FINAL REPORT ON PALEOLITHIC SAMPLING AT ABU EL KHAS, NORTH N.

by
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Introduction

Abu el Khas is a Lower Paleolithic site located 1.3 km. north-east of ancient Pella of the Decapolis (Smith, Hennessy, McNicoll, 1980). The first report on Abu el Khas (Villiers, 1980) dealt briefly with the site setting, sampling methodology, and ancillary work carried out during the 1980 field season. This final report summarizes the results of artefactual analysis, and investigations into the geology and environment of the site area. Certain limited Levantine site comparisons have also been made. Complete details of the research may be found in "Exploration of the Lower Paleolithic Period in Jordan: The Abu el Khas Site" (Villiers, 1981).

Both Pella and Abu el Khas are located within an area known as Tabaqat Faḥl. This area forms a natural physiographic unit consisting of an alluvial plain bordered by the ʻAjlun highlands in the east, the Wadi Jirm drainage system in the south, and the Wadi Ḥammeh in the north. Tabaqat Faḥl is separated from the Jordan Valley in the west by a steep drop of some 120 metres, and constitutes a transitional terrain between the valley and Eastern Highlands.

Abu el Khas is located in the north-east corner of the Tabaqat Faḥl area, at an elevation of between 0-45 metres A.S.L. It consists of the Tell el Baab hill spurs and the Tell abu Ramileh ridge which partially enclose a small plain lying some 50 metres above the large Tabaqat Fahl fan terrace (Fig.1).

Although artefacts may be found throughout the Abu el Khas area (60,000 sq.m. plus), erosion and slopewash (due primarily to cultivation during winter, the period of maximum erosion) have been the primary agents of this spreading. Scatters of artefacts are concentrated immediatly below the south facing crests of the Ramileh ridge and the Tell el Baab hill. In this latitude these south-facing slopes are constantly in sunlight and, as a consequence, are noticeably drier, less vegetated and exposed to active erosion. On the el Baab hill erosion has exposed sections of a conglomerate formation along the south face which excavation subsequently showed to be closely connected with the surrounding artefact concentration.

The size of the present site area, together with the limited field resources available, precluded intensive sampling over the whole area. A form of stratified random sampling was selected in order to test what relationships existed between topographic variation and artefact density and distribution (Villiers, 1981: 62-3). This was supplemented by a "selective sample" of artefacts haphazardly collected from the rest of the site. Further material was also recovered from the test excavation. Investigation focused on the Tell el Baab hill spurs where the excavation and random sample were located (see Villiers, 1980: 164 for selection criteria and site map).

Test Excavation

According to local informants a flat-topped spur of the el Baab hill, in the western section of the sample grid, had not been ploughed in living memory, the owners preferring to use it as a harvest collection area. In the hope of minimal disturbance on this level, grassed area (as compared to the rest of the site which was sporadically cultivated on the fallow system) a 1.00 m. x 1.00 m. test trench was dug here to attempt to clarify the depositional events of the site.

Excavation was by trowel and handpick, following natural stratigraphy. Facilities were not available to sieve the material so each handful of soil removed was "hand- sieved" for artefacts. Level depths given are approximate only as

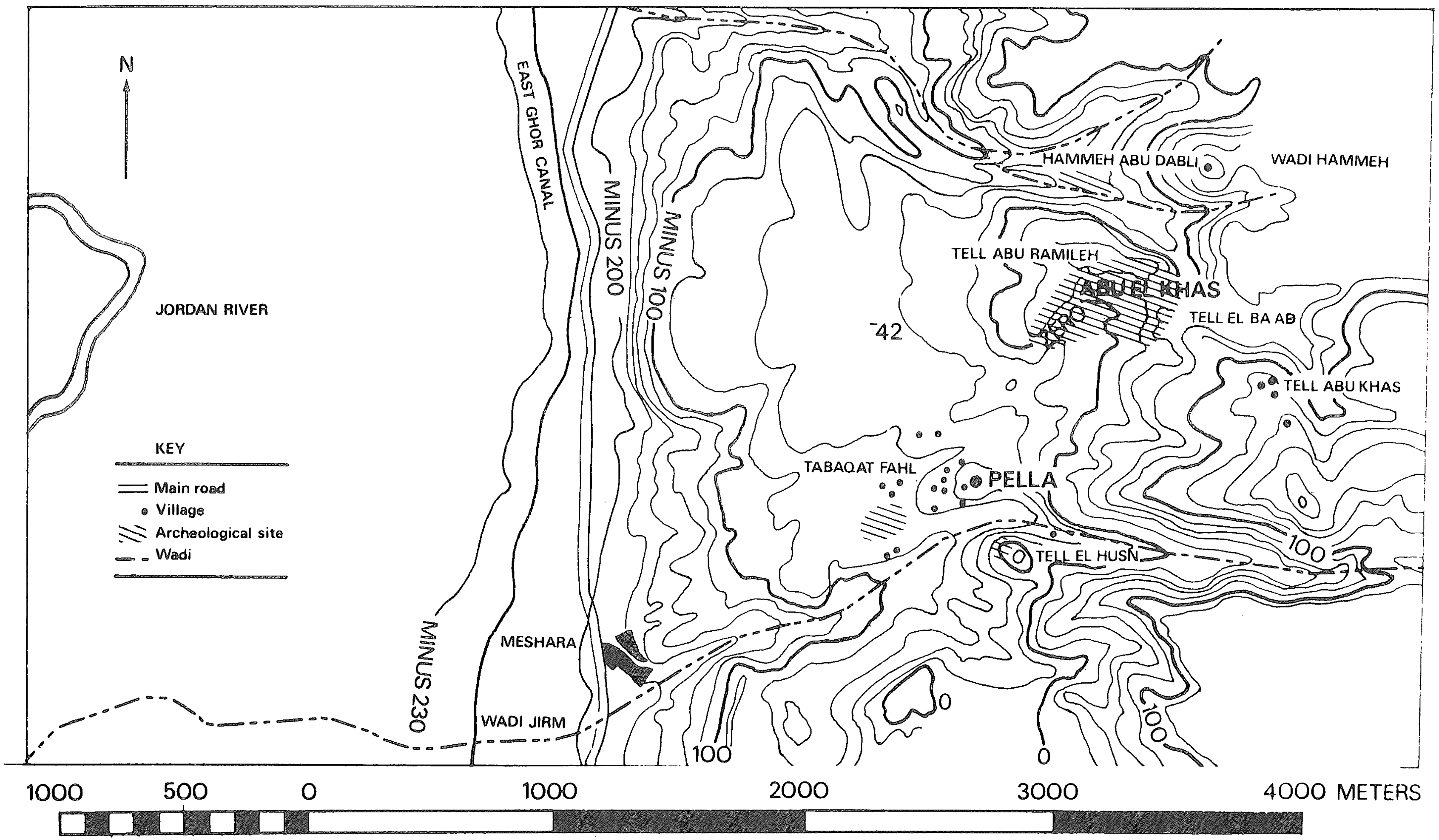

Fig. 1: Topographic map of Pella - Abu el Khas Region.

excavation followed the uneven stratigraphy which rose towards the west.

Levels 1 and 2 (0-0.12 m.) form a shallow reworked soil lying unconformably on a conglomerate unit. The soil was alkali (Ph 8.5-9) with an increasing number of rocks with depth. Artefacts included four Roman-Byzantine sherds as well as small (less than 0.05 m. diameter) non- cortical flakes and chips. Levels 3 and 4 (0.12-0.30 m.) comprised of conglomerate with soil filling the upper depressions and interstices. Some sorting, of the disassociated conglomerate components was noted. The artefacts from these levels were cemented into the conglomerate, with a brittle calcareous cementing matrix, and included flake and pebble tools ranging in size from 0.04 m. to 0.12 m. in length. They were roughly worked and most displayed a heavy white patina with evidence of crushing.

Lenses containing a higher proportion of clay were discernable in the south section above the conglomerate, and appear to represent remains of a weathering surface. No sorting of the constituent components of the conglomerate was noted, with material ranging in size from 0.01-0.02 m. to over 0.12 m. subrounded and subangular in shape. The conglomerate rises from east to west, but whether this is a result of an initial dip of deposition or a structurally controlled tilt, associated with tectonic activity, is unclear.

The conglomerate is part of a formation exposed on the southern face of the el Baab spur, and appears to overlie the Cenomanian limestone base. The formation is well over a metre thick and lying so close to the surface it explains why the hilltop was not ploughed. Fragments of conglomerate were found in collection squares of the sample grid around the hill, and inspection of sections in the military trenches on the adjoining hill showed conglomerate at an equivalent level. The formation is subject to constant erosion and the areas located appear to represent remnants of a formerly more extensive formation.

Analysis of conglomerate samples (kindly undertaken by Dr. Paul Goldberg, during a visit to Australia) indicated that the original deposit was either fluvial with a likely admixture of slopewash sediments, or a slopewash with fluvially worked chalk clasts rounded by a previous phase of transport. After deposition it was cemented by a fine grained calcite and voids filled with a coarser calcite. It is not clear whether cementation was from the soil downward or from groundwater upward.

Artefact Analysis

Sampling methodology and sorting procedures are discussed in the first report on Abu el Khas (Villiers, 1980: 164-5). A 10. sample was collected from randomly selected squares in a 3,000 sq. metre sample grid laid over the el Baab spur (Villiers, 1981: 70-3; 78-81). After preliminary sorting and division with the Department of Antiquities a group of 442 artefacts from the Random Sample, and 28 from the Selective Sample, were available for analysis. The artefacts remaining with the Department of Antiquities were finally analysed in 1982 but the results did not alter the overall picture of the industries represented at Abu el Khas. The Excavation Sample was kept intact and analysed as a whole.

The Abu el Khas site has, at various times during its history, been exposed to denudation, fluvial action, erosion, trampling by man and animals, and disturbance through agriculture and military activity. It is not surprising therefore that many of the artefacts exhibited signs of rolling and crushing. This led to considerable difficulty in distinguishing natural edge damage from intentional edge modification (by retouch and/or utilization). Consequently, for the sake of logical consistency as well as for reliability of results, the unmodified category as used here includes only artefacts with fresh, whole edges. All artefacts with edge alteration (resulting from deliberate modification, utilization, or natural causes) were classed as "edge damaged". This cautious approach clearly leads to under-representation of the "utilized" category, and the figures given must be viewed with this in mind.

The following technological attributes were recorded: striking platform type, flaking technique, flake form, amount of cortex, flake condition (i.e., "wholeness"), artefact alteration (i.e., patina and freshness), flake length, width and weight (Rollefson, 1980: 136-9).

The significance of the observed technological variations between Groups A and B in the samples was tested by the use of chi-square analysis. The small size of many of the technological subcategories required their pooling in order to produce two major variables for each charecteristic e.g.: "plain platforms" included plain and transversely prepared variants; "facetted platforms" included dihedral, multiple facet, and dihedral with one transverse flake variants, and so on. With one degree of freedom the level of significance was set at 0.001. Although there are problems associated with this method, it proved useful in view of the nature of the samples (see Doran, Hodson, 1975: 54-6; Villiers, 1981: 119).

The composition of the samples is given in Table 1.

Both nodular and tabular flint from the local limestone are used for artefacts, as well as cobbles from the *wadi* beds. The exact source of the brecciated chert is at present unknown although the geological makeup of the area indicates it should occur locally.

Random Sample

The length-width frequencies and weight distribution of whole flakes were graphed and compared and while there is a curious hint of a bimodal size distribution in Group B, the results are inconclusive due to the low ratio of complete flakes in the sample. It is possible that this may be a reflection of the age of these artefacts, with greater damage and breakage being more likely over long periods of exposure.

While both, Group A and B of the random sample represent flake based industries, there are a number of (statistically) significant differences between them. These include striking platform type, flaking technique, amount of cortex present and incidence of patina. Also, while no Group A artefacts show any sign of carbonate concretions nearly 10% of Group B artefacts exhibit this, indicating a close association with the conglomerate unit present on the site.

Table 1. Composition Of Sample Groups

	Random Sample		*Excavation*	*Selective*
I (a) Artefact Form	A n=148	B n=294	n=76	n=28
Bifaces	0	1	0	3
Flakes	128	220	43	17
Cores	5	5	3	1
Chunks/Fragments	12	27	14	2
Natural Flakes	3	39	16	3
Hammerstones	0	0	0	2
(b) Artefact Class				
Implements	58	106	15	20
Cores	5	7	3	1
Artefacts (debitage and utilized)	85	181	46	7
Non-artefactual debris	0	0	12	0
(c) Modification				
Cores	5	7	5	1
Modified/edge damaged	128	284	73	27
Unmodified edge	15	3	0	0
II. Raw Material				
Flint	137	173	60	25
Brecciated chert	0	8	12	2
Other (limestone, chert etc.)	11	13	4	1

With platform type, the difference between Group A and B in the incidence of "facetted" and "plain" platforms respectively resulted in a chi-square of 33.8, with the probability that both groups were drawn from the same population being less than one in a thousand (0.001). Comparison of flaking technique indicated a similarly highly significant difference. The incidence of the use of "normal" (normal, angular) and "prepared" techniques (Levallois flake and blade, normal blade, and non-Levallois prepared core) resulted in a chi-square of 39.1 with p being greater than 0.001. While these differences between the two groups centre on the use of techniques for preparing cores for flake production, there is no evidence for the consistent production of predetermined flake forms (e.g., blades, points, Levallois flakes, etc.) in either group.

The groups vary significantly in the presence of cortex on artefacts (chi-square $=$ 14.9, $p = 0.001$) with Group B being consistently more cortical. This suggests that either substantially different approaches to core reduction and preparation existed between the two groups, or that Group B was manufactured on site while Group A artefacts were made elsewhere and brought to Abu el Khas before being discarded.

Although clearly observable patination is difficult to quantify and control, especially for borderline cases (e.g., light overall patina, heavy partial patina, etc.). Patination processes are as yet incompletely understood and research remains inconclusive (Schmalz, 1960). However, a highly significant difference (chi-square $=$ 20.1, $p \leq 0.001$) was found between artefacts with zero or light patina (Group A) and those with overall or differential patina, i.e., two periods of patination (Group B).

An interesting difference between the two groups which warrants further investigation involves the use of chunks and natural flakes as artefacts/implements, as against the use of struck flakes. The difference between Groups A and B is less marked statistically than those discussed above (chi-square $= 9.7$, $p =$ between 0.01 and 0.001) but the evidence indicates that this feature would be better explored with larger samples.

Comparison of other features of the assemblages was restricted by either the difficulty in establishing objective criteria for assignment to the relevant subcategories (as in the case of artefact freshness), or by the lack of sufficient relevant items (e.g., transverse platform preparation, hinge flakes, blades). Differences in the use of various types of raw material (flint and the pooled values for the other two types) proved insignificant (chi-square $= 0.012$, $p = 0.90$). This suggests that the lack of artefacts made on the more robust brecciated chert in Group A may be due to chance.

Table 2. Summary Of Random Sample Technological Features: Relative Percentages

Platform Type	*A*	*B*	*Flake Condition*	*A*	*B*
Plain	37.5	59.5	Complete	25.8	22.5
Facetted	32.0	8.6	Platform absent	26.6	27.5
Absent	26.6	27.5	Other edges absent	47.7	50.0
Crushed	3.9	4.5			
			Artefact Alteration	*A*	*B*
Flake Form	*A*	*B*	Differential Patina	13.3	13.9
Normal	40.6	22.5	Partial/Light patina	32.9	53.7
Angular	34.4	61.3	Overall patina	9.8	31.5
Blade	8.6	1.8	No patina	44.1	1.1
Hinge	4.7	11.3			
Cortex	*A*	*B*	Fresh	92.4	12.2
Cortical	34.3	54.1	Slightly rolled	7.7	62.4
Non-cortical	65.7	46.1	Very rolled	0	25.6

Core Type	*A*	*B*
Levallois	1	0
Flake core		
Proto-Levallois	2	0
Single platform	1	0
Formless	1	0
Discarded	0	4
Core frag./chunk	0	3

Flaking Technique	*A*	*B*
Normal; "Clactonian"	61.7	86.9
Levallois; Prepared		
Core; Blade	35.9	8.6

As may be seen from the comparison of typological indices (Table 5) Mousterian elements (Bordes, 1950; Bordes, Bourgon, 1951) are moderatly well represented in Group B but relatively low in Group A. The composition of the scraper class in Group B is brought out in the Charentian and Yabrudian indices, with Group A lacking the canted convergent scrapers typical of the latter. The Denticulate group value of Group A is almost twice as high as that of Group B. While the absence of backed knives (Group A) has been taken as a characteristic of Late Acheulian assemblages in the Near East (Rollefson, 1980: 135), Group A's low Levallois index suggests a variation to the usual Late Acheulian, where this feature is usually better represented. No Levallois items occur in Group B.

There are clear differences between core types of the two groups. Specialized core types are found only in Group A (Levallois, proto-Levallois, single platform), and the average number of flake scars on the cores is 8.8. In Group B only amorphous, casually utilized cores were found, and the overall impression was one of irregular use of suitable cobbles or chunks to strike off one or two flakes when required. The average number of flake scars is 3.8. This difference in core types correlates well with the lack of specialized flaking techniques notable in Group B (Table 2).

Excavation Sample

As discussed earlier the artefacts from Levels 1-2 derive from a substantially later, reworked soil now covering the artefactual conglomerate. Re-analysis of the sample, keeping material from the first two levels separate is underway, but the information presented here is based on the excavated sample as a whole.

The majority of flakes exhibit plain platforms (65%) and normal flaking technique predominates. Angular and "normal" flake forms constitute 72% of all forms. Over 42% of items were cortical or had cortical platforms, and the rather high value for non-cortical artefacts is attributable to the higher incidence of chronologically later small flakes in the upper two mixed levels. There was an equal division between complete flakes and those with absent platforms (23% each). Other edges were missing on 53% of the sample. Over 60% of flakes, and 76% of chunks/ natural flakes, showed evidence of concretion. No artefacts were without patina and 47% had a heavy, overall patina. The large size of many of the artefacts recovered from the conglomerate is reflected in the length-width frequency of whole flakes (up to 0.00110 m. width, 0.00100 m. length) and in the weight distribution (up to 345 gms.).

Only fifteen recognizeable implements were found and indices were not calculated. Tools include one scraper, two awls, two naturally-backed knives, nine irregularly retouched pieces, two choppers, and one "diverse" implement. With the exception of the scraper and awls (from Levels 1-2) none of the tools could be called typical examples of their class, being minimally and crudely worked.

Artefacts from Levels 3-4 were originally associated with Group B, Random Sample, which also showed varying degrees of abrasion and conglomeratic adhesions. Although there were differences, (i.e., size, patination colour, and an extremely basic technology evident in the excavated material, the sample was too small to permit comparative quantification. While the excavated artefacts do appear to have certain similarities to some pre-Acheulian material found at Abu Habil in a similar geological context to Abu el Khas (Bender, 1968: plates; Huckreide, 1964,) this possibility of a third, even earlier, pre-Acheulian assemblage existing at Abu el Khas will certainly require further investigation and collection of larger samples.

Selective Sample

The significance of this group lies primarily in indicating the range of artefact types to be found at Abu el Khas. Being selectively collected they (unsurprisingly) show a finer degree of workmanship to most of the other samples. The small size and selectivity of the group rules out any statistical treatment, and only the implement class was divided into A and B types. Group A comprised of two Levallois flakes, a convex transverse scraper, two denticulates, and one item with fine alternating retouch (Type 49). Group B included a convergent sidescraper, a naturally backed knife, three chopping tools, three bifaces, four implements with crude retouch (Types 46-47) and two "divers" items. Two Chalcolithic chisels were also found on the site.

Artefact Density And Distribution

A subsidiary goal of the Abu el Khas research was to determine the origin of the artefacts, were they surface scatters now eroding down-slope from a high point of the site, or did they originate from a stratigraphic context now being broken up and eroded? The use of probability sampling enabled investigation of the relationship between topographic variation and artefact distribution and, within the limits of the stratified random sampling procedure used, allowed some conclusions to be drawn.

Table 3 shows a marked difference in the distribution patterns of the two groups. While Group A shows a comparatively even weight distribution across both sectors of the sample grid, the average weight of Group B per m² is nearly twice as heavy in the south sector. This difference is not dependent on the number of artefacts occurring, which remains proportionally constant, rather it illustrates the difference suggested in the comparison of whole flake weights—Group B artefacts are, as a whole, larger (heavier) than the Group A material. A slight majority of Group A artefacts are found in the higher north sector of the grid, while the Group distribution reverses this pattern — the majority of artefacts are found in the south sector, and the average weight/m² there is more than twice as heavy as in the north sector.

Erosion may provide an explanation for the distribution of Group B artefacts, if heavier artefacts are more likely to erode downslope than smaller, lighter ones (cf. Rick, 1976). But this does not explain Group A distribution which, although with a lower density per m² in the higher north sector of the grid, has a higher average weight per m² there. This pattern suggests

Table 3. Artefact Density And Distribution

	Total Sample		*Group A*		*Group B*	
	North Sector	South Sector	North Sector	South Sector	North Sector	South Sector
No. of squares sampled*	44	31	32	24	37	23
No. of artefacts	220	222	76	72	144	150
Overall weight (grams)	4970.2	6199.4	1552.4	1062.8	3417.8	5136.6
Average density/m²	1.3	1.8	0.6	0.8	1.0	1.6
Average weight/m² (gms)	28.2	50.0	12.1	11.1	23.1	55.8

* In the Group A and B columns the number of squares sampled refers to the number of squares in which artefacts of the relevant type occurred.

that the material was probably discarded on the upper north sector and has not yet eroded significantly downslope.

The sample grid was divided into four equal quadrants running from east to west, and the relative percentages of artefacts in each was calculated. This showed a concentration of Group B artefacts surrounding the flat-topped hill in the west where the conglomerate outcrops. If Group B derives from a unit within the conglomerate, which appears likely, then their occurrence further upslope in the northeast sectors of the grid suggests that the conglomerate formation may have once extended over this area but has since been destroyed.

The Group A pattern of distribution appears to be independent of that of Group B. It is also independent of the prevailing drainage direction, a factor influencing erosion patterns, which is from north to south.This suggests that Group A represents a later episode of site use, with artefacts experiencing only limited downslope movement since their deposit on the higher and flatter north sector of the site.

Site Comparisons

Inter-assemblage comparisons highlight the inadequacies of the various systems of lithic analysis in use in the Levant. Until recently the emphasis has been on tool typologies (usually classified according to Bordes' system, variants thereof, or site-specific systems such as 'Ubeidiya) and little data is available on the technological features of assemblages (Rollefson, 1980: 130). Clear comparisons are further limited by the lack of comparative quantitative data, variations in criteria for ascription to artefact type classes, non-equivalence of sampling procedures and sample sizes, and differences in the nature of assemblages due to depositional contexts.

Given these problems it was only possible to highlight general similarities and differences between Abu el Khas and other selected sites (e.g., 'Ubeidiya and Latamne). These sites are discussed in detail in Villiers (1980: 132-145) and on the present evidence it appears that Group B may probably be placed at the end of the 'Ubeidiya sequence but preceeding Latamne (Fig. 2). Until recently Paleolithic investigations in Jordan have been sketchy and unsystemmatic. At the time of this analysis comparative data was available from only two sites. 'Ain el Assad and Fjaje, both kindly made available to the author by Dr. G. Rollefson. Comparison of both Abu el Khas groups with 'Ain el Asad is presented here, while comparison with the Fjaje site may be found in Villiers (1980: 145-150).

'Ain el Assad is a spring at Azraq oasis in the eastern desert area of Jordan. The existence of Paleolithic artefacts there has been known since 1958, but the collection derived by Dr. Rollefson from back-dirt piles left by sump excavation is the first to be analyzed in detail (Rollefson, 1980: 129). This collection consists of 538 artefacts, including 62 bifaces, 71 cores, 112 flake implements and 293 other flakes.

Technologically, this collection showed little effort at platform preparation on cores, with the majority of flakes and blades being produced by either the non-specialized "normal" technique or by the high-angle ("Clactonian") method, itself a variant of "normal" technique. Normal flake form predominates and the low incidence of cortex on flakes is taken to indicate that much of the lithic manufacturing process occurred elsewhere (Rollefson, 1980: 139). Although the Levallois technique is not utilized extensively at this site, the "recognizable techniques of flake production, based primarily on patterns of flake scars observed on the exterior surfaces of flakes conform... to what would be anticipated in a Late Acheulian assemblage" (*Ibid:* 136).

Comparison with Abu el Khas indicates that Group A exhibits the closest technological similarity with 'Ain el Assad (Table 4) further supporting its Middle to Late Acheulian identification.

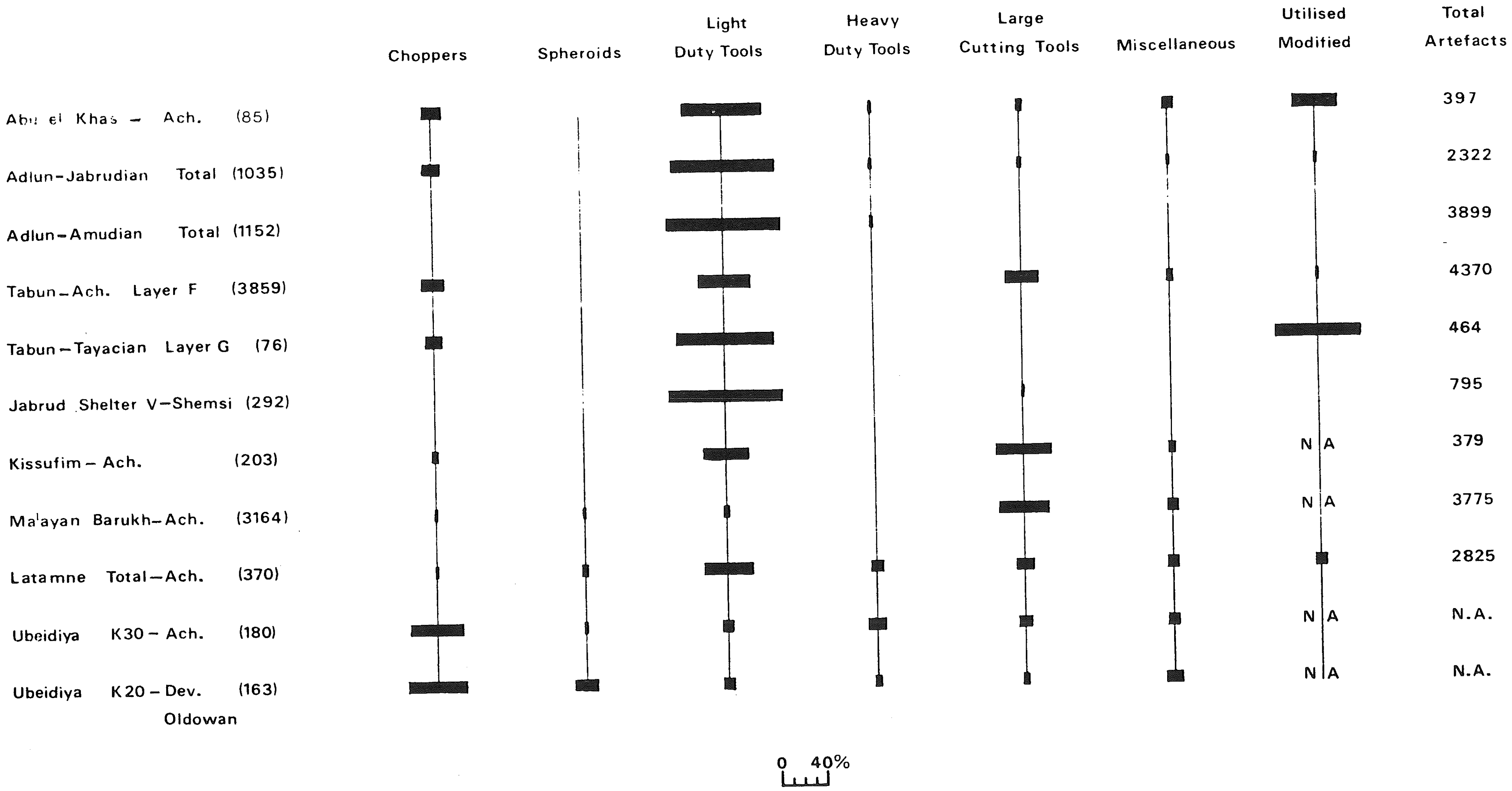

Fig. 2 Comparison of Acheulian and Related Middle-Upper Pleistocene Industries: Variability. (After Clark 1975)

Table 4. Technological Features From Jordanian Sites

		'Ain el Assad	*Abu el Khas*	
			Group A	*Group B*
		n = 405	*n = 128*	*n = 222*
Platform:	Plain	48.2%	37.0%	59.9%
	Facetted	22.5	32.0	8.6
	Cortical	9.1	11.2	8.4
		n341		
Technique:	Normal	32.8	59.4	82.0
	High-angle	29.0	203	5.0
	Levallois	1.8	3.1	—
	Blade	7.6	7.8	1.8
	Prepared Core	22.6	25.0	6.8
Form:	Normal	79.0	40.6	22.5
	Angular	8.9	34.4	61.3
	Blade	6.2	8.6	1.8
	Hinge	—	4.7	11.3
	Debris	0.5	10.2	1.8
			n = 143	*n = 289*
Cortex:	Cortical	41.4	34.3	54.5
	Non-cortical	58.5	65.7	46.0

Group A diverges in the lower incidence of use of the high-angle (Clactonian) technique, larger numbers of flakes with angular form and greater proportion of debris. The non-equivalence of sampling methods used at both sites, and the possiblity that two periods of occupation may be represented in the 'Ain el Assad sample (Rollefson, 1980: 142), means that the significance of such differences remains unclear. It is worth noting though that while Group A and 'Ain el Assad are similar in their ratios of cortical and non-cortical artefacts (suggesting manufacture elsewhere), the high proportion of debris in Group A seems to indicate that post-decortication reduction was carried out at Abu el Khas.

Group B artefacts exhibit substantial differences to the 'Ain el Assad material: a very low percentage of facetted platforms, little use of blade-production and prepared core techniques, a very high proportion of angular flake forms, and a low number of blade forms. The majority of artefacts are cortical, indicating manufacture on-site, but the extremely low percentage for debris suggests that little secondary reduction occurred.

Of classifiable tools at 'Ain el Assad (Rollefson, 1980: 130- 132) 46.9% are bifaces, and 53.1% are flake tools. An unusual feature of this assemblage is that cleavers form 30.2% of the total biface class (14.2% of all tool types) and none are made on flakes. Customarily in Late Acheulian assemblages of the Levant cleavers account for only 2-4% of the bifaces, and they are commonly made on flakes. There is also a relatively high proportion of bifaces of the "diverse" type (24.5%) and as this also occurs at other Levantine sites, Rollefson suggests that Bordes' biface typology is not entirely appropriate for classification of bifaces in this area (*Ibid,* 1980: 130).

Table 5 presents the essential typological indices for flake implements from both sites:

Fig. 3

1 . Single platform core (Grp. A. Random Sample)
2 . Failed Levallois core (Grp. A. R.S.)
3 . Double notch on thick flake (Grp. A. R.S.)
4 . Naturally backed knife (Grp. A. R.S.)
5 . Denticulate (Grp. A. R.S.)
6 . Convergent scraper (Grp. A. R.S.)
7 . Levallois flake (Grp. A. R.S.)
8 . Denticulate (Grp. A. R.S.)
9 . Denticulate (Grp. A. R.S.)
10. Compound notch (Grp. A. R.S.)
11. A Typical Levallois blade (Grp. A. R.S.)
12. Microdenticulate (Grp. A. R.S.)
13. Awl/borer on natural flake (Grp. A. R.S.)
14. Utilized flake (Grp. A. R.S.)
15. Retouched Levallois flake (Grp. A. Selective Sample)
16. Trihedral pick (Grp. B. S.S.)
17. Distal truncation on Levallois flake (Grp. A. R.S.)

fig. 4

1 . Diverse-bifacially retouched primary flake, a type of "bec". interior. (Grp. B. Random Sample)
2 . Chopping tool (Grp. B. R.S.)
3 . Chopping tool (Grp. B. R.S.)
4 . Concave sidescraper (Grp. B. R.S.)
5 . Concave sidescraper on primary flake (Grp. B. R.S.)
6 . Convergent sidescraper (Grp. B. R.S.)
7 . Steepscraper on angular chunk (Grp. B. R.S.)
8 . Convex transverse scraper (Grp. B. R.S.)
9 . Large denticulate on primary flake (Grp. B. R.S.)
10. Sidescraper on natural flake (Grp. B. R.S.)
11. Denticulate (Grp. B. R.S)
12. Denticulate (Grp. B. R.S.)
13. Denticulate on primary flake (Grp. B. R.S.)
14. Naturally backed knife (Grp. B. Selective Sample)
15. Notched flake (Grp. B. R.S.)
16. Notched flade (Grp. B. R.S.)
17. Abbevillian- style handaxe (Grp. B. S.S.)
18. Levallois blade, interior retouch (Grp. A. S.S.)
19. Chopping tool (Grp. B. S.S.)

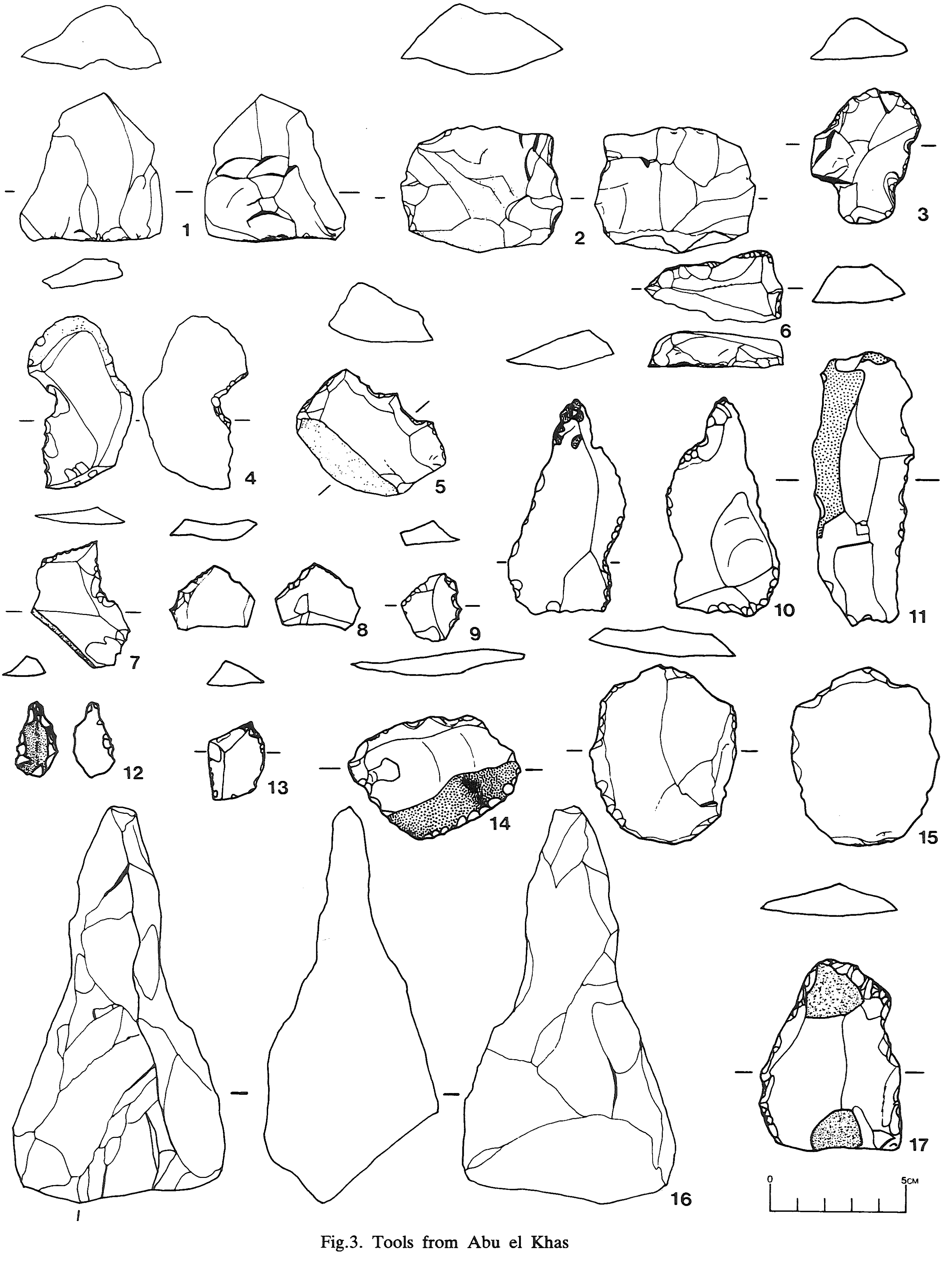

Fig.3. Tools from Abu el Khas

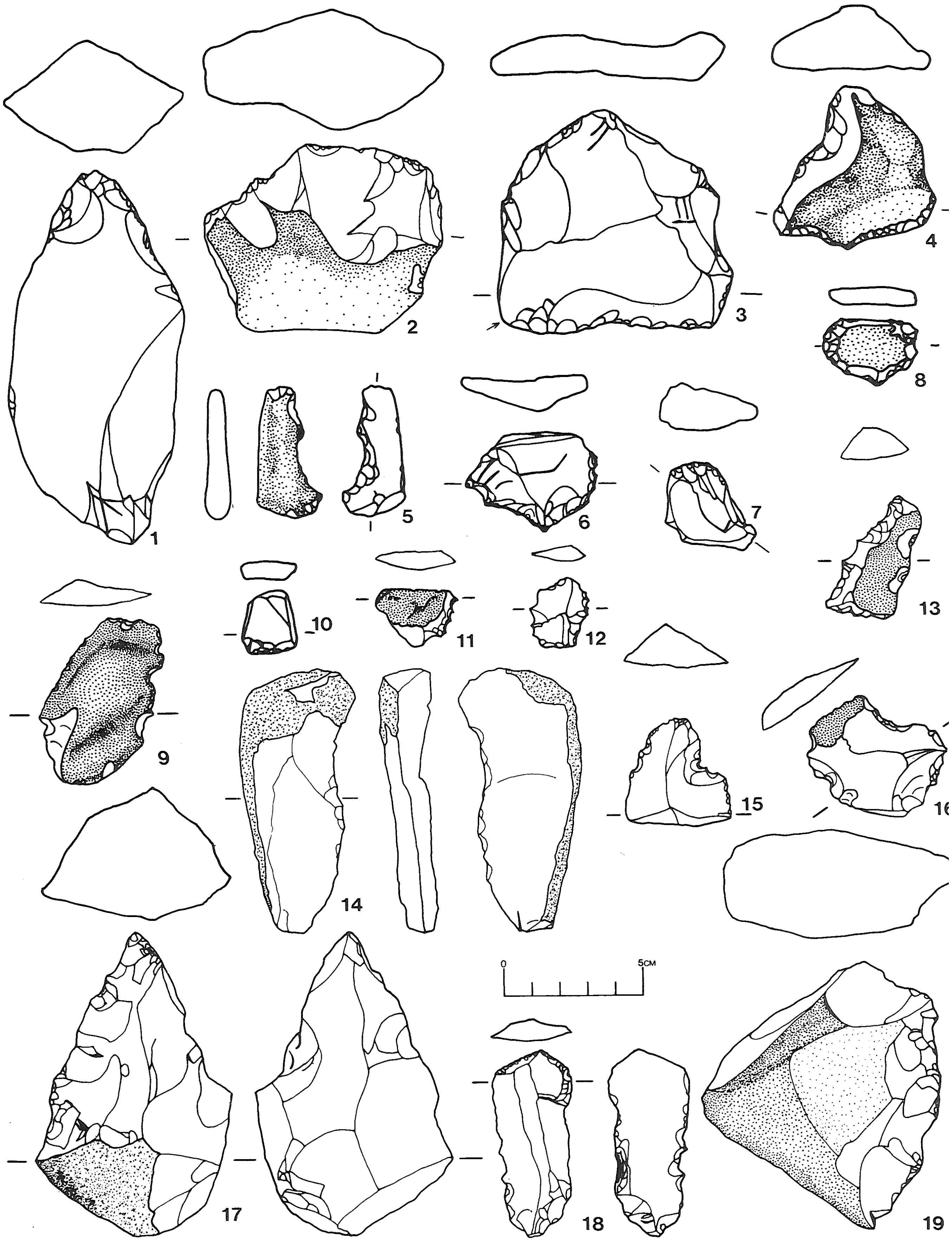

Fig.4. Tools from Abu el Khas

Table 5. Essential Typological Indices for Jordanian Sites

	'Ain el Assad	*Abu el Khas*	
		Group A	*Group B*
Scraper Index	51.7	16.7	32.3
Charentian Index	25.0	5.5	15.4
Yabrudian Index	28.3	—	16.9
Backed knife Index	—	—	3.1
Group I-Levallois	13.8	5.6	—
Group II-Mousterian	55.0	16.7	32.3
Group III-Upper Pal.	16.7	11.1	9.2
Group IV- Denticulate	10.0	44.4	24.6

This method of summarizing typological characteristics of assemblages tends to obscure the degree of similarity or difference between them, and is further hampered by varying criteria used by workers in the inclusion of tool types in the indice groupings (cf. Wendorf, 1968: 198; Rollefson, 1980: 134). In this table it would appear that Group I characteristics are better represented at 'Ain el Assad, yet the technological evidence would seem to belie this. The actual incidence of the use of Levallois flaking technique is only 1.8%, and only one Levallois flake core was found. At Abu el Khas (Group A) the incidence is 3.1% and four of the five cores in this group are either Levallois or proto-Levallois.

Variations in the nature of the samples and sampling methods used may explain many of these differences, but the point here has been to show, mainly through technological comparisons, that Abu el Khas, Group A, would not be out of place being grouped with Middle to Late Acheulian industries as they are presently known from Jordan. Nevertheless if one accepts that associations of artefact types may be repeated in innumerable variations throughout the Acheulian (Clark, 1976: 461) then diversity may be expected.

Geology Of The Site

Certain geological and pedological investigations were carried out in an attempt to date the site independently of artefact analysis. Subsequent research enabled a picture of the formation of the site to be pieced together which later professional investigation of the Pella-Tabaqat Faḥl area has generally confirmed.

The Eastern Highlands and scarp area is mostly composed of Cenomanian-Turonian limestone with small areas of Neogene deposits (Bender, 1974: 177-178). At Abu el Khas the basal limestone includes shales, marls, gypsum and dolomite. The establishment of the geological sequence in the study area focuses on the Wadi Hammeh. Abu el Khas with its conglomerate appears to be a remnant formation above the general level of the surrounding area, and above the now deeply entrenched *wadi,* having been isolated by changes in the prehistoric drainage pattern.

Bender (1974:93-4) recorded sediments in the *wadi* similar to the Plio-Pleistocene Shagur Formation, overlain with an angular unconformity by the Ghor el Katar series. Approximately 9 km. to the south, at Abu Habil, conglomeratic limestones unconformably overlie the Ghor el Katar series. In the upper part of this Abu Habil formation, artefacts of a supposedly "Oldowan" type occur, and the formation was ascribed an early Middle Pleistocene age (Huckreide, 1964: 211-212). Although considerable uncertainty exists regarding the chronological relationships of the units, Dr. N. Schulman (geological advisor on the 'Ubeidiya excavations 1960) has suggested that the upper artefactual levels of Abu Habil may be tentatively correlated with the 'Ubeidiya Formation. Similarly, the artefactual conglomerate of Abu el Khas may be regarded as correlative to the 'Ubeidiya Formation, and of assumed Middle Pleistocene age (Dr. N. Schulman, pers. comm. 1980). Horowitz (1979: 335) also correlates the 'Ubeidiya Formation and the corresponding upper part of the Abu Habil series and assigns them an Early/ Middle Pleistocene age (between 1.2 million years-600,000 years).

An alternative correlation for the Abu el Khas formation may be with the succeeding Naharayim Formation. At 'Ubeidiya and Banat Ya'cub this is marked by a distinct angular unconformity, and is ascribed to the transition between the Early and Middle Pleistocene (Picard, 1965: 351-2). Prior to the deposition of the Naharayim Formation the 'Ubeidiya beds were deformed in a phase of tectonic activity that resulted in the conglomerates of Layers K29, K30 being tilted 45 degrees to the north-west (Stekelis, 1969). If the tilting of the Abu el Khas formation towards the west is indeed structural, and not a depositional dip, this would correlate well with the last phase of the 'Ubeidiya Formation. The Naharayim Formation consisting of fluvial and colluvial sediments has been correlated with poorly consolidated gravels with a red, argillaceous matrix, containing early Paleolithic artefacts in the Wadi Kufringa—Wadi Yabis area, approximately 7-20 km. from Abu el Khas (Bender, 1974: 95). These sediments overlie the Abu Habil series, and are themselves overlain by the Lisan marls, deposition of which ceased between 12,000-18,000 years ago (Bender, 1974: 97; Horowitz, 1979: 342).

Although there had been no geological investigation of the Pella-Tabaqat Faḥl area prior to this research, P. Macumber (a professional geologist) surveyed the area for the Pella project in early 1981. In his unpublished report he notes the problem of repetition of fluvio-lacustrine sediments along the eastern graben, complicated by tectonic activity, which makes geological identification and correlation very difficult. These formations have been deposited from Plio-Pleistocene time onwards, and in the present absence of means of directly dating them their clear identification is going to require much work. A start on this project is scheduled for the 1982/3 Australian Pella field season.

Paleoenvironment Of The Site Area

The botanical profile of the Pella-Tabaqat Faḥl area was investigated and together with other environmental and geomorphological data this allowed tentative reconstruction of the paleoenvironment of the study area. This information is briefly summarized here and more detailed discussions may be found in Villiers (1980; 1982).

Tabaqat Faḥl is located in a specifically (microclimatically) favourable area within the general semi-arid, Mediterranean type climatic pattern of the Levant (Smith, 1973: 91-107). Its water resources are substantially augmented by spring flows which geological evidence indicates have existed throughout the Pleistocene (Bender, 1974:177). The present flora of the area clearly indicates that the former climax vegetation of the area was an ecotone of park forest of *Quercus ithaburensis* and savanna grasslands, including *Zizyphus* spp. Botanical evidence shows little, if any, change in the distribution of plant territories since the Plio-Pleistocene (Zohary, 1973) and a vegetation similar to the former climax is inferred for the Middle Pleistocene period at Tabaqat Faḥl. The Abu el Khas site would have then been situated in a biotype of savanna grassland margins, adjacent to open oak forest covering the higher slopes of the eastern Jordan Valley graben. The work of Ronen (1975) and Gilead (1975) indicates that this was a common preferred pattern for Acheulian site location in the Levant. These areas supported a mixed fauna of European and African elements, with elephant, deer, horse and other grassland species being the most common (i.e., a fauna very similar to that recorded at 'Ubeidiya).

The oldest sites in the Middle East are located in or adjacent to the Rift Valley (e.g., 'Ubeidiya at -200 metres, Jisr Banat Ya'cub at +75 metres). Abu el Khas at approximately +45 metres appears to fit well into this pattern, both environmentally and situationally. A pollen sample taken at Pella, although lacking chronostratigraphic profile (Smith, 1973: 136), indicates that the plant species recorded there are at least congruent with those found at other Pleistocene sites in the Valley. The size and density of the Abu el Khas site suggests a probable pattern of repeated visits, possibly connected with seasonal herd migrations between the valley and highlands.

Summary and Conclusions

Abu el Khas is the first paleolithic site in Jordan to have been systematically sampled and test excavated. While the use of explicit sampling strategies is still uncommon in the Levant, the stratified random sampling approach designed for Abu el Khas proved responsive to feedback at various stages of the project and constituted a straight forward strategy for field use.

The analysis of the Abu el Khas assemblages was guided by the need to establish clearly its technological and typological characteristics. It was also concerned with establishing quantifiable criteria for distinguishing between the cultural elements of a mixed site. This met with a certain amount of success. The artefacts from the controlled random sample originally sorted into two groups on impressionistic criteria (fresher edges, less patina), were shown to have less than one chance in a thousand of originating from the same "population". Testing for the significance of technological variations between the two groups by use of the chi-square method showed the existance of highly significant differences between Groups A and B in terms of platform types, flaking techniques, presence of cortex and the use of struck flakes as artefact blanks.

Group B may be characterized by a significantly greater incidence of plain platforms, the use of normal flaking technique (simple hard hammer flaking), a large number of cortical items and items with overall or differentiated patina. The Group B assemblage indicates a preference for utilization of a rudimentary reduction sequence in association with minimal core preparation techniques. An early Acheulian origin is indicated for Group B, while Group A represents a Middle to Late Acheulian assemblage.

The nature of the samples limited the utility of the comparisons of length/width frequencies and weight distributions but differences in flake size production between the two groups are indicated. The use of size factors in providing discriminatory data on mixed Lower Paleolithic assemblages warrants further exploration to test its apparent applicability.

Mapping of artefact densities and distribution across the sample grid indicated that Group A was discarded on the flatter, north section of the site and, while limited downslope movement seems to have occurred, the assemblage is at least partially in position of its original discard. This is further substantiated by the generally fresh condition of the artefacts. The low density may reflect either a shorter or less intense period of site use. Group B artefacts have evidently eroded out of a conglomerate unit but whether they derive from the same unit of conglomerate and the excavated sample, or a now destroyed upper unit which once extended across the upper sections of the site, is still to be determined.

The investigation of the Abu el Khas site suggests that along the graben rim there is an association between conglomerate formations and early Paleolithic occurrences. Further research in the Wadi Hammeh-Abu el Khas area will provide an excellent opportunity to clarify the local cultural and geological sequence and provide a basic model of cultural succession for the area.

The analysis of technological features of the Abu el Khas assemblages, using a slightly modified version of the system adopted by Rollefson (1980), proved an efficient method for describing the technological characteristics of the samples and for distinguishing between its mixed Lower Paleolithic elements. Typological information was of only limited value in this respect.

Jelinek (1977: 18-19) has already questioned whether the European derived typologies in use are either adequate or suitably formulated to cope with the task of distinguishing related culturally or functional units in the Levant. Clearly there is a need to move away from this typological emphasis and expand the scope of technologically oriented studies, a subject barely touched upon in this region.

Much of the confusion in Levantine prehistory is due to the partial recovery of assemblages and the selectivity evident in the retention of artefacts for analysis. Uncontrolled sampling of sites had also led to distortion of expectations of what constitutes a "characteristic" assemblage of a particular period. The lack of comparative technological and typological data obtained under controlled conditions remains a major obstacle to clarification of these problems and to the development of appropriate techniques of lithic analysis and cultural interpretation.

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