Studies in Early Near Eastern
Production, Subsistence, and Environment 1

Neolithic Chipped Stone Industries of the Fertile Crescent

edited by

Hans Georg Gebel
and
Stefan Karol Kozłowski

Berlin, *ex oriente* (1994)

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

Seminar für Vorderasiatische Altertumskunde,
Free University of Berlin, 29th March - 2nd April, 1993

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gedruckt mit finanzieller Unterstützung der / *Printed with the financial support of*

Ständige Kommission für Forschung und wissenschaftlichen Nachwuchs (FNK)
der Freien Universität Berlin

Ernst Reuter- Gesellschaft der Förderer und Freunde
der Freien Universität Berlin

Studien zu Produktion, Subsistenz und Umwelt im frühen Vorderasien 1
Studies in Early Near Eastern Production, Subsistence, and Environment 1

Die Reihe wird z.Zt. von Hans Georg Gebel und Reinder Neef herausgegeben für
A series currently edited by Hans Georg Gebel and Reinder Neef for

ex oriente e.V. *Produktion, Subsistenz und Umwelt im frühen Vorderasien,* Berlin

ex oriente e.V.
c/o Seminar für Vorderasiatische Altertumskunde
Bitterstr. 8-12, D - 14195 Berlin
Fax Berlin 8314252 and 7959937

Printing house: Zakład Graficzny, Uniwersytet Warszawski
ul. Nowy Świat 4, PL – 00–497 Warszawa
Zam. 493/94

ISSN 0947-0549
ISBN 3-9804241-0-3

Contents

Northern Syria

Central and Southern Levant

Editors' Concluding Remarks

* Contribution not hold as lecture during workshop.

Research Cooperation and Goals in Near Eastern Neolithic Chipped Industries

Preface[1]

Hans Georg Gebel and Stefan Karol Kozłowski

For the first time Near Eastern prehistoric research had arrived at the point where an international meeting needed to be devoted exclusively to a single artefact group from one period, that of the Pre-Pottery Neolithic (PPN) chipped stones of the early Fertile Crescent. The aim of the workshop was to avoid any more partial and fragmentary approaches in a field which today requires a comprehensive taxonomic review of the chipped lithics interaction spheres. At the same time a forum is also needed for differing views on isolated regional traditions. Research in the Pre- and Pottery Neolithic chipped industries has intensified more than any other field of prehistoric research in the Near East. As a result, even terminology is in danger of developing disparately in a community consisting of at most 50 active specialists, who are however isolated in many different institutions around the world. From the outset, stimulated by the intriguing questions and results concerning earliest sedentary life and productive management of food resources, chipped lithic typology provided the relative chronological backbone for large, problematic yet nonetheless rapid achievements in mankind's development; sedentarism, domestication of cerials and vegetables, the domestication of ovicaprines, cattle and pigs as well as water management by lowland irrigation techniques were all achieved within four millennia.

Chipped lithic industries are generally valued by non-flint-specialists only in terms of serving the understanding of the cultural sequences, although they do also tend to be seen as merely an artifact class like any other, even if bit more analysis-intensive. However, even among we flint specialists, PPN chipped lithic industries are rarely recognised as having guided the "high-tech" developments in craft specialization. But the aforementioned achievements can hardly be expected to have taken place without the innovative background and constant stimulation of craft specialization associated with flint technology. The PPN adaptions in flint exploitation, standardized core reduction techniques and workshop organization, as well as standardized, single-function tools in specialized tool kits, etc., certainly illustrate what Peder Mortensen described as the "domestication of flint"[2]. More than with any other artefact or tool class, we can trace in the PPN chipped flint industries the earliest processes of specialization in craftsmanship which were the first steps towards the mass production of consumer goods. These industries paved the way for the inter-regional and long-distance exchange patterns which developed from the large "sub-urban" communities during the latter half of the 7th millennium BC. We can also trace the reversal of these processes wherever the environmental and thus economical basis of such communities changed, e.g. to a more mobile way of life with fewer and different needs in specialization.

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1 This introduction partly represents the opening address to the workshop participants by Hans Georg Gebel and Stefan Karol Kozłowski.

2 P. MORTENSEN, A note on a small f box with flint blades and arrowheads from Beidha and its implications. In: A.N. GARRARD and H.G. GEBEL (eds.), *The Prehistory of Jordan. The State of Research in 1986. British Archaeological Reports - International Series* 396.1 (1988): 199-207. Oxford, B.A.R.

In 1991 Stefan Kozłowski had aproached Hans Georg Gebel with a suggestion: the chipped lithics research community should gather as soon as possible to discuss and settle crucial issues associated with analysis methods, terminology and taxonomy. His successful experience with workshops on the European Mesolithic[1] led us to propose something similar for the Pre-Pottery and Pottery Neolithic of the Near East. The overwhelmingly positive response to an initial circular gave us the confidence that we were on the right track.

Some years earlier H.G. Gebel had already approached several colleagues working in PPN Jordan to try and agree on analysis standards and terminology in PPN chipped lithics production, before some of the final publications in preparation are printed. Even for such a small region and issue, he found that the terms and standards which appeared to be of common useage had different meanings to different people. Normally, this would not have been recognized without intensive personal data exchange, comparison and interpretation, whilst handling the original artefacts. Besides these communications difficulties, we are also able to recognize today that considerable technological and morphological differences and traditions can be apparent within single periods. This is particularly true of intensively researched areas such as the Southern Levant. Both these aspects -the type of communication amongst ourselves and the current increasingly differentiated data from throughout the region- are liable to cause a research disaster if we do not use the opportunity the Berlin workshop provided, to at least begin to reach agreements and start practising closer cooperation and communication.

Certainly we went to this workshop accustomed to different modes of evaluation and with approaches influenced by varying schools of thought. Furthermore, our personal backgrounds and experience also differ considerably. There are the "generalists" and the "regionalists" among us, the "measurementalists", the "true typologists" and the "functionalists"; the "Franco" and the "Anglo-Saxon" schools, even those who like computers and those who don't. Shouldn't we look at recent developments honestly enough and admit that we have become "divorced" rather than "wedded" within "the more general field of lithic analysis" (Ofer Bar-Yosef)? Despite being a very small group of isolated specialists, we even tend to split ourselves further into much smaller research units.

We need not recapitulate PPN lithics research history here. The current state of the art however, is such that each of us is burdened with masses of material from an increasing number of sites. We are in a period in which ever more numerous "type site" final reports create a steadily growing number of standards. But the time demands on each of us for data management and presentation, caused by intensified levels of parameter evaluations[2], besides the intriguing and lovely morpho-technological details, prevent us in the main from seeing beyond our own individual research tables. On top of this, we barely have time to read carefully the growing number of publications and the increasingly numerous theses.

It is at this current stage of research development that we have to remind ourselves to reconsider general work strategies. On the material level this implies e.g. concentrating on *chaîne opératoire*-approaches. On a general level, in our view, this implies reevaluating the general techno-morphological developments in the Fertile Crescent, both in terms of primary and secondary lithics production, by stressing and isolating regional departures to this hypothetical general trajectory. Additionally, we have to describe precisely the current terminological difficulties, to prepare a list of the major categorisation problems to be initially solved, to discuss basic standards of primary and secondary classification, and to adopt consensus on metric analysis procedures. The Berlin workshop was instrumental in starting to deal with these issues and helped the will for a common approach to the most urgent analytical and terminological issues, including plans for a lithics dictionary. Suggestions were made, agreements arrived at, and an agenda was set for continued cooperative research.

The Berlin meeting was the first of a series of workshops to be held biannually. Invitations have already been extended for the next one, to be held in Warsaw in spring 1995. However, we realize that regular workshops do not provide for constant cooperation in the absence of 1) a regular forum of communication and exchange and 2) occasional interim meetings as specific regional, thematic, or dictionary issues become apparent. In order to maintain regular contact among the members of this

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1 Stefan Karol KOZŁOWSKI (ed.), Cultural Differentiation of Europe Between the 10th and 5th Millennia B.C. Warsaw (1975).

2 More than once (Hans Nissens' opening address) during our workshop we had to stress the needs to find analysis procedures which reduce the materials processing time in order to spend the funds economically.

workshop, and among others interested in our goals, we have established a biannual PPN lithics newsletter, entitled *NEO-LITHICS. A Newsletter on Southwest Asian Lithics*[1] .

With regard to any expectations you may have, we would like to stress that the initial workshop in Berlin could not achieve either broad or very specific results, agreements, or solutions to analytical or terminological problems. It's more realistic aim was to evaluate and define properly the major research problems, to develop and agree on guidelines to resolve them, to arrange to carry out the resolutions during the interim before the next workshop, and to agree on some basic standards. We hope to promote further our field of research as a sound techno-historical approach to the understanding of resource management and craft innovation under the conditions of the earliest human modes of production. We would like to thank our host, Hans J. Nissen, who joined our initiative at the beginning, and who was instrumental in the realization of the first gathering and the spirit in which we met.

The major workshop results can be summarized as follows: a second workshop will be held as early as spring 1995 at Warsaw University, in order to maintain and foster the Berlin enthusiam. It was also agreed to meet in independently working sub-groups meanwhile, in order to prepare the dictionary/ handbook on Neolithic chipped stone industries which was also agreed on. Each sub-group will consider a major section[2] of the planned dictionary. The biannual newsletter *NEO-LITHICS* will also serve to distribute (modular) pre-prints of dictionary sections for internal discussion. The first issue was published in June 1994 and it contains the minutes of the workshop agreements of April 1993, as well as the minimum standards agreed on for preliminary publications.

The editors would like to point out that synthesised contributions in these proceedings are summaries which were requested by the editors about the current status of discussion on regional sequences; they were not expected to present new results or data. The spellings of geographical and site names are according to the individual authors conventions, whereby the editors also respected the linguistics and grammar of the texts received. It was the editors aim to encourage authors to submit well-illustrated contributions, since this was considered as an essential though, frequently neglected source of information. Obviously this issue provides a good insight into the current analysis methods and approaches evident today in the "chipped lithics familiy".

The editors very much regret that our colleagues Nikolai M. Bader, Jacques Cauvin, Ian Kuijt, Peder Mortensen, Mujahed Muheisen, Jacob Roodenberg, and Alan Simmons were unable to attend our gathering and to contribute to this volume due to other commitments.

Hans Georg Gebel and Stefan Karol Kozłowski

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1 Advisory board: Ofer Bar-Yosef, Jacques and Marie-Claire Cauvin, Frank Hole, Marie-Louise Inizan, Peder Mortensen, Hans J. Nissen, Mehmet Özdoğan; editorial board: Hans Georg Gebel, Stefan Karol Kozłowski, and Gary O. Rollefson; address: c/o G.O. Rollefsoln, 'Ain Ghazal Research Institute, Pragelatostr. 20, 64372 Wembach.

2 Five working groups, which represent the main sections of the planned *Dictionary on PPN/PN Chipped Lithic Industries* were established: "Technology" (chairwoman: Marie-Louise Inizan), "Projectile Points" (chairwoman/-man: Marie-Claire Cauvin and Avi Gopher), "Microliths" (chairman: Frank Hole), "Glossy Elements" (chairwoman: Patricia Anderson), and "Non-Formal/ Abraded/ Bifacial/ Heavy Duty Tools" (chairman: Gary O. Rollefson).

Acknowledgements

Organizing Institutions and Workshop Concepts:
Freie Universität Berlin (Hans Georg Gebel, Hans Jörg Nissen) and
Uniwersytet Warszawski (Stefan Karol Kozłowski)

Financing of Workshop:
Deutsche Forschungsgemeinschaft, Bonn

Workshop Organizational Assistance:
Marcin Bednarz (Uniwersytet Warszawski),
Jutta Lienhard and Bernd Müller-Neuhof (Freie Universität Berlin)

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Publication Layout:
Hans Georg Gebel (Freie Universität Berlin)
<assistance by Nawal al-Ḥawari (Berlin/ Irbid) and
Bernd Müller-Neuhof (Freie Universität Berlin) for some of the illustration parts>

Editorial Help for Some Contributions:
Gary O. Rollefson (AGRI, Wembach), Eric Coqueugniot (Maison de l'Orient, Lyon)
and Brian Willcock (Berlin)

Financing of Publication:
Freie Universität Berlin (FNK) and the Ernst-Reuter-Gesellschaft, Berlin

Printing of Publication:
Zakład Graficzny, Uniwersytet Warszawaski
(in cooperation with Stefan K. Kozłowski and Marcin Bednarz)

Publisher:
ex oriente e.V., Berlin

Form, Function and Numbers in Neolithic Lithic Studies

Ofer Bar-Yosef

Introduction

The study of Near Eastern Neolithic lithic assemblages has not been, nor is it presently, divorced from the more general field of lithic analysis. A brief historical survey both illustrates this point and serves an essential role in our critical examination of the existing classificatory glossaries.

Systematic studies of the technology and typology of chipped stone assemblages were a central topic from the 1950's to the early 1970's, in part due to the international influence of F. Bordes. These studies were essentially aimed at supplanting the traditional approach, which relied on the *fossil directeur* for incorporating assemblages within 'prehistoric cultures'.

The Bordesian approach departed from previous typologies in two ways: it involved (a) the systematic counting of retouched pieces or 'tools' according to a previously arranged type-list and (b) the counting of debitage products ('non-tools' in the traditional morphological approach) that included flakes, blades, points, various types of cores and débris. Relative frequencies of selected or clustered categories of both type-lists (known as indices) were considered as the basis for the definition of 'prehistoric cultures' or a 'facies' within these entities. Other scholars who developed additional type-lists added metrical attributes found to be essential in classifying 'tools' into categories and making detailed comparisons among assemblages (e.g., BOHMERS and WOUTERS 1956; PETERSEN 1966). It is unfortunate that in the years following its introduction, the Bordesian type-list was remembered mainly as stressing the tool counts while ignoring the information concerning core reduction strategies which was reflected in the debitage type-list.

During the same decades, practical knowledge of the knapping techniques was advanced by F. Bordes, J. Tixier, D. Crabtree and others, without necessarily leading to further paleo-behavioral conclusions (SACKETT 1991). Experiments in making stone tools by the old techniques caught the attention of the public both in North America and in Western Europe.

With the publication of the English translation of Semenov's volume (SEMENOV 1964), functional aspects received increasing attention. Most notably, the Bordes-Binford debate, dubbed the "cultural versus functional" argument (e.g., BORDES 1973; BINFORD 1973) motivated the emergence of high and low power edge wear analysis (e.g., KEELEY 1980; ODELL 1979). However, Bordes (1967) continued to stress the difference between 'morphological typology', in which pieces are classified according to their final shape, and 'functional typology', which takes into account the utilization of the pieces (whether retouched or left as blanks). The insistence that the study of style can be separated from function led others to propose ways of identifying style of prehistoric artifacts (e.g., SACKETT 1977, 1986, 1989; CLOSE 1978; DUNNELL 1978).

Further attention to the subject of retouched pieces led Jelinek (1976) to define the 'Frison effect' which marks the results of resharpening. The recognition of such an effect on possible shifts in the forms of retouched pieces has since led others to suggest that the number of types within the same class should be reduced (e.g., racloirs, endscrapers, etc.; see DIBBLE 1987 and 1988 for details). It is worth noting that contrary to the general belief that Upper Paleolithic tool types are better shaped and easier to classify, many can simply be considered sub-types within a few groups such as endscrapers, burins, backed blades, microliths, and geometric microliths (e.g., SACKETT 1989).

Another step in the development of lithic studies was the admission that the quality, accessibility, reliability, and size of acquired raw material might play an important role in determining the size and shape of the artifacts. Systematic research of raw material resources began in order to asses the role played by raw material in every region and for each prehistoric time transect or 'culture' (e.g. GENESTE 1988). Palaeolithic archaeologists sometimes employ the raw material argument to interpret the observable morphological variability among West European Mousterian assemblages (ROLLAND and DIBBLE 1990). Unfortunately, this argument does not hold for the Levantine region (e.g., JELINEK 1991) or for the East Asian sequence (SCHICK and ZHUAM 1993). With the exception of obsidian, little field work has been done on sourcing raw material exploited during the Near Eastern Neolithic. Suggestions such as those made by Crowfoot Payne (CROWFOOT PAYNE 1983) who was interested in finding the sources of the Jericho flint/chert, were not followed. Instead, the interest in the obsidian trade increased, perhaps due to the ease with which obsidian pieces could be identified during excavation. While the hypothesis that good quality flint was transported could be tested, the technical aspects involved in the identification of heated flints in the Natufian and the Neolithic contexts have not yet been rigorously resolved despite some efforts in this direction (ROBINS 1981; MILLER 1983; EDWARDS and EDWARDS 1990; NADEL 1989).

Recently we entered the research phase that recognizes the entire sequence of the core reduction strategy known as *chaîne opératoire* (e.g., LEROI-GOURHAN 1943; CRESSWELL 1983; LEMONNIER 1992; PERLÈS 1992) as the most informative procedure. Thus, increased attention is given to the various stages within each sequence of experimental knapping. The reconstruction of past *chaîne opératoirs* requires considerable effort. These include the location of raw materials sources, the selection of nodules, the possible reduction of cortex in quarry sites, the transportation of cores/nodules, the removal of blanks, the reshaping and/or reorienting of the core axis, the choice of blanks for secondary modification or use, tool use (whether retouched or plain), tool resharpening, and final discard of used objects (e.g., BAR-YOSEF 1981a; PERLÈS 1992). The recognition that one can reconstruct the 'life history' of a core resulted in time-consuming efforts of refitting (e.g., LEROI-GOURHAN and BRÉZILLON 1972; MARKS 1983). When added to the 'life history' of each tool, one may reconstruct a series of human activities, hitherto known only partially, by taking into account other aspects such as the stratigraphic situation, spatial distribution, presence or lack of patina, and the ratios of broken retouched pieces and/or blanks. In well preserved levels, animal bones, architectural features, and installations are incorporated as well. However, site formation processes pose certain difficulties, which are discussed below.

In sum, the analysis through the concept of *chaîne opératoire* has replaced quantitative devices as the indicator for clustering assemblages within a cultural entity. While the *chaîne opératoire* can be considered the general common denominator, the rest of the hierarchy is built upon the typological elements (without their quantitative aspect). Qualitative traits or 'style', identified by attributes (metrical and non-metrical) are included, but their detailed discussion is beyond the scope of this paper.

The Neolithic Chronological Subdivisions and Lithic Techno-Typology

Neolithic typological studies, often dealing with definite forms such as celts or axes, arrowheads and sickle blades, were employed similarly to the Palaeolithic approach in order to seriate assemblages through time (e.g. CAUVIN J. 1968; CAUVIN M.-C. 1974a, b; BAR-YOSEF 1981b; CRAWFOOT PAYNE 1983; GOPHER 1989; GOPHER and GOFNA 1993; HOLE 1983; VOIGT and DYSON 1992). In many instances radiocarbon dates, when available, provided support for previous designations and enabled archaeologists to refine the chronological ordering of sites and assemblages.

In the Levant the subdivision between Pre-Pottery Neolithic A (PPNA) and Pre-Pottery Neolithic B (PPNB) was originally based on the differences between the lithic assemblages and the shift from curvilinear to rectangular house plans in Jericho (KENYON 1957). From the onset of lithic research it became obvious that PPNA core types were often unidirectional while the PPNB cores were bi-polar (or bi-directional). In addition, the forms of arrowheads were different. In later years PPNA arrowheads classified as El-Khiam, Salibiya and Jordan Valley points and PPNB arrowheads classified as Helwan, Jericho, Byblos and Amuq points (e.g., CAUVIN J. 1968; CAUVIN M.-C. 1974a,b; BAR-YOSEF 1981b; GOPHER 1989; NADEL *et al.* 1991) replaced a numerical system (MORTENSEN 1970).

The last decade has demonstrated that this general dichotomy between the PPNA and PPNB lithics is valid at least within the southern Levant, even if the quantitative chronological ordering (e.g., GOPHER 1989) is sometimes problematic (BAIRD and GARRARD in press). In addition, the correlation between the recognizable lithic and architectural phases holds only in the central area of the Levant, excluding the arid belt both in the Syro-Arabian and the Sinai deserts (e.g., BAR-YOSEF 1985; GARRARD *et al.* 1987); BETTS 1988; BAIRD *et al.* 1992). A similar picture has emerged in the northern Levant and southeast Anatolia (e.g., REDMAN 1982; SCHMIDT 1988; CAUVIN M.-C. 1988; ROSENBERG, this volume). For example, the excavations of Phase III at Mureybet uncovered rounded dwellings with core reduction technique that is already based on bi-directional removals, including the 'naviform' shapes CAUVIN J. 1977; CAUVIN M.-C. and STORDEUR 1978; CALLEY 1986). This blade core technique characterizes the PPNB in the southern Levant since its early phase, around 9,200 B.P. In addition, extensive field work in the desertic region demonstrated that curvilinear structures are associated with a typical PPNB industry (KIRKBRIDE 1978; BAR-YOSEF 1984; BAIRD *et al.* 1992; GARRARD *et al.* in press).

The recent proposal to add a PPNC phase in the central-southern Levant (ROLLEFSON 1990) is based on similar premises, i.e., shifts in core reduction strategies. One may therefore employ the identified *chaîne opératoire* to delineate 'prehistoric provinces'. In this sense, the use of pressure flaking in the northern Levant, Anatolia and the Zagros (or western Iran) would define a technological province. In addition, when tool forms are taken into account, the general picture is that western Iran and northern Iraq probably belong to a province where microliths served as projectiles, as most of the common PPNB Levantine types do not occur there (HOLE 1983).

It should be stated briefly that by employing a chronological sub-division, either by calling them Periods 1,2,3, etc. or just PPNA, PPNB, etc., we abandoned the socio-economic terminology as offered by R. L. Braidwood, one of the most influential pioneers of Neolithic research in the Near East. Braidwood's terms were based on the interpretation of the archaeological record and read as follows: "terminal level of food collection," "level of incipient cultivation and domestication," and" level of primary village farming communities " (BRAIDWOOD 1975). Braidwood was right to look for the nuclear zone in Southwest Asia, but on the basis of what was known at the time, he incorrectly identified it in the hilly flanks of the Taurus-Zagros, where climatic conditions were different from those of today, as was recently admitted by Wright (1993). While Braidwood's general socio-economic sequence still holds, his proposed terminology cannot be practiced on a daily basis. Keeping to a simplified chronological subdivision based on radiocarbon readings makes facilitates communication among scholars from diverse schools. The new calibration curve (STUIVER and BRAZIUNAS 1993) provides the possibility of delineating isochronic lines for technological innovations and tool types across the Near East. However, the curve also presents difficulties in calculating B.C. dates. In several crucial time spans there are 'plateaus' caused by variations of $^{14}C/^{12}C$ ratios in the atmosphere, which result in the overlap of radiocarbon dates even if they are sequenced on the basis of the stratigraphic observations. A detailed analysis will be published elsewhere.

The Need for a Type-List and Some Selected Pitfalls

Language is our common means for communication. Through time the meaning of words change and some terms are replaced by others. Thus, we use dictionaries, even specialized ones for different subject matters. The need for a common terminology in prehistory became obvious in the 1950's and 1960's when the number of archaeologists began to grow significantly. Pioneering endeavors for prehistory were made by French prehistorians (e.g., LEROI-GOURHAN 1965; BORDES 1961; BRÉZILLON 1968).

Apart from the scientific aims, a common glossary or a classificatory system is needed when reporting lithic assemblages to departments of antiquities, as lists of finds are generally requested. Educational efforts in recent decades have led to increased public awareness of the importance of the prehistoric periods. Thus such listings are expected to accompany pieces selected for show cases in national and local museums.

Cumulative experience in creating and employing type-lists has demonstrated that consensus can be reached when forms are defined and the text accompanied by both schematic and actual drawings of artifacts. Using this technique, the Bordesian type-list for the Middle Paleolithic (BORDES 1961) was able to diffuse beyond western Europe.

Although new excavations sometime bring to light new types, the building of a type-list is generally based on types already described in the literature. For example, the main Neolithic projectile points were already known in the 1960's (e.g., CAUVIN J. 1968; CAUVIN M.-C. 1974a) long before I proposed (BAR-YOSEF 1981b) a type-list which proved useful for chronological determinations (GOPHER 1985). Similarly, the type-list employed by Mortensen (1970) based on the study of the Beidha assemblages was later modified employed by others (e.g., GOPHER 1985).

While classifying assemblages, most lithic analysts are aware of morphological ambiguities, such as when a Byblos point grades into an Amuq point. This, methodologically, is not different from the problem of zooarchaeologists who sometimes cannot separate the bones of sheep and goats and end up counting them in a general category of 'caprovines'. Similarly, the variability among the bifacial tools leads to the mixed category of 'axe-adze' especially while categorizing Tahunian axes-adzes. In the latter group the determination of chisels relies on the width of the working edge, which relative to the axe-adze is narrower in the chisels. This does not mean that their function was different. The group of perforators/borers (including *mêche de forêt*) does not escape obvious inter-grading of subtypes.

More difficult for classification is the class of retouched, nibbled, and used blades. What someone calls signs of utilization may be interpreted by another as a fine retouch. Both could be created by scraping and sawing hard materials. In addition, notches and denticulates sometimes are the result of trampling.

Therefore, it seems advisable to proceed in a three-level analysis as follows. The first list includes arrowheads (or projectile points), retouched and non-retouched sickle blades, axes-adzes/celts (or bifacials), scrapers, burins, Hagdud truncations, and microliths (lunates, backed bladelets). The second list reports the less well defined forms, such as retouched or nibbled blades, denticulates and notches. Finally, the third list deals with debitage products such as flakes, blades, burin spalls, cores, etc.

Except for sickle blades, which are classified according to their use, it should be understood that other categories, unless demonstrated by micro-wear, are considered only as forms without taking into account their function.

Using this approach I presented (BAR-YOSEF 1981b) a map of the southern Levant in which differences among sites and sub-regions become evident. A similar effort is made in Fig. 1, although some of the information is derived from unsieved collections.

Beyond the classification of main groups there is question of sub-types. M.C. Cauvin's detailed list of Early Neolithic arrowheads (CAUVIN M.-C. 1974 a,b) raised some queries. One may argue that the morphological subdivisions of the Khiam (or El-Khiam) points are often variants of the same 'type'. Within this trend a recent paper (NADEL *et al.* 1991) furnishes additional sub-types or perhaps even real different types that occur in a PPNA assemblage. In both studies the practical question of how the arrowheads were hafted does not receive the adequate experimental attention. Testing potential hafting methods, as proposed for example by Burian and Friedman (1988), requires detailed microwear examination.

Finally, core reduction sequences can be described on the basis of core categories such as uni- or bi-directional with 'navifoirm' as a special sub-type. Other debitage products could follow the common Paleolithic conventions. In every case the follow up investigation would concentrate on identifying the *chaîne opératoire* that was practiced locally. Since this is not always a practical option, the descriptive type-list, while not the sole avenue for research, is a desirable tool.

Although presently limited by political realities, in the future sourcing nodules will be highly advisable. Hopefully, with the changing geopolitical situation in this region, such a large-scale endeavor will become possible. Additional attention to the raw material origins will enable us to evaluate the amount of transport and the extent of curation, as well as possible exchange patterns within the Neolithic world.

The Functional Study of Neolithic Tools

Function is often studied by identifying the causes for edge damage and/or polish. This type of analysis also takes into account the overall shape of the artifacts (e.g., MOSS 1983; ANDERS=N-GERFAUD 1983). Function can be related to the basic form of the object, the way it was handled or hafted. However, in every case the assertion that the form of a tool is related to function should be demonstrated and not assumed. Numerous examples indicate that tool forms, provided they have the desired working edges, can vary considerably. In addition, a tool that serves one function under certain circumstances can be employed for another activity, for example arrowheads that were also used as butchering knives. Sickles also appear to have experienced multi-use in a variety of activities, as reflected in both traceology and ethnography.

While resharpening is directly related to tool use, little has been done concerning this issue in Near Eastern Neolithic studies, although it has occupied the minds of Palaeolithic archaeologists (e.g., TIXIER 1963; DIBBLE 1987, 1991). The transformation of a particular piece from one type to another, as well as simple resharpening, can be accomplished by retouch. As the bulk of the material of the piece diminishes, the shift from one category to another can not always be achieved. For example, one can shape Nizanim or Herzeliya points from an elongated Amuq point but it would be impossible to retouch a Jericho point, which has tangs, into an Amuq point. The same is true for microliths that are an integral part of the Zagros Neolithic. Transition from narrow backed bladelet to a lunate or vice versa is in most cases impossible unless the final form is much smaller than the original. Here, detailed metric measurements of pieces included in each category can be helpful. The chance of recovering the microscopic debitage involved in this process in Neolithic (or for that matter in Epi-Palaeolithic sites) is practically nil. Taking into consideration the limitations imposed on current quantitative studies we now turn and review what can be done with Neolithic assemblages.

Quantitative Studies - What Do They Mean?

The final aspect to be discussed is the 'numbers', what is often known as 'quantitative' studies in archaeology. It is a topic on which diverging viewpoints exist.

Primarily, the question of how to define an 'assemblage' comes to mind. Let us therefore turn to one of the proposed definitions. In discussing the theoretical aspects of what forms an assemblage, Clarke (1978: 245) defines it as "an associated set of contemporary artefact-types". In the ensuing discussion he warns against the aggregation of artefacts from contexts of uncertain chronology. This formula was and is practiced in many regions of the Old World. The importance of the basic definition of an assemblage cannot be exaggerated because it is the cluster of similar assemblages that forms an "archaeological culture" (CLARKE 1978).

It should be noted that this procedure has no meaning to those who do not believe in the past existence of "archaeological cultures". Moreover, extending the presence of such 'cultures' from the archaeological records into a period from which ethno-historical documents are available is considered a doubtful procedure. According to this approach, archaeological remains, especially when defined on the basis of lithic assemblages, only reflect local human adaptations. When environmental conditions change, shifts in lithic technology are supposed to follow. Under these circumstance it is sufficient if inter-site and intra-site comparisons are done among available archaeological samples within the same region. This approach emerged in part for the time when regional studies were advocated as the best means for understanding cultural processes and inter-regional correlations. It is true, however, that the original Bordesian stand did not take into account site formation processes, although Bordes himself was fully aware of the difficulties caused by re-occupation by the same group, re-occupation of the site by different groups within a short time interval, and the effects of post depositional agencies.

There is today a clear understanding among many Paleolithic archaeologists that even when a well-preserved uni-layer or uni-cultural site is excavated in entirety, the recovered assemblage is incomplete. Humans, who produced most of the chipped stone industry in a given place, also brought in and took away some of the pieces. In addition, the growing recognition that site formation processes cause some lithic elements to disappear and others to become incorporated in the excavated level, has major implications for quantitative aspects (BAR-YOSEF 1993). The detailed discussion concerning the pre-Neolithic period is, however, beyond the scope of this paper.

Site formation processes in Neolithic sites are often more complex than those in Palaeolithic sites. Neolithic sites resemble historical mounds in the variety of identifiable site formation processes (e.g., MILLER-ROSEN 1986; COURTY *et al.* 1989): building activities resulted in large volumes of sediment; stones were brought in to erect foundations, sometimes walls (e.g., Basta, Beidha), and fireplaces; clay was imported either as raw material or in the form of mud-bricks; and wood and brush were collected and used for building, cooking, tool making, mats and basketry. The obvious result is when volumes are compared to pre-Neolithic sites, there is an evident decrease in lithic densities per cubic meter. In addition, the use and re-use of wood collected in the immediate environment often result in some aberrant ^{14}C dates. The on-site mixing of the lithics could have been caused by digging, leveling, and cleaning by the inhabitants, as well as the incorporation of lithics in mud-bricks (as at Netiv Hagdud). This should warn us against far-reaching conclusions based on quantitative studies. Clearly, if we are looking for the reflection of daily life and labour division within a Neolithic household we should look for a "Pompeii premise" (BINFORD 1981). Burnt or collapsed houses which were not levelled or cleaned-up for subsequent rebuilding are our best approximations of a 'real life' assemblage. Unfortunately such examples are rare.

In practice, despite the introduction of systematic screening in the 1970's, not all Neolithic deposits are carefully sieved. Quantitative studies of sites excavated in previous years are biased, since many small elements (such as the El-Khiam points in Jericho) escaped the eyes of many workers at the site. Even today, exposing large areas (of hundreds of square meters) in order to recognize the intra-site settlement pattern within one or two seasons means that only selected areas or floor levels can be carefully sieved. Thus, quantitative comparisons among fills or between fills and floor levels are impossible. It is therefore advisable to report the volumes and contexts from which lithic assemblages are derived. In addition, in order to keep inter-assemblage comparisons of any value, only a selected list of tools should be used. Samples of cores and debitage products can be employed for comparing core reduction strategies. The holistic approach, common in Palaeolithic studies, is inapplicable in Neolithic excavations in the Near East.

Final Remarks

The conclusions of a discussion paper such as this one can only be very general. While in the past we concentrated on the study of lithic assemblages, today it is essential to move towards another level of examination. While type-lists are invaluable for recording purposes, the analysis of *chaîne opératoire* is critical to the identification of the cultural entity based on learned behavior.

While detailed attribute analysis is useful when the targets are clear, measuring or recording every minute detail can be a waste of time and funds. Since the collections in most Near Eastern countries are currently better maintained than in the past, when a new question arises one can return to a published assemblage and re-study it.

What is needed today is a better awareness of the role site formation processes play in determining the composition of lithic collections. The clusters retrieved from excavated areas could represent various mixtures. Without a selection of assemblages from large, exposed areas for detailed analysis, we may miss the more general picture of human activities, and instead be left looking at a biased lithic assemblage. Examining selected collections across excavated surfaces and through stratified loci may reveal special activity areas, caches, and in burned or suddenly collapsed houses may provide a good picture of the context of the household.

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La circulation de l'obsidienne au Proche-Orient Néolithique

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ABSTRACT. *Recent research concerning the circulation of obsidian in the Near East has revealed, most importantly, new natural sites in Cappadocia and in the Bingöl region (Taurus). Geochemical analyses using different methods showed that individual sites could comprise several different lava flows and that these flows could be distinguished from one another chemically.*
Which obsidian sites were exploited during the PPN ? What is the distribution of this raw material, and in what form (as cores, blanks, retouched tools, prestige items such as arrowheads and personal adornment objects) is it present in PPN "receiver" sites ? We are thus attempting to define the technological systems (knapping techniques, typology, function) with which it is associated. We are also trying to determine socio-économic systems related to the circulation of this material (sedentary/nomadic, hunting/livestock breeding groups) and any other relationships existing among these communities.

L'obsidienne est une matière première comme le silex et à ce titre elle n'a pas être traitée seule, indépendamment des autres matériaux, ni pour l'interprétation de son rôle ni pour sa circulation. Or, elle l'est ici car les différentes approches méthodologiques qui lui sont appliquées pour la caractériser sont très différentes de celles utilisées pour les roches sédimentaires. Nous allons présenter successivement les dernières données concernant les gîtes naturels, les méthodes d'analyses et l'interprétation de leurs résultats pour appréhender la circulation de l'obsidienne au Néolithique préceramique (PPN).

Gîtes naturels

Les dernières prospections ont mis en évidence de nouveaux gîtes en Cappadoce et dans la région de Bingöl. Ainsi, au lieu de parler simplement d'Acıgöl et de Çiftlik (RENFREW 1966) on peut signaler maintenant dans la région de Çiftlik autour du Göllü Dağ les nombreuses coulées de Komürcü, les gîtes de Kayırlı, du Nenezi Dağ, de Boşkoy (Fig. 1). Il en est de même à Acigöl où onze points de ramassage ont été signalés (ERCAN, YEGINGIL et BIGAZZI 1989) tandis qu'à Bingöl une brève prospection nous avait permis de mettre en évidence les gîtes de Bingöl Çavuşlar, Çatak, Alatepe (CAUVIN M.-C., BALKAN, BESNUS et ŞAROĞLU 1986). Chaque gîte peut présenter plusieurs épisodes éruptifs (coulées ou bombes). Si chaque coulée est de composition homogène, elles sont différentes entre elles, chacune a ses propres caractéristiques géochimiques. Ainsi non seulement on peut différencier un gîte mais un épisode éruptif. Il est donc indispensable de pratiquer un bon échantillonnage sur chacun d'eux.

Cette obsidienne prélevée sur les sources naturelles ne présente pas partout les mêmes qualités de taille. Il est donc préférable que le préhistorien définisse aussi avec le géologue cette matière première brute. En effet certaines obsidiennes de la région d'Acigöl se taillent très mal, par exemple Karakapu (RENFREW *ibid.*); il en est de même d'une des coulées du Süphan Dağ, ou nous l'avons vu, d'une de celles du Nemrut Dağ. Par contre les obsidiennes de Bingöl ou de Kayırlı se débitent très bien. Il est évident que ce facteur va jouer dans l'utilisation et la circulation de l'obsidienne. Ces obsidiennes provenant de gîtes naturels constituent les référentiels et forment les pierres de fondation d'une banque de données collectives.

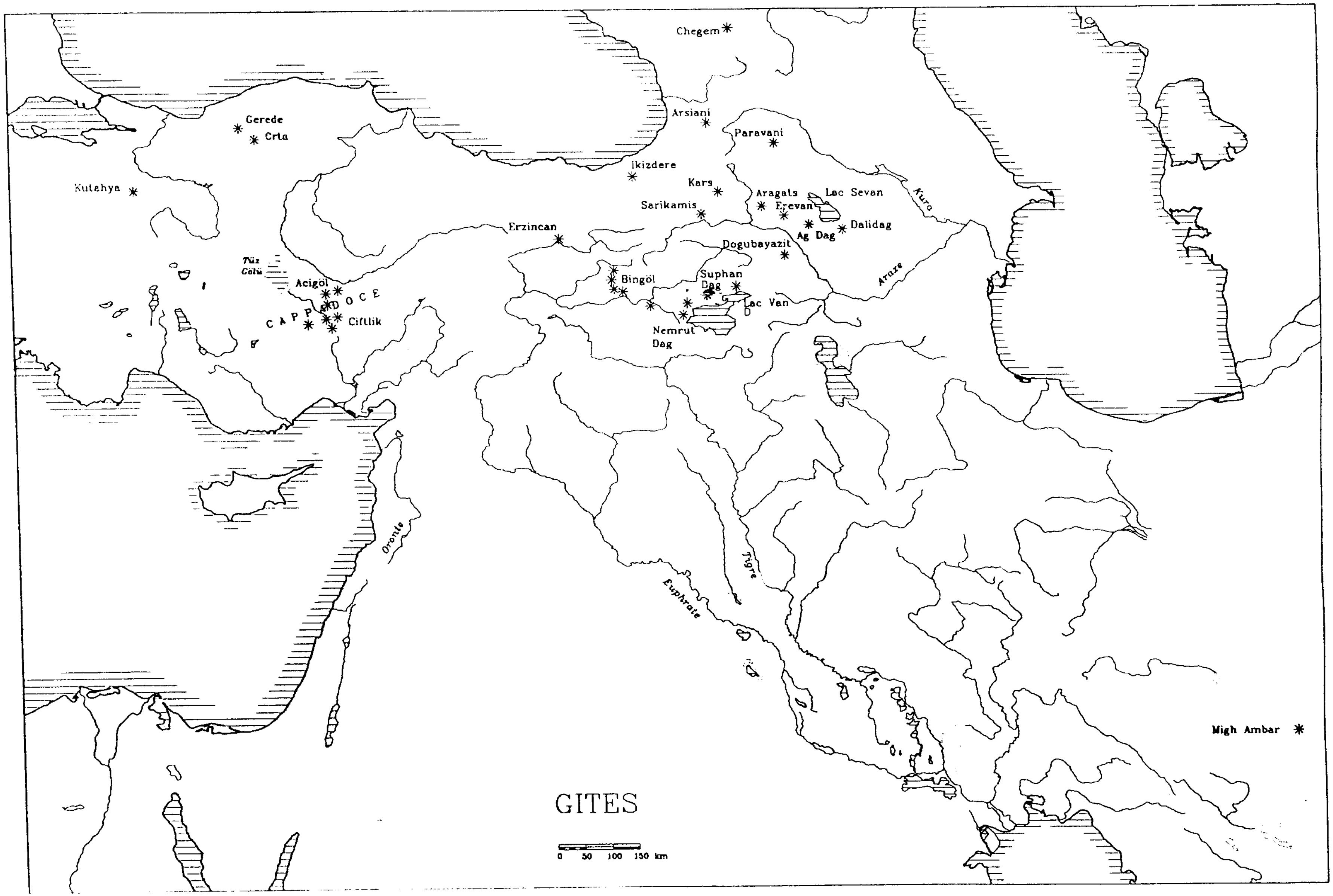

Fig. 1. Carte des gîtes d'obsidienne au Proche-Orient

	Renfrew et al 1966 *Cambridge -OES*	Wright, Gordus 1969 *Michigan-neutr.*	Renfrew, Dixon 1976 *Cambridge-OES*	Fornaseri et al 1975-1977 *Rome-XRF*	Mc Daniels et al 1980 *Bradford-neutr*	Perlman, Yellin 1981 *Jerusalem-neut*	Blackman 1984 *Berkeley-neutr*	Cauvin, Besnus et al 1986 *Strasbourg-ICP*	Pernicka 1991 *Heidelberg-neutr*	Al Isa et al 1992 *Orléans-neutr*
CAPPADOCE										
Hasan Dag	1h									
Göllü Dag	2b (=Ciftlik)			D (=Komurcu, Boz Köy...)	B1	GLD	Hasan Göllü			gr 3 (=Kayirli)
Nenezi Dag						NNZD				gr 5 (=Nenezi Dag)
Hotamis Dag						HTMS A/B/C*	Hotmis I/II/III			
Koru Dag						KRUD	Koru			
Kulaklikepez	4 f									
Acigöl	1e-f (= Acigöl ou Kars/Erevan)		1e (=Acigöl) 1f (=Van-Azerb. -Armenia)	E (=Acigöl) (=Kars / Erevan)	B5					
EST ANATOLIEN										
Lac Van (Suphan Dag)				C (=Suphan Dag)			Suphan I/II			
Lac Van (Zarnaki Tepe)						ZNKT	*groupe E* 3a (?) de Renfrew B4 (?) de Bradford			
Lac Van (Nemrut Dag)					G1	NMRD 1/2	Nemrut I/II *groupe A (= Nemrut I)*		(OK)	
"Nemrut Dag ou Bingöl	4c (=Nemrut Dag ou Bingöl)	Nemrut Dag A/B Bingöl		A1 (<- Nemrut Dag) A2 (<- Bingöl)						
Bingöl					G2		Nemrut III /IV *groupe A' (= N. III)*	Bingöl A (= Orta Duz, Cavuslar)	(OK)	gr 1
	1g (=lac Van ?)				B2		*groupe D*	Bingöl B (= Ala tepe, Catak)	(OK)	gr 2
Bayezid	3a (= Bayezid)		3b (= Bayezid)							
Armenia	3c (= Armenia)			(= lac Urmiah ?)						
Sevan						Sevan	Sevan I/II *groupe F (= Sevan I)*			
?										gr 4
?										gr 6

Fig. 2. Tableau d'équivalence des gîtes et groupes géochimiques d'obsidiennes établis par divers laboratoires *<Tableau établi par C. Chataigner, E.R.A. 17 - Maison de l'Orient>.*

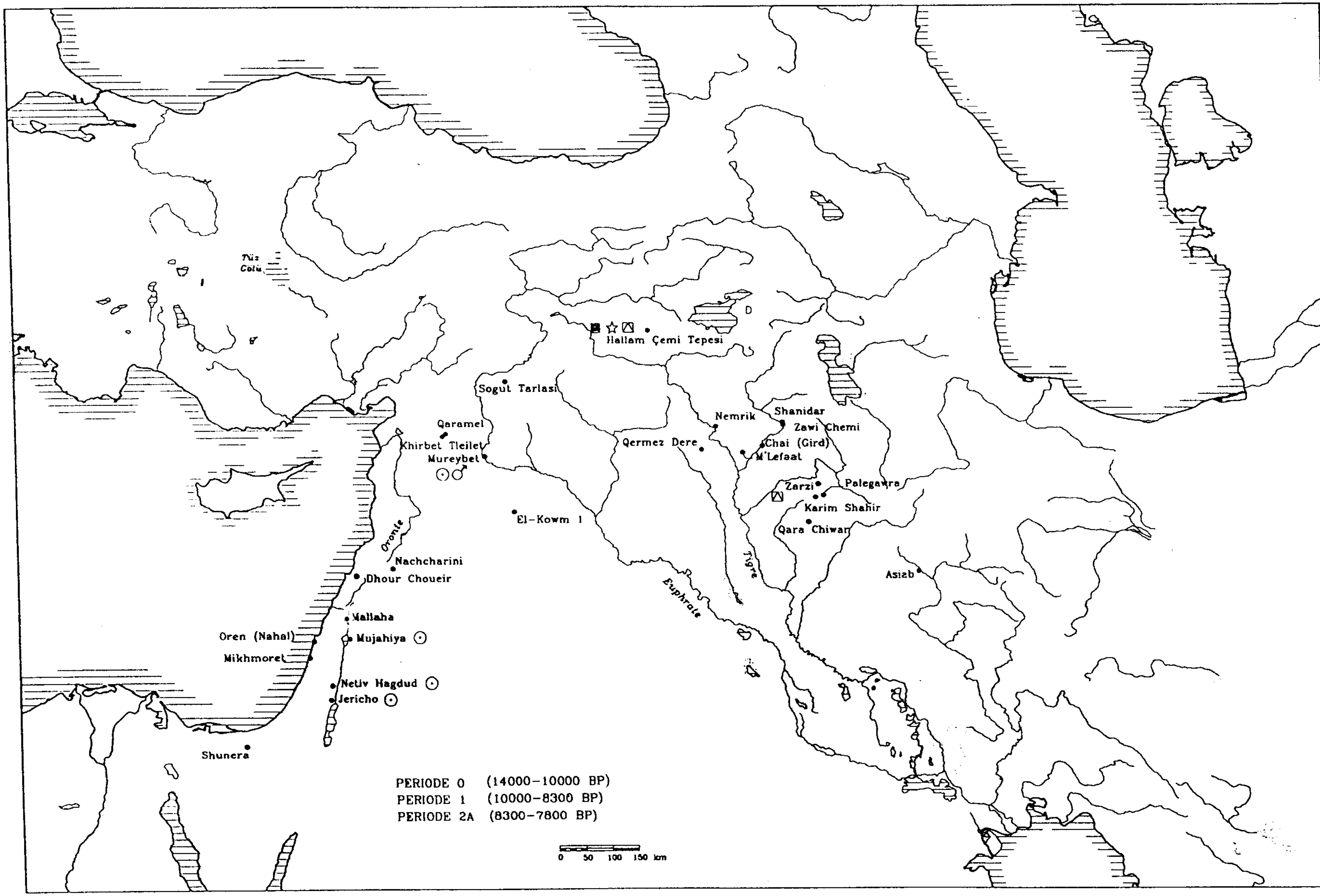

Fig. 3. Carte des sites archéologiques avec de l'obsidienne appartenant aux périodes 0 à 2A de la Maison de l'Orient *<L'obsidienne analysée provenant de Cappadoce est indiquée par des cercles, celle du Taurus oriental ou du lac de Van par des carrés ou des étoiles.>*.

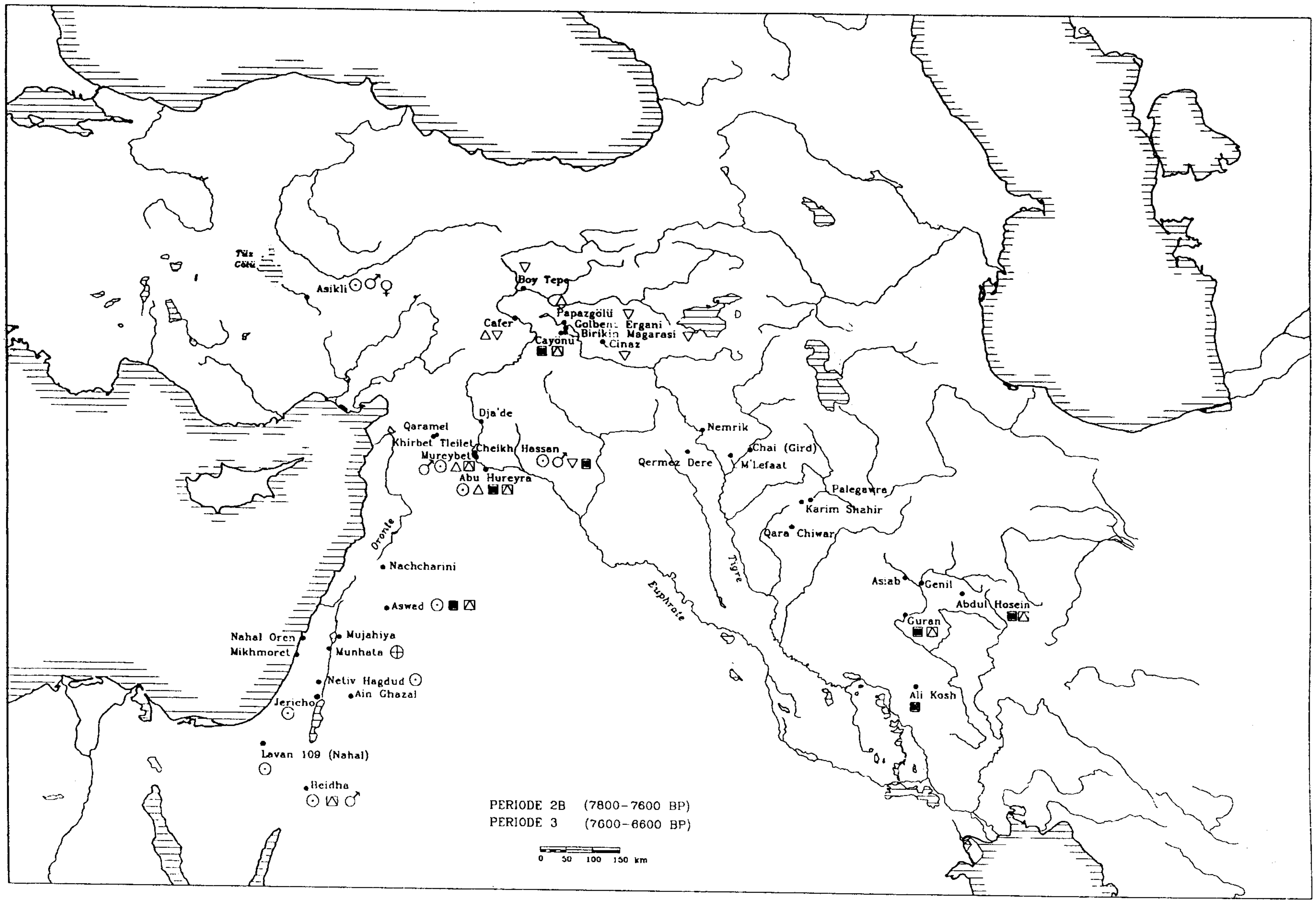

Fig. 4. Carte des sites archéologiques avec de l'obsidienne appartenant aux périodes 2B et 3 de la Maison de l'Orient *<L'obsidienne analysée provenant de Cappadoce est indiquée par des cercles, celle du Taurus oriental et du Lac de Van par des carrés ou des étoiles>.*

Méthodes d'analyses

Pour améliorer les comparaisons parfois difficiles, notamment par le choix et le nombre des éléments-traces analysés, sur leur mode de publication, un référentiel commun à divers laboratoires a donc été mis en place sous forme d'un étalon-obsidienne permettant d'étalonner les différentes mesures dans le même laboratoire et d'un laboratoire à l'autre. D'autre part un réseau obsidienne s'est crée en 1991 dans le cadre d'un PACT du Conseil de l'Europe.

Une banque de données informatisée répertorie dans ce cadre d'une part les sites archéologiques du Proche-Orient ayant livré de l'obsidienne, d'autre part les analyses en cours effectuées par les laboratoires sur les échantillons géologiques et archéologiques en gérant également les résultats des anciennes analyses. Les résultats sont concordants quelle que soit la méthode utilisée (spectrométrie optique ou par plasma, activation neutronique, protonique ou XRF). D'autre part la compréhension de ces résultats n'a été possible que grâce à la collaboration d'un géophysicien (MONTIGNY, In: M.-C. CAUVIN *et al.* 1991 *ibid.*): ainsi il a démontré par l'étude des rapports entre éléments-traces (plus spécialement les lanthanides) qu'il y avait eu dans le même secteur, à Bingöl, deux éruptions successives et qu'on pouvait les ordonner dans le temps, compte tenu de l'appauvrissement du magma, de l'une à l'autre, en certains éléments.

Mais des problèmes subsistent: on peut s'étonner que l'une des deux obsidiennes de Bingöl soit pratiquement impossible à distinguer, par l'analyse, de l'obsidienne connue d'une des coulées du Nemrut Dağ, c'est-à-dire d'un complexe volcanique situé plus à l'Est sur les bords du lac de Van à 80 km environ de Bingöl. Des recherches géochimiques plus précises sont donc en cours avec G. Poupeau (Institut Dolomieu, à Grenoble). Peut-on penser qu'il s'agisse de part et d'autre de coulées simultanément issues de la même chambre volcanique ? Cela apporterait des précisions nouvelles sur la structure des systèmes volcaniques.

Interprétation archéologique

Les obsidiennes recueillies dans les sites archéologiques sont analysées par les mêmes méthodes. Des groupes géochimiques (2b, B4, D etc.) sont ainsi mis en évidence que l'on compare aux obsidiennes des gîtes naturels (Fig. 2, tableau établi par C. Chataigner dans le cadre du PACT).

On constate dès lors d'après les résultats des analyses, qu'entre 12.000 et 9.800 BP elle diffuse de la région du lac de Van vers Zarzi et Hallan Çemi Tepesi, tandis que dans les autres sites archéologiques de cette période elle provient de Cappadoce, que ce soit à Mureybet ou à Jéricho (Fig. 3). A partir de 9.800 BP les sources se diversifient (Fig. 4) et on trouve dans le même site archéologique, Aswad II en Damascène par exemple, de l'obsidienne provenant de Cappadoce et du lac de Van (M.-C. CAUVIN 1991). Mais il ne suffit pas en outre de constater que l'obsidienne se répand de l'Anatolie jusqu'à la Mer Morte et d'en reconstituer le parcours. Elle n'arrive pas partout en même quantité ni sous la même forme ni sans doute avec la même signification.

L'identification du cortex est importante : elle révèle la présence du support primaire comme c'est le cas à Bouqras (ROODENBERG 1986), 'Ain Ghazal (ROLLEFSON 1985) ou Choga Sefid (HOLE 1977) encore qu'il ne soit pas forcément significatif car l'obsidienne peut provenir d'une coulée et être présente comme un fragment d'un banc prédécoupé avec des surfaces correspondant à des plans de fracture naturels. Les modalités de débitage utilisées sont également pertinentes. Les produits laminaires sont débités en général par percussion directe, mais la technique par pression a été signalée notamment pour l'obsidienne de Nemrik (INIZAN, 1986). En fait la taille par pression apparaît vers 9.700 BP sur le Moyen Euphrate à Mureybet III B (CALLEY 1986) et vers 9.000 BP dans le Taurus oriental à Cafer et Çayönü. On la trouvera plus tard notamment à Bouqras vers 8.000 BP.

Enfin il n'y a en général pas d'outil retouché spécifique en obsidienne sauf l'"outil de Çayonü" (*cf.* P. ANDERSON, N. BALKAN-ATLI, I. CANEVA, ce volume) que l'on trouve dans de nombreux sites archéologiques, le long de l'Euphrate associés à des objets en pierre (bols, bracelets) et que l'on imaginait diffuser sous cette forme. D'après les analyses des microtraces d'utilisation l'objet a eu les mêmes fonctions aux divers lieux; la forme qu'il présente résulte de son utilisation et n'est donc pas un indice de sa circulation.

D'autre part tandis que sur bien des sites anatoliens elle est un matériau banal pouvant atteindre comme à Cafer Höyük jusqu'à 90% des artefacts taillés (alors que ce village est à 200 km des sources où il s'approvisionnait), l'obsidienne au Levant demeure toujours un matériau d'appoint qui joue un rôle insignifiant dans le système lithique techno-économique des communautés et reste réservée comme à Mureybet ou plus tard à El Kowm 2 à des lamelles, toujours rares et à des "objets de prestige" également rares: armes, un vase d'obsidienne dans la culture de Halaf (à partir de 7.500 BP) perles, à Ras Shamra Vc, ou à Qdeir 1, incrustations soulignant les yeux sur une tête en relief de Bouqras etc. Autrement dit sa signification y reste dès lors plus symbolique qu'utilitaire.

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L'adoption du débitage laminaire par pression au Proche-Orient

Marie-Louise Inizan et Monique Lechevallier

Le débitage laminaire par pression affecte une partie du Proche Orient à partir du néolithique. Débitage laminaire élaboré et standardisé, il semble y être en concurrence avec un autre débitage laminaire, également élaboré, le débitage naviforme. Tous deux y apparaissent vers le 9°-8° millénaire. Leur histoire et leur contexte d'apparition semblent très différents. C'est aux incidences de ces observations que nous nous attacherons.

Nous ne reviendrons pas sur l'importance de l'évolution et des changements que l'apparition nouvelle d'une économie de production qui caractérise le néolithique fait subir au système technique, car c'est un sujet longuement débattu qui a fait l'objet de nombreuses publications. Il est néanmoins souvent difficile de détecter les prémices des changements, tant les divers phénomènes impliqués sont en interaction. En nous attachant au seul sous-système technique lithique taillé, il va être tenté de montrer le rôle joué par l'adoption d'une nouvelle technique de débitage, la pression, dans le contexte du PPN dans des aires géographiques précises (ou localisées) (Fig. 1).

Deux débitages laminaires standardisés au PPN

On observe dès la mise en place du néolithique la présence de deux débitages standardisés, très caractéristiques (naviforme et par pression), qu'il est possible de bien identifier et donc de repérer dans les industries : les méthodes et schémas de débitage sont originaux et les techniques d'obtention des produits laminaires sont différentes[1], ce qui entraîne également des produits laminaires différents.

1 - Le débitage par pression

Il était admis jusqu'à une date récente que cette technique était une invention datant au plus tôt du paléolithique final, dont on expliquait mal, faute de l'identifier, la présence dans des aires géographiques différentes. Or l'invention du débitage laminaire par pression, qu'il est désormais possible de reconnaître, grâce aux progrès de l'expérimentation, remonte à environ 20.000 ans, dans l'aire d'apparition des peuples mongoloïdes qui devaient se répandre en Extrême Orient et en Amérique (INIZAN, LECHEVALLIER et PLUMET 1992). Une autre invention technique, la chauffe de la matière première, semble liée à cette technique qu'elle améliore indéniablement. Le débitage par pression va se répandre d'est en ouest, 10 000 ans plus tard, lors des prémices des changements de systèmes de production qui annoncent les cultures néolithiques.

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[1] Nous entendons par technique les procédés d'obtention des produits: en l'occurrence, la pression dans l'un des cas et la percussion dans l'autre cas (indirecte ou directe).

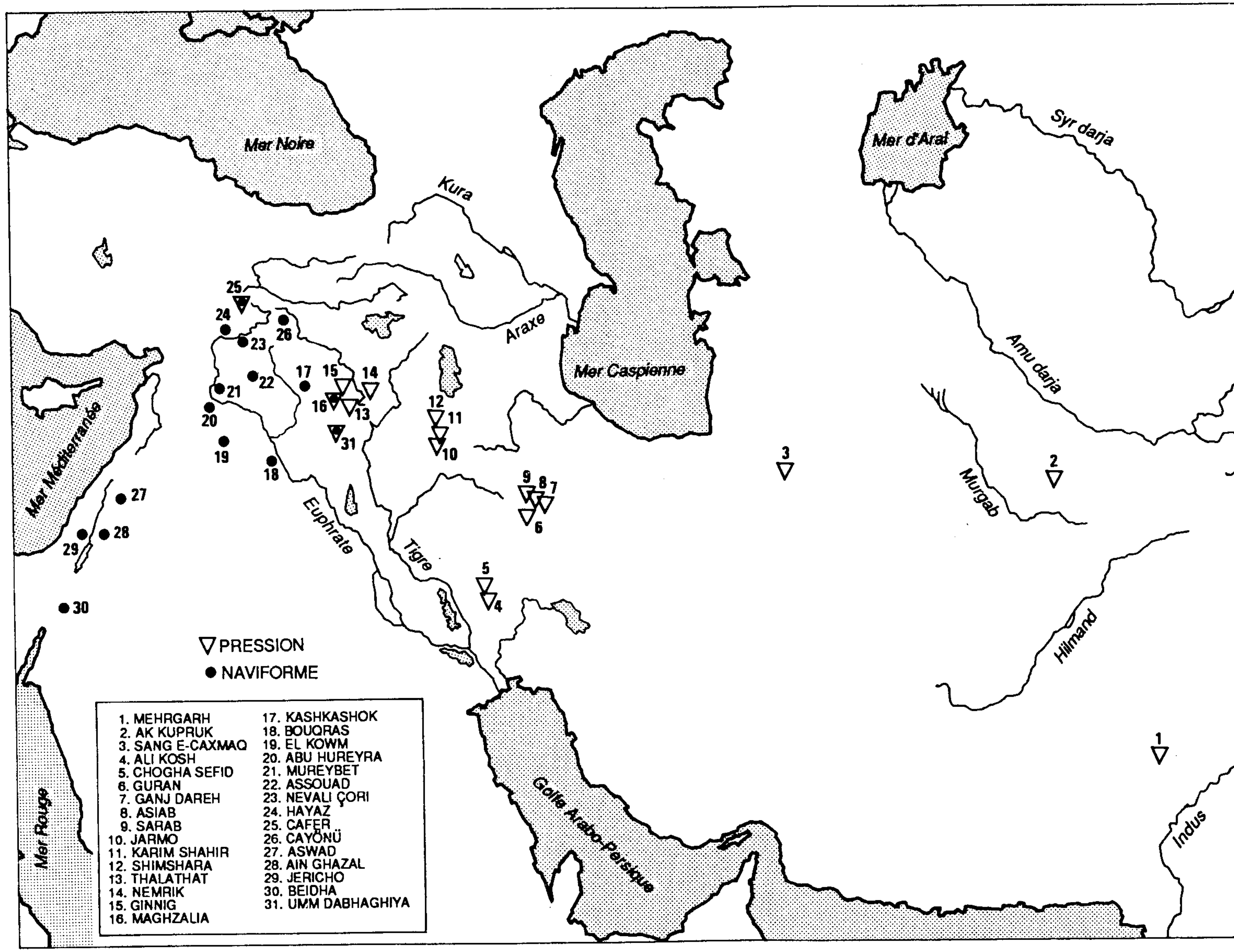

Fig. 1. Carte de distribution des débitages naviforme et par pression.

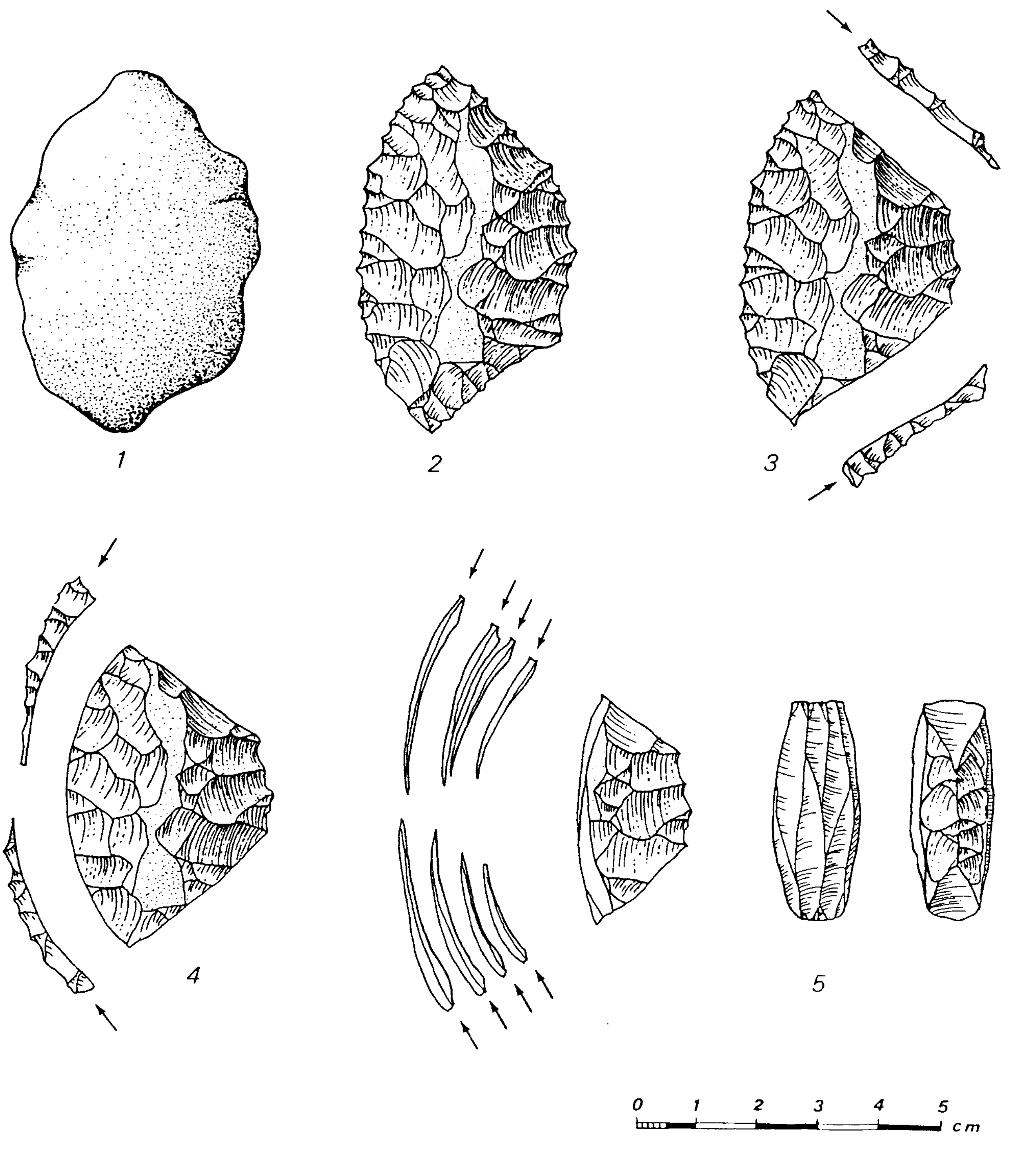

Fig. 2. Schéma théorique de la mise en forme et de l'exploitation d'un nucléus naviforme, d'après CALLEY 1985a <*Ce schéma présente des produits laminaires trop incurvés. De plus, le dessin 5 devrait mieux marquer l'alternance du débitage effectué à partir d'un, puis de l'autre, plan de frappe.*>.

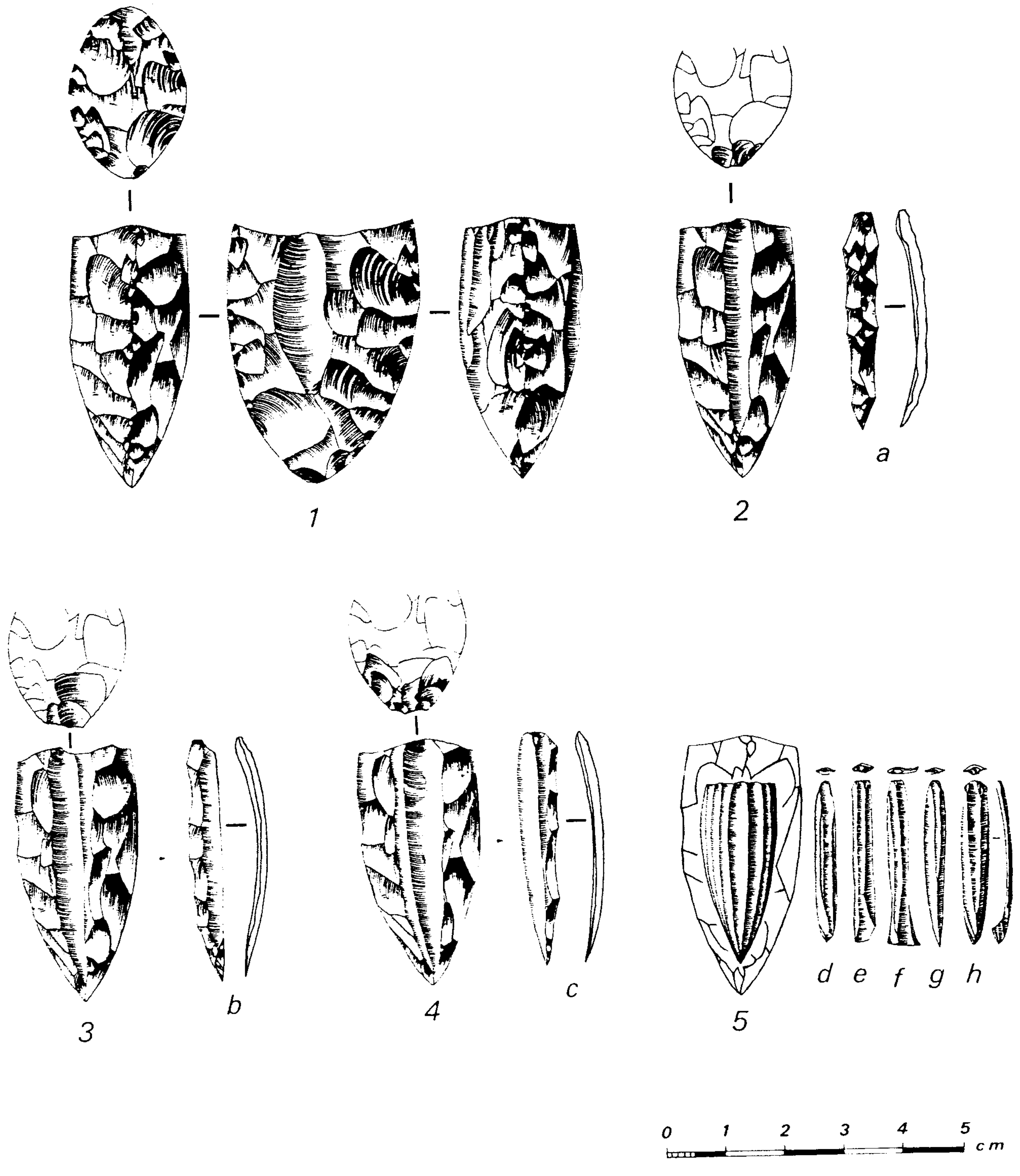

Fig. 3. Schéma du débitage capsien par pression, d'après TIXIER 1984.

Rappel des critères d'identification

Si les critères proposés ont un caractère qualitatif, c'est seulement l'association de plusieurs critères sur une série quantitativement bien représentée qu'un diagnostic précis peut être posé. En effet, il s'agit de différencier le débitage par pression du débitage au punch, débitage qui lui est le plus proche (TIXIER 1976; PELEGRIN 1988). Nous prenons comme exemple le schéma de débitage par pression présenté par J. Tixier pour le Capsien (fig. 2). Il va de soi que les méthodes de débitage sont spécifiques des industries et varient selon la matière première et les traditions lithiques. Il y a néanmoins des traits généraux qui caractérisent nucléus et produits de débitage.

- Les nucléus :

Un nucléus débité par pression s'identifie grâce à la régularité de ses nervures rectilignes et parallèles.

La morphologie du nucléus peut être variée; elle dépend essentiellement du schéma technique prévu par le tailleur et de la nature de la matière première (galet, rognon, plaquette, etc). C'est l'observation des nucléus qui permet de déterminer les différentes méthodes adoptées.

L'unique plan de pression (comme les plans de frappe) peut être lisse ou préparé.

- Sur les lames et les lamelles de plein débitage on observe :

des bords et des nervures qui tendent à être rectilignes,

une faible épaisseur dans la partie mésiale,

une face inférieure sans ondulations marquées,

un talon toujours plus étroit que la largeur qui atteint très vite sa largeur maximale. Les talons sont de bons indicateurs des plans de pression et de la conduite technique du débitage (abrasion ou non des corniches). Ils ont des surfaces réduites, voire punctiformes.

Les directions des nervures donnent des indications pertinentes quant à la forme et aux dimensions des nucléus dont proviennent les lames.

Le profil rectiligne des lames avec une courbure distale est un excellent indicateur de la pression.

Caractères des produits

Si les produits laminaires sont de très petites dimensions (lamelles et microlamelles) au paléolithique, à partir du néolithique leurs dimensions s'accroîssent, impliquant un équipement et un savoir-faire plus complexes. Néanmoins les produits gardent les mêmes caractères. Il est important de noter le rôle important joué par la matière première qui doit être homogène et de préférence à grain fin, ainsi que la grande productivité que permet cette technique.

Apparition au néolithique en Orient et diffusion (fig. 1)

Jusqu'à présent, les dates d'apparition les plus anciennes relevées en Orient étaient en Iran, le long du Zagros et dans le nord de l'Iraq. La présence du débitage par pression, toujours associée à des lamelles d'obsidienne (INIZAN 1986) sur l'horizon du 8ème millénaire, dans des contextes néolithiques sans céramique, semble marquer des importations de deux types (matière première et technique de débitage) dans la région du Deh Luran en Iran dès la phase de Bus Mordeh (HOLE *et al.* 1969). Plus au nord, on observe les mêmes phénomènes à Jarmo (HOLE 1983), à Ml'efaat (DITTEMORE 1983) avec intervention de la chauffe dans les deux cas.

Désormais, depuis les datations du village néolithique de Nemrik[1] (KOZŁOWSKI 1989, 1990 et 1992; KOZŁOWSKI and SZYMCZAK 1989) montrant que le début de l'occupation se situe dès 8.500 B.C. (dates calibrées), l'apparition du débitage par pression dans cette région est très précoce, précédant le Zagros, le Deh Luran, etc. Elle témoigne peut-être d'une voie de pénétraiton en provenance de l'est par le nord de l'Iran et de l'Iraq. Dans ce gisement néolithique précéramique, il y a quelques traces de céréales, une présence plus importante de légumineuses. La domestication est bien attestée. L'industrie

[1] Nous remercions tout particulièrement Stefan Kozłowski d'avoir permis à l'un d'entre nous (M.-L.I.) d'examiner le débitage de Nemrik.

osseuse, des statuettes en pierre, un matériel en pierre montrent la diversification des industries en l'absence de céramique.

L'industrie lithique est marquée par deux traditions: la première concernant l'outillage offre des affinités avec le Proche Orient levantin/anatolien (pointe d'el-Khiam par exemple) alors que le débitage naviforme est inconnu et le débitage par pression, tradition empruntée à l'est, parfaitement maitrisé. L'obsidienne est présente mais en quantité infime (moins de 1%). L'absence de données sur la fin du paléolithique dans cette région n'autorise pas à préciser les dates d'apparition de l'obsidienne.

A l'ouest de ces régions, en Europe, toutes les dates des sites où la pression a été observée sont plus récentes (Anatolie, Balkans, Europe de l'ouest, etc.) (KOZLOWSKI 1989; BINDER 1987; BINDER et PERLÈS 1990). Il ne semble pas y avoir de témoignage avant le néolithique; cependant, les dates d'apparition du débitage par pression en Europe sont encore trop peu nombreuses, par absence d'identification des techniques de taille.

2 - Le débitage naviforme

Les nucléus naviformes ont été dénommés par J. Cauvin, pour la première fois, en raison de leur forme, à Tell aux scies, site contemporain du Néolithique Ancien de Byblos (CAUVIN 1966: 226). S. Calley a décrit ces nucléus et proposé un schéma de la séquence de taille (CALLEY 1985a: 195 et 291) (fig. 3). Le débitage naviforme est un des types de débitage à plan de frappe opposé[1] qui se développent au PPN pour la production de lames. On a noté la relation entre ce débitage et la production au PPNB de pointes élaborées (Amouq, Byblos), à retouche plate.

Rappel sommaire des critères d'identification

- sur les nucléus :

Les nucléus ont deux plans de frappe opposés lisses, fortement inclinés (angle 40 à 45°), et une seule surface de débitage où sont visibles les traces d'enlèvements laminaires issus alternativement de l'un et l'autre plan de frappe.

- sur les lames :

Les produits laminaires portent sur la face supérieure des négatifs d'enlèvements issus d'un débitage opposé successif ou alternatif.

La technique utilisée pour ce débitage n'est pas réellement élucidée. L'usage de la pression, cependant, paraît exclu (études en cours, Wilke et , Abbès, Nishiaki).

Caractères des produits

Les produits laminaires sont rectilignes; les lames peuvent être très régulières, atteindre une assez grandes dimensions; elles sont également caractérisées par une certaine robustesse (épaisseur supérieure aux produits obtenus par pression). L'intérêt du nucléus naviforme est donc de permettre la production de lames rectilignes par une correction constante de la surface de débitage.

Apparition au néolithique en Orient et diffusion

La plus ancienne manifestation (1 exemplaire) du nucléus naviforme a été mise en évidence au Levant nord dans la région de l'Euphrate, à la Phase IIIA de Mureybet entre 8.200 et 8.000 B.C. (CALLEY 1985a). Il se répand au PPNB dans tout le Levant; il est attesté au Qatar au 7e millénaire où il est aussi associé à des pointes à retouche par pression en écharpe de type pointe d'Amouq (INIZAN 1988).

[1] dénommé aussi bipolaire.

Destination des produits laminaires (nucléus naviforme et par pression)

L'analyse de l'économie du débitage a permis de mettre en relation les supports laminaires du plein débitage avec des outils privilégiés. Pour la pression, ce sont essentiellement des microlithes dans les phases anciennes, puis des éléments de faucille, la standardisation des produits assurant une production d'éléments à insérer interchangeables.

Pour le débitage naviforme, la relation entre des pointes pédonculées et foliacées sur lame (type armature) et ce type de débitage a été relevée dès l'identification de ce dernier (CAUVIN 1968). En effet, le succès de cette méthode semble en relation avec l'émergence à cette époque d'un armement constitué de pointes diverses (pointe d'Amouq par exemple), pour lesquelles la rectitude du débitage est un atout (sinon une partie du support doit être sacrifiée, ce qui était le cas dans les productions précédentes telles que la pointe d'el-Khiam au PPNA).

En conclusion, la pression permet une productivité et une standardisation des lamelles et des lames alors que le naviforme favorise la rectitude et la robustesse des produits laminaires assurant la performance des pointes en particulier.

Distribution du débitage naviforme et du débitage par pression

Cette proposition, schématique, sera soumise à révision avec le développement des fouilles et l'identification des techniques et des méthodes de débitage qui jouent un rôle dans le repérage de la circulation des hommes et des idées.

Les nucléus naviformes sont présents au PPNB ancien en Syrie du Nord soit à partir de 7 600 B.C. (Mureybet, phase IV) (CALLEY 1985 : 222) et se répandent sur toute la zone levantine du Proche Orient à partir de 7 000 B.C. au PPNB moyen, période dont ils deviennent un des traits distinctifs (MORTENSEN 1970; ROODENBERG 1979-1980; CROWFOOT PAYNE 1983; etc.). On constate leur disparition au cours du PPNB récent ou final vers 6 000 B.C. (BAIRD, ce volume).

Il y a donc une grande province naviforme qui couvre un à deux millénaires et dans laquelle le débitage par pression ne pénètre pas, soit toute la façade méditerranéenne du Proche Orient jusqu'à l'Euphrate à l'est. Elle n'y pénètre pas davantage lorsque disparaissent les nucléus naviformes, alors qu'elle se répand vers les Balkans et une partie de l'Europe durant tout le néolithique.

On retrouvera aussi le débitage par pression, qui apparaît subitement au Capsien supérieur, en Afrique de nord (TIXIER 1976) et en Egypte au pré-dynastique (MIDANT-REYNES 1983) sans origine allochtone décelée.

L'un des cheminements du débitage par pression progresse à travers l'Europe du sud (KOZŁOWSKI 1989)[1], selon toute vraisemblance, par l'Anatolie, les Balkans, la Grèce (PERLÈS 1992) le long de la Méditerranée.

Sa pratique en Orient semble durer jusqu'au 3ème millénaire, avec une destination privilégiée de ses lamelles comme éléments de faucille. On en observe à la période d'Uruk, dans le nord de la Mésopotamie, sur un silex qui n'est pas local[2]. Dans le sud, à proximité de Larsa, à la période Early Dynastic I, des éléments lustrés denticulés comme de véritables scies étaient exécutés sur des lamelles en silex débitées par pression[3].

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[1] Il y a eu certainement plusieurs voies de pénétration de la pression qu'il faudrait suivre à partir de l'Iénissei.

[2] Ces observations ont pu être faites sur le matériel de tell Karana grâce à l'obligeance de Mr. Toma qui en dirigeait la fouille.

[3] Cette observation a été faite dans la région de Larsa par M.-L. Inizan et J. Tixier.

Compatibilité ou exclusion

Comme on l'a vu, il existe manifestement une province où est né le naviforme ignorant le débitage par pression et qui semble la refuser. Le débitage par pression, à la même période, recouvre une immense aire géographique, soit pour la période qui nous concerne, de la vallée de l'Indus à la Mésopotamie. Les contacts étant démontrés entre le nord de la Mésopotamie et le Proche Orient levantin à ces périodes, l'adoption de la pression ou son refus témoignent donc de traditions culturelles différentes.

Influence d'une technique :

Peut-on considérer comme une simple coincidence, l'apparition de la retouche par pression, retouche dite "en pelure", en "écharpe" sur les armatures comme les pointes d'Amouq, de Byblos, etc. ?

Quelles sont les différences dans les deux traditions techniques qui permettent de proposer une interprétation ?

1) Les supports n'ont pas les mêmes dimensions, ni les mêmes caractères : plus grande légèreté, plus petites dimensions pour les supports débités par pression, plus robustes (plus épais), plus longs et surtout une rectitude des lames issues du naviforme et une destination des supports laminaires différente (*cf. supra*).

2) L'adoption de la pression qui nécessite un équipement spécial (PELEGRIN 1988) vient de l'est, dans des territoires qui ne semblent pas fournir en abondance une matière première à grain homogène et de volume important. La matière première a pu favoriser l'adoption de cette technique qui s'épanouira en Anatolie en présence de l'obsidienne.

3) La présence simultanée sur certains sites, comme Cafer Hüyük, Cayönu (CAUVIN 1989; CALLEY 1985b), du débitage par pression et de nucléus à plan de frappe opposés (éventuellement naviformes) pose problème :
- S'agit-il de la même phase d'occupation du site ?
- S'agit-il d'ensembles lithiques distincts ? Dans ce cas, l'utilisation de la pression apparaît-elle comme la manifestation d'un débitage spécialisé lié à l'utilisation de l'obsidienne, matériau privilégié pour la pression ? Aussi le problème qui se pose est celui de l'Anatolie où se situent les sources d'obsidienne utilisées au Proche Orient[1].
- Le débitage par pression répond-il à d'autres exigences? Sa caractéristique est de fournir des produits extrêmement réguliers, mais relativement légers et à courbure distale prononcée. Il peut donc fournir des tranchants d'une parfaite régularité, utilisés sans modification; de plus, la lame peut être sectionnée et dans sa partie proximo-mésiale donner des éléments très plats, prêts à servir d'inserts. Ces caractéristiques correspondent bien aux industries contemporaines du PPNB à l'est de l'Euphrate jusqu'à la vallée de l'Indus à Mehrgarh (INIZAN et LECHEVALLIER, 1989).

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[1] Le développement de la recherche en Préhistoire en Anatolie doit permettre de faire progresser cette question.

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Naviform Core-and-Blade Technology: Assemblage Character as Determined by Replicative Experiments

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ABSTRACT. *Analysis of the naviform core-and-blade industry from 'Ain Ghazal, Jordan, coupled with lithic replication experiments, provides a basis for understanding core production and reduction strategies. A variety of knapping choices, some of which were raw-material dependent, are evident in the industry. These include selection of suitable stone, steps in initial core preparation, probable means of detaching spalls to create striking platforms, the method of blade detachment, manipulation of working angles using the opposed platforms of the core, measures taken to prevent and correct errors, maintenance of the core, and decisions of when cores were considered exhausted. These observations encourage correct assessments of meaningful categories of data, such as intentional products versus byproducts of core reduction, and such as technologically significant debitage. In addition, they provide a basis for comparing assemblages from diverse regional and temporal contexts. The analysis of the 'Ain Ghazal collection, enhanced by replication experiments, reveals behavioral choices and technological parameters that governed the local prehistoric industry, and that characterize PPN naviform core-and-blade technology at large.*

RÉSUMÉ. *Une analyse de l'industrie du nucléus naviforme et de la lame du site de 'Ain Ghazal en Jordanie, incluant des expériences sur la réplication lithique, offre des données de base pour comprendre les stratégies de production et de réduction de nucléus. Une variété de choix de pierres de travail, -certains de ces choix étant effectués en fonction de la pierre de travail elle-même-, sont évidents dans l'industrie. Ces choix englobent une sélection de pierres appropriées, les étapes à suivre dans la préparation naviforme initiale du nucleus, les moyens probables pour détacher des élats afin de créer des plans de frappe, la méthode de détachement des lames, la manipulation des angles de travail utilisant les plans opposés du nucléus, les mesures prises pour éviter et corriger les erreurs, l'entretien du nucléus et savoir déterminer quand les nucléus sont épuisés. Ces observations encouragent des évaluations correctes de catégories importantes de données, telles que les produits intentionnels contre les sous-produits de réduction de nucléus, et telles que des produits de débitage technologiquement importants. De plus, elles offrent une base de comparaison des ensembles à partir de divers contextes régionaux et temporels. L'analyse de la collection du site de 'Ain Ghazal, illustrée d'expériences sur la réplication, révèle des choix de conduite et des paramétres technologiques en vigueur dans l'industrie locale préhistorique et qui caractérisent la technolgie du nucléus naviforme du PPN et de la lame en général.*

This paper examines naviform core-and-blade technology, which formed the basis of lithic blade-tool production in the Pre-Pottery Neolithic cultures of the prehistoric Near East. The technology involved production of bidirectional, opposed-platform, percussion-blade cores, and reduction of such cores to produce straight blades for use directly, or as tool blanks (Plate I.a-c).

Naviform core-and-blade technology has very ancient roots that can be traced to the production of similar opposed-platform cores in the Levantine Upper Paleolithic, as at Ksar Akil, Lebanon (OHNUMA 1988: 156). Naviform core precursors are apparent in Epipaleolithic deposits, such as those at Mureybet in Syria (CALLEY 1984, 1986a), and Kharaneh IV (GARRARD and STANLEY PRICE 1975-77: Fig. 1:4; personal observation of the authors) in Jordan. Opposed-platform blade cores of naviform configuration are present also in the Upper Paleolithic Swiderian Culture of Poland (KOBUSIEWICS 1967; KOZŁOWSKI and SACHSE-KOZŁOWSKA 1976; SCHILD 1980; JASNOSZ 1982). During early Neolithic times the technology was widespread and dominant throughout much of the Near East with strong expressions in the Levant, Anatolia, and the Tigris-Euphrates Basin. At the onset of the Pottery Neolithic, the technology declined.

Depending on the raw material used for core production, the technology left varied archaeological debris. Flint in a variety of forms, including tabular and nodular material, as well as obsidian[1], were the major lithic resources used. Because these materials required different reduction approaches to produce similar naviform cores and blades, the various industries have different assemblage characteristics. This variability has been emphasized by previous researchers whose work was generally typological in nature and did not address the overall technological similarity of the different industries (MORTENSEN 1970; SUZUKI and AKAZAWA 1971; CALLEY 1986a, 1986b; NISHIAKI 1993). Assemblage variability and character in the naviform core-and-blade industries has thus remained poorly understood.

It is our position that, in addition to typological studies, a technological approach based on replicative experiments provides a productive means of understanding both assemblage variability and character, and the processes by which naviform cores and blades were produced. Replication begins with observations drawn from the archaeological record, is guided by constant reference to the record, and ends when the record has been closely duplicated and conclusions reached about the processes and decisions that structure the technology.

Background

J. Cauvin was one of the first to recognize and describe a naviform core-and-blade industry. His description[2] still serves well today:

> Ils sont d'un type à duex plans de frappe qu'on pourrait appeler "naviforme", tellement le bord opposé à la surface d'éclatement ressemble, avec son arête et ses enlèvements bifaces, à une carène de navire. . . . Très allongés, ils ont servi à donner de longues lames, celles-là mêmes que nous voyons utilisées pour les flèches, les faucilles et certains grattoirs.

Cauvin's characterization of the morphology of naviform cores from Tell aux Scies was followed by more detailed descriptions of assemblage character by Mortensen (1970, 1988), Crowfoot Payne (1983), and others. These early analyses were primarily typological studies, but in some cases, such as the work of Suzuki and Akazawa (1971), and Calley (1986b), important aspects of technology were interpreted from artifact attributes. The view of naviform core-and-blade technology that emerged, however, was essentially static and incomplete, and lacked the underlying behaviors that produced the artifacts.

This lack of information has resulted in confusion about certain aspects of the technology, one of which is the means of blade detachment. The prevailing view has been that blades with punctiform platforms were produced by indirect percussion or the use of billets (*cf.* SUZUKI and AKAZAWI 1971; INIZAN 1980; VALLA 1984; CALLEY 1984, 1986b; CAUVIN and COQUEUGNIOT 1988; ROLLEFSON 1990). While this view is widely held by researchers, its validity has never been tested adequately by experimentation.

Equally confusing has been the reason for morphological and technological variation in naviform core industries. A common procedure has been to assign cultural and/or temporal significance to variation that may be apparent in these assemblages. For example, Calley suggested that "derived shapes" of naviform cores from Qdeir 1, Syria, "seem to be a cultural feature, maybe specific of a 'desertic facies' of the PPNB or a very final phase of this cultural horizon" (CALLEY 1986b: 49). And yet, the full range of potential causes of such variation (other than cultural) was not explored. Likewise, researchers have lacked basic information on the processes and constraints that structure the technology. Early work on naviform cores from the Palmyra Basin, Syria, by Suzuki and Akazawa

1 Primarily in Anatolia (BALKAN-ATLI 1993; I. Caneva, personal communication 1993).

2 CAUVIN 1968: 226. There is, however, some confusion about the relationship between naviform cores and "rabots" (scrapers). Rabots were described by researchers in the early 1900s (see BRÉZILLION 1983: 345, Fig. 206).

(1971), and a more recent study by Nishiaki (1993) of similar material, sought to understand the significance of unusually tilted core platforms. The trait was seen as an example of regional variation, but no underlying causes of such variation were explored.

Surely, without a basic understanding of the dynamics of the naviform blade-core technology, and of the constraints and sources of variability within it, questions of cultural and temporal variation cannot be resolved.

Aspects of Naviform Core-and-Blade Technology

Basic Parameters

Technological analyses, such as this one, are inherently processual in nature since they are concerned with sequences of behavior. Among other things, these behaviors include the selection of raw material, its alteration in the course of forming a product, and modification of the product through its use. The resulting technology is dynamic, the outcome of considerable flexibility within each of these actions. Variation in technological processes is incurred from many sources. For example, it is affected by the skill levels of artisans, and incorporates their varying decisions and strategies. It results from culturally determined patterns, such as the range of variation of acceptable designs, the appropriateness of reuse or recycling, and the final point of discard. Also, since technology is material-dependent, it reflects diverse choices of raw material and various approaches to its manipulation.

Given the above, it seems clear that variability must be expected in the archaeological record, at least that portion of it that is technological in nature, and that technological processes are flexible. An analysis of naviform core-and-blade technology, then, must be processual in nature, rather than purely descriptive or typological, in order to explain both the causes of variation and the behaviors that shaped the technology.

Our understanding of the steps involved in creating the naviform blade-core technology is derived from an analysis of archaeological collections and an extensive program of replicative experimentation. The primary archaeological resource was the 'Ain Ghazal collection, both Pre-Pottery and Pottery Neolithic assemblages, although other pertinent collections were also examined[1]. Analyses were conducted of nearly 1,400 blade and flake cores, 325 of which are naviform blade cores. We also studied the core production and reduction assemblages from 20 chipping floors, a PPNB blade cache, and several thousand pieces of core production and reduction debris, blades, and formed tools. These analyses guided our own production and reduction of several hundred replicated naviform core-and-blade sets using obsidian and Cretaceous flint from the Edwards Plateau of Texas. Referral to the archaeological data was constant, as was the process of replication by trial and error, and testing alternative procedures and knapping strategies. Our study led to the conclusions detailed in the following pages regarding basic characteristics and constraints of naviform core-and-blade technology. Table 1 presents a typology of technological categories that result from reduction of naviform cores.

Raw Material Selection and Production of Preformed Cores

The choice of raw material was an important element of the technology. It is clear from both the archaeological record and from replication experiments that naviform core reduction depends on the availability and selection of excellent quality stone. In Levantine archaeological contexts, the material selected for use generally was very fine-grained, lustrous, highly siliceous flint. Such was the case at 'Ain Ghazal. The pristine nature of the flint cortex, which lacks incipient cone fractures, and the configuration of the raw material indicate that flint was freshly mined from a limestone matrix as rather flat nodules. Bedded cherts and wadi-rolled flint were not chosen; their inferior nature apparently was not conducive to core production. Occasionally at 'Ain Ghazal, and at some sites such as Wadi el-Jilat (BAIRD 1993a, 1993b, and personal communication 1993) and Basta (H.G. Gebel, personal

[1] Portions of collections from Wadi el-Jilat, Wadi Shu'eib, and Basta in Jordan, and the Palmyra Basin in Syria.

Table 1. Basic Technological Categories Resulting from Naviform Core Reduction

Final Core Preparation. The following are predominantly final core-preparation byproducts, and do not include debitage resulting from reducing raw material to configure the preformed core prior to removal of platform spalls. These byproducts result primarily from final preparation of the core by creating the platforms.

- **initial platform spalls** (removed to create striking platforms at opposite ends of the core)
  - **unprepared** (often have a natural cortical "ridge," especially when cores are made from flat nodules; or may be flat, removing squared edges on tabular material)
  - **faceted** (flat dorsal surface usually created by unidirectional faceting; typically occur on tabular material that does not require bifacing; often used in preparing cores from flat nodules)
  - **crested** ("boat spalls"; bifacially prepared ridge, usually a result of core shaping)
- **noninitial platform spalls** (removed subsequent to, or spontaneous with, the initial platform spall)
  - **corrective** (establish or reestablish a more advantageous platform)
    - **flat** ("ski spalls," "tablets"; dorsal and ventral surfaces are flat; typically increase width of striking platform or eliminate irregular surface)
    - **crested** ("boat spalls"; bifacially prepared dorsal ridges)
    - **faceted** (correct platform angle if canted laterally)
  - **spontaneous** ("ski spalls"; flat platform spalls that can occur with any of the above; noncorrective; dorsal and ventral surfaces are usually parallel and of similar width)
- **back core-trimming flakes** (shape the backs of cores following detachment of platform spalls; facilitate holding cores)
- **faceting flakes** (flatten platforms; typically detached from tabular material)

CORE REDUCTION AND MAINTENANCE. After final core preparation, the following products and byproducts are created during core reduction, which involves blade production and core maintenance.

- **initial blades** (first blades removed from cores; may run the length of the core, may fall short, may overshoot)
  - **crested** ("lames à crête"; bifacially or unifacially prepared ridge)

    - **unprepared** (natural "ridge"; often a natural cortical "ridge," especially when cores are made from flat nodules; or a natural squared edge if core is made on tabular material)

- **noninitial blades** (all subsequent blades)
    - **intended blades** (the intended products of core reduction)
    - **ridge-straightening blades and "bladelets"** (small blades and "bladelets" detached to straighten and define ridges and align blade platform for detachment of blade)[a]
        - **crested blades** (often crested to one side only; improve the profile or direction of an existing ridge)
        - **noncrested blades and "bladelets"** (usually lack carefully prepared platforms and are of irregular form; straighten ridges and align platforms with ridges prior to blade detachment)
    - **hinge- and step-removal blades** ("clean-up blades"; remove hinge and step terminations from the working face of the core)
    - **profile-correction blades** (straighten the profile of the face of the core; necessary following a series of short blade detachments from one platform)
    - **overshot blades** (plunging, or outrepassé blades that remove a portion of the opposite platform; detached by excessive force or by lack of support at the distal end of the core, especially along angular edges of the working face of the core, or detached intentionally to remove defective platform margin at the opposite end of the core)
- **platform-isolation elements** (adjust the core platform margin and align the platform and ridge of the intended blade)
    - **edge-preparation flakes and blades** (small, generally broad flakes and short blades detached to strengthen the core platform margin by removing overhangs and negative bulbs; also help narrow, isolate, and align the platform area of the intended blade)[a]
    - **"bladelets"** (small curved blades that narrow, isolate, and align the platform area of the intended blade)
- **lateral core-trimming flakes** (detached from lateral margins of core platforms, from the back of the core, or from a lateral margin of the working face of the core to regularize lateral topography)
- **back core-trimming flakes** (establish platforms for removal of lateral core-trimming flakes from the back of the core)
- **corrective platform spalls** (most often "ski spalls"; platform area may include a damaged remnant of the working face of the core; reestablish advantageous platform)
- **faceting flakes** (flatten platforms prior to rejuvenation)

[a] can include so-called "upsilon" blades

communication 1993), high quality, tabular flint also was selected for naviform core production (Plate I.d).

Each form of raw material required a different set of knapping strategies to achieve a common goal, production of a bidirectional, opposed-platform, naviform blade core. Therefore, as initial preformed cores were produced from different types of stone, quite different debitage assemblages resulted. The reduction of large, thick nodules to produce preformed cores resulted in large quantities of cortical and noncortical core-production debitage. Since the preformed core was essentially a triangular-shaped biface, the debitage emphasized biface production. Small, flat nodules required only minimal alteration to produce the naviform configuration. Little bifacial shaping or platform preparation were needed, and the small quantity of resulting debitage was largely cortical. Tabular material also generally required only minimal preparation, as its naturally flat surfaces were ideally suited for naviform cores (Plate I.e).

Knapping procedures, then, were governed by the form and quality of the available stone and what was selected for use. Various knapping options were chosen from several strategies at the knappers' disposal. Since these options were raw-material dependent, one should be cautious when assessing the significance of different core forms[1] .

Final Steps in Core Production

In spite of resource variability, the basic core design was remarkably consistent. Many researchers have noted its triangular, or "boat-shaped" configuration, the opposed platforms with a common working face, and the acuteness (roughly 50 degrees) of the platform angles to the face of the core (notably MORTENSEN 1970; SUZUKI and AKAZAWA 1971; CALLEY 1986b). In addition, the core had to be relatively narrow, of a consistent width, and with parallel sides that framed a narrow working face. These constraints were quite rigid and were faithfully adhered to by PPN knappers as they preformed cores and maintained them during reduction (Plate I.e-f).

Final production of the preformed core entailed preparation of the front (or potential working face) of the core, preparing the striking platforms, and shaping the back of the core. During each of these activities, knapping decisions were governed by the form of the raw material. At 'Ain Ghazal, as at many other sites[2], thick nodular flint that required bifacial thinning was often used. In these cases, the front of a preform was generally straightened bifacially by creating a crested ridge in preparation for detachment of the initial blade. This procedure was also useful when thick tabular flint was shaped (Plate II.a-b). Thinner nodular and tabular flint with suitably straight, natural ridges on the front of the preformed core required little or no preparation prior to the detachment of the initial blades. In some cases, such as at Wadi el-Jilat (BAIRD 1993a, 1993b), tabular material was faceted to create a straight, flat working face and corner ridges. A corner ridge would then become the initial blade[3].

Preparation of striking platforms entailed shaping the initial platform area of the preformed core, and detachment of platform spalls. *Initial platform spalls* were prepared in much the same manner as the working face of the preformed core, and their configuration was governed by the same constraints. They were formed of either essentially unmodified, natural surfaces, or of shaped margins of the preformed core. Their morphology was determined by both the type of raw material being altered, and the discretion of the knapper. *Unprepared platform spalls* most often were generated from natural, cortical ridges of preforms made from thin, flat nodules; or, they were detached from naturally flat edges of tabular material. Minimal modification was sometimes needed to prepare the platforms of the

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1 For example, naviform core variants from Kharaneh IV were not recognized as such in early literature, but were in fact claimed not to be naviform cores (GARRARD and STANLEY PRICE 1975-77: Fig. 1:4). Also see CALLEY 1986b.

2 For instance, at Beidha (MORTENSEN 1970), Jericho (CROWFOOT PAYNE 1983), Qdeir 1 (CALLEY 1986b), and Wadi Shu'eib (personal observation of the authors).

3 As noted above, these knapping strategies were detailed by Polish researchers some years ago in assemblages of the Upper Palaeolithic Swiderian Culture of Poland (see citations in text). The similarity between the Near Eastern naviform core-and-blade tradition and that of the Upper Palaeolithic of northern Europe has not been generally recognized. Moreover, the distribution in time and space of the broadly defined naviform core-and-blade technology remains to be investigated.

prospective spalls; however, these spalls were essentially unaltered since their natural form was fortuitously shaped and needed no further adjustment (Plate II.c).

Most often it was necessary to shape the margins of the preformed core in order to detach a spall. In such cases, platform areas were either crested or faceted to create desirable topography. Crested margins were made on thick nodules and on tabular material that required bifacial preparation. Detachment of these margins generated *crested platform spalls* ("boat spalls"; Plate II.d)[1]. Flat tabular or nodular stone that required no bifacial shaping was often faceted on the margins to adjust the topography prior to spall detachment (Plate II.e). Such faceting usually was unidirectional and served to flattened the dorsal surface of the intended *faceted platform spall* (Plate II.f). Knappers used the most logical strategy to shape the spall area, selecting what was easiest, most likely to be successful, and what was the most judicious use of the stone.

Platform spalls usually were detached before the initial blade was removed. Spalls were removed either by direct percussion with a hammerstone, or by a burin blow. In the latter case, the prepared platform end of the intended spall was struck on an anvil stone and the spall was detached in the same manner as a large burin spall[2]. It is our experience that this type of spall removal is more likely than the use of hammerstones to result in flat core platforms that duplicate those in the archaeological sample.

Noninitial platform spalls sometimes were detached to correct a defect in an existing platform. Such *corrective platform spalls* were either flat ("ski spalls" or "core tablets"), crested ("boat spalls"), faceted, or a combination of these forms, as the situation dictated (Plate II.g). Evidence of prior platform spall removals usually remains on dorsal surfaces of corrective spalls, and their corrective role generally is apparent. Corrective platform spalls often were removed to widen a platform; in such cases their ventral surfaces are wider than their dorsal surfaces. Corrective spalls were detached in the same manner as initial spalls.

Occasionally, noninitial platform spalls were detached spontaneously with the removal of other spalls. These detachments most likely were the result of double contacts between the spall platform and the anvil or hammerstone. These *spontaneous spalls* may be recognized in archaeological deposits by their flat dorsal and ventral surfaces, and by the fact that they have no corrective attributes; they generally mirror the ventral surface of the intentionally removed spall, and have parallel dorsal and ventral surfaces that are of similar width (Plate II.h).

Modification of the back of the core was usual when cores were bifacially prepared, or when spall scars met in a sharp edge at the back of the core. This adjustment in core morphology facilitated holding the core in the hand during blade production. When spall scars were separated by a smooth cortical area, the back of the core was left unaltered. When core backs were shaped, this was done in a variety of ways, generally by bifacial cresting, or by the removal of *back core-trimming flakes* (Plate III.a-b). Back core-trimming flakes are expanding, faceting flakes that flatten and smooth the back of the core. Usually they were removed unifacially.

The procedure chosen depended on the type of material being modified, and on the more general core production approach that the knapper was using. Thick, nodular and tabular stone that was bifacially shaped to make preformed cores generally was shaped on the back by bifacial cresting or by removing back core-trimming flakes. Tabular preformed cores that needed no bifacial shaping usually had unifacially trimmed backs that preserved their flat, parallel-sided topography. An important point is that the procedures chosen to trim the back of the core were determined by the same constraints that governed other aspects of core production. Ultimately, these choices depended on the form of the stone being used, the easiest strategy for core preparation, and the skill of the knapper. It is interesting to note that the 'Ain Ghazal PPN collection contains all of these variations.

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1 "Boat Spall" is also used to refer to crested platform spalls from bifacially prepared Yubetsu cores of the East Asiatic Upper Palaeolithic and Neolithic.

2 Douglas Anderson (personal communication 1988) originally suggested that burin blows may have been used to detach platform spalls from Yubetsu cores.

Blade Production

As in all other blade technologies, blade production and core reduction are different conceptualizations of the same process. This process involves preparing and configuring prospective blades on the core face, detaching the blades from the core, and maintaining the core. The naviform core configuration was extremely efficient for blade production because it permitted a high degree of control over all aspects of the process. Of all percussion-blade technologies, it provided the knapper with the greatest number of options to ensure continued and successful production of blades. It did so by allowing the knapper the flexibility to change readily from one platform to the other as the situation required to prepare and detach blades (Plate III.b-c).

Reduction of naviform cores by PPN knappers was accomplished by direct percussion with a hammerstone, not by indirect percussion as sometimes argued by others (SUZUKI and AKAZAWA 1971; CALLEY 1984, 1986a; ROLLEFSON 1990), or by pressure. During reduction, cores were hand-held and rested against a resilient surface such as the inside of the knee or thigh. It is unlikely that a hard rest or support was used. This conclusion is indicated archaeologically by the presence of trimming on the back of the core (which, as noted, enabled the core to be held comfortably in the hand); the lack of abrasion of the cortex on the sides of the core, which probably would occur if the core were immobilized in a vise; and the common occurrence of overshot (plunging, outrepassé) terminations on archaeological blades. Replicative experiments also have shown that holding cores in the hand and detaching blades with a hammerstone is convenient and efficient, and yields cores, blades, and other reduction products that match perfectly those in the archaeological collections.

Analysis of the 'Ain Ghazal collections and experimental replication lead to the conclusion that the basic core reduction strategy was as described in the following paragraphs. Blades were configured on the core prior to detachment. This process involved the actions detailed below, but they need not always have been accomplished in the same order. Some of the byproducts detached in the course of these actions might have been used as tools, but most often they probably ended up as discarded debris on the chipping floor.

(1) A prominent ridge (or ridges) was selected to become the dorsal face of the intended blade. The ridge usually required straightening and enhancing by detaching *ridge-straightening blades and "bladelets,"* which could be detached from either platform, as required. They sometimes were crested (either unifacially or bifacially) to improve a ridge and ensure successful blade detachment. Generally, ridge-straightening blades (both *crested blades* and *noncrested blades and "bladelets"*) were detached with little preparation of their platforms, which might be relatively broad and single-faceted. Detachment of these blades also helped to maintain and properly configure the profile of the core face. Careful detachment of ridge-straightening blades is a necessary step in preparing the core face to produce a blade with a desired cross section, such as a trapezoidal one.

(2) One of the two core platforms was selected for detachment of the blade. The choice was determined by a combination of factors, including the best angle between the platform and the working face of the core, and the most favorable access to a dominant ridge on the core face.

(3) The margin of the selected core platform was strengthened and the intended blade platform was isolated and aligned with a prominent ridge (or ridges) on the face of the core (Plate IV.a-c). Blade platform isolation and alignment were accomplished by removing a series of *platform-isolation elements*. These byproducts included small *edge-preparation flakes and blades*, and what might often be classified as *"bladelets"*[1]. The former of these removed overhangs and negative bulbs from the margin of the core platform and moved the margin back slightly from the working face of the core. This action ensured that the working face was slightly rounded rather than perfectly straight, as a straight core face was likely to cause failure of the blade during detachment. A slight rounding of the working face of the core was especially important where the blade was to be detached. Small,

[1] Although such "bladelets" are quite common in the 'Ain Ghazal collections, cores specifically intended for production of bladelets or microblades are all but absent. This fact reinforces the technological classification of these small blades as byproducts of standard blade production.

often curved, "bladelets" were detached adjacent to the intended blade platform to help isolate, align, and strengthen it. Pressure, as well as direct percussion with a very narrow hammerstone may have been used for these detachments. The detached byproducts tend to have somewhat broad, unprepared platforms.

(4) During the preparation and detachment of a blade, one of the core platforms was working, or active, and the other inactive; both required final preparation. The opposed (inactive) platform was raked with the hammerstone in the direction of the core face. This action removed existing overhangs or negative bulbs and set the margin of that platform slightly back from the face of the core. Such treatment helped to ensure that a blade detached from the active platform would end in a feather termination near the inactive platform, rather than an overshot termination. The isolated platform of the intended blade usually was abraded. Abrasion provided a roughened surface for firm contact of the hammerstone, and strengthened the platform by eliminating surficial fractures and irregularities that could lead to platform collapse. It also strengthened the platform area by moving it back from the working face of the core. Careful preparation resulted in a minute potential blade platform. The width of the initiating fracture was thereby greatly reduced, enabling the blade to be detached with minimal force. These combined actions resulted in the punctiform platforms of blades detached from naviform cores (Plate IV).

Once these preparatory actions were completed, actual blade detachment was accomplished by a sharp, glancing blow of a hammerstone that peeled the blade away from the face of the core. This method of detachment is quite different from the indirect percussion (or punch) method, which more consistently produces blades with broader and less isolated platforms. Detachment of blades by pressure results in very regular blade morphology, with straight and parallel dorsal ridges and lateral margins; such blades are quite unlike blades detached from naviform cores.

In the archaeological collections, often the *initial blade* is a *crested blade*; that is, the dorsal ridge of the blade is the former bifaced margin of the preformed core. Usually these margins were carefully executed and straightened, and formed into a flat, graceful curve running the length of the core (Plate II.a; Plate V.a). This profile was necessary to ensure that the blade ran the approximate length of the core and left a smooth detachment surface for subsequent blade removal. If the initial blade failed to run the full length of the core, the shortfall usually was detached from the opposite platform. Depending on the configuration of the preformed core, the initial blade also might be *unprepared*, with a natural or cortical dorsal face. Or, it might be unifacially crested, or a combination of these forms.

Noninitial blades were detached from the core in the same manner as the initial blade, that is, by direct percussion with a hammerstone, but they required more extensive preparation prior to detachment. More effort was needed to configure and straighten the guiding ridges and align the platform of the intended blade with a ridge on the face of the core (Plate IV.d-e). There also were frequent changes in the direction of blade detachment as the knapper selected the better platform (the one with the better angle to the working face of the core, and the better access to a ridge or ridges on the face of the core) (Plate V)[1].

Both initial blades and noninitial blades sometimes overshot, plunging into the distal end of the core. *Overshot blades* typically were detached when the guiding ridge was especially prominent, such as during detachment of an initial crested blade (Plate V.a). They often resulted from a blade being detached along one edge of the working face of a core (Plate VI.a). In such cases, the blade thickened, plunged, and turned laterally back into the mass of the core, often causing its complete destruction. The cause of such accidents was a combination of excessive force directed along a prominent ridge and failure to support the core properly.

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[1] Usually, compression rings, gull wings, undulations, and previous blade scars on blades indicate the bidirectional nature of the parent cores.

Plate I. Naviform core, blade, and raw material characteristics.

a: Profile view of an expended naviform core with a natural cortical back and straight working face, and straight blade tools (sickle blades) detached from such a core; archaeological examples, here, and elsewhere, of flint from 'Ain Ghazal, Jordan <scale here, and elsewhere, in centimeters>.

b: The same sickle blades, dorsal faces, showing characteristics of blades detached from naviform cores: punctiform platforms, bidirectionality of blade scars, and evidence of platform isolation.

c: Typical projectile points and edge-modified blades made from straight blade blanks struck from naviform cores; archaeological.

d: Raw material configurations (tabular flint, flat flint nodule, thick flint nodule) from which naviform cores were made.

e: Preformed naviform cores (upper and right), and completed core with platform spalls removed (left) replicated from the raw material configurations shown in d.

f: Replicated (left) and archaeological (right) naviform cores made from flat flint nodules; note the pristine quality of the cortex in each case, indicating freshly mined flint.

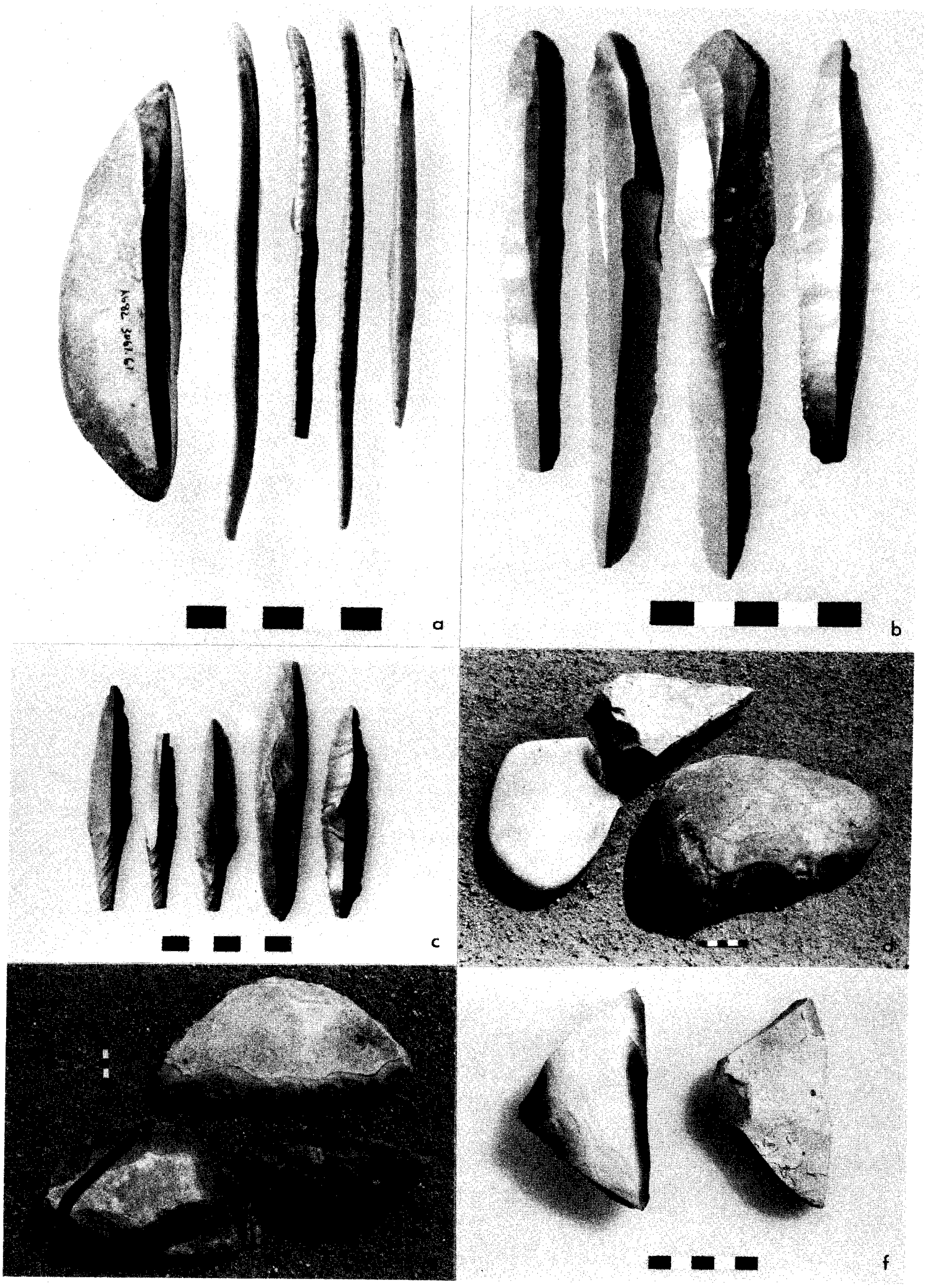

Plate I

Plate II. Naviform core and platform spall characteristics.

a: Replicated preformed core made from tabular flint, showing faceted ends at left and right where platforms will be created by detaching platform spalls.

b: Same preformed core showing bifacially configured (crested) front margin prior to detaching the initial blade.

c: *Initial (cortical) platform spalls*, profile views, spall platforms at top; archaeological.

d: *Crested (initial or noninitial) platform spalls*, dorsal faces, spall platforms at top; archaeological.

e: Same replicated preformed core as in a and b showing one of the faceted ends prior to detaching the platform spall; back of preformed core at lower right.

f: *Faceted platform spalls (initial or noninitial)*, dorsal faces, spall platforms at top; archaeological.

g: *Noninitial, corrective, platform spalls*, dorsal faces, spall platforms at top; archaeological.

h: *Noninitial, corrective*, and *spontaneous, platform spalls*, dorsal faces, spall platforms at top; archaeological.

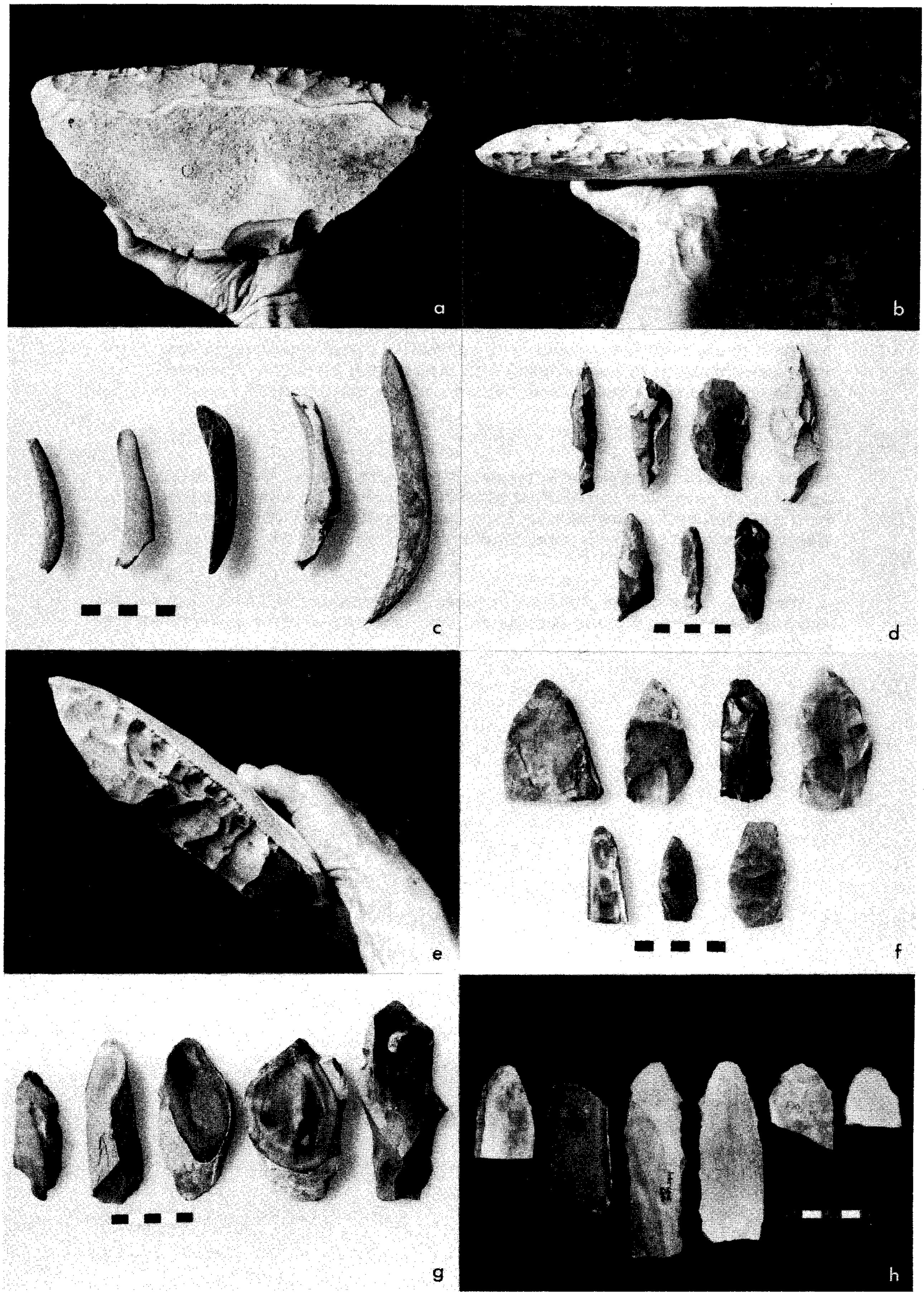

Plate II

Plate III. Characteristics of expended archaeological naviform cores.

a: Profile views of cores with typical naviform configuration; note opposed platforms at acute angles to the straight working faces of the cores; upper left pair, made from flat nodules, with substantial cortex remaining; upper right pair, made from flat nodules, with intersecting platforms; lower left and lower right pairs, made from thicker nodules that required extensive modification.

b: Back views of the same cores; upper left pair, with natural cortical backs; upper right pair, with unmodified platform intersections; lower left pair, with modified backs showing scars from detachment of *back core-trimming flakes*; lower right pair, with remnant bifacially worked margins.

c: Working faces of the same cores; note parallel sides of cores, scars showing bidirectional blade detachment, and evidence of error correction on core faces.

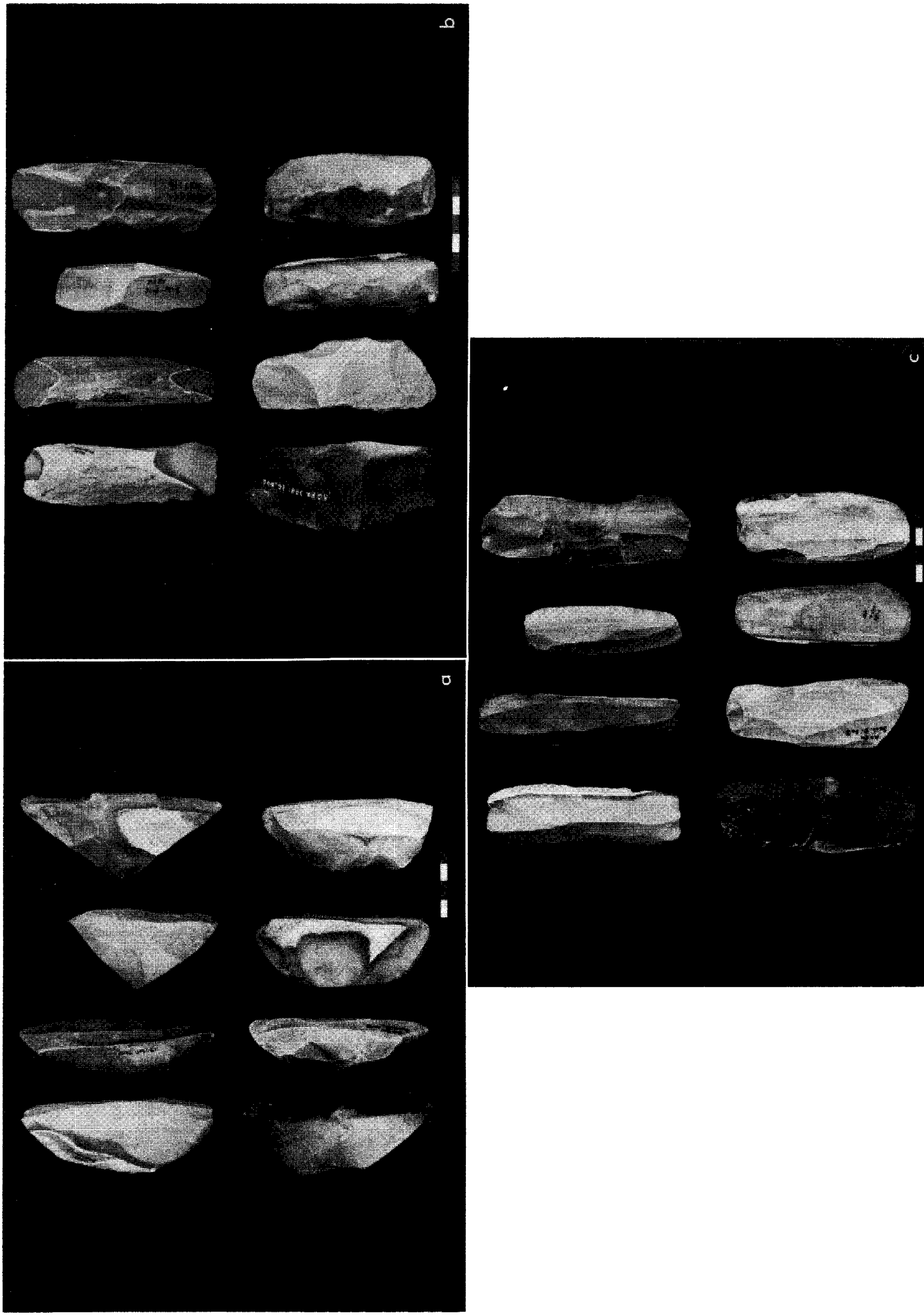

Plate III

Plate IV. Core reduction and blade characteristics.

a: Working face of a replicated naviform core and detached blade showing characteristics of the bulb area and detachment surface.

b: Platform of the same core with three refitted blades; note the amount of material expended in isolating platforms of prospective blades.

c: The same core and blades.

d: Experimental (left five examples) and archaeological blades detached from naviform cores; dorsal faces; note similar characteristics: punctiform platforms, alignment of arrises, and dorsal scar patterns.

e: The same blades, ventral faces.

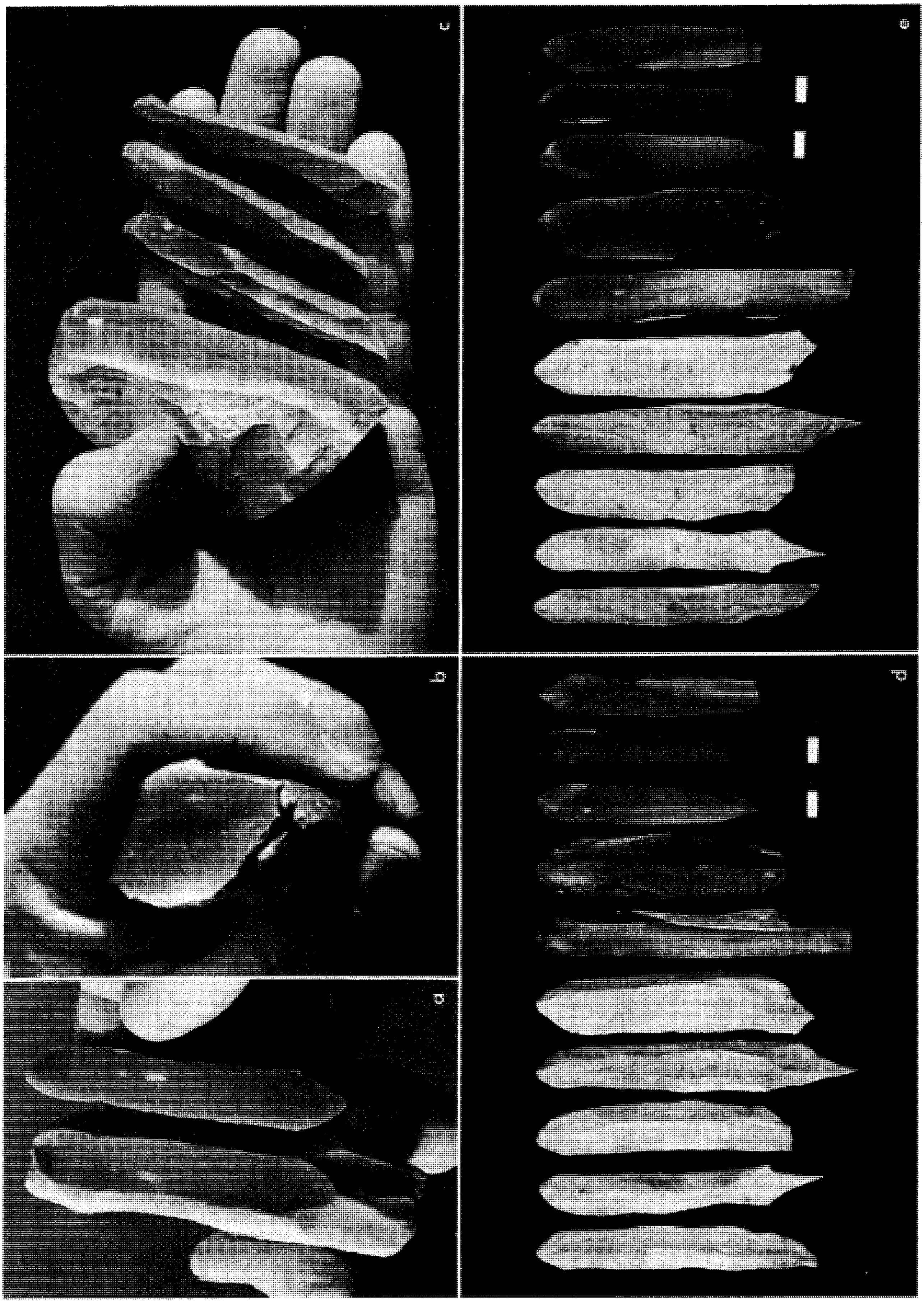

Plate IV

Plate V. Replicated naviform core reduction.

a: Exploded view showing the relative position and characteristics of the component parts; note *initial* (upper and lower) and *noninitial (corrective) platform spalls* (lower), *back core-trimming flake* (left center), expended core, *initial (crested) blade* at right (with minor overshot termination), and the better blades (potential tool blanks) positioned and sequenced as detached from the core.

b: Other blades and *platform-isolation elements* arranged in the same relative order indicated in a; note *"bladelets",edge-preparation flakes and blades,* and *ridge-straightening blades and "bladelets".*

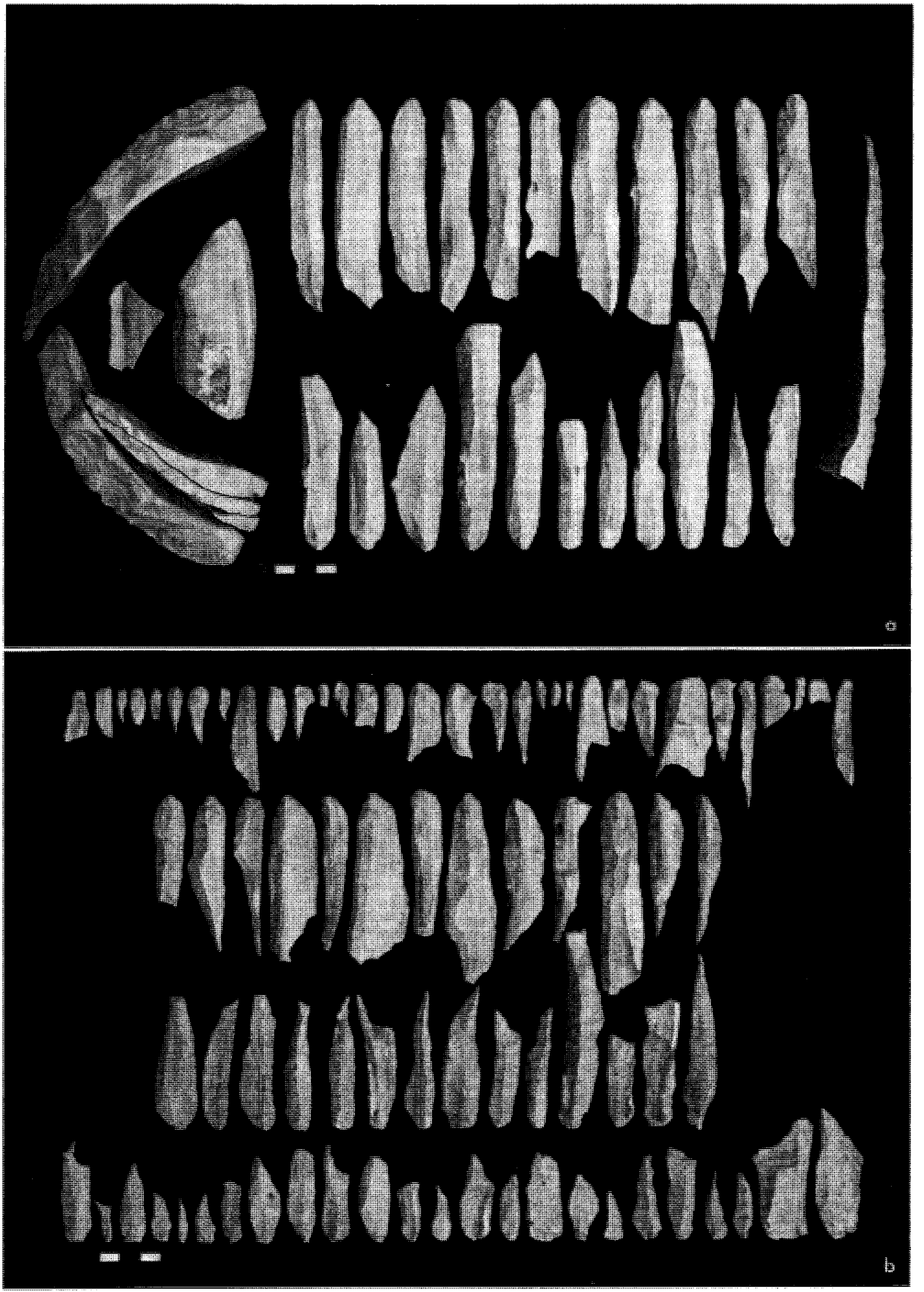

Plate V

Plate VI. Additional assemblage characteristics.

a: Distal ends of *overshot blades*; note removal of core edge and much of the inactive core platform.

b: *Hinge- and step-removal blades.*

c: Cores showing scars from detachment of *lateral core-trimming flakes*; note scars from core-trimming flakes detached from the platforms, from the working face, and from the back of the core.

d: Expended naviform blade cores recycled as flake cores and completely exhausted; original working faces to the left, original platforms to the right. All archaeological.

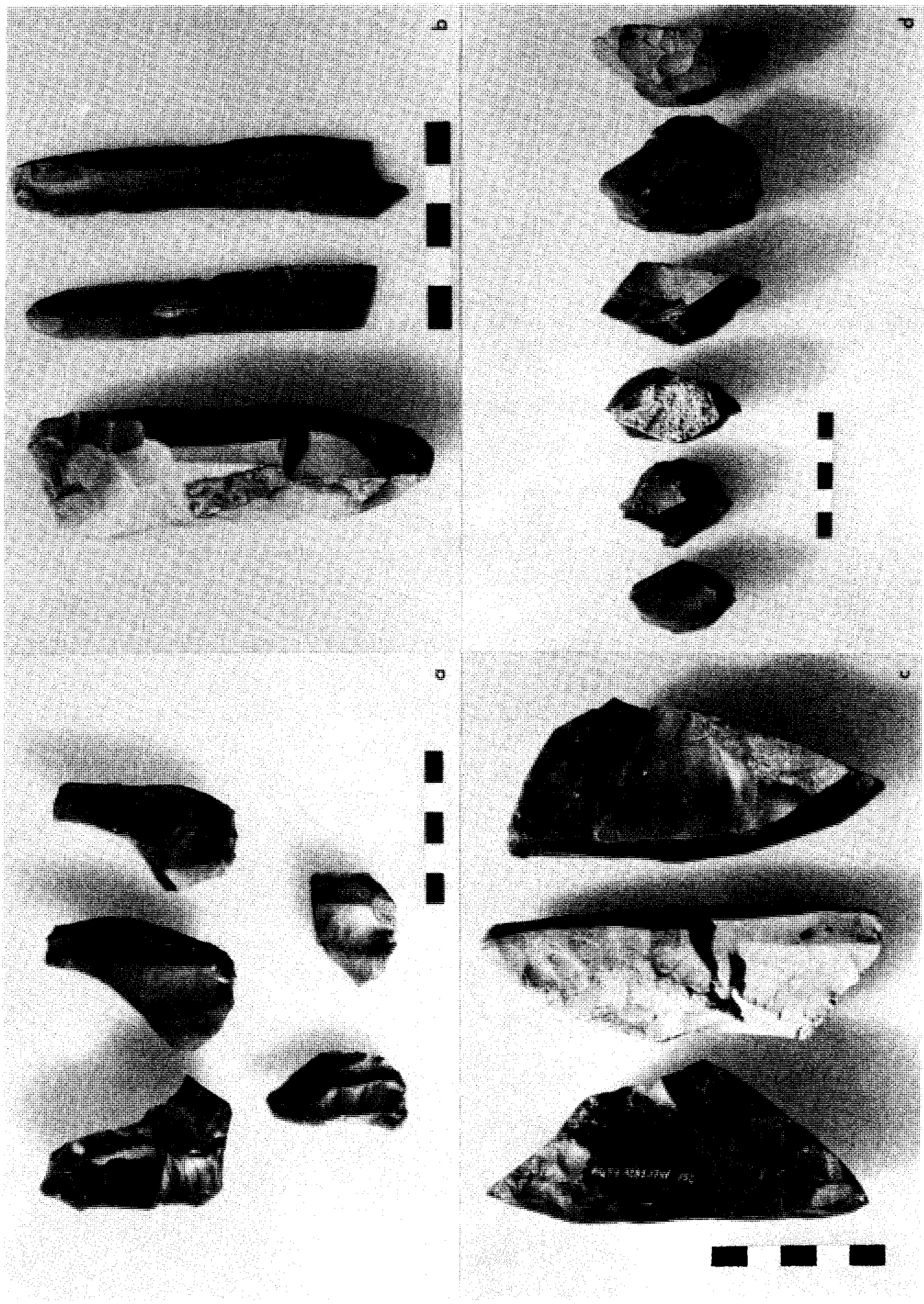

Plate VI

Plate VII. Hammerstones and expended naviform cores.

a: Flint hammerstones with heavily battered, incipient-cone surfaces; poor choices for blade detachment, but useful for heavy percussive work such as dressing milling stones; archaeological.

b: Softer hammerstones of consolidated sandstone used in replicative work reported here.

c: Uniform size of typical cores when considered expended; archaeological.

d: Expended cores used as pecking stones, possibly for shaping axes or other tools; note battered areas; archaeological.

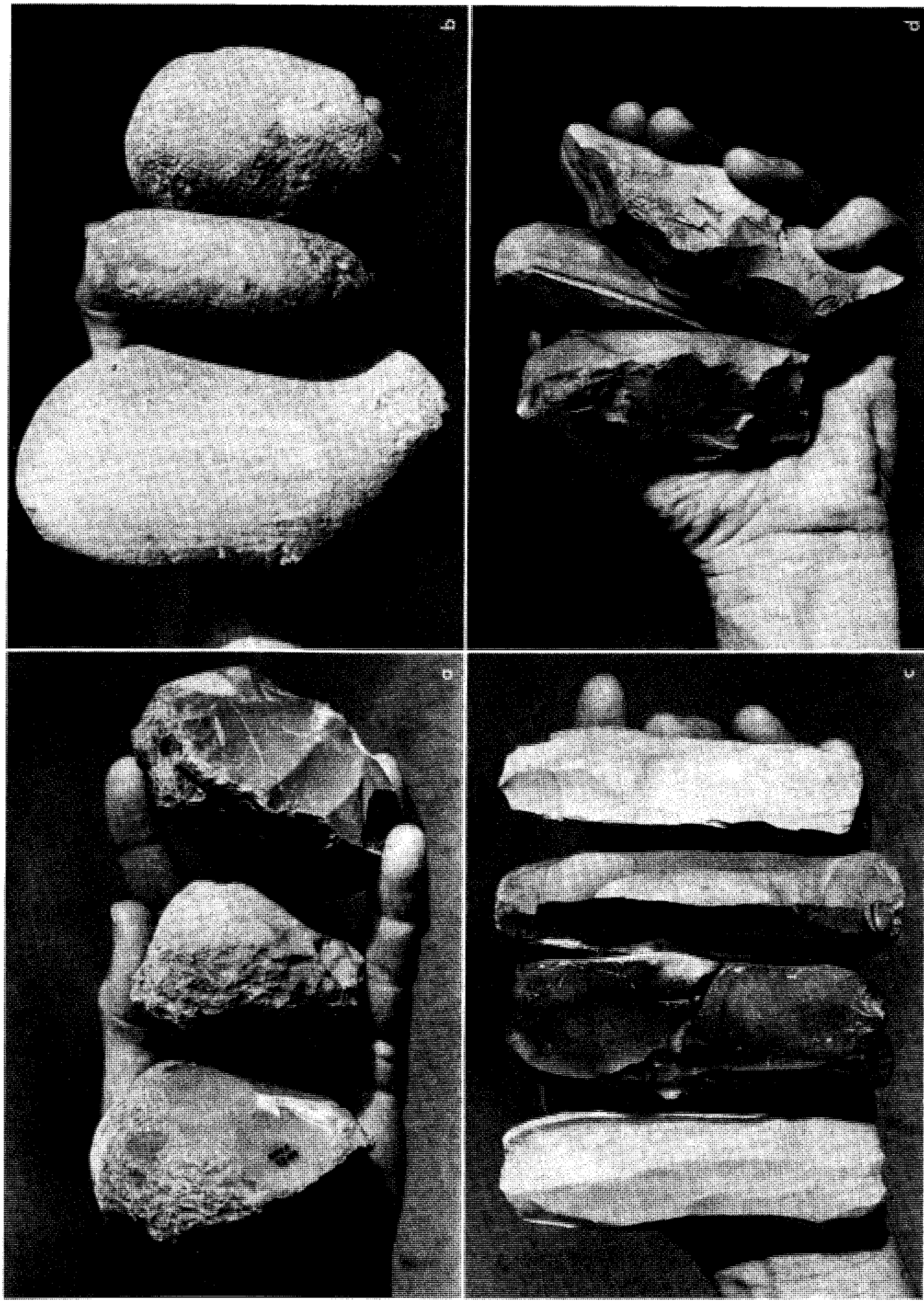

Plate VII

Core Maintenance

Core morphology was carefully maintained during reduction. Attention was given to both the working face and the sides of the core. Maintaining the working face of the core was largely accomplished incidental to preparing blades for detachment, as successful blade production could not occur if the working face of the core was not well maintained. Often blades failed to run their intended distance and ended in hinge terminations. Highly diagnostic *hinge- and step-removal blades* ("clean-up blades"; Plate VI.b) are common in the collections, and indicate intentional removal of topographic irregularities from the face of the core[1]. *Profile-correction blades* sometimes were detached to help straighten the face of the core. Removal of such blades became necessary if one platform was used to detach a succession of blades that failed to reach the opposite platform, leaving the face of the core with a bulge near the opposing platform.

It was necessary to ensure that the core remained parallel-sided and of approximately the same width as the platforms. Cores made from rounded flint nodules were particularly critical in this regard, as they required constant maintenance. The sides of cores were flattened during reduction by detaching *lateral core-trimming flakes* from the lateral margins of the platforms, from the backs of cores, or even from lateral margins of the working faces (Plate III.b; Plate VI.c). Often only scars of lateral core-trimming flakes originating from the platforms can be shown conclusively to be evidence of core maintenance during reduction. Removal of lateral core-trimming flakes also trimmed existing cortex from the sides of the core, ensuring that subsequent blades would not have cortical margins. Occasionally the back of the core was modified by removal of *back core-trimming flakes* in order to prepare platforms for detachment of lateral core-trimming flakes. Thus, core-trimming flakes result from both core preparation and core maintenance.

Archaeological collections show that it sometimes became necessary to establish a new platform at one end of the core. This action usually followed a series of margin collapses at one platform, or encountering a flaw in the stone during blade production. New platforms were made by detaching *corrective platform spalls*. Such spalls were detached from the platform margin at the working face of the core, most often are flat ("ski spalls"), and may include at their proximal ends remnants of the defects that led to their detachment.

A suitable hammerstone for reduction and maintenance of naviform blade cores was a stone softer than the material from which the core was made. Flint is far too hard a material for this purpose. Flint hammerstones commonly reported from PPN contexts are heavily battered, with incipient-cone surfaces from heavy percussion use, perhaps from dressing milling stones (Plate VII.a). It is unlikely that they were used to produce blades. Experience has shown that softer hammerstones, particularly long and flat ones of consolidated sandstone or weathered limestone, are excellent choices for blade production. Such hammerstones were used in the replicative work reported here (Plate VII.b). One soft limestone hammerstone bearing abrasion marks on its flat surface was noted in the 'Ain Ghazal assemblage. Soft hammerstones must be maintained by abrading their working surfaces to smooth them and eliminate roughness and pitting that can cause multiple contacts with the platform during a detachment blow.

Discussion

The above discussion describes in a very general way the basic strategy involved in PPN naviform blade-core technology. Many subtle aspects of the technology, and how it has been perceived, cannot be addressed here, but a few should be mentioned. The first involves acceptable width and length of cores. Naviform cores in collections with which we are familiar are mostly of similar width, averaging a little over 3 cm at 'Ain Ghazal. This width was important and strongly influenced the average width of blades that could be produced from them. Blade width in turn was dictated by the nature of the tools

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[1] Hinge terminations are common on blade scars on the faces of cores. They indicate the point at which the fracture detaching a blade abruptly halted and the blade rolled out from the face of the core. Step terminations are not common midway on the core faces, but tend to occur near the ends where platforms collapsed. Hinge- and step-removal blades were detached to remove both of these types of terminations.

(projectile points, sickle blades, borers, etc.) to be made from blades. The many facets of PPN blade technology are therefore interrelated.

Core reduction usually proceeded until the core became too small to hold effectively in the hand. In most assemblages that we have examined, this point was reached when core length was reduced to the width of a handgrip (Plate VII.c). Experience has shown that at this point the core is more difficult to hold and has lost mass and inertia necessary for immobilization during blade detachment. Most PPN naviform cores were considered expended for blade-making when they reached this size; they were in fact still usable, but they would have yielded shorter and less regular blades, and with greater difficulty. That they were retired from blade production when their length was still the width of a handgrip is evidence of two factors: a need or preference for long blades for tools, and the availability of abundant quantities of excellent flint in the nearby lithic landscape. Both situations clearly apply at 'Ain Ghazal, where the prehistoric flint mines recently were found less than two kilometers from the site. This extensive flint deposit must have yielded ample supplies of high-quality stone for a long period of time.

At 'Ain Ghazal, however, the situation actually is more complex. When no longer capable of yielding blades of desired length, many naviform cores were discarded, but others were recycled as flake cores and further reduced to very small size. These much-reduced flake cores no longer have the appearance of naviform cores. Many of them were reduced to the extent that only very careful examination reveals their origin as standard naviform blade cores. That they originally were naviform cores is indicated by remnants of blade scars on what remains of the former working face, cortex adjacent to the working face, and remnants of the original platforms, all still in their proper spatial relationship to one another (Plate VI.d). Whether this situation occurred at other sites is not known. Examination of the 'Ain Ghazal collections reveals also that naviform blade cores of the best flint were most often reduced the farthest during blade production. Moreover, when blade cores were recycled as flake cores, the ones of better flint also were reduced the farthest. There is, however, little evidence of blade production during the Pottery Neolithic at 'Ain Ghazal. Rather, it appears that the need for blades was met by scavenging old blades from the PPN deposit, and that old naviform cores were recycled out of the same archaeological deposit and used as flake cores.

Some PPN naviform cores also were recycled and used as pecking stones, possibly for shaping axes or other tools (Plate VII.d). Evidence of such use is seen as battering, usually at the ends of the cores.

Understanding the characteristics of naviform core-and-blade assemblages requires careful study of the local stone sources used for core production. The use of tabular flint, such as at Wadi el-Jilat and Basta, and its role in determining assemblage characteristics (especially the abundance of faceting, and the scarcity of cortical platform spalls and cortical initial blades) has already been alluded to. At 'Ain Ghazal most of the flint was mined from seams of nodules exposed in the walls of a nearby wadi. Most of this flint has a very thin cortex, often only a millimeter thick. Removal of the cortex from the sides of the cores was not mandatory. Many cores and blades have some cortex, and cortical platform spalls and initial blades are common at the site. In places where the available raw material had thick cortex, or where the nodules were thicker, stone may have been completely decorticated where it was obtained. This situation would of course result in somewhat different assemblage characteristics at the places where cores were both produced and reduced.

Earlier studies revealed general aspects of the lithic reduction sequence that characterizes naviform core-and-blade technology. By focusing on the morphology of the abandoned remnants of the technology, these studies were able to describe the principal artifacts, but were less able to explain why the artifacts have the forms they do. Strict typological approaches may also hinder recognition of important aspects of the technology, with the result that artifacts may be misinterpreted. For example, the small "bladelets," which are byproducts of blade production, have been interpreted as evidence of a microblade industry. Likewise, "upsilon" blades, which are unavoidable byproducts of percussion-blade production, have been interpreted as intentionally made tools[1]. And variations in naviform core morphology have been interpreted as temporal markers.

Typological analyses combined with replicative studies permit a fuller awareness of the range and functions of artifacts representative of a technology. This combined approach reveals the rules that structured the technology, the choices available, and the actions carried out. It provides experience that enables one to identify behaviors: the work of master knappers by their skillful use of the options; that of unskilled knappers by their errors. It reveals the degree to which the raw material constrained the technology and ultimately structured the archaeological record. And perhaps most importantly, it provides a secure basis for addressing broader issues of prehistory.

Acknowledgments: The 'Ain Ghazal project, begun in 1982, continues under the joint direction of Gary Rollefson and Zeidan Kafafi, whom we thank for permission to study the flaked stone assemblages. The project is administered by Safwan Tell, Director-General of the Department of Antiquities of the Hashemite Kingdom of Jordan. We thank HRH Crown Prince Hassan bin Talal for his continued interest in the project. Pierre Bikai, Director of the American Center for Oriental Research, and his staff in Amman provided research facilities and many conveniences. We thank Hans Georg Gebel and Stefan Karol Kozłowski for asking us to prepare this paper, and Gary Rollefson for his kind encouragement. This work has benefitted from discussions with Hans Georg Gebel, Douglas Baird, Eric Coqueugniot, Isabella Caneva, and Nur Balkan-Atlı. Hans Georg Gebel, Douglas Baird, and Yoshihiro Nishiaki allowed us to examine portions of their research material. Del Bryan and Bill Snead made it possible for us to obtain flint for our replicative work from the quarries of the Texas Crushed Stone Company at Georgetown. Allen Bettis and Glenn Goode generously shared their flint supplies. We especially thank Glenn Goode for donating many of the flat nodules of Texas flint we reduced in the course of this research. Joëlle Henderson prepared the French résumé, and Janusz Kozłowski and Louis Pedrotti helped with the Polish literature. Steve Walag and Mike Capriotti prepared the photographs from our negatives. Funds for this research were provided in part by the Graduate Division and the Academic Senate of the University of California, Riverside.

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[1] These short blades with bifurcate distal ends have been a source of confusion. While they may have been used occasionally in prehistory for tools, or for tool production, it seems unlikely that they were intionally made since they are common debris from blade production (cf. ATAMAN 1988, 1989-90; CALLEY 1988; ROODENBERG 1989).

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Reflections on the Significance of Two PPN Typological Classes in Light of Experimentation and Microwear Analysis: Flint "Sickles" and Obsidian "Çayönü Tools"

Patricia C. Anderson

Introduction

Most typological categories of chipped stone tools are defined using attributes which are the result of modifications of the working edge or of the shape of a blank by voluntary retouch, a burin blow, etc. The definition of some particular classes relies, on the contrary, on the presence of macroscopically-visible traces produced by the tool use. Two easily-recognizable classes of this latter sort are flint blades and flakes with gloss, usually called sickles, and a more regionally and temporally-limited tool type, abraded "Çayönü" tools in obsidian. In this article we wish to discuss some results from our experimental and functional analysis of many of these tools in terms of what their typological classes signify. The "Çayönü" tools (sometimes called "backed blades", see REDMAN 1973, and CANEVA *et al.* this vol.), have marked linear abrasion on a single face of the tool, often the bulbar face adjacent to a steeply retouched edge. Many researchers have likened the abrasion on the latter to gloss on flint tools, with the two kinds of macro-traces considered to be manifestations of their use as sickles (ex. CAUVIN J. 1985, CAUVIN M.-C. 1988, BADER 1989). This has led to an interpretation of agricultural activities from the presence of these tool types in archeological assemblages, and morphological sub-groups described for these "harvesting" tools have been considered to be culturally-related attributes. Can these affirmations be demonstrated?

We have carried out experiments with modern copies of flint and obsidian tools like these, first in order to test how they function on various materials and using different working motions, and second, to reproduce the kinds of macro-traces of use (and study microscopic characteristics) seen on prehistoric tools. We will discuss use-related variables underscored by this research (shape, retouch and macrotraces on tools), as well as problems and potential in using them as criteria in establishing and interpreting typological groups.

Retouch/ Use Cycles and Tool Form

It seems to us that even in a preliminary phase, a formal typology should give different weight to tools with retouch occurring before use, as opposed to those which began their use-life as unretouched blanks and were retouched or otherwise modified as they evolved through their use-life. Studying tools microscopically for use-traces provides a means of determining the temporal relationship of tool retouch to use, enabling us to differentiate among the following groups of "tools" (see figures for examples of these types):

1) "Preform" retouch, occurring prior to use which modifies:

a) the shape of the overall blank. This may indicate there was a mental "template" operating, beyond the mere choice of a blank. This retouch prior to use may reflect style, hafting accomodation (Fig. 1:3), tool balance, etc. and would often be used for projectile points, or
b) only a future working edge. This would strengthen, sharpen or regularise it. This intentional retouch may be confused with retouch resulting only from use, in the absence of appropriate experimental use-wear data.

2) "Evolutive" retouch, occurring for tools which were first used with unretouched working edges, when these same edges needed resharpening, strengthening, or regularising to continue use on the same material (identified when vestigial parts of the unretouched working area can be found, despite subsequent retouch and re-use of the edge, see Figs. 1:1,5< and all of Fig. 3). The tool thus "evolves" through one or more cycles of use/ dulling/ resharpening for working of one kind of material.

3) "Transformation" retouch, occurring after first use of the tool when the second material worked is different from the first:
a) In the same working edge zone as that used previously (Figs. 3:4,1:8), or
b) In a different area of the tool from that used previously, modifying its shape, or causing a marked change in the shape of a former active zone. These modifications change the form of the tool from that in which it was first used (Figs. 3:1,4-6).

In our microwear analysis of several hundred "glossed" tools and "Çayönü" tools, we found examples of each retouch type, although most were of types two or three. In these latter cases, the retouched tool shape did not correspond to a pre-use concept (Type 1), but rather occurred during or after the use creating the gloss or the abrasion.

Methods of Study of Use-Traces and Function

Another problem of interpretation of typological groups occurs when site activities are deduced from shape and macrotraces on tools studied only with the naked eye, as is often the case for the two categories discussed here. Does the assumption frequently made, that glossed tools and Çayönü tools are sickles, hold up when experimental microwear analysis of use-traces is applied? We have briefly illustrated the methodology used to find various uses of glossed tools or sickles in Plates 1-3 and Figs. 1-2, and for Çayönü tools in Figs. 3-4, and Plate 4 (see captions for explanations). We addressed this question by carrying out harvesting experiments over a period of approximately ten years, as well as other experiments, in order to find out:

a) whether all harvesting created gloss on flint tool edges, (or abrasion, for obsidian tools),

b) whether working other materials with tools also caused macroscopic gloss to form on flint tool edges, or special abrasion on obsidian tools,

c) whether microscopic analysis of the traces could separate gloss on flint tools from harvest from plant processing, and furthermore separate working of plants from that of other materials. (It was rapidly clear that harvest and plantworking with obsidian tools did not create the marked abrasion traces characteristic of Çayönü tools, which therefore will be discussed later.).

We found that:

a) all harvesting of siliceous plants in field or aquatic contexts, created gloss just detectable to the naked eye on flint tools after about an hour or two of use,

b) traces virtually indistinguishable from these using the naked eye, were produced on flint tools by working of other soft or humid mineral materials such as clay (ANDERSON-GERFAUD *et al.* 1989), or materials with mineral material included (*ex hide* with ochre, see Plate 3.C and Fig. 2:5). For obsidian tools it was a particular motion of working of certain mineral materials which produced abrasion like that on Çayönü tools, a special case which will be discussed below.

c) microscopic analysis (if added to visual inspection) provided criteria adequate to distinguish among these uses, in most cases (see plates and captions for examples explaining the techniques and data used).

Experiments and microscopic and chemical analysis of residues (SEM and EDAX; ANDERSON 1980, ANDERSON-GERFAUD 1986) have shown that gloss corresponds to smoothing of the flint grain boundaries with a small component of residue material adhering in crevices or between grains, and that the appearance and distribution of this surface smoothing and of any linear traces crossing it such as striations, will closely reflect the nature of the material worked, conditions of work (abrasiveness, humidity, etc.) and direction of a repeated working motion. These are microscopic attributes which can be seen in most cases at 100-200x magnification according to methodology originally elaborated by Semenov (1964) and his students, and by Keeley (1980). SEM and EDAX (energy-dispersive) analysis of residues can complement observations using the above techniques (see Plate 4 and Fig. 4). Microscopic wear traces recognized in specific replicative experiments, therefore, differ in some detail, whether cutting (harvesting) stalks of cereal (Plate 2) or cutting reeds (Plate 1), or on the contrary, cutting or working clay, plaster or other soils or mineral materials (Plate 3) - all of which can cause "sickle-gloss" to form. Our observations on these points have been corroborated by other experimentally-based microwear studies (ex. VAN GIJN 1992, JUEL JENSEN 1988 who have shown certain Mesolithic and Neolithic glossed tools from Northern Europe were not used as sickles).

Therefore, cereal harvest as a tool use is usually deduced only after taking into account a variety of information on motion and worked material.

Traces of Cereal Harvesting and Processing on Flint Tools from the PPN

Experiments carried out since 1986 with wild cereals (Plate 2) and early domestic cereal types corresponding to those identified in the sites from grain material, have produced characteristic use-traces on copies of prehistoric harvesting tools, like those on the Pre-Pottery Neolithic glossed tools we have seen over a period of ten years. Our experiments show the particular, identifiable microwear trace attributes correspond to cutting stems of cereals near the ground, where the field density is such that stems can be held in groups with one hand as the tool, held in the other hand, is drawn across the bundle. Fine, short striae seen with a microscope as traversing the smooth bright-appearing surface of the microwear polish on the tool edge, (see Plate 2) are present when the harvest occurs near (ie., at 20-30 cm.) from the soil, (Plate 2.A) whether or not the soil has been worked (contrary to UNGER-HAMILTON, 1989), an issue important for questions concerning the nature of wild cereal "cultivation".

Furthermore, when the harvest occurs at a time at which most wild cereal grains will still be attached to the stem (the rachis will not have shattered), there is a characteristic appearance of the polish at 100-200x (ex. Plate 2.B and 2.C) -in brightness and in extent of distribution over the microscopic grain structure- which precisely reflects the particular humidity content (which we measured, ANDERSON 1992) and hardness of the stems as they are cut at that moment. These microscopic variables and the harvest yield change rapidly as stems lose humidity, ripening occurs and grain is shed (Indications of stems cut after this point of humidity would suggest the cut occurred more to obtain straw, because grains would have fallen to the ground (ANDERSON *op. cit.*).).

Microwear traces we have seen on a certain number of glossed tools from the pre-domestic PPN, show harvesting occurred during this key period when grain is viable but before most has fallen, and that the harvesting technique most commonly attested to is the one described above (ex. Mureybet, ANDERSON 1992; Hatoula, ANDERSON, in press 1). The technique continues to be attested to by traces on tools from domestic PPNA (Aswad, ANDERSON in press 2), and PPNB sites (see Fig. 1, *cf.* Magzalia, and Abu Hureyra, ANDERSON 1992). However, it was also commonly occuring in Epipaleolithic (Abu Hureyra, ANDERSON 1991), and Natufian (Hayonim, ANDERSON *op. cit.*) sites. What is its significance for exploitation and domestication of wild cereals?

This activity must first be correctly identified among the "glossed tool" candidates by microwear analysis (our research thus far shows many or most of the latter are actually used to harvest reed in PPN sites). Harvest of wild cereals using a sickle has been shown to have potential for "unconscious selection" for "domestic-type" cereals hidden in the wild population, and when associated with other behaviour, it can lead to cereal domestication (see below and HILLMAN and DAVIES 1992). However, our experiments ANDERSON-GERFAUD *et al.* 1991, ANDERSON 1992) partially explain how domestication would not have been the most likely outcome of sickle-harvesting of wild grain in most sites, even if cultivation were occurring. This was due to the fact that other behaviours necessary to assure that the future "domestic-type" harvested grain was kept from being re-mixed with the wild population, were unlikely to have been occurring. Such behaviours, (annual soil preparation or change in field location), seem to be inefficient techniques for wild cereal exploitation by a sedentary population (ANDERSON 1992). Even though "efficient" sickle-harvesting of nearly "green" grain was occurring (as shown on prehistoric tools), our experiments showed that wild cereal grain spilled would have been sufficient to grow back in the field the following year as richly as a planted field. Harvest of this would be mixed with that from any existing planted fields of "selected" grain, by the harvesters. If growback alone was counted on to propogate the population "naturally", without intentional planting, as is most often the case for wild grasses exploited even today (HARLAN 1992), this may also explain why domestication of wild cereals has not been identified in large sedentary PPNA sites. However, it is interesting that harvesting technique as seen from traces on tools, appears thus far to be common to both wild and domestic cereal exploitation *(ibid.)*. This is despite the fact other aspects of wild vs. domestic cereal exploitation involved very different behaviours (see above refs. for discussion).

New tools for cereal processing seem to occur once cereal is morphologically of domestic type. Bone tools for separating heads from stalks after the harvest have been identified at Ganj Dareh (STORDEUR and ANDERSON-GERFAUD 1985, ANDERSON *et al.* 1991). Our recent research has discovered traces on a few glossed tools suggesting they were hafted and dragged over plant material on the ground; their traces are like those of flint inserts from ethnographic threshing sledges (Plate 3.A). For example at Magzalia (BADER 1989) and Feyda (HOLE, this volume) a few tools with such use-traces (see Figs. 2:1-3 and Plate 3.B; also ATAMAN 1992, SKAKUN 1992), show that processing techniques of quantities of grain as well as of straw (for mudbrick temper, animal fodder?), may have an origin in this period. Skakun finds such traces on Neolithic tools from Bulgaria (personal communication, 1993), and Ataman *(ibid.)* on one tool from Can Hasan III.

Harvesting motion shown by microwear traces on tools from the PPN seem thus far to always involve the cutting motion described earlier. Also,when glossed tools have traces showing transverse motion in relation to the tool edge, we find these are not used for edible plants, but on other materials to transform them into various objects (ex. Plate 3.C and Fig. 2:5 see captions).

The purpose of this rapid summary is to alert archeologists to the fact that much remains to be learned about pre-agricultural and agricultural plant exploitation; that important and unexpected details concerning plant processing may be lurking in microtraces on glossed tools when seen by a specialist; that unfortunately many are not related to sickle use or to plant exploitation at all. In the absence of microwear analysis, the evidence is insufficient to make any deductions concerning site economy from the presence of glossed tools. At such a preliminary stage of observation, it is appropriate to note the presence of glossed tools and treat gloss only as a descriptive attribute of tool morphology.

Abraded "Çayönü Tools"

Exploration of Use

Our research has shown that Çayönü tools (Fig. 3) have abrasion traces and retouch which are are due to the fact they are obsidian, as opposed to flint, and are specialized tools used in a particular way. These special linear abrasion traces are not readily visible to the eye on flint tools which are used in the same way, with a few exceptions (ex. Fig. 2:4).

Our experiments have shown that abrasion traces on the two Çayönü obsidian tools in an earlier study (ANDERSON-GERFAUD 1982), as well as on each of the hundreds of "Çayönü" tools we have since studied using high-power microscopy (100-200x), from Cafer Höyük (CAUVIN *et al.* 1990) and Magzalia (see Fig. 3), could only be produced by abrasion against another lithic material. This use of Çayönü tools was suggested by REDMAN (1973, 1982). We have discounted the possibility this contact

Plate 1.

A : Harvesting of reeds using experimentally-made sickle with flint blades hafted in an antler handle. Blades are set in a groove in the antler and fixed using bitumen. (Photo: P. Anderson)

B : Photomicrograph of the edge of one of the flint blades used in Plate 1.A, seen at 100x. Note "flowing", bright polish left by reed-harvesting, practically devoid of any dark, narrow striae, leaving much of the (matte, dark) flint surface unaffected. Polish appears to stop just back from the edge. (Photo: P. Anderson)

C: Photomicrograph of the edge of the glossed blade shown in Fig. 1:2 (arrow), from the Sultanian (PPNA) at Hatoula (Israel). Bright gloss appears to "flow" in "hilly" undulations over the flint surface but is limited to the edge area and devoid of dark narrow striae, like the experimental gloss in Plate 1.B. These and other use-trace features show the best interpretation for the use of this tool is harvesting of reed. (Photo: P. Anderson)

Plate 2.

A : Use of experimental tool like that in Plate 1.A, with an antler haft and flint insets, for harvesting wild cereal from Anatolia, experimentally-grown at Jalès (Ardèche, France). (Photo: J. Matthei)

B : Photomicrograph (200x) of the edge of one of the flint inserts from the tool in Plate 2.A. Note the abundance of characteristic fine, narrow striae (arrows), which occur with harvest of cereal near the ground, and smooth polish which appears to be bright over much of the dark (matte) flint surface, and is not restricted to the edge area. (Photo: P. Anderson)

C: Photomicrograph (200x) of the edge of the glossed tool (Neolithic) from Mureybet shown in Fig. 1:3 (arrow). Arrows show some of the numerous striae in the polish, as in Plate 2.B, and the smooth, bright polish. The tool is interpreted as having been used to harvest wild cereal, cutting near the soil, as in Plate 2.A. (Photo: P. Anderson)

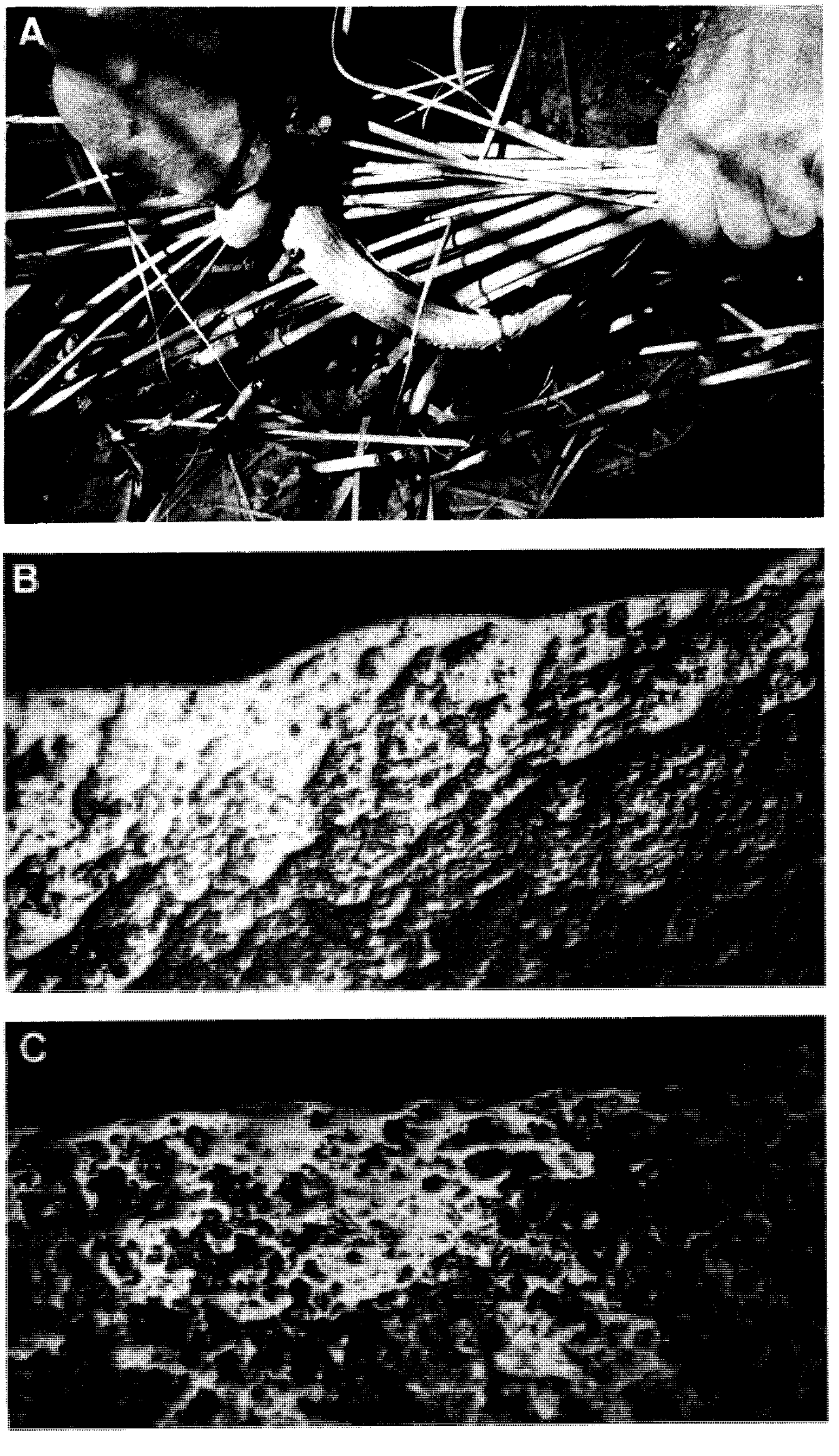

Plate 1.

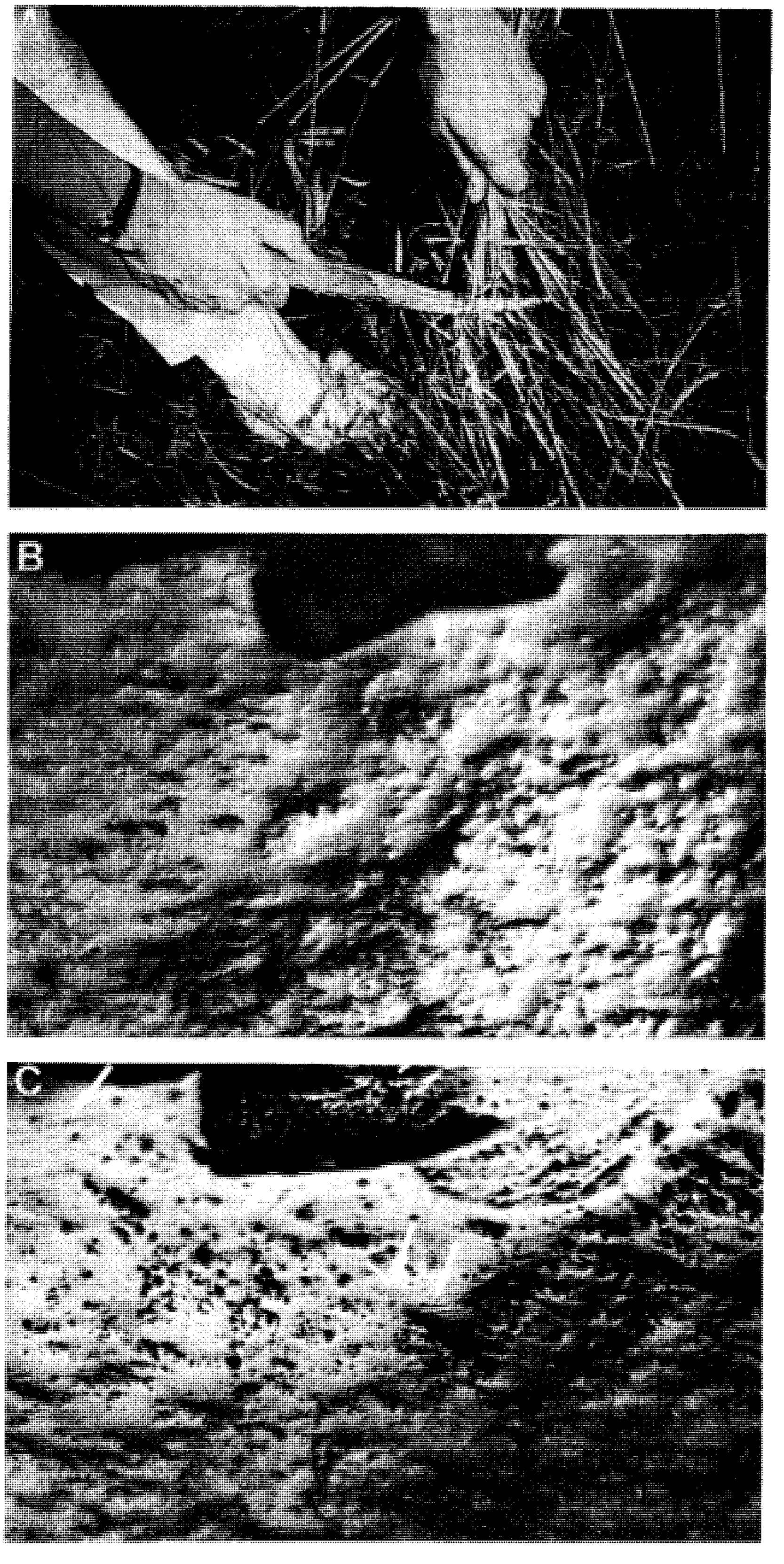

Plate 2.

Figure 1. Actual use is shown for glossed tools which typologically would be considered to be "sickles". Tiny circles indicate location of macroscopic gloss, black arrows show where micrographs were taken.

1. Tool from the PPNB of Magzalia (Iraq). The interpretation from microwear traces is that it was hafted obliquely and used to harvest reed, and retouched in the course of use.

2. Unretouched glossed blade from the PPNA of Hatoula (Israel), which microwear analysis indicates was used to harvest reed (see Plate 1.C).

3. Backed blade with gloss from Mureybet, Epi-Natufian (see micrograph of use-traces, Plate 2.C). Traces on this tool best match those on experimental tools used to harvest wild cereals, cutting near the ground.

4. Blade fragment from Magzalia with gloss, whose traces, like those on the blade in .Fig. 1:3, show the tool was hafted parallel to a handle and used to harvest cereal.

5. Blade fragment with evolutive dentate retouch, with traces as for 1: 4, characteristic of harvesting cereal.

6. Truncated glossed blade from Magzalia with traces characteristic of its having been used in a haft to harvest reed.

7. Unretouched blade fragment from Magzalia with microwear traces showing it was used to harvest reed (use-retouch occurred on the right edge), then the piece was (intentionally?) broken after use.

8. Truncated blade from Magzalia with traces characteristic of harvesting reed with each edge in succession, hafted parallel to a handle; edges were then retouched, and burin removal occurred. We did not identify traces from any second use corresponding to the transformation retouch of the edges.

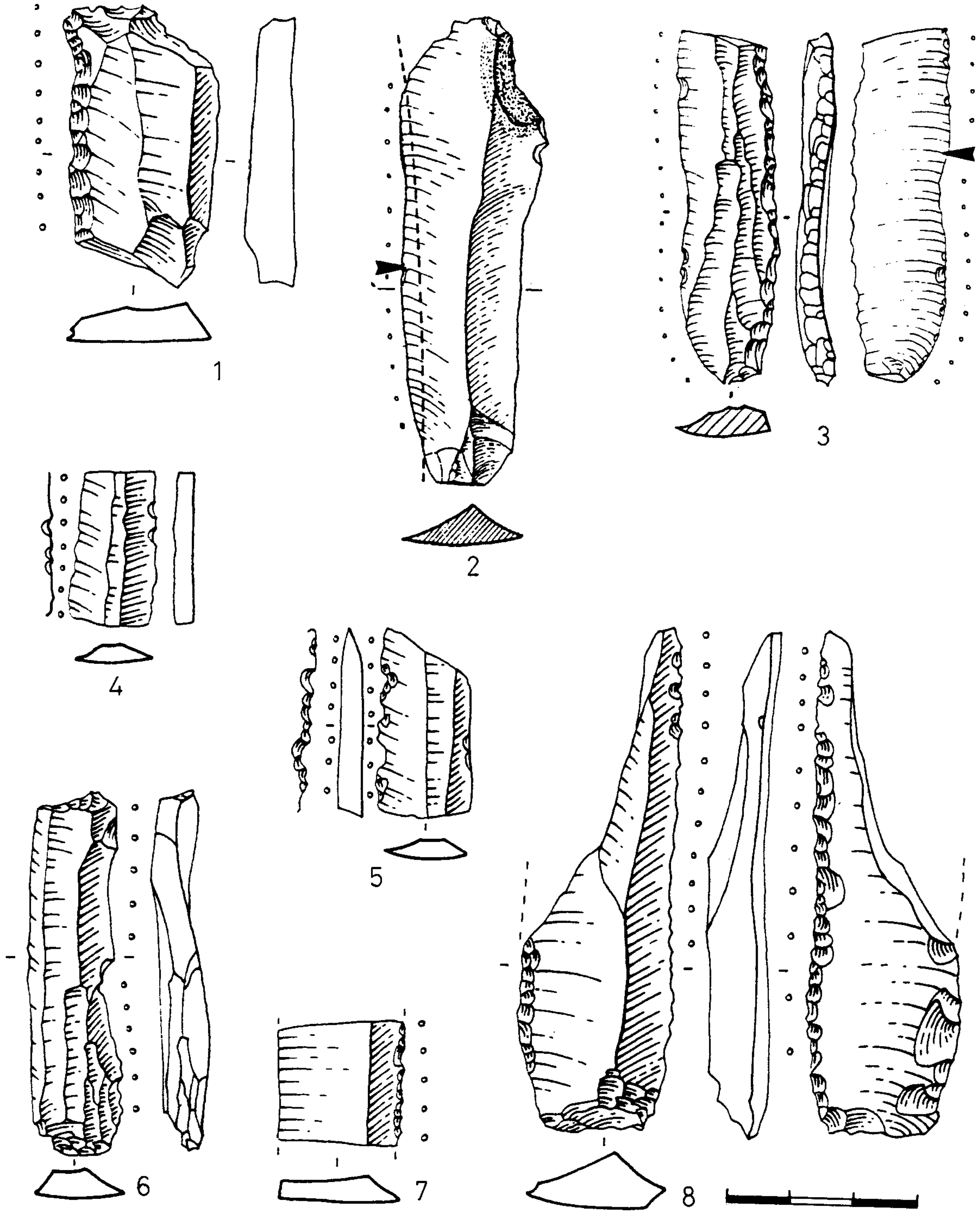

Figure 1.

Figure 2. Various flint tools with gloss, whose extent and location is shown by tiny circles and broken lines *<arrows: location of photomicrographs in plates>.*

1. Broken blade with gloss from Magzalia with splintering at the end, which was hafted and used, according to the characteristic appearance and distribution of the use-traces (cf. Plate 3), in a "tribulum"- like tool to thresh and chop plant material. We did not see a prior use of the tool; the splintering and retouch may be the result of insertion in a log or plank or pressure from this use.

2. Glossed flake from Feyda with traces of adhesive (bitumen?) shown by dark broken lines on the opposite edge. Microwear analysis shows the tool may first have been used "for" harvesting cereals or reed, then most clearly shows traces from the tool's use in a "threshing" tool (compare traces Plate 3.B with those on an ethnographic threshing sledge flint, 3:A). "Retouch" on edge is likely due to insertion (hammering) into the log, plank etc. forming the tool body.

3. Broken glossed blade from Magzalia with traces characteristic of use for harvesting with the right-hand edge, then use in a "tribulum"(?)-like instrument to thresh plant material with both edges, turning the tool once. Retouch appears to have occurred after harvesting, (transformation retouch) and is associated with the use of each edge in the threshing tool.

4. Truncated and retouched blade from Magzalia with glossy abrasion of the bulb area. Microwear traces were not detected on the edges, but gloss on the bulb with microscopic "grooves" is characteristic of the use to abrade (finish or "polish") an object in a fine-grained, fairly soft lithic material, as for the "Çayönü tools" (see Plate 4 and Fig. 3). This use leaves a gloss on flint tools, and a matte, abraded "grooved" area on obsidian tools.

5. Glossed tool from the PPNA of Hatoula. Although this appears to be a sickle, microwear analysis (see Plate 3.3 of the traces) shows it was used to scrape, probably ochre-covered hide (with the humid ochre powder's being responsible for creating a "sickle-gloss" appearance). This was apparently the only use of the tool, and use-damage caused the edge "retouch".

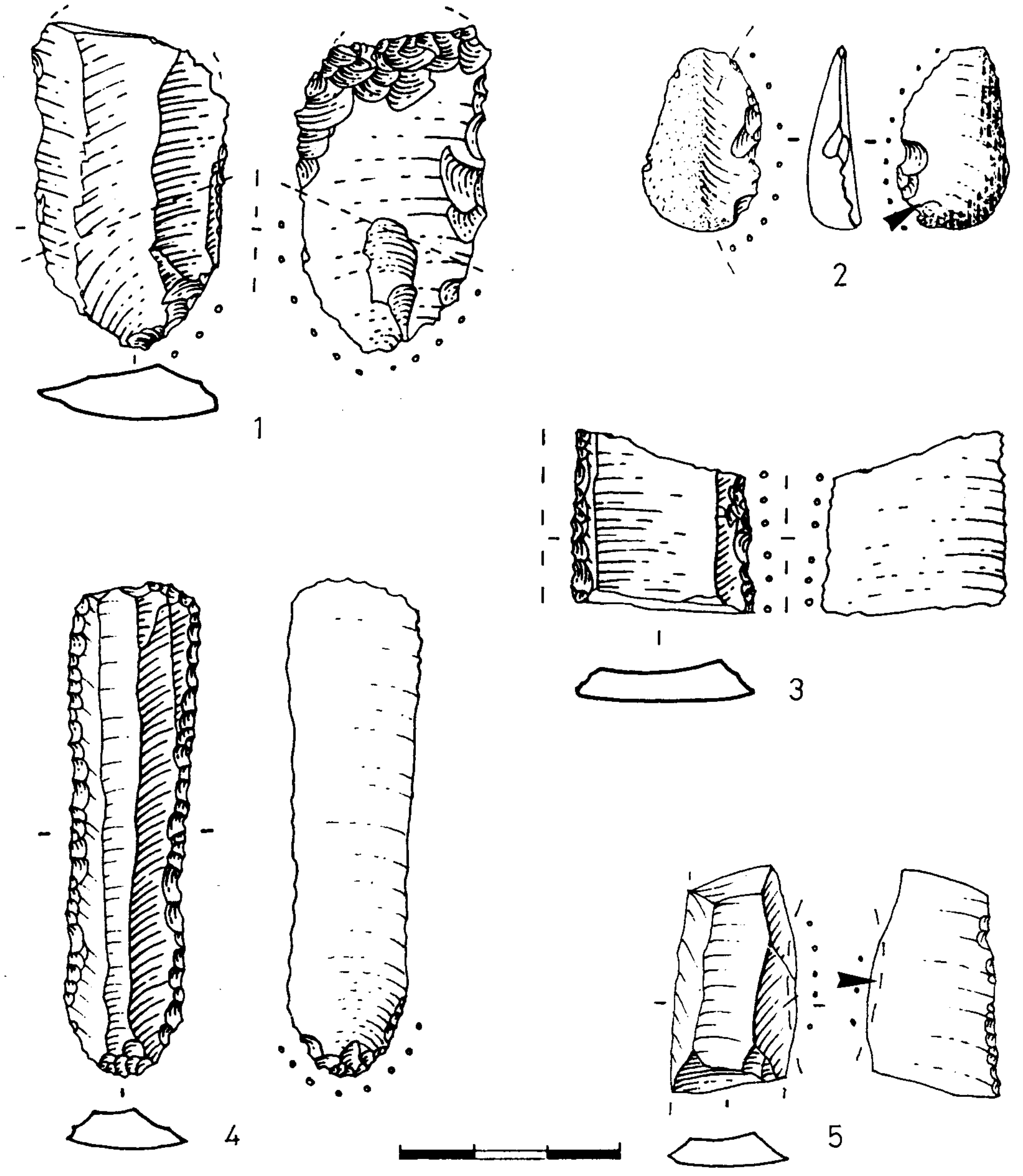

Figure 2.

Plate 3.

A: Micrograph (100x) of the edge of a flint flake inserted in a threshing sledge from Anatolia. Note long, wide shallow grooves and striations (arrows), pronounced abrasion, edge-rounding, and surface deformation. These are due to intense abrasion and pressure against the threshing floor and the plant stems and seed heads spread over it. (Photo: P. Anderson)

B: Digitized microscope image (100x) printed on a laser printer, of a flint flake with gloss and bitumen traces, from Feyda (Syria), Late PPN (Fig. 4:2, arrow). Note similarity to Plate 3.A: abrasion, wide grooves and striae, general abrasion and edge rounding. The tool is interpreted as having been used first as a sickle insert to harvest (e.g. general bright appearance of the surface), then as an insert in a threshing tool (sledge?). (Photo: P. Anderson)

C: Micrograph (100x) of a glossed tool from the PPNA of Hatoula (Israel), shown in Fig. 4:5, (arrow). Note the very bright, abraded appearance, linear grooves (arrow) and edge rounding, best matching microtraces obtained for tools used in experiments scraping hide and ochre; this is the use interpreted for this tool. (Photo: P. Anderson)

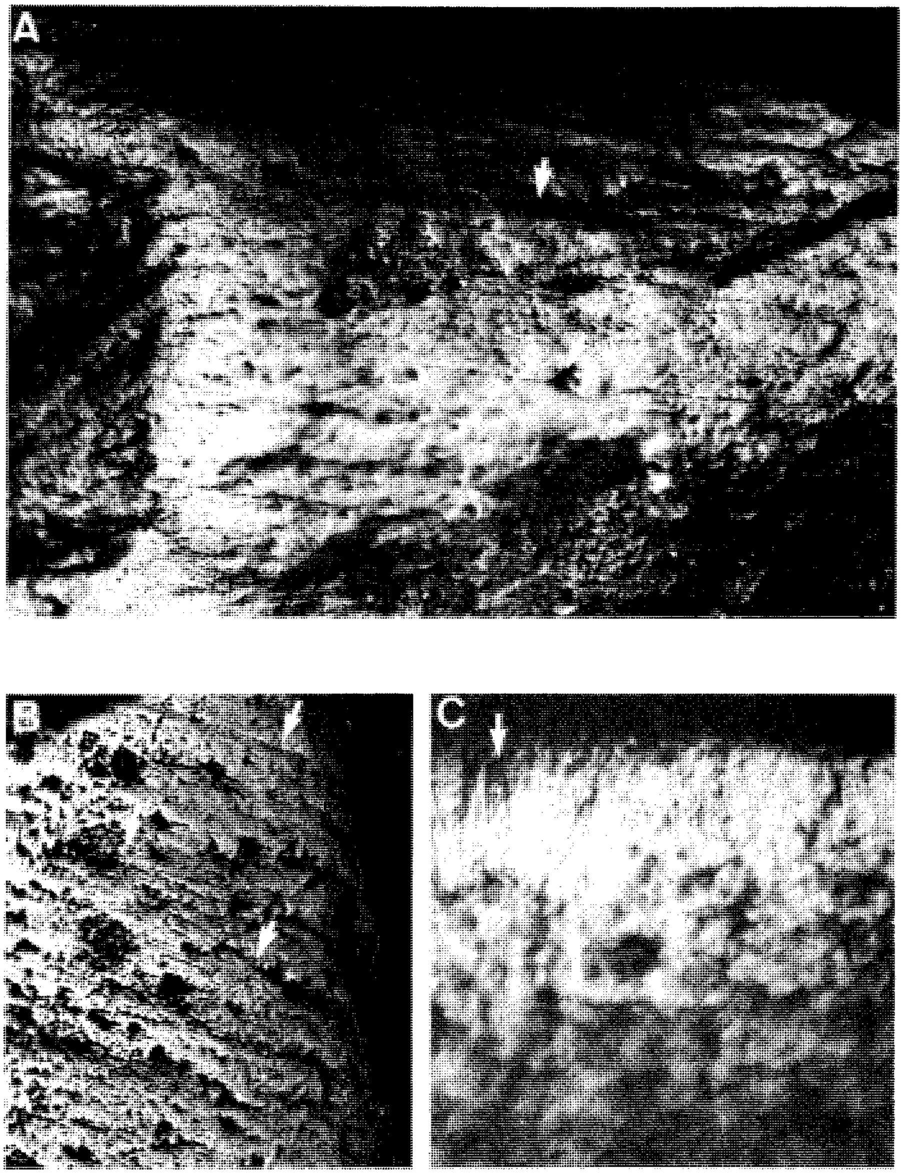

Plate 3.

Plate 4.

A : SEM photomicrograph (120x) taken near the edge of an obsidian tool used experimentally to decorate a limestone plaque, rubbing the edge, bulbar surface against the stone, using motions identified on Çayönü tools. Similar abrasion occurred, and this closeup view of use-striae shows residus of limestone trapped in the striae troughs. Chemical analysis of residues (arrows) is shown in Fig. 4:1. The dark, smooth-appearing areas show the unaltered obsidian surface. (Photo: P. Anderson)

B : SEM photomicrograph (25x) showing the smooth, unaltered obsidian surface and striae comprising the abrasion use-traces on the edge of an obsidian "Çayönü tool" from Magzalia (PPNB), shown in Fig. 3:4 (arrow). Residues on this tool (arrow, and see Fig. 4:2), barely visible at this magnification, were like those on the experimental tool in Plate 4.A, and because they are absent elsewhere on the tool than where use-traces occur, they are most likely from the lithic material abraded by this tool rather than simply contamination from the burial context of the tool. (Photo: P. Anderson)

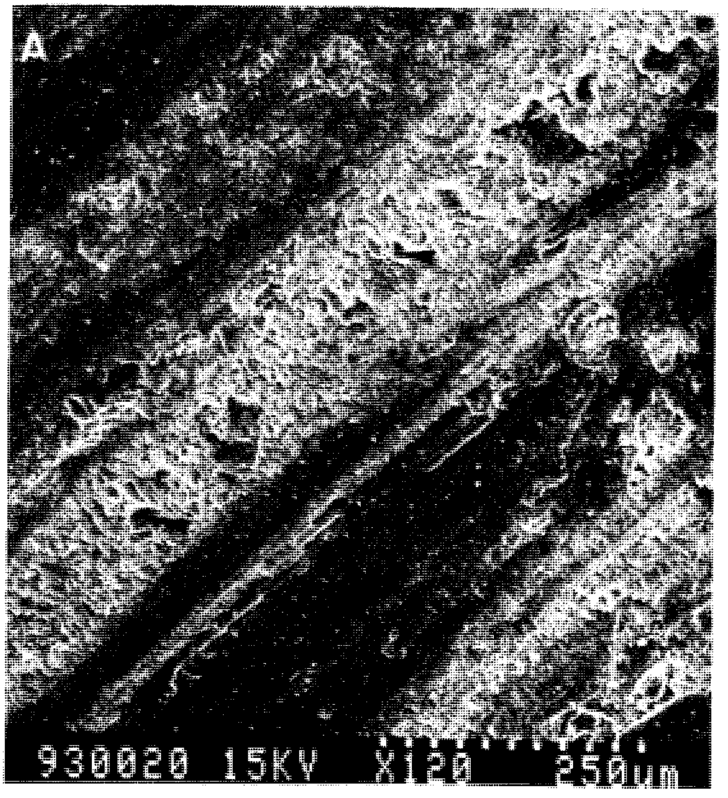

Plate 4.

Figure 3. "Çayönü" tools in obsidian from Magzalia and Cafer Höyük

1. Obsidian blade from Magzalia which, according to our experimentally-obtained traces, was used to finish a lithic object (in soft stone, plaster?) by abrading it with the dorsal facet flat against the object, creating visible abrasion on the obsidian tool. Retouch on the ventral aspect of the edge occurred as the use progressed, so the edge would stabilize the tool. "End-scraper"-like retouch and breakage occurred after this use, but a second use was not identified.

2. Broken "Çayönü" tool from Magzalia, used to abrade (finish, decorate, etc.) a lithic object with the ventral face rubbing against the object. Both used edges have evolved though several phases of use and retouch, until the edge has become steep; pressure retouch is used as the edge angle increases.

3. "Çayönü" blade from Cafer Höyük (Anatolia) used, like the three preceding tools, to abrade and finish objects using a back-and-forth motion, but these objects are of a of a finer-grained lithic material than those worked using tools in Fig. 3:1-2,4. The tool has evolved through several use/retouch cycles, with further evolution of the tool stopped by the retouch's having reached the central dorsal facet. The shape of the base of the tool seems due to the presence of the bulb and possibly to prehension.

4. "Çayönü" tool from Magzalia which was broken and had burin-like removals from this break, after its use to abrade soft lithic objects to decorate them, causing the abrasion traces. No other functions were identified which could explain the fracture and burination. Retouch occurred as the use proceeded; apparently the tool was first used without retouch. A microphoto of the use-striae is shown in Plate 4.B, and chemical analysis of residues (arrow) within the use-striae (Fig. 4) give further information on the granuometry and composition of the soft lithic material worked.

5. Fragment of a "Çayönü tool" from Cafer Höyük, showing use of the bulb area (as for the flint tool in Fig. 2:5) to rub flat surfaces of a lithic object, as if to smooth it. The abrasion traces, like those for tools in Fig. 3:3,6 from the same site, suggest the stone worked was very fine-grained and perhaps humid when worked; this lithic raw material is different from the one(s) worked using the tools from Magzalia shown here, although the objects may have been of a similar morphology.

6. Fragment of a "Çayönü tool" blade from Cafer Höyük, used on each edge without retouch to finish or decorate a lithic object. Retouch occurred as the work progressed, then the tool was broken.

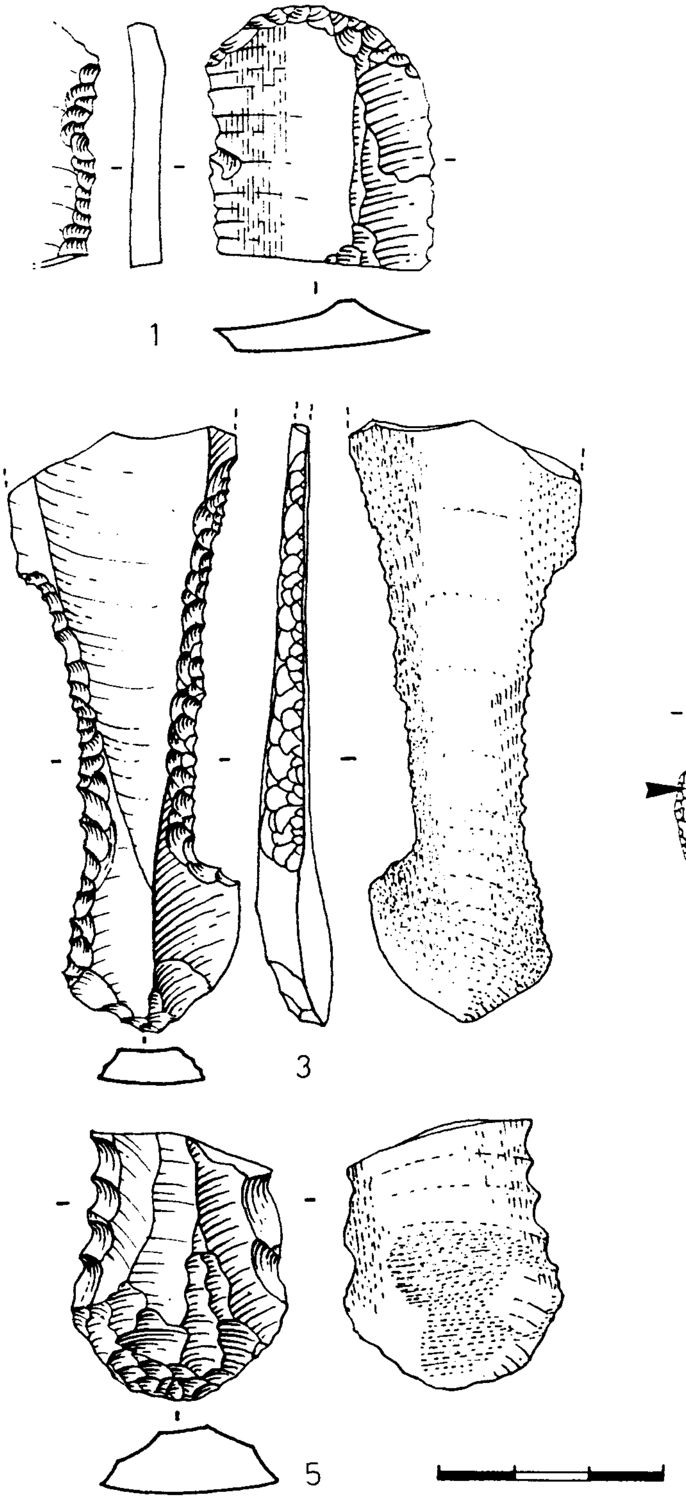

Figure 3.

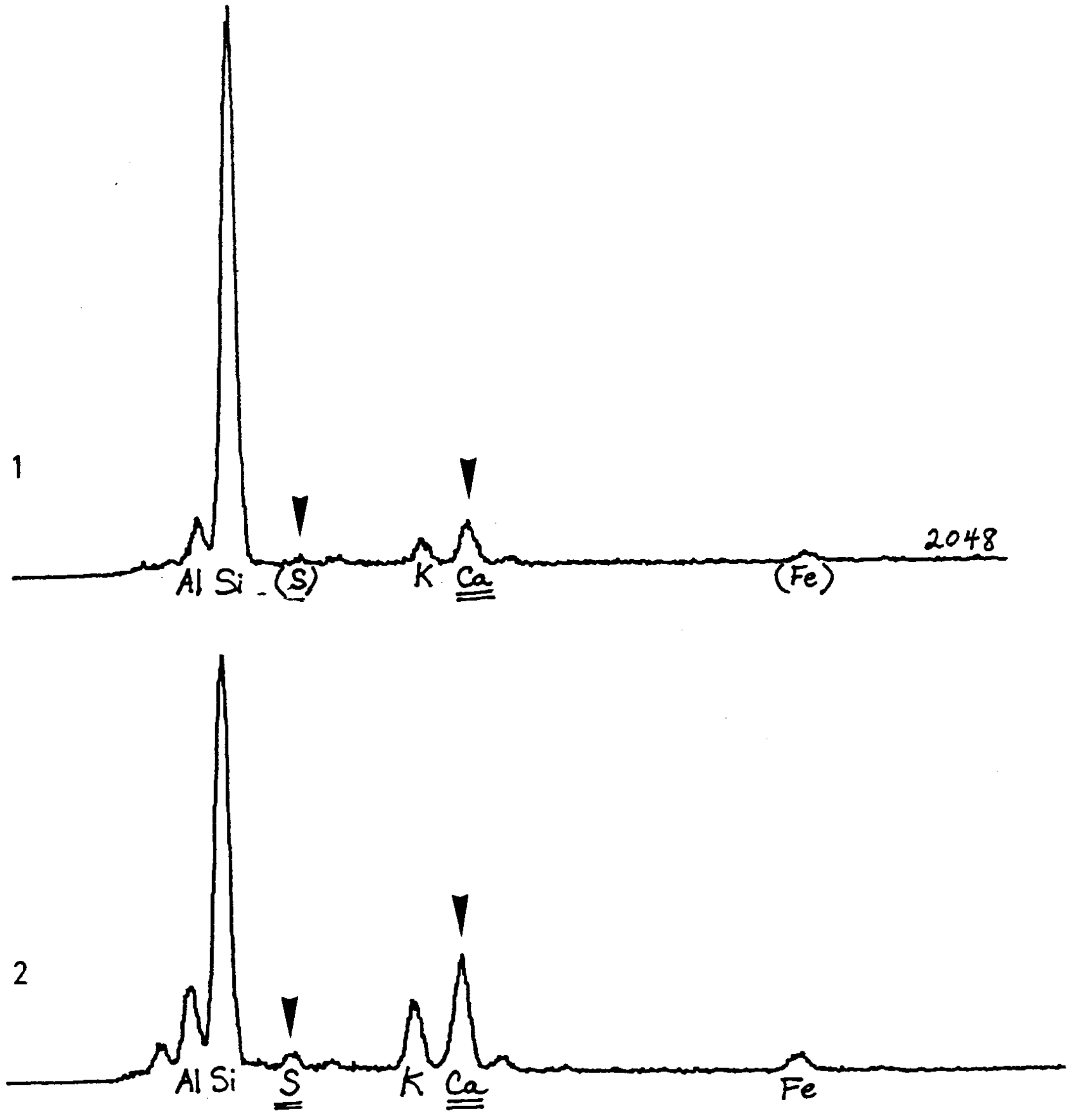

Figure 4. EDAX (energy-dispersive) spectra of mineral components of residue material present in use-striae on a experimental tool used to work soft limestone, and on a prehistoric tool from Magzalia having the same type of use-abrasion. Arrows and elements underlined are those not found in the obsidian, thus most likely compopnents of only the residue material. Other elements could be only background "noise" produced by the obsidian itself.

1. Analysis of mineral components of residue material stuck in grooves produced by use of and experimental obsidian tool, used to work limestone. Elements indicated by arrows were found in a separate analysis of the limestone worked, and are not found in the obsidian itself.

2. Analysis of mineral components of material found in troughs of the use-striae in Plate 4.B, like that shown by the arrow. Sulphur and calcium (arrows) were not were not detected in the obsidian itself, and did not occur on all of the tools analysed from this site, therefore they are considered to be residue components, like Fig. 4:1, of residues on an experimental tool. The morphology of use-strie plus more specific study of components of residues compared with composition of objects from these sites, may enable us later to differenciate between working of marble, plaster and limestone objects using these tools.

was technological rather than functional in purpose (ex. related to hafting or to "scrubbing" retouch), because hafting experiments did not produce abrasion traces located and oriented like these. Also it is highly unlikely the areas corresponding to abraded edges were hafted. The abrasion was not "srubbing" used as a means of keeping a retoucher from slipping because the abraded areas often do not reach to the pressure-retouched edge itself, and it can occur adjacent to edges without pressure retouch (ex. Fig. 3:6).

The function of these tools was explored by experiments over several years using copies of Çayönü tools, for varied activities including harvesting cereals. The hypothesis we once proposed (ANDERSON-GERFAUD 1982), that of harvesting using an unretouched and unabraded edge of one Çayönü tool having a possible residue of plant material, has been discounted due to the complete lack of characteristic harvesting traces associated with this residue. Also we did not see harvesting traces like those obtained in experiments with obsidian tools, on any Çayönü tools we have since examined (ANDERSON-GERFAUD in: CAUVIN *et al. op. cit.*). Indeed, soil on stems contacting the tool was shown not to produce abrasion traces such as those on Çayönü tools; rather what was shown was another kind of much finer and shorter striae like those on flint harvesting tools, which spread over the tool edge surfaces in contact with the plant stems, not just over a single tool face, as on the Çayönü tools. Furthermore, the traces were oriented differently (obliquely) from the (longitudinal) abrasion traces on the prehistoric obsidian implements. Finally, the microscopic "dovetail" morpholology of the abrasion traces on the Çayönü tools (ex. Plate 4.B) shows a "back and forth" motion was used, not a pulling, harvesting-type motion.

In that the distribution of the abrasion showed Çayönü tools were not used to cut or saw, and that the material worked was lithic, only decoration or finishing of objects could be accomplished using the tools with the use-motion indicated by the traces. The special striae were produced only when a lithic material much softer than the obsidian (hardness of 5) was worked (hardness of 3 or less), where the work detatched powder-like particles from the stone, which abraded the tool edge surface. Taking this into account, objects from the same levels in the sites which were possibly worked with Çayönü tools include: marble bracelets, various limestone, marble and gypsum plaster recipients and limestone plaques, although a less likely possibility to consider is polished axes, whose tips could have been resharpened with the tools. Study with the SEM and EDAX chemical analysis of residues we carried out for eight experimental and prehistoric tools, and of several fragments of stone objects from the sites which could have been worked using the tools, also lends support to the above evidence of use of Çayönü tools (captions, Plate 4 and Figs. 3 and 4 describe this research).

Çayönü Tool Form

Our study showed that Çayönü tools could begin use-life as unretouched blades; however as the abrasion produced attrition of the edge, it needed to be resharpened. The concave outline of the edges was practical for working of convex surfaces of objects, and evolutive retouch occurred as long as possible, until the central facet was reached (ex. Fig. 3:3) or the edge angle became too great. Pressure retouch characteristic of Çayönü tools in their last stages was probably the only option available for retouch without breakage, given edge angle and raw material (personal communication, F. Abbès). We found the "toothed" edge outline helpful in stabilizing the tool on the worked surface. The wide ends on many Çayönü tools are useful for convenient holding of the tools in many positions, and the position of the use-traces also shows they were used unhafted, in contradiction with earlier suggestions by M.-C. Cauvin (1988) and myself (ANDERSON-GERFAUD 1982).

Discussion and Conclusions

The most acute problems for the two categories discussed in this article are:

1) the assumption that these tools functioned as sickles; their function has been shown often to be far from even the general realm of subsistence activity,

2) misleading discussion of pre-agricultural and agricultural activity which has ensued.

3) the kind of functional typology said to be characteristic of certain cultural groups which has been created around this supposed activity. Unfortunately, such appealing but unfounded affirmations tend to be published in a preliminary stage of analysis and discourage further questions into the actual significance of such important tools (or at least cause the wrong questions to be asked of them).

The microwear analysis of Çayönü tools has shown that no data relate them to cereal harvesting at any stage of use (contrary to most earlier articles about them, see M.-C. CAUVIN 1988). However, its demonstrated uses do all relate to artisanal fashioning of objects in lithic materials, regardless of differences in kinds of objects, tool size or macrotrace location. The presence of the tool in sites therefore shows that finishing or decoration of "prestige" artisanal objects such as bowls and bracelets, occurred there.

It seems that this is a typological group may which be tentatively assigned to the general realm of activity described above on the basis of macroscopic abrasion traces, because of findings of our experimental and microscopic analysis of Çayönü tools carried out thus far. However, further issues to examine are more precisely showing which different raw materials and objects were worked with different Çayönü tools, and why transformation retouch occured after use, has a second use has not been identified (Figs. 3:1,4 and probable voluntary breakage in Figs. 3:5-6).

However, as stated earlier, no functional deductions can be made regarding tools on the basis of gloss, because varied functions concerning different activity domains can create gloss on a tool edge. Only microscopic analysis can separate glossed tools into evengeneral groups, identify those used on plant material, or provide any information concerning harvesting.

More Interpretive Problems: Evaluating Activity Intensity from Numbers of and Retouch of Tools

It seems to us that measuring or counting retouch cannot show intensity of use of tools before distinguishing what their actual uses were. Those experiments using copies of stone tools which have been successful in closely approximating microscopic use-traces on Neolithic tools, have underlined the great potential differences in "exhaustion rate" of tool edges. For example, a "sickle" may harvest many hectares of cereal over a period of years without needing retouch, whereas a Çayönü tool used to work stone objects may last only a matter of minutes before the edge will need reshaping, and perhaps finish its use-life after another several minutes of use. The particular material worked, material of the tool, and kind of use-motion, directly influence attrition, need for retouch, and tool exhaustion. Experimentation can give a a very general idea of duration of tool use (hours, or seasons for material only harvested or available seasonally), as well of amount of material produced (harvested, shaped, etc.) using any one tool. However, the amount of use or material produced using any one tool is also affected by whether the tool is used alone, is a specialized part of a toolkit (probably the case of Çayönü tools), or is just one element of a hafted working edge assembly (i.e. sickles).

For these same reasons, the frequency of two different activities is difficult to compare in terms of numbers of tools used to execute each one. For example, a single Çayönü tool may have finished very few stone objects, or even less than one, or may have executed only a small part of the work on many objects (perhaps with different sizes of tool serving in different parts or stages of the decoration or finishing process), whereas one glossed tool may have (hafted with others) executed the entire harvesting process over many years, producing many kilos of grain, roofing material or fuel. We would therefore be unable to evaluate the importance of harvesting vs. decorating of stone objects simply by comparing the relative number of glossed harvesting tools to Çayönü tools in a site, for example.

We have seen that in the same site, the same two activities, harvesting and working of stone objects, do not in most cases produce macrotraces on both flint and obsidian tools. Only study of microscopic use-wear traces can allow recognition of the activity, for tools of both raw materials.

Tool Use Sequences

Where multiple uses of a tool occur, and one of those uses is harvesting, it has been our experience that the harvesting use tends to be the first activity. Thus, harvesting tools may have a particular tendency to be found in a form different from the one in which they were used, or even be disguised by subsequent tool use transforming them beyond recognition. We have found that, generally, where tools can be seen to have been used on more than one material, this use tends to progress both in the order of softer to harder materials and from longitudinal to transverse motions. The practicality of this is borne out by our experiments. For example, cutting of soft, pliable materials (plant stems, skin, etc.) can be done using many edge shapes and angles, particularly if any irregularities are compensated for by set in a haft, but the edge functions poorly if it has been worn by any prior use of another kind. However, harvesting does not damage the tool edge for future use-with or without transformation retouch-on most other, harder materials (wood, stone, bone, etc.). Use-retouch-discard sequences translated by tool morphology do complicate its interpretation, but these use-sequences are also a promising avenue of investigation for characterizing specific behaviour defining certain Neolithic groups.

It is hoped the issues and methodology discussed in this article concerning the basis of typological attributes and interpretative possibilities in analysis of PPN lithic variability, will help guide research into other areas of inquiry into the nature of PPN cultural identity and activities.

Acknowledgments: Research discussed here has greatly benefitted from help with experiments and creative ideas of Abro Deraprahamian, Frederic Abbès, Claudine Maréchal and George Willcox, and from discussions with Nikolai Bader, Marie-Claire Cauvin, and Natalia Skakun. We thank Jacques and Marie-Claire Cauvin, Nikolai Bader, Monique Lechevallier, Frank Hole, Andrew Moore and François Valla for inviting us to study tools cited in this article. Finally, we thank Abro Deraprahamian and Madeleine Riviere for having provided line drawing illustrations shown here, and A. Perra of the Centre de Microscopie Electronique, Université de Lyon I, Villeurbanne for help with printouts of EDAX analyses in Fig. 4.

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The Late Epipaleolithic Chipped Stone "Heritage" in Early Aceramic Neolithic Assemblages in the Northern Fertile Crescent

Deborah I. Olszewski

ABSTRACT. *The number of known late Epipaleolithic and aceramic Neolithic assemblages from the northern Fertile Crescent is small. Since there are few single sites with both late Epipaleolithic and early aceramic Neolithic occupations, and even fewer with a continuous sequence, comparisons are of assemblages that may be separated by a considerable and unknown passage of time, during which many changes could have occurred in the ways that prehistoric peoples acquired and reduced raw materials. The nature of lithic technology, being a reductive rather than an additive process, ensures that there are many ubiquitous tool types found in assemblages from many different regions and time periods. These kinds of similarities over time in a region thus may have little to tell us about specific links between earlier and later lithic assemblages from a particular area. Technological aspects of assemblages are perhaps a more appropriate way to examine the possible "heritage" from earlier periods. Presumably, one can trace gradual changes in how artifacts are manufactured (given an adequately controlled chronology). The use of refitting also has great potential to document continuities and differences in technology.*

Introduction

It seems surprising that our knowledge of the late Epipaleolithic and the early aceramic Neolithic chipped stone assemblages in the northern Fertile Crescent can be, on the one hand, relatively detailed, but on the other, scarcely informative of continuity between these traditions. There are, however, a number of reasons for this apparent dichotomy. These include the unavoidable use of chronological blocks of time, few relevant sites, and the nature of lithic assemblages themselves.

Discussion of Problems

Surface finds of lithics during surveys often place sites only within general time blocks, such as early Epipaleolithic, late Epipaleolithic or early aceramic Neolithic. Obviously, these do not necessarily record continuity at a site or even within a region, as such sites potentially can be separated in time by centuries or millennia. Recent surveys across some areas of northern Syria, northern Iraq and southeastern Turkey have, in fact, suggested that late Epipaleolithic presence in these regions was sparse at best (HOLE and JOHNSON 1986-87; MOORE 1989: 625; NISHIAKI 1992: 100; WATKINS *et al.* 1989: 23-23). Currently, data are available only from the surface site of Dibsi Faraj East (OLSZEWSKI 1986: 215-218), and the excavation contexts at Mureybit (CALLEY 1984, 1986; CAUVIN 1987: 257) and Abu Hureyra 1 (OLSZEWSKI 1986: 154-160; 1988, 1989, 1991, in press a.). The late Epipaleolithic is also known from Aarida 7, a surface site (CAUVIN 1981: 380-384), and el Kowm 1, (CAUVIN 1987: 256) where the collections are very small.

The Epipaleolithic from elsewhere in the northern Fertile Crescent is documented by the Zarzian tradition of the Zagros and has been reported from both survey and excavation contexts (BRAIDWOOD and HOWE 1960: 55-60; GARROD 1930: 13-23; HOLE and FLANNERY 1967: 159; MORTENSEN 1974: 15-20, 1993: 165-168; SMITH 1986: 30-31; SOLECKI 1955: 410-414, 1963: 182-183; YOUNG and SMITH 1966: 387). However, aside from brief descriptions in preliminary reports, only the materials from Zarzi (GARROD 1930: 13-23; WAHIDA 1981) and Warwasi Rockshelter (OLSZWESKI 1993b: 207-236, in press b) have been published sufficiently with respect to lithic data. There are also small collections from test excavations at Mar Gurgalan Sarab and Mar Ruz detailed in MORTENSEN 1993: 165-166. The fact that the Zarzian tradition is thought to date between about 22,000 to 12,000 BP makes it older than the late Epipaleolithic farther west (12,500-10,300 BP), and of a considerably longer time span.

Our knowledge of the earlier part of the aceramic Neolithic is scarcely more extensive than that of the late Epipaleolithic. Only a small handful of sites have been located for this time block. Across northern Syria and Iraq, excavations at Mureybit (CALLEY 1986), Qermez Dere (BETTS, this volume; WATKINS *et al.* 1989) and Nemrik 9 (KOZŁOWSKI S. and SZYMCZAK 1989, 1990, 1992) comprise the data base. In the Zagros, sites such as Shanidar Cave B1 (SOLECKI 1964), Zawi Chemi Shanidar B SOLECKI 1981), Karim Shahir (HOWE 1983), and M'lefaat (*ibid.*; KOZŁOWSKI, this volume) represent the proto-Neolithic and the earlier aceramic Neolithic in that region.

Our sample size (those sites with informative data bases) is therefore small, and restricted to two late Epipaleolithic sites in the northern Levant, and two in the Zagros. The earliest aceramic Neolithic in the northern arc is represented by three sites, and, in the Zagros, by four sites. Obviously, this situation lends itself to site-centered analyses, with few comparisons within small regions possible, and recourse most often made to farther-flung comparisons (i.e., northern Iraq to the Zagros, the northern Levant to the southern Levant).

In addition to the limitations posed by few available lithic data sets, there are also problems associated with the way that lithic assemblages are analyzed and reported, and with the nature of lithic assemblages themselves. There can be great variability between researchers in the definitions that are applied to categorize assemblages. This is a product not only of the specific typologies that might be used, but also of the network of individuals with whom one studied and interacted, and the amount of experience one has accumulated. It seems to me that there often is relatively good agreement on terminology that is used within blocks of time (for example, within the Neolithic), but that difficulties arise when one attempts to compare across blocks of time (for example, a comparison of the Epipaleolithic to the Neolithic). This latter case involves not only occasional terminological problems, but also emphases on differing research questions.

Problems of lithic analysis requiring further resolution and agreement are almost innumerable. They include the following: the definition of blades and bladelets, the maximum size for microliths, if small flakes (2.5 cm or less) are counted as flake debitage, whether broken flakes and blades are lumped with counts of complete specimens or listed separately, and if blank scar configurations on cores can be used to assess flake as opposed to blade blank manufacture, since cores are often reduced by different strategies during the use life of a particular core. Other aspects might include the meaning of an assemblage described as blade-based or as flake-based. These terms could refer only to the blanks chosen to manufacture tools, or to the majority of nonretouched blanks in the debitage category, or to the frequency of a particular blank regardless of whether or not it is used as a tool.

It is also important that assemblages be reported in a usable (and probably standardized) format. All too often, reports present information in sets of combined categories, both for debitage and for tools. For example, how does one decipher the combined category of blade/bladelets? It might be quite important to know the percentage of the bladelet component as opposed to blades.

Beyond these considerations of definitions, standards and reporting, there is also another very important aspect. The nature of lithic technology, which is reductive rather than additive, almost guarantees that there will be ubiquitous tool types that are found in assemblages from many different regions and time periods (what SACKETT 1988: 419 has termed "banal" tools). This applies to the majority of scraper, burin, notch, denticulate, perforator, truncation, retouched piece types, and even to many of the microlithic tools. These kinds of similarities over time in a region thus probably have little to tell us about specific links between earlier and later lithic assemblages from a particular area, since they are a reflection of the limited number of options a flintknapper has in making a tool from a particular blank. If truly distinctive tool types can be isolated in the late Epipaleolithic context, and these types are also found in the aceramic Neolithic, then a better case can be made for continuity in lithic typology within a region.

Technological continuity between major time blocks may be a reflection of continuity in lithic traditions, especially if this is documented as a gradual change through time at a single site. However, even technological similarities are subject to the reductive paradigm, especially if one is comparing two different sites over time (regardless if these are in the same region or widely separated spatially). That is, a flintknapper either manufactures flake or blade blanks. Flake blanks can be made using either hard or soft hammer methods. Blade blanks can be produced through hard hammer, soft hammer, punch, or pressure techniques. This is a small number of options, subject also to availability of raw material and quality of raw material. Thus, two groups of people separated in time (and especially if they occupy different sites), but who are doing the same things with respect to lithic manufacture, may or may not demonstrate continuity in lithic traditions over time.

The problems discussed in this section, availability of pertinent sites, unavoidable resort to chronological blocks, and factors related to lithic assemblages, all currently limit the conclusions we can draw about relationships in lithic typology and technology between the late Epipaleolithic and early aceramic Neolithic. These difficulties increase the probability that the addition of sites to the present scanty data base will certainly modify and possibly replace a number of the observations presented below.

The Zagros Aspect of the Fertile Crescent

Zarzian Epipaleolithic

The Zarzian Epipaleolithic may span ca. 10,000 years if projected dates are appropriate (HOLE and FLANNERY 1967: 153). Obviously, we are most interested only in the last portion of this long-lived tradition, that which presumably is immediately prior to the proto-Neolithic and early aceramic Neolithic in that region. Of the two sites with detailed published data (Zarzi and Warwasi), Warwasi (OLSZEWSKI 1993b) is the more comprehensive data base, since Garrod (GARROD 1930), who noted changes through the sequence at Zarzi, unfortunately published her materials as a combined unit. The remainder of this Zarzian section thus focuses on Warwasi, with some comparisons to Wahida's counts from Zarzi (WAHIDA 1981).

The Warwasi Zarzian sequence was subdivided into four units based on changes in microliths and other tools. The uppermost subset is that of Unit 4 (Levels A-D); the other units (1-3) from Warwasi will not be used since they are older than Unit 4. One striking feature of Unit 4 is that 42% of the assemblage (n=2989) consists of tools (n=1227). Tools are most often made on bladelet blanks (51.3%), followed by blade blanks (25.3%), and flake blanks (23.2%); there is one tool on a burin spall (0.1%). The Unit 4 tool industry is thus dominated by bladelets and blades. Not surprisingly, the debitage (n=1522) exhibits the same patterning, with bladelets (49.6%), then blades (24.7%), and flakes (20.8%); the rest are burin spalls (2.7%) and shatter (2.2%). Identifiable cores (n=62) are more evenly distributed, with 33.9% for bladelet manufacture, 45.2% for flake production, 1.6% for blade, and 19.4% with a mixed pattern. Except for illustrations in GARROD 1930: 18, that show several core types, no other information is available for the Zarzi cores or debitage.

No one pattern predominates among the Warwasi Unit 4 core types, since 19.3% are single platform, 20.9% are opposing platforms on the same face, 16.1% are ninety-degree platforms, and 25.8% are multiple plaform. Neither the cores nor the debitage were produced using the pressure technique. The lack of hammerstones at the site might suggest that hard hammer technique was not frequent.

The most important tool classes are microliths (44.1%) and notch/denticulates (28.7%); these are also the most important classes at Zarzi (WAHIDA 1981), with 29.2% notch/denticulates and 35.2% microliths. Notch/denticulates are not very useful for establishing continuities, since they are particularly ubiquitous both temporally and spatially[1]. The majority of the microliths at both Warwasi and Zarzi are nongeometric forms; predominant among these at Warwasi Unit 4 are truncated bladelets, pointed bladelets, curved backed bladelets, and inversely or alternately retouched bladelets (lamelles Dufour). Wahida (*ibid.*: 27) simply lists backed bladelets without further detail, although illustrations in GARROD 1930: 19 show both pointed and curved backed forms. Many of these nongeometric forms have a great antiquity in the Zagros, for example, lamelles Dufour are characteristic of the late Baradostian levels at Warwasi (OLSZEWSKI 1993a).

The geometrics from Zarzi (GARROD 1930: 10; WAHIDA 1981: 27) include mainly scalene triangles and a few lunates. Most geometrics from Warwasi Unit 4 (n=91) are scalene triangles; there are also a number of isoceles triangles, lunates and quadrulaterals (trapezes and parallelograms).

There are small numbers of microburins at both Zarzi (n=6) and Warwasi (n=36).

Zagros Proto-Neolithic and Early Aceramic Neolithic

Of the potential four sites of this time block, only materials from Karim Shahir (HOWE 1983: 103-104), Zawi Chemi Shanidar (SOLECKI 1981) and M'lefaat (HOWE 1983: 118-119; KOZŁOWSKI, this volume) are published in sufficient detail. In the following, data from Karim Shahir (hereafter, KS) is emphasized, with comparisons to Zawi Chemi Shanidar (hereafter ZCS) and M'lefaat, where appropriate.[2]

If the used and nibbled flakes and blades, microburins, burin spalls, and unworked triangular or trapezoidal segments of blades are removed from Howe's tool counts at KS, then 12.3% tools (n=9204) are present in the assemblage (n=74,563)[3]. Thus, there are considerably fewer formal tools in the earlier Neolithic than in the Zarzian. Although it is not possible to calculate exact percentages of types of tool blanks for KS (owing to how this information is reported), it is obvious from the partial counts possible that blades are the most frequent tool blank, followed by flakes, and then bladelets. Thus, while the tool industry is dominated by blades and bladelets, their respective significance contrasts with that of the Zarzian. The debitage (n=54,566)[4] is 33.7% blades, 6.2% bladelets and 60.1% flakes. This documents the relative unimportance of the bladelet component of the earlier Neolithic, but provides a contrast in tool blank selection from existing debitage, with more blade tools than flake tools.

Although it is difficult to ascertain exactly, at least half of the cores were used to manufacture blades, bladelets or blade-like flakes. Most of the KS core types (n=1684) are described as pyramidal (n=1335) (HOWE 1983: 93), and illustrations of these (*ibid.*: 140-150) show that they include single platform cores (as described for Warwasi), as well as cores that are more "bullet-like." There are also some bipolar[5] and polyhedral (multiple platform) cores. A number of the illustrated KS cores clearly indicate blank removal techniques that are not common in the Zarzian. The scarcity of hammerstones suggests that hard hammer percussion was not commonly employed at KS. The majority of cores from ZCS and M'lefaat are single platform. If the photograph of the cores from ZCS (SOLECKI 1981: Plate 13) is any indication, then cores from ZCS are very undistinquished. There are quite a few hammerstones reported for ZCS (n=41). The cores from KS and M'lefaat appear to be more "specialized" than those from ZCS, suggesting punch and pressure production.

The overwhelmingly dominant tool class at KS is that of notches and denticulates (76.3%), of which most are notches. ZCS and M'lefaat present a similar pattern of high numbers of notches and denticulates. At KS, scrapers are the next most frequent, at 11.4%. Scrapers are well represented at M'lefaat and ZCS, although at the latter site, *piéces ésquillées* are almost as frequent as the denticulates. There are 4.8% microliths at KS. Microliths appear to be relatively important at both M'lefaat and ZCS,

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1 Some might argue that many notches and some denticulates are not tools, but "accidents" of site formation processes.

2 There are potential problems with the data from KS and ZCS. Howe (1983: 118) reports that KS was extremely disturbed, which may mean the lithic assemblage is mixed. The materials from ZCS, which represent several levels were treated by SOLECKI 1981 as a single unit; this may mask chronological variability.

3 With used and nibbled pieces, which are not formal tools, the tool frequency would be 47.0%.

4 I have placed the core parts, and used and nibbled flakes and blades in this category.

5 These appear to include opposing platforms on the same face, and ninety-degree platform core types.

where numerous backed bladelets occur (curved and angled base forms). ZCS also has a significant number of lunates (n=111). Unfortunately, most of these tool categories are not particularly distinctive. The microliths from KS are mainly fragments that are unidentifiable as to type, but there are a small number of pointed bladelets and 4 "chance geometrics" (HOWE 1983: 108) The curved forms and lunates would appear to be a link back to the late Zarzian; the angled-base backed bladelets reported might suggest a connection to the scalene triangles of the Zarzian.

A small number of microburins (n=30) were recovered at KS. ZCS produced a small number of heavy tools (chipped celts with chipped bits).

Comments

There are a few general patterns that might indicate continuity between the Zarzian Epipaleolithic and the early aceramic Neolithic in the Zagros[1]. One feature is an emphasis on producing blanks that are linear (bladelets in the Zarzian, blades in the Neolithic). New techniques of producing these blanks probably arose during the Neolithic ("bullet-cores"). Another feature is the presence of microliths in both traditions. These are less numerous in the Neolithic, and generally of forms not dominant during the Zarzian. One exception might be the lunates (present both in late Zarzian and at some early Neolithic sites). It would be easier, although still not completely satisfying, to trace continuities if we had at least one site with the complete sequence from the Zarzian to the early aceramic Neolithic.

The Northern Fertile Crescent Aspect

Late Epipaleolithic

The analyses of the excavated assemblages from Abu Hureyra 1 (OLSZEWSKI 1991, in press a) and Mureybit (CALLEY 1984, 1986; CAUVIN 1987: 257) provide the most detailed data for this temporal block in this region. The late Epipaleolithic occupation at Abu Hureyra 1 (hereafter, AH1) span at least a millennium; thus, I use only the information from the last Epipaleolithic phase (Phase 3) at AH1. The occupation at Mureybit (Phase Ia) is final Epipaleolithic in date (CAUVIN 1987: 257) and probably postdates the occupation at AH1.

At AH1 Phase 3, 5.8% (n=3240) of the assemblage (n=55,496) is tools, while at Mureybit Phase Ia, there are 4.5% tools (n=401) in a sample (n=9000) of the assemblage (*ibid.*). Tools at AH1 are almost equally made on blade(let) (51.3%) and flake (46.7%) blanks. Calley's (1986: 375) analysis reports on only about half of the sample of 9000 mentioned by Cauvin (1987: 257). However, if Calley's data are minimally representative, they indicate that a much greater emphasis is placed on blade(let) (74.4%) tool blanks than on flake blanks (20.5%) for tools at Mureybit. In the debitage from both AH1 and Mureybit, flakes are more common than blade(let)s. As might be expected, at AH1 cores are mainly for the production of flakes, while at Mureybit, cores for bladelet production are most common (CALLEY 1986: 165). At both sites, the cores are primarily single platform types.

Microliths are the most common tool type at AH1, followed by notch/denticulates, retouched pieces, and scrapers (OLSZEWSKI 1991: 439). There are also 27 heavy tools, including axes, gouges and blunted implements (OLSZEWSKI, in press a). Cauvin (1987: 257) mentions scrapers, microliths and heavy tools (erminettes, thick pedunculated points) as important in the Mureybit assemblage. There are about equal numbers of nongeometric (12.3%) and geometric (11.9%) microliths at AH1. Lunates are the most common geometric microlith at both sites.

There are small numbers of microburins at both AH1 and Mureybit.

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[1] It is worth remembering, however, that there is an apparent 3500 year gap between the latest known Zarzian sites and the earliest proto-Neolithic sites in the Zagros (HOLE, this volume).

Early Aceramic Neolithic

Included here are the "Epi-Natufian" of Phase Ib at Mureybit, as well as the PPNA from that site (Phases II, IIIa-b) (CALLEY 1986), and data from Qermez Dere (BETTS, this volume; WATKINS *et al.* 1989) and Nemrik 9 (KOZŁOWSKI and SZYMCZAK 1989, 1990, 1992). I begin with Mureybit Phase Ib (hereafter, MIb). Then, a brief treatment is accorded Mureybit Phases II and IIIa-b (hereafter, MII/III[1]), and Qeremez Dere (hereafter, QD), and Nemrik 9 (hereafter, N9).

The overwhelming use of blade blanks (85.1%) for tools continues into MIb from MIa. While flakes still dominate the debitage of MIb, they are not as numerous as in the debitage of MIa. The cores from MIb are not particularly enlightnening, although Calley suggests (1986: 165-168) that the technique of removing blanks from cores is undergoing a shift during this period. Microliths (including lunates) continue to occur in MIb, and the first arrowheads (manufactured on bladelets) appear.

Tool blanks are predominantly blade(let)s at MII/III (67.7%) and QD (82.8%) (BETTS, this volume), whereas flake tool blanks predominate at N9 (KOZŁOWSKI and SZYMCZAK 1990: 73). In the debitage, however, MII/III, QD and N9 all exhibit high numbers of flakes relative to blade(let)s. Examples of both naviform and pressure technique cores were found in MII/III (CALLEY 1986: 168-171); at N9, conical[2] cores for the manufacture of blades are very prominent (KOZŁOWSKI and SZYMCZAK 1990: 66, 1992: 46). QD is characterized by single platform and opposing platform blade(let) cores; a few cores there approach the "bullet" form (BETTS, this volume).

The most common types of tools at QD are points and notch/denticulates, while at N9, retouched blades, perforators and points are common. Microliths are present at MII/III, QD and N9; with the exception of a few lunates from MII, microliths in these contexts appear to be various retouched bladelets. No heavy tools were found at QD (*ibid.* WATKINS *et al.* 1989: 32), but picks were found at N9 (CALLEY 1986). A small number of microburins (n=4) were recovered at QD.

Comments

Mureybit provides the only in situ sequence from the late Epipaleolithic to the early aceramic Neolithic. Calley (1986) has documented the shift to more formalized blade cores through time there. While debitage assemblages are rather equivocal, there is a clear chronological trend toward increasing selection of blade(let) blanks for tool manufacture. Points of similarity between the late Epipaleolithic and the early aceramic Neolithic include continued production of microliths (although geometric forms appear to be abandoned fairly early), and a heavy tool component at several of the sites[3].

Final Remarks

It is obvious that only very general continuities can be documented given the present data base. The only site that has a sequence spanning the late Epipaleolithic through the early aceramic Neolithic is Mureybit. However tempting it might be to use the information from Mureybit as a guide, it is well to remember that it is only one site, and we need many more sites with such a sequence in order to place confidence in these types of observations. I note in passing that the PPNA of the southwestern leg of the Fertile Crescent appears to share some of these continuities, in particular the presence of either undistinquished microliths (CAUVIN 1974) or the retention of some lunate microliths (GARFINKEL and NADEL 1989: 140), as well as a heavy tool component (picks and axes) (*ibid.* 146).

It is clear that we need to establish standardized terminology and reporting formats, to facilitate not only the comprehension of data from within each major time block, but also that which entails comparisons across time blocks. Having always been somewhat more of a "lumper than a splitter," I that

1 I have collapsed these into one unit, although there are some differences in technology between these phases.

2 These sometimes are called pyramidal or prismatic in other classifications.

3 The specific types (erminettes, picks, axes, gouges) differ from site to site.

we not rush into naming new industries (or even new tool types in some instances) whenever we find slightly differing chipped stone patterns.[1] I think such practices ultimately only serve to obscure our ability to interpret prehistoric behaviors.

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[1] I recognize that I differ on this point from many of my colleagues at this workshop. It seems to me that the designation of new entities should be on the basis of more than stone artifacts.; a good example is the integration of differences in stone artifact assemblages, subsistence data, ritual behavior, and architectural forms that serves as the foundation for the recognition of the Pre-Pottery Neolithic C at 'Ain Ghazal.

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The Lithic Continuity in the Jordan Valley: Natufian Unto the PPNA

Anna Belfer-Cohen

ABSTRACT. *The relationships between the Neolithic and the preceeding cultures are most crucial for understanding the process of transformation which brought about the change from extractive to productive mode of living. Where should we look for these changes? The examination and comparisons of the lithic industries in southern Levant shed some light on this particular aspect of the archaeological record. It seems that the lithic comparisons indicate rather a smooth evolution through time, i.e. Neolithic innovations side by side with traits retained from the Natufian tradition. Apparently the focal evidence of these major changes is to be searched in other domains of the material culture.*

Introduction

The transition from the Natufian (ca. 12,500-10,300 B.P.) to the following Neolithic cultures (the Pre Pottery Neolithic A (PPNA) dated to 10,300/10,100-9,500/9,300 B.P.) is usually considered as marking the transition from one mode of subsistence to another, i.e. a change from intensive hunting-gathering to incipient agriculture (BELFER-COHEN 1991). Still the change was not a complete turn-over, as the archaeological evidence testify to a continuity in certain aspects of the material cultures from the Natufian unto the early Neolithic. The present article will try to concentrate on the lithic assemblages of the Late Natufian and Early Neolithic cultures and examine their relations. It is a difficult task to perform as there is a scarsity of data relevant to this endeavour, the particular assemblages are widely distributed and excavation reports are not as detailed as required for the task at hand (for a review see BAR-YOSEF 1991). The Jordan Valley region is quite unique in providing a number of Natufian and Neolithic assemblages all derived from sites located more or less in a restricted geographic area. Thus the data presented herewith to illustrate the various points raised concerning the above mentioned transition and continuity, are derived from the assemblages recovered from sites in the Jordan Valley.

The Characteristics of the Natufian and Neolithic Lithic Assemblages

The Natufian

The guide-fossil tool of the Natufian lithic industry is the lunate, a geometric microlith, to the extent that every lunate-bearing assemblage was considered as necessarily Natufian, and it was claimed that the Natufian stretches from the Nile Valley to southern Anatolia ... (see BAR-YOSEF 1983; BELFER-COHEN 1989). The reduction in the lunate size as well as the type of retouch are the basis for the chronological subdivision of the Natufian into Early (12,500-11,000 B.P.), Late (11,000-10,500) and Final (10,500-10,200B.P.) stages (VALLA 1987). Thus while most of the lunates in the Early Natufian are Helwan retouched and the average length is >18 mm, most of the Late and Final Natufian are of the backed variety and the average length is 18-15 mm and <15 mm respectively. Another distinct Natufian trait is the use of the microburin technique (=mbt), apparently mainly for the production of the backed lunate variety. Once its absence or presence were also markers for the chronological subdivision of the Natufian into Early (without the mbt) and Late (with the mbt) stages, but it seems that this subdivision is not quite clear-cut (BAR-YOSEF and VALLA 1979). Yet it was observed that though quite prevalent in the Late Natufian, the mbt diminishes in numbers in the Final Natufian (see VALLA 1984 on the Natufian sequence of Mallaha). Beside the lunate dominancy and the use of the mbt, the Natufian lithic tool-kits are characterized also by the appearance of sickle-blades and picks. The latter are considered as the forerunners of the Neolithic axes. Usually it is an elongated (8-10 cm) bifacially or trifacially flaked chunk. In the debitage the flakes outnumber blades and bladelets.

Further away into the southern part of the Levant (mainly the Negev and Sinai regions, but coming up to the southern Hebron hills, see GORING-MORRIS 1991) there are sites attributed to the Harifian culture which is contemporaneous with the Final Natufian (10,750 to 10,000/10,000 B.P.). The Harifian is characterized by microlithic tools (*ibid.* 195, Table 10), mainly the lunate and a variety of points. The Khiam point characterizes the final stage of the Harifian. Normally, the flakes outnumber blade/lets amongs the debitage. Although difficult todemonstrate unequivocally, many 'bladelet' tools actually appear to have been manufactured on blanks of flake proportions. The mbt percentage is very high. Though the lunates are of the backed variety there areoccasional lunates with Helwan retouch. Also distinctive, though always numerically rare, are elongated borers. According to GORING-MORRIS (1991), the Harifian points seem to represent amongst the earliest, unequivocal evidence for the bow and arrow technology.

The Neolithic

There is an ongoing debate concerning which is the first entity bridging between the Natufian and later Neolithic cultures. While some scholars claim that there are two sequential cultures occuping the PPNA time period, others perefer to consider all the PPNA entities as representing one culture only, synonymous with the term PPNA (see NADEL 1990; BAR-YOSEF 1992; present volume).

Suffice it to say, without taking sides in this debate, that according to the former, the "Khiamian" (defined by ECHEGARAY 1966) (or "Epi-Natufian", CAUVIN 1989), is considered as demarcating the short transitional period

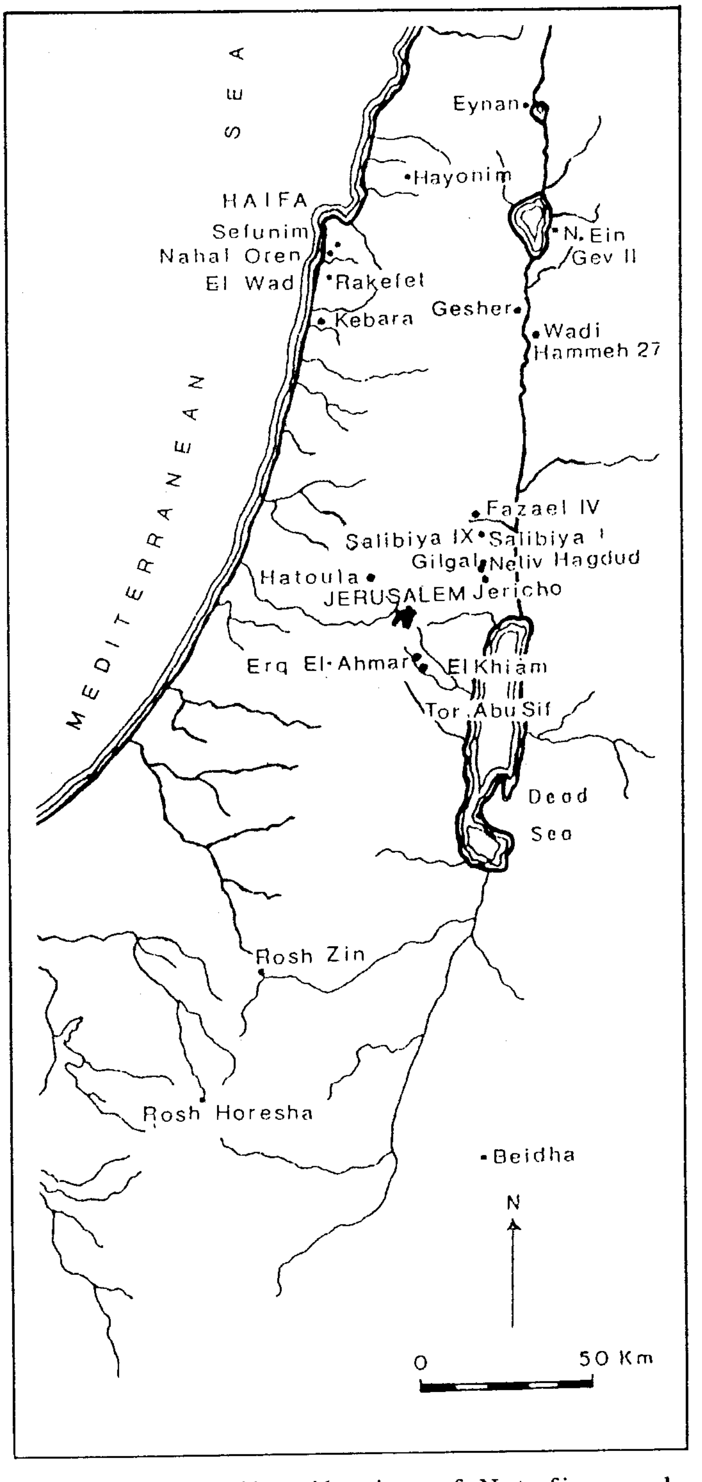

Fig.1. The distribution of Natufian and Khiamian sites in the Jordan Valley.

from Late Natufian economy to the establishment of PPNA villages. Most of the PPNA time period is represented by the later Sultanian entity. The main differences dividing those cultures lithic wise are the absence of bifacial tools, Hagdud truncations and Beith Ta'amir sickle knifes from the khiamian assemblages. Microliths are rare in the Sultanian assemblages or totally absent. It should be noted that though the Beith Ta'amir knife is unique to the Sultanian it is present only in small numbers (7% of the sickles in Netiv Hagdud, NADEL 1990) and totally absent from other Sultanian assemblages such as Hatula F (LECHEVALLIER *et al.* 1989) and Gesher (GARFINKEL and NADEL 1989). There is a great variability in the intra-site distribution of various tool types at the same site (a fact which is amply used by those denying the existence of an independent Khiamian entity and consider it as a case of Sultanian variability, see NADEL 1990, Tables 1 and 2). Thus for example in many loci in Netiv Hagdud, there are no bifacial tools, Hagdud truncations or Beit Ta'amir knives (*ibid.*, Fig. 2).

The Jordan Valley Sites

Though most of the assemblages discussed herewith are retrieved from sites located quite close to each other (see Fig. 1), only at one site there is a supposed stratified continuity from Natufian unto Neolithic levels, i.e. Jericho (CROWFOOT PAYNE 1983). Unfortunately, as there was no systematic sieving (see BAR-YOSEF 1991), the assemblages of Jericho cannot be used for the detailed comparisons between the lithic industries of the Late Natufian and the Early Neolithic. The other sites vary in their extent and variety of material culture. Thus Eynan (Mallaha), located in the Upper Jordan Valley, is the only Natufian site presently discussed, with architecture and burials. The area of the excavations at the other Natufian sites (Fazael IV, Salibiya I) is quite limited, while the Natufian of Jericho was only glimpsed (if at all). It is just possible that the three lunates recovered from the PPNA layers and the other three from the PPNB layers at Jericho, belong to the PPNA layers and did not originate, as Kenyon stated, in Natufian ones. Conversely, most of the PPNA sites do present architectural remains, burials, a plethora of non-lithic finds (bone, groundstone, obsidian, shell, etc.), the only exception being the site of Salibiya IX which is lacking architectural remains and human burials.

As most of the sites lack detailed reports, we are forced into comparing mainly the tool-categories rather than whole assemblages (tools and debitage alike). Reference to debitage and technology will be made only where there is data pertaining to those issues. The assemblages compared are varying in their numbers. For example while there are 4058 tools from Netiv Hagdud and 1027 tools from Salibiya IX, there are only 122 tools accounted for from Gesher (see below).

The Natufian Assemblages (Table 1)

Eynan : The site of Eynan (Mallaha) is one of the most spectacular Natufian sites known to date, presenting a complete Natufian sequence (from the Early to the Final stages). Located in the northern part of the Jordan Valley, in the vicinity of the Hula Lake (see Fig. 1), it is considered one of the first villages established in the Levant. Its material culture comprises living structures, storage pits, cemeteries and a plethora of various finds (made of bone, limestone, basalt, shells, flint, etc.) (for detalied bibliography see BELFER-COHEN 1991). The flint industries from Eynan were studied primarily by F. Valla (1984). The assemblages relevant for the present discussion are derived from Layers Ic and Ib.

Fazael IV : This is an open air site, with no architectural remains (Fig. 1). Though the excavated material is derived from a limited in size test pit (BAR-YOSEF *et al.* 1974), the area of the site is estimated (through surface finds) to be over 1000-1500 m^2. The tool assemblage is dominated by four tool groups: backed and retouched blades, microliths, geometric microliths and notches and denticulates. Most of the backed and retouched bladelets are broken items.

Salibiya I : It seems that in the case of Salibiya I (see Fig. 1) we actually possess material either of two Natufian short-term occupations or a clear case of an intra-site different distribution (perhaps task-specific ?) as the mean length of the lunates sample from two different localities on the site varies significantly (BELFER-COHEN, in preparation). The site was discovered and surface collections were obtained through a survey conducted by O. Bar-Yosef in 1977. A limited excavation (2.8 m^3) was done in 1978 (SCHULDENREIN and GOLDBERG 1981). A new series of excavations was planned for the site, though as yet only one season was conducted which yielded material from both, surface collections and an in-depth excavation in one square (CRABTREE *et al.* 1991). A difference was observed between the excavated material and that collected from the surface both in the old and new excavations. Thus for example in the material excavated and collected in 1978, there was four times the number of mbt in the test pit and there are four times the number of sickle blades in the surface sample. The counts presented in Table 1 are derived from the in situ material of both excavations. The excavated material from the test pit dug in 1978 was studied by D. Enoch (personal communication). The sickle blades are longer than the regular ones (4-6 cm) and some of them are unretouched. There was a moderate number of notches and denticulates.

Table 1. Natufian assemblages from sites in Jordan Valley

	Eynan Ic	*Eynan Ib*	*Fazael IV*	*Salibiya I#*	*Salibiya I##*
Tool Groups	%	%	%	%	%
Scrapers	1.2	1.9	1.0	2.4	3.9
Burins	7.8	5.1	0.1	3.7	5.2
Borers/awls	2.2	2.4	1.7	1.9	2.9
Axes/Picks	0.2	0.1	-	0.2	-
Microliths	41.5	32.6	21.3	32.3	43.5
Geometrics	8.2	11.0	26.2	21.3	18.1
Lunates	4.4	7.1	20.7	18.5	16.3
Sickles	0.7	1.2	6.4	2.0	1.5
Number	*1221*	*2043*	*1143*	*492*	*717*
InMbt	*4.2*	*11.0*	*20.7*	*5.2*	*4.0*
Number	*54*	*253*	*298*	*27*	*30*

- Old excavation ## - New excavation

It is of interest to note that at Eynan the majority of the mbt products can be considered as 'accident du travail' (for example the Krukowski microburins). Thus there are only 17 'true' microburins in Eynan Ic and 46 in Eynan Ib which means that the actual mbt index in Eynan Ic is 1.3% and at Eynan Ib only 2.9%! (Table I; VALLA 1984). In Salibiya I there are 21 microburins and 6 Krukowski burins in one sample and 30 microburins in the other. As there is no detailed subdivision of the mbt category at Fazael IV it is difficult to assess its nature and 'true' extent at that site. Elsewhere at the same time-period, most prominently in the Negev, there are more microburin technique products than tools, as for example at the site of Rosh Zin (VALLA 1984)!

There is a great difference in the percentages of geometrics among the different sites. Though the majority of the lunates belonged to the backed variety, Helwan retouched ones were present in all the sites (though very rare at Salibiya I) with the exception of Fazael IV. According to the subdivision offered by Valla (1984, 1987) while Eynan Ic and Salibiya I (old excavation) belong to the Late Natufian stage, Eynan Ic, Fazael IV and perhaps Salibiya I (new excavation) are of the Final Natufian. This could be observed through the differences in the average length of the lunates (see Table 3).

Another point of interest is the varying percentages of other geometrics in the various assemblages. Thus in Eynan the dominant types are the trapeze rectangles. In Layer Ic they are nearly half of the geometric component and consist mostly of trapezes-rectangles (41 items as opposed to 54 lunates) and only 5 triangles, In Eynan Ib their relative number diminishes 64 items as opposed 146 lunates and 14 triangles. In both Fazael IV and Salibiya I the lunates are by far the dominant geometric microliths but while in Fazael IV second to them are the triangles with only very few trapezes, the opposite is true for Salibiya I. With the exception of Fazael IV, the burins outnumber the scrapers. Sickle blades are rare.

The Neolithic assemblages (Table 2)

Though the lithic assemblages from Jericho could not be used for detailed comparisons (see above), it should be pointed out that while Crowfoot Payne suggested to retain the definition of the Khiamian as a separate industry in the Neolithic sequence, she thought it was missing in Jericho. Rather, the lithic assemblages from Jericho provided Crowfoot Payne with the basis needed for the definition of the Sultanian industry (1983). The tool types recovered include Helwan points, sickle blades (including the Beit Ta'amir sub-type), polished celts, tranchet axes-adzes, burins, numerous retouched blades and low frequences of microliths.

Gilgal I: The site (Fig. 1) has been only partially published, thus, as in the case of Jericho, its lithic assemblages could not be included in the detailed comparisons presented below. Still according to various preliminarly publications (NOY 1977 1989) its lithic assemblages present the characteristic artifacts of other PPNA sites: Khiam points, burins, sickle blades, retouched blades, bifacially flaked axes-adzes, polished limestone and basalt celts. The sample presented in NOY *et al.* 1980 (the season of 1974) consists of two main assemblages. Slope of GIII (N=250); Excavated Area, Sq.A (N=54). In the collection of the slope there were 24.4% bladelets and 4.4% arrowheads. In the excavated area there were 3.8% retouched bladelets and 18.5% arrowheads. Awls and borers account for 13.2% and 20.3% of the assemblages respectively. No geometrics were recovered. Though mentioned, there are no numbers of sickle blades and according to the excavator (T. Noy, personal communication) they are very similar to the Natufian ones. There are very few flint axes (four?; Tamar Noy, personal communication) and none is a tranchet-axe.

Netiv Hagdud : The lithic assemblages from this site (Fig. 1) were described in detail in several publications (BAR-Yosef 1991; BAR-YOSEF *et al.* 1991; NADEL 1988). The dates obtained for the site correlate well with the early part of the PPNA period. Prominent among the tool types are three types of projectiles: Khiam points, small triangular points and small tanged points. Other tools are Hagdud truncations, various sickle blades (including the Beit Ta'amir knife), tranchet axes-adzes, notches and denticulates, etc. The microlithic component vary from 5% to 15% in the different areas of excavation and consists of various geometrics including lunates. While the lunates were possibly produced by the inhabitants of the site, the trapeze-rectangles were perhaps an admixure from earlier sites, as clay and rubble, used as building substances, were collected from the Salibiya basin which is rich in Geometric Kebaran and Natufian sites. "It seems likely, therefore, that select microliths such as trapeze-rectangles were not produced by the Neolithic inhabitants of Netiv Hagdud" (BAR-YOSEF 1991: 6; see also NADEL 1988).

Salibiya IX : This site is located in the vicinity of Gilgal I (Fig. 1). Perhaps because of the limited excavations (8 m^2), no architectural remains or burials were recovered (BAR-YOSEF 1980, 1991). This site has provided one of the few lithic assemblages upon which the "Khiamian" industry is defined. The dominant tool types include Khiam points, perforators and borers, notches and denticulates, and retouched flakes. Other tools recovered are: retouched and backed microliths, burins and scrapers, unmodified sickle blades and a few backed small lunates (Table 2). Niether axes-adzes nor Hagdud truncations were recovered. The perliminary publication (BAR-YOSEF 1980) presents a sample of 211 retouched tools, yet a more detailed study (D. Enoch, personal communication) encompasses the whole lithic assemblage recovered from this site, including 1027 tool and 27 microburins. Most of the sickle blades are unretouched and 20 bear bitumen traces. The standartization of the lunates is sharply in contrast to its absence in the arrowheads. In the debitage the bladelets (23.1%) and blades (6.1%) are outnumbered by the flakes (59.9%).

Gesher : The site is situated in the Beit Shean valley, at the drainage outlet of Nahal Tabor (Fig. 1) (GARFINKEL and NADEL 1989). The tools (Table 2) include Hagdud truncations but no Beit Ta'amir sickles were found. Most of the sickle blades are made on elegant blades, with parallel edges and back ridges. There are a few Helwan lunates. There were additional 4 lunates from the as yet unpublished second season (D. Nadel, personal communication).

Table 2. PPNA assemblages from sites in Jordan Valley

	Netiv Hagdud	*Salibiya IX*	*Gesher*
Tool Group	%	%	%
Scrapers	1.3	1.8	4.1
Burins	8.3	3.3	7.4
Borers/awls	18.3	20.2	15.6
Axes/Picks	3.7	-	5.7
Microliths	6.7	6.9	4.1
Geometrics	6.2	6.0	0.8
Sickles	4.0	4.5	15.6
Points	3.5	17.6	8.2
Number	*4058*	*1027*	*122*
Index Mbt		*2.6*	

Table 3. Average length of lunates from Natufian and Neolithic assemblages

Natufian	
Eynan Ic	17.5 mm (N=30, Range:11-29 mm)
Eynan Ib	13.5 mm (N=69, Range:10-23 mm)
Fazael IV	13.3 mm (N=38, Range:11-17 mm)
Salibiya I (1978)	20.0 mm (N=56, Range: <16 to >20 mm)
Salibiya I (1988)	16.2 mm (N=89, Range:....).
Hatula A(4-5)	18.3 mm (N=285)
Neolithic	
Netiv Hagdud	17.0 mm (N=41, Range:10-23 mm)
Salibiya IX	11.7 mm (N=27, Range:9-16 mm)
Gesher	20.0 mm (N=2)
Jericho	19.6 mm (N=3)
Hatula A(2-3)	18.4 mm (N=52).

Comparison

All in all, it seems that the Neolithic assemblages presented above have much in common with the Natufian ones. Indeed, there is a reduction in the numbers of the microliths and especially in the percentages of the geometrics, i.e. the lunates. Yet various points categories should be incorporated into the microliths, as in Salibiya IX, all the points and in Netiv Hagdud 90% of the points are made on bladelets. This is true for the PPNA points in general as observed by NADEL *et al.* (1990: Table, 1, 113). The same is true for other typical Neolithic tools such as the Hagdud truncations with more than two thirds being shaped on bladelets. The same is quite true also as regards the growing category of awls and borers where most of the borers are made on bladelets. Thus for example if we add to the percentages of the microliths in Netiv Hagdud and Salibiya IX the percentages of the points, two thirds of the Hagdud truncations and only half of the borers, we will see a change from 6.7% and 6.9% of microliths to 19.8% and 34.6% respectively! All the other components such as the bifacial tools appear in small numbers and their first appearance was observed in the Natufian. The range of sickles frequencies in the Neolithic assemblages peresented in Table 2 is 15.6% to 4.5% while that of the Natufian (see Table 1) is 0.7% to 6.4%. The sickle blades vary not so much in the frequencies as in types (for exmple the Beit Ta'amir sickles are found in Netiv Hagdud and Jericho while absent from Salibiya IX, Gilgal and Gesher). We should consider the great variability which exists among the various sites concerning various other tool categories. We should also take into consideration the intra-site variability as mentioned above (see the case of Jericho and Netiv Hagdud). Unfortunately, due to the preliminary nature of most of the site reports it was impossible to make detailed technological comparisons. Thus it is quite possible that there are greater changes observed in the technological aspects of the various assemblages yet we should remember that the unique mbt which is so typical of the Natufian lithic tradition was not observed in all the Natufian assemblages and is actually declining in the Final Natufian (VALLA 1988). Moreover, both the Natufian and the Early Neolithic assemblages are dominated by the flakey component both in the debitage and in the tool-kits as opposed to earlier Epi-Palaeolithic and later Neolithic assemblages. For example in Netiv Hagdud the bladelets and blades all together are twice outnumbered by the flakes (BAR-YOSEF *et al.* 1991, Table 1). Nadel (1988) states that there is a continuity in the technology of creating tools *ad hoc* ! Yet we should reserve judgment till more complete studies will be available. For example it is very clear that there is flint baking in the Neolithic while it is absent in the Natufian (but see more in NADEL 1988).

Discussion

In the Levant there is only a number of sites with an uninterrupted sequence of occupations from the Late Natufian unto the Early Neolithic. Two sites were reported from the northern Levant, Mureybet in Syria and Nacharini Cave in Lebanon (see Olszewski present volume). In general the same phenomena are observed as those detailed above for the Neolithic assemblages from the Jordan Valley: a decrease in the microliths and especially in the geometrics (i.e. lunates), increase in perforators and sickles (as well as in the intensity of the lustre) and marked presence of Khiam points (frequently atypique) (CAUVIN 1991). It is of interest to note that in Mureybet the 'herminettes' (which are a variety of a bifacial tool) rise in numbers from the Natufian unto the PPNA layers. In southern Levant, the only site with such a sequence published in detail is the site of Hatula. It was suggested by Noy *et al.* (1973) that there is a thin layer (IV - a Khiamian layer ?) between the Natufian and the Sultanian at the site of Nahal Oren, but as there are no detailed reports as yet, we cannot use data from Nahal Oren to compare or contrast it with the data from the Jordan Valley. Hatula is situated in colluvial deposits forming the terrace above Nahal Soreq at the foothills of the Judean Hills (Fig. 1). According to LECHEVALLIER *et al.* (1989) the area of the site is ca. 2-3000 m^2. The lower layers exposed at various localities at the site are Late Natufian without any architectural remains. Above the Natufian occupation there were Neolithic onces, designated as the Khiamian phase/culture. Such a sequence was detected in two areas of the excavation, once with Khiamian structures intruding into the Natufian layers, while elsewhere both the Natufian and Khiamian occupations were devoid of architectural remains (RONEN and LECHEVALLIER 1985, 1991). A Sultanian structure and installations were uncovered at the eastern sector of the site on top of the Natufian and Khiamian occupations (LECHEVALLIER *et al.* 1989). The flint used by the Khiamians was the same as in the Natufian. In both, the Natufian and Khiamian, flakes constitute the most numerous blanks. Likewise, there are no mbt products either in the Natufian nor in the Khiamian assemblages. It seems that due to the very good quality of the flint and the fact that it was carried to the site as evidenced by the absence of flint nodules, the cores in the Natufian and the Neolithic occupations alike went frequently through an extreme reduction, and the lithics are in general of small size.

When compared, it seems that there is a reduction in the numbers of the microliths from the Natufian unto the Sultanian. The rise in the sickles percentages is quite minor. When compared to Salibiya IX and Netiv Hagdud, the latter have more Khiam points and celts, and far fewer microliths, than Hatula. It is of interest to note that the Natufian blades are longer on the average than the Neolithic ones ! (30.1 mm versus 27.1 mm). There is no change in the average length of the lunates (Table 3). The most obvious change through time is in the percentages of awls and borers, from 3.8% in the Natufian to 17.4% in the Khiamian to 28.6% in the Sultanian. The dimensions of the artifacts are the same which means that most of the items in this tool-category are microliths. It should be added that the Natufian in Hatula is unique as it presents the highest ratio of microliths among all Natufian sites, the highest ratio of geometrics and of awls/borers. Burins, on the contrary are scarce at Hatula, compared with other Natufian sites. The excavators assume that the inter-site typological variations in Hatula are best explained as functional.

Another site with a Natufian-PPNA sequence is Sabra I, in the Petra area, Jordan (SCHYLE and UERPMANN 1988; GEBEL 1988). While the lithic industry of the lower levels is mainly of an Early Natufian character, it was claimed that it is an Early, perhaps even Late Natufian temporarily or seasonally occupied site. Above is a Khiamian occupation and though no detailed studies of the lithics are available, the preliminary reports enumerate Khiam points, lunates, triangles, rare mbt products and at least one chisel (see GEBEL 1988, Fig. 6:15). Above the PPNA there is surface PPNB finds.

Table 4. The Natufian and PPNA assemblages from the site of Hatula. Tool types in %

	Natufian			Khiamian	Sultanian
	Areas: A	G	F	Area A (N=705)	Area F (N=1595)
	N= 1483	327	277		
Scrapers	2.9	2.8	2.2	2.1	1.6
Burins	2.7	4.9	0.7	2.6	2.5
Awls/borers	3.8	10.1	10.8	17.4	29.0
Sickles	0.9	0.3	-	1.4	2.1
Microliths	14.2	19.9	10.8	8.8	6.9
Geometrics	49.2	32.1	21.7	36.0	6.8
Points	-	-	-	3.1	3.4
Pics/axes	-	-	-	- -	0.6

A recently excavated site in southern Jordan, the cave site of Iraq ed Dubb sheds light on the earliest phase of the Neolithic. It is contemporary with or somewhat earlier than Netiv Hagdud and the PPNA levels of Jericho (KUIJT *et al.*. 1991). The upland location of the site in an extensively forested area is suggestive of the use of different subsistence resources, and by inference, a different economic focus from sites in the Jordan valley. The lithic assemblages from the site include much debitage items. The following tool-categories were present in a descending order of frequency: retouched pieces, small lunates, Hagdud truncations, Khiam points, sickle blades, perforators and some bifacial tools (including several large picks). It is of interest to note that in the report of the 1989 season (*ibid.*), some mbt production was mentioned. Still, perhaps we have here once again a Natufian/Neolithic sequence, as in a recent report, de Vries and Bikai (1993) state that the majority of the cultural deposits, and all of the structures, date to the Early Neolithic period (10,500-9300 B.P.) and that deposits below this level date to the terminal stages of the Late Natufian period (12,800-10,500 B.P.) (*ibid.*: 463).

Those who claim a break between the Natufian lithic tradition and that of the Neolithic on the basis of the appearance of new tool types as well as the demise or rise of various tool-categories, ignore the fact that most of the latter appeared in earlier in the Natufian (bifacial tools, awls and borers, sickles and Khiam points). For example the Khiam points' presence is noted in Mureybet in the second half of the IXth millennium B.C. (CAUVIN 1989). There are also some sporadic appearances of Khiam points in Late Natufian and Harifian assemblages (see above). Other new tool types, such as the Hagdud truncation or the Beit Ta'amir sickle are not present in every Neolithic assemblage or if they do, their numbers, especially those of the Beit Ta'amir sickles are very low. There is of course a difference in the intensity of geometrics presence in the Neolithic assemblages. It seems that in general they could be divided into two groups - the ones with geometrics (Mureybet Ib, Salibiya IX, el Khiam IV, Hatula, Abu Maadi I) and those without (Jericho, Gilgal). Also the presence of the mbt is still recorded in post-Natufian sites such as Mureybet, el Khiam, and Abu Maadi in Sinai (VALLA 1988).

We should bear in mind the fact that the Neolithic subsistence system was more diverse and that agriculture was not the only mode of living in the early Neolithic even in the non-arid regions. This diversity should be kept in mind as it definetely had implications on the nature of the various assemblages discussed in the present paper, as well as on their inter-and intra-site variability. Thus for example Copeland (1991) claims that the Natufian of the Nacharini Cave (Level 5) should be termed as a Natufian variant, because of the constrained environmental situation at the site and since no 'luxury' items were found. The same is true for the PPNA levels. Thus Level 4 seems to be a seasonally occupied camp of hunting parties, perhaps engaged in the annual cull of migratory or resident game species; the artifacts are dominated by hunting weapons (arrowheads with impact fractures); repair, and flint knapping generally seems to have taken place on site; heavy milling equipment is virtually absent. In short, there is a striking contrast betweeen the material remains here and those of the Natufian 'village' at Eynan (Mallaha) or the PPNA settlements in the Jordan Valley or at the site of Hatula.

Undoubtly the nature of the site, task specific, of short-duration, a permanent settlement etc., influenced greatly the lithic assemblage as well (the Negev sites are a good example, see GORING-MORRIS and BAR-YOSEF 1987 concerning the Natufian site of Nahal Sekher VI). Nevertheless, it seems that the similarities between the Natufian and Neolithic assemblages, are not a coincidence, and it is not due solely to stratigraphic problems, that the Natufian evidence is difficult to separate from that for the earliest "PPNA" at some sites (Nachcharini, Borj Barajne, etc. see COPELAND 1991). Indeed, speaking of the Levant as a whole, these two cultural phases are bracketed by Cauvin as the "phylum culturel Natufien/Khiamien" (1989:7). He distinquishes between those two not on the basis of the material finds but rather because of a religio-cultural revolution which he claims occurred in the PPNA. BAR-YOSEF (1989) also points out that the non-lithic material remains at PPNA sites (such as female figurines, projectile points, cultivation of barley, appearance of celts and obsidian, some building techniques, etc.) are the onces that differentiate them from those of the Natufian, clearly indicating significant changes in the lifestyles. And indeed, changes in these domains rather than those in the lithic assemblages are the ones that both reflect and brought about the revolution that placed humankind on a new and different level of existence...

Acknowledgments: I would like to thank O. Bar-Yosef for the access to the lithic assemblages of Salibiya I and IX as well as to D. Enoch for her comments on the material above. Also I would like to thank D.. Nadel for information as regards the site of Gesher.

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Interregional Aspects of the Khuzestan Aceramic - Early Pottery Neolithic Sequence

(Synthesis Contribution)

Frank Hole

Introduction

Knowledge of the prehistory of lowland Iran and immediately neighboring regions has remained nearly static for the past 15 years owing to cessation of fieldwork; however, the Jarmo Project publication of 1980 (BRAIDWOOD et al. 1983) substantially improved the situation, and the latest calibrations show the true place of the Zagros in the development of Neolithic societies. Fortunately work has continued in northern Iraq and southeastern Anatolia, amplifying somewhat the spotty Iranian results.

The primary evidence for lowland Iran comes from Deh Luran and Khuzistan; the work done by the Rice University group has been published (HOLE, FLANNERY, and NEELY 1969; HOLE 1974, 1977) whereas that done by the Chicago group (DELOUGAZ and KANTOR 1972) has not. No other excavated sites in the lowlands have aceramic or early ceramic exposures. For reference, the sites listed in Table 1 and Fig. 1 in Iran and adjacent Iraq/Turkey are relevant to the discussion.

Table 1. Excavated sites in Iran and Iraq that pertain to the discussion of lithics. *<NB: This chart does not imply strict chronological succession among sites in different regions.>*

Comparative Sites

Period	Sites
Halafian	Banahilk
Hassunan/Samarran	Hassuna 1b-V, Ali Agha, Thalathat, Shimshara, Sawwan, Chagha Sefid
"Umm Dab"	Umm Dabaghiyah, Tell Sotto, Thalathat, Hassuna Ia
Jarmoan	Jarmo II, Guran (ceramic), Sarab, Ali Kosh, Chagha Sefid
Aceramic	Ali Kosh, Chagha Sefid, Guran, Boneh Fazili, Jarmo I, Abdul Hosein
Aceramic (PPNB)	Karim Shahir, M'lefaat, Nemrik 9, Qermez Dere, Hallan Çemi
Proto-Neolithic	Shanidar B1, Zawi Chemi,
Zarzian	Zarzi, Palegawra, Pa Sangar, Gar Arjeneh

Table 2. Deh Luran Sequence with approximate interregional periods indicated

Deh Luran Chronology	
Period	Local Phase
Samarran	Choga Mami Transitional
Hassunan	Surkh Phases
	Sefid Phase
Jarmoan	Mohammad Jaffar Phase
CERAMIC ABOVE, PRE-CERAMIC BELOW	
Aceramic	Ali Kosh Phase
	Bus Mordeh Phase

Characterization of Lowland Lithics

There are several ways to characterize the lithic assemblages from the PPN and early PN villages on the Deh Luran plain, Tepes Ali Kosh and Chagha Sefid, each of which was occupied through several recognizable phases prior to and after the introduction of pottery, (Drawings and counts of the Deh Luran types are in Figs. 2-6 and Tables 3-4).

1. Lithics were abundant. In the two aceramic phases of Ali Kosh (Bus Mordeh and Ali Kosh), we recovered 63,000 lithics (nearly 40,000 tools including blades); and in equivalent layers at Chagha Sefid, some 7300 lithics (3400 tools). After the introduction of pottery, similar quantities of lithics and essentially the same types continued to be produced. The differences between the sites resulted from volumes excavated and types of deposit, a point that is made clear by the recovery of 23,000 artifacts from Sefid Phase layers at Chagha Sefid.

2. The industry is overwhelmingly based on blades. About 80% of the lithic material recovered consisted of blades and tools made on blades. In one deposit in the Bus Mordeh Phase, we recovered part of a chipping floor with more than 10,000 blades and dozens of bullet cores.

3. The quality of pressure flaking that resulted in these enormous numbers of blades has not been exceeded in any other site. The discarded bullet cores are from 2 to 5.5 cm long with platform diameters of 0.3 to 2.5 cm. The resultant blades are often only a few millimeters wide.

4. Obsidian is found in all Neolithic phases: 1-2 percent in the aceramic phases, nearly 8 percent in the Mohammad Jaffar Phase at Chagha Sefid and then declines to 1-2 percent by the end of the Neolithic.

5. Of the 27 tool types, obsidian was used for no more than 12, nearly all plain, unretouched blades or various kinds of retouched or used blades. No tool type was made exclusively of obsidian.

6. The assemblage contains a large microlithic component, including rare geometrics, and numerous backed and diagonally-ended bladelets.

7. Sickles increase in frequency through the Neolithic phases, but they are never very numerous. At Ali Kosh they rise from 3 to nearly 8 percent from the Bus Mordeh to Mohammad Jaffar Phases, and in comparable layers at Chagha Sefid the proportions are esssentially the same.

8. There is very little discernible change in presence or absence of types from the Bus Mordeh Phase to the Surkh Phase; the significant change occurs with the intrusion of late Samarran ceramics into Deh Luran, after which there is a total change in lithic technique, a shift in raw material used, a vast reduction in the range of types, and an absolute diminution in the frequency of lithics. By way of comparison, while the three phases in Ali Kosh held an average of some 13,000 lithics each, equivalent deposits in

Table 3 . Occurrence of chipped stone tool types from phases at Tepes Ali Kosh, Chagha Sefid, and Sabz on the Deh Luran Plain (from HOLE, FLANNERY and NEELY 1969, and HOLE 1977).

A All chipped stone (flint, obsidian and crystal) tool types at Chaga Sefid by cultural phase.

B Occurrence of chipped stone (both flint and obsidian) tool types at Ali Kosh, Tepe Sabz, and Tepe Musiyan by cultural phase.

A

	Geometric and Other Microliths						Piercing-Reaming Tools					Sickles		Scrapers				Cutting-Scraping Tools								Misc. Tools						
Phase	Trapezes and Triangles	Crescents	Diagonal-ended	Diagonal-ended and Backed	Backed Bladelets	Nibbled Bladelets	Drills	Reamers	End Reduced on Bulbar Side	Pointed Pieces	Frags. of Drills and Reamers	Plain Sickles	Truncated Sickles	Blade, Round-end Scrapers	Flake, Round-end Scrapers	Blade, Misc. End Scrapers	Flakes with Bulbar End Retouch	Plain Blades	Backed Blades	Truncated Blades	Retouched or Used Blades	Notched Blades	Retouched or Used Flakes	Notched Flakes	Denticulated Flake Scraper	Burins	Micro-burins	Scaled Pieces	Blades with Ground Edges	Bifacially Chipped Flakes	Bifacial Picks	Total Tools
Sabz	1					1	5	2			6	4	1	2				68		1	15	2	16	1	7	2						134
Choga Mami Transitional	2	1			1	1	7	2			1	10	1	5		8		212	2	1	46	21	49	10	25	1				1		407
Surkh	9		2	3	12	2	45	13		6	15	135	13	29		30	8	1,182	6	4	320	100	116	17	60	8	2	2	2	2		2,143
Sefid	16		5	9	11	1	154	47	9	15	36	349	11	59	29	25	11	4,793	8	7	686	319	342		45	20		14	2		1	7,035
Mohammad Jaffar	2		3	8	12	8	8	2	2		2	17		10			1	728		1	87	44	15	4	5	1						960
Ali Kosh			5	15	16	2	43	15	3	7	26	93	3	142	9	16		2,442	5	7	220	320	90		4	2			1		1	3,487
Totals	30	1	15	35	52	15	262	81	14	28	86	608	29	257	39	79	20	9,425	21	21	1,374	806	628	32	146	34	2	16	5	3	2	14,166

B

	Geometrics and Other Microliths						Piercing-Reaming Tools				Sickles		Scrapers				Cutting-Scraping Tools							Misc. Tools			
Phase	Trapezes	Crescents	Diagonal-ended	Diagonal-ended and Backed	Backed Bladelets	Nibbled Bladelets	Drills	Reamers	End Reduced on Bulbar Side	Pointed Pieces	Plain Sickles	Truncated and/or Backed Sickles	Blade, Round-end Scrapers	Flake, Round-end Scrapers	Blade, Misc. End Scrapers	Flakes with Bulbar End Retouch	Plain Blades	Backed Blades	Truncated and/or Backed Blades	Retouched or Used Blades	Notched Blades	Retouched or Used Flakes	Notched Flakes	Burins	Bifacially Chipped Flakes	Bifacially Chipped Point	Total Tools
Bayat	1	. . .	. . .	. . .	. . .	. . .	11	. . .	. . .	. . .	81	6	. . .	. . .	2	. . .	356	2	9	53	5	14	11	. . .	. . .	. . .	551
Mehmeh	. . .	. . .	. . .	. . .	. . .	. . .	10	. . .	. . .	. . .	18	1	. . .	. . .	. . .	. . .	101	1	5	20	1	14	5	. . .	2	. . .	178
Khazineh	. . .	. . .	. . .	. . .	. . .	. . .	1	. . .	. . .	. . .	12	9	. . .	. . .	. . .	. . .	50	1	1	8	2	12	10	. . .	1	. . .	107
Sabz	. . .	2	. . .	. . .	. . .	. . .	2	. . .	. . .	. . .	6	18	. . .	. . .	1	1	73	4	8	10	1	19	30	1	1	. . .	177
Mohammad Jaffar. .	. . .	. . .	6	18	15	172	73	24	10	2	119	2	31	6	13	6	10516	. . .	. . .	603	463	11	. . .	1	. . .	. . .	12091
Ali Kosh	. . .	. . .	6	10	15	140	79	27	2	5	110	4	73	14	32	6	9789	. . .	. . .	826	683	26	9	2	2	. . .	11860
Bus Mordeh	. . .	. . .	3	13	66	79	110	19	2	7	42	. . .	103	2	20	. . .	15082	. . .	. . .	423	319	3	2	2	. . .	1	16298
Total	1	2	15	41	96	391	286	70	14	14	388	40	207	22	68	13	35967	8	23	1943	1474	99	67	6	6	1	41262

Table 4. Occurrence of chipping debris from phases at Tepes Ali Kosh, Chagha Sefid, and Sabz on the Deh Luran Plain (from HOLE, FLANNERY and NEELY 1969, and HOLE 1977).

A All chipping debris (flint, obsidian and crystal) at Chaga Sefid by cultural phase.

B Occurrence of chipping debris (both flint and obsidian) at Ali Kosh, Tepe Sabz, and Tepe Musiyan by cultural phase.

A	Flint									Totals	
Phase	Bullet Cores	Blade Cores a	Blade Cores b	Blade Cores c	Bullet Core Frags.	Blade Core Frags.	Flake Cores	Flake Core Frags.	Debitage	Total Chipping Debris	Total of All Chipped Flint Stone
Sabz		1				5	6	7	594	613	747
Choga Mami Transitional	3	1	2	5		13	35	13	1,543	1,615	2,022
Surkh	6	10	4	36	4	47	79	59	3,253	3,498	5,641
Sefid	92	18	44	141	50	106	150	270	14,823	15,694	22,729
Mohammad Jaffar	8	2	1	5		9	8	19	987	1,039	1,999
Ali Kosh	86	4	2	22	37	13	29	93	3,576	3,862	7,349
Totals	195	36	53	209	91	193	307	461	24,776	26,321	40,487

B	Blade Cores				Flake Cores						Core Fragments						
Phase	Bullet Cores	Tongue-shaped Cores	Semi-chipped Cores	Very Large Blade Cores	Whole-chipped Cores	Tea Cozy Cores	Discoidal Cores	Semi-chipped Cores	Amorphous Cores	Thin Nodule Cores	Tablets of Blade Cores	Edges, Platforms	Faces	Miscellaneous	Debitage	Total Chipping Debris	Total Chipped Stone (Tools and Debris)
Bayat	. . .	. . .	6	. . .	. . .	. . .	. . .	3	1	. . .	. . .	10	6	5	685	716	1267
Mehmeh	. . .	. . .	5	. . .	. . .	. . .	. . .	12	3	2	. . .	7	7	5	494	535	713
Khazineh	. . . .	. . .	2	. . .	. . .	. . .	2	22	1	4	. . .	6	10	6	660	713	820
Sabz	2	. . .	3	. . .	. . .	. . .	. . .	55	12	13	1	9	25	12	1564	1696	1873
Mohammad Jaffar . .	221	8	13	. . .	32	3	. . .	17	3	. . .	20	70	165	76	11215	11843	23934
Ali Kosh	182	9	21	5	35	11	1	38	17	. . .	11	67	143	83	10748	11371	23231
Bus Mordeh.	159	1	63	. . .	12	. . .	1	17	8	. . .	3	73	77	22	23380	23816	40114
Totals	564	18	113	5	79	14	4	164	45	19	35	242	433	209	48746	50690	91952

the Sabz and later phases averaged about 250 each (Tables 3-4). (see Table 5 in HOLE, FLANNERY, and NEELY 1969: 84)

I regret that it is not possible to compare these sites with Tepe Tula'i in Khuzistan, a tent camp with ceramics similar to those of the Deh Luran Sefid Phase. The entire assemblage of material is in the Teheran Museé Bastan where it has not been accessible. The excavation took place under difficult conditions and had to be terminated before we had accomplished all our objectives, and the artifacts were given only a cursory in-field examination. I have counts only on sickles, plain blades and débitage for Area A, the mounded portion of the site. For the volume excavated, the material was as abundant as in Deh Luran, but I cannot be specific about the occurrence of particular types. Superficially Tula'i, as well as Choga Bonut and other early sites that I know from surface collections, have the same quality and range of lithics as those in Deh Luran.

Interregional Chronological Outline

Epipaleolithic

Although this period lies outside the immediate concern of this workshop, one expects to find continuities that go back into the Pleistocene; indeed Braidwood used this expectation as the guiding principle in his research on the origins of agriculture, and such continuities exist in the southern Levant. Nevertheless, Braidwood's team concluded that there are "discontinuities between the Palegawra, Karim Shahir, Jarmo and Matarrah industries," (BRAIDWOOD et al. 1983: 14) and subsequent surveys and excavations have not yet discovered a convincing series of bridging sites from the Epipaleolithic to the Neolithic. Now that accurate calibrations of the radiocarbon dates exist for this range of time the reasons for the lack of typological continuity are evident: there is a chronological gap in the series of dated sites that spans some 3000 years from Palegawra (15,500 BC) to Zawi Chemi and Shanidar B1 (10,500 BC). Whether this gap is real, or results from faulty dates, or is simply a sampling problem remains to be determined. Nevertheless, no site in Iran is known to fall into this range and even the Epipaleolithic is sparsely represented (HOLE and FLANNERY 1967; MORTENSEN 1974: 18; ROSENBERG n.d.; SMITH 1986). The situation is similar to that for Anatolia and may have a climatic/environmental explanation.

Proto-Neolithic Sites

No site in the lowlands like Zawi Chemi or Shanidar B1 has yet been described. (SOLECKI 1981) So far the only sites of roughly equivalent radiocarbon age are found along the upper Tigris in Turkey at Hallan Çemi, in the Iraqi Jezireh at Qermez Dere, or the foothills of the Zagros at M'lefaat, and along the middle Euphrates at Abu Hureyra and Mureybet. (CAUVIN 1977; HOWE 1983; KOZLOWSKI n.d.; MOORE 1979; MORTENSEN 1962; ROSENBERG and DAVIS 1992; WATKINS, BAIRD et al. 1989). Karim Shahir in Iraq shares a number of typological similarities with these sites but it is undated. The oldest dated aceramic Neolithic sites in Iran are the mountain sites of Asiab, Tepe Abdul Hosein and Ganj Dareh, but they are 2000 years *younger* than the aforementioned sites, despite alleged typological similarities with Zawi Chemi and Karim Shahir. (HOWE 1983: 117; SMITH 1971, 1976) In the absence of any publication of the Asiab lithics, we cannot judge the degree of similarity; however, as I recall from casual observation during the excavation of the site, there were large numbers of relatively long bullet cores, a feature that suggests a later rather than an earlier date. My guess is that Asiab lies closer in time to Ganj Dareh and Abdul Hosein than to Zawi Chemi, a judgment that is shared by Pullar (1990: 5).

No direct evidence of agriculture exists at either Zawi Chemi or Karim Shahir despite the presence at both of numerous grinding stones. Domestication has been alleged at Zawi Chemi but the evidence cannot now be corroborated. (PERKINS 1964). These two sites suggest that some limited sedentism precedes domestication in this region as it did in the Levant. However, later PN sites definitely do hold evidence of domestication. At both Ganj Dareh and Abdul Hosein, there are domestic crops and, at least in Ganj Dareh and possibly Asiab, domesticated goats. (HESSE 1978) The radiocarbon dates make it clear that still at this stage, there are no sites yet known in the lowlands of Iran.

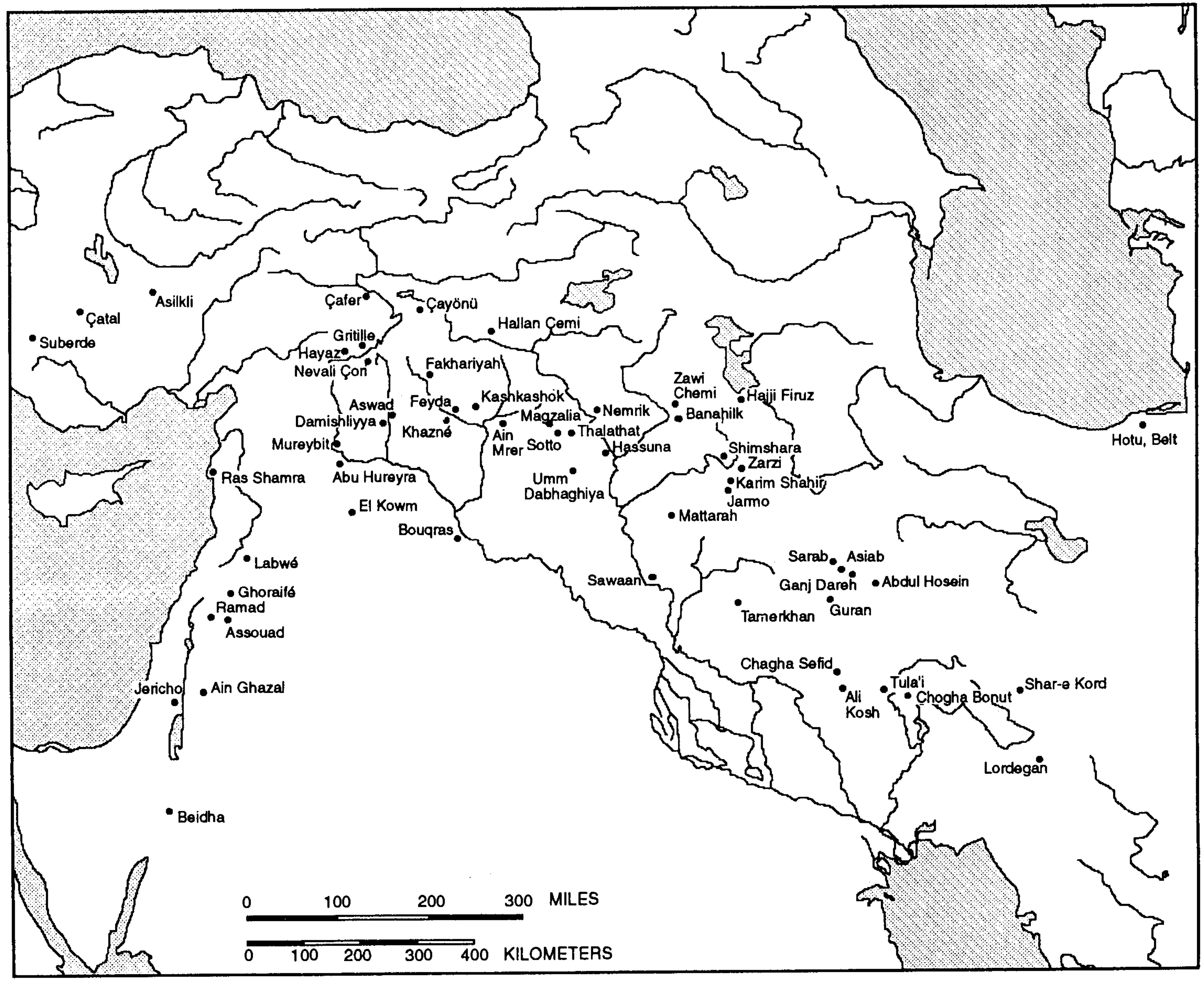

Fig. 1. Selected Pre-Pottery Neolithic (PPN) and early ceramic Neolithic (PN) sites.

Aceramic Neolithic

There are four excavated lowland aceramic sites, Ali Kosh (Bus Mordeh Phase, 7000 BC) and Chagha Sefid on the Deh Luran plain and Choga Bonut and Boneh Fazili in Khuzistan. The latter two, excavated by the late Pierre Delougaz and Helene Kantor, have not been published. All these sites continued to be occupied during the early introduction of pottery.

The lowest layers in these sites predate the introduction of ceramics in this region, an event that lags its appearance in northern Mesopotamia by as much as 500 years. That the absence of ceramics is real is suggested by (a) the lack of sherds, (b) deposits of substantial depth that represent some change (and hence a prolonged period of time), and (c) the fact that the same situation occurs at several sites. It is more than a local sampling problem (as, e.g., Assouad). Other sites of the period may have been found as surface scatters but, in view of the evident continuity in lithic techno-typology into the PN, the absence of sherds (that are friable and may not be very numerous) cannot be taken as evidence of their absence from sites. In Deh Luran there are some lithic indicators of the period but, because they occur in low frequency, their possible absence in surface collections is as likely to be an artifact of sampling as an indication of their absence from the site.

None of these sites is nearly as old as either the Proto-Neolithic of the Zagros (e.g., Zawi Chemi or Hallan Çemi), or the early part of the PPNB in the Levant, but they do fall comfortably into the latter end of the PPN and the beginning of the PN. The Deh Luran sites show the use of both cereal and animal domesticates, with an apparent intensification of their use during the occupation of Ali Kosh. At Chagha Sefid there is a greater emphasis on herds. A similar picture occurs in Tepe Guran, where the site begins before the local use of pottery, and herding seems to take precedence over agriculture early in the site.

There are only a few sites south of the central Zagros that are reported to have Neolithic lithics. In two of the lower small mountain valleys fringing the Khuzistan plain (Izeh, Dasht-e Gol and Iveh), some possible aceramic Neolithic sites were discovered. (WRIGHT, KOSSARY *et al.* 1976: 431; WRIGHT 1979) In the same Bakhtiyari mountain region, but at higher elevations, Zagarell reports finding a cave site, Eskaft-i Sangiyan in the Shar-e Kord plain. (ZAGARELL 1982: 18-20) Although this was only a surface collection, the types (relatively crude blades) seem appropriate for a Proto-Neolithic or possibly later aceramic Neolithic site. Although Zagarell looks to the Zarzian for parallels, the lack of geometrics suggests a later date. Nearby rockshelter S4 has a characteristic bullet core, but little else that is diagnostic. A third site, in the Lordegan plain is Qal'e Geli which has a variety of small blades and an obsidian scraper, all of which signal the Neolithic. Zagarell's survey took him through some remote mountain country where sites of any kind are not numerous, but it is striking that neither surveys in the large mountain plains, nor excavations in southern Iran have turned up material older than the ceramic Neolithic. (Summner, Rosenberg, Miroschedji, Prickett, Lamberg-Karlowsky, Fukai et al.: all cited in HOLE 1987)

I infer from the assembled evidence that settlement slowly spread from north to south, along with animal husbandry and agriculture and that the sites mentioned above are all relatively late. Another possible indicator of a retarded penetration of this region is that none of the sites reported by Zagarell closely fits the typical Zagros Group assemblage. It remains to determine whether the Epipaleolithic sites discovered by Rosenberg in the Marv Dasht plain are also late hangers-on of an old tradition. At the moment there is no way to tell, but it appears that there is a typological disjunction between the Epipaleolithic and the Neolithic there as elsewhere.

Because of the possibility of local traditions in this large and environmentally varied region, it is difficult to specify single types that invariably signal different periods. The most evident indication that a PPN site may be present in Iran is the occurrence of numerous bullet cores whose last products were microblades. Although these have a fairly long period of use, beginning as early as Karim Shahir, they end by the mid-sixth millennium, after which there is a sharp decline in the occurrence of blades and a number of other tools, including all of the backed and some of the geometric forms (Tables 3-4). There is little question that a fundamental change in production and use of lithics had taken place everywhere by the Chogha Mami Transitional (Late Samarran) around 5500 BC. The quality of chipping, the specific flint and chert sources used, and the decline in quantity of lithics all signal this change.

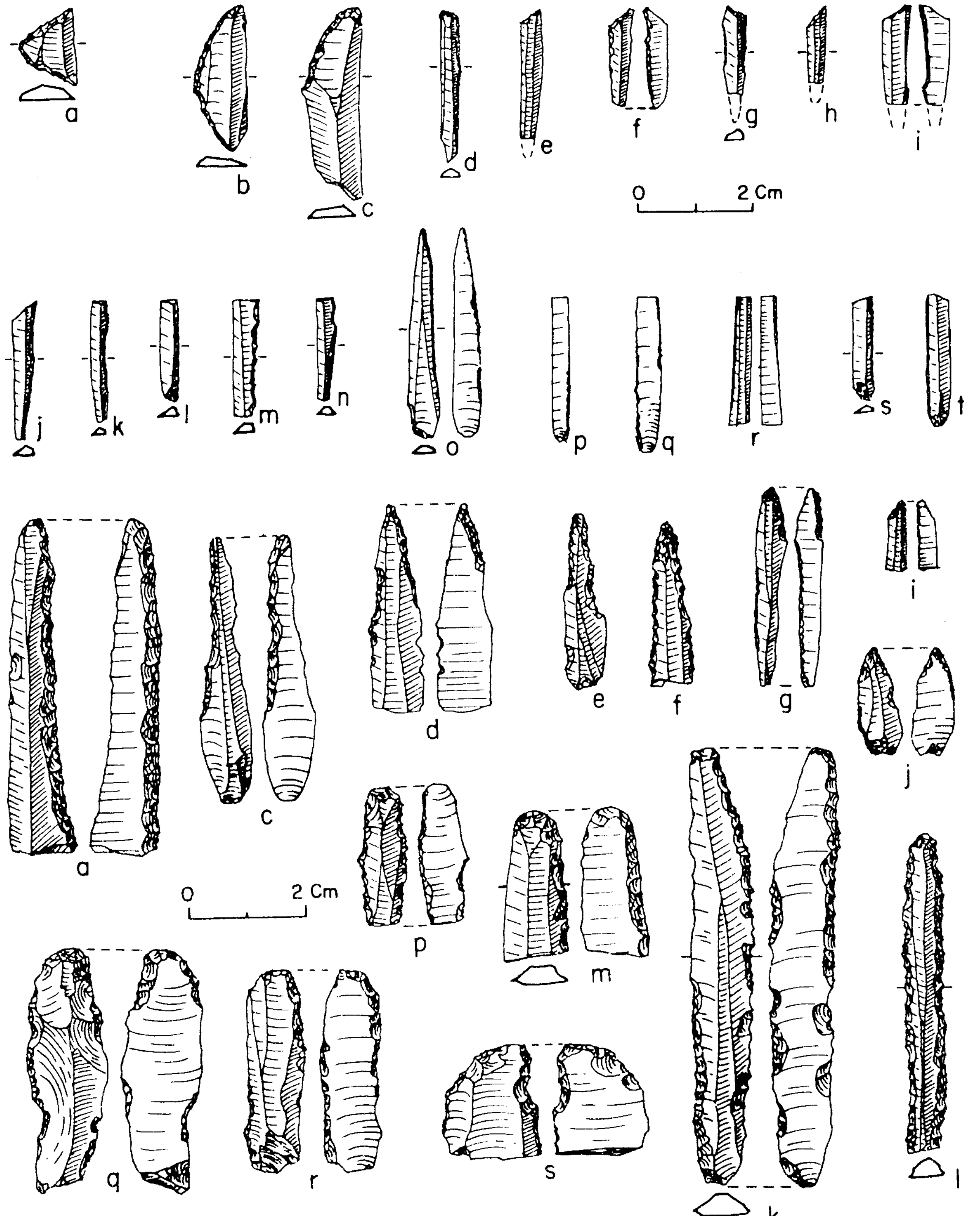

Fig. 2. Tool types from Tepe Ali Kosh.
(upper) a trapeze, b-c crescents, e,h diagonal-ended bladelets, d,f-g,i diagonal-ended-and-backed bladelets, j-n backed bladelets, o-t nibbled bladelets.
(lower) a-g drills, i,j pointed pieces, k-p reamers, q,s blades with end reduced on bulbar side.

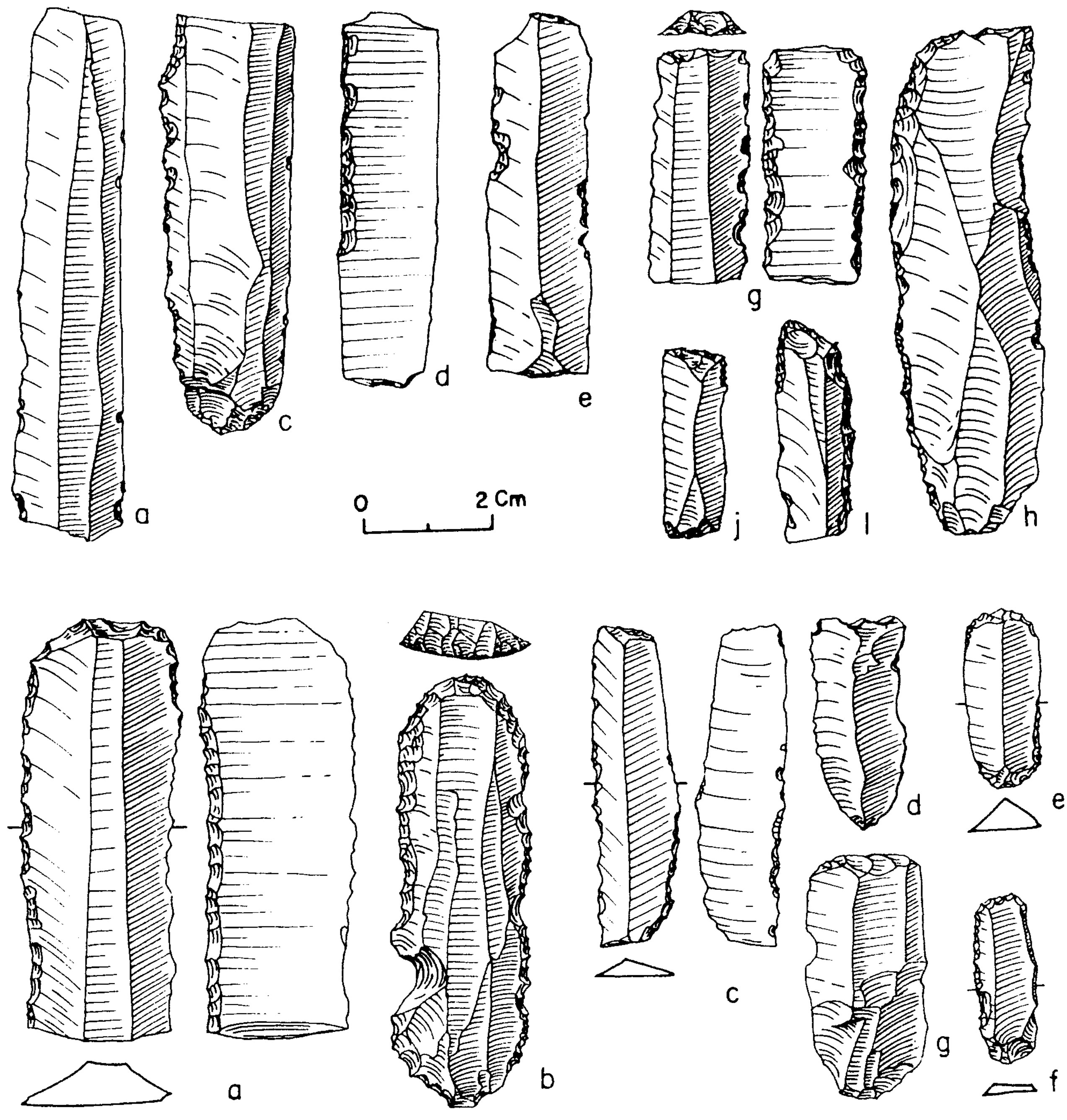

Fig. 3. Tool types from Tepe Ali Kosh.
(upper) a-e plain sickles, g-j truncated and/or backed sickles.
(lower) a-b,e-f blade, round-end scrapers, c-d,g miscellaneous-end scrapers.

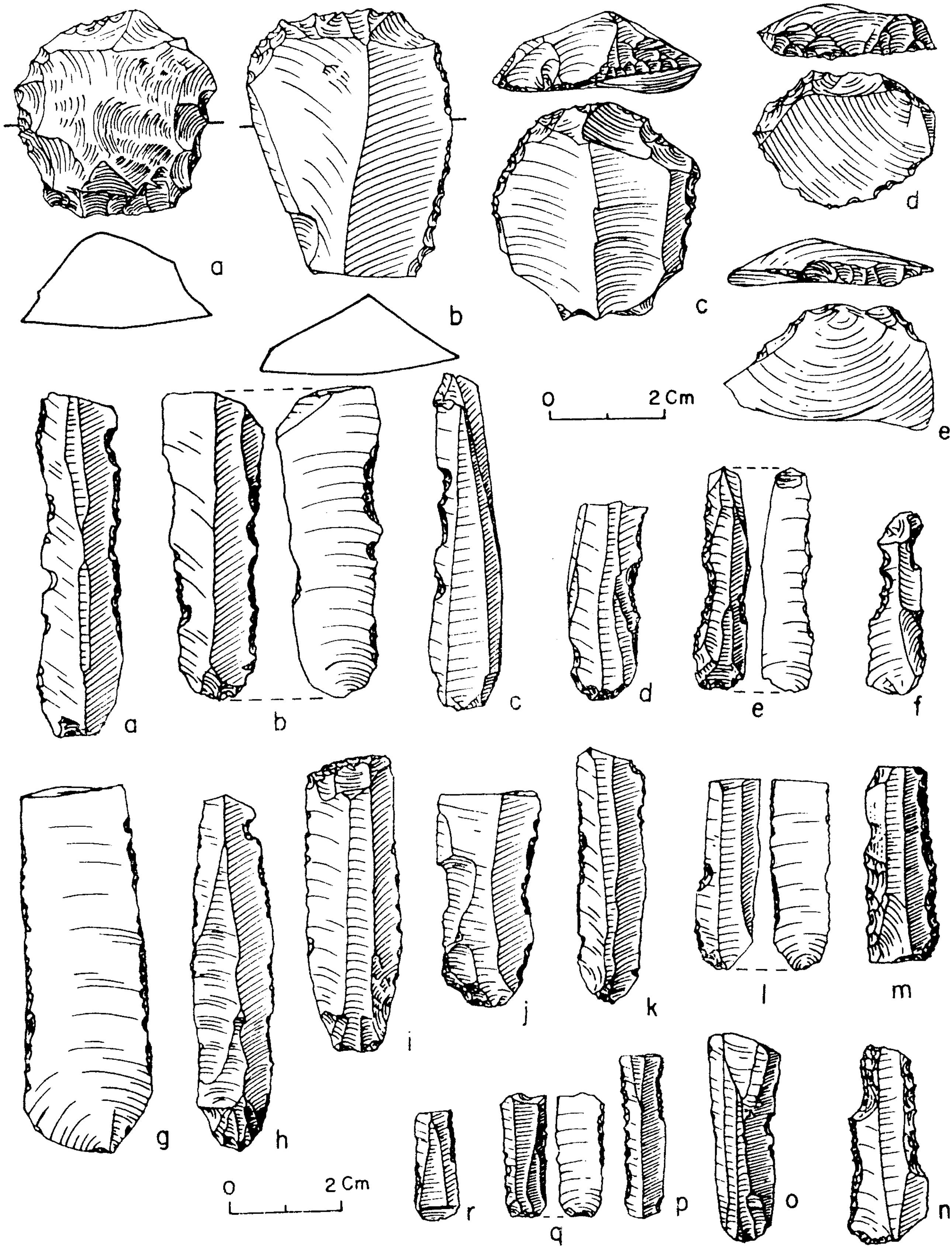

Fig. 4. Tool types from Tepe Ali Kosh.
(upper) a-c flake, round-end scrapers, d-e flakes with bulbar end retouch.
(lower) a-f notched blades, g-r retouched or used blades.

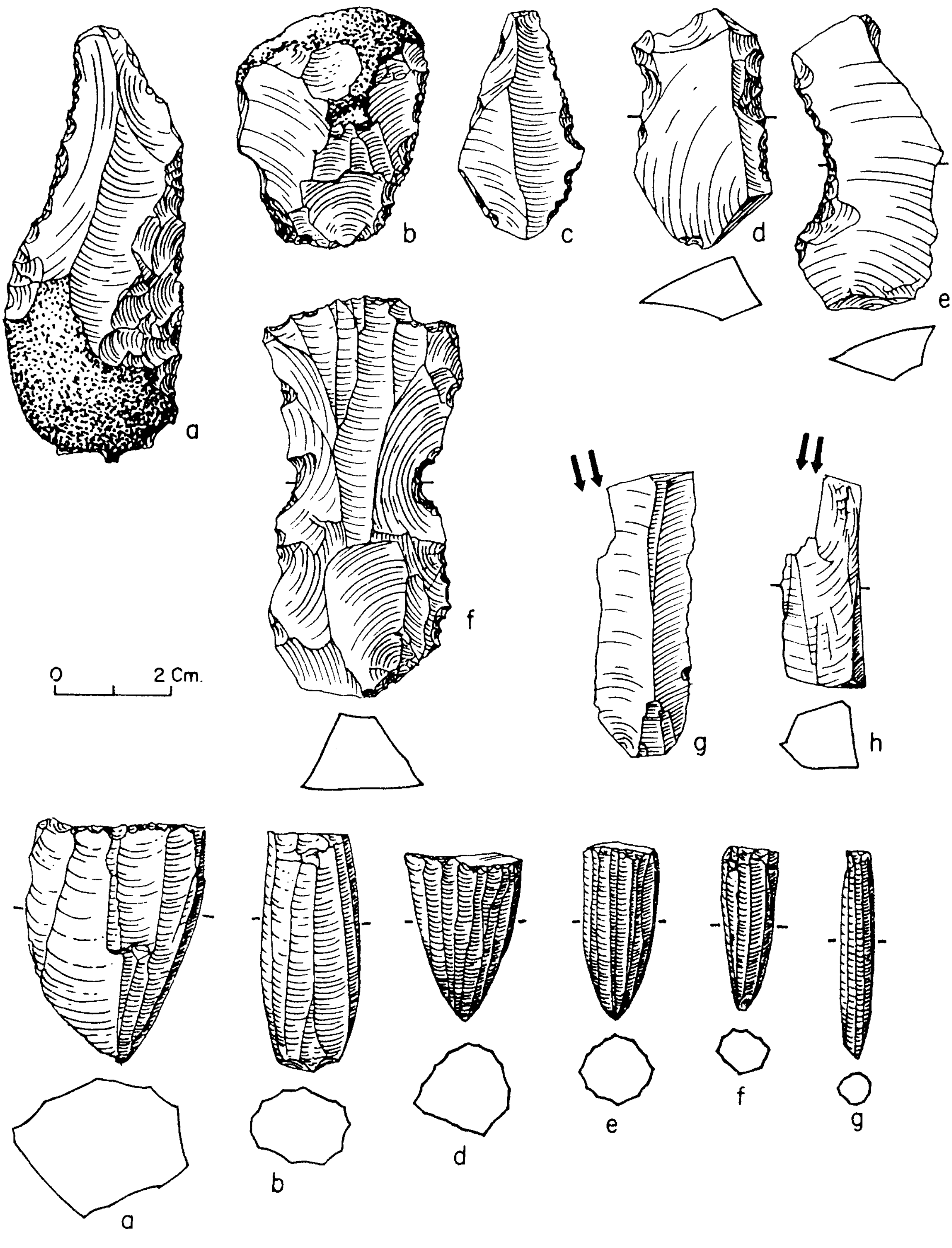

Fig. 5. Tools and blade cores from Tepe Ali Kosh.
(upper) a-d retouched or used flakes, e-f notched flakes, g-h burins.
(lower) a semi-chipped blade core, b-g bullet-shaped blade cores.

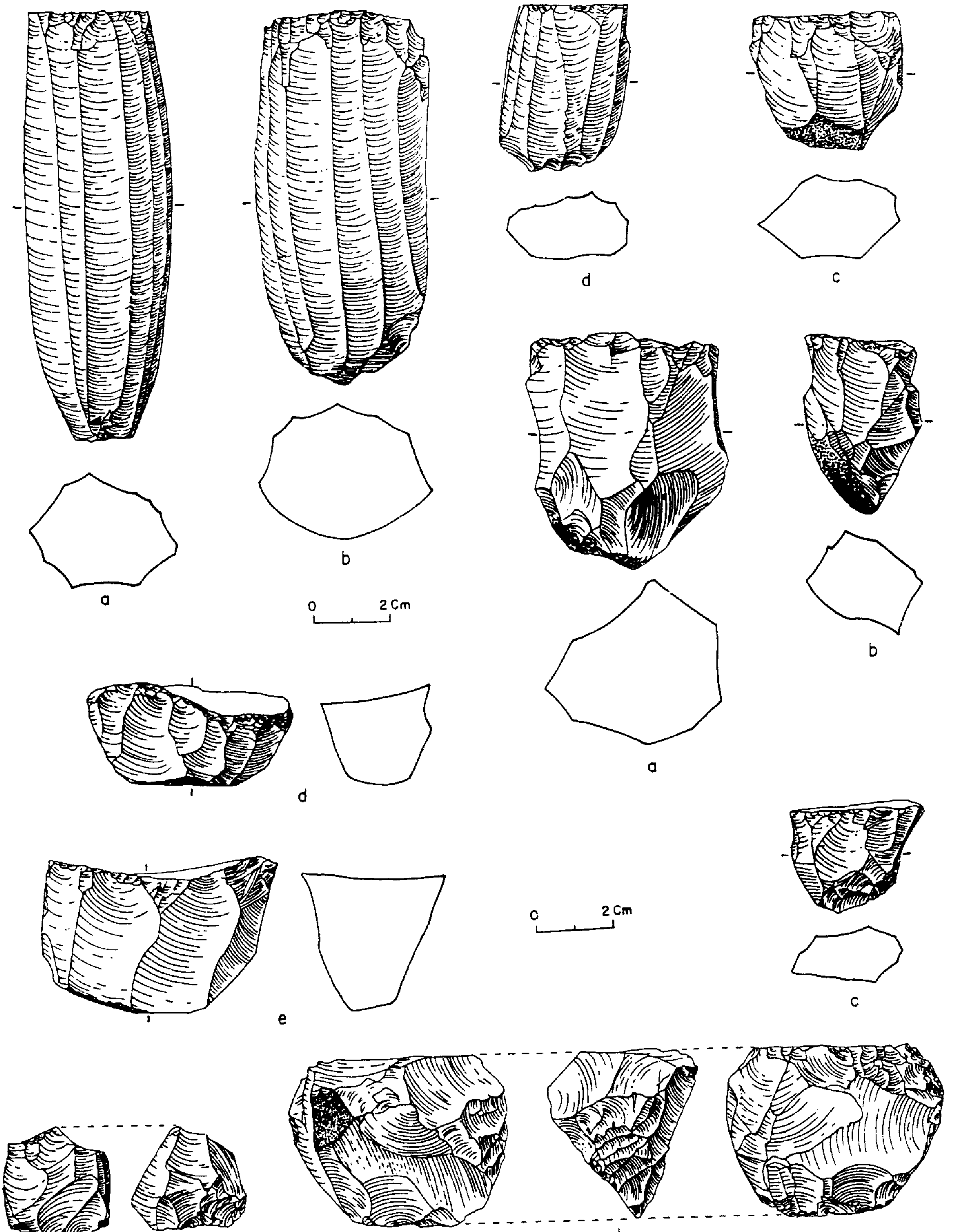

Fig. 6. Cores from Tepe Ali Kosh.
(upper) a-b large blade cores, s-d tongue-shaped cores.
(middle) a-c whole-chipped flake cores, d-e tea cozy flake cores.
(lower) a-b amorphous flake cores.

However, it is evident that while people in Deh Luran continued to make fine bladelets and use copious amounts of flint, toward the end of the sixth millennium BC, the contemporary Hassuna and Samarra people had already given up these practices. After the beginning of the "'Ubaid" there are invariably many fewer lithics than potsherds in sites.

The other good chronological marker is the presence of obsidian, which is rare or absent from Zagros Proto-Neolithic sites. Although this material probably "falls off" in frequency with distance from source, beginning with the aceramic Neolithic, sites usually have some obsidian and it occurs in impressive quantities in the early ceramic Neolithic.

Zagros Group

Mortensen defines a "Zagros Group" of Neolithic sites,

> "related not only in time and by their ecological background ... [but] also related by having ... a varied chipped stone industry based principally on blades and with a few geometric microliths, a ground stone industry with polished bowls, bracelets and beads of marble, and a rich occurrence of clay figurines. Further ... they all [Jarmo, Guran, and Sarab] have the same ceramic tradition."

The sites in question are dated to the 7th-6th millennia BC; thus there is ostensibly a considerable gap between these settlements and the "Proto-Neolithic" sites such as Karim Shahir and Zawi Chemi. Mortensen points to differences between these sites and Ali Kosh which, he says, does "not seem to show any special signs of dependency on the Zagros Group." (MORTENSEN 1964: 33-34) He goes further in asserting that there is little reason to believe that the Zagros Group played a role in the origin of the Hassuna-Samarra tradition -- "the ceramic tradition and the chipped-stone industry, for example, must either have been derived from the Taurus mountains north of Mesopotamia or must have been developed *in* the area." (MORTENSEN 1964: 35-36). We might add, there is little to suggest a direct relation between the Zagros Group and the sparse lithic industry of Hajji Firuz, a site in the northern Zagros with obvious ceramic affinities to the Hassuna tradition. Although Hajji Firuz is slightly later than the Zagros Group sites, despite a paucity of lithics of any type, there are obsidian side-blow flakes and Çayönü double backed blades, both of which point to an Anatolia rather than Zagrosian origin, rather like Shimshara. (VOIGT 1983: 234-236)

Thus, while the Northern Zagros is part of a different tradition with north Mesopotamian/Anatolia links, I am not convinced that the Central Zagros Group can be wholly excluded from consideration of lowland Iran; in fact, I would say there are quite clear parallels, as is evident from the fact that I used precisely the same classification for the two regions. (HOLE, FLANNERY, and NEELY 1969; HOLE 1983) Nevertheless, Deh Luran has fewer types and the relations between the two regions are likely to have been attenuated by the distances between sites which, after all, come from regions separated by a major mountain chain where there is ethnic diversity today.

In summary, in the PN we may distinguish the following traditions: (a) the Northern Zagros, probably related to the Hassuna/Samarra lowland region, (b) the Central Zagros and lowland Iran/eastern Iraq, and (c) the Southern Zagros, a late ceramic Neolithic, that is not relevant here. The reasons for such a division probably relate to different historical traditions that are dominated by ecological considerations. When material can be cross-dated, it is evident that the northern and the central regions followed different trajectories. In Deh Luran, there was a gradual shift away from intensive blade making after the early phases and an eventual loss of the finer skills of knapping by the time of the Samarran intrusion. The Proto-Neolithic antecedents of the northern tradition probably lie outside Iran and may have much more to do with south eastern Anatolia and the northern fringe of lowland Mesopotamia. (KOZŁOWSKI n.d.)

Northern Mesopotamia

Although a number of sites with pre-Hassunan "Umm Dab" and Hassunan pottery have been excavated, there are just a few aceramic sites (discussed in the Workshop by Stefan Kozłowski); therefore I shall make only a few remarks. Bader (1989: 346-347) notes that Tell Sotto and Kül Tepe, with "extremely archaic ceramics" represent the oldest settlements on the north Mesopotamian plain, and that for antecedent sites one must look to the "hilly spurs of the surrounding mountains" where sites such as Tell Magzalia, only 7.5 km distant from Yarim Tepe, are found. Circumstances no doubt differ from region to region, but the Soviet survey of some 100-150 km^2 near Yarim Tepe did not reveal aceramic sites on the plain itself. (MERPERT and MUNCHAEV 1981) The problems of identifying an aceramic site are evident at Ginnig, (CAMPELL and BAIRD 1990) and the reported lack of such sites cannot be taken as evidence that they do not exist.

For purposes of understanding the development of lithics, Magzalia and Ginnig, both aceramic Neolithic sites, are instructive. At Magzalia, obsidian accounted for about 75% of the lithics when the site was founded, but the proportion had dropped to half by horizon 13 and to a minority throughout the remaining layers. Kozłowski and Scymczak take the abundance of obsidian as an indication that the site is later than Nemrik 9 where obsidian was rare.(KOZŁOWSKI 1990: 101) Other artifacts at Magzalia also point to a later date: the "Cayönü tools" (CAUVIN 1988: 29) that I originally referred to as "pressure flaked obsidian" (HOLE 1961: 39) and have been called by many other terms over the years; possible geometrics (but only two were found and these have "carelessly worked ends;" and flint arrowheads, some with tangs and others lozenge-shaped. All of these sites seem to be well within the late pre-pottery Neolithic, and there are lithic similarities with Shimshara, a site with ceramics.

Ginnig illustrates the complexity of using types to establish cross-dating. There are three types of projectile points that have presumed chronological implications: Khiam points, "lozenge-shaped" Nemrik points, and Byblos points, in ascending chronological order. However, as these varieties occur side by side in some sites, none is definitive of period. Another type with chronological implications is side-blow flakes which begin at Jarmo and are found at Ginnig as well as Hassunan sites. Despite some similarities, specific differences between the Zagros and these lowland sites (such as the lack of bullet cores and resultant microblades in Iraq, and the absence of projectile points in Iran) that one cannot regard this northern group of sites as deriving from the same tradition.

Having noted the differences between traditions, it still remains to determine the origin of the Hassunan tradition. Presumably the evidence lies in sites that have been excavated, but I was unable to find any drawings of lithics from Tell Sotto or Yarim Tepe I, the next stage of local development in the Sinjar region. However, Merpert and Munchaev remark that only 500 flint and obsidian artifacts were recovered from an area of 400 sq m, "being considerably inferior to the number of finds from the earlier settlements," and that flint accounts for 77 percent of the total. (MERPERT and MUNCHAEV 1981: 271)The implications are that both Magzalia and Tell Sotto had considerably more lithic artifacts and, as in lowland Iran, there was a precipitous decline in the use of lithic artifacts shortly after pottery appears.

The lithics from Umm Dabaghiyah were briefly described in the first preliminary report. Kirkbride reports "far more" flint than obsidian and a general Levantine rather that Zagros appearance to the assemblage, based partly on the presence of arrowheads. (KIRKBRIDE 1972: 10-12). One notes, however, the presence of side-blow flakes and well-made blades and bullet cores, all found in Jarmo. Thus, apart from the arrowheads, the site has obvious relations to the Zagros tradition. Similar lithics are reported from Thalathat II (FUKAI AND MATSUTANI 1981) and Kashkashok in Syria (see HOLE, this volume). Hassuna itself has only scrappy lithics and little has been reported from Samarran sites.

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Die Silexindustrie von Qale Rostam, NE-Zagros, Iran

Hans Georg Gebel

Einleitung

Der 1974 entdeckte Fundplatz Qale Rostam in der Khana Mirza- Ebene im östlichen Bakhtiyari-Gebiet (ca. 90 km südsüdöstlich von Shar-e Kord beim Dorf Silah) wies eine bis dahin unbekannte neolithische Keramik auf (ZAGARELL 1975), die 1975 Anlaß zu weiteren, begrenzten Untersuchungen (NISSEN und ZAGARELL 1976; ZAGARELL 1982) gab. Hierbei wurde eine Klingenindustrie entdeckt, die ohne den keramischen Befund (BERNBECK 1989) aufgrund der wenigen Vergleichscharakteristika generell als "akeramisch- bis frühkeramisch-neolithisch" angesprochen worden wäre.[1] Diese chronologische Unbestimmtheit ist auch durch eine Bearbeitung wie die folgende nicht behebbar und macht deutlich: Die Industrie und die ihr vergleichbaren Industrien des Zagros, der Vorgebirge und der südlichen Alluvialgebiete sind eng mit den bäuerlichen Wirtschaftsweisen ihrer Orte verbunden und hiervon funktional geprägt, was sie chronologisch schwer untereinander abgrenzbar macht: Stefan Kozłowski (i.Dr.) prägte für diese Industriecharakter im nördlichen Fruchtbaren Halbmond den Begriff "Agro-Standard", dessen Gebrauch sehr zuzustimmen ist. Das zuverlässigere Datierungsmittel für den Fundort bleibt seine Keramik; die Silexindustrie muß sich hieran anlehnen.

Absicht dieses Beitrags ist die Materialvorlage: Die geringe Artefaktzahl (Tabelle 1-2) erlaubt zwar die Charakterisierung der Industrie von Qale Rostam, hätte jedoch dafür nicht unbedingt die aufwendige, seit längerem zum Standard gewordene (UERPMANN M. 1976) merkmalanalytische und statistische Auswertung erfordert. Sie wird hier geboten, um diese Industrie in vollem Umfang zu publizieren. Wegen der geringen Artefaktzahl und der Einheitlichkeit der Industrie war es nicht sinnvoll, im Sinne der stratigraphischen Unterteilung des Fundorts bzw. seiner keramischen Phasen (siehe unten) bei der Auswertung die Industrie unterscheiden zu wollen. Gleichwohl wird die Herkunft der Stücke in Tabelle 6 dokumentiert. Der Exkurs in die Befunde genommener Sedimentproben begründet sich nicht nur mit den hierdurch erhaltenen Informationen zum natürlichen Vorkommen des Rohmaterials 1a-c in den Kulturschichten, sondern auch damit, daß diesen Ergebnissen ein Ort der Publikation zu geben ist.

Fundortlage und stratigraphische Information

Die Khana Mirza- Ebene (1830m NN) ist ein abflußloses intermontanes Becken auf 1830m Höhe zwischen den hier am höchsten, bis 4300m ansteigenden NW-SE- verlaufenden Auffaltungen des nordöstlichen Zagros. Der Fundort liegt am südlichen Ende der Ebene, wo die meisten unterschiedlichen Habitate sowie zahlreiche Quellen beieinander liegen. Das Gebiet ist -klimatisch gesehen- kühlgemäßigt und trockenkalt. Das 6. Jahrtausend war wahrscheinlich etwas trockener und kälter als heute, wenngleich Pollenergebnisse aus Qale Rostam darauf hinweisen, daß es während der Existenz der Siedlung feuchter geworden sein könnte (BERNBECK 1989). Moderne und historische Perioden schädigten durch Überweidung und Brennstoffabholzungen die Eichen- und die Bergmandel-/ Ahornwälder. Die noch unpublizierte neolithische Fauna zeigt ein Dominieren von Wildtieren (C.

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[1] Ich danke Hans J. Nissen für die Übertragung der Bearbeitung der Steingeräte und Reinhard Bernbeck für die Betreuung mancher Fragen zum Fundort und seiner Keramik. Ihm ist ebenfalls für die Hilfe bei der Sichtung und dem Schlämmen der Sedimentproben zu danken.

Becker, pers. Mitt.), was mich auf eine Mischsubsistenz von Ackerbau, Jagd und möglicherweise einer schlecht belegten Yayla-ähnlichen Vieh- und Milchwirtschaft schließen läßt. Die Ackerbaukomponente läßt sich über die Silexindustrie[1] gut fassen.

Die folgende Tabelle gibt Aufschluß über die keramische Phaseneinteilung für Qale Rostam sowie die vorgenommene stratigraphische Zusammenfassung und Gleichsetzung der Abhübe in den Untersuchungsarealen A und B (aus BERNBECK 1989).

Tabelle 1. Stratigraphie des Fundorts *(Stratigraphy of excavations).*

Phaseneinteilung	Schnitt A Abhübe	Schnitt B Abhübe	Archäologische Merkmale der Abhübe in Schnitt A	Archäologische Merkmale der Abhübe in Schnitt B
QR 0		0	A0 Planierung der Grabungsfläche / Muslimische Gräber/ Störungen	B0 3 Nivellierungsniveaus, gestörtes Material
QR Ia	1-5	1-5	A1-3 noch Störungen A4-5 Feuerstellen, alte Oberflächen	B1-5 keine Trennungen von Schichten möglich
QR Ib	6-9	6-8	A6-9: Unterkanten A9 Aschereste, Lehmziegelbruch oder Lehmklumpen, Eintiefung einer Grube	B6 Rest einer Ascheschicht an der Unterkante von B6 B7-8 evt. zwei Benutzungsphasen einer (baulichen?) Einrichtung
QR II	10-15	9-11	nach A11 mit Asche- und Knochenresten A 10-11 grünliche feste Lehmschicht A12 getrennt von A 11 durch Ascheschicht A13-15 kleine Steine in A 13, A14-15 bodenähnliche Schicht	B9 hat an Unterkante die Ascheschicht B10
QR III		12-17		B12-14 zu einer Mauer gehörige Schuttstraten B15-16 Benutzungsniveaus (B15: Vermischungshor.)

Probennahme, Aussagemöglichkeiten und Artefaktverteilung

Die jeweils 5x1m großen Suchschnitte A und B ergaben in Flucht liegend einen 10,50 m langen Suchschnitt, der in künstlichen Abhüben von 10-15 cm Stärke auf Tiefen von 260 cm in A und 320 cm in B unter Oberkante abgetragen wurde (BERNBECK 1989). Unter Berücksichtigung des Hanggefälles und dem Verlauf der Schnittgrenzen ergibt sich hieraus ein ergrabenes Kulturschichtvolumen von maximal $13 m^3$ für A und $15 m^3$ für B; die Funddichte von Scherben in A beträgt 107 Scherben/m^3, in B 60 Scherben/ m^3.

Die Silexproben entstammen diesen künstlichen Abhüben und wurden während der Grabung durch Auslesen gewonnen. Ein systematisches Sieben war wegen der auf 5 Arbeitstage begrenzten Untersuchung nicht möglich. Die Ausgräber bemühten sich um möglichst vollständiges Auslesen aller Artefakte über der Grösse von Chips (H.J. Nissen, pers. Mitt.).[2] Mitausgelesen wurden auch ungeschlagene, im Fundortsediment natürlich vorkommende Knollen und Kiesel, die vorwiegend die Rohmaterialgruppen IA-C repräsentieren (Tabelle 3). Setzt man die Zahl der Silexartefakte in Beziehung zur bewegten Sedimentmenge (maximal 28 m^3 / 280 Artefakte = 10 Silexartefakte je Kubikmeter), so ergibt sich hieraus eine für neolithische Kulturschichten des Zagros ungewöhnlich geringe Verteilung.

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[1] In dieser Publikation wird der im Deutschen vorwiegend gebräuchliche Begriff "Silex" ohne irgendwelche mineralogischen Implikationen verwendet, weil er einen weiteren Bereich der mineralogischen Erscheinungsformen von silifizierten Gesteinen abdeckt und in Bezug auf den Chemismus der Gesteine neutraler genutzt werden kann.
Die Möglichkeit von Gebrauchsspurenanalysen wurde mit Lykke Leonardsen, Kopenhagen am Material erörtert und als nicht sinnvoll verworfen: Die natürliche Splittrigkeit des Materials, die durch die neolithischen Aktivitäten im Ort, nachablagerische Bodenprozesse sowie den Transport nach der Ausgrabung weitere Schäden verursachte, hat den vollständigen Erhlatungszustand von Gebrauchsspuren sehr stark beeinträchtigt, wovon besonders die so schon schwer erkennbaren Glanzpartien an den Klingenkanten betroffen sind.
Zu den Abbildungsunterschriften der Artefaktillustrationen: Die Ziffer hinter der Abhubangabe und dem Punkt bezeichnet eine fortlaufende Stücknummer der Silexartefakte innerhalb des Abhubs.

[2] Die Schlämmung der Bodenproben zeigte, daß Chips und chipgroße Artefaktfragmente der Größenklasse 5-8 mm vorhanden waren und beim Auslesen vor Ort übersehen wurden.

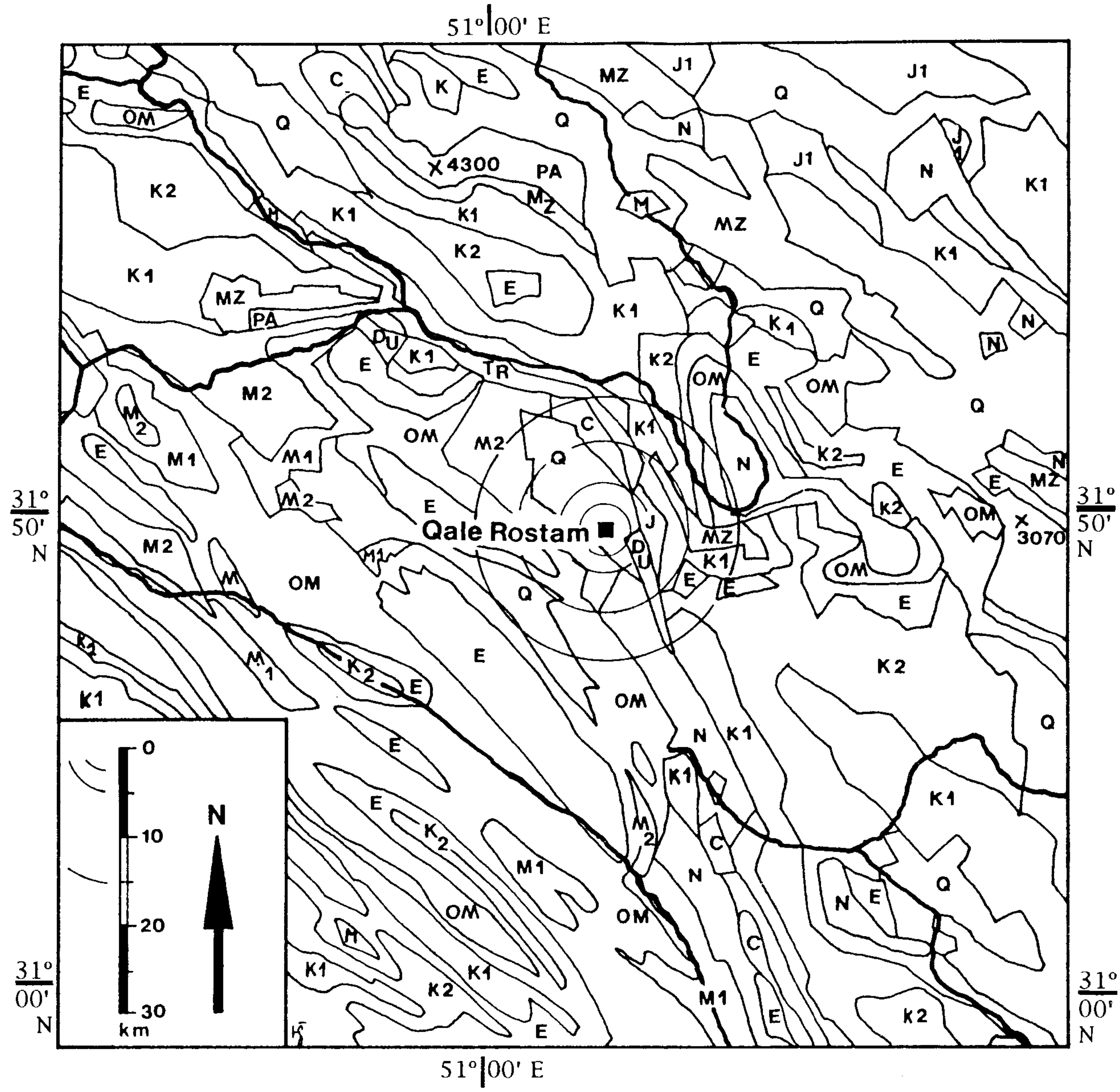


Abb. 1. Geologische Lage von Qale Rostam (Skizze nach: DEWAN und FAMOURI 1964: Geological Map of Iran)
Q intermontane Schwemmebenen, N Bakhtiari Konglomeratfazien, M1 oberes Miozän, M2 unteres Miozän, OM Oligo-Miozän mit oligozänen Rotschichten/ Asmari-Kalken SW-Irans, MZ Mesozoikum (meist Kalke), K Kreide, K2 Obere Kreide (Turon-Senon), K2 Untere und Mittlere Kreide (meist Orbitolina-Kalke), MZ silifizierte Fazien der Jura und Kreide des Zagros, J1 Unteres und Mittleres Jura, Tr Trias, PA Paläozoikum, C vordevonisches Paläozoikum, DU diapirische Hebungen (meist Salzstöcke).

Geological setting of Qale Rostam (after: DEWAN and FAMOURI 1964: Geological Map of Iran)
Geological Map of Iran): Q intermontane alluvial plains, N Bakhtiari conglomerate facies, M1 Upper Miocene, M2 Lower Miocene, OM Oligo-Miocene with Oligocene red beds/ Asmari limestones of SW-Iran, MZ Mesozoic (predominantly limestone), K Cretaceous, K1 Upper Cretaceous (Turon-Senon), K2 Lower and Middle Cretaceous (predominantly Orbitolina limestone), MZ silicified facies of the Zagros Jurassic-Cretaceous, J1 Lower and Middle Jurassic, Tr Triassic, PA Palaeozoic, C Pre-Devonian Palaeozoic, DU diapiric uplifts (predominantly salt domes).

Tabelle 2. Umfang und makroskopisch ansprechbare Befunde der Schlämmrückstände der 10 genommenen Sedimentproben *(Macroscopically identified flotation residues and volumes of the 10 sediment samples taken).*

Probenherkunft	A5	A9 (1)	A12	A15	B2	B4	B9	B11	B11 (1)	B17
Probengröße (Schüttvolumen in ml)	3400	1900	3300	3600	2400	2500	2900	4300	2100	3500 (7)
davon reserviert als Zeugenprobe (ml)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
davon als C14-Probe reserviert (ml)									400	
davon geschlämmt (ml)	2400	900	2300	2600	1400	1500	1900	3300	700	2500
Schlämmrückstände / Auftrieb										
Silexabsplisse		x	x	xx	x	xx	x (5)	xx		x (5)
gebranntes gemagertes Material (2)		x	x	xx				xx		x
(gemagerte) Lehmfragmente	xxx			xx (3)			xx	xxx		xxx
verbrannte Knochensplitter	x	x	x	xx		x			x	x
unverbrannte Knochensplitter	x	x	x	xxx	x	xx		x	x	x
karbonisierte Pflanzenreste		x	x		x					x
Landmollusken			?	xxx						
Kleinsäuger/ Reptilien										x
Sonstiges				(4)	(9)		(6)	(10)		(8)

xxx häufig xx gelegentlich x selten/ einzeln

Anmerkungen :

(1) Probe aus dem unteren Bereich von A9; zweite Probe aus B11 stammt aus der dortigen Feuerstelle.
(2) soweit identifizierbar, vorwiegend auf ihre Brennkernteile reduzierte Scherben.
(3) mit Pflanzenabdrücken.
(4) häufige Insektenreste, gelegentliche Bivalven, einzelne Fischreste? und Zahnlamellen?.
(5) darunter ein Obsidianchip.
(6) hitzezersprungene Steine.
(7) Gewicht ohne die hier häufigen Lehmfragmente.
(8) hitzezersprungene Steine? und Eierschalenfragmente?.
(9) Keramik.
(10) wenige Funde gemessen an Sedimentmenge.

Ergänzende Informationen / Beobachtungen beim Schlämmen zu :

A5: kaum feste Matrix im Rückstand, Lehmfragmente lösten sich rasch "schmierend" auf
A9: staubige Konsistenz, Grundmatrix 2-4mm, einzelne Steine bis 20mm, 1a/b- Kiesel/ -fragmente (Munsell 5Y 8/1, 7/1, 6/1)
A12: staubige Konsistenz, Grundmatrix 2-6mm, einzelne Steine bis 15mm, gelegentlich 1a/b- Kiesel/ -fragmente (Munsell 10YR 7/2)
A15: stark variierende Korngröße, 1a/b- Kiesel/ -fragmente bis 15mm
B2: einzelne 1a/b- Kiesel/ -fragmente bis 10mm
B4: einzelne größere Steine, häufige 1a/b- Kiesel/ -fragmente bis 8mm (einzelne bis 20mm)
B9: häufige 1a/b- Kiesel/ -fragmente bis 10mm
B11: Grundmatrix 2-4mm, einzelne größere Steine, wenig Fundinhalt gemessen an Schlämmenge
B11"Feuerstelle": aschiges Material mit einzelnen Knochenresten
B17: häufige 1a/b- Kiesel/ -fragmente bis 10mm

Tabelle 3. Natürlich im Kultursediment vorkommendes Rohmaterial (zu klein für Kerne), getrennt nach Rohmaterialklassen *(Naturally available raw material available in the sites' sediments, separated by classes (pebbles to small for cores)).*

	RM	(insges.)				1a				1b				1a /b				8				sonst. /unid.			
Abhub	Phase	n	%	g	%	n	%	g	%	n	%	g	%	n	%	g	%	n	%	g	%	n	%	g	%
A1	Ia	1	0,45	11	1,56					1	0,78	11	2,89												
A10	II	21	9,38	59	8,37	3	5,00	12	9,68	14	10,94	38	9,97	4	11,11	9	4,50	2	33,33	1	10,00				
A11	II	15	6,70	107	15,18	7	11,67	31	25,00	6	4,69	25	6,56	2	5,56	51	25,50	1	16,67	2	20,00				
A12	II	3	1,34	74	10,50	1	1,67	1	0,81	1	0,78	28	7,35	1	2,78	45	22,50								
A15	II	4	1,79	3	0,43	2	3,33	2	1,61	2	1,56	1	0,26												
B5	Ia	1	0,45	2	0,28					1	0,78	2	0,52												
B6	Ib	2	0,89	12	1,70					2	1,56	12	3,15												
B9	II	2	0,89	9	1,28	1	1,67	5	4,03	1	0,78	4	1,05												
B10	II	2	0,89	11	1,56					1	0,78	1	0,26	1	2,78	10	5,00					1	10,00	7	50,00
B11	II	3	1,34	82	11,63					3	2,34	82	21,52												
B12	III	13	5,80	26	3,69	4	6,67	10	8,06	5	3,91	12	3,15	4	11,11	4	2,00	1	16,67	2	20,00				
B13	III	5	2,23	34	4,82	1	1,67	2	1,61	3	2,34	23	6,04	1	2,78	9	4,50								
B14	III	86	38,39	106	15,04	21	35,00	28	22,58	50	39,06	55	14,44	15	41,67	23	11,50	1	16,67	2	20,00	6	60,00	3	21,43
B15	III	26	11,61	55	7,80	14	23,33	26	20,97	11	8,59	23	6,04	1	2,78	6	3,00	1	16,67	3	30,00				
B16	III	15	6,70	72	10,21	1	1,67	3	2,42	7	5,47	26	6,82	7	19,44	43	21,50					3	30,00	4	28,57
B17	III	25	11,16	42	5,96	5	8,33	4	3,23	20	15,63	38	9,97												
Summen		224	100,00	705	100,00	60	100,00	124	100,00	128	100,00	381	100,00	36	100,00	200	100,00	6	100,00	10	100,00	10	100,00	10	100,00

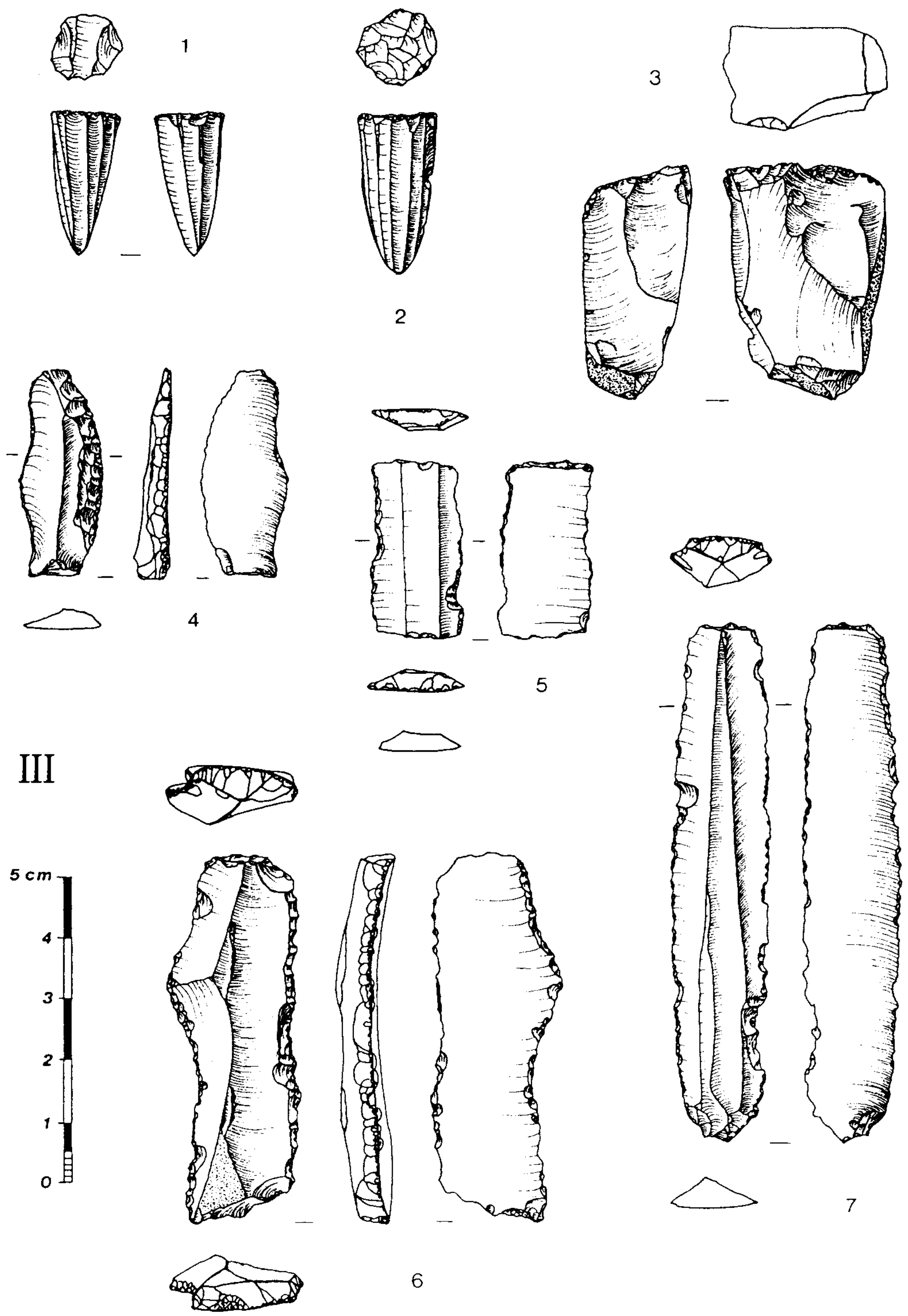


Abb. 2. Qale Rostam III (B12-17)

1 "bullet core" (B12.1); *2* "bullet core", gesprungen entlang Materialkluft während des Abbaus / "bullet core", broken during flaking along a fracture line (B14.1); *3* Klingenkern mit einer Schlagfläche, Gerölloberflächen / single-platform blade core, pebble cortex (B13.1); *4* Klinge, lateral formgebend steilret. durch parallele Ret. / blade shaped laterally by steep parallel ret. (B15.1); *5* mediales Klingenfragm., Perlretuschen an Bruchkanten, laterale Kerbung und steilret. Partien nach dorsal und ventral / medial blade fragm., beaded ret. at breaks, lateral notch and partly steep ret. on dorsal and ventral surfaces (B12.2); *6* Klingenfragm., Bruchkanten endret., lateral steilret. bzw. dorso-ventral ret. / medial blade fragm., broken ends ret., dorsal and ventral steep ret. on laterals (B14.2); *7* Klinge, endret., bilateral unregelm. dentikuliert, teilweise nach ventral ret. / blade, endret., bilateral irr. denticulation, partly on ventral side (B14.1).

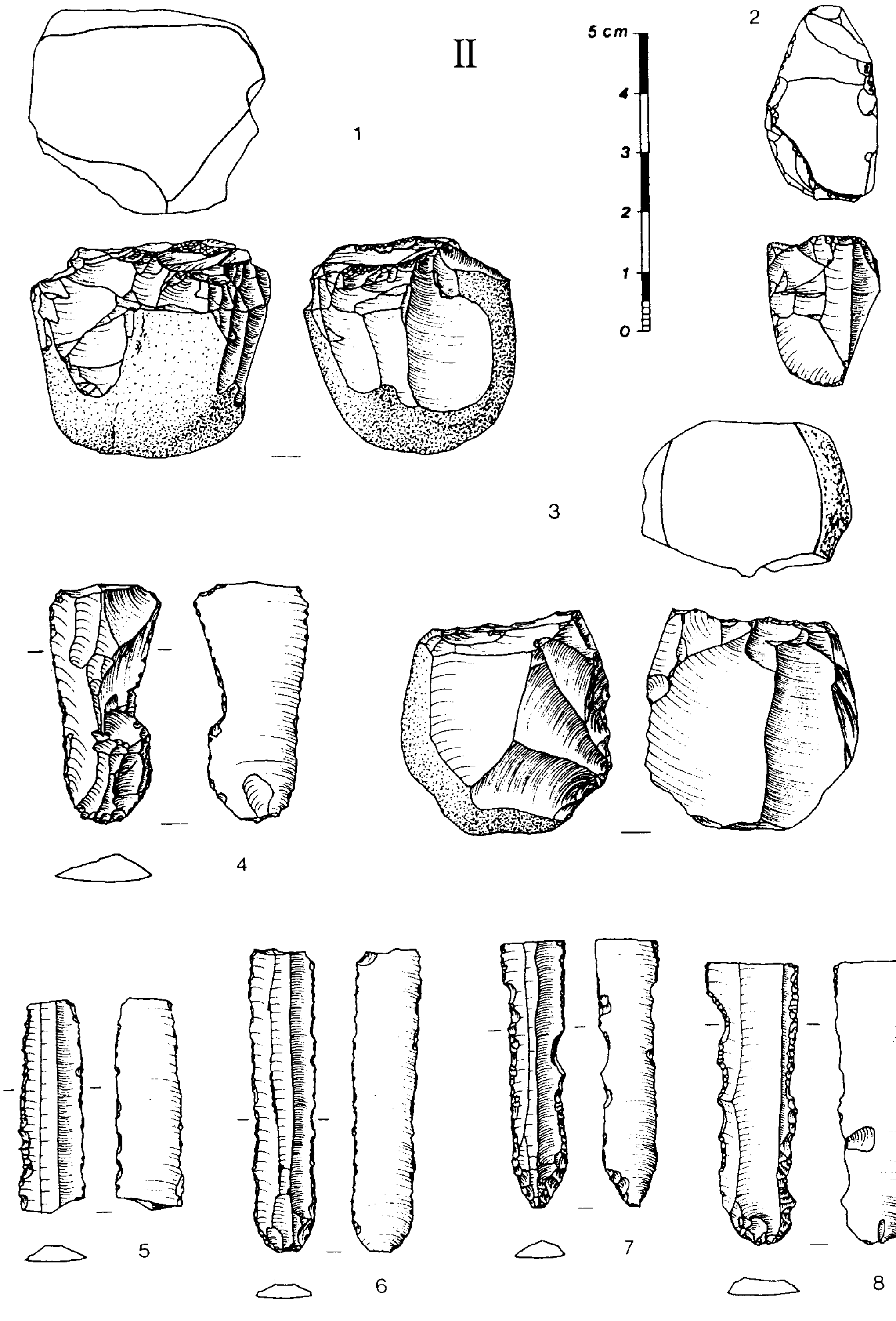


Abb. 3. Qale Rostam II (A10-15)
1 Abschlagkern mit mehreren Schlagflächen, Gerölloberflächen / multi-platform flake core on a small nodule, cortex (A11.21); *2* Klingenkern mit einer Schlagfläche, Geröllоberflächen / single-platform blade core, cortex (A12.1); *3* Klingen-/ Abschlagkern mit "gewechselter Schlagfläche", Geröllоberflächen / blade-flake core with "shifted platform", cortex (A11.11); *4* unregelmäßige Klinge (Obsidian), distal gebr., laterale Partien steiler ret., links-lat. leichter Sichelglanz / irr. (non-parallel-sided) blade (obsidian), distally broken, lateral steep ret., left-lat. slight sheen (A11.1); *5* mediales Klingenfragm., lateral einmal nach dorsal und einmal nach ventral ret. / medial blade fragm., one edge ret. on dorsal, the other on ventral surface (A10.1); *6* Klinge, distal gebr., bilateral steiler ret. / medial blade fragm., distally broken, bilateral steep ret. (A.11.2); *7* Klinge, distal gebr., bilateral steiler ret. / blade, distally broken, steep bilateral ret. (A14.2); *8* Klinge, distal gebr., bilateral unregelm. gekerbt und steilret. / blade, broken distally, irr. bilaterally notched and steep ret. (A14.1).

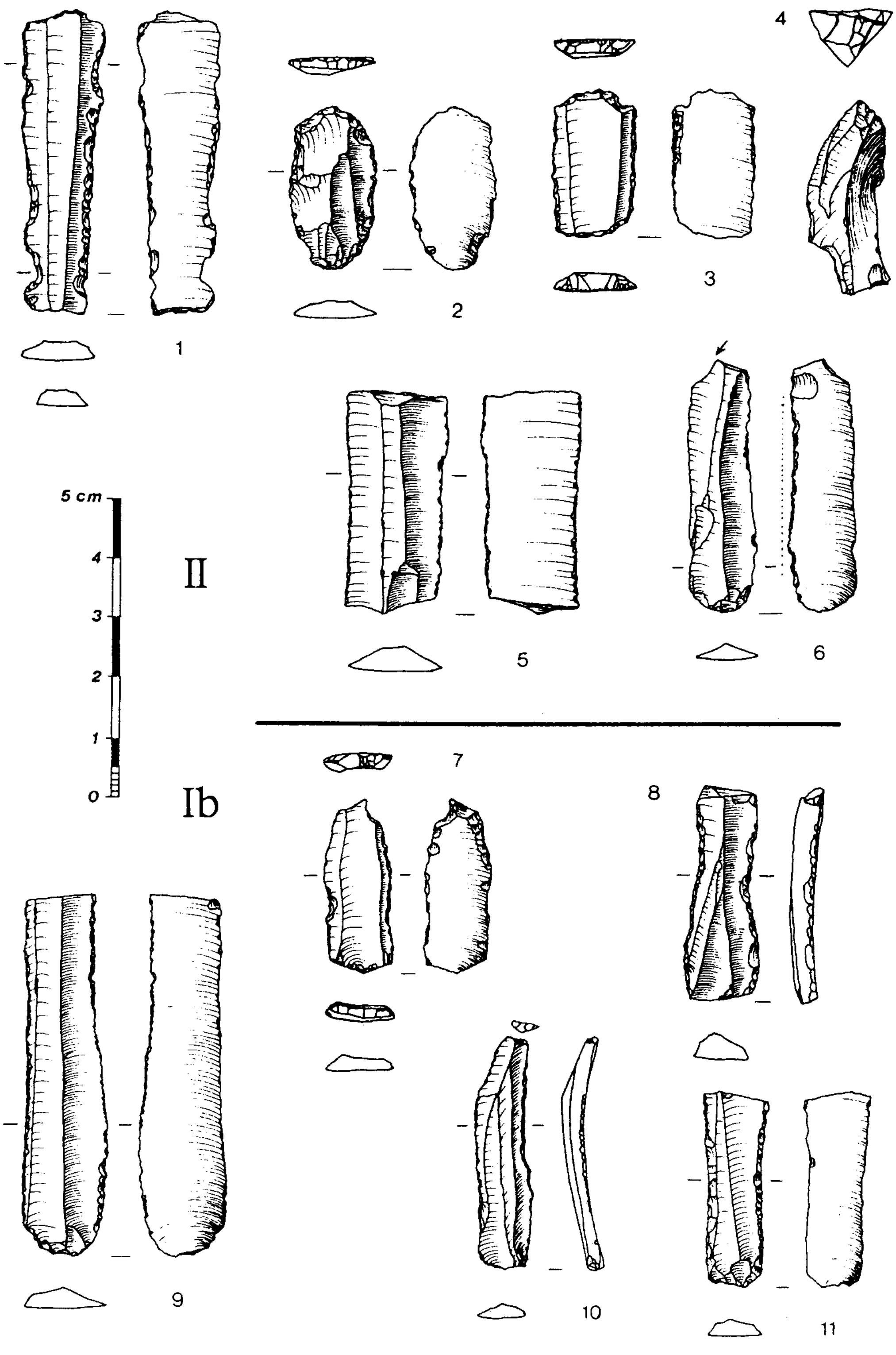


Abb. 4. Qale Rostam II (A10-15, B9-11)

1 Klinge, distal und proximal gebr., laterale Partien gekerbt und steiler ret., z.T. nach ventral / blade, distally and proximally broken, steep ret. and notched lateral parts (A 13.2); *2* Klingenfragm., endret., allseitig z.T. steiler ret. / endret. blade fragm., edges (partially steep) ret. (A14.3); *3* mediales Klingenfragm., Bruchkanten endret., lateral steilret. bzw. steilret. mit flächigen Aussplitterungen / medial blade fragm., ret. truncations, laterally steep ret. or splintered (A15.1); *4* Trümmer, steile Schmalkante ret. / debris, steep marginal edge ret. (A13.3); *5* mediales Klingenfragm., bilateral Perlretuschen, links-lat. leichter Glanz / medial blade fragm., bilateral beaded ret., left-lat. slight sheen (B10.3); *6* Klingenfragm., Pseudo- Stichel, ret. Schneide trägt Glanz / blade fragm., pseudo burin, ret. edge with gloss (B10.5).

Qale Rostam Ib (A6-9, B6-8)

7 Klingenfragm., distale Kerbungen erzeugte bohrende/stechende Spitze (Ahle), lateral vollständig (z.T. steil-) ret., auch nach ventral / blade fragm., piercing/drilling tip created by distal inverse notches, laterally (partly steep-) ret., also on ventral side (A6.1); *8* Klinge, distal und prox. gebr., Retuschierung und Aussplitterungen nach dorsal / distally and proximally broken blade, ret. and splintered on dorsal surface (A8.6); *9* Klinge, distal gebr., bilateral ret. oder mit Perlretuschen, z.T. auch auf den Ventralseiten, links-lat. leichter Glanz / blade, distally broken, bilateral ret./ beaded ret., also partly on ventral side, left-lat. slight sheen (B8.1); *10* Klinge, endret., laterale Partien steilret. / endret. blade, partly steep ret. edges (B6.4); *11* Klinge, distal gebr., bilateral steilret. / blade, distally broken, bilaterally steep ret. (A8.1).

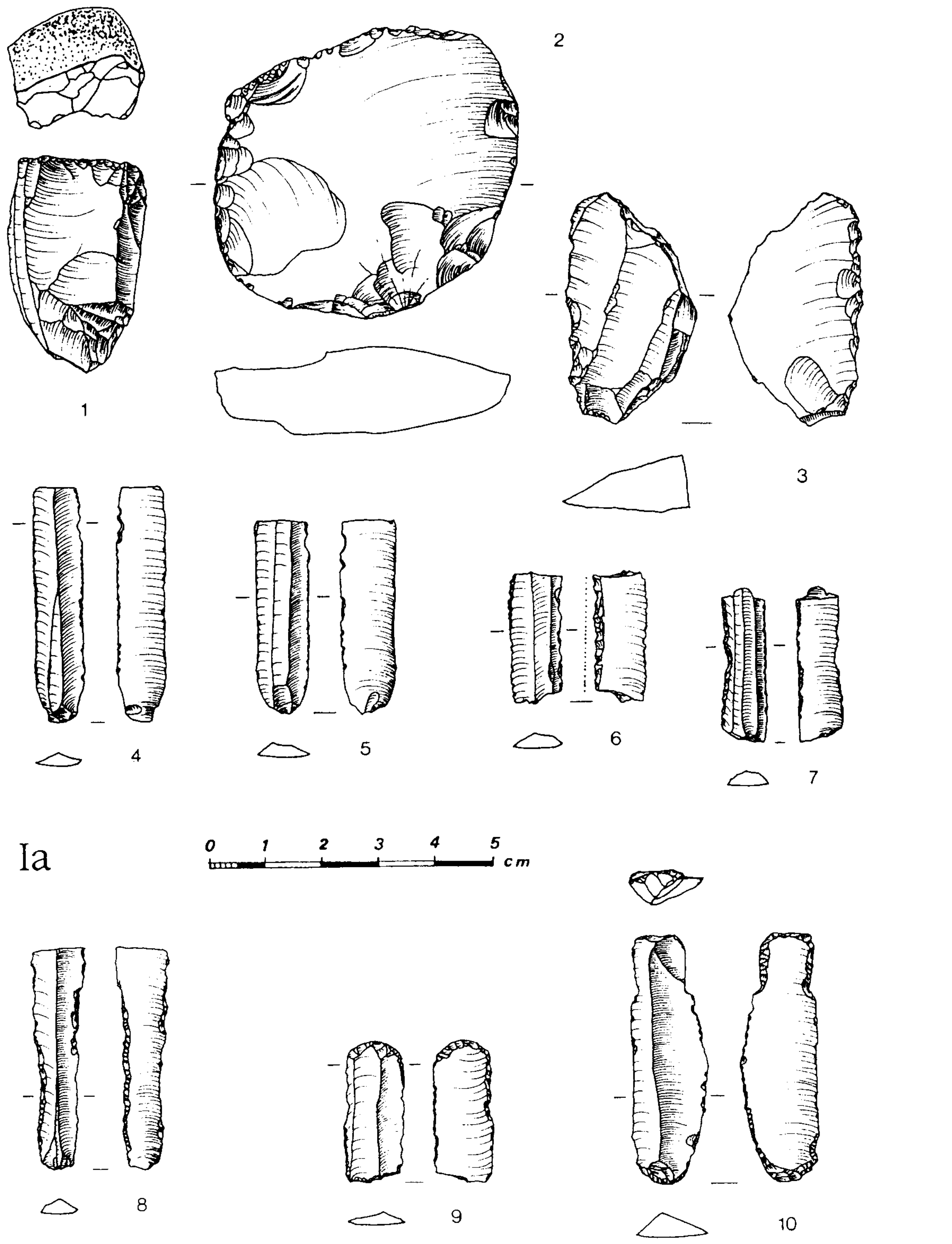


Abb. 5. Qale Rostam Ia (A1-5)
1 Klingen-/Abschlagkern aus kleiner Knolle mit einer Schlagfläche, Geröllоberflächen / single-platform blade/-flake core on a small nodule, cortex (A2.3); *2* Cortex-Abschlag, flache Retuschenbahnen ventral / cortical flake with flat ret. on the ventral side (A1"120 cm"); *3* Abschlag (alte Kernoberfäche) an scharfer Kante teilw. bifazial ret. / flake (with older core surface), with partial bifacial ret. on the sharper edge (A2.5); *4* Klinge, distal gebr., bilateral Perlretuschen und feinste Aussplitterungen (ventral und dorsal) / distally broken blade, bilateral beaded ret. and fine ventral/dorsal splinterings (A4.1); *5* Klinge, distal gebr., bilaterale Perlretuschierungen (ventral und dorsal) / blade, distally broken, bilateral beaded ret. (ventral and dorsal) (A5.2); *6* mediales Klingenfragm., Sichelglanz an einer nach ventral ret. Schneide / medial blade fragm., gloss on one edge with inverse ret. (A4.2); *7* mediales Klingenfragm., bilateral ret. (ventral und dorsal) / medial blade fragm., bilateral ret. (dorsal and ventral) (A5.3); *8* Klinge, distal gebr., alternierend ret. Kantenpartien/ blade, distally broken, alternate edge ret. (A3.1); *9* mediales Klingenfragm. aus bidirektionaler Herstellung, distal bifazial formgebend ret., bilateral überwiegend nach ventral ret. / bidirectional blade fragm., distally shaped by bifacial ret., bilateral ret. mostly on ventral surface (A3.2); *10* Klinge, distal formgebend nach ventral ret. (Schäftung?), proximal formgebend bifazial ret., lateral partiell vorwiegend nach ventral ret. / distally shaped blade by inverse ret. (hafting?), proximally shaped by bifacial ret., lateral partially and mostly ret. on ventral side (A5.2).

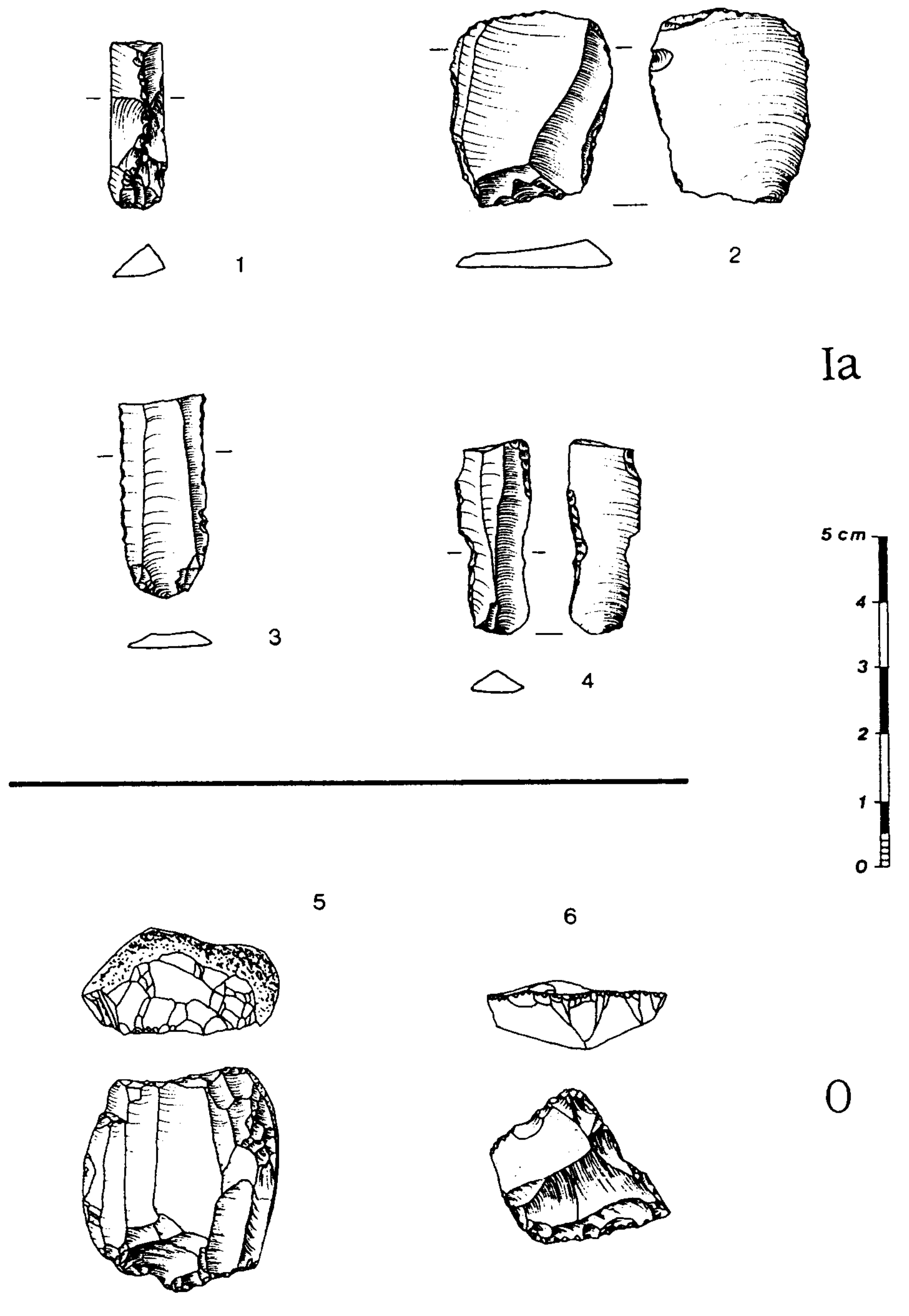


Abb. 6. Qale Rostam Ia (B1-5)

1 Kernkantenklingenfragm. (Obsidian), unret. / crested blade (obsidian), unret. (B5.1); *2* Abschlag, distal und an einer Schneide ret. / flake, ret. distally and on one edge (B3.1); *3* Klinge, distal gebr., bilateral ret. / blade, distally broken, bilateral ret. (B3.2); *4* Klinge, distal gebr., alternierend steilret. Kantenpartien / blade, distally broken, alternate steep ret. edges (B5.2)

Qale Rostam 0 (B0)

5 bidirektionaler Klingen-/ Lamellenkern, Gerölloberflächen / bidirectional (micro-) blade core, cortex (B0.1.3); *6* Abschlag mit "Kratzerstirnen" / flake with "scraping edge" (B0.1.14).

Tabelle 4. Beschreibung der Rohmaterialklassen *(Description of raw material classes).*

RMC	1) Schotter-/ Knollen- und Plattenmerkmale der Chert- und Jaspisarten	2) Cortex und Kluftflächen	3) Körnigkeit und Homogenität	4) Einschlüsse, Klüfte/ Hohlräume, Schlagbarkeit	5) Lichtdurchlässigkeit	6) Farbvarianz der Grundmatrix (Munsell)	7) Farbliche Musterungen (Munsell)	8) Glanz
1a	für Kerne wurden kugelige bis unrunde Kiesel (ohne Cortexreste) und Knollen (Cortexreste) mit Durchmessern von 4-6 cm ausgewählt; größere Kiesel/Knollen kommen bei diesem Rohmaterial offenbar nicht vor; Rohmaterial auch in den Abhüben als (unbearbeitete) Kiesel um 1-2 cm vorhanden (Jaspis)	deutlich transportabrasierte glatte Cortexreste (10YR8/2-4,8/6: sehr blasses braun, gelb) oder -bei vollständiger Entrindung durch Transport- mässig glatte bis glatte und z.T. polierte "Kieselcortex" von leicht dunklerer Färbung als die des Silex selbst (patiniert); Klüfte selten nachweisbar	feinkörnig bis mäßig feinkörnig	fast ohne Einschlüsse: Trennflächen mitunter mit schuppigen Partien / sehr splittrig, Schlagbarkeit offenbar trotzdem gut	keine	variiert zwischen 10R 3/3, 3/4, 3/6, 4/4, 4/6, 4/8 (dunkles Rot, dunkelrot, schwach rot, rot) und 2.5YR 2.5/4, 3/4, 3/6, 4/4, 4/6, 4/8, 5/4, 5/6, 5/8 (dunkles rötliches braun, dunkles rot, rötliches braun, rot)	überwiegend homogen, selten Streifen mit Färbungen (*grün); in cortexnahen Bereichen oft Übergänge in Farbwerte wie bei lb	matt
1b	wie 1a (Jaspis)	wie 1a	wie 1a	wie 1a	wie 1a	2.5YR 2.5/4 (dunkles rötliches Braun) - 2.5/2 (sehr dunkles Rot)	keine	wie 1a
1c	wie 1a (Jaspis)	wie 1a	wie 1a	wie 1a	wie 1a	10YR 6-7/6-8 (gelb - braungelb)	keine	wie 1a
2	? (Chert)	?	feinförnig	? / gut (-sehr gut?)	keine	5YR 5/4-6 (gelbliches Rot)	5YR 6/3 (hellrötliches Braun)	schwach
3	? (Chert)	?	mäßig feinkörnig	? / gut	keine	2.5YR 4-5/8 (rot)	?	leicht
4	? (Chert)	?	mäßig feinkörnig	ohne / gut (zäh)	keine	10YR 3/2-3 (sehr dunkles Graubraun - dunkelbraun)	ohne?	leicht
5	? (Chert)	?	feinkörnig	ohne/ sehr gut	keine	5Y 7/1 (hellgrau)	?	leicht
6	Knollen? (Chert)	?	grobkörnig	rel. große Fossilien / schlechte Schlagbarkeit	keine	5YR 7-6/1 (hellgrau-grau)	?	ohne
7	? (Chert)	?	feinkörnig	ohne/ sehr gut	keine	helles Pistaziengrün	?	leicht
8	Knollen (Chert)	z.T. korallenartig	brekziös	stark geklüftet/ schlecht schlagbar	keine	alle Grau- und Graubraunfärbungen	alle Grau- und Graubraunfärbungen	stellenw. leicht
9	?	?	mäßig feinkörnig	ohne?/ gut	keine	10YR 6/1 (grau)	nach 5YR 6/6 (rötliches Gelb)	leicht
10	Knollen? (Chert)	z.T. korallenartig	mäßig feinkörnig	ohne?/ gut (zäh)	milchig	10YR 8-7/1 (weiß - hellgrau)	?	ohne/ rauh

Tabelle 5. Rohmaterialnutzung bei Kernen, vollständig erhaltenen Schlagabfällen und Geräten *(Raw materials of cores, completely preserved debitage, and tools).*

Qale Rostam: Rohmaterialverwendung / Raw Material Use	**RM1a-c**		**RM2**		**RM3**		**RM4**		**RM5**		**RM6**		**RM7**		**RM8**		**RM9**		**RM10**		**exot. Mat.**		**Obsidian**	
(Prozentangaben bez. auf / percentages rel. to 938g)	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%
Kerne / Cores **	470	50																						
vollst. erhaltene Schlagabfälle / Debitage (completely pres.)	174	19			5,9	0,6	4,4	0,5	0,9	0,1	4,3	0,5			12	1,3	0,5	0,1	4,3	0,5				
Geräte / Tools	124*	13	4,5	0,5	3,5	0,4	6,3	0,7	23	2,5	50*	5,3	3,2	0,3	15	1,6	16	1,7	4,1	0,4	9,4	1	2,5	0,3
Summen / Total (938g)	**768**	82	4,5	0,5	**9,4**	1	**11**	1,1	**24**	2,5	**54**	5,8	**3,2**	0,3	**27**	2,9	**17**	1,8	**8,4**	0,9	**9,4**	1	**2,5**	0,3
* Zahl bedingt durch schweren Abschlag / figure caused by heavy flake																								
** ohne angeschlagene Stücke u. Kernfragm. / without "pre-cores" and core fragm.																								

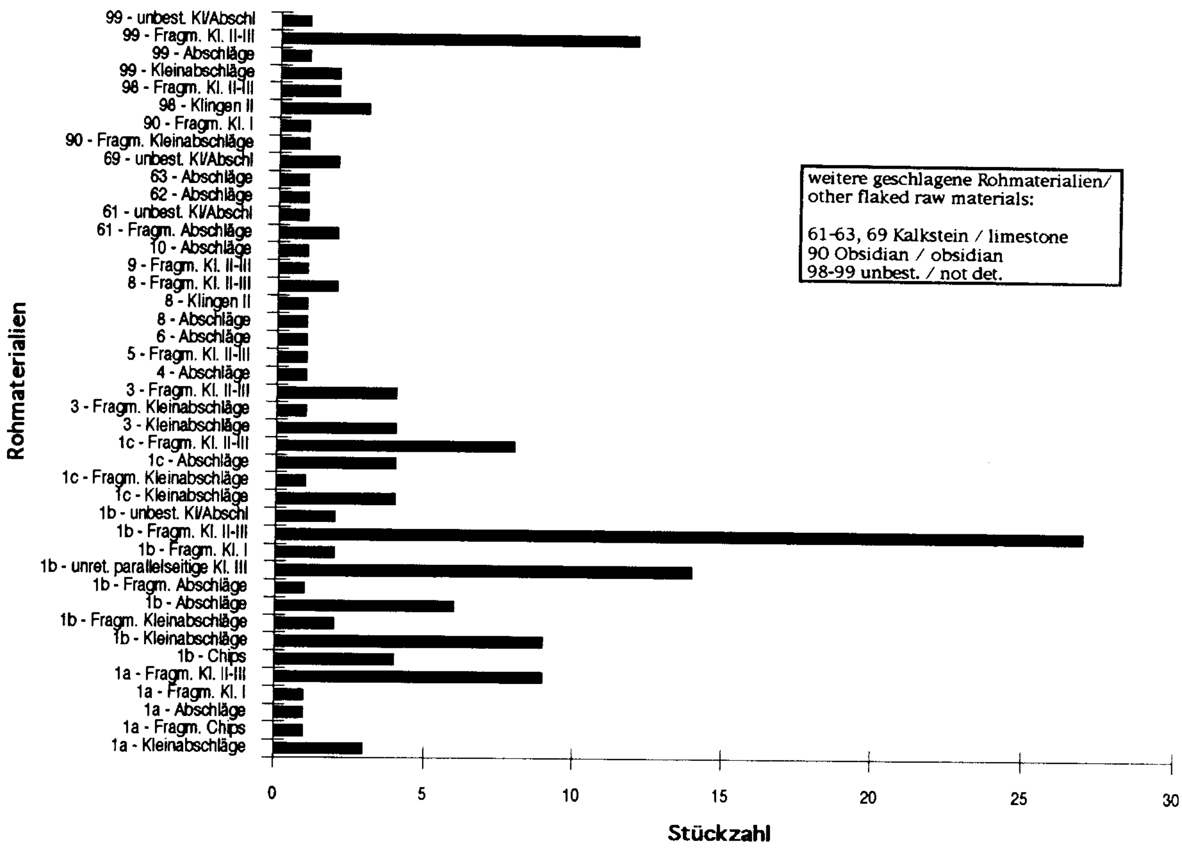


Fig. 7. Rohmaterialien der Schlagabfälle nach Stückzahlen *(Raw materials of debitage according to piece numbers).*

Tabelle 6. Grundklassifikation der Silices, die Geräterohlinge berücksichtigend.
(Primary classification of flint artefacts, including the tool blanks).

Qale Rostam: Grundklassifizierung / Primary Classification / Qale Rostam Phasen / Phases	all				B 0 / 0				A 1 ... A5 / I a				B1 ... B5 / I a				A6 ... A9 / I b				B6 ... B8 / I b				A10 . A15 / I I				B9 . B11 / I I				B12 ..B17 / II I			
Classes	n	%	g	%	n	%	g	%	n	%	g	%	n	%	g	%	n	%	g	%	n	%	g	%	n	%	g	%	n	%	g	%	n	%	g	%
Trümmer / Debris					1		12		3		30,3		2		25,6		6		67,7		1		25,8		9		98,3		3		16,5		1			19,2
Angeschlagene Stücke /"Pre-Cores"	6	2,14	156,2	9,94					1	2,44	22,2	6,4								0	1	4,35	48,1	25,9					2	8	47,8	34,6	2	3,64	38,1	16
Abschlagkerne / Flake Cores (Total)	9	3,21	254,6	16,2					3	7,32	56,1	16,2					1	9,09	39,1	39,7					2	2,38	87,3	23,9	2	8	39,2	28,4	1	1,82	32,9	13,8
Abschlagkerne mit einer Schlagfläche / single-platform flake(let) cores	6	2,14	144,2	9,18					3	7,32	56,1	16,2					1	9,09	39,1	39,7					1	1,19	16,1	4,41					1	1,82	32,9	13,8
Abschlagkerne mit mehreren Schlagflächen / multi-platform flake(let) cores	3	1,07	110,4	7,03																					1	1,19	71,2	19,5	2	8	39,2	28,4		0		0
Klingenkerne/ Blade Cores (Total)	10	3,57	214,7	13,7	1	7,14	21,4	30,6	1	2,44	15,9	4,58	1	3,7	21,2	16,6					1	4,35	40,8	21,9	2	2,38	62,5	17,1					4	7,27	52,9	22,2
"bullet cores" / bullet cores	2	0,71	7,2	0,46																													2	3,64	7,2	3,03
Klingenkerne mit einer Schlagfläche / single-platform blade(let) cores	5	1,79	99,5	6,33					1	2,44	15,9	4,58	1	3,7	21,2	16,6									1	1,19	16,7	4,58					2	3,64	45,7	19,2
Klingenkerne mit Schlagflächenwechsel / blade cores with shifted platform	2	0,71	86,6	5,51																	1	4,35	40,8	21,9	1	1,19	45,8	12,5								
Klingenkerne mit gegenüberliegenden Schlagfl. / opp. platform blade(let) cores	1	0,36	21,4	1,36	1	7,14	21,4	30,6																												
Andere Kernprodukte / Other Core Products (Total)	5	1,79	65,3	4,16	1	7,14	11,3	16,1									1	9,09	16,3	16,5	1	4,35	6,7	3,6	1	1,19	12,3	3,37					1	1,82	18,7	7,86
Kernfragmente / core fragments	5	1,79	65,3	4,16	1	7,14	11,3	16,1									1	9,09	16,3	16,5	1	4,35	6,7	3,6	1	1,19	12,3	3,37					1	1,82	18,7	7,86
Produkte der Kernzurichtung / Core Trimming Elements (Total)	30	10,7	310,9	19,8	2	14,3	17,3	24,7	7	17,1	43,2	12,4	2	7,41	41,4	32,3	1	9,09	9,5	9,63	4	17,4	26,5	14,2	5	5,95	108	29,5	3	12	30,8	22,3	6	10,9	34,5	14,5
Kortexabschläge / cortex removal flakes	16	5,71	183,9	11,7	2	14,3	17,3	24,7	2	4,88	3,3	0,95	1	3,7	12,7	9,92					2	8,7	8,6	4,62	3	3,57	99,8	27,3	2	8	22,5	16,3	4	7,27	19,7	8,28
Fragm. von Kortexabschlägen / fragm. of cortex removal flakes	2	0,71	17,9	1,14																	2	8,7	17,9	9,62												
Klingen der Kernkantenentfernung / edge-of-core removal flakes	2	0,71	13	0,83					1	2,44	6,4	1,84													1	1,19	6,6	1,81								
Cortexklingen / cortex removal blades	5	1,79	26,2	1,67					2	4,88	11,4	3,29													1	1,19	1,3	0,36	1	4	8,3	6,01	1	1,82	5,2	2,18
davon anteilig Geräterohlinge/ of which served as tool blanks :	*1*	*0,36*	*6,7*	*0,43*					*1*	*2,44*	*6,7*	*1,93*																								
Abschläge mit Kernoberfläche / flakes removing substantial parts of core faces	5	1,79	69,9	4,45					2	4,88	22,1	6,37	1	3,7	28,7	22,4	1	9,09	9,5	9,63													1	1,82	9,6	4,03
Schlagabfälle / Debitage (Total)	220	78,6	569,5	36,2	10	71,4	20	28,6	29	70,7	210	60,4	24	88,9	65,7	51,3	8	72,7	33,7	34,2	16	69,6	63,7	34,2	74	88,1	95	26	18	72	20,4	14,8	41	74,5	61,3	25,8
Chips / chips (<10mm)	4	1,43	0,4	0,03					1	2,44	0,1	0,03	1	3,7	0,1	0,08									2	2,38	0,2	0,05								
Kleinstabschläge / flakelets (10-25mm)	20	7,14	26,6	1,69	3	21,4	6,3	9					1	3,7	1,2	0,94	1	9,09	0,2	0,2	2	8,7	1	0,54	6	7,14	9,1	2,49	3	12	3,9	2,83	4	7,27	4,9	2,06
davon anteilig Geräterohlinge/ of which served as tool blanks :	*2*	*0,71*	*3,4*	*0,22*																					*1*	*1,19*	*2,1*	*0,58*					*1*	*1,82*	*1,3*	*0,55*
Abschläge / flakes (>25mm)	24	8,57	247,8	15,8	1	7,14	3,5	5	3	7,32	125	35,9	7	25,9	43	33,6	1	9,09	25	25,4	3	13	25,6	13,8	6	7,14	19,7	5,4	2	8	3,6	2,61	1	1,82	2,7	1,13
davon anteilig Geräterohlinge/ of which served as tool blanks :	*6*	*2,14*	*25,1*	*1,6*									*3*	*11,1*	*14,5*	*11,3*									*2*	*2,38*	*8,3*	*2,27*	*1*	*4*	*2,3*	*1,67*		*0*		*0*
Fragm. von (Klein-) Abschlägen / fragm. of flakes(-lets)	14	5	67,3	4,28	1	7,14	4,9	7	3	7,32	52,7	15,2	1	3,7	1,4	1,09									2	2,38	1,3	0,36	2	8	3	2,17	5	9,09	4	1,68
davon anteilig Geräterohlinge/ of which served as tool blanks :	*8*	*2,86*	*64,4*	*4,1*	*1*	*7,14*	*4,9*	*7*	*2*	*4,88*	*52,5*	*15,1*	*1*	*3,7*	*1,4*	*1,09*									*1*	*1,19*	*1,1*	*0,3*	*2*	*8*	*3*	*2,17*	*1*	*1,82*	*1,5*	*0,63*
Fragm. von nichtparallelstgn. Kl. II-III / fragm. of non-parallel-sided blades II-III	1	0,36	2,1	0,13																					1	1,19	2,1	0,58								
davon anteilig Geräterohlinge/ of which served as tool blanks :	*1*	*0,36*	*2,1*	*0,13*																					*1*	*1,19*	*2,1*	*0,58*								
parallelseitige Klingen II / parallel-sided blades II (25-50mm)	30	10,7	57,6	3,67	1	7,14	1,9	2,71	4	9,76	9	2,59	4	14,8	8,4	6,56	2	18,2	2,5	2,54	2	8,7	9,6	5,16	8	9,52	12,8	3,51	3	12	3,3	2,39	6	10,9	10,1	4,24
davon anteilig Geräterohlinge/ of which served as tool blanks :	*12*	*4,29*	*18,5*	*1,18*					*1*	*2,44*	*0,7*	*0,2*	*2*	*7,41*	*4,3*	*3,36*	*2*	*18,2*	*2,5*	*2,54*	*1*	*4,35*	*1,3*	*0,7*	*1*	*1,19*	*0,6*	*0,16*	*2*	*8*	*2,5*	*1,81*	*3*	*5,45*	*6,6*	*2,77*
parallelseitige Klingen III / parallel-sided blades III (50-80mm)	1	0,36	17,7	1,13																	1	4,35	17,7	9,52												
parallelseitige Klingen IV / parallel-sided blades IV (>80mm)	1	0,36	9,1	0,58																													1	1,82	9,1	3,82
davon anteilig Geräterohlinge/ of which served as tool blanks :	*1*	*0,36*	*9,1*	*0,58*																													*1*	*1,82*	*9,1*	*3,82*
Fragm. von parallelseitigen Klingen I / fragm. parallel-sided of blades I	4	1,43	0,4	0,03									1	3,7	0,1	0,08									2	2,38	0,2	0,05					1	1,82	0,1	0,04
davon anteilig Geräterohlinge/ of which served as tool blanks :	*1*	*0,36*	*0,4*	*0,03*																													*1*	*1,82*	*0,4*	*0,17*
Fragm. von parallelseitigen Klingen II-III / fragm. parallel-sided of blades II-III	112	40	114,6	7,29	4	28,6	3,4	4,86	18	43,9	23,2	6,69	9	33,3	11,5	8,98	4	36,4	6	6,09	5	21,7	2,5	1,34	45	53,6	47,5	13	7	28	6,2	4,49	20	36,4	14,3	6,01
davon anteilig Geräterohlinge/ of which served as tool blanks :	*45*	*16,1*	*64,2*	*4,09*	*1*	*7,14*	*1,5*	*2,14*	*13*	*31,7*	*18*	*5,19*	*3*	*11,1*	*4*	*3,13*	*2*	*18,2*	*4,8*	*4,87*	*2*	*8,7*	*1,6*	*0,86*	*18*	*21,4*	*24,9*	*6,82*	*3*	*12*	*4,8*	*3,48*	*3*	*5,45*	*4,6*	*1,93*
Fragm. von parallelseitigen Klingen IV / fragm. parallel-sided of blades IV	3	1,07	18,4	1,17																	1	4,35	3,8	2,04									2	3,64	14,6	6,13
davon anteilig Geräterohlinge/ of which served as tool blanks :	*3*	*1,07*	*18,4*	*1,17*																	*1*	*4,35*	*3,8*	*2,04*									*2*	*3,64*	*14,6*	*6,13*
Fragm. von) unbest. Abschlägen/Klingen / (fragm. of) undet. flakes/blades(-lets)	6	2,14	7,5	0,48																	2	8,7	3,5	1,88	2	2,38	2,1	0,58	1	4	0,4	0,29	1	1,82	1,5	0,63
Gesamtsummen der Primärprodukte/ Total of Primary Products	280	100	1571	100	14	100	70	100	41	100	347	100	27	100	128	100	11	100	98,6	100	23	100	186	100	84	100	365	100	25	100	138	100	55	100	238	100

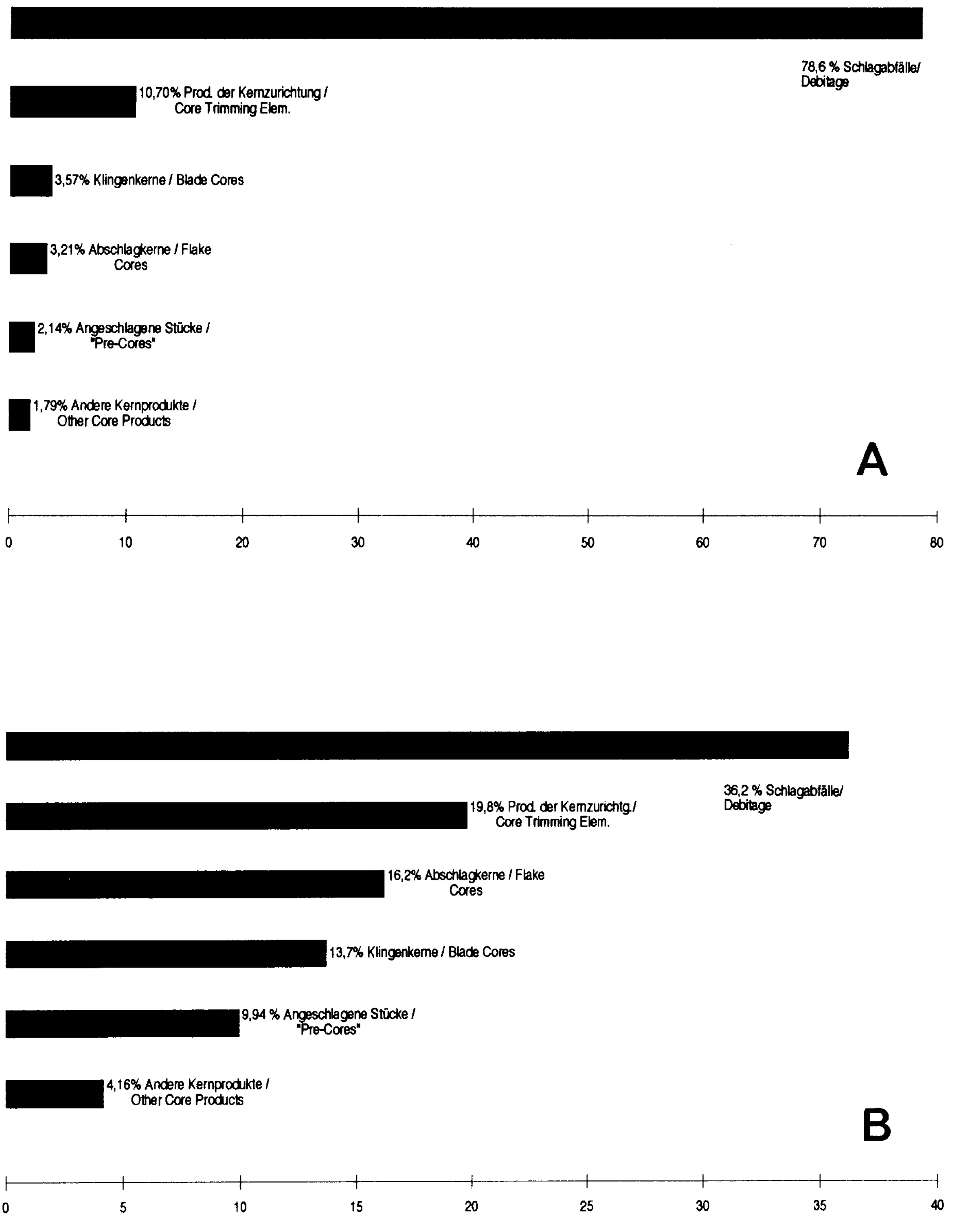


Abb. 8. Prozentanteile der Primärklassen nach *(Percentages of primary classes according to)*
A Stückzahl / piece numbers (n=280) *B* Gewicht / weight (1571g)

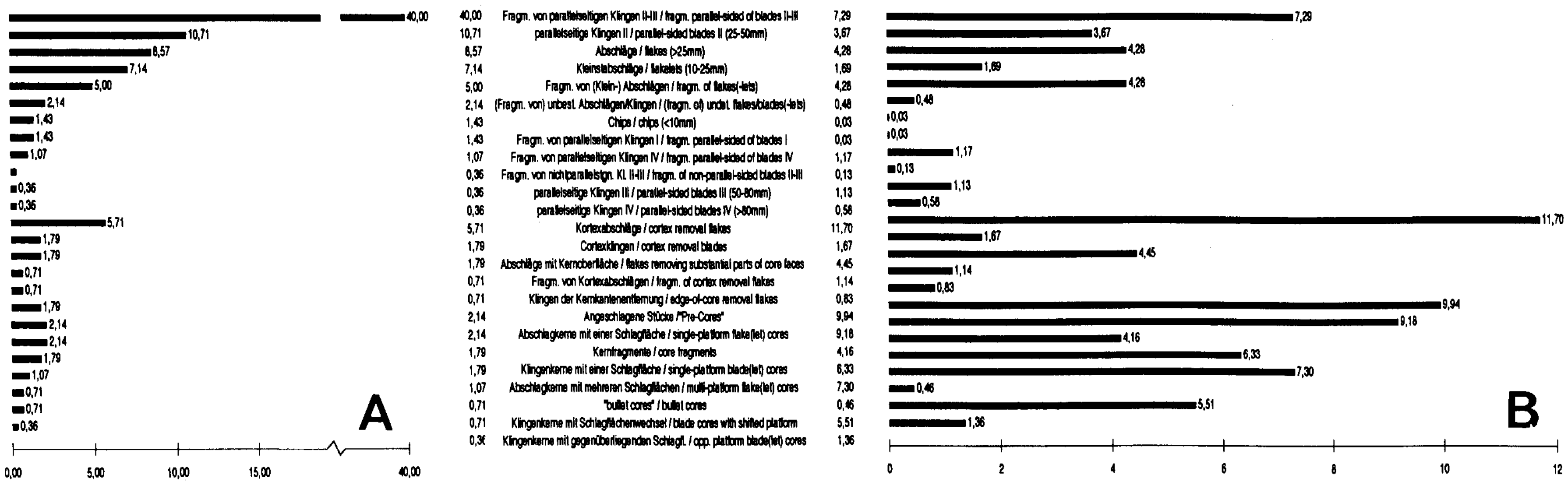


Abb. 9. Prozentanteile der Primärprodukte nach *(Percentages of primary products according to)*
A Stückzahl / piece numbers (n=280) *B* Gewicht / weight (1571g)

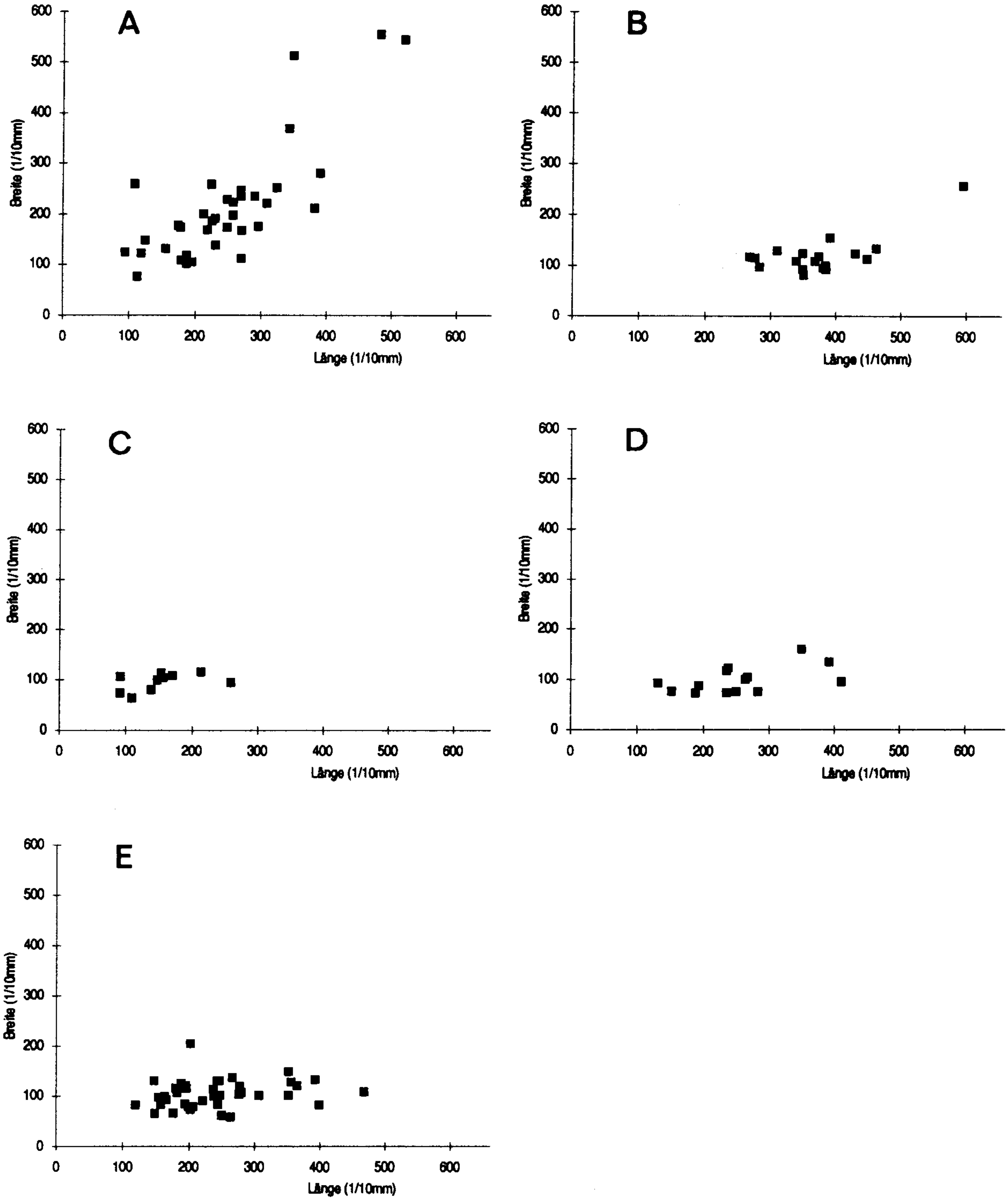


Abb 10. Längen-/ Breitendiagramme für Abschläge und (Fragm. von) Klingen (Primärproduktion) *(Length-/ width scattergrams of flakes, blades, and blade fragments (primary production)).*

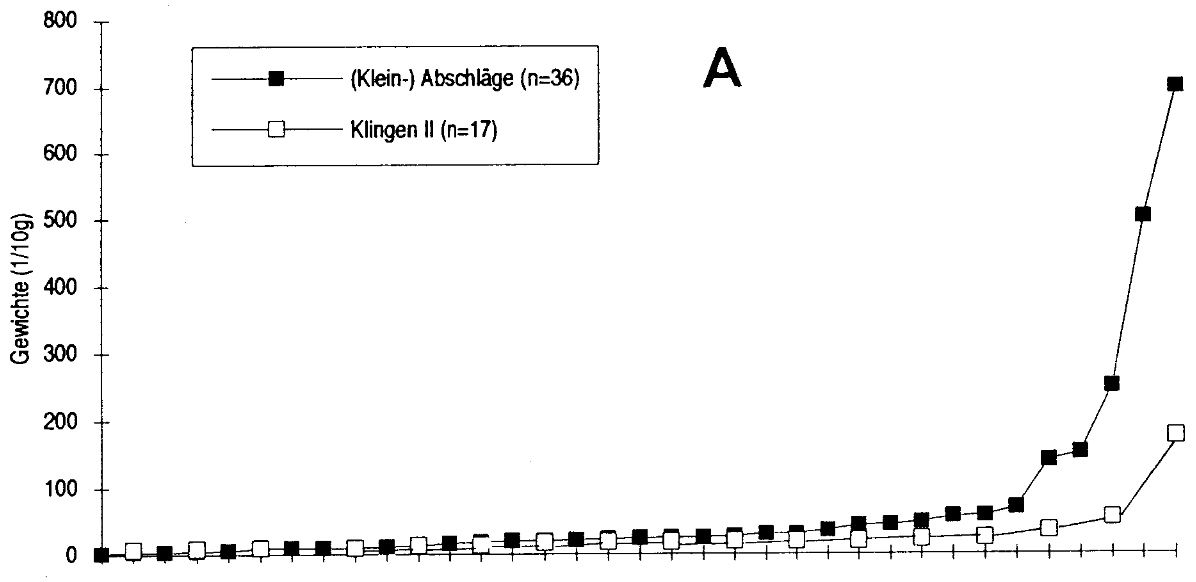
A Abschläge / flakes (n=37)

B Klingen / blades (n=17)

C mediale Klingenfragm. / medial fragm. of blades (n=10)

D medial-distale Klingenfragm. / medial-distal fragm. of blades (n=14)

E prox.-mediale Klingenfragm. / prox.-medial fragm. of blades (n=39)



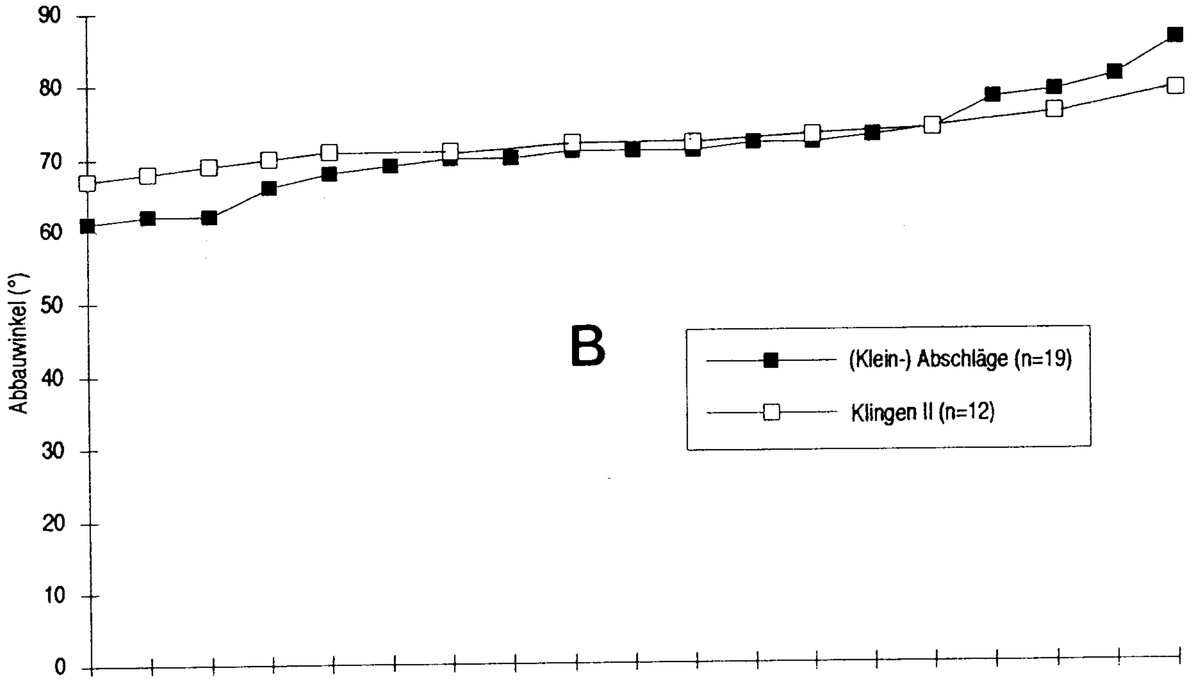


Abb. 11. Kumulative Häufigkeitskurven für vollständige Klingen II und Abschläge (Primärproduktion) für die *(Frequencies of complete blades II and flakes for the)*

A Gewichte / weights B Abbauwinkel / angles

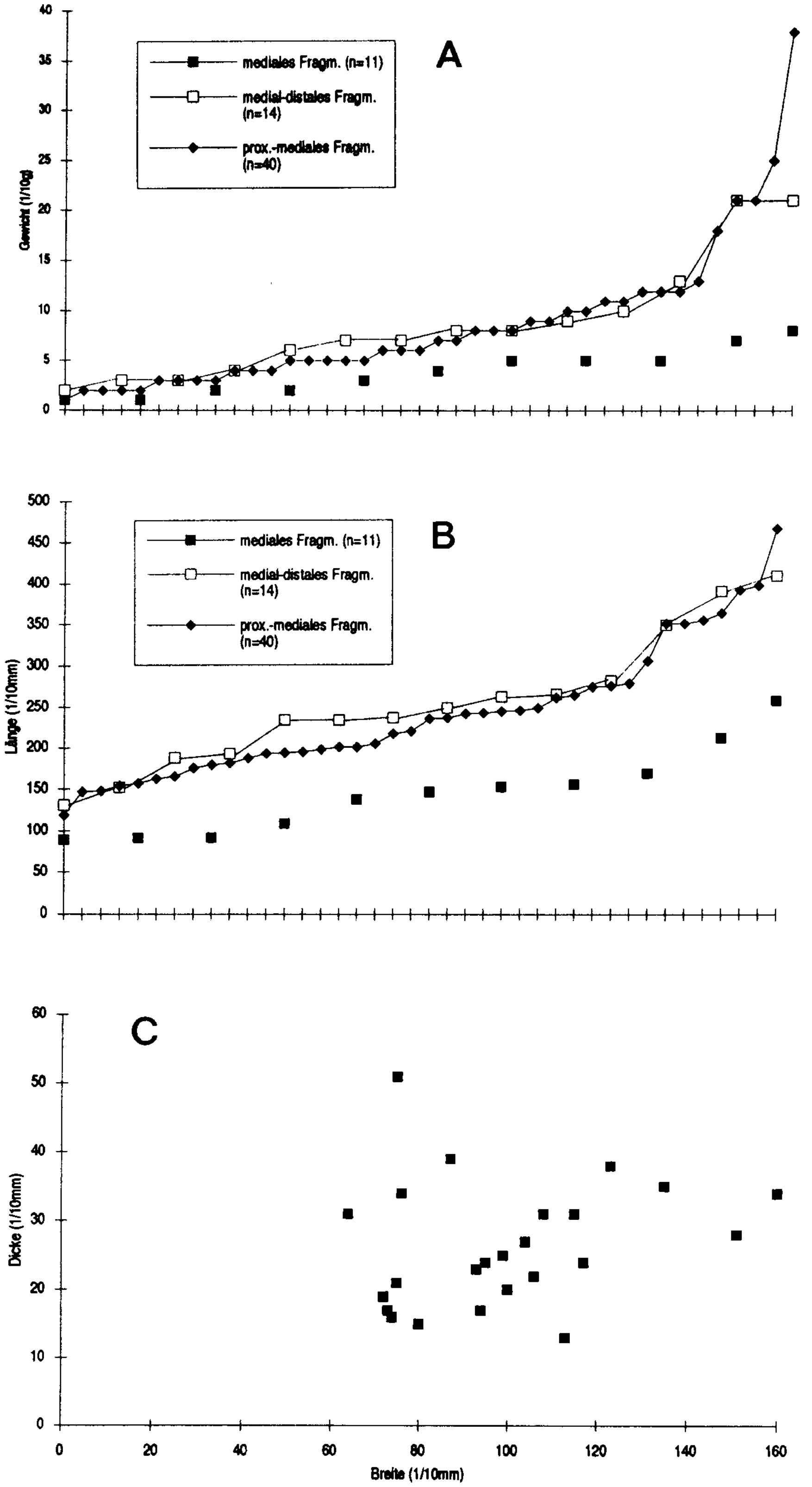
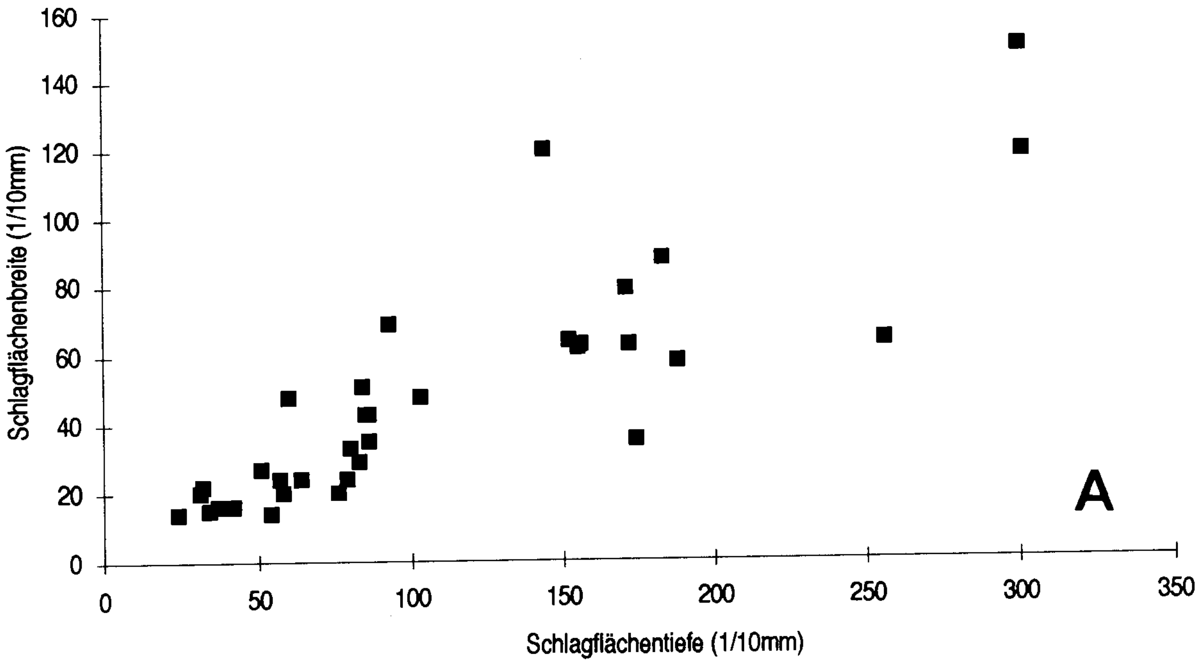


Abb. 12. Metrische Daten von Klingenfragmenten II-III (Primärproduktion) *(Metrical data for blade fragments II-III (primary production)).*

A Häufigkeiten Gewichte / frequencies of wheights

B Längen / lengths

C Dicken / Breiten von medialen und medial-distalen Klingenfragm. II-III / thicknesses/ widths of medial and medial-distal blade fragm. II-III



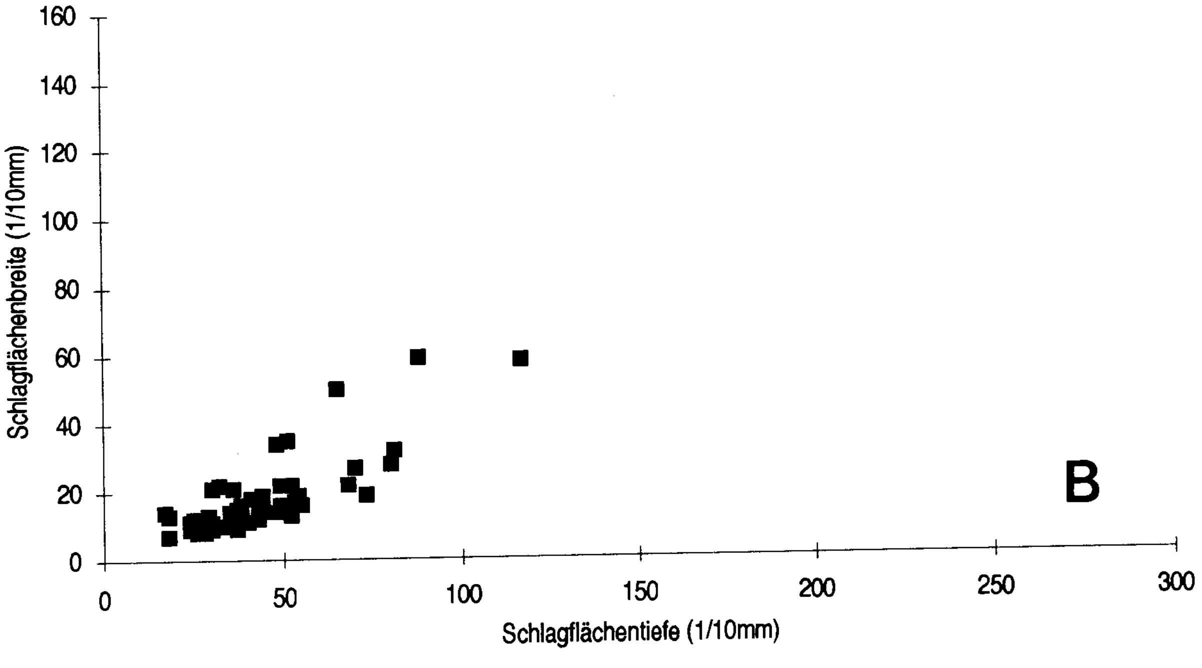


Abb 13. Längen-/ Breitendiagramme (Primärproduktion) der Schlagflächenreste für *(Length-/ width scattergrams (primary production) of butts for)*
A meßbare Abschläge / measureable flakes (n=32) *B* meßbare Klingen (-fragm.) / measureable blades (incl. fragm.) (n=61)

Tabelle 7. Produkte der Sekundärproduktion (Geräte) und ihre Rohmaterialien.
(Products of secondary production (implements) and their raw materials).

Qale Rostam: Klassifikation der Werkzeuge und ihrer Rohmaterialien	**Anz.**	***Anz.***	**Gew.**	**Gew.**	**RM1**			**RM2**			**RM3**			**RM4**			**RM5**			**RM6**			**RM7**			**RM8**			**RM9**			**RM10**			**Obsidian**			**exot. Mat.**		
Qale Rostam: Implement and Raw Materials Classification	n	%	g	%	n	g	g%	n	g	g%	n	g	g%	n	g	g%	n	g	g%	n	g	g%	n	g	g%	n	g	g%	n	g	g%	n	g	g%	n	g	g%	n	g	g%
(A) Pfeilspitzen / Projectile Points																																								
(B) Blattspitzen / Foliates																																								
(C) Bohrende/Stechende Geräte / Drilling/ Piercing Tools	1	*1,25*	3,4	*1,30*	1	3,4	*2,7*																																	
Spitze an trans. steil-ret. Klinge / borer point on trans. steep-ret. blade	1	*1,25*	3,4	*1,30*	1	3,4	*2,7*																																	
(E) Steil-ret./ ret. steilkantige Geräte / Steep-Ret./ Ret. Steep-Sided Tools	13	*16,25*	33,9	*12,96*	4	11	*8,8*										1	3,2	*14*				2	3,2	*100*	1	1,1	*7,5*	2	4	*26*				1	2,1	*84*	2	9,4	*100*
(Fragm.) lat. steil-ret. Klingen / (fragm. of) lat. steep-ret. ret. blades	8	*10*	14,2	*5,43*	1	1,4	*1,1*										1	3,2	*14*				2	3,2	*100*				2	4	*26*				1	2,1	*84*	1	0,3	*3,2*
(Fragm.) lat.-term. steilret. Klingen / (fragm. of) lat.-term. steep-ret. blades	3	*3,75*	11,5	*4,40*	1	1,3	*1*																			1	1,1	*7,5*										1	9,1	*97*
(Fragm.) lat. ret. steilkantiger Klingen / (fragm. of) lat. ret. steep-sided blades	1	*1,25*	3,3	*1,26*	1	3,3	*2,7*																																	
(Fragm.) term. ret. steilkantiger Abschläge / (fragm. of) term. ret. steep-sided flakes	1	*1,25*	4,9	*1,87*	1	4,9	*4*																																	
(F) Dentikulierte Geräte / Denticulated Tools																																								
(G) Geräte mit Glanz / Glossed Elements	6	*7,5*	12,8	*4,89*	2	2,4	*1,9*										1	3,8	*16*							1	1,4	*9,5*	2	5,2	*33*									
(Fragm. von) Klingen mit lat. Glanz / (fragm. of) blades with lat. sheen	6	*7,5*	12,8	*4,89*	2	2,4	*1,9*										1	3,8	*16*							1	1,4	*9,5*	2	5,2	*33*									
(H) Geräte mit Kerbungen / Notched Tools																																								
(I) Kombi-Geräte / Multiple Tools	4	*5*	10,8	*4,13*	1	1,2	*1*										2	6,4	*27*										1	3,2	*21*									
9023 steilret. Kante + bohrende/stechende Sp. / steep- ret. edge + piercing tip	1	*1,25*	1,2	*0,46*	1	1,2	*1*																																	
9025 steilret. + gekerbte Kanten / steep-ret. + notched edges	1	*1,25*	2,8	*1,07*													1	2,8	*12*																					
9125 ret. + steilret. + gekerbte Kanten / ret. + steep-ret. + notched edges	1	*1,25*	3,2	*1,22*																									1	3,2	*21*									
9159 ret. + gekerbte + gebrauchsret. Kanten / ret. + notched + use-ret. edges	1	*1,25*	3,6	*1,38*													1	3,6	*15*																					
(J) Retuschierte Klingen/ (Klein-) Abschläge / Retouched Blades/Flakes(-lets)	33	*41,25*	171,2	*65,44*	22	96	*78*										3	7,5	*32*	1	50	*100*				3	11	*76*	1	1,7	*11*	2	4,1	*100*	1	0,4	*16*			
(Fragm.) lat. ret. Klingen / (fragm. of) lat. ret. blades	8	*10*	10,4	*3,98*	6	6,2	*5*										1	1,2	*5,2*													1	3	*73*						
(Fragm.) lat. ret. (Klein-) Abschläge / (fragm. of) lat. ret. flakes(-lets)	9	*11,25*	78,5	*30,01*	8	76	*61*																			1	2,3	*16*												
(Fragm.) lat.-term. ret. Klingen / (fragm. of) lat.-term. ret. blades	3	*3,75*	3,7	*1,41*	1	0,9	*0,7*																						1	1,7	*11*	1	1,1	*27*						
(Fragm.) lat.-term. ret. (Klein-) Abschläge / (fragm. of) lat.-term. ret. flakes(-lets)	3	*3,75*	62,5	*23,89*													1	4,8	*21*	1	50	*100*				1	7,4	*50*												
(Fragm.) lat. steil-ret. Klingen / (fragm. of) lat. steep- ret. blades	2	*2,5*	2,9	*1,11*													1	1,5	*6,4*							1	1,4	*9,5*												
(Fragm.) lat. inverse ret. Klingen / (fragm. of) lat. inverse ret. blades	4	*5*	8,6	*3,29*	4	8,6	*6,9*																																	
(Fragm.) lat. inverse steil-ret. Klingen / (fragm. of) lat. inverse steep- ret. blades	4	*5*	4,6	*1,76*	3	4,2	*3,4*																												1	0,4	*16*			
(K) Nichtgeometrische mikrolith. Geräte / Non-Geometric Microlithic Tools																																								
(L) Gebrauchs- und andere ret. Stücke / Use- and Other Retouched Pieces	23	28,75	29,5	11,28	12	10	*8,2*	3	4,5	*100*	2	3,5	*100*	2	6,3	*100*	2	2,4	*10*							1	1,1	*7,5*	1	1,5	*9,6*									
(Fragm.) lat. gebrauchsret. Klingen / (fragm. of) lat. use-ret. blades	19	*23,75*	21,9	*8,37*	10	8,2	*6,6*	3	4,5	*100*	2	3,5	*100*	1	2,2	*35*	2	2,4	*10*							1	1,1	*7,5*												
(Fragm.) lat. gebrauchsret. (Klein-) Abschläge / (fragm. of) lat. use-ret. flakes(-lets)	4	*5*	7,6	*2,91*	2	2	*1,6*							1	4,1	*65*													1	1,5	*9,6*									
(M) Klopfsteine / Hammerstones																																								
(N) Beile / Celts																																								
(P) Picks / Picks																																								
(Q) Meißel / Chisels																																								
(R) Other Heavy Duty Tools																																								
Gesamtsummen der Geräte und Rohmat. / Total of Implements and RMs	80	*100,00*	261,6	*100,00*	42	124	*100*	3	4,5	*100*	2	3,5	*100*	2	6,3	*100*	9	23	*100*	1	50	*100*	2	3,2	*100*	6	15	*100*	7	16	*100*	2	4,1	*100*	2	2,5	*100*	2	9,4	*100*

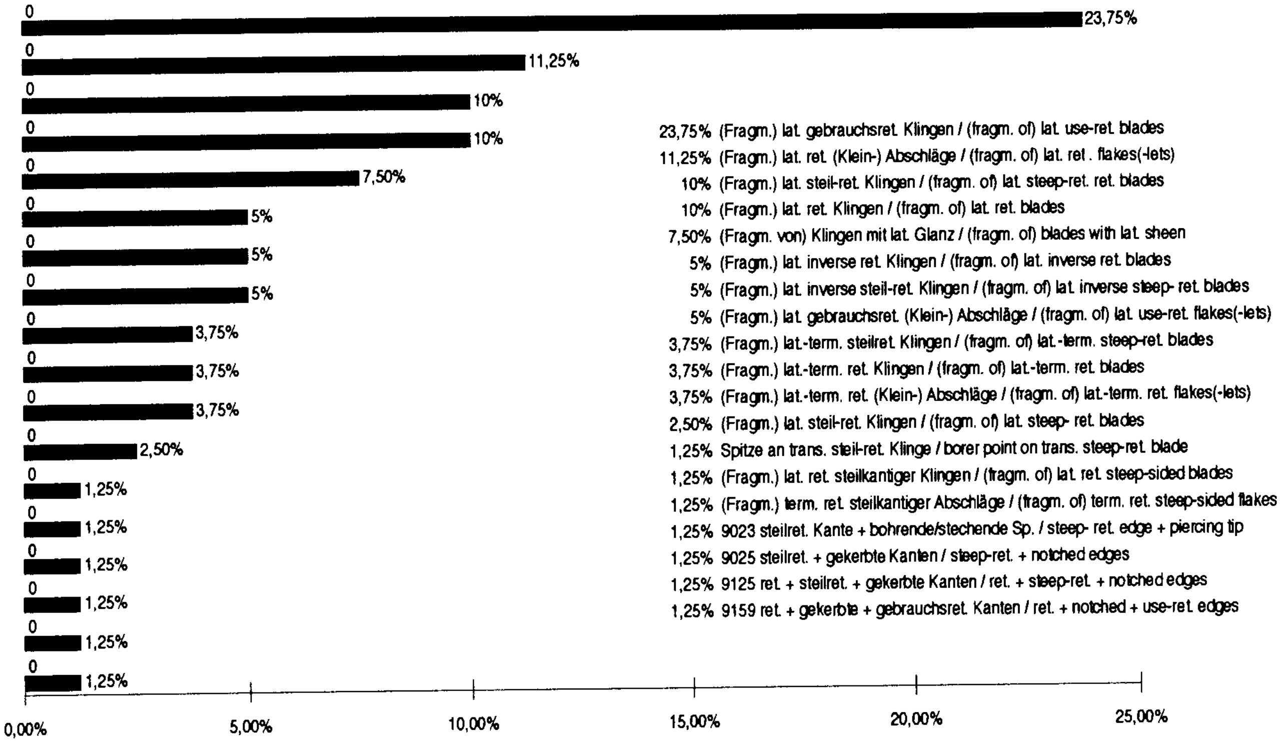


Abb. 14. Prozentuale Häufigkeiten bei Geräten *(Frequencies of implements by percentages).*

Die Aussagemöglichkeiten zur Industrie sind unterschiedlich zu werten: Die örtliche Primärproduktion, d.h. das Herstellen von Geräterohlingen, dürfte mit der Probe hinreichend charakterisierbar sein; entsprechend wurde dieser Teil auch graphisch besser illustriert (Abb. 10-13). Dies betrifft nur die aus lokalem Rohmaterial entstandenen Artefakte (Rohmaterialklasssen 1a-c). Schwer einschätzbar ist, inwieweit die Sekundärproduktion in der Probe hinreichend erfaßt wurde, d.h. inwieweit die 80 Geräte eine Aussage über den Werkezeugkasten der Bewohner machen. Es ist durchaus möglich, daß alle Werkzeugklassen qualitativ in der Probe vertreten sind und der Werkzeugkasten damit grob charakterisierbar ist. Mit Blick auf z.B. HOLE 1977 ist es aber auch denkbar, daß einige Werkzeugklassen fehlen. Auf jeden Fall muß davon ausgegangen werden, daß über die quantitative Verteilung der Klassen die Probe keine Aussage gemacht werden kann. Es wird daher nur die Klassifizierung der Werkzeugarten (Tabelle 7; Abb 14) dargestellt; für weitere -insbesondere merkmalanalytische und metrische- Details hätten sich keine statistisch verläßlichen Aussagen machen lassen. Dies ist bedauerlich, da das mögliche intentionelle Zubrechen der Klingen auf bestimmte Längen nicht faßbar wird.[1]

Die Trennung der Silexartefakte nach stratigraphischen Einheiten (Tabelle 6) ergab keine Hinweise auf technologische oder typologische Veränderungen im Fundinventar; ebenso zeigt ihre Verteilung in den Abhüben keine besonderen Auffälligkeiten, außer: In B12-17 konzentrieren sich Kerne und Kernzurichtungsprodukte, A10-15 weist vergleichsweise viele Schlagabfälle auf. Beide Befunde dürften noch erhaltene Aktivitätshinweise für die Loci sein.

[1] Bei der Klassifizierung der Artefakte wurden Zuweisungen nach dem Prinzip vorgenommen, daß ein Artefakt bei unsicheren Merkmalen in eine weitergehende Kategorie in jene eingeordnet wurde, die es sicher repräsentiert: z.B. unsichere Trümmer wurden den Kieseln zugerechnet, zweifelhaft gebrauchsret. Klingen den unret. Klingen der Primärproduktion etc. Letztlich bedeutet dieses Vorgehen eine hierarchische Staffelung der Auswertung.

Bemerkungen zum Rohmaterial in den Sedimentproben[1] (Tab. 2-3)

In Tabelle 2 werden die nichtlithischen Befunde aus den Sedimentproben dargestellt. Was den Silex angeht, so konnte mit den Befunden aus den Sedimentproben nachgewiesen werden, daß das hauptsächlich in Qale Rostam genutzte Rohmaterial 1a-c (cf. Tabelle 5) tatsächlich in dem, den Fundort mitaufbauenden natürlichen Sediment vorkommt und daß die Bewohner die Kiesel über 2cm Größe zur Nutzung ausgelesen haben müssen (In den Proben kamen fast nur die unter 2cm großen Kiesel- und Kieselfragmente vor.). Diese waren, ebenso wie das geschlagene Material, z.T. stark versintert.

Rohmaterialgruppen und -nutzung (Tabellen 4-5, 7; Abb. 7)

Silifiziertes Gestein ist mit 10 Rohmaterialklassen bzw. -gruppen vertreten, 4 Arten von Kalkstein wurden geschlagen. Ein "exotischer" Feuerstein, der aus dem Spektrum der Silices fällt, wurde neben sehr wenigen Stücken Obsidian (bisher ohne Herkunftsbestimmung) nachgewiesen. Die Menge der Rohmaterialien sagt nicht aus, daß ein breites Ressourcenspektrum genutzt wurde. Wie Tabelle 5 zeigt, sind 82% aller Rohamatrialien der Gruppe 1a-c zugehörig, eine lokal am Fundort vorkommende Jaspisart. Die Rohmaterialien 2-10 sind von z.T. von ausgezeichneter Qualität, sind aber mit nur sehr wenigen Artefakten vertreten. Alle gefundenen Kerne gehören zu den 1a-c -Materialien[2].

Aus den dargestellten Daten folgt, daß für dèn Werkstoff Silex ortsfremdes Material nur in geringen Mengen verwandt wurde. Ob die Rohmaterialklassen 2-10 lokal-regional vorkommen, ist unbekannt und auch für den Nutzungsaspekt unerheblich. Die Bevölkerung von Qale Rostam mußte mit einem leicht splitternden Material vorlieb nehmen, das Klingen bis zu einer maximalen Länge von 6cm zuließ (= durchschnittliche max. Kieselgröße). Unklar bleibt die Ursache dieser Splittrigkeit, da die durchweg parallelseitigen, von stark konvexen Kernoberflächen stammenden Klingen deutlich kontrollierbare Schlagtechniken bezeugen. Wenige Stücke aus allen Rohmaterialgruppen bezeugen einen von den Dorsal- und Ventralflächen unterschiedlichen Glanz in den Retuschennegativen, was auf Tempern von Klingen schließen läßt.

Primärproduktion[3] (Tabelle 6; Abb. 8-13)

Alle Kerne sind sehr klein und in ihrer Größe durch die Abmessungen der Kiesel bestimmt; maximale Restkernausdehnungen betragen 40mm, die längste vollständig erhaltene Klingenbahn 35mm. Alle repräsentierten Kerne gehören zur Rohmaterialgruppe I, das ein äußerst schlechtes, splittriges, jedoch im Schlagverhalten kontrollierbares Rohmaterial ist. Die Kerne scheinen vor Ort entstanden zu sein; es sind jedoch keine Kerne belegt, die Klingen- und Abschlagabmessungen

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1 Die Daten zu den 10 in Qale Rostam genommenen Kultursedimentproben beruhen auf einer makroskopischen Ansprache der ungeschlämmten Proben sowie den Ergebnissen des Auslesens der Schlämmrückstände und des Schlämmauftriebs nach Absonderung einer Zeugenprobe von jeweils 1 l Schüttmenge. Die geoarchäologische Auswertung steht noch aus.
Mit der Schlämmung der Proben sollte der Frage nach der Funddichte der Silices -insbesondere der Absplisse- nachgegangen werden; ebenso sollte eruiert werden, ob die Kiesel der Rohmaterialklasse Ia-c tatsächlich natürlich in den Schichten vorkommen. Durch die Schlämmung wurden auch die karbonisierten Pflanzenreste (in Bearbeitung durch Reinder Neef) gesichert.
Die Aussagefähigkeit der Proben wird dadurch eingegrenzt, daß nicht alle Schichten miteinander verglichen werden können und der Probenumfang allenfalls eine qualitative Liste des Probeninhalts erlaubt. Daher begründet sich die Verwendung der relativen Bezeichnungen "häufig, gelegentlich, selten/einzeln". Der geschlämmte, geringe Probenumfang variierte -nach Absonderung der Zeugenprobe- zwischen 700 und 3300 ml ungeschlämmter Schüttmenge (insgesamt 18.5l Schüttmenge). Der Umfang der Rückstände (Maschengröße 1mm) und Auftriebe (Maschengröße 0,5mm) im Verhältnis zur jeweiligen Probengröße weicht probenindividuell beträchtlich voneinander ab. Die Anteile der Feinsedimente wurden nicht dokumentiert.
Ergänzend zu Tabelle 2 sind folgende, weitere Befunde für die Abhubinhalte festzuhalten: Brennkernteile von Keramik in A15 und B17; gebranntes und ungebranntes, gemagertes amorphes Lehmmaterial (z.T. mit Pflanzenabdrücken) in A12, B11 und B17 (z.T. sicherlich Lehmziegelbruch).

2 Mineralogisch gehören die in 1a-c unterschiedenen Rohmaterialien zusammen; sie waren nur farblich zunächst nach den rotbraunen, violetten und ockerfarbenen Kieseln unterschieden worden.

3 Die Materialaufnahme der Schlagabfälle berücksichtigte die metrischen (Ventrallängen, Breiten und Dicken; Abbauwinkel; Breiten und Tiefen der Schlagflächenreste) und merkmalanalytischen Daten (Bruch- bzw. Erhaltungzustände; Anzahl der Negative; Hinweise auf bidirektional genutzten Kern; dorsaler Cortex- oder Kluftflächenanteil; Art des Schlagflächenrests; Verlauf der Ventralfläche; etc.)

aufweisen, die den Abschlägen und Klingen im Debitage- und Gerätematerial nahekommen. Die hier bestimmten Kerne sind zur Gänze als Restkerne anzusehen.

Der Cortex- und Kluftflächenanteil an den Gesamtkernoberflächen ist beachtlich; er liegt oft bei 50%. Die Herstellung einer Schlagfläche durch einen Entrindungsabschlag war üblich; Abhübe direkt von Cortexoberflächen kommen praktisch nicht vor. Eine besondere Präparation der Kerne, die schließlich die "bullet cores" hinterließen, kann am Material nicht beobachtet werden und scheint auch ausgeschlossen, da die Form das Ergebnis erfolgreich im Schema abgehobener Klingen ist, in dessen Verlauf Neupräparationen offenbar nicht vorkamen. Diese mit den "bullet cores" verbundene Technik zeigt eine sehr spezialisierte Klingentechnik, die vermutlich die Arbeit von Spezialisten ist.

Angeschlagene Stücke (2,14%)

sind durch angeschlagene Kieselbruchstücke vertreten, die ein oder zwei Negative aufweisen und bis zu 80% natürliche Oberfläche zeigen. Sie gehören alle der Rohmaterialgruppe 1 an.

Abschlagkerne (3,21%)

Abschlagkerne mit einer Schlagfläche (2,14%)
sind durch einen einen Entrindungsabschlag charakterisiert, dessen Negativ die einzige Schlagfläche des Kerns abgab. Die Abschlagbahnen dieser Kerne sind bis zu 35mm lang, in der Regel aber kürzer. Die Splittrigkeit des Rohmaterials und die geringe Größe dieser Kerne muß veranlaßt haben, sie zu verwerfen.

Abschlagkerne mit mehreren Schlagflächen (1,7%)
sind unregelmäßige Kerne mit bis zu drei Schlagflächen, die aus dem gleichen Grunde wie die Abschlagkerne mit einer Schlagfläche aufgegeben wurden. Wie diese zeigen ihre Negative die Produktion von zuletzt klingenartigen Abschlägen, obwohl die noch vorhandenen Cortexanteile und die Kieselgröße darauf schließen lassen, daß es bei diesen Stücken kaum zu einem Klingenabbau gekommen war. Die drei gefundenen Stücke gehören ebenfalls der Rohmaterialgruppe 1 an.

Klingenkerne (3,57%)

"bullet cores" (0,71%)
sind formal Mikrokerne mit Negativbahnen von extremer Schmalheit (0,5-4mm), die von einer meist runddurchmessenden Schlagfläche um 12mm und weniger ausgehen. Im Material von Qale Rostam haben sich keine Mikroklingen erhalten, die die Größe dieser letzten Abbauzustände aufweisen. Die Funktion dieser formal als Kern anzusprechenden Stücke erscheint diskussionswürdig.

Klingenkerne mit einer Schlagfläche (1,79%)
unterscheiden sich von den Abschlagkernen mit einer Schlagfläche lediglich dadurch, daß ihre Negative Klingenbahnen repräsentieren. Bei den hier klassifizierten Stücken sind dies bereits keine parallelseiten Bahnen mehr; sie repräsentieren klingenartige Abhübe. Ebenso wie bei den Abschlagkernen entstanden die Schlagflächen durch einen einfachen Abschlag, der die Rinde der durchweg kleinen Kiesel (bis 35mm) wegnahm.

Klingenkerne mit Schlagflächenwechsel (0,71%)
sind durch zwei Stücke belegt. In einem Fall wurde durch Drehung des Kerns die ehemalige Kernoberfläche zur neuen Schlagfläche umfunktioniert, im anderen Fall erfolgte die Drehung auf die Cortexoberfläche, von der in Richtung der alten Kernoberfläche abgehoben wurde. In beiden Fällen wurden entstandene, spitzwinklige Kernkanten als neue Abbaukanten ausgewählt.

Klingenkerne mit gegenüberliegenden Schlagflächen (0,36%)
sind durch ein Stück belegt. Gegenüberliegende Seiten des Kiesels wurden durch einen Abschlag entrindet; von den beiden so entstandenen Schlagflächen wurden Klingen abgehoben. Ob dieser bidirektionale Kernabbau ein Merkmal der Industrie ist, bleibt bei nur einem belegten Stück fraglich; bei der Rohmaterialarmut am Fundort wäre eine derartige rohmaterialschonende Abbautechnik angebracht.

Kernfragmente (1,79%)
sind Fragmente von Abschlagkernen, die wiederum alle der Rohmaterialgruppe 1 zugehörig sind. Klingenkernfragmente sind nicht unter ihnen. Ursache der Fragmentierung dürfte die Abtrümmerung

während des Schlagens sein; bei der Brüchigkeit des Rohmaterials wundert es, daß diese Gruppe im Inventar nicht stärker vertreten ist.

Produkte der Kernzurichtung (10,7%)

Kortexabschläge (5,71%)
sind Abschläge, deren "Dorsalseite" vollständig oder durch wenigstens 80% von der natürlichen Oberfläche des Rohmaterials bestimmt wird. Ihre Abmessungen und Gewichte zeichnen sich durch eine große Varianz auf: Von 60 bis 2g wiegend, weisen sie Längen von 67 bis 15mm auf. Die kleinen Cortexabschläge repräsentieren nicht unbedingt Produkte der Kernzurichtung; ein Teil der hierunter bestimmten Abschläge dürften jene Abschläge sein, die bei der Schaffung einer Schlagfläche entstanden. Die Abbauwinkel der Kortexabschläge liegen bei 120°.

Fragm. von Kortexabschlägen (0,71%)

Klingen der Kernkantenentfernung (0,71%)
könnten möglicherweise von einer intentionellen Entfernung benutzter Kernkanten stammen (40 bzw. 28mm lang); ihr Querschnitt ist dreieckig.

Cortexklingen (1,79%)
haben einen dreieckigen Querschnitt und jeweils rechts oder links ihres zentralen Grates auf voller Länge Cortex; die andere Hälfte zeigt einen Teil eines Klingennegatives. Sie fallen am Anfang des Klingenabbaus an, können demzufolge einen stark konvexen Verlauf der Ventralfläche haben und zeigen eine Tendenz zur Kernfußklinge. Beides ist charakteristisch für die 4 gefundenen Stücke dieser Klasse.

Abschläge mit Kernoberfläche (1,79%)
sind große Abschläge, die einen substantiellen Teil der Kernoberfläche -oft mit einem Anteil Cortexoberfläche- entfernt haben. Zwei der gefundenen Stücke stammen von einem Klingenkern mit parallelseitigen Klingennegativen, drei stammen von Abschlagkernen. Ein Minimum von 4 Negativen ist erkennbar. Ihre Abbauwinkel liegen bei 110-120°. Ob diese Stücke tatsächlich Produkte einer intentionellen Kernzurichtung sind, d.h. der Schaffung einer frischen Kernoberfläche oder neuen Schlagfläche dienten, kann zweifelhaft sein. Sie isolieren sich mit ihren Merkmalen deutlich von den übrigen Abschlägen der Primärproduktion.

Schlagabfälle (78,6%) (Tabelle 6; Abb. 8-13)

Die Schlagabfälle sind der statistisch zuverlässigste Teil des Inventars. Die Informationen zu den metrischen Kennzeichen der Industrie sind in den Abb. 10-13 zusammengefaßt und dort zu entnehmen. Bemerkenswert ist, daß sich die Klingen und der Großteil der Abschläge in ihren Gewichten und Abbauwinkeln kaum unterscheiden. Die Frage des intentionellen Brechens von Klingen konnte nicht hinreichend geklärt werden, die metrischen Daten lassen es vermuten. 17,6% der der Primärproduktion zuzurechnenden Klingenfragmente sind mediale Fragmente, 21% medial-distale und 59% sind proximal-mediale Fragmente. Die letzte Gruppe mag für Einsätze ungeeignete Rohlinge repräsentieren.

Von den (Klein-) Abschlägen zeigen 76% eine ebene Schlagfläche, 3% eine gepickte Schlagfläche, 9% die Form "aile de oiseau" und nur 12% eine punktförmige Schlagfläche. Die Formen der ebenen Schlagflächen sind dreieckig/ sub-dreieckig/ trapezoid/ polygon sowie oval/ sub-oval/ ellipsoid/ rhomboid/ planoconvex. Bei den Klingen, die oft stark gekrümmt sind, zeigen 67% eine ebene Schlagfläche (Formen wie bei den Abschlägen), 16% eine gepickte Oberfläche und eine die Cortexoberfläche des Kerns. Die Anrauhung der Schlagfläche durch Pickungen bleibt nicht sicher nachzuweisen.

Chips (<10mm) (1,43%)
Kleinstabschläge (10-25mm) (7,14%)
Abschläge (>25mm) (8,57%)
Fragm. von (Klein-) Abschlägen (5%)
Fragm. nichtparallelseitiger Klingen (II-III) (0,36%)
parallelseitige Klingen II (25-50mm) (10,7%)
parallelseitige Klingen III (50-80mm) (0,36%)
Fragm. von parallelseitigen Klingen I (1,43%)
Fragm. von parallelseitigen Klingen II-III /40%)

Fragm. von parallelseitigen Klingen IV /1,07%)
(Fragm. von) unbest. Abschlägen/Klingen (2,14%)
fraglich ret. (Fragm. von) Klingen/ Abschl. / ? ret. (fragm. of) blades/ flakes

Sekundärproduktion (Tabelle 7; Abb. 14)

Die folgende Einteilung der Geräte ist an ihren Merkmalen orientiert; so kann es auswertungsbedingt zu einer formalen Trennung von funktional gleich genutzten Klingengeräten gekommen sein: Die meisten der retuschierten Klingen zeigen einen lkaum erkennbaren Glanz im unmittelbaren Retuschenbereich, der nicht oder kaum auf die dorsalen bzw. ventralen Oberflächen übergreift.

Tabelle 7 enthält zur Verdeutlichung sämtliche Werkzeugklassen, um nicht belegte Werkzeuggruppen auffällig zu machen.

Bohrende/Stechende Geräte (1,25%)

Spitze an transversal steil-ret. Klinge (1,25%)
Bohrende und stechende Geräte fehlen merkwürdigerweise im Inventar völlig. Bei dem Stück handelt es sich um eine ahlenartige Spitze, die durch eine steile Transversalretuschierung ausgeformt wurde.

Steil-ret./ ret. steilkantige Geräte (16,25%)

(Fragm.) lat. steil-ret. Klingen (10%) / (Fragm.) lat.-term. steilret. Klingen (3,7%)
Diese Gruppen sind ein Charakteristikum der Industrie: Ihre lateralen, mitunter auch ihre terminalen Kanten zeigen eine durchgehende steile Kantenretusche, die in Partien auch formgebend angebracht ist (Schäftungen?). Diese steilretuschierten Kanten sind z.T. sehr stumpf, d.h. die Kanten wirken verrundet. Mitunter ergibt der Kantenverlauf formal eine Kerbung. Die Bruchzustände in dieser Gruppe ergeben kein Bild. Es ist möglich , daß es sich bei diesen Klingen um Ernteeinsätze handelt, da einige einen leichten Glanz aufweisen. Dieser Glanz ist jedoch kaum zu erfassen gewesen, weshalb diese Stücke nicht unter die Geräte mit Glanz geordnet wurden.

(Fragm.) lat. ret. steilkantiger Klingen (1,25%) / (Fragm.) term. ret. steilkantiger Abschläge (1,25%)
Bei der Klinge und dem Abschlag handelt es sich um retuschierte Steilkanten, d.h. eine morphologisch am Primärprodukt existente steile Seite wurde retuschiert.

Geräte mit Glanz / Glossed Elements (7,5%)

(Fragm. von) Klingen mit lat. Glanz (7,5%)
Bei allen Stücken handelt es sich um parallelseitige Klingenfragmente II-III. Der kantenseitige Glanz ist deutlich ausgeprägt, greift aber kaum über die steilretuschierte Region hinaus. Die Kanten sind teilweise durch ihre steile Retuschierung verrundet, was sie -ohne Glanz- zu lateral steil-retuschierten Klingen (s.o.) machen würde. Funktional sind beide Gruppen mit großer Wahrscheinlichkeit nicht zu trennen, ihre Morphologie ist bis auf den Glanz identisch. Distalteile solcher Klingen sind in beiden Gruppen nicht belegt (nur mediale und proximal-mediale Teile), was das Argument stärken könnte, daß es sich um Einsätze handelt. Distalteile wären dann intentionell weggebrochen, da sie bei Belastung am ehesten brechen würden.

Kombi-Geräte (5%)

9023 steilret. Kante + bohrende/stechende Spitze (1,25%) / 9025 steilret. + gekerbte Kanten (1,25%)/ 9125 ret. + steilret. + gekerbte Kanten (1,25%) / 9159 ret. + gekerbte + gebrauchsret. Kanten (1,25%)
Zu diesen Geräten, die mehrere unterschiedliche Arbeitskanten aufweisen, kann nicht mehr ausgeführt werden als daß sie in der Industrie existieren und Merkmale aufweisen, die sie durchaus mit den lateral steilretuschierten klingen funktional in Verbindung bringen.

Retuschierte Klingen/ (Klein-) Abschläge (41,25%)

(Fragm.) lat. ret. Klingen (10%) / (Fragm.) lat. ret. (Klein-) Abschläge (11,25%) / (Fragm.) lat.-term. ret. Klingen (3,75%) / (Fragm.) lat.-term. ret. (Klein-) Abschläge (3,75%) / (Fragm.) lat. steil-ret. Klingen (2,5%) / (Fragm.) lat. inverse ret. Klingen (8,6) / (Fragm.) lat. inverse steil-ret. Klingen (5%)

Auch diese Arten retuschierter Klingen zeigen große Ähnlichkeiten mit den lateral steil-ret. Klingen und den Stücken mit Glanz. Ihre Kantenretuschierung ist jedoch oft invers.

Gebrauchs- und andere ret. Stücke (28,75%)

(Fragm.) lat. gebrauchsret. Klingen (23,75%) / (Fragm.) lat. gebrauchsret. (Klein-) Abschläge (5%)
Diese Gruppen unterscheiden sich lediglich durch ihre unregelmäßige Retuschierung von den vorgenannten Gruppen; klingenmorphologisch sind die Stücke identisch mit den anderen Klingen. Die Verwendung der Kategorie "gebrauchsretuschiert" ist bekannntermaßen problematisch und wurde auf jene Stücke angewandt, bei denen die Retuschenfolge mit Sicherheit keine Transport- oder Ablagerungsfolgen sind; zweifelhaftes Material wurde ausschließlich in der Statistik der Primärproduktion gezählt.

Diskussion

Die Industrie von Qale Rostam fügt sich in das Bild der Technologien und Gerätemorphologien anderer frühkeramischer Inventare des Zagros. Die Industrien dieser "Initial Village Period" (HOLE 1987) verhalten sich undiagnostisch in Bezug auf akeramische Vorgängerindustrien wie die der Deh Luran- Abfolge. Näher eingrenzende Unterscheidungsmerkmale für Qale Rostam scheinen -bedingt durch die Probengröße- zu fehlen; die Artefaktmenge ist für die bewegte Sedimentmenge und den in Frage kommenden Zeitraum, das erste Viertel des 6. Jts. vergleichsweise gering (siehe auch VOIGT 1983: 219). Auffällig bleibt das Fehlen der mikrolithischen Geräte, die erwartet werden müssen; die geringe Menge von Obsidian mag darin begründet sein, daß Qale Rostam von den Haupttrouten abgelegen ist. Die belegten "Leitfossilien" der "bullet cores" sind wegen ihrer langen Laufzeiten unscharf datierend: Sie sind mit der Bus Mordeh-Phase (um 7500 v.Chr.) belegt und laufen bis in die Sefid-Phase (HOLE 1977), und sie kommen noch vereinzelt in der Surkh- Phase (um 5500) vor. Klingenindustrien mit Glanz sind ein funktionales und kein datierendes Element, das dem "Agro-Standard" der Fundorte zwischen 7500 und 5500 v.Chr. gemein ist. Eventuell ließen sich hier einmal über die Kerntechnologien zeitliche Untergliederungen vornehmen.

Zusammenfassend ist zu sagen, daß die Produktion der Werkzeugrohlinge in Qale Rostam mit dem dort im Sediment natürlich vorhandenen Rohmaterial vorgenommen wurde. Es besteht ein Widerspruch zwischen der schlechten Qualität des hauptsächlich genutzten Rohmaterials und der belegten, kontrollierten Abbautechnik der Klingen (vermutlich durch Druck mit Zwischenstück); dieser Widerspruch wird unterstützt durch das fast völlige Fehlen von Trümmern und Kernfragmenten, die zu erwarten wären. Es ist möglich, daß das Rohmaterial der Artefakte nach Ablagerung bodenchemisch verändert wurde und danach erst diese Splittrigkeit erlangte. Der Werkzeugkasten besteht fast ausschließlich aus retuschierten Klingen, die sich in ihrer Retuschierungart und dem (Nicht-) Vorhandensein von (Sichel-?) Glanz unterscheiden. Charakteristisch sind kantenverrundende steile und kurze Retuschierungen, die formgebend sein können (Abb. 2-6). Der Werkzeugkasten enthält keine Werkzeuge, die auf die Produktion von Gebrauchs- oder Konsumgütern schließen läßt, sondern nur schneidende Geräte, die mit großer Wahrscheinlichkeit im Subsistenzbereich eingesetzt waren. Es ist möglich, daß es sich dabei um Teile von Erntegeräten bzw. -messer handelt, die durch intentionelles "Zubrechen" dafür hergerichtet wurden. Die steile und die inverse Kantenretuschierung, die an einem Teil der Klingengeräte vorhanden sind, können nicht näher interpretiert werden und sind vermutlich als gerätefunktional anzusehen.

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Chipped Neolithic Industries at the Eastern Wing of the Fertile Crescent

(Synthesis Contribution)

Stefan Karol Kozłowski

Introduction

The present article is devoted to the early Holocene (8th-6th millennia bc) chipped industries of greater Mesopotamia, from the Syrian Desert to the Khuzistan Plain. It also presents a more general panorama of a larger area surrounding greater Mesopotamia (Anatolia, Levant, and the Caucaso-Caspian region). This could help to understand local developments, especially when some non-Mesopotamian phenomena appear in our territory.

I had a chance to examine samples from most of the classical sites of the region (original pieces or unpublished drawings). I studied the materials in Jalès (Mureybet, excavations by J. and M.-C. Cauvin), Jerusalem (Gilgal I, excavations by T. Noy), Moesgård (Umm Dabaghiya, Beidha, Guran, Ali Kosh, Ganj Dareh, excavations by D. Kirkbride, P. Mortensen, F. Hole, and P. Smith respectively), Tel Afar and Edinburgh (Qermez Dere and Ginnig, excavations by T. Watkins and S. Campbell respectively). I had access to unpublished drawings by K. Schmidt (Nevalı Çori), A. Betts (Qermez Dere), M. Rosenberg (Hallan Çemi), and P. Mortensen (Tepe Guran). F. Hole showed me the pieces from Ali Kosh. I also received much valuable information from A. Garrard, G. Albrecht, D. Baird, M.-C. Cauvin, H.G. Gebel and A. Gopher. I am very grateful to all the mentioned colleagues for their help.

"Cultural"/Ecological Provinces

The Near East in the Proto-Neolithic and early Neolithic periods could be divided into four distinct provinces. They differ from one another ecologically and "culturally" or stylistically as follows:

1. The Anatolian province (excluding eastern Turkey), rather poorly researched, is characterized by the industry known from Öküzini, Beldibi and Belbaşi near Antalya, as well as by material probably from the lower layers of Aşıklı Höyük (backed points and bladelets, triangles). It stems from the Karain B type Paleolithc industry (ALBRECHT, this volume).

2. The Caucaso-Caspian province extends over large territories north of the Zagros Mountains, including the Caucasus, Crimea and Trans-Caspian. Several industries originate there from the local Upper Paleolithic, changing into the "geometric" units, mostly with trapezes (BADER and TSERETELI 1989).

3. The Levantine province occupies territories from the Sinai to south-eastern Anatolia, including the Syrian Desert as well as parts of northern Iraq (northern Jezira). This is the western wing of the Fertile Crescent. In contrast to the rather stable conditions observed in other provinces, the "cultural" situation

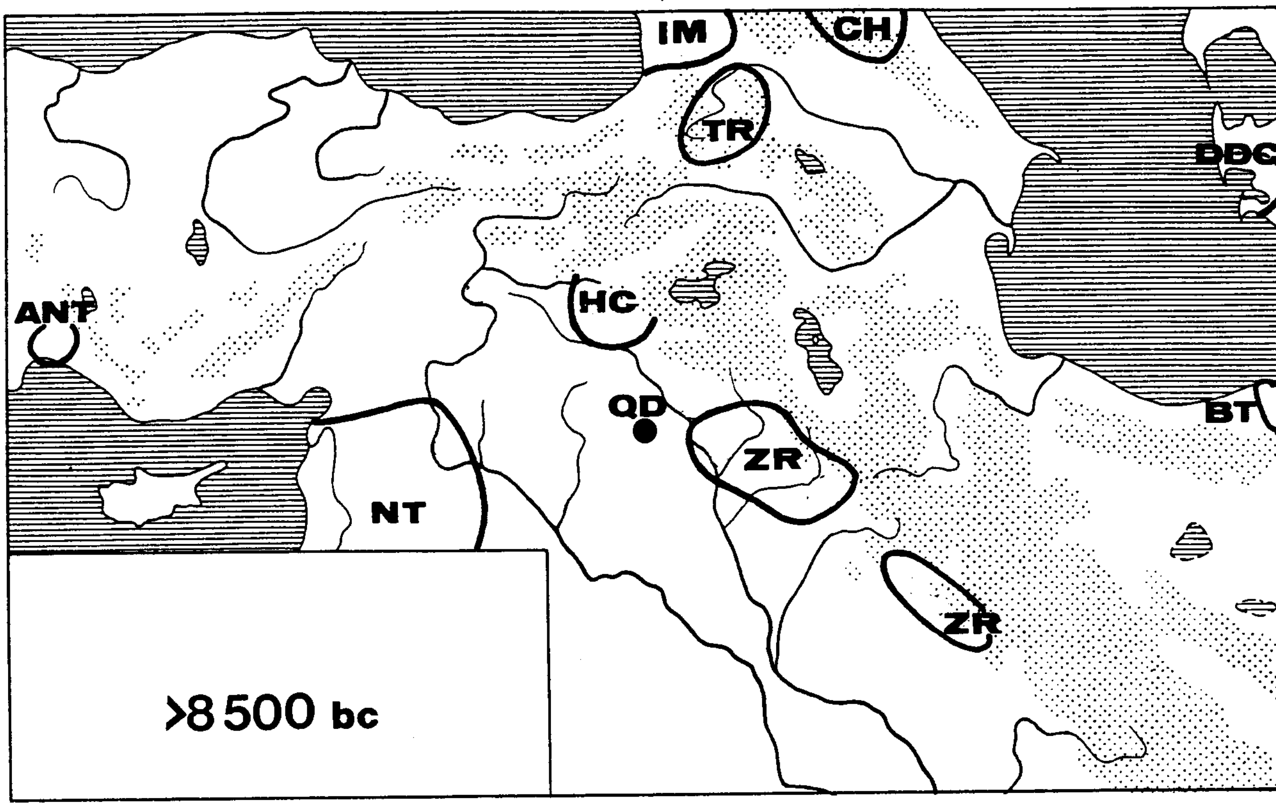

Fig. 1. Local industries around 8.500 bc. (ANT Antalian, NT Natufian, HC Hallan Çemi, QD Qermez Dere, ZR Zarzian, IM Imeretian, TR Triaulian, CH Chokhian, BT Belt Cave , DDC Dam-Dam-Cheshme).

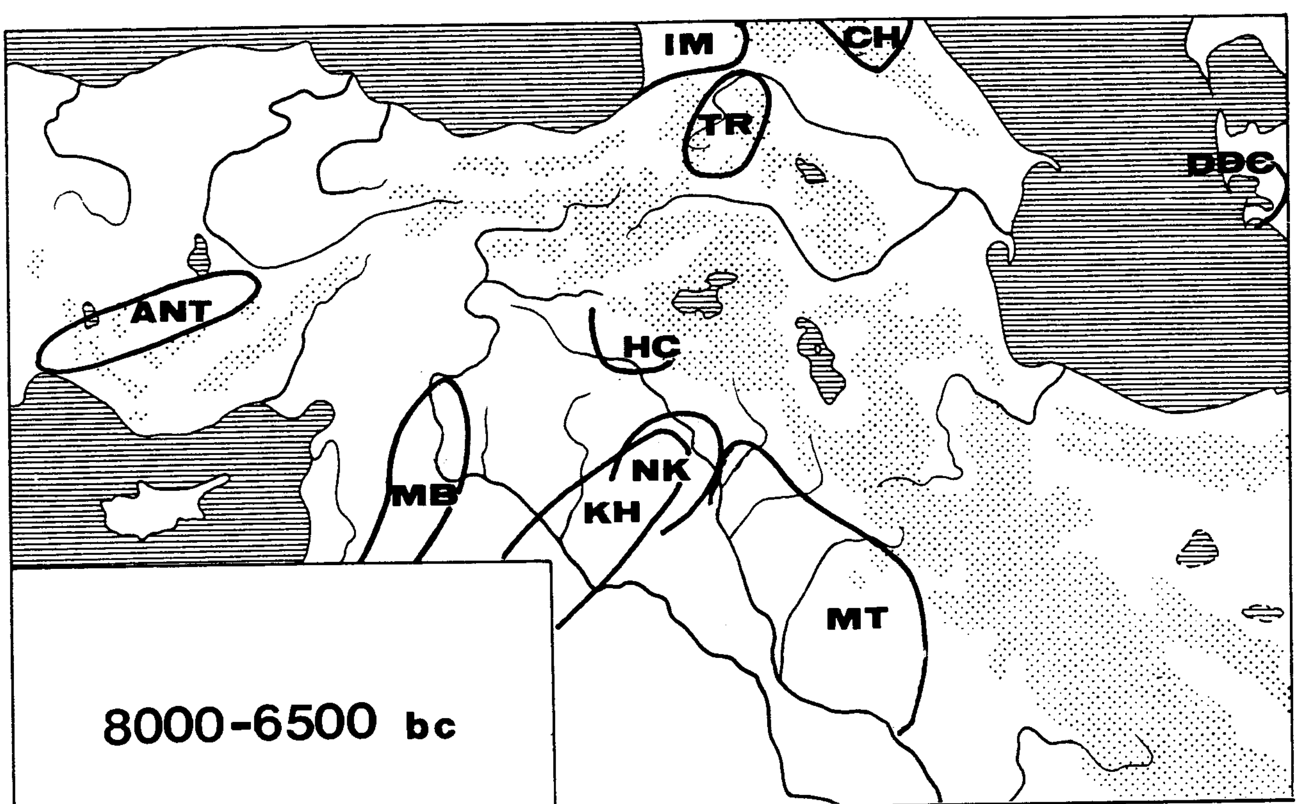

Fig. 2. Local industries between 8.000 and 6.500 bc (MB Mureibetian, NK Nemrikian, MT Mlefatian; *other symbols cf. Fig. 1*).

The large tanged point was introduced (locally differentiated) and accompanied by numerous large sickles. Most of the former features (microliths, characteristic point types, etc.) gradually disappeared, while others (cores, perforators, endscrapers, retouched flakes, and even some point types, like Nemrik points at Telul eth-Thalathat or Umm Dabaghiya) remained in use but were less common. These developments were later accompanied by the first introduction of primitive pottery. It must be stressed that many of the mentioned features (architecture, stone bowls, pottery) also reached the Zagros and the Deh Luran Plain, causing some changes in the local Mlefatian industry (exotic raw materials, broad blades, sickles), where the PPNB culture *per se* did not become established.

Differentiation. The whole PPNB culture split into several distinct zones that coincided with the former pre-PPNB zonation (see above remarks on the Nemrikian and Mlefatian). The western zone covered at least central and eastern Anatolia and northern Syria, while the eastern part extended over northern Mesopotamia.

The Western Zone. According to M.-C. Cauvin (1988), we can distinguish two different industries there. The first exists in the Taurus region Çayönü, Boy Tepe, and Cafer Höyuk), while the second is associated with the southeast Anatolian steppe on the upper Euphrates and in Syria (Nevalı Çori, Gritille, Hayaz, the El-Kowm sites, Buqras, Abu Hureyra, and Ras Shamra).

Differences can be noted in the use of obsidian, which is dominant in the first group and associated with pressure technique. Other differences also occur. For example, there is the absence in some northern sites (Boy Tepe) of naviform cores, and while Çayönü knives are common in the Taurus area, there is a lack of heavy duty tools there. Byblos points, often with covering retouch *en echarpe* occur in the Taurus region but not Amuq points, which exist in the southern area.

All this, although not very precisely elaborated, shows tendencies to local differentiation of the western zone of the PPNB culture. As it was stressed by J. Cauvin and A. Gopher, PPNB developments start earlier in the north (Mureybet III) than in the south and east.

The Eastern Zone (Figs. 16-18). Very poorly studied, the Eastern Zone occupies northern and perhaps central Iraq. Several sites (Magzaliya, Telul eth-Thalathat XVb, Tell Sotto, Umm Dabaghiya I-IV, and possibly KHl Tepe (*cf.* BADER 1989; FUKAI *et al.* 1981; MORTENSEN 1983) maintain single-platform conical cores stemming from the older local tradition. The cores are accompanied by big arrowheads, with characteristic covering retouch, and also by sickles and broad blades, Çayönü tools, backed knives and side-blow flakes. In addition there remain several other elements of local origin, including retouched flakes, geometrics, Nemrik points, endscrapers, perforators, and short tanged arrowheads.

The entire phenomenon is badly dated in Iraq, but it must be rather recent and short-lived, as shown by 6th millennium bc dates and the presence of proto-Hassuna pottery at Umm Dabaghiya, Telul eth-Thalathat and Tell Sotto. It is younger than the Nemrikian and older than the "Agro-Standard" industry (see below). Later evolution led to the full "Agro-Standard" industry, with the disappearance of arrowheads, the full standardization of blades, impoverishment of the tool kit, the domination of sickles, and widespread trade in exotic raw materials.

The Third Major Change: The Agro-Standard Industrial Tradition

This was the last stage of development of chipped industries in the whole region (BRAIDWOOD *et al.* 1952; LLOYD and SAFAR 1945; MORTENSEN 1970; 1973; MERPERT and MUNCHAEV 1981). The industry became fully standardized in the second half of the 6th millennium bc in Mesopotamia at Yarim Tepe I, Matarrah, Sawwan, Hassuna, ceramic Shimshara, and Choga Mami, but slightly later (ca. 4,900 bc) in the Deh Luran Plain at Tepe Sabz.

Even if it had a few locally distinctive features, such as the retention of arrowheads or geometric microliths, the industry was generally the same everywhere. It stemmed from local roots: the PPNB in the west and the Late Mlefatian in the east. The single-platform core technology dominated. Most of production seems to have been done outside villages at flint or obsidian mines and outcrops and in specialized workshops. This could mean that core preparation, core exploitation, and even blade production were specialized activities, with the products available for trade in a market network.

The next step in this evolution is marked by total disappearance of microliths. This "Post-Mlefatian" industry retains the main body of the Mlefatian, but it is dominated by sickles (up to 42% of tools) and has no microliths. It can no longer be called "Mlefatian", since it presents a standardized picture of the well developed chipped industry of farming groups similar to those known earlier from the Mesopotamian Plain (Hassuna, Sawwan, Choga Mami, etc.). Eventually there is an almost complete transformation into a standarized, simplified, and banal "agricultural" industry.

Retouched tools. Fig. 11 shows the indices of three Mlefatian collections according to the list of 13 categories of retouched tools. The curve for M'lefaat and Jarmo is characterized by high peaks of E (retouched blades) and B (retouched flakes), and low values of F (perforators) and K (microliths). It differs slightly but visibly from the curve of the Nemrikian, which has higher values of F and, on average, lower values of E, with J (tanged points) absent in the Mlefatian. The curve of Deh Luran assemblages differs from those of western Mlefatian, and it is strongly dominated by retouched/used blades, while the index of B (retouched flakes) is very low. The difference between the eastern and western versions of the Mlefatian is due rather to local typological preferences than to functional specialization of the sites. At the end of its sequence, Deh Luran approaches western standards (Sefid and Surkh phases) with c. 18% for retouched flakes.

Points/Arrowheads (J) are very rare, occurring only in the west; at M'lefaat (ca 7,800-7,600 bc) they are represented by a few Khiam points. They signify contacts with the western neighbors, either the Khiamian or the Nemrikian.

The Second Major Change and the New Tells

As mentioned above, many settlements of the Iraqo-Iranian province were occupied for a long period, and this led to the formation of tells. The first tells started in the 9th millennium bc (Zawi Chemi, Nemrik, Qermez Dere). These "old tells" were localized at strategic points, mainly near springs and along streams, and occupied for long periods, even 1,000 or 1,500 years before eventual abandonment. This happened around 6,500-6,000 bc when water disappeared from the springs and streams. It was connected, at least in northern Iraq, with strong erosion, which deepened the valleys of big rivers and dessicated small drainages, forcing people to descend from the foothills into the big valleys. People abandoned the traditional settlements such as Nemrik and founded new places on the Mesopotamian Plain at, for example, Telul eth-Talathat, Tell Rimah, Magzaliya, Umm Dabaghiya, Hassuna, and Shimshara. Most of these "new tells" would be occupied until protohistorical or even historical times.

The youngest date at Nemrik for this event is about 6,500 bc. The oldest dates on the new tells cluster around 6,000 bc or slightly later. It could be that socioeconomic factors in addition to ecological changes provoked this change in the relocation of sites.

This was the time of the second major change, the intensification of agriculture, population growth, a great "boom" in trade in lithic raw materials, and perhaps also exchange of highly developed stone bowls manufactured in specialized workshops. All this led in Iraq and Iran (and in other provinces) to new cultural standards after 6,500 bc (see below).

The PPNB Culture, a New Standard

The PPNB was a highly organized new taxonomic unit extending over large territories from the Sinai and Qatar to central Anatolia and northern Mesopotamia, but it did not extend, at least as far as chipped industries go, to the eastern part of the "Eastern Wing" (e.g., Jarmo, Deh Luran). It is characterized by standardized architecture (rectangular houses containing several rooms); village structure (regular plan); well developed, elaborated, and differentiated stone/marble jewelery and bowls that were probably produced in specialized workshops; highly organized and far-reaching acquisition of raw materials for chipping (obsidians, high quality flints), with mines and workshops; and the massive importation of raw materials and broad, regular blades as blanks, knives, or sickles. Both the import of pre-cores/cores and ready-to-use blades was probably practiced (BADER 1989; CAUVIN 1988; 1991; GOPHER 1989; MOORE 1975; MORTENSEN 1983; SCHMIDT 1988).

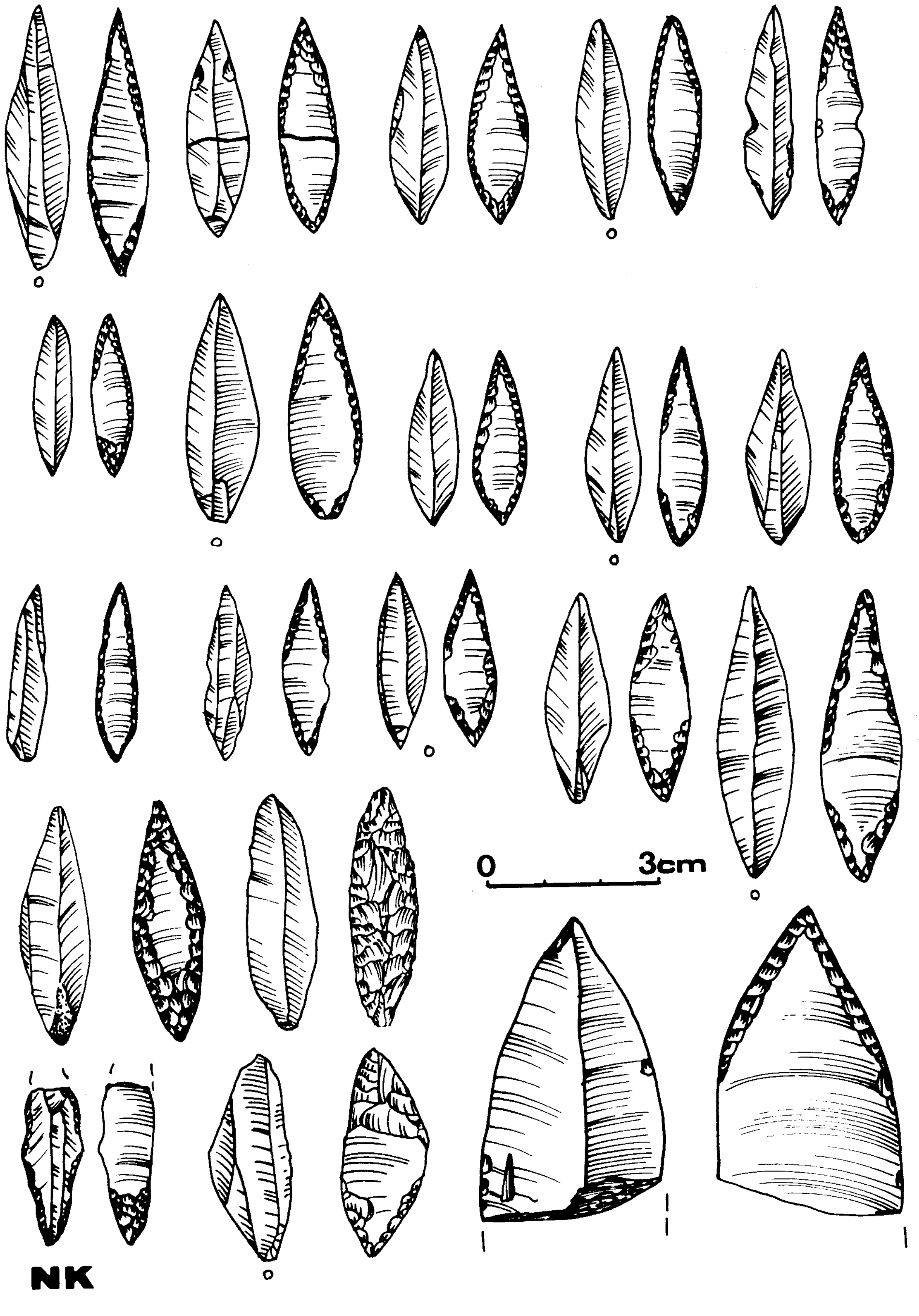

Fig. 15. Nemrik 9: Nemrikian leaf-shaped arrowheads.

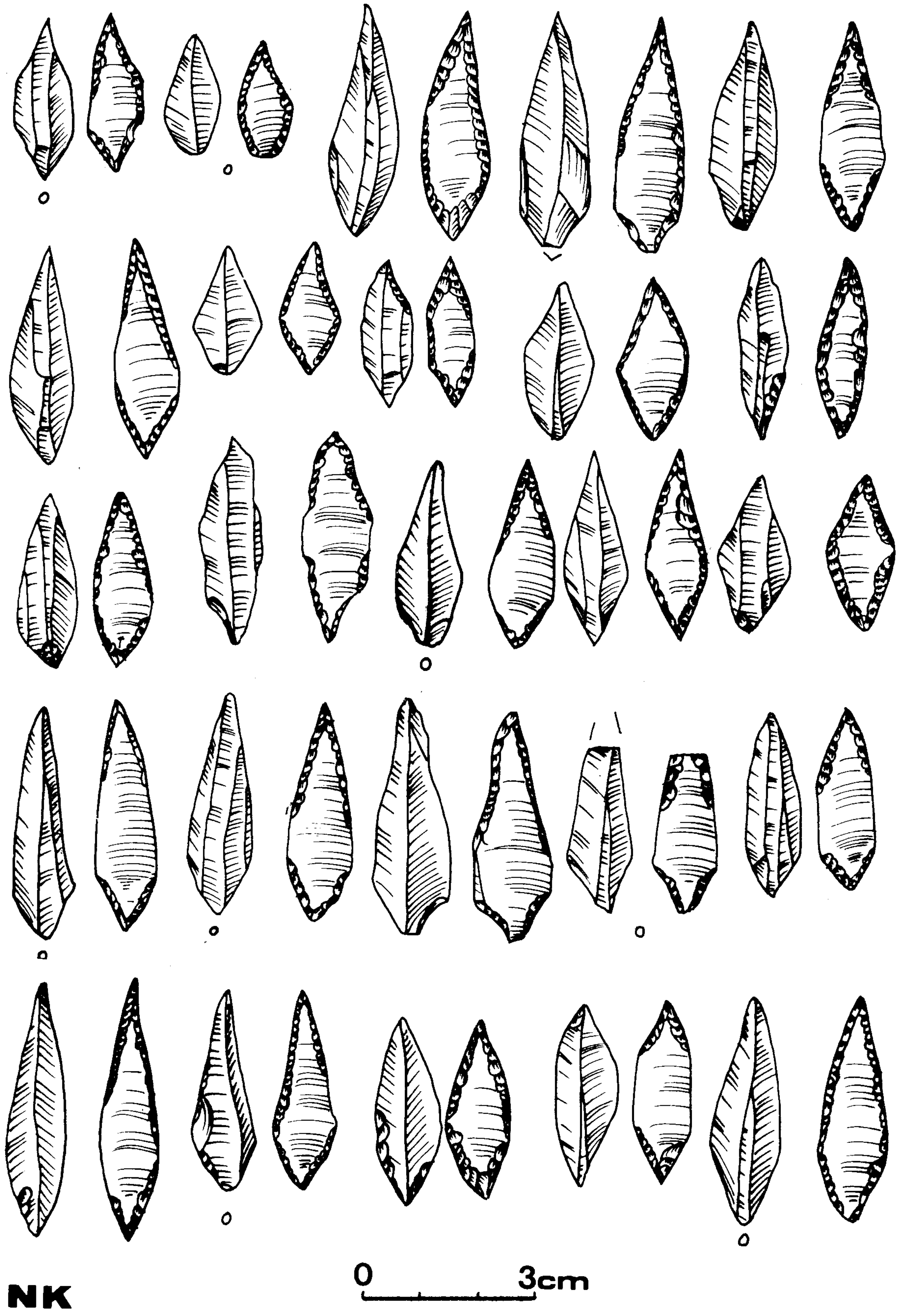

Fig. 14. Nemrik 9, Nemrikian: Nemrik points.

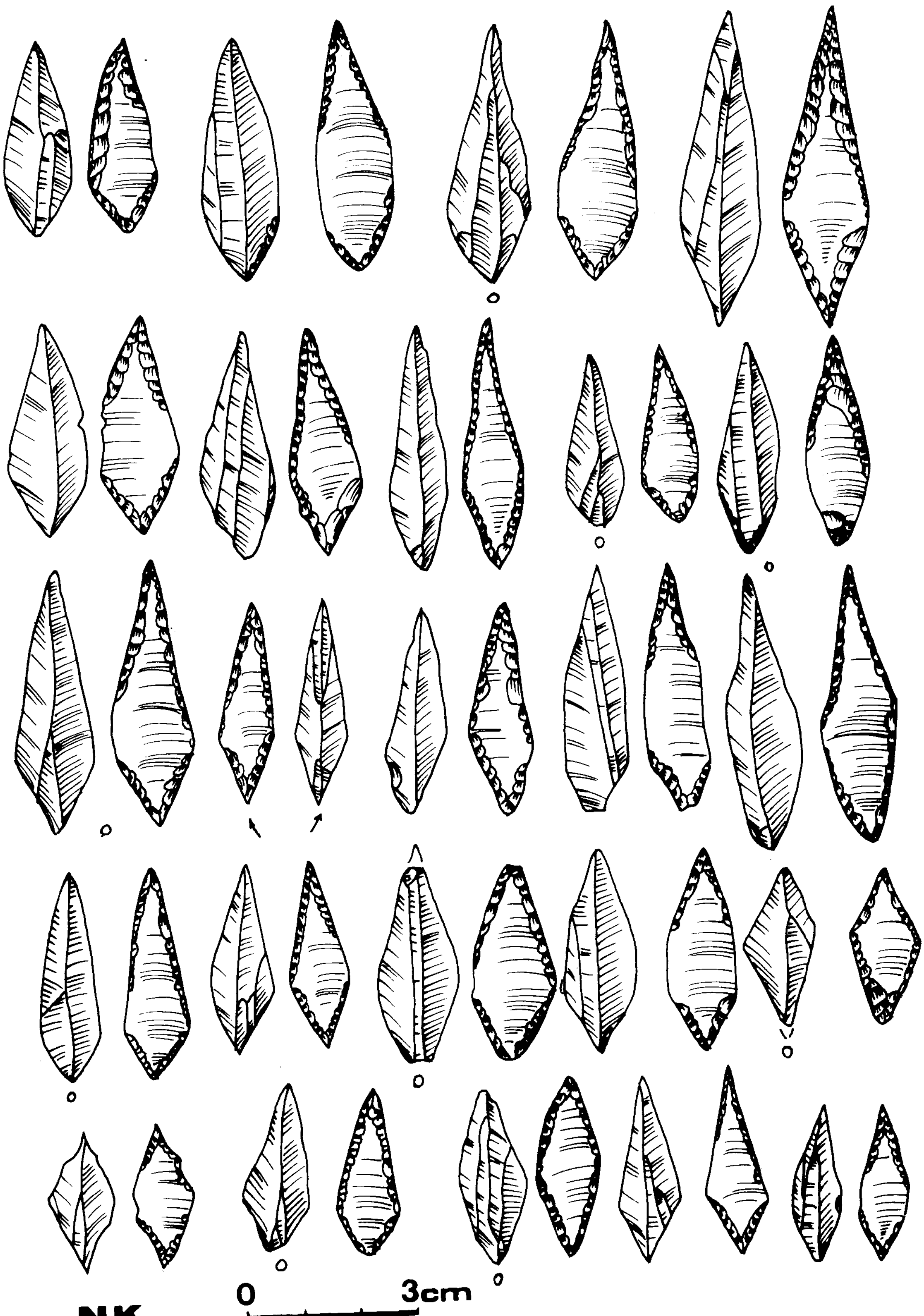

Fig. 13. Nemrik 9, Nemrikian: Nemrik points.

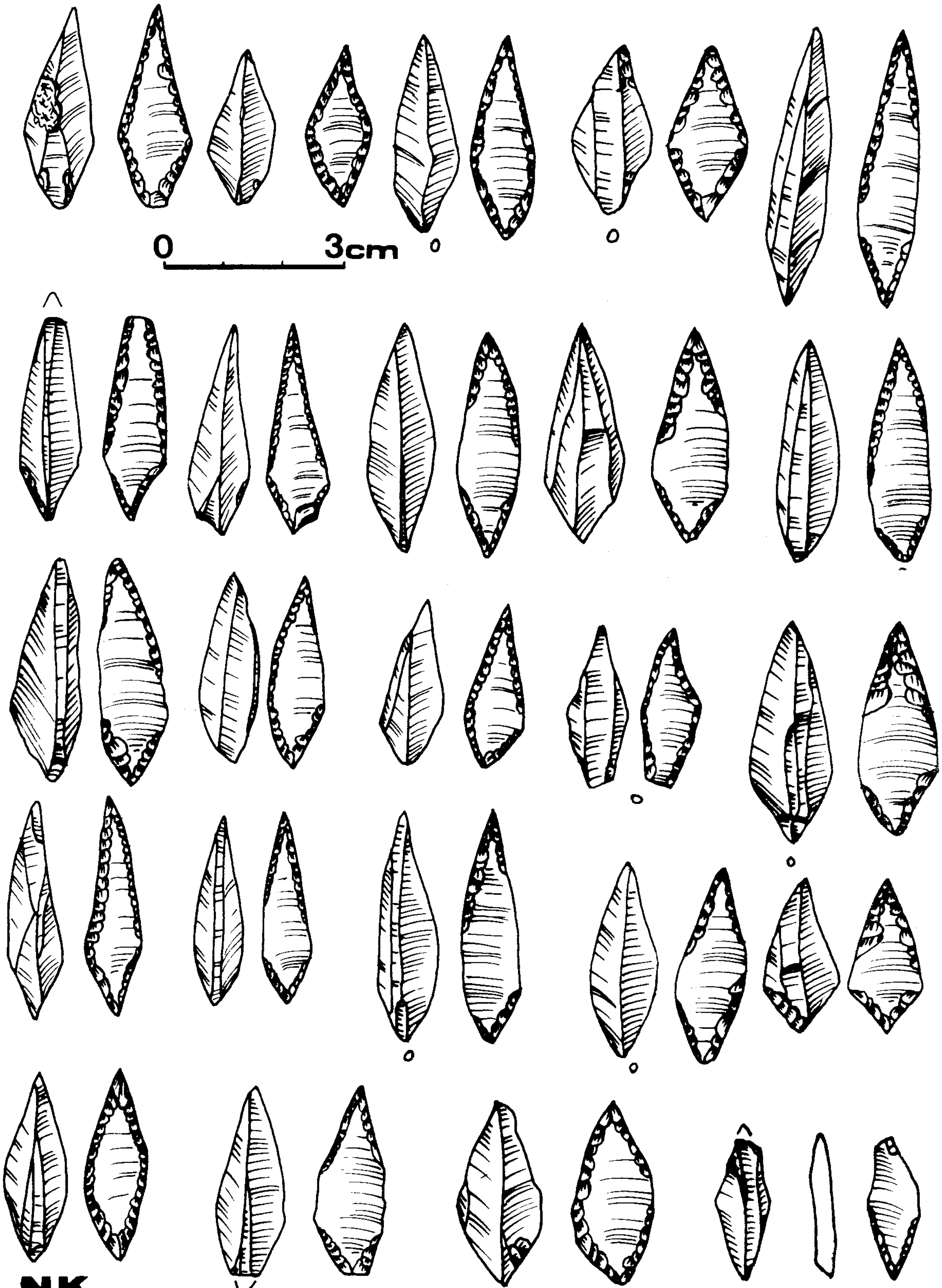

Fig. 12. Nemrik 9, Nemrikian: Nemrik points.

half of sequence (Fig. 20). The Mlefatian persisted longer in the Zagros and the Deh Luran Plain, but it was shorter-lived on the Mesopotamian Plain, where it was replaced by the Agro-Standard tradition, as in the upper layers at Shimshara, Sawwan, Choga Mami, etc. (see below).

The geographical range of the Mlefatian includes the main chain of Zagros in the east, at elevations lower than 1500 m, and the middle Tigris, including the eastern Jezira and the eastern part of the Mesopotamian Plain, plus the Deh Luran Plain. There is a possible extension up to the Euphrates, but there the sites (if they exist) are covered by recent alluvia or younger tells, as was the case with Tell Rimah in the Hamrin Basin.

The main character of the industry is very stable as regards typology and technology, but there is considerable variability when one considers statistical representation (compare the sequences of Jarmo and Deh Luran, Fig. 20).

The first change came at ca. 6,000 bc with the introduction of pottery, stone bracelets, and geometric microliths (*cf.* HOLE, FLANNERY and NEELY 1969; HOLE 1977; 1983). This was followed by an impressive increase of the number of sickles, especially in the Chaga Sefid phase, preceeded by an increase in the numbers of broad (15-20 mm) blades (21% in aceramic, but 51% in ceramic layers in Jarmo; Fig. 20). This phenomenon has an intercultural significance (already noted for the Nemrikian), and it is confirmed by the Tepe Guran sequence (MORTENSEN, personal communication). However, in the mountains, as at Jarmo, an increase in the index of sickles did not follow the increase of the index of broad blades. Locally at Jarmo in the west, the index of imported obsidian increased at the same time from 24-33% (aceramic layers) to 31-50% (ceramic layers) (Fig. 20).

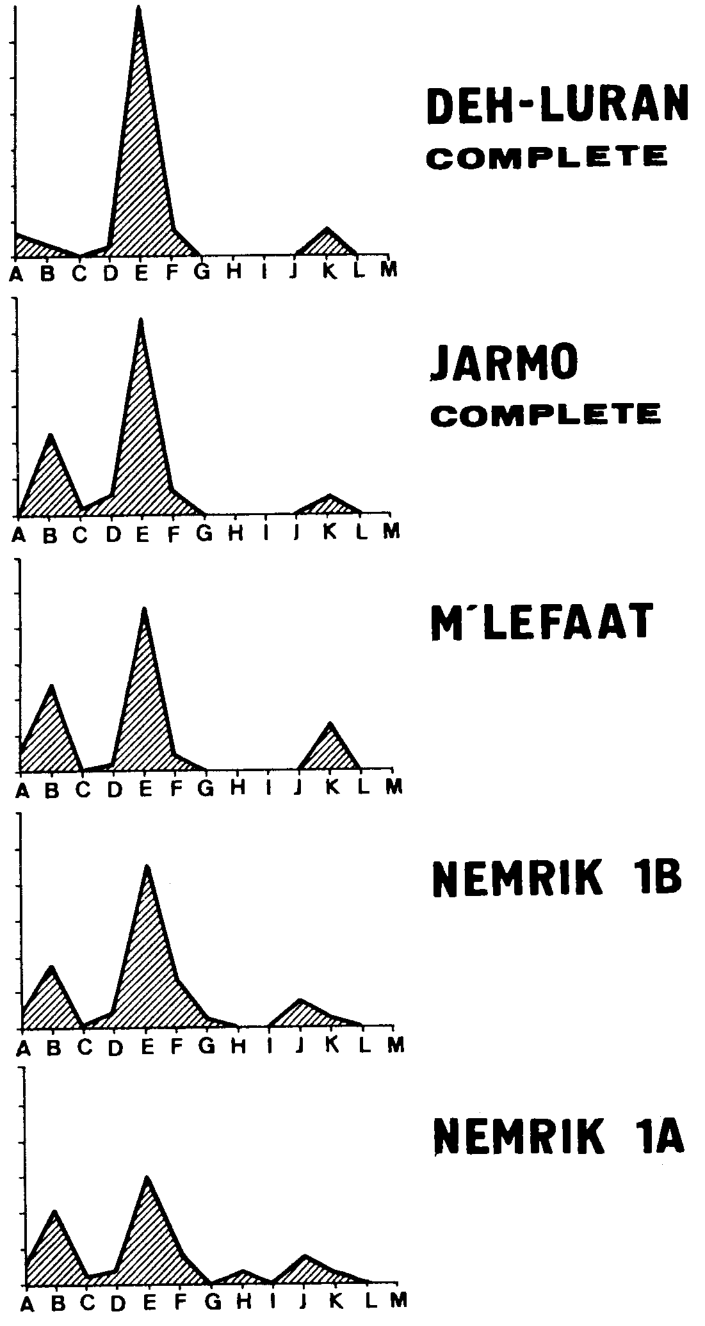

Fig. 11. Iraqo-Iranian province: structure of retouched tools in the M'lefatian and Nemrikian <*after F. Hole and the author*>.

The Nemrikian industry is characterized by a long typological, technological, and statistical stability in the 8th, 7th, and possibly the first half of the 6th millennia bc (*cf.* Nemrik sequence, Fig. 10). The only (and marginal) elements of temporal significance are rare Khiam points in Nemrik 1-3 and Qermez Dere. In the 6th millennium proto-Hassuna pottery was introduced (Telul eth-Thalathat XVI-XV and Ginnig). In Telul eth-Thalathat the pottery accompanied the PPNB standard (large arrowheads, numerous sickles, Çayönü knives, and numerous broad blades made on imported material). The Nemrikian industry eventually disappeared, fully replaced by a standardized PPNB-type industry such as at Magzaliya, Umm Dabaghiya, and perhaps Buqras (Fig. 20).

Retouched tools. The list of 13 categories of "retouched tools" used by the author to characterize the Mesolithic taxnonomic units in Europe (KOZŁOWSKI 1975) shows that the indices of these categories are more or less stable in each unit, and that the curve obtained from this list differs according to different taxa (Fig. 11).

According to this method, the Nemrikian is characterized by the highest (30-45%) index of retouched or utilized blades (E), followed by retouched flakes (B=20%) and perforators (F=10-15%), and then a few tanged points (J), microliths (K) and macroliths (H). These figures repeat over the entire sequence of Nemrik with only minor and insignificant fluctuations (Fig. 20). The Nemrikian curve differs from that of the Mlefatian (*cf.* Fig. 11), which has a higher index of retouched blades (E) and does not contain tanged points (J) and macroliths (H). Finally, the index of retouched flakes (B) is lower in the Mlefatian then in the Nemrikian.

H. Heavy duty tools (Fig. 6) are rare, but nevertheless they exist in the whole sequence of Nemrik, amounting to 1.0-3.5% of tools. They are mostly picks with triangular or polygonal cross sections; axes/adzes are very rare. This group of tools is well known from the Levant (axes, adzes, *herminettes* etc.) but not elsewhere from the east. This suggests western ties for the Nemrikian heavy duty component (see remarks on points below).

K. Points/arrowheads account for 8% of the tool finds and are represented by two classes: tanged points (Figs. 12-15) and Khiam points (Fig. 7). The first class predominates (>95%), and is very characteristic for the Nemrikian. Small rhomboidal Nemrik points (Figs. 12-14) are the most numerous type. They bear ventral semisteep retouch of both ends, and only a few pieces have dorsal retouch near the base. A few pieces (< 5%) have flat covering retouch. Nemrik points are accompanied by less numerous leaf-shaped points (Fig. 15). Points with a pronounced tang are very rare and probably do not belong to the Nemrikian tradition; perhaps they are associated with the Mureybetian tradition. A few specimens similar to the Nemrik points are known from Mureybet (CAUVIN 1978), Sheikh Hassan, Nevalı Çori and Buqras. This could suggest some western ties of the Nemrikian.

The second class of points is represented by Khiam points and is associated with the early Nemrikian (Fig. 10). They are more numerous in Qermez Dere and could also be proof of contacts with the Levantine tradition.

The Mlefatian Industry

The Mlefatian industry includes the "Jarmoan" industry (HOLE 1983) and exists in the "Zagros Group" (MORTENSEN 1964). In Iraq this industry is found at M'lefaat, Jarmo, Palegawra (upper layers), Tamerkhan, part of Karim Shahir, and Rimah. In Iran sites include Ali Kosh, Chaga Sefid, Sarab, Asiab, Ganj Dareh, and the lower and middle layeres at Tepe Guran (DITTEMORE 1983; HOLE 1961; 1977; 1983; HOLE, FLANNERY and NEELY 1969; KOZŁOWSKI, in press).

Although it is easy to demonstrate a long local development of the "Mlefatian" industrial tradition, I arbitrarily limit the "Mlefatian" to the horizons with microliths (equivalent to Hole's Bus Mordeh to Sabz phases). Most of the sites are multilayered and present long stratigraphic sequences of the same industry.

Altogether almost 70 C-14 dates (KOZŁOWSKI 1993; HOLE 1987) show that the Mlefatian spans the first half of the 8th millennium (Bus Mordeh phase) until the first quarter of the 5th (Sabz phase). There are several typological indicators, including Khiam points in M'lefaat, ceramics in the later stages, a locally growing index of obsidian, and the appearance of broad geometrics in the second good quality materials that could produce a blade of the needed morphometry, such as "chocolate" flint (*cf.* Figs. 5 and 8) and the "blackish" flint in the older sites of Nemrik and Qermez Dere. All this coincides well with increased numbers of Variety C (large) blade cores in the younger part of the Deh Luran sequence, proved by the presence of some big cores in Jarmo and similar specimens made of allochthonous material in the Ali Kosh phase at Ali Kosh (*cf.* CAUVIN 1991a; HOLE, FLANNERY and NEELY 1969; KOZŁOWSKI and SZYMCZAK 1992; RENFREW 1977; WATKINS *et al.* 1991; KOZŁOWSKI, in press). The proportions of imported raw material increase steadily (Fig. 20).

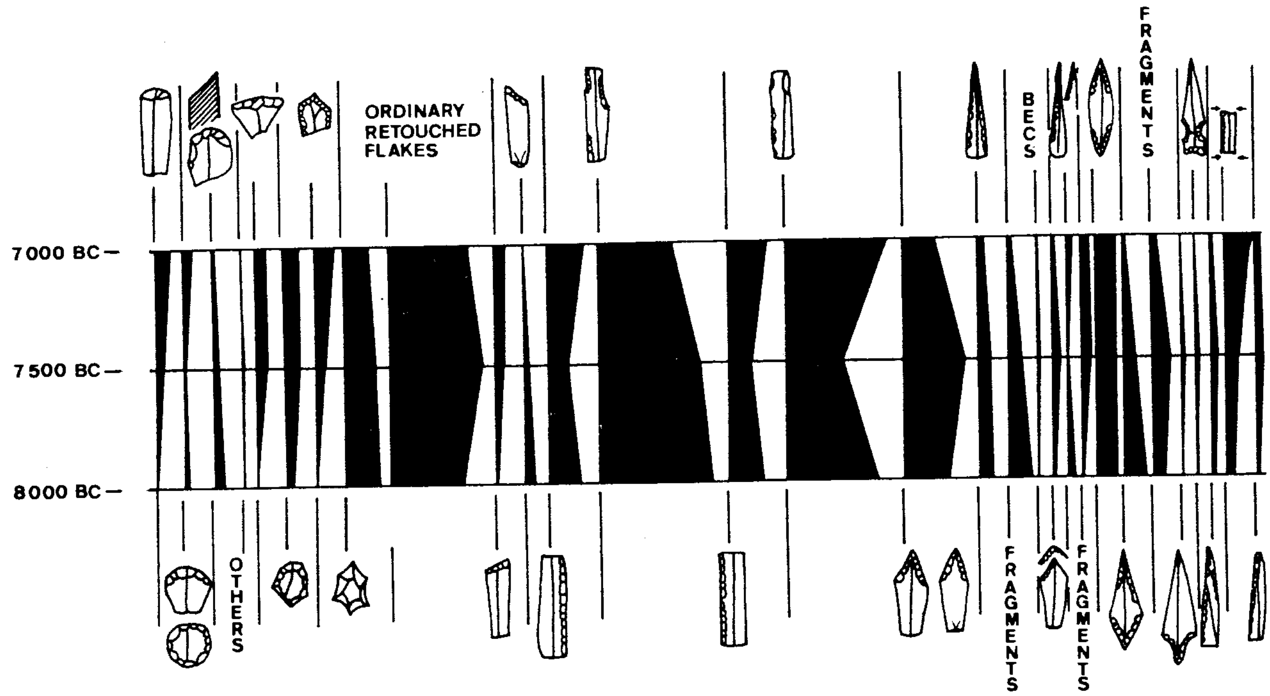

Fig. 10. Nemrik 9. Nemrikian retouched tools from 1st, 3rd and 4th phase.

Finally, a few words on the importation of blades. The figures shown in Table II (blade:core ratio) on some sites, especially Jarmo (upper layers), show a strong predominance of blades/bladelets compared to the cores for their production. This means that not only large blades could be imported, but also standard bladelets.

The Nemrikian Industry

The Nemrikian Industry occurs in northern Iraq at sites such as Nemrik 9 (phases 1-5), Qermez Dere (upper layers), Ginnig, Baqaq, and Telul eth-Talathat XVI (*cf.* CAMPBELL and BAIRD 1990; FUKAI *et al.* 1981; KOZŁOWSKI and SZYMCZAK 1990; 1992; WATKINS *et al.* 1989). The first three sites contain long sequences of this industry. Isolated Nemrik points also appear in other areas or in later contexts, such as at Buqras (?), Nevalı Çori, Mureybet III, Sheikh Hassan, Magzaliya, and Umm Dabaghiya.

Chronlogically, the industry covers a period from the end of the 9th or beginning of the 8th to the first half of 6th millennia bc, as reflected by 90 ^{14}C-dates (KOZŁOWSKI 1993) and supported by several good typological indicators, such as Khiam points in Nemrik 1-3 and Qermez Dere, early ceramics in Telul eth-Thalathat and Ginnig, and abundant obsidian in Telul eth-Thalathat.

The territory of the Nemrikian ranges over the Jezira between Jebel Sinjar and the foothills of the Kurdish mountains, across the basin of the upper middle Tigris and possibly into eastern Syria. Buqras, with its single platform cores and Nemrik point could be also a descendant of the Nemrikian tradition.

M. Other tools. Rare broad (15-27 mm) blades (Fig. 9) with lateral retouch or retouched truncations are mostly made of imported raw material ("chocolate" flint, blackish flint, or obsidian), and often bear gloss. They could be called "sickles". (CAMPBELL and BAIRD 1990; DITTEMORE 1983; HOLE 1961; 1977; 1983; HOLE, FLANNERY and NEELY 1969; KOZŁOWSKI and SZYMCZAK 1990; 1992; WATKINS *et al.* 1991; KOZŁOWSKI, in press).

General Technological Structure The general technological structure of the sites shown in Table I is rather homogeneous. Flakes from core preparation and reparation predominate over blades, but in one case (Jarmo) blades are as numerous. The described structure is typical for "home" sites (base camps or villages), where the whole chipping process (core preparation, core exploitation, core reparation, tool preparation) took place. The case at Jarmo could suggest a preparation of certain cores outside the village and even the production of most of the blades in special off-site workshops. This interpretation is supported by the extremely high blade:core ratio at Jarmo (Table II).

Table I. General technological structure (percentages after Hole, Watkins, Baird, and the author).

	cores	*flakes + core fragm.*	*unret. blades*	*ret. tools*
Jarmo (total) (no 106.882)	0.4	48.0	41.7	9.8
Deh Luran BM+AK+MJ (no 71040)	1.5	93.7	4.1	0.7
Mlefaat, House 3	1.1	62.3	29.3	7.2
Nemrik, first season (no 7574)	3.0	79.3	9.5	8.1
Nemrik, House 1B	3.4	62.0	21.9	12.7
Nemrik, House 1A, floor	1.0	61.2	27.5	10.0
Ginnig	0.1	59.0	11.0	25.0
Qermez Dere, Layer 3	0.7	79.0	13.0	7.0

Table II. Blade to core ratio (after Hole, Betts, Baird, and the author).

	blade cores + fragments of cores	*unretouched blades*	*no of blades per 1 core*
Jarmo (total)	104	44,556	428.4
Deh Luran BM+AK+MJ	812	2,929	3.6
Nemrik, first season	233	719	3.1
Nemrik, House 1B	40	257	6.4
Nemrik, House 1A,floor	11	290	26.3
Qermez Dere, Layer 3	46	900	19.0
Ginnig	10	84	8.4

Raw materials. Local flint, chert, or radiolarite were mostly used and worked in the "home" sites. But even at the beginning of the Holocene sequence some special products were made outside villages in special workshops. Imported obsidian from Nemrud Dağ and "Source 1g" appears (no more than 5-8%, normally <1-2%) at Ali-Kosh, Chaga Sefid, Nemrik, and M'lefaat, for example. Later in the west (after 6,500 bc) at Jarmo and Telul eth-Thalathat, more substantial use of these resources is noted (30-50%). It was used mainly to produce large blades. Similar large blades (but not made of obsidian) appear simultaneously in the east, serving mostly as sickles. Their number grows following that time (Fig. 20). Some or all of the large blades, as well as the large cores for their production, were produced in specialized workshops and traded over long distances. This is true not only of obsidian but also of other

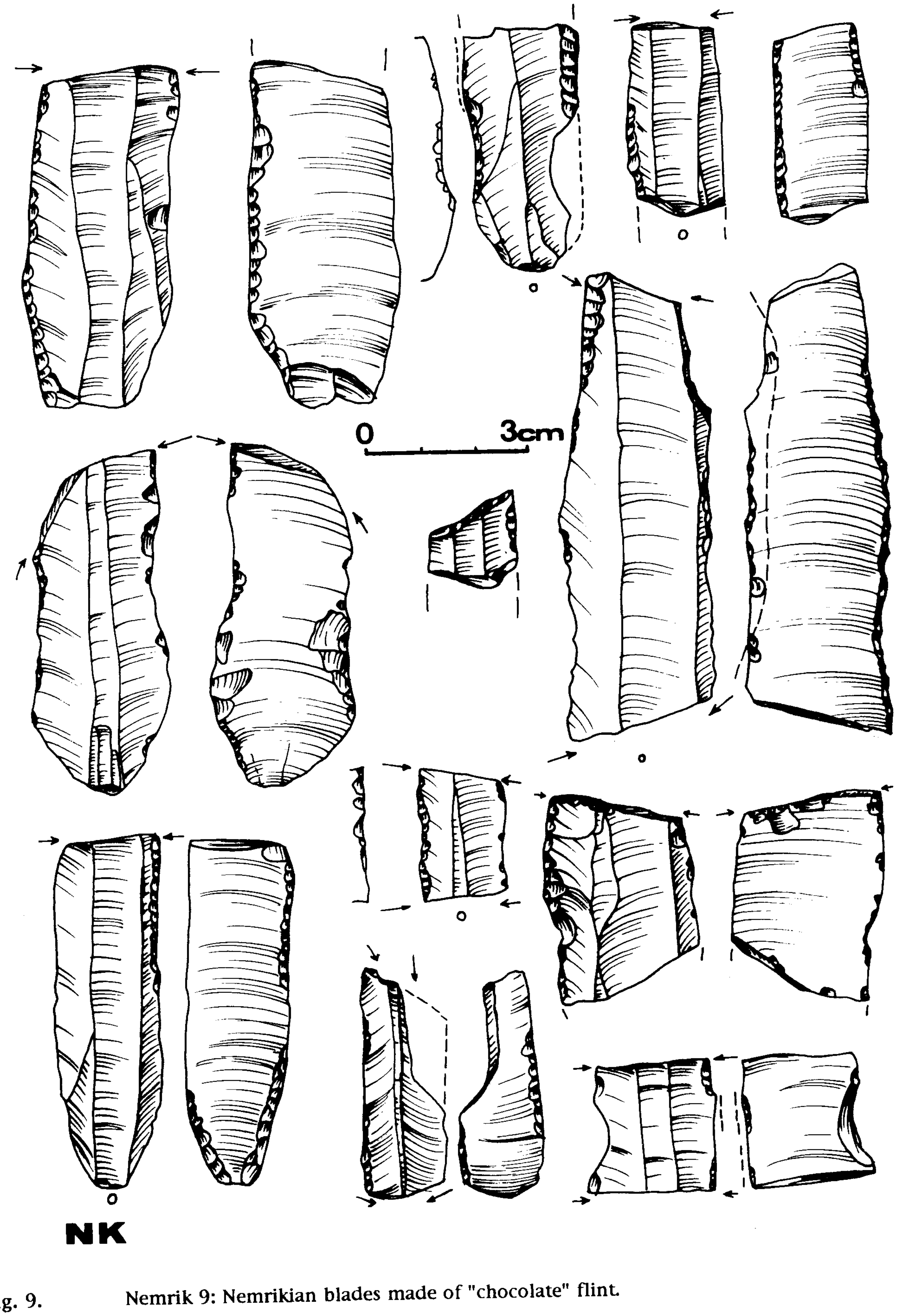

Fig. 9. Nemrik 9: Nemrikian blades made of "chocolate" flint.

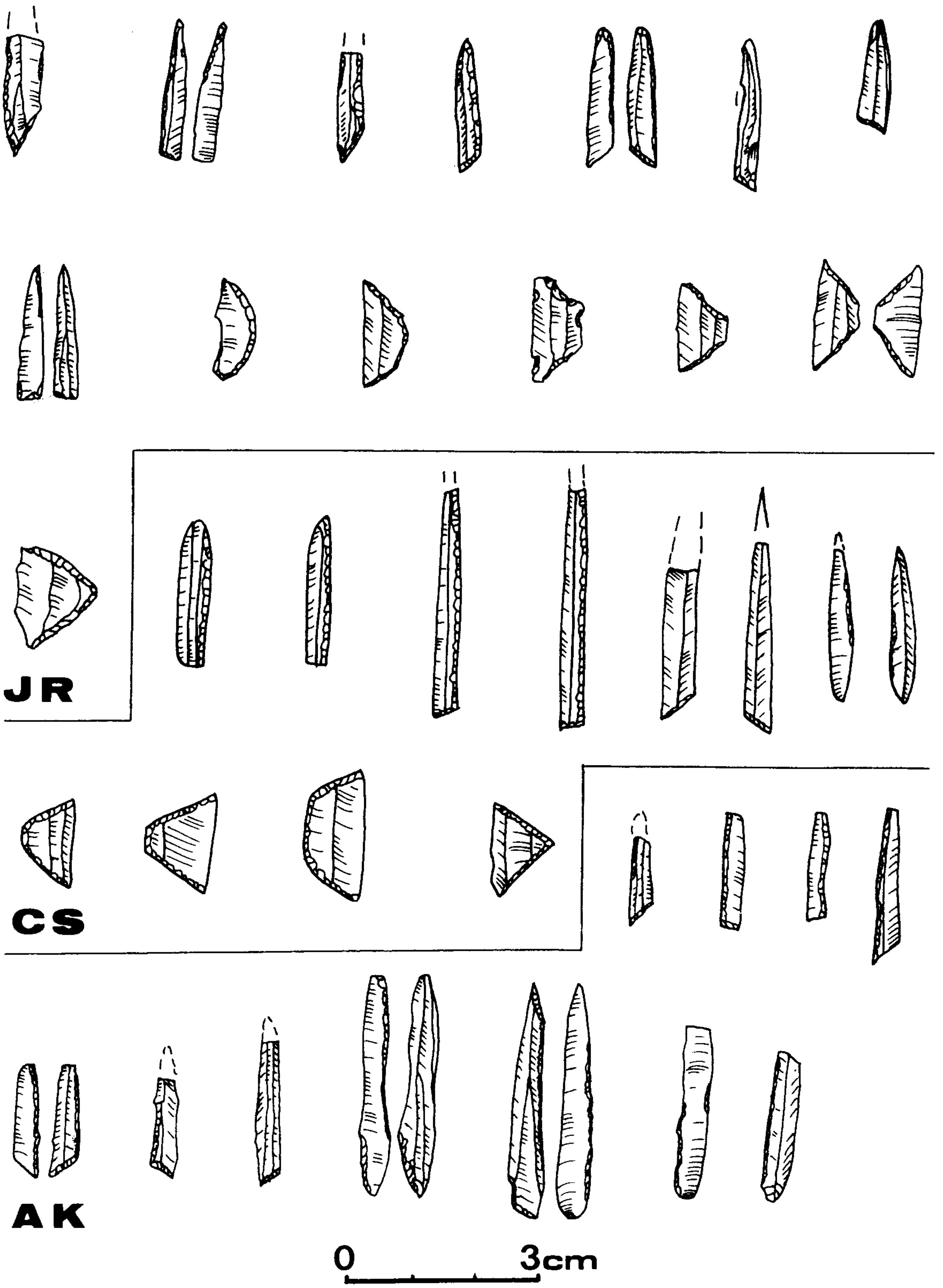

Fig. 8. Jarmo, Chaga Sefid and AliKosh: Mlefiatian backed pieces and geometrics *(after F. Hole).*

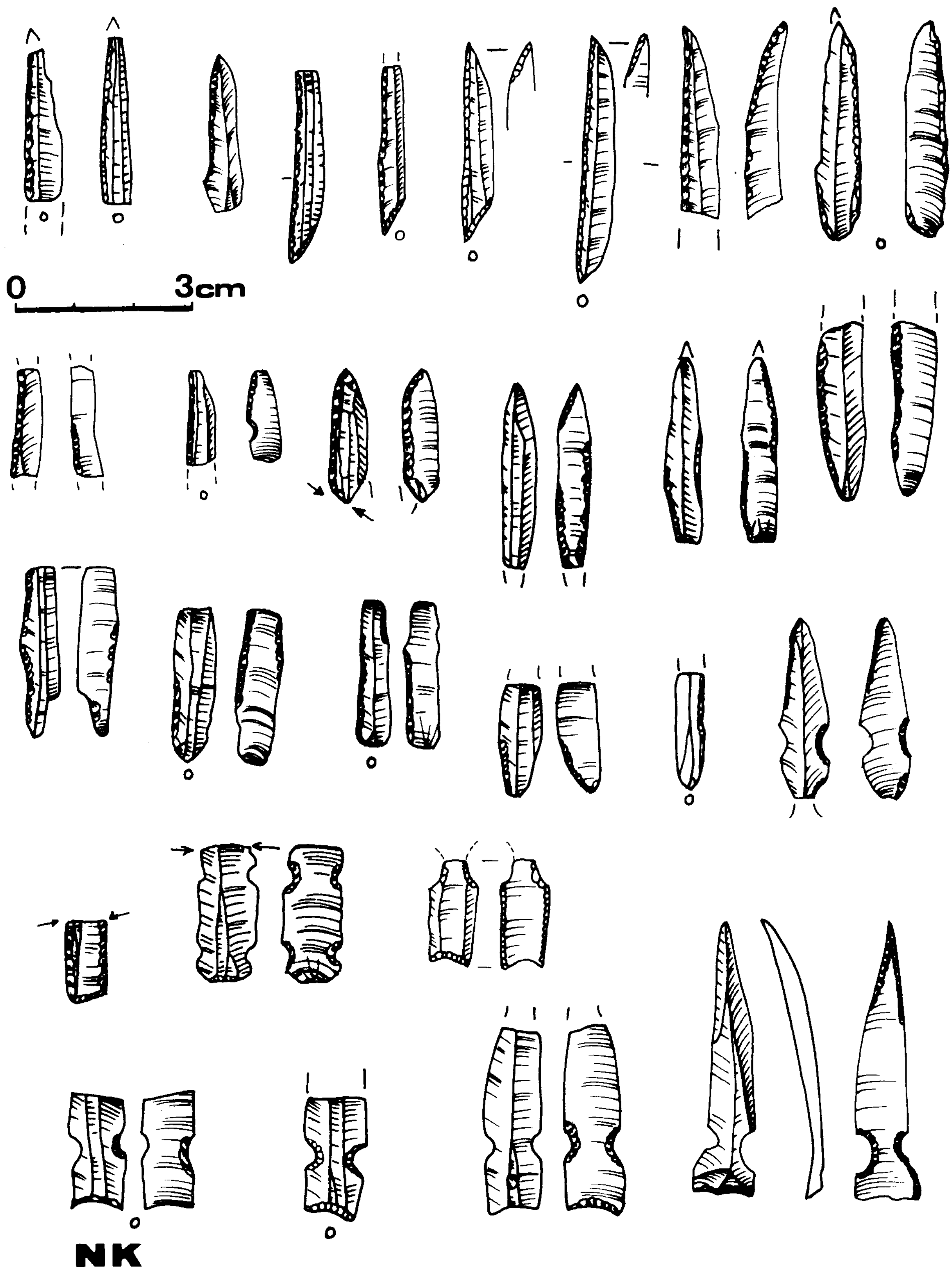

Fig. 7. Nemrik 9: Nemrikian backed pieces and Khiam points.

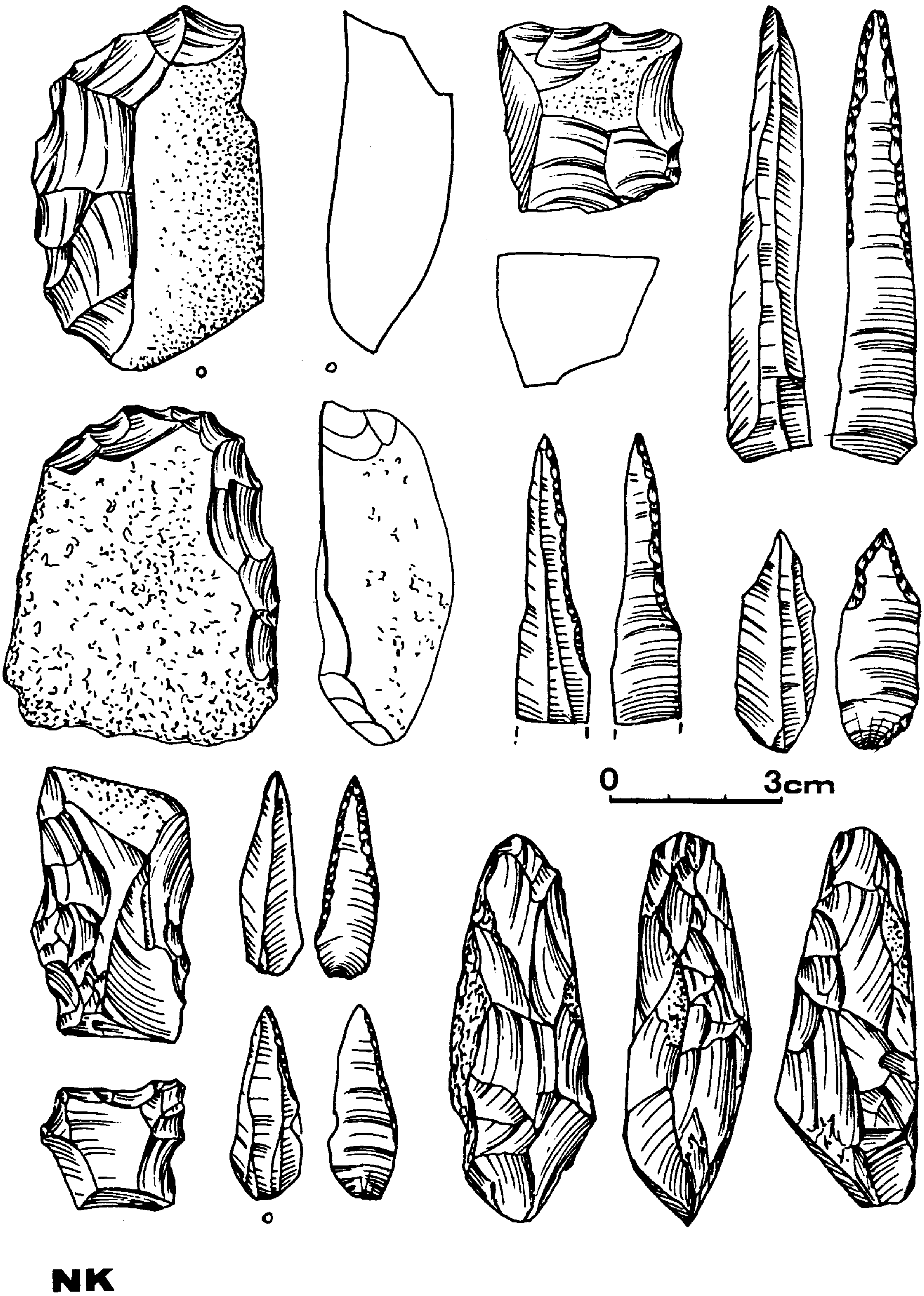

Fig. 6. Nemrik 9: Nemrikian denticulated scrapers, borers, pick.

1983; HOLE 1961; 1969; 1977; 1983; KOZŁOWSKI and SZYMCZAK 1990; 1992; KOZŁOWSKI, in press).

Most of the tools in the following standard are small or medium-sized, closer to the Mureybet II than to the Mureybet III standard:

A. Endscrapers (Figs. 10, 11) are made on blades or flakes. One group includes elongated specimens with one or two arched fronts; they are accompanied by short and very short (1:1 ratio) endscrapers, mostly flake specimens, as well as by pieces made on thick flakes.

B. Retouched flakes (Figs. 6,10,11) are more numerous in the west (e.g., in the Nemrikian industry, but also at Jarmo) than in the east. They include sidescrapers, *skrobaczes* (endscraper retouch on pieces of irregular shape), raclettes, and especially massive denticulates and amorphic flakes with use retouch.

C. Burins, dihedral or on retouched truncations, are very rare.

D. Retouched truncations (Fig. 10) usually occur on blades with retouch on one end. Larger specimens of this class are interpreted as sickles due to visible gloss.

E. Retouched blades/bladelets with use retouch (Fig. 10) make up a very important and numerous group (Fig. 11) in the Nemrikian, attaining the highest indices among "retouched tools" (even 50% !). Most of them are not intentionally retouched, bearing only "use retouch". Most of the retouched blades follow the width standard of the bladelets, but some pieces greatly exceed it, attaining 15-27 mm (*cf.* Class 5, Figs. 5,9). Many of them are sectioned, and a few (also some unretouched) have gloss on one or both edges. Retouched blades can be subdivided as follows:
1. specimens with continuous retouch ("knives") covering at least two thirds of one of the edges, usually on the dorsal face, uni- or bilateral, sometimes with alternate retouch or notches.
2. blades with retouch on dorsal (rarely ventral) face. This retouch reaches up to 60% of the length of specimens.
3. microretouched blades, uni- or bilateral.
4. blades with traces of retouch (mostly use retouch).
5. sickles are pieces either retouched as in classes 1-4 above, or unretouched, that bear gloss. (Also see Group M below).

F. Perforators (Fig. 6). This is a large and diversified group of tools. They are classified according the tip treatment (one or two faces, ventral or dorsal retouch) as well as the tip form (distinct/not distinct). Single-faced perforators are predominant (about 70%) and can be subdivided into long and short specimens. Borers (alternate retouch) are also either long or short, and becks (single-faced but with strong tip) are rare.

K. Microliths (Figs. 7,8). Microlith indices differ slightly depending on regions or industries. But these differences can also result from the method of sampling. They number ca. 13% in M'lefaat (sieved) but only 3-8% in the other sites (e.g. Nemrik, not sieved). In the East (Deh Luran) they are generally smaller (Fig. 8), possibly due to the smaller average size of the original bladelets in this region than those from Jarmo or Nemrik (HOLE, personal communication). Two subgroups can be distinguished here: elongated microliths (Fig. 7) and broad microliths (Fig. 8, second row).

The first group is common for the Mlefatian and Nemrikian. It includes delicate backed bladelets with straight or slightly arched (complete or incomplete) backing and straight backed bladelets combined with a retouched base (perpendicular as "rectangles" and obtuse as "triangles"). Some of them have alternate retouch. There are also two triangular points in M'lefaat that fit well in the Mlefatian tradition (combination of backing and retouched truncation). To the same group belong backed bladelets with obliquely retouched truncation on one (e.g., in Guran) or both ends. Finally, there are "diagonal" pieces, without backing but with an obliquely retouched base. Other elements of this subgroup are "nibbled bladelets", some of which could be classified as "flèchettes".

The broad geometric microliths appear only in the early ceramic or late aceramic phases. They are represented by a few broad lunates/segments, symmetrical trapezes (some of them are close to broad segments), and broad, short isoscele triangles. They could be proof of influences crossing the Zagros chain from the north.

and a very original industry, characterized especially by geometrics, mostly different trapezes and backed and truncated pieces (ROSENBERG, this volume). This is very similar to what we know from the Caucaso-Caspian province.

The oldest layers at Çayönü date to about 7400 bc; circular dwelling structures are known from this phase. The chipped industry (*cf.* CANEVA, this volume) has no tanged points or microliths, imported materials are present, and the size of the pieces is considerable. The naviform core is very rare (M.-C. CAUVIN, personal communication). But most important are the points with concave bases similar to those from the Mureybetian of Syria. This could signify close connections of the northern part of the Levantine province with the upper Euphrates basin. Similar points occur in the PPNB industry at Nevalı Çori (SCHMIDT, this volume).

Iraqo-Iranian province (Figs. 2,16)

The two early industries (Mlefatian and Nemrikian, Figs. 4-15) stem from the Zarzian, which was transformed by the new single-platform bladelet core technology. The Nemrikian additionally has some elements common in industries to the west, including tanged points and macrolithic tools (Figs. 6,12-15). Both industries share many features, which constitute the local tool standard (general technological structure; core technology; blanks; and several tool groups, including endscrapers, retouched flakes, retouched truncations, retouched blades, perforators and microliths).

The Iraqo-Iranian Techno-typological Standard. The single- platform conical/subconical core was preformed (Fig. 4) by the trimming of the edges, then the striking platform was formed, with subsequent use of the punch technique and at the final stage by the pressure technique. They were often repaired or rejuvenated, resulting finally as discarded "bullet cores".

Two products came from these cores: very regular blades and bladelets as the main products and flakes from core formation. Other cores - multiplatform and discoidal - are rare. Bladelets are very small, regular (straight parallel edges), and elongated (length: width ratio 3:1); blades are bigger and less regular (Fig. 5). Some of the blades and bladelets served as blanks for retouched tools (ret. blades, truncations, sickles, end-scrapers, microliths, points), but most of them were used un-retouched, acquiring gloss during use (sickles), or "use retouch" (mostly "retouched blades"), or microwear. Even if not retouched, many of these blades were altered by breaking (sectioning); standardized rectangular medial sections of bladelets (serving as inserts?) are very common.

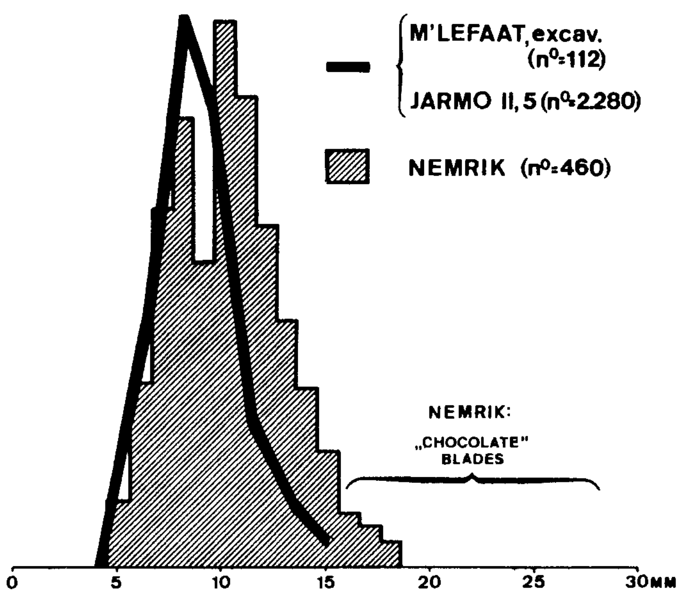

Fig.5. Iraqo-Iranian province: width of blades in Nemrikian and M'lefatian and of "chocolate" blades from Nemrik.

Flakes were mostly the waste of core preparation, especially cortical specimens, but some of them (e.g., massive flakes for denticulates, *cf.* Fig. 6) could have come from special cores. Core trimming and rejuvenation elements are present at all sites.

Retouched tools (Figs. 6-8,11). Most of the retouched tools are common for the early industries of the Iraqo-Iranian province. The specimens which are restricted regionally are presented below in the separate sections devoted to individual industries (*cf.* CAMPBELL and BAIRD 1990; DITTEMORE

The First Major Change: New Tool Standards

All the information gathered above leads to the following observations:

1. Each province has its own "cultural" or taxonomic character.

2. Each presents a local, slow, and consistent development of the Upper Paleolithic "Gravettoid" industries.

3. At the end of the Pleistocene, the whole region was overrun by a "fashion" or "intercultural trend" that introduced regionally emphasized types of points: lunates, triangles, double truncations, and others. This led to the formation of different regional taxonomic units (Fig. 2).

4. At the Pleistocene/Holocene boundary, new technologies were introduced and new types of cores appeared, at least in some regions. This led to the first big change and a new standard of tools. The new standard stemmed from a regular pre-formed core which yielded a regular and standardized blade or bladelet, being tool-ready (knife or sickle) or serving as a standardized blank (CALLEY 1986; HOLE, FLANNERY AND NEELY 1969; KOZŁOWSKI and SZYMCZAK 1990) for standardized tools. This blade/bladelet was often sectioned (intentionally broken); it was produced by the punch and/or pressure technique. Most were retouched blades and perforators; other retouched pieces represent the old heritage (backed microliths, scrapers) mostly reduced in size, or had only (at least at that time) a local significance (tanged points, Khiam points, Nemrik points, heavy duty tools).

Early Holocene Industries

The Levantine Province

The "classical" sequence of the Levantine province (Natufian - Khiamian/Sultanian - Tahunian, or Proto-Neolithic - PPNA - PPNB), has only regional value. I will not describe it here. But the development in the northern part of the province differs from the "classical" one, and this will be described.

Khiamian/ Sultanian. This industry of the Levantine type is present in phases 7-5 of Qermez Dere. A few Khiam elements are also known from Mureybet II-IV (Fig. 3), Nemrik 9 (Fig. 7), and M'lefaat, but only in Mureybit II in a Khiamian context. After a short existence in northern Jezira, and eastern Syria, it disappears, replaced by the Nemrikian (the Qermez Dere sequence, *cf.* BETTS, this volume; INIZAN and LECHEVALLIER, this volume).

Mureybetian (Fig. 3). This industry occurs in Mureybet III-IV (*cf.* CAUVIN this volume, also CALLEY 1986, CAUVIN 1978 and in press) and perhaps Aswad, and develops after the Khiamian/Sultanian. The double-platform core appears here, large blades are common, and other tools tend be be of greater size. The tanged point, with or without notches, originates from the Khiam point and gradually replaces it.
The double-platform core technology coincides with the introduction of mined or imported raw material. The notable increase of the size of blanks and tools is also connected with this phenomenon. All these are features of a PPNB-type industry (*cf.* GOPHER, this volume) which here appears much earlier than in the southern Levant. The earliest PPNB-type industry existed in Syria from 8000 to 7500 bc, followed by the developed industries of the "PPNB Culture", with Byblos and Amuq points, naviform technique, sickles, etc. (see below). A broadly similar pattern also occurs among the early east Anatolian industries, especially those from lowest Çayönü and Nevalı Çori, which could stem directly from the Mureybetian (CANEVA, this volume; SCHMIDT, this volume).

The Early East Anatolian Industries. Evidence from the early Holocene remains too scarce to confidently trace developments during this period in the upper Euphrates and Tigris drainage. However, the site of Hallan Çemi, east of Çayönü, dates to the 9th-8th millennia bc and features circular structures

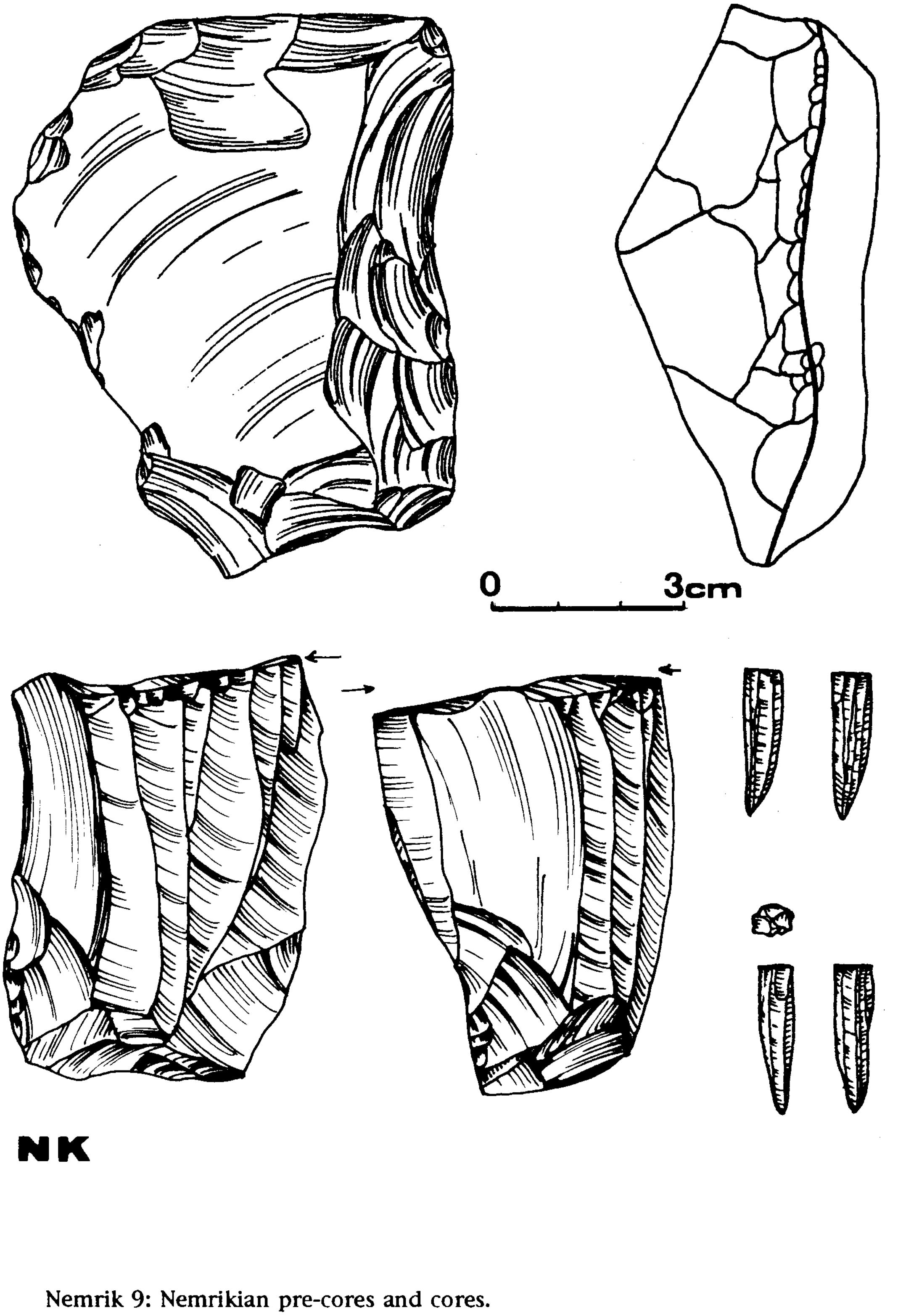

Fig. 4. Nemrik 9: Nemrikian pre-cores and cores.

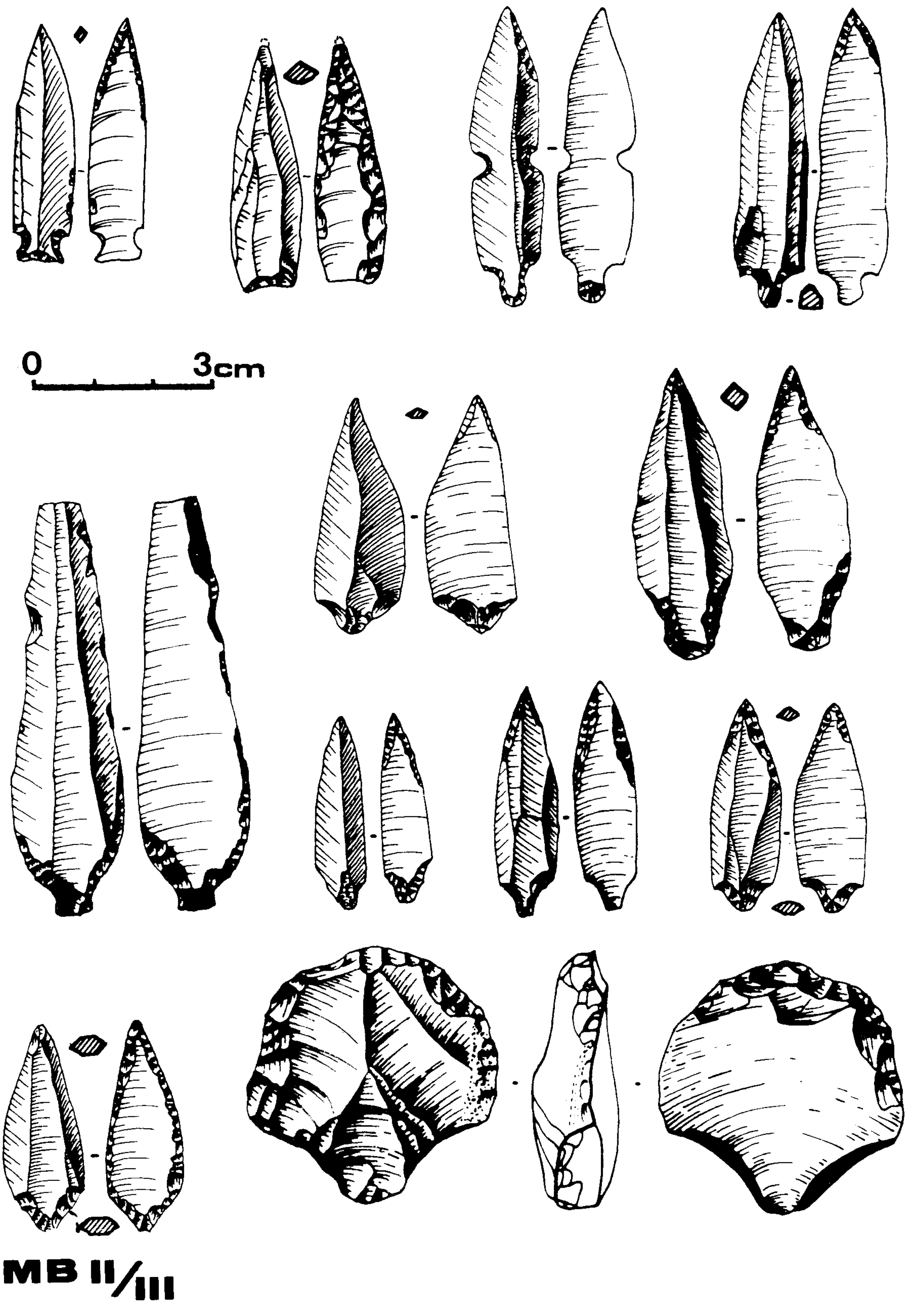

Fig. 3. Mureibet II/III: Mureibetian.

changes here profoundly several times (Natufian to Khiamian/Sultanian) and even radically (PPNA-PPNB transition, especially in the south) (*cf.* CAUVIN 1978, 1988; GOPHER 1989).

4. The Iraqo-Iranian province includes Mesopotamia, Khuzistan and the southern slopes of the Zagros Mountains, and perhaps the Mesopotamian Plain. This is the eastern wing of the Fertile Crescent. The local industries are only slightly differentiated and undergo a slow evolution. They stem from the Zarzian, which is a Late Glacial mutation of the Baradostian (OLSZEWSKI 1993).

Traditions, Stability and Change

Each province has its own long development preceeding the early Holocene industries. This development can be observed in the local "Para-Gravettian" Upper Paleolithic (Karain B industry in Anatolia, the Imeretian and related industries in the Caucasus, the Shpan-Koba industry in Crimea, the Baradostian in Iraq, the Kebaran and Geometric Kebaran in Levant), and later in its "geometric" stage as exemplified by the Beldibi-Belbaşi in Anatolia, the "Early Mesolithic" in the Caucaso-Caspian region, the Zarzian in Iraq and Iran, and the Natufian in Syro-Palestine. A similar phenomenon could be observed in the Balkans and Italy (KOZŁOWSKI 1975).

All Final Paleolithic (in the Levant referred to as Epipaleolithic) industries are characterized by different backed pieces. They bear different regional features, but they also show many general similarities. A straight or arched back is often combined with a retouched truncation. Pieces appear in microlithic and non-microlithic variations. They are accompanied by simple backed pieces, straight or arched (CAUVIN 1981).

At the end of the Final Palaeolithic/Epipaleolithic comes an "intercultural trend", leading to the "geometrization" of the industries. There appear several new classes of microliths, including crescents/lunates and double truncations/trapezes. The first element, although differentiated regionally (e.g. with or without the Helwan retouch) is popular in the industries of the whole region. The trapezes/double truncations exist only, or at least mainly, in the Caucaso-Caspian province. This new cultural phenomenon is dated to around the 9th millennium bc. Its local names and features are as follows (Fig. 1):

- Zarzian (with lunates and backed pieces and truncations) (OLSZEWSKI 1993).
- Natufian (with segments [Helwan retouch] and triangles) (CAUVIN 1981; MOORE 1975).
- Harifian (characterized by the Harif points).
- the lower Qermez Dere industry (with hypermicrolithic geometrics) (BETTS, this volume).
- Caucaso-Caspian "Mesolithic" industries (with crescents, pen-knives, double truncations, and backed elements with truncations) (BADER and TSERETELI 1989).
- Antalyan (Öküzini) (with small backed pieces, segments and isosceles triangles) (ALBRECHT, this volume).

The next stage (9th-8th millennium bc, Fig. 1), locally called the "Proto-Neolithic" or "Mesolithic", shows the following features:

- In the Antalyan, several new types, including scalene triangles appear, accompanied by a ground stone industry. The Antalyan finds its continuation in the upper layers of the Aşıklı Höyük (*cf.* BALKAN-ATLI, this volume).
- The Natufian passes locally into the Khiamian/Sultanian, new Khiam points are introduced, geometrics gradually disappear, and a ground stone industry develops.
- In the north of the Levantine province, the new unit (Mureybetian) stems from the Khiamian and has its Khiam as well as different big tanged points; the first double-platform cores appear (CAUVIN, this volume).
- There is no doubt of the destiny of the Zarzian. All its main features are recognizable in new "Proto-Neolithic/ Early Neolithic" industries of the Iraqo-Iranian province: the Mlefatian and the Nemrikian. The old traditions are mostly visible in the group of points, repeating the old inventory of impliments (lunate, backed bladelet or points, backed elements with truncation), but in microlithic dimensions (Fig. 7). This results from the change of core technology (punch or pressure technique) (OLSZEWSKI, this volume).

The root cause for these developments was the demand for large, broad, and very regular and standardized blades, serving in villages as blanks or even ready (unretouched) tools. Such blades dominated the assemblages and were accompanied by bladelets made of local and imported raw materials. They were formed into specific "retouched tools" or used without retouch.

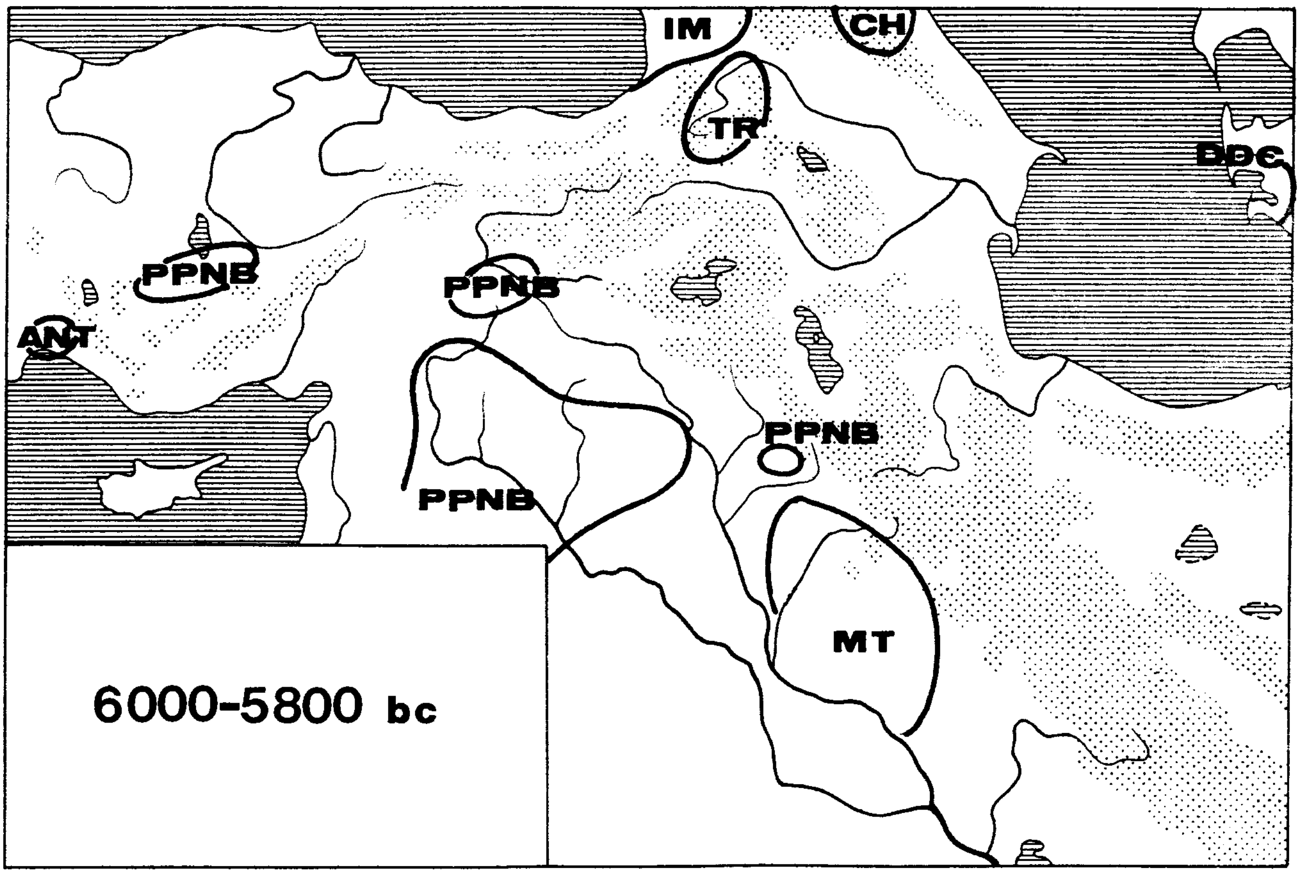

Fig. 16. Local industries between 6.000 and 5.800 bc (PPNB-type industry; *other symbols cf. Figs. 1 and 2)*

Among the retouched tools, the following forms were commonly produced: endscrapers; retouched truncations, single or double, serving as sickles; backed blades, with natural or retouched backing; perforators; retouched flakes; and hoes. It is important to note that the number of classes among retouched tools decreased. Nemrik points and different microliths were absent or very rare, but some PPNB arrowheads still persisted at the beginning (Fig. 19).

The second group of tools is represented by sectioned unretouched blades (mainly medial parts), sometimes with gloss or use-retouch, and whole blades with the same features as above.

The Agro-Standard industrial tradition (later without arrowheads) persisted for a long time, at least up to the Uruk period. It is also worth noting that the first Balkan and central European Pottery Neolithic industries curiously repeat the Agro-Standard.

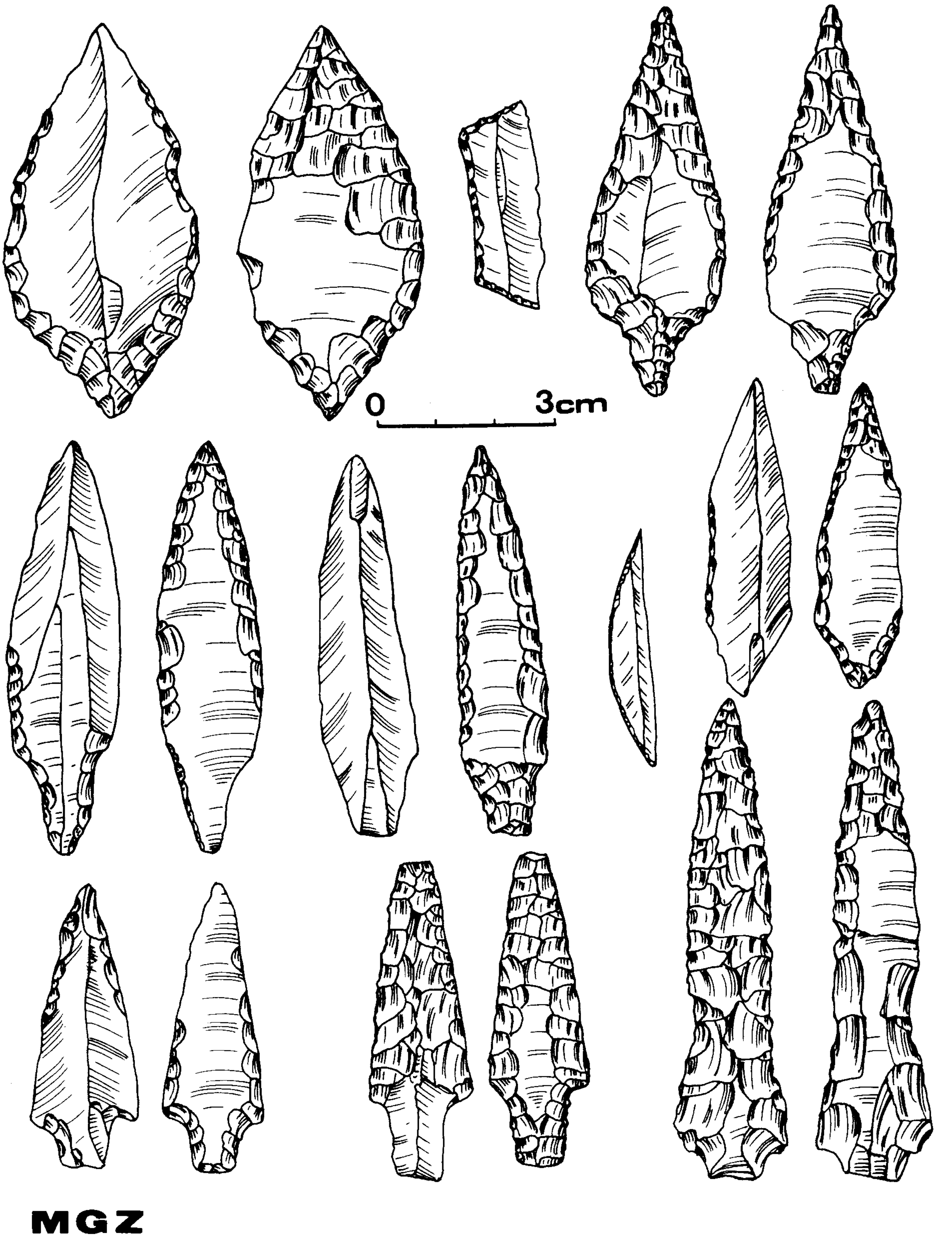

Fig. 17. Magzaliya: PPNB-type industry with some Nemrik points *(after N. Bader).*

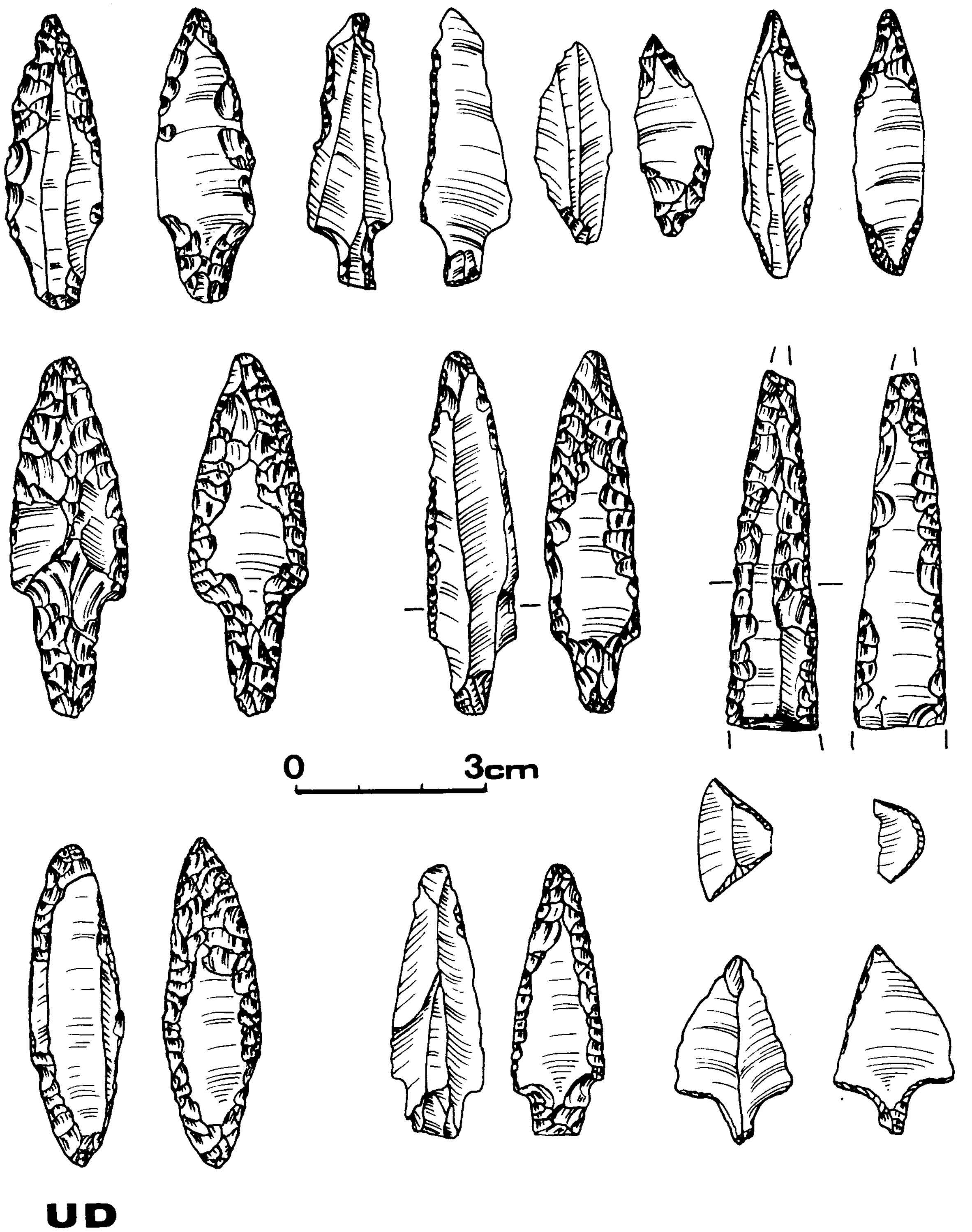

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Fig. 18. Umm Dabagiya: PPNB-type industry with some Nemrik points *(after P. Mortensen and the collection in Moesgård).*

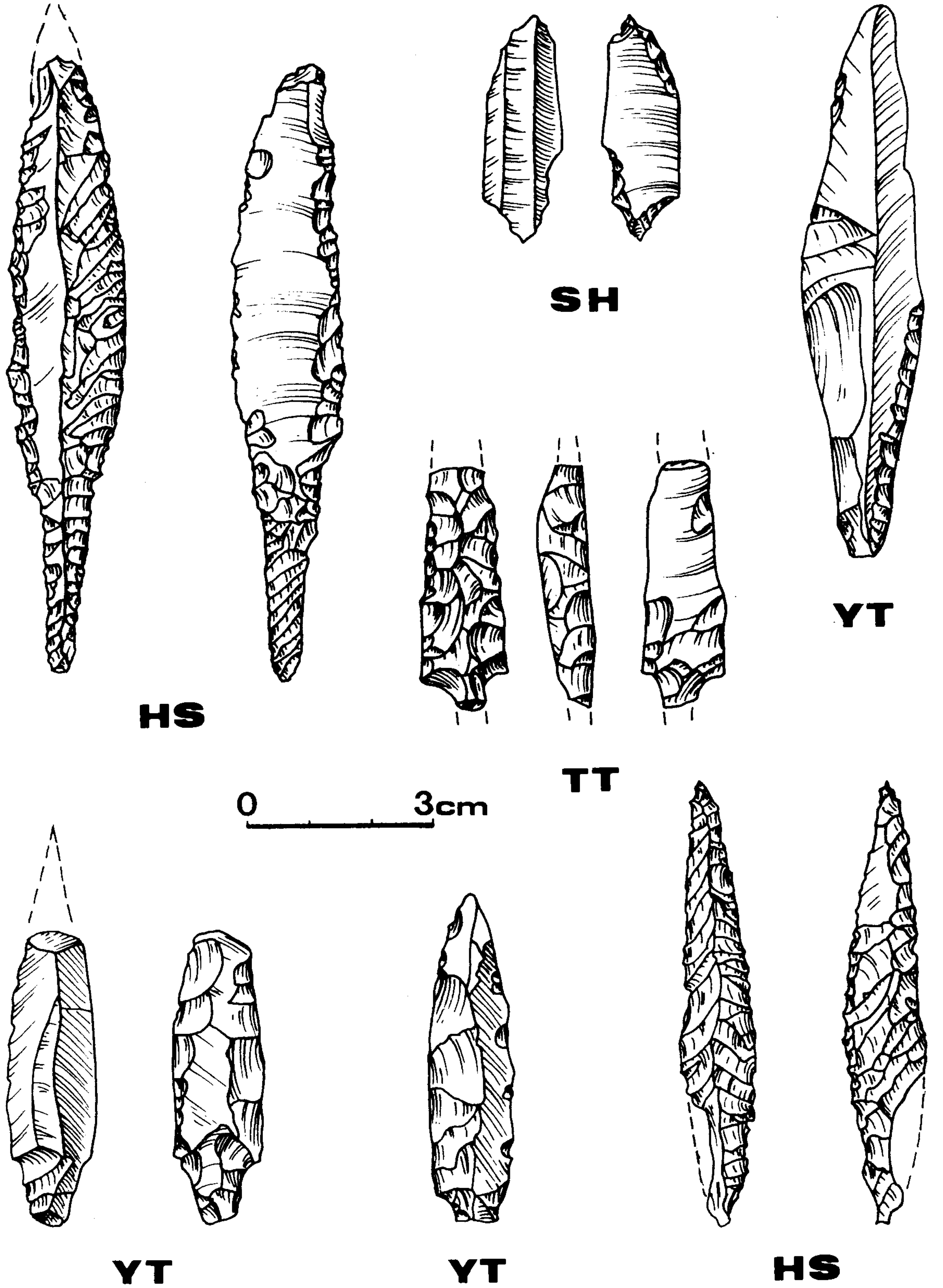

Fig. 19. Hassuna, Shimshara, Telul-eth-Thalathat, and Yarim-Tepe I: PPNB-type arrowheads of the early Agro-Standard.

Conclusions

According to what has been said above, the Proto-Neolithic/ PPN chipped industries of the eastern wing of the Fertile Crescent characterized the Iraqo-Iranian cultural/ecological province. This province had its own features in ecology, tool standards, and rhythm of development and evolution.

The earlier industries (Nemrikian and Mlefatian) originated in the 9th millennium bc from the Zarzian mainly as the result of core technology developments, the first major change in lithic tradition. After a long period of stability (8th-7th millennia bc), at around 6,000 bc several important developments arose, with an increase in the number of broad blades as well as of imported raw materials; introduction of geometrics; appearance of big, PPNB-type arrowheads; and later the introduction of pottery. This resulted in the introduction of the PPNB-type industry in northern Iraq, where it replaced the Nemrikian, and the strong modification of the Mlefatian into the Late Mlefatian, establishing the second major change.

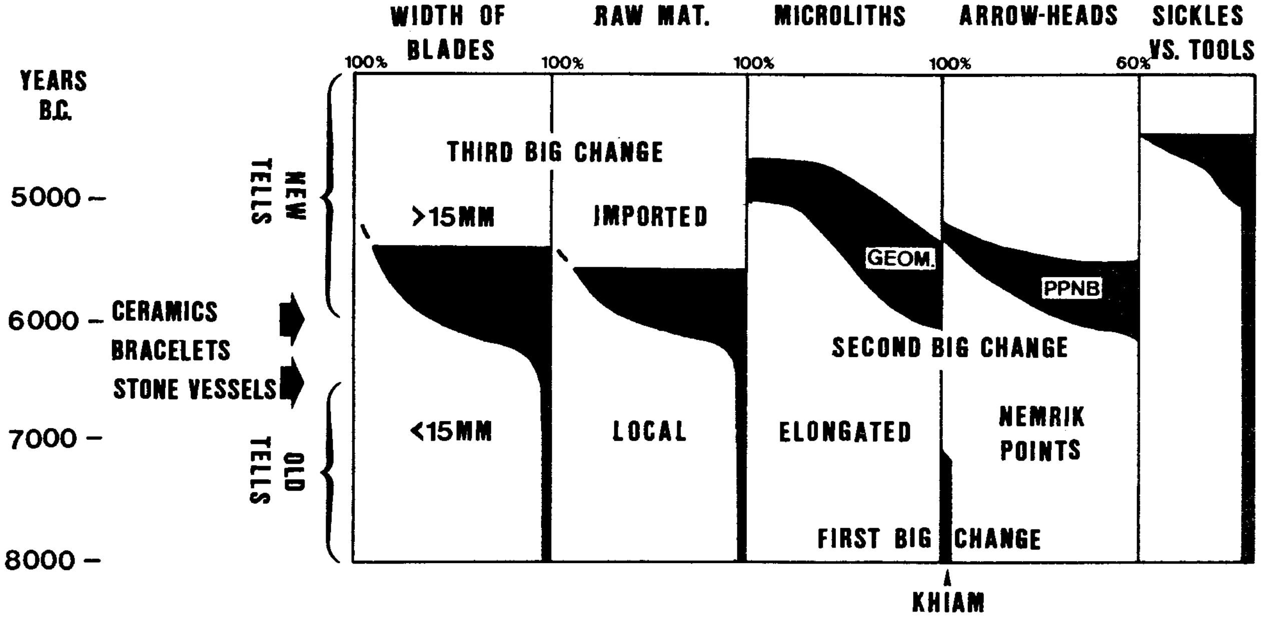

Fig. 20. Iraqo/ Iranian Province: main features and changes in the chipped industries.

By ca. 5,500 bc in Mesopotamia (but somewhat later in Iran), this evolution culminated in the third major change: the formation of the simple and highly standarized industrial variants that can be called "Agro-Standard".

Note: Tools are classified according to the following categories: A- endscrapers; B- retouched flakes; c- burins; D- retouched truncations; E- retouched blades; F- perforators; G- combination of tools; H- macroliths/heavy duty tools; I- leaf points; J- tanged points; K- microliths; L- scaled pieces; M- other (KOZŁOWSKI 1975).

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Flint Bolas Balls and Chopper/Chopping Tools from Nemrik 9 and Tell M'lefaat

Ryszard F. Mazurowski

Introduction

During the excavations at Nemrik 9 and Tell M'lefaat a rich collection of balls and chopper/chopping tools made of flint and other stone was found. According to the author's classification of PPN stone implements in northern Mesopotamia, they belong to Groups I (balls) and XX (choppers and chopping tools) (MAZUROWSKI 1990, 1992, 1993).

Group I: The Stone Balls

Group I includes 687 spherical or ovoid balls made of local flint and stone pebbles. Flint specimens dominate the collection and are characterized by regular crushing over part or all of the surface. The term "crushing" is in this case rather imprecise. It refers here to a strong abrasion of the hard surface of a ball previously shaped by chipping and the subsequent crushing of negative flake scars. The purpose of the process was to gain a more or less spherical shape devoid of sharp edges or marked irregularities. This may be supported by the occurrence of spherical and ovoid balls made of pebbles that bear no trace of any processing altogether (forms IA1), bearing one (IA2) or several flake scars at one end (Class ID), or sometimes formed by means of abrasion of an otherwise unaltered surface (IB1). We may thus assume that classes and varieties distinguished within Group I represent various methods of the same technological process, whose ultimate goal was to provide a spherical or nearly spherical tool. One cannot exclude the possibility that some of the balls from Classes IB and ID, especially those having wholly negative poles (IB5, ID1), were the results of repairing damaged specimens of Classes IA and IB.

Dissenting from opinions generally held in literature on the subject, the author assumes that all traces of work on the surface of the artifacts in Group I are the result of the preparation of a given tool for its utilitarian function and not as consequence of its use. This is well supported by the semi-finished balls (IE1, IE2) as well as IC forms. The latter were made from various types of more or less worn out flake cores by abrading sharp ridges between flake scars. Apart from the general practice of utilizing natural flint and stone pebbles, it was quite common to use rejected or discarded flake cores as resources for the production of balls of Classes IA and ID.

Generally, the artifacts of Group I are subdivided into more detailed classification units, i.e. classes and varieties (Fig. 1-3):

Diameters of balls range from 42 to 124mm. Most specimens range between 51-80mm; very few are larger than that. A representative collection of balls from Nemrik 9 may serve as an example. Measurements of 676 specimens (excluding Class IF) showed that 84.8% had diameters between 51 and 80mm (Fig. 4). The weight of specimens with the smallest diameter (42-50mm) ranged from 91 to

110g; with an average diameter (51-80mm) the range was from 115 to 455g; and large diameter balls (81-124mm) weighed between 460 to 1,119g.

Stone ball classes and varieties

Class A (IA)	Spherical or ovoid with crushing over the entire surface.
Variety 1 (IA1)	As above
Variety 2 (IA2)	As above but with one small negative indentation
Class B (IB)	Spherical or ovoid with crushing around the perimeter between two poles formed by remains of natural cortex or flake scars
Variety 1 (IB1)	With natural surface of both poles
Variety 2 (IB2)	With one pole natural and the other with flake scars
Variety 3 (IB3)	The surface of one pole natural, the other with cortex and flake scars
Variety 4 (IB4)	One pole covered completely with flake scars, the other with cortex and flake scars
Variety 5 (IB5)	Both poles covered completely with flake scars
Variety 6 (IB6)	Both poles covered with cortex and flake scars
Class C (IC)	Spherical or ovoid, with crushing in various directions along the edges of the core
Class D (ID)	In the form of sphere section, with one pole covered with flake scars or cortex or both, the rest of the surface covered with crushing or crushing and flake scars
Variety 1 (ID1)	One pole completely covered with flake scars
Variety 2 (ID2)	One pole covered with flake scars and cortex
Class E (IE)	Semi-finished balls
Variety 1 (IE1)	Blanks of classes IA and IC
Variety 2 (IE2)	Blanks of classes IB and ID
Class F (IF)	Unidentifiable fragments

At M'lefaat, only two stone balls (both ID1 variety) were discovered, one of them made of flint and the other of limestone. Both of them were found in the upper layer of trenches I/1954 and II/1989. But stone balls were much more numerous at Nemrik 9 (Table 1), totalling to 685 specimens that accounted for 22.5% of all ground and pecked stone artifacts from the site. A total of 647 balls were made of flint pebbles (94.5%) and the rest of other stone pebbles (5,5%). Stone balls rarely occurred in functional levels of houses in phases I to IV, and in a single case two specimens (both IA1) were grave goods (Grave 33 in House 10). Stone balls appeared most frequently in the KM layer (stone pavement) outside houses, the area where most household activities were concentrated. In Layer KM, Group I artifacts occurred singly or in groups; in four cases groups included four to five balls.

One can observe a significant increase in the number of balls during the chronological development of the settlements at Nemrik 9. The presence of artifacts in the house fill from phases I to III is commonly the result of post-abandonment activities of the inhabitants or of later natural factors. Therefore, balls discovered in those stratigraphic positions need not necessarily be contemporaneous with the houses in question; neither can they be confidently assigned to a given phase of settlement. Nevertheless, disproportionate distribution of the p1 index between phases I-III linked with life in the settlement at Nemrik before the construction of the stone pavement, and phases IV-V, when pavements appeared, is quite evident. The p1 index shows proportionally quantity of Group I artifacts at a given occupational phase of the site (in the original text, the p1-index is explained below Table 1). The p1 index has a value of 5.2% for phases I-III and 82.2% for phases IV-V. According to the author's

Settl. phase	Localization x	x_1	IA1 a	IA1 b	IA2 a	IA2 b	IB1 a	IB1 b	IB2 a	IB2 b	IB3 a	IB4 a	IB5 a	IB5 b	IB6 a	IC a	ID1 a	ID1 b	ID2 a	IE1 a	IE1 b	IE2 a	IF a	Together l	Together l_1	Together p_1
I-V	Surface	sp	8	2	5	1	2		2			3	4		10	9	4						1	51	51	7,45
V	PTstruct.	w	1		1		1									1			1					5	27	3,94
	House 2	y	4	1								2			1	2							1	11		
	House 5	y	1	2	1		1		1						1	1	1			1	1			11		
IV-V	KM layer	w	73	16	66	3	18	2	10	1	22	42	31	2	75	49	37	3	10	9		11	7	487	520	75,91
	House 3	y	11		1							2	2		9	1	1		4			1		32		
	Grave29	y	1																					1		
IV	House 1	y	2										1		1	1								5	37	5,40
		z	2								1													3		
	House 4	y	5	1							1	3	4		4	3	6		1					28		
	House 8	z							1															1		
III-IV	K/KM layer	w	3		2		1					1	2		1	2			2					14	14	2,04
I-III	K layer	w	2	1							1	4	1		8	3	1		1					22	22	3,21
III	House 1A	y														1								1	10	1,46
	House 2A	y	1	1																				2		
		z			1												1							2		
	House 4A	y										1												1		
	House 8A	z														1	1							2		
	Grave 33 (house 10)	z	1	1																				2		
II	House 6	y															1							1	2	0,29
		z											1											1		
I	House 1B	y	1																					1	2	0,29
		z											1											1		
Together		l	116	25	77	4	23	2	14	1	25	58	47	2	110	74	53	3	19	10	1	12	9	685	685	99,99
		p	20,58		11,82		3,65		2,19		3,65	8,47	7,15		16,06	10,80	8,18		2,77	1,61		1,75	1,31	99,99		

sp secondary position y fill of house z living floor w cultural layer l in number p in percent
l_1 in number, quantity of bolas balls in the settlement phase p_1 percent, quantity of bolas balls in the settlement phase

Table 1. Nemrik 9. Flint (a) and stone (b) bolas balls.

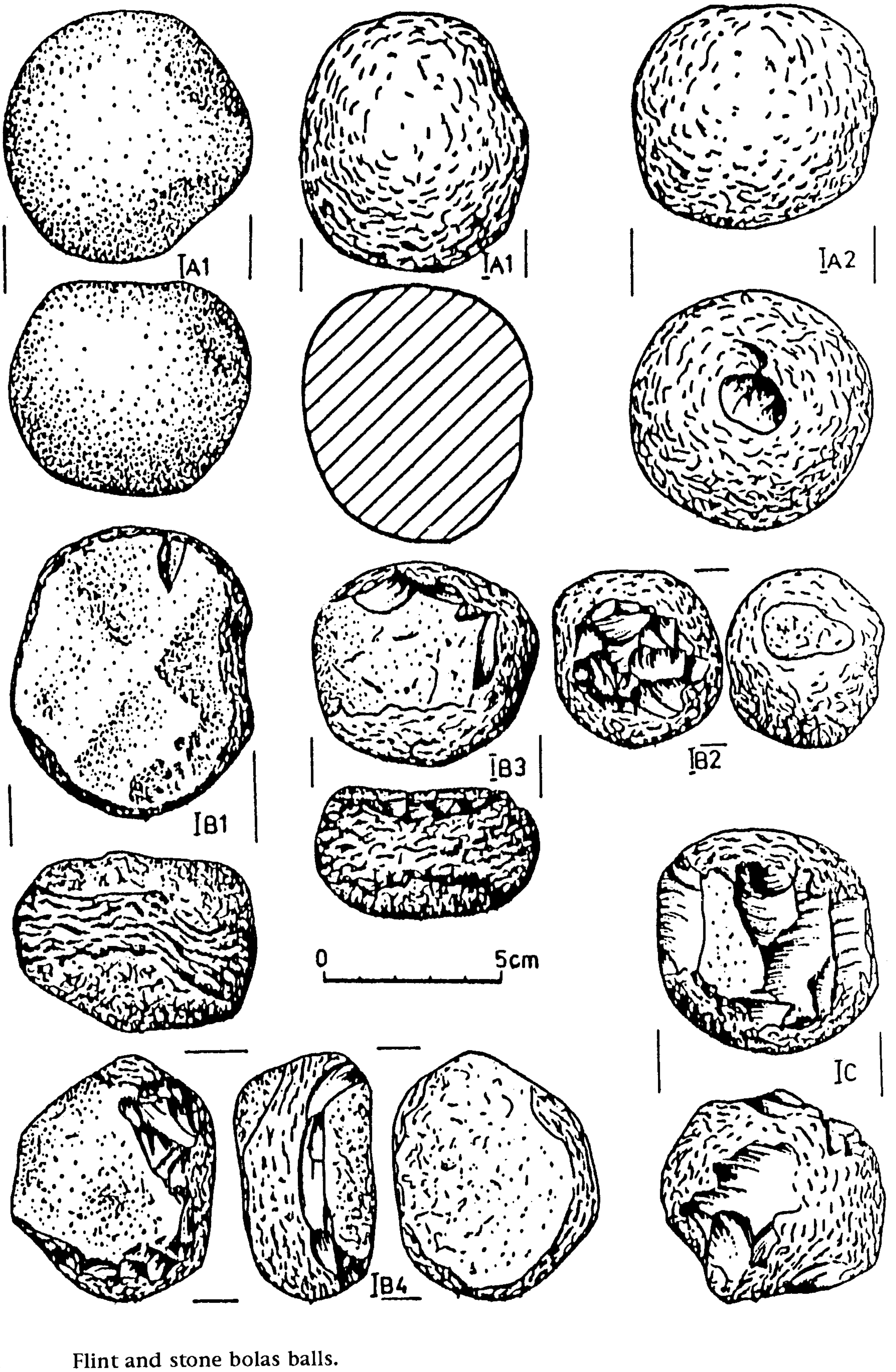

Fig. 1. Flint and stone bolas balls.

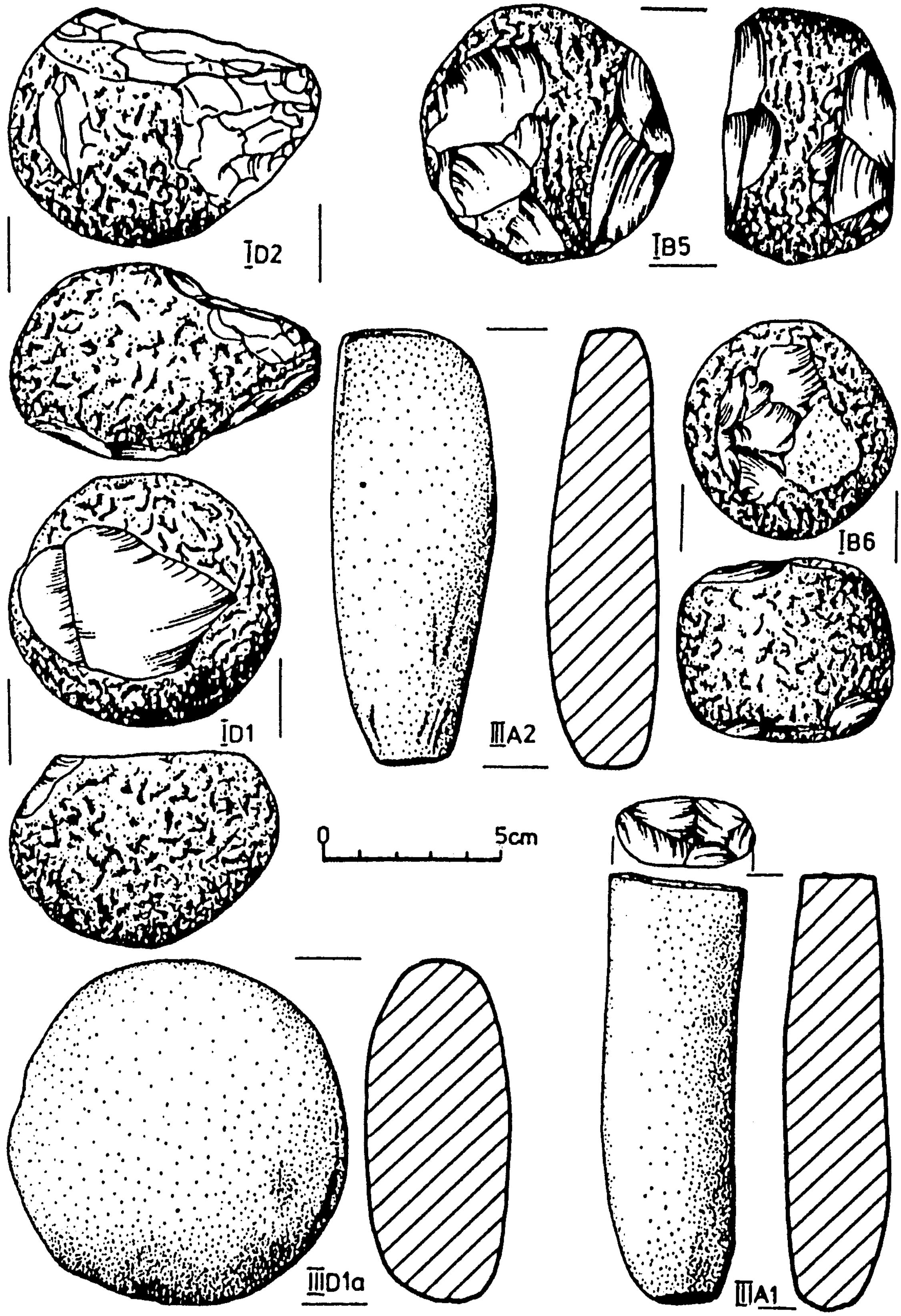

Fig. 2. Flint bolas balls, pestles, and grinder made of sandstone.

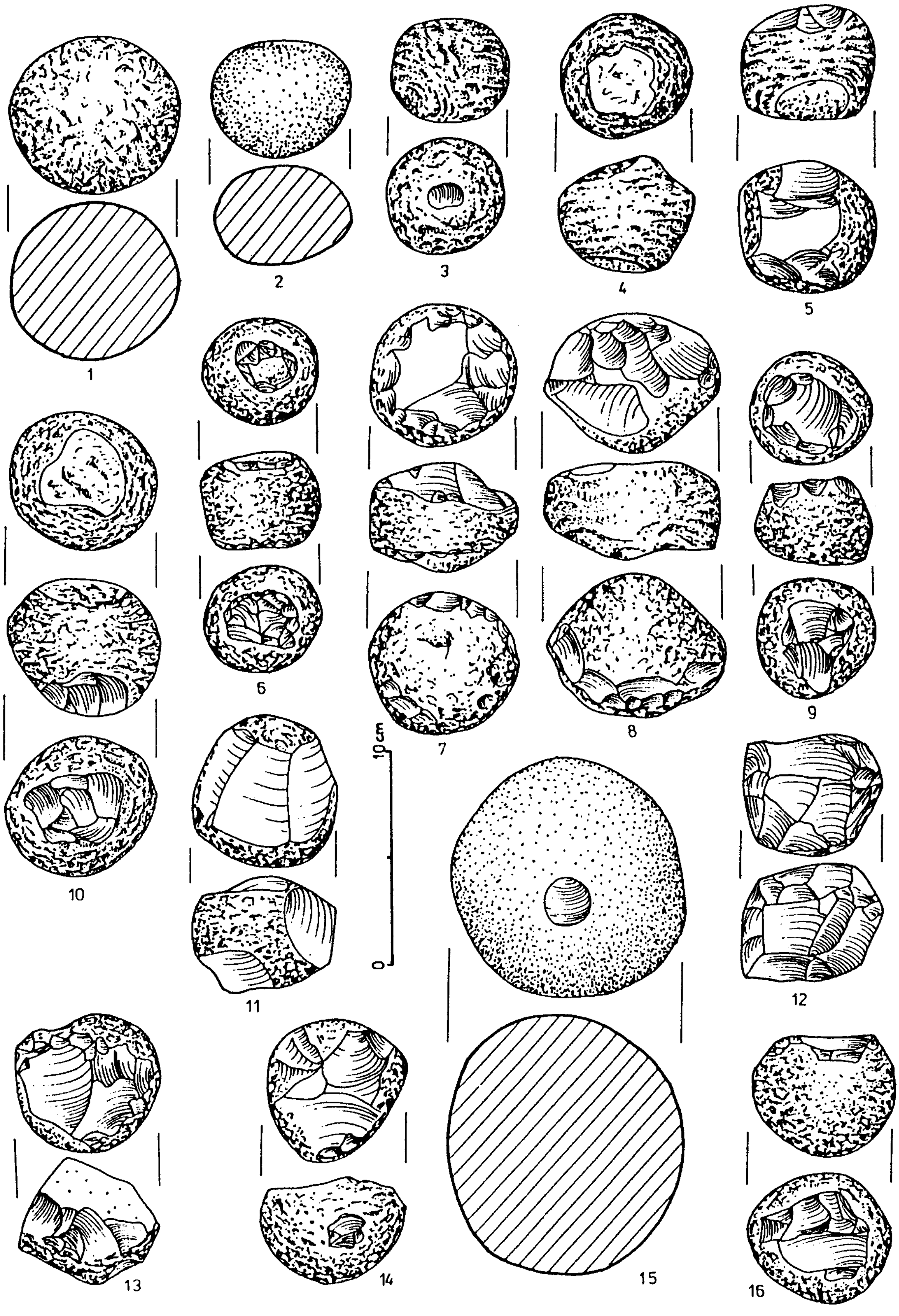

Fig. 3. Flint (1,3-14,16) and stone (2,15) bolas balls.

chronological interpretation for the Neolithic of northern Mesopotamia, phases I-III at Nemrik 9 represent the PPNA and phases IV-V are PPNB (MAZUROWSKI 1993).

Stone Balls from Other Sites and Regions

Similar kinds of stone balls were also discovered in Proto-Neolithic layers at Zawi Chemi (SOLECKI 1981: Pl.5:m-q), although it is not clear if all artifacts really belong to this period. In my opinion, the archaeological materials from this site represent several horizons of a settlement occupied for a long time through Proto-Neolithic and developed PPN periods (MAZUROWSKI 1993). Flint balls occurred also at Karim Shahir (BRAIDWOOD and HOWE 1960: Pl. 23:4; HOWE 1983: 103,105-106). In northern Mesopotamia, artifacts from Group I were also found in aceramic layers at Qalat Jarmo and Tell Magzaliya (MOHOLY-NAGY 1983: 299-300; BADER 1979: Fig. 9:4; 1989, Plate 36:4-6). The above mentioned sites, together with Tell Shimshara, represent PPNC elements in northern Mesopotamia. The analyzed flint balls, especially variety IA1, occurred in Early Pottery Neolithic (EPN) sites of the Proto-Hassuna culture (ceramic layers at Jarmo, Tell Sotto, Telul eth-Thalathat, Umm Dabaghiyah) and the Hassuna culture (MOHOLY-NAGY 1983: 299-300, 325; Fig. 137:2-4; Pl. 141:2,4-6; BADER 1989; FUKAI and MATSUTANI 1981: 54-55; LLOYD and SAFAR 1945: 255-289). These forms survived most probably until the end of the Halaf culture, since IA1 and IB forms were found in the middle and late Halaf phases at Tell Karrana 2, a site ca. 4 km east of Nemrik 9. I was able to verify this personally in 1988 and 1989 through the kindness of Mr. Karim Thoma Yusuf from the Department of Antiquities and Heritage in Mosul, who headed the excavations.

In the southern Levant, the oldest basalt and limestone balls appear as early as the early Natufian culture. This is verified at the site of Wadi Hammeh 27 in Jordan, dated to between 12,000±160 to 11,920±150 bp (EDWARDS 1988). Balls occasionally turned up in PPNA and PPNB layers at Jericho (DORELL 1983: Fig. 221:21, 228:3) and at Hatoula in Israel the first PPN phase (LECHEVALLIER *et al.* 1988). Stone balls were more frequent in the Levantine PPNB settlements of Beidha, Beisamoun, 'Ain Ghazal, El Kowm 2, Bouqras, and Qdeir 1 (*cf.* KIRKBRIDE 1966: 30, Pls. 17B, 19A; LECHEVALLIER 1978: 155, Fig. 53:6; ROLLEFSON *et al.* 1984: 153; MARÉCHAL 1982: 227; CONTENSON 1985: 347; LeMIÈRE and MARÉCHAL 1985: 170).

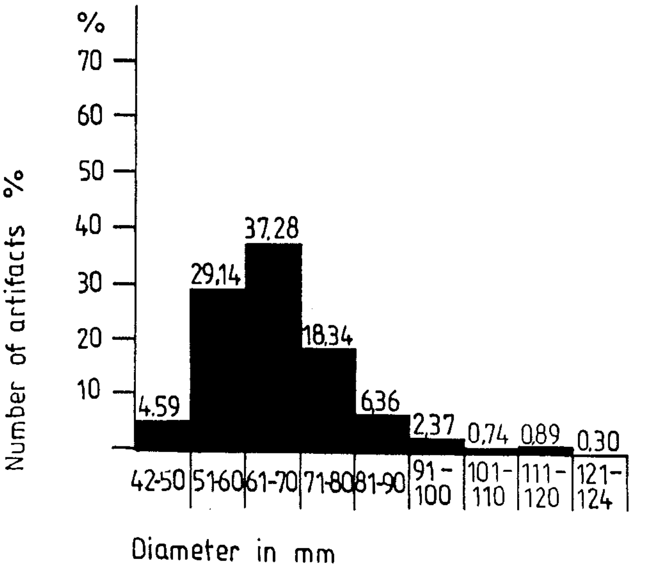

Fig. 4. Diameters of flint and stone balls.

Stone balls from the beginning of the second half of the 8th millennium b.c. have been found in southeastern Anatolia at Çayönü (DAVIS 1982: 114-116, Pl. 3 III: 9), Cafer Höyük (J. CAUVIN and AURENCHE 1982: 123-137 and O. Aurenche's paper delivered at the Institute of Archaeology, Warsaw University, 1988) Çayönü yielded the richest collection of Group I forms (371), second only to that of Nemrik 9. They were made, however, with soft and hard limestone, basalt, chert and other unidentified hard stones. According to Davis, the artifacts rarely appeared in the earliest phases of the settlement, which coincides with our observation for Nemrik 9; at Nemrik, however, flint specimens predominated. Flint balls from Cafer Höyük tended to occur in sets of three large and three small specimens, suggesting a magic or cultic association (Aurenche, personal communication). Again, this corresponds to those cases at Nemrik in which sets of balls of similar sizes were discovered; they numbered, however, not more than four to five specimens.

In the first half of the 7th millennium bc, stone balls appeared in Gritille (VOIGT 1985: Fig. 20a; 1988: 225) and in Nevalı Çori (SCHMIDT 1988: Fig. 17:9,10). Balls from Gritille in particular stand out regarding their diversified sizes and shapes, ranging from IA to ID forms. Almost all of them were made of flint or chalk, and some of them bore traces of red ochre, possibly through re-use as grinders.

In the Khuzistan lowlands, numerous stone balls were found in aceramic layers at Tepe Guran (MORTENSEN *et al.* 1964: 119). and at Ali Kosh (HOLE *et al.* 1969: 186, 200, Figs. 79 f-g, 84e-f). Although they appeared as early as the Bus Mordeh phase at the latter site, the largest collection comes from the Ali Kosh and EPN (Mohammad Jaffar) phases. In the fully developed Pottery Neolithic and Chalcolithic of the region (e.g. Tepe Sabz and Tepe Musiyan), balls were still in use, though on a smaller scale, until 3,700 b.c. (HOLE *et al.* 1969: Table 32, *cf.* "spherical pounder", and Table 37, "pecked stone balls" and "grooved stone balls").

The Function of Stone Balls

One IA1 specimen from Ali Kosh is of particular interest. Made of quartz, it was found near the knee of a skeleton in Ali Kosh phase Grave 26 (HOLE *et al.* 1969: 200, Fig. 84f). In the archaeological literature, such artifacts are usually described as cores, grinders, pounders, elements of games, weights or simply balls with no indication concerning their actual use. The only scholars who consider it possible that they were used as bola stones, and correctly so in my opinion, are HOLE, Flannery, and Neely (1969: 200) in their comparison of analogous forms from Ali Kosh and Tepe Sabz. A decisive factor for raising such an interpretation was the discovery of the above mentioned ball with a circumscribed groove that served for fixing it as a bola stone.

A comparative analysis indicates that Group I artifacts were very popular in Near Eastern settlement zones that are associated with early stages of animal breeding and agriculture. In the period between the middle of the 10th and the end of the 8th millennia bc, stone balls numbered from one to five at each site. It was not until the 7th millennium that these numbers increased in a significant way. Materials from phases IV and V at Nemrik 9, Çayönü, Cafer Höyük, and the Ali Kosh phase sites in Khuzistan demonstrate this well. At the time of emergence of early EPN cultures in the first half of the 6th millennium bc, the number of balls in tool inventories decreased. Eventually, in the 5th millennium bc, they occurred as rarely as in the earlier stages of their use. This is directly connected with structural transformations of economy and social life, corresponding to the gradual process of supplanting hunting with increasingly widespread animal breeding and agriculture.

In my opinion, Group I artifacts represent typical bola stones employed for hunting. Bolas were widely known among the Paleo-Indians and other pre- and protohistoric tribes in the Americas (ARQUEOLOGIA TAINA 1973: 69-72). They consisted of two or three leather sacks linked with thick thongs or ropes. Smooth stone balls were put into the sacks. A hunter would then swing the set above his head and throw it at a herd of animals. Depending on the species and size, the animals that were hit were either killed instantly, wounded, or knocked down. Thongs or ropes would twist round the feet of nearby animals, tethering them and hindering their escape. Thus, the implement did not merely serve for hunting, but also (perhaps primarily) for catching wild animals alive. Obviously, bolas were most effective when hunters had managed to drive the herd into a deep wadi. These natural conditions existed in all regions were bola balls have been found. It is also worth stressing that bone inventories from the sites included a high percentage of the remains of wild animals such as gazelles, onagers, boars, wild cattle, sheep, goats and deer (REED 1960: 119-145; KIRKBRIDE 1966; HOLE *et al.* 1969: 262-230; DUCOS 1978: 107-120; SOLECKI 1981; LAWRENCE 1982: 175-199; HOWE 1983; HELMER 1985: 117-120; BADER 1989; LASOTA- MOSKALEWSKA 1990: 185-208). It is worth adding that animal remains at Nemrik 9, and wild animals in particular, were most numerous in phases IV and V. It is unlikely only a coincidence that 85.2% of the balls come from the same period. It is also important that the bola technique of hunting allowed catching wild animals without wounding or injuring them severely. It could thus represent a major way of acquiring wild animals for domestication and subsequent breeding (sheep, goats, cattle, or boar). The use of bolas rendered big game hunting much easier since it could immobilize, weaken, or fetter large animals that could be afterwards killed off with bows, bludgeons or simple wooden clubs.

A diversification of ball sizes was most probably connected with adjusting the weight of bolas to the hunted animal species. It can also serve to explain the varied number of balls in sets discovered at Cafer Höyük and Nemrik 9. These sets may also confirm the way balls were tied together, that is, by means of leather sacks linked with thongs or ropes. However, the find of the earlier mentioned IA1 ball with a circumscribing groove suggests that another method of ball fixing was possible: a direct binding by means of a thong or rope. Yet this method seems to have been used only occasionally in prehistoric times. Present-day ethnographical analogies are relatively rare. In the area of Ethiopia, bolas with a single ball on a piece of rope are used to scare away apes from dura plantations (LEONARD 1973: 153). According to the same author, bolas could have been formerly used for hunting. All other implementations of flint and stone balls should be considered in terms of their re-use.

Group XX: Chopper/Chopping Tools

The sites of Nemrik 9 and Tell M'lefaat provided numerous artifacts made of large oval flint or other stone pebbles. They have been assigned to Group XX in the author's classification of ground and pecked stone artifacts in the PPN of northern Mesopotamia (MAZUROWSKI 1992; 1993). In Group XX, two taxonomic categories have been distinguished. Class XXA (unifacial) comprises forms whose working edge resulted from flaking from one surface only (choppers). Class XXB (bifacial) comprises tools whose working edge was made by removing flakes from both surfaces of the stone (chopping tools).

All 13 specimens of Group XX from Tell M'lefaat and Nemrik (98) were made of massive flint or stone pebbles from local deposits or in the close vicinity. There are sound reasons to presume that Nemrik inhabitants also reuse Middle Paleolithic XXA and XXB forms found on surfaces of neighbouring sites or in wadi beds and banks. In order to distinguish artifacts from different cultural and chronological periods, but which show similar morphological features, it was necessary to resort to the criteria of degree and type of patination of surfaces bearing flake scars (MAZUROWSKI 1990b; 1993).

Flint choppers and chopping tools from the Lower and Middle Palaeolithic period are characterized by the presence of brown cortex on natural surfaces and thick matt brown patina that seems almost "coarse-grained" on flaked surfaces. Ridges between flake scars are most often worn away and sometimes bear a sheen. Generally, the working edge is locally rounded due to patinization and erosion. Negative undulations are indistinct or barely visible under the patina.

Patination and surface alteration of group XX specimens coming from PPN settlements is never so extreme. One can only detect a slight change of hue - light brown - of the flint, and in most cases the patina is missing altogether. A slight sheen on flake scars is similar among a majority of tools, cores, flakes and blades from PPN at Nemrik 9. Flake scar ridges are quite distinct, negative ripples are preserved and the working edges remain sharp. Choppers made of shale or quartzite barely show any post-depositional surface abrasion; flake scars are fresh, and their negative undulations are sometimes discernable. Moreover, they show characteristic frayed lines radiating from the point of percussion. Measurements range from 63-134mm for length, 51-145mm for width, and 21-76mm for thickness.
All 13 specimens from Tell M'lefaat belonged exclusively to Class XXA (choppers). Ten were made on pebbles of very fine- grained, non-calcareous quartzite, and three were of grey shale. Their distribution is shown on Table 2.

Table 2. Tell M'lefaat. Distribution of Forms XXA.

Surface	Plough zone	Layer A	House 1 fill	Total
4	3	2	4	13

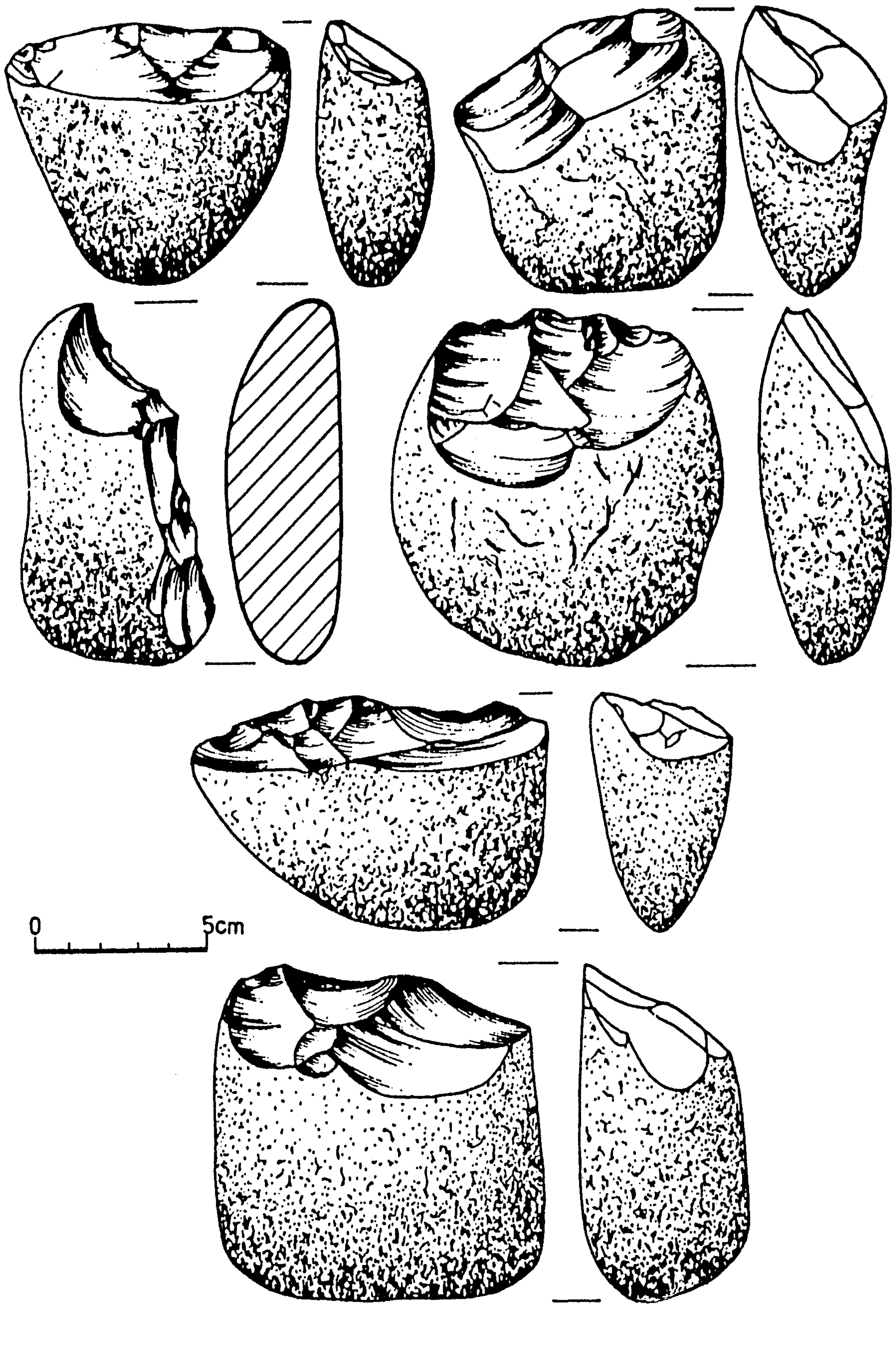

Fig. 5. Lower and Middle Paleolithic choppers made of flint.

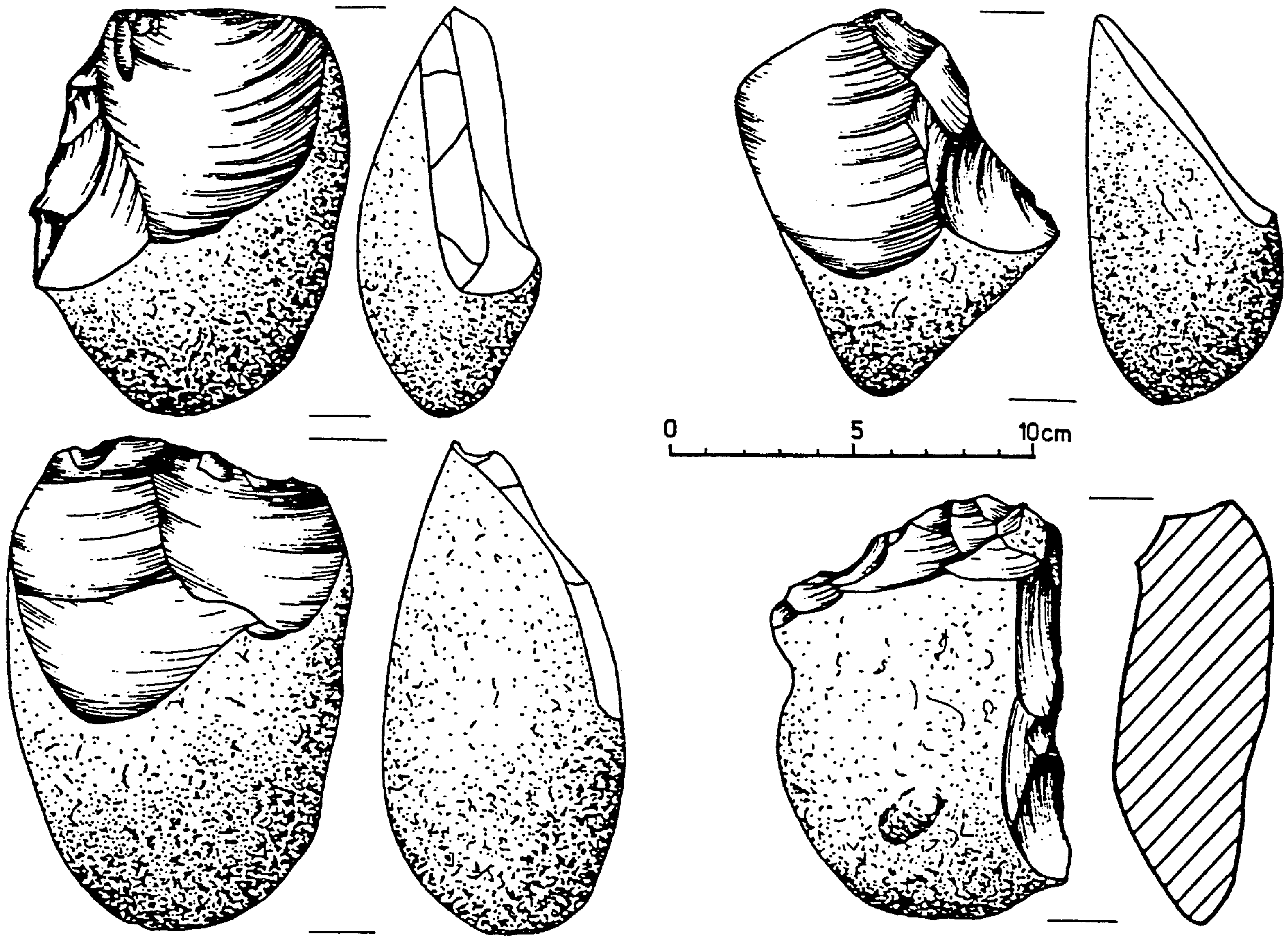

Fig. 6. Lower and Middle Paleolithic choppers made of flint.

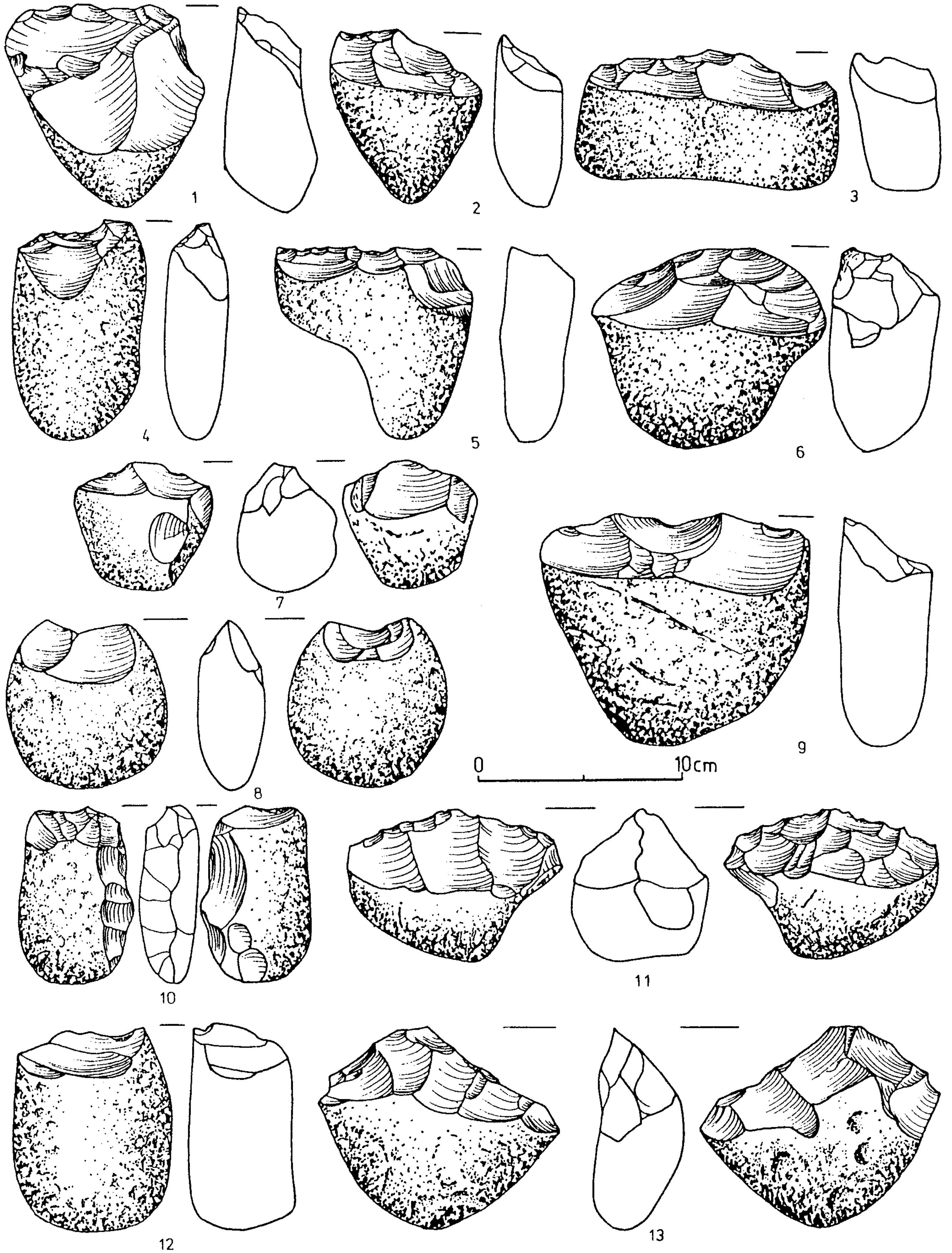

Fig. 7. PPN choppers (1-6,9,12) and chopping tools (7,8,10,11,13) made of flint.

Artifacts from Nemrik are much more diversified in terms of morphology and raw material (Table 3 and Figs. 5-7). PPN specimens were equally divided between the two Classes (19 choppers and 19 chopping tools). They were probably used throughout the period of the habitation of the settlement, and they were made mainly of black shale and various kinds of flint. Among the flint pebbles two kinds were favoured: a) pebbles of grey frosted material with brown or dark-brown cortex, and b) pebbles of dark-brown lustrous material with brown cortex. There is a striking lack of choppers made on pebbles of matt beige flint with light or dark-brown cortex, which represents the major raw material among Palaeolithic choppers. This selection is a significant differentiating feature in cultural and chronological terms. A specimen of form XXB found in the fill of House 4 is a re-used Palaeolithic XXA form whose new working edge was shaped in the PPN by means of blows along the original cortical surface. As a result, each of the lateral surfaces shows different technological features and different states of preservation. For some PPN forms, especially Class XXB, flake scars cover a considerable part of the pebble's circumference. Thus, one cannot rule out the possibility that they were flake-cores (Fig. 7:10,11). Pebble cores are a characteristic element of flint industry at Nemrik.

Lower and Middle Palaeolithic choppers occurred at Nemrik almost exclusively in the KM layer and in chronologically correlated structures such as the fills of Houses 2, 3, and PT. They are missing among earlier levels. If we associate the phenomenon with a marked predomination of Class XXA specimens, and in view of the choice or raw materials and degree of patination, we may conclude that we are actually dealing with chronologically and culturally distinct collections.

Table 3. Nemrik Group XX choppers (XXA) and chopping tools (XXB) from Lower and Middle Paleolithic periods.

Phase	*Form*	*Flint*	*Other Stone*	*Total XXA*	*Total XXB*
V	XXA	1		1	
	XXB	2			2
IV-V	XXA	51	1	52	
	XXB	3			3
III-IV	XXA	2		2	
Totals		*59*	*1*	*55*	*5*

Palaeolithic artifacts seem to have been simply gathered in the vicinity, along with other stones, and brought to Nemrik 9 to pave the ground between houses of phases IV and V (KM layer). Such an assumption is supported by the appearance, in the KM layer and in the surface of the settlement, of 29 flint artifacts belonging most probably to the Acheulian culture and the local taxonomic variant of the Moustero-Levalloisian tradition. Part of the collection has already been published (KOZŁOWSKI 1990). All pieces were made of matt beige flint with light- or dark-brown cortex. They include one ovoid handaxe, one Levallois flake core, four discoidal cores, a fragment of a Quina endscraper, and 23 Clactonian flakes. (One of the last was reused in the PPN as a flake core). The state of preservation is identical to the state of the choppers mentioned above.

Chopper/ Chopping Tools from Other Sites

In northern Iraq, choppers were in use in Proto-Neolithic Zawi Chemi (SOLECKI 1981: Fig. 16:h-i). They were also discovered, although not in great number, in the Levant. At PPNA Jericho, several specimens were reported (CROWFOOT PAYNE 1983: 657, Fig. 286). At PPNB ' Ain Ghazal, 92 Group XX specimens were discovered during the 1982 season (ROLLEFSON *et al.* 1984: 144).

To the south-east, in Khuzestan, similar relicts were discovered at Ali Kosh (HOLE *et al.* 1969: 189, Tab. 33, Fig. 80, Plate 31:e-h). They belonged exclusively to Class XXA and contained a single find from the Bus Mordeh phase and a rich collection from the Ali Kosh and Mohammad Jaffar phases. At Tepe Sabz and Tepe Musiyan, a few specimens were in use until the Mehmeh phase. The above cited authors also mention the occasional appearance of choppers at Tepe Sarab and Tepe Guran. In contrast to the region of northern Iraq, analogous artifacts from the above mentioned Near Eastern sites were made exclusively of flint.

The artifacts' function in the PPN and EPN was probably the same as in the Palaeolithic period. They were thus used for quartering meat, splitting and cutting bones, and other needs that required sharp edges and considerable force.

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Qermez Dere : The Chipped Stone Assemblage

Alison V.G. Betts

The site of Qermez Dere was occupied from late Epi-paleolithic times into the early Neolithic period (WATKINS and BAIRD 1987: 3). C14 dates for the site, as yet unpublished, fall in the late ninth and the first half of the eighth millennium BC, contemporary with the early aceramic Neolithic of Syria/Palestine (Watkins, pers. comm.). The QD chipped stone industry reflects this contemporaneity. Some aspects of the assemblage show clear parallels with those from sites such as Jericho, Netiv Hagdud and Gilgal (CROWFOOT PAYNE J. 1983; BAR-YOSEF *et al.* 1980; NOY 1989) in Palestine and Mureybet in Syria. There are also similarities between certain tool types in the Qermez Dere repertoire and those from sites in the Taurus and Zagros regions.

Nature of the Sample

With the exception of a portion of the material from the final season in 1990, all chipped stone found at the site was collected and analysed. Due to unforseen circumstances, the chipped stone from the second part of the 1990 season was put into store to await processing on a future occasion. Unfortunately, the outbreak of hostilities made this impossible, and only a basic description of the finds is available (WATKINS *et al.* 1992).

All soil from the site was sieved. Most was dry-sieved using a 5 mm mesh, and a proportion was wet-seived using a 1 mm mesh. Finds recovered in wet-seiving included a higher proportion of small chips, but there was no indication that the 1 mm mesh was more effective in the recovery of significant artefacts. Even with a small microlithic component in the assemblage, most artefacts, even in fragmentary form, could be recovered using 5 mm mesh.

Raw Material

The most common raw material for the chipped stone industry was a medium/fine grained chert, which varied in colour from light grey/brown to dark greyish-brown or black. It occured in nodular form, with a thin layer of irregular, buff-coloured cortex. The nodules were small, c. 5- 10 cm in diameter, and roughly rounded. There were no obvious signs of water-rolling, which suggests that the nodules were obtained from an outcrop, and not from the streambed. Relative proportions of this type of chert used in the chipped stone industry indicate that it was probably obtained locally. In the early phases of the sequence most of the chert was dark brown and fairly fine-textured, but in later phases use was also made of a paler and more coarse-grained chert.

In addition to the grey/brown chert, very small amounts of other raw materials occured in the QD assemblage. These are imports and give a useful indication of trade or exchange in raw materials, blanks or artefacts in this period.

Obsidian

Ph.	*Comment*	*No.*
0 / 1	Unstratified	1
2 / 3	House fills	10
4		2
5		2
6		3
7		5

Isolated pieces of grey/black obsidian occured throughout the sequence. Most were small chips or unretouched bladelet fragments, among which were two broken retouched blade/bladelets and one chip from a retouched piece. No cores or core preparation elements were recovered, which suggests that obsidian may have been traded as struck blanks.

Artefact	*No.*
Chip	12
Blade/bladelet fragment	6
Flake	2
Retouched piece	3

Brown Flint

Ph.	*Comment*	*No.*
0 / 1	Unstratified	31
2 / 3	House fills 4	47
4		2
5		7
6		0
7		0

Some blanks and retouched pieces are of a smooth-textured mid-brown flint. This type of raw material occurs only in the later phases, mostly in the form of unretouched blade segments and blade tools. The blade blanks are regular, and most commonly trapezoidal in cross-section. This brown flint does not occur in the earliest stages at the site, which suggests the introduction of new exchange networks by Phase 5. The brown flint was used to make both Khiam and Nemrik points, and for other items including scrapers and retouched blades.

Artefact	*No.*
Chip	14
Chunk	2
Blade/bladelet	32
Flake	2
Retouched blade/bladelet	25
Arrowhead	9
Endscraper	3

Radiolarite

Red-brick/liver coloured radiolarite was used as a raw material at Nemrik where two cores, a Nemrik point and a blade were recovered (KOZŁOWSKI 1990:64). A few small chunks of this stone

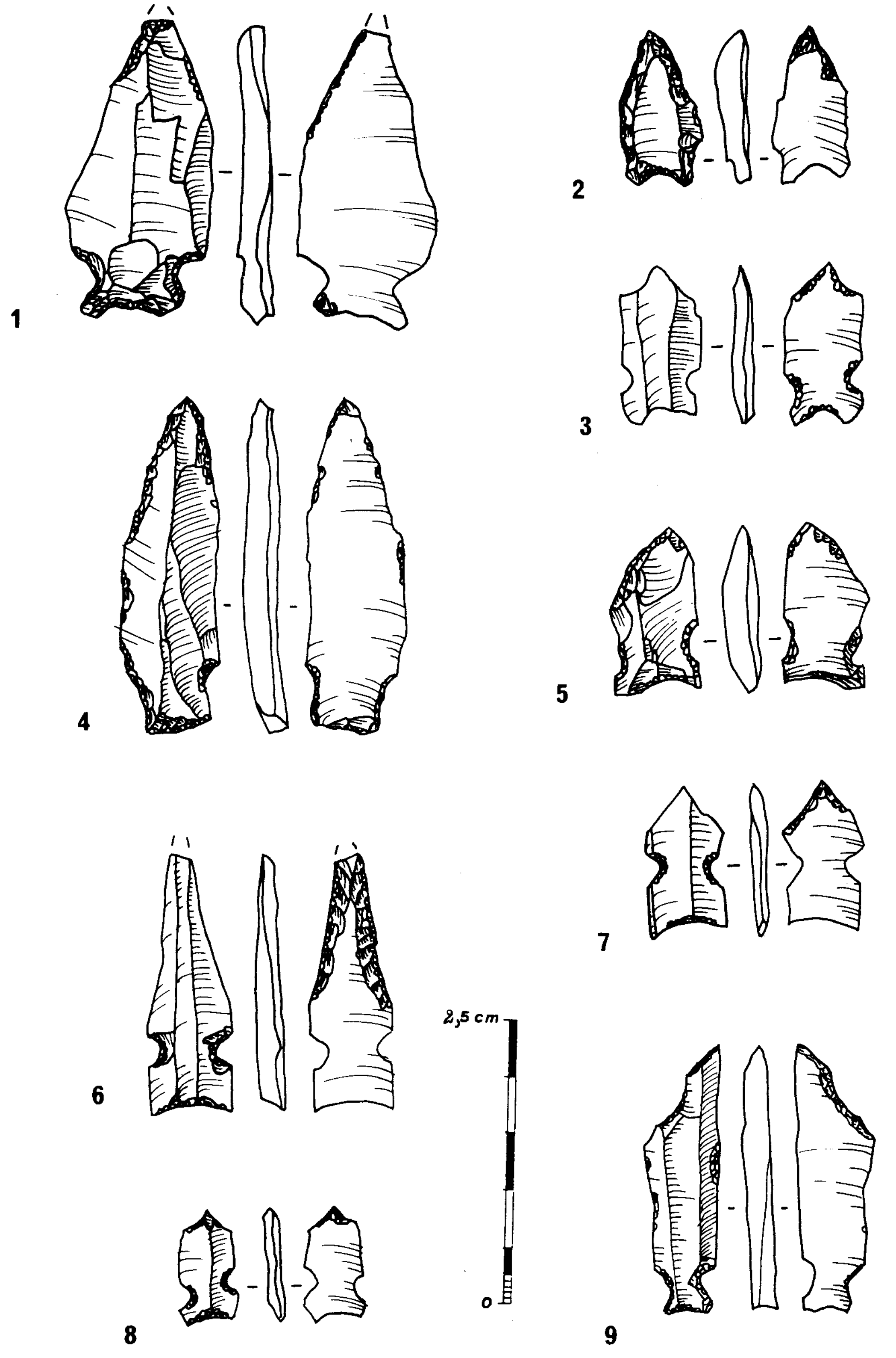

Fig. 1. 1-8 Ka (Khiam points on blades/ bladelets with concave truncations at base, two opposed notches towards the proximal ends, and points usually formed by fine inverse retouch); 9 Kc (same as Ka, but with points formed by oblique truncation).

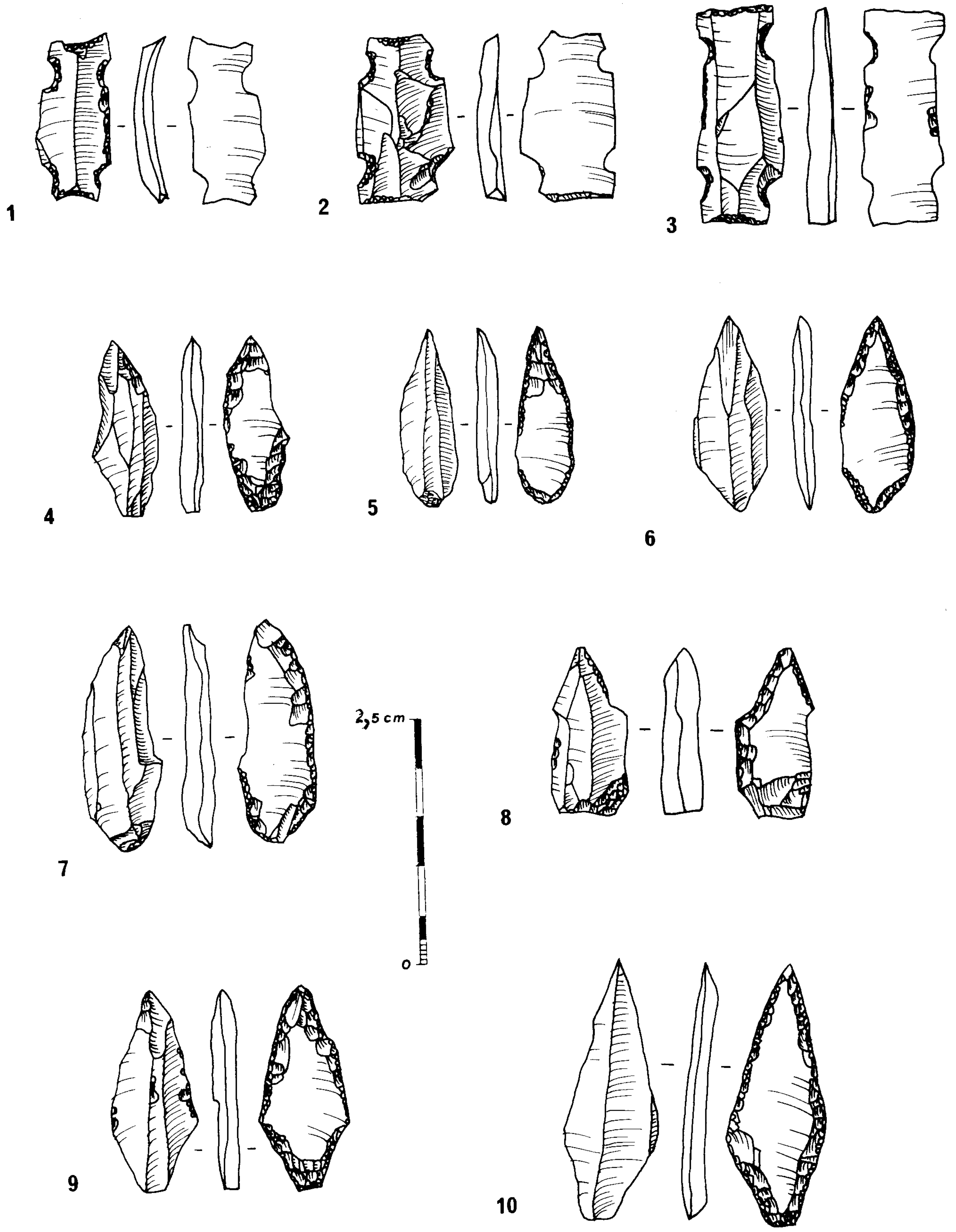

Fig. 2. 1-3 Ha (blades/bladelets with bipolar concave truncations and two pairs of opposed notches towards the ends of the piece; 4-7, 9-10 Na (blades, pointed at both ends by inverse retouch); 8 Nb (same as Na, but shaped by alternate retouch at base).

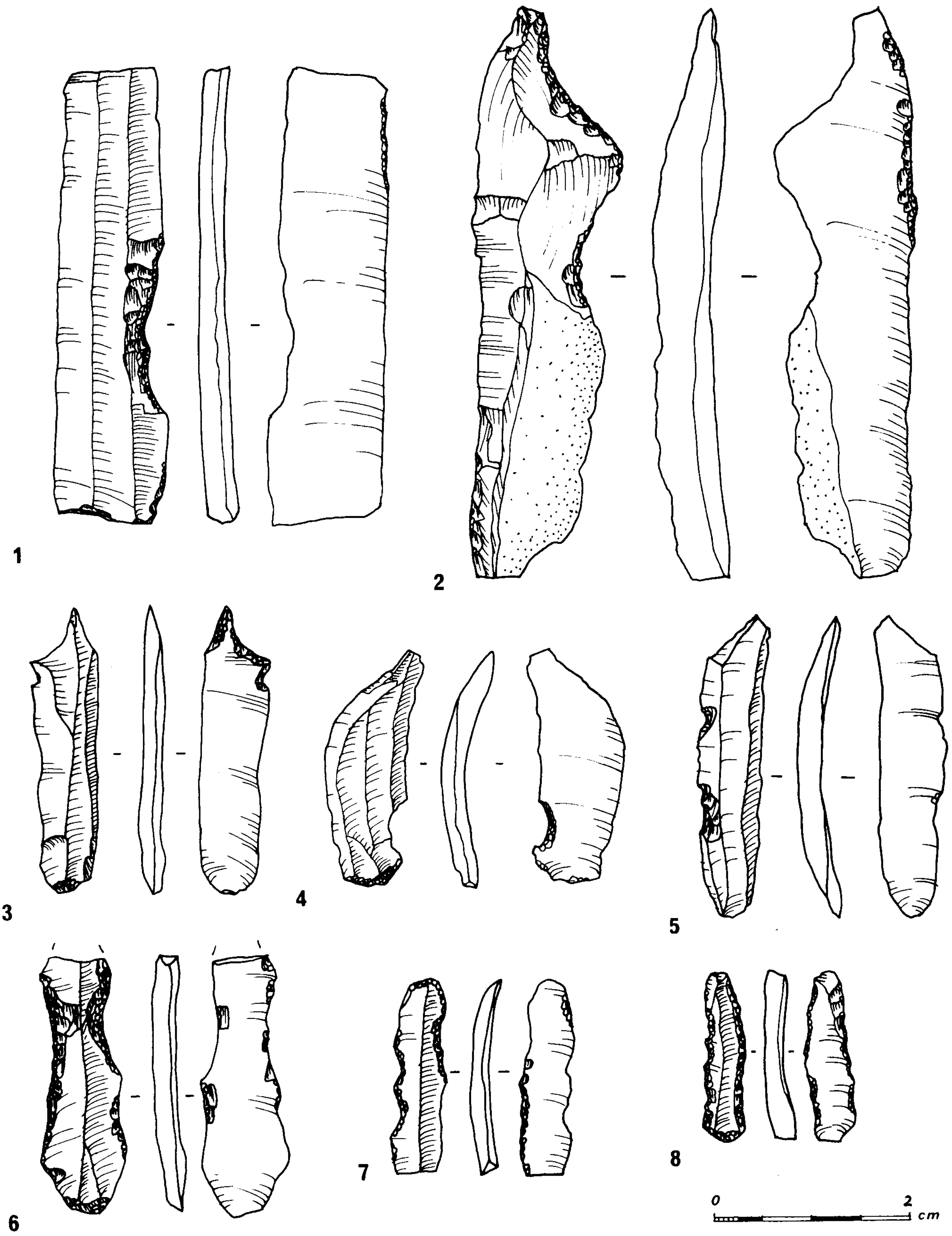

Fig. 3. 1-4 NBa (notched blades/ bladelets with single lateral notches); 2-3 NBb (notched blades/ bladelets with concave truncations at the distal ends and several notches along both sides); 5-8 NBc (similar to NBb, but with no concave truncations).

occurred at Qermez Dere, but there was no indication that it was used as a raw material for the chipped stone industry.

Regional Raw Material Distribution

Small quantities of obsidian were found at Nemrik (KOZŁOWSKI (ed.) 1990: 64), and at Ginnig (CAMPBELL and BAIRD 1990). Trapezoidal blades of brown flint were also found at both sites, again in low numbers. At Ginnig most of the blades occurred as retouched pieces, while at Nemrik a brown flint core was recovered, together with a brown flint Nemrik point and several sickle elements (KOZŁOWSKI and SZYMCZAK 1990: 64). Further afield, at Mureybet, raw materials included small amounts of obsidian, and also a particularly fine chocolate brown flint which was obtained from the paleocene chalks of the river terrace (M.-C. CAUVIN 1978: 5). However, it is not known if this flint is the same as that which appears to have been traded among the early settlements of the middle Tigris.

Technology

Cores are small and relatively poorly worked. Most are fairly heavily reduced. Single platform blade/bladelet cores are most common (26%). Some of these are well prepared and regular, but others are less so. Among those with regular, parallel blank removals are a few single platform pyramidal bladelet cores. Opposed platform blade/bladelet cores occur with moderate frequency (20%), while crossed platform (changed orientation) cores are rare (4%). Flake cores (26%) are irregular. Some are made on exhausted blade cores. Quite a high proportion of the cores are fragmentary or otherwise unclassifiable (24%). Blank removal seems to have been somewhat hapahazard in many cases. Removal scars tend to be uneven, and hinge fracture is relatively common. The low numbers of cores make it hard to determine changes in technology through time, but there is a slight indication that opposed platform cores may be more common in the earlier phases.

The Qermez Dere core technology is generally similar to that of the Nemrick knappers, although at Nemrick more care appears to have been taken in blade removal and finely worked conical blade cores occur as a higher proportion of the single platform core class (KOZŁOWSKI and SZYMCZAK 1989; 1990: 64). Such core forms are fairly typical of the period elsewhere, at sites in the Jezireh such as Ginnig (CAMPBELL and BAIRD 1990), and along the Euphrates at Mureybet (M.-C. CAUVIN 1978: 5).

Phase	*0/1*	*2/3*	*4*	*5*	*6*	*7*
single platform blade/bladelet	26	17	4	2	20	7
opposed platform blade/bladelet	7	9	2	5	17	9
crossed platform blade/bladelet	3	4	0	2	1	0
flake	12	30	3	10	16	8
indeterminate	20	13	7	4	11	6

Core preparation appears to have been a relatively simple procedure involving rough flaking of small nodules to create a platform for blank removal. Primary elements occur in moderate numbers throughout the sequence (4.2% of unretouched blanks), suggesting that some on-site knapping was carried out in each phase. Low numbers of core preparation elements (0.28% of unretouched blanks) may reflect simple knapping techniques which did not involve much in the way of core shaping prior to blank removal. Higher figures for core trimming elements (0.83% of unretouched blanks) indicates intensive use of cores. This efficient use of raw material is also shown by the heavily reduced state of cores from the site. In the simple unretouched blank classes, flakes (12.1%) outnumber blades and bladelets (5.57%). This may be due both to preferential selection of blades and bladelets for tool production, and to the fragility of these particular blanks. The unretouched flakes may represent either unused blanks or waste products of the core reduction sequence. Blades and bladelets have been grouped together as the standard cutoff between the two classes of 1.2 cm seems to be of little significance in the Qermez Dere assemblage. With the exception of blanks on the brown flint, most elongated, parallel-sided blanks fall within the bladelet class. Only a small proportion can be classed as blades, but there is no indication that these were produced in different ways, or that there was deliberate selection of larger blanks for certain tools. They appear simply to be fortuitously larger blanks. Striking platforms on flakes vary from punctiform through facetted to broad and plain. Blade/bladelet striking platforms are punctiform, and there is evidence that before striking, cores were trimmed to remove protruding scar ridges. Blades are generally less regular than bladelets and tend to become wider towards the middle. Bladelets are generally parallel-sided. Most blades and bladelets are snapped, but it is not clear whether these are intentional or accidental breaks. Trapezoidal cross-sections occur more frequently than triangular cross-sections on both blades and bladelets. Debitage has been divided into regular (parallel sided) (9.67% of unretouched blanks) and irregular (55.66% of unretouched blanks). The regular debitage includes small blade/bladelet segments and waste products of blade/bladelet production. Irregular debitage includes other blank fragments and chips. The debris category (11.66%) comprises angular waste material. With the exception of Phase 6, the proportions of all categories remain fairly consistent throughout the sequence. The anomalous figures for Phase 6 may be due to a higher frequency of knapping waste in levels of this phase, much of which is midden deposit.

Phase	*0/1*	*2/3*	*4*	*5*	*6*	*7*
primary element	136	185	183	119	371	320
core reduction element	20	48	4	17	17	4
core trimming element	40	33	30	12	106	42
blade/bladelet	356	419	195	191	388	271
flake	598	952	443	364	1047	537
regular debitage	546	1039	269	443	722	363
irregular deb.	3216	5431	1252	1657	3378	2850
debris	507	1216	184	344	771	578

Burin spalls and microburins have been catalogued separately, as pieces relating to particular types of secondary retouch. Splintered pieces have also been separated out, although since their function is not known, it is unclear as to whether they should be classed as tools or specialised waste products. The numbers of these elements change with time. Burin spalls occur with roughly equal frequency throughout the sequence, but splintered pieces and microburins occur predominantly in the early phases. Microburins are probably associated with the production of geometric microliths, although some may have been accidentally produced in the preparation of notched tools. The function of splintered pieces is uncertain, but they are found in Natufian assemblages in the Levant and in early Neolithic levels at Mureybet. They are rare in the PPNB of the Levant, and it is possible that the figures from the Qermez Dere assemblage reflect a similar trend towards fewer splintered pieces in the later stages of the early Neolithic.

Phase	*0/1*	*2/3*	*4*	*5*	*6*	*7*
burin spall	9	22	6	16	22	5
splintered piece	0	3	0	0	4	5
microburin	1	0	1	2	1	2

Retouched Pieces

A particular problem in analysis of the Qermez Dere assemblage was to establish a typology which made adequate allowance for broken pieces. A high proportion of the retouched pieces were apparently fragmentary. Some of the blade segments may have been deliberately snapped. Tools of this kind have been identified at Nemrik (KOZŁOWSKI ed. 1990: Fig. 35; see also WATKINS *et al.* 1992: 32). In the case of pieces such as broken notched blades, it is not always clear to which class the fragment may have belonged. A notched fragment could have been part of a Khiam point, a notched blade or a Qermez Dere truncation. Similarly, some of the blade ends pointed by normal or inverse retouch may have come from either Nemrik or Khiam points. The solution to this problem has been to divide the typology into intact and fragmentary pieces. The intact pieces can be used as a reliable indicator of spatial or temporal differences. The fragments can be tested against any apparent patterns to see if they echo the same trends.

This report is restricted to an analysis of intact retouched pieces. While limited in number, these present the most accurate indication of change and variation within the site. A full analysis of both broken and intact pieces will appear in the final report on the site.

Khiam Point

Khiam points have been divided into three classes:

Ka: on blade/bladelet with concave truncation at base, two opposed notches towards the proximal end, and a point usually formed by fine inverse retouch.
Kb: the same form as Ka but without the opposed notches.
Kc: the same form as Ka but with a point formed by oblique truncation.

Almost all the points fall into class Ka. The group as a whole is relatively homogeneous and noticably lacks the variety of forms found at Mureybet (M.-C. CAUVIN 1978). There is no evidence of development in style through time. Blanks vary from fine regular bladelets to larger and more irregularly shaped blades. A few pieces have the point worked at the proximal end of the blank, and some of the shorter points may have been re-sharpened after breakage. Class Ka is equivalent to M.-C. Cauvin's Form A10 (1978: Fig. 3). Some fall close to Form A6, which differs from A10 only in that the basal truncation is straight, and not concave. Khiamian points occur throughout the sequence.

Class	*0/1*	*2/3*	*4*	*5*	*6*	*7*
Ka	5	18	7	6	16	4
Kb	1	0	0	0	0	0
Kc	1	1	0	0	0	0

Gilgal Truncation

The Gilgal truncation has its only direct known parallels at Gilgal and Hatula in the Jordan valley (Noy, pers. comm.). Only four have been recovered intact from Qermez Dere, but significantly, two of these came from phase 7. The three intact pieces are on blades with occasional discontinuous retouch on the sides of the blanks. The tool type is sub-divided into two classes, both of which occur at Gilgal.

Ha: blade/bladelet with bipolar concave truncation and two pairs of opposed notches towards the ends of the piece.
Hb: the same form as Ha, but with only one pair of opposed notches.

The function of this tool is obscure. The Hagdud truncation, a bitrunctated piece without notches, has been identified as a discrete tool type within the PPNA of the Levant (BAR-YOSEF *et al.* 1987). The function of the Hagdud truncation is similarly unclear. The researchers who identified Hagdud truncations explored the possibility that they were made from broken Khiam points. They concluded that the truncations were unique tools, and not simply modified fragments.

Class	*0/1*	*2/3*	*4*	*5*	*6*	*7*
Ha	1	0	0	0	0	2
Hb	0	1	0	0	0	0

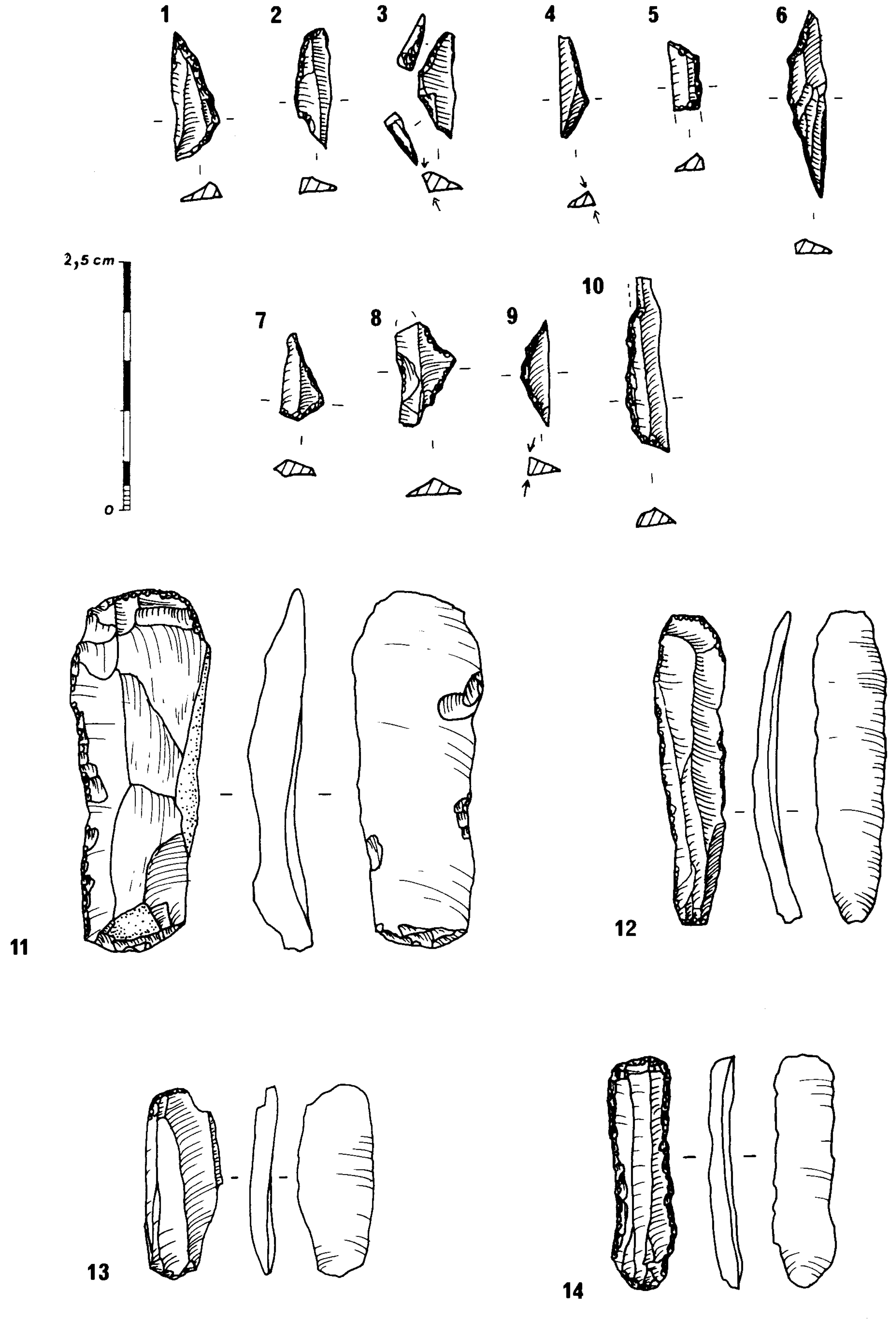

Fig. 4. 1-2, 6-8 Ma (triangles shaped by abrupt, bi-polar retouch); 3-4, 9 Mb (assymetric triangles, normally more elongated than Ma and shaped by abrupt unipolar retouch); 5, 10 Mc (backed bladelet segments with oblique truncation at one end; opposite ends are snapped); 11-14 Sa (endscrapers, usually on blades, but occasionally on elongated flakes).

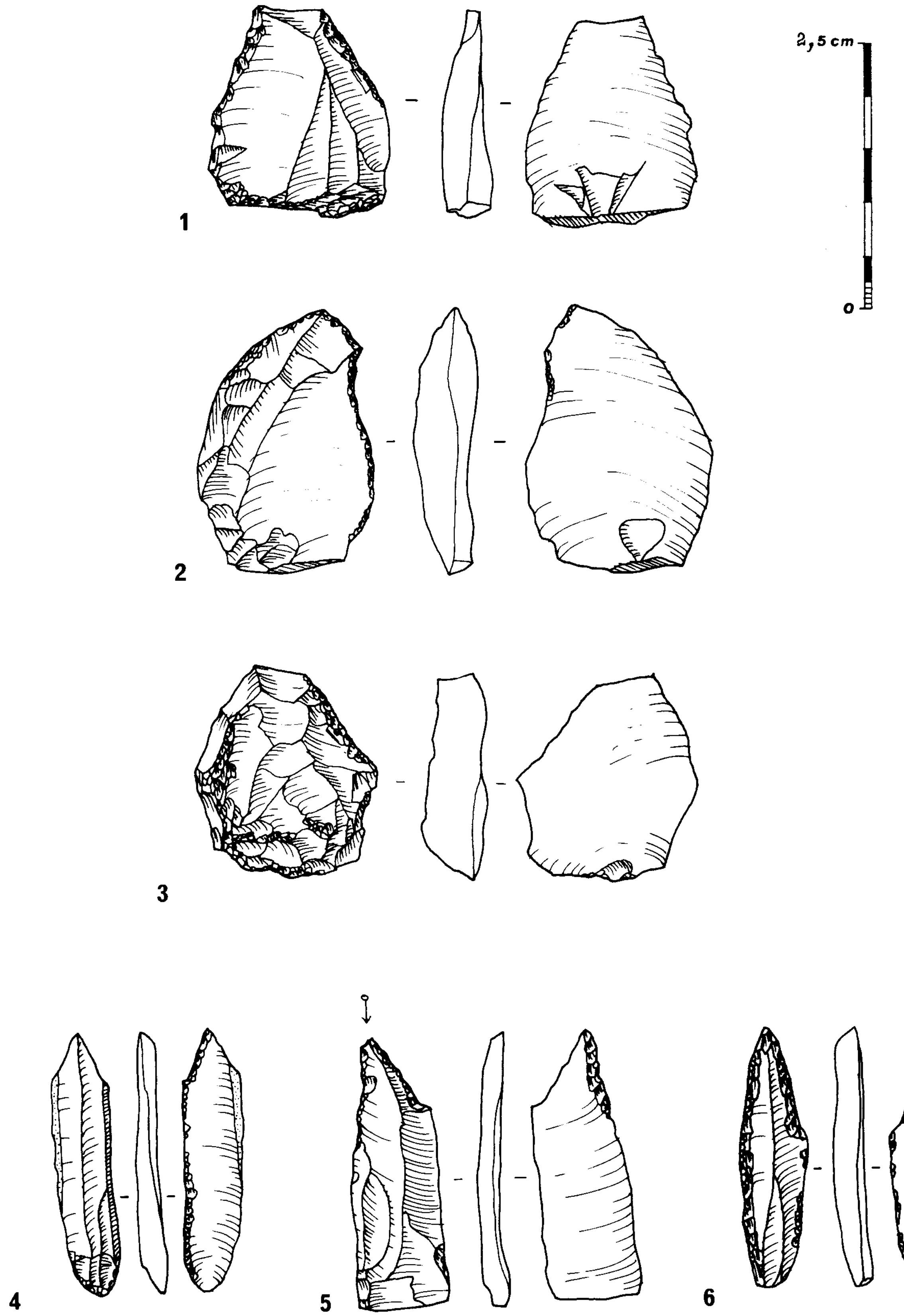

Fig. 5. 1-3 Sc (scrapers on flakes); 4-6 BOa (short points on one end of a blade).

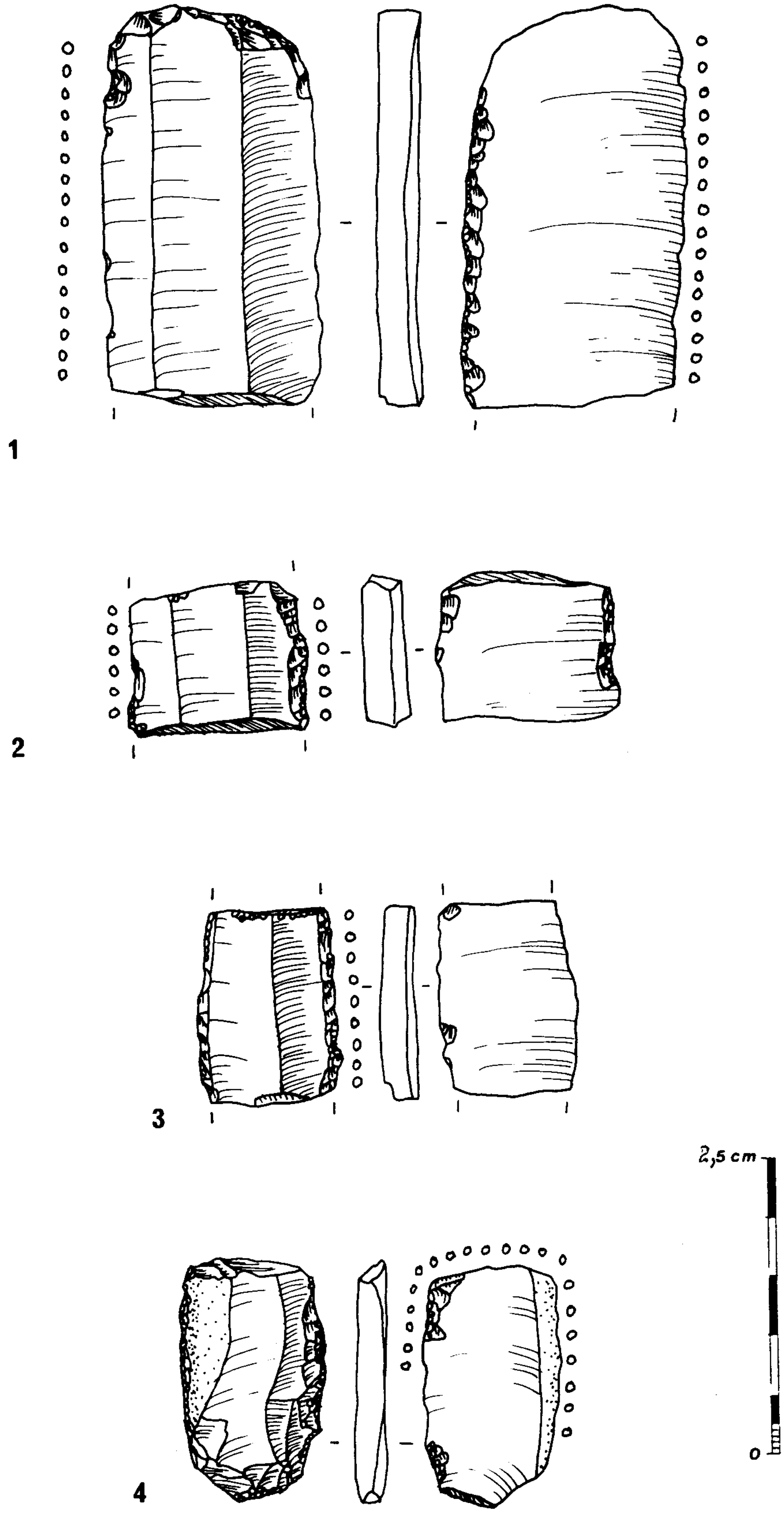

Fig. 6. 1-4 Sla (pieces with sickle gloss, mostly on the edge of blade segments).

Notched Blade

Some blade/bladelets are notched but do not fall into either of the above categories. These have been divided into four classes:

NBa: blade/bladelet with a single lateral notch.
NBb: blade/bladelet with a concave truncation at the distal end and several notches along both sides.
NBc: similar to NBb but with no concave truncation. The tip of the blade is preserved intact and unretouched.
NBd: bladelet with a concave truncation at the proximal end. Two opposed notches have been worked close to the proximal end. The blade has then been snapped at the notches and slightly modified by further retouch.

Class	*0/1*	*2/3*	*4*	*5*	*6*	*7*
NBa	0	3	0	0	1	0
NBb	2	1	0	0	0	0
NBc	1	0	0	1	0	0
NBd	1	0	0	0	1	0

Notched Flake

NFa: typically, medium sized flakes with one or more notches.

Class	*0/1*	*2/3*	*4*	*5*	*6*	*7*
NFa	10	17	4	2	15	3

Nemrik Point

Na: blade, pointed at both ends by inverse retouch. Sometimes the retouch is fine and restricted to the edge of the piece, but it is more commonly semi-invasive, particularly at the proximal end where attempts have been made to flatten the bulb of percussion.
Nb: the same form as Na, but shaped by alternate retouch at the base.
Nc: the same form as Na but shaped by obverse bilateral retouch at the base.

Class	*0/1*	*2/3*	*4*	*5*	*6*	*7*
Na	5	22	6	0	0	1
Nb	1	3	0	0	0	0
Nc	0	1	0	0	0	0

With one exception, Nemrik points occur only in the later part of the sequence, appearing in Phase 4 together with Khiamian points.

Geometric microliths

There are three basic forms, although none of the examples conform to strict types. Even among the small collection in this class, there is a high degree of diversity. Geometrics occur in Neolithic assemblages in the Taurus and Zagros regions (eg. HOLE 1983).

Ma: triangle, shaped by abrupt, bi-polar retouch.
Mb: assymetric triangle, normally more elongated than Ma and shaped by abrupt uni-polar retouch.
Mc: backed bladelet segment with an oblique truncation at one end. The opposite ends are snapped, but it is not clear whether this is intentional or accidental.

Class	0/1	2/3	4	5	6	7
Ma	0	2	0	0	0	0
Mb	3	1	2	0	2	0
Mc	0	1	1	0	0	1

Scraper

Sa: endscraper, usually on a blade, but occasionally on an elongated flake.
Sb: sidescraper.
Sc: a range of scrapers on a flake, ranging from fairly carefully worked round scrapers to flakes with irregular semi-abrupt retouch.

Class	0/1	2/3	4	5	6	7
Sa	5	27	0	8	3	1
Sb	1	3	1	1	1	0
Sc	6	11	0	3	2	1

Burin

Ba: dihedral burin
Bb: burin on a break, either on blades, or more commonly on flakes and chunks.
Bc: broken burin, included as a separate class, although they are incomplete tools.

Class	0/1	2/3	4	5	6	7
Ba	1	1	0	3	0	0
Bb	2	10	1	2	2	1
Bc	4	6	0	1	0	2

Borer

BOa: short points on one end of a blade.

Class	0/1	2/3	4	5	6	7
BOa	2	3	0	0	3	2

Sickle

SIa: piece with sickle gloss, mostly on the edge of blade segments.

Class	0/1	2/3	4	5	6	7
SIa	0	4	0	0	1	0

Other

There are a few miscellaneous tools (Oa) which do not fit into any of the above categories. Among these is a broken core tool which may have been part of an axe/adze tool type.

Class	0/1	2/3	4	5	6	7
Oa	3	4	1	1	2	0

Retouched Blade/Bladelet

This class comprises intact retouched blades which are not included in the notched blade class.

BLa: truncated blade/bladelet.
BLb: backed and pointed blade/bladelet.
BLc: bilaterally backed blade/bladelet.
BLd: crested blade with fine retouch.
BLe: blade/bladelet with normal retouch.
BLf: blade/bladelet with inverse retouch.
BLg: blade/bladelet with alternate retouch.

Class	0/1	2/3	4	5	6	7
BLa	1	10	2	1	6	4
BLb	1	0	2	0	2	1
BLc	2	7	3	1	4	4
BLd	1	2	3	0	6	3
BLe	0	6	0	5	6	4
BLf	0	3	2	2	1	0
BLg	0	1	1	0	2	1

Retouched Flake

FLa: one or two pieces have some inverse retouch, but most are medium-sized irregular flakes with normal retouch around part of the edge.

Class	0/1	2/3	4	5	6	7
FLa	22	31	10	15	27	15

Summary

The Qermez Dere lithic sequence shows some development through time, marked most conspicuously by the appearance of Nemrik points from Phase 4 onwards. The industry has its closest parallels with north Iraqi Neolithic sites such as Ginnig, Nemrik and M'lefaat. This cultural group has affinities with Neolithic industries to the west, most closely with sites on the Middle Euphrates, but more distantly with early aceramic Neolithic sites in Palestine. Khiamian points occur in both areas, but forms related to the Nemrik point appear to be found only in the Euphrates region. By contrast, Gilgal truncations have not been recorded from sites in northern Syria.

However, cultural connections are not purely with the west. The microlithic tradition indicates connections with the Taurus region and, more closely, with the Zagros/Iranian zone.

Acknowledgments: This report is published by kind permission of the Project Director, Dr Trevor Watkins. We are most grateful for the assistance of the Director-General of Antiquities and Heritage of Iraq, Dr Mu'ayyad Sa'id Damerji, Director of the Northern Region in Mosul, Manhal Jabr Ismail, and Moslem Mohammed Ahmed, the Representative of the Department of Antiquities in Tell Afar.

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South-East Anatolian Chipped Stone Sequence

(Approach for a Synthesis)

Mehmet Özdoğan and Nur Balkan-Atlı

ABSTRACT. *Chipped stones industries of the Anatolian neolithic sites cannot be synthesized as the final results have not been reached yet. For the moment the observations indicate different traditions for the south-east and central Anatolia. South-east Anatolia seems to be a contact zone with elements from the Levant and Zagros to which local elements are added. Central Anatolia seems to have different kinds of traditions difficult to compare themselves as well as with other regions.*

RÉSUMÉ. *A présent il est difficile d'arriver à une synthèse sur les industries lithiques taillés des sites néolithiques acéramiques d'Anatolie car les résultats finaux ne sont pas encore disponibles. Pour l'instant les observations indiquent des traditions différentes pour l'Anatoile du sud-est et pour l'Anatolie centrale. L'Anatolie sud-est semble être une zone de contact où des éléments du Levant et du Zagros sont ajoutés aux éléments locaux. L'Anatolie centrale semble avoir des traditions variées qui sont difficiles à comparer entre elle-mêmes ou avec les autres régions.*

At present it is impossible to arrive at a synthesis on the Anatolian lithic industries. Most of them are still being worked on, and the final results have not been reached yet. Here we will give -as a basis for discussion- an archaeological sequence in regards to certain lithic criteria. We would like to emphasize that there is no evident comparison between the south-east and central Anatolia, so they should be considered as different entities.

For south-eastern Anatolia the following observations can be stated:

-The use of raw material seems to depend on the geographical setting of the sites; those on lower elevations use mostly flint whereas those on higher elevations, nearer to the obsidian sources, begin with the use of flint which is replaced by obsidian.

-The general tradition of technology (opposed platform cores) and typology (Byblos points) cannot be separated from the Levant.

-Pyramidal cores and Nemrik points show affinities with the Zagros until the end of the early PPNB.

-To these elements from two different zones, a local element, Çayönü tools, can be added from the beginning of the middle PPNB.

-Microliths are present in most of the sites of the early PPNB whereas geometrics are observed, only in small numbers, at Cafer Höyük and Nevalı Çori.

Briefly, we can say that the south-east Anatolian chipped stone industry shows affinities with the Zagros and the Levant, besides having probably a local traditon.

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Period	Criteria / Sites	Obsidian	Flint	Bullet Cores	Bidirect. Cores	Micro-liths	Geo-metrics	Çayönü Tools	Byblos Points	Oval Points	Nemrik Points
PN	Çayönü	x									
Late PPNB 6500-6000 BC	Hayaz		x		x				x		
	Gritille		x		x			x	x	x	
	Boytepe	x						x			
	Cafer H. (Late Phase)	x						x	x	x	
	Çayönü "Large Room"	x						x	x	x	
Middle PPNB 7200-6500 BC	Çayönü "Cobble Paved"	x			x			x	x	x	
	Nevalı Çori		x		x				x		
	Çayönü "Cell Plan"	x			x			x		x	
	Cafer H. (Middle Phase)	x			x			x	x	x	
Early PPNB 7600-7200 BC	Nevalı Çori		x			x	x			x	
	Cafer H. (Early Phase)	x	x	x		x	x				
	Çayönü "Channel Plan"	x									
	Çayönü "Grill Plan"	x	x	x		x					x
PPNA 8300-7600 BC	Çayönü "Wattle and Daub"	x	x	x		x					x
	Hallan Çemi	x	x			x	x				x

Fig. 1. The south-east Anatolian chipped stone sequence and its criteria, as a basis of future chronological discussion.

Die frühholozänen Horizonte der Öküzini - Sondage 1989

Gerd Albrecht

Über die allgemeinen Ergebnisse der 1989 vom Institut für Urgeschichte, Tübingen, durchgeführten Sondage in der Öküzini bei Antalya/ Türkei ist an anderer Stelle berichtet worden (ALBRECHT *et al.* im Druck). Hier sollen zusammenfassend die frühholozänen Horizonte beschrieben werden. Es handelt sich um die archäologischen Horizonte AH 2 und AH 3, etwa 30 - 70 cm unter der Oberfläche im hinteren Höhlenteil. In der Sondage waren diese Horizonte auf einem Viertelquadratmeter aufgeschlossen, die Kubatur der Abtragungen betrug nur 0,1 m^3.

Datierung: Es liegen zwei 14C-Daten vor. Das Probenmaterial war Holzkohle (Quercus). Der AH 2 ergab durch konventionelle Messung ein unkallibriertes Datum von 8.595 ± 80 bp (HD 14363-13884), der AH 3 wurde mit dem Beschleuniger auf 8.800 ± 80 bp (ETH 8031) datiert.

Sedimente: Sie unterscheiden sich nach der Analyse kaum von den liegenden Sedimenten der Archäologischen Horizonte bis zum AH 8 (die Sedimente sind bis zu einem AH 17 aufgeschlossen) und sind in hohem Anteil anthropogen überprägt.

Artefakte: Das Steingerätinventar ist gekennzeichnet durch trapezförmig retuschierte Mikrolithen (Abb. 3-5), langschmale ungleichschenklige Dreiecke (Abb. 7,8) und Segmente (Abb. 2); außerdem liegt das Fragment eines geschliffenen Steinbeiles vor. Gegenüber den älteren "pleistozänen" Inventaren der Öküzini fehlen die dort typischen geometrischen Dreiecke und Rückenspitzen. Auch Rückenmesser, die für den untersten Komplex der Abfolge charakteristisch sind, fehlen völlig. Auffälligerweise sind auch keine Reibsteine gefunden worden, die in den Schichten der Öküzini schon um 12.500 bp (unkallibriert) auftauchen. Für diese frühe Zeit sind auch recht häufig sogenannte "Scapulamesser" belegt, aus einem Schulterblatt von Ovis oder Capra herausgeschnitten, bei denen es sich um Erntemesser im weitesten Sinn handeln könnte: Sie fehlen ebenfalls in den holozänen Horizonten.

Trotz der geringen ausgegrabenen Kubatur sind aufgrund des großen Fundreichtums genauere statistische Angaben zur Steingerätindustrie möglich. Ein guter Wert zur Bestimmung der Qualität der Abschlagtechnik ist das Verhältnis der Fläche eines Abschlages zu seiner Dicke (Wurzel L x B : D). Bei gleichen Rohmaterialvoraussetzungen und einem ähnlichen Anteil an Kernen (0,7% der Abschläge > 1 mm) ist dieser Wert mit 4,3 deutlich geringer als in allen vorangegangenen Horizonten. Dies liegt an der im Durchschnitt 10-20% größeren Dicke der Stücke. Die erhaltenen Schlagflächen sind in den holozänen Horizonten zudem um mindestens 15% größer. Ebenso ist der Anteil der modifizierten Stücke mit nur 1,5% der Abschläge um die Hälfte und mehr niedriger als in den älteren Komplexen. Dies alles zeigt eine deutlich weniger effektive Klingentechnik für den jüngsten Abschnitt in der Öküzini.

Ein weiterer interessanter Aspekt ist ein leichter Rückgang des Kratzeranteils auf 30%: Die mittleren Horizonte, mit "neolithischen" Elementen wie Reibsteinen oder "Erntemessern", zeigen fast durchweg etwa 50%, der unterste, "jägerische" Horizont hat mit 15% den geringsten Anteil.

Schmuckmollusken gewinnen bei der Zuordnung von Industrien eine immer größere Bedeutung: Sie bezeichnen "Moden", die sich über große Entfernungen verbinden lassen. Alle Besonderheiten des Schalenschmucks aus den holozänen Horizonten der Öküzini weisen auf ähnliche Erscheinungen des ostmediterranen Neolithikums hin. Dazu gehören bis auf den "Mund" abgeschliffenen Exemplare von

Arcularia sowie die Verwendung der Porzellanschnecke (*Luria lurida*) mit vulvaähnlicher Ventralseite. Dazu wird aber die Schmucktradition der tieferen Schichten fortgesetzt.

Fauna: Nachgewiesen für die holozänen Abtragungen ist Wildschaf, Damhirsch, Wildschwein und Wildrind. Ob auch Wildziege gejagt worden ist, läßt sich nicht entscheiden. Mit einem Anteil von unter 30% Dama und dem Fehlen von Reh (ebenso wie dem fehlenden Nachweis von Wildziege ?) gleicht diese Einheit dem untersten, "jägerischen Horizont" der Öküzini und unterscheidet sich deutlich von den dazwischenliegenden Horizonten mit "neolithischen" Erscheinungen.

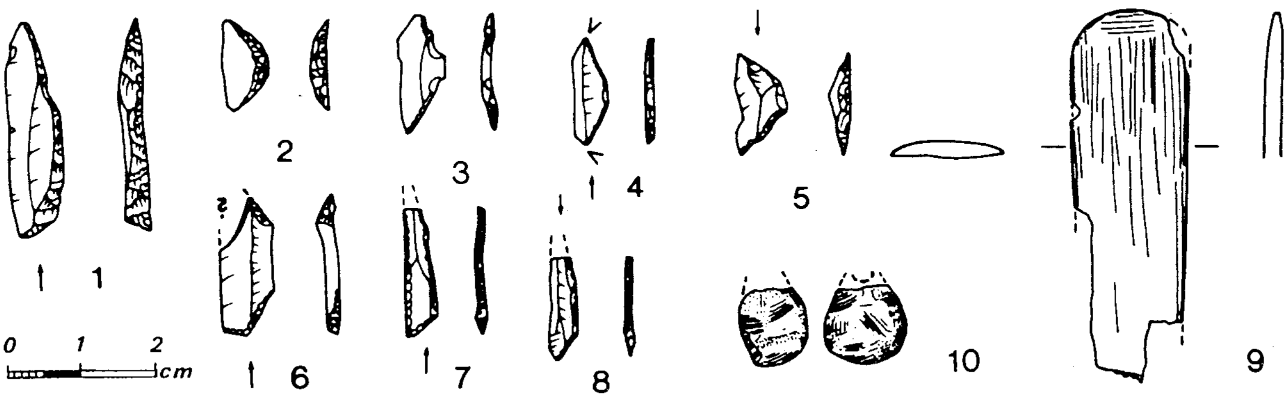

Fig.1. Öküzini 1989, holozäne Horizonte AH2 und AH3: 1 Rückenspitze, 2 Segment, 3-5 Trapeze, 6 spezielle mikrolithische Formen, 7-8 langschmale ungleichschenklige Dreiecke, 9 Knochenspatel, 10 Steinanhänger.

Schlußfolgerungen: Der holozäne Komplex der Öküzini ist zeitgleich mit dem akeramischen Neolithikum in der Türkei. Dieser bisher jüngste Horizont in der Fundstelle enthielt zwar ein geschliffenes Steinbeilfragment, was jedoch keinen Gegensatz darstellt zu den sonst ausschließlich jägerisch/sammlerischen Komponenten. Damit ist dieser Komplex an die 50 km südlich an der Küste liegen-den Station Beldibi anzuschließen, von der es leider keine detaillierten stratigraphischen Angaben gibt.

Da es die für die späten "jägerischen" Inventare typische Mikrolithik (Segmente, langschmale Dreiecke) auch im neolithischem Zusammenhang gibt, hat eine Begehung am 30.4.1982 mit I. Yalcinkaya am Aşıklı Hüyük gezeigt (Funde in der Universität Ankara). Leider ist bisher bei den Grabungen dort (bis 1991) das Sediment nicht gesiebt worden, sodaß die Kleinformen fehlen. Ebenso sind bei den Grabungen in Nevalı Çori nur äußerst vereinzelt Mikrolithen gefunden worden (schriftl. Mitteilung Klaus Schmidt).

Nur knapp ein Jahrtausend später hat mit dem frühen Chalkolithikum endgültig eine neolithische Wirtschaftsform den Raum Antalya erreicht, wie die reichen Funde aus Karain B, AH 13-11 belegen (SEEHER 1987).

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The Typological Characteristics of Aşıklı Höyük Chipped Stone Industry

Nur Balkan-Atlı

ABSTRACT. *Aşıklı Höyük is situated in central Anatolia, not far from obsidian sources, and its chipped stone industry is entirely of obsidian. Obsidian was brought to the site in the form of blocks or tablets and all the knapping took place on the site. The obsidian tools of Aşıklı Höyük are dominated largely by scrapers of all types and diversely retouched blades. Microliths as backed and truncated bladelets, and geometrics as triangles and lunates, are also present. Arrowheads, borers and burins are quite rare.*

RÉSUMÉ. *Aşıklı Höyük se trouve en Anatolie centrale, près des sources obsidienne, et son industrie lithique est entièrement en obsidienne. L'obsidienne a été apportéeau site sous forme de blocs et de tablettes, et tout le débitage était pratiqué sur le site. L'outillage de Aşıklı Höyük est dominé par les grattoirs de types varieés et par les lames diversement retouchées. Les microlithes, comme des lamelles à dos et des lamelles tronquées, et les géométriques, tels que des segments et triangles, sont aussi présents. Les pointes de flèches, les perçoirs et les burins sont plutôt rares.*

Aşıklı Höyük is an aceramic Neolithic settlement in central Anatolia, near Aksaray in the Cappodoce region. Excavations have been going on since 1989[1]. The site is dated to 8700-8500 BP. and it presents well preserved rectangular architecture of mud brick, closely knitted with narrow spaces and garbage areas in between. The economy was based on hunting, and no evidence of agriculture has been found yet (see ESIN 1993; ESIN *et al.* 1991).

Technological Remarks

The chipped stone industry of Aşıklı Höyük is entirely of obsidian amounting 72,000 pieces in four campaigns of excavation. The site, situated in the region of obsidian sources of central Anatolia, acquired its raw material from two sources as far as the analyses show: the Kayırlı source and the Nenezi Dağ source (BALKAN-ATLI 1993). The obsidian seems to have been brought to the site in the form of blocks and tablets, and the knapping took place on the site.

The debitage amounts to 83.5% of the industry (Table 1). The cores, 2.3% of the industry, are mostly opposed platform blade cores (Fig. 1); single platform blade cores and flake cores are less frequent. The cores were usually found in exhausted or small broken states. In the debitage blades are far more numerous than flakes. No pressure technique nor indirect percussion were observed in the knapping. Hard percussion seems to be the technique used.[2]

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[1] The excavations at Aşıklı Höyük are by the Prehistory Section of the Istanbul University directed by Prof. Dr. U. Esin.

[2] A workshop was organized for the analysis of the technology during the 1993 campaign with the participation of M.C. Cauvin, D. Binder, F. Abbès and the author. The methodology was established and the results will be reached in the forecoming years.

Table 1. Debitage in general (core trimming and preparation pieces counted in blades and flakes).

blades	23.041	38.1%
bladelets	4.192	6.9%
flakes	16.540	27.4%
burin spalls	47	0.1%
chips	8.200	13.5%
chunks	8.409	13.9%
Total	60.429	99.9%

Typology

The retouched obsidian artefacts constitute 13.6% of the industry. These tools have blanks as flakes (52.2%), blade and bladelets (46.3%) and fragments of cores or tablets (1.5%).

Table 2. Tool Types

Type	*Number*	*Frequency*
Microliths	434	4.23%
truncated	20	
pointed	63	
backed	177	
notched	14	
various	135	
lunates	16	
triangles	9	
Arrowheads	88	0.86%
Pointed Blades	176	1.72%
Perforators	61	0.59%
Scrapers	6.444	62.83%
endscraper/flake	2.564	
double scraper/flake	185	
semi-circular	511	
circular	327	
endscraper/blade	1201	
double scraper/blade	81	
fan scraper	18	
scraper/core	103	
various	154	
fragments	866	
Sidescrapers	17	0.17%
Truncated blades	82	0.80%
Backed blades	698	6.81%
Various retouched blades	1.650	16.08%
Notched pieces	166	1.62%
Retouched flakes	361	3.52%
Burins	72	0.70%
Pièce esquillée	7	0.07%
Total	*10.256*	*100.00%*

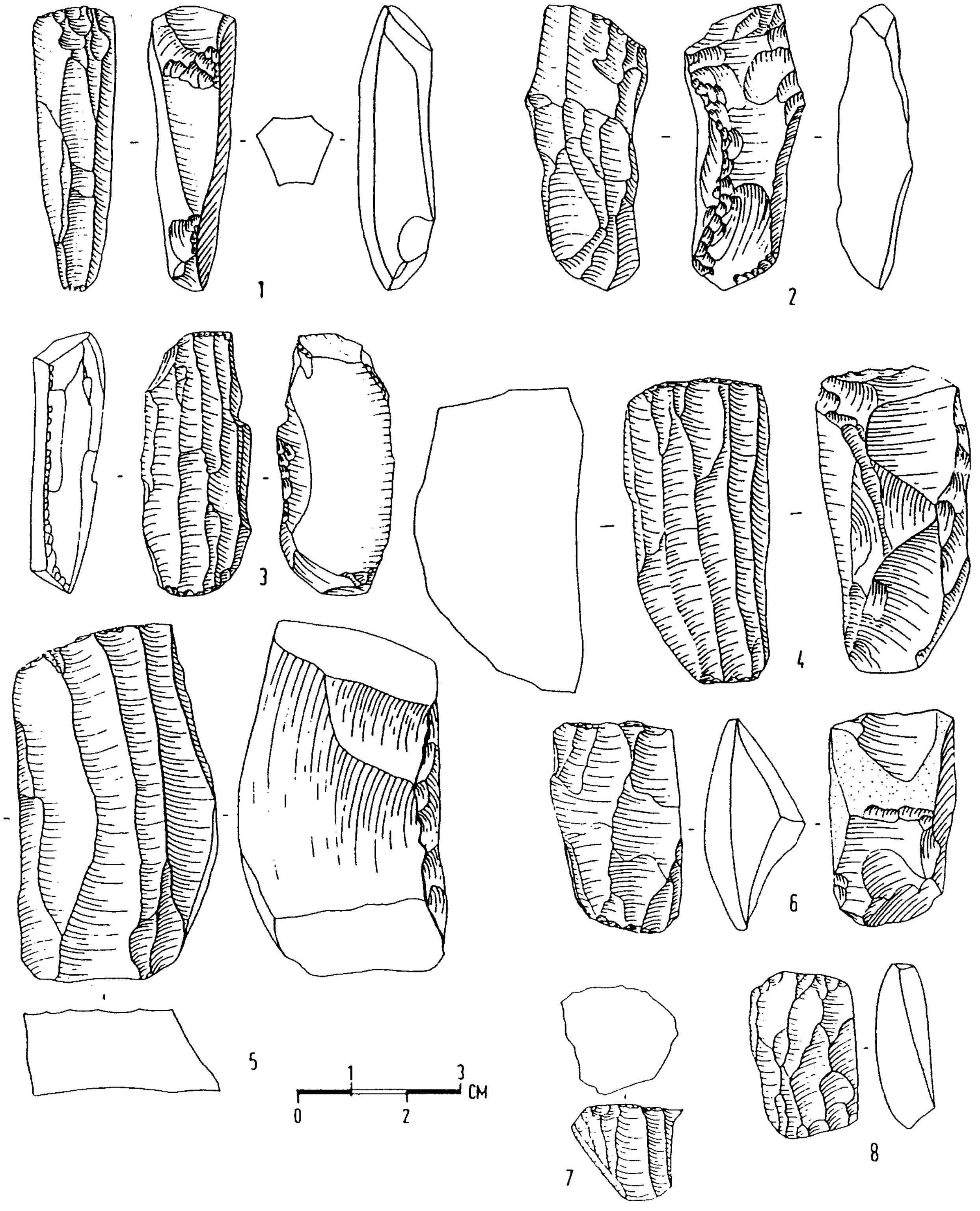

Fig. 1. Aşıklı Höyük cores: 1-6,8 opposed platform cores, 7 pyramidal core.

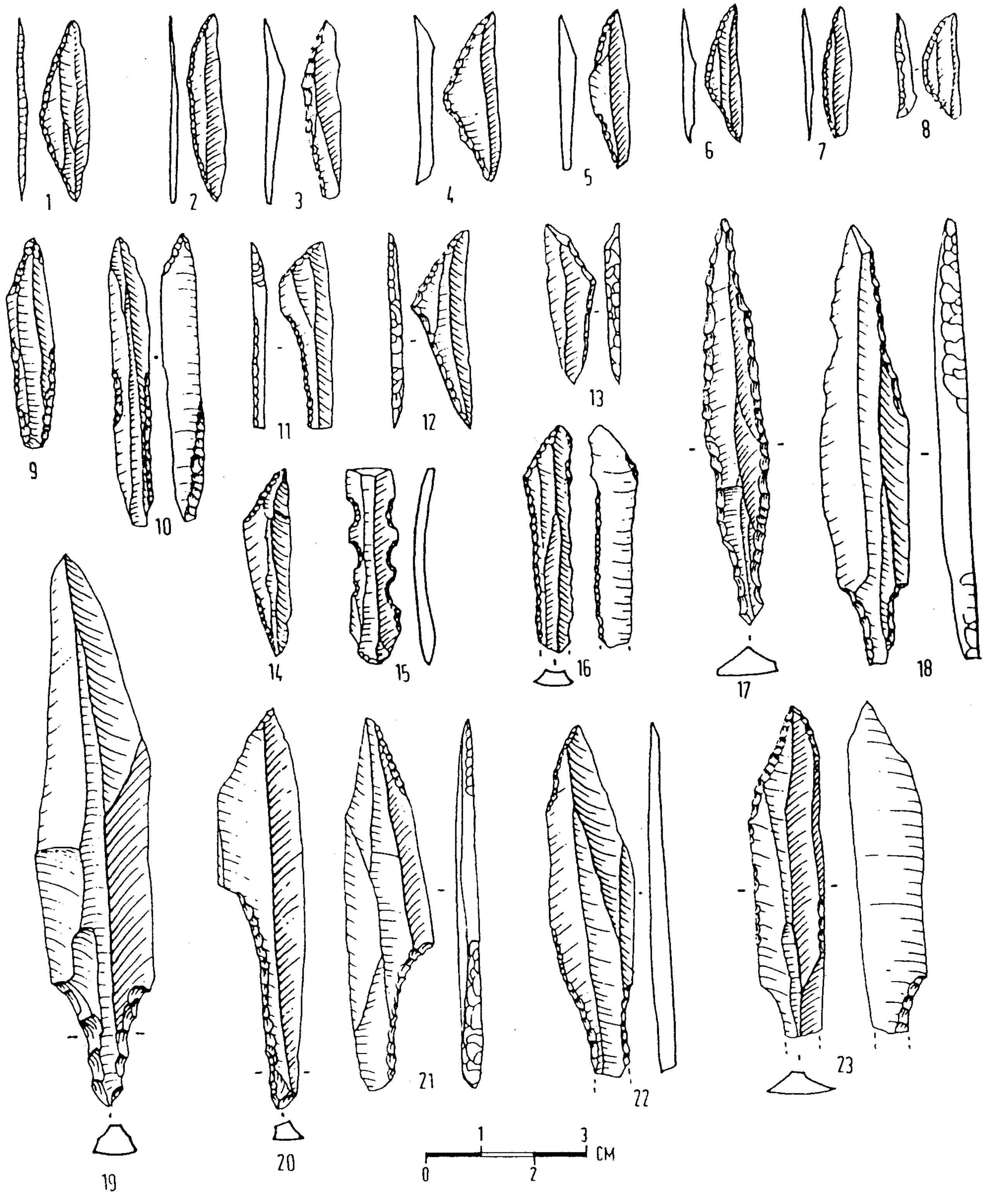

Fig. 2. 1-6 microliths, 17-23 arrowheads.

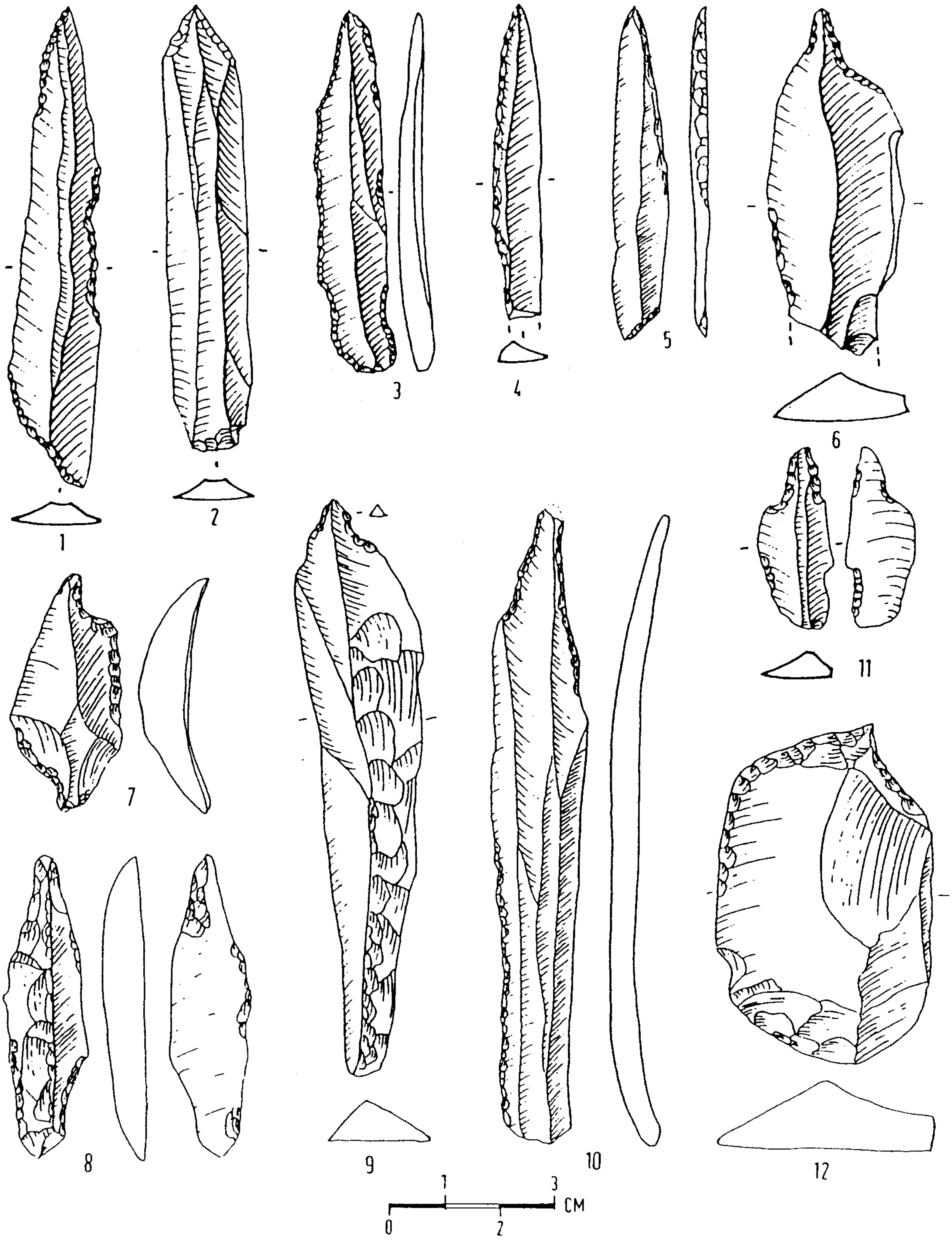

Fig. 3. 1-5 pointed blades, 6-12 perforators.

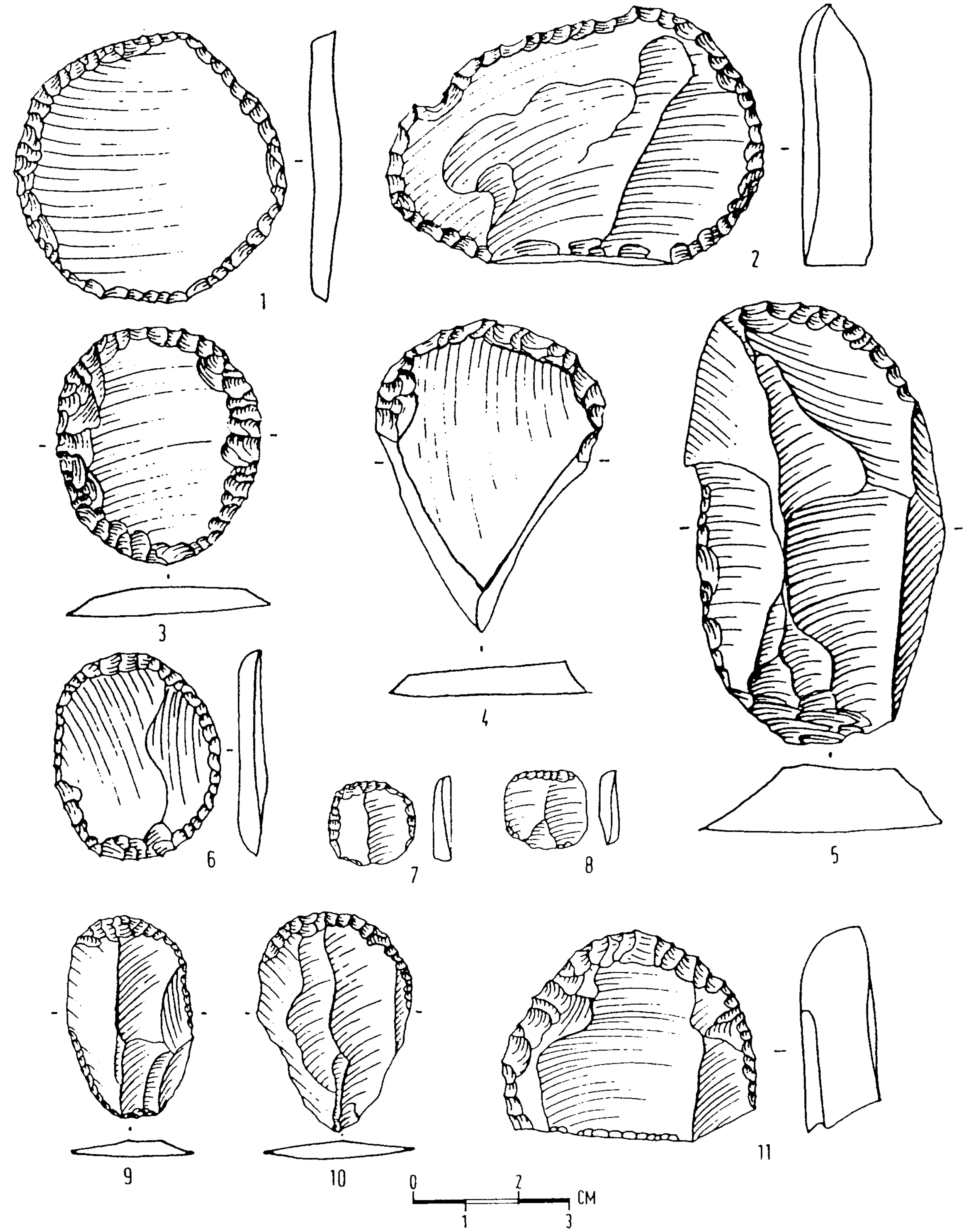

Fig. 4 . 1,3,6 circular scrapers, 2,7,11 semi-circular scrapers, 5,8-10 endscrapers on flake, 4 fan scraper.

Microliths

The microliths form 4.1% of the tools. They display a variety of forms: obliquely truncated bladelets (Fig. 2: 9,11,14,16), pointed bladelets (Fig. 2:10), rarely notched or denticulated bladelets (Fig. 2: 15), backed bladelets and finely retouched bladelets. The microliths comprend also geometrics in form of small triangles and lunates (Fig. 2: 1-8,12,13).

Points

Arrowheads are found in scarce numbers (0.9% of the tools). They are made on long , regular blades. The tangs are formed by direct steep retouch either on both sides forming two-shouldered Byblos kinds of points (Fig. 2:18,19,22), or on one side forming one-shouldered points (Fig.2:20,21,23). The point may be left unretouched (Fig. 2:19), retouched on both sides (Fig. 2:23) or most commonly retouched on one side (Fig.2: 18, 20, 21, 22). In most of the one shouldered points the tip is not axial, it is more or less oblique (Fig. 2:20). Another kind of arrowhead is formed by steep retouch all along the sides (Fig.2:17). This type is not clearly defined and may be bi-pointed blade or a kind of piercing tool.

Pointed Blades

This group of tools is composed of pointed blades which in some cases enter the class of toois as projectiles and in some cases as piercing tools. The tip is formed by steep retouch on one or both sides, either limited to the tip (Fig. 3:1,2) or continuing along the side (Fig. 3:3-5). The proximal end is often truncated obliquely (Fig. 3:1,5).

Piercing Tools

Clearly defined perforators are quiet rare (0.6%). They may be fabricated on blades, regular or crested (Fig. 3: 6,8-9,10-11) or more rarely on flakes (Fig. 3:7,12). The tip is usually made by steep retouch on both sides forming more or less long tips. Double perforators are rare (Fig. 3:7).

Scrapers

Scrapers compose the most abundant and popular tool type in the settlement, forming 62.8% of the retouched pieces. Scrapers on flakes (77.4%) are most numerous, and they can be divided into four categories: simple end scrapers on flakes (39.8% of the total of scrapers), double scrapers on flakes (2.9%), semi-circular scrapers (7.9%) and circular scrapers (5.1%). Simple scrapers are the most common type. They can be on large flake blanks (Fig. 4:5) or small flake blanks (Fig. 4:8-10). The abrupt retouch is mostly limited to the distal part forming a rounded front. The sides rarely bear retouch, the distal end is seldomly transformed and the bulb is usually present. Double scrapers on flakes are rare (Fig. 5:3,9). The fronts are usually on the sides and sometimes alternating (Fig. 5:6,8). Semi-circular scrapers (Fig. 4:2,7,11) are usually formed by steep retouch continuing all along the sides except the proximal end, which is often left untouched. Circular scrapers are usually finely executed on medium to small sized regular flakes. The bulb is usually removed and the abrupt retouch continues all around the piece (Fig. 4:1,3,6). Fan scrapers are very few (Fig. 4:4).

Scrapers on blades constitute 19.9% of the scrapers and 1.3% of them are double scrapers. They are executed mostly on regular blades, the front being limited to the distal end which is again mostly rounded (Fig. 6). The sides are rarely retouched and the bulbar end is either left untouched (Fig. 6:2,5-9) or retouched (Fig. 6:1,3-4,10). The double blade scrapers display the same characteristics, except the bulb is taken out and the proximal end is transformed by steep retouch (Fig. 5:1,2,4-5,7,10).

Scrapers on core fragments, thick primary flakes and rejunavating tablets are quite common (Fig. 7). Some of the cores broken by plunging accidents were transformed to scrapers (Fig. 7:4,7). A big number of broken scrapers was found. As they are mostly in form of small fragments, it was impossible to classify them. Sidescrapers are very few (0.17% of the tools) being executed on large flakes.

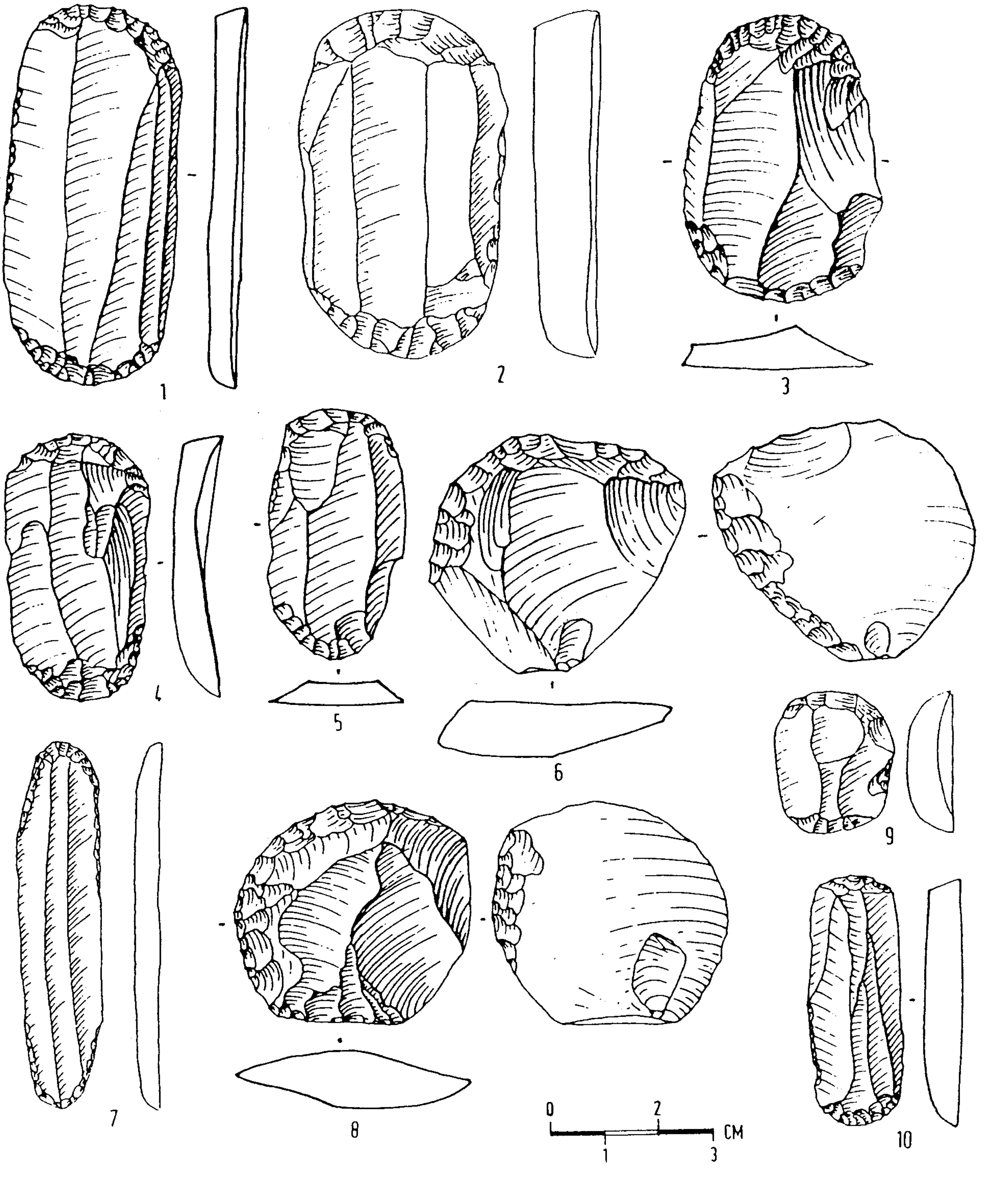

Fig. 5. Double scrapers on flakes and blades.

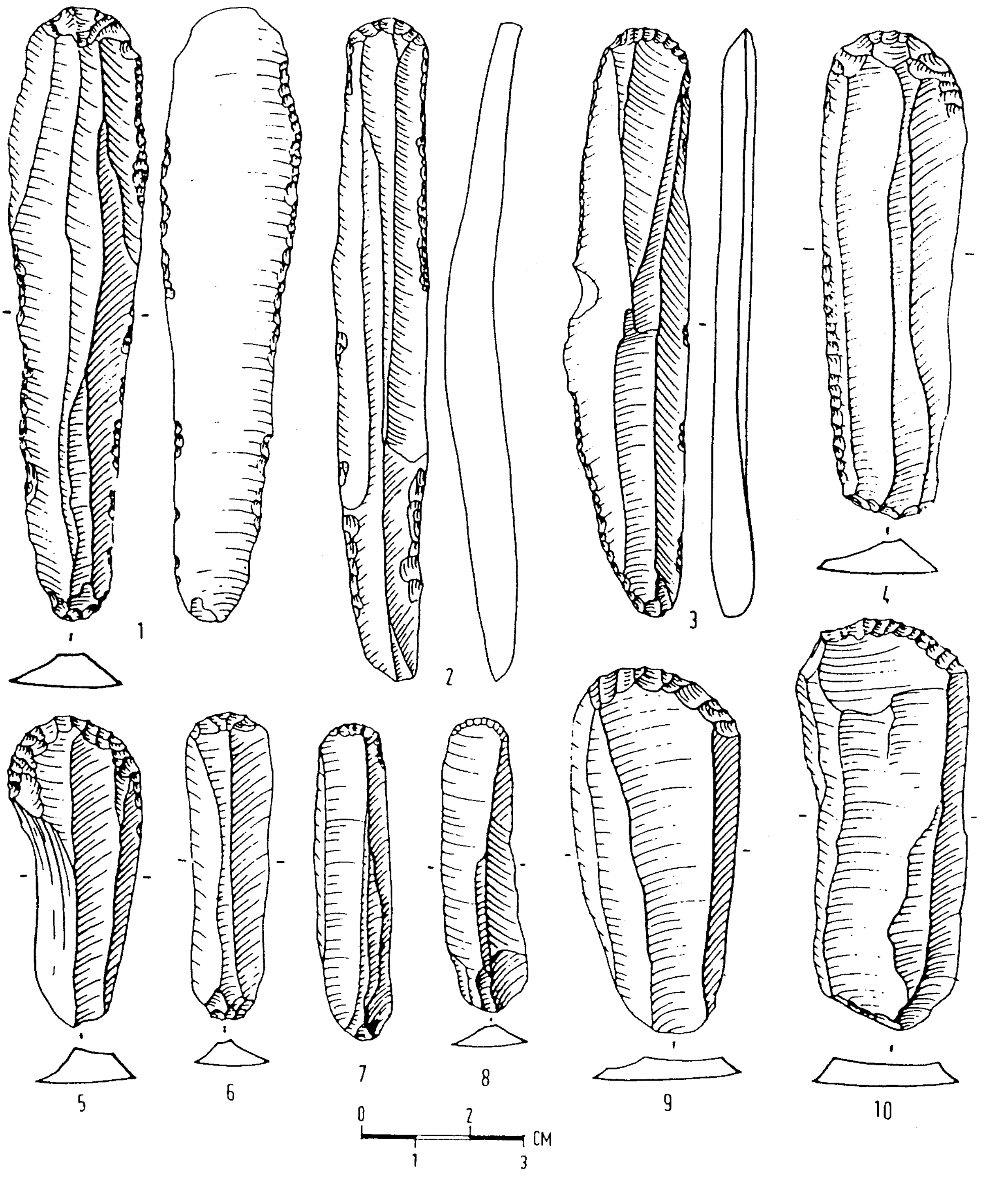

Fig. 6. Endscrapers on blades.

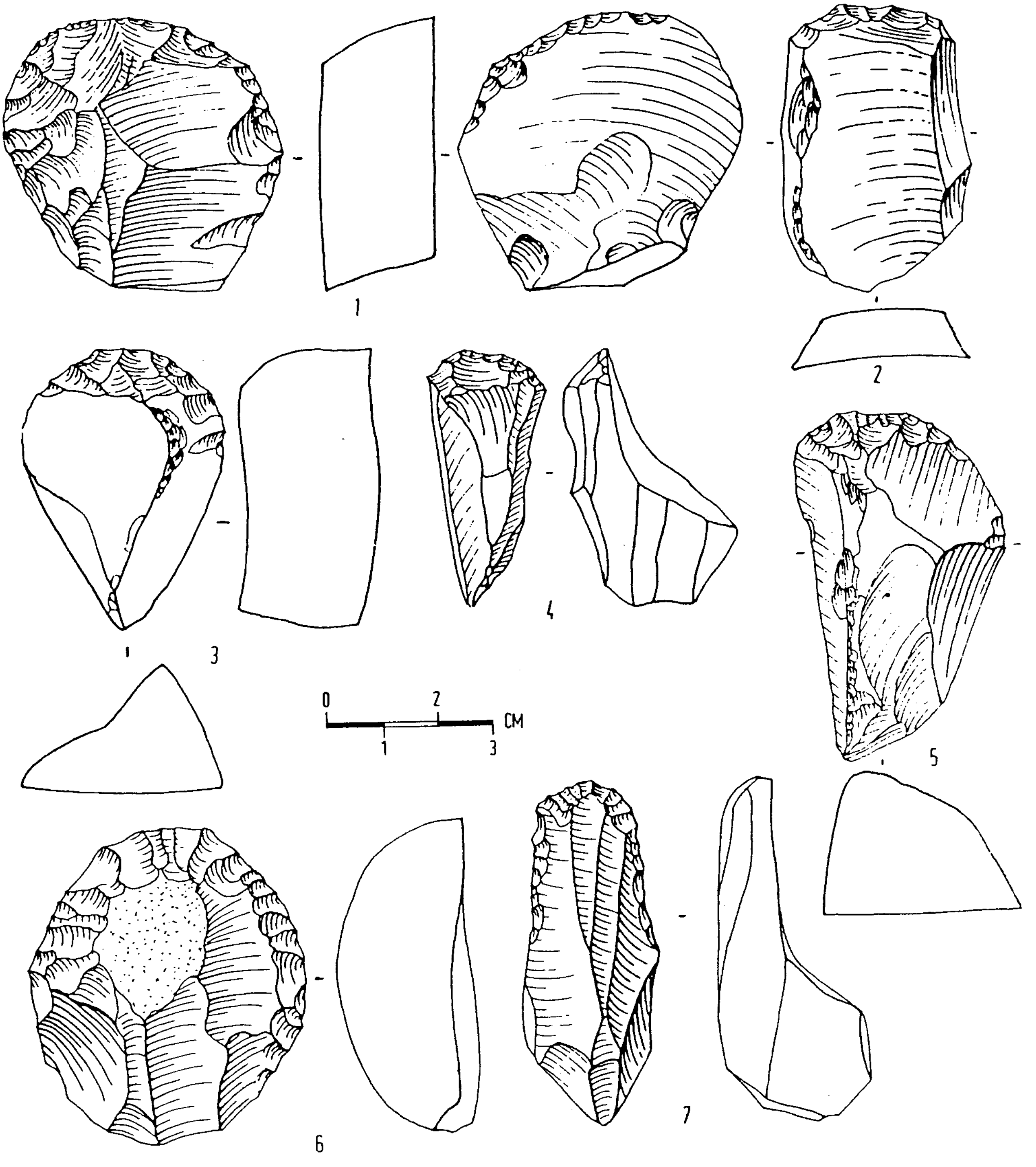

Fig. 7. Scrapers on revival tablets (2,3), on cores (4-5,7), and carinated scrapers (1,6).

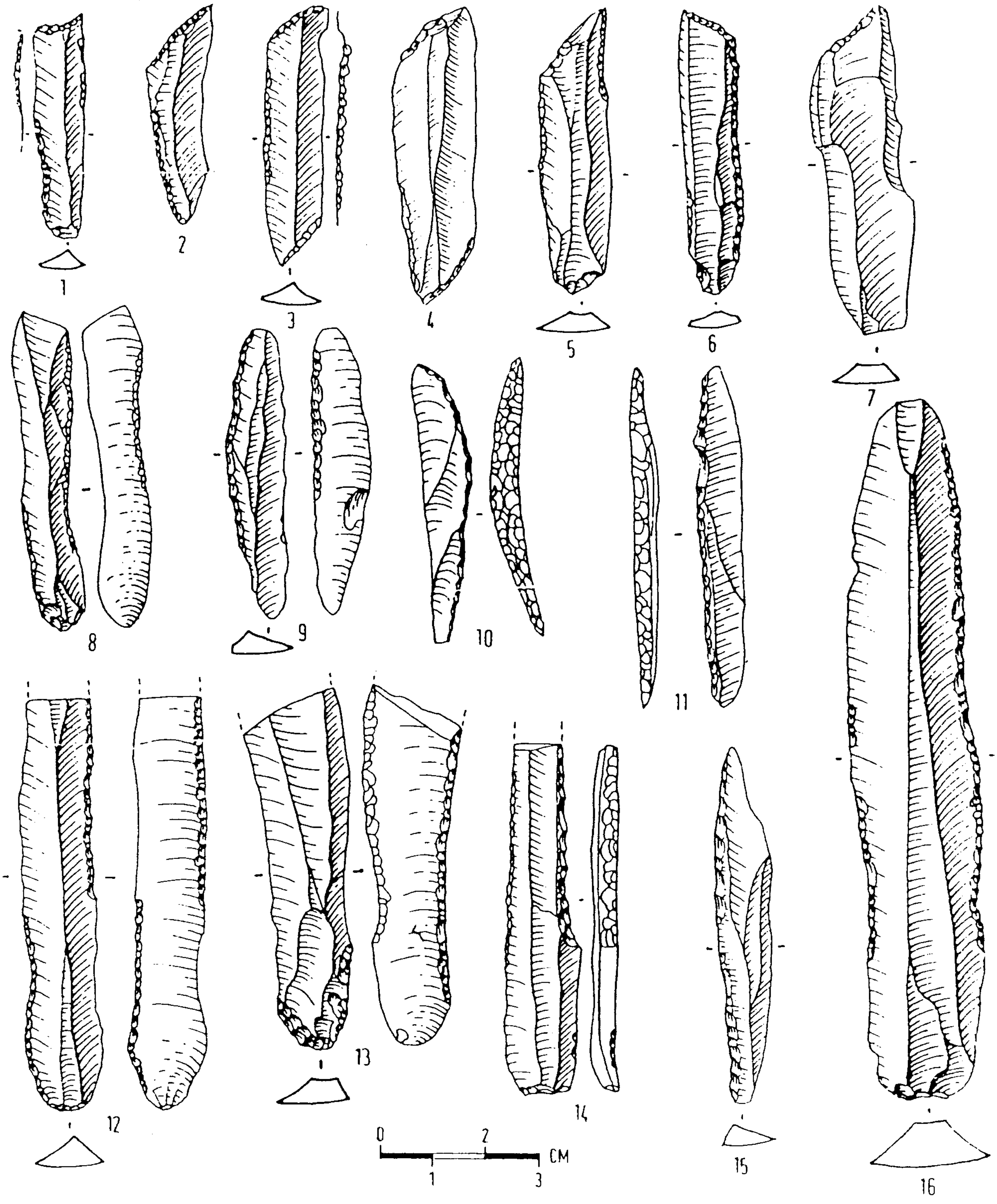

Fig. 8. 1-7 truncated blades, 8-9,12 alternately retouched blades, 10 crossed retouched blade, 11,14-15 steep retouched blades, 16 retouched blade.

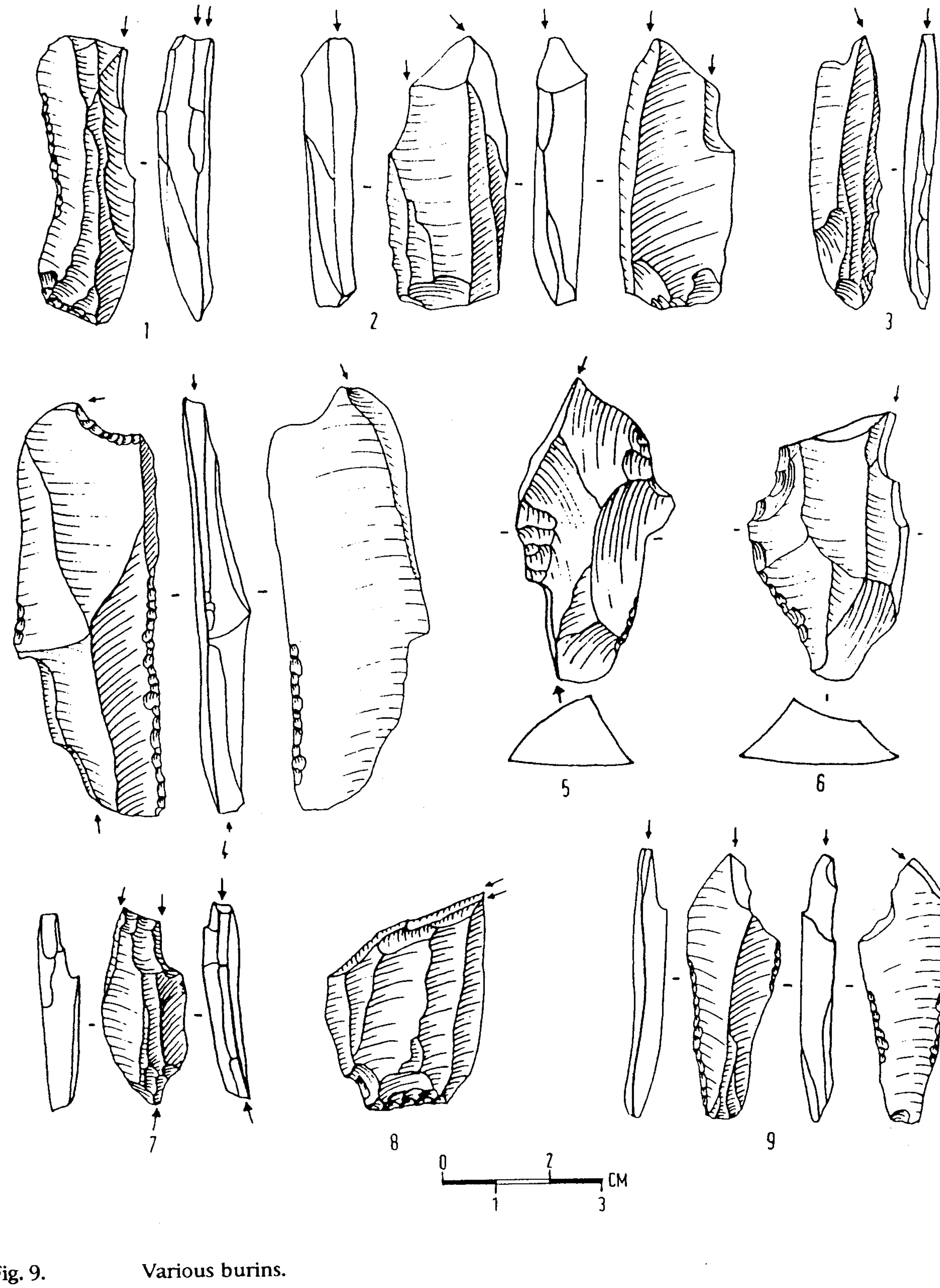

Fig. 9. Various burins.

Retouched Blades

Diversely retouched blades constitute 25.7% of the retouched artifacts. Truncated blades are rare (%). They are mostly obliquely truncated (Fig. 8:1,2,5-7), although sometimes they have double truncations (Fig. 8:3,4).Steep retouched blades are quiet common (Fig. 8:11,14,15). Crossed retouch also exists but very rarely (Fig.8:10). Alternate and alternating retouch is widely used in the industry (Fig. 8: 8,9,12).

Burins

Burins are quiet few ,and being mostly angle burins on break,often it is difficult to recognize them (Fig. 9:1-3,6,7,9). Burins on truncation (Fig. 9:4), transverse burins (Fig. 9:8) and dihedral burins (Fig. 9:5) are rare.

Various

The rest of the industry is composed of retouched flakes, notched pieces, and a few *pièces esquillées*. Retouch on flakes is not very common, and it is usually in form of partial fine retouch. Notches appear on flakes and on blades, often formed by utilization.

Conclusion

The outstanding elements of Aşıklı Höyük are the presence of microliths with geometrics, one-shouldered arrowheads and an abundance of scrapers. For the moment we can see no evident parallels with other sites in central or south eastern Anatolia.. The bipolar cores and the Byblos points are known from the south-east and the Levant; the one-shouldered arrowhead was defined by M.C. Cauvin from the earliest levels of Cafer Höyük (CAUVIN 1991) Microliths and geometrics were also reported from Suberde, situated in the western part of cenral Anatolia (BORDAZ 1969). As far as we know, it bears no resemblance with the other central Anatolian industries such as Can Hasan III or Çatal Höyük. Future research may bring new elements for comparison to this site.

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A Preliminary Description of the Lithic Industry from Hallan Çemi

Michael Rosenberg

Introduction

Hallan Çemi Tepesi is a c. 0.7 hectare site in eastern Anatolia that has, to date, been excavated during the course of two short seasons in 1991 and 1992[1]. It is situated at an elevation of c. 640 meters on the west bank of the Sason Çayı (a tributary of the Batman River and, in turn, the Tigris), in the foothills of the Sason Dağları (a chain of the eastern Taurus). The nearest excavated aceramic Neolithic sites are Çayönü, c. 100 km. to the west, and several sites in the Mosul region (i.e., Zawi Chemi, Nemrik, Qermez Dere, and M'lefaat) c. 150 km. to the southeast. Based on a series of ten radiocarbon dates, the site appears to have been occupied between c. 10,600 and 10,000 B.P. (uncalibrated). Thus, it appears to be several hundred years younger than Zawi Chemi, slightly older than to contemporary with Nemrik, Qermez Dere, and M'lefaat (see WATKINS *et al.* 1988: 23), and approximately 1,000 years older than Çayönü.

The seasonal availability of the various faunal and botanical remains recovered during the course of excavation, along with the presence of substantial round stone-built structures, strongly suggest year-round occupation of the site. Stone platforms, which may be foundations for above-ground storage silos, are also found. However, clear cut evidence of storage facilities, as might be expected to be present at a fully settled village community, is still lacking. The economy of the site's inhabitants revolved around the exploitation of numerous wild animal and plant species. It is worth noting, however, that cereal grasses are conspicuously absent in the archaeobotanical assemblage.

The material culture of Hallan Çemi's prehistoric inhabitants includes several ground stone and worked bone artifact types that suggest a cultural connection with broadly contemporary sites in northern Iraq such as Zawi Chemi and Nemrik. A cultural connection with later sites in eastern Anatolia, such as Çayönü, is also suggested by aspects of the ground stone assemblage.

What follows is based on an analysis of a 5mm mesh screened sample of 4,340 pieces (including waste) of chipped stone recovered from the uppermost levels of the site and treated as a single unit. Unfortunately, the size of the chipped stone sample thus far recovered from lower levels was deemed insufficient to use at this time. That said, preliminary indications are that all the types present in the sample studied also occur in the site's lower levels, though there may ultimately prove to be some stratigraphic variation in type frequencies. By the same token, there is no indication at all that any of the tool types that are completely absent in the sample are present in the site's lower levels.

[1] The 1991 and 1992 excavations at Hallan Çemi were supported by the National Geographic Society, The University of Delaware Research Foundation Inc., The American Research Institute in Turkey, the University Museum of the University of Pennsylvania, and Mobil Exploration Mediterranean Inc.

Table 1. Frequencies of primary products and implement classes.

GENERAL CATEGORIES	FLINT	OBSID.	TOTAL	% OBSID.
WEIGHT (GRAMS)	7060	3295	10355	31.8%
COMPLETE COUNT	1839	2501	4340	57.6%
UNUTILIZED COUNT	844	607	1451	41.8%
RETOUCH MODIFIED TOOL COUNT	169	342	511	66.9%
BLADES (INCLUDING BLADE FRAGMENTS)	25	336	361	93.1%
% OF TOTAL COUNT	0.6%	7.7%	8.3%	
% OF FLINT/OBSIDIAN COUNT	1.4%	13.4%		
BLADES (INCL. BL. FRAGMENTS & INTACT GEOMETRICS)	36	445	481	92.5%
% OF TOTAL COUNT	0.8%	10.3%	11.1%	
% OF FLINT/OBSIDIAN COUNT	2.0%	17.8%		
BLADE CORES	3	6	9	66.7%
FLAKE CORES	23	1	24	4.2%
CRESTED BLADES	1	7	8	87.5%
BLADE CORE REJUVENATION FLAKES (VARIOUS)	9	14	23	60.9%
MICROBURINS	0	1	1	100.0%

RETOUCH MODIFIED TOOL TYPES	FLINT	OBSID.	TOTAL	% OBSID.
TRIANGLES	5	124	129	96.1%
CONVEX PIECES	1	5	6	83.3%
TOTAL GEOMETRICS	6	129	135	95.6%
% OF TOTAL COUNT (TOTAL GEOMETRICS)	0.1%	3.0%	3.1%	
BACKED & TRUNCATED BLADES	1	17	18	94.4%
BACKED BLADES	1	11	12	91.7%
TRUNCATED (UNBACKED) BLADES	0	5	5	100.0%
TOTAL MODIFIED BLADES	2	33	35	94.3%
% OF TOTAL COUNT (TOTAL MODIFIED BLADES)	<0.05%	0.8%	0.8%	
BACKED (MEDIAL) BL. FRAGMENTS	0	23	23	100.0%
BACKED & TRUNCATED (PROXIMAL) BL. FRAGMENTS	0	10	10	100.0%
BILATERALLY BACKED TRIANGULAR POINTS	2	4	6	66.7%
UNILATERALLY BACKED POINTS	2	2	4	50.0%
BACKED FOLIATE FLAKES	1	3	4	75.0%
TOTAL POINTS	5	9	14	64.3%
% OF TOTAL COUNT (TOTAL POINTS)	0.1%	0.2%	0.3%	
END SCRAPERS	3	20	23	87.0%
'THUMBNAIL' SCRAPERS	3	24	27	88.9%
SIDE SCRAPERS	3	6	9	66.7%
CARINATED SCRAPERS	5	1	6	16.7%
MASSIVE SCRAPERS	9	0	9	0.0%
MISC. SCRAPERS	46	31	77	40.3%
TOTAL SCRAPERS	69	82	151	54.3%
% OF TOTAL COUNT (TOTAL SCRAPERS)	1.6%	1.9%	3.5%	
BURINS	21	7	28	25.0%
% OF TOTAL COUNT	0.5%	0.2%	0.6%	
BORERS	4	8	12	66.7%
% OF TOTAL COUNT	0.1%	0.2%	0.3%	
NOTCHED PIECES	58	40	98	40.8%
% OF TOTAL COUNT	1.3%	0.9%	2.3%	
DENTICULATES	4	1	5	20.0%
% OF TOTAL COUNT	0.1%	<0.05%	0.1%	

Raw Materials and Utilization Patterns

Both flint and obsidian were used by the site's inhabitants to manufacture stone tools. Flints of varying quality are readily available locally from a variety of sources. These include large nodules of grayish flint eroding out of exposed limestone strata and more diversely colored river pebbles/cobbles in the channel of the Sason Çayı. It should be noted, however, that the distinctive fine-grained chocolate flint thought to be an import at Nemrik and Qermez Dere (see KOZŁOWSKI and SZYMCZAK 1989, 1990; WATKINS *et al.*1989) is apparently not present at Hallan Çemi.

Obsidian is not available locally and, therefore, the obsidian used by the site's inhabitants had to have been imported. A trace element analysis conducted in 1991 on 16 obsidian samples[1] indicates that at least three sources[2], all at least 100 km. distant, supplied the obsidian used at Hallan Çemi.

Given the distances over which it was brought and the early age of this site, the extent to which obsidian was utilized is noteworthy. Obsidian accounts for c. 58% (2,501) of the 4,340 pieces examined and c. 33% of this sample by weight. Thus, the comparatively high count percentage seems to be an indication of the intensiveness with which this relatively valuable commodity was utilized (but, perhaps also the greater brittleness of obsidian) and the resulting small average size of the obsidian pieces. The intensiveness with which obsidian was utilized is also visible in the degree to which the obsidian at the site was actually utilized. Of the 1,839 pieces of flint in the sample, c. 46% were neither shaped by means of retouch nor exhibit visible use wear of any kind. In contrast, only c. 24% of the obsidian pieces were similarly unutilized and that unutilized fraction largely consists of just the very smallest pieces of shatter.

Finally, it should be noted that the site's inhabitants apparently exhibited preferences for one raw material over another in the manufacture of some specific artifact types. These specific preferences will be discussed individually below.

Raw Materials and Reduction Techniques

Excluding geometrics, virtually all of which are almost certainly derived from blades (see Fig. 4), blades of varying size minimally[3] account for c. 8% of the total sample. If one chooses to include intact geometrics in the blade category, the percentage of blades in the sample rises to c. 11%. Blades are typically derived from simple single platform prismatic cores (see Figs. 1:1-7, 2:1-2). A few individual blades (e.g., Fig. 3:15), however, show evidence of prior opposed platform detachments in their dorsal flake scar patterns, indicating at least the occasional use of multi-platform cores.

Obsidian was clearly the raw material of choice for the manufacture of blades. Whether or not one considers geometrics to be blades, c. 93% of all blades in the sample were made of obsidian. Of the blades cores in the sample, c. 67% are obsidian and all appear to be exhausted cores. This preference is also reflected in the degree to which obsidian seems to have been largely reserved for the manufacture of blades. For example, c. 86% of all obsidian cores in the sample are blade cores. Furthermore, blades minimally constitute c. 18% (if one includes geometrics) of all the obsidian pieces in the sample, with much of the balance likely being either by-products of or waste from blade manufacturing processes (i.e., core fragments, fragments of shattered blades that were too small to count as blades, etc.). Bearing in mind that any manufacturing process generates a certain amount of waste and likely results in at least

[1] The obsidian trace element analysis was graciously conducted by Dr. James M. Blackman, Smithsonian Institution.

[2] A total of ten samples are derived from what Blackman (1984) has called the Nemrut Dağ I source group. An additional five samples are derived from what has until recently been the problematic 1G obsidian source (see RENFREW *et al.* 1966), but which CAUVIN *et al.* (1986) now call the Bingöl B source. The remaining sample is derived from what Blackman (1984) had labelled the Nemrut Dağ III source, but which is probably now called the Bingöl A source (see CAUVIN *et al.* 1986).

[3] Numerous very small fragments (mostly of obsidian), which are likely pieces of blades, were not counted as blades. Thus, the percentages for obsidian blades are likely understated.

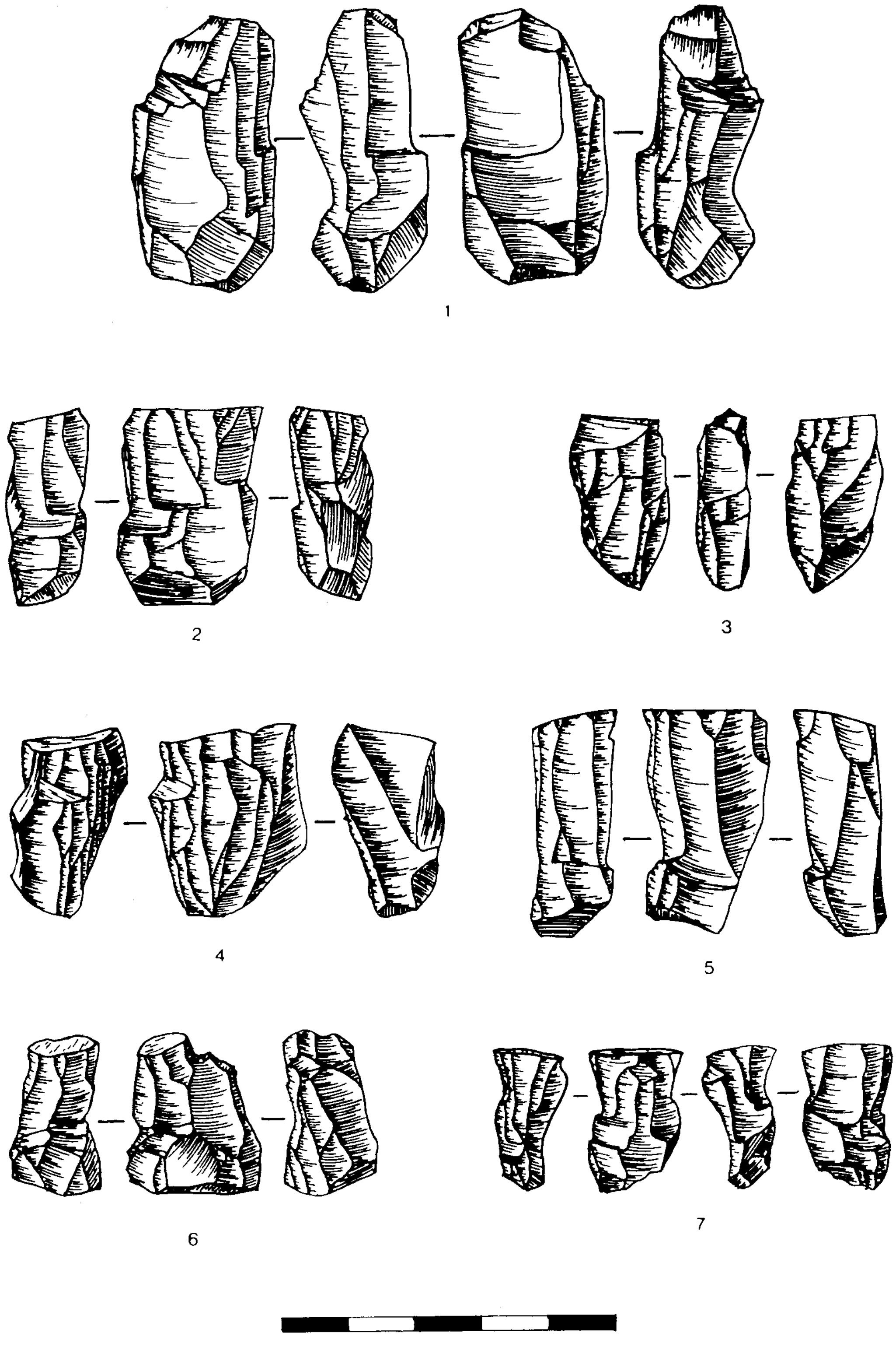

Fig. 1. Obsidian blade cores.

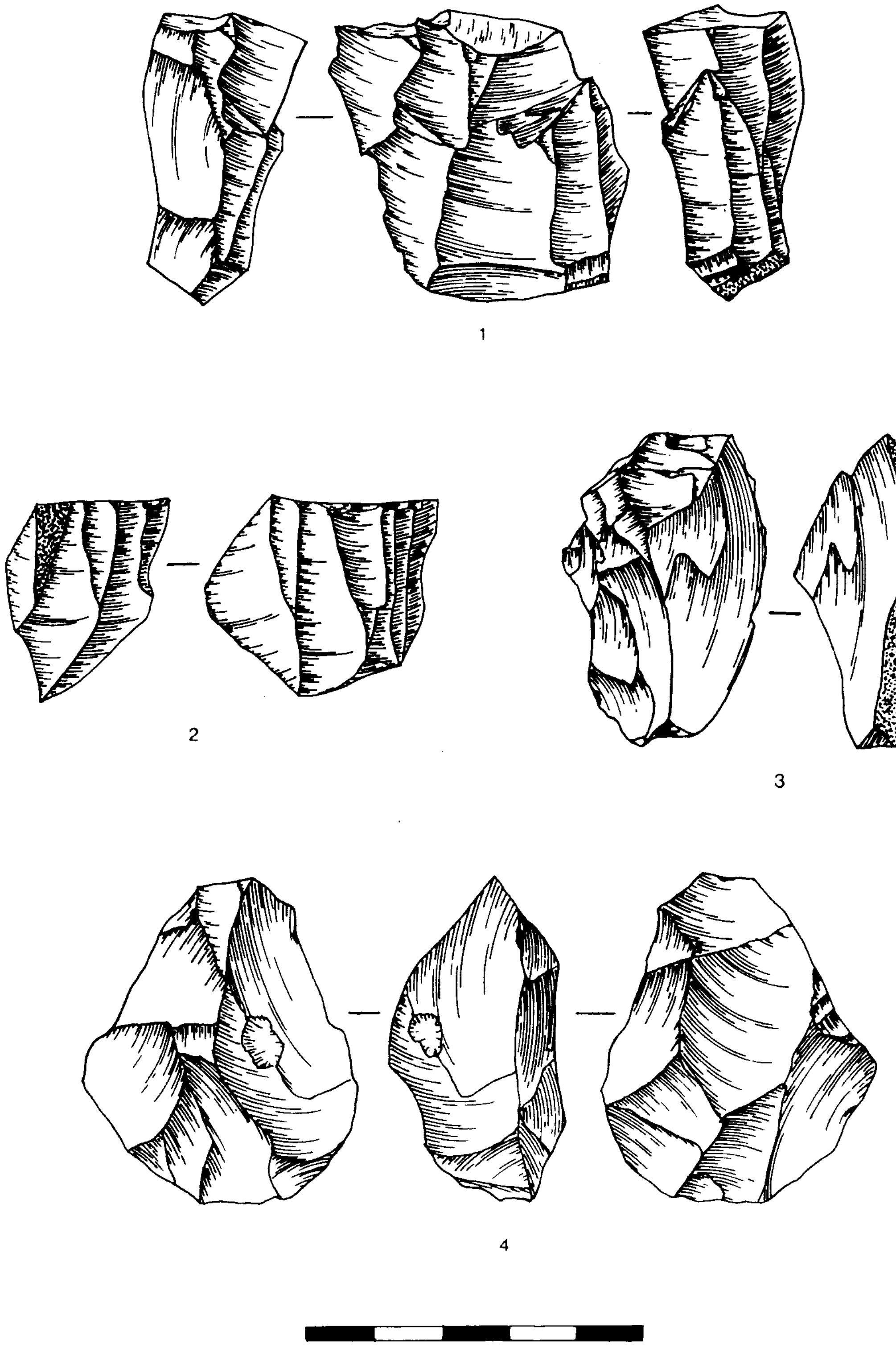

Fig. 2. 1-2 flint blade cores, 3-4 flint flake cores.

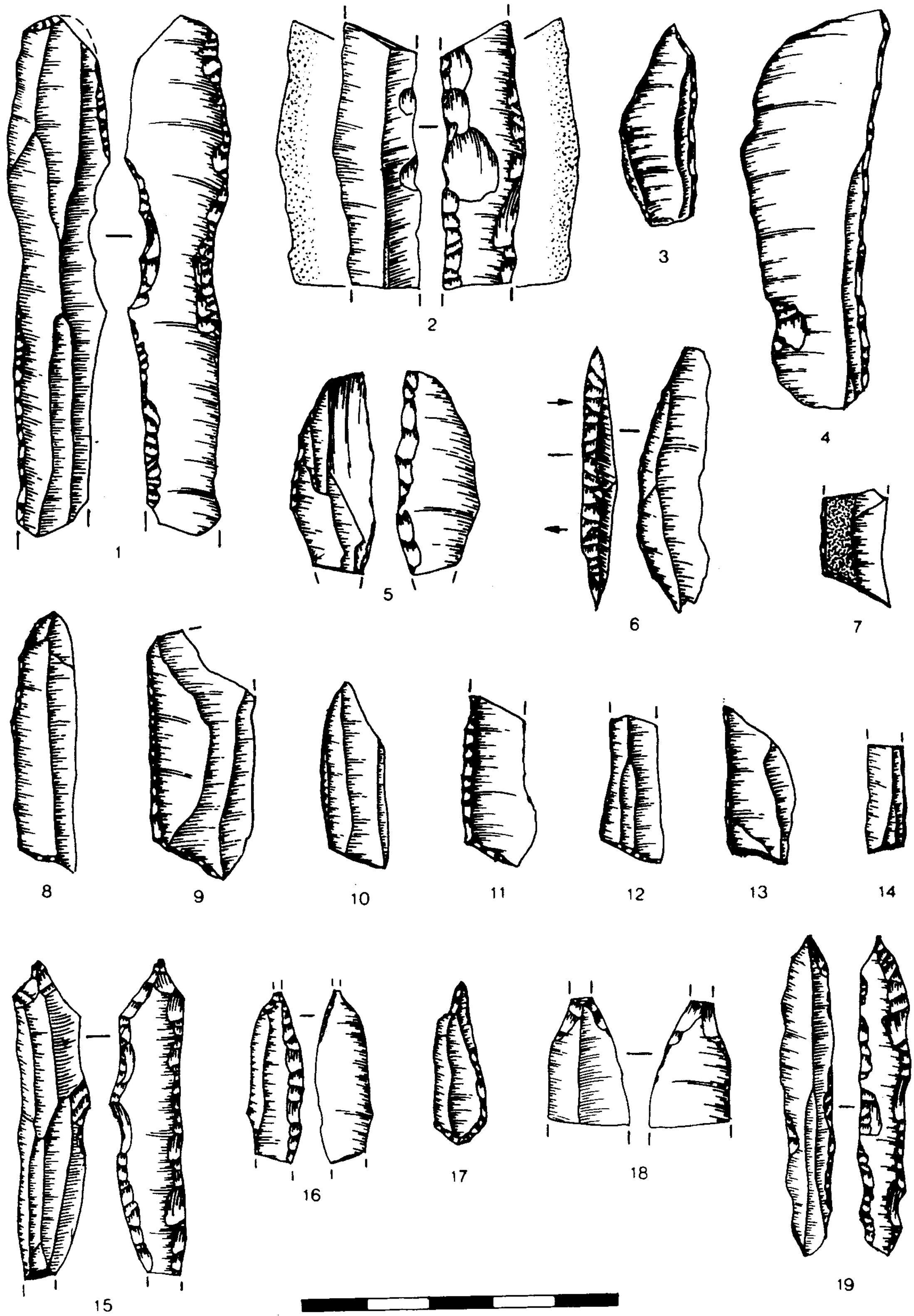

Fig. 3. 1 use modified blade, 2 sickle blade, 3-6 backed blades, 7-14 backed and truncated blades, 15-19 borers on blades.

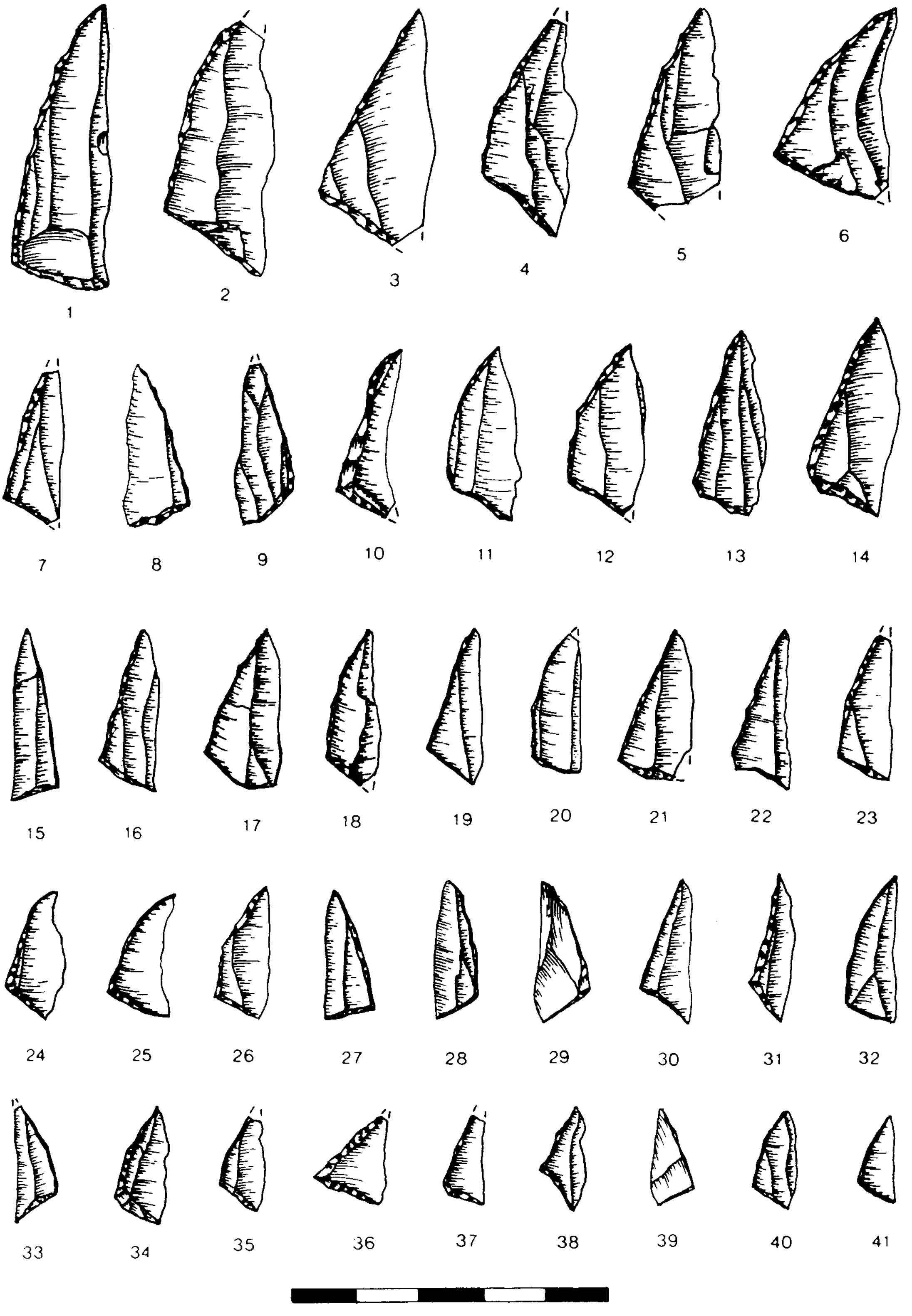

Fig. 4. Obsidan triangular pieces.

some mechanical errors, the almost 1 in 6 pieces of obsidian that are blades or blade segments seems a substantial number.

The majority of all blades are triangular in section, though almost as many have multi-facetted or irregular dorsal surfaces. Trapezoidal sectioned blades are relatively rare. In the case of obsidian blades, the butt ends are typically small and lenticular. suggesting the use of indirect percussion as the primary method of detachment[1]. The flint blades, on the other hand, appear to have been produced by a wider variety of methods. In general, the obsidian blades are more consistently well made than the flint blades, though well made flint blades do exist (e.g., Fig. 3:1-2). The large majority of all blades were used without significant further purposeful modification. Of those that were purposefully retouched, the most common method was abrupt retouch designed to produce geometrically shaped pieces (Fig. 4:1-41, 5:14-20), backed blades with (Fig. 3:7-14) and without (Fig. 3:3-6) retouch truncations, and a very few (unbacked) truncated blades. Only one (flint) sickle blade segment (Fig. 3:2) was noted. It exhibits what may be flat marginal retouch along the unutilized edge and breaks at both ends. Beyond the geometrics and retouch modified blades, the artifact class most commonly made from blades is borers (Fig. 3:15-19).

Non-blade flakes were derived from a variety of core types, including globular cores, pyramidal cores, and radially flaked pebbles (see Fig. 2:3-4). Examination of the debitage products indicates that no particular type of flake core was favored. Of the flake cores in the sample c. 96% are flint; only a single small irregular obsidian flake core was noted. This would seem to support the above-noted observation that obsidian was largely reserved for the manufacture of blades.

Geometrics and Other Retouch Modified Blades

Geometric pieces, minimally numbering 135[2] and c. 3.1% of the total sample, constitute the single largest category of retouch modified blades. 96% of all geometrics are obsidian. Elongated scalene triangular pieces, with 129 examples (c. 96% of all geometrics), are by far the most common type of geometric (Fig. 4:1-41, 5:19-20). Convex pieces are relatively rare, with only 6 examples noted (Fig. 5:14-18). Trapezoidal pieces are apparently absent. Non-geometric microliths are not particularly common. An occasional backed bladelet, invariably of obsidian, was noted and there are a few examples of a small, partially to fully backed ovate form described more fully below (see possible points type III). Only a single example of a micro-burin was noted.

All the geometrics from Hallan Çemi are typically shaped by unidirectional abrupt retouch that is quite variable in quality, ranging from relatively fine to quite coarse. Often, the originating edge of the retouch scars defining the backed lateral edge of the triangular pieces shows evidence of what may be either smoothing by purposeful abrasion or crushing (as might result from hafting). Both the triangular and convex pieces vary greatly in size, ranging from a minimum size of slightly over 1 cm. long to a maximum of almost 5 cm., with the majority in the 2 to 3 cm. size range (see Fig. 4). A few of the triangular pieces show what may be evidence of repair to correct for breakage of the original tip (see Fig. 4:12,26). As implicit in the earlier discussion of blades, the large majority (c. 96%) of all geometric types are made from obsidian.

Backed blades minimally (see footnote) number 40 in all and 95% are of obsidian. The backed blades used by Hallan Çemi's inhabitants were made with and without retouch truncations, at a ratio of 3:2. With the exception of one that exhibits alternating retouch (Fig. 3:6), the shaping retouch by which the backed blades were fashioned is essentially similar to that by which the geometrics were made and

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[1] It should be noted that numerous deer-antler tines, of a type that could serve as a suitable punch, were also recovered. Whether they were actually used for that purpose remains to be determined.

[2] This number includes both substantially intact examples (107) and smaller recognizable fragments (28). An additional 33 possible fragmentary pieces were not counted. Of these 10 were not counted because it could not be determined whether they are basal fragments of triangular pieces or backed and truncated blades. Another 23 fragments were not counted because it could not be determined whether they are medial fragments of geometric pieces or backed or truncated blades. However, given the ratio of geometrics to backed and truncated blades, the large majority of these questionable pieces are likely geometric fragments.

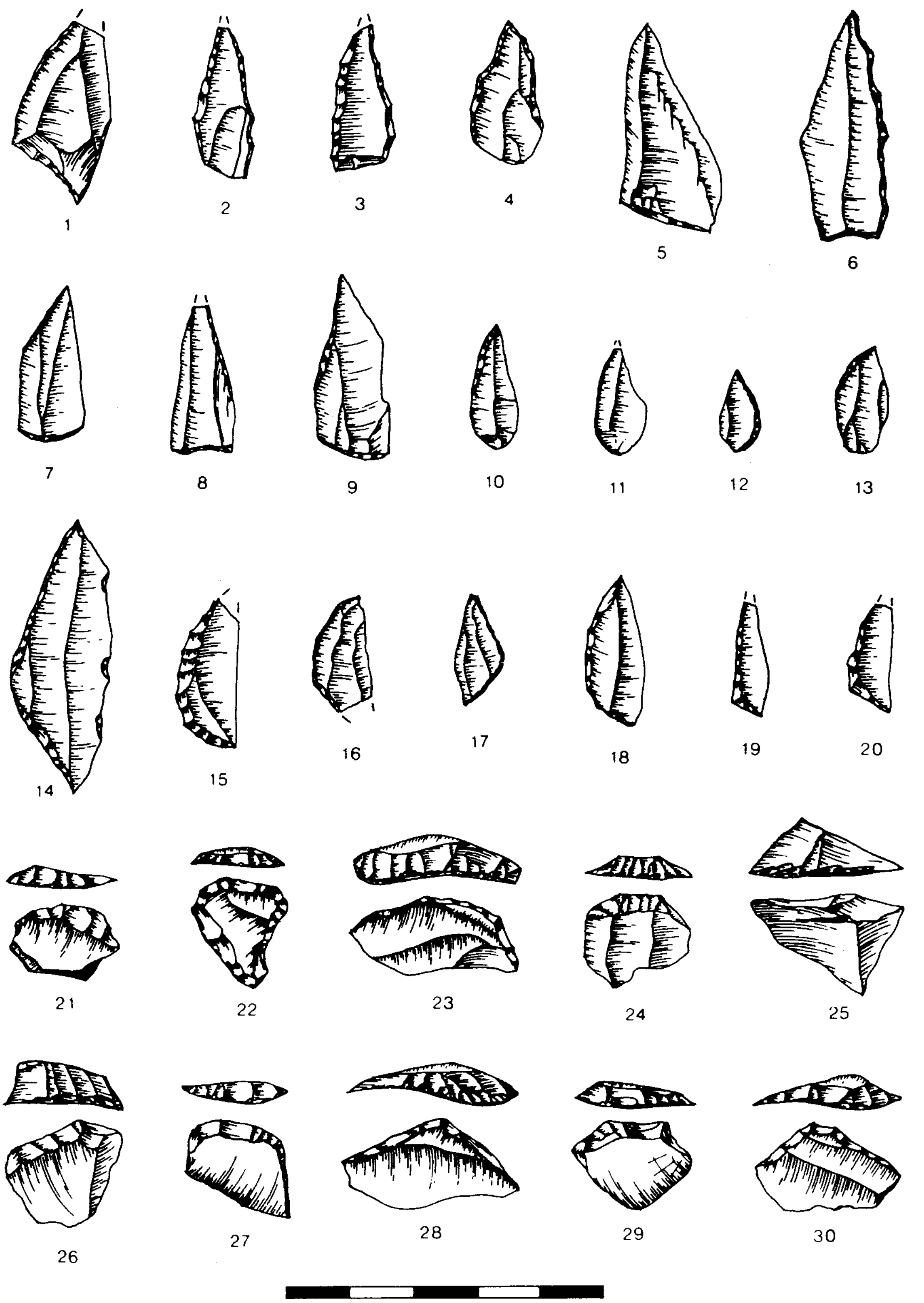

Fig. 5. 1-13 possible point types, 14-18 convex pieces, 19-20 flint triangular pieces, 21-30 thumbnail size scrapers.

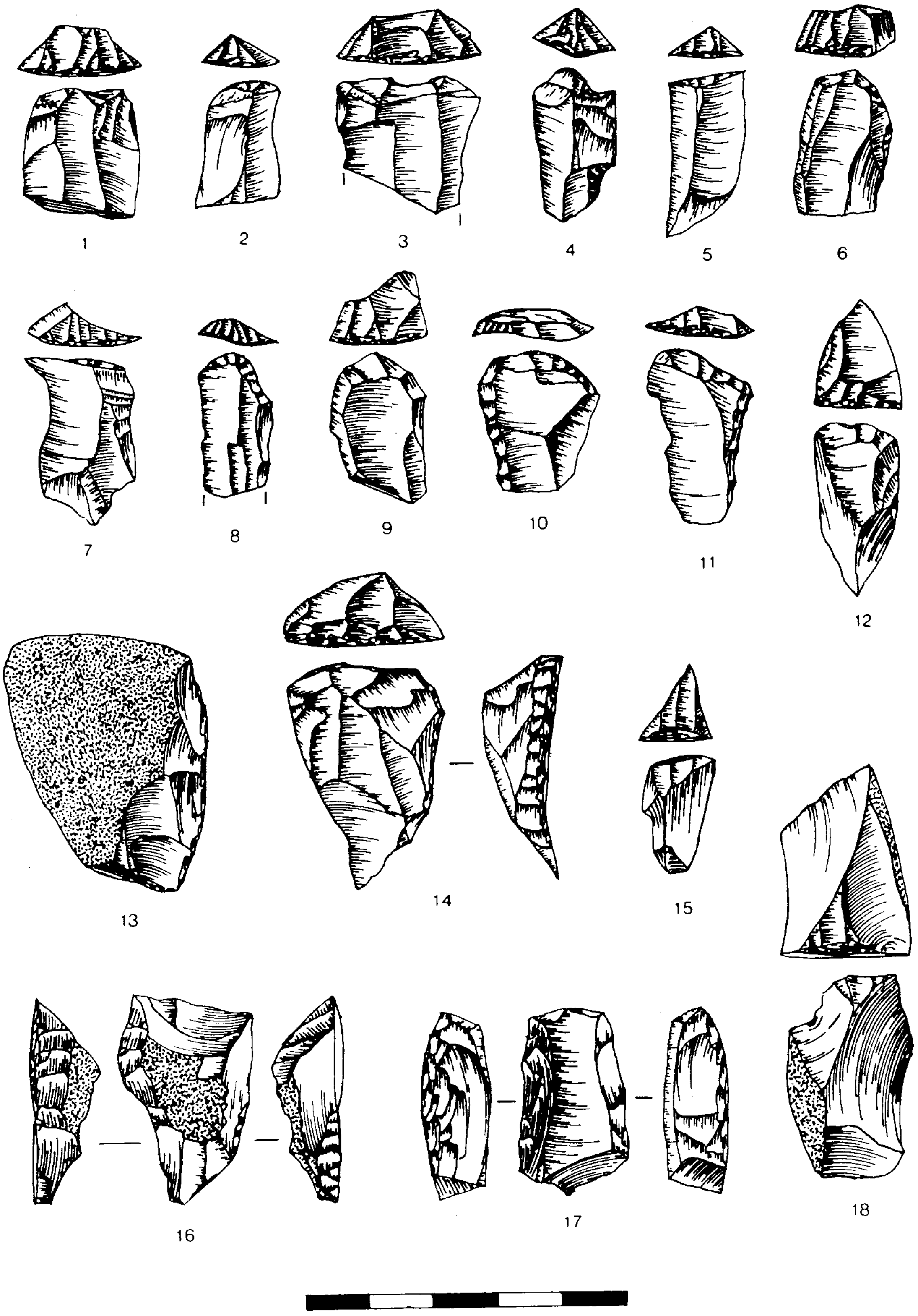

Fig. 6. 1-11,14-15 end scrapers, 12,18 carinated scrapers, 13-14,16-17 side scrapers.

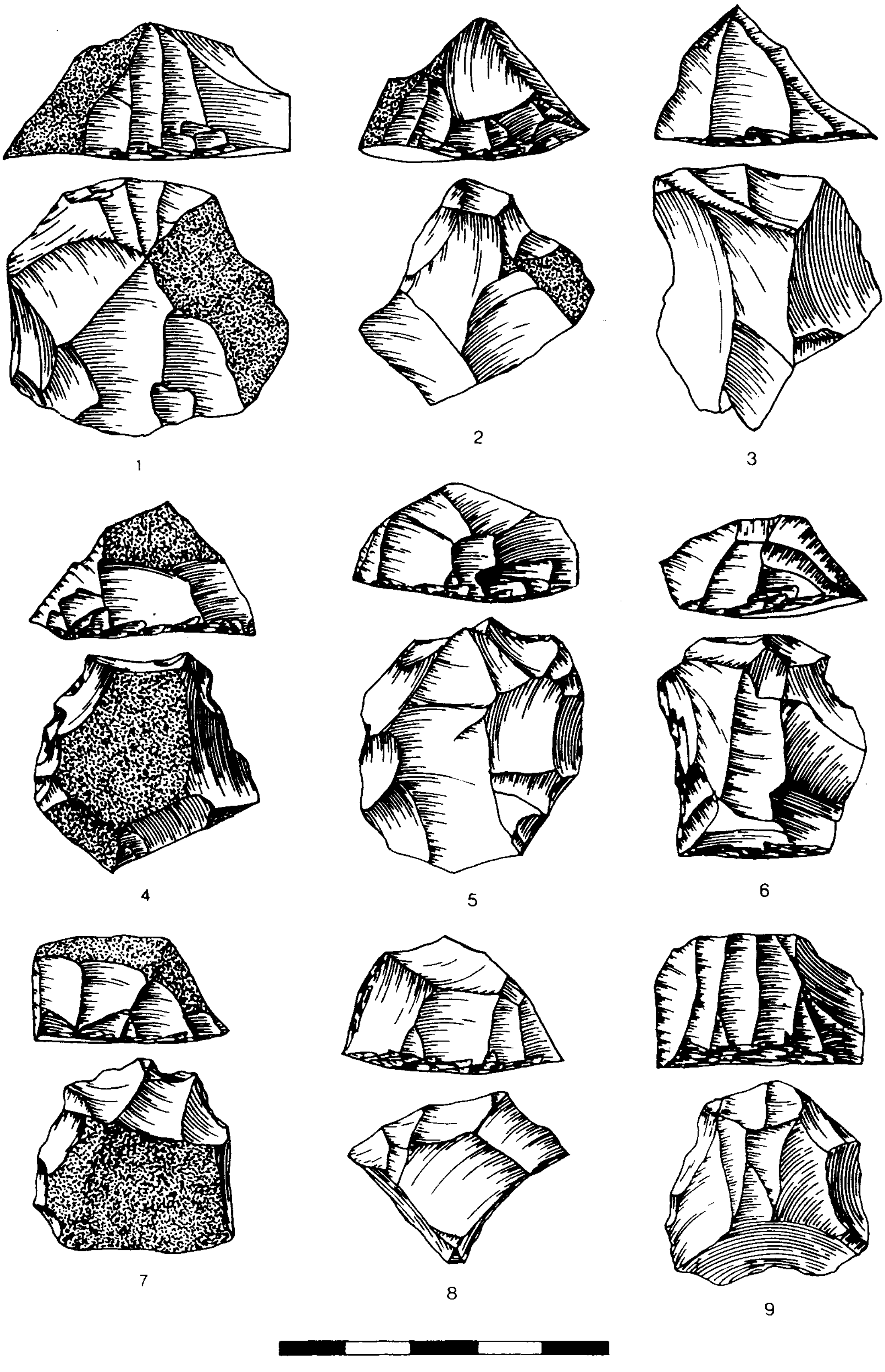

Fig. 7. Flint massive scrapers.

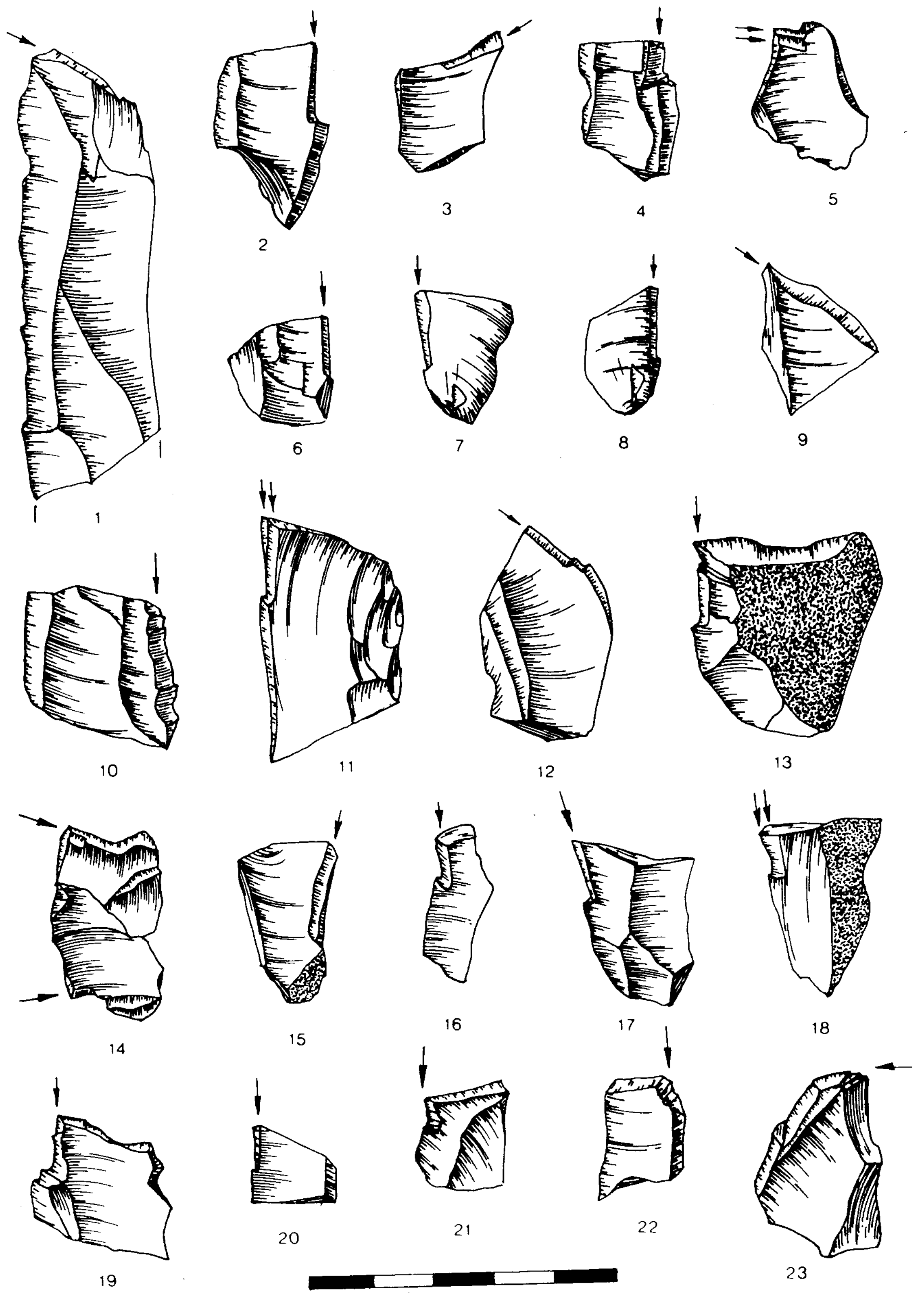

Fig. 8. Burins

equally variable in workmanship. However, whereas the backed and truncated blades are typically in the 3 to 5 cm. size range, those without retouch truncations also occur in larger sizes (e.g., Fig. 3:4). Blades that have simply been truncated, but are not also backed number 5 in all. As in the case of other types mentioned above, the truncating retouch varies in workmanship. All are made of obsidian.

Finally, it is worth noting that the bilaterally retouched obsidian blade-like rods (commonly called 'Çayönü rods') that typically occur at tenth millennium B.P. sites such as Çayönü (see REDMAN 1982) and Cafer Höyük (see CAUVIN and BALKAN 1985) appear to be completely absent at Hallan Çemi. This is significant, because they do occur at Nevalla Denik, another (presumably later) aceramic site within the Batman River drainage (see ROSENBERG and TOGUL 1991).

Points

A very few highly questionable abruptly backed diamond shaped fragments of possible Nemrik style points aside (e.g., Fig. 5:1), foliate, notched or tanged points appear to be conspicuously absent at Hallan Çemi. However, the geometrics also aside, there are several types that may perhaps be simply-made points. None are particularly numerous and all occur in both flint as well as obsidian form. None exhibit the opposing retouch or wear in the vicinity of the tip that would suggest that they were used as rotary perforators.

The first of these types is an equilateral triangular type abruptly retouched along both lateral edges, and usually the basal edge as well (Fig. 5:2-4). A total of 4 typical examples (1 flint, 3 obsidian) were noted in the sample. An additional 2 atypical examples of what are probably this basic type were also noted. One, made of flint (Fig.5:5), is a naturally triangular flake with just the basal retouch; the second, made of obsidian (Fig. 5:6), lacks the characteristic retouch along much of one lateral edge that would otherwise define the tip were that edge not already naturally oblique.

The second of these types is a unilateral obliquely backed form, asymmetrically trapezoidal in configuration, with an abrupt perpendicular retouch truncation forming the base and a longer lateral area of oblique abrupt retouch defining the tip (Fig.5:7-9). A total of 3 examples (2 flint, 1 obsidian) were noted in the sample.

The third type is typically made on a small, intact, roughly ovate flake, by typically backing the distal end of one lateral edge to form a point (Fig. 5:10-13). The resulting shape can best be described as similar to a miniature Chatelperron 'point.' A total of 4 examples (1 flint, 3 obsidian) were noted in the sample.

Whether any or all of these types are actually points is debatable. It should, therefore, be noted that Kozłowski and Szymczak (1989:33) illustrate what appears to be an example of the third type in the Nemrik assemblage, but consider it to just be a retouched blade.

Scrapers

A total of 151 scrapers, constituting c. 3.5% of the sample, were noted. Of these, approximately half (74) fall into several basic types. The remaining 77 (46 of flint, 31 of obsidian) do not conform to any recognizable type, being simply irregular pieces having one or more areas of steep retouch of the type commonly found on more regularly configured scrapers. Presumably many of the utilized pieces fall within the functional category of 'scraper', but lack the resharpening that would impart the morphological attributes characteristic of scrapers as a type.

The single most common type, with a total of 27 examples, is a thumbnail size partially to fully rounded form made on moderately thin flakes (Fig. 5:21-30). Obsidian appears to have been the raw material of choice for this type, as only 3 (c. 11%) are made of flint. Two distinct varieties were noted, but this distinction may be a product of nothing more that the original attributes of the flake on which they were made. The first variety occurs on flakes of relatively even thickness and is characterized by regular to irregular retouch around much of the flake's periphery, giving it a crudely circular configuration (Fig. 5:21-22). The second variety occurs on the side of flakes, giving it a wedge-shaped form vaguely reminiscent of a lunate with a single contiguous convex area of retouch along the thick edge of the flake and the complete absence of retouch (and use wear) along the sharp edge (Fig. 5:23-30). In general, examples of this second scraper variety are distinguishable from geometrics by being thicker than geometrics in the area retouched and by having individual retouch scars that are considerably wider than those found on geometrics.

End scrapers, with 23 examples, are the next most common type (Fig. 6:1-11,14-15). Obsidian appears to have been the raw material of choice for the manufacture of end scrapers also, with only 3 of the 23 (c. 13%) being made of flint. As a type, the end scrapers at Hallan Çemi are quite variable. End scrapers on true blades are actually quite rare. More commonly they were made on elongated flakes or core fragments (Fig. 6:1,3,6,9), with the result that they are often quite thick in cross-section. Convex working edges, either perpendicular to the axis of the tool or on an oblique angle to it are the most common configurations. Sinuous (Fig. 6:4,7-8) or straight working edges are together present in only about one third the cases (Fig. 6:1,3,5,7) and more or less evenly divided within that number.

Side scrapers are represented by just 9 examples (Fig. 6:13-14,16-17), with both obsidian and flint used in their manufacture at a ratio of 2:1 in favor of obsidian. These largely occur on relatively thick core fragments and do not conform to any particular configurational pattern.

True carinated scrapers (Fig. 6:12,18) are relatively rare and as a type these grade into the thick end scrapers on core fragments (Fig. 6:15). Of the 6 examples in the sample, 5 are of flint.

The last recognizable scraper type is a distinctive massive type scraper that is made exclusively of flint and represented in the sample by a total of 9 examples (Fig. 7:1-9). This type typically occurs on large flint (flake) core fragments or halved flint pebbles, but rarely covers more than a single quadrant of the blank's perimeter. These scrapers are characterized by an irregular, often deeply undercut, roughly convex working edge, resharpened periodically by means of either indirect or direct percussion flaking. The resulting form is somewhat similar to an excessively shallow and narrow prismatic flake-blade core. The combination of this type's heavy mass and deeply undercutting wear suggests that it was used for tasks requiring a heavy-duty implement; the irregular configuration of the working edge suggests that at any given moment only a very limited portion of the full working edge was in contact with the substance being worked.

Burins

The crafted burins in the sample number 28 in all (c. 7% of the sample) and are virtually all made by burin blows on either breaks or natural surfaces (Fig. 8:1-23). Flint blanks were preferred to obsidian by a ratio of 3:1. With a few conspicuous exceptions (e.g., Fig. 8:1,7-8), blades were not used as blanks and no other particular type of blank seems to have been favored. Rather, burins seem to have been made on any appropriately stout piece of chipped stone that was handy and the result is a highly variable group of artifacts.

In addition to the crafted burins, there exist within the sample a number of what can be called natural burins. These are typically stout flakes (including core-rejuvenation flakes) or core fragments having a natural corner that appears to have been utilized as a burin (Fig. 8:22-23). Because this variety of utilized flake grades into the more general category of utilized flakes, a precise count of these natural burins was not attempted. However, at a minimum, these natural burins equal the crafted burins in number and occur on both pieces of flint and obsidian.

Borers

The sample contained a total of 12 recognizable borers (c. 3% of the sample), with both obsidian and flint examples represented and obsidian favored over flint by a ratio of 2:1. In the case of the obsidian borers, blades appear to have the blank of choice, with the tip often produced by purposeful bilateral retouch (Fig. 3:15,18). The flint borers are more variable and were typically made by only minor retouch modification to a piece already having a natural protrusion.

Notched Pieces and Denticulates

The sample contained a total of 98 notched pieces (c. 2.3% of the sample), defined as pieces exhibiting one or more discontinuous concavities at least half as deep as they are wide. The notches characterizing this type are usually not the product of a single blow designed to produce a notch, but rather usually appear to be the product of localized retouch. The notches themselves rarely exceed 1cm in diameter. Notches were produced on both pieces of flint and obsidian, with flint pieces moderately outnumbering obsidian in the sample by a ratio of c. 3:2 (58:40).

The sample contained a total of only 5 denticulates (c. 1% of the sample), defined as pieces exhibiting a contiguous series of single-blow notches creating a saw-tooth edge. Of these 5 denticulates, 4 are of flint and only 1 is of obsidian.

Summary

In general, several aspects of the Hallan Çemi assemblage are particularly striking. To begin with, there is the intensiveness with which obsidian was apparently utilized and the degree to which it was reserved specifically for the manufacture of blades. In addition, there is the relatively high geometric component, dominated by triangular shaped pieces of varying size. Equally striking is the general paucity of recognizable projectile points. Given the large and varied wild fauna exploited by the site's inhabitants, a larger point component could be expected, raising the possibility that the geometrics were the functional analogs of points. Also striking is the apparent absence of heavy-duty chipped stone tools, such as picks, celts, etc. It should be noted in passing that ground stone variants of these types are also quite rare at this site (see ROSENBERG and DAVIS 1992).

Finally, though the Hallan Çemi chipped stone assemblage contains both microliths and geometric forms in significant numbers, to call it an example of a microlithic industry may be somewhat misleading. That is, it also contains a very substantial number of full-size tools in all blade tools categories from geometrics through unmodified blades. Moreover, given the preference for obsidian in the manufacture of blades and the intensiveness with which this valuable imported commodity was utilized, the small size of some tools made from blades may not reflect a preference for small size, but rather simply nothing more than the already reduced size of the available obsidian blade cores.

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The Nevalı Çori Industry. Status of Research

Klaus Schmidt

The excavations at the site of Nevalı Çori - headed by Prof. H. Hauptmann, Institut für Ur-und Frühgeschichte der Universität Heidelberg, in cooperation with Adnan Misir, director of the Urfa Museum - ended in 1991 after 7 field seasons. During the first campaigns the site appeared to be a relatively small, quite normal settlement with well built stone houses of channel type and a typical PPNB flint industry of the Levantine variant (H. HAUPTMANN 1988; SCHMIDT 1988). That view was modified in the last 3 seasons by the discovery of monumental limestone sculptures and a non-domestic, temple-like terrazzo building (H. HAUPTMANN 1991-92; 1993). The settlement consists of 5 building layers, each with 5 houses on the average. The excavated part is a 100 m long strip on a natural hill east of the Kantara Çay - a small brook flowing into the Euphrates - where the Neolithic layers were preserved. The Neolithic layers there were excavated in the western row (areas G2 to G10) of three rows of trenches; the eastern ones are mainly related to Halaf and EBA (areas H4 to H9, I5 to I9) (H. HAUPTMANN 1991-92: 19; A. HAUPTMANN *et al.* 1993: 548). The terrazzo building is located in the northern part of the excavations (areas H10, H11, I10, I11). The remains on the east slope represent only a small part of the former settlement, which was eroded in its central area.In some terst trenches on the western side of the Kantara Çay we found a continuation of the settlement, but it was immediately beneath the surface and therefore badly preserved. All the soil removed from the Neolithic layers was collected in baskets, labeled according to square meter and level and brought to the wet sieving installation on the Kantara Çay. The sieving was carried out using two sieves, the first one with a mesh of 10 mm, the second of 4 mm. About 20,000 sieving samples were recovered for sorting and analysis.

The site has been covered by the Atatürk Baraj lake since the spring of 1992. Before that time the study of the material was done only during the field seasons, and there was no possibility to continue work the rest of the year due to other obligations. Intensive analysis did not begin until 1991. In a study season in 1992 the sorting of the sieved samples for the recovery of lithics and other finds was completed. Within the organization of the Nevalı Çori project, this was only step 1. It produced the main data base, including all artefacts with entries regarding the find spot and registration, raw material, primary industry, main tool classes and measurements. Step 2 involves the detailed work with the tools. For the tools, sub-data bases were created with specific fields for each group. This work is not yet finished, and in a further campaign detailed typological work will be done. Therefore, only some selected aspects of the Nevalı Çori industry can be considered at the present time.

In total there are about 320,000 artefacts. Fig. 1 gives the percentages of find groups for the total sample of lithics in a logarithmic scale. The numbers above each column give the quantity of finds. The percentage for the tool groups is around or less than 1%. Flakes, the dominating group, were not used for tool production - except for some scrapers - and were only the by-products of core preparation.

In general the flint industry of all the layers is dominated by PPNB traditions. The raw material is local flint, with virtually no use of obsidian. The most frequent tools are sickle blades and tanged points, followed by burins. The main aim of further study is the correlation of the excavation levels with the building phases in the 100 m long strip of the excavated settlement to separate the industry stratigraphically, a goal that has not yet been accomplished. Final results exist for area G7, located in the center of the excavation, and they form the core of the discussion given below.

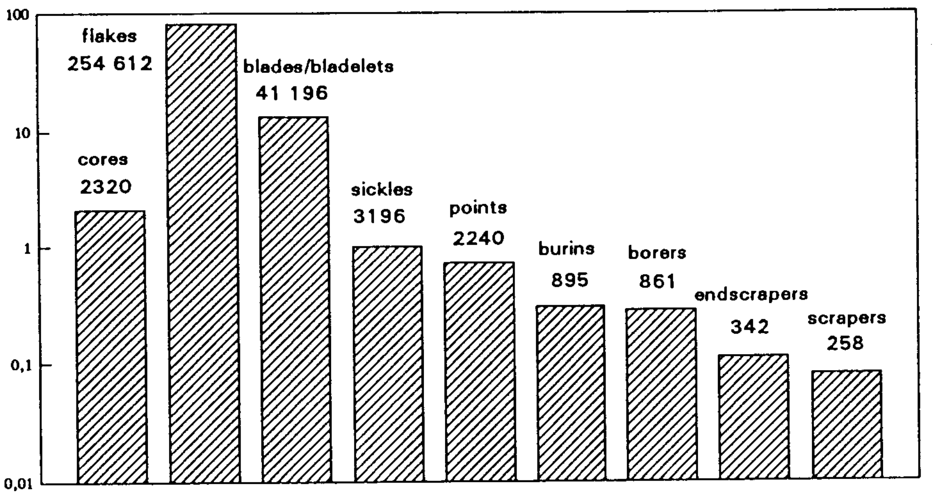

Fig. 1. All areas: Cores, debitage and tools *<columns in logarithmic scale, numbers represent number of specimen>*.

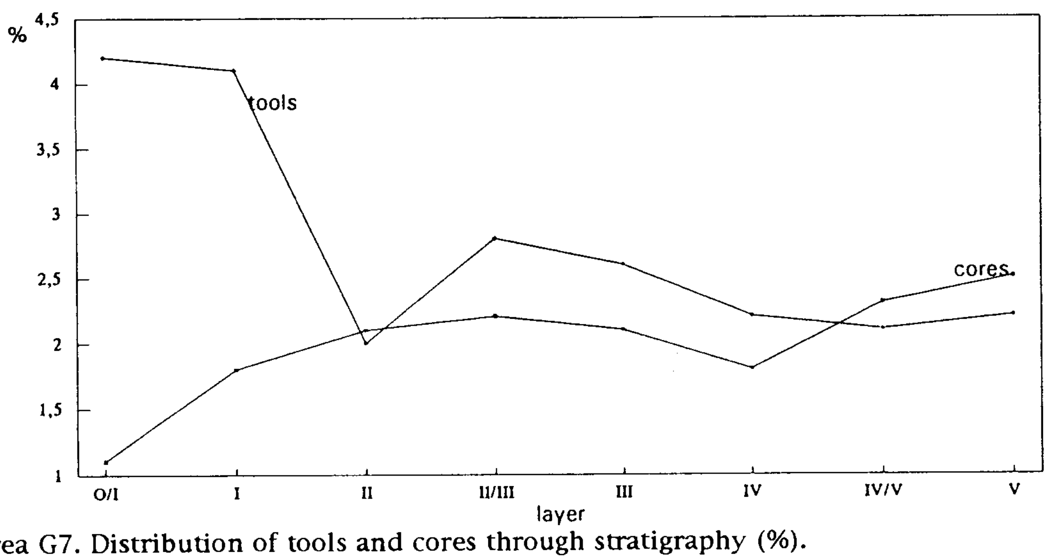

Fig. 2. Area G7. Distribution of tools and cores through stratigraphy (%).

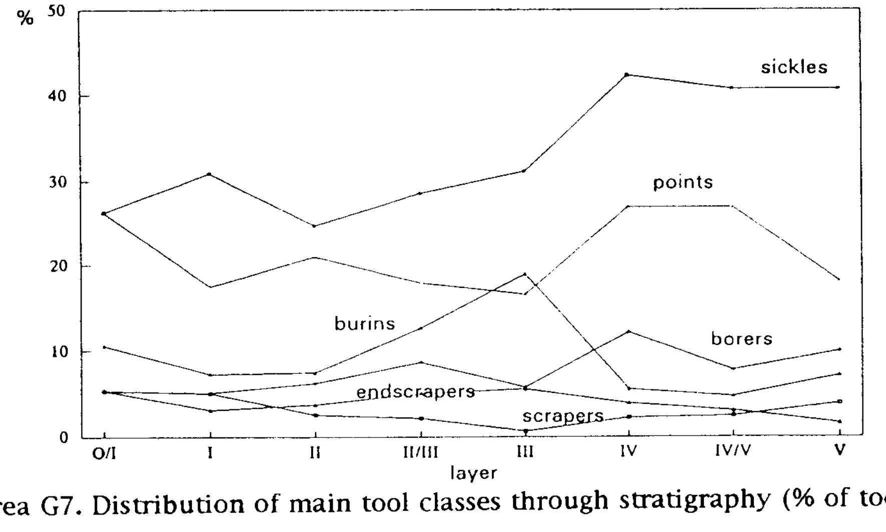

Fig. 3. Area G7. Distribution of main tool classes through stratigraphy (% of tools).

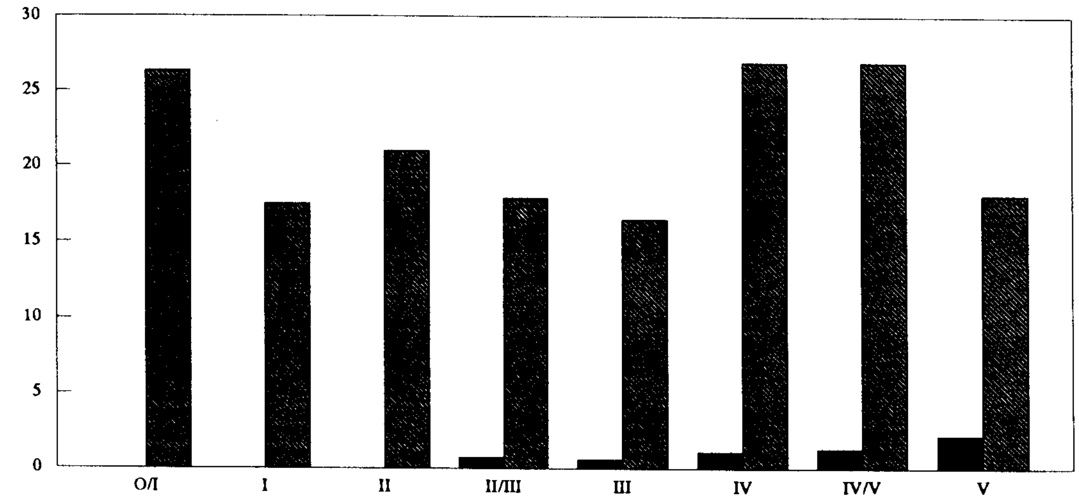

Fig. 4. Area G7. Distribution of total of points *(light)* and hollow based points *(dark)* through stratigraphy (% of tools).

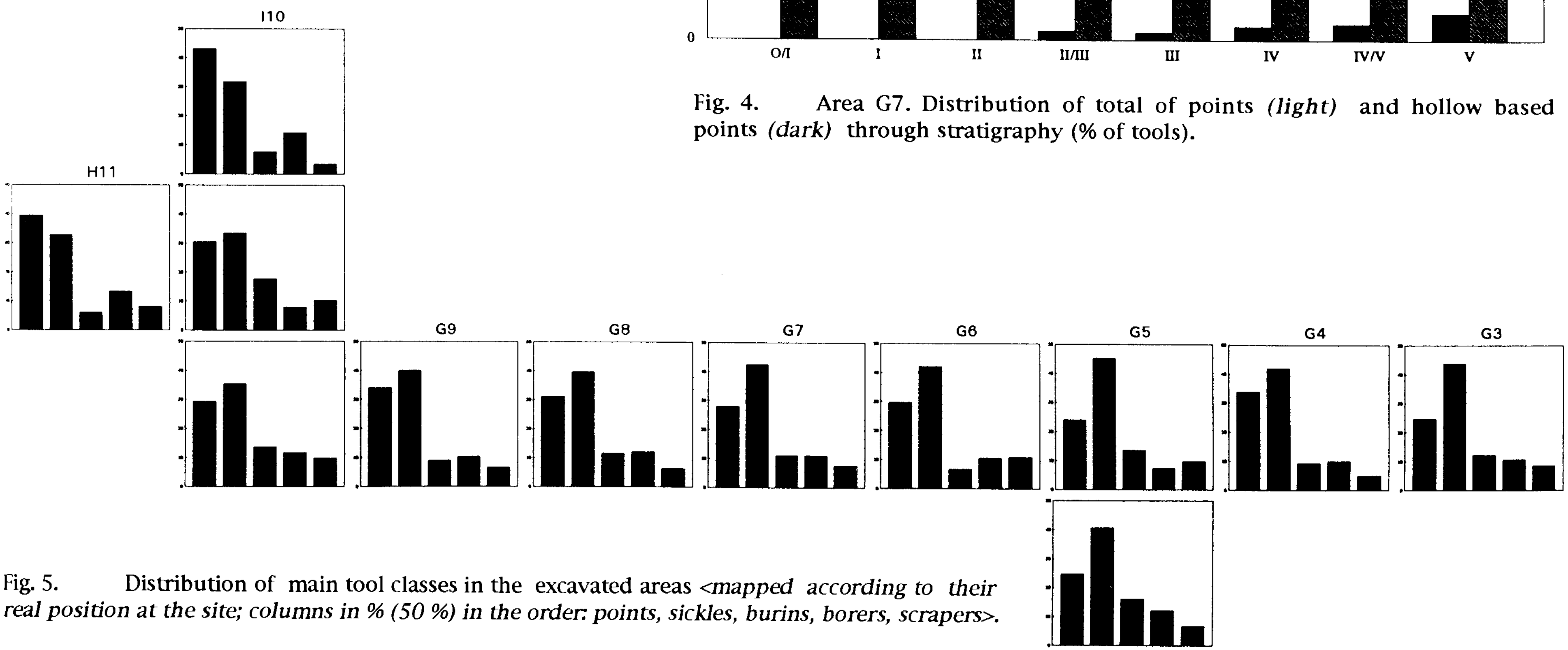

Fig. 5. Distribution of main tool classes in the excavated areas *<mapped according to their real position at the site; columns in % (50 %) in the order: points, sickles, burins, borers, scrapers>.*

In area G7 the percentage of tools through the stratigraphic sequence is low for all layers except Layer 1 (Fig. 2). This picture is paralleled by the proportion of cores - including core fragments - which are at nearly the same percentage except for Layer 1. The inventory is dominated by unretouched flakes which, as already mentioned, are mainly the waste of core preparation.

Regarding the percentages of the main tool classes, the sickles clearly dominate, especially in the lower layers (Fig. 3). Overall one can observe a relatively constant distribution pattern among sickles and points as well as borers, endscrapers, and scrapers. Only the burins have a pronounced peak in Layer 3. In this layer there is a notable decrease of both sickles and points, and these tool classes never regain the popularity they had in the early layers. Other tool classes - such as bifacial tools, "Çayönü tools" or *pièces esquillées* - do not occur in particularly large numbers. It is very striking that in the early layers sickle blades occur at 15-20% higher than arrowheads. Later the numerical differences decrease until Layer 1, where the tool classes are equal. Points are always more numerous in Layer 1 in other excavation areas. An earlier statement that points are the dominant tools at Nevalı Çori was based on counts from the upper layers only, especially Layer 1 (SCHMIDT 1988: 171).

At present it cannot be said with certainty if the distribution picture for area G7 is representative of the development for the whole settlement or if it reflects mainly the activities of one special area within the settlement. But it is already apparent that the relationship between sickles and points will be the same, or even more pronounced, in the other areas. Fig. 5 shows the percentages for five tool classes in each of the 10 by 10 m areas; here the figures refer to the entire collections and are not stratigraphically separated. (The trenches in Fig. 5 are arranged according to their real location in the field). The columns are always in the same order left to right: points, sickles, burins, borers, and endscrapers (including scrapers). The picture in the 100 m strip is very homogeneous, with sickles dominant followed by points. Only the northern areas around the terrazzo building are clearly different with a huge proportion of points. A decrease of points from north to south and a corresponding increase in sickles is evident. Once again the situation in the area of the terrazzo building is clearly distinctive. Explanations for these patterns must wait until all the material from all the trenches are examined in detail. It is obvious that the sickle-point complex dominates in all the areas. This is in distinct contrast with other sites such as Gritille (DAVIS 1988) or Cafer Höyük (CAUVIN M.-C. and BALKAN 1985; CAUVIN M.-C. 1991).

Limited space prevents a detailed discussion of the different tool classes. Therefore, a group of special interest is selected: the hollow based points. The overwhelming majority of points are tanged, only a small proportion are hollow-based: from all the areas there is a total of 2,089 tanged points but only 151 hollow-based ones. Fig. 4 graphs the percentages of hollow-based points compared to the percentages of points in area G7. The chronological situation is quite clear: hollow-based points are absent in the uppermost layers, but they increase in importance until the lowermost Layer 5. An important question is if these points may be related - with chronological implications - to Khiam points (CAUVIN M.-C. 1974), or if these points represent an independent group in the PPNB. Therefore, a detailed analysis of the Nevalı Çori hollow-based points must be undertaken. It is obvious that these points include a variety of forms. In the case of fragments, it is often difficult to decide if they really represent points or some other tool, but generally the determination should be correct.

To begin with, there a hollow-based points without lateral notches (Fig. 6:1-3,5,8). Lateral retouch is often evident, with a tendency to produce slightly concave edges (Fig. 6:4,6-7). One point is typologically extreme and a unique example (Fig. 7:8). The tendency to slightly concave edges is more developed, leading to real notches, on points in Figs. 7 and 8. The lateral retouch is often very steep (Fig. 8:6-9). Fig. 9 provides schematic views that demonstrate how standardized the hollow- based are. The two top rows of Fig. 9 show a series of the possible retouch patterns on points without lateral notches. The thick lines indicate the position of retouch, such as dorsal- basal, or dorsal-basal and partly dorsal-lateral, etc. The number below each figure represents the quantity of analyzed examples. The lower two rows represent in the same ways the lateral-notched pieces. It is obvious that not all of the possible retouch patterns were used. Hollow-based points with lateral notches are few in number, and there is no preference for a specific pattern. With the notched examples it is different, with a clear concentration on distinct patterns.

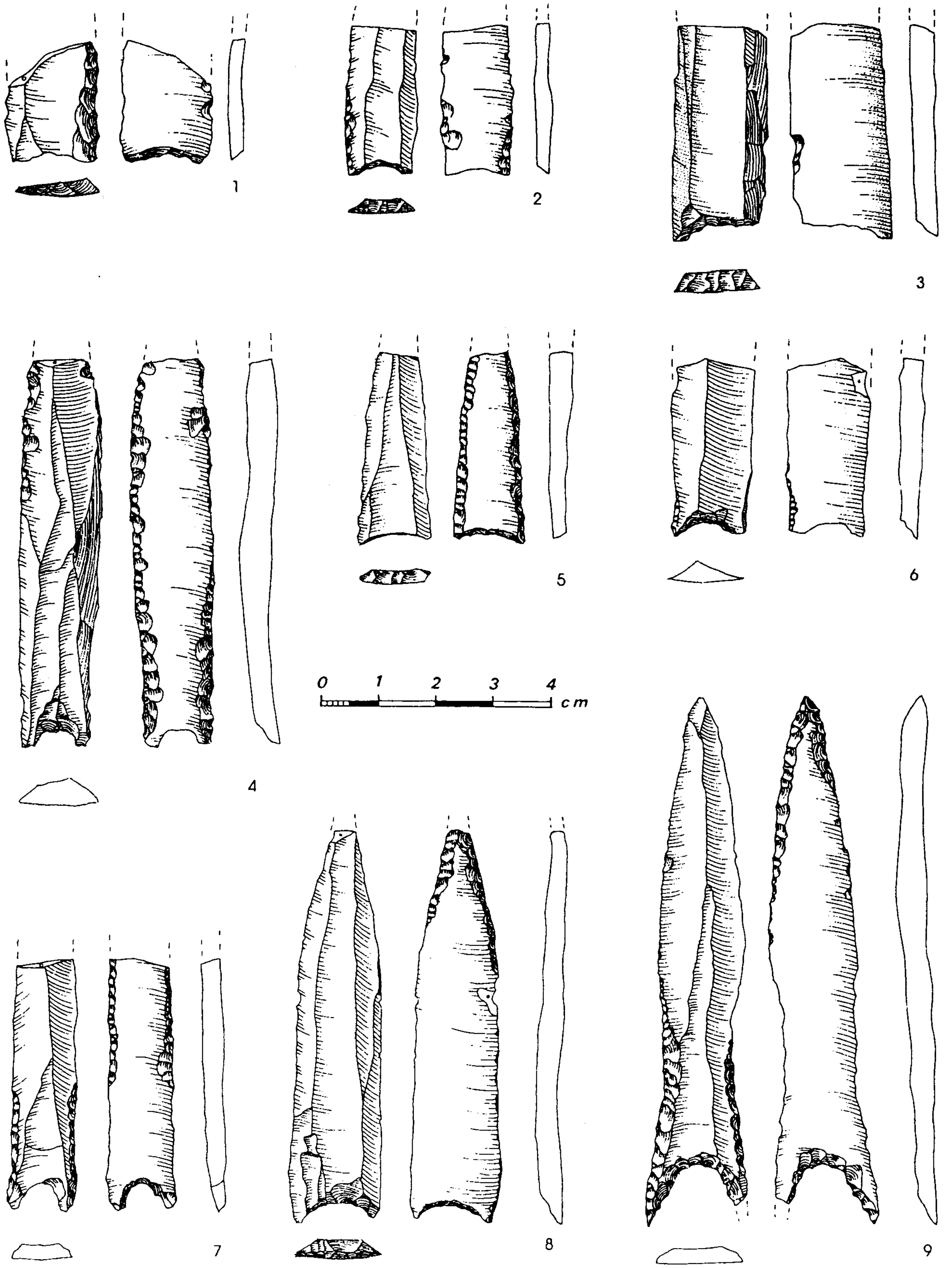

Fig. 6. Hollow-based blades and points (silex).

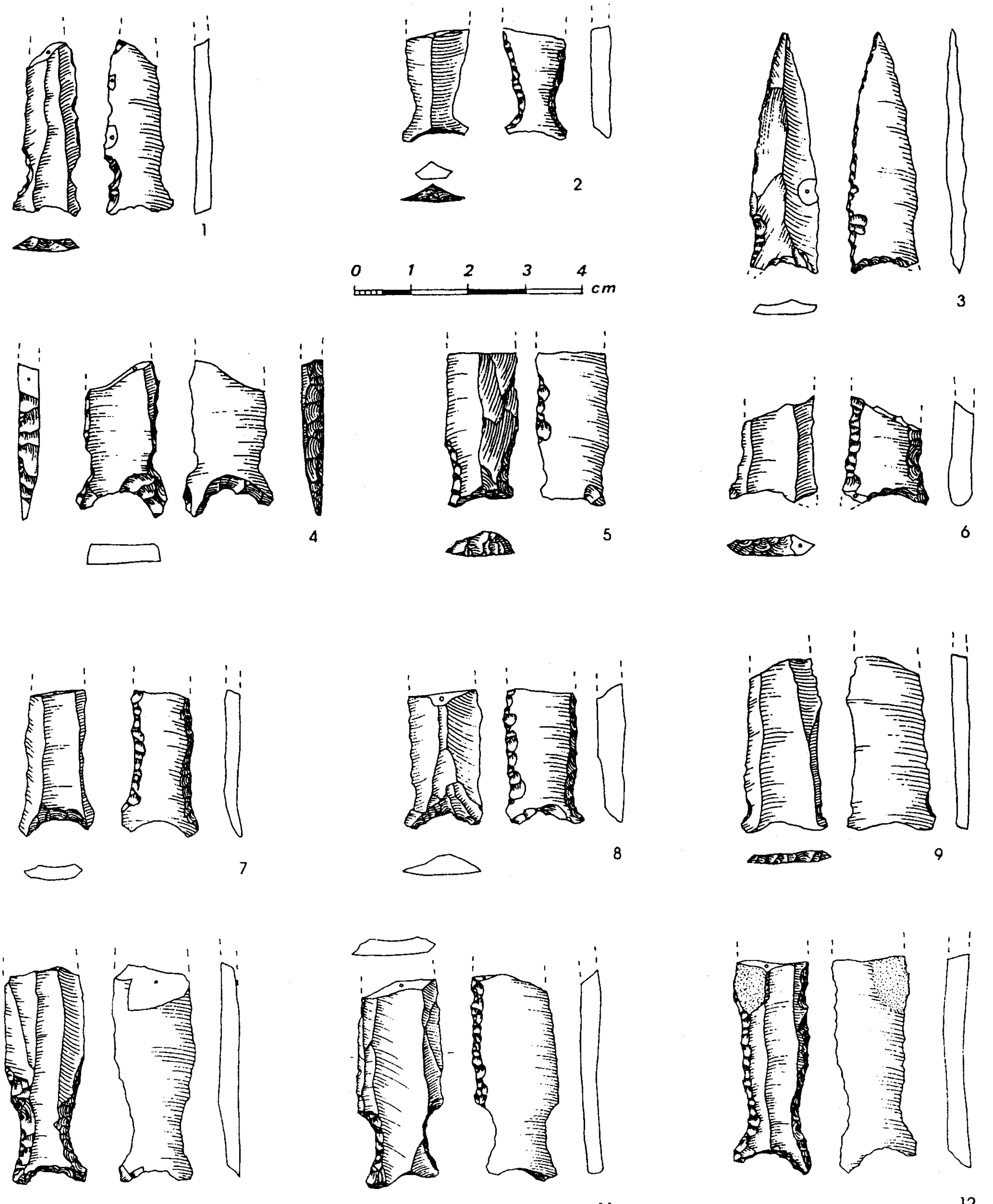

Fig. 7. Fragments of hollow based points with lateral notches (silex).

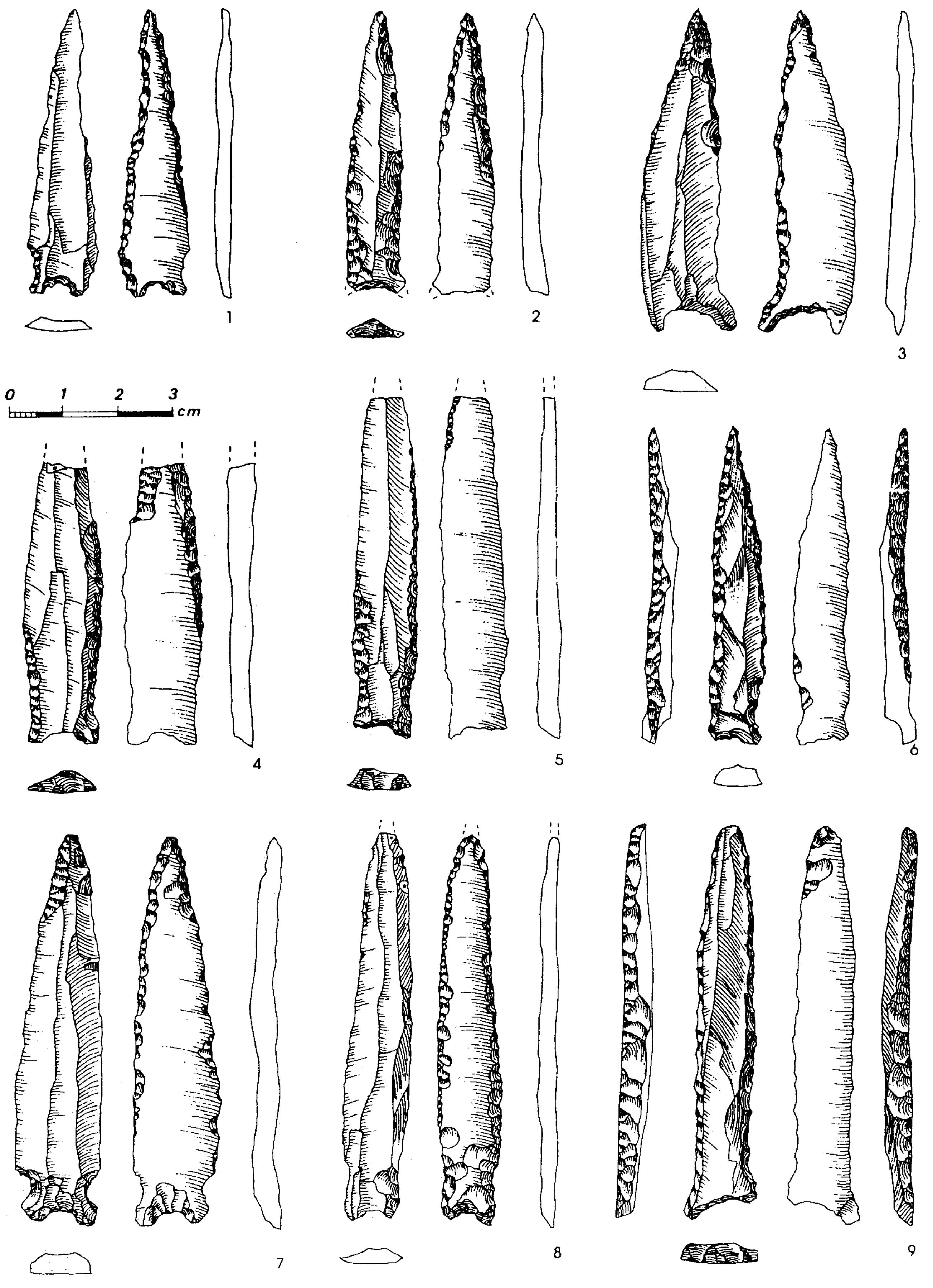

Fig. 8. Hollow-based points with lateral notches (silex).

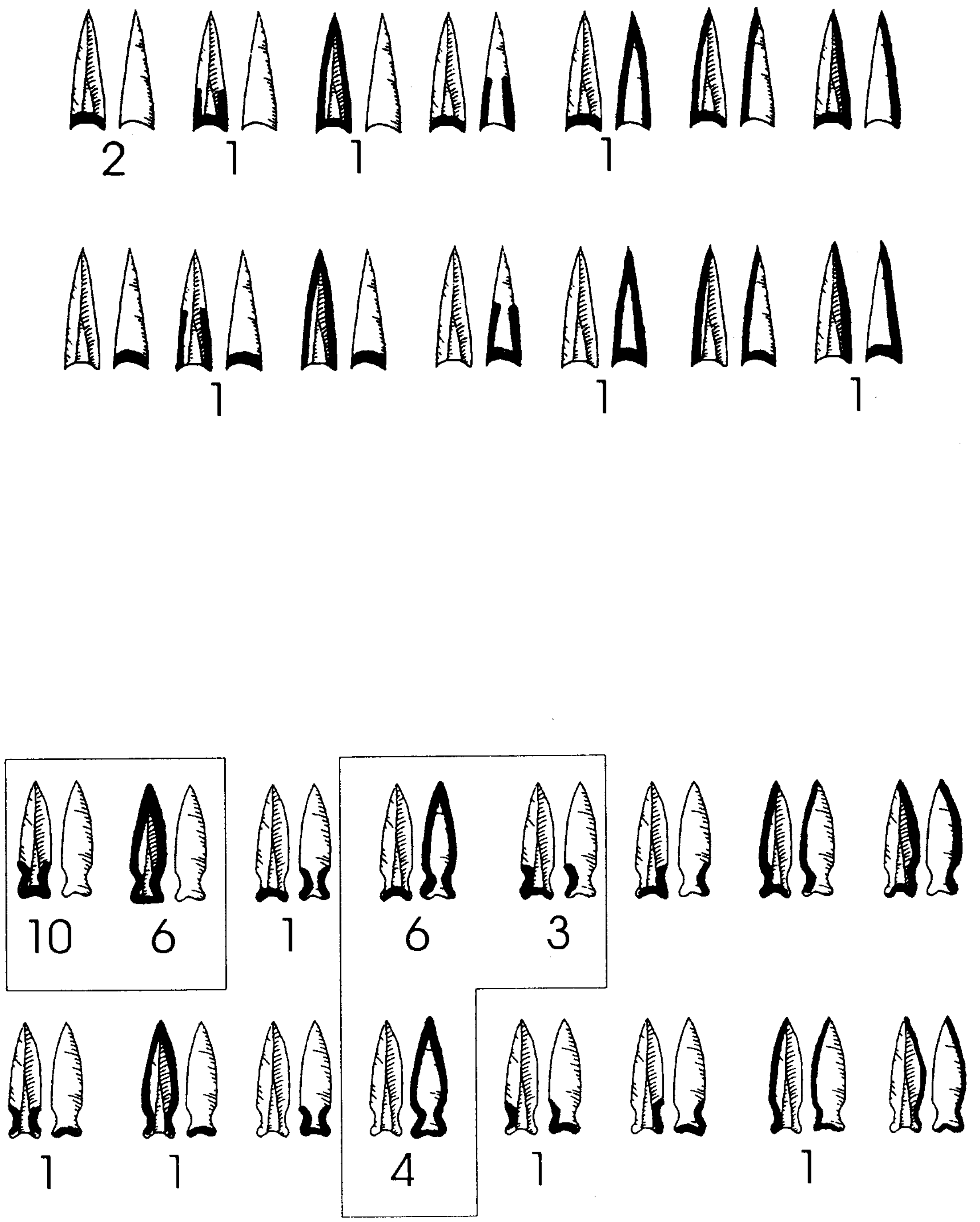

Fig. 9. Hollow-based points: schematized drawings with possible retouch positions *<thick line> <numbers: amount of recorded artefacts.>.*

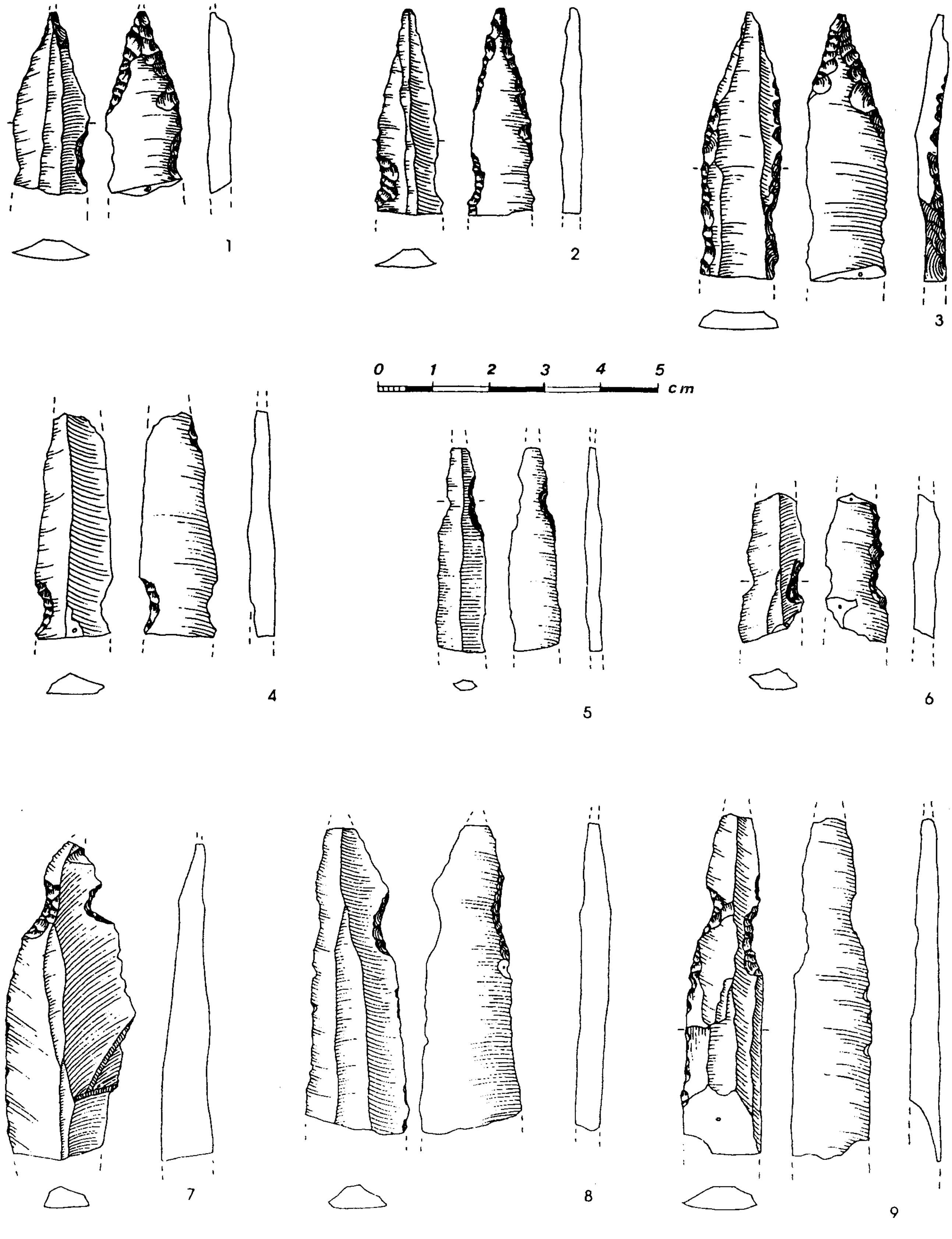

Fig. 10. Notched blades and points (silex).

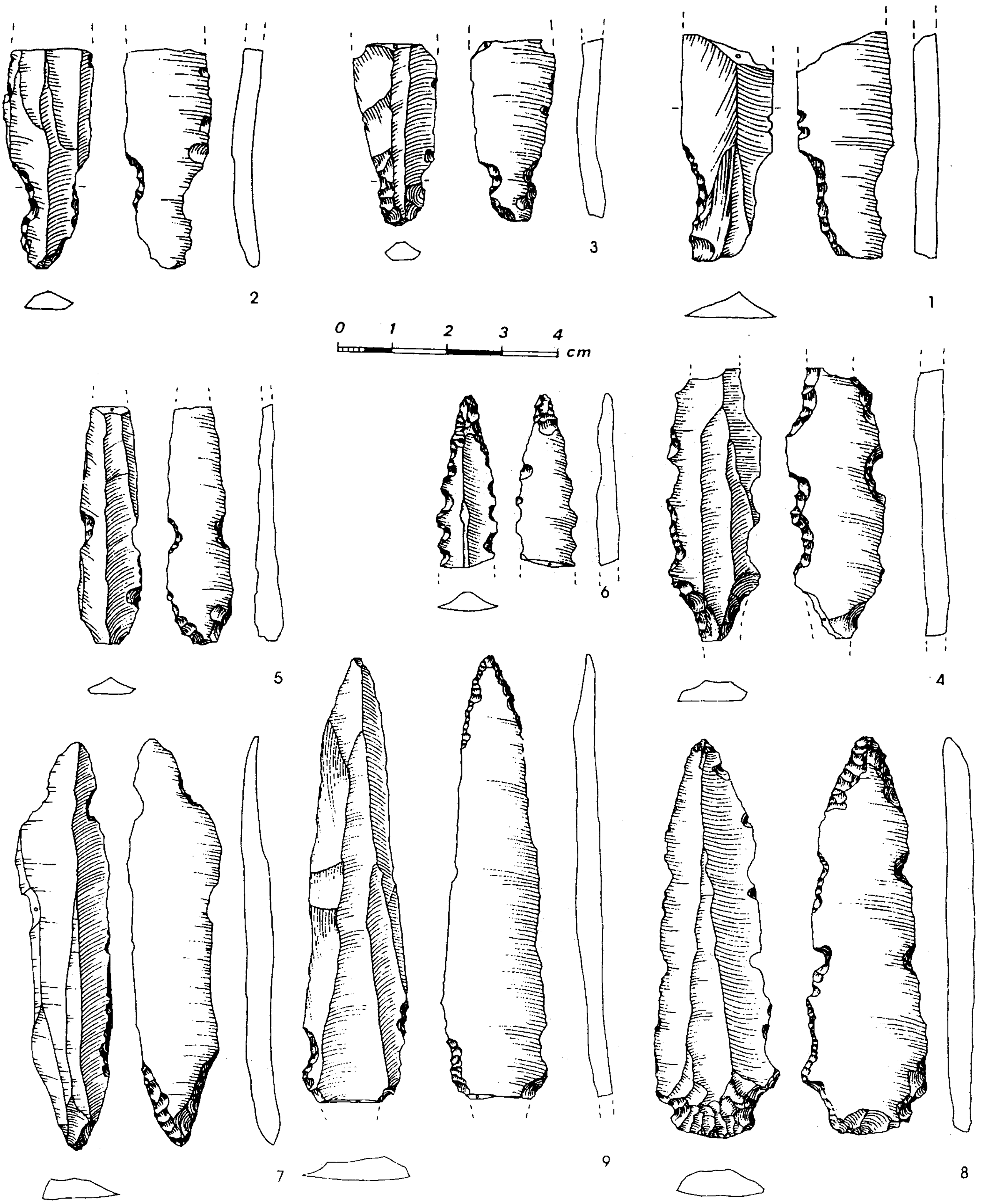

Fig. 11. Notched blades and points (silex).

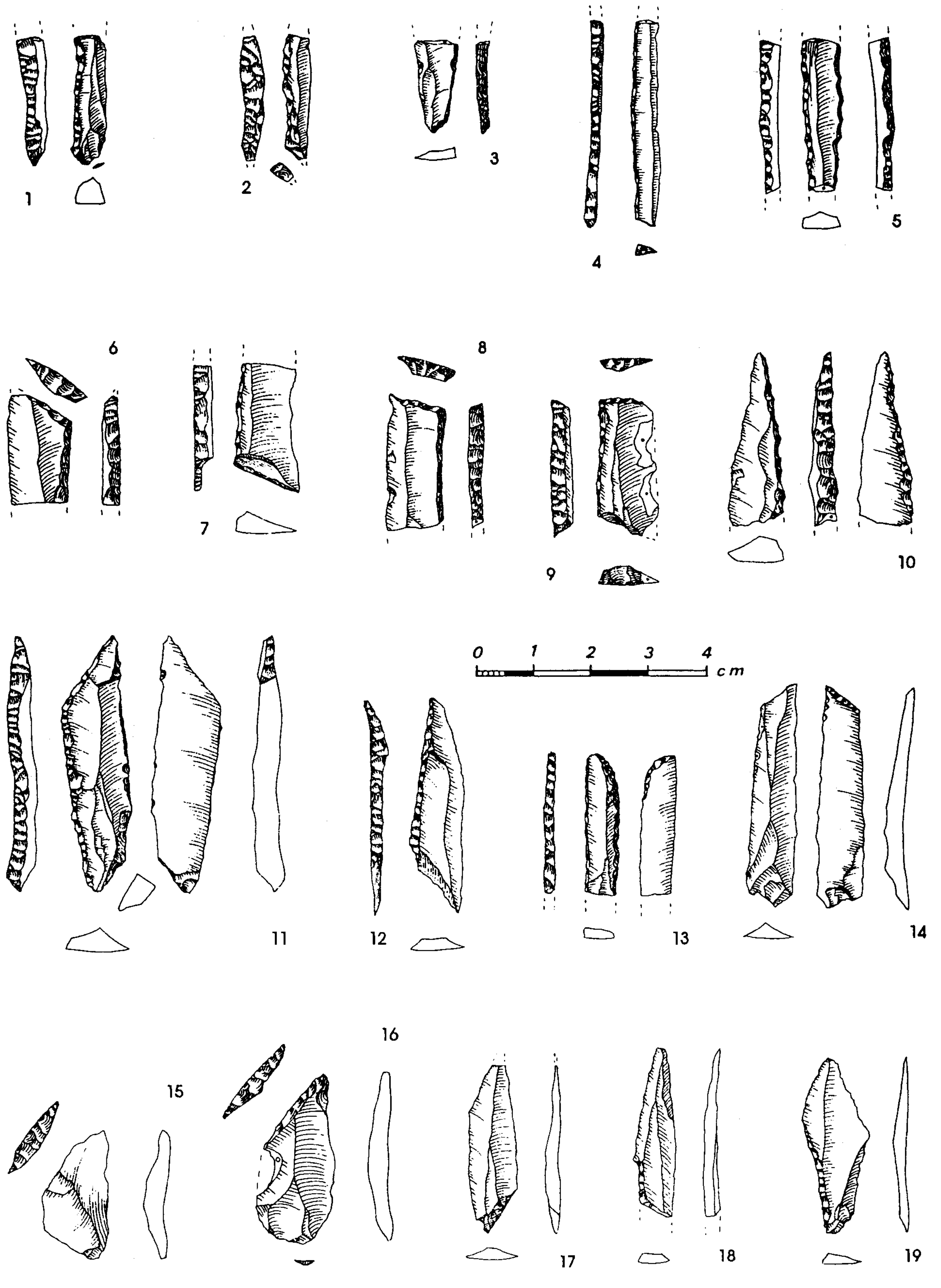

Fig. 12. Microlithic tools (1 obsidian, 2-19 silex).

In summary, the hollow-based points from Nevalı Çori form a typologically well developed group, not a random scatter of various forms. The basic type is characterized by a pair of lateral notches at the very basal end, forming a hollow base with a fishtail outline. Usually the ends are more like rounded wings than pointed barbs. The Nevalı Çori notches are not very deep, and it is clear that there is a strong tendency towards points without lateral notches. Regarding the primary production, hollow-based points are clearly connected with tanged points. All these observations make the Nevalı Çori hollow-based points different from el Khiam points, where the lateral notches are normally separated from the hollow base by some distance. But the stratigraphic position makes it clear that the hollow-based points represent an old type within the Nevalı Çori industry. In view of the scarce occurrence of these points at other sites, such as Çayönü (CANEVA, this volume), the term Nevalı Çori Point is proposed for this type.

There are also distal fragments with lateral notches (Fig. 10). Again, it is difficult to decide in the case of the fragmented pieces if they actually represent points, but generally this seems to be so. It is possible some belong to hollow-based points, but no complete example has distal notches. It is more probable that they belong to the group of tanged points with lateral notches, which resemble in some ways Helwan points. On these pieces the notches are not restricted to the very basal part of the point (Fig. 11:9), occurring sometimes in the middle or distal section (Fig. 11:5,7). Multiple notching also occurs (Fig. 11:4,6,8). These points are rare, but it is obvious that they represent different types. Stratigraphically, these points also belong to the lower layers as is the case for hollow-based points.

The chronological position of the settlement of Nevalı Çori has been discussed in different ways in the past (E.g. SCHMIDT 1988; CAUVIN M.-C. 1988; CAUVIN J. 1988). Unfortunately there are still no radiocarbon dates available, so dating must be attempted archaeologically. Young elements, such a multiple burins, no doubt exist, but the settlement of Nevalı Çori could have had a long life span. The following points can be cited for an early beginning within the PPNB at Nevalı Çori:

- There are almost no obsidian artefacts, and only one Çayönü tool (made of flint) from the upper layer. This should be chronologically significant, since obsidian is present throughout the layers of nearby Gritille (about 5 km distant), and Çayönü tools occur there in low frequencies in the basal layer (DAVIS 1988).

- The occurrence of hollow-based ("Nevalı Çori Points") and tanged and notched points in the lower layers at Nevalı Çori, which do not appear to occur at excavated PPN settlements of the Samsat region at Hayaz (ROODENBERG 1989) and Gritille, should also be chronologically important, although the hollow-based points are not closely related to Khiam points.

- Beyond lithics, there is a 5-phase development of house types at Nevalı Çori. In Layer 5 there are channel houses with two rows of rooms (H. HAUPTMANN 1991-92: Fig. 13). These houses continue into Layer 4. In Layer 3 the tripartite channel houses begin and continue into Layer 2 (H. HAUPTMANN 1991-92: Fig. 17). The architecture of the uppermost Layer 1 is little known: we have only one complete house, but it has no channels and is characterized by buttresses (H. HAUPTMANN 1988: Plate 1, Figs. 1-2). In comparison with Çayönü (ÖZDOĞAN and ÖZDOĞAN 1989), the early channel houses at Nevalı Çori are not very different from grill plans; they are similar to the channel type houses at Çayönü, which follow the grill plan in time. There may be a strong chronological link between Nevalı Çori Layers 2-5 with the intermediate phase at early middle Çayönü between the grill and cell plans.

Finally, the presence of microlithic tools should be considered. They were found only in small numbers, but it is clear that this is not due to excavation methodology: as was mentioned earlier, all excavated soil was wet sieved. There are backed bladelets (Fig. 12:1-5,10,13), truncations (Fig. 12:14-19), trapezes (Fig. 12:6-9), one la Mouillah point-like piece (Fig. 12:12), and one lamelle scalene (Fig. 12:11). The microliths were concentrated not only in the lowest Layer 5 but also in the top Layer 1. This situation can be explained by the topography of the area. There is a hill overlooking the site. A soil with pre-Neolithic occupation, underlying Layer 5, may also have covered the hill, which today is denuded. The soil could have been eroded and redeposited on top of the Neolithic settlement, causing the admixture both in Layer 1 and Layer 5. The microlithic tools probably represent an epipaleolithic occupation mixed accidentally with the Neolithic material and not a microlithic tradition within the Nevalı Çori industry.

Acknowledgments: The Nevalı Çori- Project is supported by the Deutsche Forschungsgemeinschaft. I am grateful to Gary O. Rollefson for reading and commenting on this contribution.

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The Lithic Production at Çayönü: a Preliminary Overview of the Aceramic Sequence

Isabella Caneva, Anna Maria Conti, Christina Lemorini, and Daniela Zampetti[1]

The site of Çayönü is well known to all prehistoric archaeologists as one of the most spectacular examples of the PPNB cultures in the Near East. It consists of an impressive stratigraphic sequence of architectural levels dated between 7500 and 6500 BC (BRAIDWOOD, ÇAMBEL, and SCHIRMER 1981). Each level includes a complex topographic layout of highly standardised large buildings separated by courtyards and by a large plaza. The mound is located on the north-western edge of a fertile alluvial basin in the Diyarbakir plain, one of the richest natural habitat zones of wild cereals in the Middle East (Fig. 1). The site was discovered in the early sixties and revealed the earliest Anatolian evidence of domesticated and intensively cultivated cereals. Since then, extensive excavations aimed at the research on the formation of the earliest agricultural societies have been conducted (BRAIDWOOD and BRAIDWOOD 1982; BRAIDWOOD, ÇAMBEL *et al.* 1981; ÇAMBEL 1980; ÖZDOĞAN and ÖZDOĞAN 1989).

The analysis of the chipped lithic materials, partially carried out in the past by Linda Braidwood and her collaborators (REDMAN 1982), was recently resumed by the University of Rome "La Sapienza", thanks to the invitation of the excavators. Our approach is no longer aimed at the general definition of this culture, as was originally the case. It instead focuses on the characteristics of the architectural sub-phases of the site and on the comparisons with contemporary sites. Together with this diachronic perspective, our attention is also concentrated on the synchronic organisation of the settlement. Thus, a further, major aim of the analysis is the functional interpretation of the various buildings, open areas and other topographic contexts present in each sub-phase.

The first step in this multistage study was the definition of the basic characteristics of the lithic industry from Çayönü through time. A lithic sample collected from four out of the sequence of six main sub-phases has so far been examined. In order to ensure the significance and homogeneity of the samples selected for study in each stage, the material was grouped in specific contexts to be analysed each time. The materials from one or two complete buildings from each sub-phase were taken into consideration in this preliminary study. A comparison between different buildings and between buildings and open areas in each sub-phase will be the subject of the next steps of the research.

As far as flint is concerned, a scarcity of cores, cortical objects and core preparation elements was observed in this collection. No core reconstructions, with the exception of the Large Room sub-phase,

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the latest in the aceramic sequence at Çayönü, were possible. This would suggest that flint tools were produced outside the buildings during all the occupations but the latest. A similar suggestion can be deduced by the analysis made by Redman (1982) on a collection which also included materials from undifferentiated areas. It therefore seems probable that the knapping areas were not frequent in the village itself, but were instead confined either to a few specific places, as yet unrecorded, or to areas outside the village. It should be noted, however, that a reserve of tabular flint can also consist of massive flakes with hardly any cortical parts, as seems to be the case in one of the buildings of the Large Room sub-phase.

As for obsidian, the similar low frequency of core preparation elements in relation to the mass of extracted artefacts is less significant, as the core productivity was probably much higher than for flint in terms of the number of artefacts obtained. The analysis of the material from the site of Gritille, on the Turkish Lower Euphrates, revealed that obsidian weighed less than 1% of the total mass of lithics, but accounted for 5% of the number of pieces (DAVIS 1988). Moreover, the large size of many obsidian tools, larger than any flint tool, suggests that massive blocks were initially exploited, though only very small, heavily exploited cores were found in the site. Different core reduction strategies were probably applied to obsidian and to flint, and would thus influence their overall productivity. These problems will be analysed in detail in the research progress.

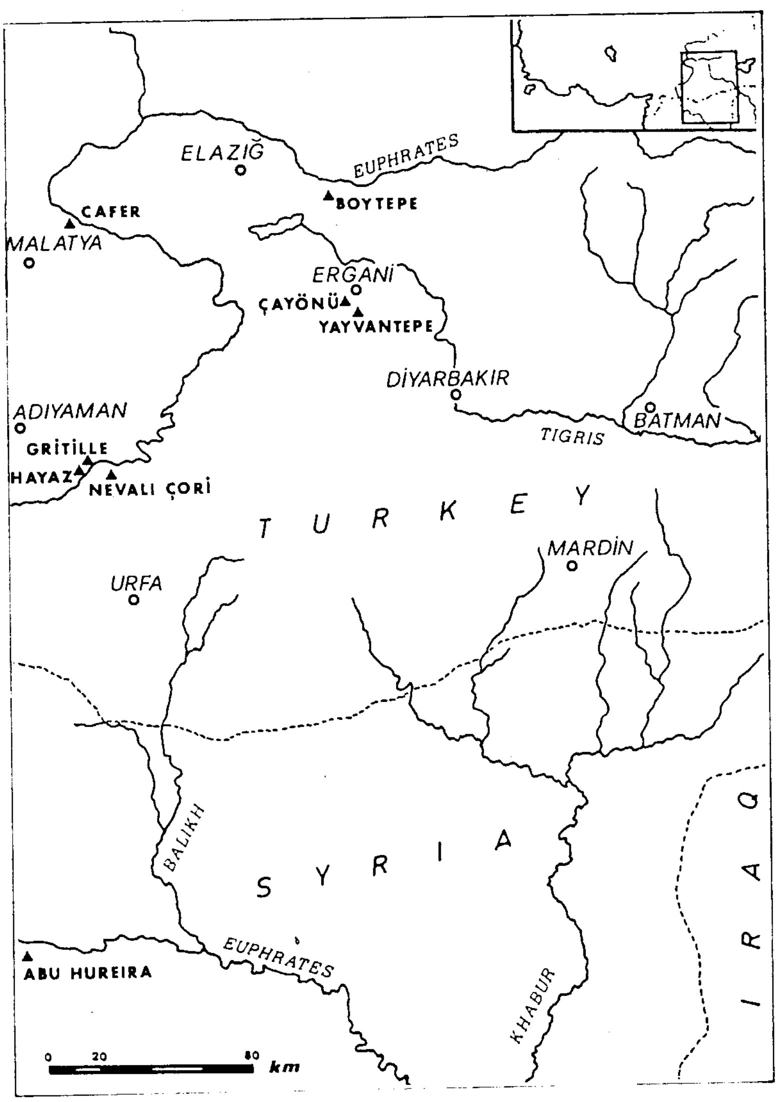


Fig.1. Location of sites quoted in the text.

The earliest sub-phase, characterised by Round Plan wattle and daub buildings, contains a lithic assemblage rich in well defined flint tools (especially points, perforators and burins) (Fig. 2). Blade points were obtained with inverse retouch on the tip, while the base consisted of a coarser point or either a concave or a convex truncation. Glossy (sickle ?) elements include blades of varying sizes and shapes (Fig. 6:B). Obsidian accounts for as little as 20% of the assemblage and is not used for distinct tool types, with the exception of some good quality end scrapers. In the debitage, flakes are more numerous (50 %) than blades and bladelets (38%) (Fig. 5).

The following Grill Plan sub-phase represents the first of an impressive stratification of rectangular buildings with a complex design of stone foundations. In spite of the re-markable changes in the architectural features, however, this sub-phase does not show any major changes in the typology and composition of the lithic assemblage (Fig. 2). However, obsidian starts to be used for specific tools, such as projectile points and Çayönü backed blades. In the debi-tage, flakes (45%) still exceed the number of blades and bladelets (38%) (Fig. 5).

The Channeled and Cobble Paved building sub-phases, as well as a series of transitional sub-phases stratigraphically included between the Grill Plan and the Cell Plan Buildings, show a progressive

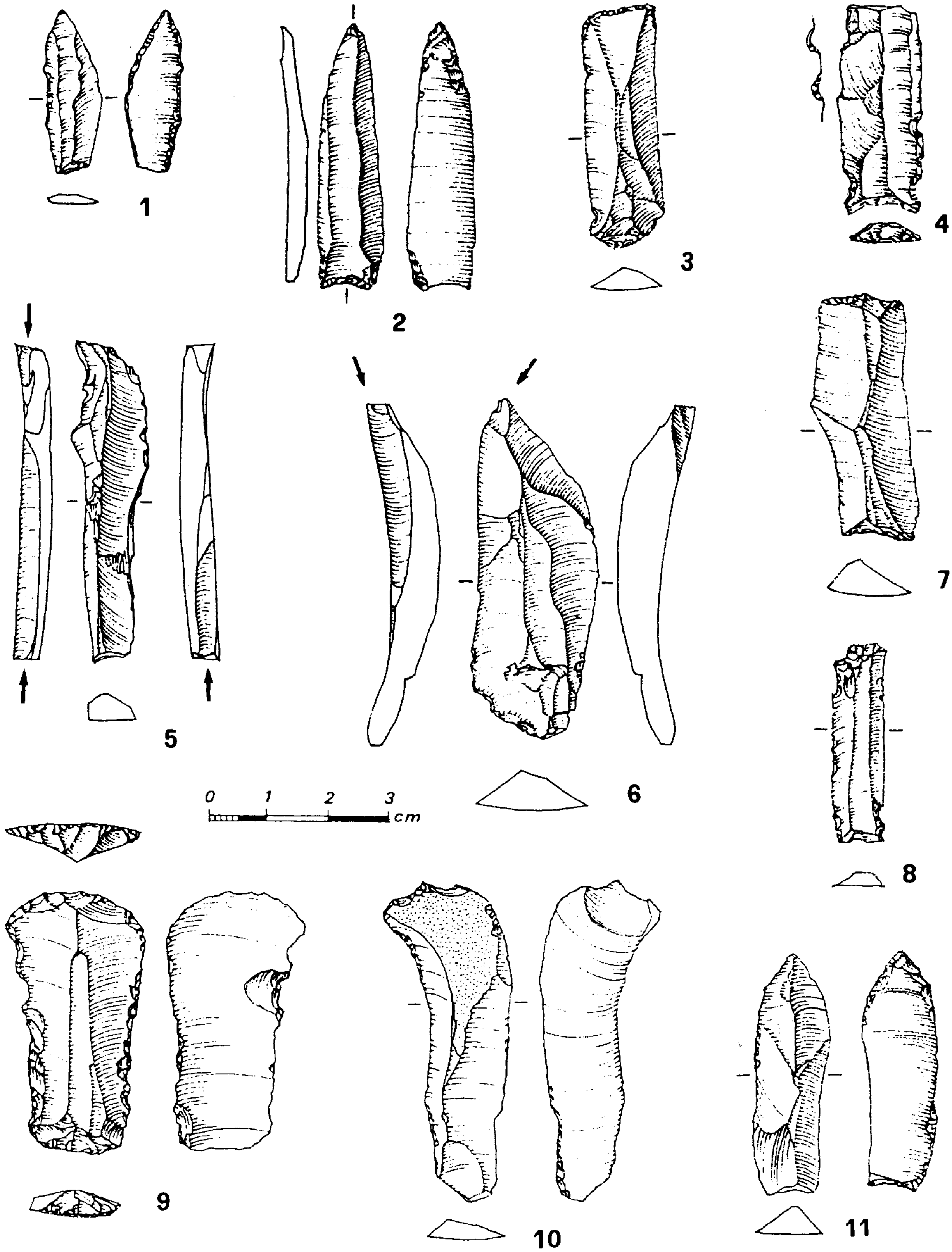


Fig. 2. Lithic implements from the Round House (1-7,9) and the Grill Plan (8,10,11) subphases: 1,2,11 points, 3,7 double truncations, 4 multiple perforator on concave truncation, 5,6 burins, 8,10 microperforators on bladelets, 9 double-end-scraper *<obsidian in italics>*.

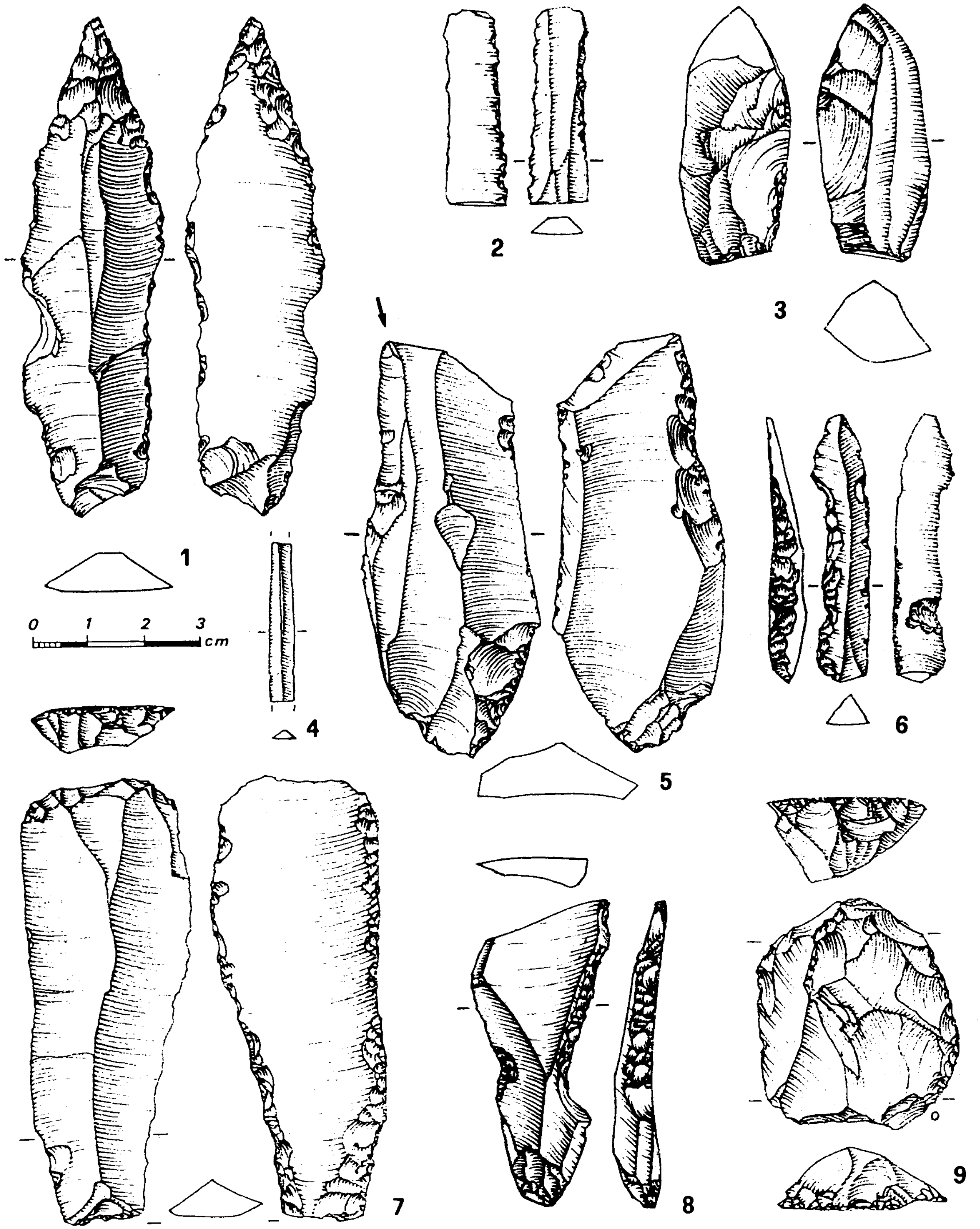


Fig. 3. Lithic implements from the Cell Plan sub-phase: 1 projectile point, 2 glossy blade, 3 naviform core, 4 bladelet, 5 burin, 6,8 Çayönü backed blades, 7,9 scrapers *<obsidian in italics>*.

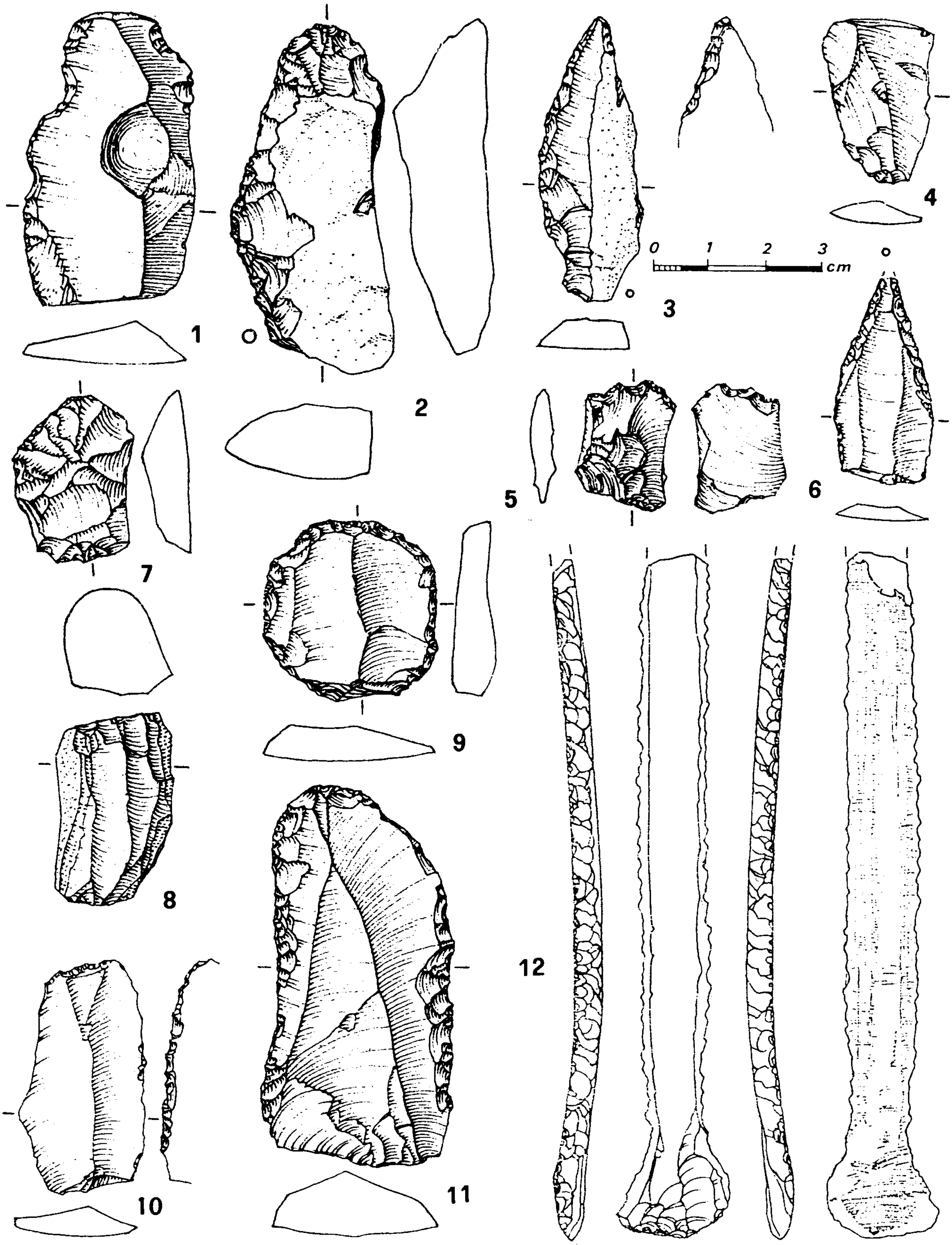


Fig. 4. Lithic implements from the Large Room sub-phase: 1,4,10-11 glossy pieces, 2,7,9 scrapers, 3,6 points, 5 denticulates, 12 Çayönü backed blades, 8 cores *<obsidian in italics>*.

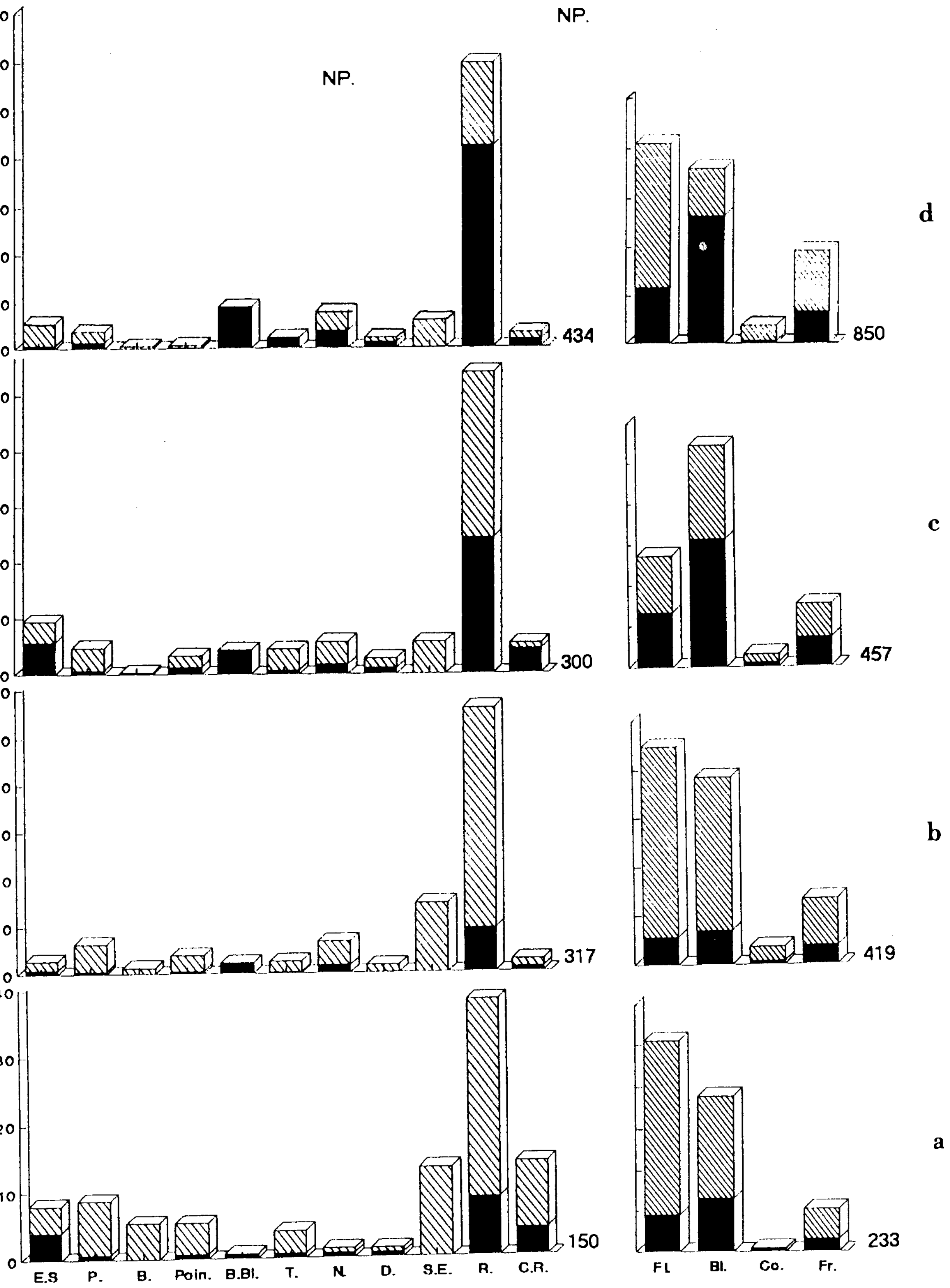


Fig. 5. Frequency of debitage and retouched artefacts in the various sub-phases: a Round Houses, b Grill Plan, c Cell Plan, d Large Room.
Retouched tools <left> : E.S.: end-scrapers; P: perforators; B.: burins; Poin.: points; B.Bl.: Çayönü backed blades; T: truncations; N: notches; D: denticulates; S.E.: sickle elements; R: slightly retouched pieces; C.R.: continuously retouched pieces <*obsidian in black*>.
Debitage <right> : Fl.: flakes; Bl.: blades; Co.: cores; Fr.: fragments <*obsidian in black*>.

packing of the stone foundations, which end up forming what might be described as solid platforms. These sub-phases were only briefly analysed in this preliminary study and are not shown in the graphs. As far as we could observe, however, the general characteristics of their lithic assemblages do not differ substantially from those described so far. The flint:obsidian ratio is still 80:20, while the frequency of blades seems to increase. The naviform core, which is specifically preformed in order to obtain long and narrow blades, appears among the cores in this phase.

The Cell Building sub-phase shows more substantial differences in the architectural features. Significant changes also appear in the lithic assemblage (Fig. 3). The flake:blade ratio is reversed in favour of blades (24:52%). Blade tools include end scrapers and points. Sickle elements reach a remarkable standardisation in both size and shape: 35 mm long and 10 mm wide blades with trapezoidal section and very regular, parallel sides (Fig. 3:2). Obsidian increases considerably in all tool classes (Fig. 5). Obsidian objects were certainly produced locally: in one of the buildings the complete "*chaîne opératoire*" for the exploitation of obsidian blocks in the form of naviform cores was documented: cores, skey spalls, crested blades and the first long blades extracted from the core (Fig. 7). The comparison between two buildings belonging respectively to the beginning and to the end of the stratigraphic superimposition of Cell Building layers did not show any remarkable difference in the composition and characteristics of the tool kit. The same results were obtained when a separate analysis of the materials from the floor level of the buildings and from the filling of the cells underneath was made.

A radical change is shown by both the characteristics of the architecture and the composition of the lithic assemblage of the Large Room sub-phase (Fig. 4). Retouched tools are in general less standardised than before, and quite inaccurate in shape and retouch. The "Çayönü blade", which predominates among the tools, is an exception. The lack of standardisation is particularly evident in the types of scrapers and sickle elements, which are frequently made with unpatterned flint flakes (Fig. 6: A). The assemblage includes large quantities of debitage, mainly flint flakes, suggesting changes not only in the tool kit but also in the function of the buildings: flint objects were produced in the building and massive flakes from the same block were found stored all together, probably as a reserve stock. Crested blades sharply decrease in number, while naviform cores disappear and are replaced by flake cores and pyramidal bladelet cores (Fig. 5).

Elements of continuity exist throughout the sequence. In the architecture, this is suggested by the constant standardisation of the size, plan and orientation of the buildings in their respective sub-phases and by the presence of changes which are considered transitional by the excavators. Moreover, a number of non-domestic buildings with monumental characteristics and probable ceremonial functions seem to have been used through several sub-phases (ÖZDOĞAN and ÖZDOĞAN 1989). In the lithic production, a trend towards a more intensive and differentiated use of obsidian is observed from the beginning to the end. However, at least two abrupt steps can be identified in this trend, one preceding the other following the Cell Plan sub-phase. The ratio of obsidian to flint is less than 1 to 4 in the first sub-phases, including the Cobble Paved one, but is 1 to 1 in the Cells and almost 2 to 1 in the Large Room sub-phase (Fig. 5). Moreover, obsidian is used in different tool classes in the different sub-phases: it is used indifferently in almost all tool classes in the Cells, whereas it is well separated from flint in the tools of the Large Room sub-phase. It is therefore clear that the function of the two materials changes also in the two uppermost sub-phases, in spite of the relatively similar large quantities of obsidian found. A parallel trend towards an almost exclusive use of blades and bladelets emphasises the same subdivisions in the sequence: flakes prevail in the first two sub-phases, but this ratio is reversed in the Cells and the two raw materials are strongly differentiated by respectively inverse obsidian/flint blade/flake ratios in the Large Room sub-phase (Fig. 5). The overall increase in blade products in this late context must be considered in conjunction with the selection of obsidian as a favourite raw material.

In addition to these differences, a considerable variety also exists in the composition of the tool kit of the various sub-phases. The typological categories do not account for the peculiarity of each tool class in each sub-phase. One of the most striking examples are the pieces with glossy edges, which have so far been grouped under the traditional heading of "sickle elements". These include very different types of blanks, which are specifically distinguished in each sub-phase: either blades of different size and shape, as in the earliest levels (Fig. 6:B), or very standardised truncated blades in the Cells (Fig. 3:2), or various kinds of flakes in the last levels (Fig. 6:A). The same goes for the end scrapers, which were mainly thick, circular pieces in the lower part of the sequence, front edges on long blades in the Cells and mainly thick flakes in the uppermost levels.

Finally, besides the easily recognisable tool types, a high percentage of the tool kit is formed by artefacts which were used "as is", either without any intentional retouch or with scattered, atypical retouches. These are mainly pieces with evident traces of use. Despite their obvious characterisation as "tools" on account of the evidence of their use, these objects show unpatterned characteristics which make their classification a difficult task. These "use modified" artefacts (R and C.R. in Fig. 5) account in each sub-phase for more than 50% of the tools and therefore contain the most important potential of information on the activities performed. Any global analysis and regional comparison should not ignore this problem. It is clear that the morphological analysis of the lithic artefacts in these contexts cannot account for all the characteristics of a tool. We should therefore make an attempt to include in the concept of "tool" both retouch and wear traces, as two complementary elements of analysis. A distinction between shaping, hafting, resharpening etc., should also be made for the retouch. A functional approach in this situation was considered to be of fundamental help in the definition of the entire tool kit, including in it that 50% or more of artefacts which has so far been excluded from any description and comparison. In this sense, this approach should not be considered an optional addition to the traditional analysis, but an integral part of it.

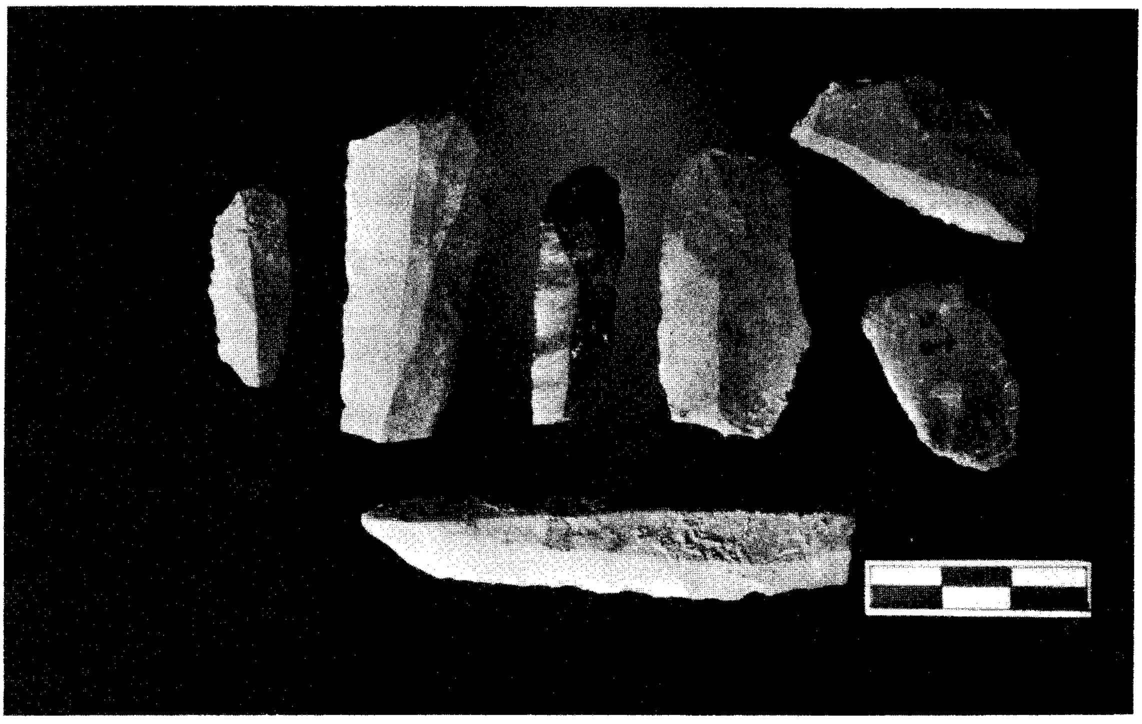
The functional analysis of this material was preliminarily made with a low-power approach (edge removals, edge-rounding and polish brightness analysis) following the methods of ODELL 1975 and SHEA 1991) using a stereomicroscope Zeiss CITOVAL 2 with magnification between 6.3x and 60x. Adequate criteria for material collection for an edge wear analysis were only recently established and are now used in the archaeological excavations. Despite the pessimistic estimate made for the Çayönü materials, functional inferences, however, were obtained on a high percentage of the studied sample, especially flint. Obsidian is obviously more fragile and therefore more damaged, on account of its vitreous structure and the thinness of its products.

The sample analysed in this first phase consisted of about two hundred pieces, mainly flint, from one of the Grill Plan buildings. On 70% of the artefacts analysed diagnostic wear-traces were found, more than half of the blanks not being retouched (Fig. 8). In the débitage, the traces were functionally divided in: longitudinal motion (cutting, engraving, sawing, shaving: 50%) and transversal motion (scraping, planing: 40%) on medium-hard/hard material; a smaller percentage were protruding points used for rotation motion on various kinds of material. These materials are conventionally defined as soft (some non-woody plants, meat, fat, fresh hides), medium-hard (fresh and soaked wood, some non-woody plants, wet and soften hides, leather, soaked antlers, butchery) and hard (dry wood, dry antlers, horn, fresh bone, shells, teeth, ochres, ceramics, stone).

These data clearly indicate that different activities were performed with the debitage, even with the same object. Plant cutting was recognised among these activities. It is interesting to note that flakes were used mainly for transversal motions (scraping, etc.), whereas longitudinal motions (cutting) were performed with blades. This suggests that the morphological features of flakes and blades were intentionally produced for separate functions.

Different activities were performed also with the slightly retouched objects. Plant cutting was recognised on 5 edges. Retouch was very often located close to either the proximal or the distal end, or both. Only in 7 cases out of the 33 analysed was the retouched part clearly used; retouch and wear-traces were usually found either on different edges or in distinct zones of the same edge. This suggests that retouch on these non-distinct tool types might have been applied in order to haft rather than use the object. The fact that this retouch occurs especially on blades would also suggest that blades were better suited for hafting than flakes, probably because of their greater standardisation in size and shape.

Finally, diagnostic traces were found on 43 edges of 34 distinct tool types, only about half of this number being retouched edges. Various activities, related mainly to transversal and longitudinal motions on medium-hard/hard material, were again identified. Blades were used above all for longitudinal motions. In four cases edges previously used for cutting hard material (plants in two cases) were re-sharpened.



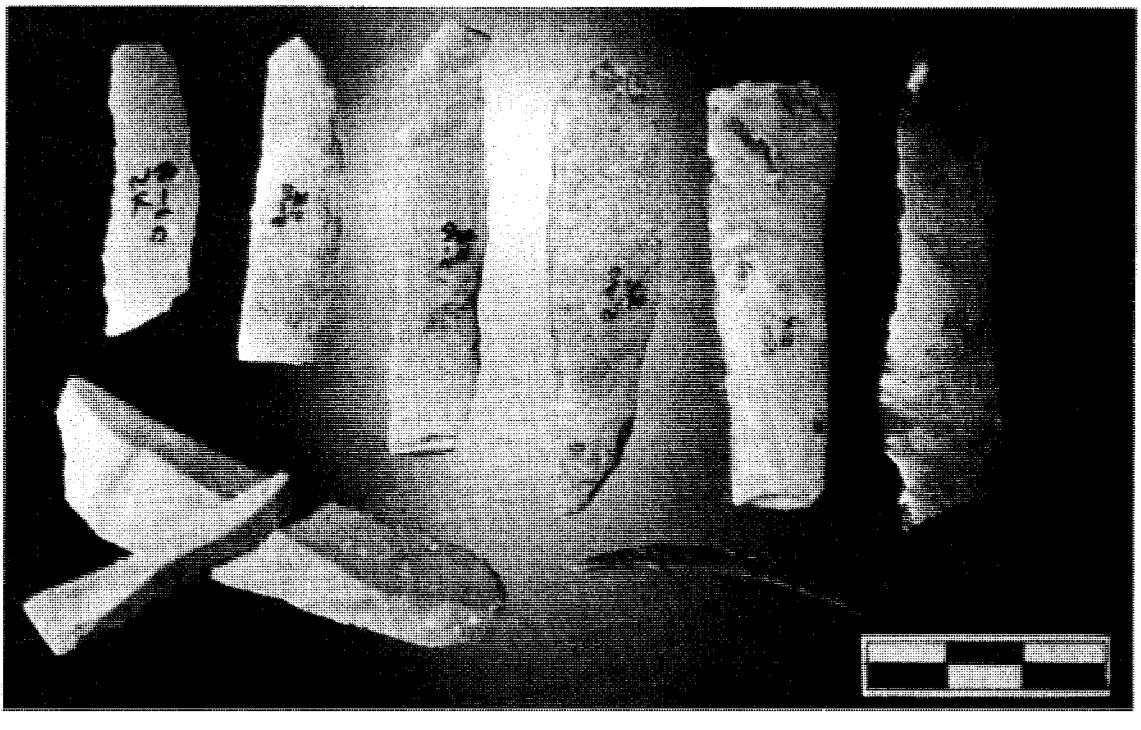


Fig. 6. Glossy (sickle ?) elements in the Round Houses (B) and the Large Room (A) sub-phases.

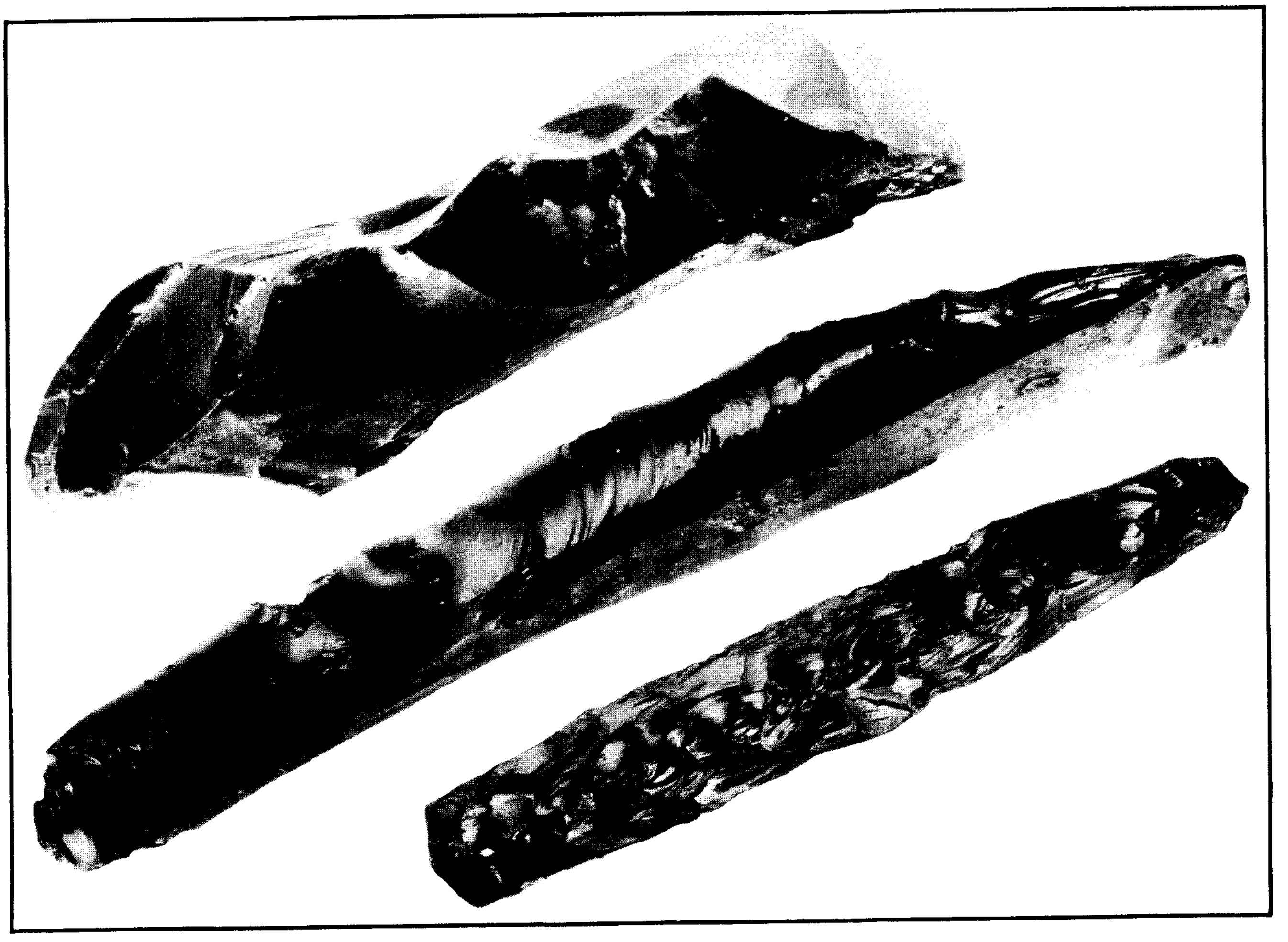


Fig. 7. Obsidian reserve stock and blade production in a Cell Building.

The use of tools on soft material and the use of retouched edges is underestimated in these preliminary results, owing to the lack of the analysis of micro-wear traces with a high-power approach. The high power approach (KEELEY 1980) was applied only to a lithic sample, in order to evaluate the significance of this kind of analysis on the collection from Çayönü. These preliminary inspections gave promising results for a future successful extension of the analysis in this sense. The indications obtained so far, however, confirm and add weight to those obtained by the typological analysis. The notion of tool in this context should include a large part of the débitage, which was in fact used for a wide spectrum of activities. The mass of used artefacts is striking when compared with the small number of retouched tools, suggesting that these were probably confined to very few, specific activities.

Comparisons of our results were limited, in this first step of the research, to the closest Anatolian aceramic sites. The data from these sites, however, are not homogeneous, owing to the different stages of the research. It is only as a basis for discussion, therefore, that a tentative effort of comparison is mentioned here.

Our definition of the single sub-phases at Çayönü tended to emphasise the elements of discontinuity in the stratigraphic development of the site, rather than those of continuity. This perspective aimed at the identification of well-defined separate "periods" for an easier association of each sub-phase with other comparable evidence in the region. However, the idea of a comparative chronological reconstruction of the prehistoric evidence in this area is not at all implicit in this seriation. It is quite possible that the buildings so far analysed represent specific functional areas and therefore peculiar contexts in each sub-phase. Moreover, the stratification of architectural levels at Çayönü does not seem to represent a normal process of modification of buildings following damage by fire or wear, but rather systematic reorganisations of the entire village plan as a result of more general needs and changes, at variable intervals of time. In this sense, the chronological value of the changes observed in the development is highly relative and inconsistencies between sub-phases defined on either architectural or lithic tool elements have to be expected. A similar inconsistency was observed for instance at Cafer (CAUVIN M.-C. 1991).

With regards to the raw material, increasing obsidian use characterises both stratigraphic sequences at Çayönü and Cafer Höyük. At Çayönü, obsidian was almost constantly used for only about 20% of the lithic production in the earlier sub-phases (Round Plan, Grill Plan and Cobble Paved). This rate increases to 40-45% in the Cell Building sub-phase and up to 62% in the Large Room sub-phase. At Cafer, only the lowest level shows a higher frequency of flint products, though not comparable with that observed at Çayönü. Obsidian was almost exclusively used at Boytepe, where, however, the sample analysed was obtained only with a surface collection (BALKAN 1989). In this case, the upper levels of a possible stratigraphic sequence would probably be over-represented in the collection. Obsidian was either scarce or totally absent in the aceramic sites of the Turkish lower Euphrates basin (Hayaz, Gritille and Nevalı Çori). The gradual shift from flint to obsidian shown by the group of northern sites seems to be a cultural choice probably favoured by the proximity of the Bingol obsidian sources. Such a diversified use of raw materials in the different areas and different phases should not be underestimated. The use of different raw materials not only concerns the procurement and exploitation of the material, but also affects the technological procedures, yield of artefacts and labour organisation. Different speeds of production, waste, fragility, wearing, etc. should be considered as well. This difference must also have been clear in the past, particularly as regards some specific types of tools, for which the use of one or the other raw material should not have appeared alike. Unlike Çayönü and other sites, at Cafer, for example, burins are only made of flint.

Distinct retouched tool types are mostly on blades. They always represent a very low percentage of the assemblages. There are trends in the percentages of tool types that are shared by all the Anatolian sites. Gritille is an exception, with a somewhat inverse trend (DAVIS 1988). Burins sharply decrease in later phases at Çayönü, Boytepe (?) and Cafer. Microlithism also seems to decrease. Çayönü backed blades, which are absent in the first sub-phases, increase markedly from the Cell Building sub-phase onward at Çayönü and in the recent levels at Cafer. At Boytepe, which is considered to correspond to the later levels of Çayönü and Cafer, they represent the main tool class. They occur only in the lowest levels at Gritille and are absent in the rest of the Anatolian sites. Similar occurrences are known outside Anatolia, for instance at Bouqras, on the Euphrates, and at some sites on the Zagros. All these, however, seem to belong to considerably later periods.

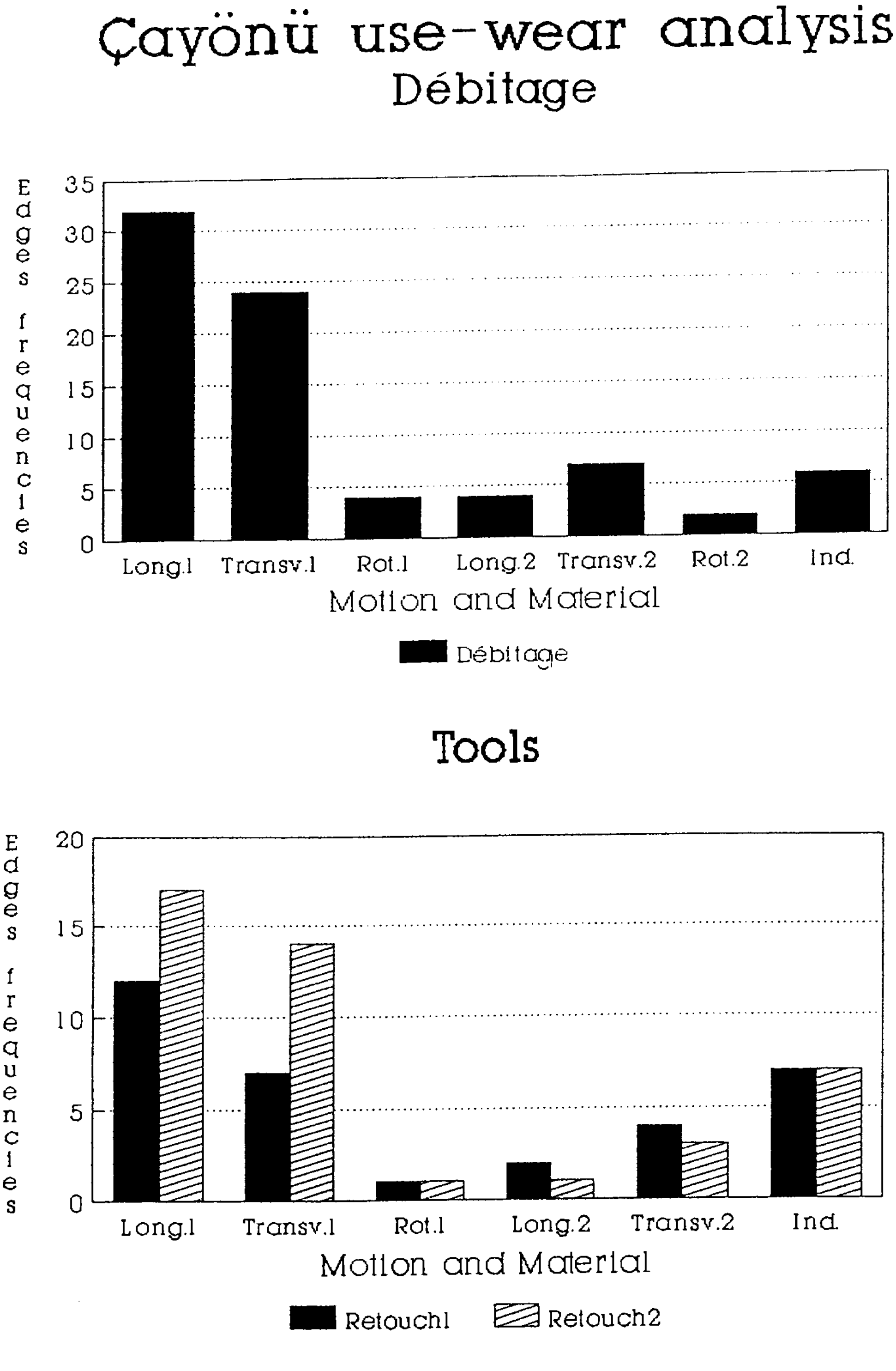


Fig. 8. Frequency of wear traces on debitage and retouched artefacts.
Long.: longitudinal; Transv.: transversal; Rot.: rotation. 1. medium-hard/hard material; 2. soft/medium-hard material. Retouch 1. slightly retouched tools; Retouch 2. distinct tool types.

Standardised end scrapers on blade seem to characterise the earliest phases at Cafer and Çayönü. Those on flake and tablette occur more frequently in the upper levels of Cafer and Çayönü, as well as in the relatively late periods represented at Nevalı Çori and Boytepe.

Standardised non-retouched sickle blades and bladelets are observed in the lowest levels at both Çayönü and Cafer, whereas a tendency towards bigger, sometimes tanged blades, is shown by the sickle elements in the later levels at Çayönü, Nevalı Çori and at Gritille.

Points with truncated concave base, which are found at Çayönü only in the earliest sub-phases, can be compared with those from Nevalı Çori and, outside Anatolia, with those at Mureybet III-IV. Nevalı Çori and Gritille, however, contain a greater variety of points, associated with different architectural remains.

As a general statement, the earliest sub-phases of Çayönü seem to be comparable with the lowest levels at Cafer, while the assemblages from the Cells are more similar to those from Gritille, Hayaz and Nevalı Çori. Interesting comparisons can be found between the assemblage from the Large Room sub-phase at Çayönü and that from Boytepe. The variability found in each site and period, however, would support Roodenberg's statements on the possibility of some of these assemblages representing specialised activities (1989).

Our comparisons are limited to the lithic industry. Nevertheless, in order to thoroughly evaluate lithics, they should be viewed in the general framework of the other activities (economic, ritual, etc.) carried out during the different periods of occupation of the site. In fact, the organisation of the site on the whole and the relations of its inhabitants with the surrounding areas and sites may have changed through time. Therefore, also the role of lithic working might not have been the same or might not have had the same aims. The effort to identify these relations and their dynamics is a further objective of the present research.

Acknowledgments: Many thanks to Profs. Halet Çambel, Robert and Linda Braidwood and M. Özdoğan for having proposed the comprehensive study of the chipped stone materials from Çayönü. Our gratitude also goes to Aslı Özdoğan for her collaboration in explaining the complex stratigraphic and topographic subdivisions of the materials. The project is directed by Isabella Caneva on behalf of the Dipartimento di Scienze dell'Antichità of the University of Rome. The financial support of the project is provided by the Comitato per le Tecnologie Applicate ai Beni Culturali of the Italian National Research Council and by the Oriental Institute Prehistoric Project of the University of Chicago.

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Çayönü: The Chipped Stone Industry of the Pottery Neolithic Layers

Mehmet Özdoğan

The site of Çayönü, reputed for its pre-pottery layers, is conventionally considered within the PPNB horizon of the Levantine Neolithic. However, the last three campaigns have clearly indicated that the sequence at the site was of longer duration, covering cultural horizons both earlier and later than PPNB. The presence of round and oval houses at Çayönü was known from earlier campaigns; however, their significance as being the earliest sub-phase was conceived only after the field season of 1978. This early sub-phase was thoroughly excavated during our last field season in 1991; thus for the first time a quantitatively dependable amount of artifactual material as well as a series of C14-dates became available. It is now clear that the beginning of Çayönü culture was much earlier than previously envisaged, being as early as 10.000 BP[1]it will be briefly presented in the paper on the lithic assemblage of Çayönü by I. Caneva in this volume, the early stages of Çayönü cover most of the PPNA.

Another significant achievement of the last campaigns was our work on the northern section of the site in an area where the presence of early pottery had already been attested through earlier surface surveys[2]. In three consecutive seasons of work in this section of the mound, a total of 1000 sq.m. was exposed, yielding a long sequence of Pottery Neolithic overlying the latest PPN layers[3]. As the uppermost levels in this part of the mound have been much disturbed by ploughing, the end of the sequence is not very clear; nevertheless, the presence of some Halafian sherds in the top soil, which are not otherwise present in the sequence, provides a *terminus post quem* for underlying deposits.

It also became clear that there was no break in the occupation of Çayönü in transition from the pre-pottery to pottery stages. Thus, Çayönü provides a unique case, not only giving information on early Pottery Neolithic, but also in providing an uninterrupted sequence of 3000 years, running from 8000 to 5000 b.c.

There is no indication of a break within the Pottery Neolithic phase of Çayönü, for the artifactual assemblage indicates a gradual development from the earliest layers on. However, this long sequence can be classified into three phases according to the changes in architecture, as well as to the distinct pottery types. The latest phase, immediately below the disturbed Halafian level, has mainly a knob-decorated variety of the so called Dark Face Burnished Ware (DFBW) with some Samarra-like painted sherds, the middle phase is characterized with a fine red-slipped ware, some of which are cream on red

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[1] The dates from various archaeological layers of the "Round House Sub-Phase" of ± Çayönü are: GrN 19482: 10230 ± 200 BP; GrN 119481: 10020 ± 240 BP; GrN 4458: 9520 ± 100 BP; GrN 10360: 9300 ± 140 BP; GrN 10361: 9290 ± 110 BP; GrN 10358: 9180 ± 80; GrN 19481: 9050 ± 50BP; GrN 10359: 9050 ± 40 BP.

[2] See ÇAMBEL and BRAIDWOOD 1980: 52; ÖZDOĞAN and ÖZDOĞAN 1993.

[3] For preliminary reports on the Pottery Neolithic layers see ÖZDOĞAN and ÖZDOĞAN 1993, ÖZDOĞAN *et al.* 1991, and ÖZDOĞAN *et al.* 1992.

painted; also in the same phase there are a few Hassuna elements, including "husking-trays". The earliest phase has a sort of rather coarse pottery.

Concerning the chipped stone assemblage, this paper will consider three basic issues: a) Are there any marked differences between the prepottery and pottery assemblages?, b) Are there any specific changes in chipped stone artifacts within the pottery sequence ?, c) Defining the chipped stone assemblage of pottery phases. It should be noted that the work on Çayönü chipped stone assemblages is still in an incipient stage[1], and this presentation should be considered not in terms of conclusive remarks but preliminary observations.

The chipped stone assemblage of the earliest pottery-bearing horizon is a direct descendant of the large room sub-phase of the pre-pottery mound. However, some changes in the composition of the assemblage are apparent: there is a sharp decline in the amount of flint and obsidian recovered, which became even rarer in upper pottery layers. The number and types of retouched tools are also very limited compared to pre-pottery horizons. It is interesting to note that the ratio of obsidian to flint, which in the large room sub-phase was over 1:1, rises to almost 1:2 in the earliest pottery phase. which, in later phases of the Pottery Neolithic, will come down to 1:1 again. All through the Pottery Neolithic phase, "Çayönü" type backed blades constitute the main part of retouched tools. However, most of them are much smaller compared to those of the PPN samples, and some of them have a steep retouch on the frontal end; there are also some odd backed blades having either alternating retouch or steep retouch on the dorsal surface.

All through the pottery layers there is a marked increase in the number of sickle blades, and a new type emerges in the middle horizon of the pottery phase which is almost like a large lunate. Among other new types that occur in the pottery phase are small, almost microlithic, arrow points of obsidian, some of which are tanged, while other have a concave base. Large drills, large chunks with invasive retouch are among the new types present. Among retouched tools there are also significant numbers of end scrapers on thick blades, and also notched blades. Most of the obsidian tools are clearly microliths or on small blades. In general very few cores or core fragments have been recovered.

A Brief Description of the Lithic Assemblage

As it has been noted above, the description to follow is based on a preliminary study of the material and subject to change in future.

In the preparation of this paper, all of the material has been examined for typological series and for significant pieces; then a stratigraphic series of collection units was selected to inspect sequential differentations. The description of the assemblage, as well as quantitative remarks, are based on these selected samples.

Raw Materials

In the preceding phase of Çayönü, that is during the latest pre-pottery sub-phase, there was a marked increase in the use of obsidian, constituting roughly 50% of the total chipped stone assemblage[2]. In the earliest pottery phase there is still a marked tendency to use more obsidian. In the earliest pottery layer the ratio of obsidian to flint is roughly about 1:2, and during the second pottery phase was 65%; and later by the end of our sequence, it comes down to 50%. The types of flint used were essentially the same as in the preceding phases.

In the production of small to medium sized bladelets, obsidian was much preferred to flint. Larger blades and irregular blades are mostly of flint. Double-backed blades are exclusively of obsidian.

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1 The detailed study of Çayönü lithic material is being undertaken by Dr. I. Caneva.

2 As noted by Caneva and others, obsidian was present at Çayönü from the earliest sub-phase in large quantities; while in the earliest sub-phase it constituted 25% of the lithic assemblage, this ratio steadily increased in time.

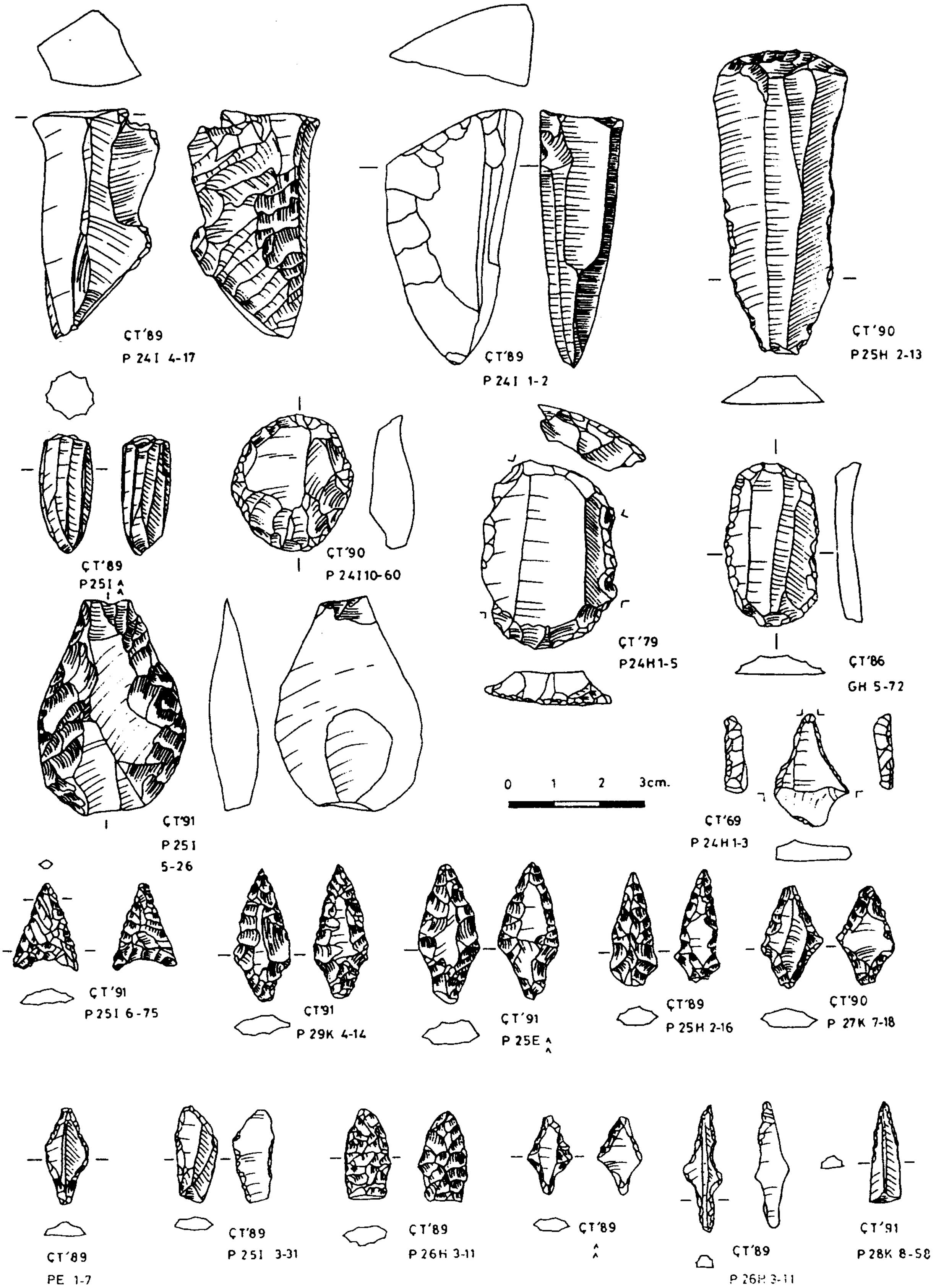

Figure 1. Cores, scrapers, projectile points, borer

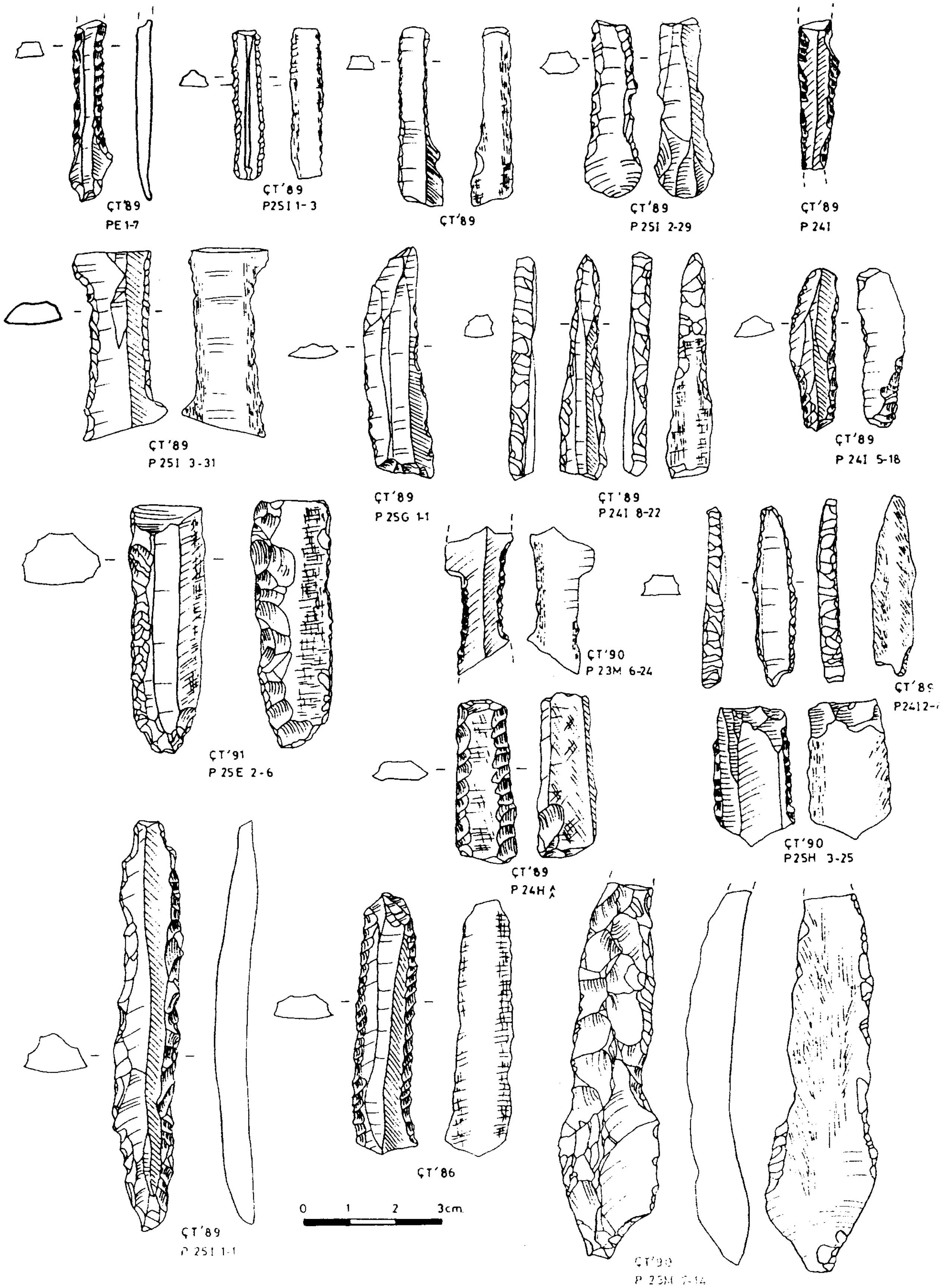

Figure 2. Backed Blades or "Çayönü Tools"

Cores and Core Fragments

Surprisingly few cores or core fragments have been recovered, and among these, typical cores with clear-cut platforms are exceptional. As most of the cores show signs of secondary utilization as scrapers or heavy duty tools, it seems more probable that some of the cores were collected from earlier deposits.

a) Flake cores : Most of them are amorphous cores with multiple platforms; only one double platform core was recorded.

b) Blade cores: Most of the blade cores are single platform cores, some having a well developed crest at the back. Most of the blade cores have traces of heavy wear, and some are reflaked as carinated scrapers. Only one typical micro-blade core has been recovered (Fig. 1: P 25 I). Among the interesting pieces, there is an odd double platform blade core (Fig. 1: P 24 I.4-17).

c) There are occasionally some core revival blades and flakes, the most most common type being crested blades, most of which have traces of secondary utilization.

Backed Blades or "Çayönü Tools" (Fig. 2)

The most common type among the retouched tools is the obsidian double backed blade with steep side retouch, commonly known as the "Çayönü Blade". As the description of this significant tool, as well as its stratigraphical position in the prepottery layers of Çayönü are being covered by Dr. I.Caneva in this volume, here we will concentrate only on its occurrence in the pottery-yielding layers.

Çayönü blades are present in all layers in significant amounts; however, there is a marked decrease in their number towards the end of the sequence. Even though the basic features of this tool, the continuous steep retouch along both sides with traces of heavy wear on the ventral surface, are essentially the same as in the preceding sub-phases. But some minor differences are also apparent. Compared to the specimens from pre-pottery phases, the tools are much smaller, the average length being around 4 cms, with the biggest hardly exceeding 9 cms. Occasionally some of the backed blades terminate on the distal end by heavy retouch (Fig. 2: P 24 I 8-22; P 24 I 2-6 etc.), almost resembling so-called "fabricators", some of which might have been used as a borer. Besides the conventional steep side retouch, some of the blades are also retouched along the ventral surface. The quality of retouch on the ventral surface varies considerably from steep, (Fig. 2: P 25 E 2-6) to squamous flaking (Fig. 2: P 24 H). However, even in cases where there is flaking on the bulbar surface, the characteristic traces of abrasion are still present. In a few specimens, the degree of abrasion on the ventral surface is very high, almost like grinding. Occasionally there are some pieces shaped on very thick blades (Fig. 2: P 24 E 2-6) or even on crested blades (Fig. 2: P 23 M 7-14), types which were totally absent in pre-pottery layers. In comparison to similar tools of the preceding phases, there is also some change in the type of backing along the sides, for flake scars are usually at an oblique angle to the bulbar surface, and sometimes even torsional scars are present.

It seems clear that whatever the function of these tools may have been, it continued all through the Pottery Neolithic period. The reduction in size possibly indicates that they were used more for precision implements during the pottery period.

Arrowheads (Fig. 1)

A new type of an implement, totally absent in preceding phases, includes the small arrowheads. These small points, appearing together with the use of pottery, are very few in number; however, they are typologically very distinctive, and they seem to have almost equal distribution all through the Pottery Neolithic layers. In spite of their limited occurrence, they display a typological diversity, both in shape and in type of retouch:

a) Bifacially retouched, concave based, small point. Extensive squamous flaking covers both surfaces (Fig. 1: P25 6-75).

b) Short tanged, slightly shouldered points; some bifacially retouched (Fig. 1: P29 K 4-14), but more commonly finished by extensive flaking on the dorsal surface, and by only edge retouch on the ventral side (Fig. 1: P 25 H 2-16).
c) Single shouldered asymmetric point, represented by only one specimen (Fig. 1: P 26 3-11), bifacially worked by pressure flaking.
d) Trapezoidal points, worked only along the lateral edges (Fig. 1: P 27K 7-18, :PE 1-7).

These points, hitherto unknown from any other site in Turkey, stand as the only intrusive new element appearing with the use of pottery.

Borers

Borers and drills are rather common in the pottery phase. Two main types are easily distinguishable, both of which are direct descendents from the preceding phase:

a) Borers on large blades, usually tanged (Fig. 3: P 24 4-1). The tip is formed by semi-steep retouch on converging sides. Occasionally the bifacially worked tip is slightly curved (Fig. 3: P 25 6-77).
b) Small drills on microblades. sometimes tanged (Fig. 1: P26 H 3-11). Usually the tip is elongated by steep side retouch on the dorsal side (Fig. 3: P 25 G 3-15; P 24 6-13).

Scrapers

Round or circular scrapers with steep working edges are more common (Fig. 1: P 24 10-60; P 24 H 1-5; GH 5-72). Most of them are made of obsidian, though occasionally there are some from flint. Towards the end of the sequence there is a sharp decrease in the number of round scrapers. Endscrapers (Fig. 3: P 25H 2-13), most of which are of flint, are less common, even though they are well shaped. There are also a few endscrapers on re-modified old blade cores (Fig 3: P 25).

Geometrics

Blade segments backed by a half circular retouch also seem to be a new innovation appearing by the second architectural layer of the Pottery Neolithic phase. These lunate-like implements, with the exception of a single specimen (Fig. 5: P25 H 4-40), are crudely shaped and retouched. Some of them have silica sheen along the cutting edge.

Sickle Blades (Fig. 5)

There is a fair amount of blades with silica sheen; most of them also have traces of edge-wear in various degrees of intensity. Most of the blades are medium size regular blades, very infrequently are there some microblades with silica sheen. They seem to have an equal distribution during the pottery phase.

Notched blades (Fig. 3)

There are numerous notched blades; the blades vary in size from medium to large. Some of the notches are evidently due to use. However, there are some which are intentionally made by semi-steep retouch (Fig. 3: P 25 6-72). There are also some strangled blades. All specimens are of flint, and none of them have the characteristic traces of heavy wear on the ventral surface.

Other Tools

Among other significant tools, some blades with curvilinear edges reflected attentioned the tips. The curved side as well as the pointed distal end was formed by removing small scars, sometimes almost like nibbling. Occasionally there is some flaking along the proximal end (Fig. 4: surface).. Most of the flaking is on the dorsal surface, though some implements have alternating retouch (Fig. 4: PE 1-7; P 24 9-22). Some of these might have been used as points, while others possibly as knives.

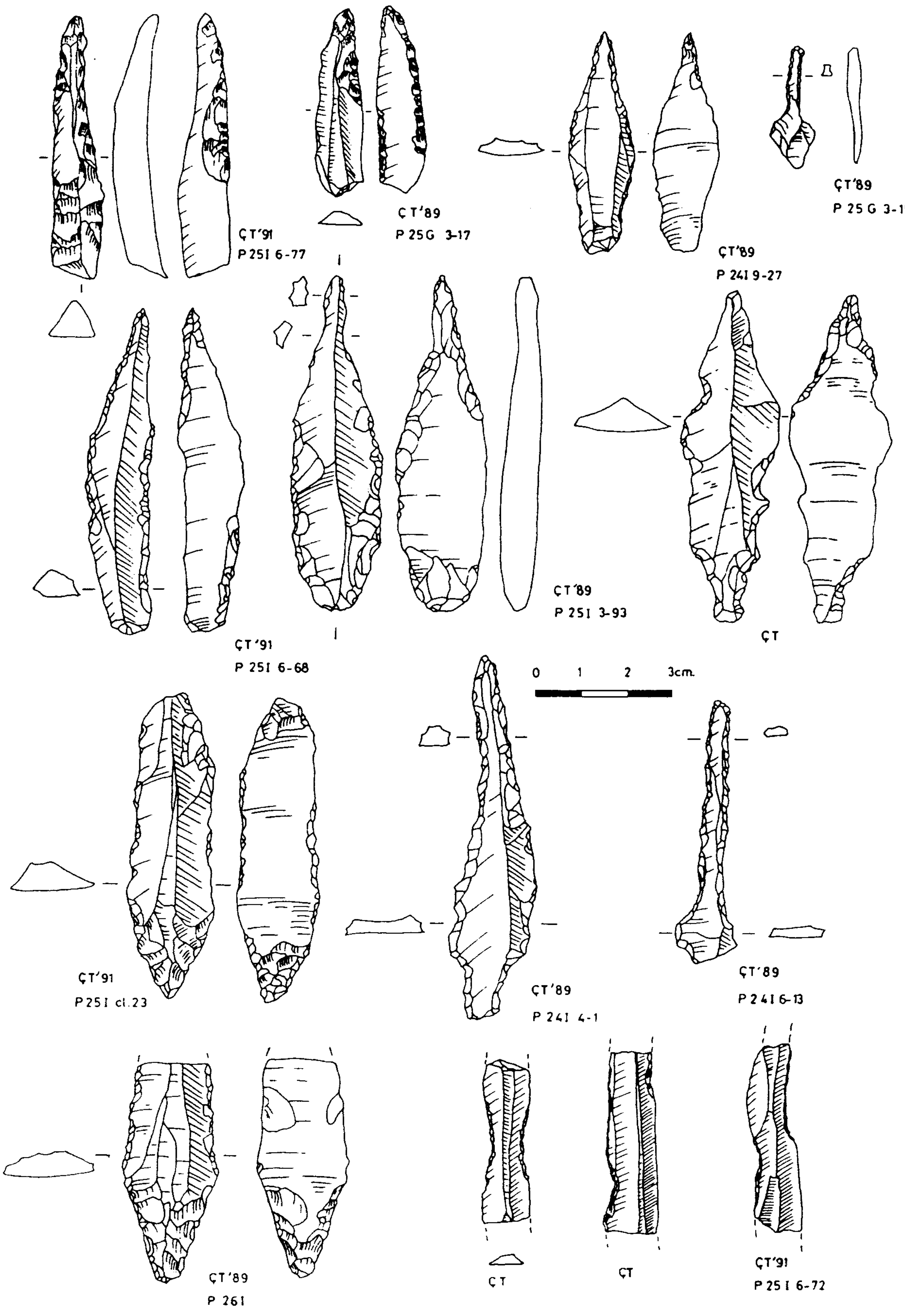

Figure 3. Notched blades, borers, other tools

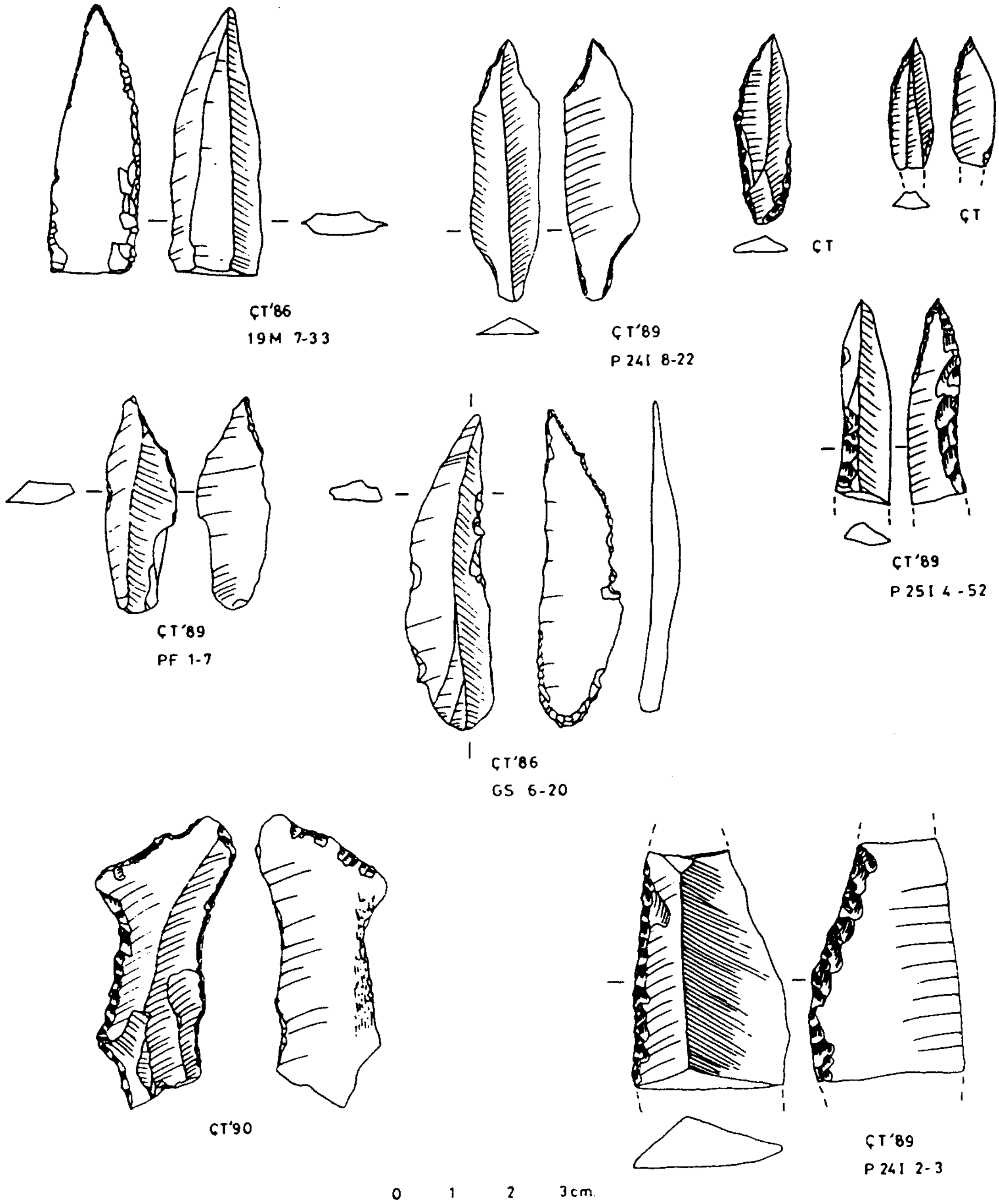

Figure 4. Various other tools

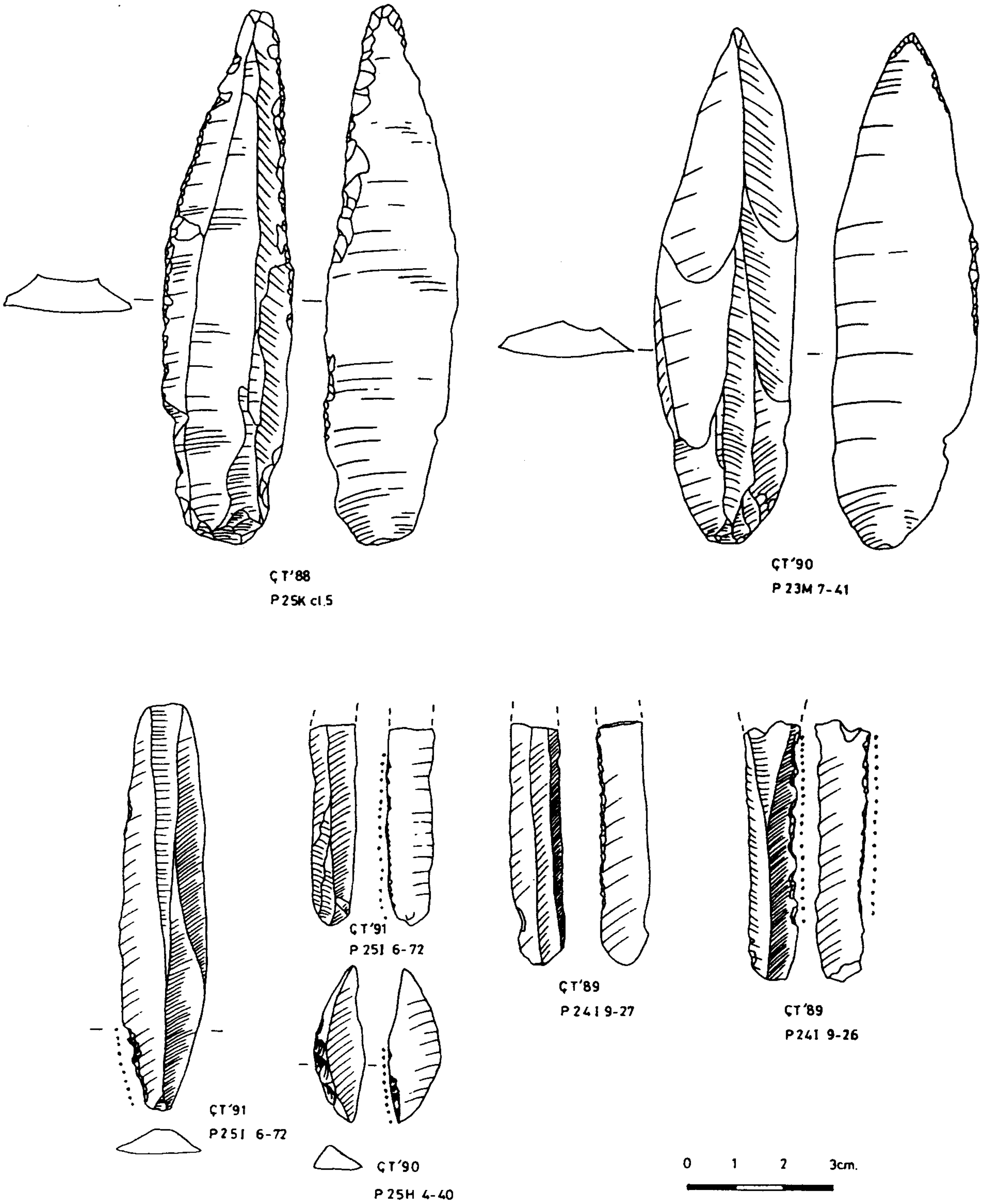

Figure 5. Sickle blades, geometric

There are a few large blades of flint with well developed tanged proximal ends (Fig. 3: P 25E cl.23; P 25). Most probably they belong to large points, or to large borers. Very few segments of denticulated blades have been recorded.

Blade Blanks

Well-made blades and microblades are quite frequent. Microblades, almost all made of obsidian. are more common in the earlier pottery layers, though they continue until the end. Most of the blades have edge wear in varying degrees of intensity. The presence of large number of segments, mostly small blades or microblades of obsidian, indicates that they were intentionally broken. Flint blades have more heavy wear then the ones of obsidian.

Used Flakes

Large to medium size flakes mainly of flint, with various degree of wear, occur through out the pottery phases. There is no apparent pattern neither in size nor in type of flaking; possibly all are utilized flakes from primary core processing.

Some Conclusive Remarks

The most significant outcome of this preliminary assessment is the continuing importance of imported obsidian, which was mainly used for blades, bladelets and for the double backed blades. Besides the double backed blades. borers and drills seem to be the only other significant type of tool within the chipped stone assemblage. Small arrow heads. though very few in number, constitute the most significant new element of the Pottery Neolithic phase.

There are virtually no published contemporary assemblages from southeastern Turkey for comparison. The affinity of Çayönü assemblage to contemporary sites of the south, such as Tell Kashkashok (NISHIAKI 1991) is apparent, but before making conclusive comparisons, final work on the Çayönü assemblage should be finished.

In the course of our surveys in the plain of Ergani,, a number of large Pre-Pottery Neolithic sites were discovered in the close vicinity of Çayönü, the most remarkable ones being Papazgölü and Gölbent[1]. The surface assesment of these sites were all alike and were somewhat different from all known sub-phases of pre-pottery Çayönü. The most apparent differences were the high ratio of obsidian to flint constituting almost 90% of the surface material), the presence of microblades and bladelets in large numbers, and also the presence of some geometrics. While the high ratio of obsidian was indicative of a late phase of PPN, the micro blades and geometrics are suggestive of an earlier horizon. However, taking into consideration the Pottery Neolithic assemblage of Çayönü, we are more inclined now to date these sites to the very end of the PPN.

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Synthèse sur les industries lithiques Néolithique Préceramique en Syrie

(Synthesis contribution)

Marie-Claire Cauvin

ABSTRACT. *Sequence of Northern Syria. Relations to Neighbouring Regions*

1. PPNA Horizon

A. On the Euphrates, Epipalaeolithic levels (referred to as the Euphrates Natufian) are followed by phases (Ib-II at Mureybet, a Khiamian industry characterised by blade debitage with (among other types), bipolar prismatic cores. The retouched artefacts comprise principally El Khiam points, which, although variable, all have proximal notches. There are also several points with a straight base and without notches (Salibiya points ?), and projectile points with distal notches. Microborers are abundant and several geometric pieces are still present. Lustred blades sometimes having worked bases, rate end-scrapers, burins, and adzes also characterise the assemblage. Aside from adzes, this chipped stone assemblage is comparable to Khiamian assemblages from the Southern Levant.

At the end of phase II changes are evidenced, in particular, by projectile points: El Khiam points sensu strictu decrease in number, while tanged points with proximal notches increase (Heluan points). Geometric tools disappear altogether.

During phase III at Mureybet as well as at Cheikh Hassan, naviform cores are present among the bipolar cores. Debitage techniques produce larger and thicker blades. Most projectile points have short tangs, still shaped using abrupt retouch, often with concave edges. The base of the tang is straight or losange-shaped. In addition to these, there are points with triangular bases and even several daggers. Lustred pieces are often on large blades and resharpened. End-scrapers are abundant, usually circular or semi-circular, or with pointed base formed by retouch or by convergent breaks. There are almost no microborers and no geometric tools. Some chipped flint adzes are still present, and polished greenstone tools appear at the end of this phase. This assemblage characterises the Mureybetian.

B. In the Damascene, Aswad IA has a peculiar chipped stone industry which is contemporaneous with the Mureybetian and referred to as the Aswadian. Altough like the Mureybetian, it is characterised by blade debitage, naviform cores and lustred pieces on large blades, the Aswadian has projectile points which are entirely different. Aswad points have notches and a very short, wide tang shaped using oblique or flat retouch, with either straight or sharp, incurving "ailerons" (i.e. fins).

2. PPNB horizon

A. During the early PPNB of the Euphrates Valley (Phase IV at Mureybet), the occupations at Dja'de and Abu Hureyra correspond to the end of Mureybet. They have abundant blade debitage and tanged points. Byblos points have flat, lamellar retouch and a tang, created by a double shoulder, with or without Abu Gosh retouch. Large flat-based points with flat retouch also appear. These two types are comparable to the points from the same period found at Cafer Höyük.

B. In the Damascene, during the Middle PPNB (Aswad II), there is also an increase in projectile points, which include oval-shaped points, Amuq points (with a thick, triangular-shaped section), and tanged points (Byblos points, Jericho points). Aside from long lustred pieces, there are much shorter blades without indentations, dihedral or transverse burins and chipped stone axes.

C. Still in the Damascene, in the Late Final PPNB at Ramad, there is the same debitage and variety of projectile point forms (Amuq and various Byblos points) as before, along with several Aswad points and projectile points with notches and a truccated base. In addition to axes like those found earlier at Aswad, there are very short flint axes with a wide, polished tip ("taillant") and several tranchet flakes (tranchets). The lustred pieces are different from before, on short elements, some having flat, covering retouch. The latter attribute, along with the presence of tranchets, indicate a link with the Southern Levant (Final PPNB-PPNC).

D. Finally, on the Euphrates during the Middle PPNB (Halula, Abu Hureyra) and the Late PPNB (Buqras), Byblos points are found with variants (ie. Buqras points) and Amuq points increase. Lustred pieces are either blades or convex-backed elements. The techno-typological nature of several pieces in obsidian found at Buqras attest to Eastern influences.

This is also the case during the Final PPNB in the semi-desert zone (El Kowm oasis) where there is intensive blade debitage, and Byblos and Amuq projectile point production. However, lustred pieces occur on a diversity of blanks (blade, flake) or are on convex retouched elements. "Desert burins" (with concave truncations) or numerous transverse burins also characterize these sites. Transverse burins were either used as gravers, or only testify to a particular technique (transverse burin blow) for breaking blade blanks.

Il s'agit ici d'une brève présentation des traits principaux des industries lithiques néolithiques précéramiques de Syrie provenant des sites de la vallée de l'Euphrate, de Damascène ou de la zone semi-désertique entre Palmyre et l'Euphrate entre 10.300 et 7.500 BP.

La matière première est essentiellement le silex, l'obsidienne est présente mais toujours rare (ce volume). En ce qui concerne par exemple Mureybet, quelle que soit la période, on constate l'utilisation de deux variétés de silex. Le silex à grain fin, provenant des rognons de la formation géologique de l'éocène inférieur de Mureybet où est implanté le site archéologique, est utilisé pour les flèches ou les lames lustrées. Sur le silex à grain plus grossier, provenant des galets de l'Euphrate, sont façonnées surtout les erminettes.

Les gisements de la vallée de l'Euphrate ont livré des industries lithiques dont l'analyse permet de reconnaître différentes cultures se succédant durant tout le Précéramique. On note cependant un passage progressif de l'une à l'autre avec notamment un débitage de plus en plus laminaire permettant d'obtenir des lames de plus en plus grandes.

1. Khiamien (10.300 - 10.000 BP)

L'industrie khiamienne est définie à partir du mobilier de Mureybet durant les phases IB[1] et II[2] qui succèdent directement au Natoufien. Elle est associée à une architecture circulaire, la chasse-cueillette est diversifiée, et la pêche abondante.

Le débitage montre une maîtrise du débitage lamellaire et devient au cours de la phase II de plus en plus laminaire. Le mode de percussion est direct (CALLEY 1986). Lors de la phase IB (Fig. 1) dite aussi épinatoufienne (CAUVIN M.-C. 1991), les pointes d'El Khiam apparaissent. Il s'agit d'armatures sur lame ou lamelle présentant une paire d'encoches basilaires opposées et une troncature proximale (Fig. 1:12). Les microlithes, persistent sous forme de rares géométriques (Fig. 1:1-4), et d'abondants microperçoirs et mèches (Fig. 1:5-8). Il y a quelques pièces lustrées (Fig. 1:10). Les autres pièces façonnées sur éclats comportent notamment des erminettes (Fig. 1:15) et des pointes lourdes pédonculées (Fig. 1:14) dont une utilisée en couteau (P. Anderson, com. pers.).

Pendant la phase II les pointes d'El Khiam se diversifient selon d'une part la position des encoches par rapport à la base de l'armature et les modalités des retouches des encoches, d'autre part en fonction de la forme de la base de l'armature.

1 Niveau 4 des fouilles J. Cauvin (CAUVIN 1977, 1978).

2 Niveau 5 à 10 des fouilles J. Cauvin ou 1-VIII des fouilles M. van Loon (CAUVIN *ibid.*; van LOON 1968).

En effet la base est rectiligne (Fig. 2:3)[1] ou concave (Fig. 2:4)[2], façonnée par retouches abruptes; parfois, plus rarement il s'agit d'une cassure (Fig. 2:2)[3] ou d'une base laissée sans retouches (Fig. 2:1) et comportant encore le bulbe (notre classe 2) . Selon l'épaisseur de la lame, les encoches sont plus ou moins profondes (Fig. 2:3), plus ou moins larges (Fig. 2:7). Elles sont obtenues par retouches directes (Fig. 2:3,5,9), inverses (Fig. 2:4) ou alternes (Fig. 2:6) mais dans les séries étudiées on ne note pas de différences nettes entre les encoches situées près de la base ou à mi hauteur de l'armature. Au niveau des encoches mésiales l'armature présente une zone de moindre résistance, d'autant plus si les encoches sont profondes. Il s'ensuit de nombreuses pièces fragmentées. A Mureybet ces cassures distales ne sont pas transformées en troncatures retouchées[4]. Quant aux extrémités distales des flèches elles portent fréquemment des retouches abruptes inverses, parfois même l'armature elle-même est reprise en perçoir (Fig. 2:7).

Outre ces pointes d'El Khiam se trouvent quelques flèches àpédoncule très court obtenu par retouches abruptes directes inverses, ou alternes, à bords rectilignes ou légèrement concaves (Fig. 2:10-11). On note de plus la présence de très rares pointes à base tronquée (*cf.* pointe de Salibiyah, GOPHER 1989), sans encoche (Fig. 2:13), de pointes à base tronquée portant 2 paires d'encoches opposées distales (Fig. 2:16) et enfin de pointes pédonculées à encoches opposées (Fig. 2:14-15)[5].

Selon les niveaux la proportion relative des divers types varient; ainsi au début de la phase II (niveaux 5 à 7) les pointes d'El Khiam forment les 3/4 des armatures de flèches, les flèches à court pédoncule sont rares (moins d'un quart). Par contre à la fin de la phase II (niveaux 8 à 10) les pointes d'El Khiam et les flèches à court pédoncule sont presque aussi nombreuses les unes que les autres. Les pointes d'Héluan apparaissent alors. Ce sont des pointes pédonculées avec deux encoches proximales opposées[6].

Outre ces flèches il existe encore des microlithes, il n'y a pas de géométrique mais de très nombreux microperçoirs. Les lames lustrées sont présentes. Parmi les outils retouchés sur éclats, on note l'absence de pointes lourdes pédonculées mais les erminettes (Fig. 3:4) sont abondantes.

2. Mureybetien (10.000 - 9 600 BP) et Aswadien (9.800 - 9.600 BP)

Il s'agit du mobilier recueilli durant les phases IIIA[7] et IIIB[8] de Mureybet. Il s'y joint celui provenant des niveaux découverts à Cheikh Hassan par J. Cauvin (1977, 1978, 1980) ainsi que le matériel de la phase IA d'Aswad en Damascène (CONTENSON 1979).

Le matériel de la phase IIIA (10.000-9.800 BP) provient de structures rondes parfois à cloisonnement intérieur. La pêche décroît d'importance tandis qu'il y a une chasse spécialisée de grands herbivores. Le mode de débitage change: il y a des nucléus naviformes (s.s., Fig. 4:1), les produits laminaires deviennent de plus en plus grands. Parmi les pointes de flèches il s'agit essentiellement de pointes à court pédoncule (Fig. 4:4-8) et de pointes d'Héluan (Fig. 4:2-3). Il y a également de grandes lames appointies ou poignards (Fig. 4:9). Les pièces lustrées sont plus nombreuses avec une base

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1 Il s'agit selon le tableau à double entrée que nous avions présenté (CAUVIN M.-C. 1974c) de notre classe 6 correspondant aux types 1/2 de NADEL *et al*. 1991.

2 Il s'agit de notre classe 10 (CAUVIN M.-C. *ibid.*) correspondant aux types 5/6 de NADEL *et al. ibid.*

3 Il s'agit de notre type 6a ou 9 de NADEL *et al.*

4 Il n'y a pas de rectangle de Nacharini dit aussi Troncature de Hagdud (BAR-YOSEF *et al.* 1987).

5 cf. type 7 de NADEL *et al. ibid.*

6 Il s'ajoute quelques flèches atypiques certaines présentant une base losangique obtenue par retouches abruptes analogues aux pointes de Nemrik (Fig. 2:12).

7 Cette phase correspond aux niveaux 11 à 14 des fouilles J. Cauvin ou IX-XI des fouilles M. van Loon.

8 Cette phase comprend les niveaux 15 à 18 des fouilles J. Cauvin ou XV à XVII des fouilles M. van Loon. Le site de Jarf el Ahmar en cours de fouille semble livrer un mobilier pouvant appartenir à cette phase (MOTTRAM 1991).

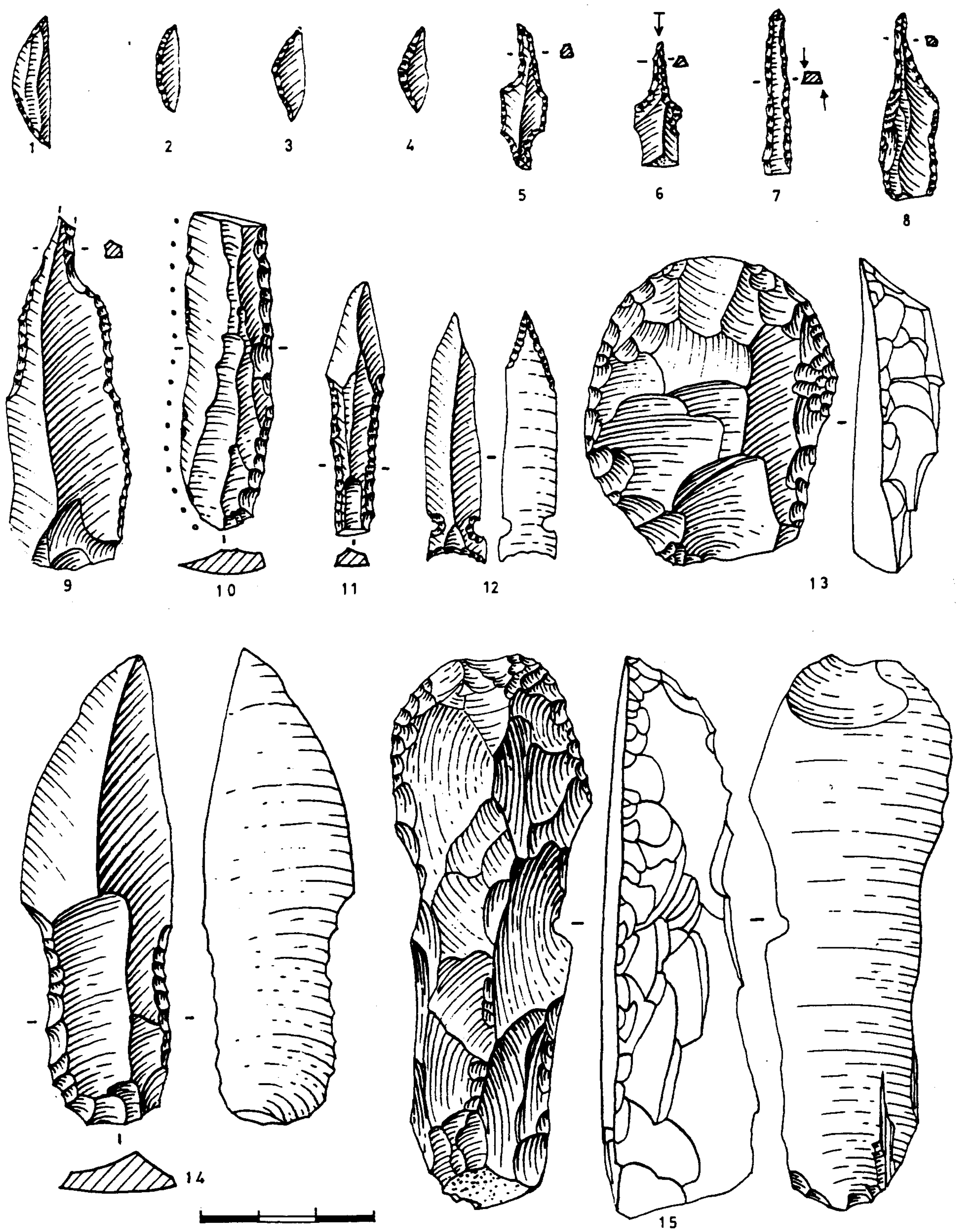

Fig. 1. Industrie lithique de la phase Ib de Mureybet *(fouilles J. Cauvin)* .

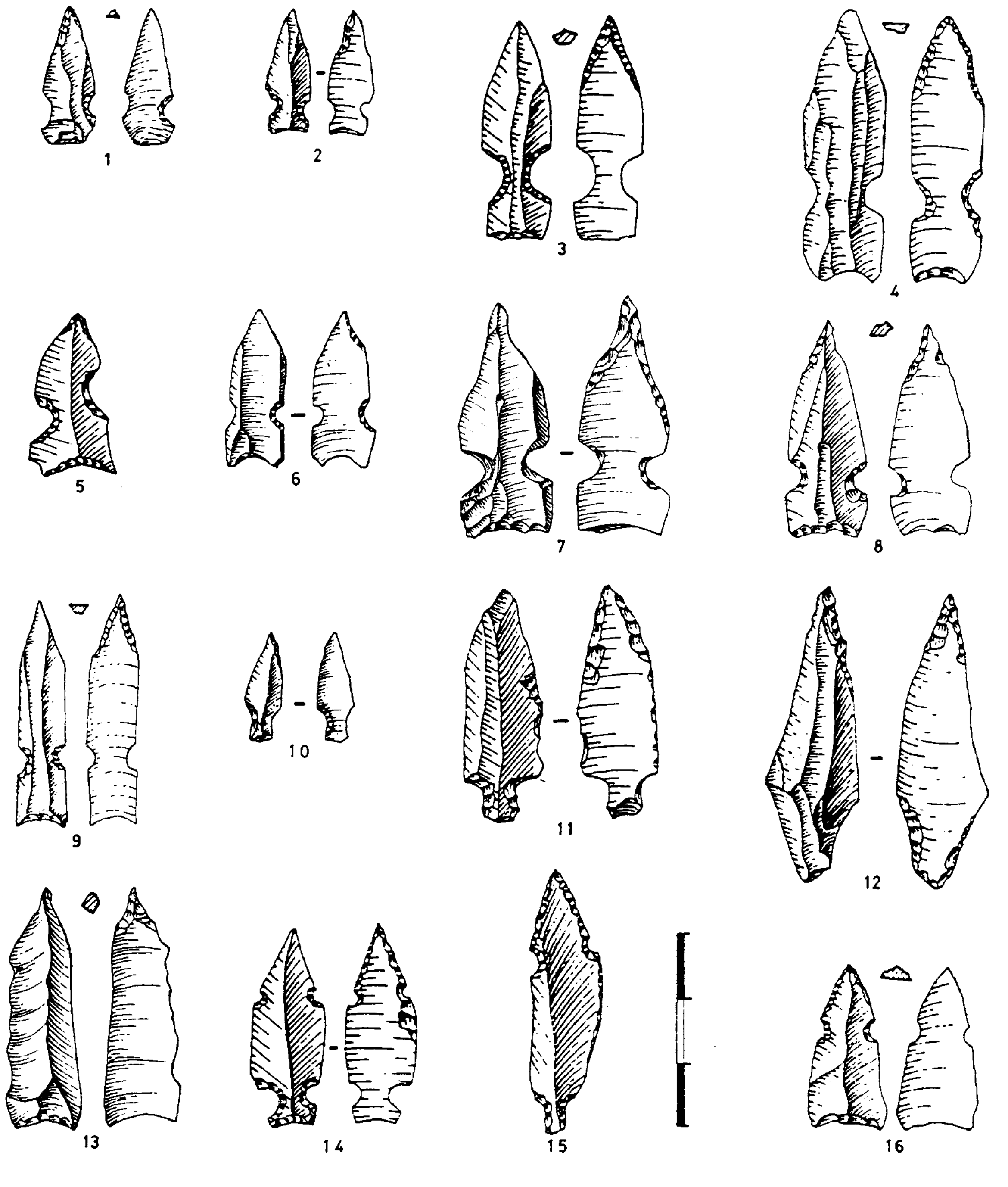

Fig. 2. Pointes de flèches de la phase II de Mureybet *(fouilles J. Cauvin)*.

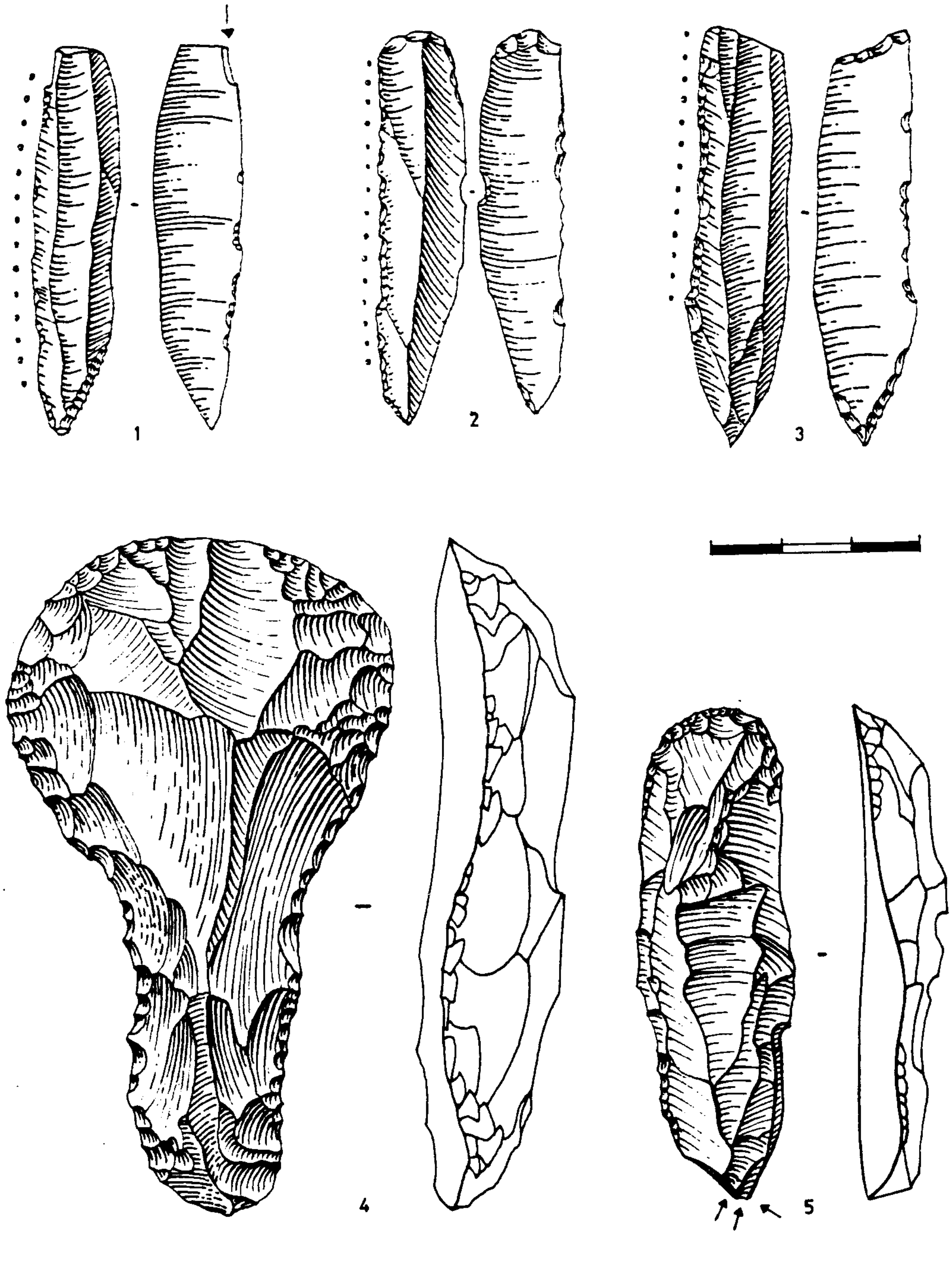

Fig. 3. Industrie lithique de la phase II de Mureybet *(fouilles J. Cauvin)* : 1-3 lames lustrées, 4 erminette, 5 grattoir-burin.

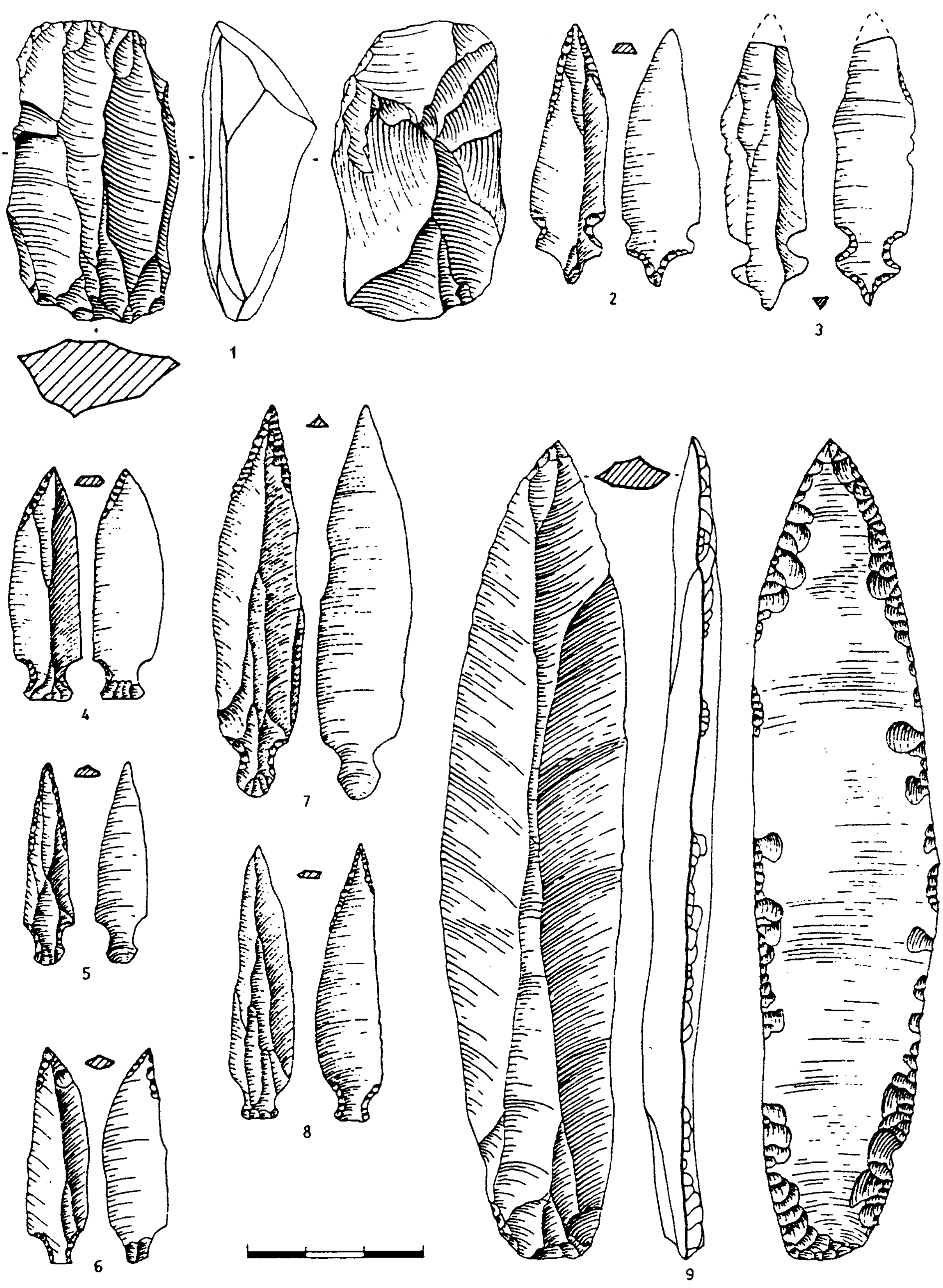

Fig. 4. Industrie lithique de la phase III de Mureybet *(fouilles J. Cauvin)* : 1 naviforme, 2-8 pointes de flèches (2-3 pointes d'Héluan, 4-8 pointes pédonculées de Mureybet), 9 poignard.

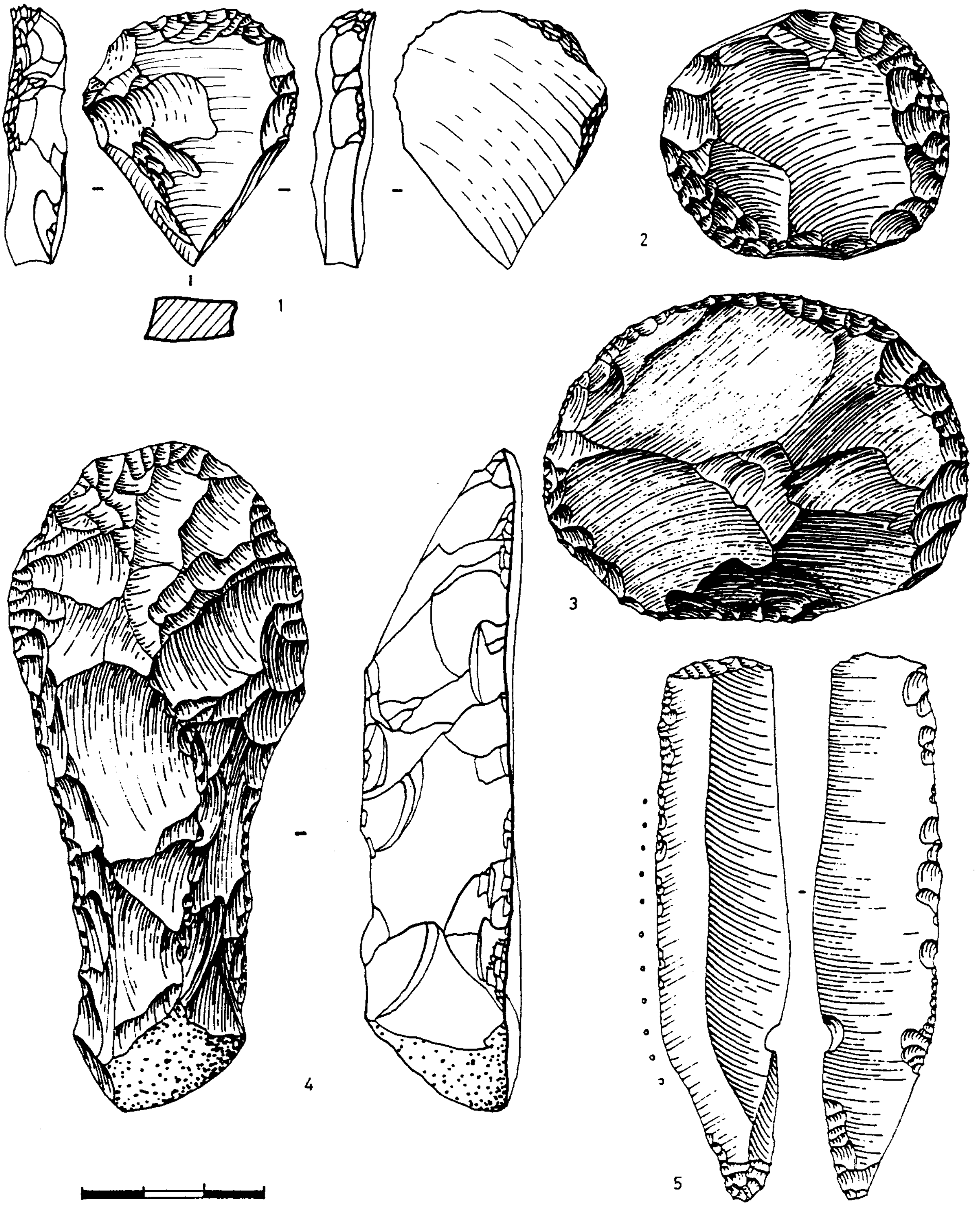

Fig. 5. Industrie lithique de la phase III de Mureybet *(fouilles J. Cauvin)* : 1-3 grattoirs, 4 erminette, 5 lame lustrée.

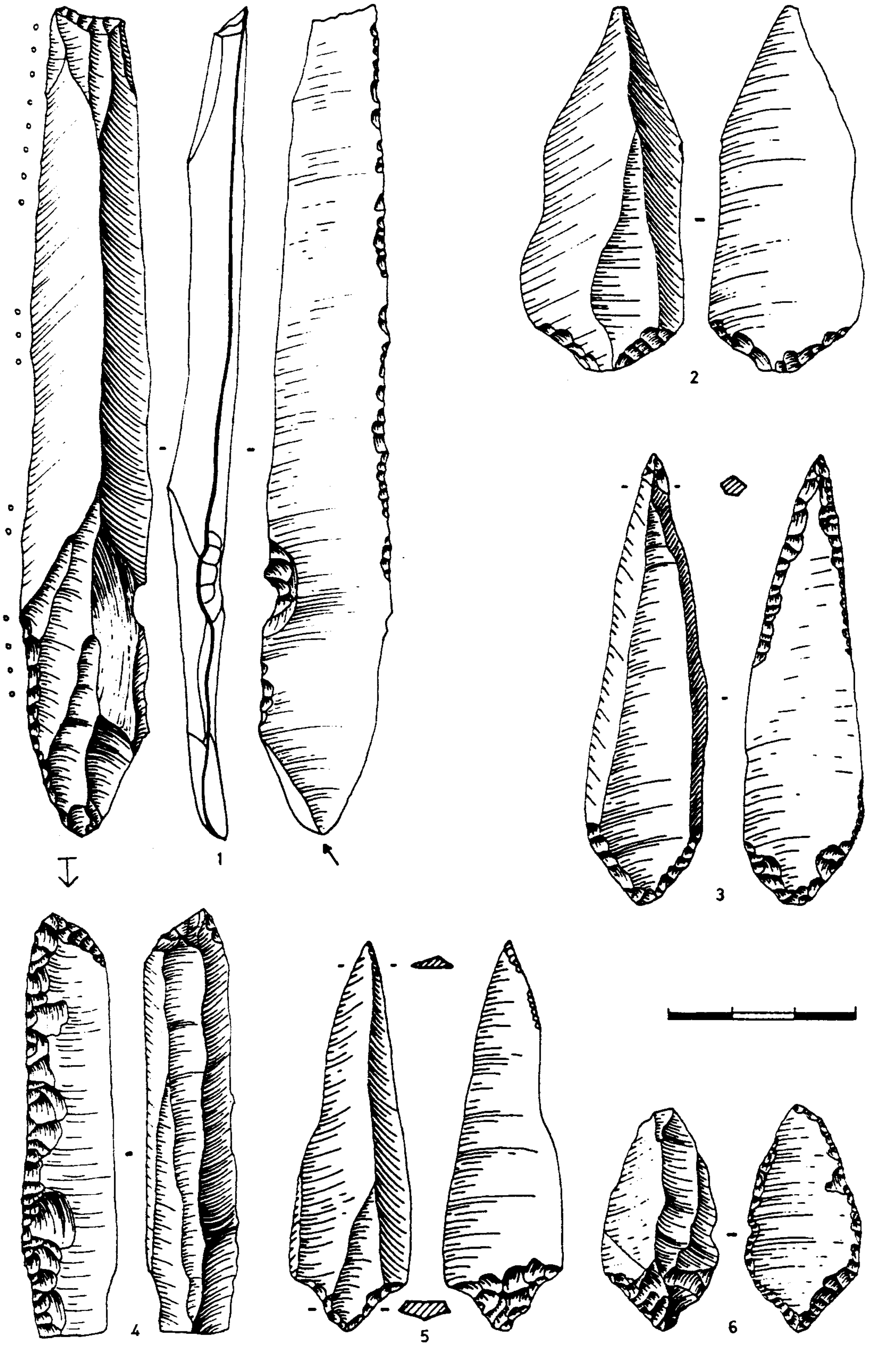

Fig. 6. Industrie lithique de la phase IIIB de Mureybet *(fouilles J. Cauvin)* : 1 lame lustrée, 2-3,5-6 pointes de flèches, 4 lame à taillant rafraîchi.

aménagée, présentant un rétrécissement progressif ou même un pédoncule. Elles sont limitées parfois par une troncature distale (Fig. 5:5).

Durant la phase III les grattoirs deviennent de plus en plus abondants. Ils forment le tiers des outils retouchés de la structure XLVII: la plupart de ceux-ci ont travaillé le bois en percussion posée ou même lancée, quelques uns présentent des traces d'usages multiples (COQUEUGNIOT 1981, 1983). En général les grattoirs de la phase III sont courts (Fig. 5:1-3), à bords retouchés, certains à pans coupés (CAUVIN M.-C. *et al.* 1987) (Fig. 5:1).

Le mobilier de la phase IIIB (9.800-9.600BP) provient de structures rondes et des premières structures rectangulaires de Mureybet. Durant cette phase on assiste à l'intensification de la moisson des céréales voire de "l'agriculture prédomestique" (CAUVIN J., sous presse). Le mode de débitage du silex est surtout bipolaire (CALLEY, *ibid.*), les lames sont très élancées et minces (ABBES, ce volume). Les lames lustrées témoignent d'un débitage remarquable (Fig. 6:1), il s'agit alors de lames faucilles ayant un bord tranchant fréquemment rafraîchi par retouches inverses sans être denticulé (Fig. 6:4). Il y a toujours des pointes de flèches à court pédoncule analogues aux précédentes mais on voit apparaître des flèches présentant une base losangique (Fig. 6:2-3) ou même un pédoncule plat et court lui aussi souvent losangique (Fig. 6:5-6) obtenu par retouches abruptes directes et aminci par retouches inverses. Il y a quelques pointes ovalaires. A la fin de la phase III les erminettes (Fig. 6:4) disparaissent. L'obsidienne provient dès lors non seulement de Cappadoce mais aussi du Taurus. Elle est taillée par la technique de la pression (CALLEY, *ibid.*).

Parallèlement au Mureybetien qui vient d'être décrit se trouve en Damascène l'Aswadien (CONTENSON 1979, 1989): il s'agit de l'industrie recueillie dans les premiers niveaux de tell Aswad: on note un débitage bipolaire, la présence de grandes lames lustrées (Fig. 8:2) et de pointes d'Aswad (CAUVIN M.-C., sous presse a; voir aussi 1974b et 1979) ou pointes à pédoncule large et très court obtenu par retouches obliques ou plates et flanqué d'ailerons droits, récurrents ou acérés. Une ou deux paires d'encoches se trouvent sur les bords (Fig. 8:3-5).

3. PPNB ancien (9.600-9.200 BP)

Au PPNB ancien correspond sur l'Euphrate l'occupation de Mureybet à la phase IVA (CAUVIN J., sous presse) et celle de Dja'dé (COQUEGNIOT, ce volume). En Damascène Aswad continue avec la phase Ib.

Mureybet IVA

Ce niveau a été fouillé sur une très petite surface où il n'a pas été trouvé d'architecture. Il y a alors la chasse spécialisée du boeuf. Le débitage est toujours laminaire mais les lames sont plus épaisses (ABBES, ce volume). Parmi les armatures de flèches on relève, à côté de pointes à pédoncule denticulé (Fig. 7) des pointes à retouches plates lamellaires et base tronquée (Fig. 7:3) et on voit l'apparition de pointes de Byblos s.s. Ce sont des pointes laminaires à retouches longues et plates dont le pédoncule est obtenu par un double épaulement sans que les ailerons soient nettement marqués (CAUVIN 1968). Ces retouches plates sont alors limitées à la base. Les pièces lustrées sont plus courtes.

Aswad IB

Les caractéristiques essentielles de cette phase consistent en la raréfaction de flèches à encoches et en l'apparition également de pointes de Byblos (CAUVIN M.-C., sous presse a).

4. PPNB moyen (9.200-8.500 BP)

L'occupation de Mureybet se finit avec la phase IVB (CAUVIN J. 1974). Sur l'Euphrate également ce sont les premières occupations néolithiques d'Abu Hureyra (MOORE 1975, 1992) et d'Halula (MOLIST, ce volume). En Damascène il s'agit surtout de la phase II d'Aswad.

Mureybet IVB

Le débitage est fait à partir de nombreux naviformes (Fig. 7:7) (CAUVIN M.-C. 1974). Les armatures perçantes beaucoup plus grandes sont façonnées par des retouches envahissantes. Il y a des pointes de Byblos en général sans retouches couvrantes et à pédoncule "tige" (Fig. 7:5) ou "Ugarit", certaines à pédoncule Abou Gosh où une retouche en pelure en écharpe[1] façonnée à partir d'une retouche abrupte inverse, outrepasse l'arête médiane et atteint une retouche courte semi abrupte sur le bord opposé (Fig. 7:6). Il y a des pointes ovalaires et des pointes à base tronquée et retouches en pelure sur la face inverse (Fig. 7:4)[2].

Abu Hureyra Neolithic Aceramic A

Notons qu'à ce niveau les pointes de Byblos ne portent pas non plus de retouches couvrantes. Une étude fonctionnelle (MOSS 1983) des micropolis des pointes, a montré qu'après avoir été utilisées comme projectiles, ces pièces, comme les burins dièdres, avaient servi pour travailler bois et roseaux.

A Aswad II où là aussi les naviformes sont présents (Fig. 8:1), les pointes de flèches se diversifient et portent des retouches couvrantes: il y a des pointes de Byblos (Fig. 9:1), d'Abou Gosh (Fig. 9:4) et des pointes ovalaires. On voit apparaître quelques pointes d'Amouq (Fig. 9:2) et de très rares pointes de Jéricho (Fig. 9:3), Aswad constituant semble-t-il la limite la plus septentrionale de la dispersion de ces dernières (CAUVIN M.-C., sous presse a). De rares haches taillées sont présentes.

5. PPNB récent (8.500-8.000 BP)

Les occupations d'Abu Hureyra (2b) et d'Halula continuent tandis qu'en aval sur l'Euphrate débutent celles de Bouqras (ROODENBERG 1986) et sur le Balikh (CAUVIN J. 1972) celle d'Assouad . En Damascène, à la fin du PPNB récent on trouve Ramad I-II (CONTENSON 1971) tandis que sur le littoral commence l'occupation de Ras Shamra (CONTENSON 1977).

Les pointes de flèches sont partout nombreuses et portent fréquemment dès lors des retouches couvrantes. Les pointes d'Amouq sont présentes à Abu Hureyra et Bouqras. A Ramad se trouvent également de rares flèches à encoches comme cela peut être le cas au Levant Sud à Abou Gosh par exemple et de très nombreuses haches et hachettes taillées en silex ce qui n'est pas le cas sur l'Euphrate. Les pièces lustrées deviennent de plus en plus courtes; elles sont fréquemment, à Assouad (CAUVIN M.-C. 1972, 1973) comme à Bouqras,des éléments d'outil composite, à dos convexe ou à dos rectiligne, avec ou sans grosses dents comme c'est le cas à Ramad.

Le débitage par pression de l'obsidienne est important à ce moment, à Bouqras par exemple.

6. PPNB final (8.000-7.500 BP)

Le PPNB final est contemporain de certaines cultures avec céramique (BRAIDWOOD 1960; AKKERMANS 1988; MATSUTANI 1991) telles qu'on les trouve tant dans la plaine d'Amouq (Judaideh A) que dans la région de l'Euphrate (Halula, Damishliyya, Kashkashök) ou en Damascène (Ramad III). Il se présente comme une culture sans céramique exclusivement dans les oasis d'El Kowm et de Palmyre (AKAZAWA 1979). Il s'agit d'industries liées, dans l'oasis d'El Kowm (STORDEUR 1993) à des modes de vie d'agriculteurs-éleveurs-sédentaires ou de pasteurs-nomades.

Les gîtes de silex sont très proches des deux sites archéologiques, El Kowm 2 et Qdeir. Le débitage, à partir de nucléus uni et bipolaires est utilisé dans les deux gisements, avec des naviformes (Fig. 10:1).

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1 En général orientée de la gauche vers la droite.

2 Type que l'on retrouvera au PPNB à Cafer Höyük.

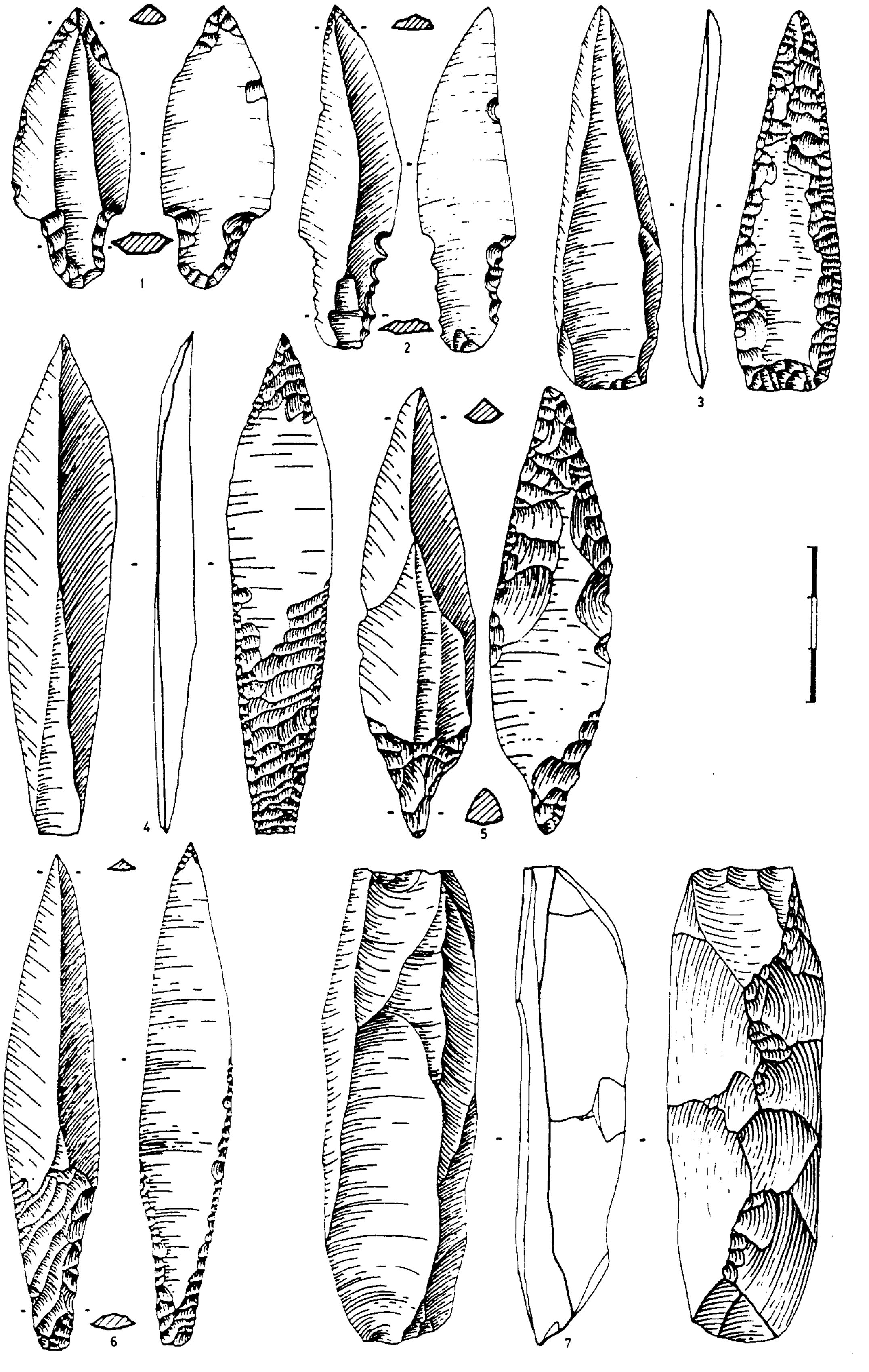

Fig. 7 Industrie lithique des phases IVA (1-3) et IVB (4-7) de Mureybet *(fouilles J. Cauvin).*

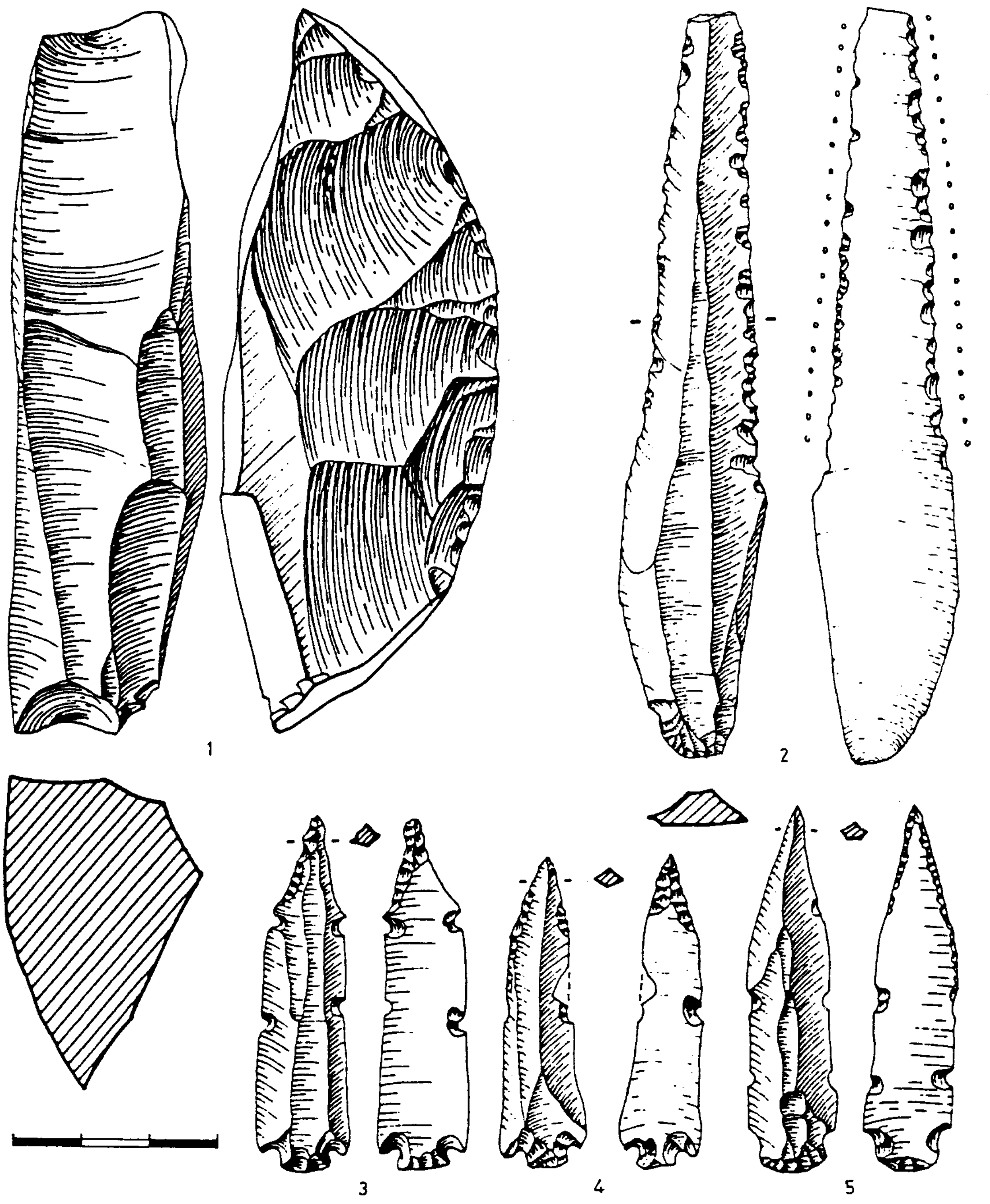

Fig. 8. Industrie lithique d'Aswad- Damascène: 1 nucléus naviforme d'Aswad II, 2-5 lame lustrée et pointes d'Aswad IA *(fouilles de H. Contenson)* .

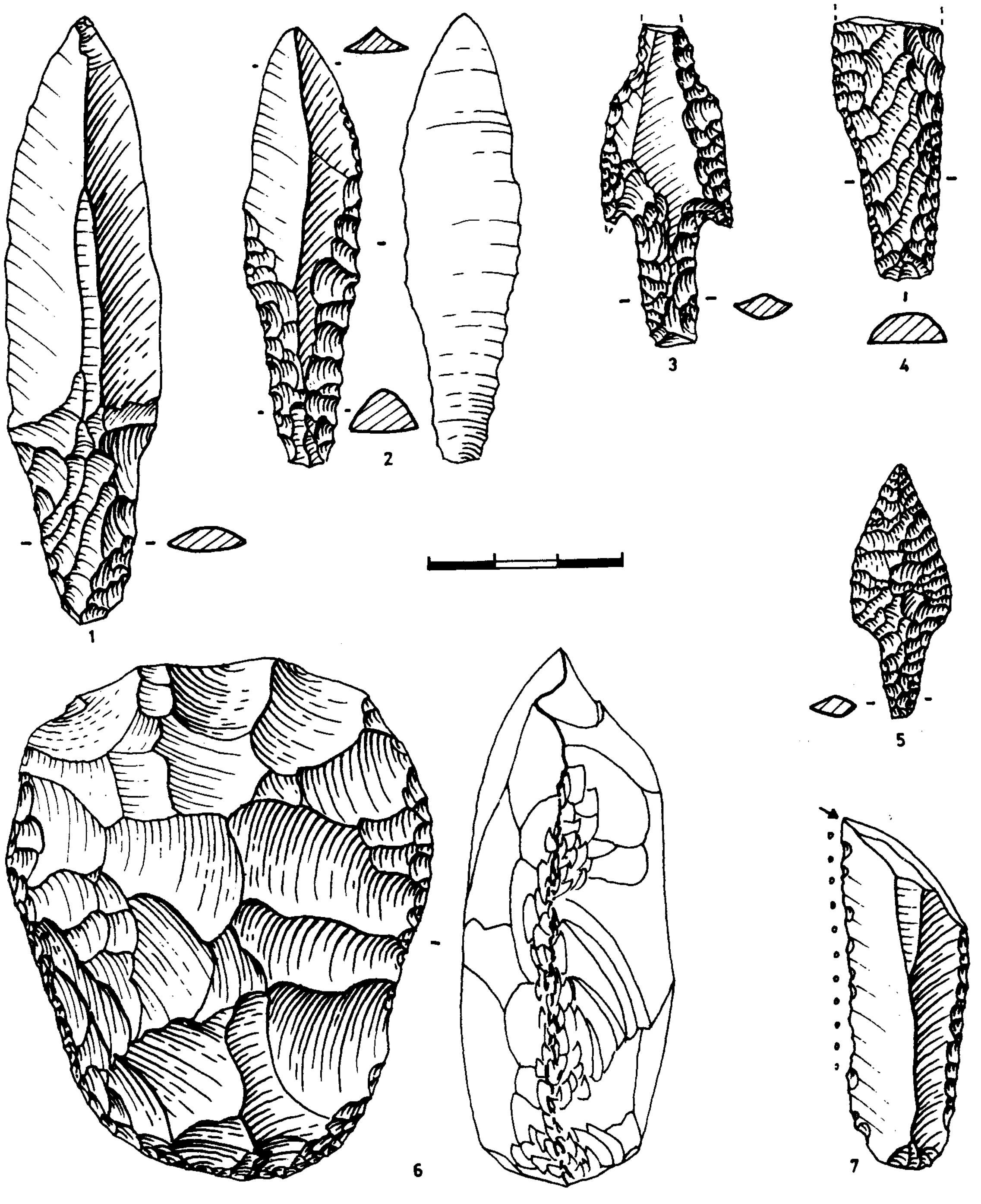

Fig. 9 Industrie lithique PPNB moyen d'Aswad II- Damascène *(fouilles de H. Contenson)*.

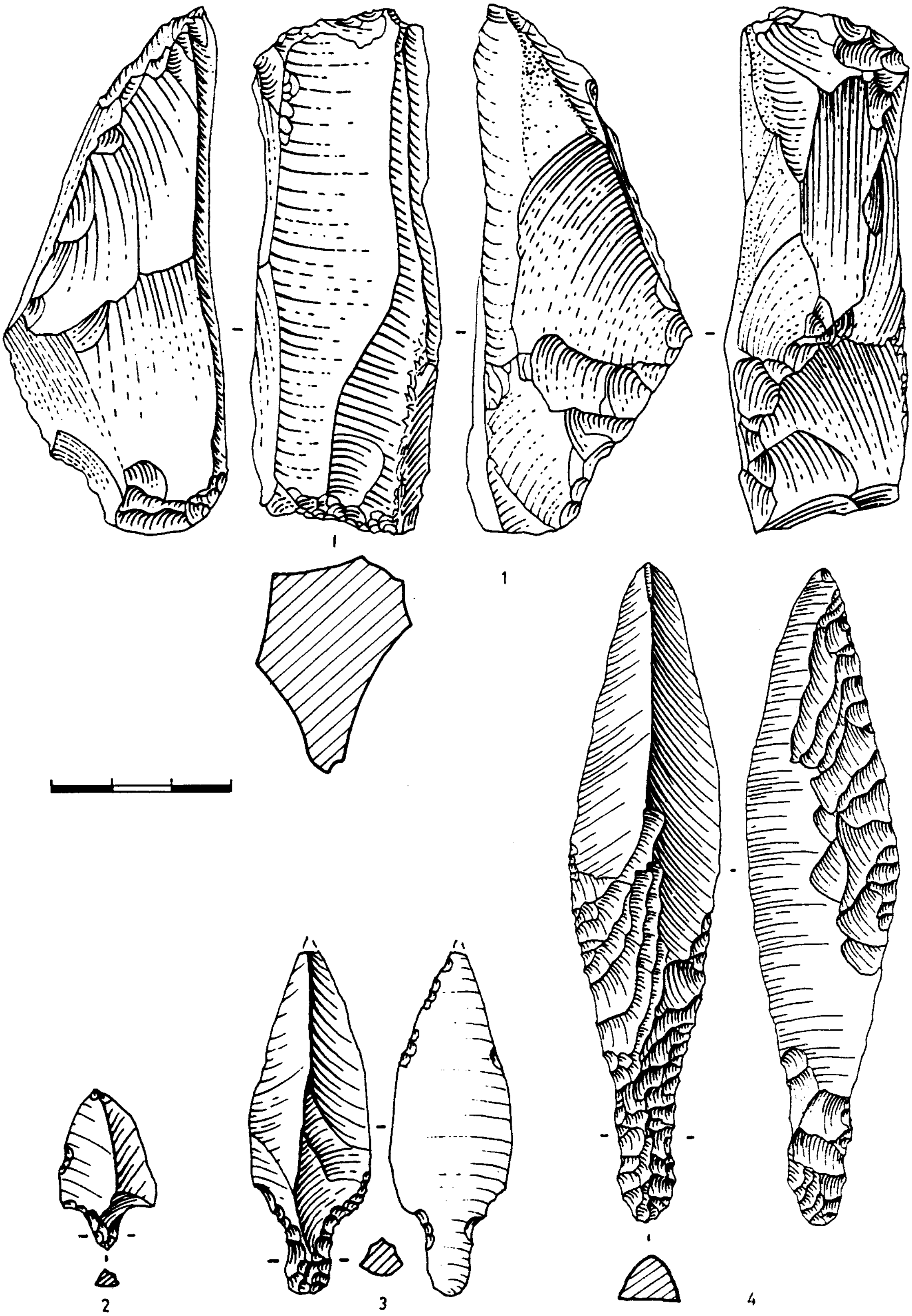

Fig. 10. Industrie lithique PPNB final de l'oasis d'El Kowm (1-3 El Kowm, 4 Qdeir 1): 1 naviforme, 2 petite pointe pédonculée, 3 pointe de Byblos *(fouilles D. Stordeur)* , 4 pointe d'Amouq *(fouilles O. Aurenche)* .

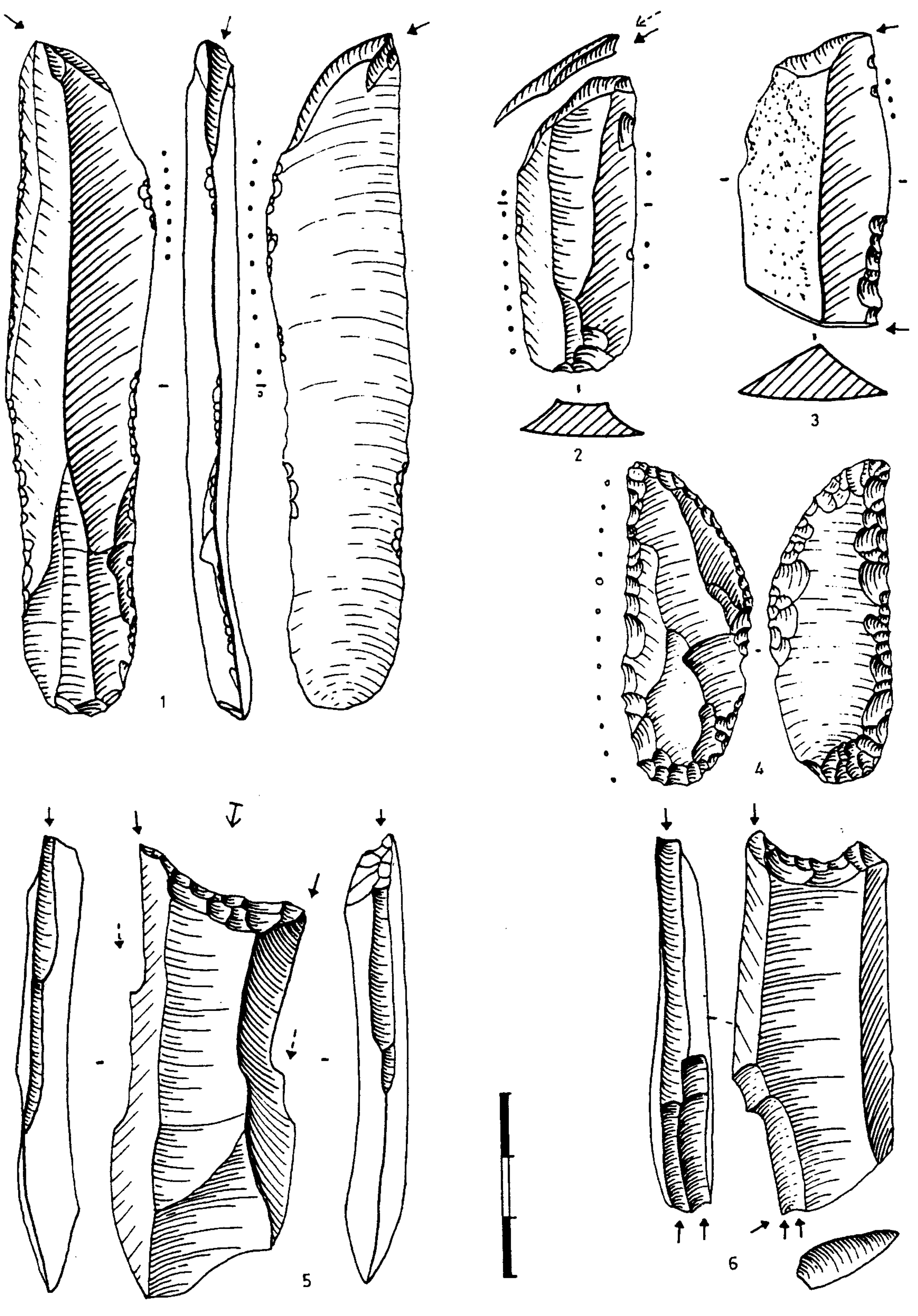

Fig. 11. Industrie lithique PPNB final de l'oasis d'El Kowm: 1-3 lames lustrées d'El Kowm 2 *(fouilles D. Stordeur)* , 4 élément lustré de Qdeir 1 *(fouilles O. Aurenche)* , 5-6 burins d'angle sur troncature concave de Qdeir 1 *(fouilles O. Aurenche)*.

Dans le village d'El Kowm 2 les flèches sont rares: quelques pointes de Byblos (Fig. 10:2) sans retouches couvrantes et des pointes pédonculées à retouches abruptes (Fig. 10:3). Les outils sont des petits grattoirs circulaires, des grattoirs semi-circulaires sur gros éclats et surtout des burins: dièdres, d'angle sur cassure, et de très nombreux burins transverses (Fig.11:1-3). Ceux-ci sont en grande majorité orthogonaux, avec ou sans préparation latérale. Le terme "burin transverse" est appliqué à des artefacts d'après leur morphologie et la technique utilisée pour les obtenir. Ces burins transverses peuvent correspondre aussi bien à des outils aux multiples fonctions d'après les traces qu'ils présentent qu'à un simple procédé utilisé pour fractionner les lames. Une grande partie d'entre eux sont sur des lames lustrées (Fig. 11:2-3).

Le mobilier des pasteurs nomades de Qdeir présente de très nombreux nucléus bipolaires ou des naviformes, et donc de nombreuses lames en upsilon (CALLEY 1986; ABBES 1993). Les pointes de flèches sont de belle venue, Byblos ou Amouq (Fig. 10:4). Les burins eux aussi sont très nombreux mais sont en majorité des burins sur troncature concave (Fig. 11:5-6). Les pièces lustrées comportent des éléments à dos (Fig. 11:4).

Les différences entre les techniques de débitage employées à Qdeir et dans la région de Palmyre (ABBES 1993; NISHIAKI, ce volume) sont liées sans doute aux aspects différents présentés par les blocs de matière première (rognon ou plaquette) mais à Qdeir comme à Palmyre se trouvent ces très nombreux burins sur troncature.

7. Conclusions

Cette courte synthèse nous a permis de mettre en évidence les traits principaux des industries lithiques précéramiques de Syrie:

- les caractéristiques du Khiamien et son évolution;

- les grands traits du Mureybetien où le PPNB ancien plonge ses racines[1];

- la mise en place d'un débitage laminaire et sa maîtrise durant le Mureybetien et le PPNB;

- l'absence de microlithes au Mureybetien et au PPNB à l'Ouest du Khabbour[2]

- l'extraordinaire développement des pointes de flèches dès le Mureybetien et à travers tout le PPNB. L'abondance de ces armes et leur qualité laissent supposer, comme le suggère J. Cauvin (sous presse), non seulement une fonction de chasse mais de prestige.

Appréciation: L'illustration de cet article a été assurée par G. Deraphramian et M. Riviere: je les remercie ici vivement.

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1 CAUVIN M.-C. et CAUVIN J. 1993: on connaît le rôle du PPNB de l'Euphrate et de Damascène dans sa diffusion au Levant.

2 A la différence de l'Est du Khabbour (HOLE, ce volume).

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Techniques de débitage et gestion de silex sur le Moyen-Euphrate (Syrie) au PPNA final et au PPNB ancien

Frédéric Abbès

ABSTRACT. *Debitage technique and flint management patterns on the Middle Euphrates during the late PPNA and Early PPNB in Syria*

Mureybet and Cheikh Hassan are tell sites in the Middle Euphrates Valley in Syria, excavated by J. Cauvin, and found 15 km apart. The occupation at Cheikh Hassan is contemporaneous with the late PPNA at Mureybet, based upon data from architectural and artefact styles. This study discusses the nature of the PPNA-PPNB transition in the northern Levant. Our analysis is based on the late PPNA at Cheikh Hassan, with reference to the late PPNA at Mureybet, and on the early PPNB of the site.

The late PPNA period at Cheikh Hassan and the early PPNB at Mureybet had similar blade debitage systems. Both used a bipolar blade debitage from naviform cores, associated with another blade debitage with a preferred striking direction. Each system of blade debitage was geared to producing particular end-products. It was through study of the management of raw material, as well as of non-retouched blanks and artefacts such as arrowheads and "glossed" blades, that we were able to distinguish between different technical behavior patterns occurring during these periods.

RÉSUMÉ. *Les industries du PPNA final de Cheikh Hassan et du PPNB ancien de Mureybet offrent des systèmes de débitage laminaire similaires. A l'intérieur des deux sites distants de 15 km un débitage bipolaire de lames sur des nucléus parfois "naviformes" est associé à un débitage de lames à un plan de frappe préférentiel. Les deux systèmes sont orientés vers la production de produits différents à l'aide de techniques différentes. Une étude de la gestion de la matière première ainsi que des produits bruts et des artefacts retouchés (pointes de flèches, lames retouchées...) permet d'établir une différenciation des comportements techniques au PPNA final et au PPNB ancien.*

Objectif et méthode

L'objet de cet article est de présenter une méthode d'analyse basée sur la notion de *variabilité laminaire* et de son application concrète sur deux échantillons de lames, l'un du PPNA final provenant de Cheikh Hassan, l'autre du PPNB ancien de Mureybet (phase IVa de Mureybet). Il s'agit de deux ensembles pour lesquels la grande similitude des modes de débitage ne permet pas toujours d'établir des éléments de différentiation. Chaque mode de débitage présente en effet des caractéristiques particulières liées à des facteurs différents: choix de la matière première, techniques de débitage, gestion des produits, outils recherchés etc. Ainsi une bonne connaissance à la fois des techniques de débitage et de l'outillage fini nous paraît nécssaire pour aborder une étude telle que nous l'envisageons. A notre sens une approche technologique et une approche typologique sont intimement liées.

Application de la méthode

Cheikh Hassan

Cheikh Hassan est un gisement de la Haute Mésopotamie Syrienne à 15 km en amont de Mureybet. Différents sondages ont été effectués en 1976 (fouilles de J. Cauvin). Ils ont livré une industrie lithique et osseuse ainsi qu'une architecture identiques à celles de la phase IIIb de Mureybet[1], soit de la période 2b du Levant (CAUVIN J. 1987: 327; PPNA final). Les chaînes opératoires présentées

[1] Les dates obtenues pour Mureybet IIIb oscillent entre 7954 et 7545 BC.

dans cette étude ont été élaborées à partir du matériel lithique récolté lors d'un des sondages (secteur D.S.). L'industrie lithique s'y caractérise par une utilisation dans des proportions équivalentes[1] de pointes de flèches à encoches et de pointes de flèches pédonculées (fig. 4, fig. 5:1-6 et fig. 7:1-2).

Mureybet IVa

La phase IVa de Mureybet correspond au début de la période 3 du Levant[2] (PPNB ancien). Malgré l'absence de raccord stratigraphique direct, les données archéologiques indiquent une continuité entre cette phase et la phase IIIb. L'industrie lithique y est caractérisée par l'introduction de nouveaux types d'armes (pointes de Byblos) et d'outils (lames denticulées, lames à ergot[3], fig. 6,1,5) et par des techniques de retouches différentes (retouches plates lamellaires, fig. 5,7). Cet outillage nouveau peut être interprété comme le reflet de nouvelles modalités d'emmanchements.

Débitage bipolaire

Sur les deux sites un débitage bipolaire, parfois "naviforme"[4], a été observé (fig. 4,9). La matière première locale se compose de rognons de silex fin de très bonne qualité. Quelque soit le type de nucléus, la volonté des tailleurs est le contrôle de leur géométrie et de leur volume afin "d'optimiser" la production laminaire. Les différents moments décrits (fig. 1) regroupent les différentes options de débitage observé, aucune différence significative n'a pu être dégagée entre les débitages de Cheikh Hassan et ceux de Mureybet IVa. La gestion des nucléus et les types de lames utilisées sur les deux sites sont en revanche nettement différents.

La variabilité laminaire

Les débitages laminaires produisent d'une part des lames recherchées pour leurs qualités propres, et d'autre part des lames techniques "obligées". Les lames recherchées sont les produits réels. Le débitage est orienté dans le but de les obtenir. Les lames techniques "obligées" sont des lames indispensables au bon déroulement de l'exploitation laminaire. Ce sont des lames à part entière avec leurs qualités propres mais elles restent des sous-produits dans la mesure où elles représentent des moments techniques et non des moments de véritable pleine exploitation laminaire. Ce sont par exemple dans un débitage de type bipolaire, les lames en "upsilon" (CALLEY 1988) ou encore les lames débordantes dont la fonction technique est la reprise de convexité et de "renervuration" de la surface de débitage des nucléus. La variabilité laminaire n'exclut pas une standardisation du débitage, mais au contraire, dans bien des cas, elle la permet. En effet l'exploitation laminaire se construit autour d'un même "jeu" constant de contrôle de la surface de débitage et des plans de frappe. Ainsi dans un débitage donné, face à un problème donné, la panoplie de solutions techniques sera logiquement toujours la même. Seuls, peut-être les systèmes hyperstandardisés du type "pression" limitent, voire excluent, la notion de variabilité.

Les schémas proposés (fig. 3) présentent, au sein du débitage bipolaire, les grands types de lames produites. C'est en fonction de ces types que les décomptes d'outillages ont été élaborés. On distingue les types suivants:

Lames techniques précédant le plein débitage (1-3):

---

1 23,8% des pointes sont à encoches, 25,9% sont à pédoncule et à encoches et 28% sont des pointes à pédoncule. Le fort pourcentage des pointes à encoches de Cheikh Hassan pose le problème de leur survivance dans le contexte culturel de la fin du PPNA où sur d'autres sites elles se rarifie.

2 ibid. 328-329. Trois dates sont connues pour cette phase, 7650, 7180 et 7080 BC.

3 En préparation

4 Les nucléus "naviformes" sont un aspect complexe des débitages bipolaires. Dans les exemples présentés ici leurs gestions ne semblent pas radicalement différentes des simples nucléus bipolaires comme cela est le cas dans des industries PPNB plus tardives. Les deux types de nucléus n'ont donc pas été différenciés.

1- Les lames d'ouverture de surface de débitage: elles sont façonnées par des crêtes latérales et sont de section trapézoädale et épaisse sans nervure-guide dans l'axe de débitage (fig. 3:1).
2- Les lames à crête dorsale: elles sont à section triangulaire haute et large (fig. 3:2).
3- Les lames "secondes": elles sont à section trapézoïdale haute. Certaines peuvent être débordantes (fig. 3:3).

Lames de plein débitage (4-6):
4- Lames à nervuration régulière épaisse (sup. à 5 mm): elles sont de section trapézoïdale ou triangulaire (fig. 3:4).
5- Lames à nervuration régulière de faible épaisseur (inf. à 5 mm): elles sont de section trapézoïdale plus rarement triangulaire (fig. 3:5).
6- lames à nervuration multiple (plus de 5 nervures): elles sont épaisses et de section "sub-trapézoïdale". Elles correspondent à Cheikh Hassan à des reprises de la surface de débitage (ABBÈS, sous presse). A Mureybet elles ne semblent pas avoir de fonction particulière (fig. 3:6).

Lames techniques durant le plein débitage:
7- Lames de reprise de réfléchissement: elles sont de section diverses et épaisses et portent sur leur face supérieure un ou plusieurs réfléchissements (fig. 3:7).
8- Lames torses: elles sont de faible épaisseur et courtes (fig. 3:8).
9- Lames débordantes: elles sont généralement épaisses et présentent un angle droit sur un de leurs bords (fig. 3:9).
10- Petites lames ou lamelles de reprise de convexité distale. Elles sont très peu épaisses (fig. 3:10).

Déroulement de la chaîne opératoire

Cette dernière s'organise en trois grandes phases; une phase de préparation (production des lames de type 1 à 3), une phase d'exploitation (production des lames de type 4 à 10) et d'auto-entretien, et une phase d'abandon de l'exploitation laminaire bipolaire (fig. 1).

Phase de préparation

Dans son acception la plus large, elle comprend l'acquisition de la matière première et sa transformation en nucléus prêt à être exploité. Le degré de mise en forme est tributaire du type de rognon de silex sélectionné et de l'objectif visé, bipolaire ou "naviforme".

Le façonnage du bloc a pour objectif de lui donner une configuration exploitable. Durant cette étape les surfaces du nucléus (flancs, surface de débitage, plans de frappe) s'articulent entre elles, ce qui est nécessaire au contrôle de leur mise en forme.

L'ouverture de la surface de débitage modifie le rapport entre les faces du nucléus. La surface de débitage fonctionne alors en autonomie avec les plans de frappe par rapport au reste du nucléus. Les plans de frappe assurent en même temps la production de lames et l'entretien de la surface de débitage. Les interventions depuis les flancs sont rares et correspondent à des situations "critiques" où l'entretien "normal" de la surface de débitage ne peut plus être assuré (plans de frappe abîmés, accidents importants sur la surface de débitage...).

Phase d'exploitation et d'auto-entretien: Gestion différentielle

Si les mêmes types de produits laminaires (lames de plein débitage et lames techniques) peuvent être extraits des nucléus bipolaires de Cheikh Hassan et de Mureybet IVa, la gestion des lames est radicalement différente d'un gisement à l'autre.

- Cheikh Hassan

Les lames de plein débitage sont produites par une utilisation alternée des deux plans de frappe des nucléus après chaque série laminaire. Les seules exceptions concernent des cas de reprise d'accident sur la surface de débitage ou encore l'extraction de lames sur des nucléus en fin d'exploitation laminaire. Dans ce dernier cas, la volonté est de pousser au maximum une production sans souci de

Tabl. 1. Utilisation des lames en fonction de leurs types à Cheikh Hassan.

Type de lame	Cheikh Hassan secteur D.S.	
	L. Brutes	L. Retouchées
1	2	-
2	3	2
3	12	7
4	120	92
5	4	77
6	16	98
7	2	40
8	1	2
9	14	23
10	3	5
Total	177	346

Tabl. 2. Utilisation des lames en fonction de leurs types à Mureybet IVa.

Type de lame	Mureybet IVa	
	L. Brutes	L. Retouchées
1	-	-
2	5	29
3	12	21
4	25	252
5	12	25
6	7	79
7	4	48
8	4	5
9	10	56
10	13	39
Total	92	554

Tabl. 3. Répartition des lames provenant des nucléus à un plan de frappe préférentiel de Cheikh Hassan en fonction des lames aigües.

	Lames aiguës	Lames diverses
Outillage		
Lames retouchées	5	16
Grattoirs sur lame	-	3
Lames denticulées	-	2
Lames appointées	2	-
Lames brutes	3	37
Total	68	

Tabl. 4. Répartition des lames provenant des nucléus à un plan de frappe préférentiel de Mureybet IVa en fonction des lames aigües.

	Lames aiguës	Lames diverses
Outillage		
Lames retouchées	10	15
Lames denticulées	1	-
Burins sur lame	2	3
Perçoirs	1	
Lame à encoche	-	1
Lames appointées	2	-
Lames brutes	8	30
Total	73	

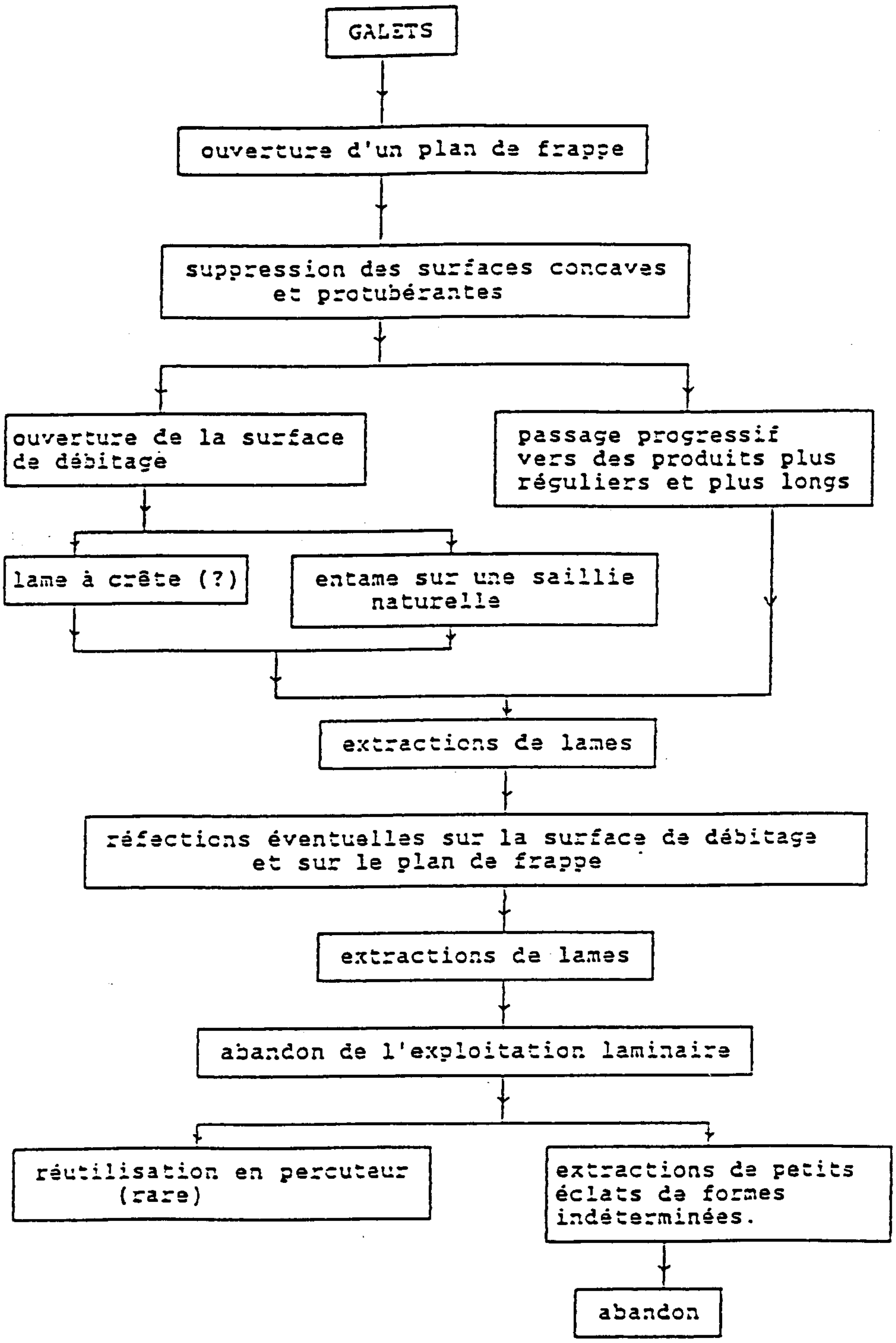

Fig. 1. Déroulement de la chaîne opératoire des nucléus bipolaires.

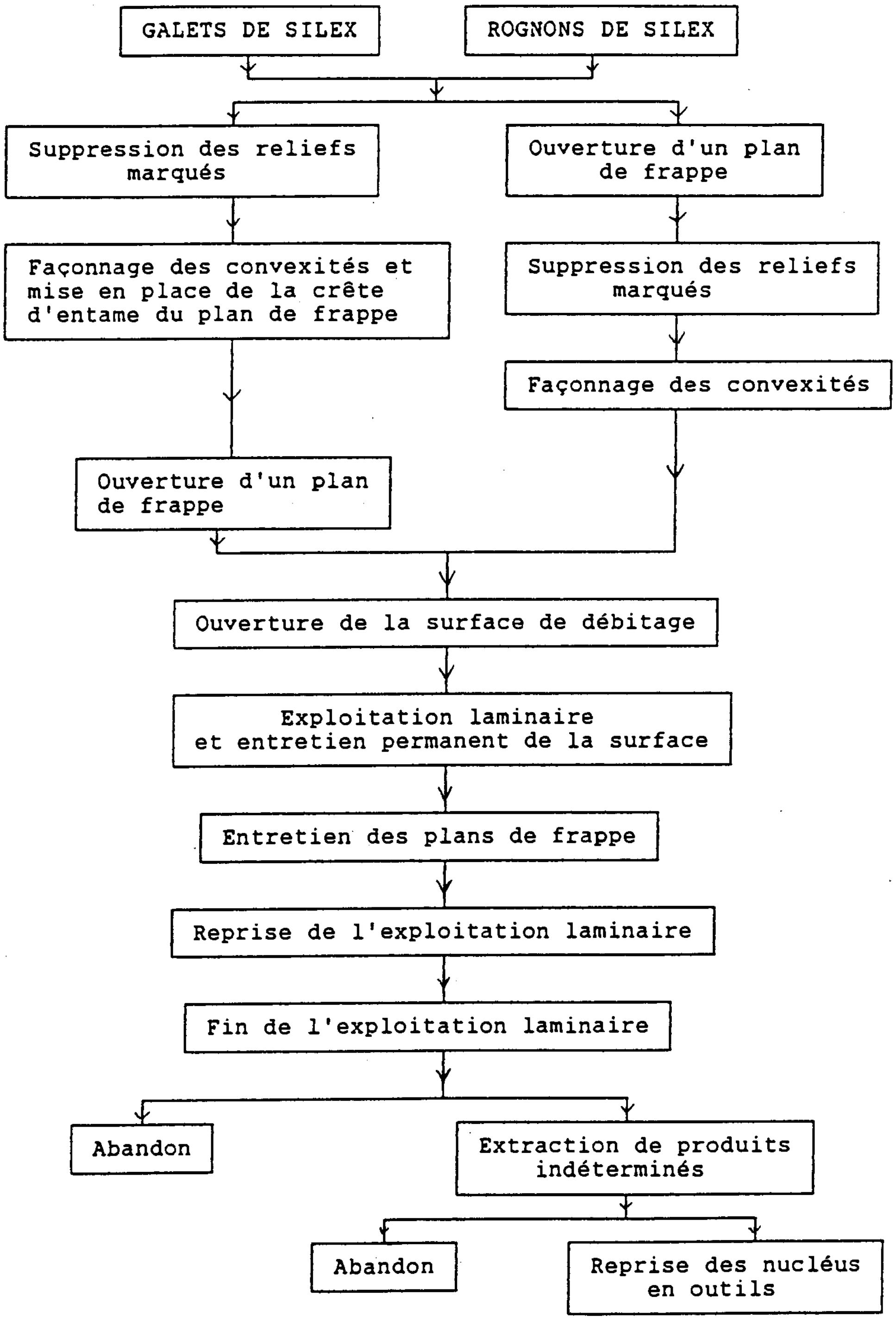

Fig. 2. Déroulement de la chaîne opératoire des nucléus à un plan de frappe préférentiel.

l'entretien de la surface de débitage. Les lames de plein débitage sont à profil rectiligne, avec deux à trois nervures principales[1], et une faible épaisseur. Cette faible épaisseur est l'élément-clef de cette gestion. Les lames de plein débitage sont ensuite utilisées principalement dans la confection de pointes de flèches (fig. 3:5), ce qui est démontré par la proportion élevée de lames de plein débitage susceptibles d'être façonnées en pointes de flèches[2]. La sélection de ces lames particulières peut s'expliquer par le mode de retouche. Les pointes à encoches, (pointes d'El Khiam, pointes d'Hélouan et autres pointes dérivées, fig. 4:1-6), compte tenu de leur fragilité ne peuvent être retouchées que par pression (quel que soit le mode de pression), ce qui exclut la possibilité d'utiliser des lames trop épaisses. En d'autres termes, la retouche a une action essentiellement "rétrécissante" (elle agit davantage sur la largeur que sur l'épaisseur des lames). Les pointes pédonculées obéissent à la même règle. Elles peuvent être classées en deux groupes: les pointes façonnées sur le même type de lame que celles des pointes à encoches (elles sont en ce sens de conception pleinement PPNA; fig. 3:5, fig. 4:7-8) et les pointes façonnées sur des lames épaisses (fig. 3:4, fig. 5:1-6), ces dernières étant rares. Mais là encore, elles sont façonnées par une retouche abrupte agissant davantage sur la largeur que sur l'épaisseur. Les seules exemples de lames où une retouche "amincissante" à pu être observée ne concernent que des cas particuliers: la retouche est localisée sur l'extrémité proximale des lames, une zone où la convexité importante du bulbe favorise le développement de l'onde de choc de la pression. Cependant, même dans ce cas, la retouche est isolée, presque marginale, et n'implique pas forcément une connaissance de ce mode de retouche.

Le reste de l'outillage est façonné sur des lames plus variées; les lames retouchées et lustrées sur des lames de plein débitage aux profils rectilignes et aux dimensions variables, les perçoirs sur des lames de plein débitage ou parfois encore sur des lames techniques de petites dimensions, les grattoirs et burins essentiellement sur des lames techniques épaisses.

- Mureybet IVa

Les lames de plein débitage sont sensiblement plus épaisses qu'à Cheikh Hassan. La distinction de la production des nucléus bipolaires et "naviformes" n'a pu être clairement précisée. Les enlèvements laminaires exploitent une zone plus importante de la surface de débitage. L'équilibre de cette surface est en permanence maintenue par des enlèvements de lamelles. Le "jeu" exact des plans de frappe demeure pour l'instant un problème. Il n'est en effet guère possible de préciser si ces derniers fonctionnent en alternance dans l'exploitation laminaires ou si l'un des plans est réservé à l'entretien de la surface de débitage, et donc à assurer l'extrémité distale des lames extraites.

Les pointes de flèches sont toutes à pédoncule (fig. 3:4, fig. 6:4,6-8) et façonnées grâce à des retouches par pression (sur des lames du type de la fig. 3:4). Les retouches agissent à la fois sur la largeur et sur l'épaisseur des lames. D'un point de vue strictement technique, l'épaisseur des lames rend impossible la confection d'encoches à la pression. On assiste donc à une production différente de lames sur des nucléus pourtant comparables, et à un traitement post-débitage nettement différent. Le reste de l'outillage se comporte sensiblement de la même manière qu'au PPNA final.

Phase d'abandon de l'exploitation laminaire

Cette dernière phase enveloppe des comportements très différents d'un nucléus à l'autre. Cette diversité de comportement est le reflet de l'absence de schéma de taille rigide et d'un besoin constant de support, ceci en dépit de la présence d'amas de débitage inhérents à toute production et pouvant procurer apparemment une matière première facilement accessible.

Débitage à un plan de frappe préférentiel

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[1] Les lames à une nervure sont rare mais non absente. Les lames à nervuration importante sont aussi souvent les plus épaisses et correspondent principalement à des "néttoyages" de la surface de débitage (ABBÈS, sous presse).

[2] et non par la comparaison du pourcentage des flèches par rapport au reste de l'outillage laminaire qui a peu de sens en soi (ABBÈS, sous presse).

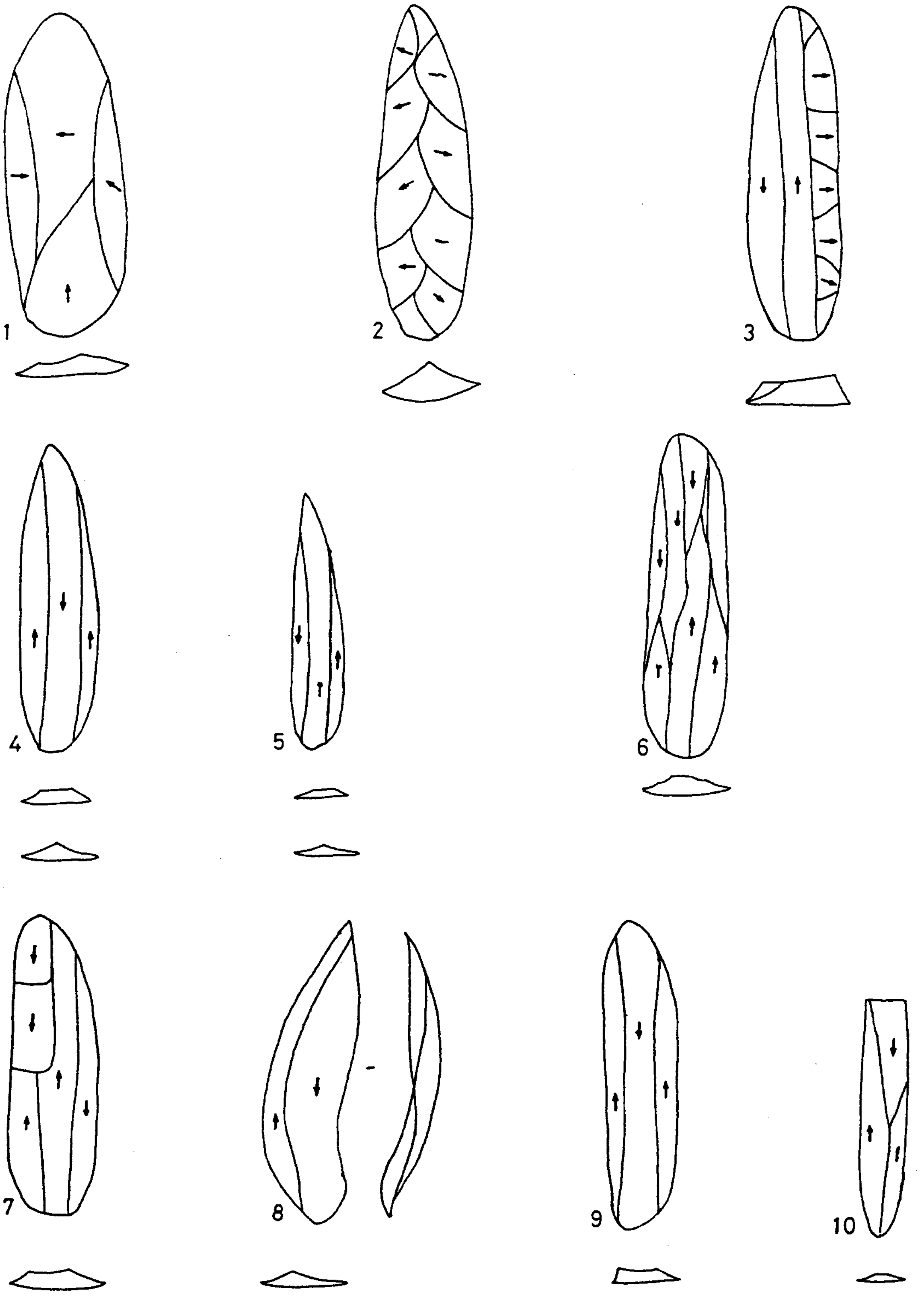

Fig. 3. Ensemble schématique des différentes lames produites par les nucléus bipolaires de Cheikh Hassan et de Mureybet IVa: 1 lame d'ouverture de surface de débitage, 2 lame à crête dorsale, 3 lame seconde, 4-6 lames de plein débitage, 7 lame de reprise de réfléchissement, 8 lame torse, 9 lame débordante, 10 petite lame ou lamelle de reprise de convexité distale.

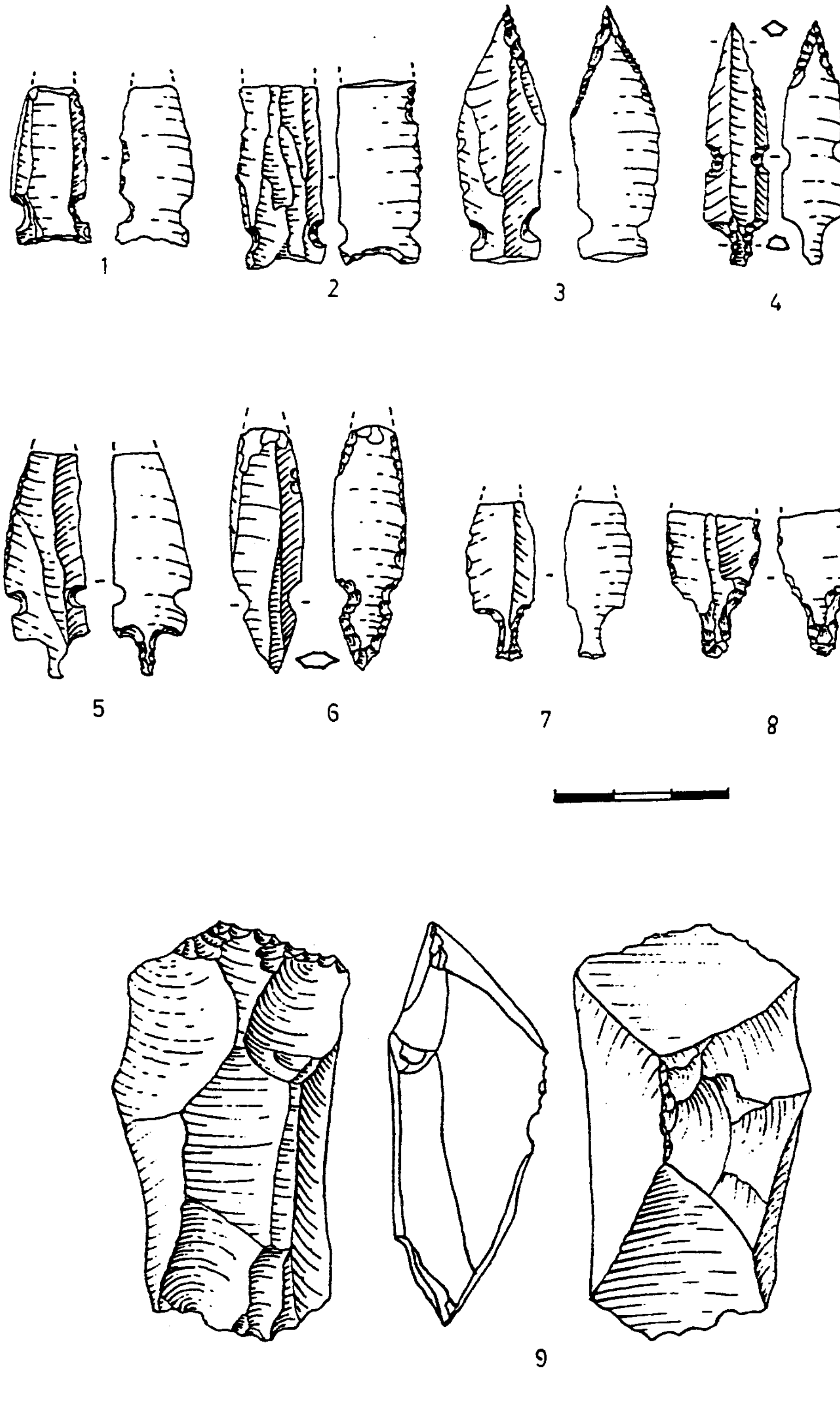

Fig. 4. Débitage bipolaire de Cheikh Hassan: 1-3,6 pointes à encoches, 4-5 pointes à encoches et à pédoncule, 7-8 pointes à pédoncule (épaisseurs inf. 5mm), 9 nucléus "naviforme".

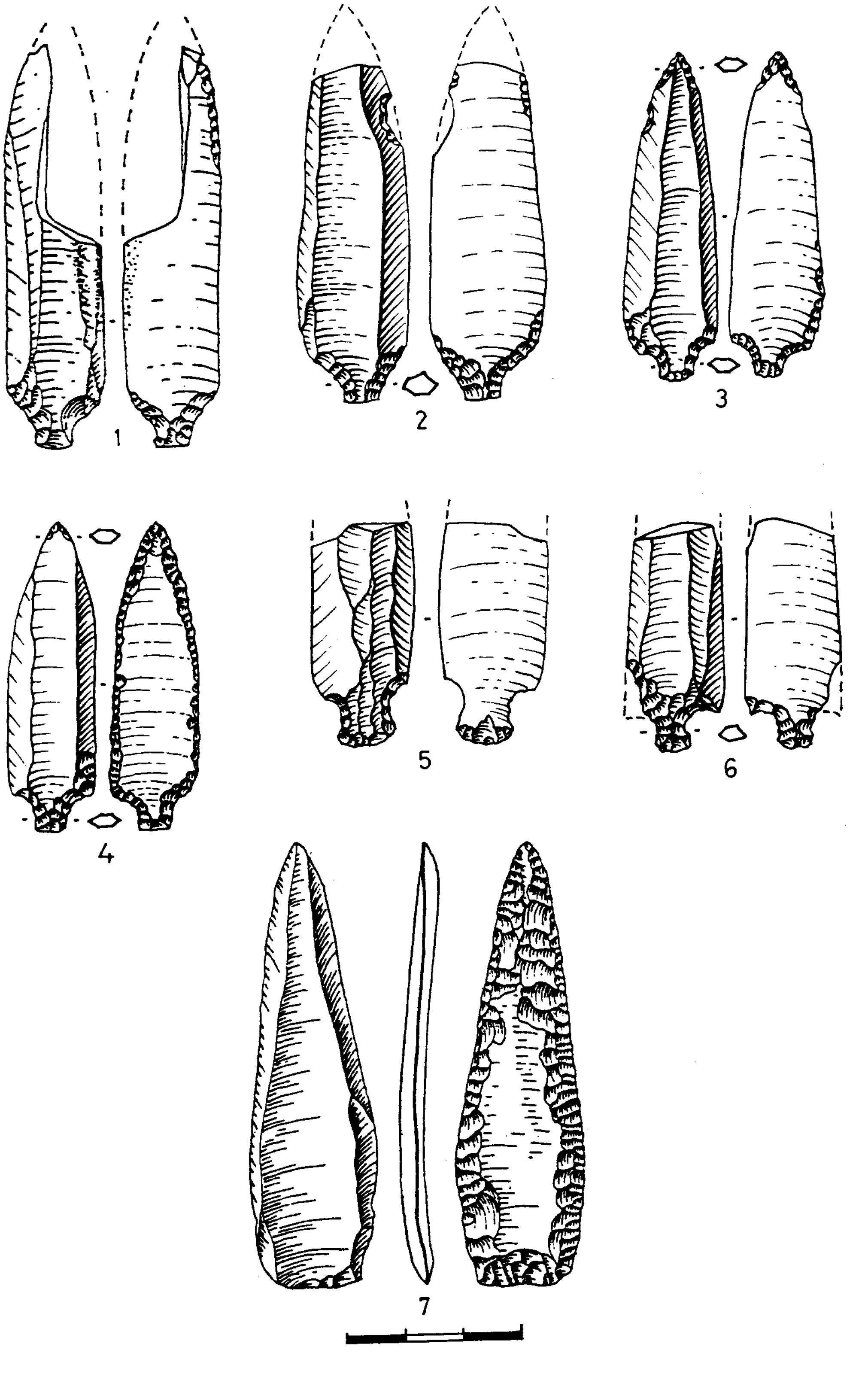

Fig. 5. Débitage bipolaire de Cheikh Hassan : 1-6 pointes à pédoncule (épaisseurs sup. 5mm), débitage bipolaire de Mureybet IVa : 7 lame à retouches plates lamellaires.

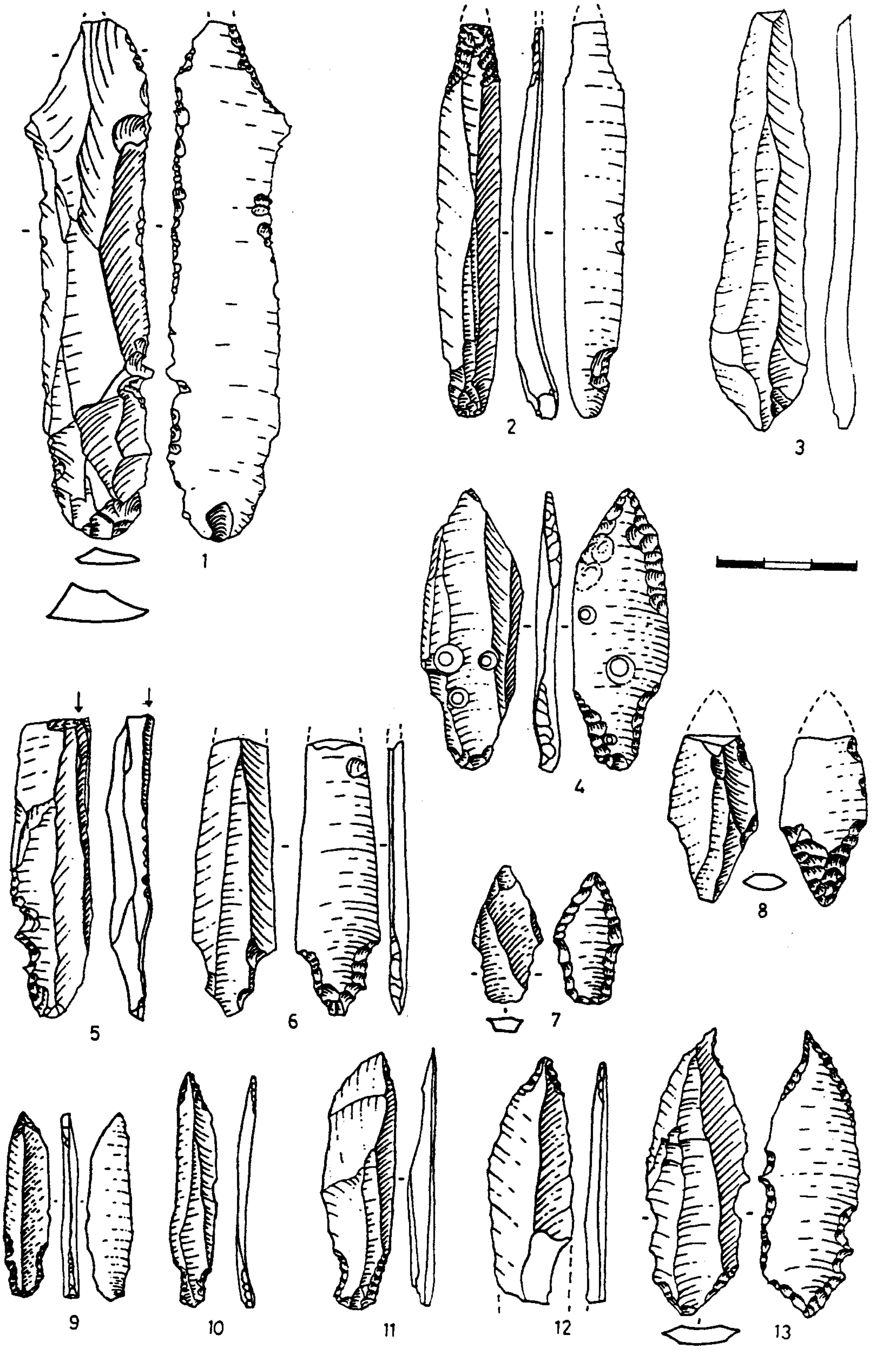

Fig. 6. Débitage bipolaire de Mureybet IVa : 1 lame à ergot retouchée et lustrée, 2 lame à retouches plates lamellaires, 3 lame brute, 4,6-8 lames à pédoncule (épaisseurs sup. 5mm), 6 burin sur lame à ergot, 9-11 pointes à pédoncule (épaisseurs inf. 5mm), 12 fragment de lame appointée, 13 lame à retouches proximales denticulée et à extrémité distale appointée.

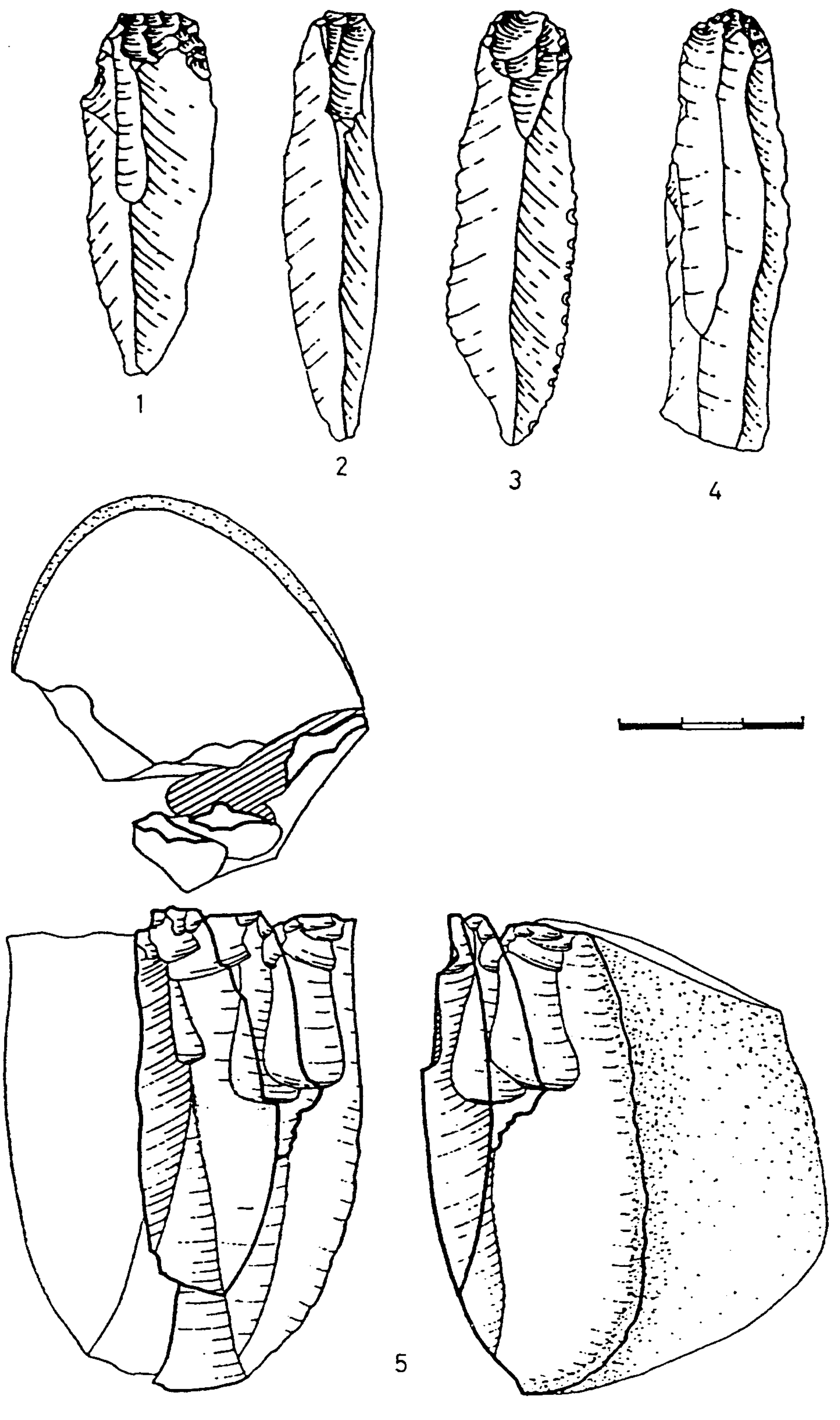

Fig. 7. Débitage unipolaire de Cheikh Hassan : 1-2 lames à extrémité distale aigua; débitage unipolaire de Mureybet IVa : 3 lame à extrémité distale aigüe et à retouches denticulées, 4 lame outrepassée, 5 remontage de trois lames sur un nucléus.

Le débitage revêt la même forme à Cheikh Hassan et à Mureybet IVa. Quelles que soient les options de débitage[1], la production de lames reste inchangée. La qualité de la matière première est très variable, depuis des "chailles" à peine silicifiées jusqu'à des silex à grain très fin. Dans tous les cas le débitage est mené à la percussion de pierre. L'existence de produits d'aspects plus grossiers[2] a amené, dans un premier temps, à parler d'un débitage sans orientation particulière hormis la volonté d'obtenir rapidement et à moindre frais des supports allongés. Une étude plus précise du débitage et de l'outillage révèle qu'il n'en est rien.

Le déroulement de la chaîne opératoire observée témoigne de toute la diversité des étapes qui ont été adoptées par les tailleurs préhistoriques (fig. 2). Cette diversité est le reflet direct de leurs compétences techniques pour la gestion d'une matière première difficile (le silex est souvent très dur avec différentes densités de grain à l'intérieur d'un même bloc).

A travers la variabilité de cette chaîne *opératoire* quatre étapes se retrouvent toujours:

- le choix du galet
- l'ouverture du plan de frappe
- le passage progressif vers des produits de plus en plus réguliers.
- la gestion des lames.

Exploitation

Malgré l'absence de véritable mise en forme, il y a une recherche évidente de produits précis et normalisés (fig. 7:1-4). Cette normalisation des produits ne s'attache pas strictement à leur aspect morphologique, mais à la volonté d'obtenir des lames rectilignes à l'extrémité distale aigue (fig. 7:1-3). La gestion du nucléus est assurée par un contrôle permanent de l'extrémité distale. Celui-ci s'exerce en deux temps:

- 1er temps: Un enlèvement provoque un léger outrepassage. La maîtrise de cet outrepassage volontaire est facilitée par la surface convexe de l'extrémité distale du nucléus. On tire donc partie de la forme naturellement convexe du galet (fig. 7:5).

- 2ème temps: la lame suivante plus courte, profite d'une nervure haute pour se développer. Elle exploite les 2/3 supérieurs du nucléus pour s'interrompre progressivement et terminer naturellement appointée.

Ce schéma est "couteux" en matière première et nécessite l'extraction d'un grand nombre de produits intermédiaires entre chaque série de lames appointées. Les accidents de débitage sont fréquents[3].

Conclusion

Cette première approche techno-morphologique a permis d'individualiser les différentes chaînes opératoires présentes aussi bien à Cheikh Hassan qu'à Mureybet IVa. La similitude de ces ensembles laminaires limitait considérablement les possibilités de les distinguer et ceci malgré les apports de la typologie qui permettaient déjà d'observer des différences importantes au niveau des modes de retouches utilisés durant les deux périodes concernées. La prise en compte de la variabilité laminaire au sein d'un même débitage a permis de clarifier cette situation.

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1 Ces dernières sont le reflet de la morphologie de départ de la matière première.

2 Cet aspect est dû à la qualité de la matière première et à une morphologie des lames moins bien contrôlée que celle des lames bipolaires.

3 surtout les réfléchissements.

L'épaisseur d'une lame résulte d'une volonté des tailleurs durant le débitage. A Cheikh Hassan cette volonté a pu être démontrée dans la gestion des nucléus. A Mureybet, si la stratégie de débitage n'est pas pour l'instant définitivement reconstituée il est manifeste que la plus grande épaisseur des lames traduit une gestion différente de celle observée sur les nucléus de Cheikh Hassan.

Nous sommes donc en présence de gestions différentes des nucléus bipolaires et ceci dans un contexte de continuité culturelle manifesté d'abord par l'utilisation d'un débitage bipolaire similaire, ensuite par une gestion inchangée des nucléus à un plan de frappe préférentiel depuis le PPNA final jusqu'au moins au PPNB ancien.

Les modalités de retouche sont des éléments clés dans la compréhension des outillages et par la même des stratégies de débitage (TIXIER 1991: 392). Il ne semble pas que la retouche par pression ayant pour but d'amincir une lame ou un éclat ait été pratiquée durant le PPNA de Cheikh Hassan (ABBÈS, sous presse) ou même de Mureybet (phase IIIa/b; CAUVIN M.C. 1978: 76)[1]. En revanche elle a été largement pratiquée durant la phase IVa de Mureybet. Une étape technique a peut être alors été franchie.

L'étude de nouveaux gisements sur l'Euphrate permettra de préciser la portée réelle des observations faites quant à la gestion des produits laminaires de ces périodes et des distinctions technologiques éventuelles à établir au sein des débitages bipolaires. D'ores et déjà il semble acquis que la simple mention de débitage bipolaire ("naviforme" compris) n'est plus suffisante pour caractériser les ensembles lithiques du PPNA et du PPNB.

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1 Il est difficile de véritablement identifier ce type de caractère sur la documentation existante pour le Proche-Orient, il ne semble pas cependant que ce type de retouche ait été pratiqué durant le PPNA.

L'industrie lithique de Dja'de el Mughara et le début du P.P.N.B. sur l'Euphrate Syrien (Sondages 1991 et 1992)

Eric Coqueugniot

RÉSUMÉ. *Deux campagnes de sondages à Dja'de el Mughara (Syrie) ont mis en évidence l'importance des niveaux archéologiques appartenant au PPNB ancien, avec des vestiges de maisons rectangulaires séparées par des espaces ouverts. Ces sondages n'ont pour l'instant pas permis de rencontrer de zones d'ateliers de taille du silex et les rares nucléus naviformes recueillis présentent souvent une réutilisation secondaire (broyeurs...); ces nucléus et les produits obtenus attestent cependant une très grande maîtrise de la technique de débitage bipolaire, orientée vers la production de supports laminaires longs, réguliers et très peu arqués. Le matériel lithique recueilli est très abondant et il témoigne de choix préférentiels de la matière première en fonction des artefacts désirés. Sans être très abondante, l'obsidienne est toujours présente et témoignent d'échanges avec l'Anatolie. Les burins sont présents mais peu nombreux; les lames lustrées sont éventuellement très longues et à tranchant finement denticulé, les pointes de projectiles comportent de nombreuses pointes de Byblos (présence de pédoncules denticulés, abondance des pédoncules larges et équarris) ainsi que des pointes à pédoncule court qui évoquent Mureybet III et des pointes à pédoncule denticulé similaires à celles de Mureybet IV*$_A$.

Entreprise dans le cadre de la campagne de sauvetage organisée à l'occasion de la construction du barrage de Tichrine, la fouille de Dja'de el Mughara a débuté en 1991[1]. Situé en amont de Qara Qosak, le site de Dja'de constitue un tell bas (5 à 6 m au dessus de la plaine actuelle), établi sur la moyenne terrasse en rive gauche de l'Euphrate, au contact entre la steppe de Jezireh et la vallée. Les deux premières campagnes de sondages ont mis en évidence l'importance des niveaux archéologiques appartenant au *P.P.N.B.* ancien, avec des vestiges de maisons rectangulaires séparées par des espaces ouverts. Le sol vierge n'a pas encore été atteint et, au stade actuel de l'étude, le matériel apparaît relativement très homogène aussi préférons nous, pour l'instant, considérer les industries lithiques comme appartenant à un ensemble unique dont la subdivision fine en diverses phases ne sera effectué que lorsque la séquence complète sera connue, tout au plus signalerons nous les tendances observées. Pour les mêmes raisons d'état d'avancement de l'étude de ce site, les effectifs et proportions donnés ne concerneront que la campagne 1992 et n'auront par suite qu'une valeur indicative, par contre les pièces figurées proviendront des deux campagnes 1991 et 1992.

Pour des besoins de clarté, nous étudierons séparément les problèmes concernant la matière première, la technologie du débitage, puis le façonnage des outils et leur utilisation. Toutefois il ne s'agit que d'étapes successives de la chaîne opératoire qui va de la sélection du rognon ou du galet de silex à l'abandon des outils à l'issue de leur utilisation. Comme les choix finaux conditionnent toutes les phases

[1] Notre travail a été facilité par l'appui que nous avons trouvé auprès de la Direction des Antiquités et des Musées de Syrie, à Damas et à Alep: nous en remercions particulièrement le Dr Adnan Bounni, Directeur du Service des Fouilles et M. Wahid Kayyata, Directeur des Antiquités de la région d'Alep. Nous tenons à remercier Danielle Stordeur (CNRS et Mission Permanente d'El Kowm), titulaire du permis de fouilles à Dja'de, qui nous a confié la responsabilité technique et scientifique de cette fouille, ainsi que Jacques Cauvin qui a favorisé le financement de cette fouille sur les crédits de la Mission Permanente d'El Kowm (Ministère des Affaires Étrangères) qu'il dirige. Mes remerciements vont aussi à G. Deraprahamian, dessinateur de l'ERA 17 du CRA, qui a dessiné ces artefacts de pierre taillée. L'intérêt archéologique de Dja'dé avait été révélé par la prospection du Haut Euphrate syrien effectuée par M.-C. Cauvin et M. Molist 1991.

de cette chaîne (et *vice versa*), nous avons tenté de lier au mieux ces différentes parties qui ne doivent donc en aucun cas être considérées comme indépendantes les unes des autres.

La matière première et sa disponibilité dans l'environnement

L'obsidienne ne représente qu'une part très faible des produits retrouvés, elle est cependant toujours présente et témoigne d'échanges avec l'Anatolie[1] . La matière première lithique taillée à Dja'de est pour l'essentiel constituée de silex avec deux catégories principales très distinctes: un silex très homogène, à éventuel cortex crayeux, à grain (très) fin et de couleur brun sombre dont la finalité du débitage était orientée vers l'obtention de produits laminaires (il existe cependant de nombreux éclats dans cette variété de silex car la mise en forme et l'entretien des nucléus à lames nécessite le détachement de nombreux produits non laminaires) et des silex souvent homogènes mais à cortex généralement roulé et de texture plus grossière utilisés principalement pour le débitage des éclats.

Une prospection a été effectuée afin de tenter de reconnaître les sources possibles de matière première siliceuse dans le voisinage du site. Il est évident que les ressources reconnues ne représentent qu'une partie de ce que les Préhistoriques avaient à leur disposition car cette prospection a été rapide et des bancs de silex nous ont certainement échappé. L'absence d'une variété de silex dans la zone prospectée ne signifie donc pas nécessairement que les Préhistoriques n'en disposaient pas à proximité de leur établissement. En dépit des réserves précédentes, nous avons pu reconnaître plusieurs sources potentielles de matière première siliceuse lors de cette recherche qui a concerné l'environnement de Dja'de[2]:

* Le silex brun sombre à grain très fin semble absent de l'environnement immédiat du site et nous ne l'avons retrouvé que dans les bancs crayeux de la région en amont d'Halawa (région de l'actuel lac de Tabqa en aval de Dja'de), secteur dans lequel ce silex se trouvait *in situ* dans les banc de craie sous forme de rognons allongés et de très gros rognons à deux faces subplanes[3]. Ce silex à texture très fine présente une excellente aptitude à la taille et sa cassure est luisante; il est similaire à celui utilisé pour la plupart des produits laminaires tant à Dja'de que dans les sites *P.P.N.A.* de Mureybet et de Cheikh Hassan. Par contre cet affleurement de craie à silex ne semble pas présent dans l'environnement immédiat de Dja'de (ou plus en amont le long du fleuve) et le silex brun très fin a donc du y être importé depuis un secteur distant de plusieurs dizaines de kilomètres en aval. Cette disponibilité restreinte doit justifier le degré d'exhaustion très poussé des nucléus correspondants.

* Les bords du fleuve et les grandes nappes d'épandage quaternaires de la rive gauche présentent de nombreux galets de silex arrachés à des formations géologiques diverses. Certaines peuvent être lointaines ainsi que le suggère le cortex très roulé et altéré des galets, d'autres sont voisines ainsi que l'attestent des blocs portant un cortex crayeux, encore épais et assez peu altéré. Ces silex ont une texture allant du grain fin au silex grossier et une couleur variable avec d'éventuelles imprégnations de fer et de manganèse.

Technologie du débitage

Le matériel lithique recueilli est très abondant mais les sondages n'ont pour l'instant pas permis de rencontrer de zones d'ateliers de taille du silex. De tels ateliers doivent cependant être présents dans les secteurs encore non explorés du tell car des aires de vidange ont fourni (en position secondaire) des

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[1] Études de provenance en cours par G. Schneider, Institut für Anorganische und Analytische Chemie, Freie Universität, Berlin. L'examen macroscopique semble indiquer plusieurs variétés d'obsidienne mais seules les analyses physico-chimiques permettront de trancher sur ce point.

[2] La prospection effectuée en 1991-92 autour de Dja'de est venue compléter une enquête effectuée plus en aval en 1988 lors de l'étude du matériel lithique Uruk de tell Sheikh Hassan (fouille J. Boese, Université de Saarbrücken [il s'agit de Cheikh Hassan dont les niveaux *P.P.N.A.* ont été sondés en 1976 par J. Cauvin]).

[3] Plus en aval, ce silex était présent en gîte primaire similaire dans la falaise bordant l'Euphrate à Mureybet (J. Cauvin communication personnelle).

nucléus[1], des pièces techniques et de nombreux déchets de taille présentant (semble-t-il) toutes les étapes de la chaîne opératoire (avec notamment des tablettes de ravivage de nucléus naviforme).

Tableau 1: Comparaison des mesures (en mm) des flèches pédonculées et des lames pédonculées. <* *Effectifs sur lesquels les mesures ont été prises*>.

	Largeur moyenne du corps	Épaisseur moyenne du corps	Largeur du pédoncule	Épaisseur du pédoncule	N*
Flèches pédonculées	17,9	5,04	7,1	3,1	22
Lames pédonculées	17,9	4,6	7,3	3,3	136

Tableau 2: Comparaison des mesures (en mm) des flèches pédonculées et des lames pédonculées suivant les divers types de pédoncules.

	Largeur moyenne du pédoncule	Épaisseur moyenne du pédoncule	N
Flèches à pédoncule arrondi	7,3	3,2	6
Lames à pédoncule arrondi	7,4	3,1	30
Flèches à pédoncule équarri	7,0	2,4	9
Lames à pédoncule équarri	7,2	3,2	49
Flèches à pédoncule rectiligne	7,0	4,0	4
Lames à pédoncule rectiligne	6,9	3,9	7

Tableau 3: Fréquence de rencontre des principaux modes de retouche directe et inverse du pédoncule des flèches (N = 41) et des lames pédonculées (N = 152).

Mode de retouche	Flèches pédonculées	Lames pédonculées	
Directe simple périphérique	24%	25%	Semblables
Directe abrupte périphérique	39%	48%	Mode dominant en supérieur
Alterne abrupte	10%	2%	≠
Inverse brut (non retouché)	20%	24%	Semblables
Inverse simple bilatérale	10%	9%	Semblables
Présence de retouches directes plates	5%	3%	Rares
Présence de retouches inverses plates	37%	26%	Fréquent dans les deux cas

Les rares nucléus naviformes recueillis présentent souvent une réutilisation secondaire (broyeurs, débitage sommaire d'éclats...); ces nucléus (fig. 1:3) et les produits obtenus attestent cependant une très grande maîtrise de la technique de débitage bipolaire, orientée vers la production de supports laminaires longs, réguliers et très peu arqués ainsi que l'attestent notamment un nucléus (fragmentaire) et de nombreux produits laminaires (fig. 1:1-2). Parmi ces derniers une large proportion présente un talon

[1] Sur un total de 36 nucléus, la campagne 1992 a livré deux naviformes, 13 nucléus à éclat unipolaires, 8 nucléus bipolaires, 6 nucléus globuleux...

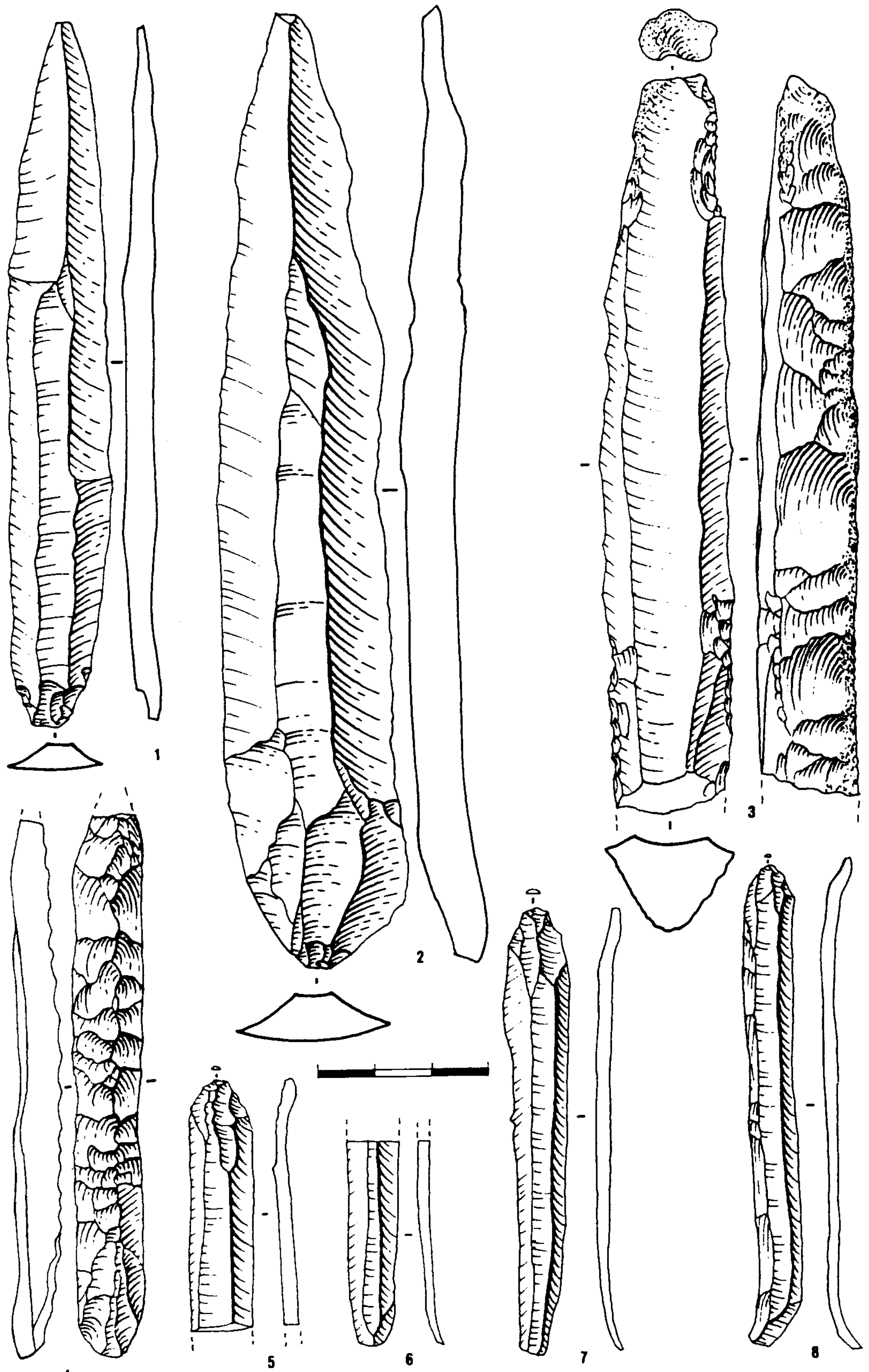

Fig. 1. Dja'de - Débitage: 1-2 lames de silex , 3 nucléus naviforme réutilisé et cassé après abandon (remarquer la rectitude du dernier enlèvement) , 4 lame à crête (remarquer la préparation par détachement de trois lamelles) , 5-8 lamelles d'obsidienne.

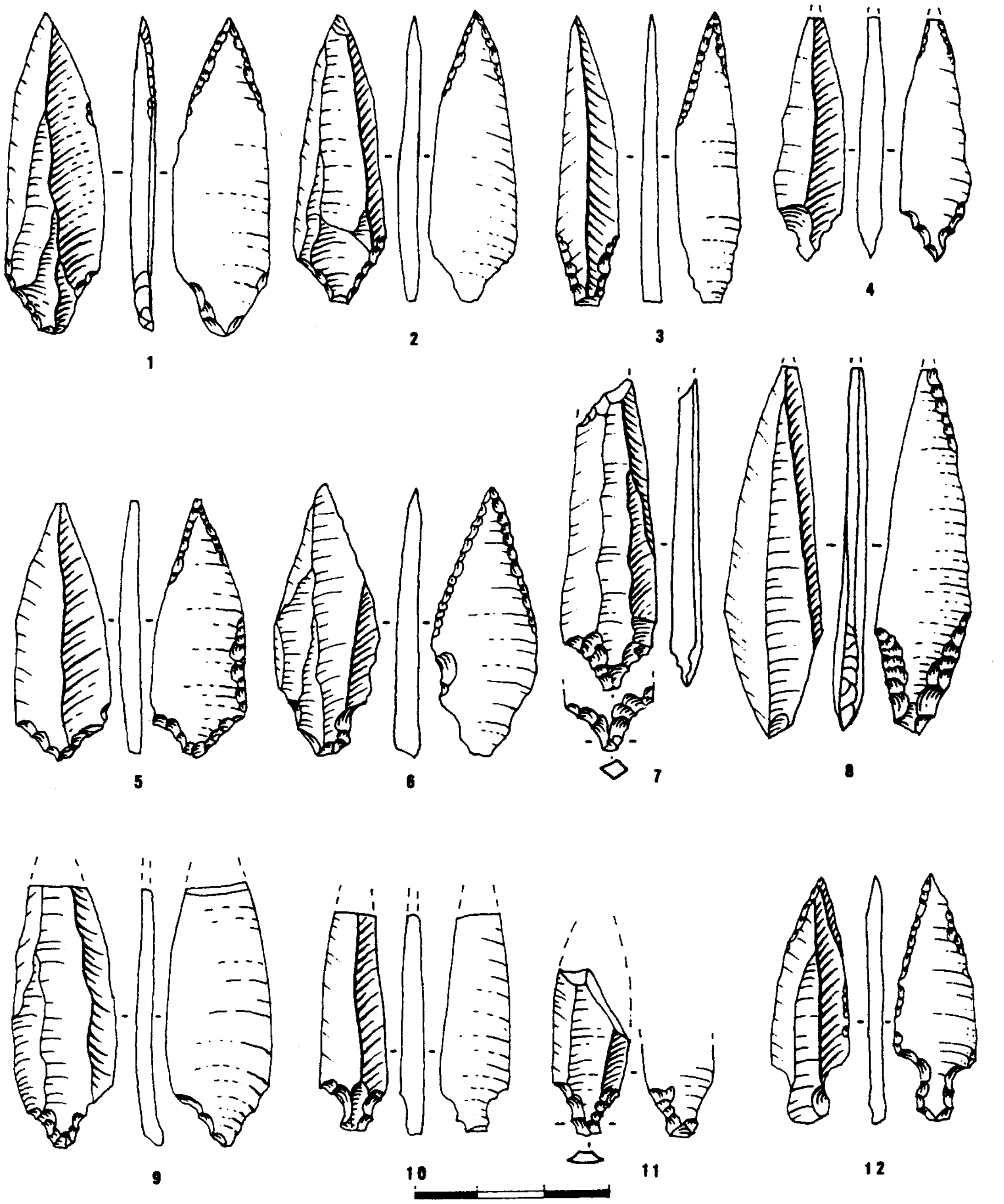

Fig. 2. Dja'de - Armatures de flèches.

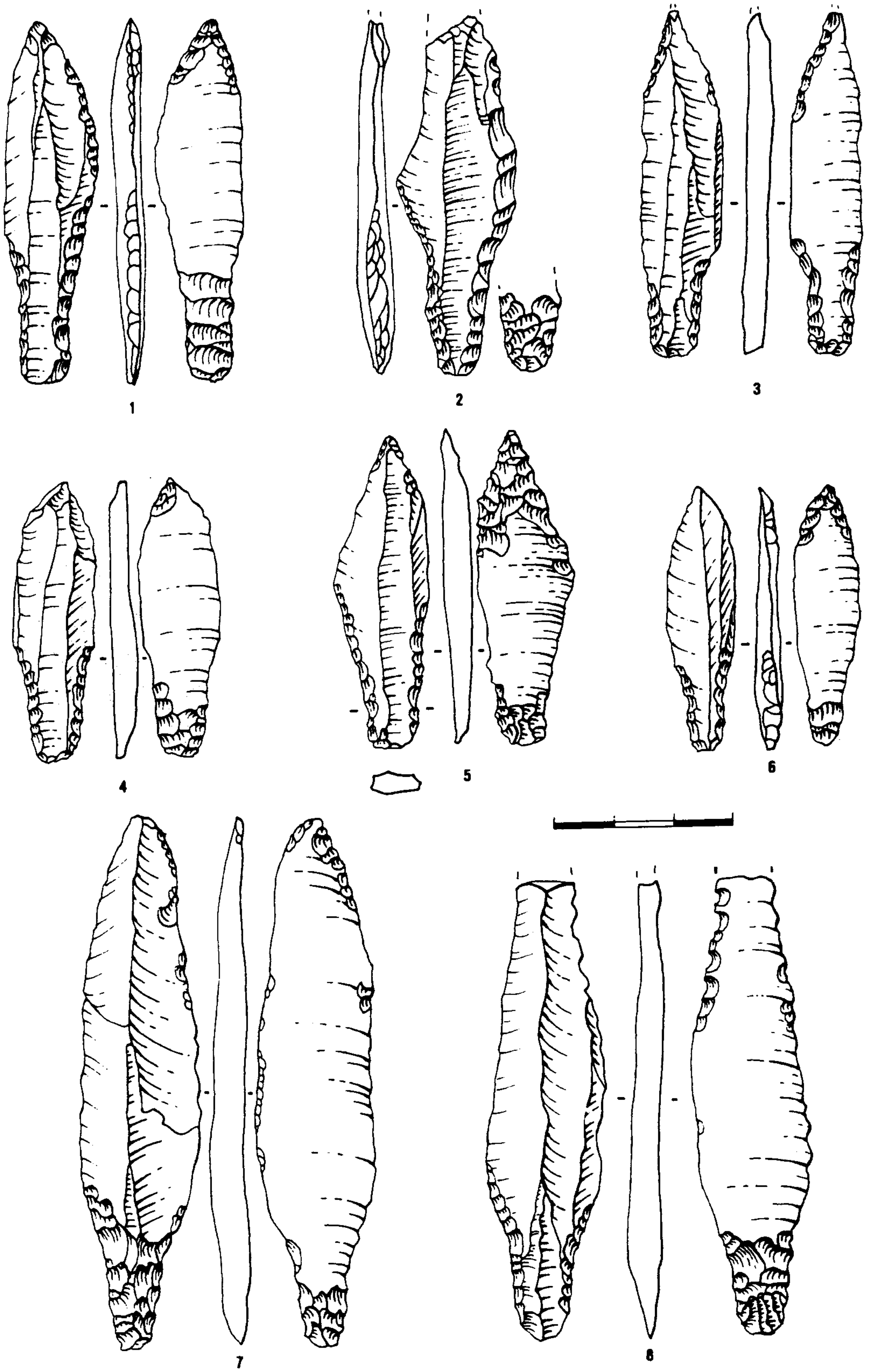

Fig. 3. Dja'de - Armatures de flèches cassées ou à reprise distale sommaire.

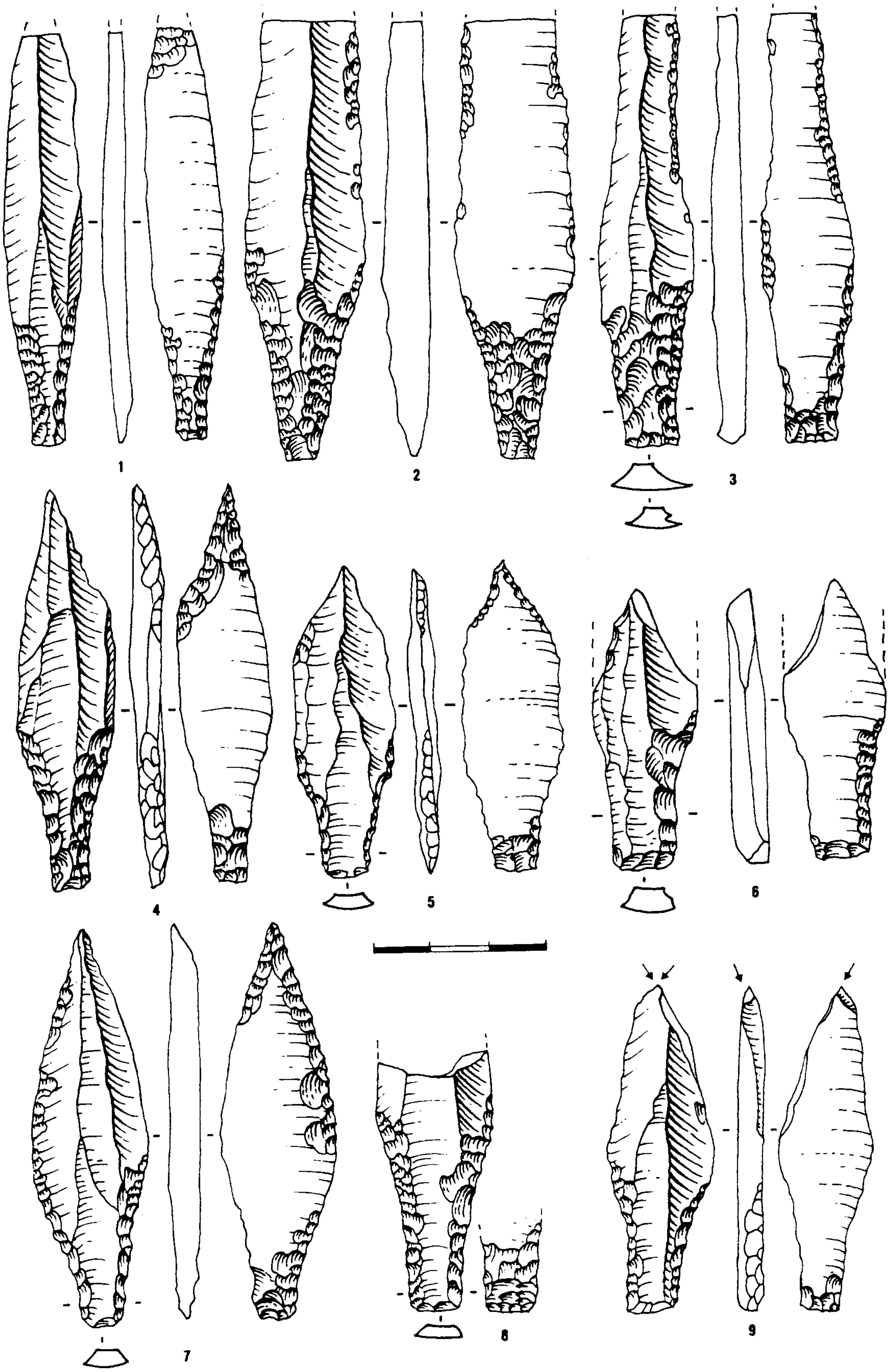

Fig. 4. Dja'de - Armatures de flèches (1,4-5,7,9) et lames pédonculées (2-3,6,8).

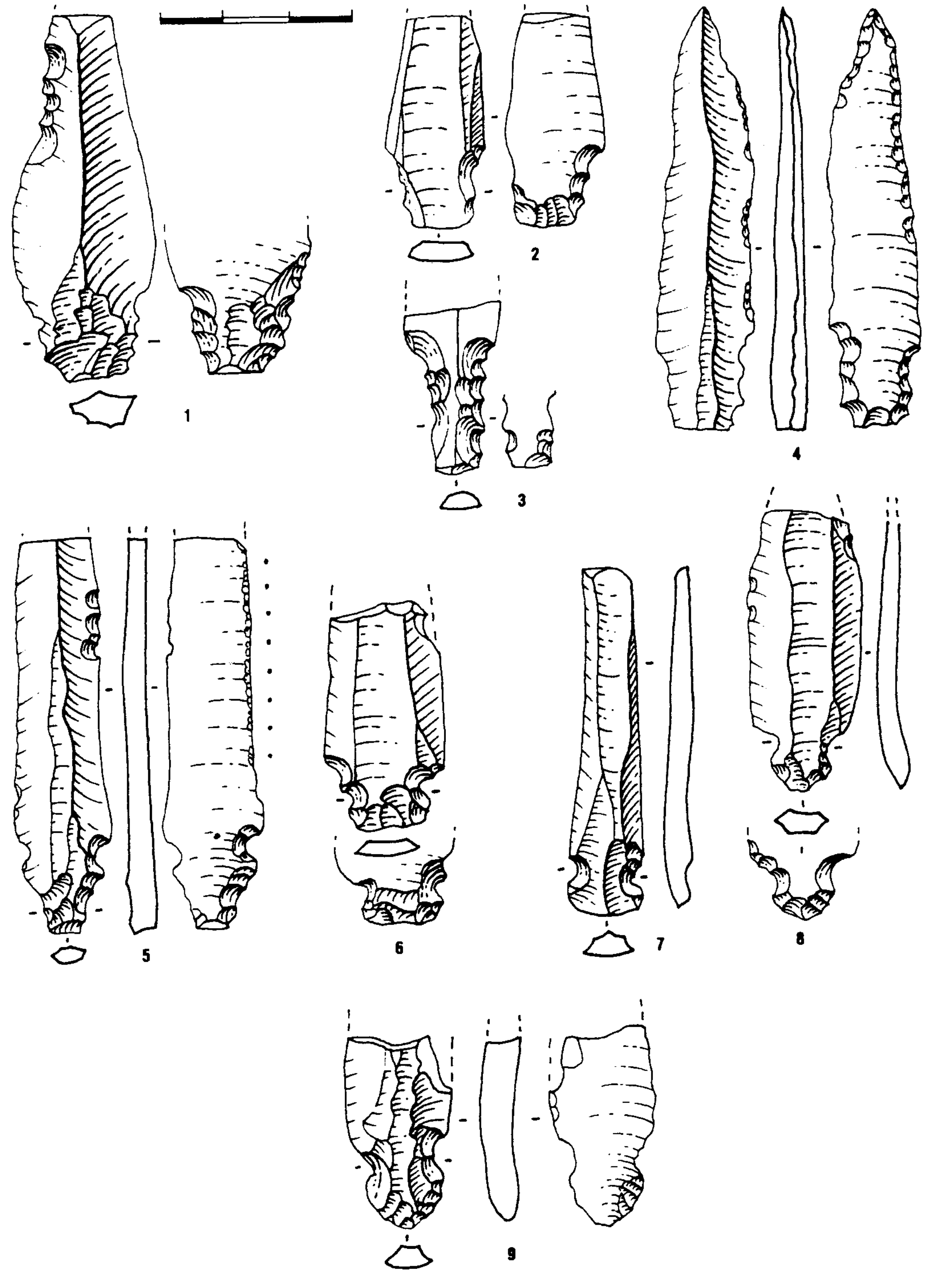

Fig. 5. Dja'de - Armatures de flèches (et/ou lames pédonculées) à pédoncule denticulé (1-4) ou présentant un rétrécissement (5-9).

très réduit associé à une importante abrasion préliminaire du front du nucléus[1]. A côté des nucléus naviformes il faut noter la présence de nombreux nucléus à débitage unidirectionnel (nucléus à un plan de frappe préférentiel) ou multidirectionnel (nucléus discoïdes, bipolaires et globuleux) ayant fourni des éclats de dimensions variables et utilisés soit tel quel, soit pour façonner des outils peu élaborés. Au stade d'abandon où ces pièces ont été retrouvées, les nucléus à éclats dominent largement sur ceux à lames, cependant un premier échantillon de 9165 produits de débitage (associé à 22 nucléus) se décompose en 1942 produits laminaires (dont 754 lames entières et fragments proximaux de lames), 1831 éclats et fragments d'éclats (dont 1041 comportant le talon), 2057 esquilles, 1415 débris et 1920 débris thermiques. Il apparaît que la proportion de produits laminaires est anormalement élevée[2] ce qui semble indiquer soit que (à la différence du débitage domestique d'éclats) le débitage laminaire était effectué (en totalité ou en partie) hors du secteur concerné par les niveaux d'occupation et les aires de vidanges étudiés, soit une sous représentation des nucléus à lames à la suite de leur reprise pour débiter des éclats.

Les lamelles d'obsidienne semblent avoir été débitées par pression (fig. 1:5-8).

Les armes et outils en silex

La campagne 1992 a fourni 896 artefacts retouchés en silex. Du fait de son statut particulier, l'obsidienne a été envisagée séparément.

Armatures de flèches

Les armatures de flèches constituent un des éléments les plus caractéristiques des industries lithiques du Néolithique acéramique pour lequel elles constituent d'excellents marqueurs chronologiques et régionaux. A Dja'de elles sont au nombre de 41 (4,5% de l'outillage) mais cet effectif constitue un minimum car dans le doute les pièces pédonculées cassées ont été classés avec les lames pédonculées bien que beaucoup semblent être des fragments proximaux d'armatures. La plupart de ces armatures sont des pointes à pédoncule bien marqué (30 exemplaires), un type plus rare étant constitué par des pointes ovalaires à base éventuellement équarrie ou tronquée. Parmi toutes ces armatures des sous-types se distinguent suivant notamment :

* la nature de leur base[3], selon qu'elle est arrondie, équarrie, rectiligne dépourvue de retouches d'équarrissage, appointée ou en tige acérée,
* le mode de retouche de la partie proximale,
* le mode de passage entre cette partie proximale et le corps de la flèche (passage continu ou marqué par une rupture...),
* le mode de façonnage de la pointe.

Parmi les flèches pédonculées, les pédoncules équarris et arrondis ont une largeur voisine (*cf.* tableau 2) et les deux types de préparations ont abouti, à des degrés divers, à un amincissement du pédoncule certainement en liaison avec son insertion dans la flèche (alors que le corps des flèches a une épaisseur moyenne de 5 mm, cette épaisseur est voisine de 3,2 mm pour les pédoncules arrondis et de 2,4 mm pour les équarris, *cf.* tableau 2). Lorsque le support initial le permettait la pointe pouvait être dépourvue de toute retouche (22% des armatures de flèches ont une extrémité distale brute), la pointe est cependant généralement acérée par une retouche inverse courte (58% des flèches présentent une telle retouche). Il faut noter que la majorité de ces armatures sont soit cassées, soit fortement déformées par des reprises distales sommaires (fig. 3) probablement effectuées à la suite d'accidents au cours de l'utilisation, ces armatures ayant dû ensuite être remplacées par des pièces "neuves" lors du retour au

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1 A Mureybet cette abrasion du front des nucléus existe pour l'obsidienne dès la phase III mais elle n'est pratiquée pour le silex qu'à la phase IV_A (Abbès, communication personnelle).

2 Les éclats sont non seulement le produit du débitage des nucléus à éclats mais ils résultent aussi de la préparation et de la réfection des nucléus à lame.

3 CAUVIN M.-C. 1974: 60-61, ces critères présentent notamment l'intérêt de pouvoir être utilisés aussi pour les lames pédonculées (cassées ou non).

camp de base que constituait le village de Dja'de (ceci expliquerait l'abondance des pédoncules cassés, ramenés au site encore fixés dans la hampe, *cf. infra* la question des lames pédonculées).

Certains types sont rares mais importants du fait même de leur présence, il s'agit d'une part des flèches à pédoncule court (fig. 2:12) très voisines de celles reconnues à Mureybet III et d'autre part des flèches à pédoncule denticulé (fig. 5:1-4) caractéristiques de Mureybet IV_A. Par contre il faut signaler l'absence des retouches en écharpes apparues à Mureybet IV_B.

Lames pédonculées

Les lames pédonculées sont nombreuses (163 pièces soit plus de 17% de l'outillage) et elles ont été analysées suivant les mêmes critères que les flèches (hormis évidemment le mode de façonnage de la pointe).

Pour les flèches comme pour les lames pédonculées, les pédoncules équarris dominent largement (44% des flèches et 50% des lames pédonculées), suivis par les pédoncules arrondis (25 et 29%), par contre les formes droites (à base non retouchée) sont beaucoup plus rares parmi les lames pédonculées que parmi les flèches (8% contre 22%), les pédoncules appointés (3,1 et 2,7%) et tige (6 et 9%) étant rares dans les deux cas. Sur le plan des dimensions les tableaux 1 et 2 indiquent que les mesures sont voisines en ce qui concerne aussi bien le support initial que le pédoncule, hormis dans le cas des pédoncules équarris. La lecture du tableau 3 indique que l'orientation de la retouche du pédoncule est elle aussi très similaire entre les deux séries. La similarité des caractères observés sur les armatures de flèches et sur les lames pédonculées confirme l'existence de liens entre ces deux classes et suggère qu'une partie au moins de ces dernières est constituée par des armatures soit cassées, soit inachevées, même si un certain nombre d'autres ont pu être utilisées à d'autres fins.

Lames lustrées

Les lames lustrées sont relativement nombreuses à Dja'de (72 pièces soit 8% de l'outillage) et l'étude tracéologique en cours[1] permettra de montrer s'il s'agit d'éléments de faucilles ayant servi à récolter des céréales, de lames utilisées pour la coupe d'autres végétaux tendres (fourrage, litières, pisé...) ou même d'outils ayant servi à d'autres fonctions. Typologiquement il s'agit le plus souvent de tronçons de lames (50% des cas) ou associant une cassure à une extrémité naturelle (31%) tandis que la présence d'une ou deux troncatures (7%) semble aussi exceptionnelle que celle d'un pédoncule (5%, fig. 6:4) ou que l'emploi de lames entières (4%, fig. 6:1). Le tranchant lustré peut être brut (33%) mais il est généralement repris[2] avec des retouches denticulantes (60% des cas avec notamment 3 pièces à fines dents régulièrement espacées) ou plus rarement avec des retouches simples (7%), une légère préférence étant marquée pour les retouches directes par rapport aux retouches inverses (27 cas contre 19). Les lames à deux tranchants lustrés (lames ayant été utilisées sur un bord puis sur l'autre, il s'agit donc de faucilles *doubles*, fig. 6:2-3) sont rares (7%) et le type courant comporte un bord lustré opposé à un bord brut (82%) ou parfois à un dos continu (10%, fig. 6:6) ou partiel (1%). Quelques pièces présentent des traces de bitume (?) parallèles au bord lustré et la plupart sont courtes ce qui confirme leur utilisation comme éléments d'un tranchant composite; toutefois, la présence de quelques pièces très grandes ne permet pas d'exclure un emmanchement comportant une lame unique (une lame entière lustrée à tranchant réaffûté et base aménagée [fig. 6:1] mesure 143 x 18 x 6 mm !).

Burins et lames à chanfrein

Les burins sont peu nombreux (31 pièces soit 3,5% de l'outillage) mais présents dans tous les niveaux fouillés avec semble-t-il toutefois une raréfaction dans les niveaux inférieurs. Ils sont généralement façonnés sur des lames de silex fin; les burins d'angle sur cassure sont les plus nombreux (fig. 7:1), suivis par les burins transverses sur bord brut ou retouché et par les burins dièdres d'axe ou d'angle (fig. 7:2-3). Dans les niveaux supérieurs la technique du coup de burin est en outre attestée par la présence de plusieurs *lames à chanfrein* (outils spécifiques ?). Plusieurs armatures de flèches

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[1] Analyse fonctionnelle en cours par P.Anderson, en liaison avec l'étude des graines et des restes végétaux par G. Willcox et V. Roitel.

[2] L'étude tracéologique montrera si —comme il le semble— ces retouches du tranchant sont des retouches de rafraîchissement.

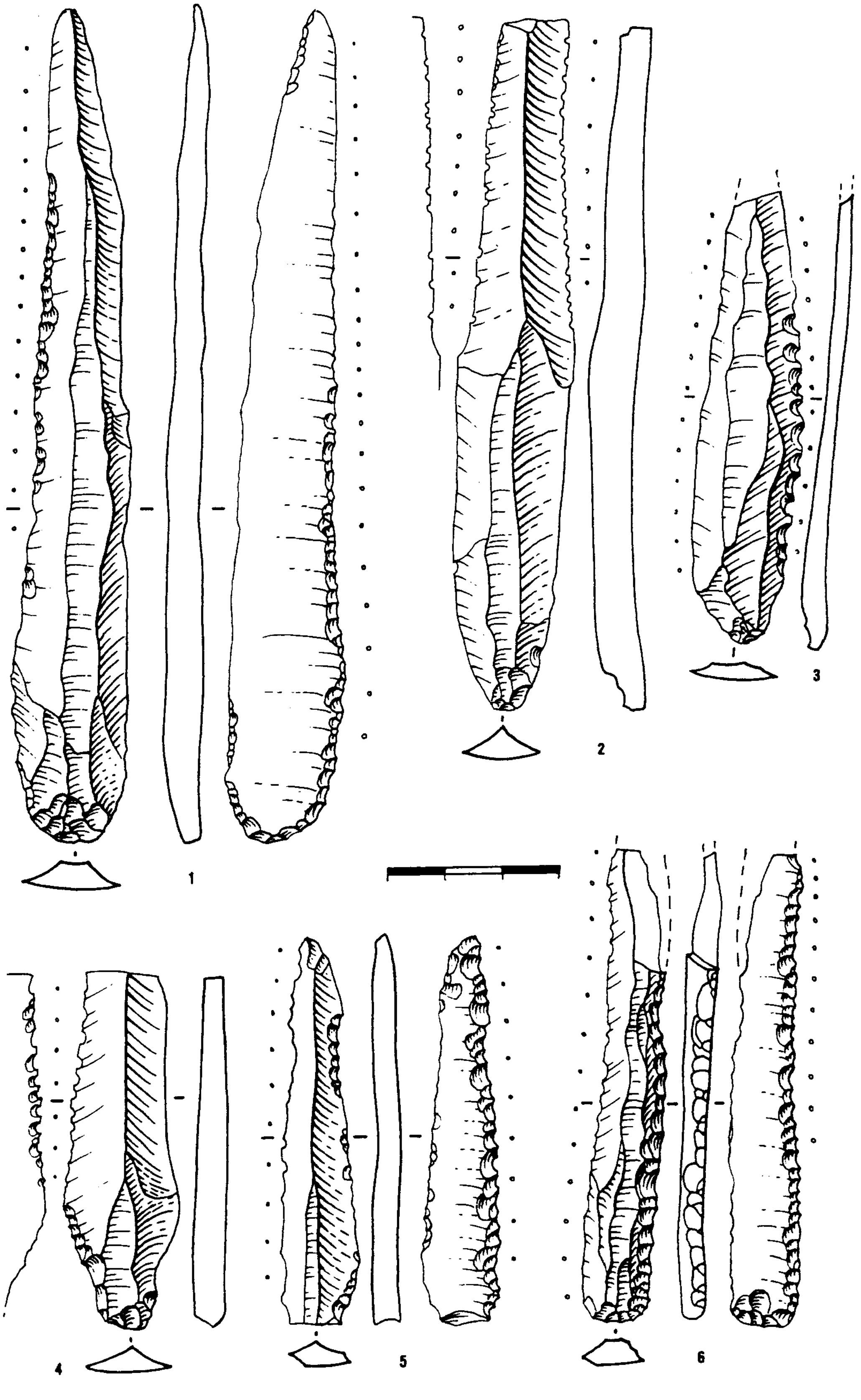

Fig. 6. Dja'de - Lames lustrées.

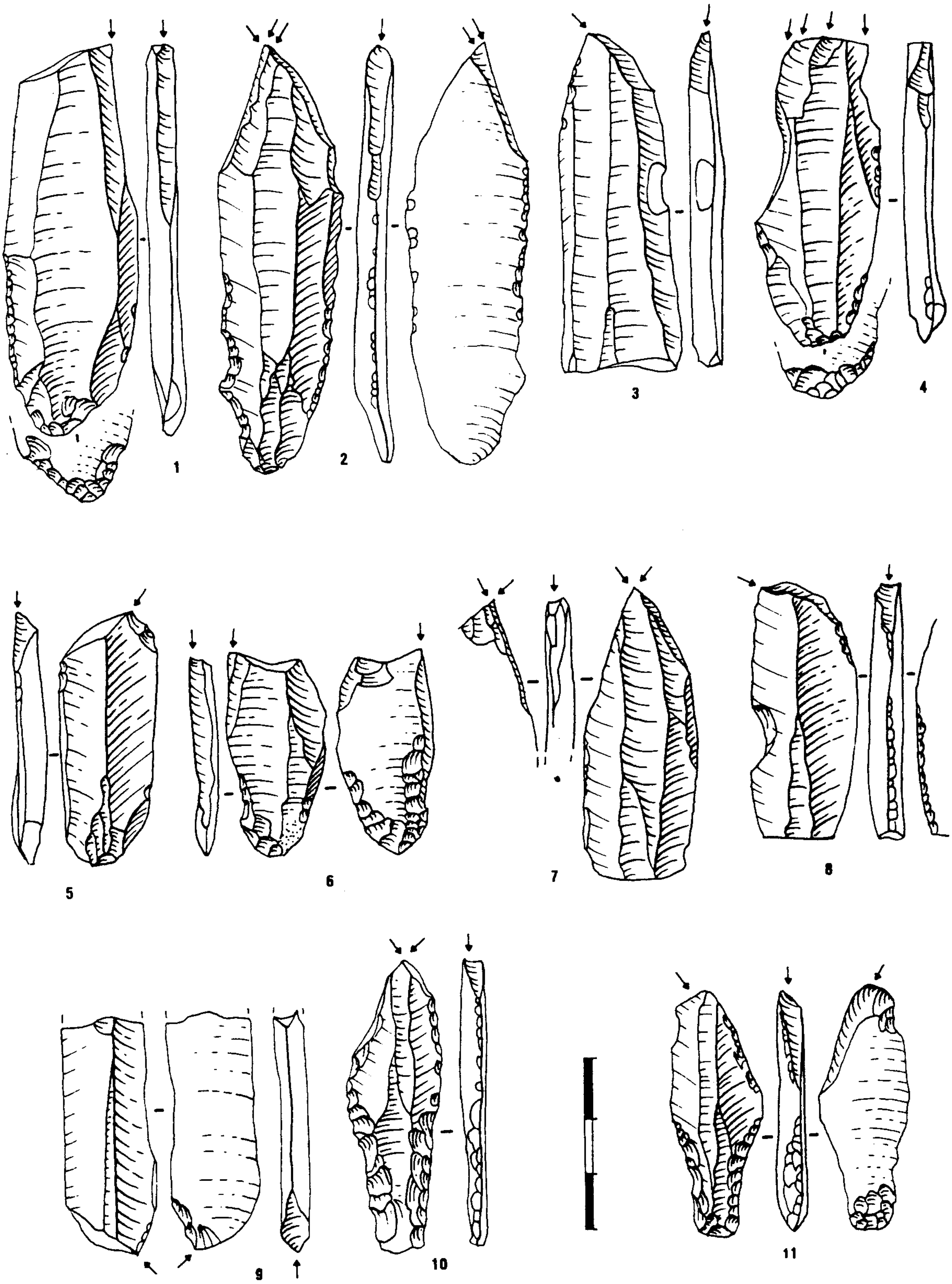

Fig. 7. Dja'de - Burins et pièces présentant des enlèvement «en coup de burin ».

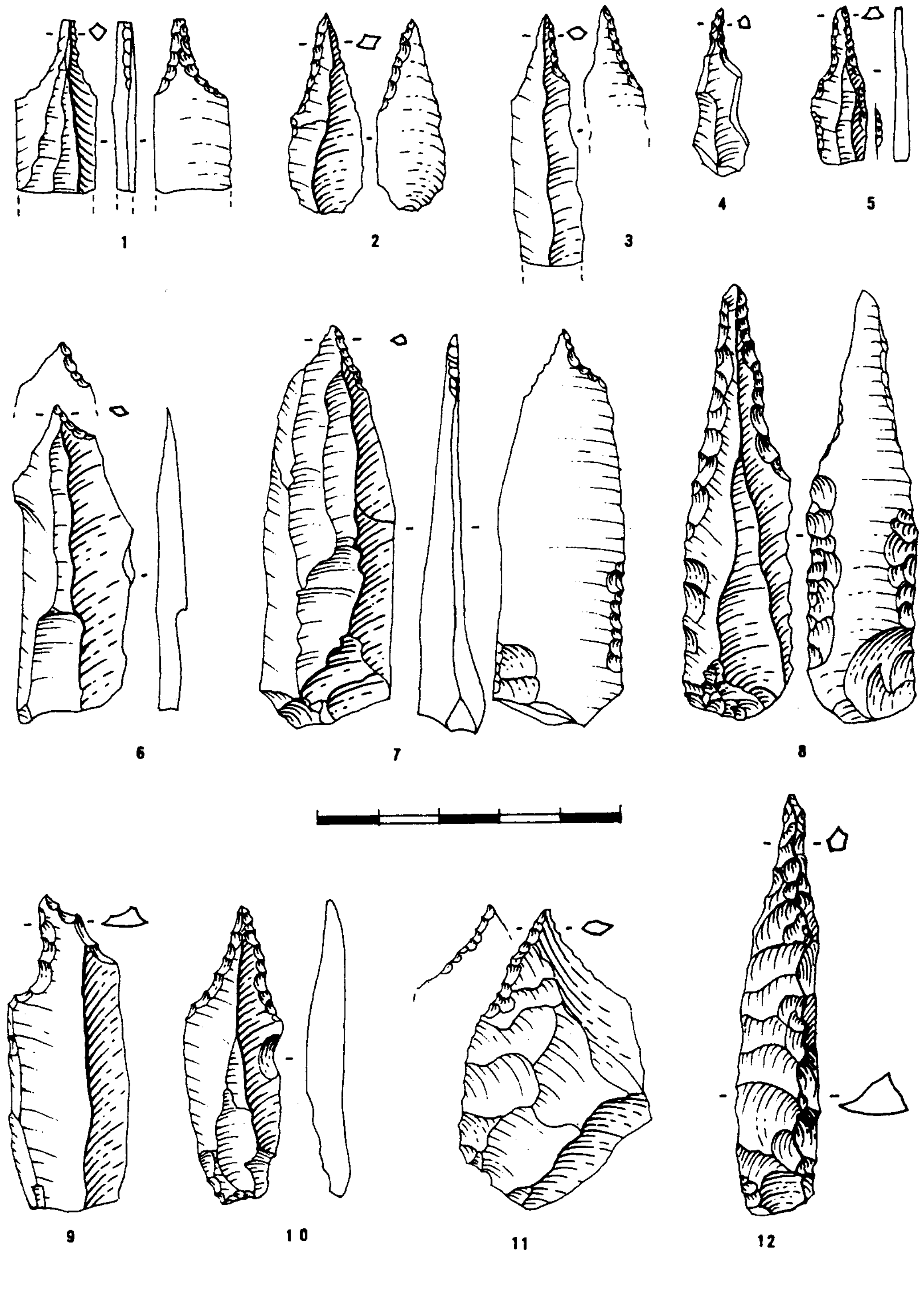

Fig. 8. Dja'de - Outils perçants.

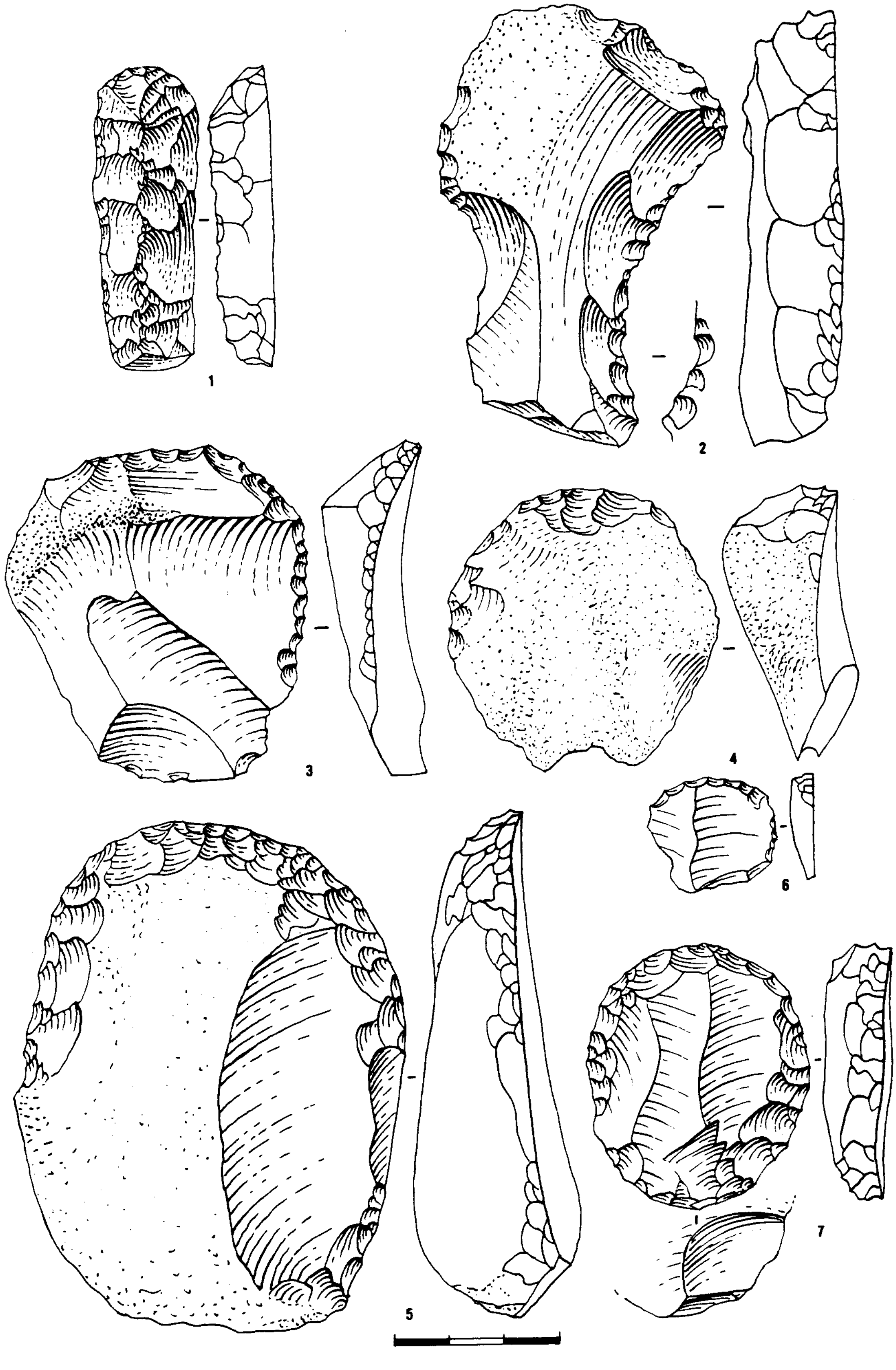

Fig. 9. Dja'de - Grattoirs.

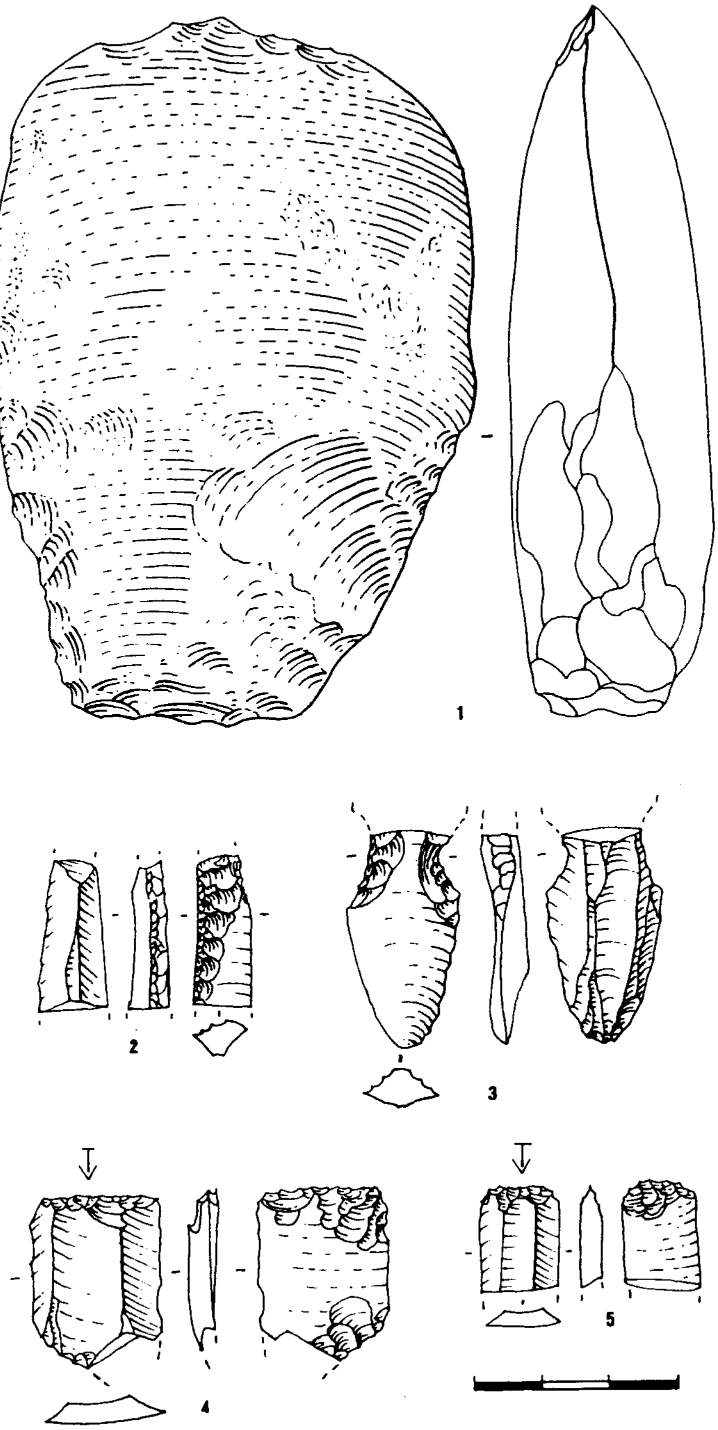

Fig. 10. Dja'de - Hache polie (1), outils en obsidienne (2-5).

présentent des enlèvements distaux en coup de burin qu'il s'agisse d'un mode volontaire d'appointage (ou de réaffûtage sommaire) ou plus probablement de fractures consécutives au choc de la flèche sur un corps dur (TIXIER 1966; MOSS 1983) (fig. 4:9, 7:10-11).

Grattoirs

Les grattoirs sont nombreux (121 pièces soit 13,5% de l'outillage) et ils n'ont pas fait l'objet d'un choix préférentiel quant au support (lames à crête, lames diverses, éclats primaires ou non...). Ils sont de types et de modules très variés avec cependant une préférence pour les grattoirs simples sur éclat. Il faut signaler un grattoir pédonculé lourd qui n'est pas sans évoquer certaines herminettes de Mureybet (fig. 9:2). Sur le plan de l'évolution, les grattoirs lourds et massifs (certains atteignent 9 x 7 x 3 cm) semblent caractéristiques des seuls niveaux supérieurs.

Outils perçants

A l'exclusion des armatures de flèches qui sont des armes, nous avons regroupé dans cette catégorie les outils dont la partie façonnée est une pointe retouchée (perçoirs, mèches et pointes, fig. 8). Assez nombreux (82 pièces soit 9% de la série), ces outils ont principalement été taillés sur des lames (plus de 85% des cas) de silex fin (70% des cas) mais des lames à crête (fig. 8:12) et des éclats (fig. 8:11) ont éventuellement été employés. Les *pointes* (dont "la retouche respecte le support sans en modifier le contour"; CAUVIN M.-C. 1978: 63) sont aussi nombreuses que les *perçoirs* parmi lesquels les pièces déjetées sont plus rares que les axiales; les mèches sont représentées par une seule pièce. La retouche des outils perçants est généralement bilatérale inverse (plus de 50% des cas) ou alterne (30% des cas), mais il faut signaler trois cas de pointes à retouche bilatérale biface (opposant une retouche abrupte à une retouche simple) et trois cas de pointes dégagées par une retouche unilatérale (opposé à un bord brut). Les modules des outils perçants sont variés mais il faut noter l'absence de microperçoirs.

Pièces à encoches et pièces denticulées

Les *pièces à encoche* (46 outils soit 5% de la série) regroupent des lame et des éclats présentant une coche retouchée (à l'exclusion des encoches clactoniennes). Généralement la coche concerne le milieu d'un côté et elle est directe. Six pièces présentent deux coches opposées formant un étranglement.

Les *pièces denticulées* (95 outils soit plus de 10% de la série) regroupent des lames à fines denticulations régulières (21 pièces) et des pièces à dents plus larges et plus irrégulières (74 pièces). Dans les deux cas la retouche est généralement directe et concerne la totalité du bord concerné (le bord gauche est plus fréquemment denticulé que le bord droit). Si les grosses dents sont adjacentes les unes aux autres par contre les micro-denticulations sont généralement largement mais très régulièrement espacées et elles sont présentes sur des outils qui présentent en outre soit du lustre soit un pédoncule.

Lames et éclats retouchés

Ils s'agit des pièces atypiques présentant des retouches autres que des coches ou des denticulations, ces retouches caractérisant soit la zone active soit la zone de préhension.

Les *lames retouchées* (106 pièces soit 12% de la série) présentent généralement une retouche directe (55% des cas), plus rarement inverse (37%) et exceptionnellement alterne (7%) ou biface (un seul cas). Cette retouche est en général simple (31%) ou marginale (32%), moins fréquemment abrupte (19%) ou irrégulière (10%) et il faut noter 7 cas de retouche plate peu envahissante; elle est peu souvent bilatérale (22%) et concerne préférentiellement le bord gauche (42 cas contre 29 pour le droit) et la partie proximale de la lame (43 cas contre 13 pour la partie mésiale et 14 pour la section distale).
Les *éclats retouchés* (91 pièces soit 10% de la série) présentent de même une retouche généralement directe (64 des cas contre 30 % d'inverses). La retouche est plus souvent irrégulière (42% des cas) que simple (27%), abrupte (24%) ou marginale (3%), les retouches plates (2 cas) et envahissantes (un cas) étant quant à elles exceptionnelles; elle est rarement bilatérale (14% des cas) et concerne la totalité du bord (54%) ou sa partie proximale (29% contre 6% pour la partie mésiale et 11% pour la partie distale)

mais sans choix préférentiel d'un bord. Il apparaît donc que les éclats retouchés sont moins standardisés que les lames.

Il faut signaler la présence de 7 *lames* légères à extrémité *esquillées* alors qu'il n'y a aucun éclat esquillé. L'étude tracéologique en cours permettra de savoir s'il s'agit d'outils (au sens typologique du terme) ou de simples lames utilisées (*outils a posteriori*).

La question de l'obsidienne

En l'absence de nucléus, le débitage de l'obsidienne ne semble pas avoir été pratiqué sur place et elle a du être importée sous forme de supports bruts qu'il s'agisse de lamelles débitées par pression (fig. 1:5-8) ou d'éclats de petite taille. Ces artefacts ont pour la plupart été utilisés tel quel (*outils a posteriori*) et les pièces retouchées sont rares (4 pièces). En nombre absolu les pièces d'obsidienne recueillies sont assez nombreuses (65 lors de la campagne 1992) mais leur proportion par rapport au silex est difficile à exprimer (CAUVIN M.-C. 1991: 167) car le statut de l'obsidienne n'est pas le même que celui du silex, les effectifs bruts sont surévalués (en raison de la fragilité du matériau et de la minceur des pièces les artefacts d'obsidienne sont plus fragmentées que ceux de silex) et cette série comporte aussi bien des produits entiers que des tronçons de lamelles, des esquilles et des débris de très petites dimensions. Il semble donc difficile de comparer l'effectif des artefacts d'obsidienne aussi bien aux seuls outils de silex (896 pièces) qu'à l'ensemble des produits bruts (9165) ou même aux seuls éclats et lames (3773 artefacts).

Les pièces retouchées sont toutes fragmentaires, il s'agit d'une lamelle et d'une lame à une extrémité esquillée (selon le modèle signalé en silex, *cf. supra*), une lame présentant un étranglement constitué par deux coches à retouches inverses et un fragment de lame à retouches inverses bilatérales obtenues par pression (fig. 10:2-5).

Outillage en roches dures

Les outils de pierre polie sont exceptionnels et nous ne pouvons mentionner qu'une hache (fig. 10:1) en roche grenue verte trouvée en 1991 dans un niveau profond et un ciseau très peu élaboré façonné sur un galet plat allongé.

Conclusion

Bien qu'abondant dans l'environnement du site, le silex à gros grain (galets transportés par l'Euphrate) a été peu utilisé, au profit d'un silex à structure plus fine probablement extrait de gîtes primaires plus éloignés. Le matériel lithique recueilli témoigne de choix préférentiels de la matière première et de la technique de débitage en fonction des artefacts désirés, avec notamment un débitage de nucléus naviformes orienté vers la production de lames pointues à profil très rectiligne destinées au façonnage d'armatures de flèches. Ces pointes de projectiles comportent de nombreuses *pointes de Byblos* (présence de pédoncules denticulés, abondance des pédoncules larges et équarris) ainsi que des pointes ovalaires et des pointes à pédoncule court qui évoquent des types rencontrés à Mureybet III. Les burins sont présents mais peu nombreux; les lames lustrées sont éventuellement très longues et à tranchant finement denticulé.

A la fois homogène et variée, cette industrie présente des indices qui permettent d'espérer que Dja'de contient non seulement des niveaux du début du *P.P.N.B.* ancien (similitudes avec Mureybet IVA et à un moindre degré avec Abu Hureyra Néolithique ancien dont le matériel est plus évolué; MOORE *et al.*), mais aussi de la transition *P.P.N.A.-P.P.N.B.*, transition connue en Syrie du nord uniquement à Mureybet. Les campagnes à venir devraient permettre d'une part de tester cette hypothèse et d'autre part de mieux connaître toutes les étapes de la chaîne opératoire concernant le débitage du silex. Le mode d'exploitation de l'environnement (archéozoologie et archéobotanique) et les datations

^{14}C obtenues[1] confirment l'ancienneté du *P.P.N.B.* de Dja'de. L'abondance des pointes de flèche et la composition de la faune indiquent que l'économie des habitants du village néolithique de Dja'de était principalement centrée sur la chasse des animaux sauvages. Les lames lustrées et l'étude des graines brûlées attestent l'exploitation de l'environnement végétal dans une phase (immédiatement) antérieure à la domestication des céréales.

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[1] Pour la campagne 1991 cinq dates ^{14}C ont été obtenues: Ly-5821 : 9610 ± 170 BP, Ly-5820 : 9540 ± 290 BP, Ly-5822 : 9160 ± 75 BP, Ly-5823 : 9140 ± 390 BP, UtC-2369 : 9200 ± 100 BP.

Khabur Basin PPN and Early PN Industries

Frank Hole

The Khabur Basin lies in northern Mesopotamia geographically surrounded by four major techno-regions, the Levant, the middle-upper Euphrates, the Taurus/Zagros flanks and the Central Zagros.[1] (CAUVIN J. 1989; KOZLOWSKI n.d.; ROLLEFSON 1989; ROSENBERG and DAVIS 1992). At some distance from the apparent heartlands of each, the Khabur may be expected to display either mixtures or attenuated versions of these traditions but, without considerably more excavation and analysis, it will be difficult to specify relations confidently. Indeed, in this geographically open region, there have probably only rarely been sharply drawn boundaries. At this time few sites have been excavated and, although surveys have revealed only limited material, the neighboring and better investigated Balikh and Iraqi Jezireh provide illuminating comparisons. On the basis of admitted deficiencies in primary data from the Khabur itself, but building on the perceptive insights of others, (CAUVIN J. 1989; ROLLEFSON 1989; ROSENBERG and DAVIS 1992; CAUVIN J. 1988; GOPHER 1989; AKKERMANS 1990) I shall sketch an outline of a sequence, followed by brief descriptions of the sites and illustrations of the lithics.

Epi-Paleolithic

In order to understand the PPN, one should consider first the status of the Epipaleolithic in this region. No sites have yet been excavated, and the general period is known only from surface finds in two locales. The first of these consists of some geometric microliths and other flints from two small caves above a spring named Khazné on the north side of the Jebel Abd-al Aziz, northwest of Hasseke (Fig. 1). These finds, made during survey in 1984 by Andrew Moore and Frank Hole, were the first of their period to be found in the Khabur region. (MOORE 1989: 624) At **Khazné II** we found a triangle and a lunate (Fig. 2:1,2), a possible tip fragment (Fig. 2:4) and possible tang fragment (Fig. 2:5), along with burins (Fig. 2:6,7), backed bladelets (Fig. 2:3), a perçoir (Fig. 2:8), and a bladelet core (Fig. 2: **1: 9). All of these occurred on the talus outside the shelter, and we were unable to find deposits suitable for excavation.

The second locale is around the modern brackish spring, **Ain Mrer** where our surveys since 1988 have located a number of discrete clusters of lithics. Although these are entirely surface finds, they were particularly abundant at one locale, designated K-1 and K-7. The lithics from Khazné II and Ain Mrer are similar and probably roughly of the same age. The backed elements and the small, crude, bladelet cores with steeply angled platforms, point to the late Epipaleolithic stage.

Nevertheless, the question of the age of geometric microliths cannot be easily resolved, for one notes that backed elements identical to those from Ain Mrer occur in the lowest layers of Cafer Höyük (XIII-IX) along with Byblos-type points, sickles, abundant obsidian, and micro celts, implying that Ain Mrer could be well within the PPNB. (CAUVIN J. 1989) However the lack of obsidian and celts at Ain Mrer suggests an earlier date. The ambiguity in this instance reinforces the impression that the pace and

[1] I have adopted a broad regional view that expands on the picture developed for the Levant by Cauvin and Rollefson.

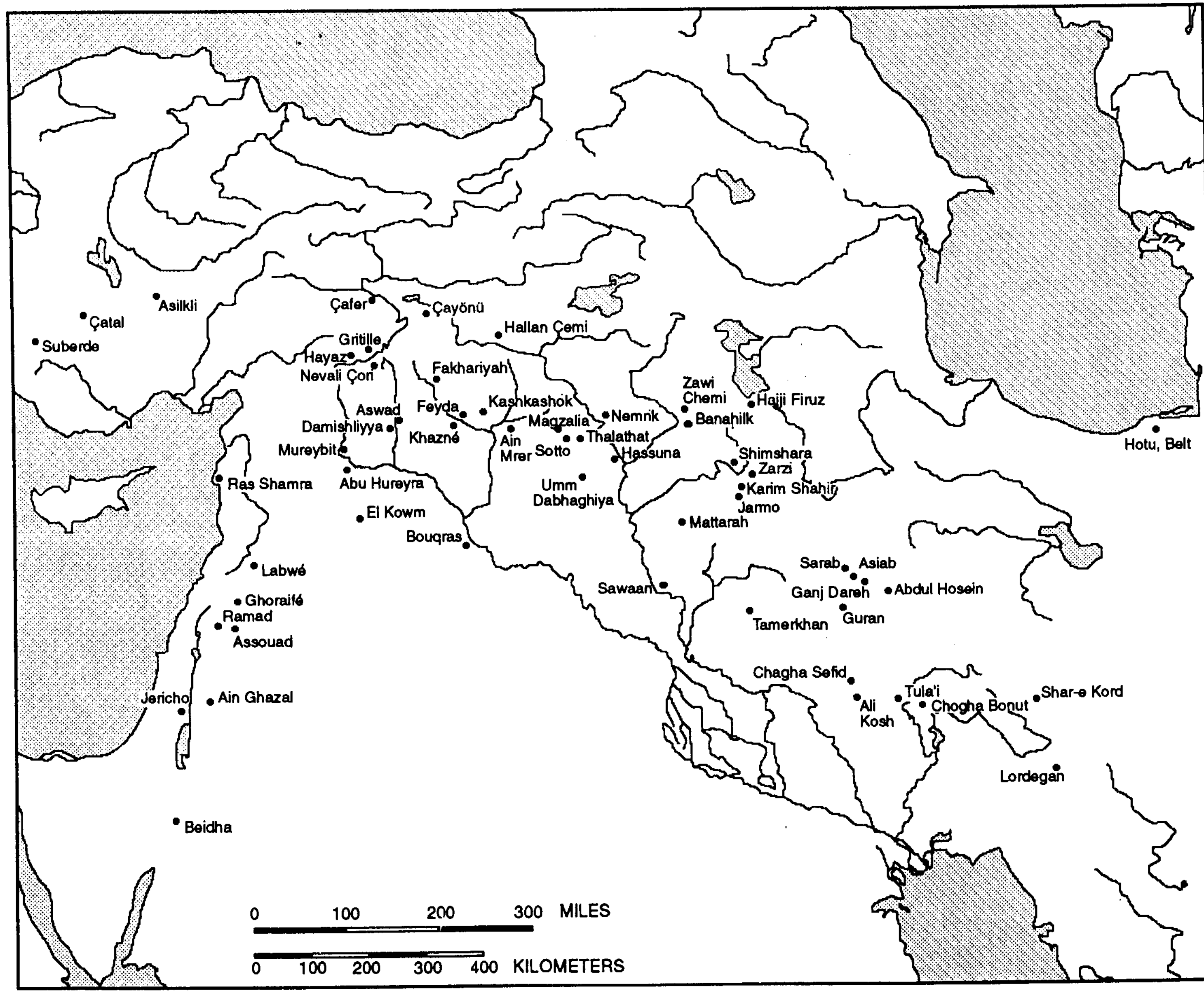

Fig. 1. Selected Pre-Pottery Neolithic (PPN) and early Ceramic Neolithic (PN) sites.

nature of change varied in the different regions of the Near East, in particular that the PPN arrived late and merged with (unspecified) indigenous cultures in the north. (CAUVIN J. 1989: 83)

Gopher (1989: Fig. 5) and Cauvin infer that the PPNB actually begins in the northern Levant, a region that might include the Khabur as well as the lower elevations of the southern Taurus. They infer that the lithic technology characteristic of the PPNB had antecedents in the north that it did not have in the south, but the antecedent cultures have yet to be identified. The question of an antecedent Epipaleolithic, perhaps derived from the Zarzian, has also been raised by Watkins *et al.* (WATKINS, BAIRD, and BETTS 1989: 23-24) for the Iraqi Jezireh, without resolution. As yet no transitional sequence has been described.

Outside the southern Levant the Epipaleolithic is rarely found, and then usually in association with caves or shelters, either because such sites do not exist or because they are buried or so ephemeral as to have gone unnoticed. Our sites and the presence of Epipaleolithic at both Mureybet and Abu Hureyra on the middle Euphrates clearly signal that the region was occupied, and imply the probability that we will find more such sites as surveys become more intense. Nevertheless, as Moore remarked, surveys north of Lake Assad have "failed to detect either Epipalaeolithic or early Neolithic occupation, in spite of ample evidence for such settlement in the segment from Meskene to Tabqa." (MOORE 1989: 624).

Pre-Pottery Neolithic

According to accepted chrono-typology, PPNA sites contain variants of El Khiam points, and the recent survey by Nadel *et al.* (NADEL, BAR-YOSEF, and GOPHER 1991) lists Mureybet Ib, Nemrik 9 and Qermez Dere as sites geographically bracketing the Khabur where these points occur. Since we have found no hint of these points, it is possible that the period is missing in the Khabur; however one should note that the region has yet to be surveyed either intensively or extensively and that points are relatively rare in Nemrik 9, but not in Qermez Dere. In short, we can make little of the apparent absence of implements that are diagnostic of PPNA. Moreover, Cauvin (1989: 176) maintains that these northeastern sites show more resemblance to the Zagros Epipaleolithic than to the Levant. Whatever the import of such limited similarities may be, we should note that no PPNA sites have been reported for the Balikh either, a neighboring region that has been surveyed by several teams whose members were well acquainted with PPNA diagnostics. (AKKERMANS 1989, 1990; COPELAND 1979, 1989) Thus, at least in the Balikh there is reason to believe that the PPNA (=Balikh I) is missing, despite its presence on the middle Euphrates. Cauvin (1988) makes the same point about Southeastern Turkey. We should note too that naviform cores are absent east of the Euphrates, although sites with PPNB Byblos points occur in all these regions. The presence of a large number of PPNB sites in the Balikh, dated to 7500-6000 uncal BC, was taken to indicate a long passage of time during which there was relatively little change in the lithic types. (AKKERMANS 1990: 111-115)

The site of Hallan Çemi on the upper Tigris may shed some light on the sequence. According to preliminary reports, there are no projectile points at all and no Çayönü tools, but there are backed blades, bladelets, and geometrics, all of which point more to the Proto-Neolithic of the Zagros than to the PPNA. This assessment is substantiated by a series of radiocarbon dates (ca. 10,000 BC) that put Hallan Çemi back as far as the late Natufian and close to Zawi Chemi.[1] On these grounds Hallan Çemi may turn out to be antecedent to Qermez Dere. (ROSENBERG and DAVIS 1992)

In the Khabur itself, the evidence for the PPN is sparse.

Khazné I, another small cave on the north side of the Jebel Abd al-Aziz in the Khabur has backed bladelets (Fig. 2:10, burins (Fig. 2:11), and a possible tang from a point (Fig. 2:12), as well as an obsidian blade/end scraper (Fig. 2:13). These finds suggest the PPNB.

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1 Unpublished radiocarbon dates kindly provided by Michael Rosenberg.

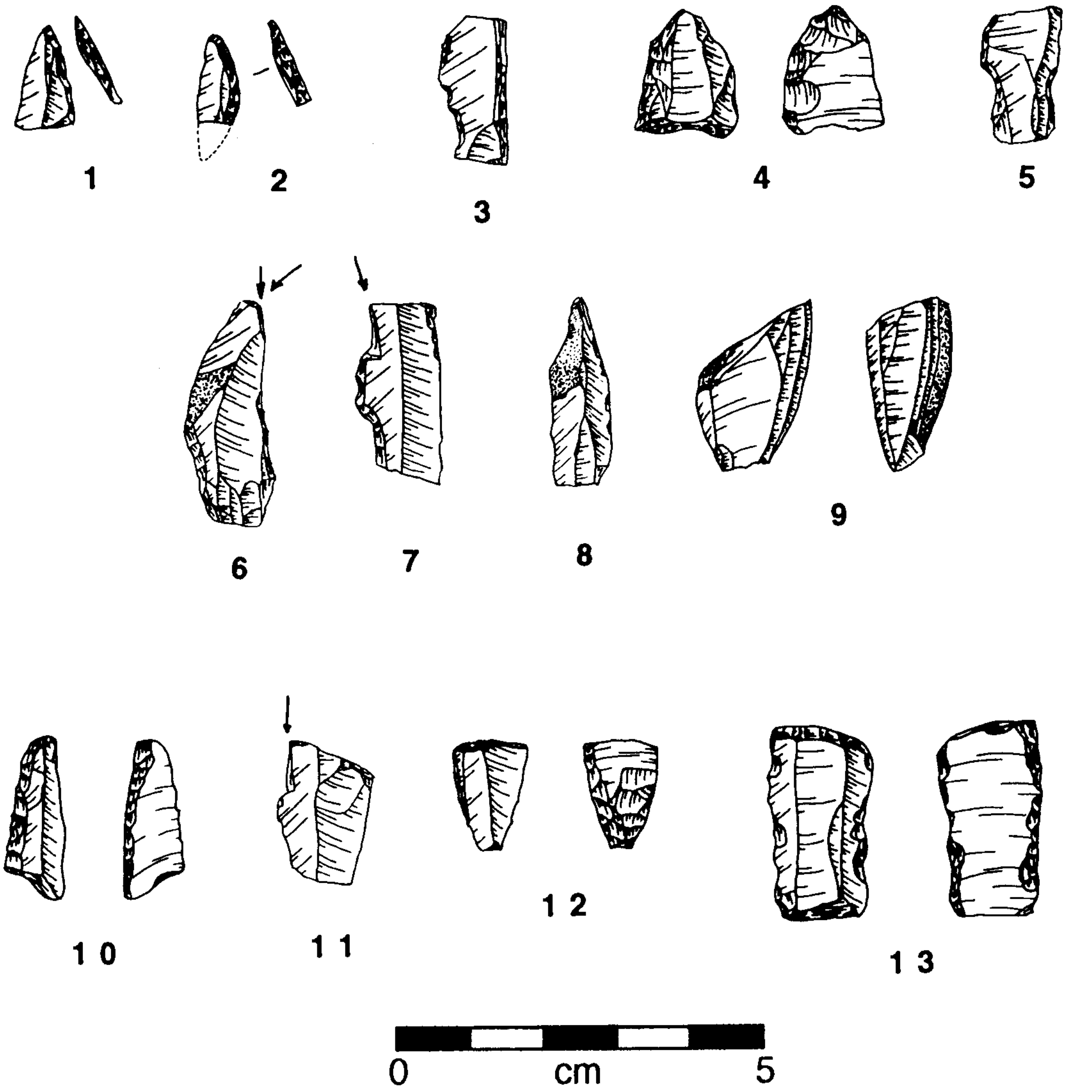

Fig. 2. Lithic artifacts from the Khazné caves on the north side of the Jebel Abd al Aziz *<These examples were traced from field drawings made by Andrew Moore during survey in 1984. The original lithics are in Damascus.>*.

Khazné I

1 Backced triangle on a bladelet
2 Backed lunate on a bladelet
3 Backed bladelet
4 Possible tip of an arrowhead
5 Possible tang of an arrowhead
6 Dihedral burin
7 Single blow burin on a break
8 Perçoir on a cortical blade
9 Bladelet core

Khazné II

10 Backed bladelet
11 Single blow burin on a break
12 Pressure flaked tang, retouched as end scraper
13 Obsidian end scraper on a blade

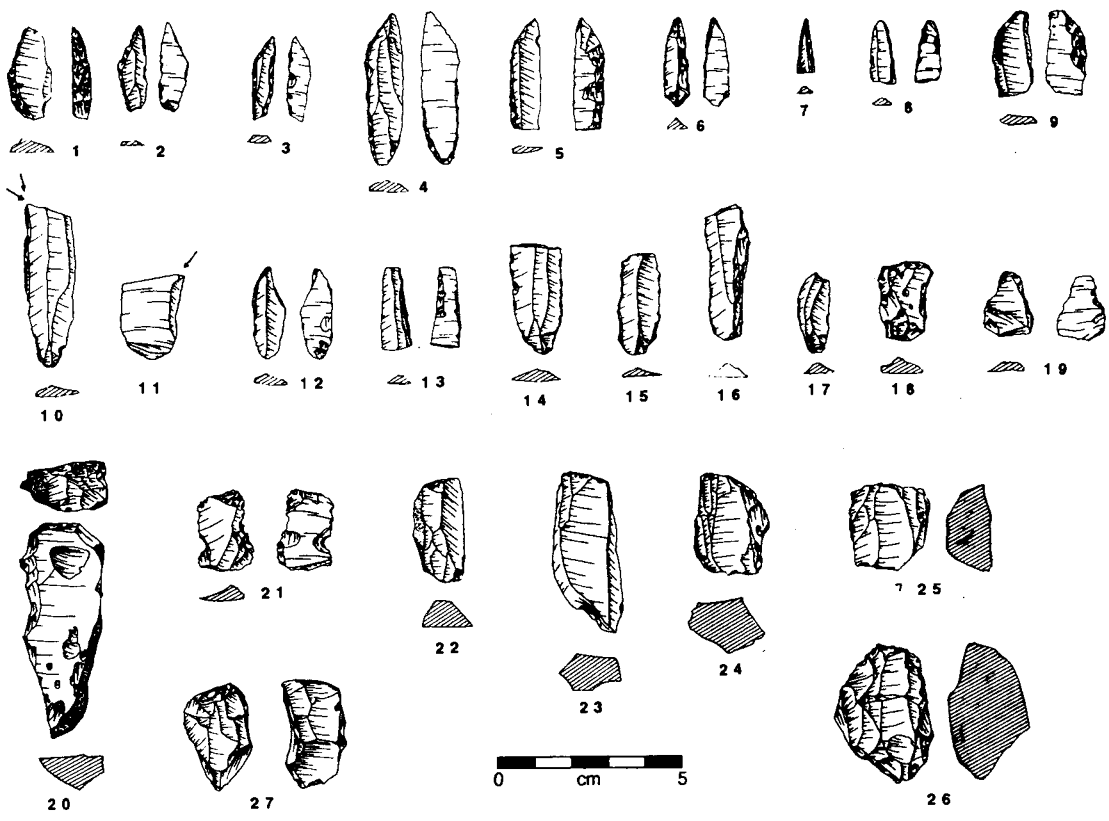

Fig. 3. Lithic artifacts from Ain Mrer K-1 and K-7 *<All from surface survey>*.

1 Backed crescent on a flake
2 Backed and diagonal-ended blade
3 Backed and diagonal-ended bladelet
4 Backed and diagonal-ended bladelet
5 Blade with squamous bulbar retouch
6 Perçoir on a bladelet
7 Perçoir on a bladelet
8 Perçoir on a blade
9 Blade fragment with squamous bulbar retouch
10 Dihedral burin
11 Burin on a break
12 Micro-burin
13 Blade with backing and bulbar retouch
14 Blade with edge nibbling
15 Blade with edge nibbling
16 Blade with edge nibbling (thick edge retains cortex)
17 Twisted bladelet
18 Crude end scraper
19 Flake with edge chipping
20 Steep end scraper with natural backing
21 Notched and used flake
22 Steep end scraper on thick cortex flake
23 Microblade core
24 Microblade core
25 Microblade core fragment
26 Crude blade core
27 Crude blade core in front and side views

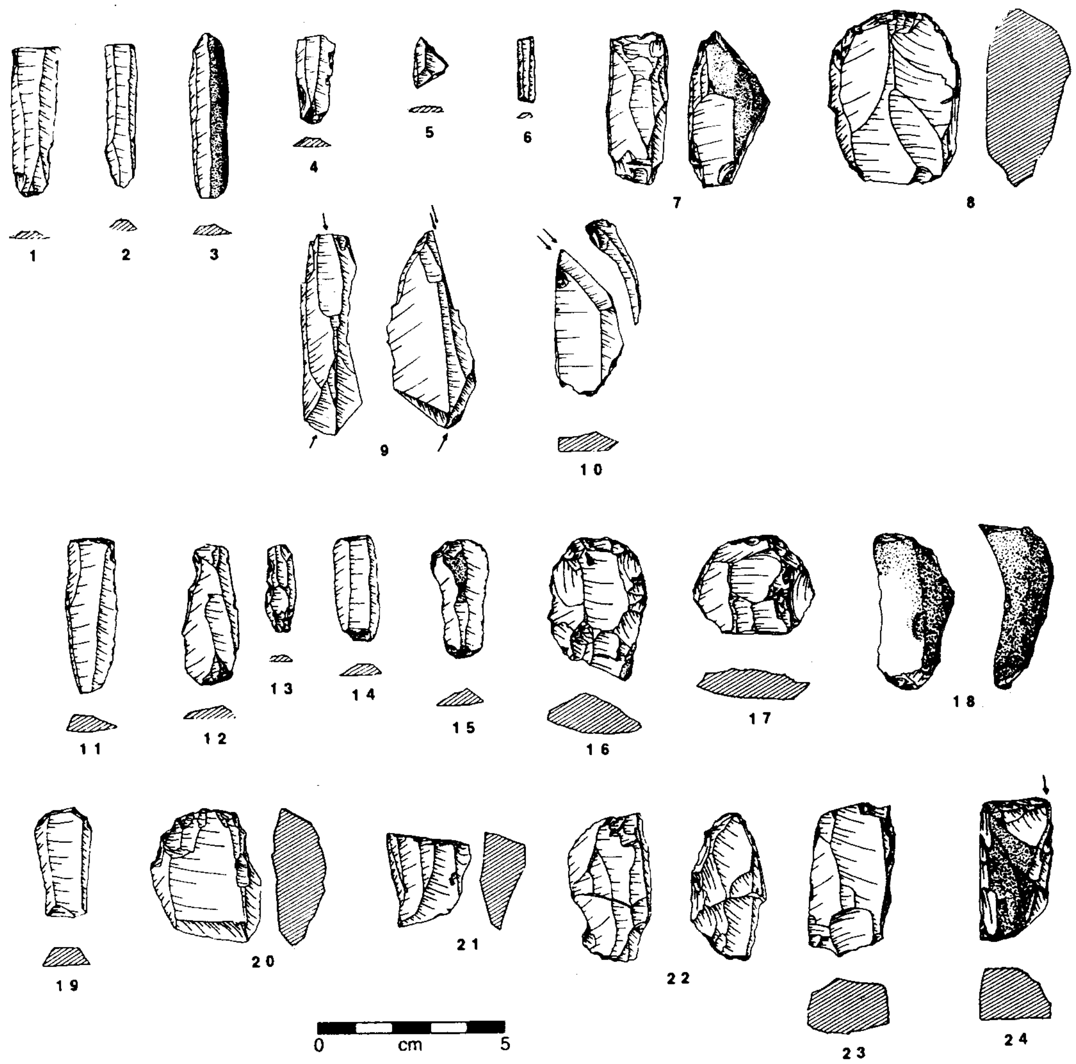

Fig. 4. Lithic artifacts from Ain Mrer K-3 (1-10) and Ain Mrer K-4 (11-24) *<From surface survey>*.

Ain Mrer K-3
1-2 Blade
4 Blade fragment with edge chipping
6 Backed bladelet
7 Double ended core/burin
9 Dihedral, double-ended burin
3 Blade with cortex
5 Diagonal-ended bladelet snapped into trapeze form
8 Single platform flake core
10 Obsidian, dihedral burin and spall

Ain Mrer K-4
11-14 Blades with nibbling
16-17 End scrapers on a flake
19 End scraper on a blade
21 Single platform bladelet core
22-24 Double ended crude blade cores
15 End scraper on a blade.
18 End scraper on a thick cortex flake
20 Single platform bladelet core with cortex on the back

Fakhariyah, a site situated on the spring at the head of the Khabur River, yielded typical PPNB lithics from secondary contexts. (BRAIDWOOD L. 1958: 53-55, Plates 54-55:2-6, for examples of PPN lithic types) These included tanged arrowheads, burins and scrapers in the Levantine tradition, and obsidian "strangled blades" that are similar to those found at Cayönü. Small celts are commonly found at PPNA sites, but they also occur at late as the 'Ubaid in the Khabur. When I visited Fakhariyah with Moore in 1984, we located a deposit at the base of the site with this PPNB material *in situ*. Unfortunately it was being quarried to provide material for bricks and it is unlikely to have survived.

Feyda is an enigmatic site at the base of the first Khabur River terrace, about 45 km downstream from Fakhariyah. We discovered this site during survey in 1988 and attempted a sounding in 1990. Recent trenching at the base of the site for an agricultural drain had left piles of backdirt on the lower edge of the terrace in which many flints, bones and other artifacts could be seen. We first opened a trench on the mound (terrace edge), but it consisted solely of secondarily deposited material although its surface was the source of our initial collections of lithics. Since it was evident that the trenching machine had found a primary deposit, we attempted to locate it by re-opening the pipe trench and examining the profile. Unfortunately we found no cultural strata above the level of the pipe and we were unable to dig beneath it owing to water. It thus appears that the site lies entirely under the modern floodplain and artifacts from it were excavated when the sediments were quarried to provide material for an historic building on top of the terrace.

The lithics at Feyda clearly point to the PPNB (Figs. 5-6). We cannot state with certainty, however, that the site is "preceramic" in view of the situation at Assouad. Nevertheless it is similar to Fakhariyah, perhaps with less obsidian and hence perhaps older. If it is aceramic, it is equivalent to Abu Hureyra II and Mureybit IV, but if it should fall into the ceramic range it would be equivalent to Abu Hureyra III, Assouad and Damishliyya. The lack of lozenge-shaped points, but the presence of Byblos points may indicate a late aceramic date for the oldest sites in the Khabur. On the other hand, this region may lie outside the distribution of lozenge-shaped points.

The other artifacts from Feyda bear strong resemblance to Assouad in the Balikh. (CAUVIN J. 1972) For example, the incised plaque or palette (Fig. 6:17) compares with a similar object from Assouad (Fig. 4:9); the plaque fragment (Fig. 6:28) resemble Assouad's (Fig. 4:8); the figurines (Fig. 6:26-27,29,30) are similar to Assouad's (Fig. 1,4,5); and the celts (Fig. 6:15,16) compare with Fig. 3:4.

Nishiaki reports a site with lithic material similar to Feyda about 10 km to the northwest but the presence of side-blow flakes there implies an early Neolithic age, despite the lack of ceramics (NISHIAIKI 1992: 100). Our survey did reveal some instances of lithics in irrigated fields on the floodplain that probably derived from similar Neolithic sites but the amount of material was too small to allow for definitive identification. If Feyda does lie beneath the modern flood plain, it is probable that other sites will occasionally turn up by accident. However, one cannot hope to gain more than unsystematic hints of occupation from such chance finds.

Pottery Neolithic

The earliest ceramics in northern Syria probably date to close to 6500 cal BC. (AKKERMANS 1990: 113-115) Akkermans notes that Byblos points continue in use at Assouad and Damishliyya after the introduction of pottery, but that at Abu Hureyra III, Amuq points are found. At Bouqras, Byblos and Amuq types occur together with the earliest ceramics. Although the artifacts in these sites are very similar they may be separated by a century or more in time from one another, and the fact that they occur in different geographic regions may account for some of the variability among them. Because of the strong possibility that ceramics were not universally adopted simultaneously across Mesopotamia (*cf* .Assouad) and were also rare in the oldest sites, one cannot use their absence as a valid indicator of relative chronology. And, inasmuch as the lithics demonstrate continuity with the PPNB, those that were made in the early sixth millennium cannot at present be distinguished from those made a millennium earlier. Rather than using solely lithics or ceramics to establish relative chronology, in the absence of radiocarbon dates, we must turn to other indicators, such as the proportion of obsidian, presence of other artifacts, architecture, etc.

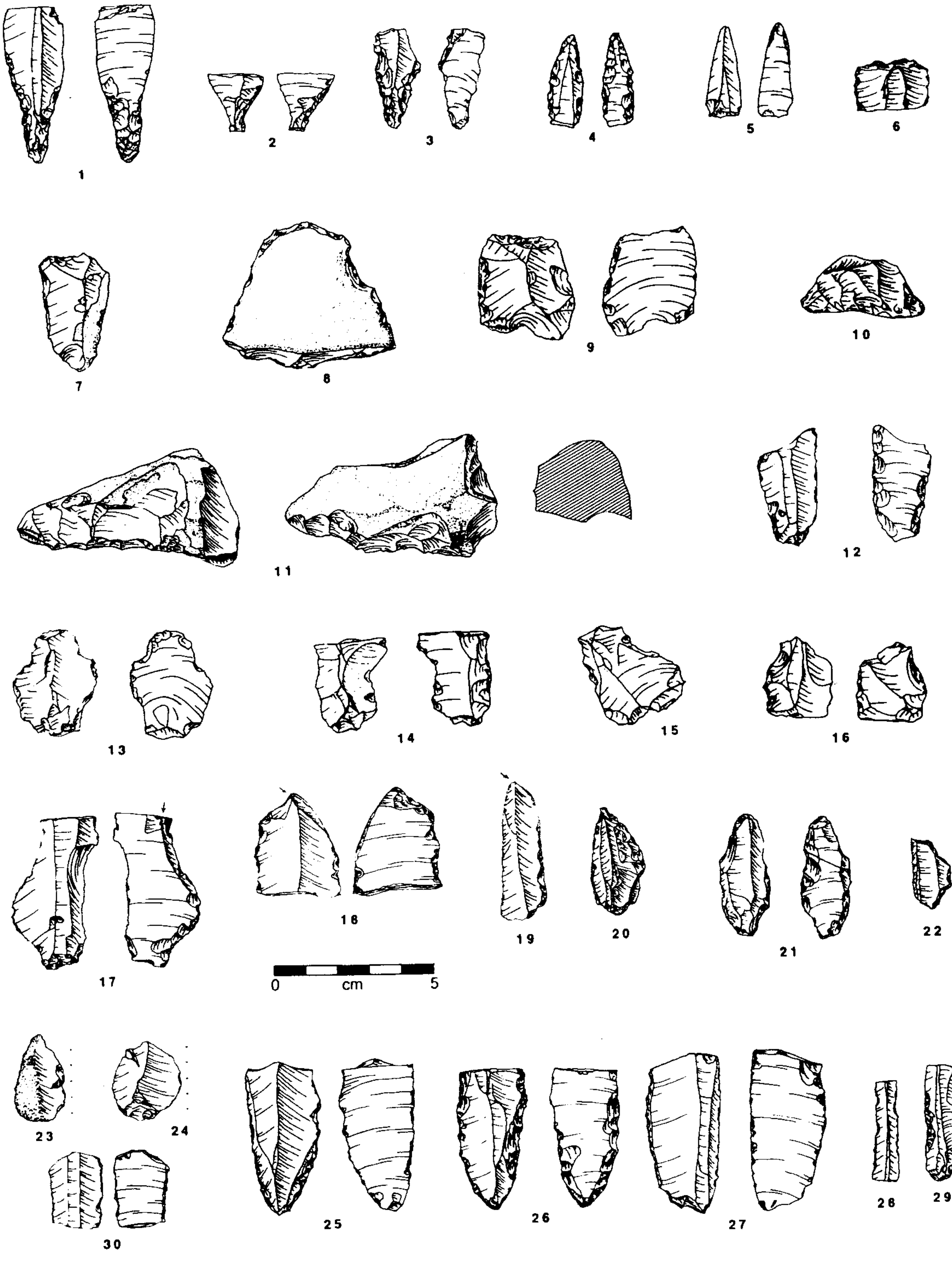

Fig. 5. Lithic assemblage from Tell Feyda <*From surface survey and sieving of backdirt left by a trenching machine* >.

1-3 Bases of Byblos points
7 End scraper on flake
10 Steep scraper on flake
13 End scraper on flake
17 Simple burin on break
20 Perçoir
22 Trapezoid on blade segment
25-26 Retouched blade

4-5 Tips of Byblos points
8 Rounded scraper on flake
11 Steep scraper
14-16 Retouched flakes
18 Dihedral burin on truncation
23-24 Flakes with sheen
27 Nibbled blade

6 End scraper on blade segment
9 Retouched and truncated flake
12 Thick blade with bilateral, bulbal retouch
19 Simple burin on blade
21 Reamer or thick blade with bulbar, bilateral retouch
28-29 Nibbled bladelets

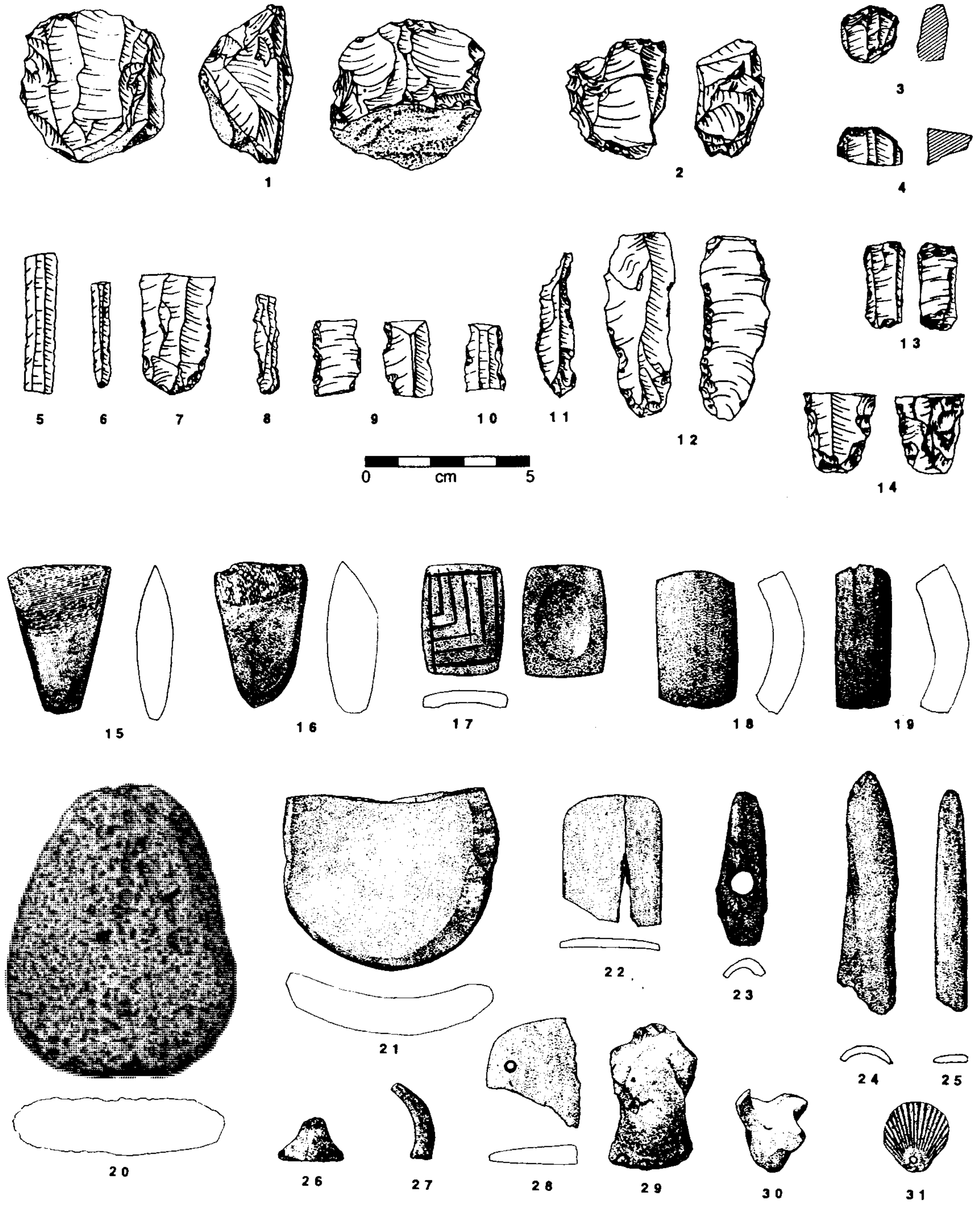

Fig. 6. Lithic assemblage from Tell Feyda <*From surface survey and sieving of backdirt left by a trenching machine*>.

1 Flint blade/flake core
2 Flake core
3-4 Obsidian blade core fragments
5 Obsidian blade
6 Obsidian bladelet
7 Nibbled obsidian blade
8 Nibbled obsidian bladelet
9 Retouched obsidian blade
10-11 Nibbled obsidian bladelets
12 Retouched blade
13 Scaled obsidian blade
14 Retouched and scaled obsidian blade
15-16 Polished black stone celts
17 Incised limestone palette/plaque
18-19 Marble bracelet fragments
20 Basalt handstone
21 Limestone palette with red pigm.
22 Tip of bone spatula on long bone section
23 Pierced long bone fragment
24 Crude bone awl on long bone splinter
25 Flat, bone spatula or shuttle
26 Base of stalk figurine
27 Clay horn of animal figurine
28 Polished and pierced marble plaque fragment
29 Torso of clay figurine
30 Head of animal figurine
31 Drilled shell pendant?

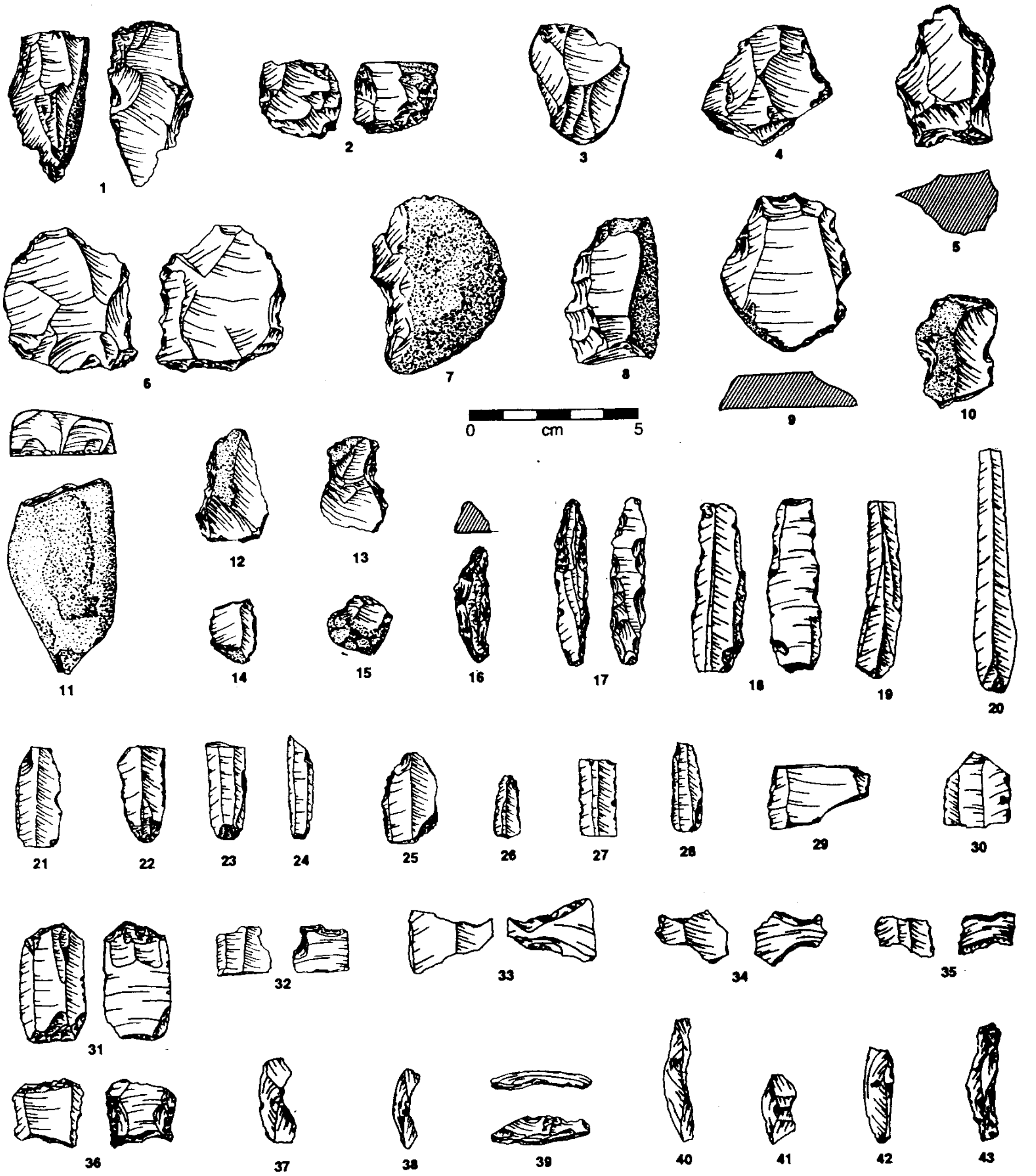

Fig. 7. Lithic assemblage from Tell Kashkashok II <*From our small-scale archaeobiological sampling of sections left by the Japanese team.*>.

1 Bladelet core, K20/3
2 Flake core, F1
3 Core fragment with edge nibbling, K20/3
4 Core fragment with edge nibbling, K20/1
5 Steep scraper, G27/13
6 Core biface (reused paleolithic?), M33-6/5
7 Steep scraper, M32-6/5
8 Steep, denticulated scraper, M33-6/5
9 Steep scraper, heavily patinated, M33-6/5
10 End scraper on thick flake, M33-6/2
11 Steep scraper on tabular flint, ???
12 Retouched flake, K20/3
13 Notched flake, K20/3
14 Lightly retouched flake, K20/4
15 Lightly retouched flake, K20/1
16 Limace, with steep, bifacial retouch, M33-6/3
17 Blade with bifacial retouch, G27/10
18 Obsidian blade with burin, M33-6/4
19 Obsidian blade, M33-6/3
20 Obsidian blade, M33-6/3
21 Obsidian blade, K20/4
22 Obsidian blade with edge nibbling, G27/10
23-24 Obsidian blades, G27/10
25 Obsidian blade with edge nibbling, K20/7
26 Obsidian blade, K20/4
27 Obsidian blade, M33-6/5
28 Obsidian blade, K20/2
29 Broad obsidian blade, M33-6/6
30 Obsidian blade, M33-6/2
31 Scaled obsidian blade, M33-6/6
32 Obsidian blade segment with bulbar retouch, K20/4
33 Obsidian trapezoid with side-blow flake removals, M33-6/3
34 Obsidian trapezoid with side-blow flake removals, M33-6/5
35 Obsidian trapezoid with side-blow flake removals, M33-6/6
36 Thick obsidian blade with retouch around entire perimeter, M33-6/5
37-38 Obsidian side-blow flakes, M33-6/5
39 Elevation and plan of obsidian side-blow flake, K20/2
40 Obsidian side-blow flake, M33-6/2
41 Obsidian side-blow flake, M33-6/3
42 Obsidian side-blow flake, M33-6/5
43 Heavily retouched obsidian side-blow flake, M33-6/5

Once again the Balikh provides the most useful examples of early ceramic Neolithic sites, Assouad and Damishliyya. At Damishliyya, the ceramics are all coarse, mostly chaff tempered and occur in three basic shapes, tall, narrow pots with loop handles, shallow, flat bottomed bowls, and hole mouth pots. (AKKERMANS 1990: 34-35) The pottery at Assouad is very similar except for its anomalous disappearance from the upper layers (I-VI) and the presence of a few sherds with red paint .(CAUVIN J. 1972: 87) At both sites there are stone bowls, one at Assouad with incisions (Fig. 4:9) and "stud" figurines of lightly baked clay. (AKKERMANS 1990: 37) At Damishliyya, obsidian increases through the early layers (2-7) from 6-16%, and it comprises 6% of the lithics in VIII-VII at Assouad where sickles account for 10% and points 14% of the tools.(CAUVIN M.-C. 1972: 92) The corresponding numbers at Damishliyya are sickles about 2% and points less than 1%. Such differences in proportions may be just sampling error and differences in excavation and recovery techniques, (LeMIÈRE 1979: 40) or economic differences as in Deh Luran. (see HOLE, Iran-Synthesis this volume) In most respects the two Balikh sites compare closely with one another and with Bouqras. (ROODENBERG, THISSEN, and BUITENHUIS 1989-90)

What in the Khabur corresponds with these sites? There are several candidate sites - Tell Halaf, Tell Habesh, Chagar Bazar - none of which has been properly excavated to expose the earliest layers, but at all of which seemingly early ceramics have been reported.

The *Altmonochrome* of **Tell Halaf** (von OPPENHEIM and SCHMIDT 1943: 67) and **Tell Habesh** (DAVIDSON 1977: 88) is possibly the oldest ceramic on the plain, although the prehistoric date for some of the wares has been challenged. (BARTL 1989) As Akkermans notes, there may have been considerable regional differences at this time, thus vitiating close comparisons among sites. At both Halaf and Habesh, the early monochrome burnished wares are later joined by early Halaf ceramics. Similarly, although Mallowan did not distinguish them as a separate layer, monochrome ceramics in the typical early forms also occur at Chagar Bazar.

These cases, where monochrome wares are succeeded by Halaf may, therefore, be relatively late, equivalent to the Amuq A to which they once were ascribed. This possibility is also implied by the finding of ceramics closely related to those of Umm Dabaghiyah and Hassuna at the site of **Kashkashok II**. The Japanese team excavated this small mound extensively, finding it almost hopelessly invaded by fifth and fourth millennium burials. Nevertheless on the original land surface, there was a small "Hassuna Ia" settlement, similar to what had been found previously at Hassuna itself (LLOYD and SAFAR 1945) and Telul eth-Thalathat (MATSUTANI 1991: 99) Yarim I and Tell Sotto (BADER 1989).

This early deposit features Byblos points and significant quantities of "side-blow" flakes, along with the Hassuna-like ceramics, including husking trays. The closest parallels are with sites in the Iraqi Jezireh, Thalathat (FUKAI and MATSUTANI 1977: Fig. 3), Tell Sotto, Kul Tepe and Umm Dabaghiyah (MORTENSEN 1983: Fig. 4:m-q). Sites in the Balikh with side-blow flakes are probably contemporary with Kashkashok (COPELAND 1979: 254, Fig. 2:14,16). However, we note that side-blow flakes extend geographically from Gritille to Hajji Firuz and had an unknown long life span. Sabi Abyad, which has a husking tray, but apparently no side-blow flakes (COPELAND 1989: 244-246), is considered by Akkermans to be later than Assouad and Damishliyya. (AKKERMANS 1989: 126)

At this time we know of only one other site in the Khabur Basin with similar material, a site a few hundred meters south of Tell Khazné (not the same as the Epipaleolithic site), currently under excavation by a team from Moscow. If the settlement pattern is similar to that of the Balikh, we may expect to find more such sites in the northern part of the basin where rain-fed agriculture is more predictable. (AKKERMANS 1989: 129) As yet no survey in this region has focused on the early prehistoric periods.

We may compare the Khabur with the Iraqi Jezireh where few early settlements have been found. Mortensen suggests that the north Mesopotamian plain was marginal to agriculture until 6000 bc and was occupied chiefly by mobile hunters, some of whom had begun to use ceramics of Hassuna Ia type. (MORTENSEN 1983: 216-218) This scenario could fit Kashkashok and the Khabur region too, for despite traces of architecture and storage, analysis may show that the site served as only a seasonal residence by people who also ranged widely with their herds or on the hunt.

Site Descriptions and Lithic Figures

This section contains additional information on the sites discussed, and illustrations of their lithics, arranged chronologically: Khazné Caves, Ain Mrer, Tell Feyda, Kashkashok.

Ain Mrer

Some 34 km east of Hasseke on the paved road to Lake Khatuniyeh, Ain Mrer (bitter spring) is seen on the north side of the road. The spring is a mere trickle of bitter water flowing into a reed-filled basin next to a low barren hill. The spring is one of the headwaters of the Wadi Al Furat (Chaïb al Frati on the topographic map), a seasonal drainage that empties into the Khabur below Hasseke.

There are two low hills separated by a saddle that also serves as an access road, for one of the hills has been extensively quarried. The spring descends into a lower pan (seasonally dry) and thence into the deeply incised wadi. On the opposite bank of the wadi there is another small hill. The land immediately surrounding the spring is so degraded (much of it covered with gypsum pans) that economically useful plants can no longer survive. The area is frequented by nomads whose tent sites are encountered along the wadi, presumably located so as to provide drinking water for the herds during the winter months when the spring flows copiously.

We carefully searched the surface here, finding a number of concentrations of lithics ranging in age from Epipaleolithic to Neolithic or Chalcolithic, most of which appear to result from very short-term visits to the spring. We looked carefully to try to determine without digging whether there was any depth of deposit that might repay excavation but we found none. Rather, we found concentrations of lithics in the wadi banks, on the flat land well above the spring and especially in the saddle between the two mounds near the road. The major remaining question is whether the hills represent fossil springs or deposits in which there might be relatively undisturbed material.

Sites K-1 and K-7 These are probably part of one extensive scatter of lithics in the saddle and on the inner flanks of the two low hills. We collected here on several occasions concentrating on different parts of the scatter, hence the two site numbers. All of the material is from the surface but it was collected with great care and some "complete" clusters were recovered.

Site K- 3 This concentration of lithics, on the east side of the wadi flowing from Ain Mrer, occurred about half way up the wadi bank. The scatter, which includes both flint and a few pieces of obsidian, had a horizontal extent of about 5 m and 2-3 m vertically. The material seemed to be eroding from the bank but it is probably redeposited.

Tell Feyda

This enigmatic site (K-124), is located about 35 km northwest of Hasseke, at the first terrace on the right bank of the Khabur River. The site probably lies under the modern floodplain. (HOLE 1991b: 688) We first recovered material from the surface of a low mound on the terrace and in a subsequent year discovered that a trench for an irrigation drain had been dug into the deposit. We recovered a great deal of material from the backdirt left by the trenching machine but we were unable to find an material *in situ*, despite digging down to the level of the drain, at which point we hit the water table and could not dig further.

Discussion of Feyda Lithics

Both obsidian and flint were recovered from the screened backdirt and surface collections, although the counts given in the Table below consist only of pieces from the screened backdirt. However, in some instances, illustrated examples are from the surface collections. Virtually all blades and bladelets are of obsidian, whereas virtually all other tools and projectile points are made on flakes. Clearly local flint was chipped, but unskillfully. Obsidian may also have been chipped locally although its debitage is largely missing from our collections.

Despite the relatively large number of lithics recovered, there is a paucity of well-defined tools and of tool types.

Points. No complete points were recovered but the fragments seem most likely to be of the Byblos type. All are made on dark brown-gray chert, probably derived from outside the immediate vicinity since none of the ubiquitous debitage is of this material (Fig. 5:1-5) .
Scrapers. This is a varied group, ranging from end scrapers on flakes (Fig. 5:7,8,13) or heavy blades (Fig. 5:6) to steep, denticulated scrapers on chunky pieces of chert (Fig. 5:10,11).
Retouched Flakes. A diverse group that probably represents "use-retouch," that often resulted in notches (Fig. 5:9,14-16).
Burins. These pieces are made both on fractures (Fig. 5:17,19) and on a truncation (Fig. 5:18). All of these are on chert.
Borers/Perçoirs/Reamers. A single chert flake with a retouched tip is considered to be a percoir (Fig. 5:20), whereas a heavily retouched, thick flake may have been used to ream existing holes (Fig. 5:21).
Trapezoid on blade segment. Roughly flaked, this may be fortuitous (Fig. 5:22).
Sickles. These two small chert flakes have traces of sheen and bitumen (Fig. 5:23-24), indicating that there were hafted, as were similar pieces at Asouad. (CAUVIN M.-C. 1972)
Retouched/Used Blades. These are in both flint and obsidian; however most were of obsidian (Figs. 5:25-30, 6:7-11,12). The few flint blades were irregular and thick as compared with the obsidian and we note that there are no flint blade cores. It is likely that the few flint blades of dark, fine-grained chert were imported to the site since the debitage is a different material. (note that some of the points are also made of "foreign" material).
Plain Blades. There are nearly 25 times as many obsidian blades as flint blades. These range from relatively broad and thick to extremely narrow and thin (Fig. 6:5-6). All were made by pressure flaking.
Scaled Blades. Two obsidian blade segments, one with flat flaking over the entire bulbar surface, as well as chipping on both dorsal edges (Fig. 6:14), the other has scalar retouch on the bulbar face at both ends of the segment (Fig. 6:13).
Flint Cores. The few cores consist of a crude pyramidal core made on a small nodule that retains cortex over have its circumference (Fig. 6:2) and a multi-platformed core from which some irregular blades, as well as flakes were struck (Fig. 6:1).
Obsidian Cores. From the surface we recovered one complete (now in Damascus) and one platform rejuventation tablet from a bullet core; and from the screened backdirt, the tip of a bullet core and a platform rejuvenation flake (Fig. 6:3-4).

Counts of Feyda Lithics

Type	# Flint	# Obsidian
Byblos point fragments	5	
Scrapers	4	
Retouched flakes	14	
Burins	5	
Borer	1	
Reamer	1	
Sickles	2	
Retouched blades	9	
Plain blades	8	192
Scaled obsidian blades		2
Cores	3	
Obsidian core fragments		4
Flint core fragments	11	
Debitage	159	26
Totals	*223*	*224*

Other Artifacts

Celts. There are two whole micro-celts, both made of a dense black stone. They are fully polished. One (Fig. 6:15) has a symetrical bevel and the other, which was evidently reground after a break, has an adze-like bevel from a single edge (Fig. 6:16). There are also two fragments of celts.

Incised plaque. A rectangular plaque shaped in dense gray stone. The dorsal surface is incised with a rectilinear pattern of lines enclosed in an outline. The ventral side has a small hollow ground into its center, as if it had been used as a palette (Fig. 6:17). A similarly incised stone is seen at Assouad. (CAUVIN J. 1972: Fig. 4:9)
Bracelet Fragments. There are three of these. One is a light marble, oval in section (Fig. 6:18). The other two, both smaller than the first, are a gray stone. One (Fig. 6:19) has been burned and developed cracks from the heating.
Pendants. One, a fragment of a marble pendant with a small hole bilaterally bored in it (Fig. 6:22), is similar to an obsidian piece from Assouad. (CAUVIN J. 1972: Fig. 4:8) The other is a fossil (?) shell with a hole bored near its hinge (Fig. 6:31).
Palette. About two-thirds of an oval palette, ground from a thin slab of dense gray limestone, has traces of red pigment in its surface (Fig. 6:21).
Bone Tools. A number of pieces of polished and worked bone were recovered. These include fragments of a broad and narrow spatulas made on ribs (Fig. 6:22), two examples of thick awls on shaft fragments (Fig. 6:24,25), several pieces of burned and polished bone whose overall shape could not be determined, and a shaft bone with a drilled hole 0.8 mm in diameter (Fig. 6:23).
Figurine Fragments. These include the head of a horned animal (Fig. 6:30), three horns (Fig. 6:27), the base of a "stalk" figurine (Fig. 6:26) and nearly an entire figurine, very crudely made (Fig. 6:29). All these are in lightly fired clay. Close comparisons to the horns and stalk are seen in Assouad. (CAUVIN J. 1972: Fig. 14)
Basalt. Small fragments of basalt were commonly encountered on the surface. A small, lightly facetted, hand stone of vesicular basalt is illustrated (Fig. 6:20).
Hematite Crayon. A piece of hematite, facetted on several surfaces, was probably the source of the red pigment on the palette.

Discussion of Feyda's Chronology

Assouad and Damishliyya appear to be the closest to Feyda. (AKKERMANS 1988) This implies a second half of the 7th millennium date, and the strong possibility that more extensive excavations would reveal ceramics at Feyda; however, none were observed in the extensive backdirt piles and it is more likely that Feyda is approximately at the interface between PPNB and PN in the Khabur. There are several indications of this. The nearly even split between flint and obsidian argues for a later rather than earlier date, as does the apparent lack of projectile points. The incised plaque, the bracelet fragments, and the figurines all fit comfortably with either a late PPNB or an early PN. The lack of stone bowls at Feyda and their ubiquity at other supposedly contemporary sites is puzzling but may simply reflect sampling bias or that Feyda is a special purpose (i.e., not residential) site. The absence of these artifacts at Fakhariyah cannot be taken as a reliable indication of differences between the sites because of their occurrence in secondary contexts at Fakhariyah and the differences in techniques of recovery by the different archaeologists.

Kashkashok Lithics

Chronology

In the Balikh there is an apparent sequence from the earliest PN ceramics to those that have "coarsely executed geometric designs in red paint on a whitish slip." (AKKERMANS 1990: 119) Such ceramics antedate the Halaf and thus are roughly equivalent to the Kaskhashok II ceramics which, in turn, closely resemble those of Hassuna Ia, Umm Dabaghiyah, Thalathat, Yarim I and others. Radiocarbon dates from Kashkashok itself cover too wide a range for comfort, but Matsutani believes the site was occupied during the first half of the sixth millennium, equivalent to the Hassunan layers in Telul eth-Thalathat. (MATSUTANI 1991: 99)

The only published site known to have such material in the Khabur is Kashkashok II, excavated by Matsutani's team and whose lithics have been described by Nishiaki (1990, 1991). Following the Japanese excavations, our team conducted some additional biological sampling of the early strata and recovered an additional sample of lithics, ceramics and other artifacts, as illustrated in Fig. 7.

There is a great disparity between the flint and obsidian artifacts. The flint, almost entirely of local material, is smashed rather than skillfully flaked. None of the local flint produced blades, and most of the pieces still bear cortex, indicating that the cores were small. By contrast, virtually all of the obsidian consisted of well-made, pressure flaked blades and bladelets, or tools made on these blanks.

Since Nishiaki has fully published the material from this site, it is only necessary here to list the types we recovered. Since we sieved all deposits, we may have recovered a greater number of small fragments, but the overall picture, including the proportion of obsidian, is the nearly the same as reported in MARSUTANI 1991 The major differences are as follows. We found no arrowheads and the few recovered by the Japanese were nearly all from uncertain context.(NISHIAKI 1991: 44) Nor did we find sickles. The Japanese team found few sickles, (NISHIAKI 1991: 45) mostly in uncertain contexts and we found none. Nor did we find obsidian "strangled blades, but these are rare in the Japanese collection too (NISHIAKI 1991: 51).The so-called "corner-thinned blades" (NISHIAKI Y. 1990) are, to my mind, a dubious category; in any case, I could find only two examples among our collection.

Possible Other Sites of the Same Age

Nishiaki (1992: 100) reports more than fourteen sites with "Pottery Neolithic materials" discovered during surveys conducted by Bertille Lyonnet in 1989 (Lyonnet B. 1993) and joined by Nishiaki in 1990,1991. He raises the possiblity that some of these sites may have been for special activities such as hunting. In fact, we might wonder whether Tell Seker al Aheiman, about 10 km northwest of Tell Feyda, on which he discovered lithic artifacts similar to those of Kashkashok, including Byblos points, and the characteristic side-blow flakes, a type that seems to be very restricted in time, may be such a site despite the absence of ceramics from the survey collection. As yet there is no indication whether any of these supposed Neolithic sites contains Kashkashok-type ceramics, or the more generally distributed unpainted, coarse Neolithic wares, or just lithics in typical PN style.

The Soviet team discovered one such site near the third millennium site of Tell Khazné, and it is probable that early ceramics could be found among the litter of later sherds on large sites such as Chagar Bazar where a Neolithic has long been suspected beneath the Halafian layers. Nishiaki's survey report shows a wide distribution of early ceramic sites, many in parts of the plain that have been little investigated.

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Étude préliminaire sur les industries lithiques du PPNB moyen et récent de Tell Halula (Haute Vallée de l'Euphrate, Syrie)

Miquel Molist, Joaquim Mateu et Toni Palomo

RÉSUMÉ. *Cette contribution porte sur l'analyse préliminaire de l'industrie lithique des niveaux PPNB du site de tell Halula (Syrie). L'analyse se centre tant sur les aspects technologiques (matière première exploitée, systemes de débitage, produits, ...) que sur ceux plus typologiques. Les conclusions préliminaires le mettent en relation avec le facies PPNB du Moyen Euphrate, dans ses étapes moyenne et récente.*

Introduction: Le site néolithique de Tell Halula

Le site de Tell Halula (Vallée de l'Euphrate), se situe dans la région du futur barrage de Tichrine, sur la rive droite de l'Euphrate près de la ville de Djerablous. Ce tell de grandes dimensions (360 m x 300 m et une hauteur de 8 m sur la plaine environnante), fut prospecté pour la première fois en 1986 par la Mission Australienne de l'Université de Melbourne (SAGONA and SAGONA 1988) et en 1989 par M.-C. Cauvin (C.N.R.S.), Ahmet Taha (Musée de Palmyre) et nous même (CAUVIN and MOLIST 1987-88), en reconnaissant en surface des occupations qui correspondraient aux périodes P.P.N.B., Pré-Halaf, Halaf et Obeid.

Depuis l'année 1991 nous avons entrepie la fouille et l'étude exhaustive du site[1]. Les objectifs des premieres campagnes (1991 et 1992) étaient la réalisation d'une série de sondages afin de reconnaître la séquence stratigraphique des occupations humaines sur le site d'une part et d'autre part la fouille en extension des niveaux correspondants à l'horizon culturel P.P.N.B. (Pre-Pottery Neolithic B). Comme zone de recherche priviligiée nous avons choisi les parties sud et sud-est du tell où la hauteur était la plus importante et où elle présente une forte pente apte à des sondages échelonnés.

La séquence PPNB de la partie sud et sud-est du tell

Les niveaux correspondants aux occupations du néolithique précéramique B sont attestés dans la partie sud du tell, directement au-dessus de sa base naturelle. La fouille de cette zone (secteurs I, II, IV) avec près de 169 m^2 a permis d'observer la séquence stratigraphique, caractérisée par une occupation continue du site, sans évidence de ruptures stratigraphiques, avec des niveaux d'occupation représentés soit par des bâtiments construits, leur abandon et destruction/comblement, soit par des occupations liées

[1] Notre travail a été facilité par l'appui et l'aide de la Direction des Antiquités et du Service de fouilles de la Syrie. Nous remercions particulièrement le Dr. A. Abu Assaf, Directeur Générale des Antiquités, le Dr. A. Bounni, Directeur du Service de fouilles, le Dr. W. Khayatta, Directeur des Antiquités de la région d'Alep et de Monsieur Mohammed Ali, représentant auprès de la mission.
Le projet de la Mission Archéologique Espagnole de Tell Halula s'insère dans le programme de Activités Archéologiques du Ministère de la Culture (Espagne) à partir de la Direction Générale des Beaux Arts et des Archives. Nous remercions particulièrement le Dr. Sr. José Mª Luzón Nogué, Director General de Beaux Arts et Archives. Nous voudrions également exprimer notre reconnaissance pour l'aide apportée par L'Ambassade d'Espagne à Damas et par le Centro Cultural Hispánico de Damas.

a des aires extérieures, avec des couches charbonneuses et cendreuses. La position topographique et surtout stratigraphique permet d'observer les niveaux les plus anciens du site dans le secteur IV (carrés IVA, IVB et IVC) tandis que les secteurs II (carrés IIA, IID, IIB et IIC) et IA seraient plus récents.

Les résultats nous ont permis de définir, dans l'ensemble des niveaux, des architectures domestiques à plan rectangulaire, de type pluricellulaire à divisions internes, construites en briques crues sur fondations de pierres avec des sols et des murs enduits de chaux ou en terre battue. A l'intérieur des maisons des installations domestiques sont normalement attestées (foyers, fours, silos ...).
Dans deux de ces constructions on a pu mettre en évidence des concentrations de sépultures, avec 4 unités sépulcrales dans chacune, principalement des enfants, et parfois partielles, avec un rituel de dépôt en fosses creusées dans le sous-sol des maisons.

Le matériel archéologique le plus abondant, associé à cette partie du tell, est le matériel lithique, que nous allons analysé en détail plus loin.

Parmi les autres types de matériel on trouve des éléments de parure avec des perles, en roches vertes ou calcaire, et deux exemplaires en obsidienne. Le type le plus caractéristique est la perle en "papillon" commune au PPNB moyen de l' Euphrate.

On soulignera également divers fragments de figurines animales en terre crue et un riche mobilier en pierre formé par des fragments de perles en roches dures, des balles de fronde, des meules en basalte ou calcaire, réutilisés comme éléments architecturaux dans les fondations des murs; des haches polies et des ciseaux réalisés sur des roches métamorphiques, des roches vertes, des jadéites et des fragments de vaisselle. Un crochet en os, des poinçons, aiguille et lissoirs constituent l'industrie osseuse.

Les données sur la paléoéconomie et sur l'environnement

Dans les niveaux du PPNB qui constituent l'échantillon le mieux analysé jusqu'à présent, la faune est très abondante et elle est en cours d'étude[1]. Les premieres études permettent l'attestation de la consommation d'espèces sauvages comme le boeuf *(Bos Primigenius)*, des équidés, du daim (*Dama mesopotamica*) et de la gazelle *(Gazella subgutturosa)* déterminée sur la taille et sur la morphologie des chevilles osseuses des cornes (analogues à Cheikh Hassan PPNA situé a environ à 30 km au sud et à Dj'adé, PPNB ancien, à 30 km au nord). La présence de Daim de Mésopotamie (*Dama mesopotamica*) est confirmée, ce qui infère un boisement relativement dense de la vallée. Le mouton et la chèvre sont domestiques dans les niveaux supérieurs et sauvages ou en cours de domestication dans les niveaux inférieurs. Le boeuf présente également des variations qualitatives ou quantitatives qui montrent le processus de domestication dans les niveaux supérieurs du site (secteur 7), hors du cadre étudié ici.

Les restes végétaux récupérés grâce à une flottation extensive des sédiments montrent une grande richesse dont l'analyse préliminaire[2] a permis de reconnaître, dans les niveaux PPNB, différentes variétés de blé (*Triticum aestivum/durum; Triticum monococcum /dicoccum)*, de l'orge (*Hordeum* sp.), des petits pois et des lentilles ainsi que des restes de charbons de type *Quercus* et *Pistacia*, qui fournissent des éléments pour proposer une couverture végétale arborée plus importante qu'actuellement.

Les documents montrent qu'il s'agit d'une installation rattachable à la culture PPNB dans la phase moyenne et récente, en rapport avec la tradition culturelle du nord de la Syrie, et qui selon la chronologie relative couvrirait le VIIè millénaire B.C. Les datations absolues obtenues s'étalent entre 8700 et 7900 B.P.

On n'aborde pas du tout dans cette communication la documentation des niveaux plus récents du site, même si on sait que toute une série d'installations et occupations, en probable continuité stratigraphique d'occupation avec les niveaux proprement PPNB, couvrait la première moitié du VIe millénaire B.C. La présence des premières productions de céramiques dans ces occupations fait, que cette partie échappe, par définition, à la problématique du present colloque.

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1 Analyses réalisées par D. Helmer (CNRS- ERA 17 du CRA, France) et M. Saña (UAB, Espagne).

2 Etudes réalisées par G. Wilcox (CNRS-ERA 17 du CRA, France) et M. Català (UAB, Espagne).

L'industrie lithique des niveaux PPNB

L'étude que nous allons présenter ici a pour but d'établir une première approximation du matériel lithique provenant de la séquence clairement rattachable au PPNB du site. Le fait que nous sommes encore en cours de fouilles et d'étude donne a ce travail un caractère préliminaire qui essaie surtout de montrer les directions de travail et les premières hypothèses dans le domaine lithique. Pour cela nous avons sélectionné pour cette étude le matériel provenant de 4 carrés de fouille (25 m^2 chacun), deux appartenant à la séquence ancienne (carrés IVB et IVC) et deux à la récente (IA et IIC). L'échantillon

	NUCLEUS	%	ÉCLAT CORT.	%	ÉCLAT	%	LAME	%	LAMELLE	%	LAM. CR.	%	LAM. EP.	%	TABL.	%	BUR.	%	TOTAL
2B	1		284	41,58	324	47,44	75	10,98	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	683
2C	9		245	29,55	448	54,04	126	15,20	5	0,60	1	0,12	0	0,00	1	0,12	3	0,36	829
2D	2		22	21,36	50	48,54	31	30,10	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	103
4B	13		289	32,69	403	45,59	169	19,12	12	1,36	2	0,23	1	0,11	6	0,68	2	0,23	884
4C	1		204	20,52	532	53,52	223	22,43	20	2,01	9	0,91	3	0,30	2	0,20	1	0,10	994

Fig. 1. Nombre et proportions des produits de débitage en silex.

tient compte de la totalité des produits trouvés dans chaque secteur de fouille. Le besoin d'avoir un échantillon un peu large nous a amenés à ne pas tenir compte de la nature des couches. L'étude définitive abordera de façon plus claire ce problème.

Analyse technologique

Matières premières

Le matériel le plus abondamment utilisé est le silex et de façon plus réduite on trouve également de l'obsidienne.

Lors d'une analyse préliminaire des matières premières utilisées, on observe que le silex des niveaux analysés présente deux variétés principales: l'une à grain grossier et moyen et l'autre de meilleure qualité à grain fin, avec des colorations qui varient du noirâtre au beige. Dans l'attente de pouvoir réaliser une prospection systématique des matières premières dans les environs du site, la comparaison avec les analyses déjà effectuées sur les sites voisins de Halula comme Mureybet ou Cheik Hassan permet de suggérer quelques hypothèses. Ainsi, le silex à grain grossier pourrait provenir de la formation tertiaire de Tellik dont les affleurements naturels sont à une quarantaine de kilomètres au nord-est du site mais dont le transport est naturel, par la voie de rognons transportés par l'Euphrate ou par les alluvions quaternaires, et localisées sur les anciens terrasses près du site même. Pour le silex à grain fin -formation de Maksar-, on lui suppose une position en place stratifiée dans les craies mais aucun affleurement dans la zone environnante du site ne nous est, pour l'instant, connu.

L'analyse des produits de débitage reflète une exploitation différenciée entre ces deux variétés de silex. La presque totalité des produits de taille sont fabriqués sur la variété à grain moyen ou grossier, tandis que ceux fabriqués en grain fin sont très peu représentés. Ceci nous permet d'envisager pour ce dernier type de matière première, l'apport sur le site de matériaux déjà préparés pour la taille, sans cortex et configurés pour une exploitation laminaire. La distance plus lointaine de l'affleurement pourrait expliquer cette moindre présence des produits de débitage. Les matériaux de moindre qualité, en provenance des terrasses de l'Euphrate, seraient completement exploités sur le site.

L'autre grande catégorie de matière première lithique exploitée à Halula est l'obsidienne. Cette matière première a fait l'objet d'analyses phisico-chimiques pour déterminer les gites de provenance et

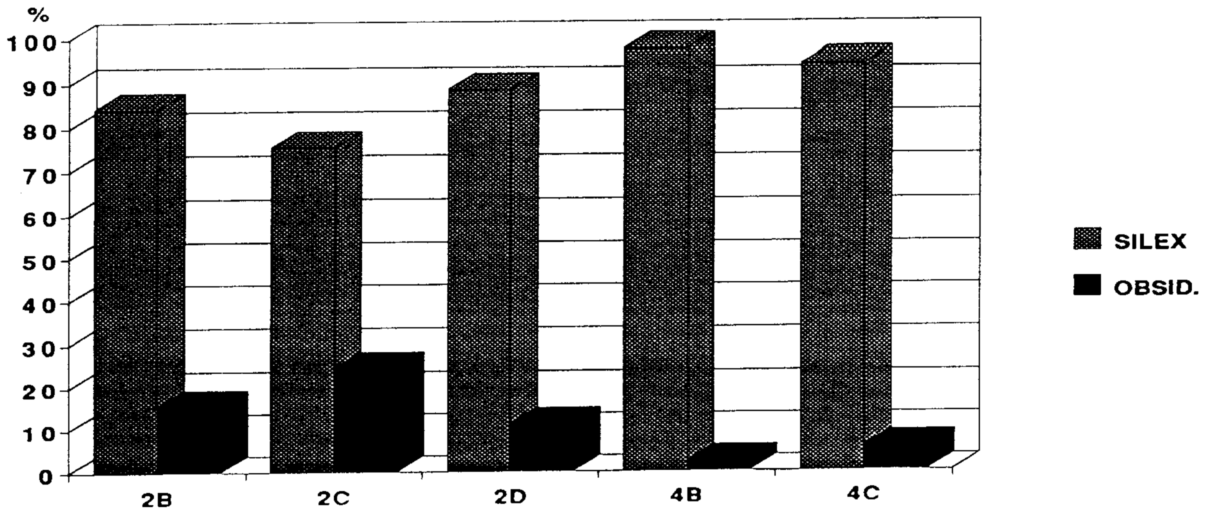

Fig. 2. Proportions des produits de débitage: silex et obsidienne.

	ÉCLAT	OUT. ÉCLAT	LAME	OUT. LAME	LAMELLE	OUT. LAMELLE
2B	643	35	123	48	2	2
2C	746	53	220	94	5	0
2D	75	3	66	35	0	0
4B	700	8	266	97	18	6
4C	754	18	337	114	25	5
	%	%	%	%	%	%
2B	94,66	5,44	60,98	39,02	0	100
2C	92,9	7,1	57,23	42,72	100	0
2D	96	4	46,97	53,03	0	0
4B	98,86	1,14	63,54	36,46	66,66	33,33
4C	97,62	2,38	66,18	33,82	80	20

Fig. 3a. Nombre et proportions des différents types de produits de débitage (éclats, lames et lamelles), selon sa nature: bruts et retouches.

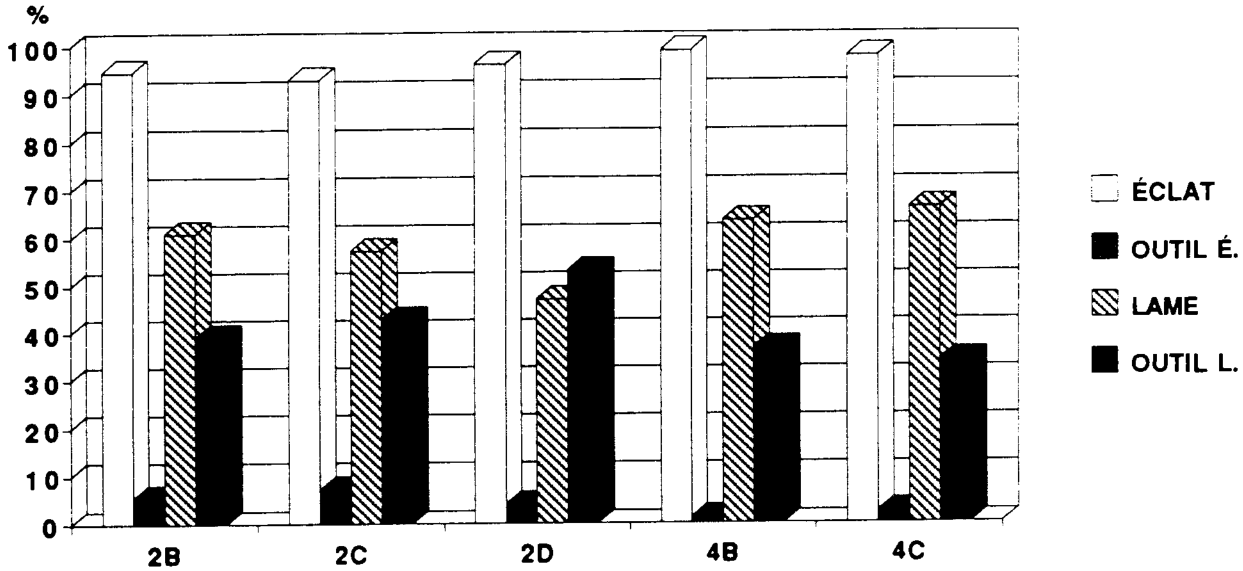

Fig. 3b. Proportions des différents types de produits de débitage (éclats et lames), selon sa nature: bruts et retouches.

	1 A	%	2C	%	4B	%	4C	%
ÉCLAT. RET.	15	10,27	2	2,66	4	4,87	3	2,27
LAM. RET.	30	20,54	10	13,33	23	28	41	30,8
LAM. TRON	0	0	3	4	1	1,21	5	3,8
GRATTOIR	44	30,13	30	40	2	2,43	8	6,06
DENTICULÉ	0	0	5	6,66	5	6,09	3	2,27
POINTE	50	34,24	13	17,33	30	36,58	39	29,54
BURIN	4	2,73	4	5,33	8	9,75	22	16,66
PERÇOIR	3	2,05	4	5,33	3	3,65	2	1,51
AUTRES	0	0	3	4	6	7,31	9	6,81

Fig. 4a. Nombre et proportions des différents catégories d'outils retouches en silex.

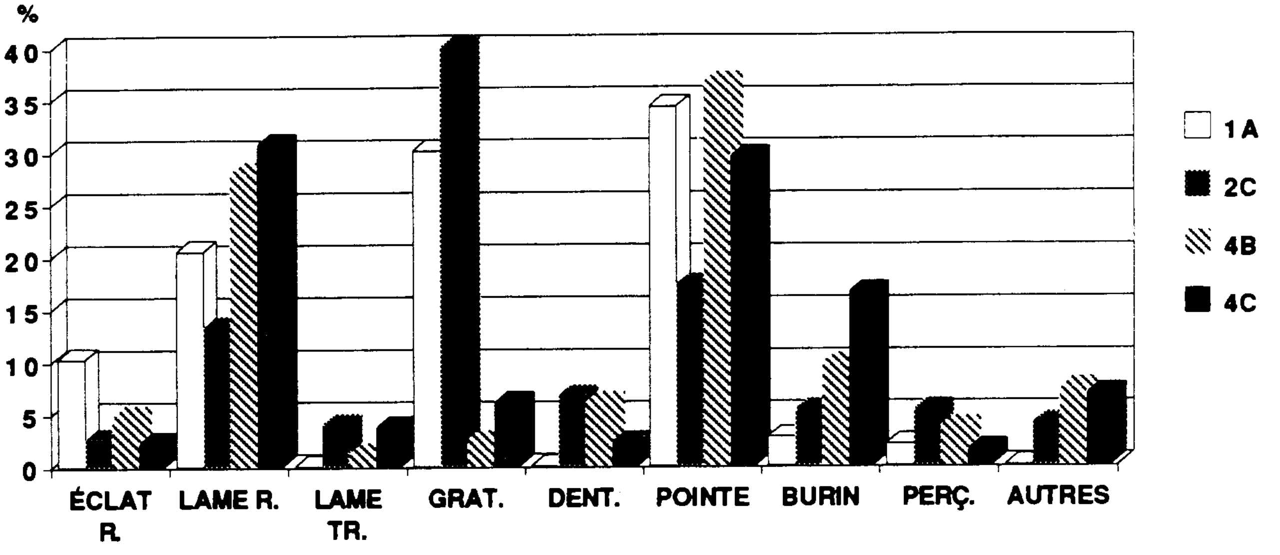

Fig. 4b. Proportion des différents catégories d'outils retouches en silex.

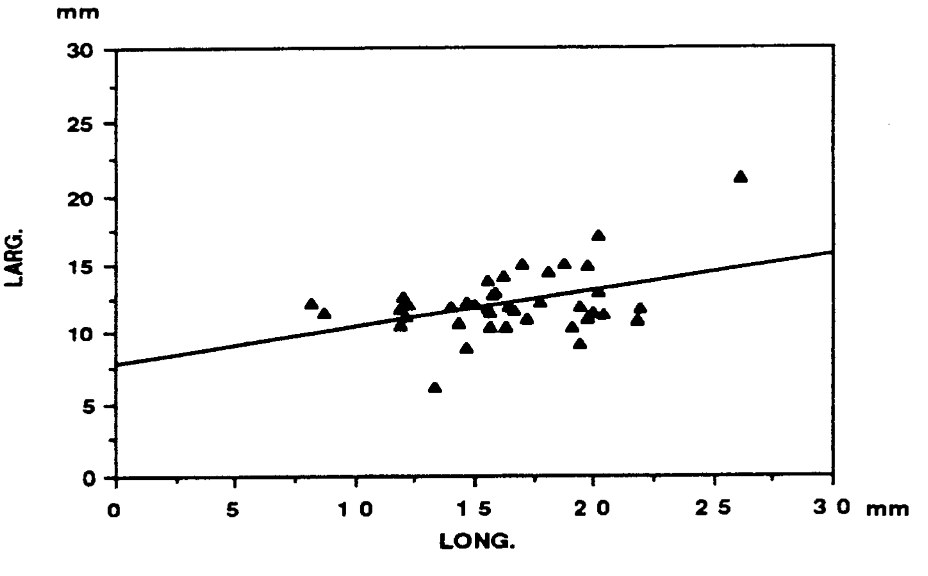

Fig. 5. Typométrie des pédoncules des points (carrés 4B-4C).

les résultats obtenus récemment montrent pour les niveaux récents une provenance des gites d'Acigöl enAnatolie Centrale et de Bingöl et Nemrud Dağ en Anatolie Orientale[1]. Ceci elargit et corrige les résultats obtenus à partir de l'analyse des échantillons de prospection de surface, faits par la Mission Australienne, et qui reflétaient une provenance exclusive de l'Anatolie de l'Est plus précisement du groupe du Lac Van-Azerbaijan-Armenian S.S.R. (SAGONA and SAGONA 1988).

La relation entre les deux types de matériaux silex et obsidienne montre, comme on pouvait s'y attendre, une grande prédominance du premier matériel sur le deuxième; mais lorsqu'on compare cette relation dans une vision diacronique on observe que dans les secteurs inferieurs la proportion d'obsidienne est très fiable, non supérieure aux 6% (carré 4C),tandis que dans les carrés superieurs elle augmente de maniere significative (32% par exemple dans le carré 2C). Ces differences pourraient montrer une augmentation des échanges dans les niveaux les plus récents de la sequence du PPNB. Il en est de même à Abu Hureyra (MCDANIELS *et al.* 1976).

Produits de débitage

Le matériel lithique est représenté par toutes les catégories produites dans la chaîne opératoire. Sa distribution dans les differents secteurs fouillés est clairement en relation avec la nature des couches et la structuration de l'espace. Ainsi les produits de débitage sont nettement plus abondants dans les aires extérieures, notamment c'est là que se concentrent la plupart des nucléus et percuteurs, comme par exemple dans le secteur 4B où l'on a trouvé groupé un nombre important de nucléus et percuteurs, tandis que proportionellement les espaces construits contiennent une majorité de produits retouchés.

Les percuteurs trouvés présentent une forme cylindrique et sub-cylindrique, il s'agit normalement de galets de silex grossier, de dimensions qui varient entre 85/82/71 mm et 50/49/47mm. Les nucléus ne sont pas très nombreux, un total de 26 pour l'échantillon étudié ici et ils sont tous en silex à l'exception d'un seul exemplaire qui est en obsidienne. Les nucléus sont pour la plupart à lames, normalement naviformes (fig. 6:1) tandis qu'on en observe également quelques uns à éclats dont la morphologie est irréguliere et parfois prismatique. En termes généraux on peut donc conclure que les nucléus montrent essentiellement une exploitation laminaire du silex à partir d'un systeme de taille bipolaire, et dans quelques cas unipolaire, bien que la taille d'éclats soit présente dans une moindre proportion.

Jusqu'à présent on a trouvé un seul nucléus à lamelles d'obsidienne (secteur 2C), unipolaire de forme conique et de petites dimensions (30,7/14,3/8,8 mm) réaménagé à la fin de son exploitation par une extraction laminaire épaisse opposée au plan de percussion préférentiel (fig. 6:2).

Lames et lamelles

On a distingué entre lame ou lamelle selon la définition traditionelle, c'est à dire un support allongé dont le rapport longueur/ largeur est égal ou superieur à 2. Toutefois nous désignons comme support laminaire celui qui, ayant ces caracteristiques métriques, montre une intentionalité tecnhique au moment de la conceptualisation du volume pour le développement de méthodes de taille laminaire, ne tenant pas compte donc des supports allongés (éclats) qui ne présentent pas ces caractéristiques.

En ce qui concerne les lamelles on considère le seuil de 10 mm de largeur en nous appuyant sur les observations de J. Tixier: "C´est à l´intérieur de chaque complexe industriel concerné que l'on peut établir et chiffrer une limite lame/lamelle." (TIXIER *et al.* 1980). Le groupe de lamelles est essentiellement représenté par le matériel lithique taillé en obsidienne, constituant 46% des produits en ce matériaux. En ce qui concerne le silex, les lamelles ne sont presque pas représentées n'atteignant que 1% de l'ensemble des produits de débitage.

Les lames sont faiblement représentées dans les produits de débitage, n'atteignant jamais de pourcentages supérieurs à 30% (secteur 2D), tandis que dans les secteurs inférieurs du tell elles peuvent arriver à 10,98% (secteur 2B).

[1] Communication personnel de G. Schneider (Institut für Anorganische und Analytische Chemie, Freie Universität Berlin).

Les caractéristiques technologiques des lames et lamelles en silex reflètent une taille unipolaire essentiellement avec le silex à grain grossier tandis que la taille bipolaire est représentée dans les deux qualités de silex.
En ce qui concerne l'obsidienne elle reflète une taille unipolaire par pression produisant des lames et lamelles aux aretes rectilignes et parallèles, avec une légère convexité distale reflétant une standardisation de la production laminaire.

Eclats

Les éclats constituent la majorité des produits de débitage, entre 70% et 90%. On doit signaler que parmi eux on retrouve une grande proportion d'eclats avec cortex, qui peuvent atteindre dans le cas exceptionnel du secteur 2B 41,59%, mais plus régulièrement 20-30% du matériel (fig. 1). Ceci met en valeur le processus de décorticage réalisé sur le site pour le silex de variété courante (grain grossier), tandis qu'on observe l'absence de ce type d'éclats sur les autres types de matériaux.
Cette plus grande frequence des éclats est opposer à la finalité de la taille orientée vers la fabrication de supports lamellaires. La raison serait probablement en relation avec la preparation des nucléus bipolaires qui demandent un long aménagement des blocs et donc entraine une grande quantité de restes de taille.
Les éclats en obsidienne sont très peu representés, avec seulement un total de 56 produits pour l'ensemble de l'echantillon presenté ici. L'absence d'un volume significatif d'éclats liés à la préparation des nucléus nous amène à considerer, à nouveau, que l'obsidienne devait arriver probablement préparée pour le débitage, dont la presence d'un nucleus prouverait la réalisation sur le site.

L'outillage lithique

La comparaison des pourcentages de produits bruts et de pièces retouchées montre, à un niveau général, que le type de support le plus utilisé pour la fabrication des outils est la lame. Ainsí, les artefacts retouchés sur supports laminaires ont des pourcentages qui varient entre 33,8% (secteur 4C) et 53,03% (secteur 2C). Le rapport entre le nombre d'éclats utilisés comme supports d'outils et ceux bruts reflète une faible utilisation, car le pourcentage d'éclats transformés en outils ne dépasse pas 7,1% (carré 2C). En ce qui concerne les lamelles les effectifs sont trop faibles (fig. 3:a-b).

Armatures

Le type d'artefact retouché les plus représenté dans l'ensemble des différents secteurs est constitué par les pointes de flèche. Parmi celles-ci on retrouve surtout des pointes de Byblos (fig. 7:3-5 et fig. 9:2-4), définies par J. Cauvin, comme une pointe laminaire avec pédoncule réalisé par un double "épaulement" et sans ailerons (CAUVIN 1968). De façon générale les pédoncules sont realisés par retouches abruptes ou semi-abruptes directes qui n'affectent pas la totalité de la face dorsale, à l'exception de quelques cas où la retouche est abrupte profonde, donnant alors une section plus triangulaire. Sur la face inverse, l'ablation de la convexité bulbaire par des retouches plates ou par un coup de burin est courante. Cet aménagement observé sur d'autres sites de la Vallée de l'Euphrate, comme par exemple Bouqras (ROODENBERG 1968), serait en relation avec la recherche d'une utilisation de la zone pédonculaire, trait qui faciliterait l'emmanchement de l'objet. A partir des mesures des pedoncules des secteurs 4B et 4C on observe une standardisation typométrique (fig. 5).

La partie médiane apparaît brute et dans quelques cas présente une retouche directe ou inverse continue, tandis que la partie distale se présente sans retouche ou bien retouchée sur la face inverse pour renforcer la pointe. Le support normal consiste en lames longues (6/9 cm) qui normalement presentent une extremité distale déjà legerement appointie naturellement.

La présence de pointes d'Amuq est attestée surtout dans les secteurs plus récents. Leur nombre n'est pas très abondant (un total de 10 exemplaires a été observé, deux dans le carré IA et 8 dans le carré IIC). Elles présentent deux variétés, selon que la retouche de type plate couvrante, transversale ou en écharpe, concerne la totalité de la pièce (pointe dÀmuq 1, fig. 7:2) ou seulement couvre le tiers proximal (pointe d'Amuq 2, fig. 7:1).

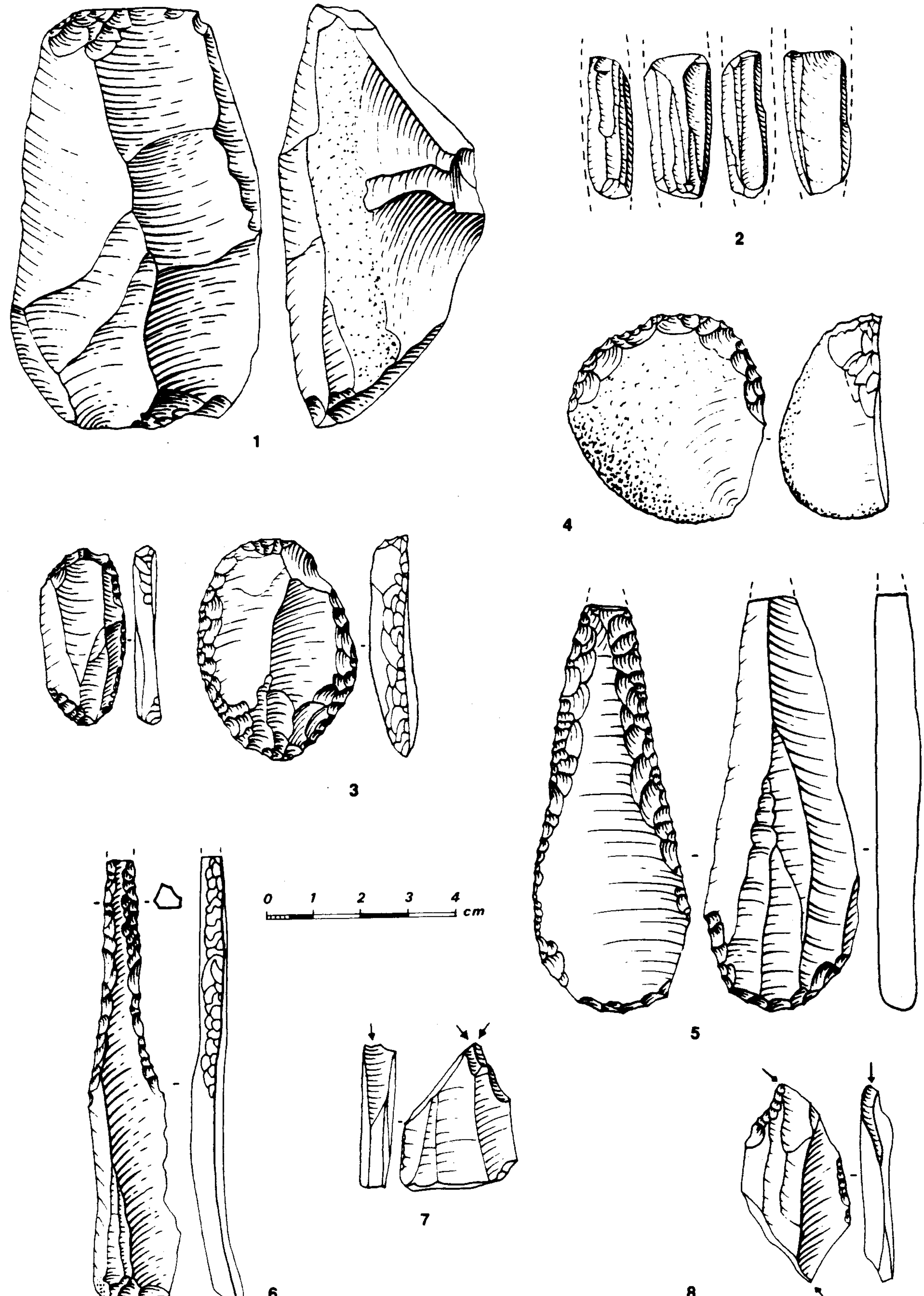

Fig. 6. Nucléus et outils des niveaux reécents (carrés 1A-2C).

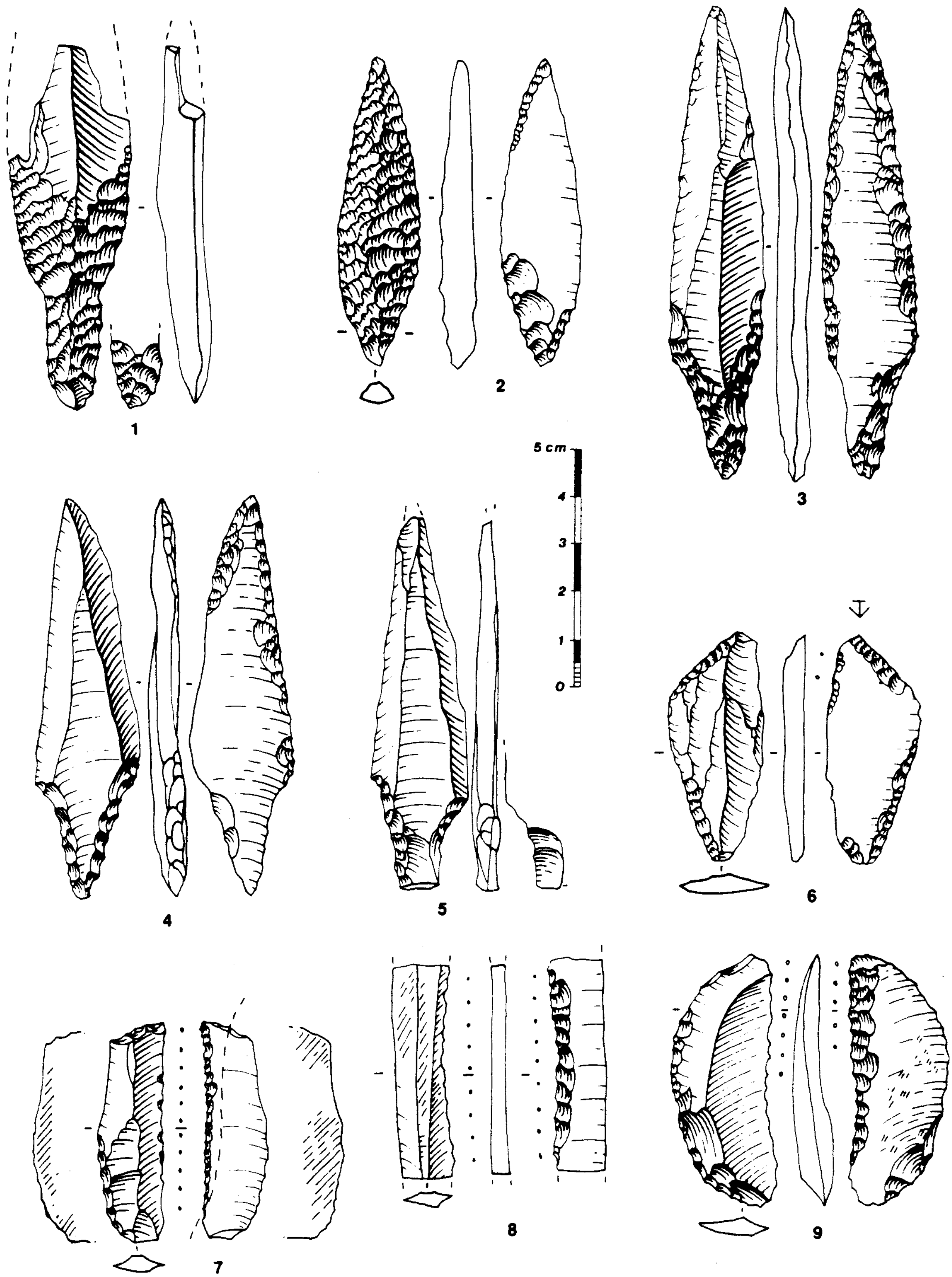

Fig. 7. Outils des niveaux récents (carrés 1A-2C).

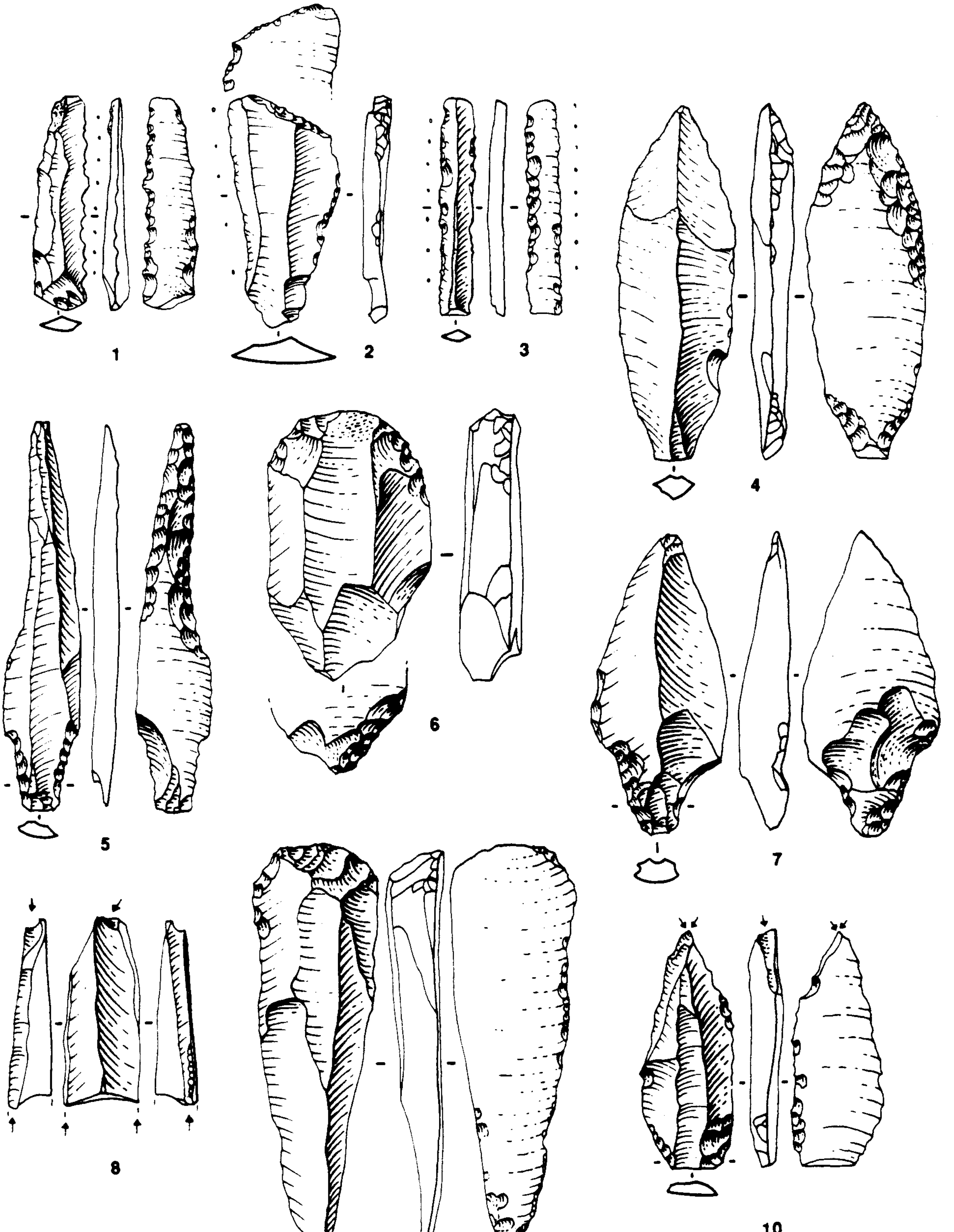

Fig. 8. Outils des niveaux anciens (carrés 4C-4B).

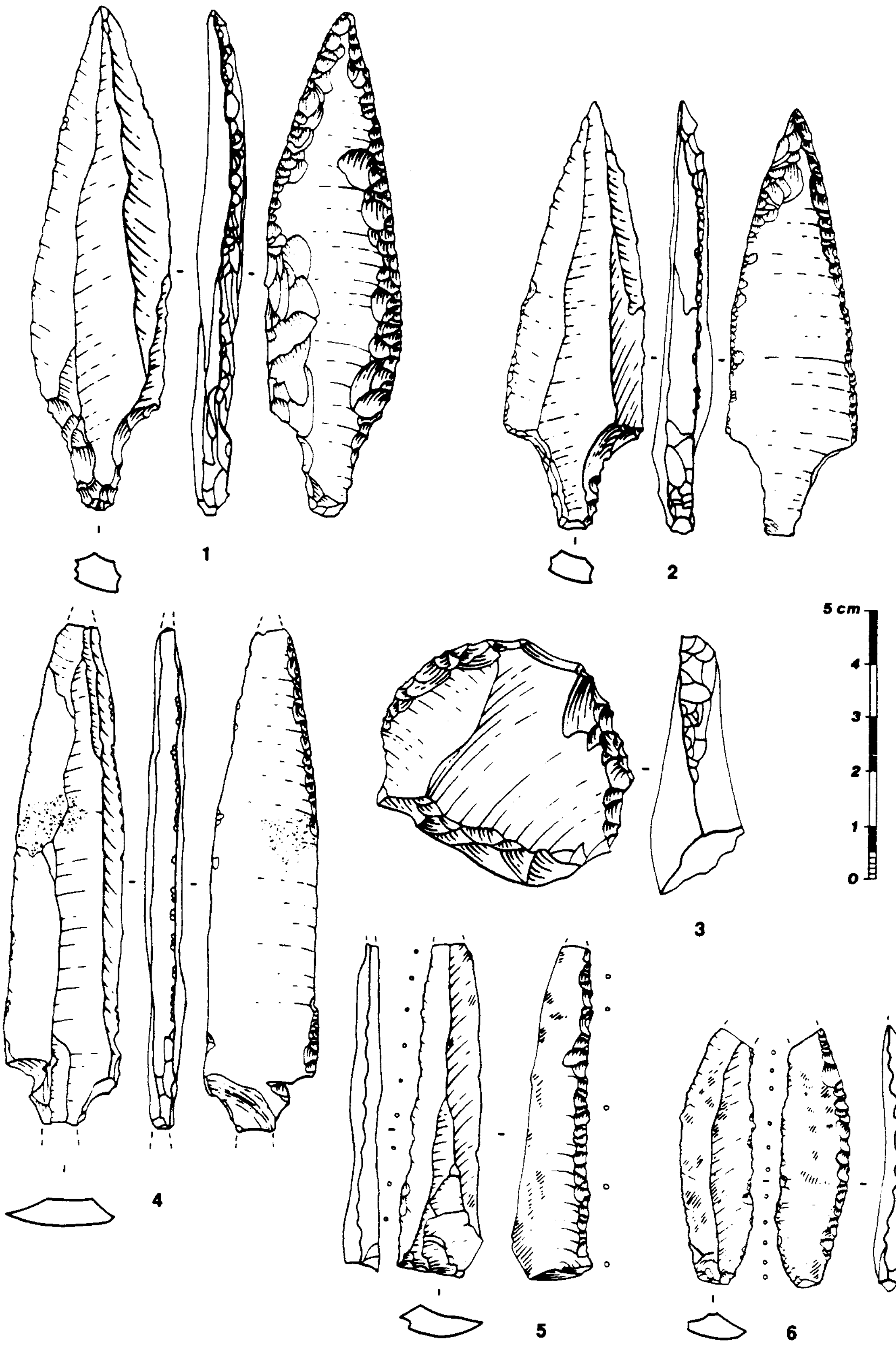

Fig. 9. Outils des niveaux anciens (carrés 4C-4B).

Pour la fabrication des pointes on note une selection de matière première, dont l'indice d'utilisation montre une nette préférence pour la varieté de silex à grain fin. On doit noter également la présence d'un pédoncule de flèche fait en obsidienne. L'état de conservation montre également des aspects significatifs: dans l'échantillon observé (n=128) la partie proximale est la plus fréquemment mieux conservée (53,1%); la partie mediane est seulement présente dans 7,8% , la distale pour 23,4% et seulement 15,6% sont conservées entières. Cette prédominance de parties proximales est significative et pourait être en relation avec la reparation de la partie lithique du projectile dans l'habitat. Dans la même ligne il faut souligner la réutilisation des parties distales des lames-pointes comme supports pour la fabrication de burins qui peuvent être dièdres, obliques ou d'axe avec préparation. Cette dernière variété montre une nette intentionalité de ces burins en les différenciant des autres types, également présents sur le site, qui sont souvent le résultat des impacts. Ceux-ci montrent d'autres caractéristiques, comme des extractions irrégulières ventrales et dorsales dans le sens de l'impact, coups de burins sans préparation et marquant des xarneles.

Lames retouchées

Après les pointes, le groupe le plus abondant est celui des lames retouchées avec un total de 113 artefacts. A l'intérieur de cette catégorie on différencie les lames et fragments de lames avec des retouches, normalement marginales ou semi-abruptes.

On doit souligner qui les lames qui presentent un poli visible à l'oeil nu, le plus souvent caractéristique de travaux sur des matières végétales et appelées lames-lustrées, sont associées dans la plupart des cas à des traces de goudron qui sont à mettre en relation avec le système d'enmanchement des élements. Le nombre de lames-lustrées parmi les lames retouchées est élevé ainsi, par exemple, dans les carreés 4B et 4C, sur un total de 64 lames retouchées 45% présentent du lustre et parmi celles-ci 72% présentent des restes de goudron.

Il s'agit de lames, dans la plupart de cas fracturées dans la partie distale et proximale, bien qu'il existe également des lames entières qui peuvent mesurer jusqu'à 8 cm de longueur. Elles présentent une retouche semi-abrupte continue inverse et dans certains cas peuvent comporter de légères denticulations (fig. 7:8 et fig. 8:1), ou des retouches marginales. Parfois ces retouches correspondent au ravivage de la partie active de l'outil.

Il existe d'autres traits technologiques qui ont un rapport avec l'enmanchement de la lame: c'est le cas de la troncature (fig. 7:7 et fig. 8:2) et de la bitroncature de quelques lames ainsi que l'ablation de la convexité bulbaire par des retouches inverses.

Grattoirs

Le grattoir est un des autres outils le mieux représentés avec un total de de 87 unités; la majorité est en silex à grain grossier (62%) et l'utilisation des types de support montre la même proportion entre éclats et lames. Lorsqu'on observe les effectifs dans les différents secteurs on note qu'ils sont très nombreux dans les carrés supérieurs, avec près de 88% du total, tandis que dans les carrés inférieurs ils sont très peu representés. L'explication de cette nette différenciation de distribution devra attendre un echantillon plus large: elle relève peut être d'une interpretation chrono-culturelle ou d'une différentation dans d'espace (aires de travail significatives, ...).

Le type de grattoir le mieux représenté est le grattoir à front arrondi (63%) où la retouche est limitée au front et dans quelques cas peut s'étendre légèrement latéralement (fig. 6.4). Les grattoirs doubles sont également présents avec une proportion de 13,7% du total. Ils sont surtout présents dans les carrés supérieurs et seulement un exemplaire dans les carrés inférieurs (4B et 4C). Il y a aussi des grattoirs à front rectiligne, semi-circulaires, dejetés et obliques.

Burins

En ce qui concerne les burins, ce groupe typologique est representé par un total de 38 exemplaires dont 78.9% on été trouvés dans les secteurs inférieurs, sans tenir compte des burins sur pointes de flèches. Les types dominants, dans tout l'ensemble, sont celui d'angle et le dièdre (fig. 6:7 et fig. 8:8,10) qui peut être d'axe ou d'angle. Il y a également des burins transverses et doubles (fig. 6:7).

En ce qui concerne le support on note une nette prédominance des lames (79%) par rapport aux éclats. La preference est également pour le silex à grain fin (58%).

Divers

Les catégories moins représentées sont formées par les perçoirs sur lames à grain fin (qui constituent entre 1,5% et 5,3% selons les carrés. La presque totalité des exemplaires présentent une grande taille et pourrait être considérés comme des mèches-allumettes (fig. 6:6). On retrouve également des éclats retouchés dont la proportion est plus variable encore, entre le 10,2% et 1,27%, et quelques denticulés.

Discussion

Les caractéristiques générales de l'industrie de tell Halula rentrent donc dans la tradition technologique et typologique du PPNB. L'analyse préliminaire montre une rationalisation dans les types de support recherchés et exploités avec une nette préférence pour la transformation des lames à grain fin en outils, en particulier pour la fabrication de pointes. En ce qui concerne les différentes proportions et les typologies précises des outils on peut signaler les similitudes avec les sites des périodes comtemporaines de la vallée de l'Euphtrate. En effet les parallélismes avec Bouqras sont très nombreux, depuis l'aspect purement technologiques comme l'enlèvement de la convexité du bulbe, comme aux niveaux récents la présence de pointes d'Amuq. Il en est de même avec les sites de Abu Hureyra (MOORE 1875) et avec Tell Assouad (CAUVIN 1972).

Lorsqu'on veut s'approcher a une vision diacronique de la séquence, on est limité par la représentativité de l'échantillon choisi et par la difficulté à lui configurer une valeur chrono-culturelle. En effet, on observe que la proportion entre burins et grattoirs est inverse selon les secteurs. Ainsi, dans les niveaux inferieurs les burins dominent, tandis que dans les supérieurs ce sont les grattoirs qui on une nette dominance, en plus d'observer que les grattoirs doubles sont partiquement représenté exclusivement dans les carrés supérieurs. D'autres différences significatives sont attestées dans le domaine des armatures. En effet, les pointes d'Amuq sont uniquement representées dans les carrés supérieurs, parfois avec un nombre tel qu'elles l'emportent même sur celles de type Byblos (carré 2C).

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The Naviform Method at Douara Cave II, Palmyra, Syria

Yoshihiro Nishiaki

The lithic technology of the Levantine PPNB is characterised by a special kind of core reduction strategy, known as the Naviform method. Cores characteristic of this method, which were first described by Cauvin (1968), have been reported from numerous sites over a wide area of the Levant including Sinai, Anatolia and the inland desert. The temporal distribution of the method appears to have been largely confined to the later Pre-Pottery Neolithic period, and is thus considered as representing a wide cultural horizon in the Levant. However, new data from more recent archaeological research has made us increasingly aware that the technology so far designated as 'Naviform method' at various sites may not be uniform but could contain considerable local/functional varieties (*cf.* CALLEY 1986; NISHIAKI 1992b). In this paper, the Naviform method at Douara Cave II, Palmyra, is presented as an example of one variation of this technology.

Douara Cave II and the Sampling

Douara Cave II is situated on the northern slope of Jabal ed-Douara, about 20km northeast of Palmyra, inland Syria. The Palmyra region has been subjected to several seasons of prehistoric investigations by a Tokyo University team since 1967. The investigations, including intensive site reconnaissance surveys in 1967 and 1974, have recorded dozens of late Pre-Pottery Neolithic cave and open-air sites (SUZUKI and KOBORI 1970; HANIHARA and AKAZAWA 1979). Douara Cave II is one of the eight caves (Douara Caves I-VIII) discovered along the Jabal ed-Douara in 1967. The Palaeolithic site of Douara Cave I, situated about 250m to the east, is the largest one to have been excavated in this area (AKAZAWA and SAKAGUCHI 1987 and ff.).

Two seasons of systematic artifact sampling were undertaken in 1967 and 1974 at Douara Cave II. A rock shelter rather than a cave, its entrance is only about 10m wide and 3m high. About 6m inside the cave entrance, the surface is almost flat, with bedrock exposed at the innermost end. A terrace of about 40 x 15m extends southwestward. Although the lithic artifacts scattered on the surface indicated that the cave was occupied in the late Pre-Pottery Neolithic period, a small test-pit was opened in front of the cave in order to obtain more precise information on human occupation at the cave. The bedrock was not reached, but the geomorphological setting of the cave suggested that the archaeological deposits would not have been thick. According to the excavators (T. Akazawa, pers. com.), the deposits contained 'amazingly rich' flints for the volume of soil removed. This observation and extensive edge-damage seen on the flints suggest that most of the original soil deposits were probably washed away by water activities. In fact, no occupation floor that could have been dated by radiocarbon methods was identified.

The total artifacts obtained from the 1974 sampling were about 3600 flints. There were no obsidian or sherds. These flint artifacts are very homogeneous in techno-typological terms, and are all considered to have been derived from a single PPNB industry. In spite of the rather unsatisfactory archaeological context outlined above, this collection is believed to deserve detailed analysis for two reasons. First, it represents the largest, and the most sytstematically collected sample so far available on the PPNB industry of the Palmyra basin. Second, the collection provides a view of the flaked stone industry at an 'occupation' site in this area. Most of the PPNB sites so far reported in the Palmyra basin are either factory or quarry sites, with lithic collections containing numerous cores and debitage but virtually no tools (AKAZAWA 1979). Douara Cave II might also well have been visited for activities relating to flint knapping, but it has produced a reasonable number of retouched tools available for typological analysis as well.

The Lithic Artifacts

The general inventory of the flint artifacts is shown in Table 1. Retouched pieces constitute about 10% of the assemblage, while the majority of the artifacts are cores and debitage derived from core reduction. Typological variability of the retouched pieces is limited (Table 2). The dominant group, comprising more than 70% of the total tools, is retouched blades and flakes, most of which are so called 'proximal-scarred pieces' (COPELAND, n.d.). They are blades, more rarely flakes, with a pseudo-burin-facet at the ventral surface of their bulbar end (Fig. 1:7, 8). This type of retouch is mostly situated parallel to the left lateral edge of the tool blanks. Unlike the ordinary burin facet, it slants onto the ventral surface, resembling the 'burin plan' or the obsidian corner-thinned blade (NISHIAKI 1990). A number of retouch spalls were also collected at the cave (Fig. 1:9). Pieces with the same type of retouch, first reported at Bouqras (de CONTENSON and van LIERE 1966: 183), have been known from many PPNB sites particularly in inland Syria (e.g. MOSS 1983; FUJII 1986). Since close examination of the examples from Douara II shows that this retouch was employed to modify conventional tools as well (Fig. 1:1, 3, 6), it should be regarded as representing a retouch technique rather than a single tool type.

Categories	No.	%
Cores	121	3.38
Core trimming pieces	270	7.53
Cortex flakes	62	1.73
Part-cortex flakes	258	7.20
Flakes	814	22.71
Part-cortex blades	229	6.39
Blades	1081	30.16
Retouched tools	341	9.51
Retouch spalls	100	2.79
Chips	272	7.59
Fragments	36	1.00
Total	3584	100

Table 1. Flint artefacts from Douara Cave II

Categories	No.	%	%
Points	4	1.17	4.00
Burins	65	19.06	65.00
Scrapers	24	7.04	24.00
Borer	1	0.29	1.00
Truncation	1	0.29	1.00
Rods	3	0.88	3.00
Splintered pieces	2	0.59	2.00
Retouched blades	209	61.29	Na.
Retouched flakes	32	9.38	Na.
Total	341	100	100

Table 2. Retouched pieces from Douara Cave II

Apart from these enigmatic pieces, the remaining retouched tools are dominated by burins (65.0%). Burins from Douara II include several types such as angle (Fig. 1:4), transversal, and dihedral burins (Fig. 1:6). Truncation burins are an interesting type (Fig. 1:5), comprising about 11% of the total burins. They often have a concave truncation, similar to the burins from the inland burin Neolithic sites of the late 7th and the 6th millennium BC (BETTS 1986; ROLLEFSON and SIMMONS 1988: 102). Another interesting piece is the tanged burin. Similar pieces are common in the PPNB levels of Abu Hureyra (MOSS 1983). Tanged points that can be designated as Byblos points are rare at Douara II (4.0%; Fig. 1:1). Retouch, probably made by pressure flaking, is generally limited to the tang. End-scrapers, the second most common tool group at Douara II, comprise 25.0% (Fig. 1:2, 3). They were made by steep retouch at the distal or proximal end of the blank. Interestingly, end-scrapers were often made on core-tablets, which were otherwise rarely used as tool blanks. A few of the end-scrapers have burin facets at the end opposite the scraper end (Fig. 1:4). Other tools include a borer, a truncation, rods, and splintered pieces, all rather atypical specimens. Long borers made on thick blades such as those from the middle PPNB levels of Abu Hureyra (MOORE 1975) are not included.

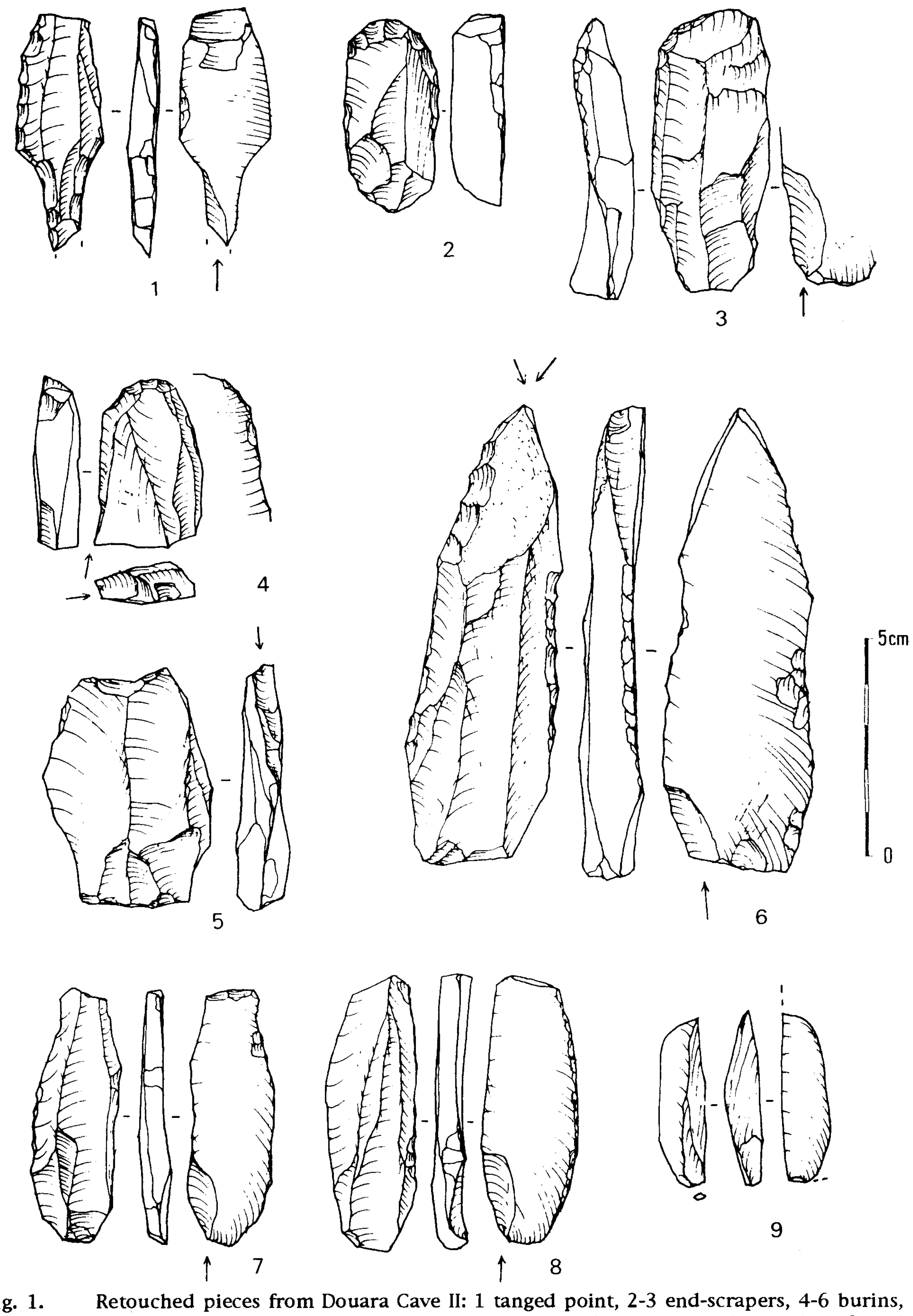


Fig. 1. Retouched pieces from Douara Cave II: 1 tanged point, 2-3 end-scrapers, 4-6 burins, 7-8 proximal-scarred pieces, 9 retouch flake of proximal-scarred piece (Note that tools 1, 3 and 6 retain proximal-scarring retouch.).

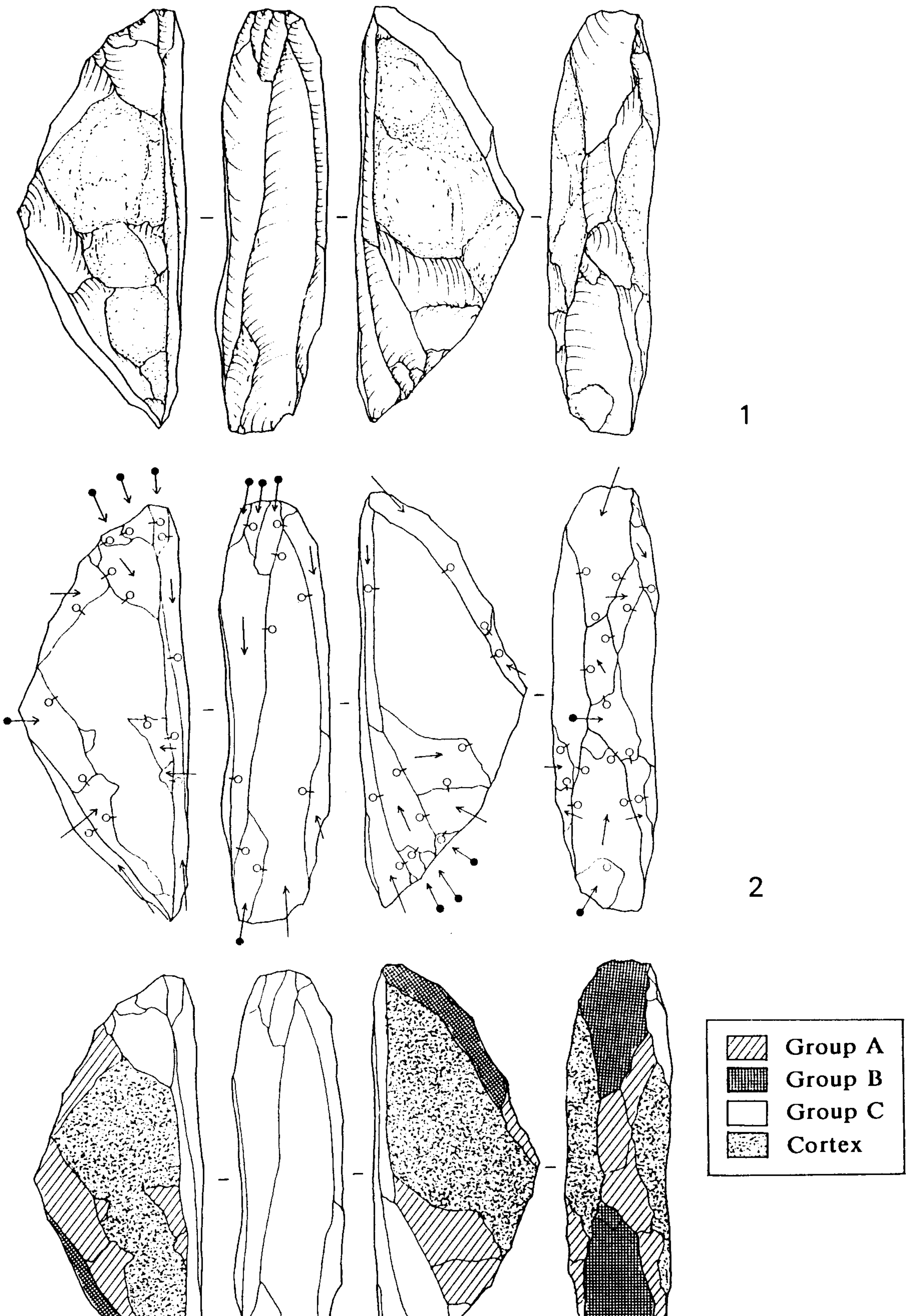


Fig. 2. Scar-pattern analysis of a naviform core from Douara Cave II: 1 naviform core, 2 order of flake scars, 3 grouping of flake scars.

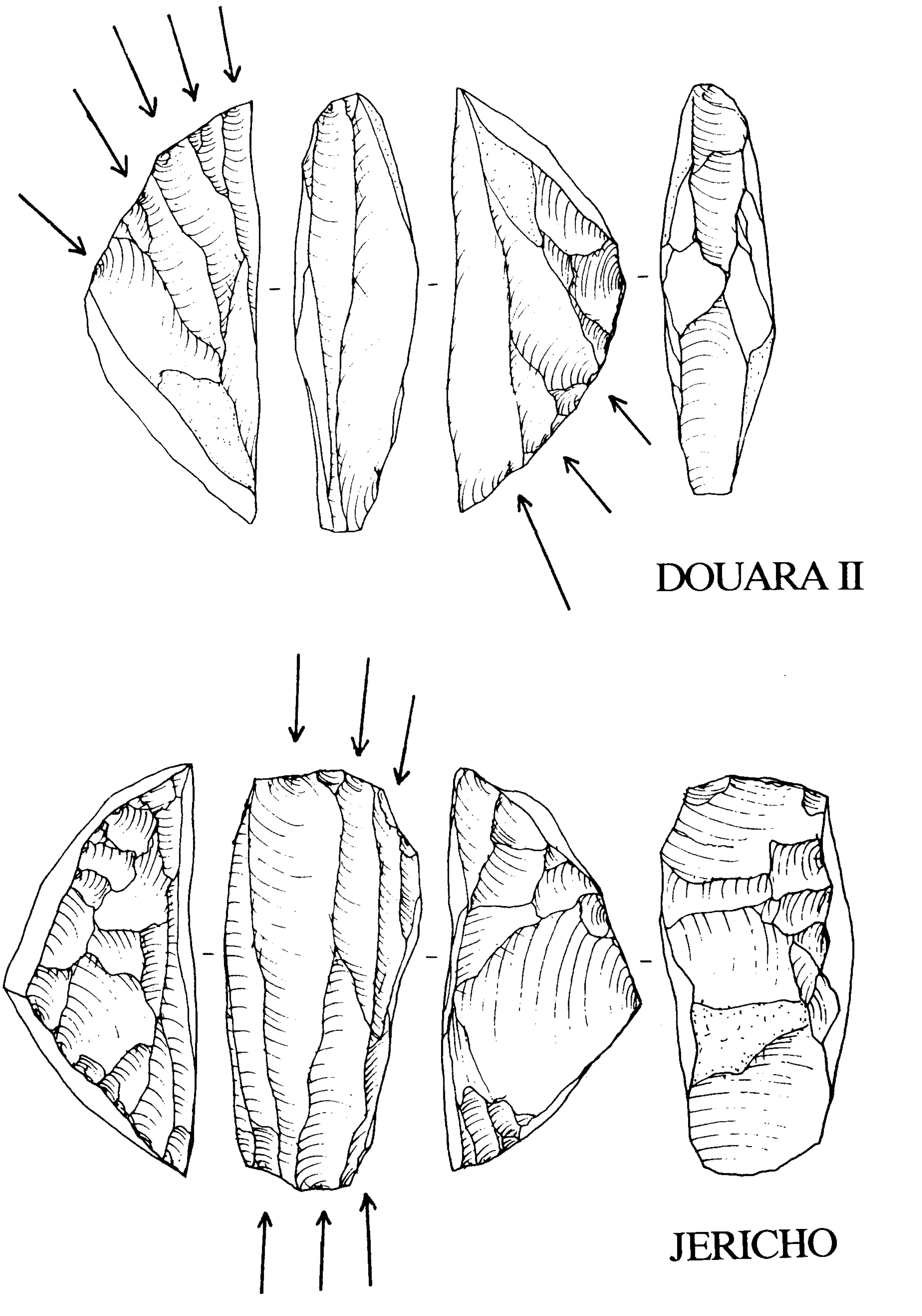


Fig. 3. Naviform cores from Douara Cave II and Jericho (Ashmolean Museum collections) *<Arrows indicate the flaking axes. Note the twisted flaking axis of the Douara core.>*

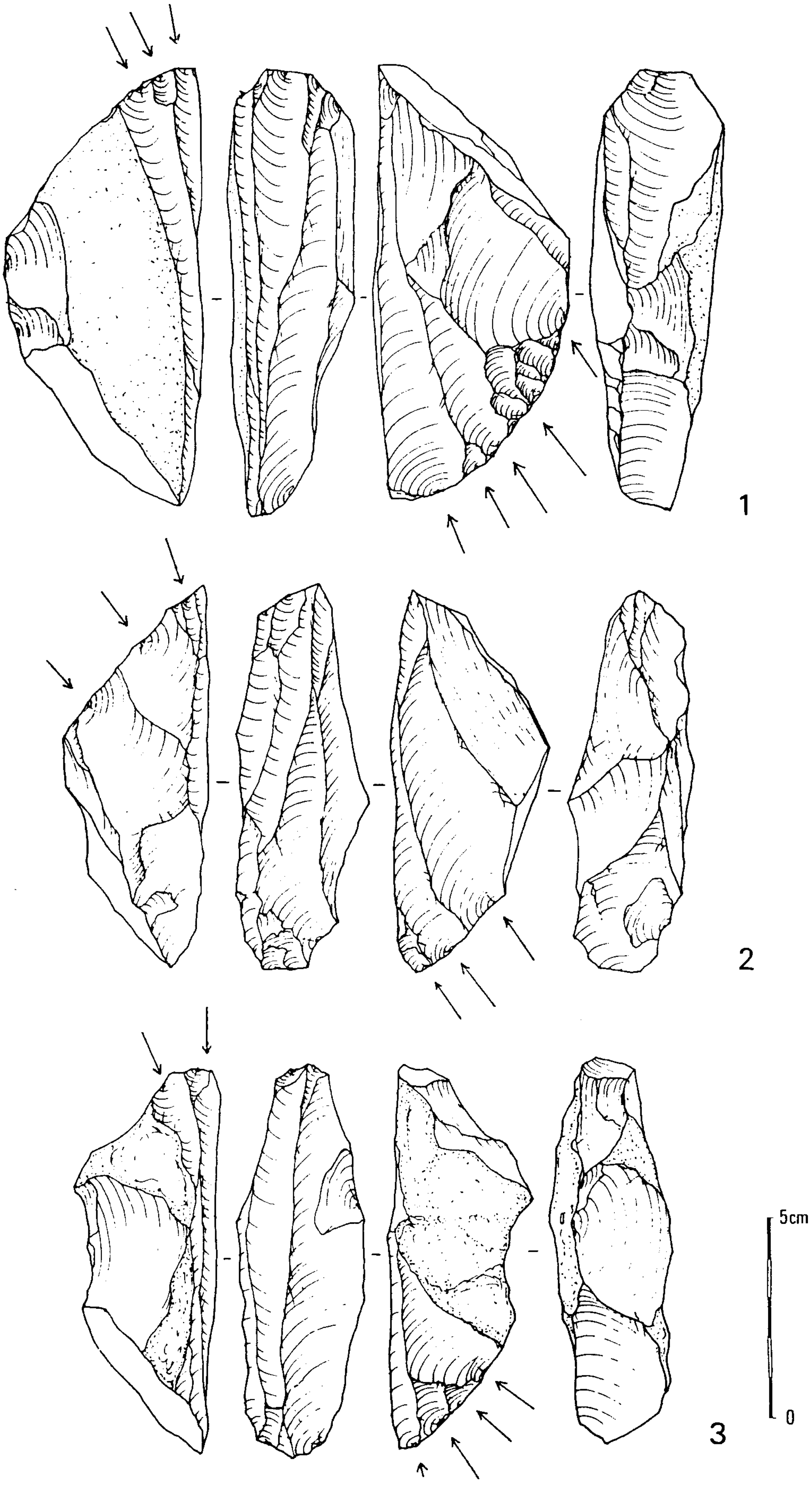


Fig. 4. Naviform cores from Douara Cave II.

Among the typological characteristics, the rare occurrence of points and the dominance of burins including truncation burins deserve particular attention, for these can give an approximate date to the Douara collection. Similar features have been noted at Bouqras, Tell es-Sinn, Thanniyet Wuker, and a series of sites in the el-Kowm basin, all belonging to the late 7th and the early 6th millennium BC.Qdeir 1 in the el-Kowm basin, about 80km north of Douara, have typological features much like those at Douara Cave II. The retouched pieces from Qdeir 1 are also characterised by a simple combination of tanged points (5.3%), burins (51.4%), end-scrapers (24.1%) and a few other types such as borers and denticulates (CAUVIN 1981), with the proportion of each tool type as well as the typological characteristics being remarkably similar to these at Douara II. In view of the radiocarbon dates from Qdeir 1 (5610 ± 340), el-Kowm 1 (5450 ±45), and el-Kowm 2 (5730 ±200; 5810 ±280) (STORDEUR 1989), we may date Douara II to the final PPNB, that is the early 6th millennium BC.

The Naviform Method at Douara Cave II

The basic reduction process of the Naviform method in inland Syria was first reconstructed in detail by Suzuki and Akazawa (SUZUKI and AKAZAWA 1971), and was later elaborated by Akazawa (1979) and Calley (1986). The process may be summed up as consisting of at least four stages:

1) manufacture of a biface as a core preform,
2) preparation of two platforms and the main flaking surface by removing crested blades,
3) platform preparation by abrasion, and
4) blade production.

The Naviform method of Douara follows these stages, but also includes unique strategies, particularly in the blade production stage, which the following discussion will focus on.

Cores

The cores from Douara Cave II include a large number of Naviform cores and related opposed-platform cores, which form about 80% of the total (95/116). Other core types include single-platform, multiple-platform and change-of-orientation cores. It is not known whether these latter represent independent reduction methods or are merely exhausted/reused forms of Naviform cores. In any case, they appear to have relatively little importance in the core technology at Douara II. The Naviform cores of Douara cover a wide range of reduction stages from preform bifaces to exhausted cores. These cores, and a larger number of flakes and blades, can be used to examine reduction strategies in detail.

Refitting is one of the best ways to reconstruct any core reduction method. However, it requires special conditions of artifact preservation. When refitting is impossible, as at Douara, scar-pattern analysis provides an alternative source of useful information. This method of analysis was considerably developed by Matsuzawa (1959, 1960; also see ABE 1976), who outlined a procedure for the examination of flake scars. Following Matsuzawa's scheme, we use symbols to indicate the flaking order of overlapping scars (Fig. 2:2). The open circle denotes the scar younger than the one truncated by the short bar attached to the circle. The arrow indicates the flaking direction, while the closed circle at the end of arrows shows that the scar retains a negative bulb. Using these symbols, each flake scar on the Douara cores was examined. The scars of each Naviform core were then sorted into three major groups. An example of the results is shown in Fig. 2:3. Group A scars represent lateral sides of the original biface, or core-blank. Group B corresponds to platforms created by crest removals. Group C, consisting mostly of elongated scars, are those left on the main flaking surface by blade production.

It has become evident from this analysis that Group C scars on many Naviform cores from Douara are distributed on one side as well as on the front of the cores. In other words, the axis of the main flaking surface does not conform to, but shifts anti-clockwise from the longitudinal axis of the core (Figs. 2-4). This curious aspect was, in fact, pointed out by Suzuki and Akazawa (1971: 118, 125) in their study of surface materials from the Palmyra basin, but has long been neglected in the current archaeological literature. Here, I would like to reemphasise this feature as one of the most important characteristics of the Naviform method of the Palmyra region.

Blades

Since blade production was conducted in a rather strange way, blades detached from the cores were also unusual. In the blade assemblage from Douara, four major types of blades were defined mainly on the basis of butt morphology (Fig. 5).

D-shaped blades: Blades with a small punctiform butt (74 pieces).

Type L blades: Blades with a butt intersecting the longitudinal axis of the blank at an acute angle (253 pieces).

Type M blades: Blades with a butt intersecting the longitudinal axis of the blank at a more or less right angle (171 pieces).

Type R blades: Blades with a butt intersecting the longitudinal axis of the blank at a wide angle (111 pieces).

It is very likely that these four types of blades were detached by means of different reduction processes.

D-shaped blades show a very standardised shape similar to an elongated capital 'D'. They share the following techno-morphological features: 1) they have a small punctiform butt; 2) they are asymmetrical in outline with a straight dorsal ridge parallel to the left edge; 3) there is a tiny flake scar on the proximal end of the ridge; 4) most are mostly around 3 x 1 cm; 5) their profile and a transversal section are a flattened scalene triangle; 6) their tip is feather-ended or often broken. These blades comprise 12.2% of the total complete, proximal blades from the Douara Cave II (74/609). The remarkably consistent shape of these blades suggests that they were produced not by accident but on purpose. A close examination reveals traces of their removals on the front of some cores (Fig. 2:1, 4:1). Since these blades were never used as tool blanks at Douara, they were probably detached for core preparation. They may have been removed to ensure that the subsequent percussion blow would penetrate well onto the flaking surface. In other words, these small blades might have been detached in order to prevent subsequent blades from plunging. Alternatively they could have been removed to adjust the flaking angle between the platform and the main flaking surface. The profile of D-shaped blades is always 'humped' near the proximal end (Fig. 5), indicating that the exterior platform angle, before their detachment, was too wide for successful subsequent blank production. In any case, it is believed that detachment of these blades was a deliberate core preparation procedure, which should be isolated as a unique aspect of the Douara method.

The other types of blades were probably detached as tool blanks. Type L blades, in particular, were most commonly selected as tool blanks. It is highly probable that the different types of blades were produced from different parts of a Naviform core. As shown schematically in Fig. 6, Type L blades were detached probably from the <u>left</u> side of the core, Type M blades from the <u>middle</u>, and Type R blades from the <u>right</u> side of the core. This interpretation is well supported by a couple of morphological features on the blades. First, the position of cortex on blades shows a strong left/right bias. Cortex on Type L blades is exclusively situated along the left edge (Fig. 5), and that of Type R blades is along the right. Additional evidence relates to the position of Group A scars on the blades. Those scars also show the same pattern on the dorsal surface of blades as that observed for cortex.

Interestingly enough, these three types of blades were produced not only from different parts of a core, but also with different technological strategies. First of all, the butt morphology is clearly different. Suzuki and Akazawa (1971: 114, 120) found that their collection from the Palmyra basin sites contained a large number of blades with a butt reminiscent of a dihedral burin. The blades from Douara also include many such examples. The butt in question actually represents not a burin edge (see Type L blade in Fig. 5), but consists of the platform and a lateral edge intersecting at an acute angle each other. Butts of the same type have been noted at the Upper Palaeolithic levels of Ksar Akil (Lebanon) as well, where it was described as *'talon imitant un burin dièdre d'axe'* by Tixier and Inizian (1981: 361), later translated as a butt 'imitating a dihedral burin' by Bergman (1987: 11). It is abbreviated as an IDB butt in this paper. The present analysis shows that IDB butts are closely associated with Type L blades, about 90% of which have this butt type (221/253), while none of Type M and R blades have an IDB butt. A second interesting technological difference concerns the depth of the percussion point from the core edge which is markedly different between the three types of blades. The point for Type L blades was chosen well away from the core edge, while that for Type R and M blades was selected very close to the edge (Fig. 7).

As for the overall morphology of the blades, one point worth mentioning here is the distal shape. It takes on a characteristic form on most of the blades from Douara Cave II: they rarely have a symmetrical, either pointed or rounded, tip, but often have a distal tip curved to the right (197/451 or 43.7%). There is no doubt that this anomaly in distal tip shape is related to the use of twisted cores as described above. Upsilon blades recently defined by Ataman and Calley (1988) at Turkish PPNB sites are extremely rare at Douara Cave II. These blades, which have a symmetrical Y-shaped dorsal ridge pattern, are found on a few specimens only (8/451 or 1.8%). Since the collection from Douara thus contains very few blades with a punctiform butt and symmetrical outline, we may stress that there are virtually no 'true blades' here (*cf.* BORDES and CRABTREE 1969: 1).

Interpretation

The above analysis shows that the Naviform method at Douara produced peculiar kinds of cores and blades. The most impressive feature of the method is the common use of twisted cores, and the abundant production of Type L blades. While this feature was first noted by Suzuki and Akazawa (1971) on the Palmyra basin collection and is confirmed at Douara in this paper, it seems not to have been reported from other regions of the Levant. In fact, Crowfoot Payne (1983: 667), who studied the PPNB lithics from Jericho, commented on Suzuki and Akazawa's discovery as follows: 'this unusual feature is not found at all on Jericho cores, which are struck across the front, and to a varying extent, but equally, from <u>both</u> sides' (underline by the present author; also see Fig. 3). We should then pose two questions. The first is related to the technological advantage of this 'unusual' method, and the second is whether the method represents a time-space specific technology or merely a functional variation of the Naviform method in general.

It is difficult to give a definite answer to the first question. For the time being, a careful examination of the pieces reveals one important feature: the platforms are not set up at right angles to the longitudinal axis of the core. The angle a , as shown in Fig. 8:2, is always larger, and the angle b is smaller than 90 degrees on Douara cores. From an experimental knapper's point of view, keeping those angles at about 90 degrees is essential in order to produce blades regularly along the long axis of the core (P.WILKE, pers. comm.). The cores from Douara, nevertheless, rarely show the 'correct' angle, but maintain the relationship of $a > 90^o > b$ so that one (i.e. b 's) side of the core are more easily exploited (Fig. 8:4). We cannot determine whether this strategy was conducted on purpose or in error, but the remarkable consistency strongly argues that it was an important habit of the Douara knappers. Whatever the case, one possible advantage of the use of this technology is that it allows plentiful production of Type L blades. As already noted in the previous section, Type L blades were apparently the most favoured tool blanks at Douara, probably due to their parallel lateral edges and robust proximal end (Fig. 7). Type L blades might have been produced with a view to hafting them.

We should also mention an obvious disadvantage of the Douara method in that the blades produced from this method are unavoidably often twisted. Nearly 70% of the total blades (137/209) are twisted in profile, while only about 20% (45/209) have a straight profile. Twisted blades would have been inconvenient for hafting. In order to compensate for this disadvantage, the knappers might have employed, in my opinion, the curious 'proximal-scarring' retouch so as to make the twisted blanks symmetrical (Fig. 8:5). The fact that the retouch was almost always applied to the left side of the ventral surface may support this interpretation.

In short, the method we are dealing with here probably represents a highly specialised technological system, consisting of a series of 'unusual' procedures which are closely related to each other from core preparation to final retouching (Fig. 8).

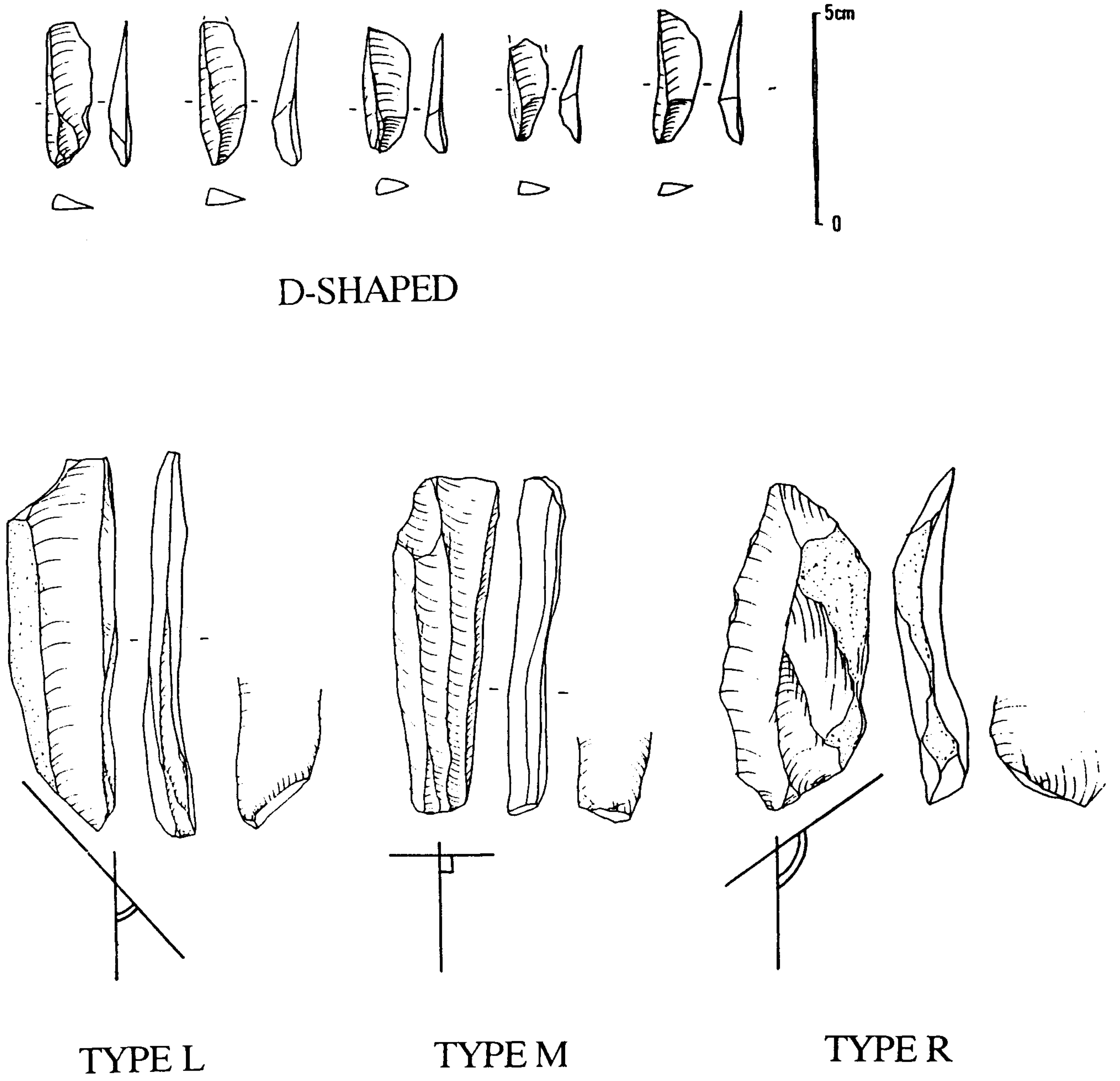


Fig. 5. Blade types for Douara Cave II.

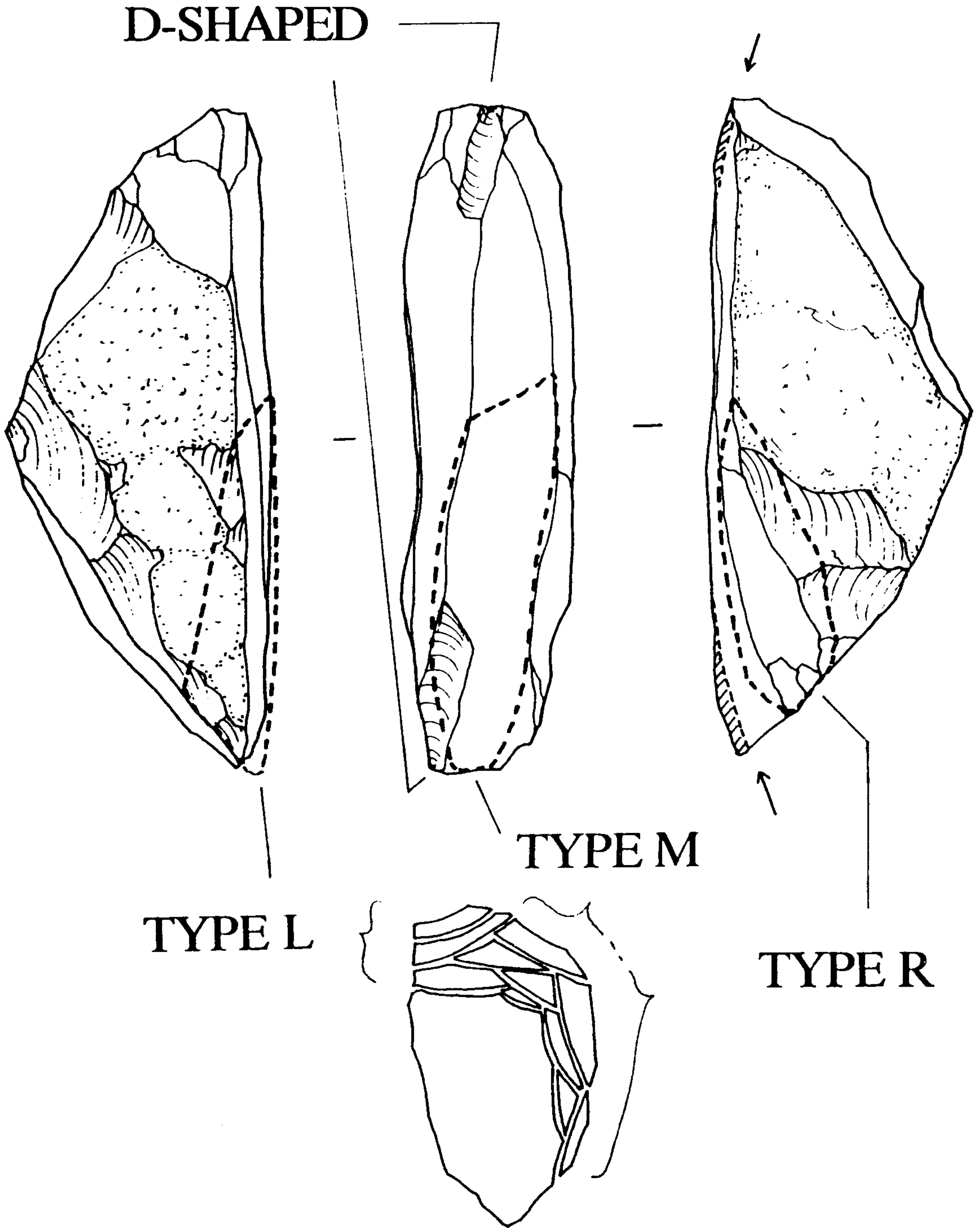
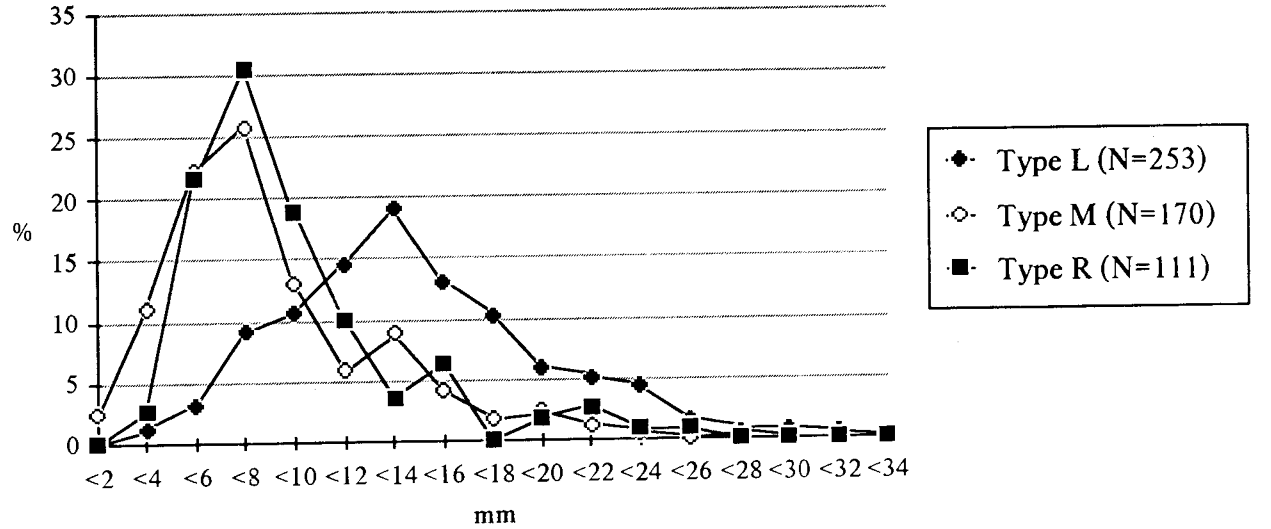


Fig. 6. Suggested positions on the core from which different types of blades were detached.

BUTT WIDTH



BUTT DEPTH

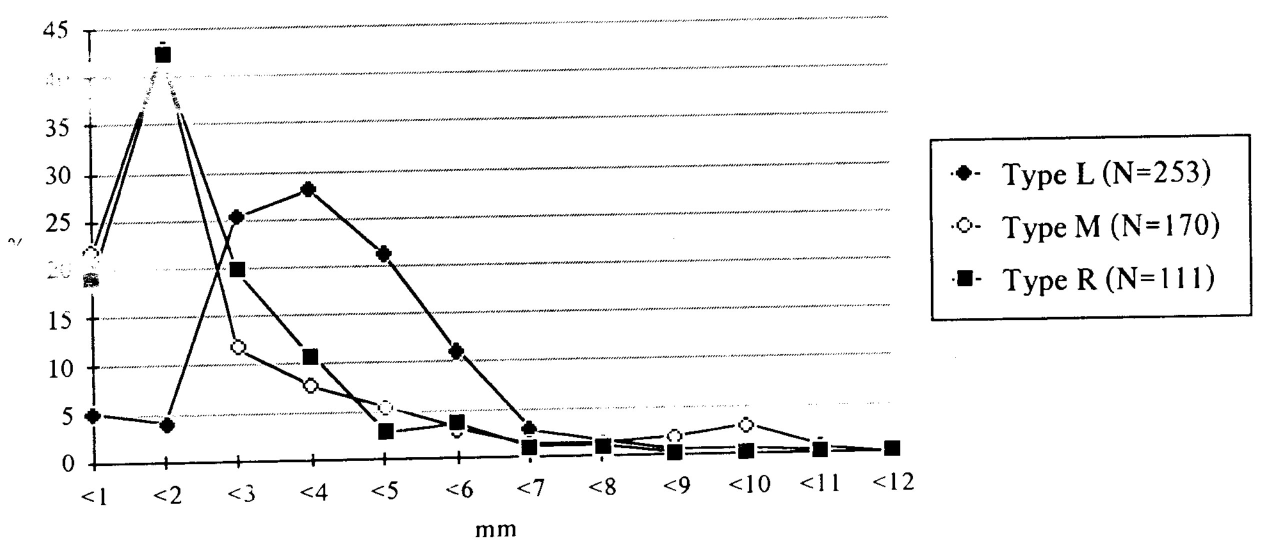


Fig. . Butt width and depth of blades from Douara Cave II.

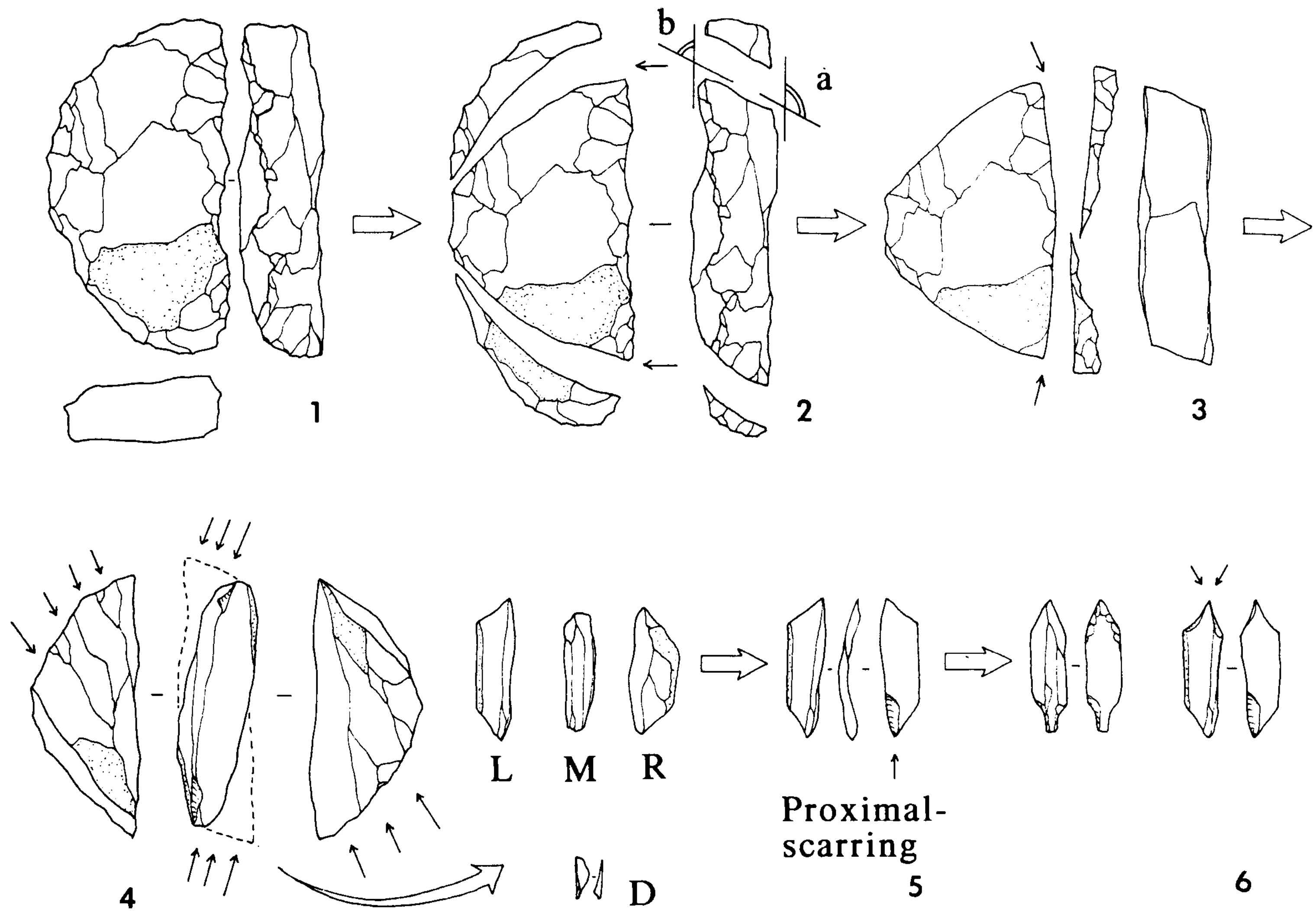


Fig. 8. A schematic model of the reduction stages for the Douara type Naviform method.

The second question is whether the Douara method represents a specific cultural entity. For quantitative comparison, two additional PPNB collections have been available so far: one from Abu Hureyra as an example of the North Syrian industry, and the other from Jericho, Palestine. The Abu Hureyra collection comprises about 8300 flint artifacts from Level 1 of Trench D (British Museum) and that from Jericho consists of 4000 pieces excavated from PPNB levels of Trench M (Ashmolean Museum). Both collections were derived from mid-7th millennium BC contexts, a period probably earlier than at the Douara cave. A comparable analysis reveals striking similarities between Abu Hureyra D and Douara, as well as differences observed at Jericho M (NISHIAKI 1992a). The method practiced at Abu Hureyra D is almost identical to that at Douara. Type L and D-shaped blades are also characteristic at Abu Hureyra, in proportions of about 35% and 10% respectively. These two types of blades are almost absent from Jericho M, on the other hand. The blades from Jericho M are characterised by fine Type M blades with a very small butt (c. 80% of the total), with a distal end which is either pointed or Y-shaped. The latter, or Upsilon blades, constitute as many as 14.8% of the blades at Jericho M (For more detailed data, see NISHIAKI 1992a). The technological similarity between Abu Hureyra D and Douara is even more striking when we look at the typological differences between them. The retouched pieces from Abu Hureyra D contain a large number of tanged points and elongated thick borers, both of which are rare in the Douara collection. Burins are common at Abu Hureyra, but they do not include truncation ones that are common at Douara. These differences probably reflect the fact that the Abu Hureyra D occupation was several centuries earlier than at Douara. It should be emphasied, nevertheless, that the inhabitants at both sites employed an almost identical core reduction strategy. The available literature suggests that a similar technology was also employed at Thaniyyet Wuker, Bouqras, Tell es-Sinn, and the el-Kowm basin sites (NISHIAKI 1992b). The Douara type Naviform method appears to have been used between the middle PPNB (Abu Hureyra D) and the late/final PPNB (el-Kowm), and to have a geographical distribution largely confined to northern inland Syria.

Conclusions

The regional variability of the Levantine PPNB has been repeatedly noted in many cultural elements, for instance, arrowhead typology and architectural technology (*cf.* GOPHER 1985; ROLLEFSON 1989). Rather unexpectedly, however, this seems not to have been the case for the study of the Naviform method. The Naviform method itself is known over a very wide region of the Levant, and it is admittedly 'the chief unifying factor' of the cultural provinces during this period (CROWFOOT PAYNE 1983: 705). This does not necessarily mean that exactly the same method was utilised everywhere in the Levant. Instead, a preliminary analysis in this paper suggests that, at least in northern inland Syria, a quite distinct variant of the Naviform method appears to have been used, possibly representing part of a North Syrian cultural entity (*cf.* MOORE 1981). Although this view obviously needs more comparative data for confirmation, there seems to be no doubt, to say the least, that a very specialised core reduction method was utilised in North Syria. The use of this method suggests that the knappers had a type of specific knowledge as well as a considerable amount of technical skill. This in turn raises new questions about craft specialisation during the PPNB. While this paper unfortunately does not answer them nor all the other problems posed in the text, but I hope that it has successfully shown that there is still a great deal to learn about the Naviform method.

Acknowledgments: Discussions with P. Wilke were very useful to formulate my idea about the Douara technology. I am also very grateful to the following for their assistance and comments during the present research: T. Akazawa, K. Assad, C. Bergman, L. Copeland, S. Kozłowski, N. Moloney, A.M.T. Moore, R. Morrey, and L. Quintero.

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A Cache of 56 Flint Transverse Arrowheads from Tell Sabi Abyad, Balikh Valley, Syria

Lorraine Copeland and Peter M.M.G. Ackermans

The Site and the Excavations

Sabi Abyad is a large tell covering over 4 ha, situated in the upper Balikh valley of northern Syria, about 30km south of the Syro-Turkish border; it is the largest of a cluster of prehistoric mounds (locally known as Khirbet Sabi Abyad) adjacent to each other in a linear pattern.

The archaeological work at Tell Sabi Abyad is part of a regional research project of survey and excavation which aims to explore the social and economic structure of later Neolithic society in the Balikh basin. Since the spring of 1986 four campaigns have been undertaken on the site, which showed that the mound was primarily occupied in the 6th mill. B.C. (AKKERMANS 1987; AKKERMANS and LeMIÈRE 1992). The earliest of the eleven main building levels now distinguished (Levels 11-7) belong to a pre-Halaf Neolithic phase of occupation, whereas the subsequent three levels (6-4) are part of a transitional stage between the earlier Neolithic and the topmost Early Halaf period (Levels 3-1). The 1986-1988 seasons revealed a series of superimposed, well-preserved Early Halaf multi-roomed rectangular buildings and small circular structures, dated around 5100 - 5000 B.C. In 1991 and 1992, as well as expanding and modifying these results, entirely new information was gained on the earlier 'Transitional' Levels 4-6 (in which the arrowheads described here were found). According to several radiocarbon dates, these transitional levels occurred around 5200 - 5100 B.C. (AKKERMANS 1991) and immediately preceded the Halaf at the site. No occupational hiatus is indicated, and the Halaf at Sabi Abyad was apparently the result of a gradual and continuous process of local cultural change.

The Context of the Flint Transverse Arrowheads

The transverse arrowheads were all found together (with some other flint implements and some traces of red ochre) on the floor in the southeast corner of one of the rooms in an irregularly-built Level 5 house, dated around 5150 -5100 B.C. (uncalibrated). The findspot was close to the south section of square Q15, and more arrowheads may be found when removing this baulk. This building, so far partially excavated, consists of several rather small oblong or nearly square rooms. Many contained ovens and hearths, suggesting an intensive domestic use. The arrowheads came from the largest room which was long and narrow, measuring 5 x 1.05 m.

The Arrowhead Cache

Transverse arrowheads of flint are here defined as a type of projectile having a straight or *tranchet* cutting edge instead of a point (extant examples of such a projectile type, still embedded in the arrow shaft, have been found in Egyptian Middle Bronze tombs). Those which occur at prehistoric Levant sites usually date, as at Sabi Abyad, to Late Neolithic or Early Chalcolithic cultures. Although perhaps more numerous in the southern Levant (BAR-YOSEF 1981: Fig. 3), they are quite rare in the northern Levant, for example one was reported at Mersin Level24, datable to about 5,000 B.C. (GARSTANG 1953), another at Byblos (*Néolithique Récent*; CAUVIN 1968), and four were found at Arjoune in a local Halaf context (Copeland, in Parr, forthcoming). It was therefore somewhat surprising

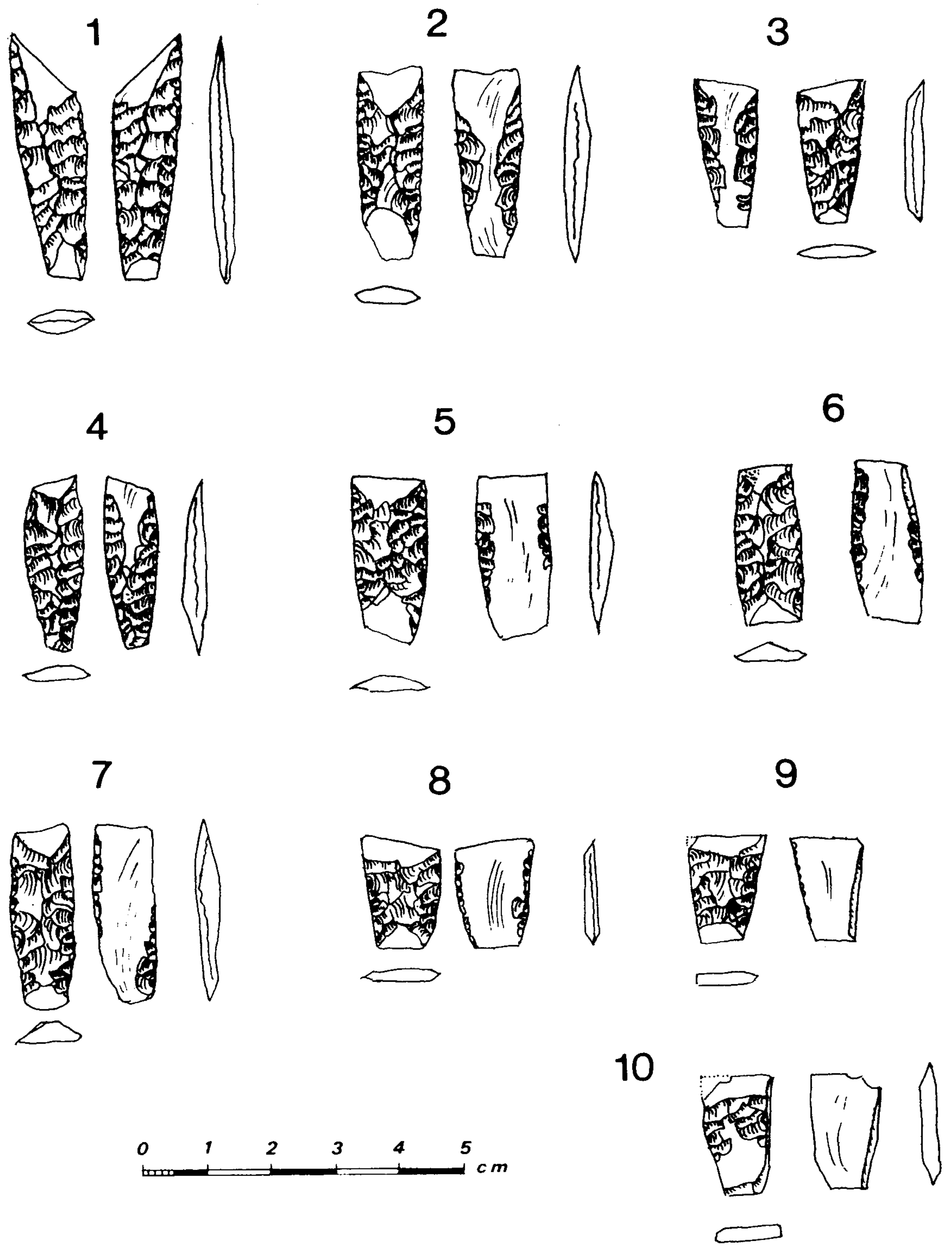

Fig. 1 Inventory of the cache of transverse arrowheads found at Tell Sabi Abyad.

to find no less than 56 examples and two fragments at Tell Sabi Abyad in one spot, in the Transitional (to Early Halaf) layers, as described above.

The specimens at other site differ from those at Sabi Abyad; some have one *tranchet* edge, the rest of the piece forming a tang, or they are trapeze-like or triangular (as in e.g. ROSEN 1982: Fig. 6), while those at Sabi Abyad are apparently 'double-ended', having two *tranchet* edges (only one of the 56 has a single edge; Fig. 1, 4).

The Sabi Abyad pieces are made on narrow (c. 1-1.2cm) segments, detached either on truncation or snapping from parent blades or flakes near the tip. Examples of suitable blanks from which such segments (averaging c. 2.8 cm from edge to edge) could be obtained abound in all the layers, but in every case a glossy beige flint was chosen although black, brown and rose flint raw material is used for other implements. The preferred thickness at the centre of the segment ranges from 0.4 (Fig. 1:1) to 0.2 cm (Fig. 1:8).

The sample may be divided broadly into three types:

(1) The elongated bifacial type shown on Fig. 1:1-4, where both dorsal and ventral surfaces of the segment blank have been retouched by pressure-flaking from each truncated or break-surface, often meeting at the centre (1 and 4).

(2) More common is the sub-rectangular type (25 specimens) as on Fig. 1:5-7; here only the dorsal surface is pressure-flaked, while the ventral surface has scalar, non-invasive retouch on the break-surfaces to make the piece lentoid in section (see profiles).

(3) This type (9 pieces) is short and more resembles a trapeze (Fig. 1:8-10); on half of these, one or both of the two break-surfaces have been very slightly semi-abruptly retouched (no. 8), the rest having no retouch on the break-surfaces (no. 9); very similar specimens (except that they are made of obsidian), have ben reported from Syrian and Iraqi sites of broadly the same general stage (see e.g. NISHIAKI 1990).

Sabi Abyad has so far produced no other flint transverse arrowheads, although three obsidian trapeze-type specimens occurred in the same level and in the level immediately above. The lithic industries of these phases are undistinguished, but characterised by the presence of tile-knives (tabular scrapers) in the flint and by side-blow blade-flakes and 'cores' for same in the obsidian.

It is not known how the projectiles were attached to the arrow shaft, but bitumen is present (on sickle-blade elements) at the site, and plaster is reported as the adhesive used at Tell Hadidi to attach a transverse obsidian specimen to the shaft (R. Miller, personal communication). As to the rest of the prehistoric Near East, a group of transverse arrowheads (37 pieces) was reported from the central Negev at Kvish Harith (ROSEN 1984), but so far the occurrence from Sabi Abyad is unique at Syrian sites.

Discussion

Present evidence from the Balikh valley has suggested that, following a widespread trend towards site abandonment in the first half of the 6th mill. (as elsewhere in the Levant, *cf.* the *hiatus palestinien*) the region gradually recovered. Some important changes now took place in settlement organisation and material culture, which undoubtedly affected the lifeways of later local Neolithic societies as well. Towards the end of the 6th mill., the latter folk seemed gradually to have recolonised the land, with the population now largely accommodated in a few major centres, such as Sabi Abyad. By 5200 B.C. only five settlements seem to have existed in the Balikh region, all with an area of occupation less than 2-3 hectares, all located in the northern, rainfed part of the valley. Our excavations indicate that settlements were villages formed of dense clusters of carefully planned, rectangular, multi-roomed pise structures surrounded by circular ones (curiously, mud-brick was the main building material used at earlier tells Damishliyya and Assouad (dating to the 7th to early 6th mill.; AKKERMANS 1986/87; J. CAUVIN 1972).

In addition to the changing pattern of settlement and the adoption of new building traditions, innovations took place in the artifact assemblages, of which perhaps the foremost were:

(1) the introduction of fine painted pottery closely resembling Samarra-like ceramics from sites in north-central Iraq;
(2) the appearance of clay sealings, pointing to the rise of a widely accepted, standardised administrative system involving the ownership concept and the means to control it; and
(3) the disappearance of the early 6th mill. Byblos and Amuq Point types of arrowheads and appearance of sling missiles made of sun-dried clay, suggesting changes in subsistence strategies.

However the finding of a cache of transverse arrowheads in one of the Level 5 houses at Sabi Abyad (most of which were not of the trapeze type usually seen in obsidian examples) shows that use of projectiles was not wholly abandoned (and in fact this can also be inferred from the decoration of painted ceramics illustrating persons with bow-and-arrow, found in Level 3 at Sabi Abyad and elsewhere, e.g. at Arpachiyah; *cf.* AKKERMANS and LeMIÈRE 1992, Fig. 21; HIJARA *et al.*, 1980: Fig. 10). It may not be without significance that the adoption of certain foreign styles and techniques from further east followed a period of instability, and that affiliation and conformation to new cultural norms may have given a considerable adaptive benefit. However, Balikh valley folk must have maintained links to the west as well, where transverse arrowheads were also in use at the same time.

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Late Neolithic-Chalcolithic Chipped Stone from Tell Mashnaqa, Northern Syria

Charlott Hoffmann Pedersen

Introduction

It seems that chipped stone inventories from the Late Neolithic and Chalcolithic periods in Northern Syria show similar characteristics. Therefore it is possible to consider these industries as one group. This is highly convenient because only few Late Neolithic/ Chalcolithic site reports include a detailed description of the chipped stone material and each site only produces a limited quantity of lithics.

Tell Mashnaqa is situated in the Khabur region in Northern Syria and is dated to the Ubaid period, Stratum I-III (radiocarbon datings: 5200-5000 B.C.), and the Uruk, Stratum IV-VI (radiocarbon datings: 4500 B.C.)[1]. So far excavation has been carried out in 1990 and 1991. Two further seasons are planned in 1994 and 1995. The total amount of chipped stone material found is 1687 pieces of which more than 80% derive from Ubaid layers[2], see Table 1.

Most Late Neolithic/ Chalcolithic sites have a rather large amount of obsidian in the assemblage[3]. At Tell Mashnaqa obsidian accounts for about 22% of the total. Obsidian is found mostly as blades; cores and flakes are only seen in small numbers (COPELAND 1989: 244). This indicates that obsidian was imported to the sites primarily as blade blanks. The flint assemblages show a more mixed content of both cores, flakes, blades, etc.

Technology

At Tell Mashnaqa the flaking industry mainly shows a simple flaking technique on multi-platform flake cores of a coarse-grained flint with only few flakes produced from each platform. This is also seen on other Late Neolithic and Chalcolithic sites i.e. Choga Mami and Umm Dabaghiyah (MORTENSEN 1973, 1983). A number of the blades found at Tell Mashnaqa are of a fine-grained flint of good quality. The flaking technique used in this case is more elaborate with indications of trimming of the edge of the core before flaking. The very few recovered cores of fine-grained flint are all entirely exhausted. Since the fine-grained material is found almost exclusively as blades, it is possible that this material was imported to the site as blade blanks as opposed to the coarse-grained material which was probably found and produced locally. The same situation is observed at Tell Kashkashok and Umm Dabaghiyah (NISHIAKI 1991: 41 and MORTENSEN 1983: 210). Since a large part of the Mashnaqa material is made from small pebbles, most of the debitage consists of flakes with cortex on

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1 The excavation at Tell Mashnaqa is part of a joint American-Danish regional project represented by Frank Hole (Yale University), Peder Mortensen (Moesgård Museum, Århus) and Ingolf Thueson (Copenhagen University).

2 The chipped stone assemblage of Tell Mashnaqa will be published in THUESEN (ed.), forthcoming.

3 e.g. Balikh Valley sites incl. Tell Sabi Abyad, Tell Kashkashok, the early layers of Umm Dabaghiayah (COPELAND 1979, 1989: 237; MORTENSEN 1983: 208; NISHIAKI 1991: Table 3).

the dorsal side. Among the total assemblage about 50% show cortex. The same situation is observed elsewhere, since the cores on most sites are made from small pebbles covered with cortex (NISHIAKI 1991).

Stratum	*Tools (#)*	*Debitage (#)*	*Other (1) (#)*	*Total (#)*	*Tools (%)*	*Debitage (%)*	*Other (%) (1)*	*Total (%)*
I	64	319	126	509	12.6	62.7	24.8	100.1
II	72	317	162	551	13.1	57.5	29.4	100.0
III	42	177	103	322	12.1	55.9	32.0	100.0
IV-VI	32	105	59	196	16.3	53.6	30.1	100.0
- (2)	21	68	20	109	20.2	61.5	18.3	100.0
Total	***231***	***986***	***470***	***1687***	***13.7***	***58.4***	***27.9***	***100.0***

(1) "Other" include cores, core trimming elements and indeterminable pieces.

(2) Include pieces found in contexts which could not be asigned to any strata , i.e. topsoil etc.

Table 1.

Tool Types	#	%	*Tool Types*	#	#
Scrapers	20	8.7	Arrowheads	3	1,3
Borers	9	3.9	Backed Pieces	16	6.9
Burins	7	3.0	Truncations	6	2.6
Notches	27	11.7	Lunate Shapes	9	3.9
Denticulates	15	6.5	Multiple Tools	2	0.9
Sickle Elements	38	16.5	Retouched Pieces	79	34.2
			Total	***231***	***100.1***

Table 2.

Typology

Concerning retouched material certain characteristics were prefered in the selection of tool blanks. Obsidian seems to have been favoured, since 40% of the tools were made in this material which only comprised 22% of the total. Other Late Neolithic sites show the same tendency, i.e. Tell Sabi Abyad and Yarim Tepe II (COPELAND 1989: 246; MERPERT and MUNCHAEV 1987). On Tell Mashnaqa blades were the prefered form of tool blanks, as seen on other sites too i.e. Umm Dabaghiyah (MORTENSEN 1983: 209), 75% of the tools are made on blades, while only 20% of the total are of blade size. Tools, defined as pieces with retouch or other signs of modification, i.e. sickle sheen, comprise almost 14% of the total assemblage.

Tool groups such as sickle elements and other cutting tools, such as backed, truncated and simple retouched blades, are always among the most numerous in Late Neolithic/ Chalcolithic assemblages (BRAIDWOOD and BRAIDWOOD 1960; COPELAND 1989). Such an inventory clearly shows a functional linkage with agriculture. At Tell Mashnaqa these tool groups account for 64% of the tools. Here, the group includes pieces with sickle sheen, tool groups similar to the sickle elements with no traces of sheen, denticulated pieces, and simple retouched blades. The rather high number of unretouched obsidian blades, which are found mostly as fragments, are potential tools for use in an agricultural context.

Tool groups often seen in earlier Neolithic contexts, such as projectile points, are now very few or absent (COPELAND 1979, MORTENSEN 1973), at Tell Mashnaqa only three pieces have been found, indicating a shift in major working processes from Early to Late Neolithic.

The retouched material at Tell Mashnaqa has been divided in twelve different groups divided into subtypes. No great differences are seen between the strata, except that a few subtypes disappears from stratum IV onwards. The distribution can be seen in Table 2.

The largest tool group is simple retouched pieces, constituting 34% of the tools. These are mostly blades found as fragments showing retouch on either one or both lateral sides. Other major tool groups

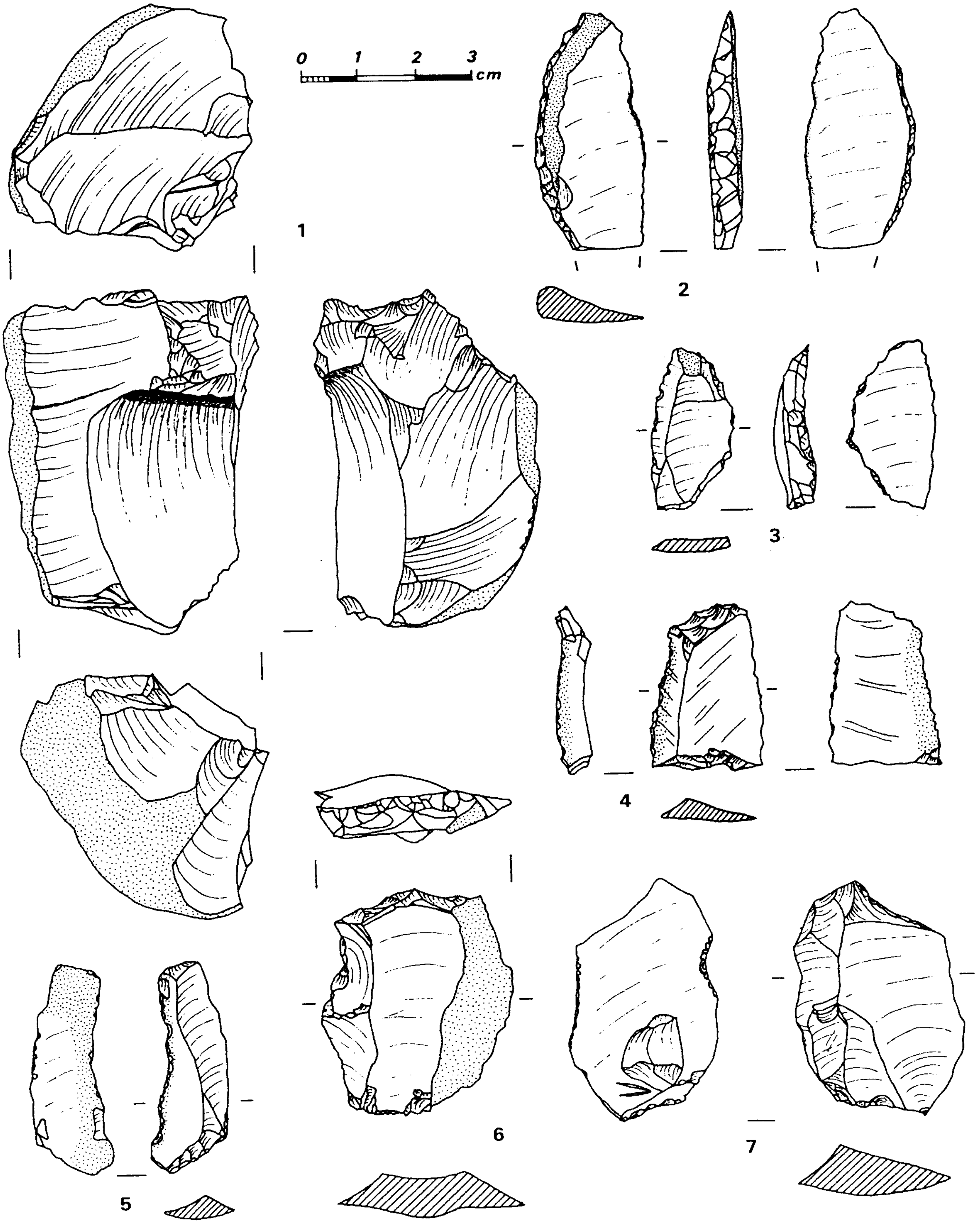

Fig. 1. 1 multiplatform flake core, 2-3 large lunates, 4-5 sickle elements, 6 scraper, 7 notched flake.

are sickle elements with 16.4% and notched pieces and scrapers with 11.6% and 8.6% respectively. Of the sickle elements 80% are made on blade blanks, the rest on flakes. Almost all show retouch either as backing, truncations or simple retouch on one or both lateral sides; only few are unretouched. More than 30% of the sickle elements are lunate shaped, these are also found without sheen, and as such constitute about 4% of the tool assemblage. Lunate shaped sickle elements are represented on sites dated to the Halaf and Ubaid periods (CAUVIN 1983), but absent on later sites which are characterized by sickle elements with denticulated cutting edges. Denticulated sickle elements are not represented at Tell Mashnaqa, not even in the Uruk strata (IV-VI), as might be expected. However, the lunate shaped sickle elements disappear from stratum IV onwards. A large number of the sickle elements have traces of bitumen indicating hafting.

As shown above the Tell Mashnaqa chipped stone assemblage fits other Late Neolithic-Chalcolithic assemblages containing a tool inventory oriented towards agricultural activities This is shown by the large amount of sickle elements, simple retouched or denticulated blades etc. Compared to the flaking technology used in the Early Neolithic periods, the flaking technology used in the Late Neo-lithic and Chalcolithic periods is simple with no preparation of the core before blank removal. There-fore the debitage consists mostly of flakes and irregular blades. Long blades with parallel sides are few. In Northeastern Syria the simple flaking technique used in the Late Neolithic and Chalcolithic might be explained by the low quality of the local flint ressources, unfortunately very few Early Neolithic sites have been located in the area, so a thorough study of Early Neolithic flaking techniques is difficult.

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Central-Southern Levant PPN Cultural Sequences: Time-Space Systematics Through Lithic Typology and Style

(Synthesis Contribution)

Avi Gopher

Introduction

This paper is a summary of a lecture delivered in the Berlin workshop of PPN chipped lithic industries in March-April 1993. It was presented as an introduction to the Central and Southern Levant session which included a series of lectures on analyses of lithic aspects of PPNA-PPNB assemblages. It can, however, be seen in a way, as a summary paper in the sense that it reflects thoughts and results of analyses of many central and southern Levantine lithic assemblages. However, when I prepared the lecture, I had not seen the papers presented here, and so, it represents rather my own overview and can in many ways be tested for its validity against the papers presented in the session and published in this volume. It may be viewed perhaps as a summary into which most of the work presented can be incorporated.

Methodology

The time aspect can, and has been achieved by two means :

a) a seriation of flint tool-types (arrowheads in my case, but could be other tool types, too). Seriation should be effective for suitable space and time ranges and in one general cultural milieu. The PPN Levant meets these requirements and is thus suitable for this kind of analysis (see below). A seriation analysis can be performed in many different ways, and dealing as we do with complex systems such as the PPN Levant, the use of multidimensional analysis techniques may be involved (e.g. GOPHER 1985, 1989).

b) The second means is, of course, the C14- record which can be used as an independent control method against the results of seriation analysis. At present we use uncalibrated dates because of the early parts of the sequence. In the near future, we can overcome the calibration difficulties and calibrated radiocarbon dating can be applied to tackle chronological problems more efficiently.

The spatial aspect can and has been achieved through:

a) general typological distinctions including assemblage type compositions or even a simple Presence-Absence analysis (e.g. BAR-YOSEF 1981) and

b) a detailed stylistic analysis (e.g. GOPHER 1985, in press).

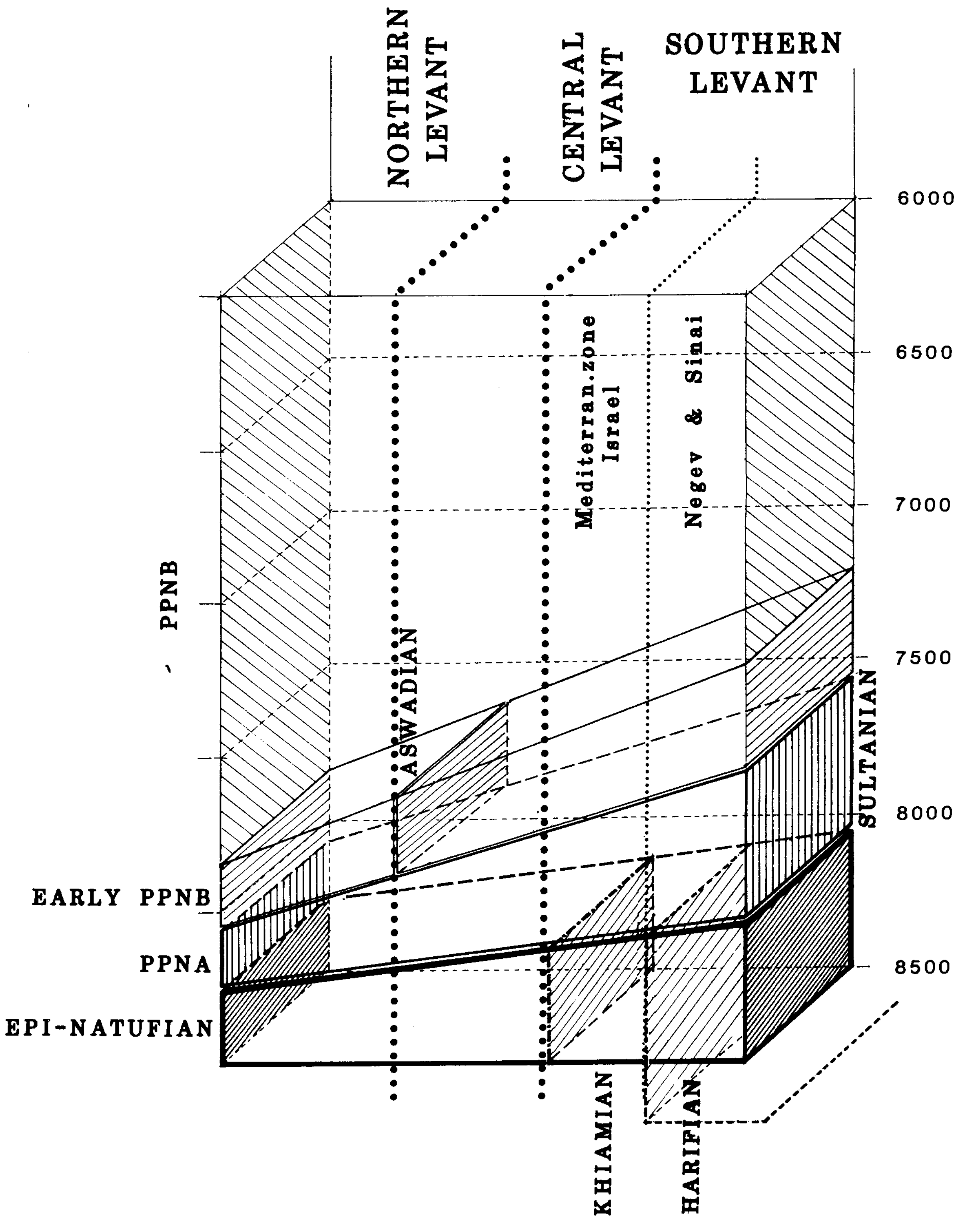

Fig. 1. A general chronology of the Levant showing "inclined" time-units.

The typological levels of analysis may and should contribute towards the distinction of subgroup traditions and/or the understanding of functional aspects as reflected in lithics. The stylistic level of analysis would on the other hand be free of functional aspects and thus have a potential to contribute towards a reconstruction of geographical-spatial subgroupings.

The use of seriation analysis for the whole Levant must be based on the assumption that the PPN Levant is a single cultural system, accompanied by "proof" of such. Thus an important objective prior to time-space analysis would be to examine and develop methods for measuring the rate of variability/homogeneity of the Levant's PPN entities at each of its time subdivisions. Since, in my opinion, the PPN Levant is a large scale cultural phenomenon like a culture-group, or even a larger system as described by D. Clarke (1978) I would suggest that relatively low similarity levels are needed to be assigned to it.

The assignment of assemblages, subcultures and cultures to the larger system can be based upon a polythetic set of qualities including the nature of the site, its architecture, the economy, burial customs, social structure etc. ... and the lithics... all forming a common background that goes through changes in time. Or in other words a dynamic common background. Since, however, the topic of our meeting is the lithic aspect, and this sybsystem too quite clearly bears out the PPN as a single cultural system, I shall deal here with the lithics only. More general discussion on the PPN Levant as a system based on a wider set of qualities was recently published (BAR-YOSEF and BELFER-COHEN 1989). To return to Clarke, the polythetic set of the PPN Levantine cultural system and especially the essential components which have a role in defining the system includes the lithic aspect as animportant and readily accessible component for analysis. Both technological and typological lithic aspects are involved.

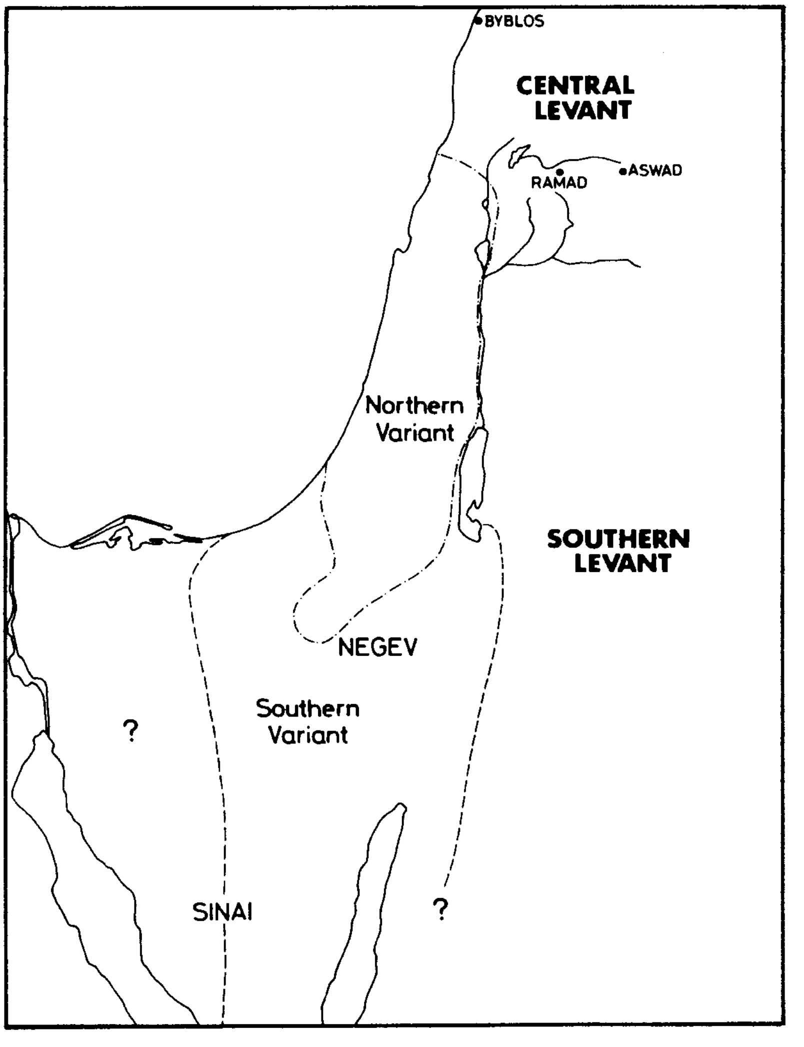

Fig. 2. Geographical subdivisions of the Southern Levant according to the analysis of metrics, symmetry, and barb-type of arrowheads.

Homogeneity

Technology

I will not enlarge here on this subject as we have heard it from others, but mention only that the knapping tradition as reflected by naviform cores reduction appearing as soon as 8000 B.C. in the northern parts of the Levant (Mureybet, Tel Aswad) which spread rapidly down to the Sinai desert and remained an important characteristic of the technology until the end of the PPNB and even later. This does not mean that it was the most popular technology in each assemblage but that it represents a pan-Levantine tradition for the production of long straight blades for sickle blades and arrowheads. The presence of other core-types reflects the diversity and flexibility in blank production throughout the system. Naviform cores remain, however, essential in defining the 8000-6000 B.C. (in the Northern Levant) and 7500-5500 B.C. (in the Southern Levant) lithic system, reflecting homogeneity, cultural contacts and information flow.

Other more specific technological aspects feature sporadically in parts of the region and for varying time spans. Such is for example the case of the using transversal blows in preparing working edges of bifacial tools; and the use of polishing techniques.

Typology

In analysing PPN lithics homogeneity is obvious on the level of assemblage type composition. Here essential components in the system's polythetic set repetitively appearing are arrowheads, sickle blades - glossed artifacts and bifacial - axes. Other components in the set do appear as well such as awl-borer types, burins, end-scrapers notched and denticulated pieces etc.

Among the most common lithic denominators of the Levant system's lithic typology, one can note the El Khiam and Helwan points for the early parts of the PPN, Byblos and Amuq points for later parts of the sequence and other aspects such as for example denticulated (PPNB) sickle blades.

Variability

Not surprisingly for such an ecologically diversified region, variability will occur alongside homogeneity. It is reflected in both technolgical aspects and in tool-types specific to subregions of the Levant some of which will be mentioned below.

Summarizing the above, in my opinion, the PPN Levant can and should be perceived of and treated as a single cultural system, an interaction sphere, and the apparent variability within it is to be expected.

Discussion

If we summarize past work in the spirit of the above comments, and with time-space systematics in mind as one of our goals, a few points are notable:

Time

1. Seriating arrowheads of the PPN Levant shows a generally homogeneous system and enables the identification of diffusion direction and measurement of diffusion rates (GOPHER 1985, 1989, 1989a, in press). The results of such a study show "inclined" time-units that may enable valid subregional comparisons.

2. To clarify what is meant by diffusion, I would agree with suggestions that have been offered in the past such as movement of information and ideas, or sometimes materials, but not people. Mechanisms for the operation of such cultural contacts were suggested as well (BAR-YOSEF and BELFER-COHEN 1989).

Space

On a general level, sub-regions could be traced on a Presence/Absence basis of typological aspects basis for example: During the PPNA (early parts of the Neolithic sequence), in the northern provinces of the Levant, the erminette appears which is an alien type in the southern Levant. There, (in the south), bifacially flaked axes are present, with a transversal blow (or flaking) shaping their working edge and with a polished finish as well. Another example is the presence of Hagdud truncations (BAR-YOSEF *et al.* 1987) in the Southern Levant and their absence (as far as known now) in the north. The same could be said for Gilgal truncations (NOY 1987) but it seems possible now that these appear in northern provinces as well (see for example Betts in Qermez Dereh, this volume).

During the PPNB, the Jericho point is specific to the southern Levant as well as the long borer (see GOPHER and GORING MORRIS, this volume - Nahal Issaron) which may be limited to the later parts of the PPN. The case of the Upsilon blade is not sufficiently clear since it seems to appear in the whole region. Northern items, such as for example the obsidian Çayönü blades (see for example Caneva, this volume) which are altogether missing from the Southern Levant may reflect similar phenomena.

On a more specific level, the analysis of arrowhead attributes such as metrics, tool symmetry, retouch type and amount, and barb shape would enable the tracing of smaller, subregional units. For example, if we examine a map of the Southern Levant based on metrics, symmetry, and barb shapes of arrowheads (mainly Jericho points) we can see that the Negev Highlands join the Mediterranean more northern zone while the rest of the Negev is a stylistically different subregion (Fig. 2).

Endnote

On a wider view, lithic technology and typology are changing in the PPN Levant, similarly patterned onthogenetic processes of different scales and rates, operating contemporaneously (of course with retardation effects considered). These processes operate at all levels beginning with attributes and up to the sub-culture, culture and culture-group level. The changes along the time axies in each aspect and level can be reconstructed as a series of Ghaussian curves.

Such is the case with technology where in general bladelet oriented industries of the Epipaleolithic. Early Neolithic (PPNA) are replaced by blade oriented industries in the PPNB which are replaced by flake dominated industries in the PN.

Such too would be the case with typological elements such as for instance arrowhead types where Harif and Abu Maadi points are replaced by El Khiam, Jericho, Byblos, Amuq, Haparsa, Nizzanim, Herzlia points and transversal arrowheads along the time axis starting ca. 8600 and up to 4500 B.C. These appear first in generally one-type and later in multi-typed compositions. In all cases the "life" pattern of each type can be draw as a unimodal curve. However, not all types reach the same peak frequencies and not all change at the same rate.

Similarly with sickle blades - Epipaleolithic Natufian backed bladelets give way to plain sickle blades and PPNA Beit Taamir knives; to PPNB finely denticulated reaping knives; to PN (Yarmukian) deeply denticulated and with flat retouched sickle blades; and to later PN (Wadi Raba) "geometric" truncated and backed sickle blades.

Although my statements here are based on lithic analysis, and lithics are only one aspect of the rich and varied record of the PPN Levant, I believe that as the complexity of the level of analysis increases when other aspects are added, the patterning of the lithic (technological and typological) subsystem must have value and can make an important contribution.

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Neolithic Primary Production in the Southern and Central Levant

(Theses to Approach a Synthesis)

Hans Georg Gebel

Viewed generally, Early Holocene primary production in central and southern Levant is characterized initially by a transition from unidirectional, (sub-) pyramidal bladelet core technologies, of the final Natufian and Early Pottery Neolithic (between the late 10th and early 8th millennium BC), to the increasing use of unidirectional cores of blade-like dimensions. At the beginning of the Khiamian/Sultanian, the use of micro-cores is still a substantial element of applied core techniques. The growing predominance of "pre-crest" techniques observed, with increasing blade sizes, is not believed to result from core technology innovations, but rather of functional demands for larger blades for a tool kit needing long-bladed blanks (to produce arrowheads and later, knives and borers, etc.). With sedentary exploitation of raw materials and tool blank manufacture, together with an increased demand for a larger standardized tool kit caused by new crafts related to changing consumer requirements, the "more economic" crest technique(s) emerged. They were possibly encouraged by an intensified tabular flint exploitation from permanent sites. At this stage, village based specialization had opened possibilities for the innovation and diffusion of more efficient *chaînes opératoires* of core preparation and rejuvenation. The bidirectional blade core reduction, of which the later, more commonly applied naviform techniques gained widest distribution, was in use by the mid-8th millennium. The naviform techniques increasingly dominated the inventories technologically (but not necessarily statistically) until 6000, gradually disappearing by the beginning of the Yarmoukian. From the late 7th millennium onwards, owing to increasing pastoral migration, flake core techniques gained dominance in the inventories of the permanent sites remaining, and especially in seasonal and ephemeral camp sites. This technological change is viewed as resulting from reduced village-based specialization in flint crafts, caused by reduced and changing demand for consumer goods, which had previously been characteristic of permanent village habitation. Flake core and *ad hoc* (bidirectional) core technologies remained an essential element throughout this general development, only being phased out by the specialised or mass consumption of the later part of the aceramic period.

The aim of the following theses is not to explain a sequence of stages in primary production. Instead they illustrate the principles behind developments which are not at all sequential. These developments were indeed reversible when environmental and therefore socioeconomic conditions modified economic activity. It must be stressed that we consider core technologies to be one of the most sensitive and obvious indications of such changes.

Thesis 1. Explanation of core technological developments (changes in core reduction strategies) in the Levantine Neolithic has to be a systemic approach, in order to trace the regional and local conditions for such developments in their following subsystems: *1.* Regional/Local Geo-Environmental Subsystem; *2.* Exchange Subsystem (long-distance trade of materials and technological know-how/innovation); *3.* Non-Specialized Technological Subsystem: Household Level; *4.* Specialized Technological Subsystem: Industrial Level; *5.* Socio-Economic Subsystem (of craft, household, and *ad hoc* production); *6.* Cognitive Subsystem (innovative potentials).
These subsystems should provide specific information for a given site for the following levels of the primary *chaînes opératoires*: *A.* Acquisition Level: Exploitation/Resource Management; *B.* Primary Production Level I: Core Preparation/Core Reduction Strategies; *C.* Primary Production Level II: Debitage Management and Blank Production; *D.* Distribution Level; *E.* Redistribution/Recycling Level.

Thesis 2. The system is stimulated variously by locally and regionally changing conditions within one or more subsystems, e.g. through demand, surplus production near resources, innovative strategies made known through distant contacts/know how from earlier materials. Negative feedback, such as a reduced pressure on flint resources by exploitation of the debitage deposits of earlier PN generations, can also be influential. The flow of energy within the system network was always influenced by a dualistic technological framework, operating between high-tech and minimum/low/*ad hoc* technology levels in core techniques.

Thesis 3. The gradual change to larger, unidirectional blade core techniques, from the final Natufian through the Khiamian/Sultanian, is basically the result of socioeconomic changes requiring tool blank standardization. The socioeconomic changes responsible for this long process are believed to be connected with the establishment of sedentary life and locally supported and viable economic patterns, including the market for consumer/ prestige items. P. Mortensen broached this subject with his idea of "the domestication of flint".

Thesis 4. Opposed-platform strategies occurred at regionally different times between the late Khiamian/Sultanian and the Early PPNB, depending on whether sedentarism had entered a particular region or not. Already, by then, the core inventories of environmentally arid and permanent sites are believed to have been different.

Thesis 5. Opposed-platform strategies technologically led to naviform and naviform-like strategies (beginning with the Early PPNB), at first probably in areas providing parallel-sided flint bodies/tabular flint. The development may have originated in southern Levantine areas.

Thesis 6. Already at this technological stage we are dealing with technological dualism in core techniques. Alternative, "low-tech" technologies were used; varying from simple unidirectional to opposed-platform cores. They co-existed with the high-tech naviform modes of core reduction. The naviform techniques are so highly specialized that they must have been confined to established workshops, themselves supported by steady demand and the natural availibility of appropriate resources. The non-naviform products were not industrial workshop products and must be seen as common houshold products. Naviform-workshops operated on an industrial scale from the dawn of the Early PPNB, in which the primary *chaîne operatoire* was probably work-division, promoting working hierarchies by the development of individual skills and training. On this level, naviform core technologies developed distinctive regional and even local features and workshop traditions.

Thesis 7. A similar technological dualism (cf. Thesis 6) applies to our beloved "types", the workshop-standardized tool manufacture on the one hand, and those *ad hoc,* multi-purpose, non-formal tools for our attribute analysis on the other. A close relationship between the development of highly standardized, single-purpose tools and the technological need to produce specialised consumer goods must be assumed. The range of products developed with the spectrum of single-purpose tools and *vice versa.* The climax of this relationship is believed to have been during the Late PPNB.

Thesis 8. The "household level" of primary production gained importance when village life became partially mobilised with the dawning of pastoralism, at the end of the 7th millenium., A less specialized resource exploitation can be found in these groups. This is another example of how a gradual environmental disaster, caused by a combination of overgrazing, monocultures, regional climatic effects of these, etc. can finally cause a technological decline, in this case that of the specialized naviform workshops: The decline in comsumer goods production for permanent village life, as shown amongst the small finds assemblages of the first half of the sixth millennium, reduced the demand in standardized blanks for the tools with which the goods had been made. However, naviform strategies show some continuity until the early Pottery Neolithic, although they later gave way again to the technologically less demanding flake cores and sometimes opposed-platform strategies.

Thesis 9. Only those tools can be expected to remain standardized in mobile economies which were required in large quanities for economic purposes. Such tools require a standardization which can only be reached by producing them industrially at sources/regional centers/places of use. Arrowheads and sickles must be seen thus, but also the celts/adzes in the wooded areas, the burins of the burin sites, etc. to mention some more. This feature of highly specialized tools in poor and undistinguished tool kits are later the characteristics of Chalcolithic and early Bronze-Age tool kits. In this kind of milieu we must also see a general decline in broad, tabular flint exploitation, whilst exploitation by resource-bound specialists developed. Because high proportions of chronologically indeterminable, non-standardized cores and tool types are found alongside distinct tool types in use for long periods (e.g. the foliates and slugs of the arid fringes of the Fertile Crescent in the 6th and early 5th millennium), these inventories are difficult to classify.

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The Lithics of the Early Neolithic at Hatoula

Monique Lechevallier and Avraham Ronen

Hatoula, an open air site in the western foothills of Judea, was occupied in the Late Natufian (Level 3) and in the early Neolithic (Level 2). In this level two distinct phases have been recognized: one belonging to the Khiamian and the other to the Sultanian (LECHEVALLIER and RONEN 1985, in press; RONEN and LECHEVALLIER 1985; LECHEVALLIER *et al.* 1989). The site, presently covering about 2000 m^2 (Fig. 1), has much suffered much from erosion and later disturbances, and its original surface area cannot be well ascertained.

The Khiamian layer, between 50 and 80 cm thick, has been exposed in the Trenches G, A, J, H and partially in F. In A, J and F, oval pit structures have been evidenced. The Sultanian occupation has been recognized only in the western part of the site (Trench F): it is characterized by large oval stone-based structures, partially dug into the Khiamian layer and partially into the Natufian layer.

Four radiocarbon dates have been obtained:

Natufian, area A :	11.020 ± 180 BP	(Gif A 91141)
Khiamian, area A :	10.170 ± 120 BP	(Gif A 91139)
Sultanian, area F :	10.030 ± 140 BP	(Gif A 91360)
Sultanian, area F :	8.890 ± 120 BP	(Gif A 9138)[1]

The Raw Material

As in the Natufian, the flint used in the neolithic levels most probably comes from three sources identified in the vicinity of Hatoula (RONEN, CHINN, and BUYTNER in press). The nodules, of good quality, are medium-sized; a small part is in tabular form. Heterogeneous flint of lesser quality, locally available, was used for large tools.

The Debitage

The debitage characteristics of the Khiamian and Sultanian are inherited from the Natufian. The knapping procedures, using percussion only, are simple and opportunistic with the preparation of a crest and the formation of a single plain platform. When necessary, the cores were prepared again, with a new, eventually opposed or crossed, platform until no more possibility was available.

The cores are of small size (mean size: 29 to 34 mm): most of them were abandoned after complete exploitation. Their maximum height (60 to 80 mm) corresponds well to the maximum length of blades (Tables 1 and 3).

1 This sample, too close to the surface (-0,25 m), may have been contaminated.

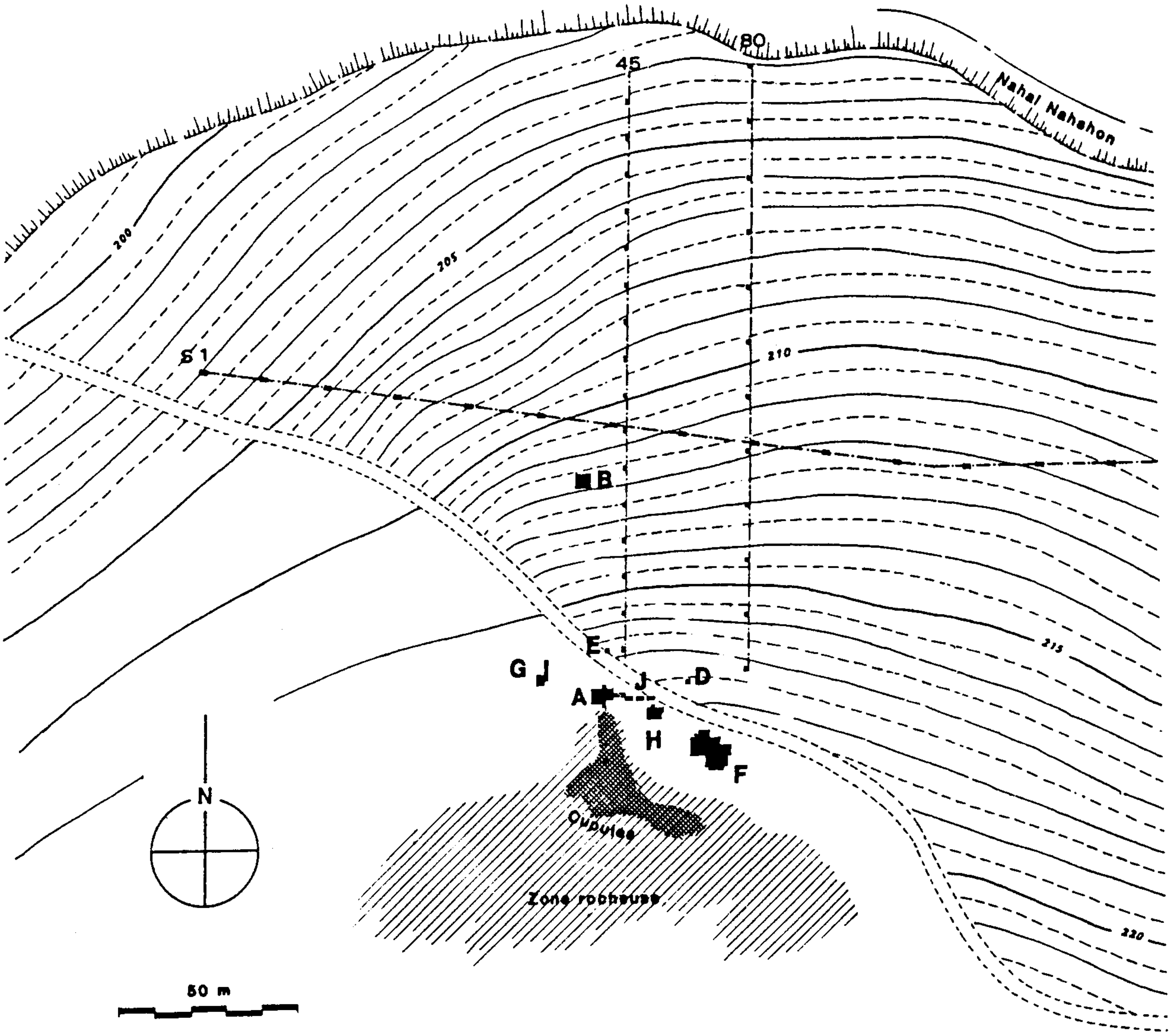

Fig. 1. Map of the site.

Table 1. Core dimensions.

	Area	N	Height				Width				Thickness			
			Mean	S.D.	Max	Min	Mean	S.D.	Max	Min	Mean	S.D.	Max	Min
Khiamian	G	40	39,8	10,4	76	22	33,1	16,5	127	20	21,8	7,9	47	9
	J	68	29,3	9,4	62	13	29,5	10,1	78	14	20,6	10,4	67	4
	H	55	36,5	12,7	80	15	28,8	9,1	57	14	20,0	6,6	42	8
Sultanian	F	363	34,4	11,6	81	13	30,6	10,8	75	12	23,9	9,4	55	3

The core morphology is a function of the blanks produced (Table 2): prismatic and pyramidal cores, which are together the dominant groups correspond to blade cores, while globular and formless cores produced flakes.

Table 2. Core morphology.

	Area	N	Prismatic		Pyramidal		Flat		Globular		Irregular	
			N	%	N	%	N	%	N	%	N	%
Khiamian	J	70	31	44,28	16	22,86	6	8,57	6	8,57	11	15,71
	H	253	87	34,39	7	2,77	39	13,78	51	20,16	69	27,27
Sultanian	F	182	32	17,58	35	19,23	1	0,55	23	12,64	91	50,00

From the absence of fully cortical flakes it may be assumed that a preliminary roughing out of the cores was made at the extraction sites. Althouth they represent from 80 to 93% of the debitage, flakes are the by-products of blade core preparation; they also result from the knapping of flake cores, unsuitable for blade debitage. The blade blanks obtained are irregular, with sinuous edges and ridges. There is a continuous production from large blades to bladelet and microblades. On the whole there is an increase of the size of blade blanks (Table 3) and tools in the Neolithic compared to the Natufian .

Table 3. Blade dimensions.

	A-rea	N	Length				Width				Thickness			
			Mean	S.D.	Max	Min	Mean	S.D.	Max	Min	Mean	S.D.	Max	Min
Khiamian	G	50	39,0	11,0	73,0	16,5	14,0	5,1	31,0	4,0	4,9	2,6	13,0	1,0
	A	10	39,8	6,4	49,0	30,0	13,8	3,2	18,5	10,0	4,9	1,7	8,5	3,0
	J	49	38,0	10,0	74,0	25,0	15,8	3,8	30,0	12,0	6,1	3,3	15,0	3,0
Sultanian	F	14,8	44,1	13,2	116,0	21,5	16,9	9,2	30,0	7,0	5,6	2,7	16,0	1,0

The Tools

Although flakes were widely produced and used, tools were mostly made on blades (Natufian: 79%; Khiamian/Sultanian: 65-72%), with a slight increase of flake tools compared to the Natufian, partly due to the decrease of the number of microliths. We will now compare the tools of the Khiamian and Sultanian assemblages (Table 4).

Table 4. Tool distribution in the Khiamian and Sultanian phases

	Khiamian								Sultanian	
	Area A		Area J		Area H		Total		Area F	
	N	%	N	%	N	%	N	%	N	%
End-scrapers	43	3,47	20	2,69	20	2,71	83	3,03	38	1,22
Burins	40	3,23	37	4,98	45	6,11	122	4,45	55	1,78
Borers	193	15,58	94	12,65	137	18,59	424	15,47	919	29,70
Mixed tools	4	0,32	4	0,54	-	-	8	0,29	1	0,03
Backed blades	22	1,77	20	2,69	32	4,34	94	3,43	51	1,65
Truncations	60	4,84	40	5,38	17	2,31	117	4,27	109	3,52
Notches & denticulates	92	7,43	58	7,81	37	5,02	187	6,86	323	10,44
Non-geometric microliths	110	8,88	84	11,30	96	13,02	290	10,58	148	4,78
Geometric microliths	290	23,41	113	15,20	207	28,09	610	22,26	174	5,62
Glossed blades	15	1,21	8	1,08	12	1,63	35	1,28	39	1,26
Retouched blades	175	14,12	130	17,52	53	7,19	358	13,06	712	23,01
Retouched flakes	134	10,80	112	15,09	53	7,19	299	10,91	405	13,09
Arrowheads	28	2,26	23	3,10	13	1,76	64	2,33	76	2,45
Hagdud truncations	-	-	-	-	1	0,13	1	0,03	27	0,88
Picks/Axes/Adzes	1	0,08	-	-	1	-	1	0,03	17	0,55
Various	33	2,66	-	-	14	1,90	47	1,72	-	-
Total	*1240*	*100,0*	*743*	*100,0*	*738*	*99,99*	*2740*	*99,97*	*3094*	*99,99*

The Khiamian Phase

Most of the end-scrapers and two-thirds of the burins are made on flakes. Among these, angle truncation burins are the most frequent, followed by dihedrals and burins on a break.

Borers are the dominant category of tools. Half on blades, half on flakes, they are made of beaks (2/3), either thick or delicate (spikes), points and drills. Notches and denticulates are well represented. Non-geometric and geometric microliths together constitute about 33% of all retouched items. The geometric microliths are almost exclusively lunates with semi-abrupt retouch. Lunate size ranges from 18 to 20 mm.

Arrowheads (2,6%) are el-Khiam points. Most of them are irregular with large mesial notches; their length ranges from 15 to 30 mm (sub-type A). 3 points have a small irregular tang.

A rough adze of limestone is the only heavy duty tool present[1].

The Sultanian Phase

End-scrapers and burins are less frequent than in the preceding phase. Borers increase considerably (30% of the tool kit) while non-geometric and especially geometric microliths decrease (10,4% all together). Glossed blades, in small number (1,3%), are large blades, some cortical or backed.

Arrowheads increase slightly in number (2,4%) but, what is more significant, the characteristics of the el-Khiam arrowhead, the dominant type, have changed: they are small (mean size: 20,5 mm), regular, and have small, proximal notches (sub-type B). There are also 3 Salibiya points and 2 tanged points.

1 not counting a basalt polished axe found near the surface in Area G.

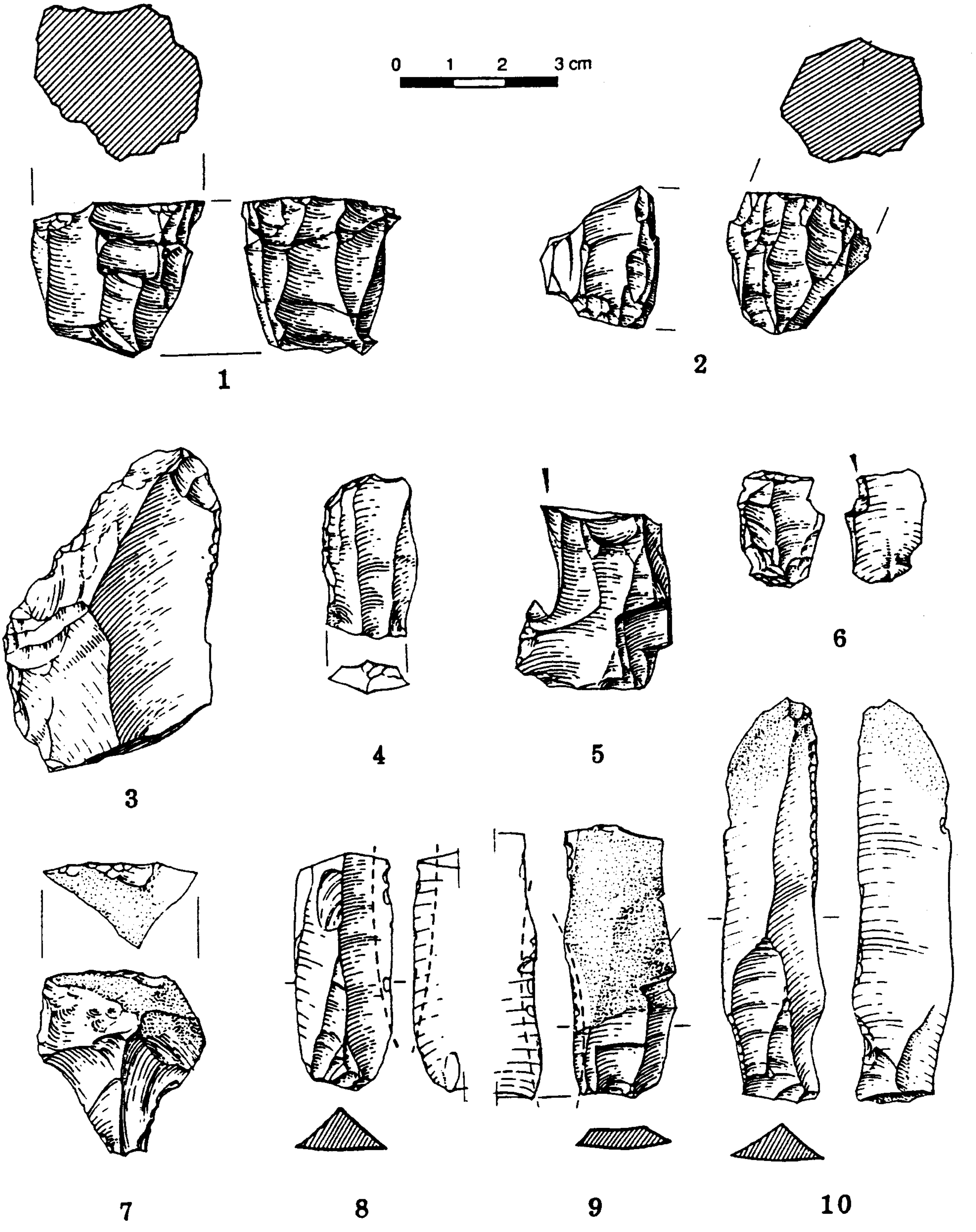

Fig. 2. 1-2 Khiamian cores, 3-4,7 end-scrapers, 5-6 burins, 8-9 glossed blades, 10 retouched blade.

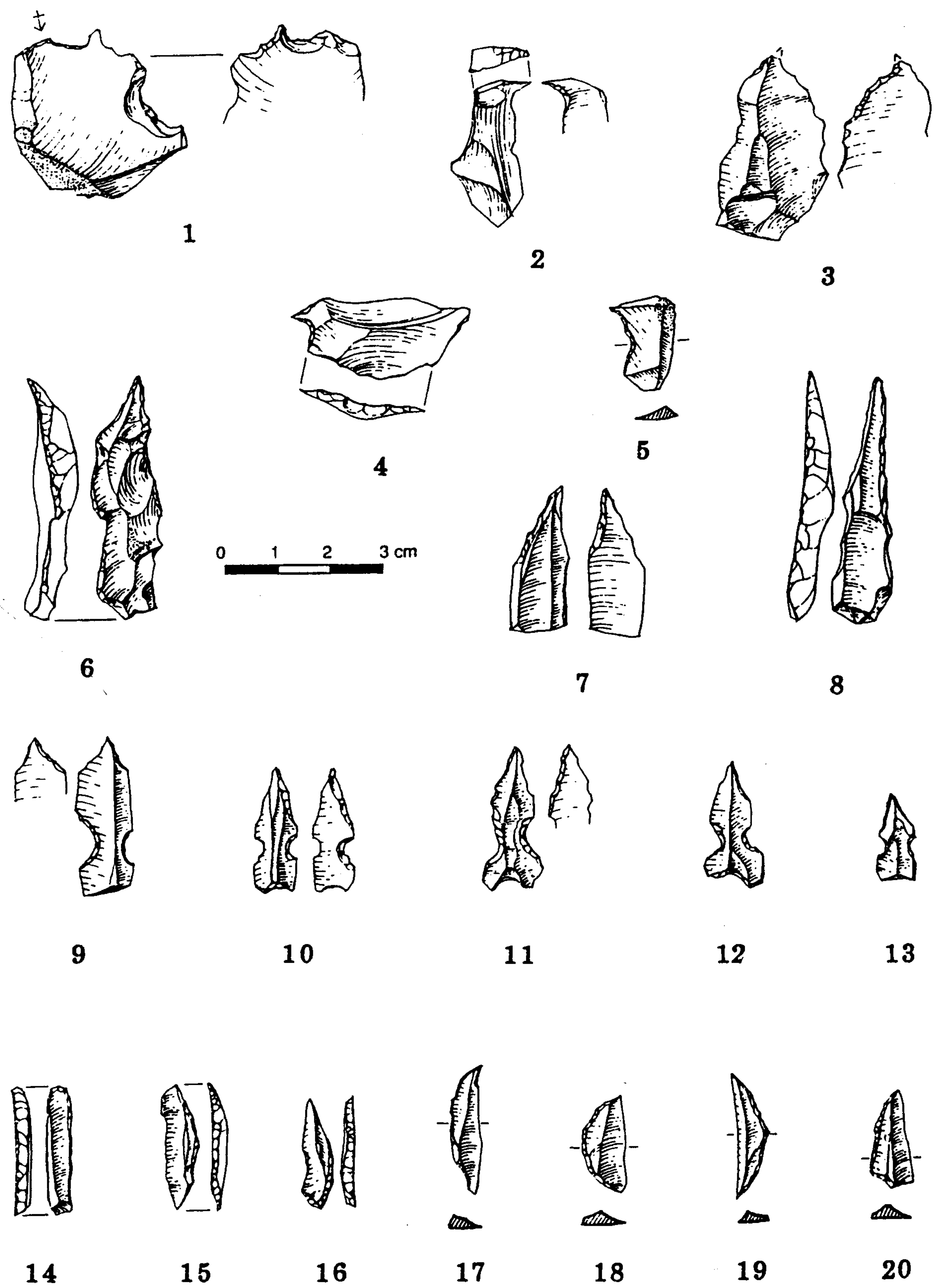

Fig. 3. 1-5 Khiamian borers, 6-8 points, 9-13 el-Khiam points, 14-16 backed bladelets, 17-19 lunates, 20 triangle.

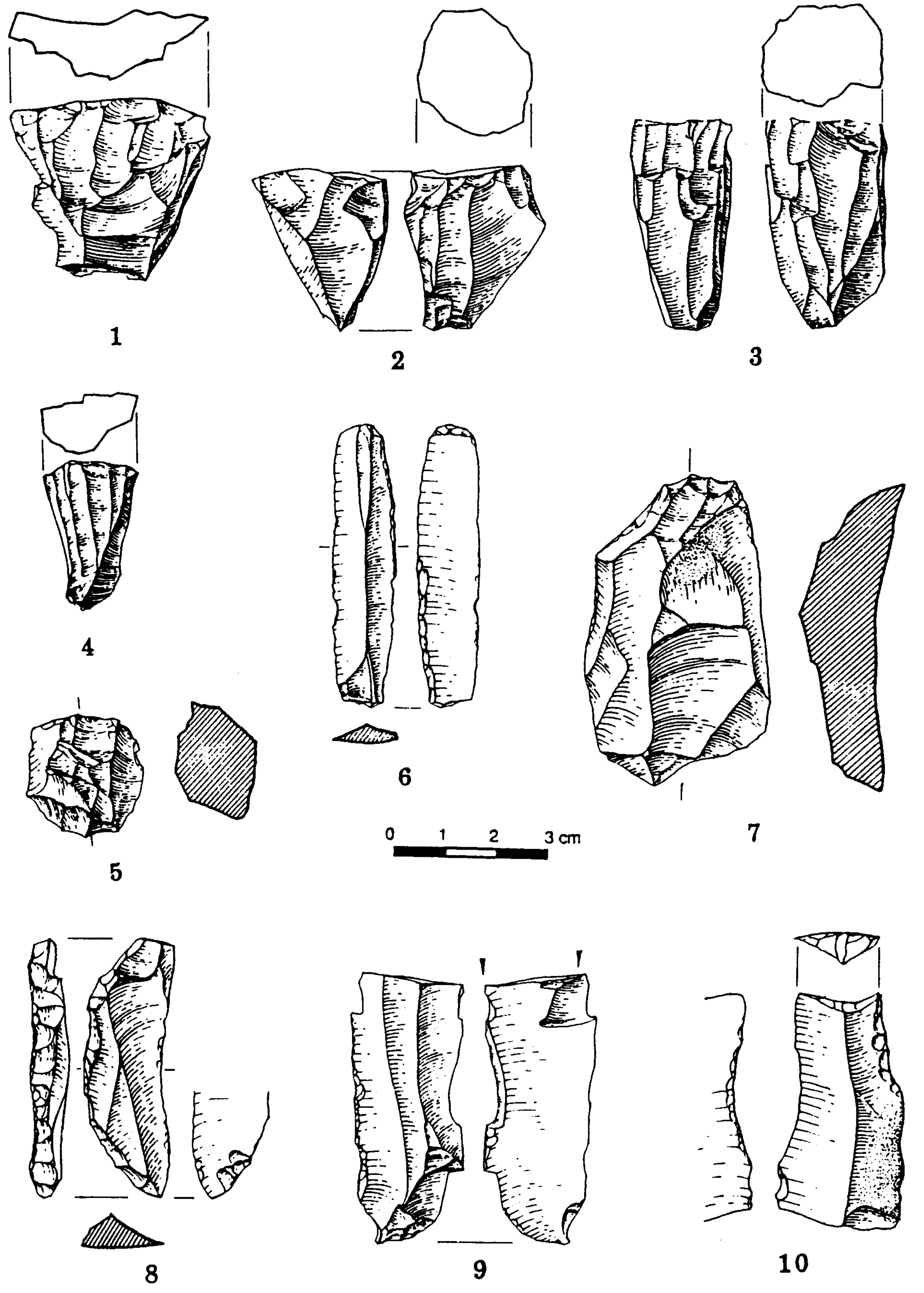

Fig. 4. 1-4,5 Sultanian. cores, 3-7 end-scrapers, 8 backed blade, 9 burin, 10 truncation.

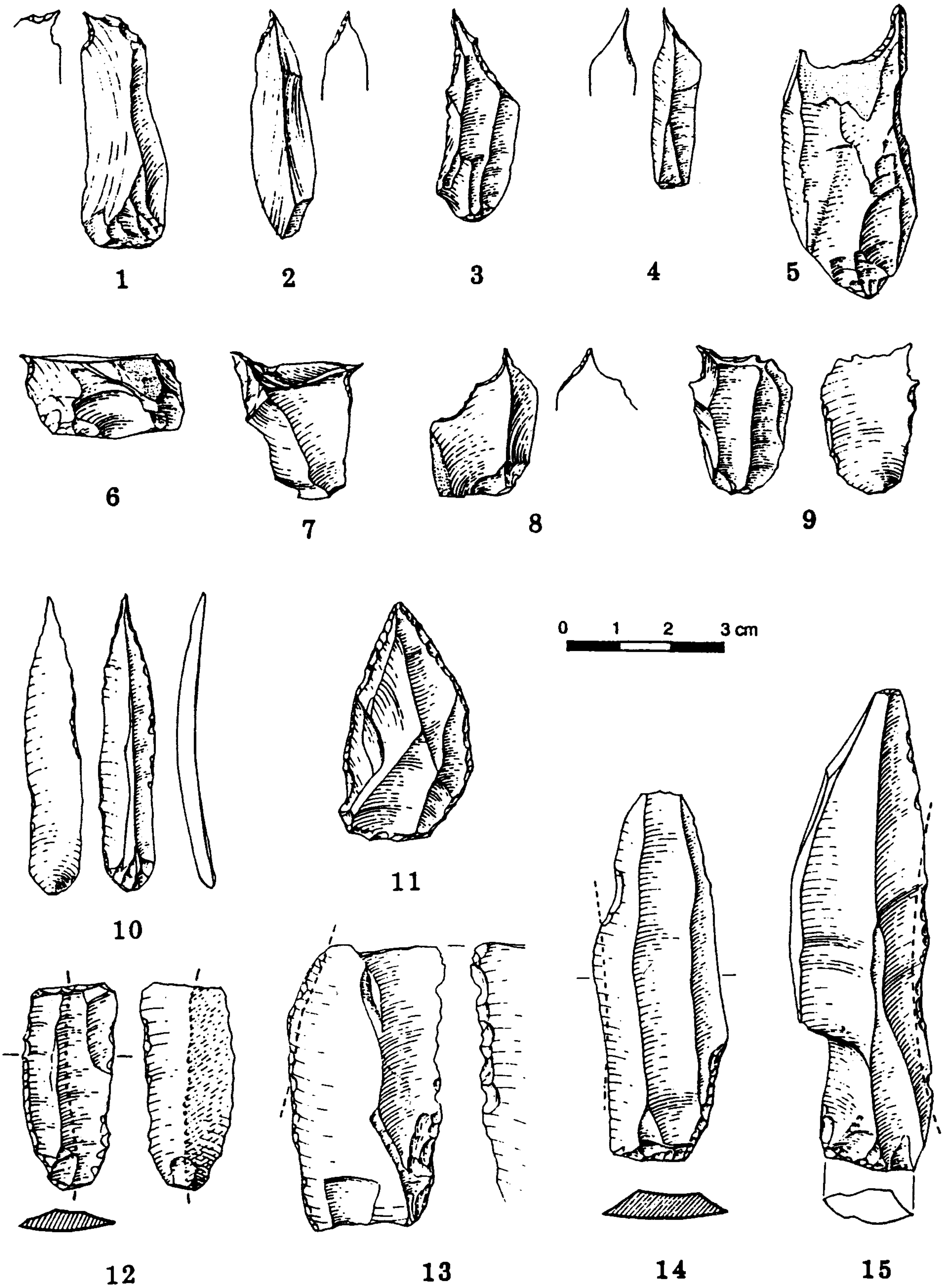

Fig. 5. 1-9 Sultanian borers, 10-11 points, 12-15 glossed blades.

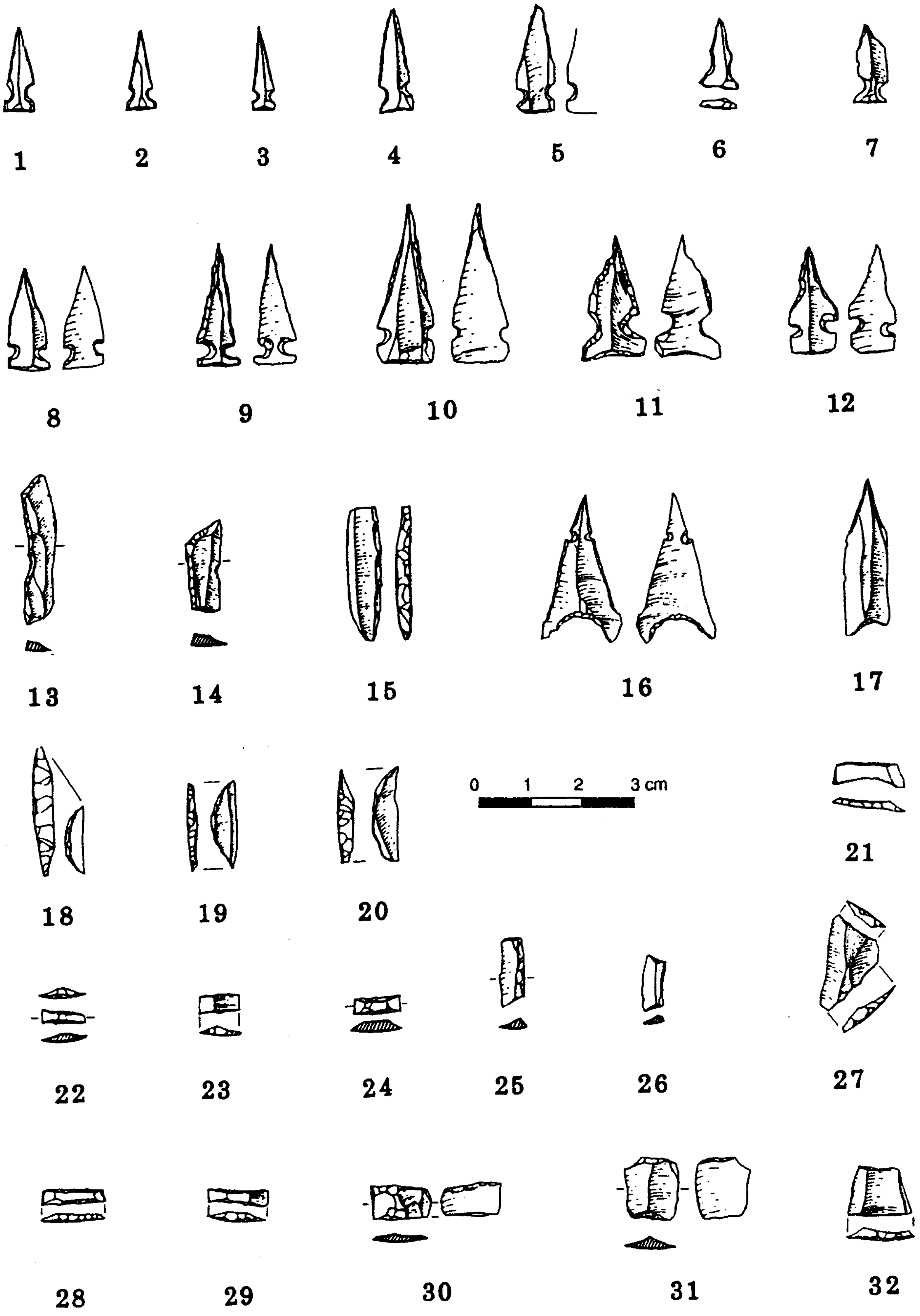

Fig. 6. 1-12,16,17 Sultanian arrowheads, 13-15 backed blades, 18-20 lunates, 21-24,27-32 Hagdud truncations, 25-26 backed bladelets.

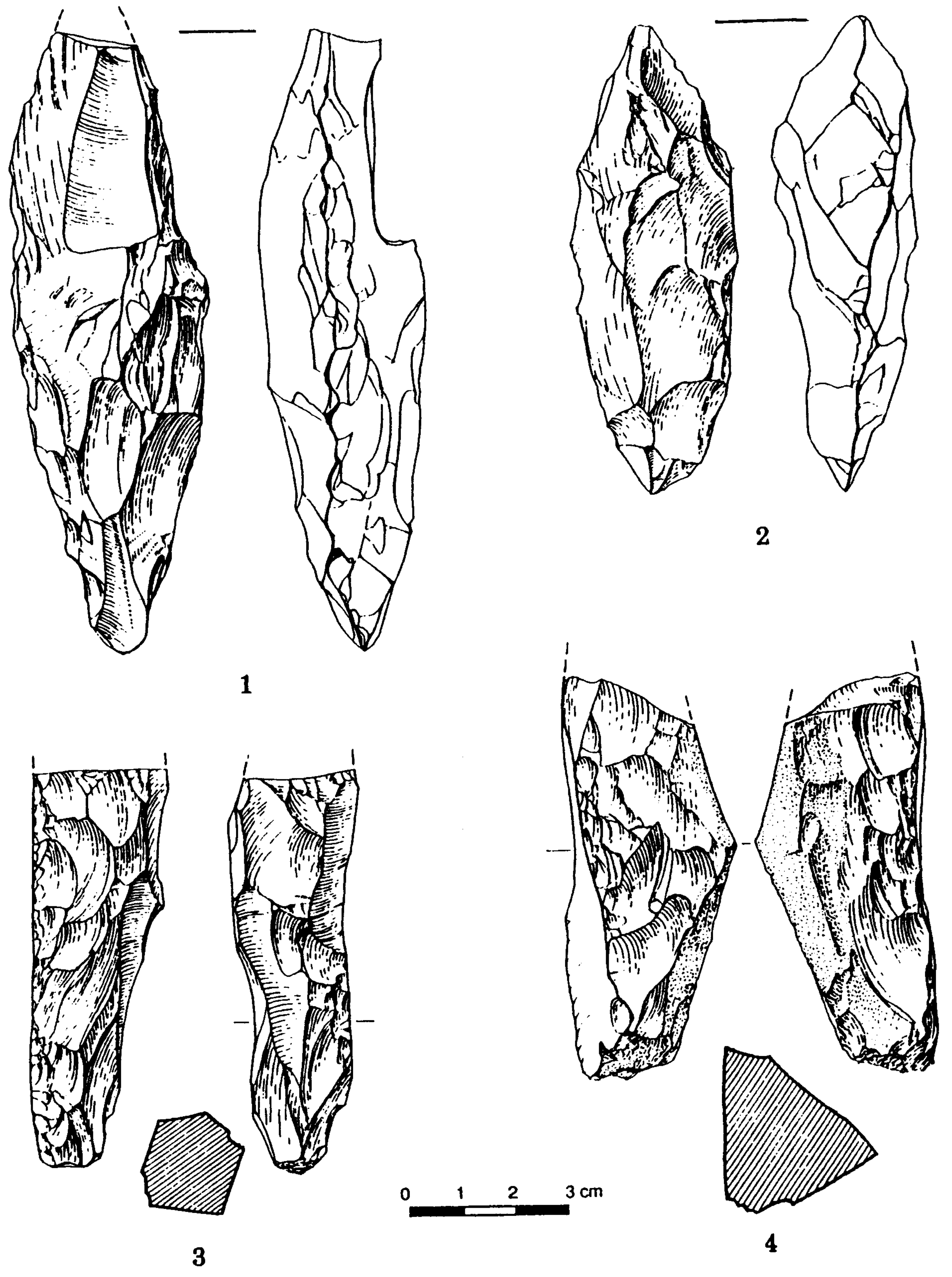

Fig. 7. 1-4 Sultanian picks.

Hagdud truncations are present in small number, as well as a few heavy duty tools: picks, axes and adzes, some with a tranchet blow.

Remarks

The debitage in the Khiamian and in the Sultanian shows the same technological features, inherited from the Natufian. The blanks are nearly identical in the three periods due to the use of the same raw material and the same technology. The retouched artifacts are also marked by a certain similarity, and types like end-scrapers, burins, borers are interchangeable with the Natufian tools.

The changes, mainly statistical, are related to various aspects:

- The increase of the relative number of larger blade blanks and blade tools in the Khiamian and even more so in the Sultanian is largely due to the gradual decrease of the use of microliths.
- The decrease of the number of geometric microliths from 22% in the Khiamian to 6% in the Sultanian (Natufian: 29%).
- The increasing number of borers is also a striking feature of the lithics of Hatoula. Microwear analysis has shown their importance in various activities going on at the site: boring of stone beads (UNGER-HAMILTON *et al.* 1989) and piercing reeds (WINTER and RONEN, in press).

Other changes refer to typology with the appearance of new classes of tools. They either reflect new ways in the handling of the same activities or the development of new activities. The main element in that respect is the emergence, as on all Post-Natufian industries, of a new type of projectile: the arrowhead, which gradually eliminates the lunate, thus eventually indicating a new form of hunting with the bow and arrow. The introduction in the Sultanian of the Hagdud truncation, whose function is not yet elucidated, is another case. The appearance of heavy duty tools, although in small number in the Sultanian, is also significant of the diversification of activities in that phase.

Although this period is characterized by a growing interest in plant exploitation and in particular of cereal harvesting, glossed blades are few in the Khiamian and Sultanian phases. This may be explained by the emphasis in Hatoula on animal exploitation (gazelle, birds, fish) (*cf.* DAVIS 1985; PICHON 1985; LERNAU 1985). However, microwear analysis has shown the relation of glossed blades to cereal reaping. Moreover, the fact that a number of non glossed-retouched blades also reflect cereal reaping indicates that the activity of cutting vegetal material is under estimated when "sickle-blades" alone are considered (ANDERSON, in press). Similarly, some unretouched blades have the faint gloss characteristic to reed cutting (WINTER and RONEN, in press). The glossed pieces are found among the largest blades, which are probably the strongest when hafted and thus the longest time in use.

Hatoula is so far the only site in the southern Levant where a distinction has been possible between an early and a late aspect of the PPNA, the Khiamian and the Sultanian. The distinction relies not only upon the analysis of the lithic assemblages but on all the elements available (architecture, fauna, stone and bone tools). Due to this situation and also perhaps to the fact that we are dealing with short transitory phases, we may not find precise parallels for its lithics. However, its lithic material may well be compared to other contemporary industries if we rely on general trends. There may be also some local differences, as seen for example in the absence of Beit Ta'amir sickle blades which are characteristic of the Jordan Valley and the Carmel area assemblages. On the other hand, the polished basalt axes which have been found (one on the surface, one at the top of the Khiamian layer in area G and one in place in a Sultanian house) connect Hatoula with the Jordan valley sites and the northern areas of the Levant.

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New Symmetry of Early Neolithic Tools: Arrowheads and Truncated Elements

Dani Nadel

Introduction

The flint assemblages of the Pre-Pottery Neolithic A sites in the Levant exhibit, for the first time, new left-right symmetry of projectile points. The left-right symmetry term used here refers to the two sides of an artefact when the main longitudinal axis (usually parallel to the direction of percussion) is the reference line. The symmetry of these small Neolithic tools is in sharp contrast to the wide variety of the preceding microliths, all of which are asymmetrical.

The new types, arrowheads and Hagdud truncations, are a minority within the retouched tools, but their presence marks new means of hafting arrowheads and barbs to the shafts of arrows.

This presentation focuses on the arrowheads and small truncated elements. These two groups have been the subject of several recent studies, in which the author has suggested to add new tool types to the typelist used so far (BAR-YOSEF *et al.* 1987; NADEL 1988; NADEL *et al.* 1991). It is the aim of this paper to present new data, discuss the possible relationship between El Khiam points and Hagdud truncations, and place them in the general technological trend of improving bows and arrows.

PPNA Flint Assemblages

Levantine Early Neolithic flint assemblages have been typologically defined and distinguished mainly by a small range of "typical" tools. Of these tools, projectile points serve as the most common cultural marker of the Sultanian industry, while sickle blades (including low percentages of the Beit Ta'amir type) and axes/chisels/adzes are also used as such, but are less indicative in most cases (CROWFOOT PAYNE 1976, 1983; GARFINKEL and NADEL 1989).

The Sultanian tool kit was defined according to the finds in PPNA Jericho (CROWFOOT PAYNE 1976, 1983). A second *in situ* and large PPNA assemblage was found in Netiv Hagdud (BAR-YOSEF *et al.* 1980, 1991) and analysed by the author (NADEL 1988, 1989). These and other assemblages will be discussed below (Fig. 1).

Recently a new type was added to the PPNA type list as the result of on-going analyses of Sultanian assemblages, namely the Hagdud truncation (BAR-YOSEF *et al.* 1987; NADEL 1988). Another tool which received renewed attention is the lunate.

The Sultanian lunates are remnants of the Natufian tool kit, where they comprise a large proportion of the retouched items. They were found in low percentages in PPNA sites across the Southern Levant: Gesher (GARFINKEL and NADEL 1989: Fig. 2:23-26, Table 3), Hatula (LECHEVALLIER *et al.* 1989: Fig. 2:9-11, Table 1; LECHEVALLIER and RONEN, this volume), Jericho (CROWFOOT PAYNE 1983: Fig. 291:4-6), Netiv Hagdud (NADEL 1988) and 'Iraq ed-Dubb

(KUIJT *et al.* 1991: Fig. 5:1-3). They are not used as a distinguishing marker between Early Neolithic traditions (NADEL 1990). However, they do disappear later, and they are not an integral part of the PPNB assemblages.

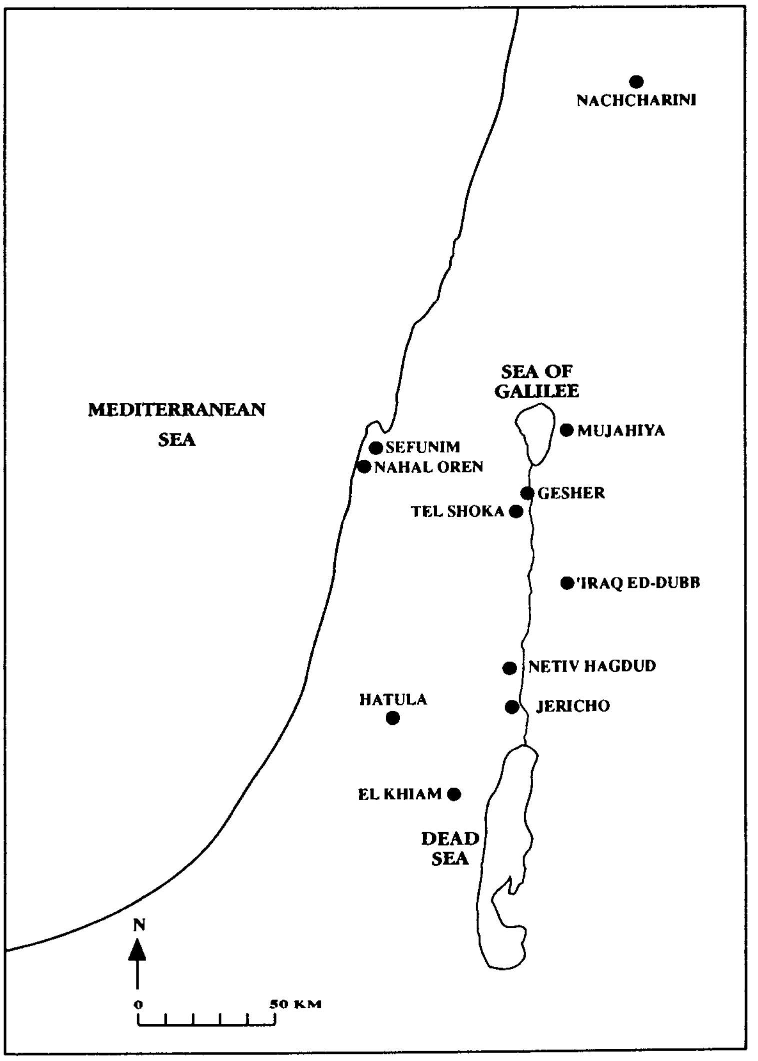

Fig. 1. Location of sites with Hagdud truncations.

The only archaeological entity contemporaneous with the Sultanian in the non-desertic regions of the Southern Levant is the ill-defined Khiamian. In all descriptions of Khiamian flint assemblages (ECHEGARAY 1966; CROWFOOT PAYNE 1976; BAR-YOSEF 1980, 1987a: 114; 1989: 59; 1991: 13; LECHEVALLIER and RONEN 1985; LECHEVALLIER *et al.* 1989), there are no conclusive quantitative and qualitative criteria which clearly distinguish them from the Sultanian industry (GARFINKEL and NADEL 1989; NADEL 1988, 1990). There is one C14- date from the Khiamian layer at Hatula F (LECHEVALLIER and RONEN, this volume), and two dates from Salibiya IX (too old, BAR-YOSEF 1981: 7). The evidence from Hatula does support the claim for a Khiamian entity. However, it has been suggested that intra-site and inter-site variability within the Sultanian complex could include the "Khiamian" assemblages (NADEL 1988).

Arrowheads

The most common indicator of Neolithic assemblages are the arrowheads. They still serve as "fossil director" for distinguishing the various Levantine Neolithic cultures (e.g. GOPHER 1985 and many others) (Fig. 2).

For PPNA assemblages, in the southern Levant the El Khiam point was the only defined type for c. 20 years of research (following the excavations of Echegaray in the terrace of El Khiam: ECHEGARAY 1963, 1966). However, recent work found it difficult to include all PPNA arrowhead types under one category. The first manifestation of the problematic state was presented by Gopher who added a subtype to his list (the tanged variant - A24), in order to account for the wide range of variability (GOPHER 1985).

A more detailed approach was used by the author, after analyzing 120 arrowheads from Netiv Hagdud. The fact that in addition to the notched point (El Khiam) there were many tanged points and many retouched triangular points (with no tangs or notches, but complete specimens) led to the suggestion of distinguishing three arrowhead types: El Khiam, Jordan Valley and Salibiya (NADEL 1988; NADEL *et al.* 1991).

The three types have one common characteristic, namely, they are all triangular in their general shape (NADEL *et al.* 1991: Fig. 1). They all have a narrow base, whether straight (on a break or retouched), concave or tanged. The sides converge, and they end in a point, commonly retouched at the tip. They all have a general left-right symmetry, though in some specimens the points are lopsided (e.g. NADEL *et al.* 1991: Fig. 2:24,27).

Hagdud Truncations

The first sample of small flint elements with double truncations was reported by Schroeder for the Nachcharini cave (SCHROEDER 1977). In that preliminary report, they were called "bitruncated rectangles", and later were assigned the name "Nachcharini bitruncated rectangles" (COPELAND 1991: 31). Meanwhile, in the mid 1980s, I identified 63 bitruncated elements in the Netiv Hagdud assemblage. At the time, we had no means to compare the finds to the Nachcharini ones (due to the preliminary nature of the 1977 paper of Schroeder). In addition, many of the Netiv Hagdud specimens have concave edges - they are not rectangles. Thus we decided to call them Hagdud truncations (BAR-YOSEF *et al.* 1987). It should be mentioned that by then we knew that at least one specimen was found in Jericho prior to the Nachcharini excavations (see below), and thus the name Jericho truncations was also a possibility. However, as we had at hand what we thought to be the largest and most varied sample, the new name was given. In several later reports from Israel and Jordan, the name assigned by us was used (e.g. LECHEVALLIER *et al.* 1989; KUIJT *et al.* 1991; GOPHER 1990). It is my opinion that the specimens from Israel, Jordan and Lebanon should all be considered one type.

Table 1. Sites with Hagdud truncations.
<Note that the tools are very small, and unsieved assemblages are under-represented (Jericho, first seasons at Nahal Oren). The truncations are a minor part of each assemblage, but are similar in quantities to local El Khiam points. >

** represents sites where PPNA tool types are mixed with early PPNB industries. The Tel Shoka*

*** industry is too small to be characterized.*

H.T.= Hagdud truncations, E.K.= El Khiam points.

Sources: 1) GARFINKEL and NADEL 1989; 2) LECHEVALLIER et al. 1989; 3) KUIJT et al. 1991; 4) CROWFOOT PAYNE 1983: Fig. 273:9; 5) GOPHER 1991; 6) SCHROEDER 1977, COPELAND 1991; 7) NADEL and GOPHER n.d.; 8) BAR-YOSEF et al. 1987, NADEL 1988: 9) RONEN 1984: Fig. 22.7:8; 10) pers. observations.

sites	location	industry	n	H.T./E.K.	ref.
Gesher	Jordan Valley	Sultanian	4		1
Hatula F	Judean Hills	Sultanian	8?	0.4	2
Iraq ed-Dubb	Gilead Hills	Sultanian	3?		3
Jericho	Jordan Valley	Sultanian	1		4
Mujahiya	Golan	PPNB*	1		5
Nachcharini	Anti-Lebanon	Early Neol.	tens?		6
Nahal Oren	Carmel	Sultanian	15	ca. 1	7
Netiv Hagdud	Jordan Valley	Sultanian	63	1.1	8
Sefunim	Carmel	PPNB*	1		9
Tel Shoka	Jordan Valley	**	1		10

The Hagdud truncations are short segments of bladelets or small blades, truncated at both distal and proximal ends. They manifest a wide range of variability in their shapes and types of retouch, but they all have an unmistakeable left-right symmetry (Figs. 3, 4). They are considered today an integral part of the Sultanian tool kit (BAR-YOSEF *et al.* 1987; NADEL 1988; GARFINKEL and NADEL 1989, and later site reports). An inventory of sites where these tools were found is presented below (Fig. 1).

EL KHIAM. In the mixed assemblage found in the Neolithic layers of the terrace, two short truncated blades were noticed (ECHEGARAY 1966: Figs. xxix-8,xxxiv-20). None of the typical Hagdud truncations have been reported, though El Khiam points and lunates were common.

GESHER. In this Sultanian site four Hagdud truncations were found (Fig. 3:27-29). The assemblage also includes 10 points, all of them of the El Khiam type (GARFINKEL and NADEL 1989). Four small lunates were recovered from the site.

HATULA (F). In one report (LECHEVALLIER *et al.* 1989) on the Neolithic flint assemblage eight Hagdud truncations are presented (Fig. 3:19-26) (*ibid.* Fig. 2). In a paper presented in this volume, there are 76 arrowheads and 27 Hagdud truncations in Area F; lunates are more common than both these types together (LECHEVALLIER and RONEN, this volume, Table 4).

IRAQ ED-DUBB. The preliminary report does not include quantitative data on the flint assemblage from this cave site. It does specify the presence of El Khiam points, Hagdud truncations and lunates. Four El Khiam points, three Hagdud truncations and three lunates are illustrated (KUIJT *et al.* 1991: Fig. 5) (Fig. 3:7-9).

JERICHO. One Hagdud truncation is presented in the PPNA report (CROWFOOT PAYNE 1983: Fig. 273:9 and the description on page 648) of this type site (Fig. 3:31). El Khiam points are also rare, no doubt as the result of recovery techniques. Altogether there are 8 arrowheads described in the PPNA section, of which only two are true El Khiam points with basal notches (*ibid.* Fig. 273:2,4), and two are probably not arrowheads (*ibid.* Fig. 273:3,5). Two El Khiam points were also found in PPNB layers and are thought to be "derived specimens" (*ibid.* Fig. 331:4,5). It should be noted that square segments of obsidian blades, with "crushed" edges (*ibid.* Figs. 262:3 and 289:2-4), seem to belong to the group of bitruncated elements.

MUJAHIYA. One Hagdud truncation has been found in this early PPNB site (Fig. 3:30) (GOPHER 1990: Fig. 7:3). However, the presence of two El Khiam points could possibly suggest a short episode of PPNA occupation of the site.

NACHCHARINI. This Natufian and early Neolithic site is in a cave in an altidude of ca. 2,600 m. Due to local political problems, a comprehensive study of the lithic material was impossible. From data available so far, it seems that Hagdud truncations and El Khiam points are very common in the early Neolithic assemblage (SCHROEDER 1977; COPELAND 1991). The drawings include 21 truncations, of various shapes and dimensions (Fig. 3:11-17).

NAHAL OREN. This stratified terrace site has yielded flint assemblages of various Epipalaeolithic and at least two Neolithic cultures (STEKELIS and YIZRAELI 1963; NOY *et al.* 1973). A comprehensive analysis of the Neolithic flint assemblages has been recently conducted (NADEL and GOPHER, unpublished). Arrowheads were found in the Stekelis excavations (1954-60) and the later excavations (1969-71), but Hagdud truncations were only found in the recent excavations (due to better recovery techniques). Altogether there are 15 Hagdud truncations (Fig. 3:1-6) and 17 El Khiam points, as well as many lunates, probably some of which are intrusive from the Natufian occupation layers.

NETIV HAGDUD. This PPNA mound was extensively excavated in the mid 1980's (BAR-YOSEF *et al.* 1980, 1991). Sixty three Hagdud truncations were found at the site (Fig. 4A) (BAR-YOSEF *et al.* 1987; NADEL 1988). The assemblage also includes 120 arrowheads, of which 55 are of the El Khiam type (NADEL 1988). In addition, several square bladelet segments made of obsidian should be noted. Ninety lunates were found at the site.

SEFUNIM. One Hagdud truncation was reported from the Neolithic Layer V (Fig. 3:18) (RONEN 1984: Fig. 22:7:8). It was thought at the time to be a microlith. No El Khiam points have been found at the site.

TEL SHOKA. This site was never reported as a PPNA site. It was found during a survey in the Bet Shean Valley (grid ref. 1933.2115) and reported as a tell with finds belonging to various prehistoric and historic periods (ZORY 1962). While working at the Israel Antiquities Authority (1989) I found one small box with material from the site. There were several retouched flint tools, a couple of obsidian bladelets and one Hagdud truncation (Fig. 3:10). No arrowheads were found in the box, and there are no other typological details available from the only report. It was mentioned in the report, however, that the Neolithic tools were collected from the northern slope of the tell. During my two short visits to the site, many flint artefacts were observed scattered on the surface. Among these, several sickle blades were identified, none of which was characteristic of a specific prehistoric industry.

Another PPNA- site was recently found in the Judean Desert. The flint assemblage includes el-Khiam points and Hagdud truncations (GOPHER, personal communication).

Correlation between Hagdud Truncations and El Khiam Points

TECHNOLOGY. The two tool types were manufactured on bladelet or small blade blanks. They all have left-right symmetry. All the El Khiam points and many subtypes of the Hagdud truncations have notches. The kinds of secondary retouch used for their final shaping vary considerably.

However, one type of retouch is worth mentioning, namely Couze retouch (BORDES and FITTE 1964). Couze retouch results in very fine flat shallow scars on the dorsal face of the artefact, making it just a little thinner along the retouched edge. It is not common in Levantine flint industries, and so far has been reported for some of the El Khiam and Hagdud truncation specimens. At Netiv Hagdud, 10 of the El Khiam points (18%) and 17 of the Hagdud truncations (27%) were modified by this technique. No other tools at the site were modified in this manner. Thus, not only was this retouch used exclusively for the two tool types, it even appears in similar frequencies in the two types. Couze retouch is also present on the Mujahiya specimen (Fig. 3:30) and on some of the Nahal Oren specimens.

MORPHOLOGY. Morphologically, the arrowheads and the truncated pieces are very different. However, there is a remarkable similarity between the Hagdud truncations and the bases of the El Khiam points. A detailed study of the sample from Netiv Hagdud showed clearly that the truncations are not reworked broken El Khiam points. Rather, they are an independent tool type, the resemblance deriving from functional and/or stylistic factors (BAR-YOSEF *et al.* 1987; NADEL 1988).

INTRA-SITE DISTRIBUTION. For some of the sites, an analysis of the distribution patterns of the two tool types has been conducted. Only for the Netiv Hagdud assemblage was this possible on the locus level; for the other sites, only a more general study was possible. In Netiv Hagdud a large area (ca. 500 sq.m) on top of the mound was excavated (henceforth "upper area"), and a sounding more than 4 m deep was also conducted (henceforth "sounding") (BAR-YOSEF *et al.* 1991: Figs. 2-3). While studying the flint assemblage, the provenance by loci was divided into three: floors, fills of structures and open areas.

Table 2. Distribution of arrowheads and Hagdud truncations in three types of loci in the two areas of excavation at Netiv Hagdud (after NADEL 1988).

tool type	*floors*		*fills*		*open area*	
	Upper	*Sounding*	*Upper*	*Sounding*	*Upper*	*Sounding*
arrowheads	1	2	7	10	43	49
Hagdud trun.	1	2	7	5	20	24

As can be seen in Table 2, there is a high correlation between the distribution of arrowheads and truncations at the site. Furthermore, there are actually two kinds of patterned relationships. The first is 1:1, while the other is 1:2. This dichotomic association is far too close to be random. It has too be explained in terms of human behaviour, where the two types were used, stored, or disposed of in similar quantities and together.

Table 3. Distribution of three arrowhead types and Hagdud truncations in the phases of the deep sounding at Netiv Hagdud (Phase 1 is the oldest) (after NADEL 1988).

phase	EL Khiam	Jordan V.	Salibiya	Hagdud t.
Phase 3	2	2	1	6
Phase 2	26	5	10	23
Phase 1	3	4	1	3

The deep sounding at the site was divided into three phases, 1-3 from bottom to top. The absolute numbers of El Khiam points and Hagdud truncations change from phase to phase, but the two types show very similar trends (Table 3). It is also true for the Salibiya points in these phases. This high correlation, again, points to a positive association between the arrowhead types and the Hagdud truncations.

At Gesher, four Hagdud truncations were found in unit 2, where seven of the ten El Khiam points were also found (GARFINKEL and NADEL 1989). Though the sample is small, it does suggest a trend of clear association between the points and the truncations. Furthermore, a proportion of 1:2 can be inferred.

At Hatula F, there are 76 points (not all of the El Khiam type, as can be seen in LECHEVALLIER *et al.* 1989: Fig. 2:16), and there are 27 Hagdud truncations. The Hagdud truncation: el Khiam -ratio would be less than 3 : 1.

At Nahal Oren, there are 15 truncations from the recent excavations, where 17 El Khiam points were also present. This is roughly a 1:1 association.

This section has shown that the numbers of the two types are usually of the same scale at each of the sites (where samples are available). Their patterns of distribution are closely associated, and the frequencies are either 1:1 or 1:2 (in favour of the arrowheads). These data suggest that the two artefacts were used together, either on the same arrows or in the same numbers but on different arrows.

INTER-SITE COMPARISON. There is no doubt that the Hagdud truncations are an integral part of the Sultanian tool kit. However, their geographical distribution is not as wide as the El Khiam points. The points are found in many sites from southern Sinai to the Damascus basin and further north.

The Hagdud truncations, according to available data, were used mainly in the southern Levant along the Rift Valley. Jericho, Netiv Hagdud, 'Iraq ed-Dubb, Gesher, Tel Shoka, Mujahiya and Nachcharini are all located along the Valley or on the hills above. The two assemblages from Hatula and Nahal Oren indicate their presence in the Judean hills and the Carmel.

The absence of this type from the well excavated sites of Gilgal and Salibiya IX is conspicuous, especially as they are so near Netiv Hagdud (less than 1 km). It either reflects an earlier phase (the Khiamian) or a functional difference (though the flint assemblages of Salibiya IX and Gilgal do not seem to belong to the same tradition). This issue has been discussed in detail elsewhere (e.g. NADEL 1988; LECHEVALLIER *et al.* 1989; BAR-YOSEF 1991: 13). It should be pointed out, though, that in many of the Netiv Hagdud loci there are no El Khiam points, or no Beit Ta'amir sickle blades, or no Hagdud truncations, or no bifacial axes. In other words, the absence of a tool type should not be inferred, automatically, as a mark of a different cultural entity.

Other Symmetrical Blade/ Bladelet Tools

In several of the Sultanian flint assemblages there are small numbers of symmetrical tools (additional to the arrowheads and Hagdud truncations) made on bladelets or small blades.

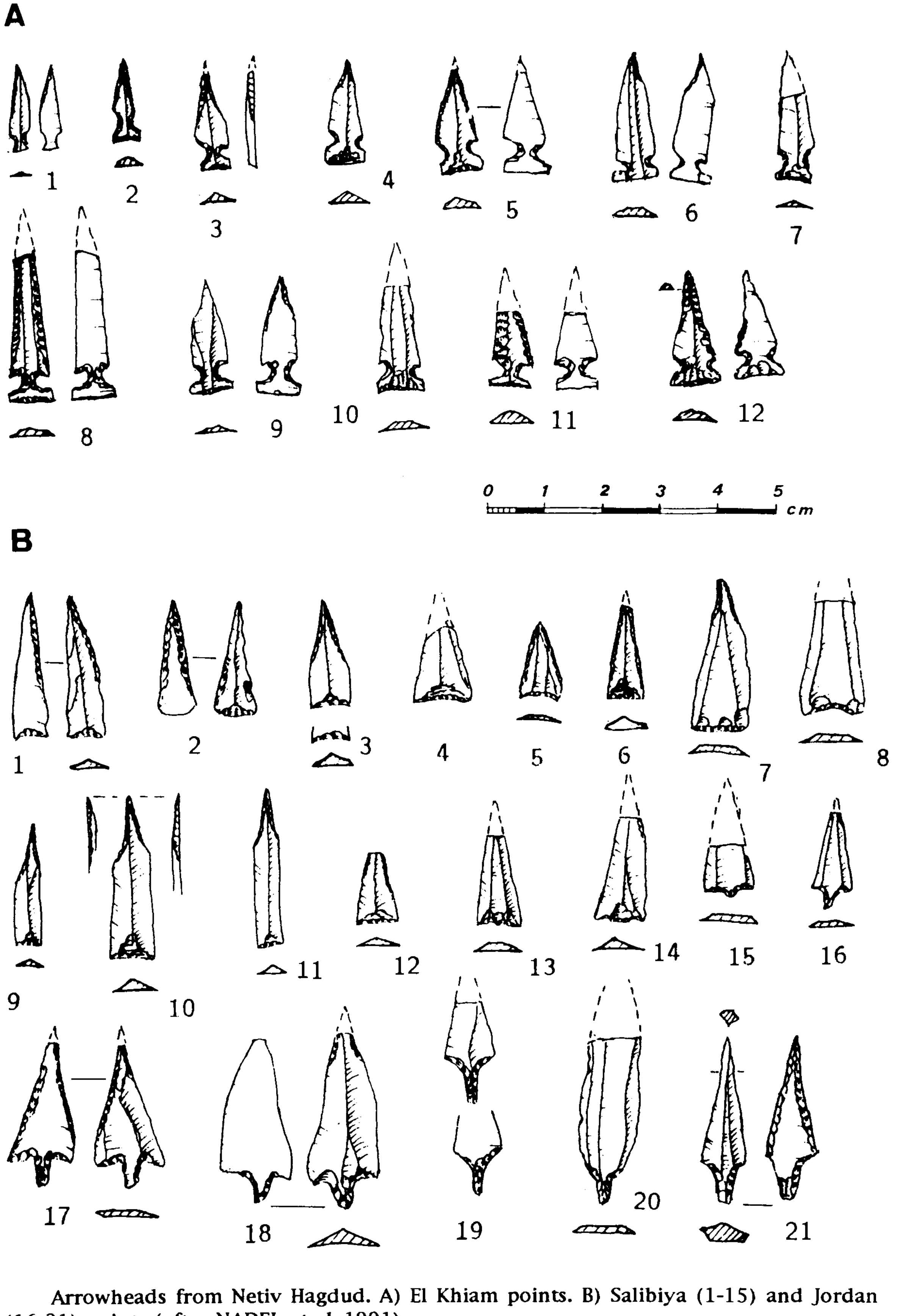

Fig. 2. Arrowheads from Netiv Hagdud. A) El Khiam points. B) Salibiya (1-15) and Jordan Valley (16-21) points (after NADEL *et al.* 1991).

At Gilgal, several truncated blades with two pairs of side notches, called "Gilgal truncations" have been reported (Fig. 3:32-34) (NOY *et al.* 1980; NOY 1987: Fig. 1:1-3,5; NOY, this volume). A possible addition to this group could be a similar artefact with one pair of notches, found at Gilgal (Fig. 3:35), Hatula (Fig. 3:36) and Jericho (CROWFOOT PAYNE 1983: Fig. 261:7). Two similar artefacts were reported from El Khiam (PERROT 1952: Fig. 1:25; ECHEGARAY 1966: Figs. 21:14, 42:24). This group of artefacts is definitely outside the range of variability of the Hagdud truncation type. They resemble El Khiam arrowheads in the general morphology and presence of side notches, but they lack a pointed tip; they usually have a proximal and/or distal truncation.

In various sites, truncated or bitruncated bladelets or blades, in the dimensions of PPNA arrowheads but with no tips or notches, have been found in extremely small numbers. There was one in Netiv Hagdud (NADEL 1988), one in Gesher (GARFINKEL and NADEL 1989: Fig. 1:27), at least three at Nachcharini (SCHROEDER 1977), possibly one at Jericho (CROWFOOT PAYNE 1983: Fig. 273:3), three at Nahal Lavan 108 (NOY *et al.* 1981: Fig. 2:2,10,11).

All these rare specimens do have a clear left-right symmetry, and thus they should be viewed as part of a systematic production of a wide variety of small symmetrical artefacts.

Function of the Hagdud Truncations

The small size of the Hagdud truncations strongly suggests that they were hafted if used for any task of cutting or penetrating bone, flesh, wood etc. This is because they are too small to handle and use without any attachment. And indeed, when they were hafted, only a small corner or a short active edge would have been available for work. It is possible that they were used as transverse arrowheads or barbs. As points, they could have been attached in various angles at the end of the arrow (Fig. 4.B) (BAR-YOSEF 1987b and see references there).

The use of small sharp flint implements as barbs has probably began long before the Neolithic period. In reconstructions of Epi-Palaeolithic microliths, for example, they are commonly shown to have been used as diagonal or paralell barbs (e.g. MOSS 1983; BAR-YOSEF 1987b; LEROI-GOURHAN 1983). This technique was widespread in time and space (CLARK *et al.* 1974: Fig. 9).

The above examples (and there are many others) were presented in order to show that there is ample archaeological evidence for the use of flint pieces similar to the Hagdud truncations as transverse arrowheads and barbs. Furthermore, the same use was observed in many ethnographical studies (CLARK *et al.* 1974).

Cross-Cultural Comparisons

In the Middle East, contemporaneous sites with small truncations are rare, while morphologically similar tools are present mostly in later industries. Karim Shahir, which is dated to the middle of the 9th Millenium B.C. and situated on the fringes of the Zagros Mountains, has yielded one relevant artefact. It is a small piece with a double truncation called there a geometric microlith, but it resembles in size and shape the Hagdud truncation (HOWE 1983: 130, Fig 14:21).

The finds from the upper layers of Jarmo (6th millennium B.C.) include 513 "thin sections" made of obsidian blades. Most of them are not retouched (437), while 76 are modified on one or both ends. They were produced by dorsal or ventral blows on the blades, and not by double truncations like the Hagdud truncations (HOLE 1983: 247-8: Figs. 122-123).

The Halafian site of Shams ed-Din Taneira produced one obsidian piece with parallel truncations (MILLER *et al.* 1982). In addition, late Neolithic and Chalcolithic industries in the Levant have transversal arrowheads somewhat similar to the Sultanian Hagdud truncations (BAR-YOSEF *et al.* 1977; DUNAND 1968: Fig. 49), though they are only similar to the rectangled subtype and not to the truncations with concave edges.

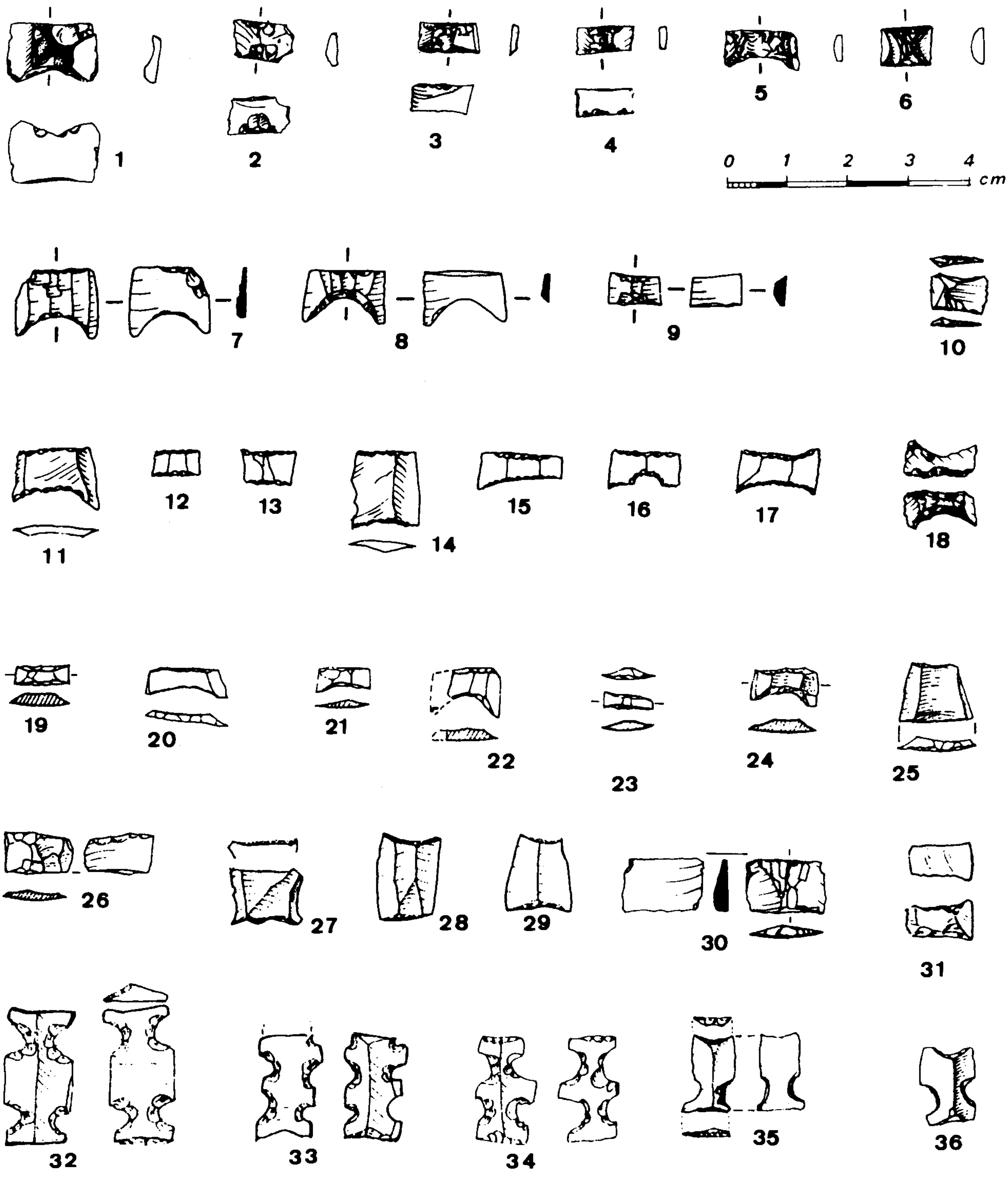

Fig. 3. Hagdud truncations from Nahal Oren (1-6), `Iraq ed-Dubb (7-9), Tel Shoka (10), Nachcharini (11-17), Sefunim (18), Hatula (19-26), Gesher (27-29), Mujahiya (30) and Jericho (31). Gilgal truncations from Gilgal (32-34); bitruncated elements with one pair of notches from Gilgal (35) and Hatula (36) *<see text for references>*.

In western Europe, several Mesolithic industries include in their geometric types specimens very similar to the Levantine Hagdud truncations, but not the concave ones (e.g. ROZOY 1978: Plates 79,138,202,232). The Western European Neolithic industries include the combination of projectile points and double truncations (COURTIN 1976: Fig. 1:4-8). Apparently, many prehistoric industries have produced - independently - the same type of flint tools.

Discussion

Two news types of tools appear at the beginning of the Neolithic period in the Levant. These are arrowheads and short bitruncated elements - the Hagdud truncations. In addition, there are very small numbers of longer truncated blade-bladelet elements: some with a basal truncation, some with basal and distal truncations, some with one or two truncations and a pair (or two) of notches. All types of arrowheads and truncations exhibit left-right symmetry, regardless of their dimensions. The Neolithic people did not invent the notion of left-right symmetry. There are symmetrical handaxes in the Lower Palaeolithic assemblages, there are symmetrical Mousterian and Levallois points in the Middle Palaeolithic industries, and there are symmetrical retouched and pointed blades in the Upper Palaeolithic assemblages (such as the El Wad point).

However, during the Epipalaeolithic period the most common retouched tool is the microlith - a bladelet retouched almost exclusively along one edge. The result is a delicate and well-shaped artefact, but it has no left-right longitudinal symmetry. It has been suggested by many that the microliths were used as points and barbs of arrows (e.g. BAR-YOSEF 1987b; MOSS 1983). Thus, the Neolithic innovation is the replacement of asymmetrical points and barbs by symmetrical ones.

Nonetheless, many of the Epipalaeolithic traditions of flint knapping and use were retained by their successors. First, the production of lunates did not end at the final Natufian. Rather, they were manufactured by Neolithic knappers in quantities similar to (and sometimes even higher than) the El Khiam points. In addition, the production of tools on bladelets continued, though not on the same quantitative scale. Furthermore, the use of bladelets for blanks of points and barbs is manifest in both industries.

It is only during the PPNB period that many long and straight blade blanks were produced (mostly from naviform cores). It is possible that the more common use of heat treatment of flint facilitated such excellent results (NADEL 1989)). By now, many of the arrowheads were much larger and heavier than the Sultanian ones (GOPHER 1985). For example, the average length of El Khiam points at Netiv Hagdud is 21.8 mm (NADEL 1988), and at Hatula (F) 23.5 mm (for El Khiam "type A": LECHEVALLIER *et al.* 1989: Table 2). In contrast, at PPNB Munhata the average length of the Jericho point (the most common type at the site) is ca. 60 mm, depending on the layer (GOPHER 1989: Table 7). In addition, large flint spearheads were also produced (see exceptional examples in NADEL 1993). PPNB flint assemblages do not include small flint implements which could be iterpreted as barbs - the various small sharp truncations completely disappear. The trend of developing bigger pointed implements reverses by the Pottery Neolithic period. A general reduction continues into the Chalcolithic period, where transversal arrowheads become common (BURIAN and FRIEDMAN 1979).

Flint arrowheads and barbs should be understood in the general context of hunting traditions. There is no doubt that the shift from microliths to symmetrical arrowheads reflects a basic change in hafting methods (e.g. BAR-YOSEF 1987b; see CLARK *et al.* 1974 for examples). The small new (PPNA) arrowheads also evolved in a few generations into larger arrowheads (PPNB). This is no doubt a part of a continuous improvement of bows and arrows. They become bigger, stronger and more accurate.

The Sultanian variety of arrowheads, and most probably of arrows, is indicated by the flint artefacts: El Khiam, Jordan Valley and Salibiya points, the assortment of Hagdud truncations (rectangles, squares, concave), lunates, and the square elements of obsidian (found at Jericho and Netiv Hagdud). Most probably bone and wood points were also used. This variability reflects a hunting kit suitable for a wide range of game.

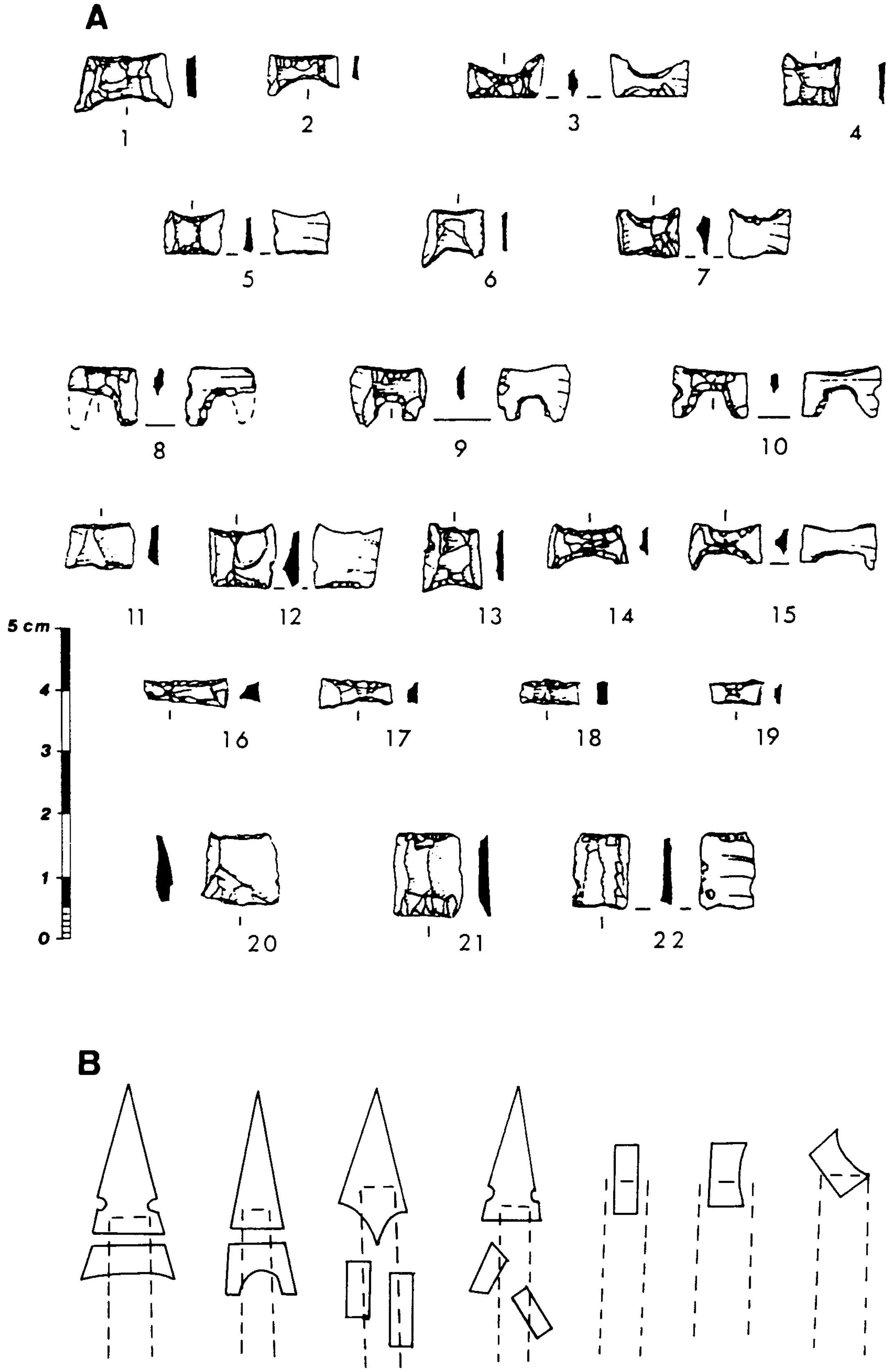

Fig. 4. A) Hagdud truncations from Netiv Hagdud (after BAR-YOSEF *et al.* 1987). B) Suggested use of Hagdud truncations <*schematic*>.

The wide range of variabilty within the Hagdud truncations deserves special attention. Why are there so many types - are the differences just functional? Could it be that they, as small as they are, served as a means of social communication? In this regard, it should be noted that obsidian is found in very small numbers in Sultanian sites (if at all), and several of these rare exotic artefacts are shaped as Hagdud truncations and not as arrowheads. It should be stressed that the variabilty of the truncations is found in their many shapes, dimensions and types of retouch. For such small items, some of the retouch seems more stylistic than functional - the best example is the Couze retouch which hardly changes the edge of the artefact. Are these small specimens, most probably hafted on arrows, a reflection of individual signatures or signs of certain social units? Could the Hagdud truncations be regarded (maybe together with the more typical arrowheads), as many material remains should, and arrowheads have been reported to do so, not only as functional artefacts - but also as a means of conveying social messages (WOBST 1977; WEISSNER 1984; LARICK 1985)?

Returning for final remarks on symmetry, one should not forget that pointed bone tools, with excellent symmetry, are present in many sites from the Upper Palaeolithic onwards. It is reasonable to assume that some of the smaller ones (and maybe some wooden points) were used as projectile points. If so, these were probably the first symmetrical arrowheads.

It is interesting to note that small pointed bone implements are very common in PPNB sites, and when preservation conditions are good, even wooden points can be found (e.g. Nahal Hemar Cave: BAR-YOSEF and ALON 1988: 13-16; Plates 3-4). In addition, there are rare examples of bone artefacts flaked into typical shapes of flint arrowheads. Two such examples, in the shape of Byblos flint arrowheads, were found at Shaldag Beach on the shore of the Sea of Galilee (NADEL 1993). Another unique bone arrowhead was found at Tell Ramad (de CONTENSON 1985: 19).

The development of hunting techniques in general, and archery in particular, is reflected in the tool repertoire found in the prehistoric sites. Once bows and arrows were invented, there is a constant improvement towards better results in the hunt. The physical characteristics of bows (strength, flexibility, weight, etc.) and arrows (stability in flight, penetration strength, wound damage, etc.) were improved in a series of innovations during the Pre-Pottery Neolithic period. The symmetry of flint artefacts used as points and barbs was a new solution to an old issue: the improvement of the hunting kit. The silent stone remains are a reminder of this process.

Acknowledgments: I wish to thank all those who gave me an opportunity to study material from their excavations: Ofer Bar-Yosef and Avi Gopher for the Netiv Hagdud material and much encouragement during my M.A. thesis; Yosi Garfinkel for the opportunity to participate in the Gesher excavation and the analysis of the flint assemblage; Tamar Noy for the opportunity to study the Nahal Oren assemblage and publish the Hagdud truncations; Avi Gopher for the Mujahiya specimen, the information on the Judean Desert site, and the cooperative work on the Nahal Oren assemblage; Monique Lechevallier and Avraham Ronen for the Hatula material; Avraham Ronen for the Sefunim material, and the Israel Antiquities Authority for the permission to study and publish the Tel Shoka specimen.

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Gilgal Truncation.
A New Type of Tool from Early PPNA

Tamar Noy

Three items with opposed notches and distal truncations, found in Gilgal III, were published several years ago (NOY 1987, Fig. 1:3,8-9)[1]. However, as they were only few in number, they were not coined as a separate group of tools, despite the fact that a similar item had been found at the Hatula site (LECHEVALLIER *et al.* 1985, Fig. 21:5). In the meantime, six additional items have been found at the same site[2], which encourages their defininion as a new group of tools. All the items been found on the western and southern slopes of the site and none from the small trial excavations.

The ten artifacts discussed in this article are characterized by opposite pairs of notches (Fig 1:1-7,10), sometimes by additional pairs (Fig 1:8-9), and by truncated bases and distal ends. Their lengths run between 10-21 mm and their widths are between 12-15 mm (Table 1). The notches vary in shape and size; some were produced near the base of the item and continue smoothly from it, while others are a short distance from the base.

The bases are mostly straight truncations. The distal end is mostly truncated concavely, but it is sometimes straight and may even be convex (Fig 1:7). The retouch is fine and occurs along the edges as well.

Practically all of the elements just described are similar in width and shape to the El-Khiam points found at the site (Table 1) except for the distal truncation. It is irrelevant whether they were made on broken items such as El-Khiam points or made intentionally using the same technique and forms (Fig 1:11-15). Even the use of pink flint for all these artifacts, as evidenced in the El-Khiam points, is additional support for a resemblance between the two groups of tools. However, the new feature is the truncation.

The function of these tools is not clear. They probably were attached to a shaft as with the El-Khiam points and were used as transverse arrowheads, or they may have functioned as delicate scrapers in order to clean and smooth handles made from reeds, branches of trees and bushes[3]. There is no doubt that tools other than arrowheads were hafted.

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1 The site Gilgal III, in the lower Jordan Valley, was discovered at the end of 1973, together with four more sites closely connected. It is located on the eastern-most side of the Salabiya Valley around 231 m, b.s.l. Only a small test trail was made in the site for examining the stratigraphy. Here, most of the flint artifacts were collected from the south-west slopes, which were densely covered with artifacts.

2 D. Nadel, while searching for the Netiv Hagedud truncation, provided me with references on items similar to those which I published in 1987, which encouraged me to write this article. I am most grateful to D. Nadel, F. Burian and E. Friedman from Ramat Gan for allowing me to use the artifacts from their collection

3 Microscopic work was not done, and without it, signs of use were not evident.

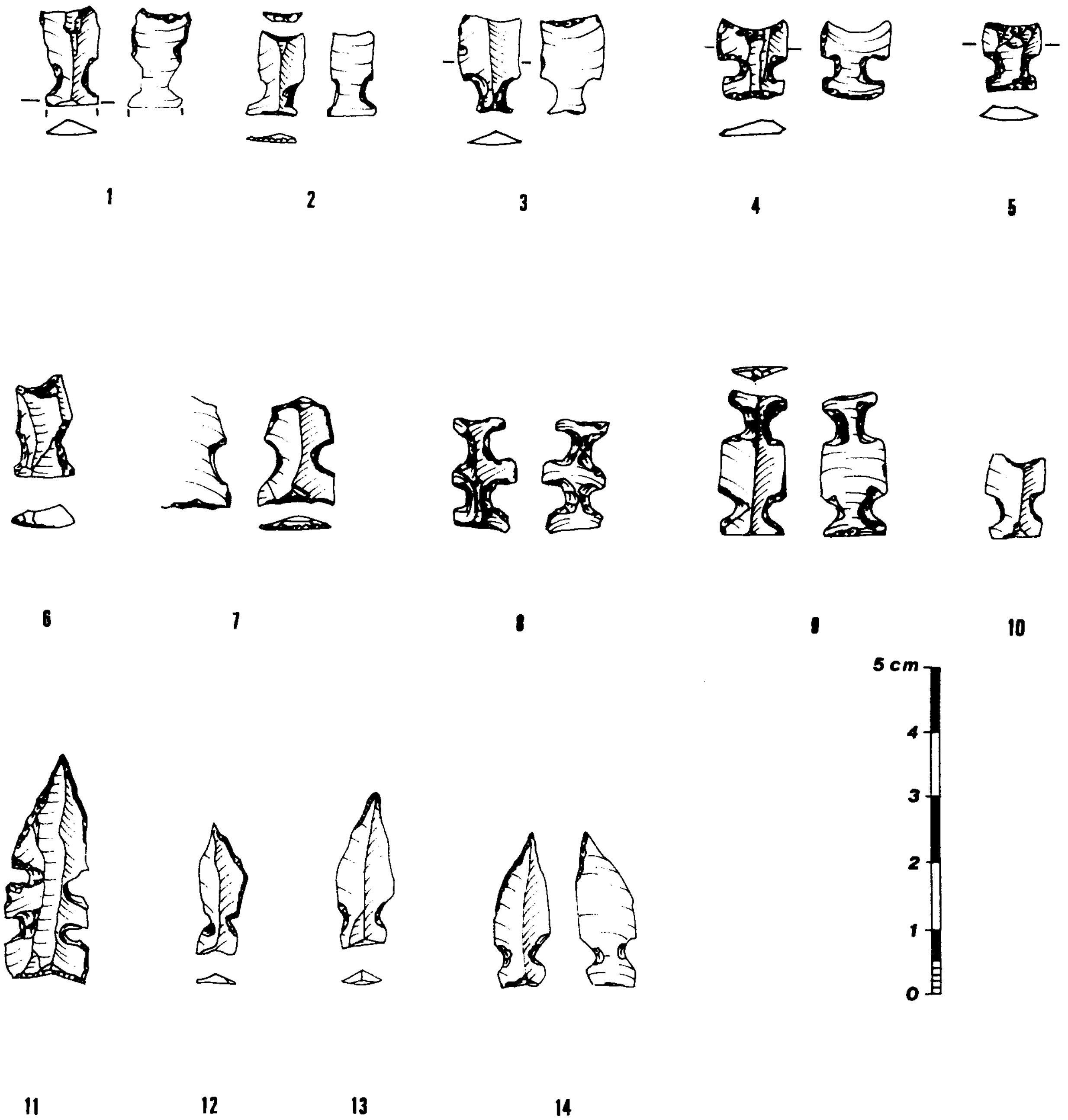

Fig. 1. Gilgal Truncation from Gilgal III (1-9), Hatula (10); El-Khiam points (11-14).

Table 1: Sizes of Gilgal Truncations and El-Khiam Points (in mm)

	Gilgal Truncation		*El-Khiam Points*	
	Length	*Width*	*Length*	*Width*
1.	15	5	26	10
2.	15	9	24	12
3.	12	8	23	9
4.	18	8	21	8
5.	10	8	20	10
6.	16	10	20	9
7.	11	11	20	11
8.	21	12	20	9
9.	13	9	15	7
Mean	*14.55*	*8.88*	*21*	*9.44*
S.D.	*3.5*	*2.02*	*3.12*	*1.50*

The technique of producing small notches near the base served the purpose of binding the flint artifacts to long or short shafts or handles. This technology is commonly known in the PPNA with the El-Khiam Points, which is known throughout large areas of the Near East, from the Negev and Sinai to northern Iraq, and continued in the early phases of PPNB with the Helwan point. In addition, the use of notches for these purposes is known in the cases of a few awls, Gilgal truncations, and a few other items in the PPNA. Additionally, different techniques of joining the small artifacts to handles (probably short ones) with a natural mastic are well-established among small artifacts of the PPNA, such as Hagdud truncations (BAR-YOSEF, GOPHER, and NADEL 1987), and various small truncated items (NADEL 1988).

As mentioned above, the only similar artifacts belonging to the early phases of PPNA were found in Hatula Layer 2. Surprisingly, similar artifacts are known from Qermez Dere in northern Iraq, as represented by A. Betts at the Berlin Workshop "Qermez Dere: Basic Tool Typology"[1], as well as in this volume. Moreover, the El-Khiam point is also part of the flint industry assemblage at this site.

Beyond this, there is, as yet, no additional evidence of Gilgal truncations between these two areas. However, the El-Khiam point is well known in northern Syria in Mureybet Layer 2, which bridges these two areas (CAUVIN and STORDEUR 1978). In general, there are components of culture that are similar to the entire original area mentioned above, such as in the architectural features, new ways of exploiting resources, new ideological ways (symbolic art), etc.

In terms of stratigraphy and chronology, it seems that the people of Gilgal III (including Gilgal IV - Salabiya IX) were the first Neolithic people that occupied the Gilgal-Salabiya area and were followed by the people of Gilgal I (both phases that were culturally named Khiamian). The people of

[1] At the Berlin Workshop I had the opportunity to read my notes on "Two Issues in the PPNA Culture: The Gilgal Truncation and The Tahunian Flint Axes." My aim was to discuss the interaction between people while sampling these two items. Gilgal truncation was to demonstrate a small circle of interaction, and the Tahunian flint axe demonstrated a large circle of interaction, while still within geo-cultural boundaries. As the Gilgal truncation might be a secondary product of El-Khiam Points, the Tahunian flint axe is a primary product involved with successful technology producing the cutting edge. Therefore, this technology continued to be used by the people who followed, in the Early PPNB phase. For two reasons, I was unable to continue with this work for the time being. Firstly, at the Berlin Conference I learned that the Gilgal truncation appeared also in the Qermez Dere in northern Iraq, a far distance from the Jordan Valley. Secondly, I found that it would be of interest to include other flint groups such as Hagdud truncations, Beit Ta`amir knives, and Helwan point to illustrate human interaction within the PPNA period.

Netiv Hagdud and Jericho, who culturally belonged to the Sultanian phase of the PPNA culture, later inhabited this region[1]. (NOY, SCHULDENREIN, and TCHERNOV 1980)

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[1] It is difficult to be sure whether this area was continuously occupied from the Natufian through the PPNA periods. Within the PPNA phases some hint exists, in spite of the differences characteristic of each phase of the culture.

Aspects of the PPNB Lithtic Industry at Kfar HaHoresh, near Nazareth, Israel

Nigel Goring-Morris

Introduction

Chipped stone assemblages are widely considered to represent amongst the most distinctive and characteristic elements of the material culture repertoire of the Near Eastern Pre-Pottery Neolithic B interaction zone. Yet it is only in recent years that numbers of PPNB lithic assemblages from throughout the Levant have been published. These include recently excavated sites, as well as the belated publication of excavations conducted in the more distant past. Most common are general descriptions of entire assemblages from sites or, at best, the assemblages associated with architectural phases (BAIRD *et al.* 1992; BETTS 1989; CROWFOOT PAYNE 1983; GARFINKEL 1987; GOPHER 1981, 1989; GOPHER *et al.*, in press; GORING-MORRIS and GOPHER 1983; LECHEVALLIER 1978; ROLLEFSON and SIMMONS 1986, 1988; SIMMONS *et al.* 1988). However, virtually no attention has been focused upon presenting more detailed analyses by loci or other circumscribed areas (e.g. structures, pits, fills, etc.).

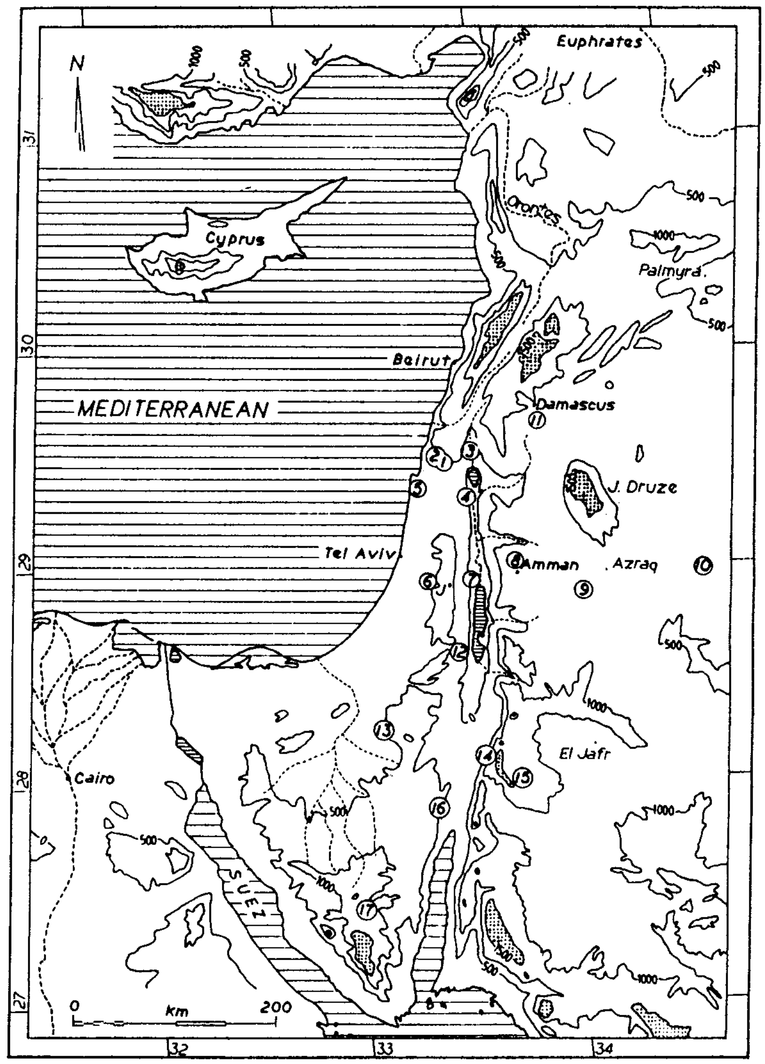

Fig.1. Map showing the location of Kfar HaHoresh in relation to other major 7th Millennium BC PPNB sites in the central and southern Levant: 1 Kfar HaHoresh, 2 Yiftahel, 3 Beisamoun, 4 Munhata, 5 Nahal Oren, 6 Abu Gosh, 7 Jericho, 8 'Ain Ghazal, 9 Wadi Jilat, 10, Dhuweila, 11 Ramad, 12 Nahal Hemar, 13 Ein Qadi, 14 Beidha, 15 Basta, 16 Nahal Issaron, 17 Wadi Tbeik

From these publications it is obvious that field recovery techniques are quite variable, as indeed are some of the methodologies applied to the analysis of the chipped stone assemblages. With the exception of some of the most distinctive tool forms, such as projectile points, elements bearing (sickle) gloss, and bifaces, the lack of standardisation clearly inhibits and hampers detailed comparisons at both the inter- and intra-assemblage levels.

The aim of the present paper is to use data from the preliminary lithic analysis of a recently tested 7th millennium B.C. PPNB settlement at Kfar HaHoresh in the Galilee, Israel, to focus on and illustrate several aspects of the assemblage which are are likely to have wider ramifications concerning PPNB lithic industries and how these articulate and integrate with other aspects of PPNB lifeways. These include: inter- and intra-site variability, raw material procurement, blank production and modification, and patterns of discard.

Kfar HaHoresh

Two short seasons of excavations were conducted at the small, 6 dunam, PPNB settlement of Kfar HaHoresh, in the Nazareth Hills of lower Galilee in 1991/92 (Fig. 1 and acknowledgments). These revealed typical large quadrilateral, limeplaster floored structures, subfloor burials and a plastered skull, as well as good faunal preservation (GORING-MORRIS 1991; in press; GORING-MORRIS *et al.*, in press a, b; in prep.; HERSHKOVITZ *et al.* in press). Other material remains recovered included a typical PPNB marine mollusc assemblage as well as exotic minerals, such as obsidian, turquoise and asphalt.

Although no C14 dates are currently available, the material culture remains from Kfar HaHoresh indicate close analogies to the nearby site of Yiftahel, well-dated to the first half of the 7th millennium BC (GARFINKEL 1987).

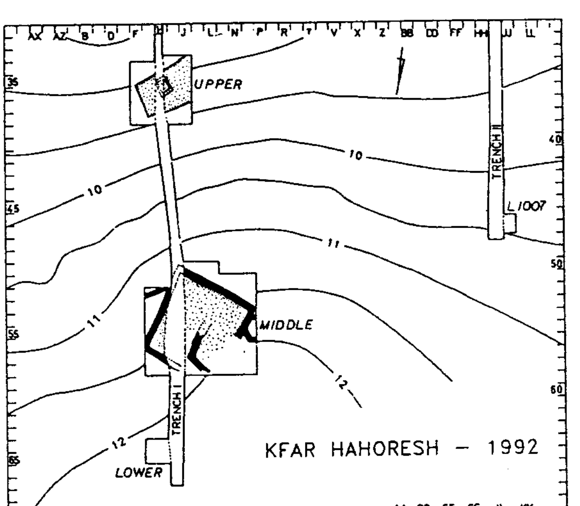

Fig. 2. General plan of site showing the main excavation areas and architectural features. Plastered surfaces are stippled.

Three separate areas were excavated along a mechanically excavated test trench (Trench I), labelled (from south to north) upper, central, and lower (Fig. 2). It should be noted that the material deriving from the upper area is probably not in primary context and represents natural post-depositional processes derived from further upslope following abandonment of that area of the site. The associated structure has still to be excavated. The central area corresponds to several architectural phases, including large, rectangular limeplaster floored structures. The lower area represents a small exposure of a sequence of limeplaster floored structures whose extents remain uncertain. A small additional area, Locus 1007, was excavated at the northern end of an additional exploratory test, Trench II. This seemingly represents a rather shallow refuse pit filled with knapping waste. The excavations were conducted in 0.5-1.0 m^2 quadrants and 5-10cm spits, depending upon the context. All sediments were dry-sieved through 0.3mm mesh, with a number of loci additionally being wet-sieved.

Table 1. Lithic counts and waste frequencies from the various excavated areas (1991-92 seasons).

	L1007		*Lower*		*Middle*		*Upper*		*Total*	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Primary elements	1547	9.4	147	39.7	842	27.2	399	41.2	2935	14.1
Flakes	8431	51.3	146	39.5	1528	49.3	418	43.2	10523	50.4
Blade/lets	5271	32.1	65	17.6	558	18.0	124	12.8	6018	28.8
Core tablets	232	0.1	1	0.3	4	0.1	1	0.1	238	1.1
Ridge blades	649	4.0	5	1.4	84	2.7	15	1.5	753	3.6
CTE	292	1.8	6	1.6	71	2.3	11	1.1	380	1.8
Burin spalls	1	0.0	-	-	13	0.4	-	-	14	0.1
Total:	*16423*		*370*		*3100*		*968*		*20861*	
Chips*	94876		277		2052		456		97661	
Chunks	171		103		553		185		1012	
Cores	19	0.0	3	0.4	64	1.0	14	0.8	99	0.1
Debitage	16423	14.7	370	47.5	3100	50.3	968	57.6	20861	17.4
Debris	95047	85.2	380	48.8	2605	42.3	641	38.1	98673	82.1
Tools	59	0.1	26	3.3	392	6.4	59	3.5	536	0.4
TOTAL:	*111548*		*779*		*6161*		*1682*		*120170*	
Debitage/Core	864.1		123.3		48.4		69.1		210.7	
Tools/ Core	3.1		8.7		6.1		4.1		5.4	
All CTE/Core	61.7		4.0		2.5		1.9		13.8	
Debitage/Tool	278.4		14.2		7.9		16.7		39.1	
Flake/Blade	1.6		2.2		2.7		3.4		1.7	

* Estimate based on weight of a representative sample
● Above surface of Locus 1010 only

Table 2. Core types from the various excavated areas <*absolute numbers*>.

	Middle	*Lower*	*Upper*	*L1007*	*Total*
Single platform	30	-	5	1	36
Two platforms	12	-	2	-	14
Opposed platform	5	-	3	-	8
Naviform	2	-	-	13	15
Amorphous	2	3	1	1	7
Fragments/incomplete	9	-	3	3	15
Discoidal	2	-	-	-	2
Levallois	2	-	-	-	2
Total:	64	3	14	18	99
Hammerstone on core	5	-	-	1	6

Table 3. Tool classes from the various excavation areas (1991-92 seasons combined).

	Middle		*Lower*	*Upper**	*L1007*	*Total*	
	n	*%*	*n*	*n*	*n*	*n*	*%*
Arrowheads	49	12.5	1	6	2	58	10.8
Bifaces	3	0.8	-	-	1	4	0.7
Sickles	59	15.1	7	8	1	75	14.0
Burins	43	11.0	1	1	3	48	9.0
Scrapers	11	2.8	-	3	1	15	2.8
Notches & Denticulates	35	8.9	-	4	22	61	11.4
Awls & Borers	72	18.4	4	5	20	101	18.8
Truncations	4	1.0	-	1	-	5	0.9
Retouched Blades	68	17.3	10	12	6	96	17.9
Multiple Tools	7	1.8	1	2	1	11	2.1
Varia	41	10.5	2	17	2	62	11.6
Total:	*392*		*26*	*59*	*59*	*536*	

*above surface of Locus 1010 only

The Lithic Assemblages

While the total area excavated at Kfar HaHoresh is, to date, limited, and analyses of the material culture remains necessarily provisional, preliminary investigation nevertheless provides several insights as to certain operational aspects of PPNB raw material procurement and production systems as regards the chipped stone tool assemblage.

A total of 120,170 artefacts have been recovered from all excavation areas (GORING-MORRIS *et al.*, in press). Summaries for the individual excavation areas are presented in Tables 1-3. It should be noted, however, that these do not correspond to phases within the span of the occupation. Densities of chipped stone artefacts throughout the site are, all-in-all, low, though Locus 1007 is clearly aberrant; this represents what can be interpreted as a flint dump of waste from one or a series of intensive knapping episodes conducted elsewhere on site.

The vast majority of artefacts at Kfar HaHoresh are knapped on a light, creamy beige, rather cherty flint which is seemingly of local origin (the material is very similar to that from Yiftahel). However, numbers of the more standardised tools (especially projectile points and sickles) and larger, more symmetrical blanks (especially blades) are manufactured on finer textured flint. This ranges from pink and purple through dark brown in hue, the two former colours perhaps representing material which had been intentionally heat treated. The complete absence to date of cores and virtual lack of debris and more irregular debitage on finer-textured flint indicate that they were originally fabricated elsewhere, and most likely were obtained through exchange or special procurement parties, a phenomenon widely documented in the central Levantine PPNB. Interestingly no finer material was encountered amongst the abundant material recovered from Locus 1007, though a small proportion comprises chert. Locally available flint occurs as medium-sized frequently globular nodules, though there is also some use of flatter plaques of flint, particularly for some of the bifacial tools.

Though not included in the counts presented here, hammerstones/bolases on spherical flint and limestone nodules are present in some numbers (Fig. 3). Cores were also on occasion used as hammerstones.

Amongst the cores the majority, at least in their discarded state, tend to be rather irregular and amorphous flake types. There is little smoothing or preparation of removal surfaces and platforms. Numbers of the single and double platform pieces approach chopper/chopping tool or even massive awl forms. Signs of battering of the platform edges are quite common, but differ significantly from the battering marks on hammerstones (see below). Direct, hard hammer percussion is almost certainly indicated for this aspect of the lithic assemblage. The occasional Levallois items are intrusive, with a few displaying more recent opportunistic removals.

Only rarely are typical naviform (opposed platform blade) forms encountered. Again Locus 1007 is the exception, in that the vast majority there are classic naviform cores or broken preforms (Fig. 4).

The debitage counts display a preponderance of flakes in all assemblages. In general this contrasts with the tool assemblages, where the more standardised forms display an overwhelming predominance of blade blanks (see below). Considerable variability is apparent in the various technological indices, part perhaps reflecting different sample sizes, but also probably real intra-site patterning. Locus 1007 differs from the other samples in the varying frequencies of the different types of core rejuvenation types, having much higher frequencies of ridge blades and core tablets, as opposed to other core trimming elements, and thus reflecting the emphasis on blank production from naviform core.

The tool assemblages totalling 536 items are quite limited in size at present, with the exception of the Middle Area (Table 2 and Fig. 5). Arrowheads are quite frequent and are generally well-made (Figs. 6-7). The principal forms are Byblos and Amuq variants, commonly with wide, squared tangs and with Abu Gosh pressure retouch. More of the Byblos points tend to be less irregular in general morphology and have triangular tangs. The tips and bodies of both Byblos and Amuq rarely display major retouch,

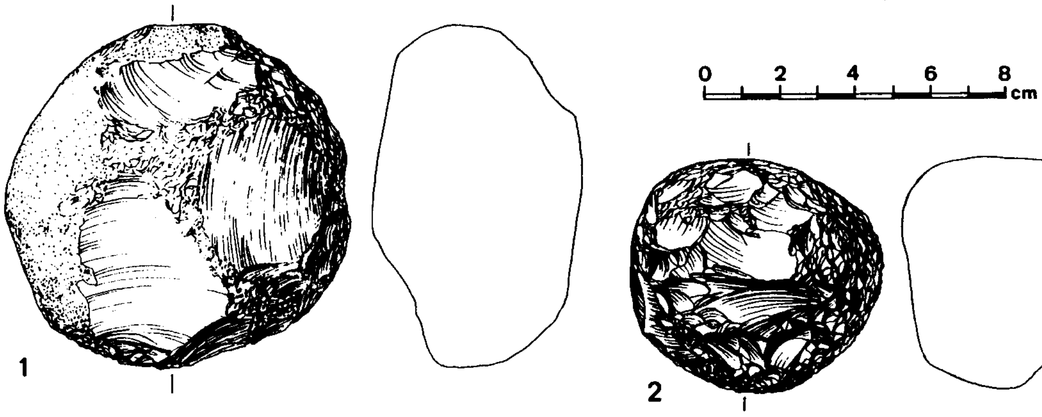

Fig. 3. Hammerstone/ bolas on flint nodules.

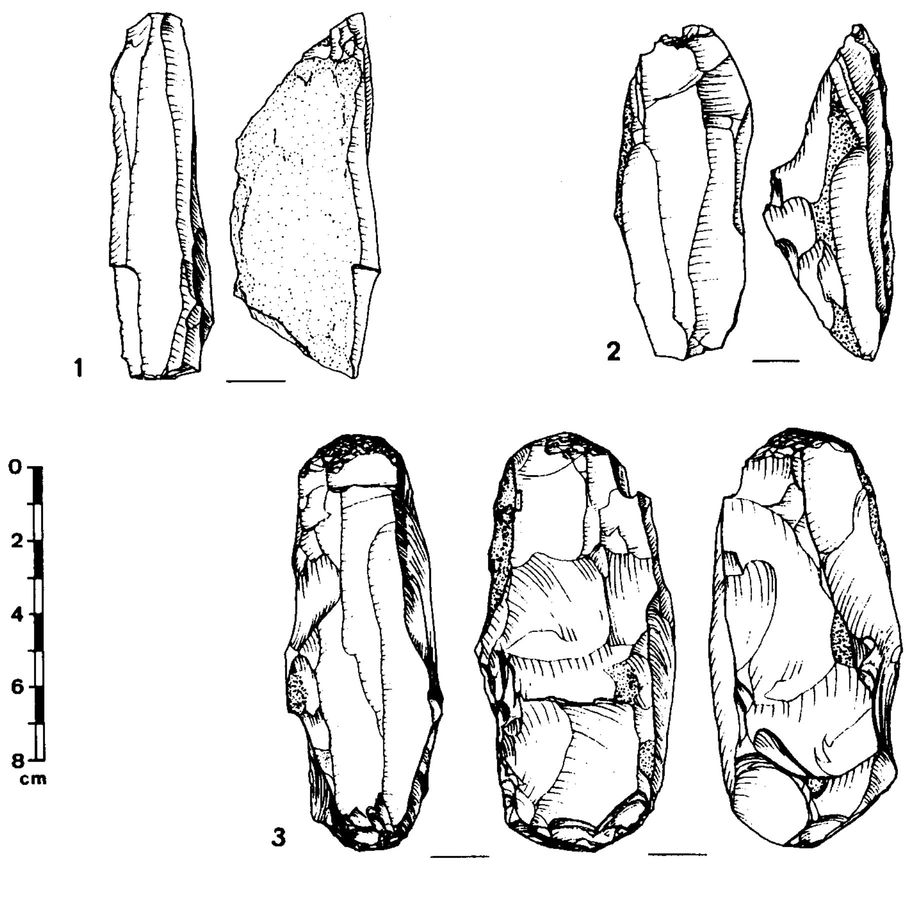

Fig. 4. Naviform cores from Locus 1007 (Note that #3 subsequently functioned as a hammerstone.).

pressure or otherwise. Relatively few are complete, and tangs are more commonly represented than tips. Of interest are a Jericho point from the Middle Area, a Helwan point from Locus 1009 in the Lower Area, and a Byblos point associated with the plastered skull in Locus 1004 from the Upper Area. The Amuq and, to a lesser extent, the Byblos points are rarely manufactured on the exotic fine-textured and coloured flint.

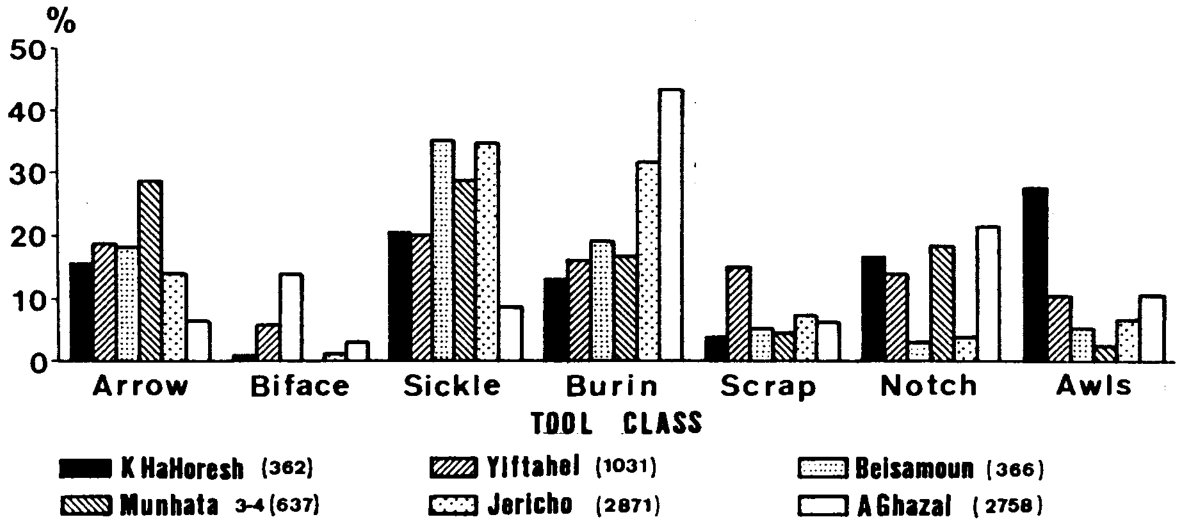

Fig.5. Frequency distributions of main tool classes from PPNB assemblages. *<Note that some of variability may result from different classificatory systems. Data modified after: CRAWFOOT PAYNE 1983, GOPHER 1989; LECHEVALLIER 1978; GARFINKEL 1987; ROLLEFSON and SIMMONS 1985.>*

Sickle blades are more common than arrowheads and frequently display fine denticulation or retouch along one or both edges, though some are unretouched (Fig. 8). No evidence for deep denticulation has been noted to date. Some are tanged with somewhat pointed, offset triangular tangs and several display transverse burin blows at the other extremity, sometimes approaching chamfered pieces. A number of others display clearly later burin blows.

Burins are quite numerous and often well-made, in contrast to the *ad hoc* nature of the rare scrapers (Figs. 9-10). Truncation burins, especially those on lateral retouch, are common, as are those on a break or natural pan and multiple, mixed varieties.

Bifacial elements are rare and vary in quality, though a finely flaked, complete dagger/knife on a tabular plaque of flint deserves mention (Figs. 11-12).

Awls and borers are the most common class of tools in the assemblages and encompass a wide range of forms (Figs. 13-15). The vast majority comprise *becs* and *epines*, frequently on irregular flakes, with the working tip formed by minimal, and often unilateral retouch. Choice of blanks appears to be entirely opportunistic. It is quite probable that this form has commonly been overlooked in other sites, hence resulting in correspondingly lower frequencies for the class. There are also, however, small numbers of more characteristic awls and borers, the former in particular occuring in a wide range of sizes.

The vast majority of the retouched blades are broken, especially medial fragments. Retouch tends to be normal, semi-abrupt and not to be particularly regular.

Notches are evenly divided between those on flakes and those on blades, while denticulates are more commonly made on blades (Fig. 14). By contrast, however, Locus 1007 displays the opposite trend. Of some interest are three strangled blades, two of which are proximal fragments.

Amongst the varia are numbers of large battered and/or irregularly retouched flakes. Also of interest are several denticulated discs on flakes.

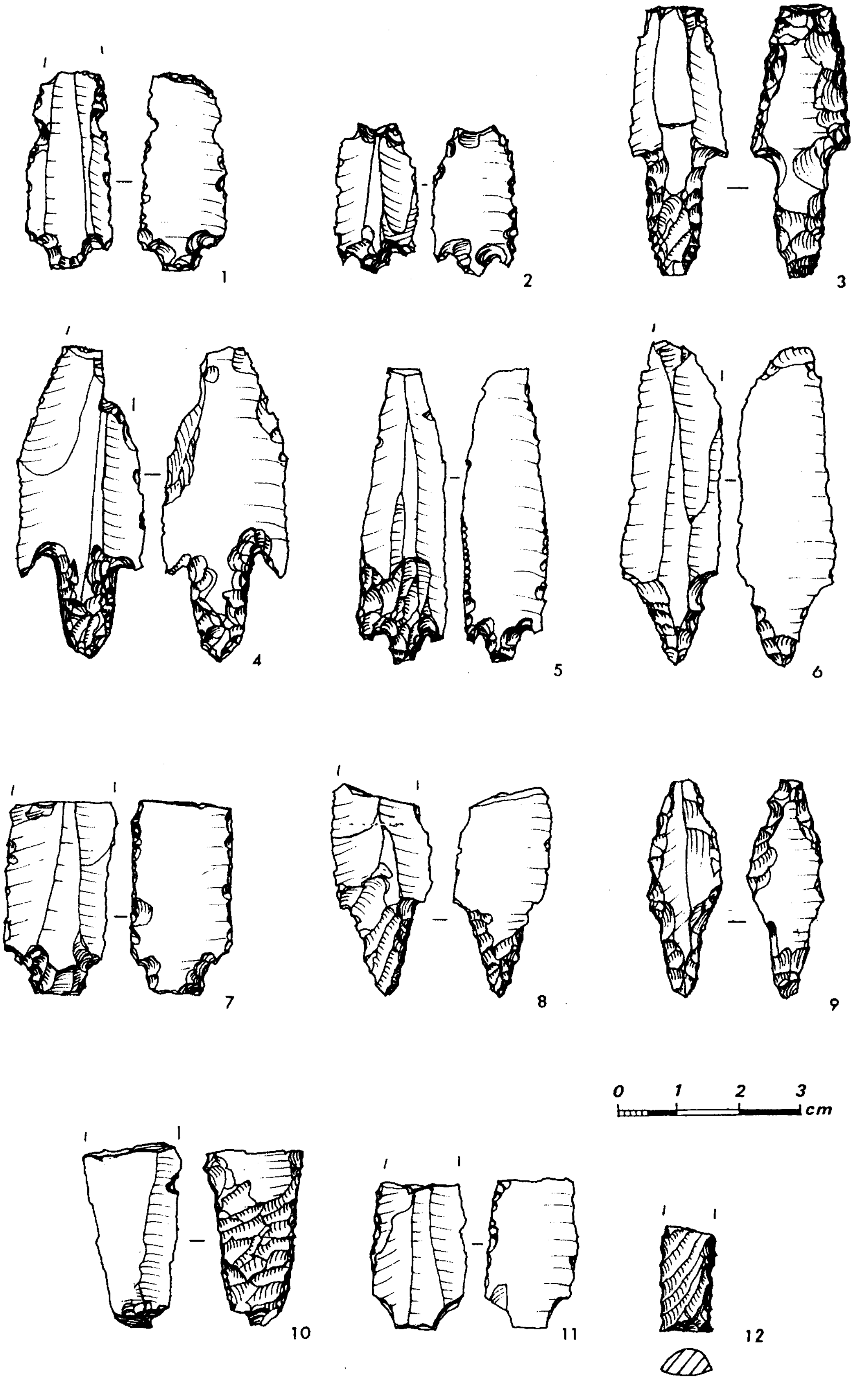

Fig. 6. Projectile points.

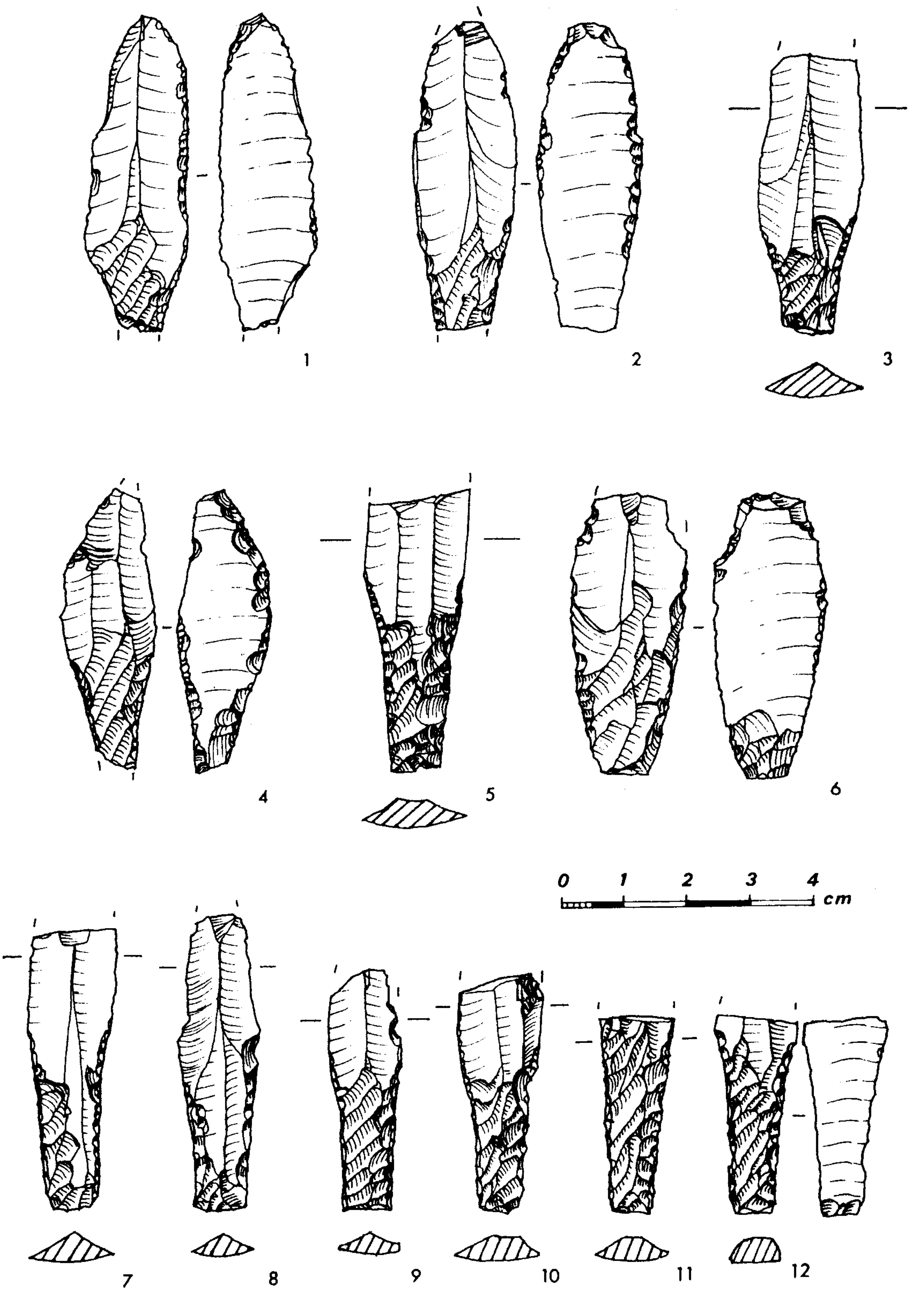

Fig. 7. Projectile points.

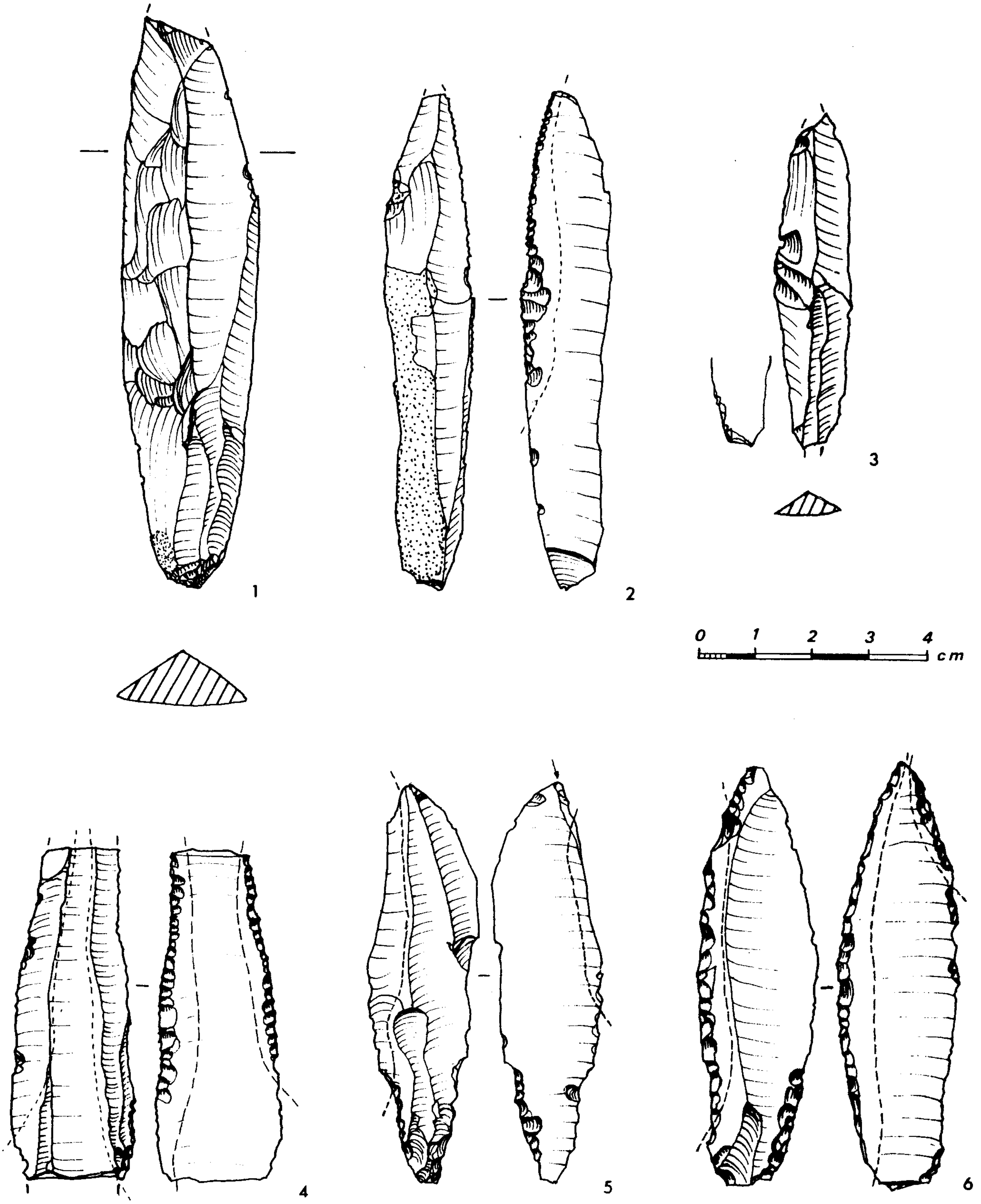

Fig.8. Sickle blades and reaping knives.

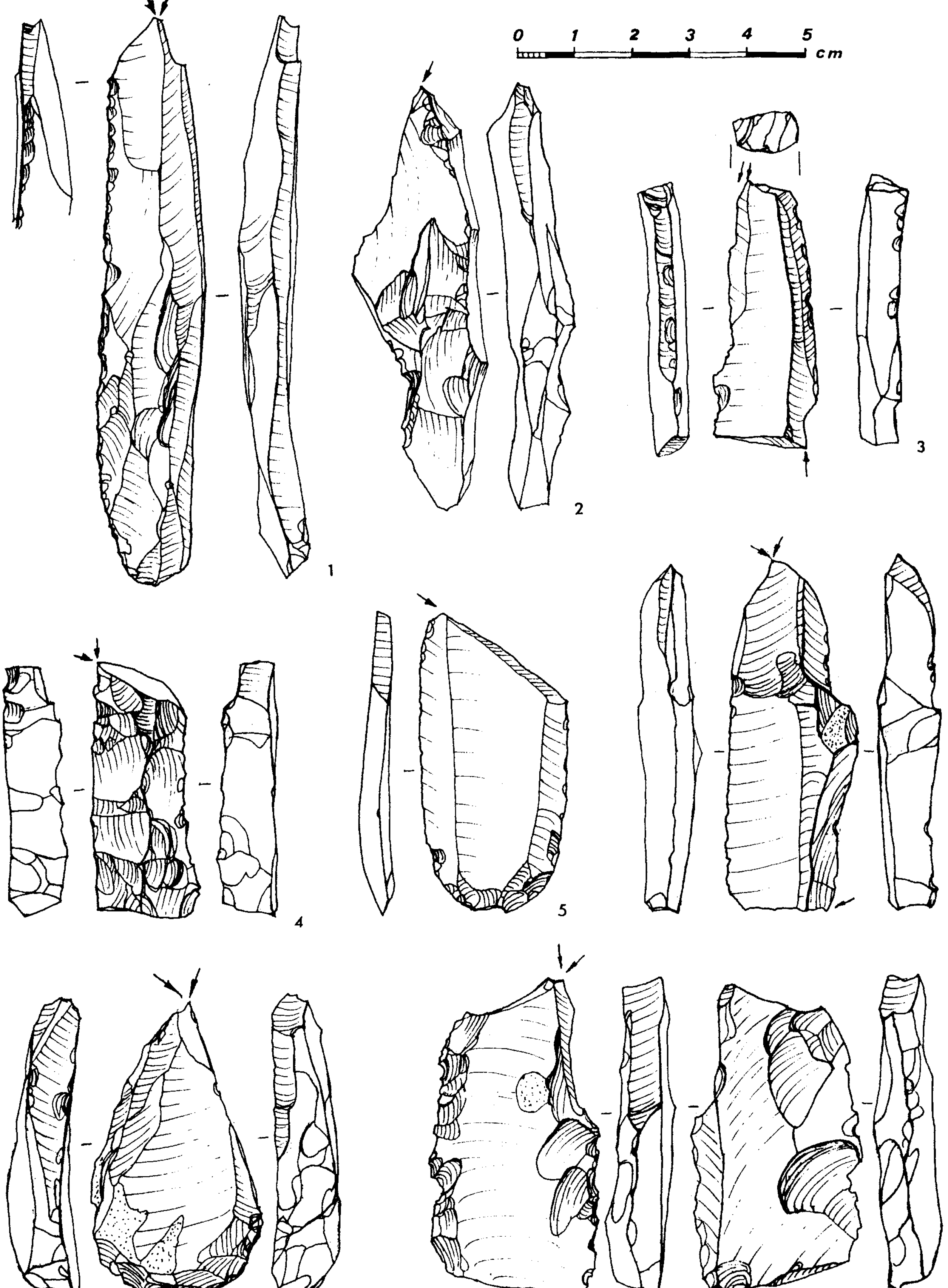

Fig. 9. **Burins.**

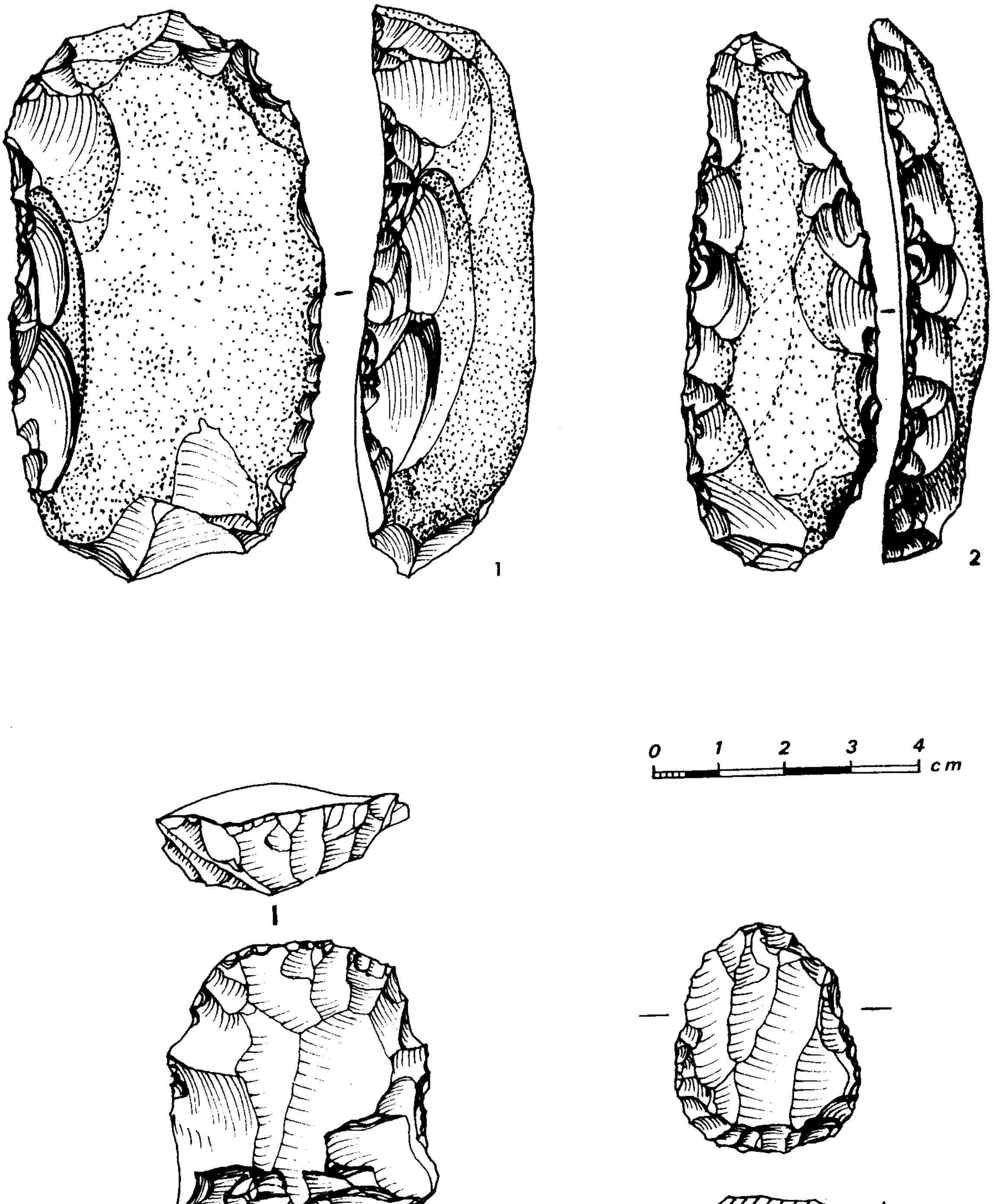

Fig. 10. Scrapers.

In summary, the assemblage recovered to date from Kfar HaHoresh appears entirely consistent with a relatively short-term, single main phase of occupation dated to the mid/late PPNB.

Discussion

The preliminary analysis of the limited testing conducted to date at Kfar HaHoresh illustrate several aspects concerning PPNB attitudes to flint knapping *chaînes operatoires* and the manner in which these articulate and integrate with other aspects of subsistence and mobility patterns. Examples will briefly discussed below concerning variability in raw material procurement and production at the more general, inter-regional level and more specifically concerning local, on-site patterns.

The generally low lithic densities at Kfar HaHoresh seem to conform to many other sites located in the Mediterranean zone of the the central Levant (notwithstanding differences in recovery techniques), as opposed to sites in such desert areas as the Negev and Sinai. Differences in the densities in the two provinces most probably reflects a combination of differences in site-planning and construction techniques. Thus sites in the Mediterranean zone tend to be composed of spaced, large-scale architectural units (sometimes with more than one storey?) constructed largely of mud-brick, wheras the desert sites comprise tightly clustered, dry-stonewalled structures (tent-bases?) with more flimsy superstructures. These undoubtedly reflect differences in social structure, permanence of occupation, and subsistence base between the two provinces (GORING-MORRIS 1994). Another contrast concerns disposal of waste. The typical limeplaster floored rectangular structures in the Mediterranean zone were clearly cleaned on a regular basis, such that only in exceptional, catastrophic circumstances, are most artefacts recovered in their primary contexts; generally most smaller artefacts, and especially the flint assemblages derive from refuse areas and pits beyond the confines of the structures. Many of the items recovered from the structures probably represent post-depositional processes following the abandonment of structures and their subsequent collapse and destruction. In the desert areas, by contrast, housecleaning appears to have been the exception rather than the rule, resulting in dense accumulations of debris throughout the occupation and living areas. It is possible that these represent differences in the respective lengths of occupation of sites in the two areas (permanent versus seasonal), though other explanations are also plausible. In any event, it does seem clear that recovered location of the majority of chipped stone artefacts in many Mediterranean zone settlements probably do <u>not</u> reflect the original locational contexts in which they were used.

The lithic assemblage from Kfar HaHoresh appears to indicate that at least three quite distinct approaches to flint knapping by the occupants can be discerned:

1. *Ad hoc* knapping for the manufacture of common, though non-standardised and irregularly-shaped tool forms, such as borers, awls, becs, scrapers, various retouched flakes etc. These are frequently produced from rather amorphous flake cores on locally available flint. The *ad hoc* nature of this production may be indicated by the non-centralised spatial distributions of cores and debitage, though not necessarily the tools themselves.

2. The local production of more standardised blanks on locally available material, especially blades, for the production of more standardised tool types, such as projectile points, sickles and perhaps also burins. The presence of the dump in Locus 1007 (and another dump identified in 1992 but presently untested - Locus 1013) are suggestive of perhaps more spatially and/or temporally focused knapping episodes and locales within the site. Here knapping focused on specialised, specific reduction techniques, such as the use of the naviform core. It is uncertain whether such episodes/locales were primarily for the production of blanks, which were then cached for future modification, as for example at Beidha (MORTENSEN 1986) and Nahal Issaron (GOPHER, GORING-MORRIS, and GORDON, this volume), or whether the complete *chaîne opératoire* of blank production and tool manufacture were completed as a single event. At Munhata the possible presence of what Perrot designated as 'ateliers' has been described by Gopher (1989:75, Note 7): however, even allowing for different recovery techniques, as described these do not appear to have had anywhere near the density present in Locus 1007.

Also it remains unclear at present whether other tool categories, such as heavy duty bifacial tools were manufactured under such conditions or within a different framework: the presence in the Locus 1007 assemblage of what is defined as a chopper on a flint plaque, but which could represent an

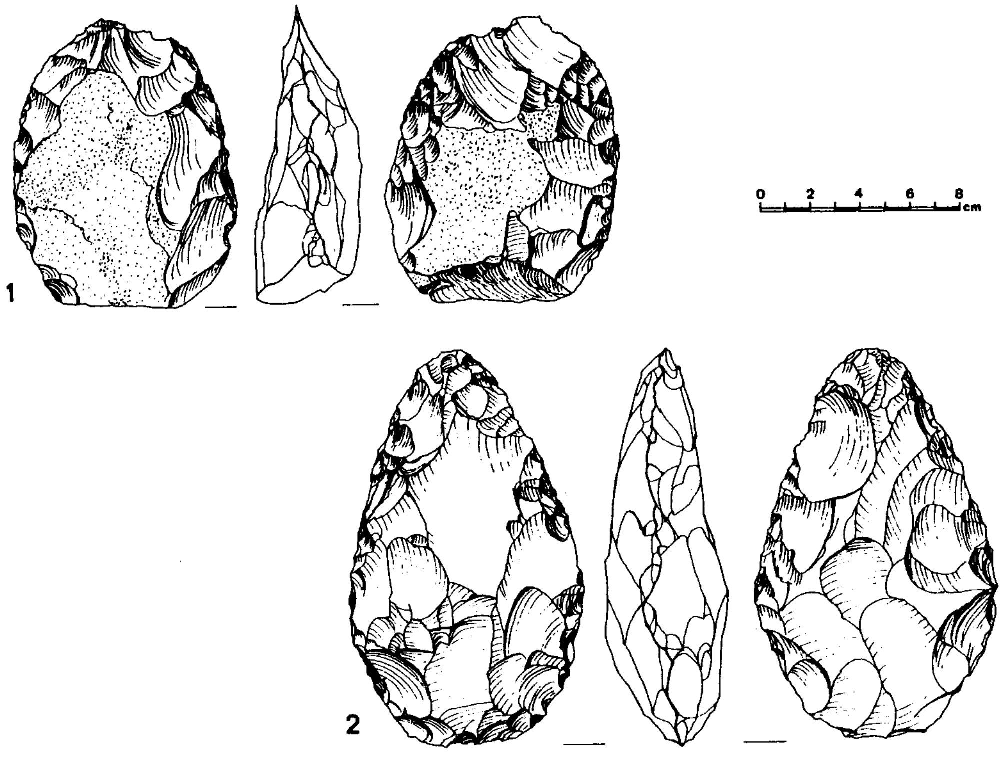

Fig. 11. Axes.

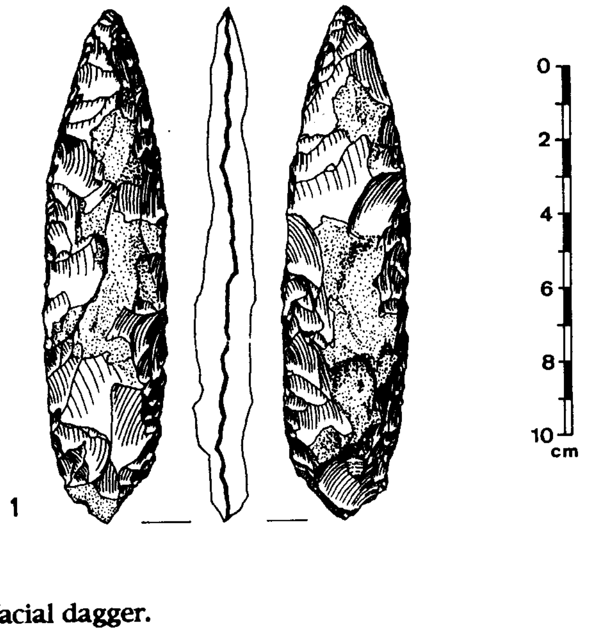

Fig. 12. Bifacial dagger.

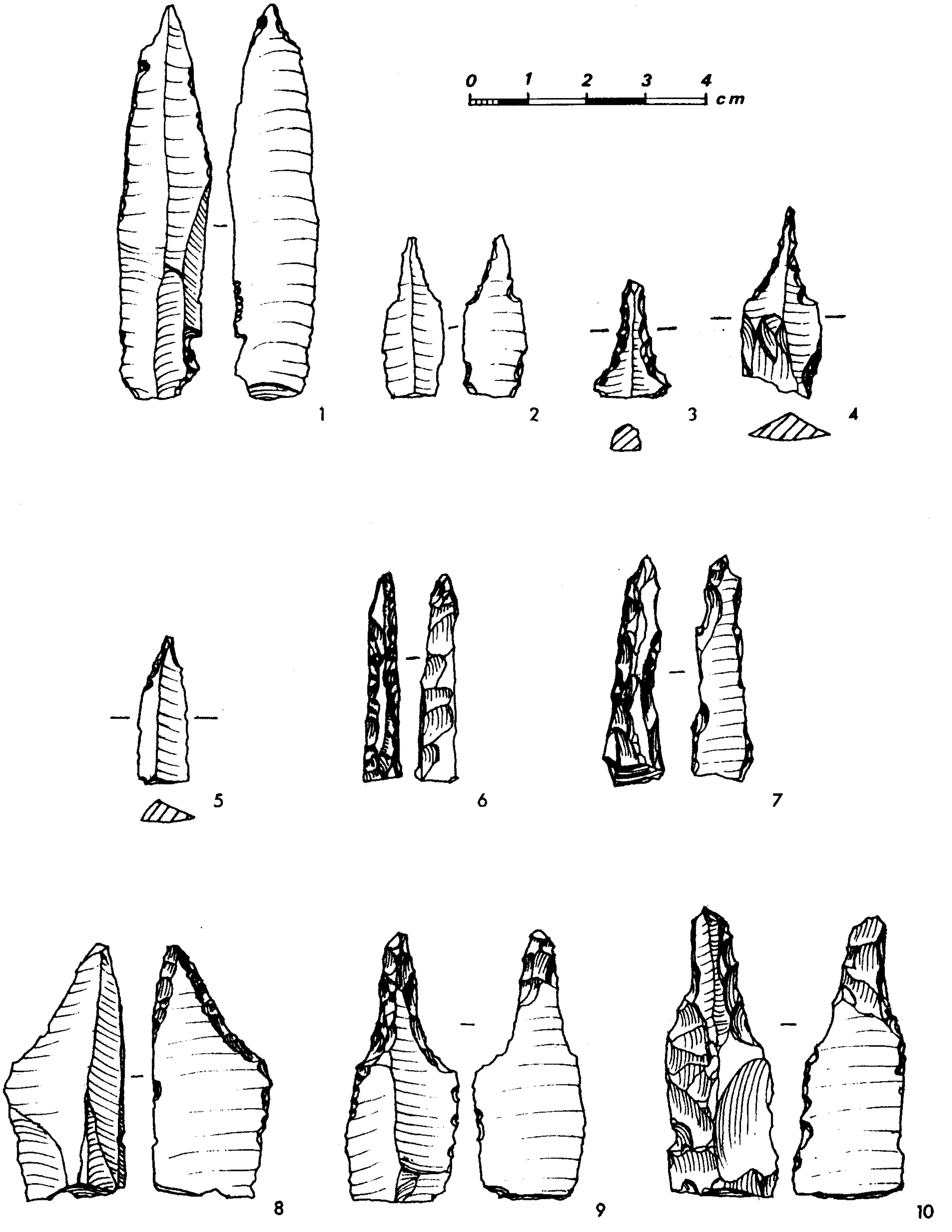

Fig. 13. Borers.

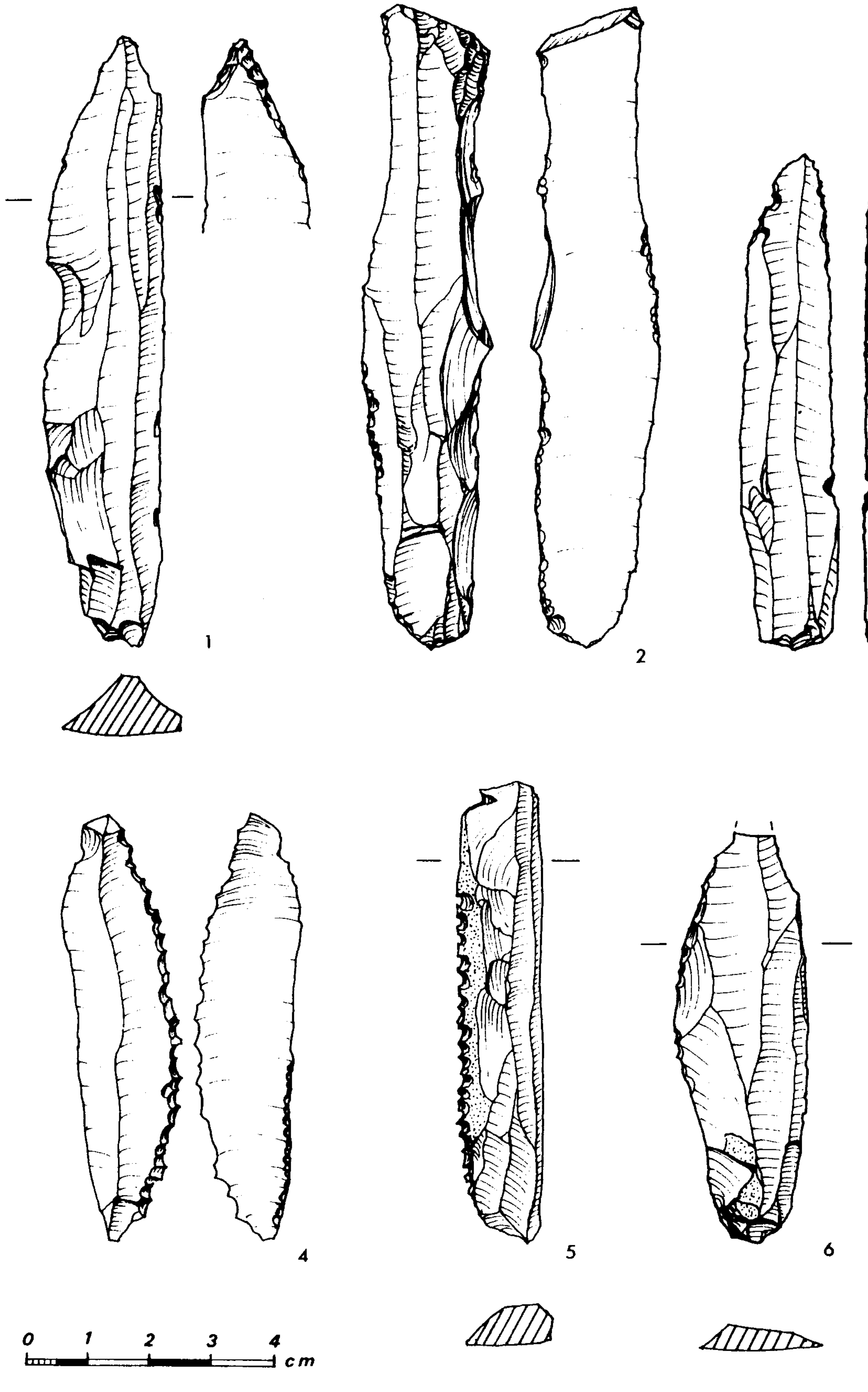

Fig 14. Borers, retouched and denticulated blades.

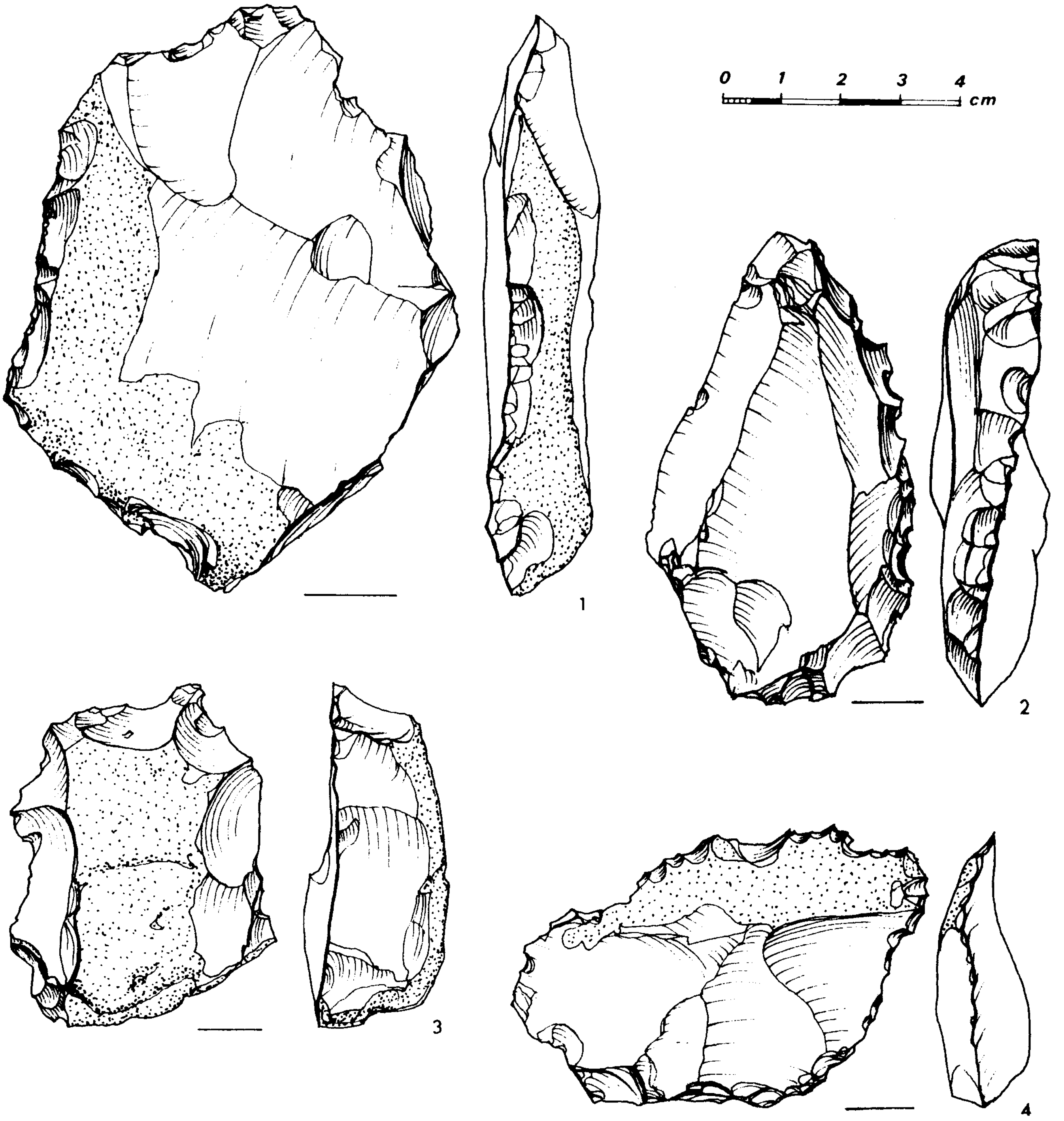

Fig. 15. Denticulated flakes and awls.

abandoned bifacial tool roughout, may indicate that they were also produced within this operational framework.

3. It presently remains uncertain as to whether the purple and pink hued, heat-treated material represents locally produced blanks and/or 'imported' pre-treated blanks (see below). It is to be hoped that future experimental studies will be able to provide conclusive results concerning this oft-discussed but poorly researched aspect of lithic production.

4. The import of standardised, more symmetric blanks and/or tools, such as arrowheads and sickleblades, and larger blanks on non-locally available, finer raw materials. The absence of cores and debris indicate that they were manufactured elsewhere, though it remains unclear whether procurement was direct, by the exploitation of off-site quarry/workshop sites within the range of the Kfar HaHoresh occupants' catchment area, or whether they were obtained by exchange with other groups in the same manner as other exotics such as obsidian, turquoise etc. They may have been procured either as blanks or as finished items: detailed analysis of the smaller debris may shed further light upon this. As noted by others, however, these items often appear to display evidence for re-cycling, indicating that subsequent modification, following breakage, was on-site.

The presence of at least two distinct modes of lithic production on-site may have various social, gender and even ritual implications, which it is not possible at present to evaluate: they could represent some form of craft specialisation within the community, either gender or individually based or, alternatively they may simply represent separate concepts in terms of the immediate versus delayed use of certain tool classes: the latter display greater investment in terms of stylistic elements (e.g. Abu Gosh retouch, pressure flaking and greater symmetry and standardisation) associated with basic food procurement tasks relating to the subsistence of the community -hunting and harvesting- such knapping episodes may have have been invested with particular social and/or symbolic significance.

Further planned excavations at Kfar haHoresh are designed to investigate in greater detail several of the questions raised above. However, it is clear that in order to facilitate detailed studies concerning variability in lithic reduction sequences, including raw material procurement, production, modification and use cycles, and to integrate these within PPNB lifeways, it is critical that assemblages be reported not just by site or architectural phase, but also by specific contexts within sites. Also of critical importance is the standardisation of techno-typological analyses is vital: different approaches in the description of lithic assemblages in the past have undoubtedly masked both differences and similarities between sites, rendering inter-assemblage comparisons at various levels problematic. As such it was obvious to at least most of the participants that the PPN lithic workshop organised in Berlin fulfilled a long overdue and major need and, as such, represents a new chapter in remedying the situation.

Acknowledgments: The excavations at Kfar HaHoresh were funded by the Irene Levi-Sala Archaeological CARE Foundation, and the Israel Antiquities Authority, with the additional support of The Jerusalem Center for Anthropological Studies. Leonid Zaiger drew the plan and artefact illustrations. Marianna Greenblat and Josette Sarel helped with the initial sorting of the lithic assemblages.

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A Preliminary Typological Analysis of Scrapers, Knives, and Borers from 'Ain Ghazal

Gary O. Rollefson, Michael Forstadt, and Roman Beck

Introduction

Over the past two decades the intensity of Neolithic surveys and excavations has intensified dramatically. Understandably, the analysis of chipped stone collections from this research has focused on projectile point typology, for this tool class is useful for the seriation of undated or poorly dated assemblages (e.g., MORTENSEN 1971; M.-C. CAUVIN 1974; BAR-YOSEF 1981; GOPHER 1989).

With few exceptions, the remainder of the chipped stone tool inventory of Neolithic assemblages has received little detailed analysis and publication. The intensive studies of the Jericho and Beidha assemblages (CROWFOOT PAYNE 1983; MORTENSEN 1971) suffered in their potential impact among other lithics analysts, in part, because of the lack of satisfactory criteria for distinguishing types and subtypes within tool classes. Burins have recently received increased techno-typological attention (ROLLEFSON 1988; n.d. a), for this tool class has demonstrable seriational potentials as well as subtle implications for general environmental exploitation (ROLLEFSON n.d. b).

But for the most part, interests in the general interpretation of Neolithic tools other than projectile points and burins remain impeded due to the lack of a systematic method of description and classification of other tool types.

At 'Ain Ghazal, burins always constituted the predominant tool class, ranging between 26-39% of the formalized tools in the four occupational phases (ROLLEFSON, SIMMONS, and KAFAFI 1992: Table 4). The other tool classes were variable in importance, but scrapers (5-9%), knives (1-17%)[1] and borers (6-12%) were consistently popular, at least compared to projectile points. Since these tool classes range between a fifth to a quarter or more of the tools at 'Ain Ghazal, we decided to investigate the variability within each tool class to determine what patterns might emerge during the occupation at 'Ain Ghazal.

Scrapers

A preliminary type list for scraper classification was developed based on the number and location of scraper edges, scraper size, and the presence of other retouch on scrapers (Figs. 1-3). As part of the investigation of typological variability, it was felt that the 33 types listed in Table 1 would be unwieldy for examining broad patterns of scraper manufacture at 'Ain Ghazal. Consequently, the individual types were grouped according to the general character of the tool into the Lateral Scraper (racloir),

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1 The low knife count for ther MPPNB in the citation in note 5 is due to changes in the analytical methods since the project began in 1982. Note that the knife sample for the MPPNB has n=150, which is minimally 4.6% of the MPPNB formal tool collection. The actual number of MPPNB knives is probably much higher (cf. ROLLEFSON, KAFAFI, and SIMMONS 1990: 99-101).

Transverse Scraper, Endscraper, Lateral Scraper Combination, Diverse, and Raclette Groups. These groupings follow the general definitions and patterns for scraper classification developed for the Lower and Middle Paleolithic of Europe (BORDES 1981). To facilitate comparisons of changes in the relative importance of these broad scraper groups, group indices were calculated according to the formulas in Table 2.

After typological sorting, scrapers were described in terms of technological and metric attributes according to the coding sheet in Table 3. In the descriptive procedure, tools were oriented with the bulbar surface facing down and the striking platform area towards the observer (*cf.* INIZAN *et al.* 1992: Fig. 5).

The left lateral edge was termed "Edge 1", the right lateral "Edge 2", the distal transverse edge as "Edge 3" (if present), and the proximal transverse edge as "Edge 4". Information Classes 1-9 and 25-26 in Table 2 were coded for every tool. For Information Classes 10-21, only scraper edges were described. For example, if the tool was a simple lateral scraper, with scraper retouch on the right lateral edge, then only Information Classes 13-15 were recorded; columns corresponding to Information Classes 10-12 and 16-21 were left blank. For the aims of this preliminary study, edge angles (that is, the angle formed by the intersection of the surfaces of the tool) were judged simply by estimation; accurate angle measurements were not taken.

Metric attributes (Information Classes 22-24) were measured only if the particular dimension was not affected by breakage. Thus a scraper whose tip was snapped was measured for maximum width and thickness, but not for length; a scraper that lost one lateral edge could not be measured for width, but length and thickness were measurable.

Flint "type" (Information Class 26 in Table 3) was intended to reflect combinations of color (brown, pink-purple, gray, and white), texture (fine and coarse) and presence/absence of mottling or banding. The actual variability proved to be too subtle for accurate description according to the preliminary categories, and analysis of the variability will not be considered here. Better discrimination is necessary for future analysis in this regard.

Results of the Typological Analysis

A total of 1217 scrapers from 'Ain Ghazal were sampled for analysis, including 465 from the PPNB period[1], 198 from the PPNC, and 554 scrapers from the Yarmoukian collection. Roughly a fourth of each sample was too badly damaged to classify according to the typelist (Table 4).

The figures in Table 4 are overwhelming at first glance, but in terms of general importance, there are similar patterns for all three cultural periods. Simple lateral and simple transverse scrapers (Types 1 and 4) tend to dominate along with the small raclettes (Type 32). Transverse + Lateral Scrapers (Types 7 and 8) are twice as numerous in the PPNC and the Yarmoukian compared to the PPNB; the same pattern holds true for Endscrapers + Lateral scrapers (Types 13 and 14). Simple endscrapers are rare in the PPNC period, but this may be related to sampling error.

Despite specific typological differences, the scraper group indices at the bottom of Table 4 show strong overall differences, particularly in terms of the pre- and post-6th millennium boundary. In no case, for example, are the differences between the PPNC and Yarmoukian indices statistically significant in Chi- Square comparisons. Nor is there any meaningful variation among the three periods for the endscraper or raclette groups, which suggests that these general kinds of scrapers served essentially the same purposes throughout the occupational history of 'Ain Ghazal. For the Diverse Scraper Group, the absolute and relative frequencies are so low that interpretations of variation are spurious.

The relationship of the Lateral Scraper Group vs. the Transverse Scraper Group is inversely proportional before and after 6,000 BC; although these two groups are roughly of equal importance in

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[1] The scraper sample from the LPPNB was too small to serve any statistical purposes, so it was combined with the MPPNB sample. It should be noted that 78% of the PPNB sample in this study is from the MPPNB.

Table 1. Preliminary typelist for 'Ain Ghazal scrapers.

Lateral Scraper (Racloir) Group
1. Simple lateral scraper
2. Double lateral scraper
3. Convergent double lateral scraper

Transverse Scraper Group
4. Simple transverse scraper
5. Double transverse scraper
6. Convergent double transverse scraper
7. Transverse + single lateral scraper
8. Transverse + double lateral scraper

Endscraper Group
9. Simple endscraper
10. Nosed endscraper
11. Tanged endscraper
12. Double endscraper
13. End- + simple lateral scraper
14. End- + double lateral scraper
15. Endscraper + burin
16. Endscraper + borer
17. Endscraper + denticulate
18. Endscraper + notch
19. Endscraper + wedge

Lateral Scraper Combination Group
20. Lateral scraper + burin
21. Lateral scraper + borer
22. Lateral scraper + denticulate
23. Lateral scraper + notch
24. Lateral scraper + other retouch

Diverse Scraper Group
25. Core scraper
26. Massive scraper
27. Circular scraper
28. Bifacial scraper
29. Tabular scraper
30. Tanged scraper
31. Diverse

Raclette Group
32. Raclette
33. Tanged raclette

99. Indeterminate

(Note: for scrapers made on cortical elements, add "100" to the code types. E.g., a cortical transverse scraper is "104", an indeterminate scraper on a cortical fragment is "199", etc.)

Table 2. Calculation of 'Ain Ghazal scraper indices.

Racloir Index	= n (types 1-3)/N total	(excluding 99, 199)
Transverse Index	= n (types 4-8)/N total	(" " ")
Endscraper Index	= n (types 9-19)/N total	(" " ")
Combination Index	= n (types 20-24)/N total	(" " ")
Diverse Index	= n (types 25-31)/N total	(" " ")
Raclette Index	= n (types 32-33)/N total	(" " ")
Cortical Index	= n (types 101-133)/N total	(" " ")

Table 3. Coding sheet for 'Ain Ghazal scraper analysis.

Info	(Columns)	Codes			
1. Provenience data	(1-13)				
2. Tool Blank	(14)				
	1. Flake	4. C.T.E.	7. Bur Spall	0. Indet	
	2. Blade	5. Core	8. Microflake		
	3. Bladelet	6. Overshot	9. Other		
3. Striking Plat	(15)				
	1. Plain	3. Mult facet	8. Other	0. Missing	
	2. Dihedral	4. Punctiform	9. N/A		
4. Cortex	(16)				
	1. 1-10%	3. 51-90%	9. Indeterminate		
	2. 11-50 %	4. >90%	0. None		
5. # Ret. Edges	(17)				
	1. 1	3. 3	0. Indeterminate		
	2. 2	4. 4			
6. Edge 1 Retouch	(18)				
	1. None, flint	4. Scraper	7. Backing	0. Missing	
	2. None, cortex	5. Dentic	8. Burin		
	3. Steep cortex	6. Notch	9. Other		
7. Edge 2 Retouch	(19)				
	(same codes as Column 18)				
8. Edge 3 Retouch	(20)				
	(same as Column 18)				
9. Edge 4 Retouch	(21)				
	(same as Column 18)				
10. Scraper edge 1	(22)				
	1. normal, ext.	4. abrupt, ext.	7. serrate, Int	(Blank)	
	2. normal, int.	5. abrupt, int.	8. serrate, bif.		
	3. normal, bif.	6. serrate, ext.	9. alternating		
11. Edge 1 Angle	(23)				
	1. <30°	2. 30-45°	3. 45-60°	4. >60°	
12. Edge 1 Contour	(24)				
	1. Straight	3. Concave	0. Indeterminate		
	2. Convex	4. Variable			
13-15. Scraper edge 2 retouch, angle, contour	(25-27)				
	(see Columns 22-24)				
16-18. Scraper edge 3 retouch, angle, contour	(28-30)				
	(see Columns 22-24)				
19-21. Scraper edge 4 retouch, angle, contour	(31-33)				
	(see Columns 22-24)				
22. Tool Length, in mm	(34-36)				
23. Tool width	(37-39)				
24. Tool thickness	(40-42)				
25. Scraper type	(44-46)				
26. Flint type	(48-49)				

Table 4. Typological analysis of scraper samples from 'Ain Ghazal <*Numbers in parenthesis are cortical pieces. Percentages are based on Total' (excluding Type 99)*>.

Type	PPNB n(c)	PPNB %	PPNC n(c)	PPNC %	Yarmoukian n(c)	Yarmoukian %
1	39 (9)	11.2	17 (2)	11.3	41 (3)	10.4
2	34 (6)	9.7	6	4.0	19	4.8
3	9	2.6	1	0.7	12	3.0
4	45 (8)	12.9	24 (1)	15.9	54 (5)	13.7
5	8 (2)	2.3	3 (2)	2.0	3 (1)	0.8
6	0	0.0	0	0.0	1	0.3
7	26 (6)	7.5	20 (1)	13.2	52 (6)	13.2
8	8 (3)	2.3	14 (4)	9.3	34 (3)	8.6
9	24 (4)	6.9	4	2.6	25 (2)	6.3
10	7	2.0	5 (1)	3.3	11 (1)	2.8
11	0	0.0	1	0.7	0	0.0
12	3	0.9	1	0.7	3 (1)	0.8
13	7 (1)	2.0	7	4.6	25 (1)	6.3
14	8	2.3	8 (1)	5.3	12 (1)	3.0
15	9 (1)	2.6	1	0.7	5 (1)	1.3
16	1	0.3	1	0.7	0	0.0
17	3	0.9	2	1.3	4	1.0
18	4	1.1	1	0.7	2	0.5
19	0	0.0	0	0.0	0	0.0
20	31 (3)	8.9	1	0.0	9 (2)	2.3
21	1	0.3	1	0.7	2	0.5
22	7 (1)	2.0	3	2.0	10	2.5
23	12 (1)	3.4	3	2.0	8	2.0
24	2 (2)	0.6	0	0.0	0	0.0
25	3	0.9	0	0.0	4	1.0
26	2	0.6	2 (1)	1.3	0	0.0
27	2	0.6	1	0.7	2	0.5
28	1	0.3	2 (2)	1.3	0	0.0
29	0	0.0	1	0.7	1	0.3
30	1	0.3	0	0.0	2	0.5
31	4	1.1	4 (1)	2.6	10 (1)	2.5
32	46 (7)	13.2	17	11.3	43 (2)	10.9
33	1	0.3	0	0.0	0	0.0
99	117 (17)	(25.2)	47 (3)	(23.7)	160 (15)	(28.8)
Total	465 (71)		198 (19)		554 (45)	
Total'	348	100.0	151	100.3	394	99.8
Racloir Index		23.6		15.9		18.3
Transverse Index		25.0		40.4		36.5
Endscraper Index		19.0		20.5		22.1
Combination Indx		15.2		5.3		7.4
Diverse Index		3.7		6.6		4.8
Raclette Index		13.5		11.3		10.9
Cortical Index		15.5		10.6		7.6

Table 5. Means for length, width, and thickness of scraper groups from 'Ain Ghazal <*Numbers in parenthesis = n*>.

		PPNB	PPNC	YARM
All Scrapers				
	L	51.6 mm	46.8 mm	41.0 mm
	W	36.4	35.9	31.5
	T	12.4	12.3	11.7
Lateral Scraper Group				
	L	56.0 (44)	48.2 (17)	48.6 (38)
	W	36.3 (59)	26.5 (23)	32.2 (62)
	T	12.9 (66)	10.4 (24)	12.3 (69)
Transverse Scraper Group				
	L	44.6 (58)	44.3 (50)	37.7 (120)
	W	45.3 (63)	42.1 (54)	36.6 (133)
	T	13.3 (73)	13.8 (60)	12.8 (140)
Endscraper Group				
	L	55.0 (34)	51.2 (18)	44.6 (65)
	W	24.4 (53)	28.0 (27)	25.5 (74)
	T	11.6 (56)	13.0 (28)	11.2 (81)
Lateral Combination Group				
	L	52.8 (31)	43.0 (7)	38.8 (20)
	W	40.9 (44)	33.2 (8)	32.1 (23)
	T	14.3 (49)	12.8 (8)	10.9 (28)
Diverse Group				
	L	74.6 (11)	72.2 (9)	61.9 (13)
	W	52.6 (12)	62.2 (9)	31.6 (17)
	T	22.8 (13)	22.9 (9)	20.5 (18)
Raclette Group				
	L	40.3 (17)	30.7 (10)	26.5 (24)
	W	27.0 (29)	24.6 (11)	22.6 (29)
	T	6.2 (33)	6.1 (15)	6.5 (33)

Table 6. Absolute and relative frequencies of scraper retouch type on 'Ain Ghazal scraper edges.

	PPNB		PPNC		YARM		ALL	
Type	n	%	n	%	n	%	n	%
1	348	50.8	182	55.5	440	50.6	970	51.5
2	63	9.2	13	4.0	65	7.8	141	7.5
3	16	2.3	8	2.4	8	0.9	32	1.7
4	126	18.4	43	13.1	147	16.9	316	16.8
5	6	0.9	5	1.5	28	3.2	39	2.1
6	94	13.7	60	18.3	152	17.5	306	16.3
7	19	2.8	12	3.7	15	1.7	46	2.4
8	0	0.0	0	0.0	5	0.6	5	0.3
9	13	1.9	5	1.5	10	1.1	28	1.5
BR*	16	2.3	8	2.4	13	1.5	37	2.0
IR*	88	12.8	30	9.4	108	12.4	226	12.0
SR*	113	16.5	72	22.0	172	19.8	357	19.0

* BR = Bifacial retouch, including types 3 + 8.
IR = Interior retouch, including types 2 + 5 + 7.
SR = Serrated retouch, including types 6 + 7 + 8.

Table 7. Preliminary type list for 'Ain Ghazal knives.

Type K-1. Bifacial-lenticular knives.
Made on large flakes or thin nodules. Deeply invasive bifacial flaking on both lateral edges, usually extending to the center of the tool, results in a lenticular or sub-lenticular cross section. Two possible sub-types:

- K-1a: Pointed bifacial-lenticular knives. Convergent edges meet at one or both ends at an acute angle.
- K-1b: Blunt bifacial-lenticular knives. Parallel or sub-parallel edges with rounded ends.

Type K-2. Tabular Knives.
Made on pieces of tabular flint. Variation in the degree of retouch defines two sub-types.

- K-2a: Tabular-lenticular knives. Made on relatively thick pieces. Deeply invasive bifacial flaking along lateral edges produces a lenticular or sub-lenticular cross section. The presence of cortex on both surfaces distinguishes type K-2a from type K-1 knives.
- K-2b: Tile knives. Minimally worked thin pieces of tabular flint, both surfaces retain most of the cortex. Bifacial retouch along the edges is typically shallow; unifacial retouch occurs more rarely. Most Tile Knives (21 of 30; 70%) are broken longitudinally, producing a "snap-backing" that might be intentional.

Type K-3. Blade Knives. Made on blades. Four sub-types are based on differential retouch.

- K-3a. Casual blade knives. Blades that are not intentionally retouched but which show use wear consistent with a cutting motion or by edge deposits.
- K-3b. Unifacial blade knives. Blades with unifacial retouch creating an edge angle that is sharp. Considerable variability in retouch type (nibbling, shallow, invasive, deep invasive) may indicate additional sub-types in this very numerous classification.
- K-3c. Bifacial blade knives. Blades with bifacial retouch.
- K-3d. Tanged knives. Knives as defined in K-3a-c, but which possess a tang evidently for hafting. The tang may be extensively worked or may be made by a pair of opposed basal notches.

Type K-4. Flake Knives. Made on flakes, not blades, but otherwise with edge characteristics similar to type K-3.

Type K-5. CTE Knives. Made on core-trimming elements (crested blades, core edges, etc.). Edge characteristics the same as in K-3 and K-4.

Type K-99. Indeterminate knife type. Pieces of knives too badly damaged for classification.

Table 8. Typological distribution of knife samples from 'Ain Ghazal.

TYPE	MPPNB		LPPNB		PPNC		YARMOUKIAN	
	n	%	n	%	n	%	n	%
K-1*	0	0.0	7	4.7	21	14.1	16	10.9
K-2*	1	0.7	13	8.8	15	10.1	10	6.8
K-3*	140	94.6	121	81.8	103	69.1	107	72.8
K-4*	5	3.4	7	4.7	10	6.7	12	8.2
K-5	2	1.4	0	0.0	0	0.0	2	1.4
Total	148	100.1	148	100.0	149	100.0	147	100.1
K-99	2	(1.3)	2	(1.3)	1	(0.7)	3	(2.0)
Type K-2 Sub-type Variability								
2a	0	0.0	3	23.1	5	33.3	1	10.0
2b	1	100.0	10	76.9	10	66.7	9	90.0
Type K-3 Sub-type Variability								
3a*	52	37.1	34	28.1	19	18.4	19	17.8
3b*	75	53.6	76	62.8	71	68.9	77	72.0
3c	3	2.1	3	2.5	5	4.9	3	2.8
3d	10	7.1	8	6.6	8	7.8	8	7.5

* Types and sub-types with possible temporal sensitivity

Table 9. Dimensional means of 'Ain Ghazal knife types.

TYPE	xL	xW	xT	xT/W
K-1	53 (n= 2)	26 (n= 37)	8.5 (n= 44)	.333 (n=37)
K-2	108 (n= 3)	30 (n= 16)	7.0 (n= 38)	.252 (n=16)
K-3	59 (n=126)	15 (n=338)	5.0 (n=471)	.313 (n=338)
K-4	48 (n= 12)	29 (n= 15)	8.0 (n= 34)	.276 (n= 15)

Table 10. Preliminary type list of 'Ain Ghazal borers (after MORTENSEN 1971).

Type B-1a. Flake borer, distal end.
B-1b. Flake borer, lateral edge.

Type B-2a. Blade borer, exterior semi-steep retouch.
B-2b. Blade borer, interior semi-steep retouch.

Type B-3. Blade borer, alternating semi-steep retouch.

Type B-4. Leaf shaped borer, extended lateral retouch.

Type B-5. Lancet-shaped, complete lateral retouch

Type B-6. Drill, short bit.

Type B-7a. Drill, long bit.
B-7b. Drill, extended narrow bit.

Type B-8. Tanged drill (similar to Type B-7).

Type B-9. Tanged drill (similar to Type B-5).

Type B-10. "Meche-de-foret" drill.

Type B-11. Crested Blade borer.

Type B-12. Drill on burin spall.

Table 11. Typological distribution of borer samples from 'Ain Ghazal.

	PPNB		PPNC		YARMOUKIAN	
TYPE	n	%	n	%	n	%
B-1a*	25	9.9	2	1.9	9	3.6
B-1b*	6	2.4	6	5.7	25	10.1
B-2a*	15	6.0	0	0.0	3	1.2
B-2b*	19	7.5	2	1.9	2	0.8
B-3*	51	20.2	12	11.4	25	10.1
B-4	2	0.8	1	1.0	4	1.6
B-5	4	1.6	1	1.0	2	0.8
B-6*	69	27.4	58	55.2	113	45.7
B-7a	31	12.3	14	13.3	36	14.6
B-7b	8	3.2	1	1.0	4	1.6
B-8	1	0.4	0	0.0	1	0.4
B-9	3	1.2	1	1.0	1	0.4
B-10	5	2.0	0	0.0	6	2.4
B-11	3	1.2	0	0.0	0	0.0
B-12	10	4.0	7	6.7	16	6.5
Totals	252	100.1	105	100.1	247	99.9

the PPNB period, there is a major shift from the Lateral to the Transverse Scraper Groups in the PPNC and Yarmoukian periods. This undoubtedly reflects the shift in debitage techniques towards the dominating flake industry of the two later periods (*cf.* ROLLEFSON, SIMMONS, and KAFAFI 1992: Table 3).

The dramatic differences in the shifts towards decreased importance over time for the Lateral Scraper Combination Group is almost entirely driven by the high popularity of the Lateral Scraper + Burin Type (Type 20) in the PPNB period. This situation represents, in part, the relative decline of burin manufacture during the 6th millennium (*cf.* ROLLEFSON, SIMMONS, and KAFAFI 1992: Table 4). But it may also indicate that burin functions changed significantly after the PPNB, so that burins and scrapers were used in closely associated sequential tasks before 6,000 BC, followed by a time when burins were more specialized tools in the 6th millennium.

Technological Variation in Scraper Manufacture

The Cortical Index (Table 4) for the three periods is unexpectedly high for the PPNB period, which differs significantly from the Yarmoukian phase in terms of this aspect. This trend for increasing selection of non-cortical flakes for scraper manufacture remains enigmatic, but it is possible that changes in debitage techniques are responsible.

The size of scrapers from 'Ain Ghazal shows a relatively consistent diminution in all three dimensions over time (Table 5), regardless of Scraper Group. (The Raclette Group is interesting in this regard, since the tools take on minute proportions). The decrease in scraper length is particularly notable, even in PPNC-Yarmoukian comparisons. Once again, debitage techniques that increasingly emphasized flake manufacture at the expense of naviform blade production were probably responsible in many cases. For example, flake cores accounted for about 35% of the PPNB cores, 85% in the PPNC, and 81% in the Yarmoukian. Almost 90% of the PPNB blade cores were naviform types, compared to 45% in the PPNC and 24% in the Yarmoukian (L. Quintero, personal communication).

In terms of the kinds of scraper retouch (Table 3, Information Classes 10, 13, 16, and 19), it appears as if the tools changed very little over time. Normal exterior scraper retouch always predominated (Table 6) and interior (bulbar) and bifacial retouch played minor roles. Serrated scrapers appear to have become slightly more popular in the 6th millennium, but the samples need to be increased to be certain.

Knives (FORSTADT 1993)

The knife tool class is one that has received little formal attention in Levantine Neolithic assemblages. Part of the reason may be because it is difficult to distinguish morphological attributes from several other tool classes, especially scrapers and large projectile points. "Bifacial foliate" knives, due to their size and mass, and "Tile knives", in view of their morphological shapes, have been consistently set apart from other tools in Levantine site reports, but other artifacts have characteristics consistent with a function as knives as cutting tools, with or without deliberate retouch.

Both scrapers and projectile points often exhibit invasive parallel or semi-parallel retouch, although the edge angle in the former instance, and the size and shape of the latter, are usually sufficient to ascribe such pieces to the scraper or point classes. Knives are generally larger and heavier than projectile points, although the range of edge angles are shared; on the other hand, knives are less symmetrically shaped, even when tangs are present.

At the other end of the spectrum, the knife-scraper distinction is more ambiguous. Scraper edges tend to have higher angles of convergence between the ventral and dorsal surfaces, but this is not always a predictable pattern; it is not infrequent that on knives the steeper of the two lateral margins was used as the cutting edge. The best evidence is to be found in the microwear along the retouched edges, usually visible with the naked eye or with low-power microscopy. Microscalar chipping, consistent with a motion opposed (90°) to the long axis of the edge, defines scraper use, while longitudinal attitudes of microscars and striations along the axis of the edge signifies knife use.

Edge damage, whether intentional through retouch or sporadic through use, is not the only indication for knife classification. Substantial numbers of blades (and flakes, to a lesser extent) from the 'Ain Ghazal collections show narrow bands of matte or semi-lustrous edge deposits along lateral edges that are correlatable with use as cutting tools (ROLLEFSON; KAFAFI, and SIMMONS 1990: 99). Colors of the edge deposits range from black to orange to yellow to colorless, indicating that a variety of materials was involved[1].

Samples of 150 knives were randomly selected from each of the occupational phases for typological and technological analysis. Table 7 provides the preliminary type list definitions for knife analysis at 'Ain Ghazal (Figs 4-7); technological attributes that were monitored included metrical attributes and ratios, number of knife edges, retouch type and location, depth of retouch, type of backing if present, edge deposit character, and raw material.

Typological variability is reflected in Table 8. Type K-1 knives are notably absent in the MPPNB sample, rare in the LPPNB,but strongly represented in the 6th millennium samples. Tabular knives (Type K-2) follow a roughly similar pattern of popularity, although there is a marked decrease from the PPNC to the Yarmoukian periods. Blade knives (Type K-3) heavily dominate all four periods, but there is a strong decrease in the 6th millennium samples, as confirmed by Chi-Square significance tests. Flake knives (Type K-4) rise steadily through the temporal sequence, a trend inversely proportional to blade knives that parallels nicely the increasing focus on flake manufacture through time. Knives made on core trimming elements (Type K-5) were always very rare, and perhaps they should be considered as "diverse" tools rather than a formal type of their own.

When tabular flint was used for knife manufacture, there was a distinct probability that retouch would be minimal, shown by the relationships between subtypes K-2a (Tabular-lenticular knives) and K-2b (Tile knives) in Table 8. The sample sizes are too small for verification, but this may be a result of the generally delicate character of most tabular material, so that invasive bifacial percussion retouch was possible only on relatively thicker pieces.

Among the Blade Knives (Type K-3), bifacial retouch was sporadic at best, and tanged blades were consistent but relatively low in popularity (Table 8). There is an interesting pattern of contrast between the "casual" subtype (i.e., unretouched blades used as knives) that decreased over time and the unifacial blade knife that correspondingly became more prominent. It is tempting to suggest that this pattern is associated with diminishing importance of naviform blade technology in the 6th millennium, when broad platform blades were generally thicker in cross section than their 7th millennium counterparts. Another explanation could involve a higher degree of curation of blade knives during the 6th millennium, where blades were initially used as Type 3a, then resharpened through retouch during the life of the tool. Both ideas require more intensive research for supporting evidence.

Table 9 shows the dimensional variability among the knife types at 'Ain Ghazal. It is clear that knives were often subjected to damage, whether through use or post-depositional forces. This is a problem for the comparison of knife type lengths, particularly for K-1 and K-2 types. Blade knives were consistently narrower and thinner, as expected for blades as opposed to other blanks, which superficially suggests that they were used in lighter duty tasks than types K-1, K-2, and K-4. But the Thickness/Width ratio shows a different pattern: blade knives and bifacial lenticular knives share a relatively robust cross section compared to tabular and flake knives. Examination of edge deposits and contextual evidence (especially association with faunal material) may help to resolve this apparent paradox.

Borers (Beck 1992)

As has been the case with scrapers and knives, the internal variability within the borer tool class has received little detailed regard with the exception of Mortensen's (MORTENSEN 1971: 26-29)

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[1] Analysis is currently underway by Dr. E. Pernicka, Max Planck Institute of Nuclear Physics, University of Heidelberg.

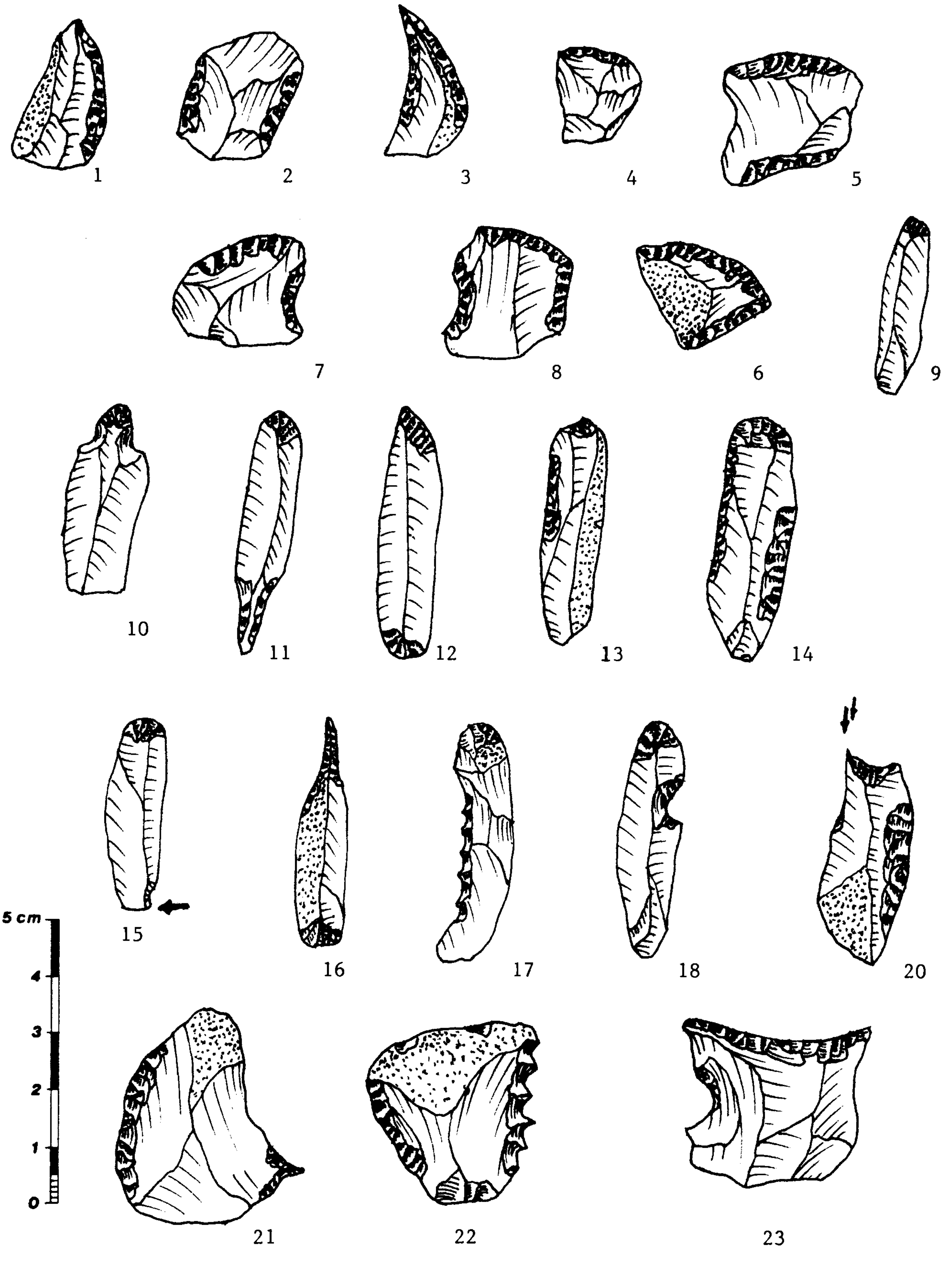

Fig. 1. Schematic examples of 'Ain Ghazal scraper types 1- 23.

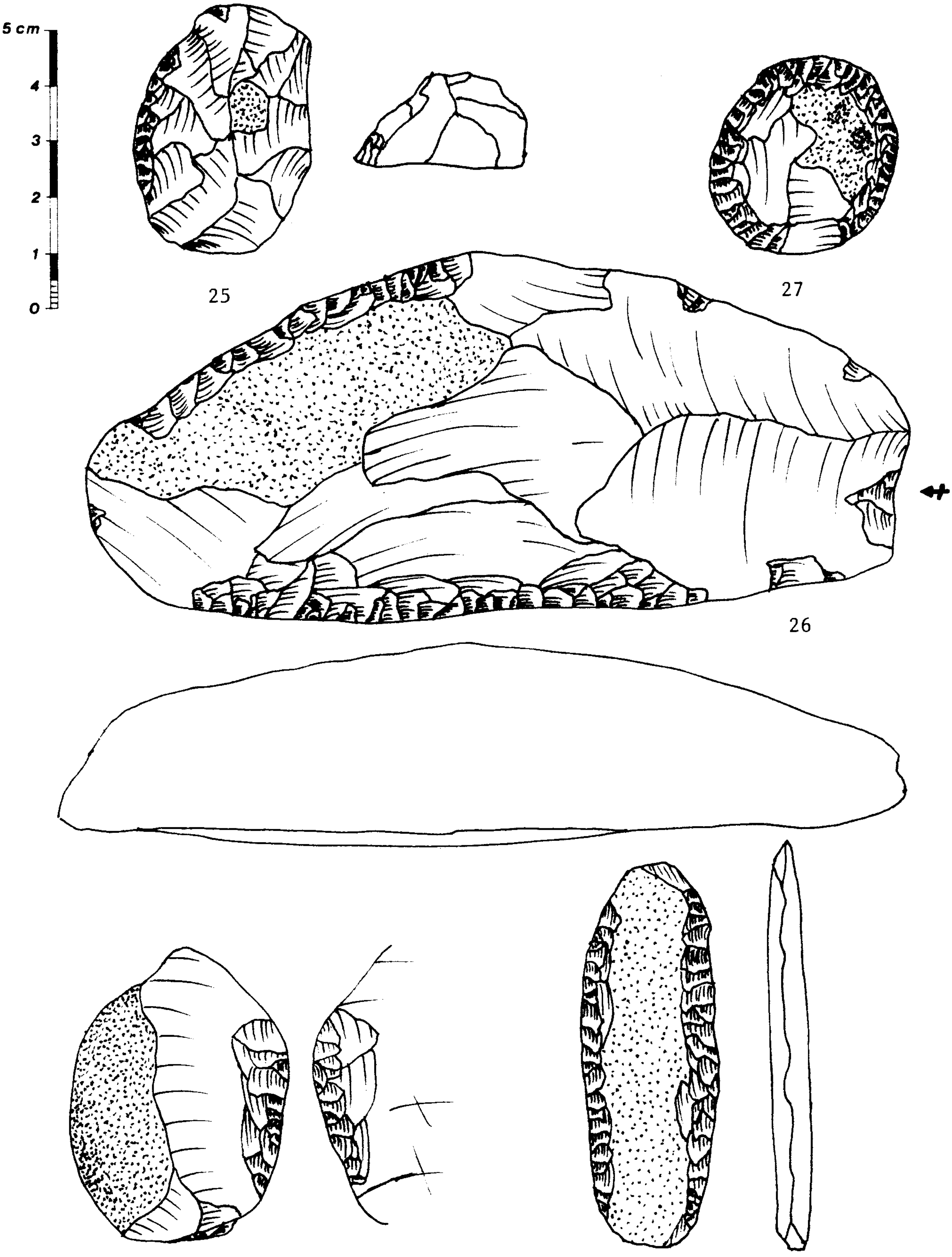

Fig. 2. Schematic examples of 'Ain Ghazal scraper types 25- 29.

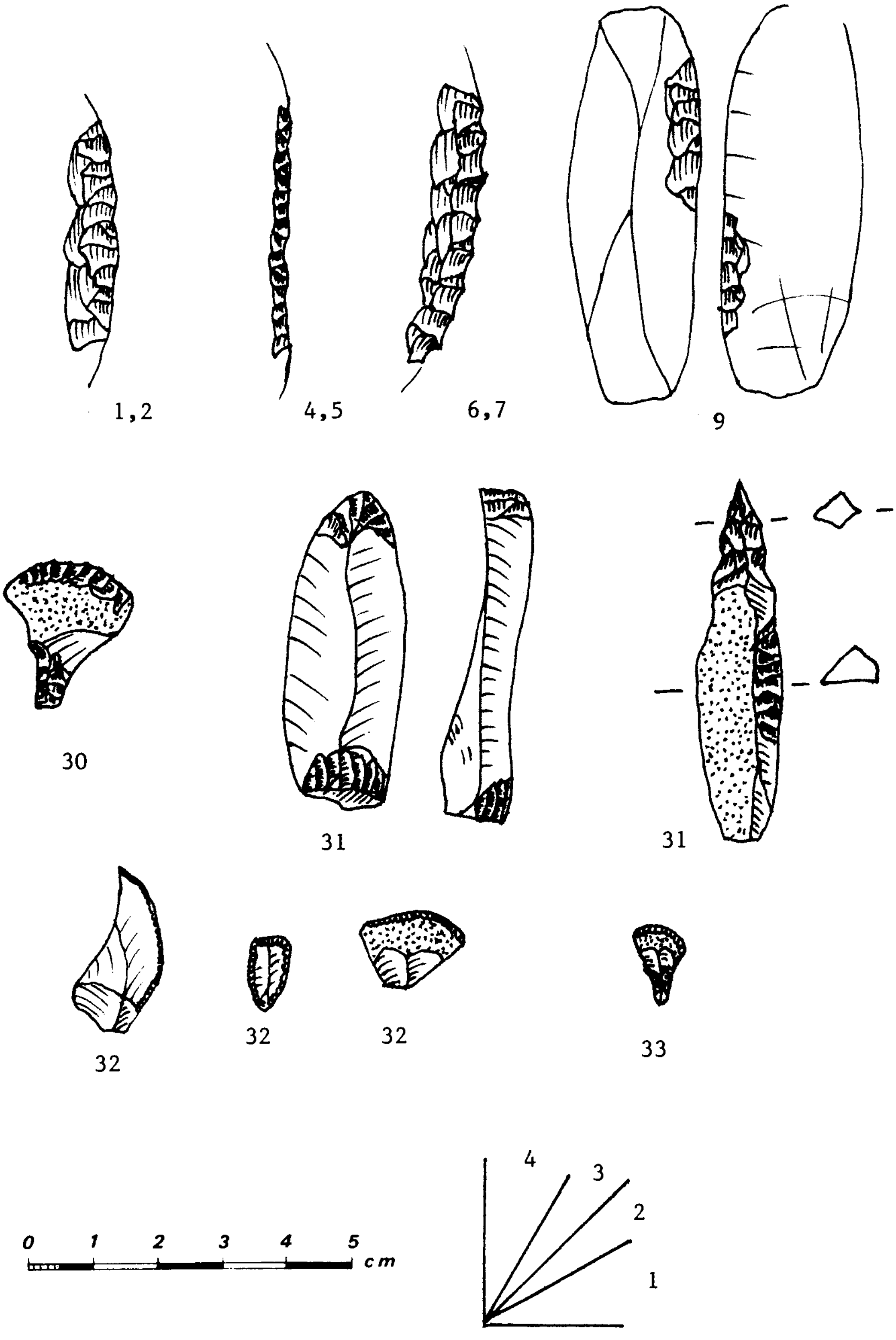

Fig. 3. Schematic examples of 'Ain Ghazal scraper types 30- 33, and examples of scraper retouch type and edge angle classes.

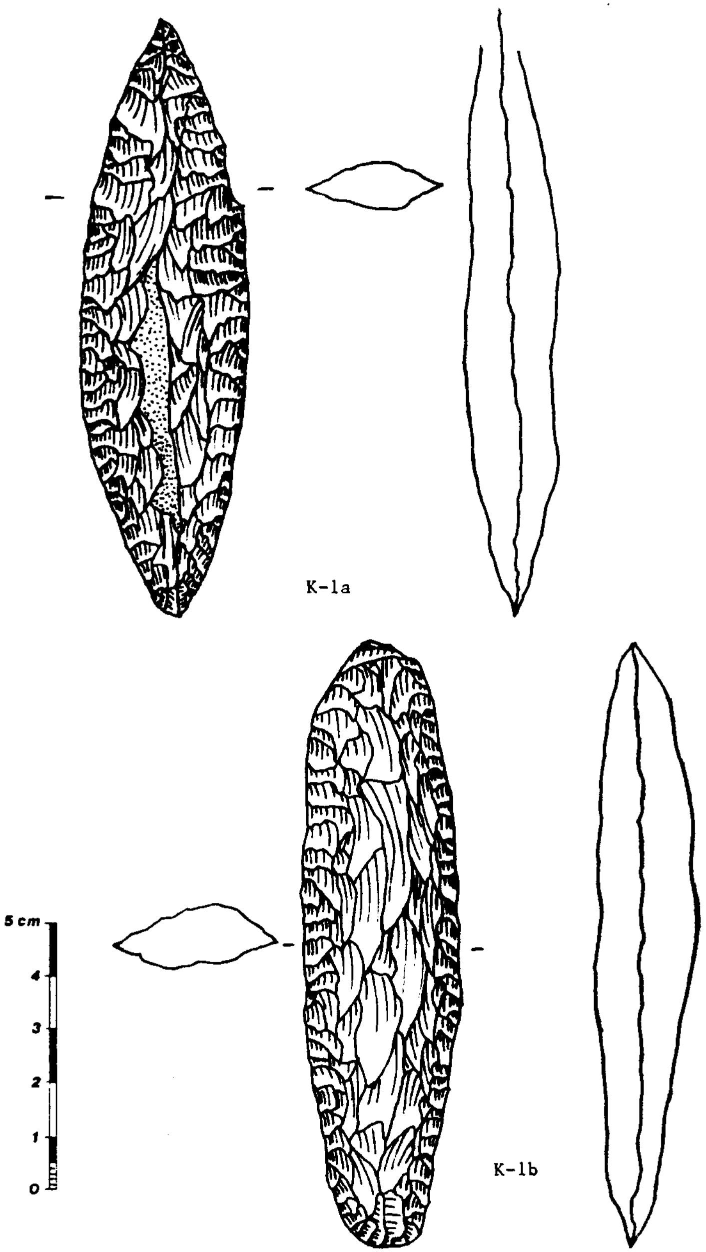

Fig. 4. Schematic examples of 'Ain Ghazal knives, Subtypes K- 1a and K- 1b.

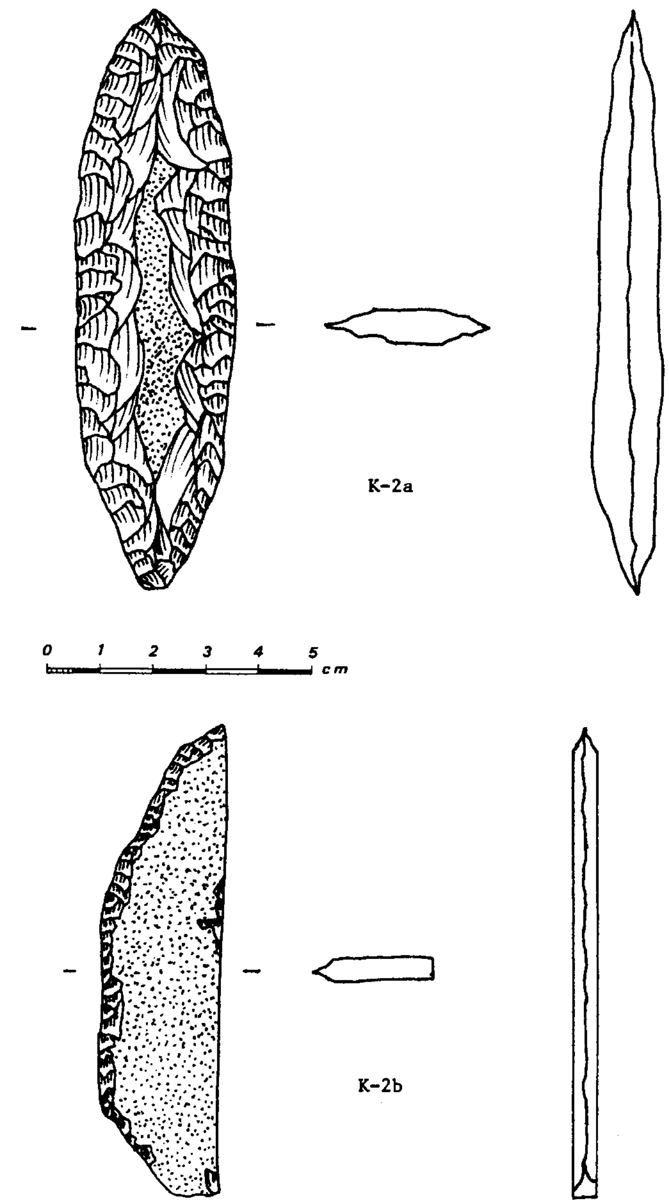

Fig. 5. Schematic examples of 'Ain Ghazal knives, Subtypes K- 2a and K- 2b.

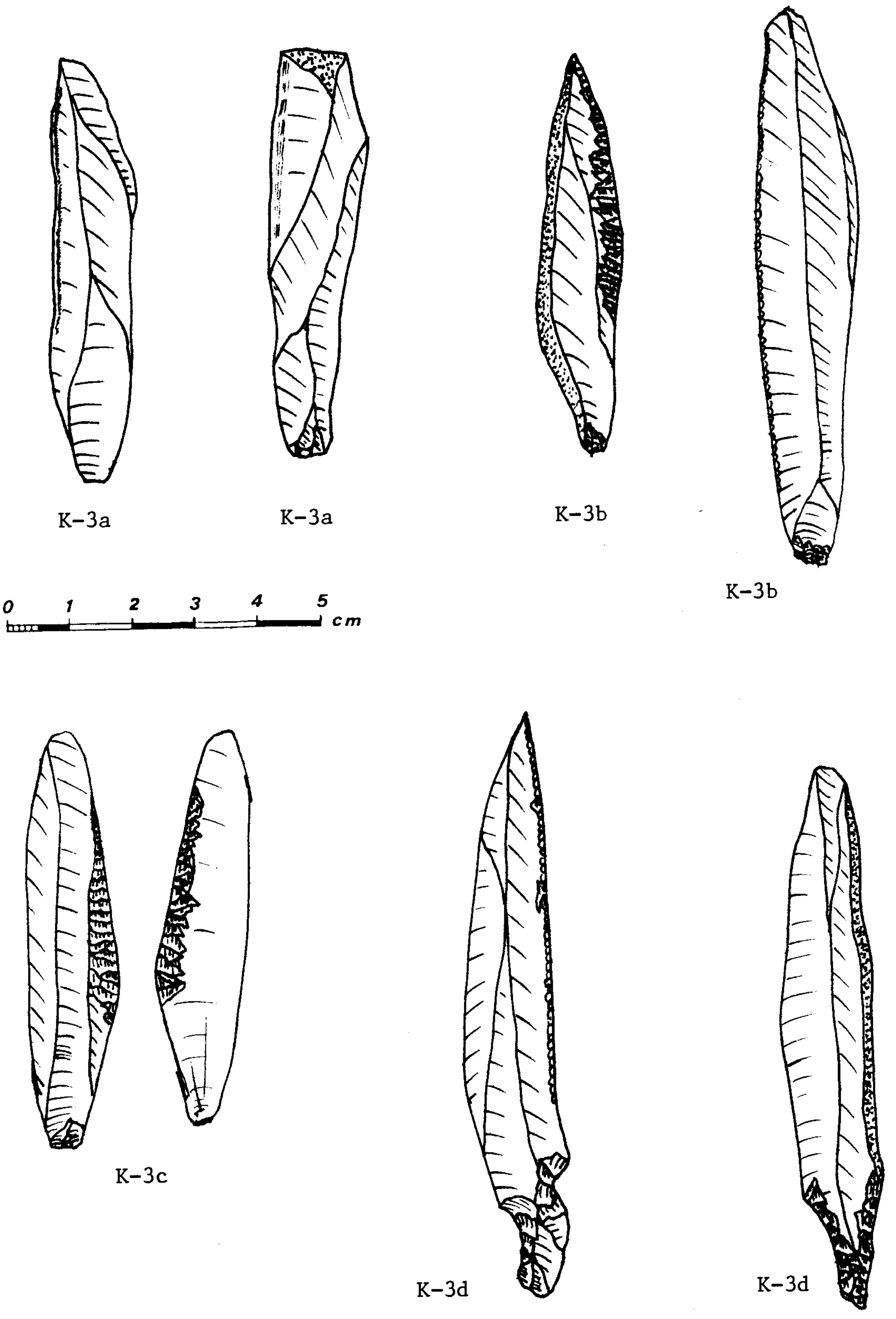

Fig. 6. Schematic examples of 'Ain Ghazal knives, Subtypes K- 3a through K- 3d.

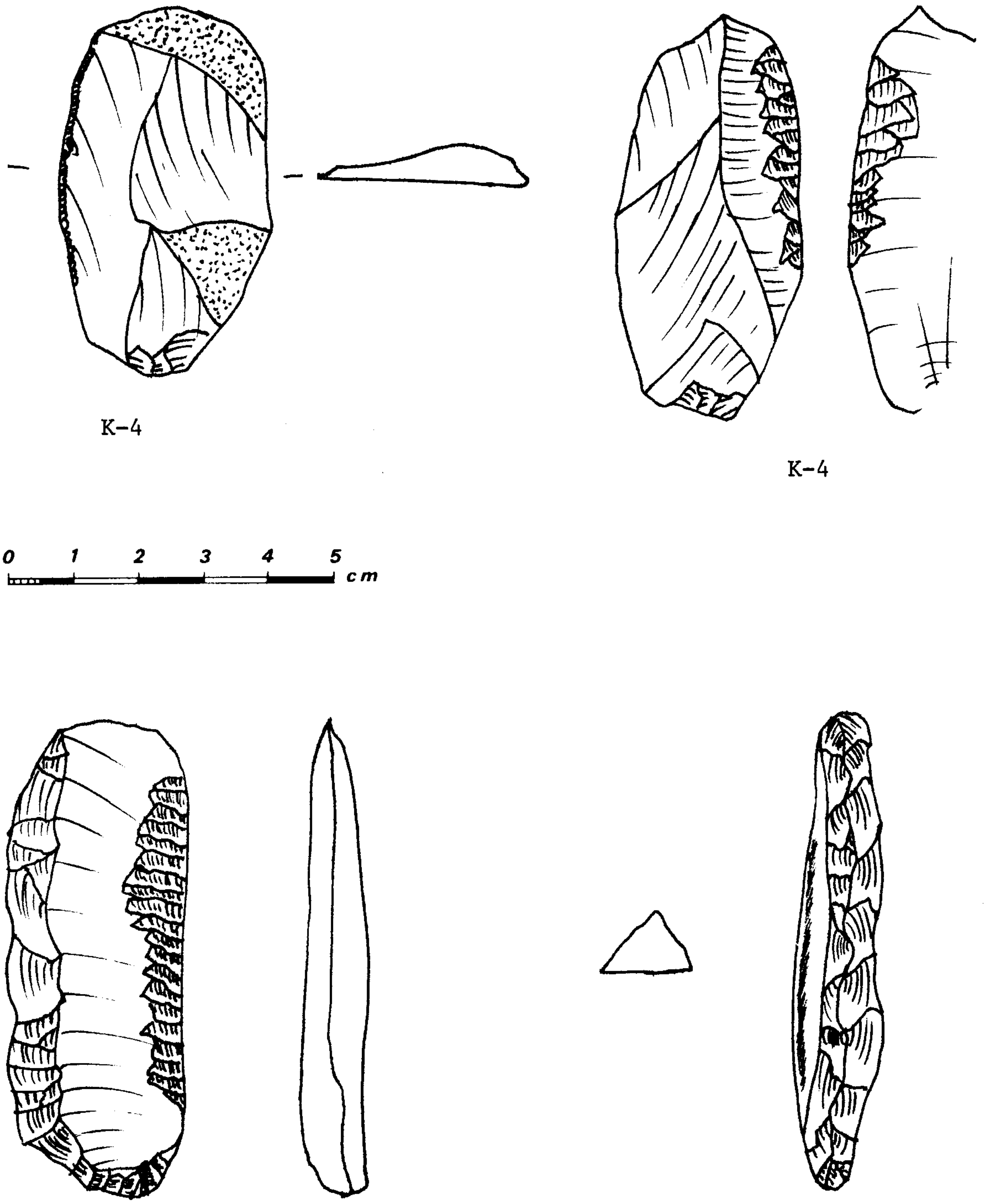

Fig. 7. Schematic examples of 'Ain Ghazal knives, Types K- 4 and K- 5.

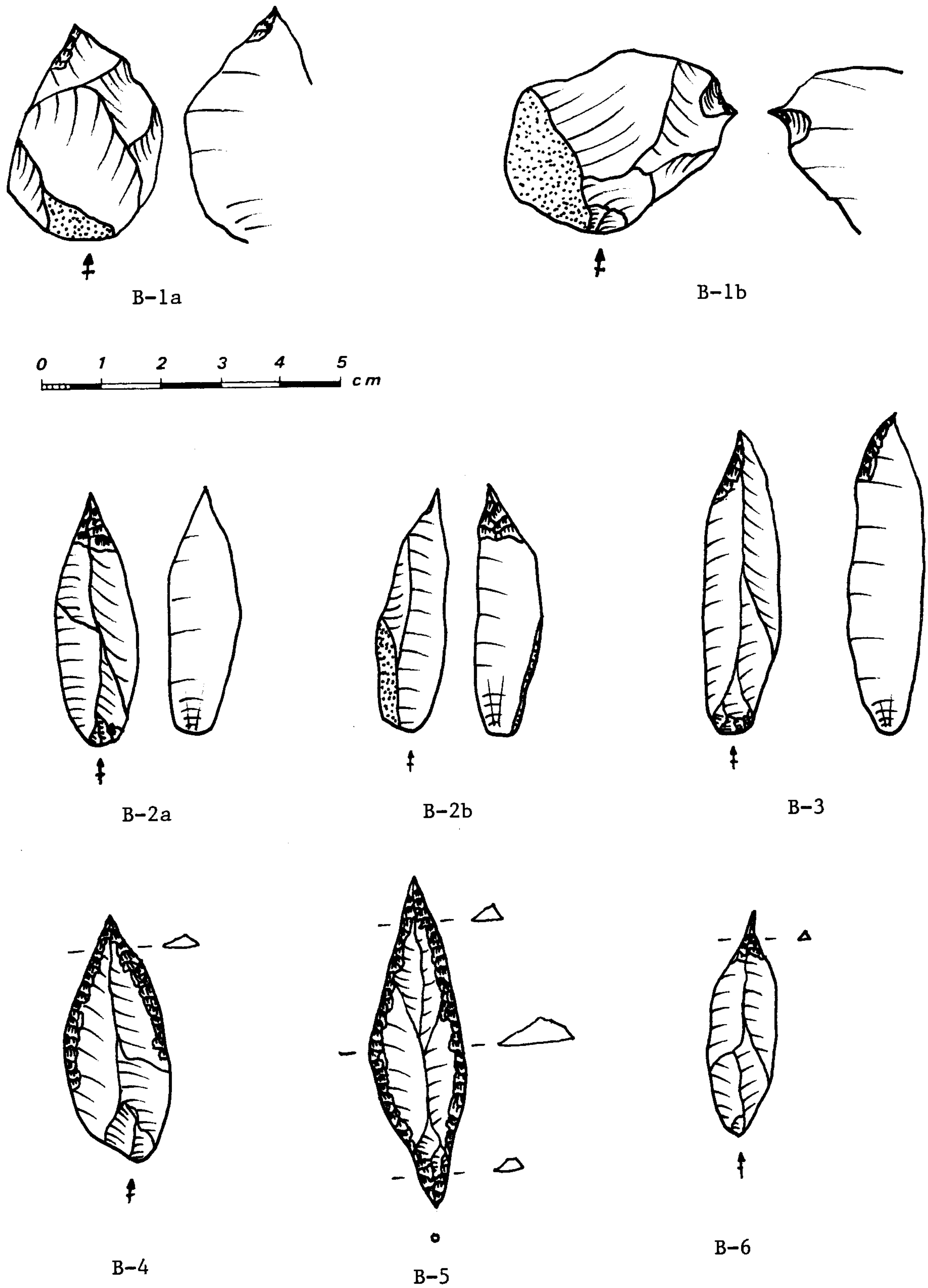

Fig. 8. Schematic examples of 'Ain Ghazal borers, Types B- 1 through B- 6.

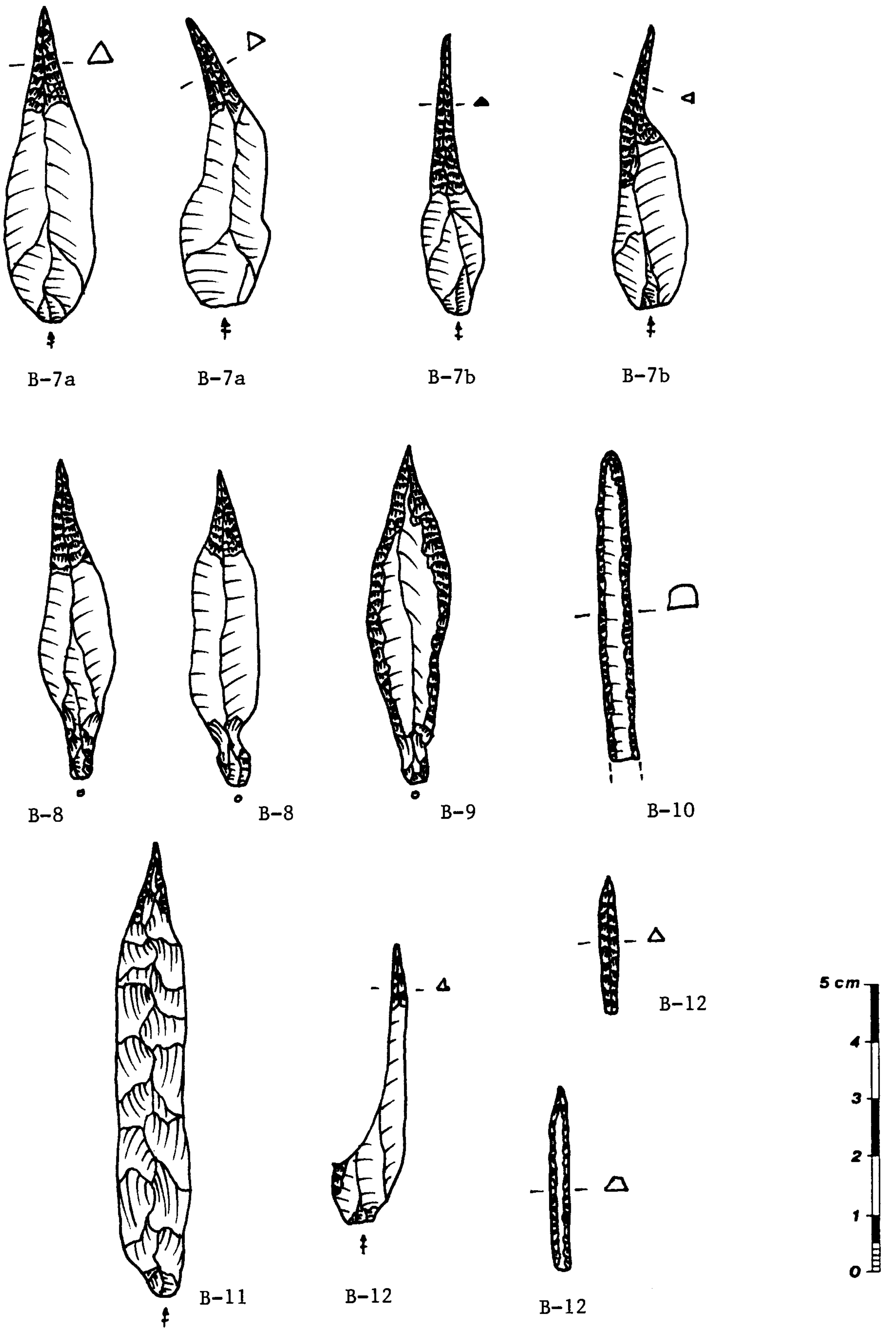

Fig. 9. Schematic examples of 'Ain Ghazal borers, Types B- 7 through B- 12.

analysis of the Beidha collections. Mortensen's approach of classification based on blank type, retouch location and degree, attenuation and width of the bit, and presence/absence of tangs were used for the analysis of borers at 'Ain Ghazal. In addition to Mortensen's 11 borer types, a 12th type was added (B-12, drill on burin spall). In addition, two subtypes have been added o three of Mortensen's type s(Table 10, Figs. 8-9).

Random samples of borers were selected from the 'Ain Ghazal collections; the number of LPPNB examples was too small for reliable interpretation, so they were included with the larger MPPNB sample. Table 11 (which does not include unclassifiable pieces) shows the typological variability through the 7th millennium, early 6th, and late 6th millennium samples.

Flake borers[1] (Type B-1) show a poorly patterned general trend over time, although when the presence of distal vs. lateral retouch is compared, there is a clear preference for increasing use of lateral edges. Blade borers (Types B-2 and B-3), regardless type of retouch, decreased through time, matching the debitage focus during the occupation at 'Ain Ghazal. The extent of retouch (Types B-4, B-5), whether partial, extended, or complete, does not appear to be of chronological significance.

Types B-6 through B-10 are considered to be drills based on the narrow width of the bit of the tool. PPNB short-bit drills are only about one-half as frequent as the PPNC and Yarmoukian examples, but the figures of Table 11 do not indicate a simple pattern of development. The absence of B-11 type borers in the 6th millennium is probably a consequence of sampling error.

The augmentation in Type B-12 drills (on burin spalls) suggests an increased emphasis in the 6th millennium, but this trend is not supported by Chi-Square measures of significance. The larger numbers of Type B-12 drills in the later periods runs counter to the significant decrease in burin production compared to the PPNB (E.g., ROLLEFSON 1988 n.d. a), and perhaps the long, relatively slender burin spalls from PPNC and Yarmoukian concave truncation burins were better suited for drill bits than blades, explaining in part the decreased popularity of Type 7b drills in the 6th millennium (FINLAYSON and BETTS 1990: 20).

Concluding Remarks

The term "preliminary" in the title of this study must be emphasized, for it would be presumptuous to claim that the samples from 'Ain Ghazal's 7th and 6th millennia occupations represent the full scale of typological and technological variability for scrapers, knives, and borers in the Levant.

But we hope that our efforts will stimulate parallel analysis for collections from other Levantine sites. All three tool classes deserve more investigation, in our view, and the present study has demonstrated that several types of scrapers, knives, and borers hold potential value for temporal sensitivity, as well as perceivable stability and change in tool kit functions over time.

We especially welcome comments on the utility, ambiguity, and misperceptions entailed in the preliminary typologies presented in this analysis. In the past, communication among prehistorians has been facilitated, to some extent, through international meetings, but the results have been sporadically successful, at best. Published comments and criticisms have suffered from the inevitable lag time involved in most journal publication schedules, so that two years or more pass by in one direction; responses to such critiques involve a similar passage of time. With the establishment of the *Neo-Lithics* - Newsletter, such interaction between and among prehistorians can be intensified, and we ask that

[1] It is likely that the terms "blade" and "flake" used by Mortensen differ from our concepts of the terms, which are strictly technologically defined without regard to length:width ratios.

reactions to the present paper be addressed to the editors of the newsletter[1].

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The PPN Glossed Blades from 'Ain Ghazal, Jordan (1982-85 and 1988-89 seasons)

Deborah I. Olszewski

ABSTRACT. *The complete Pre-Pottery Neolithic (PPN) collection of glossed blades (PPNB and PPNC) from the 1982-85 and 1988-89 field seasons at 'Ain Ghazal, Jordan, are discussed. The author examined a variety of metric and nonmetric attributes on 327 broken and complete glossed blades. The majority of the blades are broken, most probably through use rather than as a deliberate procedure to shorten blade length. Metric attributes analyzed include length (when possible), width and thickness of the blade, and the invasiveness of the gloss on both the exterior and interior surfaces. Nonmetric attributes consist of various types of modification present on the polished edge of the blade, the modification on the lateral edge opposite the polished edge, characteristics of the distal and proximal ends, blade section (proximal, medial, distal), and whether the glossed blade exhibits uni- or bilateral gloss. There are two blades that appear to have fragments of wood embedded in remaining traces of mastic. The results of these analyses are compared to previous research.*

Introduction

'Ain Ghazal is a major Neolithic settlement located along the Wadi Zarqa, in the outskirts of Amman, Jordan. There have been six field seasons, from 1982-85 and 1988-89, with one just completed in the summer of 1993. The main settlement dates to the Pre-Pottery Neolithic B (PPNB) period, from about 7200 to 6000 B.C.; there are also occupations during the PPNC and Yarmoukian periods. Field seasons at 'Ain Ghazal, and various aspects of the data recovered, have been extensively published (ROLLEFSON 1983, 1984, 1985, 1986, 1990; ROLLEFSON and KÖHLER-ROLLEFSON 1989; ROLLEFSON and SIMMONS 1985, 1986, 1987; ROLLEFSON *et al.* 1984, 1989, 1992; SIMMONS and ROLLEFSON 1984; SIMMONS *et al.* 1988).

General Description

This paper focuses on one small portion of the 'Ain Ghazal data base, the glossed blades. The six excavation seasons prior to 1993 have produced a total of 413 sickles, of which 302 are PPNB, 25 are PPNC, 26 are Yarmoukian, and the rest are from mixed or surface contexts. The PPNC sample does not appear to be significantly different from that of the PPNB, and the two are treated here as a single unit (n=327). The majority of the PPN glossed blades are broken (n=301). Based on the dual observation of the gloss patterning and the active edge retouch (when present), this breakage appears to be have occurred either during use of the blade or after discard of worn glossed blades, rather than as a deliberate snapping of blades to yield shorter segments. The most frequent glossed blade portion is the medial segment (44.0%), followed by the distal segment (30.6%) and the proximal ends (25.3%)[1]. The high frequency of medial sections probably indicates breakage after the blade was removed from the haft and discarded, since, regardless of how the blade was hafted, one would not expect medial sections to be the most numerous.

[1] Within the very small PPNC sample, the distal segment is the most frequent (45.8%).

A wide range of colors of flint (and some cherts) were used to manufacture these implements. The most common were greys (49.2%), followed by tans and browns (30.5%), pink/purple/mottled (16.5%), and black (3.7%).

Width and thickness were recorded for all 327 glossed blades; length was recorded for the 26 complete examples. Table 1 presents these data. Broken glossed blades are only slightly less wide and slightly thicker than the sample of complete glossed blades.

Table 1a. Width and thickness for broken PPN glossed blades from 'Ain Ghazal (n=301) (in mm).

	Average	Maximum	Minimum	Standard Deviation
Width	15.5	29.6	8.1	3.1
Thickness	4.9	17.6	2.4	1.3

Table 1b. Length, width and thickness for complete PPN glossed blades from 'Ain Ghazal (n=26) (in mm).

	Average	Maximum	Minimum	Standard Deviation
Width	15.7	26.0	9.8	3.8
Thickness	4.7	6.7	3.1	0.9
Length	73.6	104.3	38.2	19.5

The presence of polish on the 'Ain Ghazal PPN glossed blades is typically unilateral (88.4%, n=289) (Figs. 1-3,4:a,5), rather than bilateral (11.6%, n=38) (Fig. 4:b-f).

Tables 2 and 3 present information concerning the appearance of the glossed edge. For unilateral glossed blades, the most common modification is a fine denticulation. Following that are nibbling, no modification, and fine retouch. Fine denticulation is somewhat less common on bilateral glossed blades, where nibbling and no modification are prevalent.

Table 2. 'Ain Ghazal unilateral glossed edge appearance (n=289).

Modification	Exterior		Interior	
None	58	20.1	44	15.2
Nibbling	72	24.9	61	21.1
Notch	5	1.7	8	2.8
Fine	29	10.0	26	8.9
Fine denticulation	101	34.9	125	43.2
Large denticulation	9	3.1	9	3.1
Semi-abrupt	6	2.1	9	3.1
Invasive	8	2.8	5	1.7
Burin spall scar	1	0.3	1	0.3
Semi-steep	-	-	1	0.3

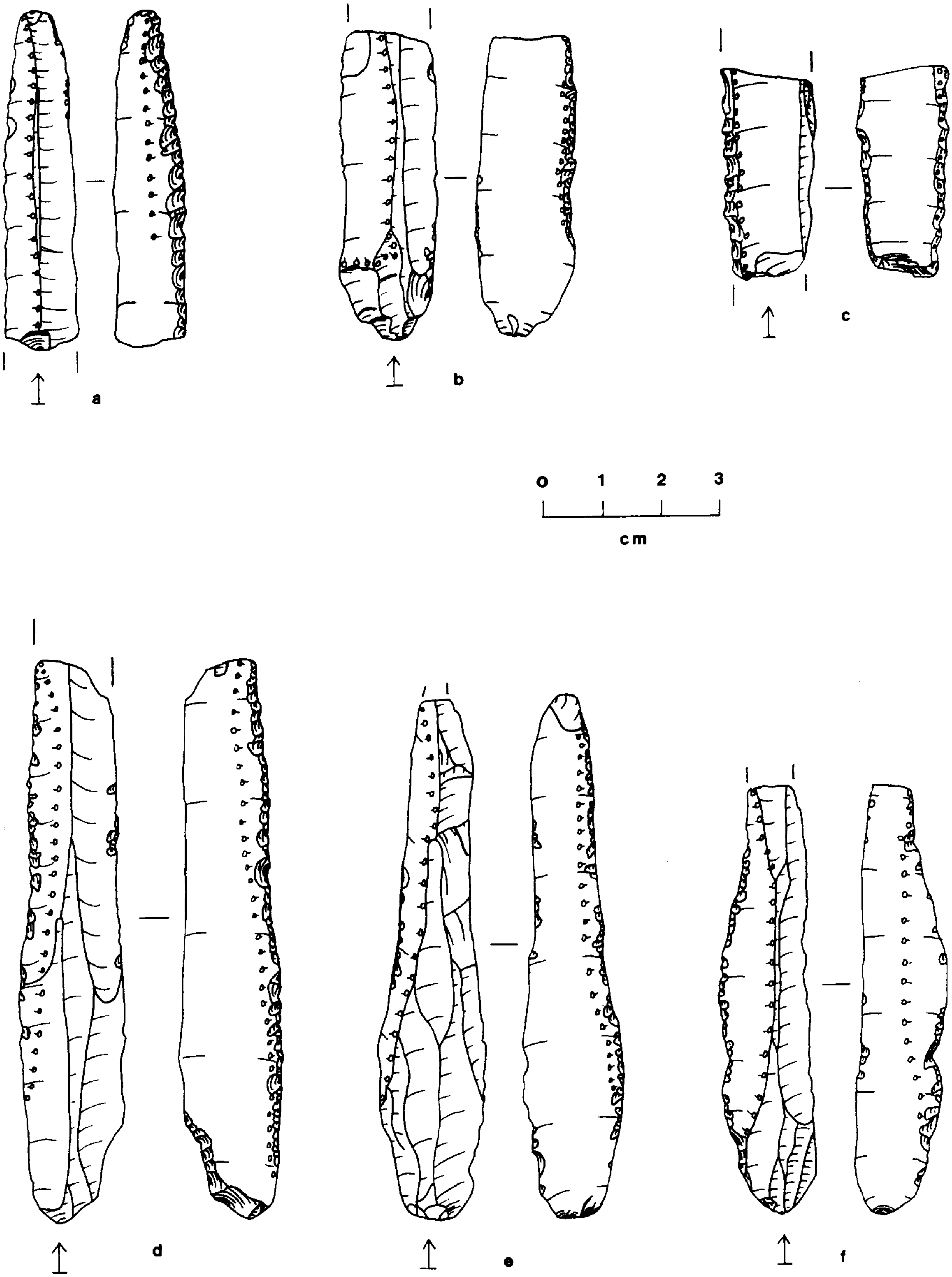

Fig. 1. 'Ain Ghazal unilateral sickles: a (Square 3273, Locus 14), b (Square 3074, Locus 5), c (Square 4453, Locus 101), d (Square 3083, Locus 39 floor context), e (Square 3482, Locus 000), f (Square 3073, Locus 31) <PPNB: a,b,d,f ; PPNC: c; mixed: e>.

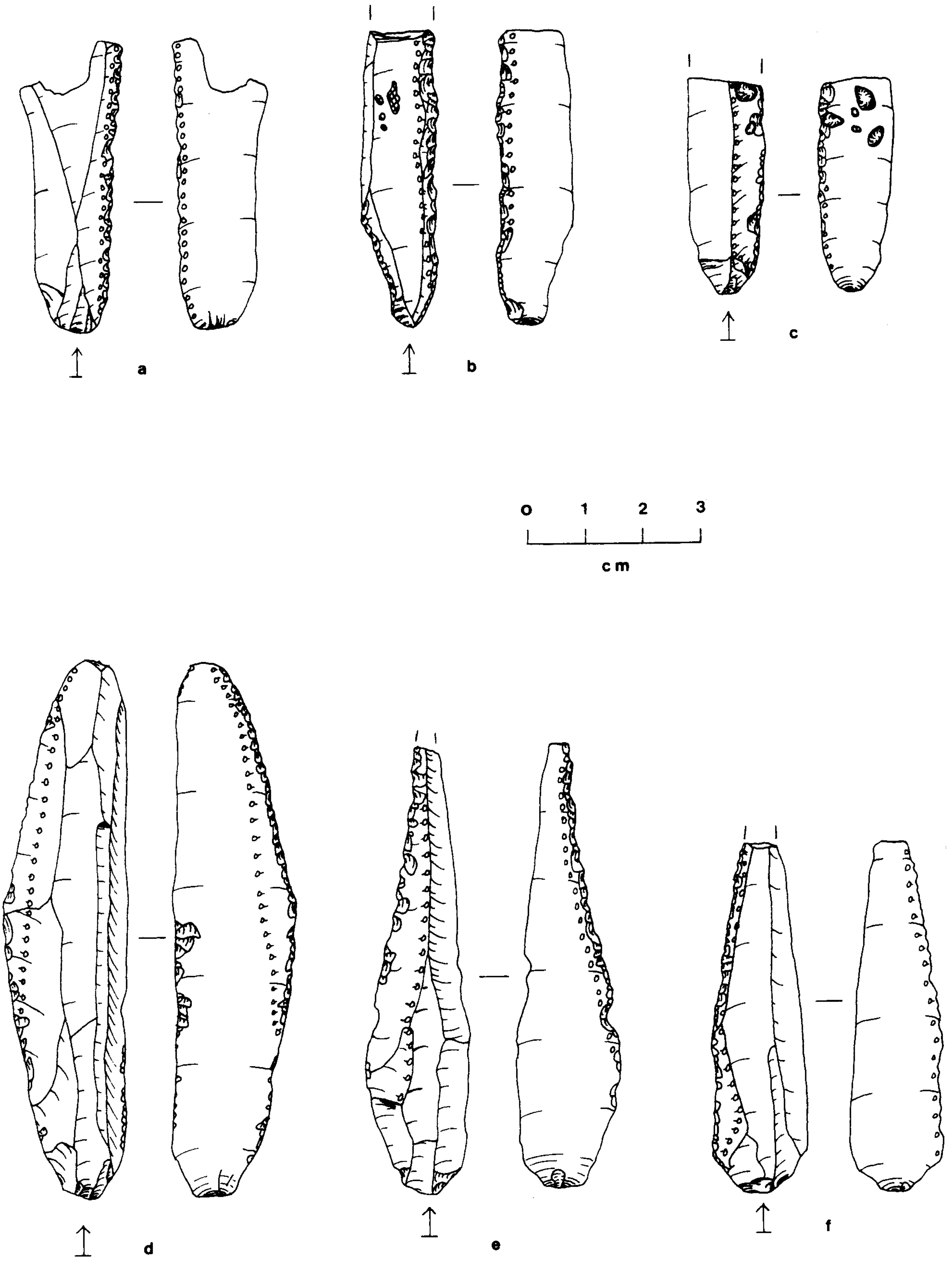

Fig. 2. 'Ain Ghazal PPNB unilateral sickles: a, c, f (Square 3073, Locus 30), b (Square 3081, Locus 33), d (Square 3077, Locus 34), e (Square 3076, Locus 8)

Table 3. 'Ain Ghazal bilateral glossed edge appearance (n=38).

Modification	Exterior1		Interior1		Exterior2		Interior2	
None	9	23.7	9	23.7	10	26.3	3	7.9
Nibbling	12	31.5	10	26.3	9	23.7	9	23.7
Notch	2	5.3	-	-	2	5.3	-	-
Fine	1	2.6	7	18.4	2	5.3	4	10.5
Fine denticulation	10	26.3	8	21.0	9	23.7	16	42.1
Large denticulation	2	5.3	1	2.6	1	2.6	-	-
Semi-abrupt	2	5.3	1	2.6	2	5.3	3	7.9
Invasive	-	-	2	5.3	2	5.3	2	5.2
Burin spall scar	-	-	-	-	1	2.6	1	2.6

Table 4 lists the appearance of the edge opposite the gloss edge for unilateral glossed blades. The pattern there is somewhat different, with no modification the most common, followed by nibbling and fine retouch.

Table 4. 'Ain Ghazal unilateral sickle nonactive appearance (n=289).

Modification	Edge Opposite Gloss	
None	130	44.9
Nibbling	58	20.1
Notch	9	3.1
Fine	25	8.6
Denticulation	11	3.8
Semi-abrupt	19	6.6
Abrupt	9	3.1
Invasive	9	3.1
Cortex	10	3.5
Burin spall scar	4	1.4
Semi-steep	2	0.7
Helwan	1	0.3
Missing edge	2	0.7

There were 110 proximal and 84 distal blade ends that could be examined for possible modification. About 54% of the proximal and 34% of the distal ends showed no modification. Proximal ends showed thinning (possibly for hafting purposes) (Fig. 1:d,2:b,3:d,4:f), burins (Fig. 3:a), tangs, and notches, while the distal ends exhibited burins, truncations, distal thinning (possibly for hafting purposes), notches, and tangs (Fig. 5:a). The modification of proximal and/or distal ends of blades into various tools such as burins, perforators, or tangs (possibly for arrowheads) appears to postdate the use of the glossed blade.

The invasiveness of the gloss on both the exterior and interior of each active edge was also measured. Not all edges exhibited bifacial presence of gloss. The results are presented in Table 5. Exterior (dorsal) edges yielded the most invasive gloss on the average, although the range of values for interior (ventral) edges is somewhat larger than that of the exterior edges.

Table 5. Gloss invasiveness on exterior and interior edges of blades from 'Ain Ghazal.

	Average	Maximum	Minimum	Standard Deviation
Exterior 1	5.7	12.0	0.5	2.7
Interior 1	3.1	17.4	0.1	2.4
Exterior 2	6.2	14.1	0.5	2.8
Interior 2	3.1	17.4	0.3	2.4

It is very common for the gloss invasiveness to reach the first exterior arête, occurring on 61% of the unilateral sickles, and on 82% of the bilateral examples. Occasionally, the gloss extended to a second arête, as on 4% of the unilaterals and on 5% of the bilaterals[1].

Finally, when the blade was positioned with the proximal end toward the viewer, 59.2% of the unilaterals exhibited gloss along the left edge, while only 32.5% occurred along the right edge. There were 8.3% of the fragments which could not be oriented. This might be evidence for preferential siding of blades on the haft (see below).

Morphology and Hafting

Active Edge Appearance

As a group, the PPN 'Ain Ghazal glossed blades are a close match with the descriptions of glossed blades by Cauvin (1983) for her Period 3 (PPNB). Morphologically, the 'Ain Ghazal glossed blades include moderately large numbers of the unmodified "type" of blade (exhibiting either no modification or only nibbling through use along the active edge). These are about 45% of the unilaterals and about 50-55% of the bilaterals (Tables 2, 3). For the nonactive edge of unilateral glossed blades, ca. 68% exhibit cortex, no modification or nibbling (Table 4). This basically unmodified form of glossed blade is not temporally or spatially diagnostic since it has a wide chronological range (occurring as early as the Kebaran and as late as the 4th millennium B.C.), as well as a wide geographical range (including Cyprus, Turkey, the Levant, the eastern Fertile Crescent, and Turkmenistan) (*ibid.* 65).

Fine denticulation is found on about one-quarter to one-third of the active edges of unilateral and bilateral examples (Tables 2, 3). Such retouch on the active edge is a feature of 7th millennium sites, as pointed out by Cauvin (*ibid.* 71), and a period certainly represented at 'Ain Ghazal on the basis of available radiocarbon dates. Examples can be found at other PPN sites including Jericho, Tell Aswad, Mureybit, Abu es-Suwwan, and Wadi Shueib, among many. The large (or coarse) type of denticulation along the active edge, which appears in the late PPN (*ibid.*), is also found in the 'Ain Ghazal sample, but is not very common (ca. 3%-5%). Although Cauvin describes large denticulation as appearing in conjunction with bitruncated elements, this pattern is not present in the 'Ain Ghazal data. Of the 194 ends that are present, 47 (24.2%) show thinning or truncation, but only two have truncation or thinning associated with large denticulation on the same piece[2].

The only other active edge retouch of note is fine retouch. This occurs about equally on the exterior and interior of unilateral active edges, and is quite common on the interior surface of bilateral glossed blades (Tables 2, 3). Other forms of retouch are extremely rare, although bilaterals do yield about 5% invasive retouch.

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1 Although the PPNC sample is very small, gloss invasiveness is almost equally devided between examples of gloss reaching the first arête, and gloss that is less invasive than the first arête.

2 Both of these are from PPNB contexts at 'Ain Ghazal.

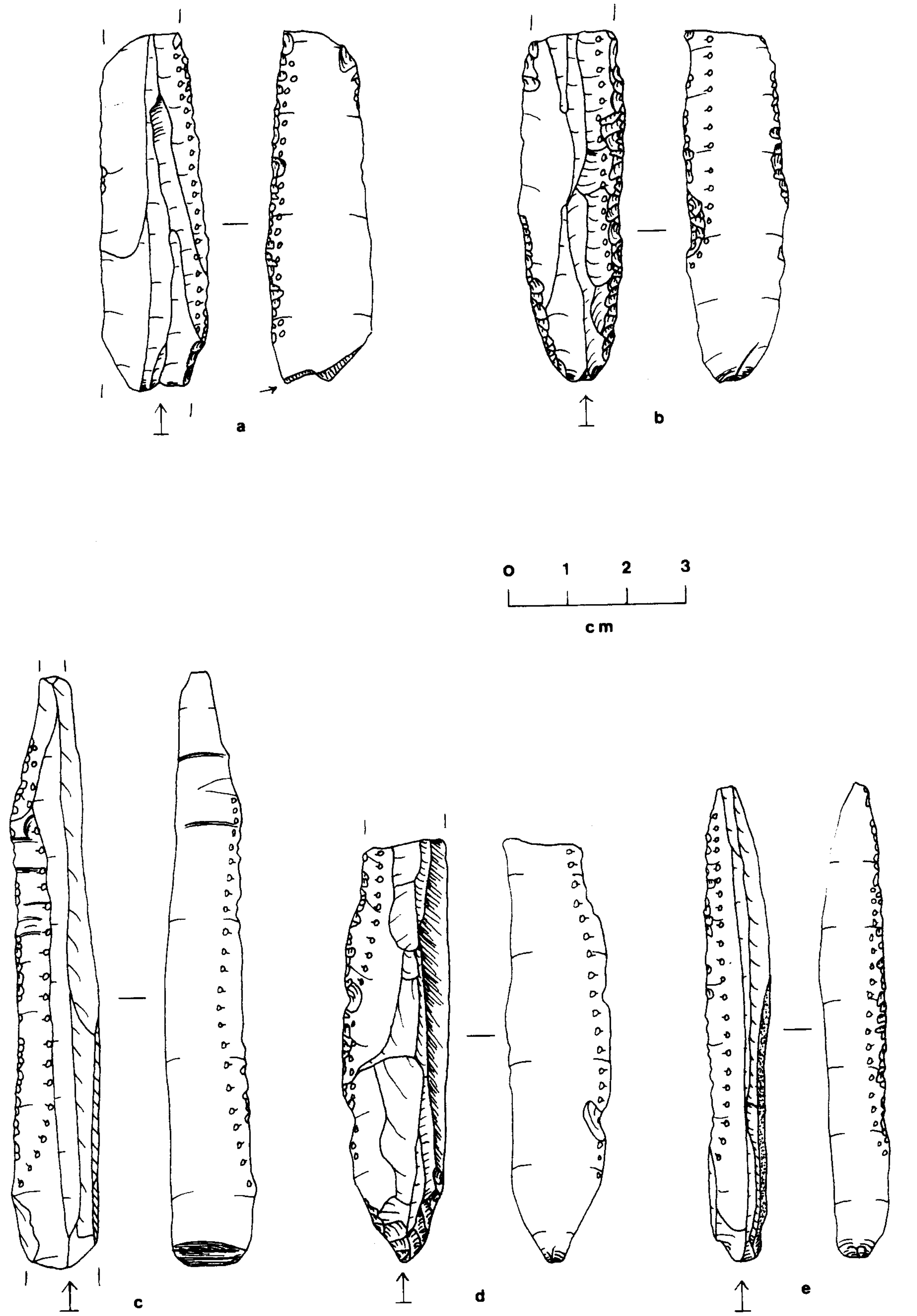

Fig. 3. 'Ain Ghazal PPNB Unilateral Sickles: a-c (Square 3080, Locus 46), d-e (Square 3081, Locus 30)

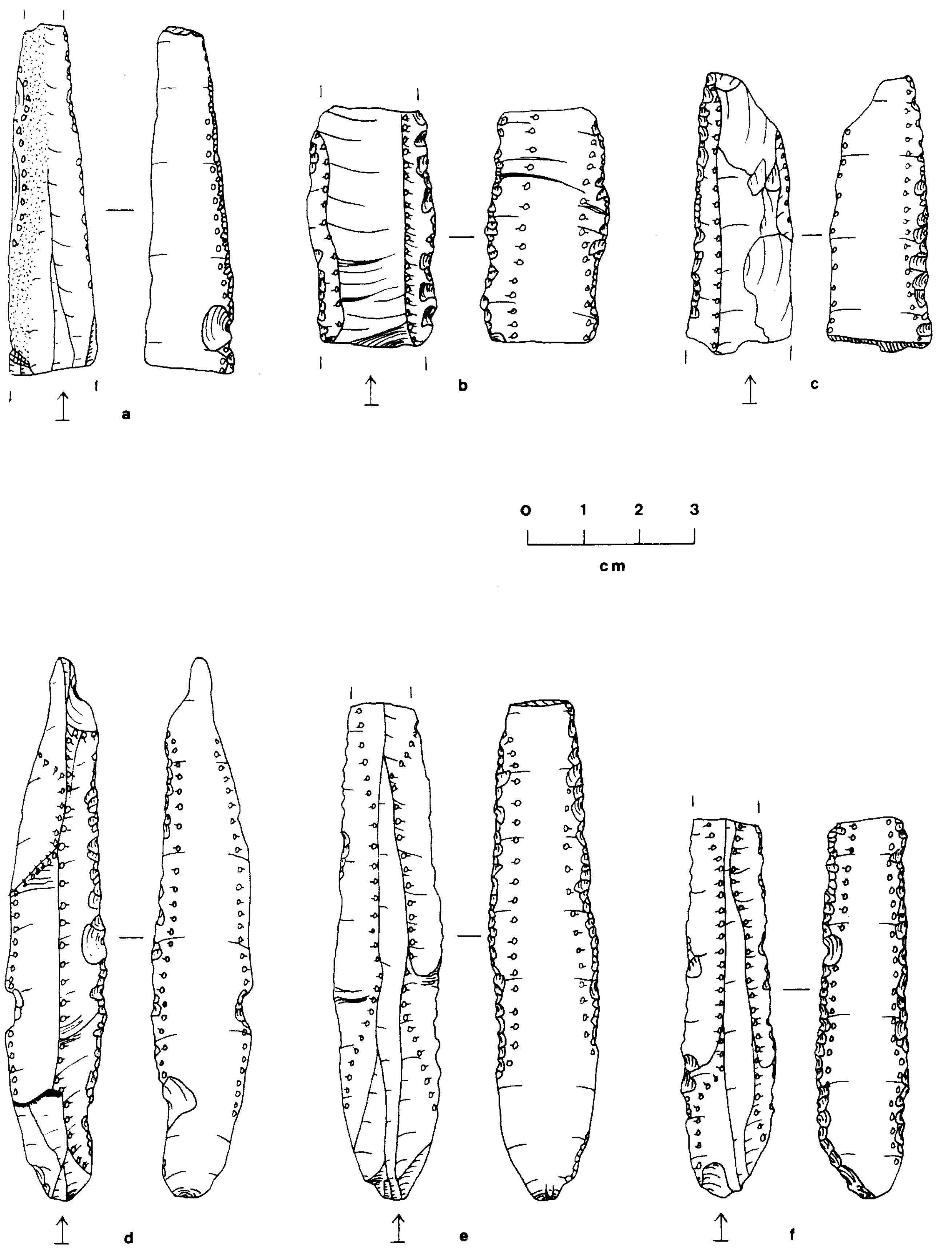

Fig. 4. 'Ain Ghazal PPNB unilateral and bilateral sickles: a (Square 3076, Locus 8), b (Square 3982, Locus 18), c (Square 3282, Locus 113), d (Square 3081, Locus 31), e (Square 3283, Locus 6), f (Square 3080, Locus 2)

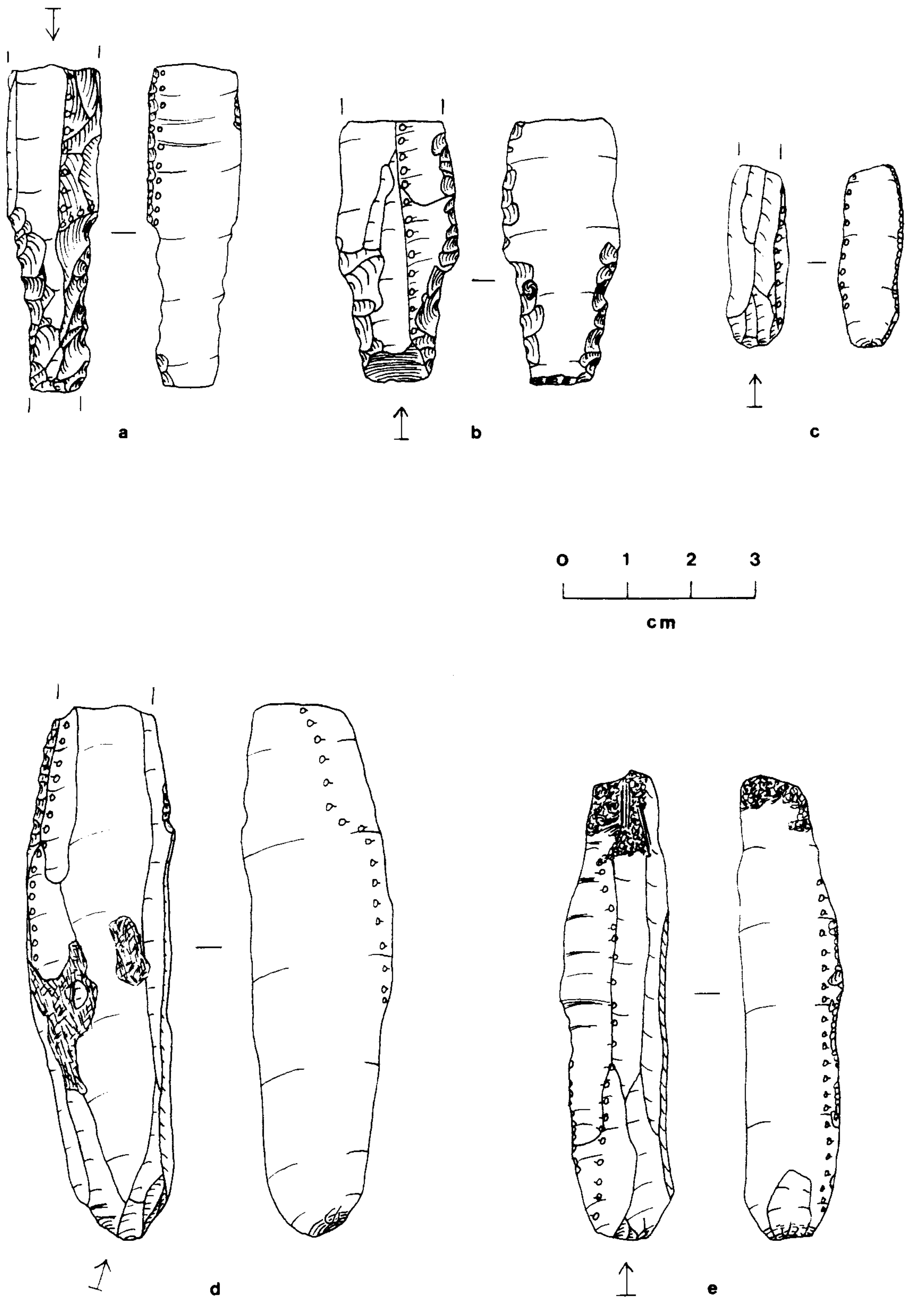

Fig. 5. 'Ain Ghazal unusual unilateral sickles: a-b tanged, c bladelet, d mastic with possible bone fragments, e mastic with possible wood fragments; a (Square 3076, Locus 18), b (Square 3481, Locus 8), c (from section cleaning, Locus 000), d (Square 3076, Locus 18), e (Square 3079, Locus 70) <PPNB: a, c-e; Yarmoukian: b>.

Nonactive Edge Appearance of Unilaterals

About 32% of the 'Ain Ghazal PPN unilateral glossed blades underwent nonactive edge modification, possibly for hafting purposes, although this is not clearly indicated. The nonactive edges exhibit fine, semi-abrupt, abrupt, invasive, semi-steep, and Helwan retouch, notches, denticulation and removal of lateral edge by a burin spall (Table 4). Most edges are unmodified (68%).

Hafting Possibilities

Experimental and microwear analyses (Anderson 1991, 1992; ANDERSON-GERFAUD 1988; ANDERSON-GERFAUD *et al.* 1991; UNGER-HAMILTON 1989) strongly suggest that glossed blades were most frequently hafted parallel to the handle, either as a single blade or as multiple blades in a row. The gloss patterning on the illustrated 'Ain Ghazal glossed blades (Figs. 1-5) yields no evidence to contradict a parallel hafting arrangement. The extent of the gloss invasiveness can be due to either how deeply the blade was set into mastic or how intensively the blade was used in plant cutting.

The predominance of active edges located on the left lateral of the blades suggests that the glossed blades were most often hafted on the left side of the haft, and with the proximal end pointing toward the base of the haft. However, some sickles were probably placed along the right side of the haft (see gloss patterns on Figs. 2a,3b). Bilateral glossed blades probably represent unilateral glossed blades that have been rehafted and used (Fig. 4:b-f).

Gloss Invasiveness

Previous research by Unger-Hamilton (1983, 1989)has combined the results of both macroscopic and microscopic inspection of glossed blade edges from both experimental and archaeological samples. One of the variables measured in her studies, as well as in this study of the 'Ain Ghazal glossed blades, is the average width of the gloss (gloss invasiveness). Of Unger-Hamilton's (1989: 93) experimental sickles, only those used to harvest reeds (*Phragmites communis*), domesticated bread wheat (*Triticum aestivum*) and macaroni wheat (*Triticum durum*) exhibited average gloss widths similar to those of the 'Ain Ghazal PPN glossed blades (for exterior surfaces since these are apparently the most extensively used) (Table 5). Interestingly, the PPN archaeological sample examined by Unger-Hamilton (*ibid.* 97) mainly yielded values extremely close to those from 'Ain Ghazal. Unger-Hamilton's sample shows a clear relationship of polish (*ibid.* 96-97) width to blade width, which in turn is probably related to wider stems; that is, the wider the plant stem and the blade, the wider the polish. This pattern is not evident at 'Ain Ghazal, where the average blade width (Table 1) is similar to Unger-Hamilton's examples that have average polish widths of 4.1-4.6 mm, rather than the 'Ain Ghazal average polish width of 5.7-6.2 mm.

Paleobotanical work at 'Ain Ghazal (ROLLEFSON and SIMMONS 1986: 162) has shown that a variety of wild (vetches, various grasses, chenopods, pistachio, fig, almond) and domesticate (horse beans, lentils, field peas, einkorn and emmer wheat, bread wheat/macaroni wheat, barley) plant species were used. The presence of bread/macaroni wheat at 'Ain Ghazal, in conjunction with the large average gloss widths, might lend some support to the sickles from this site being used to harvest these plants. Admittedly, there are many factors that influence gloss width (UNGER-HAMILTON 1989: 92), so that it would be necessary to examine the 'Ain Ghazal sickles microscopically in order to place much confidence in this macroscopic observation. It is interesting that cutting reeds produces very invasive gloss patterns, and although there is no macrobotanical evidence for reeds at 'Ain Ghazal, the location of this site near the River Zarqa might have yielded areas where reeds grew prehistorically.

Unger-Hamilton (*ibid.* 99-100) remarks that the archaeological sample she studied showed a clearly delineated gloss distribution, which she interprets to indicate that these blades were hafted as a row of blades in a slightly curved haft (with the additional microscopic observation of oblique streaks of gloss). The 'Ain Ghazal glossed blades also exhibit this macroscopically clear demarcation, especially in those cases where the gloss ceases at the first or second exterior arête (65% and 87% of unilateral and bilateral sickles, respectively). The patterning of the gloss as it nears the proximal and/or distal ends of the blade in the 'Ain Ghazal sample often curves out towards the lateral edge. This pattern probably represents how mastic covered the sickle in the parallel hafting of 1-2 sickle blades.

Since gloss invasiveness on the average is wider on the exterior surface of the 'Ain Ghazal glossed blades, it is probable that the exterior surfaces were more extensively exposed to the plant stems during cutting. That is to say, the angle at which the blade was used against the plant stems must have resulted in exterior surfaces being the first to encounter the stem, so that the resultant gloss is greatest on this surface.

The sample of PPN glossed blades used by Unger-Hamilton (*ibid.* 100) is similar to that of 'Ain Ghazal with respect to retouch of the active edge. Combining her PPNA and PPNB sample yields 65% sickles with retouch. The 'Ain Ghazal PPN sample is about 40%-55% retouched. Her PPNB sample alone is 81% retouched sickles, which is a somewhat higher value than that from 'Ain Ghazal. Use of experimental blades by Unger-Hamilton (UNGER-HAMILTON 1991: 491-493, 505) suggests that denticulated edges are especially helpful in cutting domestic cereals, while nonretouched edges are much more efficient in cutting wild cereals as well as a variety of other plants. Her experiments in cutting reeds necessitated coarsely denticulated blades. Thus, it may be possible that early Neolithic peoples manufactured two discrete categories of harvesting implements, those for use on domestic cereals, and those for use on wild cereals and other plants (excluding reeds). The fact that coarsely denticulated glossed blades are uncommon in the early Neolithic might suggest that reed cutting was a minor activity.

Summary

Six field seasons at Neolithic 'Ain Ghazal, Jordan, have produced a wealth of data about the prehistoric lifeways of early farmers in the Levant. This paper has dealt with a small portion of that data base, the glossed blades. A study of the 327 PPN glossed blades has confirmed observations on glossed blade morphology, first detailed by M.-Cl. Cauvin (1983), and on hafting for the PPN phases. Thus, inhabitants of 'Ain Ghazal used glossed blades rather than glossed elements. These often have little modification, with most retouch (mainly fine denticulation) located along the active edge of the sickle. The majority of the sickles are unilateral (88.4%) rather than bilateral, and gloss patterns indicate that the exterior surface of the sickles probably encountered the plant stems more extensively than did the interior surfaces.

The majority of the unilateral sickles exhibited gloss patterns suggest that they were inset parallel to the side of hafts. The 'Ain Ghazal gloss patterns also indicate that these were most often placed on the left side of the haft, rather than the right. It is possible that this latter patterning is indicative of hafting "styles" or of right versus left handedness.

Gloss invasiveness averages are relatively high. Compared to experimental work by Unger-Hamilton (1989), the closest analogues are cutting of domesticated bread and macaroni wheat, and of reeds. Bread/macaroni wheat is present in the macrobotanical remains from 'Ain Ghazal; reeds are not present, but probably grew along the River Zarqa near the site. It is interesting that the PPN sample examined by Unger-Hamilton exhibited gloss invasiveness averages similar to those of 'Ain Ghazal. Based on microscopic work, the gloss of her PPN sample is mostly attributable to the cutting of cereals (63% of the PPN sample for definite cereal polish). Obviously, it is most important that some sample of the 'Ain Ghazal sickles are eventually subjected to similar microscopic techniques.[1]

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[1] Several PPNB, PPNC, and Yarmoukian glossed pieces from 'Ain Ghazal are under study by P. Anderson.

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Nahal Issaron. The Lithics of the Late PPNB Occupation

Avi Gopher, A. Nigel Goring-Morris, and David Gordon

The Site. Location and Environmental Setting

Nahal Issaron is located on the alluvial fan at the outlet of Nahal Issaron to the Uvda Valley in the southern Negev. Biq'at Uvdah is located some 35 km north of the Gulf of Eilat in the southern Negev desert, 5 km west of the escarpment bordering the 'Arabah Rift valley. It is bounded on the west by low Campanian hills while on the east Turonian age hills reach elevations up to 625 m. The area presently receives an average annual precipitation of less than 50 mm and lies in the Saharo-Sindian vegetation zone.

Several short wadis, amongst them Nahal Issaron, drain west into Biq'at Uvdah from the edge of the escarpment dominating the 'Aravah valley. The site of Nahal Issaron, also designated Biq'at 'Uvdah Site 14, is located some 250 m west of the point where the wadi debouches from the low hills into Biq'at Uvdah, in the centre of the alluvial fan. The closest sources of water in the area at present are the wells of Be'er Milhan and Be'er Meteq, some 10 km to the south and the spring of 'En Yotvatah, 10 km to the south east, in the Aravah.

The site was excavated extensively by Goring-Morris and Gopher in 1980-1981 and some 260 square meters were exposed (GORING-MORRIS and GOPHER 1983, 1987).

1. The major stratigraphic units include the alluvial top Layer A, the fifth mill. B.C. Layer B; the Late PPNB - Layer C and the sterile alluvium on which the site sits Layer D. A series of some 35 C14 dates, most of them recently obtained, show a major PPNB occupation dated 66-6500 to 6100 B.C. (uncalibrated); a fifth millennium B.C. occupation around 45-42000 B.C. and a later post Neolithic 37-34,00 B.C. occupation, partially overlapping the Neolithic Nahal Issaron. Single C14 determinations point to a possible 71-7000 B.C. occupation and a 57-5600 B.C. occupation which may represent either sporadic use of the site, and less likely, C14-errors.

Architecture (Fig. 1)

Architectural remains from Layer B are poorly preserved. At least two probable structures are indicated by several clusters of large stones. However, beyond the fact that these clusters are circular in plan, no walls could be defined. Several smaller features, such as hearths, ovens and possible storage facilities were preserved, especially on the eastern side of the site, but also on the west. The architectural features of Layer C remain relatively complete with free-standing walls preserved to a height of at least 75 cm. At least four main architectural phases can be discerned with eight large structures constructed of limestone blocks up to 75 cm long. The structures vary in plan from amorphous through oval and subcircular to polygonal and sub-rectangular. The maximum dimension of these dwellings varies from 2 to 3.5 m; some evidence for red plaster was recovered from one locus and a single entrance providing access has been identified. Sediment within the structures consisted of powdery fine ashes, sands and gravel and extended from the base of the structures and frequently reached the top of the walls. With the exception of hearths at various depths, no living floors could be identified. Smaller architectural features in Layer C include shallow slab-lined pits; ovens were similarly lined with limestone slabs and were frequently accompanied by large quantities of charcoal at the base. Hearths can be subdivided into three basic types. One type is lined with stones containing light grey ashy deposits. It occurs most frequently inside the larger structures. Another type, the most common, appearing both within and outside the larger structures consists of small angular stones with a dark grey black sediment that includes quantities of charcoal.

The third type occurs at the base of the occupation and comprises small steep-sided pits excavated into the alluvial fan; it contains dark grey-black deposits with charcoal.

In general, the Nahal Issaron PPNB occupation has beehive type arrangement recalling in a way the early layers of the PPNB at Beidha.

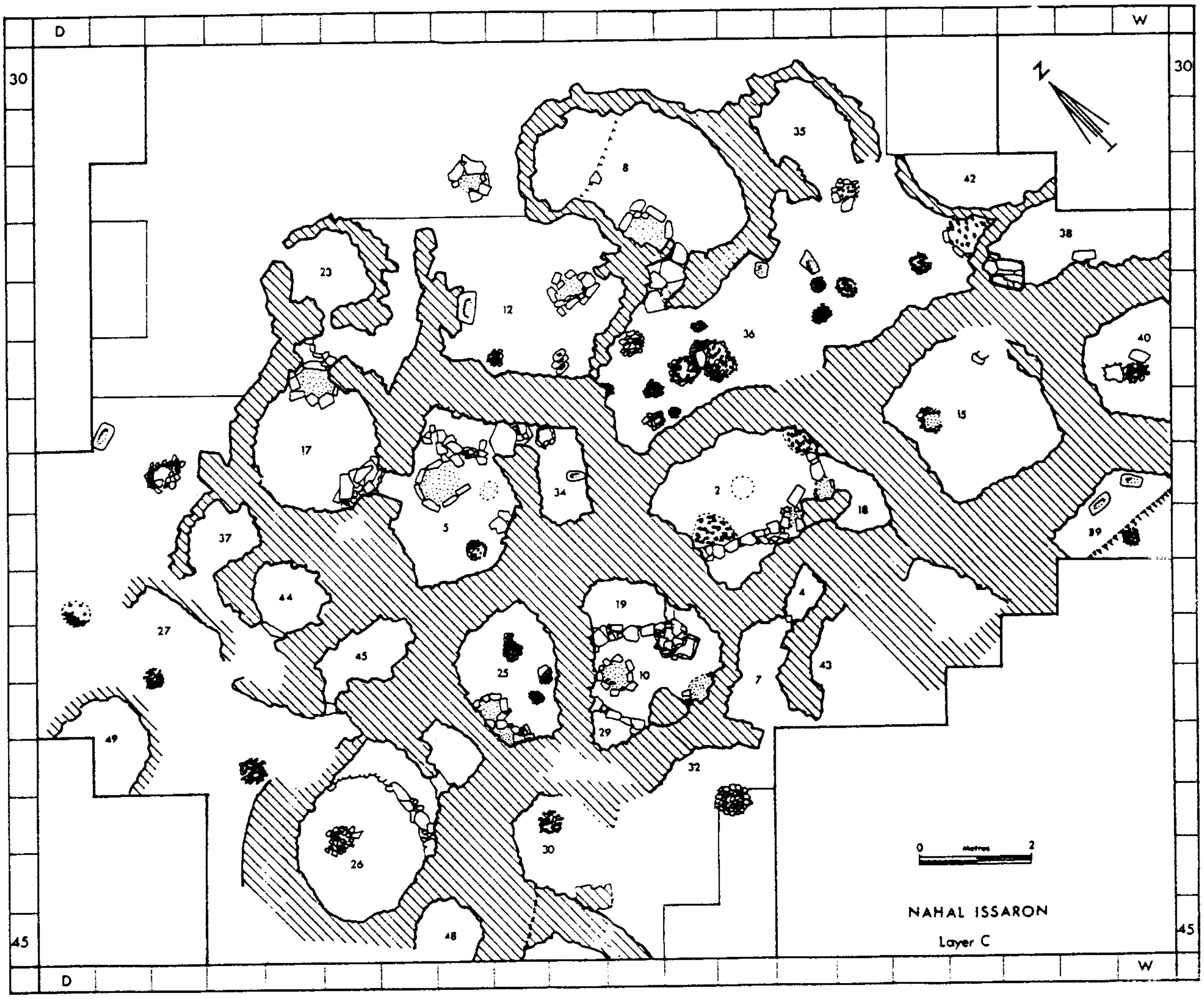

Fig. 1. General plan of Nahal Issaron.

Finds

Apart from chipped stone items, an abundant ground stone tool assemblage was recovered, principally from Layer C but also from Layer B. It comprises mainly shallow grinding slabs (metate) and oval or elongated mullers (processors; mano) although other elements, such as platters, bowls and shaft-straighteners were also found. Manos were frequently found in pairs and/or in associations with the grinding slabs. While the heavier metates occur on locally available limestone blocks, many of the manos were made on exotic materials such as sandstone and granite, the closest sources of which are at least 10 km. distant in the Timna' area of the 'Aravah.

Exotic artifacts include stone beads of various minerals, including limestone, sandstone, quartzite, quartz turquoise, and malachite. A few of these had been elaborately carved. Nodules of malachite, mica and quartzite were recovered, as well.

The faunal assemblage was derived almost exclusively from Layer C and there was clear patterning in terms of its distribution within the layer, which did not correlate with the state of preservation, varying from excellent to extremely friable. Preliminary analysis indicates the absolute dominance of Capra sp., rare Gazella sp. and the presence of wild ass and aurochs. While hare was rare, avifauna were relatively abundant. The presence of fish vertebrae is of interest.

The rich molluscan assemblage is dominated by Red Sea species, as could be expected in view of the relative proximity of the Red Sea. Many of the molluscs have been pierced and ground into beads, while mother-of-pearl was fashioned into pendants.

Bone objects are represented by beads, points, and awls, as well as a spatulae. Ostrich egg-shell was recovered in some abundance.

Lithics[1]

All sediments were dry-sieved using a mesh of 2-3 mm. Lithic artifacts in the order of hundreds of thousands of pieces were collected during the excavation. We have choosen to present a sample from the Late PPNB Layer C. Lithics from five features are thus presented including an assemblage of over 107,000 industrial waste items and over 2500 shaped tools. The raw material is locally available to the east.

Technology

The industry is dominated by blades; core preparation elements (RB) are much more abundant than core rejuvenation elements (CT) and together with the rest of the CTE group constitute up to 3.5% of the debitage while cores make up 1.5%. Thus CTE to cores ratio is over 2:1 (Table 1).

Opposed platform cores appear in high percentages, but classic naviform- cores-bidirectionally and alternatively flaked - are rare or missing altogether (Table 2). Examples of cores are shown in Figs. 2-3 including opposed platform cores (Fig. 2:1-4), and classic naviform cores (Fig. 2:5-6), discoidal (Fig. 3:1-3) cores.

Tool composition (Table 3)

- arrowheads vary from 14-26% (averaging around 20%);
- awls and borers 3.7% with an exception in Locus 8;
- endscrapers and burins around 1.2%;
- notches and denticulates - over 40%;
- retouched flakes and blades around 20%;
- upsilon blades up to 8%.

[1] The full asemblage - debitage and tools of each structure with no internal stratigraphic subdivisions is presented in Tables 1 and 3. Table 4 shows an example of three samples subdivided by internal structure stratigraphy. Lower samples are the original "floor" samples while upper samples are the fill - which in some cases includes later items. We should note here that Nahal Issaron has generally a shallow sedimentalogical sequence but is very dense in lithics - thus mixing of lithic elements must be anticipated.

Table 1. Frequencies of industrial waste from Nahal Issaron

	PR	FL	BL	CT	RB	CTE	BS	
Loc36	1495	4339	4022	36	135	145	57	10229
Loc17	559	1742	2296	17	33	64	8	4719
Loc5	873	2427	3153	9	60	118	8	6648
Loc34	33	475	775	4	16	27	6	1336
Loc26	78	607	2104	14	33	28	3	2867
Loc15	443	2639	3372	51	84	96	1	6686
								32485
Percentages								
Loc36	14.62	42.42	39.32	0.35	1.32	1.42	0.56	100.00
Loc17	11.85	36.91	48.65	0.36	0.70	1.36	0.17	100.00
Loc51	3.13	36.51	47.43	0.14	0.90	1.77	0.12	100.00
Loc34	2.47	35.55	58.01	0.30	1.20	2.02	0.45	100.00
Loc26	2.72	21.17	73.39	0.49	1.15	0.98	0.10	100.00
Loc15	6.63	39.47	50.43	0.76	1.26	1.44	0.01	100.00

	chips	*chunks*
Loc36	11385	1536
Loc17	5235	1602
Loc5	7854	1958
Loc34	3072	79
Loc26	15479	1403
Loc15	20160	5029
Total	*63185*	*11607*
		74792

PR primary elements
FL flakes
BL blades
CT core tablet
RB ridge blade
CTE core trimming blade
BS burin spall

Table 2. Cores

	Loc 5	*Loc 17*	*Loc 36*	*Loc 34*
1 platform	11	8	4	2
2 platform	2	9	11	0
opposed plat.	20	15	67	11
diskoidal	0	3	17	1
amorphous	21	2	15	1
Total	*54*	*37*	*114*	*15*
				220

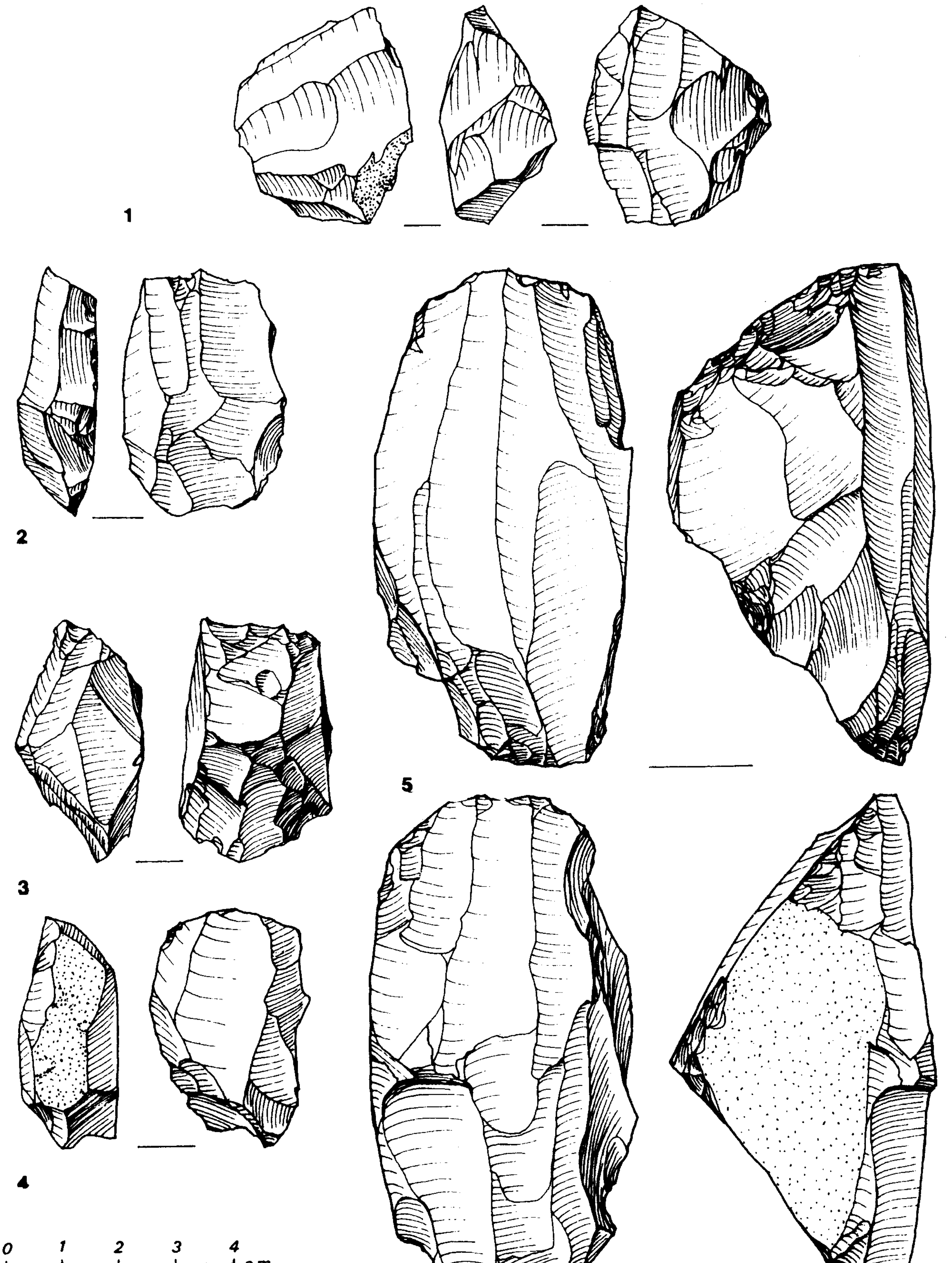

Fig. 2. 1-4 opposed platform cores, 5-6 classic naviform cores.

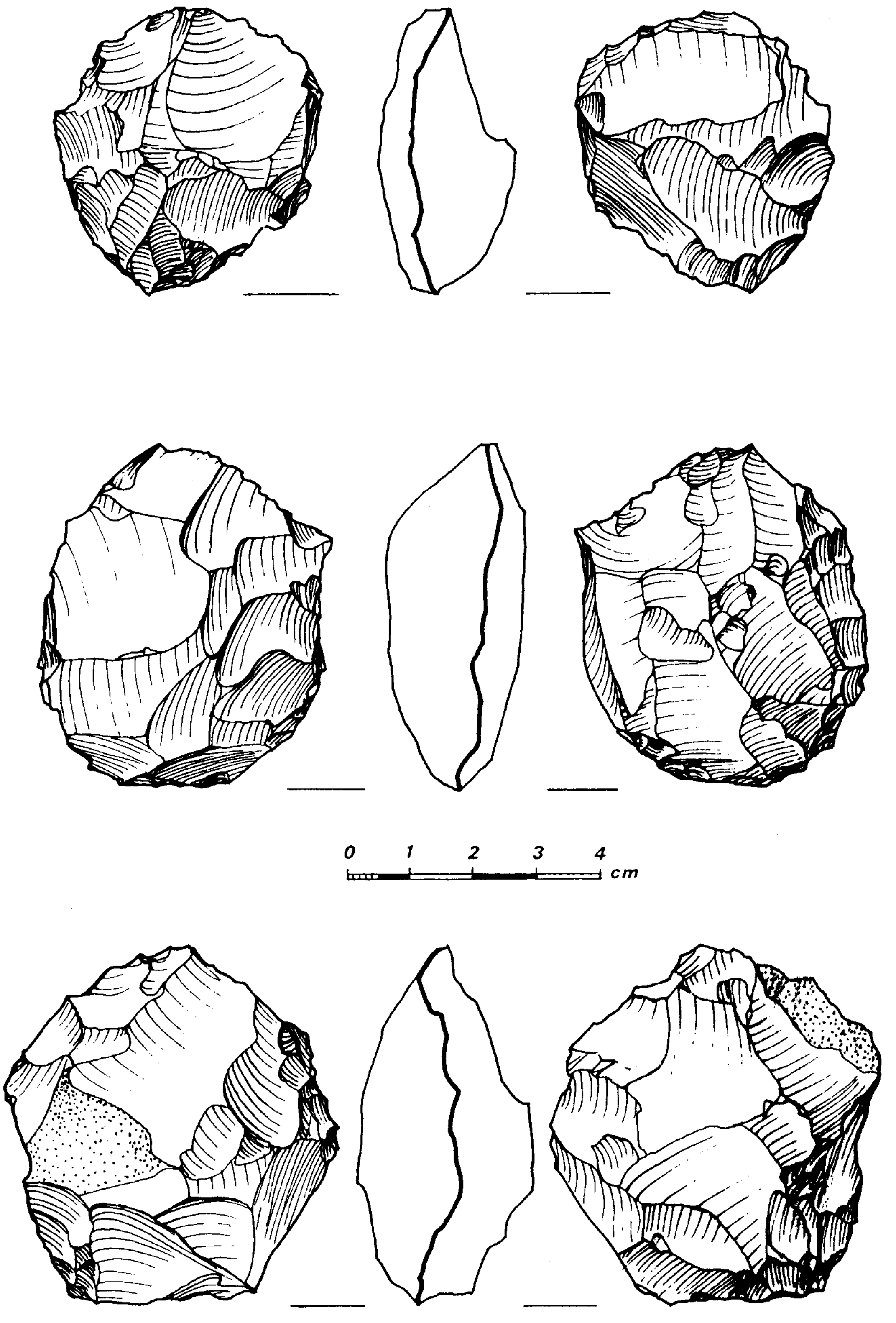

Fig. 3. Discoidal cores from Nahal Issaron.

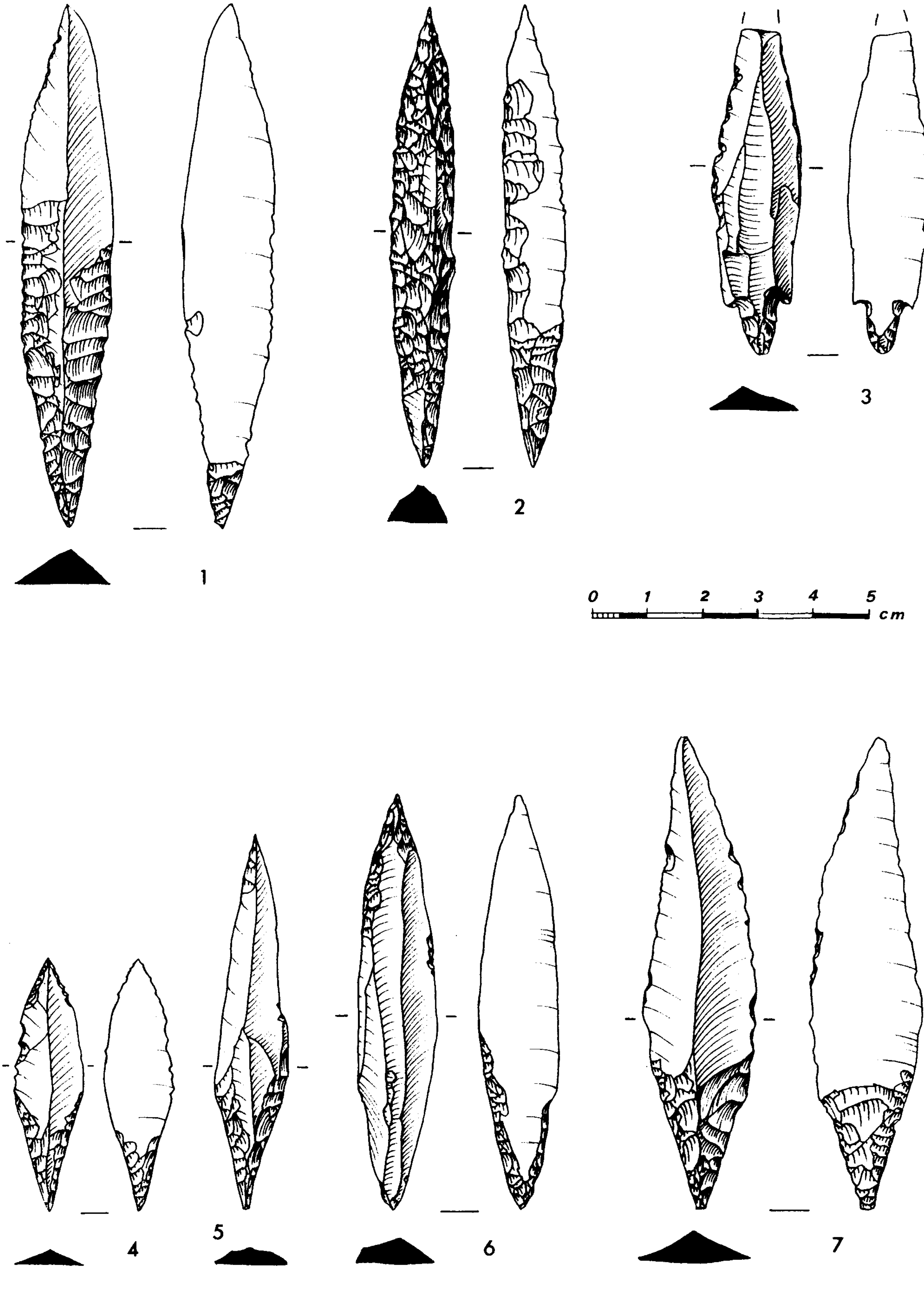

Fig. 4. Amuq points and Jericho point (3).

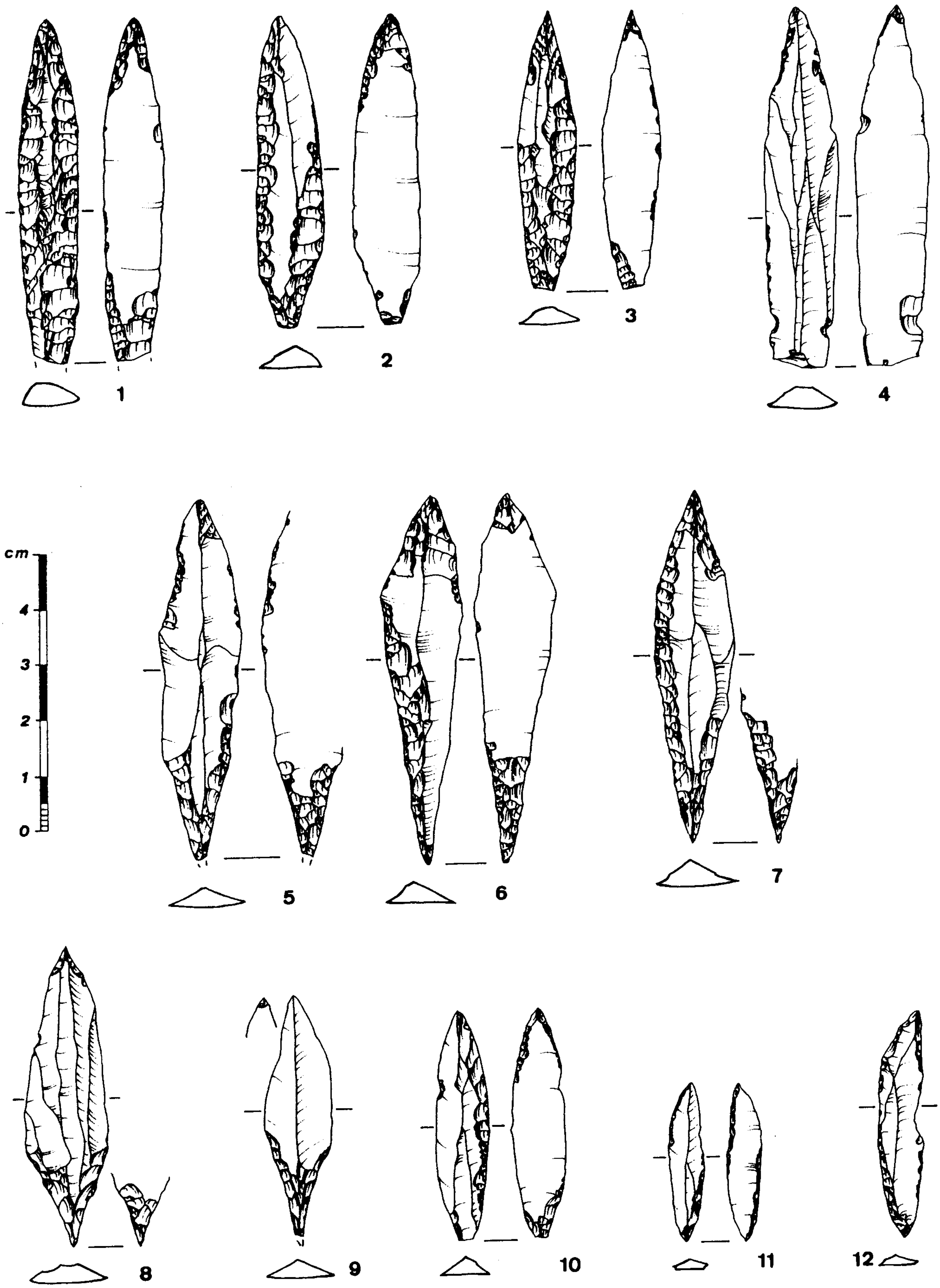

Fig. 5. Amuq and Byblos points.

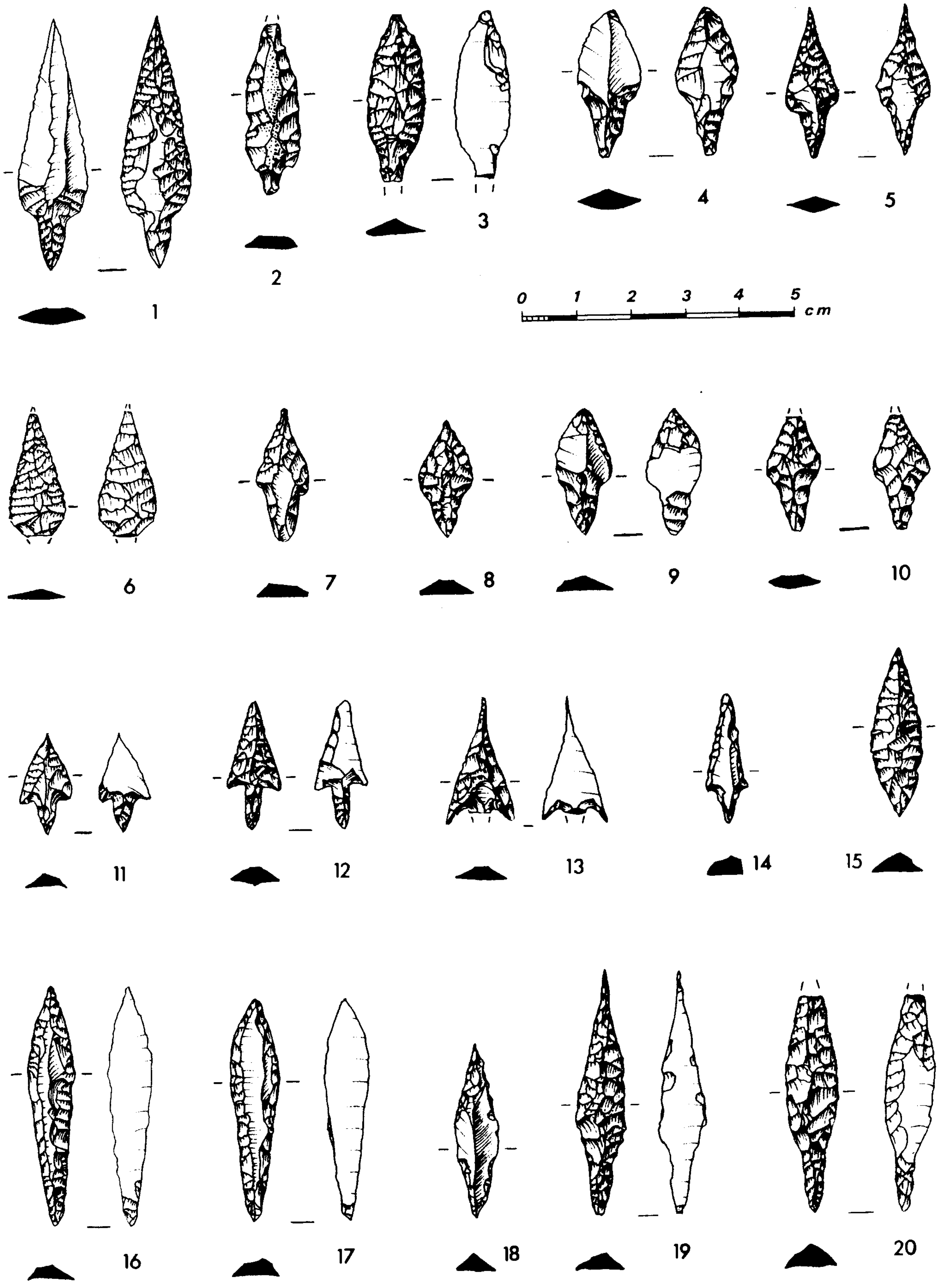

Fig. 6. Haparsa, Nizzanim, and Herzlia points.

Table 3.

	Loc 5		Loc 17		Loc 36		Loc 34		Loc 8	
arrowheads	88	14.1%	87	21.9%	132	16.6%	47	21.5%	86	26.1%
awl/borer	33	5.3%	12	3.0%	43	5.4%	16	7.3%	66	20.0%
endscraper	9	1.5%	4	1.0%	12	1.5%	0	-	4	1.2%
burin	12	1.9%	3	0.7%	17	2.1%	3	1.4%	1	0.3%
notches	209	33.6%	136	34.3%	278	35.0%	57	26.0%	42	12.8%
denticulates	68	10.9%	36	9.0%	62	7.8%	38	17.3%	38	11.5%
ret. flake	46	7.4%	17	4.3%	12	1.5%	9	4.1%	8	2.4%
truncation	10	1.6%	0	-	0	-	0	-	1	0.3%
ret. blade	93	14.9%	55	13.8%	114	14.4%	39	17.8%	51	15.5%
upsilon bl.	16	2.5%	25	6.3%	64	8.0%	0	-	2	0.6%
massive scr. and dentic.	12	1.9%	12	3.0%	49	6.2%	2	0.9%	0	-
varia	25	4.0%	10	2.5%	10	1.3%	8	3.6%	30	9.1%
Total	*621*	*99.6%*	*397*	*99.8%*	*793*	*99.8%*	*210*	*99.9%*	*329*	*99.8%*

Table 4.

	Loc5		Loc17		Loc34	
	upper	*lower*	*upper*	*lower*	*upper*	*lower*
arrowheads	12.3	17.1	27.8	21.1	18.9	24.1
awl/borer	4.6	4.4	9.5	0.0	10.4	4.5
endscraper	1.5	1.4	0.0	1.6	0.0	0.0
burins	1.8	2.1	0.0	1.2	1.9	0.9
notches	36.9	31.8	27.8	41.1	39.6	31.3
denticulates	10.2	12.5	9.5	9.7	6.6	9.8
ret. flakes	9.2	5.7	3.2	4.9	3.8	2.7
truncations	1.5	1.8	0.0	0.4	0.9	0.9
ret. blades**	16.3	14.3	20.0	12.2	14.2	21.4
massive*	1.2	2.9	0.8	4.5	0.9	0.0
bifacials	0.6	0.7	0.0	0.0	0.0	0.0
varia	3.7	3.2	1.6	3.3	2.8	4.5
N	*325*	*280*	*126*	*246*	*106*	*112*

** massive scraper and denticulates*   *** upsilon blades included with retouched blades*

**** sample sizes slightly differ from Table 3*

Typology

1. Arrowheads are mainly of Byblos and Amuq types (Figs. 4,5), a composition fitting well with many of the C-14 dates. Later - Layer B arrowheads are shown for comparison (Figs. 6-7 including Haparsa, Nizzanim and Herzlia points as well as a few transversal arrowheads Fig. 7:1-3).

2. Long borers appear as a clear group, though a very small one (Figs. 8-9). These too may reflect a late seventh millennium B.C. phenomenon absent from northern earlier PPNB assemblages such as Munhata, Jericho, Kfar Hahoresh or Yiftahel. This borer has a very delicate and fragile "working edge" and its function is still not quite clear. Other borer and awl types appear as well (Fig. 8:4, 9:2-9).

3. Burins are few and burin to burin spalls ratio is 1:2.3. Endscrapers are even fewer (Figs. 10:1-4).

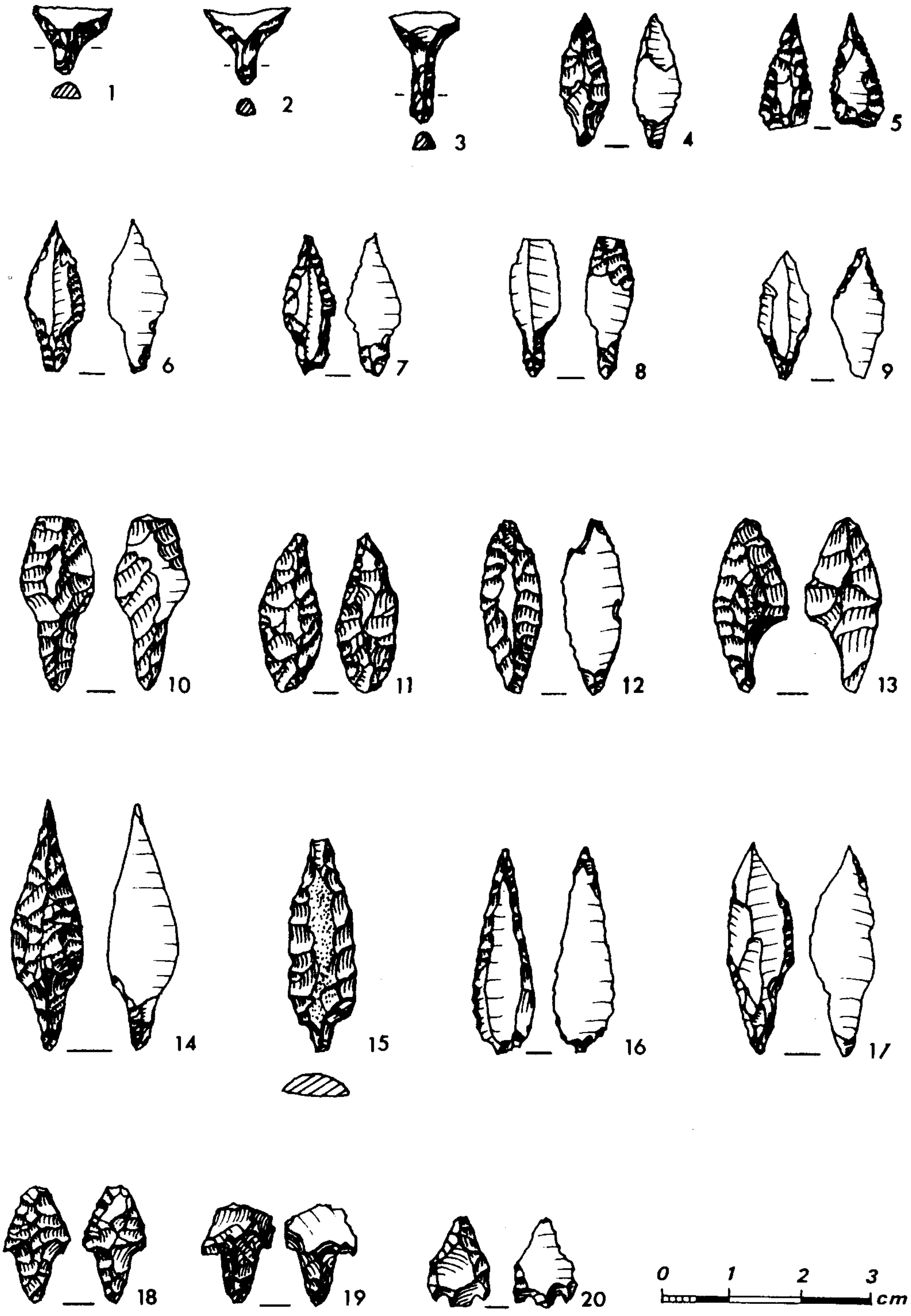

Fig. 7. 1-3 transversal arrowheads, 4-20 Haparsa, Nizzanim, and Herzlia points.

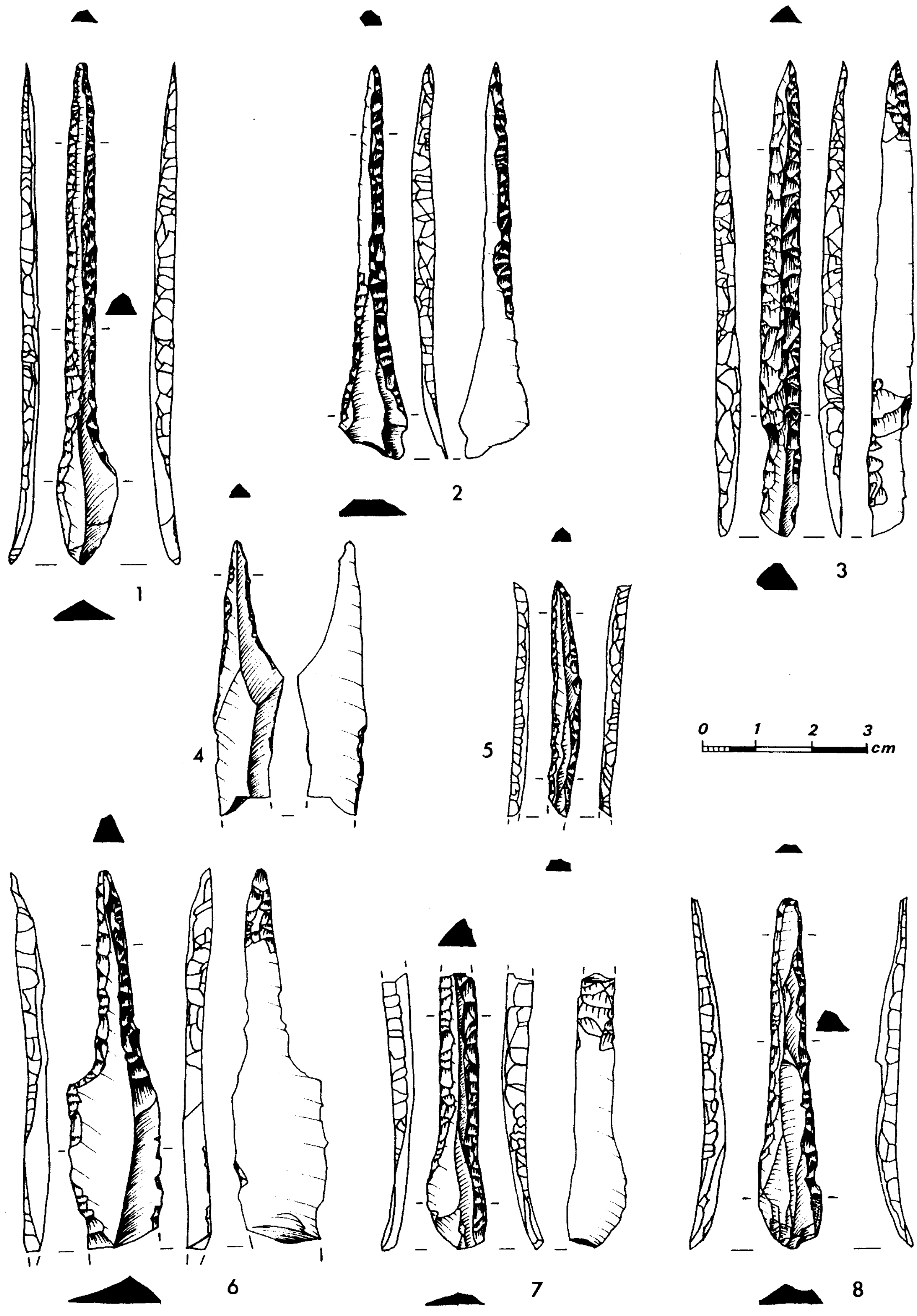

Fig. 8. Long borers.

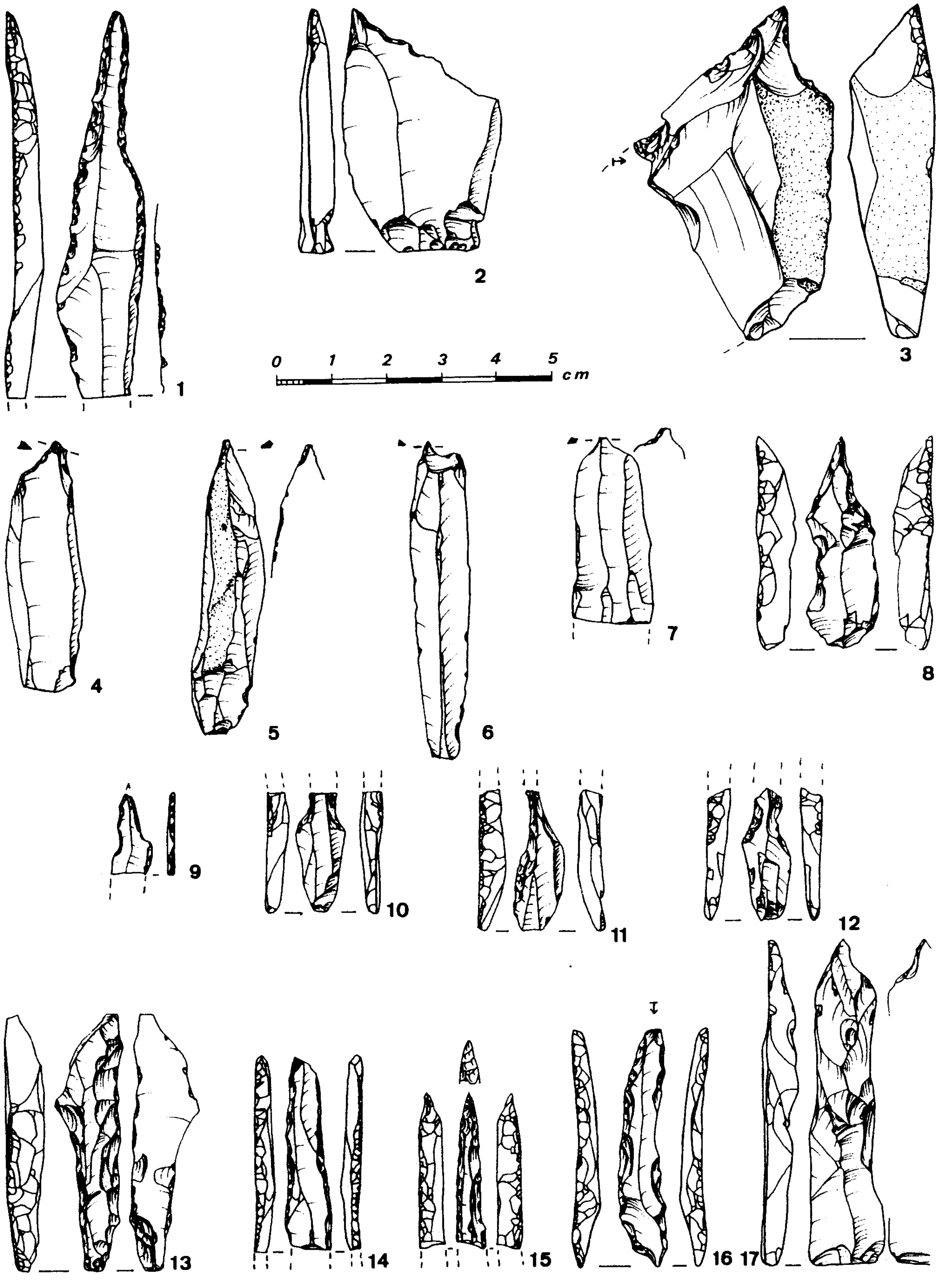

Fig. 9. Borers and awls.

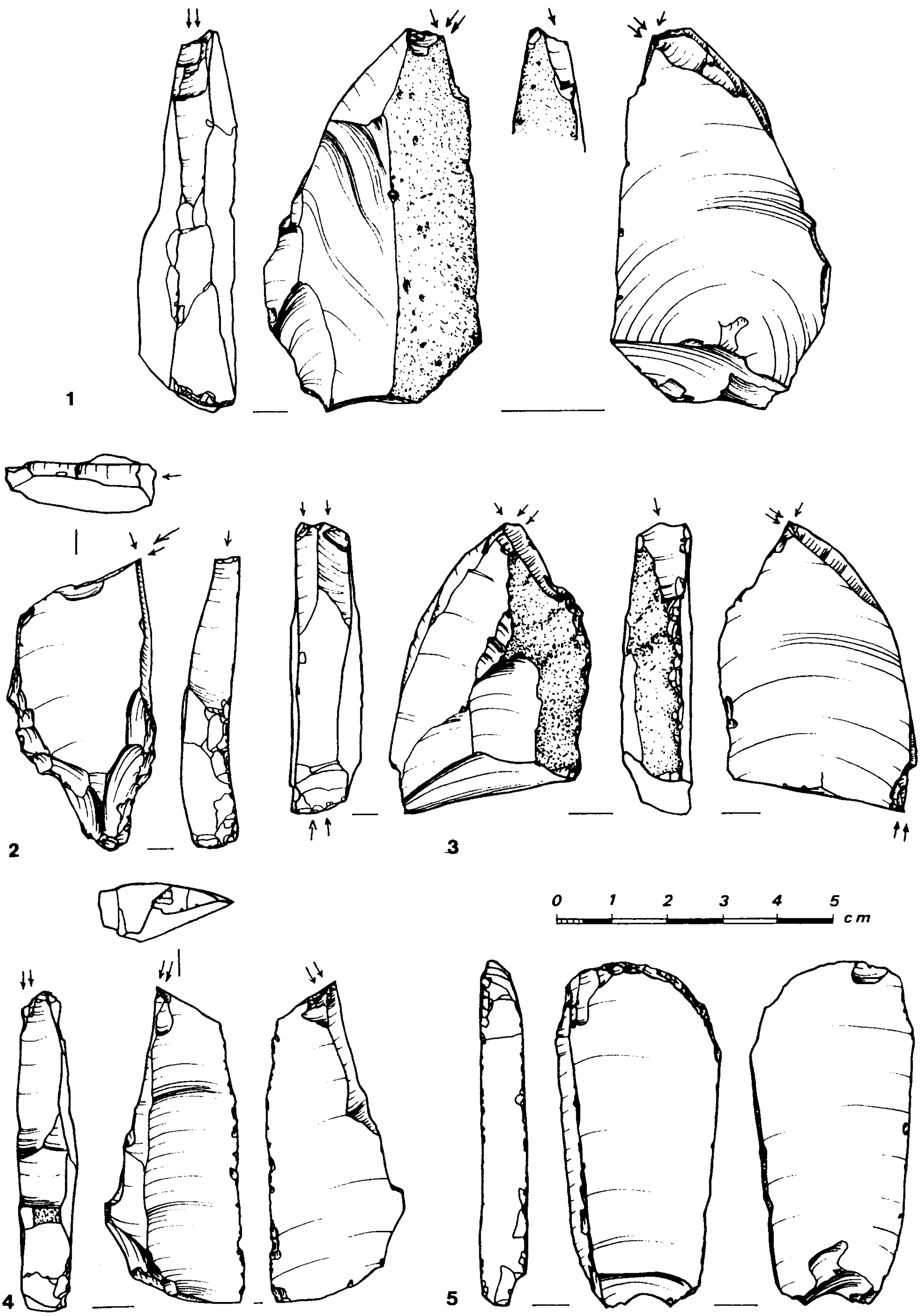

Fig. 10. 1-4 burins, 5 endscraper.

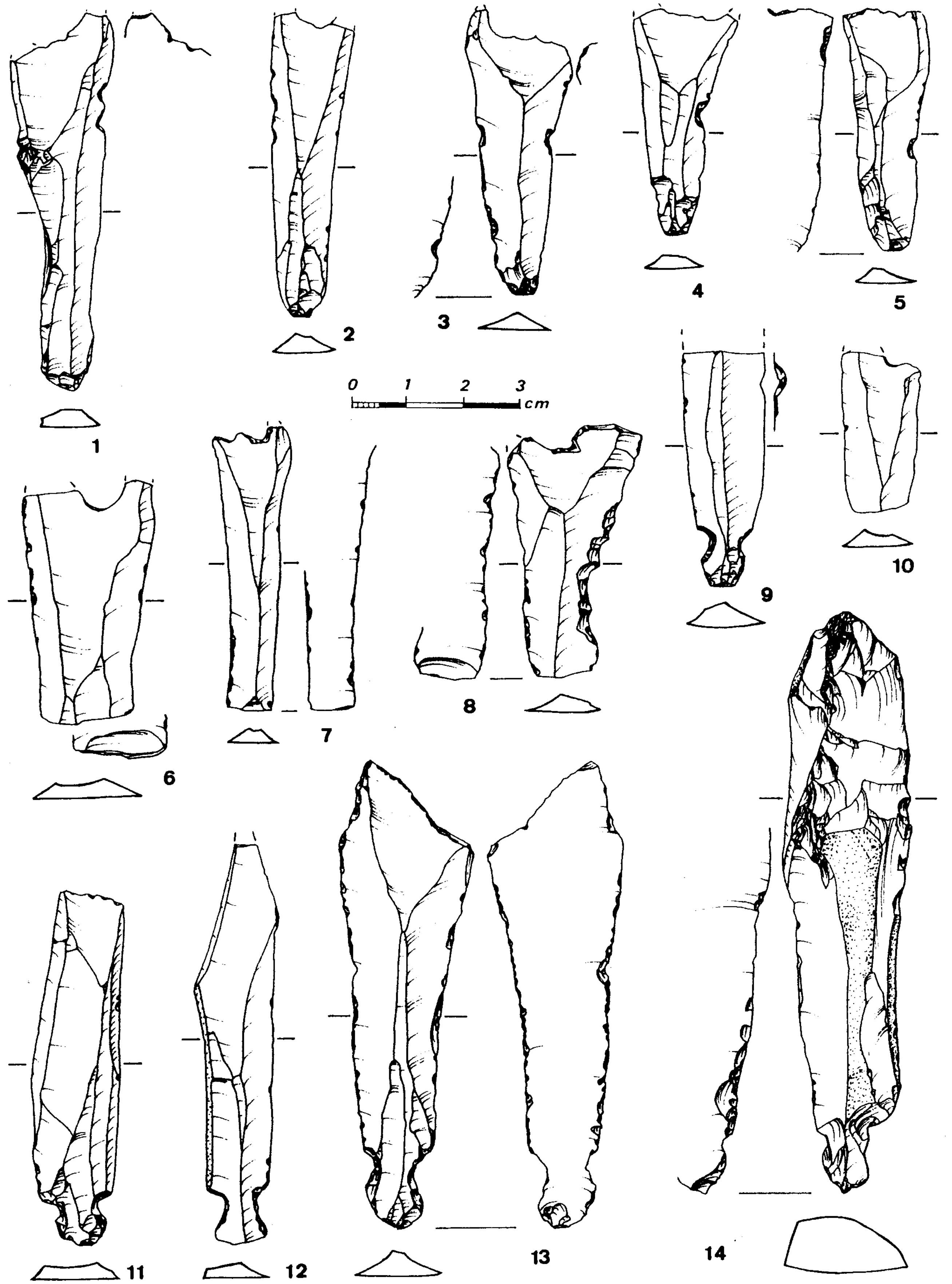

Fig. 11. 1,8,10 upsilon blades; 9,11-14 Nahal Hemar knives.

4. Nahal Hemar knives appear at Nahal Issaron in small numbers and are not typical as at Nahal Hemar Layer 3. This type (Fig.11:9,11-14) appears sporadically in other PPNB sites such as Basta and fits well a second half of seventh millennium B.C. dating.

5. Upsilon blades appear in relatively high frequencies with very little retouch and use signs (Fig.11:2-8,10). Reference is made here to the northern Levantine occurences. No bifacials (axes, adzes, chisels) were found and no sicklelades.

Summary

1. We should not forget the spatial distribution of lithics at the site which is not dealt with here. This relates both to activity areas rich in debitage and debris and to differential tool types distribution which may be accounted for as in Tables 1 and 3. Table 4 further emphasizes aspects of lithic variabiity within and between structures which will be dealt with at length in a separate study.

2. On-site production is indicated, contrary to PPNB sites in the north such as Munhata and most probably other sites too. The question of small scale trade-exchange is raised.

3. In addition to presenting a rich Late PPNB assemblage, Nahal Issaron may contribute a glimpse at a long sequence from 66-6100 to 37-3400 in one locale, thus enabling a controlled study of trends through time.

Endnote: Nahal Issaron Layer C of the Late PPNB is now securely dated by a large series of C-14 dates and is in a final stage of preparation for publication. Its industry is much in the same tradition of the Late PPNB of Southern Jordan comparable to assemblages such as from Basta or in some aspects even to the earlier Beidha.

Acknowledgments: The excavations at Nahal Issaron were conducted under the auspices of the Israel Antiquities Authority in the framework of the Uvda Valley Salvage Project directed by A. Eitan then head of the Authority and R. Cohen, head of the Emergency Archaeological Survey of the Negen. Our thanks to them both. The analysis of the finds was kindly supported by the *Basic Research Foundation* administered by *The Israel Academy of Sciences and Humanities* (1989-1991).

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Pre-Pottery Neolithic Flint Mining and Flint Workshop Activities Southwest of the Dead Sea, Israel (Ramat Tamar and Mesad Mazzal)

Wolfgang Taute

The two sites are located about 12 km southwest of the Dead Sea in a dry desert region, were the present mean annual precipitation amounts to 50 mm merely (Fig. 1:1). The landscape is not suitable for agriculture nowadays and presumably has not been in Neolithic times either.

Mesad Mazzal

Mesad Mazzal (TAUTE 1981) is situated on a Lissan-plateau with a diameter of 60 m and lies on the western edge of the Arava-valley (Fig. 1:2). The site was presumably used for a considerable length of time as a settlement: The cultural layer accumulated to a total thickness of 50 cm and containes amounts of wood charcoal and cleaved animal bones of gazelle as well as domesticated cattle and goats (determination by H.-P. Uerpmann, Tübingen). A variety of stone bowls, pestles and milling stones were also found. The age of the site can be estimated on the base of six radiocarbon dates, measured by three laboratories (Hannover, Cologne, Bern). The dates lie consistently between 6530 and 6120 conventional C14 years B.C. Using the new 1993 calibration curve recently published by Stuiver and Reimer (1993) the dates range from 7500 to 7000 cal B.C. In archaeological terms such dates are typical of the late Pre-Pottery Neolithic B or PPNB (BAR-YOSEF 1981: 564-566) or the Period 4 of the Levant (AURENCHE, CAUVIN J., CAUVIN M.-C., COPELAND, HOURS et SANLAVILLE 1981: 576-601, Carte 9).

However, a comparison of the very rich flint inventory of Mesad Mazzal with stone atefact industries from other PPNB-settlements, for example Abou Gosh (LECHEVALLIER 1978: 41-74), Jericho (CROWFOOT PAYNE 1983) or Beidha (MORTENSEN 1970), shows that the tool percentages from Mesad Mazzal are quite untypical for the Neolithic settlements in this part of the Levant. This can be demonstrated when comparing the map worked out by O. Bar-Yosef (1981: 558, Fig. 1) showing the relative frequency of points (arrowheads), the axe-pick-family and sickleblades in various Neolithic sites in the Southern Levant: at Mesad Mazzal sickle blades are completely lacking. The most likely explanation is that the site was not used for harvesting. However, we can further assume that harvesting was not possible in the surroundings of the site. There may be climatic reasons for this. The fact that the tool percentages from Mesad Mazzal differ from those found in permanent settlements is further illustrated by the extremely low percentages of the projectile points, burins, borers and scrapers. By far the highest percentage of the modified artifacts are represented by products of the axe-pick-family, that is axes (Fig. 2), adzes (Figs. 3-4) and picks. Further it is of highest interest that at Mesad Mazzal enormous amounts of flakes and blades are found, and the percentage of the modified pieces is lower than 1%, as can be seen from Table 1. All this shows a remarkable difference between Mesad Mazzal and all other known Neolithic settlement sites of the region.

Table 1. Artefact classes from surface and the upper 5 cm of the cultural layer (sample of one squaremeter).

Object	Number			Weight		
flakes, blades and shattered artefacts	1940	=	99,0 %	7817 g	=	84,7 %
retouched blades and flakes	7	=	0,3 %	117 g	=	1,3 %
axes/adzes	8	=	0,4 %	564 g	=	6,1 %
cores	7	=	0,3 %	730 g	=	7,9 %
flint artefacts	1962	=	100,0 %	9228 g	=	100,0 %

Among the blades from Mesad Mazzal, including some of the flakes, a large number of finds (Fig. 5:1-4 and 6:1-4) show on their edges a weak gloss of a residue which is surely the result of cutting bones (TAUTE 1981: 244-247, Fig. 5-6). This interpretation, purely on the base of visual inspection, is supported by details of the test excavation, namely, that the culture layer contains a number of quite massive bones (*metacarpalia)* with the actually corresponding saw grooves (Fig. 6:5). Indeed, the depth of the grooves on the bones is equal to the width of the gloss on the blades. Direct microwear analysis by P. Vaughan and experiments by J. Weiner gave us the same result. As a conclusion we note that when comparisons are made using drawings only, and not on the base of the original artefacts, the flint blades used to saw the animal bones can easily be mistaken with the long sickle blades well-known from Jericho (CROWFOOT PAYNE 1983: Fig. 313-314), Beidha (MORTENSEN 197O: Fig. 36-37) and many other PPNB sites.

Ramat Tamar

We will now address the question as to the source of the flint raw material found in such large quantities at Mesad Mazzal. First of all, in the Arava Valley, on the west edge of which lies the site of Mesad Mazzal, there are no flint deposits at all. However, only 1700 m to the west and 200 m higher than the site of Mesad Mazzal, an opencast flint mine was discovered. The mine is on the eastern edge of the Negev Plateau, built of cretaceous limestone and dolomite (Fig. 1:2). The mine, which I named Ramat Tamar 1, is associated with a large atelier or flint workshop (Fig. 7).

The mining waste has been carefully excavated. In the waste was found a typical mining tool: a heavy hammer of basalt, a material which must have been braught here from far. The main result was that the miners had exploited the flint nodules from an outcrop at a depth of 1,50 m below a rocky horizon of dolomite. The mining waste covers an area of 9 x 11 m. Under the waste, which consists of small and large broken fragments of dolomite dispersed with flint flakes and debries, we found a few flint nodules still *in situ* (Fig. 8). Having lifted these nodules we noted underneath hollow depressions of the same size as the nodules. Such depressions appeared in quite large numbers under the mining waste. Obviously, each depression represents a nodule taken out by the miners. Thus, the number of depressions gives an estimate of how many flint nodules were mined. A quick calculation shows that more than 6000 kg (6 tons) of flint must have been won from that mine. The Turonian flint of Ramat Tamar has a colour varying from yellow to gray with characteristic concentric bands. The same material is found at the site of Mesad Mazzal.

Partly on the surface of the mining waste, but mainly in an area to the north of the mine not covered by the waste, a large atelier or flint workshop with an extension of about 10 to 20 m was

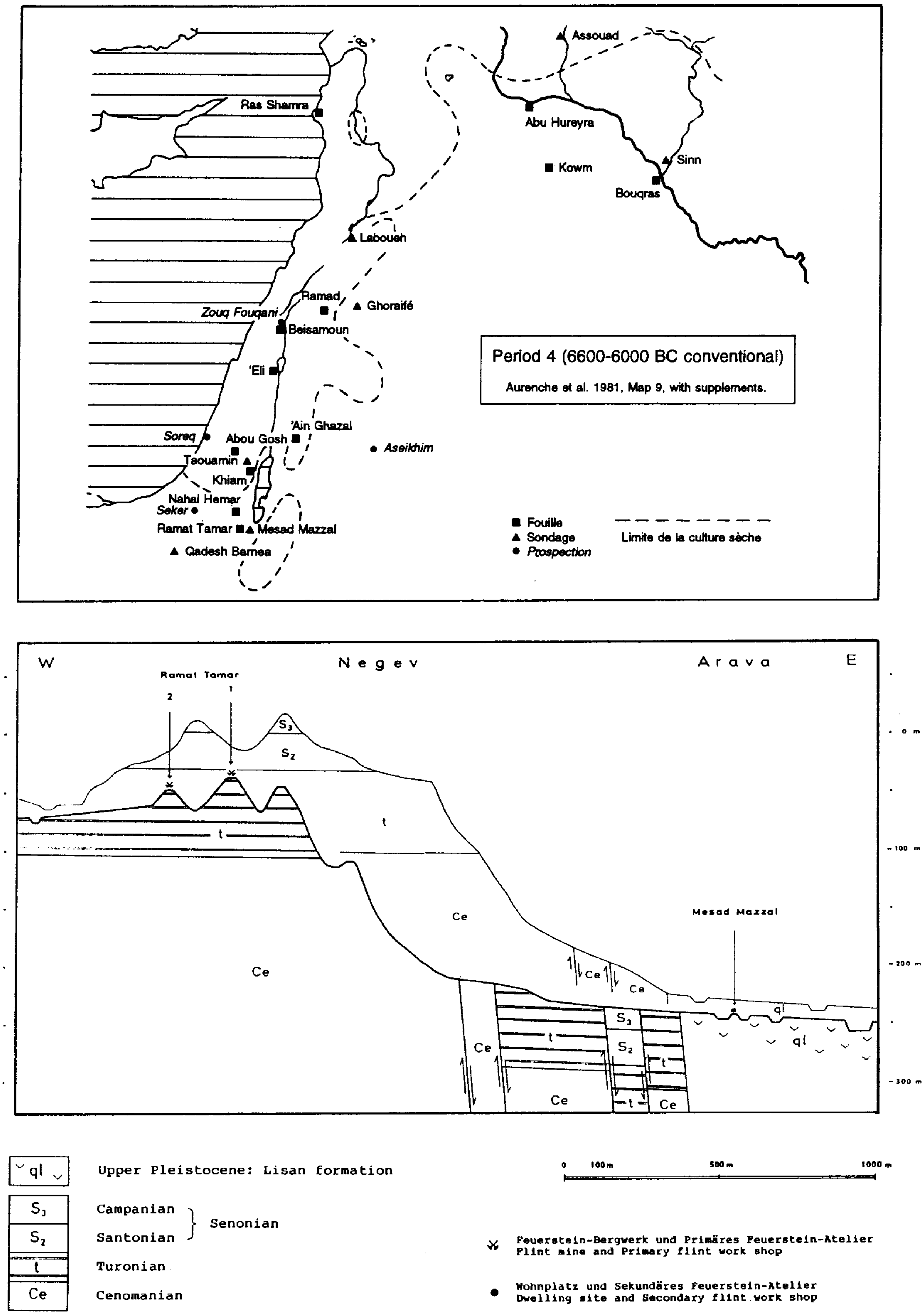

Fig. 1.1-2. Geographical, geological and morphological setting of Ramat Tamar and Mesad Mazzal.

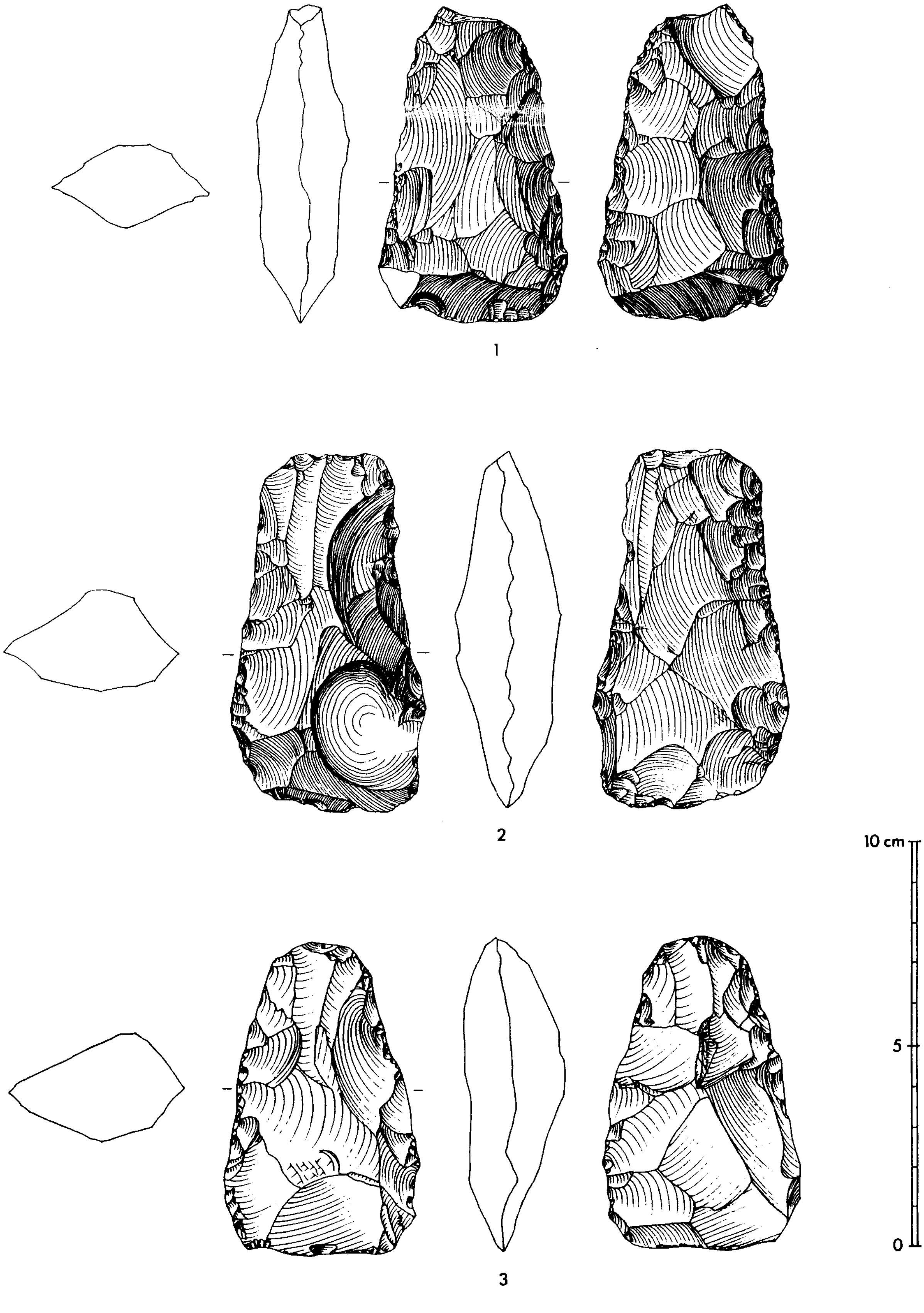

Fig. 2. Flint axes from Mesad Mazzal.

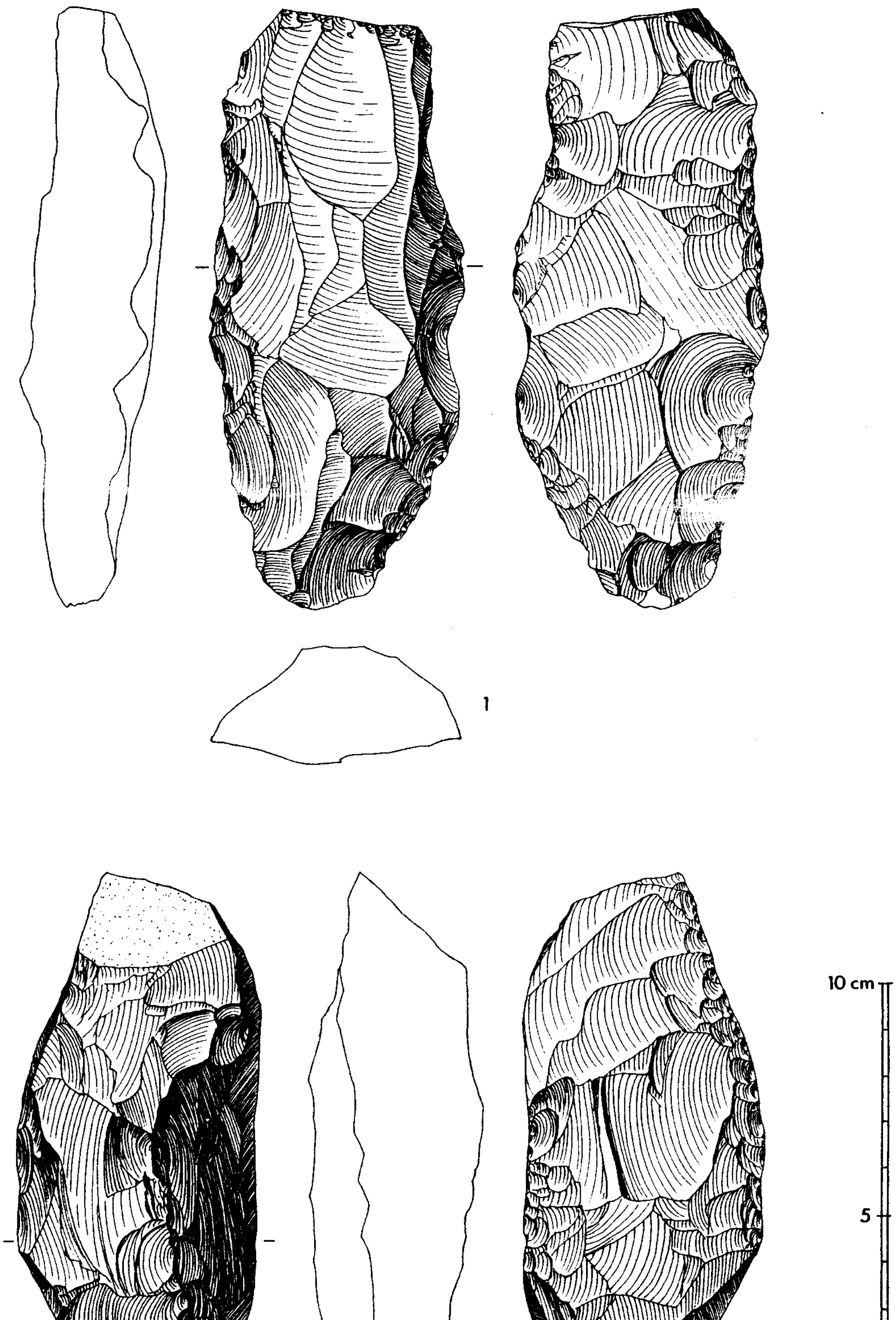

Fig. 3. Flint adzes from Mesad Mazzal.

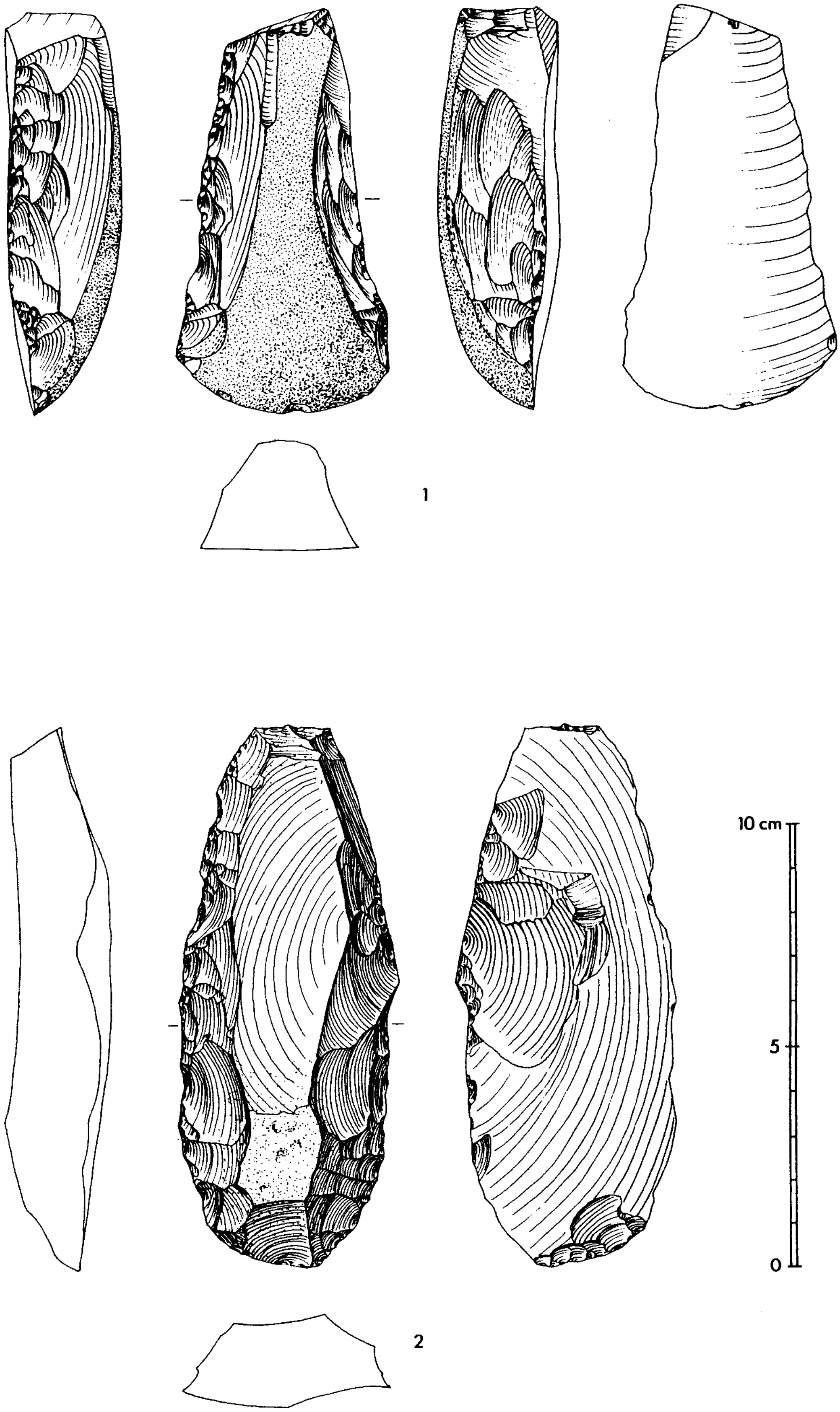

Fig. 4. Flint adzes from Mesad Mazzal.

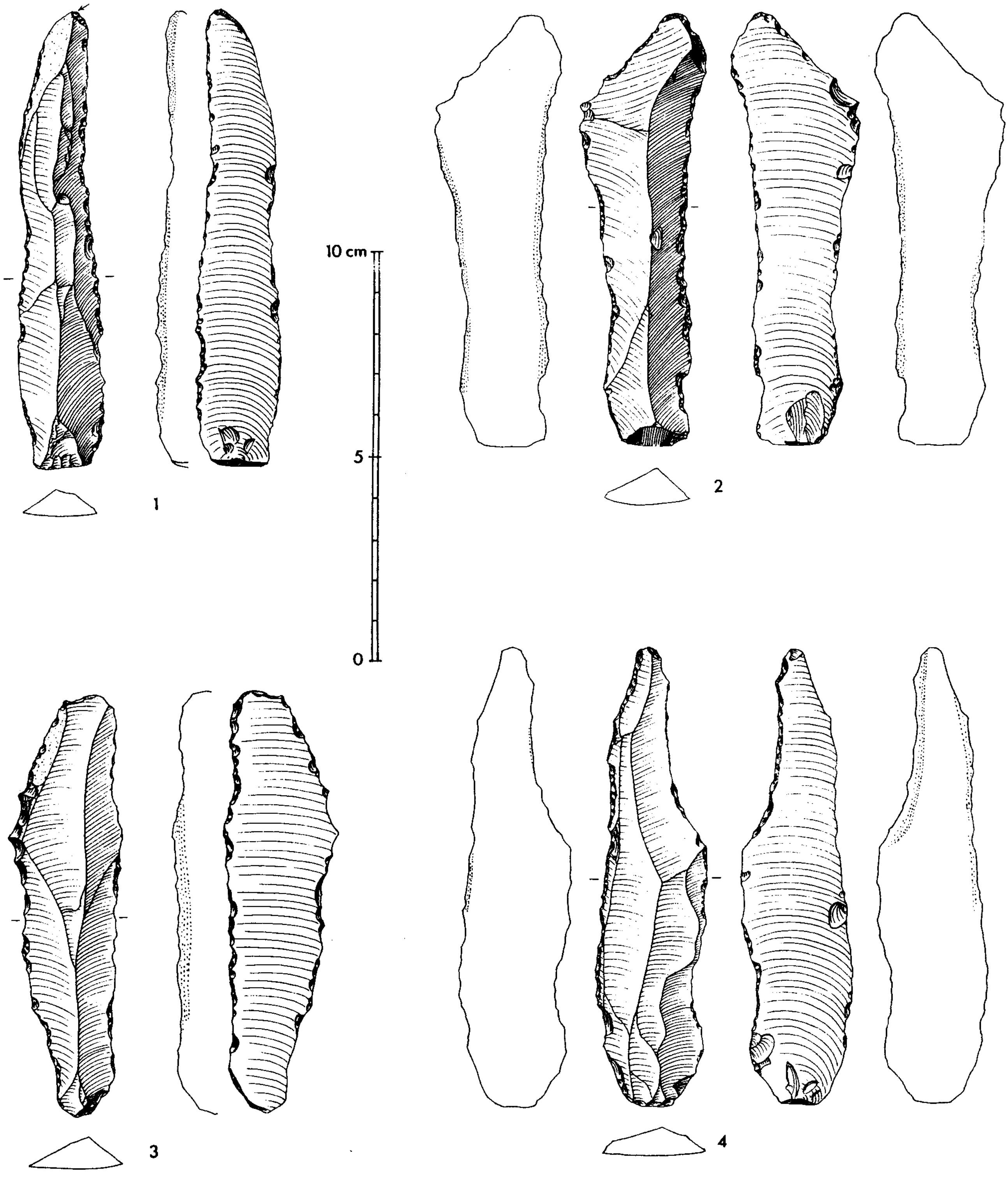

Fig. 5. Flint saws with moderately shining residue along the edges as the result of sawing bones from Mesad Mazzal.

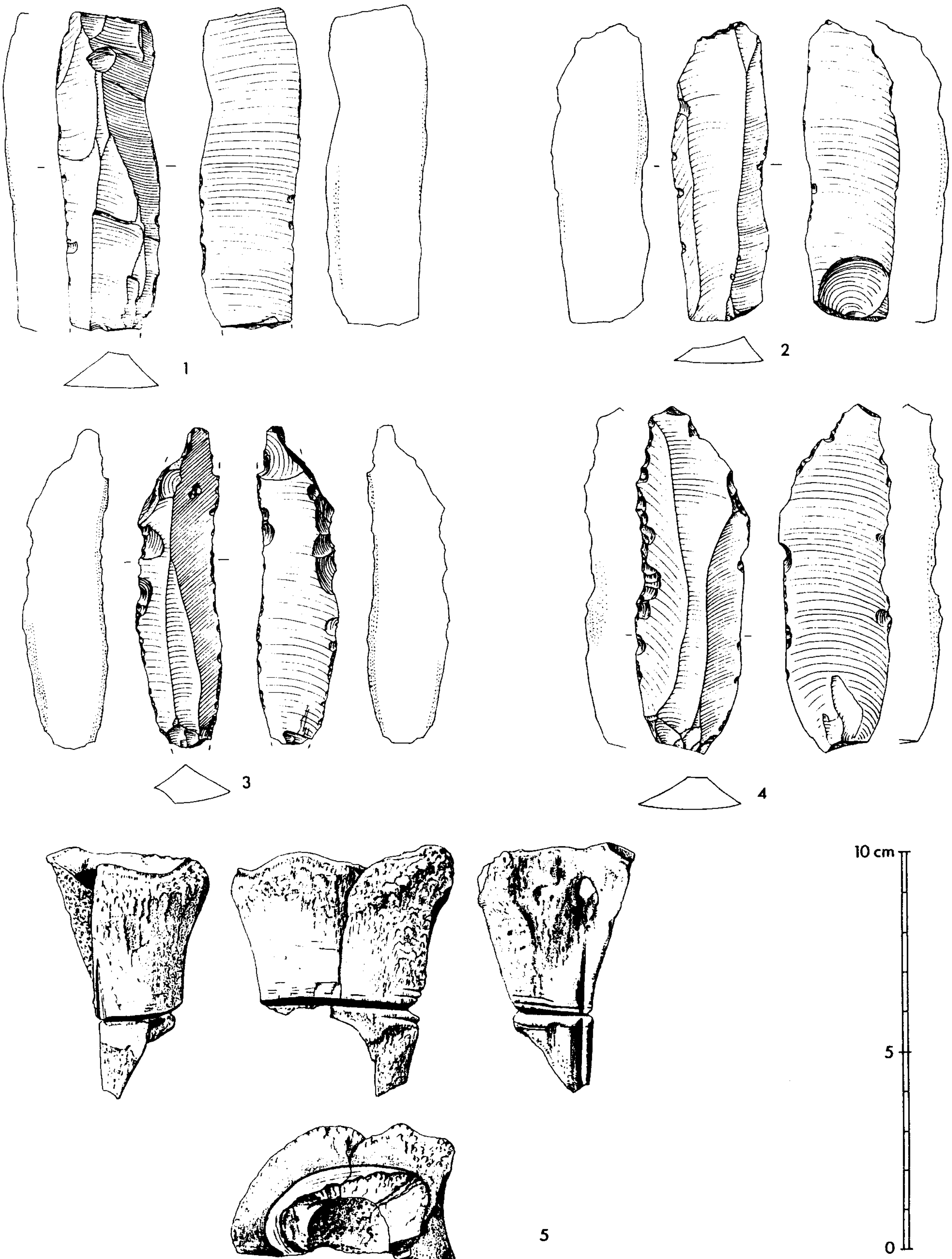

Fig. 6. Flint saws with moderately shining residue along the edges as the result of sawing bones (1-4) and a *metacarpus* fragment with diagonal and longitudinal grooves due to sawing (5) from Mesad Mazzal.

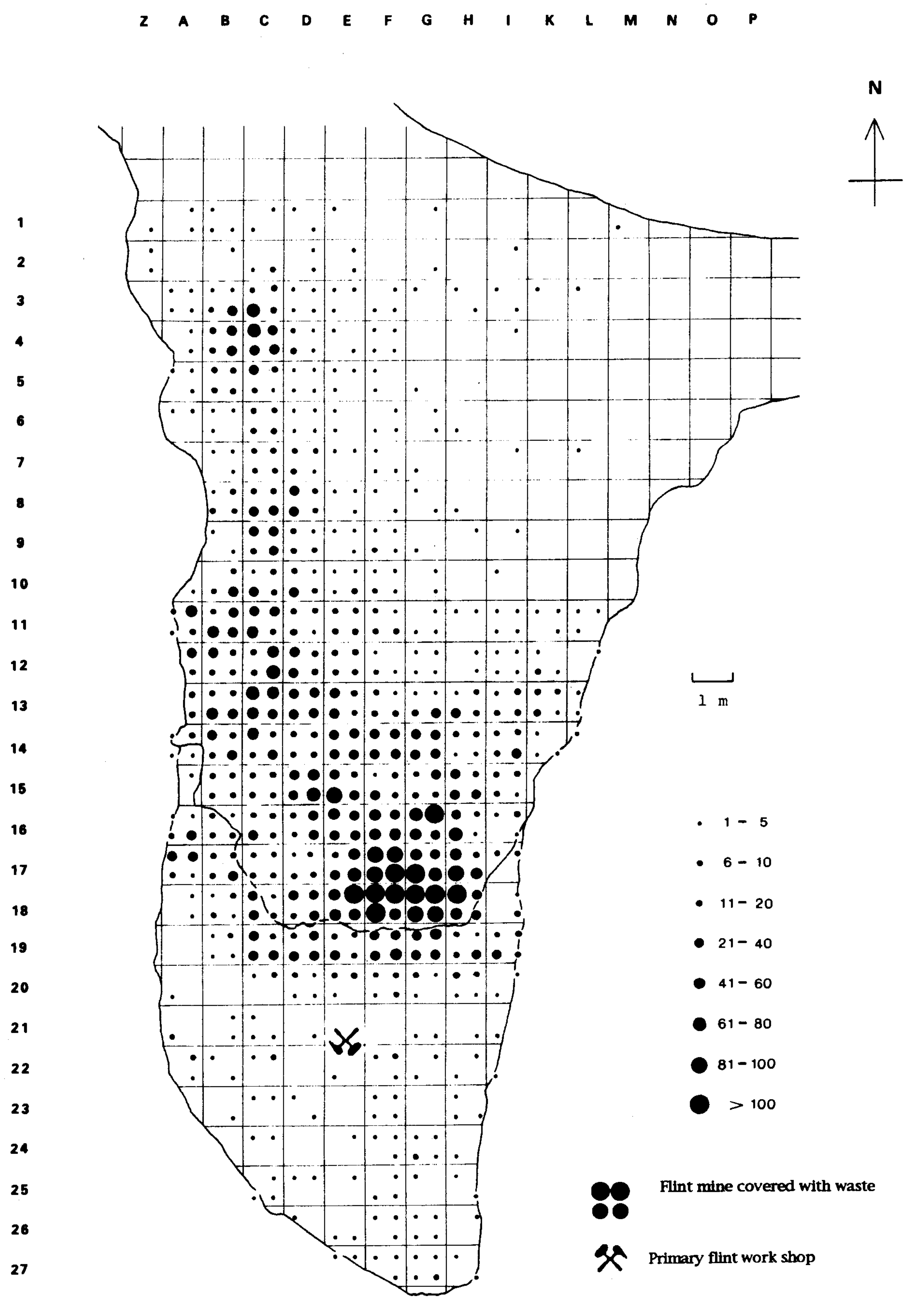

Fig. 7 Flint mine and primary flint work shop on the Turonian plateau spur of Ramat Tamar.

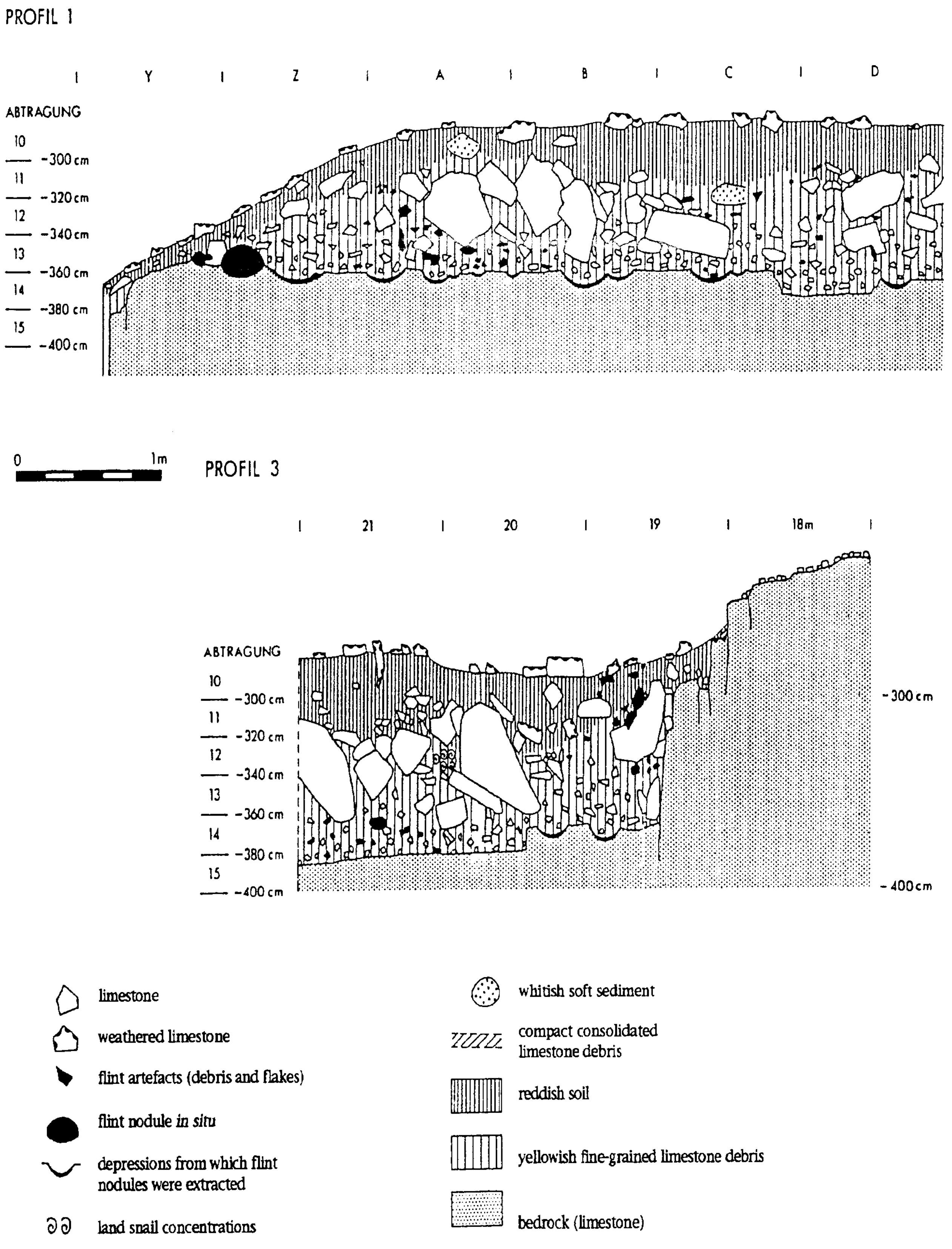

Fig. 8. Sections of the flint mine waste of Ramat Tamar.

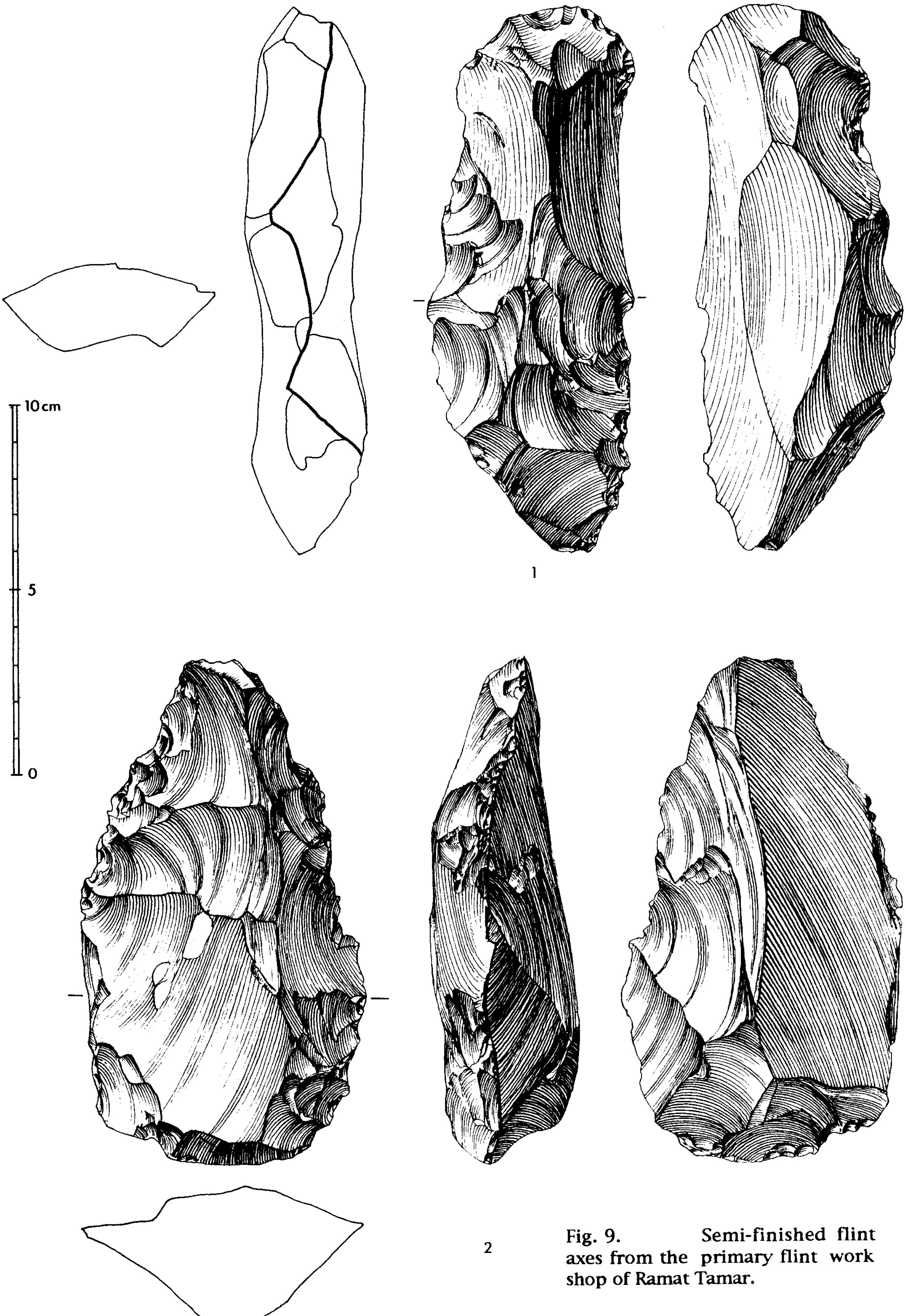

Fig. 9. Semi-finished flint axes from the primary flint work shop of Ramat Tamar.

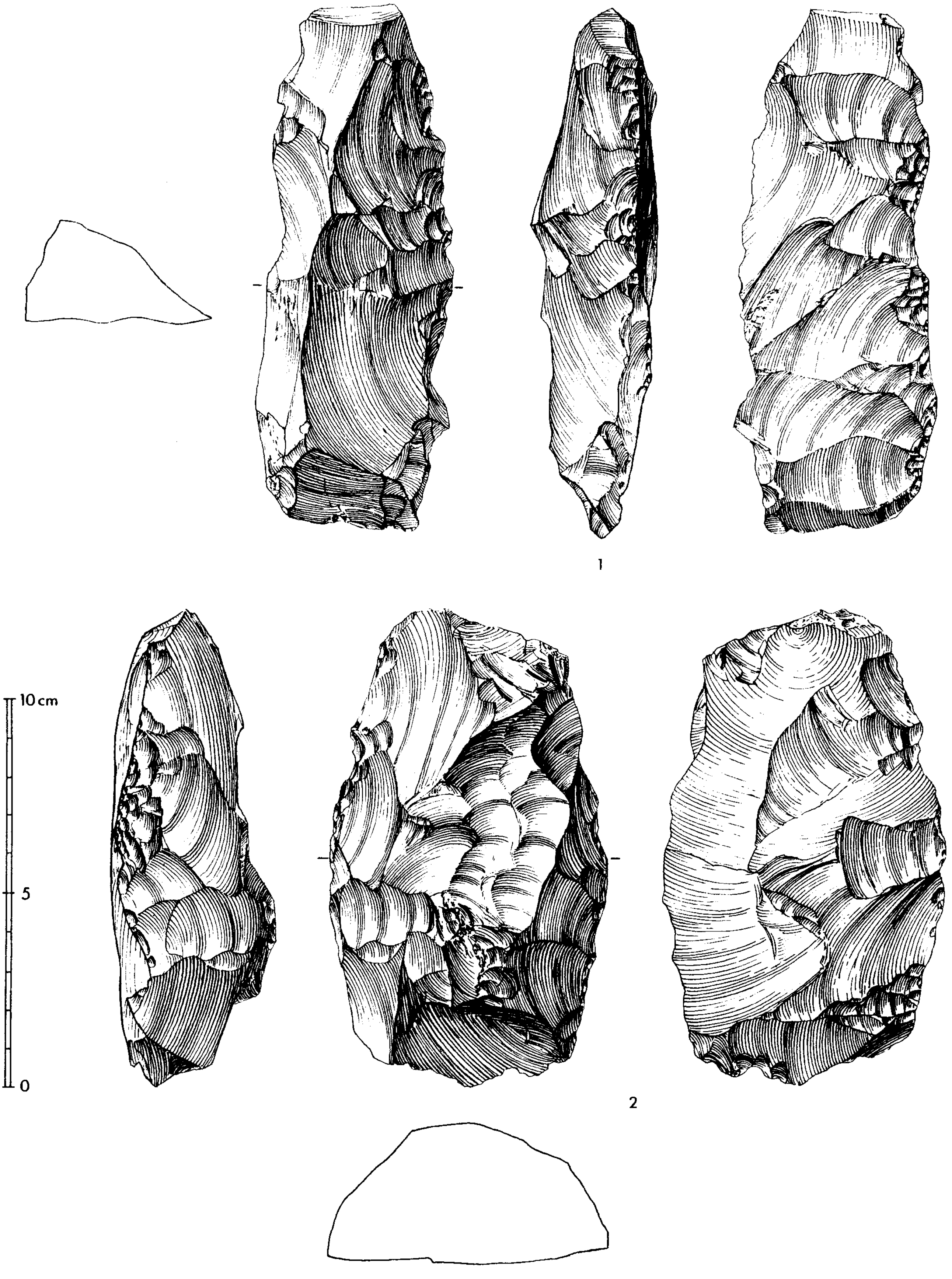

Fig. 10. Semi-finished flint adzes from the primary flint work shop of Ramat Tamar.

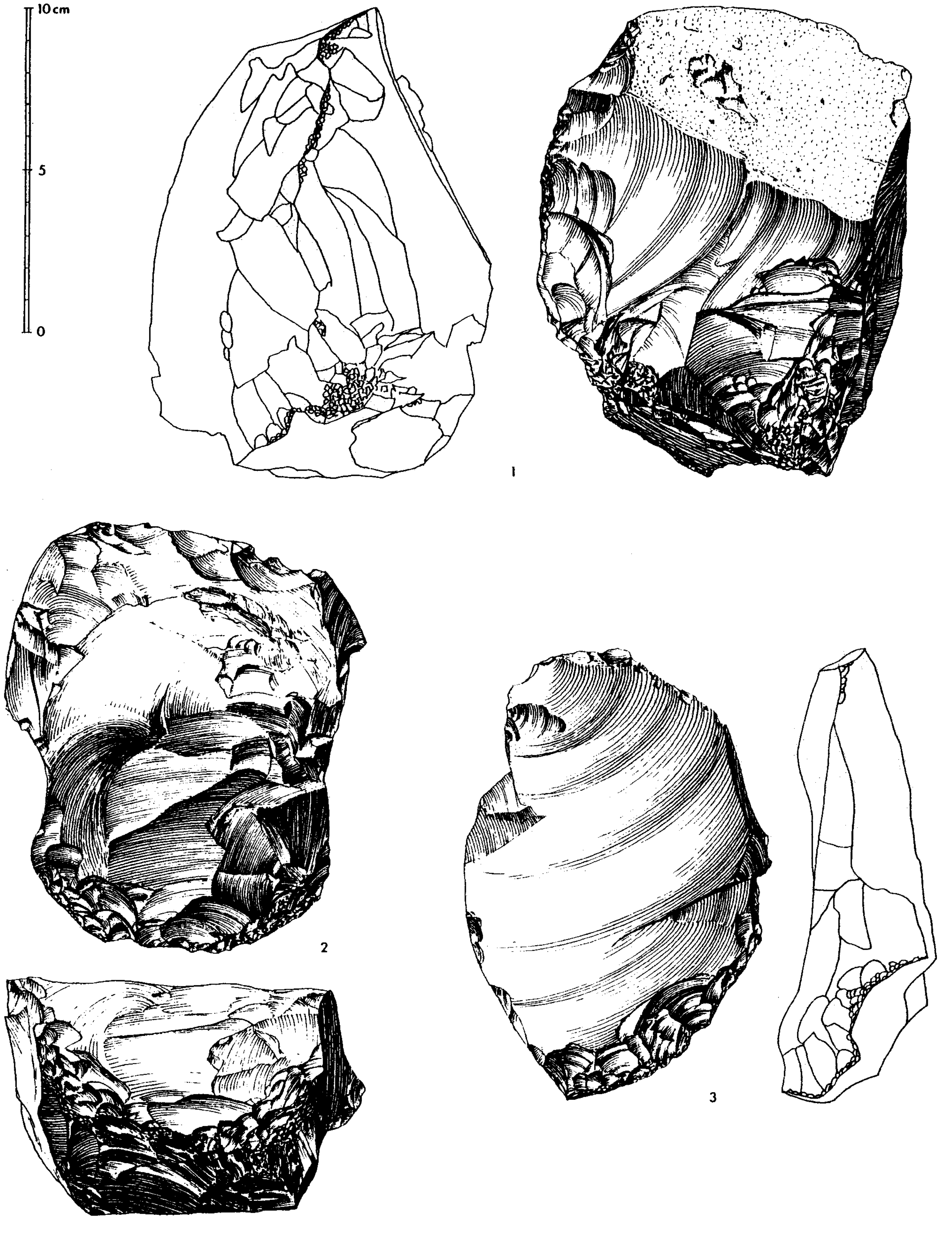

Fig. 11. Heavy hammerstones from the primary flint work shop of Ramat Tamar.

identified (Fig. 7). The survey of the workshop showed a total surface coverage of flakes, cores and flint debries ranging up to a maximum of 378 pieces per square meter. Notable are heavy flint hammerstones (Fig. 11) presumably used in breaking down the large flint nodules or to remove the dolomite from the cortex. In addition, a total of 17 semifinished axes and adzes (Figs. 9 and 10) were counted. These finds give us information as to the main purpose of the mining activities at Ramat Tamar, which was to produce axes and adzes.

Unfortunately, no organic substances were preserved and it was thus not possible to date the mining operations directly, by means o the physical sciences. Nevertheless, it does seem quite reasonable to assume that the mine represents one of the original sources for the flint processed at the nearby site of Mesad Mazzal. Altogether, we were able to identify three further flint mines in the direct vicinity of Mesad Mazzal. Thus, the topographic situation is that we have one settlement only, but four mines close together, clustered within a radius of one kilometre. Even at larger distances no other stone age settlements were found.

Conclusions

The following picture of the activities in this region during the late PPNB emerges: The site of Mesad Mazzal in the Arava-valley was repeatedly visited by people coming from permanent settlements presumably located in climatic areas favourable in regard of agricultural economy. They carried with them various foodstuffs, notably cereal grains, and brought with them domesticated animals. It can be assumed that the main purpose of these visits was to exploit the grey-yellow banded Turonian flint occuring in outcrops of the Negev plateau at Ramat Tamar. The flint material was important enough to be exploited by hard work in opencast mines.

The freshly mined flint underwent a first processing stage already at the mine. The place can thus be interptreted both as a mine and a primary flint workshop. The average weight of the semifinished axes and adzes produced was 334 g (N=17). In a second step the successful products were taken to the settlement at Mesad Mazzal in order to be finished. Measured on 92 axes and adzes, the average weight of the final products amounts to 102 g. Thus Mesad Mazzal can be considered to represent a repeatedly occupied probably temporary used settlement and a secondary flint workshop. The large number of bone saws found at Mesad Mazzal demonstrates the importance of other manufacturing processes as yet unidentified.

It is difficult to assume that the production of stone axes at Mesad Mazzal was mearly for local purposes. Presumably the finished axes and adzes were transported to the regions with regular settlements, perhaps for direct use only, but quite possibly with the additional purpose of being traded to other settlements. This trading model would be substantiated if the stone artefacts made of Turonian flint from Ramat Tamar were to be found in other regions.

Finally it should be noted that - with the exception of Egypt - Ramat Tamar seems to be the first flint mine reported from the Near East. Although flint mining is well-known from all over Europe (WEISGERBER, SLOTTA ,and WEINER 1980), it is an extremely rare case to find both the mine and the associated settlement where the miners lived and had their recreation and where they continued their flint work in order to finish well useable and highly desired flint tools .

Acknowledgements: The archaeological field work at Ramat Tamar was supported by the Deutsche Forschungsgemeinschaft. The helpful collaboration with the Institute of Archaeology of the Hebrew University and the Department of Archaeology, Jerusalem, is also gratefully acknowledged.

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The Neolithic Tuwailan Cortical Knife Industry of the Negev

Nigel Goring-Morris, Avi Gopher, and Steve Rosen

Introduction

Three large cortical tile knives purportedly discovered by bedouin some 60 years ago at or near Tell Tuwail (Beer Osnat) at the confluence of Nahal Besor and Nahal Beersheva in the western Negev were briefly reported in 1978 by Crowfoot Payne (Figs 1 and 2). In the absence of other parallels at the time she described them as likely local Chalcolithic imitations of well-known Egyptian Pre-dynastic knives. However, during the course of the Emergency Archaeological Survey of the Negev a series of sites were discovered necessitating re-evaluation of the above-mentioned attribution.

The following paper briefly relates to a series of recently investigated related sites from the western Negev lowlands which appear to be attributable to the 6th millenium BC (uncalibrated), i.e. early Late Neolithic (GORING-MORRIS 1994, in press). This is followed by a short discussion of the broader chronological and economic implications of this distinctive industry within the Southern Levant.

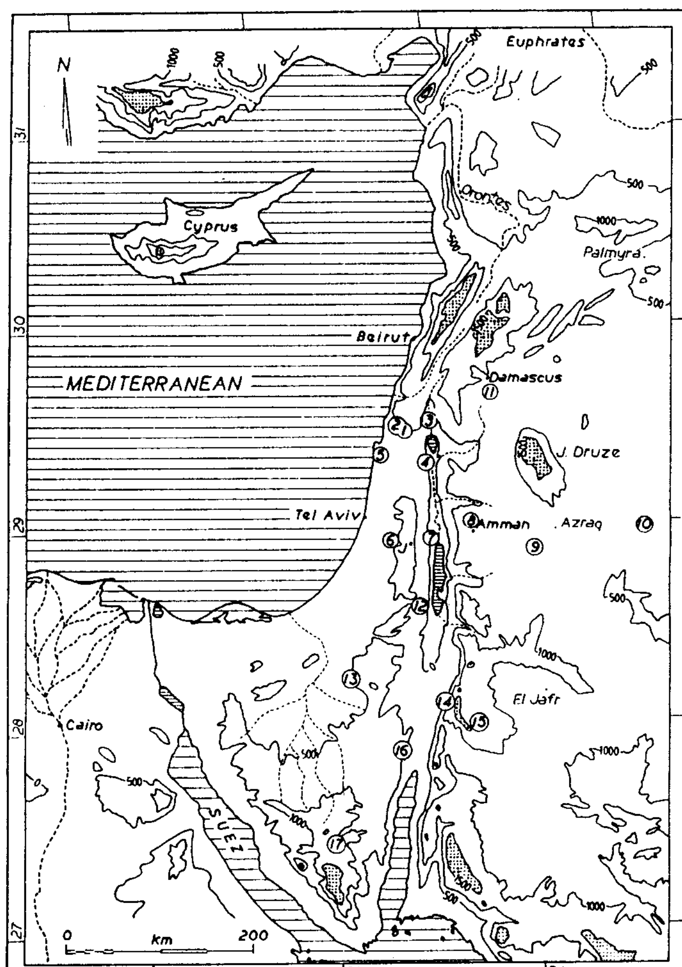

Fig.1. Map of the southern Levant showing locations of 6th millennium BC sites featuring cortical/tile knives: 1 Tell Tuwail (Beer Osnat) and Hamifgash, 2 Har Qeren, 3 Qadesh Barnea, 4 Ziqim, 5 Azraq, 6 Black Desert

The Tuwailan Industry

Hamifgash III and V are two open-air occupations located at the Nahal Besor - Nahal Beersheva confluence, less than 2km from Tell Tuwail (Fig. 3), and were discovered during the Emergency Archaeological Survey of the Negev.

Surface collections and limited testing produced assemblages including somewhat smaller and less elegantly finished cortical knives with retouch covering the entire ventral surface (GORING-MORRIS, in press). A few examples were also discovered with complete bifacial retouch. These were discovered in association with opposed platform blade cores and smaller numbers of finely pressure flaked large Byblos/Nizzanim and Amuq points (Figs. 4-6). Other characteristic items appear to be large awls on flat limestone flakes (Tables 1-3). The small test pit seemingly chanced upon a workshop area for the application of finishing retouch of knife blanks as indicated by the quantities of characteristic 'biface' flakes (thin, incurved flakes with splayed distal tips), presumably resulting from soft-hammer treatment of the ventral surfaces of the knives.

Har Qeren V and XIV are two of several cortical knife workshop sites discovered less than 15km southwest of Tell Tuwail (GORING-MORRIS and ROSEN 1987). Systematic excavations at the two sites enable reconstruction of the *chaîne opératoire* in the production of these distinctive knives. The collections revealed that the profusion of locally available Eocene flint nodules, measuring up to 80cm in diameter, served as the raw material for these knives, with large cortical flakes removed by the block-on-block technique either on-site or immediately adjacent. These were then flaked by direct (soft?) percussion around the perimeter from the prepared dorsal (cortical) surface, removing all traces of the ventral face. This process produced huge quantities of typical 'biface' flakes, items with narrow striking platforms, expanding lateral edges and thin, incurvate profiles (Table 2). Finally the perimeter of the knives were carefully retouched to produce regular working edges.

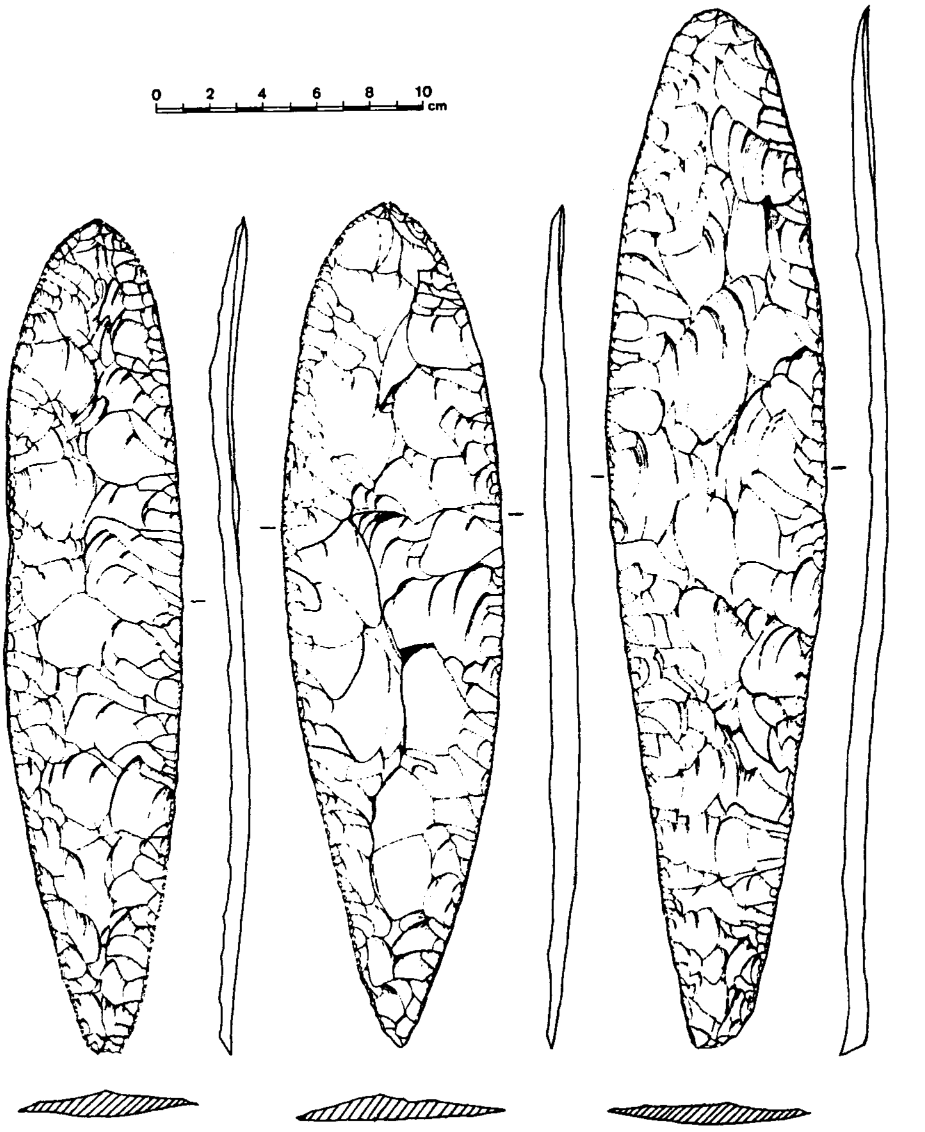

Fig. 2. Cortical/tile knife hoard from Tell Tuwail (Beer Osnat), after CRAWFOOT PAYNE 1978: Fig. 1.

The shapes so produced vary considerably, from symmetrical examples to those with handles (Figs. 7-10). In some instances, natural fracture planes perpendicular to the ventral face were utilized as backs to the knives. At both workshop sites the only knives recovered were roughouts or items broken in the course of manufacture. The few other other accompanying tools were all *ad hoc*, or unintentionally retouched 'tools'.

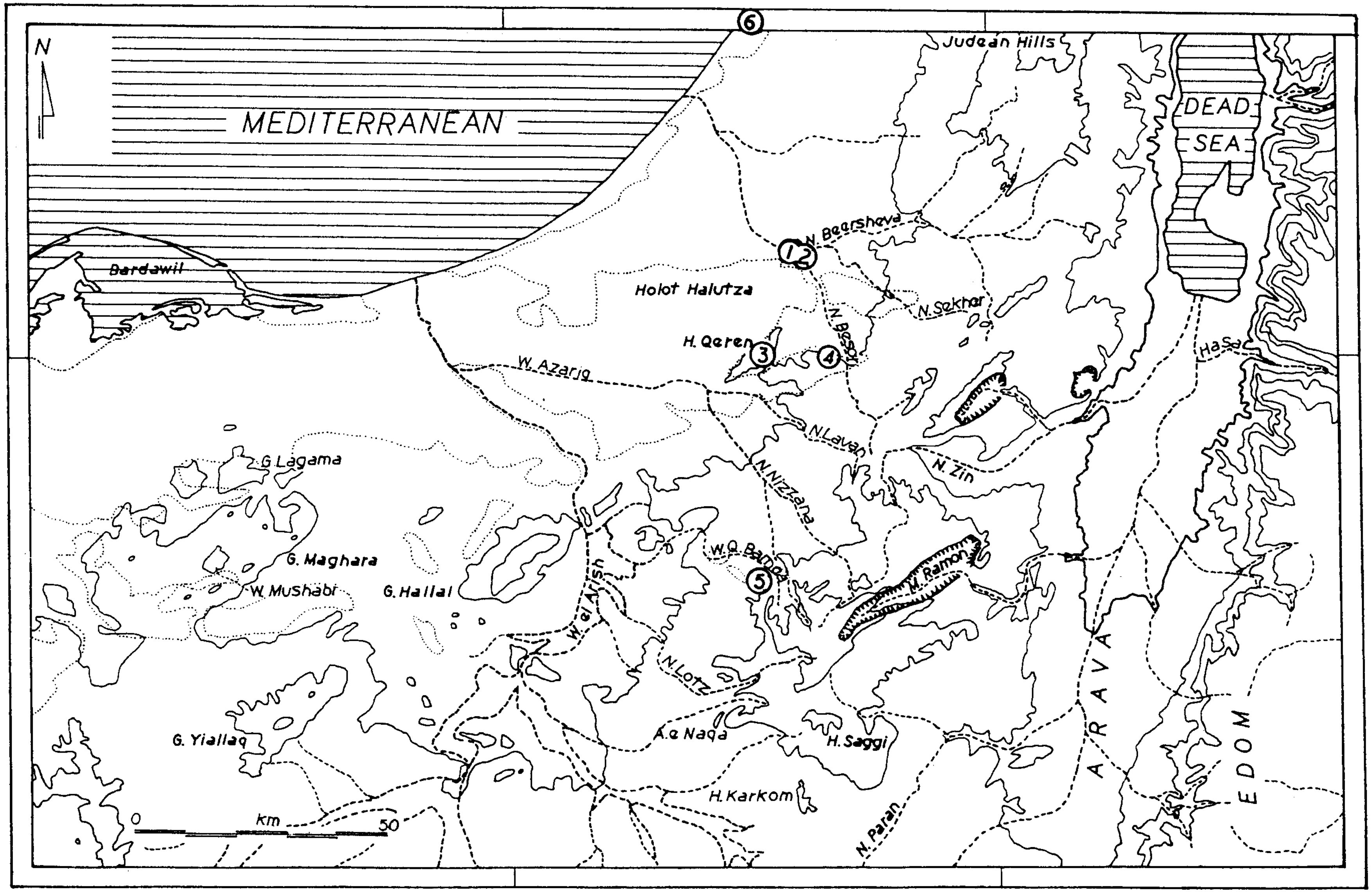

Fig. 3. Map of Negev showing location of Tuwailan industry sites : 1 Tell Tuwail (Beer Osnat), 2 Hamifgash III, V, 3 Har Qeren V, XIV, XX, 4 Shunera XXIII, 5 Qadesh Barnea 31, 6 Ziqim.

Table 1. Artefact counts and frequencies for Tuwailan assemblages.

	Har Qeren V %	Har Qeren XIV %	Hamifgash III %	Hamifgash V(test pit) %	Shunera XXIII %
Primary elements	8.7	4.1	nd	11.6	
Flakes	87.0	94.6		81.3	
Blade/lets	1.9	0.9		6.9	
Core tablets	-	-		-	
Ridge blades	0.1	0.4		0.2	
CTE	2.3	0.0		-	
Total n:	6542	16788		956	
Chips	10096	27158			
Chunks	405	115			
Cores	5	0	(29)	1(12)	(1)
Tools	37	78	(64)	1(65)	(18)
Cores	0.03	-		0.03	
Debitage	38.29	38.03		30.52	
Debris	61.46	61.79		69.41	
Tools	0.22	0.18		0.03	
TOTAL n:	17085	44140		3132	

Table 2. Core types from Tuwailan assemblages.

	Hamifgash III n	Hamifgash V n	Shunera XXIII n
Opposed platform	16	8	1
Pyramidal	3	1	-
90 degree	2	1	-
Single platform	4	1	-
Discoidal	1	-	-
Amorphous	2	1	-
Fragment	1	-	-
Total:	29	12	1

Table 3. Tool typologies for Tuwailan assemblages.

	Har Qeren V %	Har Qeren XIV %	Hamifgash III %	Hamifgash V %	Shunera XXIII %
Scraper	5	2	1	1	-
Burin	-	-	-	1	-
Massive borer	-	1	-	-	-
Massive awl	-	-	2	1	1
Arrowhead	-	-	6	8	1
Truncation	1	-	-	-	-
Notches & Dentic.	4	-	3	6	-
Ret. flake	6	1	1	1	-
Ret. blade	-	-	-	1	-
Axe	-	-	4	8	1
Knife (roughout)	3	3	-	-	-
(complete)	-	2	-	-	-
(conjoinable)	-	5	-	-	-
(fragment)	19	62	41	47	15
Chopper/pick	-	-	2	1	-
Hammerstone	1	2	2	1	-
Varia	-	-	1	-	-
Total:	37	78	64	65	18

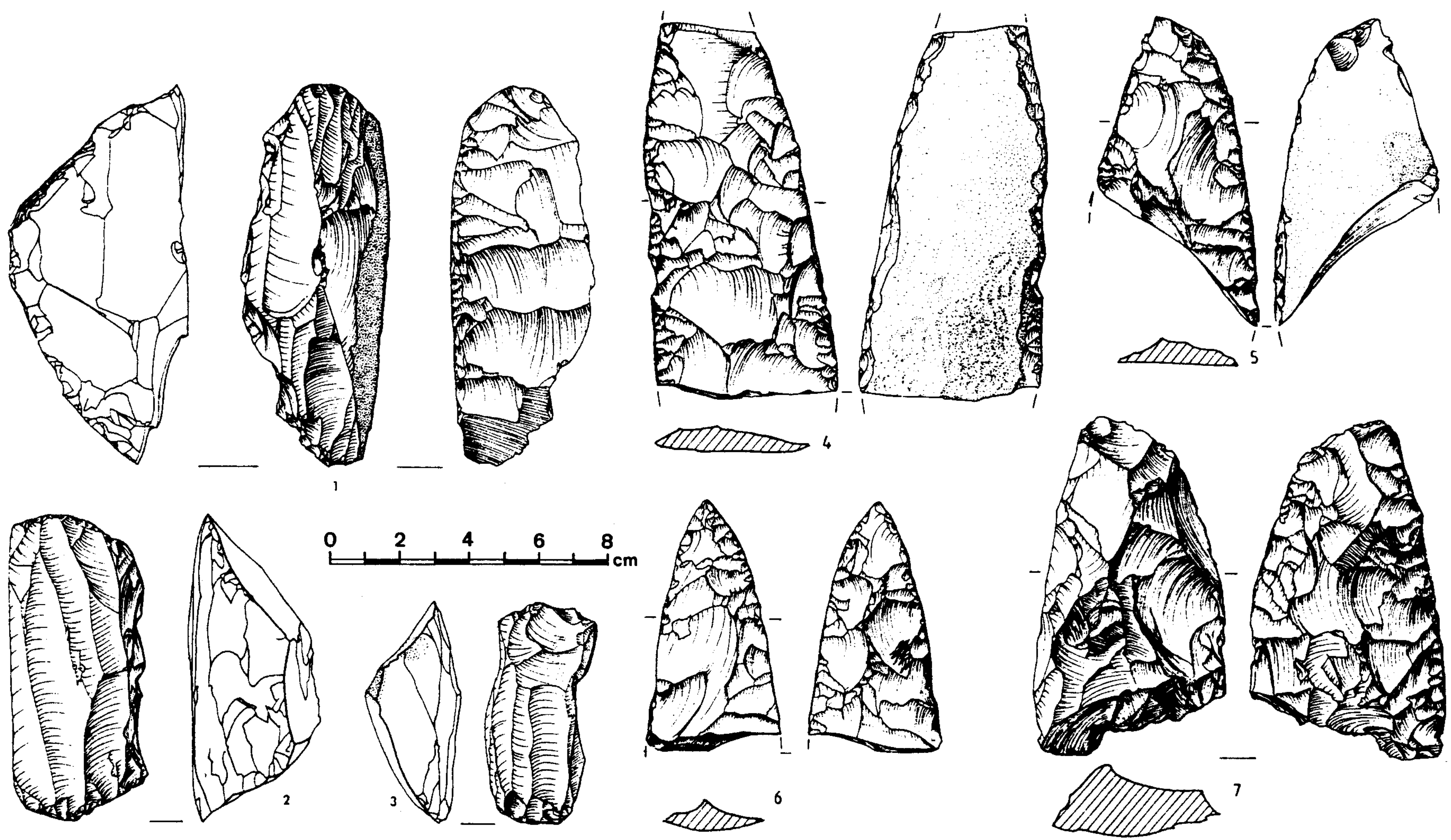

Fig. 4. Artefacts from Hamifgash III: 1-3 naviform cores, 4-6 cortical knives, 7 bifacial piece.

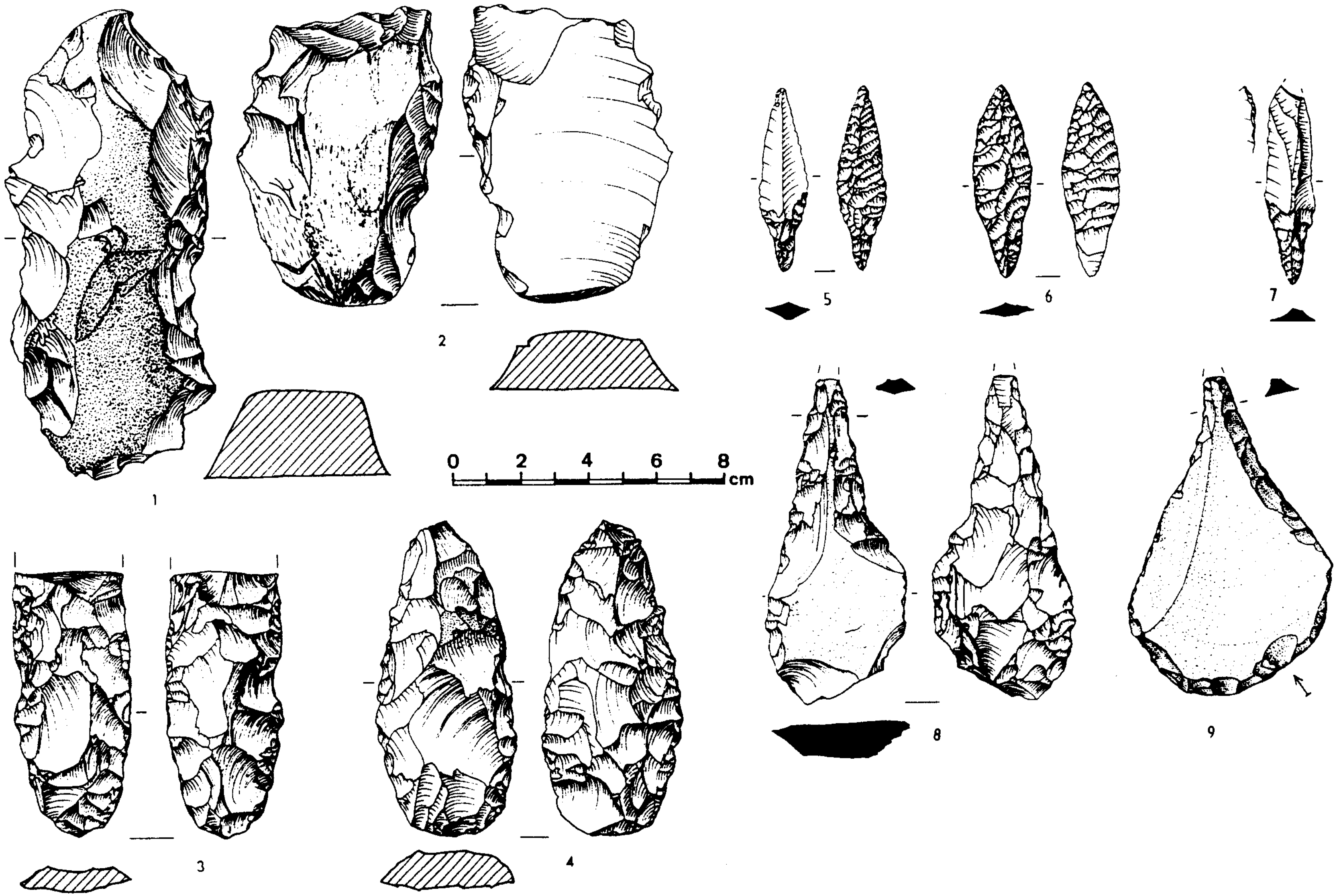

Fig. 5. Tools from Hamifgash III: 1-2 massive denticulates, 3-4 bifacial pieces, 5-7 Byblos/Nizzanim points, 8 cortical knife, 9 massive awl (on chert).

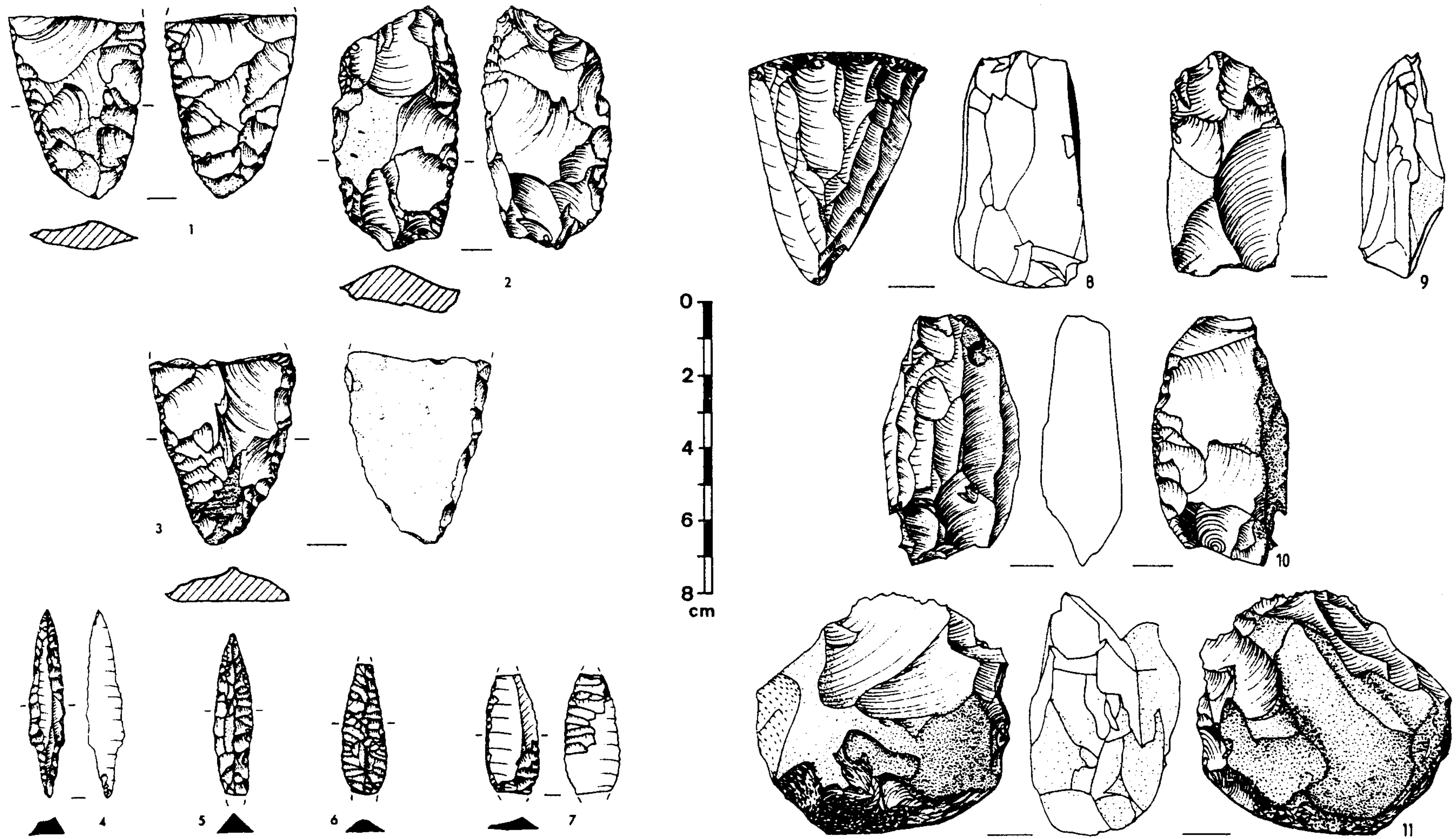

Fig. 6. Artefacts from Hamifgash V: 1-2 bifaces, 3 cortical knife, 4-7 Byblos/Nizzanim points, 8-10 opposed platform cores, 11 chopping tool.

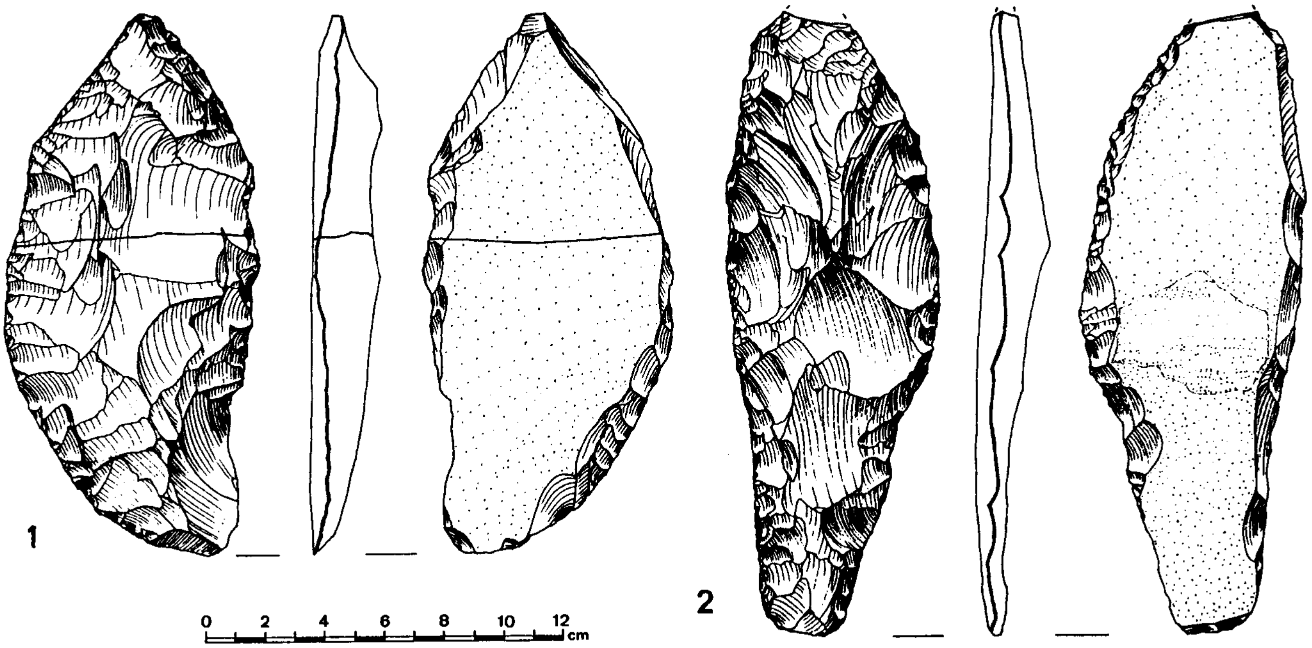

Fig. 7. Cortical knives from: 1 Har Qeren V, 2 Har Qeren XIV.

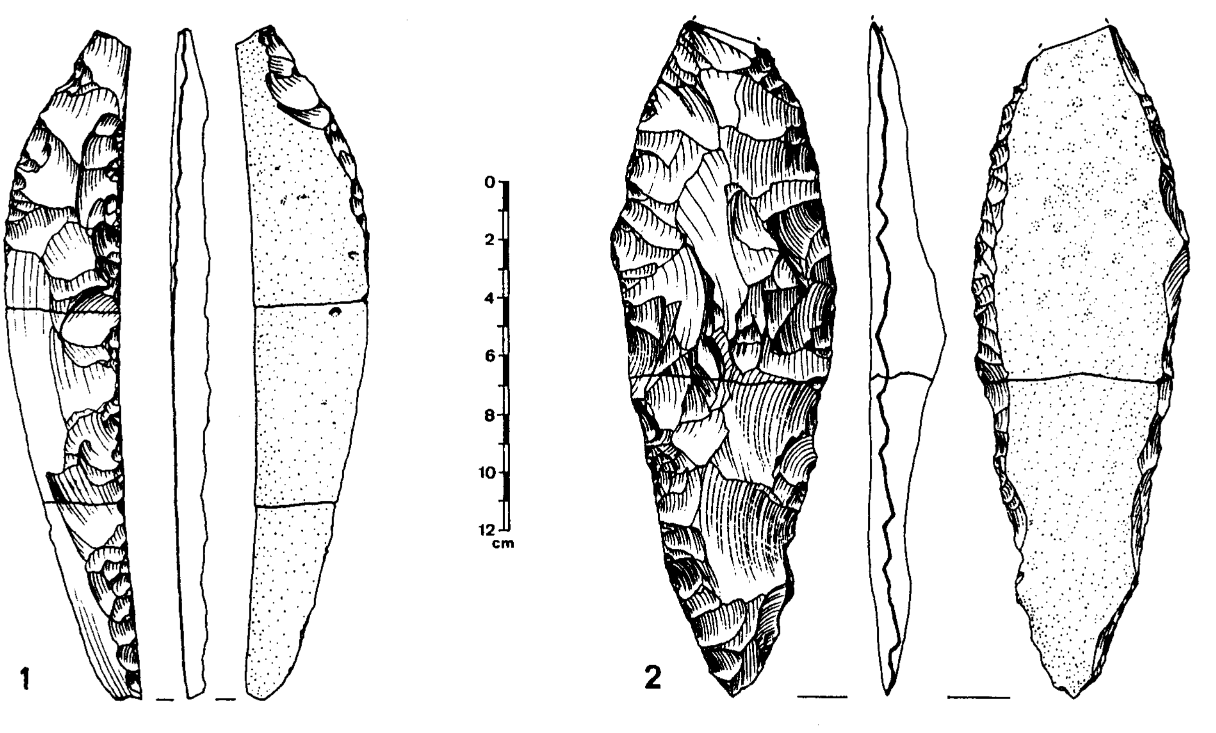

Fig. 8. Cortical knives from Har Qeren XIV *<Note natural fracture plane back on #1.>*

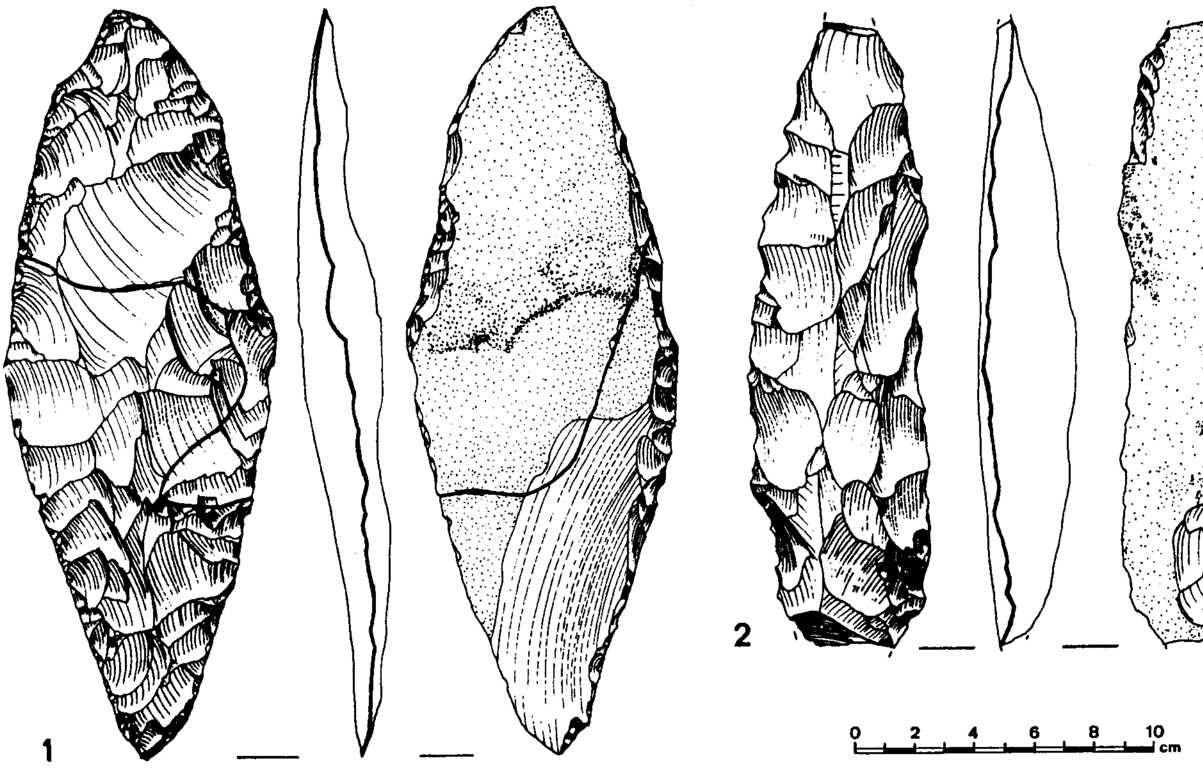

Fig. 9. Cortical knife roughouts from : 1 Har Qeren V, 2 Har Qeren XIV.

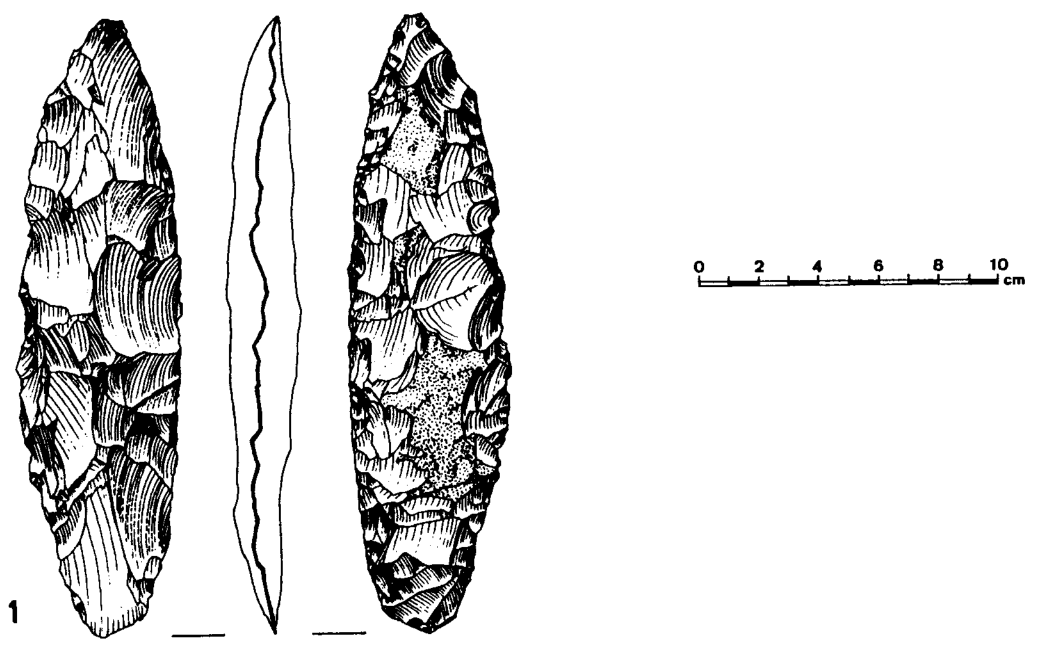

Fig. 10. Cortical knife roughout from : Har Qeren V.

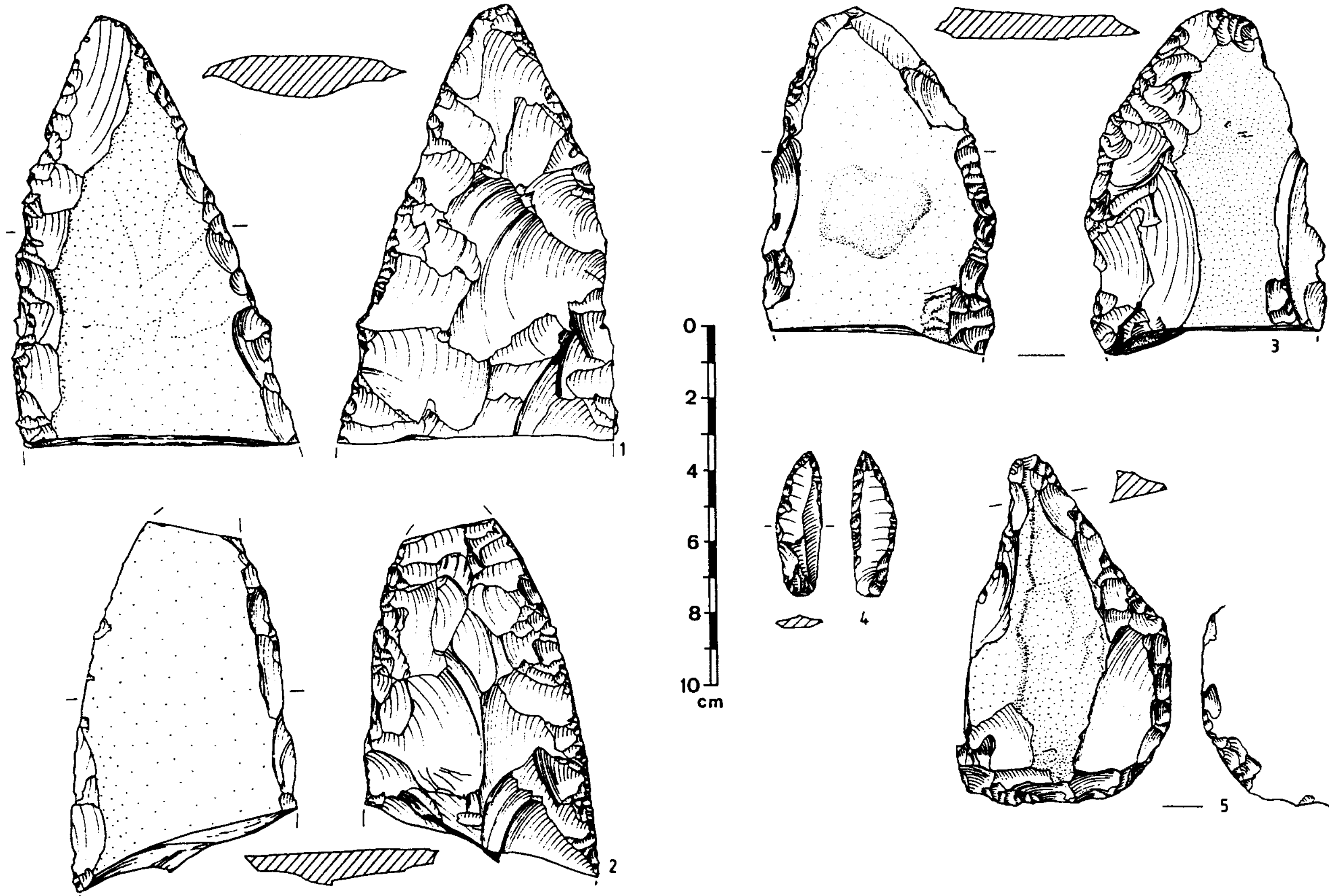

Fig. 11. Artefacts from Shunera XXIII: 1-3 cortical knives, 4 point, 5 massive awl.

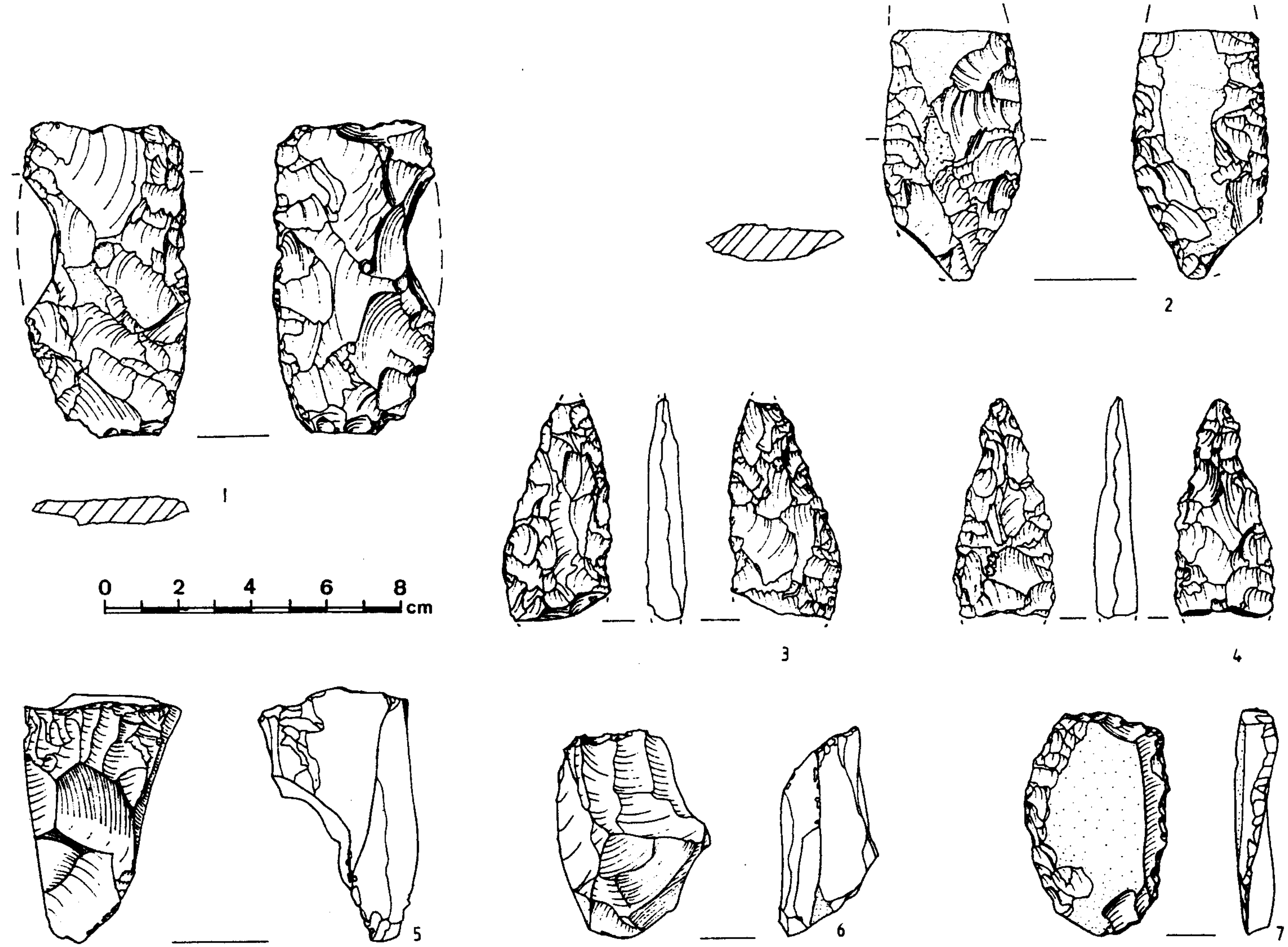

Fig. 12. Artefacts from Qadesh Barnea 31.

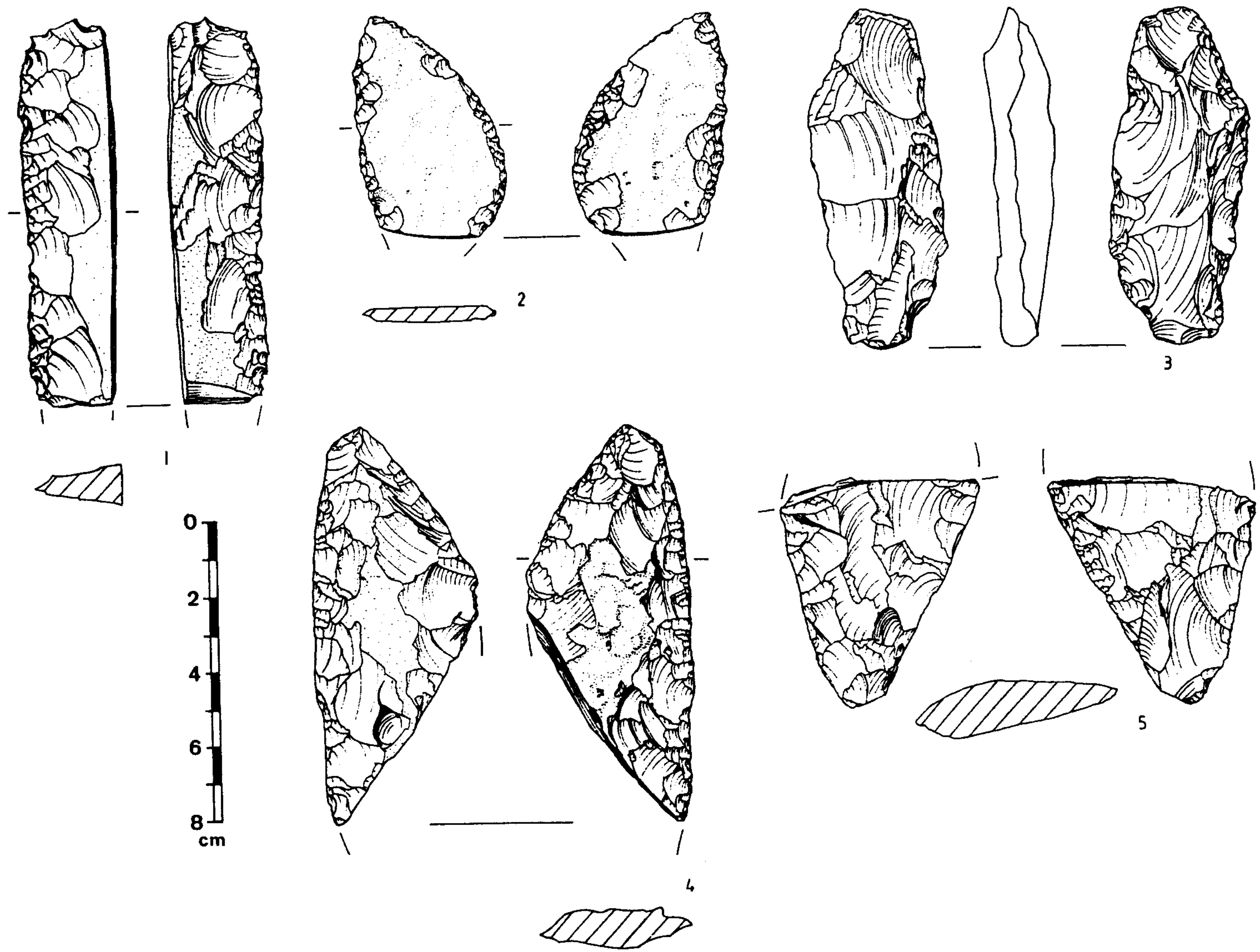

Fig. 13. Artefacts from Qadesh Barnea 31.

Shunera XXIII, in the western Negev dunes is an ephemeral occurrence which yielded a couple of examples of these cortical knives, together with a poorly executed point and a massive awl (Fig. 11; and see GORING-MORRIS, in press).

Qadesh Barnea 31, seemingly a habitation site, and located just across the border in Sinai, was surface collected by Gopher and Rosen. Here, the assemblage was quite varied but included bifacial knives, some apparently on tabular flint. These were accompanied by opposed platform cores and arrowheads, especially Byblos/Nizzanim forms, some quite small (Fig. 12).

Discussion

The recurrent association of cortical knives, Byblos/Nizzanim arrowhead forms featuring invasive, squamous pressure retouch and an opposed platform blade technology appears solid. The shapes of the knives are quite varied, with some having handles/tangs, while others are more symmetrical, and some have naturally broken backs. At the Hamifgash sites many seem to have been retouched again following breakage. One of us has proposed that these distinctive assemblages be grouped under the term "the Tuwailan industry" (GORING-MORRIS 1994, in press).

As to the chronological/cultural assignment of this distinctive industry, the Late Neolithic of the Negev and Sinai remains poorly documented (GORING-MORRIS 1994). This situation results from a combination of reasons: the lack of specific research programs specifically aimed at this period, perhaps in part due to the fact that this time span represents the transition from 'classic' hunter-gatherer communities and the more settled agricultural and pastoral communities of proto-historic periods, as well as the major drop in artefact densities at many of these sites. The latter seemingly reflects changes in the raw materials and characteristic types of artefact classes, patterns of curation, and a probable decline in population densities. Such a situation is somewhat perplexing and anomalous, given the recent surge of interest in the origins of pastoral societies in the Near East (see BAR-YOSEF and KHAZANOV 1992).

The above-described assemblages seem to predate the briefly described site of Qadesh Barnea 3, with Haparsa points and large quantities of axes, and dated to the mid 6th millenium BC (uncalibrated). However, parallels to the above-described assemblages can be found in the southern Coastal Plain, especially at Ziqim (NOY 1977a, b): such cortical knives appear in small quantities together with projectile points and sickleblades which Noy ascribed to an 'early Pottery Neolithic phase'. Comparisons with several Late Neolithic sites featuring tile knives in Eastern Transjordan also seem pertinent (BAIRD *et al.* 1992; BETTS 1989; MCCARTNEY 1992). Similarities are also apparent further afield in the Qatar (INIZAN and TIXIER 1978).

As in the Mediterranean zone, where the 6th millenium BC final PPNB (=PPNC) and Yarmukian continued to employ an opposed platform blade technology (STECKELIS 1972), so too the technology appears to have persisted in the desert areas through much of the 6th millenium BC. Given the desert-based orientation of this cortical knife industry and its apparent early 6th millenium BC attribution, there are considerable ramifications concerning both the economy of the knappers, as well as the origins of both the later Egyptian Pre-dynastic knife and local Chalcolithic fan scraper industries (GORING-MORRIS 1994). Though direct evidence for subsistence is entirely lacking for the Tuwailan sites, the nature and composition of the assemblages, small though they are, are of considerable interest in this respect. Projectile points appear to drastically decrease in frequency, suggestive of a decline in hunting. Neither real bifacials nor sickleblades are found, perhaps indicating that agriculture was still not practised in the region. It seems reasonable, if speculative, however, to hypothesize that the unifacial knives, which closely correspond in concept, if not execution, to later Predynastic knives, might fulfill a similar function. In Egypt there is considerable evidence to indicate the use of such knives in the ritual and profane slaughtering, skinning and butchering of medium-sized mammals (HOLMES 1992; see also SMITH 1989). Microwear analysis of two specimens from Hamifgash V indicated the presence of ochre impregnated hide use and the cutting of meat and bone (BUHLER 1988). Is it possible then to further speculate that these reflect the introduction of domesticated animals (goat?) in the desert fringes and the beginnings of pastoralism? These matters are, however, beyond the scope of the present paper.

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Chipped Stone Production Technology from the Azraq Project Neolithic Sites

Douglas Baird

A comparison of developments in the arid and moister zones of the southern Levant could potentially inform on the nature of developments in each zone. In order to interpret these comparisons we must have some idea of the nature of the relationships between communities in more arid and those in moister areas. The comparative status of the lithic assemblages in each area might indicate such relationships. The extent to which differences in tool assemblages might reflect differences in the nature of adaptations to different environments complicates comparisons based on tool assemblage composition and even, potentially, those based on the nature of individual tool types. The burin site phenomenon may be one good indication of the extent to which tool assemblages may be affected by environmental context (BAIRD 1993; GARRARD *et al.* 1994: 90-91). In which case features of technology might do more to inform on the affiliation of groups if raw material variation is taken into account. This seems especially likely when idiosyncratic features of production would be most likely to be communicated on a face to face basis. It is feasible that manufacturers of chipped stone artifacts could replicate the appearance of objects, but less likely that they would replicate precise features of production, in the absence of intercommunication. The assemblages discussed here come from Azraq Project Neolithic sites in the centre and west of the Azraq basin in the steppe and desert areas of eastern Jordan (Fig. 1) (GARRARD *et al.* 1988; GARRARD *et al.* 1994).

The chronological status of the sites was determined on the basis of C14 dates and point assemblages and is discussed in detail by the author elsewhere (BAIRD 1993; GARRARD *et al.* 1994). The `Phases' in Table 1 and throughout this text refer to periods of occupation defined on the basis of distinct chipped stone assemblages, often combining a number of stratigraphic phases from the sites.

An analytical distinction between reduction strategy and technique is employed here. Method indicates the broad approach of knappers to the reduction of their material involving a series of steps during which characteristic removals are effected (NEWCOMER 1975: 97). It is thus manifest in the manner of preparation of cores, the point at which striking platforms are created, the pattern of removals from the major removal surfaces etc. I will refer to this as the reduction strategy. Newcomer has made a further distinction between mode and technique. Mode for Newcomer represents the type of impactor, hard hammer, soft hammer, pressure (NEWCOMER 1975: 97-98). Technique for Newcomer involves all the other aspects of flaking, the way in which the core was held, angle of blow, direct or indirect percussion, point of impact on the platform, strength of blow, etc. It may be seen already that Newcomer's distinction is not a precise one. Pressure is as much technique as mode. Most analysts have not made a distinction similar to that between mode and technique. They prefer to treat this analytical aspect of reduction sequence studies as one (*cf.* BONNICHSEN 1977 - input variables; KNUTSON 1988: 18) and usually refer to it as technique, as I will. This is sensible, in that these aspects are not independent (KNUTSON 1988: 38).

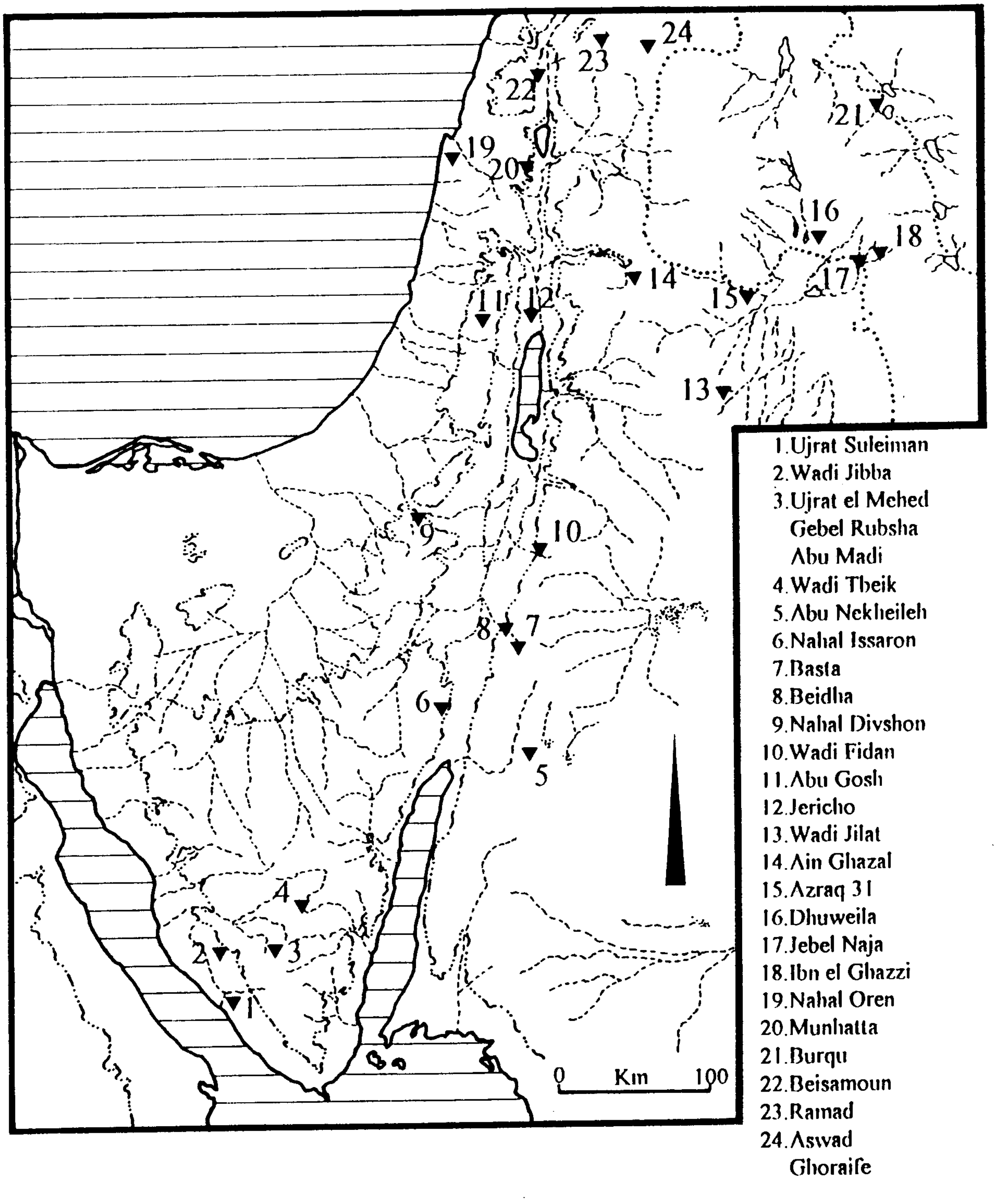

Fig. 1. Jilat (Sites 13) and Azraq (Site 15) sites in relation to other south Levantine Neolithic sites.

Reduction Strategy in Azraq Project Assemblages

In the case of the Azraq Project assemblages cores provided a good guide to reduction strategy for three reasons:

1) Cores representative of the complete range of material types were present, with the exception of obsidian.
2) The complete reduction sequence for each of these material types was well represented, with the exception of obsidian.
3) Cores were not so heavily reduced as to preclude identification of patterns of reduction.

An extensive analysis of 863 cores and attribute analysis of 250 of these suggested two main classification avenues for cores, one which reflected number and relative position of platforms, the other the final core shape (BAIRD 1993: 176-204). Used together these provided an exhaustive classification of cores. The proportions of each of these types at each occupation is presented in Table 3.

Three major core types were defined by their platform positions:

1) Single platform cores (Fig. 2:2 and 2:3)
2) change of orientation cores (Fig. 2:1 and 2:4) and
3) opposed platform cores (Fig. 2:5).

Analyses indicated that single platform and change of orientation strategies were linked by several factors and that the latter could merely represent a more progressive use of the core than the former. Major developments through time, reflected in the proportions of these types in assemblages, are summarized in Table 3 and Fig. 4. In the Early PPNB (WJ7 Phase I) single platform and change of orientation strategies, considered together, dominate over opposed platform strategies (c. 52%). In the 7th Millennium b.c. the relative importance of these two sets of strategies is reversed. In most 7th Millennium b.c. occupations opposed platform strategies are over 50%. The exceptions are a context WJ7 Ab14a, which may have many residual Early PPNB cores, and WJ32. WJ32 has a very small core sample, however, and opposed platform strategies are still more important than single platform and change of orientation strategies as a group. In the Early Late Neolithic in Jilat the situation is reversed and single platform and change of orientation strategies as a group are more important than opposed platform strategies. The Azraq 31 Late Neolithic sample is problematic in this regard. It is probably an Early Late Neolithic, but opposed platform cores are a high proportion of cores and single platform and change of orientation cores a very low proportion. However, there is only a small sample and specific types (edge of biface and flakes as cores, Table 2) have an unusual importance. Late PPNB residuals may also complicate the picture (BAIRD *et al.* 1992).

We can effectively document the rise and decline of naviform strategies which are clearly related to the relative importance of opposed platform strategies. Naviforms are a low proportion of Early PPNB cores (c. 9%) and rise to relatively high proportions in the 7th Millennium b.c. Thus naviforms range from 25-45% in 7th Millennium b.c. occupations (with the exception of WJ7Ab14 with is suspected to have many Early PPNB residuals). In the earliest Early Late Neolithic occupation (WJ 13 Phase I) with other transitional PPNB-Late Neolithic features (BAIRD 1993; GARRARD *et al.* 1994:88) naviforms are still present in reduced proportions (c. 14%). Their very low rate of occurrence in WJ13 Phase II deposits makes their presence problematic (residuals). They occur as 10% of the problematic Azraq 31 Late Neolithic core sample. Small sample size and the possibility of residuals makes their presence questionable in this occupation. However, they are definitely absent from analysed contexts on WJ25, probably at a slightly more advanced stage of the Early Late Neolithic.

If other features of core morphology are addressed other information emerges. The Early PPNB phase, WJ7 Phase I, has a very distinctive and wide range of core types (Table 2). There is, therefore, considerable variety in strategy represented. The most important group is prismatic cores, of a variety of platform types. Pyramidal cores are also important (Fig. 2:2).

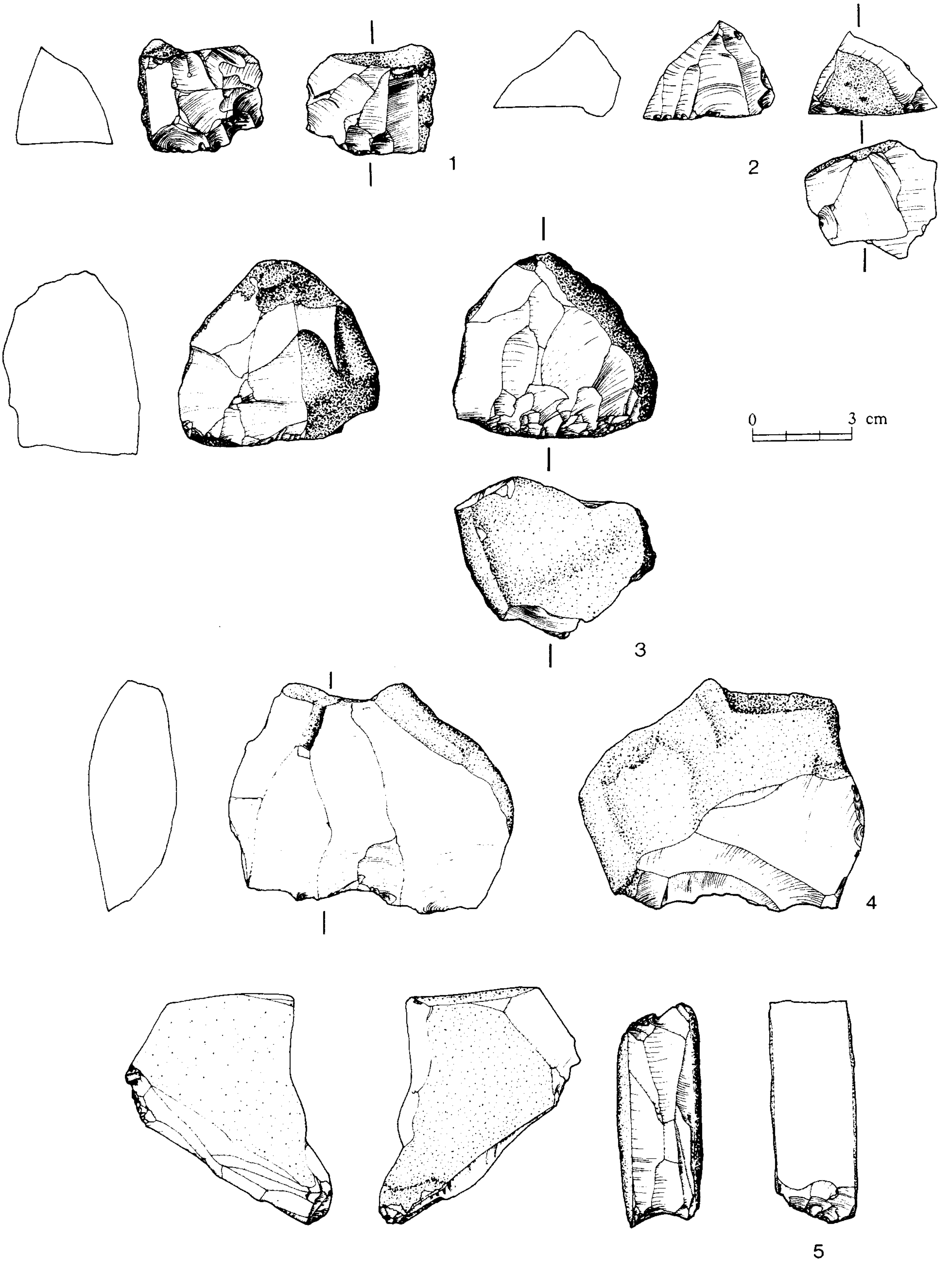

Fig. 2. Azraq Project Neolithic cores.

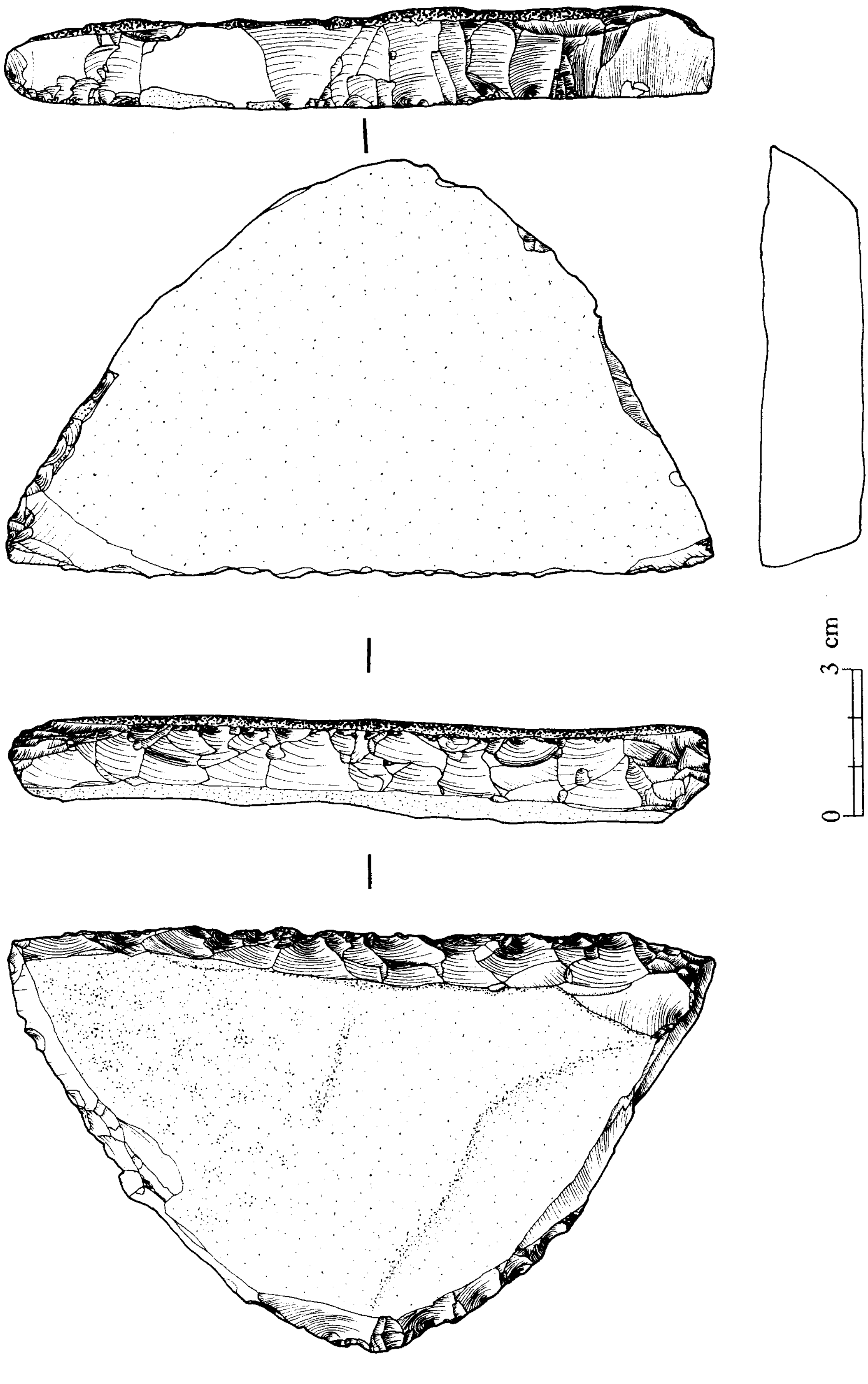

Fig. 3. Naviform preform, WJ7 Phase I.

Table 1. Chronological status of each occupation on Azraq Project Neolithic site.

Site	*Phase*	*Period*	*Date b.c.*
WJ7	I	Early PPNB	7,600-7,200
WJ7	II	Middle PPNB	7,200-6,500
WJ7	III	Middle/Late PPNB	7,200-6,000
WJ26		Middle PPNB	7,200-6,500
WJ32		Middle PPNB	7,200-6,500
WJ13	I	Early Late Neo	6,000-5,600
WJ13	II	Early Late Neo	6,000-5,600
WJ25		Early Late Neo	6,000-5,600

Table 2. Proportions of various core types in Azraq Project Neolithic assemblages.

	WJ7I	WJ7II	WJ7B9	WJ7A14	WJ7III	WJ26	WJ32	A31I	WJ13I	WJ13II	WJ25	A31II
N=	95	25	11	18	72	179	9	7	36	156	104	20
	%	%	%	%	%	%	%	%	%	%	%	%
Cobble Opposed	1.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.56	0.00	0.00
Cobble Single	3.16	4.00	9.09	5.56	1.39	2.23	0.00	0.00	11.11	8.33	8.65	0.00
Cobble Change	4.21	0.00	0.00	5.56	1.39	1.12	0.00	0.00	11.11	11.54	20.19	0.00
Discoidal	1.05	0.00	0.00	0.00	0.00	0.56	0.00	14.29	0.00	1.92	0.00	0.00
Edge of bifacial	0.00	0.00	0.00	0.00	0.00	1.12	11.11	0.00	5.56	1.28	2.88	30.00
Flake	2.11	4.00	0.00	5.56	4.1	70.56	11.11	14.29	5.56	3.21	2.88	10.00
Irregular	6.32	0.00	0.00	11.11	4.17	2.23	0.00	0.00	5.56	1.92	6.73	0.00
Naviform	5.26	36.00	36.36	16.67	19.44	18.99	33.33	28.57	8.33	1.92	0.00	5.00
Naviform-tabular	4.21	8.00	9.09	0.00	5.56	18.44	11.11	0.00	5.56	1.28	0.00	5.00
Preform	5.26	4.00	0.00	16.67	4.17	6.70	0.00	0.00	11.11	3.85	4.81	0.00
Prismatic Opposed	11.58	8.00	0.00	0.00	5.56	3.35	0.00	0.00	0.00	8.33	0.96	5.00
Prismatic Single	16.84	8.00	9.09	16.67	6.94	2.23	22.22	0.00	5.56	1.92	1.92	5.00
Prismatic Change	8.42	24.00	0.00	0.00	6.94	3.35	0.00	0.00	2.78	7.05	10.58	0.00
Prismatic Alternate	1.05	4.00	0.00	0.00	9.72	1.68	0.00	0.00	2.78	5.13	3.85	20.00
Pyramidal Opposed	3.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.78	1.92	0.00	0.00
Pyramidal Single	5.26	0.00	9.09	11.11	2.78	1.12	11.11	0.00	0.00	7.69	10.58	0.00
Pyramidal Change	9.47	0.00	0.00	5.56	2.78	0.00	0.00	0.00	0.00	5.13	4.81	0.00
Sub-naviform	2.11	0.00	9.09	0.00	11.11	4.47	0.00	0.00	0.00	1.28	1.92	5.00
Sub-naviform-tabular	0.00	0.00	0.00	5.56	0.00	6.70	0.00	0.00	2.78	1.92	0.96	5.00
Tabular Opposed	2.11	0.00	18.18	0.00	1.39	5.03	0.00	28.57	5.56	7.69	6.73	5.00
Tabular Single	2.11	0.00	0.00	0.00	2.78	10.06	0.00	0.00	11.11	6.41	7.69	5.00
Tabular Change	3.16	0.00	0.00	0.00	2.78	5.03	0.00	14.29	0.00	5.13	2.88	0.00
Tabular Alternate	2.11	0.00	0.00	0.00	6.94	5.03	0.00	0.00	2.78	2.56	0.96	0.00

Table 3. Proportions of opposed/alternate platform cores compared to single platform/ change of orientation cores at the Azraq Project Neolithic sites.

	WJ7 I	WJ7 II	WJ7B9a	WJ7Ab14a	WJ7 III	WJ26
Opposed/alternate	32.63%	56.00%	72.73%	22.22%	59.72%	63.69%
Single/change	52.63%	36.00%	27.27%	44.44%	27.78%	25.14%

	WJ32	A31 I	WJ13 I	WJ13 II	WJ25	A31 II
Opposed/alternate	44.44%	57.14%	30.56%	34.62%	15.38%	50.00%
Single/change	33.33%	14.29%	41.67%	53.21%	67.31%	10.00%

In the 7th Millennium b.c. this diversity decreases. Prismatic cores and tabular cores are relatively important. Tabular cores are characterised by the exploitation of the narrow edge of tabular slabs (Fig. 2:5). They are particularly important at WJ26, which witnesses a significant role for clearly related naviform strategies (Table 2).

In the Early Late Neolithic tabular and cobble (Fig. 2:3) cores are the most important, both `opportunistic' in their exploitation of the raw material contours (Table 2). Pyramidal cores become more important through the Early Late Neolithic (at WJ13 Phase II and WJ25). In this and other regards e.g. disappearance of naviforms (see BAIRD 1993: 250-252 and 279-283) the technology represented on WJ25 can be seen as the culmination of technological developments in the transition from the PPNB to the Late Neolithic (see below).

One particular set of strategies is characteristic of a proportion of Jilat core reduction from the Early PPNB to the Early Late Neolithic. First coherently documented at Basta it involves a specific preparation of the thin edge of tabular slabs by characteristic flake removals (NISSEN *et al.* 1987: 97-98), certainly for naviform, and probably for opposed platform strategies (Fig. 3). In Jilat additional strategies, involving minimal preparation, exploited the edge of tabular slabs. The morphology of these slabs provided a narrow, long edge ideal for lamellar removals, particularly an opposed platform removal surface (Fig. 2:5). There was clearly a preference in Jilat assemblages (BAIRD n.d. a.) for utilising tabular material for opposed platform production and particularly naviform production (Fig. 3).

Table 4. Numbers and percentages of cores with various platform characteristics in each occupation.

		Naviform platforms				Total
	Removal surface	Fine	Coarse	Cortex	Plain	cores
	%	%	%	%	%	
WJ7I	72.72	36.36	27.27	18.18	100.00	11
WJ7II	45.45	36.36	27.27	9.09	72.7211	11
WJ7B9	33.33	16.67	50.00	0.00	100.00	6
WJ7A14	50.00	0.00	50.00	0.00	100.00	4
WJ7III	27.77	36.11	36.11	5.55	52.77	36
WJ26A	21.74	13.04	30.43	8.70	69.57	23
WJ26B	46.81	21.28	12.77	6.38	91.49	47
WJ26C	47.06	29.41	23.52	11.76	88.24	17
WJ32	25.00	25.00	50.00	0.00	50.00	4
A31PPN	0.00	33.33	100.00	0.00	100.00	3
WJ13I	33.33	16.67	50.00	0.00	100.00	6
WJ13II	50.00	0.00	20.00	10.00	100.00	10
WJ25	33.33	0.00	0.00	33.33	100.00	3
A31LN	25.00	0.00	25.00	0.00	100.00	4
		Non naviform platforms				
WJ7I	10.71	9.52	15.48	36.90	67.86	84
WJ7II	21.43	50.00	7.14	42.86	50.00	14
WJ7B9	20.00	20.00	20.00	20.00	80.00	5
WJ7A14	0.00	14.29	14.29	42.86	71.43	14
WJ7III	10.86	21.74	17.39	41.30	67.39	46
WJ26A	0.00	22.22	11.11	44.44	33.33	27
WJ26B	13.73	13.72	15.69	33.33	82.35	51
WJ26C	0.00	11.76	11.76	47.06	58.82	17
WJ32	0.00	0.00	0.00	40.00	40.00	5
A31PPN	0.00	0.00	0.00	20.00	40.00	5
WJ13I	3.33	16.67	6.67	46.67	80.00	30
WJ13II	14.184	10.64	3.55	43.26	75.89	141
WJ25	6.93	10.89	4.95	46.53	63.37	101
A31LN	0.00	0.00	37.50	18.75	93.75	16

Platform Preparation

Preparation of the main removal surface on the platform edge and faceting of the striking platform perform a variety of functions in maximising effective and appropriate removals.

There are clear disparities between the frequencies of all types of platform preparation on naviform *(sensu lato)* as opposed to other core types (Table 4). This indicates that naviform cores have high degrees of investment, as witnessed by this preparation, in maintaining effective production compared to non-naviform cores.

At Azraq 31, in both Late PPNB and Late Neolithic, there appears to be less investment in edge of platform preparation on the main removal surface and fine preparation on the platform, from the evidence of cores, in naviform or non-naviform strategies than in Jilat. Coarse faceting is the only preparation that has any importance on naviform or non-naviform cores in PPNB or Late Neolithic at Azraq. At Azraq 31 there thus seems very little interest in specifically targeting or modifying impact areas. The evidence of the platforms of lamellar debitage from both periods at Azraq 31 provides paradoxically contrasting information to that gained from cores indicating a high degree of such removal surface edge of platform preparation at Azraq 31 (see below and Table 5).

Core Size

The more formal and investment intensive nature of naviform production demands an investigation of naviform homogeneity/diversity especially in relation to other reduction strategies. A plot of length against width of a sample of naviforms *sensu lato* and sub-naviform cores (Fig. 5) indicates the considerable degree of size overlap between the cores of these types regardless of site or period. In particular it should be noted that the 8th M.b.c Early PPNB naviforms (Fig. 3) (this is true for naviforms *sensu lato* and *sensu stricto*) overlap completely with the distribution of those of the 7th Millennium b.c. and that the Azraq 31 cores overlap completely with those from Jilat (Fig. 5). Neither chronological nor regional variability appears to be reflected in any systematic manner by naviform core size variation. At least in Jilat and Azraq we are faced with a relatively homogeneous group of cores over considerable time spans.

The Early PPNB non-naviform cores (Fig. 6) show a quite different distribution on length:width scattergrams when compared to the later non-naviform cores, exemplified here by a sample from WJ26 (Fig. 7). In the Early PPNB non-naviforms are the most significant part of the assemblage. The bulk of these cores are between 20 and 60 mm. in width and 10 and 60 mm. in length (Fig. 6) i.e. all small. Most 7th Millennium b.c. non-naviforms not thought to be residuals are over 55 mm. long (Fig. 7). This variability probably reflects preferred blank sizes.

Naviforms, and therefore presumably naviform strategy, remain a very homogeneous phenomenon throughout the period, well over a millennium of uncalibrated radio-carbon years, and locus of their use, whether an important part of reduction strategies or not. This homogeneity occurs regardless of raw material used. It is reflected in size of core at deposition and as far as can be ascertained, as preforms. It is also reflected by preforming methods (including the particular tabular edge methods (Fig. 3) shared with tabular edge strategies), degree of platform preparation relative to other core types (Table 4), final position of crest relative to main removal surface (suggested by CALLEY 1986b as of potential chronological significance), platform angles and main debitage product.

Technique in Azraq Project Assemblages

Technique is used in the sense of those factors that influence the nature of the impact that removes a piece of chipped stone from its parent body. A very wide range of key factors have been observed by experimenters (BORDES 1947; BONNICHSEN 1977; OHNUMA and BERGMAN 1982; KNUTSON 1988). The potential complexity of the relationship between input factors and observed features on the platforms and bulb areas of debitage suggest the following two stage methodology. 1)

The identification of patterns of technique related differences between assemblages. 2) The separate inference, in a necessarily imprecise manner, of some probable reasons for technique related differences.

Several clear distinctions can be made between different Jilat and Azraq occupations on the basis of the data relating to platform and bulb features of blade-bladelet debitage (Table 5). Most of the categories used are familiar from the literature (TIXIER *et al.* 1980: 105). One distinction that I have considered useful is between two kinds of platform preparation; that is preparation of the platform edge on the main removal surface (through faceting and grinding - removal surface prep in Table 5) and faceting of the platform itself (from the other core surfaces - platform facet in Table 5).

Table 5. Numbers and proportions of different types of platform features in each occupation.

	WJ7 I	WJ7 II	WJ7 III	WJ26	WJ32	WJ13 I	WJ13 II	WJ25	Az31 I	Az31 II
Total Platforms	180	247	164	255	61	168	212	60	63	56
Platform type										
	%	%	%	%	%	%	%	%	%	%
Plain	48.89	41.70	46.95	34.12	14.75	47.02	50.47	46.67	47.62	42.86
Winged	5.00	4.45	4.88	4.71	9.84	10.12	0.94	3.33	4.76	3.57
Dihedral	9.44	7.69	9.15	7.84	3.28	3.57	6.60	6.67	3.17	1.78
Punctiform	7.22	5.67	7.32	7.45	4.92	6.55	3.30	1.67	14.29	12.5
Filiform	14.44	10.53	12.80	19.61	16.39	8.33	11.32	0.00	25.39	21.43
Platform facet	4.44	8.09	9.76	7.84	13.11	9.52	2.36	5.00	1.58	1.78
Removal surface prep	20.00	24.29	20.73	14.51	13.11	16.07	15.56	1.67	34.92	26.78
Cortical	14.44	7.28	10.36	10.98	6.55	13.09	8.02	20.00	12.69	10.71
Crushed	15.00	16.19	15.24	14.90	19.67	16.07	18.40	16.66	0.00	7.14
Lip	30.55	25.51	24.39	28.24	42.62	23.81	23.11	20.00	61.90	42.86
Ring crack	0.00	4.05	2.44	4.31	0.00	5.95	1.88	5.00	0.00	0.00
Bulb features										
Diffuse	38.33	32.79	29.27	34.12	37.70	32.14	21.23	21.67	68.23	48.21
Prominent	20.55	13.76	15.85	14.90	11.47	10.71	10.85	26.67	1.58	12.50
Clear cone	13.89	6.88	6.71	12.16	6.56	11.90	4.25	11.67	1.58	3.57
Conical	0.00	0.40	2.44	0.78	0.00	1.78	0.00	1.67	1.58	5.36
Siret	0.00	0.81	0.00	0.00	1.64	2.97	0.00	0.00	0.00	1.78
Large Eraillure	2.78	7.69	10.97	10.59	3.28	10.71	8.49	13.33	4.76	10.71

Table 6. Sizes of naviform cores from various Levantine sites.

	Mean			Range		
	Length	Width	Thick	Length	Width	Thickness
Azraq	67	31	33	50-90		
Divshon	57			-74	35-46	
Tbeik				53-69	27-37	19-35
Dhuweila	67	29		42-78	22-46	
Beidha	c.70			50-136		
Basta				50-90		
Jericho				70-over 100		over 40
Munhata				43-	24-	30-
Hahoresh				80-103	27-44	40-44
Beisamoun				-over 100		
Douara	75	36	34	-105		
Palmyra 35				-300		
Bouqras				80-over 100	c. 40	
Qdeir	84	47	31			

1) Technique related features on the lamellar debitage from the Azraq 31 occupations occur with dramatically different frequencies compared with the Jilat sites' assemblages. The Azraq 31 PPNB sample is particularly distinctive (Table 5). At Azraq 31 there are very high proportions of filiform and punctiform platforms relative to the Jilat sites (Table 5). The Azraq 31 blade-bladelets have the lowest proportions of platform faceting but very high proportions of removal surface faceting (Table 5). This reverses the situation noted on the cores (see above and Table 4). This suggests abandoned cores might not reflect the degree of preparation of the platform edge on the removal surface during their lives, but does not necessarily explain the disparity in faceting of the striking platform itself. This, with other factors, may suggest the introduction of blades to the site from other areas of the site or off-site. Crushed platforms are quite common in Jilat samples, but rare on the Azraq 31 blade-bladelet sample (Table 5). Lips occur on a very high proportion of Azraq 31 platforms. There are very high proportions of diffuse bulbs at Azraq 31 compared to Jilat sites, no ring cracks, very low proportions of clear points and cones of percussion and in the Azraq 31 Late PPNB sample a very low proportion of prominent bulbs (Table 5).

2) The WJ25 sample is very distinct from those of Azraq and other Jilat occupations (Table 5). There is a very low proportion of punctiform and filiform platforms, but cortical platforms occur in very high proportions, c. 20% (Table 5). Platform faceting is quite low, but platform preparation on the edge of the main removal surface is very low indeed, only 1.67%. This WJ25 blade-bladelet sample has the lowest proportion of lips of any occupation (still 20%), the highest proportion of ring cracks, the lowest proportion of diffuse bulbs and the highest proportion of prominent bulbs (Table 5).

3) Of the other Jilat sites WJ32 is somewhat distinct with a very low proportion of plain platforms (Table 5), a relatively low proportion of dihedral platforms, a relatively high proportion of winged, filiform, and punctiform platforms, a very high proportion of lips (42%) and a relatively high proportion of platform faceting (Table 5).

4) The lamellar debitage samples from most other Jilat occupations have relatively similar proportions of technique related characteristics. Some occupations can be distinguished by the importance of individual attributes. Plain platforms are dominant and make up 36-50% of all platforms from these Jilat occupations (Table 5). Dihedral platforms occur in low but similar proportions, 6.6-9.5%, with only a slightly lower proportion in WJ13 Phase I. Winged platforms are relatively uncommon, 3.3-4.5%; the exceptions are WJ32, and WJ13 Phase I (Table 5). Punctiform platforms occur in the range 5-7.5%, WJ13 Phase II has slightly lower proportions. Filiform platforms occur in the range 8.5 -14.5% except on WJ26 where they are 19.5% (Table 6.12). Platform faceting is not common (BAIRD 1993: 222-229), it is in the range 8-13%, it occurs in lower proportions on WJ7 Phase I and is very low on WJ13 Phase II (2.3%) (Table 5). On the other hand removal surface platform preparation is high on all the WJ7 phases where it is found on 20-25% of platforms; it is lower on other occupations 13-16% (Table 5). Cortical platforms occur in the range 6.5-15%. Crushed platforms are a regular and standard occurrence and are 15-20% of all platforms. Both lips and diffuse bulbs occur within these Jilat occupations in restricted ranges in significant proportions, lips 20-30%, diffuse bulbs 29-39% (Table 5). The exception in this regard is WJ13 Phase II which has lower proportions of diffuse bulbs c. 21%. Prominent bulbs occur in the range 10-16% except on WJ7 Phase I where they are 20% (Table 5).

The inference of technique variations that might explain these patterns is difficult. One factor that has received particular, and perhaps undue, attention is the nature of the hammer. It has been effectively demonstrated by Ohnuma and Bergman (1982) that it is the hardness of the hammer relative to the hardness of the core material, rather than the precise nature of the material (wood, stone, antler), which determines, in combination with other factors, the nature of many features on platforms and bulbs of removals. Thus stone hammers, which are softer than the core material, will produce features on platforms and bulbs similar to other soft hammer materials. It seems likely that pressure, indirect percussion, softer and harder hammer techniques form a spectrum of techniques and analysis will only allow us to discuss broad zones of this spectrum. For the purposes of this discussion pressure/indirect percussion and percussion with materials softer than the core are treated together as the softer hammer end of the spectrum in contrast with harder hammer direct percussion.

Lips have been associated consistently with softer hammer techniques and clear points and cones of percussion with harder hammer techniques (BORDES 1947; TIXIER *et al.* 1980; OHNUMA and

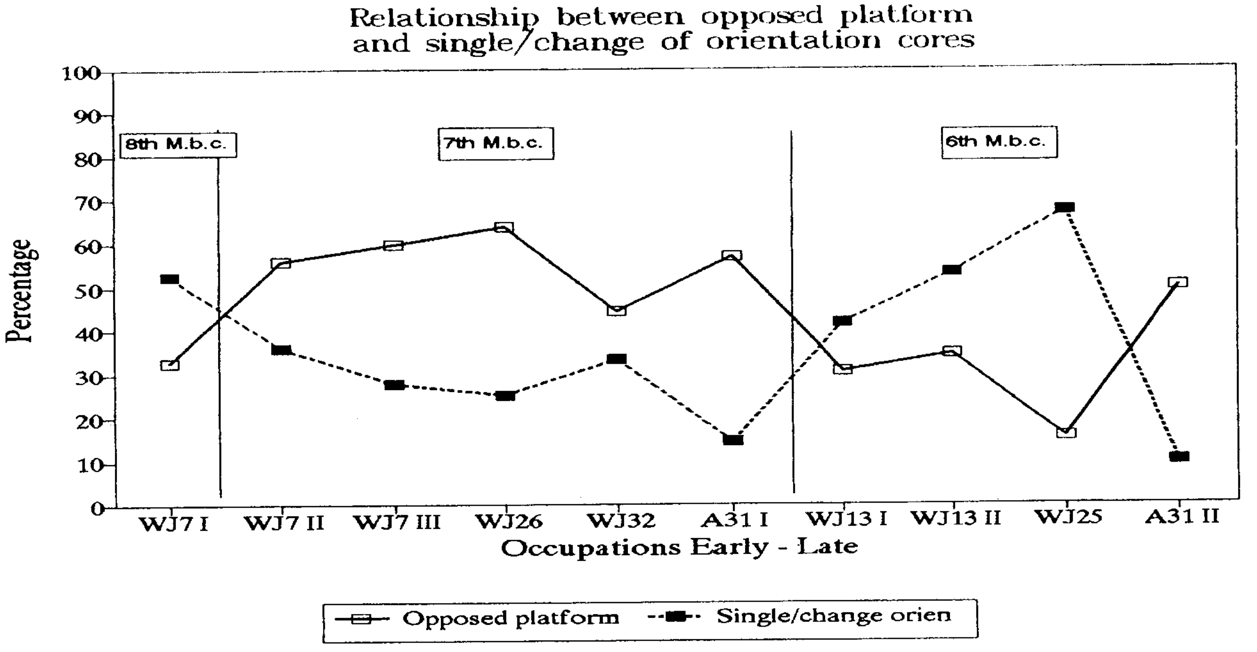

Fig. 4. The relationship between the use of opposed platform and single platform/change of orientation cores through time on Azraq Project Neolithic sites.

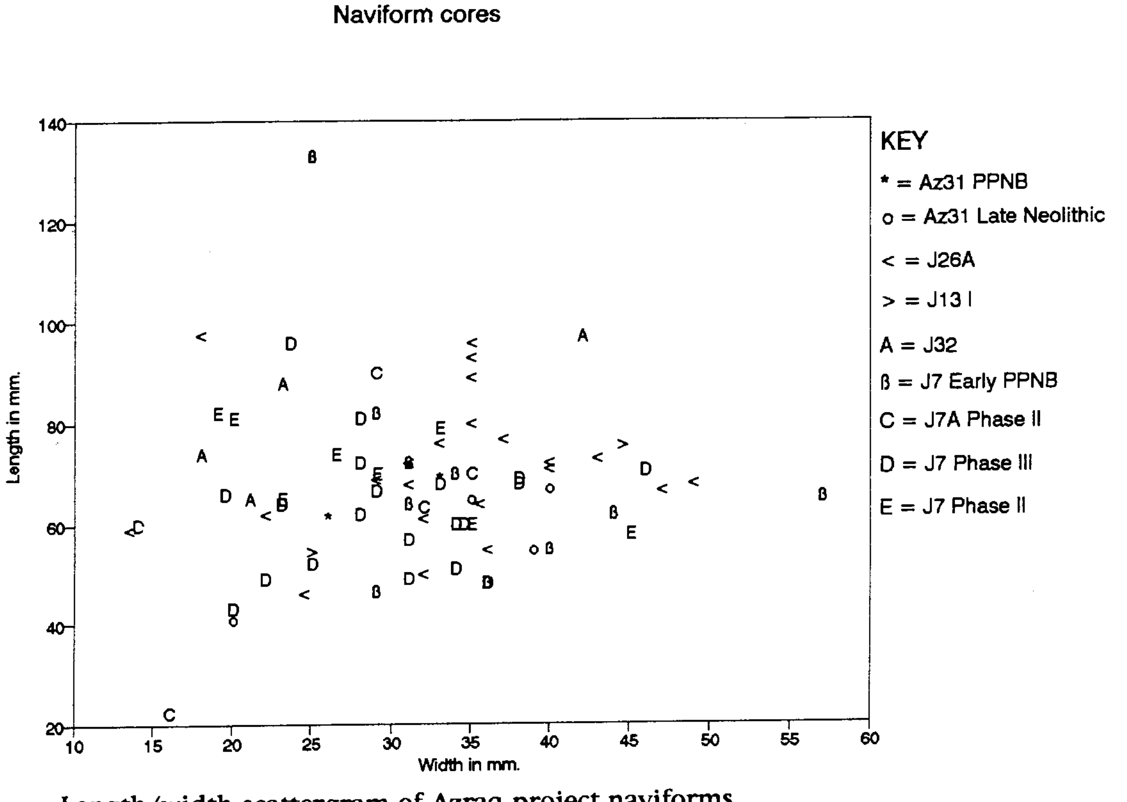

Fig. 5. Length/width scattergram of Azraq project naviforms.

BERGMAN 1982). If these stigmata accurately reflect these technique differences in a consistently observable fashion they should not occur on the same pieces of debitage. Of the 1488 platforms studied, of which 420 had lips and 127 clear points and cones of percussion, Siret fractures or ring cracks, there are 8 examples of concurrence. It is possible that these are the results of misascription of phenomena observed. If a genuine concurrence they may indicate very specific technique factors; that this might be the case is suggested by the fact that four of the examples come from one context's (WJ7 A34a) small blank sample. Whilst these 8 cases of concurrence suggest that lips or clear points cannot be used to indicate individual instances of harder or softer hammer techniques, they are discrete enough groups to give, by their contrasting importance, broad indications of use and importance of softer and harder hammer techniques.

Other features that have been suggested as associated with harder hammer and softer hammer techniques respectively are prominent and diffuse bulbs. In this sample 226 diffuse bulbs have lips and only 17 have clear points and cones of percussion. Use of diffuse bulbs as a soft hammer indicator will, this suggests, give a less precise picture of softer hammer use than lips but probably a broadly accurate one. Of prominent bulbs 54 had clear points and cones of percussion, but fully 23 had lips. This indicates that there might be some association between prominent bulbs and harder hammer techniques, however, use of prominent bulbs will certainly not produce a reliable index of harder hammer use. This may be due to a lack of distinct enough criteria for the identification of bulb prominence.

Punctiform and filiform platforms have been associated by experimenters (TIXIER *et al.* 1980: CALLEY 1986a) with softer hammer techniques. In these samples 133 filiform and 33 punctiform platforms have lips. Only 1 punctiform and 1 filiform platform had possible harder hammer stigmata (clear points and cones of percussion and in one case a ring crack). This strongly suggests that both these platform types may be good softer hammer indicators.

It has been suggested that variations in platform size are partly related to relative softness and hardness of hammer (BORDES 1947). Both Azraq 31 occupations stand out with high proportions of particularly small platforms. WJ25 has the highest proportions of relatively large platforms (BAIRD 1993: 271-272). These distinctions correlate closely with the presumed importance of softer hammer use at Azraq 31 and harder hammer use at WJ25. The general similarities in platform size between the other Jilat samples, except for WJ13 Phase I, may well reflect the similar role and relative importance of softer hammer techniques in these samples. The greater importance of larger platforms at WJ13 Phase I may be partly explained by the somewhat more important role of harder hammer use indicated above, relative to some of the other Jilat assemblages. However, this is not likely to be the complete explanation as other Jilat assemblages, notably WJ26, have a similar range of harder hammer indices.

It seems unlikely that variable use of relatively soft and hard percussors will account for all the variability in platform and bulb indices. Experimenters suggest this and clearly a significant component of these samples have platform and bulb features undiagnostic as to hammer hardness/softness. Softer hammer features are generally more important in these assemblages than harder, but perhaps harder hammer use produced or was associated with clear attributes less frequently. The fact that there was variability in the proportions of platforms and bulbs in each sample with diagnostic features might suggest that a variety of technique factors are responsible for this variability.

Comparative Status of the Technology of the Jilat and Azraq Assemblages

Strategy. Developments in strategy in the Azraq Project sequence are clear. In the Early PPNB naviforms have limited importance, but a distinctive method of naviform reduction adapted to tabular material is already present (NISSEN *et al.* 1987: 97-98). Diverse core types indicate a range of strategies in which `bladelet' production was important. There are distinct similarities between these Jilat Early PPNB cores (Fig. 2:1-2) and those from PPNA Jericho in their morphology and size, particularly small single platform pyramidal, small change of orientation, and small opposed platform prismatic bladelet cores (CROWFOOT PAYNE 1983: Fig. 264:1,3-5). This and the importance of Hagdud truncations, Khiam points, bladelet tools and bladelets (BAIRD 1993) all indicate the transitional nature of this Early PPNB in Jilat between PPNA and 7th Millennium b.c. assemblages. The site at Mujahiya (GOPHER 1990) remains one of the few Early PPNB sites with which comparison can be made. Cores similar to the diverse, small cores of WJ7 Phase I dominate at Mujahiya and like WJ7 Phase I, naviforms are rare (GOPHER 1990: 121-2 and Figs. 6-7). It would appear that communities using Jilat were participating in developments in chipped stone technology common to the southern Levant.

There seems to be considerable variability in the degree of representation of opposed platform and naviform strategies in 7th Millennium b.c. core assemblages in the southern Levant. Some assemblages have only limited proportions of naviform and opposed platform cores, for example Beidha (MORTENSEN 1970: 15-16), Abou Gosh (LECHEVALLIER 1978: 42), Beisamoun (LECHEVALLIER 1978: 154), Kfar Hahoresh (GORING-MORRIS 1991: 86), and Munhata (GOPHER 1989: 16, Table 1). The significance of this is unclear. The very reasons for the employment of diverse strategies, the more specialised and investment intensive naviform and opposed platform strategies and the formal single platform and change of orientation strategies, requires investigation. There is some suggestion that the products of naviform/opposed platform production reached areas of sites from specific production locales, some of which may have been off-site (LECHEVALLIER 1978: 42; GOPHER 1989: 16). Naviform/opposed platform cores illustrated and described from Jericho (CROWFOOT PAYNE 1983: 667, Figs. 292: 1-2, 293:3, and 294; NISHIAKI 1992: Fig. 4.30:1*), Basta (GEBEL *et al.* 1988; NISSEN *et al.* 1987 and 1991), Beidha (MORTENSEN 1970: 15-16; Figs. 3a, 5 and 6), 'Ain Ghazal (personal observation), Munhata (GOPHER 1989), Kfar Hahoresh (GORING-MORRIS 1991: Fig. 6) and Wadi Tbeik (GOPHER 1981) indicate that very similar naviform strategies to those of Jilat/Azraq were followed. The `Douara method' described by Nishiaki (1992: 147-148) from sites in the northern Levant appears to be absent, whatever it represents. Specific tabular reduction strategies appear to be present in identical form on a number of sites, as represented by cores and typical cortical flakes at Basta (NISSEN *et al.* 1987: 97-98), by cores at Beidha (MORTENSEN 1970: Fig. 5: upper), and by typical rejuvenation `spalls' at Basta (NISSEN *et al.* 1991: Fig. 2) and probably at Munhata (GOPHER 1989). The communities using Jilat and Azraq are difficult to distinguish from those in other areas of the southern Levant whether one assesses relationships on the basis of the diversity of strategies, or the nature of specific strategies, or even of the nature of the more formal naviform strategies.

One feature that may differ on an inter-site/inter-region basis is the size of naviforms. Size, at least partly, indicates the point at which their exploitation was no longer considered desirable - not necessarily because no more removals could be effected. However, naviform width, across the main removal surface, should be close to the thickness of the original preform. There is some evidence to indicate that a considerable number of naviforms from south Levantine Mediterranean zone and north Levantine sites are in the upper part of the size range of, indeed larger than, most Jilat and Azraq naviforms. Since much of this information is taken from illustrations, and only the largest most classic naviforms may be illustrated, this may be illusory. Where more complete data is available, Jericho (COWFOOT PAYNE 1983: 667; NISHIAKI 1992: Fig. 4.30: 1 and 3*), Douara (NISHIAKI 1992: Fig. 4:2), Bouqras (ROODENBERG 1986: Figs. 7:1,2,4-5,8:1,3), and Qdeir (CALLEY 1986b), more long naviforms were certainly present (Table 6). At Palmyra locality 35 massive preforms are present (NISHIAKI 1992: 122). As supporting evidence there are large blades and crested blades from sites like Abou Gosh and Beisamoun that are suggestive of naviform production from cores respectively 88-185 mm. (LECHEVALLIER 1978: 42) long and 85-125 mm. (LECHEVALLIER 1978: 154) long. In the arid zones of the southern Levant at Dhuweila (the closest PPNB site with data - kindly supplied by C. McCartney), Nahal Divshon (SERVELLO 1976: Table 12.14), and Wadi Tbeik (GOPHER 1981) there is clear evidence of smaller cores. These facts may relate to desired blade size.

The Early Late Neolithic sees the decline and rapid disappearance of naviform strategies and probably an increasing role for flake production from single platform and change of orientation strategies concurrent with a shift in raw material use (BAIRD n.d. a). Some of these developments seem to be closely echoed at sites with coeval sequences like Basta (NISSEN *et al.* 1987: 97-98), Ain Ghazal (ROLLEFSON *et al.* 1989: 12-13), and Bouqras (ROODENBERG 1986: 19-21). There are indications that changes in technique at Ain Ghazal (ROLLEFSON 1990) are reflected at WJ25 (see above). However, in Jilat blade production persists into the earliest Early Late Neolithic. We are thus either 1) better able to document the detail of that development in the Early Late Neolithic or 2) blade production persisted longer in the Jilat/Azraq basin. Thus, in this regard also, the Jilat and Azraq communities participate in widespread technological developments. One further deduction seems clear.

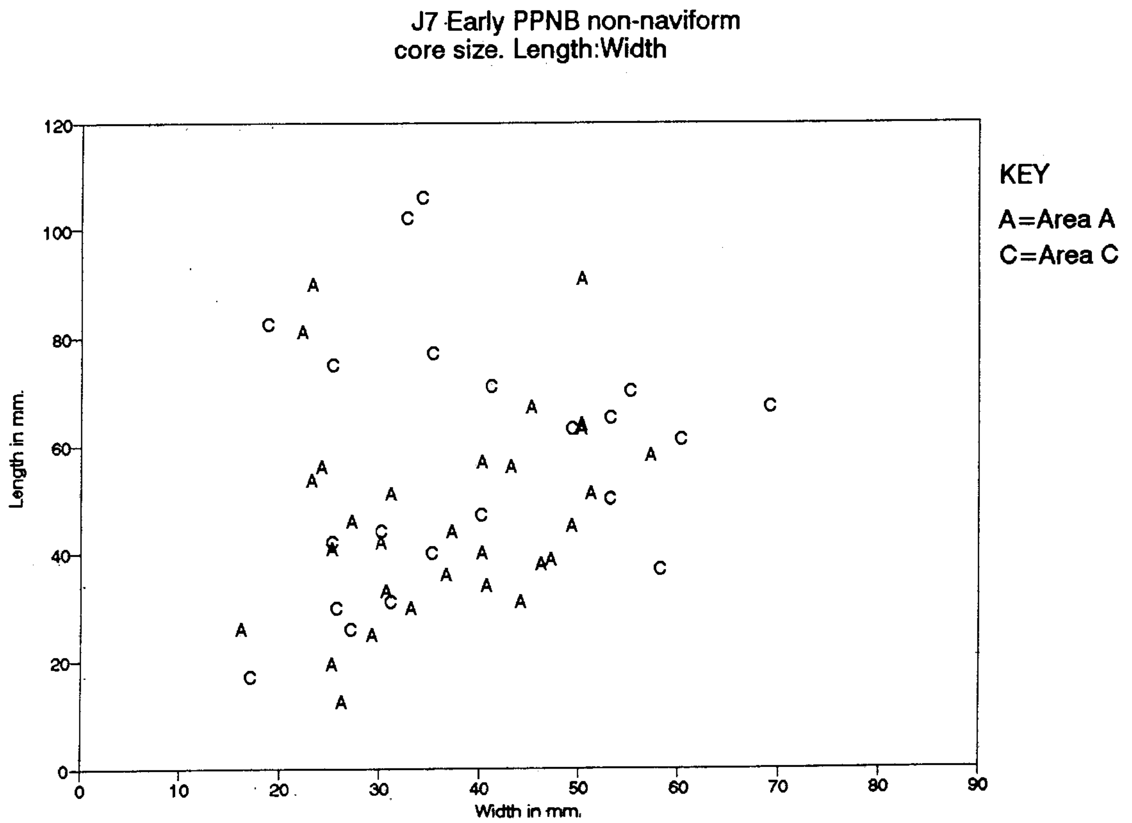

Fig. 6. Length/width scattergram of Early PPNB non-naviform cores from WJ7.

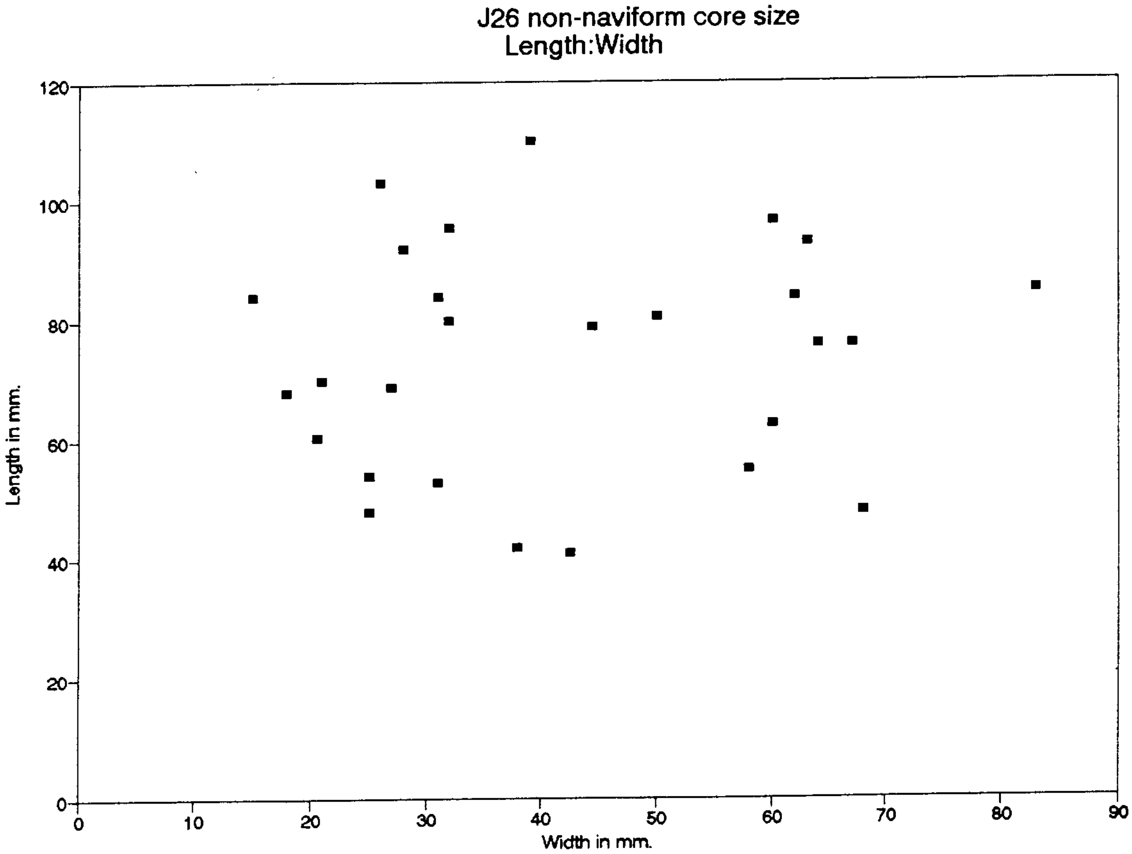

Fig. 7. Length/width scattergram of non-naviform cores from Middle PPNB WJ26.

The persistence of tabular reduction strategies and the homogeneity of Jilat/Azraq naviforms points to a considerable degree of continuity in local traditions alongside the more general changes.

The evidence from within the Azraq basin itself suggests that features of technique may indicate the affiliation of communities more clearly than strategy. There appear to be two discrete traditions coexisting in the 7th-6th Millennium b.c., one in the centre and one in the west of the basin. The potential significance of this is given greater support when it is clear that the Dhuweila lamellar debitage platform and bulb indices (C. McCartney, pers. comm.) share much in common with those from Azraq 31 Late PPNB (BAIRD 1993: 441-442) that is similar proportions of cortical, punctiform, plain, and dihedral platforms. Preparation of the edge of the platform on the main removal surface is somewhat more common at Dhuweila than Azraq 31, but much higher than in Jilat assemblages yet lower than sites to the west and north. Further blade-bladelet assemblages from 7th Millennium b.c. Jericho (CROWFOOT PAYNE 1983: 671; NISHIAKI 1992: 387-388 and Table 4.18), Basta (GEBEL *et al.* 1988) and Ain Ghazal (ROLLEFSON 1990: Table 1) have very high proportions of punctiform and filiform platforms with edge of platform preparation on the main removal surface. These are, thus, in marked contrast to the assemblages in Jilat. Other features contrast, in particular the proportions of cortical, dihedral and faceted platforms. These differences cannot be linked to variability in the nature or degree of use of naviform strategies because these factors appear more variable than the technique indices in Jilat. Further, naviform strategies, which indicate at least higher investment in preparation, are as common, if not more common, in Jilat than elsewhere. Yet as indicated above Jilat lamellar debitage demonstrates relatively low proportions of preparation compared to many other sites.

What do such patterns of contrasting techniques indicate? They may indicate 1) the traditional practices of groups reflecting specific intercommunication or 2) the requirements of adaptation to local raw material. The various raw materials actually utilised are similar in Azraq and Jilat and the tabular material exploited in Basta and Beidha is also closely related. Such materials and related flat cobbles, were also used at Jericho and Ain Ghazal. It seems unlikely that raw material variation can itself explain technique variation. Percussors available in various local environments may have differed, but suitable hammers are likely to have been curated, particularly by mobile groups and variations in percussor are unlikely to explain the whole gamut of technique variation. Adaptation to different raw material settings is unlikely to explain variation in technique, therefore. These features, along with the composition of the tool assemblages (BAIRD 1993), suggest considerable continuity from 8th into early 6th Millennium b.c. and the technique factors suggest a certain autonomy for potentially small scale communities utilising various areas of the steppe.

Acknowledgments: This paper was written whilst the author was holder of the G. A. Wainwright Fellowship, Oriental Institute, Oxford University.

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The 'PPNC' Flint Assemblage from Tel 'Ali

Yosef Garfinkel

Introduction

The classic sequence of the Neolithic period in the southern Levant was formulated by Dame Kathleen Kenyon after her extensive excavations at Jericho in the 1950s (KENYON 1957, 1960). She suggested a division of two pre-pottery phases, namely Pre-Pottery Neolithic A (PPNA) and Pre-Pottery Neolithic B (PPNB). These were followed, in her opinion, by a settlement gap which lasted several centuries. Later on two successive pottery phases emerged, namely Pottery Neolithic A (including the Yarmukian culture in the north and the Jericho IX culture in the south, see GARFINKEL in press) and Pottery Neolithic B (PNB/Wadi Rabah). The earlier part of this sequence, the PPNA and PPNB, was accepted from the 1960s to the 1980s without any serious criticism (PERROT 1968, CAUVIN 1978, BAR-YOSEF 1981, MOORE 1982).

However, since the mid-1980s, as a result of the excavations at 'Ain Ghazal, it has become more and more obvious that the 'gap' between the end of the PPNB and the beginning of the PNA was actually not a gap in the settlement of the Southern Levant but a gap in our knowledge (ROLLEFSON 1989). The excavators of 'Ain Ghazal suggested the term 'Pre-Pottery Neolithic C' (PPNC), also known as 'Final PPNB' (ROLLEFSON 1989: 169), to describe the cultural unit which existed between the PPNB and the PNA. In our recent excavations at Tel 'Ali, a Pre-Pottery Neolithic settlement layer was exposed whose associated flint assemblage displayed a mixture of features, some typical of the PPNB and others typical of the PNA. It seems to us that this layer should be attributed to the period between the PPNB and the PNA, and is therefore another example of the so-called 'PPNC' period.

Since the main argument against the hypothasis presented here is that this layer is a mixture of different periods, we shall first present the stratigraphy of Tel 'Ali and the relevant excavation units (loci) in detail. The data concerning the flint industry is also presented in the tables, arranged according to the specific loci, so that every excavated unit can be separately examined and scrutinized.

The Stratigraphy of Tel 'Ali

The traditional Arabic name of the site is Khirbet esh-Sheikh 'Ali, though in the first preliminary publications it was designated 'Alumoth' (PRAUSNITZ 1955, 1957), and in later publications Tel 'Ali (PRAUSNITZ 1970). In order to avoid confusion we will use the name employed by the previous excavator. The site is located in the central Jordan Valley, about 1.5 km south of the sea of Galilee, at the confluence of Nahal Yavniel and the Jordan River (Israel map reference 2027.2342). The site was excavated between 1955 and 1959 by M. Prausnitz, on behalf of the Israel Department of Antiquities and Museums (PRAUSNITZ 1955, 1957, 1960, 1965, 1970: 84-144), and in 1989-1990 by the author, on behalf of the Institute of Archaeology of the Hebrew University of Jerusalem. In the last forty years the site has been subjected to various development projects which have badly damaged it and its archaeological remains. The original surface and topography, as seen on maps from the British mandatory period, are now quite unrecognizable. They show, for example, a sheikh`s tomb that no longer exists. The digging of fish ponds (subsequently filled in), the construction of oxygenation pools for the local sewage system, the laying of a central water pipe leading to reservoirs and to a subterranean

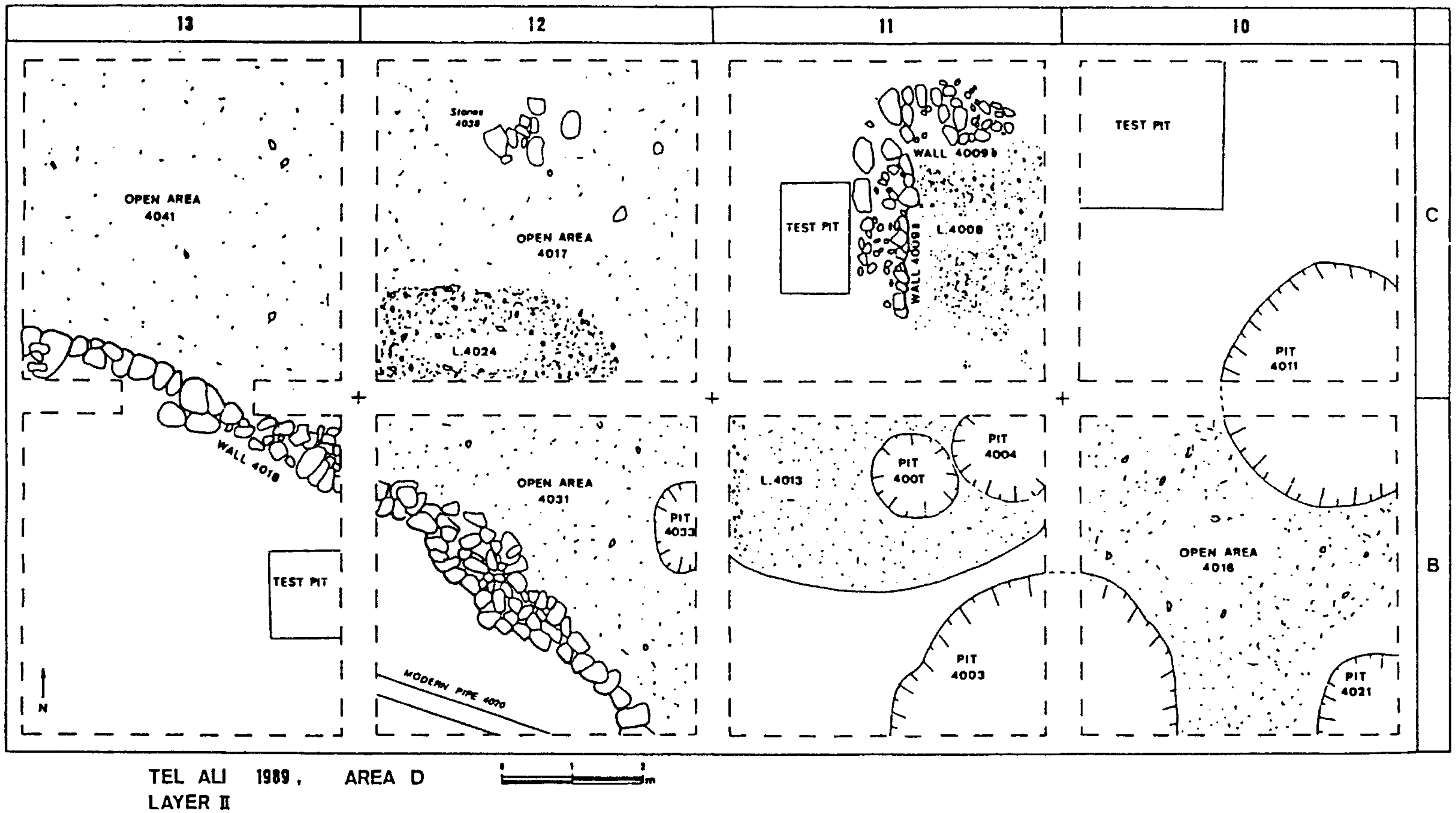

Fig. 1. Tel `Ali Area D, Stratum 2: Map of excavations.

irrigation network, and intensive agricultural activity, including annual ploughing and harrowing, have damaged the site. The area excavated by Prausnitz in the 1950s cannot be identified today. During the summer of 1990 the site suffered badly when 70 illegal soil sample trenches (1 by 3 m long and 2-3 m deep) were dug in its central part. Systematic recording of the profiles exposed, and collection of finds from each trench, gave additional information on the archaeological deposit of Tel 'Ali.

Prausnitz excavated in three areas:

Area A: a small probe in the northern part of the site.
Area B: the main area at the centre of the site.
Area C: a section of 2.5 by 10 metres excavated by V. SUSSMAN (1991) in the southern part of the site.

Prausnitz distinguished seven stratigraphic stages. The sequence from top to bottom is as follows:

Stratum 1a contained sherds of churns and large clay vessels decorated with bands of thumbprints, defined by the excavator as Ghassulian Chalcolithic (PRAUSNITZ 1970: 144).

Stratum 1b containeed pottery, stone-lined silos (PRAUSNITZ 1970: 105, Pl. c), and basalt chalices (PRAUSNITZ 1970: 95, Fig. 35), defined as pre-Ghassulian Chalcolithic.

Stratum 1c yielded bow-rimmed storage jars decorated with red and black burnish (PRAUSNITZ 1965), and was defined by the excavator as Pottery Neolithic, apparently parallel to the Wadi Rabah/PNB phase. The plan published from this stratum showed several rectangular structures, including one with two adjoining rooms (PRAUSNITZ 1970: 102, Fig. 39).

Stratum 2: A flint assemblage including sickleblades with coarse denticulation (PRAUSNITZ 1970: 132), characteristic of the PNA. Pottery was also attributed by the excavator to this layer, but no drawings were published (PRAUSNITZ 1970: 142). This pottery, according to the description, did not include the typical herringbone decoration characteristic of the nearby site of Sha`ar Hagolan and of the Yarmukian culture. As a matter of fact, this pottery is similar to that reported from Strata 1c and 1b. In our new excavations this stratum did not yield any pottery at all, so it seems to us that Prausnitz included intrusive sherds, probably from pits cut into this pre-pottery layer.

Stratum 3: Pre-Pottery Neolithic B.

Stratum 4a: Pre-Pottery Neolithic B

Stratum 4b: Pre-Pottery Neolithic B.

Prausnitz's publications show that several well-known phases can be discerned here, such as the Ghassulian Chalcolithic (Stratum 1a), the Wadi Rabah/PNB (Stratum 1c) and the PPNB (Strata 3, 4a and 4b). He also described two other phases whose nature is less clear:

Stratum 1b: found in stratigraphic context between the Wadi Rabah and Ghassulian phases, contained silos lined with stone slabs and basalt chalices, which are features not known from Wadi Rabah sites.

Stratum 2: found in stratigraphic context between the Wadi Rabah and Pre-Pottery Neolithic B phases. It yielded flint tools characteristic of the PNA phase, such as sickleblades with coarse denticulation. However, as noted, the pottery reported from this stratum is completely different from that of Yarmukian sites. Clay or pebble figurines, also characteristic of Yarmukian sites (STEKELIS 1972), were not found at Tel 'Ali at all.

Since the ceramic assemblages from the different strata have not been published, it is impossible to check, confirm, correct or reject Prausnitz's conclusions. It is also not clear what characterizes the two less well-defined strata, and they cannot be compared to assemblages from other sites. In order to clarify the nature of these two enigmatic strata (1b and 2), we carried out a new excavation project at the site in 1989 and 1990. Two new areas (D and E) were opened and altogether 300 sq. m were excavated.

Area D: Excavated in the 1989 season, this area covers about 200 sq.m. Two occupational strata, one above the other, were found here above virgin soil:

Stratum D1: characterized by pits, silos lined with stone slabs, basalt chalices, pottery and flint tools. The pottery includes very simple types: deep bowls, hole-mouth jars and storage jars. The vessels are characterized by handles that widen markedly at their juncture with the vessel's body. The decorative techniques include broad red stripes on the rim, stripes of paint drizzling down the vessel from its top, incised and impressed decoration and occasionally slip and burnish. Similar pottery has been reported in the Jordan Valley, from Beth Shean Layer XVIII and pits (FITZGERALD 1935), and from the lower levels at Tell esh-Shuneh, Tell Abu Habil, and Tell es-Sadiyeh el-Tahta (de CONTENSON 1960).

Stratum D2 yielded remains of walls and pits. No pottery was found, but some small fragments of 'white ware' vessels, moulded out of burnt lime, were discovered. The flint tools included Neolithic arrowheads and sickleblades.

Area E: Excavated in 1990, this area is about 200 m south of Area D. A square of 10 by 10 m (100 sq.m) was unearthed, two occupation strata were exposed, one above the other, and virgin soil was not reached:

Stratum E1 yielded carefully-built rectangular structures and broad walls. An infant burial in a storage jar was also found. The ceramic repertoire is characteristic of the Ghassulian Chalcolithic and includes sherds of both large and small churns, large and small deep bowls, hole-mouth jars, various storage jars and a sherd from a huge pithos, of a type characteristic of the central Jordan Valley.

Stratum E2: an earlier occupational stratum which contains part of a residential structure with two rooms and an open courtyard with a flat basalt mortar. The pottery from this stratum is identical to that found in Stratum D1.

The data from both the early and the new excavations suggest the scheme of occupational phases shown in Table 1. As Prausnitz's stratigraphic framework is still largely acceptable, his numbering system for the strata has been retained. The main difference, however, is that no pottery should be related to Stratum 2. As this workshop concentrates on the chipped lithic industries of the Pre-Pottery Neolithic period, my paper presents the finds from Area D, Stratum 2, which is the only Pre-Pottery Neolithic layer unearthed so far in the new excavations.

Stratum D2

In Area D a 200 sq.m area was exposed. A settlement layer was discovered which contained part of a structure, consisting of a corner created by two straight walls meeting at a right angle (Loci 4009a and 4009b), which indicated the existence of rectangular architecture. Around it open areas 4013, 4016, 4017 and 4042 were discovered. In these open areas six round pits of varying diameters were excavated (4003, 4004, 4007, 4011, 4021, and 4033). Two pits (4003 and 4007) were full of angular limestones piecas. Pit 4004, on the other hand, was filled with a thin grey sediment enriched with organic material. All the area was enclosed to the south and west by Wall 4018, which is 12 m long. Its two ends extend beyond the excavated area. In the open areas and pits various finds were unearthed: flint, animal bones, stone vessels, art objects and some sherds of 'white ware'. It should be noted that no evidence for the plaster floors typical of the PPNB was found. Such floors were found neither in the excavated areas, nor in the deep sections created by trenches dug for a soil study, though these trenches reached strata in which no pottery was observed.

Here is a list of all the loci in this strata. Tables 2-6 present the various finds collected at each locus:

Locus 4003- A deep round pit full of angular limestones piecas in Squares B-10/B-11.
Locus 4004- A shallow round pit full of soft grey sediment enriched with organic material in Square B-11.
Locus 4007- A shallow round pit full of angular limestones piecas in Square B-11.
Locus 4008- A concentration of angular stones in Square C-11, between Walls 4009a and 4009b, perhaps serving as a foundation fill for a floor surface which did not survive.
Locus 4009a- Part of a stone wall running north-south in Square C-11, which forms a right angle with Wall 4009b.
Locus 4009b- Part of a stone wall running east-west in Square C-11, which forms a right angle with Wall 4009a.
Locus 4011- A shallow round pit in Squares B-10/C-10.
Locus 4013- An open area in the shape of a shallow round depression in Square B-11, characterized by relatively high concentration of animal bones.
Locus 4016- An open area in Square B-10.
Locus 4017- An open area in Square C-12.
Locus 4018- A long stone wall in Squares B-12,13/C-13.
Locus 4021- A round pit in Square B-10.
Locus 4024- An area paved by pebbles in the southern part of Locus 4017, in Square C-12.
Locus 4031- An open area in Square B-12, north of Wall 4018.
Locus 4033- A shallow round pit in Square B-12.
Locus 4038- A concentration of grinding stones in Locus 4017, Square C-12.
Locus 4041- An open area in Square C-13.

The Technology of the Flint Industry

The flint assemblage of Stratum D2, which includes 8,622 items, was been collected in the various loci, as listed in Tables 2-6. All the sediment was sieved through a 2 by 2 mm mesh. The source of the flint should be stressed, because there is no exposed flint in primary depositions in the central Jordan Valley, neither in the Lisan layers, which are the most common substance in the area, nor in the basalt stone covering the hills of the eastern Galilee which slope down to the Jordan Valley.

The major source of flint in Stratum D2 of Tel 'Ali (and other Neolithic sites in the central Jordan Valley, such as Gesher [GARFINKEL and NADEL 1989: 147], Pottery Neolithic Munhata [GOPHER 1989a: 81] and Sha`ar Hagolan [GARFINKEL 1992a: 126-127]) is grey medium-sized river pebbles, which were collected from the river beds of Nahal Yavniel, the Yarmuk River or the Araq el-Ahmar formation. The diameter of these pebbles, as they are reconstructed from the cores which were produced from them, was between 7 and 10 cm Of the assemblage of 100 cores, most have retained traces of the original surface on their periphery, indicating that they were produced from river pebbles. The pebble's surface is not covered by cortex, since this cover had eroded away as a result of the pebble's journey down-stream in the river. The surface of the pebbles is either battered and scarred like that of a hammerstone, or smoothed and grey or reddish-brown patinated.

In addition, in the Stratum D2 assemblage flakes and blades were found which were made on flint of a better quality, imported to the site from a great distance away from the central Jordan Valley. These include two different sorts of flint:

a) Brown flint. Some cores and debitage of this type of plint were also found.
b) Purple flint. No cores of this flint were found, but mostly blades and tools. This sort of flint is familiar from other Neolithic sites and probably underwent a process of heating, so as to transform it into better knapping material.

The flint assemblage was divided into the following categories (see Table 3):

Primary Elements- Items whose surface retains at least 30% of the original face of the core. The core face may be composed of cortex, but since the main source of flint for the site was river pebbles, the surface is more often light grey patinated or battered and coarse. This category included 926 items, constituting 10.7% of the assemblage.

Flakes- Items longer than 1.5 cm with their length less then double their width. This category included 1,810 items, constituting 21% of the assemblage.

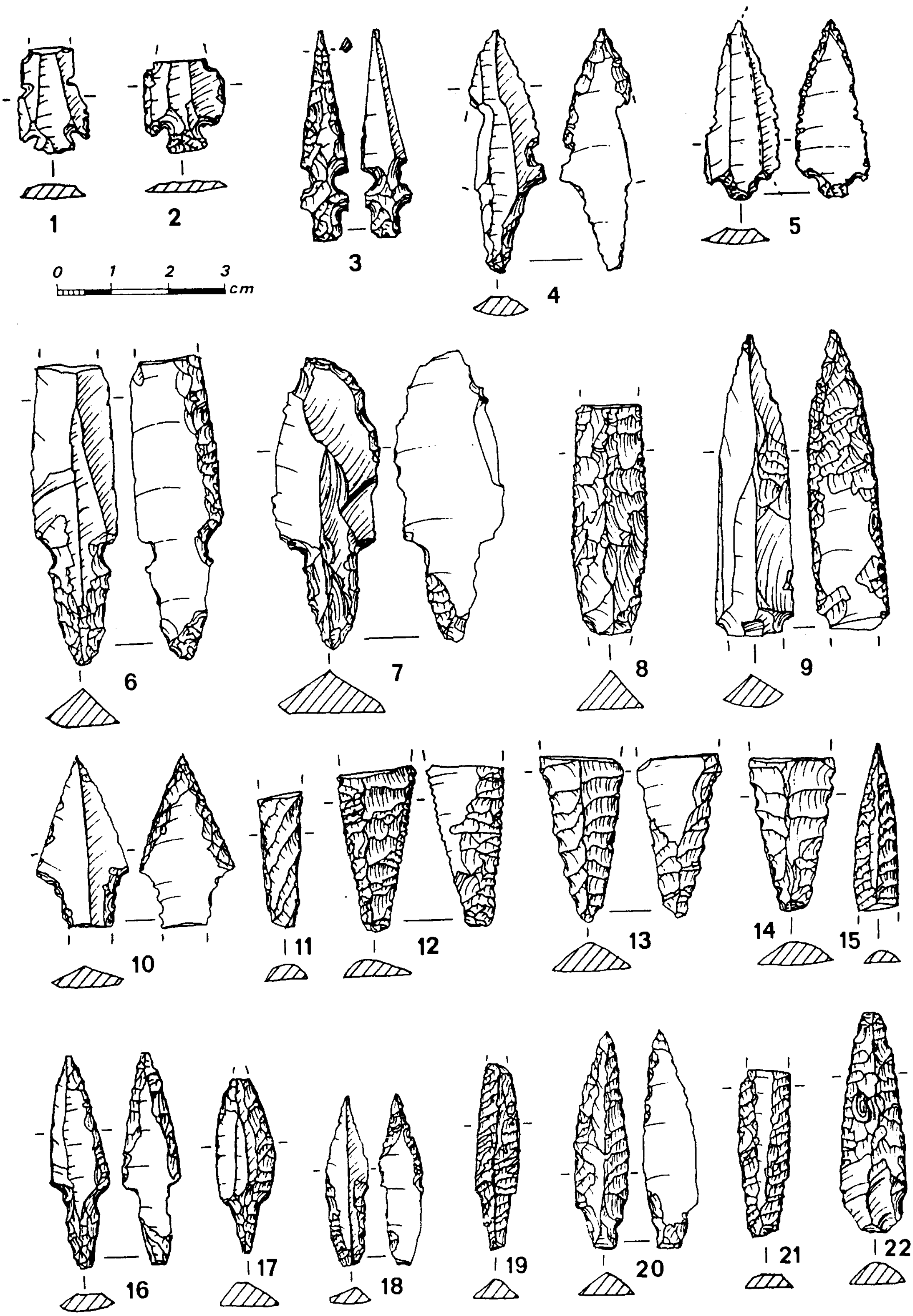

Fig. 2. Tel `Ali Area D, Stratum 2: Arrowheads.

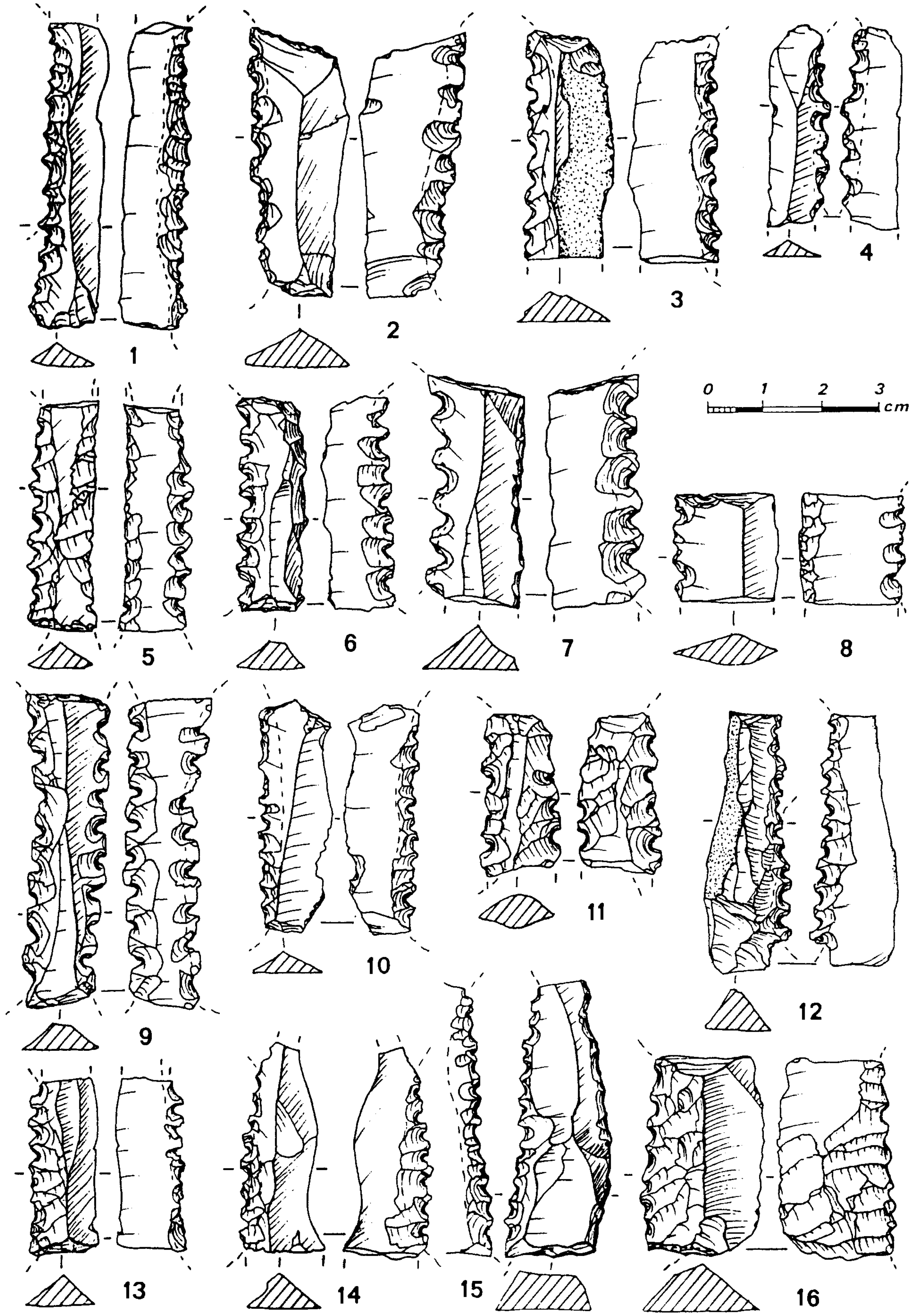

Fig. 3. Tel `Ali Area D, Stratum 2: Sickleblades.

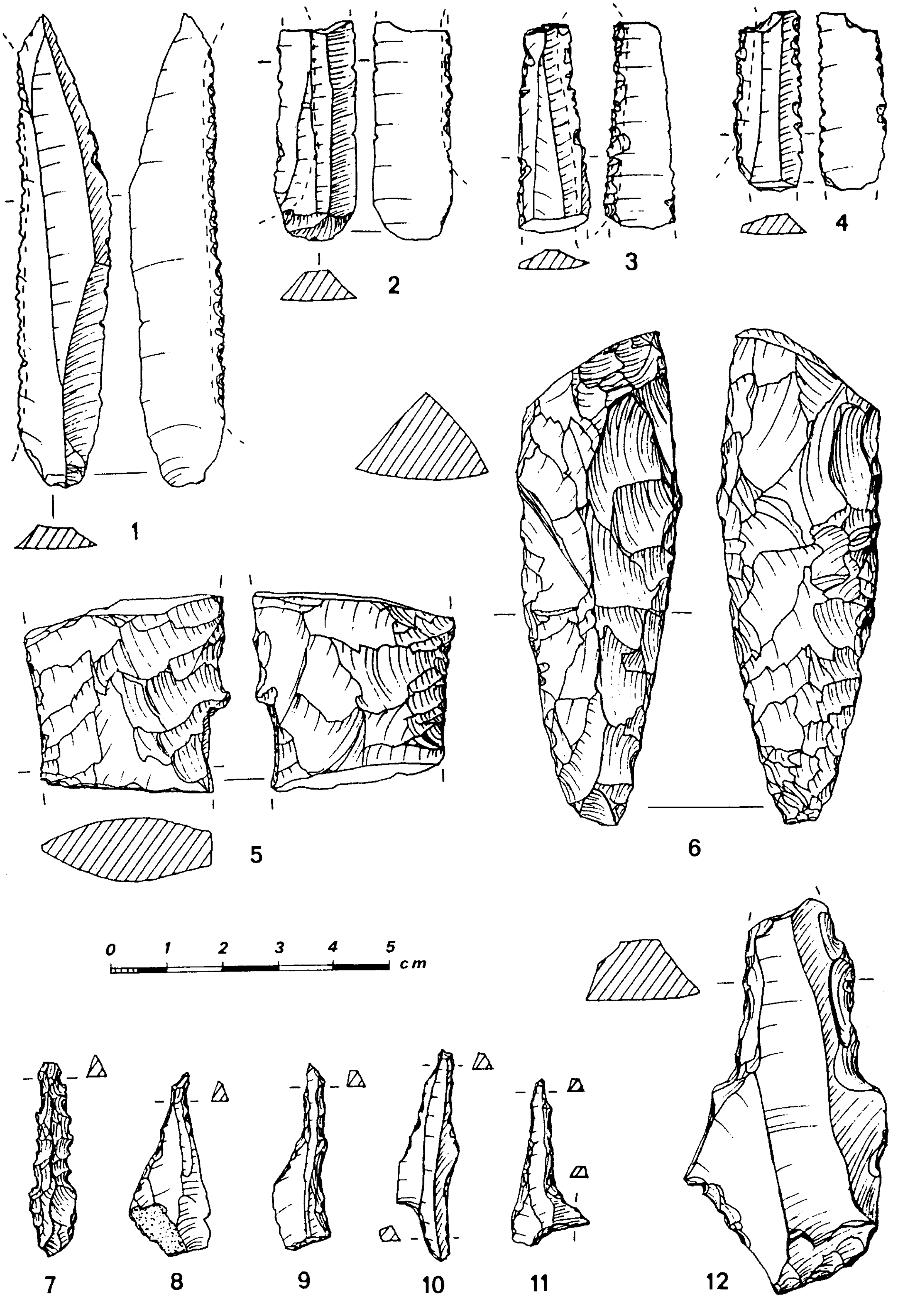

Fig. 4. Tel `Ali Area D, Stratum 2: Sickleblades, bi-facials, and borers.

Blades- Items whose length is more than double their width. This category included 366 items, constituting 4.2% of the assemblage.

Bladelets- Small blades whose width does not exceed 1.2 cm and whose length does not exceed 4 cm. This category included 350 items, constituting 4.1% of the assemblage.

Chips- Small flakes whose size does not exceed 1.5 cm. This category included 3,738 items, constituting 43.4% of the assemblage.

Chunks- Lumps of flint which are not the result of intentional knapping. This category includes items of an amorphic shape, and particularly items which exploded as a result of heating. These are of a bluish-grey flint. This category included 532 items, constituting 6.2% of the assemblage.

Cores- This category included 100 items, constituting 1.2% of the assemblage. The description of the different types will be given below.

Core-Trimming Elements- These are various forms of flint, knapped in order to rejuvenate the striking platform of the core. This category included 147 items, constituting 1.7% of the assemblage. These items are not identical to the typical core trimming elements of the naviform industry, as discussed in detail in the analysis of the PPNB flint industry of Yiftahel (GARFINKEL 1987a).

Burin spalls- Items with a triangular or quadrangular section and two smooth sides. They may have been the result of knapping burins, but it also seems that some of them were created as a result of knapping carried out on the core and are in fact another kind of core-trimming element. This category included 141 items, constituting 1.6% of the assemblage.

Axe spalls- Items obtained by width knapping carried out on bi facial tools, in order to rejuvenate the working edge. This category included one item, constituting less than 0.01% of the assemblage.

Tools- Flaked items bearing systematic retouch or heavy duty items like bi-facials and hammerstones. This category included 436 items, constituting 5.1% of the assemblage. These include six hammerstones.

Use signs- Various items with scars but which had not been systematically retouched. At Jericho this group was designated "nibbled tools" (CROWFOOT PAYNE 1983). This category included 64 items, constituting 0.7% of the assemblage.

Palaeolithic Flint- In the sediment of the site were a few thick flakes patinated differently from the other flint knapping elements found. These are probably Palaeolithic flakes which were washed and redeposited in Stratum D2. This category included 11 items, constituting 0.1% of the assemblage.

The assemblage includes 100 cores, as specified in Table 4. These are divided into six types:

a) Cores with one striking platform (28 items, 28%).
b) Cores with two opposed striking platforms (22 items, 22%). Some of these cores are of classical naviform shape.
c) Cores with several striking platforms (10 items, 10%). A systematic removal of products from each platform can be identified.
d) Ridge-cores (15 items, 15%). This definition is used for a group of cores without a clearly defined striking platform. Flakes were knapped alternately on the left and right, creating a ridge along most of the item's circumference.
e) Small cores (17 items, 17%). The size of these does not exceed 3 cm, and they have no defined striking platform.
f) Amorphic cores and core fragments (8 items, 8%). These are items which are larger than 3 cm but do not have a defined striking platform. They were knapped freely, with no clear pattern.

In contrast to the elaborate PPNB naviform tradition of producing elegant blades, in Tel 'Ali Stratum D2 a decrease in blade production is evident. This is apparent both in the cores used and in the

Table 1. The stratigraphy at Tel `Ali *(based on GARFINKEL 1992a).*

Cultural Stage	Chronology (uncalibrated)	Prausnitz excavations	Area D	Area E
Ghassulian Chalcolithic	4000-3200 B.C.	1a	--	E1
Pre-Ghassulian Chalcolithic	4600-4000 B.C.	1b	D1	E2
Wadi Rabah/PNB	5000-4600 B.C.	1c	--	--
Sha`ar Hagolan/PNA	5600-5000 B.C.	--	--	--
'PPNC'	6100-5600 B.C.	2	D2	--
PPNB	7200-6100 B.C.	3-4	--	--

Table 2. Tel `Ali Stratum D2: General information on the distribution of the finds in the excavated units.

Category of finds	4003	4004	4007	4008	4011	4013	4016	4017	4022	4024	4031	4033	4038	4042	Total
Total flint items	1212	331	512	638	833	2372	649	729	218	246	70	208	-	604	8622
Flint tools	60	30	33	25	26	77	46	66	15	25	1	10	-	22	436
Stone tools	27	1	3	9	9	7	6	12	3	6	4	3	5	3	98
Obsidian	5	-	1	1	-	1	-	3	1	1	-	1	-	3	17
Green stone	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1

Table 3. Tel `Ali Stratum D2: Distribution of the flint assemblage in the various excavated units.

Category of finds	4003	4004	4007	4008	4011	4013	4016	4017	4022	4024	4031	4033	4038	4042	Total	%
Primary elements	134	33	48	53	100	213	87	91	22	33	7	37	-	68	926	10.7
Flakes	277	87	87	130	183	416	146	189	49	48	21	55	-	122	1810	21.0
Blades	61	17	17	23	31	85	34	28	9	21	5	14	-	21	366	4.2
Bladelets	43	21	16	19	41	89	33	32	6	12	3	12	-	23	350	4.1
Chips	428	112	247	335	387	1216	224	251	90	88	19	63	-	278	3738	43.4
Chunks	155	12	41	10	16	175	36	28	11	6	7	2	-	33	532	6.2
Cores	20	3	5	7	12	17	11	8	1	6	3	4	-	3	100	1.2
Core T.E.	7	6	9	14	19	37	12	19	7	3	2	4	-	8	147	1.7
Burin spalls	15	6	4	17	11	35	14	11	5	2	1	3	-	17	141	1.6
Axe spalls	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	0.1
Tools	60	30	33	25	26	77	46	66	15	25	1	10	-	22	436	5.1
Us signs	7	4	5	4	7	11	5	4	2	2	1	4	-	8	64	0.7
Palaeolithic items	5	-	-	1	-	1	-	2	1	-	-	-	-	1	11	0.1
Total	1212	331	512	638	833	2372	649	729	218	246	70	208	-	604	8622	100.1

Table 4. Tel `Ali Stratum D2: Distribution of the cores in the different excavated units.

Type of core	4003	4004	4007	4008	4011	4013	4016	4017	4022	4024	4031	4033	4038	4042	Total	%
One striking platform	6	-	1	1	1	8	5	3	-	2	1	-	-	-	28	28
Two striking platforms	3	3	1	3	2	5	1	-	-	1	2	-	-	1	22	22
Several platforms	3	-	-	-	-	1	3	1	-	-	-	-	-	2	10	10
Ridge-core	7	-	-	-	3	1	1	1	1	-	-	1	-	-	15	15
Small core	1	-	1	3	5	1	1	2	-	2	-	1	-	-	17	17
Amorphic and fragments	-	-	2	-	1	1	-	1	-	1	-	2	-	-	8	8
Total	20	3	5	7	12	17	11	8	1	6	3	4	-	3	100	100

percentage of blades in the debitage. Similar observations have also been reported from PPNC 'Ain Ghazal (ROLLEFSON 1990).

The Flint Tool Typology

The breakdown of the tools, 436 items, was carried out according to the common typology of PPNB flint tools (see, for example, CROWFOOT PAYNE 1983, GOPHER 1989a). The breakdown of the items found in each locus is presented in Table 5 according to a detailed typological classification, and in Table 6 according to main types.

Table 5. Tel `Ali Stratum D2. Distribution of the main flint tool categories in the various excavated units.

Category	4003	4004	4007	4008	4011	4013	4016	4017	4022	4024	4031	4033	4038	4042	Total
Helwan point	-	-	1	-	-	-	-	2	-	-	-	-	-	1	4
Jericho point	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
Large Byblos/Amuq point	1	-	1	1	1	2	2	-	-	-	-	-	-	1	9
Medium Byblos/Amuq point	1	1	2	1	1	-	2	-	-	-	-	-	-	-	8
Point fragment	-	1	-	-	-	-	-	-	-	-	-	-	-	1	2
Sickleblade a	4	9	5	2	3	8	2	2	1	-	-	-	-	2	38
Sickleblade b	1	1	1	1	-	3	1	-	-	-	1	-	-	-	9
Sickleblade c	3	-	-	1	-	3	-	-	-	-	-	-	-	-	7
Sickleblade d	3	6	5	1	-	2	-	-	-	-	-	-	-	1	18
Sickleblade e	-	3	1	1	-	4	1	-	-	1	-	-	-	-	11
Sickleblade f	3	3	5	1	1	6	3	4	3	4	-	3	-	5	41
Sickleblade g	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Sickleblade h	-	-	-	-	-	-	-	2	-	1	-	-	-	-	3
Sickleblade i	-	-	-	-	2	-	-	-	1	1	-	-	-	-	4
Bi-facial	2	1	-	-	1	1	-	2	-	1	-	1	-	1	10
Awl	-	-	-	-	-	3	1	2	1	2	-	-	-	1	10
Epine	-	-	-	-	-	2	-	2	-	-	-	1	-	-	5
Borer	1	1	-	1	2	2	1	16	-	6	-	1	-	-	31
Double borer	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
Coarse borer	-	-	-	-	-	-	-	1	-	-	-	-	-	1	2
Scraper on a flake	-	-	-	-	-	-	1	-	1	-	-	1	-	-	3
Rounded scraper	2	-	1	-	-	1	3	3	-	-	-	-	-	-	10
Denticulated scraper	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Scraper on a blade	-	-	-	-	-	1	1	1	-	-	-	-	-	-	3
Carinated scraper	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Scraper fragment	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
Side scraper	3	-	-	-	2	1	1	-	1	-	-	-	-	-	8
Dihedral burin	2	-	1	1	-	1	-	-	1	-	-	-	-	-	6
Burin on truncation	-	-	-	1	-	1	-	-	-	-	-	-	-	-	2
Burin on natural face	-	-	-	-	1	1	2	1	-	-	-	-	-	-	5
Double burins	1	-	-	1	-	-	2	2	-	-	-	-	-	1	7
Single notches	1	-	1	2	-	3	-	1	-	1	-	1	-	-	10
Two parallel notches	-	-	-	1	-	1	-	-	-	-	-	-	-	-	2
Denticulate	-	-	-	1	-	-	1	1	-	-	-	-	-	-	3
Saw	2	-	-	-	1	1	4	2	-	-	-	1	-	-	11
Truncation	4	1	2	2	3	6	7	2	-	1	-	-	-	2	30
Ret. blade on one side	1	-	1	1	2	3	1	3	-	-	-	-	-	1	13
Ret. blade on two sides	1	-	1	-	1	-	-	-	-	-	-	-	-	-	3
Backed blade	-	-	-	-	-	-	-	2	2	1	-	-	-	-	5
Ret. bladelet	-	1	-	-	1	3	1	2	1	1	-	-	-	-	10
Retouched flake	7	1	2	-	1	9	2	2	1	1	-	-	-	1	27
Chopping tool	5	-	-	-	1	-	-	-	-	-	-	-	-	-	6
Hammerstone	4	-	-	1	-	-	-	1	-	-	-	-	-	-	6
Pièce esquilé	5	-	2	1	1	2	1	2	-	-	-	1	-	1	16
Points and tangs fragment	1	1	1	1	-	4	1	1	1	1	-	-	-	-	12
Retouched fragment	-	-	-	2	1	2	1	2	1	-	-	-	-	-	9
Retouched blade fragment	-	-	-	-	-	-	1	1	-	1	-	-	-	1	4
Rounded retouch large flake	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Lunette	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Double tool	1	-	-	-	-	1	1	1	-	-	-	-	-	-	4
Total	60	30	33	25	26	77	46	66	15	25	1	10	-	22	436

Table 6. Tel `Ali Stratum D2: Distribution of the flint tools in the various excavated units.

Flint Tools Category	4003	4004	4007	4008	4011	4013	4016	4017	4022	4024	4031	4033	4038	4042	Total	%
Arrowheads	2	2	4	2	2	2	4	2	-	1	-	-	-	3	24	5.5
Sickleblades	15	22	17	7	6	26	7	8	5	7	1	3	-	8	132	30.3
Bi-facials	2	1	-	-	1	1	-	2	-	1	-	1	-	1	10	2.3
Awls & borers	1	1	-	1	2	7	2	23	1	8	-	2	-	2	50	11.5
Scrapers	5	-	1	-	2	3	7	4	2	1	-	1	-	1	27	6.2
Burins	3	-	1	3	1	3	4	3	1	-	-	-	-	1	20	4.6
Notches & denticulates	3	-	1	4	1	5	5	4	-	1	-	2	-	-	26	6.0
Truncations	4	1	2	2	3	6	7	2	-	1	-	-	-	2	30	6.9
Retouched blades	2	1	2	1	4	6	2	7	3	2	-	-	-	1	31	7.1
Retouched flakes	7	1	2	-	1	9	2	2	1	1	-	-	-	1	27	6.2
Pounding tools	14	-	2	2	2	2	1	3	-	-	-	1	-	1	28	6.4
Varia	2	1	1	3	1	7	5	6	2	2	-	-	-	1	31	7.1
Total	60	30	33	25	26	77	46	66	15	25	1	10	-	22	436	100.1

Table 7. The frequencies of the sub-types of deep coarsely denticulated sickleblades in Tel `Ali Stratum D2 and Sha`ar Hagolan (GARFINKEL 1992b: 132, Table 12).

	Tel 'Ali Stratum D2		Sha'ar Hagolan	
Sub-type	No.	%	No.	%
No retouch on the opposite side	38	70.4	33	54.1
Some retouch on the opposite side	9	16.7	17	27.8
Denticulation on both sides	7	13.0	11	18.0
Total	54	100.9	61	99.9

Table 8. The stratigraphy of the main Neolithic sites of the seventh and sixth millennia B.C.

Phase	Jericho	'Ain Ghazal	Tel 'Ali	Tell Ramad	Megiddo	Byblos	Munhata
Wadi Rabah PNB	PNB	---	1c	---	---	N.M.	2a
Yarmukian PNA	PNA	Yarmukian	Gap	III	Yarmukian remains	N.A.	2b
PPNC	Gap	PPNC	2	II	Cave 4067	---	Gap (3a)
PPNB	PPNB	PPNB	3-4	I	---	---	3b-6

Arrowheads- 24 items, constituting 5.5% of the tools (Fig. 2). The arrowheads are divided into to a number of well-defined types:
a) Helwan point (4 items, Fig 2:1-4).
b) Jericho point (one item on purple flint, Fig. 2:5).
c) Large Byblos/Amuq point (9 items, Fig. 2:6-14).
d) Medium-sized Byblos/Amuq point (8 items, Fig. 2:15-22). These items have not been considered an independent type in the past and were classified under the regular PPNB large Byblos and Amuq arrowheads. This discrepancy has affected seriation analysis, for example, which fails to recognized the PPNC phase (GOPHER 1989b).
e) Fragments of arrowheads which could not be defined were also found (2 items).
It is possible that the Helwan arrowheads are intrusive, and do not belong to the assemblage of Stratum D2 at Tel 'Ali, since they usually appear in early PPNB assemblages (GOPHER 1989b). The other types, especially the medium-sized Byblos/Amuq arrowheads, which appear in large quantities, are an integral part of the assemblage. The medium-sized arrowheads are apparently a type intermediate between the elongated Byblos/Amuq types typical of the PPNB and the minute arrowheads of the Haparsah and Nitzanim types, typical of the Pottery Neolithic. In order to differentiate them from the classical Byblos and Amuq arrowheads a new common terminology for them is needed.

Sickleblades- 132 items, constituting 30.3% of the tools (Fig. 3,4:1-4). The sickleblades have been divided into nine different groups. The first four groups are characterized by a wide coarse bi-facial denticulation on the active side of the blade, lending the tool the general character of a coarse saw. A further sub division has been suggested on the basis of the treatment of the opposite side of the blade.
a) A blade with wide coarse denticulation on one side, and with no retouch on the opposite side (38 items, Fig. 3:1-4). The denticulation was fashioned by bi-facial semi-pressure retouch. Sometimes the item is truncated on one or both sides. The denticulation is widely spaced on the blade, with wide and deep notches.
This and the following two types of sickleblades are typical of PNA sites, such as Sha`ar Hagolan (STEKELIS 1972, GARFINKEL 1992a), Munhata (GOPHER 1989a), Jericho (CROWFOOT PAYNE 1983), Giv`at Haparsa (OLAMI *et al.* 1977), and Nitzanim (YEIVIN and OLAMI 1979). Their appearance in Stratum D2 at Tel 'Ali, unaccompanied by pottery, is of great significance. This seems to be an important characteristic element of the PPNC assemblages, as will be emphasized in the discussion below. In Table 7 we compare the frequencies of the wide coarsely denticulated sickleblades in Stratum D2 at Tel 'Ali and the similar items unearthed in our new excavations at the Pottery Neolithic site of Sha`ar Hagolan.
b) A blade with wide coarse denticulation on one side, and some retouch on the opposite side (38 items, Fig. 3:5-8). The retouch may be abrupt (beaked blade), semi-abrupt, fine or bi-facial. Sometimes the item is truncated on one or both sides.
c) A blade with wide coarse denticulation on both sides (7 items, Fig. 3:9,11). Sometimes the item is truncated on one or both sides.
d) Small fragments of blades with wide coarse denticulation on one side, in which the nature of the opposite side was not clear (18 items). Most of these items are burnt and it is obvious that they were broken as a result of heating.
e) Sickleblades with deep, dense denticulation (11 items, Fig. 3:12-15). The denticulation was fashioned by bi-facial, semi pressure retouch, with relatively large notches, but in comparison to blades of types a-d, they are crowded together. Schematic comparison of this type and types a-d is presented in Fig. 5). We suggest this type of tool be called the 'Tel 'Ali sickleblade'.
f) Sickleblades typical of the PPNB (41 items, Fig. 4:1-4). They were made on long, elegant blades made of superb (purple/cooked) flint, produced on naviform cores. Sometimes there is no denticulation on them but only lustre, and sometimes the denticulation is fine and covers the ventral side.

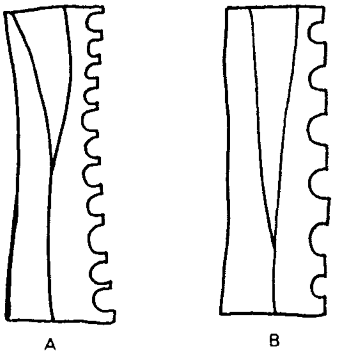

Fig. 5. Schematic drawings of sickleblades from Tel `Ali (A) and Sha`ar Hagolan (B).

g) A wide sickleblade with pressure retouch (1 item, Fig. 3:16). This item is more typical of Pottery Neolithic sites of the southern parts of the Levant: Nahal Qana (GOPHER and TZUK 1991), Nitzanim (YEIVIN and OLAMI 1979) and Givat Haparsah (OLAMI, BURIAN, and FRIEDMAN 1977).
h) Sickleblades typical of the Chalcolithic (3 items). These are made on blades typical of Chalcolithic sites from the Wadi Rabah stage onwards, and are an intrusive element in Stratum D2, probably from Stratum D1.
i) Unidentified fragments with lustre, indicating that they were used as sickleblades (4 items).

Bi-facials- 10 items, constituting 2.3% of the tools. Three long and narrow specimens fall into the category of chisels. Two special flat items fall into the category of spear-heads or bifacial knives (Fig. 4:5). Three items are axes; one polished all over, another has a transversal blow (Fig. 4:6). Two items were broken and further subdivision was not possible.

Awls and borers- 50 items, constituting 11.5% of the tools. These are divided into six groups:
a) Awls (10 items).
b) Delicate awl (épine) (10 items).
c) Borers (31 items, Fig. 4:7-9). It should be stressed that 71% of the borers were discovered in Square B-12; 16 items in Locus 4017 and another six items in Locus 4042.
d) Double borer (2 items, Fig. 4:10-11). One is a double drill and the second is a borer/awl. Both were found in Locus 4017 and increase the concentration of borers in this part of the site.
e) Coarse borer (2 items, Fig. 4:12).

Scrapers- 27 items, constituting 6.2% of the tools. This category includes six groups of end scrapers and one group of side scrapers.
a) Scrapers on flakes (3 items).
b) Rounded scrapers (10 items).
c) Denticulated scraper (1 item).
d) Scrapers on blades (3 items).
e) Carinated scraper (1 item).
f) Scraper fragments (exact type undetermined) (3 items).
g) Side scrapers (8 items).

Burins- 20 items, constituting 4.6% of the tools. They were divided into four groups:
a) Dihedral burins (6 items).
b) Burins on a truncation (2 items).
c) Burins on a natural surface (5 items).
d) Double burins (7 items.)

Notches and denticulates- 26 items, constituting 6% of the tools. They were divided into four groups:
a) Items with a single notch (10 items).
b) Items with two parallel notches (2 items).
c) Denticulates (3 items).
d) Saws (11 items). Blades with denticulation on one side in the form of a saw. Some of these items are close to the sickleblades with a narrow denticulation and may actually be a stage in the preparation of sickleblades, which were not used in harvest and therefore do not display lustre.

Truncations- 30 items, constituting 6.9% of the tools. Most of the truncations are made on blades (18 items) and the rest on flakes (7 items); primary items (2 items) and a core-trimming element (1 item). The rest are fragments which could not be defined as either flakes or blades (2 items).

Retouched blades- 31 items, constituting 7.1% of the tools. The retouched blades were divided into four groups:
a) Blades with full or partial retouch on one side (13 items).
b) Blades with full or partial retouch on both sides (3 items).
c) Backed blades (5 items).
d) Retouched bladelets (10 items).

Retouched Flakes- 27 items, constituting 6.2% of the tools.

Pounding Tools- Under this heading we have collected all heavy tools manufactured on pebbles or on thick flakes. The category includes 28 items, constituting 6.4% of the tools. They were divided into three groups:
a) Chopping tools (6 items).
b) Hammerstones (6 items).
c) Pièce esquilé (16 items). This is the French name of these items. In the Jericho report a similar group is designated "blade chisel" (CROWFOOT PAYNE 1983), although these two groups are not completely identical. These are coarse flakes with knapping on the ventral and sometimes also on the dorsal side.

Varia- 31 items, constituting 7.2% of the tools. The items were divided into six groups as follows:
a) Fragments of points and tangs (12 items). These points cannot be defined with certainty as arrowheads, awls or other tools.
b) Retouched fragments (90 items). These are fragments, usually small, of various tools which cannot be identified more specifically.
c) Blade fragments with retouch and thinning on the proximal side (4 items).
d) A large flake with rounded retouch, similar to bi-facial items. Another such item was picked up on the surface.
e) Lunette (1 item). A microlithic tool in the form of a crescent with abrupt dorsal retouch. This is probably an intrusive item from a Natufian site.
f) Double tools (4 items). These include a truncation/burin on a natural face, a scraper/burin on a natural face, a backed blade/notch, and a burin on a truncation/sickleblade.

Obsidian

In Stratum D2 of Tel 'Ali 17 items of obsidian were found. Data on their provenance in the various excavated units is presented in Table 2. They are minute items: bladelets, chips and in one case a core-trimming element from a small bladelet core. We intend to perform an archeometric inquiry into the exact geographical origin of the raw material. The ratio between obsidian and flint in this stratum is 1:1,507, a relatively high ratio for Neolithic sites in the southern Levant.

Discussion

The most important characteristic of the flint assemblage of Stratum D2 from our excavations at Tel 'Ali is the co-existence of elements of the Pre-Pottery Neolithic together with elements of the Pottery Neolithic periods. The following features should be stressed:

a) Sickleblades with wide coarse bi-facial denticulation, typical of the PNA.
b) Sickleblades with narrow, bi-facial denticulation (Tel 'Ali sickleblade).
c) Wide sickleblades with pressure retouch.
d) A combination of these items, together with medium-sized Byblos/Amuq arrowheads.

It seems that the following assemblages in the central and southern Levant should be attributed to this stage:

1. 'Ain Ghazal- The settlement layer between the PPNB and the PNA (Yarmukian), designated as PPNC. Not much has been published on the typology of the flint of this stage, but medium-sized arrowheads were attributed to it, for example (ROLLEFSON *et al.* 1991, Fig. 2, center row), as at Tel 'Ali. The architecture of this layer includes rectangular houses subdivided into several small rooms (ROLLEFSON *et al.* 1992, Fig. 5), and a "massive courtyard wall" (ROLLEFSON *et al.* 1992, Fig. 6). Radiocarbon dates from the PPNC of 'Ain Ghazal fall between 6000-5700 B.C. (see Table 9).

2. Tel 'Ali- The assemblage from Stratum D2, as discussed in this paper.

3. `Atlit-Yam- This submerged site has yielded radiometric dates from the end of the seventh millennium and the first half of the sixth millennium B.C. (see Table 9). Not much data has been published so far on the flint assemblage, but pressure flaked medium-sized arrowheads (GALILI *et al.*

1993, Fig. 11:6-9) and sickleblades (GALILI *et al.* 1993, Fig. 12:4-5) were reported. The site also includes a 60 m long wall whose function has not been clarified (GALILI *et al.* 1993, Fig. 5).

4. Tell Ramad Layer II- The same stratigraphic sequence reported from 'Ain Ghazal was already discovered at Tell Ramad in the mid 1960s (de CONTENSON 1971): Layer I at the base of the site consists of a typical PPNB settlement. It was radiometrically dated to 6260-6140 B.C. (see Table 9). Layer II is also a Pre-Pottery settlement, but the flint assemblage includes deep denticulated sickleblades (de CONTENSON 1971, 1983). The use of 'white ware' vessels is another characteristic element of this layer. Layer II is radiometrically dated to the beginning of the sixth millennium B.C. (see Table 9). Layer III is a Pottery Neolithic settlement with "coffee bean eyes" clay figurines, a type typical of the second half of the sixth millennium B.C. Layer II is thus located between PPNB (Layer I) and Pottery Neolithic remains (Layer III).

Table 9. Radiometric datings in the southern Levant from the end of the PPNB to the Sha`ar Hagolan/ PNA Phase *<All dates are uncallibrated B.C.>*.

Culture Phase	Site & Layer	Sample Number	Date	Reference
Late PPNB	`Ain Ghazal, Late PPNB	Grn 12971	6510+90	Rollefson et al. 1992:445
6500-6100	`Ain Ghazal, Late PPNB	GrN 14259	6360+230	Rollefson et al. 1992:445
	`Ain Ghazal, Late PPNB	AA 5199	6320+75	Rollefson et al. 1992:445
	`Ain Ghazal, Late PPNB	GrN 12972	6215+50	Rollefson et al. 1992:445
	`Ain Ghazal, Late PPNB	AA 5197	6140+75	Rollefson et al. 1992:445
	`Ain Ghazal, Late PPNB	AA 5206	6040+80	Rollefson et al. 1992:445
	Tell Ramad, Layer I	Grn 4426	6260±50	de Contenson 1983
	Tell Ramad, Layer I	Grn 4428	6250±80	de Contenson 1983
	Tell Ramad, Layer I	Grn 4421	6140±50	de Contenson 1983
	Gurife, Layer II	GIF 3372	6200+190	de Contenson 1983
	Basta	Grn 14537	6430+100	Nissen et al. 1987
	Basta	Grn 14538	6205+50	Nissen et al. 1987
	Nahal Hemar, Layer III	Pta 3650	6320+80	Bar-Yosef & Alon 1988
	Nahal Hemar, Layer III	BM 2298	6300+70	Bar-Yosef & Alon 1988
	Nahal Hemar, Layer III	RT 650	6250+100	Bar-Yosef & Alon 1988
	Nahal Isaron, Layer C	Pta 3000	6480+100	Goring-Morris & Gopher 1983
	Nahal Isaron, Layer C	Pta 3377	6230+80	Goring-Morris & Gopher 1983
	Nahal Isaron, Layer C	Pta 3376	6100+80	Goring-Morris & Gopher 1983
PPNC(*)	`Ain Ghazal, PPNC	AA 5198	6010+75	Rollefson et al. 1992:445
6100-5500	`Ain Ghazal, PPNC	GrN 17495	5965+95	Rollefson et al. 1992:445
	`Ain Ghazal, PPNC	GrN 17494	5875+65	Rollefson et al. 1992:445
	`Ain Ghazal, PPNC	AA 1165	5874+240	Rollefson et al. 1992:445
	`Ain Ghazal, PPNC	AA 5196	5720+100	Rollefson et al. 1992:445
	`Atlit-Yam	Rt 707	6190±120	Galili et al. 1993:139
	`Atlit-Yam	Pta 3950	6050±90	Galili et al. 1993:139
	`Atlit-Yam	Rt 944a	5720±85	Galili et al. 1993:139
	`Atlit-Yam	Rt 944c	5660±90	Galili et al. 1993:139
	`Atlit-Yam	P.I.T.T. 0622	5610±80	Galili et al. 1993:139
	Yiftahel	Rt 702b	5510±210	Carmi 1987:105, (Braun 1986)
	Tell Ramad Layer II	Grn 4427	5970±50	de Contenson 1983
	Tell Ramad Layer II	Grn 4822	5950±50	de Contenson 1983
	Tell Ramad Layer II	Grn 4823	5930±55	de Contenson 1983
Sha'ar	`Ain Rahub	GrN 14539	5530± 90	Garfinkel 1992b:91
Hagolan	Munhata, Loc. 644	M 1792	5420±400	Garfinkel 1992b:91
5500-5000	Munhata, Loc. 626	Ly 4927	5380± 70	Garfinkel 1992b:91
	Byblos, n. ancien	GrN 1544	5410± 80	Garfinkel 1992b:91
	Nahal Qanah	RT 861d	5030±190	Garfinkel 1992b:91

* for additional dates from `Ain Ghazal, rejected by the excavators, see Rollefson et al. 1992:445.

5. Megiddo- The earliest remains reported from Tel Megiddo were found inside Cave 4067. They included: "stone and bone objects without a single trace of pottery" (LOUD 1948: 59). The flint industry included some arrowheads and "The thirteen sickle blades all have deep denticulation, made by retouch on both surfaces" (CROWFOOT 1948: 141). This cave has been generally interpreted as part of a PPN settlement (KEMPINSKI 1989: 19). However, the deep denticulated sickleblades never appear in a PPNB context, and it seems that Cave 4067 should be specifically dated to the PPNC. As the next settlement in Megiddo was a Pottery Neolithic layer with typical Yarmukian finds: pottery, flint, architecture and a figurine (GARFINKEL, in press), one might say that the cave also reflects Yarmukian activities. But since no pottery was found in it we prefer to see it as an earlier stage in the history of Megiddo.

6. Abu Ghosh- The excavators recognized a homogeneous sequence of PPNB settlements here (LECHEVALLIER 1978). However, the site also produced deeply denticulated sickleblades (LECHEVALLIER 1978: 44, Fig. 13:3) and medium-sized arrowheads (LECHEVALLIER 1978: 50-52), and their appearance has already been criticized in the past (BAR-YOSEF 1981: 557). Now it seems that the site consists of two phases of occupation: the lower one dated to the PPNB with plastered floors in the structures, and the upper one dated to the PPNC, with the following architectural elements attributed to it:
a. Structure 564, constructed of many small rooms with no plastered floors, similar to the structures from 'Ain Ghazal mentioned above.
b. Wall 735-539, which was interpreted as part of Structure II, but does not link up to any structure and seems to be an independent elongated wall.

7. Beisamun- At this site a classical PPNB structure, with plastered floor and plastered skulls, was unearthed. The finds included a typical PPNB flint industry (LECHEVALLIER 1978). In addition, material collected from the site surface yielded deeply denticulated sickleblades (LECHEVALLIER 1978: 209-210) and medium sized or small arrowheads (LECHEVALLIER 1978: 205, 207), but no pottery. This seems to indicate that somewhere, outside the area excavated, PPNC remains also exist at the site of Beisamun.

8. Tannour- This site is located in the upper Jordan Valley. Surface collection of artifacts yielded medium-sized and small arrowheads and coarsely denticulated sickleblades, but no pottery (LECHEVALLIER and DOLLFUS 1973). It is possible that other sites mentioned by Lechevallier and Dollfus are also related to the PPNC.

9. Ashkelon- Excavations carried out at this site revealed pre pottery remains, but the flint assemblage bears similarities to the flint of Sha`ar Hagolan (PERROT 1955).

10. Yiftahel- This site was excavated in three different campaigns. Typical remains of the PPNB settlement were exposed in trial soundings (LAMDAN and DAVIS 1983) and in Area C (GARFINKEL 1987a, 1987b). Above these remains, additional remains (Layers III-IV) were unearthed (BRAUN 1986), radiometrically dated to 5600 B.C. (CARMI 1987: 105). It seems possible that these remains are related to the PPNC.

The accumulation of fresh data enables us to place information gathered from old excavations in context and, to close the gap between the PPNB and the PNA. At least ten sites in the central and southern Levant (not including desert sites) can be attributed to this period. The sites which provide stratigraphic information are presented in Table 8. The available radiometric datings relevant to the PPNC are presented in Table 9 (uncalibrated B.C.). They clearly indicate that PPNB sites do not continue beyond 6100 B.C. Thus PPNC datings are concentrated between 6100-5600 B.C. Yarmukian datings are spread between 5600 5000 B.C.

In summary, the following data about the material culture of the PPNC or Final PPNB stage should be emphasized:

Flint typology: The most characteristic elements ("fossil directeur") of this pre-pottery period are the appearance of flint sickleblades with deep denticulation and medium-sized arrowheads.

Architecture: The architecture includes structures with many small rooms (reported from 'Ain Ghazal, Abu Ghosh and Yiftahel), usually without the elaborat plastered floors typical of the PPNB. Another important component of the sites' architecture is elongated walls which could have functioned as fences and marked ownership of land (reported from 'Ain Ghazal, Tel 'Ali, `Atlit Yam, Abu Ghosh and Yiftahel).

Acknowledgments: The excavations at Tel 'Ali were sponsored by the Irene Sala CARE Archaeological Foundation. The analysis of the material was supported by the Philip and Muriel Berman Centre for Biblical Archaeology Research. The flint figures were drawn by Karina Vertiger.

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Pottery Neolithic / 6th-5th Millennia B.C. Industries of the Southern Levant Seen Through PPN Glasses

Avi Gopher

Introduction

In the spirit of the opening lecture of the session on the PPN (see GOPHER, this volume) I continue my "journey" into the sixth and fifth millennia B.C. through PPN glasses. My views were crystalized mainly through working on PPN lithics, but PN lithic studies are gaining momentum and soon they will produce results in their own right.

Chronostratigraphy

It was accepted for many years, that PN cultures of the Levant cover the 6-5th millennia B.C. mainly following Northern Levant squences. In recent years it was clearly shown that in the Southern Levant, pottery does not appear prior to the mid 6th millennium B.C. Rollefson's experience at Ain Ghazal has shown that the early parts of the 6th millennium B.C. can still be assigned to the PPN to what he called the PPNC - following the Jericho terminology. Rollefson and his colleagues presented various aspects of the Ain Ghazal PPNC in a number of publications (e.g. ROLLEFSON and SIMMONS 1986, 1988; ROLLEFSON *et al.* 1992; SIMMONS *et al.* 1988) and have dated it mainly to the first half of the 6th millennium B.C. Other assignable candidates for the PPNC, mainly in regard to their dating, are Atlit Yam on the Israeli Coastal Plain (GALILI *et al.* 1993) and possibly Tell Ramad in the Damascus basin. More data is accumulating from the desertic regions of the Southern Levant such as some Tuwailan industry assemblages (GORING-MORRIS and GOPHER, this volume) and possibly from Nahal Issaron as well (see GOPHER and GORING-MOORRIS, this volume). Data from the Azraq Basin area in Jordan (BAIRD, this volume) and other Eastern Jordan assemblages (BETTS, this volume) may also be assigned to the PPNC by virtue of their dating, even though in some cases they are called Late PPNB. Thus the general picture of the very late 7th and first half of the 6th millennium B.C. in the Southern Levant will and must be a focus of research in the coming years if we wish to reconstruct the developments leading to the appearance of pottery-bearing entities. I shall however, stick to the flint assemblages of the PN entities *per se* - i.e. those found in pottery-bearing layers. The sequence for the Mediterranean zones of the Southern Levant is shown on the left side of the diagram below (Fig. 1) while the southern and desertic regions sequence are shown on the right side. For a detailed summary see GOPHER and GOPHNA 1993.

Methodology

What is it that we are looking to see in PN lithic industries through PPN glasses ? Basically, a simple analysis of continuity versus change through lithic aspects, both technological and typological, from the PPNB to the PN. We ignore all other aspects which are very important of course such as the nature of the site, economy, ideology ... and of course the pottery which has an enormous analytical potential. Here, we deal with the lithics only.

Technology

One important PPNB feature, the naviform and opposed platformed cores continues into the PPNC (e.g. Atlit Yam, GALILI *et al.* 1993). These also appear in the Yarmukian (e.g. Shaar Hagolan, Stekelis 1972) but their frequencies decrease through time. In the Lodian and Wadi Raba cultures, postdating the Yarmukian, these cores are completely absent - thus ending a long tradition of blade production that prevailed for over 3000 years.

At the same time, a change in strategies of raw material procurement takes place. PN lithic industries are usually made on small nodules reduced into small amorphic cores. High quality flint is rare and heat-treated flint is not reported. In general, it seems that PN knappers did not invest in raw material selection and trade in flint was rare as opposed to the PPNB (e.g. Munhata, GOPHER 1989). As we already know, not all PPNB debitage assemblages were blade dominated or as "bladey" as was generally considered, but blade production or use was always an important component. PN debitage assemblages, on the other hand, are always flake dominated. On the other hand, a selective process in favour of blades for tool production can still be observed in the PN, as was the case in the PPNB. However, PN blades are generally shorter than the PPNB average and long straight blades are absent altogether or very rare. Other PN technological aspects show differences from the PPNB, for example tranchet blows on bifacial tools disappear, but the use of polish continues; pressure flaking is very conspicuous - both in points and sickle blades.

Typology

In type-composition of PN assemblages arrowheads decrease from peaks of 15-40% in PPNB to very low percentages in the Yarmukian and Lodian assemblages (the high percentages of arrowheads in PN lithic assemblages on the Israeli coastal plain are most probably a specific regional phenomenon). Arrowheads disappear in Wadi Raba assemblages almost entirely. No dramatic changes were observed in other major tool type frequencies. Sickle blades are usually an important group and "new" types appear such as bifacial knives, tabular scrapers, massive borers, and in a specific case chamfered pieces (GOPHER and ORRELLE 1990).

A more detailed observation at the attribute level shows that arrowheads change, mainly in size and in specific attributes such as shaping of tangs and barbs, retouch amount and location etc. There is also a slight change in form especially of Byblos and Amuq point types. These changes must be related to hunting methods and equipment.

Sickle blades undergo a series of changes starting already in the PPNC. Yarmukian sickle blades are narrow, shorter than those of the PPNB, have deep denticulation and flat retouch which sometimes appears bifacially. Lodian sickle blades are wider, with different types of denticulation. They are generally trapezoidal in shape, have "rounded corners" and are fashioned by pressure flaking. Wadi Raba sickle blades are rectangular with fine denticulation, backed and truncated at the ends and considerably thick. PN sickles contain a hafted series of blades while reaping knives as in the PPNB are absent. This is, in a way, a return to an old conception. All this must reflect changes in agrotechology and may be in the fields too in terms of species grown, seasonal sheduling, density of fields, (stalks) etc.

In the bifacial tool types, there is a tendency towards more thick "high" chisels, mostly appearing in the Wadi Raba assemblages; and nice trapezoidal, thin, flaked and polished axes (Wadi Raba). Trapezoidal shaped adzes become more dominant in this group in the Chalcolithic period.

Summary

The processes of change can be summarized in a number of points:

1) the blade-naviform technology comes to an end - thus PN cores and debitage are changing.
2) the era of hunting with heavy "aerodynamic" arrowheads,- like the PPNB comes to an end.
3) reaping knives, or long-blade sickles disappear and the composite short-blade sickles take over.

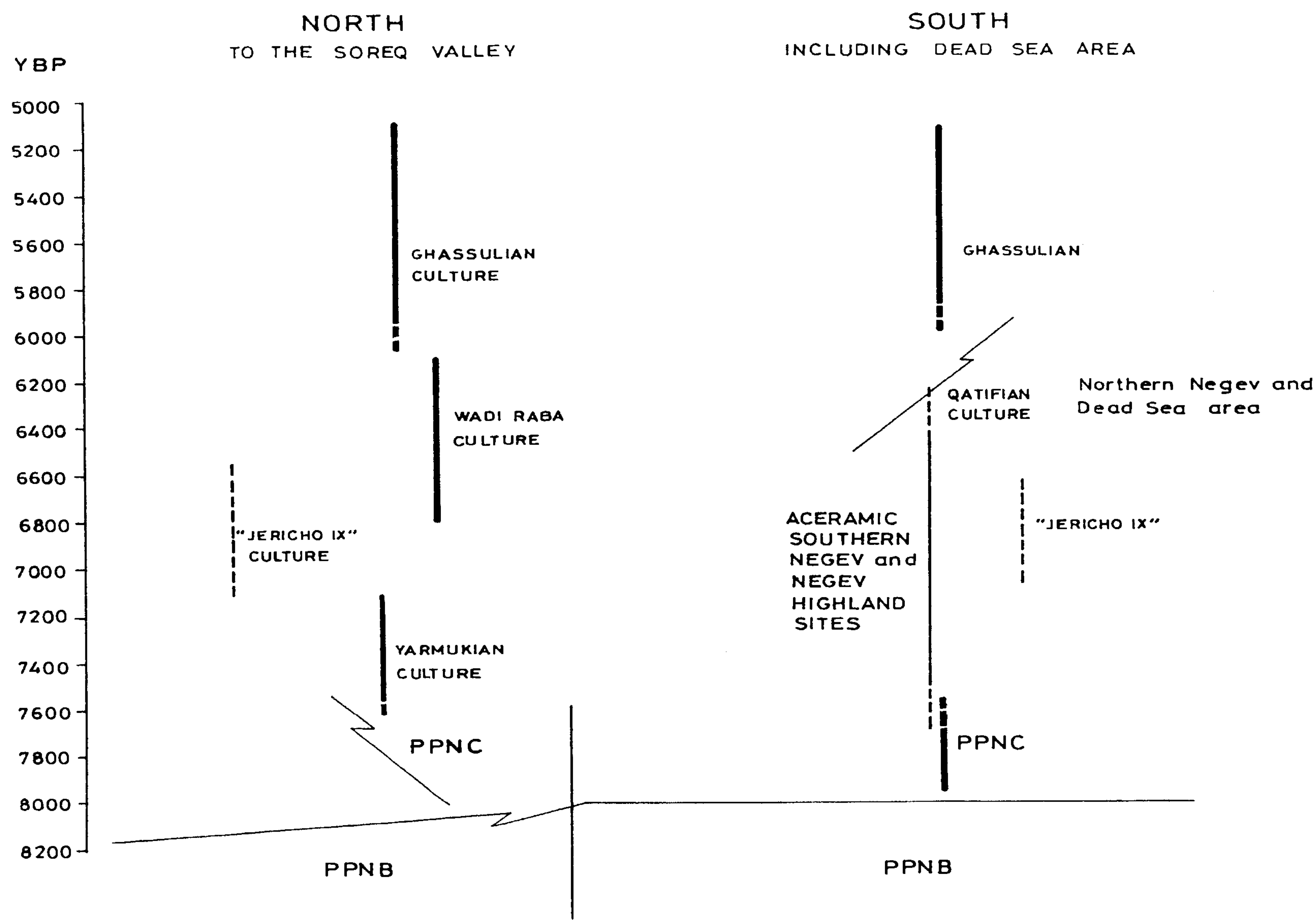

Fig. 1. Chronostratigraphic scheme of archaeological entities in the 8th and 7th millennia B.P. in the Southern Levant.

All these are changes, that most probably derives from a general process of economic change accompanied by technological change. No new lithic technologies appear.

PN industries show carelesness in raw material selection and core reduction but shaping tools is at its best. New and elaborated types appear such as bifacial knives and old know-how is retained. (polish, burins, chamfered pieces). One cannot, however, ignore the appearance of pottery on the scene and its analytical capabilities must be used. Flint, though at its peak begins its descent from the stage.

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Yarmoukian 'Ain Rahub, Northern Jordan.
The Chipped Industry

Hans Georg Gebel and Bernd Müller-Neuhof with Georg Heistermann, Manuela Hennig, and Marco Zabel [1]

Introduction (H.G.G.)

Yarmoukian layers were encountered[2] in a small test trench (3 m^2) made into the colluvials of the sites' slope stratigraphy, covering the Epipalaeolithic layers of Late/Final Natufian 'Ain Rahub. This was an extraordinary finding, since no surface evidence in the area indicated a Yarmoukian settlement. 'Ain Rahub was indeed, at the time of excavation, amongst the first Yarmoukian settlements found east of the Rift Valley (GEBEL and MUHEISEN 1986a,b; MUHEISEN, GEBEL, HANNSS, and NEEF 1988).

This test unit at 'Ain Rahub revealed a sloped stratigraphy of colluvial and cultural deposits; excavation in arbitrary 10cm- layers was stopped, when the mid 6th millennium BC Yarmoukian layers were passed and the 9th millennium Late/Final Natufian layer, one meter below, was encountered (3.30m below present suface). One radiocarbon date for the Yarmoukian levels is available (7480+/- 90 B.P.; GrN-14539).

Two layers of limestone rubble (1-1.50m thick), separated by a lens or layer of mud-brick debris, contained a lot of Yarmoukian sherds (including DFBW). Flint artefacts were found with the pottery, concentrated in levels 59.60- 59.50- 59.40- 59.20m (no artefact fittings observed). The test unit most likely passed through a settlement debris area of the former Yarmoukian occupation.

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1 This contribution was submitted jointly by students attending a basic course in Neolithic chipped lithics analysis, under the supervision of their course tutor and co-author (H.G.G) at the Seminar für Vorderasiatische Altertumskunde, Free University of Berlin in the Wintersemester 1992/93. The part "Secondary Production" of this contribution represents -in addition to a standard analysis (Table 3)- a test approach (Table 4) for the analysis of multiple tools and other non-formal tools according to the descriptive means and standards introduced by M.L. Inizan and J. Tixier (INIZAN, ROCHE, and TIXIER 1992). This test showed that ideal descriptive records could be made for these tool classes, but that this method is not economic with materials nor that it is easy that the many inherent analysis levels can be reduced to reproducable clusters (which is, however, not the suggestion of the mentioned authors). Later, the development of a less formal and more simple recording and analysis system was begun by the *Sub-Group* "Non-Formal Tools" of the *Workshops on PPN Chipped Lithics Industries* (Wembach - Meeting). The earlier Inizan/ Tixier- oriented approach with the limited number of implements from 'Ain Rahub is published here as a document to show the limits of such analysis approaches.
The authors thank Brian Willcock, Berlin for his proof-reading efforts of this contribution.

2 The excavations at 'Ain Rahub were carried out by Mujahed Muheisen and Hans Georg Gebel during one season in 1985, within the framework of the Joint Archaeological Projects of the Tuebingen and Yarmouk Universities (co-directors: Siegfried Mittmann and Moawiyah Ibrahim). Subsequently this promising site was partially destroyed by road construction and other activities. Intact Natufian and Yarmoukian layers of unknown extension are expected in the colluvials north and west of the main area of excavation. The efforts of Reinder Neef (square supervisor of the Test Unit) and his workmen were well rewarded by this test operation, being as it was, in 1985, only the third Yarmoukian site encountered in Jordan.

Table. 1. Raw material description <*according to GEBEL 1994*>.

		Raw Material 1a	Raw Material 1b	Raw Material 2	Raw Material 3?
A	**Characteristics of pebbles/ nodular/ tabular bodies**				
A.1	dimensions/ thicknesses	2-12 cm, occasionally 20 cm	12-12 cm, occasionally 20 cm	2-8 cm	same as 1a/b?
A.2	shapes	lenticular slabs, some-times parallel- sided tabular bodies (often holey)	lenticular slabs, some-times parallel- sided tabular bodies (often holey)	lenticular nodules	same as 1a/b?
B	**Natural surfaces**				
B.1	cortical and cleft surfaces of bedrock material	chemically weathered chalky cortex formed in bedrock, patinated naturally flaked surfaces of exposed fractures	chemically weathered chalky cortex formed in bedrock, patinated naturally flaked surfaces of exposed fractures	scratchable/ easily worn cortex etc.	quartzitic deposits in clefts
B.2	eroded chalky cortex	thin (below 1mm) - medium thick (2-4mm)	thin (below 1mm) - medium thick (2-4mm)	regular thick (4-8 mm) cortex	
B.4	characteristic patination of raw material etc.	5 YR 5/6-8	?	heavy patination (5YR 6/1)	
B.5	character of contact area between cortex and silicified core	clear separation	clear separation	indistinct - sharply separated contact area	gradual transition?
C	**Matrix/ texture and homogenity (characterized with chipped surfaces)**				
C.1	matrix/ texture	slightly fine grained - sligthly coarse grained	sligthly coarse grained - coarse grained	slightly fine grained	coarse grained?
C.2	homogenity	homogen	rather homogen	homogen	?
D	**Inclusions, clefts/ pores, flaking ability**				
D.1	macroskopically recognized inclusions and fossils	rare lime inclusions	lime inclusions		lime inclusions
D.2	clefts/ hollows etc.			"brecious"- brittle	
D.4	distribution of inclusions	occasionally and discontinous	equally distributed - discontinous		irregular?
D.5	flaking ability	good	"tough"	hardly to be controled	flakeable
E	**Translucency (characterized by edges of blade-flakes)**	completely opaque	completely opaque	completely opaque	completely opaque
F	**Colour variation of main matrix (without coloured patterns; Munsell Soil Colour Chart notation(s))**				
F.1	Munsell notation	10 YR4/1-3 and 5/1	10 YR5/1 and 6/1-2; 5YR 7/1-2 and 8/1	7.5 YR 2/0 and 3/0	7.5 YR 6/2-4 and 10 YR 5/4-6
G	**Coloured patterns (Munsell Soil Colour Chart notations)**				
G.1	character of pattern				coloured bands?
H	**Lustre (characterized with fresh chipped surfaces, sickle/ tempering sheen not considered)**	faintly lustrous	faintly lustrous - without lustre / dull	faintly lustrous	without lustre / dull
I	**Geological context/ Alloacated resource (areas)**	see text	see text	see text	see text

This study concentrates on the material found in the arbitrary levels 59.90-59.00m. Although Yarmoukian material was found in layers immediately above and below these, these levels were considered the safest representation of unmixed Yarmoukian deposits; they are not colluvially deposited and represent part of the *in situ* Yarmoukian occupation, embedded in the slope colluvials. Except for artefact concentrations, the distribution of flint artefacts in the 6 artificial layers 59.90 - 59.00m does not indicate further stratigraphical meaning (Table 1). All material studied here was sampled by dry sieving of the sediments removed (4mm sieves).

The authors are well aware that the limited number of artefacts found in the test unit is not sufficient to characterize a Yarmoukian industry as such. Therefore, the sample might appear overvalued when it receives such a detailed stud
y as this report. However, such standards appear desirable for final publications of Neolithic assemblages and there are also valid reasons, given in Footnote 1, for the following analysis.

Table 2. Classification of primary products.

'Ain Rahub: Primary Classification	all layers				59.90 - 59.70 m				59.70 - 59.60 m				59.60 - 59.50 m				59.50 - 59.40 m				59.40 - 59.20 m				59.20 - 59.00 m			
	n	%	g	%	n	%	g	%	n	%	g	%	n	%	g	%	n	%	g	%	n	%	g	%	n	%	g	%
Chunks (not counted with Primary Products)	4	100	458	100	0	0	0	0	1	25	84	18	2	50	210	46	1	25	164	36	0	0	0	0	0	0	0	0
Thermal Debris, etc. (not counted with Primary P.)	71	100	858	100	1	1,4	1	0,1	8	11	162	19	9	13	55	6,4	22	31	288	34	4	5,6	78	9,1	27	38	274	32
Debris,	49	12	899	13	4	21	131	43	5	8,2	90	5,5	19	17	271	16	9	12	240	14	5	9,8	57	7,7	7	6,8	110	13
of which served as tool blanks :	*4*	*0,9*	*119*	*1,7*	*1*	*5,3*	*70*	*23*	*1*	*1,6*	*16*	*1*	*2*	*1,8*	*33*	*2*												
Flake Cores (Total)	27	6,4	2314	34	0	0	0	0	4	6,6	774	47	10	8,9	341	21	10	13	797	46	2	3,9	230	31	1	1	172	20
spherical flake cores	3	0,7	288	4,2									1	0,9	12	0,7	1	1,3	88	5,1	1	2	188	25				
irregular flake cores,	7	1,7	654	9,5					1	1,6	112	6,9	1	0,9	84	5,1	5	6,5	458	27								
of which served as tool blanks :	*2*	*0,5*	*176*	*2,6*					*1*	*1,6*	*112*	*6,9*					*1*	*1,3*	*64*	*3,7*								
flake cores with a platform shift	5	1,2	814	12					1	1,6	530	33	2	1,8	86	5,2	2	2,6	198	12								
single-platform flake cores	9	2,1	518	7,5					2	3,3	132	8,1	4	3,6	124	7,5	1	1,3	48	2,8	1	2	42	5,6	1	1	172	20
other flake cores	3	0,7	40	0,6									2	1,8	35	2,1	1	1,3	5	0,3								
Core Fragments (Total)	6	1,4	106	1,5	1	5,3	41	13	0	0	0	0	1	0,9	11	0,7	1	1,3	16	0,9	1	2	18	2,4	2	1,9	20	2,4
fragm. of flake cores	5	1,2	96	1,4	1	5,3	41	13					1	0,9	11	0,7	1	1,3	16	0,9	1	2	18	2,4	1	1	10	1,2
undet. core fragm.,	1	0,2	10	0,1																					1	1	10	1,2
of which served as tool blanks :	*1*	*0,2*	*10*	*0,1*																					*1*	*1*	*10*	*1,2*
Cores/ Unfinished Heavy Duty Tools ? (Total)	4	0,9	204	3	0		0		2	3,3	116	7,1	2	1,8	88	5,3	0	0	0	0	0	0	0	0	0	0	0	0
CTE and Other Core Elements (Total)	48	11	880	13	3	16	23	7,5	7	11	83	5,1	16	14	313	19	7	9,1	196	11	11	22	188	25	4	3,9	77	9,1
edge-of-core removal flakes,	7	1,7	103	1,5									5	4,5	56	3,4	1	1,3	13	0,8					1	1	34	4
of which served as tool blanks :	*2*	*0,5*	*28*	*0,4*									*1*	*0,9*	*15*	*0,9*	*1*	*1,3*	*13*	*0,8*								
cortical/ cortex removal flakes,	30	7,1	696	10	3	16	23	7,5	5	8,2	74	4,5	8	7,1	224	14	5	6,5	176	10	6	12	156	21	3	2,9	43	5,1
of which served as tool blanks :	*1*	*0,2*	*38*	*0,6*									*1*	*0,9*	*38*	*2,3*												
cortical/cortex removal blades	7	1,7	58	0,8					2	3,3	9	0,6	2	1,8	26	1,6	1	1,3	7	0,4	2	3,9	16	2,2				
fragm. of cortical/ cortex removal blades/flakes	3	0,7	16	0,2									1	0,9	7	0,4					2	3,9	9	1,2				
crest blades	1	0,2	7	0,1																	1	2	7	0,9				
Debitage (Total)	289	68	2498	36	11	58	111	36	43	70	567	35	64	57	635	38	50	65	467	27	32	63	251	34	89	86	467	55
chips (<10mm)	2	0,5	1	0					2	3,3	1	0,1																
flakelets (10-25mm),	39	9,2	106	1,5	3	16	5	1,6	4	6,6	15	0,9	8	7,1	25	1,5	7	9,1	19	1,1	7	14	20	2,7	10	9,7	22	2,6
of which served as tool blanks :	*1*	*0,2*	*5*	*0,1*													*1*	*1,3*	*5*	*0,3*								
flakes (>25mm),	79	19	1020	15	1	5,3	19	6,2	5	8,2	70	4,3	24	21	408	25	23	30	246	14	11	22	118	16	15	15	159	19
of which served as tool blanks :	*36*	*8,5*	*577*	*8,4*					*5*	*8,2*	*70*	*4,3*	*10*	*8,9*	*226*	*14*	*10*	*13*	*134*	*7,8*	*3*	*5,9*	*33*	*4,4*	*8*	*7,8*	*114*	*13*
fragm. of flakes/ flakelets,	36	8,5	357	5,2	1	5,3	5	1,6	10	16	153	9,4	10	8,9	61	3,7	4	5,2	58	3,4	1	2	6	0,8	10	9,7	74	8,7
of which (flake fragm.) served as tool blanks :	*10*	*2,4*	*175*	*2,5*					*3*	*4,9*	*75*	*4,6*	*1*	*0,9*	*8*	*0,5*	*2*	*2,6*	*44*	*2,6*					*4*	*3,9*	*48*	*5,7*
non-parallel-sided blades II (25-50mm),	5	1,2	22	0,3					1	1,6	3	0,2					2	2,6	11	0,6	2	3,9	8	1,1				
of which served as tool blanks :	*1*	*0,2*	*5*	*0,1*													*1*	*1,3*	*5*	*0,3*								
non-parallel-sided blades III (50-80mm),	3	0,7	67	1													1	1,3	13	0,8	2	3,9	54	7,3				
of which served as tool blanks :	*2*	*0,5*	*56*	*0,8*													*1*	*1,3*	*13*	*0,8*	*1*	*2*	*43*	*5,8*				
non-parallel-sided blades IV (>80mm),	2	0,5	66	1	1	5,3	29	9,5	1	1,6	37	2,3																
of which served as tool blanks :	*2*	*0,5*	*66*	*1*	*1*	*5,3*	*29*	*9,5*	*1*	*1,6*	*37*	*2,3*																
fragm. of non-parallel-sided blades II-III,	6	1,4	30	0,4													1	1,3	2	0,1					5	4,9	28	3,3
of which served as tool blanks :	*5*	*1,2*	*28*	*0,4*													*1*	*1,3*	*2*	*0,1*					*4*	*3,9*	*26*	*3,1*
fragm. of non-parallel-sided blades IV,	1	0,2	32	0,5																					1	1	32	3,8
of which served as tool blanks :	*1*	*0,2*	*32*	*0,5*																					*1*	*1*	*32*	*3,8*
parallel-sided blades I (<25mm)	1	0,2	1	0									1	0,9	1	0,1												
parallel-sided blades II (25-50mm),	16	3,8	44	0,6	1	5,3	7	2,3	2	3,3	6	0,4	4	3,6	7	0,4	2	2,6	7	0,4	3	5,9	6	0,8	4	3,9	11	1,3
of which served as tool blanks :	*8*	*1,9*	*30*	*0,4*	*1*	*5,3*	*7*	*2,3*	*1*	*1,6*	*5*	*0,3*	*1*	*0,9*	*3*	*0,2*	*1*	*1,3*	*6*	*0,3*	*2*	*3,9*	*4*	*0,5*	*2*	*1,9*	*5*	*0,6*
parallel-sided blades III (50-80mm),	8	1,9	63	0,9					2	3,3	34	2,1	1	0,9	5	0,3	1	1,3	6	0,3	1	2	6	0,8	3	2,9	12	1,4
of which served as tool blanks :	*6*	*1,4*	*52*	*0,8*					*2*	*3,3*	*34*	*2,1*									*1*	*2*	*6*	*0,8*	*3*	*2,9*	*12*	*1,4*
parallel-sided blades IV (>80mm),	3	0,7	82	1,2													3	3,9	82	4,8								
of which served as tool blanks :	*2*	*0,5*	*40*	*0,6*													*2*	*2,6*	*40*	*2,3*								
fragm. of parallel-sided blades II-III,	22	5,2	72	1					3	4,9	5	0,3	2	1,8	24	1,4	2	2,6	6	0,3	1	2	4	0,5	14	14	33	3,9
of which served as tool blanks :	*14*	*3,3*	*58*	*0,8*					*2*	*3,3*	*4*	*0,2*	*2*	*1,8*	*24*	*1,4*	*2*	*2,6*	*6*	*0,3*					*8*	*7,8*	*24*	*2,8*
fragm. of parallel-sided blades IV,	1	0,2	29	0,4	1	5,3	29	9,5																				
of which served as tool blanks :	*1*	*0,2*	*29*	*0,4*	*1*	*5,3*	*29*	*9,5*																				
(fragm. of) undet. flakes/blades (-lets),	65	15	506	7,3	3	16	17	5,6	13	21	243	15	14	13	104	6,3	4	5,2	17	1	4	7,8	29	3,9	27	26	96	11
of which served as tool blanks :	*10*	*2,4*	*359*	*5,2*					*4*	*6,6*	*234*	*14*	*2*	*1,8*	*104*	*6,3*									*4*	*3,9*	*21*	*2,5*
Total of Primary Products	423	100	6901	100	19	100	306	100	61	100	1630	100	112	100	1659	100	77	100	1716	100	51	100	744	100	103	100	846	100
Doubtful Ret. Implements / Damaged Material?	43	100	501	100	2	4,7	32	6,4	7	16	258	51	8	19	54	11	11	26	54	11	3	7	13	2,6	12	28	90	18

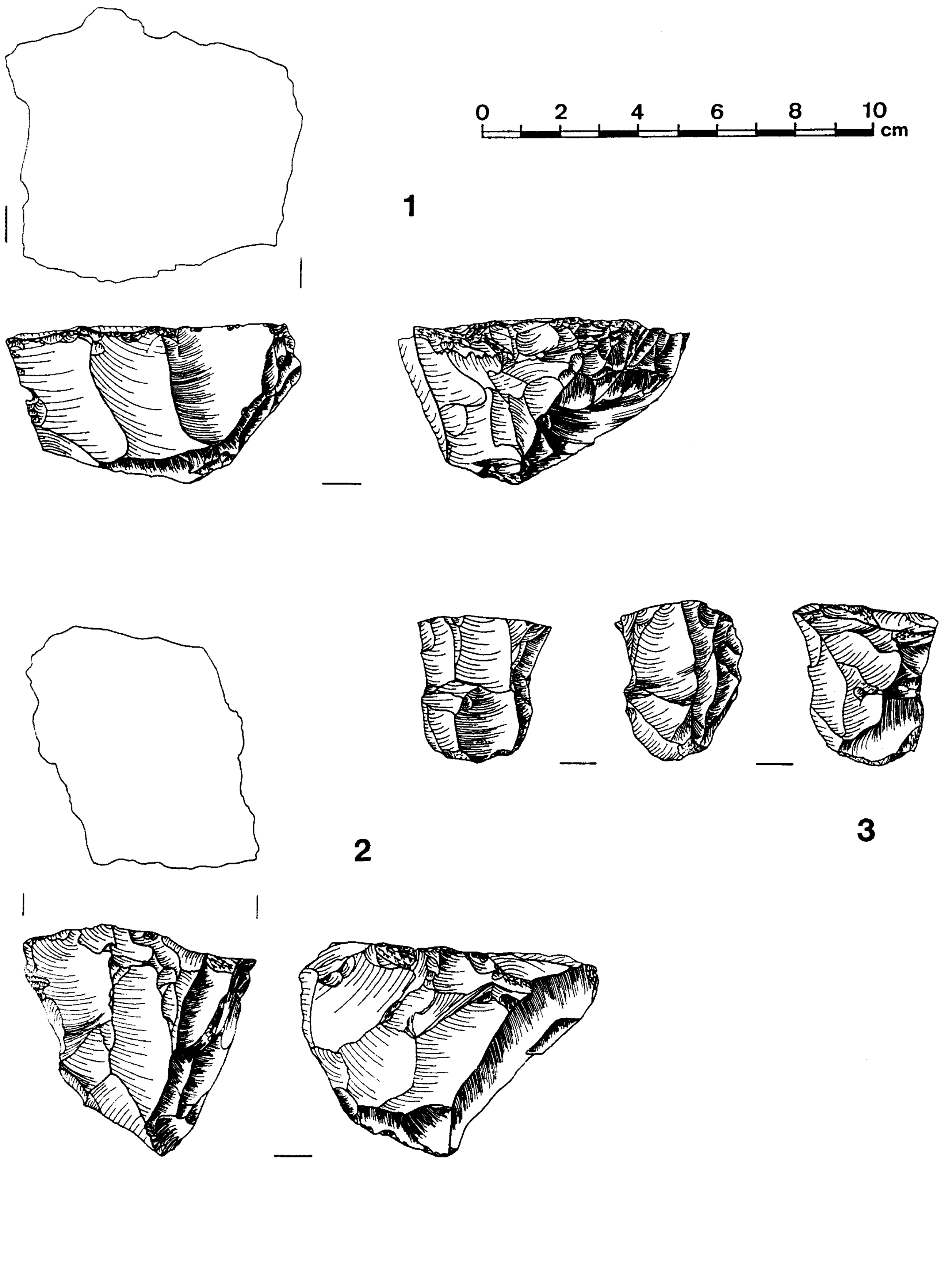


Fig. 1. *1-3* single-platform (blade-) flake cores.

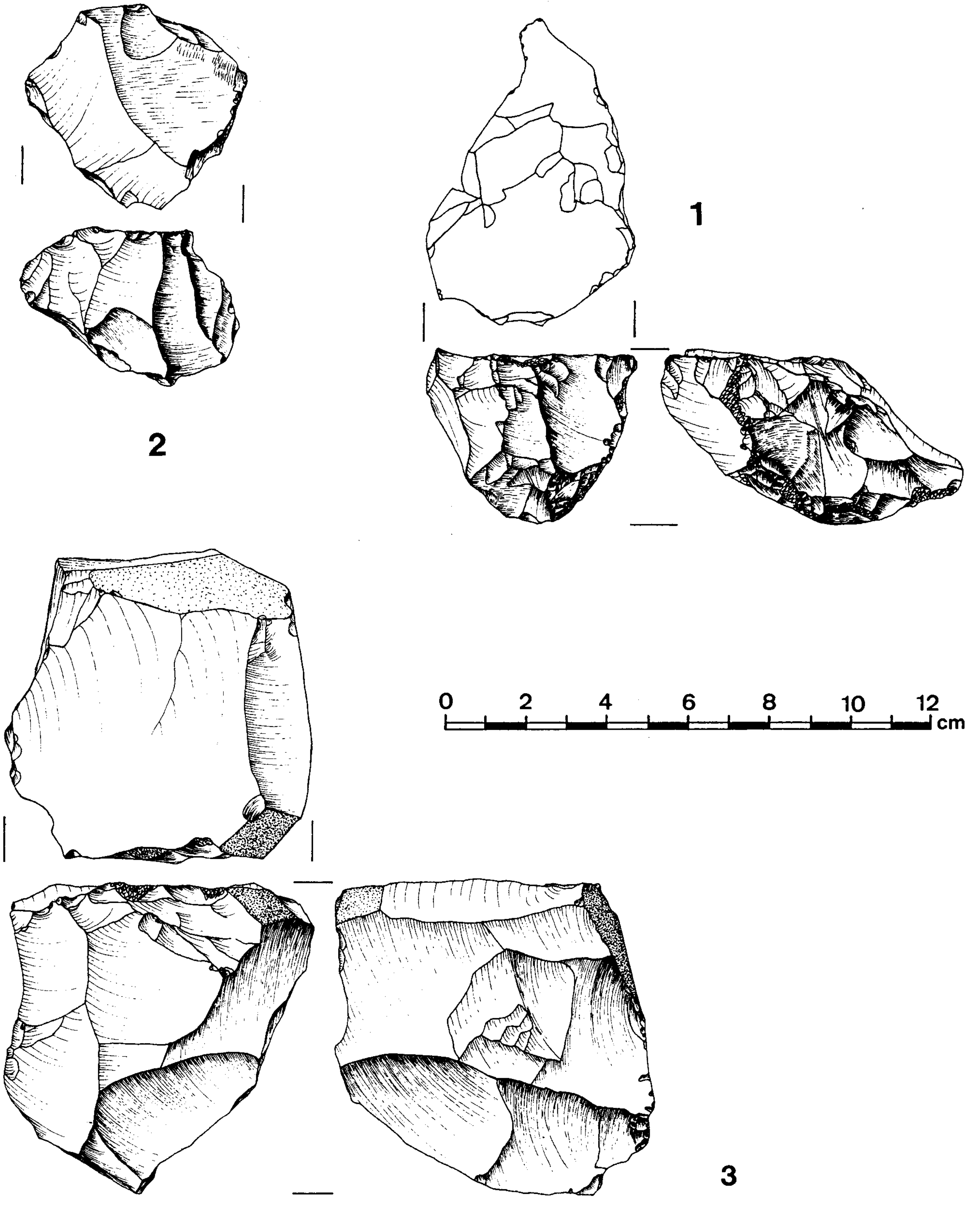


Fig. 2. *1-2* single-platform (blade-) flake cores, *3* flake core with a platform shift.

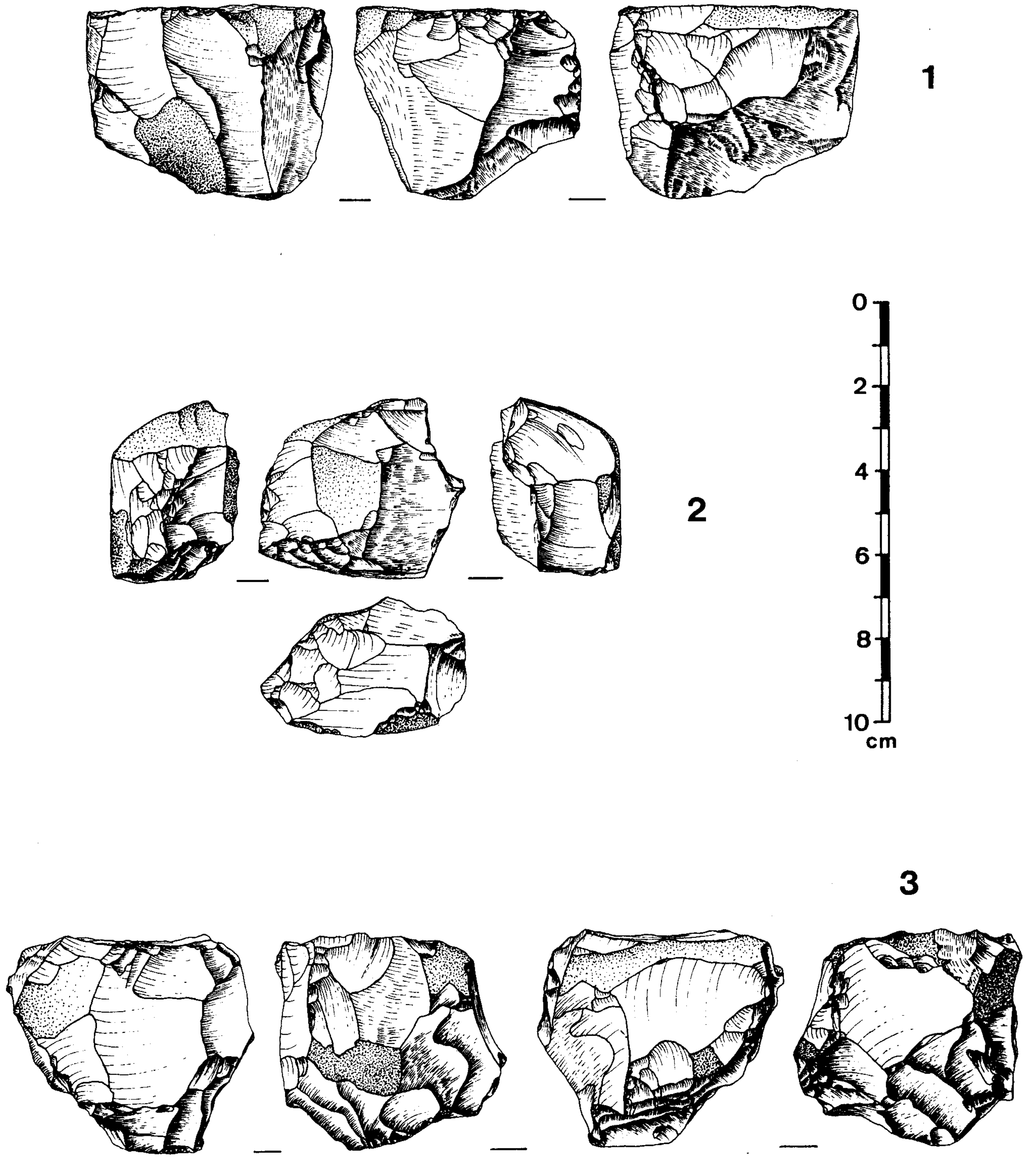


Fig. 3. *1* flake core with a platform shift, *2* irregular flake core, *3* spherical flake core.

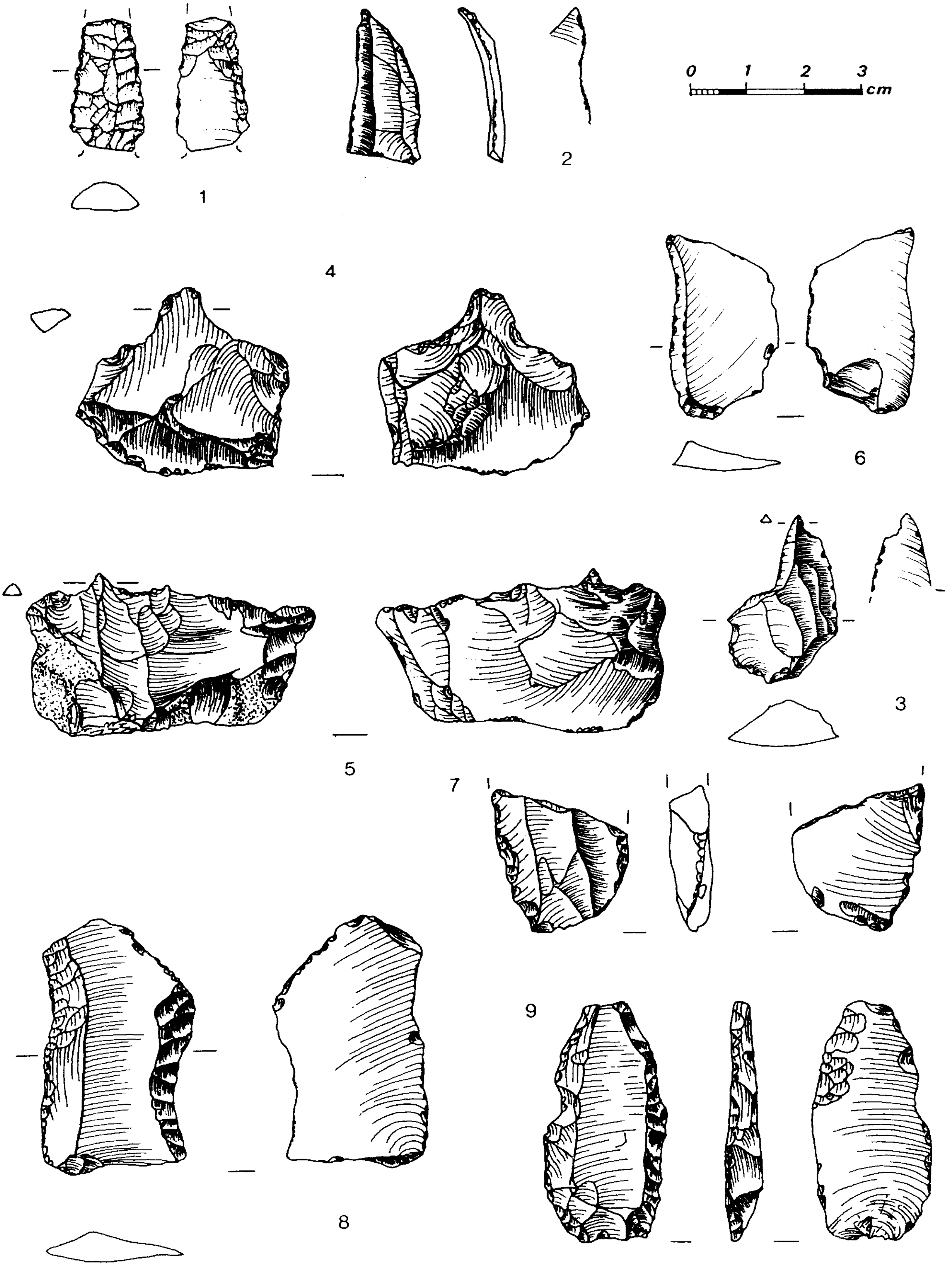


Fig. 4. *1* projectile point cf. type GOPHER 1989: Fig. 37.6; *2-3* drilling/piercing tools on "morphological" tips of (broken) blades/flakes; *4-5* drilling/piercing tools with tips formed by notches on lateral edges of blades/flakes (*5* possibly on an unfinished bifacial tool); *6* basal steep-ret. flake; *7-9* bilateral parallel ret. blades (*9* partially bifacial).

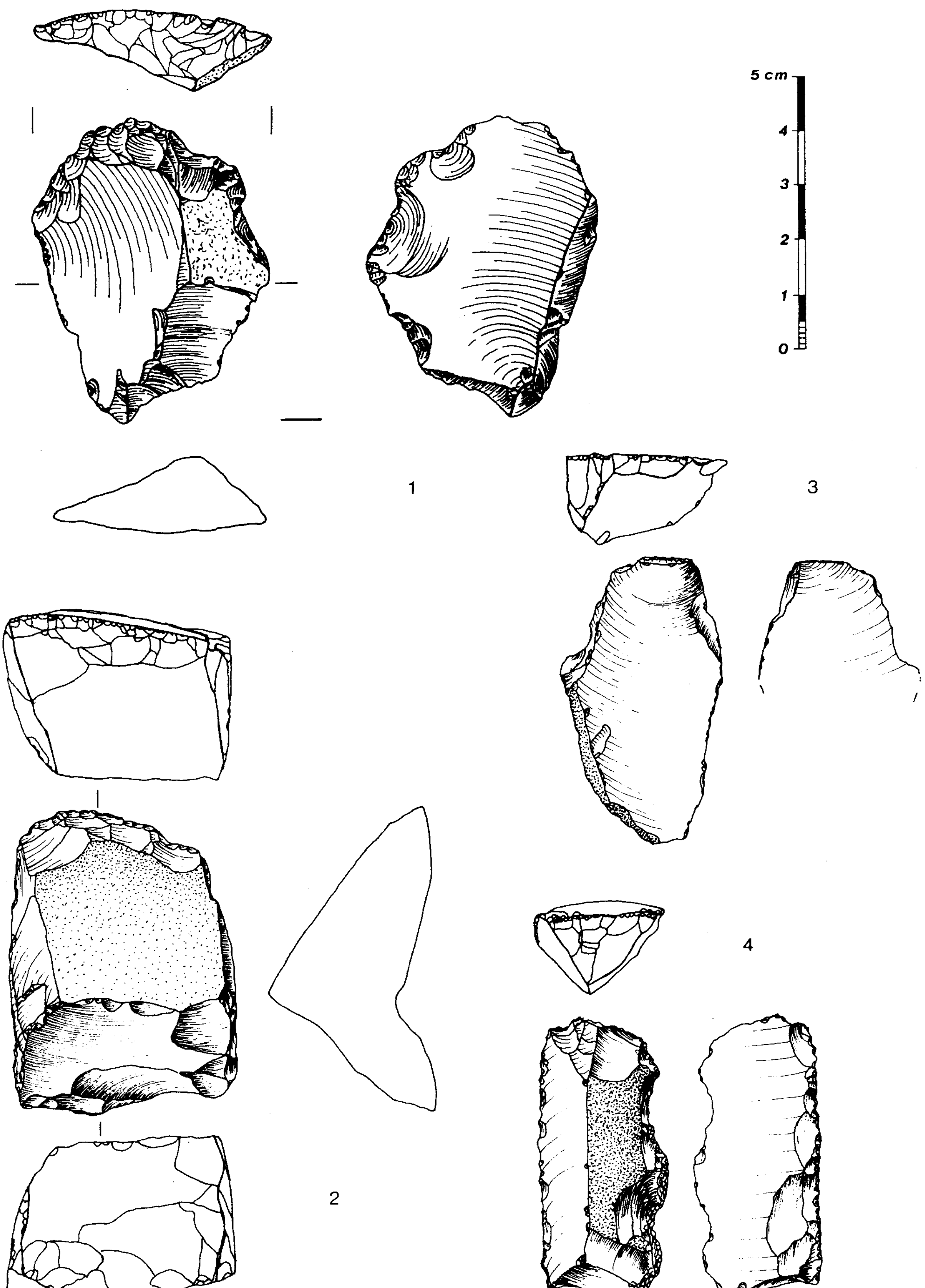


Fig. 5 *1* terminal steep-ret. flake (broken); *2* "terminal" and "basal" ret. steep-sided piece of debris; *3* proximal/basal steep-ret. flake; *4* fragm. of lateral and terminal steep-ret. blade.

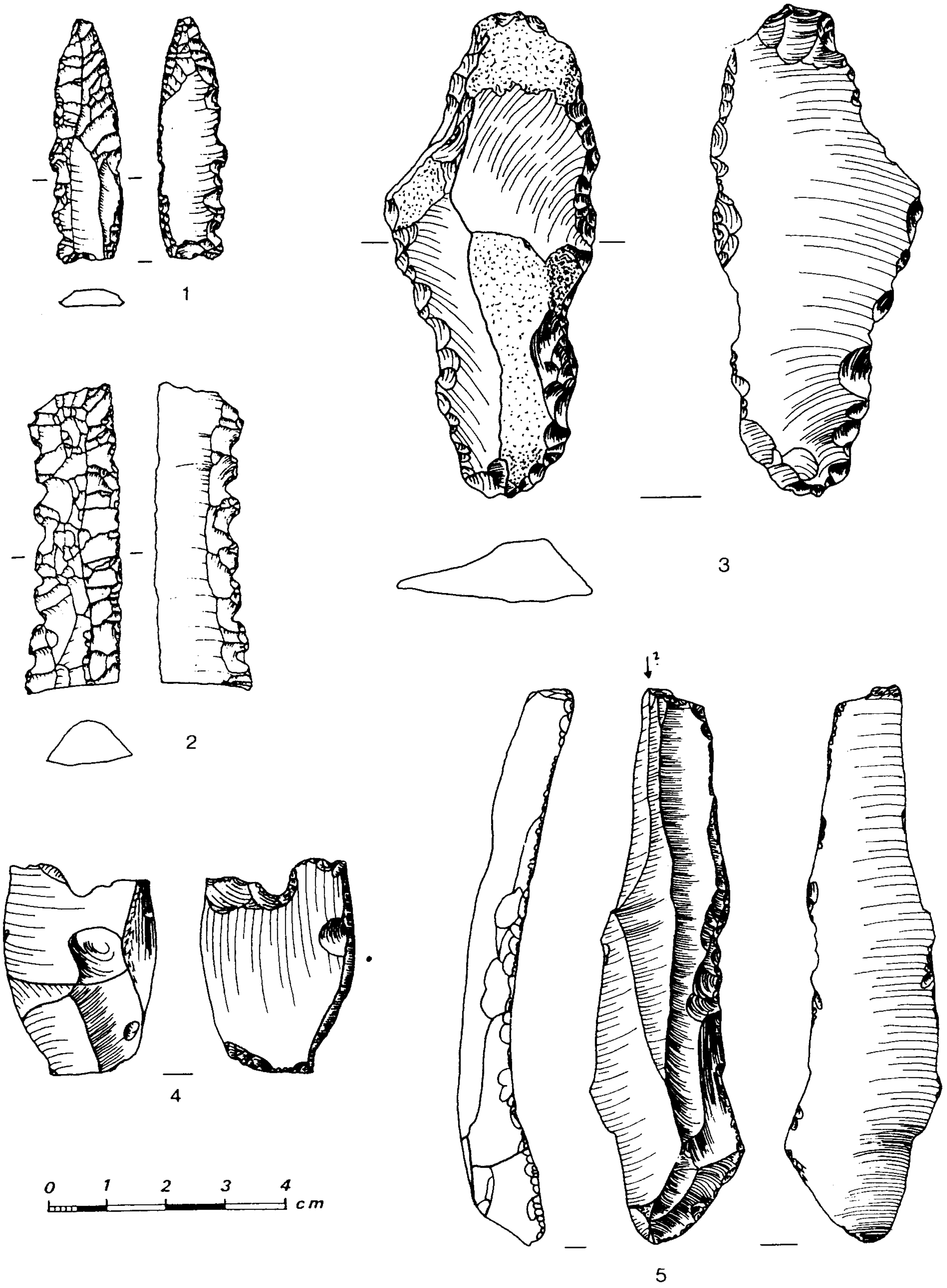


Fig. 6 *1-2* sickle elements; *3* terminally and laterally ret. non-parallel-sided blade IV with "alternating" ret. edges; *4* multiple tool 9015: ret. and notched edges; *5* lateral and terminal steep-ret. blade IV.

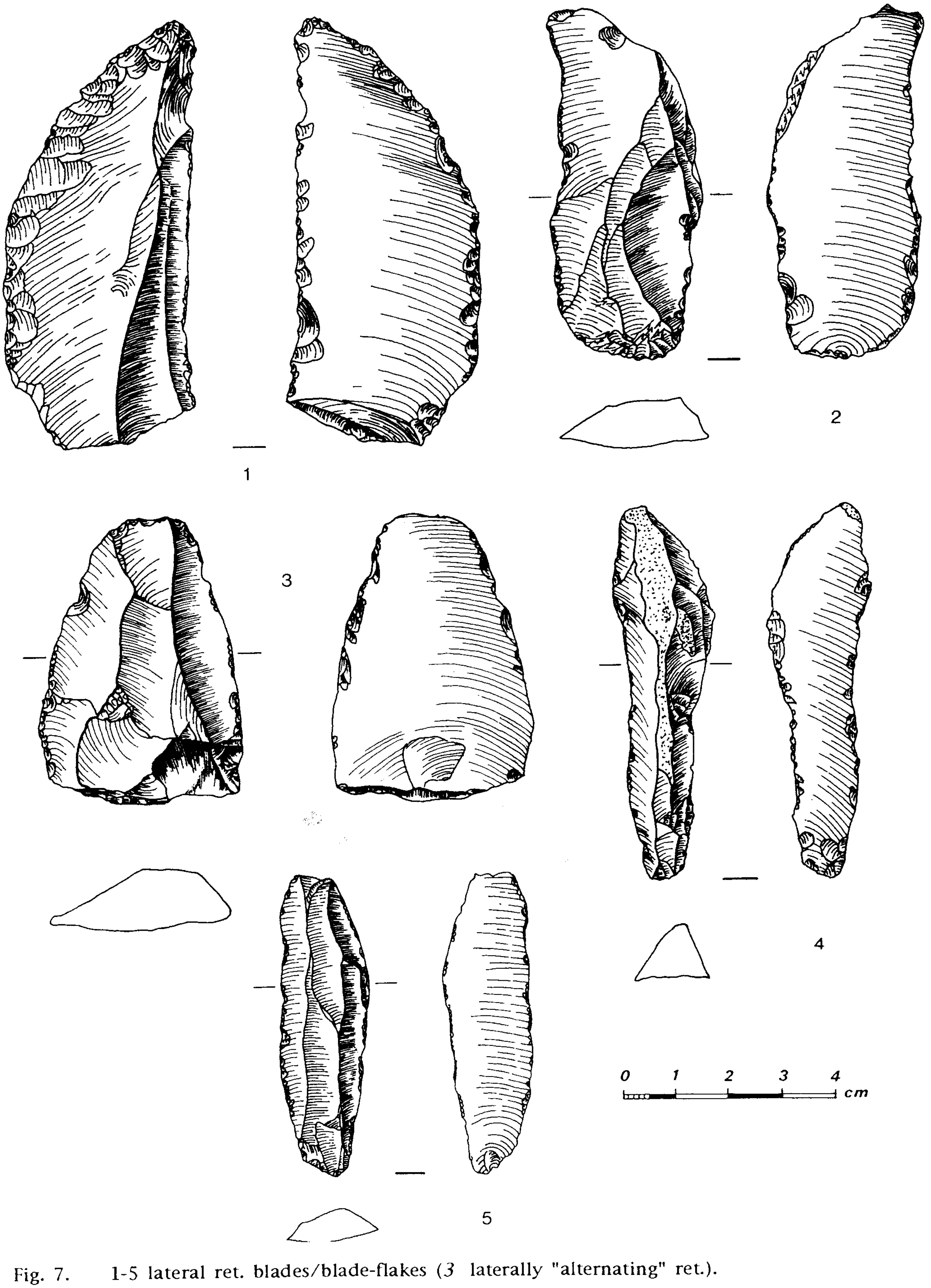


Fig. 7. 1-5 lateral ret. blades/blade-flakes (*3* laterally "alternating" ret.).

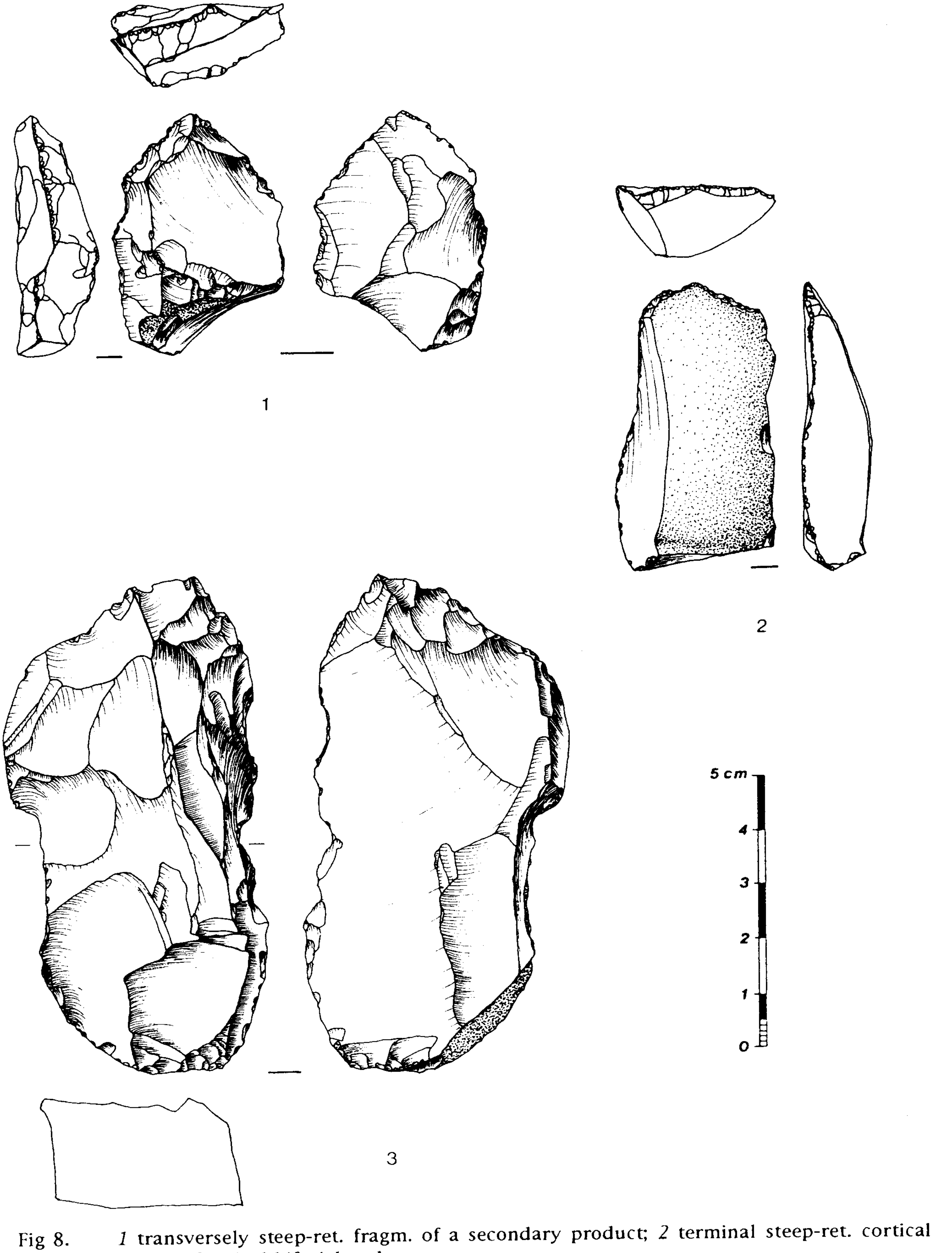


Fig 8. *1* transversely steep-ret. fragm. of a secondary product; *2* terminal steep-ret. cortical blade fragm.; *3* unfinished bifacial tool.

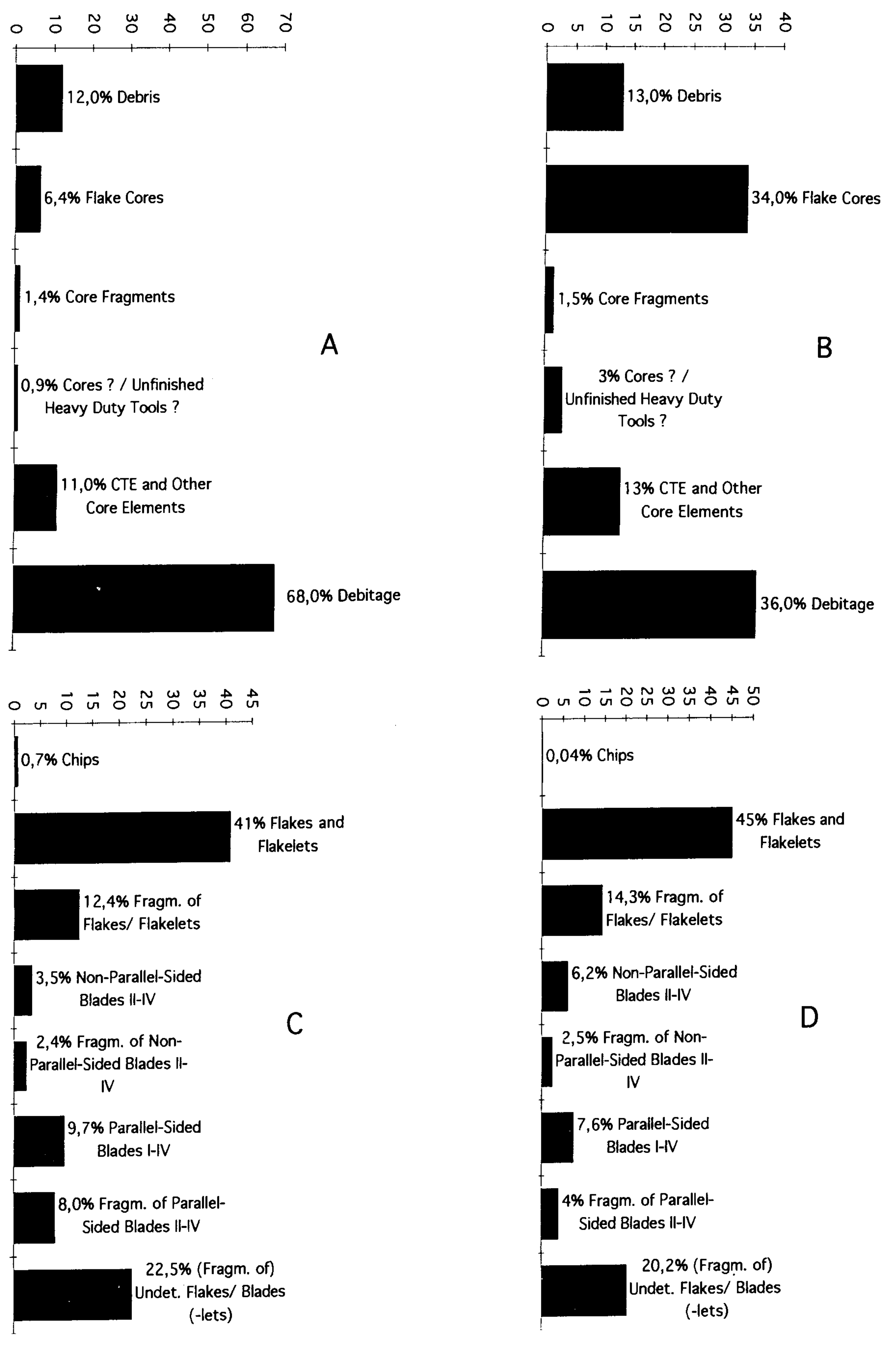


Fig. 9. Frequencies of primary products by percentages.

A Cores/CTEs/debitage by piece numbers *<blanks of implements are considered with primary products>*.

C Debitage classes by piece numbers.

B Cores/CTEs/debitage by weights *<blanks of implements are considered with primary products>*.

D Debitage classes by weights.

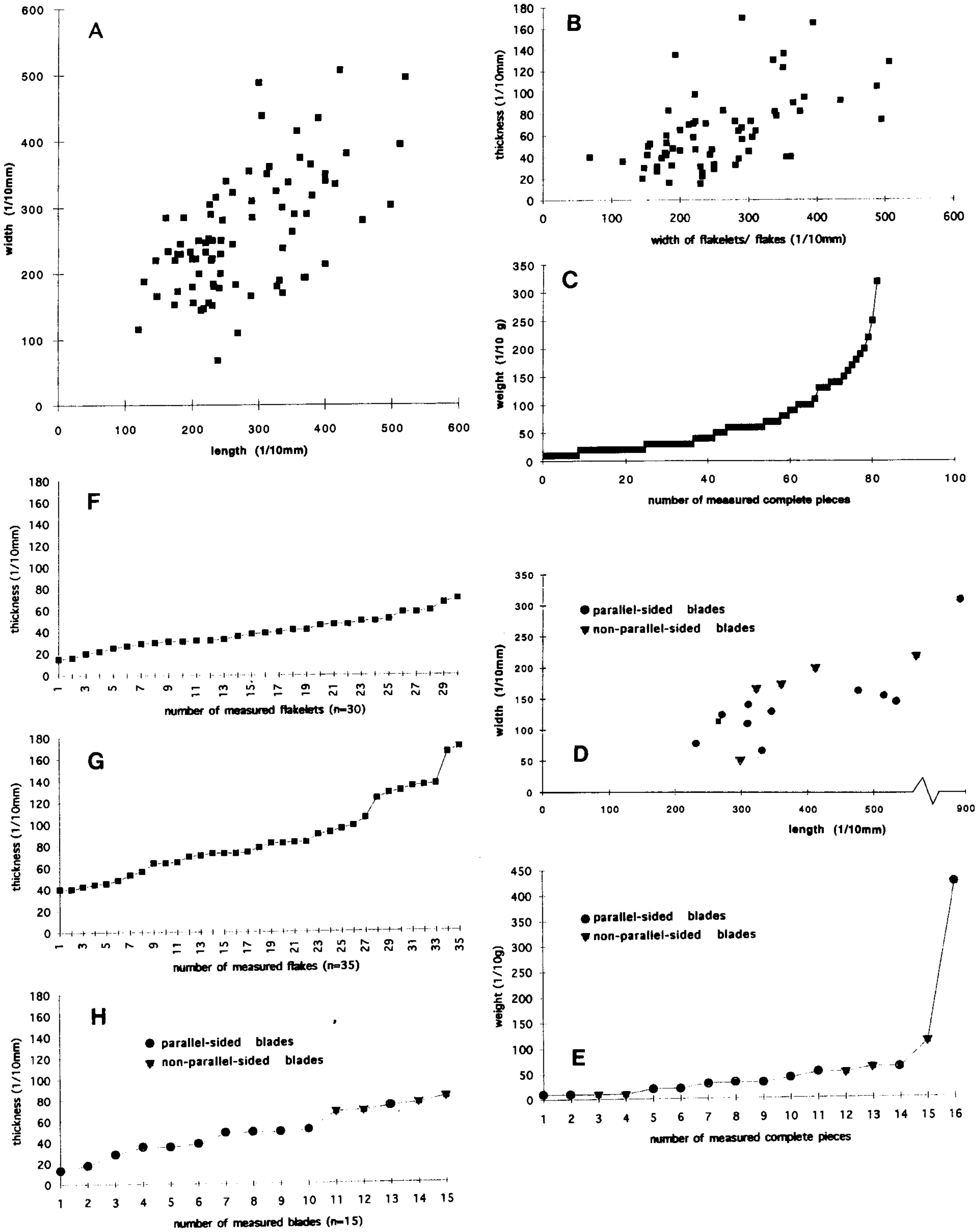


Fig. 10 Dimensions and weights of debitage.

A Lengths/ widths of flakelets/ flakes.

B Thicknesses/ widths of flakelets/ flakes.

C Weights of flakelets/ flakes

D Lengths/ widths of blades.

E Weights of blades.

F-H Thicknesses of flakelets (F), flakes (G), and blades (H).

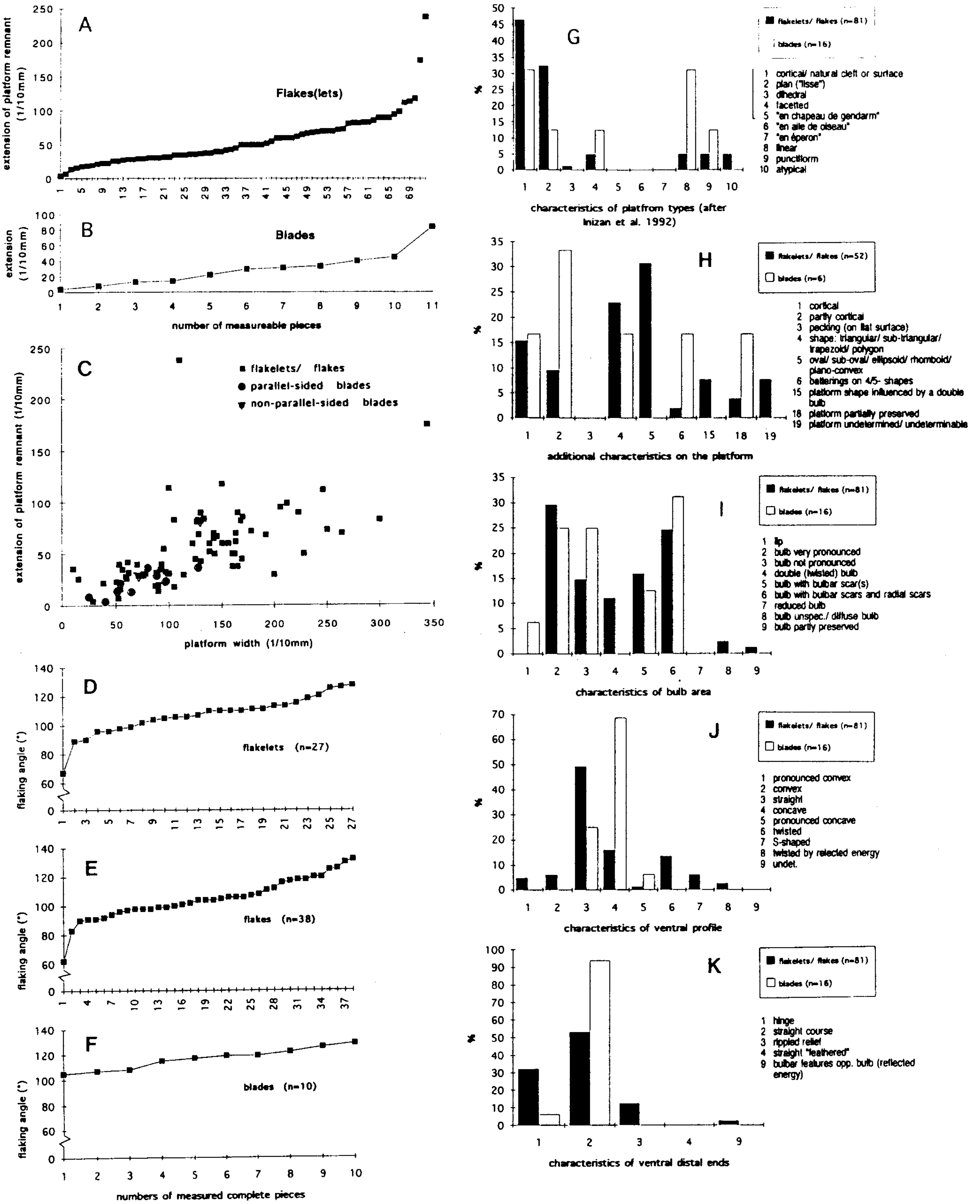


Fig. 11. Dimensions and frequencies of characteristic features of debitage.

A-B Extensions of butts of flakes/ flakelets (A) and blades (B).

C Butt dimensions of flakelets, flakes and blades.

D-F Flaking angles of flakelets (D), flakes (E) and blades (F).

G Butt types of flakelets/flakes and blades.

H Additional information on butt types of flake(-lets) and blades.

I Characteristics of bulb areas of flakelets/flakes and blades.

J Characteristcis of ventral profile.

K Characteristics of ventral distal ends.

Table 3. Classification of secondary products: Standard classification of implements *<right: codes for Tables 3 and 4>.*

'Ain Rahub: Classification of Secondary Products (Implement Classes with Types/ Sub-Groups)	pieces (#)	pieces (%)	weight (g)	weight (%)
(A) Projectile Points	**1**	**0,92**	**2**	**0,11**
cf. type GOPHER 1989: Fig. 37.6	1	0,92	2	0,11
(C) Drilling/ Piercing Tools	**4**	**3,67**	**39**	**2,09**
drilling/piercing tool on morph. distal tips of bl/fl/ other prim. p.	2	1,83	5	0,27
drilling/ piercing tools formed between lat. notches of bl/fl	2	1,83	34	1,82
(E) Steep-Ret. / Ret. Steep-Sided Tools	**23**	**21,11**	**543**	**29,11**
(fragm. of) lat. steep-ret. ret. bl/ fl/ other primary products	3	2,75	51	2,73
(fragm. of) lat. ret. steep-sided bl/ fl/ other primary products	4	3,67	55	2,95
(fragm. of) lat. and term. steep-ret. bl/ fl/ other primary prod.	1	0,92	31	1,66
(fragm. of) term. ret. steep-sided bl/ fl/ other primary products	10	9,17	268	14,37
(fragm. of) term. and basal ret. steep-sided bl/ fl/ other prim. p.	1	0,92	70	3,75
(fragm. of) transverse ret. steep-sided bl/ fl/ other primary p.	1	0,92	7	0,37
(fragm. of) term. steep-ret. bl/ fl/ other primary products	1	0,92	21	1,13
(fragm. of) transverse steep-ret. bl/ fl/ other primary products	2	1,83	40	2,14
(G) Glossed Elements	**2**	**1,83**	**8**	**0,43**
cf. type GOPHER 1989: Fig.41.1	1	0,92	2	0,11
cf. type GOPHER 1989: Fig. 40.10	1	0,92	6	0,32
(H) Notched Tools	**3**	**2,75**	**8**	**0,43**
term. notched bl/ fl/ other primary products	1	0,92	5	0,27
left-lat. notched bl/ fl/ other primary product	1	0,92	2	0,11
lat. opposed notches on bl/ fl/ other primary products	1	0,92	1	0,05
(I) Multiple Tools	**8**	**7,34**	**115**	**6,17**
cutting/ ret. + notched edge (*9015*)	3	2,75	51	2,73
scraping/ steep-ret./ ret. steep-sided ed. + use-ret. ed. (9 *029*)	1	0,92	19	1,02
two cutting/ ret. edges + edge bearing a burin negative (9 *114*)	1	0,92	21	1,13
two cutting/ ret. edges + notched edge (9 *115*)	2	1,83	11	0,59
cutting/ ret. edge + scraping/ steep-ret./ ret. steep-sided edge +edge with a drilling/piercing tip (9 *123*)	1	0,92	13	0,70
(J) Retouched Blades/Flakes	**44**	**40,37**	**515**	**27,61**
(fragm. of) lat. ret. bl/ fl	32	29,36	332	17,80
(fragm. of) lat.-term./distal ret. bl/ fl	9	8,26	141	7,56
(fragm. of) lat. basal/prox. ret. bl/ fl	1	0,92	17	0,91
(fragm. of) term./distal ret. bl/ fl	1	0,92	21	1,13
(fragm. of) basal/prox. ret. bl/ fl	1	0,92	4	0,21
(L) Use- and Other Retouched Pieces	**18**	**16,51**	**201**	**10,78**
(fragm. of) lat. use-ret. blades	7	6,42	26	1,39
(fragm. of) lat. use-ret. flakes/ flakelets	7	6,42	153	8,20
(fragm. of) lat.-term. use-ret. flakes	1	0,92	3	0,16
(fragm. of) unid./ undet. ret./ use-ret. bl/ fl/ other primary prod.	3	2,75	19	1,02
(M) Hammerstones	**2**	**1,83**	**176**	**9,44**
cf. Type 1 (GEBEL n.d.)	1	0,92	64	3,43
cf. Type 3 (GEBEL n.d.)	1	0,92	112	6,00
(N) Celts	**1**	**0,92**	**114**	**6,11**
unfinished celt	1	0,92	114	6,11
(P) Picks	**1**	**0,92**	**74**	**3,98**
unfinished pick	1	0,92	74	3,98
(Q) Chisels	**1**	**0,92**	**27**	**1,48**
unfinished chisel	1	0,92	27	1,48
(R) Other Heavy Duty Tools	**1**	**0,92**	**43**	**2,31**
unid./ undet. heavy duty tool	1	0,92	43	2,31
Total of Implements	**109**	**100**	**1865**	**100**

Abbreviations used: *bl* blade(s), *fl* flake(s)/flakelet(s), *ret.* retouch(es)/ retouched, *prim. p.* primary products

Codes: Implement Data (cf. Table 4), after INIZAN et al. (additions by H.G. Gebel)

Loc.	LOCALIZATION OF MODIFICATION
1	distal
2	medial
3	proximal
4	right
5	left
6	basal
7	terminal
Dist.	DISTRIBUTION OF MODIFICATION
1	discontinous
2	partial
3	complete edge
Del.	DELINIATION OF MODIFICATION
1	rectilinear
2	concave
3	convex
4	notched
5	denticulated
6	shouldered ("cran")
7	shouldered ("épaulement")
8	tongued ("languette")/tipped
9	tanged ("pédoncule")
10	tanged ("soie")
11	irregular
12	regular
17	"morphological" tip of blank used
18	"morphological" notch of blank used
19	combination of deliniation features
Pos.	POSITION OF MODIFICATION
1	direct
2	inverse
3	alternate
4	alternating
5	crossed ("croisée")
6	bifaciale
Ang.	ANGLE OF MODIFICATION
1	abrupt
2	bipolar abrupt ("abrupte croisée")
3	semi-abrupt
4	semi-abrupt ("rasante")
5	low-angle on steep-sided edge
Morp.	MORPHOLOGY OF MODIFICATION
1	scaled ("écailleuse")
2	stepped ("scalariforme")
3	subparallel
4	parallel
8	burin blow negative(s)
9	isolated retouch
Ext.	EXTENSION OF MODIFICATION
1	short
2	long
3	invasive
4	covering ("couvrante")
9	short and long

Code: Multiple Tools (proposal H.G. Gebel) (considers the main three working edges)

9	spreadsheet sorting figure
	following figures: working edges in strict formal order of the following figures/ parameters:
1	cutting edge/ ret. edge
2	scraping edge/ steep-ret. or ret. steep-sided ed.
3	edge with a drilling/ piercing tip
4	edge bearing a burin blow negative
5	edge with notch
8	edge with denticulations/ notches/ sickle edge,
7	edge with alternating ret.
8	splintered edge
9	use-ret. edge
0	a third edge is missing/ position and dominant edge fearure not relevant)

For other abbreviations used in Table 4 cf. Table 3.

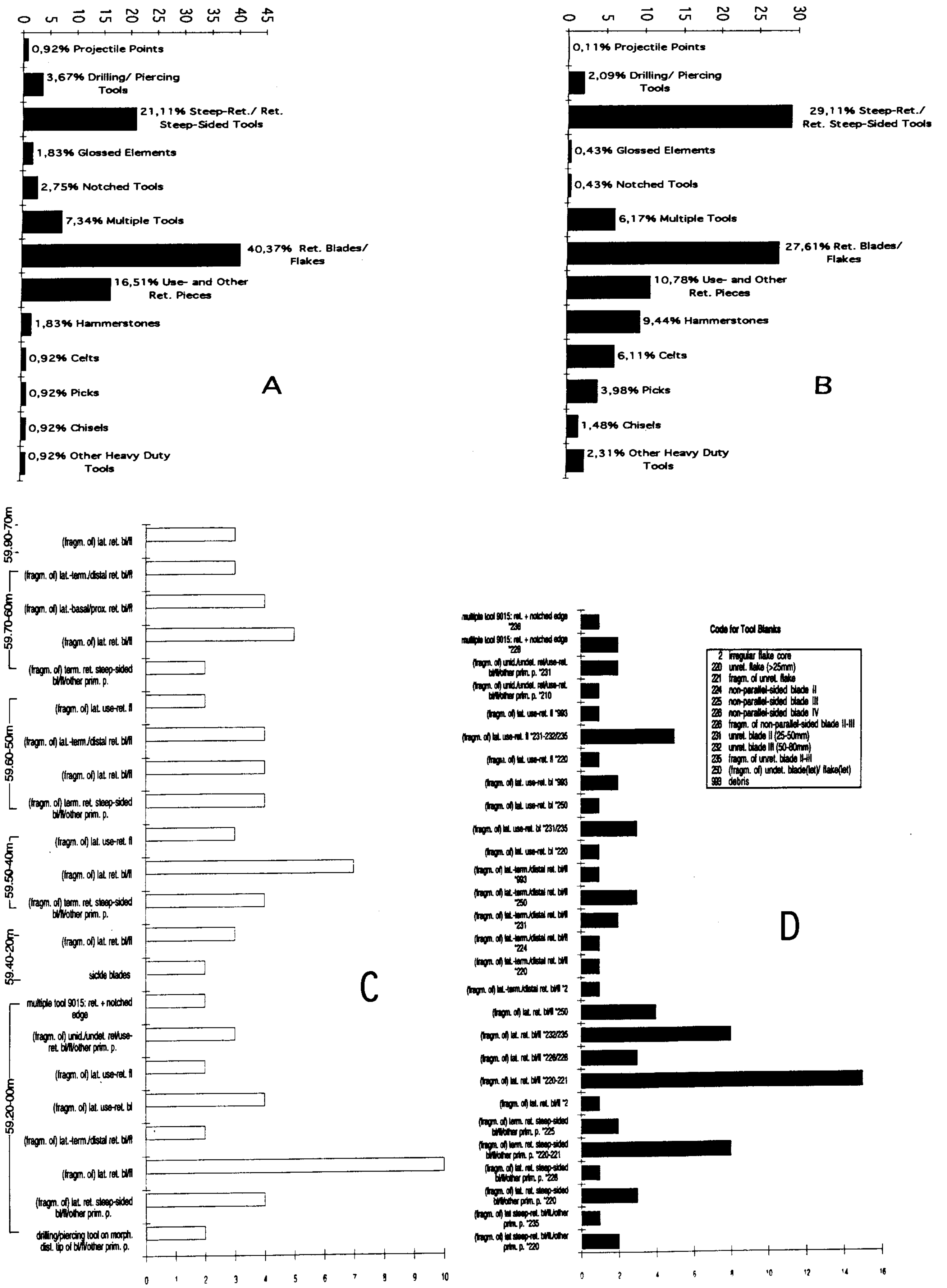


Fig. 12. Frequencies of secondary products.

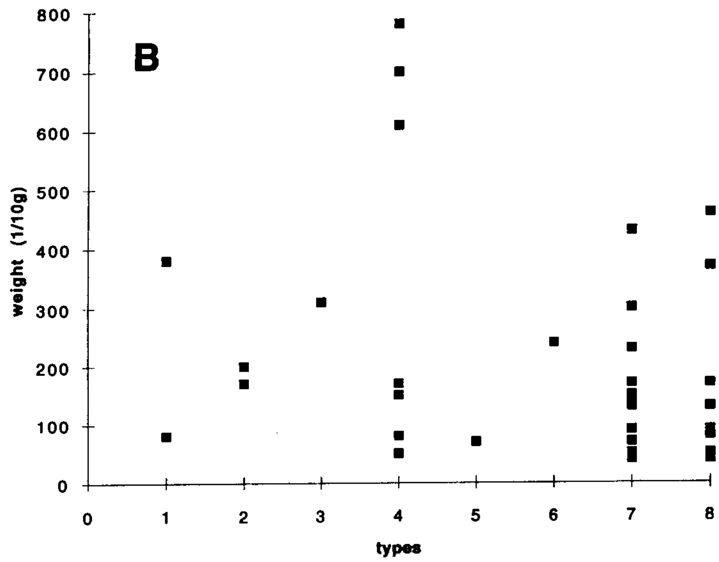
A Implement classes by percentages of piece numbers.

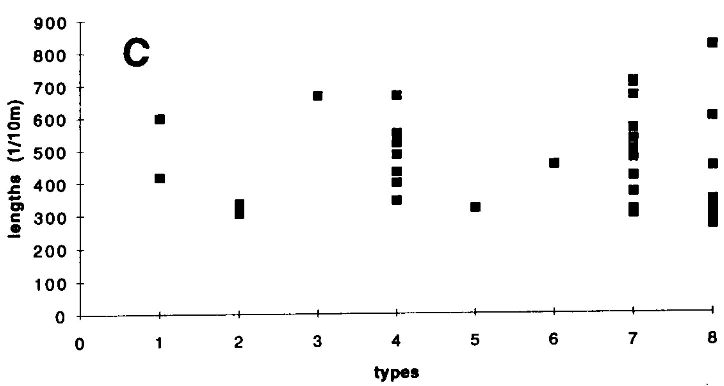
B Implement classes by percentages of weights.

C Distribution of implements in the levels by piece numbers *<for types represented by more than one piece>.*

D Distribution of implement blanks related to tool types by piece numbers *<for types represented by more than two pieces>.*

Selected Tool Types (complete pieces)	fig. ref.	type	blank	wght.	length	width	thickn.	st	angle
lat steep-ret. bl/fl./other prim. p.	1	300	220	80	416	231	70		76
lat steep-ret. bl/fl./other prim. p.	1	300	410	380	599	343	154	2	
lat. ret. steep-sided bl/fl/other prim. p.	2	301	220	170	304	· 478	120		65
lat. ret. steep-sided bl/fl/other prim. p.	2	301	221	200	334	412	163	2	
lat. and term. steep-ret. bl/fl/other prim. p.	3	302	220	310	667	327	210		82
term. ret. steep-sided bl/fl/other prim.p.	4	303	220	170	520	300	139		
term. ret. steep-sided bl/fl/other prim.p.	4	303	220	150	397	508	95		
term. ret. steep-sided bl/fl/other prim.p.	4	303	220	80	343	456		1	82
term. ret. steep-sided bl/fl/other prim.p.	4	303	220	780	666	641	200		
term. ret. steep-sided bl/fl/other prim.p.	4	303	224	50	396	120	51	1	76
term. ret. steep-sided bl/fl/other prim.p.	4	303	250	610	484	553	250	1	
term. ret. steep-sided bl/fl/other prim.p.	4	303	400	150	431	343	119		
term. + bas. ret. steep-sdd bl/fl/other p. p.	4	304	993	700	550	309	252		
transverse ret. steep-sdd. bl/fl/other prim. p.	5	305	220	70	319	404			79
transverse steep-ret. bl./fl/other prim. p.	6	315	220	240	453	296			
lat. ret. bl/fl	7	550	220	70	315	222	94	98	102
lat. ret. bl/fl	7	550	220	90	367	320	72	98	117
lat. ret. bl/fl	7	550	220	40	300	248	30	98	107
lat. ret. bl/fl	7	550	220	40	300	267	45	2	71
lat. ret. bl/fl	7	550	220	230	531	367	110	1	81
lat. ret. bl/fl	7	550	220	140	478	351	103	2	
lat. ret. bl/fl	7	550	220	140	417	319	160	1	70
lat. ret. bl/fl	7	550	221	150	500	326	94		
lat. ret. bl/fl	7	550	221	300	473	426	112	98	
lat. ret. bl/fl	7	550	225	430	710	303	179		66
lat. ret. bl/fl	7	550	225	130	703	204	108	1	75
lat. ret. bl/fl	7	550	231	70	418	199	63	1	
lat. ret. bl/fl	7	550	232	50	565	165	52	98	80
lat. ret. bl/fl	7	550	232	170	665	273	82	98	
lat. ret. bl/fl	7	550	401	130	499	295	71	98	100
lat.-term./distal ret. bl/fl	8	551	220	90	323	250	115		
lat.-term./distal ret. bl/fl	8	551	220	130	295	360	121		90
lat.-term./distal ret. bl/fl	8	551	220	80	336	413	50		70
lat.-term./distal ret. bl/fl	8	551	220	40	268	170	64		
lat.-term./distal ret. bl/fl	8	551	220	460	600	502	140		60
lat.-term./distal ret. bl/fl	8	551	220	50	343	211	74		70
lat.-term./distal ret. bl/fl	8	551	221	170	447	329	102		82
lat.-term./distal ret. bl/fl	8	551	226	370	822	368	128	1	76





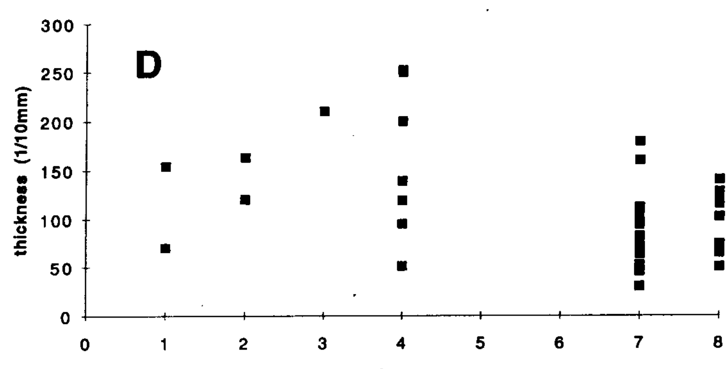


Fig. 13. Dimensions of complete steep-ret. and ret. steep-sided blades/ flakes/ other primary products, lateral and lateral-terminal retouched blades /flakes *<for codes cf. also Tables 3 and 4>.*

A List of implements considered in A-C.
B Weights of 1-8 (cf. A).
C Lengths of 1-8 (cf. A).
D Measureable (max.) thicknesses of 1-8 (cf. A).

Table 4. Classification of secondary products: Test data record according to parameters proposed by INIZAN *et al.* 1992 for non-formal implements <*additions to parameter list by H.G. Gebel; for the code cf. Table 3*>.

'Ain Rahub: Implement Data after INIZAN et al. 1992	blank	Mod. I dist./term.							Mod. II prox./basal							Mod. III left-lat.							Mod. IV right-lat.						
Characteristics of Modifications		Loc.	Dist.	Del.	Pos.	Ang.	Morp.	Ext.	Loc.	Dist.	Del.	Pos.	Ang.	Morp.	Ext.	Loc.	Dist.	Del.	Pos.	Ang.	Morp.	Ext.	Loc.	Dist.	Del.	Pos.	Ang.	Morp.	Ext.
arrowhead cf. type GOPHER : Fig. 37.6	231																												
drilling/piercing tool on morph. dist. tip of bl/fl/other prim. p.	220	1	2	4	1	1	3	1																					
drilling/piercing tool on morph. dist. tip of bl/fl/other prim. p.	235	1	2	17	1	5	9	1																					
drilling/piercing tool formed betw. lat. notches of bl/fl	220	5	3	4	6	1	3	2																					
drilling/piercing tool formed betw. lat. notches of bl/fl	220	4	3	4	2	1	3	9	5	2	3	1	5	3	1														
(fragm. of) lat steep-ret. bl/fl./other prim. p.	220															1	2	1	1	5	3	3	2	2	11	1	5	3	2
(fragm. of) lat steep-ret. bl/fl./other prim. p.	228																						3	1	11	1	5	9	1
(fragm. of) lat steep-ret. bl/fl./other prim. p.	410															5	3	1	1	5	3	2	3	2	1	1	5	2	2
(fragm. of) lat. ret. steep-sided bl/fl/other prim. p.	220	1	3	11	1	5	9	9															4	1	11	1	5	9	2
(fragm. of) lat. ret. steep-sided bl/fl/other prim. p.	221	1	2	1	1	5	4	9															4	3	3	1	5	3	9
(fragm. of) lat. ret. steep-sided bl/fl/other prim. p.	221	1	2	1	4	5	4	1								5	3	1	1	5	9	9							
(fragm. of) lat. ret. steep-sided bl/fl/other prim. p.	228	7	3	1	1	5	3	9								1	3	2	4	5	9	1	1	3	11	1	5	9	9
(fragm. of) lat. and term. steep-ret. bl/fl/other prim. p.	220	1	2	11	1	5	3	9																					
(fragm. of) term. ret. steep-sided bl/fl/other prim.p.	220	3	3	1	2	5	4	1																					
(fragm. of) term. ret. steep-sided bl/fl/other prim.p.	220	1	3	3	1	1	4	1																					
(fragm. of) term. ret. steep-sided bl/fl/other prim.p.	220	1	3	3	1	1	4	2															3	2	1	2	4	1	9
(fragm. of) term. ret. steep-sided bl/fl/other prim.p.	220	1	3	19	1	5	3	9																					
(fragm. of) term. ret. steep-sided bl/fl/other prim.p.	221	7	3	19	1	5	2	9																					
(fragm. of) term. ret. steep-sided bl/fl/other prim.p.	221	7	3	3	1	5	4	9																					
(fragm. of) term. ret. steep-sided bl/fl/other prim.p.	224	1	2	3	1	1	3	2	3	2	3	1	3	3	1								1	2	1	1	5	2	9
(fragm. of) term. ret. steep-sided bl/fl/other prim.p.	250	7	3	8	1	1	2	3																					
(fragm. of) term. ret. steep-sided bl/fl/other prim.p.	400	3	2	1	2	5	4	9																					
(fragm. of) term. ret. steep-sided bl/fl/other prim.p.	993	7	2	11	2	3	2																						
(fragm. of) term. and basal ret. steep-sided bl/fl/other p. p.	993	7	3	1	1	5	3	9	6	3	3	1	5	2	9														
(fragm. of) transverse ret. steep-sided bl/fl/other prim. p.	220	7	3	1	1	7	4	9																					
(fragm. of) term. steep-ret. bl./fl/other prim. p.	235	1	3	3	1	1	4	1																					
(fragm. of) transverse steep-ret. bl./fl/other prim. p.	220	7	3	1	2	1	2	9																					
(fragm. of) transverse steep-ret. bl./fl/other prim. p.	993	7	3	11	1	1	4	9																					
sickle blade cf. type GOPHER 1989: Fig. 41.1	231																												
sickle blade cf. type GOPHER 1989: Fig. 40.10	232																												
term. notched bl/fl/other pim. p.	210	1	2	4	1	5	4	2																					
left-lat. notched bl/fl/other pim. p.	228															5	2	4	1	4	9	1							
lat. opposed notches on bl/fl/other pim. p.	228								3	3	8	1	3	3	1	3	2	4	1	3	3	1	3	2	4	1	1	4	1
(fragm. of) lat. ret. bl/fl	52															5	3	1	4	4	3	1							
(fragm. of) lat. ret. bl/fl	220																						4	2		2		4	2
(fragm. of) lat. ret. bl/fl	220															5	2		2	3		1	4	2	3	1			1
(fragm. of) lat. ret. bl/fl	220																						4	2	3	1	3	4	1
(fragm. of) lat. ret. bl/fl	220																						3	2	3	1	3	4	1
(fragm. of) lat. ret. bl/fl	220															5	3	1	4	4	4	1	4	3	1	4	4	9	1
(fragm. of) lat. ret. bl/fl	220															5	2	11	4	3	9	9							
(fragm. of) lat. ret. bl/fl	220																						2	2	1	6	3	3	9
(fragm. of) lat. ret. bl/fl	221																						4	2	2	1	3	3	1
(fragm. of) lat. ret. bl/fl	221															5	1		2			1	4	1		1			1
(fragm. of) lat. ret. bl/fl	221															5	3	1	1	3		2							
(fragm. of) lat. ret. bl/fl	225															2	2	1	5	2	3	1							
(fragm. of) lat. ret. bl/fl	225															5	1	1	2	4	9	9	4	2	1	2	4	4	1
(fragm. of) lat. ret. bl/fl	226															5	3	3	6	4	4	2	4	1	1	2	4	9	9
(fragm. of) lat. ret. bl/fl	231								3	3	1	1	3	2	2	5	1	11	1	5	9	9	4	3	1	4	3	4	1
(fragm. of) lat. ret. bl/fl	232															5	3		4			1	4	3		1			1
(fragm. of) lat. ret. bl/fl	232								6	3	3	1	4	3	9	5	3		4				4	3		1			1
(fragm. of) lat. ret. bl/fl	235															5	3	1	4			1	4	1		1			1
(fragm. of) lat. ret. bl/fl	235															5	2	4	4	4		1							
(fragm. of) lat. ret. bl/fl	235															1	3	3	1	4	3	1	1	3	1	1	1	3	1
(fragm. of) lat. ret. bl/fl	235															2	3	1	3	3	3	1							
(fragm. of) lat. ret. bl/fl	235								3	1	3	1	1	1	1	3	1	1	1	4	3	1	3	1	1	1	3	3	1
(fragm. of) lat. ret. bl/fl	235															2	3	1	1	1	4	1	2	3	1	4	4	4	1
(fragm. of) lat. ret. bl/fl	235															5	3	1	1	4	4	1	4	3	11	1	4	3	1
(fragm. of) lat. ret. bl/fl	235															5	1		6			1	4	1		6			1
(fragm. of) lat. ret. bl/fl	235															5	1		1			1	4	1		1			1
(fragm. of) lat. ret. bl/fl	235								6	2		5	2		1	5	2	1	1		3	2							
(fragm. of) lat. ret. bl/fl	235															5	3	1	1	3	3	1	4	3	1	1			1
(fragm. of) lat. ret. bl/fl	235															5	3	1	4	4		1	4	3	4	1	3		1
(fragm. of) lat. ret. bl/fl	236															5	3	3	6	4	3	2	4	3	1	2			1
(fragm. of) lat. ret. bl/fl	250	1	3	3	1			1															4	2	1	1	4		1
(fragm. of) lat. ret. bl/fl	401																						4	2	3	1	4	3	1
(fragm. of) lat.-term./distal ret. bl/fl	220	7	3	1	1	5	4	1								5	3	3	4	4	4	1							
(fragm. of) lat.-term./distal ret. bl/fl	220	7	2	3	1	3	4	1								5	3	3	4	4	4	1							
(fragm. of) lat.-term./distal ret. bl/fl	220	7	3	1	1	3	3	1								5	3	3	4	4	3	1	4	3	1	1	4	3	1
(fragm. of) lat.-term./distal ret. bl/fl	220	7	3	1	1	3	4	1								5	2	1	3	3	3	1	4	3	3	1	3	4	1
(fragm. of) lat.-term./distal ret. bl/fl	220	7	3	3	4	4	3	1								5	2	1	4	3	4	1	4	3	19	4	4	4	1
(fragm. of) lat.-term./distal ret. bl/fl	220	7	3	3	1	4	4	1								5	3	1	6	3	4	1	4	2	1	6	3	4	1
(fragm. of) lat.-term./distal ret. bl/fl	221	7	3	1	1	4	3	1								5	2	4	1	4	3	1	4	3	1	3	4	2	1
(fragm. of) lat.-term./distal ret. bl/fl	221	7	3	4	1	3	3	1								5	2	1	2	4	4	2	4	2	1	4	4	4	1
(fragm. of) lat.-term./distal ret. bl/fl	226	1	3	3	2	4	2	9								5	2	11	4	5	9	1	4	3	1	4	5	3	1
(fragm. of) lat.-basal/prox. ret. bl/fl	232								3	3	3	1	4	4	3	5	3	1	4	4	3	1	3	2	1	4	4	9	1
(fragm. of) term./distal ret. bl/fl	993	7	3	1	1	3	4	9																					
(fragm. of) basal/prox. ret. bl/fl	220								6	2	3	6	1	4	2														
(fragm. of) lat. use-ret. bl	231																												
(fragm. of) lat. use-ret. bl	231																												
(fragm. of) lat. use-ret. bl	231																												
(fragm. of) lat. use-ret. bl	231																												
(fragm. of) lat. use-ret. bl	231																												
(fragm. of) lat. use-ret. bl	232																												
(fragm. of) lat. use-ret. bl	232																												
(fragm. of) lat. use-ret. fl	220																												
(fragm. of) lat. use-ret. fl	220																												
(fragm. of) lat. use-ret. fl	220																												
(fragm. of) lat. use-ret. fl	220																												
(fragm. of) lat. use-ret. fl	220																												
(fragm. of) lat. use-ret. fl	220																												
(fragm. of) lat. use-ret. fl	221																												
(fragm. of) lat.-term. use-ret. fl	220																												
(fragm. of) unid./undet. ret/use-ret. bl/fl/other prim. p.	250																												
(fragm. of) unid./undet. ret/use-ret. bl/fl/other prim. p.	250																												
(fragm. of) unid./undet. ret/use-ret. bl/fl/other prim. p.	250																												
hammerstone Type 1 (cf. GEBEL n.d.)	2																												
hammerstone Type 3 (cf. GEBEL n.d.)	2																												
unfinished celt	250																												
unfinished pick	250																												
unfinished chisel	250																												
unid./ undet. heavy duty tool	250																												
multiple tool 9015: ret. + notched edge	220	7	2	4	2	1	3	1	6	2	3	2	4	9	2								3	1	1	6	4	9	1
multiple tool 9015: ret. + notched edge	220	1	2	4	1	1	9	9								2	2	4	1	5	4	1							
multiple tool 9015: ret. + notched edge	229	1	2	1	2	1	3	2								3	2	18	1	3	1	9	4	3	3	2	3	4	1
multiple tool 9029: steep-ret/ ret. st.-sdd. ed.+use-ret. ed	233	1	3	3	1	1	2	2								5	3	1	2	5	9	9	4	3	11	1	1	9	9
multiple tool 9115: two ret. edges + notched edge	233	3	1	1	1	1	4	2								4	2	16	9		8	2	3	2	1	1	5	3	9
multiple tool 9115: two ret. edges + notched edge	220	1	2	4	1	1	3	2								5	1	1	1	3	9	9	4	3	1	2	4	3	1
multiple tool 9123: ret.ed.+st.-ret./ret.st.-sdd.ed.+drillg.tip	228	1	3	8	1	1	3	2															4	1	1	6	4	9	9

Code for Tool Blanks

2	irregular flake core
220	unret. flake (>25mm)
221	fragm. of unret. flake
224	non-parallel-sided blade II
225	non-parallel-sided blade III
226	non-parallel-sided blade IV
228	fragm. of non-parallel-sided blade II-III
229	fragm. of non-parallel-sided blade IV
231	unret. blade II (25-50mm)
232	unret. blade III (50-80mm)
233	unret. blade IV (>80mm)
235	fragm. of unret. blade II-III
236	fragm. of unret. blade IV
250	(fragm. of) undet. blade(let)/ flake(let)
400	edge-of-core removal flake I
401	edge-of-core removal flake II
410	cortex removal flake
993	debris

Primary Production[1] (Table 2)

423 primary products with a weight totalling almost 7kg were identified in the assemblage; thermal debris and chunks were not counted with the primary products, but the identifiable blanks of implements had to be included. 68% of the primary products is debitage (by weight: 36%), 11% are CTEs and other core elements (by weight: 13%), 6,4% are flake cores (by weight: 34%), and 12% is debris (by weight: 13%). This distribution indicates that we are dealing with flint manufacturing in the Yarmoukian occupation, which used nearby raw material as a resource. Approx. 25% of the primary products were modified into implements, almost exclusively from debitage blanks.

Apart from the uppermost Layer 59.20-00m, the debitage material of which counts as high as 86%, the debitage proportion in the artificial layers ranges between 57-70%. Layers 59.70-60m, 59.60-50m and 59.50-40m provided most of the material, both in terms of the number and weight of pieces; they allow definitive statements about artefact concentrations. It is the Layers 59.60-40m, from which 74% of all the fake cores come from.

Raw Materials and Raw Material Selection (H.G.G.) (Table 1)

The 'Ain Rahub industry is characterized by the use of locally available flint[2]; no use of imported flint materials has been observed in the small sample obtained. Three, possibly four raw material classes are in evidence (Table 1), of which certainly Classes 1a and b belong to one raw material group (description according to GEBEL 1994). Actually, it was sometimes an arbitrary act in attributing pieces to either 1a or 1b.

Raw Materials 1a/b and 2 derive from the right banks of Wadi 'Ain Rahub; they are easily accessible as veins in these Lower Tertiary/Upper Cretaceous limestone/chalky limestone/marl formations (MUHEISEN, GEBEL, HANNSS and NEEF 1988: Fig. 3). They are veins of flattish nodules, which sometimes change into tabular bodies; they occur approx. 20-30m (Raw Material 1a/b) and approx. 10-15 m (Raw Material 2) above the present-day wadi floor. Raw Material 3? must represent the rarely used nodular flint from the surrounding plateau surface. However, Raw Material Classes 1a/b and 3? might be difficult to separate in the sense of artefacts.

Ignoring the chunks and debris, the 'Ain Rahub flint artefacts were almost exclusively of the good quality 1a and 1b raw materials. Inferior quality Raw Material 2 is rarely seen amongst the artefacts, and is mostly represented in the debris group. Except for one (Raw Material 3?), all the flake cores are made exclusively of the 1a (approx. 40%) and 1b (approx. 60%) raw materials.

Cores[3] (6,4%)[4], Core fragments (1,4%) and Core Trimming Elements/ Other Core Elemets (11%) (H.G.G. with G.H.) (Fig. 9; Table 2)

Cores and other primary products (CTEs and debitage) indicate that the 'Ain Rahub Yarmoukian industry was predominantly a flake industry. The blade elements of the industry can only be traced through the proportions of the non-parallel-sided and parallel-sided blades (4% and 12% of the primary products, including the fragments). These 16% contrast with the evidence that no true blade cores were found in the sample from the Test Unit. Amongst the exhausted flake cores, only 3-4 show the negatives of blade-like removals (e.g. Fig.2:1-2): The flake/flakelets:blades ratio shows a proportion of approx. 2.2:1, if the non-parallel-sided blades and fragments are included.

The absence of blade cores is explained by decreasing core dimensions during core reduction and the obvious inability of the knappers to create and maintain the necessary ridges, thus restricting them to flake production. However, no blade technology in the sense of a distinguished blade core preparation

1 Only those classes of primary products are described in the following, which require special information.

2 In the geological context, the correct term here would be "chert".

3 Shadowing in Figs. 2: 1-2 and 3:1-3 indicates patinated naturally flaked surfaces, probably resulting from resource exposure.

4 Precentages in the headlines for cores and core trimming elements refer to the total of primary products.

is evidenced by the core trimming elements (CTE). Blades were most likely only produced from successfully used ridges in earlier stages of core reduction. The one crest blade found is not regular in the sense of naviform core preparation. Elements in the debris and flake classes show evidence of intentional core remnant splittering *(Kernzertrümmerung)*. This was most likely done in order to select suitable blanks from the resulting debris of exhausted cores.

Flake cores (6,4%) (Figs. 1-3)

Although the limited number of cores restricts comment about core reduction strategies, it appears justified to interpret the distribution of non-single-platform cores:single-platform cores as 1:2. The flake cores with a platform shift are an intermediate reduction stage, ending with the irregular and spherical shapes. Together with the single-platform flake cores, these cores with a platform shift will be considered regular (see definition below), although their morphology make them appear irregular and they are classified as such in other publications. In that sense, the 'Ain Rahub core reduction technique shows a strategic pattern, illustrating the tendency to work from one platform only:

spherical flake cores (0,7%) (Fig. 3:3)
Spherical cores are distinguished from irregular cores by having reached a spherical morphology by extensive use of all the pronouced edges for flake removals. They have to be considered as true remnant/exhausted cores. Only 11% or 3 pieces of the cores can be described as spherical, covering all weight classes in this limited sample.

irregular flake cores (1,7%) (Fig. 3:2)
Irregular flake cores (26% of all the cores) still show pronounced edges which would allow platform shifts, meaning that their cubical shapes offer the use of former core faces as new platforms. These cores developed from flake cores with a platform shift, most likely by corresponding reduction strategies.

flake cores with a platform shift (1,2%) (Figs. 2:3; 3:1)
This type (19% of all the cores) basically respresents an intermediate reduction stage between the irregular and the single-platform flake cores; when a single-platform cores' face got spoiled (e.g. by hinge negatives or ridges interfering with each other) or a platform was exhausted, the platform was shifted. In 'Ain Rahub a pattern can possibly be observed with just this platform shift; as in the upper Neolithic strata of Basta (Gebel, under study), the newly chosen platform is situated in such a way that the new core face underneath does not interfer with negatives of the former; although it can be a non-spoiled part of the former core face (especially to be found with single-platform cores with extensive core edges). This mostly results in a sort of a shift of the core edge through approx. 90°, using an acute "corner" of the earlier core face. However, the new platform, respectively core edge, must be located above another, suitably even face of the core. This core type mostly shows the negatives of blade-like flakes or even of non-parallel-sided and parallel-sided blades. Within the team we call these cores "A-B-cores", in order to describe this characteristic shift from an earlier "A"- platform to a later "B"-platform. Since these core types seem to be characteristic for the late Neolithic in Jordan, I propose this term forthwith.

single-platform flake cores (2,1%) (Figs. 1:1-3; 2:1-2)
33%, respectively 9 pieces, of the flake cores are single-platform flake cores. Natural clefts or the cortex surface of the raw material often serve as the platform, a feature also indicated by the 46% of the cortical/ natural cleft butts of flakes (31% with blades) (Fig. 12: G). Again, as with all the other core types, all size and weight classes are represented in this group.

other flake cores (0,7%)
These 3 pieces consist of a true micro-core and two artefacts on small flint chunks all fulfilling the core definition of having two removals at least.

Core Fragments (1,4%) (Table 2)

CTEs and other core elements (11%) (Table 2)

edge-of-core removal flakes (1,7%)
Of triangular section, the dorsal sides of these blade-flakes are parts of former core edges; this characteristic may point to intentional removals of core edges, as evidenced in the upper strata at Basta (Gebel, under study.).

cortical/cortex removal flakes (7,1%)
are very amorphous flakes with a minimum of 30% cortex. The evidence of cortical/cortex removal flakes/blades (complete pieces: 9.8%) indicates intentional cortex removal.

cortical/cortex removal blades (1,7%)
are irregular thick blades whose main dorsal ridge on either side bears cortex, to wit, the negative of a previous cortex removal blade. Per definition, these blades must show a minimum of 30% dorsal cortex.

fragm. of cortical/cortex removal blades/flakes (0,7%)

crest blades (0,2%)

Debitage (68%)[1] (H.G.G. with M.H. and M.Z.) (Figs. 9-11; Table 2)

All debitage was classified, counted and weighed according to classes, as explained in Table 2. In addition to this primary classification, all classes of completely preserved primary products (flakelets, flakes, non-parallel- and parallel-sided blades I-IV) were documented according to the following technological and dimensional characteristics: preservation, cortical features, weight, natural dorsal features; measurements of length, width, and thickness; flaking angle; butt types and measurements; features of the bulb area, ventral profile and ventral distal end.

The majority of debitage (41%) consists of flakelets and flakes (by weight: 45%), followed by the fragments of flakelets/flakes (12,4%). The blade element of the industry, compared to total debitage, is 23,6% (including fragments comprising 10,4% of the total debitage), which is 16% of all primary products (including fragments comprising 7% of total primary products). This shows that blade manufacture is a substantial part of the industry, represented by a relationship of 1:2 to flakelets/flakes. When the non-parallel-sided blades are separated from the parallel-sided, their ratio is 1:2,8. Given the limited amount of material analyzed and tool blanks selected, this still proves a considerable element of successful parallel-sided blade making, which is not evidenced by the cores. The flake cores in the industry obviously represent the former blade cores, see above.

Flakelets/flakes (41%), and fragments of flakelets/flakes[2] (12,4%) (Figs. 9-11; Table 2)

The proportion of flakes to flakelets is 2:1, by weight approx. 10:1.

Flakelets (10-25mm) are removals from cores (or "core tools" like the heavy duty tools) of amorphous shapes without parallel ridges; their longitudinal dimensions are less than double the width. Longitudinal dimensions of flakelets are - per definition - between 10 and 25mm. Short parallel- or non-parallel-sided blades I are counted as flakelets if their lengths are less than twice the width. The same definition is used for flakes, whose longitudinal dimensions are - per definition - >25mm, representing less than double the width. Short parallel-sided or non-parallel-sided blades II-IV were counted with the flakes if their lengths were <= twice the width.

The technological characteristics of flakes/flakelets can be described as follows: Only 7,6% of the dorsal faces show cortical or other natural surfaces, generally not covering more than 30%. This information appears striking when compared with the fact that almost 50% of flake removals occurred

1 This figure refers to the total of primary products; the percentages in the section below refer to the total of debitage.

2 Flakelets and flakes are handled together in evaluation, and are only separated for purposes of the primary products statistics (Tab. 2).

from cortex or natural surfaces being used as a platform. The platform remnants or butts show that 46% of the flake/flakelets were removed directly from the cortex, natural surfaces like clefts, wadi transport batterings etc. 33% are plan (*lisse*), taking up a part of a larger platform negative. The other platform types (facetted, linear, punctiform) are represented equally by 5% (dihedral: 1,25%). Looking at butt shapes whilst excluding plan butts, 31% are (sub-)oval/ellipsoid/rhomboid/planoconvex, 23% have a (sub-)triangular/trapezoid/polygon shape, 7,6% of butts' shapes are influenced by a twisted/"double" bulb.

Bulb characteristics are: very pronounced without scars (30%), with bulbar and radial scars (25%), with bulbar scars only (16%), non-pronounced bulbs (15%), and twisted/"double" bulbs (11%).

The profiles of the ventral sides are straight (49%), pronounced concave and concave (17%), twisted (14%), convex and pronounced convex (11%), and S- shaped (6%). Two pieces have developed, clear bulb features at their distal end. These products are possibly the result of applying an anvil technique, in the sense of smashing cores, debris, or chunks (aforementioned core remnant splittering). These "opposed bulbs" are distinctive but rare in the sample. However, other pieces without "opposed bulbs" among the debris and tool blanks which show ventrally bipolar interfering surfaces (often with ridges between), are understood to be products of an anvil technique as well. The ventral distal ends usually extend linearly (53%), but hinges are well represented too (32%). 12% end with a rippled relief.

(Fragm. of) Non-parallel- (3,5%+2,4%) and parallel-sided (9,7%+8%) blades[1] (Fig. 9-11; Table 2)

Only 38 complete debitage (16) and tool blank (21) blades were recovered in the sample, among which two-thirds are parallel-sided and one-third is non-parallel-sided. In both groups, most specimens fall into size category II (25-50mm). Size classes I and IV are virtually non-existent. The sample size gives only limited information. All percentages given below refer to 16 debitage blades = 100% (parallel- and non-parallel-sided treated together, tool blanks excluded).

Non-parallel-sided blades I-IV (<25mm, 25-50mm, 50-80mm, >80mm)
are removals whose length is more than double the width. Sides and ridges are not parallel to each other. Fragm. of non-parallel-sided blades II-III: For classification purposes, dimensions and morphology of fragments must allow for clear attribution into the class of non-parallel-sided blades, otherwise the fragment would be counted with the "(fragm. of) undet. blades, flakelets, and flakes".

Parallel-sided blades (<25mm, 25-50mm, 50-80mm, >80mm)
are removals from cores where the length is more than double the width. Sides and ridges are parallel to each other. Fragm. of parallel-sided blades I, II-III, IV: see definition for "fragm. of Non-Parallel-Sided Blades".

The following percentages should be considered very carefully, due to the small sample size. Similar to the finding with the flakes/ flakelets, a large proportion of the butts are cortical (31%). The same percentage applies to linear butts. The other butt types (punctiform, facetted, plan) are represented equally with two specimens each. Due to the small number of blades in the sample, features of bulb areas and profiles of ventral sides do not provide specific information on primary production; a quarter of the bulbs are not pronounced, another quarter are very pronounced (without scars), and one-third have bulbar and radial scars. Two pieces (12%) have only bulbar scars, and one piece shows a lip. Ventral profiles vary from straight (25%) to concave (69%) to pronounced concave (6%). The ventral distal ends extend in a linear fashion, except for one specimen with a hinge.

(Fragm. of) undet. flakes/blade(-let)s (22,5%) (Fig. 9; Table 2)

These are mostly fragments, in rare cases complete removals, which cannot be classified clearly as (deriving from) either a blade, flakelet or flake. Classification is generally rendered impossible by condition, doubtful breakages, unclear position of bulbs or other flaking features.

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[1] It is certainly correct to argue that size classes of blades have no inherent technological meaning. This method was used here only for primary classification purposes (like the flake/flakelet distinction), in order to gain a general idea about blade size distributions. Again, these classes of course are evaluated together (Figs. 10-11).

Secondary Production (B.M.-N. and H.G.G.) (Figs. 4-8, 12-13; Tables 3-4)

The analysis of the secondary production at 'Ain Rahub was limited to 109 artefacts only, comprising one fourth of the counted primary products. Apart from the 2 sickle blades and 1 arrowhead fragment, no standardized implements are in evidence. Confronted with the well-known problem of non-formal-tool classification, a true headache with Pottery Neolithic material, we decided to present here a standard descriptive classification seen in Table 3, whilst also experimenting with two other approaches. These approaches were: 1) a classification according to standards proposed earlier by Tixier *et al.* (INIZAN, ROCHE and TIXIER 1992)[1] and 2) a special and more economic analysis documentation system for the multiple tools[2]. More experience is needed before we can present the results of an approach according to INIZAN et al. This method requires difficult statistical analysis, so only the records pertaining to the non-formal tools are shown in the relevant spreadsheet (Fig. 4).

The dominant implement classes (Fig. 12:A-B) are the retouched blades and flakes (40,4%), the steep-edged tools represented by either steep-retouched or retouched steep-sided edges (21,1%), and the use- and other retouched tools (16,5%). Less frequent are the classes of the multiple tools (7,3%), the drilling/piercing tools (3,7%), the notched tools (2,8%) and others. If we regard the first three classes mentioned together with the multiple tools as indicating *ad hoc* tool production, the 'Ain Rahub tool kit represents a non-standardized, probably household manufacture, crafted on principles which may also have been used in primary production too.

The uppermost layer considered in this analysis contained a greater variety of tool classes, as well as a comparatively high number of tools (Fig. 12:C; for types represented by more than one piece). The layer also stands out by virtue of its high percentage of debitage (86%) amongst the primary product figures.

The distribution of implement blanks in the tool classes (Fig. 12:D; only for types represented by more than two pieces) allows only generalisations. Among the use- and other retouched pieces, the (fragm. of) laterally use-retouched blades were primarily on (fragm. of) parallel-sided blades II-III (Code numbers 231-232,235). The same is true for the laterally retouched blades, which made use also of the non-parallel-sided blades. The most commonly used tool blanks were the flake(-let)s, mostly for laterally retouched flakes, and the terminally and laterally retouched steep-sided flakes.

Projectile points (1%) (Fig. 4:1)

Only one projectile point was found, of a type resembling Nizzanim points (Gopher 1989: Fig. 37:6). The body fragment (both the tang - at the opposite notches - and tip are broken off) is covered dorsally by parallel pressure-flaking, which left regular, lateral denticulations together with ventral, alternating short-long, flat retouches covering the entire terminal area.

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[1] cf. Table 3 (code to the right). This parameter list had to be enlarged, since not all attributes found during analysis were in the Inizan/Tixier-system (H.G.G.). The experience is that a recording time for each implement by the method used for Table 4 is 5-7 minutes, including other basic records like weight, blank type, measurements, etc.! More economic is the method proposed in Footnote 5 (1-2 minutes), but a lot of information is lost like this. It was also developed purely with the multiple tools in mind. The future will show that attempts to economize the essential, more detailed artefact recording is not so much a matter of economic code systems. It is rather a matter of a restricting/restricted sample strategy, so that important, meaningful artefact groups can be fully recorded. (H.G.G.).

[2] This was developed earlier on a test basis for other sites by one of the authors. It considers a maximum of three working edges, which can each be characterized by the parameters 1-9 (cf. Table 4, bottom right; examples in Tables 3 and 4). The sequence of the working edges in this tool code is, in order to avoid a subjective element by identifying "dominant and less dominant" edges, in the strict serial order of the parameters 1-9. Of course, the artefact receives all the other basic recording such as on the blank etc. For easy understanding we identify the code of the multiple tool *9115* : 9 (this is a sorting figure for the spreadsheet; no meaning inherent other than easy identification of the multiple tool amongst the other implements in the data sheets);*1* (represents the first attested characteristic in the parameters sequence 1-9, a), *1* (represents the second certified characteristic in the parameters sequence 1-9, another *ret. edge),* *5* (represents the third certified characteristic in the parameters sequence 1-9, an *edge with a notch*).

Piercing/drilling tools (3,7%) (Fig. 4:2-5)

are represented by non-formal borers made on morphological tips (Fig. 4:2-3), or tips formed between two lateral notches or larger lateral removals (Fig. 4.4-5).

(Fragm. of) Burins

No burins were found, but possibly the piece Fig. 6:5 has a burin blow, which would make it more correctly a multiple tool.

Steep-retouched (6,4%) / retouched steep-sided (14,7%) tools (Figs. 5;6:5;8:1-2)

We differentiated between two groups, which are technologically different but most likely served similar purposes:

1. Steep-ret. tools: Tools with working (usually known as scraping) edges created by steep retouches ("retouche abrupte"/"abrupt retouches"), modifying thinner, acutely angled edges of the blank. Characteristic for this group is the use of any suitable edge of the primary product.
The blanks of these tools are morphologically diverse flakes; one is a piece of debris. With 4 out of the 7 pieces of this group, the position of the scraping edge is on a narrow part of the blank. On other pieces, or additionally, use has been made of other suitable edges, such as lateral sides. The edge retouches show a tendency towards being parallel or sub-parallel, although retouches can show all kinds of coarse to fine retouching. The range of fine to coarsely retouched edges can be seen from the examples in Figs. 5;6:5;8:1-2).

2) Retouched steep-sided tools: Tools whose working edges make use of the existing, suitable, dorsal steep sides of the primary product, which are modified by simple retouches. Characteristically, the deliniation and position of the working edges depend on a suitable edge shape and thus tend to be irregular. Basically this group represents single-modification tools, with hardly any intentionally modified edge deliniation. Only in cases of re-shaping of working edges does a sort of intentional deliniation happen. As the position of a working edge is accidental and depends on the individual morphology of the primary product, it is difficult to assign them to categories such as basal, terminal, end, lateral etc.: It appears practical, however, to define them using the main/dominant/latest used working edge and its relation to the morphological longitudinal axis, thus making it a lateral, transverse or terminal working edge, to which other working edges are in secondary position. Ambiguous interpretation of some of the fragments is inevitable.

Blanks of these tools are mostly fragments of large, amorphous flakes or pieces of debris with morphologically steep edges. These blanks should be considered as having been selected for the steep sides they provided, and may even have been modified previously by intentional fracturing for just that purpose. (Ventral) surfaces below the steep working edges are not necessarily smooth. The deliniation of terminal working edges tends to be convex to rectilinear, lateral ones rectilinear to concave or convex. Insignificant in number but clearly visible are pieces showing evidence of a retouching of the butt (e.g. Fig. 5:3).

(Fragm. of) laterally steep-retouched blades/flake(-let)s/other primary products (2,8%)
(Fragm. of) laterally retouched steep-sided blades/flake(-let)s/other primary products (3,7%)
(Fragm. of) laterally and terminally steep-retouched blades/flake(-let)s/other primary products (1%)
(Fragm.of) terminally retouched steep-sided blades/flake(-let)s/other primary products (9,2%)
(Fragm. of) terminally and basally retouched steep-sided blades/flake(-let)s/other prim. products (1%)
(Fragm. of) transversely retouched steep-sided blades/flake(-let)s/other primary products (1%)
(Fragm. of) terminally steep-retouched blades/flake(-let)s/other primary products (1%)
(Fragm. of) transversely steep-retouched blades/flake(-let)s/other primary products (1,8%)

Glossed elements (1,8%) (Fig. 6:1-2)

of the types found in 'Ain Rahub are characteristic for the Yarmoukian (STEKELIS 1972). The two sickles found in the samples from the test unit are made on parallel-sided blades, which had been shaped before denticulation by total or partial, dorsal, parallel pressure-flaking. One piece (broken near proximal; Fig. 6.2) was rectangularly shaped at its terminal end, caused by parallel pressure flaking to a semi-steep edge, possibly using a former truncation. The other piece (Fig. 6.1), whilst only partly covered on the dorsal side by parallel flat retouches, is shaped to a point by pressure-flaking the ventral side too. The truncated "basal" part was modified rectilinearly by a bifacial retouch. A denticulation was executed by a continuous row of notches, each created by several (stepped) bifacial flat retouches (dimensions of notches see drawing Fig. 6.1). The denticulations use one edge only, and cover its whole length.

Notched Tools (2,8%)

are defined here as having one or more notches, which may occur on any of the edges either ventrally or dorsally. Notches can be retouched internally by usage or by intentional retouches. Two notched fragments of non-parallel-sided blades are in evidence: one with two, opposite lateral and dorsal notches on a proximal fragment, which was drop-shaped proximally (possibly for shafting the blade or, more likely, to produce a small arrowhead), and one with a simple notch created by a deep broad retouch. Another notched piece is a flake with a notch on its steep-sided distal end.

Terminally notched blades/flakes(-let)s/other primary products (1%)
Left-laterally notched blades/flake(-let)s/other primary products (1%)
Laterally opposed notches on blades/flake(-let)s/other primary products (1%)

Multiple Tools (7,3%) (Fig. 6:4)

are defined as implements with two or more working edges of different character, which may result from intentional modification by retouches or show traces of use. Multiple functions have to be presumed such as scraping, drilling, burinating, etc.

Retouched + notched edge (9015) (2,75%)
Steep-retouched/retouched steep-sided edge + use-retouched edge (9029) (1%)
Two retouched edges + edge bearing a burin negative (9110) (1%)
Two retouched edges + notched edge (9115) (1,8%)
Retouched edge + scraping/steep-retouched/retouched steep-sided edge + edge with a drilling/piercing tip (9123) (1%)

Retouched blades/flakes (40,4%) (Fig. 4:7-9; 6:3;7)

(Fragm. of) laterally retouched blades/flakes(-lets) (29,4%)
are blades/flakes retouched by all kinds of retouch types on one or both lateral edges. A characteristic feature seem to be alternating retouches, e.g. Fig. 7:3.

(Fragm. of) terminally/distally retouched blades/flake(-let)s (1%)
are blades/flakes with simple retouches at the distal or proximal end thus making that the terminal end.

Lateral-terminally/distally retouched blades/flake(-let)s (8,3%)
are blades/flakes with simple retouches at the distal or proximal end, thus creating a terminal end, and on either one or both lateral edges. All combinations of edge positions modified by inverse, direct simple or "alternating" retouches are represented in this sample, of which more than 90% are based on flakes. No combination/distribution of working edges appears in more than two pieces. In several cases, scraper-like edges were produced by simple retouches on steep-sided proximal or distal ends, defining these as the "terminal" working edge.

(Fragm. of) lateral basally/proximally retouched blades/flake(-let)s (1%)
(Fragm. of) terminally/distally retouched blades/flake(-let)s (1%)
(Fragm. of) basally/proximally retouched blades/flake(-let)s (1%)

Use-[1] *and other retouched pieces (16,5%)*

are modified by use only, and do not show any regular/intentional retouches. However, the retouches must exhibit some regularity of feature. This group is rather difficult to define and to separate from the group of possibly use-retouched pieces and the groups of definitively retouched tools. Chipped lithics analysis experience shows that firm parameters can hardly be applied to this group. 8 out of 18 tools have retouched edges opposite a steep-sided part of the blank such as a "natural" or "morphological" back, large butt, etc. The remaining pieces, exclusively (fragm. of) blade or blade-like blanks, have irregular direct and/or inverse retouched edges on either one or both lateral sides.

(Fragm. of) laterally use-retouched blades (6,4%)
(Fragm. of) laterally use-retouched flakes/flakelets (6,4%)2
(Fragm. of) lateral-terminally use-retouched flakes (1%)

Hammerstones (1,8%) (Fig.)

are selected spherical or sub-spherical pieces, which bear battered edges or have batterings over large areas of the surface. Mostly cores, but also, rarely, core fragments, debris or other suitable solid pieces, these were use-modified by hammering activities. Only two, core-based, sub-spherical hammerstones are present. They show minor hammering traces on several edges. One acutely-angled edge opposite a "grip-handle" appears intensively used.

Unfinished Heavy Duty Tools (2,8%) (Fig. 8:3)

are artefacts which received initial bifacial modification using flake core techniques. Blanks may be large flakes, but also suitable chunks, debris or even (remnant) cores. The pieces found may represent an unfinished celt, pick and chisel. The piece in Fig. 8:3 is on an undeterminable blank and shows initial bifacial flaking. The dimensions still suggest the possible intention of manufacturing a celt, or even a chisel (cf. GOPHER 1989: Fig: 44:1-2, Fig. 45:1).

Other heavy duty tools (1%)

Doubtful retouched implements/damaged material (Table 2)

are flakes, blades, debris or fragments of such with isolated/irregular/irregularly distributed retouches, which neither appear intentional nor tsurely are the result of useage. Retouching is considered as accidental and a result of transport and depositional processes. All classes of primary products, except for cores, are found in this group. Striking enough, at 30%, is the high proportion of parallel blades in this sample, concentrated locally in 59.60-40. This group is not counted with the primary products at all, since it is impossible to decide whether they represent unmodified primary products or have to be recorded separately as tool blanks. If they were to be included, these 43 pieces might alter the percentages in Table 2 slightly.

Discussion

The unmixed 'Ain Rahub assemblage is very small. It is therefore difficult to judge how representative it is of (or whether it belongs to) a permanent settlement workshop and tool kit. To date little is known - especially on the non-formal tool classes - besides the general characteristics known of Yarmoukian industries (BETTS 1986, CRAWFOOT PAYNE 1983, GOPHER 1989, ROLLEFSON 1990; more detailed in BAIRD 1992). We felt it worthwhile to make a detailed study of these 423 artefacts. This contribution is a special consideration of these "Non-Hollywood-Tools", which can only be approached by attribute analysis methods.

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[1] The authors are well aware of the problems associated with this kind of classification. It was applied restrictively in the sense that the only retouching considered was that which had some sort of regular/repetitive feature.

The 'Ain Rahub core technique does not show any evidence of opposed platform techniques (e.g. bi-directional negatives on blades) which would have at least inferred that early 6th millennium core traditions were present. As Douglas Baird (1992) recently deduced, these core techniques should be considered as a continuous element in both the "arid" and "moister" zones, extending into the Yarmoukian period. Instead of this, we see here a reduction technique using platform shifts, which may be an isolated, possibly regional development.

Little can be said about secondary production, which shows no specific or meaningful features not already described in the aforementioned publications. The missing burin element might not be remarkable for a "moist region" inventory. The tool kit appears quite diversified for such a small assemblage. This is not merely due to such detailed analysis; it clearly shows the *ad hoc* element in tool production, which is characterized by improvised use of tool blanks rather than by intentional realisation of preconceived tool shapes.

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Editors' Concluding Remarks on Chipped Lithics Techno-Taxa and Interaction Spheres Throughout the 9th to 6th Millennium BC [1]

Stefan Karol Kozłowski and Hans Georg Gebel

One of the major issues discussed during the workshop was the taxonomy of the chipped lithic industries developing and interacting between the 9th to 6th millennia bc in the circum- Fertile Crescent (see especially CAUVIN M.-C., HOLE F., S.K. KOZŁOWSKI, GOPHER A., this volume). As a very general idea and concept, it was accepted by most of us -to varying degrees- that several local industries/ taxons developed independently in separate regions, interacting from here with the adjacent areas and influencing local traditions there.

Several new industries in the last decade of research were distinguished and described (Mureybetian, Aswadian, Ghazalian, Nemrikian, Mlefatian, Ghazalian etc.), which do not fit into the "classical" scheme of the PPNA - Early/ Middle/ Late PNNB-PPNC - sequence. In this respect, discussion also concentrated on the problems created by applying a sequence originally based on cultural arguments (architecture, economic stata, etc.) for the chronology of industries. According to our point of view, it was a major mistake in research development that lithic sequences, both technological as well as typological or "stylistic", were made to suit cultural sequences rather than being treated independently.

As has long since been learned from European Neolithics, developments of chipped industries are different to and regularly do not follow other related cultural elements: Several regional sequences in the Fertile Crescent, which are now dated firmly by radiocarbon methods (southern Levant, Syrian Middle Euphrates, Jezira, Zagros, Khuzistan) also show anachronisms with respect to developments of the various industries and cultural elements (see especially the work of A. Gopher).

The "classical" PPNA-B scheme, developed in a research period dominated by stage- concepts (stadial evolutionism), presumed chronological and cultural similarities to co-exist in the whole area, ignoring possible regional determinants of developments. Today, this stage- approach has to be at least reconsidered, if not rejected, for chipped lithic research and its chronological systems.

The alternative we are proposing here is based upon:

- analyzing an industry exclusively by its own standards, ignoring its cultural context,
- constructing the local sequences, based on 14C- dates,
- comparison of locally distinguished industries on an interregional level, whilst maintaining the integrity of their standards.

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[1] The maps Fig. 2-4 illustrate the core distribution of techno-taxa expected at given dates (8000, 7000, 6000 B.C.). Therefore, the geographical distribution might not cover all the fringe areas in which (elements of) the techno-taxa actually were present.

Regional Chipped Lithic Taxons	*Levant / Tauros*	*Anatolia / SE-Turkey*	*Zagros*
8000 - 7500 B.C. (Fig. 2)	PPNA Interaction Sphere **Khiamian-Sultanian** **Aswadian** **Mureybetian**		Zagros Interaction Sphere **Nemrikian** **Early M`lefatian**
7500 - 7000 B.C. (Fig. 3)	Early PPNB Interaction Sphere **North Syrian Facies** **Tauros Facies**	**Unnamed Anatolian**	Zagros Interaction Sphere **M`lefatian** **Nemrikian**
7000 - 6500 B.C. (Fig. 3)	Middle PPNB Interaction Sphere **Tauros Facies** **North Syrian Facies** **Central and Southern Levant Facies**	**Central Anatolian Neolithic I (Aşıklı Höyök Industries)**	Zagros Interaction Sphere **M`lefatian** **Nemrikian**
6500 - 6000 B.C. (Fig. 4)	Late PPNB Interaction Sphere **North Syrian/ Tauros Facies** **Central and Southern Levant Facies**	**Central Anatolian Neolithic II (Çatal Höyök Industries)**	Zagros Interaction Sphere **Nemrikian** **M`lefatian**
6000 - 5500 B.C. (Fig. 4)	Levantine Interaction Sphere **Syrian Final PPNB Facies** **PPNC- Facies (Ghazalian)**	**Central Anatolian Neolithic II (Çatal Höyök Industries)**	Zagros Interaction Sphere **Late M`lefatian/ Jarmoan (Sinjar-Industries: Magzaliya-Umm Dabaghiyah)**

Fig. 1. Techno-taxa and interaction spheres throughout the 9th to 6th millennium (as discussed by N. Balkan-Atlı, O. Bar-Yosef, E. Coqueugniot, H.G. Gebel, A. Gopher, F. Hole, S.K. Kozłowski, and G.O. Rollefson) *<uncalibrated dates>*.

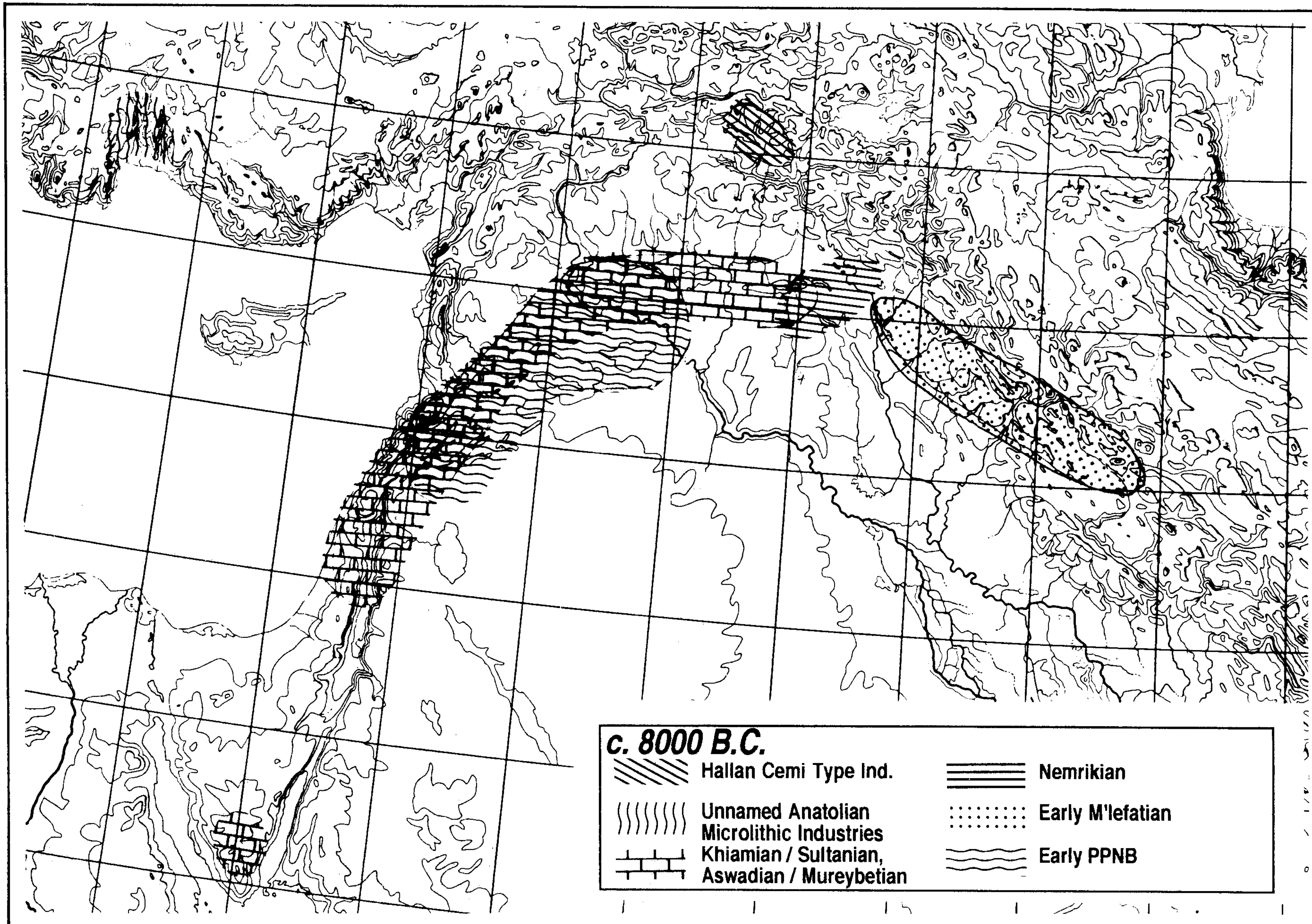

Fig. 2. Primary geographic distribution of techno-taxa and interaction spheres approx. 8000 B.C. <*uncalibrated dates*>.

This approach comes very close to what is an old standard in European prehistorical research, especially the French and German traditions, and introduces such approaches for the Circum-Fertile Crescent as they have already been introduced for the Southern Levant by Joan Crawfoot Payne and Ofer Bar-Yosef.

After we had explained this basic point of view, we illustrated our understanding of regional taxons in a sequence of maps (Fig. 2-4) and a chronological scheme (Fig. 1).

We are well aware that this should be subject to reconsideration owing to the use of uncalibrated dates; it's intention is to demonstrate a principle. Still guided by the uncalibrated chronology, we chose the dates as windows for insights into the geographic relationships or interaction spheres of the taxons.

From the beginning in the Post-Epipalaeolithic, the circum- Fertile Crescent appears to be split, by means of technology and stylistic characteristics, into three major different zones as a basis of the three different traditions we traced in the following millennia:

1) The early Levantine industries of the Khiamian and Sultanian (8300-7600 bc, mostly named PPNA before): Distributed from the Sinai to the Jezira, these industries are characterized by irregular bladelets, non-regular single-platform blade cores, Khiam points and and a few Jordan valley type tanged points, as well as heavy duty tools such as adzes, chisels, celts.

2) The central and northern Levantine industries of the Mureybetian/ Aswadian, c. 8000-7600 according to M.-C. Cauvin, begin with Mureibet III, preceeded by Mureybet II (van Loon Layers I-VII) with its Khiamian features. Mureybetian/ Aswadian tools have Khiam points, few double-platform cores, broad blades, large tanged and notched arrowheads, celts and large-sized end-scrapers produced from imported raw materials. This original industry has to be unterstood as an own tradition with the earliest elements of a PPNB-type industry as mentioned above.
We consider the Mureibetian/ Aswadian as the origin of the "Early" PPNB-type industries, which develop later into the "Middle" and "Late" PPNB [1] with their Byblos- and Amuq- type and -related points, broad blades, imported obsidian, sickles and, of course, the highly specialized core-reduction techniques of the double-platform naviform technique.

3) The eastern province of the Fertile Crescent with the Nemrikian and Mlefatian: It is characterized by conical and sub-conical cores, small regular bladelets, backed microliths, and retouched blades. Arrowheads and heavy duty tools are known only from a zone with Levantine contacts. The proportions of imported raw materials increase with time, as well as the width of the bladelets/ blades. While the early Levantine industries were replaced by the Middle PPNB industries (in some areas the Tahunian), the eastern province development was that of a continuation, except for the contact zone of the Jezira, where PPNB industries appeared only very late, replacing the old industries.

4) The eastern Turkish sequence is imperfectly understood, as of yet. However, we expect that the Hallan Çemi - industry represents the early stage, chronologically (but not stylistically) of a northern equivalent of the Khiamian/ Sultanian/ Mureybetian. From the earlier Çayönü layers, some Mureybet related elements can be reported. Each of these individual industries were replaced by PPNB - industries.

5) The problem with the (culturally influenced) use of the terms "Middle"- and "Late"- PPNB in chipped lithic research has been explained before. Clear distinctions between the "Middle" and "Late" PPNB industries are difficult. Technological (core techniques) and functional (tool kit) diversification appears to mean less chronologically than does specialization and stylistic traditions in the respective settlements, camp sites, or specialized stations. To illustrate this problem: the ratios of Byblos-:Amuq-

[1] Although we argue against the PPNA/B designations as names for industries, along with their "cultural" implications, in the absence of other labels we have to make use of the terms "Middle and Late PPNB". No new suggestions have, as yet, been forthcoming in discussions. The term Tahunian is a bit ambigious, and would only be applicable to a limited region. It should become the aim of future research to painstakingly identify the local chipped lithic traditions of the late 8th to the late 7th millennium BC. Then as now, chipped lithic research should use "Middle PPNB" and "Late PPNB" exclusively in their techno-typological meaning as taxons.

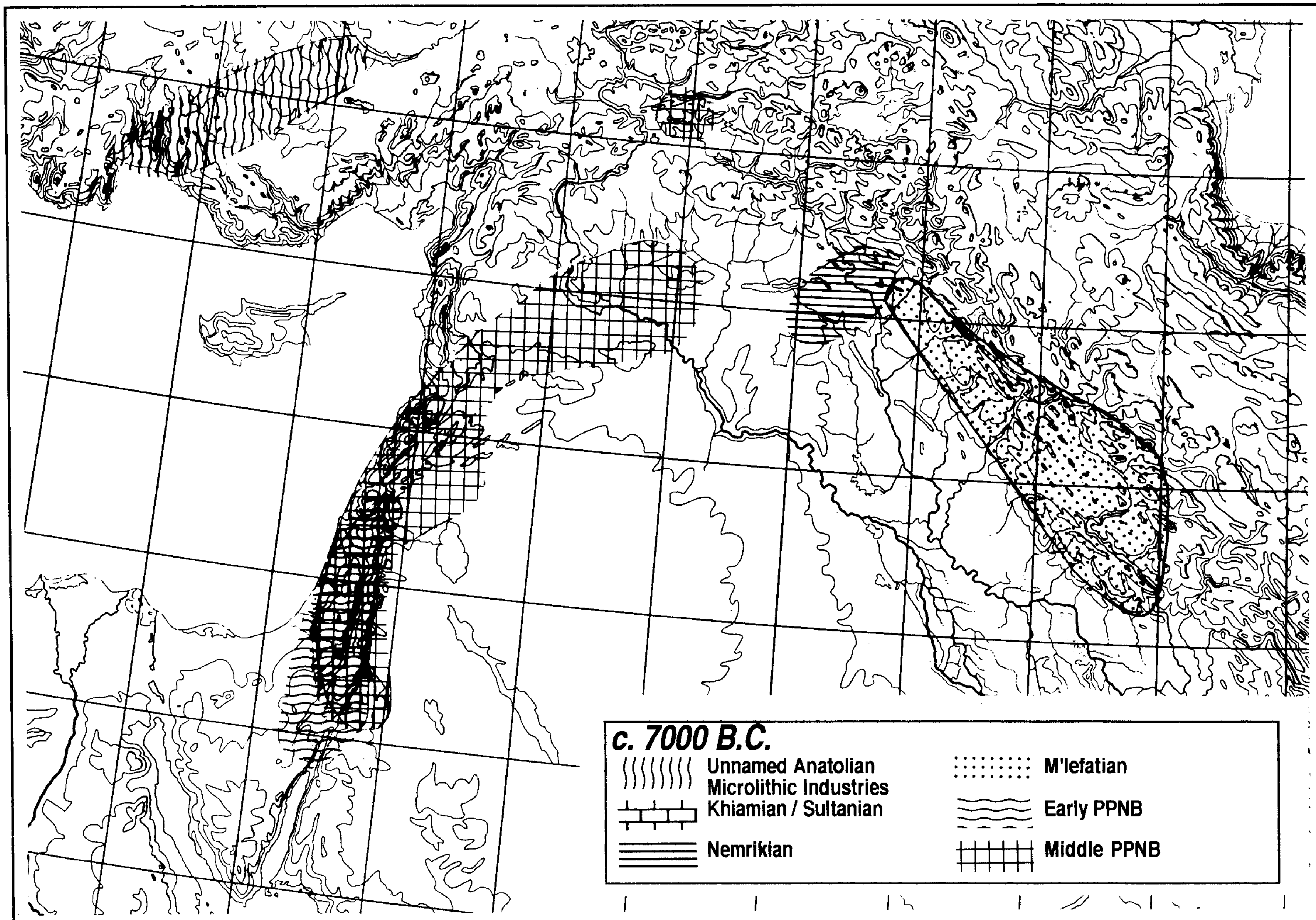

Fig. 3. Primary geographic distribution of techno-taxa and interaction spheres approx. 7000 B.C. *<uncalibrated dates>*.

related arrowhead types, which would essentially be attributed to either the "Middle"- or "Late"-PPNB periods, were probably influenced by local stylistic traditions which varied geographically. Another example is the application of naviform core techniques, as opposed to other bi- and unidirectional blade core techniques. Their distribution seems to be influenced - at least in the Late PPNB - by local/regional demand for the standardized tool blanks, required in turn by the demands being made on consumer goods manufacture (see GEBEL, this volume).
We can certainly identify general traits of the southern Levantine industries between the 8th and 6th millennium. They are characterized by a gradual shift from unidirectional core techniques to bidirectional, of which in the 7th millennium the naviform technique became prevalent. This development brought an increase in blade sizes. For the implements, a clear tendency towards standardized, mostly single-purpose type tools can be observed, which is another element of the industrialisation of their production. In particular the apparent uniformity of inventories, at least of those found in the second half of the 7th millennium, make it tempting to consider them as taxonomic entities. When looked at regionally, many differences in both technologies and tool kits become evident. Although they are determined by the environmental setting of the industries, they should be viewed individually in order to facilitate taxonomic analysis. Fine examples are local workshop traditions in naviform core reduction or the burin elements of the Jordanian harra and reg.

6) A considerable change in the character of the industries can be seen during the Early Pottery Neolithic of the southern Levant. Whilst in the northern Fertile Crescent industries the Agro-Standards dominate, at the southern end of the Fertile Crescent pastoralism, and its associated, regionally developing economies, altered the tool kits and core technologies according to local demands. Truly regional traditions in technology and tool attributes should possibly be identified as new taxons. The Ghazalian and Burin sites (even those of the mid-7th millennium) might represent such new taxa, not to mention the more complicated situation in the Mediterrannean lands or the Kilwa-type industries.

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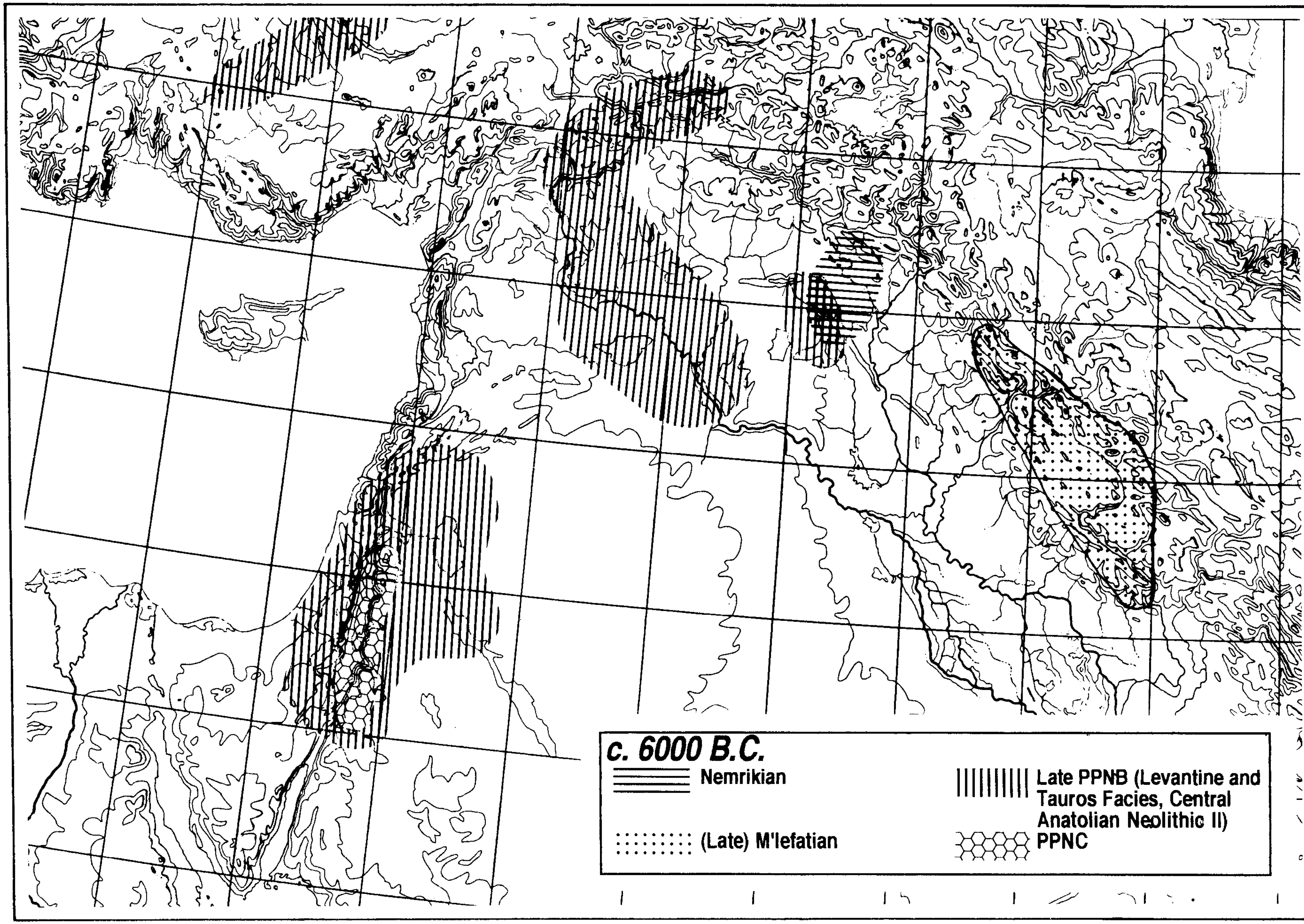

Fig. 4. Primary geographic distribution of techno-taxa and interaction spheres approx. 6000 B.C. <*uncalibrated dates*>.

Druk i oprawa: Zakład Graficzny UW, zam. 493/94

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