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An Excavation near a Pre-Pottery Neolithic A Flint Quarry on Kaizer Hill, Modi'in

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Introduction

In January 2010, a five-day trial excavation was conducted on the eastern slope of Kaizer Hill, Modi'in (Giv'at Kaizer; Spivak 2016; map ref. 19928–31/64565–70).[1]

During the excavation, anthropogenic bedrock markings, possibly related to flint quarrying activity, and a Pre-Pottery Neolithic A (PPNA) flint industry, were documented. Kaizer Hill was previously surveyed and excavated, and identified by the lithic assemblage as a PPNA site (Zbenovich 2006; Fig. 1:1).[2] More recently, Grosman and Goren-Inbar (2010) revealed the remains of a PPNA quarry at the site (Fig. 1:2).[3]

The Excavation

During the excavation four natural steps of limestone bedrock descending northward were exposed (Steps A–D; Plan 1). Flint items were systematically collected from the topsoil and the surface of the steps. A one-meter test square (C1) was excavated down to bedrock to a total depth of 10–20 cm; its sediment was sieved using a 2 mm mesh. On the surface and edges of the rock steps, dense concentrations of bedrock cupmarks were documented. Following the conclusions of Grosman and Goren-Inbar (2010), who excavated similar features less than 150 m south of this area, these cupmarks are interpreted as the result of the extraction of flint nodules.

The Flint Assemblage

A total of 2639 flint implements were collected (Table 1), 592 of which were retrieved from the excavated square (C1). The rest was collected from the exposed rock steps (1847) and from the topsoil between the steps (200). The lithics from all parts of the studied area are of gray Senonian flint from the Meshash formation, and exhibit uniform morphology and technology; therefore, the entire surface collection is presented as a single unit (Table 2).

The debitage is strongly dominated by flakes (1:76). The cores are relatively small, varying in length from 1.6 to 4 cm. Each bears negatives of three to seven small flakes. The CTEs are mostly fragmentary core sections. The assemblage in general contains relatively few tools (0.8%). The toolkit (Table 3) is composed mainly of bifacials and their fragments (together 60%) and extremely small fragments of retouched blades (20%). The bifacials are

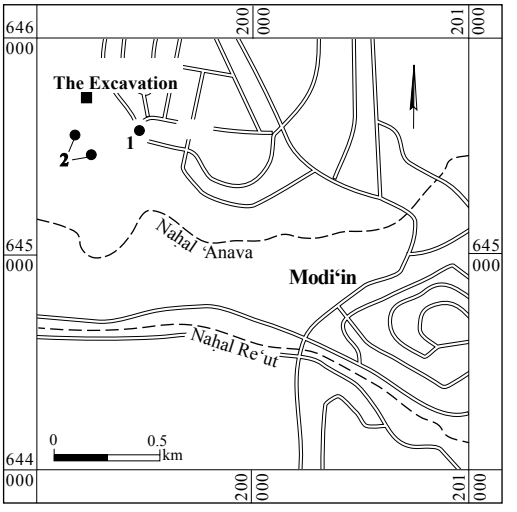
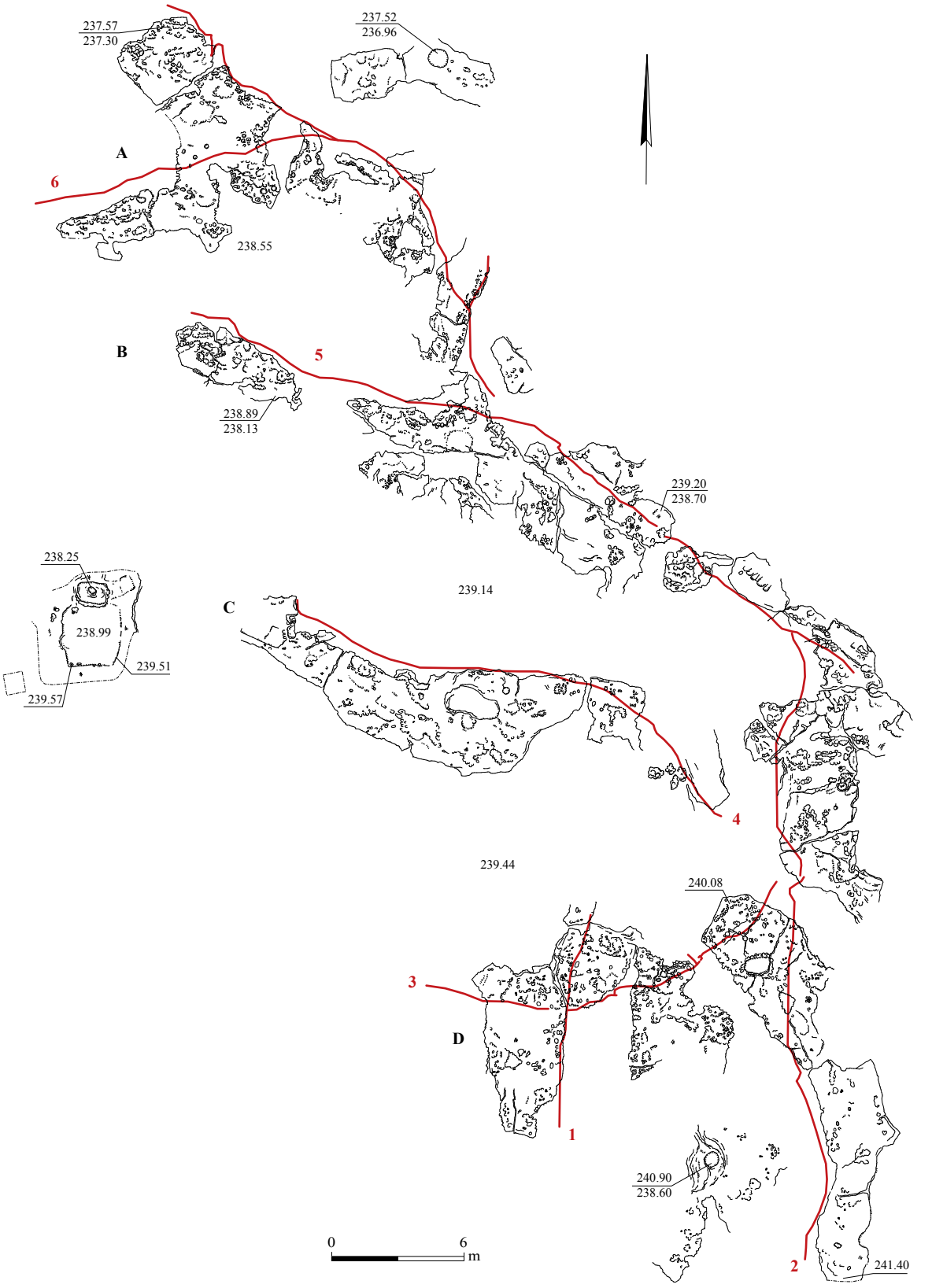


Fig. 1. Location map of the site and previous excavated areas.



Plan 1. The excavation area; note: the seven flint veins (1–7; marked in red) correspond with the four rock steps (A–D) that descend northward.

quite fragmentary, but share characteristics comparable to those previously collected in the area, first by Zbenovich (2006:10–13; 2014:15–19) and then by Grosman and Goren-Inbar (2010:46–48), as well as to other PPNA sites in Modi'in (Spivak 2010; Zbenovich 2014; forthcoming [a]; forthcoming [b]). *In situ* use and repair of PPNA bifacials is indicated by the presence of transversal flakes (0.2% of the assemblage; Table 2), with typical techno-typological characteristics of the PPNA bifacial complex (Barkai 2000).

Table 1. Spatial Distribution of the Flint Finds

Unit	N	%
Step C	881	33.4
Step B	425	16.1
Step A	250	9.5
Step D	291	11.0
Between steps C–D	46	1.7
Between steps A–B	109	4.1
Between steps B–C	45	1.7
Square C1	592	22.4
Total	*2639*	*99.9*

Table 2. Breakdown of the Flint Assemblage

Type	N	%
Chips	764	29.0
Chunks	1286	48.7
Flakes	533	20.2
Blades	7	0.3
CTEs	19	0.7
Transversal flakes	4	0.2
Cores	6	0.2
Tools	20	0.8
Total	*2639*	*100.1*

Table 3. Tool Frequencies

Tool Type	N	%
Retouched blades	4	20
Burin	1	5
Bifacial fragments	10	50
Bifacial axes	2	10
Sickle blades	2	10
Retouched flake	1	5
Total	*20*	*100*

The extremely low percentage of complete bifacials (Table 3) within the assemblage may be the result of the intensive collection of flint during the 2007 field season of the Grosman and Goren-Inbar excavation (2010). Given that large items are more likely to be collected than small ones, it is not surprising that the present assemblage comprises mostly small cores (average 2.8 cm) and flakes (average 3.1 cm).

After the surfaces of the four exposed rock steps were cleaned, an extremely rich concentration of cuplike depressions became visible. Following the study conducted by Grosman and Goren-Inbar (2010) on the summit of the hill (Fig. 1:2), the examination of the cupmarks was aimed at identifying possible anthropogenic bedrock markings associated with flint quarrying.[4] As in Grosman and Goren-Inbar's study (2010:42–46), the documented cupmarks can be roughly classified into three main groups. The first consists of rounded individual cuplike marks (Fig. 2), and the second, of clusters of individual cuplike marks, usually forming a flower-like depression (Fig. 3). Both types are horizontally oriented markings on top of flat rock surfaces, where the remains of primary deposited flints are still visible. Analogous markings were recorded

Fig. 2. Rounded individual cuplike extraction marks, looking north.

by Grosman and Goren-Inbar (2010) on the surfaces of exposed rock on the hill summit. The third group includes cupmarks incised on the vertical edges of the rock steps (Fig. 4). Similar markings were recorded as quarry fronts by Grosman and Goren-Inbar (2010) at the top and on the slope of the hill.

All the identified marks are shallow and eroded, and suffer from extensive damage by water and wind. Although our short-term fieldwork did not allow for a comprehensive examination of the technique(s) employed in hewing the marks, based on Grosman and Goren-Inbar's (2007) re-examination of

Fig. 3. A flower-like depression formed by individual cuplike marks, looking south.

Fig. 4. Quarry fronts incised on the vertical edges of the rock step, looking southwest.

Fig. 5. Flat rock surfaces accompanying the extraction marks, looking east.

Fig. 6. Small, poor quality flint nodule still embedded in the rock.

Fig. 7. A crossing point between two flint veins that are perpendicular to each other.

analogous markings at the site of Ḥatula (Ronen and Lechevallier 1985), it seems that they were drilled. Grosman and Goren-Inbar (2007:734) also suggest that the flat rock surfaces around the marks, which appear to be natural, are in fact exhausted rock surfaces that are the result of extensive "peeling" carried out in order to mine for limestone. It is noteworthy that most of the recorded marks are indeed found on flat rock surfaces (Fig. 5).

The clusters of extraction marks reported by Grosman and Goren-Inbar (2007; 2010) exhibit no particular spatial arrangement. In the present case, both horizontally- and vertically-oriented marks seem to follow a pattern of gently curved lines, which appear to be naturally formed veins containing flint nodules and pebbles. Most of the flint extracted from the veins left quarrying marks, and poor quality nodules and small pieces were left embedded in the rock (Fig. 6). Thus, identifying the quarried veins and distinguishing between them and the untouched rock was simple. In total, seven potential flint veins were documented (Plan 1), and a number of crossing points between the veins were identified (Fig. 7).

Several similar PPNA flint extractions from accessible, on-surface sources have been documented in diverse, and in some cases, isolated regions of Israel, including the Judean Hills (Grosman and Goren-Inbar 2007; 2010), the central Shephelah (Ẓur Natan; Marder et al. 2007) and Galilee (Gopher and Barkai 2006). Known examples of more challenging raw material procurement during the Neolithic period, e.g., mining from unexposed flint veins, are similarly widespread (Taute 1994 and references therein; Quintero 1996; Schyle 2007).

DISCUSSION AND CONCLUSIONS

The study of prehistoric quarrying is relatively new. Flint quarrying sites are known from as early as the Lower Palaeolithic (Barkai, Gopher and LaPorta 2002; Gopher and Barkai 2011b), though most are known from Neolithic contexts. In addition to the above-mentioned quarries of Ḥatula (Grosman and Goren-Inbar 2007), Ẓur Natan (Marder et al. 2007) and Kaizer Hill (Grosman and Goren-Inbar 2010), PPNA flint extraction has been reported from Galilee (Gopher and Barkai 2006), at Tel Bareqet (Rosenberg and Groman-Yaroslavski 2005) and Qula (Zbenovich, forthcoming [c]). A plethora of influential data concerning Neolithic quarrying strategies has also emerged from PPNB sites in the region (Taute 1994; Quintero 1996; Barkai and Gopher 2001; Barkai, Gopher and LaPorta 2002; Gopher and Barkai 2006; Schyle 2007).

The excavation presented here contributes to this burgeoning area of research. The documented exposure of quarrying features on the northern slope of Kaizer Hill suggests that the border of the PPNA quarry identified by Grosman and Goren-Inbar (2010) extends farther north. If so, the quarry may well stretch over an area of more than 200 sq m. Exhausted extraction surfaces of a similar scale have been reported at the opencast Neolithic flint mining complexes of Ramat Tamar (Barkai, Gopher and Weiner 2007); likewise, at Ẓur Natan, cupmark-like cavities from flint extraction were documented over an area of 100 sq m (Marder et al. 2007).

Experimental mining has shown that during a single work day, each worker could extract approximately 1.5 cu m of raw material (Barkai 2005:8; Barkai, Gopher and Weiner 2007 and references therein). As the quality of flint varied, some of the nodules were not extracted. Moreover, taking into consideration the fact that some (or even most) of the accessible raw material was exposed to natural erosion and weathering, it may be assumed that the loss of usable material would have been even higher. Thus, it seems likely that flint procurement required the exploitation of an extensive area.

Limited time in the field did not allow the investigation of raw material procurement techniques. Nevertheless, a distinctive spatial distribution of extraction marks was observed. Undoubtedly, the correlation between this spatial arrangement and the natural structure of the flint veins requires additional examination.

The most frequent tool type found at most Neolithic quarries are bifacials—mainly axes (Gopher and Barkai 2006; 2011a; Barkai, Gopher and Weiner 2007; Grosman and Goren-Inbar 2007; 2010; Marder et al. 2007; see also the discussion in Barkai 2005:5). The possible connection between bifacial tools and quarries has already been pointed out by Grosman and Goren-Inbar (2010:46–48).

Correspondingly, the Kaizer Hill tool assemblage is significantly (60%) dominated by bifacials, though the percentage of complete bifacials is very low (Table 3). The bifacials discovered in quarries are usually found at different stages of manufacture and use (Barkai 2000; 2005). Of the rare whole bifacials, most are in fact preforms, rejected during the early stages of preparation due to unsuccessful shaping. These discard patterns, as well as the low percentage of complete bifacials, may be indicative of workshops or task-specific production camps, where bifacials were processed, used and repaired (Barkai 2005:53–55).

Comparable PPNA flint assemblages that are exceptionally rich in bifacial tools and spalls are constantly reported in the Modi‘in vicinity (Spivak 2010; Zbenovich 2014; forthcoming [a]; forthcoming [b]; Yaroshevich, pers. comm.; Marder, pers. comm.). All are located where flint is easily accessible and used for typical PPNA bifacials, and none are associated with additional finds and architectural features. The Kaizer Hill quarry seems to represent an individual site within a much more extensive PPNA industrial complex, possibly covering the entire Modi‘in area. Further investigation of the

rich PPNA material culture in this region will no doubt contribute to a better understanding of prehistoric raw material procurement and exploitation strategies. Furthermore, it has the potential of shedding light on the large-scale collective patterns of land-use that evolved during this enigmatic period (Belfer-Cohen and Gorring-Moris 2010).

NOTES

[1] The excavation (Permit No. A-5814) was directed by the author on behalf of the Israel Antiquities Authority, with the appreciated assistance of Zah Kanias, Ofer Marder, Angelina Dagot and Chen Ben-Ari (GPS), Shlomo Ya'acov-Jam and Ely Bahar (administration), Mark Kunin and Tania Kornfeld (field drawings and measurements) and Shlomi Amami (field photography). Further assistance was provided by workers from Wadi 'Ara, and volunteers Ronit and Sylvia Korin and Natalia Gubenko.

[2] The survey was conducted on behalf of the Israel Antiquities Authority in 1999 on the eastern and western hills, and in the field between them. These areas were then excavated during the same year, with the exception of the western hill, which was outside the scope of the salvage excavation (Zbenovich 2006:1, Fig. 1).

[3] The survey and excavation were conducted in 2007–2009 on behalf of The Hebrew University, 20 m southwest of the present excavation, near the hill summit.

[4] I am grateful to Dr. Leore Grosman for her guidance and advice in the field on recognizing and identifying the quarry features.

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