THE GEOMETRIC KEBARAN MICROLITHIC ASSEMBLAGE OF AIN MIRI, NORTHERN ISRAEL

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Abstract : *This article discusses an important assemblage of microliths from the Geometric Kebaran site of Ain Miri in the Upper Galilee, Israel. Geometric microliths dominate the assemblage and these comprise trapezes and rectangles, with some parallelograms and a small number of lunates. Strict definitions were used to describe the complete geometric microliths (which avoided the use of the general term trapeze/rectangle) and neutral descriptive terms were used for the broken geometric microliths. Significant metrical differences were observed between the trapezes, asymmetric trapezes-A and the rectangles. It was also noticed that the various types of geometric microliths show a different pattern of change through time thus supporting the decision not to use the general term trapeze/rectangle. While analyzing the Ain Miri microliths, projectile fractures were noticed and studies suggested different hafting patterns for trapezes and rectangles.*

Résumé : *Cette étude concerne une importante série d'artefacts du Kébarien géométrique du site d'Ain Miri (Haute Galilée, Israël). Les microlithes géométriques constituent l'élément caractéristique de cet assemblage, avec principalement des trapèzes et des rectangles, ainsi que quelques parallélogrammes et un petit nombre de segments. Des définitions détaillées ont été utilisées pour décrire les microlithes entiers (en excluant le terme générique de trapèze/rectangle) tandis que des termes neutres ont été employés pour les fragments de microlithes géométriques.*
Des différences métriques significatives ont été observées entre les trapèzes stricto sensu*, les trapèzes asymétriques-A et les rectangles. Il a aussi été constaté que les divers types de microlithes géométriques présentent des tendances évolutives variées, un aspect qui corrobore la décision de ne pas utiliser le terme de trapèze/rectangle. Au cours de l'analyse de ces microlithes, les fractures d'impact ont été observées et étudiées, suggérant des modes d'emmanchement différents pour les trapèzes et les rectangles.*

Key-Words : *Geometric Kebaran, Microliths, Epipaleolithic, Northern Israel, Projectile fractures.*
Mots Clefs : *Kébarien Géométrique, Microlithes, Épipaléolithique, Nord d'Israël, Fractures de projectiles.*

The site of Ain Miri is located on the eastern bank of Nahal Dishon in the Upper Galilee, Israel ; 560 m above sea level in a valley rich in water sources, surrounded by mountain ridges (fig. 1). In the early 1970s a small test excavation by Taute produced Epi-Paleolithic and Neolithic finds[1]. The excavation at the site was renewed in 1998-2001 by Gopher and Barkai on behalf of Tel-Aviv University, and focused on the Neolithic layers. Epipaleolithic material was excavated too and preliminary findings were published[2]. Additional finds excavated in the 2001 season are presented here. The assemblage is different from previous Geometric Kebaran assemblages found in northern Israel, and it seems to represent a

1. SCHYLE and UERPMANN, 2001.

2. SHIMELMITZ *et al*., 2001.

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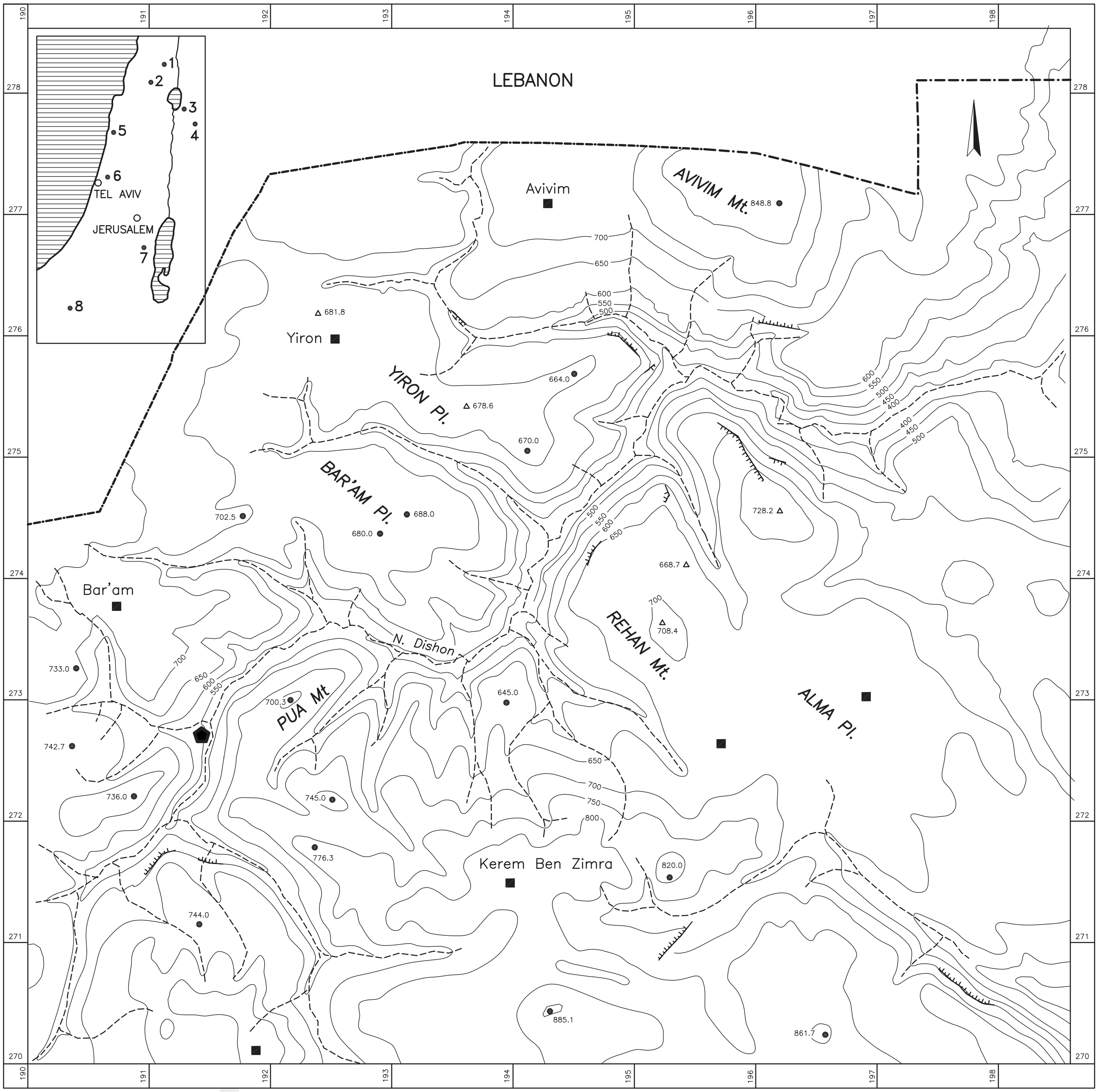

Fig. 1 : *Map of the area of Ain Miri and other sites mentioned in the article : 1. Ain Miri ; 2. Hayonim Terrace ; 3. Haon III ; 4. Wadi Ziqlab 148 ; 5. Hefziba ; 6. Kiryath Aryeh ; 7. El Khiam ; 8. Nahal Lavan VI.*

possible different facies of the Geometric Kebaran. This paper presents the microliths only, and concentrates mainly on typological aspects. Projectile fractures were noticed in some of the microliths and we argue that projectiles were an integral part of this assemblage.

AREAS OF EXCAVATION

The microliths presented in this paper originated from four different areas at the site :

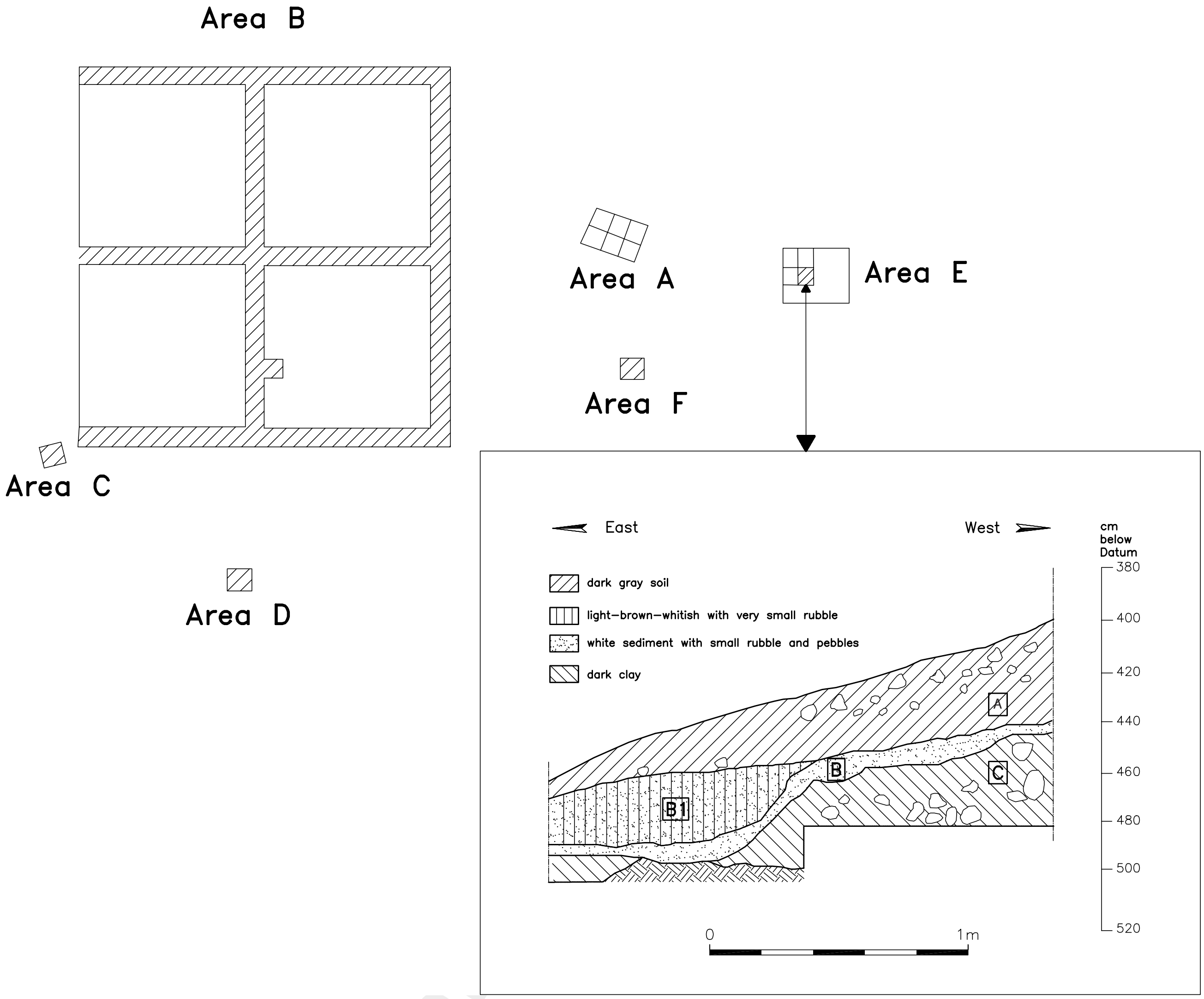

Fig. 2 : *Excavations areas at Ain Miri and the southern section of Area E.*

Area E : This area is in the eastern part of the site, at the edge of a terrace of the near-by channel. Most of the Geometric Kebaran assemblage originates from this area. Four square meters were excavated, in which three layers were identified (fig. 2). The layers are inclined to the east, following the slope at the edge of the terrace. The top layer is a dark gray soil (Unit A), and contains Pre-Pottery Neolithic B (PPNB) finds mixed with Epipaleolithic finds. Below it is a light-gray, whitish soil (Unit B) containing a high density of almost entirely Epipaleolithic lithics. The lowermost layer is dark clay, on bedrock (Unit C), with Epipaleolithic finds only.

Area F : A test pit of 1 m^2 excavated at the eastern part of the site to a depth of 350 cm below datum. Finds are Neolithic in nature with some microlithic intrusions. During the excavation it became apparent that the frequency of microliths increased with depth.

Area B, general : This is the main area of excavation (ca. 125 m^2), including mainly late Pre-Pottery Neolithic finds. The microliths found in this area are intrusive, and most probably originate from the underlying Geometric Kebaran layer.

Clay layer in Area B : In the northwestern part of the main excavation area (Area B), a layer of clay containing Epipaleolithic finds was uncovered beneath the Neolithic layer. This unit spreads over 21 m^2, varying in depth from 15 to 30 cm (110/120–135/140 cm below datum).

THE MICROLITHS

The assemblage includes 1734 microliths : 1108 from Area E[3], 216 from Area F, 182 from Area B (general), and 228 from the clay layer in the northwestern part of Area B (table 1). The microliths were shaped from various types of raw material, of which the most abundant was a highly siliceous flint, brown to gray in color. The state of preservation varies ; Area E being the best preserved, as evidenced by the large number of complete microliths in fresh condition.

Table 1: *Microliths from Ain Miri (the frequency of projectile fractures is calculated out of the total number of microliths).*

	geometric	non geometric	total	projectile fracture
Area E	695	413	1108	33
%	62,73	37,27	100	2,98
Area F	106	110	216	17
%	49,07	50,93	100	7,87
Area B, general	89	93	182	9
%	48,90	51,10	100	4,95
clay layer (in Area B)	109	119	228	17
%	47,81	52,19	100	7,46
total	999	735	1734	76
%	57,61	42,39	100	4,38

The microliths were divided into geometric and non-geometric categories (tables 2-3) following the list of Bar-Yosef[4]. The percentage of geometric microliths (out of the total number of microliths) varies between 47,8 % and 62,7 %, Area E showing the highest frequency. The abundance of trapezes and rectangles favors a Geometric Kebaran assignment. Of the 14 lunates found, some may be part of the Geometric Kebaran assemblage (see below), while others may represent a Pre-Pottery Neolithic A (PPNA) occurrence which has not yet been uncovered ; it should be noted that single Hagdud truncations were also found.

NON-GEOMETRIC MICROLITHS

The prominent category in the non-geometric group is the “medial fragment” (62,4 -77,5 %). These are medial parts of broken retouched and backed bladelets, mostly abruptly retouched (some of which could have been fragments of geometric microliths). Retouched and backed bladelets (mostly fragments) also appear. The difference from “medial fragment” is that these preserve an unshaped distal or proximal end, and thus are not fragments of geometric microliths (although fragments of proto-geometric types are still a possibility).

Other non-geometric types are : bladelets retouched on both edges (0,9 %-5 %), alternately retouched bladelets (1,2 %-9,2 %), and inversely retouched bladelets (0 %-2,7 %). Most of these microliths are broken, and might actually be fragments of other types, such as points or even geometric microliths.

Points are scarce in the non-geometric assemblage (1,7 %-4,5 %). Only two obliquely truncated backed bladelets were identified, both of which are complete. Some truncated bladelets (0,8 %-7,5 %) appear as well. Of these, 14 have an oblique truncation, three have a straight truncation and three are double-truncated. Except for the double truncations, only one complete truncated specimen was found. Shouldered bladelets appear in small numbers (1,7 %-3,2 %).

The *varia* group includes microliths that were not ascribed to the former types ; five small (less than 1,5 cm in length) non-geometric complete microliths, three notched bladelets, one Helwan retouched bladelet, one La Mouillah point, and 28 unidentified fragments of microliths. Broken-backed and truncated bladelets with a regular retouch on the lateral edge opposite to the shaped back constitute a large part of the *varia* (n = 18) (fig. 3:1-2). Of these, only one specimen is complete (fig. 3:1). It should be mentioned that the last subtype and the truncated bladelets could be recorded with the geometric microliths (as in some other studies[5]) but we have decided that only distinctive geometric types will be included within the geometric microliths.

3. The finds published from this area (SHIMELMITZ *et al.*, 2001) were added to the present analysis.

4. BAR-YOSEF, 1970 ; Some of the Ain Miri geometric microliths are wider than 9 mm. This was noticed in several other Geometric Kebaran assemblages (GORING-MORRIS, 1987 : 98-144 ; HENRY, 1989 : 158).

5. SIMMONS, 1977 : 122.

Table 2 : *Non-geometric microliths.*

	medial fragment	retouched and backed bladelet	bladelet retouched on both edges	point	alternately retouched bladelet	inversely retouched bladelet	oblique truncated backed bladelet	truncated bladelet	shouldered bladelet	varia	total
Area E	320	20	9	7	5	4	1	11	7	29	413
%	77,5	4,8	2,2	1,7	1,2	1,0	0,2	2,7	1,7	7,0	100
Area F	76	8	1	5	2	3	1	1	3	10	110
%	69,1	7,3	0,9	4,5	1,8	2,7	0,9	0,9	2,7	9,1	100
Area B, general	58	6	2	4	3	1		7	3	9	93
%	62,4	6,5	2,2	4,3	3,2	1,1		7,5	3,2	9,7	100
clay layer (in Area B)	81	7	6	2	11			1	3	8	119
%	68,1	5,9	5,0	1,7	9,2			0,8	2,5	6,7	100
total	535	41	18	18	21	8	2	20	16	56	735
%	72,8	5,6	2,4	2,4	2,9	1,1	0,3	2,7	2,2	7,6	100

Table 3 : *Geometric microliths.*

	proto rectangle	rectangle	trapeze	asymmetric trapeze A	asymmetric trapeze B	parallelogram	lunate	broken backed bladelet with an oblique truncation	broken backed bladelet with a straight truncation	broken backed bladelet with an acute truncation	total
Area E	1	28	40	102	3	5	3	283	217	13	695
%	0,1	4,0	5,8	14,7	0,4	0,7	0,4	40,7	31,2	1,9	100
Area F		5	2	9	1		4	43	39	3	106
%		4,7	1,9	8,5			3,8	40,6	36,8	2,8	100
Area B, general		4	5	6		2	2	30	34	6	89
%		4,5	5,6	6,7		2,2	2,2	33,7	38,2	6,7	100
clay layer (in Area B)		4	1	6	1		5	49	36	7	109
%		3,7	0,9	5,5			4,6	45,0	33,0	6,4	100
total	1	41	48	123	5	7	14	405	326	29	999
%	0,1	4,1	4,8	12,3	0,5	0,7	1,4	40,5	32,6	2,9	100

GEOMETRIC MICROLITHS

The geometric microliths are mainly rectangles (3,7 %-4,7 % ; fig. 3:3-9), trapezes (0,9 %-5,8 % ; fig. 3:11-16), asymmetric trapezes-A (5,5 %-14,7 % ; fig. 3:10, 17-27) and parallelograms (0 %-2,2 % ; fig. 3:28-31). In this paper we chose to use specific definitions for the geometrics, and not the general "trapeze/rectangle" category. We defined rectangles only when both ends were perfectly truncated at 90°. The few exceptions are cases in which one of the ends was truncated at an acute angle of about 70-80° (referring to the angle between the back and the truncation), while the other was at 90°. As for trapezes we cataloged only items with obliquely symmetrical truncations. In the parallelograms we cataloged backed microliths that have parallel oblique truncations at both ends. The back and truncations of geometric microliths are mostly abruptly retouched, with some cases of bi-polar

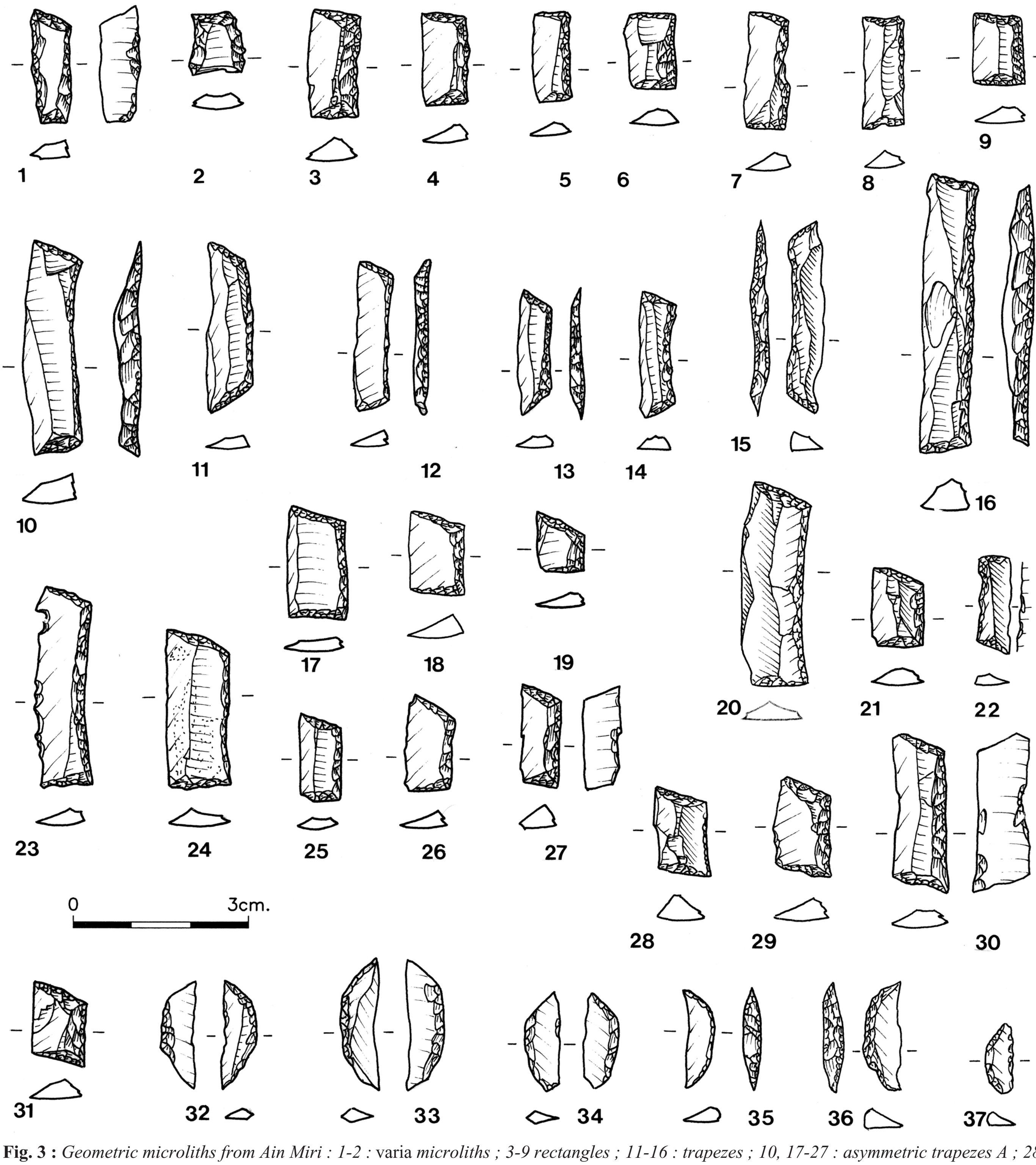

Fig. 3 : *Geometric microliths from Ain Miri : 1-2 :* varia *microliths ; 3-9 rectangles ; 11-16 : trapezes ; 10, 17-27 : asymmetric trapezes A ; 28-31 : parallelograms; 32-37 : lunates.*

retouch. A few of the truncations were inversely retouched. The shaped back is either straight or concave – a phenomenon also known from other sites[6]. Some of the geometric microliths have a partial retouch on the lateral edge opposite the back. This retouch is inverse in some cases, while in others it is more like crushing marks. A similar pattern was observed in other sites[7].

In most of the asymmetric trapezes-A (89,6 %) one truncation is straight (90°) while the other is oblique, sometimes only slightly (100-110°). It was also observed, that when holding the microlith so that its back is on top, the oblique truncation is usually placed on the left side, while the straight truncation is at the right (91,9 % of the asymmetrical trapezes-A from area E). The use of straight truncations or slightly oblique truncations seems to be dominant in the assemblage – a phenomenon also noticed at other sites[8]. Henry argues that trapezes and rectangles are shaped by simple breakage and not by the microburin technique[9]. Indeed, although a complete analysis of the waste assemblage has not yet been performed, microburin technique waste is apparent, but rare. The fact that most of the truncations of the geometric microliths at Ain Miri are at about 90-120° could indicate that simple breakage was used in achieving the desired angle of the truncation. Using the microburin technique will usually split the bladelets obliquely at an angle of ca. 135°. We therefore argue that simple breakage was preferred over the microburin technique as a technological choice, and not due to a lack of know-how.

Although the different units studied have different compositions of microliths, it seems that Area E best represents the Geometric Kebaran due to its large sample of complete geometric microliths (N = 178). Of these, asymmetric trapezes-A are dominant (14,7 %), followed by trapezes (5,8 %), rectangles (4 %), parallelograms (0,7 %, N = 5) and asymmetric trapezes-B (0,4 %, N = 3). Lunates also appear, but in small numbers (0,4 %, N = 3), all from the upper layer.

Three abruptly retouched lunates were found in area E, two of which are very small (less than 1,5 cm in length). In the other areas lunates are more common (2.2 %-4,6 %) ; Five lunates were shaped by Helwan retouch (fig. 3:32-34), four by abrupt retouch (fig. 3:37), two by bi-polar retouch (fig. 3:35-36) and one by alternate retouch. An interesting characteristic of the Helwan lunates is that the Helwan retouch appears in the middle part of the back and is quite straight, while the ends are shaped by simple retouch and the item, as a whole, is a little angular and looks like an intermediate type between a lunate and a trapeze. Lunates with only partial Helwan retouch are known from other sites[10]. Similar lunates were found at some late Hamran sites and Henry[11] suggested they are a type that predates the true Helwan lunates of the Early Natufian. The appearance of other lunates, particularly the small ones, may indicate a PPNA occurrence at the site.

BROKEN GEOMETRIC MICROLITHS

The assemblage includes many broken geometric microliths, whose assignment is somewhat problematic. We chose not to use definitions such as “broken rectangle” and “broken trapeze”. An asymmetric trapeze, for example, could be broken into two fragments : one with a straight truncation and another with an oblique truncation. If such terminology were used we would have an absurd situation where one item is broken into two types – one “broken trapeze” and one “broken rectangle”. Therefore, a different terminology is needed, especially for assemblages such as that from Ain Miri, in which asymmetric trapezes-A are the dominant geometric microlith type.

1. *Broken-backed bladelets with an oblique truncation :* A total of 405 items was found, constituting 33,7 %-45 % of the geometric microliths. We assume that most of these are broken trapezes and asymmetric trapezes-A since only two complete obliquely truncated backed bladelets were found. A few of these broken pieces could also be parts of parallelograms.

2. *Broken-backed bladelets with a straight truncation :* A total of 326 items was found, constituting 31,2 %-38,2 % of the geometric microliths. These items are easily identified as broken geometric microliths, and can be fragments of rectangles, proto-rectangles or asymmetric trapezes-A.

3. *Broken-backed bladelets with an acute truncation :* A total of 29 items was found, constituting 1,9 %-6,7 % of the geometric microliths. These broken-backed bladelets are truncated at an acute angle, mostly *ca* 70-80°. Most of these are fragments of parallelograms.

The fact that broken-backed bladelets with oblique truncations are the largest group in the “broken geometric microliths” is not surprising, since all the geometric microliths,

6. *E.g.* Goring-Morris, 1987 : 133.
7. *Ibid.* : 134.
8. *E.g.* Marks, 1976 : 310 ; Simmons, 1977 : 126-127.
9. Henry, 1989 : 93.
10. Bar-Yosef, 1970 : 220 ; Henry and Leroi-Gourhan, 1976 : fig. 6 : e, g-h ; Goring-Morris, 1987 : 300.
11. Henry, 1995 : 275.

except for rectangles, have at least one end with an oblique truncation.

METRIC ATTRIBUTES OF THE GEOMETRIC MICROLITHS

The assemblage from Ain Miri includes a large sample of complete geometric microliths, enabling a thorough analysis. We concentrate on Area E that provided a large sample from a specific stratigraphic context. We start by analyzing complete geometric microliths of all types (without the lunates and proto-rectangles). The distribution of length in figure 4 shows a clear division between the relatively shorter rectangles, and the longer trapezes and asymmetric trapezes-A. The ean length of trapezes is 22,5 mm (s.d. 6.1), asymmetric trapezes-A 19,3 mm (s.d. 6.1), and rectangles 14,6 mm (s.d. 2.9).That of parallelograms is 19,2 mm (s.d. 5.9) ; however the sample of parallelograms is small (N = 5). A significant difference was found between the trapezes and rectangles (22,52±6,11 *vs* 14,61±2,94, P < 0,05)[12].

The width of geometric microliths (fig. 5) also shows a clear pattern : trapezes are relatively narrow (most of them about 6-7 mm in width), and rectangles similarly are also quite narrow. Asymmetric trapezes-A tend to be a little wider (mostly about 7-9 mm in width). The parallelograms are the widest (most of them 8-9 mm). Mean width shows a similar pattern : for trapezes : 7 mm (s.d. 1.3), for rectangles 7,4 mm (s.d. 1,1), for asymmetric trapezes-A 8,2 mm (s.d. 1,4), and for parallelograms 8,8 mm (s.d. 0.8). A significant difference was found between the asymmetric trapezes-A and rectangles (8,23±1,37 *vs* 7,39±1,07, P < 0,05).

Thus, while length shows a clear division between rectangles and trapezes, the two geometric categories are very similar in width. A clear division is indicated between rectangles and asymmetric trapezes-A that tend to be wider. This emphasizes the problem involved in combining these geometric microliths into one general "trapeze/rectangle" category.

In search of chronological trends we looked at all the complete geometric microliths of the southern 2 m^2 of area E by stratigraphic unit. The top unit (A) represents the uppermost layer (N = 26), and the lower unit (B-C) represents the lower layers (B + B1 + C) (N = 91). The length of all geometric microliths (as one group) shows that those from the upper unit are a little shorter than those from the lower unit (fig. 6). The peak of those from unit A is about 11-15 mm, while the peak of those from unit B-C is about 16-20 mm. A clear pattern was observed in the width (fig. 7) – those from the upper unit tend to be wider than those from the lower unit. The peak of unit A is about 9 mm, while the peak of unit B-C is about 7 mm. Nevertheless, it should be noted that the described differences were not found to be statistically significant.

Looking for diachronic trends in a single microlith type was only possible for the asymmetric trapezes-A, of which there is a relatively large sample (13 from unit A and 52 from unit B-C). The asymmetric trapezes-A length distribution shows that those from the upper unit tend to be shorter than those from the lower unit (fig. 8). The peaks are the same as in the previous analysis ; however the trends here are clearer. As for width, those from the upper unit tend to be wider than those from the lower unit (fig. 9). The peak of unit A is around 9 mm, while that of unit B-C is around 7-8 mm. These differences were not statistically significant. The fact that the metric attributes of the asymmetric trapezes-A are somewhat different than the attributes of the geometric microliths as a whole (fig. 6-7), implies that different patterns of change characterized the various microlith types. This point further emphasizes the importance of not uniting the geometric microliths into a single category of trapeze/rectangles.

PROJECTILE FRACTURE ON MICROLITHS FROM AIN MIRI

During the analysis we noticed projectile fractures in some of the microliths (N = 76). Similar fractures are known from experimental work and from archaeological material[13]. A unique case of a Helwan lunate embedded in a vertebra of a Natufian male was recently reported[14]. We only refer to macro-fractures visible to the naked eye[15]. Projectile fractures were separated into six types following a study of the assemblage of the Kebaran site of Nahal Hadera V[16] :

Fluted fracture : This fracture is characterized by the reduction of a small chip, mostly from the ventral face[17]. The items also fit some of the "step-terminating bending fracture-

12. The statistical analysis was carried out using SPSS Version12.

13. Bergman and Newcomer, 1983 ; Fischer *et al*., 1984 ; Odell and Cowan, 1986 ; Bergman *et al*., 1988 ; Friis Hansen, 1990 ; Nuzhnii, 1990 ; Knecht, 1997 ; Couch *et al*., 1999 ; Philibert, 2002 : 15-25.

14. Bocquentin and Bar-Yosef, 2004.

15. Fischer, 1990 : 30.

16. Gersht *et al*., n.d.

17. Bergman and Newcomer, 1983.

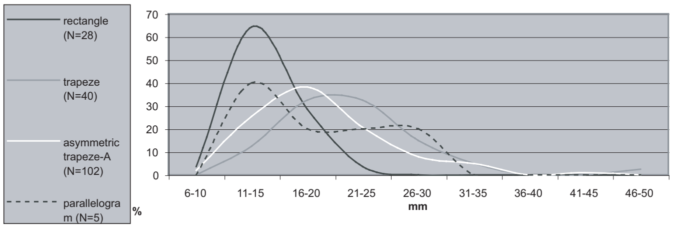

Fig. 4 : *Geometric microliths length.*

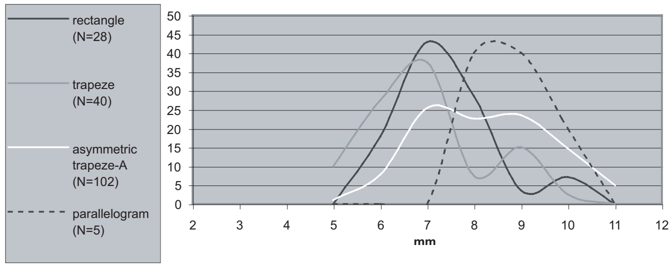

Fig. 5 : *Geometric microliths width.*

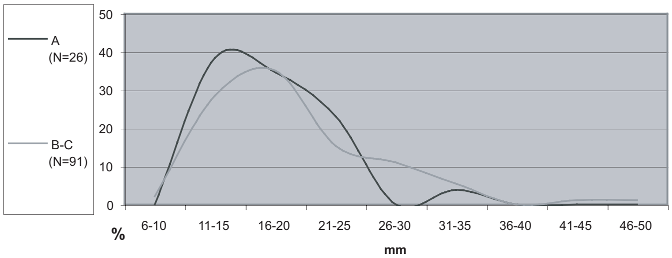

Fig. 6 : *Geometric microliths length in relation to stratigraphy (Area E).*

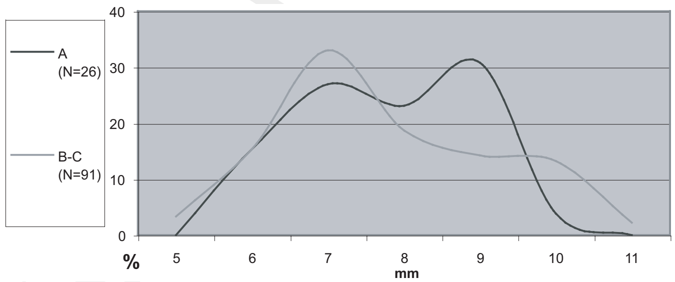

Fig. 7 : *Geometric microliths width in relation to stratigraphy (Area E).*

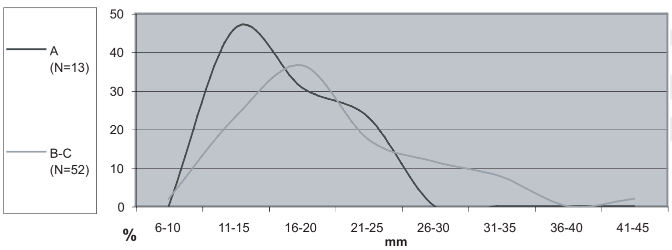

Fig. 8 : *Length of asymmetric trapezes-A in relation to stratigraphy (Area E).*

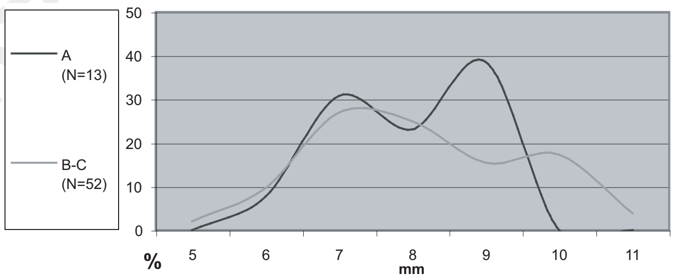

Fig. 9 : *Width of asymmetric trapezes-A in relation to stratigraphy (Area E).*

sand the small spin-off scars described by Fischer[18] (fig. 10:1).

Burin-like fracture : This fracture is characterized by the appearance of a burin-like scar on the lateral edge of the bladelet originating from the tip. This breakage is usually the result of a direct hit on a hard object[19] (fig. 10:2).

Burin on a break : This fracture is characterized by a burin-like scar originating from a bending fracture. This fracture is assumed to be the result of the collision of flint pieces during the hit (fig. 10:3-4).

Side fracture : This fracture is a burin-like scar originating from one of the lateral edges at a straight or oblique angle. It should be noted that these are not scars resulting from the use of the microburin technique. The fact that many of these fracture scars appear on a shaped end and are overlying the retouch (fig. 10:5-7) clearly emphasizes the difference from the microburin technique.

Multi-fractures : This type is characterized by the appearance of more than one projectile fracture at one end of the bladelet (fig. 10:8-13).

18. FISCHER, 1990 : 31.
19. BERGMAN and NEWCOMER, 1983 : 241.

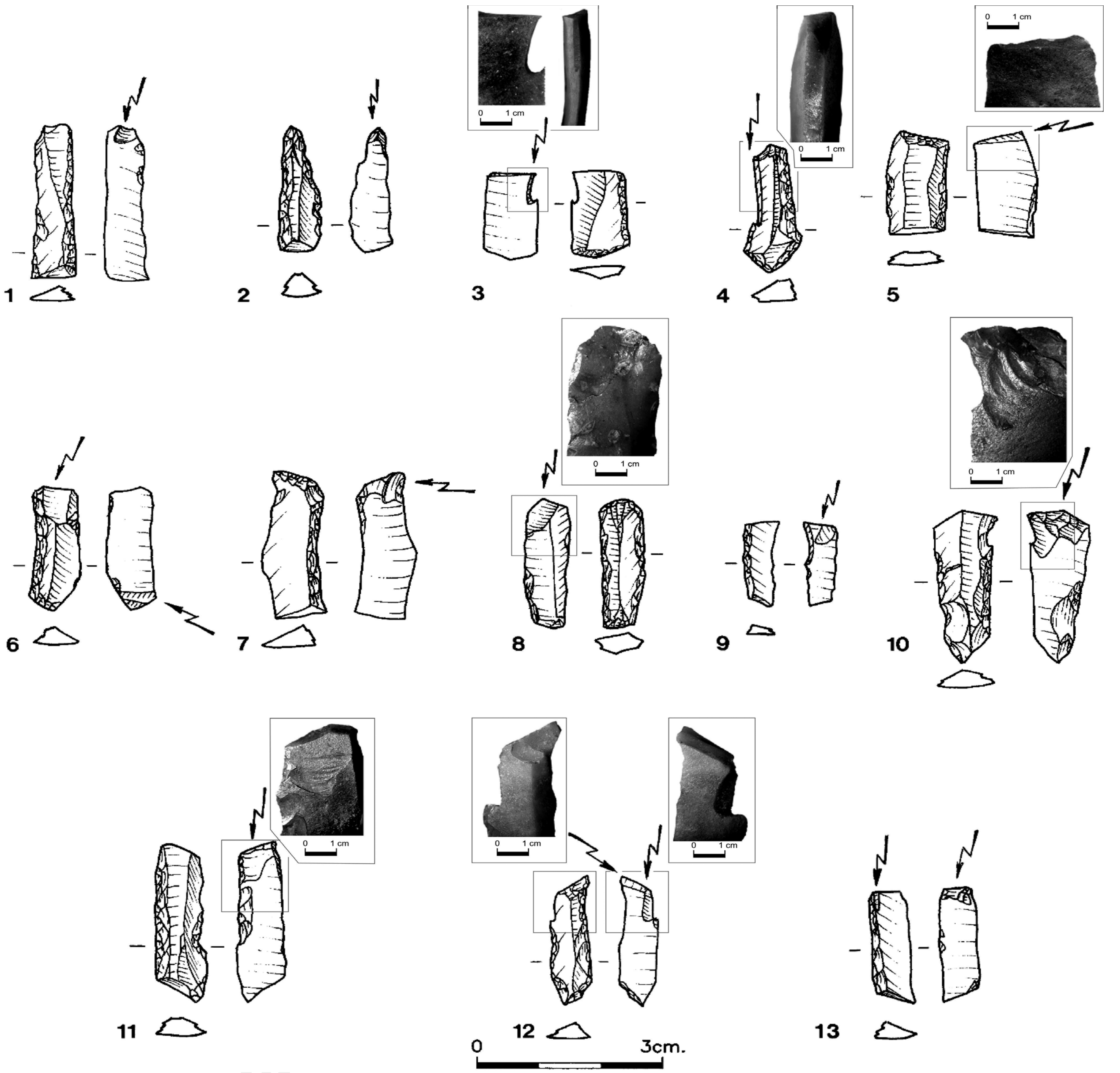

Fig. 10 : *Projectile damage on microliths from Ain Miri.*

Double fracture : This type is characterized by the appearance of projectile fractures at both ends of the microlith. Some of these also bear a multi-fracture pattern at one end.

The distribution of the different fracture types in the various microlith categories (table 4) may help in reconstructing hafting patterns. One of the interesting results of this analysis is the difference between broken-backed bladelets with an oblique truncation and broken-backed bladelets with a straight truncation. In the former, which may represent broken trapezes, the frequency of double fractures is higher than in the latter, which may represent rectangles (28,6 % and 14,3 % respectively)[20]. In contrast, the frequency of side fractures is higher in the latter

20. See our comment on “broken geometric microliths” in the section “geometric microliths” where we suggest refraining from using “broken trapeze” or “broken rectangle”.

Table 4 : *Projectile fracture types in relation to microlith types.*

	medial fragment	backed and retouched bladelets	bladelet retouched on both edges	point	varia	asymmetric trapeze A	broken backed bladelet with an oblique truncation	broken backed bladelet with a straight truncation	broken backed bladelet with an acute truncation	total
burin				1			1			2
%				50,0			50,0			100
burin on break	8	1	1		1		3	3	2	19
%	42,1	5,3	5,3		5,3		15,8	15,8	10,5	100
double	3				1		2	1		7
%	42,9				14,3		28,6	14,3		100
flute	10	1		1	2	1	7	3		25
%	40,0	4,0		4,0	8,0	4,0	28,0	12,0		100
multi	7						1	5		13
%	53,8						7,7	38,5		100
side	3		1				2	4		10
%	30,0		10,0				20,0	40,0		100
total	31	2	2	2	4	1	16	16	2	76
%	40,8	2,6	2,6	2,6	5,3	1,3	21,1	21,1	2,6	100
% of total projectile fractures out of the total sum of the type	5,8	4,9	11,1	11,1	7,1	0,8	4,9	4,0	6,9	4,4

(40 %, as opposed to 20 % in the broken-backed bladelet with an oblique truncation). It is assumed that double fractures are characteristic of a direct hit on a solid object, and probably represent microliths that were hafted at the point. Side fractures, on the other hand, represent a fracture originating from the side (maybe while penetrating the tissue). This may indicate that trapezes (as represented by the broken-backed bladelets with an oblique truncation) were more often hafted at the point, while rectangles (as represented by the broken-backed bladelets with a straight truncation) were mostly hafted at the lateral edge of the composite tool.

This pattern is in good accordance with the archaeological data and experimental results. Some hafted microliths from the European Mesolithic show the use of one microlith at the end of the shaft while a second one is hafted at the side[21]. The remains of adhesive material on some microliths from desert sites in Israel show that many microliths were hafted along the shaft[22]. In the Kebaran site of Nahal Hadera V a few microliths were found bearing hafting residue, indicating that microliths were hafted both along the shaft and at the tip[23]. Experimental studies show that microliths hafted at the side of the shaft are important in achieving a neater cutting of the tissues, and reducing the friction of the shaft during penetration[24].

Studying microliths as projectiles may improve our understanding of the changes in technology and typology of microliths during the Epipaleolithic period. Many of the microliths from the Early Epipaleolithic are curved and some are twisted[25]. In contrast, almost all the geometric microliths from Ain Miri are straight. A large portion of straight geometric microliths also appears in other Geometric Kebaran

21. Friis Hansen, 1990 : 499, fig. 3:6.

22. Bar-Yosef and Goring-Morris, 1977 : 119 ; Goring-Morris, 1987 : 138.

23. Gersht *et al.*, n.d.

24. Friis Hansen, 1990 ; Rozoy, 1990 : 18.

25. *E.g.* Shimelmitz, 2002 : 78.

sites[26]. This is highly advantageous for projectiles, since the purpose is to pierce the hide and to cause maximum bleeding during penetration. The piercing of the hide involves great pressures on the projectile that might cause breakage if it is too fragile. A curved microlith is less likely to withstand these pressures. Furthermore, in order to cause maximum bleeding, a penetration of 15 to 20 cm is needed, thus requiring the least friction possible[27]. In situations where the projectile breaks during the piercing of the hide, there will be more friction. In addition, curved or twisted bladelets, even if not broken, will also increase friction. The straight microliths of the Middle Epipaleolithic seem to be more effective in reducing friction, and thus have a potential for better penetration, causing greater bleeding. We see this aspect as an important development in geometric microliths.

Another difference between the Early Epipaleolithic and the Middle Epipaleolithic concerns the technology used to produce microliths. It was noticed that while in the Early Epipaleolithic cores were meticulously shaped, those of the Middle Epipaleolithic were only roughly shaped. As a result, blanks produced in the Middle Epipaleolithic were less standardized, and more pronounced secondary modification was required in order to achieve the desired end product[28]. This "new" concept of knapping facilitated the production of straight geometric microliths by removing/snapping the curved ends.

CONCLUSIONS

The analysis of the microliths from Ain Miri raises some new questions regarding the Geometric Kebaran complex. Before evaluating the contribution of Ain Miri we briefly review the current state of Geometric Kebaran research on relevant issues. Two main groups in the Geometric Kebaran were characterized by the width and the frequency of trapezes/rectangles[29]. Some assemblages consist of very narrow geometric microliths like Haon III[30] and Hayonim Terrace[31], while other assemblages consist of wide geometric microliths, such as Nahal Lavan VI and Kiryath Aryeh[32]. Goring-Morris, basing his arguments on sites from southern Israel and Sinai, argued that one group is characterized by a mean width of over 7,5 mm and by a mean length of over 20 mm, while the second group is characterized by smaller mean measurements[33]. Henry, on the other hand, who focused on a different sample of sites, chose to separate the assemblages differently. The first group is characterized by a mean width of 10-11 mm, and the second group by a mean width of 13 mm[34]. The differences between the two groups are assumed to reflect chronological and regional aspects. The geometric microliths tend to become wider over time, and in general, wide geometric microliths are characteristic of the south and the desert area[35].

The only stratigraphic evidence for a diachronic trend is from el-Khiam, where Bar-Yosef claims that the microliths are wider in the upper layer[36]. However, we are familiar with the problematic nature of the El-Khiam assemblages[37]. Fellner claims that there is no stratigraphic evidence for a clear chronological subdivision within the Geometric Kebaran, and he suggests that the differences that do occur are due to some interaction with the Mushabian entity in the south. In his opinion, "The Geometric Kebaran of *Northern and Central Palestine* [our emphasis] remained typologically unchanged until the emergence of the Natufian…"[38].

This is where the contribution of the assemblage from Ain Miri lies. Until now, only three excavated Geometric Kebaran sites from central and northern Israel provided detailed lithic descriptions : Hefziba[39], Haon III[40] and Hayonim Terrace[41]. Another site is Wadi Ziqlab 148 from Northern Jordan[42]. The first three sites have very narrow microliths. In Hefziba the mean width of the geometric microliths is a little less than 5 mm[43], in Haon III the mean width is around 4-6 mm[44], and in Hayonim Terrace the mean width is 5,3 mm[45]. The mean

26. *E.g.* Kaufman, 1976 : 59, 90.
27. Friis Hansen, 1990.
28. Ferring, 1980 : 281 ; Fellner, 1995 : 53 ; Goring-Morris *et al.*, 1998.
29. Bar-Yosef, 1981 : 397.
30. *Ibid.* : 397, fig. 7.
31. Valla, 1989.
32. Bar-Yosef, 1981 : 397, fig. 7.
33. Goring-Morris, 1987 : 130.
34. Henry, 1989 : 158.
35. Bar-Yosef, 1970 : 172, and 1981 ; Bar-Yosef and Vogel, 1987 ; Goring-Morris, 1987 : 143-144 ; Henry, 1989 : 155, 159.
36. Bar-Yosef, 1976.
37. Bar-Yosef, 1981 ; Garfinkel, 1996.
38. Fellner, 1995 : 47.
39. Ronen *et al.*, 1975 ; Kaufman, 1976.
40. Bar-Yosef, 1975.
41. Henry and Leroi-Gourhan, 1976 ; Valla, 1989.
42. Maher *et al.*, 2001.
43. Kaufman, 1976 : 86, table 26.
44. Bar-Yosef, 1981 : 397, fig. 7.
45. Valla, 1989 : 259.

width of the geometric microliths from Ain Miri is higher than the mean width in the above-mentioned three sites, and falls between the two groups of the Geometric Kebaran suggested by Goring-Morris[46]. The average width for all the Geometric microliths at Ain Miri is 7,8 mm. The mean length of the geometric microliths is 19,3 mm, and again seems to fall between the two groups (the mean length of Hefziba is 16,1-17,7 mm[47] and of Hayonim Terrace is 15,6 mm[48] – very different from Ain Miri). Wadi Ziqlab 148[49] is different from these three assemblages with narrow microliths, and greatly resembles that of Ain Miri. In Wadi Ziqlab 148 the mean width is 7,6 mm and the mean length is 20,9 mm[50]. The similarity of Wadi Ziqlab 148 to Ain Miri might indicate that we are dealing with another facies of the Geometric Kebaran of northern Israel and Jordan.

The Ain Miri assemblage is different from most other known Geometric Kebaran assemblages in the northern region of Israel and Jordan. The difference may be of a chronological nature. In spite of the variability observed at Ain Miri, it is not an assemblage that resembles the sites of Haon III or Hayonim Terrace. If at all, Ain Miri seems to represent a site later than the northern sites mentioned.

This chronological difference, if verified, is expected to have an expression in the composition of the microlith assemblage as well. Fellner, for example, emphasized that the difference in width of microliths is accompanied by a difference in the trapeze/rectangle ratio, whereby trapezes are more common in assemblages characterized by narrow microliths[51]. The assemblage from Ain Miri does not accord with this suggestion, being dominated by asymmetric trapezes-A.

The presence of projectile fractures in a large number of the microliths was also discussed, and we suggest that it is an integral part of the assemblage that must be treated in order to better understand some of the lithic changes during the Epi-Paleolithic period. The fact that geometric microliths are straighter than in the Early Epipaleolithic seems to be significant for hunting tools.

46. GORING-MORRIS, 1987 : 130.
47. KAUFMAN, 1976 : 86, table26.
48. VALLA, 1989 : 259.
49. MAHER *et al*., 2001.
50. Maher, pers. comm., 2003.
51. FELLNER, 1995 : 46-47.

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