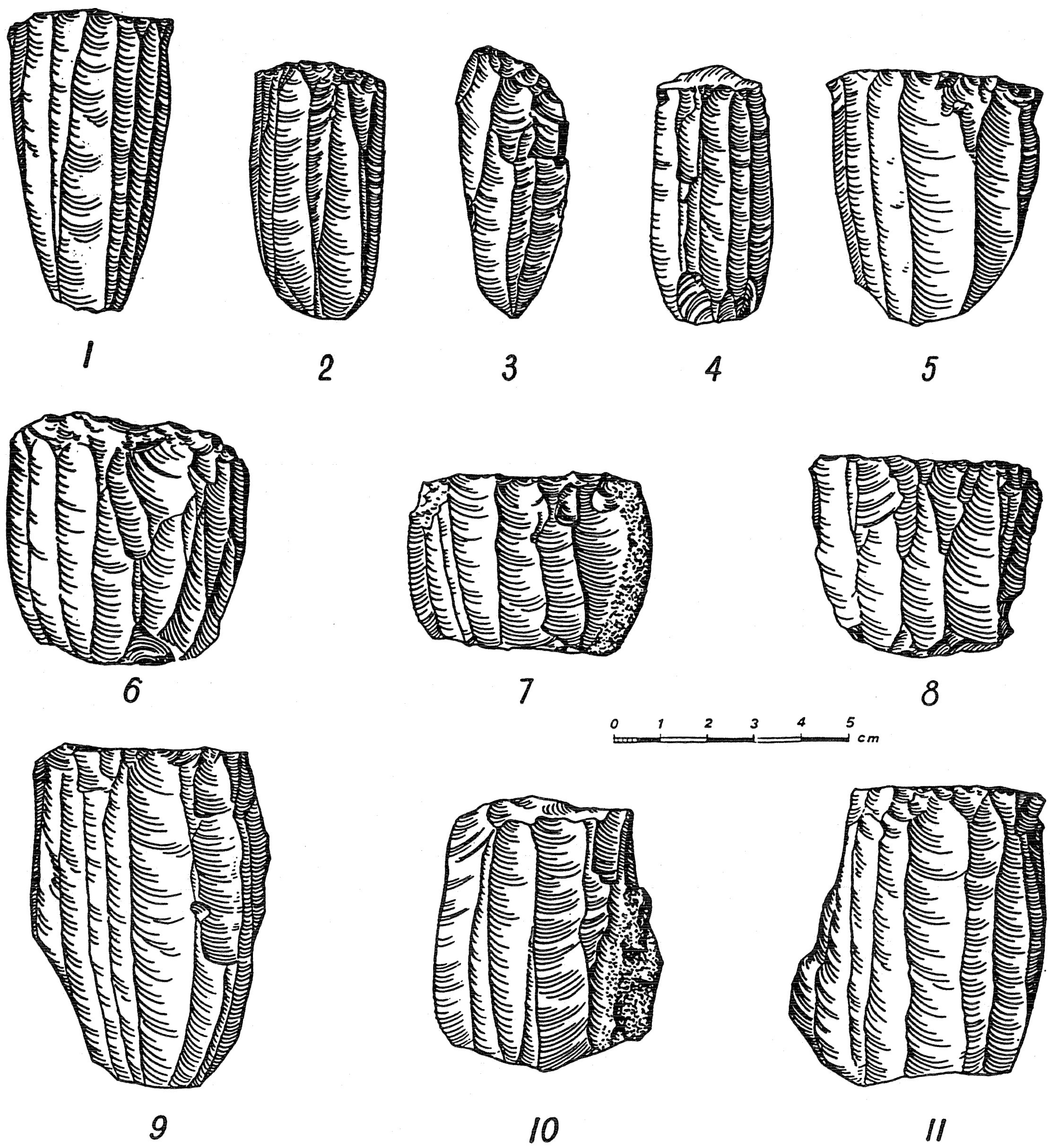

Fig. 2. Cores from Djeitun.

We have to consider each of the Djeitun culture settlements as a community consisting of several small families united by shared economic pursuits. Their centers were the communal houses distinguished by large dimensions and massive coloured or painted walls (Pessedjik-depe, Gadymi-depe and Chagylly-depe). House 4 at the center of the Djeitun settlement with its massive walls, the southern of which had a ledge and traces of polychrome painting probably had the same function.

The group of settlements situated at Geok-depe oasis (Pessedjik-depe, Togolok-depe and Chopan-depe) is of great interest. According to V.M. Masson (1971), the settlements belonged to one rather small tribe.

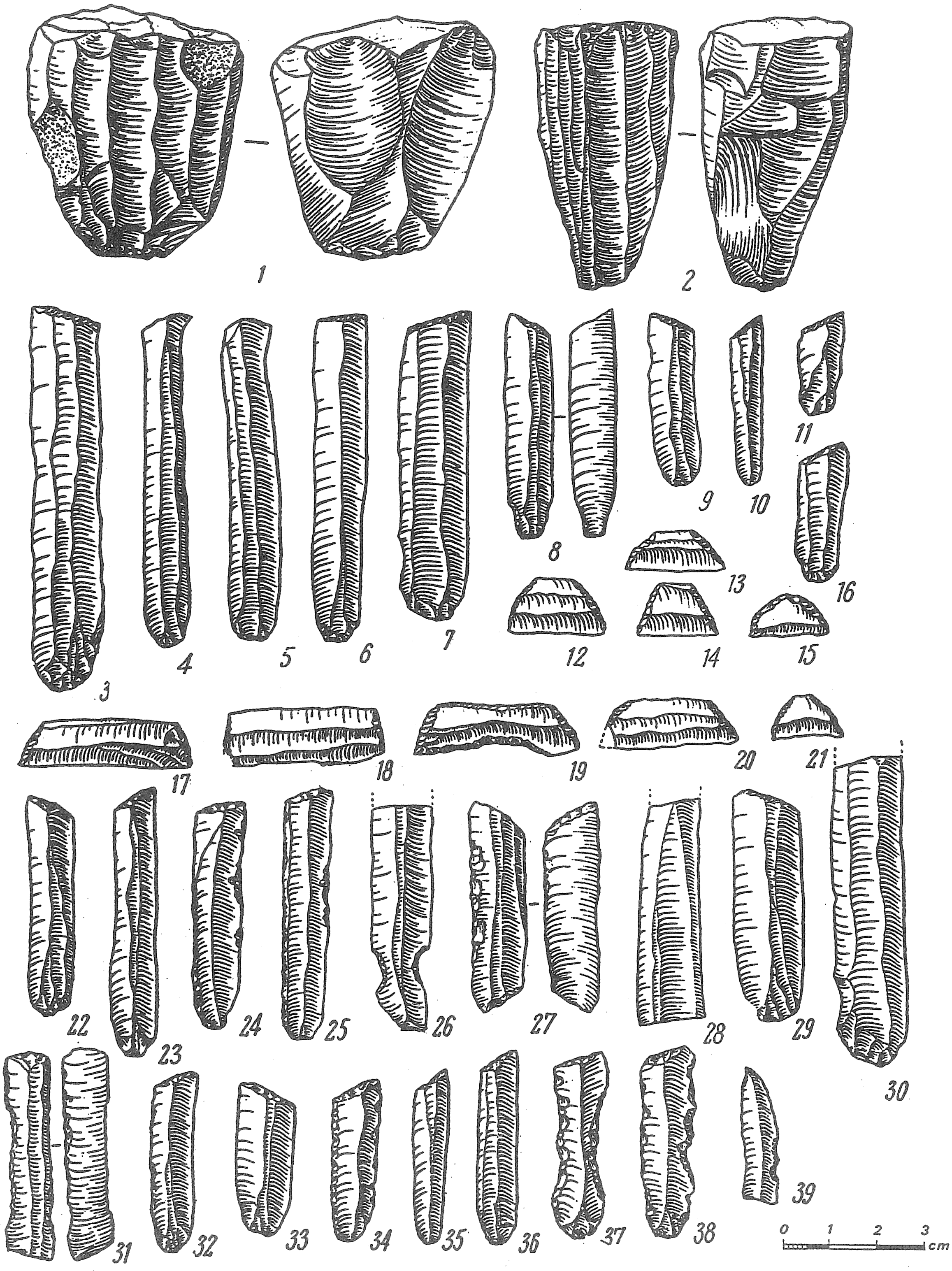

Fig. 3. Cores, blanks and tools from Djeitun.

Details of the Djeitunian Industries

Flint and other stone and bone tools are the most numerous finds; these define the industry proper of the Djeitun culture. The author has examined all these materials from the 17 settlements, including more than 18.000 artefacts, using the methodology of typology and experimental micro-wear (KOROBKOVA 1969, 1987). A statistical description based on typological criteria of the Djeitun industry, its division into periods and the characteristics of the local variants were isolated. The meticulous technological and morphological analysis of the blank types (Table 1), types of retouch (Table 2) and types of tools (the set of shaped tools) (Table 3) was made taking into consideration the statistical data and the studies of the characteristics of the blank types. The latter is especially important for analysing the blade industries present at the majority of the Central Asian Neolithic sites. The results allow a characterization of the distinctive features of the Djeitun cultures knapping technique and a definition of chronological trends including a loss of some specific technological features over time (KOROBKOVA 1987).

The industry is characterized by a very pronounced blade technology with some microlithic features (Figs. 3-9). The raw-materials were high quality semi-transparent flint of honey-like yellow and reddish-brown colours (91-97%), other fine-grained types of stone (1-1,5%) and bone (1,8-8,8%). Flint was imported from the area of the Sulphuric Factory at the center of the Kara-Kum desert and probably also from the Krasnovodsk plateau. These materials were transported to sites as pre-formed cores rather than as nodules and then further reduced. Four such cores were found on the floor of the IIIrd building horizon at Djeitun.

The absence of knapping waste at the sites is significant because it documents the preparation of cores outside the settlement areas. It is probable that a shortage of good flint raw-material led to a search for effective substitutes for tools. These were found in the use of goat and sheep bone (shoulder-blades, ribs, tubular bones cut laterally and lengthwise, metapodial fragments, etc.), sandstone slabs and, rather unexpected, pottery sherds. The latter type of blanks appeared for the first time in the Djeitun IIIrd building horizon which was excavated between 1987-1992 (Figs. 6:16-17).

"Nonflint" types of stone, such as pebbles, and large and small slabs of sandstone and diorite, were transported to the sites for knapping which was undertaken using hammer-stones. Macro-tools (grain-grinders, mortars, pestles, paint-grinders) were prepared with pecking and abrasion techniques.

The technology of the assemblages can be examined through analysis of the cores, blanks and tool waste (Figs. 2-5). The dominant groups of cores are prismatic single-platform types with one or two faces (32,4-62,5% and 2,9-18,6% of all cores respectively), two-platform types characterized by bidirectional removals on the same face (5-27,9%) or from two different faces (4,4-9,3% of all cores). Pyramidal cores with one face (2,2-5,1%) or with flaking around the circumference (2-2,5%) are also represented. Single-platform prismatic cores with a single face tend to increase through time as is documented by late assemblages. Multiple-platform cores with adjacent platforms and three faces (2,5%) occur during the late stage of Djeitunian culture. All the striking platforms are prepared by striking off the lipping over the core face. Blank removal carried across the entire surface of the core face and followed a certain set of stages. Blank shape and size was obtained by Djeitunian knappers by controlling the striking platform, angle of flaking and the proximal surface shape of the blank. This is supported by core and blade blank data from the sites. Technological analysis by E. Ju. Girya (1993) demonstrates that this core reduction process was standardized - there is a standard shape to cores, a standard shape to preparation flakes and a standard way of forming core faces at Djeitun. Blanks were removed using pressure flaking. Standardization in core face preparation was used to obtain certain standard blade shapes.

Prepared cores transported to the settlements needed little other than slight knapping adjustments for control of the core face. According to experimental data, flaking on one- or two-sides is sufficient to maintain the standard shapes, proportions and sizes of the resulting blanks. Each blade removal was parallel to the previous one and followed its topography without changing the width of the flaking surface. According to E. Ju. Girya, use of the flat flaking surface is the most effective way of obtaining the blades-inserts for tool manufacture. The existence of blades with straight profiles, parallel sides, sharp edges and a standardized length suggests mass-production of them. Djeitunian cores and blanks document this highly developed technological process of obtaining blades of certain shapes and proportions.

The extremely regular, parallel-sided, elongated blades with tiny striking platforms, thin cross-sections and a low edge angle were produced (Fig. 3). Such blanks make up more than 90% of the industries at the early phase sites. The regularity of blank shape and size is emphasized by the straightness of the profile. This last trait is important because it reduces friction when the tool penetrates an object. The characteristics of these high-quality blades made them the universal blanks for each type of composite-tool. The straightness of the profiles was achieved by a special technique consisting of removal of the upper curved end of a blade and backing this truncated beveled edge.

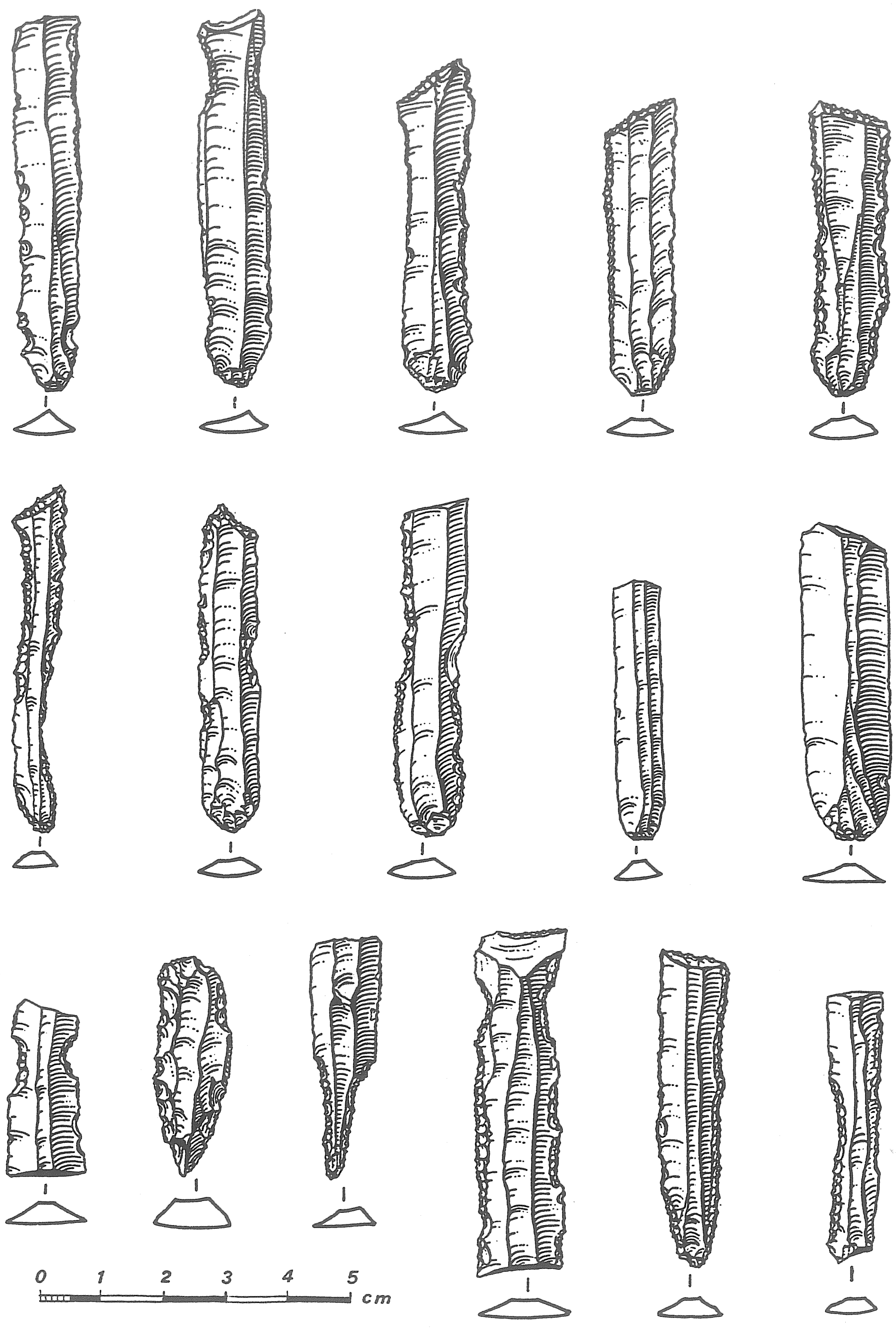

Fig. 4. Blanks and tools of Djeitun.

This type of blade is typical for the Djeitunian industry as a whole. These tools have not yielded evidence of wear-traces. This type of blade is the most important for early sites and decreased in late sites of the culture. Truncated blades were very common (10,9-18,4% of all finds). They were used for geometric microlith production (about 18%) and also as universal inserts for different tools (Fig. 5). Symmetrical and asymmetrical trapezes are typical of the early stage; these become smaller in the later phase and have a tendency to decrease in numbers during the middle and especially in the late stage (Chagylly-depe is the exception). As a rule, the proximal and distal edges ("sides" of the trapeze) were retouched. The large elongated trapezes with a retouched lateral edge are known only from the Djeitun settlement. Short, wide small lunates and asymmetrical triangles with alternate steep retouch of the edges are present in small numbers.

Medium-sized blades with a width of 1-1,4cm were the main blanks (40,9-63,8%). Large elongated blades with a width of more than 1,5cm constitute 4,7-8,7% of the blanks. This frequency decreased noticeably during the late stages (1% at Chagylly-depe). Microblades are not typical at early sites, becoming popular in the later industries (7,5-18%).

The eastern group of settlements is distinguished by the presence of a flake-industry in conjunction with a blade-industry (Fig. 9). Flakes comprise from 27,5% to 36,5% of the assemblage and also are a characteristic type of blank. These are supplemented by medium-sized, curved profile blades with a width of 0,9-1,4cm and a length of 2,5-5,5cm. They make up more than 20% of the assemblage, while the medium-sized blades with a straight profile that were characteristic of the earlier industries are only about 14%. The local distinctiveness of the eastern settlement group is apparent by

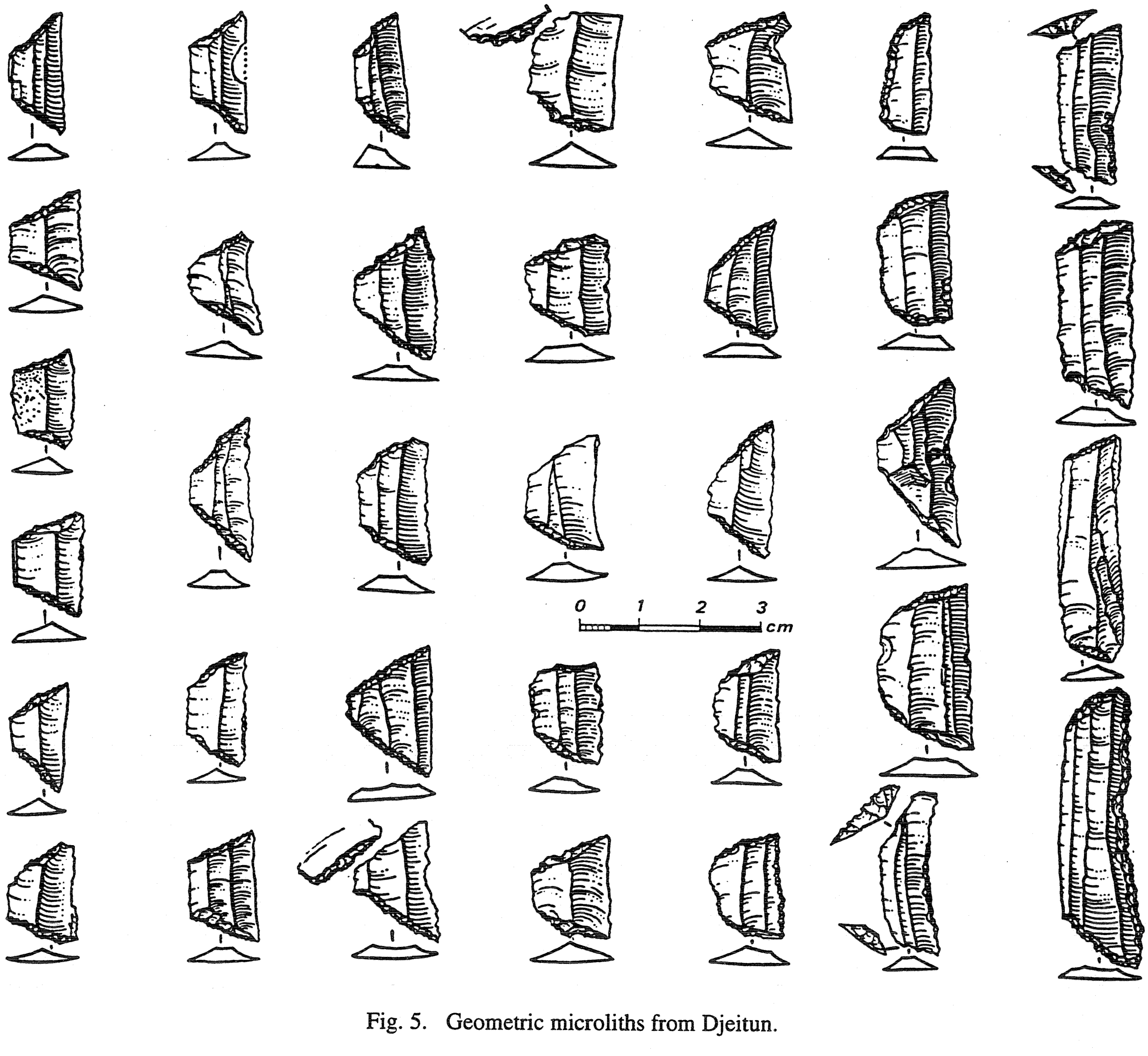

Fig. 5. Geometric microliths from Djeitun.

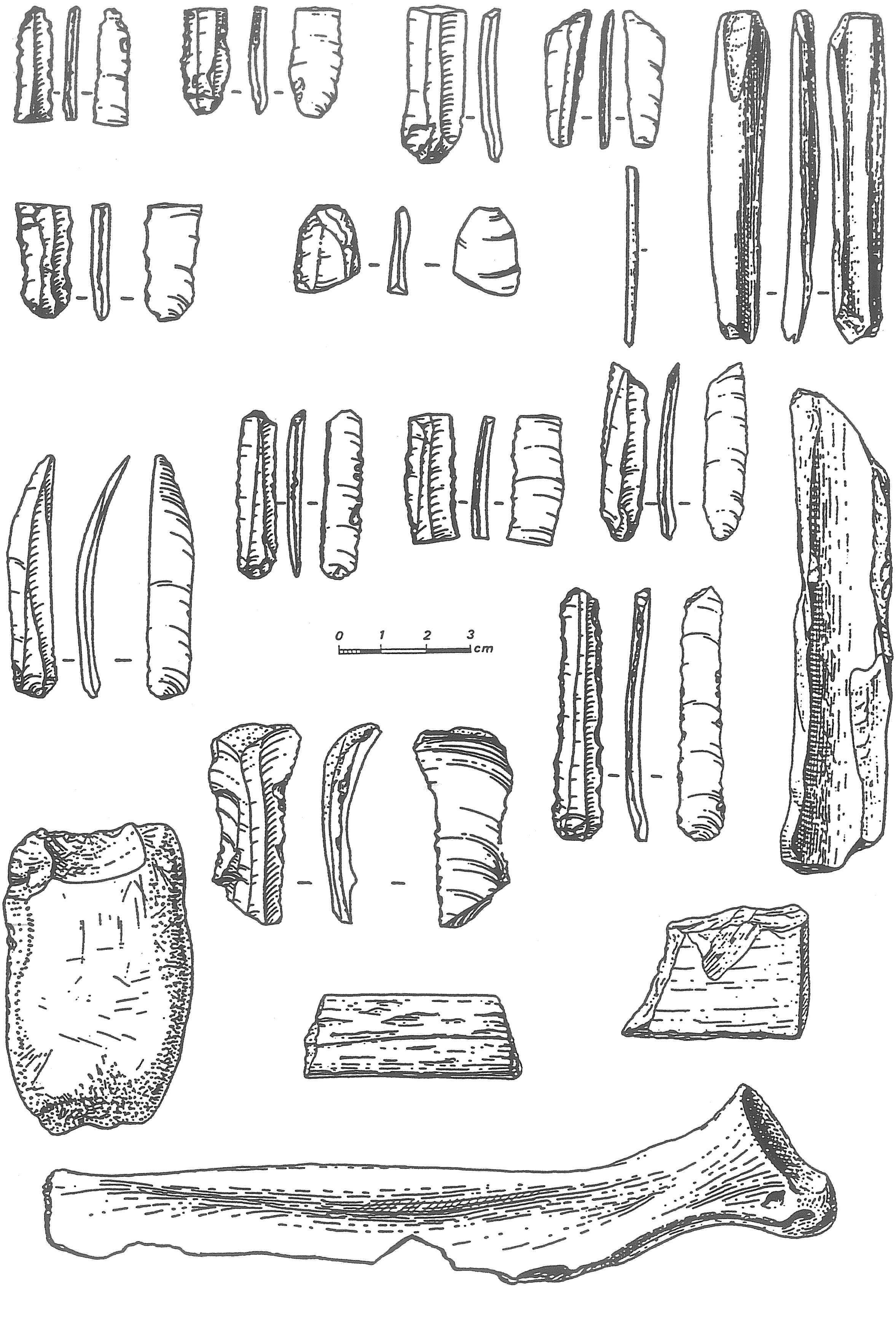

Fig. 6. Tools from Djeitun, third stage.

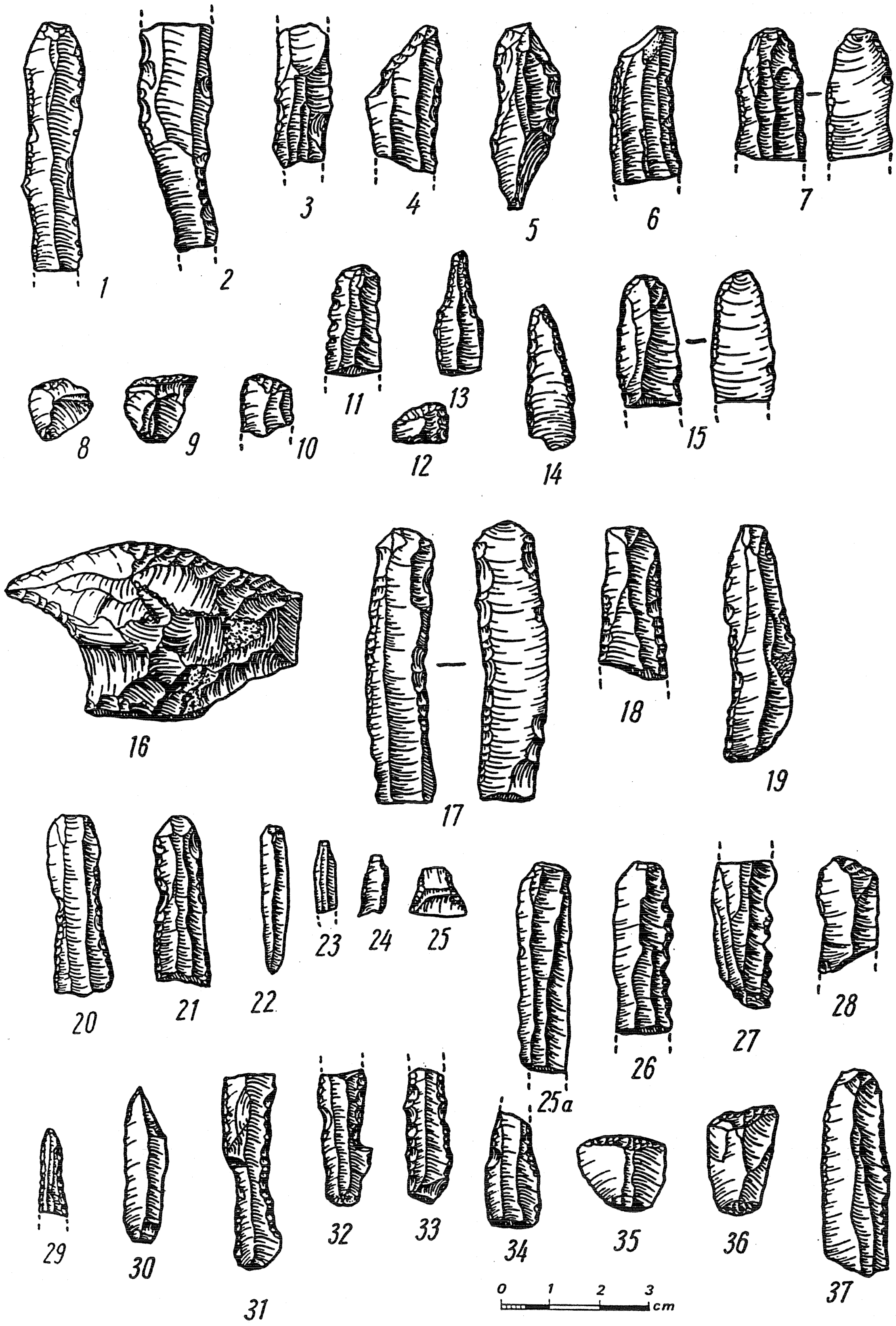

Fig. 7. Tools from Chopan-depe (middle stage).

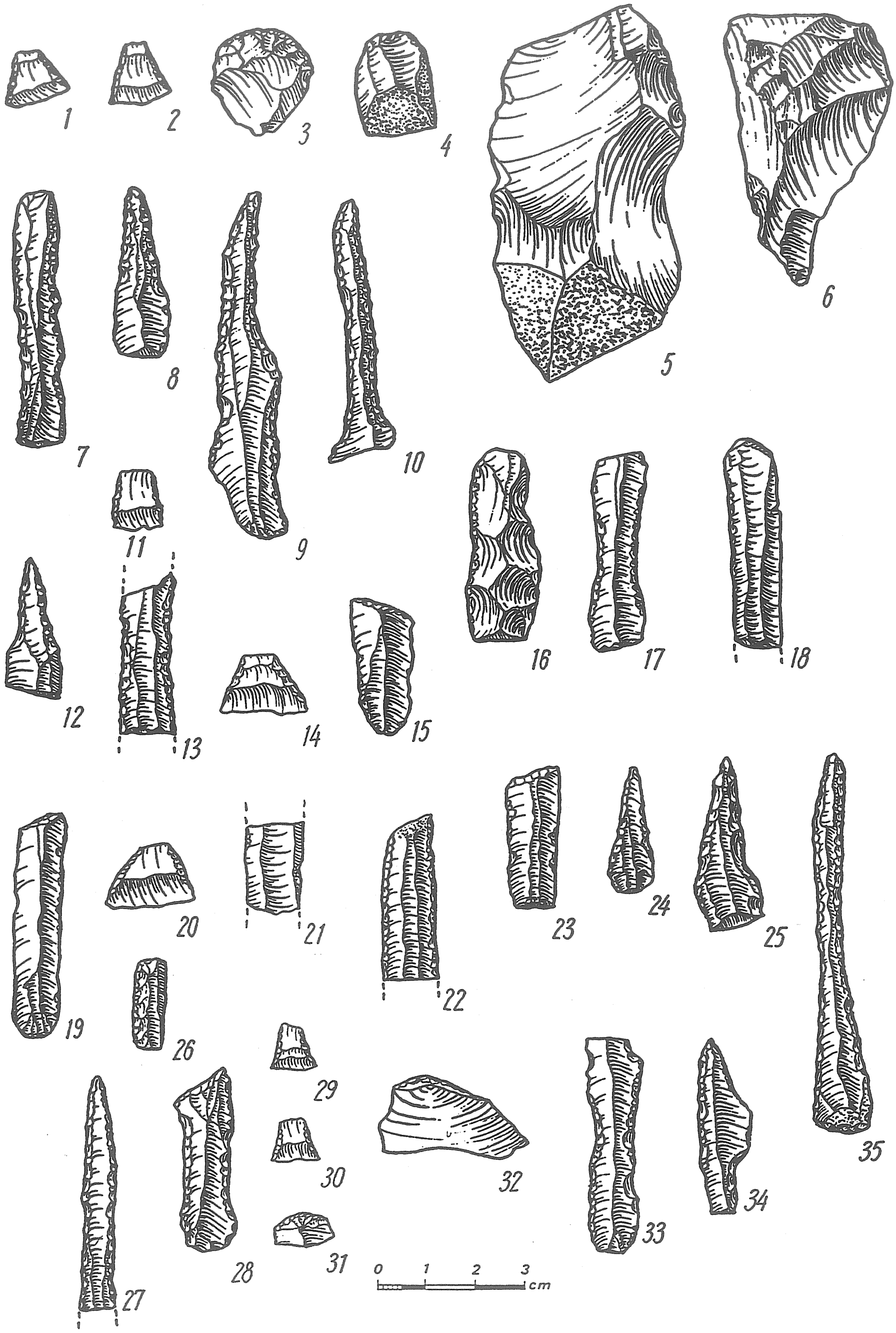

Fig. 8. Tools from Chopan-depe (middle stage).

the middle developmental stage (Gadymi-depe, Mondjukly-depe). The tendency for medium-sized curved blades (Figs. 7-8) to increase in the central group of sites is also observable during the period of the height of Djeitun culture (Pessedjik-depe, Chopan-depe, Togolok-depe and others). This type of blade comprises 10-16% during this middle phase. Thus the Djeitun knapping technique is defined by medium-sized prismatic blade blanks with straight profiles (Djeitun: 63,8%, Togolok, lower part of the layer: 55,4% and upper part: 36,3%, Chopan- depe lower part of the layer: 54,6% and upper part: 40,9%, Pessedjik-depe: 39,7%, Gievdjik-depe: 43,4%, Gadymi: 20,8%, Chagylly: 14%) and truncated blades (13,7; 16,7; 15,6; 18,4; 17,2; 11,4 and 10,9%, respectively). Medium-sized blades with curved profiles and flakes become the main blank types during the late stages.

Despite the predominance of blade technology (from 51,5-90,4%), the classification of blank types as medium-sized blades with a straight profile (from 14-63,8%) and the truncation of blades (from 10,9-18,7%) in the industries of the middle and the late stages, there are some observable differences with the early stage. The set of cores becomes more diverse. Medium-sized blades with a curved profile and microblades increase in frequency (4,2-4,4% at early sites, 5,1-10% during the middle stage and 20,3% during the late stage) and large blades with a straight profile decrease (7,6-8,7% in the early stage, 2,4-4,7% in the middle stage and 1% in the late stage).

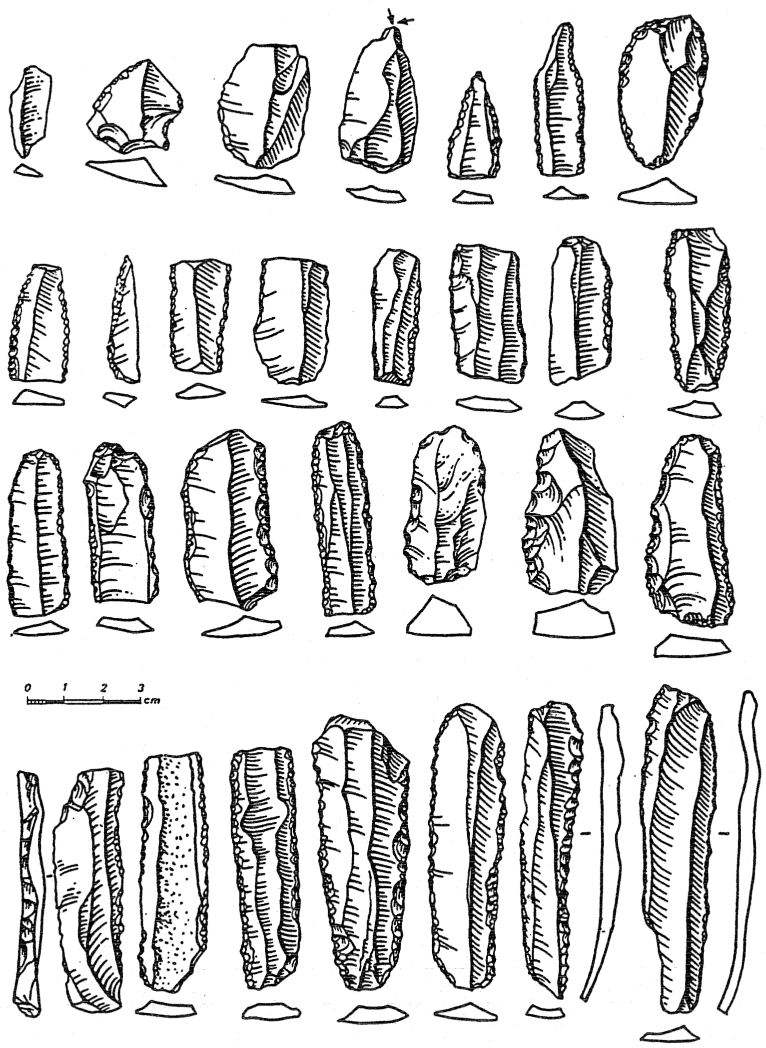

Fig. 9. Tools from Chagylly-depe (late stage).

The excavations of a Russian-Turkmenian-UK expedition in the IIIrd building horizon of the Djeitun settlement showed the similarity of the flint knapping techniques of this horizon with those horizons above it. Differences are illustrated by the stratigraphically restricted distribution of geometric microliths. These were present in very high frequency in the second horizon.

Retouch is very rare, being used mainly for touching up blanks, preparing individual tools or resharpening of tool-edges. Artifacts were finished by polishing some tools, retouching scrapers, microscrapers, geometric microliths, and perforators, and use of the pecking technique for preparing grain-grinders, mortars, etc. Although the Djeitun inhabitants were able to use these different techniques (retouch, flaking, pecking, abrasion), the majority of the tools were used without any additional treatment. The retouch observed on the working edges often appeared as utilisation traces. This retouch is uneven, irregular, and has indistinct top-grenzes and is found only on the working-edges. The luster on the surface of facets is always weaker than on unretouched surfaces.

The techniques used for special tools are present on 15,1-18,6% of the finds (Table 2). Retouch is the most common (from 16,9-39,6% of all these special tools). Backing retouch dominates (Djeitun: 77,7%, Togolok, lower part of the layer: 76,6%, upper part of the layer: 52%, Chopan-depe, lower part of the layer: 77,2%, upper part: 59,1%, Pessedjik-depe: 57,6%, Gievdjik-depe: 79,6%, Gadymi: 67,6%, Chagylly-depe: 47,6%). The most common was retouching of one beveled end of a blade (39,7; 38,3; 35,4; 20,8; 22,8; 23,1; 22,4% respectively). Lateral retouch is also used at Gadymy-depe and Chagylly-depe only. Resharpening retouch was rarer (12,9-18,2%) with a tendency to increase during the late stages (24,7-28,5%). Methods of retouching became more diversed. This is especially visible in the materials of the middle and late stages. Burin-spall technique and trimming are uncommon. The technique which is more characteristic for pebble tool industries, and abrasion is sometimes also used. The latter was used more often during the late stages (from 8 to more than 21%).

Scrapers comprise the majority of the tool-set (34,2-41,9%) with a tendency to decrease at the late sites (Table 3). They make up 41,9% at Djeitun, at Togolok-depe lower 32,6% and upper 22%, at Chopan-depe lower 34,3% and upper 20,1%, at Pessedjik-depe 21,3%, at Gievdjik-depe 20,4%, at Gadymi 30,6% and at Chagylly-depe 16%. Within this class are microlithic scrapers (3,5-28%), side-scrapers (10-11,4%); end-scrapers on blades and flakes occur less often (2,4-3,9%). Microscrapers decrease in frequency over time. They are 28% at Djeitun and at Chagylly-depe only 3,5%. The same tendency holds true for end-scrapers, 3,9% at Djeitun and 2,4% at Chagylly-depe. Ceramic-scrapers are in the majority in the industry of the Djeitun IIIrd horizon.

Tools with mirror-like polishing dominate among the retouched blades (21-36%), as well as among notched blades (5,7-13,6%) and blades with lateral retouch (10,7-25,5%). The tendency for all three blades categories to increase in frequency is noticeable.

Moderate quantities of geometric microliths are a hallmark of the Djeitunian industry. There is a relatively high percentage of geometrics at Djeitun (17,2%) and less at Chopan-depe (1,6%) and Chagylly-depe (8%). The miniature trapeze was found only at the late Bami-site.

Symmetrical trapezes of elongated (47,4%) or smaller (22,6%) proportions with retouched beveled ends dominate the microliths. Three large elongated trapezes resembling rectangles with three retouched edges were found at Djeitun only. It is interesting that geometric microliths are confined to the third horizon. Trapezes underwent some changes through time. They decreased in size and went from asymmetry in early sites to symmetry in late sites. Trapezes persisted until the final phase of Djeitun culture. Small and wide lunates and elongated and symmetrical or asymmetrical triangles are typical in the early assemblages only. Chagylly-depe is the exception. Lunates and triangles occur there with small trapezes. This is specific to the eastern sites group. Significance are points of rod-like shape and emphasized tip (3,5-5,8%) or shouldered ones. Burins and arrowheads are not typical.

The thorough technological and morphological analysis of the blade industries allowed a systematic approach to the ordering of the material. It also led to the creation of typological and quantitative criteria for the differentiation of archaeological cultures and their local variants and for determination of chronology (KOROBKOVA 1987).

The main chronological criteria for the Djeitun culture are the changes in geometric microliths and microlith size and frequency; the decrease in scrapers, including microscrapers (rounded and almond-like shapes); the diversity of blades with "mirror-like" polishing that occur on resharpened, toothed, and inversely retouched tools, and the increase in notched blades and blades with lateral retouch on one side.

Temporal trends in knapping technology are the increase in core diversity, the decrease of large- and medium-sized blades with a straight profile, the increase in frequency of medium-sized blades with a curved profile, which became the main blanks at the end of the Djeitun culture (20,3%), and an increase in flake-blanks (27,5%).

As a secondary technological attribute, the increase in the variety of retouch methods is of chronological significance. Backing retouch dominates but an increase in resharpening retouch is observable during the second stage of Djeitun culture, as is an increase in the use of the pecking and abrasion techniques during the late stage (21,6%).

Examination of the type-lists shows the distinctiveness of the eastern group (Gadymi-depe and Chagylly-depe). It reflects a local development that is also confirmed by the pottery data. These local changes appeared during the middle stage (Gadymi) and become more pronounced during the late stage (Chagylly). The specific local trait is use of microblades and flakes as the main blank types for tool manufacture. The use of pebble-blanks is also distinctive, as are large blades with a curved profile and the considerable use of bone at Chagylly-depe. Certain bone tools have chronological implications. These are the shoulder-blades split lengthwise with the working edge along the broken edge. They occur in large numbers only in the early assemblages of Djeitun culture (87 specimens at Djeitun). These tools decrease sharply during the middle stage (being represented by an isolated specimen) and they disappear completely in the late stage. Bone awls were widespread, and were made using the abrasion technique either for the entire surface or on the working-point only. Eyed needles and palette-knifes for pottery are also present.

Ceramic scrapers were found unexpectedly in the Djeitun IIIrd building horizon (83 specimens). Typologically they are fragments of painted pottery without modificiation to the edges. The shape is the shape of the sherd and can be rectangular, square, round or lunate. They are made on fragments of the walls, rims and bottoms of vessels. Similar tools were defined previously among Bronze Age materials of Turkmenia (KHLOPINA 1974, SKAKUN 1977). They appear, however, for the first time in the Neolithic (KOROBKOVA, LOLLEKOVA, and SHAROVSKAYA 1992).

Polished axes-adzes made from a soft green stone (steatite?), paint-grinders, grain-grinders, mortars, pestles, pressure-retouchers, and trowels used for smoothing-out clay walls and floors and for rubbing of paints occur among the stone tools.

The microwear analysis results on Djeitun culture industries clarified and helped define the activities engaged in by the people of the Djeitun culture.

The percentage of tools increased significantly as a result of tools being defined among the stone waste, blanks, bone-remains and the pottery scraps. Second, the set of implements was enriched by functional categorization of the tools. Third, the relationship of the tools to definite activities was determined. Fourth, the technologies of production were reconstructed. Fifth, experimental reconstruction of the entire set of activities of the Djeitun culture and determination of trends was undertaken (KOROBKOVA 1987). The tool set contains more than 35 functional categories.

The majority are composed of reaping-knives, representing more than 30% of all tools. Scraping-tools are the most numerous in the IIIrd horizon at Djeitun. They were made on flint, bone and pottery. There are end-scrapers, side-scrapers (represented typologically by blades without retouched lateral edges), inserts of double-handed adzes, and almond-like scrapers. The main tool group of the IIIrd horizon is the ceramic-scrapers. These tools, according to experimental data, have high efficiency because of the abrasive properties of the pottery. Ceramic-scrapers wore out quickly as a result of the smoothing out of the working-surfaces but it was easy to replace them because new pottery sherds were abundant at each site (SEMENOV and KOROBKOVA 1983).

It should be mentioned that the industry of the IIIrd horizon at Djeitun is somewhat different from the industries of the upper-levels not only in the appearance of ceramic-scrapers, trowels for smoothing clay walls and floors, and reaping of plants, but also in the frequency of several diagnostic groups of tools (KOROBKOVA, LOLLEKOVA, and SHAROVSKAYA 1992). These are connected, probably, with microchanges happening in the economy. Thus, for example, although the agricultural complex was well represented in the tool-set of the IIIrd horizon, leather-dressing implements consisting of different scrapers for the treatment of skins and meat-knives were also prevalent. Hunting at this time had not yet lost its economic significance. At the same time, however, stock-breeding and agriculture were gaining in importance.

Scrapers for wood, bone, antler, and paint; borers for wood, bone, and stone; piercers for skins; different kinds of abraders for stone and bone (which are numerous especially in the IIIrd building-horizon at Djeitun); knives for cutting, saws, planes for woodwork; grind-stones for grain, mortars, pestles, grind-stones for paint, polishers for leather and pottery; anvils, hammer-stones, and retouchers are typical. Among the bone tools there are gouges for woodwork, palette-knives for smoothing unfired vessels, awls, needles, and tools for plaiting mats.

The complete absence of arrowheads is interesting. Slings were used instead of them. Sling balls are present at almost all Djeitunian sites. These are stone or clay (unfired) balls 3 5,5cm in diameter. The arrowheads are absent in the early agricultural assemblages of the Near East - Jarmo, Sialk I, Tepe Sarab, Khassuna, where they were also replaced by the sling.

Comparisons to the Near East

The strong Near Eastern influence on the formation of Djeitun culture is seen in the traditions of building techniques and pottery-production. It is evidenced by the painting of lime plaster floors, known at a number of settlements dated to the VIIIth-VIth mill. B.C.: Jericho, Çayönü Tepesi and Tepe Guran (KENYON 1957; ÇAMBEL 1974; MELDGAARD, MORTENSEN, and THRANE 1964) - and by the same motifs on the vessels (Tepe Guran).

Close parallels to the Djeitun culture materials are found at Jarmo-type sites. There are small symmetrical trapezes, bone beads, flat stone discs with a hole in the center, clay cones, similar shapes of vessels and painting motifs on pottery (BRAIDWOOD and HOWE 1960). The clay bracelets found at Togolok-depe and Chagylly-depe are of special interest. According to O. Berdyev (1976), these objects are imitations of Jarmo stone bracelets.

There is also similarity to the Tepe Guran materials. Here sun-dried bricks were used for building, and lime plaster and red ochre for wall-and floor-painting. Analogies are also detected in the vessel-shape, elements of painting and in stone and bone beads (MELDGAARD, MORTENSEN, and THRANE 1964).

There are also some parallels with Jericho (Layer B) architecture. The dwelling-floors were covered with lime plaster and coloured in red and brown in the same manner as at Djeitun (KENYON 1957, KIRKBRIDE 1967). Similarities in stone and shell beads are found.

Similarity in building technology is found between the Asia Minor settlements (Hacilar and Chatal-Hüyük) and the Central Asian Djeitun. These consist of use of sun-dried bricks or blocks of similar proportions and floor-colouring. There are also resemblances in the details of paintings and in some vessel shapes (MELLAART 1965, 1975).

The example of the comparisons of Djeitun culture and the contemporary assemblages of Asia Minor and the Near East indicates the existence of a certain resemblance. This could be explained on the one hand by cultural contacts and on the other hand by a common heritage.

Djeitun-type material is found in the lower layers of the Yarim-tepe settlement in the southeastern Caspian area (CRAWFORD 1963). This new data allows for the possibility that the Djeitun cultural community embraced the territory of southern Turkmenia and in part the central and northeastern Iranian areas.

Summary

The Djeitunian culture is considered as one of the earliest farmer-herders cultures of the Middle East. As a taxonomic unit it was first distinguished by V.M. Masson (1960). Seventeen Djeitunian sites are known, among which are: Chopan-depe, Togolok-depe, Mondjukly-depe, and Bami, all multi-layered sites (Fig. 1). The sites cluster in three regions: the western (Bami 1 and 2), central (Djeitun, Chopan, Pessedjik, Togolok and others), and the eastern (Chagally, Monjukly, and Gadymi) groups. The western and eastern regions were settled during the middle and late phases of Djeitunian culture, while the central cluster of sites existed in the early and middle phases.

Chipped stone and bone materials of all seventeen sites were studied by the present author. Typological and microwear methods were used (KOROBKOVA 1969, 1987). The chipped industry is characterised by well developed blade technology and microliths (Figs. 2-9). Raw material included the high quality and highly transparent flint of honey-like and brown color (91-97%), a fine-grained stone (1-1.5%), and bone (1.8-8.8%). Flint was imported from the central part of the Karakum, or from the Krasnovodsk Plateau.

Among the cores, the most characteristic are prismatic single-platform specimens, with a single flat striking face (32.4-62.5% of all cores) or a double face (2.9-18.6%). Several double platform specimens with a common (5-27.9%) or separate striking face (4.4-9.3%) are also evident. Other cores are conical with flat (2.2-5.1%) or circular (2-2.5%) faces. The index of single-platform, prismatic cores with single striking face grows in the later phase of the Jeitunian. During this phase some triple platform also cores appear (2.5%, Fig. 9). The sectioning of blades is also very characteristic for the Djeitunian industry (10.9- 18.4% of all pieces).

The blanks (Table 1) are mostly middle-sized prismatic blades with straight longitudinal profile, but during the late phase of debitage the blades became more curved, and flakes are more frequent. In the assemblages of the middle and late phases, the variability of cores grows, as well as the amount of bladelets (4.2-4.4 in the early phase, 5.1-10% in the middle phase, and 20.3% in the late). At the same time the index of long blades with straight profiles drops (7.6-8.7%, 2.4-4.7% and 1% respectively).

The assemblages of the eastern group (Gadymi-depe and Chagally-depe) show additionally some specific local features (mainly the use of river pebbles, microbladelets and flakes as blanks: in Chagally-depe big prismatic blades with curved profile). Secondary treatment reached 15.1-18.6% of all finds (Table 2), but the retouch could be found on 16.939.6% of all secondary treated pieces. One of the most popular technique of shaping by retouch was the creation of transverse truncation at the distal end of the blade. This could also serve as a preparation for a future burin.

Among the retouched tools (Table 3), endscrapers were the most numerous (34.241.9%); at the end of the development of the Djeitunian the short specimen were more numerous. Micro-endscrapers as well as sidescrapers are more characteristic than the arched/transverse specimens. A special role was played by ceramic endscrapers (Djeitun, Layer III).

Among the blades with secondary treatment the most important and characteristic are blades with high gloss, or sickle inserts (21-36%), with notches/denticulation (5.7-13.6%), and with side retouch (10.7-25.5%). One of the most characteristic features of the Djeitunian industry is a presence of a big series of the geometric microliths (Fig. 5), mostly trapezes (elongated in early, and short in late periods). Trapezes became less numerous in the middle and especially the late (except for Chagally-Depe) phases. Only in Djeitun were long elongated trapezes present, with retouch on the back. Some

short, small crescents and scalene triangles were also present in Djeitun site and in the Djeitunian industry.

When comparing the Djeitunian industry with contemporaneous industries of Anatolia and the Near East, there are several similarities, which are the result of intercultural contact and genetic ties.

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The Neolithic Chipped Stone Industries of the Southern Caucasus

Galina F. Korobkova

Abstract: *Highly differentiated environments and separation in cultural traditions led to a pronounced variability in the Neolithic chipped industries in the Caucasus, where more than 10 clusters of sites are known. Some of the clusters are characterised by their own original cultures/industries. In western Transcaucasia two groups of sites with two different cultures/ industries are known. The first group is known from the southeastern side of the Black Sea, the second from the area to the northeast. The first group is represented by the aceramic sites Anaseuli 1, Khutzubani, and Kobyleti. The second group, referred to as the Odishi Culture, is represented by the late Neolithic sites of Odishy, Anaseuli 2, Kistrik, Nizhniaya Shilovka, and others. This taxonomic unit, with coarse ceramics, has its origins in aceramic industry of the first group of sites.*

In the upper Dagestan the late Mesolithic and early Neolithic Chokh culture/industry occurs, dated to 8th to the beginning of the 6th millennium bc. Some dwellings of unworked stones are known from this culture. The Ginchi Culture (5th -4th millennium bc) is known from northeastern Dagestan. Flint dominates as raw material, obsidian is very rare. Industry is based on big blades and flakes.

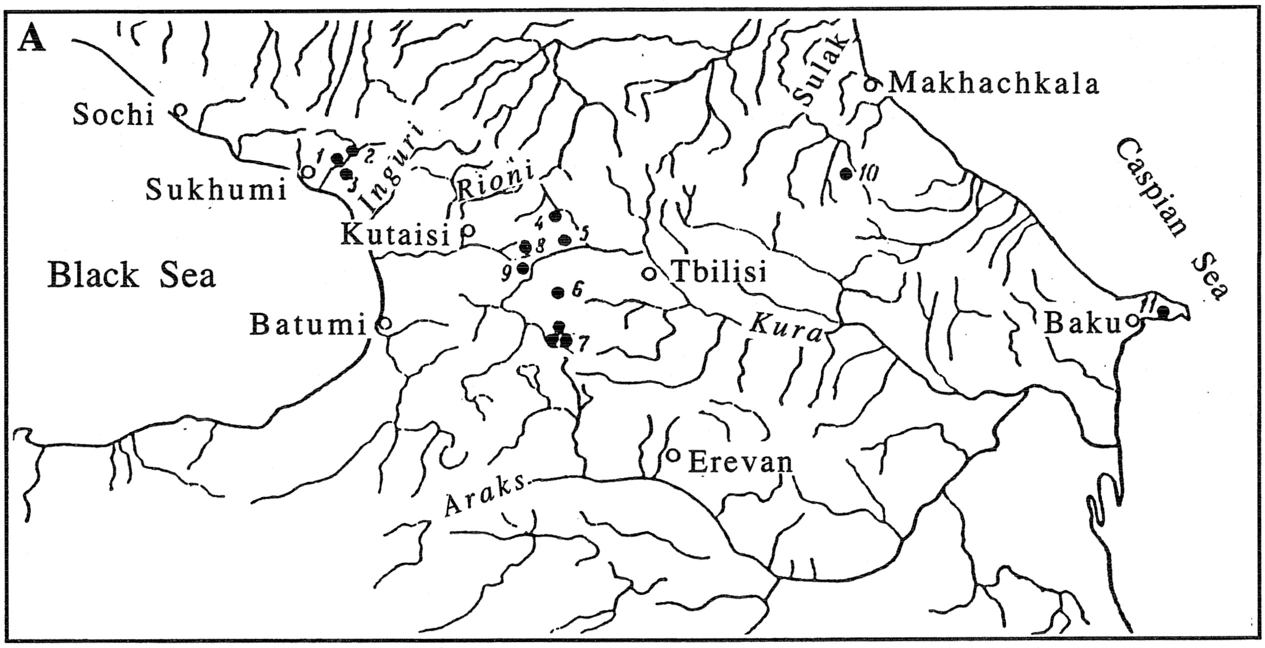
In the region of northern Caucasus another culture/ industry is known, called Domaikopskaia, and dated to the Eneolithic. The assemblages are rarely distinguishable from those of Ginchi and have common features with western Caucasian industries.

A poorly known group of Neolithic sites is known from Kobystan (southeastern Transcaucasia). A different state of research exists in southern Transcaucasia, where several villages occupied by farmers and stock breeders are known. The most characteristic unit there is the Shomu-Tepe-Shulaveri Culture, dated to the 6th -5th millennia bc. Obsidian is the dominating raw material there, imported from the region of the Small Caucasus. Another cultural/chronological group date to the Eneolithic, called Khandarskaia. It is known from Azerbaijan (Site 133, Kilikhagskie workshop). An important group of settlements partly contemporaneous to group of Shomu-Tepe-Shulaveri was also discovered in the Magneul region of Georgia. Chronologically close to the Shomu-Tepe-Shulaveri culture is the complex of settlements in the Ararat Valley. All tools are made there from local obsidian.

A separate tradition is known from Kul-Tepe I in the Nakhichevan region, Alikemek-Tepesi in Mugan-Tepe, and Tekhut in the Ararat Valley, although some investigators classify those sites as belonging to the Shomu-Tepe-Shulaveri Culture. The tools were made of obsidian imported from the Armenian outcrops. The site of Tekhut (end of 5th-beginning of 4th millennium) has many original features, including painted pottery and singular copper pieces.

The Caucasus is noted for its palaeoecological diversity, vertical zonality, distinctive palaeoclimate and landscapes, presence of endemic plants, and richness of raw material sources. All of these circumstances influenced the formation of different cultures, their specific character and their development. Quite remarkably this region retained its distinctiveness during all stages of history.

The settling of the Caucasus was uneven and depended largely on changes of climate and landscape that were correlated with transgressions of the Caspian sea. Coinciding with the New Caspian transgression about 9000 b.p. (LEONTIEV and RYCHAGOV 1982), many areas of the Caucasus were settled: the Black Sea and Caspian Sea coasts (west Georgia and southeastern Azerbaijan), the highlands of Dagestan and the valley plains of the central and southern Caucasus. The different ecological zones were home to, on the one hand, sites and settlements of Neolithic hunters and food-gatherers and, on the other hand, settlements of farmers and stock-breeders. The archaeological map of the period unfortunately contains fewer sites than desired. Single points or groups of points designating sites or occurrences are shown only for some regions (Fig. 1). This is not because



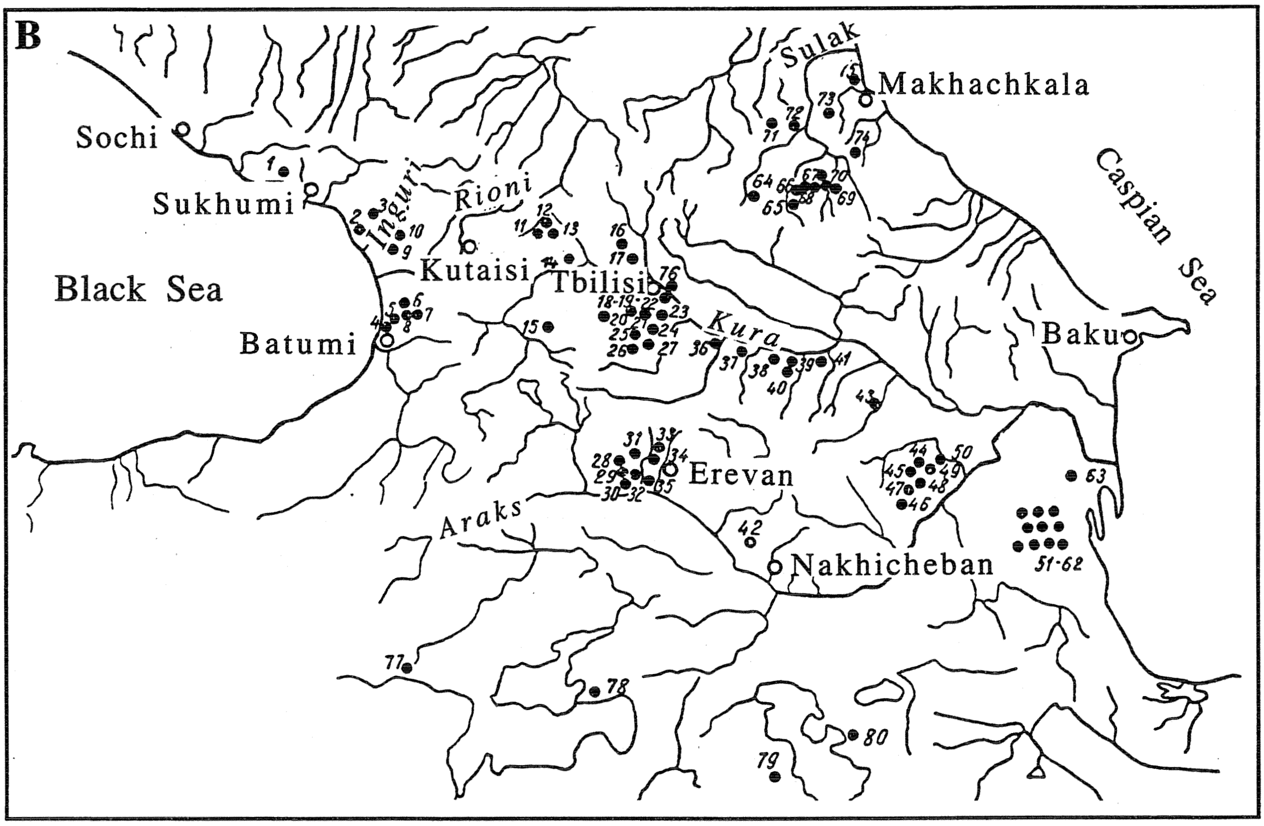


Fig. 1. Mesolithic (A) and Neolithic and Eneolithic (B) sites from the Caucasus.

A: 1 Apiancha; 2 Kvachara; 3 Tsivi-Mgvime; 4 Sagvardzhile; 5 Darkveti; 6 Barmaksiz; 7 Edzani-Eurtaketi; 8 Tsona; 9 Chakhati; 10 Chokh; 11 Firuz.

B: 1 Kistrik; 2 Ochamchire; 3 Chkhortoli; 4 Khutsubani; 5 Kobuleti; 6 Mamati; 7 Anaseuli; 8 Gurianta; 9 Urta; 10 Odishi; 11 Samertskhle-Klde; 12 Samele-Klde; 13 Sagvardzhile; 14 Darkveti; 15 Amiranis-Gora; 16 Natsar Gora; 17 Khizanaant-Gora; 18 -19 Dangreuli-Gora, Gadachrili-Gora; 20 Tetri-Tskaro; 21 Shulaveri; 22 Abeli; 23 Imiris-Gora; 24 Arukhlo; 25 Khramis-Didi-Gora; 26 Tsopi; 27 Sadakhlo; 28 Mokhra-Blur; 29 Shengavit; 30 Evartnots; 31 Khatunarkh; 32 Mashtots-Blur; 33 Ksyakh-Blur; 34 Sev-Blur; 35 Tekhut; 36 Shomu-Tepe; 37 Baba-Dervish; 38 Gargalar Tepesi; 39 Toire-Tepe; 40 Mentezh; 41 Rus-Tepesi; 42 Kyul'-Tepe; 43 Ilanli-Tepe; 44 small tepe without a name; 45 Shakh-Tepe; 46 Karakhan-beili; 47 hill without name, some 5km from Kyamil'-Tepe; 48 Kyamil' Tepe; 49 tepe next to the dry Shoparti river; 50 channel in Ordzhonikidze; 51 62 Misharchai II-VII; 63 Alikemek-Tepesi; 64 Ginchi; 65 Muchu-Bakhil-Bakli; 66 Malin-Karat; 67 Arkhinda; 68 Koz'ma-Nokho; 69 Chokh; 70 Rugudzhinskie stoyanki; 71 Galgalatli; 72 Kharitani; 73 Buinaksk; 74 Mekegi; 75 Tarnair; 76 Didube; 77 Mush; 78 Til'ki-Tepe; 79 Geoi-Tepe; 80 Yanik-Tepe.

archaeological sites are absent in other areas but is a reflection of inadequate investigation of the region and sometimes the questionable chronology of relative dates, not to mention absolute ones.

Absolute dating of Mesolithic sites has not been done. The Neolithic Shulaveri-Shomutepe culture is contemporary with the Eneolithic Vth mill. B.C. (KIGURADZE 1976) or the Neolithic of the VIth mill. B.C. (KAVTARADZE 1981). Early Neolithic cave sites of the Black Sea area, according to L. Nebieridze (NEBIERIDZE 1972), are of the IXth mill. B.C. (this is obviously too old); N.O. Bader and L.D. Zereteli (1989) believe the sites are not later than VIth mill. B.C. Neolithic sites are concentrated in different geographical and ecological zones of the Caucasus. These are: the western Transcaucasian (or Black Sea coast) zone with two groups of sites; northeastern Dagestan where the mountain settlements are situated; the central and eastern Caucasus with the Shulavery-Shomutepe culture sites occupying the territory of what is now Georgia and Azerbaijan; the southern Transcaucasian area with the settlements of Kjul-tepe I-type, Alikemek-Tepesi, and Tehut; the southeastern Transcaucasian area with the Kobystan assemblages; and the northern Caucasus where the sites of Svobodnaja-type, Meshoko, Kamennomostskaja-cave and others are situated.

The Western Transcaucasian Area

This area was intensively settled during the transitional period from the Mesolithic to the Neolithic as it is attested to by the archaeological sites found on river-terraces and hills. The foot-hills of western Transcaucasia were occupied from the Early Neolithic on. The area is contiguous to the north with the foot-hills of the Agriss- and Kodor-mountain ridges and to the south with the Meskhetian ridge. Sub-tropical climate and types of endemic plants and animals are characteristic. According to D.D. Nebieridze, the western Transcaucasian cultures during the Mesolithic, Neolithic and Eneolithic periods had common technological traditions and clearly pronounced continuity (NEBIERIDZE 1986). This is seen at sites of the transitional period from the Late Mesolithic to the Early Neolithic. This phenomenon is observable mainly in the stone industry, in aspects related to knapping technology, and in changes within the geometric microlith assemblages.

Presently there are more than one hundred sites of Mesolithic, Neolithic and Eneolithic affiliation that have been located and studied in the western Transcaucasian area (ZERETELI 1973a, b; GABUNIYA and ZERETELI 1977; NEBIERIDZE 1972, 1978, 1986; BADER and ZERETELI 1989; KUSHNAREVA 1993). Some contain several stratigraphic layers: Darkvety shelter, Apiancha, Kvachara, Sosruko, Sagvardjle and others. L.D. Zereteli's research here aided in the definition of the Mesolithic cultures of the Black Sea coast and the Imeretian (ZERETELI 1973a,b). M. Gabuniya defined the Trialetian culture and divided it into phases (GABUNIYA and ZERETELI 1977).

Here I focus primarily on the Neolithic sites which have yielded the most interesting evidence with respect to the appearance of agriculture in the Caucasus. The Mesolithic is discussed partly in connection with this theme.

The western Transcaucasian Neolithic is represented by two groups of sites belonging to different parts of the period and to different cultures (NEBIERIDZE 1972). They are single-component, open-air sites lacking traces of dwellings.

Western Transcaucasian Aceramic Neolithic

The first group consists of the Aceramic Neolithic sites of Anaseuli I, Hitzubani, Kobuleti and the second one includes the Late Neolithic sites of Odishy, Anaseuli 2, Gurianta, Mamati, Kistric, and Shilovka Lower (Fig. 1). The first group occupied the south-eastern part of the Black Sea coast area where the sites of the Imeretian Mesolithic culture were found and the second, the north-eastern part of the area, the former zone of the Black Sea coast Mesolithic culture. One interesting exception is the multi-stratified site of Darkvety shelter situated in the western Transcaucasian foothills. The site contains several layers of the Trialetian Mesolithic culture; Layer IV is Early Neolithic. This layer is distinguished by a distinctive character (NEBIERIDZE 1978). Both groups of sites are defined on the basis of technological and morphological analysis of the industries, the stratigraphy and by the appearance of pottery in the second group of sites.

Knapping technology is studied from a typological point of view in terms of the classification of cores, blanks, final products, methods of knapping and the preparation of core cleavage faces. In the absence of experimental modeling and usewear, technology and morphology is the only approach to the analysis of the use of stone. It is the most common and informative way to obtain information concerning the aims, methods and sequence of blank removal. The essential features are the cores' cleavage surfaces, their position, the shape of striking platform and how it is modified, the striking angle, the analysis of the cores, etc. It is necessary to take into consideration the way the core face is prepared: by hammer, by pressure, by abrasion or by pecking techniques. Flakes from the core's edges yield important information concerning renovation of the cleavage-face. Of no less importance are the traces on the cores' bases, or their absence, that define the method of flaking (held in the hand, using an anvil or using special vises). The character of the blanks and finished tools, their qualitative and quantitative indices, comparisons of the negative flake scars, and details of the striking platform preparation allow an identification of their contexts, the approximate *chaîne opératoire*, and a reconstruction of whether the stone-knapping process underwent change or was stable over time. Important supplements to this information come from the analysis of special tools: hammer-stones, retouchers, anvils, and other intermediaries used in the process of stone knapping.

I summarize the characteristics of the groups of sites listed above taking into account these methodologies. Inhabitants of the Aceramic Neolithic sites mainly used obsidian for tool-making (73-76%); use of local flint and pebbles occurred more rarely (less then 1%). It is necessary to stress that obsidian sources in western Transcaucasia are unknown. The raw material was brought there probably from the Ahaltzik or Paravan sources in Georgia where shiny black or dark-grey obsidian is found.

Prismatic, pyramidal and elongated "pencil-shaped" cores were used. They had a single platform and were struck partially or completely around the circumference of the striking platform. The striking platforms and core-edges were prepared carefully with light blows. Judging by the negative flake scars and the blanks removed, thin narrow microblades with a straight profile and regular medium-sized blades with a width of about 1cm were produced. Microlithization of the blade industry is observable. Striking off blanks was accomplished by hand-pressure and the succession of removals followed the circumference of the core's striking platform. A vise to hold the core was used. Standardization of blanks was obtained by forming cores into specified shapes and by special preparation (modifying striking platforms and angles of flaking). The latter conditioned use of and control of the flaking-surface and avoidance of surface deformities. These technological contexts, according to Girya (1993), were designated the process of flaking-surface use. Because of this process and avoidance of deformities, it was possible to obtain standard-shape and dimension of blade-blanks. The blades were produced by hand-pressure either along a uni-directional face or by succession around the circumference of the core. Core preparation waste is found in low frequency. Waste from knapping is absent. Knapping was done outside the sites. Ready to use pre-cores and cores were transported to the sites and then were further prepared only slightly during the core reduction process to control the removal of microblades and medium-sized blades. Retouch was the common method of tool treatment. This is a small-facet steep retouch placed along the back or on the nonworking edges of tools. The working-edge as a rule lacked special treatment; in rare cases, it was modified by the type of retouch described above. Retouch was typical mainly for scrapers, backed microblades, points, and burins. The common use of burin-technique should be noted. Abrasion, pecking and flaking were less often used (about 1%).

The microlithic character of the obsidian and flint technology is emphasized by the presence of small symmetrical trapezes with a retouched base or slightly concave sides. They are about 0,2% at Anaseuli I. The tool-kit includes artefacts mainly made on bladelets (Fig. 2). They are evidence for the spread of the insert-technique. Backed microblades constitute about 50% of all tools. Burins are typical (with a prevalence of angle burins made on broken blades), as are rounded scrapers, microscrapers, points, retouched blades, and blades with retouched truncations. Carinate scrapers with large-facet retouch along the perimeter stand out among the scrapers group. They are made mainly on flakes. Scrapers with double lateral retouch and core-shaped scrapers are rare. There are end-scrapers on large and medium-sized blades; some are double scrapers. Notched tools are not common. Microwear analysis of the Anaseuli I industry yielded examples of reaping knives for cultivated cereals.

Artefacts made on other kinds of stone are represented by polished axes, gouges, hand-hammers, anvils, grain grinders, abraders, and sling-balls, but their frequency is insignificant (somewhat more than 1% of all tools). At the same time at Kobuleti and Hutzubani both geometric microliths and polished tools are absent (NEBIERIDZE 1972). This probably indicates distinctions in palaeoeconomy or in microchronology between the sites.

The Darkvety-shelter is distinctive among the Aceramic Neolithic sites in certain characteristics. It is a multi-stratified site situated in the limestone canyon of the Kvirila river in the Chiaturi district of Georgia (NEBIERIDZE 1978). There are five cultural layers and one sterile layer. The VIth (lowermost) layer is separated from the upper four layers by one meter of sterile sediments. On the basis of stratigraphy and artefact typology, the Darkvety shelter is dated to the Late Mesolithic (lowermost VIth layer), Early Neolithic (IVth layer), Eneolithic (IInd and IIIrd layers) and to the Early Bronze Age. I believe the materials of the IInd and IIIrd layers are similar to the finds of the IVth layer. They form a chronological succession. The layers could be dated to Late Neolithic - Eneolithic based on the tool-kit and the character of the artefacts. No metal is present. Metal appears first in the uppermost Ist layer of the shelter. In all the layers of Darkvety, only flint is present. This trait distinguishes the shelter from the Aceramic assemblages of Anaseuli I-type and makes it similar to the other Neolithic group known as the Odishy culture.

Microlithic blade technology is characteristic of the IVth layer. The main blanks are thin regular-shaped prismatic blades with a straight profile that were struck from pyramidal and "pencil-

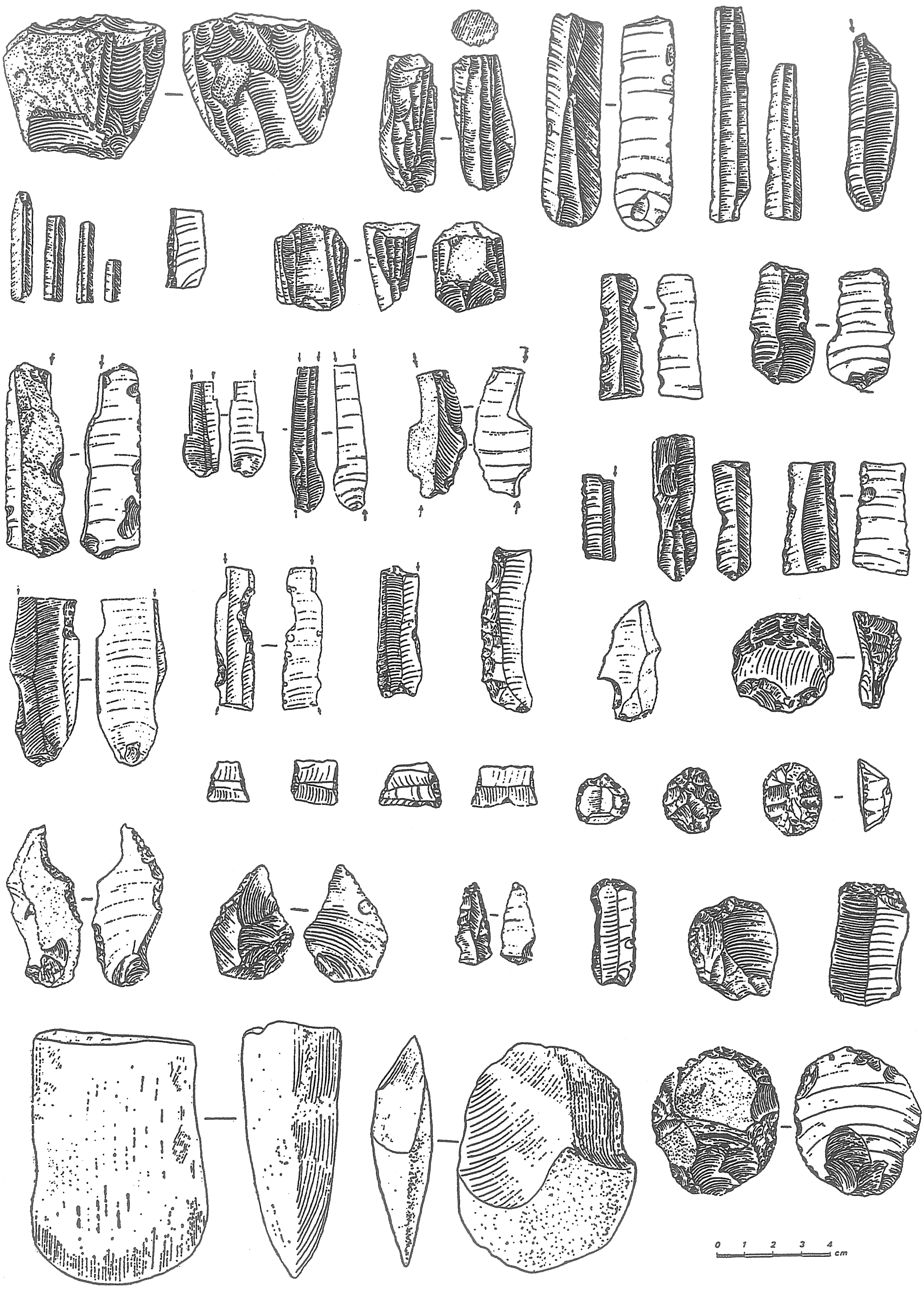


Fig. 2. Anaseuli 1 artefacts.

shaped" cores. Numerous miniature trapezes with oblique, or slightly concave retouched sides, are important. Burins, end- and rounded scrapers made on short flakes, blades with retouched truncations, and borers are common in the tool-kit (Fig. 3). Inserts for reaping knives for cultivated cereals, the earliest in the Caucasus area, were defined by me. Bone and antler tools are present (awls and mattocks). Among the stone tools are polished axes, sling-balls, grain-grinders, etc. The IVth layer is similar to the industry of the western Transcaucasian Aceramic Neolithic (Anaseuli I-type) based on the technology of working stone and the tool-kit, but differs in its raw-material. In the former case, flint is used and in the latter, obsidian.

The assemblages of the two upper layers (IInd and IInd) differ from the IVth layer because they contain small quantities of miniature symmetrical trapezes, stone bracelets, pottery and an increase in the number of bone and polished stone tools.

The sixth layer, in contrast to the IVth, contains large asymmetrical triangles, two large, wide trapezes, and backed blades including microblades. The abundance of burins compared to scrapers is striking. The latter were made on small blades, their fragments and flakes and have end- or oval-shapes. Notched blades, blades with oblique or straight truncations, and piercers are present in the industry (Fig. 4). Polished tools are absent. Other stone tools are represented by net-weights (strangled in the middle).

Close analogies to these materials are found with Layer B-2 of Holodnyi Grot (the Cold Shelter), and in the layers of Apiancha and others that are dated to the Late Mesolithic (NEBIERIDZE 1978). N.O. Bader and L.D. Zereteli classify the Darkvety VIth layer assemblage as the final stage of the Mesolithic in the Imeretian area (BADER and ZERETELI 1989). Darkvety shelter thus provides valuable information about the succession of the Late Mesolithic-Neolithic-Eneolithic-Early Bronze Age. Furthermore, it is one of the key Caucasian sites with clear-cut stratigraphy. Additionally, at Darkvety there is evidence of the transition from a food-gathering to a food-producing economy. This was discovered in the IVth layer assemblage. Here, for the first time, bones of domesticated animals are found: cattle, pig, goat, and dog. Pig bone is the most abundant. Reaping knives, hoes, grain-grinders, and pestles indicate the appearance of agriculture in the Aceramic Neolithic. However, only wild millet is present among the macrobotanical remains. We cannot exclude the possibility that millet was the object of initial cultivation but had not yet evolved the morphological traits of a cultivated plant. Similar cases are known from the Natufian culture of the Near East. It is sufficient to recall the assemblages of Kebarah (Layer B), Abu Hureyra, Nahal Oren, and Beidha where reaping tools with micro-wear traces representative of cutting cultivated cereals without a domesticated morphology were found (KOROBKOVA 1994).

Based on the microwear analysis of the tools, the IVth layer of the Darkvety-shelter could be considered the first evidence of the initial steps of agriculture in the western Transcaucasian area. This agriculture was based on the cultivation of the endemic plant, millet.

Thus, in western Transcaucasia there are two Aceramic Neolithic groups that used the microblade technique. In one case the technique was used on obsidian (Anaseuli I, Hutzubani, Kobulety) and in the other case on flint (Darkvety shelter IVth layer). The origin of these cultures was rooted in the Black Sea coast Mesolithic culture represented by the materials of Holodnyi Grot (the Cold Shelter), Kvachara, Atzyn-cave, and Chahata-cave. The backed bladelets, trapezes, truncated blades, carinate scrapers and other tools are similar. This is an indication of the survival of Mesolithic traditions in the Aceramic Neolithic of the western Transcaucasian area. In contrast to the Mesolithic, abrasion and polishing techniques and new tools for gouging and chopping appeared in the Aceramic Neolithic. Among the innovations are reaping tool inserts found at Anaseuli I and at Darkvety-shelter (Layer IV).

The assemblages of the site groups under consideration show the existence of a complex mixed economy in the Aceramic Neolithic. From a foundation of developed individual and collective hunting and specialised food-gathering of wild cereals (millet) in the western Transcaucasian area, the prerequisites for the origin of agriculture and stock-breeding (initially pig-breeding) appeared. This is demonstrated by reaping knives and hoes at Anaseuli I, Darkvety-shelter, Holodnyi Grot Layer B-I and others, and also by the presence of domesticated animal bones in the IVth layer of Darkvety-shelter and seeds of wild millet at Holodnyi Grot. Cattle, goats/sheep, pigs and dogs were domesticated in the Early Neolithic. It is natural that we have to look for the first steps of the taming of animals and domestication of wild cereals in the Caucasian Mesolithic-Neolithic materials.

There is some evidence of the existence of ephemeral surface dwellings at Anaseuli 1 and 2, Kobulety, Chortoly, and Horshi. The remains of clay-coating with traces of twigs and post holes of about 25cm diameter are found. Based on L.D. Nebieridze's research, the houses were of rectangular shape with walls covered by a clay-coating; the hearth was placed inside the dwelling (NEBIERIDZE 1986). These constructions could be used all year-round considering the presence of a hearth and the mild subtropical climate. Most likely the inhabitants of Anaseuli 1, Kobulety and other sites followed a settled way of life, fully provisioning themselves with the products of hunting, food-gathering, stock-breeding and agriculture.

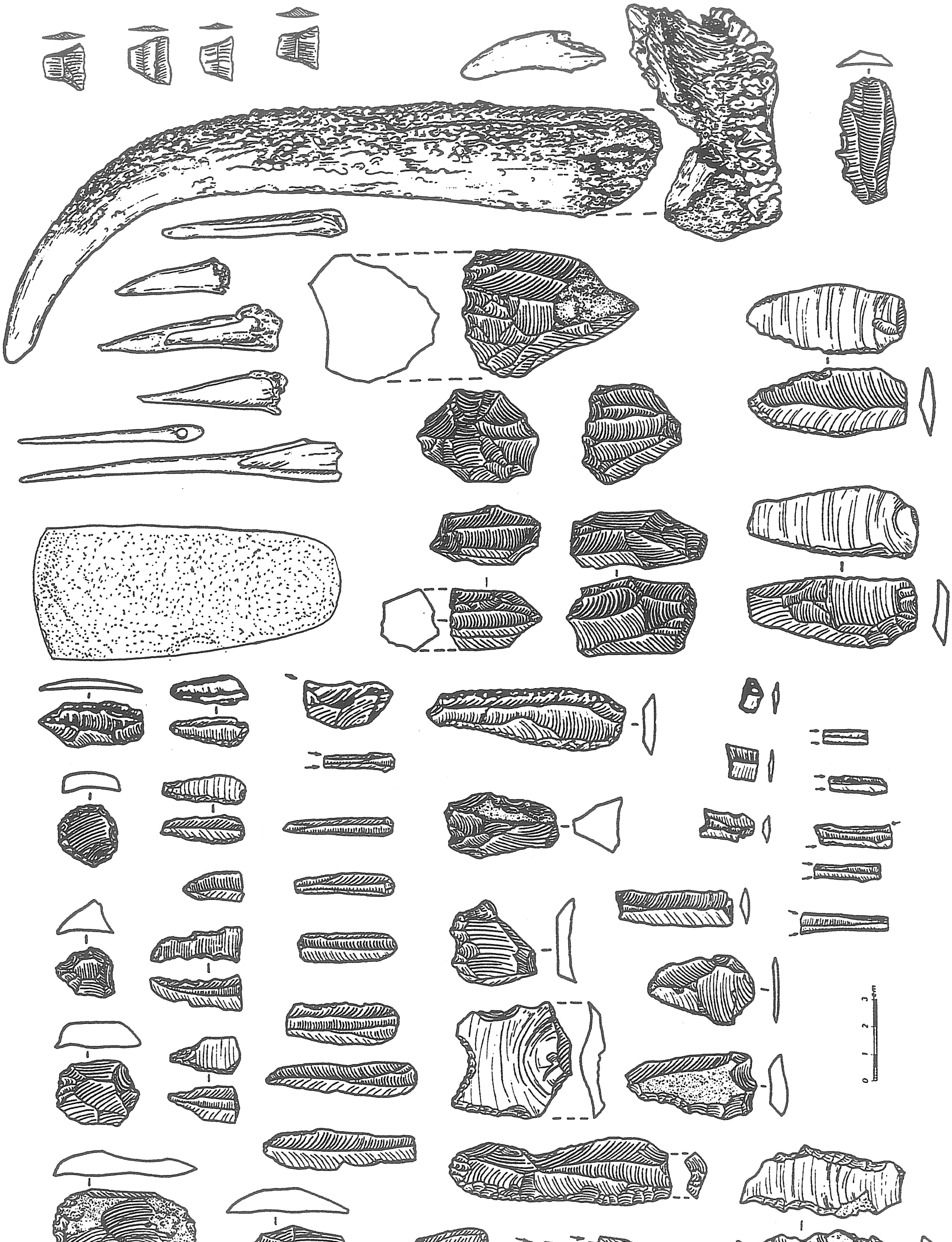


Fig. 3. Darkvety-shelter artefacts (Layer IV).

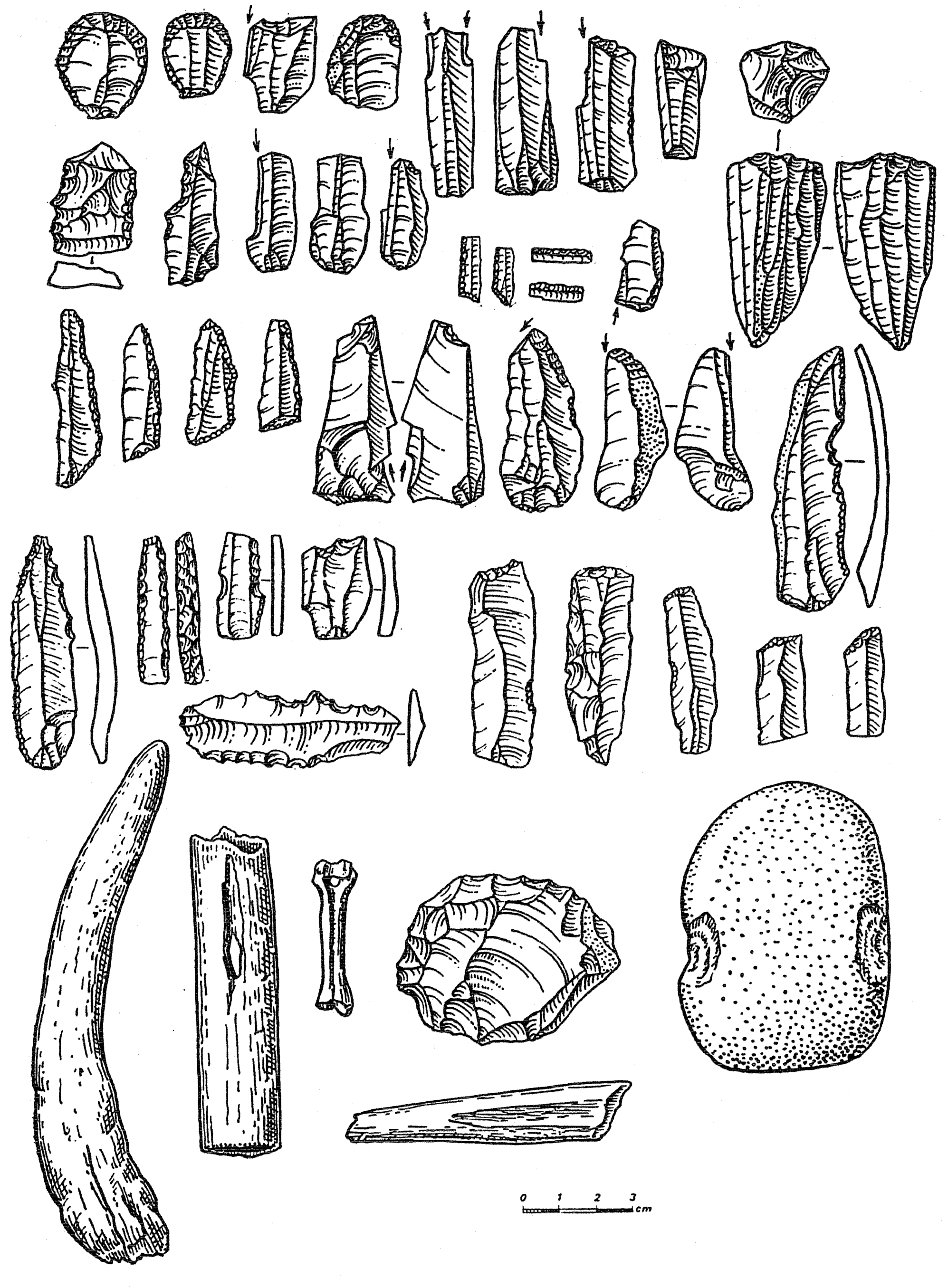


Fig. 4. Darkvety-shelter artefacts (Layer VI).

Western Transcaucasian Late Neolithic

The second site group is the Late Neolithic of western Transcaucasian and was defined as a separate culture, the Odishy (NEBIERIDZE 1972). It is found on the north-eastern Black sea coast close to the city of Suhumy (Abhazia region) and shares a common origin with the sites of the first group (Aceramic Neolithic). Besides Odishy, the second group includes the sites of Anaseuli 1, Gurianta, Mimaty, Kistrik and Lower Shilowka (Fig. 1). These are single-layer sites. The assemblages are identical with those of the first group, according to L.D. Nebieridze (1972). In contrast to the first group, crude pottery is present in the Odishy group.

Microlithic knapping technology is typical of the Odishy culture as well. In contrast to the first group, however, the raw-materials are flint, pebbles and, more rarely, obsidian, although the sites of the Odishy culture are situated in the same zone as the sites of the Aceramic Neolithic. This is the first distinctive trait of the industry of the Odishy culture. Microblades were the main tool blanks (greater than 18%). Large elongated blades obtained from single-platform prismatic cores with one and two cleavage faces and pyramidal cores with one-face or removals around the circumference were used more rarely. Sometimes flakes were obtained from cores resembling a discoidal core. The microblades are notable for their regularity of shape and straight profiles. Standardization of shapes and parameters is observable. It was obtained by controlling the process of consecutive removals from cores. The characteristics of the blanks indicate the use of a phased sequence to remove microblades.

The geometric microliths of the Odishy industry are more numerous and their shapes more diversified compared to the industry of the first group (Fig. 6). They constitute 0,2% of all artefacts at

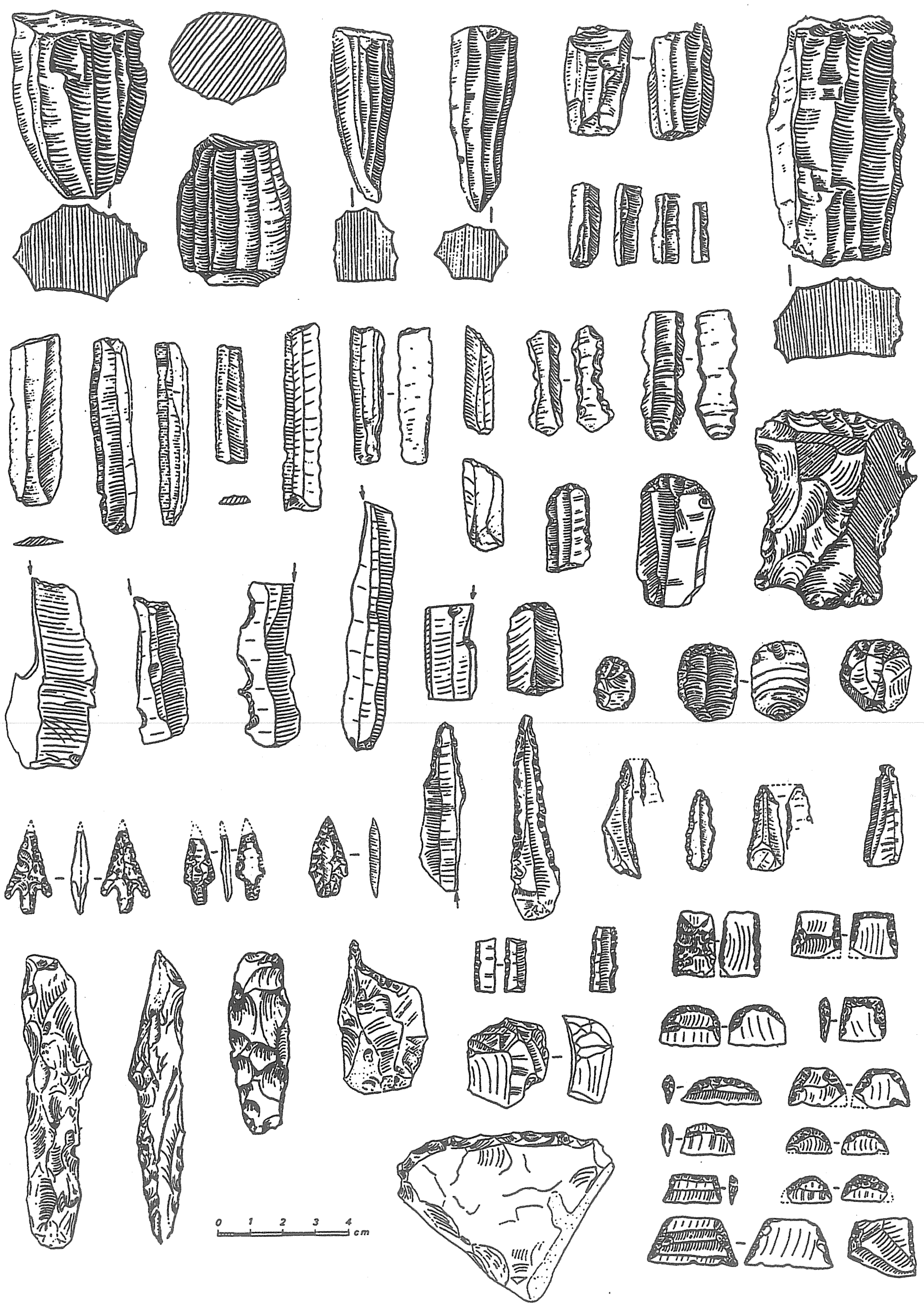


Fig. 5. Artefacts of Odishy Culture: 1,3-5,10,20-24,28,32,35,37,42,45 Odishy; 2,6-9,11-19,25-27,29-31,33-34,36 Anaseuli 2; 41-44,46-61 Kistrik.

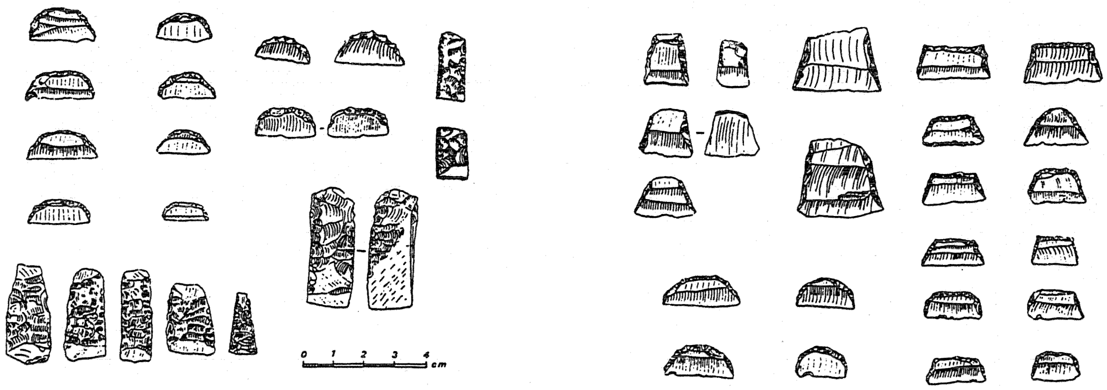


Fig. 6. Anaseuli 2 geometric microliths.

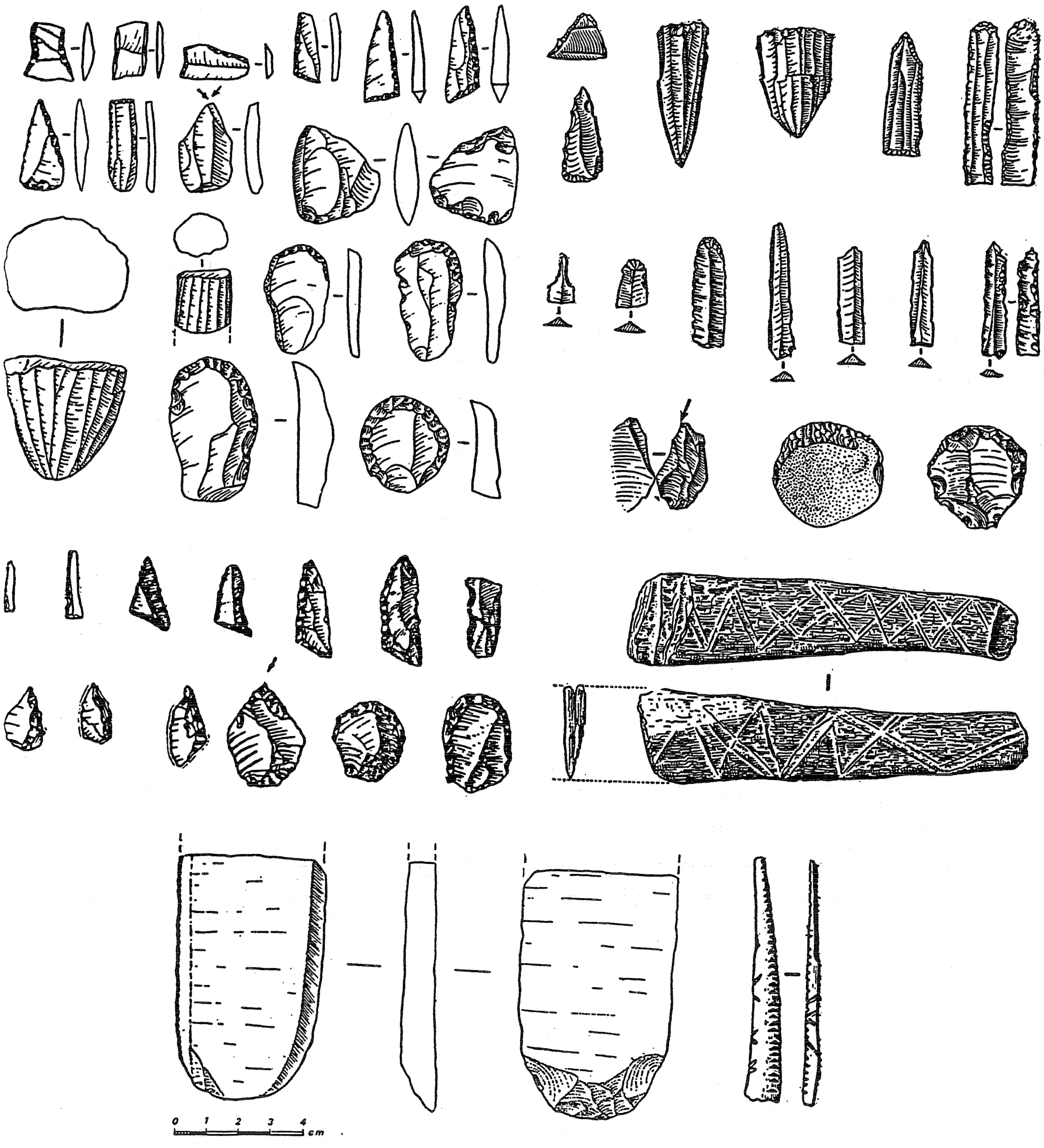


Fig. 7. Artefacts of Choh Culture: 1-32,46-48 Choh (Layer C); 33-45 Kozma-noho.

Anaseuli, 1,2% at Odishy and 3% at Anaseuli 2. New types of microliths and new modes of modifying them appeared. This is the second distinctive trait of the Odishy industry. Predominant among the geometric microliths are short, wide trapezes made of obsidian, rectangles with the back trimmed by long flat retouches (15-20%) and elongated trapezes with three retouched edges. Microliths with bifacial retouch and massive lunates with "Helwan" retouch appeared. Retouch on blades and geometric microliths includes bifacial, flat, elongated, scalar retouch (invasive retouch). This is the third trait of the Odishy industry. All these traits are uncommon in the western Transcaucasian Mesolithic and Early Neolithic. The abrasion and pecking techniques were also used. Backed microblades, various burins and tools exhibiting burin-spall technique dominate, indicating the widespread use of burin-technique in the tool-kit of the Odishy industry. The latter is characteristic for the entire western Transcaucasian Neolithic and is representative of its distinctive nature.

The number of scrapers decreased. They constitute 3% of all artefacts at Anaseuli; only 0,7% at Anaseuli 2 and 1,6% at Odishy. There are micropoint-piercers with an emphasized tip, notched blades, and blades with an obliquely retouched truncation. The fourth major characteristic of the Odishy industry is the presence of tanged arrowheads with lateral retouch. They co-existed with the other type of weapon - sling balls.

Another trait, the fifth, of the Odishy industry is the appearance of large, bifacial pick-shaped tools (Fig. 5).

In addition to the main characteristics of the Odishy tool-kit, headed blades, lunates with Helwan retouch and arrowheads with both lateral edges retouched are typical at the Kistrik and Lower Shilovka sites. According to L.B. Nebieridze (1972), these sites are later than Odishy, Gurianta and Anaseuli 2. This is demonstrated by the presence of crude unornamented pottery and an increase in polished tools. The latter constitute only 1,5% at Anaseuli 2 and at Kistrik about 10% of the assemblage. Amongst the tools are wedge-shaped axes with short-or elongated proportions, and hewing tools with a flat-convex cross-section. There are numerous pick-shaped tools, pole-axe shaped hoes, abraders, mortars, and grain-grinders.

The particular distinctiveness that is observable in the Kistrik - Lower Shilovka assemblages allows definition of two local variants in the Odishy culture (NEBIERIDZE 1972). The first is represented by the sites of the Guria and Mengrelia regions (Anaseuli 2, Odishy, Gurianta and others) and the second by the sites of the Abhazia region and the Adler district (Kistrik, Lower Shilovka). The differences are recognizable in the industries: wide rectangles with faceted dorsal faces made on obsidian are in the 1st group and in the second are wide trapezes with faceted dorsal faces, lunates with Helwan retouch and headed blades. Pottery is also different. Decorated ware with incisions on the rim is characteristic for the Odishy group and plain pottery with unornamented rims for the 2nd group. Probably the differences between the two groups are not only of local, but also of chronological significance.

In discussing the Odishy culture we cannot ignore the Tetramitza site, situated on a hilltop inside the city of Kutais (KILADZE 1951). The site contains assemblages that are almost identical to the Odishy assemblages. A variety of raw-materials were used, but flint was preferred. Blade technology was prevalent. Scrapers and burins dominate the tool-kit, and piercers, bifacially retouched sickle inserts and other tools occur more rarely. In contrast to the Odishy group sites geometric microliths are absent. Bifacial arrow- and javelin-points, mainly tanged-points (the same type that is present at Anaseuli 2 and at Odishy) are typical. The macrolithic tool kit is similar to the Odishian. It includes picks, hoes of the Sochi-Adler type, wedge-shaped stone axes, chisels, gouges, and fishing-weights made on notched ("strangled") pebbles. There are many limestone stone bracelet fragments. The same type of bracelet is present at Late Neolithic-Eneolithic sites of the northern Caucasus and Transcaucasia (NEBIERIDZE 1978). Pottery and dwellings show a certain resemblance to the Odishy culture. These traits illustrate the similarity of Tetramitza to the later Odishy culture sites of Kistrik and Lower Shilowka. The absence of geometric microliths and other early tool-types suggests that Tetramitza is one of the latest sites of the Kistrik variant of the Odishy culture.

For the western Transcaucasian Neolithic, microblade and blade technology is characteristic, as is the diverse macrolith tool kit. Wide-spread burin and abrasion techniques also are typical. Pottery is absent in the entire group of early sites; in the Odishy group decorated pottery is common. Geometric microliths of different shapes and modifications are present. The abundance of burins and piercers, as well as the low frequency of rounded scrapers are characteristic. Also distinctive is the combination of arrowheads and sling-balls. Headed blades of distinctive shape with are present at Kistrik and Lower Shilowka. Polished tools increase. A tendency to microlithization of blade technology and of the entire assemblage is observable. Reaping-tools are numerous. The Neolithic of western Transcaucasia is derived from the local Mesolithic represented by the sites of the Black sea coast culture. According to H.A. Amirhanov (1985), we must look to the Mesolithic of the northwestern Caucasus, the Satanay shelter-type (or Gubsk Shelter 7 after LYUBIN a.o., 1976, 1977) for the origin of the Neolithic of this region. The Neolithic assemblages are closest to the local Mesolithic sites. It is probable that the Neolithic here was influenced by the neighbouring Mesolithic including the northern

Caucasian industries. It is important to remember at this juncture that the Early Neolithic sites of the Transcaucasian Black sea area (Anaseuli I, Kobuleti and others) use obsidian that comes from the raw-material sources of the northern Caucasus. Lunates with Helwan retouch and blades with the singled-out head were found at Kistrik and Lower Shilowka. These artefacts are similar to those found at the Ovechka-sites of the northern Black Sea coast area (LYUBIN 1966) and at Satanay shelter which is dated to the Early Mesolithic.

The original centre of this distinctive Mesolithic-Neolithic culture is traced in the mountain region of Dagestan in the north-eastern part of the Caucasus. This is the Chokh culture that existed during the Late Mesolithic - Early Neolithic. The culture was defined by H.A. Amirhanov using materials from the eponymous Choh-site from undisturbed cultural layers from the Late Mesolithic to the Bronze Age (AMIRDJANOV 1985, 1987) and the open-air single-layer site of Kozma-Noho (KOTOVICH 1964). The origin of this culture is connected to the Early Mesolithic and Late Palaeolithic of the northern Caucasus. The lower Choh section is comparable to the post-Chvalyn Caspian sea regression (10.000-9000 b.p.), based on pollen-diagrams, and the upper section with the New Caspian transgression (8000 b.p.). Radiocarbon dates suggest the end of VIIth - beginning of VIth millennium B.C. (Neolithic) and VIIIth-VIIth mill. B.C. (Mesolithic). The Choh culture thus spans about 2000-2500 years. The earliest Caucasian area permanent dwellings were found at Choh. Dwellings have a corridor-shaped entrance and a hearth in the centre; they were constructed using unworked stone-blocks and were built up against the rock-cliffs. According to ethnographers, this type of small mountain settlement was traditional until recent times (ISLAMMAGOMEDOV 1967).

Stone artefacts are the most common finds at Choh. The industry has certain distinctive traits (Fig. 7). The main raw-material was black or light-grey coloured flint (91,5%), with rarer occurrences of slate and limestone. The nearest flint raw-material sources are situated about 30km from Choh. Cores are represented by prismatic, pyramidal, "pencil-shaped," archaic discoidal, and Levallois-like types. Single-platform and double-platform cores with two cleavage faces are included. The technology and typological characteristics of the cores, blanks and tools show the domination of the microblade technique of flint knapping with some archaic elements of Mesolithic origin. Cores are of shortened proportions (in contrast to the western Transcaucasian ones) and have horizontally modified striking platforms with "lipped edges" removed. The removal of microblades and (more rarely) blades was regular and followed a succession around the circumference of the striking platform. The striking-platforms were prepared with one blow and then were modified by slight blows that removed the over-hanging "lips". Removals were vertical, parallel and without fractures. The negative scar width is 0,5cm on average which corresponds to the width of the majority of the microblades. Thus flint knapping was organized to obtain microblades. The negative scars are situated along the entire cleavage face and the core reduced to a "pencil-shape" with no further removals possible. "Pencil-shaped" cores first appeared in the lower Mesolithic layers but became typical only during the Neolithic. All of the blade-blanks correspond to the dimensions of the negative scars on the cores and have regular shapes and high-quality characteristics. The *chaîne opératoire* of stone knapping at Choh and the standardization of microlithic blanks indicates that these were produced to be used as inserts.

The Neolithic assemblage from Choh has a higher percentage of microlithic blanks compared to the Mesolithic layers (27 and 14%, respectively); it also has more flake-blanks. The distinctive trait of the Choh assemblage is the presence of unique geometric microliths. They are different from those known in the western Transcaucasian Neolithic. There are elongated, asymmetrical, obtuse-angled triangles (symmetrical ones are rare), wide trapezes with both sides obliquely retouched, trapeze-shaped truncations without any retouch, and rare lunates.

The use of many types of retouch is significant in the treatment of tools, but was used for a restricted number of tools only (about 4%). Burin-spall technique, trimming of the blanks' ends and also truncation of blades are present. Steep backing retouch on the sides of blanks is the most typical. Small-facet sharpening retouch and semi-steep retouch occurred more rarely. The modification of tools did not change throughout the entire period of the Choh culture, although the microlithization of blanks increased (AMIRDJANOV 1985).

Various scrapers are the predominant form in the tool-kit. This is in contrast to western Transcaucasia where burins and burin-technique tools prevail. Scrapers constitute more than 50% of all Choh tools. There are end-scrapers made on irregular blades with a broad working-edge. Elongated scrapers are present in some cases but short ones are more common. Carinate massive tools occurred. Rounded carinate scrapers with steep circular retouch appeared in the Neolithic. These carinate types and the short scrapers are more common than end-scrapers. A tendency for scraper dimensions to decrease is noted.

Geometric microliths are present in moderately high frequency (about 14%). These microliths are smaller than those from the Mesolithic assemblages. Choh-type points are common. There are small blades or flakes with obliquely retouched truncations and an invasively retouched base (about 10%). Knives with an oblique distal retouched end are rare but significant finds in the Neolithic layer. At Choh, various burins typical in western Transcaucasia are represented by a restricted number of types. These are mainly angle burins on broken blades and dihedral burins. Micropoints-piercers are also rather uncommon.

New tools, reaping-knife inserts, appeared. They were used in slate, bone and probably wooden hafts. The slate haft is analogous to the Sialk 1 find (GHIRSHMAN 1939) and is unique in the Caucasus. Cultivated cereals and bones of domesticated animals are found. The knapping technology and tool treatment of the Choh inventory continues the local traditions, as was correctly suggested by H. A. Amirhanov (1987). At the same time, new elements appeared in the Neolithic together with a tendency to microlithization in the knapping technology, an increase in geometric microliths, and a decrease in their dimensions. Inserts and hafts for reaping knives, grain-grinders, mortars and pottery appeared. There is evidence of the transition to new types of economy - agriculture and stock-breeding. This is reflected in the increased role played by the insert-technique which affected microlithization and standardization of blanks, manufacturing of new tools associated with the new economy, and also in the appearance of a settled way of life and long-term permanent-type dwellings.

According to H.A. Amirdjanov's (1985) investigation, interrelations with neighbouring cultures occurred throughout all the southern Caspian area including the caves of Hotu and Gar i-Kamarband (COON 1957). He explains the similarities by convergence in the development of the industries or by a common cultural foundation. H.A. Amirdjanov is more inclined to the second hypothesis. I favor the hypothesis of R. M. Munchaev (1975), who explains use of similar tools in the Black sea area and at sites in the Near East as a result of convergence. The Transcaucasian Neolithic sites, to me, were the recepients of significant contacts from the Near Eastern cultures.

Besides the Choh culture in Dagestan, there are about 20 known Neolithic sites situated in the foot-hill area and in the sea-coast zone. Among them, the sites of Tarnair (situated close to Mahachkala-city) and Bujnakskaja (Fig. 8) stand out because of the large number of finds. Both sites were discovered and investigated by V.I. Markovin (1957, 1959; MARKOVIN and MUNCHAEV 1957). According to the researchers, the sites are dated to the Early Neolithic. There are no radiocarbon determinations. No cultural layers were extant. Nevertheless the assemblages are rather significant and homogenous.

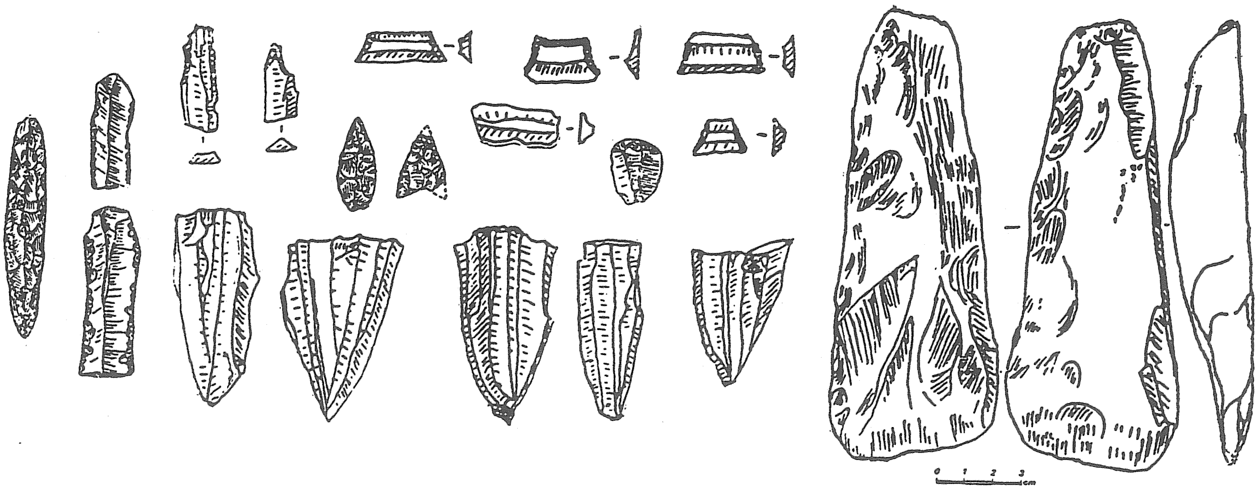


Fig. 8. Artefacts from Tarnair and Buinakskaya sites: 1,7-14 Tarnair-site; 2-6,15-18 Buinakskaya site.

Transparent and semi-transparent flint is characteristic for the industry at Tarnair with quartz used in rare cases. The main blanks are large and medium-sized blades struck off discoidal and pyramidal cores. The latter is represented by 70 specimens. There are also pre-cores or flint nodules with traces of initial knapping. A concentration of cores, flakes, fragments of blades, chipping waste and nodules is observable at the site. An anvil and hammer-stones were found close to this place. All of it is evidence for the transport of flint nodules to the site and then knapping for producing blanks. Bifacial, large-facet, flat retouch of the entire surface and also retouch along one lateral edge were used in the manufacture of tools.

The tool-kit combines microliths and macrotools. Geometric microliths are represented by asymmetrical wide trapezes with small retouch on the lateral sides (3 specimens). Scrapers are made on large regular blades with short or more rarely elongated end-scrapers prevailing. Some double-end scrapers are also found. The tool-kit includes elongated (up to 6,3cm) blades with lateral retouch. Rod-shaped points are numerous. Burins are rare (4 specimens), as are piercers and bifacial, leaf-shaped arrowheads. Microblades and arrowheads with concave bases are rare.

The macrotools include side-scrapers of discoidal and rectangular shapes, pick-shaped tools with bifacial retouch, "cigar-shaped" pressure blades (8,4-10,6cm in length) with large-facet retouch on the entire surface, polished axes, and pestles.

The assemblage from Tarnair is typologically close to the Agubekovo site situated in the central part of the northern Caucasus (KRICHEVSKIJ and KRUGLOV 1941) and to the Buinakskaja site. The presence of small trapezes with lateral retouch, "pencil-shaped" and discoidal cores combined with macrotools suggests that the Tarnair site is Early (Aceramic) Neolithic. The Agubekovo site looks the latest among the sites mentioned above because of the presence of crude pottery.

The industry of Buinakskaja is represented by the microlithic technique used to manufacture microblades of standard shape and dimensions. Microblades were produced from miniature "pencil-shaped" cores. The "microlithic" character of the complex is accentuated by the presence of small elongated symmetrical trapezes including ones with slightly concave lateral- and upper sides with the front edge showing small-facet edge retouch. Small, rounded and end-scrapers are present in significant numbers. There are also retouched microblades, piercers with sharp emphasized tips, and retouched blades and flakes. There are also macrotools as in the Tarnair assemblage. They are represented by wedge-shaped axes with a polished edge and by blanks of a similar tool. Pottery is absent.

The Tarnair and Buinakskaja sites are comparable, in terms of the phase of development, with the western Transcaucasian sites of the Early (Aceramic) Neolithic (small trapezes with slightly concave lateral sides, "pencil-shaped" cores, rounded scrapers and microscrapers, microblade technology, the absence of pottery, the presence of macrotools, etc.). At the same time, there are sharp distinctions between the assemblages. Arrowheads with bifacial retouch are absent in the Transcaucasian area, obsidian there was the main raw-material, and carinate scrapers on flakes and numerous burins are typical.

The group of sites belonging to the Ginchi culture (Vth-IVth mill. B.C.) is extremely distinctive. The sites are situated within the mountain zone of Dagestan, in the north-eastern Caucasus. The origin of the culture can be traced to the Early Neolithic represented at the sites of Rugudji and Chinna (KOTOVICH 1964). The culture was defined and investigated by M.G. Gadzhiev. The chronological framework covers the late Neolithic - Eneolithic. It was named after the eponymous site of Ginchi dated to the Eneolithic (GADJIEV 1991). The earliest occurrence of the culture is found at sites of the Late Neolithic (Rugudji sites). The Ginchi site represents a permanent base camp with numerous dwellings of semi-subterranean type and surface constructions of rounded or rectangular shape. Grain storage pits and defensive walls are found. The Rugudji sites and Chinna are seasonal temporary camps.

The industry of the Ginchi culture is characterised by large blade and flake technology. Flint was extracted from neighbouring districts. The same areas were also used for flint extraction by the inhabitants of Choh. Flint knapping for the preparation of pre-cores was done outside the sites at workshops. These were found in the area of the Akushinskij and Levashinskij raw-material sources. At Ginchi sites, further reduction of prepared pre-cores and cores was undertaken, therefore, the products of initial knapping are absent there.

Blades constitute about 85% of all tools and flakes about 13%. The tools were prepared mainly on large blades measuring in width 1,5-2cm and 5-7,5cm in length. They comprise 35% of the blade tools, and medium-sized blades with a width of 1-1,4cm, about 12%. Macroblades with widths more than 2,5cm are rare; microblades and geometric microliths were not found. Large single platform, elongated cores, and pyramidal cores struck completely around the circumference were used for producing blades. Truncation of the upper curved edge of blades was used to obtain straight blanks. As a result, blades are of regular prismatic shapes and straight profiles.

Tool treatment has distinctive traits. Several kinds of retouch were used. Abrupt retouch and semi-steep retouch occur about equally, 50% and 48%, respectively. Small-facet lateral retouch along the dorsal blade-edge predominated (more than 54,5%). Denticulated, inverse, and bifacial retouch are not found. No ventral surface treatment occurred. Burin-spall technique was used very rarely-only for preparing burins, for backing the edges of knives and for reworking of some tools.

The tool-kit is monotonous from a typological point of view (Fig. 9). Retouched blades are most common (more than 60%). Scrapers, mainly end-scrapers, constitute 11,5%, retouched flakes about 8% and points - 5%. Arrowheads are absent. Macrotools includes grain-grinders, mortars, pestles, and abraders. All of the tools were prepared by pecking and abrasion techniques.

The assemblages of the Ginchi culture show a decrease in the flint portion of the industries. At the Neolithic/Eneolithic boundary, the Mesolithic/Neolithic tradition of knapping was replaced by the large blade - and partly flake-technology. The blanks from the industry of the Rugudji sites indicate the tendency for blade-technology to decrease and flake technology to increase. The Chinna site is an example. It contains only two prismatic blades of regular shape and flakes comprise almost 50% of the assemblage (GADJIEV 1991). This stage concludes the period when stone was the dominant raw-material for tool production in the mountainous Dagestan area. At the same time, the character of the industry demonstrates the distinctiveness of the local technological tradition.

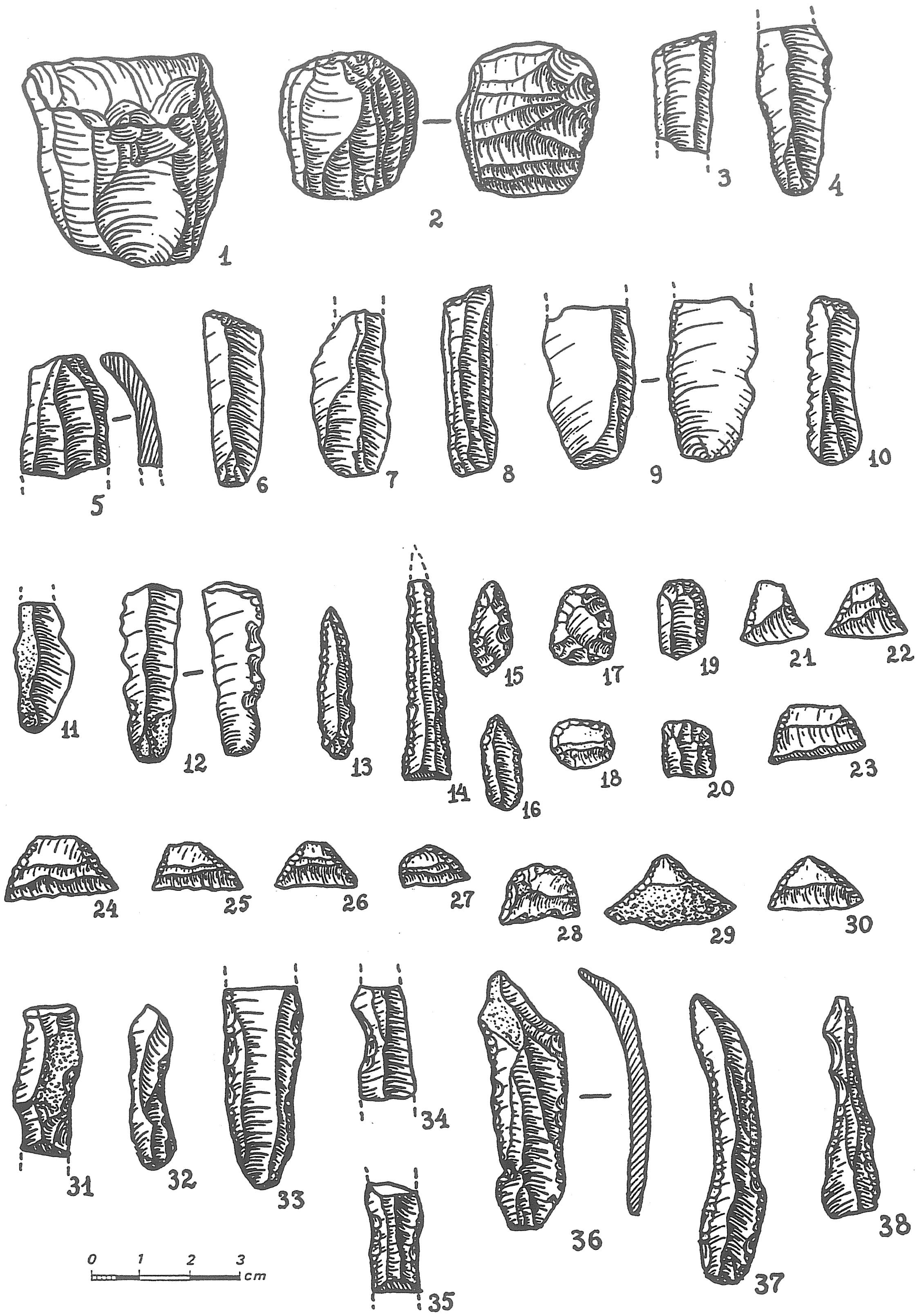


Fig. 9. Ginchi artefacts.

Comparison of the Western Transcaucasian Sites to the North-Western Transcaucasian Sites

A comparison of the industries from this western Transcaucasian area to the northwestern Caucasus area (contemporary sites of Meshoko-type, Ovechki and Kamennomostskaja cave) (FORMOZOV 1965, STOLJAR 1961, MUNCHAEV 1975) shows striking distinctions. The latter sites resemble the western Transcaucasian Neolithic/Eneolithic assemblages. It is sufficient to remember the

Darkvety shelter assemblages (IInd and IIIrd layers) and the new and prominent site of Svobodnoje (northern Caucasus), discovered and investigated by A.A. Nehaev (1992). This researcher corrected the understanding of the Maikop culture. The new materials allowed A. A. Nehaev to define a pre-Maikopian horizon (or the pre-Maikopian culture) of the Final Neolithic/Eneolithic. It unites all the cave-assemblages of the Caucasian foot-hills (Meshoko, Ovechka, Kamennomostskaja cave, Svobodnoe, not excluding the IInd - IIIrd layers of Darkvety shelter) that contain blade flint industries with clear definable "microlithic" traits. Miniature symmetrical trapezes, numerous prismatic microblades of regular shape and rounded microscrapers are typical (Fig. 10). Triangular-shaped, bifacial arrowheads with a concave base, end-scrapers, reaping-tool inserts, blades with singled-out head, points, polished axes, gouges, chisels, stone bracelets, antler hoes, harpoons, fish-hooks, tools for plaiting mats, and other implements are diagnostic, including a bone spoon. There is anthropomorphic art and numerous different ornaments. The richness and diversity of the materials of the pre-Maikop sites allow a division into three periods (NECHAEV 1992).

The data obtained are convincing for the apportionment of the pre-Maikop culture. The culture has many resemblances to the western Transcaucasian sites of the Late Neolithic-Early Eneolithic and is definitely different from the synchronic assemblages of Ginchi type.

The Southeastern Transcaucasian Area

The original centre of Neolithic culture is found in the southeastern Transcaucasian area in the region of the Kobustan State Preserve of History and Art, famous for its rock-pictures. The work of D.N. Rustamov and F. M. Muradova revealed several Mesolithic and Neolithic assemblages with a distinctive microlithic industry (RUSTAMOV and MURADOVA 1971, 1972, 1975, 1976). There are multi-stratified sites with lower horizons dated to Neolithic. The key-site is the Firuz shelter situated close to the isolated rock of Kichikdash. The lower layer contains stone artefacts only (no pottery) and the upper layer - materials of the Bronze Age. The thickness of the Neolithic layer is 10-20cm. Among the faunal remains are bones of only wild animals.

Some sites were situated on the terraces of Bejukdash mountain. The assemblages, based on the knapping technology, tool treatment and tool-kit are somewhat similar to the Mesolithic/Neolithic sites of Gari-Kamarband- and Hotu-type (COON 1957) in the southern Caspian area and the eastern Caspian sites of Dam-Dam-Chashme 1 and 2 (OKLADNIKOV 1953; MARKOV 1966, 1981). The composition of the toolkit and the ratio of geometric microliths from the Mesolithic sites of Kobustan are most similar to the assemblages of Zarzi-type, Dam-Dam-Chashme 1 (Layer 2) and Dam-Dam-Chashme 2 (Layer 4, upper part) (KOROBKOVA 1989). There are elongated asymmetrical triangles, large elongated lunates with "Helwan" retouch, and trapezes with concave sides (Ana-Zaga site).

The stone artefacts assemblage from the Neolithic layers is representative and rather significant. At the Kjaniza site alone more then 10.000 artefacts were found. Flint and pebbles only were used for the manufacture of tools. The presence of "exhausted" prismatic microcores of short proportions, and the considerable amount of microblades and geometric microliths indicates the use of microblade-technology. Microblades, small flakes, and more rarely pebbles and chips were the major types of blanks. Lateral retouch was the principle tool modification and end's trimming, pecking and bifacial retouch occur more rarely. Burin-spall technique is present among the rare types of modification. Retouched microblades, micro-endscrapers with concave sides, and rounded scrapers made on flakes and microblades are on the main tools. The industry includes backed micropoints produced on thin regular blades, flakes with trimmed edges, blades with concave retouched sides and a significant number of trapezes. The latter are small and symmetrical with oblique sides. They constitute 25% of all lower layer finds at Firuz, but at Kjaniz they are less frequent. Hammerstones, choppers, grinders, and fish-weights must be mentioned among the other tools. A fragment of an antler-haft with grooves on both edges for microblades and a ball-shaped mace-head were found in the lower layer of Kjaniz. Stone vessels and two female figurines are also of interest (RUSTAMOV and MURADOVA 1976).

The comparison of the Firuz and Kjaniz materials and their stratigraphic contexts compared to the Mesolithic assemblages of Kobustan and neighbouring areas allows a relative dating of the sites in question to the Early Neolithic. The isolation of the Kobustan area, relatively little Mesolithic/Neolithic exploration and few publications except some notes and studies published in the Azerbaijan language have made it difficult to define the cultural affiliation of the Firuz-type sites. At the same time, however, it is possible to speak about the distinctiveness of the Kobustan Neolithic group of sites and their links with the local Mesolithic.

The geometric microliths and their dominance in the industry are strikingly similar to sites from the southern and eastern areas of the Circumcaspian zone. There is no doubt that the Kobustan group must be attributed to the sites of this area but with the recognition of the existence of distinctive aspects of technology.

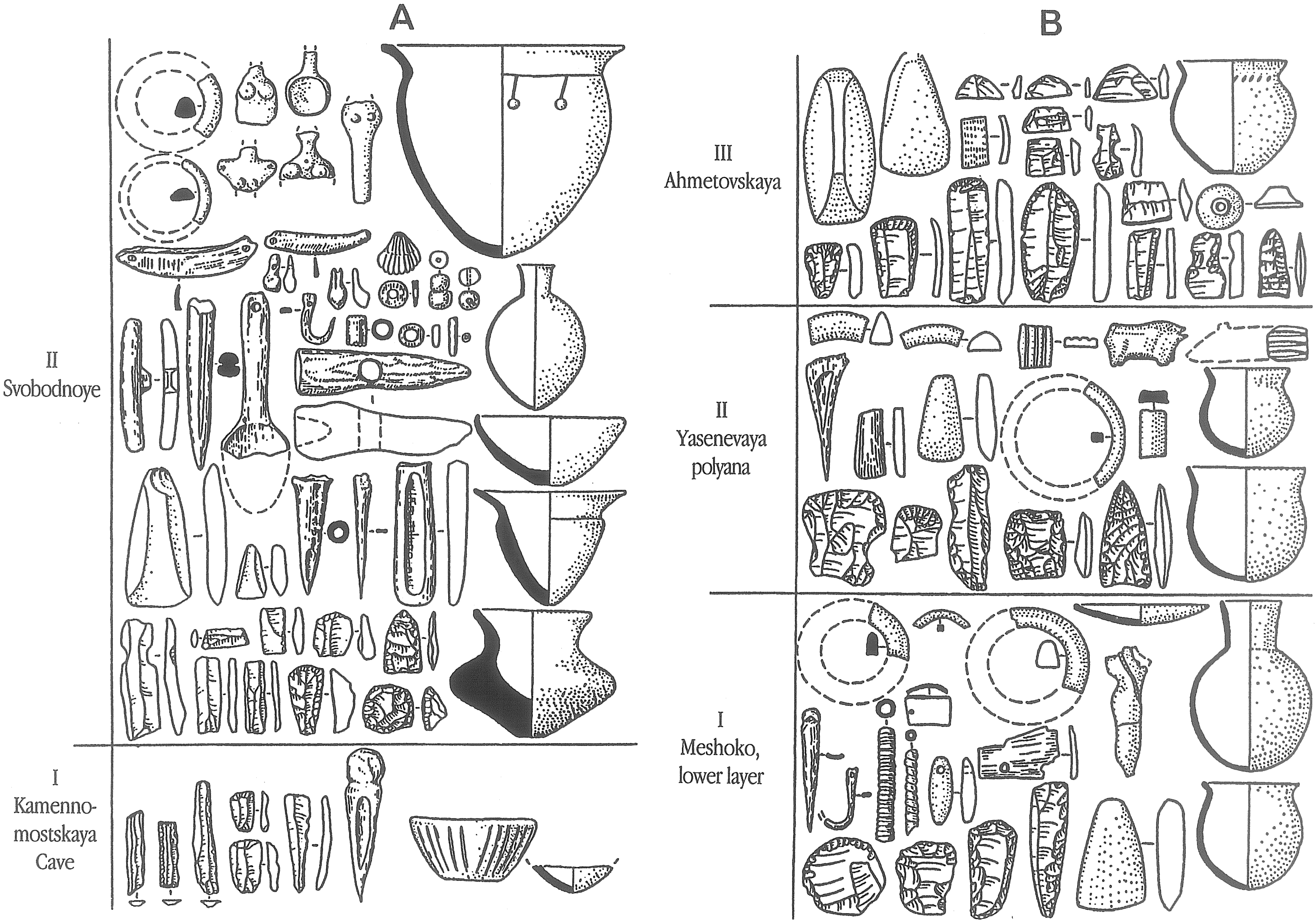


Fig. 10. Artefacts of pre-Maikop Culture (after NEHAEV 1992): A Early stage (I Kamennomostskaya Cave, II Svobodnoye), B Middle stage (I Meshoko, lower layer; II Yasenevaya polyana; III Ahmetovskaya).

The Central and Southern Transcaucasian Area

The territory of central and southern Transcaucasia was occupied during the VIth-Vth mill. B.C. by settled farmers and stock-breeders initially named the Shomu-tepe culture (NARIMANOV 1987) and later the Shulaveri-Shomu-tepe culture (KIGURADZE 1976, DJAPARIDZE 1976). It is represented by numerous open-air sites, clustered in 2-5 settlements per group, situated in the Kura-river valley. It is the most studied group of the Caucasian Neolithic and has yielded the most differentiated information. The settlements are represented by "tells" or "gora" or "tepe" of 2,5-8 metres height that contain several building-horizons with the remains of rounded *pisé*-walled dwellings and other household constructions. The settlements lack a clear planning layout, with the exception of Imiris-gora where the concentration of houses and house-hold constructions around an open area is observable (AMIRDJANOV 1983). At Hramis-Didi-Gora, constructions are situated around yards (KIGURADZE and DILBARJAN 1983). There are, however, examples of tentative settlement planning. At Shomu-tepe, Aruhlo 1, Toire-tepe, and Chagalan-tepe, rounded dug-out dwellings coexisted with *pisé*-walled houses. According to researchers, the round cupola architecture is a local traditional style not connected with the architectural tradition of the Near East. The insidee walls of one of the Chalagan-tepe constructions were covered with grout. Traces of painting remained on the partition dividing the construction into two parts (NARIMANOV 1985). The floors of some rooms were coloured with red ochre. The remains of kilns for pottery-firing were discovered in the settlement area.

The industry of the Shulaveri-Shomutepe culture is quite distinctive. The use of obsidian is typical (84-87%); more rarely flint or other kinds of stone occur. Sources of obsidian are situated in the area of the Minor Caucasus. Based on the refraction index of obsidian from the Neolithic sites of Azerbaijan and Georgia, the inhabitants of Shomu-tepe, Toire-tepe, Gargalarytepesi, Shulaveris-gora and others used raw material that originated in the Paravan valley of Georgia (ARAZOVA 1974). Obsidian was also transported from the Atis raw-material source in Armenia. It is striking that despite the rich sources of flint situated close to Shomu-tepe, inhabitants of the tepe mainly used obsidian. The same is true of Shulaveris-gora where artefacts made on flint constitute only 2,5% of the assemblage.

The use of obsidian as the main raw-material for tool manufacture is another distinctive trait of the Shulaveri-Shomutepe culture. New sites, for example, Chalagan-tepe, confirm the priority of obsidian for the tools (NARIMANOV 1987a, 1987b; NARIMANOV *et al.* 1988).

All settlements are no more than 300km from the obsidian raw-material sources. The other types of stone constitute about 17-20% (flint, tuff, argelite, and limestone occur in abundance in the area). Pebbles were also used. These kinds of stone were used for manufacturing sickle inserts, and more rarely for scrapers, borers and knives. The toolkit demonstrates the high-developed blade-technology of the Shulaveri-Shomutepe culture (Figs. 11-12). Single-platform prismatic or pyramidal cores with circular or single face cleavage patterns and their edges carefully prepared are found at the sites. They show that a phased sequence of blank removal was used. The final goal of the process was to obtain standardized blanks for composite tools. The cores were used to different degrees. There are miniature specimens as the result of intensive reduction and large cores of elongated proportions (length about 10-14,5cm and width of 4,3-8,2cm). Medium-sized cores occur with a length of 10-14,5cm and width of 4-4,2cm, as well as those with short proportions (length 6,6-12cm and width 5,5-11,5cm). The negative flake scars of regular prismatic blades have elongated proportions mirroring the blades that were recovered.

Large blades, 5,6-7,5cm in length and 1,5-2,5cm in width, are the most numerous. Medium-sized blades (3,5-5,5 by 1,0-1,4cm) are somewhat less common. Blades of 7,6-10cm length and a width of 2,6-3cm were used only rarely.

Different techniques and methods were used in tool modification. Retouch technique is the most definitive. Abrupt retouch (an angle about 90 degrees) was most common; more rarely, acute retouch (an angle not more than 30 degrees) was used. Retouch is divided into a large facet type with a diameter from 3 to 5mm and a small facet type with a diameter up to 2mm. The latter appeared only rarely. Partial lateral retouch and denticulated retouch also appeared rarely. Different placement of retouch on the faces of the blank are also apparent. Inverse retouch and lateral single-edge retouch of different variants prevailed.

The tool-kit (43-46% of the industry) reflects a blade technology. Blades with lateral retouch prevailed (30-59% of the tools), as well as flint sickle-inserts of lunate and rectangular-shapes made on blades without retouch (10,5-13,5%). Burins are common (from 6 to 18,5%), as are tools with trimmed ends (from 6 to 19,5%) and retouched flakes (from 8,5 to 9,5%). Points are rare (1-5%), as are scrapers (1,5-8,4%), blades with obliquely retouched truncations and blades with concave sides (about 5%). Geometric microliths are very rare (less than 1%), as are headed blades (Fig. 11-13). Microliths are represented by small-sized, symmetrical and asymmetrical trapezes with "wide" proportions; the back is trimmed by long flat retouches. There are also elongated lunates with abrupt "Hel-

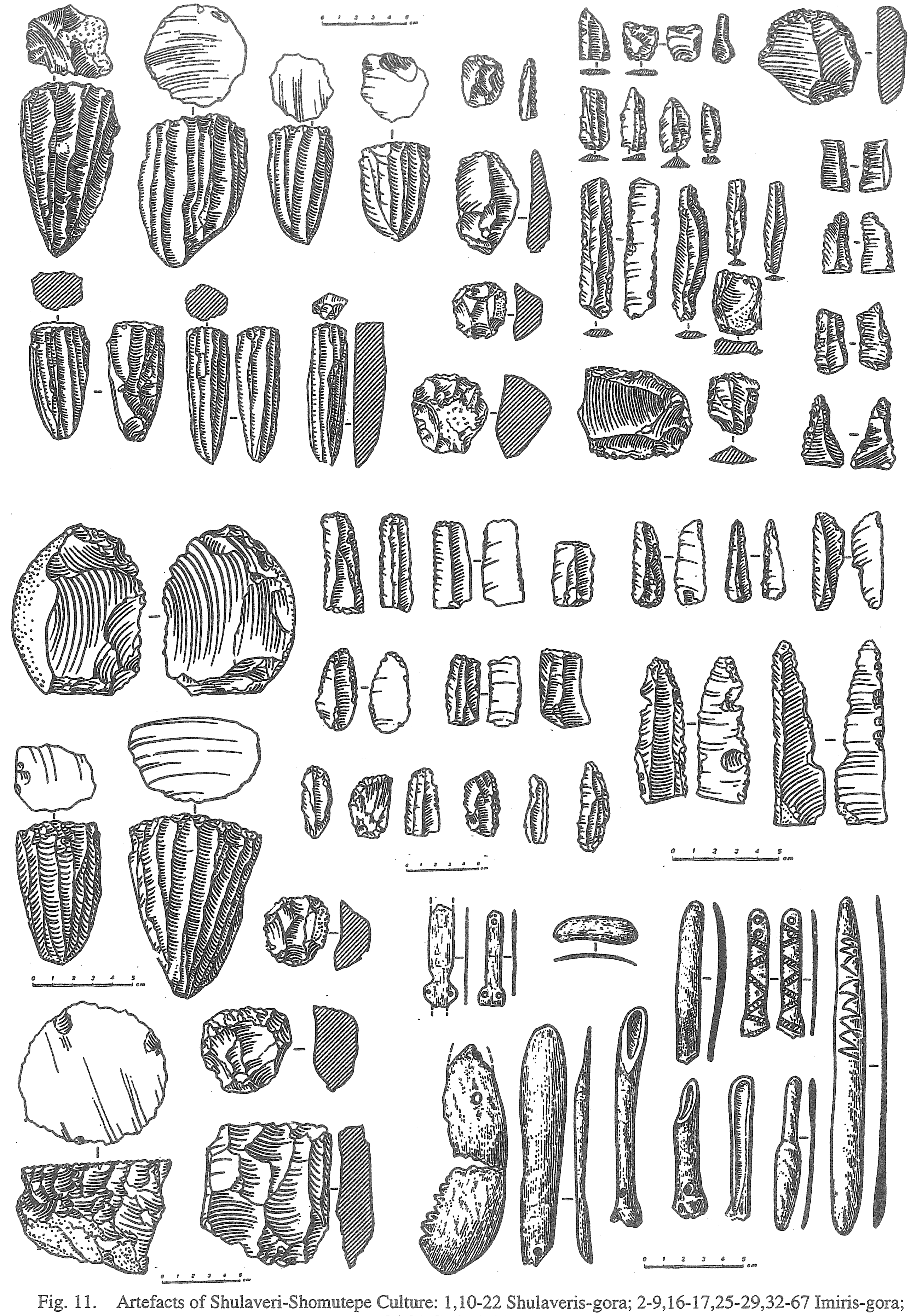


Fig. 11. Artefacts of Shulaveri-Shomutepe Culture: 1,10-22 Shulaveris-gora; 2-9,16-17,25-29,32-67 Imiris-gora; 24,31 Gadachrili-gora.

wan" retouch. Traces of bitumen remained on some of the inserts (mainly on sickle inserts). Arrowheads are absent. Exceptions are the finds from Zopi (bifacial arrowhead), Aruhlo 1 (tanged willow-leaf shaped arrowhead worked by inverse retouch), and Imiris-gora (triangular-shaped, bifacial arrowhead with a straight base). The industry is supplemented by polished axes, wedge-like gouges, large, oval, rounded or triangular shaped side-scrapers made on flint, basalt, and obsidian (less than 1%), and by bone awls, polishers, needles, spoons, antler hoes, digging stick heads, and other tools (Figs. 11-13).

Straw-tempered pottery and terracotta figurines of seated corpulent women are distinctive. Some parallels can be traced in the materials of the Hassuna and Halaf cultures of the Near East. For example, the spoons are similar to the finds at Haçilar, the ornamented artefact from Imiris-gora is comparable with the find from Sialk 1, and the clay cones with the finds from Djeitun, Sialk 1 and other sites.

There is a tendency toward increased blade size compared to earlier Transcaucasian assemblages and a disappearance of geometric microliths. Macrotools and sickle-inserts increased in frequency.

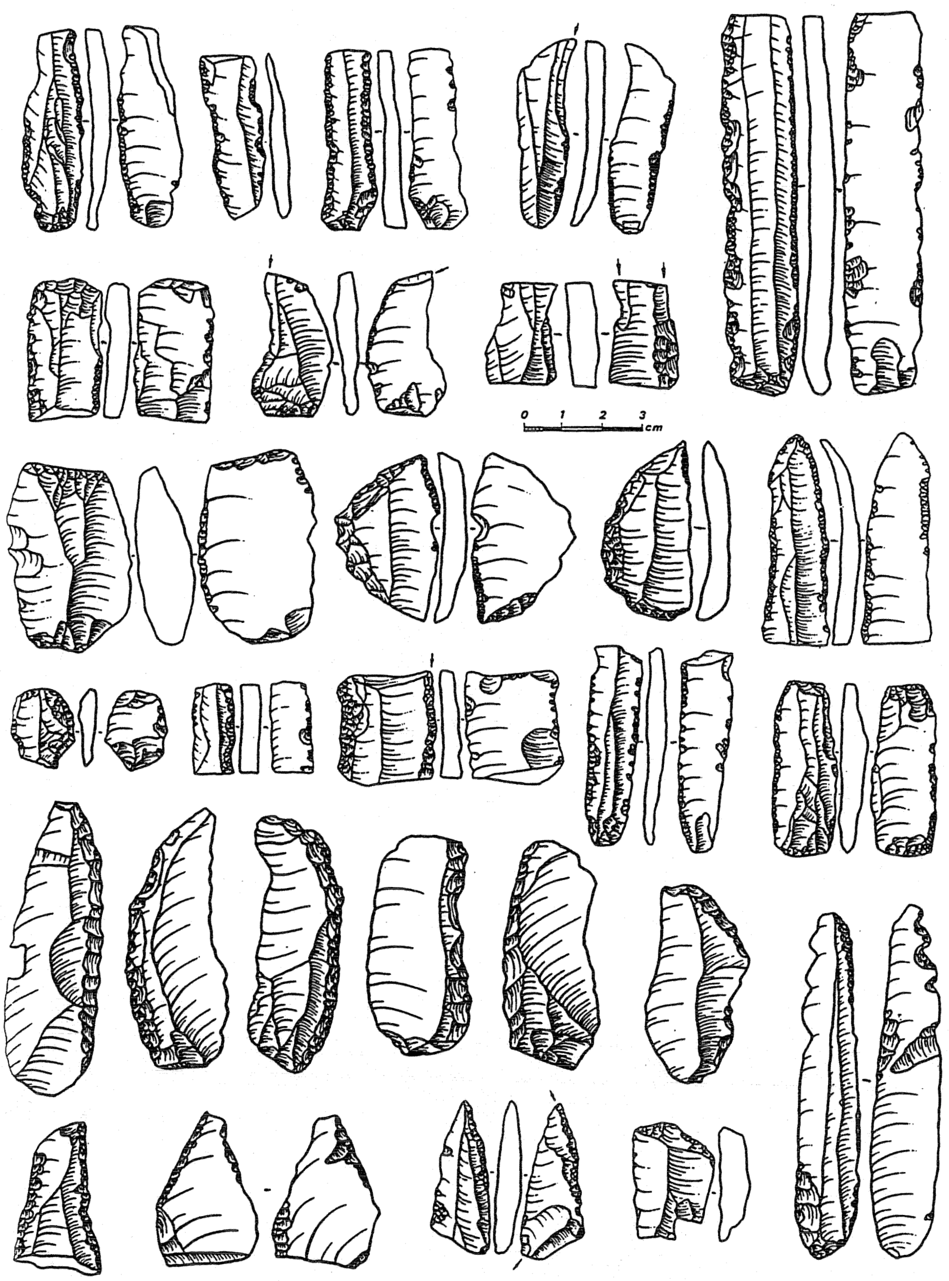


Fig. 12. Artefacts of Shulaveri-Shomutepe Culture: 1-8,12,16-17,23-24,26-28 Gargalar-tepesi; 9-11,13-15 Toire-tepe; 18-22,25 Baba-dervish.

The distinctiveness of the Shulaveri-Shomutepe culture traditions compared to the Odishy, Choh, Ginchi and other Caucasian cultures is obvious.

The sites neighbouring the settlements of the Shulaveri-Shomutepe culture and situated practically in the same culture distribution area are of interest. They attract attention because of the appearance of the industry, as well as pottery. They can be considered sites of a distinct cultural-chronological group. The group consists of the site of N 133, the workshops of Kilikdag and the settlement of N 1 situated in the Gjandja-Kazah district of Azerbaijan to the west of the city of Hanlar (GUMMEL 1948). The sites are well-stratified and contain layers of the Eneolithic-Early Bronze Age.

In contrast to the Shulaveri-Shomutepe culture, the industry of the Hanlar group is represented mainly by flint finds and very rare finds of obsidian. The main raw-material was flint of local origin procured at the Kilik-Dağ workshops. Blade technology oriented to obtaining of large elongated blades (length of 5-10cm) with slightly curved profiles and produced from a prismatic single-platform, relatively flat core with a single cleavage face is typical. More than 50 cores of this type were found at Site N 133. The lateral sides of the cores were shaped with short diagonal blows to create a special form and to restrict the cleavage face. The surface is one-sided, broad and slightly concave. Negative scars of successive large and small blade blanks along the entire length of the core remain. Blades of standardized shape and dimension were achieved as a result of the successive chipping along the broad front of the cleavage face.

Special treatment of tools was used very rarely- mainly for scrapers and arrowheads. This is another characteristic of the Hanlar group. Lateral and bifacial retouch were used for a number of tools. Lateral retouch was used for the butts of blades and bifacial retouch for arrowheads.

The tool-kit includes unretouched blades, end-scrapers, and bifacial leaf-shaped arrowheads with a straight base. The elongated, large knife with a backed butt-edge and base and slightly concave-convex upper edge is distinctive (Fig. 14). No geometric microliths or burins were found. This is the third trait of the Hanlar sites. Axes, wedge-shaped gouges, hammers and blanks are present among the macrotools. The workshop at N 78 was intended for stone groove-edged axe manufacture. Tools used for preparation and axes were found there. Abundance of flint raw-material, cores, chipping waste, including knapping waste, documents flint knapping and tool modification at the site.

Pottery found at Site N 133 is archaic. It is characterised by a rounded or pointed bottom and pit -or seed-like ornamentation on the rim. This is the fourth characteristic of the Hanlar sites.

The sites of the Hanlar area do not resemble the Shulaveri-Shomutepe culture assemblages either in raw material used, or in the technology, or in the treatment of tools, or in the tool-kit, or in pottery. Regretfully, there are few sites and to call them sites of a separate Neolithic culture is possible only as a working hypothesis. In all probability, they represent a distinct cultural and chronological complex which does notyet have analogies among the Neolithic cultures of the Caucasus.

One more enigmatic group is found in the Marneuli district of Georgia where sites of the Shulaveri-Shomutepe culture spread. This the Sioni settlement situated in the valley of Shulaveri river, which lacks visible surface traits, and the group of analogous sites. Houses are of circular-form as in the Shulaveri-Shomutepe culture but they are not *pisé*-walled but constructed from stone or on stone foundations (MENABDE and KIGURADZE 1981). Pottery is distinct. It is tempered with sand, crushed obsidian, mica, and straw and was well-fired; it has traces of polishing. Rims are ornamented with depressions and incisions. According to researchers, the pottery of Sioni resembles the Transcaucasian assemblages of Anaseuli II, Chortoly and others and at the same time has some traits similar to Alikemek-tepesi (KUSHNEREVA 1993). The characteristics of the dwellings and pottery allow definition of the assemblages of the Sioni sites as a separate cultural community or a culture that coexisted with the Shulaveri-Shomutepe culture (MENABDE and KIGURADZE 1981). The sites of the Sioni group range in time from the Neolithic to the Eneolithic period. This group is contemporary with the northern Ubaid culture (PERKINS 1957).

The stone industry is represented by obsidian artefacts (almost 94%). Tools on other kinds of stone are rare. Blade and flake technology was used for manufacturing tools. Retouched blades, retouched flakes and scrapers prevail in the tool-kit. Tools with trimmed ends are present in significant numbers. Among the other artefacts are burins, side-scrapers on flakes, points, drills, sickle-inserts of Shomu-tepe type, and crude axes.

Because of the lack of more detailed publications, we cannot present other than these brief Sioni group characteristics.

The Hatunarh settlement situated in the Ararat valley of Armenia is close in time to the early assemblages of Shulaveri-Shomutepe culture. It is an early agricultural multi-stratified settlement situated on a hill about 120m in diameter. The settlement was investigated by R.M. Torosyan. Regretfully, Hatunarh materials have not yet been published. They are only mentioned in the literature (MARTIROSYAN and TOROSYAN 1967; TOROSYAN a.o., 1970). The settlement contains two layers. The lower is Neolithic, which for some reason is attributed to the Eneolithic, and consists of 7 building-horizons, the upper of which is Medieval. The Hatunarh assemblage probably preceded the Shulaveri-Shomutepe culture judging from the character of the finds. The material has certain archaic

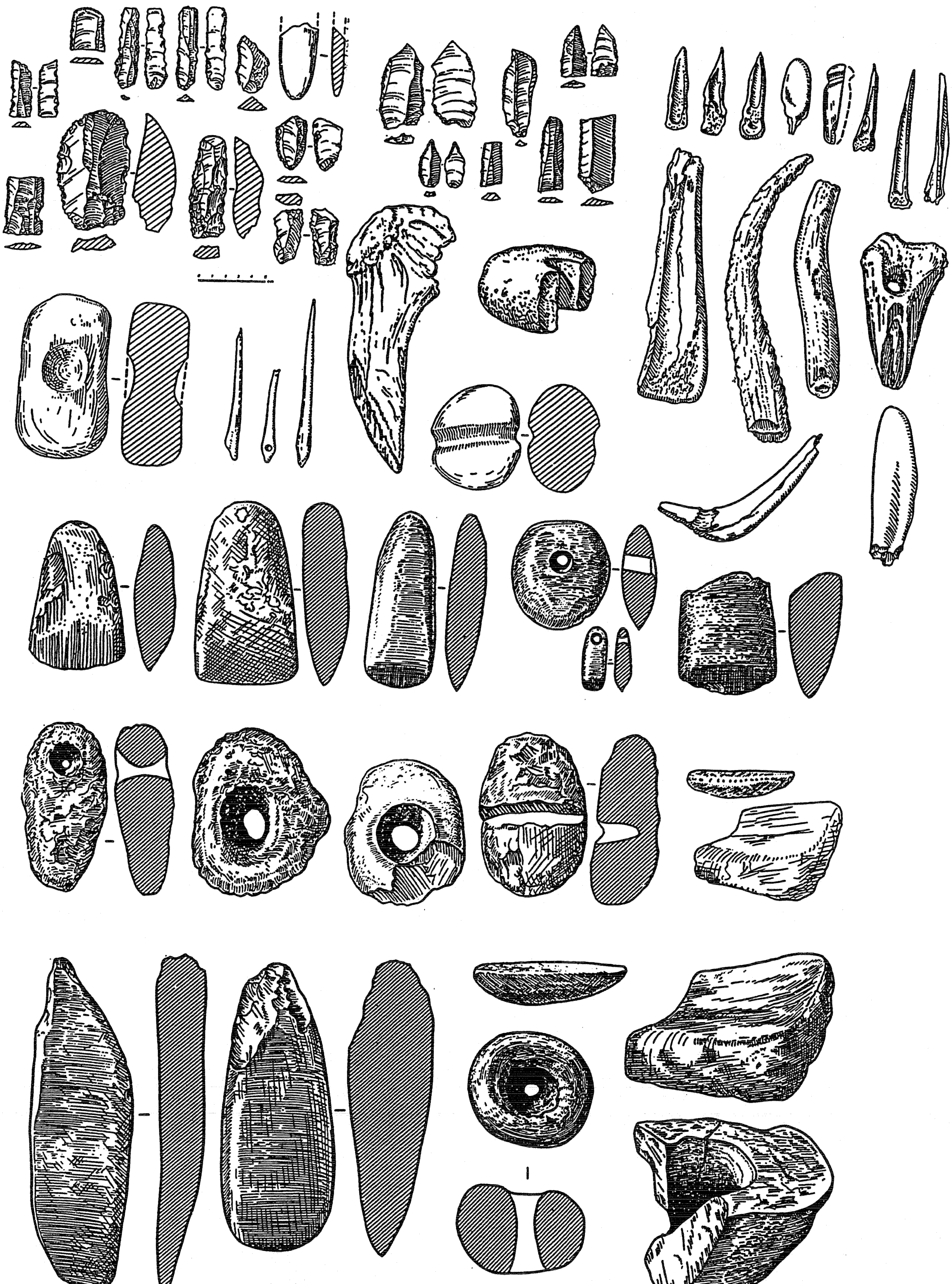


Fig. 13. Artefacts of Shulaveri-Shomutepe Culture: 1-29,32-35,37-38 Aruhlo1; 30-31, 36, 41-43 Shulaveris-gora; 44 Gadachrili-gora; 39-40, 45-56 Imiris-gora.

traits. The majority of the finds consist of tools and their manufacturing waste. Pottery is represented by three fragments of flat-bottomed bowls. The assemblages of all seven building-horizons are homogeneous and basically belong to the same time period. Because of this, I will consider it as a single analytical unit.

All of the industry was made on obsidian of local origin, with a few exceptions. There are thousands of blades, flakes, chips, cores and implements in amounts analogous to the assemblages of one of the later sites of Armenia - the Tehut site- but the Hatunarh assemblage is closer chronologically to the earlier assemblages of the Shulaveri-Shomutepe culture. The main blanks were large and medium-sized blades and flakes struck from prismatic and multi-platform cores. A number of different techniques were used to modify tools: retouch, burin-spall technique, scaling of ends, "pecking" and abrasion. The burin-spall technique dominates (more than 15% of all tools), as does lateral retouch on tools. Large, abrupt single-edge retouch is also common.

Blades with concave retouched sides and burins dominate the tool-kit (18,6 and 15%, respectively). Scrapers are represented in high frequency (about 11%). With regard to the microwear data, the

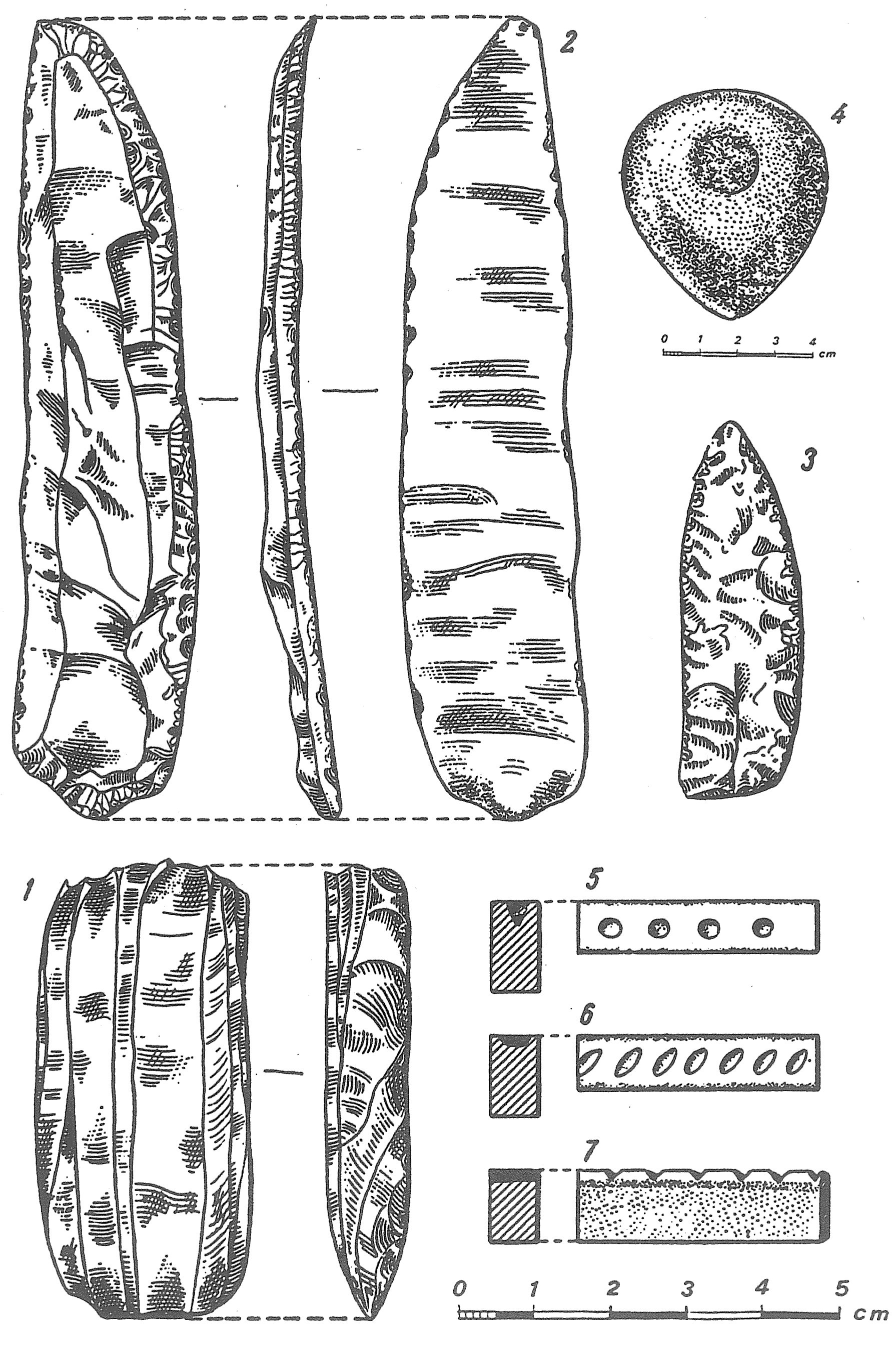


Fig. 14. Hanlar site N 133 artefacts.

dominant types are reaping-knife inserts and sickles (more than 25%) and inserts for knives used for meat (18,2%). Scaled pieces, drills, and piercers also occur. Some researchers have found microliths. Stone tools also include hoes, weights for digging implements, retouchers, polished axes, grain-grinders, mortars, pestles, and hammers. Bone implements are represented by scrapers on shoulder-blades (the same type as in the Djeitun assemblage), polishers for pottery, and antler hoes. The haft for a composite sickle with a groove for inserts also was found. The sickle was of very developed shape, consisting of one large blade fixed into the curved groove. Some of the sickles were set with several small inserts fitted tightly together.

Based on functional characteristics, Hatunarh is close to Shomu-tepe and has the same economic orientation of agriculture and stock-breeding. Typologically, it is an earlier assemblage with its own distinctive traits, especially in knapping technology, tool treatment, toolkit, and their ratios.

The technological tradition of three other sites of southern Transcaucasia is also distinctive. These are the multi-stratified settlements of Kjul-Tepe I in the Nakhichevan area, Alikemek-tepesi in the Mugab Steppe, and the Tehut-settlement in the Ararat valley. The settlements are dated to the Eneolithic, although the assemblages of the first two suggest a more probable Late Neolithic attribution. A number of archaeologists consider these settlements to be part of the Shulaveri-Shomutepe culture, placing them in the later stage of this culture (DJAPARIDZE and DJAVAHISHVILI 1971, DJAPARIDZE 1976, KIGURADZE 1976). Others, including myself, believe that these are different cultural complexes (NARIMANOV 1966, CHUBINISHVILI 1971, MASSON 1971, KOROBKOVA 1987). The latest publications mention the central Caucasian (or Shulaveri-Shomutepe) and southern Caucasian (or Kjul-tepe 1, Alikemektepesi, Tehut-type) cultures (MUNCHAEV 1982, KUSHNAREVA 1993). I believe the introduction of new names for old cultures will lead to confusion. The southern Transcaucasian sites, in view of their individuality, could be divided into three different cultural-chronological complexes. This is less contradictory to the notion of grouping them. Conversely, Kjul-tepe 1, Alikemek-tepesi and Tehut could be seen as one chronological group; they could be transition between the Shulaveri-Shomutepe and Kuro-Araks cultures.

Kjul-Tepe 1 is the best known Caucasus multi-stratified site away from the settlements of the Shulaveri-Shomutepe culture. Four cultural layers were exposed with a total thickness of about 22 metres.

The lower layer of the settlement is our concern here. It has a thickness of 9,2-9,4m and dates to the Vth mill. B.C. (ABIBULAEV 1982). The combination of rounded and rarer rectangular houses is typical for the dwellings. They are *pisé*-walled or made of stone and have rounded stone hearths and pit-hearths. The floors are earthen and coated with straw-tempered clay. The pottery is distinctive and has straw-tempering and various shapes; it is undecorated. Painted ware occurs in rare cases (20 fragments). The pottery is connected, according to R. M. Munchaev (1975), to Halafian imports. The small pot is identical with Halafian ones (DABBGAH 1966). Tools made on obsidian and other kinds of stone and bone-antler implements are found in this layer. All the inserts are made only on obsidian which was transported from the raw-material sources in Atis and Sisian (Armenia), close to the Nakhichevan area.

The technology is different from that of Shulaveri-Shomutepe (Fig. 15). It is also blade technology but the dimensions of the blanks are different. Macro-blades of widths more than 2,5cm were the main blanks, as were large blades of super-elongated proportions. They were struck from long pyramidal and prismatic single-platform cores with regular parallel negative scars. The knapping surface is circular or one-faced. The angles between the striking-platform and cleavage surface were modified by the use of small retouch. Both types of cores are represented in large numbers. They were used for obtaining the large or, more rarely, medium-sized, elongated blades with lengths of 10-15cm and rectangular cross-sections. Blades, produced from the same core, of lengths up to 20cm were found (21 specimens). The large long blades are a distinctive feature of the Kjul-Tepe 1 knapping technology. Flakes were used in rare cases. Geometric microliths are absent.

Lateral retouch, mainly dorsal, prevailed in the treatment of tools. Trimming of the ends and burin-spall technique were used rarely. Pecking, abrasion and flaking techniques were very common.

The tool-kit also differs from the Shulaveri-Shomutepe culture. Flint sickle-inserts are absent (inserts are made only on obsidian), as are blades with retouched ends, points and scrapers. Burins are insignificant (somewhat more than 1%), as are pieces with trimmed ends and notched blades (somewhat more than 2%). Blades with lateral retouch (about 30%) and blades with partial irregular retouch (55%) prevailed. Polished axes, gouges, chisels, and hoes measuring 15cm in length with a hole perpendicular to the edge are known. There are many (hundreds) of grain grinders, mortars, and pestles. Stone hammers with a transverse ring-like groove for attachment to a handle, palettes for paint, grinders for paint, ball- and pear-shaped mace-heads, sling-balls, weights for digging implements, and spindle-whorls occurred.

Bone artefacts are represented by awls, polishers, gouges, piercers, and palette-knives for pottery-treatment. Hoes, digging implements, hafts with a side-groove for a large blade (most probably, of sickles), implements for plaiting mats, and others are among the antler tools.

The technological and morphological characteristics of the industry of Kjul-Tepe I and other related sites (for example, Ilanly-tepe) show that the industry differs sharply from the Shulaveri-Shomutepe industry in the character of the blanks, tool treatment and the tool-kit. This is strengthened by the dissimilar architecture and pottery when compared to the Shulaveri-Shomutepe culture.

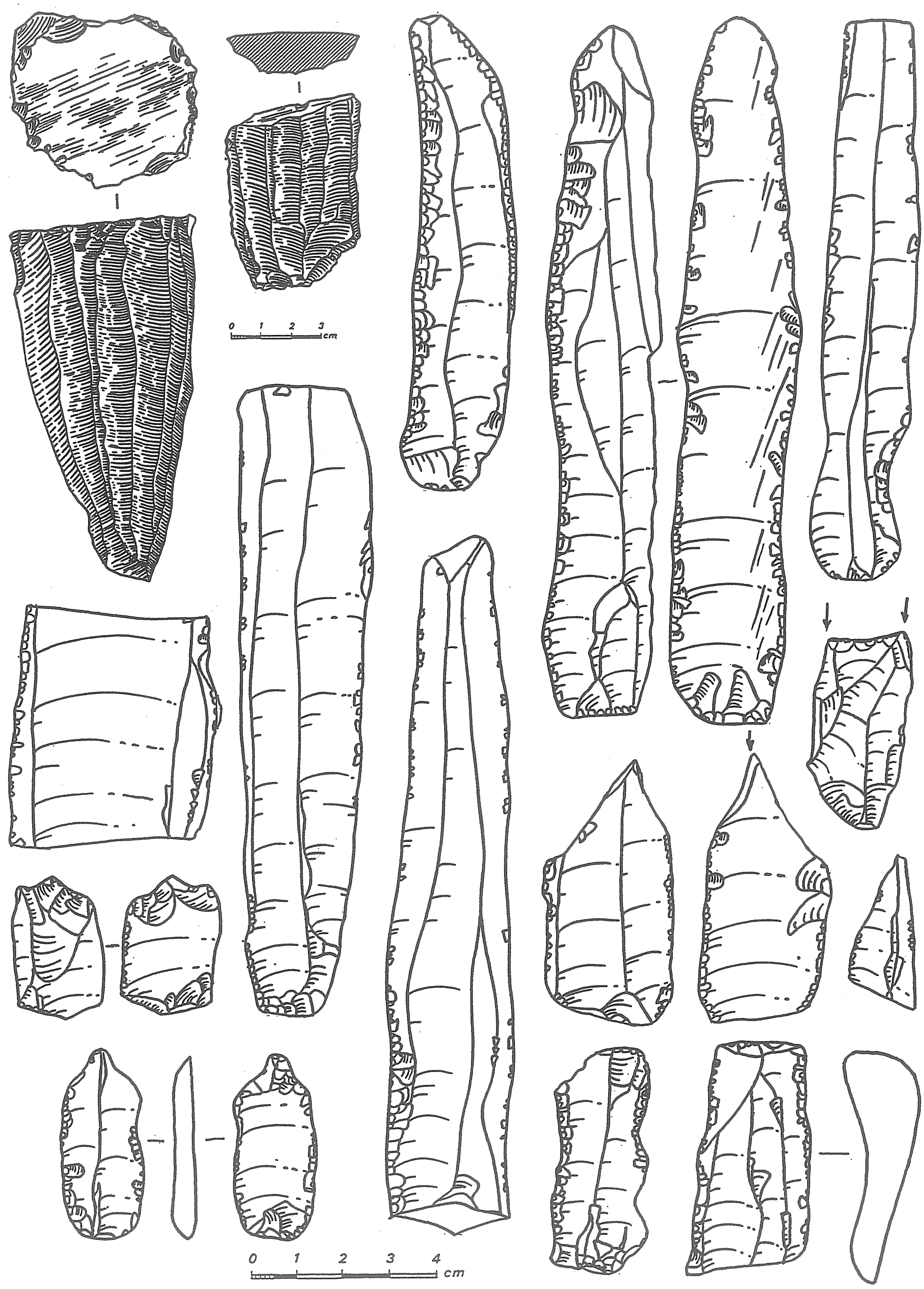


Fig. 15. Kyul-tepe 1 artefacts.

At first glance, the new settlement discovered in the Mil-Steppe area (the Ag-Dam district of Azerbaijan) by I. G. Narimanov shows a close resemblance to Kjul-Tepe 1 and Ilanly-tepe. This site is the hill of Leila-tepe, 2 metres high and about 50 metres in diameter (NARIMANOV 1986, NARIMANOV et al. 1988). Also present are a group of other sites: Shomulu-tepe, Chinar-tepe, and Abdalaziz-tepe. The remains of elongated rectangular *pisé*-walled dwellings consisting of two rooms were found at the centre of the hill. Red-clay pottery with plant tempering and slipped and polished surfaces is distinctive. Traces of black paint remained on some fragments. The vessels are round- and flat-bottomed. The latter prevailed. The industry is represented by flint and obsidian tools manufactured using blade technology. There are flint scrapers, notched blades and retouched blades of obsidian.

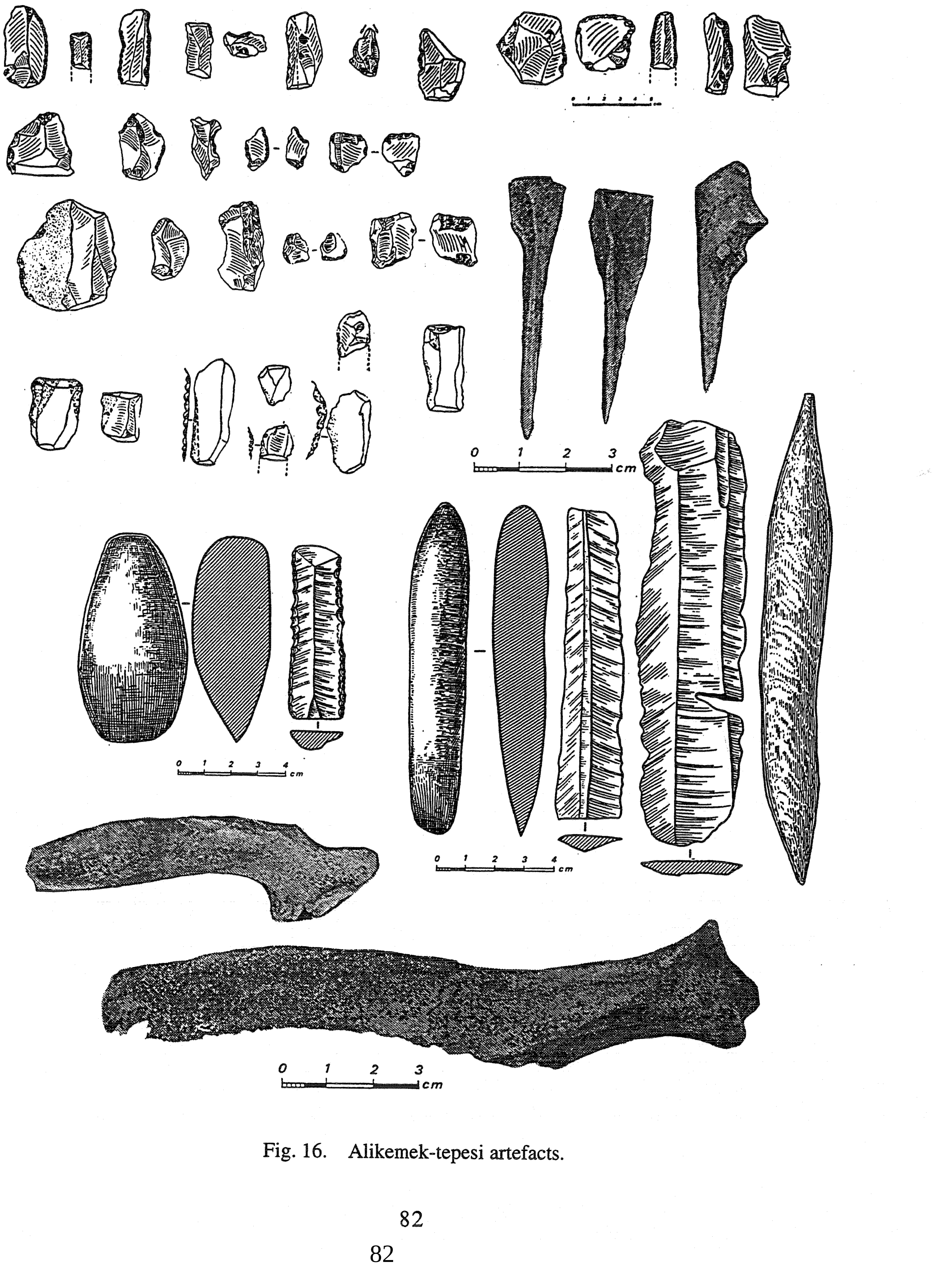


Fig. 16. Alikemek-tepesi artefacts.

82

Regretfully, the material of Leila-tepe is not published, therefore our information is preliminary. According to I. G. Narimanov (1986), the assemblage of Leila-tepe indicates the appearance of a new culture, an opinion also supported by other researchers (ALIEV 1991). Judging from the characteristics of architecture, ceramics and the industry, this assemblage really is distinct. However, proof of the sites' cultural attribution must be undertaken by new large-scale excavations, use of modern typological analysis of the entire assemblage and comparative studies with synchronic assemblages of the Caucasus and neighbouring areas.

The assemblage of Alikemek-tepesi is distinctive in its traits. The settlement occupied a hill about 1 square hectare in size. The thickness of the cultural layers reaches 4 metres, and six building-horizons were defined by the researchers (MAHMUDOV and NARIMANOV 1972, 1974, 1975). The settlement is situated in the Mugan-Steppe area to the south of Shomu-tepe. Rounded *pisé*-walled dwellings with rectangular extensions are typical. Open-type hearths are placed in the centre of dwelling with nearby household pits. Painted pottery with geometric ornamentation is similar to the ware from the Iranian sites of Yaniktepe and Dalmatepe (MUNCHAYEV 1982).

In contrast to the Shulaveri-Shomutepe culture and the settlements of Kjul-tepe 1 and Ilanly-tepe, the industry of Alikemek-tepesi is based on flint raw-material (78,3%). Obsidian is about 22%. It was transported from the Kelbajary raw-material source in Azerbaijan (ARAZOVA 1974). Flint is of local origin as are also the other kinds of stone. The negative scars on pyramidal, prismatic and discoidal (1,5%) cores, and the blanks and tools document use of blade-and-flake technology. Irregular blades prevail (58,5%). Flakes were often used (41,5%). Cores were of small-size compared to the size of nodules. There are single-platform cores with circular- or single cleavage faces. Negative scars are not parallel although they are present across the entire face. Blades are of standardized, prismatic shape and dimensions, although the lateral edges are uneven and the profiles curved. Typologically, these are irregular blades. They constitute 58,5% of all blanks. The second significant group consists

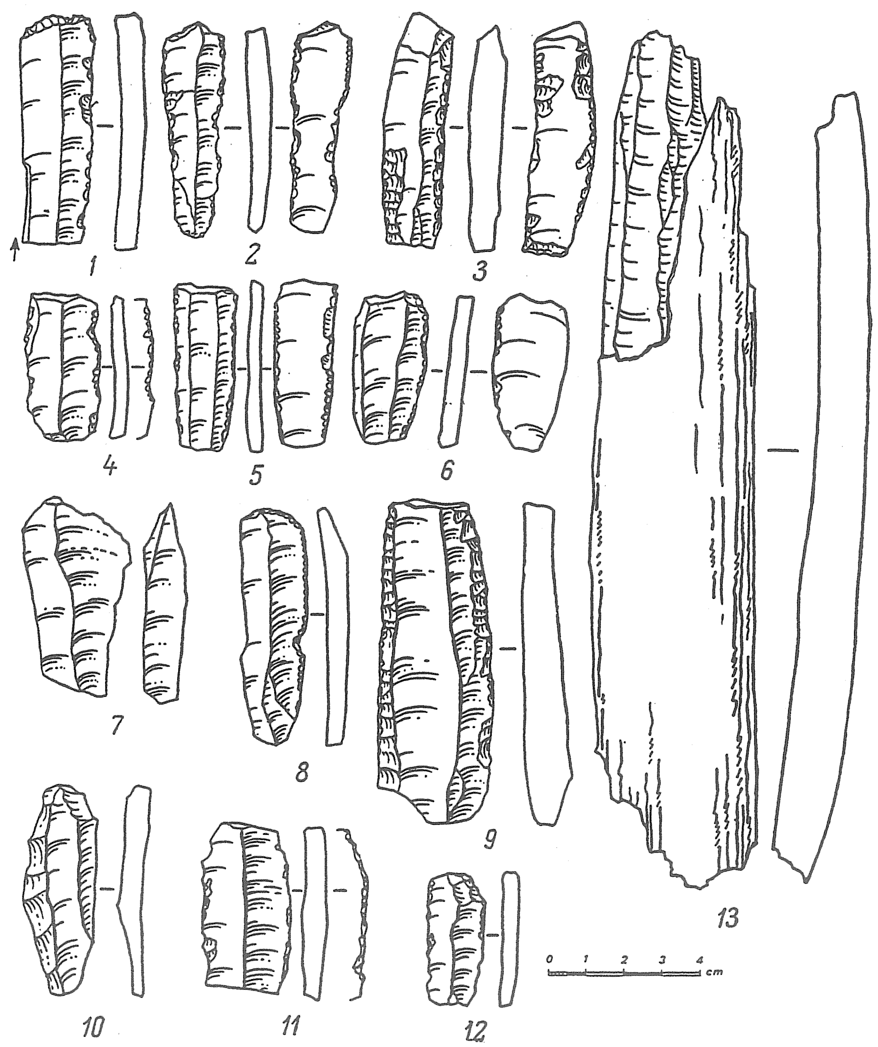


Fig. 17. Tehut artefacts.

of flakes (about 41,5%). The blade-and-flake technology along with obtaining medium-sized irregular blades and flakes is characteristic. Large, acute single-side retouch dominates in the treatment of tools. Abrupt retouch on one or two edges of the blanks occurs more rarely. Inverse retouch is extremely rare.

The tool-kit (constituting 38% of the industry) is distinctive (Fig. 16). Sickle-inserts of rectangular shape with lateral retouch prevail (51,4%). Use of two types of hafts is the main characteristic. One is the Karanovo-type with inserts placed to create gaps and the other one is the Hassuna-type with the blades tightly placed. Some implements are relatively stable in representation. Among them are hammerstones (more then 12%), retouched flakes (more then 12%), end scrapers made on flakes (some more than 8%), pieces with scaled ends (about 8%) and retouched blades (5,4%). Burins, points and blades with retouched truncations (in each case about 1,3%) are insignificant. Notched blades are absent.

Bone artefacts are diverse. There are awls, scrapers made on the shoulder-blades of sheep/goats, polishers, antler hoes and hammers (MAHMUDOV 1978). Scrapers made on shoulder-blades are of astonishing resemblance to the finds from Djeitun (KOROBKOVA 1969) and Jarym-tepe II (MUNCHAEV and MERPERT 1981). Sling-balls are numerous (15%), as are polished axes, gouges, and chisels.

The original character of the dwellings, pottery assemblage, flint industry, treatment of tools, tool-kit, the specific reaping-tool hafts, the raw-material used for tools, and the absence of geometric microliths, notched blades and arrowheads shows the distinctive nature of the Alikemek-tepesi assemblage. It does not closely resemble the contemporary assemblages of the Caucasus. All of these data suggest that Alikemek-tepesi is a separate cultural and chronological type, *e.g.*, the Alikemek-tepesi-type culture.

The other settlement that differs from the Shulaveri-Shomutepe culture is Tehut situated in the Ararat valley of Armenia (TOROSYAN 1971, 1976). The assemblage is somewhat similar to the group of sites of the pre-Kuro-Araks period but has its own traits. The settlement dates to the end of Vth - beginning of IVth mill. B.C. The hill is about 2,5 square hectares and the cultural layer is approximately 1,6m thick. Two types of houses are represented - semi-subterranean and small rounded *pisé*-walled constructions. The floors are clay-coated and the hearth is situated in the centre. The diameter of the dwellings is 2,6-3m and the depth 0,7-1,6m. Traces of paint remained on the walls of several dwellings. All the buildings are laid out around the site with house-hold constructions adjoining them. Similar architectural complexes are known in sites of the Near East from the VIIth-IVth mill. B.C. Pottery is made with sand- and straw-tempered clay. It was manufactured using the impressions of textiles and sometimes of mats. Imprints of other kinds also occur. The shapes of the vessels are diverse. Small numbers of pottery-sherds are a painted ware that resembles the pottery of the northern Ubaid (TOBLER 1950, DABBAGH 1966). The "stream-like" painted motif is unknown either in Kjul-tepe I or in Alikemek-tepesi. According to R.M. Munchaev, the Tehut pottery, based on the painting-motifs, is similar to the decoration of the Tilky-tepe post-Halafian layer (MUNCHAYEV 1975).

Flint, obsidian and other kinds of stone, as well as bone, antler and, in rare cases, metal (copper), were used for tool manufacture. Thus there was a kind of raw-materials admixture. Stone blanks were obtained from pyramidal cores with a circular pattern of parallel blade removal. The blade-technology is aimed at producing large and medium-sized blades of regular prismatic shape and triangular cross-section. Microlithic features are not typical.

Retouch methods are diverse. Abrupt scale-shaped lateral one-side retouch of blades occurred most often. Denticulated lateral retouch was used rarely. Retouched blades, sickle and knife inserts with lateral retouch and end-scrapers dominate the tool-kit (Fig. 17). There are neither microliths nor notched tools and only one burin was found.

The macrotools are represented by a marked series: grain-grinders, mortars, pestles, sinkers, abraders, weights for digging-instruments, polished axes, gouges, and hammerstones.

The bone inventory is varied. There are awls, needles, polishers, piercers, and antler hoes. The bone-haft with a knife insert for meat was defined by me. The haft is 18cm in length. A spade-like tool made on a cattle shoulder-blade was found.

The characteristics of the entire Tehut assemblage show its obvious distinctiveness and its dissimilarity compared to the Late Neolithic-Eneolithic cultures and sites of the Caucasus discussed above. The different dwelling plans within the settlement area, their construction, the sand-and straw-tempered pottery, the raw-materials used, and the tool-kit - all constitute the foundation for the definition of the Tehut-type sites as a distinct cultural and chronological complex.

Summary

Such is the general picture of the Caucasus cultural development. It is distinguished by the diversity of the assemblages displayed in the architecture, pottery and especially in the industries.

Highly differentiated environments and separation in cultural traditions led to a pronounced variability in the Neolithic chipped industries. The distinctiveness of the inventory is revealed in the character of the raw-materials, the knapping technology, the treatment of tools, and the tool-kit. Not all the cultures and cultural-chronological complexes are defined to the same extent, naturally. This is due to the differential study and publication of the results, the differences in the typological approach to the investigation of these artefacts, the debate over cultural attributions, dating and other details. A synthesis of the entire Caucasian Neolithic is still lacking, although this paper is a preliminary effort. The cultural attribution of many sites is unclear and a division into periods is absent.

More than 10 clusters of sites are known. In western Transcaucasia two groups of sites with two different cultures/ industries are known. The first group is represented by the aceramic sites Anaseuli 1, Khutzubani, and Kobyleti. The second group is represented by the late Neolithic sites of Odishiy, Anaseuli 2, Kistrik, Nizhniaya Shilovka, and others. The first group is known from the southeastern side of the Black Sea, the second from the area to the northeast. In the aceramic assemblages the most common raw material is obsidian (73-76%). The obsidian might come from Georgia (Altsikhi, Paravan). The knapping was based on prismatic conical and bullet cores. For secondary production, retouch techniques are well represented, as well as the burin technique. Small symmetrical trapezes, backed bladelets (50% of the tools), burins, endscrapers (also in microlithic version) are present. Microwear study has proved the presence of knives. The Darkvetski rock-shelter had a similar industry in its five layers, but here it was mainly made of flint.

The second group of sites mentioned above could be classified as a separate culture/ industry, which we called Odishi. This taxonomic unit with coarse ceramics has its origins in the aceramic industry described above. The tools were made of flint and sometimes of obsidian. Bladelet core reduction was typical here (more than 78%). The microlith index of, as compared with aceramic industry, is slightly higher, and new types of microliths appear (high trapezes, rectangles with ventral retouch, crescents and others). Flat, covering retouch was introduced. Among the most characteristic items, the most numerous were backed bladelets and burins. A few tanged points also occur in this industry.

In the upper Dagestan the Chokh culture/ industry occurs (late Mesolithic and early Neolithic), dated to 8th to the beginning of the 6th millennium bc. Some dwellings of unworked stones are known from this culture. The tools are made of flint (91,5%), rarely from slate and limestone. The cores are prismatic, conical, bullet-like but also discoidal. Bladelet technology dominates (Neolithic layer 27%). Among microliths (14%) the elongated triangles, high trapezes and single crescents are present. Other tools are as follows: different endscrapers (*c.* 50%), mostly at the end of blades, geometrics and points; single burins are present. There exist also inserts of knives.

The Ginchi culture (5th - 4th millennium bc) is known from northeastern Dagestan. Flint dominates as raw material and obsidian is very rare. The industry is based on big blades and flakes (13%). Tools are not very diversified: retouched blades (almost 60%), endscrapers, retouched flakes, points.

In the region of northern Caucasus another culture/ industry is known, it is called Domaikopskaia, and dated to the Eneolithic. The main site of this industry is called Svobodnoe. Blade technology, with tendencies to microliths, are characteristic for this unit, as well as symmetrical trapezes, bladelets, small round endscrapers. These items are accompanied by bifacial arrowheads and points. The assemblages are rarely distinguishable from those of Ginchi (*cf.* above), and have common features with western Caucasian industries.

Another group of Neolithic sites is known from Kobystan (southeast of Transcaucasia). This badly known and published industry is characterized by the use of flint as raw material and numerous trapezes (Firuz, 25%).

A different state of research is in southern Transcaucasia where several villages occupied by farmers and stock breeders are known. The most characteristic unit there is the Shomu-Tepe-Shulaveri Culture, dated to the 6th - 5th millennia bc (Imiris-Gora, Arukhlo, Tsoni, and other sites). Obsidian is the dominating raw material there (84-97%), imported from the region of the Small Caucasus. Blade technology is highly developed: the main blanks are blades up to 7.5 cm long. Among the tools retouched blades dominate (30-59%), followed by unretouched sickle inserts (10-13%), burins, endscrapers, single geometrics, and in a few cases tanged points (Arukhlo, Tsoni, Imiris-Gora). Over time the size of blades increased, geometrics disappeared, and the number of sickle blades augmented.

Another cultural/ chronological group, called Khandarskaia, dates to the Eneolithic. It is known from in Azerbaijan (Site 133, Kilikdagskie workshops).

An important group of settlements partly contemporaneous to the Shomu-Tepe-Shulaveri group was discovered in the Magneul region of Georgia (*e.g.* Sioni). Tools were mostly made of obsidian blades and flakes(94%). Among them the most numerous are retouched blades and flakes, followed by endscrapers, burins, sidescrapers, points, sickle inserts, and heavy duty tools.

Chronologically close to the Shomu-Tepe-Shulaveri Culture is the complex of settlements in the Ararat Valley. All tools are made there from local obsidian, big and middle-sized blades as well as flakes are serving as blanks: among the tools predominating are the notched blades (18%) and burins (more than 15%). Microwear study revealed the presence of knives (> 25%) and meat knives (18%).

A separate tradition is known from the Kul-Tepe I in the Nakhichevan region. The same is true for Alikemek-Tepesi in Mugan-Tepe and Tekhut in the Ararat Valley, although some investigators classify those sites as belonging to the Shomu-Tepe-Shulaveri Culture. The tools are made of obsidian, imported from the Armenian outcrops. The main blanks are long blades, including some up to 20cm. In the secondary production, edge retouch predominates. Points and endscrapers are absent and burins rare. The most numerous tools are retouched blades. Polished axes and chisels are also present. The pottery differs from Shomu Tepe Shulaveri I. At the site of Alikemek Tepesi the tools are made of flint (>70%) and obsidian (< 30%); among the blanks blades are more numerous (58,5%) than flakes (41,5%). Blades are standardized, with prismatic cross-section and curved profile. The tools are formed mainly with semi-abrupt and less frequently by steep retouch. The sickle inserts are rectangular and were mounted in the handles obliquely. There were also retouched flakes (12%), end scrapers (8%), and retouched blades (5,4%); burins were rare and geometrics absent, stone axes and chisels are present.

The site of Tekhut (end of 5th beginning of 4th millennium) has many original features, including painted pottery and singular copper pieces. Tools were made of flint and obsidian, conical cores were typical there, and microliths were absent. Among the tools were retouched blades, sickle blades and the endscrapers.

Summing up: at the present stage of research there are two macro-provinces definable for the Caucasus - the northern and southern (Transcaucasian) areas. They include assemblages of different cultural attribution or different cultures. The latter has specific technical and technological traditions in the development of the industries. Three chronological groups of sites are defined within the two macro-zones.

1. The sites of the Early Aceramic Neolithic (the group of Anaseuli I-type, Hutzubani, Kobulety, Darkvety; the Kobustan sites of Firuz-type; Tarnair and Buinakskaja sites and others).
2. The group of Pottery Neolithic sites (Odishy, Shulaveri-Shomutepe, groups of Choh, Hanlar, Sioni, the sites of Hatunarh-type and others).
3. The group of Late Neolithic-Early Eneolithic sites. These are the sites of Ginchi-type, pre-Maikopian group Kamennomostskaya cave-type, Meshoko, Svobodnoje and others in the north and the sites of Kjul-tepe I-type, Alikemek-tepesi-type, Leila-tepe, Alikemek-tepesi, and Tehut in the south. According to stratigraphy and typology of the investigated groups of the Late Neolithic-Early Eneolithic sites, these are transitional between the Shulaveri-Shomutepe and Kuro-Araks cultures.

The Transcaucasian cultures show links with the southern part of Circumcaspian zone and with the contemporary assemblages of Central Asia, the Near East and the northern Caucasus - with the cultures of the foot-hills of the Caucasus and the northern Caspian area. Furthermore, the sites of northeastern Caucasus differ sharply from the sites of northwestern Caucasus. This is observable especially in the industries.

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The Cultural Zones and Variations of the Late Chipped Stone Industries in Central Asia

Vadim M. Masson

Abstract: *At the beginning of the 6th millennium bc when agricultural communities developed in southern Turkmenistan, Central Asia was divided into two major cultural and economic zones: the farmers and pastoralists of the south (Djeitun) and the hunter-gatherer-fishers in the north (Kelteminar, Hissar, Fergana).*

The starting base of the development of these northern cultures is characterized by the early layers of the Caspian Caves (Dam-Dam-Cheshme 8-5 and Jebel 7-8). Blade technology with microlithic elements is present here. Geometric microliths are represented by big trapezes and isosceles triangles. The main territory of Central Asia was occupied by the Kelteminarian sites with several local variants. Two cultural and economic models are known from this zone: Hunter-fishers of the old delta of the Amu-darya and Zarafshan Rivers are characterized by sedentary settlements with big dwellings. The second model consists of the migrating hunters of various steppic environments for which seasonal sites are known. For the seasonal industries of the Kelteminarian zone the following tools are characteristic: backed pieces, endscrapers on short blades and flakes, elongated triangles, points à cran, and singular leave-shaped points with bifacial retouch.

In the Fergana region the oldest sites are Tashkumyr and Obishir; the younger are represented by seasonal sites in the desert-steppic zones. The people who lived here hunted mammals of two different environments: mountainous archar and Siberian goat, and the desert steppic species: wild boar, giran, and deer. For the early stage, dated to the Mesolithic, blade technology is characteristic but associated with pebble technology. The following items are present: microbladelets, high flake endscrapers, and rare elongated crescents. Later on the seasonal sites the microbladelets and microflakes are present. The industries are characterized by a high degree of microliths. The specific cultural tradition is represented in the mountainous regions of western Tadshikistan: the Hissar culture. At the early stage dated to the 7th millennium bc (2nd layer of Tucta'ul), blade technology is present together with microlithic elements and pebble technology. Elongated crescents are also present. Later the pebble component increased.

Kelteminar, Hissar and Fergana industries have no clear continuity. In the middle of the second millennium bc they were replaced by the sites which are close to the cultures of the pastoralists and farmers of steppic Eurasia, mainly by the Andronovo Culture.

The History of Research

The discovery of the Central Asian Mesolithic and Neolithic is connected with the names of two prominent Soviet researchers. In 1939, S.P. Tolstov found on the lower river Amu-Darja basin a site of the Neolithic culture, which he named the Kelteminar culture (TOLSTOV 1948, VINOGRADOV 1967). During the late 1940s and 1950s, A.P. Okladnikov excavated the caves of Djebel and Dam-Dam Chasme near the Caspian (OKLADNIKOV 1956). At the same time, he discovered the first sites of the mountain Neolithic in western Tajikistan, which he defined as the Hissar Neolithic culture. Of principal importance for agricultural Neolithic research were the Djeitun settlement excavations (MASSON 1971) and the studies of other Djeitun culture sites (KOROBKOVA 1969). Gradually, the archaeological studies developed and the entire area of Central Asia was investigated. New sites of Kelteminar culture were researched in the deserts of Kara-Kum and Kyzyl-Kum (VINOGRADOV and MAMEDOV 1975, VINOGRADOV 1981). Kelteminar sites were studied also in the lower river Zeravshan basin (GULJAMOV, ISLAMOV, and ASKAROV 1966). Research continued in the Caspian area (MARKOV 1966). Tutkaul, a site of prime importance for the Hissar culture research, was excavated in Tajikistan (KOROBKOVA and RANOV 1971). The numerous Neolithic sites were discovered in Ferghana valley (ISLAMOV and TIMOFEEV 1986) and quite similar but more archaic materials were found in some caves (ISLAMOV 1980). There are about 1500 points with Late Stone Age (Post-Palaeolithic) finds in the region now. Most are open-air sites with dispersed sediments, but some settlements with well-preserved cultural layers are known also.

Terminology and Definitions

The Russian archaeological school is using the terminology different from the western ones. A three-components system is usually employed for the classification and grouping of sites: the local variant, the archaeological culture, and the community of cultures. In cases where researchers are uncertain of the position of a defined group of sites within the frames of the system, the term "complex" is used as the preliminary definition (KOROBKOVA 1975). The division of the post-Palaeolithic epoch into the Mesolithic and Neolithic is of classificatory significance (MASSON and KOROBKOVA 1978) and remains in operation. The division reflects the chronological evolution of the flint industries. The large blades, the flattened cores with one-side chipping, and the carinate scrapers made on thick blades and flakes are all characteristic of the Central Asian Mesolithic, following the conclusions of G.F. Korobkova (1983).

The beginning of the Neolithic is attributed approximately to VI mill. B.C. After the transition of the South Turkmenian tribes to agriculture, the region of Central Asia divided into two cultural-economic "super-zones" (Fig. 1): the agriculturists and stock-breeders of the south (Djeitun), and the hunters, fishermen and food-gatherers of the north (Kelteminar, Hissar, Ferghana). Mesopotamian-type evolution led to the rapid replacement of the flint industry by the copper tools in the south. Flint industries persisted nearly to the beginning of IInd mill. B.C. in the north and it is possible to discuss several local regions inside the vast northern super-zone.

Sites of the Eastern Caspian Area

A considerable part of the eastern Caspian area consists of monotonous elevated steppe plains with the surface smoothed out. The plateaus of Ustjurt and of Krasnovodsk are such ones. They are crossed by ridges mountain ridges. The main ridge is Bolshye (the Large) Balkhany. Flat tops covered by thick turf deposits are characteristic for these eminencies. Numerous springs and also groundwater reserves are known in the Balkhany mountains. The old river-bed of Amu-Darja river (Uzboj) crosses the Balkhan's ridge. The natural conditions, including heightened humidity from at least VII-III mill. B.C. were favourable for the ancient hunters and fishermen. The excavations of the camp-sites in the grottos Djebel and Dam-Dam-Chashme (Fig. 2) showed that the main game had been goitred gazelle (*Gazelle subgutturosa*). During the same period, urial sheep (*Ovis vignei*), bezoar goat (*Capra aegagrus*) and more rare wild ass (*Equus hemionus* Pall.) also were the objects of hunting. The fish bones found in Djebel cave attest to the function of the Uzboj river during this time.

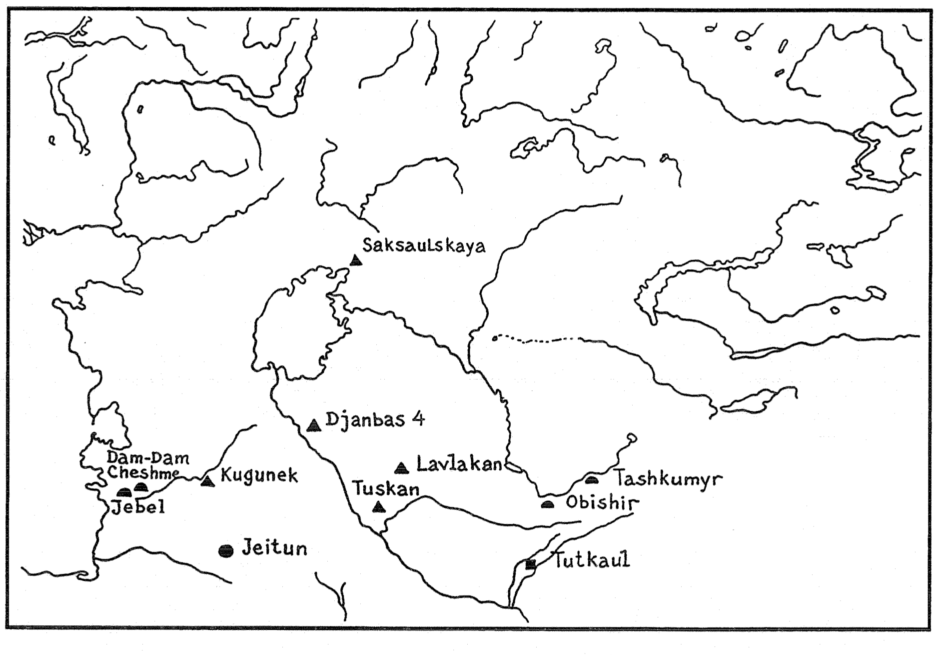

Fig. 1. Central Asia in the Late Stone Age (Post-Palaeolithic).
▲ caves, ▲ Kelteminarian sites, ● Jeitun Culture sites, ■ Hissar Culture sites

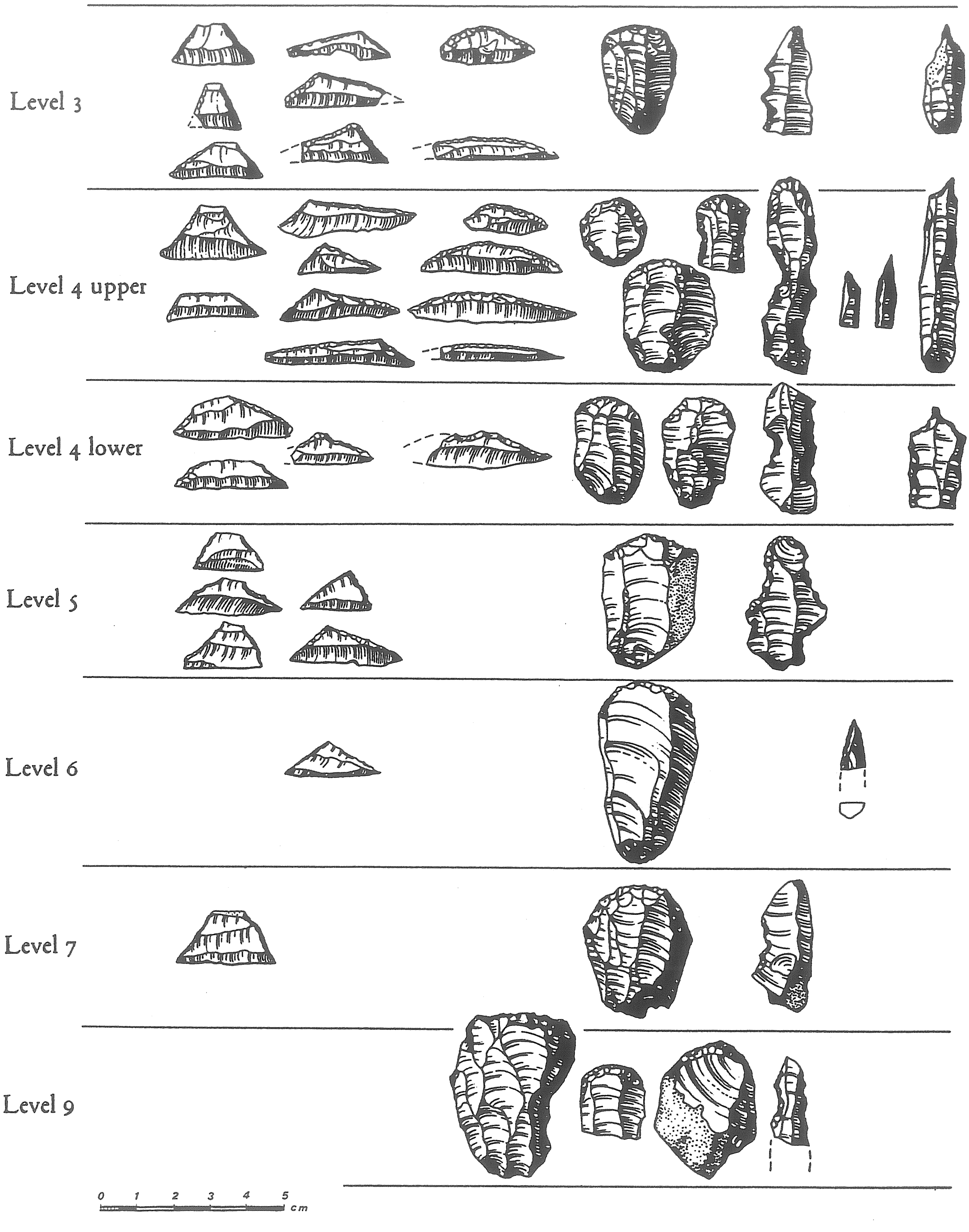

Fig. 2. Dam-Dam-Chashme: evolution of chipped lithic industry.

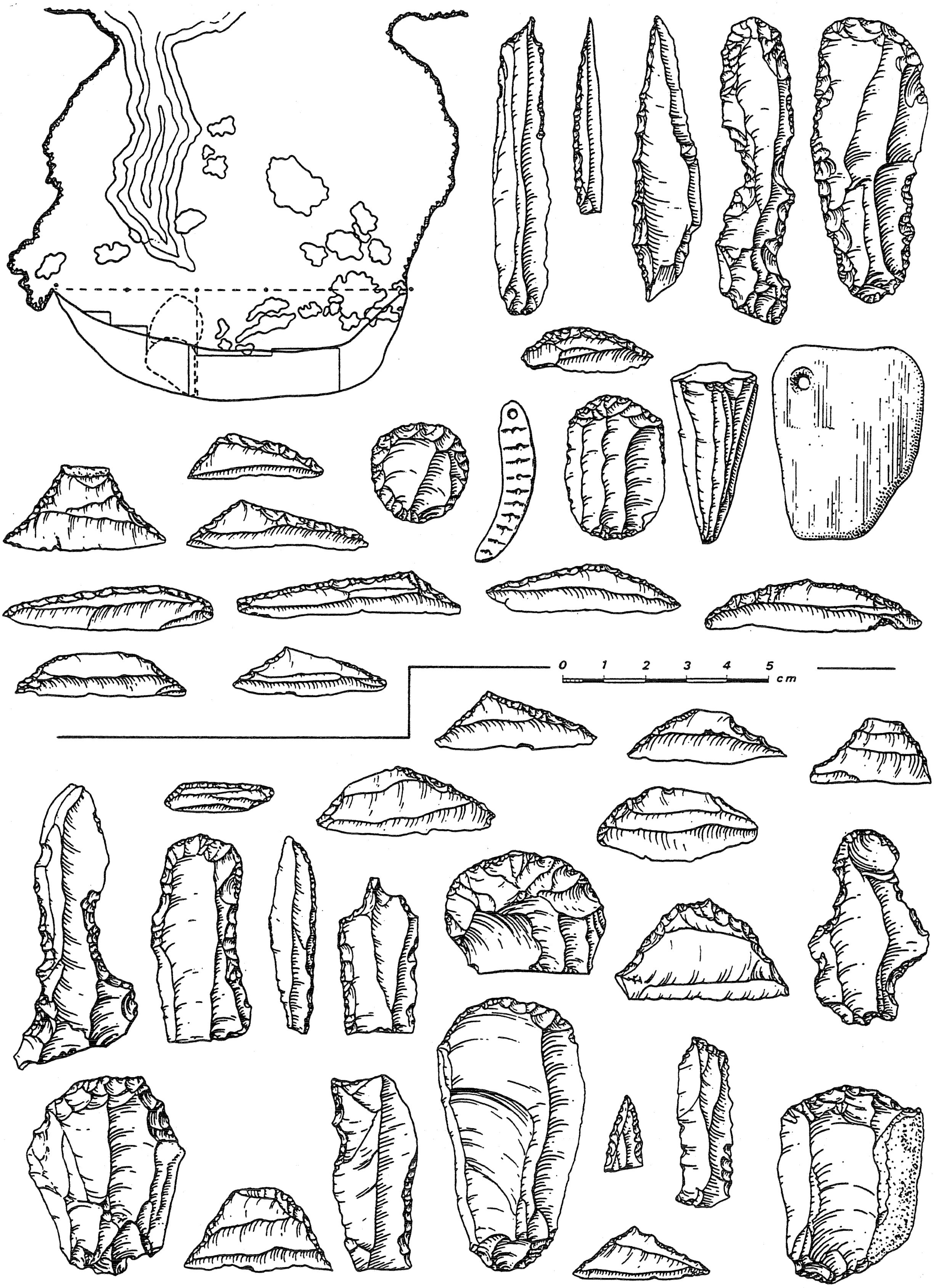

Fig. 3. Dam-Dam-Chashme 2: plan of the cave and chipped lithic artefacts from upper Layer 4 (top), chipped lithic artefacts from Layers 7 - lower 4.

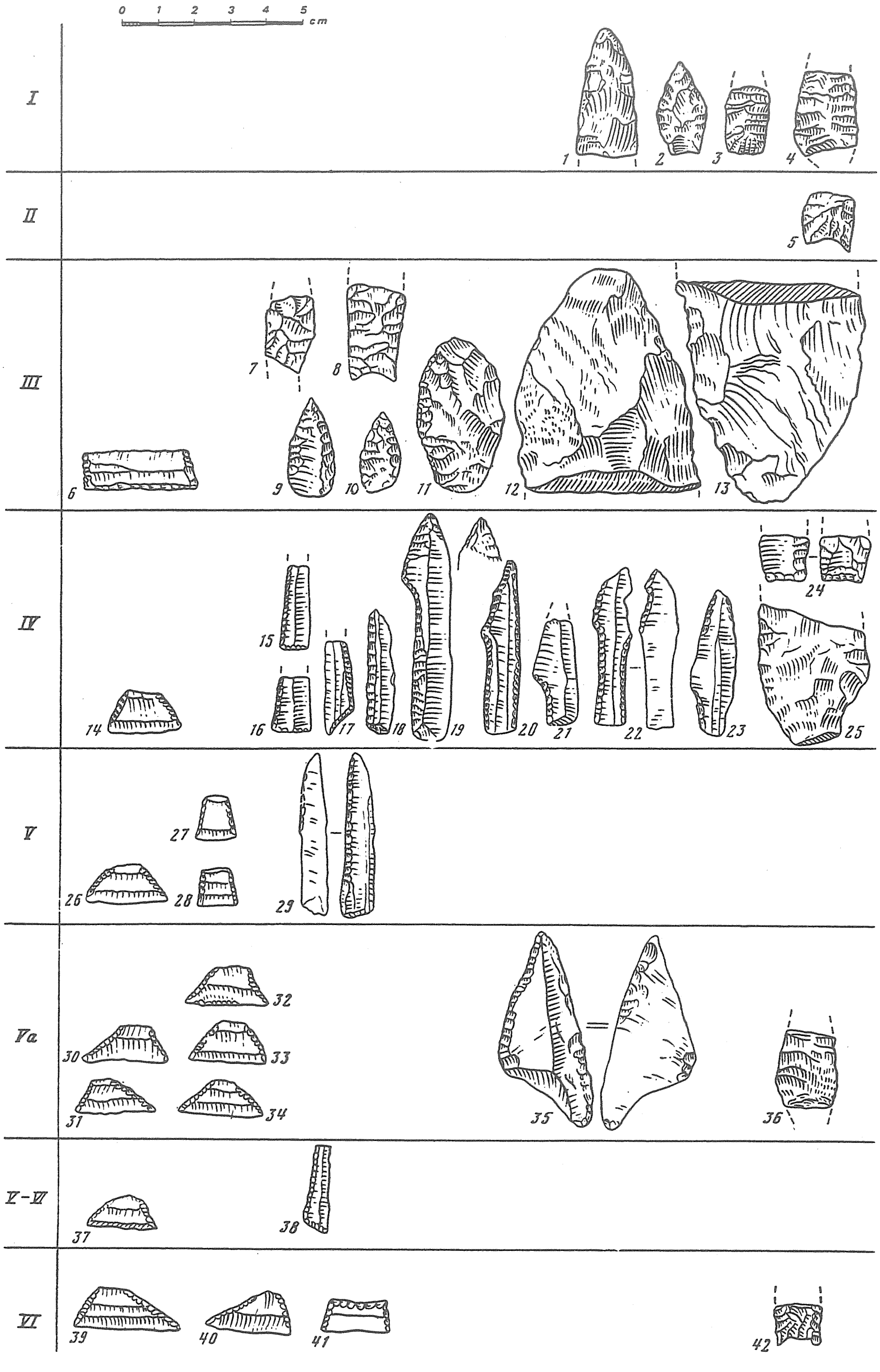

Fig. 4. Jebel: evolution of chipped lithic industry.

Numerous open-air sites of the Late Stone Age (Post-Palaeolithic) in the eastern Caspian area usually did not preserve cultural layers, but testify to comparatively intensive population of the area.

The earliest industry is represented by the materials from Dam-Dam-Chashme Layers 8-5, and from Djebel Layers 7-8. G.F. Korobkova consolidates their finds into the separate Balkhan Mesolithic group (Fig. 3 bottom). A blade industry with some microlithic elements is represented. The main blanks are large and middle-sized blades. There are shaving-knifes on large blades, and geometric microliths are represented by the large trapezes and asymmetrical triangles.

The industry of Dam-Dam-Chashme Layer 4-upper part is defined as a separate one by researchers (Fig. 3 top). Elongate triangles and lunates are characteristic of the industry. They resemble the Zarzian industry types and may indicate Near Eastern influences.

Djebel cave Layers 6-3 represent the Neolithic developed upon the foundation of the Balkhan group traditions. Small, symmetrical trapezes gradually become the steady type of tools. The arrowpoints made on shouldered blades appear in the fourth layer (Fig. 4). This type of arrow is termed in the literature as Kelteminarian, following the Khorezm investigations. Arrowpoints with bifacial retouch are represented in materials from the third layer. Crude hand-made, pointed-bottomed pottery appears in fifth layer. High-quality grey pottery obviously imported from the Shah-tepe district of northeastern Iran is found in the third layer. This find indicates the co-existence of the eastern Caspian archaic Neolithic and the southern settled agricultural cultures until IV-III mill. B.C. Probably, the eastern Caspian area had been a kind of "corridor" for the northward movement of the ancient populations. This movement brought specific traditions of flint industry, including the Zarzian. In any case, such influences are recognisable in the north Caspian materials and in the opinion of some researchers, even at the southern Ural area.

Ovicaprid bones are found in the upper layers of Caspian caves. The gracility of the animals, according to archaeozoologists, allows one to consider them as domesticates. But this innovation did not change the traditional culture of local archaic tribes. Stock-breeding was probably insignificant to local lifeways until the spread of bronze-bearing steppic tribes from the north in II mill. B.C.

The Kelteminarian

The main part of Central Asia was occupied by the Kelteminar-type tribes. S.P. Tolstov was first to recognise the archaeological complex of this type. It is natural that in such a vast area, local peculiarities may be recognised. Initially, researchers spoke of the Kelteminar culture and several of its local variants. Now they refer to the Kelteminar community including several local archaeological cultures. Ancient tribes opened up two kinds of ecological provinces of the area. First of all, there were parcels of the ancient Amu-Darja and Zeravshan deltas. The ancient deltas were functioning streams during the Mesolithic and Neolithic. Such ones were the ancient Akcha-Darja delta at lower river Amu-Darja basin and the two systems of pre-Zeravshan old deltas - Darjasaj and Mahandarja. Delta lands were equipped with water, had "Tugais" (delta forests) and dense bushes, and were rich in fish resources. The second type of the physical-geographical province opened up by Late Stone Age (Post-Palaeolithic) peoples is the inner parts of the Kara-Kum and Kyzyl-Kum deserts. The provision of the water was of the extreme importance in these areas. In Kara-Kum, the ancient sites were situated along the Uzboj, which at this time was the course of Amu-Darja river. In the inner Kyzyl-Kum, natural depressions and hollows with low-water lakes, now salted, were loci of population concentrations. The climate of VIII-III mill. B.C. was more humid and cool than it is today. Ground-water levels were higher, and the water was not salty but fresh. The period favourable for the settlement in the Kyzyl-Kum desert was even named Ljavljakan pluvial, after the lakes in the desert.

Two cultural-economical types and two ways of life were developed accordingly inside the Kelteminar tribes community. The first one is represented by the hunters and fishermen of the ancient deltas of Amu-Darja and Zeravshan provinces where provision of food resources promoted the development of stability. The area contains sites with large dwellings and well-preserved cultural deposits. The nomadic hunters of the steppes and semideserts represent the second type. Dispersed traces of temporary camp-sites prevail here. The base-camps existed at the places able to provide stable food-resources but the stability here was not so pronounced as in the first zone area. In the first zone the camps with large dwellings and numerous fire-places Djanbas 4 and Tolstov-named site are found (VINOGRADOV 1967, 1981). The dwellings are of post-construction and have large squares from 120 to 300 sq. metres. The composition of the hunter's bag obviously indicates two kinds of hunting areas including Tugai forest (deer, wild boar, roe deer) and desert (goitred gazelle, camel, wild ass). Fishing was regular. Nets and fish-spears were used. The main part of catch consisted of pike. The range of fishing was large. Around one of the dwellings were found fish bones indicating a general fish weight of about 8-9 tons. Large dwellings also were constructed in the Zeravshan ancient delta area. Hunting there also was combined with fishing activity (Tuzkan).

The earliest sites in the Kelteminar zone date to the Late Mesolithic -Early Neolithic. At this time, probably during VII mill. B.C., under more humid climatic conditions the broad opening up of the area had begun. Such sites are known in the Ljavljakan lakes territory and on the Darjasaj ancient delta land (Uchaschi sites 84, 85, 153) (Fig. 5). The chipping technique is represented by large blades and numerous microblades of regular and prismatic shape. There are many scrapers made on blades and flakes. The geometric microlith assemblage consists of the small triangles and trapezes of a specific shape with a concaved upper edge. This type is designated as the "horned trapeze" type in Russian literature.

The period of Kelteminar flourishing fell on V-IV mill. B.C. Researchers have defined a num-

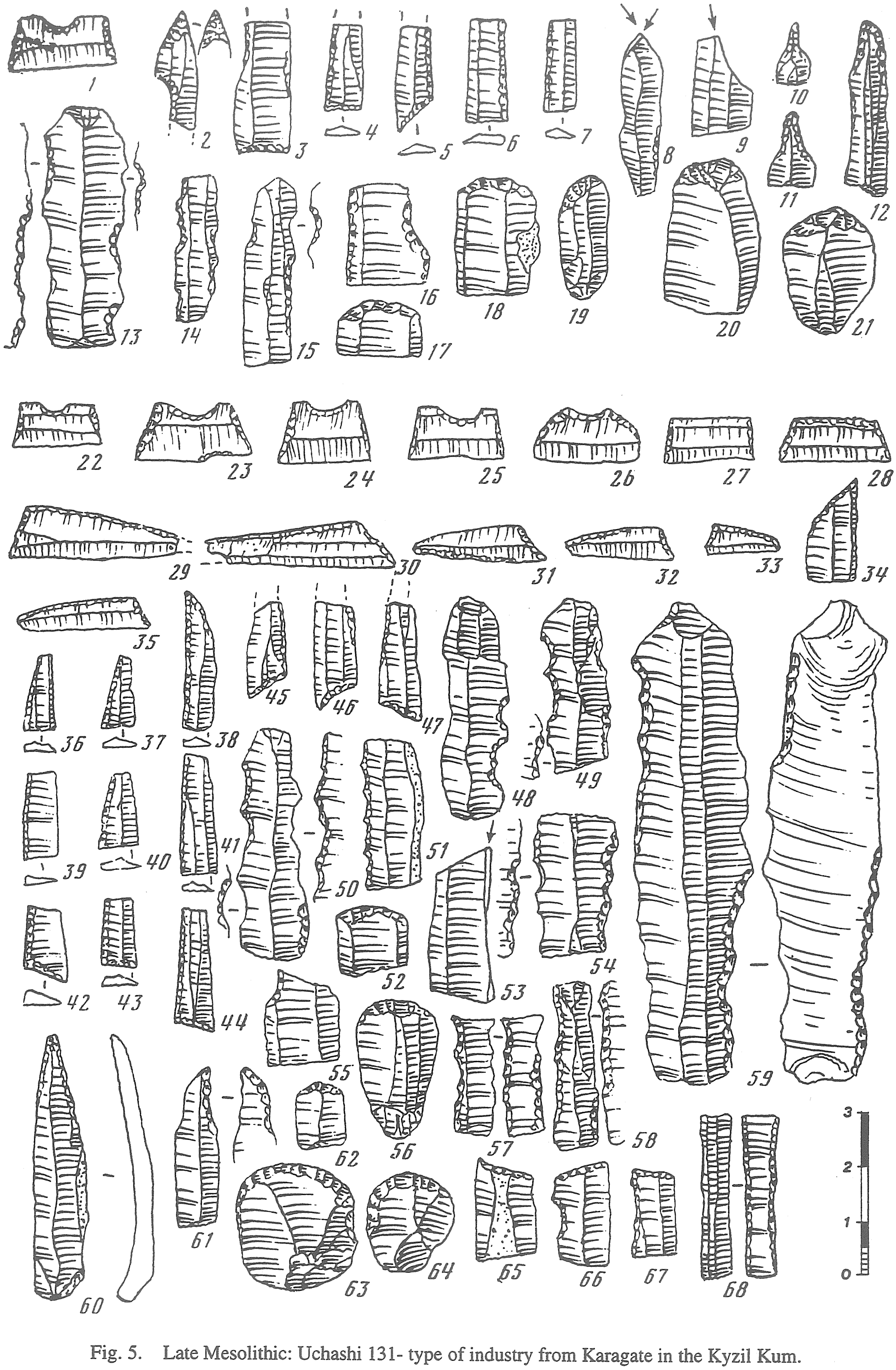

Fig. 5. Late Mesolithic: Uchashi 131- type of industry from Karagate in the Kyzil Kum.

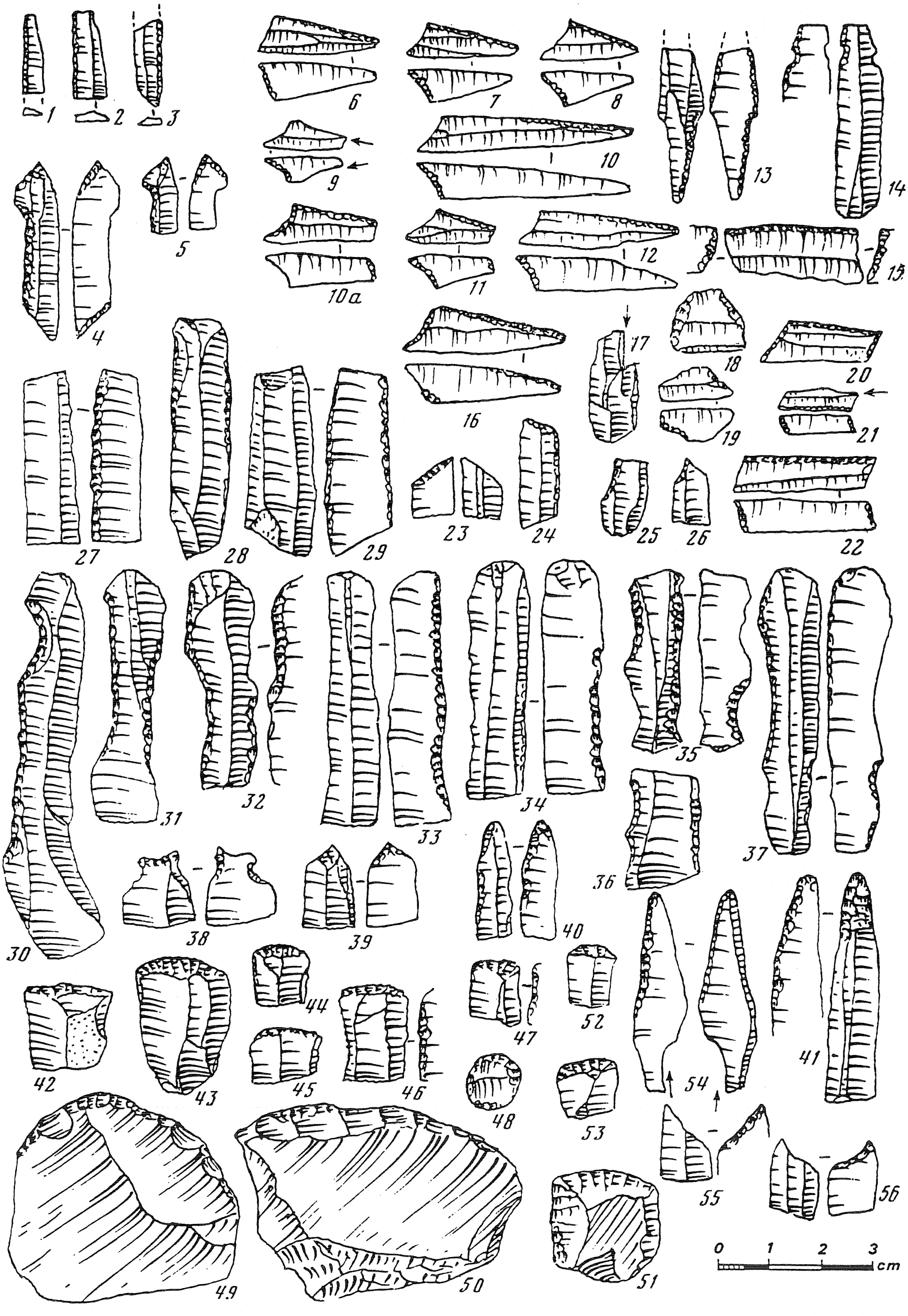

Fig. 6. Early Kelteminarian industry of the Tolstov site.

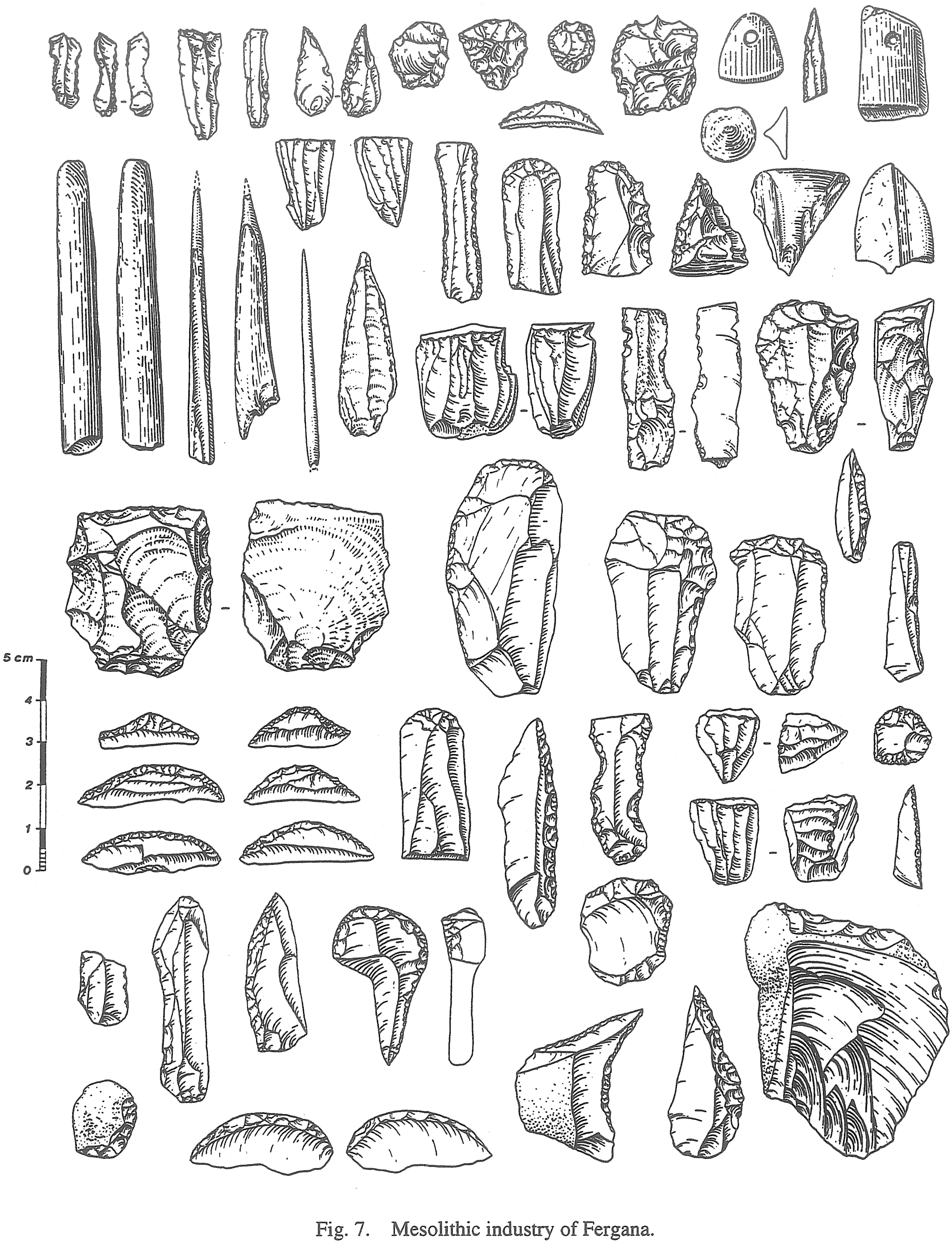

Fig. 7. Mesolithic industry of Fergana.

ber of local groups or separate cultures for the period. Sites of Akcha-Darja area have given the most remarkable materials. The blanks for tool preparation were microblades and medium-sized blades. There are also notched blades with retouch and end-scrapers. Arrowpoints made on shouldered blades of so-called Kelteminar-type are numerous (Fig. 6). Leaf-shaped arrowpoints with bifacial retouch occur at the same time. Geometric microliths are represented by long narrow triangles and the "horned trapezes". The Upper-Uzboj culture belongs to the same Kelteminar community. The sites of the culture are distributed at the upper river Uzboj basin and in the area of Sarykamysh hollow. The sites

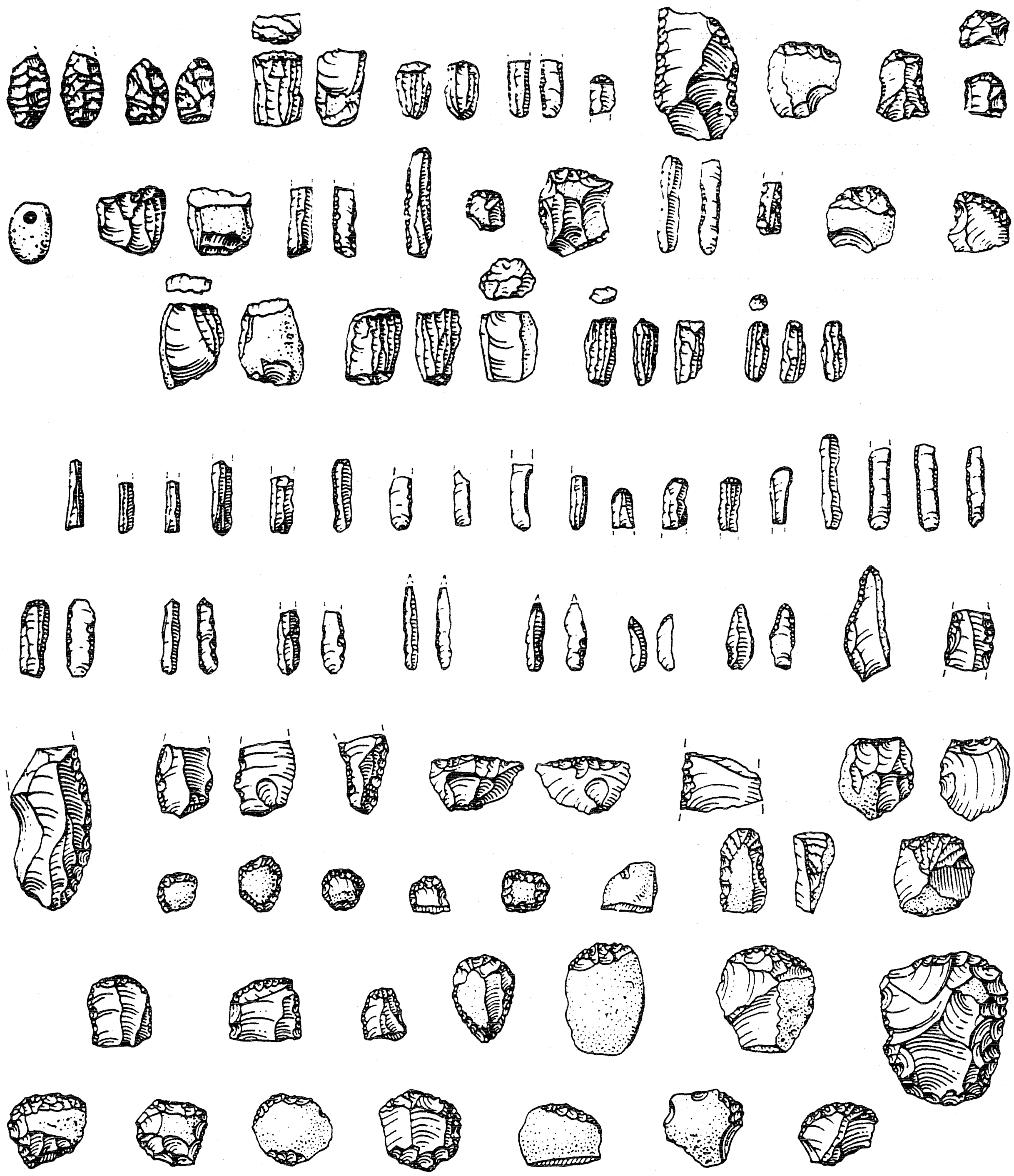

Fig. 8. Neolithic industry of Fergana.

of Ljavljakan-type are characteristic of the inner Kyzyl-Kum area. Here are found workshops for the manufacturing of turquoise ornaments, with the appropriate assemblage of implements ,including a range of microdrills. The special group represents the Tuzkan area sites. A large amount of raw material was necessary for the production of numerous stone tools. Flint mines were discovered at the eastern periphery of Kyzyl-Kum, on foothills in Uchtut district.

G.F. Korobkova has defined the main traits of the Kelteminar community flint industry: backed microblades, endscrapers made on short blades and flakes, elongated asymmetrical triangles, arrowpoints on shouldered blades and rare leaf-shaped arrowpoints of bifacial retouch. Analogies in mate-

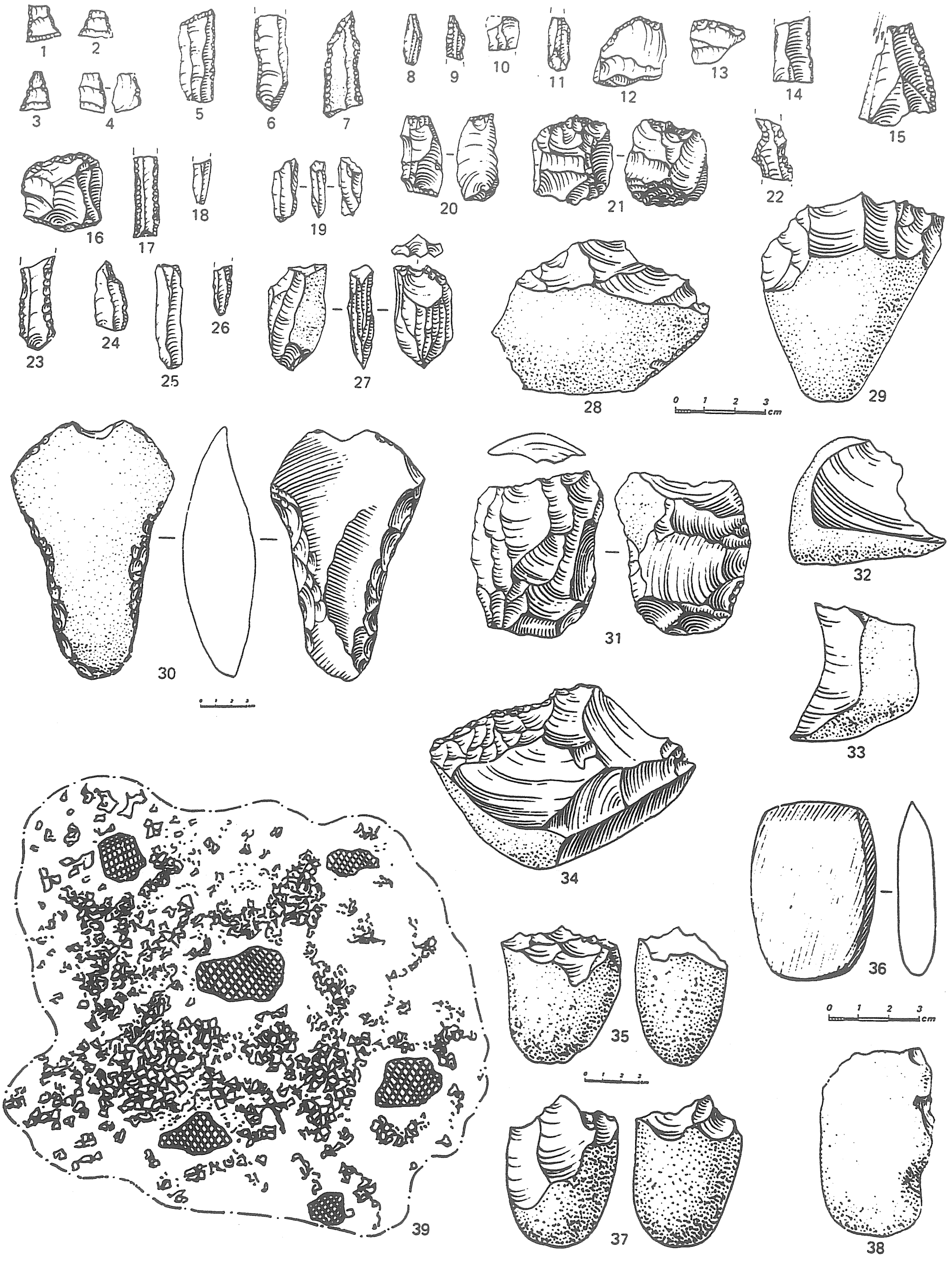

Fig. 9. Hissar Culture industry.

rials of the eastern Caspian area allows one to conclude that the formation of Kelteminar resulted at least in part from the movement of tribes bearing the Balkhan group traditions (Fig. 7). The definitive differences are in comparison to the Djeitun industry, and indicate distinct cultural traditions. The triangular microliths and the "horned trapezes" must be mentioned in particular. The latter have closest parallels in Afghanistan site materials and, interestingly, especially in the pre-pottery Mehrgarh assemblage of the oldest Baluchistan agricultural materials (LECHEVALLIER and QUINTON 1981). Mehrgharh and Djeitun are similar events that belong to the same phase of development. The same time peculiarities of the flint industries are noticeably different.

The Ferghana Sites

Ferghana is a valley enclosed on three sides by mountains. Ridges of the Tjang Shang system lie to the north. To the south is range of Alaj, the first ridge of which is the least high. Numerous temporary and perennial water-streams run down from the mountains. Between the streams are desert areas covered by sand or pebbles. Dry sandy and saline steppes are situated in the center of the valley. Small lakes and rushy zones of water accumulation appear after the floods of temporary streams occurs here. The earliest campsites are the caves of Tashkumyr in the north and Obishir in the south. Inhabitants of the caves hunted animals of the two geographical zones: mountain (wild ram, Siberian goat) and steppe-desert with Tugai bushes (goitred gazelle, wild boar, roe deer). One of the caves, Obishir 5, is a base-camp judging from the character of the cultural remains.

The flint industry of Ferghana differs noticeably from the eastern Caspian and Kelteminar traditions. The blade industry with the elements of pebble-technique is characteristic for the Mesolithic caves. Blades and microblades are represented in almost equal portions. Scrapers made on thick flakes are numerous. Some finds of elongated lunates are known. The presence of pebble technique represents the evident difference if compared with the traditions of eastern Caspian area and Kelteminar. The settling of the central Ferghana plain, as that of the Kyzyl-Kum area, apparently occurred during the rise in humidity at VII-VI mill. B.C. Many dispersed camp-sites found here probably belonged to nomadic hunters and food-gatherers. There are some rare finds of sickle-inserts used for cutting off grasses and wild cereals. The microlithisation process is recognisable in the flint industry differs also the Ferghana and the Kelteminar traditions. Microblades and microflakes are most typical for the central Ferghana Neolithic. Medium-sized blades and flakes occur much more rarely (Fig. 8). Tiny dimensions are characteristic for the tools. The main part of the tool assemblage consists of different scrapers but piercers and arrowpoints of bifacial retouch technique are known also. The pebble element is not represented at the plain area sites. Probably it is connected with the absence of the necessary raw-material.

The Hissar Culture

The fourth specific cultural tradition is represented by the sites of the Hissar culture in the mountain districts of the western Tajikistan. At the present time, about 300 points of the culture finds are known. The sites are situated in the side-valleys of the large rivers (for example at Kafirnigan) often close to the cones of accumulation of temporary or permanent channels. Together with the short-time camp-sites, base-camps with cultural layers, remains of dwellings and fireplaces are known (Tutkaul, Saj-Sajed sites). Pit-dwellings and surface-dwellings had post-constructions. The floors were often lined with the stone slabs. The main objects of hunting were deer, wild boar and aurochs. Presence of domestic sheep/goat is suggested for the late stages. The rare inserts of sickles were used for cutting off grasses and wild cereals.

Excavation of multilayered sites, first of all at Tutkaul, shows the development of the Hissar culture upon a local base. Probably we will need to include into the initial base the sites of the neighbouring Afghanistan area (KOROBKOVA 1985). In the Tutkaul Layer 2, which dates probably to VII mill. B.C., a mixed technique of tool preparation is represented. Alongside the blade technique (Fig. 9), which includes some microlithic-related elements, the manufacturing of pebble-tools was practiced. The large elongated segments are characteristic of the kit of geometric microliths. The increase of the pebble element in the industry is observable in the Hissar culture in proper sense, and dates to the same period as the Kelteminar VI-III mill. B.C. Tools made on pebble-flakes and even on whole pebbles represent up to 60-70% of the tool inventory and give a quite archaic look to the culture. Medium-size blades were used for the blanks. Trapezes and short segments are rare. The mountain culture and the Kelteminar did not give the definitive genetic continuations. At the middle of II-d mill. B.C., western Tadjikistan witnessed an influx of communities of farmers and stock-breeders partly connected with the settled culture of middle river Amu-Darja basin (the Sapally-type) and partly with pre-analogs to the steppe-bronze cultures of the more northern regions. The same picture may be observed in principle in the areas of the Kelteminar and central Ferghana Neolithic. The entire change in traditions occurred there also. In the Neolithic of the Central Asia, hunters and fishermen reached homeostasis and stagnation, and the area became the blind alley of development in contrast with the agriculturally-settled Djeitun.

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The Perspectives of the Studies on the Early Neolithic of the Kyzylkum Desert. Ayakagytma "The Site" and Other New Collections

Karol Szymczak and Tatiana Gretchkina

Abstract: *The results of archaeological survey carried out in 1995 by Polish-Uzbek Archaeological Expedition in southeastern Kyzylkum Desert are described. At least one of the locations ("The Site") in the region of the Ayakagytma depression yielded extremely rich and very interesting Kelteminarian material.*

In recent archaeological literature a considerable intensification of research devoted to the beginnings of Neolithic period can be noted (*e.g.* GEBEL and KOZŁOWSKI eds. 1994). New data have been presented, and some new theories formulated, regarding the genesis of the Neolithic in its original territories in the Near East, as well as the mechanisms of the spread of productive economics toward and in Europe. On the other hand, much less is being said about the problem of the northeastern direction of neolithisation that leading to Central Asia and further on.

For many years this problem was an object of interest of some Russian researchers (MASSON 1964, 1971; VINOGRADOV 1968, 1981; KOROBKOVA 1969, 1970, 1977) who collected to the very end of the 1970s quite an amount of extremely interesting archaeological material. This period of studies has been summed up in the English written works by P.M. Dolukhanov (1986) and G. Matyuishin (1986) and also in G.F. Korobkova's book (1987, in Russian). One of the main results of these works was the distinction in the Central Asian Early Neolithic three big cultural units, differentiated not only by material culture, but also on the basis of economics:

1. Djeitunian - thanks to the long-term and still continuing work of V.M. Masson and his colleagues, the Djeitunian is a well recognized unit, representing relatively the most advanced level of farming and animal breeding economics;
2. Hissarian - is a unit mainly representing the economics founded on animal husbandry, with a considerable share of hunting and gathering;
3. Kelteminarian - a steppe unit representing the most traditional hunting-gathering-fishing way of life, possibly with some elements of herding (KOROBKOVA 1987; see also Fig. 1).

Especially the last of the cultures mentioned above is still poorly recognized, although the archaeological finds themselves are pretty numerous and rich (VINOGRADOV 1968, 1981). We do not have this unit dated precisely enough yet (only two ^{14}C dates known), neither can we show its exact territorial range, not to mention other details. Such a situation clearly points out that a return to the investigation of the Kelteminarian culture would be very advisable.

A splendid opportunity to do that was the founding in 1994 of the Polish-Uzbek Archaeological Expedition to work mainly in the western part of the Republic of Uzbekistan. In the season of 1995, which was the first season of field activity, one of the three strategic tasks set before the Expedition was to carry out an archaeological survey in southeastern part of the Kyzylkum Desert in order to establish the possibilities of starting the large-scale studies on the Mesolithic and Neolithic periods, with a special respect paid to the process of neolithisation of that area.

The region to be surveyed was not chosen only by accident, of course. It is clearly shown in the literature of the subject, especially in the works of A.V. Vinogradov (1981), that the southeastern part of the Kyzylkum Desert, or more exactly, the area of a Late Pleistocene and Early Holocene delta of the Zeravshan River, is extremely rich in archaeological material, especially in regards to the periods we were particularly interested in. There are mentioned hundreds of finds, though most of them are

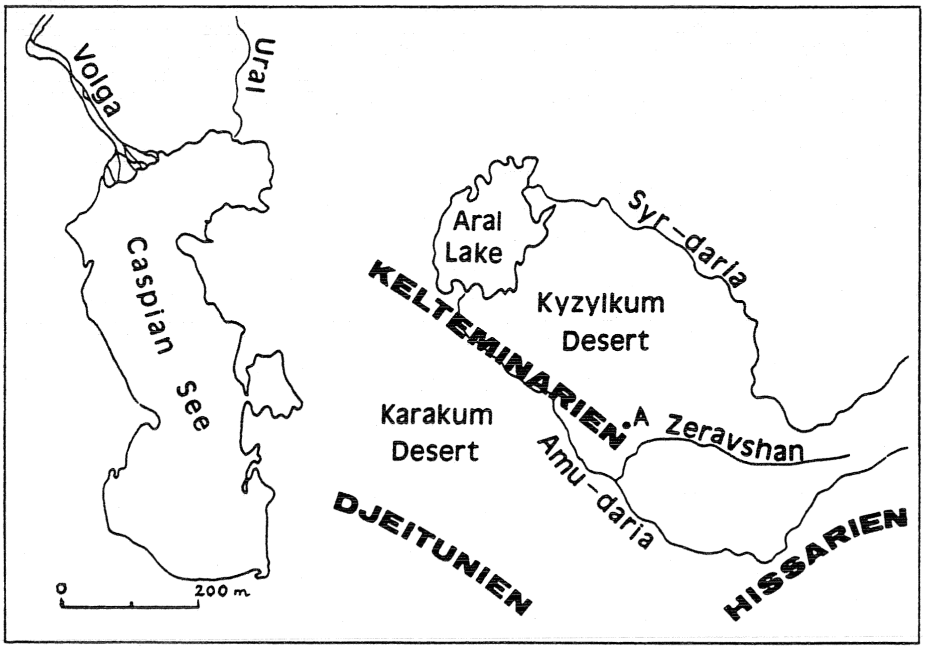

Fig. 1. Cultural zones in Central Asian Mesolithic/ Neolithic: the survey area.

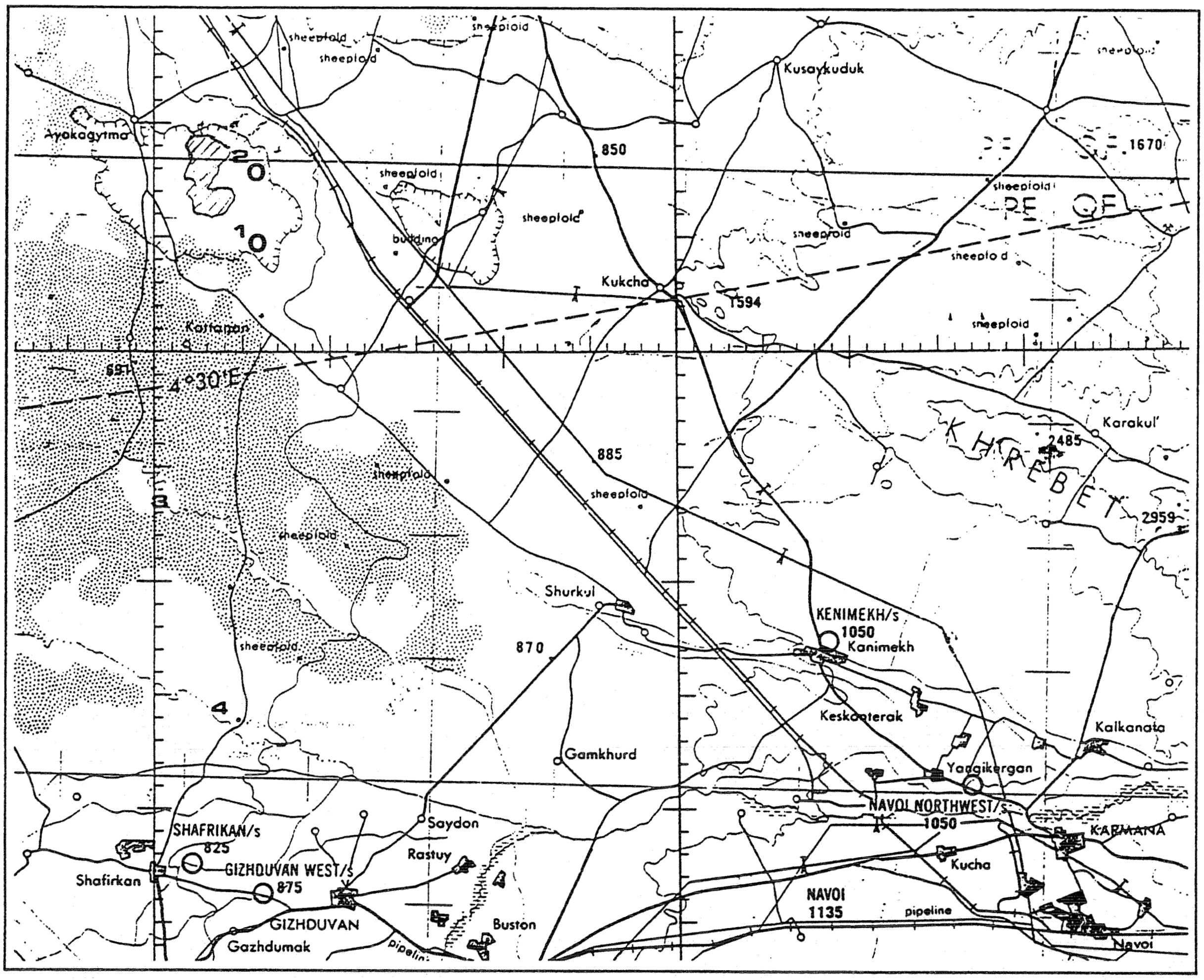

Fig. 2. The survey areas in the southeastern part of Khyzylkum Desert: 1 Ayakagytma "First Stop", 2 Ayakagytma "Second Stop" (= "The Site"), 3 Khodzshagumbaz area, 4 Dzshilduvan area.

the poorly preserved sandy surface sites. Bearing in mind information from the literature, we chose two particular regions for systematic detailed prospection: 1) the small, now completely dry Etshkiliksai and Dzshilduvan Valleys, both former branches of Zeravshan delta that cut the desert from west to east, and 2) located some dozen kilometers north of them, a wide depression (about 12km in diameter) with a salty lake, known as Ayakagytma (Fig. 2).

Our first trip on Etshkiliksai and Dzshilduvan gave quite exciting results. During 6-8km transects along the valleys we have managed to locate more than a dozen Mesolithic/Neolithic sites, at least 3-4 of which yielded very rich series of flint artifacts.

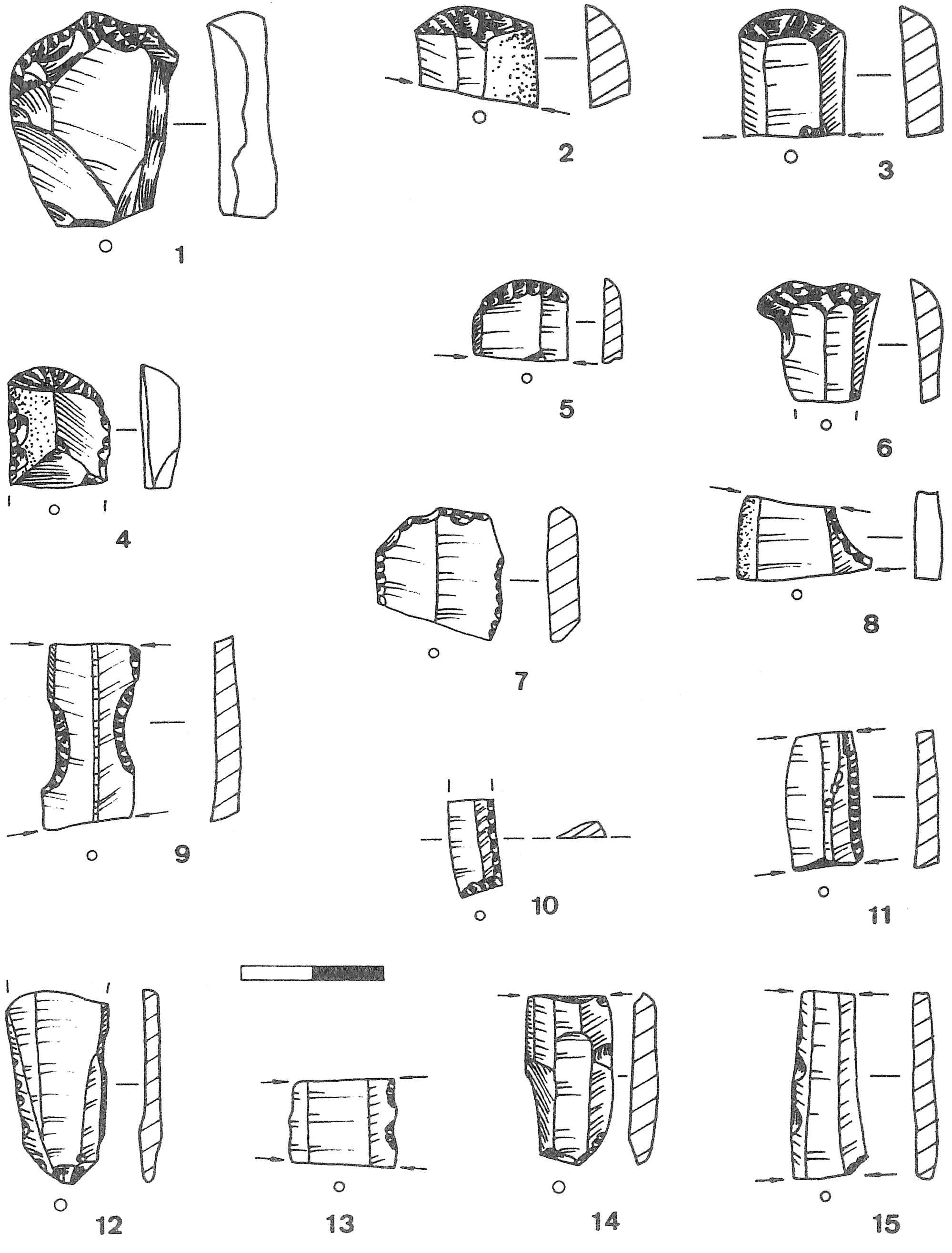

Fig. 3. Khodzshagumbaz, survey collection: 1-7 end-scrapers; 8-9,11-15 retouched blades; 10 microlith fragment (drawn by D. Bagińska and K. Szymczak).

Special attention should be paid to the site located about 1km east of the Khodzshagumbaz sheepfold, near Etshkiliksai Valley (a region described also in VINOGRADOV 1981). On the surface of the northern slope of a small (less than 2m high), sandy-gravel holm, we found 81artifacts including two fragments of blades with well-marked retouch (Fig. 3:11) - one of them with typical parallel notches on both edges (Fig. 3:9), seven small, sometimes even tiny, mostly regularly arched endscrapers (Fig. 3:1-7), and a fragment of microlith, probably a basal part of right-angled triangle (Fig. 3:10). The remaining part of the collection consists of debitage, *e.g.* trimming blades (Fig. 4:4-5); highly regular blades, with (Fig. 3:8,12-15), or without slightly retouched edges (Fig. 4:2,6-11)

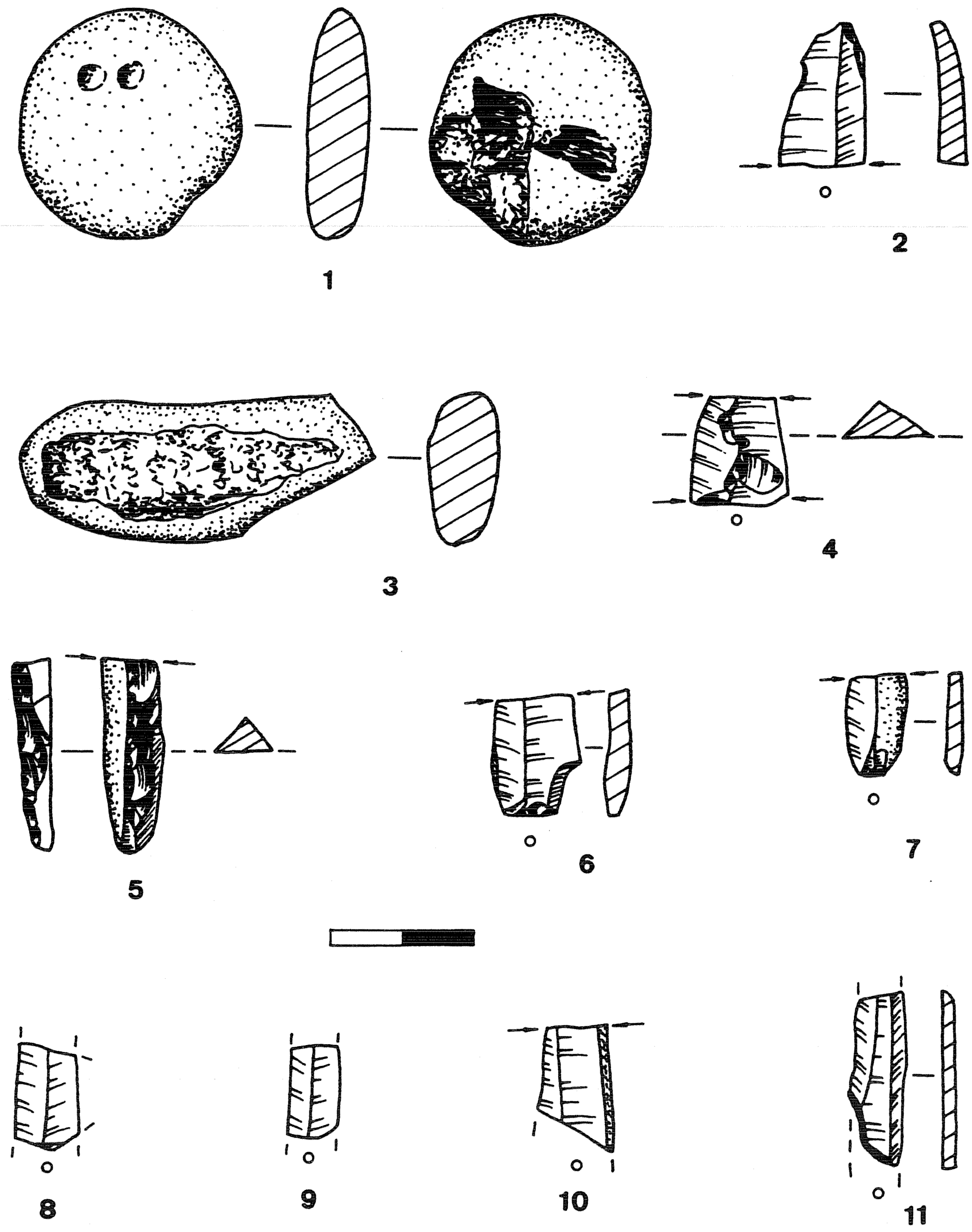

Fig. 4. Khodzshagumbaz, survey collection: 1,3 stone implements; 2,4-11 unretouched blades (drawn by D. Bagińska and K. Szymczak).

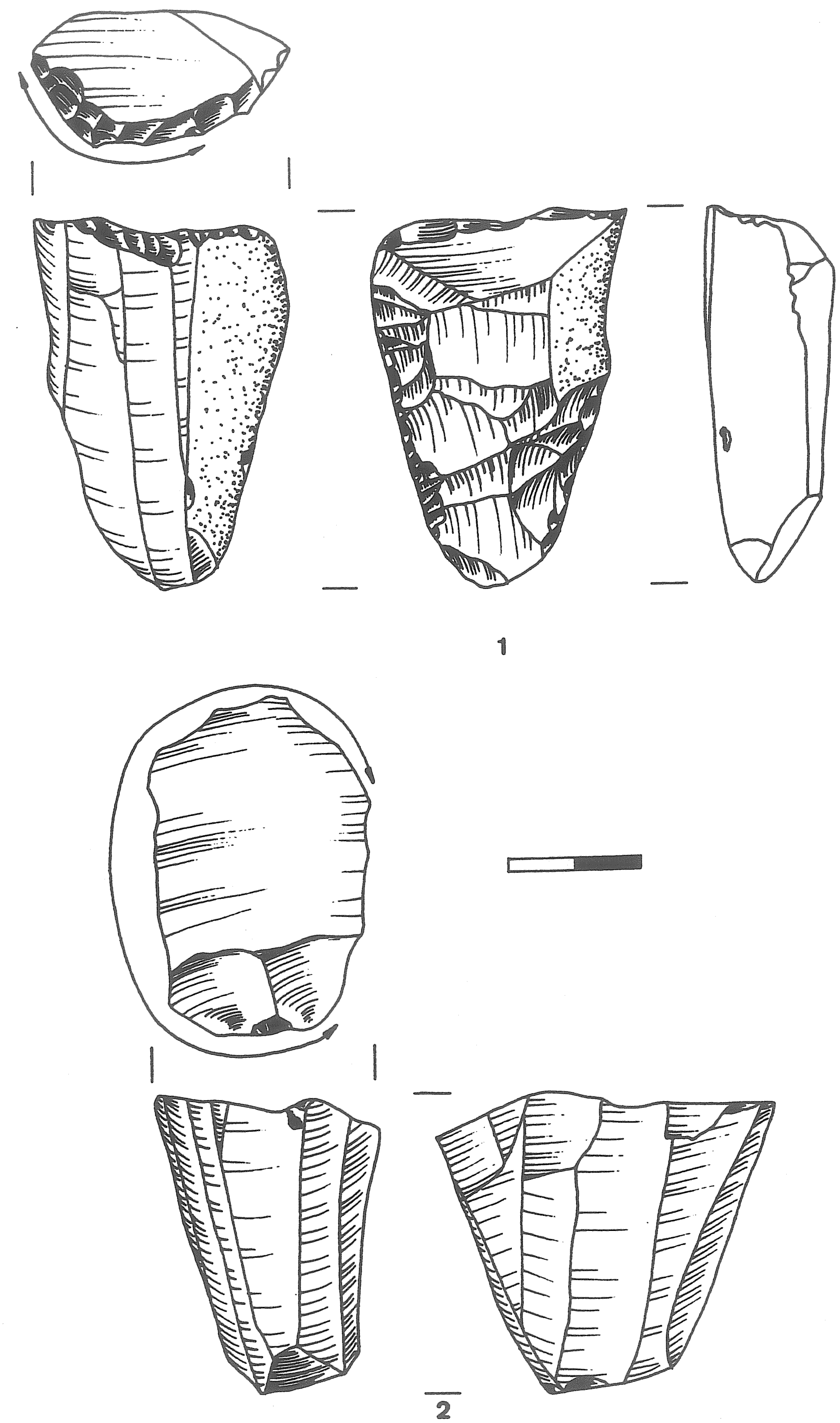

Fig. 5. Ayakagytma "First Stop", survey collection: 1-2 cores
(drawn by D. Bagińska and K. Szymczak).

(many of these pieces are transversally broken small flakes), and three groundstone implements (Fig. 4:1,3). Though the site seemed to be rich, we did not select it for systematic excavation because it was so disturbed that we could not expect to find in any part of it the material lying in its primary position, either stratigraphical, nor planigraphical.

In his book, Vinogradov (1981) mentions that there are at least about 300 Stone Age sites in the region of Ayakagytma Depression. Such an information encouraged us to revisit that area, and, indeed, from the point of view of future field research, our second trip was much more successful.

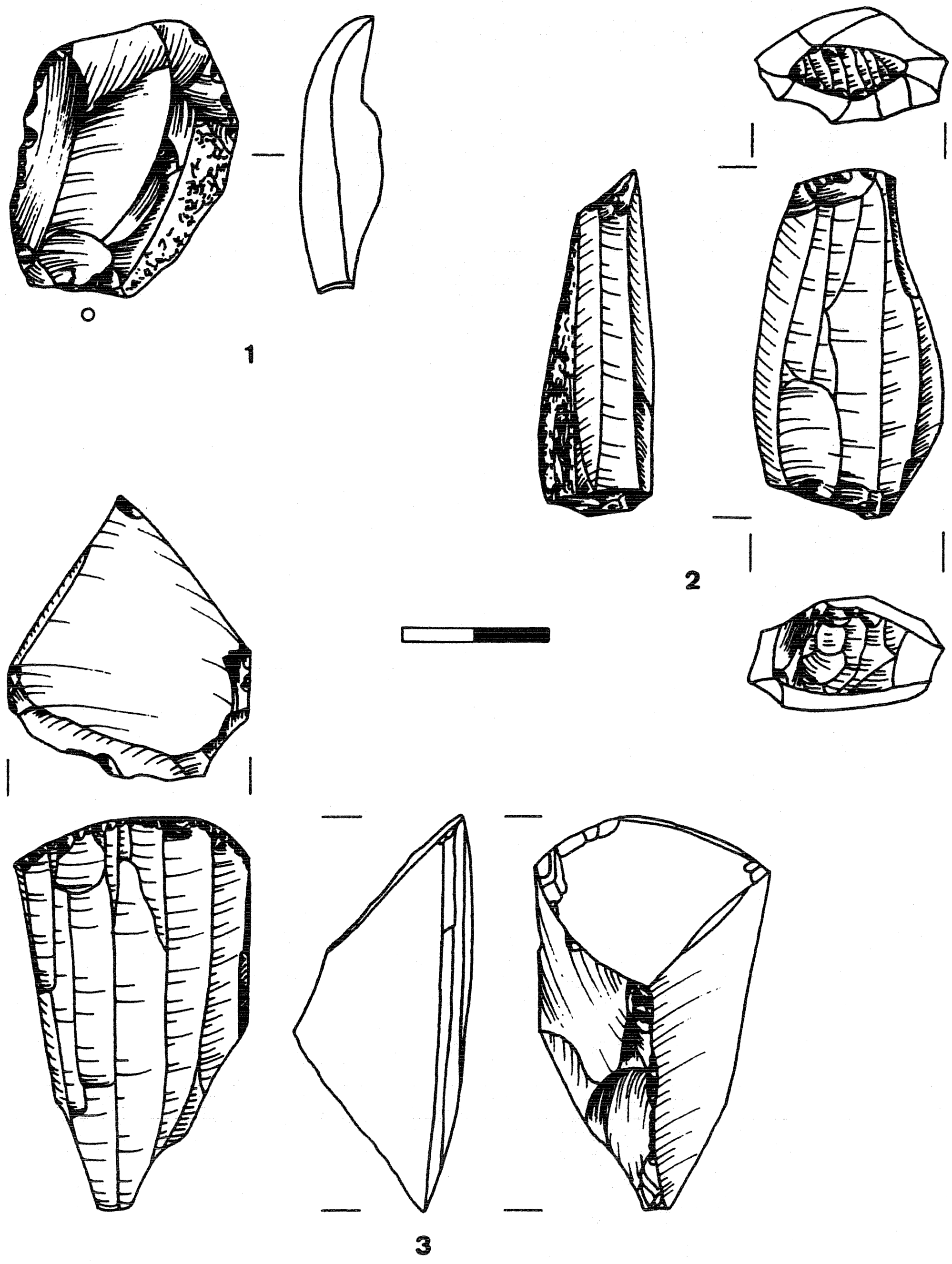

Fig. 6. Ayakagytma "First Stop", survey collection: 1 retouched flake, 2-3 cores (drawn by D. Bagińska and K. Szymczak).

As already mentioned, Ayakagytma is a circular, slightly oval depression of a diameter not exceeding 12-13 km. On the bottom of it there is a strongly salted lake (6-7km in diameter; Fig. 2). The relative height of an edge of the hollow in relation to an current water level seems to be about 30-40m. In the 3-4km wide strip between the edge and the lake shore line one can find complicated systems of terraces, peninsula, points and plains, all cut by the valleys, gorges, ravines and gullies to a relative depth from some dozen centimeters down to a dozen or so meters. In some places more eminent island hills could be noted.

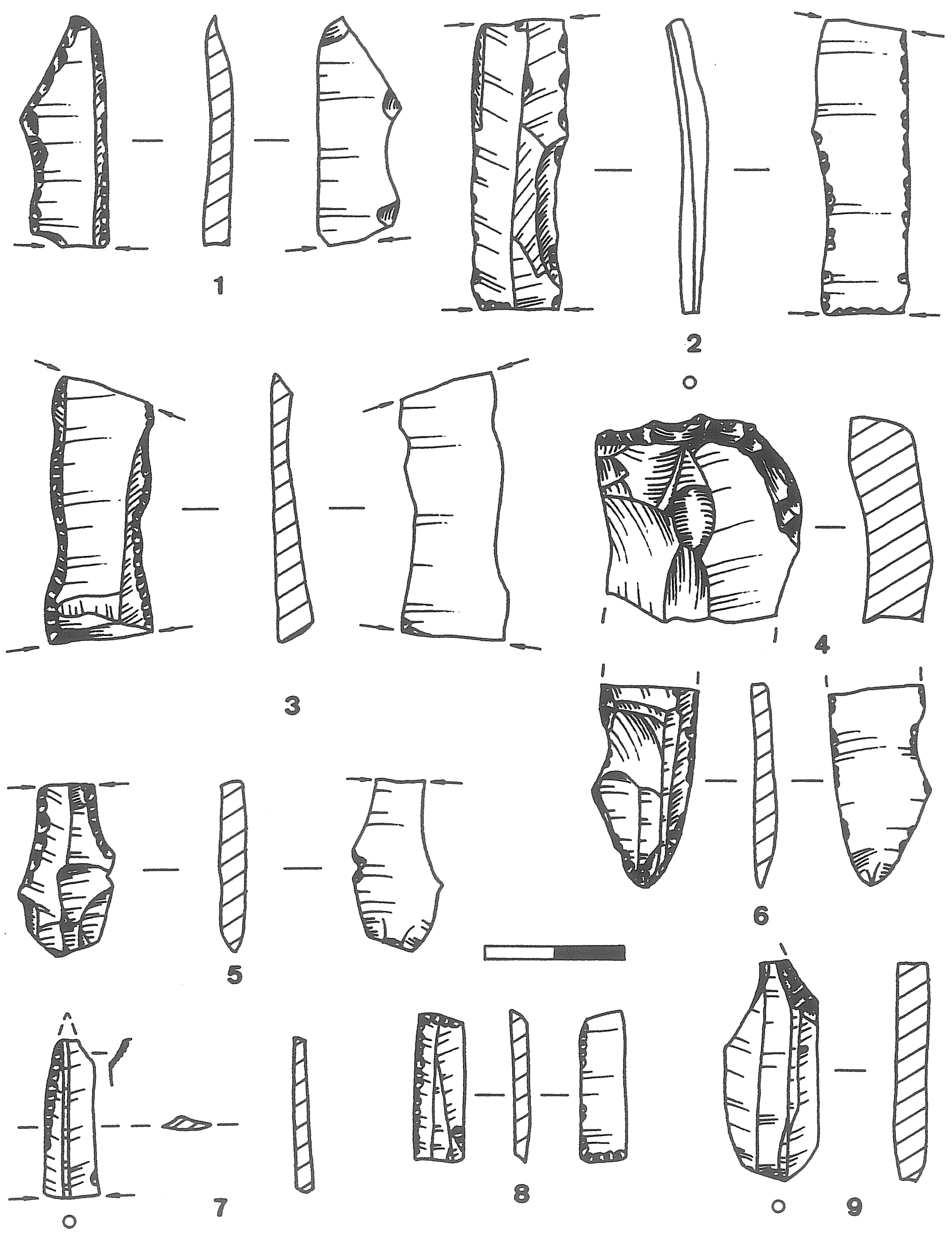

Fig. 7. Ayakagytma "First Stop", survey collection: 1-3,5-6,9 retouched blades; 4 end-scraper; 7-8 microliths (drawn by D. Bagińska and K. Szymczak).

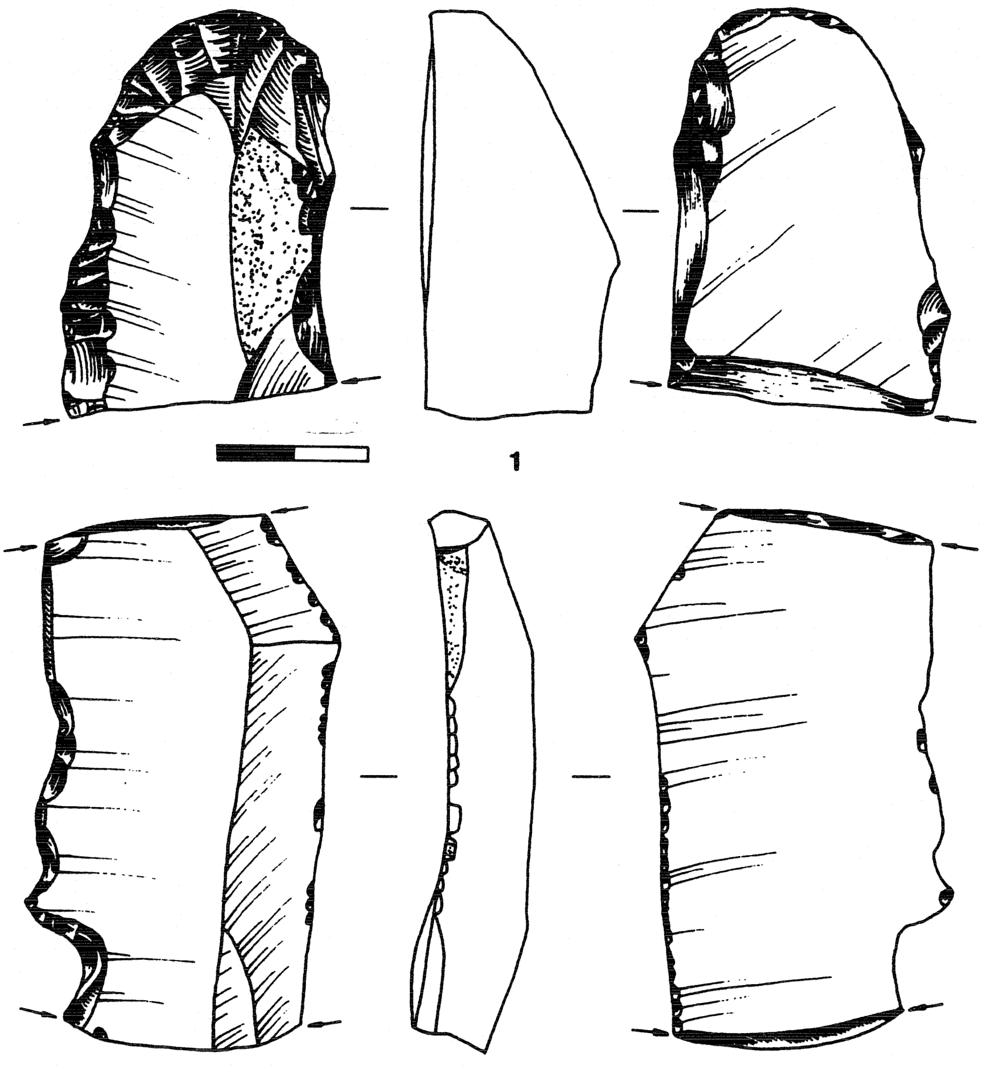

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Fig. 8. Ayakagytma "First Stop", lower terrace, survey collection: 1 end-scraper, 2 broad insert (drawn by D. Bagińska and K. Szymczak).

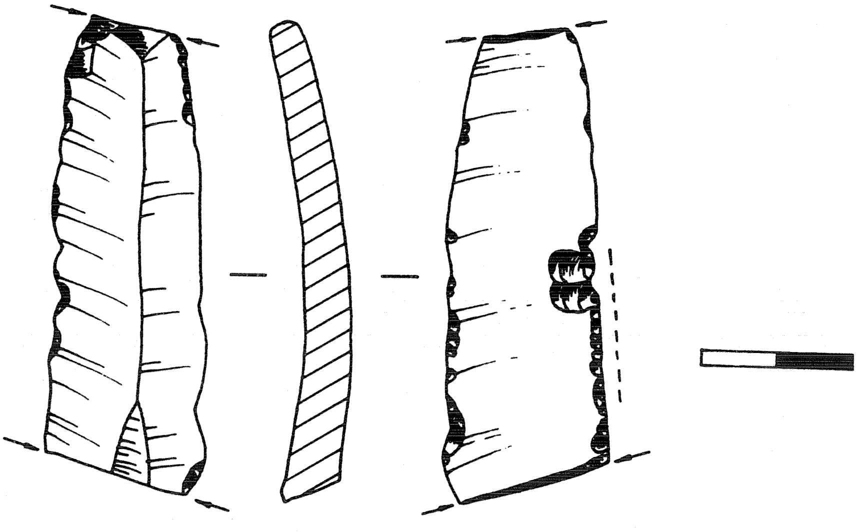

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Fig. 9. Ayakagytma "First Stop", upland, survey collection: 1 isolated find of an insert (drawn by D. Bagińska and K. Szymczak).

The described terraces and points yield extremely numerous flint finds, among which we managed to isolate Middle and Upper Palaeolithic items, but the majority of the collected material was identified as Mesolithic/Neolithic.

In southeastern and eastern part of the Ayakagytma hollow, we intensively examined two areas, lying about 4km from each other, which we marked as the "First" and the "Second Stop" (Fig. 2).

At the "First Stop" we located, among others, a quite rich Mesolithic/Neolithic site with some regular blade cores of conical shape (Figs. 5:1-2, 6:2-3); an endscraper (Fig. 7:4); blades with a well marked retouch (Fig. 7:3), including a typical specimen with the parallel notches on both sides (Fig.

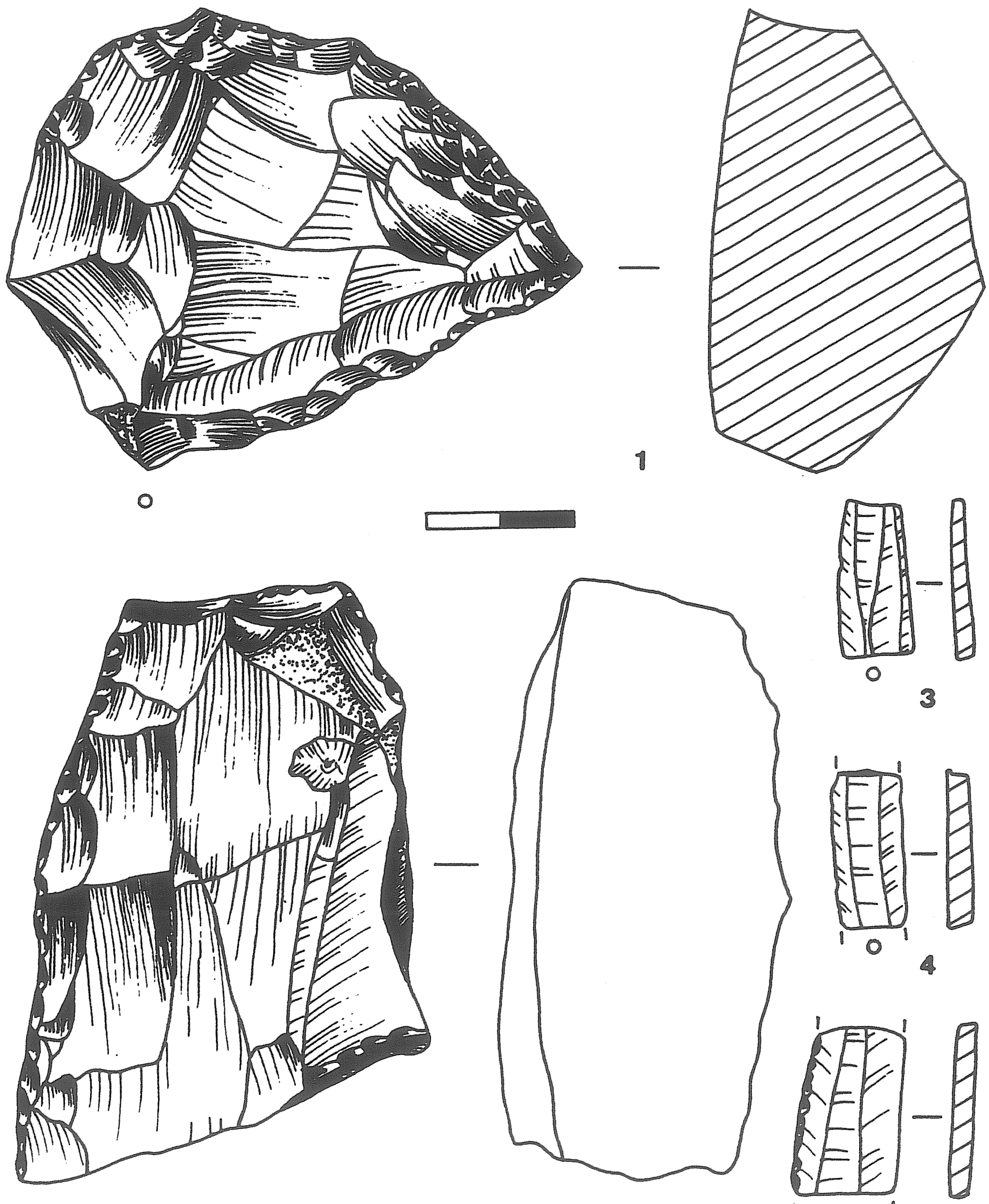

Fig. 10. Ayakagytma "The Site", survey collection: 1-2 retouched flakes (pre-cores?), 3-4 unretouched blades, 5 retouched blade (drawn by D. Bagińska and K. Szymczak).

7:5); and microliths, including a regular rectangular insert (Fig. 7:8) and probably a fragment of a triangle with a finely made tip (Fig. 7:7). There were also a number of lightly retouched blades (Fig. 7:1-2,6,9) and flakes (Fig. 6:1). Some blades, fresh as well as retouched ones, and both microliths are produced of a pure white raw material, closely resembling the most delicate porcelain.

Another site, found on the lower terrace, could be probably dated to the advanced Neolithic or even later. The most interesting flint artifacts in this collection are the very wide, thick blades and equally massive, intentionally broken inserts (Fig. 8:2). Out of a blank of similar proportions an

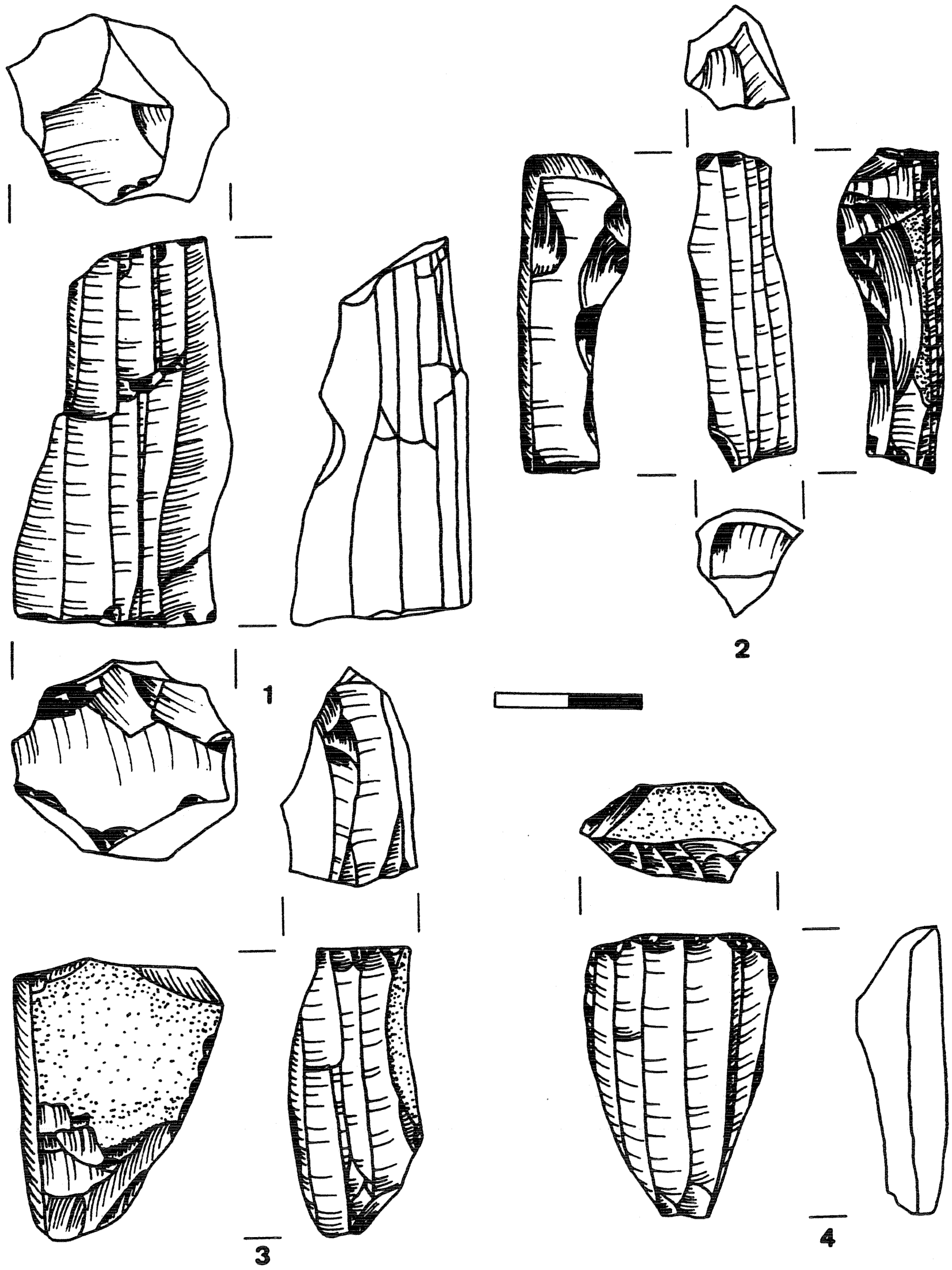

Fig. 11. Ayakagytma "The Site", survey collection: 1-4 cores (drawn by D. Bagińska and K. Szymczak).

endscraper was made (Fig. 8:1). Some of the artifacts are patinated to a brownish-yellow colour.

An important though isolate artifact, found on the surface of the upland some dozen meters from the edge of the Ayakagytma Depression, is more than 20mm wide and more than 60mm long flint insert, intentionally broken at both ends, with an irregular denticulated retouch, most probably of a functional origin, and a slight sickle gloss on a ventral part of one of the edges (Fig. 9).

But all the hopes were fulfilled by the "Second Stop", around which the next dozen or so archaeological sites were located. One of them was so incredibly rich that we have called it "The Site" - spelled with capital "S" - and qualified it as the first to be excavated next season.

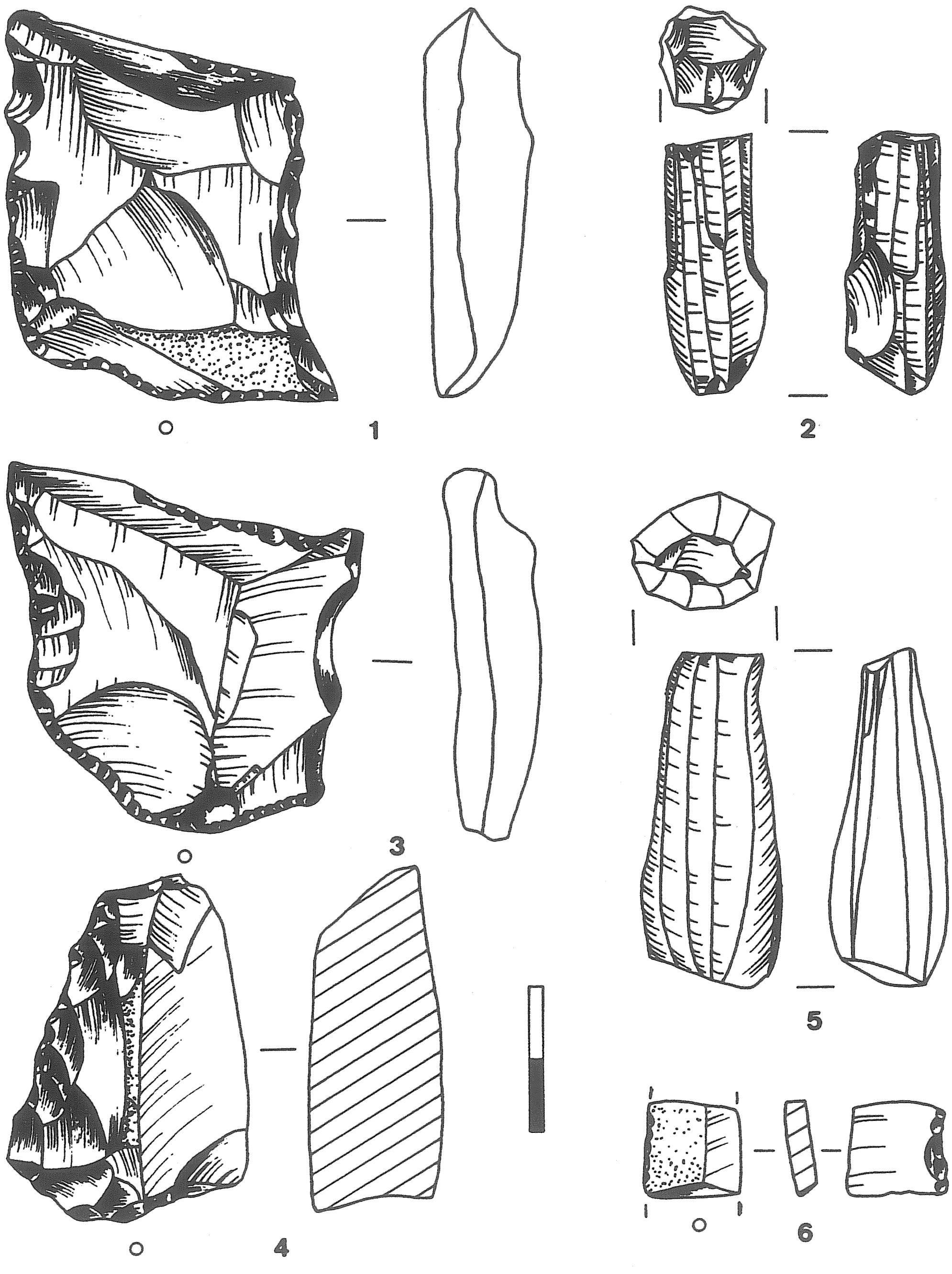

Fig. 12. Ayakagytma "The Site", survey collection: 1,3-4 retouched flakes (pre-cores?); 2,5 cores; 6 retouched blade (drawn by D. Bagińska and K. Szymczak).

Ayakagytma's "The Site" is located on a flat terrace of moderate extent, limited on the southeast by the slope of a hill and from the northwest by the cliff of a 8-10m deep gorge. The artifacts appear in an enormous density over an area of about 30 by 60m. The majority of this area is disturbed, and a great amount of archaeological material lies directly on the surface in a loose sand. Even so, some of the finds remained in their primary position in a 35-40cm thick layer of sand, hardened by the strong precipitation of salt and gypsum. In the same layer, in a central part of the flint artifact concentration, the relicts of hearth are also preserved.

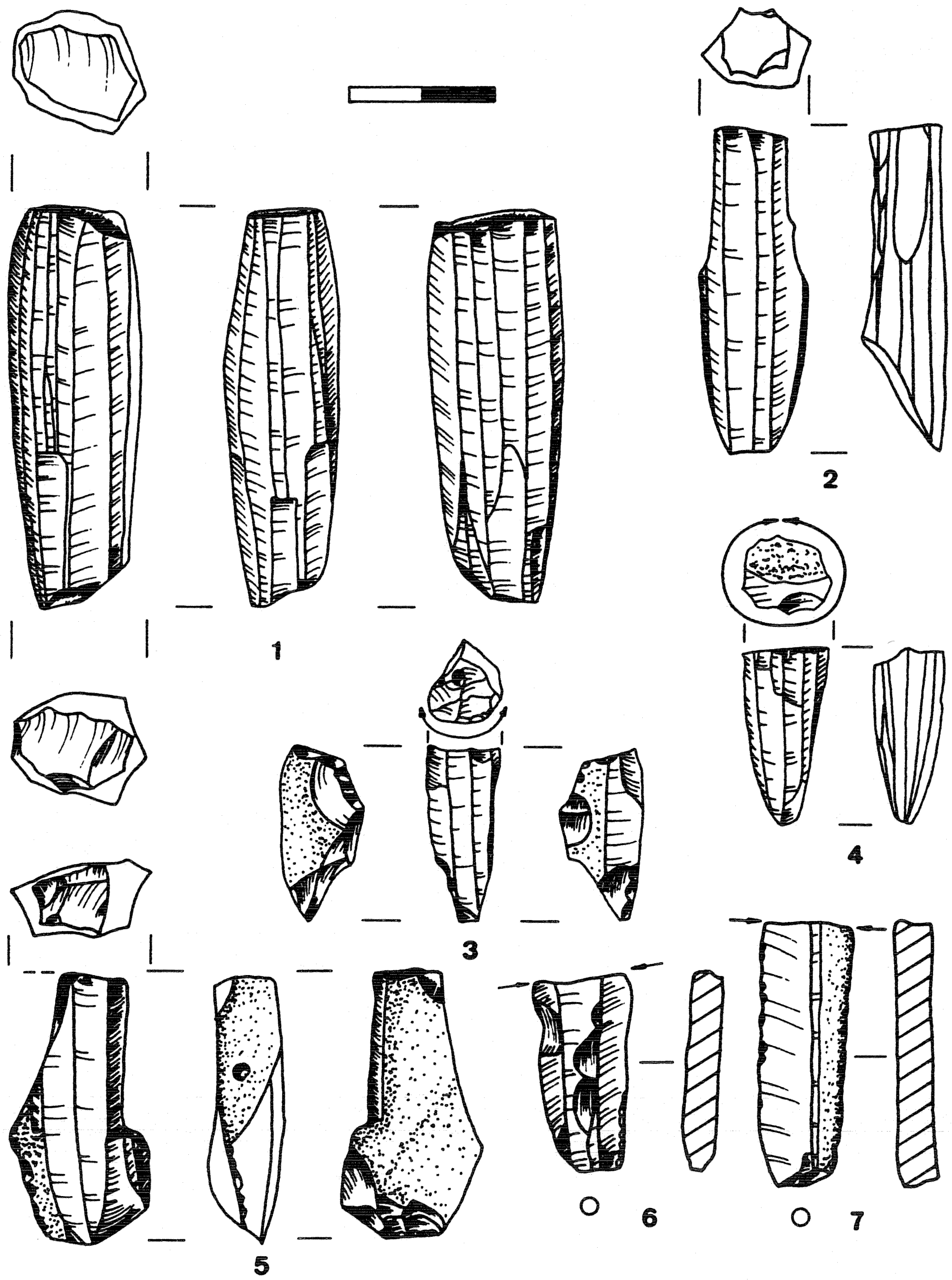

Fig. 13. Ayakagytma "The Site", survey collection: 1-5 cores, 6-7 retouched blades (drawn by D. Bagińska and K. Szymczak).

The most characteristic feature of the flint material is a great amount of very regular blades and blade tools. One could even have an impression that "The Site" itself is a blade producing workshop, although present are also other elements that could testify to a more stable and permanent settlement.

As a sample, we picked up 544 flint and 4 stone artifacts from the surface, together with 3 non-diagnostic fragments of thin, excellently fired pottery. A general structure of a flint sample (6.25% cores, 32.35% flakes, 42.28% blades and 19.12% of retouched tools) is most probably distorted to

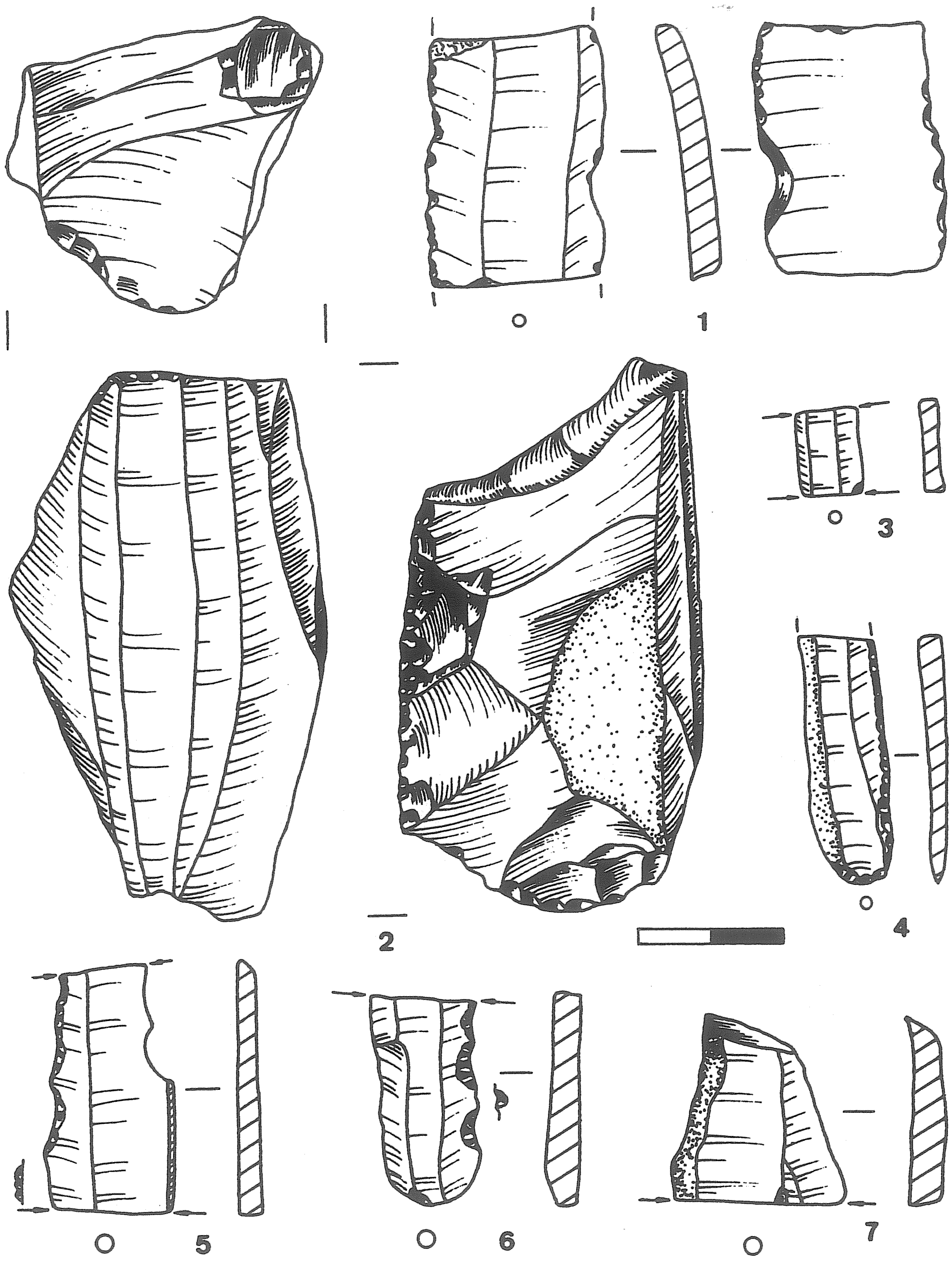

Fig. 14. Ayakagytma "The Site", survey collection: 1,4-6 retouched blades; 2 core; 3,7 unretouched blades (drawn by D. Bagińska and K. Szymczak).

some extent by unconsciously selecting the particularly regular specimens in the course of collecting the material from the site surface.

The series of flint artifacts consists of conical blade cores of various sizes, from large (Fig. 20) to tiny, microlithic items Fig. 13:3-4), sometimes with changed orientation and often with distinct initial shaping (Figs. 11:1-4; 12:2,5; 13:1-2,5; 14:2; 15:1 - 23 pieces); other kinds of cores (Fig. 16); debitage from initial shaping as well as exploiting cores (Fig. 14:5 - almost 50 pieces); highly regular blades, which are mostly intentionally broken (Figs. 10:3-4; 14:3,7; 16:3-4; 17:2 - 210 pieces); and

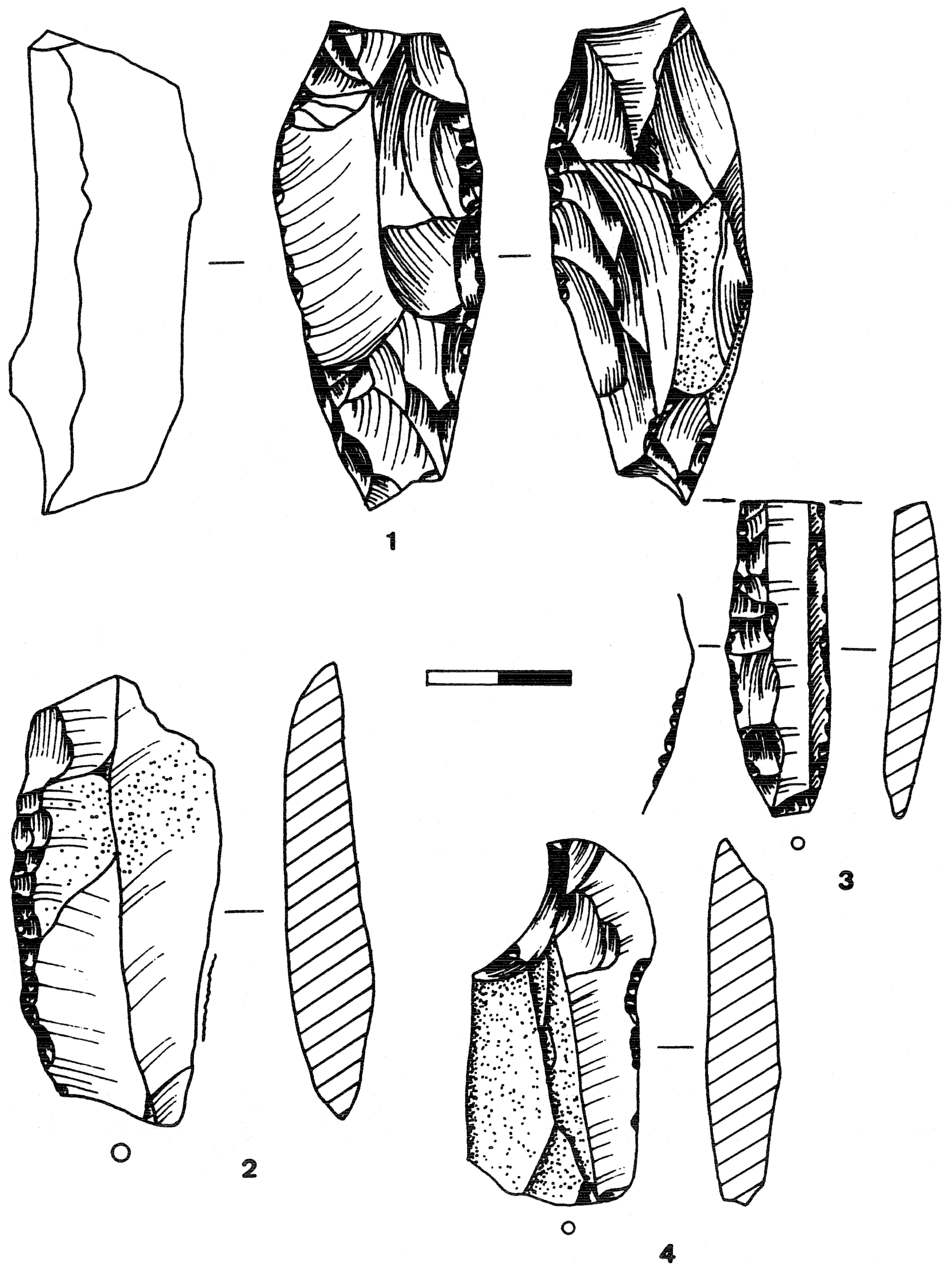

Fig. 15. Ayakagytma "The Site", survey collection: 1 pic, 2-4 retouched blades (drawn by D. Bagińska and K. Szymczak).

retouched tools. The tools include blades with light (49 pieces) or well-marked retouch (16 pieces; Figs. 10:5; 12:6; 13:6-7; 14:1,4-6; 15:2-4; 16:2,6; 17:3-6; 18:8-10; 19:7,9-13), many intentionally broken, some of which could be even counted as inserts (e. g. Figs. 14:1; 18:8 or 20:9,12); very thick and massive flakes with a rich, semi-abrupt or abrupt retouch of the edges, some maybe precores (?) (Figs. 10:1-2; 12:1,3,4 - 7 pieces); endscrapers, mainly short with a regular, arched scraping end (Fig. 18:1-7 - 7 pieces); microretouched truncations (Fig. 19:4-6 - 4 pieces); a slender perforator on a blade (Fig. 20:8); a pick (Fig. 15:1); and among the microliths two triangles (Fig. 19:2-3) and a typical shouldered point of Kelteminarian type (Fig. 19:1).

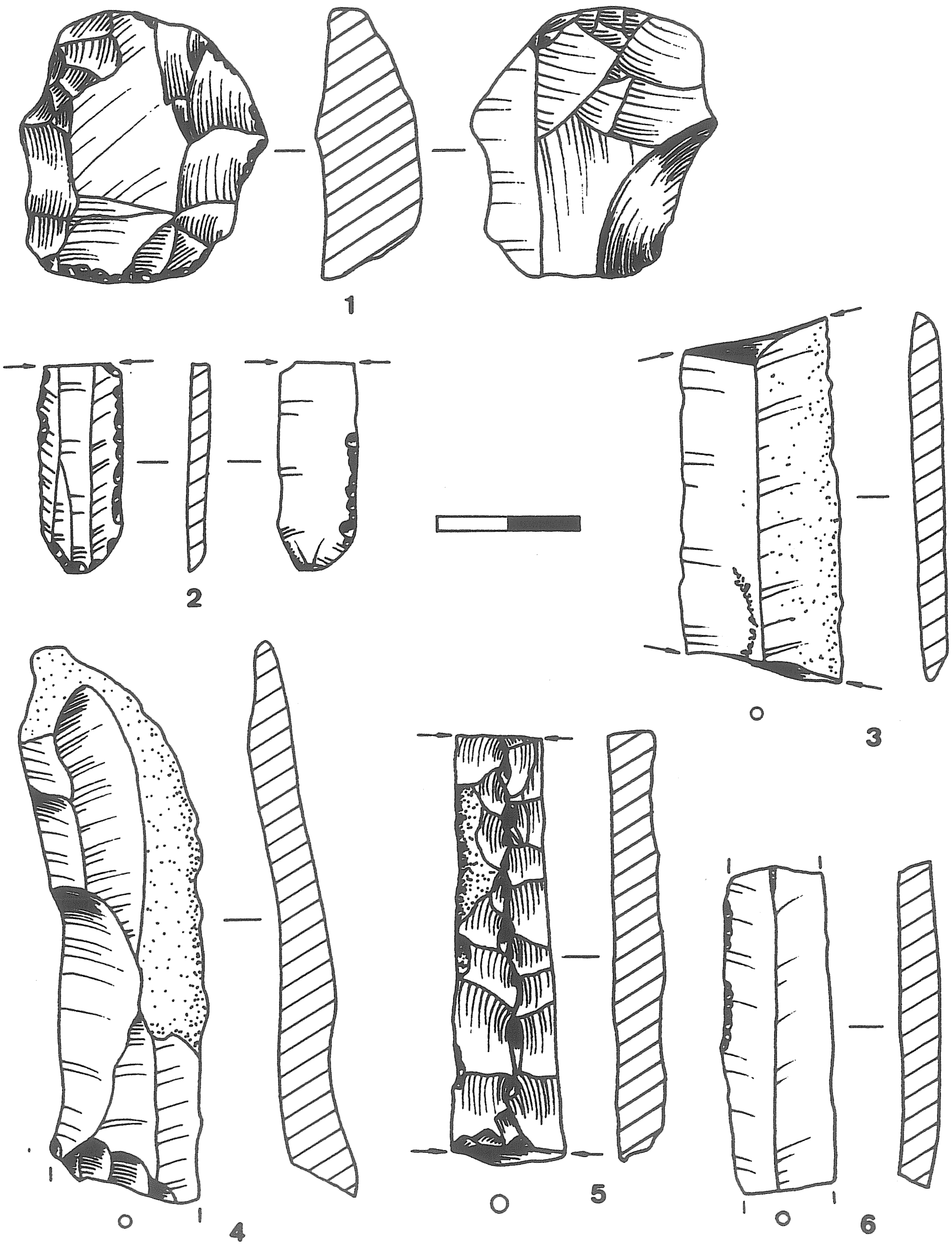

Fig. 16. Ayakagytma "The Site", survey collection: 1 core; 2,6 retouched blades; 3-4,6 unretouched blades; 5 trimming blade (drawn by D. Bagińska and K. Szymczak).

Three artifacts (a perforator, a Kelteminarian point and one fragment of a retouched blade) are made of the white raw material mentioned earlier, which according to the Uzbek researchers was imported from the area of the uplands in central part of Kyzylkum Desert. Another probably imported raw material is the flint of yellow-brownish colour with a warm, velvet hue (some blades, an insert, one of the triangles), although the source has not yet been identified. However, more than 98% of the collection consists of artifacts produced from the grey-beige flint with a metallic glaze, often covered by more poorly crystallized parts. The white 2-3mm thick cortex, preserved perfectly well on

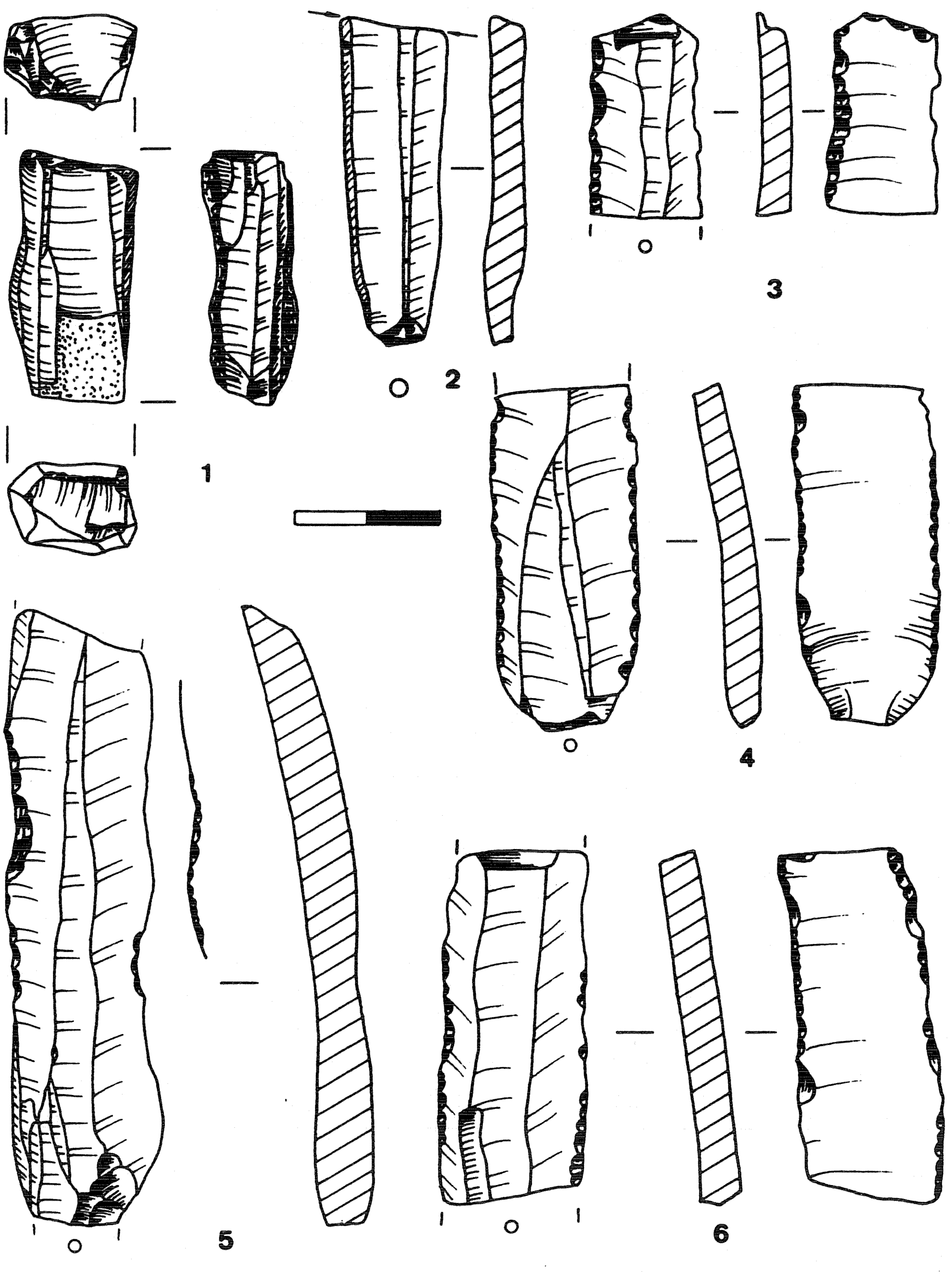

Fig. 17. Ayakagytma "The Site", survey collection: 1 core, 2 unretouched blades; 3-6 retouched blades (drawn by D. Bagińska and K. Szymczak).

many specimen, testifies undoubtedly that the used raw material was being obtained directly from its primary bed, located most probably somewhere in the nearest vicinity of "The Site" some hundreds of meters, probably towards the west.

The set of groundstone artifacts, the presence of which would suggest that the function of "The Site" was not limited only to blade production, consists of four implements. One of them, a face-hammer outstandingly polished on the whole surface (an object refitted from two separately found fragments), had a well preserved sharp edge, but it was strongly damaged by crushing and scaling on the head and on one of the sides (Fig. 21). The tool was made of a stone black inside and bluish-gray on the surface. Another groundstone implement, a pestle (Fig. 22:2), was produced from an elongated

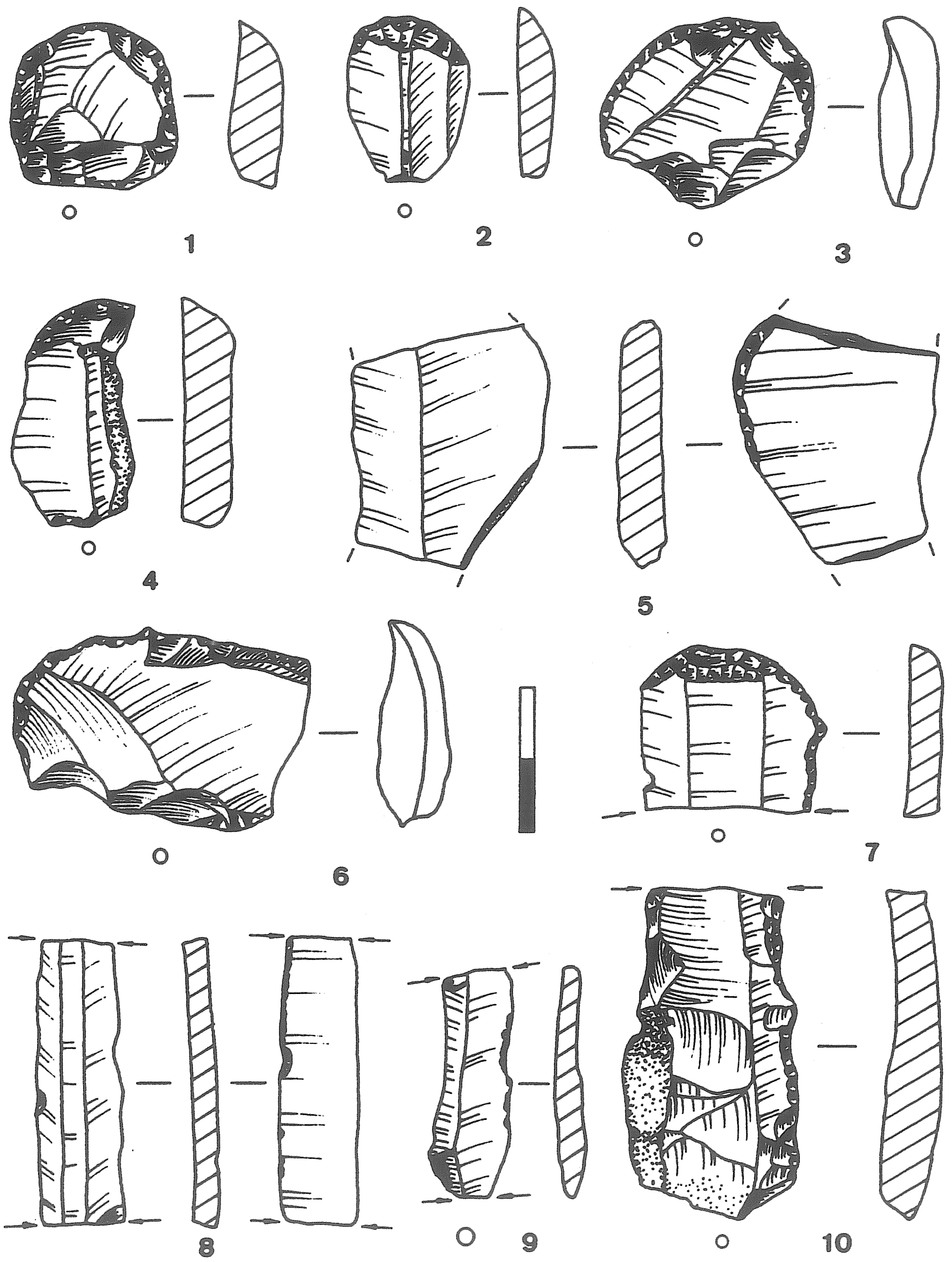

Fig. 18. Ayakagytma "The Site", survey collection: 1-7 end-scrapers, 8-10 retouched blades (drawn by D. Bagińska and K. Szymczak).

pebble of similar raw material. The artifact was damaged severely on both ends by heavy crushing, as well as by accidental chipping, resulting probably from strong but imprecise hits.

A third stone product, a plate made of light yellow-beige sandstone, has a form of a thin, regular circle worked on both sides (Fig. 22:1). This is a type that appears in many Mesolithic/Neolithic assemblages of Central Asia, although the function is not clear. The last specimen was a fragment of a thick, poorly worked slab, made of black-grey raw material in which numerous feldspar particles could be seen.

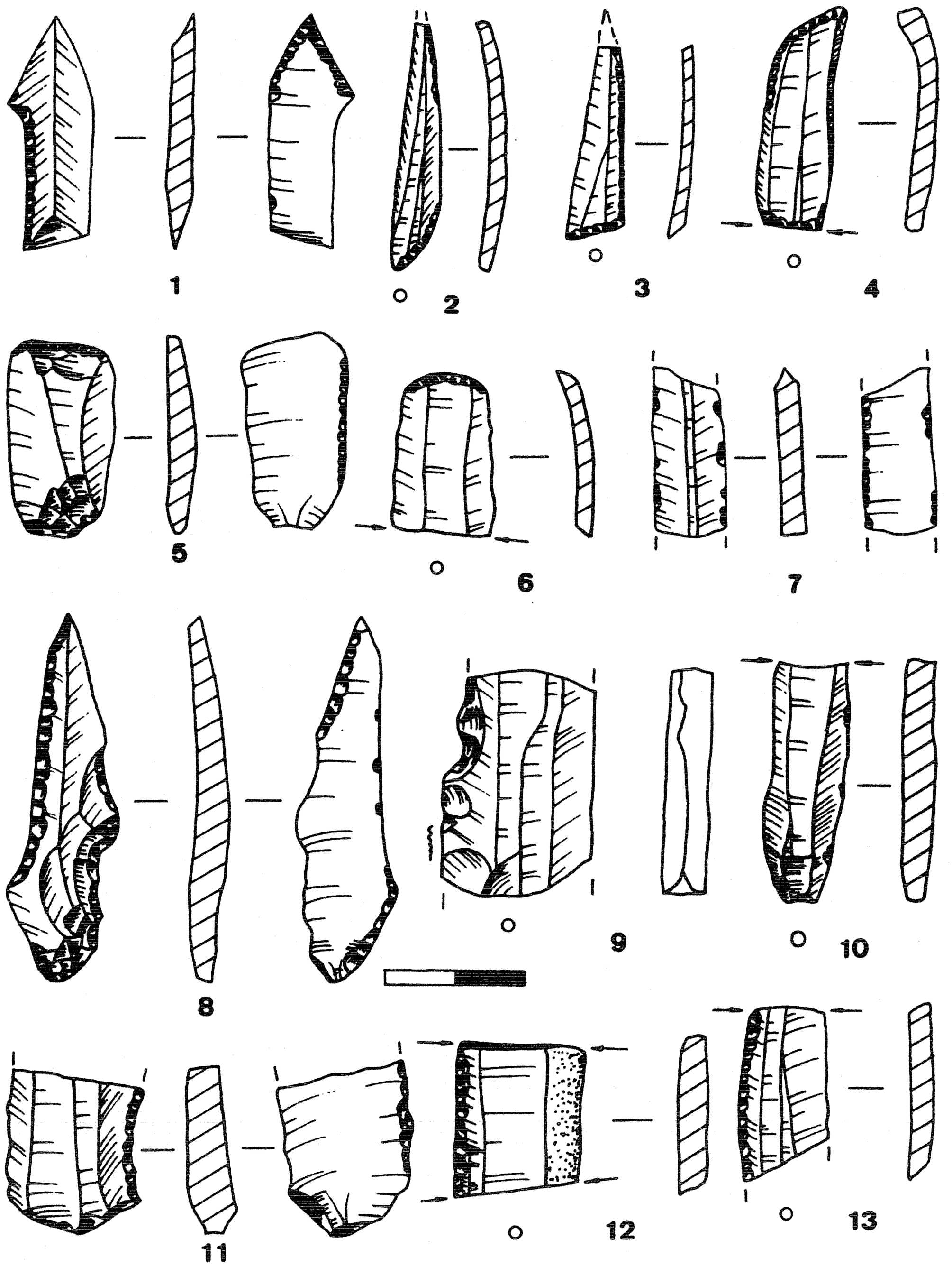

Fig. 19. Ayakagytma "The Site", survey collection: 1 Kelteminarian Point; 2-3 triangles; 4-6 truncated pieces; 7,9-13 retouched blades; 8 perforator (drawn by D. Bagińska and K. Szymczak).

Fig. 20. Ayakagytma "The Site", survey collection: 1 core (drawn by D. Bagińska and K. Szymczak).

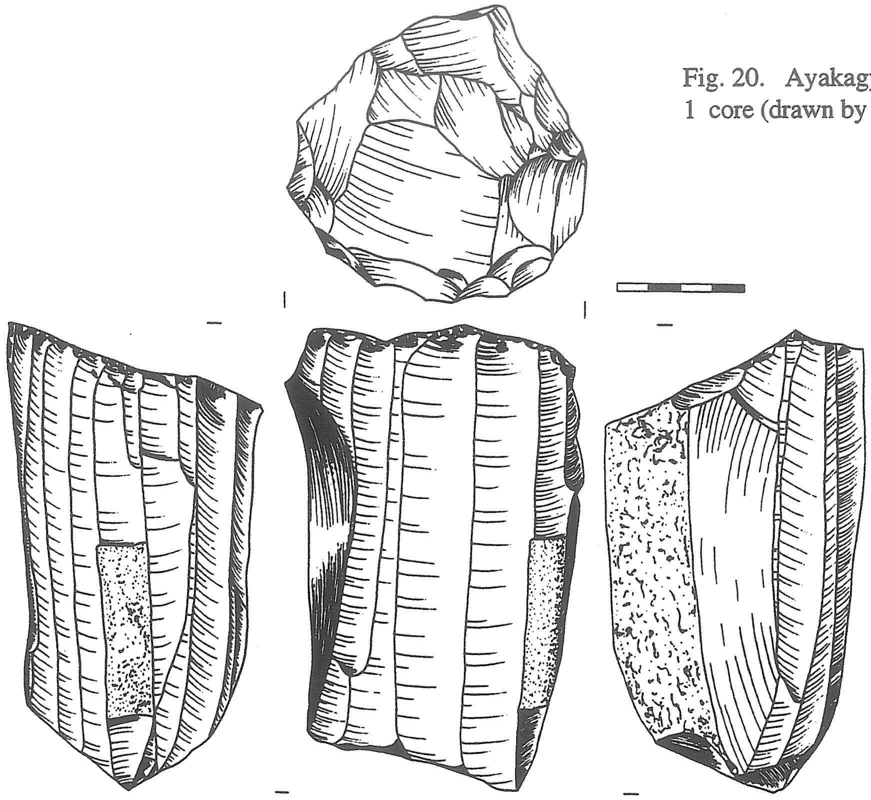

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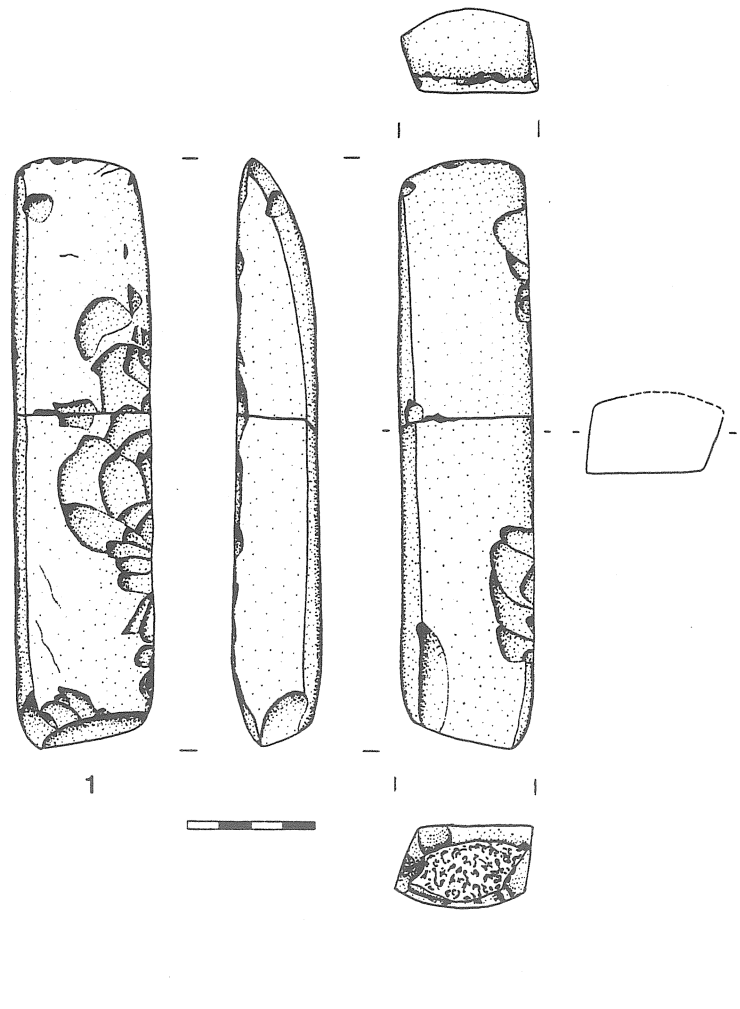
Fig. 21. Ayakagytma "The Site", survey collection: 1 stone-face hammer (drawn by D. Bagińska and K. Szymczak).



According to G.F. Korobkova, who kindly looked at the material discussed above, Ayakagytma "The Site" unmistakably represents the earlier phases of Kelteminarian culture, which means at the very transition of Central Asian Mesolithic and Neolithic, the period we would be particularly interested in.

In case of obtaining a proper subvention, Polish-Uzbek Archaeological Expedition would plan to stay for a couple of coming seasons in the region of the southeastern Kyzylkum Desert to try to widen our knowledge about the neolithisation of that area.

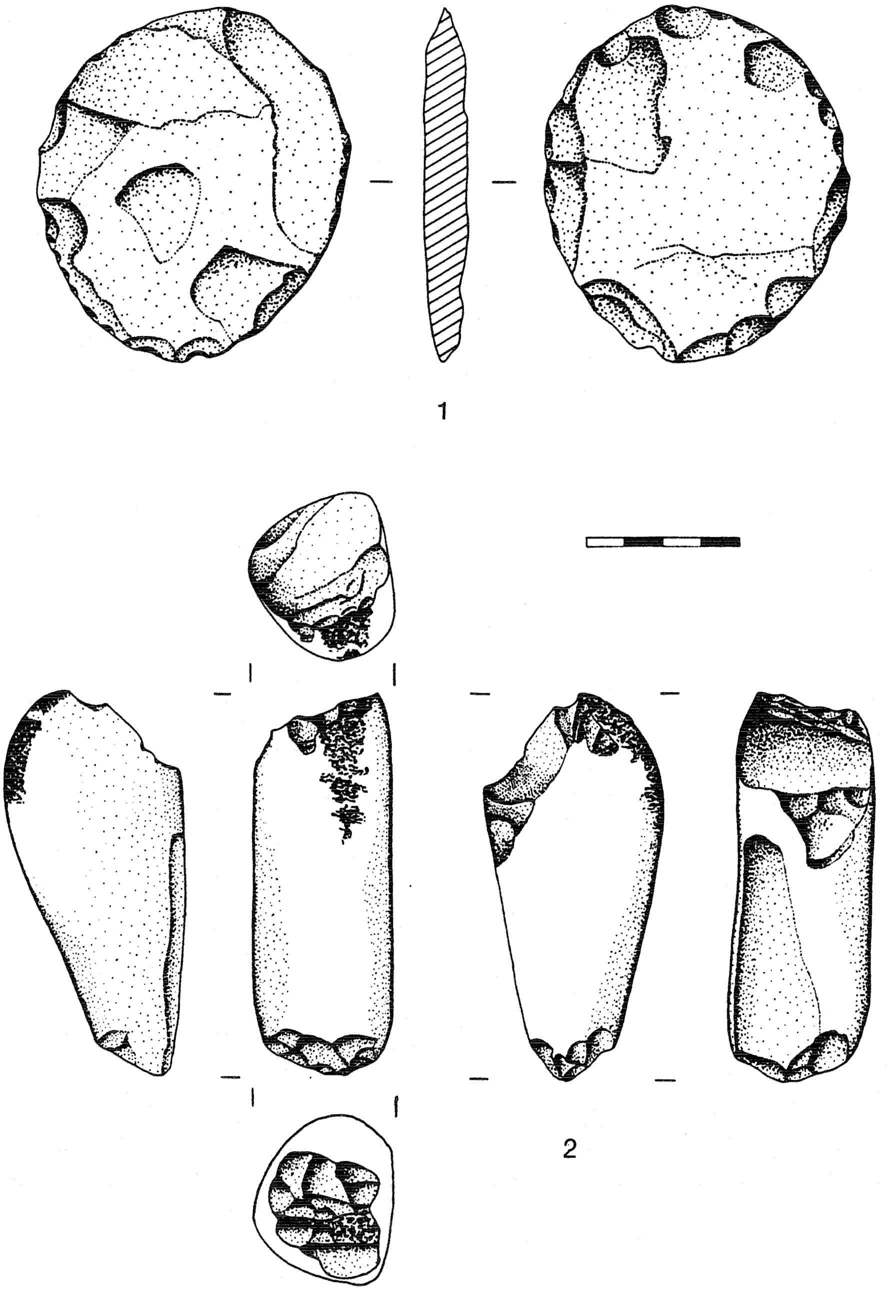


Fig. 22. Ayakagytma "The Site", survey collection: 1 stone disc, 2 stone pestle (drawn by D. Bagińska and K. Szymczak).

Supplementary Note: Ayakagytma "The Site" was excavated in 1996. 80m^2 of surface layers were explored, and two 2m trenches probed down to sterile soil. Two main settlement levels could be differentiated. A sample of charcoals from a lower layer provided the radiocarbon date: GIF 10660, 6770 ± 90 bp (Acknowledgement for this goes to M. Fontugue from the Centre des Faibles Radioactivités, Giffyvette, France.). Altogether 27,375 flint artefacts, 49 stone objects, 5 ornaments, and 131 fragments of pottery were recovered. Also present were architectural remains connected with the upper level. Among 421 faunal remains, bones and teeth of equids were identified. Two teeth belong to the shark family. The excavations will be continued for two more seasons.

Acknowledgements: The first (1995) season of field work of Polish-Uzbek Archaeological Expediton was financed by the Foundation On Behalf of Polish Science, the University of Warsaw, and the Institute of Archaeology of Uzbek Academy of Sciences in Samarkand.

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Helwan in Egypt - a PPN Site?

Klaus Schmidt

Abstract: *Helwan in Egypt has been known since more than a hundred years for its microlithic industries dominated by lunates and other bladelet tools. It is the type site for the Helwan retouch, a kind of bifacial backing and the bilateral notched Helwan points. In spite of its previous importance the site has nearly been forgotten: Helwan material was known mainly from collections made in the late 19th and early 20th century. In 1941 the area was lost for archaeology, first becoming a military area and today completely covered by the modern town of Helwan. The last exploration of this area was made by Fernand Debono from 1936 until 1941. In cooperation with him the author studied his collection in 1992, divided in 23 sites (all surface collections) and containing about 3000 artefacts. The preliminary results of these examinations include the following: There are several Late Upper Palaeolithic, non- microlithic complexes of probably Nilotic tradition. The Epipalaeolithic material is dominated by scalene bladelet tools, and abruptly backed triangles and lunates. Few Kebara points, almost no Geometric Kebarian A types, no Mushabi/Shunera, Harif or el Khiam points were observed. The bulk of the Helwan material can be attributed to Mushabian, Ramonian and Harifian (without Harif points) type inventories, known from Sinai and Negev. The "Helwan lunate" - and "Helwan retouch" at all - is a rare and foreign element at Helwan. The same is true for the "Helwan points". They are not comparable with most of the Levantine "PPNA-Helwan points" but belong to variants which seem to occur in the southern Levant in Early PPNB industries.*

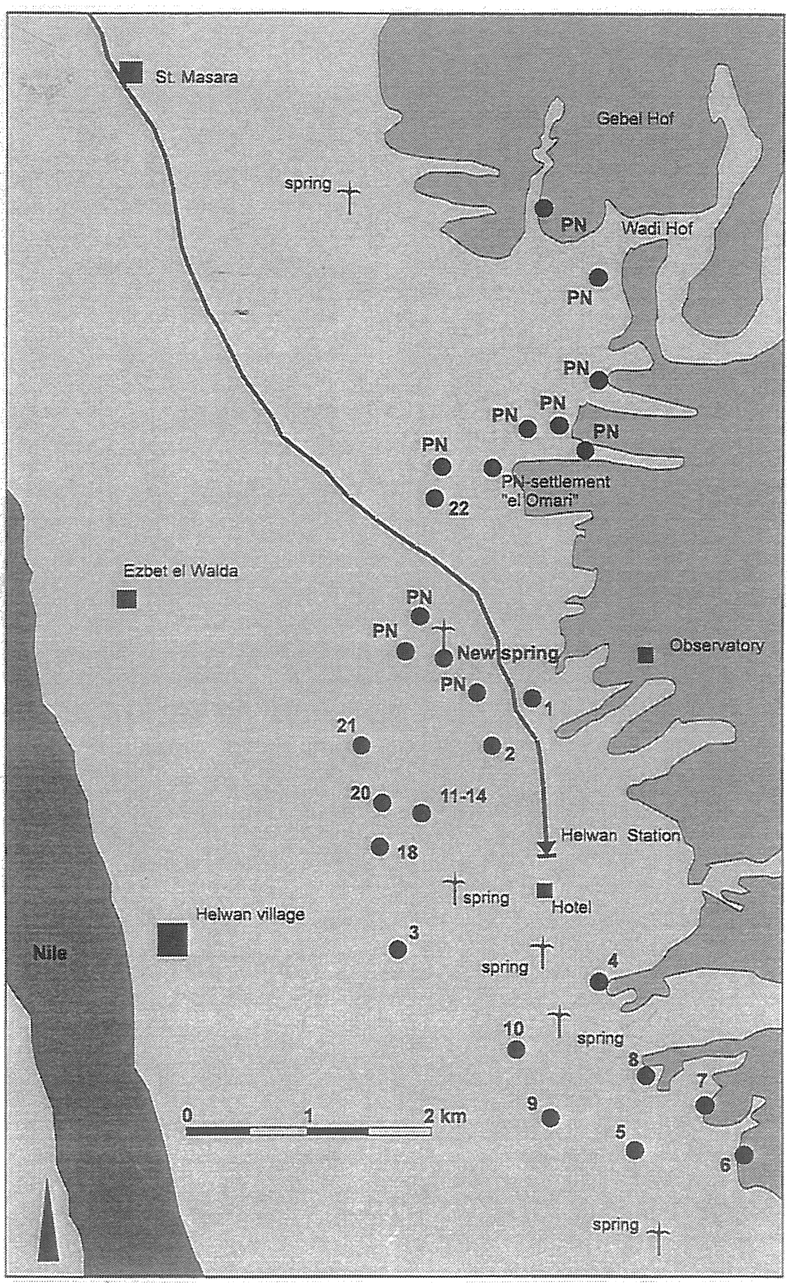

Fig. 1. Helwan area with located sites <*based on DEBONO and MORTENSEN 1990: Fig. 1; "PN": Pottery Neolithic*>.

Once Helwan was a famous site. It has been known for more than a hundred years for its microlithic industries dominated by lunates and other bladelet tools. The sites are located around several thermal springs on the right bank of the Nile some kilometers south of Cairo. It is the type site for "Helwan retouch", a kind of bifacial backing and the bilateral notched Helwan points. In spite of its previous importance, today Helwan has been nearly forgotten or is viewed with suspicion, expressed for example by doubts regarding the provenance of Helwan points from Helwan (GOPHER 1994: 253, Fig. 8.2; compare HOURS *et al.* 1994: 165).

Helwan material was known mainly from collections made in the late 19th and early 20th centuries. Due to its thermal springs it became a spa with an elegant hotel and a golf-course. This was one reason why the site was a focus of interest for the early collectors. The only excavation was reported by Friedrich Mook 1880 (MOOK 1880: 12-14), but this was to soon to produce useful results. Most of the other early visitors seem to have concentrated more on the golf course, making collections by the way. In 1941 the area was lost to archaeology, first becoming a military area; today it is completely covered by the modern town of Helwan.

The old collections had been summarized by Fernand Debono in his volume about el Omari (DEBONO and MORTENSEN 1990). The first report on the microlithic tools was given by Reil and Chabas 1873/74 (REIL 1874, CHABAS 1873), describing 10 different sites. Many other reports followed:

Table 1. Reported flint collections made in Helwan.

Collection	Reference
Reil: 1871-1872	REIL 1874, CHABAS 1873; 10 sites
Browne: before 1877	BROWNE 1878; 4 sites
Hayns: before 1877	BURTON 1878
Mook: 1878	MOOK 1878, 1880; excavation, "aceramic site with 3 layers"
v. Holzhausen: before 1879	SEIDLMAYER 1991
Jagor: before 1882	JAGOR 1882
Schweinfurth: before 1885	SCHWEINFURTH 1885; 4 or 5 sites
Lombard: before 1896	DE MORGAN 1926, COTTEVIEILLE-GIRAUDET 1933
De Morgan: before 1896	DE MORGAN 1896
Cowper: before 1911	COWPER 1911
Seton Karr: before 1913	CURELLY 1913
Bovier Lapierre: 1918	BOVIER-LAPIERRE 1926
Caton-Thompson: 1922	CATON-THOMPSON 1922, PRAUSNITZ 1970
Sandford: 1931	SANDFORD 1934
Debono: 1936-1941	DEBONO 1948, 1978, 1981; DEBONO and MORTENSEN 1990; 23 sites

The last exploration of this area was made by Fernand Debono from 1936 until 1941. In cooperation with him I had the opportunity to study his collection in 1992. Debono reports 23 sites (all surface collections), containing about 3000 artefacts (most of them are located, Fig. 1). Since other collections have no doubt been made before at all these sites, and several sites appear to represent mixed samples, the material does not lend itself to sophisticated statistical analysis. The main task therefore was to isolate datable types or complexes, particularly regarding potential PPN artefacts.

The main type which can be isolated from the bulk of Epipalaeolithic - or better: microlithic - material is the bilateral notched and stemmed point, the Helwan point. It has been known for a long time that they are not in fact a common type at Helwan. Prausnitz even seems to believe that the examples he knows (*i.e.* the 3 points published by de Morgan) did not come from Helwan (PRAUSNITZ 1970: 37) because, in the collection studied by Caton-Thompson there are no points of this type (CATON-THOMPSON 1922).

To my knowledge, there are 8 complete or nearly complete points existent (Fig. 2). The first six come from three collections, those of Browne (1878), Lombard, published by De Morgan (1896) and Mook (1878, 1880), all made before 1896. It is quite clear that these first 6 points were known long before the PPN Helwan points of the Levant had been discovered, and long before anything about Egyptian and Levantine connections in Early Neolithic times was discussed. There would have been no reason to attribute these points to Helwan, if they had not been found there.

In the Debono collection there are 2 more points, already published as photographs and outline drawings by himself (DEBONO 1978: Fig. 44, DEBONO and MORTENSEN 1990: Fig. 7:31-32). Studies of his material have not produced any other fragment which could have been part of a similar point. These two points were not found in the vast area of the Epipalaeolithic sites but in immediate vicinity of the so called "new spring". It seems to be the same findspot as that of Brownes point 1. In the case of the points No. 2-4 it is reported by De Morgan that they were found in the vicinity of

Arab ruins, which only existed, following Debono, in the area of this spring. Only in the case of Mook's point 6 it is certain, that it comes from another locality, the "palm tree near Masaara". Most of the known points therefore seem to come from one particular locality in Helwan, the "New Spring".

It is obvious that the Helwan points from Helwan are far away from the bulk of Levantine Helwan points of PPN A time. Looking for close parallels we find, as expected, the best examples in southern Levantine sites like Nahal Lavan 109 (GOPHER 1994: Figs. 5.65a:1-8; 5.65b:4-9), Nahal Boker (GOPHER 1994: Fig. 5.63:1-5), Abu Madi III (GOPHER 1994: Fig. 5.7:1-2), or Ujrat el-Mehed (GOPHER 1994: Fig. 5.47:8-9), which are dated to PPNB. These points represent the same typological spectrum as Helwan and are close to Jericho points. So the Helwan points from Helwan can be related to the tradition of Sinai PPNB, which, clearly, once reached the Nile valley. It is an open question why these groups seem not to have been very successful in this new environment, as there is little other evidence for Levantine material in Egypt at that time - as for example the single Helwan point from Merimde I (EIWANGER 1984: Pl. 57:I.1106).

Another important type first known from Helwan is bifacially backed lunates - the Helwan-Lunates. This type also is not a common feature at Helwan itself. Their number in the old collections cannot be evaluated, but it is clear that it is small. Studying the Debono collections, the box labeled "Helwan lunates" unfortunately could not be found, but there is a note of Debono's with the quantity of Helwan lunates he found at every site (supported by the fact that photographs of the lunates have been published: DEBONO 1978: Fig. 39:42). The numbers are:

Table 2. Helwan lunates and Helwan retouch in the Debono collection.

	Helwan blades-	Helwan-lunates	total collection
Site 4	7	11	1728
Site 12	9	9	82
Site 13-14	5	2	494
Site 18	1	1	?
Site 19.7.38*	1	1	?
Total	**23**	**24**	

* During this day the Sites 4.1, 11, 7A, and 7L had been explored; it is not entirely proved but regarding the other finds it should be Site 4.

The bulk of the Helwan material is a microlithic bladelet industry dominated by arched backed and scalene bladelets, semi lunates, and triangles. Few sites have no, or almost no, microliths, as for example site 7 (Fig. 4:16-25), where from a specific place with many ostrich eggshells (Site 7 "ostrich", Fig. 3:1-8) two C14 dates around 18 000 bp are available[1]. A detailed analysis of the sites has, as mentioned, not been undertaken, since the samples had been gathered according to "beautiful piece" criteria.

But we can still look for the existent "beautiful pieces" from Helwan. Besides the large number of arched backed and scalene bladelets, there are irregular triangles and many microburins (e. g. Site 7 "lunate": Fig. 3:9-24; Site 12: Fig. 4:1-15). La Mouillah points, as well as Ramon points also exist. True geometric types are rare. There are no geometric Kebaran types, Harif points or el Khiam points.

Looking for parallels, the closest known industry in Egypt is the Qarunian in the Fayum depression (WENDORF and SCHILD 1975: 161), which has similar lunate, triangle and scalene bladelet elements to Helwan, and which should be present in some form at the Helwan sites. The Qarunian has C14 dates around 8000 bp (WENDORF and SCHILD 1975; 6150-5190 *c.* BC).

In lower and middle Egypt there are no more known sites. The next industry is the Elkabian (VERMEERSCH 1978, 1992: 143-144), again with C14 dates around 8000 bp. Further south there are many well known Upper Palaeolithic and Epipalaeolithic industries such as the Silsilian (SMITH 1966, VERMEERSCH 1992: 134-136), with mainly truncated bladelets, including the microburin-technique often with altered base, or the Afian (CLOSE, WENDORF, and SCHILD 1979; VERMEERSCH 1992: 136-139), dated from 8960-8840 bp with backing, notching, truncations, triangles and microburin technique; there are few lunates or trapezes. In the western Desert there is the so called Early Neolithic Sequence with the La Adam, el-Kortein, el Gurob and el Nabta phase (CLOSE 1992), all together dated from 9500-7500 bp. Other industries are known from the northern oases such as Kharga, Farafra and Dakhla (BARICH 1992).

But these industries seem not to be the main relatives of Helwan. After intensive explorations in Sinai we have a lot of information about the Epipalaeolithic industries of this area (BAR-YOSEF and

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1 Ostrich eggshell: Bln 4484 I: 18770 ± 130 bp; Bln 4484 II: 18110±150 bp, 19931-19415 calBC, *cf.* STUIVER and REIMER 1993: method B, 1σ.

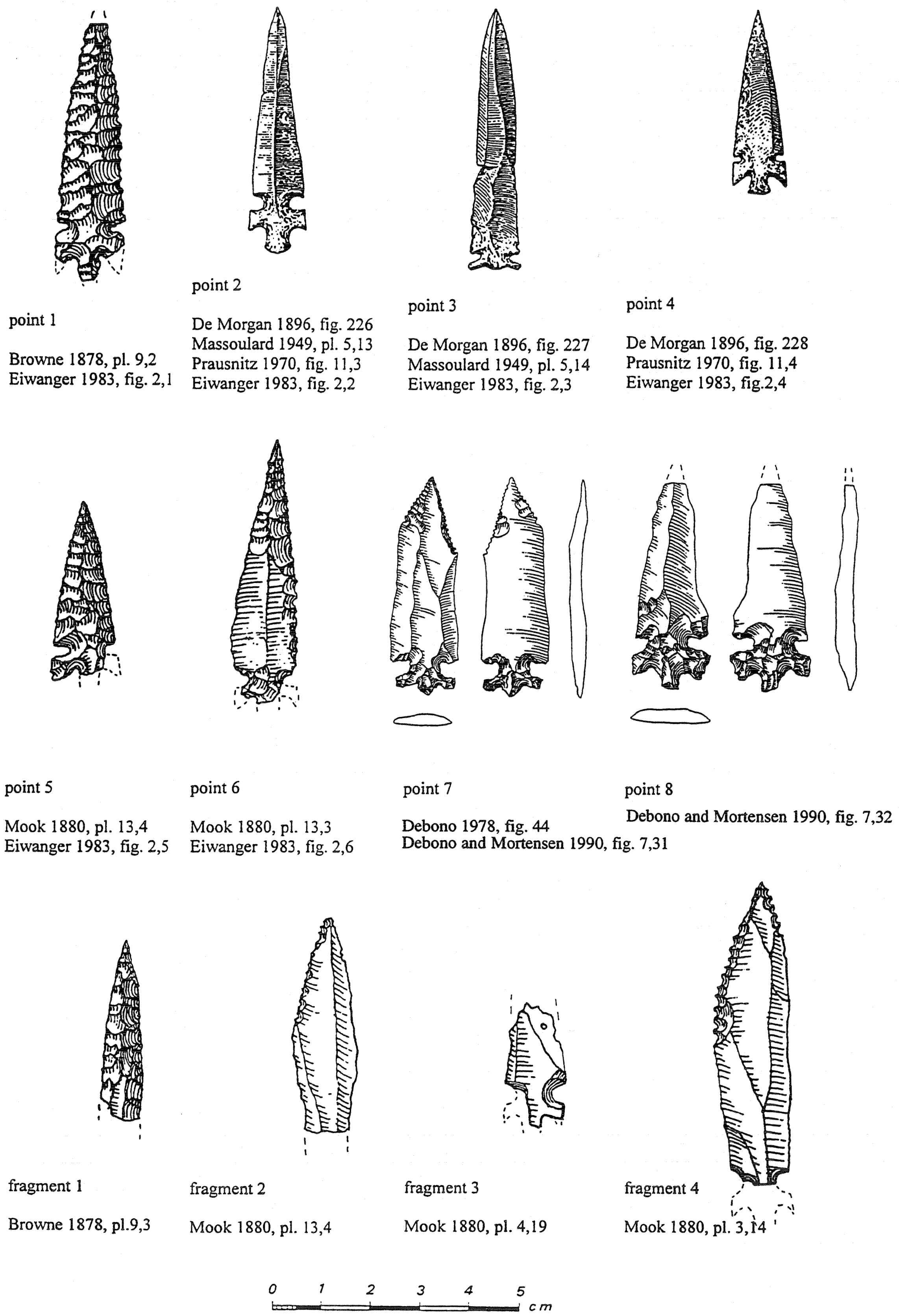

Fig. 2. Helwan Points from Helwan.

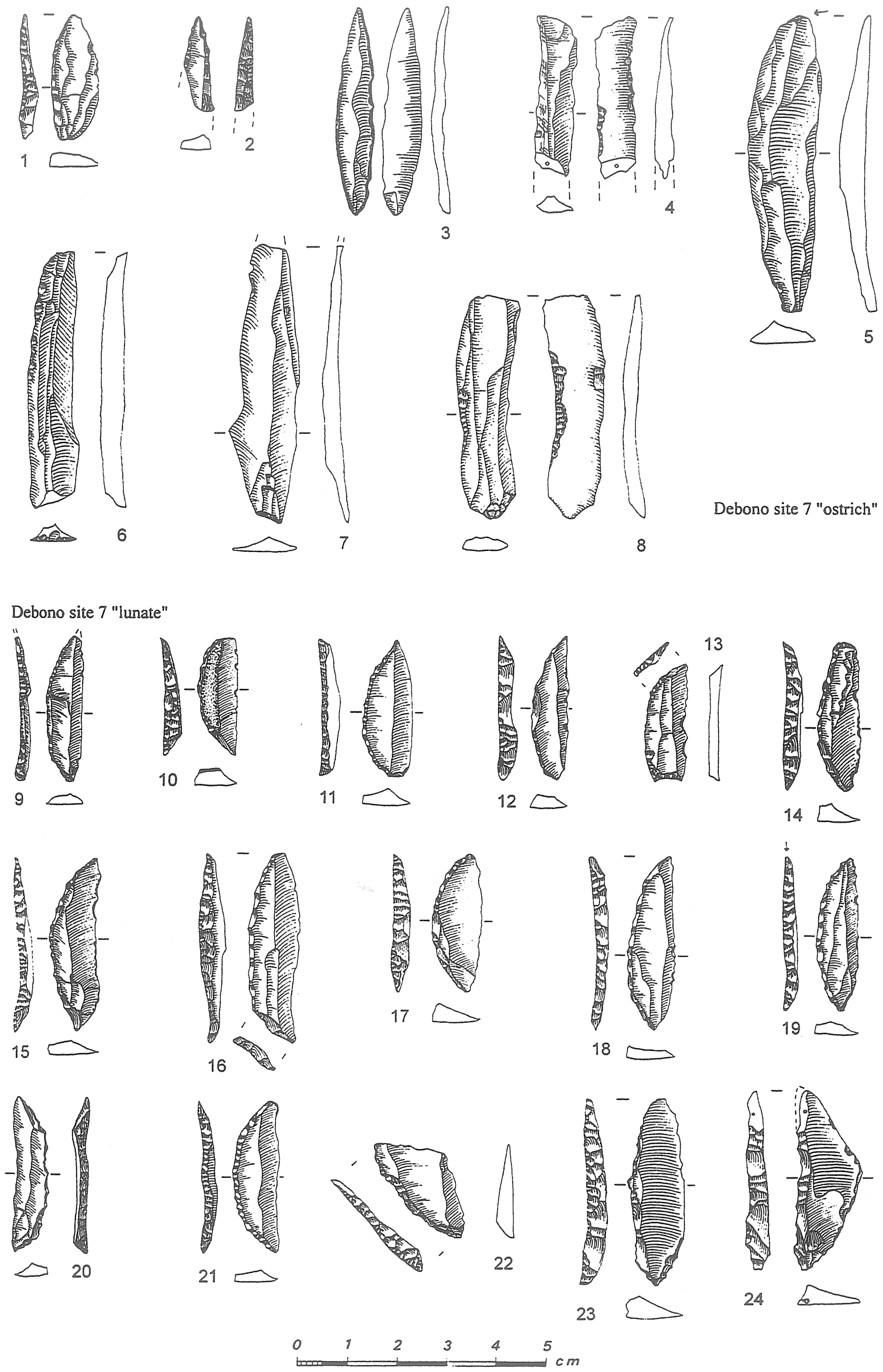

Fig. 3. Helwan, Debono sites.

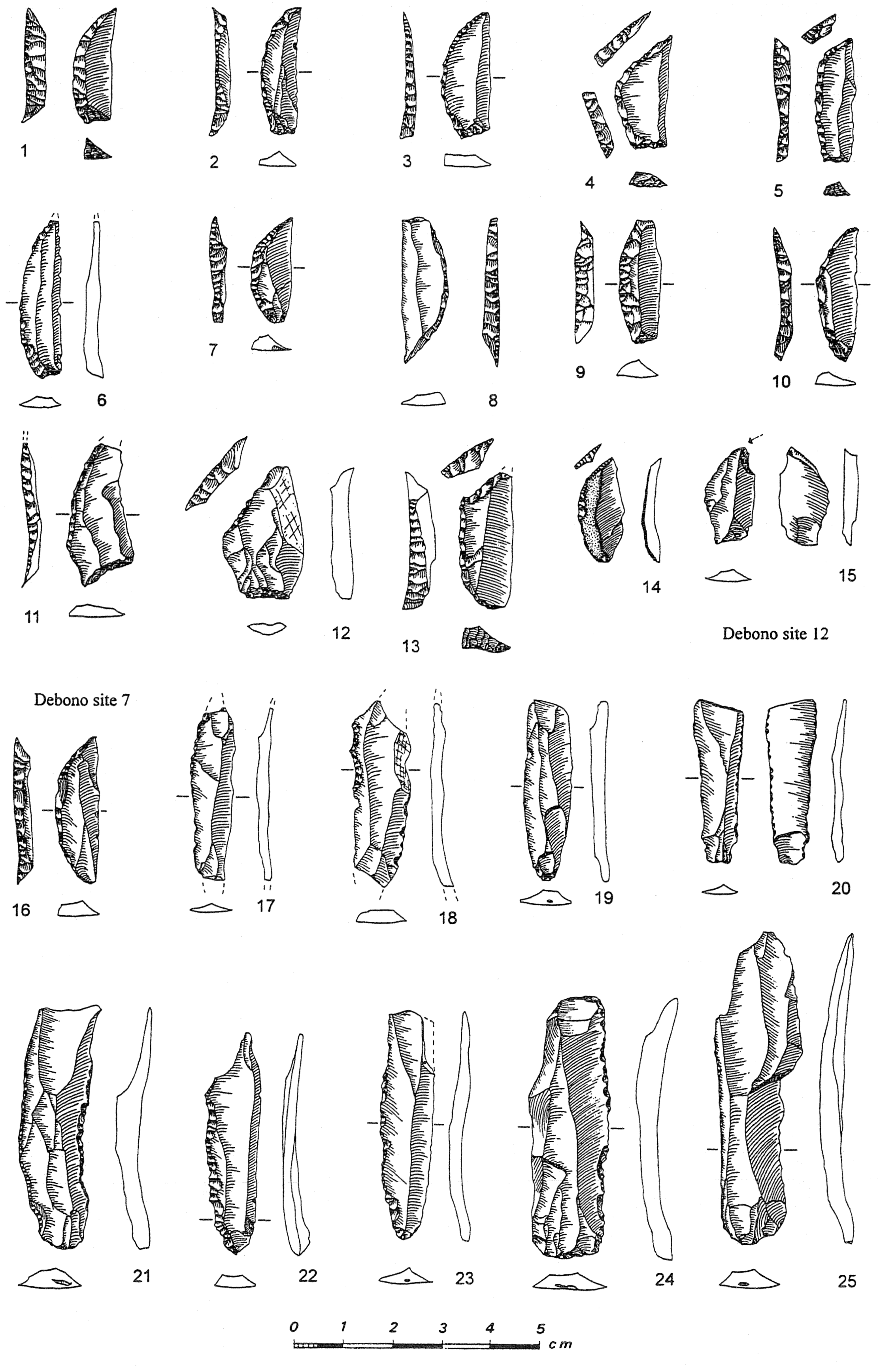

Fig. 4. Helwan, Debono sites.

PHILLIPS 1977, GORING-MORRIS 1987). There is an Upper palaeolithic Lagaman industry which is nearly devoid of Aurignacien features (*i.e.* carinated and nosed scrapers). There are the Geometric Kebaran A (12500-11000 BC), the Mushabian, the Ramonian and the Harifian.

Two industries especially, the Mushabian and the Ramonian, seem to offer the best parallels with the Helwan material. Bar-Yosef and Goring-Morris stressed the probable Nilotic origin of these industries, but there was a geographical gap of 500km between them and the nearest known sites in Upper Egypt. Following these scholars, the environmental conditions during the Mushabian had been optimal, opening an ecological corridor to northern Africa. Tchernov demonstrates the intrusion of African faunal elements into Sinai and Negev during the Epipalaeolithic period (TCHERNOV 1976).

So Helwan fills this gap a little. For some time, during optimal climatic conditions, there was a bridge between the Nile and the Jordan river and both regions seem to have shared a common cultural development. The observation of the few existing Helwan type lunates at Helwan fits best with the suggestion of a Mushabian and Ramonian industry at Helwan. From Natufian times onwards the Nile doesn't share further developments at the southern Levante. Only in PPNB times do some groups reach the Nile again, but the boundary of the Sinai desert was now too strong to allow this common development to take place again.

In summary the following prehistoric periods seem to exist at Helwan:

Table 3. Prehistoric periods at Helwan.

	Helwan	Egypt and Sinai	
PN	Merimde II-IV - el-Omari-culture Site Helwan-el-Omari		KN-3994: 4790 ± 60 bp C-463: 5255 ± 230 bp KN-3934: 5500 ± 65 bp KN-3933: 5690 ± 70 bp
Late Epi-palaeolithic	(?) (?)	Qarunian El-Kabian	7140-8220 bp 7885-8340 bp
	PPNB-intrusion at "New Spring" area of Helwan	Nahal Boker Nahal Lavan 109 Abu Salem PPNB Abu Maadi III Ujrat el-Mehed	Pta-2703: 8220 ± 80bp
Middle Epi-palaeolithic	Mushabian/Ramonian elements at various Helwan-sites		13500-12500 bp 14000-12500 bp
Early Epi-palaeolithic	Some Kebaran like elements at various Helwan-sites		
Late Upper Palaeolithic	Helwan "site 7 ostrich"		Bln-4484 I:18770 ± 130 bp Bln-4484 II: 18110 ± 150 bp
Old?/Middle Palaeolithic	Several Helwan-sites		

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Techno-Morphological Changes in the Early Holocene Lithic Industries in Southeastern Europe

Janusz K. Kozłowski

Abstract: *At the end of the Pleistocene a similar pattern of evolution of lithic industries can be observed in the Balkans and in Anatolia. At the beginning of the Holocene a breakdown of the technological development took place in eastern and central Balkan, and blade technologies were replaced by flake ones. At the beginning of the Atlantic period the rhythm of the evolution of lithic industries became more complex and regionally varied, which is especially evidenced by appearance of regular blade technologies and trapezes produced using microburin technique. The final unification of the whole south east European zone is related to the spread from Anatolia of the first pottery and macroblade technologies. At that time lithic procurement systems changed: local procurement and full reduction sequences in particular sites were replaced by long distance imports and reduction sequences split into preliminary stages in specialized workshops near outcrops and subsequent blank production or transformation in remote settlement.*

The objective of this report is to describe changes taking place in lithic industries in the Balkans during the Early Holocene. The focus of our attention will be the relation between changes in blank production technology, especially blade blanks, and typological variation of retouched tools, especially microliths. Techno-morphological transformations will be compared with changes in subsistence economy and systems of raw materials procurement. In the conclusion we hope to establish the relation between local evolution and supra-regional trends spreading through diffusion or migration.

The Late Pleistocene "Microlithization"

At the end of the Pleistocene (before 10,000 years B.P.) the continuation of local Epigravettian industries can be seen in the Balkans. These groups were subject to some unifying trends manifested in the occurrence of geometric microliths (triangles, lamelles bitronquées, etc.) in the industries that had earlier undergone, to various extents, the process of azilianization (diffusion of short end-scrapers and arched backed pieces). Such a sequence is most typical (MIHAJLOVIC 1993) of the western Balkans (*e.g.* Montenegro), where Epigravettian industries with large arched backed pieces (of the type found in Layer VIII in the Medena Stijena cave and Layer IX in the Črvena Stijena cave) are replaced by industries with numerous geometric microliths (Layers VI-V and VIII respectively). The microlithic component is particularly distinct in the territory of eastern Peloponese (Phase VI in Franchthi Cave) where the production of microliths was related to the microblade and microburin technique (PERLÈS 1987a).

It is interesting that a similar pattern of changes can be seen in southern Anatolia, for example in Öküzini cave (YALCINKAYA *et al.* 1995) where large arched backed pieces and points with a straight or *dos tronqué* blunted back are replaced, beginning in Layers IV-VI (about 12000 to 11000 years B.P.), by geometric microliths (triangles, trapezes and segments).

Early Holocene Deterioration

The beginning of the Holocene in the Balkans is characterized by a technological break-down and a decrease in the proportion of most Epigravettian typological elements. The deterioration of blade technology, which is replaced generally by flake technology, is characteristic for the whole of the Balkans. In Greece, this phenomenon can be clearly observed in Phase VII at Franchthi Cave (*c.*

9200 years B.P.) where the proportion of blades in debitage products is about 3% (PERLÈS 1990). Similarly, in the region of the Iron Gate, in the lower layers at Padina (A1, A2) the proportion of blades does not exceed 3.5% (RADOWANOVIĆ 1981). This process is less conspicuous in Montenegro: Layers VII, VI and V in Črvena Stijena cave and Ib/Ia in the Trebacki Krs cave also show a decrease in blade technology, but to a lesser extent than in that noted in the territories mentioned earlier (MIHAJLOVIĆ 1993).

As far as typology at the beginning of the Holocene is concerned, we can observe a decrease in the proportion of blade tools (for example: replacement of blade end-scrapers by atypical scrapers, denticulated-notched tools and retouched flakes), a decrease in burins, and few geometrical microliths that are limited almost completely to triangles. In some assemblages, especially in the western and northern Balkans, straight and convex backed pieces, microtruncations and simple backed bladelets continue to occur. In the Balkan assemblages from this period, the phenomenon of "sauveterrianization" is weakly marked. It is characteristic for circum-Alpine territories (KOZŁOWSKI and KOZ-

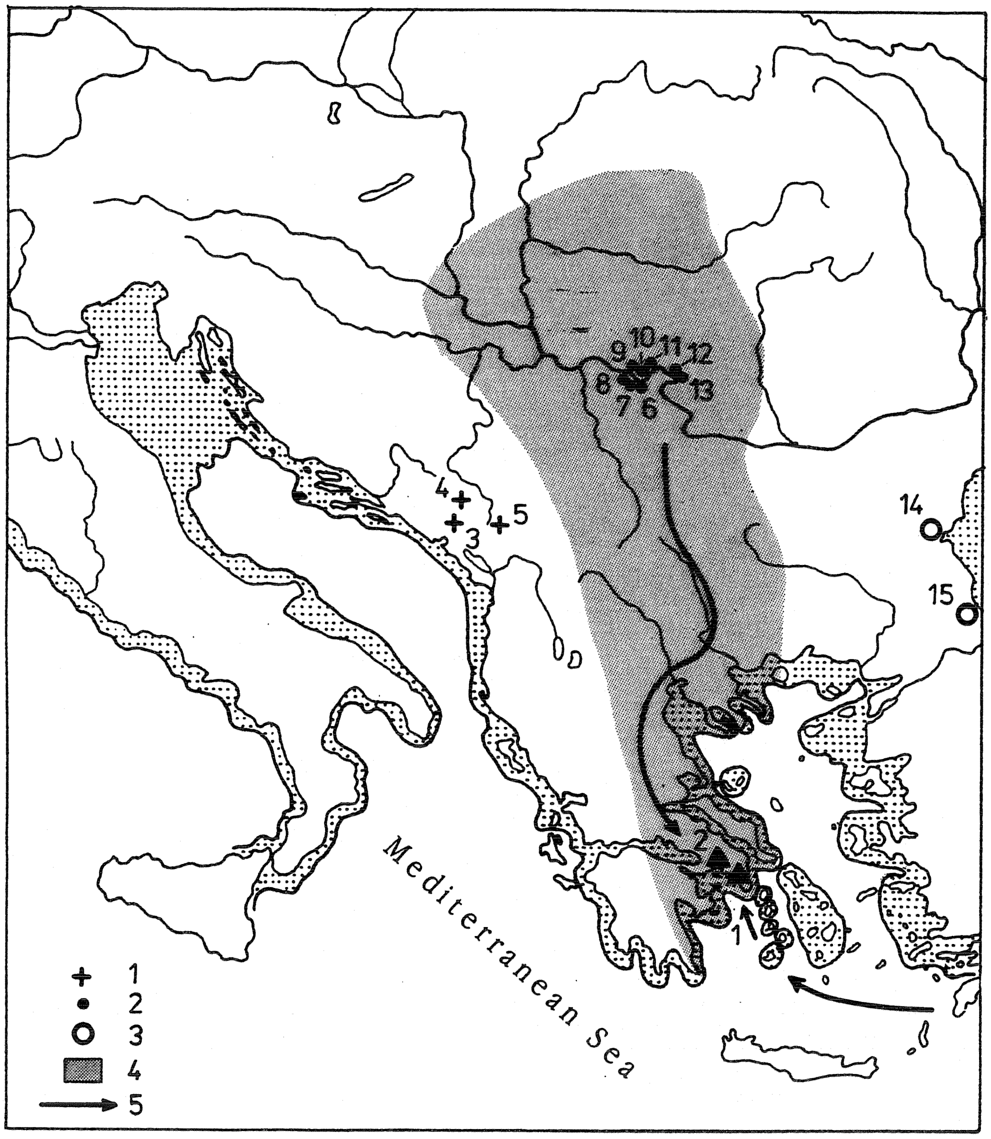


Fig. 1. Index map of the Balkans: 1 sites of the Montenegro Group; 2 sites of the Iron Gate Group; 3 sites of the Black Sea Group, "triangles": sites of the Argolid Group; 4 area of the Early Neolithic pottery groups (monochrome and white painted); 5 possible routes of "Balkan flint" and obsidian to early Neolithic Greek sites.
Sites mentioned in the text: 1 Franchthi, 2 Klisoura Cave 1, 3 Črvena stijena, 4 Odmut, 5 Trebacki Krs, 6 Padina, 7 Vlasac, 8 Lepenski Vir, 9 Schela Cladovei, 10 Veterani, 11 Climente, 12 Ogradena, 13 Ostrovul Corbului, 14 Dekilitazh, 15 Ağacli.

ŁOWSKI 1983), although individual "Sauveterrian" points are known even in Argolide (Franchthi - Phase VII, Cave 1 at Klisoura, Layer 5) (KOUMOUZELIS *et al.* 1996).

Subsistence economy in this part of the early Holocene (10000 to 8700/8500 years B.P.) was based on hunting and gathering of plants and molluscs. At the same time, longer sequences (Franchthi, Črvena stijena) show an increased importance of Cervidae and a smaller role of Bovidae, Suidae and fish.

Raw materials exploited in all the above-mentioned regions are almost entirely local. This suggests isolation of population groups both in eastern Argolide, in the Iron Gate region, and in the mountain valleys of Montenegro (KOUMOUZELIS *et al.* 1996).

Middle Holocene Industries with Regular Blade and Trapeze Technologies

The rhythm of changes taking place from 8700/8500 to 8000/7500 years B.P. is much more complex and regionally varied. In this period a special importance should be attached to:

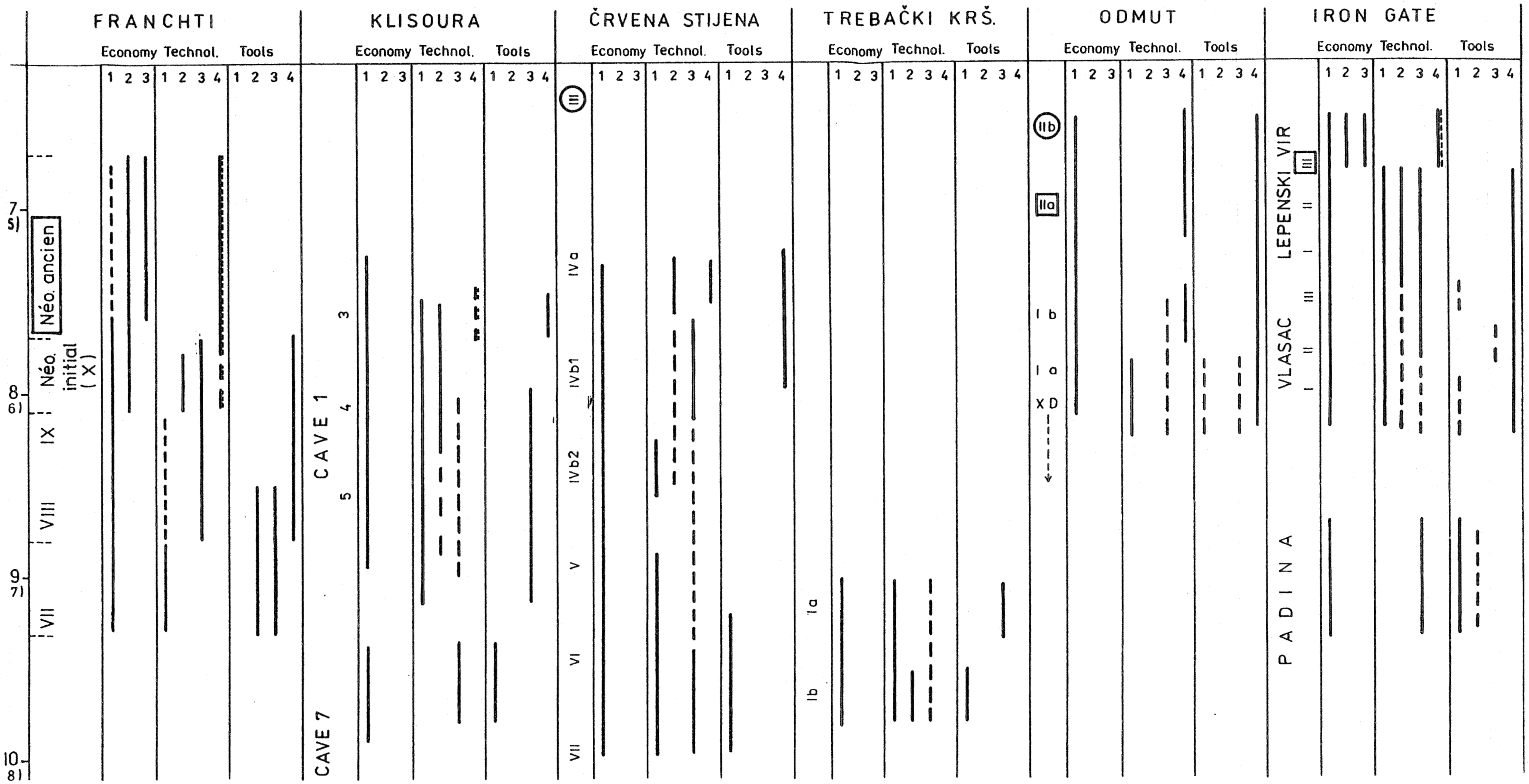
1. the replacement of flake technologies by flake-blade and blade microlithic technologies based on single- and multi-platform cores.
2. the replacement of flake-blade technologies by those aiming to produce regular blades by pressure techniques. These techniques are evidenced by the appearance of blades with parallel edges, with triangular or trapezoidal cross-sections in place of irregular blades, faceted platforms in place of *lisse* platforms, based on single-platform conical, cylindrical or even "pencil-like" cores often with advanced preparation.
3. the appearance of macro-blade technologies based on single-platform cores with full preparation. This required large nodules of raw material, which was mostly imported. Macro-blade technologies were related to the use of pressure techniques - although not always. We may assume that some macro-blades were obtained also by using a soft hammer.
4. the appearance of trapezes,
5. the standardization of lithic inventories resulting from the use of regular blade technique or macro-blade techniques,
6. the "castelnovization" of assemblages, shown by a high frequency of blades with lateral notches.

These changes were followed by the introduction of continuous marginal retouch connected with the spreading of macro-blade technology *c.* 8000 - 7500 years B.P., usually in context of first pottery.

In Argolide, trapezes are present in Phase VIII of the Franchthi sequence, dated to about 8700 to 8500 years B.P. Changes in production technology do not take place as yet: flake technology continues to dominate, and irregular bladelets are few, detached from unprepared cores. More regular bladelets with parallel dorsal scars are exceptional, detached from prepared cores. They were not produced on the site, but only a few of these bladelets are made from non-local obsidian. Trapezes at Franchthi are fairly particular. They are mostly asymmetrical, with concave truncations. Often they were very clearly made on flakes (PERLÈS 1990, Fig. 16:16, 20, 26).

However, examples of trapezes, in this case symmetrical, prior to the use of regular blade technique are known from Montenegro. In Odmut Cave (KOZŁOWSKI, KOZŁOWSKI and RADOVANOVIĆ 1993), the lowest Layers XD and Ia contain the first trapezes, whose chronological position may be also very early (8500 - 9500 years B.P.). On the other hand, there is considerable evidence against those early dates and in favour of assuming the chronology of Layers XD - Ia to be within 6000 to 5800 years B.P. Unquestionably, the regular blade technique in this sequence occurs only in Layer Ib together with a dramatic increase in the proportion of blades with regular edges, triangular cross-sections and faceted platforms (KOZŁOWSKI 1989). Other sites in Montenegro also point to the presence of trapezes prior to the regular blade technique for example in level IVb1 at in the Črvena Stijena Cave. We have no absolute dating, however, for this level. Levels with trapezes and regular blade technique (Črvena Stijena IVb2, IVa; Odmut Layers Ib, IIa, IIb) show advanced standardization of artefacts and distinct "castelnovian" features such as the domination of blades with lateral notches (MIHAJLOVIĆ 1993).

A relatively weak development of blade technique, together with the appearance of trapezes, can be seen in the region of the Iron Gate about 8000 years B.P. (*e.g.* at Icoana) (PAUNESCU 1989, PP. 151-155) and also in the period from 7500 to 6800 years B.P. (Vlasac I - III, Lepenski Vir I, II). In general on the site of Vlasac the ratio of blade cores increases, from Layer I to III, yet the blade index in the debitage for the whole sequence is maintained at about 22 - 23% (KOZŁOWSKI and KOZŁOWSKI 1982). The unique feature of sites in the region of the Iron Gate is a considerable importance of splintered pieces and specific "plate cores" with blade scars on narrow sides of flint radiolarite plaquettes. Cores like this, and splintered pieces in particular, are more numerous than typical cores, especially in level III at Vlasac. Typical cores, often blade-flake specimens, have no preparation. Trimming blades are rare, and there is a small number of faceted platforms. All this points to a



Economy: 1 - Foraging and collecting 2 - Animal breading 3 - Farming

Technology: 1 - Flake, 2 - Splintered pieces, 3 - Short and broad blade, 4 - Regular blade (–) and macroblade (=)

Tools: 1 - Segments, 2 - Triangles, 3 - Sauveterrian points, 4 - Trapezes

□ painted pottery

○ impresso pottery

Fig.2. Most important early Holocene stratigraphic sequences in the Balkans.

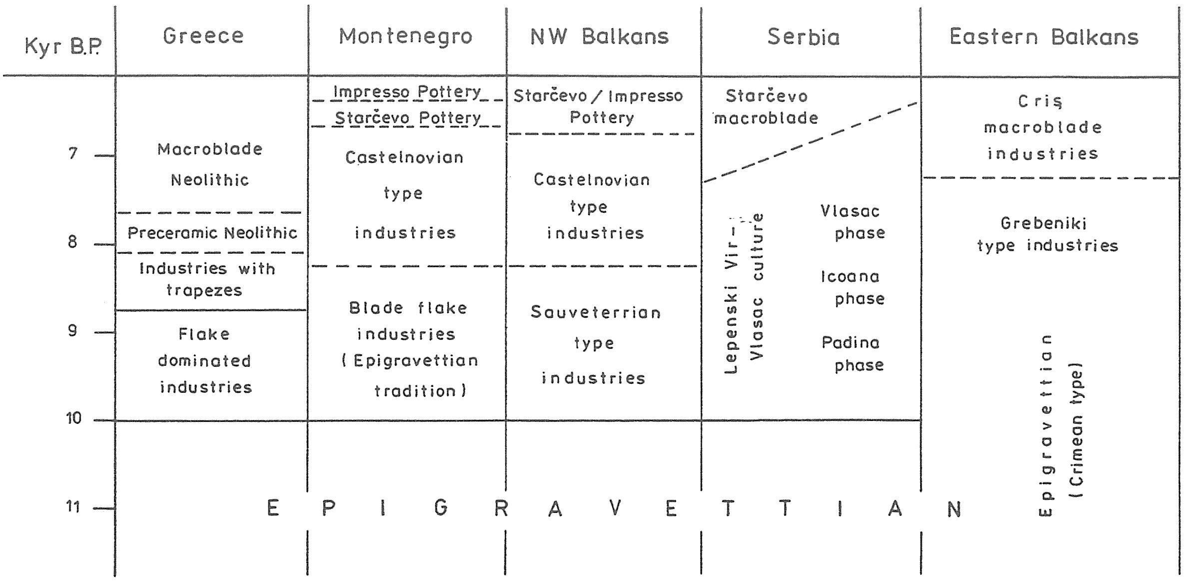


Fig. 3. Most important taxonomic groups in regional sequences.

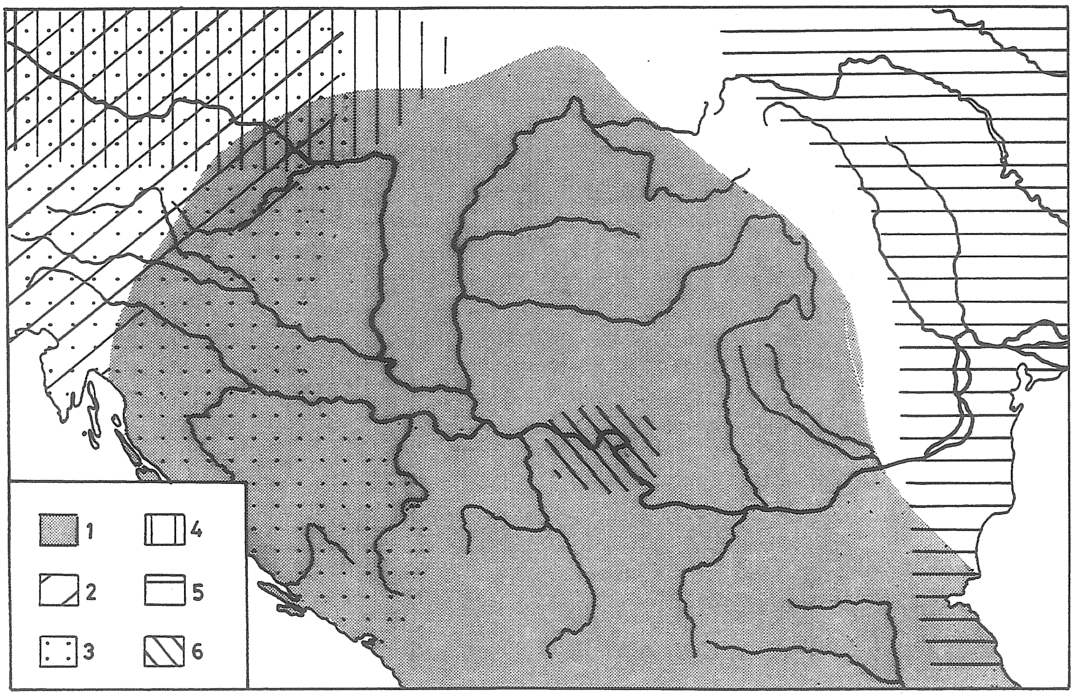


Fig. 4. The Balkans and middle Danube zone in the Mesolithic: 1 Epigravettian, 2 Sauveterrian, 3 Castelnovian, 4 Beuronian, 5 Grebenikian and connected groups, 6 Lepenski Vir Unit.

relatively weak development of blade technique which does not show standardization features typical of western Balkan assemblages. Instead of "castelnovian" elements, the sites in the Iron Gate region show stronger Epigravettian traditions such as, for example, persistence of arched backed pieces at Vlasac and Lepenski Vir I (SREJOVIĆ, KOZŁOWSKI, and KOZŁOWSKI 1980).

Together with the appearance of trapezes sporadic occurrence of imported lithic raw materials (*e.g.* obsidian at Franchthi, flint F2, F3, F4 at Odmut, possibly at Vlasac flint A2, A8 and volcanic raw materials C1 and C2) is recorded in all the regions under consideration. The proportion of imported raw materials, most probably mesolocal, increases in stratigraphical sequences but does not exceed 3 to 6%. Some of these raw materials are present only as blades and none are represented as cores. A growing proportion of mesolocal materials is recorded in levels with the regular blade technique.

In the period when industries with trapezes and regular blade technique develop, no essential changes are seen in subsistence economy, which retains a foraging character. Locally gathering and fishing can be more important (Argolide, Iron Gate).

The Black Sea coast in Bulgaria and Turkey follows a separate evolution in the early Holocene. We have no basis for distinguishing particular phases in these territories: the sites are exclusively surface ones, undated by radiometric methods, situated, in most cases on sand dunes. Materials from the region of Varna (Dekilitazh), as well as from the Turkish coast (Agacli, Gümüşdere, Domali) show - without exception - that the blade technique did not deteriorate in those territories at the beginning of the Holocene (GATSOV and ÖZDOĞAN 1994). Blade assemblages with strong Epigravettian traditions continue to develop. They are linked with the northern coast of the Black Sea, from the Crimea as far as the Danube Delta. These industries are characterized by the continuation of heavy arched backed pieces or even microgravettes, accompanied by short azilian-type end-scrapers. We do not know, however, whether these inventories had persisted until the appearance of trapezes whose age and lithic context in the territory under consideration is uncertain (for example: at Agacli on the Turkish coast).

Essential changes in south-eastern Europe are related to the emergence of macroblade technique and typical lames retouchées, which do not derive from the microlithic technology of the regular blade and local assemblages with trapezes. The situation in Greece points clearly to the association between new technologies and food-producing economy, namely wheat and barley cultivation and sheep/goat breeding (PERLÈS 1989). This type of economy could not develop locally from uncultivated grasses and wild animals known at that time in the Balkans (HANSEN 1992). The macroblade technology with the corresponding tool-kit (blades with marginal retouch, end-scrapers and perforators) first appears in Greece about 8000 years B.P. in two types of contexts: aceramic and ceramic.

Aceramic Contexts

The only unquestionable instance when some elements of macroblade technology are present in an assemblage that continues the tradition of the Late Mesolithic with trapezes, is lithic Phase X in the Franchthi cave dated to about 7930 to 7900 years B.P. This assemblage contains the earliest traces of wheat and barley cultivation and sheep/goat breeding (HANSEN 1992). Increase in the proportion of obsidian up to 12% is typical. Technological novelties such as splintered pieces and inserts with richer bifacial retouch appear (PERLÈS 1990, pp. 95-105). Other sites ascribed to the pre-ceramic Neolithic in Greece are very different. These are sites such as Argissa, Soufli-Magula, Gediki and possibly Dendra. Such sites typically show an advanced macroblade technique, a poor retouched tools kit, and a minimal ratio of trapezes. Above all, they contain a wide range of imported raw materials, especially obsidian and north Balkan flint. In conclusion, these inventories, as C. Perles (1990) has rightly observed, do not differ from "the early Neolithic in Thessaly" or from the ceramic Neolithic from Franchthi. We can, therefore, speculate whether a lack of ceramics might not be only apparent, caused by the selection of pottery which, for example at Argissa, was regarded as intrusive from overlying layers.

Ceramic Contexts: Monochrome and White-painted Ware

We should particularly stress the uniformity of macroblade technology, artefact standardization, and domination of marginal retouch on all the sites of the early ceramic Neolithic from eastern Argolide (Franchthi, Lerna I), through Thessaly as far as Greek Macedony. A similar technology and an identical tool kit is found on the sites with painted ceramic in the basin of the rivers Vardar, Morava (KOZŁOWSKI 1982, ELSTER 1976, GATSOV 1993) and Struma/Styrmen (GATSOV 1982). All these assemblages show a characteristic high proportion of imported raw materials: in Peloponese and Thessaly they consist of obsidian from the island of Melos and north Balkan flints (PERLÈS 1987), whereas in the former Yugoslav Republic of Macedonia, in Serbia and in Bulgaria they are mainly north Balkan flints. Local raw materials practically do not occur (*e.g.* at Lerna I they account for less than 0.5%) (KOZŁOWSKI and KACZANOWSKA 1996).

In stratigraphic sequences in the region of the Iron Gate (Lepenski Vir), the evolution of macroblade technology co-occurring with monochrome ceramics is in distinct techno-morphological discontinuity in relation to pre-Neolithic phases where the regular blade technique was accompanied by flake tools and splintered pieces. At Franchthi, despite the fact that individual regular macroblade items are present in Phase X (PERLÈS 1990a, Fig. 24:1-4), there is a complete hiatus between the standardized macroblade industry present simultaneously with the early Neolithic ceramics and the flake-blade industry (with splintered pieces) of Phase X. With the appearance of ceramics the proportion of local raw materials drops dramatically both at Franchthi and at Lepenski Vir. Local raw materials are replaced almost exclusively by imported flints, worked away from the site, probably in separate workshops.

Conclusion

The spreading of trapezes and the regular blade technique in the Balkans was a fairly slow process, a kind of diffusion in many directions which only with difficulty penetrated relatively hermetic settlement regions. On the other hand, the spreading of the macroblade technique, a food-producing economy and ceramics was a process that quickly took over extensive territories. In all likelihood, a settlement system emerged on the basis of migrations of new population groups. The new settlers maintained close contacts with their cradle regions. Contacts of the new arrivals with local Mesolithic groups were limited, however. Locally, they may have been more intensive, leading - over a broader time horizon - to acculturation. Mesolithic exchange networks do not seem to have played a major role in the spreading of an incipient food-producing economy (country to CHAPMAN 1993).

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PPN Flint Assemblages With Microliths: What Do We Find, What Do We Lose?

Karol Szymczak

Abstract: *The author uses the PPN chipped lithic materials found at M'lefaat in northern Iraq to explain the potential differences and similarities between the collections gathered with pick/ trowel and wet-sieving. He discusses the sample sizes, the components of general types of retouched tools and of the microliths, and the sizes of artefacts.*

The Problem

Archaeologists dealing with the Stone Age are of course well aware of the fact that during excavation they usually do not retrieve all of the lithic material present on the site, but only a part of it, depending on the precision of the applied field methods. We can expect the most serious losses in cases when the sizes of the artifacts are particularly small, especially when dealing with assemblages with microliths.

The fact that during excavations we lose something is obvious, but in this paper we will try to answer the question: what do we actually lose? what elements, and how many of them could be potentially lost during archaeological field work? How great could be the differences between the statistical pictures of the flint artifact series which were gained with the use of excavation methods of various degree of accuracy?

To examine this problem, we will use as an example a part of the flint inventory from a PPN site in M'lefaat. Of course the obtained results cannot be automatically projected onto other assemblages, even those representing similar flint industries, nonetheless we hope that these results will give some general idea about the potential distortions caused by the excavation methods used on a particular site, and thus allow us to evaluate more clearly the true importance of the problem and see it in its proper perspective.

The Material

The flint material we are going to use in this paper as an example comes from the PPN site of M'lefaat in northern Iraq. The site had been discovered and sounded in 1954 by R.J. Braidwood (BRAIDWOOD and HOWE 1960: 27-28, DITTEMORE 1983). In the 1970s the archaeological investigations were continued by an Iraqi team, conducted by Metti Baba Altun, and in 1989-90 the site was excavated by the Polish Archaeological Mission directed by S.K. Kozłowski (KOZŁOWSKI, KUŹMA, and SZYMCZAK 1991).

During the last two seasons of fieldwork more semi-subterranean dwellings were found. In this paper we will analyze the artifacts from the fill of two such features: House 3 and House 8. These features are radiocarbon dated to the first half of the 8th millennium BC (uncalibrated; KOZŁOWSKI ed. n.d.).

The fills mentioned above were explored by local, poorly experienced workers who loosened the soil with a little pick (*kazme*) and removed this soil using a little spatula. While working, they looked over the soil, picked up the artifacts they managed to notice and put them into a special container.

Besides this, some parts of the fills were not explored by the workers, but wet-sieved in a special floatation machine: House 3: about 1m^3, House 8: about 0.5 m^3. The bone and chipped stone material was collected on a 1mm mesh. This work was done by M. Nesbitt, with the assistance of F. Thornton, the members of the British team excavating another north Iraqi PPN site (Quermez Dere). The main aim of doing the floatation was to gain samples of the smallest remains of organic material, but it also gave a good opportunity for the archaeologists to look closely through all the floated soil (in little portions) and pick out all the artifacts, even those of the smallest sizes, including many microliths.

The situation when the fills of the same houses were explored with the use of two methods of completely different accuracy gives an excellent occasion to attempt to answer the question set by the title of this paper: what do we find, and what do we lose during the exploration of archaeological sites containing a significant number of microlithic artifacts?

The material for the analysis was arranged in five tables, taking into account separate the floated and non-floated series from Houses 3 and 8. In Tables 1, 2 and 3 we added for comparison the series from House 1B in Nemrik, a PPN site located some 100 miles W from M'lefaat (KOZŁOWSKI 1992). The tables show:

- the general structure of the assemblages (Table 1),
- the structure of the general types of the retouched tools (Table 2),
- the structure of the microliths (Table 3),
- the number and density of the artifacts on the PPN sites from the Near East (Table 4),
- the average width of the blade tools measured on floated and non-floated samples (Table 5).

The Analysis

The data presented below can be treated as a basis for many reflections, both detailed as well as more general ones. In this article there is no space to discuss all of these, and we can only consider what we think are the most important ones.

Sample Sizes

The statement that a sample of flint artifacts gained as a result of floatation should be more numerous than the one gained with a pick/spatula method seems to be obvious and banal, but in case of the M'lefaat material we could also try to measure these differences and show them in numbers.

House 3 is a feature of approximately circular shape with average radius of 3,4m. Its explored fill had an average depth of 1m. Thus, it appears that the volume of this fill was about 33m^3. From that, 1m^3 (3%) was floated.

If we made the assumptions that: 1) all the fill contained a uniform concentration of flint artifacts, and 2) we gained 100% of the material from the floated 1m^3, we could expect that all the fill contained about 58.000 artifacts (more than 1.750 artifacts per 1m^3). This would mean that using a pick/spatula method we managed to recover only a little more than 0.6% of the material (11.3 of an artifacts per 1m^3 on average, *cf.* Table 1).

Table 1. The general structures of the analysed series (Tables 1-5 arranged by K. Meglicka).

groups of artifacts	M'lefaat								Nemrik	
	House 3				House 8				House 1B	
	floated		not floated		floated		not floated		n	%
	n	%	n	%	n	%	n	%		
I cores	19	1,1	24	6,6	15	1,6	23	8,9	40	3,4
II flakes	1134	64,6	256	70,9	507	54,3	155	60,1	727	62,0
III blades	482	27,4	49	13,6	193	31,4	57	22,1	257	21,9
IV retouched tools	21	6,9	32	8,9	118	12,7	23	8,9	149	12,7
TOTAL	**1756**	**100%**	**361**	**100%**	**933**	**100%**	**258**	**100%**	**1173**	**100%**

House 8 was also approximately circular in shape, but with a smaller radius: 2.25m in average. The average depth of the explored fill was similar, about 1m. Excluding the capacity of the unexplored parts, we could calculate that the flint material was gained from about 11m^3, from which a little less than 0,5m^3 was floated. Using the same assumptions we have stated above, we could expect that the explored part of the filling contained more than 20,520 artifacts (more than 1,860 artifacts per m^3). Using a pick/trowel method we recovered about 1.3% of them (about 24.6 artifacts per m^3, *cf.* Table 1).

Considering only the retouched tools, in House 3 we could expect a little less than 4000 of them, from which, using a pick/trowel method we managed to recover 0.8%; in House 8, the expected number of the retouched tools would amount to 2600, from which, with the pick/trowel method we recovered almost 0.9% (Table 2). These numbers seem to be quite comparable with the ones concerning all of the flint material.

If we look at the group of microlithic tools only, in the fill of House 3 we would expect more than 2300 of them, from which with a pick/trowel method we recovered less than 0.1%; in House 8 we could expect more than 830 microliths, from which, using a pick/trowel method, we recovered 0.8% (Table 3).

Table 2. The structures of the general types of the retouched tools in the analysed series.

general types of the retouched tools	M'lefaat								Nemrik	
	House 3				House 8				House 1B	
	floated		not floated		floated		not floated		n	%
	n	%	n	%	n	%	n	%		
A. endscrapers	1	0.8	1	3.1	-	-	2	8,7	5	3,4
B. sidescrapers	20	16,5	1,5	46,9	12	10,2	2	8,7	29	19,5
C. burins	-	-	-	-	-	-	-	-	-	-
D. truncated pieces	-	-	1	3,1	-	-	-	-	3	2,0
E. retouched blades	24	19,8	10	31,3	66	55,9	12	52,2	69	46,3
F. perforators	3	2,5	11	3,1	2	1,7	-	-	21	14,1
G. combined tools	-	-	-	-	-	-	-	-	3	2,0
H. core tools	-	-	-	-	-	-	-	-	-	-
I. leaf points	-	-	-	-	-	-	-	-	-	-
J. tanged points	3	2,5	-	-	-	-	-	-	13	8,7
K. microliths	70	57,9	3	9,4	38	32,2	7	30,4	4	2,7
L. splintered pieces	-	-	1	3,1	-	-	-	-	-	-
M. other	-	-	-	-	-	-	-	-	2	1,3
TOTAL	121	100	32	100	118	100	23	100	149	100

Table 3. The structures of the basic types of the microliths in the analysed series.

types of microliths	M'lefaat								Nemrik	
	House 3				House 8				House 1B	
	floated		not floated		floated		not floated		n	%
	n	%	n	%	n	%	n	%		
1. backed bladelets	27	38,6	1	33,3	6	15,8	2	28,6	1	25,0
2. microlithic inserts	-	-	-	-	-	-	2	28,6	2	50,0
3. micro-ret. blades	30	42,9	1	33,4	23	60,5	1	14,2	1	25,0
4. triangles	4	5,7	-	-	3	7,9	2	28,6	-	-
5. bladelets with retouched base	1	1,4	-	-	1	2,6	-	-	-	-
6. segments	3	4,3	-	-	-	-	-	-	-	-
7. rectangles	1	1,4	-	-	-	-	-	-	-	-
8. microburins	4	5,7	1	33,3	5	13,2	-	-	-	-
TOTAL	**70**	**100**	**3**	**100**	**38**	**100**	**7**	**100**	**4**	**100**

Comparing the above data with House 1B in Nemrik, where the fill was excavated exclusively with the use of pick and trowel, and had a volume of about $7.5m^3$ capacity, we could calculate that in average from $1m^3$ more than 156 artifacts were recovered - about 10 times more than in M'lefaat. It could mean that either the assemblage itself was much richer or that we had in Nemrik much more experienced and skillful workers, which in fact is true.

For further comparison we present the data from some other PPN sites from the Near East (Table 4), but we will not discuss them here in detail.

The General Structure

With all the great differences in the quality of the samples, their general structures seem to be quite similar (Table I). We have tested statistically the pictures of the floated and not floated series (Z-test, valuing the relative dispersion of classification (*cf.* GÓRALSKI 1976: 190-192). The tests have shown that the observed differences are statistically not significant.

We should only notice in the non-floated series the distinctly increased proportion of cores, the artifacts of comparatively the largest sizes (Table 1). In House 3, from the expected number of almost 630 specimens, we recovered with the pick/trowel method more than 3,8%; in House 8 from the expected 330 cores almost 7% of them were recovered.

The Structure of the General Types of the Retouched Tools

Comparing the floated and unfloated series we notice some considerable differences in the percentage of the individual types, noticeable especially in House 3 (Table 2). For example, the difference in the index of sidescrapers amounts up to 30%, in the index of retouched blades to 11.5%, in the index of microliths to 48.5%. Yet, the general tendencies in the analysed samples are similar. The series from House 8 are even more balanced and should be considered as very close to each other (Table 2).

The Structure of the Microliths

The most numerous types of the microliths: Nos. 1, 3 and 4 on the typological list (see Fig. 1 and Table 3), are represented in floated as well as in unfloated samples. However, some rare types are present only in the floated samples, which would mean that without using wet-sieving we would know nothing about the presence in the fill of House 3 of triangles, microliths with the retouched base, segments (crescents) and rectangles; in the fill of House 8, segments, rectangles and microburins would be missing. This seems to be a very heavy loss of information, which would surely be even multiplied if we tried to describe the microliths in more detail and distinguish a bigger number of types or subtypes. On the other hand, we have two retouched inserts (armatures), a type found only in unfloated part of the filling of House 8 and not confirmed in the floated series.

As a result we should also consider the fact that the use of a pick/trowel method of exploration cannot in any way be treated as a statistical series. Such a situation practically wrecks all possibilities of carrying out any detail comparative, quantitative analysis of material recovered from sites using this methodology.

Table 4. The number and density of the artifacts on PPN sites from the Near East (after data collected by S.K. Kozłowski).

Site 1-10 sieved, 11-14 not sieved	Layer	Number of artifacts	Capacity in m³	Artifacts per 1m³
1. Zawi Chemi	B	~ 43.000	96	448
2. Karim Shahir	A-G, Step	44.000	74	600
3. Karim Shahir	Ext.	> 30.000	40	750
4. Ali Kosh	C 1	7.729	40	193
5. Ali Kosh	A 1	10.102	103	92
6. Ali Kosh	A 2	13.832	92	150
7. Ali Kosh	B 1	14.853	138	107
8. Chaga Sefid	A 3	287	17, 15	16
9. Chaga Sefid	A 2	913	19, 45	46
10. M. Sefra	A 1	2.287	34	67
11. Jarmo II	3	9.436	118	80
12. Jarmo II	4	6.124	90	68
13. Jarmo II	1	23.947	118	203
14. Jarmo I + II	All Average	107.204	1149	93

Table 5. An average maximum width of the blade tools measured for the floated and not floated samples <*"N": the number of measured artifacts*>.

Sample	N	$\bar{x}$
1. House 3 - floated	69	6, 6mm
2. House 8 - floated	48	7, 8mm
3. whole area of the site - not floated	67	10, 2mm

The Size of the Artifacts

The average differences in sizes of the artifacts from floated and unfloated series can be shown by the measurements of average maximum width of the blade tools in the individual samples.

The series of 69 randomly chosen blade tools (including the microliths) from the floated part of House 3 had an average width 6.6mm. The series of 48 such tools from House 8 had an average width 7.8mm (Table 5).

The average width of the series of 67 blade tools coming from the whole area of the site, explored with the use of a pick/trowel method, reached 10.2mm. In this series only 53.7% of the artifacts did not exceed 10mm in width, and 3% did not exceed 6mm (Fig. 2). At the same time in the whole floated sample (House 3 and 8) we have as much as 91.5% of the artifacts the widths of which do not exceed 10mm, and more than 29% not exceeding 6mm. This picture illustrates well the degree of loss among the artifacts of the smallest sizes in course of pick/trowel excavation.

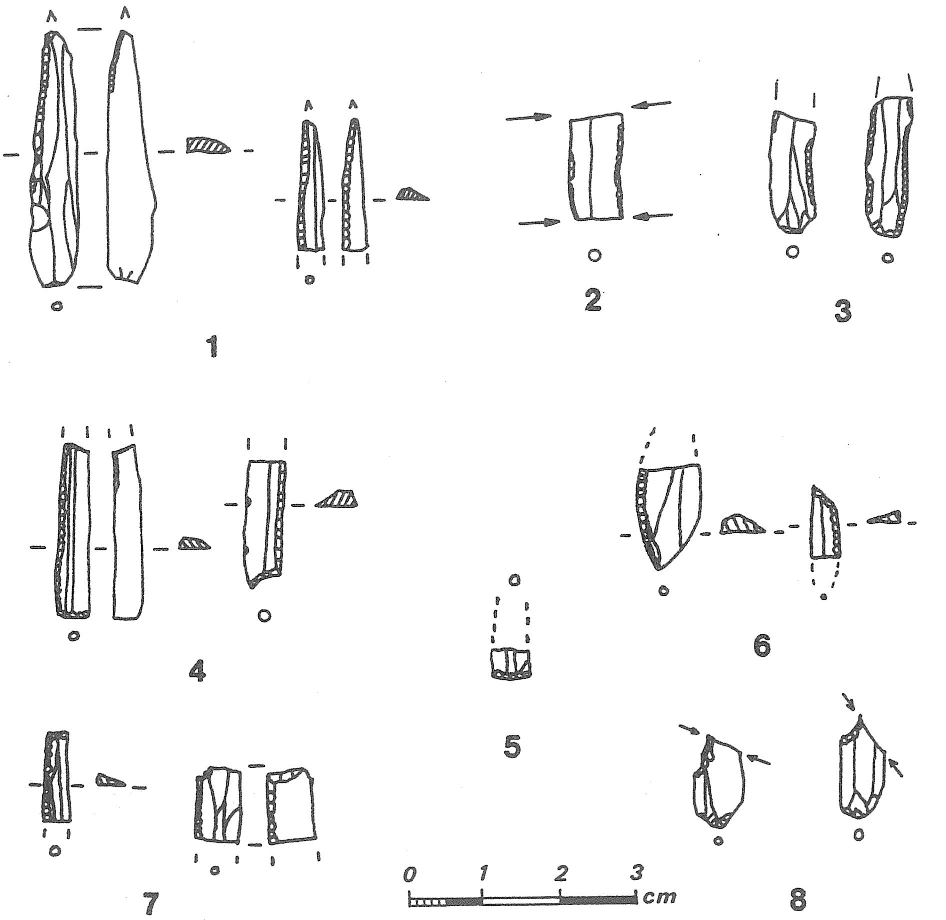

Fig. 1. The main microlith types at M'lefaat: 1 backed bladelets, 2 microlithic inserts, 3 micro-retouched blades, 4 triangles, 5 blades with a retouched base, 6 segments (crescents), 7 rectangles, 8 microburins (drawings by K. Szymczak and M. Różycka).

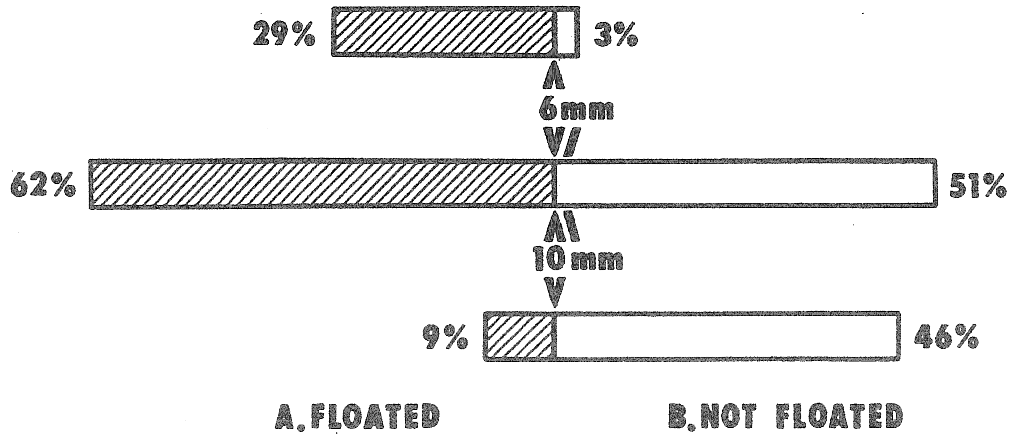

Fig. 2. The maximum width of the blade tools (indexes at particular intervals): A floated sample from House 3 and House 8, B non-floated sample from the whole area of the site (drawing by K. Szymczak and M. Różycka).

Conclusions

The simple calculations presented above give us the possibility to answer the question set in the title of this paper, and value the potential losses of information (and the material itself), in the case of applying the excavation methods of low degree of precision.

1. We must accept that using a pick/trowel method of exploration by inexperienced workers, we can gain only about 1% of the potential number of artifacts, losing the remaining 99%. This percentage is going to be even much lower: 10 times, in the extreme case of House 3 (0,1%) - in regard to the artifacts of the smallest sizes - the microliths. If we employed more experienced workers, we could count on a recovery rate of about 10% artifacts.
2. Nevertheless, the picture of the general structure of an assemblage should not be disturbed in a statistically significant way, though clearly there is a tendency that the artifacts of the largest sizes, e. g. cores, have much higher indices when the unfloated series are concerned.
3. Also the pictures of the structures of the general types of retouched tools do not necessarily have to be significantly disturbed. Even in case of clear differences, the general tendencies in ratios of the most numerous types of tools are maintained.
4. The remarks made in Point 3 basically regard also the group of the microliths, but it must be stressed that there is a high possibility of losing many of the rarer types and variations; the small absolute numbers of microliths coming from the unfloated series makes it impossible to apply any statistical method to compare the individual samples.
5. The smaller is the size of an artifact, the bigger is the chance it will be missed; in the case of M'lefaat we could expect that the width of nearly all blade tools would not exceed 10mm, and about 1/3 of them will have the width less than 6mm. Comparing that with the series gained with a pick/trowel method, we have only a little more than half of the blade tools whose width does not exceed 10mm, and about 1/30 having the width less than 6mm.

I would not like to leave an impression that I am saying that I just "discovered" wet-sieving, or that I am advising the exclusive use of a floatation method to explore the Stone Age archaeological sites, especially the ones with the microliths. I am well aware that the applied field methods depend on general strategies of excavations, chosen in specific circumstances, by an individual director for a particular site. I want only to draw attention to the need of a more detailed and critical look at the archaeological material before undertaking complex comparative analyses, because it may easily appear that the assemblages we try to compare are simply incomparable. From that derives another suggestion for the authors of the reports and monographs: about the need of describing in detail not only what was found on the site, but also how it was found or gained - and this does not apply only to the Near Eastern PPN sites with microliths.

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What Happened to the Early EPPNB?

Avi Gopher

Abstract: *It is suggested that a chrono-stratigraphic slot should be maintained in the Neolithic sequence for an Early PPNB in the 8th millennium B.C. (uncalibrated). Characteristics of the lithic assemblages of potential EPPNB samples are generally presented as well as data sets from excavated EPPNB sites throughout the southern Levant. A general attempt is finally made to incorporate additional cultural elements in the EPPNB "definition". No new terms for EPPNB archaeological/cultural units are offered despite the fact that a splitters attitude is promoted.*

Some 15 years ago following the Lyon "Préhistoire du Levant I" conference, new Neolithic terminologies were presented (AURENCHE *et al.* 1981). At about the same time, Moore (1982) offered yet another terminology for the Neolithic of the Levant, but these were not generally adopted by the profession. In class, in the field and in conversation with colleagues, we continued using the enchanted Kenyon PPNA, PPNB and PN system. On the other hand, suggestions made in the mid 1970's and the 1980's by Crowfoot Payne (1976, 1983), Bar-Yosef (1981), J. Cauvin (1989) and de Contenson (1989) rapidly entered common usage. These recommended splitting and defining cultural units in an attempt to avoid chrono-stratigraphic based terms. Thus the Khiamian, the Sultanian, the Mureybetian and the Aswadian were born - all representing assumed PPNA cultural units.

This trend skipped the later PPN and here terms such as MPPNB, LPPNB and recently PPNC gained popularity in the literature, all of course following the Kenyon mode which was not very clear to begin with on the issue of whether these represent mere temporal units based on the Jericho chrono-stratigraphy, or cultural units. The criteria for using MPPNB or LPPNB are well known to the users, each with his method and data sets, but having adopted this terminology, the question remains what happened to the EPPNB? Using MPPNB and LPPNB must naturally assume an EPPNB too but this term or unit, whatever it represents, has almost vanished from the literature at least for the central and southern Levant. Does it exist following the accepted system or is it a terminological trap? Is it a matter of insufficient research? A very specific sort of archaeological invisibility? Is it a matter of poor chronological control? These are the questions I wish to tackle in this paper. My main contention is that there is an EPPNB - it only needs better care, and by focusing on it here, where our common aim is better knowledge and reconstruction of past Neolithic societies, I hope I can provide this. I will first try to define the problem and comment on methodological aspects of it, then present chrono-stratigraphic aspects of the EPPNB, some material culture aspects (especially lithics - the topic of this meeting), and finally, briefly note some additional cultural aspects of the EPPNB such as economy, architecture, burial customs, symbolic behaviour and others, so that it will become clear that it takes more than lithics to make an archaeological entity visible.

To start, I list a number of potential EPPNB assemblages from a series of sites in Israel, Jordan and Syria, some well known and others almost totally unknown, that may be mentioned in the course of my arguments:

Horvat Galil in the Upper Galilee (GOPHER 1989a),
Mujahiya in the Golan Heights (GOPHER 1990),
Nahal Oren in the Carmel (STEKELIS and YIZRAELI 1963, NOY *et al.* 1973),
Sefunim in the Carmel (RONEN 1984),
very recently the El-Wad Cave terrace in the Carmel (Kaufman and Weinstein-Evron, pers. comm. 1996),
Michmoret Sites 26 and 26A in the Coastal Plain (BURIAN and FRIEDMAN 1965),
Nahal Lavan 109 in the northern Negev (BURIAN, FRIEDMAN, and MINTZ 1976; MINTZ n.d.; see also GOPHER 1994),

Abu Salem (Neolithic) in the Negev Highland (GOPHER and GORING-MORRIS in press),
Abu Hudhud in Central Jordan (see ROLLEFSON, this volume),
Ail 4 near Basta in southern Jordan (Gebel, pers. comm.),
Wadi Jilat 7 in Arid Jordan (GARRARD *et al.* 1994),
Tell Aswad in the Damascus Basin (DE CONTENSON 1989, 1995),
and Mureybet on the middle Euphrates.

Chronology

Absolute Chronology: the Radiometric Record

There is now a general consensus on the alignment of the Levant as a whole into an accepted PPNA time unit which dates from 8100/8000 to 7600/7500 B.C (non calibrated C14). This includes the Sultanian, Mureybetian, and the Aswadian[1]. Disagreements center on the beginning of this time unit and its end, especially in the southern Levant. Since my major issue here is the EPPNB, the chronology of the end of the PPNA is relevant to my arguments.

A review of the radiometric record of the PPNA using a measure that will limit the influence of outlying dates such as the simple interquartile range, will show that in the northern Levant the line separating the Mureybetian - Aswadian (considered PPNA) and the EPPNB is clearly around 7600 B.C (mainly based on Mureybet and Tell Aswad after CAUVIN 1978, 1989; DE CONTENSON 1995). The Aswadian may end somewhat later (DE CONTENSON 1989, 1995). In the southern Levant PPNA Sultanian dates from all sites but Jericho including those from Netiv Hagdud, Gilgal, Gesher, Drah (KUIJT, pers. comm. 1996), Iraq-ed-Dubb (and Abu Maadi in the Sinai) end at the latest at 7450 B.C and using an interquartile range these series end at around 7600 B.C. Such is also the case for most of the Jericho dates except for a group of five dates from Phases VIII-IX ranging from 7370 to 7250 B.C. These were considered by the excavators to be PPNA dates and published as such. Once again, as in the past (GOPHER 1985, 1994), I offer an alternative stratigraphic view based on the Jericho sections that claims the uppermost PPNA layers were channeled and PPNB sediments filled up these channels. It is thus possible to assign these dates ... "of the transitional PPNA-PPNB " ... (see KENYON 1981), to the PPNB itself as present on the tell or even to an unrecognized EPPNB poorly represented in Jericho. I have already suggested the possibility of an EPPNB in Jericho (GOPHER 1985: 235, 291 and 1994: 193.18) based on the fact that Helwan points in small numbers appear in Jericho all within the "PPNA-PPNB transition" or very early PPNB stratigraphic phases.

Even if the alternative offered here is not considered feasible and all the Jericho dates are used as published, still the interquartile range of all PPNA dates will show a range from 7825-7440 B.C. In general we may thus say that the southern Levant PPNA ends only slightly later then the Mureybetian sometime in the mid 8th millennium B.C

Now the question is when the MPPNB started? In Jericho, 'Ain Ghazal, Munhata 6-3, Beidha, and Nahal Hemar dates in the order of 7250 - 7000 B.C. do appear but these are few. The majority of dates from these PPNB sites (and others) range within the 7th millennium B.C. (for details see GOPHER 1994, Appendix H). Interestingly all these are assigned to the MPPNB and none mentioned as potential EPPNB. Since we used the interquartile range, for the PPNA Sultanian, as a simple statistical measure to avoid excessive influence by outlying dates, we can do the same here for the MPPNB. This will show a range from sometime around 7000 B.C. or maybe very slightly earlier. The conclusion so far is that there is a time gap of some few hundreds uncalibrated C14 years between the end of the PPNA and the MPPNB in the southern Levant - and thus, it was correct to retain a slot for an EPPNB entity.

Except for Jericho, the southern Levant is very poor in dates for the range of 7500/400 to 7100/7000 B.C. However, we do have some radiometric dates for this slot though very few: two dates from Sefunim (7445, 7170; RONEN 1984) and two dates from Horvat Galil (7390, 7000, CARMI and SEGAL 1992) we may add a date from Nahal Hemar (BAR-YOSEF and ALON 1988). If we add, as suggested above a number of radiocarbon dates from Jericho and speculate an EPPNB at this site, which is possible considering both stratigraphy and material culture, then, the EPPNB would cover those few centuries described above - around 7500/7400 - 7100/7000B.C.

In general thus the sequence in the southern Levant appears to be very similar to the northern Levant with a slight retardation.

Relative Chronology

Stratigraphy

Where a stratigraphic sequence is available, it shows clear EPPNB features (see below) to be

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1 The Khiamian issue is out of the scope of this paper but is relevant to PPNA chronology.

post- PPNA and pre MPPNB - such is the case for example in Mureybet and Tell Aswad in the north and in Jericho (after the scenario offered above) and Nahal Oren in the south.

Material Culture Elements Seriated

Dating archaeological data with the aid of frequency seriation in the PPN of the Levant confronts two major problems: A: the dynamic nature of processes of change require quantitative analysis of the seriated elements and this is hard to achieve for most of them since this kind of data is scarce. B: the basic assumptions of seriation that "like goes with like" and that it is applicable to elements of a single cultural system necessitates consideration of a spatial element. A decision has thus to be taken whether to treat the whole Levant as one unit or subdivide it into a few separate spatial-cultural units. Discussion of this issue is beyond the scope of this paper, however, the general unity of the whole region and the effects of cultural retardation have been discussed (*e.g.* GOPHER 1985, 1989b-c, 1994, 1994a) and it has been suggested that we adopt a chronological scheme which is not made up of straight parallel lines, creating equal sized boxes for the whole Levant but rather inclining lines and boxes of different sizes (see GOPHER 1994: 255, Fig. 8:3).

I shall now present briefly a number of elements of material culture in this manner illustrating what I suggest are characteristic of the EPPNB. These are taken mainly from the lithic assemblages. Seriations are on the whole rather primitive based on presence/absence matrixes or very general trends of change in relative frequencies (popularity) of material culture elements.

1. Microlithic elements are completely absent in EPPNB assemblages. Thus, this long tradition that still persisted in the PPNA has come to an end.

2. Bidirectional opposed platform - naviform cores for the production of high quality blades appeared in PPNA assemblages in the northern Levant. Bipolar cores for blade production do appear in southern Levant PPNA assemblages too (*e.g.* Netiv Hagdud, 'Ain Darat and others). However it was not until the EPPNB that the fully characteristic naviform cores appear and gain popularity in the southern Levant, and not until the MPPNB that this industry reaches its climax. It should be mentioned that in the southern Levant, new, high quality flints are being used in relation to this industry, including the purple-pink flint. This, I believe, is due to the use of new flint sources and new techniques of flint procurement, again reaching a climax in the MPPNB (QUINTERO 1994 and this vol.; TAUTE 1994), as part of a specialized sub-system (WILKE and QUINTERO, this vol.) The presence of naviform cores and blades produced from such cores and materials in EPPNB reflects early stages of this process.

3. Arrowhead typology is one of the most intensely studied topics in Levantine Neo-lithics and thus a suitable element to tackle. In the southern Levant the use of large blades for arrowheads instead of bladelets is clear in the suggested EPPNB as is the dominance of Helwan (notched) points. El-Khiam points are almost completely missing; Jericho and Byblos points also appear and there seems to be a change in the concept of arrowheads production, hafting and maybe use too. The domination of Helwan points may well be regarded as a suitable indicator for EPPNB.

In the northern Levant the transition to large arrowheads on blades takes place earlier sometime in the Mureybet III, Tell Aswad IA assemblages. The EPPNB (Mureybet IV, according to the excavators) is characterized by a change in the shaping method of the notched and tanged arrowhead namely the use of flat retouch and not abrupt (and fine) retouch that was used before.

4. The characteristic finely denticulated sickle blade - reaping knives of the PPNB appear all over the Levant. This type is typologically different from that of the PPNA - thus a clear EPPNB phenomenon which persists throughout the PPN.[1]

5. Bifacially flaked axes and adzes appear in PPNA of the southern Levant with a wide use of a tranchet blow for shaping the working edge. In the northern Levant no axes/adzes appear and the erminette may be mentioned even though it is a different type of tool. Polished axes made mostly of limestone and basalt appear too in the southern Levant. In the EPPNB polished axes /adzes on different materials are rare or absent altogether as are flaked flint axes-adzes with tranchet blow which may still appear in small numbers.

6. Hagdud truncation becomes a clear PPNA (Sultanian) tool-type in the southern Levant. Its continuation into the EPPNB is only known sporadically from Wadi Jilat 7 (GARRARD *et al.* 1994) and Mujahiya (GOPHER 1990). It seems that the use of this tool whatever it may be (NADEL 1994) has ceased or drastically diminished in the EPPNB.

7. In ground stone elements there are changes in typology and relative frequencies of the different types. Saddle shaped querns are popular in the EPPNB while pounding elements (mortars and pestles)

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1 a) Beit Taamir sickle blades known from the southern Levant PPNA (usually in very low percentages) are absent in EPPNB; b) PPNA (Sultanian) sickle blades are usually broader and thicker than the PPNB sickle blades which are also more standardized; c) the use of sickle blades as reaping knives is, of course, mentioned as one option. Hafted series of blades are surely in use too as in Nahal Hemar (BAR-YOSEF and ALON 1988).

decrease (WRIGHT 1991, 1992, 1993). The well known generally saddle shaped quern with cupmarks in it of the PPNA (*e.g.*, NOY 1979) still appears rarely in the EPPNB. Stepped querns, present mainly in the northern Levant in the PPNA (Mureybet *e.g.* NIERLE 1982) are new in the southern Levant in the EPPNB and become more abundant. This is most probably related to changing methods of food processing and preparation.

In sum, generally, the EPPNB shows the disappearance and/or sharp decrease in quantity of the microlithic element, the El-Khiam point, Hagdud truncations, polished stone axes, flaked tranchet axes, querns with cupmarks in them and pestles. New arrowhead types appear differently shaped (flat/pressure flaking) and hafted suggesting possibly different use. New types of serrated/denticulated sickle blades/reaping knives may reflect changes in agrotechnology. A few elements of earlier origin increase and appear abundantly in the EPPNB such as saddled and stepped querns indicating change in food processing and bidirectional opposed platform cores - the famous naviform cores for the production of non curved non twisted blades.

In order to substantiate the above suggestions and prepare for a wider cultural view, I devote the next section of this paper to a short presentation of excavated data. The lithic aspect remains, in any case, the central aspect of this survey.

A Presentation of Data from Excavated EPPNB Sites

This opportunity is taken to present three excavated lithic assemblages from three different regions of Israel - Horvat Galil in the Upper Galilee, Mujhiya in the Golan Heights and Abu Salem in the central Negev Mountains. All three were fully analysed but here I emphasize only points relevant to our discussion. Some notes on a few additional EPPNB assemblages such as Nahal Oren, Sefunim, Michmoret sites 26 and 26A, Nahal Lavan 109, are given, and a few from Jordan are presented in this volume or published elsewhere.

Horvat Galil

Horvat Galil is located on a north western slope of a hill 430m a.s.l. and its area is estimated at 20 dunams. It is one of the very few PPN sites known to date from the Upper Galilee - a rich Mediterranean zone. Excavations from 1985-1987 and in 1989 exposed a rectangular building with plastered floors, a few burials, faunal remains including mainly gazelle (2/3), pigs (1/10) and fallow deer, hare, birds and fish in small numbers. No sheep/goat bones were identified and it seems that the economy was based on hunting. Botanical remains were not identified however, some samples analyzed for phytoliths indicate the presence of cereals. More details can be found in: GOPHER 1989a, HERSHKOVITZ and GOPHER 1988.

A rich lithic assemblage was recovered including some 9000 artifacts of which some 8.5% are shaped tools. Cores with one striking platform constitute half of the classifiable cores and a third have two striking platforms including a few bidirectional opposed platform - naviform cores. More of these appear in the nearby Kibbutz Ailon collection. The flake:blade ratio of the assemblage as a whole is *c.* 2:1 however preference in shaping tools on blades is clear. The sample of excavated tools includes 653 artifacts of which arrowheads constitute almost 14%, sickle blades 18%, axes and adzes 1.5%, burins 4.8%, and scrapers 1.4%.

The classified arrowhead types include a single El Khiam example, over 60% Helwan points, 15% Jericho points, 15% Byblos points and single leaf shaped points. The Kibbutz Ailon collection too is dominated by Helwan points. This composition of arrowhead types accords well with an EPPNB date as shown by a seriation analysis (GOPHER 1994: Group II). Two dates from the structure (one from a post hole) show a range in the last third of the 8th millennium B.C (7390 ± 70; 7000 ± 100, see CARMI and SEGAL 1992).

Mujahiya

The site is located on a flat plateau in the southern Golan Heights some five km east of the sea of Galilee at 80m a.s.l. Tested on a very small scale in the mid 1980's the site was estimated to cover some 30-50 dunams (GOPHER 1990). Architectural features include unclear rounded structures however the exposure is limited and one cannot exclude the possibility that other structures existed. A small faunal assemblage includes mainly gazelle (2/3), wild bovids (1/4), goat (1/10) and some pig bones. It seems quite clear that the economy was based on hunting. No data was recovered for reconstruction of the botanical aspect. A rich groundstone assemblage mainly made of basalt includes pestles and saddle shaped querns some with a cupmark in them as well as stepped querns[1], many manos (*c.* 50%) and stone bowls. The flint industry includes over 8000 excavated artifacts of which

1 These were found on the surface and since the site has more than one PPN component it is hard to assign them stratigraphically, however, I believe they do appear in the EPPNB layer too.

shaped tools constitute almost 6%. Cores are mainly with one striking platform but some 17% bear two striking platforms. Only single bidirectional opposed platform cores appear including some collected on site and now stored in the Katzerin museum. Out of the 479 excavated tools only 3% are arrowheads, 4% are sickle blades and 2% are axes and adzes. A single Hagdud truncation is worthy of note. Arrowheads include a single El Khiam point, over 40% Helwan points and Jericho and Byblos points. The museum collection from the site which enlarges the sample considerably had single el Khiam points and over 60% of Helwan points. In general thus the dominance of Helwan points is clear. Sickle blades are the usual PPNB finely denticulated ones and the axes are quite crude and do not show tranchet blows except for a single possible example. A polished axe of basalt was found in excavation and there are a few more in the museum collection. Without material for dating we rely on the finds and suggest an EPPNB date (for discussion see GOPHER 1990: 140-141). In this case too the assemblage would accord well with the EPPNB group in an arrowhead seriation of the PPN Levant (GOPHER 1994).

Abu Salem (Neolithic)

The site is a PPNB occupation that represents a component of the better known Harifian site investigated by Marks and Scott (1976, SCOTT 1977). The Neolithic layers were excavated in the early 1980's by Gopher and Goring-Morris (in press) and revealed a small *c.* 150m² occupation with a series of rounded structures on top of the Harifian layer. Ground stone implements include saddle shaped querns with a cupmark, pestles, manos and bowls. It is suggested that this is a seasonal site of the EPPNB. The studied flint industry constitutes of over 40,000 chipped artifacts from two structures from which Harifian Epipaleolithic intrusion could easily be separated. Altogether some four hundred Neolithic tools were found (7% of the Neolithic assemblage). The cores included some bidirectional opposed platform - naviform varieties and blades were selected for tool shaping. The blade:flake ratio was *c.* 1:1. Arrowheads constitute 19% of the shaped tools, scrapers 10%, burins 4%, awls and borers some 9% and notches and denticulates some 14%. A single axe was also found, while sickle blades were absent altogether. The arrowheads included a few el Khiam points, some 75% of Jericho and Byblos points and over 20% Helwan points[1]. Here too an EPPNB date is suggested in light of considerations mentioned above. It is of importance to note that in the Negev Highlands another similar assemblage was reported from Nahal Boker (NOY and COHEN 1974). This site with circular structures has an arrowhead assemblage with 37% Helwan points and Jericho and Byblos points constituting most of the rest of the points.

More EPPNB Sites and Assemblages

A number of additional Neolithic sites have provided assemblages that are very similar to the ones presented above. Nahal Oren in the Carmel ridge (STEKELIS and YIZRAELI 1963; NOY *et al.* 1973) has yielded an EPPNB assemblage with bidirectional opposed platform - naviform cores, the typical denticulated sickle blades, a large number of flaked axes some with tranchet blows and an assemblage of over a hundred arrowheads with 44% Helwan points and 29% Jericho points (GOPHER 1994). Two sites on the Coastal Plain south of the Carmel, Michmoret 26 and 26A have a blade dominated tool assemblage. The arrowheads include Helwan points as the dominant type (58% in 26A and 49% in 26) and Jericho and Byblos points (BURIAN and FRIEDMAN 1965, GOPHER 1994). Nahal Lavan 109 in the northern Negev (BURIAN, FRIEDMAN and MINTZ 1976; MINTZ n.d; GOPHER 1994) has yielded a very special assemblage with thousands of arrowheads dominated by Helwan points (81%) and Jericho points (18%) and bifacially flaked tranchet axes. The site Wadi Jilat 7 in Jordan presents three layers in which flint tool assemblages show a decrease in el Khiam points (30% in the earliest layer to 6% in the top layer); a dominance of Helwan points (40-66%) and an increase in Jericho and Byblos points from the early layer (4%) to the top layer (50%). The trend of change through the stratigraphy of this site is even more important if we consider the fact that Hagdud truncations were decreasing throughout the sequence and disappeared in the top layer. Even though this site has been dated by C-14 dates to the 7th mill. B.C this is not acceptable to either the excavators or the author and still needs to be explained (see also GARRARD *et al.* 1994).

I will not enlarge here or go into detail on the EPPNB of the Damascus basin and the Middle Euphrates revealed from the excavations of tell Aswad and Mureybet since these are a topic for a full separate discussion. However, I would like to make just two points:

A. Over a decade ago I suggested the term Aswadian for the EPPNB of the central Levant - Damascus basin. Based on the data available then, mainly the lithics as published by M-C. Cauvin (1974a-b), and my own analysis of arrowheads (GOPHER 1985, and see also GOPHER 1994) I could reconstruct

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1 A detailed study of the stratigraphy of this site (GOPHER 1985, 1994; GOPHER and GORING MORRIS, in press) shows that the early occupation of this site was richer in Helwan points.

both the use of bidirectional opposed platform - naviform cores for blade production and the retardation effecting the diffusion of this technology and the spread of specific arrowhead types into the southern Levant (GOPHER 1989 b,c). In the discussion of my report on the Mujahiya excavation (GOPHER 1990) I reiterated this point. This of course has relevance to my earlier remark on the inclined chronological scheme and may be significant in relating the different parts of the Levant to each other as well as for tracing the EPPNB in the southern Levant.
B. The Mureybet material as published in the early reports (J. CAUVIN 1978, M.C CAUVIN and STORDEUR 1978) eventually treated Layer III as an EPPNB manifestation and it was correctly compared to the lower level of Tell Aswad. The arrowhead assemblage of Layer III had almost no Helwan points. These were present in Layer II and already decreasing and fading away in Layer III.

Discussion

The basic idea of this presentation was to try to find out whether there is a slot for the EPPNB in the sequence of PPN entities in the Levant (mainly the southern); try to recognize it and describe its chrono-spatial aspects; and relate to its significance in additional aspects as part of our attempt to reconstruct in a way the historical record of the Neolithic period. Emphasis naturally was put on lithics (the major issue in our meetings) and the southern Levant.

We may argue that within the dynamic process of change, the lithic sub-system (flint and groundstone tools) having demonstrated enough independent qualities and difference from both its predeccessors and followers may justify the concept of an EPPNB unit between the PPNA and the MPPNB. Being a splitter, committed to defining cultural entities, and moving away from indistinct time unit-stratigraphic based terminologies, I would have termed this EPPNB unit for the central (mainly the Damascus basin) and southern Levant - Aswadian (as I did in the past, GOPHER 1985). However, since this term has been reused and assigned to the PPNA (DE CONTENSON 1989, 1995) I will refrain from doing so since it will only cause confusion. Even so, cultural units within the EPPNB slot should be defined, and except for the chronostratigraphy, spatial aspects, and their lithics, other aspects should be added to allow for proper entity definitions.

Referring to the sites mentioned as candidates for an EPPNB unit, I will comment on a few aspects that substantiate the distinctive nature of this unit:
1. The size and depth of sites, may reflect patterns of settlement and community size - there are large-medium sites such as Mureybet or Aswad or Mujahia, but these do not exceed 1-3ha and remain in the order of large PPNA sites while in the MPPNB and LPPNB, larger 5-12 hectare sites appear.
2. Architecture - Since the pioneer article of FLANNERY 1972, social meaning has been related to the change in house shapes in the Neolithic period in our region. During the proposed time slot of the EPPNB, the common circular shaped house persists in the north and central Levant (in both Tell Aswad Ia and Mureybet III architecture is rounded, however inner subdivisions and corners appear already in Mureybet III). A clear change to rectangular house shapes is only clear at Mureybet IV. In the southern Levant, PPNA houses are round and oval. In some cases rounded structures continue in the EPPNB (*e.g.* Mujahiya), however, rectangular houses also appear such as in the case of Horvat Galil, for example, and maybe Jericho. In the desert, further south, the circular shape continues. Thus the common MPPNB rectangular house with plastered floors probably had its origins in the EPPNB and it has changed somewhat in the later MPPNB and LPPNB, however, data is very scarce. Whether the change in house shape relates to change in the social and productive unit will not be discussed here - suffice it to say that the new rectangular shape, whatever it may mean, may have originated during the EPPNB.
3. With the ever growing data base of evidence for the economy, the debate shows no signs of being resolved. There is clearly no case yet for domestication of animals in the PPNA or the EPPNB - hunting appears to continue as the major source of meat. The evidence for agriculture is scarce. Some scholars would reconstruct cultivation for the Mureybetian, Aswadian and Sultanian - mainly of cereals. It is in order to assume that this went on at least in some regions. We have scant evidence for the cultivation and use of legumes (at Horvat Galil, domesticated horsebean was found but it is hard to tell since the sample is small; Kislev pers. comm.). The positive data from Aswad must be considered too (DE CONTENSON 1995: 369-370). It is worth mentioning here the trends of a reduction in frequencies of pounding implements (pestle/mortar/cuphole) and the increase in saddle shaped and especially stepped querns. This change may reflect too a change in the processing of food. Wright (1991, 1992, 1993) has suggested recently that this would bring about a better exploitation of cereals as a food source.
Changes in lithic technology and typology summarized above seem to relate to economical aspects as well. The innovations in the tool kit may reflect change both in hunting equipment and in harvesting methods.
4. Burial customs and the treatment of the dead must reflect social and spiritual aspects. Here the separation of skulls is clear both in the north (Mureybet IV) and in the south (Horvat Galil, Jericho ?).

However, no skull treatment is yet reported. So here the older traditions continue into the EPPNB and it is not until the 7th millennium B.C. MPPNB that skull treatment seems to have been introduced. The imagery repertoire of the MPPNB includes too aspects as yet unknown from EPPNB such as figurine-statuette types, statues (*e.g.* 'Ain Ghazal, Jericho) and stone masks.

In sum, in general, one may suggest an EPPNB which is different from the PPNA in its settlement system, architecture, economic aspects lithics and more. Some of these differences persist and increase in the MPPNB when additional aspects appear.

I believe that both additional field work and more explicit tackling of methodological problems will clarify our view on Levantine PPN entities and avoid a trivial semantic-terminological debate. We will then be able to concentrate our research on cultural characteristics, cultural process and their explanation.

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An EPPNB Settlement in the Wadi el-Hasa, Central Jordan

Gary O. Rollefson

Abstract: *Surface surveys at Abu Hudhud (WHS 1008) produced a small collection of flint artifacts, including approximately ten Helwan points, a glossed blade fragment, and a broken basalt pestle. The surface of the small settlement revealed several curvilinear stone alignments and the corner of a rectilinear structure. Although no subsurface testing has been undertaken so far, it appears that Abu Hudhud belongs to a small but growing number of southern Levantine EPPNB sites.*

During the final (1982) season of the Wadi el-Hasa Survey (MACDONALD 1988) a collection of PPN stone tools and debitage was recovered from a deflated and relatively sparse lithic scatter (WHS 1008, named Abu Hudhud in view of the density of hoopoes in the nearby wadi vegetation) on the south bank of the Wadi el-Hasa near the juncture with the tributary Wadi el-'Ali (MACDONALD *et al.* 1983). The scatter was situated at the edge of a basalt outcrop and covered approximately 0.5 hectares (*c.* 80m diameter), although this estimate of site size is very tentative due to post-depositional disturbance. Several erosional channels, probably of relatively recent age, cut through the surface to produce artificial sectors; one of the widest and deepest of these channels separates the "main" PPN scatter from another cluster of surface artifacts to the west (WHS 1007). The material from WHS 1007 appears to include both PPN and Epipaleolithic material, so it is possible that Abu Hudhud may have extended across an elliptical area of *c.* 150-200 (E-W) x 80 (N-S) m. On the other hand, erosion down the *c.* 20° slope has probably contributed to an exaggeration of the site area, and it is probable that the "core" site was much smaller.

At least four oval or subrectangular stone alignments (with dimensions of *c.* 3x2.5m) occur near the upper limits of Abu Hudhud and probably represent structures using angular pieces of readily available basalt. No subsurface testing was undertaken during the survey, so it is not clear if the stone alignments are the remains of house walls or if they were simply the foundations of temporary huts or tents.

One erosional channel exposed several courses of basalt blocks that formed a right angle in another building at the southern edge of the site, and this structure, at least, appears to be a permanent house. There are also some stone "clusters" on the surface of WHS 1007, although erosion here was so severe that the original geometry of the alignments (if they actually existed) can't be reconstructed.

The steepness of the slope at Abu Hudhud is such that prehistoric residents would have had to create at least small terraces to provide anything approaching a level floor. This would have entailed a considerable degree of effort, supporting the contention that the hamlet was at least of a semi-permanent nature. If the occupants didn't reside at the site throughout the year, they most probably returned repeatedly to the same structures on a cyclical basis.

The 1982 surface collection from Abu Hudhud consisted of 56 lithics, and all appear to be PPN. Included among the pieces of debitage were there crested blades and ten cores, although field identification did not specify the kinds of cores that were recovered. The tools in this non-random sample were varied, including heavy duty tools (picks, scrapers), lustered elements, transverse burins, borers/drills, a Helwan-backed bladelet, and four Helwan projectile points. During a brief visit to the site in 1990, four more Helwan points were noticed, as well as two lustered blades, a borer/drill, and a broken basalt pestle (Table 1). The exclusive presence of Helwan points in the two collections suggests that the surface scatter belongs to the EPPNB period (BAR-YOSEF 1981; GOPHER 1989; 1994).

Admittedly, the sample is both small and biased towards the collection of blade tools and bifacial tools, but the broad range of probable activities associated with the variety still supports the likelihood that Abu Hudhud was at least a semi-permanent settlement, an interpretation that is supported by the stone alignments.

However, the surface sample from Abu Hudhud also included a handful of badly eroded pottery sherds that, although not datable to any specific period, probably come from recent times. Although the quantity of sherds may represent a single pot break, the presence of the pottery adds a degree of uncertainty for ascribing an age to the stone walls. If the pottery was discarded by Bedouin in historical times, then the smaller structures visible on the surface could conceivably be associated with temporary camps as recent as this century; similarly, it cannot be ruled out that the rectangular building may have been a farmstead building erected and abandoned in relatively recent times. Only a systematic testing of the subsurface deposits across the alignments will determine whether the structures are of prehistoric date.

Attempts in the past few years to conduct excavations at Abu Hudhud have been thwarted by lack of available funds. There is some urgency to undertake soundings at the site, for it was noted in 1993 that small irrigated plots have been established along the southern bank of the Wadi el-Hasa in the vicinity of Abu Hudhud, and in view of the probably fragile nature of the prehistoric site, there is a major threat that a rare example of EPPNB presence in the southern Levant could be destroyed in the near future.

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The Trialetian "Mesolithic" Industry of the Caucasus, Transcaspia, Eastern Anatolia, and the Iranian Plateau

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Abstract: *The article describes a geometric "Mesolithic" (hunters') industry in the Caucasus, Transcaspia, and Elbrus, which perhaps extends also on the Iranian Plateau and to eastern Anatolia (Hallan Çemi). This taxonomic unit, called the Trialetian (after a plateau in Georgia) is dated from the 11th to 7th millennium bc and belongs to the Caucaso-Caspian cultural province, together with the Imeretian, Black Sea and Shan-Koba industries. In eastern Anatolia Trialetian gave birth to the local variant of the PPNB industries (Cafer "ancien", Boy Tepe, part of Nevalı Çori).*

Introduction

This article presents the Trialetian, a Late Pleistocene / Early Holocene industry from the Caucasus, Transcaspia, eastern Anatolia and the Iranian Plateau, commonly regarded as "Mesolithic" and -in it's late phase- contemporaneous with the Mlefatian and Nemrikian industries of the south, which are considered to be Neolithic (HOLE 1994, KOZŁOWSKI 1994, KOZŁOWSKI and GEBEL 1994).

The Trialetian industry was named after a plateau in Georgia (GABUNIA 1976, TSERETELI 1973, GABUNIA and TSERETELI 1977). The industry was characterized in detail in an article on the Caucasian Mesolithic (BADER and TSERETELI 1989). Similar material from the topmost layers in Dam-Dam-Cheshme in Kazakhstan was included in the second group of the Caspian Mesolithic (KOROBKOVA 1977), while the assemblage from the Belt cave in Iran was described as "Upper Mesolithic" or "Gazelle Mesolithic" (COON 1957). In one of my publications I erroneously referred to this industry as the "Triaulian" (KOZŁOWSKI 1994).

Available Evidence

Considering the large area of their occurrence (north of the Zagros up to the eastern shores of the Caspian Sea and Georgia), the number of Trialetian sites is very small. They are either undated or the radiocarbon dates are incoherent, the exceptions here being Hallan Çemi and Ali Tepe. Moreover, the available publications omit many important details and, accordingly, the following characteristics cannot be but general in nature. The existing stratigraphic sequences, including also those on Late Pleistocene sites (Ali Tepe), give some idea about the industry's relative chronology.

Sites (Figs. 1-4)

The following assemblages are being regarded as Trialetian:

- Edzani, Georgia (Fig. 2; GABUNIA 1976)
- Hallan Çemi, Turkey (Fig. 3; ROSENBERG 1994)
- Ali Tepe, Iran (MCBURNEY 1968)
- Belt Cave, Layers 28-11, Iran (Fig. 4; COON 1957)
- Chokh, Layers E-C, Azerbaijan (Fig. 3; AMIRKHANOV 1987)
- Dam-Dam-Cheshme II, Layers 7-3, Turkmenistan (KOROBKOVA 1983)
- Nevalı Çori, Turkey - admixtures in a PPNB context (SCHMIDT 1994)
- Hotu (DUPREE 1952)

Trialetian affinities also appear to be discernible in the microliths from Çafer Hüyük "ancien" (CAUVIN 1991) and Boy Tepe in Turkey.

Cultural Sequence and Chronology

The reconstruction of the cultural sequence in the area where the Trialetian was found is based on the assumption that cultural development was everywhere more or less similar. This approach makes it possible to draw inferences from sites with stratigraphic sequences and more or less acceptable radiocarbon dates that are territorially far apart.

The sites of Ali Tepe and Belt, lying close together, form a cultural sequence spanning the period from about 10,500 to about 6000 years bc. The sequence in Ali Tepe (10,500-8870 bc) yielded six types of large microliths which are characteristic for the Trialetian (slender and short scalene triangles, slim isosceles triangles and segments, pen-knives and large backed pieces with straight backs). The top part of this sequence lacks some of these types but in all probability this does not mean they actually disappeared. Rather, we probably have here a statistical distortion: the drastic drop in the microliths index starting about 9400 bc must have led to an elimination of the poorly represented types from the collections.

The not too reliable dates we have for the lower layers (28-24) of the Belt cave (most probably from 9500 till after 7500 bc?) make it possible to place these layers towards the end or, more probably, right after the Ali Tepe sequence. The dominant implements in Layers 28-24 are also the large microliths, mainly in the form of symmetrical and asymmetrical trapezes, which are accompanied by short retouched truncations and also by a short scalene triangle (Fig. 4: bottom). The overlying Layers 22-14 also contain materials with features known from Ali Tepe: pen-knives, slender segments, triangles, single trapezes (Fig. 4: top). These finds are radiocarbon dated to 7500-6000 bc (?). It seems that the Trialetian tradition, found to have been present in Ali Tepe since about 10,500 bc, was for a while dominated by trapezes, and then experienced a "revival".

We have a similar situation in the undated site Dam-Dam-Cheshme II on the eastern coast of the Caspian Sea where the bottom layers (8-4 "bottom") are dominated by large trapezes accompanied by short triangles, while the layers higher up (4 "top" - 3) contain slender triangles together with slim and short crescents which continue to be accompanied by trapezes (*cf.* V. MASSON, this volume).

If we now look at the materials from Hallan Çemi, dated to the turn of the 9th and 8th millennium bc (Fig. 1), we will at once see a set of implement types similar to that from the upper layers in Belt and Dam-Dam-Cheshme, with only a few trapezes still present. The situation is similar in Edzani (Fig. 2) as well as in Chokh (Fig. 3), sites that were pollen dated to the Early Holocene, which, however, feature a number of local peculiarities.

It is of course impossible to demonstrate that the episode with trapezes was confined mainly to the eastern territories of the Trialetian. In any case, the industry can be divided into three phases (at least in the east): 1) the Ali Tepe, 2) with trapezes, and 3) the Edzani-Hallan Çemi.

Basic Dating and Chronology

The described stratigraphies of Trialetian cave sites and the radiocarbon dates of various reliability (with those from Ali Tepe and Hallan Çemi seen as accurate), together with the cultural sequence reconstructed above, all allow a fairly accurate reconstruction of the industry's chronology, assuming of course that development in the entire region proceeded according to the same rhythm. This chronology is as follows:

1. Typical Trialetian elements (the entire range of points and microliths) make their appearance in the Elbrus region not later than 10,500 bc (Ali Tepe) and survive there until 8870 bc.
2. Not much later (8600/8500 bc) an identical industry appears in Hallan Çemi, where it survives until 7600/7500 bc.
3. In the upper layers of Belt (20-14), the same industry apparently survives until around 6000 bc (radiocarbon dates).
4. Given all this, the previously described episode with trapezes ought to be dated to the 9th millennium bc, this being in good accord with the presence of an identical trapeze in the Post-Zarzian Iraqi site Zawi Chemi which was dated to this millennium (SOLECKI 1980).
5. The decline phase of the Trialetian, assuming it took place more or less simultaneously in the entire area of the industry's occurrence (something that is rather unlikely), should have occurred around or slightly before 6000 bc, as indicated by the available dates for the Jeitunian industry (6th millennium bc; *cf.* KOROBKOVA, this volume), which most probably evolved from the Trialetian, (Jeitun as well as Jebel yielded small, elongated scalene triangles, quite similar to Trialetian implements; *cf.* MASSON, this volume), and by the stratigraphy of Belt (starting from Layer 10-8, dated to 6000 bc), where there appear "Neolithic" materials representing a different flint-knapping technology (COON 1957).

6. In the west and north the situation appears to be different. In the Kura valley, the Chokh variation of the Trialetian persists in slightly modified technological form into the ceramic phase (AMIRKHANOV 1987), while in southeast Turkey the Trialetian probably undergoes a transformation into a local variety of the PPNB, perhaps as early as the beginning of the 7th millennium bc (Çafer Hüyük "ancien"; *cf.* CAUVIN 1991).

In Georgia itself the Trialetian does not appear to have a direct continuation in the local "Neolithic" assemblages; in the early Neolithic at Paluri and Kobuleti there are singly occurring "geometrical microliths", but none of them are very similar to their Trialetian counterparts. The same may be said of the more recent Neolithic (Makhvilauri, Anaseuli II, Odishi; *cf.* KOROBKOVA, this volume). It is only in the 5th millennium bc (Shulaveris Gora I and III, Irmis Gora I-IV) that microliths similar to the Caucasian ones appear in ceramic contexts, but this is an entirely different story of course. In this youngest context there appears in Irmis a tanged point, typologically fairly similar to the specimen from the Mesolithic Edzani. The question now arises: Does this make the Edzani tanged point Chalcolithic or Neolithic (PPNB)?

Territory

Given the little amount of research that has been carried out, it is difficult to stake out the territory of the industry. It may be confidently assumed however that the southern reaches of the phenomenon coincided roughly with the principal range of the Zagros mountains, with single specimens of Trialetian microliths being present in Zarzian and Post-Zarzian assemblages: trapezes in Palegawra (BRAIDWOOD and HOWE 1960) and Zawi Chemi, with pen-knives and small retouched truncations in the latter site; and later in Mlefatian assemblages, short triangles and small retouched truncations in Asiab and pen-knives in Sarab (PULLAR 1975), all south of the mountain range.

This mountain border line is broken by the series of Trialetian sites, or sites with Trialetian elements, along the Upper Euphrates and Tigris (Hallan Çemi, Nevalı Çori, Çafer Hüyük "ancien", Boy Tepe) which enjoyed access to the Araks Valley via mountain passages.

In the north the typical Trialetian reaches up to southern Georgia (Edzani) and the southern (Ali Tepe, Belt Cave) and eastern (Dam-Dam-Cheshme II) shores of the Caspian Sea (which, incidentally, in those days was much smaller than today). Industries similar or close to the Trialetian (Imieretian, Black Sea) are in evidence to the north of its domain; the western and eastern limits of this territory remain undetected.

All this means that the Trialetian should be present in at least the western part of the Iranian Plateau, a fact that is yet to be directly demonstrated, however. It may in the end turn out that - at least at the turn of the Pleistocene and Holocene and in the early Holocene (8th millennium bc) - the steppe and desert steppe of the Iranian Plateau were so unattractive that the Trialetians never settled there or settled rarely, with more intensive colonization beginning only in the post-Trialetian "tell" period around 6000 years bc, for example at Zaghe and Sialk. The situation in Turkmenistan could have been the same: the southern steppes there appear to be colonized only by the Jeitunian tell settlement. It is thus likely that the Trialetian is an industry of forest and woodland hunters of the Caucasus, Elbrus, Kopet-Dağ and Nebit-Dağ Mountains, the eastern Taurus and the northern slopes of the Zagros, having very little to do with the Iranian Plateau. One cannot fail to mention however the extremely copious Holocene sedimentation on the plateau (note the almost complete burial of Zaghe beneath a six-meter layer of sediments), which could have completely covered the older sites of the region. The analogy with Mesopotamia comes to mind, where older sites are known mainly from elevated places of hilly flanks, while the lower-lying sites are covered by younger sediments. This fact is responsible for the apparent grouping of sites in the Fertile Crescent, which does not necessarily have to reflect the actual settlement situation in the Early Holocene.

Industries

Technology

The Trialetian shows two types of core processing: the blade and the flake. The former is based on exploitation by indirect percussion of a conical or subconical, and sometimes cube-shaped (preformed?) cores with the view to obtaining regular and less regular blades, bladelets and, in the last stages, blade-like flakes. The final forms of some of the cores are double-platform. The other type of core processing relies on a discoidal core on a small concretion or massive flake, often with a cross-shaped flaking surface. These cores gave short and somewhat irregular blades or blade-flakes. The ceramic layer of Chokh yielded conical cores exploited with the pressure technique (?).

The blanks were the aforementioned fairly broad blades from conical cores as well as flakes from core preparation. Especially noteworthy is the use of these broad blades in the production of microliths that thereby came to differ clearly from microliths of the Zarzian and Mlefatian.

The more regular blades served as blanks in the production of microliths and of some of the "knives" and perforators. The less regular blades, which appear also to be slightly broader on average, were retouched on the sides (fine continuous retouch on one or both sides, ventral, denticulate, notched) and refashioned into endscrapers; prior sectioning of the blades is known to have been employed. The flakes likewise served to make endscrapers as well as denticulated tools and burins.

Raw Materials

Information is available only for Hallan Çemi and Chokh. In the former site the dominant raw material (up to 60%) was obsidian imported from Bingöl, some 100 kilometers away. It was used primarily to produce broad blades (which in their turn served mainly to produce microliths) from cores that were exploited on the site. In Chokh a non-local gray flint predominated over two local varieties. Here too it was used to produce blades (cores present on the site).

Retouched Tools (Figs. 1-4)

The structure of the retouched tools group is characterized by the sometimes high indices of microliths (more than 12% in Edzeni, in excess of 36% in Chokh, and also in Hallan Çemi and Belt?), which lends some of the known sites a definitely "Mesolithic" (*i.e.*, hunting) character. We have a different situation in Hotu where there was only one microlith among 169 retouched tools. Perhaps we have to do here with a division into base and satellite camps?

A. Endscrapers are usually fairly large (3-5cm), in most cases broad (1:1.5 width:length ratio), and slightly less often short (1:1). The former were made from broad (>2cm) blades and the more slender flakes, while the latter were exclusively on flakes. The dominant category are arched specimens, sometimes with a retouched side, and there are also short coin-like specimens.

B. There are two principal groups of retouched flakes: massive denticulated pieces and lateral sidescrapers, sometimes (Dam-Dam-Cheshme) with denticulated retouch.

C. Burins, if present, are on flakes more often than on blades (some specimens from Chokh), and are of the simplest kind, chiefly lateral single-blow and lateral dihedral.

D. Retouched truncations on blades, with straight or convex retouched edges, are rare (Chokh), but their miniature versions, described along with microliths, are known from Belt Cave, Çafer Hüyük and Nevalı Çori.

E. Three classes may be distinguished among the retouched blades which, in terms of numbers, are in assemblages second usually only to microliths: 1. less regular, fairly large and broad (15-20mm) with deep retouched notches on one or both sides (*pieces étranglées*); 2. similar pieces with discontinuous denticulated retouch; and 3. regular blades with continuous fine retouch on one or both sides, sometimes with retouch also on the ventral face.

F. Perforators, which are actually becs of various types, are rare, and it is hard to see them as a stylistic element shared by the entire industry. We have specimens on blades with distinct tips (Dam-Dam-Cheshme and Hotu), as well as ventrally retouched pieces (Hallan Çemi).

J. The presence of a single tanged point in Edzani is a complete surprise. The easiest explanation would be to consider it a trace of influences of the PPNB industries on the Trialetian, something that would be a logical consequence of the previously described joint occurrence of Trialetian and PPNB elements in eastern Turkey (Çafer Hüyük "ancien", Boy Tepe and perhaps also Nevalı Çori?). It may well be however that the piece is of much younger age (Chalcolithic).

K. Microliths are the Trialetian's most characteristic typological group. The specimens are nearly all forms larger than microlithic, usually more than 15mm long, made from fairly broad blades and formed by means of steep retouch.

In the group of backed pieces, which are usually large, the backed pieces and para-Gravettes are always accompanied by pen-knife points and long and narrow crescents, in most cases also by smaller but broader crescents. Another group comprises large elongated triangles which are in fact backed-and-truncated combinations (resembling specimens known from the Zarzian; the same goes for the previous backed pieces). These latter finds are accompanied by large isosceles triangles; large symmetrical and asymmetrical trapezes (which could perhaps be more adequately described as double retouched truncations in order to make them distinct from the small Mlefatian trapezes), sometimes with concave truncations; and also by small retouched truncations. As I have already suggested, the trapezes (double truncations), or at least some of their varieties (Belt, Chokh), could be elements indicating chronological and/or territorial differences within the Trialetian.

The mentioned peculiar feature of the Trialetian, namely the large dimensions of its microliths made from relatively broad blades, has Upper Palaeolithic connotations and good analogies in Zawi Chemi, for example, where the width of blades from the site's lower layers is similar (KOZŁOWSKI, this volume). However, in the uppermost layer of the Iraqi site there appear narrower blades, the result of a change in technology which north of the Zagros occurred much later.

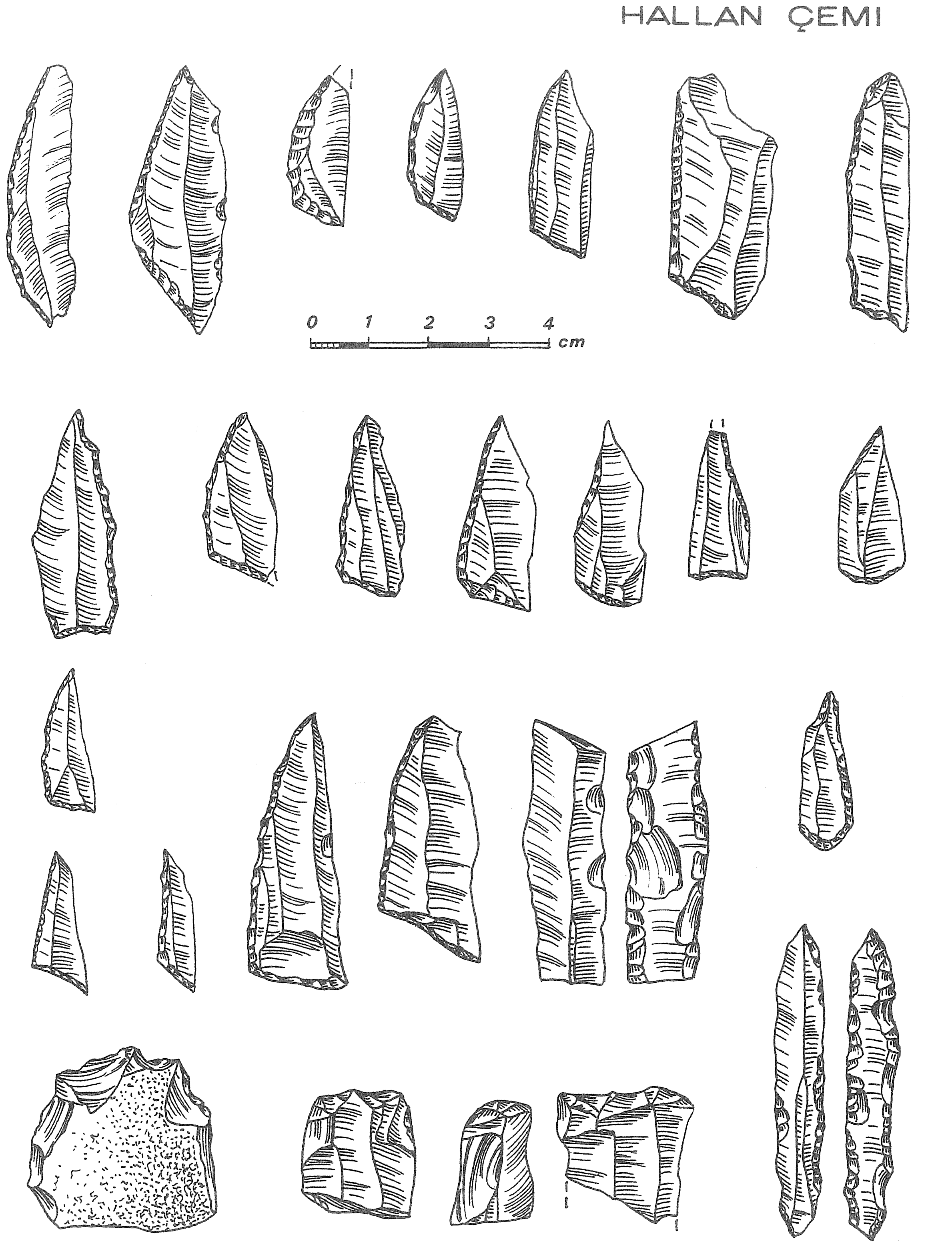

Fig. 1. Trialetian industry (according to M. Rosenberg).

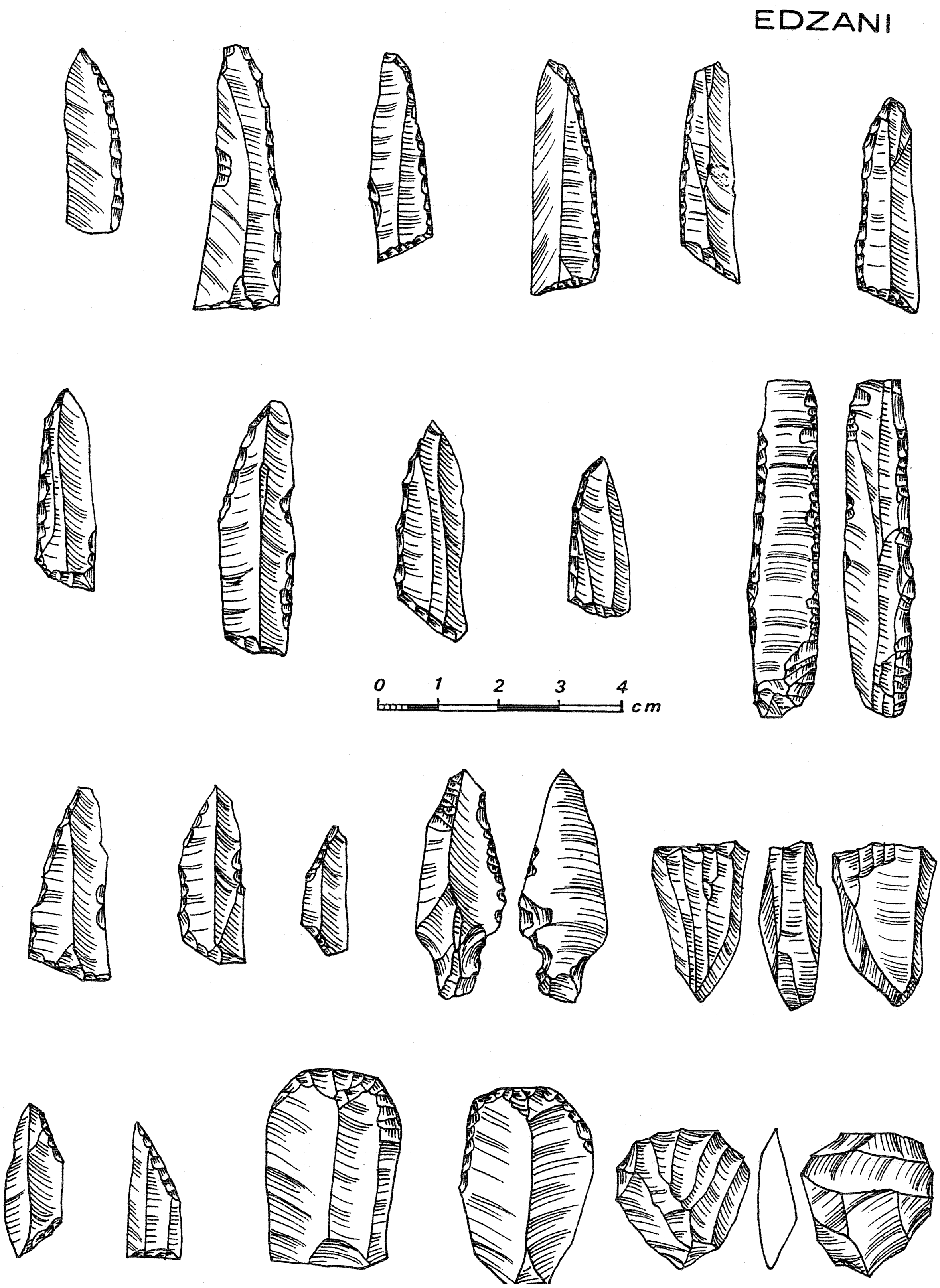

Fig. 2. Trialetian industry (according to N.O. Bader and L.D. Tsereteli).

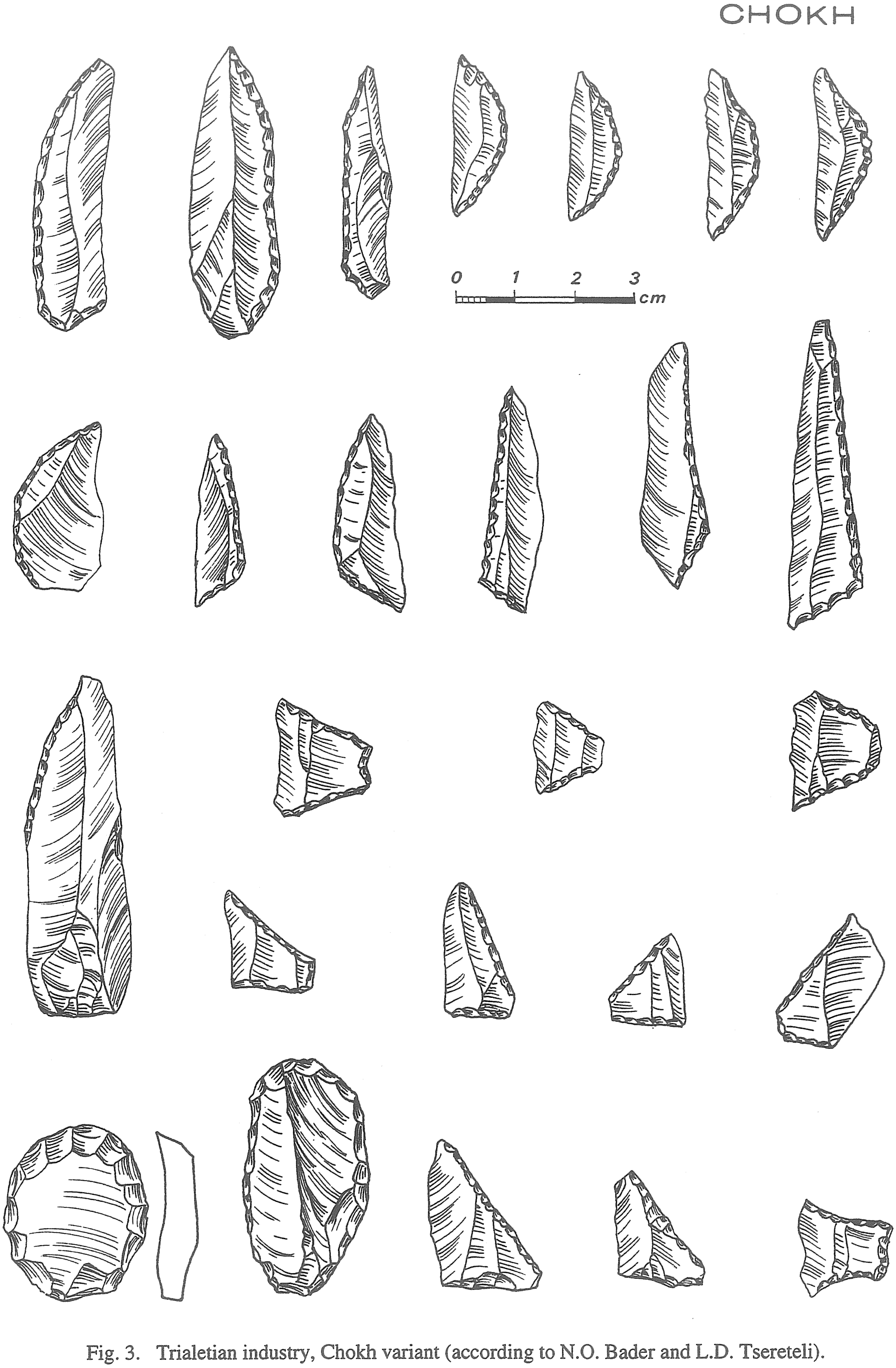

Fig. 3. Trialetian industry, Chokh variant (according to N.O. Bader and L.D. Tsereteli).

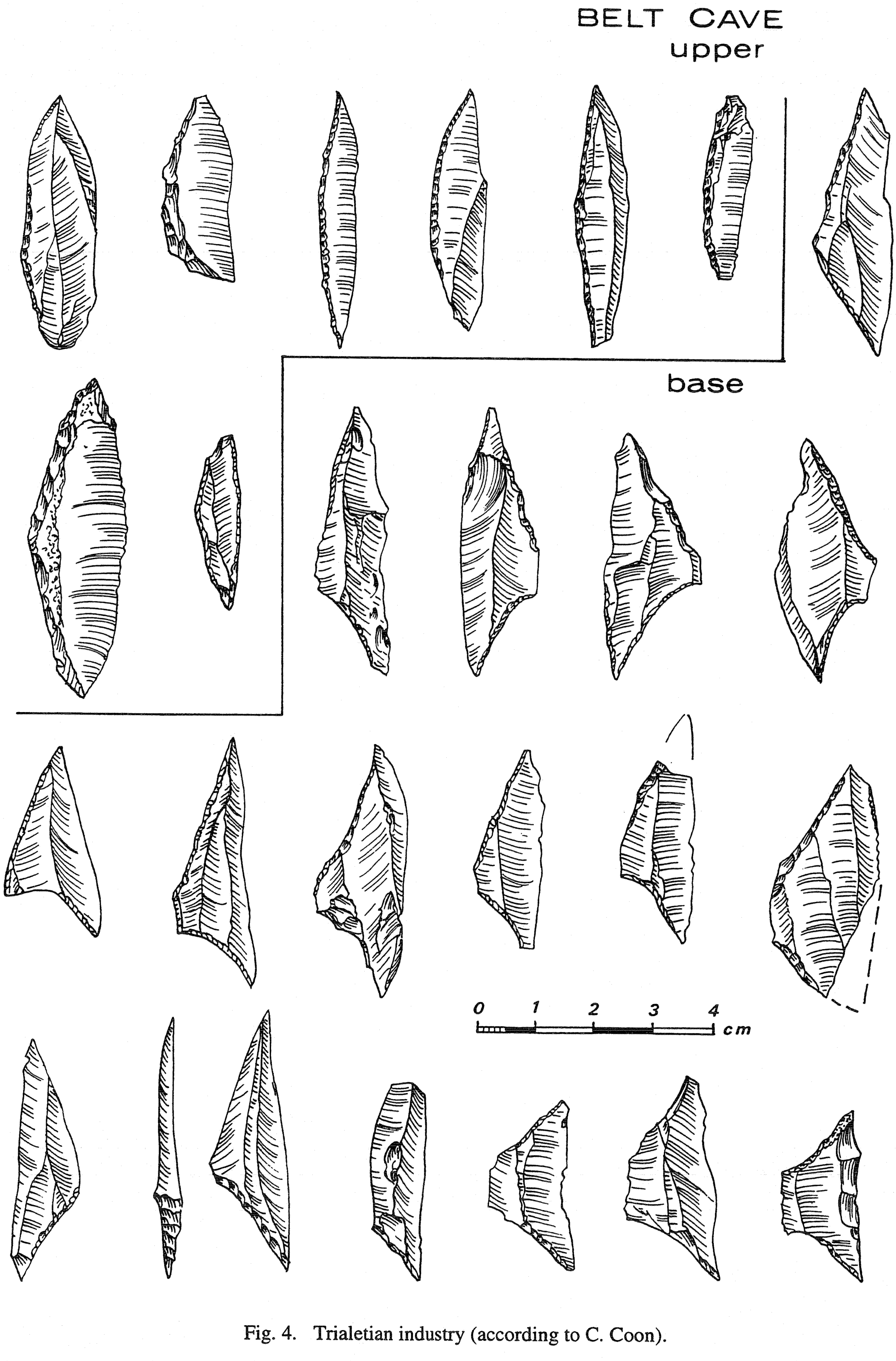

Fig. 4. Trialetian industry (according to C. Coon).

Conclusions

The characteristics given above are based on fragmentary published data and may thus be partly flawed, although this does not mean it is to be regarded as intrinsically uncertain. Details may be challenged and the presented characteristics supplemented or verified, but one must bear in mind that it is additionally supported by characteristics of the Imieretian and Black Sea industries, the northern neighbours of the Trialetian, and by my first-hand knowledge of materials of the Shan-Koba culture from the Crimea and northern slopes of the Caucasus.

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Epipalaeolithic Sites from NW Turkey

Ivan Gatsov

This paper is a preliminary presentation of the lithic assemblages from the Black Sea dune sites - Ağacli, Gümüşdere, Domali. The sites are located between 27 and 45km north-north-west and north from Istanbul on the Black Sea shore. The materials were collected by M. Özdoğan. The geological location of the region between the Black Sea and the Sea of Marmara is very important. However, the archaeological research is in an initial stage and a search for basic information on the prehistory of northwestern Turkey is still indispensable (GATSOV and ÖZDOĞAN 1994).

Ağacli: the collection from this site comprises 32 cores and 113 retouched tools. Some of the features of the artifacts such as technology, typology, state of preservation, dimensions can be regarded as a proof of their relative technical-typological and chronological homogeneity. Among the cores, 28 specimens are single-platform cores with rounded and semi-rounded flaking surfaces, usually with conical and semi-conical shape (Fig. 1:1-4). All specimens are in the final phase of exploitation; most of them are made from pebbles. It is possible to see a tendency towards correction of the core edge and also the presence of core preparation. The cores are for blades and bladelets.

Double platform cores include 7 specimen with lateral contiguous flaking surfaces and with separate flaking surfaces. Characteristic of this group of cores is that they have had single-platforms and were transformed into specimens with two platforms. The second platform is shaped on the end of the specimen and the exploitation is made by successive use of the two platforms. With changed orientation are two specimen: "90°-cores".

The group of retouched tools comprises end-scrapers, backed blades, blades with marginal retouch, retouched truncations, perforators, blades with notched retouch, fragments of retouched tools. Among the end-scrapers, specimens on flakes with rounded front and semi-circular specimens are predominant. Many of them are microlithic end-scrapers with dimensions up to 2cm or up to 3cm. The angle of the front is usually between 70°-90°. Backed blades are characterized by a straight or arched back with steep or semi-steep retouch. The group of retouched truncations includes specimens with oblique-straight and oblique-concave truncations. The blades with notched retouch and those with marginal retouch are blade fragments with notches or marginal retouching.

Gümüşdere: the collection includes 8 cores and 7 retouched tools. There are single-platform cores with conical (Fig. 1:5) and semi -conical shape. Some of the specimens are with changed orientation ("90°-cores"), and one is transformed from a double-platform core. The group of retouched tools is characterized by end-scrapers and single specimens of backed blades and segments.

Domali: the material under examination is represented by 5 cores: single-platform with semi-rounded striking surfaces (Fig. 1:6); double-platform core with conical shape and a core with changed orientation. The last specimen is made from a single-platform core. The second platform of this core is perpendicular to the earlier one. For the group of retouched tools (15 specimens) end-scrapers with rounded fronts, semi-circular specimens, and double end-scrapers on flakes are characteristic. There are also backed blades with straight and arched backs, a simple perforator on a blade, a blade with notched retouch and a retouched flake.

About the cores from these three site collections and for the core processing, the following observations can be made: the blades and bladelets and rarely flakes are removed from one striking surface and from one platform. In this case the specimens are used as single-platform cores. The double-platform cores and the specimens with changed orientation mostly result from the attempt to continue the exploitation. The second platform is shaped at the end of the specimen (double-platform core) or is perpendicular to the earlier one (core with changed orientation). Usually, the core platforms are formed by a single blow and they are very rarely prepared. Almost all of the cores are made from pebbles with 6-8cm length. The conical and semi conical shape can be linked with the final phase of

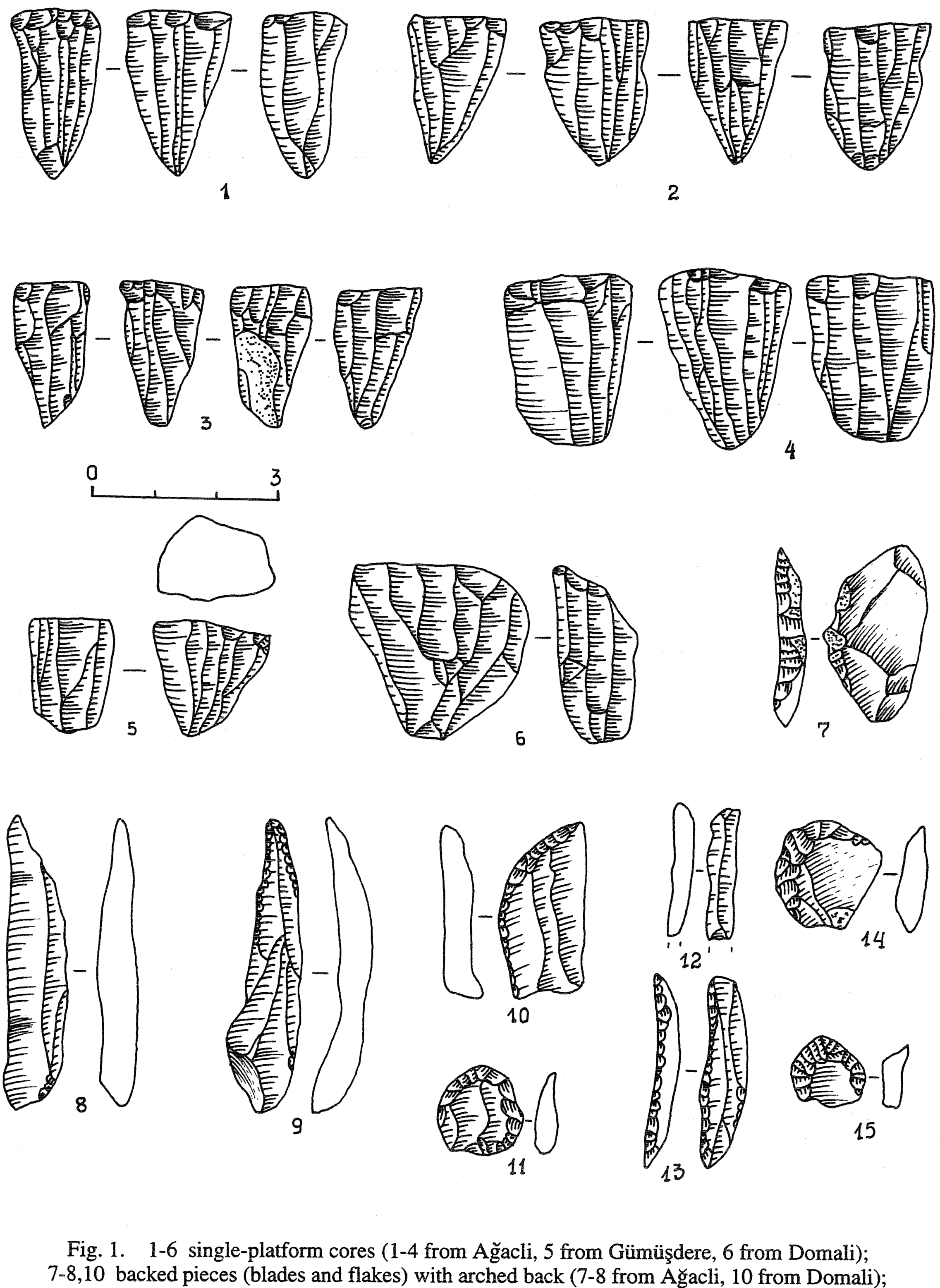

Fig. 1. 1-6 single-platform cores (1-4 from Ağacli, 5 from Gümüşdere, 6 from Domali); 7-8,10 backed pieces (blades and flakes) with arched back (7-8 from Ağacli, 10 from Domali); 9 simple perforator on blade (from Ağacli); 12-13 backed blades with straight back (from Ağacli); 11,14-15 small circular scrapers (from Ağacli).

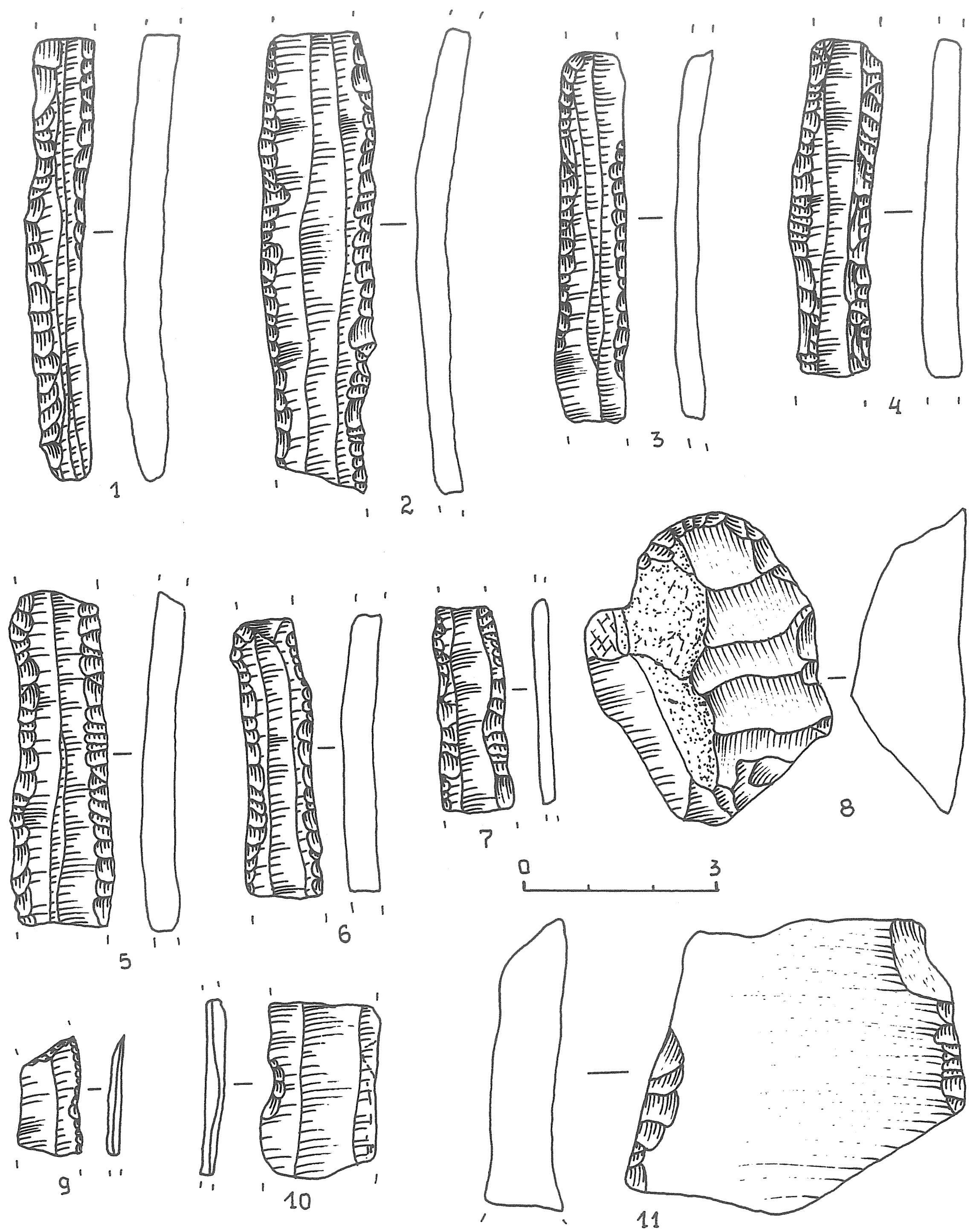

Fig. 2. 1-7 blades with high semi-steep retouch (1-3,5-6 from Azmak, 4,7 from Hoça Çeşme IV); 8 end-scraper (from Hoça Çeşme IV); 9 retouched truncation (from Hoça Çeşme IV); 10 blade with retouched notch (from Hoça Çeşme IV); 11 retouched flake (from Hoça Çeşme IV).

exploitation. Among the cores of this group there are specimens with traces of preparation.

The group of retouched tools is characterized by typological monotony: end-scrapers (Fig. 1:11,14-15), backed blades (Fig. 1:7-8,10,12-13), blades with marginal retouch and single specimens of simple perforators on blades (Fig. 1:9), blades with notched retouch, and segments. Among the end-scrapers the specimens with microdimensions predominate. The greater part of these tools have rounded fronts or semi-circular ends. For backed blades the presence of tools with straight and arched backs is typical. The length is usually between 2,5cm and 4,5cm. The semi-steep and steep retouch is done prior to breaking.

These are the basic characteristic features of the presented group of cores and retouched tools in the assemblages from Ağacli, Gümüşdere, and Domali. At this stage of research the stress should be put on the differences between the above mentioned collections and the materials from Dikilitash on the northern Bulgarian Black Sea coast. For the materials from Dikilitash, parallels in technique and typology can be found at sites such as Vlasac and Quina Turcului. They are related to the Epi-Tardi-Gravettian tradition in the Iron Gates region of the Danube. The core processing is characterized by cores with changed orientation with three or more flaking faces, "plate" cores, and discoidal cores (KOZŁOWSKI and KOZŁOWSKI 1982, GATSOV 1993).

At the present stage of the investigations it can be stressed also that there exists a technological gap not only in relation to the Epipalaeolithic collections from north-east Bulgaria but also to the Thracian Neolithic sites Hoça Çeşme -IV (Fig. 2:4,7-11), Azmak (Fig. 2:1-3,5-6), and Karanovo I. All the materials from these sites are under study but now it can be said that there is no doubt that a technological gap has also existed. For these sites one of the common elements is the presence of macroblades with high semi-steep undulating retouch (Fig. 2:1-7).

During the last 25 years, until now, the most intensive investigations have been carried out in the region of the Crimean Peninsula to the river Prut (CHERNYSH 1973, STANKO 1983). The recent research of V. Koen (1991) assigned the appearance of conical and semi-conical cores together with backed blades and rounded end-scrapers on flakes to the end of the Pleistocene and the beginning of the Holocene. These elements are typical for the above mentioned collections from the Turkish Black Sea region. This way the materials from Ağacli, Gümüşdere, and Domali can be regarded as the evidence for the existence of local Epipalaeolithic assemblages in this area at the transition from the Pleistocene to the Holocene.

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From Zawi Chemi to M'lefaat

Stefan Karol Kozłowski

Abstract: *The author suggests that a direct evolution from the (Post-) Zarzian (Zawi Chemi) industry to the Mlefatian "Neolithic" industry (M'lefaat) is proved not only by typological affinities (microliths) but also by evolutionary trends observed in the groups of microliths, and blades in the period of 9th-8th millennium bc. These gradual changes could be observed in the local western Zagros sequence, composed of multi-layer site of Zawi Chemi (9th millennium bc) and the site of M'lefaat (7850-7650 bc).*

Introduction

For some time now there have been discussions in the literature centering around the transition from Epipalaeolithic industries of the Zagros to local Neolithic industries (OLSZEWSKI 1994, and this volume). Discernible stylistic similarities between the Epipalaeolithic Zarzian and the Neolithic Mlefatian are emphasized without concealing the important differences that relate mainly to core exploitation techniques as well as dimensions and morphology of some retouched tools. Also stressed (HOLE 1987, 1994) is the considerable distance in time between the two industries (2,000-3,000 years).

Zarzian *versus* Mlefatian

Some features of the Zagros Epipalaeolithic make it similar to the local Neolithic. The similarities are evident in material culture and also in economy and the way of utilizing the surrounding territory.

As regards territory, both industries appear to have similar geographic ranges, at least in places where this can be determined objectively, *e.g.*, in the Zagros mountains (OLSZEWSKI 1993, KOZŁOWSKI 1994). In the north neither the Zarzian and the Mlefatian extend beyond the principal mountain ridge, and sites occur in valleys lying between mountain chains. The Zarzian, unlike the Mlefatian, is unknown in the Mesopotamian lowlands, possibly due to burial of older sites beneath younger sediments; more on this will be said below when discussing the sites in Jezira.

Chronologically, the Zarzian and Mlefatian form a sequence, with the latter coming after the former. The problem is the considerable time gap between the youngest Zarzian and oldest Mlefatian assemblages. It is in this gap that we should seek the "missing link" that connects the two industries chronologically, and which would be typologically and technologically similar to them both.

Similarities are also in evidence in the hunting-based economy. Depending on the given ecological niche, the hunters went after wild goats and sheep or gazelles and deer. It was only much later, in the 7th millennium bc, that sheep and goats became locally domesticated in the Mlefatian.

Although the Zarzian is a "cave" industry, there are also open-air sites containing it (*e.g.*, Turkaka). Likewise, although the Mlefatian is mainly a "tell" industry, it also found its way into caves (MORTENSEN 1974). The similarities in flint tool morphology in both industries are considerable but not all of them are equally significant. However, the differences in the way of occupying territory in the case of the two industries are more profound than the similarities.

Noteworthy in the first place are similarities among microliths and points, and particularly among backed bladelets/backed points, backs + truncations and, lastly, crescents. The differences, where there are any, concern primarily the dimensions of specimens, which are on average larger in the Zarzian, and some secondary features, such as the presence of an oblique retouched base in the Mlefatian. Secondly, there are some tool types known only in one of the industries, *e.g.* the *pointes á cran* and isoscele triangles in the Zarzian *versus* diagonal points and nibbled bladelets in the Mlefatian.

The remaining similarities, such as the short endscrapers, appear to be banal and unable to offset the plentiful significant differences between the two industries: core formation/exploitation techniques; blade dimensions; different morphology of some of the endscrapers, sidescrapers and burins; and the absence of some tool groups in one of the industries.

The described similarities might suggest possible genetic ties between the younger Mlefatian and the older Zarzian. However, this theory will not stand unless we discover and study the "missing link" between the two industries.

The "Missing Link"

The time gap between the youngest Zarzian and oldest Mlefatian assemblages is illusory, however, since we know fairly well-dated sites from northern Iraq which fall in it, namely Zawi Chemi and Shanidar Cave (Layers $B_1$and A). These are both dated to the 9th millennium bc.

The two assemblages are described in the literature as "Protoneolithic," because of the presence of a ground stone industry and traces of sedentarism (dwelling structures, cemetery). In the past there was also talk of early cases of animal husbandry, but this is no longer being mentioned. Stylistically, their flint industry resembles the Zarzian tradition, something that Ralph Solecki (1963) clearly emphasized, but this does not mean that we are dealing here with the typical Zarzian. Rather, it is a mutation thereof, a fact stressed by Frank Hole (personal communication), among others. Given this, it seems appropriate to label the Zawi Chemi industry as Post-Zarzian, a name that underscores its indisputable ties to the Zarzian but at the same time acknowledges the differences, mainly as regards the dimensions of finds and chronology.

To conclude, the "transitory" chronological position of the Zawi Chemi and Shanidar sites is indicated by the Post-Zarzian character of their industry and the presence of Protoneolithic elements that later occur in the "Neolithic" (actually Protoneolithic) early Mlefatian (*e.g.*, at M'lefaat and Asiab).

Both sites are thus ideally suited to serve as the "missing link" between the Zarzian and the Mlefatian. It now remains to analyze selected features of industries from Zawi Chemi Shanidar and M'lefaat in order to test the validity of the "missing link" hypothesis and thereby determine whether the Mlefatian actually stems from the Zarzian. Such an analysis is presented below.

Sites

Zawi Chemi Shanidar

This multilayer open-air site on an extensive terrace was explored in 1958 and 1960 (SOLECKI 1980). Its profile, more than two meters high, consists mostly of a brown sediment, apparently of aeolian origin, and features a sequence of cultural horizons (from 215 to 50cm in depth) marked by concentrations of materials as well as remains of charcoal or ash and architecture. The 120cm- horizon provided a radiocarbon date of 8920 ± 300 years bc (W-1681).

The material from "Cut II," explored in 1960, is representative for the site. The entire sediment from this excavation was sieved and positions of artifacts recorded in 2x2m squares and arbitrary horizontal layers, 25cm thick (50-75cm, 75-100cm, etc.). The Zawi Chemi flint industry[1], described in detail by Rose Solecki, is characterized, among other things, by the small, considerably diversified cores in very advanced stages of use. Among them are conical, subconical and carenoid cores (all for blades and bladelets) exploited by the indirect percussion method, but there are also multiplatform/nodular and discoidal forms. Alongside them were fairly large and wide ("Upper Palaeolithic") blades, with undulating edges, struck off with the soft hammerstone or indirect percussion method.

Dominant among the retouched tools are various denticulated and notched forms. The former are mostly on blades, while the latter are usually retouched flakes; there are also fairly atypical sidescrapers and infrequent high endscrapers with denticulated fronts. There are only a few perforators on blades, some short burins, many splintered pieces, and finally microliths. There are three main classes of the latter: backed bladelets/points, backed-and-truncated pieces, and crescents, all of them exceptionally small.

The above collective description of the Zawi Chemi industry is justified, given its considerable morphological homogeneity throughout the sequence. However, no such homogeneity is observed in some of the statistical and metrical indices of microliths and blades.

Microliths (Fig. 1)

The Washington collection includes 168 specimens recovered from depths ranging from 215 to

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[1] Half of the excavated collection (but all microliths), numbering many thousand flint artifacts and several dozen groundstone items, is kept at the Museum of Natural History at the Smithsonian Institution in Washington, DC. All of the finds are labeled and their original position recorded. Rose Solecki and Dennis Stanford (Chair of the Department of Anthropology) kindly gave me permission to examine the collection in early 1995.

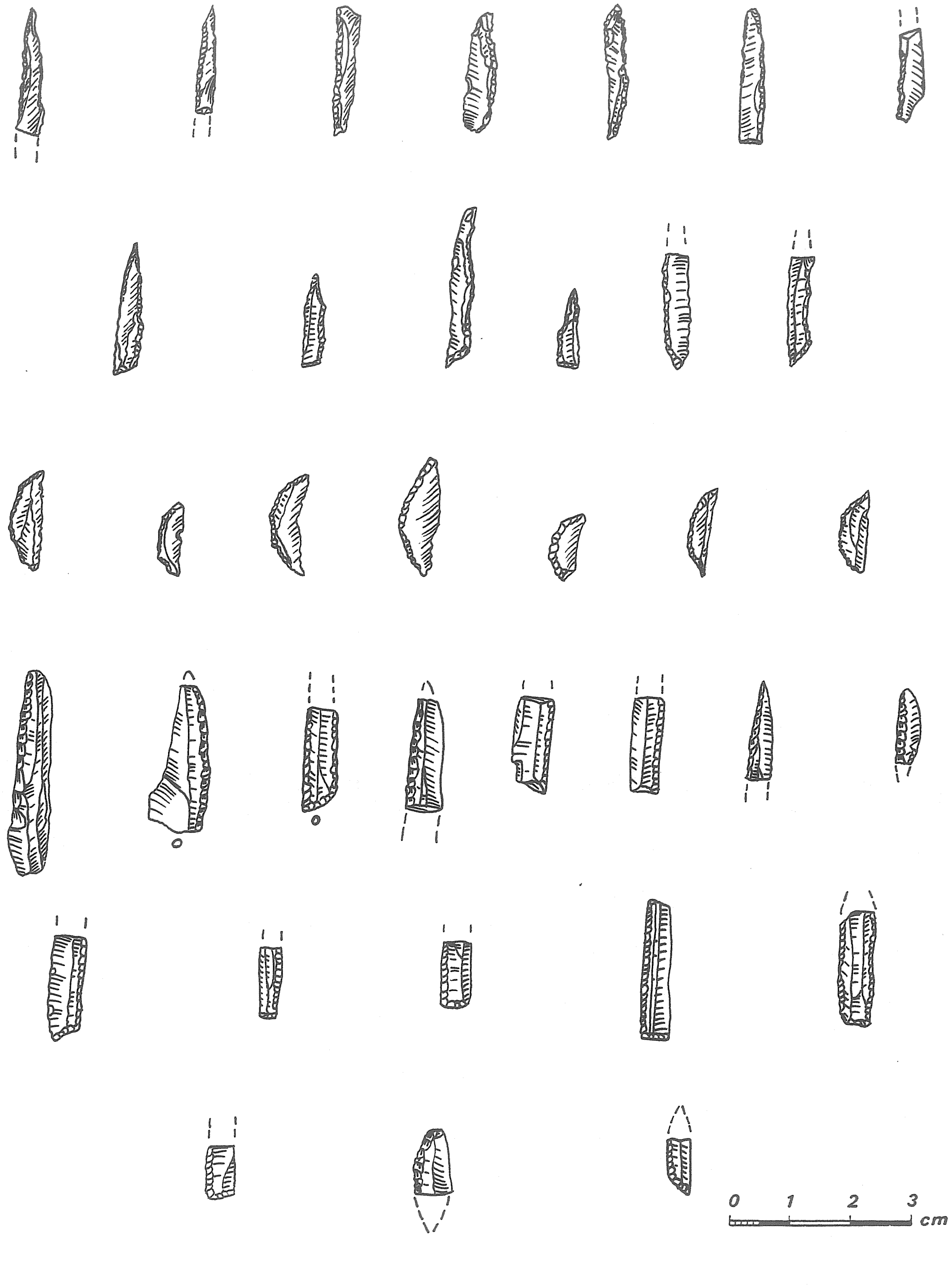

Fig. 1. Microliths from Zawi Chemi -top three rows- and M'lefaat (after Rose Solecki and the author).

50cm. They were thus present in seven successive exploration levels that revealed a constant loess deposition interstratified by several levels of settlement. The fairly numerous series from levels 125-100 and 100-75 have considerable statistical significance, whereas less valuable in this respect (because of sample size) are the series recovered from Levels 150-125 and 75-50 (nine and 19 specimens respectively).

If we sort the microliths into backed pieces, backed-and-truncated pieces and crescents, it turns out that the indices of these various classes are different for the different levels (Fig. 2), and that the differentiation increases steadily throughout the sequence. Two of the groups (backed pieces and crescents) appear to complement each other: if one index is high, the other is correspondingly lower, and vice versa. Barring the unlikely possibility of a statistical error, it would seem that there was in Zawi Chemi a tendency to replace crescents with backed pieces over time, eventually leading to a situation when the latter outnumbered the former 15 to one. In the next stage of this evolution process the crescents ought to be of course entirely eliminated in favor of the ever more numerous backs.

Blades

All available specimens from the succession of five exploration levels (200-150cm, 150-125cm, 125-100cm, 100-75cm, 75-50cm) were studied. The maximum widths of the specimens were measured to determine possible metrical changes that could have resulted from modifications in core formation techniques over the long period of occupation. The lowest level failed to provide a useful set of data, whereas data from the next three levels (150-75cm) were practically identical: the widths of blades ranged from 10 to 27mm, with maxima in the 11-15mm range. The topmost level (75-50cm) came as a complete surprise, with blade widths there ranging from 6 to 16mm and dominating numbers of specimens in the 8-11mm range (Fig. 3).

We thus have here another change in the Zawi Chemi industry: towards the end of the sequence the blade widths decreased significantly, as if announcing the future emergence of bladelets in the local early Neolithic.

Ground Stone Industry

The flint material in Zawi Chemi was accompanied by a rich groundstone industry which, together with the suspected sheep/goat husbandry on the site, prompted the Soleckis to include it in the Protoneolithic. The groundstone material occurs in several horizons (from 150 to 50cm) and is relatively homogeneous, albeit not without exceptions. Dominant among the finds are oval and circular mullers, sometimes with small depressions in the central parts, and these are accompanied by bolas (lower levels) and querns, pestles and "bread plates" (upper levels). This distribution of finds may perhaps be indicative of an increasing intensity of "village" activities that were gradually replacing hunting. Further evidence of such an evolution could be the presence of partially polished axes in the highest level. However, I failed to find a true axe in the Washington collection, although I examined most of the finds classified by Rose Solecki as such. The ground stone industry from Zawi Chemi perfectly matches the Early Neolithic Iraqi standard (MAZUROWSKI in press), represented in the region by Nemrik, M'lefaat and Jarmo, among others. What Zawi Chemi lacks, however, are the other elements of the PPN standard: the tokens, clay figurines and stone vessels.

It was at one time suggested that sheep and goat were raised on the site (PERKINS 1964), especially in its later phase (100-50cm). Today we have different explanations of the excessively large numbers of young individuals. The dominant sheep/goat are always accompanied by red deer, with the latter loosing its significance towards the top of the sequence.

Separate mention is due to a bone sickle/knife handle whose stratigraphic position is unknown to me. It has a fairly good analogy in Layer B_1 of Shanidar Cave, but even a better one in the early ceramic site Shimshara (MORTENSEN 1970).

To conclude, I would like to repeat that the Zawi Chemi site is of multilayer character, that its entire chipped industry represents the Zarzian tradition in a Post-Zarzian version that displays a number of morphological similarities (microliths) to the Mlefatian, that the sequence there dates to the 9th millennium bc, and that, finally, the indices of microliths and blade dimensions vary in the sequence, making the industry of the youngest layer (50-75cm) similar to the earliest Mlefatian assemblages.

Shanidar Cave

Layer B_1 of this cave, which was explored by Ralph S. Solecki (1963), yielded an assemblage of flint artifacts that were morphologically and technologically identical to those of the Zawi Chemi industry; the collection from Layer B_1, regrettably, remains only partly published. These artifacts were accompanied by a ground stone industry which is also similar to that from Zawi Chemi. The assemblage was dated to 8650 ± 300 bc (W-667), and Solecki classified it as belonging to the Zarzian.

The archaeological relics are accompanied by bones of goat (57.1%) and sheep (42.9%), with high percentages of immature animals (42.9 and 57.9% respectively). No red deer bones were in evidence. Solecki also claimed that the as yet unpublished material from the bottom of Layer A is identical to the Zawi Chemi assemblage.

What is significant from the ^{14}C date and the fact that the dated B_1 layer is overlain by Layer A with identical material in its bottom part is the implication that the Zarzian tradition survived at least until the middle (into the second half?) of the 9th millennium bc.

Tell Der Hall

This site was explored in 1983-1984 by H. Fuji (OHNUMA and MATSUMOTO 1988). It is an open-air site in the Tigris Valley, lying some six meters above the level of this river and about 266m above sea level. The archaeological material lies in a loess-like aeolian deposit (layer 6) in the 50-150cm layer. This suggests that, as at Zawi Chemi, we have here a multilayer site, something that was in fact noted by Fuji, who distinguished Layers 6a and 6b.

The small collection of flint artifacts excellently conforms to the Post-Zarzian standard known from Zawi Chemi (subconical and double-platform cores; indirect percussion technique; shape and large dimensions of blades; denticulated retouch, mainly along blade sides; side-scrapers, denticulates, retouched flakes, burins, perforators, splintered pieces and crescents). There was also a partially polished axe.

The finds also included animal bones, dominant among which were remains of sheep and goat (*c.* 45%). These were accompanied by bones of hare, cat, horse, wild boar, aurochs and red deer (the latter accounting for 12% of the bone assemblage).

Tell Der Hall is evidence of the existence of the Post-Zarzian in the Jezira area, *i.e.*, outside the mountain region. This could suggest that there may have been a local basis for the development of the later-day local Early Neolithic industries, and that there was no need for them to "descend from the mountains". The site lies close to Nemrik, with its Nemrikian industry related to the Mlefatian and dated from *c.* 8250 bc. Tell der Hall must thus be older than this, *i.e.*, contemporaneous with Zawi Chemi.

M'lefaat

The site was explored with sounding trenches by R. Braidwood in 1954. The work was continued by Metti Baba Altun, and finally the site was studied in 1989-1990 by the present author.

Two settlement layers, radiocarbon dated to 7850-7650 bc, yielded a Mlefatian industry accompanied by a rich local-style ground stone industry very similar to the ground stone industry from Zawi Chemi (querns, bolas, pestles and oval mullers but also fully polished celts, maceheads and mortars), as well as other products combining to form the local PPN standard (clay figurines, tokens, stone vessels). All this was discovered in a typical village consisting of circular clay houses inhabited by hunters (mainly gazelle), gatherers (wild barley) and fishermen (presence of fish bones).

The flint industry, designated the Mlefatian (KOZŁOWSKI 1994) after the name of the site, is typical for the Early Neolithic of Iraq and Iran (Jarmo, Ali-Kosh, Guran, Ganj Dareh, etc.) where it replaced the Zarzian/Post-Zarzian in the Early Holocene.

The characteristic features of the industry in M'lefaat include (KOZŁOWSKI 1994):

1. Backed bladelets (Fig. 1)
2. Backed-and-truncated pieces (Fig. 1)
3. Crescents (?) (Fig. 1)
4. Retouched flakes
5. Endscrapers on blades and flakes
6. Perforators
7. Conical and subconical cores
8. Pressure technique
9. Regular bladelets
10. Retouched blades
11. Backed bladelets with oblique base
12. Diagonal microliths
13. Nibbled bladelets
14. Rare Khiam points

The first five or six of these artifact classes, known well from Zawi Chemi, are part of the typological canon of the Zarzian tradition. They are always present in M'lefaat and the Mlefatian without any significant qualitative changes. However, the next features (8-19) distinguish our site and all of the Mlefatian from the Zarzian/Post-Zarzian, and this is mainly because of the radically different core formation/exploitation techniques in the two industries: the indirect percussion in the Post-Zarzian, and the pressure technique in the Mlefatian. It goes without saying that the shape of blades/bladelets in M'lefaat is different, and this situation results in the presence in the site of regular retouched blades (Class 10). The flint knappers of M'lefaat and the Mlefatian also took greater care to give diverse shapes to the bases of backed bladelets, which resulted in the appearance of specimens belonging to Classes 11-12; in fact, these were only developments of ideas known earlier from the Zarzian/Post-Zarzian (backed-and-truncated pieces). In addition to differences in morphology (one must also mention here the absence in M'lefaat of burins), we also have an obvious trend towards miniaturiza-

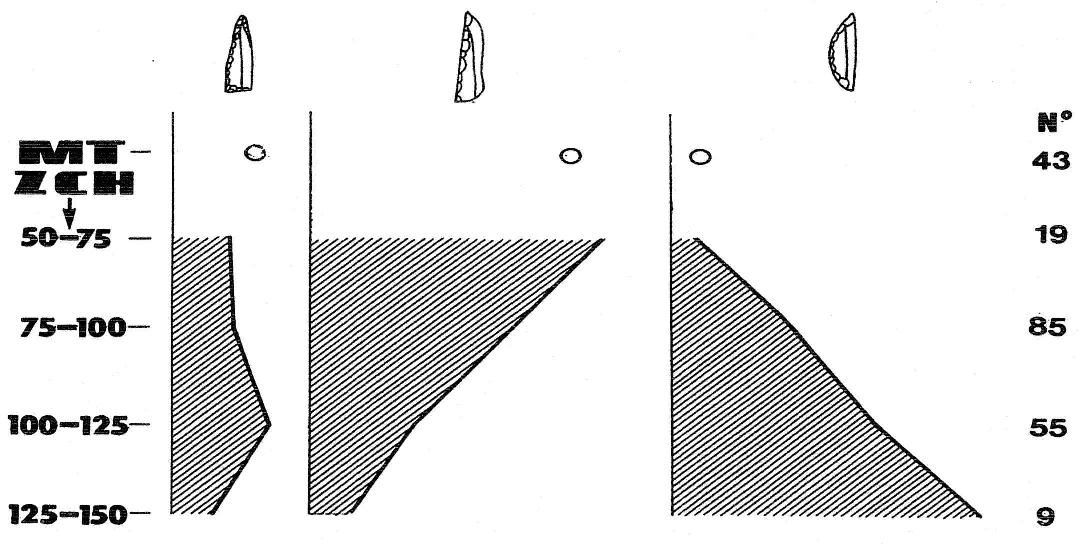

Fig. 2. Statistical indices of microliths from Zawi Chemi (stratified) and M'lefaat (from collections at Washington, D.C., Rose Solecki, and the author's excavations at M'lefaat).

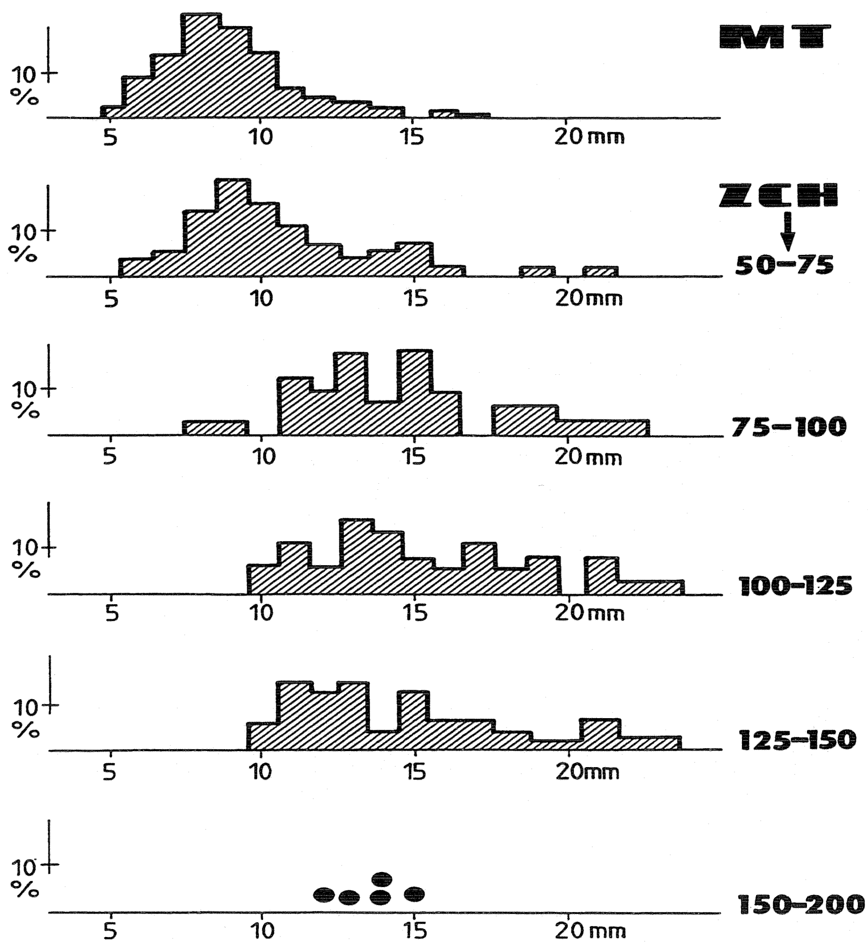

Fig. 3. Width of blades in Zawi Chemi (stratified) and M'lefaat (from collections of Rose Solecki, and the author's excavations at M'lefaat).

tion in the new flint industry. This trend is particularly evident among blades whose widths range from 5 to 18mm, with a domination of values from 7 to 11 millennium (Fig. 3).

Unless we are mistaken, the Mlefatian is a Holocene mutation of the Zarzian/Post-Zarzian, modified through the introduction of a new core exploitation technique and, consequently, miniaturization of products. The initial industry, at least in northern Iraq, is the industry from Zawi Chemi, Shanidar B_1, and Tell Der Hall.

Other Epipalaeolithic/Protoneolithic Sites in Jezira

The Protoneolithic sites described above (Post-Zarzian) are all in the mountains or in places where the mountains meet the steppe (Tell der Hall); also the known Zarzian sites occur in the Zagros. What I would like to recall is that the Epipalaeolithic/Protoneolithic phenomenon in the region is not limited to mountain regions alone, but it also occurs in open plains, as evidenced by discoveries in Qermez Dere (BETTS 1994) and work in the Khabur Valley (HOLE 1994). This does not necessarily mean, however, that there too we have the Zarzian/Post-Zarzian, but it may suggest that the confinement of the Zarzian and Post-Zarzian to mountain areas and the adjacent steppe is due to the geological structure of the region (the burial of older sites, especially in Mesopotamia proper) rather than to prehistoric reality.

From Zarzian to Mlefatian

The described sites, grouped in a single small area some dozen kilometers across, justify a number of observations:

1. It appears that the local cultural sequence consists of two successive phases: the Post-Zarzian and the Mlefatian.
2. Both phases of this sequence occur both in the mountains and on the Mesopotamian Plain.
3. Both taxonomic units share a number of similar morphological features. It seems that the most important (because the most distinctive) of these are the microliths (backed-and-truncated, backed bladelets/points, crescents). Also important are perforators and retouched flakes.
4. The relationships between the Mlefatian and the Post-Zarzian are further amplified by similarities in the ground stone industries accompanying them, especially in grinding stones, pestles, mullers, bolas and also the partly polished axes (*e.g.*, Karim Shahir)[1].
5. The internal evolution of the Post-Zarzian, consisting among other things of the gradual elimination of crescents in favor of backed bladelets and, in the last phase of Zawi Chemi, reduction in the size of blades. It appears to evolve in the direction of the Mlefatian industry standard in which the blades are narrower and the crescents unimportant or not present at all (Figs. 2-3).
6. The differences between the Mlefatian and the Post-Zarzian are not due exclusively to the internal evolution of the latter, however. A factor here is also the new core formation/exploitation technique, namely the pressure technique which leads to regular cores and hence to a regularity of tools made from them. One result of this is the disappearance of blades with denticulated retouch, which are replaced with bladelets with regular retouch of edges.
7. This change, at least as far as northern Iraq goes, most probably took place simultaneously in various ecological zones, that is in the mountains and on the plain. The theory that Mesopotamia was colonized by migrants from the mountains as late as in the Early Neolithic is entirely groundless.
8. It is quite likely that the local evolution seen in northern Iraq reflects a process also taking place further eastwards, in the entire area where the Zarzian and the Mlefatian that subsequently replaced it are observed.
9. All this is in good agreement with the logic of stylistic changes taking place at the turn of the Pleistocene and Holocene, also evident in the Levant, for example.

Chronology

The question now arises: At what point in time did there occur the technological breakthrough that triggered the transformation of the Post-Zarzian into the Mlefatian? In view of the available radiocarbon dates, assuming that the evolution was unidirectional, the answer to this question is as follows:

1. The youngest known date comes from Shanidar, Layer B_1 (8650 ± 300 bc). The B_1 is followed by the Post-Zarzian Layer A.
2. The date from the 120cm layer in Zawi Chemi (8920 ± 300 bc) was overlain by 70cm of layers

[1] I do not discuss the inventory of Karim Shahir, interpreted in the literature as a very early industry. The inventory does not appear to be homogeneous, and as such is outside the scope of this study.

containing Post-Zarzian materials. The pollen diagram published by A. Leroi-Gourhan (1980) does not show any significant environment changes in horizons from 120 to 90cm, which means that they, like the 192cm horizon, must be dated to the Younger Dryas, *i.e.*, to the 9th millennium bc.

3. In Nemrik the pressure technique and some Mlefatian microliths are present from the very beginning of the Nemrikian industry, that is to say from about 8250/8200 years bc, if radiocarbon dates can be trusted. The Nemrikian is closely related to the Mlefatian and in all likelihood underwent similar development.

4. In M'lefaat, the Mlefatian industry with the pressure technique appears around 7850 bc.

5. If we accept all the quoted dates as reliable (and there are no reasons to believe otherwise), they can be arranged in a chronological sequence from which it appears that the new technique, and hence the new industry - the Mlefatian - could have appeared in northern Iraq in the second half of the 9th millennium bc, most probably prior to (or near) 8250/8000 bc (dates from Nemrik).

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The Lithic Transition to the Early Neolithic in the Zagros Region: Zarzian and M'lefatian Industries

Deborah I. Olszewski

Abstract: *One of the most difficult tasks of lithic analysis is determination of a link or "transition" between the chipped stone industries of archaeological "cultures" that are adequately described for only a handful of sites in the temporal periods in question. This is one problematic caveat that currently cannot be resolved for the Zagros region. Bearing that in mind, however, I concentrate on a comparison of the Zarzian assemblages from the upper unit at the site of Warwasi Rockshelter (with added observations from the studies done at the site of Zarzi), to the M'lefatian industry as it is known from the research at M'lefaat (with added observations from several other proto-Neolithic sites). The typological similarity between the Zarzian and M'lefatian, particularly in some aspects of the microlithic component, is striking and intriguing given that some 3000 radiocarbon years separate the latest Zarzian and the M'lefatian. Naturally, some aspects of comparison, such as the percentage of a tool assemblage that is microlithic, can be highly variable, not only between sites of the same industry, but also between those of two chronologically separate industries. Those types of comparisons are likely to pertain to the activities conducted at sites. Although some aspects of the Zarzian and M'lefatian are similar, the industries certainly are not identical. The most striking dissimilarity is technological and readily can be seen in the appearance of standardized, parallel blade cores, that reach their apogee in later Neolithic contexts as "bullet" cores. Ultimately, of course, we need to move beyond simply describing the "transition" from one type of chipped stone industry to another. Our anthropological goal in recording and describing such changes is to provide a foundation for assessing prehistoric strategies. As with any preliminary endeavor, I hope that this contribution will serve as a building block of that foundation, as access to basic data for both ourselves and for future archaeologists, particularly since it has been relatively difficult in recent years to complete new archaeological excavations in the Zagros region of southwestern Asia.*

Introduction

One of the most notable advantages of the archaeological record is its time depth. Researchers can focus not only on the study of particular moments in time, for example, the "Zarzian" or the "M'lefatian," but also on the changes occurring over time that ultimately reflect the transition from one type of archaeological industry to another. If a data base is relatively adequate, then the processes, be they economic, social, technological or functional, that are responsible for those changes can be identified and studied within the framework of cultural evolution. While this latter step in inter-pretation is a goal shared by most modern archaeologists, it is one that is not easily realized, because there are a variety of circumstances that result in a less than perfect recovery of the necessary data.

This paper compares and contrasts the Epipaleolithic "Zarzian" and the early Neolithic "M'lefatian" traditions of the Zagros. Both traditions are known from a number of sites. There are, however, several problematic issues. First, only two sites from the Zarzian (Warwasi and Zarzi) and one site from the M'lefatian (M'lefaat) have been described in any detail[1]. This is an exceedingly small sample on which to base a discussion of the two traditions, and especially an analysis of the "transition" between them. Second, none of the reported sites has a sequence with assemblages from both traditions. Thus, one is forced to compare assemblages not only over time, but also from different geographical areas within the Zagros region. Third, neither Zarzi nor Warwasi yielded samples for radiocarbon

[1] Hildebrand (this volume) contributes detailed core technological information from Pa Sangar, Karim Shahir, Tepe Asiab, and Ali Kosh, a sequence spanning the transition from the Zarzian to the later Neolithic in the Zagros.

dates; the terminus date for the Zarzian tradition comes from the site of Palegawra (TURNBULL and REED 1974: 84), where the chipped stone assemblage has never been described in detail, although the presence of a variety of geometric microliths there makes it likely that Palegawra corresponds to the latest Zarzian unit (d4) at Warwasi (OLSZEWSKI 1993b: 222). Fourth, there is an apparent gap of some 3000 radiocarbon years separating the two traditions (HOLE 1994: 105). Finally, Zarzian assemblages have been almost exclusively recovered from rockshelter or cave sites, while those of the M'lefatian are from open-air sites. These are quite different contexts that potentially could heavily influence the types of assemblages present.

The Zarzian Tradition

The Zarzian industry was first described by Dorothy Garrod, based on her ten days of excavation in 1928 at the cave of Zarzi in northern Iraq (GARROD 1930: 10). At that time, Garrod noted the similarities of the materials from Zarzi to those of the last phase of the Upper Paleolithic, then termed an "Upper Aurignacian industry of a Grimaldian type" (GARROD 1930: 40-41). Subsequent work both in the Levantine Middle East by Garrod, and by a variety of workers in Europe, led to considerable refinement in the definitions of various late Pleistocene chipped stone assemblages, and to the attribution of the Zarzian to the Epipaleolithic period.

To Garrod, the most striking typological features of the Zarzi assemblage were its "Gravette" points, angle burins, thumbnail scrapers, shouldered point, and numerous deeply notched blades (GARROD 1930: 22). Given excavation methodologies and conditions during the 1920's, it is probable that Garrod recovered only a small portion of the microlithic component at Zarzi (various nongeometric and geometric forms). The microlithic nature of the Zarzian industry probably would have struck her more forcibly otherwise.

Since Garrod's work at Zarzi, there have been a number of expeditions to the Zagros region that have recorded the presence of Zarzian components at about a dozen sites (BRAIDWOOD and HOWE 1960; BRAIDWOOD *et al.* 1961; HOLE and FLANNERY 1967; MORTENSEN 1974, 1993; SMITH 1986; SOLECKI 1955; YOUNG and SMITH 1966). The consensus typological definition of the Zarzian tradition based upon that research is a chipped stone industry that contains microliths (especially scalene triangles), microburins, backed blades, perforators, thumbnail scrapers and occasional "shouldered" points (SMITH 1986: 29). That description, however, is quite generalized, and in some respects could be applied to any number of industries of the Epipaleolithic period throughout western Eurasia. Only three reports list the actual counts of various tool types, Garrod (GARROD 1930) and Wahida (WAHIDA 1981) for Zarzi, and Olszewski (OLSZEWSKI 1993b) for Warwasi.

Table 1: Typological comparisons of the Zarzian and M'lefatian <*in percentages*>.

CLASS	WARWASI 4 (Olszewski)	ZARZI (Garrod)	ZARZI (Wahida)	M'IEFAAT (Dittemore)	M'IEFAAT (Kozłowski)	ZAWI CHEMI (Solecki)
SCRAPERS	2.7	24.8	11.6	7.6	moderate	moderate
BURINS	0.2	3.0	5.6	0.8		
BORERS	5.5	0.6	0.8	11.6	low	
BACKED PIECES	0.9	6.0	2.1	0.4		
TRUNCATIONS	2.1	–	–	3.2	low	
NOTCHES/DENTICULATES	28.7	31.0	29.2	35.7	high	high
RETOUCHED PIECES	12.6	13.9	14.6	–	high	
MICROLITHS	44.1	20.2	25.2	30.1	moderate	moderate
OTHER	3.1	–	–	10.4		moderate

At Warwasi, four chronological units during the Zarzian period were distinguished (OLSZEWSKI 1993b). Of these, Unit 4, the uppermost set of levels, is discussed here because it is has the greatest probability of lying chronologically closest to the "transition" from Epipaleolithic to Neolithic assemblages. Warwasi Unit 4 (Table 1) has a high frequency of microliths, with notches and denticulates as the second most important tool class, and retouched pieces as the third. Within the microlithic class (Fig. 1), nongeometric forms predominate (truncated bladelets, pointed bladelets, curved backed bladelets, and inversely or alternately retouched bladelets), but geometric forms (primarily scalene triangles, with some lunates and trapezes) comprise a very distinctive element (OLSZEWSKI 1993b 1994). A comparison of Warwasi Unit 4 to Garrod's and Wahida's work at Zarzi is shown in Table 1[1]. The presence of scalene triangle microliths is a characteristic noted for almost all reported Zarzian sites, except Kowri Khan where no geometric microliths were recovered

[1] I have modified the tool lists presented in GARRODD 1930 and WAHIDA 1981 so that the tool classes can be compared with those at Warwasi.

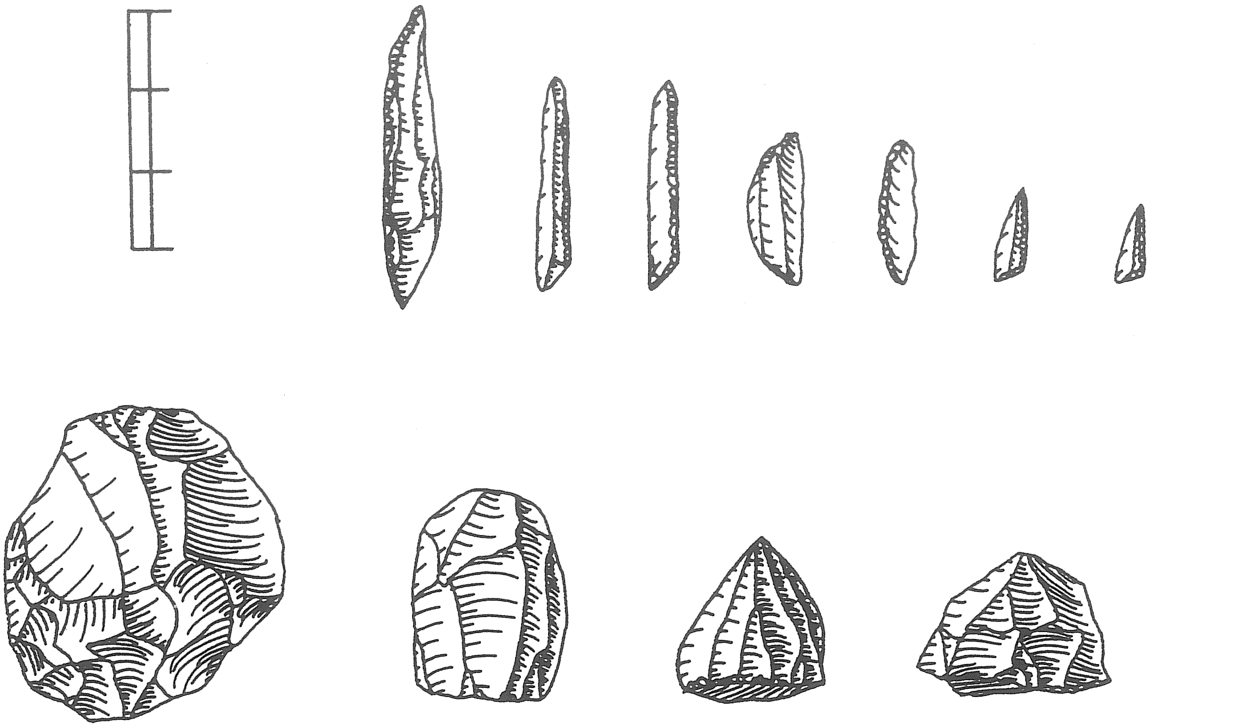

Fig. 1. Zarzian microliths and cores. Top row: microliths from Warwasi Rockshelter, Iran <*redrawn from OLSZEWSKI 1993a*>, bottom row: cores from Zarzi, Iraq <*redrawn from GARROD 1930*>.

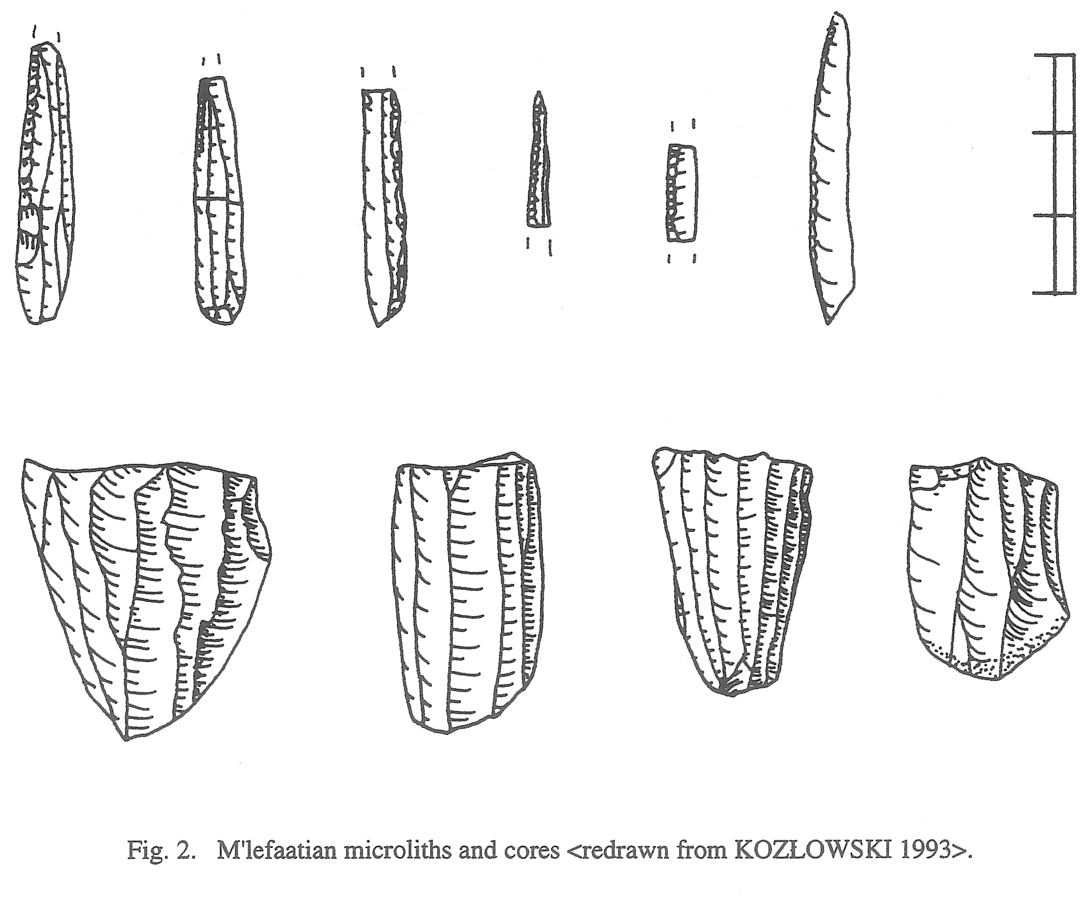

Fig. 2. M'lefaatian microliths and cores <redrawn from KOZŁOWSKI 1993>.

(BRAIDWOOD and HOWE 1960: 56). Scrapers, especially small forms such as thumbnail scrapers, also are a frequently mentioned characteristic for the Zarzian, however, Warwasi Unit 4 has a very low frequency of all scrapers and few examples of thumbnail scrapers (OLSZEWSKI 1993b: 229).

On a general technological level, the Zarzian industry was characterized by Garrod (GARROD 1930: 16) as consisting of relatively small sized artifacts. She noted that the largest tools were only 10cms in length, while the majority were under 6cms in size. Garrod recognized that the generally diminutive size of the implements was probably a function of the use of small size nodules as cores. Although Garrod did not specifically discuss the debitage blanks used for tools at Zarzi, it is clear, based on her description of the tool types, that the majority were blades and bladelets. Unfortunately, neither she nor, later, Wahida (WAHIDA 1981), described the debitage from Zarzi, but based on the apparent predominance of blade and bladelet tools, as well as the presence of single platform cores, including pyramidal forms, it is likely that the debitage consists primarily of blades and bladelets. Virtually all of the synopses of Zarzian assemblages from the various sites omit debitage descriptions (*e.g.*, BRAIDWOOD and HOWE 1960, YOUNG and SMITH 1966).

Table 2: Technological comparisons of the Zarzian and M'lefatian <*in percentages*>.

CLASS	WARWASI 4 (Olszewski)	ZARZI (Garrod)	ZARZI (Wahida)	M'IEFAAT (Dittemore)	M'IEFAAT (Kozłowski)	ZAWI CHEMI (Solecki)
DEBITAGE						
BLADELETS	49.6	moderate		74.1	moderate	
BLADES	24.7	moderate		–	moderate?	
FLAKES	13.3	low		19.7	>53.0	
OTHER	12.4			6.2	low	
BLADELET TOOLS	51.3	moderate	moderate	high	high?	moderate
BLADE TOOLS	25.3	moderate	moderate?		high	
FLAKE TOOLS	18.7	low		low	moderate	
OTHER TOOLS	4.6	low	low		low	low

The Zarzian assemblages from Warwasi, however, have been studied and reported in some detail (OLSZEWSKI 1993b: 218). The frequencies of the various debitage classes clearly indicates the bladelet orientation in the debitage and in the types of blanks chosen for tools (Table 2). Blades are only half as frequent as bladelets, and flakes are relatively uncommon. Cortical elements are few, suggesting that most cortex was removed (generally by the detachment of flakes) during the initial shaping of nodules. There are also few rejuvenation elements. Combining all rejuvenation blank types (flakes, blades and bladelets), these total less than 6% of the debitage for Warwasi Unit 4. This may reflect either little concern with the reshaping of cores, or little need to do so.

Single platform cores and pyramidal forms are one reflection of the technology involved in Zarzian assemblages. Garrod (GARROD 1930: 20-21) described a number of these as core-scrapers, and the illustrations she provided clearly show types typical of the Zarzian industry (Fig. 1). Other researchers also have noted that pyramidal forms of cores are characteristic (*e.g.*, BRAIDWOOD and HOWE 1960: 56-60). However, both the illustrations in Garrod (GARROD 1930: 18) and the descriptions by Braidwood and Howe (BRAIDWOOD and HOWE 1960: 56-60) of Zarzian cores indicate that while the majority of these are single platform types, they are not necessarily highly standardized or regular in appearance. Braidwood and Howe (BRAIDWOOD and HOWE 1960: 56, 58), in fact, describe the cores as "coarse, irregular, pyramidal pebble cores ... (of which there were only) ... a few with bladelet scars" for Kowri Khan, and as "pyramidal blade- and flake-scarred varieties...as well as a good number of amorphous subspherical ones" for Palegawra.

These "impressions" provided by Garrod and by Braidwood and Howe are borne out by the data available from Warwasi Unit 4 (OLSZEWSKI 1993b: 219). This latest unit at Warwasi has a moderate percentage of bladelet cores. However, while some of these are single platform cores, and a small percentage are pyramidal forms, the core assemblage can be more typically described as a "mixed bag" of forms (Table 3). This is because the largest percentage are actually cores whose final removals were of flakes, with various opposed platform bladelet cores second in importance, followed closely by cores with a mixture of flake and bladelet removals. Such a pattern is not particularly suggestive of highly standardized blank removals, nor of the consistent use of pressure technique, nor of cores that were refurbished so that only bladelets would continue to be produced from a particular nodule (see also HILDEBRAND, this volume). It does suggest that cores with negative flake scars as final removals are "exhausted" cores that are discarded when further knapping efforts produce flakes (which are infrequently used for tool blanks) rather than bladelets (which are consistently used for tool blanks).

The Zarzian chipped stone industry can be characterized as exhibiting: (1) a strong tendency toward the production of microliths, particularly various nongeometrics and scalene triangles, with the occasional appearance of other geometric types, (2) a general emphasis on small forms of other types of tools, for example, thumbnail scrapers, (3) a high frequency of blades and bladelets chosen as tool blanks, (4) a debitage that mirrors the blade/bladelet emphasis seen in tool blanks, (5) a core assemblage that is highly variable in character, with numerous examples of both flake and bladelet core forms, as well as "mixed" cores, (6) a general lack of regularization in most core forms, at least in their "exhausted" state, although there are some examples of well-fashioned pyramidal bladelet cores, and (7) the probability that pressure technique is either absent or infrequently utilized.

Table 3: Selected core comparison of the Zarzian and M'lefatian.

CLASS	WARWASI 4 (Olszewski)	ZARZI (Garrod)	ZARZI (Wahida)	M'IEFAAT (Dittemore)	M'IEFAAT (Kozłowski)	ZAWI CHEMI (Solecki)
SINGLE PLATFORM BLDT	8.1	present	?	65.2	high	present
PYRAMIDAL BLDT	3.2	present	?	present	present	
PRISMATIC BLDT	1.6		?	present	present	
OTHER BLDT	21.0		?	4.3	low?	
ALL BLADE CORES	1.6		?	–	low	
ALL FLAKE CORES	45.2		?	30.4	moderate?	high
ALL MIXED CORES	19.3		?	–	low?	

The M'lefatian Tradition

The M'lefatian industry has been only recently identified as a possible separate tradition (KOZŁOWSKI 1994), although the existence of an industry transitional between the Zarzian and the early Neolithic (as exemplified at Karim Shahir) was noted 35 years ago by Braidwood and Howe (BRAIDWOOD and HOWE 1960: 56). Although Braidwood and Howe remarked on the general resemblance of the chipped stone assemblage from M'lefaat to that of Karim Shahir, they did not identify the materials from M'lefaat as a transitional industry. Kozłowski, on the other hand, uses the persistence of microliths in early Neolithic assemblages, such as the M'lefatian, as an indication of continuity from the earlier Zarzian Epipaleolithic tradition. In that sense, then, the M'lefatian is a "transitional" chipped stone industry. Here, only materials from sites believed to occur early in the M'lefatian sequence are discussed (thus, omitting possible later M'lefatian manifestations at sites such as Jarmo, Chaga Sefid and Ali Kosh)[1].

Typologically, the M'lefatian, from the site of M'lefaat in Iraq, is described as an industry characterized by a high frequency of retouched blades, followed by various types of retouched flakes such as sidescrapers and denticulates. Following these are endscrapers, and then the microlithic component (KOZŁOWSKI 1993). This is a somewhat different configuration than noted by Dittemore (DITTEMORE 1983: 679) and by Braidwood and Howe (BRAIDWOOD and HOWE 1960: 51) for earlier excavations at M'lefaat (see Table 1)[2]. They recorded few blades or flakes that were formally retouched. However, the Dittemore analysis did yield relatively high frequencies of notch/denticulates and microliths, so that the comparison of the two analyses of the chipped stone materials from different excavations at M'lefaat (DITTEMORE 1983 and KOZŁOWSKI 1993) are relatively similar. The high frequency of notch/denticulates and moderate frequency of microliths also are characteristics of the assemblage from Zawi Chemi Shanidar (SOLECKI 1981), a site believed by Braidwood and Howe (BRAIDWOOD and HOWE 1960: 52) and Hole (HOLE 1994a) to be early in the aceramic Neolithic sequence.

The M'lefatian microliths are almost exclusively nongeometric forms, with the exception of a number of lunates reported from Zawi Chemi Shanidar (SOLECKI 1981). At the site of M'lefaat, judging from the illustrations provided by Dittemore (DITTEMORE 1983: 688, Fig. 241) and Kozłowski (KOZŁOWSKI 1993), the microliths comprise a series of (1) curved end, (2) pointed, (3) backed and truncated, and (4) alternately or inversely retouched forms. All are quite narrow and many of the complete specimens seem to be relatively long by microlithic standards, that is, they approach 5cms in length (Fig. 2).

The general technology is oriented toward the manufacture of blades and bladelets (see Table

1 KOZŁOWSKI (1994) discusses these latter three sites, as well as a few others, as M'lefatian. While I have no objection to this, I base my use of only the earliest M'lefatian sites (M'lefaat, Zawi Chemi Shanidar) on the observations of HOLE (1994a) that these two sites are early in the proto-Neolithic sequence. Because I am attempting to characterize the "transition" between the Zarzian and the M'lefatian, I prefer to discuss only the latest assemblages of the Zarzian and the earliest of the M'lefatian.

2 I have adjusted the figures from DITTEMORE (1983: 679) so that "used," "unused," and "nibbled" blades and flakes are not counted in the formal tool typology.

2)[1], although Kozłowski has recorded higher percentages of flake debitage than blade/bladelet debitage at M'lefaat, a marked contrast to the results of Dittemore (DITTEMORE 1983: 679). The primary emphasis for tool blank selection, recorded by both studies, is on blade/bladelet blanks. This implies that much of the flake debitage is the result of the initial shaping of cores, rather than the production of desirable blanks. Some of the flake debitage, nevertheless, was chosen for the manufacture of certain types of scrapers and for notches and denticulates.

The cores of the M'lefatian industry reflect the emphasis on blades and bladelets, as they are comprised of numerous examples of single platform bladelet cores (see Table 3). As Kozłowski (KOZŁOWSKI 1993) points out, these bladelet cores are probably the exhausted remnants of what originally began as blade cores. Illustrations provided in Dittemore (DITTEMORE 1983: 687) and Kozłowski (KOZŁOWSKI 1993) show many of these single platform cores to be pyramidal and prismatic forms (see Fig. 2). These appear to be relatively regularized forms, suggesting some standardization of production. In fact, both Dittemore (DITTEMORE 1983: 673) and Kozłowski (KOZŁOWSKI 1993, 1994) characterize the industry as one with pressure removal of bladelets from cores. There are also a number of polyhedral flake cores (BRAIDWOOD and HOWE 1960: 51, DITTEMORE 1983: 687, KOZŁOWSKI 1993). Some of the cores from Zawi Chemi Shanidar are reported to be single platform bladelet types, although the photographs of the cores from that site are mainly of undistinguished, amorphous flake cores (SOLECKI 1981: Pl. XIII). Hildebrand (HILDEBRAND, this volume) provides details of core morphology/technology for Karim Shahir, another possible early M'lefatian site, that suggests that most cores in the M'lefatian are relatively unstandardized.

The M'lefatian chipped stone industry can be characterized as (1) dominated by an emphasis on tools manufactured on blade and bladelet blanks, (2) containing a moderately high frequency of small tools, particularly various forms of nongeometric microliths, (3) exhibiting a variable frequency of flakes in the debitage, ranging from moderate to high percentages, (4) dominated by single platform cores that most often have bladelet scars, (5) showing a consistent removal of blades and bladelets by percussion and perhaps by pressure techniques, (6) containing many pyramidal and prismatic forms of cores, and (7) yielding no true "bullet" cores, although some of the small bladelet cores are beginning to approach this form.

Comparisons and Discussion

Comparing and contrasting the Zarzian and M'lefatian traditions is not in itself a difficult task. The difficulty lies in adequate explanation of the patterning present. The similarities and differences between the two industries could be the result of a number of factors, ranging from the time depth that apparently separates the two traditions, to the issue of site contexts, and to the modes of economy that characterize each tradition. These, and other themes, are discussed below, with reference to aspects of the two chipped stone industries.

Both the Zarzian and the M'lefatian share a similar emphasis on the production of blades and bladelets, and in some instances, demonstrate a marked preference for bladelets, many of which have been modified into various retouched and backed microliths. Other tool classes, such as endscrapers on blades, retouched blades and notch/denticulates, also are a shared similarity. However, the resemblance of these tool classes is, in one sense, merely the result of both industries being blade/bladelet-oriented.

For example, by definition, a microlith is a small tool on a bladelet, generally less than 5cms, and frequently less than 3cms, in length. Thus, a bladelet with retouch or backing is automatically a microlith regardless of the tool tradition in which it appears. If bladelets are present, then in most cases, there probably are microlithic tools in an assemblage. Examples are legion, and include a number of Upper Paleolithic traditions, for instance, the Ahmarian of the Levant (GILEAD 1991), the Magdalenian of western Europe (DE SONNEVILLE-BORDES 1960), the Gravettian of central Europe (KOZŁOWSKI 1986), and the Zagros Aurignacian (formerly Baradostian) of the Zagros region (OLSZEWSKI and DIBBLE 1994), as well as numerous examples of Epipaleolithic and Mesolithic industries, such as the Kebaran (BAR-YOSEF 1987) and Natufian (BELFER-COHEN 1991) of the Levant, the Tardenoisian of western Europe (ROZOY 1971), and the Epi-Gravettian of central Europe (KOZŁOWSKI and KOZŁOWSKI 1979).

The same argument can be made for blade endscrapers and retouched blades. Retouch forming a convex morphology of the distal or proximal end of a blade defines an endscraper, while retouch along the sides of a blade characterizes a retouched blade. It is no great surprise, then, that a tool class

[1] Unfortunately, a distinction between blades and bladelets is not presented in either the DITTEMORE 1983 or KOZŁOWSKI 1993 accounts. Therefore, this information for M'lefaat in Table 2 has been listed under bladelets in the case of Dittemore (which may include blades) and as qualified estimates for Kozłowski, based on the illustrations provided in his account.

can superficially indicate a conservative lithic tradition stretching over many millennia in a particular region of the world. It is only the switch from an emphasis on flake blanks to one on blade(let) blanks, or vice versa, that signals a change dramatic enough to be seen at the level of tool classes.

Tool types within tool classes, however, are a different matter. Thus, while the Zarzian and M'lefatian are similar on a class level, they are relatively dissimilar in specific tool types within tool classes. This is apparent both within the scraper class, where most Zarzian assemblages exhibit moderate to high frequencies of thumbnail scrapers, and within the microlith class, where the typical Zarzian assemblage contains several geometric forms (primarily scalene triangles and some lunates). In contrast, M'lefatian assemblages (with the exception of Zawi Chemi Shanidar) have few to no geometric forms. The limited number of ways to shape a nongeometric microlith, *e.g.*, truncation of a bladelet, use of backing or retouch to produce a curved form, or utilization of backing or retouch to accentuate a pointed form, renders the nongeometric microlith component somewhat more similar between the two industries.

The greatest dissimilarity between the Zarzian and the M'lefatian is technological, and can be seen in final core forms. While both industries produce large numbers of bladelets, how they arrive at this outcome differs considerably. In the Zarzian, about one-third of the cores (based on Warwasi Unit 4, see Table 3) exhibit bladelet scars as the final removals (OLSZEWSKI 1993b: 219). Relatively few of the Zarzian bladelet cores are single platform types, whether simple single platform, pyramidal or prismatic. Most are various opposing/opposed platform types, or are "mixed" cores showing the removal of both bladelets and flakes from the same single platform. There are, as well, numerous examples of flake cores. Hildebrand's (HILDEBRAND, this volume) data from the Pa Sangar assemblage also documents the irregularity of removals from cores during the Zarzian.

In contrast, the M'lefatian contains core forms that appear to be more regularized, although some polyhedral and amorphous flake cores are present as well. The M'lefatian single platform cores most often are pyramidal and prismatic forms, some of which are beginning to approach the "bullet" core known from later Neolithic contexts. Many researchers who have worked with M'lefatian materials explain the core forms as the result of use of punch and pressure techniques to remove bladelets (DITTEMORE 1983: 673; KOZŁOWSKI 1993, 1994). The cores from M'lefatian assemblages perhaps are beginning to approach a standardization that may suggest flint knapping by fewer, but generally more skilled, practitioners than was the case during the earlier Zarzian Epipaleolithic[1].

Having stated the "obvious" in the comparison of the Zarzian to the M'lefatian, it remains to interpret this patterning in terms of human behavioral strategies occurring minimally over several thousands of years. A number of researchers have pointed out that early Neolithic chipped stone assemblages across the northern Fertile Crescent, including southeastern Turkey, appear to share more in common with the Zarzian Epipaleolithic than with comparable industries (*e.g.*, the Natufian) from the Levant (CAUVIN 1989; HOLE 1994b, this volume; ROSENBERG and DAVIS 1992). This is not surprising given that the Natufian is an industry with microliths (primarily lunate geometrics) that are manufactured on relatively wide bladelets (HENRY 1989: 192) removed from cores that in their final form are rather undistinguished (BELFER-COHEN and GORING-MORRIS, this volume). If Zarzian cores appear to be relatively "unspecialized" technologically, those of the Natufian are even less "specialized". The Natufian bears little resemblance to early Neolithic industries of the northern Fertile Crescent because the microlithic component of these latter assemblages is extremely narrow in width and is removed by specialized knapping techniques not present in the Natufian.

There is, moreover, precedence in the notion of continuity of chipped stone traditions throughout the northern Fertile Crescent and the Zagros area. This region appears to be an extremely long-lived archaeological zone of shared similarities, with examples of affinity in archaeological lithic characteristics present across the Zagros-Taurus arc during the Upper Paleolithic (Aurignacian facies: OLSZEWSKI and DIBBLE 1993) and during the Middle Paleolithic (Zagros Mousterian and Taurus Mousterian, various authors in OLSZEWSKI and DIBBLE 1993).

If the Zagros is an area where earlier Epipaleolithic traditions "pass on" certain lithic characteristics to later Neolithic societies, why and how this occurs is of anthropological interest. One possible, and obvious, explanation is long-term limitations in raw material resources that led to chipped stone traditions with tool classes that witnessed relatively few changes over many millennia. For example, virtually all researchers who have studied assemblages from the Zagros, regardless of whether these date to the Middle, Upper or Epipaleolithic, have remarked on the fact that available nodules are frequently small in size. Large sized debitage cannot be produced from small nodules, thus most Zagros assemblages are characterized by small flakes and by bladelets. The diminutive nature of Zagros assemblages, then, is partially explained by the nature of the available raw materials.

In the early Neolithic of the Zagros, some sites, such as Shanidar B_1 and Zawi Chemi Shanidar, are in settings identical or similar to Zarzian sites. Prehistoric Neolithic groups in these areas also ex-

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1 See also HILDEBRAND (this volume) for documentation of increasing regularization of core morphology throughout the Neolithic sequence.

perienced the limitation of locally available small sized nodules, leading in some instances to superficial similarities between late Zarzian and early Neolithic chipped stone assemblages. However, the lack of larger sized nodules throughout the greater northern Fertile Crescent cannot be supported on the basis of available evidence. There, the use of manufacturing techniques resulting in diminutive assemblages that appear to be allied to those of the Zagros region suggests "choice" related to factors such as functional needs, group movements throughout this region, or shared technical knowledge.

A second possible explanation involves site functional types. While it has been common to assume that activity sets at rockshelters are more restricted than those at open-air sites, this assumption may not be valid if both types of locations were basecamps. If some of the rockshelters in the Zarzian and the open-air sites in the M'lefatian were basecamp situations, then the tool classes present and the range of lithic reduction processes in both situations might be similar. Braidwood and Howe (BRAIDWOOD and HOWE 1960: 56), however, point out that variability within the Zarzian timeframe (differences between assemblages from open-air contexts at Turkaka and Kowri Khan, if these sites are Zarzian, and from rockshelter/caves) might reflect different functional contexts. Analyses that are directed specifically at these problems remain to be accomplished.

A third possible explanation for general similarities in assemblages over time and space in the northern Fertile Crescent might be tied to the types of economies evident in those two traditions. During the Zarzian period, wild animals such as onager, goat, and pig were common prey at Warwasi, a rockshelter in the Zagros foothills (TURNBULL 1975), and onager, red deer, sheep/goat, pig, wild cattle, and gazelle were taken at Palegawra, a small cave in the Zagros Mountains (TURNBULL and REED 1974). The latter site also produced evidence of the use of land snails. Unfortunately, nothing is known of the types of plant foods exploited by Zarzian populations.

During the earliest aceramic Neolithic, at sites such as M'lefaat, next to a river at the interface between the foothills of the Zagros mountains and the Assyrian piedmont, exploited fauna includes wild pig, cattle, sheep, gazelle, birds, fish, freshwater clam, freshwater crab, and land snail (TURNBULL 1983). It is assumed that wild forms of cultivated grains also were utilized.

Later aceramic Neolithic sites, such as Qermez Dere and Nemrik 9 in northern Iraq document the continued use of wild species. For example, at Qermez Dere, in the southern foothills of the Jebel Sinjar which overlooks the semi-arid Jezirah steppe, inhabitants exploited wild plants including einkorn, barley, pistachio nuts, bitter vetch, and lentils (WATKINS *et al.* 1989). Faunal remains from Qermez Dere are undergoing study. At Nemrik 9, a site adjacent to a river at the interface between a grassy steppe and the forest, the majority of the fauna include wild species such as antelope, red deer, cattle, pig, beaver, badger, birds, crayfish, freshwater clams, and land snails. Plant remains consist of vetch, lentils, peas, and small amounts of cereals (LASOTA-MOSKALEWSKA in: KOZŁOWSKI 1989: 30, 1990: 1985: 185-208).

In other areas of the northern Fertile Crescent, later sites in the aceramic Neolithic period, such as Abu Hureyra 2 along the Euphrates River in northern Syria, continue the pattern of use of primarily wild species. Abu Hureyra 2 contains fauna that initially is wild (gazelle and some onager), but is later replaced by domesticated species such as sheep and goat (LEGGE in: MOORE 1975: 74-76). Plant utilization includes both wild (emmer wheat, barley, lentils, common vetch) and domesticated varieties (emmer wheat, barley, chick pea, and lentils: HILLMAN in: MOORE 1975: 70-73). Hallan Çemi Tepesi, a small tell on a terrace above a small tributary river in southwestern Turkey, is a second example of this later sequence within the aceramic Neolithic. This site also has wild plant forms such as lentils, bitter vetch, pistachio, and a presumably wild fauna (ROSENBERG and DAVIS 1992).

Although the Neolithic period witnessed major changes in economy, the majority of these appear to have occurred about 2000 or so years after the earliest appearance of Neolithic societies. Virtually all early, aceramic, Neolithic sites document the continued exploitation of morphologically "wild" plants and animals. This patterning seems to suggest that subsistence and procurement activities remain essentially unchanged over the millennia spanning the end of the Epipaleolithic and the beginning of the Neolithic.

Concluding Remarks

An accurate appraisal of the "transition" from the Zarzian Epipaleolithic to the aceramic Neolithic M'lefatian is hampered by the lack of documentation for the entire sequence at one or more sites and the difficulty of assessing the apparent 3000 year gap between the latest dated Zarzian occurrence and the earliest dated M'lefatian occupation. Additionally, there is a notable lack of radiocarbon dates from the majority of sites under consideration, such as Warwasi, Zarzi, Karim Shahir, and Zawi Chemi Shanidar.

Unanswered questions also remain regarding the pace of economic change relative to the pace of change in chipped stone assemblages. If economic change is gradual, as appears to be the case in the period from the late Epipaleolithic through the early aceramic Neolithic, can it be expected that technological change also is gradual? In effect, the variables of available raw material and reductive strategies inherent in chipped stone technology must be appraised against the behavioral options available to prehistoric groups in the Zagros region and in the northern Fertile Crescent as a whole.

Finally, the persistence of certain "Epipaleolithic" tool classes in early Neolithic chipped stone assemblages might signal a conservative tradition persisting over millennia, or similar approaches to common problems in subsistence strategies, such as the methodology and hafting requirements involved in weaponry for the hunting of wild game (HOLE, this volume; OLSZEWSKI 1993a). The microlithic nature of assemblages from the Zagros region itself is probably heavily influenced by the small size of available nodular raw material. Certainly, the trend toward increasing regularization of core technology implies several mutually compatible alternatives: 1) fewer, but more skilled, knappers, 2) greater "efficiency" in producing blades and bladelets, and 3) cultural contacts between groups over an increasingly wider geographic area (*e.g.*, WATKINS *et al.* 1989).

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Changes in Methods and Techniques of Blade Production During the Epipalaeolithic and Early Neolithic in the Eastern Fertile Crescent

Elisabeth A. Hildebrand

Abstract: *Methods and techniques of blade production in the eastern Fertile Crescent changed during the Epipaleolithic and early Neolithic. These changes are documented by comparing core assemblages from Pa Sangar, Karim Shahir, Asiab, and Ali Kosh. Six aspects of core form which relate to technology are examined: technique of blade detachment, platform orientation and angle, directionality of blade detachment, distal trimming, platform flaking, and the extent of removal scars around the platform. Several of these parameters vary between sites and follow diachronic trends. Interrelations between parameters, and possible causes of changes are explored. The patterning of these changes tends to support the hypothesis that the pressure technique was borrowed from elsewhere and incorporated into the local system of blade production.*

Résumé: *Cet étude évalue les changements des méthods et techniques de débitage laminaire aux Zagros pendant l'Epipaléolithique et le Néolithique ancien. Les assemblages des nucléus de Pa Sangar, Karim Shahir, Asiab, et Ali Kosh sont comparés. Six aspects de la forme des nucléus, qui ont rapport à technologie, sont examinés: la technique de débitage, l'orientation et angle du plan de frappe ou de pression, la directionalité de débitage, l'écaillage de l'extrémité distale, la présence des petits enlèvements sûr le plan de frappe ou de pression, et l'extension de débitage laminaire autour du nucléus. Quelques aspects ci-dessus varient entre les sites, et montrent des changes en travers de temps. Rapports entre ceux aspects, et des causes divers possibles des changements, sont explorés. La distribution des changements tendà supporter l'hypothèse que le technique de pression était emprunté d'une autre region, et était incorporé au système local du débitage laminaire.*

Introduction

New methods and techniques of blade production appeared in the eastern Fertile Crescent prior to and during the adoption of food production. Description and discussion of these technological changes at selected sites is undertaken in this study. To date, comparisons of most

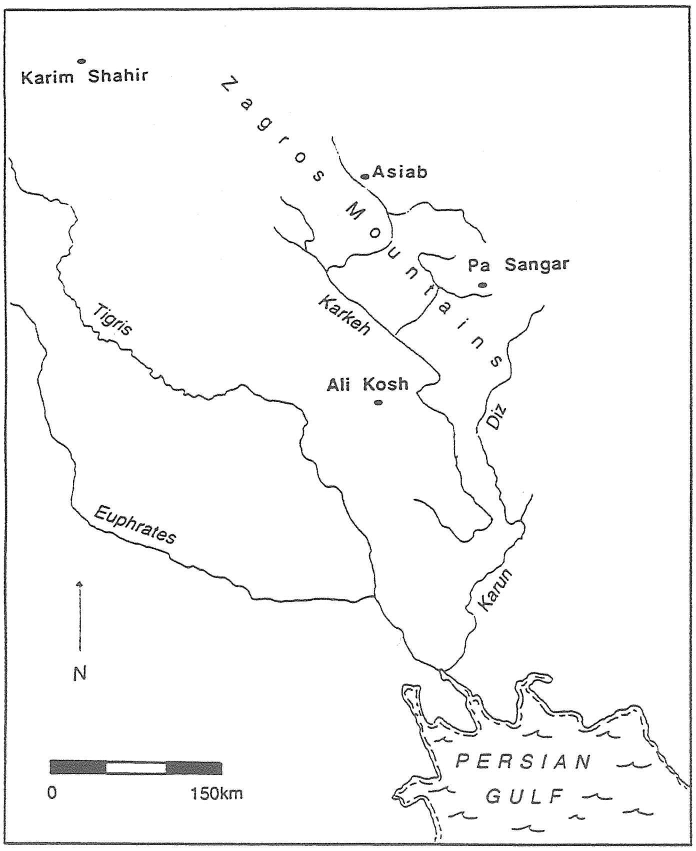

Fig. 1. Selected Epipaleolithic and early Neolithic sites in the eastern Fertile Crescent.

other chipped stone assemblages from Epipaleolithic and early agricultural sites in the Zagros have focused on the representation of particular types of blade products (HOWE 1983; KOZŁOWSKI, this volume; OLSZEWSKI 1993a, 1993b). Relations between changes in these product types, in the knapping technology that generated them, and in the lifeways of Zagros inhabitants are not yet well understood. Documenting changes in blade production strategies may help to build a more integrated framework in which to view technological developments associated with the onset of settled agricultural village life.

Core assemblages from Pa Sangar, Karim Shahir, Asiab, and Ali Kosh are examined (Fig. 1). In this regional diachronic comparison, I will address three questions. First, where and when was the pressure technique first used to detach blades in this region? Second, was the pressure technique a) a local invention; b) a non-local technique adopted and adapted to meet prior local methods and needs; or c) a completely new system of blade detachment brought in by outsiders or adopted wholesale from elsewhere? Third, if either scenario a) or b) is true how did the adoption of the pressure technique affect other aspects of blade production? To resolve these issues, I compared core traits that relate to reduction methods and techniques among the four sites.

The first section of this paper reviews the theoretical basis for studying technology via cores, identifies key terms, and delineates the technological significance of core attributes selected for study. The second section briefly summarizes the context and contents of each site, with respect to the sizes and natures of core assemblages compared here. In the third section, observed trends in core traits are described. Finally, the implications of these trends for the three issues outlined above are explored, in tandem with other factors to which inter-site differences in core traits may be attributed.

The Technological Study of Cores: Terms and Traits

Stone tool production is part of a larger Technology (*sensu* LEROI-GOURHAN 1943), which provides for the subsistence, economic, and social requirements of a particular group. It and other spheres of Technology consist of numerous *chaînes opératoires,* many of which affect each other. Inizan *et al.* (see INIZAN, ROCHE, and TIXIER 1992; INIZAN, LECHEVALLIER, and PLUMET 1992) define several key terms that pertain to technology, and that are used here. In their view, a *chaîne opératoire* of lithic production consists of raw material, physical gestures, tools, and know-how (INIZAN, ROCHE, and TIXIER 1992). They also distinguish between a "technique" (a procedure applied to a specific act during knapping, such as application of pressure to remove a blade) and a "method" (a series of acts in which various techniques are employed.[1] Each of these elements of lithic production (material, know-how, techniques, methods) may affect other elements. It follows that the first tasks in documenting change in lithic technology should be to define specific factors or indices of change, and to discuss how these factors relate to one another.

This study seeks to clarify relations between the adoption of the pressure technique in the Zagros and other coincident or subsequent changes in core reduction strategy. This may be accomplished by investigating several parameters of variation in core form. The significance of these factors and the ways in which they affect one another have been explored through experimental work by this author and by more experienced flintknappers. The parameters include the technique of blade detachment; the angle between the core's platform and its surface of blade detachment; the directionality of blade removal, the presence of various types of trimming, and the extent of blade detachment around the perimeter of the core. This background information is reviewed in the following section.

Techniques Used for Blade Detachment

Various techniques may be employed to detach blade products: direct percussion with a soft or hard hammer, indirect percussion with various implements, or pressure. Use of the pressure technique entails the preparation of a pre-core of appropriate shape (PELEGRIN 1984a), its immobilization in a holding device, and the application of pressure to the core using any one of several hand-held or crutch-like implements (PELEGRIN 1984b).

Distinguishing pressure from percussion in archaeological assemblages is essential if one is to determine the origin of the pressure technique in the Zagros. In general, pressure blades are straight and thin, with straight ridges on their dorsal surface and few ventral ripples.[2] However, pressure and indirect percussion may generate virtually indistinguishable blade products, and only some cores may be ascribed to one or the other detachment technique (*ibid.*). Consequently, it is not possible to categorize all cores in an assemblage according to specific techniques. Instead, one must employ morpho-

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[1] Use of the terms "method"and "technique"herein follows the definitions set forth by INIZAN, LECHEVALLIER, and PLUMET 1992.

[2] see BINDER 1984; INIZAN, ROCHE, and TIXIER 1992; PELEGRIN 1984a; and TIXIER 1984 for more detailed descriptions of traits characteristic of pressure debitage.

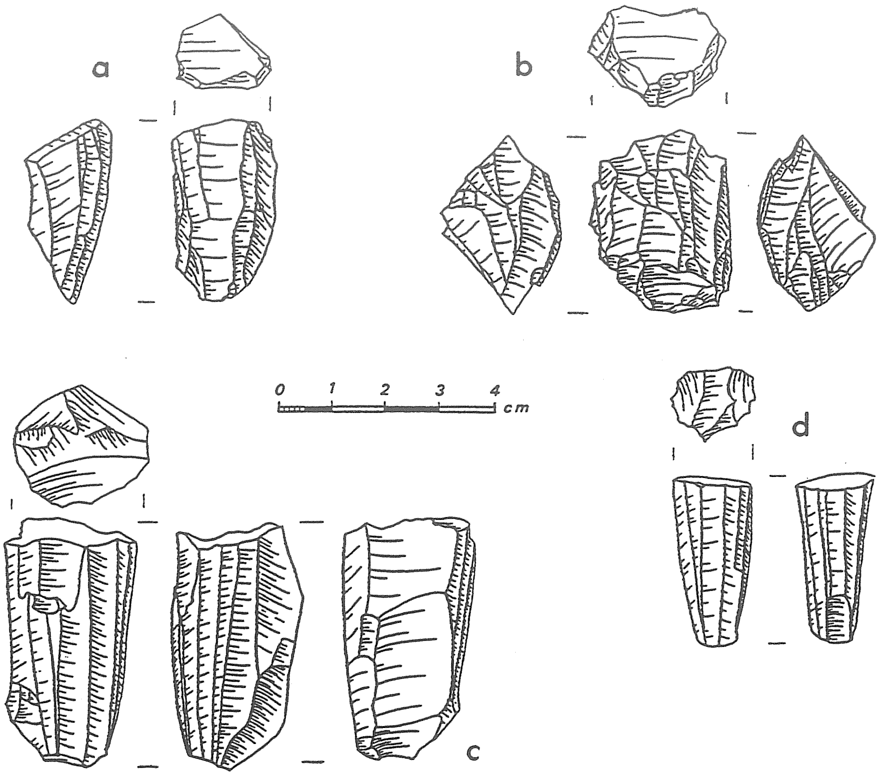

Fig. 2. a-b irregular cores, c-d parallel cores.

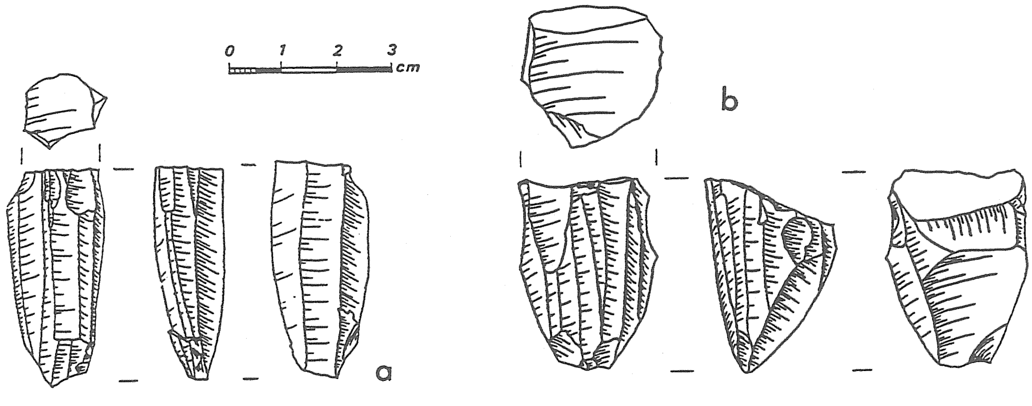

Fig. 3. a core with squarely oriented platform, b core with obliquely oriented platform.

logical categories that do not have one-to-one correspondence with specific techniques. "Irregular" cores have blade detachment surfaces with undulating, uneven ridges that could not have been produced by pressure (Fig. 2:a-b). "Parallel" cores have straight, regular scars that may have been produced via either the pressure or the indirect percussion technique (Fig. 2:c-d). Hereafter, use of the descriptive terms "parallel" and "irregular" pertains specifically to the above definitions.

Orientation and Angle of Platform[1]

One notable aspect of core form concerns whether the platform is oriented squarely or obli-

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[1] The term "striking platform" connotes use of the percussion technique for blade detachment. Therefore, the more inclusive term, "platform" is employed here.

quely with respect to the rest of the core as a whole (Fig. 3). Such orientation indicates whether the knapper aimed to use a limited or extended area of the core perimeter. A related but distinct trait is the angle between the platform and the surface of blade detachment (Fig. 4). Different techniques of blade detachment necessitate different platform angles. The pressure technique requires a platform angle of ninety degrees (PELEGRIN 1984a), whereas blade detachment via percussion may be done on cores with a range of acute angles. Several experimentalists view the establishment of an orthogonally angled platform as the crucial initial step in forming a pressure core, after which more minor adjustments may be made around the side of the core (PELEGRIN, pers. comm.; ABBÈS, pers. comm.).

Measurement of specific core platform angles is problematic. Angles vary along the edge of a single core. Angles remaining at the time of discard may be dissimilar to those prevailing during the use-life of the core. Therefore, observations regarding platform angles are quite general, and are coupled with those regarding platform orientation.

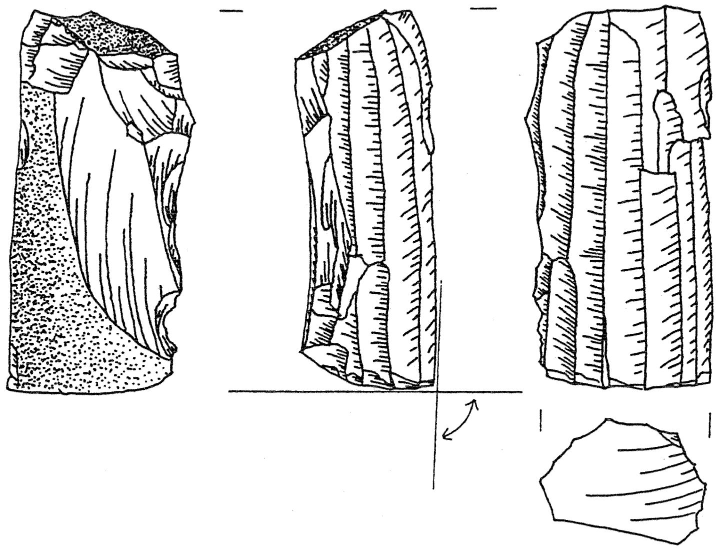

Fig. 4. The angle between the striking platform and the surface of blade detachment.

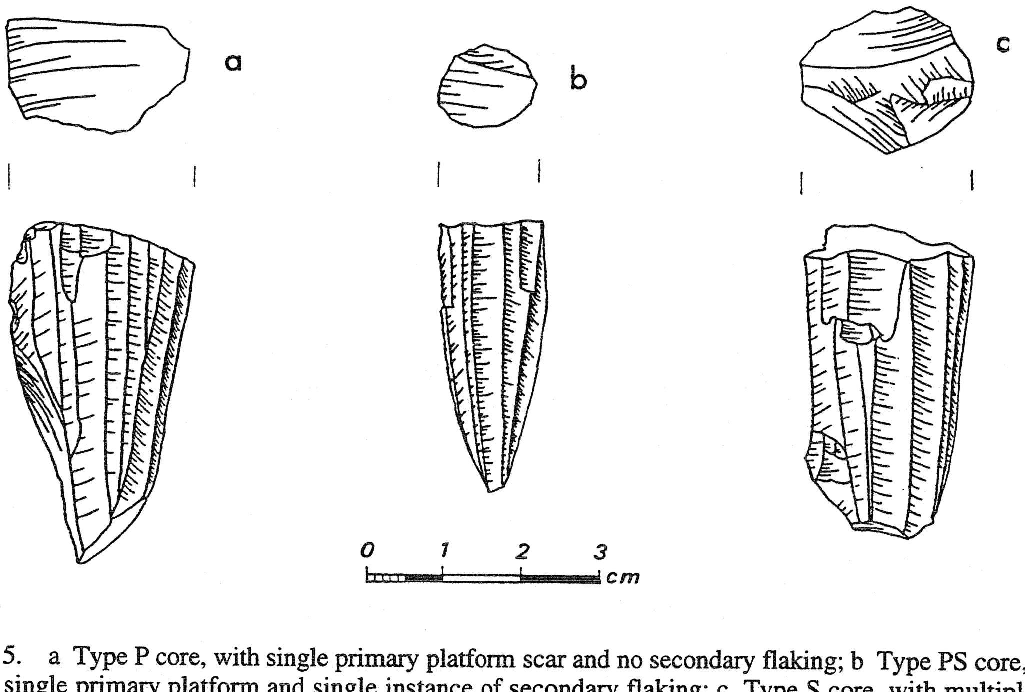

Fig. 5. a Type P core, with single primary platform scar and no secondary flaking; b Type PS core, with single primary platform and single instance of secondary flaking; c Type S core, with multiple secondary flaking scars.

Directionality of Blade Detachment

Directionality of product removal reflects both the overall plan of core reduction in the mind of the flintknapper, and the constraints of the detachment technique used. In archaeological assemblages, parallel cores typically have pointed ends in instances where cores were supported at the blade terminus, or rounded, overshot ends in instances where cores were unsupported at the blade terminus. Both conditions preclude bidirectional product detachment via application of pressure to the distal end. In contrast, percussion may be applied to a core in a bidirectional manner from two opposed platforms; indeed this approach may be more efficient. Parallel and irregular cores from archaeological assemblages were examined to determine a) whether bidirectional detachment was evident on any parallel cores, and b) whether representation of unidirectional *vs.* bidirectional irregular cores varied from site to site.

Distal Modification

Distal modification consists of systematic flaking or creation of a second platform on the end of the core opposite the platform. This flaking or platform creation may eliminate irregularities near the distal end. It may also affect the curvature of the side of the core and, hence, that of the blade products.

Two kinds of cores were excluded from evaluation for this trait. Bullet-shaped cores or those in an advanced state of reduction could not be classified with respect to distal modification; even if it had once been visible, all traces of it would have been obliterated. Bidirectional cores were excluded because distal modifications may well have been done to create or alter the second locus of blade detachment, rather than to shape the core in general. Therefore, distal modification could be evaluated only on cores that were neither bidirectional nor completely covered with blade scars. These cores are hereafter referred to as the "NN subsample", within which observations were recorded on a presence/absence basis.

Flaking Across the Platform

Platforms may show scars from the removal of small flakes across the top (Fig. 5:b-c). This type of flaking may be done to make small adjustments in the angle between the platform and the blade detachment surface. It is, however, risky: step fractures on the platform may render the core unusable later. Therefore, platform trimming is not to be expected unless minute adjustments in platform angle are required. In characterizing a core according to platform flaking, three categories were delineated. Cores with a single, primary platform scar and no platform flaking are designated Type P (Fig. 5:a). Those with a primary platform and a single instance of secondary platform flaking are designated Type PS (Fig. 5:b). Type S cores show several secondary flaking scars on the platform, which often obscure the initial platform surface (Fig. 5:c).

Extent of Platform Use

The degree to which blade removal extended around the perimeter of the platform varies. Use of the platform perimeter reflects economic considerations, such as the ease of obtaining raw material and, consequently, the efficiency with which it must be exploited. Platform use also reflects several technological factors. These include the original size and shape of the available raw material, which might favor certain core shapes and reduction strategies. They also include the skill of the artisan in establishing an evenly angled platform, or in trimming the side of the core to extend the surface of blade detachment.

Successful extension of the blade detachment surface around the core perimeter would depend on several preconditions. First, people would have to recognize a need to maximize raw material. They would then have to decide that circumferential blade detachment was the best way of doing so. If pressure or indirect percussion techniques were being used, circumferential detachment might well be optimal. On percussion cores, in contrast, the need for more acute angles and the feasibility of bidirectional reduction might not favor attempts to exploit the full perimeter. Raw material might affect this decision also; thin or tabular flint would be less suitable for circumferential removal than would rounded cobbles. Once decided upon, the successful execution of blade removal around the entire perimeter would depend on the artisan's ability to set up a correctly angled platform, and then to trim the sides of the core to make a usable blade detachment surface.

To discover how strategies and skills of platform exploitation varied between sites, cores were divided into three categories. Type C cores have blade removal scars extending around the entire circumference of the core. Both the platform preparation and the trimming were successful (Fig. 6a, b). Type D cores have removals extending around the entire perimeter of an evenly angled platform;

however, blade products were detached from a more limited area. Removal scars down the back of the core usually consisted of flaking that hinged or ended just short of a protrusion or irregularity. The orientation of the platforms on Type D cores suggests attempts to set up circumferential blade detachment that were thwarted by problems lower on the core (Fig. 6:c-d). Type E cores had obliquely angled platforms, of which only one side could be worked. They represent instances in which circumferential blade detachment was either not attempted or unsuccessful due to an incorrect angle (Fig. 6:e-f).

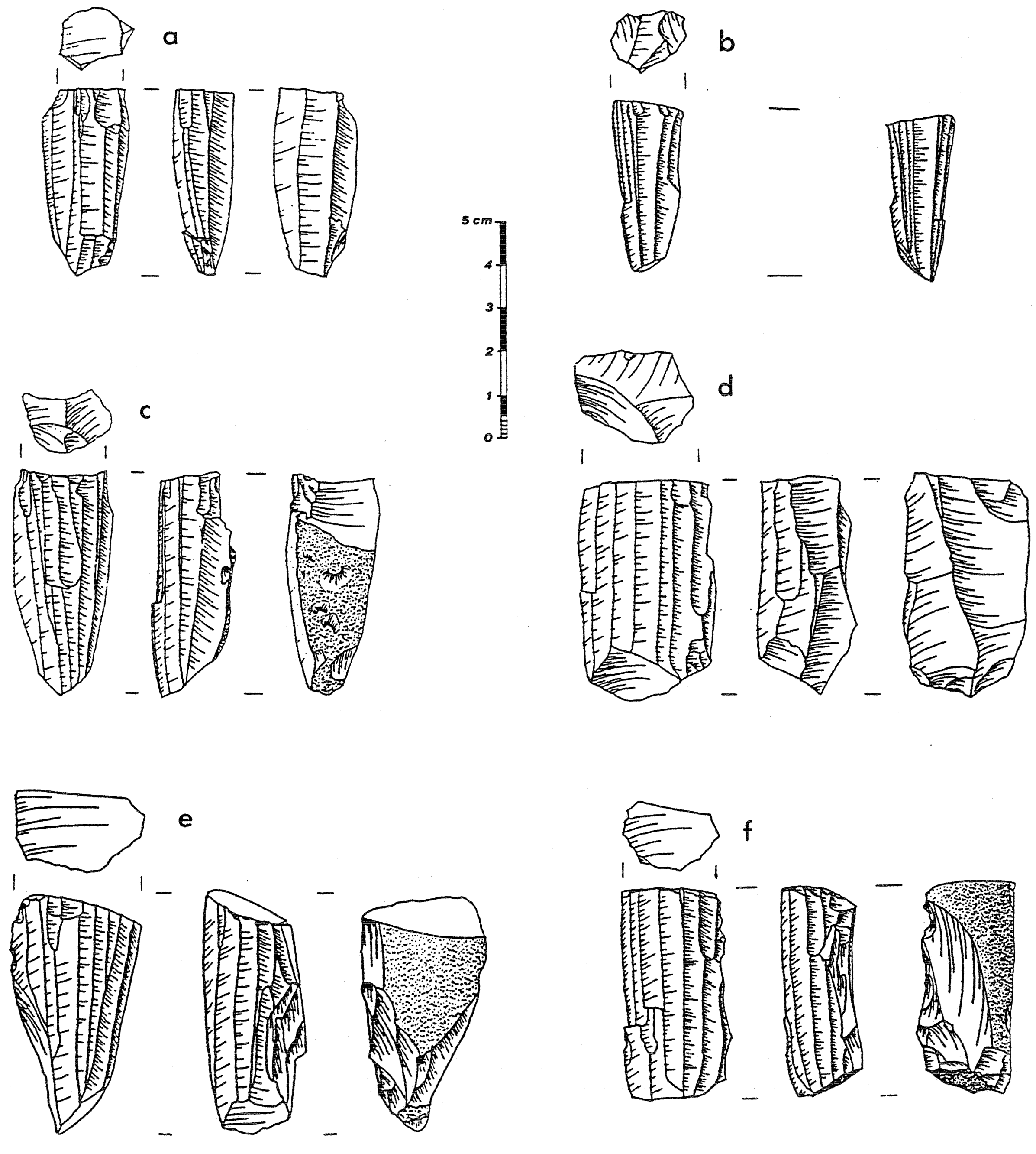

Fig. 6. a-b circumferential blade detachment; c-d circumferential removals around platform, but with blade detachment confined to a limited area of the core perimenter; e-f partial use of the perimeter of the striking platform.

Discussion

The seven parameters above should be viewed as nodes in a net of interrelating constraints, mental templates, and skills that constitute a system of lithic production. Variation along these parameters was cursorily observed both within and between assemblages during the early stages of this study. The categories within each parameter are not meant to represent arbitrary typological units to be used for chronological seriation or demarcation of spatial distributions. Rather, they are constructed as a first step toward understanding the choices faced within specific technological systems. It was not always possible to designate morphologically observable categories that correspond to single constraints. Investigation of morphological attributes has shown that they reflect a multitude of technological and economic constraints that are often inextricably intertwined.

The Assemblages Studied

Variation along the above parameters is compared between core assemblages of Pa Sangar, Karim Shahir, Asiab, and Ali Kosh. The history of excavation, chronological attribution, context, and characteristic material from each site are reviewed below. This information is relevant to the sizes and natures of samples selected for study. Dates and sample sizes for individual sites or zones are summarized in Table 1.

Table 1. Dates and number of cores analyzed by site or zone.

Locus	Dates (BP)	Sample size
Ali Kosh A1	8000-7600[1]	75
Ali Kosh B1	8700-8000[1]	85
Ali Kosh C1	9500-8700[1]	63
Ali Kosh C2	9500-8700[1]	111
Asiab	9755 ± 85[2]	110
Karim Shahir	~10,850-10,550[3]	896
Pa Sangar	$\geq$ 12,000[4]	92

1 HOLE, FLANNERY, and NEELY 1969 (adjusted from BC to BP); radiocarbon.
2 HOWE 1983; radiocarbon dating of charcoal. Dating of bone from the site was also conducted, but HOWE (1983) deems the charcoal dates more reliable.
3 HOWE 1983; based on artifactual correlations with dated contexts at Shanidar and Zawi Çemi.
4 HOLE and FLANNERY 1967; based on artifactual correlation with Shanidar B1. Radiocarbon dates are left as calibrated in their original publication.

Pa Sangar rockshelter was tested by Hole and Flannery during an investigation of the Khorramabad Valley in 1965 (HOLE and FLANNERY 1967). Three adjacent 2x3m test pits yielded Baradostian and Zarzian chipped stone, but no datable organic material. The upper 50cm of deposits are attributed to the Zarzian (HOLE, pers. comm.). They probably antedate or are contemporaneous with late Zarzian layers at Shanidar dated to 12,000 BP (HOLE and FLANNERY 1967). From the upper units at Pa Sangar, 92 cores were recovered and analyzed.

Karim Shahir is an open-air site on an eroding escarpment two kilometers from Jarmo in the Iraqi province of Kirkuk. Howe excavated several areas of the site in 1951. Cultural material consists of chipped and ground stone, and fragmentary organic remains; pottery is absent. Howe attributes this material to a single-period occupation (HOWE 1983).

Definitive radiocarbon dates have not been obtained for Karim Shahir, so it is not known exactly when or for how long the site was occupied. Chronological subdivision within the assemblage is impossible (HOWE 1983). For this study, 896 cores from Karim Shahir have been examined. With the exception of chipped stone designated by Howe as "core fragments" or "cores reused as scrapers", this sample constituted virtually the entire assemblage of cores recovered from all levels and areas excavated.

Asiab is an open-air site just east of Kermanshah. It was excavated by Howe in 1959-60 and remains unpublished. Examination of chipped stone from Asiab, and its inclusion in this study, are by kind permission of the excavator. Soundings performed at Asiab include several test soundings and a $48m^2$ pit on the south side of the site. Excavations yielded chipped and ground stone, charcoal, and burned human bone. A few intrusive ceramics were found (HOWE, pers. comm.). A single charcoal sample from the basal deposits has been dated to 9755 ± 85 BP (HOWE 1983).

Cores from the south pit are sampled for this analysis. Stratigraphic discontinuities and extensive burrowing occur throughout the south pit (HOWE, pers. comm.). In general, cultural remains give little basis for differentiating among various levels of the pit (HOWE 1983). A comparison of core assemblages from the upper and lower units concurs with Howe's observations in this regard. Therefore, material from all levels of the south pit is treated as a single assemblage for analytical purposes. To date, 110 cores from Asiab have been examined; analysis is continuing and final results are pending.

Tepe Ali Kosh lies on the Deh Luran plain in southwestern Iran. It was excavated by Hole in 1961-63 (HOLE, FLANNERY, and NEELY 1969). Two trenches and a large pit were divided into six stratigraphic zones (A1-C2) attributed to the "era of early dry farming and caprine domestication" (HOLE, FLANNERY, and NEELY 1969). A series of dates was obtained for the zones, which is summarized in Table 1. Time constraints precluded analysis of the entire assemblage of cores, so four of the six zones are included in this study: A1, B1, C1, and C2. For parameters in which different zones exhibit broad similarity, data from Ali Kosh are treated as a single unit. In instances where different zones varied with respect to a trait, dissimilarities are noted and discussed. The total sample of material drawn from Ali Kosh consists of 334 cores.

Implications for Sampling and Results

The four sites studied vary in the reliability of their dating. The quantity, distribution, and contextual integrity of the artifacts also varies from site to site. Differences in site settings and contexts have generated study assemblages of different sizes from different sites. Pa Sangar, Karim Shahir, Asiab, and Ali Kosh are dispersed spatially as well as temporally. Therefore, inter-site variation should not be attributed exclusively to diachronic change. Rather, spatial discontinuity and differences in the nature and quantity of available raw material in various locations must also be evaluated.

Results

Comparison among the four sites reveals significant variation in the traits described above. Several indices show directional change through time, and probably relate to the introduction and refinement of the pressure technique in the area. Other aspects of variation may relate to inter-site differences in the character and availability of raw material, and to differences in flintknapping skills and strategies among occupants of individual sites.

Techniques Used for Blade Detachment

No parallel cores were recovered from Pa Sangar. The pressure technique, therefore, was not practiced at the site. Among later sites, representation of cores with parallel blade detachment showed a clear increase over time (Table 2). Because traces of pressure and indirect percussion techniques are often indistinguishable, this trend is not directly indicative of growing representation of the pressure technique *per se*. Rather, it shows increasing use of either or both of the pressure and indirect percussion techniques.

Table 2. Percent representation of cores with irregular *vs.* parallel blade detachment at selected sites in the Zagros region.

Site	Cores with "irregular" scars only	Cores with "parallel" scars
Ali Kosh	<10	>90
Asiab	45.9	54.1
Karim Shahir	60.9	39.1
Pa Sangar	100	0

Pelegrin's criteria allow, in some instances, definitive ascription of the pressure technique to particular cores. Pressure cores were present at Karim Shahir, Asiab, and, in greater proportions, Ali Kosh. One may conclude that the techniques of pressure and indirect percussion first appeared in the Zagros between 12,000 and ~10,500BP, and subsequently came to dominate.

Orientation and Angle of Platform

As previously noted, platform angles are difficult to measure in a systematic fashion. However, a few general, pertinent observations should be noted. At Pa Sangar, cores had angles that ranged from fifty to nearly ninety degrees. The angles of cross-section are between sixty and eighty degrees on 74.1% of the cores. Most cores have obliquely oriented platforms. About fifteen percent of the assemblage has squarely oriented platforms, with angles between eighty and ninety degrees. Platforms on most irregular cores from Karim Shahir are obliquely oriented, but less so than at Pa Sangar. Very few parallel cores at Karim Shahir have their platforms angled squarely with respect to the whole core. On most parallel cores, however, a right angle between the platform and a restricted area of blade detachment is achieved (see Fig. 5:b).

Table 3. Percent representation of cores with unidirectional *vs.* bidirectional product debitage by site.

	"Irregular" cores		"Parallel" cores	
Site	Unidirectional	Bidirectional	Unidirectional	Bidirectional
Ali Kosh	100	0	100	0
Asiab	82.9	17.1	85.6	14.4
Karim Shahir	91.2	8.8	98.8	1.2
Pa Sangar	78.8	21.2	-	-

Angles on "parallel" cores at Asiab and Ali Kosh approximate ninety degrees with respect to some portion of the detachment surface. At Asiab, platforms are oriented squarely with respect to the whole core in two out of three cases. At Ali Kosh, platforms are nearly always oriented squarely. "Irregular" blade cores from these sites are few in number and less uniform; generalization about their platform angles is not possible.

Directionality of Blade Detachment

Bidirectional cores constitute a substantial proportion of the Pa Sangar assemblage. Smaller but significant frequencies of bidirectional irregular cores are present at Karim Shahir and Asiab. At Ali Kosh, irregular cores are so infrequent that representation of bidirectional cores can not be evaluated.

Asiab is the only site with significant numbers of bidirectional parallel cores. The pressure technique does not lend itself to simultaneous exploitation of the same removal surface from opposing ends, due to frequent overshooting. Exploitation of the two platforms appears to be serial rather than simultaneous: the majority of blade scars emanated from one platform, but one or two blades had also been detached from the opposite platform.

Ascendancy of the pressure and indirect percussion techniques coincided with a decline in bidirectional strategies of core reduction. Among the sites at which the pressure technique was used, Asiab shows the highest percentage of bidirectional cores.

Distal Modification

Evaluation of the frequency of distal modification proved to be problematic. Cores that were bidirectional or had blade scars covering all areas below the platform had to be excluded from the analysis for reasons stated earlier. The remainder of the cores (termed "NN") were checked for distal modification. Table 4 shows the number of distally modified cores; their percent of representation in the total assemblage studied (EA); and their percent of representation among the NN subsample. Because the numbers of cores excluded from analysis for this parameter varied so much from site to site, representation among the NN subsample proved to be the more salient observation.

Representation varies among the four sites, but does not follow any diachronic trend. Distal modification is frequent among the NN samples at Pa Sangar, but low among the entire assemblage because of the large number of bidirectional cores. Distal modification is present in equal frequencies of parallel NN cores at Karim Shahir, but is less prevalent among NN irregular cores, and equally represented among NN parallel cores. The frequency of distal trimming increases at Asiab; parallel and irregular assemblages show equal and high frequencies among NN cores. Virtually all cores from Ali Kosh are in an advanced state of reduction which probably prohibited detection of distal trimming in many instances.

Table 4. Percent representation of distally modified cores among a subsample of cores without bidirectional product removal or complete blade scar coverage (NN) and among the entire assemblage (EA) of irregular and parallel cores, by site.

	Distally modified "irregular" cores			Distally modified "parallel" cores		
Site	n	% of EA	% of NN	n	% of EA	% of NN
Ali Kosh	-	-	-	5	1.5	11.3
Asiab	51	51.0	75.5	47	41.5	76.8
Karim Shahir	182	33.3	38.3	167	47.7	49.2
Pa Sangar	26	28.3	50.0	-	-	-

Two tentative observations may be offered regarding distal modification among these assemblages. It is possible that distal modification consistently increased in frequency but is simply undetectable within the Ali Kosh assemblage. It is also interesting to note that among NN samples, frequencies of distal modification show rough consistency within individual sites. Variation in this trait appears to be between sites rather than according to the technique of blade detachment. The masking of distal modification scars by subsequent blade detachment, however, renders any interpretation of this trait problematic.

Flaking Across the Platform

The presence and extent of platform flaking varies both between and within sites (Table 5). Cores from Pa Sangar show infrequent platform modification. In rare instances a platform was renewed by removing a flake from the front. No cores show multiple removals. With the onset of pressure at Karim Shahir, the practice of platform alteration became more frequent and more extensive among both parallel and irregular cores. At Asiab, this trend continues; multiple scars characterize half of the irregular cores and three out of four parallel cores. Basal Ali Kosh exhibited the highest frequency of multiple-scarred platforms. Curiously, throughout the sequence at Ali Kosh the trend dissolved. Zone C1 still shows high proportions of multiple-scarred cores, but elevated frequencies of Type P cores. In Zone B1, most cores have a single, primary scar with no subsequent alteration. Zone A1 saw a resurgence of platform flaking.

The implications of these trends are twofold. First, platform flaking was probably not often done before the advent of the pressure technique in the area. This is not unexpected; as previously noted, platform flaking is good for minuscule adjustments to the platform angle but also jeopardizes the future use of the core. Second, the changing frequencies of flaking at Ali Kosh attest to different strategies or skills at a single site over time. Sources of raw material do not appear to change much throughout occupation of the site[1]. Variations in raw material can, therefore, be eliminated as a contributing factor. In comparison to other zones, cores from B1 were reduced to a much smaller size and diameter before discard[2]. One may conclude that platform flaking was a useful technique for adjusting platform angle, but that the flintknappers of Zone B1 could often create a near-perfectly angled platform. This platform required no readjustment and allowed maximal exploitation of the core. In Zone A, the frequency of multiple-scarred platforms increases, as does the average size of discarded cores.

Extent of Platform Use

Platform exploitation increased through time (Table 5). In the upper levels of Pa Sangar, most core platforms show product detachment scars around roughly half or less of the platform perimeter. Irregular cores at Karim Shahir show similar representations of exploitation patterns. Parallel cores from Karim Shahir have various sorts of removal scars extending around the entire core in more cases, but scars from blade detachment are confined to a limited area. At Asiab, use of the entire platform increases considerably among irregular cores and dramatically among parallel cores. Finally, circumferential detachment of blade products dominates at Ali Kosh.

Table 5. Percent representation of platform flaking among cores.

Site	Type P: single, primary scar only	Type PS: primary scar; one secondary scar	Type S: multiple scars
Ali Kosh A1	9.5	18.1	62.3
Ali Kosh B1	60.0	11.8	28.2
Ali Kosh C1	21.3	9.8	68.9
Ali Kosh C2	2.9	5.7	91.4
Asiab (parallel)	7.6	17.1	75.2
Asiab (irregular)	25.3	37.3	52.2
Karim Shahir (parallel)	30.2	31.1	38.7
Karim Shahir (irregular)	37.7	30.3	32.0
Pa Sangar	(100% between	Types A and B)	0

[1] The sole exception to this is the predominance of one particular type of flint in the atelier context in Zone C2 at Ali Kosh. This flint is medium to dark grey and banded, but seems to be of similar quality compared to other flint types present. These other types are present in the atelier context, though in limited numbers. The banded flint is also present in Zones C1, B1, and A1, but does not predominate in those zones. The obvious inference is that the atelier flint consisted largely of material collected in a single episode, while cores in subsequent zones reflect a palimpsest of debitage containing material collected from a variety of sources and on a number of occasions.

[2] (1994) studied morphometric characteristics and likely causes of discard (hinging, plunging, exhausted platform, etc.) of cores at Ali Kosh. Cores from Zone B1 had the smallest average length and platform area of the zones studied. It also had the highest proportion of cores discarded due to exhaustion.

Table 6. Extent of platform use among cores.

Site	Type C circumferential detachment of blades	Type D: circumferential detachment of blades and flakes	Type E: detachment from restricted area of platform
Ali Kosh (parallel)	89.6	4.5	5.9
Asiab (parallel)	34.5	33.6	31.8
Asiab (irregular)	17.1	15.7	67.1
Karim Shahir (parallel)	4.0	21.1	74.9
Karim Shahir (irregular)	5.9	10.3	83.9
Pa Sangar (irregular)	6.1	9.1	84.8

The different platform exploitation patterns indicate different constraints operating on blade detachment at the different sites. At Pa Sangar and Karim Shahir, in most cases the backs of the platforms have obtuse angles that could not be worked. Attempts to trim the sides of the core to extend the surface of detachment are not common at either site. At Asiab, in most cases, platforms are oriented squarely to most of the core. Frequent attempts to extend blade production around the whole core through either side trimming or blows from the top platform are evident. Substantial representation of circumferential cores at Asiab shows that these attempts were often successful. At Ali Kosh, a system of core preparation had developed to the point that nearly all parallel cores had circumferential blade detachment. The majority of non-circumferential cores at Ali Kosh are from Zones C1 and C2, which suggests that some final refinements in the system may have occurred during early episodes of occupation at the site.

Discussion

Several of the six parameters investigated display patterned variation among the study sites. Some such patterns follow chronological trends. Before delineating a scheme for developments in the Zagros blade production over time, however, caveats must be offered regarding other factors that may have played a role in creating the observed patterning. These include taphonomic processes, inter-site differences in the quality and nature of available raw material, and changes in the nature or size of desired blade products.

Taphonomic Processes

The sites studied each display some aspect of internal diversity in strategies of blade production. Attribution of this variation to a particular cause is problematic, for it is not certain whether variation within their lithic assemblages is synchronous or results from post-depositional mixture of remains from successive occupations. Intra-assemblage variation in core form is least pronounced among Pa Sangar's Zarzian units. Therefore, although occupation of the site probably spanned several millennia, the upper units may be treated as a coherent assemblage. At Karim Shahir, the shallow depth of stratigraphically undifferentiated deposits spread over a large area suggests a palimpsest of successive habitations. However, the dearth of material that is extremely common in only slightly earlier or later time periods[1] would suggest that the site was occupied over a limited time. At Asiab, mixing between horizons is evident. If technological diversity within Asiab were caused by incidental mixing of temporally-dispersed assemblages, one would expect to see some remaining diachronic trends between levels within the site. Instead, representation of various core traits is roughly consistent from level to level within the site. The variety within levels and homogeneity between levels suggest either that mixing processes at Asiab were incredibly thorough, or that diverse strategies were used by inhabitants throughout occupation. Because Ali Kosh is a neatly stratified site, several changes over time are identifiable. Although the contextual integrity of some of the selected sites is far from ideal, it is fair to argue that variation within assemblages from these sites reflects contemporary diversity rather than mixing of unlike assemblages.

Raw Material

Another factor to be considered is the differences in raw material available to knappers at each site. The size of original nodules or cobbles, their quality and abundance, and the distance to their source might create very different economic settings for blade production at each site. These con-

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[1] Deliberately manufactured trapezoids are nonexistent at Karim Shahir (HOWE 1983); circumferential bullet cores and other artifacts characteristic of later periods were present in very small quantities.

ditions could profoundly influence core reduction strategies of knappers with essentially the same menu of skills and strategies. None of the sources for flint from these sites has been identified, but available information pertaining to raw material is outlined here for each site.

Pa Sangar cores are all relatively small, typically measuring about 2.5x2.5x3.0cm. Most appear to come from river cobbles, most of which fall into five different color groups. Cores from Karim Shahir spread across a large size gradient. Cores as large as 3.0x2.5x6.0 are frequent, as are those measuring 2.0x1.5x3.0cm. Remaining cortical areas suggest a riverine source. Much of the flint from this site shows pronounced patination and was not grouped according to color. Asiab cores usually measure 2-3cm in width and thickness, and about 5cm in length. Blade and systematic flake debitage is accompanied by a vast quantity of small chunks and flakes of low-grade raw material. Asiab cores also show bimodality in size distribution with respect to detachment technique: about half of the irregular cores are considerably larger than all of the parallel cores, suggesting that they may be failed pre-cores. Judging the source of the good Asiab material is problematic because in most instances the cortex has been removed. The same is true for parallel cores from Ali Kosh.

Several inferences may be suggested based on this information. Knappers at Karim Shahir had access to relatively large nodules. While a large number of core tablets attest to rejuvenation efforts and some need to economize on raw material, some cores that could have been re-worked to obtain more blades were discarded; raw material may well have been abundant. At Asiab, scrappy raw material was used for a variety of opportunistic purposes, while most of the good raw material was directed toward blade production using either the pressure or indirect percussion technique. Raw material constraints also may have affected the final shapes of cores. If material were scarce at Asiab, flintknappers there may have sought to increase core productivity by extending the use of platforms. Disparities in economic constraints on tool production may have contributed to differing patterns of core exploitation. Conversely, constraints may have been similar through time, but skills at maximizing product extraction may simply have improved. At this juncture, the causal factor cannot be defined adequately. Examination of material from other sites with different degrees of raw material availability may elucidate this point.

Blade Products

Mental templates for and uses of blade products also affect knapping strategies. Changes in the size or function of intended products could influence decisions regarding the technique of blade detachment, or the size at which cores were deemed exhausted. However, the fields of raw material and blade production methods, skills and techniques, all reciprocally affect the array of obtainable blade products. Knowledge of the exact economic and technological constraints posed by raw materials and desired products at various sites is still sparse. However a preliminary synthesis of the implication of variation in blade detachment strategies may be offered.

Conclusion

Examination of six parameters of variation among core assemblages from four Zagros sites has elucidated several changes in strategies of blade production around the adoption of agriculture in the region. The pressure technique came into use locally between 12,000 and 10,500 BP. Initially, cores on which pressure and indirect percussion were used have the same base plan as the prior direct percussion cores: platforms are oriented at a slightly oblique angle and are used on one side only.

Changes in other aspects of core reduction took place coincident with the first use of pressure. The first was a decline in the bidirectional use of cores. This may have reflected the constraints on bidirectionality imposed by the new techniques of detachment, or an economic decision that unidirectional blade detachment via pressure or indirect percussion was more efficient than bidirectional direct percussion. The second change was a tendency for platform angles to approach ninety degrees on part of the blade detachment surface. This change mainly concerns parallel cores and was doubtless linked to the need of a right angle to execute pressure. The third coincident change was the beginning of platform trimming. The onset of this practice probably was also associated with the adoption of the pressure technique, which required minute adjustments in platform angles. The changes in core form occurring coincident with the adoption of pressure in the Zagros are directly related to the needs and constraints posed by the new technique.

Following the initial use of pressure, other changes in core reduction skills and strategies appear. The first of these is the gradual ascendance of the technique itself: representation of parallel cores grows steadily over time. A second aspect of gradual change concerns use of the perimeter of the platform. Such use increases steadily over time as squarely oriented platforms become more common. This change may be attributed provisionally to greater skills in economizing raw material. However, the possibility remains that differences in raw material availability between sites may have also given knappers at Asiab and Ali Kosh more incentive to economize. A final change is in the use of platform flaking, which increases in frequency from Karim Shahir through basal Ali Kosh, becomes less common during the middle occupational phases of Ali Kosh, and then predominates once more. The fluctuating use of platform flaking indicates changes in skills and/or strategies during the occupation of a single site whose raw material menu remained constant through time.

Comparison of assemblages has established a more concrete date for the inception of the pressure technique in the Zagros. It has also allowed distinctions to be drawn between changes in core reduction methods that occurred coincident with the practice of the new technique, and those that took place gradually or subsequently. The preliminary data gathered here do not allow one to discern whether the pressure technique was a local invention, a non-local technique adopted from elsewhere and integrated into the local technological system, or an entire lithic reduction system brought in by outsiders or adopted wholesale. However, the conclusions above would tend to favor one or the other of the first two hypotheses. At its inception, pressure was executed on cores very similar in form to the preceding cores of the Zarzian. The few coincident novelties in core form (platform flaking and slightly adjusted platform angle) relate directly to requirements of the pressure technique. Other aspects of core form, such as orientation of the platform with respect to the whole core, and use of the platform perimeter, changed more gradually after the technique was established. Blade detachment via other techniques also persisted alongside use of the pressure technique. The pressure technique therefore seems to have been integrated into the local Zagros system of lithic production rather than imported as a self-contained system. Pressure debitage has been recorded in early agricultural sites east of the Zagros (INIZAN 1991), which may have been the source area for adoption of this technique.

Comparison of cores from selected sites thus defines a time and suggests a technological setting for the onset of pressure blade detachment in the eastern Fertile Crescent. These conclusions are preliminary and will be subject to testing and refinement through the study of core assemblages from other Zagros sites. They do, however, establish an inclusive framework for studying changes in stone tool production. Some of these more broadly defined changes may eventually be linked to those in related spheres of subsistence and economy, which were transformed during the adoption of food production in the eastern Fertile Crescent.

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Late Pleistocene Lithic Traditions in the Near East and their Expressions in Early Neolithic Assemblages

Ofer Bar-Yosef

Why Identify Lithic Traditions?

The accumulation of systematic observations concerning human activities in recent years has led anthropologists to recognize that the sequences of human gestures and actions are the results of learned behaviors (*e.g.*, LEMMONIER 1992). The learning process occurs both within the group of peer actors as well as through the transmission of knowledge and training from an older generation to a younger one. Activities such as manufacturing artifacts, hunting, gathering, farming, and herding involve both orally-transmitted knowledge and designed artifacts. Apprenticeships, in which language and gestures are intertwined, enable the young and inexperienced to learn from a knowledgeable adult. Rehearsals, repetitions, and supervised practicing are part and parcel of the learning process through which the one who teaches becomes assured that the tutee is sufficiently familiarized with the details of the action(s) or the final design of the object.

All human activities, whether related to subsistence or religious expression, involve the use of nonperishable materials to varying degrees. The use of materials that have the potential of preservation in archaeological contexts provides researchers of the past with a great advantage as it ensures the recovery of objects, whether in their original form or a discarded shape. The disadvantage, however, is that one can never accurately reconstruct the entire array of oral or gestural expressions, often of symbolic nature, that accompanied the production process, the object's use, and its subsequent discard. Only certain aspects have the potential of being perceived through the investigation of artifacts, whether domestic or profane. In later prehistory, the investigations of building techniques, house plans, site structure, installations of various functions, as well as "art objects" and ecofacts, provide additional information concerning the activities of a given society and its unique cultural properties.

The ability to reconstruct the ways in which prehistoric humans made and employed their stone tools was already recognized by nineteenth century scholars. However, only during the twentieth century was this pattern recognition systematized. While definitions of various techniques for making stone tools were labeled intuitively during the early phase of research, the subsequent detailed analysis benefited from the introduction of quantitative classifications devised by researchers such as F. BORDES. BORDES' pioneering efforts culminated in a double type-list. One part, which unfortunately became the most famous aspect of his work, was the type-list for the Lower and Middle Paleolithic (BORDES 1960). The second type-list detailed the observations made on the entire assemblage, including the morphology of the blanks and cores, and the counts of debris. As a flint knapper himself, Bordes insisted that these type-lists should include not only the morphology of the classified artifacts (mostly retouched pieces) but also a recording of the ways or methods in which blanks were obtained and employed when defining "prehistoric cultures" or provinces.

The basic Bordesian approach was later incorporated into the concept of *chaîne opératoire,* which was borrowed from social anthropologists who first studied the technology of non-western societies (*e.g.*, CRESSWELL 1983, LEMONNIER 1992). In addition, systematic research demonstrated that the deterministic nature of cultural mental templates in modern technology, such as the aircraft industry, is not much different from the ones observed among traditional societies (LEMMONIER 1992). While A. LEROI-GOURHAN was the first archaeologist to employ this concept, it took an additional two decades for it to become a practical framework for studying prehistoric assemblages (*e.g.*, PIGEOT 1991, PERLÈS 1992, BOËDA 1995, MEIGNEN 1995, ROCHE and TEXIER 1995, TEXIER 1996). The adoption of *chaîne opératoire* as a dominant concept, first in French prehistory and later in other regions of the world, resulted in a few somewhat ambiguous translations and an entire suite of misunderstandings.

A common translation of this term is "operational sequence". In the study of lithic industries, this relates to the entire process: from the acquisition, testing, and transport of raw material to the stages of manufacturing blanks, using and discarding them. It also includes reshaping them into retouched pieces and re-tooling, resharpening, and curation. An alternate translation of *chaîne opératoire* is "reduction sequence", which is used to indicate the removal of blanks from cores or, in a more limited sense, the reduction of retouched edges of side scrapers and other tools. The term "operational sequence" is more comprehensive than the term "reduction sequence" (*e.g.*, DIBBLE 1995).

The use of ethnographic examples to determine the function of tools based on their shapes began during the nineteenth century. This was a common way in which prehistorians tried to make sense of Pleistocene cultural manifestations that were essentially known from lithic artifacts (*e.g.*, SOLLAS 1915, MacCURDY 1926). The study of tools' wear patterns by high or low microscopic magnifications began in earnest only after the 1950s. Hence our current knowledge combines both the shape of the artifacts and their function as recognized by micro-polish or edge damage. An example relevant to the following discussion is the study of arrowheads or projectile points. On the one hand, it is easy to recognize the shapes of the points as having served as arrowheads mainly because ethnographic examples closely resemble the prehistoric tools. On the other hand, butchering marks identified by microscopic study (*e.g.*, MOSS 1983) are not recognized by the naked eye when these objects are classified into a detailed type-list. The use of arrowheads as cutting knives for butchering is known from observations collected by ethnographers. However, for identifying cultural groups, the technique by which the tool was made and its form are more important than its secondary function.

When *chaîne opératoire* can be demonstrated to persist for a long time, as dated by ^{14}C, it can be interpreted as evidence of continuity of a single learning process. If such a *chaîne opératoire* seems to characterize a group of sites within a small area or the same site for a long time, one may posit that all the archaeological remains resulted from the activities of a certain "group". Hence, *chaîne opératoire* is an important component within the cultural-historical approach that aims to reconstruct the prehistory of specific populations. It is an archaeological tool that is based on what is known about human behavior in tool production and use and the manipulation of raw materials. Unfortunately, perishables such as baskets, nets, mats, wooden tools, arrows and spear shafts, and digging sticks were not preserved in most cases. In those places where cordage was found, differences between cultures or "cultural provinces" still emerge despite the limited number of ways in making strings, twinning, and plaiting (*e.g.*, SCHICK 1988).

These introductory comments are necessary in order to clarify the main issue presented here. It is my aim to demonstrate that by adopting this general approach to the Early Neolithic we can provide an interpretation of the archaeological data concerning the geographic loci in which plant cultivation was first established in southwestern Asia. Such an interpretation will also point out the geographic directions in which the suite of technological, economic, and social components of the agricultural revolution moved, together or separately, by migration and demic-diffusion (BAR-YOSEF and MEADOW 1995).

A general comparison between the lithic techniques, blank types, and tool typology during the Early Neolithic in the Near East has already revealed two interaction spheres (KOZŁOWSKI and GEBEL 1994). The western sphere covers the area of the Levant and parts of southeast Anatolia; the eastern one stretches along the Zagros and the Mesopotamian foothills. In the following pages, in addition to providing a brief description of the primary operational sequences in each province, I will try to outline the main evolutionary implications of these archaeological observations.

The Early Neolithic in the Levant

The lithic traditions of the Levantine Neolithic emerged from the preceding local Epi-Paleolithic microlithic industries (*e.g.*, BELFER-COHEN 1994). However, in most areas, the newly established knapping method departed from the Epi-Paleolithic traditions.

The Neolithic industries are classified according to the same principles as the Epi-Paleolithic ones. Subdivisions of the lithic sequence, in both time and space trajectories, are marked by the frequencies of various types of arrowheads (CAUVIN 1978; BAR-YOSEF 1981; GOPHER 1989a,b, 1994). Forms of sickle blades also change over time, but this tool type does not occur in the semi-arid region. The same holds true for the axe-adze category (*e.g.*, BAR-YOSEF 1981).

The earliest Neolithic entity was defined by ECHEGARAY (1966) as Khiamian on the basis of his excavations on the terrace of El-Khiam in the Judean Desert. In such a site, where deposition was on a slope, mixing and intrusions of artifacts are expected (BAR-YOSEF 1981). When mixture is evident or when proper sieving was not practiced (*e.g.*, Jericho), one can only refer to the typical Neolithic elements, such as sickle blades, Khiam points and other arrowhead types, perforators, and bifacial tools. This limited tool-kit designates Neolithic sites within the belt of the farming communities along the Levantine Corridor (Fig. 1). It differs from the assemblages produced by contemporary hunter-gatherers, such as in Abu Madi I (BAR-YOSEF 1985). Analysis of Khiamian assemblages by CROWFOOT-PAYNE (1976,1983) and the excavation in Salibiya IX (BAR-YOSEF 1980; ENOCH-SHILOH and BAR-YOSEF 1997) clearly demonstrate the uniqueness of this industry, in spite of claims to the contrary (NADEL 1990).

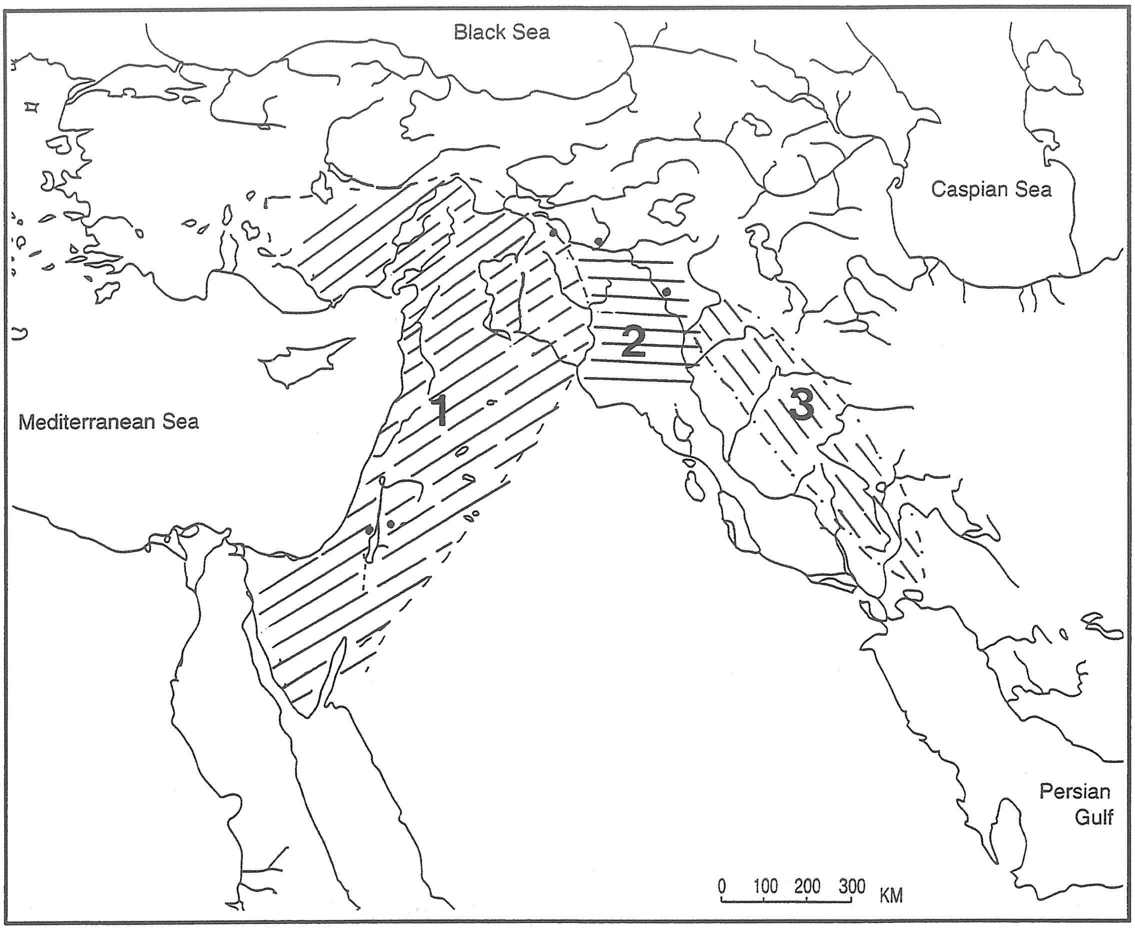

Fig. 1: The three regions in the Near East: 1) The Levant and the advance of colonizing communities into Anatolia; 2) The boundary zone between the Levant and the Zagros foothills; 3) The Zagros region.

I believe that the Khiamian occupies the short transitional period from the Late Natufian to the Sultanian villages. It includes microliths such as small lunates, Khiam points, and sickle blades but lacks the bifacial tools (axes-adzes). The geographic definition of the industry is not yet clear. KOZŁOWSKI (in press) refers to the Khiamian as a more general industry that is found across the western and eastern provinces of the Near East. However, a cautionary remark is necessary. Employing only the Khiam points as markers can be misleading if we are attempting to isolate "people" within the geographic space. Khiam points are also present in sites such as Abu Madi I in southern Sinai, which dates to the early 10th millennium B.P. and was a habitation of local foragers. Although the operational sequences of Khiamian assemblages were not studied in detail, certain aspects of the cores, debitage, and used blanks resemble an Epi-Paleolithic industry. It is not inconceivable that Khiam points and the perforators, often of small size, were shaped from blanks that were obtained from one type of core, while the somewhat elongated blades employed as sickle components were removed from another type of core. Given the ambiguities concerning the Khiamian industry, there is an urgent need for additional research.

The Sultanian is the lithic industry best documented in the Jordan Valley and its immediate environment. The sites are Jericho, Gilgal, Netiv Hagdud, Gesher, and cave of Iraq ed Dubb. This entity was first defined by Crowfoot Payne (1976, 1983; BAR-YOSEF 1980, 1991; BAR-YOSEF *et al.* 1991) on the basis of the Jericho lithic assemblages. The industry is characterized by single platform blade cores, many of which were exhausted. Among the retouched pieces are Khiam points, sickle blades on large blades, sometimes with bifacial retouch (Beit Ta'amir knives), and a preponderance of small blades and flakes shaped into burins and perforators. Other tools include the Netiv Hagdud truncations (BAR-YOSEF *et al.* 1987, LECHEVALLIER *et al.* 1989). The presence of lunates often seems to be the result of mixing with earlier assemblages although the possibility that they were part of the original assemblage is not excluded. A large class of 'nibbled' tools that were either finely retouched or bear signs of utilization are mostly blades. Tranchet axes-adzes, also known as Tahunian axes, have a working edge shaped by transverse removal. In addition, polished celts made of either limestone or basalt are included.

In the Euphrates Valley, CAUVIN (1989) defined the Mureybetian, an industry that shares some techno-typological features with the Sultanian. As mentioned above, the most obvious one is the Khiam points that are found from southern Sinai (Abu Madi I) to Jebel Sinjar (Qermez Dereh). The distribution of this point defines the PPNA interaction sphere and reflects the communication and exchange between hunters across the landscape. These long-distance connections are also evidenced in the imported obsidian items that are delivered from central Anatolia and travel over distances in excess of 1,000 km. It is proposed that forager groups were instrumental in maintaining this long-distance exchange network (BAR-YOSEF, in press).

An examination of available ^{14}C dates along the geographic axis and changes in the lithic industries appear to suggest that the PPNA period began earlier in the central Levant (the Damascus basin and the Jordan Valley) than in other areas. Radiocarbon dates indicate a somewhat later arrival of the typical PPNA village assemblages in the Euphrates Valley, in such sites as Jerf el Ahmar (STORDEUR and JAMMOUS 1995). The south-north direction possibly shifted when the earlier emergence of the PPNB lithic core reduction strategies began in the northern Levant (Mureybet IIIB). The technology and the diffusion of Helwan points was from the middle Euphrates southward (CAUVIN 1987; GOPHER 1989a,b, 1994; ROLLEFSON and KÖHLER-ROLLEFSON1989). In light of the ambiguities created by the calibrated radiocarbon chronology (*e.g.*, EVIN 1995), chronological interpretations based on short periods as defined by the uncalibrated B.P. dates should be regarded as tentative conclusions.

The Early Neolithic in the Taurus and Zagros Foothills

In Anatolia, the Zagros, and the Transcaucasian region, microlithic industries prevailed through the Terminal Pleistocene and early Holocene (*e.g.*, YALÇINKAYA *et al.* 1995; KOZŁOWSKI, in press). During the early Neolithic, a special technique for the removal of bladelets by pressure is evidenced by the presence of the "bullet cores" (INIZAN and LECHEVALLIER 1994; KOZŁOWSKI, in press). This procedure of blank manufacturing is not accompanied by secondary retouch by pressure as is common in PPNB assemblages in the Levant and Anatolia. Tool shaping is done by backing on an anvil and by some flat retouch that only resembles pressure flaking. Retouched pieces produced in this way are present in the Nemrikian and Mlefatian industries (HOLE 1983, 1987, 1994; KOZŁOWSKI 1994, in press; KOZŁOWSKI and GEBEL 1994), including the Deh Luran sequence (HOLE *et al.* 1969).

Pressure flaking seems to have originated in areas where the available nodules of hard rocks were suitable for the application of such a technique. This could have taken place where obsidian (volcanic glass) was the common raw material. In rare cases, naturally "heat treated" flint or chalcedony are found where a lava flow covered a limestone formation. One may therefore speculate that the original homeland of the pressure flaking technique in western Asia was somewhere in the region that stretches from central Anatolia through the southern Caucasus (including Armenia) and later spread southward through the Zagros (INIZAN and LECHEVALLIER 1994).

The lithic assemblages of the Zagros Neolithic conserved the old tradition of making microliths, either as barbs for hunting tools or as components of cutting tools. The suite of Levantine arrowhead types is practically unknown in the region south of the "homeland" of the Nemrikian. It seems that interaction between the Levantine and Zagrosian spheres was in the land that stretches from the Khabur river through Jebel Sinjar and into the Tigris River valley and the foothills of the Zagros (or the northern Nineveh and the Dohuk provinces; see Fig. 1). It is from this area to the Khuzestan plain that the Zagros interaction sphere produced archaeologically-similar characteristics in the lithic industries. This is also the zone in which "bullet cores" are found (see map in INIZAN and LECHEVALLIER 1994).

In the intermontane valleys, the foothills, and the Khuzestan plain, the dominant Neolithic industries are essentially blade/bladelets industries (although with a constant component of flake tools). The agricultural revolution spread in this area from north to south (HOLE 1994), reaching the Den Luran plain by 8,300/8000 B.P.

Discussion

Due to the lack of written documents, archaeologists, who are interested in cultural history, reconstruct the prehistory of various populations using archaeological methods. However, in spite of the scientific approach, we often find that, in the course of any one period, cultural and economic changes are intertwined and it is sometimes impossible to figure out which change came first. Reaching an agreement concerning the causes for cultural change, or what is often referred to as the "why" question, is an insurmountable task. Our own views on this issue are presented elsewhere (BAR-YOSEF and BELFER-COHEN 1989a, 1991, 1992; BAR-YOSEF and MEADOW 1995). We satisfy our own curiosity by addressing the first two questions of "when" and "where".

Recently we were able to identify when and where the transition from foraging to agriculture took place in the Near East. In several published summaries, we suggested that the first steps toward intentional cultivation began in the Levantine Corridor and more particularly, following an earlier proposal by VAN ZEIST (1986), between the Damascus basin and Jericho (BAR-YOSEF and BELFER-COHEN 1989a,b, 1991, 1992; BAR-YOSEF and MEADOW 1995). In order to examine the outcome of this socioeconomic change, we first need to briefly summarize the cultural evidence from the Levant. This will enable us to differentiate between the archaeological sequences of the Levant and the Zagros foothills and to conclude that the dispersal of the agricultural subsistence system involved two processes: population expansion and regional acculturation.

According to the reconstructed scenario, intentional cultivation emerged during the closing centuries of the Younger Dryas, during which time hunting and gathering continued to serve as major subsistence activities (BAR-YOSEF and BELFER-COHEN 1989a, MOORE and HILLMAN 1992).The immediate result, within only a few centuries, was the formation of villages such as Jericho, Netiv Hagdud, Gilgal, and others. Population growth in certain settlements was probably enhanced by annual aggregations or even by permanent clustering. Hence, the disappearance of the Harifian entity in the Negev and Sinai and the abandonment of most of its territory during the ensuing millennium could have been the outcome of this process. Even if the early villages were not inhabited year-round (as in some historically-known villages in the Near East that practiced a partial transhumance), they created a sedentary base in which large groups of people lived. The shift in settlement pattern, from the Late Natufian to the Sultanian, and the establishment of a new subsistence system, caused rapid population growth due to the availability of reliable supplies of weaning foods. The work load also changed as a result, leading to a shift in the roles of females and males within the society. By 10,000/9,700 B.P. (uncalibrated), large villages accommodated biologically viable groups (BAR-YOSEF and BELFER-COHEN 1989b) and minimized the need for keeping an active mating network over considerable geographic distances.

Rescheduling of activities and the increase in the number of family members seems to have been expressed archaeologically by several phenomena. First, there are clear indications for differential treatment of children and adults (BAR-YOSEF *et al.* 1991). Skull removal is practiced after death in all adult burials, though children's skeletons remained untouched. The post-burial treatment of adult skulls has been interpreted as an effort to negotiate equality within the community (KUIJT 1996). The egalitarianism which presumably characterized the foraging tradition disappeared at the village level as evidence appears for inequality in access to foreign commodities such as the Anatolian obsidian. This observation is based, for example, on the different amounts of obsidian (calculated in relation to the excavated volume) recovered in the Lower Jordan Valley sites (Jericho, Netiv Hagdud, and Gilgal). Even if the exact nature of the latter site and its apparent proximity to Netiv Hagdud is not yet well understood, the importance of Jericho among the three sites is remarkable. The intuitive feeling that the Neolithic population in such a small area was already on the road to a ranked society is thus unavoidable.

Of the various results of the agricultural revolution, the issue particularly relevant to this discussion is population growth, which is expressed by the budding-off of new communities. Villages with typical PPNA lithic industry and other attributes of early cultivating communities were established in the Euphrates Valley, bypassing the semi-arid area that stretches between the river valley and the Damascus basin. Perhaps one day similar sites will be discovered in the Orontes Valley or the Palmyra oasis. The process of budding-off did not constitute a tidal wave of farmers. It was justifiabley described by VAN ANDEL and RUNNELS (1995) as a noncontinuous occupation "leaping" from one area to another. This demonstrates the expected way in which cultivators who are looking for suitable land, easy access to fields, and water resources will move over the landscape. It also means that an extended communication system (for mating, down the line exchange, etc.) would establish permanent topographic pathways.

The process of budding-off began during the PPNA and continued into the PPNB. The ongoing process of colonization by groups of farmers who separated from a mother population is better known from later history. Our ability to identify the colonizing groups relies on recognizing material culture attributes that are found in earlier sites in the "mother-land". In the course of this inquiry, the operational sequences that characterize the production of lithic artifacts, as described above, are some of the nonperishable markers that identify a given society. The list of attributes in such a study will vary. For example, the practice of the "naviform" core technique, which is typical of the Levantine Corridor, extends into the Anatolian plateau (*e.g.*, INIZAN and LECHEVALLIER 1994: WILKE and QUINTERO 1994, QUINTERO and WILKE 1995, ABBÈS 1994, BALKAN-ATLI 1994, ÖZDOĞAN and BALKAN-ATLI 1994).

Another element which would be significant in this study is the choice of a particular raw material which is probably the expression for a pre-conditioned knowledge. Such is the case of Nevalı Çori (SCHMIDT 1994), where all the artifacts were made of flint in a region where obsidian was employed in many sites. The choice of finished forms is another example. Among the retouched pieces, the most significant are the arrowheads. As mentioned above, arrowheads often delineate the boundaries of an interaction sphere at a given time. This happens because projectiles are part and parcel of a reciprocal relationships expressed in gift-giving among hunters. Thus the far-away distribution of projectiles designates only the range of the exchange and not necessarily the boundaries of the main social entity.

When we examine the geographic distribution of the lithics and their techno-typological characteristics, it is difficult to avoid the conclusion that the move into the Anatolian plateau was done by the Levantine farmers and their descendants.

Architectural elements such as house forms cannot be easily considered as societal markers unless they are considered within a sub-region. The basic house forms (rounded pit houses) are the same among most sedentary foragers. The same is true for the oval-rounded PPNA dwellings, although local features within the houses can be identified, as in the case of Qermez Dereh (WATKINS *et al.* 1989). PPNB houses, although rectangular in plan, demonstrate a regional variability that is probably related to both materials used (adobe, bricks, stones) and the local climatic condition.

During the PPNB, the core area for innovations is either in the northern end of the Levantine Corridor or in the inter-montane valleys or on the plateau of southeast Anatolia. Craft specialization that marks the operational sequence of the "naviform cores" (ABBÈS 1994, WILKE and QUINTERO 1994; QUINTERO and WILKE 1995) possibly emerges in this region. In addition, it seems that the domestication of goat and sheep took place in the same prehistoric province sometime around 9,600 B.P. (LEGGE 1996).

The transmission of both agricultural techniques and emmer, wheat, and barley seeds into Cappadocia and the Konya plain marked another successful step in colonization. In part, sites such as Aşıklı Hüyük may represent the results of the cultural impact on local populations. The geographic location of these village sites seems to be related to the control over the obsidian resources (ESIN *et al.* 1991, BALKAN-ATLI 1994). Çatal Hüyük is a different case (MELLAART 1967). While the detailed discussion of this issue is beyond the scope of this paper, it should be stressed that annual crops generally produce higher yields in a foreign territory than in their native land. This may explain the explosive nature of the agricultural communities across the Anatolian plateau where, according to current vegetational reconstructions, the progenitors of the domesticated cereals were not present during the Late Pleistocene (HILLMAN 1996; BAR-YOSEF, in press).

A different scenario is suggested for the Zagros foothills, from the northern arch of the Taurus mountains to the Den Luran plain and through the intermontane valleys. This region was not a natural part of the homeland of the progenitors of the cereals (HILLMAN 1996).The evidence for acculturation in this region is stronger than in eastern Anatolia (KOZŁOWSKI 1994, in press). The continuity of the production of microlithic industries in Neolithic villages indicates that old traditions lasted longer. The transition to agriculture seems to have been a rapid one as indicated by the radiocarbon dates from this region (HOLE 1994 and references therein). It would therefore be an interesting research topic to investigate the process of acculturation in the Zagros foothills and its social and economic context.

In sum, the two provinces in western Asia, the Levant and the Zagros foothills, played different roles at the origins and early spread of the agricultural revolution. Instead of treating the Fertile Crescent in its entirety as the "homeland" of this important revolution, we may now examine in more detail the particulars of the late prehistory of the Levant that made it the source of this major socio-economic process.

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The Late Epipalaeolithic as the Precursor of the Neolithic: the Lithic Evidence

Anna Belfer-Cohen and Nigel Goring-Morris

Abstract: *The end of the Epipalaeolithic and the beginning of the Neolithic in the Levant is commonly presented as a major break in numerous aspects of the material-culture record. However, comparisons of selected techno-typological aspects of Late Epipalaeolithic and Early Neolithic lithic assemblages in the southern Levant, and especially the Jordan Valley and Negev/Sinai, demonstrate that this largely derives from the use of different techno-typological analytical systems.*

Our preliminary conclusions are that within the Natufian Complex considerable variability is displayed through time and space, with clear evidence for specific regional traditions. Variations in the frequencies of the more standardised tool forms appear to mostly relate to function. Some areas appear more conservative in certain typo-stylistic elements, while others appear to be more innovative. Furthermore there appears to be considerable evidence for local continuity in techno-typology from the Natufian into the PPNA: differences are primarily those of changing emphases of functional classes and hence in adaptations to various specific environmental settings. Differences are primarily one of degree rather than kind - all the major, standardised tool forms characteristic of the PPNA were already present earlier during the Natufian - projectile points, sickle blades, perforators and heavy duty tools. Microlithic tools, a hallmark of the Natufian in the form of geometrics and non-geometric microliths, are rapidly replaced by other microlithic forms in the Early Neolithic, notably the perforators and many projectile points.

It is thus clear that the major break in lithic technology and typology in southern Levant at least occurs only with the transition from PPNA to PPNB.

Introduction

The end of the Epipalaeolithic and the beginning of the Neolithic in the Levant is commonly presented as a major break in numerous aspects of the material culture record. This is particularly notable concerning lithic assemblages, yet this in large part derives from the use of different techno-typological systems for analytical purposes. The present paper attempts to investigate certain elements of Late Epipalaeolithic techno-typology, as related to the Early Neolithic in the central and southern Levant, focusing primarily on relevant assemblages from the Jordan Valley and the Negev. An important point to make is the fact that Late/Final Natufian assemblages from the so-called Natufian 'core area' are quite rare and most of them originate from multilayered sites, so that considerations of admixtures should be taken into account (*e.g.* Hayonim Cave - BELFER-COHEN 1988, BAR-YOSEF 1991a; Mallaha - VALLA 1984; Hatoula - LECHEVALLIER and RONEN 1994; and Iraq ed-Dubb - KUJIT 1994). Indeed, the final stages of the Late Natufian and the Final Natufian in particular are thought to represent a trend of growing mobility as part of the Natufian adaptation to the changing climatic conditions, so that occupation intensities of the 'core-area' camp-sites are of lesser magnitude (BELFER-COHEN 1991; VALLA 1995, in press). Conversely, all of the relevant sites in the Jordan Valley and the Negev are open-air occupation sites representing a single time unit (Fig. 1).

Preliminary investigations as well as previously published material indicate that within the Natufian Complex considerable variability is displayed through time and space, with clear evidence for specific regional traditions (thus the Harifian is viewed as the local Negev variant of the Final Natufian, see GORING-MORRIS 1991 and 1995). Natufian inter-assemblage variations in the frequencies of the more standardised tool forms appear to mostly relate to function, reflecting differences in the specific environmental settings.

Furthermore, there appears to be considerable evidence for local continuity in techno-typology from the Natufian into the Pre-Pottery Neolithic A (see BELFER-COHEN 1994). Differences are

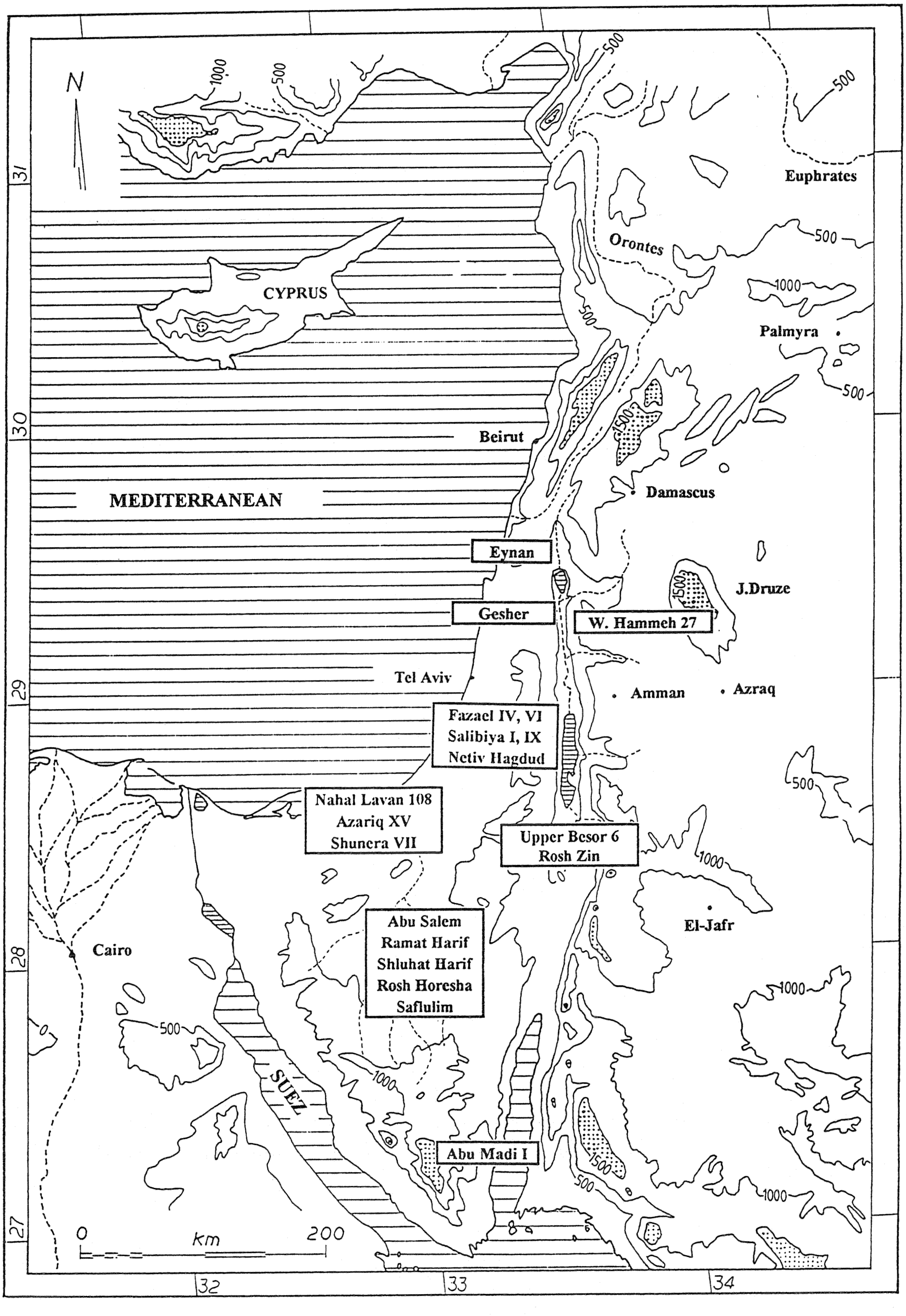

Fig. 1. Map of southern Levant (showing locations of sites discussed).

primarily one of degree rather than kind - all the major, standardised tool forms characteristic of the PPNA were already present earlier during the Natufian - sickle blades, perforators, heavy duty tools and projectile points.

Late/Final Natufian Lithics in the Jordan Valley

Most of the comparative data presented herewith is based on the detailed study of two Late/Final Natufian lithic assemblages from the sites of Salibiya I and Fazael IV (Bar-YOSEF *et al.* 1974; VALLA 1984; CRABTREE *et al.* 1991; BELFER-COHEN and GROSMAN, in press). Other Late/Final Natufian lithic assemblages were recovered further to the north, in Eynan (Mallaha, VALLA 1984). While most of the lithic attributes relevant to the issue at hand are presented in Table 1, the assemblages of Salibiya I and Fazael IV merit some detailed description since to date both have only been published in preliminary form.

Though the excavated areas of Salibiya I and Fazael IV (henceforth S I and Fz IV respectively) are quite limited ($1.5m^3$ and $1.6m^3$ respectively), it can be said on the basis of erosional exposures and intensive surface surveying that both sites lack durable stone built architecture and burials, and while there are faunal remains, bone tools are rare and there is virtually no groundstone industry. Thus the lithics comprise nearly all of the material remains recovered from these sites.

Without going into detailed discussions (the final site reports are under preparation for publication), suffice it to say that the tool categories comprising the inventories of both sites are typical for Late/Final Natufian assemblages (see VALLA 1987, Table 1). The dominant tool category is the non-geometric microliths, especially indefinable fragments (Fz IV= 44.0% and S I = 46.7%) with geometrics (predominantely lunates) comprising 17.0% of the tools in Fz IV and 15.4% in S I. The lunates are small (average length 16.4mm for S I and 13.2mm for Fz IV; average width 4.5mm for S I and 4.2mm for Fz IV), with bipolar or regular backing. Of interest is the total absence of Helwan lunates. The only other geometric microliths represented are triangles, which probably represent a variant of bipolar lunates.

The perforators and glossy tools (sickle-blades) alike are present in moderate percentages: S I - 3.5% and 2.2%; FZ- 5.2% and 4.1% respectively. Bifacial tools were recovered only from Fazael IV (two items, *c.* 0.2% of the tool assemblage). While one bifacial tool was reported from the first excavation of Salibiya I, none was recovered from the second season (BELFER-COHEN and GROSMAN, in press).

There is also a great similarity as regards the technological attributes of both assemblages. Most of the cores are rather exhausted, and their average length is smaller than that of the macrolithic component of the assemblage. Thus for example while the average length of the cores in Salibiya I (n = 131) is 23.6mm (range:10.9-51.0), the scrapers are on the average 23.0mm long with a range of 17.7 to 54.4mm (SD 8.3). The same is true for the burins: 31.7mm average length, the range being 17.4 to 65.1mm (SD 10.0). And as for backed pieces (including the sickle blades) - the average length is 47.5mm and the range is 24.1 to 60.0mm and there are longer items among the retouched pieces, the varia, etc.

It is of interest to note that while in Salibiya I assemblage microburin technique products are few and seem on the whole accidental (IMbt 5.2, IMbtr 8.3), in Fazael IV the technique appears to have been habitually employed (IMbt 20.7, IMbtr 23.8).

There is quite a considerable component of triangles among the geometrics of Fazael IV, which may have something to do with the difference in the intensive use of the microburin technique, for example the length/width ratios of the geometrics (triangles *vs.* lunates). Higher IMbt are generally found in assemblages where triangles comprise part of the reduction sequence to relatively short and squat lunates (Fz IV), as opposed to the production of elongated lunates (S I), where there is less need to use the microburin technique.

Late Natufian and Harifian Lithics in the Negev

The distributions of the relevant tool categories in various Late Natufian and especially Harifian assemblages is presented in Table 1. More detailed descriptions of the various properties of those assemblages was published elsewhere (GORING-MORRIS 1987, 1991).

Basically there is a great similarity between these assemblages and the ones described above with one outstanding exception, the presence of projectile points (Harif and other related forms) in the Harifian assemblages (MARKS 1973). Actually this was the reason that initially the Harifian culture was considered as a post-Natufian, Neolithic variant (MARKS and SCOTT 1976, SCOTT 1977). It was only after more detailed studies, as well as numerous ^{14}C dates (all clustering *c.* 10,600-10,100 BP) that it was established that the Harifian is contemporaneous with the Late/Final Natufian, and should be viewed as a desertic, local variant of the northern Final Natufian (GORING-MORRIS 1991, 1995). Indeed, it can be said that we can once again refer to the original definition of NEUVILLE (1951),

Table 1. Tool counts of major classes in Natufian and PPNA assemblages in the Jordan Valley.

	EARLY NATUFIAN			LATE NATUFIAN		FINAL NATUFIAN			PPNA	
	Eynan IVA	Wadi Hammeh 27	Fazael VI	Eynan IC	Salibiya I	Eynan IB	Fazael IV	Salibiya IX	Gesher	Netiv Hagdud
	(n=1771)	(n=2215)	(n=1331)	(n=1230)	(n=775)	(n=2058)	(n=1143)	(n=211)	(n=127)	(n=3604)
Scrapers	2.0	5.3	3.5	1.2	4.1	1.8	1.9	0.5	3.9	1.5
Burins	10.2	24.5	8.2	7.8	4.8	5.2	0.9	4.5	7.1	9.3
Sickles	2.5	3.2	1.3	0.7	2.2	11.7	4.1	3.3	7.9	4.5
Microliths	39.9	28.4	16.6	41.2	46.7	37.1	44.0	7.6	3.9	7.5
Geometrics	7.1	16.2	26.7	5.9	15.4	8.3	17.0	5.7	0.8	7.0
Points	-	-	-	-	-	-	-	22.3	7.9	3.3
Perforators	3.1	1.9	4.4	2.2	3.5	2.4	5.2	16.1	15.0	20.6
Massive	0.3	0.6	0.1	-	-	0.1	0.2	-	7.1	1.4
All others	34.9	19.9	39.2	41.0	23.3	33.4	26.7	40.0	46.5	44.9

Data sources: Eynan after VALLA 1984; Gesher after GARFINKEL and NADEL 1989; Netiv Hagdud after NADEL 1988; Salibiya IX after BAR-YOSEF 1980; Wadi Hammeh 27 after EDWARDS 1991.

Table 2. Tool counts of major classes in Natufian, Harifian and PPNA assemblages in the Negev and Sinai.

	TERMINAL RAMONIAN / EARLY NATUFIAN			LATE NATUFIAN			HARIFIAN			PPNA	
	Shunera VII	Upper Besor 6	Azariq XV	Saflulim	Rosh Zin	Rosh Horesha	Shluhat Harif	Ramat Harif 3	Abu Salem 22	Nahal Lavan 108	Abu Madi I
	(n=577)	(n=309)	(n=245)	(n=989)	(n=1226)	(n=644)	(n=387)	(n=3386)	(n=567)	(n=76)	(n=936)
Scrapers	1.9	12.9	7.3	2.7	7.3	5.8	6.2	12.7	5.3	13.2	nd
Burins	0.7	5.2	1.2	2.0	10.4	10.4	-	0.3	0.7	1.3	nd
Sickles	-	2.3	-	1.3	0.5	-	-	-	0.2	-	+?
Microliths	47.0	17.5	24.9	10.2	8.3	20.0	38.5	19.8	28.7	18.4	20.7
Geometrics	27.6	11.0	26.9	53.3	37.4	25.3	23.3	24.8	25.7	2.6	3.7
Points	-	0.3	-	0.1	-	-	9.3	13.0	10.8	15.8	17.4
Perforators	-	3.2	0.4	2.1	2.0	0.2	0.3	0.6	0.7	1.3	6.0
Massive	1.4	3.2	8.2	1.4	2.6	1.2	-	0.7	1.9	11.8	nd
All others	21.4	44.4	31.1	26.9	31.5	37.1	22.4	28.1	26.0	35.6	nd

Data sources: Abu Madi I after BAR-YOSEF 1981; Rosh Zin after HENRY 1976; Nahal Lavan 108 after NOY *et al.* 1981; Upper Besor 6, Saflulim - personal observation; for others see GORING-MORRIS 1987. (Note: nd = data not available).

Table 3. Lunate dimensions for sites from Jordan Valley and Negev.

	n	Mean Length	SD	n	Mean Width	SD	Mean L/W
EARLY:							
Eynan IVA	64	22.3	3.1	64	9.3	1.3	2.4
Wadi Hammeh 27	102	20.0	3.5		nd		nd
Salibiya XII	28	19.8	4.0	28	7.7	1.7	2.6
Fazael VI	33	20.1	4.9	52	7.7	1.8	2.6
Azariq XV	46	24.3	3.4	64	7.8	1.1	3.1
Nahal Sekher 23†	42	23.7	2.4	52	7.2	0.9	3.3
Shunera VII†	116	19.0	2.3	116	7.2	1.1	2.7
LATE:							
Eynan IC	30	17.5	4.4	30	7.2	2.1	2.4
Salibiya I*	84	16.4	3.8	84	4.5	1.1	3.6
Saflulim*	88	21.1	3.0	88	7.4	1.1	2.9
Rosh Zin*	47	18.6	4.0	47	6.3	1.9	3.1
Givat Hayil I*	78	19.5	2.7	118	7.3	1.2	2.7
FINAL/HARIFIAN:							
Fazael IV*	47	13.2	1.8	47	4.2	0.7	3.1
Eynan IB	69	13.5	3.5	69	7.0	1.5	1.9
Eynan IB*	56	12.8	nd	56	5.8	nd	2.2
Shluhat Harif*	68	13.0	1.8	90	4.5	0.6	2.9
Ramat Harif 3/2*	214	12.8	2.8	244	4.8	1.4	2.7
Abu Salem 22*	112	12.9	2.0	146	4.6	0.9	2.8
KHIAMIAN/ SULTANIAN:							
Salibiya IX*	27	11.7	nd	57	4.5	nd	2.6
Netiv Hagdud*	41	17.0	nd	90	6.0	nd	2.8

† Terminal Ramonian
* No Helwan lunates present.

Data sources: Eynan after VALLA 1984; Rosh Zin after HENRY 1976; Netiv Hagdud after NADEL 1988; Salibiya IX after BAR-YOSEF 1991; Wadi Hammeh 27 after EDWARDS 1991.

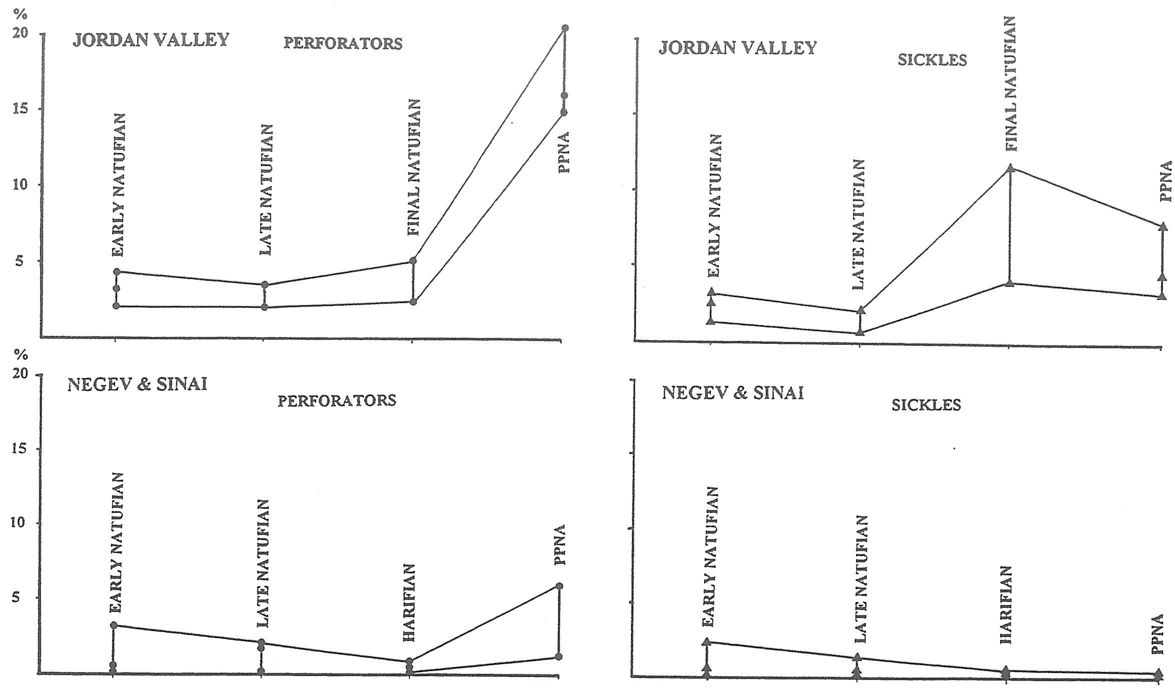

Fig. 2. Diachronic trends in the frequencies of perforators and sickles (glossy pieces) in the Jordan Valley and Negev/Sinai.

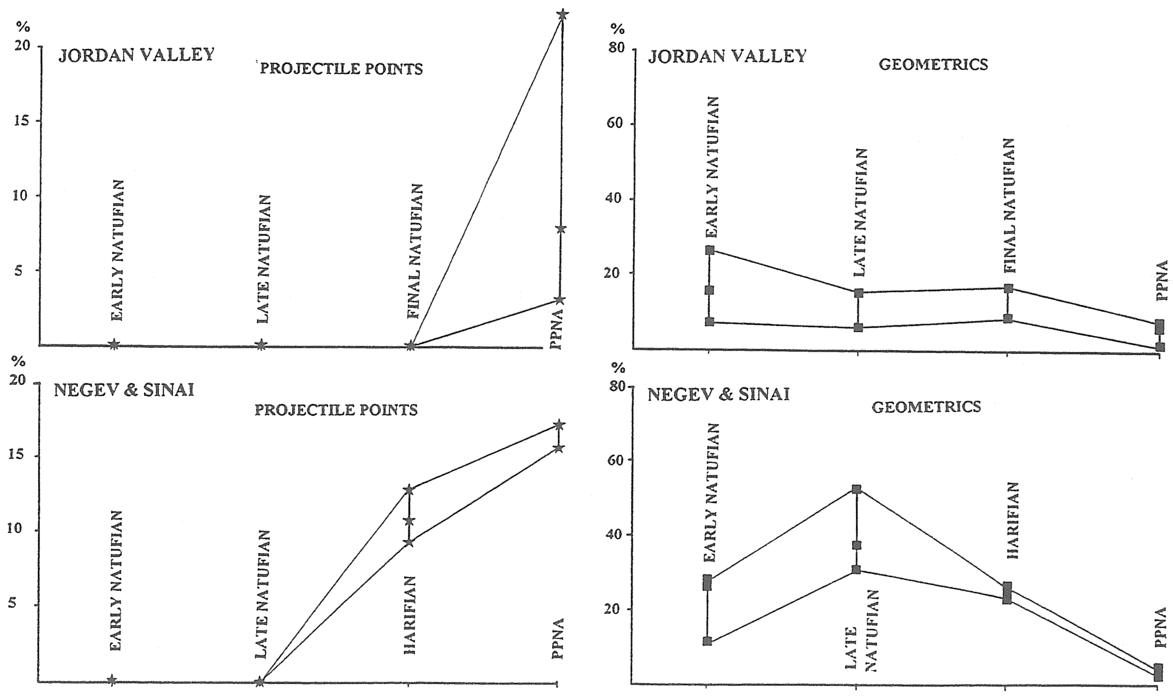

Fig. 3. Diachronic trends in the frequencies of projectile points and geometrics in the Jordan Valley and Negev/Sinai. *<Note that Harifian campsites contain much higher frequencies of projectile points than the basecamp assemblages presented herein.>*

who divided the Natufian into four stages, the last one of which was characterized by the appearance of the el-Khiam points! It is of interest to note that el-Khiam points were found in late Harifian assemblages (PHILLIPS 1977, GORING-MORRIS 1987).

There is a great similarity in the proportions of the geometric microliths between the Final Natufian assemblages from the north and the Harifian base camp assemblages from the south (see Tables 1-2). In both cases, the majority of the geometrics consists of backed, bipolar lunates. Small triangles, consistently found in the Final Natufian/Harifian can be explained as a variant of small, bipolar lunate production. There are no Helwan lunates to be found in the Harifian assemblages, and this is also true for some northern assemblages, except those originating from sites with a Natufian occupational sequence where there is clear evidence of a conservative tradition of continuity, as for example the site of Eynan (VALLA 1984). There are great similarities in the dimensions of the Final Natufian backed lunates and those of the Harifian in the south (see Table 2, Fig. 2). This also seems to be true as regards the dimensions of sickle blades, perforators, etc. (personal observations). Also in the Harifian, the cores are quite exhausted, with certain tool categories longer, on the average, than the mean length of the various core-types. This can be viewed as reflecting similar patterns of blank production. It is of interest that in both areas during the Late/Final Natufian and in the Late Natufian and Harifian significant quantities of the microlithic tools actually appear to have been fabricated on relatively short, stubby blanks (flake/bladelets?).

The PPNA Industries: the Khiamian and the Sultanian

Notwithstanding the claims that the Khiamian actually represents a mechanical mixture of Late/Final Natufian and PPNA assemblages (GARFINKEL and NADEL 1989; GARFINKEL, this volume), we nevertheless believe that a short transitional phase can be recognized separating the two (*c.* 10,250-10,000 BP; BAR-YOSEF 1991). Sites such as Salibiya IX (part of the Gilgal site complex; NOY 1989), Nahal Ein Gev II (BAR-YOSEF and BELFER-COHEN, in preparation), both in the Jordan Valley, and Hatula in the western flanks of the Judean Hills (LECHEVALLIER and RONEN 1994) should be included. These assemblages are characterized by high percentages of perforators, quantities of lunates, small numbers of bifacials and in some instances, at least, projectile points (in variable frequencies).

The differences between this transitional phase and Sultanian assemblages at the technological

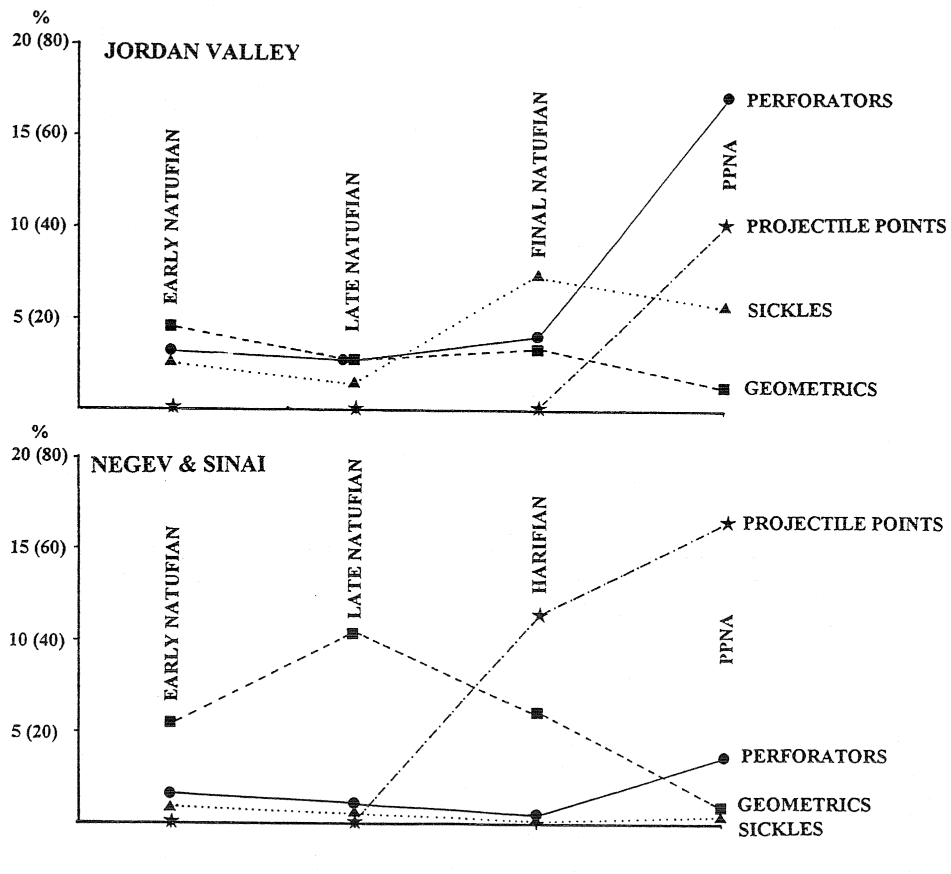

Fig. 4. Diachronic trends in the frequencies of distinctive tool classes for the Natufian and PPNA in the Jordan Valley and Negev/Sinai <*note different scale for geometrics*>.

level include in the former the continuation of small, rather exhausted cores for blank production similar to those of the Late/Final Natufian, as opposed to a greater emphasis on larger, rather unsophisticated single-platform cores in the latter (NADEL 1988).

The typological differences are expressed by a rapid decline and disappearance of geometrics, high frequencies of perforators, moderate quantities of projectile points and the appearance of bifacials made by the tranchet technique. An interesting innovation is the appearance of groundstone axes on limestone or basalt.

Discussion

All in all, it appears that Late/Final Natufian, Harifian and PPNA industries can all be described as microlithic assemblages. While various traditional microlithic categories disappear from PPNA assemblages, the rising numbers of perforators and projectile points, modified from bladelet blanks (*i.e.* microliths *sensu stricto*), more than replace them (the problem here is that anyway many of the Natufian microliths were probably not always manufactured on microlithic blanks).

As stated at the beginning of this article, all the major, standardised tool forms characteristic of the PPNA were already present earlier during the Natufian - as can be observed from the tables and figures presented herewith.

Indeed, aerodynamically shaped *projectile points* appear first in the Harifian during the 1st half of the 11th millennium BP and are absent from other Natufian assemblages. But though they constitute a major element in the Khiamian (for example in Salibiya IX - 22% - BAR-YOSEF 1991), in the Sultanian they comprise but 3 to 8% (NADEL 1988, BAR-YOSEF *et al.* 1991). In Harifian assemblages the percentage of points varies greatly, from 0% to 57%, reflecting differences in inter- and intra-site activities (GORING-MORRIS 1991).

Glossy pieces (sickle-blades) do not exceed 7% of the tool assemblages in the Epipalaeolithic or PPNA industries. However, they are relatively more common in the Early Natufian of the Mediterranean zone and decline in the Late/Final Natufian (though in certain sites with a Natufian sequence the situation is quite the opposite, *e.g.* Hayonim Cave - BELFER-COHEN 1988, BYRD 1989, HENRY 1989), to pick up again in Khiamian/Sultanian assemblages (see Table 1). In the Negev, they first appear in the Early Natufian, become more frequent in the Late Natufian and decline in the Harifian (GORING-MORRIS 1987, see also Table 1). There is a change through time in the dimensions of the sickle blades as they become more elongated (Hayonim Cave - 42.7mm, BELFER-COHEN 1988; Salibiya I - 46.2mm, BELFER-COHEN and GROSMAN in press; Hatoula - up to 50mm in the Natufian, 60.3mm in the Khiamian and 67.8mm in the Sultanian (LECHEVALLIER and RONEN 1994; see also NOY in present volume).

The *perforators,* present in small quantities (2-5%) throughout the Natufian, increase dramatically in the PPNA (15-20%), but it is worth mentioning that there are high percentages of perforators observed in Natufian assemblages from the desertic parts of northeastern Transjordan (BETTS 1991).

As opposed to the trend represented by the perforators, the *geometric microliths*, mainly the backed lunates but also small triangles and some quadrilateral items (trapeze-rectangles), present in high frequencies in the Late/Final Natufian (including the Harifian), decline rapidly during the early PPNA and soon disappear altogether.

Heavy duty tools appear in almost all Natufian sites in small quantities both in the north (chisels etc.) and south (massive denticulates) (see Table 1); they are quite standardized and clearly presage the appearance of bifacials in the PPNA.

Differences occur also in the relative proportions of *scrapers and burins*, most pronounced in the more northern assemblages (Tables 1,2), whereby the former decline in comparison to the latter from the Natufian through the PPNA. Interestingly, in the Negev, burins are more common during the Natufian, while scrapers form a major component in the Harifian industry.

There are more than two possible variants of the transitional phase. Besides the Khiamian presence in the Jordan Valley, Judean Hills and Transjordan (*e.g.* Iraq ed-Dubb, KUJIT 1994), there are other, contemporaneous 'transitional' entities such as Abu Madi I in southern Sinai (BAR-YOSEF 1991), Nacharini Cave in Lebanon (SCHROEDER, in COPELAND 1991), and further north, on the Euphrates the sequence at Tell Mureybet (CAUVIN 1991). Still, though differing typologically and to a lesser extent technologically, all these assemblages display a broadly similar character, based on the pattern exhibited by the Late/Final Natufian *sensu lato*. While changes occur rapidly during the PPNA, it is only at the end of the period that a major break in the lithic industries can be discerned, more pronounced in the south than in the north of the Levant. This may be due to a shift in the geographic focus of innovation to the north during the course of the Early Neolithic. It is interesting to observe that in addition to the mundane aspects of the lithic industries other cultural realms, for example mortuary practices of skull removal, also display continuity from the Natufian through the PPNA and onwards.

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The Blades with "Mirror-Like" Polishing: Myth or Reality?

Galina F. Korobkova

The blades or flakes with visible "mirror-like" polishing occur not rarely among the archaeological finds of the Palaeolithic-Neolithic. The polishing can be visible even without a microscope and takes up the narrow or more broad stripe along the edge (sometimes the corner part) on both their sides. The first reaction of the archaeologists to the finds of this kind is to relate them to sickle-inserts. And then the opportunity appears to speak about their connection with agriculture. Such unverified determinations are not always right. It is determined now according to the data from numerous experiments carried out with similar implements and the microwear analysis of the natural tools originating from excavations, that the blades and flakes with the "mirror-like" polishing could perform different functions. The objects could be knives for example, or small saws used for wood-work, for cutting off green branches, reed, rush or grasses, or they could be the sickle-inserts for cultivated or domestic cereals. Therefore it is an error to link the implements in question only with agriculture. The correct function could be determined only by the data from the microwear analysis of the tool surfaces at 100-200 x magnification.

The bank of experimental data, containing the information concerning the differentiation of the blades and flakes with the "mirror-like" polishing is being prepared now. Experiments were carried out on about 650 various inserts and tools used for the work on different plants. The problem was not only to differentiate the reaping-implement's attributes, but the main task was to repeat the formation of the traces. The revealed appropriateness of the origin, character and the locations of the micro- and macro-wear attributes allowed us to avoid chance results entirely. The approach gave an opportunity to work out the main determinative attributes of the macro- and micro-use wear characteristics of the tools used for cutting the wild and cultivated cereals, grasses, reed, rush, nettle, marsh or reedgrass *Acarus calamus* L., green branches and wood (KOROBKOVA 1978, 1992, 1993, 1994). The different reaping techniques were taken into account: cutting off separately the ears and stalks, at the height 15-20 and 50-60cm above the ground, breaking off the ears, tearing up by the roots.

The bank of data so far gained is being constantly replenished by new evidence and factual data. The new tool-shapes and the new plants are being included into an agricultural cycle of research. The obligatory procedure during the experiments is as ever replication to avoid chance results. Such is the scientific foundation for micro-wear analysis of reaping implements and for determining their correct functions. We shall now consider the method of the research. We have to concentrate on the description of the main feature of the trace characteristic for the most complicated types of sickles to avoid a text increase. There are sickles for cultivated and sickles for wild cereals and grasses. The solution to the problem of agricultural origin and development depends on the differentiation of the traces. This appeared after the analysis results from the Kebarah Cave flint industry. The blades with visible "mirror-like"polishing were found in the tool-kit. Other evidence of the existence in the Natufian culture of agriculture or food-gathering is absent. The only data confirming the existence of wild cereal gathering is from the excavations of large settlements such as Abu Hureira, Nahal Oren, Jericho, and many others.

Thus, reaping tools could serve as sensitive indicators of the slight changes in reaping practices and could give information concerning the presence/absence of agriculture without even direct palaeoethnobotanical evidence. The information is contained in three of the main features consisting of the trace type, the location of the polishing and the linear traces. Two other features include the character of an edge and it's crushing and give additional but not decisive arguments (KOROBKOVA 1994).

Plate 1:1. Microwear on experimental sickle used for harvesting domesticated cereals (flint) <*5hzs x100*>.

Plate 1:2. Microwear on blade used for harvesting domesticated ripe cereals from Jeitun (flint) <*x100*>.

Plate 1:3. Microwear on experimental sickle used for harvesting wild half-ripe cereals (flint) <*3hzs x100*>.

Plate 1:4. Microwear on experimental sickle used for harvesting wild ripe cereals (flint) <*3hzs x100*>.

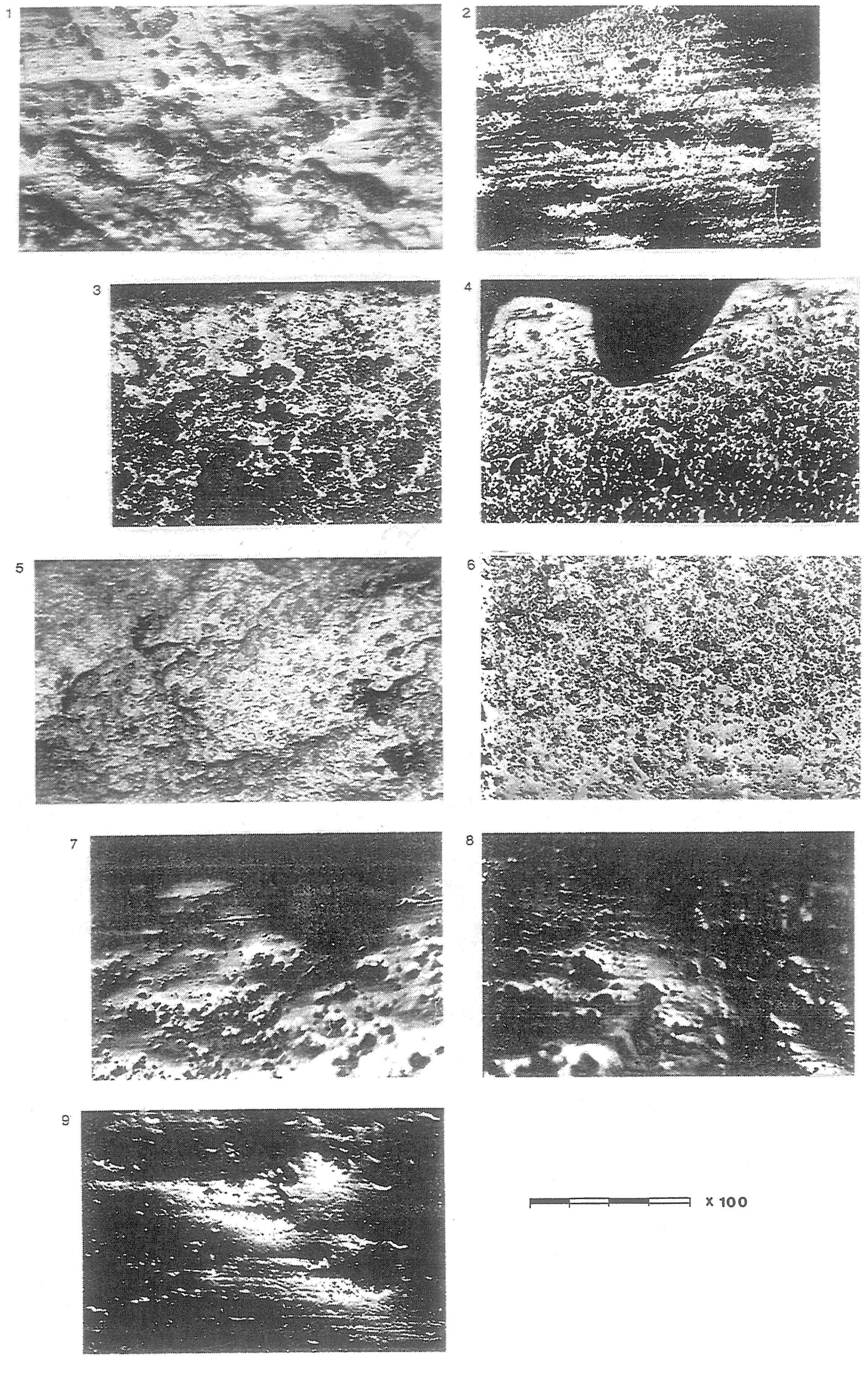
Plate 1:5. Microwear on experimental sickle used for harvesting grasses (sedge) (flint) <*3hzs x100*>.

Plate 1:6. Microwear on experimental sickle used for harvesting grasses (nettle) (flint) <*3hzs x100*>.

Plate 1:7. Microwear on blade used for harvesting cultivated wild ripe cereals from Kebara B (flint) <*x100*>.

Plate 1:8. Same as 7).

Plate 1:9. Microwear on blade used for domesticated ripe cereals from Jeitun (flint) <*x100*>.


1
2
3
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x 100

The tools used for domestic cultivated cereal reaping are characterised by the bright "mirror-like" polishing directed rectilinearly, flattening and leveling the work-surface microrelief. It takes up the narrow stripe of 3-7mm width located on both edge sides. It is observed that one side of the stripe could be more broad than the other one, which depends on the incline degree of the tool during the process of the work. The whole stripe breadth depends on the duration of use, the density of planting, the thickness of the stalk and some other factors. Both polished surfaces are covered by numerous linear traces. There are thin lines and furrows, deep and incised lines, elongated or short in proportion, located very close to and parallel to the edge, or inclined, depending on kinematics or the position of the insert inside the holder. Some are intersected forming the furrows others are crossed sometimes reflecting the changes in kinematics. The main point is that all of the scratches appeared together with comet-like figures. These ones as a rule have the same directions and reflect the kinematic work and the object of reaping- the domesticated cereals (Pl. 1:1-2).

The tools used for reaping wild cereals (Pl. 1:3-4) showed some features of the traces typical for the cultivated ones. For example, they retain the "mirror-like" lustre of the rectilinear directions. But in contrast to the sickles for the domesticated cereals, this kind of polishing appeared after the cutting off of the green or semi-green wild cereals and is salient, outlining the microrelief of the working surface and penetrating deeply into the cavities. The reaping of matured dry wild cereals has a tendency to smooth, flatten and level the working surface. In this case it resembles the polishing which appears after work with cultivated cereals but the stripe of lustre is much more narrow and is in the range for example, 1-2mm. In a polished surface the thin parallel scratches are visible, dense or rare, or short ones, without the comet-like figures. The density of the scratches depends on the amount of abrasive particles splashing onto the stalks from the ground surface due to wind and rain. The comet-like figures appeared after treatment even if only done once, and are combined with dense thin scratches. The particles of sand and dust covered all the stalk surfaces appearing after digging the soil. Because these were tools used for reaping the cereals at the stage of cultivation, even at the initial stage raised on cultivated soils and cut off in mature conditions, they have traces of the same type as the sickles used for domesticated cereals. It is the dense, penetrating, plain, leveling "mirror-like" polishing located especially close to the edge line but not the outlined salient that is characteristic of the tools used for cutting the green uncultivated cereals. At the same time the width of the polished stripe remains small, in the range of 1-3mm, in spite of the duration of the tool use, *i.e.* the same as have the tools used for non-domesticated cereals.

The linear traces located on the polished surface are also remarkable. There are the thin incised dense scratches, sometimes accumulated, laminated, located parallel to the edge and combined with the rare comet-like figures. The reaping tools used for the wild grasses (Pl. 1:5-6) also have the "mirror-like" polishing, similar to that which is characteristic of implements used for green or semi-green non-domesticated cereals. It is salient, outlining the microrelief, slightly condensed, close to the edge line only, but on the other parts of the working-surface it appears scattered and consists of small-scale cells. This kind of polishing differs from the polishing appearing after cutting the wild cereals. The polished stripe is narrow with a width of 1mm, more rarely 2mm The linear attributes are not demonstrative. The thin, rare, dotted scratches on the upper part of the insert's working surface are only visible sometimes under large-scale magnification (x 200). The scratches appeared here as result of contiguity with the soil and are due to the grasses being cut closer to the soil. Sometimes the scratches are crossing because of a kinematic change but this occurs extremely rarely. Linear, directed polishing appears instead of the linear traces. The upper border of it is always eroded. Thus the determinative attributes of the sickles used for cutting the grass are; scattered "mirror-like" polishing consisting of small-scale cells, it's location and the presence, or most often absence, of linear traces. The method of the reaping tools investigation elaborated by the author was applied to the study of the Kebarah Natufian (Layer B), Abu Hureira (Trench E, Layers 311-315), and Nahal Oren (Layer VI). The sites contained the remains of wild cereals, grass, reed, and weeds, and look as if they reflect an economy based on food-gathering. And what is more, the analysis of these and other sites' sickle-inserts carried out by P. Anderson (1991, 1992) and R. Unger-Hamelton (1992) did not reach definite results. Thus the problem of agricultural origin in the Near East is "poised in mid-air" again. It was necessary for the decision to the group of key-sites materials, to apply the micro-wear analysis to the mass of archaeological finds and to consider the results together with other evidence. Thus, in the absence of domesticated cereal remains, the leading part in the decision as to whether agriculture is present is played by the traceology on the reaping tool inserts. So far only the micro-wear analysis is able to fix this delicate (imperceptible by other archaeological sources) transition from the gathering of wild cereals to their initial cultivation.

The results of our research showed that the micro-wear traces recovered on a number of sickle-inserts originating from the above-mentioned sites allow us to consider them as the tools used for the reaping of cereals already cultivated (Pl. 1:7-8). The same evidence shows the full-scale resemblance of the micro-wear traces texture on the working-surfaces of the Natufian and the Djeitunian sickle inserts (Pl. 1:9-10). Though in the Natufian culture context cultivated cereals were not found, nevertheless the process of cultivation began. It is natural that this process cannot reflect immediately the formation of morphological traits characteristic for plants in cultivation. This process could be compared with animal domestication, when the animals had been at the taming stage but the morphological attributes remained the former, typical for the wild stage. The same applies to plants. Though the cereals were passing through a stage of primitive cultivation and selection, they retained their wild morphological attributes.

The results of the traceological investigation of the reaping tools from Kebarah, Abu Hureira and Nahal Oren allow us to speak about the very initial stages of cereal cultivation (in a proper sense the appearance of agriculture) developed against a background of a food-gathering economy. Judging by the palaeobotanical data, there were no really domesticated plants with the typical morphological attributes. There were the wild cereals, but exposed to domestication.

Thus the process in consideration ought to be linked with the Natufian culture of the 10th-9th mill. B.C., when inside of the old economic system the new economy was growing, and the definitive factor in making this statement is demonstrated by the reaping tools with their diagnostic attributes and concrete function.

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Flint Mining in the Pre-Pottery Neolithic: Preliminary Report on the Exploitation of Flint at Neolithic 'Ain Ghazal in Highland Jordan

Leslie A. Quintero

Abstract: *The first Jordanian Neolithic flint mine was recently discovered near the site of 'Ain Ghazal. The superior quality, nodular flint was extracted from seam mines in the walls of nearby wadis. These mines represent the first known source of the mysterious pink-purple flint used for naviform core production during the PPNB throughout much of the southern Levant. Discovery of the source and subsequent tests confirm that this tool stone was locally procured and was not heat-treated prior to its use by Neolithic stoneworkers. These data support the existence of incipient craft specialization and a locally autonomous lithic economy at 'Ain Ghazal during the Pre-Pottery Neolithic.*

Résumé: *La première mine de silex néolithique de Jordanie a été récemment découverte près du site de 'Ain Ghazal. Le silex nodulaire de qualité supérieure a été extrait de mines de couche dans les murs des oueds proches. Ces mines représentent la première source connue du mystérieux silex rose-violet utilisé pour la production de nucléus naviforme pendant le PPNB dans une grande partie du Levant sud. La découverte de la source et les tests subséquents confirment que cette pierre-outil a été procurée localement et n'a pas été traitée à la chaleur avant son utilisation par les ouvriers de pierre néolithique. Ces données supportent l'existence de spécialisation naissante de l'art et d'une économie lithique locale autonome à 'Ain Ghazal pendant la période Néolithique de Pré-poterie.*

Introduction: Pre-Pottery Neolithic Blade-Core Flint

Pre-Pottery Neolithic stone knappers in the southern Levant used an extraordinary, highly siliceous flint, often red or pink in color, for the production of many naviform cores and the resulting blade-tools. The exceptional character of the stone (*i.e.*, its workability, extreme luster, and unusual color) marked it as a notable resource, one that was chosen for exploitation by the occupants of many Pre-Pottery Neolithic settlements. Naviform cores produced from this flint yielded finely crafted blades that are generally judged to be the most exceptional blades in PPN collections.

While such flint has been identified in numerous assemblages, as at Jericho (CROWFOOT PAYNE 1983), Munhata (GOPHER 1989), Gilgal (NOY *et al.* 1980), Abu Gosh (LECHEVALLIER 1978), Wadi Shu'eib (ROLLEFSON 1987)[1] and 'Ain Ghazal[2], until now lithic source areas that provided the material in Neolithic times were unknown. Researchers have speculated about how and where Neolithic stoneworkers obtained their flint, but few studies have been undertaken to locate it. Consequently, methods of stone acquisition, and the economic structure that supported tool-stone procurement and the dependent blade-core technology in early Neolithic villages have been poorly understood[3].

This paper reports on the discovery of a source of such flint near Amman, Jordan, that was exploited by the PPNB occupants of the town of 'Ain Ghazal for naviform core-and-blade produc-

[1] Also, personal observations by the author.

[2] Personal observations of the author.

[3] For a detailed discussion of the technological and evolutionary significance of naviform core-and-blade production in the Levant, readers are referred to WILKE and QUINTERO 1994, and QUINTERO and WILKE 1995.

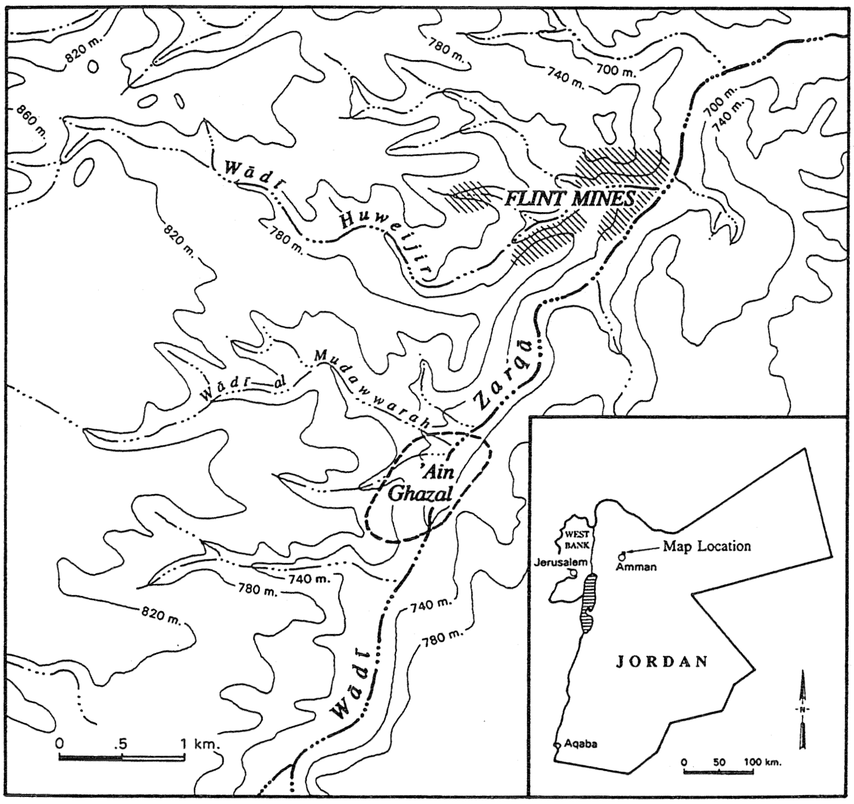

Fig. 1. Map showing the locations of the Neolithic site of 'Ain Ghazal and the nearby flint mines in Wadi Huweijir where stoneworkers from 'Ain Ghazal obtained their tool stone.

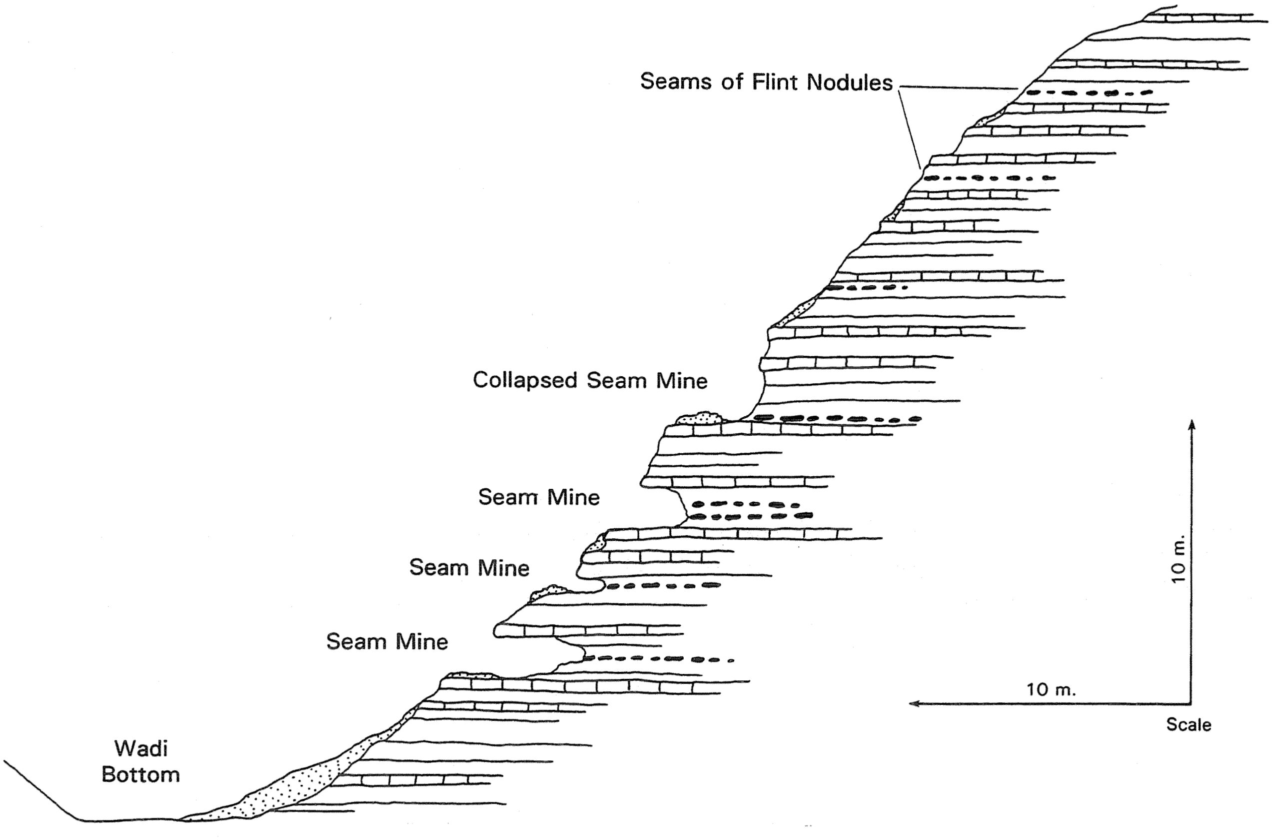

Fig. 2. Representative profile depicting the mining strategy used by Neolithic miners to excavate "seam mines" in the sides of the wadi. Note that as horizontal strata of flint nodules were mined from the limestone, a series of terraced grottos or rock shelters were carved into the face of the escarpment.

tion. The implications of this discovery are explored in an attempt to understand the technological and economic choices that were made at 'Ain Ghazal, and possibly at comparable early Neolithic settlements elsewhere in the southern Levant.

Archaeological Background

Flint of widely varying quality is ubiquitous throughout most of the southern Levant. Many arid environments, such as the desertic, eastern limestone plateau of Jordan, have extensive, deflated, surfaces containing detrital flint. Wadi-cut terrain on both sides of the Jordan River has large exposures of tabular and nodular flints, and bedded cherts. Additionally, the Jordan rift valley bisects massive deposits of Cretaceous flint-bearing limestone that yielded an abundance of tool-quality stone during the Neolithic. Others have observed that Santonian and Turonian primary geologic deposits, and their associated alluvia, were particularly fruitful, potential sources of tool stone during prehistoric times (BENDER 1974, TAUTE 1994).

Identified archaeologically exploited flint sources, however, are few, and generally contain only moderate to poor quality tabular or nodular flints that were used primarily for the production of flake cores and core tools (*e.g.*, TAUTE 1994), but not for blade cores. Although noted on rare occasions in fluvia, the high-grade, siliceous, often "pink" flint, the apparent favored resource throughout much of the southern Levant for the production of naviform blade-cores, has been of unknown origin.

Trade *Versus* Heat Treatment

While acknowledging that unknown, regionally local sources of this flint may exist, researchers have attempted to understand the behavioral implications of the above predicament. Consequently, two alternative stone-procurement schemes have been proposed for the PPNB: (1) exotic, or nonlocal, flint sources were used by Neolithic artisans to procure high-quality flint for naviform core-and-blade production (BAR-YOSEF and BELFER-COHEN 1989, GOPHER 1994); or, alternatively, (2) local flints of moderate quality were heat-treated to improve their physical characteristics and workability (thereby enhancing their luster and altering their color), to provide a superior flint for blade-tool production (BAR-YOSEF 1981, CROWFOOT PAYNE 1983, GOPHER 1989).

These differing approaches to Neolithic resource acquisition and management require two distinct economic strategies: (1) a dependence on nonlocal resources that necessitated the use of extensive transportation and/or exchange networks of large quantities of stone, and a concomitant complex economic organization; or (2) local procurement and technical alteration of lesser-quality stone that was managed within the structure of autonomous, uncomplicated community economies. In Jordan, at 'Ain Ghazal, new evidence exists that supports an economic organization of lithic tool production for early Neolithic towns that differs from those suggested above.

'Ain Ghazal Data

'Ain Ghazal is typical of many sites in the southern Levant in that its PPNB lithic assemblage is dominated by naviform core production and reduction. The major resource in this assemblage is a fine-grained, siliceous, nodular flint that ranges in color from taffy brown, to brown with green, red or pink flashes, to reddish purple, red, and pink. The high quality of the flint is evident not only by its visual characteristics but also by the merits of the products that were made from it. Reduction of naviform cores, an overwhelmingly standardized technology during the PPNB, frequently yielded fine, delicate, thin blades over 14cm in length. These in turn were fashioned into the typical PPNB assemblage consisting of, for instance, sickle blades (many extending the full length of a blade), large projectile points (such as Jericho, Byblos, and delicately pressure flaked Abu Gosh points), and long, finely constructed knife blades of various configurations.

Replicative experiments have shown that successful naviform core-and-blade production required the use of high-quality flint (WILKE and QUINTERO 1994, QUINTERO and WILKE 1995). Not surprisingly, the archaeological assemblage from 'Ain Ghazal, as well as from many PPNB sites in the southern Levant (see CROWFOOT PAYNE 1983, GOPHER 1989), attests to the selective exploitation of fine-textured, nodular flint for naviform core production, in spite of the fact that abundant quantities of lesser-quality tabular flints and bedded cherts were readily available in the local lithic environment. At 'Ain Ghazal, bedded chert underlies the town site and clearly was exploited for sturdy adze and axe blanks, bifaces, and flake-tool production during both the Pre-Pottery and the Pottery Neolithic. However, it was not commonly used for PPNB blade production.

In addition to the superior quality and unusual color variations of the blade-core flint used at 'Ain Ghazal, the following assemblage characteristics are also noteworthy: (1) small, flat nodules that were fortuitously shaped so that they required minimal preparation frequently were selected for core production; (2) these and larger nodules were transported to the site for reduction; (3) the substantial amount of lithic waste and the large size of most expended cores imply that an abundant supply of flint was readily available; (4) the cortex of the nodules was pristine and chalky, without incipient cone fractures, suggesting that nodules were obtained from the parent limestone matrix rather than from wadi gravels; and (5) although the luster, texture, and color of the flint suggest that thermal alteration may have been used to enhance the quality of the stone, experimental heat treatment of archaeological flint samples indicates that the flint had not been thermally altered. These heat-treatment studies are discussed below.

While no source of this flint was known previously, the above data imply that the stone was quarried, or perhaps mined, somewhere near 'Ain Ghazal, and that its superior characteristics occur naturally. The present discussion details the results of field and laboratory research designed to investigate these possibilities, in brief, to answer the following:
1. Was flint obtained in the vicinity of the Neolithic townsite, and if so, where was the resource located?
2. Was the stone heat-treated, or was it naturally pink or reddish in color and highly siliceous, as suggested by the archaeological data?

Field Research and Analyses

Uplifted Cretaceous limestone of the Jordanian highlands typifies the 'Ain Ghazal terrain (BENDER 1974). The site is bisected by the north-south trending Wadi Zarqa, which has several secondary drainages near 'Ain Ghazal. Wadi drainages are marked by extensive erosional features, such as carved chalky marls, and silicified limestone escarpments with many caverns and solution caves. The Upper Cretaceous sediments in the vicinity of the site are Santonian in origin, and characteristically contain massive flint deposits (BENDER 1968, 1974).

An archaeological field survey conducted in 1987 (SIMMONS and KAFAFI 1988) documented an extensive Neolithic presence in the 8.4km^2. surrounding the site, principally along the nearby drainages. Additional observations[1] suggested that wadi-rolled cobbles of good-quality flint might be located in the drainages north of the site. These data indicated that a thorough survey for *in situ* nodular flint in the wadi exposures surrounding the site might be fruitful. Priority was given to the northern portions of the Wadi Zarqa and a small tributary, Wadi Huweijir, that drains eastward into the Zarqa.

Geological Field Survey

Field surveys of the Wadi Zarqa and Wadi Huweijir drainages revealed the first known source of the mysterious pink flint approximately 2km from 'Ain Ghazal. Nodular flint deposits were discovered north of the townsite, on the east end of Wadi Huweijir ("little stone" wadi) where it intersects the Wadi Zarqa (Fig. 1). Flat nodules of highly lustrous, superior-quality flint of many colors (pink, red, red and green, golden brown, and dark brown) were visible on the talus slopes. In addition, horizontal strata of nodules laced the walls of Wadi Huweijir and its small tributaries.

Here, nodules of flint were exposed by a series of "seam mines", or linear excavations, that followed the horizontal layers of flint. This strategy created a number of small and large grottos or rock shelters (Pl. 1), some over 4m wide and 30m in length, following several distinct strata and terracing the face of the wadi (Fig. 2). The overlying rock has collapsed into some of the excavations. Unless timbers were used to support the ceilings of such mines, obtaining flint in this manner must have entailed a degree of danger. This method of mining was a common strategy during the Neolithic in Europe (see SCHMID 1973), and is well documented for the Neolithic mines at Spiennes, Belgium (HUBERT 1978). Neolithic excavations at the Wadi Huweijir mines laid bare extensive, linear exposures of flint nodules, many of which still contain nodules *in situ* and mining detritus (Pl. 2). It is important to note that numerous barren grottos are also present that appear to have been completely "mined out" by Neolithic stoneworkers. Several of these excavations have ceilings that collapsed in antiquity, and are now open terraced benches exposed to the vagaries of erosion. Superficially these mines look like natural rockshelters and close examination is necessary to determine that they are culture features. It is evident from the scale of the excavation at the Wadi Huweijir mines that the long exposures of flint nodules within the limestone matrix were extracted with considerable effort and entailed the removal of massive amounts of limestone as well as flint.

Flint debris both within the grottos and on the talus slopes immediately below the terraces includes archaeological debitage, such as tested nodules, partially formed naviform precores, flakes, and a small amount of core-reduction debris (Pl. 2), all attesting to exploitation of the resource during PPNB times. It is also apparent that the archaeological lithic debris, including naviform core-production debitage, and the natural, unaltered flint at the Huweijir mines, are identical to the lustrous, pink, red and green, and tan flint used by Neolithic stoneworkers at the site of 'Ain Ghazal. The following

[1] By Deborah Olszewski, a member of the survey crew.

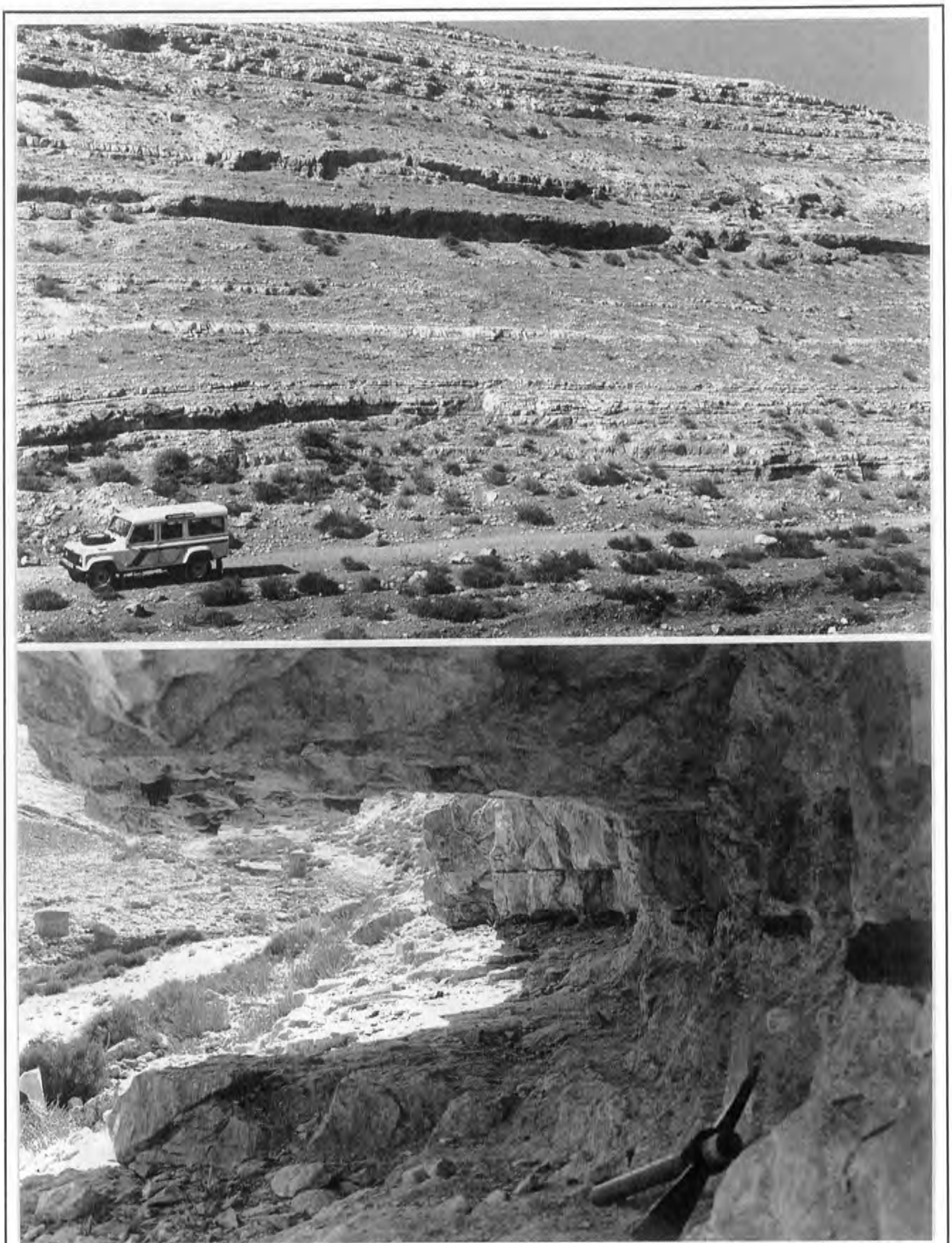

Plate 1. Views of flint mines in Wadi Huweijir. *Upper:* Seam mines as seen from across the wadi. Excavations of the mines created horizontal linear features in the sides of the wadi as seams of flint nodules were extracted. *Lower:* Inside view of the seam mine shown just above the vehicle in the upper photograph. The mine extends more than two meters back into the limestone escarpment. Note the seam of dark flint nodules visible in the back wall of the mine at the right center of the photograph.

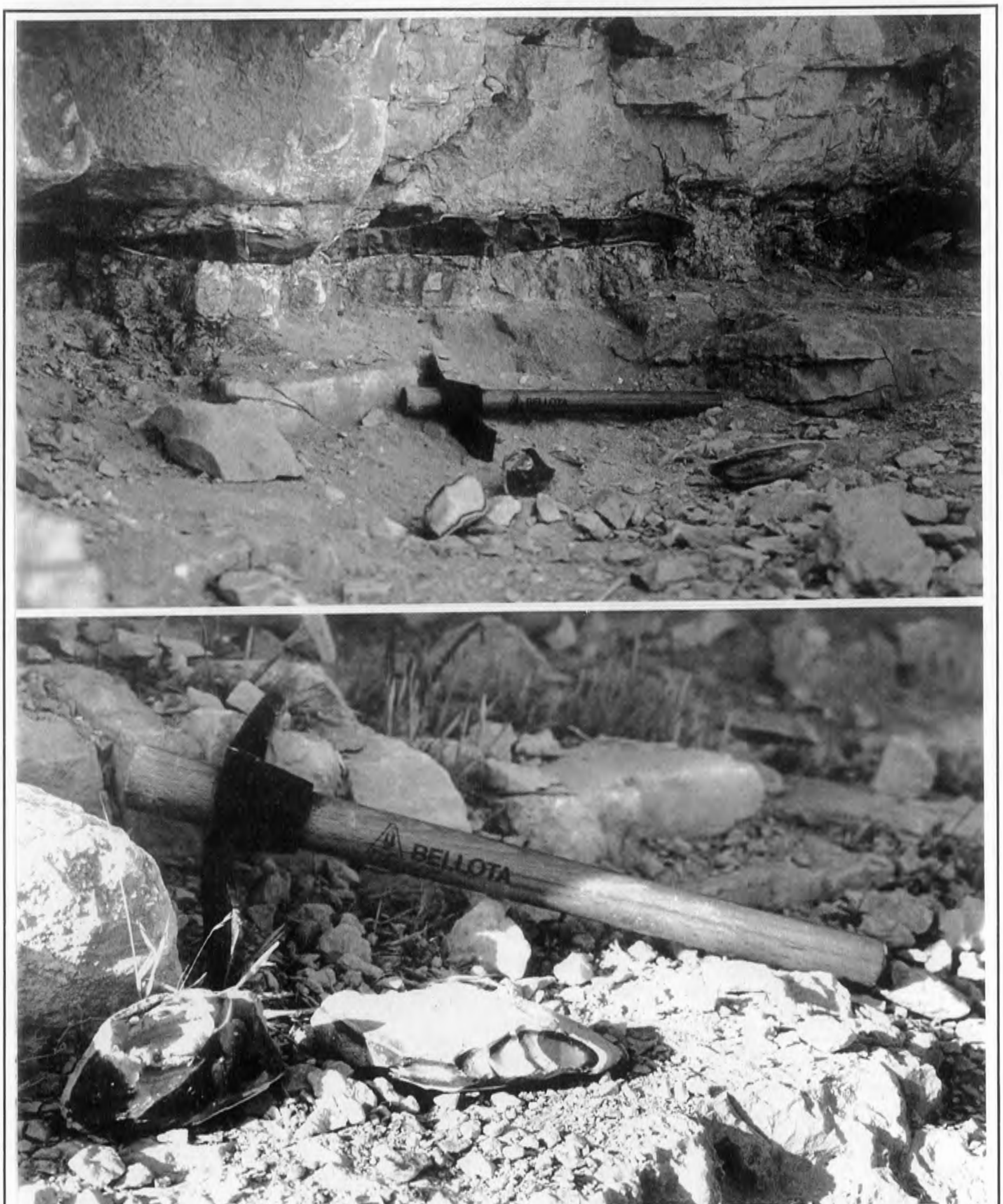

Plate 2. Archaeological setting at the flint mines. *Upper:* View of the working face in the back wall of the mine shown in Plate 1, lower. Note the seam of dark, flat, flint nodules in the wall, and flint debitage and debris on the floor. *Lower:* Tested nodule and partially prepared core of pink flint on the floor of one of the mines.

laboratory analyses provided further data that confirm these observations and attest to the common origin of the flints.

Ultraviolet Fluorescence Analyses

While accurate sourcing of cherts and flints is generally recognized as a difficult task (see BAR-YOSEF 1991), researchers in the American Plains currently are having success sourcing Folsom artifacts of chert. Ultraviolet light is used to compare the fluorescent properties of Cretaceous-age cherts and other lithic material from known sources with the fluorescent characteristics of lithic artifacts (HOFMAN *et al.* 1991). Cherts from identical sources fluoresce identically when exposed to both longwave and shortwave ultraviolet light. This work is preliminary, but it appears, nonetheless, to offer a reliable means of identifying the sources of flints.

Consequently, flint samples from the Huweijir mines and from 'Ain Ghazal were inspected in normal light, and under both longwave and shortwave ultraviolet light in order to compare pertinent characteristics[1]. Specimens were selected that represented the range of variation in the highly siliceous flint found at both sites, as well as archaeological flints and cherts from 'Ain Ghazal that did not appear in normal light to derive from the Huweijir mines. The lithic material from the Huweijir mines and its counterpart from the 'Ain Ghazal collection responded in an identical manner under shortwave and longwave ultraviolet illumination. Both collections fluoresced with the same dull yellow-brown under each wavelength[2]. The 'Ain Ghazal specimens that did not appear to originate from the Wadi Huweijir source exhibited entirely different responses; either they fluoresced as dark green, or they had no fluorescent properties and reflected purple light. These reactions argue that the fine quality, often "pink" flint used by 'Ain Ghazal artisans was obtained at the Wadi Huweijir mines. This result supports the same conclusion based on flint attributes that are apparent in normal light, and strengthens its validity.

Heat-Treatment Experiments

Intentional heat treatment of flint has been difficult to document in most archaeological contexts. This problem is due, in part, to a number of variables that affect not only how any given type of stone will respond to heat, but also how a particular sample of stone will react. Numerous researchers have noted that detection of heat-altered stone via changes in luster, color, and fracture character, for instance, depends minimally on: (1) the temperature reached in the firing; (2) the chemical properties of the stone; and (3) the grain quality and degree of silicification of the stone (see MANDEVILLE 1973, PURDY 1974, RICK and CHAPPELL 1983). These difficulties are compounded when archaeological specimens are few, and when source deposits are unknown and therefore unavailable for comparative analyses.

Because of these complexities, most of the southern Levantine cases where intentional heat treatment of flint has been suspected have proven to be equivocal, such as at PPN Jericho (ROBINS *et al.* 1981, MILLER 1983) and Netiv Hagdud (NADEL 1989), and at the Natufian occupation at Wadi Hammeh 27 (EDWARDS and EDWARDS 1990). Nonetheless, many researchers maintain that heat treatment of flint was a common practice during the Neolithic in the southern Levant (BAR-YOSEF 1981, 1991; EDWARDS and EDWARDS 1990), and that heat alteration of local flints transformed them into the highly lustrous, pink flint in question.

However, preliminary tests of archaeological flint samples from 'Ain Ghazal give clear evidence that heat treatment was not used to create the lustrous, fine quality flint used for naviform core-and-blade production[3]. Preparatory to this study a lengthy series of heat-treatment tests were conducted on a wide range of flints of varying qualities in order to establish a reaction standard and range of temperatures that changed their character. Fine-grained, highly siliceous flint, comparable to that used at 'Ain Ghazal, was altered with very low temperatures (340-350° F.), becoming extremely lustrous. These tests established the low temperature threshold for reactions to heat with which to test the flint from 'Ain Ghazal. Reheating studies then were conducted on samples of archaeological cores, blades, and core-production debitage. In all cases, marked increases in luster occurred in this low temperature range (340-355° F.), suggesting that the stone had not been previously heat-altered.

With the discovery of the Wadi Huweijir flint mines, similar tests were conducted on freshly quarried stone samples that included the range of flints from various mines. This raw flint reacted in an identical manner as the archaeological samples; an obvious increase in luster occurred within the same low temperature range. Interestingly, these and subsequent firings (up to 575° F.) did not cause

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[1] I used a Mineralight Lamp, model UVGL-48 Multi-band UV with sensors for measurements at 254/356nm manufactured by UVP, San Gabriel, California.

[2] A detailed accounting of this experiment will be presented elsewhere.

[3] These tests will be documented elsewhere.

the tan or green flints to become pink. These tests strongly confirm that the siliceous, fine-grained flint used for naviform core-and-blade production during the PPNB at 'Ain Ghazal was not heat-altered local stone of lesser quality, but was, in fact, raw, freshly mined stone from nearby Wadi Huweijir or perhaps from other mines in the same geologic formation.

In related research reported elsewhere (WILKE and QUINTERO 1994), naviform core-and-blade production was replicated using good-quality raw flint from Cretaceous deposits in Texas. When the Wadi Huweijir mines were discovered, similar replications were conducted using Huweijir flint. Not surprisingly, the knapping qualities of the superior Huweijir flint far surpassed those of the Texas stone, allowing production of exceptional blades that were strong, sharp, and easily pressure-flaked. Additionally, experiments by others have shown that heat treatment reduces the strength of flint tool edges making them more likely to fracture and wear quickly (OLAUSSON 1983), so that heat treatment probably was not desirable for PPNB blade-tool efficiency.

In sum, results of heat-treatment studies and replicative knapping experiments confirm that heat treatment was not necessary, nor was it used to produce the high-quality flint that was reduced at 'Ain Ghazal. There can be no doubt that the flint reduced at 'Ain Ghazal was mined from the Wadi Huweijir mines or from other nearby mines in the same geological strata and transported to the site for use.

Discussion and Conclusion

Blade-core flint used at 'Ain Ghazal was a local resource that was obtained by community stoneworkers from mines in the nearby wadi. It was the mainstay of an autonomous lithic economy at 'Ain Ghazal for the production of naviform cores and blades for a significant portion of the PPNB. Clearly, an abundance of high-quality stone was extracted from the mines and transported 2km back to the town site for core reduction. Extensive exchange or procurement networks were not used to obtain exotic flint for use by local flintworkers, nor was it necessary to thermally pretreat flint prior to its use for core-and-blade production.

However, while local procurement of tool stone was an economically viable choice, flint obviously was obtained through considerable effort that must have required the organization of miners to extract the stone. It is reasonable to conclude that local artisans, probably part-time craft specialists, mined the stone or organized the mining effort, selected from the resulting exposures nodules of appropriate size and configuration, and then arranged for these nodules to be carried back to the town (see LECH 1981, 1987). As discussed elsewhere (WILKE and QUINTERO 1994), lithic artisans then carefully formed the nodules into naviform precores and reduced them with great skill. The exploitation effort apparent at the seam mines at Wadi Huweijir, coupled with the expertise and organization needed to mine, select, transport, and ultimately reduce the nodules, support current interpretations that an incipient stage of craft specialization was an important part of the economic structure of stone-tool production at 'Ain Ghazal (see QUINTERO and WILKE 1995).

It is also noteworthy that proximity to the resource may have been an important factor in the selection of the initial town site in Neolithic times. It seems reasonable to assume that easy accessibility to this highly desirable resource would have prompted the earliest settlement at 'Ain Ghazal in the middle PPNB. Dependency on the resource must have grown as the town grew and the need for a consistent supply of stone tools increased. Certainly, local procurement of flint was a significant economic choice, one that must have affected the growth and economic stability of the community.

If the economic choices made at 'Ain Ghazal are typical Neolithic strategies, it is likely that formative Neolithic towns elsewhere maintained locally independent lithic economies as a fundamental aspect of their organization. The ordinary stone tools for daily activities in these first peasant communities would have been supplied locally, within the context of the community, in much the same manner as staple foodstuffs must have been provided for town members. The prevailing Neolithic lifestyle suggested here would seem to rely to a large extent on the security and dependability of the local lithic economy and its ability to meet the needs of the community.

Certainly, corroboration of the patterns seen at 'Ain Ghazal is needed. It would be profitable to investigate other Cretaceous limestone deposits similar to those discussed here for evidence of mining. It is quite likely that the seam mines documented in this paper are common occurrences near many other Neolithic townsites. It is just as likely that there are many other sources in the southern Levant of highly siliceous, "pink flint" that were sought out and exploited during the PPNB. Now that one source has been discovered, other sources surely will be found. Finally, the project reported here is not yet complete. A more thorough study and characterization of the Huweijir mines themselves is needed and planned, including comprehensive surveying and mapping of all of the Neolithic exposures. It is anticipated that future data will increase our understanding of the sophistication of the lithic economy that prevailed at 'Ain Ghazal, and, possibly, at comparable early Neolithic towns in the Levant.

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Near Eastern Neolithic Millstone Production: Insights from Research in the Arid Southwestern United States

Philip J. Wilke and Leslie A. Quintero

Abstract: *Field studies in the arid southwestern United States have revealed the character of prehistoric millstone quarry-and-production sites. Technological interpretation of the activities carried out at these sites was aided by replicative studies in millstone production. The combined field and replicative studies have important implications for the study of millstone production in the Near Eastern Neolithic.*

Résumé: *Des études faites sur place dans la partie sud-ouest des Etats-Unis ont revélé le caractére des sites de carrière et de production d'outils de moulure. Des études réplicatives de la production d'outils de moulure ont contribué a l'interprétation technologique des activites effectuées dans ces sites. Les études faites sur place ainsi que les études réplicatives ont d'importantes implications pour l'étude de la production d'outils de moulure dans le Néolithique du Proche-Orient.*

Introduction

Neolithic millstone quarry-and-production sites have not heretofore been investigated in the Near East. The purpose of this paper is to characterize such sites and the activities represented at them, as known from studies elsewhere, in order to encourage their discovery and analysis.

Millstones, including querns, handstones, mortars, and pestles, are among the most common and characteristic of all Neolithic stone artifacts. Traditionally, the study of Neolithic millstones has emphasized basic typological analyses of worn-out and abandoned artifacts, and their chronological significance (*e.g.*, WRIGHT 1991, 1992a). Recently, the economic importance of milling implements to the rise of village farming has become a focus of study (HENRY 1989, WRIGHT 1994). However, to this time there has been no serious attempt to investigate Neolithic millstone production. We believe that the reason such studies have not been made is largely attributable to a fundamental misconception of how millstones actually were produced.

A general assumption prevails in Near Eastern studies, as well as in studies throughout both the Old and New Worlds, that milling implements of all kinds are "ground-stone" artifacts that were fashioned mainly by grinding or abrasion. Researchers are now beginning to acknowledge that some flaking may have been involved in the production of milling implements, but there is an overriding assumption on the part of most analysts that flaking was far overshadowed in importance by abrasion. Most researchers appear to believe that the production of millstones, although largely unexplored, must be quite different from the production of what usually are considered flaked-stone artifacts (*e.g.*, WRIGHT 1991: 19,21, 1992b: 17, 1993: 93; PERLÈS 1992: 130). Consequently, major analyses of the debitage from specific sites (*e.g.*, Mureybet: CALLEY 1986) treat only the flints and other materials usually recognized as representing the "flaked-stone" industry. The first volume of *Neolithic Chipped Stone Industries of the Fertile Crescent* (GEBEL and KOZLOWSKI 1994) hardly addressed millstones at all. Even more broadly, the production of millstones by percussion flaking is not recognized or included in major works on the descriptive characterization or the technology of flaked-stone tools[1]. Clearly, for most researchers, the residue of millstone production is expected to be dust

[1] These works include *La dénomination des objets de pierre taillée* (BRÉZILLON 1983) and *Technology of Knapped Stone* (INIZAN *et al.* 1992).

from abrasion, not percussion flakes of giant proportions and of astounding quantities.

This conceptual problem was addressed to a degree by WRIGHT (1992a) in a paper entitled "A classification system for ground stone tools from the prehistoric Levant". Following earlier work by RUNNELS (1981: 218ff), Wright correctly pointed out (p. 53) that "the term 'ground stone' is a misnomer", and that flaking is an integral aspect of the production of so-called ground-stone tools. This important fact is largely obscured, however, by her extremely detailed classificatory approach, and by the title of her paper, which conceptually retained milling equipment in the realm of "ground stone".

While unshaped or minimally shaped querns, handstones, and pestles are the usual milling artifacts in many cultural settings in prehistory, for just as many areas and periods, many if not most items of portable milling equipment were produced and shaped entirely by percussion flaking and subsequent dressing by pecking, and are, in every sense, flaked-stone artifacts. In these latter cases, only very minor grinding may have been employed to eliminate grit that would be detrimental to the milling process. It may have been used, for example, to smooth the contact surfaces of newly made mortars and pestles. But where used at all in the production of millstones, grinding was but the final and minor stage, not the prominent one. It gave the millstone its "ground-stone" appearance, and it obscured the earlier stages of production in which all of the work was accomplished by percussion. In our experience, evidence of grinding is almost entirely a property acquired during use, and is not an important aspect of millstone production.

We propose that studying the production of Neolithic milling implements must begin with identifying and characterizing the raw material selected for millstones and the places where raw material was quarried or otherwise obtained. It must characterize the reduction loci, or work areas, where the quarried material was reduced into blanks and then preforms for final shaping. And it must include a clear description of the final shaping and dressing of preformed milling implements. A specific tool kit and a characteristic debitage assemblage associated with each stage of production must be identified and characterized. An understanding of the entire industry associated with millstone production must recognize that the archaeological expression of these stages is likely to be differentially but predictably distributed on the landscape. Only with such an approach will it be possible to understand the derivation of milling implements from raw stone, to infer the activities represented at quarry-and-production sites, and to appreciate the place of milling-implement production within the larger subsistence economy and overall technological realm.

Evidence from the New World indicates that formed pieces of milling equipment were produced at quarry-and-production sites where suitable stone was obtained, and where all but the final stages of production were performed. Archaeological and ethnographic field studies in the southwestern United States and in Central America have garnered a wealth of information on the derivation of milling implements from parent raw material. These studies have provided insights on the nature of the stone selected for millstone production, the geographic and assemblage character of millstone quarry-and-production sites and their associated work areas, the processes involved in production of milling implements, and related topics.

A brief overview of what has been learned about millstone production from studies in the arid southwestern United States, where aboriginal cultures operated at a basic Neolithic, or peasant, level of technological development, provides a conceptual basis for investigating Neolithic millstone production. The comparison is especially relevant because both the milling implements and the materials used for their production in the two areas are similar. While limestone was commonly used for millstones in some areas of the Near Eastern Neolithic (as in Highland Jordan [ROLLEFSON 1984] and lowland northwest Iran [HOLE *et al.* 1969]), our studies have not been conducted in areas where that material commonly occurs. However, basalt, andesite, and sandstone were commonly used for millstone production in both areas, and are the materials on which our studies are based. In any event, we have had the opportunity to examine many millstones from 'Ain Ghazal, Basta, and 'Ain Jammam, in Jordan, and from Ali Kosh, Iran, and have noted remnant percussion scars on many examples. Moreover, what appear to be percussion scars from production are evident on some illustrated examples of Near Eastern Natufian and Neolithic millstones of various forms and lithologies, suggesting that percussion flaking was important in the production of these implements.[1]

In this paper the term "millstone" refers to any piece of milling equipment, including querns, handstones, mortars, pestles, etc. The term "quern" is used specifically to refer to the lower stationary element of a pair of grinding (not pounding) stones that are used in conjunction. It is synonymous with the New World term metate, and with milling block, milling slab, grinding stone, etc. We avoid use of the collective term "grinding slab" for all such implements (as used by HOLE *et al.* 1969), because in our own experience a distinction between slabs and blocks is often useful for distinguishing more habitually portable gear from more habitually stationary gear. The term "portable" is used here

[1] For example, in Natufian contexts at Hayonim Cave, Israel (BAR-YOSEF and GOREN 1973: Fig. 10) and Jayroud 3, Syria (CAUVIN 1991: Fig. 4), and in Neolithic contexts at Jarmo, Iraq (MOHOLY-NAGY 1983: Figs. 127-128); and Cayönü, Turkey (DAVIS 1982: Figs. 3.7, Pl. 3.I).

to indicate milling implements that are movable, whether or not they ever were habitually transported from one place to another. In many situations, very thin milling slabs and handstones are linked to seasonal nomadism, and such implements truly are portable.

Background

Over the last decade, prehistoric millstone quarry-and-production sites have been the subject of significant field research in the arid southwest. These studies have been conducted primarily in the Sonoran Desert region of Arizona (*e.g.*, HOFFMAN and DOYEL 1985; HUCKELL 1986; BOSTWICK and BURTON 1993; SCHNEIDER 1993, 1996), and in the Mojave and Colorado deserts of California (SCHNEIDER 1993, 1996; SCHNEIDER *et al.* 1995). This vast area is drained by several rivers, of which the Colorado and the Gila are the most important. The rivers supported prehistoric agricultural economies, and in turn they appear to have played a key role in the transportation of heavy pieces of milling equipment from the places where they were produced initially to the places where they were completed and used.

Along the Gila and Salt rivers of Arizona, and along the lower Colorado River which divides Arizona and California, querns and handstones were employed by aboriginal peoples for grinding maize (*Zea mays*) and many other wild and cultivated seed crops for most of the last 2,000 years of prehistory. Prior to that, millstone production and use was integral to hunting-gathering economies of the area for at least 8,000-9,000 years. Chief among the wild crops were two species of mesquite (*Prosopis glandulosa*, *P. pubescens*), leguminous trees exploited for their edible pods, which were milled in wooden mortars with long, cylindrical stone pestles. Many other seed crops were milled with querns and handstones (CASTETTER and BELL 1951). Both querns and pestles used in the arid southwest were of substantial size, and most were well-smoothed or dressed, often displaying few if any percussion-flake scars. Querns typically weighed up to 50kg, and many were twice that large. Pestles often were up to 50-75cm or more long, and about 8-10cm in diameter. Handstones were small, for use with one hand, or large, for use with both hands.

The production of stone mortars on one of the Channel Islands of California has been reported briefly (BRYAN 1961). In Central America, the ethnographic production of milling equipment has been studied and reported in detail (COOK 1973, HAYDEN 1987, HAYDEN and NELSON 1981). An exhaustive study by Schneider (1993) addressed the matter of millstone production worldwide and summarized data on more than two dozen millstone quarry-and-production sites in southeastern California and western and southwestern Arizona. Other such sites are known to exist in northern Baja California, but have not yet been examined. Typical raw materials are andesite (which was worked at most of the California sites studied), vesicular basalt (more commonly used in Arizona), and sandstone. Most of these sites have been examined in the context of our study in sufficient detail so that it is possible to characterize the nature of the industry represented at them; a few have been recorded and analyzed in depth; others currently are under study. Information derived from these field studies provided a firm basis for replicative experiments briefly reported here to determine the specific manner of production of querns, handstones, and pestles of the forms used in the arid southwest.

Millstone Quarry-and-Production Sites

Along the lower Colorado River especially, except for final shaping and pecking to completed form, both the quarrying and production of millstones occurred at the same places. These quarry-and-production sites usually are located within a few kilometers of the river. Some sites were used for production of both querns and pestles; others, because of the configuration of the available raw material, yielded mostly pestles; probably handstones were produced at most such sites, but the evidence for their production is lacking or obscured. Failed manufacturing efforts for querns and pestles are common, even abundant. In addition to revealing the identity of the intended products, these abandoned production efforts make it clear that the failure rate for querns and pestles was so high that it was expedient to accomplish all of the high-risk percussion shaping before transporting the intended product from the quarry area.

Site Types

Whatever the intended products, quarry-and-production sites are of two broad types. *Bajadal sites* occur on detrital slopes that descend from mountains to distant lowlands. Some fine sites of this kind, including the Big Bend Quarry (HUCKELL 1986), are located along the Colorado River. The surfaces of these sites are dotted by boulders up to a meter across that were transported by surface water in recent geologic time from bedrock exposures in mountainous uplands several kilometers distant. Boulders were reduced individually at the places they occurred, and were transformed into querns and pestles. Sites of this type therefore tend to be expansive, sometimes extending over a di-

Plate 1. Millstone quarry-and-production sites along the lower Colorado River in the arid southwestern United States.

a: View of the Ironwood Quarry, southeastern California. The andesite outcrop at the upper left and the entire boulder-strewn talus and adjacent slopes contain nearly 1,350 individually recorded and characterized reduction loci where surface boulders and quarried blocks of andesite were reduced by percussion flaking to produce querns and pestles.

b: Reduction locus at the Ironwood Quarry with a failed pestle blank and associated reduction debris. *<trowel for scale>*

c: Reduction locus at the Ironwood Quarry where a large boulder was partly reduced, apparently to make a quern. The work was halted and the locus abandoned, perhaps because of the discovery of a crack in the stone. *<trowel for scale>*

d: Reduction locus at the Silver Creek Wash Quarry, western Arizona. The intended millstone or stones produced here are not present, indicating probably that they were successfully completed to the preform stage and transported from the locus. Large andesite flakes and hammerstones surround a relatively clear work space in the center. This is a very typical reduction locus at all the quarries studied in southeastern California and western Arizona. *<locus is about 3.5m across>*

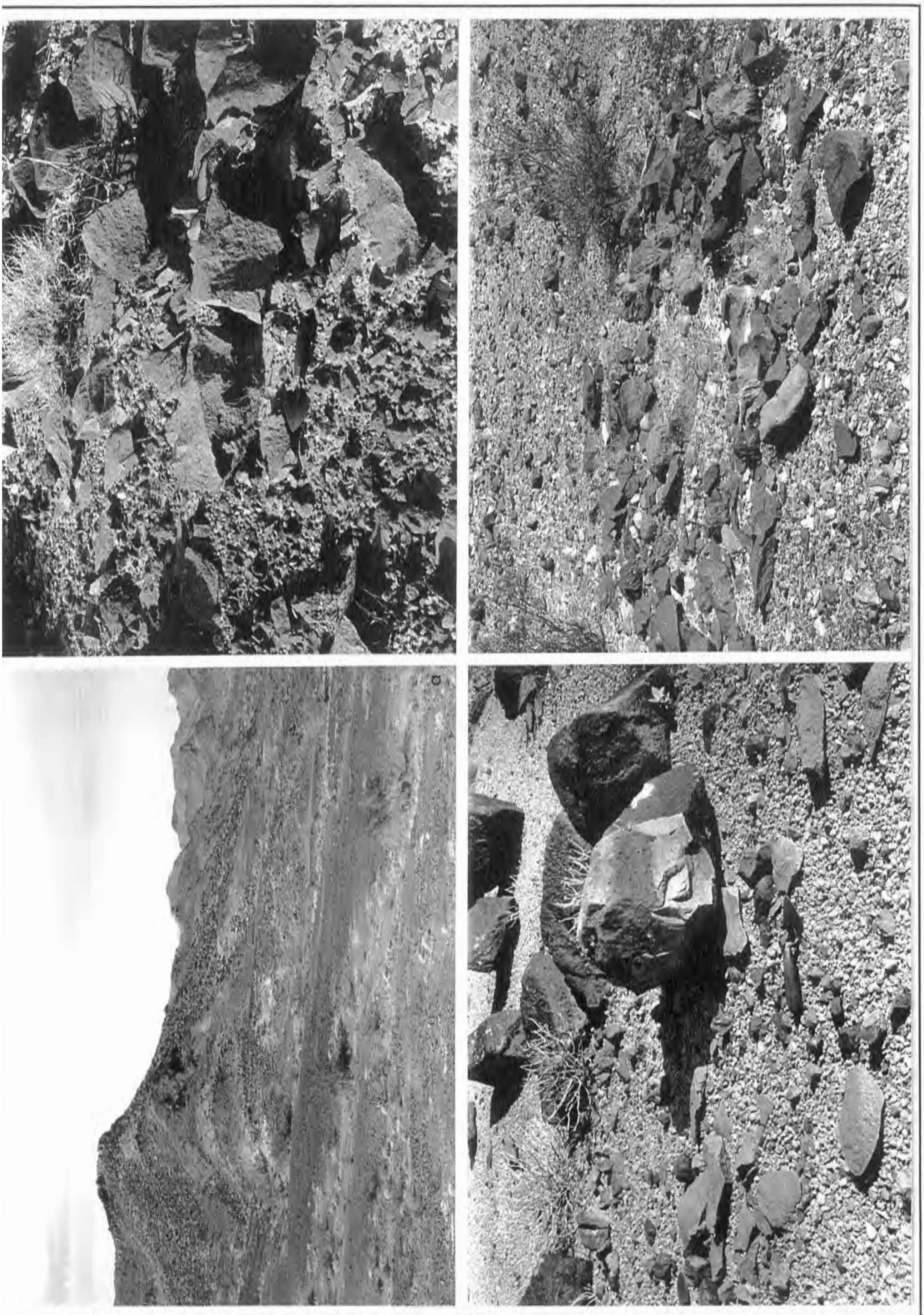

Plate 1:a-d

Plate 2. Artifacts recovered from reduction loci at millstone quarry-and-production sites along the lower Colorado River, and experimental millstone production.

a: Heavy cobble hammerstones of quartzite from the reduction locus shown in Pl. 1:d, Silver Creek Wash Quarry. Hammerstones of this size and configuration (and much larger) are suitable for reduction of andesite boulders to obtain blanks for querns and pestles. The bifacial bevelling may be a result of heavy use rather than intentional treatment of the edge. Intentional bevelling (usually unifacial) is always indicated on hammerstones used in later stages of reduction of millstones, and is necessary for careful detail work on more rounded surfaces.

b: Typical andesite flakes resulting from quern and pestle production at the Chip Hill II Quarry, California. Note the flatness of the bulbs of force, the radial lines emanating from the points of loaded force, and the characteristic hinge terminations. Flakes like this occur by the millions at large quarries. *<centimeter scale>*

c: Small, replicated quern preform of arkosic sandstone from the Antelope Hill Quarry, ready for squaring of the ends, final shaping, and dressing. The milling surface requires only dressing by pecking to remove the weathered surface material. The block of material selected for reduction required only minimal gross shaping to bring it to its present form, a desirable, though probably uncommon, situation. Most of the querns produced at the quarries studied were substantially larger and thicker. *<centimeter scale>*

d: Replicated pestle preform on which initial shaping has been completed, and resultant debitage. The material is fine-grained andesite from the Chip Hill II Quarry. *<centimeter scale>*

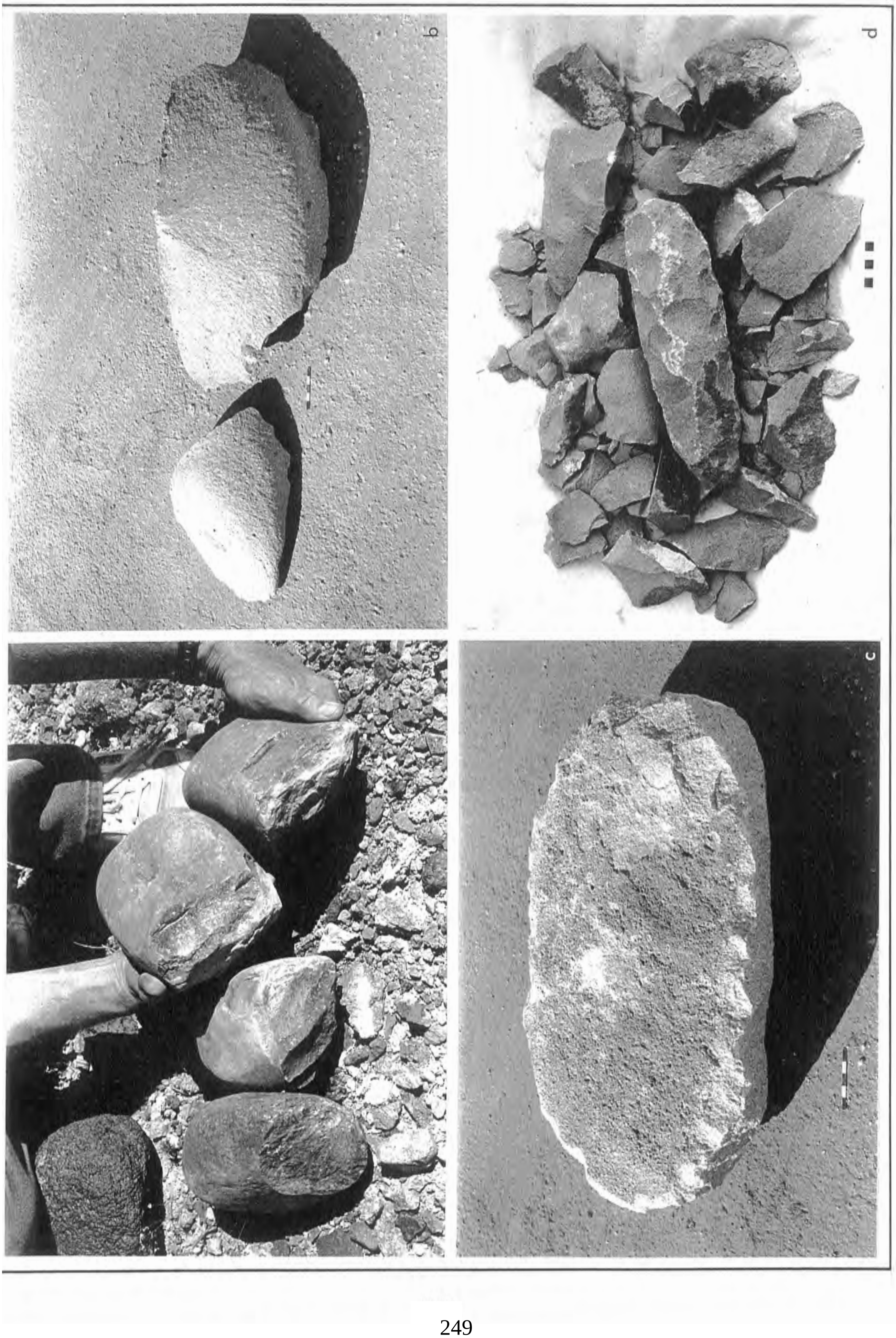

Plate 2:a-d

Plate 3. Experimental replication of millstone production.

a: Replicated pestle preform on which the final shaping has been completed. The debitage is that which resulted only from the final shaping. Also shown are the hammerstones used in the final shaping. Fine-grained andesite. *<centimeter scale>*

b: Replicated pestle reductions in various stages of completion, all fine-grained andesite. *Left to right*: rough preform No. Q3, about 0.5 hour of percussion work required to this stage; preform No. P6 after final shaping, about 1.5 hours of work expended; nearly completed preform No. P5, 1.5 hours of work to the final shaping stage, 8.5 hours of work involved for dressing to this stage (77,000 pecking strokes), about 2 hours more work are required for dressing; completed pestle No. Q3, 12.75 hours total production time, 105,000 pecking strokes for dressing, working end lightly finished by grinding for a few minutes. *<centimeter scale>*

c: Dressing a large andesite pestle (No. P4) by pecking (85,000 strokes in 9.5 hours) with bevelled quartzite cobble hammerstones.

d: Hammerstones used in millstone production. The right two examples in the lower row resulted from dressing pestles in the experimental work reported here. All of the others are from aboriginal quarries in southeastern California. *<centimeter scale>*

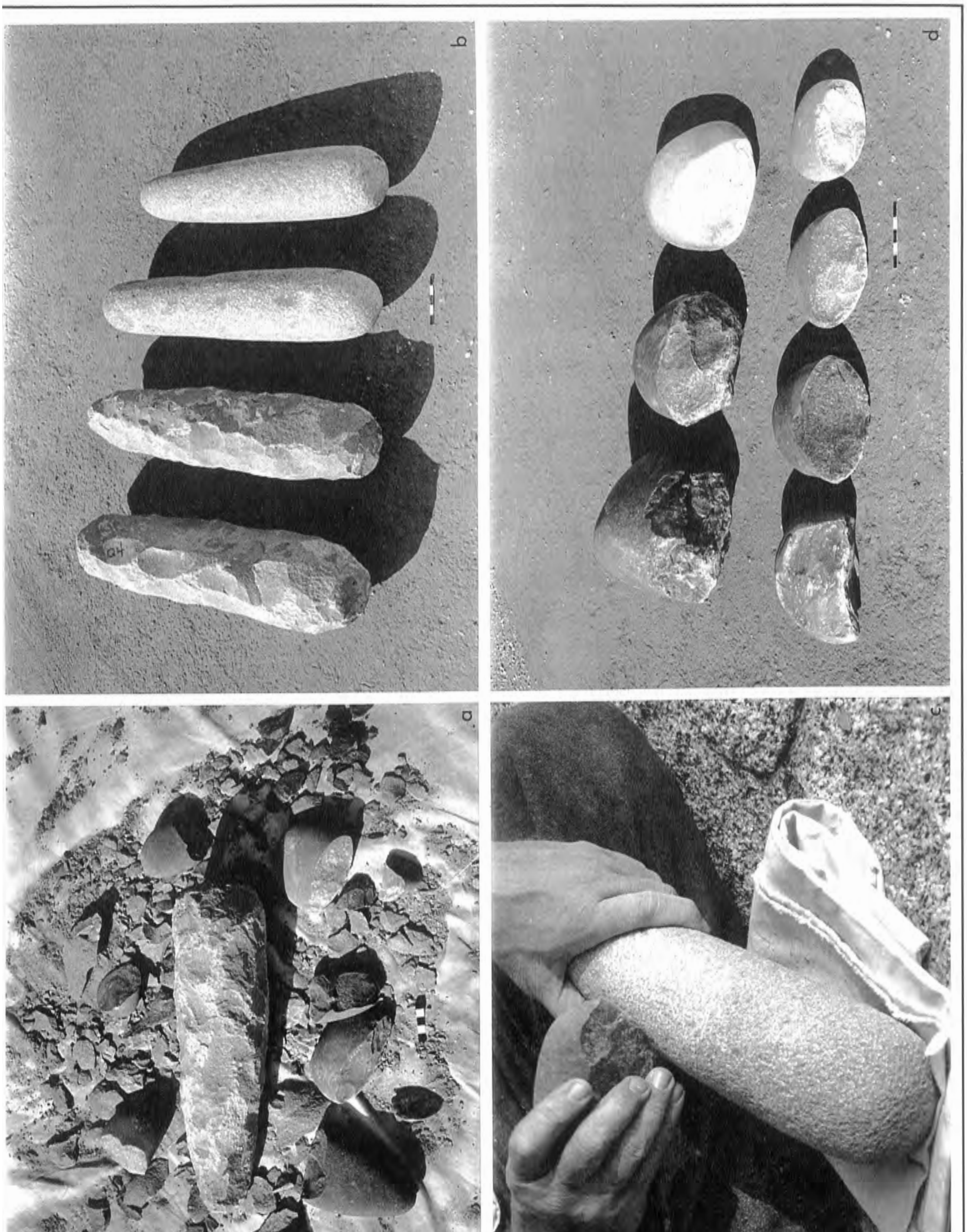

Plate 3:a-d

stance of several kilometers[1]. In any given area of such a site, the density of reduction loci is low; typically such loci are separated from one another by distances of 20-100m or more. It is thus often possible to characterize individual reduction loci with some degree of accuracy and to have reasonable confidence that only a single reduction goal is indicated at any given locus.

Quarry-and-production sites of the other type occur at outcrops of bedrock and on the adjacent talus deposits and immediate surrounding slopes. These are termed *bedrock outcrop sites* (Pl. 1:a). The outcrops slowly but continually supply boulders of suitable rock to the immediately adjacent slopes, a process that has continued throughout recent geologic time. Without such bedrock exposures to renew the supply of fresh rock to the surrounding slopes, it is likely that all surface boulders on such slopes would have become heavily weathered during recent geologic time, and would have become cracked and checked and otherwise unsuitable for millstone production long before the arrival of humans in the New World. The outcrops themselves also provided workable rock for millstone production, and careful examination of most such sites reveals evidence of actual quarrying along joint planes in the exposed bedrock.

Many bedrock outcrop sites display evidence of very intensive exploitation in prehistory. Differential patination of reduction debris suggests that quarry-and-production sites were used over a very long time. Individual reduction loci are often difficult to identify and characterize because one work episode is imposed upon another, and debris from millstone production may occur to a depth of a meter or more. Intensively used sites tend to have small terraced work areas 2-3m across perched on steep slopes. These terraced work areas resulted from the continued discarding of reduction debris on the downslope side of favored work areas. Interpreting the debris that resulted from individual work episodes at such loci may be extremely difficult, but the general character of these sites, as well as the nature of isolated loci are readily apparent.

Character of Reduction Loci

Individual redution loci, or work stations, usually under 5m across, have distinctive surface assemblages (Pl. 1:b-d). Occasionally boulders were tested for quality by detaching one or more flakes and then rejected. Usually, however, boulders were reduced with cobble hammerstones of quartzite[2] that had been gathered from nearby river terraces and transported up to several kilometers to the quarry sites. Initial reduction of boulders was accomplished with hammerstones that commonly weighed up to 5-15kg (Pl. 2:a). Hammerstones up to about 4kg in weight usually were bevelled unifacially to fashion a sharp striking end. Examples bevelled bifacially may have resulted from intentional flaking or from impact damage. Distinctive hammerstone-resharpening flakes and flakes expelled from hammerstones during use are common artifacts on reduction loci. Broken or otherwise discarded hammerstones also are common, and many loci have one or more of them.

Debitage resulting from initial reduction of boulders of andesite is of grand proportions (Pl. 2:b). Flakes up to 73cm wide and somewhat less long were observed; flakes 40cm in maximum dimension are very common. Such large flakes typically have single-facet platforms, very flat bulbs of force, massive hinge terminations, and usually are wider than they are long. There are also many failed reduction products. Querns and pestles alike often suffered bending breaks due to endshock or due to flaws in the material. Examples of extensively worked and abandoned quern blanks with estimated weights of up to 150kg were observed at the Ironwood Quarry. At the same site, occasional pestle blanks more than 80cm long and 30cm in diameter were simply abandoned when effective working angles for continued percussion flaking were lost.

Nature of the Work Indicated

Hammerstones, hammerstone-resharpening flakes, reduction debitage, and failed or aborted examples of the intended querns and pestles provide details on how massive boulders were reduced into milling implements. The evidence from a number of quarries in southeastern California makes it clear that the intended quern would typically be at least 60cm long, 35cm wide, and 20-30cm thick. If possible, a flat, weathered surface was chosen to be dressed and to become the intended milling surface, and reduction of the boulder or quarried block was carried out with that goal in mind. If such a flat surface was not available, one was created by removing massive percussion flakes with hinge terminations at the center of one face of the blank or preform[3]. Abandoned quern blanks and preforms

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[1] The Big Bend Quarry is known to occur across at least 75 km^2, and probably is much larger.

[2] In all cases this material was metaquartzite, not orthoquartzite, which fractures too easily.

[3] As used here, the terms "blank" and "preform" imply a continuum of stages in the same reduction process. Generally "blank" refers to a very early stage of reduction in which the intended product may not yet be evident, and in which a change in goal, for example, from production of a quern to production of a pestle, would still be possible. The term "preform" is appropriate to characterize the workpiece midstage in most successful reductions, as the intended form is quickly defined and

are sometimes found propped up on support stones, or anvil stones, to facilitate percussion shaping of their sides and undersides. The margins of the intended working face of a quern were always rounded slightly by percussion flaking, and often the ends of querns were squared off by detachment of a single massive flake from the end of the intended working surface. Pestles had diameters of about 8-10cm, and if preforms for them got too narrow, or if they got shorter than about 43-45cm during reduction, they were abandoned. Broken pestles may have been converted into handstones. In such cases, further reduction and refinement were almost assured, and they likely would have been removed from the quarry sites and completed elsewhere.

Intensity of Work

The intensity of use of some favored quarry-and-production sites is indicated by the great number of identifiable reduction loci, and by the number of failed efforts. Near Palo Verde, California, several miles from the Colorado River, the Ironwood Quarry is a bedrock outcrop of andesite with its associated detrital slopes (Pl. 1:a). Nearly 1,350 individual reduction loci were characterized at this site[1]. Querns and pestles (and probably also handstones) were produced at this site. The nearby Chip Hill I, Chip Hill II, and Catclaw quarries, also with andesite outcrops, have reduction debris in such volume and density that individual reduction loci can only occasionally be identified. Each identifiable locus represents one to many reduction episodes, and terraced work stations are common. The same kinds of milling implements were produced at these sites as at Ironwood. The Antelope Hill Quarry on the lower Gila River near Wellton, Arizona, occurs on a single upthrust block of arkosic sandstone about one square kilometer in area, rising high above the floodplain of the Gila River. Sampling of the Antelope Hill site indicates, however, that 49,000 failed querns and more than 87,000 failed cylindrical stone pestles are represented in the debris of this single quarry-and-production site (SCHNEIDER 1993, 1996). Evidence suggests that as available boulders on adjacent slopes were exhausted, the outcrops at each of these sites were quarried to supply raw material for millstone production.

The Elephant Mountain Quarry near Daggett, California (SCHNEIDER *et al.* 1995), is another substantial site. It is located on the bank of the ephemeral Mohave River, and it supplied querns and pestles, both of large size. Boulders of andesite that occur free on the surface of the flat-topped mountain provided the raw material. Transport of the heavy millstones from Elephant Mountain to the places where they were used would have been laborious without pack animals or access to running water, but such must have been the case in this land of little rain.

Many other quarry-and-production sites are small and inconspicuous. The reason seems always to be that the available raw material was limited in quantity or quality, or that these sites are too remote from rivers along which the completed products would have been used or on which they would have been transported (especially querns) for use elsewhere. It also may have been the case that demand in these areas simply was low. At some sites, such as a small millstone quarry in the Castle Mountains of California, the raw material was extracted from a bedded and jointed exposure of basalt bedrock. Little percussion flaking was needed or performed to complete the small, tabular, portable querns obtained there. The querns were found nearby at surface sites and small rockshelters where they ultimately were used.

Finally, at a few sites exposed dikes of fine-grained granitic rock were quarried for quadrangular blocks that required little further reduction for use as querns.

Discussion

Information obtained from the field study of sites in California and Arizona indicates that the quarrying of rock and the production of millstones of several forms was an important but heretofore largely undocumented industry in prehistory. It is ironic that Antelope Hill was recorded initially as a rock art site and that until several years ago it had never been recognized as the most intensively worked millstone quarry-and-production site ever found in the American Southwest. Fieldworkers simply walked over the one square kilometer of evidence of millstone production, failing to recognize it. The sheer abundance and volume of quarrying and reduction debris, in addition to the differential patination of worked rock surfaces, indicate that the industry at this site (and at the others as well) is of great antiquity. That it flourished late into the last century is indicated by ethnographic and ethnohistoric data.

An important ethnohistoric account dating to the early 1860s describes Yuma (Quechan) Indian men quarrying sandstone blocks and reducing them to querns for their wives at the Antelope Hill Quarry (CREMONY 1868: 145-146). The Yuma were floodwater farmers who resided on the lower

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all later work is directed toward refinement of that form.

[1] This site currently is under analysis and will be reported elsewhere.

Colorado River near its junction with the Gila. They traveled up the Gila to obtain querns (and perhaps pestles also), a trip which they are said to have made annually. The Cocopah and Kamia, other tribes of the region, are said to have quarried rock and produced millstones at the same site (SCHNEIDER 1993: 135). It would seem likely that these groups floated their millstones downstream to their homes on rafts or other watercraft. This practical behavior is suggested by petrographic comparison of quarry samples and of several museum specimens from sites downstream (SCHNEIDER 1993), and may indicate a widespread pattern in which millstones habitually were quarried upstream and transported downstream by water to the place of intended use wherever and whenever possible.

Most of the known quarries in western Arizona and southeastern California are within several kilometers of the Colorado or the Gila rivers. The heavy work of transporting querns would therefore have been minimized if these implements could have been floated downstream on these rivers. Land transport of newly produced millstones to the river (perhaps using some sort of litter for carrying) may be indicated by well-worn aboriginal foot trails leading between the Ironwood Quarry and the terraces of the Colorado River a few kilometers distant. These trails are preserved in the desert pavement surface and may well be several thousand years old.

All but the final shaping and dressing of millstones took place at the locations where the rock was quarried or obtained from surface exposures. Clearly, the high rate of failure during early stages of production is the primary reason for this occurrence. Very heavy percussion flaking was involved in the production of both querns and pestles, and all but the comparatively less traumatic final dressing of the millstones was carried out before they left the quarry-and-production sites. The desire to reduce weight for transport also must have played a role in determining how much and what kind of reduction was carried out onsite and what production tasks were performed when the new millstones arrived at the places where they were to be used.

Initial reduction of boulders for production of querns, and overland transport of the preformed implements from the quarry area, are very laborious activities. The ethnohistoric account of Yuma Indians producing querns at the Antelope Hill Quarry clearly indicates that it was men who did this work, intending to take the (nearly?) completed millstones home to their wives. Investigations at the Ironwood Quarry brought into focus the extent of work necessary to produce and transport the immense quern preforms obtained there. Together these findings suggest a division of labor involved in millstone production. Perhaps men performed the physically arduous production and transportation labor, while final shaping and dressing of millstones was accomplished by women, who were the chief users of the completed implements. In any case, it is clear that millstone production usually required a cooperative manufacturing and transportation effort, and was not a solitary economic endeavor.

The final shaping and dressing of millstones is not apparent at most quarries. It may have occurred at the quarries but seldom resulted in failure, and thus would be poorly represented there. However, abandoned pestle and quern blanks along trails leading from the Ironwood Quarry to the Colorado River were incomplete products, suggesting that the final stages of production were not carried out at Ironwood, or at most of the quarries. Only at the Antelope Hill Quarry in Arizona, where the raw material is sandstone, and where final dressing to form could be accomplished fairly quickly, were querns and pestles brought to nearly final form before they left the site. Even there, however, failure was likely to occur comparatively late in the production sequence, as shown by many nearly completed examples that still failed due to endshock, usually along old clay-cemented fracture lines. Perhaps such ancient fractures were reactivated by heavy percussion blows in early stages of production. In any case, milling implements generally were brought closer to completed form at Antelope Hill than at any of the other sites studied to this time.

Experimental Replication of Millstones

Based on information gathered in these field studies, experimental replications were conducted to understand how millstones likely were produced in prehistory, and thereby verify interpretations of this process as formulated in the field. In addition, replications led to an assessment of the amount of time and effort required to produce millstones. Querns (Pl. 2:c), handstones, and pestles (Pl. 2d, 3a-c) were replicated, with emphasis on the latter because of their higher failure rate and the greater care needed to ensure successful production. The following discussion emphasizes the production of cylindrical pestles, but most of the actions are the same as those required for making other milling implements.

Raw materials used for replications were those gathered from the surface at the aboriginal quarries, and included both andesite and arkosic sandstone. Most of the work was done using andesite. Quartzite cobble hammerstones were collected from ancient terraces of the Colorado River, where they occur in gravels. Photographic and written records were kept detailing the nature of the work and the time it required.

Initial attempts to produce pestles with unshaped hammerstones were largely unsuccessful. It was only after hammerstones were bevelled in the manner of the archaeological examples that pestle blanks could be produced fairly consistently without breaking.

The process outlined here recognizes several stages in millstone production. These are: (1) quarrying or obtaining a block of raw material; (2) reducing the block to obtain a millstone blank; (3) preforming the millstone; (4) detailed shaping of the preform; (5) dressing the surface of the millstone; and (6) finishing, or smoothing, of the surface by grinding (optional). Aside from the initial selection of the block of raw material and the smoothing of the surface of the completed millstone by grinding, all of the work was done by percussion.

Obtaining the Block of Raw Material

Raw material for the replicative studies was obtained by selecting a suitable boulder for reduction. If obtained from an aboriginal quarry area, the block was selected from the surface boulders and was considered to be a quarry reject, one that had not been selected for reduction in prehistory. As a general statement, it can be said that our experiments used the same quality but smaller-sized blocks of material that likely had been considered and rejected without modification in prehistory. In one instance, where modern rock-quarrying operations are actively destroying an aboriginal quarry (the Antelope Hill Quarry), large blocks of stone were selected from that stockpiled in the present quarry operations. No attempt was made to free blocks from parent outcrops, as doing so would have compromised the integrity of the aboriginal quarries.

Reducing the Block to Obtain a Millstone Blank

Initial block (or boulder) reduction is hard and, to a certain extent, dangerous work. Great force is needed to detach large percussion flakes, force must be applied with precision, and there is danger from flying rock fragments. Most important is the secure immobilization of the block being reduced, which usually requires the work of more than one person, one to immobilize the workpiece and minimize vibration, and the other to do the actual flaking. It is often necessary to prop the block up on a support stone, as indicated by a number of abandoned archaeological examples at the quarry-and-production sites. Bevelled hammerstones generally are not needed for this initial reduction. Once the initial and most massive reduction is completed, it is necessary to use hammerstones that have smaller contact points, or that are bevelled.

The product obtained in this stage is termed a blank, rather than a preform, because the high likelihood of failure sometimes makes it necessary to alter the intended goal of the work. Usually, most of the cortex is removed in this stage.

Depending on the shape of the block or boulder being reduced, the intended product of reduction, and the degree of success, an average of perhaps 50-60% of the mass of the original block might be flaked away to obtain a millstone blank. This task usually can be accomplished in a short time, perhaps 10-20 minutes.

Preforming the Millstone

Preforming (Pl. 2:d) is the most crucial stage of reduction, as it is during this stage that failure is most likely to occur, particularly in pestle production. It is highly advantageous, if not absolutely essential, that one person minimize shock to the workpiece while a second performs the actual percussion flaking. Immobilization of the workpiece is most effectively accomplished by resting it on the ground, propping or blocking it for support when necessary, and stabilizing it with full body weight to absorb shock. The workpiece must usually be repositioned for each blow.

During the preforming stage, flaking must be conducted with far greater care and precision. At this stage the workpiece has already become generally cylindrical, and there are few acute angles for flake detachment. Bevelled hammerstones are essential, as they permit very precise placement of blows on very small or narrow striking platforms. Continued resharpening, or rebevelling, of the hammerstones is necessary to maintain their working edges. Equally important is the creation, by pecking, of individual platforms that are otherwise far too obtuse to be used. These linear, pecked platforms, only 3 or 4mm wide, are best prepared and effectively struck with unifacially bevelled hammerstones. The flakes thus detached bring the workpiece into its proper overall form, but it still has a very rough-looking appearance. Many flakes removed in this stage have prepared platforms, and their bulbs of force are very flat, almost nonexistent. They also tend to have noticeable to pronounced radial lines or striations near their platforms and they have feather terminations. Use of a hammerstone with a unifacial bevel results in the initiation of a nearly linear fracture, rather than a cone-shaped one, much as if the flake were chopped or sheared from the surface of the workpiece. In this stage, constant maintenance produces many hammerstone-resharpening flakes, and small flakes are detached incidentally during use.

Indirect percussion occasionally was a useful tactic for detaching flakes from linear striking platforms pecked into the workpiece since it permitted very careful emplacement of force. For this procedure, a unifacially bevelled hammerstone was carefully positioned on the prepared platform and used as a punch or chisel; this intermediate tool was then struck with a second hammerstone. Whether the practice ever was used in prehistory is not known, but it is suggested by concussion marks on the ends of archaeological hammerstones, opposite those which have bevelled edges. Of course, such hammerstones may simply have been reoriented during use.

In this stage, an additional 10-20% of the mass of the original boulder may be removed, and the work might require 30-45 minutes to complete.

Detailed Shaping of the Preform

Detailed shaping of the preform (Pl. 3:a-b) is accomplished by detachment of small, carefully positioned percussion flakes. This step really is a continuation of the former stage, and only represents more detailed flaking prior to dressing by pecking. This stage is less visible archaeologically than is the preforming stage. The work is time-consuming, results in only a minor reduction of the mass of the workpiece, and is not so likely to result in failure due to endshock. Inasmuch as the preform now has rounded surfaces and lacks favorable platforms for percussion flaking, many platforms must be created by pecking with a unifacially bevelled hammerstone. Bevels must be carefully maintained on hammerstones. Flakes detached are all small, and the only other waste is finely crushed rock meal and flakes detached intentionally or incidentally from the bevelled edges of hammerstones. Work during this stage can be accomplished by one person resting the workpiece on soft ground and using body weight to minimize shock.

In this stage some bothersome ridges or arrises can be broken down by coarse pecking, but most such dressing takes place in the next stage. Detailed shaping is meticulous work. The more carefully it is performed, the less time is needed for dressing. In our experimental reductions, this stage generally required an hour or more, and the mass removed was minor, perhaps less than 5% of that of the parent block.

Dressing the Surface of the Millstone

Dressing the surface of the workpiece is accomplished working alone and entirely be pecking (Pl. 3:b-c). Compared to the earlier stages, the least amount of material is removed and the greatest time is expended in this stage. All topographically high areas are eliminated, and the result is a completely formed milling implement. The necessary tools to accomplish this task are bevelled hammerstones of quartzite[1]. They are much more effective for the task than are rounded hammerstones.

In our experiments, it was found that a well-formed pestle could best be obtained by pecking a linear zone 2-3cm wide from one end of the preform to the other, then partially rotating the workpiece and duplicating the task until all surfaces of the implement are completely dressed. This procedure enables the worker to establish straight lines and maintain symmetry in the workpiece, which is not easily accomplished if the entire circumference is worked from one end to the other. The waste products of this stage of work are rock meal and hammerstone-resharpening flakes. Occasionally a fragment of material is dislodged, revealing the presence of an underlying fracture set into the workpiece during an earlier stage of reduction. Similar emplaced fractures are seen in archaeological millstones.

During dressing the surface of a millstone, only a minor portion of the mass of the original boulder or block is removed, but the process is very dusty and time-consuming. For a typical cylindrical pestle of andesite about 45cm long and 8 or 9cm in diameter, pecking to the final form might require a total average time of 8-11 hours, or 80,000-100,000 (or more) individual hammerstone blows delivered at the rate of 9,000 per hour. Obviously, the harder the material or the less regular the detailed shaping of the preform, the more time is required for dressing. It is necessary to work outdoors, preferably with a slight breeze blowing, and to divide such work over several days in order to spare both hands and lungs.

Finishing, or Smoothing, of the Surface by Grinding (Optional)

If desired, the surface of the completed millstone can be finished, or smoothed, by grinding or abrasion, but this stage likely was optional. Where employed, grinding would seem to have been necessary only to eliminate grit that would be detrimental to the food-grinding process, not for the actual forming of the milling implement itself. It would have required only a few minutes and would have removed an insignificant amount of material. For example, the contact surfaces of mortars and pestles may have been ground lightly. Archaeological pestles from the lower Colorado River and elsewhere that we have examined have very smooth working ends but the ends that were gripped by the hands are still rough from dressing by pecking. Such roughness makes them easier to grip and hold

[1] Bevelled hammerstones of flint, as are found in the Near East, would work for this purpose also.

onto, and may have been restored from time to time by additional pecking. Much of the smoothing or grinding (and even polish) seen on the working surfaces of archaeological mortars and pestles must have resulted largely from use, rather than from intentional grinding, and there would seem to be no reason for re-roughening the working surfaces of such crushing or pulverizing tools. On the other hand, querns and handstones have working surfaces that are constantly rubbed together during use. Except for millstones made of vesicular basalt, which is self-roughening (or self-sharpening) and which was favored in many areas, these surfaces become smoothed in use and require minor pecking from time to time to restore milling efficiency.

Therefore, evidence of grinding, as seen on any part of the surface of any millstone, must be considered with these factors in mind. Moreover, there would seem to be no technological reason for grinding the nonworking surfaces of millstones. Inasmuch as these implements must have lasted for many years in normal service, their nonworking surfaces may have become smoothed from prolonged incidental contact.

Discussion

These replicative studies make it clear that inferences drawn in the field about the activities represented at millstone quarry-and-production sites are correct. The major action that transformed raw material into preformed millstones was percussion flaking. Compared to pecking the surface to dress a millstone and give it its very regular appearance, the more aggressive work of percussion flaking involved by far the lesser amount of time, removed the greater amount of unwanted material, and was a risky venture. For that reason, nearly all of the actual flaking was completed at the quarry where the stone was obtained. While pecking to final form involved far more time than did the initial shaping, the work actually goes rather fast; one can clearly see progress being made all along the way. Even resting the hands when needed and carrying out the work over several days, millstone production is accomplished in a comparatively little time. The small amount of abrasive finishing that may have been employed on some surfaces of some milling implements and gives them their "groundstone" appearance is clearly an inconsequential part of the production process compared to the other stages of production.

No doubt stone cobbles or boulders occasionally may have been found that fortuitously had the proper shape to be transformed easily into very regularly formed querns or pestles by abrasion alone. It would seem unlikely, however, that anyone ever would have lived long enough to produce even a single large, regularly formed milling implement predominantly by the "abrasive reduction" of grinding one block of stone upon another.

Inasmuch as grinding is an impractical means of shaping millstones, evidence of grinding, as seen on the surfaces of millstones, must be evaluated carefully. Grinding may have been necessary to prepare certain surfaces of certain millstones for use; it may have been necessary to maintain or refurbish such surfaces during use; or it may be the incidental result of normal use.

Implications for Near Eastern Neolithic Studies

The field and laboratory work conducted on aboriginal millstone production in arid southwestern North America has important implications for studying the production of milling equipment in the Near Eastern Neolithic. Given the importance of seed milling from the late Epipaleolithic onward, it seems likely that millstones of whatever form would have originated in favored quarry-and-production sites not dissimilar to those in California and Arizona, and that deliberate and thorough efforts to discover them will be rewarded. It is only in recent years that millstone quarry-and-production sites have been recognized in America. Any search for such sites in the Near East must be conducted with clear ideas of what raw material to look for, where that material is likely to be found, that the percussion flaking of stone rather than the grinding of stone is indicated, and with the realization that the size of the debitage at such sites will be extraordinary.

The studies reported briefly here permit a number of predictions to be made regarding the derivation of Near Eastern Neolithic millstones. These include:

1) The overall character of millstone quarry-and-production sites is likely to parallel that of the many such sites reported here.

2) Millstone quarry-and-production sites should be expected to occur in both bajadal and bedrock outcrop settings.

3) Millstone quarry-and-production sites should be expected to occur along rivers that could have been used to transport preformed milling implements to the places where they were completed and used. (In later times with the domestication of suitable pack animals, the problem of transportation would have become less significant.)

4) Individual reduction loci, or work areas, at millstone quarry-and-production sites should have assemblages containing massive and battered hammerstones, large chopper-like hammerstones,

hammerstone flakes, and very large percussion flakes of the material that was reduced for millstones, all surrounding cleared work spaces.

5) The tools used in all stages of the production/reduction process should parallel in general those reported here; use of bevelled cobble hammerstones should dominate the later stages of shaping and dressing of millstones.

6) Debitage assemblages that resulted during each stage of millstone production should parallel those reported here.

7) The likely organization and economics of millstone production should reflect the higher-risk quarrying, blank production, and preforming of millstones at quarry-and-production sites, and the dressing of these implements at the places where they were used.

It is important to perceive clearly that millstone production represents a flaked-stone industry as much as any industry based on the working of flint or other materials commonly flaked into tools. Only during slight smoothing of the contact surfaces of pestles and mortars for use, or during actual use of millstones, is grinding involved. As highlighted by RUNNELS (1981: 218ff) and WRIGHT (1992a: 53), to characterize millstone assemblages as "ground-stone" assemblages truly is a misnomer. As a catch-all term, it is inappropriate for even the broadest classification of milling equipment. It is time to bring millstone production out of the ground-stone closet and into the mainstream study of the technology of knapped stone where it correctly belongs.

The bevelled hammerstones shown to have been so important in the production of millstones (Pl. 3:d) may resemble choppers but should not be confused with these artifacts merely because of similarity in form. At Munhata, Israel (GOPHER 1989), and at many other Natufian and Neolithic sites, choppers are of flint, and show battering as if from heavy use. Such tools of flint would have been useful for both millstone production and for millstone maintenance (re-roughening of the milling surfaces of querns and handstones that had become smoothed, and thus inefficient, during use). One might expect bevelled, chopper-like hammerstones to be found wherever millstones were made and used.

Finally, it was recognized in the course of the experimental work described here that the hand that wields the hammerstone in the course of millstone production is subjected to a great deal of trauma. This trauma occurs in all stages of production, but it may be worse in dressing millstones to their final configuration because smaller hammerstones that have a tendency to become well-seated in the palm of the hand are used for prolonged periods. It may be fruitful to search for evidence of hand trauma in the skeletal remains of Neolithic people. If such evidence is found, it may be possible to address other issues, such as the organization and division of labor in the Neolithic.

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Chipped Lithics in the Basta Craft System

Hans Georg K. Gebel

Abstract: *This note is a preliminary exploratory approach to place the chipped lithic production trajectories of a LPPNB mega-site into its local craft system. With this it votes for the introduction of concepts into the study of PPN chipped stones that not only view an industry as a set of "physical and technical parameters" to be analyzed and classified, but as part of an evolutionary process that takes place in an altering socioeconomic framework, in which innovative/adaptive skills flow together with household skills, driven by developing and declining markets and surplus management.*

Introduction

The permanent village of Basta (GEBEL and MUHEISEN 1997, and references for previous publications quoted here), a constituent of the mega-site phenomenon of the 2nd half of the 7th millenium bc in the arid fringes of the western Arabian Plateau in Jordan, provides, together with 'Ain Ghazal, an extraordinary chance for the study of system determinants that resulted in dramatic innovative technological developments as well as their collapse. Traditionally, chipped (Neo-) lithic industries in the Fertile Crescent are treated in classification systems that serve cultural chronologies, dismissing many potentials these materials have for the interpretation of socioeconomic developments, an aim that should dominate studies on the history of human development. It is only[1] recently (QUINTERO and WILKE 1995, GEBEL 1994b[2]) that more appropriate approaches[3], established elsewhere in the late 1970s (*e.g.* BURTON 1980), became a requirement for the Near Eastern Neolithic. "Style and function" studies remain an imperative ingredient for the understanding of technotaxa and relative chronologies, but they are of little help for the understanding of the complex processes that generate changes in practices that we seek to understand. The question of "How?" must be followed by the question "Why?" Highly specialized chipped lithic research has to translate and thus contribute its results – hitherto often published in a hardly understandable specialists' language – to the discussion of phenomena that also are described (often contradictingly) by the many viewpoints contributed by other disciplines. Since we need to work within systemic approaches, research exchange needs to operate in mutually understandable systems.

Another concern in the research of evolutionary processes or the history of technology that has to be addressed briefly here is that habit that concentrates on or emphasizes innovative records. But the conservative or household-level technologies that function, complement and compete with high-tech developments in such a system form the comprehensive basis that defines innovation rates, and thus the non-innovative, traditional approaches are not negligible. It is generally more common that dual-technology systems operate, and these are especially visible among the flint industries of sedentary communities.

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[1] However, the *chaîne opératoire* approaches of some scholars illustrate attempts to meet needs beyond an object-minded research, but still often the process mainly is studied for a better understanding of the object and not *vice versa*. Other approaches that try to touch the patterns behind the objects are presentations of isolated loci, such as a chipping floor here, there a flint box.

[2] But see also approaches such as HENRY 1989, which deals with correlations between reduction strategies and settlement patterns.

[3] It should be emphasized that all these approaches mostly prove that we are far from general, interculturally applicable or valid models, and that singular, locally and temporally confined studies constitute the state of art we are in (*cf.* JOHNSON 1989).

It is the basic assumption of this contribution that (chipped stone) technologies are conditioned by their physical and social environments that interact and compete on various levels with other neighboring, complex reciprocal systems of micro- and macroeconomics. Data are viewed "as part of a human ecosystem within which [the Basta community] once interacted spatially, economically, and socially with the environmental matrix into which they were adaptively networked" (BUTZER 1982: 211).

The Socioeconomic Background

The Basta chipped industries reflect the shift from a pastoral/agrarian based economy (with some hunting) to a mobile pastoral mode of subsistence; it is expected that tribal structures existed but were altered in this development. This shift not only demanded adaptations of cognitive skills in the knapping industries (reflected by a fundamentally altered primary production and composition of the tool kit), it also had changed the patterns of specialization traceable on various levels within the stratified chipped material record from Basta. This material basis is the major source of information on changing behavioral patterns, if studied in a systemic framework.

Craft specialization for the first time had a social and economic basis in the densely populated expanding sedentary agglomerates of the later PPNB (ROLLEFSON 1998). Whenever these conditions (based on free potentials for the production of goods beyond subsistence needs and on a demographically powerful demand for them) were no longer profitable, the social and economic basis for craft specialization collapsed. Since this event appears to be a sharply recognizable episode in the archaeological record, it was easier to identify it than similar events that had a future (as in specialization in the Chalcolithic of the southern Levant). In their key article, Quintero and Wilke (1995: 125) suggested an "initial craft specialization" in the LPPNB, a view completely shared by the present author.

The craft system of Basta operated temporarily between two different modes of exploiting the environments in the Greater Petra Area. The first one had late Epipalaeolithic traditions (Khiamian, as cited in the reconstruction of early Holocene settlement developments in GEBEL 1998) characterized by casual and comparatively noninvasive procurement and production patterns. They were followed by the first autonomous permanent settlements of 2-4 ha (Beidha, Shaqarat Musaiyad, adh-Dhaman) as centers that developed within the limits of locally restricted acquisition. The following mode (in the 6th millennium bc) entailed a predominantly mobile exploitation that concentrated most likely on steppic pastures, agrarian niches, and occasional hunting. This latter adaptation was a decline and demise of sedentary-based production chains, which again entered the level of casual production with a much reduced inventory of tools and goods. Core reduction strategies made place to simple flake industries with small proportions of unidirectional blades; formal tools seem to have been restricted to arrowheads (GEBEL 1994b). The social basis for the Basta "Initial Craft Specialization" between these modes was only sustainable under stable sedentary conditions, for which a diversified tool kit was designed to satisfy the many and manifold sectors of work (especially architectural) and market needs, particularly that of a flourishing prestige goods sector at Basta.

The System

Chipped lithics intersected other products of the socioeconomic and ecosystem[1] of LPPNB mega-sites on various levels comprised of the

A. Acquisition Level: Exploitation (Procurement)
B. Consumption Level I: Production, Refinement
C. Consumption Level II: Processing, (Re-) Use
D. Archaeological Level I: Primary Contexts
E. Archaeological Level II: Secondary Contexts

On these levels chipped stone artefacts function and mingle together with the other ingredients of the system within various interrelated subsystems, including the

- Environmental Subsystem with the (1) Local and (2) Regional Resources;
- Exchange Subsystem with (3) Long-Distance Resources;
- Technological Subsystem with (4) Household, (5) Workshop and (6) Community Sectors;
- Socio-Economic Subsystem with (7) Social and (8) Economic/Market Means and Conditions; and
- Cognitive Subsystem with (9) Innovation and (10) Ideology

The presence of chipped lithics with their "systemic affiliation" is shown in Table 1, which has a preliminary status. It will be the basis, together with more information from other crafts, for a flow

[1] The following makes use of DAHL HERMANSEN and GEBEL n.d., the summary of raw material records in the Basta human ecosystem.

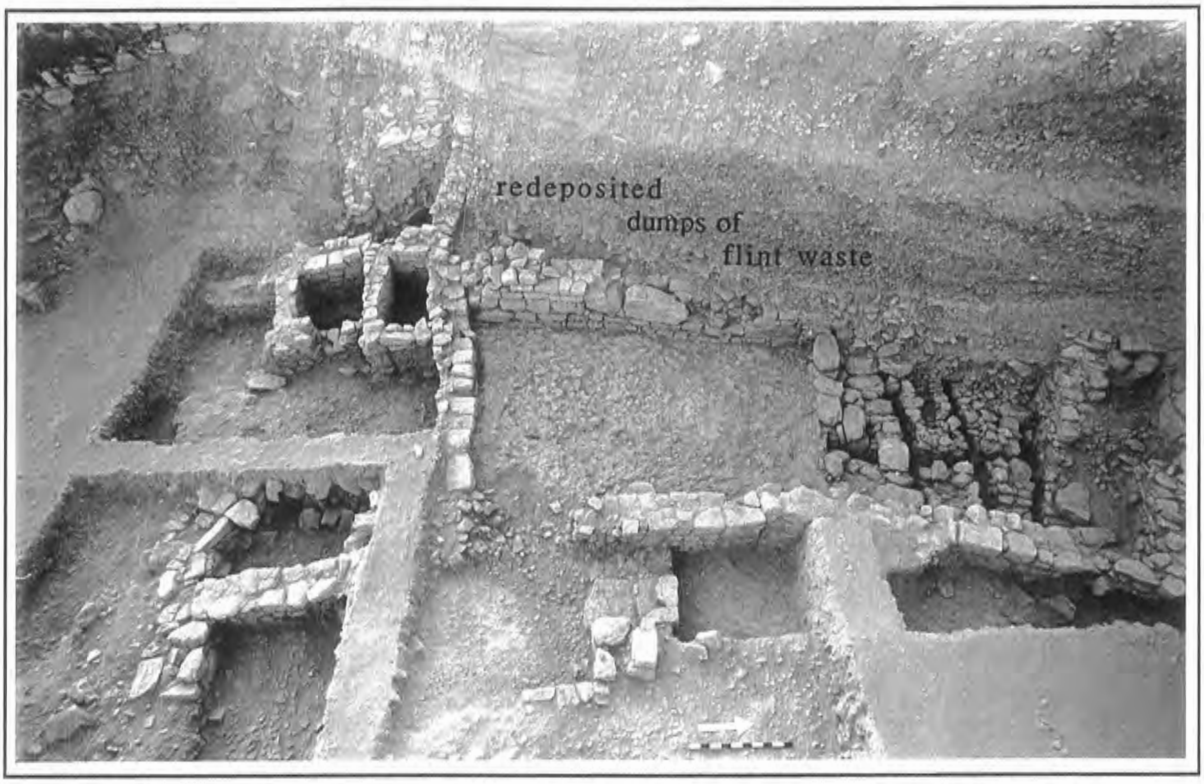

Plate 1:A. Basta: Northwestern section of Area A exposing thick layers of flint waste. (Foreground: LPPNB architecture exposed in the early 1986 season in the building lot/ Area A).

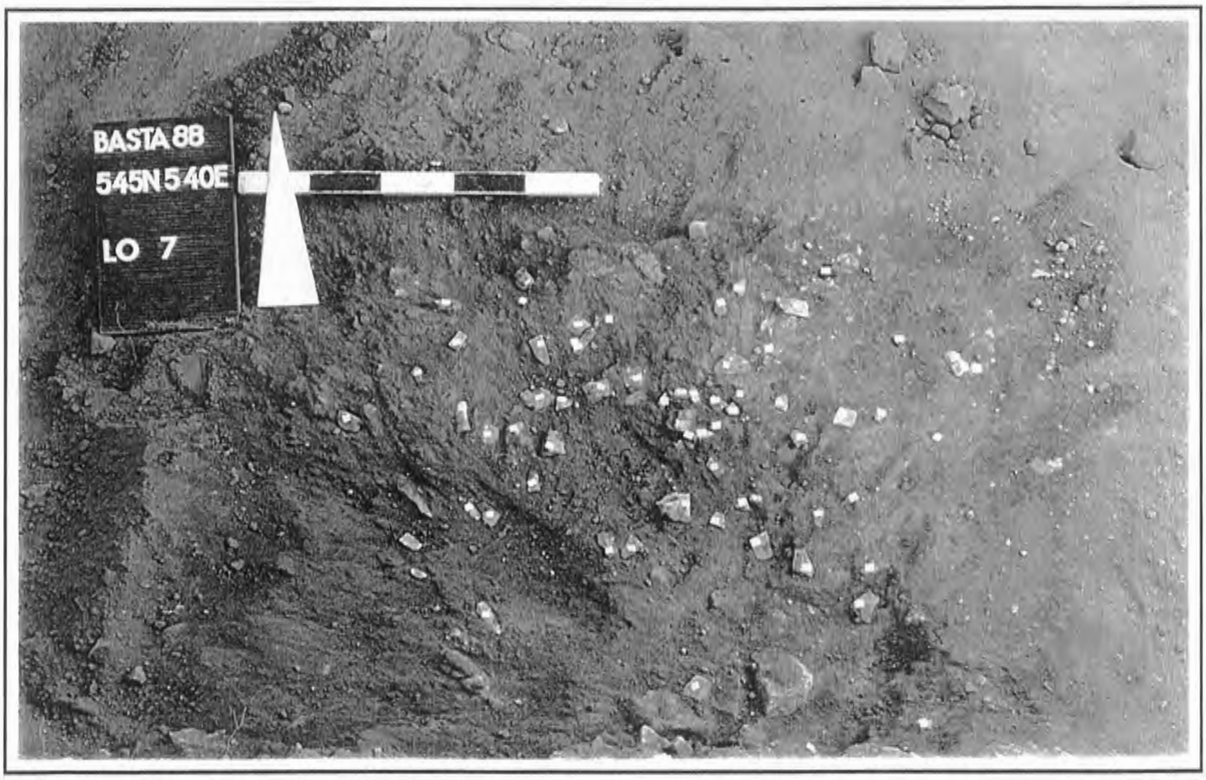

Plate 1:B. Basta: *in situ* workshop processing Raw Material II in Locus 7 (Area C, Square 208 = 545N/ 540E), embedded in a sequence of ash lenses, silt layers, and layers with high phosphate content in supposed LPPNB village fringes.

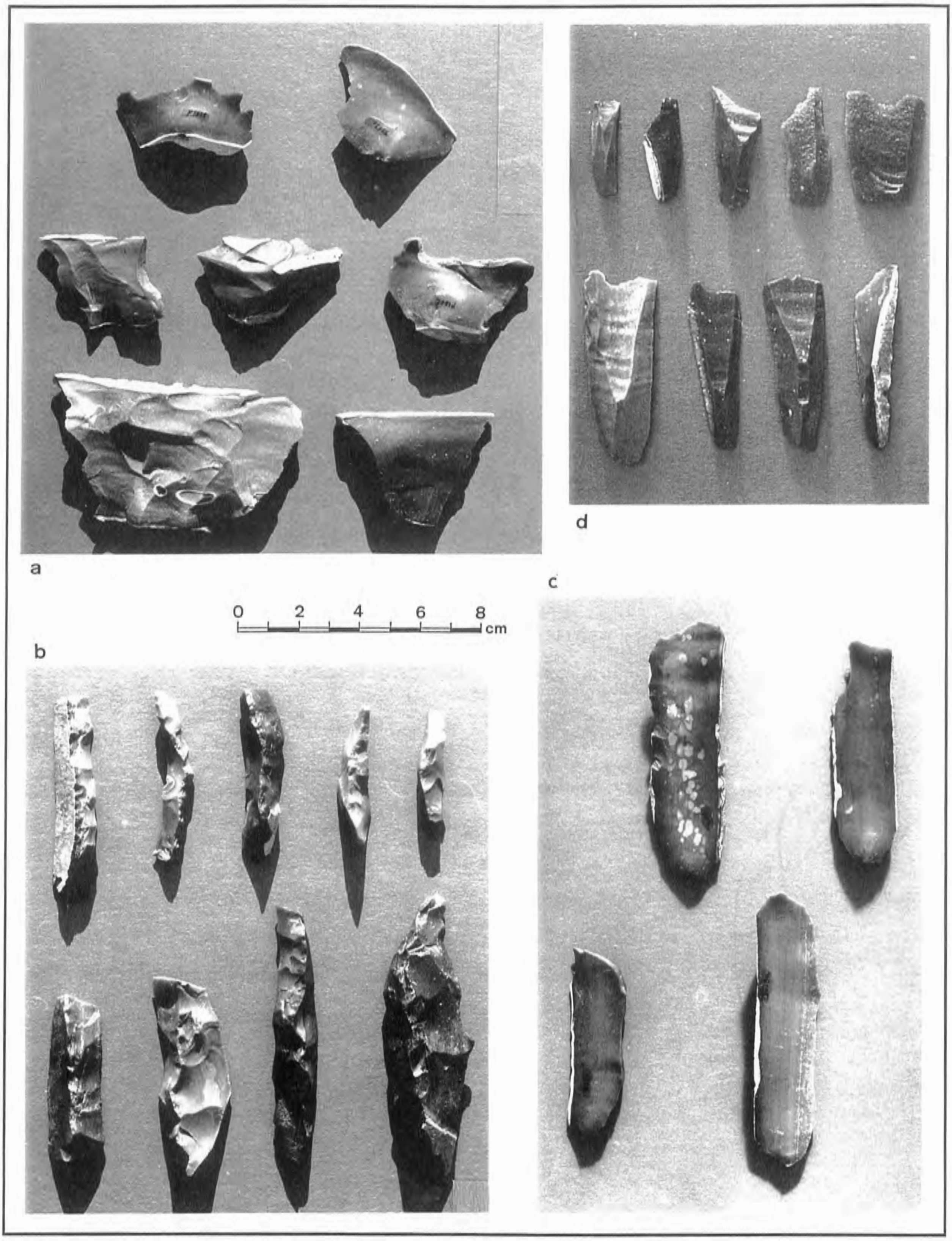

Plate 2: Basta: Some core preparation and reduction classes from a workshop specialized in the naviform technology. *a* crest trimming flakes; *b* crested blades (bifacially, partly bifacially/unifacially/cortical ridge); *c* ventral sides of non-initial (corrective) platform spalls; *d* blades with feathered ends.

diagram of the Basta socioeconomic system to be offered in the final publication.

The flow trajectory of chipped artefacts in the Basta system has to be traced by the sequential Levels A-C in their contextual subsystems 1-10, through which they passed before being (re-) deposited in the cultural layers (Levels D-E). Positive and negative feedback loops connected with this chart must be considered in order to trace all aspects in which the artefacts or artefact group was relevant for human behavior. Flint raw materials, just a small sector of the non-biotic sources used in Basta, are considered in their capacity as processed materials, which were modified through craftsmanship at the household level or *ad hoc* production among others. Consequently, Table 1 simply considers how raw materials were exploited and manipulated in the Basta behavioral system. With flint it is difficult to identify symbolic contexts, of course. Instead, the cognitive subsystem should contain most interesting results, at least for innovation aspects.

The Acquisition Level

In Basta we deal with three major types of flint raw materials[1] that were found to dominate the production levels both in terms of quantities and qualities. Raw Material Groups 1 and 3 outnumbered all the other occurrences, forming more than 70% of the material by weight or by count, respectively (Table 2). There are some 6-8 other raw material groups, but all are infrequently attested (<3%). But quartzites were, with 5% weight, a substantial part of the exploited raw materials[2]. The Basta surveys did not locate any Neolithic quarries (procurement complexes) of these raw materials, but the geological contexts (potential source areas) and some locations of occurrences are known. Thus, we cannot give information here on the operation of flint quarries[3] (which could not have been the same for all three groups, however), and some of the statements below are based on secondary evidence from the Archaeological Level. Questions about the most profitable sources (which were not necessarily the largest or nearest), engineering designs of quarrying, source-different knapping capabilities for the same raw material, etc., must remain mute.

Basta is situated in a flint-rich environment. All raw material groups seem to have been collected within 2h walking distances, so flint procurement must be seen as work easily carried out from the village as a base. Intact LPPNB workshop dumps show that we deal with discriminating and specializing procurement. Although we should expect that dumping areas in the site were used either by several workshops or were built up by waste coming from different sources, the bulk of a dump mostly represents a certain raw material or a relatively fixed proportion of two raw material groups. We do not have secure evidence for importing as a procurement method since rare and exotic raw materials have not yet been studied in this respect. However, it did not play an economically significant role in the Basta flint economies.

There is no evidence for initial core trimming at the sources, except for a possible fracturing of raw material to obtain suitably sized chunks. All stages of initial core trimming, at least for the naviform production chain, are present within the LPPNB waste dumps. This does not preclude that non-specialized production levels (household or *ad hoc* levels) were not practiced.

All this evidence shows that more than 70% of the chipped lithic raw materials processed in LPPNB Basta came from primary sources (exploited at flint mines). This changed after the end of the LPPNB occupation, since we found in the colluvials and in strata related to the decay of the LPPNB houses higher concentrations of raw materials from secondary sources (mainly of Raw Material Group 3). These are battered chunks from wadi or surface transport, sometimes heavily patinated, and obviously eroded from outcrops. This material, associated with a post-PPNB (we might hesitatingly say PPNC) flake industry, unifacially pressure-flaked small arrowheads resembling Yarmoukian shapes, and relicts of flimsy structures and ephemeral fire places, comes from the surrounding heights and was gathered in the wadis around Basta. Thus, for the post-PPNB use of the area, supposedly by mobile herders using the ruins near the spring as shelters, we must conclude a non-discriminating procurement for flint raw materials for them. This even includes evidence for "tertiary sources," such as the transformation of naviform cores, re-used as LPPNB hammerstones, into a post-PPNB flake core. The collection and use of LPPNB flint artefacts by post-PPNB visitors to Basta are not rare cases.

Compared with foragers or mobile herders, search costs for raw material procurement for the LPPNB Bastians were quite low. For a sedentary population in a flint-rich area, one has to expect that a permanent, conflict-free access to sources was a given in the territories controlled by the community; thus risk costs must have been rather low, too. Only if territories were contested by neighboring groups (or by bands within the community) would this have resulted in conflicts. Flint-rich areas did

[1] The term flint is used here in its general meaning; petrographially/ geologically we deal with cherts.

[2] Among this group we have attested locally available orthoquartzite (sandstone that consists of more than 95% detrital quartz); it is used in very fine-grained qualities. As also the industry from nearby 'Ain Jamman shows, this raw material was just used as flint in tool production.

[3] For LPPN mining evidence see TAUTE 1994 and QUINTERO 1996.

Table 1. Systemic affiliations of chipped lithic occurrences in the Subsystems 1-5, Levels A-C (clipping).

	Environmental	Environmental Subsystem	Exchange Subsystem	Technological Subsystem	Technological Subsystem
	Local Resources (1)	Regional Resources (2)	Long-Distance Resources (3)	Household (4)	Workshop (5)
Acquisition Level Exploitation (A)	1A.1.1: Natural availability of local rocks, minerals and soils (mineral, rock, chipped stone and refinement industries): samagah, limestone, calcite, quartz, marl, dolomite, clay, silt, lime, flint, chert, quartzite	2A.1.1: Natural availability of regional rocks, minerals and soils (mineral, rock, chipped stone and refinement industries): sandstone, ferruginous sandstone, calcareous sandstone, quartz?, phyllite, haematite, green feldspar, flint, chert, quartzite	3A.1.1: importing rocks and minerals (rock, mineral and chipped stone industries): green marble (Central Jordan), amber (Jordan Valley), coral (Red Sea), subfossil Tridacna (Red Sea), obsidian (Anatolia), pumice (Dead Sea), bitumen (Dead Sea)	4A.1.1: collection of local minerals and rocks: limestone pebbles, flint/chert nodules, marl pebbles, quartzite pebbles, dolomite pebbles, calcite, quartz	5A.1.1: collection of local minerals and rocks: limestone pebbles, flint/chert nodules, marl pebbles, quartzite pebbles, dolomite pebbles, calcite, quartz
				4A.1.2: collection of regional minerals and rocks: flint/chert nodules, marl pebbles, sandstone, ferruginous sandstone, calcareous sandstone, haematite, green feldspar?, phyllite?	5A.1.2: collection of regional minerals and rocks: flint/chert nodules, marl pebbles, sandstone, ferruginous sandstone, calcareous sandstone, haematite, green feldspar?, phyllite?
				4A.2.1: mining of local minerals and rocks: samagah, limestone, flint/chert, quartzite, quartz, calcite, marl, clay, lime?	5A.2.1: mining of local minerals and rocks: samagah, limestone, flint/chert, quartzite, quartz, calcite, marl, clay, lime?
				4A.2.2: mining of regional resources: flint/chert, quartzite, marl, clay, lime?, sandstone, calcareous sandstone, ferruginous sandstone?	5A.2.2: mining of regional resources: flint/chert, quartzite, marl, clay, lime?, sandstone, calcareous sandstone, ferruginous sandstone?
	1A.3.1: Natural availability of local arboreal resources (fuel, timber): Juniper, Pistachio	2A.3.1: Natural availability of regional arboreal resources (fuel, timber): Juniper, Pistachio		4A3.1: Collection of fuel/timber	5A3.1: Collection of timber/fuel
	1A.5.1: availability of local domestic fauna	2A.5.1: Natural availability of regional wild fauna (bone industry): steppe ungulates, escarpment ungulates, and ostrich (shell)	3A.5.1: importing wild animal resources: ostrich shell (desert/steppe)?	4A,5.1: extraction of bone raw materials from domestic and wild fauna	5a.5.1: collecting ostrich shell on regional basis
			3A.6.1: Importing Shell Raw Materials: subfossil Tridacna (coastal Red Sea), Nerita shells (Red Sea), Pinctada shells (Red Sea), Cypraea shells (Red Sea), Strombus shells (Red Sea), Conus shells (Red Sea)		
	1A.7.1: Natural availability of fresh water sources (water dependent technologies): permanent and seasonal springs, perennial, seasonal and subterranean water courses, rain water, smelting water	2A.7.1: Natural availability of fresh water sources (water dependent technologies): permanent and seasonal springs, perennial, seasonal and subterranean water courses, rain water, smelting water		4A.3: wadi slope terracing for rainwater collection? exploitation of naturally available water resources	5A.3: wadi slope terracing for rainwater collection? exploitation of naturally available water resources
	1A.9.1: Natural availability of Wild plant resources?	2A.9.1: Natural availability of Wild plant resources ?	3A.9.1 Importing Wild plant resources ?	4A.9.1: Exploiting fibre raw materials by collection, harvesting and shearing	
			3A.10.1: Importing Finished Goods (Location and Production unknown): Subfossil Tridacna (Red Sea coast) beads, coral (Red Sea) beads, Nerita (Red Sea) beads, Theodoxus/Smargidia (Red Sea or Med. Sea) beads, Natica (Red Sea) beads, Ancilla (Red Sea?) bead, Terebra (Red Sea?) bead, Columbella (Red Sea?) beads, Arcularia gibbosullus (Med. Sea) beads, Conus (Red Sea) beads, Strombus (Red Sea) beads, unidintified gastropod (Red or Med. Sea) beads, Cypraea (Red Sea) beads/paillettes, Dentalium (Red Sea) beads, Pinctada (mother-of-pearl) (Red Sea) beads+rings+paillettes, Engina mandicaria (Red Sea) beads		
Consumption Level Production and Refinement (B)					
				4B.2.1: Ad hoc fabrication of chipped artifacts (core prep., debitage, and tools)	5B.2.1: core preparation from locally, regionally exploited tabular flint in workshops (primary production)
				4B.2.2: Recirculation of discarded and worn out chipped stone artifacts; remodification into rores and tools (e.g. handstones made of cores)	5B2.2: Tool fabrication from blanks produced in workshops of the settlement (secondary production)
					5B.3.1: Pre-shaping of ground stone products near the sources. Grinding slabs (querns , metates): quartzite, quartzitic sandstone, sandstone, limestone, carbonate, basalt (rare), conglomerate rock (rare). Grinding slabs: quartzite, quartzitic sandstone, sandstone. Handstones (manos) of various transverse sections: quartzite, quartzitic sandstone, sandstone, limestone (rare), carbonate rock (rare), basalt (rare), volcanic rock (rare), conglomerate rock (rare). Pestles: quartzite, sandstone, carbonate stone (occasionally), limestone (occasionally), basalt (rare). Spherical hammerstones (of various diameters): limestone, quartzite, flint, carbonate rock (rare), sandstone (rare), volcanic rock (rare).Polishers: quartz. Grooved stones: sandstones, limestone (rare), quartzitic sandstone (rare), granite (rare), basalt (rare), silitites (rare). Stone vessels: carbonate limestone, soft limestone (rare), quartzitic limestone (rare), basalt (rare). Egg-shaped stones: soft limestone, quartzitic sandstone
				4B.3.2: Recirculation of discarded and worn-out ground stone objects by re-use as building material or raw material for chipped industries (quartzite)	5B.3.2:: Fabrication of ground stone objects
				4B.4: Occasional recirculation of discarded and worn-out shell objects	5 B.4: Shell ornament production of marine shell raw materials and semi finished products in workshops
				4B.5: Occasional recirculation of discarded and worn-out mineral and objects	5B.5: Mineral and rock ornament production of local, regional, and imported materials and semi-finished products in workshops: marl pebbles (beads, pendants), sandstone (rings, beads), ferruginous sandstone (rings, manuports), haematite (beads, object (production waste?)), green feldspar? (bead), phyllite? (carved objects (production waste)), clay (building material (ovens, bins, containers) clay objects (animal figurines, geometrics))
					5B.6: Production of fired and dried clay artifacts in workshops
				4/55B.7: Manufacturing of bone artifacts, incl. beads	
				4/55B.7.1: Recirculation of bone artifacts, incl. beads	
				4/5B.4.6: Manufacturing of fibres and textiles	
				4B.7: maintaining and exploiting water "reservoirs"	
				4/5C.1: Storage technology: limestone (grinding, pounding, masonry (storage magazines)), quartzite (grinding? pounding?, masonry (storage magazines), basalt (grinding, pounding), calcareous sandstone (grinding, pounding, masonry (storage magazines)), lime (rainwater collection and storage technology), clay (roasting, baking, food storage)	
Consumption Level Processing / Use (C)				4/5C.2: Food processing technology: limestone (grinding, pounding, masonry (storage magazines)), quartzite (grinding? pounding?, masonry (storage magazines)), basalt (grinding, pounding), calcareous sandstone (grinding, pounding, masonry (storage magazines)), lime (rainwater collection and storage technology), clay (roasting, baking, food storage)	
				4C.3 : Processing of other items by tool kits of households	5C.3: Processing of other items by work shop tool kits
				4/5C.2.2: Use of ornaments within the household	

not necessarily mean that there were no prestige sources, either for technological reasons, distances to cross, or unknown values related to a specific raw material.

Table 2. Description of major raw materials used in the workshops of Basta (after MUHEISEN n.d. and GEBEL 1994a; frequencies after K. Iketani and M. Muheisen, *cf.* MUHEISEN n.d.; for the geological context notations see BENDER 1968, 1974a-b).

	Flint Raw Material Group 1	Flint Raw Material Group 2	Flint Raw Material Group 3
frequencies as represented in waste dump samples	32% by weight, 41% by pieces	14% by weight, 14% by pieces	41% by weight, 32% by pieces
Characteristics of Pebble / Nodular or Tabular Bodies	parallel-sided tabular bodies with thicknesses of 1-5cm; there seem to be preferences for 1,5-2cm thicknesses	parallel-sided and roughly parallel-sided tabular bodies with thicknesses ranging between 3-8cm, occasionally beds of 12cm	nodular bodies of minimum sizes of 8cm, sizes may range up to 20cm or more; originally in the limestone bedrock as nodular, lenticular, and/or semi-tabular forms
Natural Surfaces	easily scratchable; cortex thicknesses 0,5-7mm; no evidence of rolled, patinated, or material bearing desert varnish attested with used material; clear separation between cortex and flint body	cortex preserved from geologic source (bedrock-fresh cortex), easily scratchable; thin to thick cortex thickness (1 - >4mm); no evidence of rolled material (not collected from wadis)	mostly abraded/ weathered cortex surfaces: cortex preservation ranges from completely abraded (chalky) cortex to scratchable multi-layered chalky cortex with uneven surface; mostly "cloudy" but distinct transition into lower silicified cortex layer; in some cases sharp separation of the lowermost silicified cortex layer from the flint body
Matrix / Texture and Homogeneity (Chipped Surfaces)	fine-grained, homogeneous matrix	slightly fine-grained to slightly coarse-grained, sometimes rather fine grained; inclusions influence homogeneity	fine grained to slightly fine grained; homogeneous matrix
Inclusions, Clefts / Pores, Flaking Ability	no inclusions or fossils, clefts, or hollows, very homogenous material; flaking ability: very manageable, especially because the parallel-sided tabular bodies allow for naviform cores without much core preparation	irregular distributed clearly isolated lime or phosphate inclusions (*c.* 0,5mm max.), not silicified; inclusions often are condensed in regular bands, also along cortex; no clefts or hollows, body of flint is homogeneous despite the lime inclusions; flaking ability: grim-dogged / tough material, which is very manageable for a controlled large-blade detachments, because it not allows an uncontrolled spread of the energy	no inclusions, quartz hollows possible, occasionally non-silicified clefts; flaking ability: tendency for a grim / dogged or tough material respectively: resistant against uncontrolled spread of removal energy (good flaking quality); tendency for scaly fractures and negatives
Translucency (at Edges)	opaque with slight translucency at thin edges	completely opaque, some varieties with slight translucency at very thin edges	opaque with milky translucence at thin edges; translucent parts: 5YR 7/2-4, 8/2-4 "pinkish gray - pinkish white - pink"
Colour Variation of Main Matrix (Munsell Notations without Coloured Patterns)	10YR 4-6/3-6 "pale brown - light yellowish brown - brownish yellow - brown - yellowish brown - dark brown - dark yellowish brown"; considerable variation of matrix colour	10YR 2/2-7/2 "light gray - light brownish gray - grayish brown - dark grayish brown - very dark grayish brown - very dark brown", considerable colour variation	7.5 YR 5/0, 6/0-2, 7/0-2, 8/0-2 "gray - pinkish gray - light gray - white- pinkish white" and 10YR 5-8/1-4 "white - very pale brown - light gray, gray, light brownish gray - pale brown - light yellowish brown"; colour variation concerns also the concentric coloured patterns characteristic for this raw material; considerable variation
Coloured Patterns (Munsell Notations)	irregularly distributed whitish to light coloured clouds or bands (near-cortex bands are run parallel with the cortex)	very rare and irregularly distributed coloured clouds within the flint bodies	irregularly distributed whitish "clouds", occasionally roughly parallel or concentric whitish bands with cortex delineation)
Lustre	faintly lustrous	no lustre / dull	slightly high lustre - faintly lustrous
Geological Context (Areas)	tt1	c4 areas and c4 remnants on c2 formations	c4 and tt1 areas and c4 / tt1 remnants on c2 formations (*e.g.*, Basta area bedrocks: surrounding heights and wadis); wadi catchments of *c.* 2-5 formations

Consumption Levels

In our systemic approach, "consumption" is understood as an appropriate term for all sorts of human material relationships that select a material with the aim to use it. For tools, we must generally differentiate between processes that result in a tool (tool making) and processes performed with a tool (tool use) to make other tools or non-tool items.

Production/ Refinement

Two levels of flint knapping are evident in Basta: that of a household level production and that of specialized workshops employing naviform techniques and responsible for at least some classes of formal tools (particularly borers, which were found in workshop waste). The household level is characterized by flake technology, *ad hoc* tools, and a core reduction that imitates bidirectional technology (the latter similar to nearby Ba'ja).

Chaîne opératoire investigation or (the similar) Event-Tree-Analysis (ETA), based on debitage types and classes as well as approaches using replicative system analysis (WILKE and QUINTERO 1994), makes it certain that in the LPPNB we are dealing for the first time with a highly efficient mode of core reduction that was performed as expert work in specialized workshops: bidirectional or naviform core technology. It became clear that this innovation not only required a clear design of technological steps, it also involved a longer apprenticeship for the control and position of applied energy and movements. The segregation into working steps (WILKE and QUINTERO 1994) meant not only efficiency and error reduction, it probably led to the development of various skill levels that resulted in work hierarchies.

There is evidence that at Basta the specialized workshops were spatially segregated from the household activities. It is not yet clear whether the open air workshops on the edge of the village evident on Plate 1:B are unique, but the found workshop waste dumps do appear to represent the use of a particular spatial context on the fringes of the settlement (see below).

Technically, the removal of the standardized blades most likely was executed by direct percussion (QUINTERO and WILKE 1995:22). An investigation of production failure rates has not been carried out, but we do have some evidence concerning failures. A high failure rate may be related to the limited number of core maintenance by-products, indicating there was sufficiently abundant raw material that there was no need to conserve it by avoiding failures at all cost (also a subject of further discussion). But it is also likely that the tabular form of Raw Material Groups 1 and 2 did not often require much core maintenance, since nature furnished them with parallel ridges (in this respect, it is puzzling why the more difficult nodular Raw Material Group 3 is so dominant when parallel-ridged raw materials are available). In any case, we should expect that no coherent patterns will be found in coexisting workshops (*cf. e.g.* CLARK 1991 and his report on modern Lacandon blade workshops). While the single working steps are standardized, the naviform core technologies itself represent a very flexible, even "virtuosic" set of procedures for preparation, reduction, and rejuvenation which comprise many technical alternatives, following a fixed goal, not a straight-line sequence. The evidence of the Basta LPPNB debitage strongly implies this. So we should not only expect characteristic approaches in each individual workshop, we should also expect clear regional differences in naviform techniques influenced by locally available raw materials. Little is known about heat treatment in the LPPNB (NADEL 1989); at Basta we do have infrequent evidence for heat treatment, but not enough to identify a pattern of use.

Concomitant primary production technologies in workshop are insignificantly rare, if attested at all; waste from such in bidirectional debitage might be intrusive from household production: they include non-bidirectional blade production, non-naviform bidirectional detachments from opposed platform cores, blade/ flake cores with 90°-platform shifts as are known from the Yarmoukian, etc..

Specialized tool production in primary production contexts at Basta is a difficult topic. We do not have any clear evidence that this is a regular task at the workshops producing the waste dumps. There are formal and non-formal tools in these dumps, even small amounts of unfinished tools, but they do not allow the firm conclusion that secondary production or tool curation took place here. We would not expect perfect finished tools in the debitage. We might conclude from the absence of finished tools that they are not present because they had entered the use cycle.

The mass of blanks produced at Basta is puzzling; given the supposed duration of the settlement it is possible that they are merely for use by the inhabitants. An alternative explanation is that a surplus of blanks was produced for trade outside the settlement, and was an important source of wealth for the community ("factory site"). Questions of "batch processing" and part-time professionalism etc. are among the other questions we cannot yet discuss yet with the Basta material.

Processing/ Use

The formal tools are regarded as products of the specialized workshops. Mostly borers were found in the specialized waste dumps, but pressure-flaked exotic forms and projectiles were also found. The problem of tool curation, a popular umbrella term, is also difficult to approach from the evidence of Basta.

The tool kit benefited from the standardized predictable blade blanks, and show a hitherto unknown standardization allowing to work with typologies. Tool formalization is related to a standardization of manufactured goods, and here especially the ornament industries gives good examples from that in Basta: standard items produced *en masse* required standard tools in order to have th prestige results aimed for. Questions of life history of tools, tool recycling, for Basta are still at the beginning of their evaluation.

The Archaeological Levels: Primary and Secondary Contexts

The Exit Level of the system (Table 1) is represented by the primary contexts (material left by an LPPNB activity) or secondary contexts (naturally redeposited primary contexts) in which millions of flint artefacts were found.

Remains of in situ workshops and debitage dumps of workshops are attested rarely in the spatial context of domestic activities in Basta. It is only in such contexts that we find relicts of loci that testify (by refitted material) to isolated chipping events or ephemeral dumping of workshop waste. The general pattern for large accumulations of chipping waste and debitage[1] at Basta (*cf.* Table 1, "I") is their deposition either as "caches" or as cones of waste within slope strata (as primary contexts, stratigraphically between the colluvials and the LPPNB architecture), or as high concentrations mixed with other cultural debris and colluvial material in post-PPNB slope-wash (as secondary contexts, stratigraphically within the colluvial loads covering the ruined LPPNB wall tops). While the former evidence consists of in situ preserved dumps of workshop waste and debitage on open spaces of the terraced settlement, the latter are such dumps transported down the slope and mixed by colluvial processes. In the Northeastern Section of Area A (GEBEL, MUHEISEN, NISSEN *et al.* 1988: Fig. 5), for example, we have such evidence for preserved dumps, while the slope stratigraphy marked on Pl. 1:A is an example of waste-bearing strata washed down the slope and across the LPPNB ruined wall-tops. Our observations indicate that the dumping of flint waste is related to the use of open spaces on the settlement slopes, including temporarily uninhabited parts of the settlement (ruin areas). In one case, material was dumped on the exposed bedrock and covered by slope-washed cultural layers.

Another type of primary context is represented by finds like that in Plate 1:B. These are workshops representing one chipping event (here blanks had been brought to the spot ready for tool making). They do not reflect a specific sort of tool being produced, but rather they represent an array of several different types (if this can be judged, since the finished products were extracted).

Secondary Contexts are redeposited primary contexts as described above, mostly found in the slope strata of Basta (Plate 1:A).

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[1] Waste here is defined to comprise everything left by the knappers during primary and secondary production: it includes everything from failed or broken discards to abandoned pieces suitable for secondary production, unfinished tools, even the "hammerstones" that occur frequently in the workshop dumps. The term "debitage" I use for waste deriving from core preparation, reduction, and maintenance.

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A Basket of Flint Artefacts from House 11 at Gilgal I, Locus 37/42

Tamar Noy and Stefan Karol Kozłowski

Abstract: *The article presents a unique collection of flint artifacts recovered from the site Gilgal I in the Jordan Valley in Palestine, dating to the PPNA period. The assemblage, designated "Locus 37/42," survived* in situ *on the floor of House 11. Due to its exceptionally good state of preservation, it casts new light on the Neolithic industries of the Levant.*

The Site

Gilgal is situated on a low hill in the lower Jordan Valley, about 225m below sea level, on the edge of the former Salabiya Basin. It is a large multi-layer PPNA site that was excavated by Tamar Noy (NOY *et al.* 1980, NOY 1989) from 1974 to 1987. More recently, in 1994, T. Noy and S.K. Kozłowski performed sounding excavations there.

The excavated area covers about 500m², which is only a small part of the entire site. More than ten complete and incomplete dwelling structures were discovered and excavated. These formed a dense group and appeared in a certain stratigraphic order. All but one of the structures were oval in shape and made from stones plastered with clay. They were rather small, ranging from 3-5m in diameter.

Few ^{14}C dates are available from Gilgal. Those that we have place the site between 8,000 and 7,800 years bc, *i.e.*, in the early phase of the PPNA period.

House 11

During the 1985-1987 seasons, excavations concentrated in the central part of the site, leading to the uncovering of two complete houses: Nos. 10 and 11. The more promising of the two was House 11 belonging to the late phase of the site's occupation. This subrectangular structure was well pre-served, probably because its roof collapsed to the floor. Exceptional material was recovered *in situ*, including a carbonized seed concentration (Layer 1A described below), flint artifacts located in a specific place (Locus 37/42 described below), imprints of baskets on asphalt, delicate bone and small stone artifacts, human and bird figurines, etc. Also found were two burnt pieces of wooden posts, testimony of a fire that destroyed the house (NOY 1989).

We attached particular importance to the aforementioned Locus 37/42, containing a specific assemblage of flint artifacts. The present article concentrates on this feature.

General Stratigraphy of House 11 and its Immediate Vicinity

The stratigraphy of House 11, going from the top downwards, is as follows (*cf.* Fig. 1):

- The profile begins with Layer 3 formed by remains of a poorly preserved and superficially explored house from the PPNA period, featuring a floor (a white and perfectly horizontal surface F, lying on a stone pavement and partly covering the wall of House 11; it lies at a depth of 280cm, and connected with it is a pit, cutting into the underlying layer);
- Deeper down we have the following layers:

Layer 2 (280-300cm), perfectly horizontal and consisting of a very soft dark soil; underlying it (at 300cm) is horizontal surface F1 (second floor). Layer 2, which contains flint material (Fig. 5), is the fill of House 11.

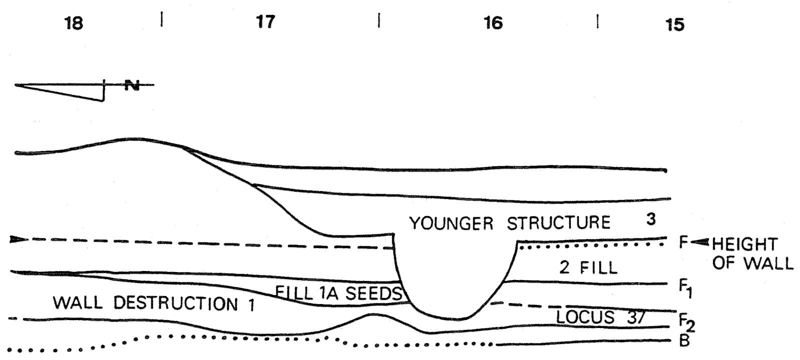

Fig. 1. Gilgal I, House 11. N-S cross section.

Layer 1A (300-315cm) is also of fill character, with abundant charred cereal grains and some flint artifacts (Fig. 6).

Layer 1 is likewise part of the fill of House 11, it is 5-15cm thick and extends downwards from a depth of 300cm to the surface of floor F2. It is mostly detected near the walls but also present in the central part of the building. It consists chiefly of a white material, with lumps of clay from the destroyed walls. Only a small quantity of flint material is connected with this layer.

Floor F2 (lying on a pebble pavement) is where Locus 37/42, of chief interest to us here, was discovered. This Locus, together with floor F2, were covered by Layer 1.

PPNA material stratigraphically older than House 11 was unearthed east of the structure.

By way of final remark, we must point out that the flint inventories from Layers 2, 1A and 1 are associated with the fills of structures (therefore being statistical representations of the successive stages of settlement and having the nature of refuse), unlike Locus 37/42, which is intrinsically linked to a brief settlement episode (early phase floor of House 11) and can thus be an assemblage individual in character.

Locus 37/42

The principal subject of this paper is the small assemblage of flint artifacts designated "Locus 37/42" by the site's explorer, Tamar Noy. It consists of 147 flint artifacts (Table 1), and in terms of composition and structure it differs from the average PPNA assemblages from the Jordan Valley, to mention but those from Layers 1 and 2 connected with House 11. This difference appears to be due to a lucky chance event: Locus 37/42 is a well preserved assemblage of flint artifacts used by inhabitants of a single house which did not undergo selection prior to these inhabitants moving out of their home. It thus appears that in the case of House 11 we have to do with a "living" assemblage rather than with a typical prehistoric refuse heap usually left behind on the site by inhabitants moving to a new location. As a rule, site inhabitants carried away with them the best part of their inventories, discarding waste material and objects that were used up. Archaeologists exploring dwelling sites usually come across such discarded inventories.

Table 1. Gilgal I, House 11: general technological structure (in %).

Typology	Layer 2	Layer 1A	Layer 1	Locus 37/42
cores	0,3	0,5	4,4	2,7
flakes, chips, chunks	52,2	51,8	71,1	57,1
blades/bladelets, blades with use-retouch	29,0	35,0	6,6	26,5
technical blades/flakes	2,5	0,5	0	4,8
retouched tools	16,0	12,2	17,7	8,8
Total	**324**	**197**	**45**	**147**

It seems that House 11 is a different case, and this of course fundamentally alters our scientific perspective. It turns out that "refuse" assemblages differ from the "living" ones, not only as regards morphology, of course, but also with respect to statistics and morphometry. It will also become clear that Gilgal I provides opportunities for a better understanding of the functioning of the Neolithic chipped industry, which we will be able to divide into various parts (*e.g.*, the active and the passive, or into waste and blanks). Indeed, Locus 37/42 greatly improves our understanding of certain aspects of the early Neolithic of the Near East.

Planigraphy (Fig. 2)

The artifacts belonging to Locus 37/42 are grouped mainly in the southern corner of House 11. The densest concentration of flints (A), oval in shape and some 0.5m in diameter, is close to this southern corner and is planigraphically associated with the bitumen section of a basket resting on the floor of the house. North and southeast of this concentration (and of the mentioned basket) are more flint artifacts arranged in two bands (B), whose relationship with the principal concentration is obvious: they are in the same layer and, like concentration A, they lie directly on the floor of the house.

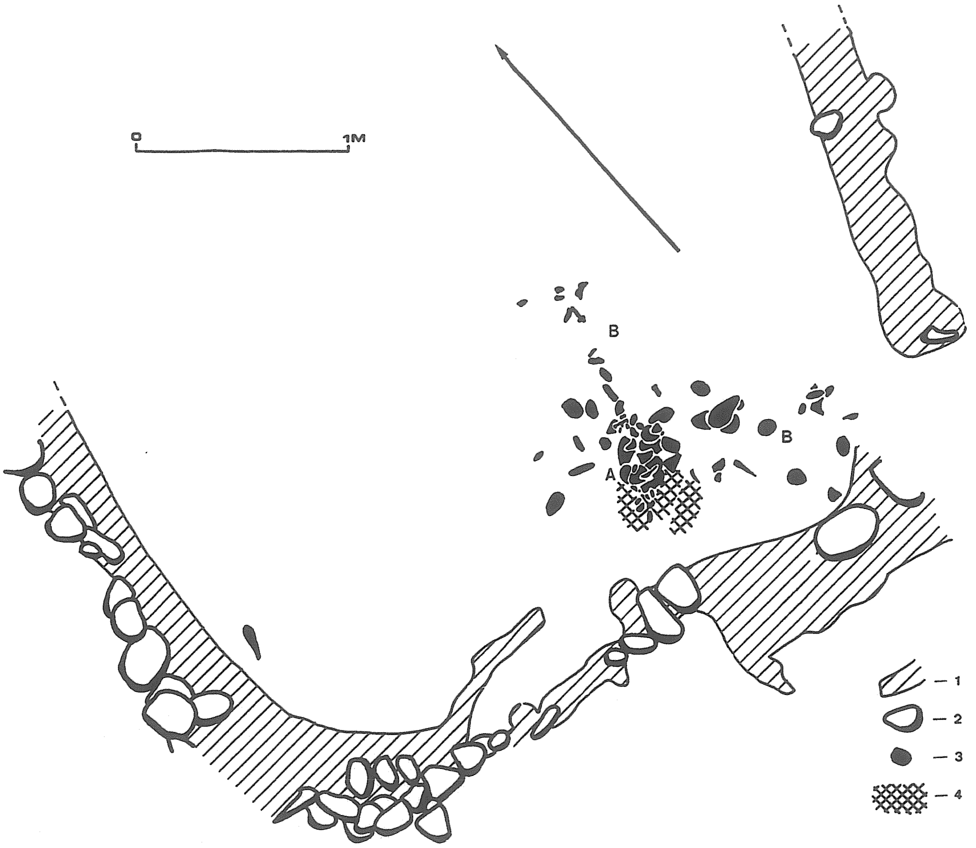

Fig. 2. Gilgal I, House 11. Flint artefacts of Locus 37/42 and the basket on the floor. 1 clay wall, 2 stone, 3 flint artefact, 4 basket.

No flint artifacts other than those in the southern corner were found on the floor of House 11. Sporadic finds did occur in Layer 1, which is part of the fill of this structure. This indicates the planigraphic homogeneity of Locus 37/42 and its planigraphic correlation with the bitumen basket.

Stratigraphy (Fig. 1)

Locus 37/42 was discovered in the 300-320cm leveling layer (in the area in question, the floor is leveled between depths of 317 and 320cm), which corresponds stratigraphically to the previously described Layer 1 (deposited after the house was already abandoned). Since it lies directly on the floor, it may be assumed that it is contemporaneous with it and, needless to say, older than the overlying Layer 1 (fill partly composed of material from water-eroded walls).

Of some concern may be the considerable dispersion of individual artifacts in the vertical plane (300-320cm range). However, this scatter is only apparent, resulting from the rather imprecise method of extracting artifacts in 10- or 15-cm layers (310-320 and 300-315cm). In places where individual artifacts were mapped, the depths are grouped in the 307-322cm range, *i.e.*, within a space of 15cm, with concentrations around the depths of 310 and 315-318cm; the basket lay at 316cm. A more precise analysis of this data clears up all doubts, the more so that some of the artifacts are quite large (*e.g.* the cores), which means they take up a considerable space in the vertical dimension. In view of this one must recognize the stratigraphic homogeneity of Locus 37/42 and its direct link to the floor of House 11 and the basket.

The Basket

If the stratigraphic-planigraphic correlation of Locus 37/42 with the bitumen basket lying on the floor of House 11 is highly likely - and everything seems to indicate that this is in fact so, - then we must ask how the basket (and the flint artifacts with it) ended up on the floor. Judging from planigraphic, stratigraphic and morphological indicators such as the basket's correlation with concentration A, the band-shaped scatter of artifacts in concentrations B, and the morphometric and technological peculiarities of the assemblage (its unusual composition; *cf.* the archaeological analysis below), then one is justified in supposing that:

-in all likelihood, all the flints of Locus 37/42 were originally connected with (placed in) the basket;

-the basket was originally suspended above the floor;

-after the house was quickly vacated by its inhabitants (fire), the basket fell to the floor and its contents spilled to form the bands of concentrations B.

If this reconstruction is accurate, then what we have is an exceptional inventory, specially stored, identical to an authentic equipment of a house ("living" inventory), most probably different from an average "refuse" inventory typical for a cultural layer from an ordinary site.

Flint Material

A description of the assemblage of Locus 37/42 and assemblages from Layers 2, 1A and 1 now follows. We treat the latter assemblages as typical for the region and age ("Sultanian"), useful as a backdrop for the specific Locus 37/42 assemblage.

General Technological Structure[1]

The flint material from the various layers associated with House 11 was here divided into five technological classes (Table 1): 1) pre-cores and cores; 2) flakes, chips and chunks; 3) blades and bladelets; 4) technical blades/flakes; and 5) retouched tools.

The varying proportions between these groups could provide clues as to the possible functional character of the assemblage, among other things indicating which part of the *chaîne opératoire* was performed on the site. Table 1 contains the relevant data for Layers 2, 1A and 1 as well as for Locus 32/47.

Assemblages from Layers 2 and 1A are very similar to each other, featuring a moderately high flake index (51-52%) and fairly high indices of blades (29-35%) and retouched tools (12-16%), with almost no cores in evidence. It seems that a substantial part of the *chaîne opératoire* took place outside the site, with mainly finished blades being delivered to it. However, the presence of rather plentiful flakes suggests that to some limited extent the *chaîne opératoire* was also happening on the site.

The proportions in the assemblage from Layer 1 are quite different, with a strong predominance of flakes and a low blade index. If it were not for the suspiciously small size of the assemblage (just 45 artifacts), one would be tempted to assume a fuller realization of the *chaîne opératoire* on the site.

The technological structure of Locus 37/42 differs from that in assemblages from Layers 2 and 1A in the following significant respects: 1) a high (2.7%) core index; a high (4.8%) technical blade/flake index; and a low (8.8%) retouched tool index.

These differences are significant enough to indicate a different function (way of functioning) of the Locus 37/42 assemblage, which either could have been of workshop character (something made less probable, however, by the almost complete absence of refittings) or else a result of some other activities/factors shaping its technological structure (*e.g.*, the absence of selection accompanying the vacation of the site, typical for "ordinary" assemblages). Further on we will point to other peculiarities of the Locus 37/42 assemblage that allow us to explain its distinct character with regard to general technological structure.

Flakes

Flakes constitute a significant part of all the described assemblages, on average accounting for some 50% of all flint artifacts; in the exceptional case of Layer 1 they number more than 70% of the finds (Table 1). Most of them originate from core formation processes, others also being the result of repairs. No flake cores are known from Gilgal, the specimens in Fig. 8 being pre-cores.

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[1] "Technical Blades/ Flakes" in this contribution are all sorts of flakes and blades occuring with core preparation and rejuvenation.

The various assemblages differ in several aspects, including 1) the proportions between flakes, chips and chunks, 2) the ratios of cortical/subcortical and non-cortical flakes; and 3) flake sizes.

Flakes *vs.* Chips *vs.* Chunks

Table 2 shows the mutual proportions among these three classes of artifacts. The collections from Layers 2 and 1A are similar (predominance of chunks and more or less equal proportions of chips and flakes), while the assemblage from Locus 37/42 is quite different (predominance of flakes, equal numbers of chips and chunks). Layer 1 is too poor in finds to be the object of analysis.

It appears that Layers 2 and 1A contain an average collection of waste material among which, by the very nature of things, there ought to dominate unspecified and destroyed flint fragments (chunks). It also seems that waste forms dominate in the category of flakes proper, since the larger ones were previously selected as blanks for future retouched tools (*cf.* remarks on flake dimensions). All the chips are waste. The assemblage from Locus 37/42 contains few artifacts which we would classify as waste; most of the flakes are large items, most probably specially selected and intended as tool blanks.

Table 2. Gilgal I, House 11: flakes, chips and chunks (in %).

Layer	flakes	chips	chunks
2	24.5	28.6	46.9
1A	30.8	27.5	41.8
Locus 37/42	60.0	18.7	17.6

Table 3. Gilgal I, House 11: flakes (number of recognizable pieces).

Layer	cortical	sub-cortical	non cortical
2	5	5	19
1A	2	8	13
Locus 37/42	9	20	17

When we look at proportions in the group of flakes proper, between forms from the early core formation phases (cortical and subcortical) and those from later stages (non-cortical), it again turns out that assemblages from Layers 2 and 1A are most similar to each other (Table 3), with the smaller non-cortical flakes being the most numerous category. The Locus 37/42 assemblage is distinct from them in having mostly the larger cortical forms.

One gets the impression that the collection of flakes in Locus 37/42 underwent special selection (positive choice of "better" flakes), while the assemblages from Layers 2 and 1A are statistically random waste series (negative choice-elimination of "better" flakes). This impression becomes almost certainty when we analyze the dimensions of flakes (leaving out chips and chunks) in the assemblages of interest to us here (Fig. 3). We find that flakes from Layers 2 and 1A are on average smaller than those from Locus 37/42, although flakes from Layers 2 and 1A also differ in size.

If we now correlate all the major features of flakes, we can group together the finds from Layers 2 and 1A, which are clearly of waste character (large proportions of chips and chunks with few cortical forms, smaller dimensions), contrasting them with the specific assemblage from Locus 37/42 being of distinctly non-waste nature (few chips and chunks, high percentage of large cortical/ subcortical flakes) and most probably the result of a selection process.

Blades and Bladelets

Blades and bladelets are fairly plentiful in House 11, accounting for 29%, 35% and 26.5% of finds in Layer 2, Layer 1A and Locus 37/42, respectively. The figure in Layer 1 was just 6.6%, which may be due to the small number (just 45) of artifacts recovered.

We adopted the maximum width of 14.5mm as the arbitrary border between blades and bladelets. All specimens in the described collection are elongated (length-to-width ratios from 2.5:1 to 3:1), with parallel edges, obtained using the indirect percussion method.

Both blades and bladelets were intentionally sectioned. Complete specimens are accompanied by numerous fragments that may be divided into the proximal, medial and distal. The impression is that sectioning was intended to obtain rectangular medial parts which served as "gillette"-like[1] implements.

[1] This term is used here for a razor-sharp blade fragment.

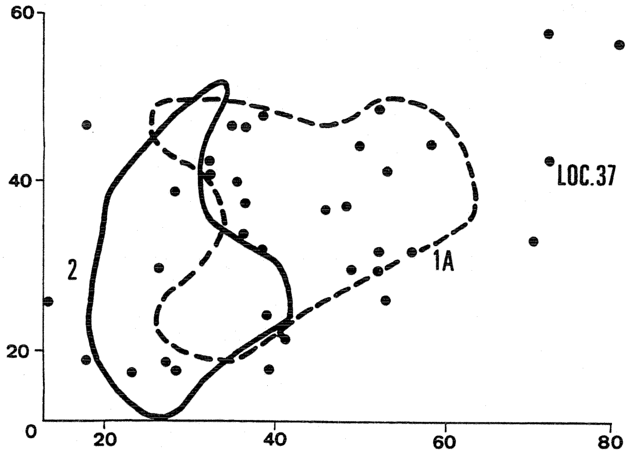

Fig. 3. Gilgal I, House 11. Dimensions of flakes according the layers.

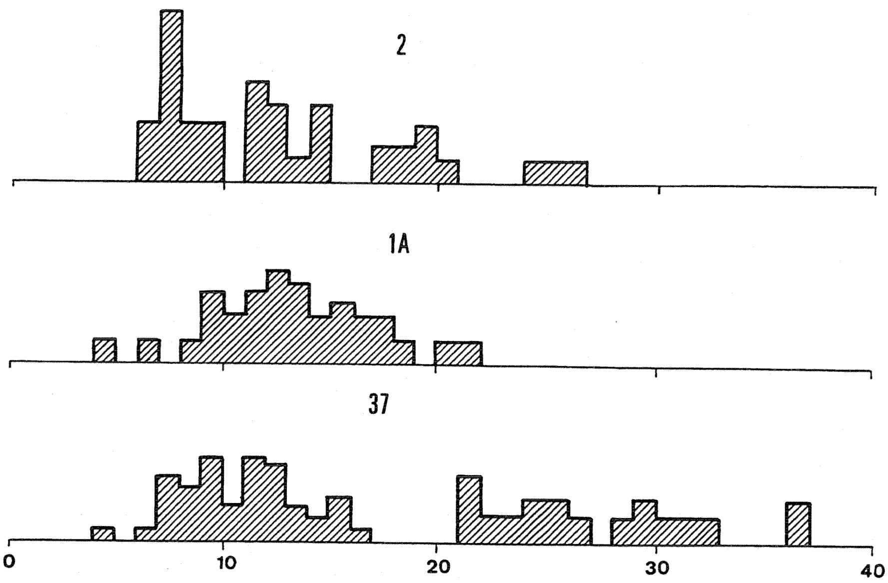

Fig. 4. Gilgal I, House 11. Width of blades according the layers.

Table 4 shows the mutual proportions between complete and fragmented specimens of blades and bladelets separately. The following conclusions may be drawn from this data. As regards the ratio of (wider) blades to (narrower) bladelets in Layers 1A and 2, the latter clearly outnumber the former (31:10 and 42:14), whereas in Locus 37/42 blades are twice as numerous as bladelets. In practical terms, this translates into a greater presence of broad forms in Locus 37/42, this being well illustrated in Fig. 4. One gets the impression that the finds from Locus 37/42 have been specially selected (blades being simply "better" than bladelets?).

Table 4. Gilgal I, House 11: counts of whole and sectioned blades and bladelets (destroyed and use-retouched specimens are omitted).

	Blades				Bladelets			
Layer	whole	proximal	medial	distal	whole	proximal	medial	distal
2	3	6	2	3	16	13	7	6
1 A	4	-	3	3	20	2	3	6
Locus 37/42	8	3	1	5	-	5	2	2

As far as blades are concerned, Locus 37/42 appears to be distinct with its numerical parity between complete and fragmentary specimens, whereas in Layers 2 and 1A fragments outnumber

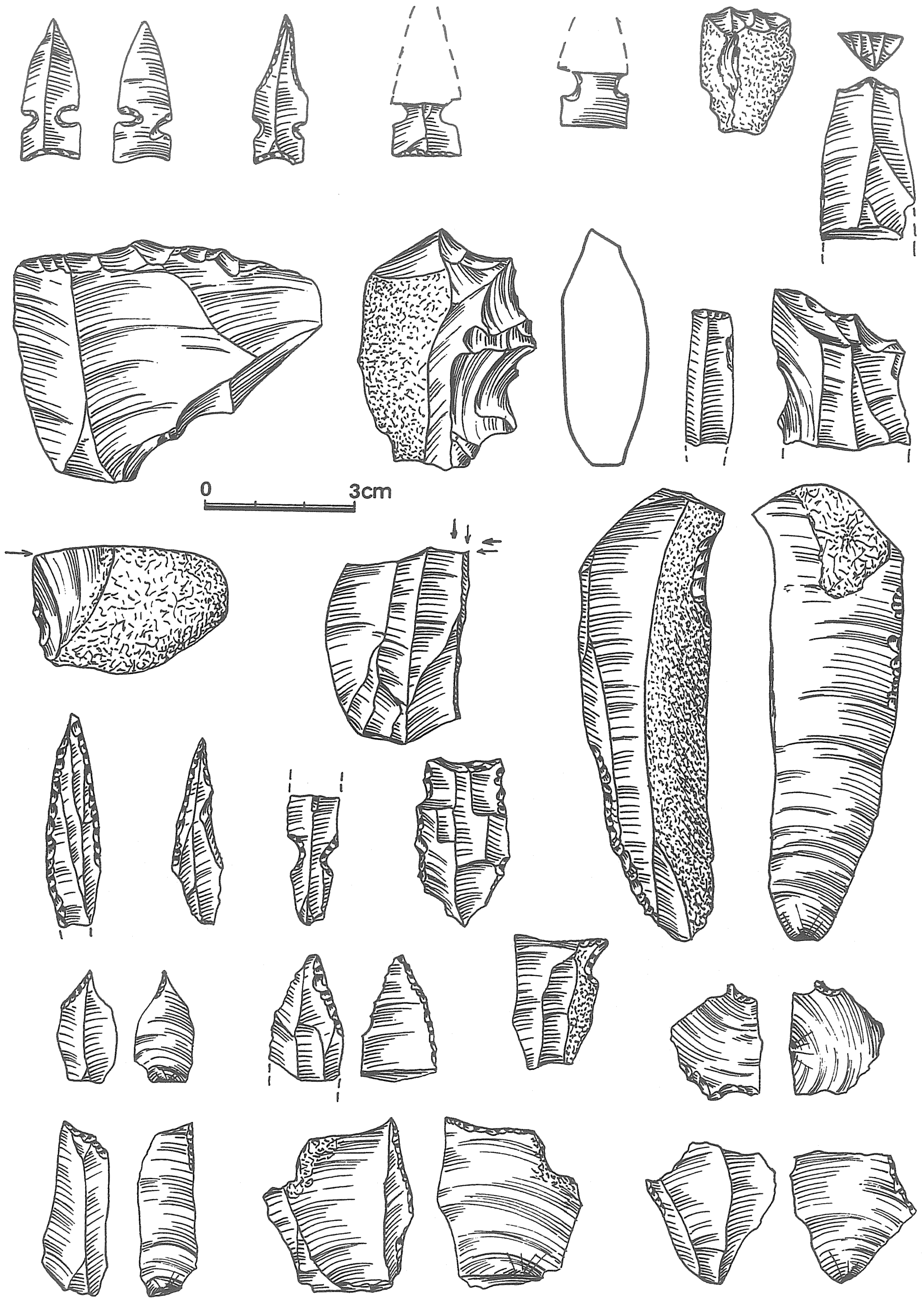

Fig. 5. Gilgal I, House 11. Artefacts from Layer 2.

whole specimens. Perhaps in this case too Locus 37/42 was a result of a special selection of some kind, but the recovered series of artifacts are too small to justify firm conclusions. As for bladelets, Layers 1A and 2 again turn out to be rather similar, with complete specimens accounting for 40-60% of the collections. Locus 37/42 contains no complete bladelets whatsoever, and in all likelihood this is not an accidental situation.

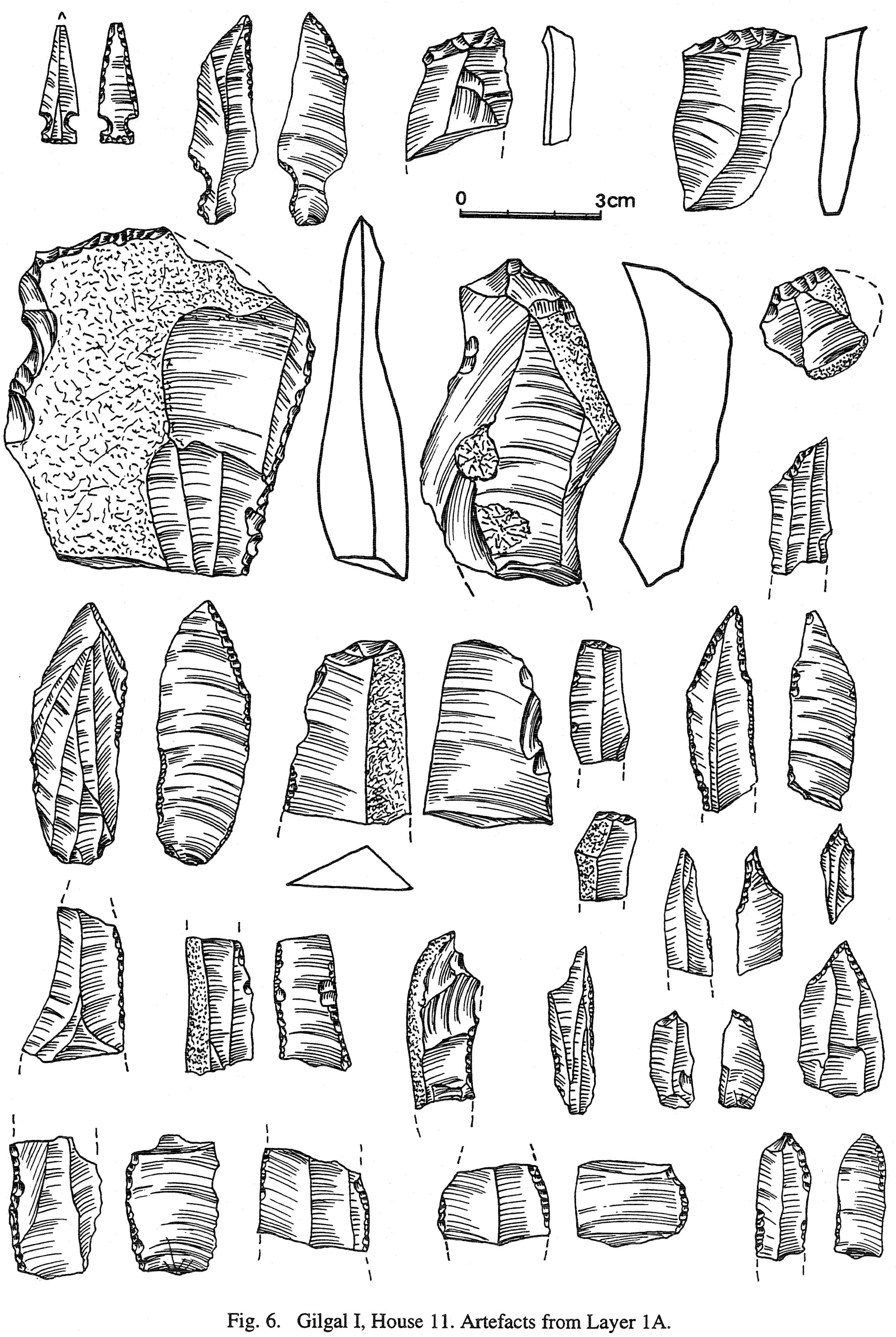

Fig. 6. Gilgal I, House 11. Artefacts from Layer 1A.

The above observations prompt us to believe that in the blades/bladelets group the "standard" assemblages from Layers 1A and 2 also differ from the Locus 37/42 assemblage. This difference boils down to a greater percentage of broad specimens (blades) and perhaps also a greater percentage of complete specimens in this category. Both these features appear to suggest that the Locus 37/42 assemblage is the result of selection by its makers/users.

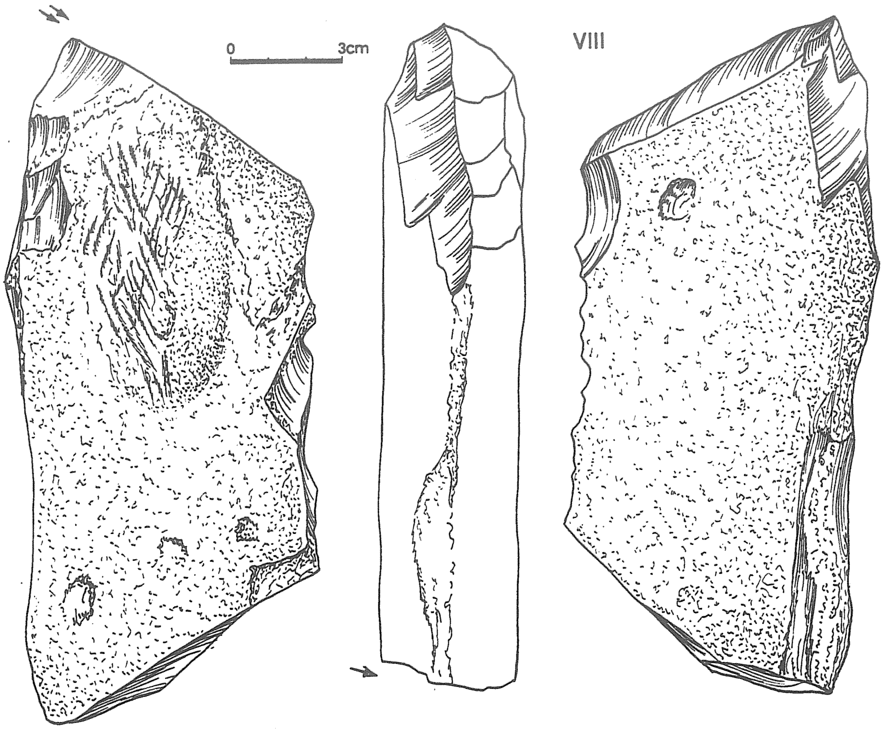

Fig. 7. Gilgal I, House 11. Artefact from Locus 37/42.

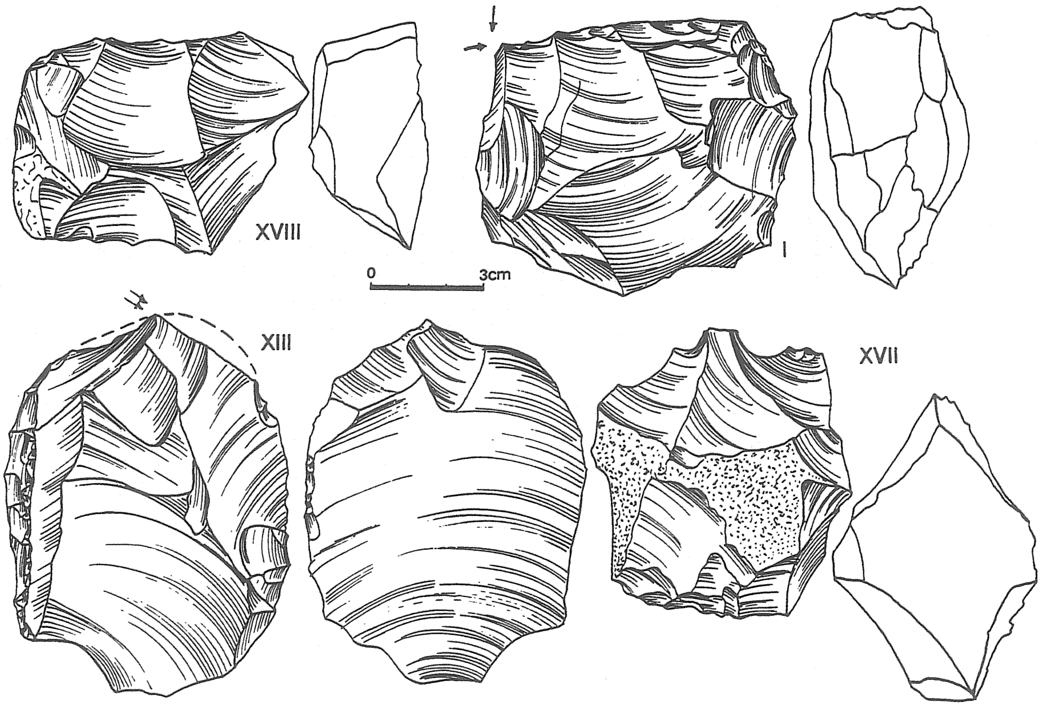

Fig. 8. Gilgal I, House 11. Artefacts from Locus 37/42.

Retouched Tools

Taxonomically, the assemblages from Layers 2, 1A, 1 and Locus 37/42 fit in the local Palestinian PPNA tradition (Gilgal III, Salabiya IX, Netiv Hagdud, Jericho, etc.), this being confirmed by the following features: El-Khiam points (Layers 2, 1A, 1), Jordan Valley points (Layer 1A), micro-perforators on flakes and bladelets (Layers 2, 1A), and a Tahunian axe (Locus 37/42). The remaining morphological features are less useful in diagnostics, but they too indicate an affinity linking all the mentioned assemblages (Figs. 5, 6, 13, 14), in spite of the fact that, for example, the Locus 37/42 assem-

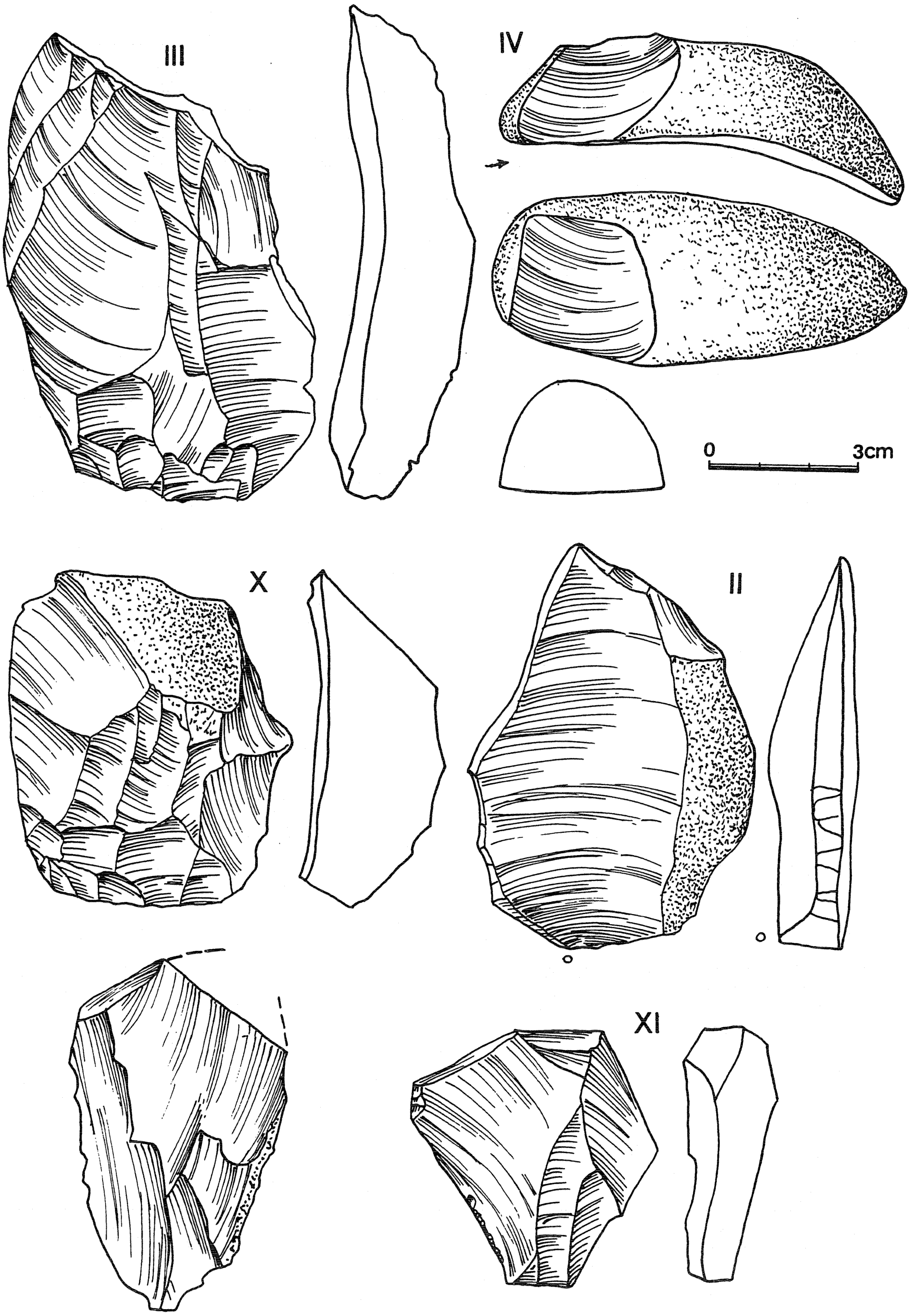

Fig. 9. Gilgal I, House 11. Artefacts from Locus 37/42.

blage contains no El-Khiam points or endscrapers. Similarities are visible in the morphology of endscrapers, retouched blades, symmetrical becs/perforators on blades, as well as big and small retouched truncations (Table 5).

Table 5. Gilgal I, House 11: numbers of retouched tools.

Typology	Layer 2	Layer 1A	Layer 1	Locus 37/42
endscraper	2	3	-	-
sidescraper	1	-	-	-
denticulate	2	-	-	-
notch	-	1	-	-
retouched flake	4	2	4	1
burin	7	1	-	2
burin spall	5	-	-	-
retouched truncation	3	3	-	3
retouched blade	3	2	-	5
sickle	3	2	2	-
awl-borer	15	7	1	1
axe	-	-	-	1
point	5	2	1	-
backed piece	2	1	-	-

Retouched tools constitute 16.0%, 12.2% and 8.8% of assemblages from Layer 2, Layer 1A and Locus 37/42, respectively (Table 1). In the very poor assemblage from Layer 1, this figure was a high 17.7%. We left out microretouched/use retouched blades/bladelets from the retouched tools category. The differences between the above indices are small and remain within the standards of the age. Accordingly, the Locus 37/42 assemblage does not differ technologically and statistically from the collections recovered from Layers 2 and 1A.

As far as morphological-statistical considerations go, only the assemblages from Layers 2 and 1A meet the statistical requirements for series of artifacts (53 and 25 tools, respectively, with a characteristically high perforator index), and this just barely. The other assemblages cannot be analyzed in this respect (Table 5), although the high index of retouched blades in Locus 37/42 is a striking feature. In the end, it is hard to point out any significant morphological differences between assemblages from Layers 2, 1A, 1 and Locus 37/42, if one chooses to overlook the slightly greater average dimensions of retouched tools in Locus 37/42.

What is puzzling, though, are the statistical differences, probably not always accidental. For example, it seems that implements normally used as hunting weapons (Khiam points) were not kept "at home" (as in Locus 37/42); the same is true for hide processing tools (endscrapers). On the other hand, stocks of raw material and blanks - in the form of pre-cores, cores but also complete blades and large flakes - were stored "on shelves" (in baskets?).

Raw Materials

Table 6 presents the raw material composition (determined macroscopically) in the described assemblages. As we can see, in each case we have the same four colors of raw materials: dark, brown, gray and pink-with brown being clearly dominant, but dark and pink also being significant.

According to information kindly provided by Fabio Frachtenberg of the Israel Museum, the three raw materials most popular in Gilgal are of Eocene age, with the leading "brown" variety possibly coming from deposits in the Judean Desert. Frachtenberg suspects that the "dark" raw material is in fact the "brown" variety discolored by fire, while Avi Gopher of Tel Aviv told us that the "brown" material occurs also in Jericho and Netiv Hagdud.

Table 6. Gilgal I, House 11: raw material (in %).

	Flint raw material						
layer	dark	brown	gray	pink	transparent	black	other
2	24.2	44.2	22.7	5.2	3.7	-	-
1 A	17.5	62.6	13.5	0.6	-	-	-
Locus 37/42	10.2	70.1	17.3	0.8	-	0.8	0.8

A more detailed analysis appears to show that in Locus 37/42 the raw material preferred in the production of pre-cores and cores was the technologically superior "brown" variety. It was acquired from primary deposits, this being indicated by the nature of the cortex of the specimen depicted in Fig. 7. Where were the workshops in which such pre-cores were pre-formed? The presence of local river pebble material (mostly gray?) is attested by a few specimens. It is perhaps interesting that the

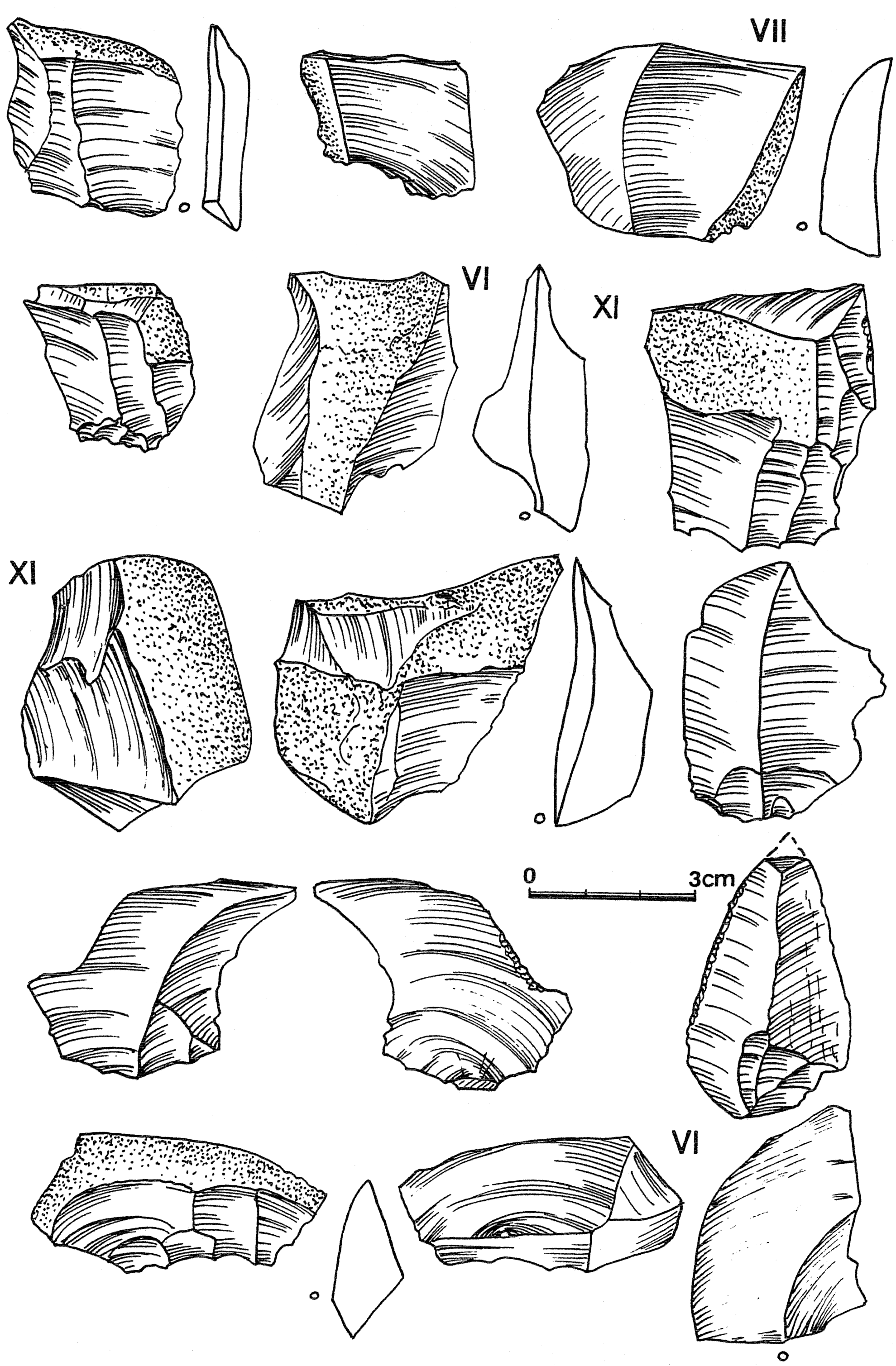

Fig. 10. Gilgal I, House 11. Artefacts from Locus 37/42.

brown and dark variations of raw material constitute 60-90% of all flint used, but in Locus 37/42 the percentage of fire-treated dark material is much smaller than in Layer 1A and 2. This could also suggest a possible "garbage" character of assemblages from 1A and 2.

Cores

As already mentioned in the remarks on flakes, the inventory from the basket in House 11 gives the impression of being a carefully selected collection, serving as a kind of raw material reserve or stock, used (but also constantly replenished) as the need arose. The dominant categories in this reserve

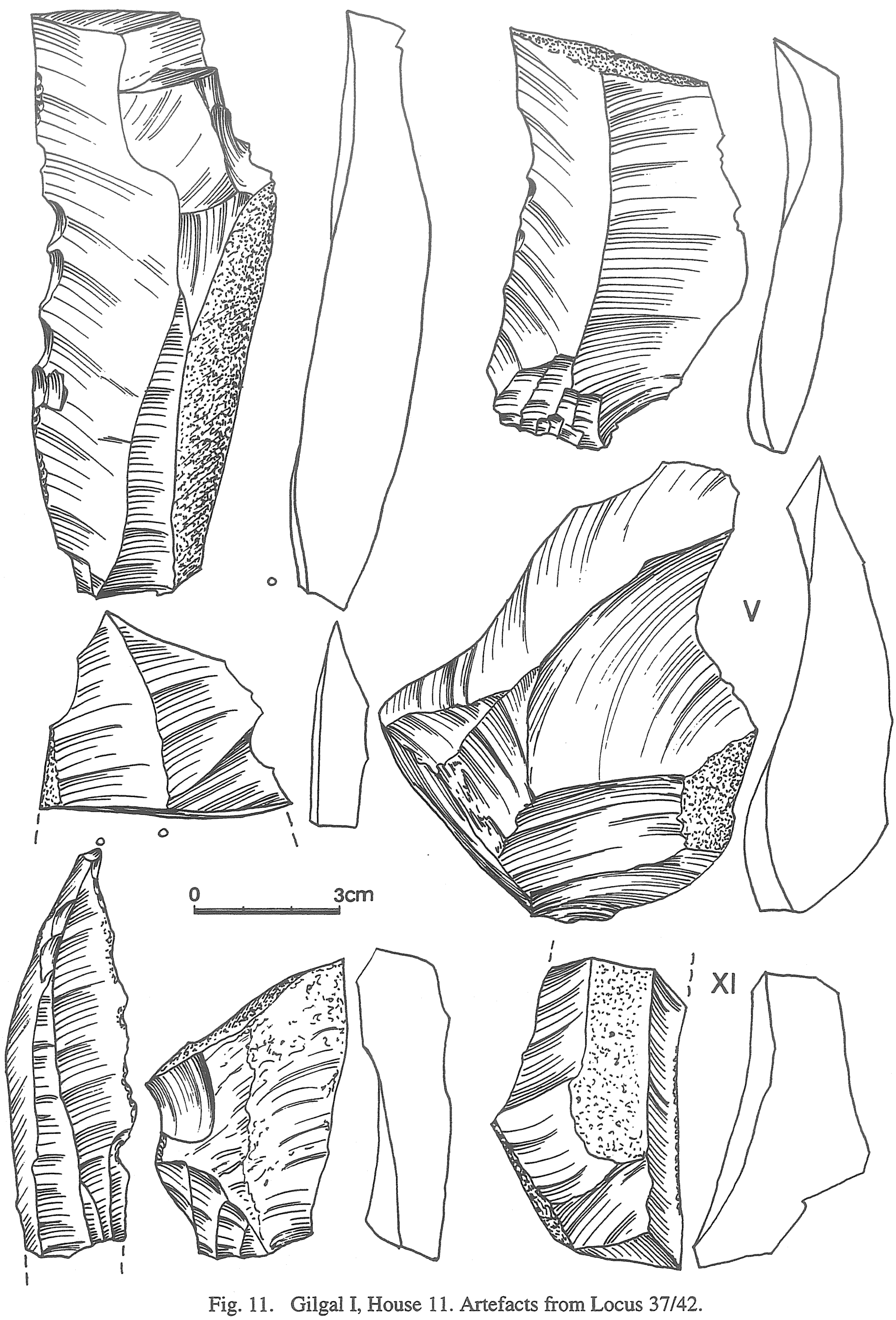

Fig. 11. Gilgal I, House 11. Artefacts from Locus 37/42.

are selected large flakes as well as unprocessed broad blades (including many complete specimens) and bladelets (these in fragmentary form), together accounting for a hefty 81.6% of the entire inventory. These forms can be easily retouched to become tools or put to work without further processing.

Another component of the reserve stock are cores which, if they were indeed to serve as reserve, cannot be in the advanced or final stages of exploitation, for then they would of course have been consigned to the refuse heap. We know four cores from Locus 37/42 (2.7%), all in the pre- or initial core stages (Figs. 7, 8), and this early phase of utilization fits extremely well in the above hypothesis about the "reserve" character of a part of the Locus 37/42 assemblage. This hypothesis is further rein-

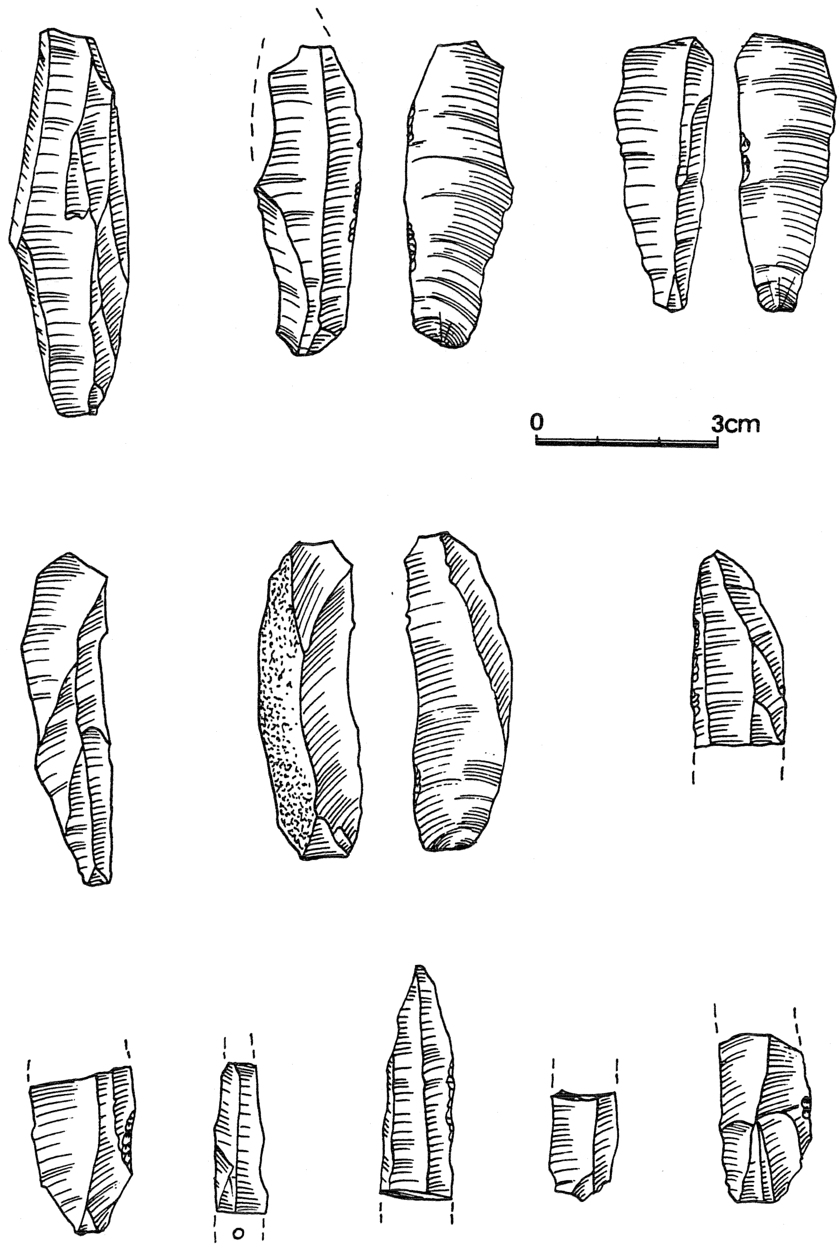

Fig. 12. Gilgal I, House 11. Artefacts from Locus 37/42.

forced by two other forms (Figs. 8, 14), formally being retouched tools (burin on rejuvenation flake and Tahunian axe, respectively), but actually serving as pre- or initial cores. Given this, the cores index for Locus 37/42 increases to more than 4%, while the retouched tools index drops to *c.* 7.5%.

The Locus 37/42 assemblage lends itself to yet another interpretation of cores. It is possible to accurately count the minimal number of cores that were being exploited, or, to be less specific, that were used, and this in turn allows a partial reconstruction of the raw material economy of the inhabitants of House 11. Information of this kind appears to be unique for the Neolithic in the Near East, and may allow a better understanding of some behaviors of the people responsible for the local Early Neolithic tradition. Basing on morphological, technological and raw material criteria, and also bearing in mind the presence of several core forms in House 11, we came to the conclusion that the minimal number of cores handled by the inhabitants of this house was up to 20 (*cf.* Roman numerals in the figures).

Of course, the cores are "present" on the site in a number of ways. The first group comprises actually present artifacts (six cores: I, VIII, XIII, XVII-XIX) in their initial phases (pre-cores and fewer initial cores). These apparently served as "strategic reserve". They are made of a high-quality mined raw material (as evidenced by the state of cortex preservation, for example) originating from deposits in the Judean Desert, some distance away from the site. These cores were most likely formed in workshops near the deposits and probably arrived in Gilgal already in finished form. In any case,

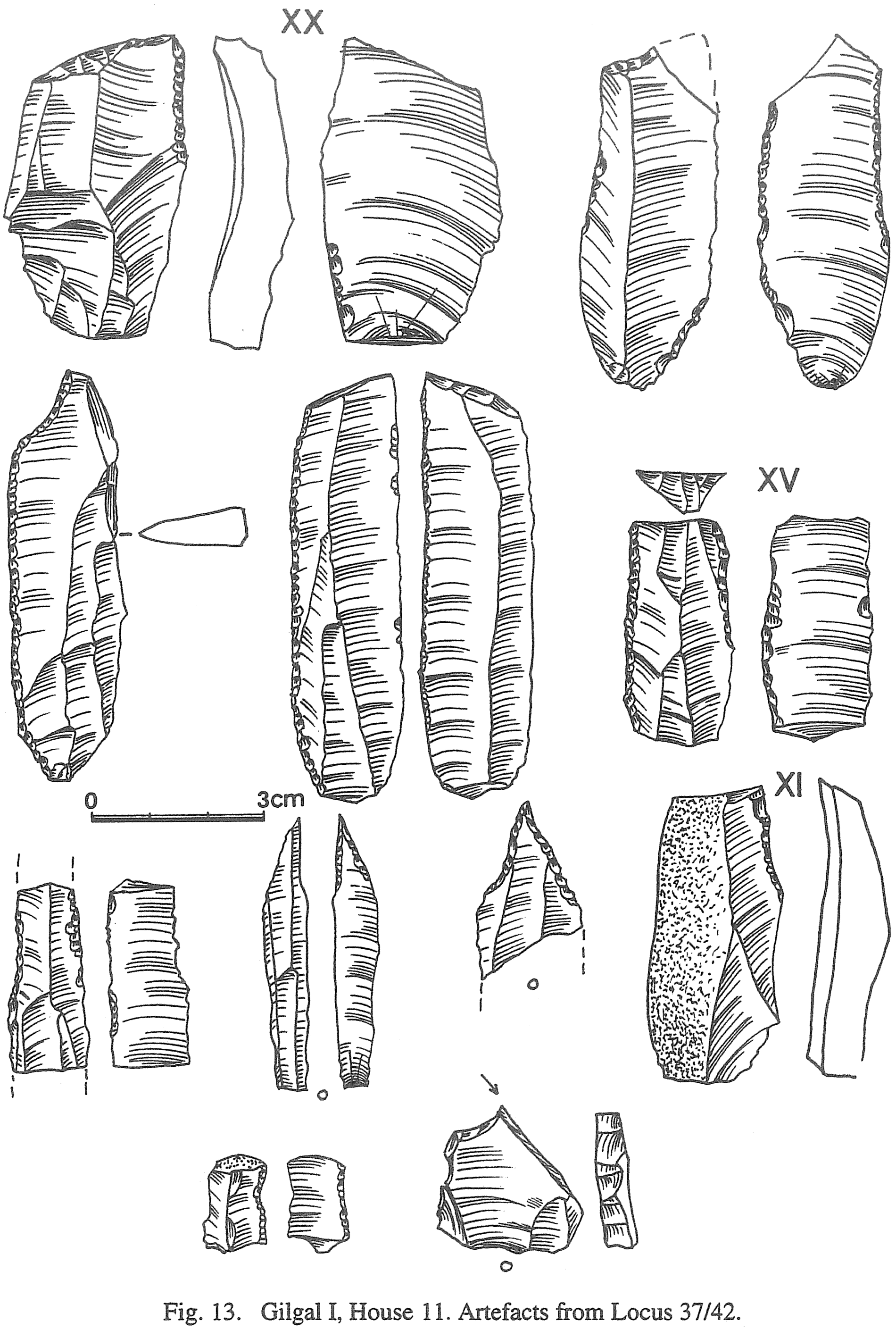

Fig. 13. Gilgal I, House 11. Artefacts from Locus 37/42.

House 11 did not yield any flakes that would refit onto them.

Among the cores there are two interesting "conversions": one a Tahunian axe (Core XIX) and the other a big rejuvenation flake (Core XIII), which seem to testify to technical flexibility of the Gilgal people and also suggest a high value of the brown flint imported from distant places: destroyed implements made from a good raw material were thriftily reprocessed. Admittedly, this reprocessing could have taken place not only in Gilgal (a more logical supposition for the axe) but also in the workshops close to the deposits (hence the enormous rejuvenation flake struck off a huge core for blades, of a kind not found in Gilgal).

Another group of cores, numbering at least 14 (Specimens II-VII, IX-XII, XIV-XVI, XX) is represented in House 11 by characteristic waste products from the initial phases of formation of cores and the subsequent stages of their exploitation and repair. We have here mostly subcortical flakes (Cores V-VII, IX-XI) accompanied by handfuls of noncortical specimens (Cores XI, XX), striking platform rejuvenation flakes (Cores II, XVI), flaking platform rejuvenation flakes (Cores III-IV) and

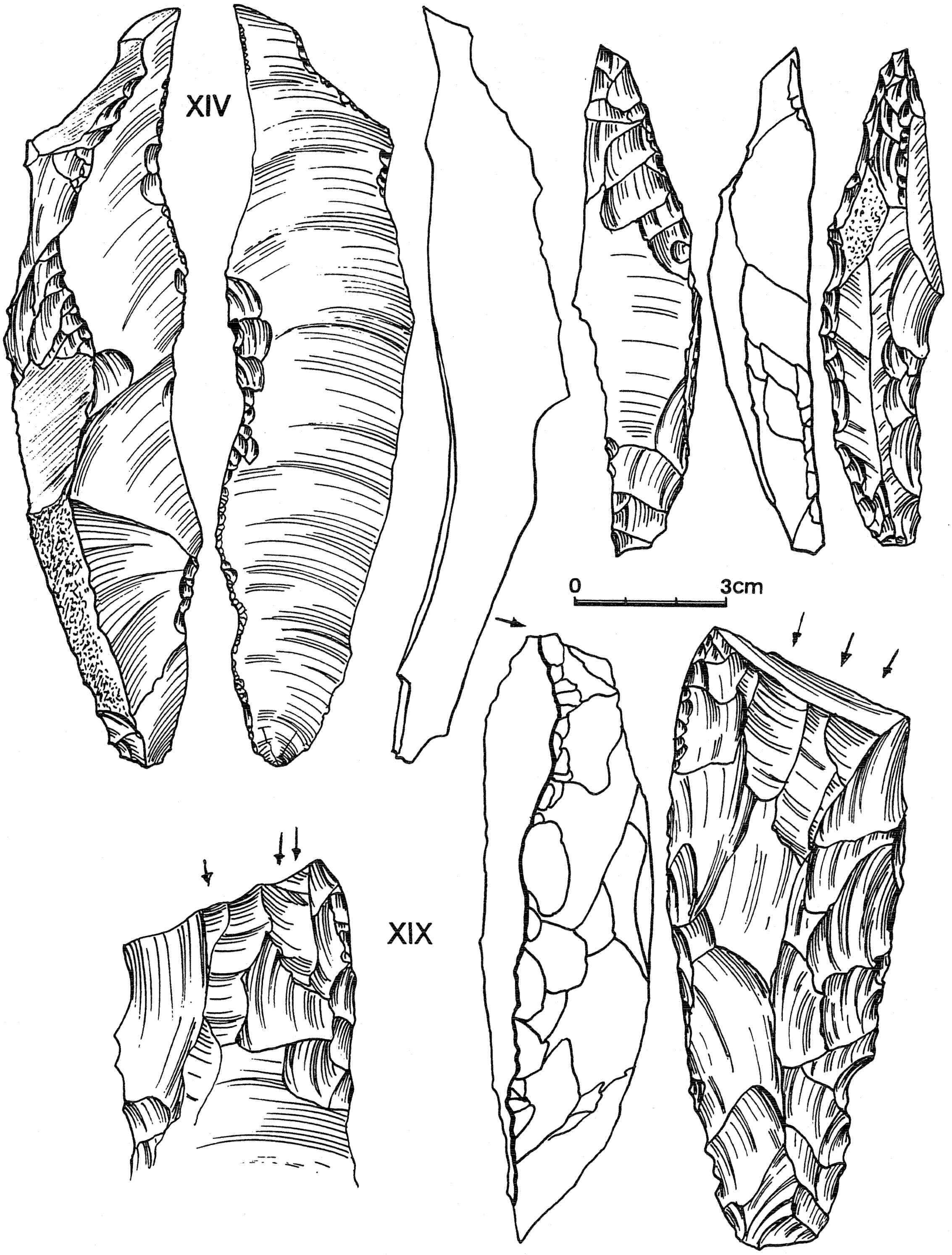

Fig. 14. Gilgal I, House 11. Artefacts from Locus 37/42.

trimming blades (Cores XI, XIV). The assemblage lacks cores in advanced stages of exploitation, although implements of this kind do of course occur in the "normal" layers in Gilgal.

The following inferences come to mind:

First, technical flakes and blades from core pre-forming and repair are overrepresented in House 11. Both groups do not fit the core forms found in the house nor are there any matching specimens of cores in advanced stages of exploitation. This proves that artifacts of both groups were not produced inside House 11 but were "imported" to it. Their cores existed somewhere outside House 11, where they were pre-formed, exploited and repaired. If this was in fact so, we must assume that all the flakes from inside the house were of usable rather than waste character. In other words, we must accept that the presence of these flakes in the basket was intentional, that they were not just "imported" (in normal circumstances waste flakes would not be brought into a house but discarded on a waste heap) but also pre-selected, something that correlates well with their above-standard dimensions (Fig. 3). Cores II-VII, IX-XII, XIV-XVI and XX therefore were used somewhere outside House 11, where they were pre-formed, exploited and repaired. It seems that there were workshops/ working places specialized in core preparation, and others which dealt with blank selection "for export". Such workshops could have been sited mainly around raw material deposits.

Second, another group of cores is represented in the basket only by their blades and bladelets (Cores XII, XV and unnumbered specimens made of the brown raw material used to produce the finds illustrated in Figs. 11-13). In House 11 there were no cores matching any of the blades illustrated in Figs. 11-13. These cores would have been in the advanced or final stages of exploitation. All of these blades and bladelets would thus have been produced outside the house.

Where would such blade workshops be situated? It seems some of them were close to deposits and others on the site itself, as suggested by the presence of pre-cores in House 11 and exploited cores in other assemblages. One gets the impression that workshops away from the site produced greater quantities of the biggest forms, including large trimming blades (Fig. 14) and large first-series blades (Fig. 11); we see, however, that also present on the site was a large pre-core (Fig. 7). Knappers on the site produced also smaller forms on an *ad hoc* basis. One must admit, however, that these suppositions are not as obvious as in the case of cores.

Conclusions

The Locus 37/42 assemblage from House 11 in Gilgal I described here is unique for the Neolithic of the Near East in having retained its original integrity, further underlined by its association with the basket in which it was stored. The assemblage is an authentic and complete tool kit of a house dating to the early 8th millennium bc which, thanks to unusual circumstances (as was also the case for example with Pompeii), never underwent a kind of selection process that usually modeled archaeological assemblages as the sites or houses were being abandoned by human groups. What we thus have here is a unique "living" assemblage, obviously differing from the "refuse" ones typically found in average archaeological sites.

The assemblage from the basket differs from an average "home" Sultanian assemblage: its indices of cores and technical blades/flakes are higher (*c.* 4 and 5% respectively), while the retouched tool index is low (*c.* 8-9%); the blade index is probably also lower. At least some of these indices are not so much a reflection of the technological activity of the people responsible for its creation or of assemblage function (theoretically, given these indices, this place should be classified as a workshop!) as apparent evidence of a rational selection during the "composition" of the assemblage. The fairly simple image of the world we have had till now begins to get more complicated. The indices we have recorded may reflect not just functional differences between the various assemblages but also may be the result of incidents such as the destruction of Pompeii.

Our hypothesis about the premeditated "composition" of the basket assemblage needs to be further substantiated. This should not be difficult since the assemblage is distinct not only as regards its general technological structure but also in the dimensions of some of its artifacts. Compared to standards of the age, we have larger dimensions of blades (Fig. 4) and flakes (Fig. 3), and this can only be the result of a planned activity: the selection of unusually large potential blanks/tools. As the equipment of the house was being assembled, the blanks (larger flakes, *i.e.*, mostly cortical) were being retained while waste material (smaller flakes) was being discarded. A similar way of thinking led to the choice of technical blades and flakes which are mostly large specimens (leading to their overrepresentation in the assemblage). Large blades are in our case also more numerous than in average Sultanian assemblages. In Locus 37/42 many of them are moreover unprocessed (not sectioned), unlike bladelets, a considerable number of which are processed (sectioned).

The few retouched tools in Locus 37/42 (Figs. 13, 14) are, of course, in the style of the times (Sultanian) and slightly less numerous than in Layers 1A and 2 of our site. More importantly, the assemblage lacks several forms typical of the period (arrowheads, scrapers). It cannot be precluded that this absence is not just a statistical matter. It is possible that arrowheads and scrapers, for example, were not normally kept (used) at home but outside it (quite likely in the case of arrowheads) and thus were not a standard element of the equipment of houses.

Work traces on blades and flakes from the basket, the reduction stage of the cores, and the presence of just a small number of tools - all these elements point to a twofold character of the assemblage. On the one hand in the Locus 37/42 assemblage are objects which were certainly, or almost certainly, used (put to work) on a regular basis by the inhabitants of House 11; on the other hand though there were objects that were unused, although they constituted an important element of the house's equipment. The home inventory of House 11 thus divides into two parts: the active versus the passive (or reserve). In modern times this is a typical, even banal, situation, but it is one hard to demonstrate for prehistoric times. An exception here is Maszycka Cave in Poland (KOZŁOWSKI and SACHSE-KOZŁOWSKA 1993), and nothing like it has been described from the Neolithic of the Near East. (Potentially, such as assemblage could be found in the "burned house" at Bouqras in Syria; ROODENBERG 1986).

In the active part of the assemblage we include all objects used regularly by the inhabitants of House 11, namely: blades and bladelets, as well as a handful of flakes (both with use retouch); retouched tools, including the small number of retouched blades, sickles, retouched truncations, a burin, perforators and a pick. All these objects are a clear minority among all the artifacts from Locus 37/42.

The passive (or "dormant") part consists of: pre- and initial cores; unretouched and unbroken blades and bladelets; and unretouched flakes; they form the majority of the assemblage. It seems that this material was a reserve, kept at hand in case of a depletion of the active part of the assemblage (damage or loss of the normally used tools). It also appears that this reserve was replenished from time to time (during expeditions to raw material deposits but also in the immediate vicinity of the site) with choice (*i.e.*, large) blanks and pre-cores.

The state of our basket inventory is of course the result of a continuous process, with specimens being constantly added to it and others taken out for use. This is one reason for its extremely complicated and to some extent unclear technological history. For example, many cores used to make the artifacts present in Locus 37/42 are not to be found in the basket, while others that were present do not match/fit any of the products that were recovered as part of the assemblage. This may mean that a big part of core pre-forming and exploitation took place outside settlements (and surely outside houses), perhaps in specialized workshops near outcrops of raw materials. (Another part of this activity was realized in the villages). What reached villages were pre-treated and selected goods: pre-cores (later treated in villages), choice blades (serving as specific "cores" for sectioned parts of blades or as half-products for retouched and use-retouched tools) and large flakes (being blanks of retouched or use-retouched tools).

It is thus a premeditated process of pre-selection that is responsible for the specific composition of flint artifact assemblages being the "living" equipment of Neolithic houses in the Near East. In cases when houses were being willfully abandoned by their inhabitants, the assemblages were subjected to selection, and the most valuable objects were taken away. What remained were typical waste assemblages occurring in typical cultural layers, and it is these that usually end up in the hands of archaeologists. We have to deal with them in most cases for lack of anything else, but we must always bear in mind that they are but a warped reflection of prehistoric reality.

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Bullet-Shaped Microblade Cores of the Near Eastern Neolithic: Experimental Replicative Studies

Philip J. Wilke

Abstract: *Replicative experiments were conducted to determine the technological parameters that account for the presence of bullet-shaped microblade cores in archaeological assemblages, with particular emphasis on the Neolithic sites along the northeastern flank of the Near East from Iran to Anatolia. Within this area, bullet-shaped cores have been found most commonly in northwest Iran, and their broader technological affinities seem to be with central and northeastern Asia. Research suggests that simple devices such as slotted blocks of bone may have been used for immobilizing and supporting small microblade cores during blade detachment. Use of such devices enables the detachment of straight microblades, while at the same time permitting maintenance of the configuration of the core. For successful microblade detachment using such a core-immobilization device, the distal end of core must be truncated to provide support of the core at that area. By applying pressure to the platform of the core, microblades are detached at the point immediately adjacent to the support. Core exhaustion occurs when continued blade detachment leads to loss of the truncated distal end of the core - in effect when the bullet-shaped configuration emerges. It is likely that in most cases bullet-shaped microblade cores are the exhausted forms of larger pressure-blade cores, the forms of which may be determinable by careful assemblage analysis.*

Résumé: *Des expériences réplicatives ont été faites afin de déterminer les paramètres technologiques qui expliquent la présence de nucléus de microlames "en balles de fusil" dans des assemblages archéologiques, plus particuliérement dans les sites néolithiques le long du flanc nord-est du Proche-Orient qui s'étend de l'Iran à l'Anatolie. Des nucléus en balles de fusil ont été découverts dans cette région, plus communément dans le nord-ouest de l'Iran, et leurs plus larges affinités technologiques semblent se rapporter à l'Asie centrale et du nord-est. Les recherches suggèrent que de simples ustensiles tels que des blocs d'os fendus, pourraient avoir été utilisés pour immobiliser et maintenir les petits nucléus de microlames lors du détachement des lames. L'utilisation de tels ustensiles permet le détachement de microlames rectilignes, tout en maintenant la configuration du nucléus. Afin de parvenir à un détachement réussi de microlames en utilisant un tel moyen d'immobilisation de nucléus, l'extrémité distale du nucléus doit être tronquée pour servir de support au nucléus de cette région. En appliquant de la pression sur le plan de pression du nucléus, les microlames sont détachées au point immédiatement adjacent au point de support. L'épuisement du nucléus survient lorsque le détachement continu de lames aboutit à la perte de l'extrémité distale tronquée du nucléus - en fait lorsque la configuration en balle de fusil émerge. Il est vraisemblable que dans la plupart des cas, les nucléus de microlames en balles de fusil sont les formes épuisées de nucléus plus grands pour les lames de pression, dont les formes peuvent être déterminées par une analyse d'assemblage approfondie.*

Introduction: Bullet-Shaped Cores and Microblades

Small bullet-shaped microblade cores, commonly 2.5 to 5.5cm long and often less than 1cm in diameter[1], occur across much of the Old World from northwest Africa to northeast Asia in contexts dating to the latest Pleistocene and early Holocene. They are one of several more or less standardized configurations of microblade cores. They represent a development in the evolution of pressure-blade technology, which began in the Old World at the end of the Pleistocene (TIXIER 1984). Until now, little research has been devoted to understanding the techniques by which these small cores were

[1] Sometimes called "pencil-shaped cores."

reduced[1] and the role they represent in Neolithic assemblages. My purpose in this paper is to report my own experimental work investigating reduction of bullet-shaped microblade cores in the Near Eastern Neolithic, and to suggest ways in which understanding the technology of these microblade cores can help account for variability in Neolithic core-and-blade assemblages.

Terminology, Definitions, and Concepts

In my view, archaeological microblades were detached by pressure from pressure platforms of small cores; they were not struck from striking platforms[2]. Nor were they detached by indirect percussion, as suggested by some authors.[3]

As used in literature, both of the terms "bullet-shaped core" and "microblade" elude clear definition. Many pressure-blade cores that were reduced around their entire perimeters can be said to be bullet-shaped regardless of their size. An example is prismatic-blade cores of obsidian, mostly large but including some very small ones, which are so well known from Mexico and Central America. Usually, however, the term "bullet-shaped" refers to very regular and symmetrical cores of rather small size that are nearly parallel-sided and of elongate conical form, and that were reduced around their entire perimeters. It should be recognized at the outset, however, that through extensive reduction, larger prismatic-blade cores can grade gradually and imperceptibly into small, exhausted, bullet-shaped cores (*cf.* INIZAN 1985: 47). The term "bullet-shaped" is thus rather arbitrary with respect to core size, and, to a certain extent, even to form.

The term "microblade" also is arbitrarily applied. The usual definitions (*e.g.*, TIXIER 1963; KAUFMAN 1986) attempt to distinguish between blades and bladelets. Bladelets are said to be blades less than 1.2cm wide regardless of their length, or they are said to be under 5cm long[4] etc. Hassan (1972) suggested a metric attribute distinction between bladelets and microbladelets. Despite long-standing tradition, such definitions are of limited explanatory value. They encourage a reliance on measurements that precludes an assessment of the technology that created the blades: core-reduction products are characterized metrically but the analysis seldom gets beyond that, so the technology itself does not get identified. Such an approach to assemblage analysis actually impedes understanding.

Narrow blades (however detached) result from the reduction of cores with working faces of small radius, regardless of form and size[5]. During advanced stages of core reduction there is a general tendency for blades to become narrower and more delicate as cores get smaller. In general, narrow blades are not consistently produced from wide cores, and wide blades cannot be produced from narrow cores. With regard to length, few cores produce blades of similar length during their reduction sequence; later blades usually tend to be shorter than earlier blades detached from the same core, once that core has begun producing its intended blades. The same core can produce both large blades and small microblades, depending on its extent of reduction.

Thus, it seems advisable to avoid definitions based on metric attributes altogether, and instead to use the term "microblade" to refer to the products of core reduction that emphasized the production of small (generally short and generally narrow) pressure blades. The term "microblade core" thus

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1 Pelegrin (1988) discussed the production of blades of various sizes, including small microblades, based on his experimental research. Ohnuma (1993) reported his experiments to determine the manner in which microblades were produced.

2 The literature on microblade technology is best described as confused. Yerkes (1994: 111) asserted that "the term *microblade* should be reserved for the blanks *struck* [emphasis added] from the wedge-shaped cores associated with the Paleo-Arctic and Arctic Small Tool traditions of northwestern North America and northeast Asia ... . *Pressure flaking* [emphasis added] techniques seem to have been used to remove these diminutive microblades from the bifacial, wedge-shaped cores ..." The literature contains frequent references to blades having been struck, by pressure, from striking platforms. Marks (1968) discussed "microblades" in the Late Paleolithic Halfan industry of Nubia (*c.* 19,000 B.P.). These appear instead to be small decortication flakes and percussion bladelets detached from unstandardized cores formed from small, sectioned, stream-deposited pebbles. The artifacts in question do not, therefore, meet the definition of microblades as used in this paper.

3 *E.g.*, REDMAN 1982. Authors who favor the idea that microblades were produced in prehistory by indirect percussion have never demonstrated that the strategy is practical or that it consistently produces straight blades, especially from very small cores. Most such writers offer no indication that they have experimented to assess the process of microblade production, and the feasibility of their claims is thus difficult to assess. Indirect percussion offers far less control over the morphology of the finished product than is possible by simple pressure detachment. It is unlikely that small bullet-shaped microblade cores could be immobilized for successful reduction by indirect percussion, or that such a procedure would consistently yield high-quality blades. Years of work have indicated that highly regular microblades can be produced very simply and consistently by pressure, and only by pressure. It is not my purpose in this discussion to be unduly critical of other authors, but these examples illustrate the misunderstanding by archaeologists of many aspects of microblade technology.

4 Pullar (1990: 106) even claimed that microblades are "always less than 3cm long." Clearly there is need for a reasoned consensus on these matters, and one based more on technology than on simple measurements.

5 Or, more correctly, of small radius at the specific locus of blade detachment.

denotes any small nucleus from which microblades were detached by pressure, regardless of its form. The term "bladelet" can then be restricted to characterize any small percussion blade. Note, however, that not all authors equate microblades strictly with pressure reduction (OHNUMA 1993: 160). Nor do they all agree that the term "bladelet" should be used to designate only small percussion blades.

Archaeological Background

Pressure-blade technology marks one of the great innovations in the development of lithic technology (INIZAN 1985). Bullet-shaped microblade cores, a form of pressure-blade cores, appeared in the Near East in proto-Neolithic or earliest Neolithic contexts. The cores and microblades detached from them are common artifacts in Pre-Pottery Neolithic (PPN) and early Pottery Neolithic (PN) contexts (*c.* 9,000 to 7,500 B.P.)[1] in some parts of the Near East, but are notably lacking in others dating to the same periods. The cores were recovered in large numbers in excavations on the

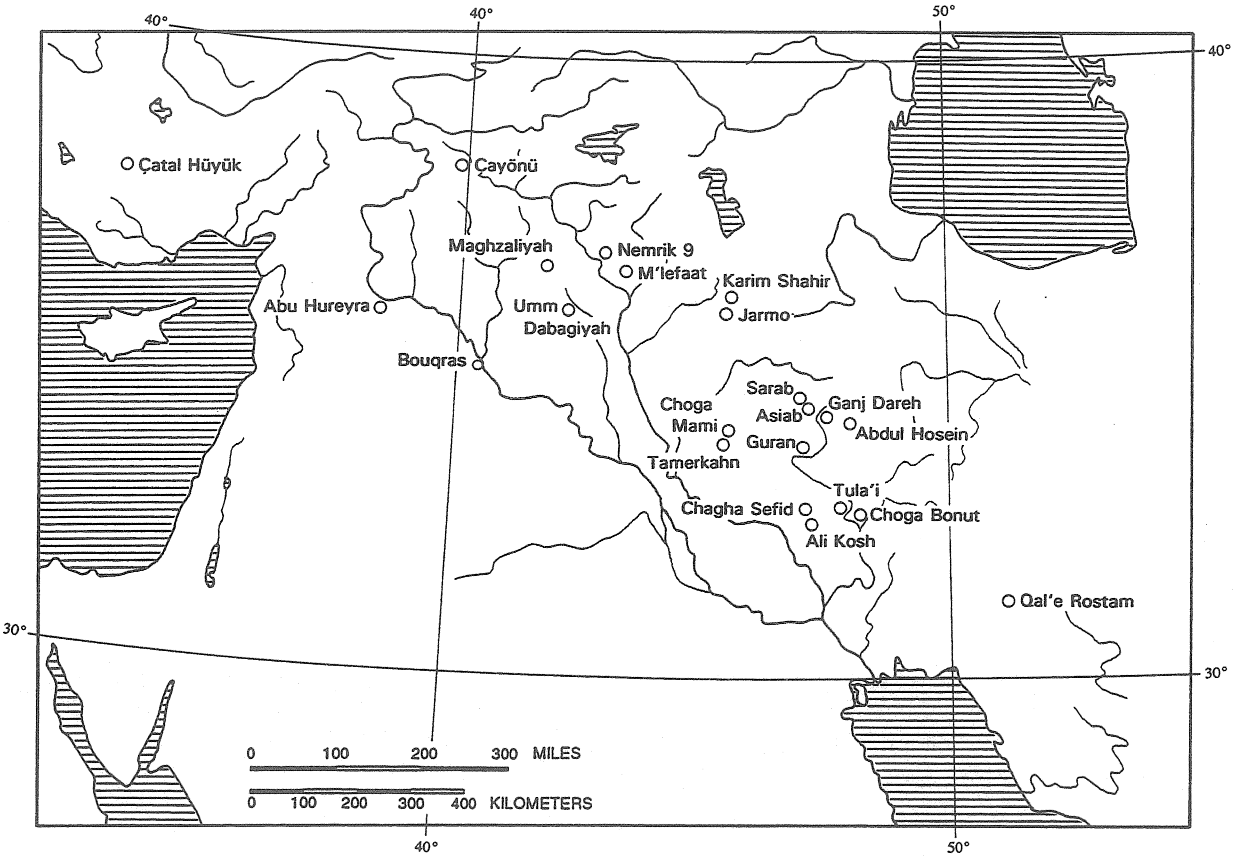

Fig. 1. Map showing locations of sites at which bullet-shaped cores have been reported in contexts ranging from Proto-Neolithic through Pottery Neolithic in the Near East. Such cores are essentially lacking south of the Euphrates River.

Deh Luran Plain of lowland northwest Iran. The sites of Ali Kosh and Chagha Sefid, in particular, produced large numbers of bullet-shaped cores (HOLE *et al.* 1969, HOLE 1977). Elsewhere in Iran, the site of Abdul Hosein yielded a large number (PULLAR 1990), and they were found at Asiab, Choga Bonut, and Tula'i (HOLE 1994), Qal'e Rostam (GEBEL 1994), Ganj Dareh (SMITH 1968), Guran (MORTENSEN 1963), and Sarab (HOLE 1961, 1994). They also were found at Kuhbanan in east-central Iran (HUCKRIEDE 1978). Bullet-shaped cores are characteristic of certain sites in Afghanistan[2], and occur eastward into Pakistan[3], and northward into Central Asia, and beyond.

[1] HOLE 1987, 1994. The whole problem of chronology in this period is unresolved due to a large number of apparently inconsistent radiocarbon age determinations.

[2] *E.g.*, at Kara Kamar (DAVIS 1978), Darrā Kalon (MUSSI 1979), and Aq Kupruk II (DUPREE and DAVIS 1972, DAVIS 1978).

[3] *E.g.*, Pre-Pottery Neolithic site MR3, Pottery Neolithic - Chalcolithic site MR4 (both Mehrgarh locality) (LECHEVALLIER and QUIVRON 1981, LECHEVALLIER 1984, *cf.* INIZAN and LECHEVALLIER 1985, LECHEVALLIER

Bullet-shaped cores are less frequently reported in sites farther to the northwest along the Zagros Mountains and through the upper Tigris-Euphrates basin of northern Iraq and southern Turkey. In Iraq, bullet-shaped microblade cores were reported at Karim Shahir (HOWE 1983), Maghzaliyah (BADER 1989, 1993), Jarmo (BRAIDWOOD and HOWE 1960, HOLE 1983), Choga Mami (MORTENSEN 1973), M'lefaat (DITTEMORE 1983, KOZŁOWSKI 1993), Tamerkhan (OATES 1968), and Umm Dabagiyah (MORTENSEN 1983). In Anatolia, they were found at Çayönü (REDMAN 1982), and at Çatal Hüyük (BIALOR 1962) far to the west, and they occur in the Crimea (KOZŁOWSKI 1989). A few have been reported from northern Syria, as for example at Abu Hureyra (MOORE 1975) and Bouqras (DE CONTENSEN 1985), but they seem not to be common there (Fig. 1)[1]. Most of these sites also produced microblade cores of less standardized forms that often comprised the majority of the microblade cores recovered. Some proto-Neolithic sites such as Karim Shahir and PPN sites such as Nemrik 9 (KOZŁOWSKI and SZYMCZAK 1990) yielded microblade cores mostly of less standardized form, that is, generally conical but with one unworked side opposite that which yielded the straight blades. In most of these cases the dating ranges from about 9,000 B.P., or somewhat earlier, to 7,500 B.P., or somewhat later. In a few cases, such as Karim Shahir (which is undated), bullet-shaped cores almost certainly are earlier, and the published records for one of the Afghanistan sites suggest a much earlier dating that probably should be questioned as it seems very early for pressure-blade technology in that area[2]. Bullet-shaped cores also carry through into, or reappear in, later times at various sites in Mesopotamia (CROWFOOT PAYNE 1980, INIZAN 1985, COQUEUGNIOT 1993).

At sites closer to Anatolian obsidian sources, bullet-shaped cores are often of that material, but otherwise most are of high-quality flint, chert, or jasper. Bullet-shaped cores occur in technological contexts in which larger pressure blades were produced, but in which the production of nearly straight microblades was also encouraged, often as a final strategy for reduction of larger pressure-blade cores (HOLE 1994). In the Near East, the technological affinities of bullet-shaped cores, and of microblades in general, are with central, eastern, and northeastern Asia (INIZAN *et al.* 1992).

For unknown reasons, bullet-shaped microblade cores and pressure blades of any derivation are essentially absent from cultural deposits of similar age in the Levant. Instead, in early Levantine farming villages, blades were produced by direct percussion from opposed-platform, naviform cores (WILKE and QUINTERO 1994, QUINTERO and WILKE 1995), and pressure blades are almost underrepresented. These contrasting solutions to the need to supply blades for tools mark the presence of persistent lithic reduction traditions in the early Neolithic of the Near East.

The Problems

Microblade cores of the Near Eastern Neolithic are of several configurations. In some Iraqi industries especially, cores are of unstandardized form, with blades having been detached from only a portion of the platform perimeter. Sometimes cores are wedge-shaped with blade-detachment scars on a narrow zone at one end only. More standardized forms are conical to bullet-shaped, the result of blade detachment from all faces. Bullet-shaped cores are an extreme form of conical cores. They resulted from highly successful detachment of straight microblades from around the entire platform perimeter, while maintaining core symmetry with little loss of core length due to blade overshot. Blade detachment depended on continued successful exploitation of the core at an angle of ± 90 degrees between the platform and the nearly straight working face. Bullet-shaped cores, particularly long and narrow ones that taper uniformly to a point, therefore represent the discarded byproducts of technically complex strategies of pressure-blade production. Moreover, many bullet-shaped cores, such as those in the assemblage from Chagha Sefid, appear to have reached their final state of exhaustion at generally similar diameters (HOLE 1977: Fig. 74).

For a clear understanding of bullet-shaped cores and microblades, especially aspects of core

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1990); Early Bronze age site of Rahman Dheri (KHAN 1979); Shadi Shadeed, Hoban Shah, and Shelter Site, all of Harappan affiliation (BIAGI and CREMASCHI 1990).

[1] No attempt has been made here to compile a comprehensive listing of sites that have yielded bullet-shaped microblade cores. In fact, such a listing cannot be compiled because of the way blade cores are reported in most of the literature. Often no distinction is made between percussion-blade cores and pressure-blade cores, and sometimes blade cores of any kind are not distinguished from flake cores.

[2] The single published date for the Kuprukian level of Aq Kupruk II is 16,615 ±215 B.P. (DUPREE and DAVIS1972). Apparently based in part on this date, Davis (1978) assigned these Afghan microblade assemblages to the Epipaleolithic, which in most Near Eastern contexts generally includes assemblages dominated by percussion bladelets but not pressure microblades. More dates are needed, particularly on the Kuprukian complex, as it is very important to understanding the origins of pressure-blade technology in Central and South Asia. The single reported date for Kara Kamar Level I, which yielded bullet-shaped microblade cores, is 10,580 ±720 B.P. (COON and RALPH 1955), much closer to the known and inferred age of pressure-blade technology in the Near East.

production and reduction, several problems must be resolved. The problems are as follows:
1. How were bullet-shaped cores configured initially in earlier stages of reduction that eventually led to their final form?
2. How did bullet-shaped cores continue to yield nearly straight blades during reduction?
3. How did bullet-shaped cores acquire their distinctive configuration by the time they were discarded?
4. Why in some ancient industries did bullet-shaped cores enter the archaeological record with approximately similar diameters?

This research suggests that the solution to the first of these problems can only be determined by examination of entire assemblages related to blade-production in specific cultural contexts, and that the solutions to the other problems lie in a common and specific manner by which the cores were immobilized and reduced. Following is a rather detailed discussion of production of microblades from cores that ultimately became bullet-shaped, after which is a brief discussion of the relevance of these findings for understanding Neolithic assemblages.

Replicative Studies of Bullet-Shaped Microblade Cores

Replicative studies were conducted to identify the reduction tactics that led to the ultimate bullet-shaped configuration of many Near Eastern microblade cores, and thereby better understand variability within and among archaeological assemblages. The experiments were guided only by published reports and brief examination of a handful of cores from the Iranian Neolithic. To date, it has not been possible to examine large collections, to compare collections, or to make careful analyses of substantial numbers of bullet-shaped cores. Although general studies of microblade production were conducted for a number of years, the specific work summarized here involved the experimental reduction of more than 100 cores, most of them reduced fully in the round. Yet, the findings should still be considered preliminary and subject to refinement.

This study led to several conclusions about the manner in which bullet-shaped microblade cores were derived in prehistory. The emphasis here is on the Pre-Pottery Neolithic and Pottery Neolithic industries of the Near East, but the research is relevant to understanding bullet-shaped cores wherever they occur. The discussion below considers the initial forms of cores that in advanced stages of reduction became bullet-shaped microblade cores, various core-production strategies that may have affected the configuration of cores and core platforms, and the process of blade production that ultimately led to the formation of bullet-shaped cores. The emphasis is on the final stages of reduction of these small microblade cores during which perhaps 30-40 straight microblades were detached prior to core exhaustion.

Basic Parameters

Experimental cores were preformed by percussion-blade techniques and reduced from a variety of raw materials, especially obsidian, but including also chalcedony, chert, and flint. All of the microcrystalline quartzes were first heat-treated to improve their flaking qualities. Heat treatment was found to be highly advantageous for all but one of the microcrystalline quartzes used, the exception being a superb nodular flint from highland Jordan, but even that material was much more workable after heat treatment.

Whether heat treatment was regularly used in preparing microblade cores of microcrystalline quartzes for reduction in prehistory remains to be determined, and its use may have varied from one context to another. However, it would have made blade detachment much easier and would have reduced wear and tear on pressure tools, as well as on the hands of the knappers. Heat treatment enables the production of blades that have sharper, but less durable, cutting edges (RICK and CHAPPELL 1983: 74). That durability alone was not always a requisite quality of microblades is indicated by use of obsidian in many such industries from the Near East to northeast Asia and northwest America. Moreover, the largest-scale pressure-blade industries of the ancient world were those of Mexico and Central America, which were based exclusively on obsidian.

Several different techniques were employed to immobilize experimental cores during blade detachment. Cores were hand-held on a pad of leather, immobilized in hand-held vices or clamps, and immobilized on hand-held slotted blocks of wood and bone. Blades were detached using pressure tools of copper and antler.

After much experimentation, it was determined that bullet-shaped microblade cores were effectively reduced using a simple hand-held device that enabled several technological constraints to be accommodated at the same time. These constraints are:
• Cores must be immobilized to prevent movement and consequent change in the direction of loaded force during blade detachment. If such movement is not controlled, detachment of blades the full length of the core is not likely to occur. The detached blades will be short and they will end in feather

terminations, thus altering the contours of the face of the core, or they will be aborted by step terminations or hinge terminations that must then be removed from the core face.
• Cores must be supported at their distal ends, both to direct the detaching force to the end of the core and to stop the detaching fracture at that point. Thus, support encourages the production of straighter blades that run the full length of the core without significant overshot. If support is not provided distally, it is likely that detached blades will either significantly overshoot (or plunge)[1], and clip off the end of the core, especially on cores that are more pointed, or they will terminate short of the distal end of the core. Either occurrence adversely alters the longitudinal contours of the face of the core. Once the working face of the core becomes curved longitudinally, straight blades cannot be detached until the working face is again straightened.
• Cores must be supported distally in a manner that leaves room for blades to detach freely from the distal end of the core. If sufficient space is not provided for detachment, blades will be compressed, bend, and break.
• Cores must be supported in a manner that allows blades to detach freely away from the working face of the core. If blades cannot detach freely from the working face, they break.
• Cores must be supported in a manner that accomplishes all of the above, and that also enables the core to be rotated and maintained easily.

A common solution to all of these concerns proved to be a small and simple core-holding device made from bone. Use of the device also accounts for the final regularized bullet-shaped core form of small diameter that is so common in some assemblages, such as that from Chagha Sefid.

Core Immobilization and Support

In the experiments reported here, conical-to-cylindrical microblade cores were immobilized effectively for blade detachment by use of a very simple, static, holding device: a slotted block made of bone (Pl. 1). Immobilizing and supporting the core in this way generally followed the technique reported by PELEGRIN (1988), who first employed a slotted wooden block (he also suggested use of bone and antler) for microblade detachment in the hand[2]. The technique used in this study is very similar to that described by Pelegrin in that the greater the force loaded onto the core platform to detach a blade, the more securely the core is immobilized. Attention in this study was focused more specifically on details of supporting the core during blade detachment, isolating and preparing blade platforms, detachment of nearly straight and unbroken blades, and maintaining the core throughout its reduction. Because very few researchers actually make blades, specific details of the process generally are not easily found in literature.

While a suitable block can be cut from any of several bones of various large mammals, wild or domesticated, the block used in this work was made from a metapodial of an elk (*Cervus elaphus*, equivalent to the red deer of the Old World). Use of the block enables all of the constraints discussed above to be accommodated at once.

Best results are achieved with the block held in the palm of one hand, that hand resting on the lap. The block is oriented with the slot upward and toward the knapper. The core rests on the slot with its distal end firmly supported, and is held in place lightly with the fingers. With a pressure tool held in the other hand, force is loaded distally and downward (outward from the core face) to detach blades. Blades are detached into the slot and pass freely down the hollow center channel of the bone block (Pl. 1, lower). I found that the channel must be smooth to prevent blades from catching and breaking. Use of wooden blocks of similar design did not yield very satisfactory results; the distal ends of detached blades became imbedded in the wood, which led to compression and breakage.

The slotted block is easy to use and has no moving parts. Core immobilization is accomplished by the force applied to detach blades. The greater the applied force, the more firmly the core is immobilized. The device is simple and effective.

For consistent, successful detachment of straight microblades, bullet-shaped cores must have their distal ends truncated (Pl. 2)[3]. The truncated end of the core rests on the base of the slot in the

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1 In blademaking, overshot is most likely to occur when the blade being detached follows a pronounced ridge down the face of the core.

2 Chris Bergman (pers. comm. 1983) shared with me his method of microblade detachment, which he says is similar to that used by Pelegrin. Tunnell (1977) attempted to replicate Folsom points (North American Paleoindian) using a similar device of antler and attempting to detach the channel flakes by indirect percussion. After completion of his study, Tunnell learned that Warren (1968) had already conducted similar experiments using similar equipment. James Woods (pers. comm. 1994) informed me that a slotted bone block similar to that used in this study was found among the flintworking tools of the late Don Crabtree (died 1980), but its significance was not understood at the time. So, the concept of supporting a workpiece on a slotted block of whatever material has been employed by researchers for a long time.

3 It seems likely that Pullar (1990: 110, Fig. 50) confused truncated ends of microblade cores with opposed platforms. None of the examples she illustrated appear to have opposed platforms.

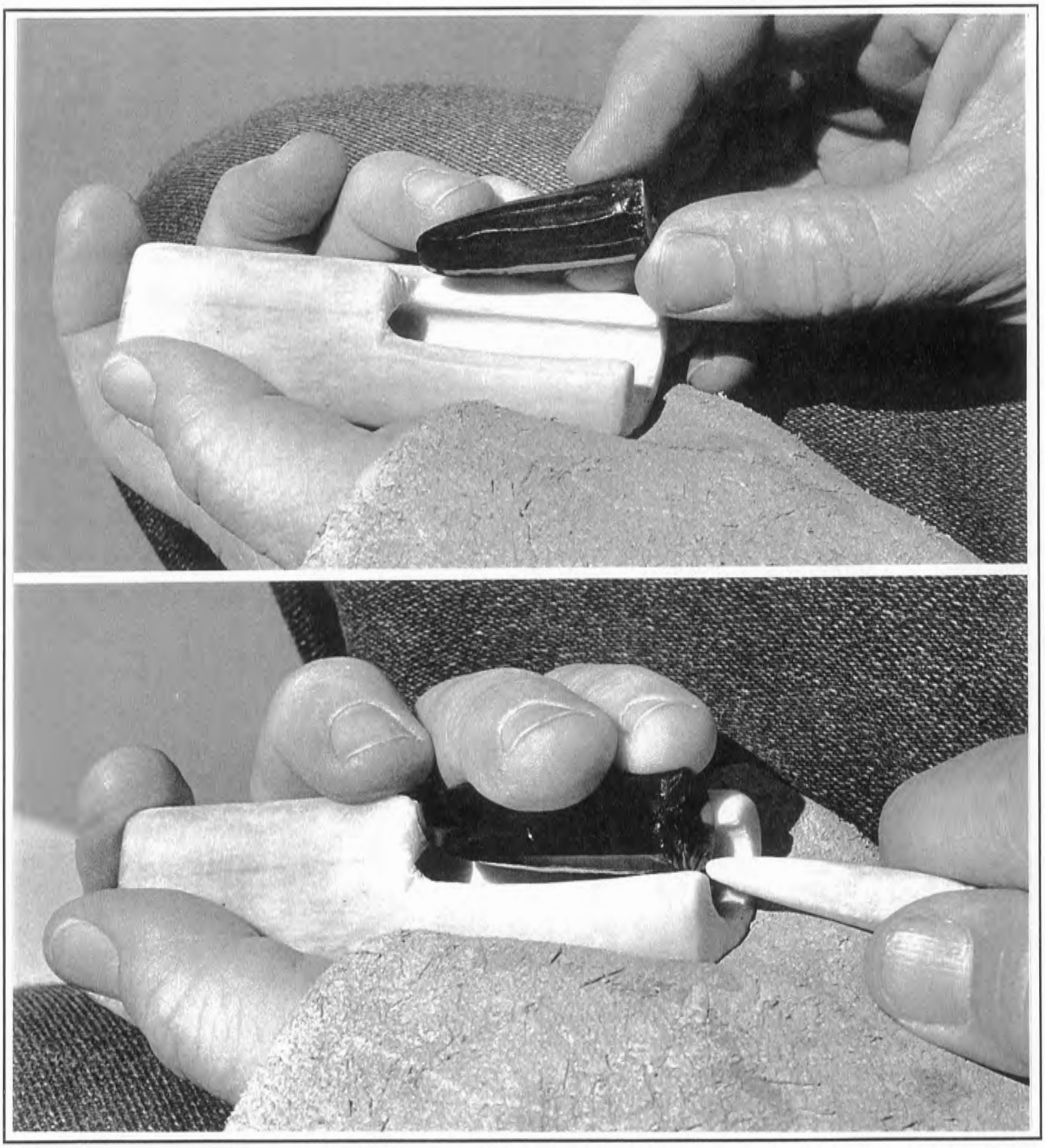

Plate 1. Use of a slotted block made of elk (= red deer, *Cervus elaphus*) metapodial bone. The distal end of the core is placed against the squared end of the slot during reduction. The detached blade drops into the slot and passes down the channel and out the other end of the block.

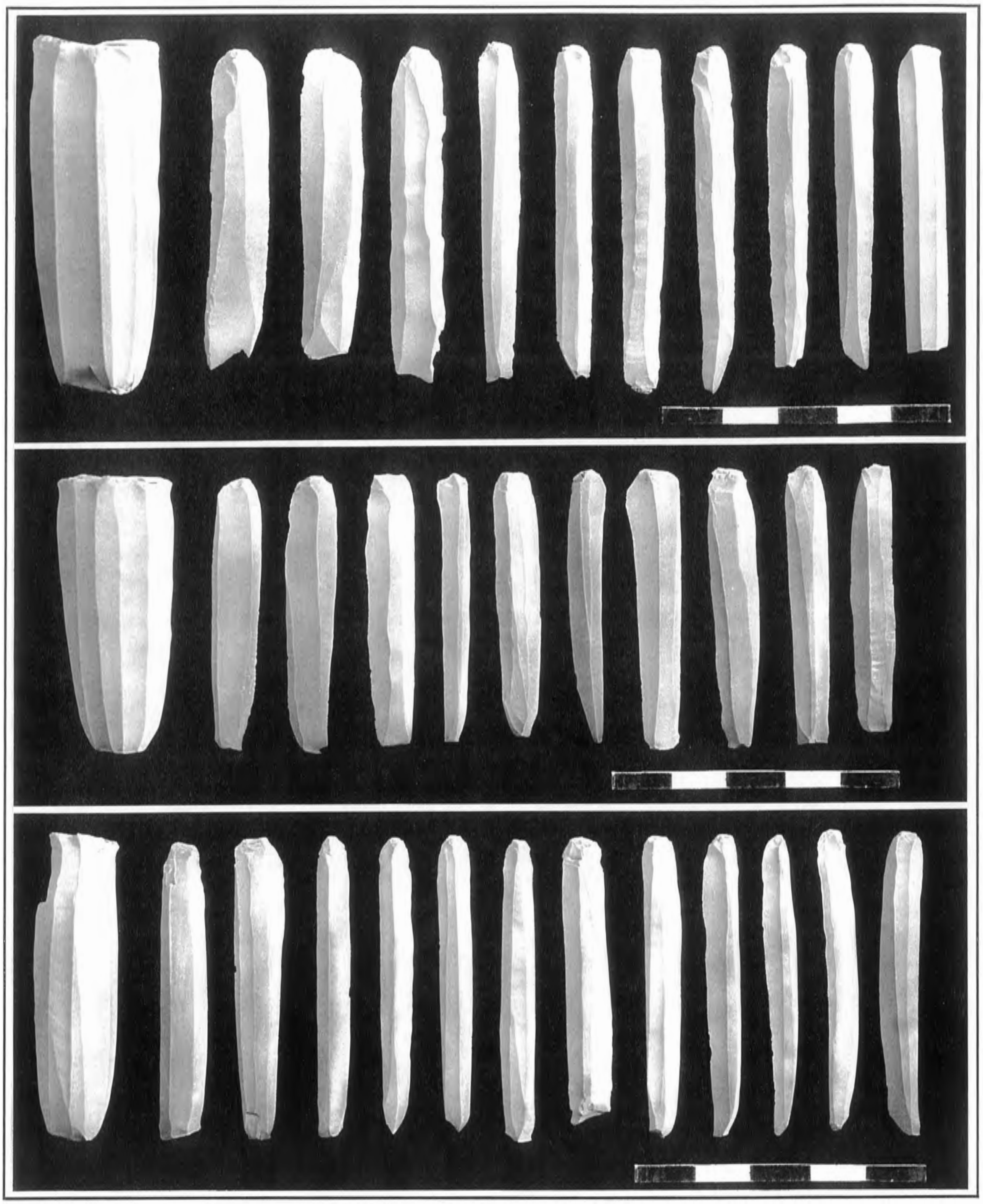

Plate 2. Experimental bullet-shaped cores and selected microblades detached from them while immobilized and supported on a slotted block of bone. *Upper and center*: The cores are still blunt and producing blades; about 15 can still be produced from each. The upper core is still cortical at the distal end. *Lower*: Several blades have failed and the core is starting to lose proper configuration due to lack of proper maintenance. All obsidian, coated with ammonium chloride vapor.

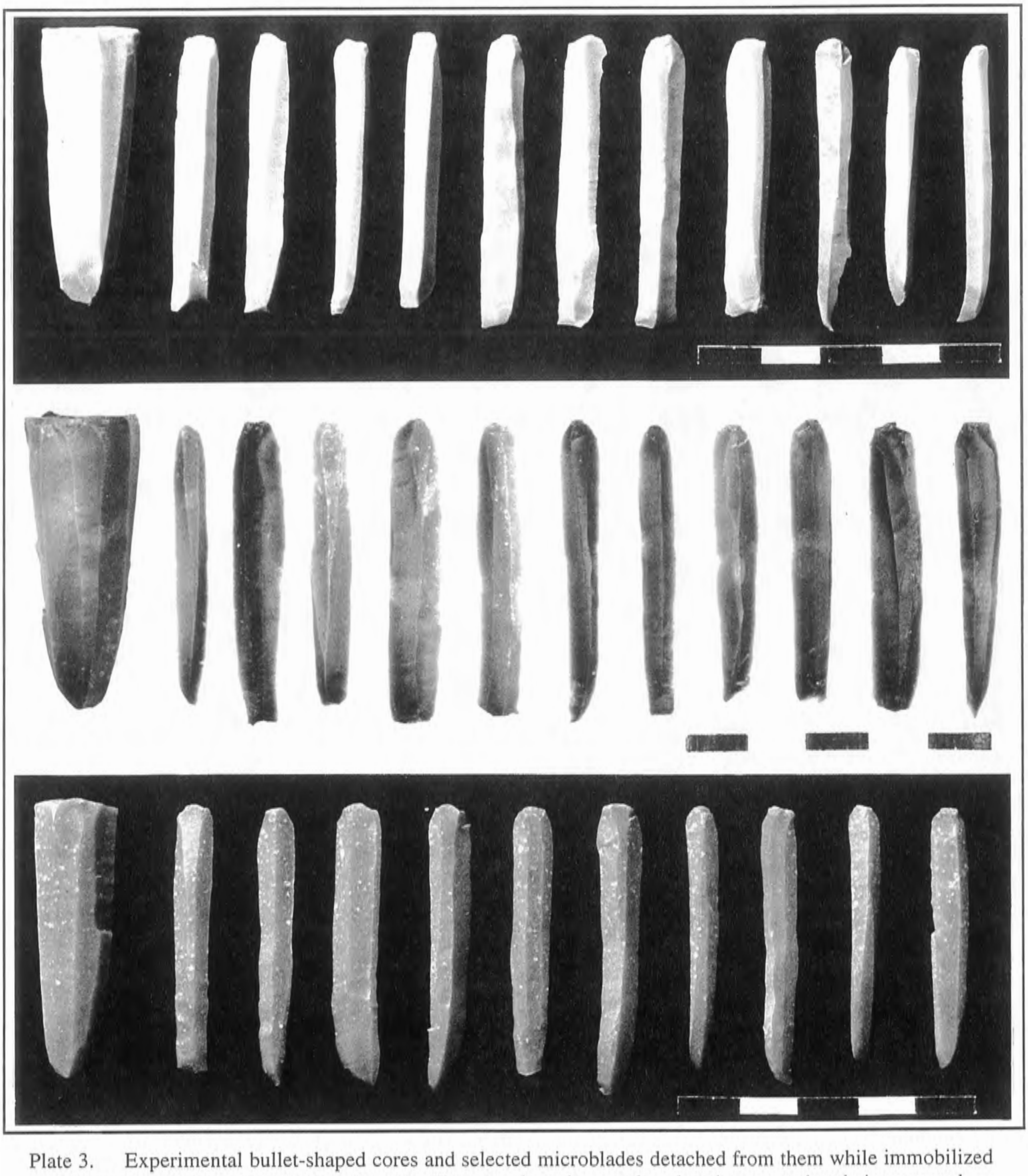

Plate 3. Experimental bullet-shaped cores and selected microblades detached from them while immobilized and supported on a slotted block of bone. The cores have been reduced to the extent that their truncated distal ends have been eliminated, and they are essentially exhausted. Each could be revived by retruncating the distal end. Hinge or step terminations on the lower two could be removed by detaching short blades from the distal ends. Heat-treated flint.

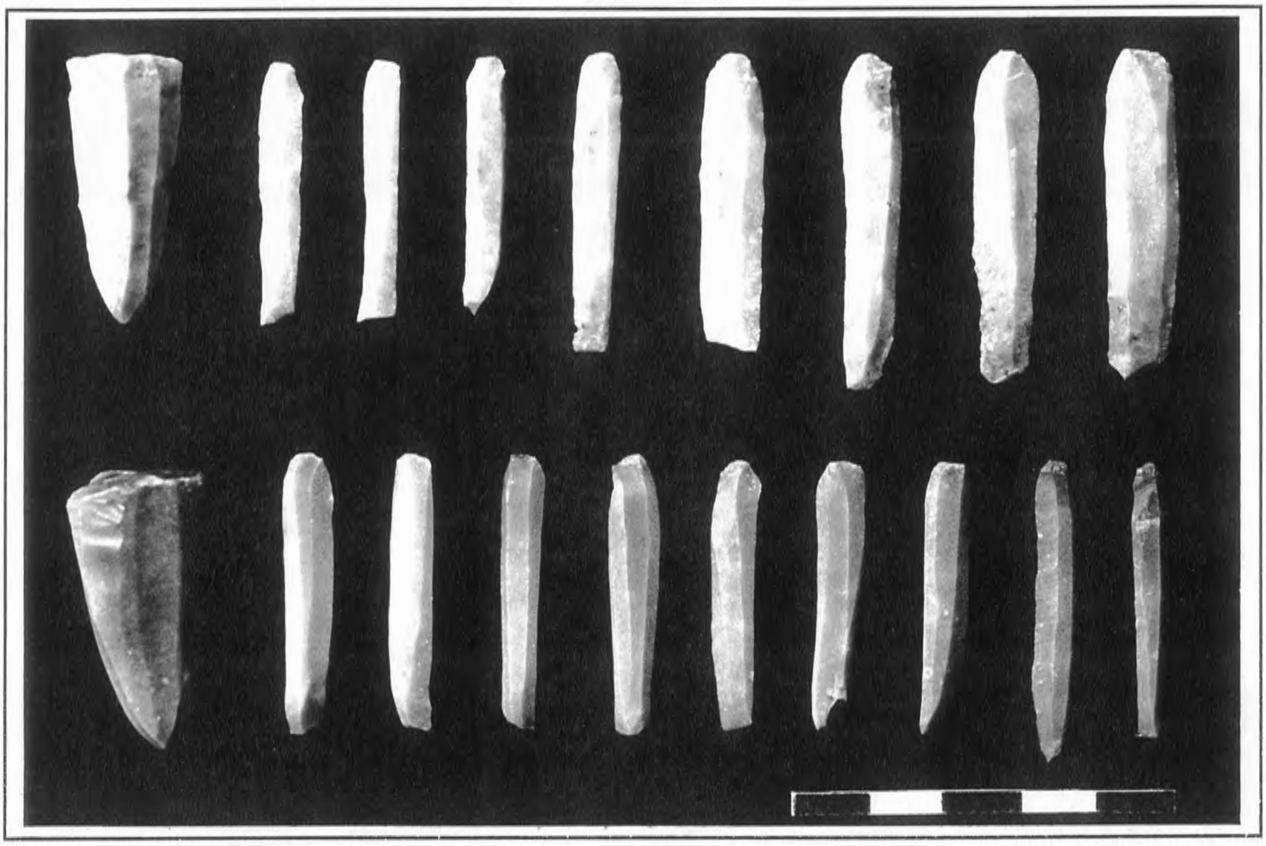

Plate 4. Experimental cores and selected blades detached from them. Cores are generally conical and exhausted due to repeated overshot, a result of improper distal support during blade detachment. Continued attempts at blade detachment using a slotted block for support will probably result in continued overshot and blade breakage. Heat-treated chalcedony.

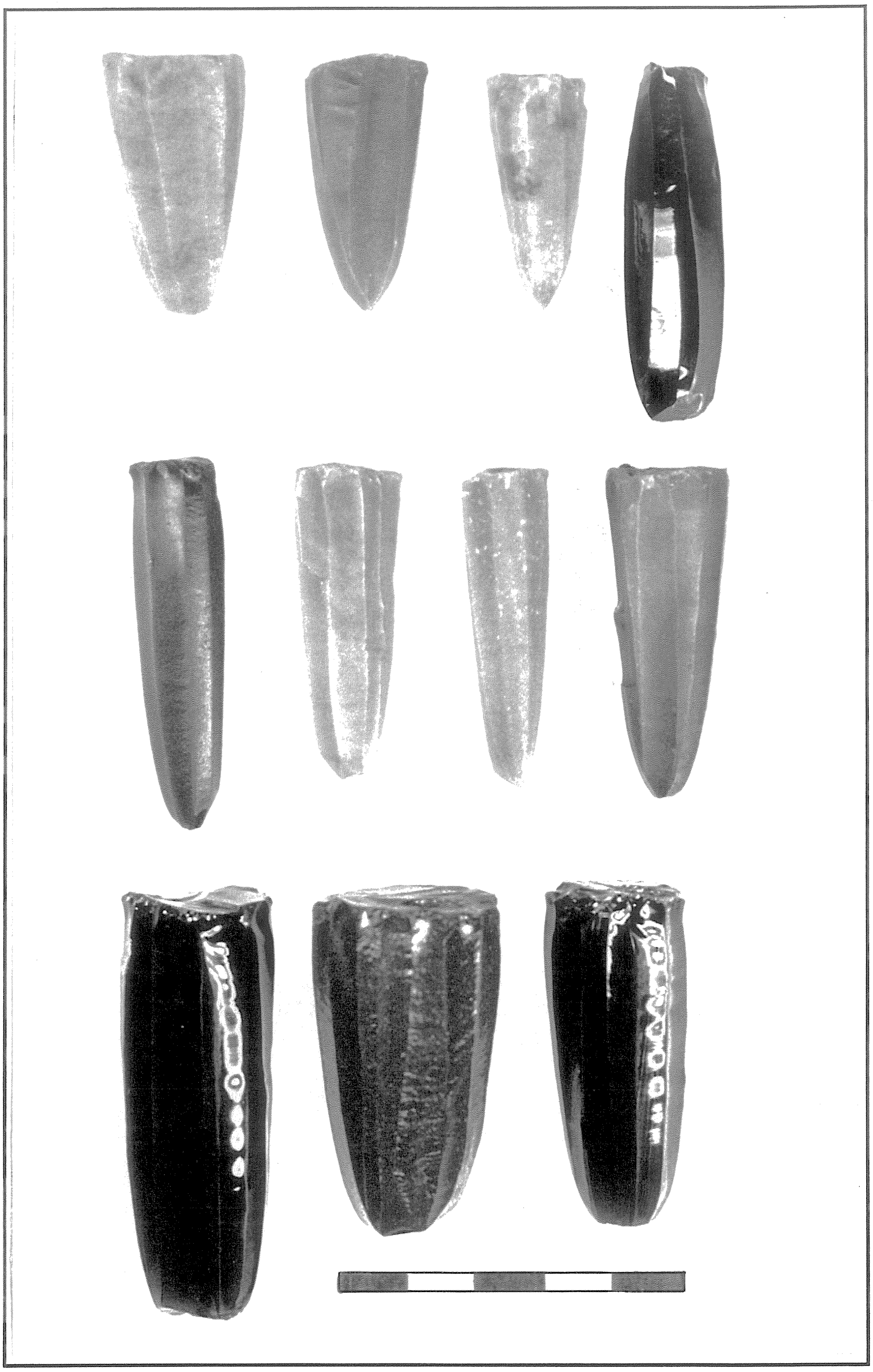

Plate 5. Technological characteristics of conical and bullet-shaped cores.
Upper: Cores that are essentially exhausted due to successive overshot and failure to maintain a truncated distal end (left three specimens), and failure to maintain an effective platform (right specimen). *Center*: Exhausted cores, the distal ends of which have become pointed. Although the diameters of the left three are too small to permit further immobilization and support on the slotted block used in this study, all could still be retruncated to permit support necessary for detachment of additional unbroken blades using a block with a narrower slot. *Lower*: Functioning cores that still have truncated distal ends and sufficient diameter to permit further reduction.

block. Distal core support is provided adjacent to the point where the intended blade will be released. Successive blade detachments reduce the area of the truncation and hence the space available for distal core support.

It is possible to detach blades from cores immobilized in the hand but not supported distally, but it becomes increasingly more difficult as the core diameter becomes smaller. The process becomes one of constantly trying to apply just the right amount of force distally while increasing the force outward from the face of the core. It is difficult to keep the core under control when detaching blades this way, as there is constant danger of significant overshot or of detaching blades shorter than the length of the core. Caution to avoid overshot often results in detachment of short blades, which leads to development of cores the diameters of which are smaller at the platform than they are distally (so-called "torpedo-shaped" cores) or midway ("spindle-shaped" cores). Some such cores can, however, be reversed, truncated near the (former) distal end, and further reduced.

Detachment of Microblades

In the experiments reported here, greatest success at detaching microblades was achieved by careful isolation and preparation of individual blade platforms over one or two straight arrises on the core face. Preparation included removal of the negative bulbs from previous blade detachments, and lightly abrading the intended blade platform. Pressure was then applied to the prepared platform to detach the blade. Selection of the specific locus for blade detachment and the thickness of the blade platform are important for configuring the intended blades. These choices determine whether the blades will be wide or narrow, whether they will be triangular or trapezoidal in cross section, and whether they will be thick or thin.

Care must be taken during blade detachment to ensure that the core is positioned on the block so that both distal support is secure and that space is provided for the intended blade to detach freely. Blades are detached by slowly loading force toward the distal end of the core while gradually increasing force outward from the working face. A distinctly audible "ping" results from vibration of the detached blade at the instant it is released. When properly detached from correctly configured and maintained cores, microblades are almost straight, and usually they have very small, sharply curved, overshot terminations (Pls. 2-3)[1]. The blades also are more parallel-sided than those typically detached from wedge-shaped cores; such cores in effect are "pointed" during their entire reduction process[2]. Only at the very end of the reduction of bullet-shaped cores are blades likely to be produced consistently with pointed distal ends, and then only with very careful work.

Directing too much force toward the distal end of the core and too little force outward from its working face results in thicker blades and more extreme overshot. Directing too little force toward the distal end of the core and too much force outward from its working face results in short blades with feather terminations. Successive repetition of either of these alternatives can have profound results; these actions can be very useful for achieving a more favorable core configuration, or they can lead to loss of control in core management. In the latter case, corrective measures must be used to straighten and maintain the face of the core (see below).

It is important to make sure the force loaded onto the core to detach a blade is directed straight toward the distal end of the core. If force is loaded at a slight angle to the distal end, the resulting blade, and the ridges it leaves on the face of the core, will be slightly twisted or helical. Such blades are difficult to use as inserts in composite tools, and subsequent blades detached in the same area of the core tend also to be twisted.

In the replications discussed here, it was not uncommon to produce 30 or more parallel-sided, trapezoidal blades (as well as many other less regular ones) from a single percussion-preformed core, depending on the core's initial diameter (mine averaged about 2.5-3cm in diameter). Successful blade production continues until reduced core diameter leads to loss of the truncated support area at the distal end of the core, in effect, until the core becomes exhausted and the distinctive bullet shape emerges (Pls. 2-3). If the core retains sufficient length and diameter for further blade detachment, it can be rejuvenated through pressure flaking (or even percussion flaking) to retruncate the distal end.

Many microblade cores from the Iranian Neolithic are more broadly conical and not really bullet-shaped[3]. Conical cores of this form cannot be truncated easily when they become pointed. It is likely that their form is due to successive overshot. Perhaps they also had been reduced to the extent that they yielded blades shorter than were desired (Pl. 4).

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1 Sometimes it is necessary to detach blades that end short of the distal end of the core in order to straighten the working face. Such blades of course have feather terminations and do not overshoot.

2 Although they can be said to be "pointed," wedge-shaped cores still offer room for support on the distal margin immediately behind the working face, and therefore they also yield straight microblades.

3 *E.g.*, some specimens identified as "blade cores, variety *a*" (HOLE 1977: Fig. 75, lower row, right two examples).

Blade Breakage

Several factors cause blades to break upon detachment, but broken blades are not necessarily worthless. Indeed, wherever microblades were made with the intention of using them as insets in composite tools, many or most of them may have been snapped at one or both ends to obtain the straight mid-section for use. The most common cause of blade breakage during detachment is compression and bending of the blade due to inadequate space having been provided for its release at the distal end of the core.

Breakage also sometimes occurs when a blade is too thin to withstand vibration upon detachment, or more often from impact against the wall of the central channel of the slotted block. Some materials, including a glassy "ignimbrite" proved too brittle to withstand consistently the shock of detachment on a slotted bone block. It was determined, however, that draping a strip of soft leather down the central channel of the block to cushion the impact of the detached blades could almost eliminate blade breakage[1]. Ironically, in one core reduction, using a very tough, good-quality flint that had been inadequately heat-treated, all but one of the first 20 or 25 blades broke. But after cushioning the channel of the block in the manner just mentioned, about 20 more blades were detached with only one or two breaking. These successful blades included some of the most delicate examples with trapezoidal cross sections produced in the entire study.

Finally, if the intended blade is too straight, it will break. Blades must have a slight curvature or they will fail part way down the face of the core in a hinge termination or a step termination. Clearly, blade breakage in archaeological contexts may be the result of intentional snapping or of production breaks, and these causes are not always readily distinguishable.

Faceted Core Platforms

Faceted core platforms may result from initial core preparation. If cores are prepared from small, irregular pieces of raw material, creation of platforms by faceting is an effective strategy that helps conserve raw material, yielding cores of the largest possible size and the best configuration.

During the work reported here, in earlier stages of reduction many cores with single-facet platforms were easily reduced, but those same cores were more easily reduced in their later stages by faceting their platforms. As the angle between the platform and the working face of bullet-shaped cores approaches 90 degrees, faceting of core platforms becomes an effective strategy for maintaining the core. Effective working angles for detaching individual blades are achieved on a minute and localized scale by removing small faceting flakes to create negative bulbs that serve as platforms for blade removal. Without faceting to prepare individual blade platforms on parallel-sided cores, the negative bulbs that result from blade detachment may become prominent. Removal of these negatives results in rapid loss of platform area, while at the same time it increases the longitudinal curvature of the working face of the core. The core becomes spindle-shaped, can no longer produce straight blades, and ceases to function (Pl. 5, upper row, right). Cores of such form are present in the archaeological assemblages from Ali Kosh and Chagha Sefid (HOLE *et al.* 1969: Fig. 33, HOLE 1977: Fig. 74). Thus, in my experiments, successful reduction of parallel-sided cores generally led to, and was made easier by, fully faceted core platforms[2].

After completion of most of the research reported here, I had an opportunity to examine briefly a few of the bullet-shaped microblade cores from Ali Kosh. Some of these, including classic examples of bullet-shaped cores with very small diameters (*c.* 4-5mm) and with nearly parallel sides, have single-facet platforms. Clearly, some very symmetrical and parallel-sided cores were successfully reduced without faceting of platforms, or via use of platform-rejuvenation spalls.

Faceting also is an effective strategy for maintaining the orientation of the plane of the platform with respect to the longitudinal axis of the core. Without invoking such corrective measures, the working angle between the platform and the working face on one side of the core becomes obtuse, making blade detachment more difficult in that area[3].

Finally, blade production, as carried out in the studies reported here, occasionally leads to spontaneous detachment of platform-faceting flakes. This occurs when pressure is exerted on the margin of the core platform by the core-holding device during blade detachment, especially if negative bulbs from previous blade removals have not been eliminated.

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[1] Pelegrin (1988) used a small piece of fur to cushion the impact of microblades during detachment on his grooved block.

[2] In advanced stages of reduction, core platforms can become so reduced that they occupy only a portion of a faceting flake scar, and thus become "single-faceted."

[3] Microblades can be detached at somewhat obtuse angles to the working face of the core, as shown by barrel-shaped (PULLAR 1990) and torpedo-shaped bullet cores, and by Danish Mesolithic wedge-shaped cores with working faces at obtuse angles to the platform (CALLAHAN 1985).

Maintaining the Working Face of the Core

As stressed elsewhere, successful blade production and core reduction are merely different aspects of the same process; this process is possible only by skillful management and maintenance of the working face of the core (WILKE and QUINTERO 1994, QUINTERO and WILKE 1995). The distal ends of bullet-shaped cores must be maintained for successful blade detachment, and maintaining a truncation for support adjacent to the point of blade detachment was discussed above. In addition, when necessary, the core can be reoriented end-for-end on the block and core-maintenance blades can be pressed from the truncated distal end. Detachment of such blades is sometimes necessary to eliminate step terminations or hinge terminations from failed blade-removal attempts. Pressing blades from the distal end of the core can also serve to restore proper contours on the working face. Support at the platform end is then necessary to minimize overshot and consequent damage at that area if such maintenance blades run the full length of the core face. Finally, detachment of blades from the distal end of the core can correct symmetry if the plane of the platform is no longer perpendicular to the longitudinal axis of the core. Recognizing this corrective strategy in archaeological contexts forestalls misinterpretation of single-platform cores as true opposed-platform cores[1]. However, a more effective strategy to correct such symmetry problems is by removing faceting flakes from the portion of the core platform that is at the most acute angle to the working face, as discussed above.

Sometimes it is necessary to resort to alternate pressure flaking ("cresting") to reduce mass and regain an effective contour on the working face of a partially reduced core. The effect is similar to that of "stitch flaking" on the handles of certain Neolithic Scandinavian daggers. Such cresting is then removed through subsequent blade detachment and would readily be identifiable archaeologically as a small, partially crested blade. Step terminations and hinge terminations from unsuccessful blade detachment can also sometimes be engaged directly with the pressure tool, with the result that the failed blade-detachment fracture can be completed. If the failure was due to a step termination that can merely be continued, no negative bulb will appear in the face of the core. However, if the failed fracture must be reinitiated[2], a negative bulb will appear on the face of the core, and the resulting topographical irregularity will be reflected in blades subsequently detached from that area of the core face.

Core Exhaustion

Cores become exhausted for several reasons (Pls. 4-5). A core can be said to be exhausted when it becomes pointed (bullet-shaped), making it difficult to detach blades without breaking them. As noted above, if the core is still of sufficient diameter that it can be immobilized for further reduction, and of sufficient length that it can produce acceptable blades, it can be retruncated, and thereby revived. If the core cannot be revived, it is fully exhausted or dead. As noted earlier, small, conical, exhausted cores result from successive overshot blades that destroy both core configuration and core length (Pl. 4). Incorrect technique can lead to general loss of core geometry, including such things as collapsed blade platforms, incomplete blade removals, and loss of straightness of the core face. Full core exhaustion occurs when the core can no longer be immobilized and supported successfully for blade detachment. Core diameter becomes so small that the core drops into the slot of the holding device. The dimensions of the device thus determine the minimum diameter to which cores can be reduced. Published illustrations of archaeological cores suggest that they may be visually grouped into populations of fairly consistent diameters[3]. This in turn suggests that diameters of exhausted cores reflect the effective minimum working limits of simple core-immobilization devices such as slotted blocks.

Antecedent Core Forms and Their Implications

By themselves, bullet-shaped microblade cores may reveal few clues to their earlier forms. Analysis of the entire assemblages in which such cores occur can, however, reveal their earlier reduction histories. There are several possibilities.

Small Nodules and Blocks of Stone

Microblade cores with working faces around their entire perimeters can be preformed from raw

[1] Such reorientation of the core may account for the origin of cylindrical, opposed-platform, microblade cores, as are sometimes reported from Northeast Asia.

[2] See COTTERELL and KAMMINGA 1987 for a discussion of the two types of step terminations.

[3] HOLE 1977: Fig. 74. Unfortunately, Hole is the only Near Eastern researcher to illustrate large numbers of bullet-shaped cores, thus enabling one to make observations about the final discard size, configuration, and range of formal variation of these artifacts.

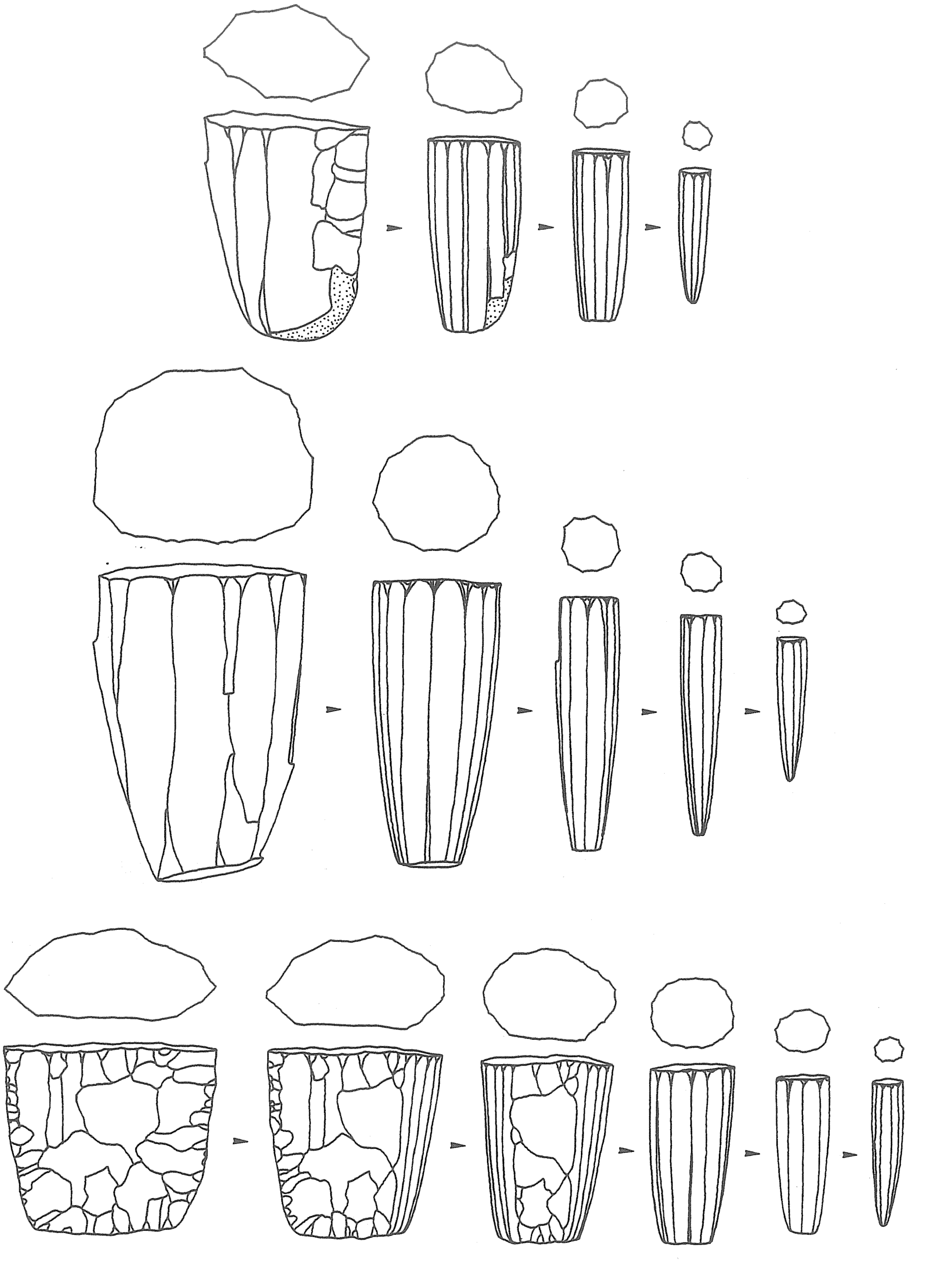

Fig. 2. Derivation of bullet-shaped microblade cores during reduction.
Upper: From reduction of a core preformed by percussion from a small flint nodule, or from an irregular block of raw material. The core is small and produces microblades from the outset. *Center*: From complete reduction of a large pressure-blade core; in this case the core was preformed by percussion-blade techniques from a large block of raw material and initially produced large pressure blades. *Lower*: From reduction of a small pressure-blade core preformed largely by bifacing; microblade production began at two crests. In each case, the bullet-shaped core is the final exhausted nucleus that by itself offers no clues to its earlier form; it only points to pressure-blade production.

material of various configurations, and this process can result in discard assemblages that contain bullet-shaped cores. All of the cores reduced in the experiments reported here were preformed by direct percussion, using percussion-blade techniques, from irregular pieces of raw material or from small pebbles *c.* 6-10cm across[1]. None of the preformed cores had crests at which to begin blade detachment. Blade detachment merely began at favorable arrises on the core face. The experimental reductions document one of several blade-production strategies that, in prehistory, probably created discard assemblages containing bullet-shaped cores.

When microblade cores are preformed from irregular material or from small pebbles, many very irregular pressure blades will be detached in the course of getting the cores properly configured, under control, and producing regular blades. Both cores and blades also may retain patches of cortex (as at Karim Shahir; *cf.* Fig. 2: upper). These assemblage characteristics can be observed archaeologically.

Larger Prismatic-Blade Cores

Bullet-shaped microblade cores may represent extreme reduction of larger pressure-blade cores of various configurations. The occurrence of long (*c.* 5-7cm.), slender, bullet-shaped microblade cores should be anticipated and expected in contexts where larger pressure blades were produced. To put it another way, if long, slender, bullet-shaped microblade cores are present in an assemblage, that assemblage should also contain evidence of the production of larger pressure blades. Indeed, given the ease with which larger pressure-blade cores can be exploited for microblades as they approach exhaustion, it seems likely that, in contexts in which microblades were useful and desired, very few such larger cores would have escaped further reduction. Instead, they would have entered the archaeological record as bullet-shaped cores. The former presence of larger cores would be indicated, however, in assemblages that include larger pressure blades and blade fragments, larger platform spalls, larger crested blades, and larger core-preparation byproducts. Such a situation is documented by the assemblage from Ali Kosh. There, 562 bullet-shaped cores of various configurations were reported along with only 5 "very large [pressure-] blade cores" (HOLE, *et al.* 1969: Fig. 33, 34, Table 6), but with many larger pressure blades and blade fragments. Similar situations apparently are represented at Abdul Hosein (PULLAR 1990) and Kuhbanan (HUCKRIEDE 1961), where illustrated examples of large blades have no counterparts in illustrated examples of the blade cores recovered.

Most instructive in this study was the opportunity to delve briefly into the literature on the obsidian pressure-blade industries of ancient Mexico and Central America. Noteworthy is the presence at some of these New World sites of the same range of large and small obsidian pressure blades and cores that characterize the flint assemblages from some of the Iranian Neolithic sites. The occurrence of exhausted bullet-shaped microblade cores alongside large cores and blades is seen at Tres Zapotes, Veracruz (HESTER *et al.* 1971), and Mayapan, Yucatan (ROVNER 1974), both in Mexico, and at Papalhuapa, Guatemala (GRAHAM and HEIZER 1968), to name only three cases. All indications are that in these Mexican and Central American economies it was prudent to reduce many pressure-blade cores to very small size, duplicating one of the technological avenues for explaining the origin of bullet-shaped microblade cores in Neolithic assemblages (Fig. 2: center).

If small pressure-blade cores result from extreme reduction of larger pressure-blade cores, almost no irregular small pressure blades or percussion blades, especially those with some cortex, will be produced.

Small Cores Begun at More Than One Crest

Preformed pressure-blade cores with two (or rarely three) crests to serve as beginning points for blade detachment can also be reduced to a final bullet-shaped configuration. Nearly a half-century ago, Maringer (1950: 172) published a short but remarkably perceptive description of this process apparent in assemblages from Mongolia (see also HAYASHI 1968: 164-165). He wrote: "In the celt- or tongue-shaped nuclei the removal of the flakes was often symmetrically done from both corners of the platform and, with proceeding utilization, these received more and more a conical form, at first much resembling a wedge, then tapering like an awl ..". The technique was later found to be characteristic of some of the microblade industries of Japan (*e.g.*, HAYASHI 1968, KOBAYASHI 1970), and Tixier (1976: Fig. 1, 1984) illustrated the strategy in the Capsien supérieur pressure-blade industries of Algeria and Tunisia. With regard to the Mongolian cores, Maringer (1950: 172) further wrote that "semi-conical nuclei..., sometimes exhibiting a sharp projection ..., were undoubtedly adaptable for cutting or scraping purposes". It is now apparent that the cores in question were the much-reduced

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[1] At the time pressure reduction began, the form of many experimental cores approximated that of a specimen illustrated by Hole (1977: Fig. 77, lower right), but the experimentally reduced cores were somewhat narrower. Most showed some transverse flake scars due to shaping of one surface (*e.g.*, as at Karim Shahir: HOWE 1983: 90).

remnants of wedge-shaped cores, and the inferred cutting edges present on one side of many of the nearly-round cores were the bifacially formed back margins of the original cores (see also FAIRSERVICE 1993: 140, Fig. 51:h-k). Detachment of these remaining "crests" would have made the cores in question bullet-shaped. Most of the microblade cores in the assemblages Maringer described are wedge-shaped, and many of the bullet-shaped cores in those same assemblages probably were derived in precisely this manner, by detachment of the second crest and of additional microblades at that area of the core platform. Many Near Eastern bullet-shaped microblade cores may have been derived in the same manner. If so, assemblage analysis should reveal that the cores in question were preformed more by bifacial flaking than by percussion-blade techniques. There should also be small crested blades in the assemblage.

In studies of assemblages with large numbers of bullet-shaped microblade cores, one should look for evidence of antecedent core forms that were reduced initially at more than one crest, regardless of the size of the cores involved. Failure of a blade in the center of the working face of the core during detachment or loss of a favorable working angle between the platform and the working face of the core could easily lead to a decision to detach the crested back of the core and initiate blade production there. Such a reduction strategy would often result in cores reduced fully in the round, and these cores likely would enter the archaeological record as bullet-shaped microblade cores (Fig. 2: lower).

This latter situation contrasts clearly with a reduction strategy that involved blade production from only one crest or other initiation point, and that resulted in expended microblade cores reduced around only part of their platform perimeters, including those with only partially worked or cortical backs. Examples of the latter include the unstandardized cores common to the northern portion of the Fertile Crescent, as well as many other areas where microblades were made.

The dynamic and fluid nature of certain strategies of microblade core production and reduction can thus be appreciated.

Discussion

This study suggests strategies and techniques that likely were employed during reduction of bullet-shaped microblade cores in prehistory. It reveals the manner by which such cores could have been exploited to produce straight microblades for use as tools, tool blanks, or parts of composite tools. It accounts for the derivation of the final bullet-shaped configuration of many microblade cores. It shows how ancient assemblages may have come to include so many cores of approximately similar diameters. And it reveals several core-reduction strategies with their respective antecedent forms of pressure-blade cores that upon exhaustion can acquire the distinctive, small, bullet-shaped configuration. Finally, from this study it is apparent that small prismatic microblade cores were reduced to a bullet shape at the time they were discarded, and the "bullet-shape" is their exhausted form. It is a misconception, therefore, to think specifically of producing blades from bullet-shaped microblade cores; rather, truncated, blunt-ended cores were the productive ones.

Because complex processes such as blade production are made possible only within the limits of very narrowly defined strategies and actions, it is probable that prehistoric blade production from bullet-shaped cores occurred in much the same manner as that described here. Slotted blocks of the kind employed in this study have never been reported archaeologically. Nevertheless, it seems likely that similar devices that served the same purpose were used in prehistory for immobilizing and supporting small pressure-blade cores during reduction. Bones suitable for such use were available wherever bullet-shaped cores are found. The appearance in prehistory of regularized pressure-blade cores marks the development of effective means for immobilizing and supporting such cores during reduction. Simple core-immobilization devices of whatever configuration should be sought in excavated assemblages, especially in the grave accompaniments of apparent craftspersons (*e.g.*, INIZAN and LECHEVALLIER 1985). If microblades were detached in prehistory in the manner suggested by this study, straight blades with small but definite overshot terminations, such as those that resulted in the core reductions reported here, should also be evident in archaeological assemblages.[1]

Bullet-shaped microblade cores represent an extreme and highly sophisticated craft of pressure-blade production. However, blades of identical quality and characteristics can be produced more easily and consistently from cores with somewhat acute angles between the platform and working face, and with reduction limited to the most favorable area of the platform, as suggested, for example, by some of the cores from Nemrik 9 in northernmost Iraq (KOZŁOWSKI and SZYMCZAK 1990). Such irregular cores may simply have started out small and irregular, perhaps in some cases due to the

[1] But they may be hard to find. If curved distal ends of microblades were snapped off to use the straight sections for insets in composite tools, such discarded fragments will be small, and careful screening of sediments will be necessary to recover them. Many of the intact microblades recovered archaeologically may have been discarded because their form or curvature rendered them unsatisfactory for use as insets.

nature of the raw material available.

Given the effort required to create small pressure-blade cores and to start them producing blades around their entire perimeters, it seems likely that bullet-shaped microblade cores most often resulted from the complete reduction of larger pressure-blade cores. Reduction of such cores may or may not have begun by removal of more than one crest. By the time such cores started yielding small blades ("microblades") they would already have had their successful form and blade-guiding ridges established. Their expanding working faces would have gradually met to result in cores reduced around their entire perimeters. But the strategies and specific techniques employed during production of larger pressure blades probably would have differed only in scale from those used for detaching microblades[1]. Successful microblade production may have eliminated most antecedent core forms from the archaeological record. The practice would have left instead a record that includes bullet-shaped cores and microblades, but that also includes larger crested blades, larger blade platform-isolation elements, larger blades and blade fragments, larger platform spalls, and larger core-preparation by-products.

Perhaps the presence of large numbers of bullet-shaped microblade cores in assemblages such as those from Chagha Sefid and Ali Kosh may indicate extreme measures to conserve valuable raw material. The material might have been valuable because it was uncommon locally, or because it came from distant places. Whatever its origin, it may have been considered valuable because it was difficult to heat treat effectively, and once proper heat treatment was achieved, the material was worked to its limits (*cf.* INIZAN *et al.* 1992: 665). My own experience suggests that some materials have very narrow tolerances with regard to heat treatment. They are difficult to heat treat effectively under field conditions and are easily ruined by only moderately excessive heating. When successfully heat-treated, I personally value this material most highly and work it until it is completely exhausted. Further, once a core is "working," it makes more sense to continue to reduce it to the limits of acceptable blade size than to abandon it and prepare a new one. Thus, aside from documenting pressure-blade technology, by themselves, large numbers of bullet-shaped cores may be as much indicative of conservation of stone as of cultural traditions.

Suggestions for Neolithic Studies

An aspect of microblade technology that should be considered in analysis of Near Eastern assemblages involves the intended tool use and the constraints of the tool design on microblade production. For example, it is possible that microblades were hafted in series as insets in composite tools, as they were in other areas of the world. Use of microblades as insets in series demands a high degree of regularity in blade production. Blades that are curved or twisted and blades of varying widths and thicknesses do not lend themselves well to being inset in a series. In such industries, many less regular blades would have to be discarded or used for other purposes. Perhaps this situation is indicated at Ali Kosh by a Bus Mordeh-phase "chipping floor" that yielded many bullet-shaped cores and more than 10,000 blades (HOLE 1994). Examination of such collections might clarify the nature of chipping floors, as well as blade requirements for tool production. Careful assemblage analysis emphasizing technological considerations, and including use-wear studies, may provide information on the function, and hence the requisite configuration, of microblades and of the possible composite tools of which they may have been part.

It is important to realize that microblades were pressed, not struck, from the cores that yielded them; neither the blades nor the cores have striking platforms. In seeking the origins of bullet-shaped microblade core industries and other examples of technological innovation, it is necessary to identify the technologies represented by them. Small bladelet cores that were reduced by percussion, as in the Near Eastern Epipaleolithic and succeeding transitional contexts, must be distinguished from microblade cores reduced by pressure, as in some Near Eastern Neolithic contexts. This basic technological distinction, percussion blades and bladelets *vs.* pressure blades and microblades, often is not made by researchers, and core-and-blade assemblages often are not described in sufficient detail to permit readers to reach reasoned conclusions of the technology represented. Experience in blade production (even if only observing the processes), is essential.

Researchers should devote more effort to a clear presentation of data on pressure-blade technology, including detailed illustrations of technologically significant debitage, microblades, and many cores of whatever configuration. Understanding pressure-blade technology requires that its diagnostic artifacts be clearly recognized and their functional significance appreciated. Otherwise, the variability

[1] In fact, larger devices, perhaps used with gut-crutches, and that functioned in precisely the same manner as the blocks used in this study, may have been employed in ancient Anatolia, Greece, Mesoamerica, and Central America where larger prismatic-blade cores of obsidian were reduced to large bullet-shaped configurations at the time they were discarded. And they may have been used widely in the Old World wherever prismatic blade cores of flint were reduced for pressure-blades in prehistory.

inherent in the technology is likely to lead to the erroneous definition of cultural-historical constructs, or to time-consuming metric reductionism of little explanatory value (*e.g.*, SHEPPARD 1987). Given that several decades often pass between excavation and final reporting, it is essential that preliminary reports specify if bullet-shaped cores dominate an assemblage or if they are merely present in low numbers among other forms.

The credibility of any description of a blade assemblage and the flaking methods and techniques that created it should be substantiated by replicative experiments. If correctly performed, such experiments accomplish two things: they demonstate the feasibility of postulated blade-production methods, and they generate reference sets of reduction products and byproducts that can be used for technological interpretation of archaeological assemblages.

All too often in Neolithic literature, architecture and ceramics dominate the discussion and the lithic assemblages documenting fundamental aspects of the overall Neolithic economic strategy are all but overlooked. In many reports, if the lithic industries are given any attention at all, it is only in broad summary statements with no presentation of the basic data that would allow other researchers to reach other conclusions. While such literature serves some research agendas, it is of little value to researchers concerned with lithic technology.

The bigger picture, of course, and that to which attention should now be devoted, involves the functions that pressure blades, including microblades, served in meeting basic tool needs in some areas, and the reasons that those apparent same needs were met at the same time in adjacent areas by altogether different lithic reduction strategies. Until we better understand the adaptive significance of pressure blade technology in Neolithic economies, we are at a loss to explain the existence of the "pressure-blade frontier" that runs from the head of the Persian Gulf up the Euphrates River to the Anatolian Plateau. This southwestern edge of the area in which pressure-blade industries flourished marks a major technological frontier that is of great importance in understanding the Neolithic. It remains essentially unaccounted for, and the explanation for its existence should become the focus of major research efforts.

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Side-Blow Blade-Flakes from Tell Kashkashok II, Syria: a Technological Study

Yoshihiro Nishiaki

Abstract: *The side-blow blade-flake is a tiny section of an obsidian blade, with a peculiar morphology that has raised a considerable amount of confusion about its production processes and function. This paper presents a detailed technological analysis of side-blow blade-flakes from the early 6th millennium BC site of Tell Kashkashok II, Syria, making reference to results of a replication experiment. The analysis shows that they were most probably produced by hard hammer percussion on a stone anvil. It also shows that they were produced not from truncating ordinary blade tools but from a special kind of large blade blanks.*

Introduction

The side-blow blade-flake was first defined by L. Braidwood at Jarmo in the foothills of the Zagros Mountains, Iraq. She described it as "an obliquely-struck transversal section of a blade .... the small transverse sections bear the plain lower bulbar surface of the blade, and on top the midrib ridges of the blade's upper surface", and also noted that some of the examples are "retouched" (BRAIDWOOD 1961: 147). Since her report, side-blow blade-flakes have been reported from numerous Neolithic sites. As shown in Fig. 1, these sites are distributed very widely in the Near East: the Queiq valley in the west, the Upper Tigris in the north, the Zagros mountains in the east, and the middle Euphrates in the south. However, their temporal distribution seems rather limited. The settlements yielding this artifact class all belong to a period between the late Pre-Pottery Neolithic and the early Pottery Neolithic, or from the late 7th to the early 6th millennium BC.

Although side-blow blade-flakes have become better known, fundamental problems relating to their technology and function have not been fully resolved. In an attempt to help understand the technology, this paper presents an analysis of obsidian side-blow blade-flakes. Technological data on the collection from Tell Kashkashok II, Syria, are examined, and reference is made to results of a replication experiment. Truncation techniques of blades are investigated in particular detail.

Due to its peculiar morphology, various terms have been used to refer to parts of a side-blow blade-flake in previous publications, causing a considerable amount of confusion. The terminology proposed in this paper is shown in Fig. 2.

The Technology and Function of Side-Blow Blade-Flakes

The basic idea on how to produce side-blow blade-flakes was presented by Braidwood (1961), who considered them to be "struck" successively one by one from a blade blank. Hole's view (1961; 1983: 247) was almost identical, but he questioned the flaking mode. He suggested that side-blow blade-flakes were produced by "pressure directed either from the top or bottom of a blade near the point of its greatest thickness". Accordingly, he rejected the term "side-blow blade-flake", referring to them as "thin sections".

Copeland (1979) put forward a different idea. Following a suggestion from M. Newcomer, she reminded us that similar artifacts could be produced by the technology of gun-flint production in modern Britain. In order to obtain a blade segment of a desired length, gun-flint knappers strike the blade on an iron bar which serves as an anvil, producing a similar small blade section among the breaks. Copeland considered that by using an equivalent procedure in segmenting a blade for sickle elements, Neolithic people could have produced side-blow blade-flakes as by-products. She consequently suggested the use of an anvil in the production of such pieces.

Braidwood (1983) later reported a replication experiment by D. Crabtree in 1974, who did in

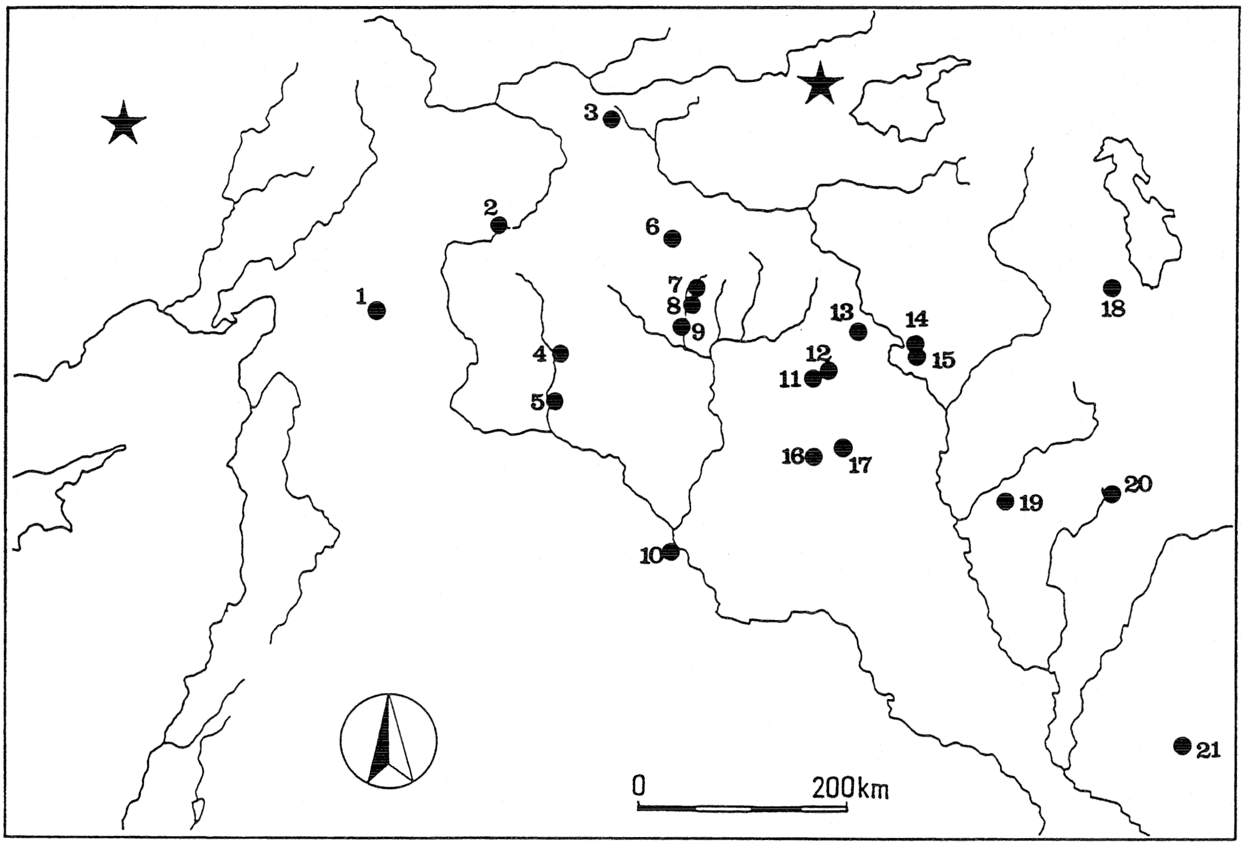

Fig. 1. Map showing the distribution of side-blow blade-flakes. 1 Bahouerte, 2 Gritille, 3 Boy Tepe, 4 Breilat, 5 Sabi Abyad, 6 Diyarbakır survey sites, 7 Khaneke, 8 Raheke, 9 Kashkashok II, 10 Bouqras, 11 Kül Tepe, 12 Thalathat II, 13 Ginnig, 14 Jigan, 15 Ali Agha, 16 Umm Dabaghiyah, 17 Umm ed-Diabba, 18 Hajji Firuz, 19 Matarrah, 20 Jarmo, 21 Tamerhan <*Stars indicate two major obsidian sources in the Anatolian mountains.*>.

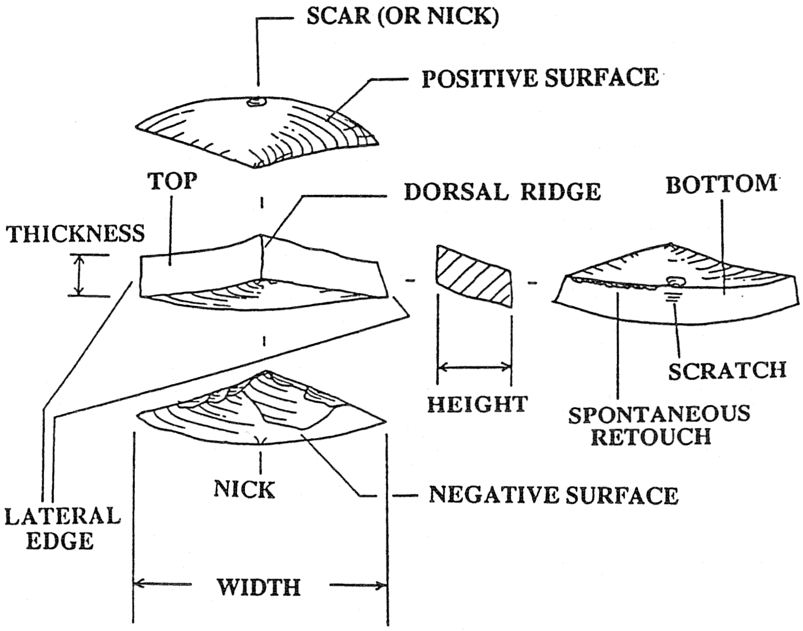

Fig. 2. Terminology for describing the side-blow blade-flake.

deed use an anvil. Crabtree "easily and swiftly" duplicated side-blow blade-flakes with a small hammer of limestone, a wooden stick with a round end, and an obsidian blade. He placed the ventral surface of the blade on the round end of the stick serving as an anvil, and struck the center of the dorsal surface with the hammer. Braidwood commented that side-blow blade-flakes could also be made by pressure as suggested by Hole, but Crabtree found percussion an easy way to duplicate them.

The function or use of side-blow blade-flakes is "indeed puzzling" (BRAIDWOOD 1983: 264); it is presently uncertain whether it was really an intended "tool". Two different interpretations in this respect have been presented to date. Braidwood (1961, 1983) considered that side-blow blade-flakes were produced as intended tools. She pointed out that in the Jarmo collection some examples are "retouched" so as to form a straight point, and she further noted that most side-blow blade-flakes from Jarmo show "signs of use" at one or both extremities, which are visible with a 10x hand-lens. Matsutani (1981) also regarded side-blow blade-flakes as tools, using the presence of "retouched" pieces at Jarmo as the main basis for his argument and stressing that the parent blades from which side-blow blade-flakes were detached should be considered "cores" or by-products. From an experimenter's point of view, Crabtree surmised that side-blow blade-flakes would make "excellent all-purpose tools" (cited in BRAIDWOOD 1983: 264).

On the other hand, as mentioned earlier, Copeland's (1979) view that side-blow blade-flakes could have been by-products yielded in the course of manufacturing other blade tools has shed new light upon this problem. This "by-product theory" is supported by Voigt (1983: 234). Voigt considered the so-called "cores" or "parent blades" to be primary products, claiming that side-blow blade-flakes from Hajji Firuz, Iran, show no retouch or sign of use, and that such traces are found instead on "cores". She suggested a possible use of "cores" as trapezes-arrowheads.

The above review shows that despite the considerable number of articles and reports, there has been little agreement on the technology and function of side-blow blade-flakes. It also shows that previous research or interpretation has been more speculative than based on concrete analysis. In the following pages, technological features of the Tell Kashkashok II collection will be reported in an attempt to reconstruct the production sequence of side-blow blade-flakes. Since the present analysis does not include a systematic study of microwear, the discussion is mainly concerned with technology. Functional argument is made solely from a view point of techno-morphological analysis.

Side-blow blade-flakes from Tell Kashkashok II

Tell Kashkashok II, one of a group of prehistoric mounds, is situated about 20km northwest of Hassake, northeastern Syria. This is a low mound about 100 by 80m rising only a few meters above the surrounding surface. Excavations carried out by a team of Japanese archaeologists in 1987 and

Table 1. Comparison of obsidian and flint tool typology of the collection from Tell Kashkashok II, Syria (after NISHIAKI 1991).

	Obsidian		Flint	
	No.	%	No.	%
Corner-thinned blades	501	42.1	0	0.0
Side-blow blade-flakes	294	24.7	0	0.0
Retouched blades	166	14.0	30	9.0
"Cores" for SBBF	54	4.5	0	0.0
Splintered pieces	27	2.3	3	0.9
Tool fragments	24	2.0	34	10.1
Notches	23	1.9	19	5.7
Truncations	23	1.9	0	0.0
Denticulates	20	1.7	53	15.8
Çayönü tools	13	1.1	0	0.0
Knives	10	0.8	0	0.0
Backed pieces	9	0.8	0	0.0
Borers	8	0.7	25	7.5
Trapezes	6	0.5	0	0.0
Burins	4	0.3	20	6.0
Retouched flakes	4	0.3	92	27.5
Rods	2	0.2	0	0.0
Pressure-flaked piece	1	0.1	0	0.0
Arrowheads	0	0.0	10	3.0
Sickle elements	0	0.0	12	3.6
Scrapers	0	0.0	35	10.4
Hoe-shaped tools	0	0.0	2	0.6
Total	**1189**	**100.0**	**335**	**100.0**

1988 exposed a small Pottery Neolithic settlement on virgin soil. The archaeological assemblages, characterized by numerous coarse ware ceramics, are generally comparable to those of the Pre- or Proto-Hassunan entity known in upper Mesopotamia at Umm Dabaghiyah, Thalathat II and Sotto. Details about excavations, site and the finds are described in Matsutani (1991).

The excavations produced nearly 5,000 flaked stone artifacts. Obsidian artifacts, consisting of 1,760 pieces, comprised about one third of them. There are 1,189 retouched pieces including side-blow blade-flakes (Table 1). The most common tool type is the corner-thinned blade, a blade tool with diagnostic burin-like retouch scars (NISHIAKI 1990). The side-blow blade-flake is the second most common type. The collection contains 294 side-blow blade-flakes (Fig. 3) and 54 related artifacts (Fig. 4). The latter consist of short blade segments that are divided into four types:

1) segments whose ends are both truncated by blows from the dorsal surface (23 pieces; Fig. 4:1-4),
2) segments with one end truncated by blows from the dorsal surface and the other simply snapped (14 pieces; Fig. 4:5-7),
3) small irregularly-shaped segments which are truncated at both end(s) and lateral side(s) (10 pieces; Fig. 4:8-11), and
4) short segments both ends of which are snapped or crushed leaving no negative or positive scars (7 pieces; Fig. 4:12-13; NISHIAKI 1991: 52).

These artifacts are considered as deriving from the side-blow blade-flake production. Types 1 to 3 may be described as "cores", and Type 4 as noncharacteristic fragments of side-blow blade-flakes. Types 1 and 2 pieces, retaining typical features as "cores", will be treated as cores in this study.

Technology

Raw Material Choice

The raw material selected for side-blow blade-flakes at Tell Kashkashok II was almost exclusively obsidian. A few questionable pieces made of flint occurred at Tell Kashkashok II as at some other sites (*e.g.* Choga Mami and Telul Breilat), but these seem to be accidental products.

Blank Selection

Regular blades served as blanks for side-blow blade-flakes. The width and height of side-blow blade-flakes provide an idea about the size of those parent blades. The average width is about 16.48mm, and thickness is around 5mm (Table 2). It should be noted that the range in size is quite large, and blades used for side-blow blade-flakes include very large pieces with a width of up to 39.8mm and a height of 12.3mm. In contrast the smallest is only 3.8 x 2.1mm.

The number of dorsal ridges on a side-blow blade-flake also reflects a morphological feature of its parent blade. About half of the side-blow blade-flakes from Tell Kashkashok II have only one dorsal ridge (147/286 or 51.4%). Pieces with two ridges are next most common (130/286 or 45.5%), while those having three or more ridges are rare (9/286 or 3.2%). This indicates that blades with one or two dorsal ridges, whose transversal section was either triangular or trapezoidal, were the most desirable blanks for side-blow blade-flakes.

Table 2. Size of side-blow blade-flakes from Tell Kashkashok II (mm).

	No.	Mean	S.D.	Min.	Max.	Median
Length	286	3.90	2.349	0.8	18.3	3.5
Width	286	16.48	5.223	3.8	39.8	15.9
Height	286	5.22	1.715	2.1	12.3	4.9

Table 3. Size of "cores" for side-blow blade-flakes from Tell Kashkashok II (mm).

	No.	Mean	S.D.	Min.	Max.	Median
Length	37	16.19	4.983	3.9	24.6	17.2
Width	37	18.64	4.574	5.4	27.2	18.6
Height	37	5.11	1.418	2.6	7.7	5.2

Table 4. Features of the bottom edges of side-blow blade-flakes from Tell Kashkashok II.

Surfaces	Tiny scars	Nicks	Plain	Total
Positive surface	10 (27.8)	9 (25.0)	17 (47.2)	36 (100.0)
Negative surface	0 (0.0)	16 (44.4)	20 (55.6)	36 (100.0)

* *cf.* Fig. 2.

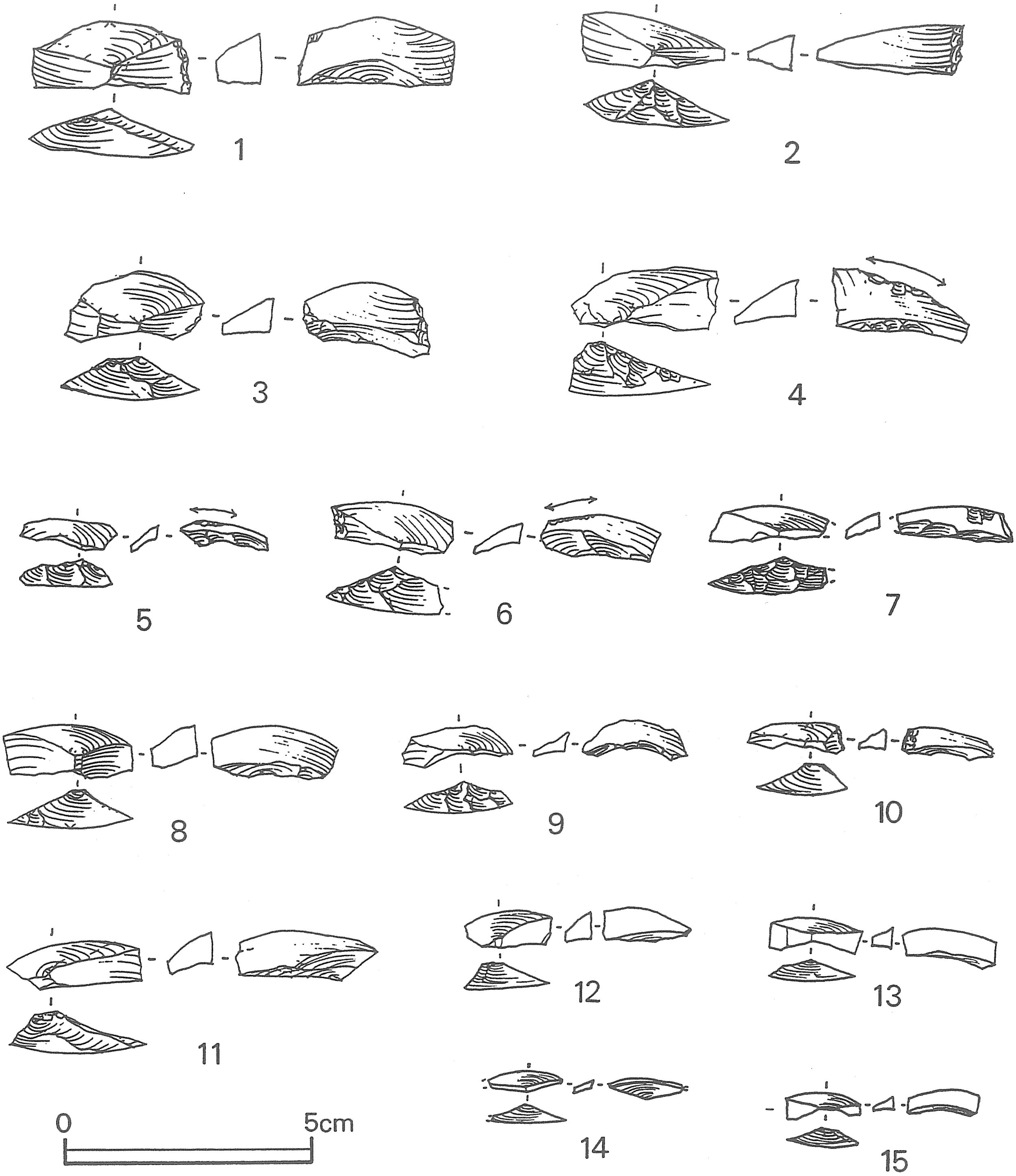

Fig. 3. Side-blow blade-flakes from Tell Kashkashok II.

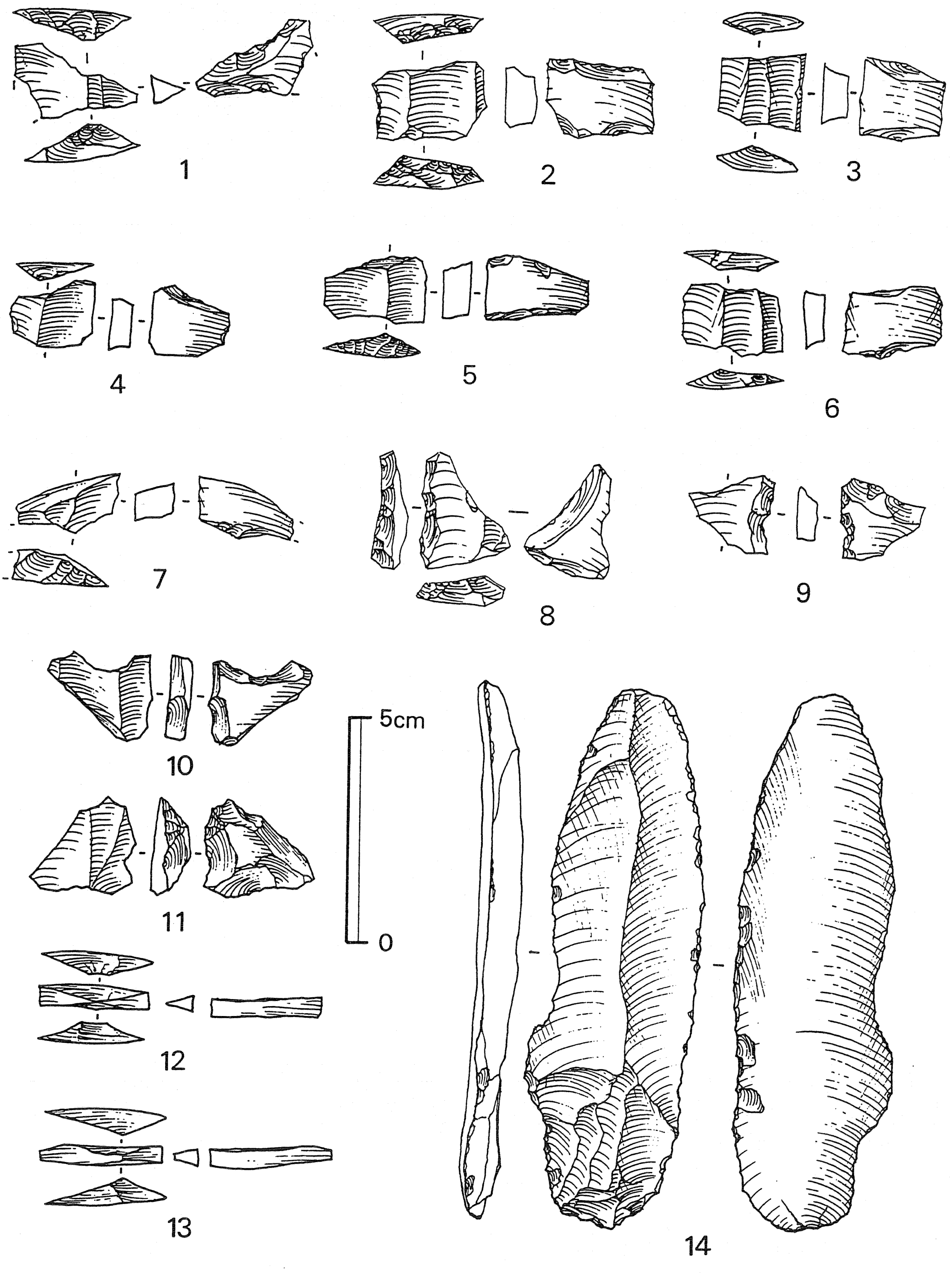

Fig. 4. Obsidian artifacts from Tell Kashkashok II. 1-11 "cores" for side-blow blade-flakes, 12-13 fragments of blade segments, 14 possible unflaked "core" for side-blow blade-flakes.

Table 5. Ridge numbers of side-blow blade-flakes and other artifact classes from Tell Kashkashok II.

	One	Two	More	Total
Side-blow blade-flakes	147 (51.4)	130 (45.5)	9 (3.1)	286 (100.0)
"Cores" for side-blow blade-flakes*	34 (54.8)	26 (41.9)	2 (3.2)	62 (100.0)
Corner-thinned blades	119 (24.4)	346 (70.9)	23 (4.7)	488 (100.0)
Retouched blades	116 (38.8)	142 (47.5)	41 (13.7)	299 (100.0)

* The ridge number was examined per end.

Table 6. Bulb of percussion of the replicated side-blow blade-flakes.

Techniques	Pronounced	Diffused	Total
SS	88 (92.6)	7 (7.4)	95 (100.0)
SW	139 (91.4)	13 (8.6)	152 (100.0)
AS	3 (4.1)	70 (95.9)	73 (100.0)
AW	1 (1.2)	81 (98.8)	82 (100.0)
WS	0 (0.0)	16 (100.0)	16 (100.0)
WW	0 (0.0)	15 (100.0)	15 (100.0)

Table 7. Positive surface of the bottom side of the replicated side-blow blade-flakes.

Techniques	Tiny scars	Nicks	Absent	Total
SS	25 (26.3)	34 (35.8)	36 (37.9)	95 (100.0)
SW	7 (4.6)	8 (5.3)	137 (90.1)	152 (100.0)
AS	24 (32.9)	18 (24.7)	31 (42.5)	73 (100.0)
AW	8 (7.6)	4 (3.8)	57 (66.7)	82 (100.0)
WS	4 (25.0)	6 (37.5)	6 (37.5)	16 (100.0)
WW	5 (33.3)	0 (0.0)	10 (66.7)	15 (100.0)

Table 8. Negative surface of the bottom side of the replicated side-blow blade-flakes.

Techniques	Tiny scars	Nicks	Absent	Total
SS	0 (0.0)	35 (36.8)	60 (63.2)	95 (100.0)
SW	0 (0.0)	6 (3.9)	146 (96.1)	152 (100.0)
AS	0 (0.0)	23 (31.5)	50 (68.5)	73 (100.0)
AW	0 (0.0)	1 (1.2)	81 (98.8)	82 (100.0)
WS	0 (0.0)	7 (43.8)	9 (56.3)	16 (100.0)
WW	0 (0.0)	0 (0.0)	15 (100.0)	15 (100.0)

Table 9. Spontaneous retouch on the replicated side-blow blade-flakes.

Techniques	Present	Absent	Total
SS	2 (2.1)	93 (97.9)	95 (100.0)
SW	8 (5.3)	144 (94.7)	152 (100.0)
AS	1 (1.4)	72 (98.6)	73 (100.0)
AW	3 (2.9)	79 (96.3)	82 (100.0)
WS	1 (6.3)	15 (93.8)	16 (100.0)
WW	0 (0.0)	15 (100.0)	15 (100.0)

"Side-blow"

Several aspects resulting from the present analysis suggest that side-blow blade-flakes from Tell Kashkashok II were detached by direct percussion instead of pressure flaking. Firstly, the bulb of percussion is well pronounced, accompanied by a clear cone of percussion and conchoidal fractures near the impact point. These features suggest the use of hard hammer as the most probable flaking tool (*cf.* OHNUMA and BERGMAN 1982, HAYDEN and HUTCHING 1989). Secondly, the collection from Tell Kashkashok II contains massive pieces. Production of thick pieces, among them one with a thickness of 18.3mm, must have required the delivery of impact load well away from the edge of the blade blank, something which would have been impractical by pressure flaking. The collection also includes very thin pieces. The large range in thickness, between 0.8 and 18.3mm, itself suggests lack of control in aiming at the impact point, another indication of the use of direct percussion. Lastly, there are no side-blow blade-flakes that show "platform abrasion" along the top edge of the ventral surface. It would have been almost impossible to obtain a flake through pressure from such an edge without platform abrasion to strengthen it.

The blow was obviously directed onto the dorsal surface of the blank. The present collection does not include clear examples detached from the ventral surface of the blank, such as those reported at Jarmo (BRAIDWOOD 1961; HOLE 1983: 247). Close examination of the breakage surface of side-blow blade-flakes from Tell Kashkashok II has revealed that 25.0% exhibit "nicks" (Fig. 3:1,10; *cf.* Fig. 2) and 27.8% show tiny scars on the positive surface (Table 4; see also VOIGT 1983: 233). On the bottom side of the negative surface, comparable traces are also detected, although consisting of nicks alone (Fig. 3:8; 44.4%). These traces are always located at the opposite end of a "blow" point, and quite possibly represent counterflaking from an anvil.

Retouch

According to Braidwood (1961) and Hole (1961, 1983), some side-blow blade-flakes from Jarmo are "retouched". Hole (1983) classified the Jarmo material into four types: 1) pieces with no secondary retouch (85.2% or 437/513); 2) pieces with retouch along the top ridge on the negative surface (10.5% or 54/513); 3) pieces with retouch that was half on the top and half on the negative surface (3.1% or 16/513) and 4) pieces with bilaterally retouched edges (1.2% or 6/513). His types 2-4 represent "retouched" examples.

However, referring to his Types 2 and 3 pieces as "retouched" is misleading, and I suggest that they should not be necessarily considered as such. Hole's "retouch" scars might well have been made before the removal of an end of the parent blade, for instance, to remove an overhang left by the previous detachment of side-blow blade-flake. Only his type 4 pieces, constituting less than two percent of the total side-blow blade-flakes, could represent genuinely "retouched" pieces since Hole (1983: 248) states that "the retouch occurred after the removal of a retouched end of the blades". Unfortunately the published drawings do not allow us to confirm this statement (HOLE 1983: Fig. 122). Strictly speaking, the "retouch" should obliterate part of the positive surface of a side-blow blade-flake, and in this sense, there seem to be few undoubtedly "retouched" side-blow blade-flake in the Jarmo collection. In fact Braidwood (1961: 147) wrote that "retouch is always confined to the concave (*i.e.* negative) face of the artifact".

"Retouched" examples in a strict sense are rare at Kashkashok II. There do exist a few side-blow blade-flakes with continuous scars that obliterate the positive surface (Fig. 3), but their status as intentional retouch is still uncertain when one considers the fragility of obsidian. Some scars could also have been produced by spontaneous retouch as discussed in the next section. It should also be noted that about one-quarter of the examples from Kashkashok II exhibit scars along the top edge on the negative surface (Hole's Types 2 and 3), which could represent the practice of "platform abrasion". In addition some pieces show damage along the right and/or left lateral edges (Fig. 3:1-3,6,10), but again, whether or not they were made after the removal of the piece cannot be determined. Whatever the case, it would be safer to consider most side-blow blade-flakes from Tell Kashkashok II as unretouched.

Function or Use

Some authors suggest that side-blow blade-flakes could be by-products of other blade tools. This speculation would only be justified when technological features of side-blow blade-flakes and their supposed counterparts correspond to each other. Size (width and thickness/ height) of the breakage surface and the number of dorsal ridges of the blank were compared between side-blow blade-flakes, their "cores", and the two dominant blade tools at Tell Kashkashok II (corner-thinned blades and retouched blades). Side-blow blade-flakes quite convincingly match the "cores" in those attributes, while corner-thinned blades and retouched tools show another pairing. Side-blow blade-flakes are significantly wider and thicker than other blades (Figs. 5-6, Tables 2-3), and their dorsal surfaces often show only one ridge, while two or more ridges are more common on other blade tools (Table 5). The only artifact class exhibiting technical features wholly comparable to side-blow blade-flakes is the cores.

The difference in size between the parent blades for side-blow blade-flakes and other blades is particularly important. In this regard, it is very interesting that the obsidian blade assemblage from Tell Kashkashok II includes one exceptionally large blade (Fig. 4:14). This blade is exceptional not only in size, but also in that it has only one dorsal ridge and that it is intact while all the other blades in the collection are broken or segmented. It seems very likely that side-blow blade-flakes were produced from such a large blade, whose width (34mm) and thickness (9mm) completely fall within the size range of the archaeological examples; this blade, in fact, might have been an unused blank for

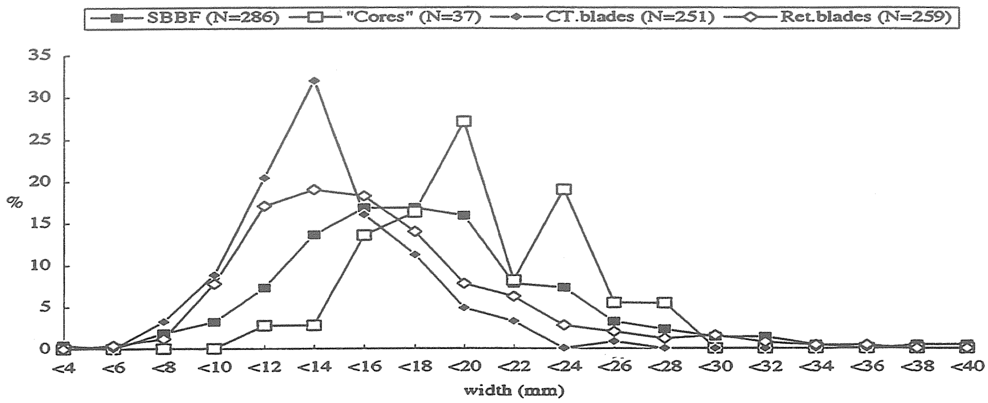

Fig. 5. Comparison of the width of side-blow blade-flakes, "cores", corner-thinned blades and retouched blades from Tell Kashkashok II (NISHIAKI 1992).

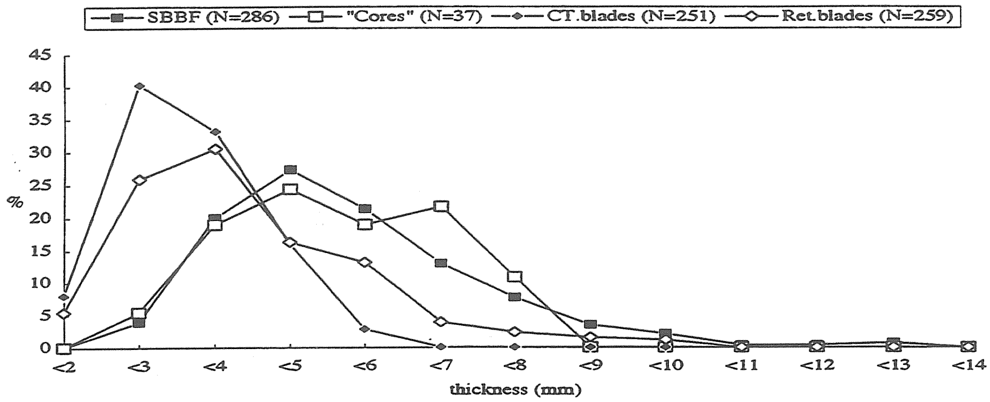

Fig. 6. Comparison of the thickness (height) of side-blow blade-flakes, "cores", corner-thinned blades and retouched blades from Tell Kashkashok II (NISHIAKI 1992).

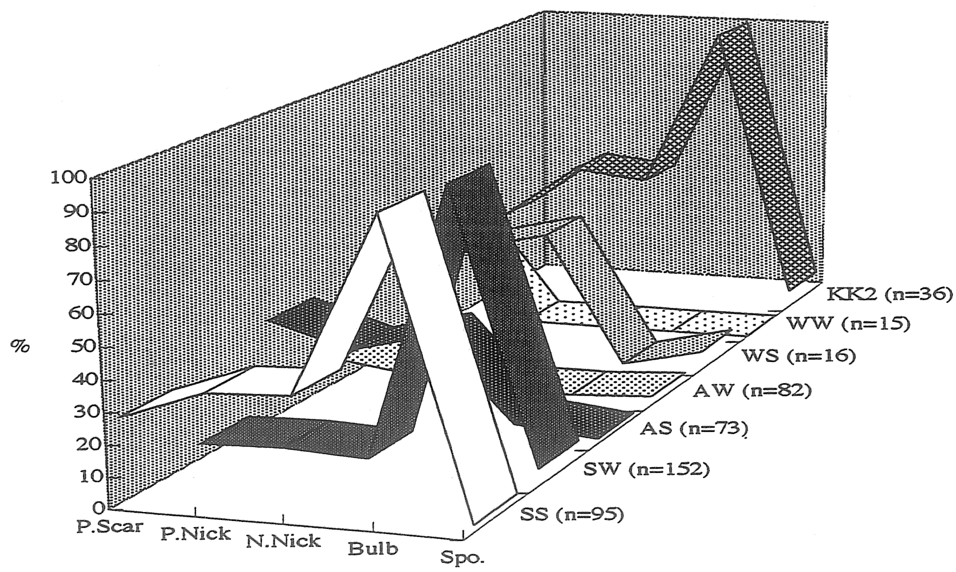

Fig. 7. Comparison of the replicated and the archaeological materials (data from Tables 6-9) *<P. Scar: tiny scars on the bottom side of the positive surface; P. Nick: nicks on the bottom side of the positive surface; N. Nick: nicks on the bottom side of the negative surface; Bulb: percussion bulb; Spo.: spontaneous retouch; KK2: the Tell Kashkashok II collection>.*

side-blow blade-flakes.

In this technological study, no conclusive interpretation about the precise function can be made. A sample of side-blow blade-flakes has been scanned under a microscope at 40 to 400 x magnifications, but no pattern of scars or polish has been detected on them so far. "Retouched" pieces are rare at Tell Kashkashok II, which may lead one to conclude that side-blow blade-flakes were not tools. However, further study is needed in view of the difficulty of microscopic studies of obsidian.

Discard

The context in which side-blow blade-flakes were discovered may provide another source of information to infer function. It may be worth mentioning that the frequency of obsidian side-blow blade-flakes at Tell Kashkashok II varies by context. These small artifacts were found frequently on the site surface, in a mixed context, and in Layer 3, but only a few were detected in the basal pit deposits in Pit 9 and Pit D8. In the case of Pit 9, the rarity of side-blow blade-flakes cannot be explained by sampling loss, because the pit deposits were carefully sieved. Since most of the deposits found in these two basal pits are considered to be rubbish thrown into them by the inhabitants of tauf-walled houses (NISHIAKI 1991: 55), the rarity of side-blow blade-flakes in the pit fills could be related to a specific but as-yet-undiscerned pattern in the making and use (?) of these flakes.

Summary

An important fact revealed in the above analysis is that side-blow blade-flakes were manufactured on blades with special characteristics: wide, thick blades, mainly with one or two dorsal ridges, were chosen as blanks. The view that side-blow blade-flakes were produced from manufacturing or truncating ordinary blade tools such as retouched blades and corner-thinned blades is not valid. The only logical counterparts of side-blow blade-flakes are the so-called "cores" which seem too exhausted and irregularly shaped to have functioned as tools such as sickle elements and trapeze-arrowheads.

Replication Study

Replication

The truncation of blades to produce side-blow blade-flakes can be accomplished in several different ways. The above analysis offers an idea about a range of possible techniques employed at Kashkashok II, among which the use of a hammer and an anvil seems almost certain. A replication experiment using the same materials as those of the knapped tools was undertaken and is examined below.

Obsidian from Hokkaido Island, Japan, was used to make parent blades. Twenty four blades, with one or two dorsal ridges, were selected from those manufactured from single-platform cores. The average size is 89.4 ± 18.81 (min. 54 - max. 128) mm in length, 27.5 ± 5.67 (16 - 44) mm in width, and 8.12 ± 2.52 (4.9 - 11.7) mm in thickness. Since the blades were manufactured by direct percussion with a wooden hammer, they were generally larger and thicker than those from Tell Kashkashok II. The latter were detached most probably by pressure flaking.

A small tuff pebble, a deer antler and a white oak stick were used as hammers in the replication of side-blow blade-flakes (Plate 1:a). A flat siliceous shale and a white oak stick were used as anvils. By employing a combination of these hammers (stone, antler, and wood) and anvils (stone and wood), six possible techniques were tested:

1) Stone hammer and stone anvil (abbreviated as SS in the following) technique
2) Stone hammer and wood anvil (SW) technique
3) Antler hammer and stone anvil (AS) technique
4) Antler hammer and wood anvil (AW) technique
5) Wood hammer and stone anvil (WS) technique
6) Wood hammer and wood anvil (WW) technique

The technique employed by Crabtree corresponds to the SW technique in this paper.

An obsidian blade was put on an anvil, its dorsal surface up with the end extending a few millimeters beyond the edge. The dorsal ridge was then struck by a hammer. Four blades per technique were segmented in this way. A leather sheet was laid on the knapping floor to avoid accidental breaks (Plate 1:b-c).

Analysis of the Results

It was possible to obtain side-blow blade-flakes by all of the above six techniques. Four hundred and thirty three side-blow blade-flakes were produced from the 24 obsidian parent blades. The number of products per blade varied greatly according to technique, the mean being 18.0 with a standard deviation of 16.10. The minimum to the maximum number per technique are as follows: 16 to 30

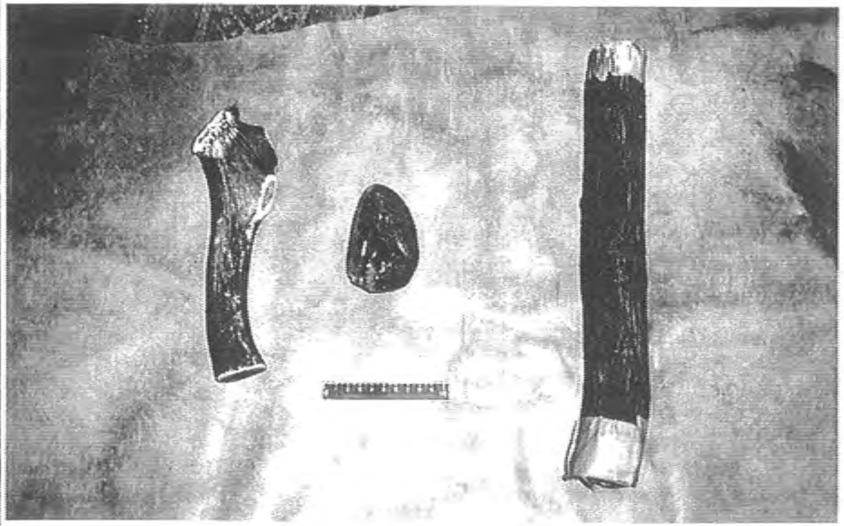

Plate 1:a (top left). Hammers used in the replication <*from left: oak, tuff, and antler*>.

Plate 1:b (bottom left). The "stone hammer and wood anvil" technique.

Plate 1:c (top right). The "antler hammer and stone anvil" technique.

specimens by the SS technique, 19-73 by SW, 16-21 by AS, 9-41 by AW, 3-6 by WS and 1-8 by WW. The SS and SW techniques yielded a relatively larger number of pieces; in one case 73 pieces were detached from a single 128mm-long blade with the SW technique. This does not necessarily mean that percussion was repeated dozens of times with great precision. Instead, more than one and up to four side-blow blade-flakes were flaked off together when a single blow was delivered. Among these accidental pieces were examples thinner than one millimeter, similar to some from Tell Kashkashok II, perhaps the result of the combination of hammer and anvil, *i.e.* hard hammer and soft anvil. On the other hand, the techniques using the wood hammer were generally unproductive. It is my impression that the use of the wood hammer required much more force when delivering a blow, which in turn made it difficult to ensure the precision of the blow point. As a result blades received unnecessary loads at unexpected parts, and were often broken into two or three segments; blades that were too short were inappropriate for further production of side-blow blade-flakes.

Despite these differences in productivity, the morphological features of the products are generally similar to each other (Figs. 8 and 9) as well as to the archaeological material (Figs. 3-4). However, a detailed analysis has revealed important technological differences between them.

Bulb of Percussion

The nature of the bulb of percussion reflects the knapping tool employed. As shown in Table 6, techniques using a stone hammer (SS and SW) yielded more specimens with a pronounced bulb, while the use of antler and wood, *i.e.* softer hammers, often resulted in the production of a diffused bulb. A sample of the side-blow blade-flakes from Tell Kashkashok II all retain a pronounced bulb (36/36), suggesting the use of a stone hammer by the prehistoric knappers.

"Nicks" and tiny scars along the bottom edges

"Nicks" and tiny scars, often observed on the Tell Kashkashok II specimens, are also seen on some of the replicated pieces. These traces occur along the bottom edges of both positive and negative surfaces (Figs. 8:1,3,5,9-11; 9:1-3,5,7). They may be interpreted as showing striking or pressure fractures from the ventral surface of the blade, but in fact they represent a counter blow from the opposite, and the actual impact point is located on the dorsal ridge(s).

According to the frequency of their occurrence (Tables 7-8), the replicated side-blow blade-flakes can be divided into two groups: one with a higher frequency (SS, AS, and WS), and the other with a lower frequency (SW, AW, and WW). This dichotomy clearly reflects the hardness of the anvil. The use of a stone anvil produced traces of nicks and tiny scars more frequently, in a proportion which is almost the same as that of the Tell Kashkashok II collection (Table 4). Interestingly, the fact that tiny scars are absent from the negative surface at Kashkashok also coincides with the replication results.

Spontaneous retouch

A series of "nibbling" scars was observed on some replicated specimens. They are distributed almost always at the same location, that is on the bottom along the positive surface (Fig. 8:1,5; 9:1). The scars look like deliberate retouch or use traces, but they occurred unintentionally as spontaneous retouch. Spontaneous retouch often arises in the course of core reduction. According to Newcomer (1976: 64), it is "typically direct, distal and abrupt". This description is wholly applicable to that of side-blow blade-flakes as well. Spontaneous retouch is located at the bottom edge of the positive surface, which corresponds to the distal edge of the dorsal surface of a normal flake. The frequency of their occurrence is generally less than 10%, and seems not to vary greatly by technique (Table 9). Of the Tell Kashkashok sample, 5.6% (2/36) show very similar scars at the same location, perhaps representing spontaneous retouch (Fig. 3:4-6).

Summary

Numerical data obtained from the replication analysis were compared with the Kashkashok II collection to see which of the six techniques produced pieces most comparable to the archaeological specimens. The result is summarized in Fig. 7, which shows the SS technique, "stone hammer and stone anvil" to be the most likely candidate. The SW, or "stone hammer and wood anvil" technique, which was employed by D. Crabtree, also produced similar pieces, but the important difference is that Crabtree's technique did not yield "nicks" or tiny scars on the bottom edges to the same extent as that employed by the prehistoric knappers. Although the present replication was limited in scale, it is nevertheless suggested that side-blow blade-flakes from Tell Kashkashok II were probably produced by direct percussion with a stone hammer and a stone anvil. This also seems a reasonable conclusion from the view point of raw material available in the steppe environments of the Khabur basin.

Conclusions

The present study examines stage by stage the production process of side-blow blade-flakes from Tell Kashkashok II. With the aid of a replication experiment, it is concluded that they were most probably produced by hard hammer percussion on a stone anvil. At the same time it is to be stressed that this paper does not propose the SS technique to have been the only one employed by the prehistoric knappers. Instead it indicates the most likely technique among the ones tested to date. A few suggestions about the functional problems, including the "tool or by-product" question, are also

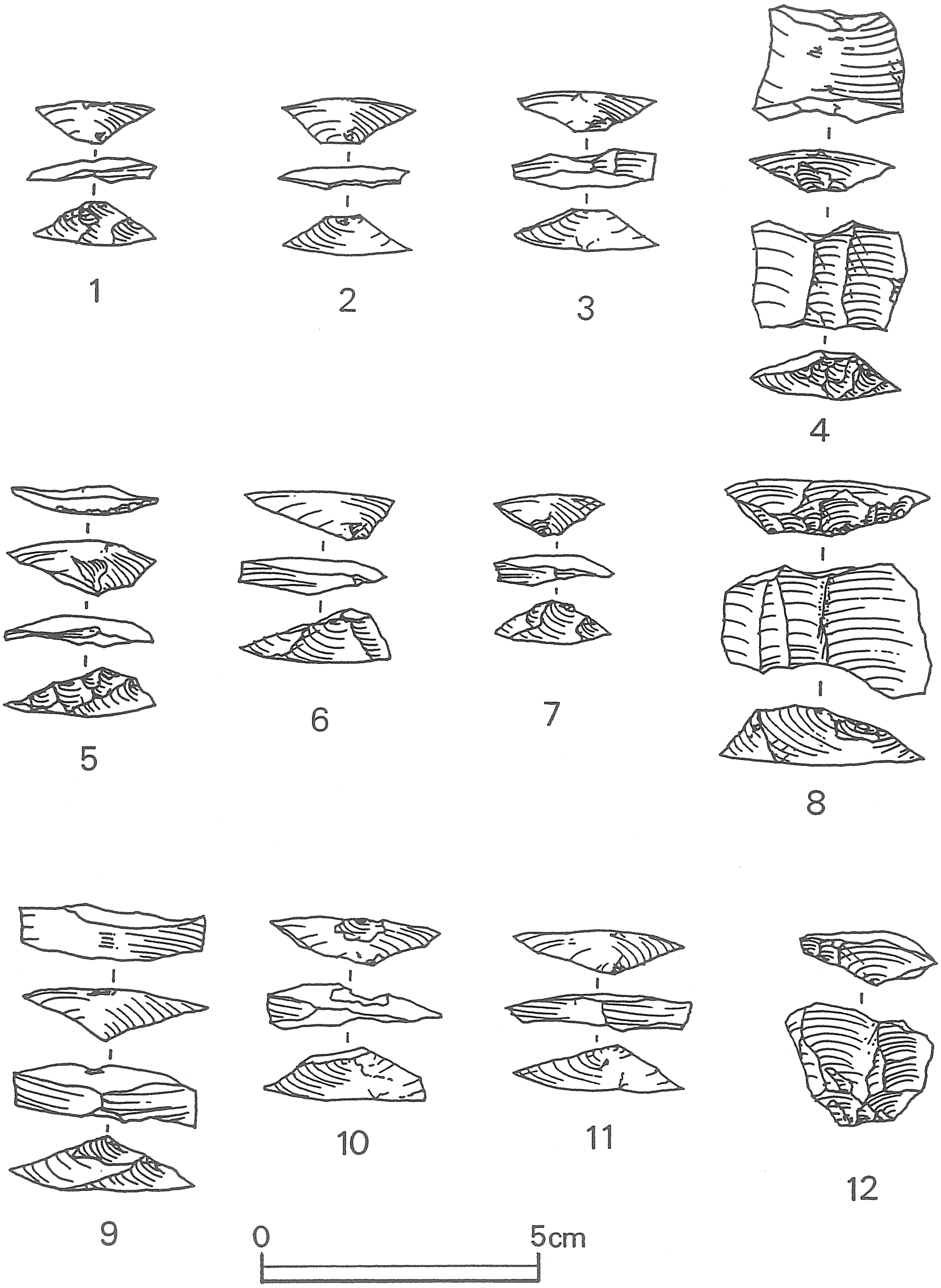

Fig. 8. Side-blow blade-flakes and their "cores" replicated in the presented study.
1-4 SS technique, 5-8 SW technique, 9-12 AS technique *<Note that No. 4 retain scratches on the ventral surface, which were caused by friction with the anvil.>*.

made. It seems true that at least a small number of side-blow blade-flakes were used as tool blanks, but the vast majority of them were not. It can also be said with fair certainty from the present analysis that side-blow blade-flakes were detached from special kinds of blades and not from ordinary tool blanks; attribute analysis indicates that side-blow blade-flakes were indeed produced from the so-called "core" that were significantly larger than "ordinary" blades. Therefore they should not be considered as mere by-products of "ordinary" blade tools.

Side-blow blade-flakes have been reported from numerous late Pre-Pottery to early Pottery Neolithic sites in the northern Mesopotamia. The distribution apparently cross-cuts different cultural zones defined by either ceramic or flint tool typology. Whatever the function, the peculiar idea of producing side-blow blade-flakes perhaps flowed through a wider obsidian trade network (COPELAND 1981, NISHIAKI 1993). Obsidian was probably not simply one of the raw materials for tool manufacture but seems to have had a special meaning for the prehistoric knappers in Mesopotamia, either due to its particular quality or its precious nature. The differential use of obsidian and

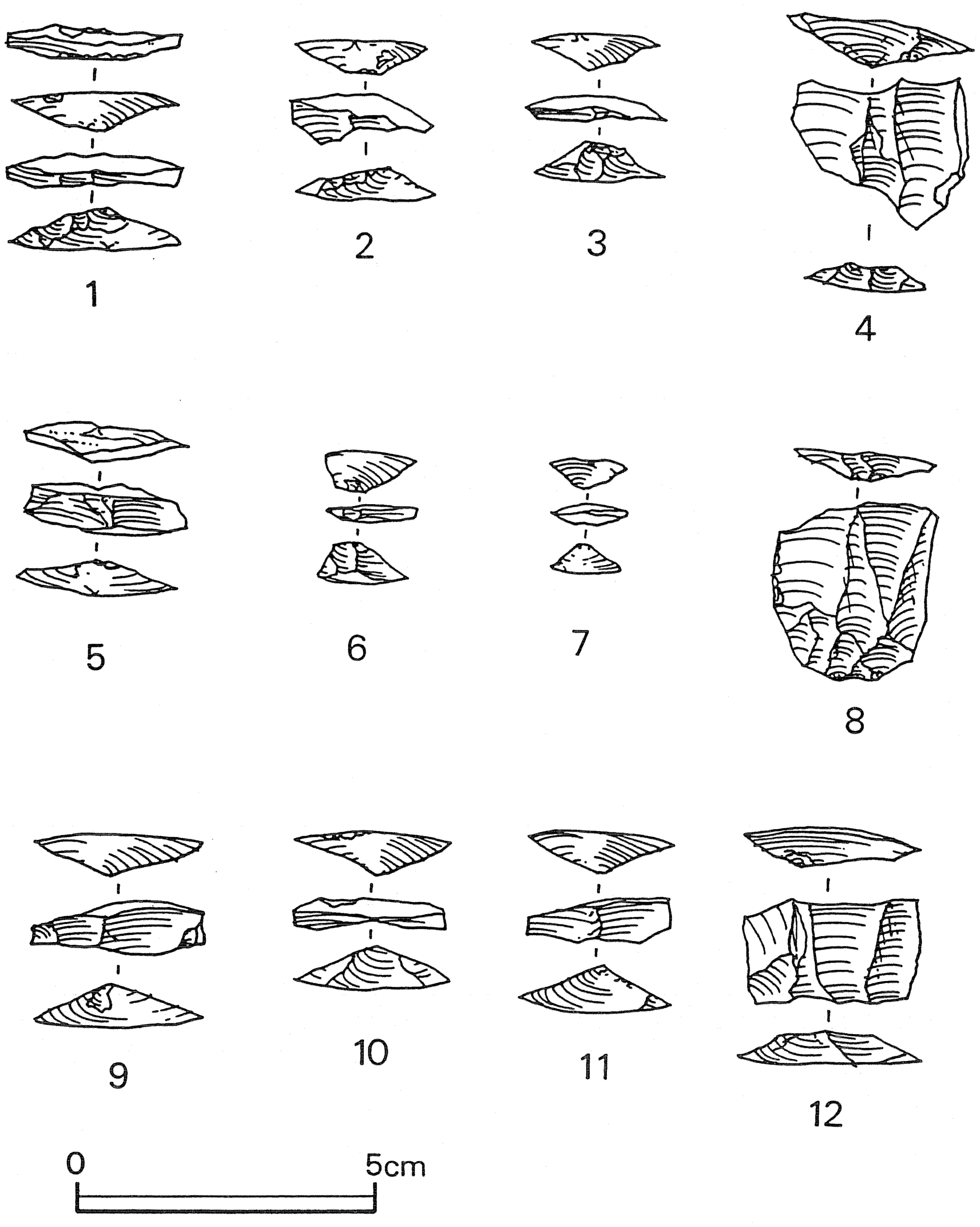

Fig. 9. Side-blow blade-flakes and their "cores" replicated in the presented study.
1-4 AW technique, 5-8 WS technique, 9-12 WW technique.

flint, for instance, is quite obvious; some tools were exclusively made on obsidian (Table 1). The side-blow blade-flake is one such example, which merits further study as a unique source of information about the technical skills and knowledge possessed by the Neolithic knappers.

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Bitumen-Coated Sickle-Blade Elements at Tell Sabi Abyad II, Northern Syria

Lorraine Copeland and Marc Verhoeven

The Site and the Excavations

Tell Sabi Abyad II, situated in the upper Balikh Valley in north-central Syria, is part of a group of four mounds dating back to the 7th and 6th millennia B.C. The site is being excavated within the framework of a regional research project (under the direction of Peter M.M.G Akkermans) which is aimed at clarifying the social and economic structure of Neolithic society in the Balikh basin. Excavations at nearby Tell Sabi Abyad I have revealed a series of well-preserved 6th millennium levels of occupation (*e.g.* AKKERMANS (ed.) 1996, AKKERMANS and LE MIÈRE 1992, AKKERMANS and VERHOEVEN 1995).

Tell Sabi Abyad II is a small low and oval mound which measures c. 123x76m at its base; it rises about 4,5m above the level of the surrounding fields. Investigations at the tell were carried out in the autumn of 1993. The excavations in three N-S oriented 9x2m trenches (H5 at the top of the tell, H6 and H7 on the southern slope), revealed nine main levels of occupation. Virgin soil was reached at a depth of c. six metre below the surface of the tell (about two metre below the surrounding fields).

Level 9, situated directly on the virgin soil, is mainly represented by parts of a NNW-SSE oriented rectangular building, measuring at least 4,25x2,00m. The walls of this structure were, like the other buildings from the tell, constructed of *pisé*. In the subsequent Levels 8 and 7 no buildings were recovered. Level 8 was marked by a rather large wall with a width of c. 90cm. A circular oven which was partly sunk into the ground, and which was incorporated in a small platform of hard-burnt clay, has been ascribed to Level 7. Level 6 is represented by the well-preserved parts of three NW-SE oriented rectilinear multi-roomed buildings. These buildings were separated by narrow alleys.

Levels 5 and 4 contained a small keyhole-shaped oven and some wall fragments respectively. Level 3 was marked by traces of a small N-S oriented rectangular structure (measuring at least 2,50x1,50m). The building stood upon a platform which was constructed of grey loam layers. Parts of three NNW-SSE oriented rectangular buildings, mainly situated in trench H5 at the top of the tell, are ascribed to Level 2. They seem to have been arranged around an open courtyard. Finally, the topmost Level 1 is as yet represented only by a medium-sized pit in the south of trench H7.

The small finds consisted of a considerable number of flint and obsidian artifacts, fragments of basalt grinding slabs, stone bowls, axes, bone awls, fragments of White Ware vessels, and some small unbaked clay objects, perhaps tokens (counting devices). Furthermore, a number of beads, including a typical "butterfly bead" of translucent light red-coloured stone, were recovered. Most interesting was the discovery of a small limestone statue of a rather corpulent seated woman. The head is missing, having been broken off in antiquity. The figurine resembles some of those from Çatal Hüyük, dated to around 6000 B.C. (MELLAART 1967). Other remarkable finds were two small stylized human heads made of soft limestone. A similar figurine was recovered earlier from Aceramic Tell Assouad, situated about 15km north-west of Tell Sabi Abyad II (CAUVIN 1972).

Interesting within the scope of this paper was the find of two small fragments of bitumen coating of basketry. One of these was found in trench H6 at floor level in an alley in the Level 6 settlement, the other was recovered from a loam deposition above the floor level related to the Level 9 building in trench H7. Both fragments showed that the bitumen had been applied to the inside of the baskets, apparently to make them water-proof. From the clear imprints in the bitumen it is evident that both baskets were woven in the same manner. The bases had been plaited with both narrow (0,2cm)

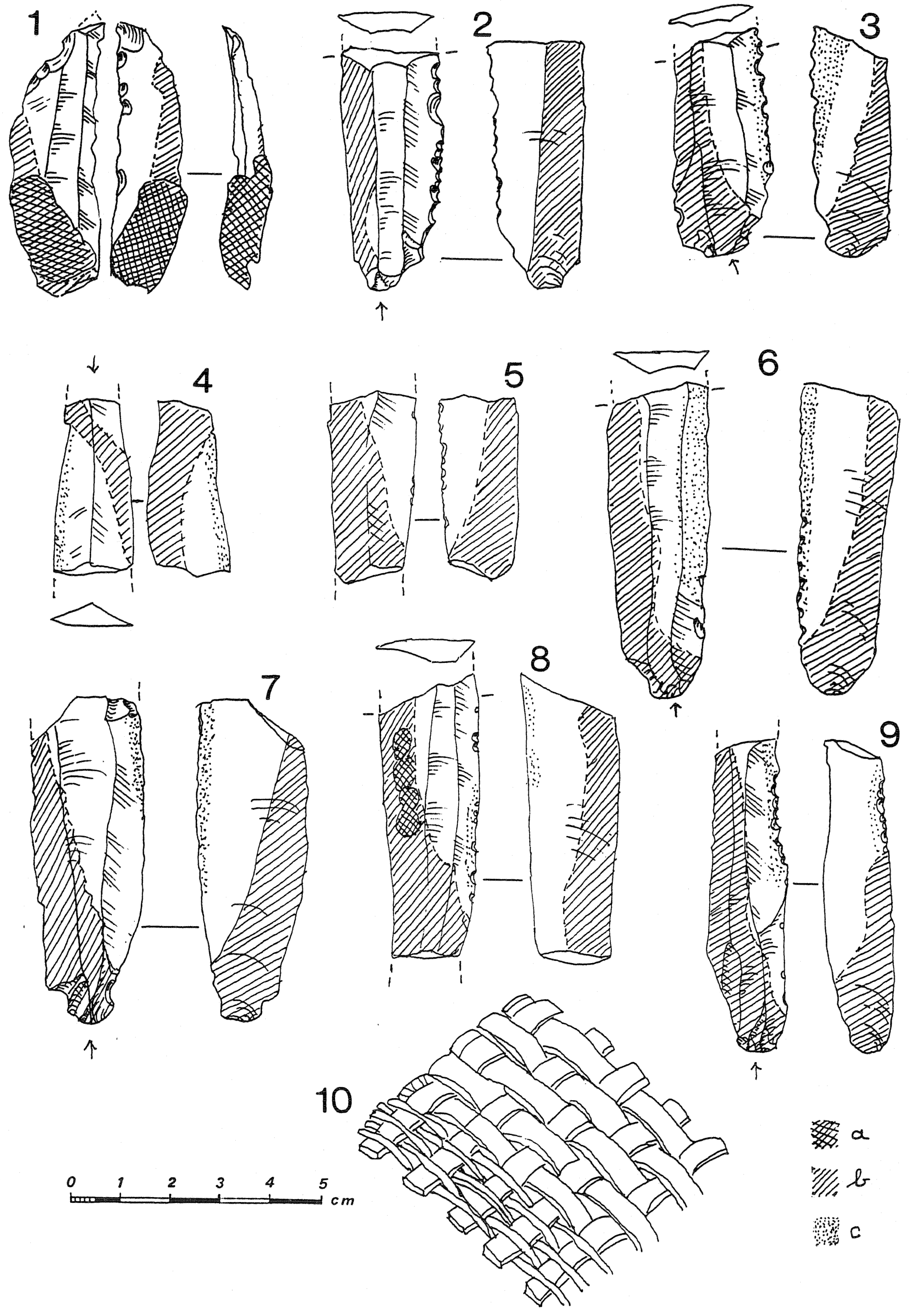

Fig. 1. 1-9 selection of sickle-blade elements with traces of bitumen adhesive, from trenches H_5-H_7 at Tell Sabi Abyad II; 10 reconstruction of basketry based on imprints in the bitumen fragments
<*key:* a *bitumen lump,* b *bitumen stain,* c *"sickle sheen" / lustre*>

and wide (0,7-0,8cm) strips, whereas the preserved upper parts were plaited only with the wide strips. Fig. 1:10 shows a reconstruction of the baskets based on the bitumen imprints. Apart from the bitumen on these baskets and on the sickle-blade elements, no other traces of bitumen have so far been found at Tell Sabi Abyad II.

Chronology

Although radiocarbon dating is still in progress, there can be little doubt that the site dates somewhere in the final stages of the PPNB period, *i.e.* in the second half of the seventh millennium B.C. The presence of Byblos and Amuq Points, White Ware fragments and a few pressure-flaked implements all point this direction. The seated female figurine and the limestone heads suggest a date around 6000 B.C. for the upper levels of occupation at Tell Sabi Abyad II, on the grounds of close parallels with the late PPNB of Assouad (particularly as concerns its very similar bitumen-coated sickle blade elements in its upper levels) and Çatal Hüyük.

The Lithic Industry

The flint and obsidian artifacts are under study at present, but a preliminary examination suggests that the industry has the following characteristics.

The raw material consists of several kinds of fine-grain flint and chert in shades of dark brown to beige; the few pieces with cortex show that nodular, tabular and pebble raw material was collected. The obsidian component also includes various qualities and colours, suggesting that supplies came from different sources.

The techniques of flint debitage were directed mainly toward production of blades, apparently from bipolar cores, but cores are very rare in the material so far excavated. The flint tool-kit is dominated by sickle-blade elements (see below), end-scrapers and tanged arrowheads. The latter are of varied shape within the general classification of Byblos and Amuq Points; some have an abruptly-retouched, square-ended tang, on others the tang is pointed, and there is a marked lack of ventral retouch, either distal or proximal. Pressure-flaking is relatively rare, occurring on a few fragments and on some of the arrowheads. Most of the scrapers, including double specimens and composites, are on the ends of blades, but short, thick scrapers on flakes also occur. The other tools include burins (often on broken tools), borers, and few heavy-duty types such as rabots and hammerstones.

The obsidian industry is comprised of small blades and bladelets, most often snapped, forming tips, butts and mid-sections. Some of these show slight "nibbled" retouch; the only other tools are corner-thinned blades, a type recently defined by Nishiaki, seen at sites such as Kashkashok II, Assouad, Abu Hureyra and Bouqras (NISHIAKI 1990) and now known to be present in basal Sabi Abyad I (AKKERMANS 1996).

The Bitumen-Coated Sickle-Blade Elements

The use of what appears to be bitumen as an adhesive for hafting sickle blade elements has already been attested at, for example, Tell Hassuna (LLOYD and SAFAR 1945), Tell Assouad (M.C. CAUVIN 1973), Tell Damishliyya (NISHIAKI 1990), and Tell Feyda (HOLE 1994). Thanks to the good offices of M.C. Cauvin and E. Coqueugniot, we have been able to send samples from Tell Sabi Abyad II to the French petroleum company Elf d'Aquitaine, which is currently carrying out a programme of research into the origins and composition of bitumen from archaeological sites in the Fertile Crescent as an aid to the discovery of oil resources.

The bitumen-coated sickle blade elements from Sabi Abyad II, both with and without lustre, bear a remarkable resemblance to those published by M.C. Cauvin from the upper PPNB levels at Tell Assouad, which is just a few kilometres north of the Sabi Abyad mounds. The elements are made from straight-sided blades, trapezoidal in section, usually either on the butt end (Fig. 1:2-3,7,9) or the mid-section (Nos. 4-5,8); the pieces so far examined are rarely retouched except by partial backing or truncation (No. 1), but they often show "sickle-sheen" on either one or both surfaces of an edge as in Fig. 1:3-6). This, evidently the cutting edge, may be slightly denticulated, usually from wear (Nos. 2-3). The lustre, whether substantial or slight, occurs on only the upper (dorsal) two thirds or so of the blade, the lower (proximal) third being taken up by the bitumen.

The bitumen traces occupy both of the surfaces of the edge opposed to the cutting-edge; they usually run in an oblique line, wider at the butt end, as shown in the illustration (Nos. 3,5,7) or in a nearly straight line from top to bottom (Nos. 2,6,8). The adhesive material can consist of a flattened lump (Nos. 1,8), or there can remain on the blade only a dark stain. The oblique position of the adhesive in relation to the position of the lustre (when present) and in similar areas on unlustred pieces (Nos. 2,5), has led M.C. Cauvin to propose that, at Tell Assouad, the elements were inserted into a curved haft, with the lustred end protruding at an angle (*ibid.*, Fig. 3) forming a curved, saw-toothed cutting edge. The same hypothesis has been supported at Damishliyya by Nishiaki (1992) and it would very well explain the features present on the elements of Tell Sabi Abyad II. If so, we have in the Balikh Valley three sites using a particular method of hafting tools for reaping (or cutting other non-cereal material) during the late PPNB and early Pottery Neolithic.

It is also worth considering the evidence of the pieces which are typologically similar to those with "sickle-sheen", bear bitumen traces as described above, but which appear, at least to the naked eye, to be unlustred. These are highly likely to be reaping/cutting tools as well, or at least they were hafted for some similar purpose (UNGER-HAMILTON 1988: 207, 210). This means that in many of the published tool-counts from Near Eastern Neolithic sites, numbers of sickle elements (or other cutting implements), when classed as such based only on the presence of lustre, may have been greatly underestimated.

If the bitumen source(s) are located by Elf d'Aquitaine somewhere to the east, it may help us to evaluate the extent of "Mesopotamian" influence in the Balikh valley as early as the PPNB. Later links are with Sabi Abyad I (AKKERMANS (ed.) 1996).

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The Glossed Blades from Nevalı Çori: Preliminary Results

Manuela Beile

Abstract: *Within the lithic assemblage of Nevalı Çori the glossed blades constitute the largest tool-group. In the following article first results about morphological and typological features will be presented including a preliminary typology (nine groups). The majority of the examined pieces consists of unmodified blades, followed by pieces with proximal lateral retouch at one or both ends. Truncated ends occur relatively rare. For lack of preserved hafts or adhesive materials on the blades the only indication for a possible hafting is the formation of the gloss which runs along the working edge in a straight or arched parallel band.*
These are only preliminary results; further points such as a definite typology, distribution of the various types in Nevalı Çori, more detailed study of glossed blades and hafts from other sites etc. have to be done and will be presented in the author's master thesis.

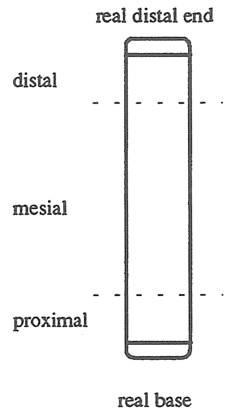
Definitions[1]

In order to prevent terminological misunderstandings a few definitions of terms used in the text will be presented in advance:

a) For lack of detailed information about the function of the objects and because they have been assigned to one class of implements solely on account of the common feature "gloss", they will be called *"glossed blades"* in this paper.

b) Pieces with truncation, if it belongs to the implement, are also considered *complete*.

c) In order to have a unique system for the description of the tools - concerning the localization of retouches and of gloss for example -, different parts of the blades are defined as follows (Fig. 1):



proximal/base: concerns the proximal end of a tool, but it will be distinguished between the real base and the proximal edges. The real base refers to the proximal narrow edge while the base edges are about the first fifth of the blade edges (seen from base to distal end).

distal: concerns the distal end of a tool with the difference between real distal end, that is the distal narrow edge, and about the first fifth of the blade edges (seen from distal end to base).

mesial: means the two longitudinal edges of a blade, *i.e.* the remaining three-fifths' length, without the above-mentioned proximal and distal fifth.

working edge: the part of a blade with traces of gloss.

back: the mesial part of a blade opposite the working edge (excluding the proximal and distal fifth).

d) *single blade* or *element*: Pieces which are inserted single in a haft are called *single blades*. *Elements* are pieces that are inserted in the haft of a so-called composite tool.

e) Kinds of retouching: *irregular denticulated*: a usual retouch without special features, which produces a more or less denticulated working edge. *Unretouched*: without retouch; includes use-retouch, too.

[1] The following article presents the first results about the so-called "sickleblades" from the aceramic settlement of Nevalı Çori which are the theme of the author's master-thesis.

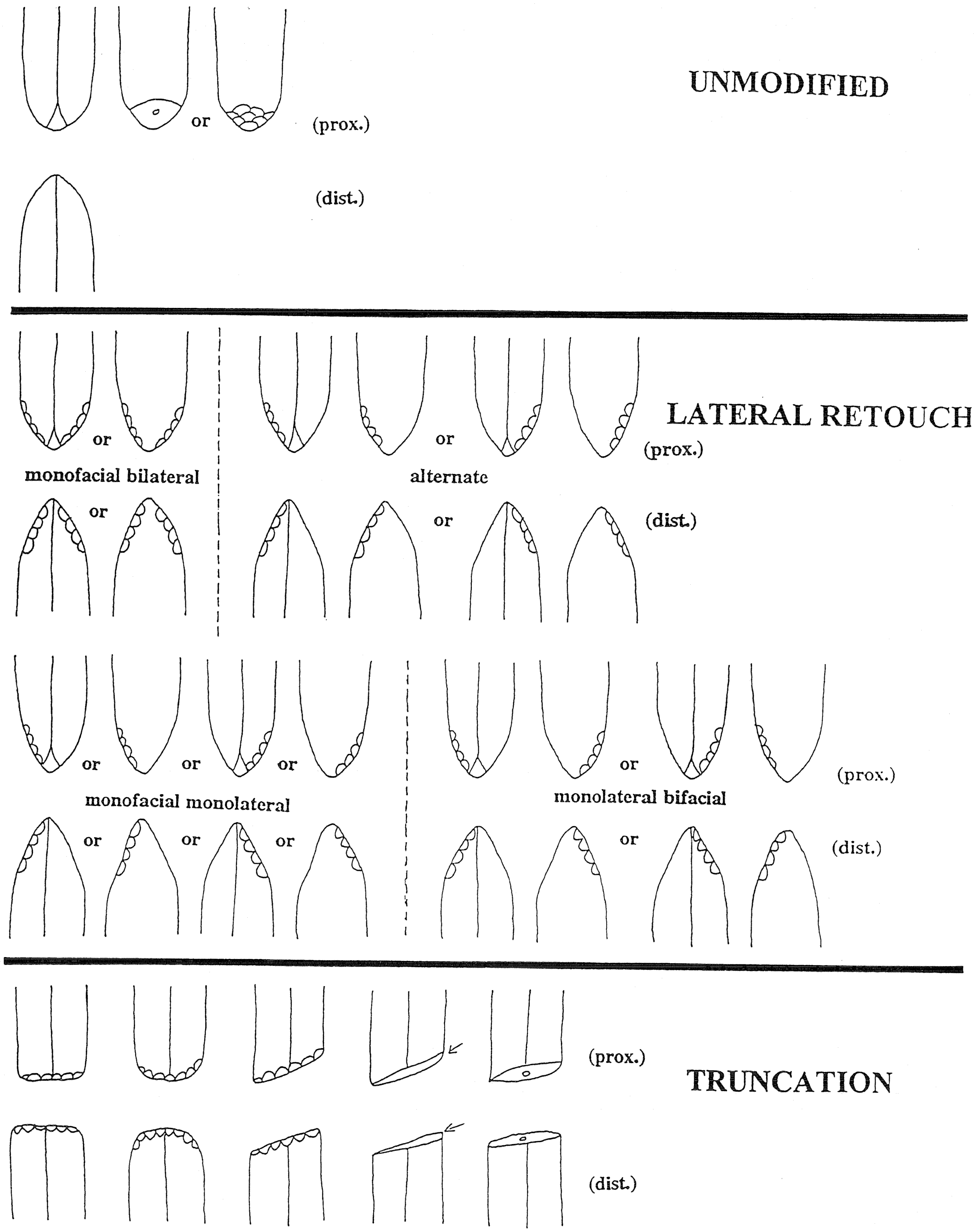


Fig. 2. Variants of the proximal and distal shaping.

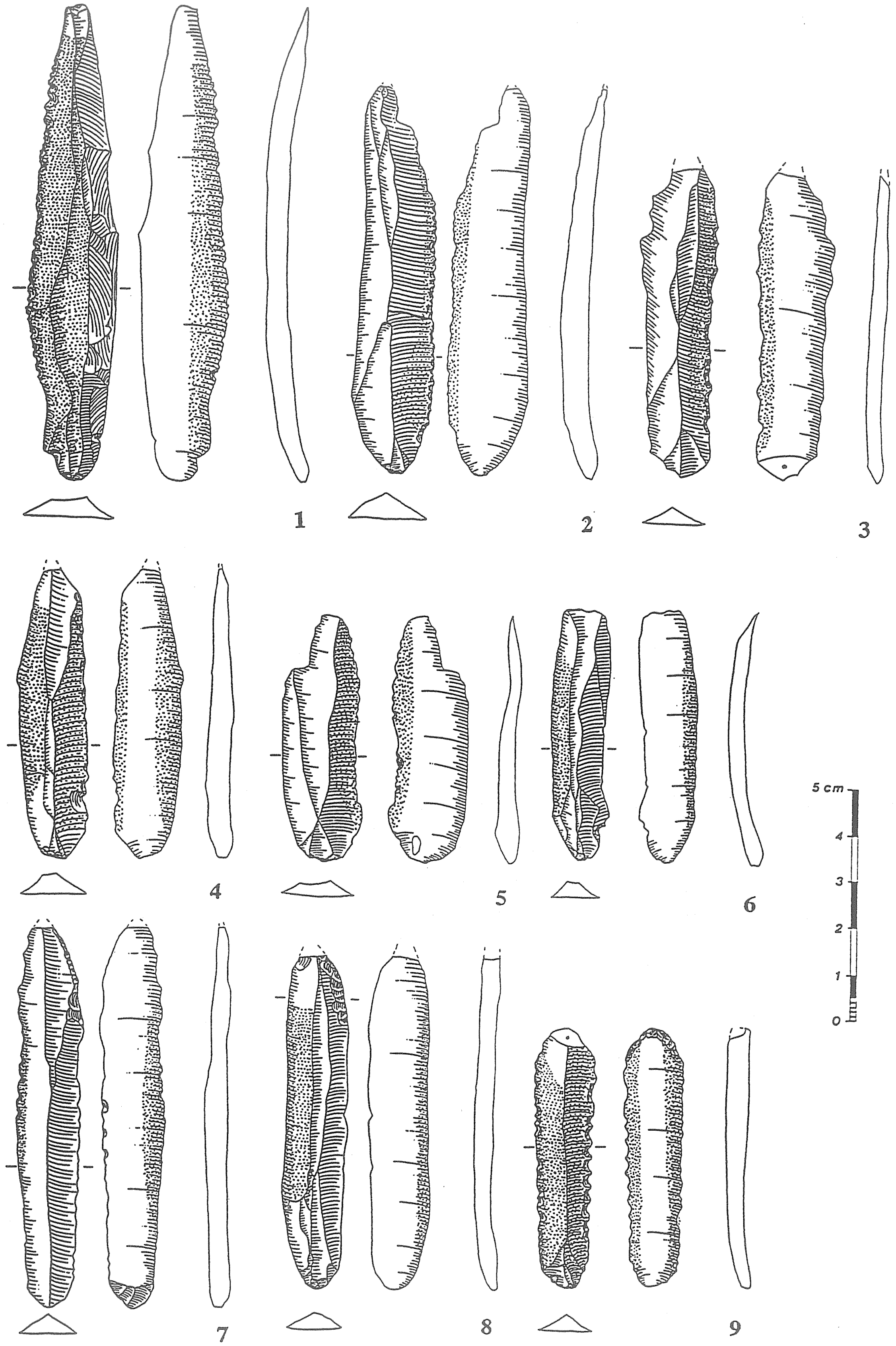


Fig. 3. 1-6 Group 1; 7-9 Group 2.

The Material

The number of tools which were interpreted as "sickleblades" during the excavations is 3784, that is 32% and therefore the largest group of the total assemblage. They are exclusively flint blades - in average 6-8cm long and 1-2cm wide. Flakes do not occur and bladelets are relatively rare. During a campaign of three months in 1993 about 1000 complete and approximately complete pieces were chosen for drawing. The rest consists of fragments which cannot be used because of their small dimensions.

Attributes of Pieces

The first task after drawing was an analysis of the pieces' attributes using the above-mentioned system (Fig. 1). It contains the proximal and distal shaping, the modification of the working edge and the back, the formation of the gloss, and the existence of striations.

Proximal and Distal Shaping

The study of the shaping of the proximal and the distal ends resulted in three variants (Fig. 2):
pieces with an unmodified end: These are pieces with an unmodified base, including those, where the bulb is removed by scaled retouch or by intentional break; and blades, where the natural distal end is not modified.
pieces with lateral retouch: These are pieces with semi-abrupt retouches along one or both proximal or distal edges, forming a more or less pointed base or distal end, rarely a tang. There are several possibilities of localization of this lateral retouch:
a) Retouch along both edges, dorsal or ventral, but monofacial.
b) Alternate retouch; this means retouching on one face along one edge and on the opposite face along the other edge.
c) Monofacial retouch along one edge.
d) Monolateral bifacial retouch, this means retouching on both faces along the same edge.
pieces with truncation: This includes several kinds of truncation: straight, convex or oblique end retouch, burin blow or intentional break.

Combination of Proximal and Distal Shaping (Preliminary Typology)

The examination of complete and approximately complete pieces as to which combinations the above-mentioned distal and proximal shapings occur, resulted in a "preliminary typology" consisting of nine groups which will be briefly described in following:

Group 1 (80) (Fig. 3:1-6)

Blades without proximal and distal modification are the most frequent group comprising 80 pieces. The *gloss* occurs parallel to the edge forming a straight or a curved band. It is remarkable that proximal and distal end often are not covered with gloss. Removal of the bulb only appears on three pieces (No. 3). The *working edge* is mainly unretouched (including use-retouch) or irregularly denticulated. The *back* is unretouched in the most cases, too.

Group 2 (14) (Fig. 3:7-9)

14 pieces show a lateral retouch at the distal end while the base is unmodified. There are two pieces where the bulb is removed (No. 7). Monolateral monofacial retouching is most frequently at the back (Nos. 7-8), rarely at the working edge. Bilateral monofacial retouching occurs only twice (No. 9) and concerns above all pieces with two working edges. The form of the *gloss* is the same as in group 1, parallel to the edge, straight or curved. The lateral retouch usually is not covered by gloss, suggesting that it was fixed in a haft and that it was made especially for this purpose. In the most cases the proximal end also is free of gloss. The *working edge* again is unretouched or irregularly denticulated. More than half of the group has an unretouched *back*.

Group 3 (15) (Fig. 4:1-2)

There are 15 pieces with a truncation at the distal end while the base is unmodified. Represented are oblique, straight or convex end retouches (No. 1) and burin blows, but above all intentional breaks (No. 2). It is often difficult to determine if the truncation belongs to a tool or if it is a secondary modification. For this the form of the *gloss* is decisive: There are no problems if the truncation itself shows traces of gloss (No. 2); pieces where the distal end of the glossy zone is preserved (No. 1) have presumably an intentional truncation; blades where the truncation overlaps the glossy zone were considered secondary used tools. One would suggest that the truncation is made in order to produce an element out of a blade which then will be inserted into a haft together with other truncated pieces. However, real blade-segments occur in this group only three times (No. 2); the rest consists of blades which were reduced in their length by truncation but where the remaining distal end is clearly free of gloss. The *working edge* shows the same features as in the groups already described. The *back* is unretouched here, too.

Group 4 (34) (Fig. 4:4-5,7-8)

This group of 34 pieces is relatively frequent, represented by blades with lateral retouch at the base and an unmodified distal end. There are several variants due to the position of the retouches: More than half (18) has this retouch at the back. 16 blades do not have any traces of *gloss* at both ends. In comparison to the groups already mentioned the number of blades with an irregularly denticulated *working edge* has increased (Nos. 5,8), but unretouched pieces are still present. The unretouched *back* again is dominant, but there also occurs a modification in the form of partial or continuous semi-abrupt retouch, often as the continuation of the proximal lateral retouch (No. 7). No. 4 shows an example for an alternating continuation.

Group 5 (18) (Fig. 4:3,6,9)

18 pieces are more or less pointed on both ends by lateral retouch. Of course there are numerous possible combinations. The most frequent is proximal and distal lateral retouch at the back (11) which can be continued by a retouching of the back. The fact that both ends in most cases have no traces of *gloss* confirms the assumption that the lateral retouch serves for a better hafting. The majority has the usual retouched or an unretouched *working edge*. Half of the *backs* are unretouched, the rest shows abrupt or semi-abrupt retouching (No. 3).

Group 6 (4) (Fig. 5:3)

Proximal lateral retouch with distal truncation occurs only on four pieces. Two blades have the proximal retouching on the back. Three pieces show a distal break which is possibly intentional, because the distal end of the *glossy zone* is preserved. One piece shows a slightly convex end retouch.

Group 7 (17) (Fig. 5:1-2)

More than half of the 17 pieces of this group shows a proximal break and an unmodified distal end. In one case the break itself is covered with *gloss*. The complete pieces usually have both ends without gloss. The rest has a truncation in the form of a slightly convex or oblique retouch - in three cases even abrupt retouch.

Group 8 (2) (Fig. 5:4)

This group consists of only two pieces with distal lateral retouch and proximal truncation. The *glossy zone* is curved and does not cover the distal end. One piece is truncated by a break, the other by a slightly convex end retouch.

Group 9 (4) (Fig. 5:5)

Three of the four pieces represented here were reduced in length by a proximal and distal break or end retouch, nevertheless both ends are without traces of *gloss*, that is these pieces are not real elements. Only one piece shows *gloss* from one end to the other but this is a 9cm long blade. The *working edge* is usually retouched, the *back* is - with the exception of one piece with abrupt retouch - unretouched.

Results

The examination has shown that there are nine groups, formed by combinations of the three variants of proximal and distal shaping, as described at the beginning ("Proximal and Distal Shaping" and Fig. 2).

Summarily one can say that the majority is represented by blades with unmodified ends (Group 1), followed by pieces with proximal lateral retouch (Group 4). The diagram (Fig. 6) shows the number of pieces in each of the nine groups.

However, one must take into consideration the fact that firstly these nine groups only concern the proximal and distal modifications of the complete pieces in the assemblage (188) and secondly

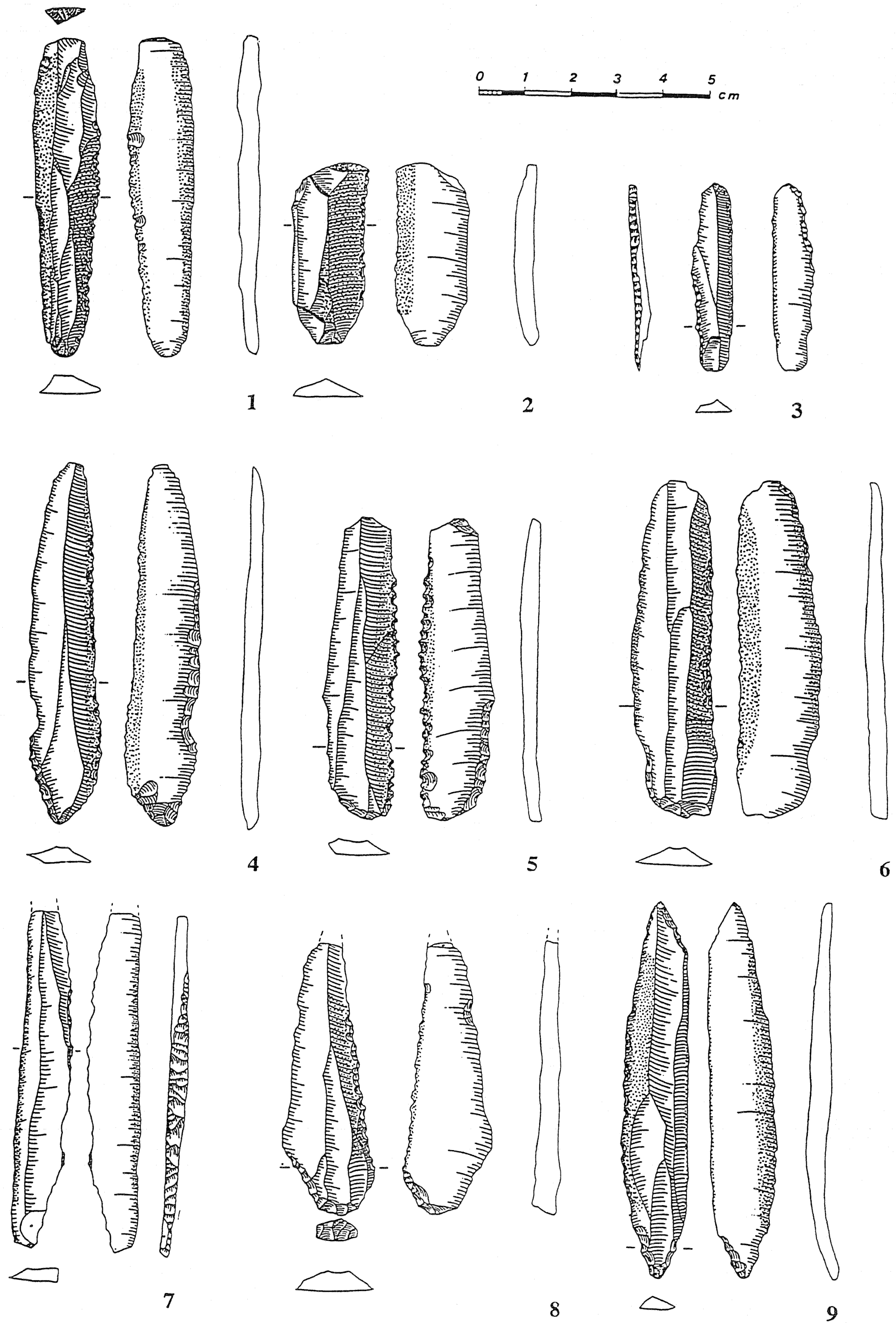


Fig. 4. 1-2 Group 3; 4-5,7-8 Group 4; 3,6,9 Group 5.

that Group 6, 8 and 9 are represented only by 2 or 4 pieces. To complete the picture the fragments have to be examined as well.

The diagram (Fig. 7) shows that fragments with unmodified or lateral retouched base predominate, whereas proximal truncation is relatively rare. Half of the distal fragments is unmodified also, whereas distal lateral retouch and distal truncation counterbalance each other.

With regard to the distribution of all examined pieces throughout the five preceramic levels of the site, one can recognize that the number of pieces - whether unmodified, lateral retouched or truncated - are rare in the upper Levels V and IV, whereas there is a sudden increase in Level III, which remains more or less constant until the lowest Level I (Figs. 8-9).

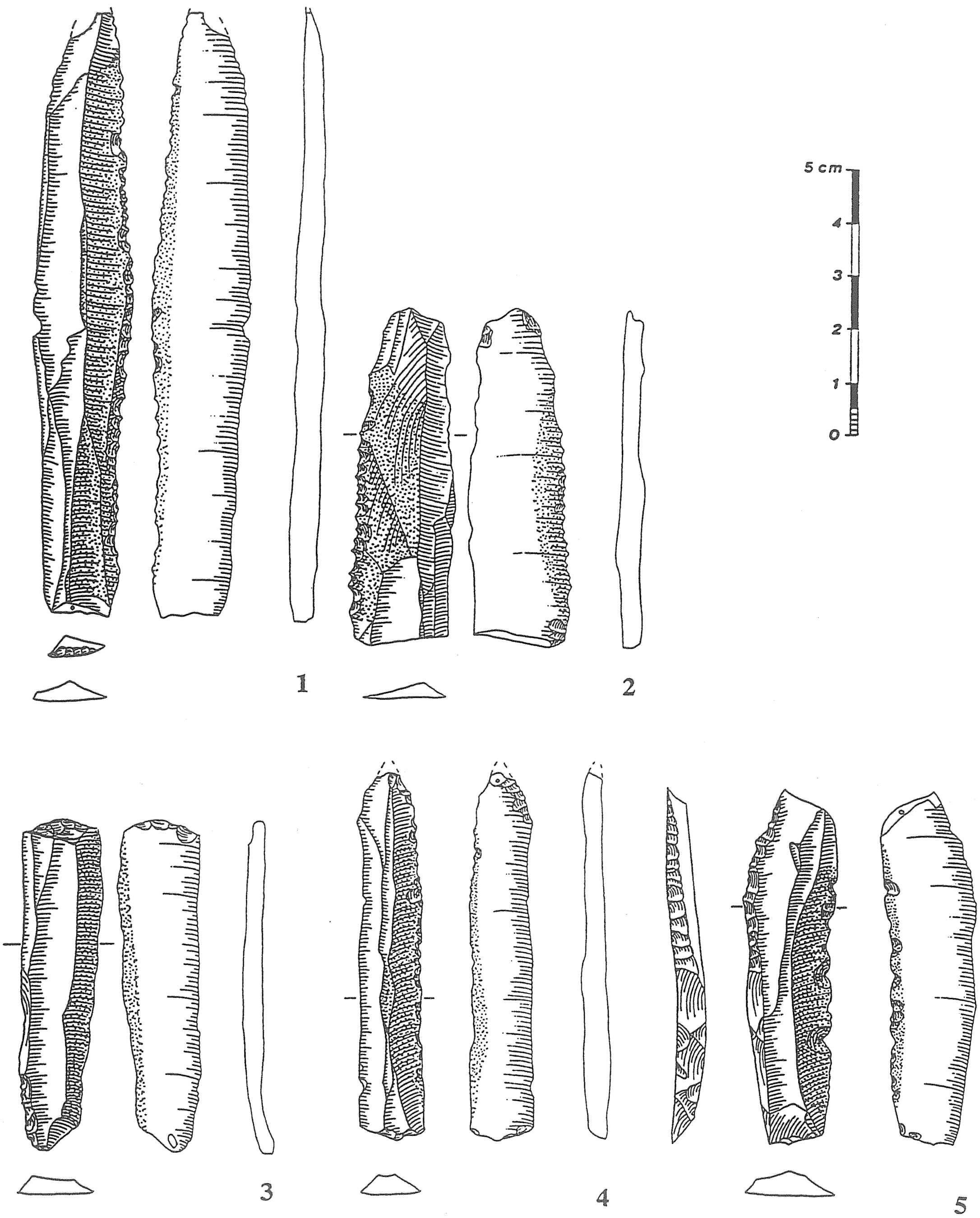


Fig. 5. 1-2 Group 7; 3 Group 6; 4 Group 8; 5 Group 9.

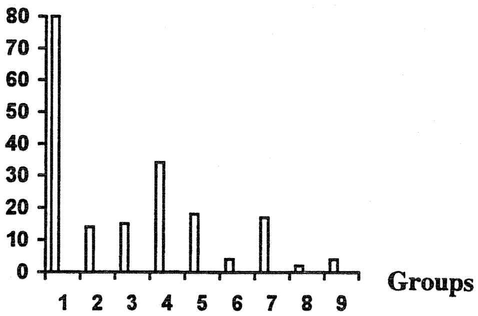


Fig. 6. Group frequencies (188).

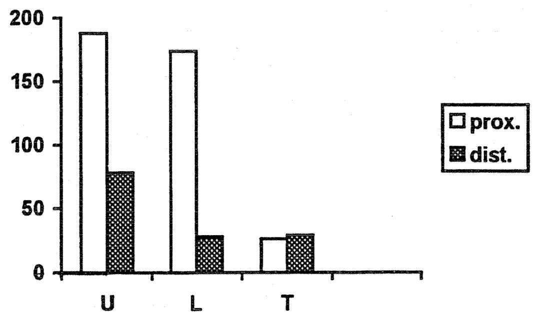


Fig. 7. Frequency of the proximal (394) and distal (135) fragments <U=*Unmodified;* L=*Lateral retouch;* T=*Truncation*>.

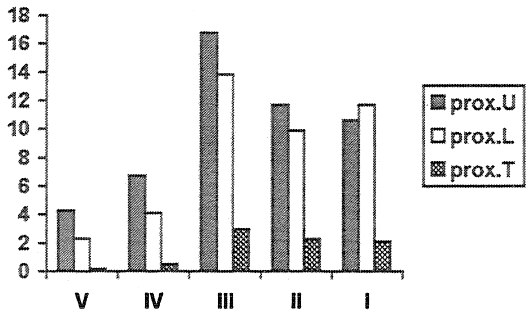


Fig. 8. Frequency (%) of proximal unmodified, lateral retouched and truncated pieces per level.

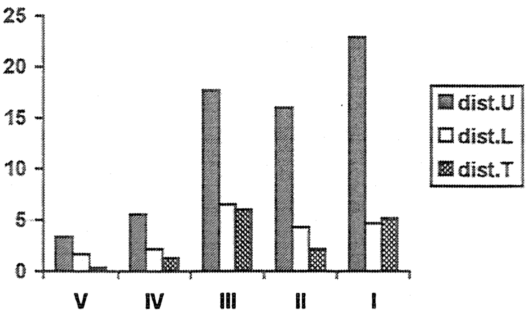


Fig. 9. Frequency (%) of distal unmodified, lateral retouched and truncated pieces per level.

Modification of the Two Longitudinal Edges

The Working Edge

Concerning the modifications of the two longitudinal edges the presentation of the groups has shown that the working edge in the most cases is unretouched or has a common retouch. Regular denticulations - fine or coarse - are the exception. Only an irregular denticulation - as defined at the beginning - is more frequent. The proximal, distal and mesial fragments do not show other features in this regard: pieces with unretouched or irregularly denticulated working edge predominate.

The Back

The majority of the complete pieces has an unretouched back. Abrupt or semi-abrupt retouching appears occasionally only in Group 4 and 5. A look at the fragments confirms the above-mentioned.

As M.C. Cauvin has already presented in her article about the prehistoric sickleblades of the Near East (CAUVIN 1983), one can say that unmodified glossed blades are a widespread type chronologically and geographically. Pieces with lateral retouch at the base were also found in numerous preceramic sites (*e.g.* Jericho, Mureybet). Pieces with truncation, above all on both ends, thus to be regarded as real elements, seem to be later.

Hence the results reached in this paper show no unusual features. Perhaps a development will become apparent after further examination of the stratigraphy and the distribution of these artifacts within the site and by more detailed comparisons with other sites.

Use-Wear

Striations

About 30% (319) of the examined pieces show macroscopically visible striations both on the

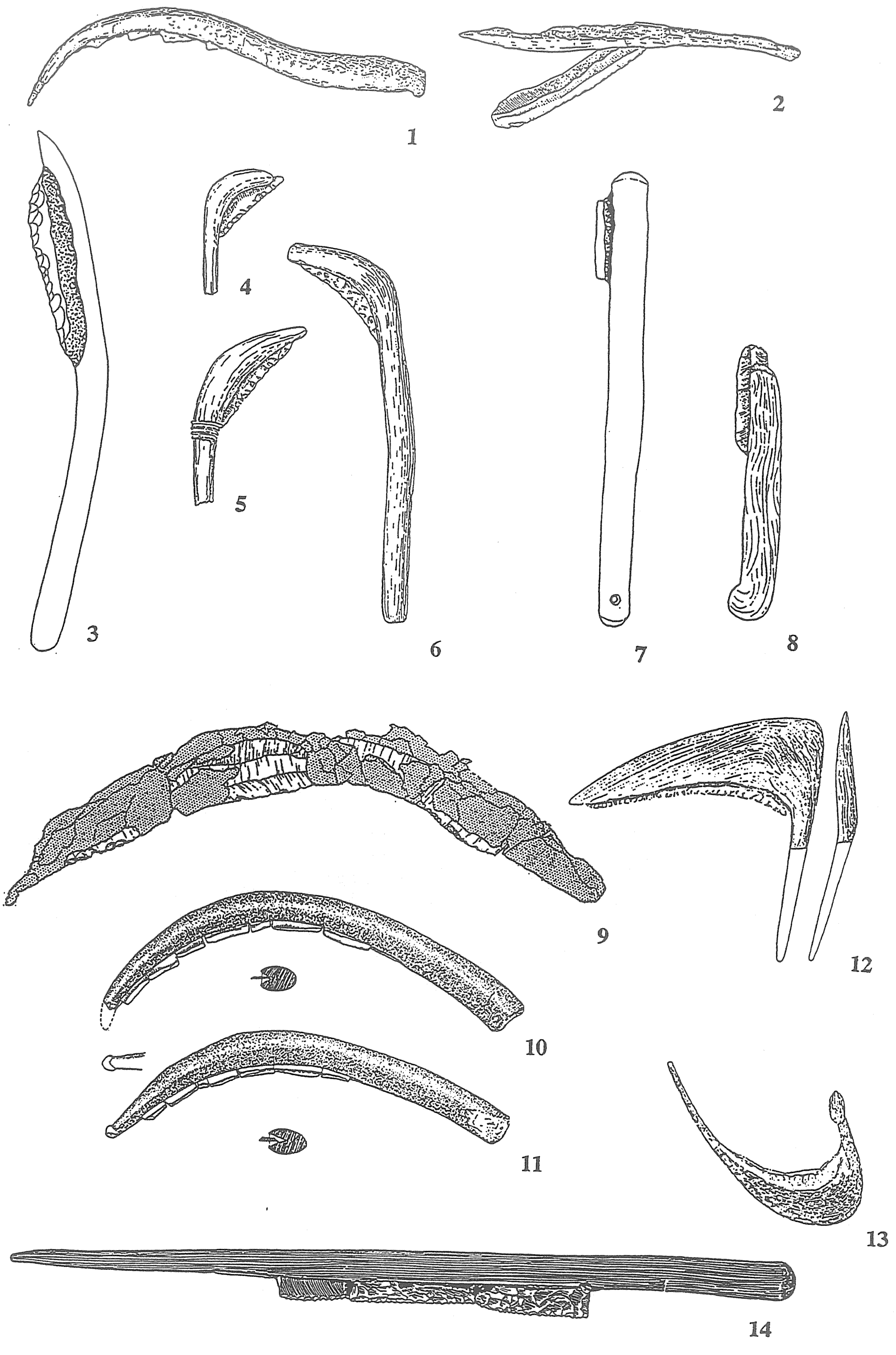


Fig. 10. Examples of original and experimental tools.

working edge and the back. Questions about the reasons of this use-wear and of the formation of gloss cannot be answered at the moment, because the microwear analysis is not yet complete.

Gloss

The gloss is always parallel to the edge in a straight or curved form, as mentioned above. Due to the lack of bone or wooden haftings in Nevalı Çori and to the absence of macroscopically visible traces of mastic, conclusions about hafting can be drawn at the moment only from the gloss formation and eventually from the dimensions of the blades. However, the dimensions offer - in my opinion - no clear solution: Blades that are longer than 8cm and are therefore usually considered single blades, rather than elements, are rare. Pieces with a length of about 6-8cm, a common occurrence in Nevalı Çori, can also be considered elements of a composite tool, as examples in Jarmo (BRAIDWOOD *et al.* 1983: Fig. 123:2) (Fig. 10:9) and Fayum (CATON-THOMPSON and GARDNER 1934: Pl. 30:1) (Fig. 10:14) testify.

Concerning the formation of gloss, there is one important feature regarding the two ends of a blade: There are three possibilities:
a) The proximal and the distal end is free of gloss.
b) Only one end is free of gloss.
c) The glossy zone includes both ends.

These facts could be criteria to determine if a piece was originally part of a composite tool or individually hafted.

The first case, where both ends are free of gloss, is probably an indication that they were covered by a haft or by mastic, as for example in Fig. 10:3 (HELMER 1983: Fig. 3:b), 5 and 6 (BEHM-BLANCKE 1962/63: Fig. 37:1). These are reconstructions of tools with a single blade that shows a curved band of gloss, parallel to the edge.

If only one end is free of gloss this piece could have been inserted at the base or the tip of a composite tool with a curved haft. If both ends show gloss, one could imagine a straight hafting of a single blade as in Shanidar (*cf.* Fig. 10:7; a reconstruction after the specimen of Shanidar: HELMER 1983: Fig. 1:a) or of several blades as in Fig. 10:10-11 (Hacilar: MELLAART 1970: Fig. 178) or no. 14 (Fayum; CATON-THOMPSON and GARDNER 1934: Pl. 30:1).

What can certainly be excluded is an insertion diagonally or obliquely to the haft as seen in Karanovo, Bulgaria (BEHM-BLANCKE 1962/63: Fig. 18:2) (*cf.* Fig. 10:1) or Egolzwil, Switzerland (BEHM-BLANCKE 1962/63: Fig. 23:2; *cf.* Fig. 10:2).

These are only considerations, based on original bone or wooden hafts or on experimentally produced and tested examples and independent of their chronological and geographical classification. Better interpretations from further examination of material - including microwear analysis - must remain open at the moment.

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"Glossed Tools" from Hayonim Terrace: Blank Choice and Functional Tendencies

Patricia C. Anderson and François Valla

Abstract: *Glossed tools, often equated with agricultural activity, were studied here in a sample from Hayonim Terrace to find their actual functions, using microwear analysis and new experiments. Then, the tool-use categories found for the sample (harvest of wild cereals, harvest of reed, working of skin, shaping of objects in mineral materials) were evaluated morpho-metrically to highlight any differences in selection criteria. Choice of blank for harvesting tools clearly differed from stone (mineral-) working tools, and harvesting tools and backed blades and bladelets corresponded to particular blank attributes in relation to lithic materials overall and to the other glossed tools. These harvesting tool blanks were found to correspond to a particular adaptation to a specific hafting arrangement, allowing them to have long use-lives in relation to other tools. Despite this, the harvesting activity was apparently not a major catalyst in debitage strategy. Microscopic traces of use on "cereal" harvesting tools most resemble experiments harvesting dense natural stands of wild cereals in the Near East, rather than in a true cultivation context.*

Introduction

Particular interest has been paid to flint tools with gloss since the discovery of the Natufian at Shukbah by D. Garrod. According to Garrod, the gloss was without a doubt caused by cutting wheat and grass (1932: 258), and on this basis she concluded that agricultural practices had occurred at this relatively early date (1932: 268). Thirty years later, after the excitement of the discovery had somewhat abated, and following much argument and critical thought, Garrod admitted that glossed tools were not absolute proof of agriculture. They could have been used for cutting wild grasses, but her conviction remained that the Early Natufians were the first farmers (1957: 216). She based her argument on the abundance of glossed pieces and on the presence of decorated handles, which were also considered to bear witness to the frequency of grain-harvesting.

The arguments presented by Garrod have since lost much of their force. First, the rare inserts found fixed in handles (at el-Wad and Umm ez-Zoueitina) were found not to have gloss, once the material was published. This appears to also be the case for elements in handles from Wadi Hammeh 27 (B. Boyd, pers. comm.). Secondly, recent exhaustive excavations have shown that glossed pieces, which Garrod considered abundant in Natufian sites, constitute in reality only a very small proportion of the overall flint tool assemblage, or are altogether absent, for example in the Negev (VALLA 1984: 188).

However, methodological progress has been made in the areas below, contributing to the debate concerning the origins of agriculture, and at present each of these have been applied at Hayonim Terrace:

1) Flotation, which allows recovery of carbonised macro-botanical remains. Buxo (1992) has identified wild barley (*Hordeum spontaneum*, small lentils and Cuscuta at Hayonim.

Wild wheat and barley were used together at this time in the Levant, for example in the Epipaleolithic at Abu Hureyra (HILLMAN *et al.* 1989), at Mureybet (VAN ZEIST and BAAKER-HEERES 1984-1986) and at Ohalo during the Kebarian (KISLEV *et al.* 1992). Plant collections and survey in the Near East have ameliorated criteria for differentiating wild and domestic plant macro-remains found in sites, as well as knowledge of distribution of wild cereals (ZOHARY and HOPF 1988, ZOHARY 1992). These show Hayonim would have been in a region for which wild wheat and wild barley are indigenous.

2) Phytolith analysis, which is the microscopic study of identifiable plant silica fragments extracted from the soil in prehistoric activity areas (MILLER-ROSEN 1992). At Hayonim, Rosen (in press) found mostly wheat, and to a significant extent barley, and very rarely other grasses, were exploited during the Natufian of Hayonim, based upon identification of phytoliths from seed husks of these plants. Phytoliths from cereal/grass stems were also present, as well as from reeds and rushes. Indeed, plants with high enough proportions of silica to produce phytoliths are the same which leave gloss on tools used to harvest them.
4) The progress made in plant genetics, allowing insight into the domestication process, and the results of experimental harvests of wild cereals in natural environments in Syria, Turkey and Israel (HARLAN 1967; HILLMAN and DAVIS 1992; ANDERSON 1994a,b; UNGER-HAMILTON 1991) and in large-scale wild cereal cultivation experiments in France (ANDERSON-GERFAUD *et al.* 1991, ANDERSON *op. cit.*).
5) The study of microscopic wear traces (polish texture, striations...) on stone tools used experimentally for harvesting (*i.e.* No. 4) and other tasks, as compared with archeological glossed tools (ANDERSON 1991, 1992; see refs. in ANDERSON 1994a,b; UNGER-HAMILTON *op. cit.*).

Although certain Natufian pieces have traces allowing us to deduce they were inserts in sickles used to harvest wild cereal in the area during this period (ANDERSON-GERFAUD 1991), there is disagreement as to whether their use-traces are sufficient data for arguing that systematic cultivation was underway as opposed to harvesting of wild cereals in their natural environment (ie. as in UNGER-HAMILTON 1991, KOROBKOVA 1993 and this vol.; *contra* ANDERSON-GERFAUD *op. cit.*, ANDERSON *op. cit.*). We will briefly re-evaluate the question of whether there is microwear data capable of differentiating between these two activity contexts, in light of recent experiments in S. Syria harvesting extensive stands of wild cereals, which extend the data set reported earlier from experiments harvesting cultivated wild cereal at Jalès (ANDERSON *op. cit.*).

In this article, we address the following questions: What were the glossed pieces found on the Terrace actually used for? Do glossed tools used for a particular purpose correspond to one or to several blank types and typological categories? Were these tools systematically re-used? How were harvesting tools used, in terms of hafting, time and context of use? It seems to us that these questions are of importance for this industry and the Natufian in general, as well as in comparison to Neolithic glossed tools, for which the Natufian pieces are a kind of forerunner. We hope that these new observations contribute to the existing data and help advance the above questions on a wider scale.

Sample and Methodology

A test excavation was carried out at Hayonim Terrace by O. Bar-Yosef, then was excavated in 1974-75 by D. Henry, and in 1980-81 and 1985-89 by one of us (F.V.). These excavations found Kebaran Geometric, Natufian, and Final Neolithic occupations (HENRY *et al.* 1981, VALLA *et al.* 1991, KHALILY *et al.* 1993). We will discuss only the Natufian occupation in this article. Henry recognized Lower and Late Natufian on the Terrace. However, our later excavations did not find Lower Natufian, either in the test trench of 1974, widened over part of its length, nor in the new areas explored. Therefore the material presented here is entirely from the Late Natufian. If we consider non-calibrated C14 dates, it is dated to between 11,200 and 10,500 BP.

The flint industry is rich on the Terrace, and the material excavated during the latter excavations is far from studied in its entirety. To date, only one sample has been completely analysed. It is composed of 4,761 identifiable objects, including cores, and 872 tools and waste products: burin spalls, microburins, etc. This sample will be used as a reference. There are 12 glossed tools, representing 1.37% of the tools. The extremely small proportion of this type in the present sample, is found also for the Terrace overall.

In order to obtain a significant sample of glossed tools, we decided to sort the entire tool assemblage excavated between 1980 and 1989. We thus isolated 344 objects, which to the naked eye, seemed to show a more or less developed gloss; about 260 of these tools were used in the present study.

The 260 tools with gloss traces which are more or less pronounced to the naked eye were examined using the microscope, over a period of 6 years off and on, in complement to detailed morphometric analysis. The tools were examined using a binocular microscope with magnifications of up to 50X and, particularly, a metallographic (reflected-light) microscope at magnifications of 100 and 200X. We used characteristic attributes of gloss distribution, texture, development and brightness, and morphology of striations to infer the nature of the material worked. Using orientation of polish and striations, and bifacial distribution of the traces, we identified the working motion. Identifying the function of the archeological tools with clear microtraces of use, was proposed when the attributes of these microtraces were replicated in experiments using copies of the ancient tools in contexts as close as possible to those present around Hayonim Terrace. We needed to use this method because experiments showed that a variety of uses involving a worked material containing fine abrasives and humidity, can cause a visible gloss to form on the tool working edge. Thus not only harvesting of cereals, but also cutting reeds and in some cases, working skin, stone, clay, ocre and soil, can cause gloss to form (see ANDERSON 1994a,b). Experiments have shown, furthermore, that certain attributes visible only on a microscopic level are often highly correlated to one or the other of these functions, and therefore uses producing gloss can be frequently differentiated on archaeological tools (*ibid.*).

Notably, a preliminary sample of tools studied and returned before the end of our experimental programme, were unable to be re-examined in light of the specialized experimental results before writing this paper, and therefore cannot be discussed here. Of the remaining glossed objects, we decided that only those for which worked material and working motion could be determined, as described above, to a similar level of precision, would be discussed in the present study. Therefore other tools which had traces which were not clear enough to identify the material they processed or worked or the mode of use, were excluded from the present sample. These either showed no traces which could be attributed to use (unused or too brief a use to mark the tool), or showed use-traces too weakly developed to identify worked material. However, the majority of objects excluded from the present discussion had post-use alterations which had introduced distortion, usually burning which altered traces or mimicked gloss all over the tool, or fragmentation too extreme to allow for analysis.

Tool Uses

Of the 69 tools for which the use can be determined in the most recent sample to the level of precision above and while examining experimentally-used tools at the same time, 48 objects had microscopic traces of use like those we obtained on blades hafted in sickles we used to harvest wild cereals and grasses in dense stands, cutting stems in groups near the ground (Figs. 1-3, 4:1-7; Pls. 1-3). This group includes 8 tools having pronounced traces of abrasion from the soil during the harvesting. 3 tools have traces characteristic of use to cut (harvest) a hard, siliceous plant such as reed (*cf.* Phragmites, Fig. 4:8-10, Pl. 5:1), 9 tools have traces of use for cutting skin at various stages of preparation of leather objects (Fig. 5, Pl. 4), and traces on 9 tools testify to shaping of objects made from various mineral materials (soft stone, etc.; Fig. 6, Pl. 5:3).

These data show that gloss which can appear similar to the naked eye, corresponds at Hayonim to several different uses, once comparison of microscopic use-traces on these tools with numerous experimental ones is carried out. The uses we found in our analysis include both subsistence activities (grain harvest, off-site) and artisanal activities (cutting of plant stems, off-site, for making objects on-site (*i.e.* basketry, roofing, making skin and hide objects for clothing, shelter; making of containers, etc. from these and stone materials). These objects and their characteristic microwear traces are illustrated and described in the figures and captions. We will first try to show, using attribute analysis, whether particular selection criteria or techniques were applied to tools used for these different purposes.

Archaeometric and Functional Attributes

Blank Selection

The sample resulting from our selection process for functional attributes (see criteria above) is too small to allow us to go far in analysing choice of particular blank types for different given tasks. However, some blank choice criteria can be easily shown. For example, if we compare the 57 glossed tools used to cut plants or skin to our original reference sample, we find a strong selection in favor of blades (as defined by CALLEY 1984). This selection is clear in comparison with the ensemble of the debitage. This tendency, perhaps not surprising, also occurs in relation to all tool blanks (glossed or retouched pieces).

Table 1.

	Small flake		Flake		Blade		Bladelet		Undet.		N
	N	%	N	%	N	%	N	%	N	%	
Debitage	2076	46.87	344	7.76	253	5.71	1756	39.64			4429
Formal tools	50	6.31	141	17.8	104	13.13	386	48.73	111	14.01	792
Glossed pieces	0		4	6.66	36	60	16	26.66	4	6.66	60

The selection was for blanks which were elongated (module 2 and greater) and usually, wide. Although the small sample size precludes any statistical proof of closer correlation between worked material and type of blank, the table below suggests a lesser selection for elongated, wide blanks occurred for working mineral materials (Fig. 10) than for other uses.

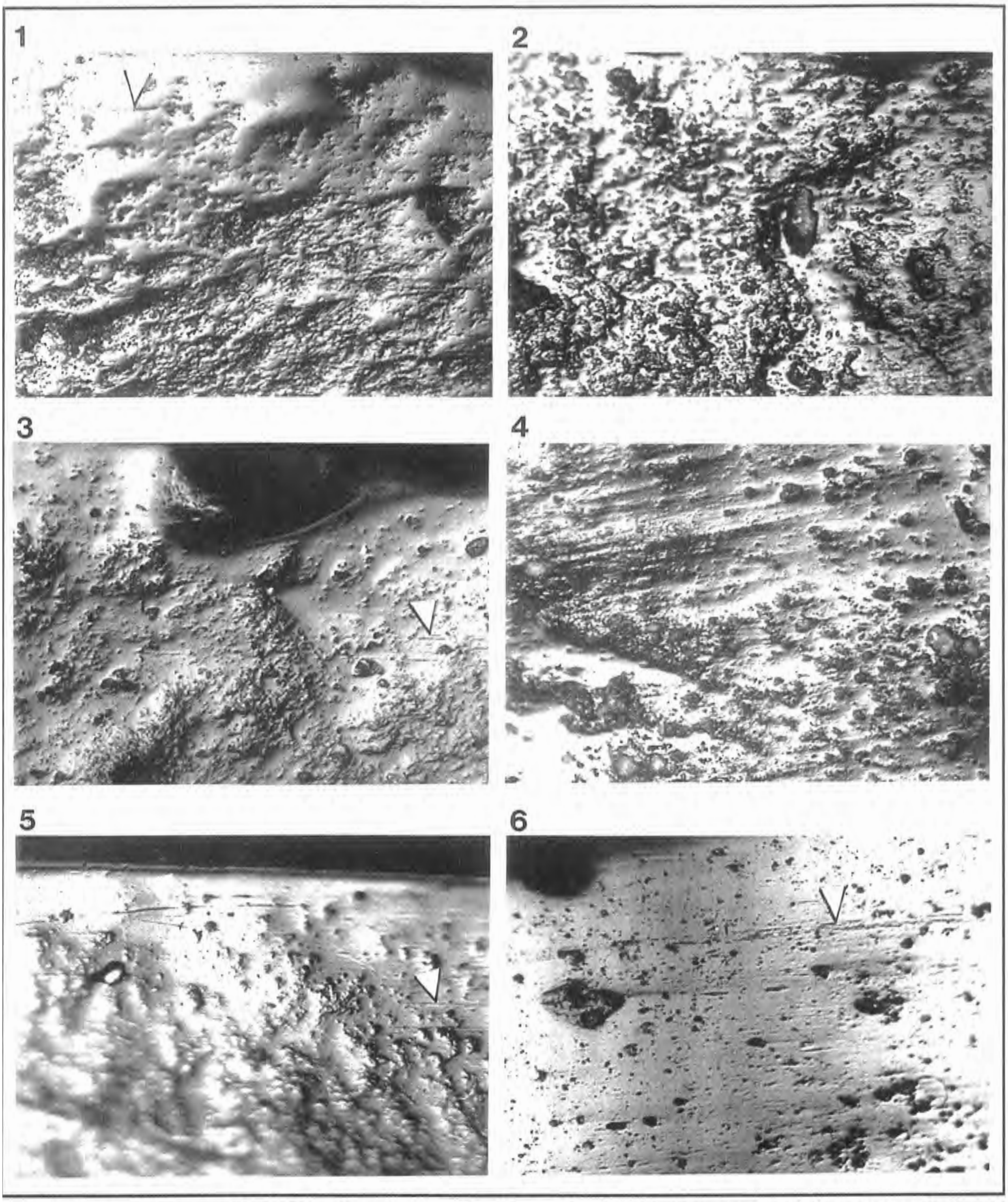

Plate 1. Micrographs of traces from harvest of wild cereals. Arrows show characteristic striations from contact with soil grains on the stems.

1,3 on elements hafted parallel to a wooden handle, and used experimentally to harvest wild cereals (principally wheats, some barley) in the Jebel Arab near Al Mushaneff, Syria for 13 hours

2,4,5,6 on various glossed blades from Hayonim Terrace not drawn in figures, similar to 1 and 3. These striae and the bright but fairly flat polish is characteristic of harvesting stems before they are dry, and before most wild cereal grain has fallen.

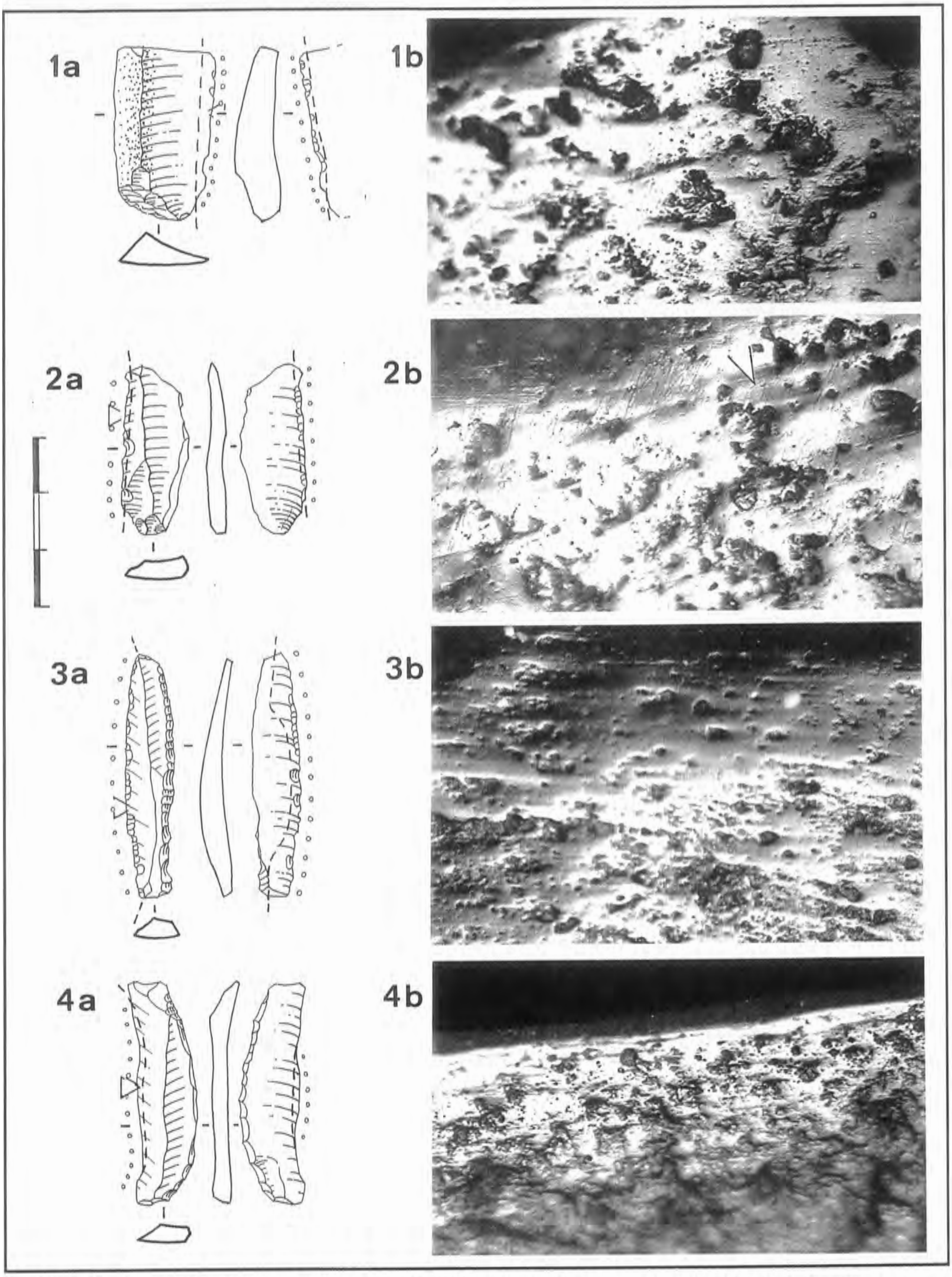

Plate 2. Traces of microwear polish and linear traces and striations characteristic of harvest of semi-green cereals cutting stems near the ground, on dorsal (upper) face, arrows, of truncated or backed elements in Fig. 2:1b,2b, and 3b have traces more developped than those in our experiments of 13 hours, which may point to a longer use-life. Traces like those in 4b were obtained after several hours of cutting.

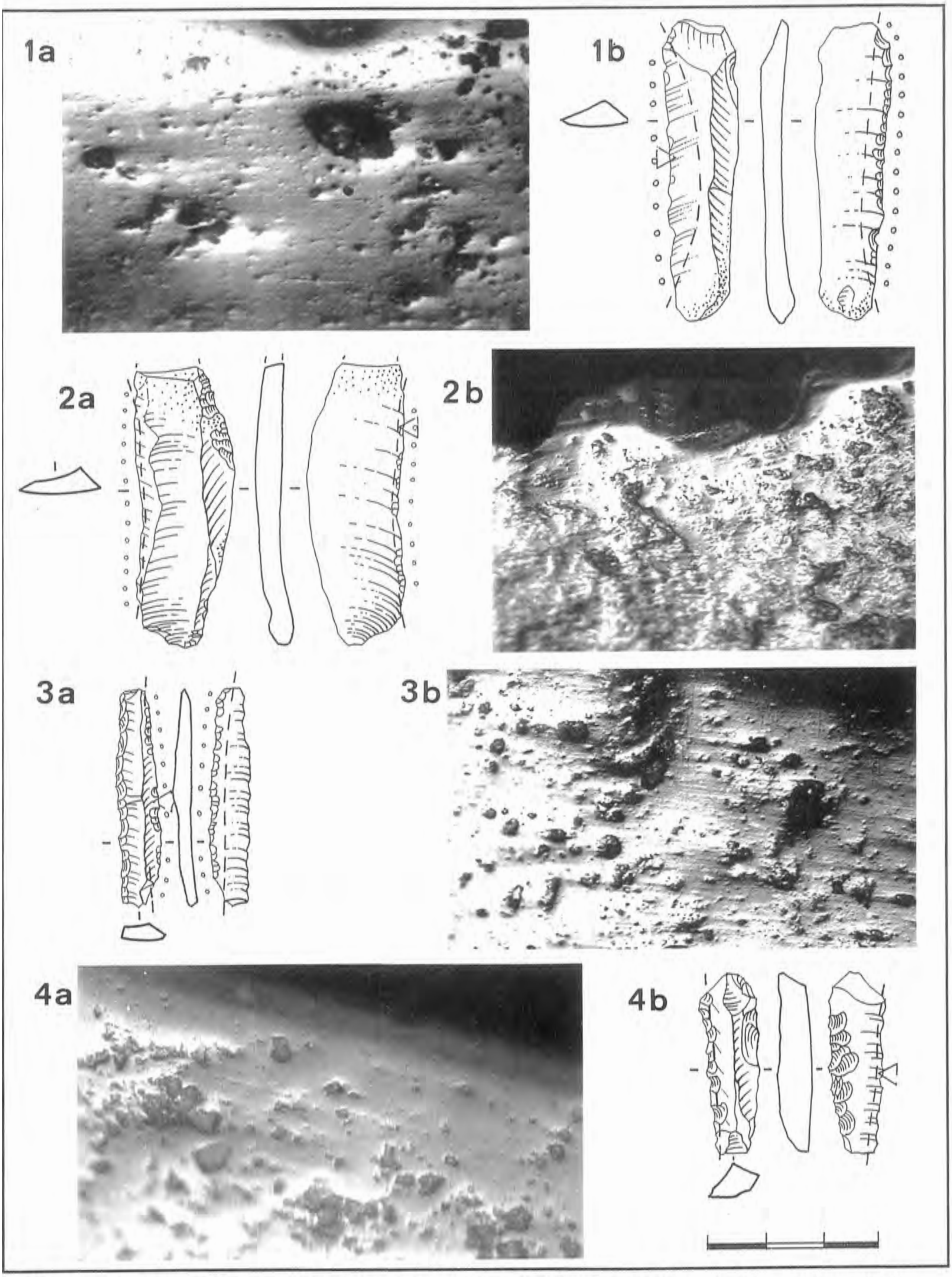

Plate 3. Tools from Fig. 3:1 and 4:1,5,7, and their traces, area of arrows, which are characteristic of intensive harvest of wild cereals (traces are as developped / more developped than those obtained in our experiments harvesting 13 hours, see Plate 1).

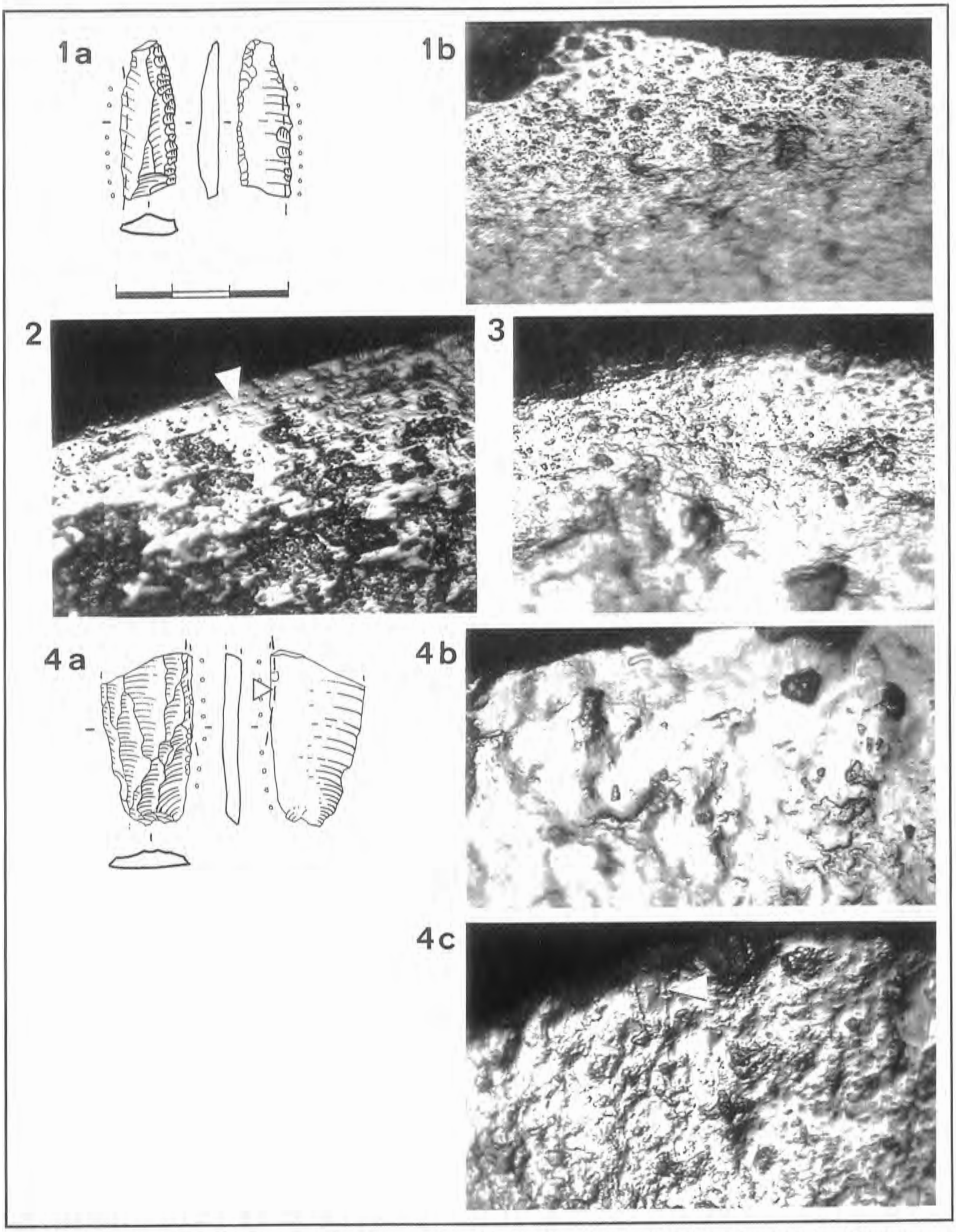

Plate 4. Traces on a tool interpreted as from cutting skin in a humid state and with a fine abrasive (Compare with micrographs of experimental tools used to cut hide with ochre for approximately 30 minutes, by J.J. Ibanez (2) and H. Plisson (3)); 4a-c tool and traces interpreted as from scraping skin (4b is taken at 200X, therefore 100 microns = 30mm. The tool surface appears to have formed an altered "layer" due to contact with lubricants and abrasives added to skin.

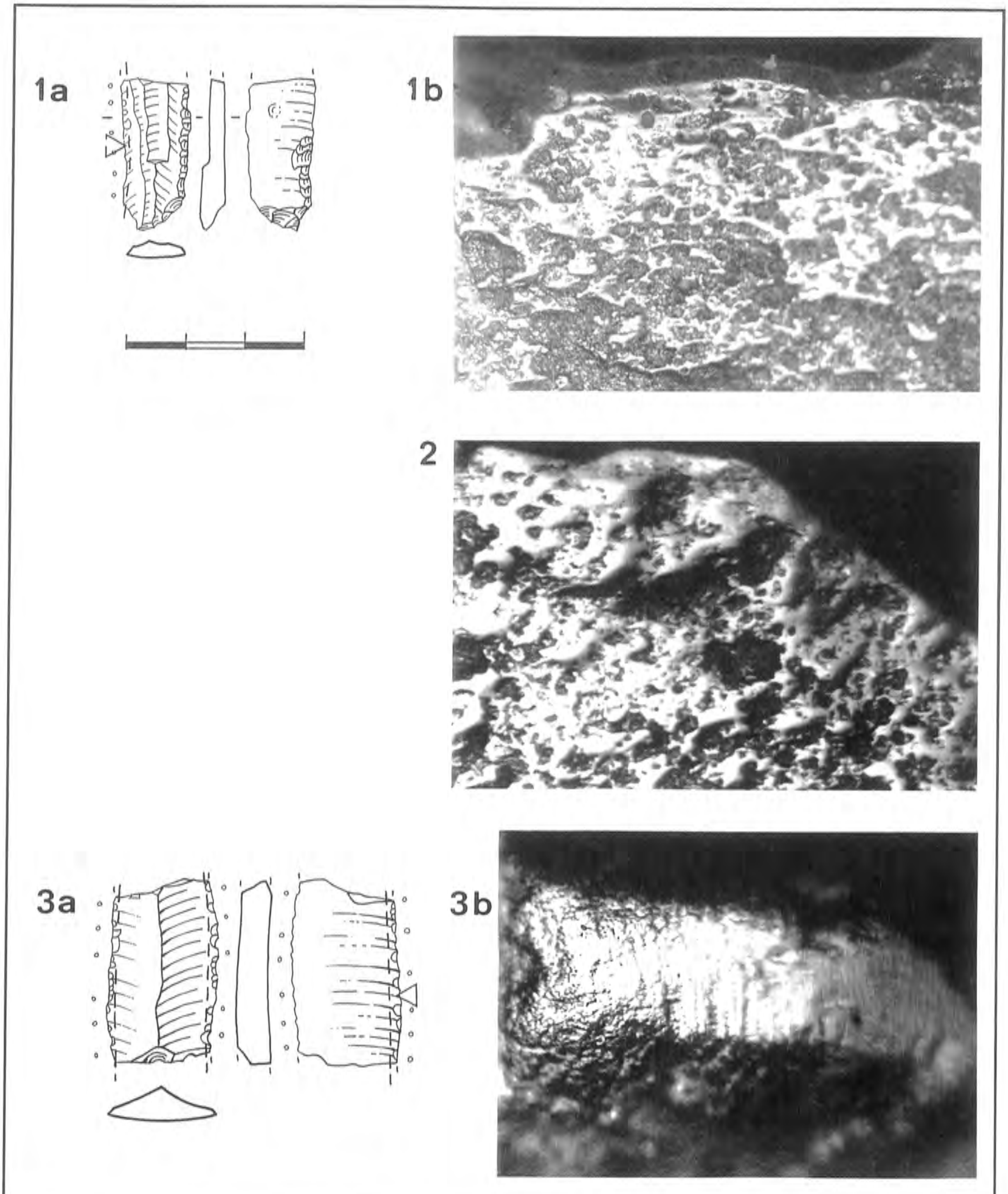

Plate 5. 1a-b Tool and traces interpreted as from cutting reed; 2 traces on an element used hafted parallel to the edge, to harvest reed for 1.5 hours. Note slightly inflated appearance of traces and lack of striae in polished areas. 3a and 3b show tool from Fig. 6:3 with traces on edge characteristic of scraping a soft stone or mineral.

Plate 6. Fragment of rib with groove probably used as a haft, perhaps to hold sickle-blades from Hayonim Terrace (photo by Marjolaine Barazani, C.R.F.J.)

Table 2.

	Small flake	Flake	Blade	Bladelet	Undet.	N
Harvest wild cereal	-	3	28	14	3	48
Harvest reed	-	-	2	1	-	3
Skin	-	1	6	1	1	9
Working mineral mats	-	3	4	2	-	9

The blank profile was also a selection criteria: flat, straight blades were preferred. This selection concerns all tool blanks (in the typological sense) in relation to all debitage products, not just harvesting tools.

Table 3.

Profile	Concave	Convex	Flat	Twisted	Other	N
Debitage	58.73%	1.58%	14.28%	22.22%	3.17%	63
Formal tools	50.54%	1.09%	30.76%	17.58%	-	91
Harvest wild cereal	52.27%	2.27%	34.09%	9.09%	2.27%	44

Blanks with distal irregularities such as plunging or hinged blades were selected against. Ripples or rolls on the ventral face, when not too pronounced, were not rejected. Selection against irregularities is overwhelming for harvesting tools; the only plunging blade used for this was straightened using a truncation.

Table 4.

Distal irregularity	None	Plunging	Hinged	Ventral ripples	N
Debitage	36.5%	30.15%	12.69%	22.22%	64
Formal tools	42.42%	27.27%	10.6%	19.67%	66
Harvest wild cereal	50.0%	5.00%	0%	45.00%	20

The process of choice which rejected curved blanks for harvesting tools is the same one which selected for flat profiles. This is confirmed by removal of certain percussion bulbs which were undoubtedly judged to be too pronounced (3 cases). Proximal arched backs (2 cases) and certain truncations may be related to similar adaptations. Any concave profiles used were not pronounced. In comparison, tools used to work objects of mineral materials show selection criteria different from those above were applied, corresponding to different functional constraints: of six determinable cases, 2 blanks are plunging, one is hinged, and one has heavy ripples on the ventral face.

Cortex was apparently avoided. Among blades left in the debitage category, only 30.15% (N=63) lack cortex. This percentage increases to 58.17% (n=98) for blanks used as tools (as identi-

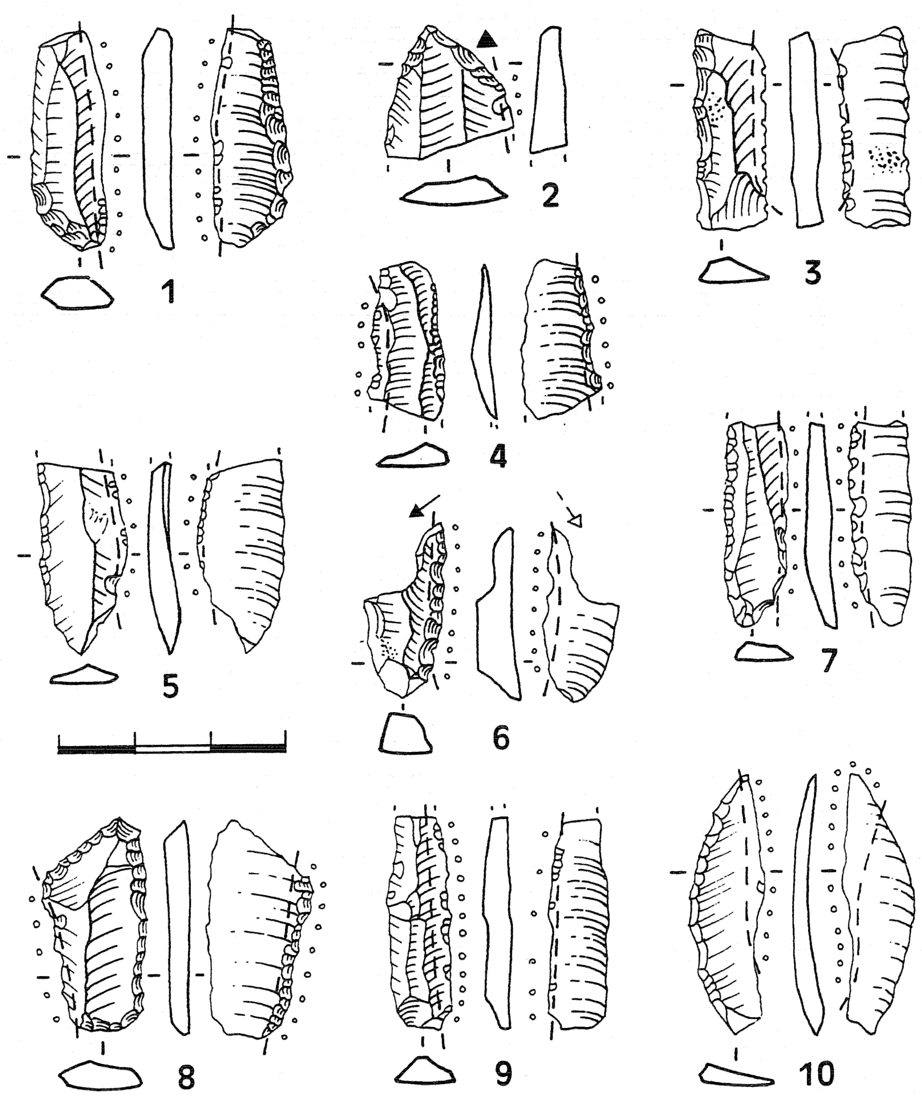

Fig. 1. 1-10 Tools with traces showing characteristics of harvesting of cereals/grasses near the ground, according to our experiments.

Note on the artefact drawings in this contribution:

All breaks, including by burin blow, occurred after the tools were used as designated, because these breaks cut through microwear traces of harvest. No traces of a second use were seen for any of the objects studied here, despite such modifications. ----- *extent of gloss* o o o o *intensive gloss*

Note on the micrographs in this contribution:

Micrographs, from observations at 100X using a Zeiss Axioscop, Nomarski lighting, are digitised images treated using the Biocom Imagenia program, and were taken by one of us (P.A.). Scale: 100 microns = 15 mm.

fied by retouch or gloss). 81.81% of tools used to harvest lack cortex (N=44), and 77.77% (N=9) of those used to work skin. These very high proportions are of the magnitude of those observed on unretouched bladelets (62.17%; N=304) and on bladelet blanks which are formal tools (85.71% N=483). Once again, tools used to work mineral materials from our glossed tool sample studied with the microscope, are selected according to less rigorous or different overall criteria, as 6 out of 9 of them are cortical, a proportion similar to presence of cortex on blades without retouch or gloss.

Retouch and Macro-traces of Use

Glossed tools often show retouch. In particular, many have a retouched back, sometimes associated with a truncation. However, many show no shaping retouch and were used unretouched. Sometimes we see traces which are superimposed on gloss (and therefore occur after or during the use producing

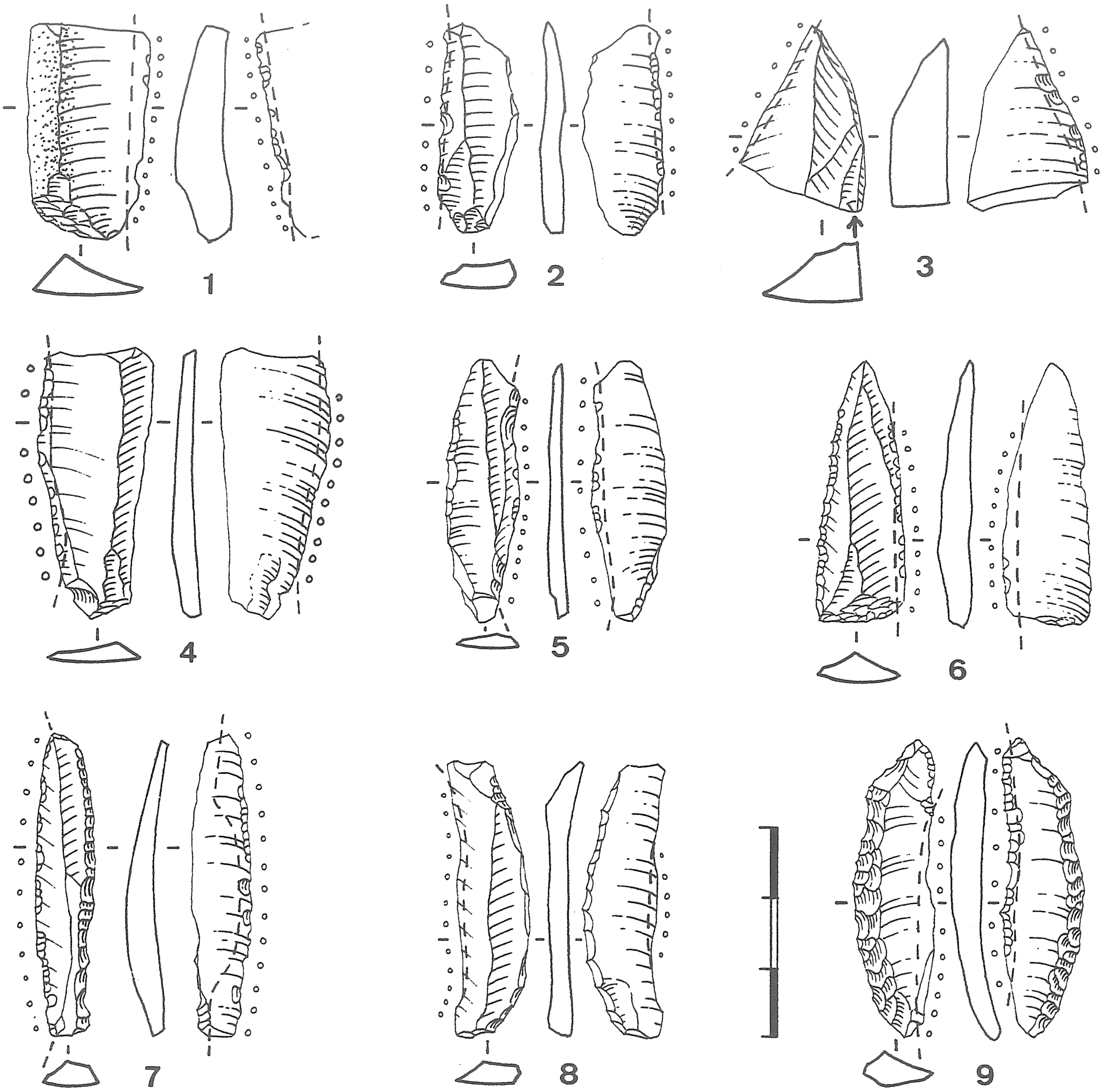

Fig. 2. 1-9 Elements, blades and blade fragments with gloss and microscopic wear traces characteristic of traces in our experiments harvesting wild cereals. Traces on 1,2,7, and 8 are shown in Plate 2.

the gloss, not before), which represent non-intentional retouch, including scars produced by use or accidental breakage not modifying tool shape or typological category. The following table shows typological categories of tools used to work plants, skin and mineral materials:

Table 5.

	D	F	G	H	J	L	M	N	Debitage	Other
Harvest wild cereal	3	17	8	1	1	1	8	1	7	1
Reed	-	2	-	-	-	-	1	-	-	-
Skin	1	2	-	1	1	2	0	-	2	-
Working mineral mats	1	0	1	-	2	-	-	-	4	1

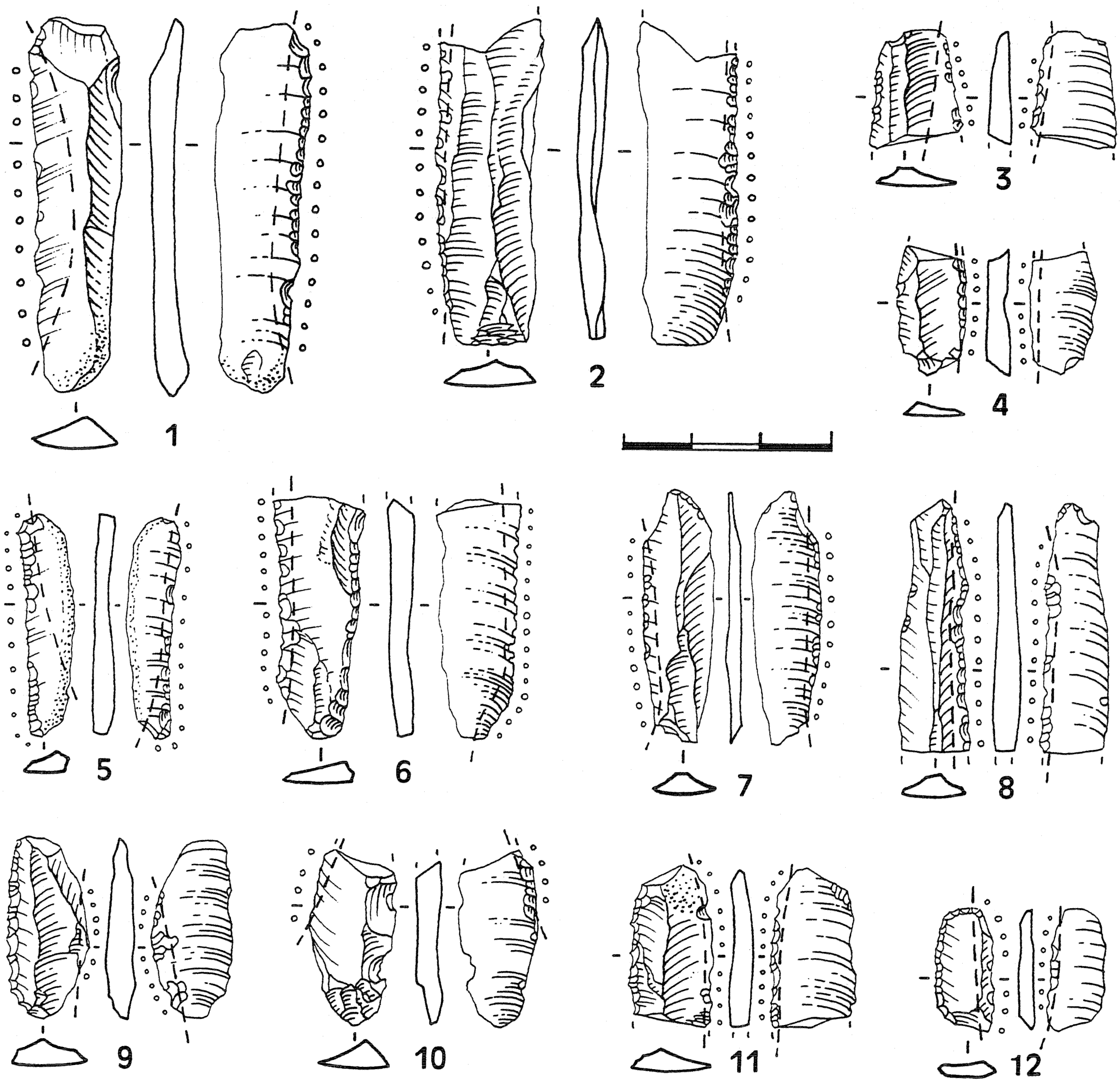

Fig. 3. 1-12 (and Fig. 4:1-7) Blades and elements with microwear traces characteristic of harvesting stands of wild cereals. Backing retouch sometimes helps calibrate the blades, and inverse retouch is sometimes used to extend the use-life of the tool, but only occurs after the tool has harvested with the same edge without retouch first.

The groups are established according to F. Hour's type-list: D-burins, F-backed pieces, G-truncations, H-notches, J- *a posteriori* tools (retouched blades and flakes), L-miscellaneous, M-non-geometric microliths, N-geometric microliths.

Of 69 tools, 21 are backed, and this group grows if we include backed and truncated (5) or bi-truncated (2) pieces. The non-geometric microliths resemble these, because they are backed bladelets which tend to be wide, and sometimes truncated (2). There is also a notched bladelet, a bladelet with direct backing retouch and one with fine inverse retouch. In fact, along with backed bladelets there are blanks without modifications or with minimal retouch such as a notch or tiny retouch scars on a non-glossed edge. Those pieces are scattered among various typological groups. These observations apply to most tools used to work mineral materials.

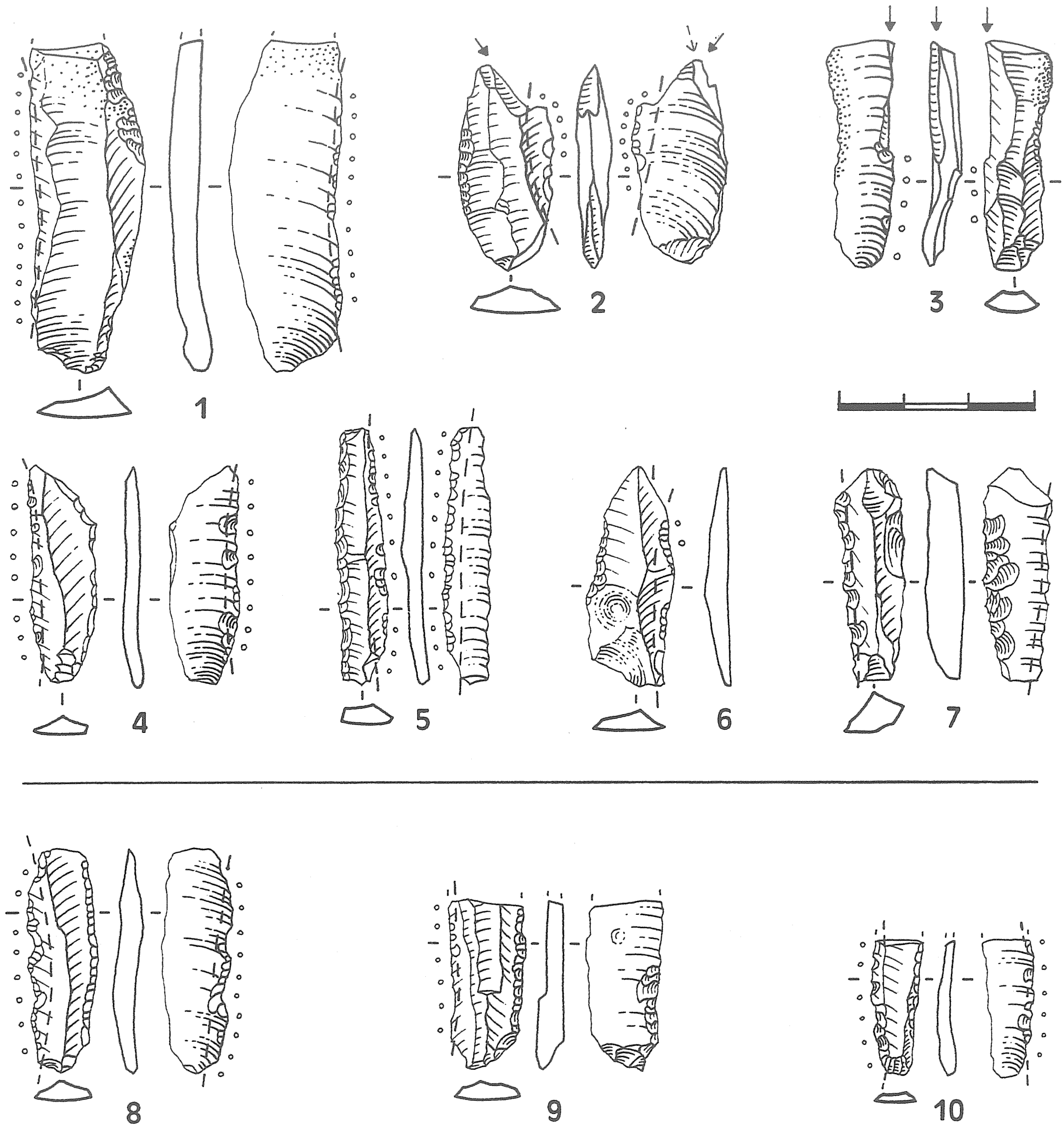

Fig. 4. 1-7 Blades and elements with microwear traces characteristic of harvesting stands of wild cereals. Backing retouch sometimes helps calibrate the blades, and inverse retouch is sometimes used to extend the use-life of the tool, but only occurs after the tool has harvested with the same edge without retouch first; 8-10 tools with traces characteristic of harvest of reeds.

Burins

Some tools were modified following use, most commonly broken by a burin blow (5), including one large tool, after use for cutting skin (Fig. 5:1). The cutting edge of another tool, after use to harvest, was retouched in preparation for a burin blow. The latter two tools were classified as "miscellaneous". Two burin spalls were put in the "other" category. One curious object from the site which is not part of the present study is a microburin. What were the reasons for these burin blows? Do they represent re-use of the tool, as is often hypothesized? Our microwear analysis (PA) of the new edges and bevels created by the burin blows shows no use-traces, implying that the tools were not re-used following the burin blow modification. Their intent remains to be established.

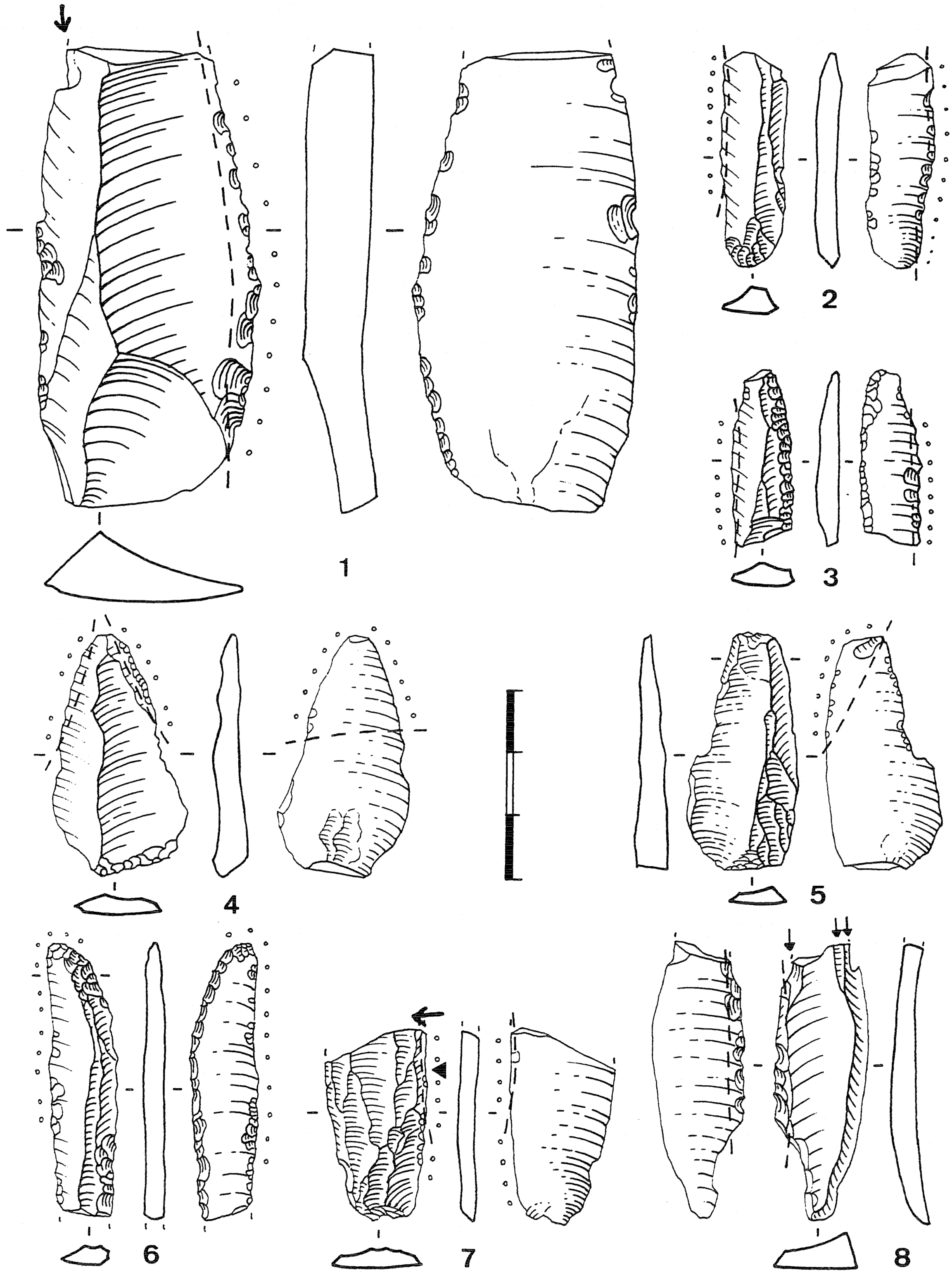

Fig. 5. Tools with traces interpreted as from cutting or scraping skin, which in some cases was treated with a fine abrasive (*cf.* ochre?). Some appear to have been used without hafting, or hafted at a more oblique angle than the harvesting tools, and probably episodes of use occured using single tools rather than hafting and composite edges for most of these.

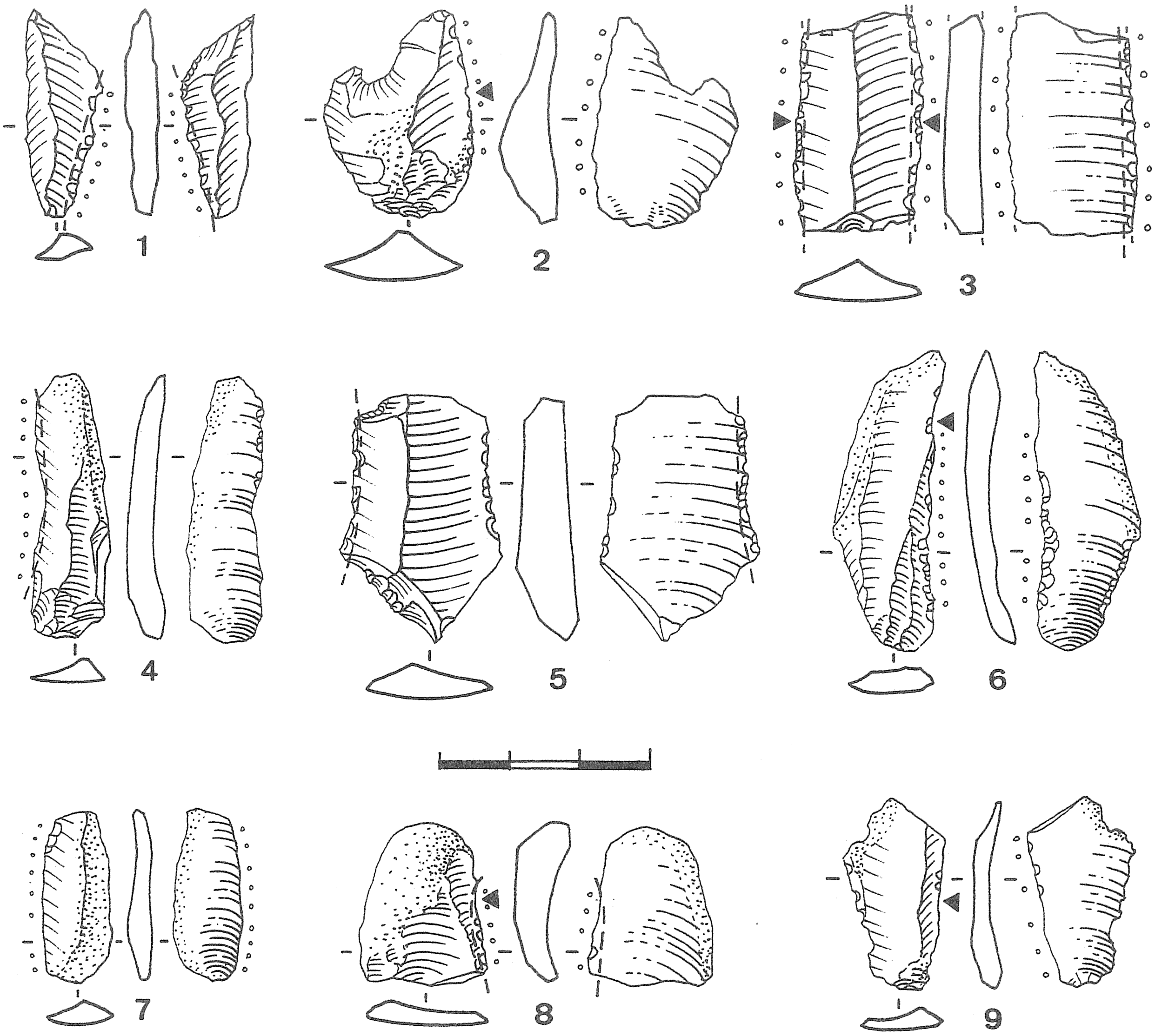

Fig. 6. Tools with more or less visible gloss and traces interpreted as from scraping, grooving or cutting soft stone, probably to shape objects of stone (limestone, perhaps ochre, etc.). Note frequency of scraping (2,3,6,8,9), according to direction of microwear traces and use of both edges. All are thought to have been used unhafted.

Standardization and Retouch

The frequence of backing and truncation retouch for glossed tools raises the question of whether these are an attempt at standardization of blank shape and dimensions, and if these were of functional significance.

One approach is to compare dimensions of glossed tools with those of whole blades and flakes in the debitage (without gloss or retouch traces). For tools used for harvest, we give separately mean dimension of whole or nearly whole tools (N=18) and those having their area of maximum width unbroken (N=47). For skin-working tools, the one large objet (74x36x12mm) was eliminated from the sample because it skewed the overall characteristics of this tool group.

Table 6.

	Blade (63)	Bladelet (304)	Harvest wild cereal (18)	Harvest wild cereal (47)	Skin (7)	Mineral (8)
Length	32.21mm	20.23	35.33			
St. Dev.	4.95	4.56	9.53			
Variance	24.56	20.85	90.7			
Range	24.5 -43	13 -36.5	17 -53			
Width	13.76mm	8.18mm	11.02mm	11.48mm	14.57mm	16.25mm
St. Dev.	1.76	1.81	2.32	2.81	4.15	4.71
Variance	3.13	3.28	5.42	7.91	17.28	22.21
Range	10.7 -19.7	3.4 -12.9	7 -17	7 -18	8 -21	10 -23
Thickness	4.65mm	2.7mm	3.72mm	3.91mm	4.71mm	4.87mm
St. Dev.	1.71	1.17	1.12	1.47	1.25	1.64
Variance	2.94	1.37	1.27	2.17	1.57	2.69
Range	2.6 -10.5	1 -8.20	2 -6	2 -9	3	3 -7
L/W ratio	2.34	2.51	3.25			
St. Dev.	0.32	0.49	0.84			
Variance	0.1	0.24	0.71			
Range	1.99 -3.14	1.9 -5.29	2.15 -4.87			

We see that tools chosen for harvesting are relatively long, the shortest being a small trapeze. Of the measureable pieces, 12 are over 30mm. There is dispersion in values compared with unretouched blades and bladelets in general, however. It appears that the narrowest bladelets were eliminated. The mean width of harvesting tools is between that for unretouched blades and bladelets. Like length values, width values are relatively dispersed if compared to the unretouched pieces. Relatively wide blanks were used as skin-working tools, and even wider ones for working of mineral materials; these are of varying morphology. The mean thickness is relatively high, between 4-5mm. The length/width ratio for harvesting tools shows elongated tools of similar proportions.

In some ways the figures show two contradictory tendencies. They show a preference for tools which are large in relation to debitage in general, of a somewhat calibrated width (centered around 11-12mm for harvesting tools), of sufficient thickness as to be strong, and very elongated (again, in relation to debitage in general).

The figures also show some flexibility in that people accepted heterogeneous objects whose length and width are less restrictive than the thickness and the "module" (length/thickness ratio). The following table explains this conclusion in showing how backing retouch was used to calibrate width.

Table 7.

Width	7	8	9	10	11	12	13	14	15	16	17	18	+	N
Backed pieces														
Harvest	1	6	1	6	2	8	3	3	-	1	-	1	-	32
Skin	-	-	-	1	-	1	-	-	-	-	-	-	-	2
Other pieces														
Harvest	-	1	4	3	1	-	1	-	1	2	1	1	-	15
Skin	-	-	-	1	-	-	-	-	1	1	-	1	2	6
Mineral	-	-	-	1	1	-	-	2	-	-	-	1	3	8

Backing, Truncation and Hafting

Over two-thirds of the backed pieces (24 out of 34) have a width between 10-14mm, whereas the width of most (19 out of 29) of the other pieces fall outside these limits. This characteristic can be seen particularly on harvesting tools (Figs. 1-4). Undoubtedly, the width of these objects is largely determined by the hafting requirements for the tools. That the tools were hafted is clear from location of traces and occasional residues of probable adhesive material near the backs. Approximately the same width of edge protruded from the adhesive material, and hafting was more or less parallel to these edges. Certain objects occupied intermediate position in the hafts, and others were at one or the other extremity, judging from gloss distribution and direction. Does this apply also to other tools? Fig. 5 shows a less homogenous situation for tools used to cut skin in various states. We undoubtedly find tools corresponding to different stages of treatment of skin or manufacture of skin objects together here, which our experience does not allow us to nuance. Fig. 5:1 may have been held in the hand.

Fig. 5:4-5 may have been held or hafted at the bulbar end, and this may be the case for Fig. 5:7. Nos. 2,3,6 and 8 of Fig. 5 may have been hafted alone or less likely in groups in a haft. Burin blows may have helped adapt Fig. 5:1 and 8 for prehension or hafting. Presence of cortex and width of blanks may have facilitated prehension during use for tools used to work soft stone and perhaps ocre in one case (Fig. 6) as if to shape objects in these materials.

The degree of shaping modification varies considerably from one tool category to another. It also varies a great deal among individual tools. Sometimes the retouch creates a desired form, sometimes the blank shape is barely modified. The majority of harvesting tools have completely retouched or partially retouched backs (32 out of 47), in clear contrast with pieces used to work skin (only two backed pieces) or mineral materials (no backed pieces). The back is almost always made using direct retouch. Bipolar retouch is practically inexistant: in two rare examples, it appears on thick objects with predominantly direct or inverse retouch. Bifacial oblique retouch (Helouan) is rare, as is to be expected in a Late Natufian context such as this.

Table 8.

Retouch	Direct	Inverse	Alter-nating	Bipolar	Oblique bifacial
Harvest wild cereal	23	1	4	2	2
Skin	-	-	-	-	2

Half of the backs are convex. Certain are arched at one or both extremities. Their mean thickness is barely less than or the same as that of the blank, giving them a triangular or trapezoidal transverse section. For harvesting tools, the left side is more often retouched (16) than the right side (11) (undetermined : 2 when the observation was made).

Ten harvesting tools have both truncations and backing. Another without backing has a truncation inclined towards the active edge. Usually, truncations are associated with a convex back, which narrows the object towards one end, and are both narrow and poorly delimited, and never form large rectangles. One of them is intended to straighten a plunging blank. We observed a small trapeze which is atypical, despite a back and truncations.

On pieces with single truncations, these are proximal (3 for harvesting, 1 for working of mineral material) or distal (5 harvesting tools) and nearly always direct. Truncations are used, in the case of harvesting tools, for pieces varying between 17mm (if we take into account the trapeze, 22mm if we omit it) and 53mm in length. This does not show any intentional calibration, but the sample is inadequate.

Attributes of the Active Edge

The active edge is found as often to the right (17) as to the left (18) for the harvesting tools which were able to be oriented. Only in the case of one tool were both edges used. Inadequate sample size eliminates tools having worked skin and mineral materials. Nonetheless, for three of these, both edges were used. The angle of the active edge varies between 20 and 60°. This angle tends to be less for tools having treated minerals than for those having harvested or worked skin.

Table 9.

Edge angle	20°	20-30°	30°	30-40°	40°	40-50°	50°	50-60°	60°	Undet.
Harvest wild cereal	3	3	9	1	14	1	8	1	5	1
Skin	-	-	2	-	1	-	4	-	-	-
Mineral	-	1	6	-	4	-	-	-	-	-

A few active edges were retouched. Four harvesting tools (Figs. 1-4) have a small direct (2) or inverse (2) denticulate retouch, and four others have restricted direct (2) or inverse (2) retouch. In one case, this retouch was done between two phases of use. Among those tools having been used to cut skin (Fig. 5), one with both edges used shows fine inverse retouch on the right edge, and a partly bifacial retouch on the left edge. The angle of each edge measures about 60°. Two other pieces show a small direct partial retouch. Tools were used without retouch to work mineral materials (Fig. 6), except one having small direct retouch. Therefore, it seems that whatever the function, unmodified active edges were preferred in this sample of glossed tools.

Other than gloss, the active edge of most of the tools shows macroscopic use-scars. For the harvesting tools, there is direct (4), often inverse (7) or bifacial (11) scalar edge damage, and sometimes direct (1) or inverse (7) splintering. The active edge of one blade broke during use. Tools used to work skin have inverse (1) or bifacial (3-with the edge destroyed in one case) scalar damage, or direct

(2) or inverse (2) splintering. The one heavy duty tool combines inverse splintering and bifacial scalar damage. Tools used on mineral materials have direct (1), inverse (2) or bifacial (5) scalar damage, more often than direct (2), inverse (2) or alternating (1) splintering. These edges often appear broken or destroyed by use (4).

Discussion

Selection and Standardization

The study of glossed pieces shows different products were selected according to the work for which they were intended. Although the sample is rather limited, it seems that tools having worked mineral materials are characterised by choice of less elongated blanks with less regular profiles and are voluntarily cortical (Fig. 6). These same objects are voluntarily less often retouched than the others and are wider (see discussion above concerning prehension). This finding is interesting because it shows behaviour corresponding to other evidence in the flint industry of the Natufians of the Terrace.

The glossed pieces destined for use for harvest and for skin-working are almost always large bladelets or small blades. On the contrary, the overall debitage abandoned on the Hayonim Terrace is rarely bladelike. It would of course be premature to affirm that no systematic blade debitage was practiced, but we cannot, on the basis of the sample studied to date, demonstrate a tendency to the contrary. The blanks used to harvest correspond therefore to reasonably consistent selection criteria. This selection is the same as the one for backed pieces, whether glossed or not, for the sample of tools analysed here. For all the other types (except the microliths, if we say, to simplify matters, that they are on bladelets), the choice is no less evident, but more varied, and none show a majority of tools on blade blanks.

The issue here is therefore standardization of the flint industry studied. This as well as tool size, appears to govern the choice leading societies living in the Levant during this period to abandon "microlithism". There was a progressive passage from a microlith debitage to irregular products (associated with microliths, which were standardized), to a debitage oriented to the production of standardized blades, which were blanks on which were made tools of a certain diversity in shape.

Harvesting Tools

In this context, the sickles of the Terrace seem to anticipate later practices, in the sense that they are relatively large and tend to be made on regular-shaped blanks, to produce objects which allow for a wide margin of variability. We may be therefore tempted to think that these tools played a major role or at least a decisive one, in the transformation of flint use, which begins a little after the Natufian (CALLEY 1986, LECHEVALLIER and RONEN 1994). Nonetheless, we recall that from a strictly technical vantage point, harvesting was only an episodic event in the lives of the societies of this period (but represents far longer use-life than for other tools, and was carried out using precisely-calibrated composite tools, see discussion below). We can nonetheless hypothesize that if the tools used for this played a role in the transformation of the modes of flint exploitation, this can only be through cultural choices of another order.

Numerous glossed pieces, including those used to harvest, are not retouched. When retouch occurs, it is very often used to back the tool. We were able to show that this back tended to calibrate the width of the blades to between 10 and 14mm. In the absence of hafting traces or intact hafted tools, it is difficult to extrapolate the significance of this optimum width (but see discussion above). In addition, we can emphasize that over time, there was a tendency towards wider and wider sickle elements or blades, perhaps corresponding to differences in hafts (*i.e.* deeper grooves). At Munhata, Gopher notes that according to stratigraphical units, the mean width of sickles (glossed tools lacking functional identification), which lack retouched backs, varies between 1.1-1.5cm. (between the limits of 0.9 and 2.3cm.) in the PPNB (GOPHER 1989: 44). This varies, for the ceramic Neolithic of this site, between an average of 14.25-19.37mm (*ibid. 102*). These figures emphasize the relatively small size of Natufian sickle inserts, but this must be balanced against their calibration to the hafts used and optimum use-life attained by using certain hafting arrangements (see below).

Harvesting Frequency

The rarity of glossed pieces on the Terrace is noteworthy, as stated for our reference sample. The proportion among the 4335 tools analysed to date by FV is not greater. They comprise in all, 49 glossed tools, or 1.13% of the total. Below we show their distribution according to F. Hours' type-list.

Table 10.

D	F	G	H	J	L	M	N	Debitage
-	19	4	-	3	1	15	1	6

Such figures can seem very low, if we imagine Natufians as living year-round on their cereal stocks. Furthermore, the microwear trace analysis shows that gloss does not necessarily signify harvesting activity, so this proportion may be still lower. Indeed, storage structures for grain may have been present at the site (VALLA 1995), as well as groundstone tools and cupstones used for grain processing. However, our experiments harvesting wild cereals show certain peculiarities of the activity of cereal procurement and the tools-or lack of them-related to it, need to be taken into consideration, before we judge significance of harvesting activity at Hayonim.

First, cereals can be harvested by hand, without use of any tool, an activity which would not leave a trace, probably unlike tools used for shaping of stone objects, cutting hide into strips, or harvesting reed. Our experience gained in ten years of harvesting wild wheat and barley we cultivated in France (brought from Syria and Turkey; ANDERSON 1992), as well as in Israel, Turkey and S. Syria over five seasons, using varied sickle blanks and hafting arrangements, indicates tools used for harvesting in this sample from Hayonim, corresponding to selection of the most desirable blade blanks produced, were optimally hafted so as to produce regular cutting edge efficient for harvest. Distribution and orientation of the harvesting traces and gloss (shown by broken lines, see figures) show Hayonim harvesting tools were hafted according to a particular pattern, with several blanks aligned precisely in narrow hafts, such as ribs with shallow grooves found in the site (pers. comm. B. Boyd, ex. Pl. 6), and fixed in such a way that adhesive extended nearly to the active edge. It could be argued that backing shortens use-life of each blade by precluding use of both edges.

However, the set of the blades in a perfect alignment would have been attained by calibration and strengthening (regularizing) of these blanks by backing. Their width made it possible to use adhesive to securely fix them to a handle with even a very shallow groove. Experiments in another context carried out by J.J. Ibanez and J. Gonzales, Bilbao (pers. comm.), used small blades such as these, fixed with adhesive to a handle without any groove, to successfully harvest. A cache of unmodified bovid ribs found in the excavation of Hayonim Cave (BELFER-COHEN 1988: 151), may have been destined for use as handles, as above.

Also, simultaneous use of two or three blanks to form one cutting edge may appear to reduce use-life of the number of sickle blades identified by a factor of two or three. However, for harvesting, a single blade in a haft would have functioned over a very short period, (an hour or so) if at all, because it would not accommodate the length of the harvesting motion, and would require sawing of stems, which in our experience rapidly dulls the blade or more likely tears it from the haft. However, single blades could form cutting and scraping edges adequate for smaller-scale motions related to working of stone or skin, (see Figs. 5 and 6 and discussion above).

The microwear traces show groups of stems were cut near the soil with each harvesting motion, with the active edge functioning unretouched for at least 12 hours and usually for much longer, if the degree of development of the polish is compared with our experiments harvesting wild cereal in S. Syria (Jebel Arab). Supposing the extreme heat in the middle of the day would render this period useless for harvesting for Natufians, as it did us, (discomfort, tendency of the cereal to shatter and of the blades to loosen in some cases), this degree of wear took a minimum of about five days of work of one individual, which could result in covering kilometers of territory, depending on the density of the stands. The small proportion of harvesting tools in the assemblage also reflects to the short annual season corresponding to this activity, as harvest is only practicable during several weeks each year at best, (only several days in areas of similar altitude, in our experience), during the time between when the grain forms and the spikelet drops to the ground, as compared with other activities represented by these glossed tools (working of skin and stone, harvest of reed) and other "artisanal" activities identified by H. Plisson (see below) on the non-glossed tools, which could have been practiced year-round in a sedentary habitation like Hayonim.

The use-life of sickle blades was long, if compared with tools on the site used for other purposes. The tools without gloss from the Terrace are mostly uni-functional, like sickles, but they were used for short periods of time (VALLA, LEMORT, and PLISSON 1991: 105), mostly in single episodes for probably less than one hour (Plisson, pers. comm.). This is reasonable if we consider most tools in Plisson's sample (other than projectiles) were used without a haft and in transformation rather than procurement activities (excepting projectiles) which involved fairly hard materials (stone, wood, bone, etc.) which would wear the tools fairly quickly to "exhaustion" stage, without further retouch transforming them or extending their use-life. On the contrary, the long use-period of given sickle inserts may correspond to use over only one season, or they may have been curated and used from one year to the next, depending upon factors we cannot control, such as number of harvesters and area harvested each year.

Given the length of use of glossed tools identified as sickle inserts relative to the other tools, the question of re-use has been considered. As seen above, retouch which occurs after use of blanks in sickles, seen as retouch removing parts of the gloss, is, even if relatively rare, noteworthy as compared to other tools. However, that this signify re-use of such tools is problematic, because we (PA) did not find use-traces to show re-use of the glossed tools, either in the area of the later retouch traces or elsewhere. An exception is an end-scraper with use-traces from working skin made on a plant cutting tool but without overlap of the use-areas, which was not part of this sample, studied by H. Plisson (pers. comm). Other research will be needed in order to shed light on this problem. However, for tools used to harvest, we wonder if burin blows and other damage to the active edge could possibly result from striking of the blank to remove it from the haft after use. In the case of Hayonim, such retouch removes parts of harvesting edges which are, in our experience, too worn to be of further use to harvest, and the same edges are not re-used for other purposes, at least not to work hard materials, which normally would be all they would be efficient for, and would have left easily detectable traces (ANDERSON 1994b).

The raw material from which the blanks for these tools is selected, is a flint of fairly good quality but of the normal standard on the Terrace. On the contrary, one of the flint types which seemed to us to be among the best or the best, a red, fine-grained flint, is almost never chosen to make the tools studied here. Unlike what Gopher (1989: 51) observes for the PPNB for tools which end up preserved as glossed pieces (in absence of a microwear analysis of use), at Hayonim Terrace the harvesting inserts do not seem to be a major goal of the debitage strategy used by the flint-knappers. Nonetheless there is no doubt that the blade products were rare and especially sought after, as is shown by their relative presence in the tool assemblage *vs.* the debitage.

Harvesting and the Origins of Agriculture

Our experiments harvesting wild cereals in the Levant in primary stands, of only wild wheats, only wild barley, or a mixture of the two, showed that significant areas of the stands were dense enough (over 300 stems per square meter) to be efficient for using a sickle by cutting bunches of stems near the ground, and at an average stage of maturity lasting only days, when the top spikelets have just begun to fall to the ground, and stems are still somewhat humid (ANDERSON *op. cit.*). We found stands are surprisingly pure, and had fewer "weeds" or other plants than cultivated fields we have seen. The "weeds", more common in thin stands, were of the kind which could be easily avoided, as they mainly consist of thistles growing near the ground. These were easily (and enthusiastically) avoided by the harvester, who either moved elsewhere, to denser areas to harvest, or harvested cutting above the thistles to avoid them. Although harvesting can be done by hand, without a tool, this was only useful in the case of a particular stand of wild barley, which did not grow densely, or where stands were reached too late and were over-ripe, with most of spikelets already fallen from the seed heads. In these cases harvesting with a sickle would have resulted in such great seed loss as to be useless. Harvesting by hand is a very slow process as compared with sickle-harvesting (ANDERSON 1992), and we do not think this would have accounted for a major part of the cereal-harvesting and therefore offer a suitable explanation for the very low proportion of tools used for this.

We feel our experiments successfully imitated Hayonim harvesters, given the harvesting wild cereals documented at Hayonim by analysis of macro-remains and phytoliths. Wheat and barley probably grew in the general area of the site during the Natufian and the Kebaran; Rosen (pers. comm.) found phytoliths of wheat and barley present at Hayonim during both periods, as well as phytoliths from cereal stems. Our experiments also successfully reproduced microwear traces found on Hayonim glossed tools (*i.e.* Pls. 1-3), including the range of variability. We harvested over calcareous and volcanic, basaltic soil. Although we did not find significant differences between harvest of different kinds of wild cereal or over different soil in terms of specific microwear traces produced, all had, like the Hayonim tools, flattish polish with fine striae or narrow "corrugations" in the polish surface, oriented parallel to the cutting edge (see plates). It can be noted in the plates that the Hayonim tools sometimes have more striae than the experimental tools, but in each case, these tools also have a far more developed polish indicating they were used for a much longer period of time than our tools, more than the 13 hours in our longest experiments, giving more time for striae to mark their surface. Striae abundance appeared to have no correlation to anything except harvesting near the soil and duration of tool use. In contradiction with Unger-Hamilton's (1991) experiments which compared harvest of wild cereals with harvest of domestic cultivated cereals in the Middle East, where the latter activity produced more striae, which she attributed to the fact the soil had been prepared, we found fewer striae on tools used to harvest wild cereals growing on worked soil at Jalès in the context of cultivation of wild cereals (ANDERSON 1992), a situation untested by Unger-Hamilton and Korobkova, than for tools used in Syria, to harvest in natural stands. Therefore striae have been experimentally shown to not be an indicator of working of the soil, of cultivation or of agriculture, and presence of striae on Natufian or PPNA tools does not show these practices occurred (*i.e.* contrary to hypotheses of KOROBKOVA, this volume and 1993, UNGER-HAMILTON 1991). These observations also apply to our study of Epi-Paleolithic glossed tools from Abu Hureyra, Natufian from Mureybet (ANDERSON 1991), and from Hatoula (ANDERSON 1994a).

We do not exclude the possibility that wild cereals could have been sporadically sown to approach them to the actual habitation at Hayonim, but this would not have needed to occur annually, and would not require working of the soil. We found that wild cereals in natural stands as well as those once moved and sown, spontaneously re-grow the next year, even if they have been intensively harvested (ANDERSON 1994a,b). Judging from microwear analysis of tools, harvesting activity at Hayonim does not appear any less intensive, or the cereal management system any different from Hatoula Natufian, Abu Hureyra Epi-Paleolithic or PPNA and early PPNB sites studied to date from northern and southern Levant (see ANDERSON 1994a,b).

This study shows that there is no data from these periods that yet support the idea that wild cereals were managed using a system of cultivation, any sowing occurring only sporadically, if at all. Nonetheless the question of the importance of producing efficient sickles at Hayonim and other sites in the S. Levant during the Natufian, and in the Levant overall in the PPNA and early PPNB, should not be underestimated, despite the brevity of the interval during which these tools were used each year. More work is needed to fully understand the question of the abandonment of microlithism, and is currently in progress.

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Nevalı Çori: Chronology and Intrasite Distribution of Lithic Tool Classes. Preliminary Results

Klaus Schmidt

Abstract: *The excavated part of the Nevalı Çori PPNB-settlement contains 21 rectangular and two round houses, grouped into five building layers (Layers I-V; I on virgin soil). Most of the rectangular houses belong to the type of channel houses (known also from Çayönü "intermediate phase"). One exception is the "Pfeilergebäude" with terrazzo floor and many limestone sculptures. Its three building phases belong to Layers I-III. Only four radiocarbon dates are available until now. The chronological position of the settlement is discussed including these dates and some other observations. The analysis of the distribution pattern of several artefact groups underlines the expected functional division of the three different house types ("Pfeilergebäude", channel houses, round houses). Distinct activity areas, shown e.g. by high frequencies of debitage material, can only be proved for open air locations. Other tool frequencies, e.g. concentrations of piercing tools, occurred sometimes in specific rooms of channel houses, but normally in the round houses and open air locations. A high variability of arrowhead types is observable for the surrounding areas of the "Pfeilergebäude".*

The settlement of Nevalı Çori is located in a small valley near the Euphrates river in the Şanlıurfa-province (eastern Turkey). It is now under the water of the Atatürk Baraj lake. The settlement was excavated by H. Hauptmann in cooperation with A. Mısır (HAUPTMANN 1988, 1991/92, 1993, 1996; MISIR 1992; PASTERNAK 1995; SCHMIDT 1988, 1994) and consists of two areas located on the terraces east and west of the Kantara Çay. Both areas belong to one settlement, but the central part has been destroyed by erosion. The former size of the settlement is estimated at 200x200m. Excavations took place both on the western and eastern slopes of the valley, but in the western part the Neolithic layers were heavily disturbed by agricultural activities. To the east the Neolithic occupation was well preserved and an area of about 2000m² was almost completely excavated. It should however be taken into account that this is only a small part of the former settlement.

Neolithic Nevalı Çori consists of 24 rectangular and two round houses, grouped into five building layers (Layers I-V; Layer I on virgin soil)[1].

Most of the rectangular houses belong to the type of channel house also known from the Çayönü "intermediate phase" (HAUPTMANN 1988, 1991/92, 1993, in prep.). The function of these underfloor channels, which also cross the walls, is still under discussion, as is the function of these buildings at all. Clear deposits on the floors of the rooms is very rare. One exception is a room with a limestone mortar plus pestle (Fig. 2:2-3; MORSCH, in prep.) and two prepared cores (Fig. 1:1-2) with a hammer made of antler (Fig. 2:1)[2]. According to J. Boessneck, the source of the antler is *Cervus elapus* maral.

A completely different type is represented by two large round buildings. The diameter of both is around 12m (a third one is not exactly proved). The outline and the dimensions of these buildings can only be reconstructed by postholes, lines of pebbles and pavements, as they were apparently made without stone or mudbrick walls. They may be similar in construction to the Mureybet III round houses (CAUVIN J. 1994: 63, Fig. 15).

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[1] Concerning the preliminary reports HAUPTMANN 1991/92 and SCHMIDT 1994 the numbering of layers has been reversed!: former Layer 5 is now Layer I, former Layer 1 is now 5; the final stratigraphy will be published by H. Hauptmann (HAUPTMANN, in prep.)

[2] The find situation: Hauptmann (1991/92: 25, Fig.18) is not entirely certain that the hammer and the two cores are an on-floor deposit. Immediately above that complex was a small pit and the artifacts could belong to the filling of that pit. Another precore comes from the pavement of House 1: SCHMIDT 1988: 164, Fig. 1.

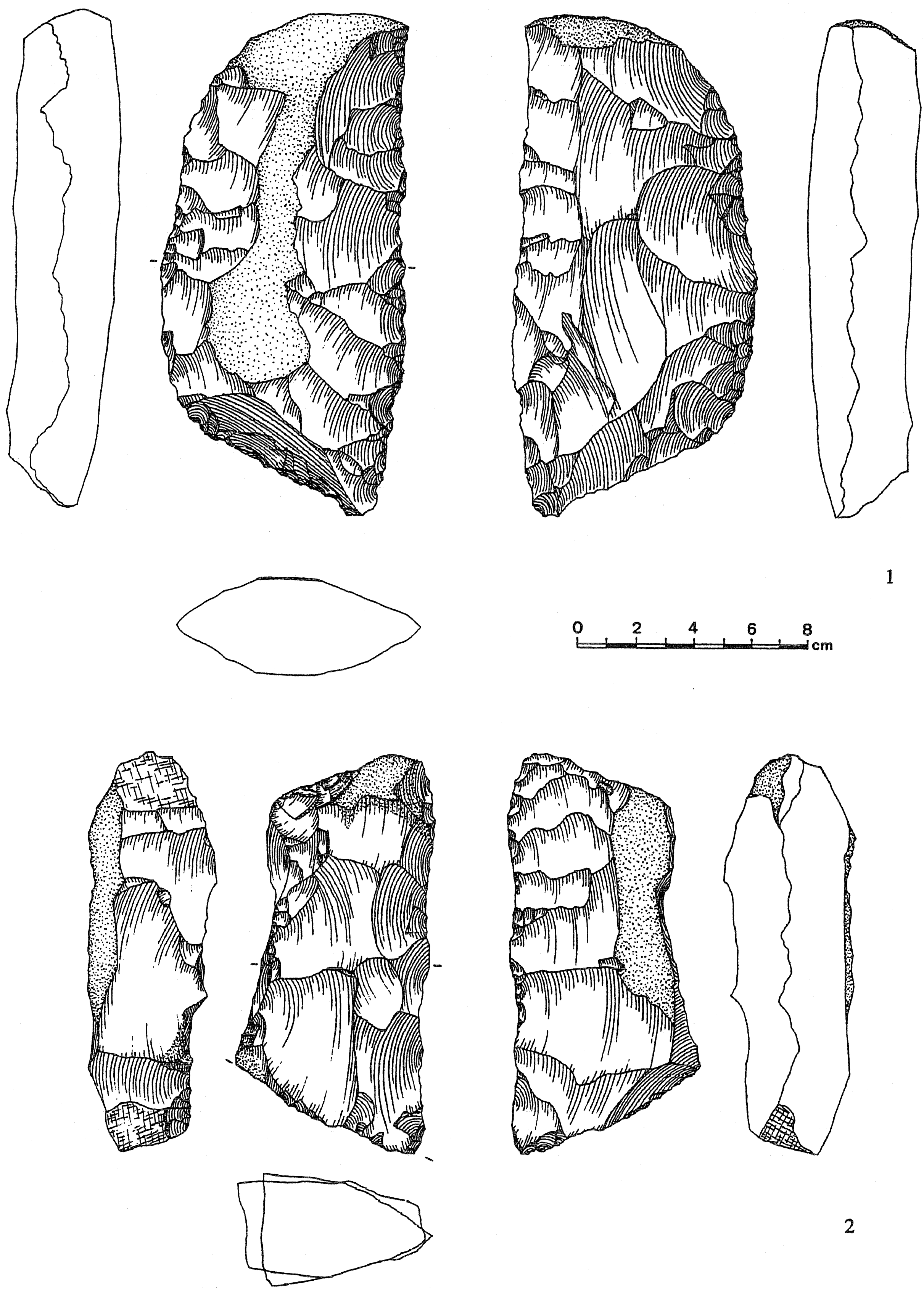

Fig. 1. Nevalı Çori, Layer IIIA, House 6, Room 2: 1-2 pre-cores (silex).

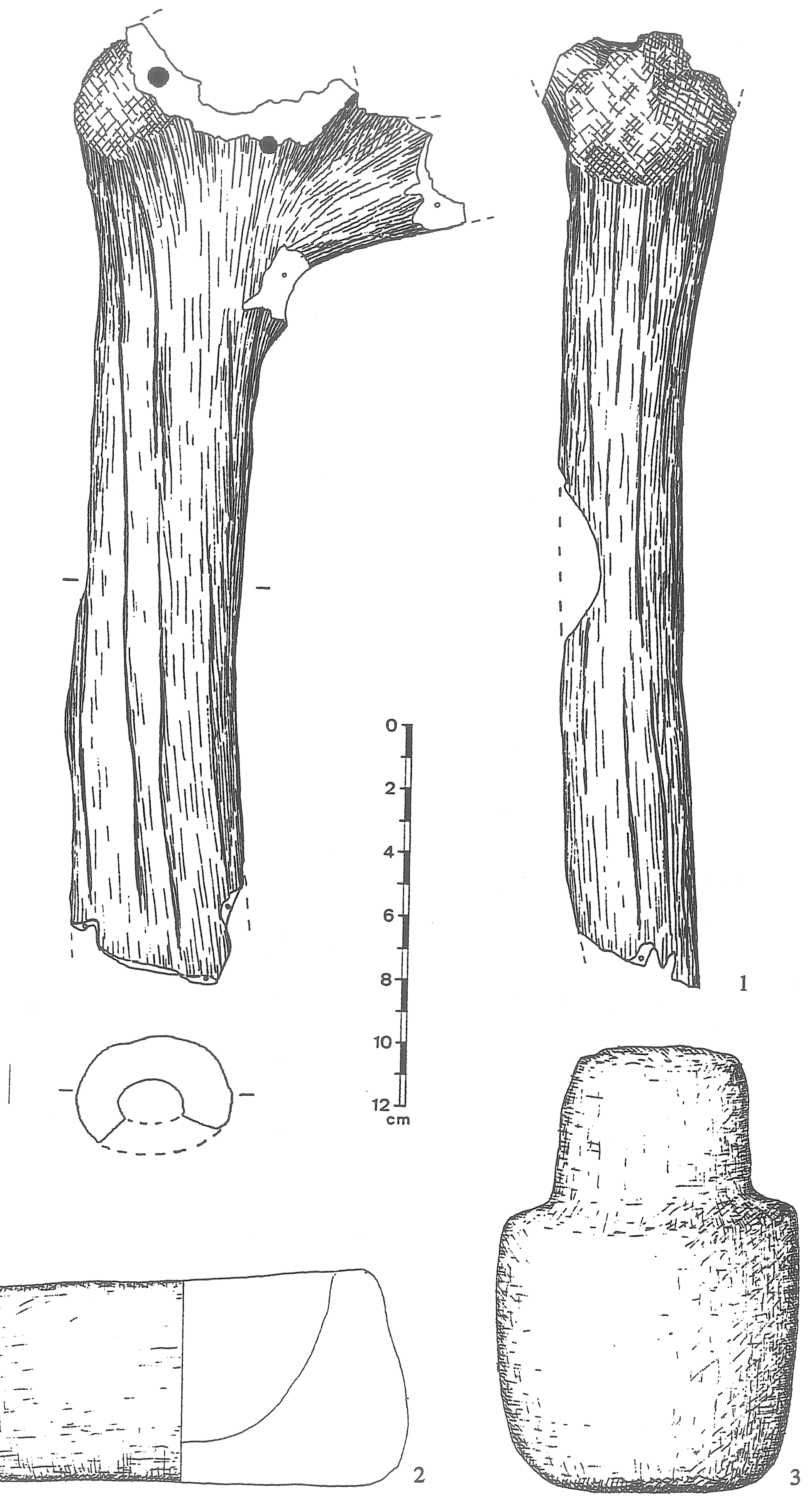

Fig. 2. Nevalı Çori, Layer IIIA, House 6, Room 2: 1 hammer (antler), 2-3 mortar and pestle (limestone).

The round and rectangular buildings are contemporary, but the location of the former was restricted to one area within the settlement; nearly every house was built on an earlier predecessor of the same type. The location of the houses was unchanging during the lifespan of the settlement and clearly shows the relatively stable distribution of discrete areas within the site. It is also clear that the rectangular channel houses and the round houses had different functions, and that these were not chronologically separated.

One notable exception within the rectangular houses is House 13, the *Pfeilergebäude* with terrazzo floor and carved pillars (HAUPTMANN 1993). The three building Phases A-C correspond with Layers I-III, again confirming the continuing specialised location. The ritual function is obvious, underlined by many limestone sculptures "buried" in secondary context in the eastern section of the surrounding walls and benches. 4 fragments from the eastern bench of House 13 B could be joined to a fascinating column of several birds and human heads, one upon the other. This *Bildsäule* somewhat resembles the *Haida* "totem" poles from the northwest coast of north America. It seems possible that it represents a similar function as a lineage or burial symbol. This question goes beyond the scope of lithic analysis but it is important in the discussion which follows.

In contrast to the close similarities of the architecture with Çayönü, the general picture of the lithic industry of all layers at Nevalı Çori is not that of the Taurus-PPNB but very close to the North Levantine PPNB with blank production from naviforme and tabular bidirectional cores (*cf.* WILKE and QUINTERO 1994). As the result of a detailed analysis of Syrian late PPNA industries we know that the bidirectional blade production - even with naviform cores - is not restricted to the PPNB but also exists in the late PPNA *Aswadien* und *Mureybetien (*ABBÈS 1994, CAUVIN M.C. 1994). What characterizes the Nevalı Çori industry? Beyond core management there is for example hardly any use of obsidian and there are no Çayönü Tools (except one fragment made of flint: SCHMIDT 1988: 167, Fig. 4:9). The tool inventory is dominated by large sickle blades (Manuela Beile-Bohn, this volume; the final report: BEILE-BOHN, in prep.), points (mainly Byblos points), and burins. In the lower Layers I-III there occur some el Khiam-like hollow based points, but distinguished by several attributes, which have been named Nevalı Çori-points. The type is characterized by a pair of lateral notches at the very basal end, forming a hollow base with a fishtail outline (SCHMIDT 1994: 250, Fig. 6:9,7:1-12,8:1-9; final report: SCHMIDT, in prep.). Within a small group of Helwan-like points (Layers I-III) there is one point from Layer I (Fig. 3,8), which exactly resembles a Syrian type recently called the Aswad point (CAUVIN 1994: 288, Fig. 8:3-5, Aswad IA). Points with *retouche en pelure en écharpe* and *retouche en pelure* (CAUVIN M.C. 1994: 289, Figs. 7:4,6; Mureybet IVB; SCHMIDT 1988: Fig. 14:1-2) are not common and are concentrated in Layer III (Fig. 4:2-3). Large daggers form a specific group (Fig. 5:1) and are common in Layer I but have almost disappeared by Layers IV/V (compare CAUVIN M.C. 1994: Fig. 4:9, Mureybet III).

Four radiocarbon dates are available, all charcoal, three from one findspot in Layers I/II[1], one from a pit dug into virgin soil. (Table 1)

The dates of Layer I/II are located in the range of Mureybet IVA. Unfortunately Pit 277 with a date within the range of Mureybet III ("*Mureybetien*") cannot exactly be correlated with the building layers, as the pit comes from a trench east of the main area G3-G10, but it cannot as late as Layer III. The filling of the pit consisted of a large quantity of animal bones together with the usual PPNB-like inventory of the settlement. To determine the entire lifespan of Nevalı Çori we will have to wait for further dates, but it seems possible the Şanlıurfa-PPNB is as early as the *Mureybetien* and the *Aswadien*. This would explain the several cited PPNA type elements in early Nevalı Çori[2]. As this relationship of lithic industry, architecture and figurative monuments is known only from sites in the Şanlıurfa province (*e.g.* Fig. 6)[3] it would be justifiable to name it *Nevalıçorien*.

Table 1.

Layer I/II	Hd-16783-769:	9212 ± 76 bp	8085-8340 cal BC*
	Hd-16782-351:	9243 ± 55 bp	8095-8345 cal BC
	Hd-16781-835:	9261 ± 181 bp	8080-8470 cal BC
Pit 277	Hd-16784-768:	9882 ± 224 bp	8950-9775 cal BC

* All four dates are calibrated by B. Kromer with CALIB 3 (STUIVER and REIMER 1993), 1σ, Method A.

1 The charcoal comes from a fire pit within the upper levels of Layer I. The pit was not observed in Layer II, but actually it could have cutting down from Layer II.

2 Further comparisons *e.g.* SCHMIDT 1988: 199, Fig. 15:7 and CAUVIN J. 1994: 47, Fig. 7:1.

3 Recent finds from the centre of Şanlıurfa seem to indicate the existence of an early Neolithic sanctuary with monumental limestone sculptures (HAUPTMANN, in prep.); at Göbekli Tepe a primary religious site on a mountain seems to exist (SCHMIDT 1995).

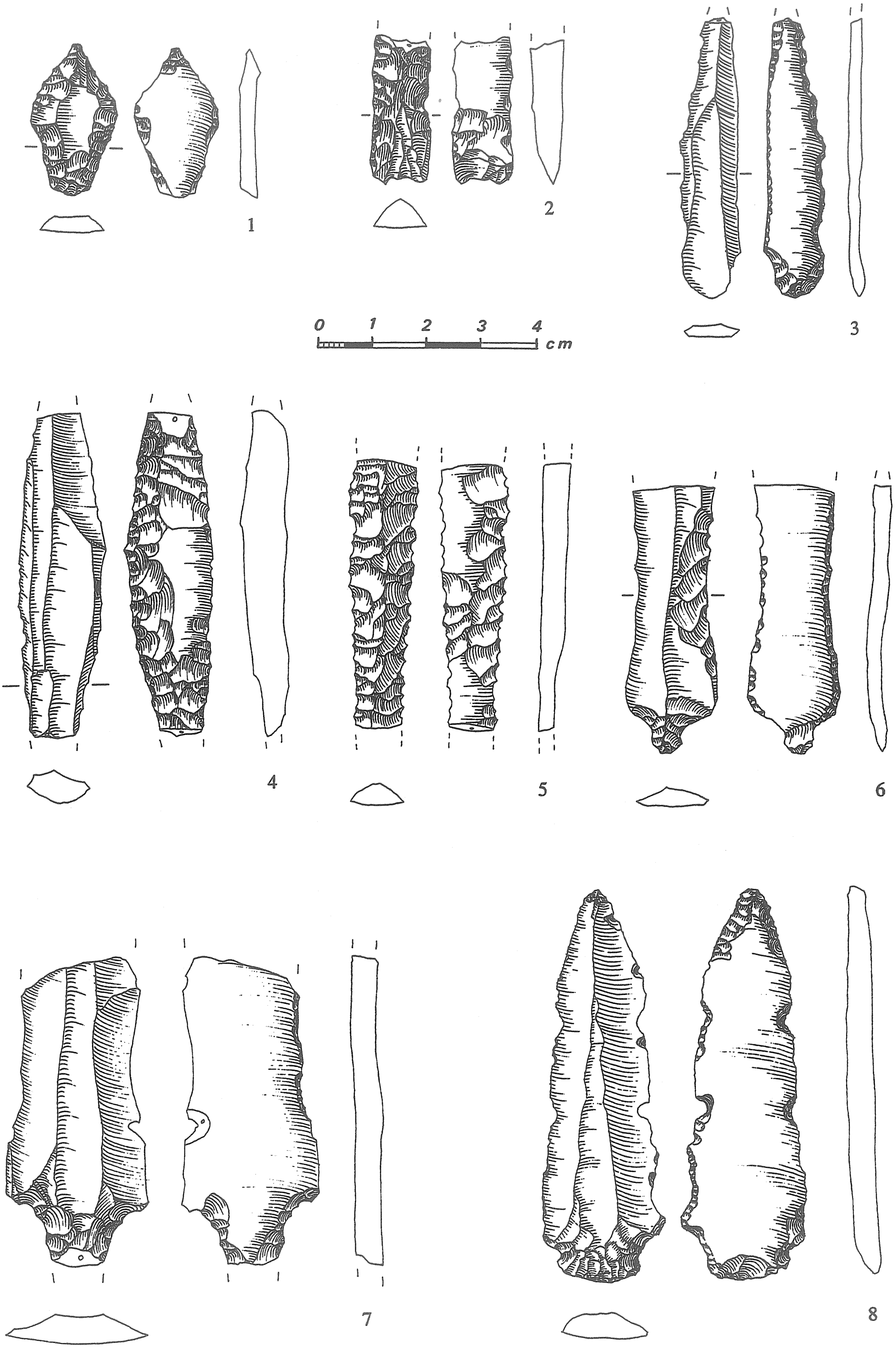

Fig. 3. Nevalı Çori: unusual points (silex; 1,4-5 surface layer, 2 Layer IV/V, 3,6-7 Layer IIIA, 8 Layer I)

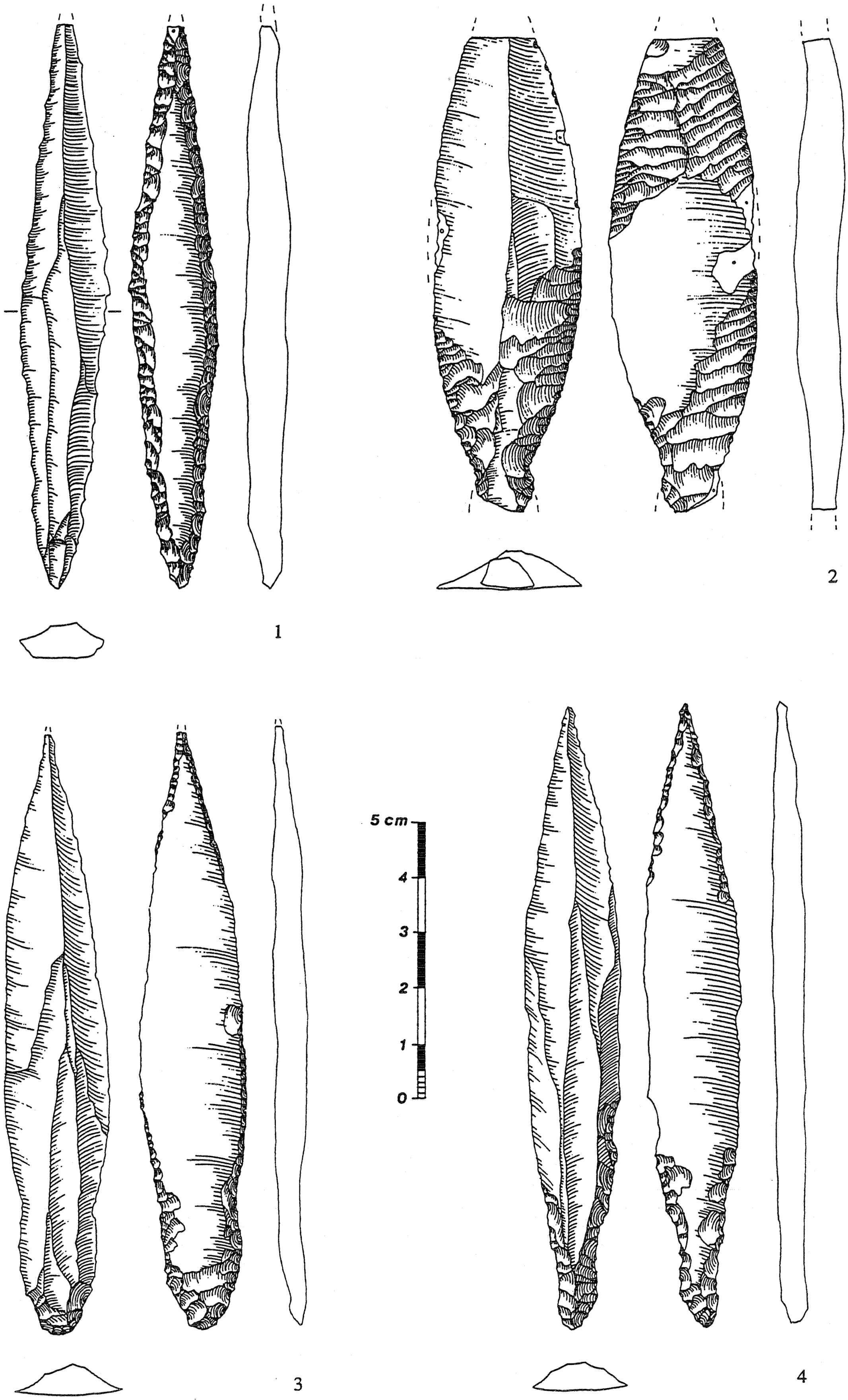

Fig. 4. Nevalı Çori: unusual points (silex; 1,3-4 Layer III, 2 surface layer).

A preliminary analysis of the Nevalı Çori data suggests the following correlations (Nevalı Çori = NÇ):

Table 2.

	Şanlıurfa Region	Syrian Euphrates	
PN	Gritille, Kumartepe, Sürük Mevkii, Gürcutepe I	PN/final PPNB	Damishliya
LPPNB	Gritille, Hayaz, Gürcutepe II	LPPNB	Assouad, Haloula, Abu Hureira
MPPNB	NÇ IV/V	MPPNB	Mureybet IVB, Haloula, Abu Hureira
EPPNB	NÇ II, Göbekli Tepe ?	EPPNB	Mureybet IVA, Dja'dé
EPPNB	NÇ I	PPNA/EPPNB?	Mureybet IIIB, Sheik Hassan
	?	PPNA	Mureybet IIIA
	?	Khiamien	Mureybet II
	?	Natufien	Mureybet I

We next consider the internal distribution of artefact groups. The goal of this analysis was to determine the function of the architectural structures and the open air locations between them. Equally, it might be possible to understand more about the meaning of the existence of morphologically different types within a functional group by their distribution within the architecture, especially the *Pfeilergebäude* which is a building of evidently ritual function.

In the Neolithic levels of the excavations the findspot of each artefact was noted by square meter and location, so it is possible to analyse the quantitative distribution of each tool class in the excavated area. The percentages of the main tool groups are relatively constant in the different layers, but it is not the same with the horizontal distribution within the layers. The mapping of the tool groups is done automatically with a CAD-system and a related database. This analysis is not yet finished, but some preliminary results can be given.

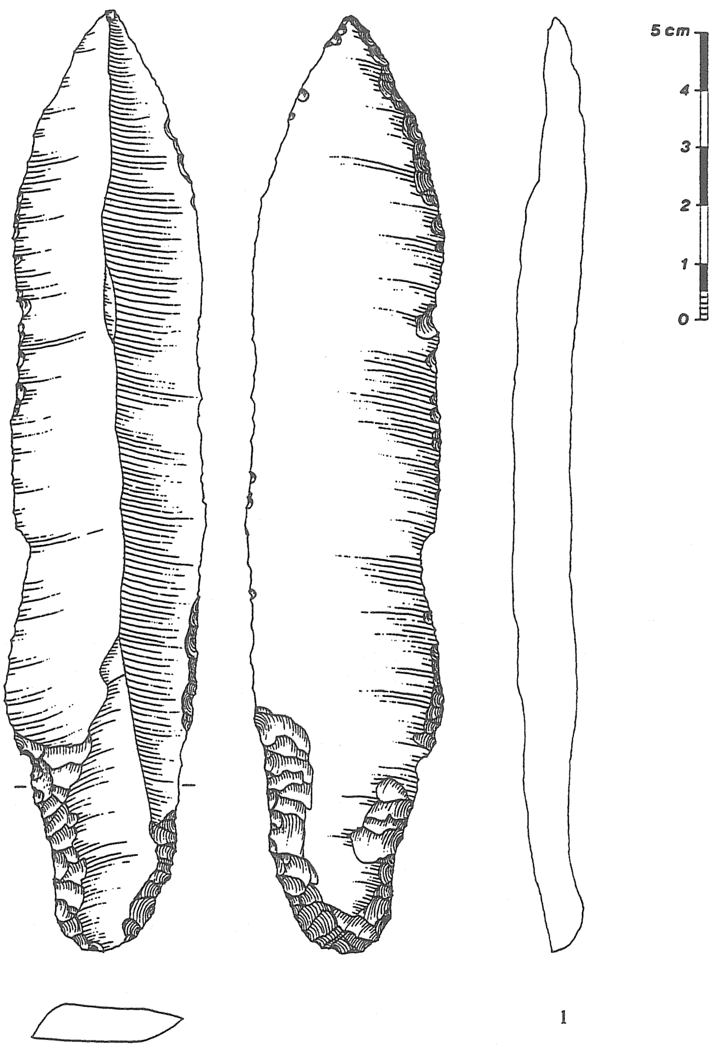

Fig. 5. Nevalı Çori, Layer I: 1 dagger (silex).

The distribution pattern of several artefact groups underlines the expected functional division of the three different building types. Regarding the *Pfeilergebäude* and its surrounding area, so it is almost untouched by debitage or tool distributions except at a place outside its southwestern corner (*e.g.* the sickle blades: Fig. 7; Layer II). The Channel Houses have very few finds inside the rooms and only within the Round Houses can high concen-trations of finds be observed. Regarding the finds in the location of House 12 it should be noted that only its substructure was found. Nearly all the walls had been removed to reuse the stones for other buildings. So its area might subsequently be regarded as anopen *plazza*. The mapping of core preparation flakes (Fig. 8; Layer II) shows three high concentrations, one again near the *Pfeilergebäude*, one in the open air location above House 12 and a third one in and outside round Building 2. Possibly this house did not exist at the time of preparing the cores as these show a similar distribution both inside and outside the structure. Other tool frequencies, e. g. concentrations of piercing tools, sometimes occur in specific rooms of the Channel Houses, but more normally in the Round Houses and open air locations. The same is true of the points.

A very interesting group is the points of unusual type - that is unusual in comparison with the bulk of the Byblos points at Nevalı Çori - they are points with fine parallel pressure flaking (*retouch en pelure en écharpe, retouch en pelure*). The distribution of these is not what might be expected. The distribution of all points from Layers I-III shows few pieces in the area of the *Pfeilergebäude*[1]. Not so the untypical points, again of Layers I-III: In the northern part of the excavated area there are the open air locations and the *Pfeilergebäude*. Here there are very few examples for almost every tool group. However there is an unusual concentration of the untypical points, mainly points with *retouch en pelure en écharpe* (Fig. 9). *It is* certain that this is not due to chronological reasons as the stratified examples of these points are concentrated in Layer III, the layer of the youngest building phase of the *Pfeilergebäude*. For further comparison the distribution of the Nevalı Çori points is presented

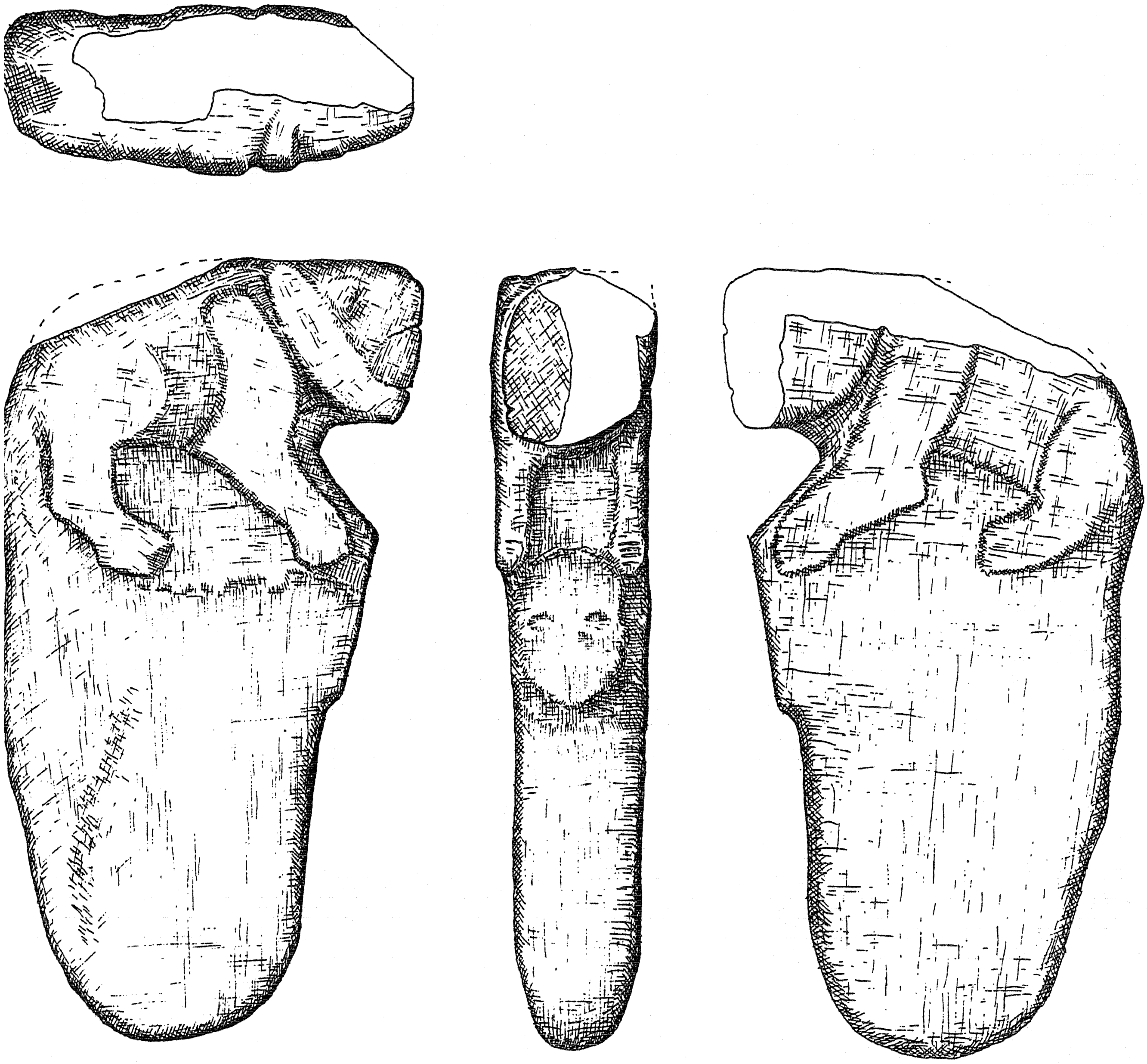

Fig. 6. Göbekli Tepe (Şanlıurfa): limestone pillar with animal and human face <*scale 1:10*>.

[1] In SCHMIDT 1994: 242, Fig. 5 the high percentage of points around House 13 has been observed. Most of these points are untypical points.

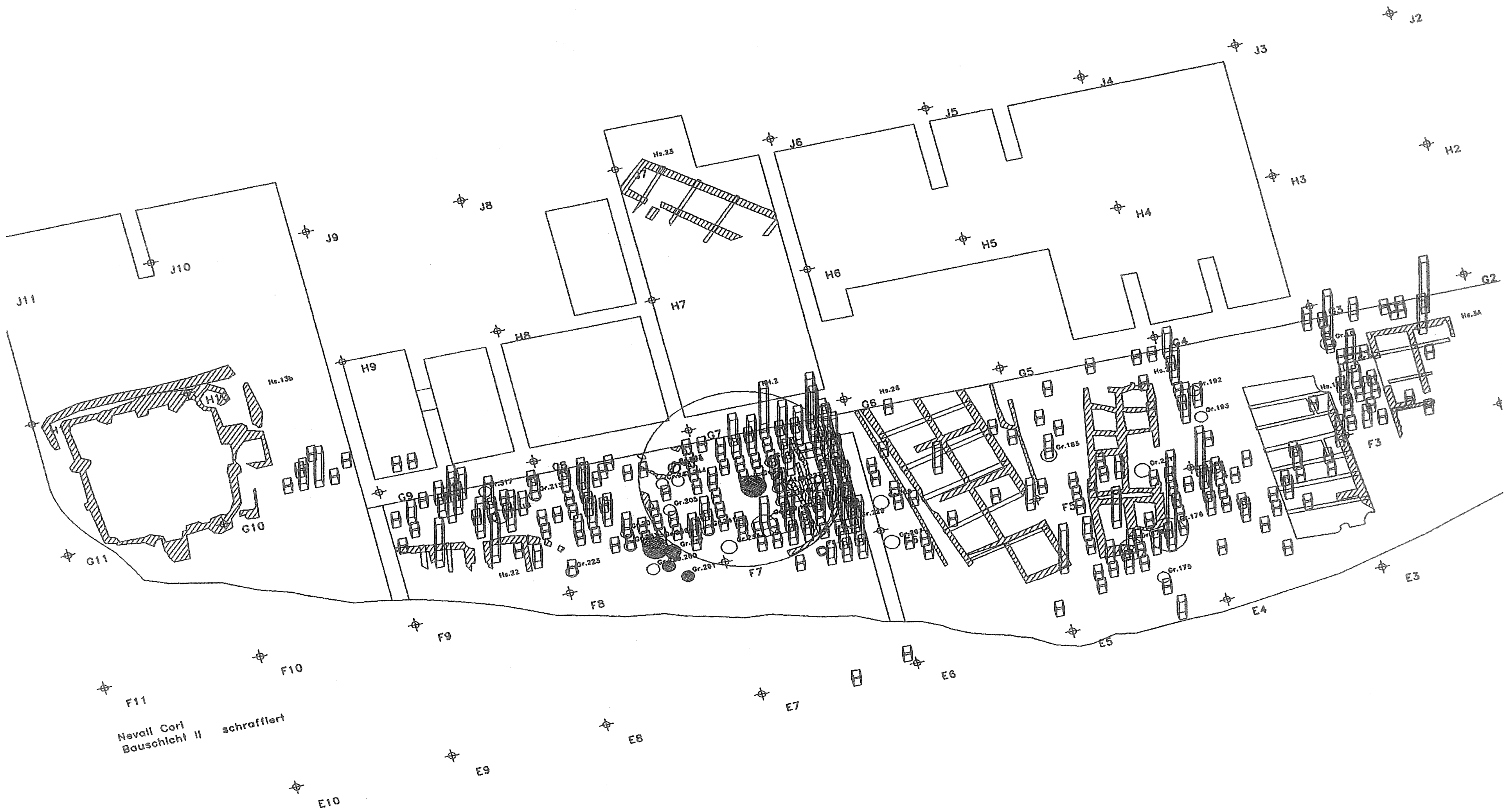

Fig. 7. Nevalı Çori, Layer II: distribution of sickle blades.

Fig. 8. Nevalı Çori, Layer II: distribution of core preparation flakes.

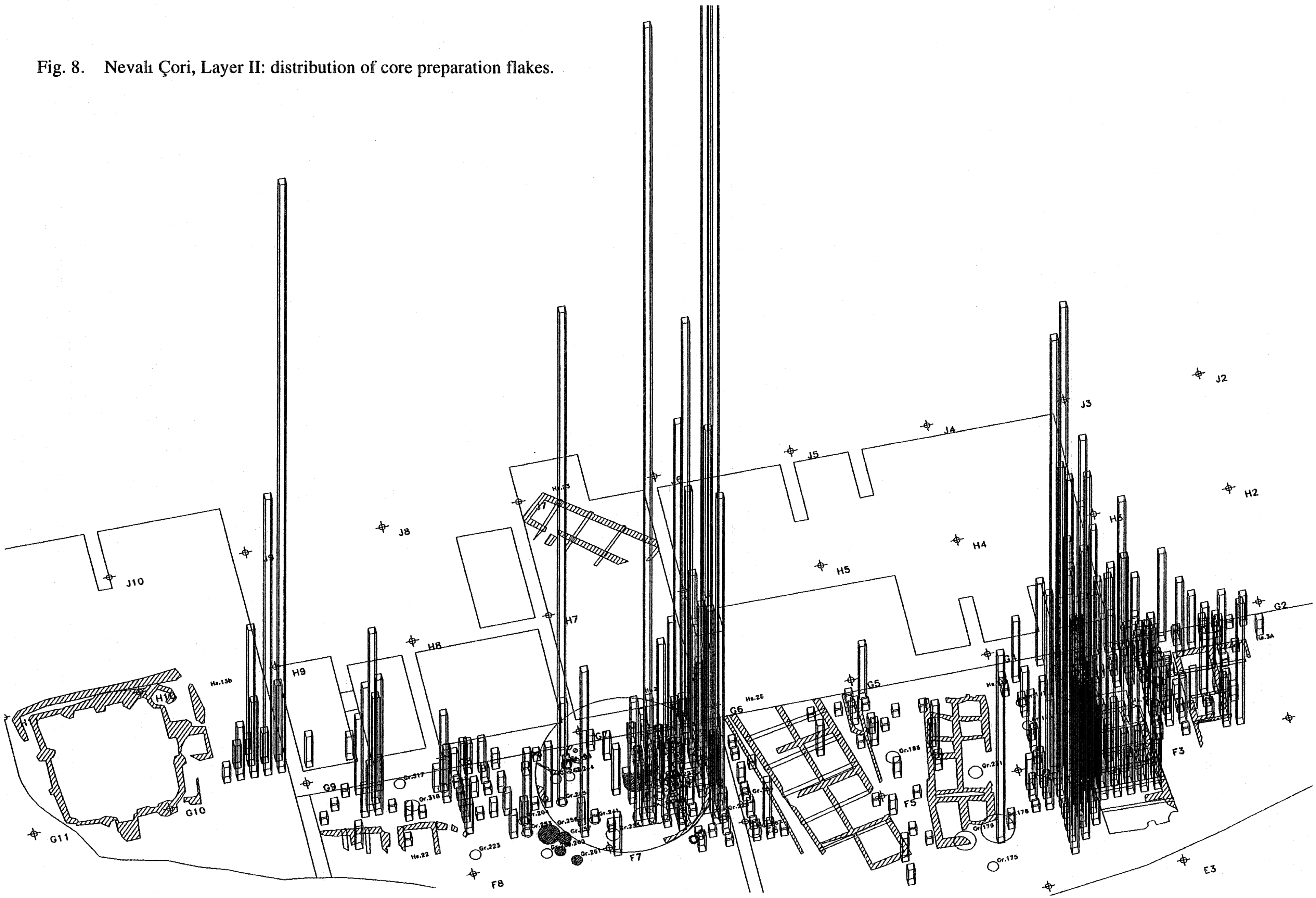

Fig. 9. Nevalı Çori Layer IIIA: distribution of points of unusual type from Layers I-III.

Fig. 10. Nevalı Çori, Layer IIIA: distribution of Nevalı Çori points from Layers I-III.

(Fig. 10), giving a distribution similar to that of the total distribution of points. It may therefore be interpreted that the Nevalı Çori points are a common type in the settlement within Layers I-III, so clearly the occurrence of the unusual points could in some way be related to the ritual function of the *Pfeilergebäude*. The recent success in reconstructing the *Bildsäule* and the new perspective this offers for the interpretation of the other sculptures and the *Pfeilergebäude,* throws new light on the ritual behaviour of PPNB people. It seems that places like the *Pfeilergebäude* were a focus for people coming for a specific purpose not only from the surrounding countryside but from a large area - perhaps only once in their lives. This speculations are outside the discussion of lithics, but it should be kept in mind when doing typological and functional analysis, that the lithics of PPN culture offer the possibility to create a wider picture when considered with the many other features of these sites.

These are the first results of studying the intrasite distribution at Nevalı Çori, an analysis which is still in progress and which has to be refined in detail. Final results of the internal find distribution will be given after the mapping of the non-lithic artefact groups and the animal bones.

Acknowledgements: The Nevalı Çori-Project was supported by the Deutsche Forschungsgemeinschaft and by the Sulzer-Escher Wyss and the ABB companies. I am grateful to Roland Gläser for arrange the C14-datings and to Christine Wilson for correcting this contribution.

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Long Sickle Blades: a Case of Cultural Change in the Early PPN in the Southern Levant. Questions and Remarks

Tamar Noy

While most of the material under discussion is well known, some points still need more clarification. Such as, what caused the change of separation from the Natufian short sickle blades to the PPN long sickle blades, and then, after *c.* 2000 years, again to revert to short sickle blades (as a composite) in the Yarmukian culture[1]?

The place of origin of this phenomenon is yet unknown. Neither long cores nor blocks of flint have been found in the very early stage of PPN. It is only in the beginning phase of the PPNB that the long cores, the "naviform" shape, has been found in sites such as Mureybete III (CAUVIN 1994) and Tell Aswad I. It was then used, over a long period of time for blade production, as it is well described by Gopher (1994: 389):"Pan-Levantine tradition for the production of long straight blades for sickle blades and arrowheads".

Even if we had convincing facts about the method in which the long blades were produced, we would have still not know why this obvious change took place. What were the motivations which have caused this 2,000-year-long change?

This tool, in its long version, has never disappeared, but rather, along the generations and with the evolvement of cultures, both its production and use were very deminished. Still, it had a short reappearance during the Early Cannaanite Period.

Yet, it should be noted that the current core goes on existing into the Yarmukian culture as well, only using short, serated blades rather than the long sickle blades.

The appearance of the long sickle blade, to be accompanied by the next stage of the PPNB by other long blades, is a cultural signifier different from what we have previously known. It is not, though, the only cultural-technological signifier separating between the Natufian Culture and the Neolithic Culture, albeit a great similarity between the two cultures when they meet.

Still, the sources for the change remain unknown. But maybe one should search for them also by tracing the sources of other raw materials, their mining and the establishment of workshops in their vicinity. Therefore, it is certainly an indication for a new organizational and social tendency.

Some Remarks for the PPNA

The first appearance and use of long sickle blades as almost the major group of harvesting tools is in the early PPNA. As yet there is not sufficient information on where the long blades were produced. While all the cores that were found at the excavated sites are small or medium in size (Fig. 4:3)[2]. Also the fashion of inserting long blades into a wooden handle was not known, but the sheen/ the gloss line being very clear (Fig. 2:1,2,4)[3] yet the thickness of the blades is sometimes very prominent.

While in the Khiamian phase there are not any particular type, except for the long-straight forms (Fig. 1:1-4), in the Sultanian, in addition, there is a new type: the "Beit Ta'amir" (BUZY 1928).

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[1] This work does not include any observations about the place of origins and comparisons between the sites.

[2] For one example of long raw material found on-site, see NOY and KOZŁOWSKI, this volume.

[3] There was understood, between P. Anderson and myself, that where there is sheen indication on the flint, its borders will be mentioned along its existence, as it is shown on the plates.

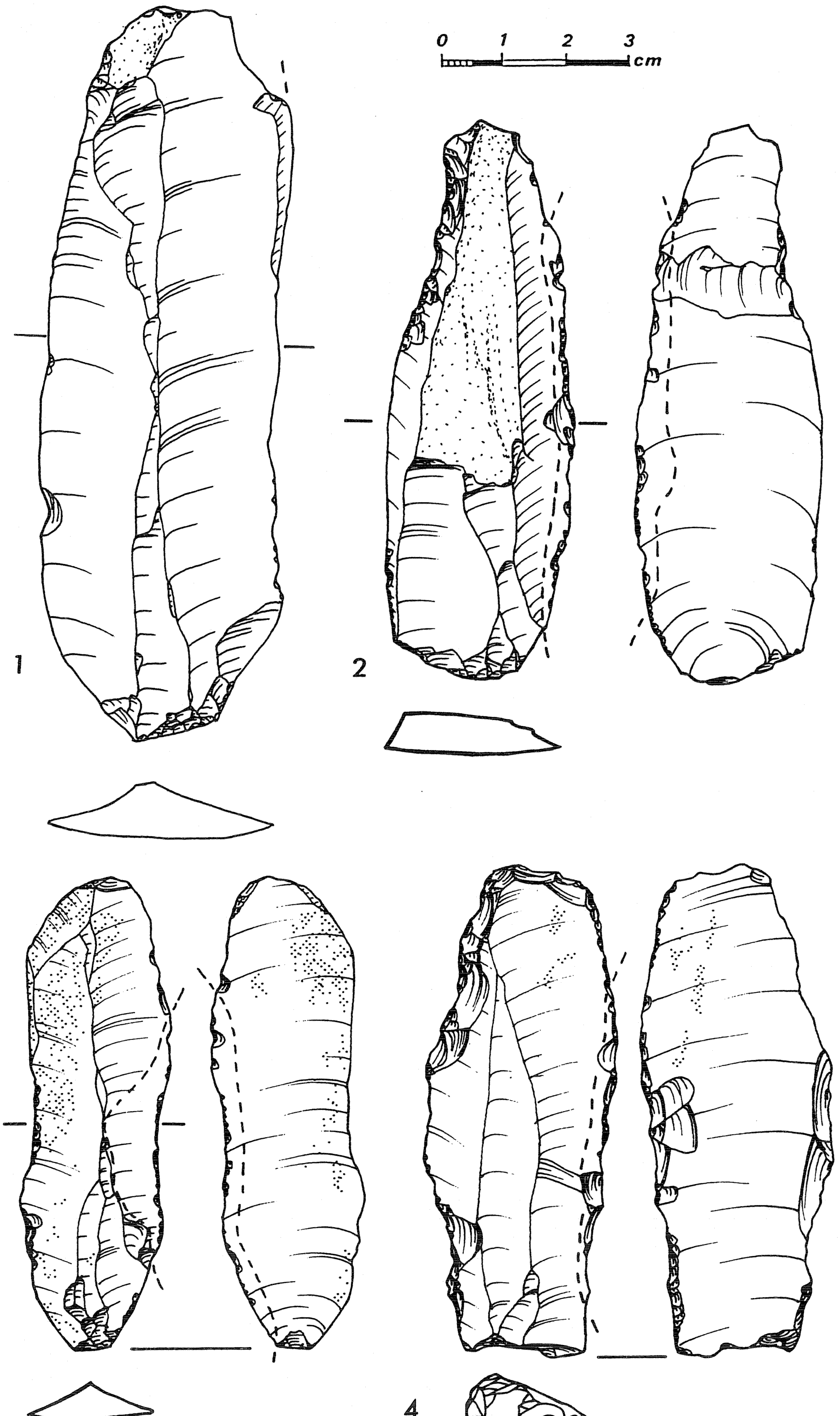

Fig 1. Gilgal 1: 1 long blade, 2-4 long sickle blades.

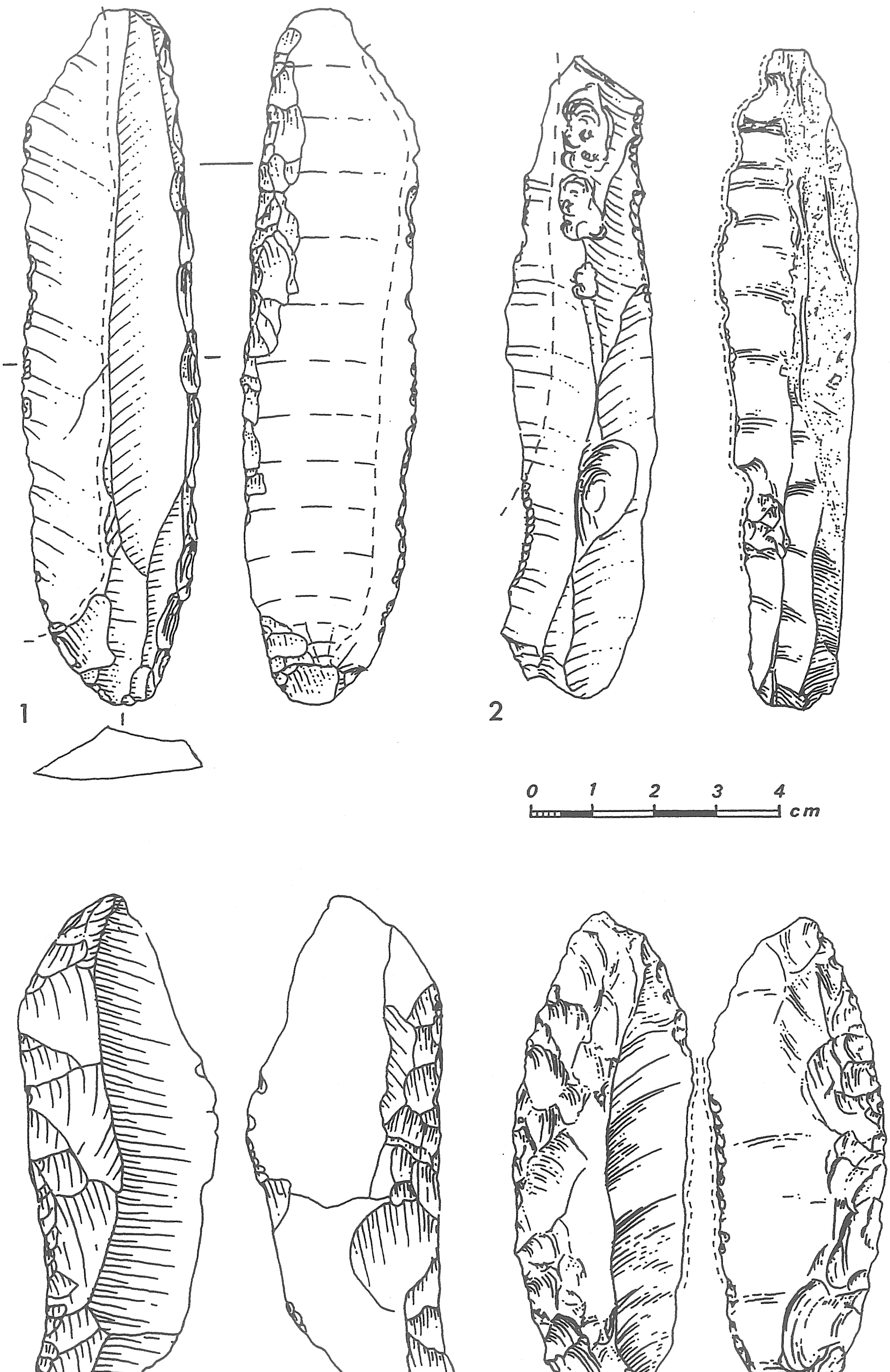

Fig. 2. Netiv ha-Gedud, Nahal Oren and Jericho: 1, 3, 4 "Beit Ta'amir-Knife".

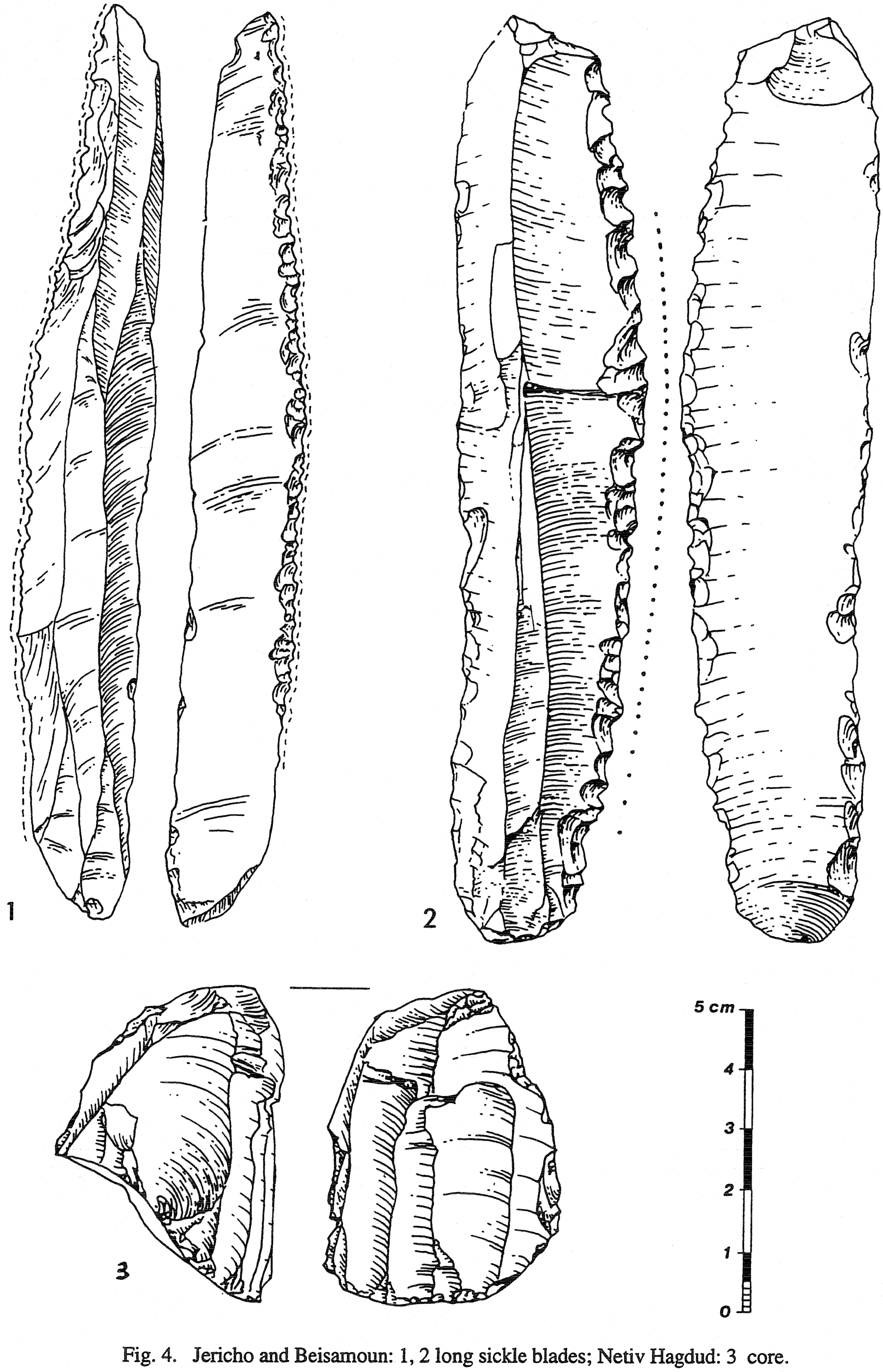

Fig. 4. Jericho and Beisamoun: 1, 2 long sickle blades; Netiv Hagdud: 3 core.

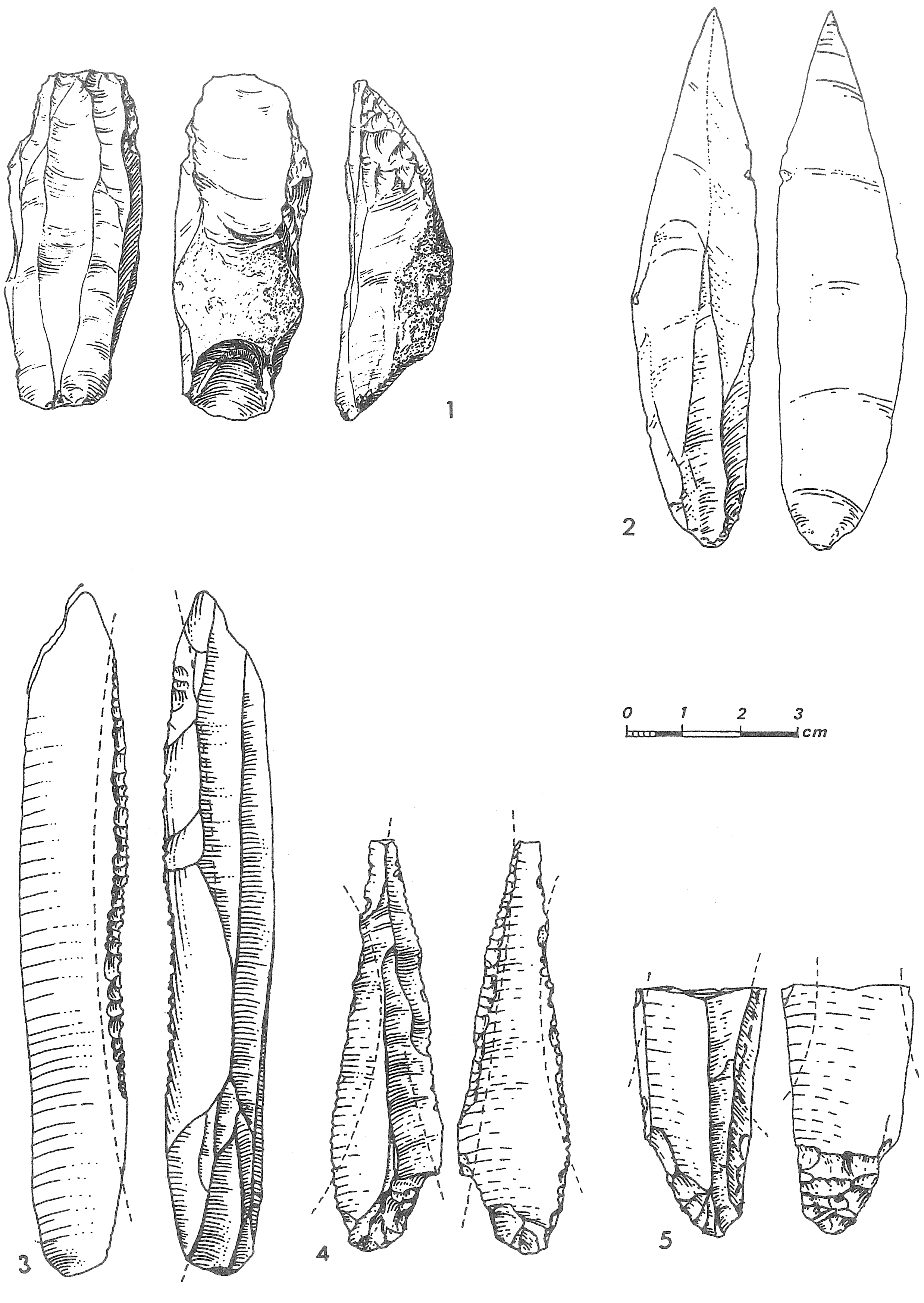

Fig. 3. Jericho: 1, 2 naviform core and long blade; Horbat Minha: 3, 4, 5 long sickle blade and tongue sickle blades.

It was found in most of the Sultanian industries in the agricultural core areas of the southern Levant, often in close similarity in shape and size (Fig. 2:3-4). It is not yet clear if this type carries different methods or direction of harvesting techniques, or a different way of fixing it to the wooden handle, or different harvesting crops or just more challenge and sophistication to produce new tools type. Communication and the information flow between the villagers, as it is clear by now, became closer and more sophisticated (NOY 1976, CROWFOOT PAYNE 1983, NADEL 1988, GARFINKEL and NADEL 1989, LECHEVALLIER and RONEN 1994).

Some Remarks for the PPNB and PPNC

A different case is with the PPNB, as cores of "naviform" shape become the major technique used in this period (Fig. 3:1). They were prepared by a particularly elaborate technique in order to produce long blades (WILKE and QUINTERO 1994). Their manufacture has the largest techno-cultural border: from the Sinai in the south to Anatolia in the north, as well as the long blades production. Unique care and choice of unique color, as well as heat treatment, gave excellent quality to the raw material for the long blades production. Even in a site where the cores are missing, such as the Nahal Hemar Cave, the blades are there (BAR-YOSEF and ALON 1988). The long sickle blades were found in each site of this period in the core area of agricultural practice[1]. Some types have been identified such as simple long shape (Fig. 3:3), or with a serrated edge (Fig. 3:4), or with a tongue (Fig. 3:5) (CROWFOOT PAYNE 1983, GARFINKEL 1989, GORING-MORRIS 1994, GOPHER 1989, LECHEVALLIER 1978, NOY 1976, OLSZEWSKI 1994). The method whereby they have been connected to the wooden handle has been demonstrated (CAUVIN 1983, GOPHER 1989, OLSZEWSKI 1994, UNGER-HAMILTON 1989). In Beisamoun there are some sickle blades which are of a unique size, and very rare in Jericho (Fig. 4:1-2). Do they exist for a real purpose? Or for the flavour of achievement, or maybe even for symbolic practice? At the end of this period in the PPNC, the long shape was still used (GARFINKEL 1994, OLSZEWSKI 1994), with some decline in features.

In Summary

The long sickle blade phenomenon, which is specified in the early Neolithic periods (the PPNA, PPNB and PPNC), is still not well understood. Some observations may hint that there was not a specific tradition of preparing cores or blocks of flint to produce such long blades in the PPNA phase. Large cores or block of flint were not found at the sites except for a very few (NOY and KOZŁOWSKI in this volume). Yet this tradition of long and wide sickle blades was found in each of the early villages of the Mediterranean core area. Only in the Sultanian phase of the late PPNA there is an additional type produced in a specific technique which is the "Beit Ta'amir Knife".

At the PPNB and in PPNC specific tradition of core preparation the "naviform" shape was used. Through this core the long blades were produced.[2] It is not impossible that the long sickle blades indicate a challenge for an artisan required to supply a unique product such as this, for a society that in most cases had very high technological ability and symbolic cultural inspiration[3]. In the PPNC some technical elements of the long blades decrease.

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1 This type of core was used also in the Yarmukian phase without such blade production. These are well known in the northern Levant and Antolia.

2 The sickle that was found in Nahal Hemar Cave has short blades (BAR YOSEF and ALON 1988). It is worth asking here, to what periods does this sickle belong? They may very well belong to the same period to which most of the artifacts belong, but for an unknown purpose.

3 P. Wilke, in the Warsaw Workshop, expressed similar ideas.

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Lithic Technology and Functionality Through Time and Space at Çayönü

Isabella Caneva, Cristina Lemorini, and Daniela Zampetti

Abstract: *Recent research has confirmed a trend towards a prevailing use of obsidian blade tools in the sequence. The morphological characteristics of the tools change through time, although within a general homogeneity of tool composition. Pressure and percussion techniques co-exist during the Cobble Paved and the Cell Building Sub-phases. They are used to obtain different products, regardless of the raw material used. Preliminary comparison between the typological data and the evidence from the analysis on use traces confirmed the need to be very cautious in attributing a precise functional feature to a lithic type. Morphological and functional data obtained with the wear analysis showed discrepancies that are reflected in tool definitions. As seen from the changes in lithic technology and typology, the development of the aceramic sequence at Çayönü contains four main stages: 1) the Round Building and a greater part of the development of the Grill Houses; 2) the latest aspect of the Grills and the Channeled Houses; 3) the Cobble Paved Buildings and the Cells; 4) the Large Room Sub-phase. The slight discrepancy between these stages and those shown by the architectural changes confirms that only the combined analysis of the different archaeological indicators will provide a significant interpretation of the investigated contexts.*

Introduction (I.C.)

This paper presents the progress of a systematic study of the lithic industry from the earliest levels (Phase I, aceramic) of the site of Çayönü Tepesi

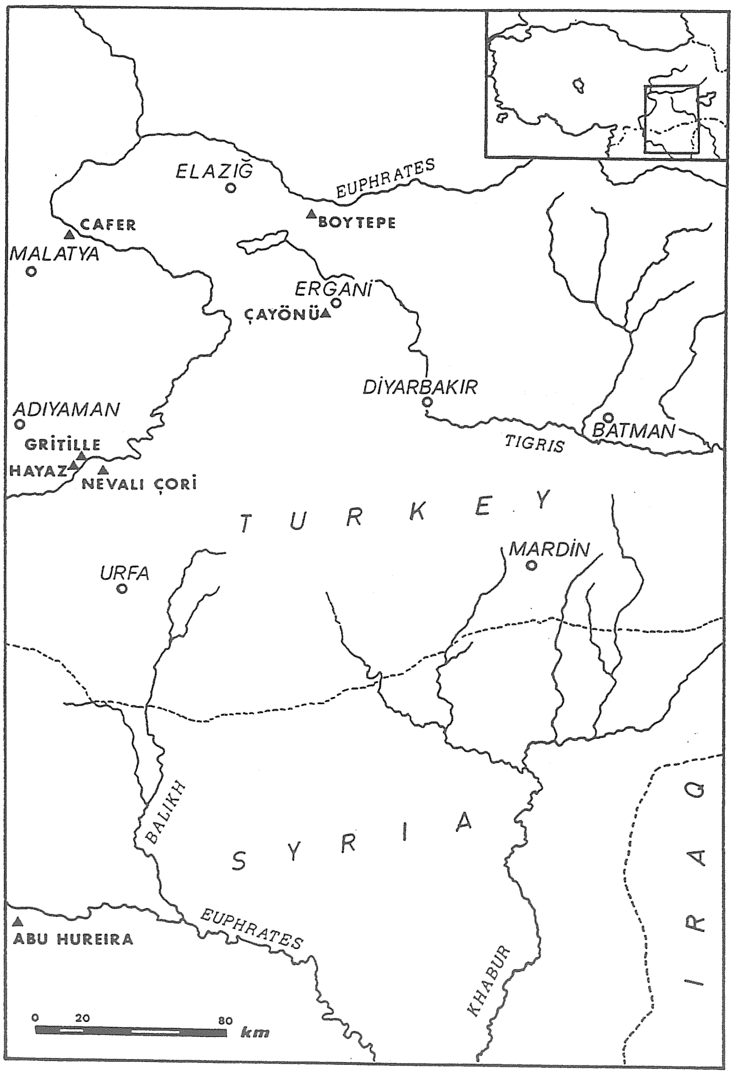


Fig. 1. Southeast Anatolia and adjacent areas.

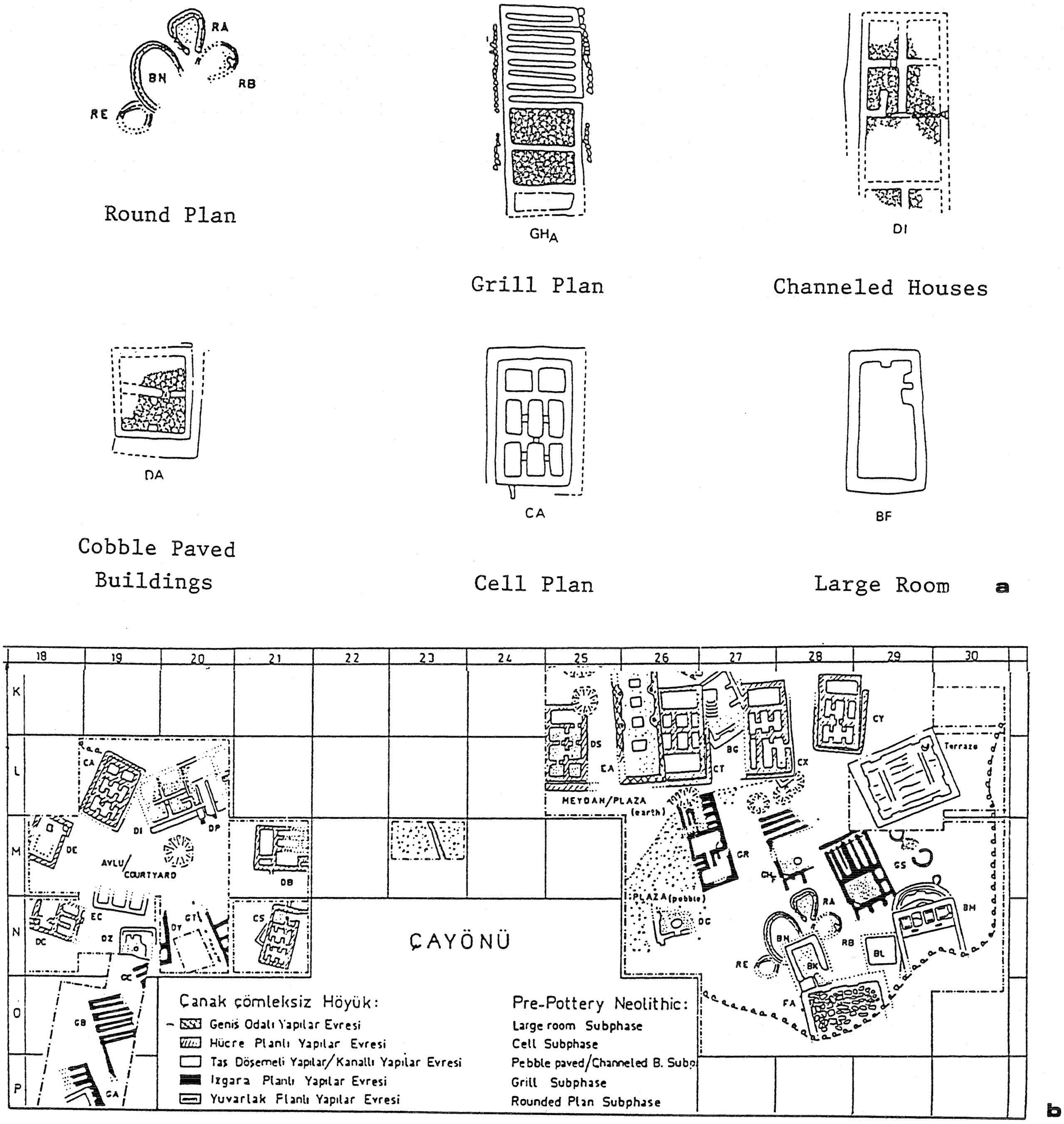


Fig. 2. Çayönü. a sequence of building types in the aceramic deposits, b partial plan of the aceramic settlement.

in eastern Turkey (Fig. 1). The principal aim of the study, started in 1992, is the reconstruction of the functional space organisation in the sequence of superimposed villages, spanning from the end of the 9th to the second half of the 8th millennium BC. A wider aim is the definition of the role of Çayönü in the development of early village communities in eastern Anatolia and adjacent areas. Although more information on east-Anatolian aceramic settlements has been provided by other excavations in these recent years, Çayönü remains a key site in the Anatolian PPNB development, owing to its impressive superimposition of building levels and to the extensive exposure of its long-term excavations (*cf.* for more information BRAIDWOOD *et al.* 1981, ÖZDOĞAN and ÖZDOĞAN 1990). This offers an almost unique opportunity to study a lithic collection in its original subdivision in several specific contemporary contexts throughout the long sequence of prehistoric villages. Preliminary investigations were conducted on the lithic production of four of the six main sub-phases recognised in the aceramic sequence on the basis of its architectural features: from the bottom, Round Buildings, Grill Plan Houses, Cell Houses, and Large Room. In this first approach to the collection, an effort was made to identify substantial changes through time, thus focusing the analysis on the more diagnostic elements in this sense: the ratios blade:flake and flint:obsidian in the different sub-phases (CANEVA, CONTI, LEMORINI, and ZAMPETTI 1994). The analysis concentrated, later, on the earliest part of the sequence, the Round Houses, as well as on the sub-phases which had not been investigated in the previous work, *i.e.* the Channeled and the Cobble-Paved Building Sub-phases, both stratigraphically located over the Grill Plan and below the Cell Houses (*cf.* A. ÖZDOĞAN 1995 for a recent review of the Çayönü sequence). The whole chronological development of the site has therefore been at least preliminarily investigated (Fig. 2). Presently, the research entails a program of comparisons between different contexts within each sub-phase. Those so far analysed include three structures of the Round Building Sub-phase, one Grill Plan House, a building and an adjacent open area of the Channeled House Sub-phase, three Cobble-Paved Buildings and two Cell Buildings, plus one Large Room building, totaling about 8,000 lithic pieces. It should be stressed, however, that each sub-phase is characterised by a certain chronological development, represented in the site by a sequence of either separate buildings or reconstructions of the same structure. This widens considerably the sample to be studied and makes the results so far obtained still largely incomplete.

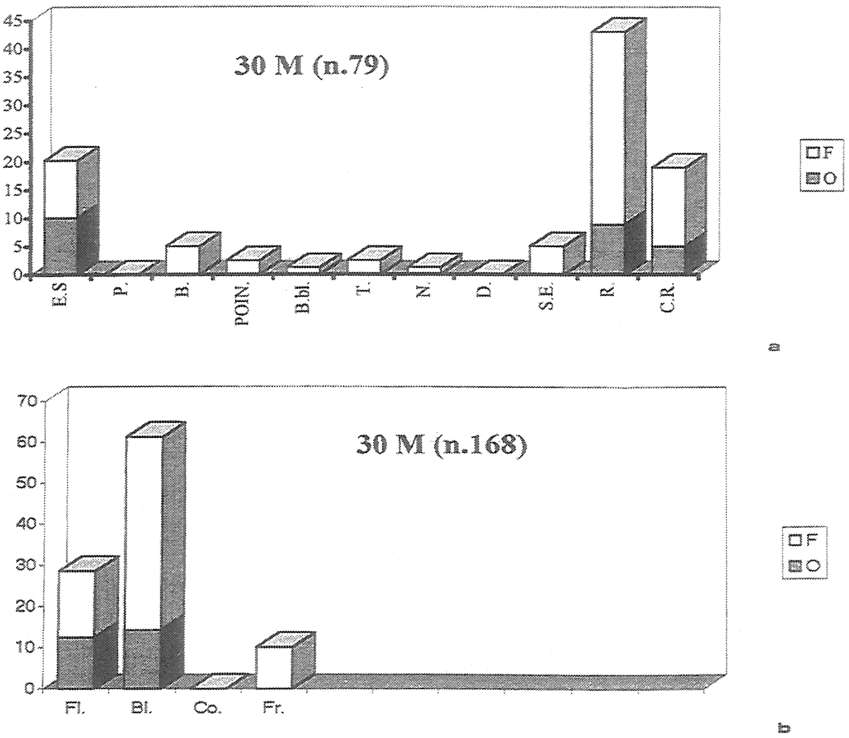


Fig. 3. Çayönü. Frequency of lithic artifacts from a Round Plan structure: a retouched tools, b debitage.

The Earliest Settlement (D.Z.)

The Round Houses represent the earliest occupation of the site, with a very simple architecture consisting of circular stone foundations of what were probably wooden superstructures (A. ÖZDOĞAN 1995). The comparison of the diagrams of the 3 complexes examined so far (RB, 29M and 30M) shows a basic similar frequency of both raw material and artifact types (Fig. 3). In the débitage, however, blades prevailed over flakes in the two new complexes, where no specific flake blank was used among the retouched tool classes (Fig. 4:1-6). Points (Fig. 5), all on flint, were always on short blades, defined by either obverse or alternate bilateral retouch. Bases were either truncated or pointed (the lozenge-shaped Nemrik point was very rare, while a more elongated type was present). Only one specimen of a possible different type - a tanged point on a blade - was found (Fig. 5:7). The proximal end is reduced to a tang by means of two lateral notches and a convex truncation with flat retouch, all obverse. Although its distal end was broken, its width (about 20mm) and thickness (4mm) fits in the dimensional range of the Cheikh Hassan and Mureybet (IIIB) tanged points (ABBÈS 1993: Figs. 8-9; CAUVIN 1994: Figs. 4:7, 7:1). Blades were particularly flat and thin and represent a very peculiar component of this context. Their dorsal surface shows traces of bipolar débi-

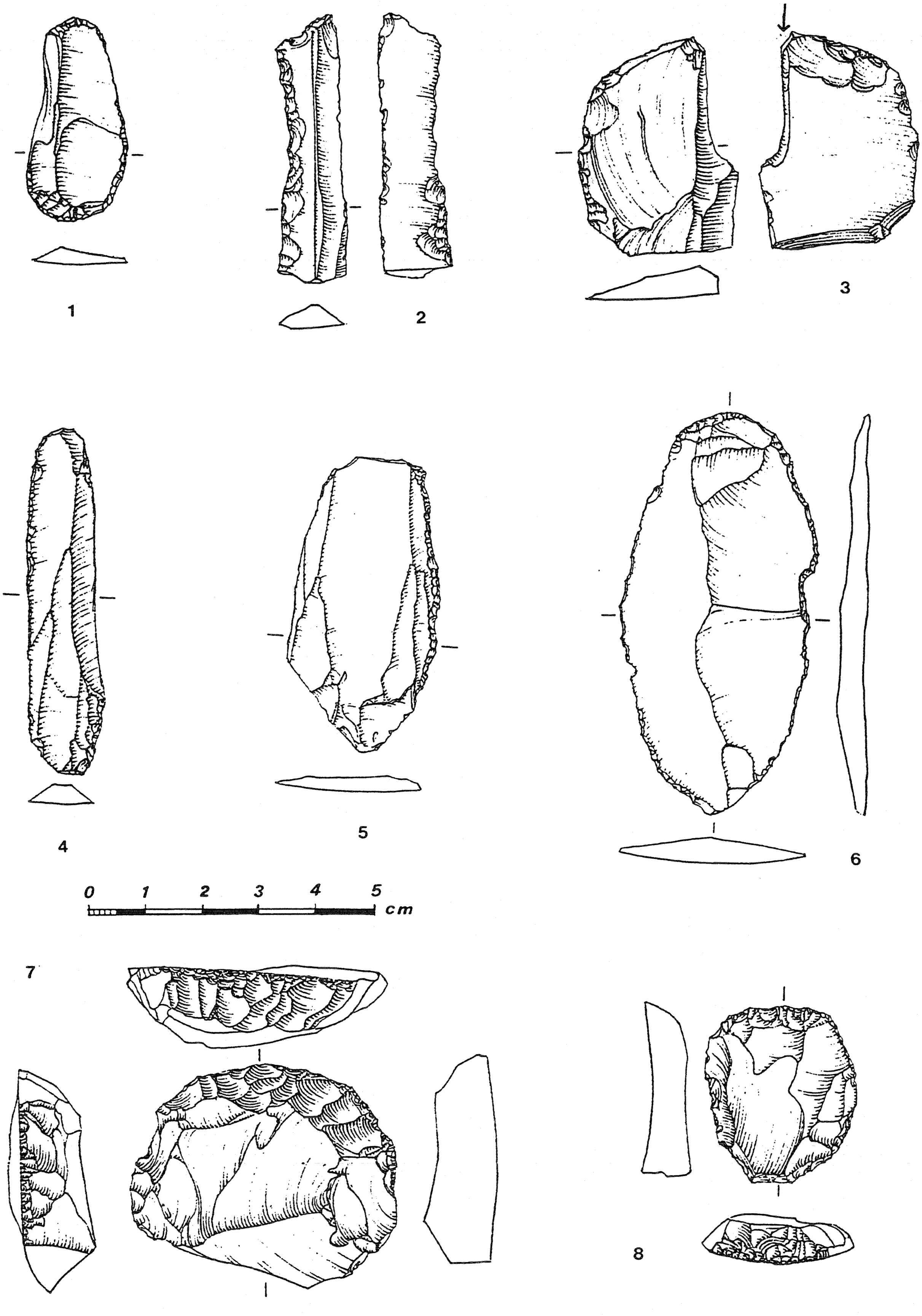


Fig. 4. Çayönü. Lithic artifacts from the Round Plan Sub-phase: 1 double end-scraper, 2 truncation on retouched blade, 3 dihedral burin, 4-5 retouched blades, 6-8 end-scrapers (7-8 in obsidian).

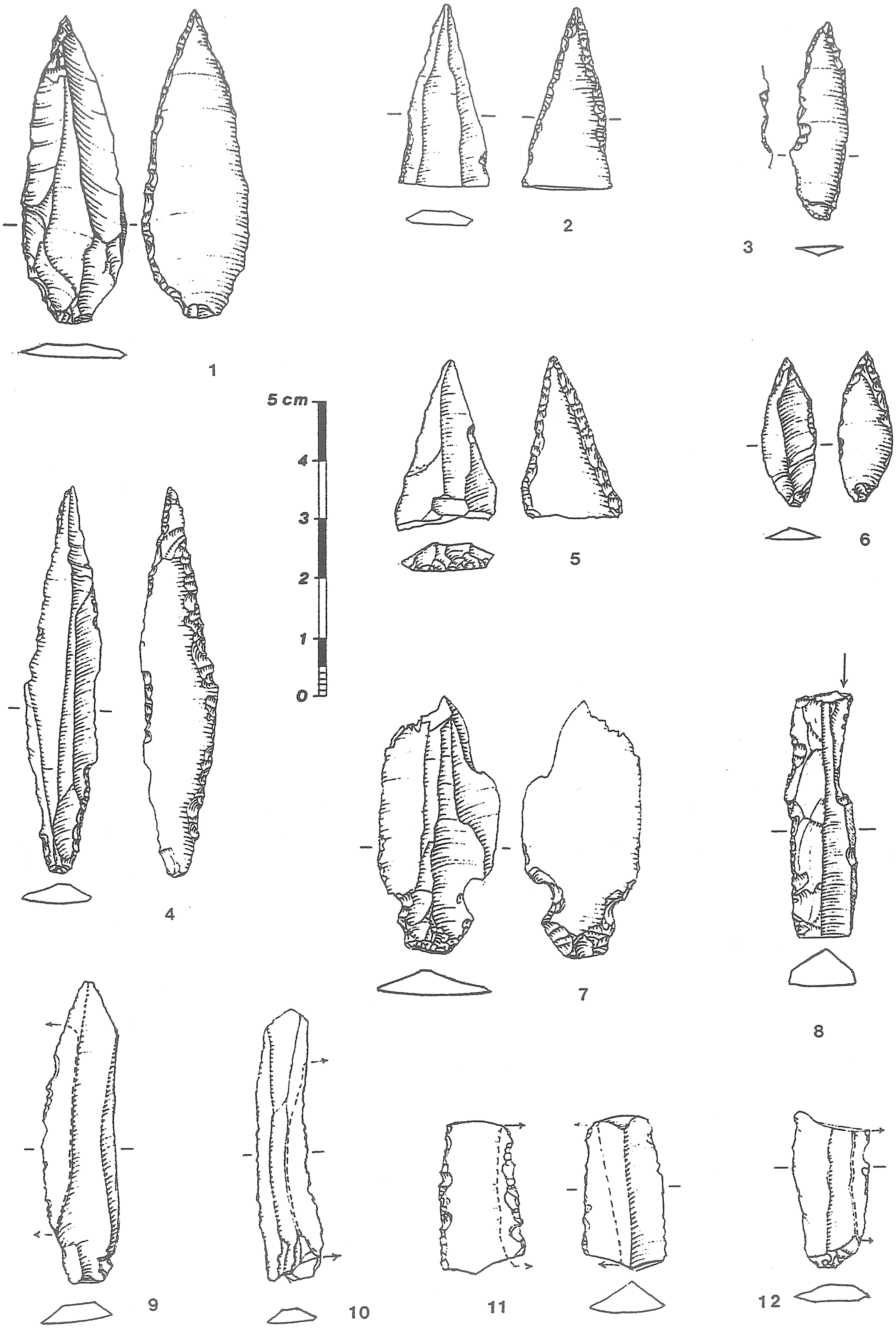


Fig. 5. Çayönü. Lithic artifacts from the Round Plan Sub-phase: 1-6 points with inverse retouch, 7 tanged point, 8 dihedral burin, 9-12 glossed elements.

tage. A central ridge between two parallel removals seems to be preferred, especially in little points with inverse retouch. This ridge was probably needed to obtain a pre-shaped, solid triangular form. Burins (Figs. 4:3, 5:8) were mainly dihedral or on fracture. Glossy pieces (Fig. 5:9-12) included specimens of varying size and shape. Among the débitage, cores, crested blades and core rejuvenation flakes were virtually absent. This would suggest that knapping was practised elsewhere in the site and that the small space in the hut was probably not organised in different activity areas. Obsidian was used relatively rarely. It increased, however, in one of the structures (30 M), which might represent the latest aspect of the sub-phase. Among the retouched tools, obsidian was used mainly for endscrapers (Fig. 4:7-8) and for pieces with occasional retouch.

Only minor differences separated these assemblages from those of the Grill Plan Buildings in the tool-kit composition. In the examined structure (GHa), endscrapers decreased in number and were all on flint, while both the other tool classes and the blade index did not differ from the earlier assemblages. Changes, however, were observed in the morphology of the tools from the different classes. Points, for instance, showed less standardised characteristics in the Grills, where the first examples of the Byblos points also appeared. Backed blades seemed to be gradually replaced by the highly standardised double-backed obsidian Çayönü tools, which first appeared in the Grills, as did flaking products, cores and core rejuvenation flakes. These differences, however, seem to appear only in the final stage of the sequence of reconstructions of the Grill Plan Buildings, represented by GHa.

The Channeled House Sub-phase (I.C.)

As far as the Channeled House Sub-phase is concerned, the analysis was conducted on two different complexes belonging to the final aspects of the period, before the Cobble Paved Building Sub-phase: the interior of a building (DI) and a contemporary open area on the outside (20M). Flint was more abundant outside the building and included more fragments, cores and other kinds of débitage. The typological characteristics of the two complexes were otherwise basically similar. Among the retouched artifacts, flakes were by far less numerous than blades. Perforators, including short beaks, borers, various types of points and microlithic bar-drills, were the most common of the recognisable

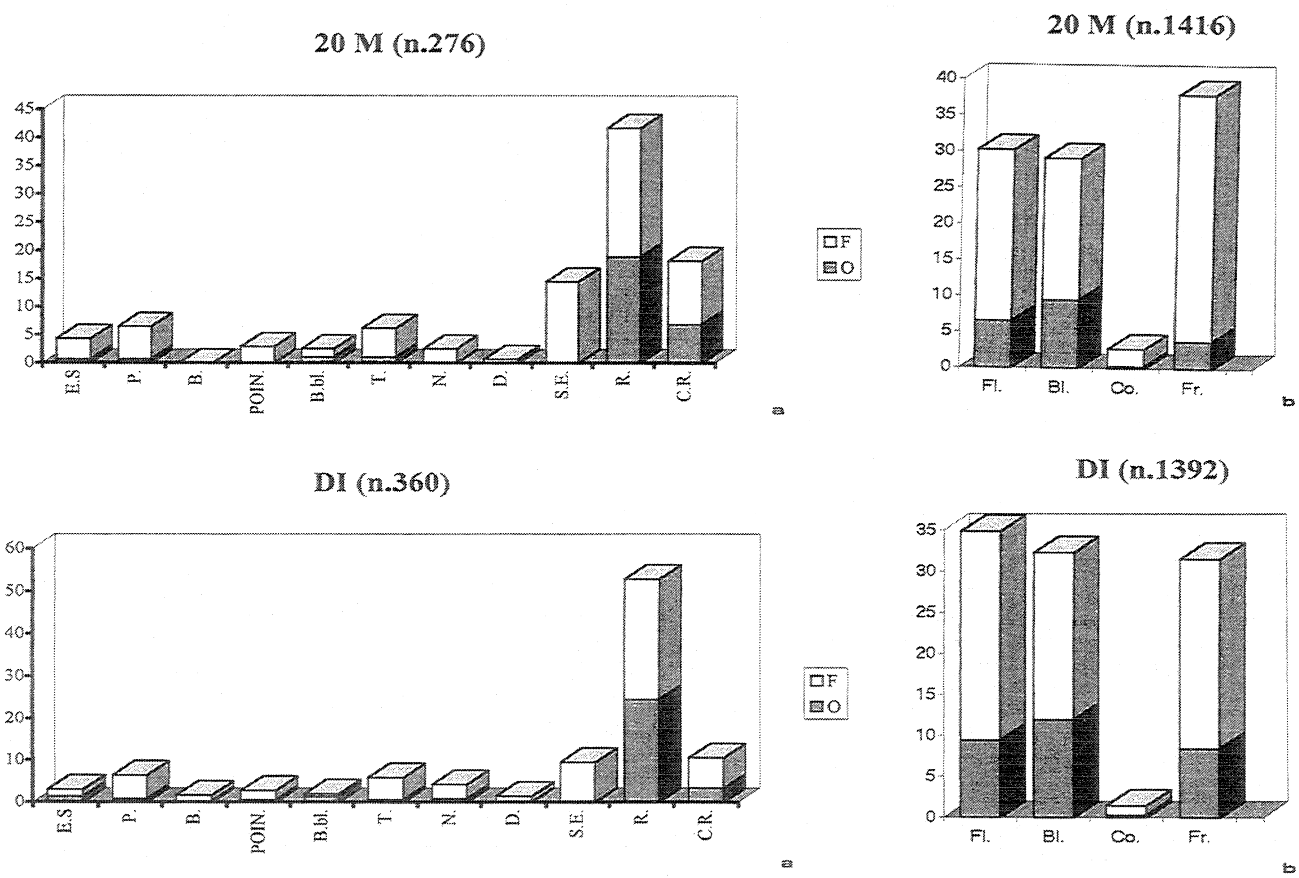


Fig. 6. Çayönü. Frequency of lithic artifacts from a house and an open area of the Channeled Building Sub-phase: a retouched tools, b debitage.

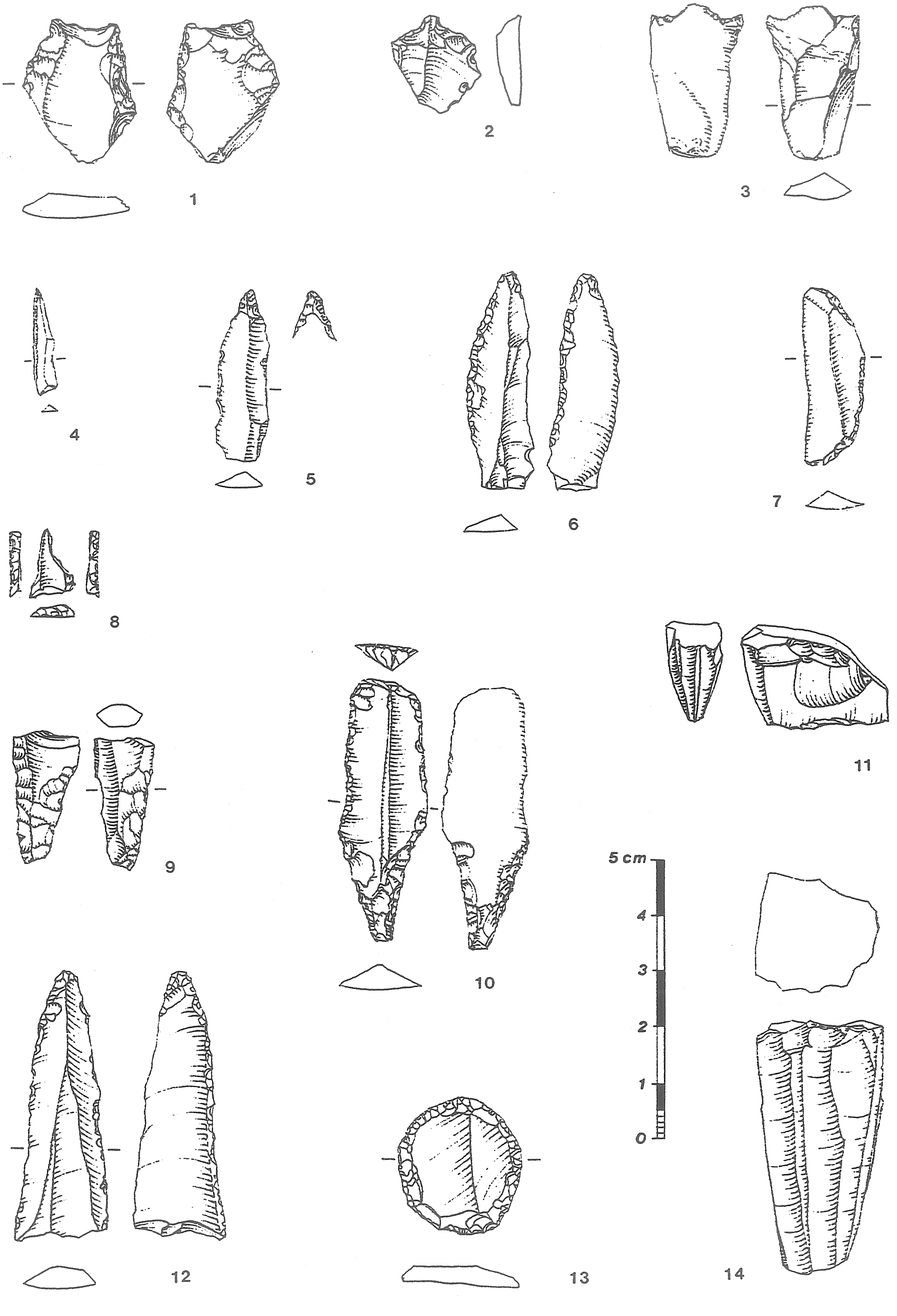


Fig. 7. Çayönü. Lithic artifacts from the Channeled Building Sub-phase: 1-3 beaks; 4-6,12 piercers; 7 backed blades; 8 drill; 9 bifacial tang; 10 tanged end-scraper; 11,14 prismatic cores; 13 scraper.

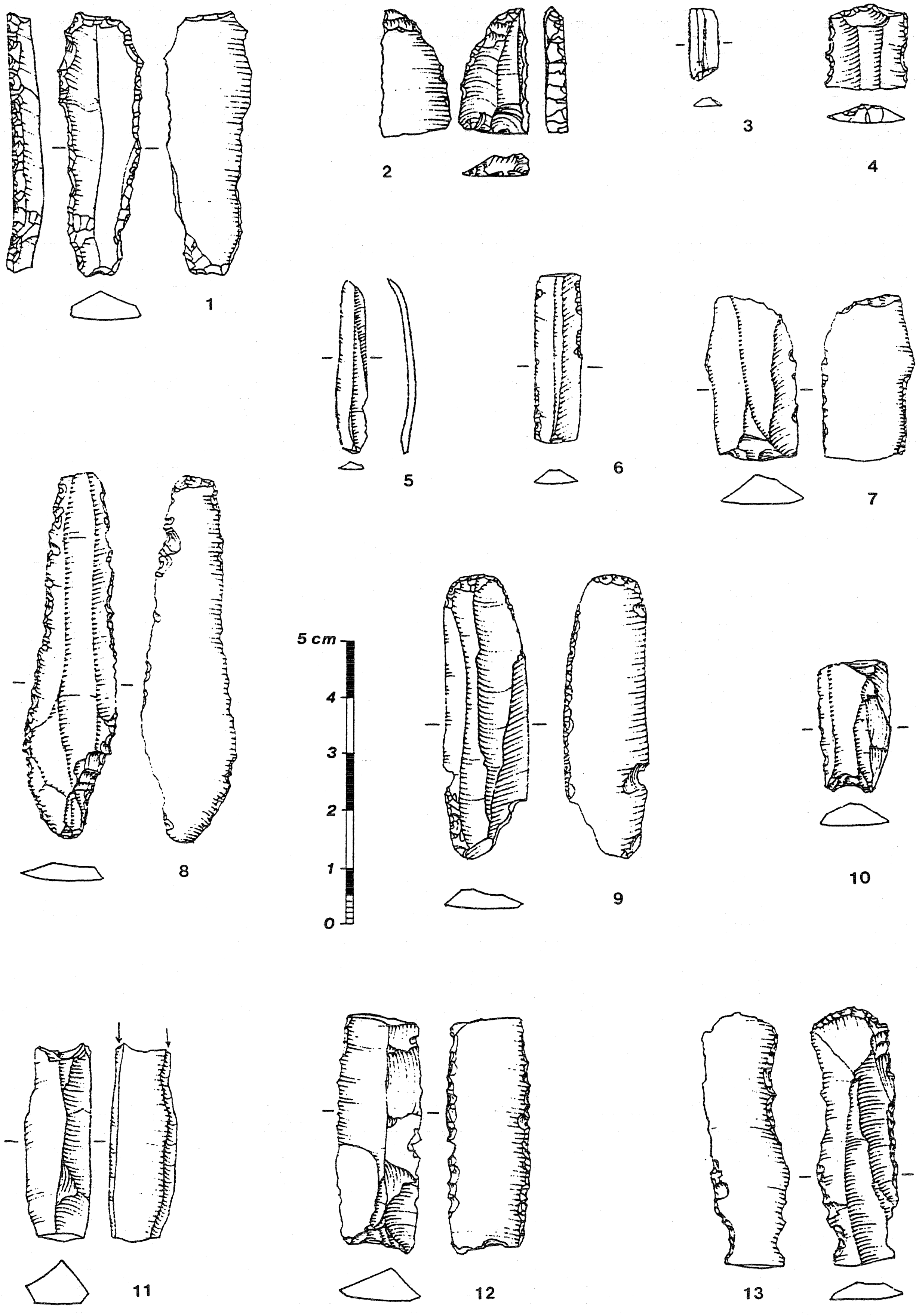
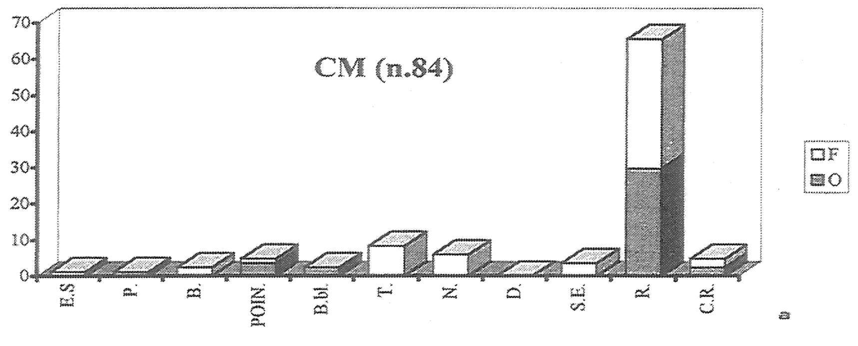


Fig. 8. Çayönü. Lithic artifacts from the Channeled Building Sub-phase: 1-4,7 double truncations; 5 unretouched bladelet; 6 retouched bladelet; 8-9 convex inverse truncations; 10-12 concave truncations; 13 convex truncation on strangled blade.

tools (Fig. 7:1-6,8,12). Glossy blades were also frequent, especially in the open area. Many of them had truncated ends, suggesting that they were used in rows of elements inserted in a shaft (Fig. 8). Truncated blades without lustrous edges were also very frequent. Some of them were extremely small and thin and in some cases showed tiny continuous retouch even on one of the edges (Fig. 7:4). Less numerous were notches and denticulates, projectile points and backed blades. Among these, the Byblos point and the Çayönü double-backed blade remained quite rare.

The class of variously retouched pieces accounted for about two thirds of the total retouched artifacts in both assemblages. A smaller class of continuously retouched artifacts, mainly blades, was extracted from this general category. Among these blades, the only recurring retouch pattern was that on symmetrically opposed short sections of the sides, as if the blade had been used on a small part of one edge and then reversed to be used in the same way on the other side (Fig. 8:6). The high frequency of microblades less than 5mm wide was consistent with the presence of several bullet-shaped microblade prismatic flint cores and of typical small obsidian pebble cores, both showing features deriving from pressure flaking techniques. Another kind of prismatic core seems to appear in these assemblages, or even in the very last development of the Grill Plan Sub-phase. The striking platform is sharply inclined and plain, and the back of the core bears transverse flake scars (Fig. 7:11). Both features seem to anticipate the main characteristics of the bipolar naviform core, with its oblique platforms, which starts being used in the following sub-phase.

There were considerable differences between the earlier sub-phases and this assemblage, although some may be due to a more accurate collection of small fragments obtained by sieving the soil from DI house. For instance, blades did not prevail over flakes in the débitage, probably because a bigger amount of flakes smaller than 5mm (chips) were collected in DI. Instead, among the retouched tools, blades were up to six times more numerous than flakes. Flint appeared to be still intensively used in both retouched and non-retouched artifacts in DI, accounting for about 80%: with the exception of the rare Çayönü blades, obsidian seemed to be only occasionally used. Compared with flint, obsidian showed a higher number of blades than flakes in all categories of artifacts, suggesting that different reduction techniques were used for obsidian and flint, and that each of these raw materials was intended for implements with different functions. Among the variously retouched tools, which were mainly on blades, obsidian frequency was in fact almost equal to that of flint. Knapping activities were probably performed outside the building. Only part of the surrounding courtyards, on the southern edge of DI (Square 20 M), has been analysed so far. Here, a big quantity of débitage occurred, including a high number of cores and all kinds of knapping products, such as core rejuvenation flakes, crested blades, fragments, chips, etc. Although only minor refitting experiments have so



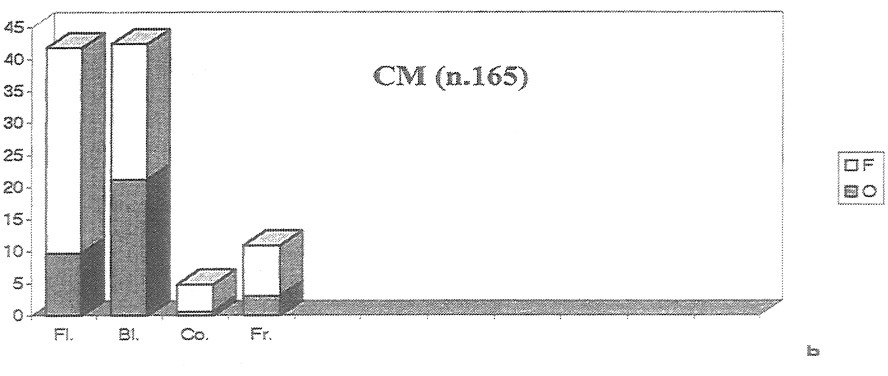


Fig. 9. Çayönü. Frequency of lithic artifacts from a Cobble-Paved house:
a retouched tools; b débitage.

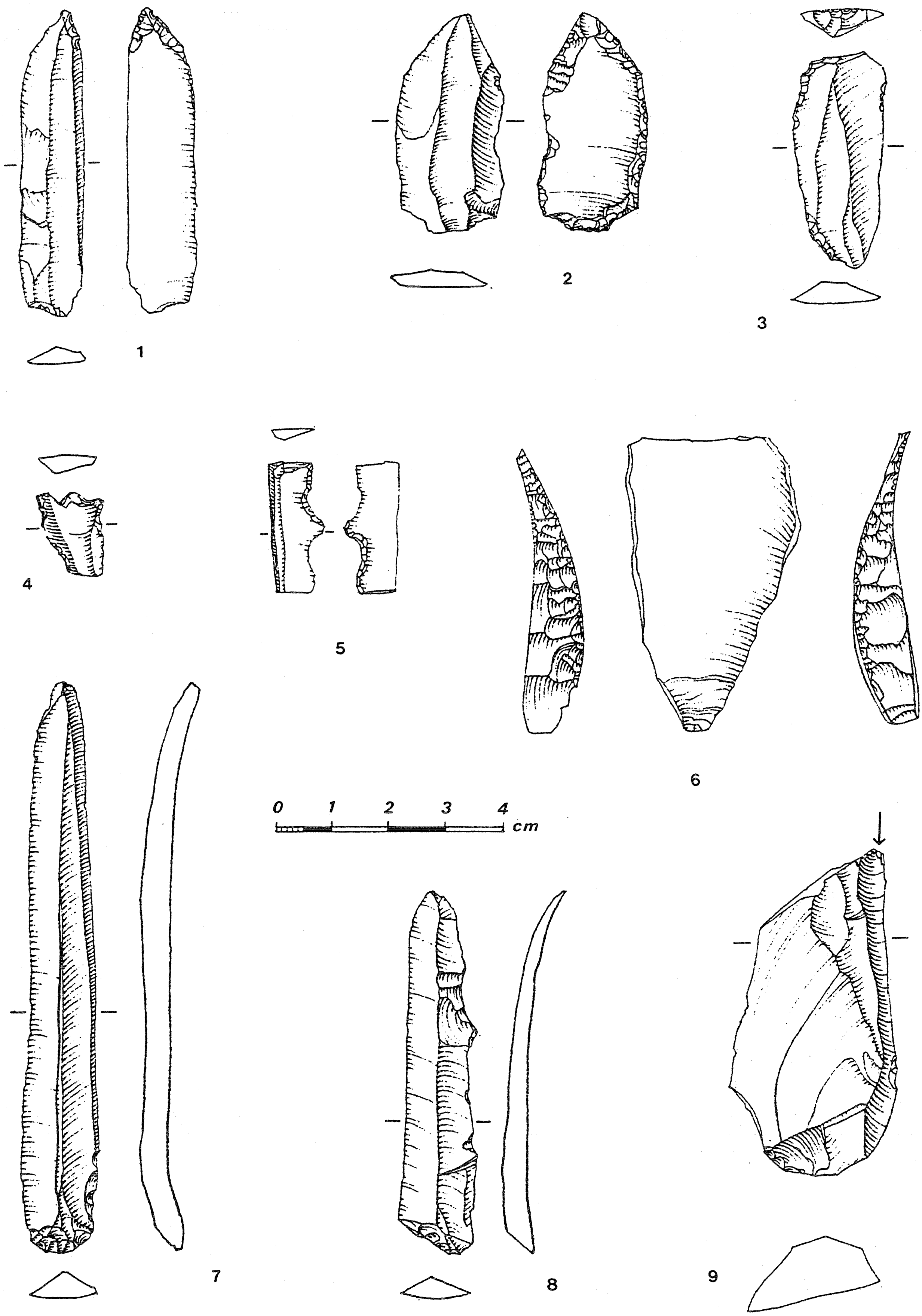


Fig. 10. Çayönü. Lithic artifacts from the Cobble-Paved Building Sub-phase: 1-2 points; 3,8 truncated blade; 4 beak; 5 denticulated blade; 6 core rejuvenation flake; 7 blade; 9 dihedral burin (4,6,7-8 in obsidian).

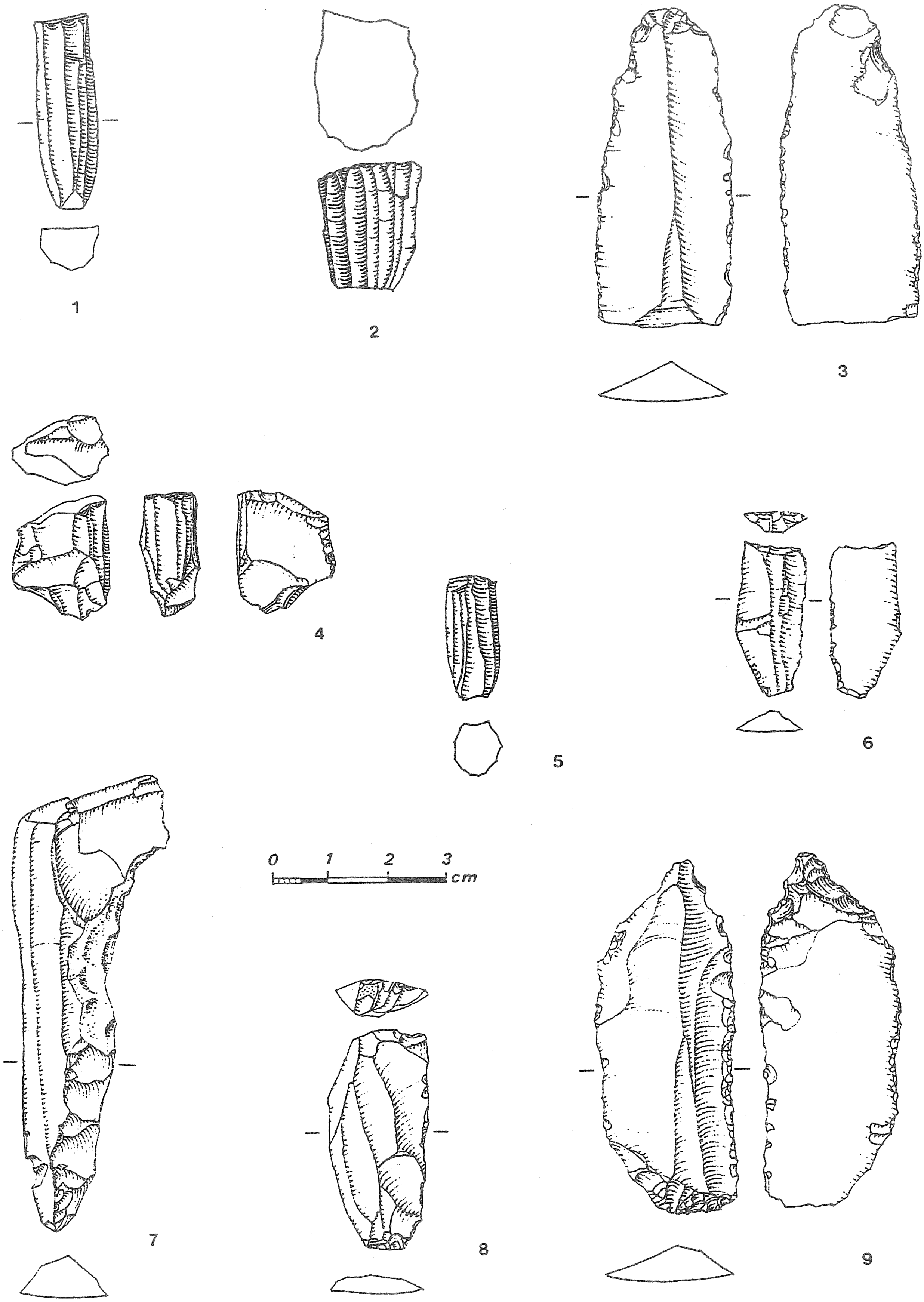


Fig. 11. Çayönü. Lithic artifacts from the Cobble-Paved Building Sub-phase. 1-3,5 cores; 4 end-scraper; 6,8 truncations; 7 crested blade; 9 end-scraper-beak.

Plate 1. Çayönü. Lithic artifacts from the Cell Plan Sub-phase: 1-2 standardised glossy elements; 3,5-6 projectile points; 4 naviform core.

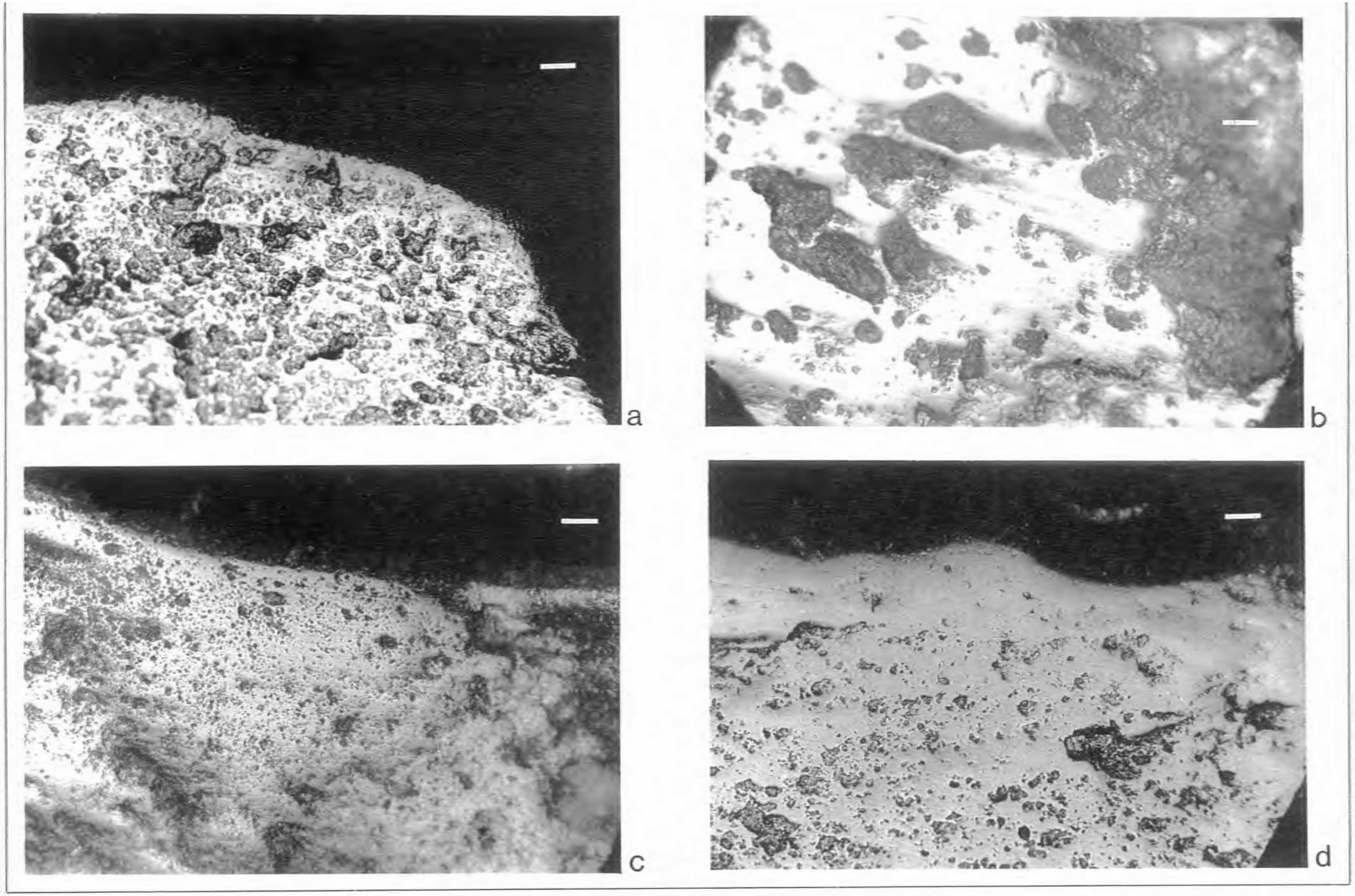


Plate 2. Photomicrographs (100X) of glossed tools <*all scale bars equal to 50 microns*>: a-b Round House tools (a sligthly developed gloss with a little edge-rounding; b developed gloss: note the striations produced by cutting plants near the ground.), c-d Grill House tools (developed gloss with a great edge-rounding: note the absence of striations inside the glossy area.).

far been attempted on this material, it is clear that it was struck on the spot, from a limited number of flint blocks. One group, in particular, consisted of one residual single-platform core plus 30 bladelets, 30 flakes, 20 chips and 9 crested blades, which could be considered as the average core production in this sub-phase, suggested also by the total count of the débitage of DI.

The Cobble-Paved Building Sub-phase (D.Z.)

A small increase in obsidian use was observed in the Cobble-Paved Buildings (Fig. 9). The materials from three separate buildings, belonging respectively to the earliest (DA) and middle (CM, CZ) development of the sub-phase, were analysed, but only the two more consistent collections, from CM and CZ, are reported here (Figs. 10-11). Among the débitage, slightly less than 50% of the artifacts were on obsidian, although cores were mainly on flint. A variety of cores were present in this sub-phase, including unipolar and bipolar prismatic cores (Fig. 11:1-2,4-5). Flaking activities on the spot are also suggested by the frequency of flaking products, such as crested blades and core rejuvenation flakes (Figs. 10:6, 11:7), as well as of cortical pieces both among the débitage and the retouched tools. As for obsidian, although a few core waste pieces occurred in the débitage, almost no cores were recovered. The only specimen was a small naviform core, a type which first appeared here in the Çayönü sequence. The pressure flaking technique also seems to be in use. Very small flint microblade cores were found, suggesting that a certain production of microliths continued, probably for specific manufacture. The selection of a particularly good quality, fine grained flint is associated with these cores, which testify to a very specialised and extremely controlled exploitation. Among the tools, obsidian and flint were used for the first time in almost equal numbers, especially in CZ. The Çayönü tool increased, as did the Byblos points, both of which are on obsidian. Obsidian, however, was not used for all the points. Some of the described features, such as the massive use of obsidian and the introduction of bipolar naviform cores, are decidedly innovative in this sub-phase. These are further developed throughout the following Cell Building Sub-phase (Pl. 1).

Use-Wear Analyses (C.L.)

Further functional analyses were applied to the Çayönü lithic material. Use traces were identified on 61 out of 99 analysed artifacts (a total of 68 edges) from a structure of the Round Building Sub-phase (RB) and on 152 out of 178 analysed artifacts (183 edges) from the latest rebuilding of a structure of the Grill Plan Sub-phase (Gha).

The functional framework of both sub-phases appears to be quite varied. Different activities were carried out and different types of materials, such as wood, hide, antler, bone, vegetals, and animal tissues connected with butchering activities, were worked in both houses (Tables 1-2). In the Grill Sub-phase, however, a certain decrease in the processing of soft materials was detected (soft materials include conventionally non-woody plants, meat, fat, fresh hide). This could be interpreted as a reduction of some specific subsistence activities, such as butchering, and the preparation of non-siliceous plants, like roots (SIEVERT 1992). When the subsistence activities decrease, other activities connected with the processing of medium-hard materials, such as wood or leather for making objects and structures, increase; the use of lithic artifacts for this type of activity in the Grill House is suggested by six examples of piercing actions on medium-hard material, actions which were not recognised on the analysed artifacts from the Round House. This evidence seems to indicate a specialisation of the inside area in the Grill House for certain functions, while more specific subsistence activities were probably performed in other places outside the building.

The fact that glossy tools occur in both sub-phases points to the exploitation of siliceous plants. Only longitudinal cutting activities on these plants were recognised in both buildings except for a single case of an unknown transversal movement on a glossy tool from GH.

Glossed tools from RB show varying features and edge rounding (Pl. 2:a-b). According to the functional inferences made by several authors (*e.g.*, ANDERSON 1992, VAN GIJN 1990), such variations could indicate that either the stalks of siliceous plants were cut at different ripening stages - dry, half-green, green - or different types of siliceous plants were cut. Glossed elements with inside striations and those without striations are both present (Tab. 3). The differences suggest that different habits to cut the stalks of the plants existed, either at ground level or higher. Moreover, edge damage is only rarely present on glossed artifacts, indicating that the stalks in contact with the use edge of the tool were not particularly thick and, therefore, did not produce much friction (Table 3). The research in its present stage does not provide specific data on the relationship between the different morphologies of glossed tools and the processed siliceous plants. However, the palaeobotanical analysis suggests that the cutting of siliceous plants, which is quite consistent in the functional panorama of this house, was related more to handicrafts than to nutrition, since nuts and fruits are more frequent than cereals in this sub-phase.

The gloss on the artifacts from the Grill House is always well developed and is always associated with a rather consistent edge rounding (Pl. 2:c-d). A fairly well-developed gloss seems to indicate that the artifacts were used for a long time and that the plants were generally cut not at a dry, but rather at a green or half-green ripening stage. The occurrence of striations on the glossed tools considerably decreases in comparison with the previous sub-phase, suggesting that the plant stalks were rarely cut at ground level (Tab. 4). On the other hand, edge damage due to a constant use increases, indicating greater friction against thicker stalks (Tab. 4). This evidence suggests that some interesting changes occurred in both the way in which siliceous plants were cut, which appears to be more homogeneous than in the previous sub-phase, and the types of siliceous plants involved, which seem to be less diversified. The limited variation of siliceous plants points to the existence of cultivation practices. In this respect, the recorded increase in the number of thicker stalks might indicate that a larger quantity of cereals with a tougher stalk were collected, supporting the hypothesis of an initial cereal domestication, also suggested by the palaeobotanical analysis. At any rate, it must be noted that, in this case, an increase in the friction between the edge of use and the cut stalk could also be due to the collection of rushes and stipa, both recorded in this sub-phase.

Table 1. Results of use-wear analysis (material worked) on artifacts from the Round House Sub-phase.

Round House	
Material	**Used edges**
Soft material	9 (13%)
Medium hard material	12 (18%)
Hard material	5 (7%)
Fleshy tissues	-
Hide	2 (3%)
Wood	4 (6%)
Glossy	24 (35%)
Indeterminate	12 (18%)

Table 2. Results of use-wear analysis (surface alteration) of artifacts from the Round House Sub-phase.

Round House	
Material	**Used edges**
Glossy	8 (33%)
Glossy + stries	8 (33%)
Glossy + edge-removals	3 (13%)
Glossy + stries + edge-r.	5 (21%)

Table 3. Results of use-wear analysis (material worked) on artifacts from the Grill House Sub-phase.

Grill House	
Material	**Used edges**
Soft material	14 (7%)
Medium hard material	93 (51%)
Hard material	18 (10%)
Fleshy tissues	4 (2%)
Hide	5 (3%)
Wood	10 (6%)
Glossy	23 (12%)
Indeterminate	16 (9%)

Table 4. Results of use-wear analysis (surface alteration) on artifacts from the Grill House Sub-phase.

Grill House	
Material	**Used edges**
Glossy	4 (17%)
Glossy + stries	2 (9%)
Glossy + edge-removals	12 (52%)
Glossy + stries + edge-r.	5 (22%)

Concluding Remarks (I.C., C.L., and D.Z.)

The progress in the analysis of the Çayönü chipped stones has confirmed the trends already observed in the preliminary stratigraphical examination of the material: 1) a progressive increase in the use of obsidian, from 20% in the basal levels, to 50% in the Cells and up to 80% in the final aceramic aspects; 2) a growing preference for blade tools, which gradually shifted towards obsidian blade tools, while flint was used in the latest sub-phases for flakes only. Elements of continuity throughout the stratigraphy are represented by the presence, from the very beginning of the occupation of the site, of glossy pieces, points and a large number of unclassifiable retouched blade/flakes, as well as by a high blade index. Only the group of piercers, burins and endscrapers shows some variations and seems to be more important in the earliest sub-phases, especially in the Round Houses.

However, the internal characteristics of the tool classes seem to change. This is especially true for the morphology of the glossy blades, as well as for the points, which change from the small, flat, truncated types of the Round Houses, to the more varied types and sizes of the Grills, and finally to the elongated, tanged obsidian types of the Cells (Pl. 1). The same can be said for the backed blades, which include very different artifacts in the various sub-phases: the flint backed blades and segments of the earliest sub-phases, in fact, are later all replaced by the Çayönü double-backed obsidian tools.

From a technological point of view, the production of particularly flat and thin blades, with a straight profile, is only observed in the Round Houses. This kind of blank was used to produce mainly endscrapers, points and retouched pieces. The almost total absence of cores makes it impossible to reconstruct the flaking methods used in this sub-phase, be it direct percussion with a soft hammer or indirect percussion. Pressure flaking was already intensively used in the Channeled Houses, in concomitance with a careful selection of better quality flint and with the production of microblades. It continued to be used, later, on both obsidian and flint, as a parallel knapping method, along with the sophisticated development of the percussion technique into the bipolar naviform cores. While bipolar cores were also used before, this new technique only appeared later, in the Cobble Paved Buildings, and was never exclusive. The co-existence of pressure and percussion techniques during the Cobble Paved and the Cell Building Sub-phases suggests that they were used to obtain different products, regardless of the raw material used. The hypothesis that blades struck from naviform cores were the best support for points (INIZAN and LECHEVALLIER 1994: 29) is corroborated by the concomitant diffusion of big points (mainly Byblos) and naviform cores in the same subphases at Çayönü. On the other hand, highly standardised blade segments, with parallel sides and glossy edges, seem to be obtained in these sub-phases by pressure technique, supporting again the above mentioned suggestions by Inizan *et al.*

The shape and size of naviform cores are less standardised at Çayönü than in other case studies, such as 'Ain Ghazal (WILKE and QUINTERO 1994). Extremely small cores, still maintaining their diagnostic features, were found in CM (Fig. 11). Obsidian, in particular, was exploited to exhaustion in all the sub-phases and with different techniques, probably because of its difficult procurement. Small obsidian pebble cores, usually with a single striking platform and still with cortical portions on the back, were found in DI. The existence of small-size cores suggests that not all the bladelets were by-products of blade production, but that some were intentionally struck, as were the bigger ones. In this sense, in the definition of by-products, a distinction should be made between real waste, discarded by the knapper, and the products of a certain series of knapping operations, which all seem to have been potential tools. In several cases, it seems that the choice of artifacts to be extracted from among the core products and used as tools included a wide range of options. At Çayönü, in particular, many "atypical" blanks were retouched or used.

If minor differences exist in the basic tool-kit composition, greater difficulties have been encountered in the characterisation of the variously retouched artifacts in all the sub-phases. These account for about 60-70% of the total retouched artifacts and, therefore, for the majority of the activities performed in the site. Their characterisation, however, can only be obtained with the systematic application of use-wear analysis and might well change the picture so far obtained for the stratigraphy of Çayönü.

A preliminary comparison between the typological data and the evidence from the analysis on use traces confirmed the need to be very cautious in attributing a precise funtional feature to a lithic type. Morphological and functional data obtained with the wear analysis showed discrepancies which are reflected in tool definitions. As an example, the dihedral area of the five analysed burins was used for engraving in one case only. In three cases, it was used for transversal actions, such as scraping or planing medium-hard or hard materials, showing that burins may have had different functions, as has already been suggested by previous functional analyses (JUEL JENSEN 1988). In one other case, only the part of the edge next to the dihedral area was used. This therefore represented either an unintentional fracture, or an intentional one, connected with a haft or to a modification of the tool after its use. Another noteworthy example is that of points and borers. The former, although scarcely represented (only four cases), either appear to have been used as perforators or do not apparently show use traces, suggesting that the thinned retouched part might have been intended for hafting. As for borers, in some cases there is a coincidence between the typological and the functional definition. However, it must be noted that the morphology of the three perforators used to pierce medium-hard or hard materials, such as wood, bone, or antler, was not the result of retouch, but of edge removals due to their use; it seems, therefore, that artifacts with natural protruding points were preferred to perform this activity. On the other hand, two perforators made by means of real retouch were used to pierce soft materials, such as wet or fresh hide. Moreover, another five artifacts used to perforate medium-hard or hard materials were identified in both categories of retouch and débitage. Thus, in a typology based on strict morphological criteria, the class of borers is obviously underrepresented.

The relatively good edge conservation of the lithic artifacts from Çayönü suggests that they were subjected to only minor post-depositional movements. Their original spatial relationships, however, may have changed, especially where intensive architectural activities were performed. Quantitative evaluations of the different features, therefore, are used in this study only to identify either trends in the chronological sequence, or major discrepancies in contemporary assemblages within the site. Absolute quantities are not always considered reliable. A careful study of site formation processes is an unavoidable step in the research to correct the results of the lithic analysis. It should also be borne in mind that obsidian is more fragile than flint, and that its presence may be over-estimated if the fragments are only numerically calculated. The problem of the difference between flint and obsidian has already been highlighted in previous reports on this collection (CANEVA *et al.* 1994), particularly with regard to the different productivity of the cores of the two raw materials. The two aspects, productivity and fragmentation, require that the frequency of each raw material to be evaluated separately at Çayönü.

The lack of systematic sieving at Çayönü is regrettable, as it may have caused discrepancies in both quantity and dimensional classes of the artifact collection between different areas. However, this does not seem to have affected the general characteristics of the tool composition. The missing part of the collection, in fact, probably consisted of chips, *i.e.* by-products of core preparation and maintenance. Instead, it is the reconstruction of the technological framework of core exploitation which would have been enriched by sieving, permitting more significant intrasite and intersite comparisons.

This is possible in some cases with the Çayönü collection, and one case is particularly interesting. A comparison between the sieved assemblages of the Channeled Houses from Çayönü and the contemporary, also sieved, assemblages from Nevalı Çori suggests that great technological differences existed in the two contexts. At Nevalı Çori, the flake:core ratio is 1000:1 (SCHMIDT 1994), whereas it is only 20:1 in DI, at Çayönü. This impressive difference should be further emphasised as it probably reflects specific core reduction strategies used at Nevalı Çori and Çayönü. An effort should be made to relate this datum to the production at Nevalı Çori of the most common tool of the assemblage, the point, which is not common at Çayönü. To sum up, in spite of the strict architectural correlation between the two sites, only minor affinities exist in the lithics. Only the declining trend shown by the hollow-based points through the sequence at Nevalı Çori is repeated at Çayönü; the marked basal and lateral concavities of the Nevalı Çori points, however, are lacking at Çayönü.

These observations suggest that architecture was quite an independent variable from other cultural components of these contexts. This consideration seems to be supported by the analysis of the small finds, recently made by A. Özdoğan (1995). The "re-phasing" of the sequence on this basis combines and separates different architectural sub-phases and partially overlaps the sequence suggested by the lithic perspective.

As seen from the changes in lithic technology and typology, the development of the aceramic sequence at Çayönü consists of four main steps. The earliest sub-phase would include both the Round Building aspect and a consistent part of the development of the Grill Houses, in spite of the macroscopic differences in the architectural planning of these two contexts. Conversely, the latest aspect of the Grills would already represent a certain change that was partially maintained through the Channeled Houses (it is not clear whether the innovative production of microlithic tools in the analysed areas of the Channeled Houses Sub-phases is a functional or a chronological indicator). The third "lithic sub-phase", characterised by the greatly increased use of obsidian blades, Byblos points, and Çayönü tools and by the introduction of naviform cores, starts with the Cobble Paved Buildings and continues, with a growing standardisation of these features, throughout all the cells. The great change produced in the lithic tool kit by the massive introduction of obsidian, therefore, is not as late as the Cell Sub-phase, as was previously thought, even though it is in certain Cell Buildings that obsidian workshops with impressive reserve stocks were found (CANEVA *et al.* 1994: Fig. 7). Finally, the Large Room Sub-phase would represent a greater change, this time reflected directly in the architectural typology and probably the overall organisation of the village.

As has already been pointed out in the first report on the lithic analysis, this sequence has no strict chronological value other than that of stratigraphic superimpositions. Each architectural sub-phase lasted for an unknown time span, which could in some cases have been very short, in others much longer. Moreover, it should be borne in mind that such a systematic, periodic, general reconstruction of the buildings of the village could be due to induced needs that have nothing to do with the normal, time-related degradation of the buildings. Lastly, while the features of each analysed building have until now been assumed to be general features of the sub-phase, it cannot be excluded that they were limited to specific functional areas. It is therefore highly possible that inconsistencies exist in seriations of the same deposits made either on lithic technology, on prestige objects or architecture. The slight discrepancy mentioned above should be considered as a further insight into the mechanisms of cultural changes in this site. It confirms, at any rate, that only the combined analysis of the different archaeological indicators will provide a significant interpretation of the investigated contexts.

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Synopsis of Recent Findings From the Analysis of Obsidian and Flint Artefacts from Çatalhöyük East (*Abstract*)

James Conolly

The following brief statements can be made regarding the Çatalhöyük East obsidian and flint industry. These are based on surface and excavation data, and the 1960's collections housed in the Konya Museum, Turkey. The analysis was conducted between 1993 and 1996 as part of the renewed excavation project at Çatalhöyük under the direction of Ian Hodder, University of Cambridge.

1) Obsidian is the predominant raw material at Çatalhöyük East, constituting approximately 96% of the assemblage by count and 93% by weight. Fine-grained tabular flint and coarse-grained cobble flint were also used, although the former is more common (2.6% of assemblage by weight). Smaller amounts of basalt and quartz occasionally show evidence of having been intentionally knapped.
2) There appear to have been several different 'technological systems' in operation at Çatalhöyük. The three major ones are: (i) an obsidian prismatic pressure-blade system; (ii) a flint and obsidian non-prismatic blade system; (iii) a flint and obsidian flake system. Cores showing these three approaches to debitage have been recovered. Core platform rejuvenation flakes and crested blades are also present. However, cortical surfaces are extremely rare on obsidian, moderately rare on flint.
3) In general, a wide variety of tool forms are present, of which 'non-formal' varieties are the most prevalent. Retouched pieces can occur on both flake and blade (prismatic and non-prismatic varieties), although attribute analysis of retouch characteristics show that some combinations of attributes occur preferentially on particular types of debitage and raw material. For example, there is a higher incidence of direct semi-abrupt convex retouch on flint flakes, of a sort suggestive of scraper retouch. Points (arrow, lance and/or spear) and pièce esquillée are the two other most common types, respectively constituting 17% and 15% of all retouched tools.
4) There is a considerable difference between the early and later phases of the assemblage. Earlier phases are dominated by flake debitage and smaller point types, later phases by blades (particularly prismatic blades) and larger point types. Regional comparisons show the earliest phases at Çatalhöyük East are broadly similar to Can Hasan III and Süberde, the later phases more akin to sites like Köskhöyük and the later Neolithic phases Yümüktepe. There are also differences in the surface collected assemblages along these lines, suggesting that occupation of some parts of the mound carried on longer than other areas. There is also good evidence of a previously unrecognised small-scale Chalcolithic inhabitation on the east mound, consisting of two transverse arrow-heads and Chalcolithic pottery recovered from deposits immediately beneath the surface in one of our excavation areas.
5) Examination of inter-building patterning in later levels shows that there are considerable discrepancies in the distribution of some flint and obsidian artefact types. This is particularly manifest in points, prismatic blades and blade cores, as well as the more unusual items such as obsidian mirrors and hilted flint daggers. High numbers of these artefacts are preferentially present in buildings Mellaart originally called 'shrines' which are often the most architecturally elaborate buildings amongst their contemporaries. The asymmetric distribution of prismatic blade (in contrast to the more even spread of flake cores) is suggestive of a restriction of production

activities. One possible interpretation of this phenomenon is that some items, particularly items requiring a high level of knapping expertise, were afforded with special symbolic and social importance, and their manufacture occurred in the more ritually complex buildings at Çatalhöyük.

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Remarques sur l'industrie lithique Néolithique de l'Iran (10.000-6.000 av. J.-C.)[1]

Jalal Rafifar

Resumé: *Cette étude est un essai de synthèse sur l'industrie lithique néolithique du Zagros, du plateau Iranien et la plaine du Khuzistan. Cette analyse critique a permis l'élaboration d'un nouveau modèle explicatif global, dans lequel s'inscrivent de manière plus cohérente l'ensemble des données fournies par les auteurs. Alors que les travaux antérieurs consistaient en des études de cas isolés, ce travail nous a permis de mettre en évidence, entre les trois sous-régions, une unité et une identité qui autorise à parler d'une région archéologiquement homogène et ce au moins dés l'epoque néolithique. Cette unité est marquée par: 1) l'emploi des matière premières utilisées, 2) la technologie mise en oevre, 3) la concomitance chronologique des phases du processus de néolitisation.*

> " La connaissance que l'on possède de l'évolution technique des anthropiens, depuis les stades les plus anciens jusqu'au début de la période climatique actuelle, est essentiellement fondée sur l'outillage de pierre taillée. A condition d'admettre que cet outillage ne représente qu'une infime partie de l'équipement des hommes fossiles, on peut lui reconnaître la valeur de témoin pertinent car sur tout ce qui est périssable nous ignorons pratiquement tout. " (LEROI-GOURHAN 1964: 188)

Ce n'est que depuis quelques années que les techniques de débitage et de taille des "cailloux" se sont révélées des sources d'information considérables. L'un des buts de cette étude est de montrer que même dans un contexte tel que le néolithique iranien où la céramique, aussi abondante que variée, est toujours considérée comme l'élément essentiel de l'analyse d'un site, les industries lithiques peuvent elles aussi être riches d'informations. Selon C. Perlès: ces informations se divisent en trois groupes:

1. Informations paléthnographiques: Elles aident à cerner la répartition des activités du groupe humain dans un lieu et précisent certaines d'entre elles sur le plan technique.
2. Informations économiques: Elles révèlent les problèmes de commerce ou d'échange à longue distance.
3. Informations archéologiques: Elles contribuent à préciser la situation chronologique et l'appartenance culturelle, et ce en raison du choix culturel dont découlent les techniques mises en oeuvre dans la fabrication des outils et des armes de pierre taillée (1981: 133). Il semblerait donc possible d'obtenir des industries lithiques l'image évolutive réelle d'une société préhistorique. Cet axe de travail occupera une place importante dans l'étude de notre région et particulièrement du Zagros.

L'époque néolithique, celle qui concerne notre travail, est le cadre d'événements importants tels que la sédentarisation, la naissance de l'agriculture, la domestication des animaux et l'apparition des villages.

Mais l'industrie lithique n'a pas la place qu'elle mérite dans la caractérisation de cette région à cette époque.

On se doit de mettre l'accent sur la pauvreté des études de la plupart des sites néolithiques iraniens. En général l'outillage lithique n'y est signalé qu'à travers quelques pièces sommairement décrites.

En outre nul décompte exhaustif ne permet d'exploiter au mieux les informations, si pauvres soient-elles, en vue de l'interprétation et de la compréhension des sites.

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[1] Dédié aux professeurs J. Cauvin et E.O. Negahban.

L'homme préhistorique en Iran comme ailleurs a taillé toutes les matières premières qui se présentaient à lui, les testant et les sélectionnant selon leur abondance, leurs dimensions, leur aptitude à la taille...

Pour tous les gisements néolithiques, les seules données en notre possession sont d'origine bibliographique. Il nous a été impossible d'accéder directement au matériel extrait de ces sites.

Dans une acception très large du mot, l'industrie se caractérise par une action de l'homme sur la matière afin de la transformer. Elle englobe ainsi toutes les activités ayant pour but de produire des objects utiles.

L'ethnographie définit une industrie (ou un métier) comme "l'ensemble de techniques que suppose l'emploi de machines différentes concourant à un même but".

Pour ce qui est des industries spécialisées M. Mauss les définit comme "Un ensemble de techniques concourant à la satisfaction d'un besoin ou plus exactement à la satisfaction d'une consommation (...) mais c'est la notion de consommation qui permet de déterminer les industries, systèmes de techniques appropriées à des fins, agencements d'industries" (1974: 26). Ces fins ne peuvent être saisies en elles mêmes par le préhistorien, qui n'a devant lui que des objets façonnés par l'homme pour juger de la façon dont ont été résolus les problèmes de l'époque, qu'il s'agisse de la satisfaction d'un besoin ou de consommation. Le sens donné au mot "industrie" est donc plus restreint et plus concret puisqu'on entend simplement par là l'ensemble des formes obtenues par l'action de l'homme sur la matière: on parle alors de l'industrie de l'os où de la pierre.

Parmi les pierres taillées, nul doute que certaines ont été des outils ou des éléments d'outils, d'autres des armes ou des éléments d'armes. Le mot "outil" désignera pour le préhistorien l'ensemble des armes et outils par souci de simplification d'une part, et d'autre part par incapacité de prouver dans la plupart des cas s'il s'agit d'une arme ou d'un outil véritable. (TIXIER *et al.* 1980: 93)

Notre étude se limitera à deux types de roches: le silex et l'obsidienne.

Au Proche-Orient, et en Iran tout particulièrement, le matériau le plus exploité par l'homme préhistorique pour fabriquer des outils de pierre est le silex.

Sa bonne qualité n'est certainement pas étrangère au fait que plus de 90% des outils de pierre sont en silex. Le chert et la chaille sont présents en faible proportion.

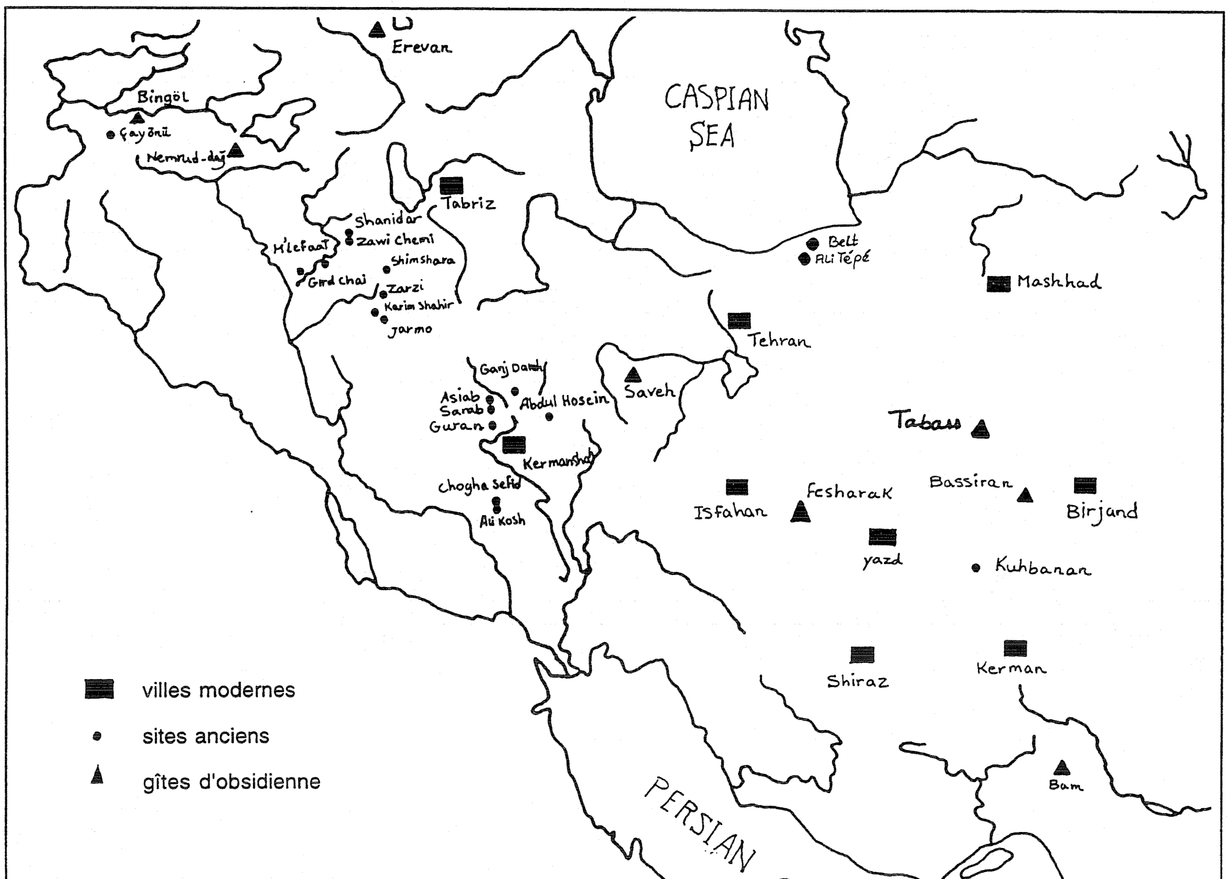

Fig. 1. Carte de la région avec les principaux sites mentionnés.

Les pierres utilisées sont vraisemblablement locales vu la richesse du sol Iranien en silex. Aux alentours des sites préhistoriques, on trouve en abondance des rognons de cette roche, souvent semblables au silex qui existe à l'intérieur des sites.

Le pourcentage d'obsidienne dans l'industrie lithique préhistorique iranienne est assez faible.

A l'exception de quelques sites, tous les gisements néolithiques d'Iran ont livré une certaine quantité d'obsidienne. Il arrive parfois que cette quantité soit importante mais elle demeure à plus de 95% inférieure à celle du silex.

La provenance de l'obsidienne trouvée sur les gisements iraniens reste le plus souvent inconnue. Néanmoins, on sait qu'une bonne partie a été importée de sources anatoliennes localisées à quelques centaines de kilomètres des gisements en question (WRIGHT 1969).[1]

9000-8000 av. J.-C.

L'industrie de cette époque, connue surtout dans le Zagros occidental (Irak), est plus ou moins la continuation de l'industrie du Zarzien. L'outillage y est en majorité macrolithique (80%) et comporte un grand nombre de pièces à encoches/ denticulées (30%) et de pièces esquillées (31%). Les grattoirs, perçoirs et racloirs sont également présents, mais en moindre quantité (voir le tableau 1).

L'outillage microlithique ne constitue que 20% du total des outils; un tiers des microlithes sont géométriques. Le reste est surtout composé de lamelles à dos (45%). Les micro-perçoirs et micro-grattoirs sont nettement moins nombreux. Quant aux géométriques (30%), ils sont eux-mêmes largement dominés par les segments de cercle (96%).

En comparaison avec l'industrie du Zarzien, rien ne prouve de prime abord un changement technologique majeur, mais quelques modifications typologiques apparaissent: deux points sont importants qui intéressent les microlithes :

1. La fabrication abondante de lamelles à dos (45%) à Zawi Chemi B, alors qu'elle était assez rare au Zarzien proprement dit.
2. La production considérable de segments de cercle parmi les géométriques et, en revanche, la présence très faible des triangles scalènes et isocèles, alors que ces deux derniers types sont incontestablement plus fréquents au Zarzien.

Tableau 1: Comparaison entre les outillages des sites de différentes régions.

région	sites	% outils	% micro-lithes	% géo-metri-ques	% lamel-les à dos	% l am. ret. discon-tinue	% macro-lithes	% grat-toirs	% per-çoirs	% faucil-les	% bu-rins	% denti-culées	% à en-coches	% lames à dos	% ra-cloirs
Zagros occiden-tal (Kurdi-stan)	Zawi Chemi	?	20	30	44,5	?	80	5,3	2,8	-	0,63	31,5	3,8	1,4	9,2
	Shanidar	17	22,7	?	14,3	?	77,3	8,3	0,88	0,24	0,8	0,15	52,7	0,8	2,38
	M'lefaat	25,19	80?	?	3,76	36,94	20?	6,35	0,23	?	0,46	?	21	?	8
	Jarmo	10,15	2,95	44,09	32,3	?	97	8,2	6,33	5,6	0,27	?	2,13	1,9	8,4
	T. Shimshara	53,5	?	?	?	?	?	9,8	2,6	8,6	2,4	5,7	2,6	2,4	?
Zagros oriental (Lorestan)	T. Ganj Dareh	-	-	-	-	-	-	10,2	-	4,3	-	5,8	-	-	-
	T. Asiab	-	-	-	-	-	-	12,9	-	4,6	-	12,6	-	-	-
	T. Sarab	-	-	-	-	-	-	8,4	-	6,6	-	4,9	-	-	-
Khuze-stan	Boz Mordeh	3,03	13,24	-	50	49	86,7	10,2	11,3	3,4	0,16	-	26,29	-	-
	T. Ali Kosh (Ali Kosh)	8,9	8,25	-	18	81,8	91,7	6,03	5,5	5,5	0,09	-	33,4	-	-
	T. Choga Sefid (Ali Kosh)	14,2	3,63	-	92,5	5,2	96,3	15,98	6	9,1	0,19	-	31	1,13	-
	T. Ali Kosh (Muh. Jaffar)	6,5	13,3	-	18,15	81,5	86,6	3,5	6,9	7,6	0,06	–	29.32	-	-
	T. Choga Sefid (M. Jaffar)	11,6	14,2	6,6	60,6	24,24	85,7	4,74	8,9	7,13	0,43	-	22,73	0,4	-
	Sefid	9,8	1,87	30	59,4	2,38	98,12	6,02	11,6	16	0,89	-	16,2	0,3	-

Macrolithes: Les composantes de l'outillage macrolithique de cette période sont les mêmes que précédemment, mais nous avons constaté quand même trois points qui méritent d'être signalés :

1. Les lames à dos, considérées comme représentatives du Zarzien (Shanidar B2) (HOLE 1988), deviennent rares (1,4% à Zawi Chemi B). Elles semblent remplacées par les lamelles à dos, elles

[1] Tout à fait récemment nous avons pu identifier un gîte d'une sorte d'obsidienne de mauvaise qualité (Picheston) dans la Kavir de Varamin (Nareh Khar Kouh) à quelques centaines de kilomètres au sud-est de Téhéran. Ce type d'obsidienne ne permet pas de faire des outils mais pourrait éventuellement être considéré comme l'indice de la présence de gîtes d'obsidienne dans la région du centre de l'Iran.

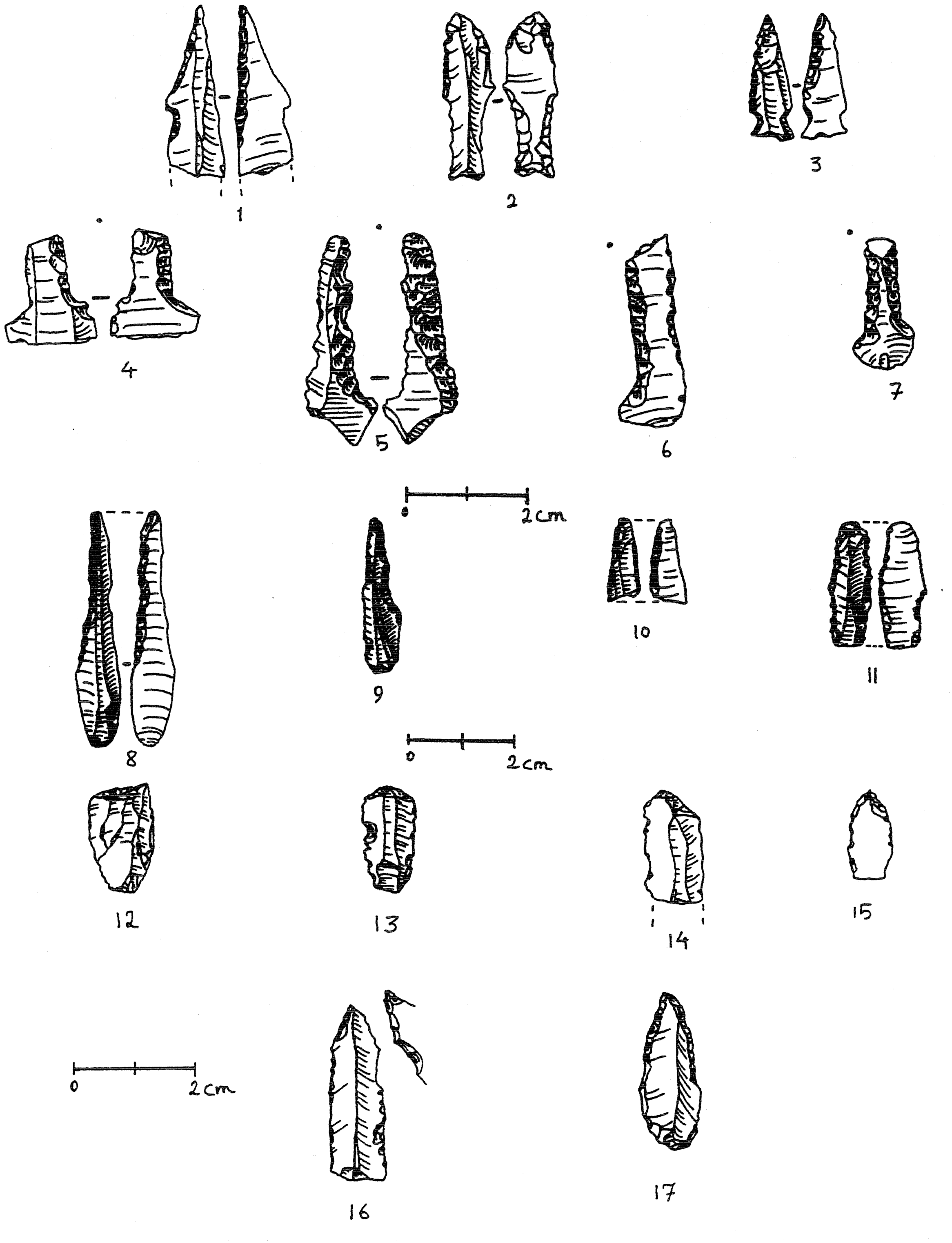

Fig. 2. 1-3 outillage de M'lefaat (d'après DITTEMORE 1983); 4-7 outillage de Jarmo (d'après HOLE 1983); 8-11 outillage de Ali Kosh, Boz Mordeh-Phase (d'après HOLE *et al.* 1969); 12-15 outillage de Karim Shahir (d'après HOWE 1983).

mêmes encore rares au Zarzien.

2. La part des grattoirs et des perçoirs baisse considérablement. Ces objets qui représentaient respectivement 30% et 50% de l'outillage du Zarzien ne comptent plus que pour 5% et 9% au "Zarzien final".

3. Enfin une troisième remarque concerne les pièces à encoches qui au Zarzien atteignaient un pourcentage équivalent à celui des denticulés alors qu'elles ne sont plus que 3.8% contre 31.5% de denticulés au niveau B de Zawi Chemi (R.L. SOLECKI 1981).

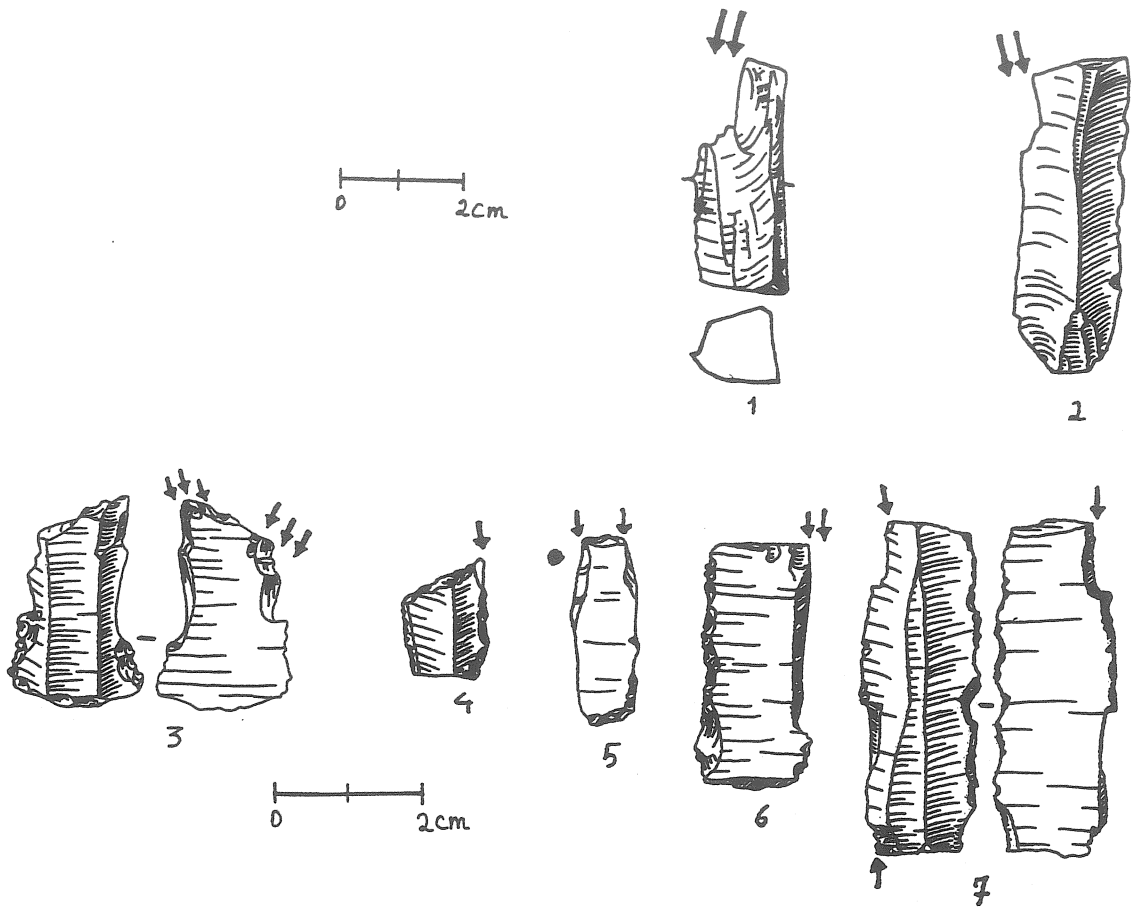

Fig. 3. 1-2 outillage de Ali Kosh (1 Boz Mordeh-Phase, 2 Ali Kosh-Phase, d'après HOLE *et al.* 1969); 3-7 outillage de Jarmo (d'après HOLE 1983).

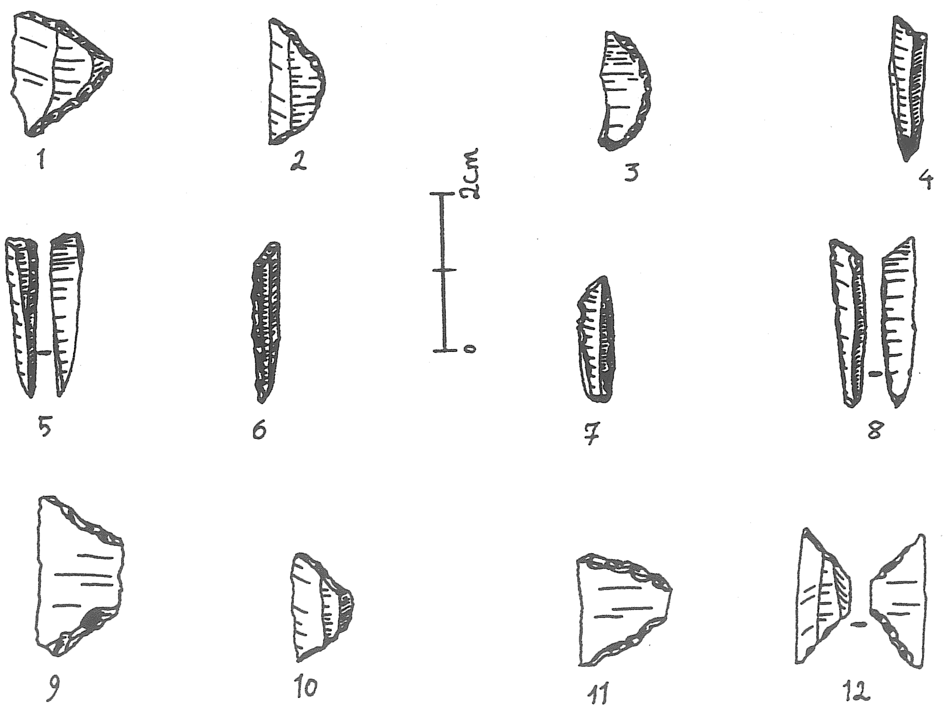

Fig. 4. 1-12 outillage de Jarmo (d'après HOLE 1983).

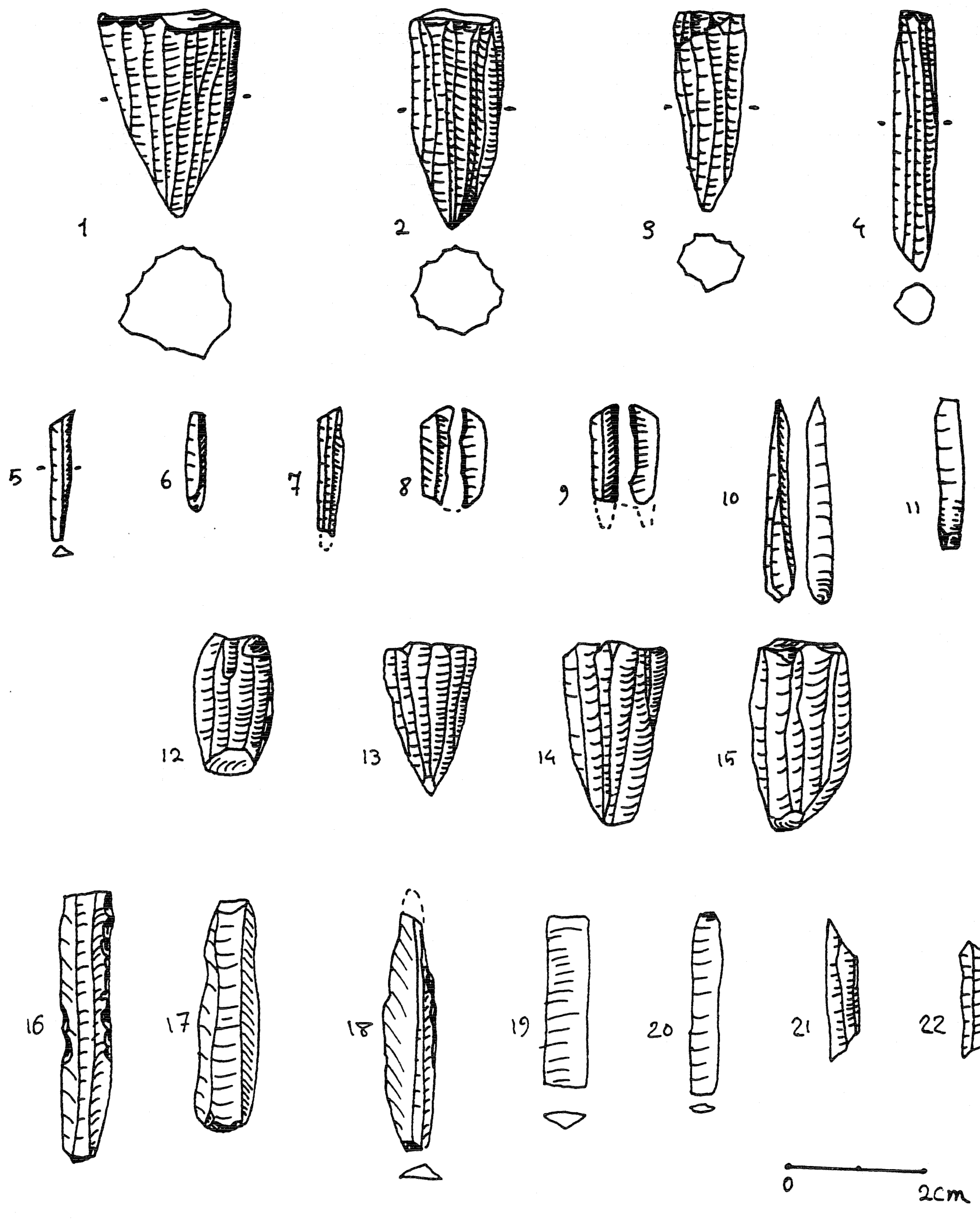

Fig. 5. 1-4 nucléus d'Ali Kosh, Muhammad Jaffar-Phase (d'après HOLE et al. 1969); 5-ll outillage d'Ali Kosh, Muhammad Jaffar-Phase (d'après HOLE *et al.* 1969); 12-15 nucléus de Kuhbanan (d'après HUCKRIEDE 1962); 16-22 outillage de Kuhbanan (d'après HUCKRIEDE 1962).

Le Zarzien du Zagros dans sa phase finale (c'est-à-dire à Zawi Chemi B inférieur), présente un trait particulier absent au Zarzien plus ancien, et d'une grande importance technologique: il s'agit de l'apparition du mobilier lourd de broyage.

Si l'on effectue à présent une comparaison avec l'est de l'Iran (Kuhbanan), pour autant que l'industrie de cette région soit plus ou moins contemporaine (ce qui semble très douteux) (RAFIFAR 1988), six points importants apparaissent :

1. L'exploitation plus intense de l'obsidienne au Kuhbanan que dans le Zagros.
2. L'importance du débitage par pression, au Kuhbanan, tandis que cette technique semble encore presque absente au Zagros.
3. La présence de lames de faucilles au Kuhbanan et son absence au Zagros à la même période.

4. La présence plus marquée, au Zagros d'alors, des géométriques, composés plus particulièrement de segments de cercle, tandis que, au Kuhbanan, les segments sont moins nombreux, l'essentiel étant constitué de trapèzes (rares au Zagros). Cette comparaison repose sur un parallélisme chronologique tout à fait incertain qui impliquerait un débitage par pression plus précoce à l'est que dans le Zagros, peut-être sous l'influence de l'Afghanistan !
5. Enfin l'abondance des segments au Zarzien final a justifié une comparaison avec le Natoufien du Levant. Ce rapprochement n'est peut-être pas aussi risqué que celui tenté avec le lointain Kuhbanan. En effet la distance qui sépare Zawi Chemi et, par exemple, Mureybet ou Abu Hureyra (sites natoufiens du Moyen Euphrate), ne dépasse pas 400km, ce qui est beaucoup mais laisse possible une influence, bien attestée plus tard dans le PPNB de Çayönü.
6. Un autre fait important est l'absence à ce jour de documents pouvant nettement être rapportés à cette période dans le Zagros iranien.

Les sites du Hulailan, encore mal datés, nous ont paru tous relever de périodes antérieures. Quant aux sites de la Capsienne (Ali Tépé, Belt) qui paraissent à peu près au même stade technique, leur datation pose problème, au même titre que la culture du Kuhbanan, située encore plus à l'est.

8000-7300 av. J.-C.

Pour cette période, il semble que seul encore le Zagros occidental nous fournisse des documents avec Zawi Chemi B supérieur et Karim Shahir (Protonéolithique).

Pour l'industrie lithique, on constate un enrichissement du fonds Zarzien final par des traits nouveaux :

1. Les haches sont taillées à Zawi Chemi, polies à Karim Shahir, qui de ce fait, selon Hole (1988) pourrait être plus récent.

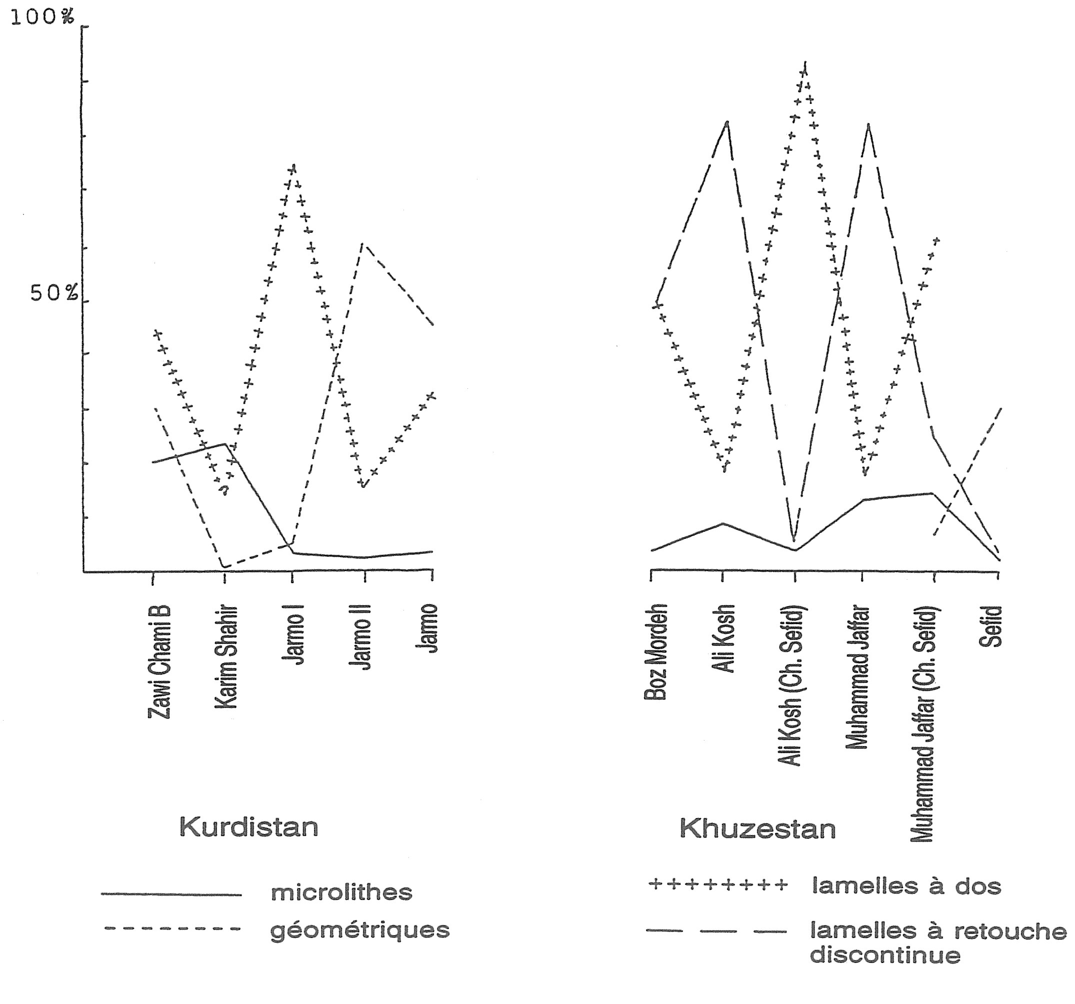

Fig. 6. Microlithiques et géométriques du Kurdistan et du Khuzestan (10.000-6.000 B.C.).

2. Le débitage par pression apparaît. Les *bullet cores*, considérés le plus souvent comme un signe de cette technique, n'existent pas à Zawi Chemi mais ils sont présents quoique rares à Karim Shahir. Un seul a été identifié à Zarzi A, mal daté (HOLE 1988). En Afghanistan ce mode de débitage est attesté encore plus tôt.
3. Les pièces lustrées: ces lames et éclats se trouvent à Karim Shahir, mais pas à Zawi Chemi, malgré les traces possibles de protoagriculture décelées sur ce site. Ces outils restent de toute manière encore rares au Zagros, ce qui peut être lié à l'absence d'une véritable agriculture.[1]

Outre les trois éléments nouveaux que nous venons de citer, quelques autres caractéristiques de l'industrie de cette époque se dégagent:
- Les microlithes géométriques (30% à l'époque précédente) et les lamelles à dos (44,5%) deviennent beaucoup plus rares (respectivement 0% et 14,35%). Par contre, une légère augmentation des micro-perçoirs a été signalée dans l'industrie de Karim Shahir par rapport à Zawi Chemi (ils passent de 9,3% à 14,5%) (HOWE 1983).

Le groupe des macrolithes, de son côté, est marqué par un recul important des denticulés (qui tombent à 1,15%), ainsi que par l'utilisation plus fréquente des pièces à retouche discontinue (38%). Les grattoirs sont utilisés un peu plus qu'avant (8,3%), au contraire des racloirs qui diminuent à 2.3% (voir le tableau 1).

Rappelons que nos informations relatives aux industries du Lorestan (Asiab, Ganj-Dareh E) sont actuellement trop pauvres pour permettre une comparaison solide avec l'ensemble de l'industrie du Kurdistan. Mais on peut constater, en tout cas, qu'il n'apparaît rien dans ces industries du Lorestan qui ne soit déjà présent au Kurdistan.

En ce qui concerne donc en gros le 8ème millénaire, quelques éléments lithiques peuvent, à notre avis, être utilisés comme indicateurs chronologiques. On en compte au moins trois dont le premier est indiscutablement les *bullet cores*. Ce sont ensuite les haches polies et enfin les faucilles.

Remarquons d'abord la présence de ces trois éléments à Karim Shahir (site non daté), et leur absence a Zawi Chemi B, même au niveau supérieur qui contient cependant des haches non polies. Cela nous incite à placer Karim Shahir parmi les gisements un peu plus récents que Zawi Chemi B supérieur.

A M'lefaat le manque de datation absolue pose un problème de chronologie. La présence d'une industrie à base microlithique associée pour la première fois dans cette zone à des pointes de fléches (pointes d'El Khiam) (fig. 2:1-3) (DITTEMORE 1983) (ces dernières étaient alors presque totalement absentes au Zagros) montre que cette région pourrait subir l'influence de la tradition de l'Euphrate.

On a remarqué d'ailleurs que, de tous les gisements étudiés, c'est le plus occidental. Microlithisme et pointes de flèches pourraient suggérer un âge au début du 8éme millénaire, si l'on adopte les critères du Levant.

7300 - 6000 B.C.

Cette période correspond à l'horizon PPNB du Levant. Les gisements dans le Zagros sont désormais nombreux et assez bien connus, mais il reste des difficultés de datation précisément à cause de l'incohérence fréquente des datations CI4.

Il y a désormais des villages dans le Zagros oriental. On ne connaît pratiquement aucun détail sur l'industrie du Lorestan. Nous savons simplement qu'à part Ganj Dareh, où l'obsidienne est complètement absente (SMITH 1975), les autres sites ont livré des quantités variables de ce matériau. On sait également que les microlithes et les géométriques étaient absents à Abdol Hossein. Les faucilles sont généralement rares dans les niveaux acéramiques de ce dernier site (PULLAR 1990). Elles deviendront plus fréquentes dans les niveaux supérieurs, en association avec une quantité importante de lames et lamelles à dos, ainsi qu'avec un certain nombre de grattoirs et de perçoirs.

En ce qui concerne le débitage, on ne signale pas de *bullet cores* à Ganj Dareh (il est vrai non étudié en détail) mais il y en a sur le site voisin d'Asiab.[2]

Il y a enfin des haches polies à partir de Ganj Dareh D, alors qu'il n'y en a pas, ni polies ni taillées, à Asiab. Pour F. Hole, ces différences, comme celles concernant l'architecture, sont sans signification chronologique et ne sont attribuables qu'à des différences de mode de vie. On sait, en effet, que trois des quatre dates C14 obtenues pour Asiab désignent avec cohérence le début du 7ème millénaire (HOLE 1988).

Au Kurdistan, les industries lithiques de Jarmo ont donné des informations intéressantes.

On constate d'abord une importante utilisation de l'obsidienne comme matière première dans la

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[1] Selon van Zeist cité par Smith (1896: 32) des grains d'orge morphologiquement domestiques auraient été trouvés dans le niveau de base de Ganj Dareh. Si ceci se trouve confirmé il faut admettre l'existence de la culture de l'orge à cette époque dans la partie centrale du Zagros.

[2] Au cours d'une récente prospection, nous avons ramassé des quantités significatives de "bullet cores" à la surface de Tépé Ganj Dareh (RAFIFAR, sous presse).

fabrication des outils, les microlithes en particulier. Rappelons que ce matériau était rarement utilisé dans le Zagros à l'époque précédente.

Sur le plan du débitage, on peut observer la présence, rare au demeurant, des nucléus en forme de balle de fusil (*bullet cores*) à Jarmo, alors qu'ils seront beaucoup plus nombreux à Shimshara au 6ème millénaire (MORTENSEN 1970). Il ne faut pas en conclure pour autant à l'absence de tout débitage par pression à Jarmo, car selon l'illustration présentée par Hole, il semble que quelques lames aient été débitées par cette technique (HOLE 1983).

Dans le domaine des outillages, on observe d'une part la diminution des microlithes (3% des outillages), et d'autre part le retour de la tendance à fabriquer des géométriques, dont on se souvient qu'ils étaient presque absents à la période précédente (Karim Shahir). Ce retour de la géométrisation sera particulièrement évident à Jarmo céramique, où elle touche 60% des microlithes (mais Jarmo acéramique a déjà livré 5,5% de géométriques parmi les microlithes). Ces géométriques sont marqués par l'abondance des trapèzes (97%). Les lamelles à dos, encore fréquentes dans les niveaux acéramiques (J.I) qui nous concernent, ne deviendront nettement minoritaires que dans les niveaux supérieurs (J.II). (HOLE 1983)

Quant aux macrolithes, ils sont nettement plus fréquents qu'à l'époque précédente: ils constituent plus de 95% des outillages. Ils sont caractérisés par l'abondance de pièces à retouche discontinue (56%) et la rareté des lames à dos et des pièces à encoches et denticulées.

Les faucilles sont plus nombreuses qu'auparavant (5,6% contre 0,24%, à Karim Shahir). C'est évidemment à mettre en relation avec l'agriculture désormais confirmée. On assiste à une augmentation parallèle des perçoirs (6,33% à Jarmo et 0.88% à Karim Shahir). Par contre le pourcentage des grattoirs reste aux environs de 8%.

C'est aussi vers 6500 av. J.-C., que l'on a remarqué l'arrivée dans le Zagros occidental des "outils de Çayönü" (HOLE 1983). Nous voulons seulement souligner ici que ce type d'outil, qui dans le Zagros a été uniquement fabriqué à Jarmo à cette époque, et qui est en obsidienne (fig. 2:4-7), suggère une fois de plus l'existence de relations commerciales et culturelles non seulement entre le Zagros occidental et la Turquie orientale, mais également entre cette dernière et le piémont du Zagros, puisque il était produit aussi en abondance sur le site contemporain de Magzalia (BADER 1979).

Dans tout le Kurdistan, les niveaux acéramiques sont en continuité avec des niveaux à poterie sus-jacents. C'est le cas, outre Jarmo, de Shimshara (14-16) et de Guran (V.T). Il est donc probable, malgré l'absence de datations précises, qu'ils se placent tous à la fin du 7ème millénaire. Cela suppose une longue lacune entre les sites plus anciens, Zawi Chemi B et Karim Shahir d'une part, et ces sites de l'autre. Il est vrai que nous manquons d'éléments particuliers pour préciser la nature spécifique des industries précéramiques de Guran et Shimshara.

Retournons au Zagros central, non plus en altitude mais dans la plaine (Khuzestan) du piemont. On sait que si on admet une très grande ancienneté pour Ganj Dareh E et Asiab, on ne peut que conclure à une extension à la plaine d'un Néolithique plus primitif montagnard. Mais depuis les récentes critiques de Hole (1988) ce mouvement n'est plus aussi sûr. Il s'ensuit que, si l'on veut comparer les industries du Deh Loran avec quelque chose de plus ancien, c'est avec les outillages du 8ème millénaire au Kurdistan qu'il faudra le faire.

La plus ancienne phase connue au Deh Loran (Boz Mordeh), datée vers la fin du 8ème et le début du 7ème millénaires av. J.-C., est caractérisée par une utilisation assez importante de l'obsidienne par rapport aux sites contemporains du Zagros (comme Ganj Dareh et Asiab), et par l'abondance des *bullet cores*, ce qui témoigne d'un développement du débitage par pression nettement plus important que dans le Zagros lui-même.

Sur le plan de l'outillage, les microlithes sont caractérisés par l'absence totale de géométriques (cette absence persiste au moins jusqu'à la fin du 7ème millénaire), et par l'abondance des lamelles à dos et des lamelles à retouche discontinue (fig. 2:8-11). Les lamelles à dos atteignent un pourcentage de 5% à la phase de Boz Mordeh, c'est-à-dire davantage que dans les sites du 8ème millénaire au Kurdistan comme Karim Shahir (1,4%). Les lamelles à retouche discontinue sont fort abondantes à Boz Mordeh (49%). Par contre, les micro-grattoirs et micro-perçoirs, relativement abondants dans le Zagros occidental (14% à Karim Shahir) (fig. 2:12-17), sont entièrement absents dans le Deh Loran. Quant aux macrolithes, les différences se marquent plutôt par l'absence au Deh Loran des lames denticulées et à encoches ainsi que des lames à dos et troncature, des racloirs et des pièces esquillées, alors que l'on connaît leur présence plus ou moins abondante dans la tradition zarzienne du Kurdistan. Par contre, les grattoirs, perçoirs et faucilles semblent nettement plus fréquents à Boz Mordeh qu'à Karim Shahir (fig. 6 et tableau 1). Le seul point commun entre les sites du Zagros occidental et le Deh Loran est la rareté des burins, dont les pourcentages restent partout inférieurs à 1% (fig. 3:1-7).

Dans la seconde moitié du 7ème millénaire av. J.-C. au Deh Loran (phase Ali Kosh), la différence avec le Zagros occidental est plus marquée. Du point de vue du débitage, le Deh Loran à cette époque reste relativement fidèle à la tradition de Boz Mordeh, c'est-à-dire à la pratique du débitage par pression (abondance des *bullet cores*) (fig. 5:1-4). L'industrie microlithique se raréfie, mais elle reste deux fois plus importante qu'au Zagros occidental (Jarmo acéramique). Elle ne comporte cependant pas de géométriques, ce qui la différencie de l'industrie microlithique kurde, où les géométriques réapparaissent juste à ce moment-là comme nous l'ont montré les niveaux acéramiques de Jarmo (fig. 4:1-5) (HOLE 1983). Par contre, les lamelles à dos et à troncature, dont le nombre est assez faible au Deh Loran (18%), constituent près de 75% des microlithes à Jarmo à cette époque (fig. 4:6-12). Les lamelles à retouche discontinue, toujours très abondantes au Deh Loran (80%), sont totalement absentes à Jarmo!?

Les macrolithes se caractérisent par une forte proportion de grattoirs, perçoirs et faucilles au Deh Loran par rapport au Zagros. Par contre, la proportion des lames à dos est égale à Jarmo acéramique (1,3%) et à la phase Ali Kosh de Tépé Chogha Sefid (1,3%). L'absence des denticulés et la rareté des burins sont communes au Deh Loran et au Zagros à cette époque.

Mais à l'extrême fin du 7ème millénaire et au début du 6ème millénaire av. J.-C. au Deh Loran (Phase Mohammad Jaffar), la production des microlithes est près de cinq fois plus forte qu'à la phase céramique de Jarmo. Par contre, les géométriques qui constituaient près de 60% des microlithes à Jarmo font une première timide apparition à cette phase du Deh Loran, et seulement à Tépé Chogha Sefid (6,6%).

En ce qui concerne les macrolithes à cette époque, à Jarmo céramique la part des grattoirs augmente légèrement, tandis que celle des perçoirs et celle des faucilles ne changent pas. Les lames à dos et troncature ainsi que les burins sont rares partout.

La conclusion est que nous voyons apparaître dans l'industrie lithique du Deh Loran, dès la phase de Boz Mordeh, un ensemble de caractères dont il est peut-être inutile de chercher la source dans les documents connus du Lorestan, puisqu'il n'est pas sûr que ceux-ci leur soient antérieurs.

A période égale, on remarque notamment que les *bullet cores* d'Ali Kosh se retrouvent à Çayönü dans le Taurus, c'est-à-dire à l'ouest du Zagros, ce qui semble indiquer des rapports nord-ouest/sud-est que nous verrons mieux se dessiner à propos du commerce de l'obsidienne. Ces rapports ne passent pas forcément par le Zagros lui-même, puisqu'on ne retrouve pas ce débitage en altitude.

Quant à la nouvelle géométrisation constatée dans le Deh Loran à partir de la phase Mohammad Jaffar, elle est analogue à celle qu'on note dans le Kurdistan mais plus tardive. Peut-être faut-il y voir une influence de cette région.

L'obsidienne

Nous allons envisager ici l'étude analytique de ce matériau à travers les différentes périodes de la néolithisation, ainsi que les problèmes relatifs à sa circulation. Les données sont très inégales et dispersées, parfois très détaillées, parfois très lacunaires.

Signalons brièvement que le Zagros a dû connaître l'obsidienne dès l'ère baradostienne au Paléolithique supérieur, comme en témoignent les deux pièces retrouvées au niveau C de Shanidar. Nous ignorons la forme de ces pièces, mais après analyse par spectrométrie d'émission, il semble que l'une appartienne au groupe 4c, l'autre au groupe lef (RENFREW 1966: 40), c'est-à-dire qu'elles viennent de sources anatoliennes.

Pendant la période épipaléolithique du Zagros, deux autres pièces en obsidienne ont été retrouvées, cette fois au niveau B de la grotte de Zarzi. L'une d'elles appartient au groupe 4c (op. cit.).

Proto-néolithique

Pendant le 9ème millénaire, l'obsidienne est encore très rare dans les sites du Zagros. On en trouve 12 pièces à Shanidar B 1, fragments qui n'ont pas été analysés.

A la période suivante, qui va d'environ 8000 à 7300 av. J.-C., le groupe de sites connus n'a encore livré que très peu d'obsidienne. Des trois sites fouillés du nord du Zagros (Kurdistan), Karim Shahir (HOWE 1983) et Zawi Chemi (SOLECKI 1981) ont livré chacun deux pièces. Neuf autres ont été retrouvées à M'lefaat (DITTEMORE 1983).

On ne connaît donc jusqu'à présent qu'une quinzaine de pièces en obsidienne pendant la première moitié du 8ème millénaire, ce qui est insuffisant pour affirmer l'existence d'une véritable industrie de l'obsidienne à cette époque. Sa présence est néanmoins importante puisqu'elle prouve l'importation d'un matériau étranger dont nous tâcherons plus loin d'analyser la provenance.

7500 - 6500 B.C.

Dans le Zagros central (Lorestan), le site d'Asiab a livré six pièces en obsidienne (MELLAART 1975). Il n'y en a aucune à Ganj Dareh. C'est à cette époque, de 7500 à 6500 av. J.-C., et seulement dans la plaine du Deh Loran, que, dès la phase Boz Mordeh de Tépé Ali Kosh, l'obsidienne commence à figurer dans des proportions notables dans l'industrie lithique.

Les 347 pièces en obsidienne de ce site indiquent une densité de 5 pièces par mètre cube fouillé. Elles se répartissent en 182 lames brutes pour 15 082 lames en silex, 155 éclats pour 23 380 en silex, et 6 lames retouchées pour 423 en silex, (HOLE *et al.* 1969). C'est-à-dire qu'elles ne représentent que 1% du total de l'industrie d'Ali Kosh. Mais il faut noter aussi sur ce site la présence de quelques nucléus à lame en obsidienne (Ibidem).

Les 347 pièces d'AIi Kosh appartiennent pour la plupart au groupe 4c, le type d'obsidienne lg étant fortement minoritaire. Le contact avec l'Anatolie est donc nettement indiqué (RENFREW 1969).

A Gird Chai, situé un peu au nord de Jarmo, 13 pièces en obsidienne seulement ont été retrouvées (BRAIDWOOD and HOWE 1960). Ceci complique l'explication du processus d'importation de l'obsidienne car Gird Chai se trouve trois fois moins loin des sources d'obsidienne de l'Anatolie centrale qu'Ali Kosh.

6500 - 6000 B.C.

Les sites de cette époque au Zagros témoignent d'une évolution importante de l'utilisation de l'obsidienne, principalement au Kurdistan. Cette matière première se trouve désormais dans tous les sites fouillés sur la longueur du Zagros et la plaine du Khuzestan.

Au nord, dans la région du Kurdistan, le site de Jarmo a livré une véritable industrie en obsidienne qui représente, à son niveau acéramique, près d'un tiers (28%) de l'industrie totale. D'après les dernières études, quoique peu de nucléus aient été retrouvés à Jarmo (19 ex.), 233 produits de mise en forme des nucléus sont présents (tablettes de nucléus, lames et lamelles à crête, fragments de nucléus). Ce chiffre élevé prouve que le débitage était effectué sur place.

Des analyses par spectrométrie ont indiqué au moins trois groupes différents d'obsidienne (groupes 4c et lg, ainsi qu'un troisième toujours inconnu). Dans l'unité X de Jarmo (acéramique), l'obsidienne constitue la matière première de près de 45% des outils et de 51% des lames (WRIGHT 1969: 33). A Shimshara acéramique, situé à 100km au nord-est de Jarmo, l'obsidienne représente 85% des outillages lithiques (MORTENSEN 1970).

A la même époque dans la vallée du Hulailan (Lorestan), les niveaux acéramiques de Tépé Guran ont également livré une quantité considérable d'obsidienne. L'analyse de 8 pièces de ces niveaux a révélé que 4 d'entre elles appartenaient au groupe lg et les 4 autres au groupe 4c (WRIGHT 1969: 22).

Quant à l'étude par niveaux de Guran, elle nous apprend que le niveau V, considéré comme le plus ancien (6700 av. J.-C.) contient 2% d'obsidienne, tandis que le niveau U en contient 0%.

Mais au niveau T, daté aux environs de 6350 av. J.-C., l'obsidienne constitue près de 45% de l'industrie (36 pièces sur 80 retrouvées). Elle retombe ensuite à 6% au niveau S et à 0% au niveau R (rappelons toutefois qu'aucun niveau de Guran n'a livré plus de 170 objets de pierre taillée RENFREW *et al.* 1966: 58).

Toujours au Lorestan, les niveaux acéramiques de Tépé Abdol Hossein ont également donné quelques pièces en obsidienne (18 ex.), dont douze semblent provenir des gîtes du Nemrud Dağ situés en Turquie orientale (PULLAR 1990).

Au sud-ouest, dans la plaine du Deh Loran, les mêmes groupes d'obsidienne (lg et 4c) continuent à être utilisés et constituent à peu près 2,5% du total de l'industrie lithique de la phase Ali Kosh de Tépé Chogha Sefid (HOLE 1977).

Le début du 6ème millenaire

A la fin du 7ème et au début du 6ème millénaires, au niveau céramique de Jarmo, le pourcentage de l'obsidienne est de 45% sur l'ensemble des pièces. 68% des pièces retouchées et 75% des lames sont produites à partir de cette matière première.

A la même époque, dans la vallée du Lorestan, les habitants de Tépé Sarab utilisaient beaucoup moins d'obsidienne que leurs contemporains du nord (Jarmo). On a retrouvé un total de 628 pièces, soit 1,7% de l'industrie, réparties entre les outils (4,8% de l'ensemble des outils) et les lames (5% de l'ensemble des lames). Mais on ne connaît encore aucun détail, ni sur les groupes typologiques auxquels les pièces appartiennent, ni sur leur morphologie physique après le débitage (PULLAR 1990).

Toujours dans le Lorestan, les niveaux P, O et N de Tépé Guran comportaient respectivement 22%, 45% et 20% d'obsidienne sur l'ensemble de l'industrie. Les niveaux les plus récents de ce gisement n'ont pas livré plus de 11% d'obsidienne (WRIGHT 1969: 33).

L'utilisation de l'obsidienne au Deh Loran reste plus ou moins stable avec un pourçentage de 1% à 2% pendant la phase de Mohamad Jaffar.

Deux conclusions s'imposent à partir de ce que nous savons sur l'obsidienne dans le Zagros et le reste de l'Iran.

La première a trait au transport

En effet, il importe d'établir la connexion avec les lieux d'extraction de cette matière première, et d'examiner les problèmes de transport que les distances suscitaient.

Rappelons que selon nos connaissances actuelles les lieux d'extraction de l'obsidienne se situaient à près de 850km des sites du Deh Loran (Ali Kosh, Chogha Sefid etc.), à 600km de ceux du Lorestan (Asiab, Guran, Abdol Hossein etc.), et à 350-400km de ceux du Kurdistan (Jarmo, Shimshara etc.). Ils se trouvent pour l'essentiel dans la région du Nemrud Dağ et dans celle du lac de Van dans l'actuelle Turquie orientale.

Dans le Zagros et dans le sud-ouest de l'Iran, une véritable industrie de l'obsidienne ne s'est développée qu'au début du 8ème millénaire à Tépé Ali Kosh (phase Boz Mordeh), site le plus éloigné des sources d'Anatolie (900 km). En revanche, dans le sud-est de l'Iran (Kuhbanan), si on se fonde sur la typologie, le travail de l'obsidienne semble plus ancien (RAFIFAR 1993).

A notre connaissance, tous les autres sites connus au Zagros sont alors vides de ce matériau (ainsi Ganj Dareh).

Si l'on admet que l'obsidienne utilisée à la phase Boz Mordeh du Deh Loran venait d'Anatolie orientale, on est en droit de se demander comment les occupants la connaissaient et l'utilisaient, alors que les habitants de Tépé Ganj Dareh, 300km plus proches des sources d'extraction, l'ignoraient?!

Le trajet de l'obsidienne jusqu'au Deh Loran n'aurait donc pas passé par les piémonts du Zagros, chemin géométriquement le plus court à partir de l'Anatolie?

Pour comprendre le commerce de l'obsidienne, les archéologues ont avancé maintes hypothèses, sans toutefois parvenir à une solution définitive.

La première de ces hypothèses veut que les habitants auraient gagné à pied les sources d'extraction pour subvenir à leurs besoins en matière d'obsidienne. Mais il est a priori illogique d'envisager une telle solution en raison des difficultés matérielles qu'elle présentait, à savoir:

-Celle de l'itinéraire et de la reconnaissance du trajet préalable à ces expéditions;

-Si ces expéditions volontaires eurent lieu, elles devaient se faire soit à pied, soit à dos d'animaux. Dans un cas comme dans l'autre, il fallait subvenir à l'approvisionnement de l'homme lui-même et de ses montures. La fertilité du sol aurait pu répondre aux impératifs alimentaires, mais deux constatations permettent de réfuter cette hypothétique solution: la première est qu'aucune trace d'animaux domestiques susceptibles de transporter un homme ou du matériel n'a été relevée à cette époque. Le chien et la chèvre ne pouvaient de toute évidence faire office de montures; par ailleurs, la domestication de l'âne est très longue, et celle du boeuf n'eut lieu au Levant qu'aux alentours de 6000 av. J.-C., mais pour des usages sans doute seulement alimentaires (J. Cauvin, communication personnelle). Et de toute façon la quantité d'obsidienne importée n'implique sans doute pas de bêtes de somme si des voyages sont assez fréquents.

-Une autre difficulté concerne l'itinéraire lui-même. Ce dernier aurait traversé la quasi totalité du Zagros (plus de 800km en terrain accidenté), avant d'arriver en Turquie orientale. On devait préférer des itinéraires plus commodes.

La deuxième hypothèse sur la façon dont est parvenue l'obsidienne au Deh Loran fait état de communications de proche en proche entre villages. Elle apparaît a priori plus plausible que la précédente. Pourtant, ainsi que nous l'avons déjà dit, nous ne connaissons aucun site du 8ème millénaire dans le Zagros entre le Deh Loran et ces sources d'extraction de Turquie orientale qui ait livré des quantités significatives d'obsidienne. En revanche si on admettait des itinéraires un peu plus méridionaux, longeant le Zagros en plaine au lieu de le traverser, des sites comme Magzalia sont des relais possibles.

De toute manière, force est de constater la disproportion entre l'importance des efforts fournis pour l'acquisition de cette matière première et l'utilité relative de celle-ci. Un bref résumé de l'industrie de Boz Mordeh a confirmé que l'obsidienne ne semble en aucune manière indispensable à la spécificité d'une pièce particulière, d'autant plus que sur le plan du fonctionnement, le silex est tout aussi performant. L'utilisation de l'obsidienne n'a donc pas correspondu à l'adaptation nouvelle et définitive de l'outil à des fonctions très précises. L'intérêt pour l'obsidienne doit par conséquent être expliqué par des motivations qui dépassent la simple portée utilitaire, et qui seraient susceptibles de justifier l'effort consenti pour se la procurer.

La seconde conclusion

La seconde conclusion à laquelle nous amènent nos connaissances sur l'obsidienne dans le Zagros et le Deh Loran concerne la typologie des outillages en obsidienne eux-mêmes. Dans la seconde partie de la période considérée, c'est-à-dire dans la deuxième moitié du 7ème millénaire, il semble qu'on assiste à une extension de l'emploi de l'obsidienne dorénavant élargi à des outils de types variés. Cela a été particulièrement démontré à Jarmo, où, à cette époque (dès 6500 av.J.-C.), l'obsidienne devient beaucoup plus abondante, et où son rôle dans l'industrie se fait de plus en plus précis et important. Nous avons vu que la majorité des microlithes, géométriques où non, y sont en obsidienne. De la même façon, parmi les microlithes, se trouvent des lamelles fabriquées à partir de cette matière première. Mais plus important, l'obsidienne devient la matière première préférentielle de certains types d'outils bien précis. Ainsi les types dits "thin section" et "pressure flacked obsidian fabricators" (outils de Cayönü) sont faits presque uniquement en obsidienne. A ces outils on peut ajouter aussi une bonne partie des pièces tronquées. On connaît l'origine anatolienne du type "outils de Çayönü". Le commerce de ce matériau a donc aussi véhiculé d'autres influences culturelles.

Nos connaissances sur la situation de l'obsidienne dans le Zagros central (Lorestan) pendant cette période sont très minces. L'étude approfondie des outillages de Tépé Guran n'est pas achevée. On possède peu de détails sur l'outillage en obsidienne de Tépé Sarab. Mais dans le Deh Loran, les phases Ali Kosh et Mohammad Jaffar, qui sont respectivement très probablement contemporaines de Jarmo acéramique et céramique, ne semblent pas présenter les mêmes caractéristiques qu'à Jarmo. Ici sur le plan typologique, la tradition de Boz Mordeh persiste au moins jusqu'en 5600 av. J.-C. Aucun changement significatif n'y a été observé. Il en est de même pour les phases Sefid et Sorkh de Tépé Chogha Sefid (HOLE 1977).

Une ressemblance étonnante s'observe par contre entre l'industrie du Deh Loran et celle du Kuhbanan (fig. 5:1-22) région située plus de 800km à l'est. Cette ressemblance tient surtout à la pratique du débitage "par pression" présent dans le Deh Loran dès la phase la plus ancienne connue (Boz Mordeh). Il en est de même dans le Kuhbanan où les nucléus et les lames et lamelles caractéristiques de ce débitage sont abondants (HUCKRIEDE 1962). Malheureusement, le manque d'étude sur ce sujet ne permet pas d'établir la comparaison entre Ali Kosh et le Kuhbanan. Nos connaissances ne proviennent que de l'étude de la phase Boz Mordeh de Tépé Ali Kosh qui est datée de la seconde moitié du 8ème millénaire (HOLE 1988), ce qui en fait non seulement le plus ancien niveau connu du Deh Loran, mais aussi le plus ancien village de l'ouest de l'Iran (Zagros compris). Les habitants y possédaient pour la première fois une véritable industrie en obsidienne et pratiquaient le débitage par pression qui était alors rare au Zagros.

Sur cette base on peut supposer que la technique du débitage par pression aurait été importée de l'est (Kuhbanan), d'autant plus que des traces anciennes de cette technique ont été retrouvées en Afghanisan (vers 16000 av. J.-C.). L'arrivée du débitage par pression dans le Kuhbanan vers le début du 9ème millénaire pourrait avoir coïncidé avec l'arrivée de l'obsidienne. En effet, les sources de cette matière première à Kuhbanan se trouvent très probablement dans la région de Bassiran (STRATIL and SAVER 1956) où à Tabass (RAFIFAR 1991), soit au nord du Kuhbanan, tout-à-fait entre les sites en question d'Afghanistan et Kuhbanan. D'autres sources possibles existent aux environs de Bam qui se trouve à prés de 400km au sud de Kuhbanan. (BEALE 1973).

Par conséquent, nous sommes en droit de croire ici à l'existence de relations commerciales-culturelles entre l'est et l'ouest de l'Iran dans la seconde moitié du 8ème millénaire. Selon cette vue l'obsidienne du Deh Loran aurait été importée du sud-est, en même temps que "la technique par pression". Cette hypothèse, bien sûr, ne pourra être parfaitement confirmée qu'après l'analyse de l'obsidienne du Kuhbanan ainsi que de ses sources présumées de l'est de l'Iran (Bassiran, Tabass et Bam). Mais il ne faut pas oublier que le débitage par pression a été signalé à la fin du 8ème et au début du 7ème millénaires dans le Taurus anatolien (CALLEY 1985), au voisinage donc, des sources du Nemrud Dağ et du lac de Van. Cela peut aussi permettre de faire l'économie de l'hypothèse de l'influence orientale.

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L'industrie lithique d'El Aoui Safa, un nouveau site Khiamien à l'Est du Jebel el 'Arab (Désert Noir, Syrie du sud)

Eric Coqueugniot et Patricia C. Anderson

Résumé: *Le site d'El Aoui Safa est situé dans une dépression du Désert Noir entre le Jebel el 'Arab et le Safa, dans un contexte écologique très défavorable. Les artefacts recueillis par tamisage indiquent une occupation du début du Néolithique acéramique (industrie lamellaire à affinités khiamiennes avec de petits segments à retouche abrupte, de nombreux microperçoirs et une troncature de Gilgal). Il n'y a ni outil lourd, ni mobilier lourd, la parure est représentée par une perle en dentale. Les trois pièces lustrées découvertes présentent des microtraces d'utilisation qui montrent qu'une est liée au travail des peaux (la faune est sauvage et comporte Bos primigenius) et les deux autres à la coupe des céréales sauvages (poussant dans le Jebel el 'Arab, ou plus près). Ces activités suggèrent une occupation plus longue qu'une simple halte temporaire.*

Abstract: *El Aoui Safa is located in a depression in the Black Desert between the Jebel el 'Arab and the Safa, in a context with very unfavorable ecological conditions. The artefacts collected by screening show the occupation dates to the beginning of the Pre-Pottery Neolithic: the bladelet industry appears related to the Khiamian, and comprises small lunates with abrupt retouch, abundant microdrills and a Gilgal truncation. There are no "heavy-duty" tools or "groundstone" artefacts, and the only item of personal adornment found is a dentalia bead. The three glossed pieces studied have microwear traces showing one was used to prepare skin objects (the fauna is wild, including Bos primigenius), and the two others to harvest wild grasses, probably wild cereals growing in the Jebel el 'Arab or nearer. These activities suggest the site represents a more extensive occupation than a single temporary halt.*

Le site préhistorique d'El Aoui Safa a été découvert en 1993 par Frank Braemer, Jean-Claude Echallier et Ahmed Taraqji[1] à l'occasion de la prospection archéologique effectuée dans la région du village de Khirbet el Umbashi (Bronze ancien et moyen) pour reconnaître les établissements de même époque et étudier les *kites* (*cf.* ECHALLIER et BRAEMER 1995).

Ce site est situé à la bordure orientale de la dépression située entre les deux nappes volcaniques du Kraa (nord-est du Jebel el 'Arab) et du Jebel Safa. Le secteur est actuellement désertique et, selon les géomorphologues, cette dépression n'a pas antérieurement pu être occupée par un lac permanent car les couches sous-jacentes sont inclinées d'Ouest en Est de telle sorte que les eaux de ruissellement s'infiltrent vers l'Est sous le Safa (*cf.* les wadi temporaires actuels, Fig. 1). Des points d'eau saisonniers sont cependant attestés en bordure du Safa, permettant l'installation de campements temporaires.

Le site est constitué par un promontoire basaltique surmonté par les vestiges d'une construction (tour de guet ou habitation similaire à celles connues dans les villages de l'Age du Bronze d'Umbashi, d'Hebariyeh ou de Nemara ?). Ce promontoire constitue un excellent poste d'observation sur une grande partie de la dépression qui a du constituer une voie de passage Nord-Sud très commode alors que plus à l'Est le Safa était peu praticable du fait de sa morphologie. Le matériel archéologique

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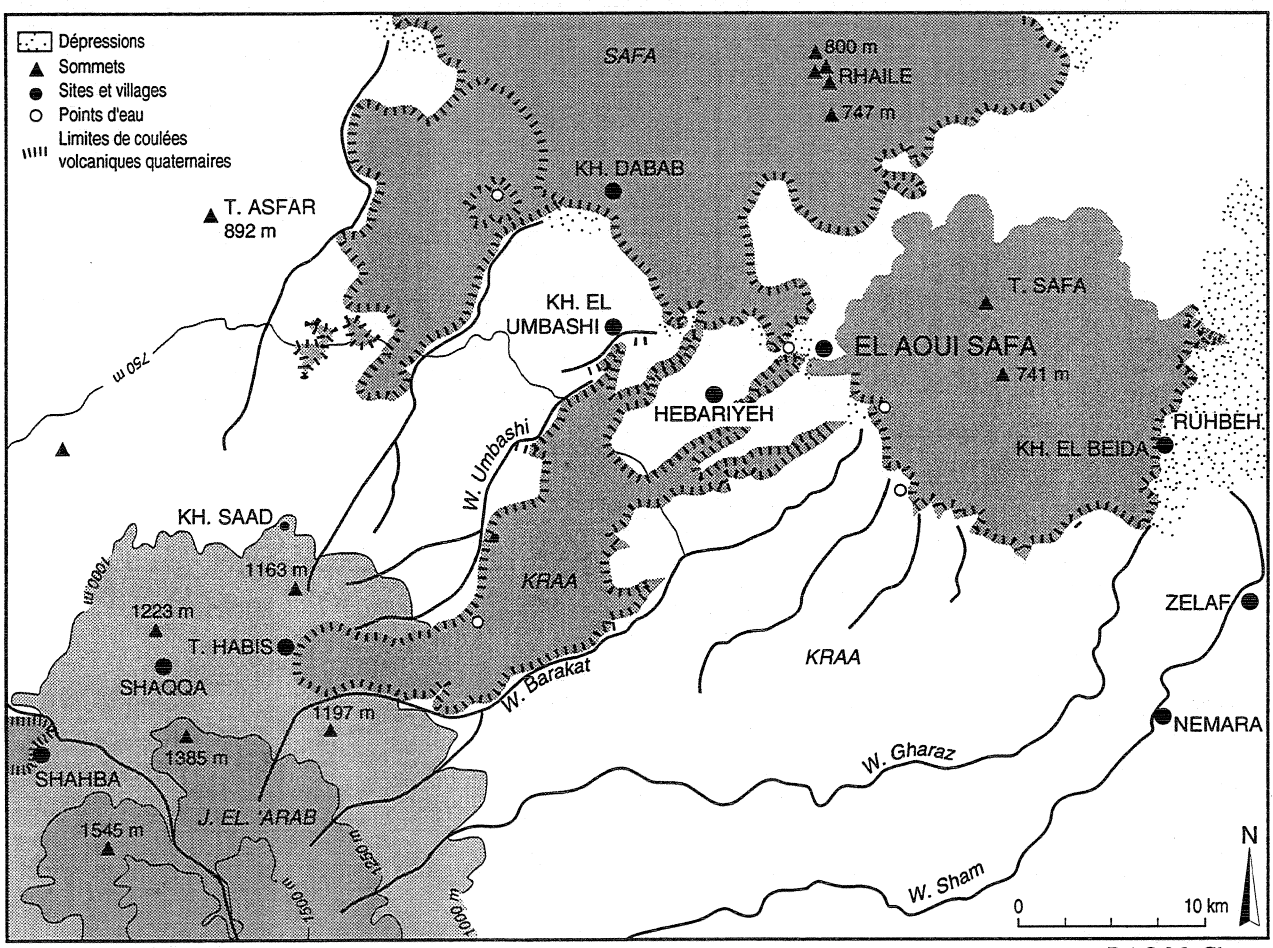
[1] Nous tenons à remercier Frank Braemer et Ahmed Taraqji, responsables de la mission archéologique franco-syrienne à Khirbet el Umbashi, qui nous ont confié l'étude de cet ensemble et autorisé à publier la date radiocarbone obtenue. P. Anderson remercie Usama al-Syasna (Archaeological Survey, Derra, Syrie) pour son aide lors des deux saisons d'expériences de moissons de céréales sauvages dans le Jebel al 'Arab. Les dessins sont de Madeleine Rivière.



DAO M. Clatot

Fig. 1. Carte de localisation d'El Aoui Safa .

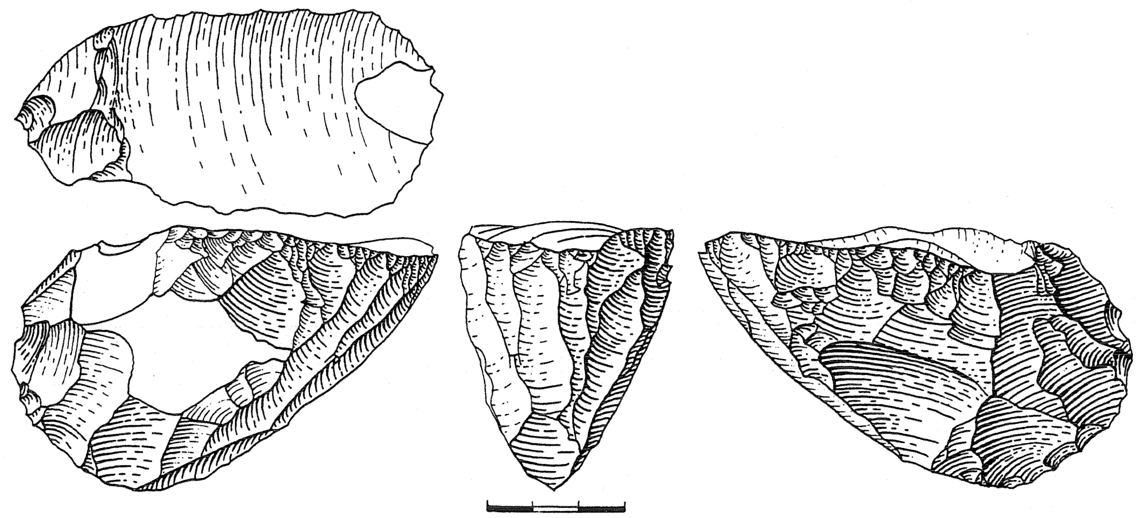


Fig. 2. El Aoui Safa: nucléus à lamelles intrusif. Il s'agit d'un nucléus de type kébarien géométrique qui a pu être rapporté au campement en tant que bloc de matière première.

présent en surface ne correspondait cependant pas à une occupation de l'Age du Bronze (absence de céramique, industrie lithique différente...) et, plutôt que d'effectuer le moindre prélèvement, les inventeurs du site proposèrent-ils à l'un d'entre nous (E.C.), néolithicien impliqué dans l'études des industries lithiques "récentes" d'Umbashi et des sites voisins, de venir sur place à l'occasion de la campagne de fouilles 1994 à Umbashi afin de préciser ce qu'il en était exactement.

A peu de distance de la construction "récente" (?), entre les blocs du chaos basaltique qui constitue le promontoire, un sédiment cendreux avec de nombreux ossements brûlés évoque le "gisement ossifère" d'Umbashi (*cf.* notamment DUBERTRET et DUNAND 1954-1955, BRAEMER, ECHALLIER et TARAQJI 1993) infiltré dans l'amas de blocs de basalte du promontoire. Ce sédiment présente un aspect de dépotoir avec de nombreux fragments osseux et des artefacts de silex sans qu'il soit possible de préciser s'il est *in situ* ou non (dépôt primaire ou réemploi, avec mélanges, dans le cadre de l'occupation voisine peut-être plus récente, par exemple pour l'aménagement de sols ou pour la confection d'un mortier de construction). Sur place, environ 100 litres (10 seaux) de ce sédiment ont été tamisés à sec (maille de 2mm), le résidu de tamisage étant ramené à Soueida où il a pu être "lavé" à l'eau afin de recueillir l'intégralité du matériel archéologique. Cet ensemble constitue l'essentiel du matériel recueilli, auquel il faut ajouter une série restreinte de pièces ramassées en surface (sans tri de taille ou de forme). Avant tamisage du sédiment, un lot de fragments de charbon de bois a été prélevé en vue d'une datation C14.

Industrie lithique

Le matériel lithique recueilli était très abondant (890 pièces, *cf.* Tableau 1), la matière première étant toujours le silex. Au niveau des produits bruts comme à celui des outils, le silex utilisé était très varié, allant d'un silex très fin miel opalescent à des matériaux grossiers. En l'absence de toute source de silex dans la région volcanique, il semble que l'approvisionnement se faisait de manière aléatoire, probablement au gré des ramassages et non pas en fonction d'une source unique, le débitage proprement dit étant cependant effectué à El Aoui Safa ainsi que le suggère l'abondance des esquilles et des petits éclats.

Technologie

Sur le plan technologique, les produits obtenus présentent des bulbes amples, généralement marqués par une lèvre, avec éventuellement des esquilles parasites. Les talons sont lisses mais de dimensions variées avec notamment des talons linéaires inclinés sur un bord (et associés à des bulbes très plats mais présentant encore une lèvre) et des talons punctiformes. Le front de taille était préparé par l'enlèvement systématique de la corniche au moyen de petits enlèvements lamellaires. Tous ces critères semblent indiquer l'emploi de la technique de la percussion directe avec un percuteur tendre. Il faut noter que la composante laminaire était forte avec un certain nombre de lames torses.

Tableau 1. Récapitulatif des artefacts recueillis à El Aoui Safa.

	Effectifs bruts		(État)		Nombre minimal estimé*	
Lames	78		Entières	7		
			Fragments proximaux	18		
			Fragments médians	32	≥28	
			Fragments distaux	21		
Éclats	61	825	Entiers	16		≥65
			Fragments proximaux	16	≥37	
			Fragments médians	8		
			Fragments distaux	21		
Micro-esquilles (<1 cm²)	214					
Esquilles	81					
Débris	322					
Débris thermiques	69					
Nuclei	4	4	(dont un "intrusif")			
Outils	61	61	(dont 18 outils perçants, 3 segments, 1 troncature de Gilgal, 3 pièces lustrées)			
Total		**890**				

* Le "nombre minimal" de pièces est obtenu en prenant les pièces entières et le plus grand des deux nombres "fragments proximaux" et "fragments distaux", soit ici 7 + 21 et 16 + 21, ceci permet de pondérer l'effet de la fragmentation qui est plus grande parmi les lames que parmi les éclats...

Quatre nucléus ont été trouvés dont un semble hors contexte (nucléus de type kébarien géométrique, Fig. 2) et pourrait avoir été ramassé par les préhistoriques comme bloc de matière première. Les trois autres nucléus sont épuisés, probablement en liaison avec la rareté de la matière première (en l'état où ils nous sont parvenus il s'agit d'un nucléus globuleux et de deux nucléus à éclats, Fig. 4:16).

Les outils retouchés

Parmi les outils (au sens typologique du terme, Figs. 3-5), 45 ont été façonnés sur des lamelles, 13 sur des lames et seulement 3 sur des éclats. Si la tendance laminaire était claire dans les produits de débitage, il apparaît que les préhistoriques ont pratiqué une *sélection quasi exclusive des supports laminaires* les plus étroits pour façonner leurs outils, les largeurs étant alors relativement standardisées (Tableau 2).

Tableau 2: Typométrie (en mm) des 61 outils selon le support.

	N	longueur		largeur		épaisseur	
		moyenne	écart-type	moyenne	écart-type	moyenne	écart-type
Outils sur lamelles	45	22,1	8	8,3	2	2,9	0,8
Outils sur lames	13	30,8	13,7	13,6	2	4,7	2,8
Outils sur éclats	3	21,8	5,3	14,9	5	5,6	1,3

Les *lamelles à bord retouché* (19 pièces; Fig. 3:3-4, 4:7-8) sont à bord abattu (13 pièces dont une à deux bords abattus et troncature oblique et une à dos opposé à une retouche fine), *à retouches marginales fines* (5) ou à retouche inverse simple (1).

Les lamelles à bords bruts *tronquées* (2 pièces) sont représentées par une lamelle bitronquée (22x8,6x3,9mm) et une pièce fragmentaire.

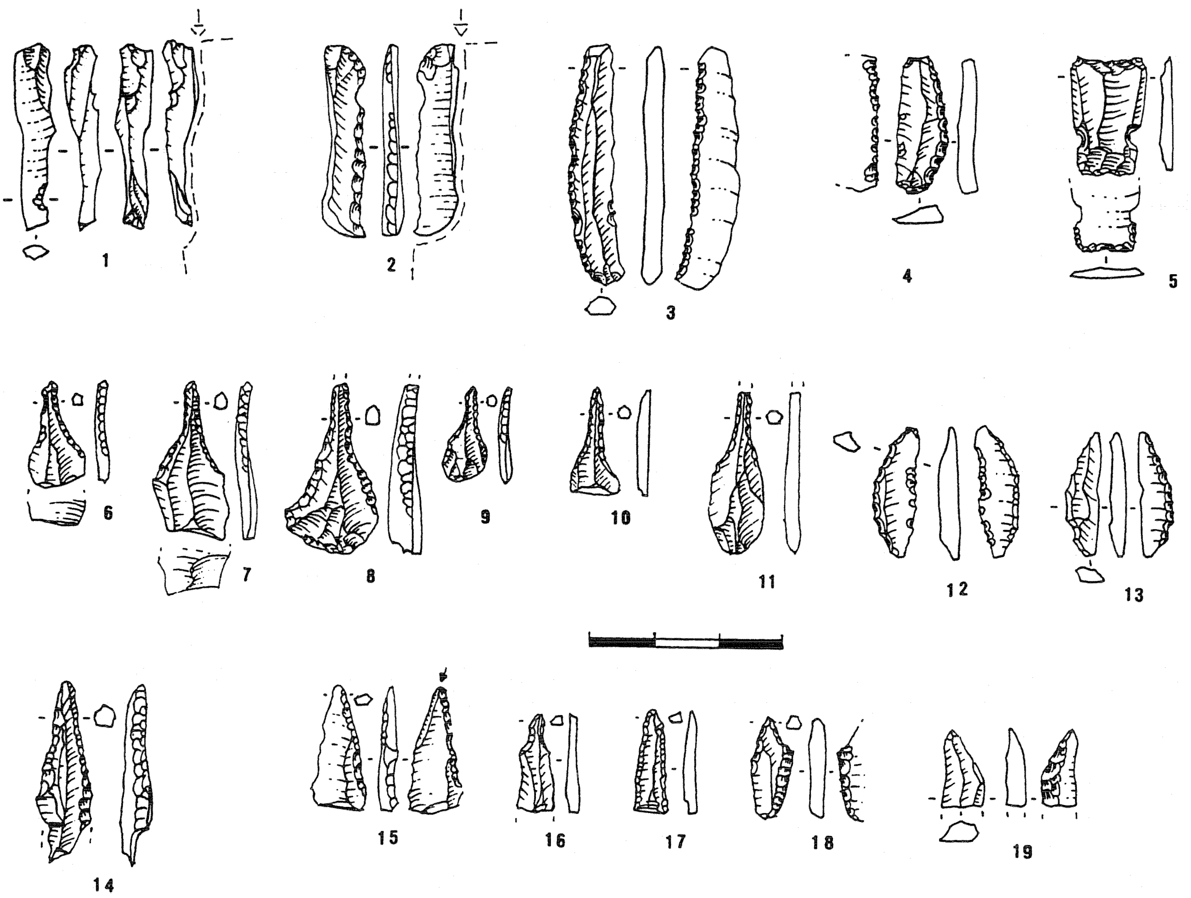


Fig. 3. El Aoui Safa: 1-2 chutes de burin; 3-4 lamelles à dos courbe (et bord opposé à retouche fine inverse); 5 troncature de Gilgal; 6-11,14-18 outils perçants (perçoirs); 12-13 segments à dos abrupt croisé, 19 fragment de segment à dos inverse.

Les *lames à bord retouché* (9 pièces; Fig. 4:4-5,13,15) sont généralement étroites (largeur moyenne de 12,5mm), à un dos bord abattu (3 dont une associée à une troncature oblique), à retouches marginales fines (2), à retouche simple directe (2), à retouche en escalier (1) ou irrégulière (1).

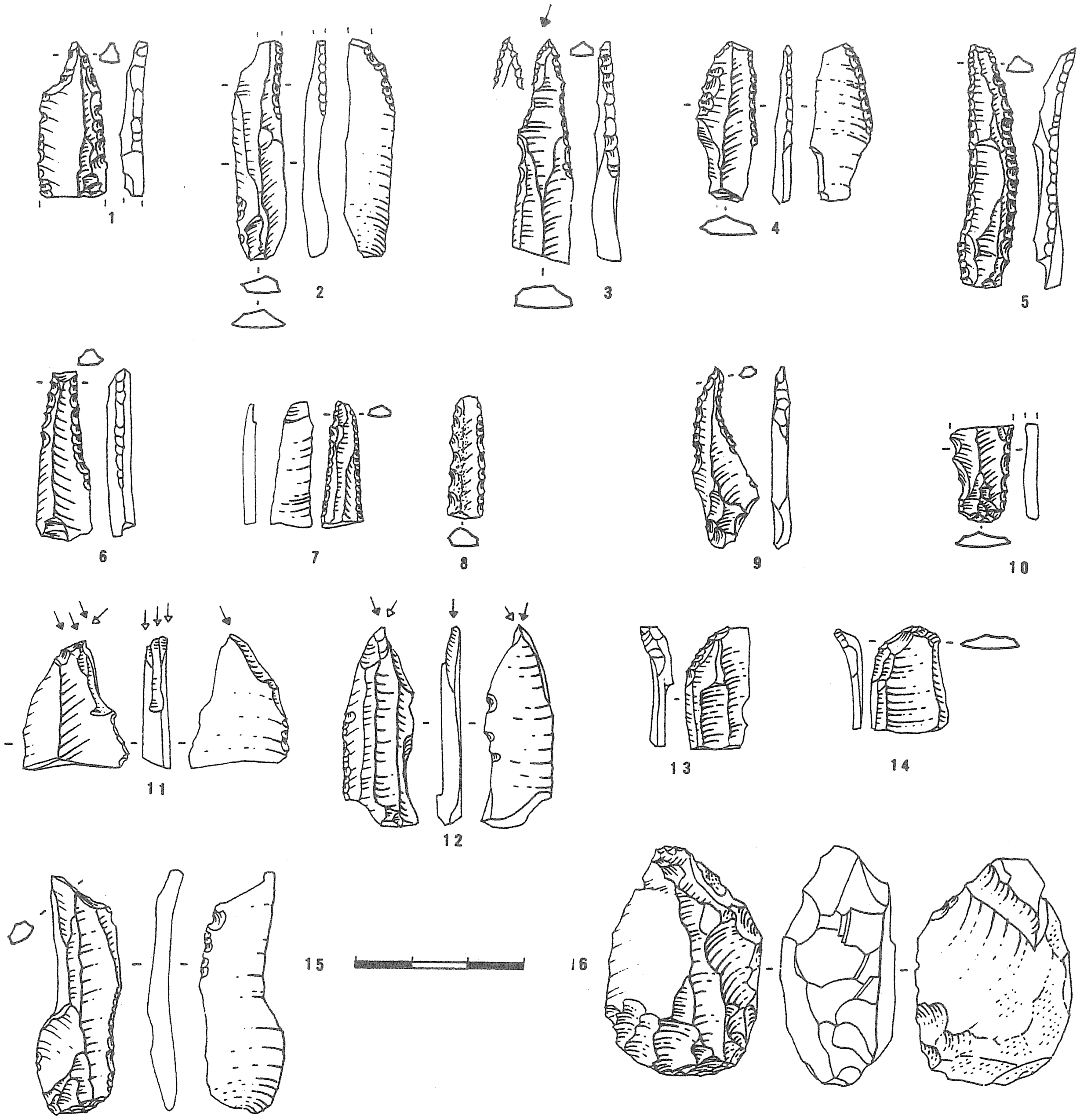


Fig. 4. El Aoui Safa: 1-3,6,9 outils perçants; 4-5,7-8,13,15 lamelles et lames étroites retouchées; 10,14 grattoirs atypiques; 11-12 burins; 16 nucléus à éclats.

Les *segments* (3 dont un fragmentaire; Fig. 3:12,13,19) sont de petites dimensions (18x 4,5x2mm, 19,5x6x3,1mm, ?x5,6x3,5mm). Les deux pièces entières ont un dos façonné par retouches abruptes croisées.

Une pièce exceptionnelle (Fig. 3:5) mais caractéristique a été trouvée sous la forme d'une lamelle bitronquée avec deux encoches opposée adjacente à la troncature proximale (long. x larg. x épais = 18x11,2x1,9mm). Cette pièce évoque une pointe d'El Khiam (type absent de notre échantillon) reprise par une troncature. Elle présente des similitudes à la fois avec les troncatures de Hagdud (ou rectangles de Nacharini) dépourvues d'encoche et avec les troncatures de Qermez Dere (qui présentent deux paires d'encoches adjacentes aux troncatures), le type correspond exactement à la *troncature de Gilgal* (dans sa version à une seule paire d'encoches) définie dans la vallée du

Jourdain dans les niveaux Early PPNA de Gilgal (NOY 1994).

Les *burins* (2; Fig. 4: 11-12) sont rares mais présents avec deux pièces d'angle (ainsi que quatre chutes de burin dont une sur bord retouché; Fig. 3:1-2), l'un sur lame, l'autre sur éclat.

Les *grattoirs* (3; Fig. 4:10,14) sont semble-t-il indépendants du support (un sur lamelle de 10,6mm de large, un sur lame de 13,4mm et un sur éclat de 18,6mm).

Les *perçoirs* constituent le groupe le plus important (18 pièces) avec des pièces généralement très légères (16 sur lamelles et 2 sur lames; Tableaux 3-4; Fig. 3:6-11,14-18, 4:1,3,6,9).

Tableau 3. Typométrie des perçoirs.

N=18	Longueur	largeur	épaisseur
minimum	11,4	4,2	1,5
maximum	38,1	14,1	5,5
moyenne	22,3	8,4	2,8
écart-type	7,9	2,4	1,1

Un éclat retouché présente une retouche abrupte inverse.

Les *pièces lustrées* (3) attestent-elles de la coupe de végétaux tendres (*cf.* P. Anderson ci-dessous) ? Ces pièces sur supports laminaires sont de modules très variés (66,3x18,9x3,8mm, 46,7x8,7x3,5mm et 9,2x12,9x2,3mm, Fig. 5:1-3). Une possède un dos partiel opposé au tranchant et une troncature proximale tandis que l'extrémité distale a été conservée (Fig. 5:2), une autre présente une troncature distale associée à une cassure postérieure à l'utilisation (Fig. 5:3), la dernière est une lame à talon punctiforme (Fig. 5:1).

Malgré sa taille réduite, cet ensemble semble homogène et correspond à ce que l'on regroupe usuellement sous le terme d'industrie khiamienne.

Tableau 4: Typométrie de la pointe active des perçoirs (mesures en mm, la largeur et l'épaisseur ont été prises à 2mm de l'extrémité, sur certaines pièces l'état de conservation n'a pas permis de prendre tout ou partie de certaines mesures).

	Mesures de la pointe		
	Longueur	largeur	épaisseur
N	7	13	13
minimum	5	1,5	1,1
maximum	18	3,5	2,5
moyenne	11,4	2,19	1,72
écart-type	4	0,56	0,41

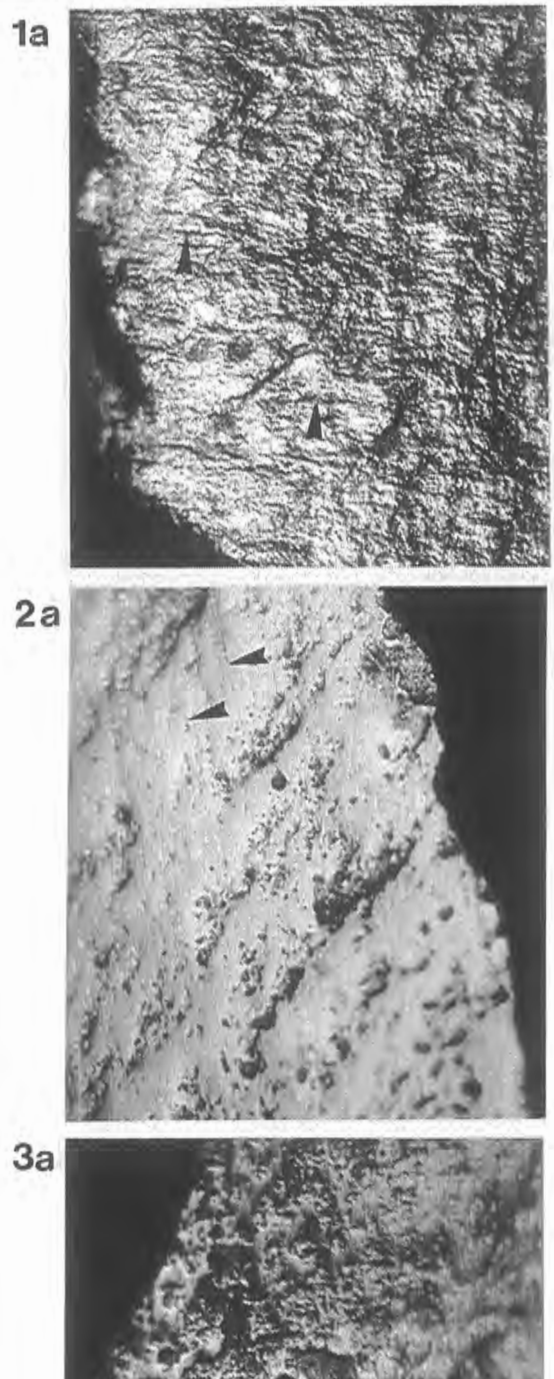
Use-wear Analysis of the Three Glossy Pieces (P. Anderson)

Do the three "pièces lustrées" (glossy pieces) described above form an homogenous functional ensemble ? Because gloss can develop on tool edges having worked a number of kinds of humid, abrasive siliceous materials, ranging from clay, to hide treated with powdered ochre to cereals or reeds, it was deemed necessary to analyse these three objects microscopically for use-wear traces allowing for distinguishing among possible uses for each object (see ANDERSON and VALLA, this volume). We also wished to see whether the use of the objects shows a range of activities, which correspond to the Khiamian age proposed for these artefacts (for example, working of ceramics may preclude this hypothesis).

Microwear analysis was carried out using a reflected-light microscope with Nomarski (Interferential) contrast at 100 and 200x, as this method has been shown to allow effective comparison between characteristic traces observed on prehistoric tools and experimentally-used tools (see methodological description in ANDERSON 1994b and ANDERSON and VALLA, this volume).

Working of Skin

The tool in Fig. 5:1b shows gloss and linear traces (Fig. 5:1a, arrows) oriented perpendicular to the right-hand edge, indicating a transverse motion, which here is scraping of a material. Traces with the same microscopic attributes are seen oriented parallel to the left-hand edge, indicating a cutting motion. The microwear polish traces, showing dull lustre and high abrasion, indicate that the material scraped and cut using this tool was humid and abrasive material. According to experiments, this was not plant material,but rather skin with a fine abrasive powder added to its surface; this could be soil or a crushed lithic material, such as ochre (see ANDERSON 1994a,b for description of these traces and



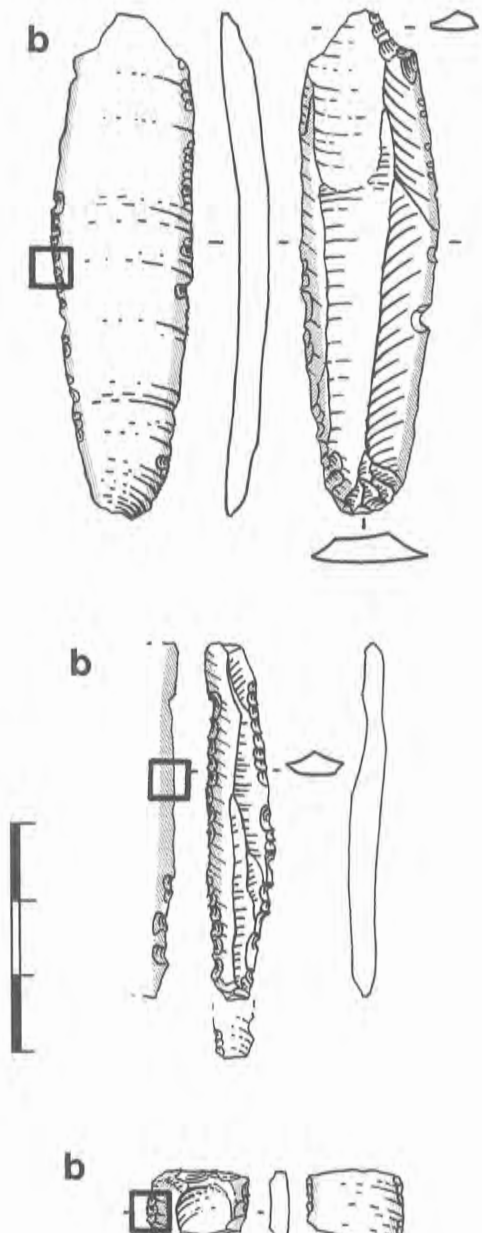


Fig. 5. 1-3a show microwear traces magnified approximately 100 diameters, taken using a Zeiss Axioscop and DIC (Nomarski) lighting. Images shown are digitised and treated using the Imagenia program of the Biocom company (Paris and Lyons). All drawings (1-3 b) are to scale (division = 1cm). Shaded areas indicate visible gloss distribu-tion, and squares show area in which the micrographs were taken. Tool in Fig. 5:1 shows traces characteristic of scraping skin treated with an abrasive powder (1a and right-hand edge) and cutting this same material (left-hand edge). Microwear traces on tools in Fig. 5:2-3 indicate they were used to harvest humid plant stems, undoubtedly wild cereals, during at least several hours. The arrows indicate examples of striations and other linear traces created during the use of the tool edges. See text for further explanation.

interpretation). We have identified similar traces for tools from two sites in Israel, the Sultanian at Hatoula (1994a: 71, ANDERSON 1994b: 287), and the Natufian at Hayonim Terrace (ANDERSON and VALLA, this volume). Cutting and scraping of skin after ochre or another fine mineral powder is added, would appear to correspond to final stages of skin treatment, for making of leather objects (ex. strips for bindings). The distribution of traces indicte that the tool was held in the hand during use, and its working edges resharpened using fine retouch in the course of use.

Harvesting of Wild Cereals

The other two glossed tools show microwear traces characteristic of harvesting, probably wild cereals, like those we have obtained in various experiments. In particular, such traces were obtained when one of us (PA) harvested wild einkorn wheat and wild emmer wheat using flint-armed sickles near Al Mushaneff, several kilometers to the west of Shahba (see map). Our experiments harvested, in several stands in this area of the Jebel el 'Arab, einkorn (*cf. Triticum boeoticum thaoudar, Triticum urartu*) and emmer (*Triticum dicoccoides*) grow on volcanic soil, in pure stands as dense as 300 stems per square meter (see description of these experiments and traces in Anderson and Valla, this volume). As this population is considered to be primary by the ICARDA, Aleppo, as well as by G. Willcox, archeobotanist, C.N.R.S., Jales, this would indicate that a distance of about 60km is most likely the maximum distance cereal ressources grew from El Aoui Safa during the Natufian and the PPNA. Harvesting of other wild grasses does not seem a likely use for these tools, as they do not grow in stands in this area, and traces show fairly dense stands were cut (*ie* the use motion indicates proximity of soil and stems cut in bunches at once). Both tools (Fig. 5:2-3) show smooth, bright gloss and fine, dotted striae (arrows) stretching parallel to one edge (Fig. 5:2a,b) or both edges (Fig. 5:3a,b)

The blade in Fig. 5:2 was used laterally hafted, with the hafted edge retouched to better its fit or stability in the handle, and the active edge was not intentionally retouched. Both edges of the broken blade in Fig. 4:3 were used while the tool was hafted, and spontaneous retouch occurred in the course of use. The blade was turned in the haft after one edge was used. This object was broken and burnt at some point following use.

It is difficult to say what the duration of use was for these tools, or surface harvested. There is no way to ascertain whether they were used in one season or over a number of years. To give a general idea, a similar intensity of development of traces was obtained on a single edge of our experimental tools, laterally hafted in groups of three in wooden and antler handles, after ten or twelve hours of harvesting wild wheats in the Jebel Arab. It is clear, however, that both tools (Fig. 5:2-3) were used to harvest in hafts, probably with other blades forming the cutting edge as well, which cut near the soil, using a motion of drawing the sickle towards the harvester. The presence of fine striae on these tools indicates their proximity to the soil, which abrades the polish in fine, dotted (interruped) striae, but cannot be construed as showing agricultural activity (*i.e.* soil preparation and sowing of grain); We recall that our experiments harvesting spontaneous cereals in a wild context only 60km or so from this site produced striae on the tools; conversely, our experiments harvesting cultivated cereals (*i.e.* after soil preparation) in various places do *not* always result in striations on the tool edge (see ANDERSON *op. cit.*, and ANDERSON and VALLA, this volume). The brightness and smoothness of the traces, according to experimental data, show that here, the cereals were harvested with some humidity in the stem, which in our experiments corresponds to a stage at which most of the grain (spikelets) has not yet fallen to the ground. The traces on these tools also show because of proximity of the cut to the ground, that a length of stem was also cut, which may have been used at the site.

Data from our microwear analysis of tools from other sites in the Levant shows tools like these, used hafted and with microwear traces corresponding to harvesting of wild cereals, are common for Natufian and Aceramic Neolithic sites in the northern and southern Levant (see summary in ANDERSON 1994b).

The site context and ressources in its environs remain to be clarified, but this short microwear analysis shows both artisanal (making of skin objects) and ressource procurement (cereal-grain and stem-harvesting) activities took place using tools found at El Aoui Safa, and these activities are certainly reasonable for tools of Khiamian age.

Autres vestiges archéologiques

Une perle constituée par un tronçon de dentale côtelé atteste de la présence d'objets de parure. Il s'agit d'un type d'élément culturellement tout à fait cohérent avec l'industrie lithique.

Les vestiges de faune étaient très fragmentés et altérés par le feu mais ils présentent notamment des restes de *Bos primigenius* (E. Vila-Meyer, communication personnelle). Cette faune très différente de celle du "gisement ossifère" d'Umbashi confirme l'homogénéité du sédiment cendreux qui n'est pas constitué par un mélange de silex "anciens" et d'éléments (rejets de foyer) plus récents et associés à la construction voisine.

Un prélèvement de charbons de bois a fait l'objet d'une datation au Centre de Datation par le Radiocarbone de Lyon qui a donné le résultat suivant[1] :
Ly-6996: 9270 ± 120 B.P., soit en date calibrée avant notre ère (avec un intervalle de 2 sigmas, selon STUIVER et REIMER 1993) (-8605, -8070), les pics de probabilités étant autour des dates -8335, -8304, -8263 et -8219 avant J.-C.

Tout en confirmant la mise en place de ce sédiment à une période très antérieure au Bronze, cette date radiocarbone semble trop récente d'environ un millénaire, sans qu'il soit possible de préciser s'il s'agit d'un rajeunissement accidentel de l'échantillon recueilli à faible profondeur ou s'il faut y voir l'attestation du maintien dans les marges arides de groupes khiamiens attardés, tandis qu'à la même époque le PPNA/Soltanien était bien développé plus à l'Ouest.

Bilan et discussion

Le contexte écologique extrêmement défavorable de la dépression située entre le Kraa et le Safa est localement pondéré par le fait que El Aoui Safa se trouve à proximité d'un point d'eau saisonnier qui à l'heure actuelle est encore semi-permanent. L'hypothèse de terrain initiale faisait de ce site l'attestation d'une halte temporaire (poste de chasse ?) tandis que la construction encore visible (ainsi que d'autres plus dégradées) aurait été plus récente (Age du Bronze ?). Il faut cependant noter que le matériel recueilli ne présentait pas l'aspect dispersé des sites de surface de la fin du Natoufien et qu'il n'a été trouvé aucun matériel archéologique post-Néolithique. Dans ce contexte nous ne devons pas exclure l'hypothèse selon laquelle les vestiges seraient tous de la même époque, attestant alors d'une occupation du début du Néolithique acéramique plus longue et organisée que celle imaginée au départ. Au stade actuel, en l'absence d'une fouille, il n'est évidemment pas possible de valider cette hypothèse mais elle doit être prise en compte même si elle heurte la vision classique de l'aire d'expansion de la culture khiamienne.

L'attribution chrono-culturelle de cette occupation à la phase de transition de la fin du Natoufien et du début du Néolithique pré-potterie est elle aussi claire. Certains y verrons un Natoufien final, d'autre un mélange entre des vestiges Natoufiens et Soltaniens[2] ou même un Soltanien ancien. Le caractère très limité de l'échantillon ne facilite pas la réponse à une telle question, les proportions et même les présences/absences de certains groupes typologiques pouvant ne traduire que des aléas d'échantillons, il nous semble cependant peu soutenable de considérer que cette série puisse être le produit du mélange d'un niveau Natoufien et d'un niveau PPNA alors que rien ne laisse présumer une longue occupation dans ce contexte atypique (tout particulièrement pour le Soltanien). Il est déjà surprenant de trouver un campement dans cette dépression aussi nous ne pouvons pas croire qu'il y ait eu en ce point plusieurs phases d'occupation dont les vestiges auraient ensuite été mélangés. La présence d'une série de segments et de lamelles retouchées évoque le matériel recueilli dans les sites du Natoufien final trouvés plus au sud (dans un environnement parfois assez similaire) par Alison Betts (BETTS *et al.*, sous presse) à l'inverse nous n'avons pas ici de mobilier lourd (absence liée au caractère occasionnel de l'occupation ?) et l'industrie lithique comporte une troncature de Gilgal, un nombre important de microperçoirs à affinités PPNA ancien mais pas d'outils lourds. Qu'il s'agisse donc d'un Natoufien final, pour ne pas dire d'un Natoufien attardé (*cf.* la date C14) et partiellement acculturé, ou d'un Soltanien ancien sans outil lourd (ni flèches) mais avec des réminiscences natoufiennes, l'occupation de El Aoui Safa doit remonter à la phase de passage entre le Natoufien et le Soltanien, phase pour laquelle nous gardons le terme de Khiamien ...

Même si l'échantillon recueilli est réduit, il fournit au minimum un indice d'incursion par un groupe de chasseurs (?) khiamiens dans la zone aride alors que cette culture n'était jusqu'à présent connue que dans un nombre restreint de sites, associés à un environnement plus favorable. Parmi un outillage lithique abondant, la présence d'outils attestant le travail du cuir et la coupe des céréales suggère une occupation plus importante qu'une simple halte temporaire.

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[1] Nous remercions Jacques Evin, Directeur du Centre de Datation de Lyon qui a effectué cette datation.

[2] Garfinkel, ce volume, conteste l'existence même d'un faciès Khiamien entre le Natoufien et le Soltanien. Garfinkel suggère en effet que toutes les industries lithiques attribuées au Khiamien sont en fait le produit de mélanges taphonomiques.

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Industries Lithiques de la Période 8000-7500 B.P. à Tell Halula (Moyen Euphrate Syrien)

Miquel Molist et Arnau Ferrer

Abstract: *The site of Tell Halula (Euphrates Valley, Syria), excavated since 1991 by a Spanish team from the University Autonoma de Barcelona, has some occupation levels from the first half of 8th millennium bp. These levels, with C-14 dates ranging from 7,880-7,440 bp, show a complex spatial patterning and an economy based on agriculture and sheep/goat herding. We present here a preliminary analysis of lithics from these 8th millennium bp levels, which show some deep changes with respect to material from the oldest occupation levels. The quantity of local raw material grows, and bipolar debitage items disappear, whereas they were among the most frequent during PPNB times. A new production of flakes is now generalized. All these modifications, similar to those produced on nearby and contemporaneous sites, are probably the consequence of a new socio-economic system, not well defined, where the management of herding and new manufactures opened the way to new and diverse ways of specialization and complementarity.*

Introduction

La région du Nord de la Syrie et plus particulièrement la vallée de l'Euphrate constitue une des zones les plus significatives du Proche Orient pour la connaissance du processus de transformation sociale et économique constitué par l'apparition des premières sociétés agricoles. Dans les années 70 et 80, la fouille des sites de Mureybet (CAUVIN 1977), Cheik Hassan (CAUVIN 1978) et Abu Hureyra (MOORE *et al.* 1975) a mis à jour les documents qui ont permis de jalonner l'évolution socioculturelle de cette transformation et de formuler, dans des synthèses (CAUVIN 1978, 1989 et 1994; MOORE 1985; CAUVIN et CAUVIN 1993), les interprétations concernant cette évolution.

Les fouilles en cours dans la région du futur barrage de Tichrine, réalisées dans le cadre des Opérations de Sauvetage proposées par la Direction Générale des Antiquités de la R.A. de Syrie, vont permettre d'élargir et de réviser les connaissances sur cette transformation du fait de l'étude de plusieurs nouveaux sites comme Jerf el Ahmar (McCLELLAN et MOTTRAM 1993); Dja'de el Mughara (COQUEUGNIOT 1994) ou de la reprise de fouilles de sites déjà connus comme Cheikh Hassan (STORDEUR, sous presse). Parmi celles-ci nous voulons présenter ici quelques résultats des travaux de la Mission espagnole à tell Halula (Ministerio de la Cultura, Espagne). En effet ce site, placé sur le moyen Euphrate syrien, en rive droite du fleuve, près de la ville actuelle de Djerablus, fait l'objet de recherches depuis 1991.

Les travaux réalisés jusqu'à présent ont montré qu'il s'agit d'un établissement d'une vaste superficie (8ha), qui a connu une occupation, probablement de type continu, du PPNB moyen aux horizons culturels de la première moitié du VIIIéme millénaire B.P. (c'est a dire couvrant la période entre 8700 B.P. et 7400 B.P. en chronologie absolue non calibrée), complétée par une réoccupation lors de la période Halaf moyen-récent sur une partie du tell.

Dans la précédente réunion scientifique dédiée aux industries lithiques (Berlin), nous avons présenté une première analyse du registre archéologique de ce type de matériel pour l'ensemble des périodes PPNB moyen et récent (MOLIST *et al.* 1994). La nouvelle réunion scientifique nous permet de présenter la suite de cette analyse préliminaire, cette fois-ci dans les niveaux d'occupation qui suivent dans le temps, c'est a dire ceux qui correspondent à la première moitié du VIIIéme millénaire B.P.

Caractérisation générale de l'occupation à Tell Halula entre 8000 et 7500 B.P.

Cette phase est attestée à Tell Halula en continuité chronologique avec les niveaux et vestiges appartenant à la période PPNB bien qu'elle ait été essentiellement repérée dans d'autres secteurs du tell. Cette époque a reçu plusieurs dénominations et elle correspond dans un sens large à un moment pré-Halaf, c'est à dire la période 5 de la Maison de l'Orient Méditerranéen (HOURS et alii 1994), et elle est à mettre en relation avec les horizons culturels définis dans le domaine littoral avec les séquences de l'Amuq ou de Ras Shamra (BRAIDWOOD 1960, CONTENSON 1992) ou pour les régions plus orientales avec la séquence établie dans la vallée du Balikh (AKKERMANS 1990). Étant donné que notre étude est actuellement en cours, nous resterons dans un cadre plus strictement chronologique, dans l'attente de définir nos corrélations culturelles avec plus de précision.

Trois secteurs de fouille sont à l'origine de nos données. D'une part celui situé dans la partie centrale et supérieure du tell (Secteur 1) où au moins trois niveaux montrent une réoccupation du spectaculaire mur de terrassement daté de la fin du PPNB. Cette réoccupation de l'espace se réalise d'une part avec des sols extérieurs contre la face externe et d'autre part dans sa partie ouest ou interne avec des niveaux d'occupation présentant des vestiges, soit des fosses, soit des constructions dont la plus importante est de type tholos. Une deuxième zone de fouilles (secteur SS14), sur la face nord du tell, a fourni trois grands niveaux architecturaux appartenant à la même période. Il s'agit d'une aire d'occupation domestique avec des maisons à plan rectangulaire pluricellulaire, séparées par des espaces extérieurs constitués par des sols en terre battue avec des structures de combustion (cuvettes). Finalement, la dernière aire de fouille, la plus importante du point de vue stratigraphique, est le secteur SS7. Nous allons l'analyser plus en détail et c'est le matériel lithique provenant de ce secteur qui constitue actuellement l'échantillon central de notre étude.

En effet, l'extrémité sud-est du tell présente d'excellentes conditions pour l'installation humaine étant donné son emplacement à la confluence des deux ouadi qui entourent le site et la visibilité sur la vallée de l'Euphrate proprement dite y est bonne. Sur cet emplacement nous avons développé depuis 1992 la fouille du secteur SS7, dégagé actuellement sur une surface de 228m². Les travaux on mis en évidence une succession d'au moins 13 niveaux caractérisés par la préparation, la construction et l'abandon de grands ensembles architecturaux. Étant donné que l'étude détaillée est encore en cours, nous allons prendre pour cette étude les carrés comme unité d'analyse. Dans la partie basse du tell le carré A couvre la séquence la plus ancienne de ce secteur, avec au moins cinq niveaux successifs au dessus du sol vierge. Deux datations absolues placent cette série stratigraphique dans le premier quart du VIIIème millénaire B.P. (Beta 58925: 7880 ± 120 B.P. et Beta 58926: 7750 ± 530 B.P.). Dans le carré B se situent les niveaux intermédiaires (au moins 3 niveaux) tandis que le carré D couvre, avec 5 niveaux, la séquence la plus récente qui se place au milieu du VIIIème millénaire B.P. (Beta 70360: 7690 ± 130 B.P. et Ly 6493: 7440 ± 80 B.P.).

La fouille des différents carrés et niveaux a mis en évidence une grande uniformité des vestiges architecturaux et du type d'occupation. De manière générale, il s'agit de constructions monumentales en pierre sèche qui, dans les niveaux les mieux conservés, peuvent atteindre 1,10m de hauteur. Les différentes parties dégagées jusqu'à présent montrent de grands murs (1,20m d'épaisseur) dont les dimensions, les traces, les éléments constructifs ainsi que l'agencement diffèrent de ceux à utilisation domestique. Il s'agirait, selon la documentation actuelle, de grands murs d'enceinte tandis que l'espace intérieur, marqué par des sols en terre battue, sans évidence de structures domestiques, serait utilisé comme espace d'occupation en plein air. Parmi les éléments attestés on soulignera une porte ou passage dans un de ces murs et surtout, dans les différents niveaux reconnus, des fosses de faible largeur mais dont la longueur atteint, dans le niveau le plus largement dégagé, presque 20m de long en continuité. Ces fosses ont été creusées dans le remplissage mais elles présentent un traitement soigné comme le prouvent leurs parois revêtues d'argile, parfois même de briques crues, ainsi que leur fond avec un radier de petits galets sous une mince couche de pisé, le tout couvert par de grandes dalles planes et jointives. Ces aménagements sont interprétés comme des structures construites, probablement destinées à l'évacuation de l'eau dans le sens ouest/est du tell.

Les documents exhumés dans ces trois zones de fouille ainsi que les petits sondages réalisés en 1992 dans d'autres secteurs, indiquent donc une large occupation du tell lors de cet horizon chronologique. Cette occupation serait caractérisée par l'existence des grands murs ou murailles, lesquelles délimiteraient l'espace habité, avec des passages bien définis. Les constructions domestiques seraient de deux types au moins. Plan rectangulaire pluricellulaire et type tholos, avec une disposition dispersée laissant de larges espaces entre les maisons. La manipulation de l'eau, même si elle est résiduelle, constitue une autre caractéristique spécifique et une des attestations les plus anciennes de la manipulation de l'eau au Proche Orient.

Vue d'ensemble des activités techniques

Outre l'industrie lithique taillée que nous analyserons plus en détail, différents témoins de

l'activité technique sont présents. A Tell Halula la nouveauté la plus importante de cette phase est l'apparition de la céramique. Malgré les différences selon les niveaux et secteurs de fouille, J. M. Faura qui en fait l'étude détaillée regroupe les ensembles retrouvés avec les observations suivantes :
- la poterie grossière à dégraissant végétal (*coarse simple ware*) constitue la série la mieux représentée. A l'intérieur de celle ci on observe une série lustrée (*burnished coarse simple ware*), une à décoration incisée (*coarse impressed and incised ware*) ainsi qu'une grossière à engobe rouge (*red-slipped coarse ware*).
- la série fine est caractérisée par un dégraissant à inclusions minérales. Il faut signaler un ensemble très bien représenté avec une pâte noirâtre à fortes inclusions de quartz, mais aussi du véritable *Dark Faced Burnished Ware* ainsi qu'une série avec des restes de peinture rouge (*red painted ware*).

L'étude en cours des différents niveaux empêche actuellement une approche plus approfondie, mais en termes généraux on note une proximité avec les séries connues sur le littoral (Amuq A et Amuq B) (BRAIDWOOD 1960).

D'autres domaines présentent des nouveautés significatives. Ainsi, pour la première fois sur le site, on trouve dans cet horizon des récipients de "vaisselle blanche" toutefois pas très abondante. Le mobilier divers est très abondant et parmi celui-ci il faut signaler des seaux, soit en pierre soit en céramique, des colliers de perles en pierre ou en céramique... Le mobilier de pierre polie est également très abondant avec diverses catégories d'objets (haches, ciseaux...). Les vases en pierre, les mortiers et les meules, ainsi que l'industrie osseuse, sont également très bien représentés.

Économie de subsistance

La consolidation des pratiques de production de subsistance constitue la caractéristique générale. Les données paléobotaniques, en cours d'étude par G. Willcox, M. Catala et V. Roitel, montrent une forte continuité des pratiques de la phase antérieure, avec une importante agriculture céréalière (surtout du blé et de l'orge) ainsi que celle des légumes (lentilles, petit pois...). Les pratiques liées à l'exploitation du monde animal mettent en évidence une consolidation de l'élevage (études en cours réalisées par M. Saña et D. Helmer). Celui-ci est dominé par les ovicaprinés avec une présence équilibrée entre les deux espèces. En importance le boeuf constitue la troisième espèce domestique et les suidés sont représentés par un échantillon très faible ce qui rend difficile la reconnaissance des suidés domestiques. Les activités de chasse sont encore présentes mais leur importance diminue fortement. Outre l'aurochs, les espèces chassées sont les cervidés, les équidés ainsi qu'une faible présence de tortues. Il faut souligner la consolidation de l'élevage avec un équilibre entre chèvre et mouton et la consolidation de l'exploitation des boeufs domestiques. Les suidés étaient probablement domestiques.

L'industrie lithique du secteur SS7

Cette étude préliminaire est basée sur le matériel lithique recueilli lors des campagnes 1992-1994, dans les carrés SS7A, SS7B et SS7D (notés A, B et D dans la suite) situés sur la pente sud-est du tell et qui couvrent la période de 8000 à 7500 B.P. (*cf. supra.*). Le nombre total des artefacts lithiques étudiés dans cet échantillon est de 22021 unités dont 1432 outils retouchés. Étant donné que l'analyse présentée ici est préliminaire, nous avons traité les données de façon globale utilisant seulement les carrés de fouilles comme unités d'analyse, toutefois leur position échelonnée dans la pente du tell depuis le sol vierge (carré A) jusqu'aux niveaux supérieurs (carré D) a une valeur chronologique relative. Bien entendu dans l'étude approfondie en cours par A. Ferrer, on tiendra compte d'une stratigraphie plus fine et de la nature de couches (zones d'habitat, de rejet...).

Analyse technologique

Matières premières

De même que pour les niveaux PPNB du site (MOLIST *et al.* 1994), le silex est le matériau utilisé de façon majoritaire bien que l'obsidienne soit également utilisée mais de manière beaucoup plus réduite. Une analyse macroscopique a montré que le silex présente deux variétés principales, l'une à grain moyen ou grossier avec des tonalités très variables (marron, gris, blanchâtre...) et l'autre à grain fin avec une tonalité majoritairement marron-brun. C'est la première variété qui a été la plus utilisée, tandis que le silex à grain fin a une moindre représentation.

Produits de débitage

De même que dans les niveaux chronologiques précédents, le matériel lithique est représenté par l'ensemble des catégories de la chaîne opératoire, depuis les nodules non débités jusqu'aux outils finis et abandonnés. On observe, par rapport à celle du PPNB récent, des changements dans la gestion

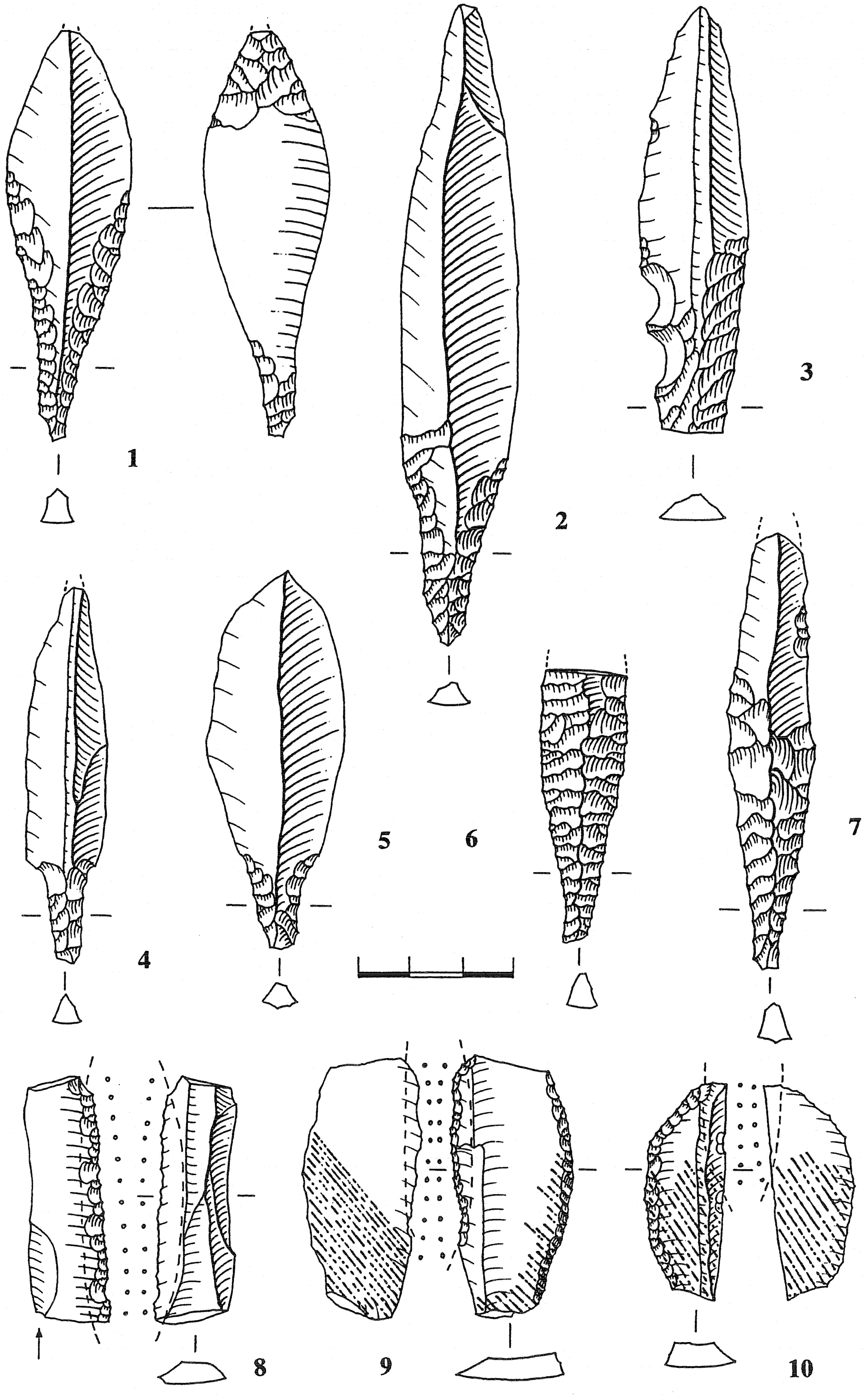

Fig. 1. Armatures de projectiles et pièces lustrées provenant de tell Halula (Syrie) (secteur SS7).

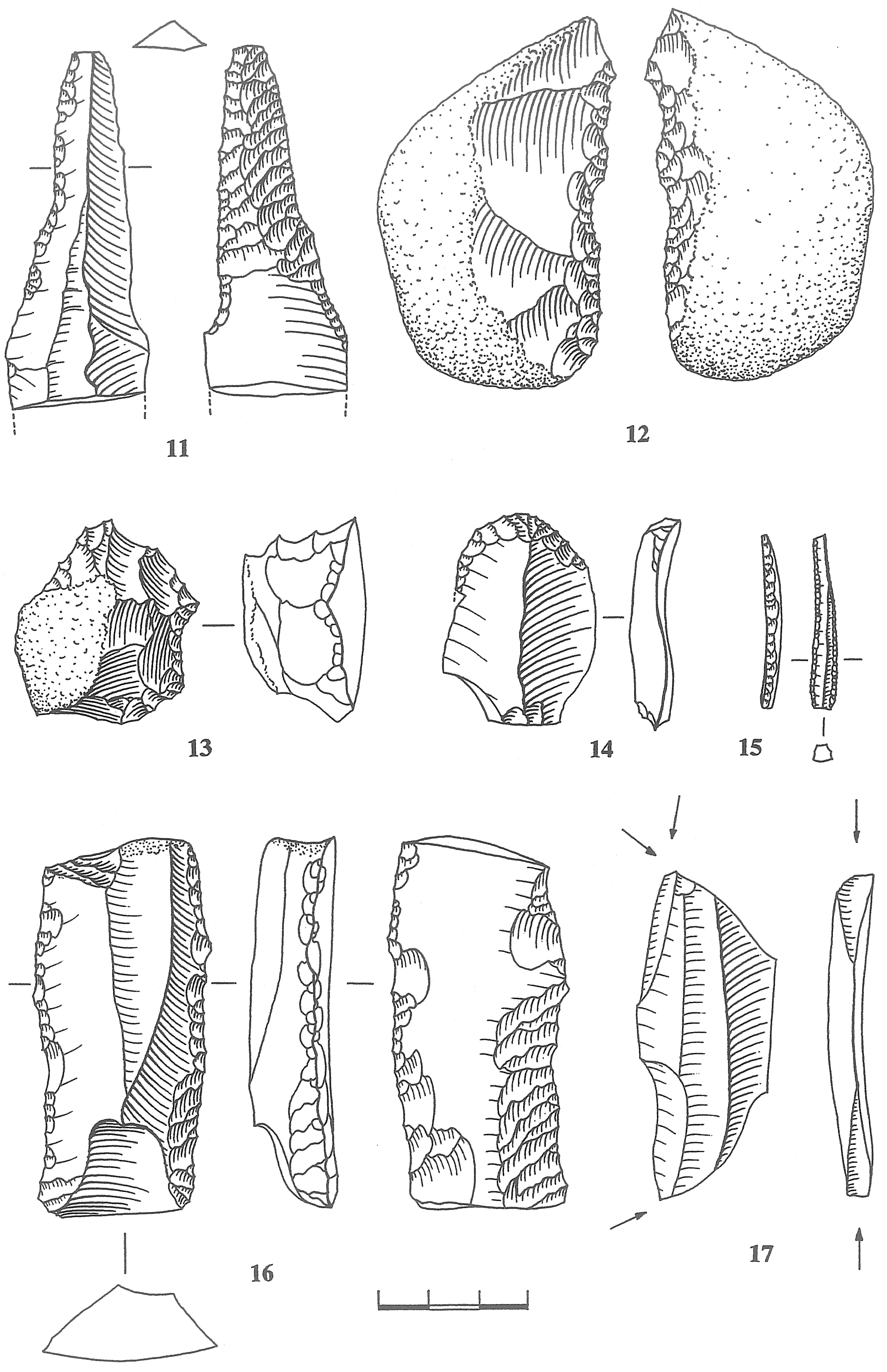

Fig. 2. Lames retouchées, éclats retouchés, grattoirs, perçoirs et burins provenant de tell Halula (secteur SS7).

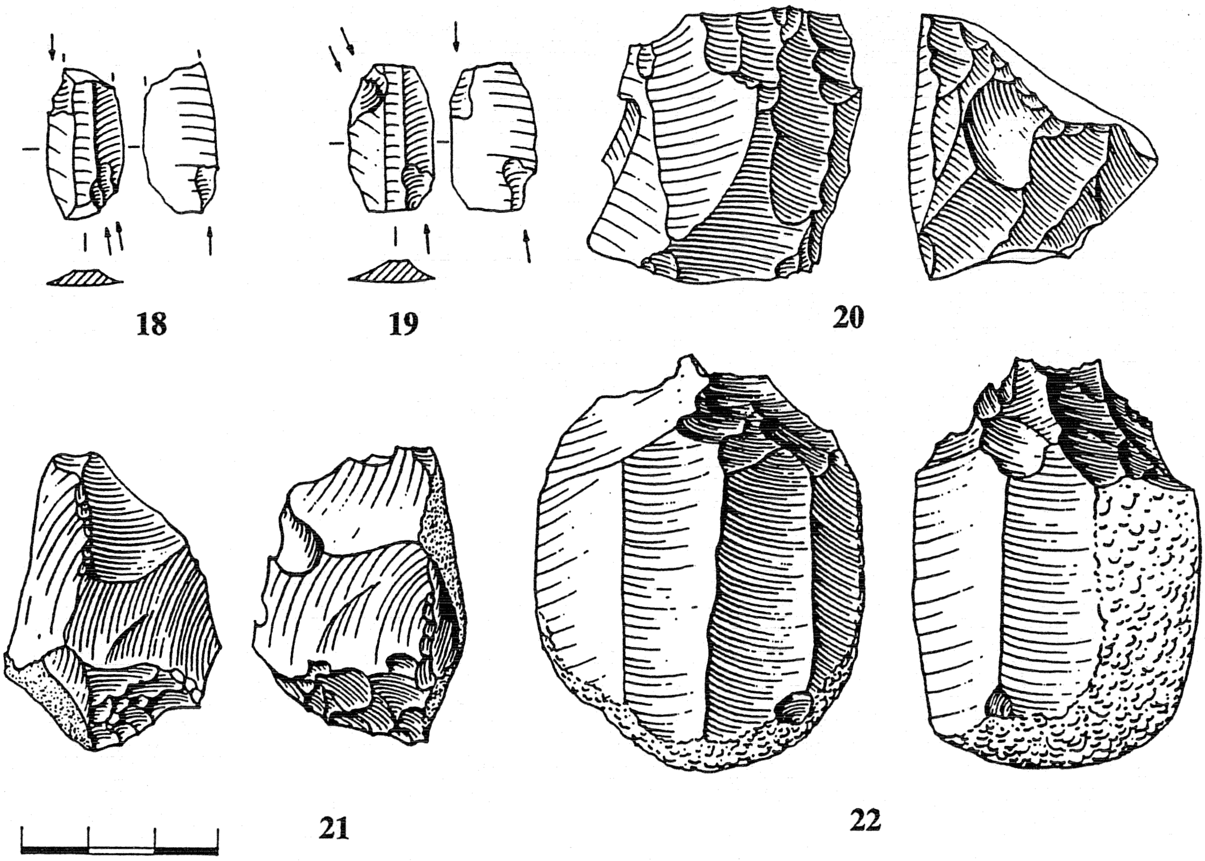

Fig. 3. *Corner thinned blades* en obsidienne et nucléus provenants de tell Halula (secteur SS7).

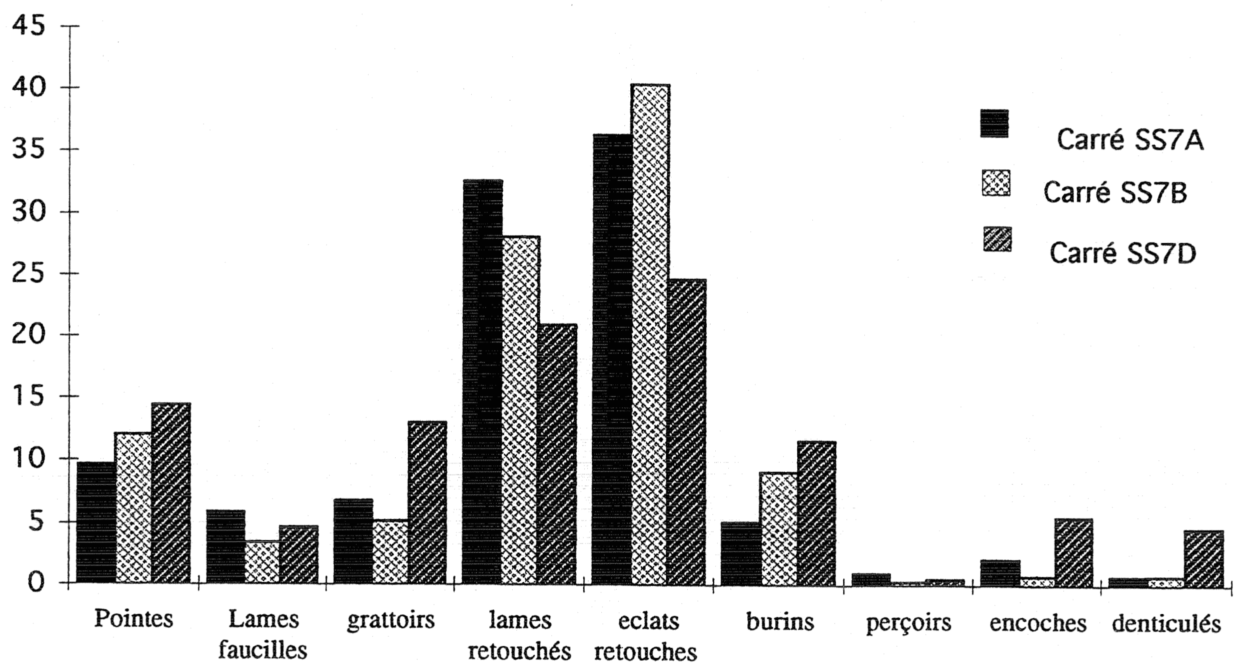

Fig. 4. Histogramme des fréquences des différents type d'outils par carré de fouille.

de la chaîne opératoire, tant au niveau des choix de matière première qu'à celui de l'économie du débitage. L'importante diminution du silex à grain fin et de bonne qualité, d'origine probablement exogène et très commun au PPNB, et l'utilisation presque exclusive du silex à grain moyen, provenant probablement des terrasses fluviales proches, fait que la présence de nodules non taillés et d'éléments corticaux devient très usuelle. La plupart des galets sont exploités entièrement dans le site ainsi que le prouve l'abondance des éclats d'entame.

Un total de 360 nucléus a été recueilli dans les carrés A, B et D. Le caractère préliminaire de cette étude ne permet pas de faire une analyse détaillée du processus technologique mais il est cependant possible d'en montrer quelques traits significatifs. Le schéma général est similaire au schéma A proposé par S. Calley à Mureybet (CALLEY 1986): absence de mise en forme préliminaire, ouverture d'un plan de frappe et exploitation de la surface de débitage. Le processus est surtout unipolaire (41,65% des nucléus), exploitant une surface unique jusqu'à l'épuisement par réduction du volume ou à la suite d'accidents de taille (réfléchissement ou fracture) (Fig. 3: 20). La réaction la plus fréquente aux éventuels accidents est l'utilisation d'une nouvelle surface de débitage (24%) ou de plusieurs à partir de changements successifs de plate-forme (21,29%). La présence des éléments de réparation est minime. Il en résulte des nucleus de dimensions réduites, à tendance prismatique ou globulaire (Fig. 3:21), dans un état d'exploitation très avancé qui empêche une bonne caractérisation du type d'exploitation initiale. À titre indicatif, 91% attestent une exploitation produisant des éclats, le reste étant des lames (Fig. 3:22). Il faut noter l'extrême rareté des nucléus à production laminaire de type naviforme.

Une analyse statistique a concerné les éventuelles différences de gestion technologique en fonction de la qualité du silex et son origine. Ainsi, 81% des nucléus présentent du cortex généralement de type fluviatile. Le silex à grain fin qui représente 22% des nucléus, présente également du cortex de type fluviatile (62% des cas). Ceci suggère une origine similaire pour les deux qualités de silex et une application du test du Chi 2 pour l'observation des différences (d'orientation) indique une différence non significative dans l'exploitation en fonction de la qualité du silex, mettant en évidence une homogénéité technologique indépendante de la qualité de la matière première.

Ce savoir faire simple et de type opportuniste (BINDER et PERLÈS 1990, NISHIAKI 1992) aboutit à une production hétérogène, sans standardisation, avec de nombreux éclats et produits corticaux (Tableau 1). Les éclats représentent toujours une proportion supérieure à 80%, avec une tendance a l'augmentation pour atteindre 90% dans les niveaux du carré D. De même que dans les niveaux PPNB (MOLIST *et al.* 1994), la fréquence des pièces retouchées est proche de 50% pour les lames tandis qu'elle n'arrive pas à 6% pour les éclats (Tableau 2).

Tableau 1. Fréquence des outils et des suports recueillis dans le secteur SS7 (N=22021 dont 1432 pièces retouchées et 360 nucléus).

carré	% éclats	outils éclat	% lames	% outils
SS7A	83,97	5,12	7,02	3,87
SS7B	89,07	3,57	4,72	2,62
SS7D	90,32	3,27	4,07	2,32

Tableau 2. Fréquences des outils retouchés en fonction du type de support.

carré	éclats %	outils éclats %
SS7A	94,25	5,75
SS7B	96,13	3,87
SS7D	96,5	3,5

carré	lames %	outils lame %
SS7A	55,2	44,8
SS7B	64,3	35,7
SS7D	63,7	36,3

L'exploitation de l'obsidienne, principalement sous la forme de lamelles, est au moins en grande partie réalisée sur le site même. Il y a quelques nucléus prismatiques et un "bullet core", tous de dimensions très réduites. Quoique quelques éclats corticaux d'obsidienne aient été trouvés, leur nombre très réduit nous fait proposer une préformation des nucléus avant leur arrivée sur le site. La régularité morphologique des lamelles avec des arêtes et des bords rectilignes, des bulbes diffus et des talons punctiformes suggèrent un débitage unipolaire par pression.

L'outillage retouché en silex

Au total 1432 produits retouchés ont été récupérés dans l'ensemble des carrés analysés jusqu'à présent (Tableau 3 et 4). Le silex employé est à grain moyen (68%) ou fin (32%), avec une présence significative des produits corticaux (41%). Pour ces derniers la plupart (90%) semblent avoir une origine fluviatile, tandis que seuls 7% présentent un cortex indicateur d'une extraction sur place. Ainsi en terme général on voit se confirmer, par rapport aux niveaux PPNB, une plus grande importance de la gestion locale de l'ensemble de la chaîne opératoire.

Comme nous l'avons déjà indiqué, les éclats constituent le type de support le plus utilisé pour la fabrication des outils bien que les lames soient également très fréquentes (38%). L'observation de l'orientation des négatifs des faces dorsales, en relation avec la direction du débitage des produits, reflète en concordance avec les données obtenues pour les nucléus, avec une prédominance de l'unipolarité (52%) et de l'orthogonalité/multidirectionnalité (22,8%), tandis que la bipolarité semblerait très peu représentée (9%).

Tableau 3. Effectifs et fréquences des différentes catégories d'outils par carré de fouille.

	SS7A	%	SS7B	%	SS7D	%	Total	%
Pointes	41	9,6	95	12,02	31	14,41	167	11,66
Lames faucilles	25	5,85	27	3,41	10	4,65	62	4,39
grattoirs	29	6,79	41	5,18	28	13,02	98	6,84
lames retouchés	139	32,55	222	28,1	45	20,93	406	28,35
eclats retouches	155	36,29	319	40,37	53	24,65	527	36,8
burins	22	5,15	72	9,11	25	11,62	119	8,24
perçoirs	4	0,93	2	0,25	1	0,46	7	0,48
encoches	9	2,1	6	0,75	12	5,58	27	1,88
denticulés	3	0,7	6	0,75	10	4,65	19	1,32
	427		**790**		**215**		**1432**	

Armatures de projectiles

Les armatures constituent la catégorie la plus représentée parmi les outils morphologiquement bien définies. On a comptabilisé 167 artefacts soit 11,66% du total de l'outillage retouché. Leur fréquence augmente progressivement depuis le carré inférieur (A=9,60%) jusqu'au supérieur (D=14,41%). Du point de vue typologique, les pointes d'Amuq sont les mieux représentées (56,94%), face au type Byblos (19,44%) (Fig. 1:4) et à quelques exemplaires à tendance plus ovalaire (Fig. 1:1, 5), tandis que d'autres pièces sont trop fragmentées pour pouvoir être classées. Dans le premier type, la variété Amuq 2 (Fig. 1:2, 3, 7) est la plus représentée, un seul un exemplaire correspondant à la variété Amuq 1 (Fig. 1: 6) selon la définition de J. et M.C. Cauvin (1968, 1988). La retouche est abrupte pour les pointes de Byblos et semi-abrupte ou simple dans le cas des pièces de type Amuq, souvent directe et/ou par pression, en recherchant une retouche "couvrante" afin d'éliminer les arête dorsales dans la partie du pédoncule. Ce dernier, normalement de section haute et étroite, avec retouche abrupte, peut se présenter renflé et avec ablation de la convexité bulbaire par retouches plates inverses, probablement pour faciliter l'emmanchement.

Pour la fabrication des armatures c'est le silex à grain fin (58%) qui domine et il s'agit de la catégorie morphologique qui présente la plus grande sélection concernant la qualité de la matière première Pour les pièces sur lesquelles on à pu le déterminer, 72% présentent des négatifs dorsaux qui montrent une exploitation sur support de type unipolaire, tandis que 28% présentent des évidences de bipolarité, sans jamais correspondre à un débitage de lames préférentielles, selon la définition de F. Abbès (ABBÈS sous presse). L'application du test du Chi2, afin de rechercher s'il y a un choix préférentiel (unipolaire/bipolaire) en fonction de la matière première (silex à grain moyen/fin), a donnés des résultats qui montrent que les différences ne sont pas significatives (Chi2= 3,18, seuil de 3,84 à 5% pour d.d.l. = 1). Le même test a été appliqué pour observer le comportement différentiel selon la typologie (Amuq/Byblos), en fonction de la matière première (Chi2= 1,82, seuil de 5,99 à 5% pour d.d.l. = 2) ou en fonction de l'orientation des négatifs dorsaux (Chi2= 2,29, seuil de 5,99 à 5% pour d.d.l. = 2) et dans les différences sont non significatives.

Lames retouchées

Cette catégorie regroupe toutes les pièces laminaires retouchées à l'exception des armatures et de celles qui présentent un lustre visible à oeil nu et pour lesquelles nous avons fait une catégorie spécifique. Il s'agit de la catégorie la plus représentée avec un total de 406 exemplaires ce qui représente 28% de l'ensemble de l'outillage. On observe une diminution progressive, depuis le carré de base A (32,5%) jusqu'au carré D (20,93%). La matière première utilisée reflète les mêmes tendances que celles signalées pour les autres catégories, avec une claire prédominance du silex à grain moyen (69,73%) et une grande tendance pour les lames avec des stigmates de débitage unipolaire (87,7%).L'analyse morphotechnique et l'étude des traces d'utilisation permettront dans le futur un classement plus détaillé de cette catégorie hétérogène (Fig. 2:11,15-16).

Pièces lustrées

On a inclus dans cette catégorie toutes les pièces, laminaires ou non, dont le lustre est visible. Nous avons comptabilisé un total de 62 exemplaires, soit 4,39% du total. Cette proportion est homogène dans l'ensemble des carrés, avec une légère tendance à la diminution. La plupart des produits présentent des retouches (Fig. 1:8), mais pas nécessairement dans la zone du lustre et l'on observe notamment des pièces à dos (Fig. 1:9,10), probablement lié à leur emmanchement. En relation avec ce dernier les traces de bitume sont abondantes (13 pièces) et sa disposition, ainsi que celle du lustre en écharpe, permettent, dans une première approche, une proposition d'emmanchement similaire à celle proposé pour Tell Assouad (CAUVIN 1983). La matière première utilisée majoritairement est le silex à grain moyen et les stigmates signalent une claire prédominance de la taille unipolaire (95%).

Éclats retouchés

Ce groupe est le plus important avec un effectif total de 527 pièces, soit 36,80% de l'outillage. Il s'agit de pièces très peu caractérisées typologiquement, avec présence de tous les types de retouche et de morphologie (Fig. 2:12). Les études tracéologiques et morphotechniques, comme dans le cas des lames retouchées, vont permettre de mieux caractériser cette catégorie. Leur proportion dans les différents carrés est stable et, autant du point de vue de la matière première que de celui des stigmates d'orientation, ils présentent des caractéristiques communes à l'ensemble de l'outillage (prédominance du grain moyen et de l'unipolarité). Un trait serait spécifique de ce groupe: c'est la présence majoritaire d'éléments corticaux, ce qui refléterait une sélection des support de type opportuniste.

Grattoirs

Ils sont au nombre de 98, soit 6,84% de l'outillage. Leur nombre augmente depuis la base (carré A=6,79%) jusqu'aux carrés supérieurs (D=13,02%). Typologiquement on différencie deux groupes: le premier, qu'on appellerait de tradition PPNB est formé par des grattoirs sur lame ou éclat avec des fronts rectilignes ou à tendance arrondie (Fig. 2:14), avec des retouches continues semi-abruptes ou simples. Le deuxième, plus caractéristique de cet horizon, est constitué par les grattoirs carénés (Fig. 2:13) dont le nombre augmente depuis la base. Il s'agit de pièces épaisses, de haute section et de grandes dimensions, avec des fronts irréguliers et des retouche abruptes. Les supports utilisés pour ce type sont des éclats épais avec du cortex et ils semblent correspondre à des éclats d'ouverture de la plate-forme de percussion dans les galets fluviatiles. Ils constituent 48,97% des grattoirs du secteur SS7 et leur importance s'accroît dans les phases les plus récentes de la succession du VIIIème millénaire B.P. à Halula (secteurs SS14 et S1, non analysés ici). Cet outil pourrait avoir une signification chrono-culturelle pour les cultures du VIème millénaire avec céramique, comme le prouve entre autre sa présence à Bouqras (ROODENBERG 1986). La matière première utilisée est le silex à grain moyen, avec une forte présence du cortex, et les supports sont presque exclusivement sur éclat, un seul exemplaire étant sur lame.

Burins

Un total de 119 burins, soit 8,24% de l'outillage, a été étudié. De la même manière que les grattoirs, leur nombre augmente au cours de la séquence stratigraphique, évoluant de 5,15% (carré A) à 11,62% (carré D). La majorité sont des types transverse, sur fracture ou sur préparation latérale. On note également la présence de burins dièdres, avec les variétés d'angle, d'axe et oblique (Fig. 2:17). Il y a en outre deux burins doubles transverses. Une seule pièce présente des traces macroscopiques (retouche dans la partie proximale et vestiges de bitume) qui suggèrent un emmanchement. Le type de matière première choisi est comme toujours le silex à grain moyen et les lames constituent le support préférentiel, sans aucune évidence concernant le cortex, avec une exploitation unipolaire (72%).

Divers

Cette rubrique regroupe les catégories d'outillages qui ont une faible représentation. Ainsi une catégorie très peu représentée est celle des perçoirs avec seulement 7 exemplaires qui constituent 0,4%

de l'outillage. Il s'agit de petits perçoirs sur lame du type à épaulement avec une partie active préparée par retouche abrupte directe, indirecte ou alterne (Fig. 2:15). Les pièces à encoche sont également très peu représentées (1,88% de l'outillage). Il s'agit de pièces épaisses, de section haute, avec une ou deux encoches formées par des retouches abruptes et présentant des traces macroscopiques d'utilisation. Souvent ces pièces ont une forte similitude morphologique avec les grattoirs carénés. Les denticulés constituent un groupe hétérogène, peu abondant (1,32% de l'outillage), et ils sont définis essentiellement par la présence d'une retouche denticulée continue ou non.

Comme pour les précédentes catégories, le silex à grain moyen est le plus fréquent, entre 60% et 86%, avec près de 50% de supports corticaux pour les encoches et les denticulées. Parmi ces outils il n'y a aucun cas de taille bipolaire.

Outillage en obsidienne

Dans les carrés A, B et D nous avons recueilli un total de 288 artefacts en obsidienne, soit 1,29% du total des artefacts taillés. On observe une légère décroissance de leur nombre avec 2,4% dans le carré A et 0.94% dans le carré D. L'origine de ce matériel est en cours d'analyse (pour les niveaux PPNB elle a pu être attribuée à l'Anatolie centrale et orientale, MOLIST et alii 1994). Nous avons identifié un total de 19 "corner thinned blades" (NISHIAKI 1989, 1992) qui constituent 6,5% des artefacts en obsidienne (Fig. 3:18,19). En suivant la classification proposée par cet auteur, on observe, dans l'état actuel de la documentation, une homogénéité dans le processus de "corner thinning" (D1-D4 et V1-V4). Cette typologie coïncide avec le "type Kashkashok" qui est attesté à Abu Hureyra, à Bouqras et le long des affluents du Haut Khabur, type qui se différencie du "type Balikh" (où il note la présence de D2-D3 et V2-V3). La technique "Side Blow Blade Flake" est pour le moment minime à Tell Halula.

Discussion

Malgré le caractère préliminaire de cette étude, les quelques caractéristiques de l' industrie lithique de la première moitié du VIIIème millénaire B.P. mises en évidence nous fournissent des éléments pour une discussion générale dans un contexte archéologique et même historique plus large. Bien entendu les analyses plus approfondies en cours vont permettre de corriger, d'élargir et d'amplifier cette discussion à partir d'observations plus concrètes. Le fait que le site de tell Halula présente une des séquences d'occupation plus les longues, du PPNB moyen à l'époque Halaf, pourra sans doute aider à comprendre l'évolution des sociétés néolithiques durant cette phase où est attestée la consolidation des nouvelles pratiques économiques et la formation des groupes culturels classiques aux portes des grandes civilisations classiques. Dans le domaine du matériel lithique, objet de cette première présentation, on note dans les niveaux étudiés des variations significatives par rapport à l'étape antérieure du site (PPNB moyen et récent). La première concerne le changement concernant le choix des matières premières utilisées. En effet, en opposition avec le PPNB où l'on constate une prédominance du silex à grain fin utilisé pour la taille générale et surtout pour la fabrication des outils, on observe ici une diminution progressive de cette variété et une augmentation de l'utilisation du silex à grain moyen. La variété de silex à grain moyen étant disponible sur les terrasses moyennes de l'Euphrate, ce changement semble avoir une signification économique qui découle d'une plus grande utilisation des matières premières les plus proches du site, alors que la variété à grain fin est peu représentée dans l'environnement du site et que son origine est probablement exogène. Peut-on suggérer a partir de cette donnée une diminution de la circulation de matières premières? À ce niveau l'obsidienne nous fournira, après les analyses, un autre élément significatif.

Ce processus à été observé dans d'autres gisements dans des contextes chrono-culturels similaires. Nous limiterons nos observations aux régions du Levant Nord bien qu'un phénomène similaire ait été également signalé dans le Levant Sud (voir par exemple ROLLEFSON 1990 et ROLLEFSON et KÖHLER-ROLLEFSON 1993). Ainsi à Bouqras on a observé une diminution du silex à grain fin et une augmentation de celui à grain moyen (ROODENBERG 1986), à Kumartepe (ROODENBERG 1989) il y a une prédominance de la variété à grain moyen provenant des terrasses de l'Euphrate, à Judaidah, phases A-B, (BRAIDWOOD 1960) on constate une prédominance du "buff colored shert" et en plus petite quantité la présence du silex brun à grain fin; à Damishliyya (NISHIAKI 1992) le "coarsed grained flint" représente 75% de l'industrie et à Kashkashok II 1,6% seulement de l'industrie est en silex fin (NISHIAKI 1992).

Au niveau technologique, on constate à tell Halula une diminution très significative du débitage de type bipolaire, avec une dominance des nucléus unipolaires. Ces mêmes caractéristiques semblent constatées à Kumartepe, dans les niveaux supérieurs de Bouqras, à Judaidah et à Kashkashok. Dans quelques cas, par exemple à Damishliyya, on note un choix préférentiel selon le type de matière première, réservant la taille bipolaire et la production de lames pour les nucléus à grain fin. Cette dernière constatation ne semble pas être attestée à Tell Halula où il y a une homogénéité indépendante de la qualité de la matière première.

En ce qui concerne l'aspect typologique, les pièces les plus significatives sont les armatures de projectiles. Face à l'importance des pointes de Byblos au PPNB, l'étape pré-Halaf (dénomination dans un sens large) est caractérisée par l'augmentation progressive des pointes de type Amuq pour lesquelles le soin et l'investissement technologique contrastent fortement avec le reste du contexte lithique de type clairement opportuniste. L'importance des pointes d'Amuq est manifeste dans l'ensemble des sites de cet horizon chronologique dans la zone nord-occidentale de la Syrie. Des particularités typologiques comme les pédoncules renflés été notées également à Bouqras et peut être à Nebi Mend (appréciation personelle d'après NISHIAKI 1992: 486, fig. 1). Un autre outil qui pourrait se convertir en indicateur culturel est constitué par les "corner thinned blades" proposés par Nishiaki, présents seulement dans la Jezireh syrienne et dans les régions proches, toujours avec une chronologie de la fin du IXème et du VIIIème millénaire B.P. Les "corner thinned blades" de tell Halula seraient les plus occidentaux trouvés jusqu'à présents, avec quelques exemplaires déjà observés dans le PPNB moyen et récent.

L'industrie lithique des niveaux datés entre 8000 et 7500 B.P. à tell Halula présente donc les caractéristiques générales des tendances observées sur les sites du VIIIème millénaire, moment qui serait caractérisé par des changements significatifs dans l'ensemble de la production des outillages lithiques. Les études détaillées portant sur les processus de changement qui ont eu lieu autour de 8000 sont encore rares et il y en a encore moins qui utilisent de manière détaillée les témoins de l'industrie lithique. En relation avec l'hypothèse proposée par Nishiaki (1993), il faut dire que, dans les niveaux considérés ici, la faune de tell Halula présente une diminution importante des animaux chassés et que la chasse reste limitée aux espèces qui pouvaient habiter dans le cadre naturel proche du site tandis que l'on observe simultanément une augmentation de l'importance de l'exploitation des animaux domestiques (M. Saña, comm. pers.). La diminution de la mobilité logistique qui en découlerait pourrait être une des causes ayant amplifié la diminution de la production laminaire. Les études en cours sur les autres variables socio-économiques ainsi que la poursuite de nos travaux de terrain vont sûrement permettre de proposer différentes hypothèses quant aux processus de changement.

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A Preliminary Report on the Flints from 'Ain Darat: a PPNA Site in the Judean Desert

Avi Gopher

Abstract: *The 1994 season flint assemblage is presented with characteristic el Khiam points, sickle blades (including Beit Ta'amir knives), Hagdud truncations and some microliths. A lithic comparison is introduced in a discussion of the assignment of PPNA assemblages to specific entities, the conclusion being that new data sets recently presented, including 'Ain Darat, emphasize how variable PPNA phenomena are.*

Introduction

The PPNA site of 'Ain Darat was discovered in 1982 by a team of the Archaeological Survey of Israel which was then surveying the Herodium Map to the north of the site (HIRSCHFELD 1985, GOPHER 1985: 20). It was revisited in 1993 and excavated in two short seasons in 1994 and an additional season in 1996.

The site lies at an elevation of 510m a.s.l. on a steep narrow ridge some 16km east of Hebron (Fig. 1). The scatter of finds covers an area of some 700-900m^2 and includes some 15 stone built structures and installations badly disturbed by robbers.

Structures were circular (3-4m diameter) built in natural bedrock basins or dug into sedimentary pockets on the rocky ridge. Walls were constructed of courses of small stone or massive blocks and were sometimes preserved up to one meter in height. In one structure a yellowish plastered (?) floor was exposed, while in other structures floors were on bed rock or consisted of a dark brown sediment.

Recovered finds include a rich variety of stone bowls, cupmarks on blocks, mortars and pestles and grinding slabs often bearing a central cupmark; green stone pendants; beads of a variety of materials; bone tools; faunal remains including sea shells; and of course, a rich assemblage of flint artifacts to be presented below.

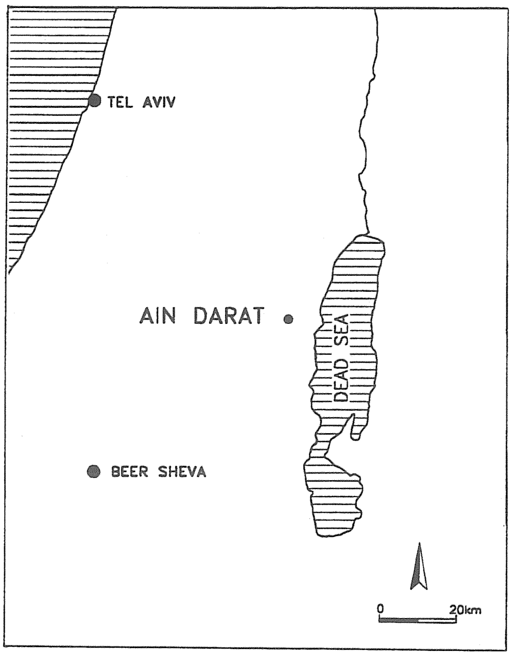

Fig. 1. General location map for 'Ain Darat.

This study relates to the 1994 recovered flint arti-facts only.

The Flint Industry

Debitage: Over 8000 debitage artifacts were collected (Table 1). Cores reveal no indication of bidirectional knapping; C.T.E. are mainly crested elements. The debitage is heavily dominated by flakes (>6:1 flake:blade ratio) and bladelets occur in only low numbers.

The presence of large straight blades knapped from bidirectional-opposed platform cores

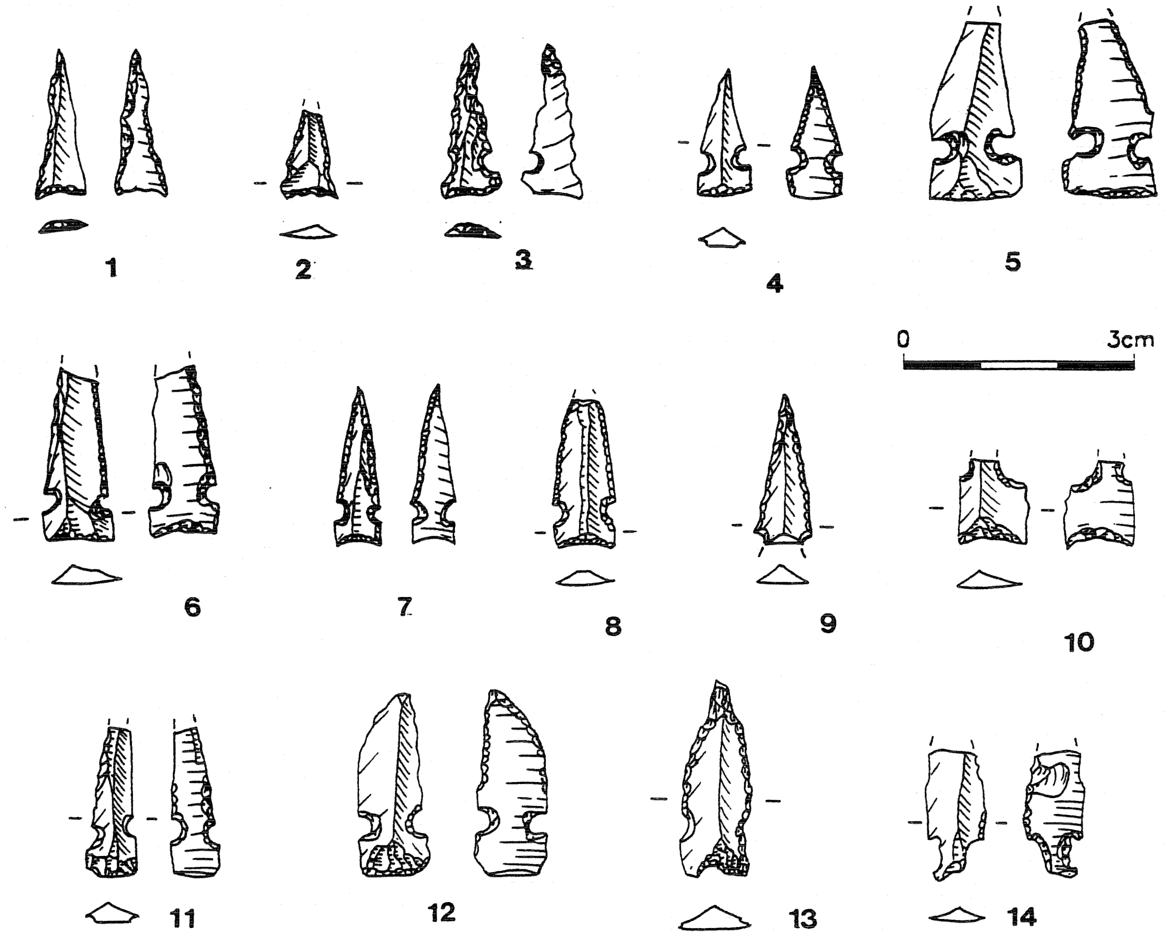

Fig. 2. 'Ain Darat. El-Khiam, Emeq Hayarden and Salibiya points.

Table 1. Debitage break-up by locus from 'Ain Darat 1994.

Loc.	Flake + Primary	Blade	Blad't	Blade Seg.	Core	Ridge Blade	Core Tab.	Plunge	Other	Burin Spall	Chip	Chunk	Tools	Totals
11	128	15	10	5	2	7	2	1	-	-	260	171	47	
12	221	20	2	-	6	2	2	-	-	4	195	218	34	
13	358	31	25	6	5	5	1	1	3	3	296	257	95	
14	188	8	7	7	7	3	1	-	4	1	165	190	33	
140	271	11	14	26	7	8	1	2	8	3	289	258	34	
15	798	58	53	37	15	20	2	3	1	9	912	763	155	
16	7	1	-	1	-	-	-	-	-	-	2	4	3	
17	5	5	-	-	-	-	-	-	2	-	2	3	3	
18	223	17	8	8	8	7	1	-	5	-	370	331	85	
26	15	3	-	1	-	1	-	-	-	-	5	19	6	
27	47	1	-	1	-	2	1	-	-	-	122	64	12	
50	203	34	19	-	3	1	-	2	3	-	229	188	43	
Tot.	2451	202	133	91	53	56	11	9	26	20	2842	2461	550	8905
%	27.5	2.3	1.5	1.0	0.6	0.6	0.1	0.1	0.2	0.2	31.9	27.6	6.2	
Surf.	165	21	15	-	8	3	1	-	1	-	71	93	71	449
%	36.7	4.7	3.3	-	1.8	0.7	0.2		0.2		15.8	20.7	15.8	99.9%

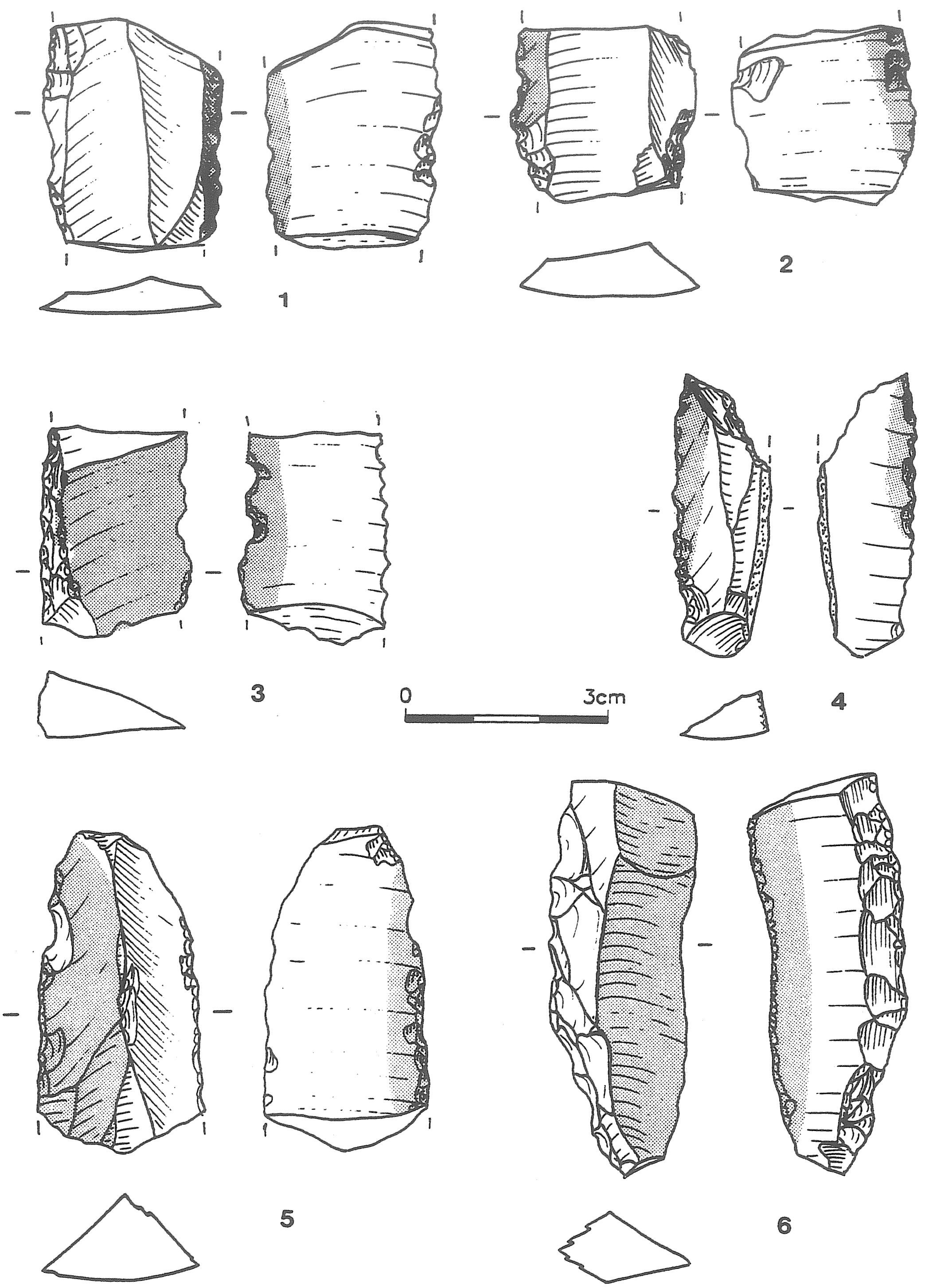

Fig. 3. 'Ain Darat. Sickle blades (Note the Beit Taamir knife No. 6).

(especially in the sickle blades group), and the fact that only one core (out of 53 excavated) has two opposed platforms may suggest that blades were imported into the site; however, this point has to be studied further. In any case, bidirectional-opposed platform knapping is marginally, if at all, present on site.

A sample of 550 shaped tools (6.2% of the total assemblage) was studied (Table 2), and it is dominated by retouched blades and flakes (36.9%), notches and denticulates (18.3%), and various fragments of retouched items classified as varia (15.3%).

The formal tools include arrowheads, mainly el-Khiam points (7.5% of the tools), sickle blades including a single Beit Ta'amir knife (4.7%); Hagdud truncations (2.6%); microliths, mainly retouched bladelets and a few backed items, but also single lunates (1.8%); awls and borers (6.6%); end-

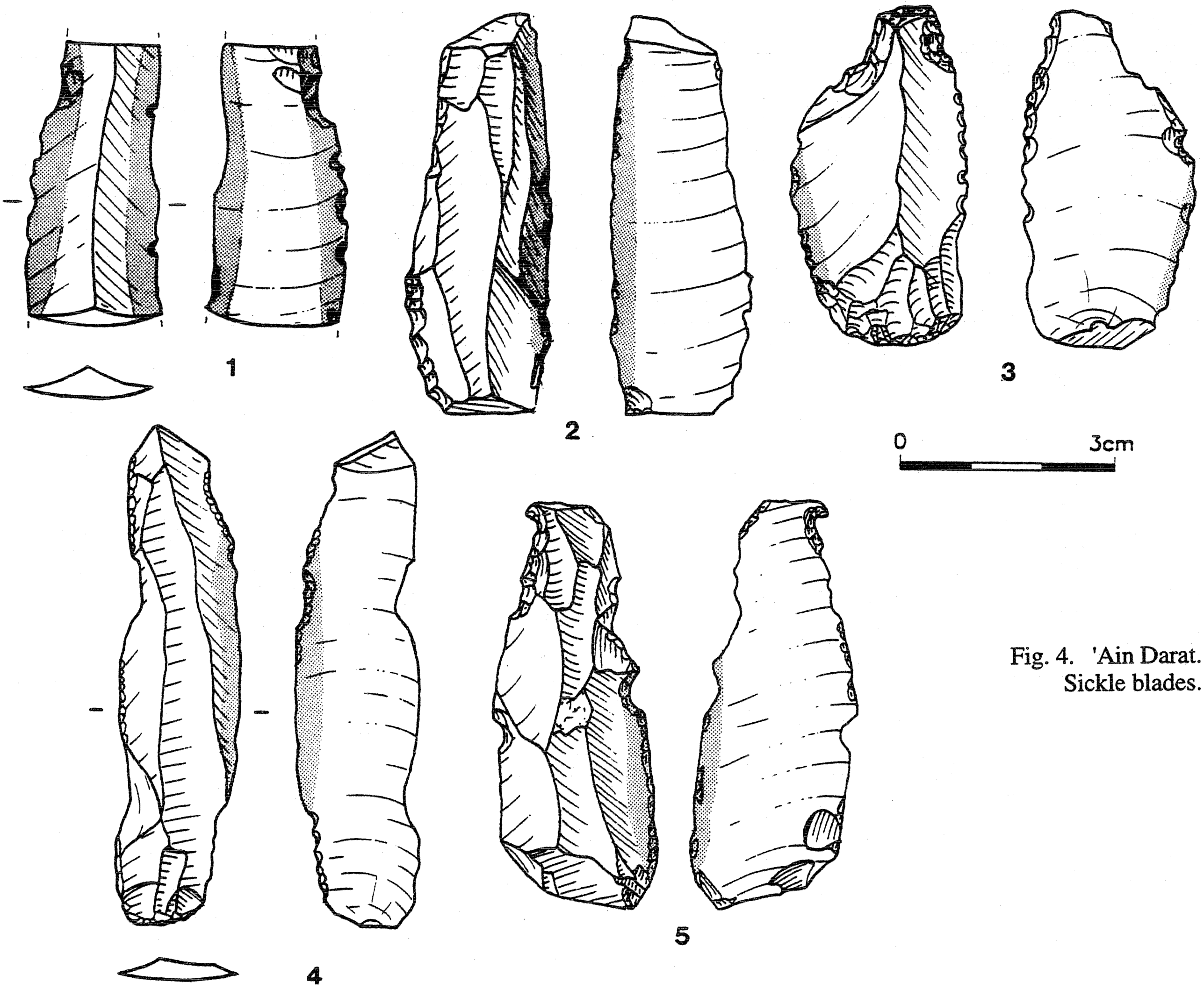

Fig. 4. 'Ain Darat.
Sickle blades.

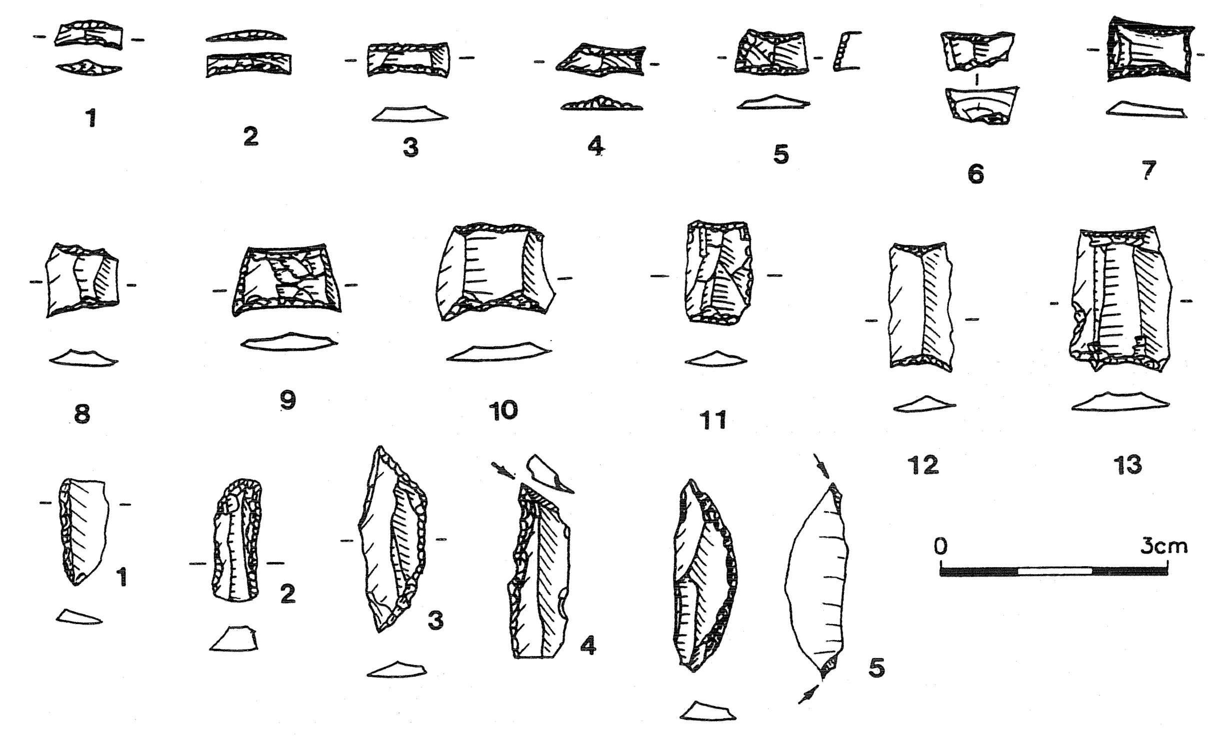

Fig. 5. 'Ain Darat. *upper* Hagdud truncations, *lower* microliths.

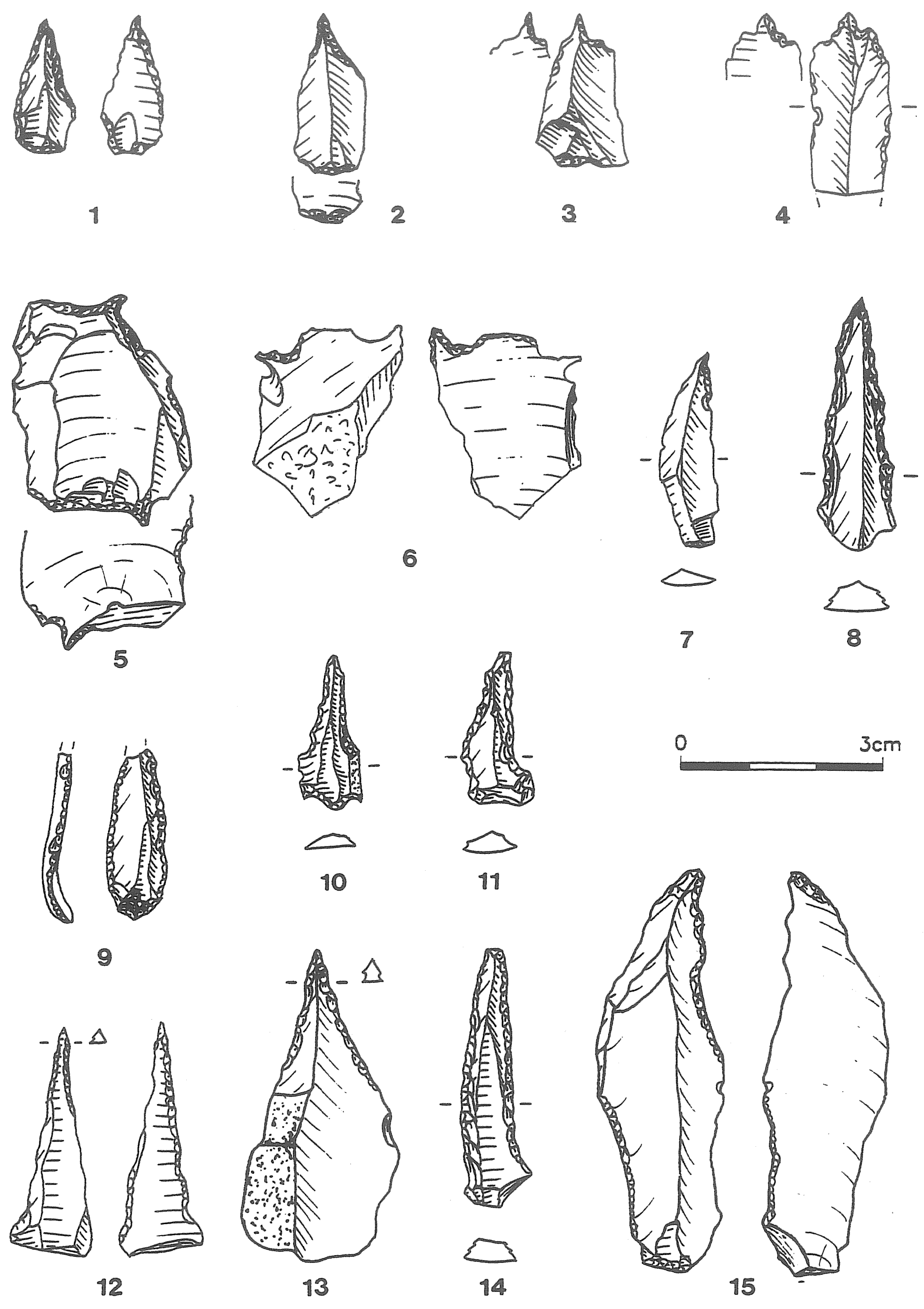

Fig. 6. 'Ain Darat. Awls and borers.

scrapers and truncated elements (5.1%); and burins (1.5%). A single doubtful pick/axe may be the only item in the bifacial group found till now, and it was on the surface (counted with the varia).

Characteristics among the implements are:

1. Arrowheads include mostly the el-Khiam type with a straight-concave base and bilateral notches (Fig. 2:3-13). Jordan Valley tanged points (Fig. 2:14) and Salibiya unnotched points (Fig. 2:1-2) appear in low numbers as in many other PPNA assemblages (NADEL *et al.* 1991).
2. Sickle blades are mostly slightly retouched, nibbled or plain on large wide blades (Figs. 3:1-5, 4:1-5) and show no hafting signs (bitumen ?). The single Beit Ta'amir knife (Fig. 3:6) is on a thick large blade and fully characteristic.
3. Hagdud truncations are varied in shape details (BAR-YOSEF *et al.* 1987, NADEL 1994), some

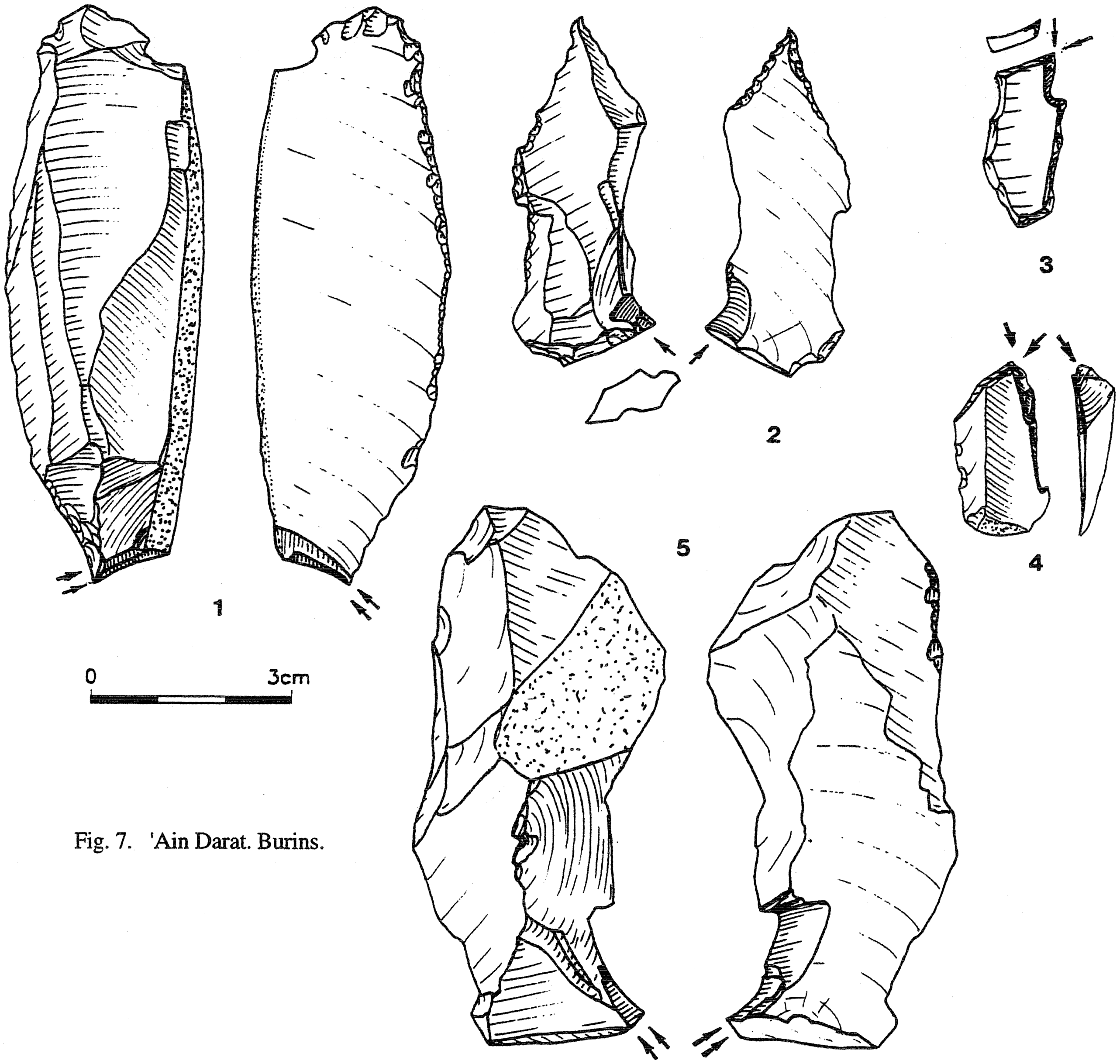

Fig. 7. 'Ain Darat. Burins.

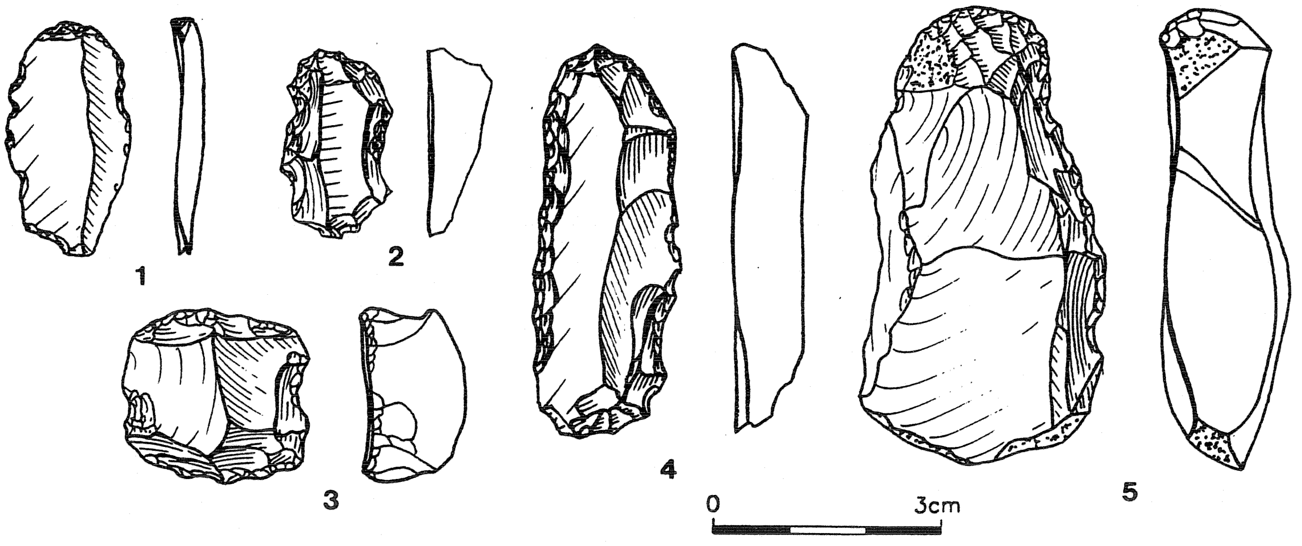

Fig. 8. 'Ain Darat. Endscrapers.

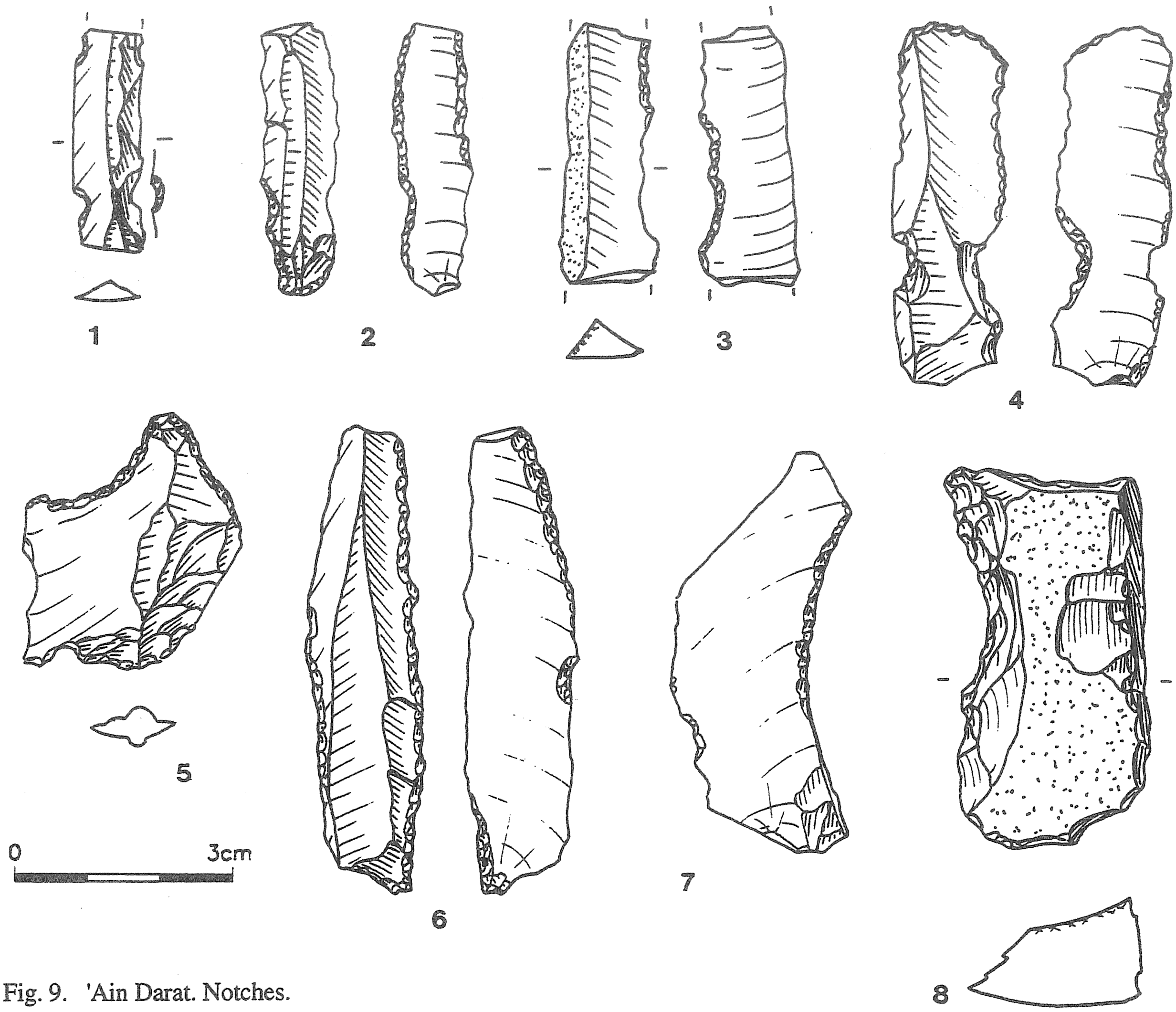

Fig. 9. 'Ain Darat. Notches.

Table 2. Tool types by locus from 'Ain Darat 1994.

Loc.	Arrow-head	Sickle Blade	Hagd. Trunc.	Micro-lith	Awl	Scraper	Trunc-ation	Burin	Notch	Denticu-lation	Ret. Flake	Ret. Blade	Varia	Total
11	-	2	-	4	4	-	1	1	7	2	4	10	12	47
12	1	2	-	2	-	1	1	-	4	3	1	17	2	34
13	15	6	2	1	6	6	-	1	10	3	10	21	14	95
14	2	1·	1	-	2	4	1	1	6	2	3	5	5	33
140	1	1	3	-	1	1	2	1	6	2	1	11	4	34
15	17	7	7	-	10	2	2	1	19	7	18	46	19	155
16	-	-	-	-	-	-	-	-	1	-	1	-	1	3
17	-	-	-	-	-	-	-	-	1	-	1	-	1	3
18	2	4	1	3	5	3	-	3	10	4	11	25	14	85
26	-	-	-	-	-	-	1	-	1	1	1	1	1	6
27	1	-	-	-	1	1	-		2	-	1	4	2	12
50	2	3	-	-	7	-	2	-	3	6	3	8	9	4
Tot.	41	26	14	10	36	18	10	8	70	30	55	148	84	550
%	7.5	4.7	2.6	1.8	6.6	3.3	1.8	1.5	12.7	5.6	10.0	26.9	15.3	100%
Surf.	2	3	-	2	3	2	2	-	10	14	8	17	8	71
%	2.8	4.2		2.8	4.2	2.8	2.8		14.1	19.7	11.3	23.9	9.8	99.8

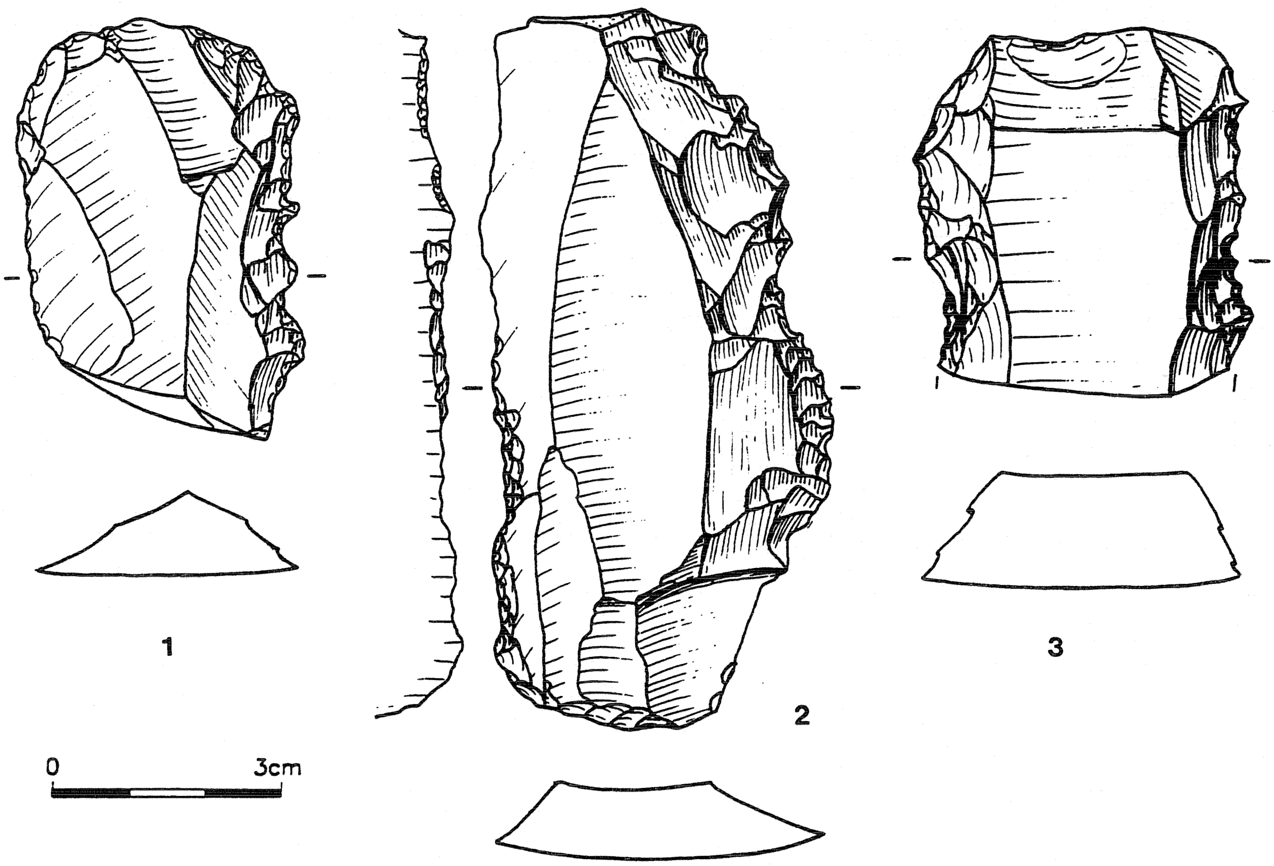

Fig. 10. 'Ain Darat. Denticulates.

being really minute in size (Fig. 5 top: 1-13). Gilgal truncations (NOY 1987) are not present.
4. Microliths are few and include backed and retouched bladelets as well as two lunates (Fig. 5 bottom: 1-5).
5. Awls and borers are varied and carefully made on blades or flakes (Fig. 6), while burins are few and carelessly shaped (Fig. 7), mostly on a break or a retouch.
6. Endscrapers are mostly made on flakes but on blades too (Fig. 8). Notches are abundant both on blades and flakes (Fig. 9) while denticulates include mainly massive items (Fig. 10).
7. Of interest is the total absence of polished items or bifacially flaked axes (except for one doubtful pick/axe). Axe spalls are absent too.

Discussion

The site of 'Ain Darat is located in steep rocky terrain overlooking a wadi confluence. It is not far (2km) from the springs of 'Ain Darat. Almost no soils are presently available around the site, the slopes being steep and heavily washed. The present vegetation is desertic and bears no trees at all and the arid characteristics increase sharply as one goes east towards the Dead Sea. To the west and north of the site, however, small valleys and plateaus offer richer soils and vegetation.

The site itself is spread along a narrow ridge and shows clusters of structures mainly in the eastern part. Deep sediments (in some cases of over 1m) as well as massive architecture and the composition of finds indicate a long term stay on-site. However, this cannot be confirmed before the faunal, botanical and environmental aspects are further investigated.

The sparse data we have on the inhabitants' economy include the fact that the small faunal assemblage (including mostly gazelle, hare and birds) was hunted. The relatively high percentage of arrowheads when compared to the PPNA of Jericho or Netiv Hagdud supports the assumption that hunting was an important activity at 'Ain Darat.

A large and rich groundstone assemblage, most probably used for processing vegetal foods provides the other face of the economy - namely gathering or harvesting of vegetal foods. Some botanical samples collected in 1996 may be of help in future reconstructions.

The assignment of the 'Ain Darat assemblage to the PPNA is quite clear although we do not yet have any radiometric dates. To which PPNA entity it is to be assigned is the question.

The presence of el Khiam points, microliths including lunates and the absence of bifacially flaked tools (or polished axes) favors a Khiamian assignment. However, the presence of Hagdud truncations, Beit Taamir knife and el-Khiam points tend towards a Sultanian assignment. This is probably too simplistic and hopefully we shall be able to refine on this using both radiometric dates and other data sets.

Table 3. Tool type frequencies for selected PPNA flint assemblages *<notes for Table 3 see below>*.

	'Ain Darat	Gesher	Irq ed-Dubb PPNA	Dhra Unit 1	Salibiya IX	Netiv Hagdud
Microliths	1.8	4.7	+	-	13.3	12.9
el Khiam points	7.5	7.9	11.0	53.2	22.3	3.0
Sickle blades	4.7	7.9	- ?	1.2	3.3	4.0
Beit Taamir	+	-	- ?	- ?	-	+
B'fac. fl. tool	-	5.5	- ?	1.8	-	3.7
polished	-	-	- ?	+ ?	-	+
Awl-Borer	6.6	15.0	+	18.2	16.1	18.3
Hagdud tr.	2.6	3.1	51.2	-	-	1.6
N	**550**	**127**	**154**	**165**	**211**	**4058**

1. Percentages are calculated for each type from the whole assemblage of shaped tools.
2. El-Khiam points is a general term to include all point types (el-Khiam, Emeq Hayarden, Salibiya).
3. Microliths at Gesher include both geometric ones and retouched or backed bladelets.
4. Bifacially flaked tools include picks for Gesher.
5. Iraq ed-Dubb data are taken from KUIJT 1994: 2 and come from one sealed PPNA 1x m unit.
6. Salibiya IX data are after BAR-YOSEF 1980. The final report with all details is not dissimilar in relative frequencies for tool-types.
7. Netiv Hagdud microliths include geometric and non-geometric microliths, some of which were interpreted as intrusive (BAR-YOSEF *et al.* 1991)
8. Where details were missing a question mark was made.

Nevertheless, a short comparative example of flint tool-type frequencies seems to be in order here. The recently excavated and published PPNA sites of Gesher (GARFINKEL and NADEL 1989) Irq ed-Dubb (KUIJT 1994) and Dhra (KUIJT) augmented by the compositions of Netiv Hagdud Sultanian (BAR-YOSEF *et al.* 1991) and the Salibiya IX Khiamian (BAR-YOSEF 1980) show a composition of flint tool types which may be confusing both in respect to entity assignment and in translating it to economic activities.

The presentation of 'Ain Darat with the other sites mentioned in Table 3 (as well as additional ones) demonstrates the variability of PPNA manifestations. Considering the fact that the PPNA lasted for some 1000 C-14 years (uncalibrated) and witnessed major socio-economic post Natufian change, variability should not come as a surprise. The later part of the PPNA (8000 uncalibrated B.C. and onwards) has recently demonstrated a variety of settlement types beyond the major, well known, large tell sites and these must be incorporated into our reconstructions their specific characteristics accounted for. Flint tools represent only one facet of this variability and other sets of data will surely appear too.

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Remarks on Taxonomy and Related Questions of Neolithic Chipped Stone Industries in the Fertile Crescent, as Related to Their Contemporaries in the Adjacent Regions[1]

Hans Georg K. Gebel and Stefan K. Kozłowski

The Early Neolithic of the Fertile Crescent (Neolithic in Gordon Childe's sense), which started to develop by the second half of the 9th millennium bc (beginning *c.* 10,000 cal. BC), was surrounded by provinces (hereafter: "border zones") characterized by environments different from those in the Fertile Crescent, in which Epipalaeolithic/ Mesolithic economies and styles of lithic traditions continued to exist. It is the concept of this contribution to contrast -in general terms- the lithic traditions rapidly developing inside the Fertile Crescent (hereafter: "core areas") as a consequence of rapid changes of subsistence patterns with the neighbouring, persisting late Epipalaeolithic/ Mesolithic lithic traditions in the "border zones". This concept considers the Fertile Crescent as the engine driving lithic traditions to change, or to interact in some areas and some periods, in the adjacent "border zones". However, we would like to emphasize that this should not support "Fertile Crescent-centric" research attitudes; too much evidence has to be expected for "retarding" traditions entering again core areas wherever the Neolithic developments urged "late Pleistocene adaptions" (for more arguments, see also "Why Identify Lithic Traditions?" by BAR-YOSEF, this volume). Moreover, we believe that this perspective - an outside view of lithic tradition developments in the Fertile Crescent - helps us to see these developments in relative rather than "centric" terms, providing an additional source of understanding of Near Eastern Early Neolithic phenomena and technotaxa (see below). Certainly, Near Eastern Neolithic research has to admit that little knowledge and even less consideration of the "border zones" was involved in the qualifying developments of here. Thus we stress the need for such outside views.

The following considerations use results from the "border zones" presented in this volume: the Early Holocene hunter-gatherer industries of southeastern Europe (J. KOZŁOWSKI), the Caucasus (KOROBKOVA) and Trans-Caspia (MASSON), NE- Africa (KOBUSIEWICZ), and the late (mostly post-6,000 bc) "Early" Neolithic industries of the same regions (J. KOZŁOWSKI, SZYMCZAK, MASSON, and KOROBKOVA).

Early Holocene Hunter-Gatherer Industries in the Border Zones

Hunter-gatherer industries are present in Egypt, Nubia, Libya, the Balkans, Caucasus, northern Iran, Trans-Caspia, but also in southern and Central Anatolia, where they seem to continue beyond the 9th millennium bc without any pronounced or abrupt changes of the local Late Pleistocene lithic traditions (Fig. 1). They include:

1) The numerous hunter-gatherer industries in Egypt, Nubia and Libya (*cf.* KOBUSIEWICZ, this

[1] This contribution does not intend to summarize workshop results nor to comment on them. It is more a "programmatic" contribution to promote further the "taxon approach" as offered in KOZLOWSKI and GEBEL 1994. The authors are aware that two problems are involved in this contribution: that of the use of uncalibrated radiocarbon dating (for the problematics see EVIN 1995) and a degree of generalization that cannot cope with the actual complexity of the expectable interaction spheres. The latter (e.g., Figs. 2-4) resulted in mapping just the core areas, and not what appears as "satellite occurrences" flourishing under similar conditions outside them (for example, the Mount Catherine area in the PPNB of southern Sinai). The use of the "radiocarbon calendar" not only has to do with some persistence or even doggedness of us prehistorians, it also results from the availability of firmly discussed calibrated settings of the periods. No doubt, we need to work with "real years", and certainly this will considerably change the relative chronological insights we currently have.

volume) are mostly characterized by varying backed bladelets/ points and short flake endscrapers; in some respects they are close to the Near Eastern Natufian and Zarzian. These Near Eastern industries developed into the PPNA and M'lefatian. (*cf.* S.K. KOZŁOWSKI, BELFER-COHEN and GORING-MORRIS, this volume), while in northeastern African (called "Epi-Palaeolithic") they diverged in other directions. The great internal taxonomic diversification of NE African industries could perhaps be partly due to the more analytical approaches to materials by the American and Polish scholars or the quality of the excavated material, but it could be also the result of environmentally caused isolation of social territories. It may happen that in the future this also must be realized for Near Eastern materials (after the publication of well-dated assemblages presented layer by layer). It will probably appear that the Zarzian, M'lefatian, Khiamian, or Nemrikian had their local variants (industries), as we already know that of the PPNB industries ("Big Arrowhead Industries"[1]). The local styles survived here beyond 6,000 bc.

2) The situation in southeastern Europe in the Early Holocene is in some ways similar to those in northeastern Africa. There is no visible change of the lithic style at the beginning of the Early Holocene (J. KOZŁOWSKI, GATSOV, this volume), but rather a prolongation of local Upper Palaeolithic Epi-Gravettian traditions into the Mesolithic/Epi-Palaeolithic (in the European sense) stage, which lasted until the Middle Holocene. This Mesolithic phase has its local variants. Stylistic changes emerged only slightly before or at 6,000 bc with new pressure technology, trapezes and retouched/ notched regular blades (see below).
3) The phenomenon of local, smooth continuity from the late Pleistocene to the Early Holocene industries appears also in southern Anatolia, where the local "Gravettian" (close to the Balkan Epi-Gravettian?) industry of the Kara'in - type continued in the Early and Middle Holocene sequences of Öküzini (ALBRECHT 1994; BAR-YOSEF, pers. comm.), Beldibi and Belbaşi . The same has been reported from the Konya Plain (BAIRD, pers. comm.; BALKAN-ATLI 1994).
4) In the Caucasus, Transcaspia, northern Iran, northeastern Anatolia and Crimea, developed industries that belong to the stylistically separate Caucasian-Caspian province existed from the Late Pleistocene (from the 10th millennium bc) into the Early Holocene (c. 6,000 bc). These industries (Trialetian, Choch, Dam-Dam-Cheshme, Belt; *cf.* S.K. KOZŁOWSKI and MASSON, this volume) did not change very much around 8,000 bc, and disappeared slightly before 6,000 bc, changing locally (eastern Anatolia) into the "Big Arrowhead Industries" (PPNB, *e.g.* Cafer Höyük *ancien*). In the Crimea this happened before 7,000 bc. In Anatolia they are known from Hallan Çemi (ROSENBERG 1994).
5) Except for some already mentioned (see above) and well known resemblances of early industries from northeastern Africa and the southern Levant (Arkinian *viz.* Natufian, the presence of Helwan crescents in the Nile Delta), as well as the later connections (Helwan arrowheads of the Nile Delta *viz.* EPPNB, *cf.* articles by GOPHER, ROLLEFSON, and SCHMIDT, this volume), the present volume adds new data to our knowledge: Harif points appear in early Neolithic sites of eastern Sahara (M. KOBUSCIEWICZ, this volume). The same is true for the triangles found in the same region (KOBUSCIEWICZ, this volume). We can observe direct ties between the eastern Sahara and the Nile Delta with Sinai and the Negev, *i.e.*, with Mushabian and Harifian traditions.
6) Similar phenomena can be noted in the north, from where the interregional borders are crossed by different exotic elements, *e.g.*, Trialetian geometrics arriving in Zawi Chemi, in early Neolithic sites of the Zagros and in Nevalı Çori (SCHMIDT 1994).
7) Summing up the information gathered above and adding the information from the Fertile Crescent, we obtain a very diversified picture of the adaptations or stylistic changes occurring in the eastern Mediterranean and Pontic-Caspian regions at the end of the 9th and the beginning of the 8th millennium bc (Fig. 2):

Changes in the Near Eastern core zones are more pronounced than in the border zones:

- The most pronounced changes happened in the Levantine strip, where the local backed bladelet/ short endscraper Natufian industries changed rather abruptly into the Khiamian. This change was mostly stylistic (replacement of crescents by Khiam points, *cf.* BAR-YOSEF, and BELFER-COHEN and GORING-MORRIS, this volume).
- Less pronounced changes could be noted for the Zagros region, where changes mostly occurred with the technology (Post-Zarzian into M'lefatian; *cf.* KOZLOWSKI, but different in opinion by OLSZEWSKI, both in this volume).
- In the surrounding provinces changes did not appear at this time; they came much later and rather slowly, such as the industries of Balkan Epi-Gravettian, "Gravettian" industries of Konya and Antalya regions in Anatolia, east Anatolia, and the Caucasia and Transcaspian Mesolithic units. Northeastern Africa did not follow this pattern at all.

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1 The term "Big Arrowhead Industries" is used here (*cf.* also KOZLOWSKI n.d.) instead of "PPNB industries" after we unsuccessfully searched for a better term that describes this techotaxon without the burden of cultural characteristics.

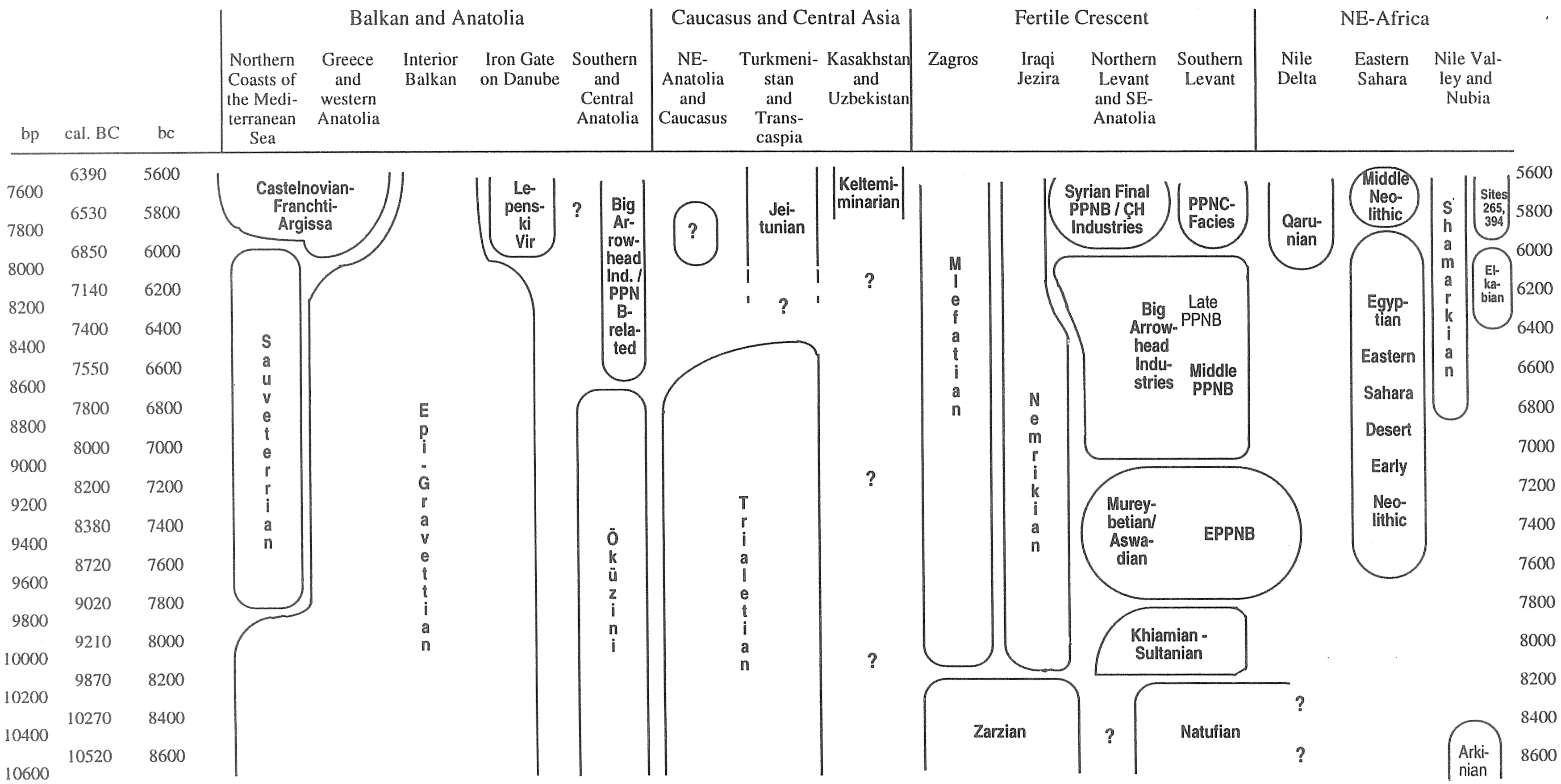

Fig. 1. Chronological chart of the Circum-Fertile Crescent and Fertile Crescent taxa from the Late Epipalaeolithic to the Early Neolithic (mid 9th - mid 6th millennium bc). *<Note: The Kelteminarian is not yet dated by radiocarbon dates; thus it is placed in the graph on the basis of its expected relative chronological position. All dates are approximate.>*

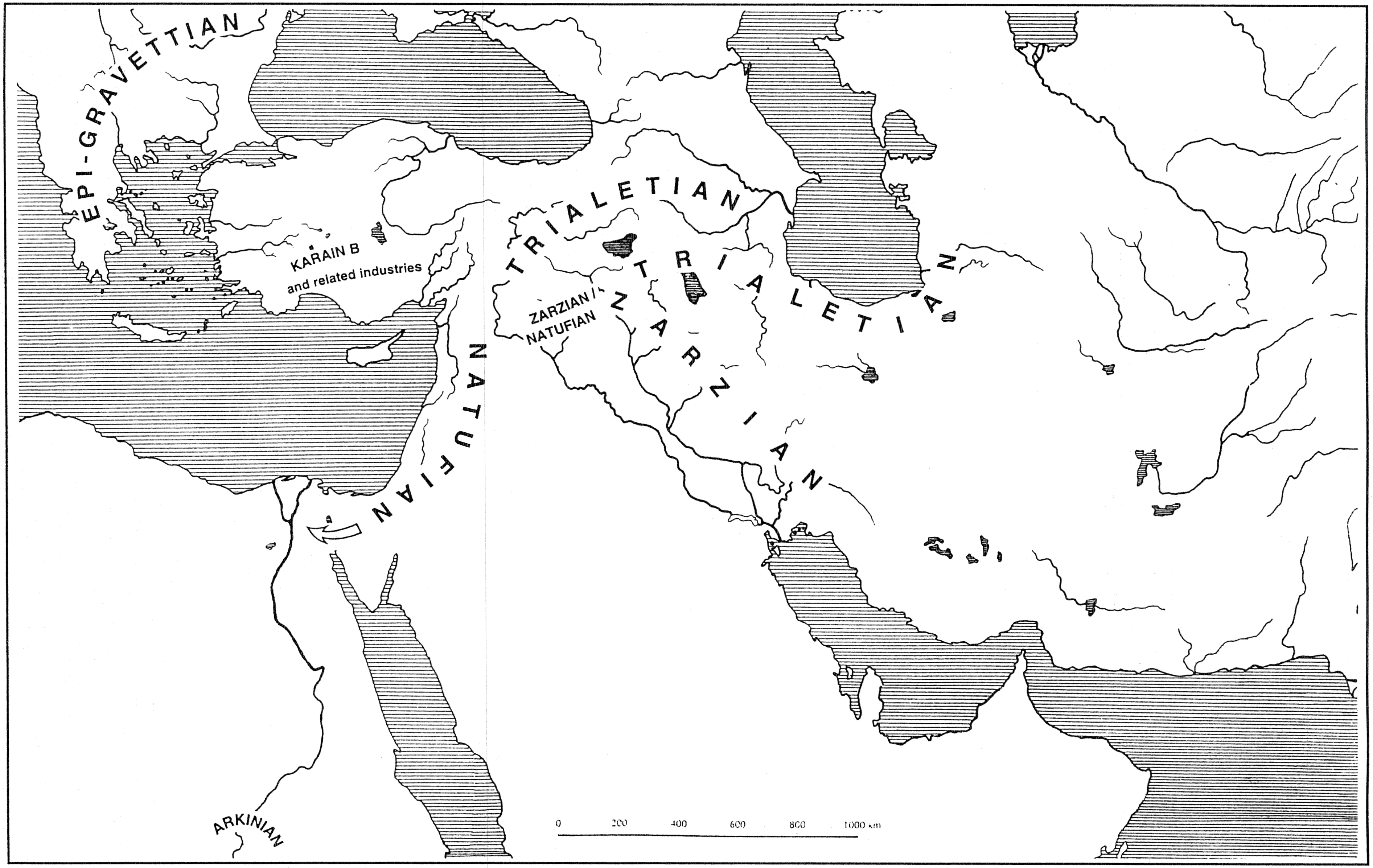

Fig. 2. Geographical distribution of lithic traditions in the 9th millennium bc.

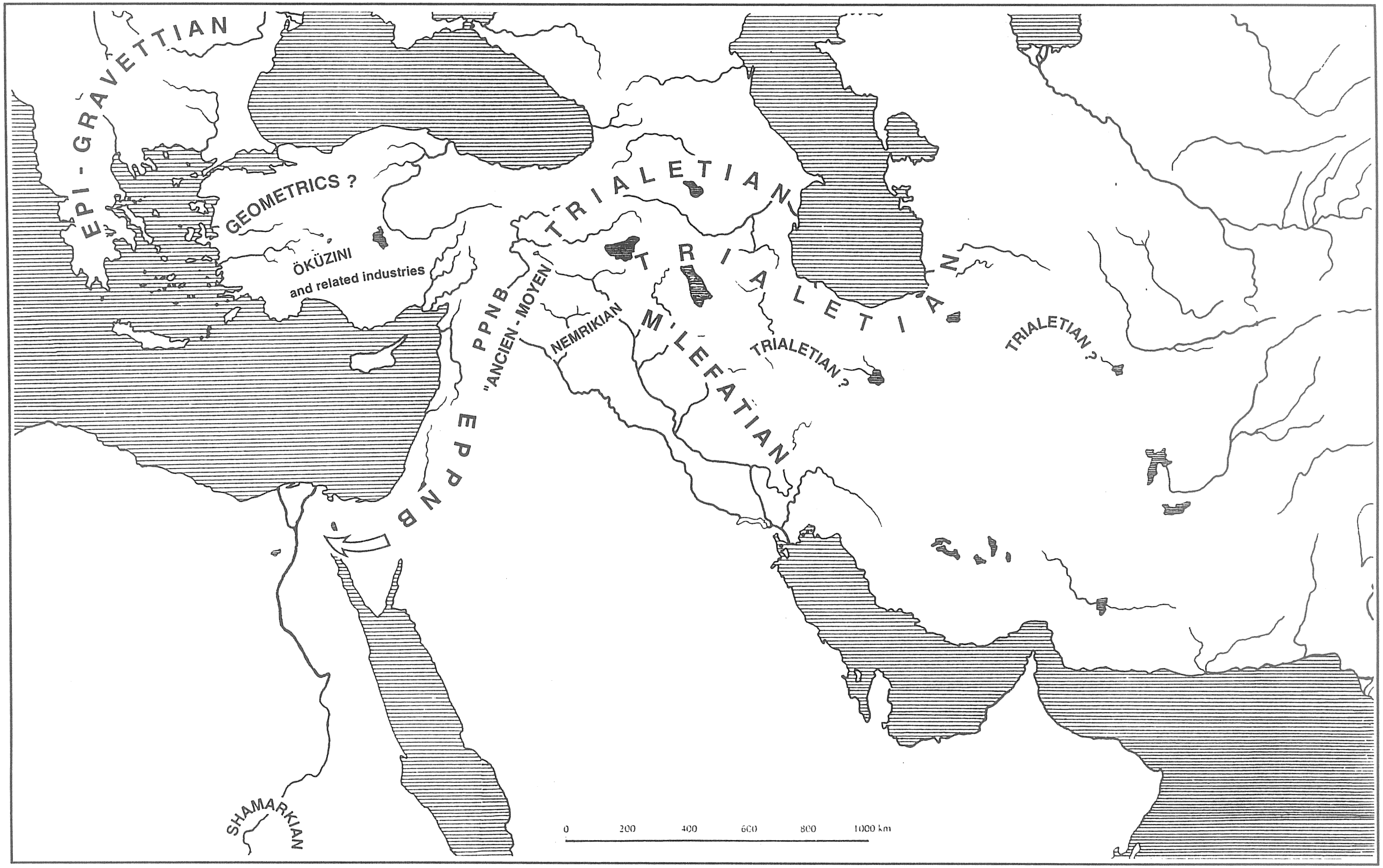

Fig. 3. Geographical distribution of lithic traditions in the first half of the 7th millennium bc.

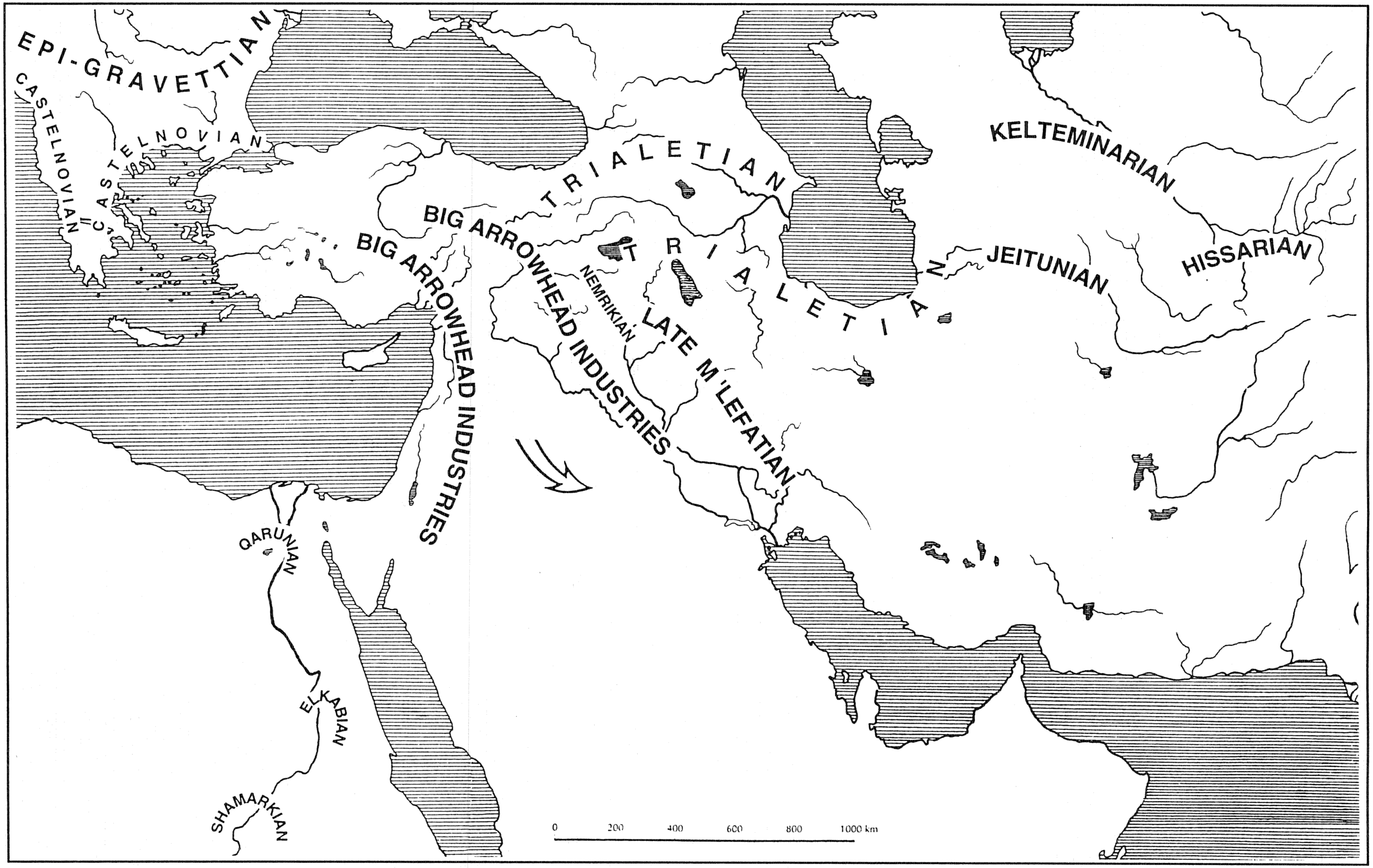

Fig. 4. Geographical distribution of lithic traditions between the late 7th - mid 6th millennium bc.

Late Mesolithic, Pre-Neolithic and Late "Early" Neolithic Industries

As mentioned above (J. Kozłowski), new industries appeared slightly before 6,000 bc in southeastern Europe, Crimea and western Anatolia, characterized by core preparation techniques, pressure techniques in core reduction, regular blades, microburin technique, trapezes and retouched or notched blades, and retouched truncations. They mainly occupied the coastal strips of the northern Mediterranean (slightly later also in Italy, France, Spain, and Portugal) and were mostly Mesolithic / Pre-Neolithic, constituting the group of so-called "Castelnovian" industries. In some regions they could also be late "Early" Neolithic (Franchthi, Argissa, both in aceramic variants). The phenomenon of trapezes appeared at the same time (c. 6,000 bc) in the east (M'lefatian in the Zagros, Jeitunian, Kelteminarian, some eastern variants of the "Big Arrowhead Industries"/ PPNB; HOLE 1994; KOZŁOWSKI 1994; MASSON, KOROBKOVA, SZYMCZAK, this volume).

Changes also appeared in the northeast, in the Caucasian-Caspian province (*cf.* MASSON, KOROBKOVA, SZYMCZAK, this volume), where the older Trialetian was replaced (probably slightly before 6,000 bc) by new industries such as the Kelteminarian/ Hissarian and Jeitunian of Central Asia. The new industries developed from the Trialetian and related industries. They were based on the new (in this region) pressure technique of core reduction, and resembled in many respects the earlier M'lefatian industries of the Zagros region (HOLE 1994, KOZŁOWSKI 1994). Could they be the results of a M'lefatian influence from the Zagros region?

This phenomenon is comparable to the territorial development of the PPNB/ "Big Arrowhead Industries" in eastern and Central Anatolia (replacement of Trialetian and other local industries), as well as the territorial expansion of the trapeze industries described above (earlier in Greece and Crimea, later in Italy, Swiss, southern Germany, France and Iberia).

Considerable research efforts need to be invested into the Early Holocene Research of the Arabian Peninsula. There do exist industries that resemble PPNB technotaxa (ZARINS 1998, Qatar D), but the exciting topic of an eastern Arabian PPNB has not attracted yet the scholars. A later phenomenon, probably starting shortly after 6,000 b.c. is a foliate horizon in the arid fringes of the Fertile Crescent, extending from the Omani Peninsula (GEBEL 1984) via the Gulf coast to southern Mesopotamia, Palmyra as far down as Kilwa; it seems to have developed from PPNB connections.

The Fertile Crescent

There is still some uncertainty concerning the subdivision of the so-called PPNA industries of the Levant (*cf.* GARFINKEL, this volume). It seems that they were more diversified than expected (*cf.* 'Ain Darat, GOPHER, this volume; *cf.* also the new publication on Netiv Hagdud [BAR-YOSEF and GOPHER 1997]) and spread more to the north (El Aoui Safa by COQUEUGNIOT, this volume; Mureybet II) and the east (Qermez Dere [BETTS 1994]). Did it exist also in the eastern Anatolia (*cf.* the "EPPNB" phase in Çayönü [CANEVA *et al.* 1994])? All this means at least that Khiamian industries were not only diverse in the south (chronologically and/or functionally, *cf.* also NOY and KOZŁOWSKI on Gilgal I, this volume), but they may have also had several local variants in the north (except for the Qermesian in northern Iraq and the Mureybet II industry on the Middle Euphrates).

There appears in this volume a definition of a cultural/ stylistic phase recognized as the EPPNB (GOPHER, ROLLEFSON, this volume; GEBEL, communication on Ail 4 during the workshop). It seems that there existed a phase that separated the classic PPNA (Khiamian/ Sultanian) phase from the Tahunian (classic "Big Arrowhead Industries"). This evolutionary step is known from the northern Levant under the designations Murebetian and Aswadian, and it is also represented in basal Çayönü, for which the dates are very early: middle of 8th millennium bc); in southern Israel, Jordan, and also as far as Helwan in Egypt (*cf.* SCHMIDT, this volume) it seems to be later. However, the "Early PPNB" discussed in this volume might not mean it is the same as the "PPNB *ancien*" of the French authors in the north.

After new excavations and analysis, the taxonomic situation for the Neolithic of the Near East has become more and more complicated, and the old static PPNA-PPNB model does not seem flexible enough to serve further. It appears that similar names do not mean the same anymore. For the future it would be perhaps more useful to change the classical but hermetic system (PPNA-B-C - sequence) into a more open one using more local or neutral names.

New facts are also coming from the PPNB context. Halula on the Middle Euphrates gives us new material of the "PPNB *moyen*" (*cf.* MOLIST and FERRER, this volume, similar to those of Djadé [COQUEUGNIOT 1994]). New studies on Çayönü (*cf.* CANEVA, LEMORINI, and ZAMPETTI 1994 and in this volume) give us a better understanding of the local east Anatolian sequence, which is still very inadequately dated. It is a pity that both mentioned articles on Çayönü have only very few figures.

After all these new data, we would suppose that the development and spread of the so-called

"Late PPNB" at the end of the 7th millennium bc was based on different local backgrounds (*cf.* basal Çayönü with points with concave base, Cafer "*ancien*" with Trialetian geometrics, Asikli Höyük with its geometrics, Umm Dabaghiyah and Magzaliya with Nemrikian points, etc.), and it was probably the result of an interregional spread of ideas rather than actual migrations of populations, as suggested by J. Cauvin.

Other important aspects of the PPNB are presented by Schmidt on Nevalı Çori in this volume, by Gebel on craft specialization in Basta, and by Quintero on the flint quarry of 'Ain Ghazal. This last discovery, coming after Wolfgang Taute's study (TAUTE 1994), introduces us to the highly organized raw material procurement in the Early Neolithic that has included obsidian, quartzite and even limestone.

New data also come from the Syrian Jezira, where F. Hole, among others, found Nemrikian material from the Khabur River basin, as well as some local pre-Neolithic flints. They could serve to establish the border zone of interaction of Levantine and Iraqi-Iranian provinces, which might be localized between the Khabur and Balikh rivers.

New data on the Iraqi-Iranian province concern the technology of core reduction, also studied experimentally by Phil Wilke (this volume). This is completed by the contribution of E. Hildebrand on the Zagros cores (this volume; *cf.* also RAFIFAR; this volume, and INIZAN and LECHEVALLIER 1994 and GEBEL 1994).

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