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Late Pleistocene Environment and Paleolithic Adaptions in Southern Jordan

Introduction

Archaeologists increasingly have come to orient their research toward the general objectives of human ecology in an attempt to identify principles that govern relationships between behavior and the natural environment. Even under the best of circumstances, however, investigations of prehistoric human ecology have at their disposal a relatively meagre body of evidence when compared to similar studies of extant societies. Environmental, economic, and demographic data are never complete and always hard to recover, while equally important evidence related to social organization and ideology is even less tangible and more difficult to obtain. Given these limitations, a question emerges as to what value studies of prehistoric societies and environments have to the more general objectives of human ecology. One might argue that those relationships that exist between behavior and environment could best be identified by studies restricted to ethnographically extant societies that yield a far more complete body of evidence than can ever be recovered from prehistory.

While recognizing the constraints on the recovery of ecologic evidence from prehistory, these questions of the value of such investigations fail to consider how seriously our overall understanding of man–land relationships would be biased if prehistoric evidence were ignored. In fact, it would seem that in order to address adequately the objectives of human ecology, we are obligated to engage in the recovery and interpretation of what ecologic evidence remains of extinct societies for several reasons. First, if we hope to develop and evaluate certain principles on human ecology, we are required to gather a universal body of data that is temporally and spatially comprehensive. This clearly requires archaeological inquiry. Secondly, it is unlikely that the ethnographic record fully reflects the diversity of Pleistocene and early Holocene environmental conditions and attendant human adaptive strategies. Such unique man–land relationships could alter or modify human ecologic constructs drawn solely from the ethnographic record. Thirdly, if we are to examine long-term changes in human adaptation, the great time-depth of the Pleistocene should be incorporated into such studies.

In light of these comments, research was initiated on the southern edge of the Edom Plateau in 1979 in order to better understand prehistoric adaptive strategies at both local and regional scales. Specifically, the objectives of the project entailed:

1) Determining if Middle Paleolithic sedentism was a regional phenomenon or one confined to the Central Negev Highlands.
2) Ascertaining the cultural-historic relationships of southern Jordan to the Levant and, in so doing, evaluate various landuse models at a regional scale.
3) Defining local settlement patterns over a sufficiently large and environmentally diverse area to identify complete settlement and adaptive systems.
4) Tracing the adaptive evolution of the prehistoric inhabitants of the area over as long a temporal sweep as could be controlled.

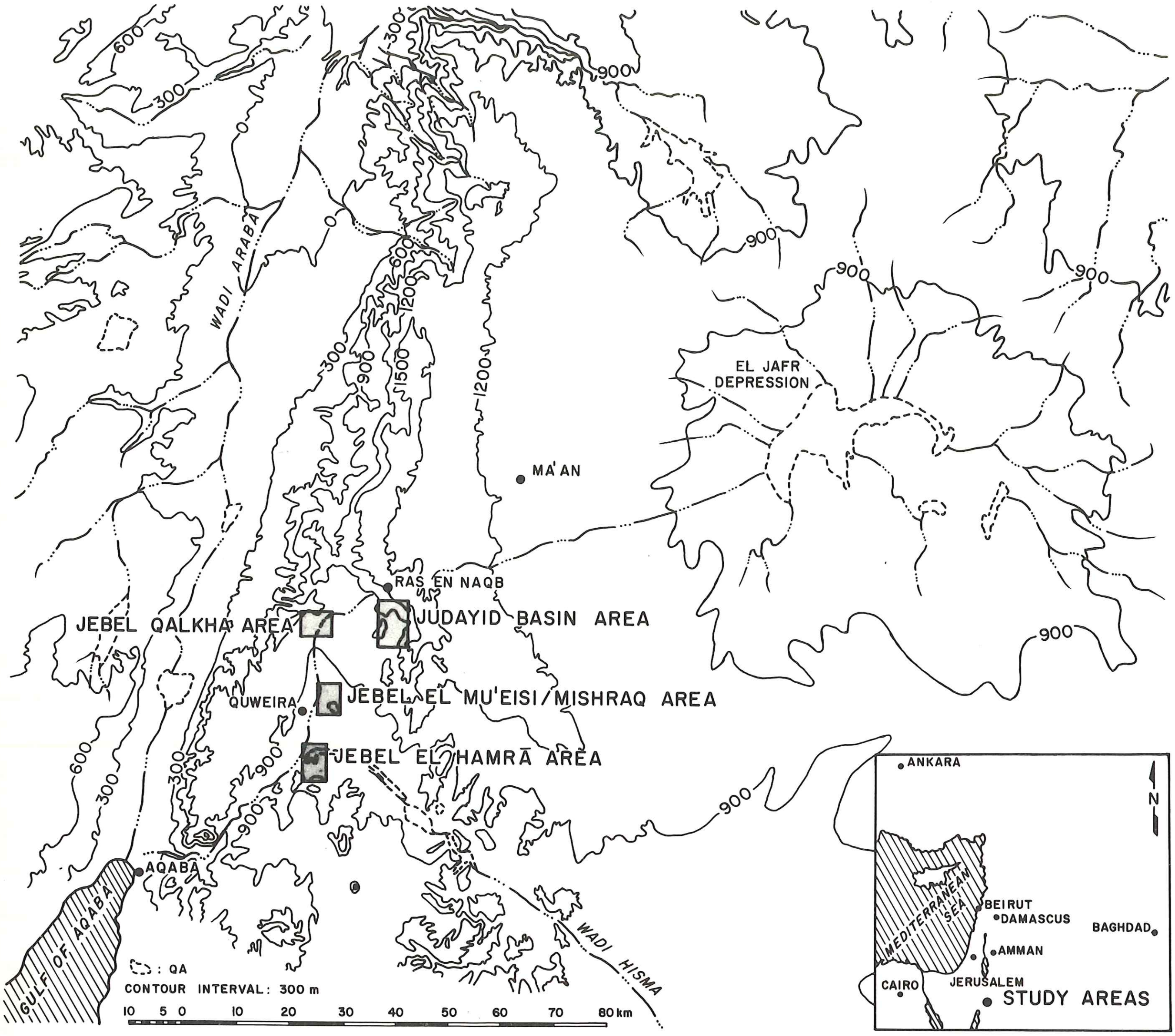
These objectives necessitated gathering, analyzing, interpreting, and ultimately synthesizing cultural-historic with environmental data.

Methodology

The investigation consisted of survey-testing and small excavation components within four study areas in the vicinity of the villages of Ras en Naqb and El Quweira (FIG. 1). The study areas were irregularly positioned along a 40 km. transect that traversed elevations from approximately 1,700 m. to 800 m. above sea level. Due to the significant environmental diversity of the region, the three principal biotic zones of the Near East (i.e. Mediterranean, Irano–Turanian, and Sahara–Sindian) were found along the transect. Various physiographic units, including uplands, piedmont, basin floor, and playa edge settings, were also encountered within the study areas.

During the two seasons of study approximately 25 sq. km. were surveyed and 81 prehistoric sites recorded. The survey procedure involved an on-foot examination of the study areas by a team of 5 to 7 surveyors who formed a picket line. In this fashion, virtually every square meter of the study areas was

1. Map showing the four study areas that were systematically surveyed.



visually inspected. Sites were identified on the basis of clear concentrations of hundreds of artifacts. Once discovered the sites were mapped, surface collected, and test excavated, if there seemed a high probability of sub-surface remains. Twenty-six sites were test excavated and small scale excavations were continued at eight of these.

Culture History

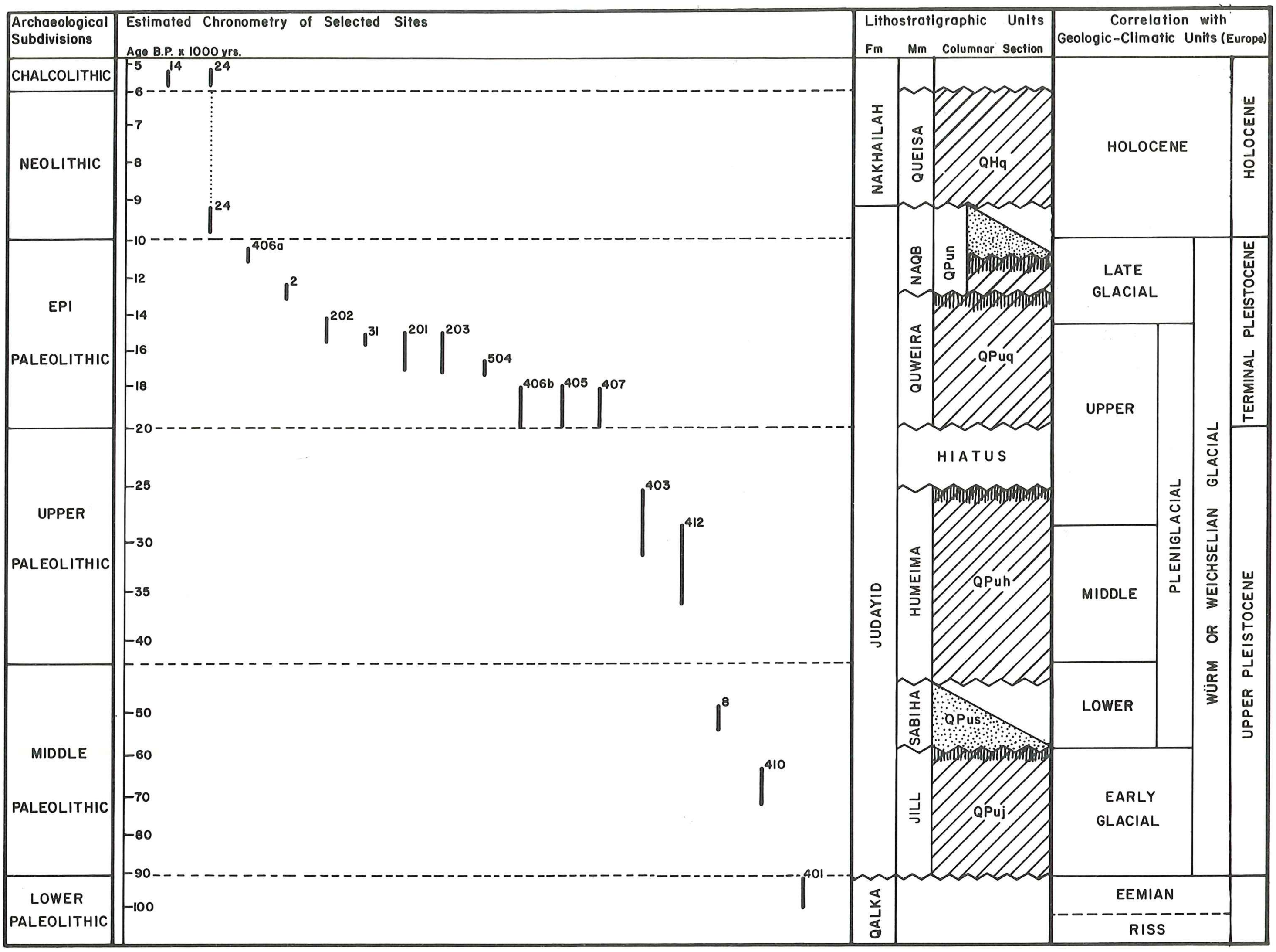
The prehistoric sites recorded in the investigation represent a time depth of over 100,000 years and include Lower Paleolithic, Middle Paleolithic, Upper Paleolithic, Epipaleolithic, Aceramic Neolithic, and Chalcolithic periods. The various assemblages have been chronologically ordered on the basis of their technological–typological characteristics, intra-site and regional stratigraphic positions, and radiometric dates (FIG. 2).

Lower Paleolithic

A single Lower Paleolithic site (J501) was found in a deep wadi cut in the Jebel Qalkha study area (FIG. 3). Although bifaces and other artifacts were initially discovered in the bed of the 30 m. deep wadi, they were subsequently found to be eroding along a horizon only some 10 m. from the modern surface. A surface collection was made of the area, but test excavations were not entertained given the steepness of the wadi bank and the thickness of the overburden.

The collection of approximately 4,000 sq. m. resulted in the recovery of only 66 artifacts most of which were lightly

2. Chart showing the positions of sites in regard to archaeological period, chronology, stratigraphic unit, and geoclimatic unit.



patinated, but with fresh edges. The low density of apparently recently exposed artifacts is consistent with a local topography that would be subject to torrential currents and high velocity sheet erosion. Once exposed, artifacts would soon fall to the wadi bed and be transported downstream.

The tool assemblage contains 10 bifaces in conjunction with lesser numbers of retouched pieces, scrapers, notches, truncations, and a perforator; all made of chert (FIGS 4 and 5). The bifaces are composed mainly of cordiforms with amygdaloid, lanceolate, and irregular forms rounding out the class.

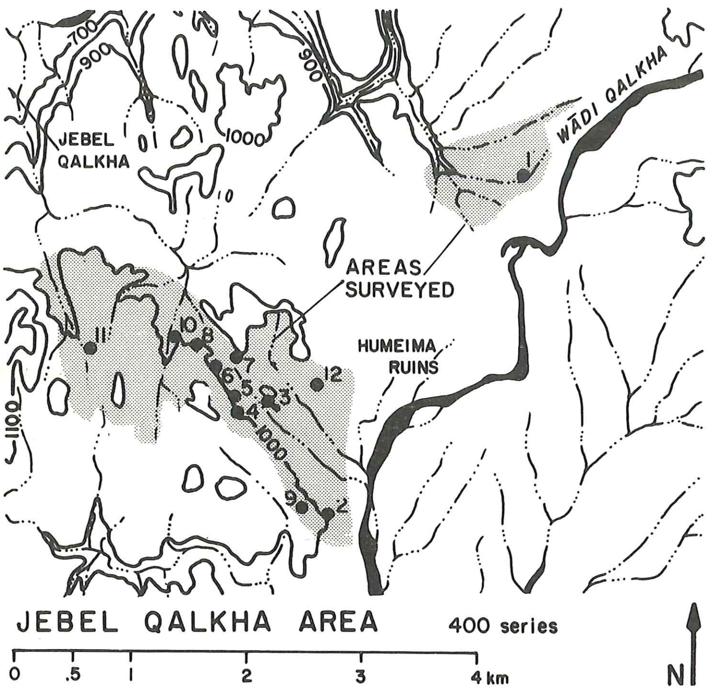
All but one of the bifaces were made on large flakes as opposed to core reduction. Consistent with the flake blank mode of production, cortex appears on less than half the specimens and, when present, is limited to only a small area. Without exception the bifaces display regular edges with fine secondary retouch suggestive of soft hammer fabrication. The mean length (i.e. 107.1 mm.) and refinement index (0.436) of the bifaces fall within the range of other Late Acheulean assemblages.

Typological and technological characteristics of the Wadi Qalkha assemblage point to a Late Acheulean affiliation of probable Last Interglacial age. The finely retouched nonsinuous edges of the bifaces in conjunction with a modest Levallois element is in concert with a Late Acheulean designation.

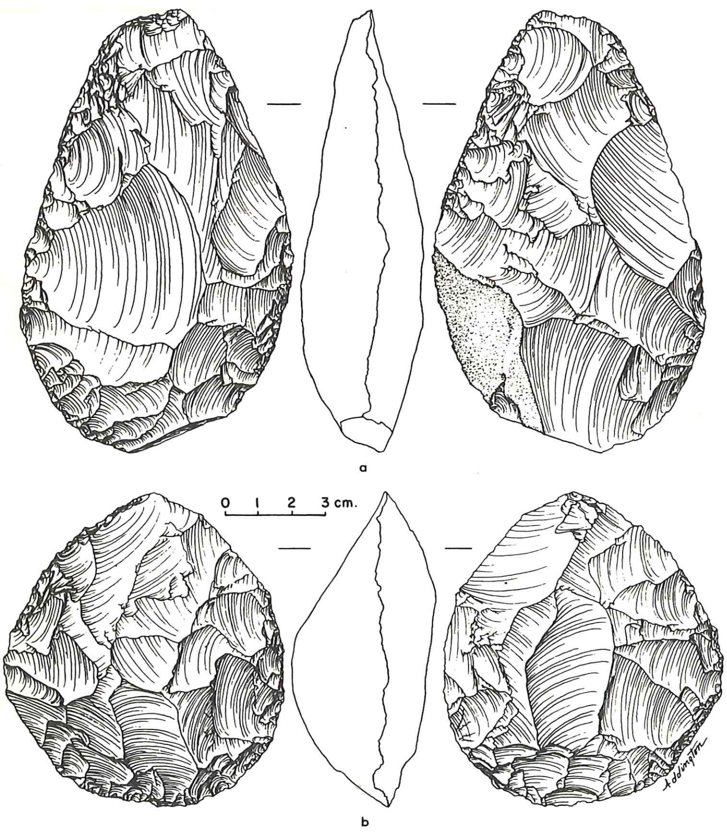
Middle Paleolithic

Although there is extensive evidence of Levantine Mousterian occupation of the uplands and piedmont of the Edom Plateau, only one *in situ* site (J8) was recorded (FIG. 6). Most of the artifactual evidence appears as isolated specimens or in low density concentrations that occur on the surface. It should be noted, however, that extensive early Last Glacial sediments

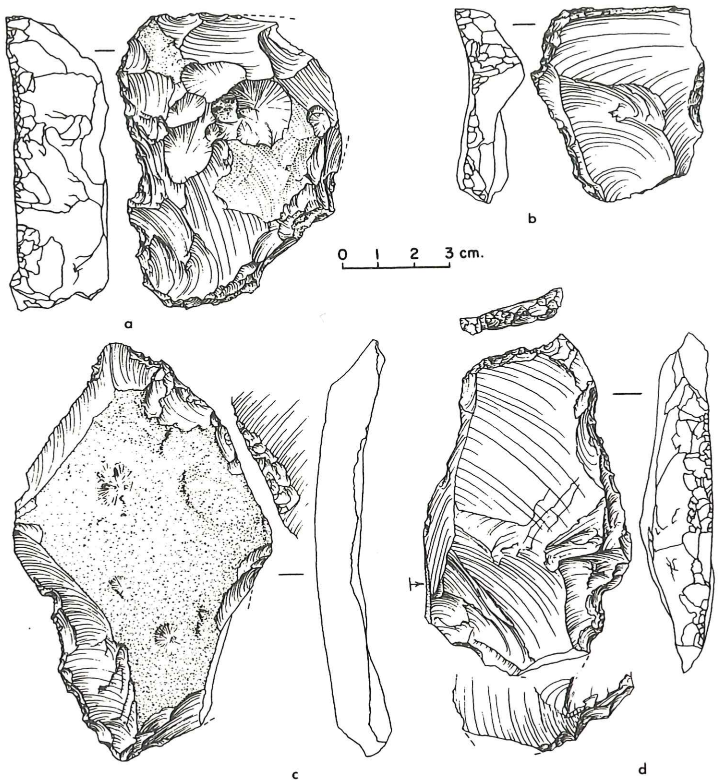
3. The Jebel Qalkha study area.



4. Amygaloid bifaces from the Late Acheulean site of Wadi Qalkha.



5. Artifacts from the Late Acheulean site of Wadi Qalkha: (a) side-scraper on thick flake, (b) perforator, (c) retouched primary flake, (d) transverse side-scraper with distal truncation.



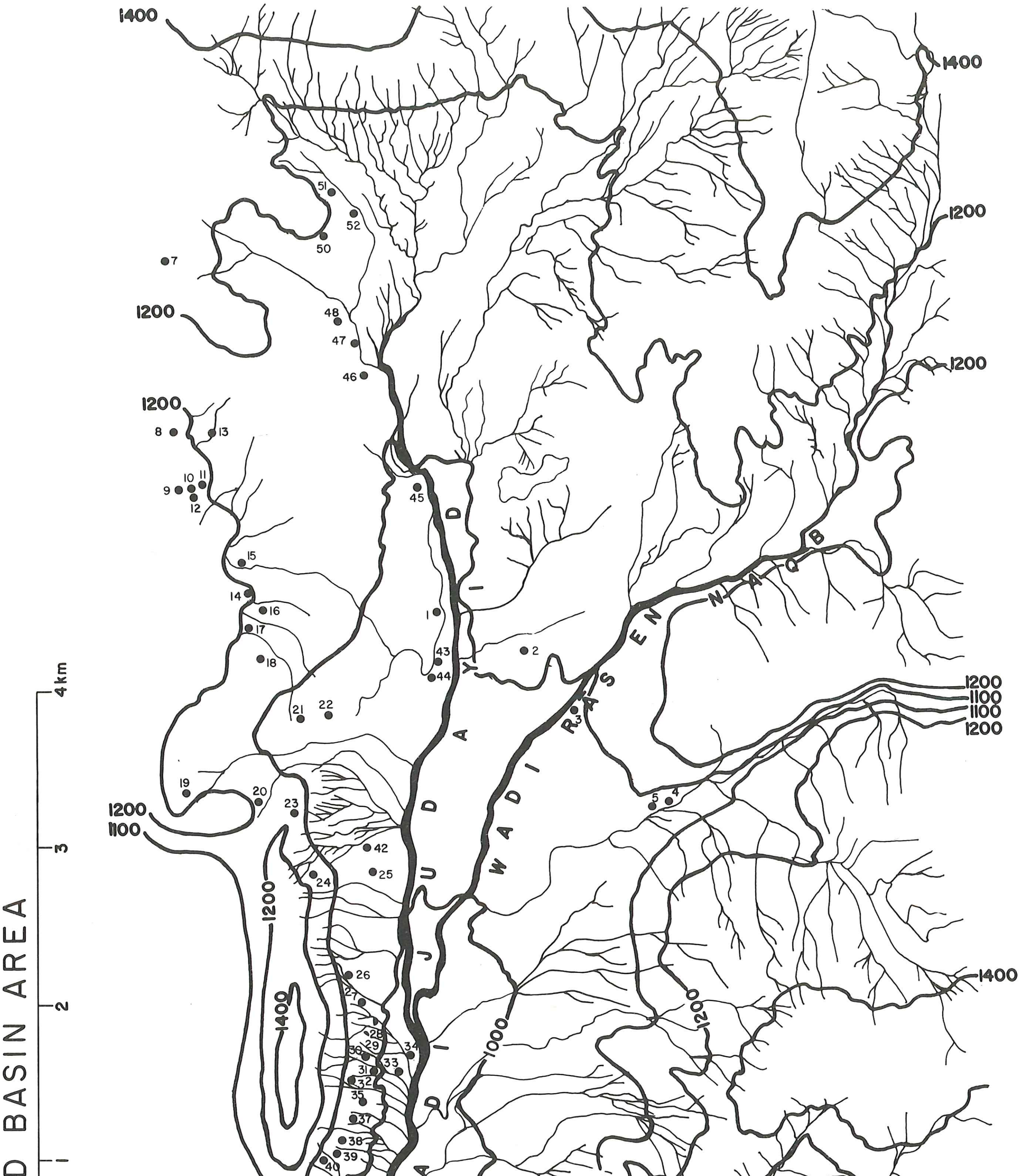
bearing fresh Levantine Mousterian artifacts (Levaillois points, blades, and flakes) were identified in a badland topography of the Jebel Qalkha area.

The only *in situ* occupation occurs on a terrace beneath a small cave known as Tor Sabiha (site J8). The cave is positioned near the crest of a sandstone outlier, Jebel el Jill, that forms part of the western edge of the Judayid Basin. Located at some 1,200 m., the cave has a commanding view of the basin resting some 200–300 m. below.

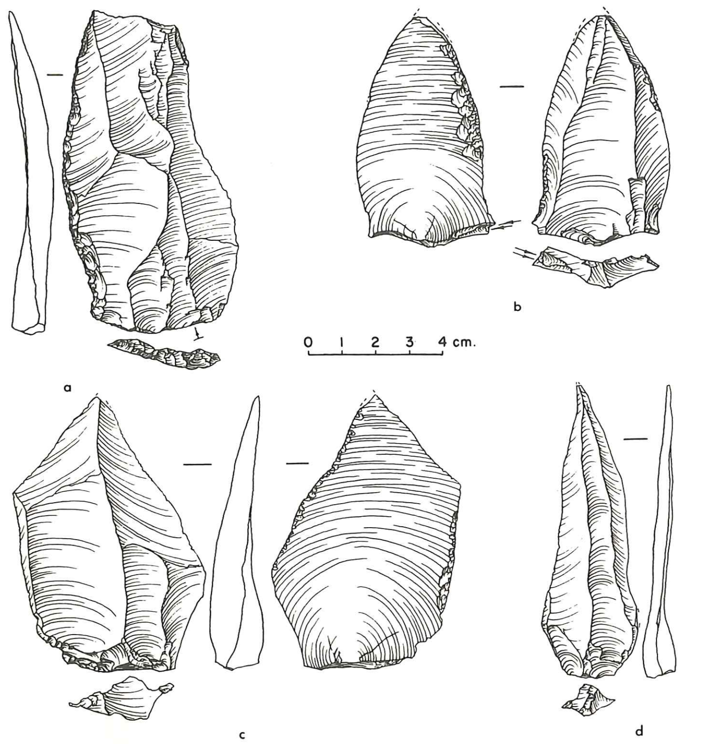
The Tor Sabiha assemblage is dominated by Levallois points, about half of which have been retouched (FIG. 7). The paucity of cores and primary elements suggests that little initial blank production or tool preparation was conducted at the site. A fairly well balanced tool-kit, however, argues for a variety of activities having been carried out by the inhabitants. The relatively small size of the occupation area (i.e. 150–200 m.[2]) in conjunction with the technological and typological configuration of the assemblage, imply a multipurpose encampment occupied by a small group perhaps on the order of 12–15 persons (Weissner, 1974).

In general, the technological and typological characteristics of the assemblage suggest affinities to the early Levantine Mousterian assemblages (e.g. Rosh Ein Mor and Nahal Aqev) of the Negev and the Carmel (e.g. Tabun D). Several specific attributes, however, point to a late Levantine Mousterian age for the assemblage (TABLE 1). When these attributes of the

6. The Judayid Basin study area.



7. Artifacts from Layer C of Tor Sabiha (J8): (a) side-scraper on Levallois blade, (b) side-scraper inverse on Levallois point, (c) Levallois flake with inverse retouch, (d) Levallois point unretouched.



Tor Sabiha assemblage are compared to those of the early Levantine Mousterian assemblage of Rosh Ein Mor and the Middle Paleolithic/Upper Paleolithic transitional assemblage of Boker Tachtit (Marks, 1977, 1981), the Tor Sabiha assemblage falls in between. These data would suggest a possible late

Table 1 Comparison of typological and technological attributes for Rosh Ein Mor, Tor Sabiha, and Boker Tachtit I

	Rosh Ein Mor	Tor Sabiha	Boker Tachtit I[1]
Per cent of Retouched Tools on Blades within Tool Assemblage	20.0	48.0	56.8
Per cent Levallois Points within Tool Assemblage	38.4	39.3	46.6
Per centage of Levallois Flakes within Debitage	52.2	1.2	0
Per cent Levallois Flake Cores within Lev. Core Types	2.7	0	0
Per cent Levallois Points Struck from Opposed Platform Cores within Levallois Points	2.7	46.0	95.2

[1] Unpublished data supplied by Professor A. E. Marks.

Table 2 A comparison of the width/thickness of complete flakes from Tor Sabiha (with data from other Levantine Mousterian assemblages as presented by Jelinek (1981).

Site	$\bar{x}$	s	N
Qafzeh L	7.03	9.51	573
Skhul B	6.53	8.98	496
Kebara F (8)	6.29	8.17	539
Qafzeh I	6.48	7.97	661
Kebara F (5)	5.96	7.60	628
Kebara F (3)	5.89	7.13	604
T. Chimney I–III	6.20	7.10	338
Shukbah D	5.63	6.30	484
El Wad G	5.62	5.69	213
* Tor Sabiha C	5.45	5.47	244
Tabun I ('C')	4.63	5.05	1377
Rosh Ein Mor	4.44	4.24	373
Nahal Aqev 3	4.93	3.90	332
Abou Sif B	4.51	3.34	214
Tabun IX ('D')	4.25	3.13	743
Abou Sif C	4.13	1.73	173

Levantine Mousterian age (i.e. 50–55,000 B.P.) for the occupation. A comparison of the variances of width/thickness ratios (Jelinek, 1981) for the assemblage to those derived for other Levantine Mousterian assemblage (TABLE 2) is consistent with such an age. Furthermore, the paleoenvironmental evidence associated with the occupation is indicative of a late Levantine Mousterian age. These data (to be discussed in the following section of this report) point to dry conditions that contrast markedly with the pluvial setting attributed to the early Levantine Mousterian.

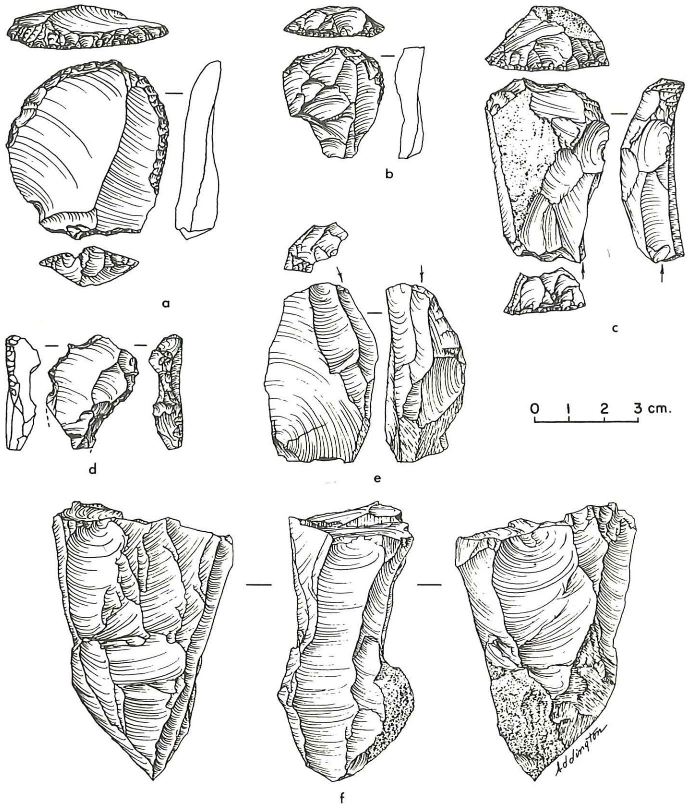
The importance of a late Levantine Mousterian age for the Tor Sabiha assemblage rests in an apparent confirmation of dichotomous evolutionary tracks for the Levantine Mousterian (Marks, 1981; Jelinek, 1981; Copeland, 1981; Henry, 1982). Following the early Levantine Mousterian, characterized by elongated Levallois points and blades, an emphasis upon a Levallois flake technology emerged in northern Israel and Lebanon. In contrast to this technological trajectory, the late Levantine Mousterian population of the steppe-desert zone continued to stress the production of points and blades into transitional times.

Upper Paleolithic

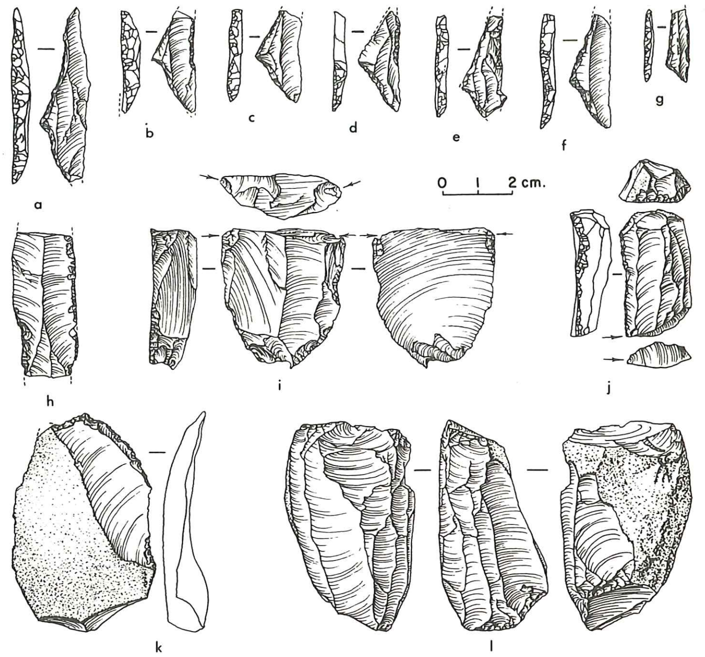
Whereas a few surface indications of Upper Paleolithic encampments were recorded in the Judayid Basin study area, the only *in situ* occurrences were represented by two sites (J403, J412) in the Jebel Qalkha study area (FIG. 3).

Both of the sites are situated in shallow, south-facing rockshelters overlooking branches of the Wadi Humeima. The sites are relatively large (i.e. 1,800 m.^{2} and +550 m.^{2}) with cultural deposits ranging from 70 cm. to 90 cm. The typological and technological configurations of the assemblages are near identical. Simple end-scrapers and burins characterize the tool-kits, while blade production from prismatic cores defines the technologic base of the assemblages

8. Artifacts from Jebel Humeima: (a, b) end-scrapers, (c) multiple tool composed of end-scraper and burin, (d) perforator, (e) burin on truncation, (f) conical blade core.



9. Artifacts from the Qalkhan assemblage of J407: (a–f) Qalkhan points, (g) scalene triangle, (h) straight backen blade, (i) transverse burin, (j) burin opposite end-scraper, (k) retouched flake, (l) opposed platform blade core.



(FIG. 8). Blade production, however, was not initiated by a *lame à crete* technique nor were subsequent core rejuvenation techniques employed. The high frequency of *fractures à languette* and pronounced bulbs of percussion indicate an habitual use of hard-hammer percussion in blade production.

The typologic and technologic configurations of the assemblages show strong affinities to the Levantine Aurignacian (Gilead, 1981). On the other hand, the sizes and compositions of the occupations differ considerably from the small and apparently ephemeral Levantine Aurignacian encampments of the Southern Levant (Marks and Friedel, 1977).

Epipaleolithic

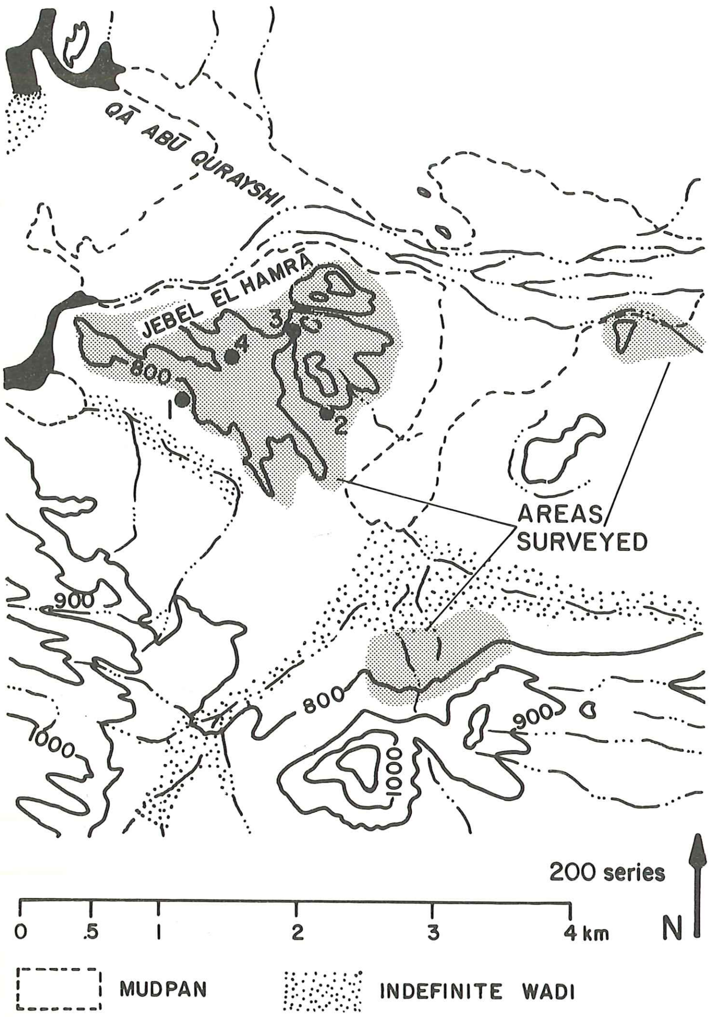
Epipaleolithic assemblages, found in all four study areas, embrace what is believed to represent a near complete cultural history of late Last Glacial times (i.e. from ca. 20,000–10,000 B.P.).

Microlithic assemblages recovered at three sites (J405, J406b, J407) in the Jebel Qalkha area, contained a unique triangular point that was produced with the microburin technique. Although containing a large microlithic component, the assemblages exhibit a blade technology that suggests an early Epipaleolithic age (FIG. 9). While parallels to these assemblages have not been recorded in Palestine, specimens that resemble the Qalkhan point in both morphology and fabrication have been identified at the Syrian Epipaleolithic site of Ain Juwal in the Region of El Kowm (Cauvin, 1981, 375–377).

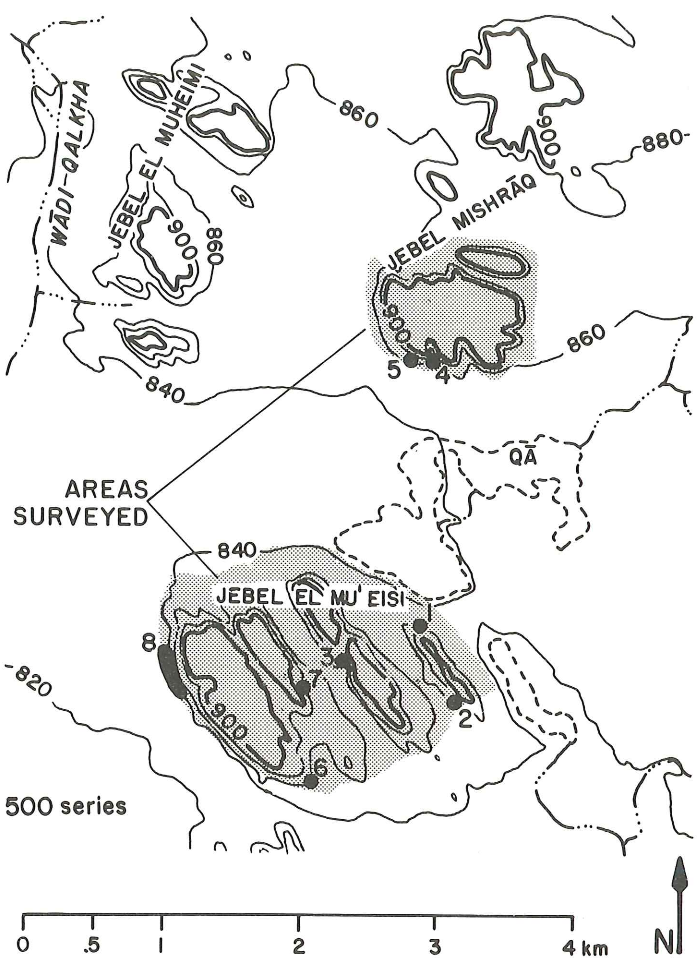
A series of stratified rockshelters in the Jebel Hamra (FIG. 10) and Jebel Mueisi/Mishraq (FIG. 11) study areas reveal a succession of non-geometric microlithic assemblages followed by an evolution of microlithic forms (i.e. trapeze-rectangles replaced by lunates). Increasing utilization of the microburin technique is also noted through time (TABLE 3). The smooth technologic and typologic successions recorded at these sites are interpreted as representing several phases of a single evolving socio-cultural system that culminates in the Natufian ca. 12,500 years ago. The archaeological expression of this system is termed the Hamran. Whereas some of the Hamran phases have affinities to the Kebaran and Geometric Kebaran of the Levant, there are sufficiently clear technological and typological differences between the Kebaran and Hamran successions to warrant a distinct designation for the latter (Henry, 1982). The Late and Final Hamran assemblage compositions are particularly noteworthy in that they have no counterparts in the Levant and yet show a number of similarities to succeeding Early Natufian assemblages.

A single Early Natufian site, Wadi Judayid (J2), was located in the Judayid Basin (FIG. 6). The occupation furnished a rich artifact and faunal inventory in addition to yielding sufficient quantities of charcoal for a series of radiocarbon dates: 10,140 ± 800 BC (SMU–805); 10,800 ± 1,000 BC (SMU–806); and 10,834 ± 659 BC (SMU–803). The pre-

10. The Jebel El Hamra study area.



11. The Jebel El Mu'eisi/Mishraq study area.



dominance of Helwan retouch on the microliths is consistent with an Early Natufian designation as are several quantitative and qualitative technologic attributes. A Late Natufian occupation was also identified in the Jebel Qalkha study area at site 405a.

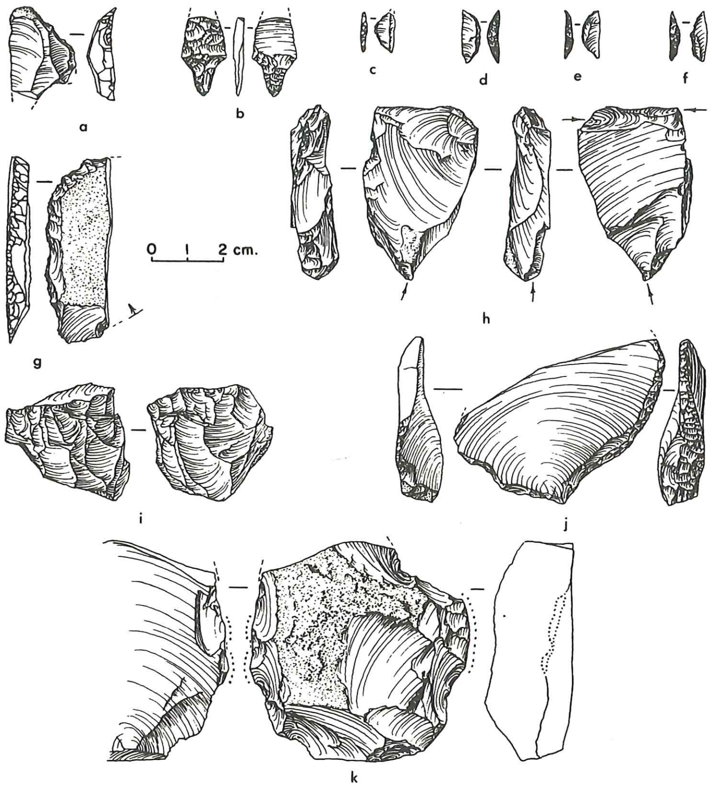
Table 3 Chart showing the industries and phases of the southern Jordan Epipaleolithic sites. Main attributes indicate the dominance (+) or presence (−) of normal lunates (L), Helwan lunates (HL), trapeze/rectangles (T/R), non-geometric microliths (NG), and Qalkhan points (PT). Microburin indices are included under (Imbt)

INDUSTRY	PHASE	CHRONOLOGY OF ASSEMBLAGES (406a 2 202 203 31 201 504 26 405 406b 407)	Imbt	L	HL	T/R	NG	PT
NATUFIAN	Late	406a	29.4	+				
	Early	2	48.5	+	+			
HAMRAN	Final	202 up, 203 up	56.7	+	−	−		
	Late	202 lw, 203 md	48.1	−		+		
	Middle	203 lw, 31, 201 a, b	0			+		
	Early	201 c, 504, 26	0				+	
QALKHAN		405, 406b, 407	17.4				+	−

Aceramic Neolithic

A single assemblage, viewed as representing an Aceramic Neolithic occupation, was found underlying a Chalcolithic Horizon at site J24, Jebel Queisa, in the Judayid Basin (FIG. 6). Although the deeply buried assemblage contained almost 2,000 chipped stone specimens, only 20 of these were tools. Among the tools, however, were three basally tanged points with opposing lateral notches. Whereas such points, classified by Mortensen (1970) as point A3, are quite rare at Beidha (i.e. represent less than 1% of the point class), they are prevalent in Phase II of the Mureybet sequence; Cauvin (1974, 311–322) classifies them as type A26 in her system. The Jebel Queisa assemblage is based upon a bladelet technology with long, thin blanks struck from naviform cores. A *lame à crete* technique was employed to initiate the bladelet production. Both naviform cores and the *lame à crete* technique are common to Beidha assemblages.

The size and composition of the Aceramic Neolithic occupation at Jebel Queisa suggests that it served as a temporary hunting camp. Based upon the point typology, an early 8th millennium age for the encampment is indicated.



12. Artifacts from the Chalcolithic sites of Jebel el Jill and Jebel Queisa: (a) truncation, (b) bifacial point, (c–f) lunates, (g) tabular scraper, (h) burin (i) microlithic core, (j) backed flake, (k) steep scraper.

Chalcolithic

Approximately a quarter of the sites discovered in the investigation are attributed to the Chalcolithic Period. The main attributes used in assigning occurrences to the period included a microlithic flint technology that employed a bi-polar technique in blank production in conjunction with certain typological indicators that included minute lunates, transverse arrowheads, fan scrapers, and small bifacial points (FIG. 12). A thick, undecorated, plainware pottery, often with chert temper was also usually associated with the Chalcolithic sites.

Although Chalcolithic occupations were identified in each of the four study areas, clear differences in site sizes, depth, and composition appeared between those sites in the higher elevations of the piedmont of the Edom Plateau and those sites occupying the lower elevations on the floor of the Wadi Hisma. While those sites in the piedmont occupy large areas (up to 2,000 sq. m.) and contain architectural evidence in the form of corrals, semi-subterranean dwellings, and storage pits, the sites in the lowlands are small (normally under 100 sq. m.) and restricted to thin scatters of lithic artifacts. Whereas the piedmont sites are normally associated with thick ash layers, as yet only a single radiocarbon date of 3,770 ± 149 BC (SMU–804) has been obtained from Layer B of Jebel Queisa.

Paleoenvironments

A reconstruction of paleoenvironmental settings for south Jordan has come principally through three lines of evidence: geomorphology, palynology, and faunal analysis.

A geomorphic investigation of the Judayid Basin by Fekri Hassan (Henry et al, 1981; Hassan, 1980) has defined three major episodes of fan activity during the Late Pleistocene and Holocene (FIG. 2). The Jill, Humeima, and Quweira numbers represent intervals of basin wide filling by coalesced alluvial fans. These intervals were likely associated with moisture regimes that exceeded modern levels. Periods of surface stability and soil formation followed by downcutting acted to complete the cycles. Extensive deposits of drift sand (i.e. the Sabiha and Naqb members of the Judayid Formation) suggest considerable aridity, probably exceeding the modern setting, for at least two Last Glacial intervals. An erosional cycle has persisted in the basin since the late Holocene as evidenced by a series of cut terraces. Drift sand is also common to the Chalcolithic sites that occupy the flanks of the basin during this interval.

Not only has the geomorphic study given a stratigraphic order to these events and furnished climatic evidence, but it has also provided an understanding of the various ages of surface sediments within the study areas. For example, within the Judayid Basin, less than 5 per cent of the surface is of Middle Paleolithic age, while over 35 per cent of the surface is Epipaleolithic in age. In contrast, extensive Middle and Upper Paleolithic age sediments are exposed in the Jebel Qalkha study area. It is only when the ages of surface distributions are considered, that we can correctly interpret the distributions of prehistoric sites and how these relate to past landscapes.

A palynological study conducted by Arlette Leroi-Gourhan and Aline Emery-Barbier (Henry et al, in press; Emery-Barbier and Leroi-Gourhan, 1983) entailed the analysis of 94 samples collected from 12 prehistoric sites that represent all the prehistoric time-frames (excepting the lower Paleolithic). A little over two-thirds of the samples yielded sufficient frequencies of pollen grains (i.e. over 250 grains for compilation and interpretation (TABLE 4).

The pollen investigation is particularly important in that it provides a parallel and complementary sequence for the climatic reconstructions based upon investigations in the Negev (Marks, 1977, 5–8) and Sinai (Bar-Yosef and Phillips, 1977). The south Jordan succession follows the climatic trends of the southern Levant during the Upper Paleolithic and fills an important void for the Epipaleolithic prior to the late Natufian (i.e. between ca. 18,000 and 11,000 B.P.). During the Epipaleolithic the south Jordan sequence indicates that a moist phase (probably equivalent in age to the Kebaran) was replaced by drier conditions (equivalent with the Geometric Kebaran) that in turn gave way to a moist interval during the Early Natufian. This interval dated to ca. 12,500 B.P. at the Early Natufian site of Wadi Judayid (J2), is overlain by Late Natufian age drift sand containing dominant chenopodia pollen and indicating dry conditions. Pollen from

Table 4 Summary of Palynological Investigation and Climatic Reconstruction

Archaeological Period	Date B.P.	Site	Climatic Interpretation[1]	Important Pollen Characteristics
	6,000			
Chalcolithic		J14/J24	Very dry	Chenopodium type Noaea 96–99%
	7,000			
	10,000			
			Dry	Chenopodiaceae dominant
		J2		
			Moist	Gramineae dominant, cereal type, Oak, olive, alder, chastetree
	13,000			
		J202	Moist	Gramineae 70% Oak, elm, alder
Epipaleolithic	14,000			
		J31	Dry	Artemisia dominant
		J201/J203	Dry	Chenopodiaceae dominant
	15,000			
		J26	Slightly humid	Compositae tubuliflorae
		J504	Moist	Compositae liguliflorae Oak 20%, elm, walnut, conifers
	20,000			
Upper Paleolithic		J403	Dry	Chenopodium type Noaea 50–80%
		J412	Slightly humid	Chenopodium type Noaea 20% Gramineae 20% Some pine and alder
	40,000			

[1]Modern climate would be interpreted as DRY.

the Chalcolithic sites (J14, J24) implies very dry conditions, as well.

Faunal remains have been recovered from Middle Paleolithic (J8), Upper Paleolithic J412), Epipaleolithic (J504, J201, J202, J2), and Chalcolithic (J24, J14) occupations. The Natufian site of J2 and the Chalcolithic site of J14 produced the largest assemblages which have recently been analyzed and reported by Priscilla Turnbull (Henry *et al.*, in press). The faunal assemblage from the Early Natufian site is consistent with a moist setting for auroch (*Bos primigenius*), sheep (*Ovis orientalis*), wild ass (*Equus hemionus*), and goat (*Capra sp.*) make up the inventory. The discovery of wild sheep dated to some 12,500 years ago in southern Jordan, considerably alters the known biogeographic range of *Ovis orientalis*. The considerable habitat diversity of the J2 assemblage (e.g. open plain and uplands forms) also argues for a large relatively permanent camp with an extensive catchment.

Adaptive strategies

The adaptive strategies of the prehistoric inhabitants of southern Jordan can be evaluated at two scales, regional and local. At a regional scale, a dichotomous adaptive response to occupation of Mediterranean woodlands or steppe-desert settings appears to have prevailed in the Near East throughout the Pleistocene. Within the Levant from Middle Paleolithic times on, this adaptive dichotomy was reflected in a parallel but distinct cultural-historic evolution for the Mediterranean and steppe-desert zones. Because of the general latitudinal zonation of Mediterranean and steppe-desert environments in the Levant, differences between cultural historic taxa have been recognized between 'northern' and 'southern' regions.

In comparing the cultural-historic sequence of southern Jordan with that of the Levant, interaction with the northern Levant is indicated for most of the Late Pleistocene and Holocene. Strong interaction with the nearby southern Levant was established only during the arid episodes of the Late Levantine Mousterian and the Chalcolithic. Given the close proximity of the south Jordan study areas to southern Levantine type localities in the Negev, the paucity of prehistoric interaction between the two areas would suggest that environmental similarity was more important than geographic proximity for maintaining social ties.

On a local scale, we can reconstruct prehistoric adaptive strategies with considerable certainity for two periods: the Epipaleolithic and Chalcolithic. A large number of sites spread over a wide elevational range represent both timeframes.

During the Epipaleolithic, Hamran sites were established in the upland piedmont zone of the Edom Plateau, at elevations of 1,000–1,200 m., as well as on the floor of the Wadi Hisma at 800–900 m. elevation. In addition to the elevational differences, the sites display marked differences in their settings, sizes, and artifact inventories. The sites in the uplands are small (i.e. under 100 $m.^2$ in area) and reveal thin lithic scatters with low densities of artifacts. These sites reveal a variety of exposures and settings with no clear pattern. The lowland sites in the Wadi Hisma are all found on south or west faces of sandstone inselbergs in shallow rockshelters. The rockshelters overlook dry lake beds that are never more than a kilometer distant. These are relatively large (i.e. 460–600 $m.^2$ in area) and contain deep, rich cultural deposits.

The upland sites most likely represent occupations by highly mobile, small social units, whereas the lowland sites probably reflect longer seasonal occupations by a large constellation of the smaller units. Given the world-wide depression of surface temperature in late Last Glacial times, it seems unlikely that uplands would have been a preferred habitat during the winter months. Such a depression in temperature, however, may have resulted in the formation of shallow lakes in the lowlands as a consequence of reduced evaporation. Lowland Hamran sites would therefore have been afforded a predictable water source and protection from the elements by their lakeside inselberg settings. The south and west exposures of the rockshelters would have benefited from radiant heating as well as blocking the prevailing wind.

During the Chalcolithic, there was apparently a reversal of the Epipaleolithic settlement pattern, for the upland Chalcolithic sites appear to represent coalesced settlements during winter months. The Holocene temperature elevation and perhaps reduced precipitation resulted in climatic-environmental setting as dry or drier than modern conditions.

Chalcolithic sites are well represented in the south Jordan study areas. Large sites (i.e. 300–2,000 $m.^2$) with architectural remains are confined to the piedmont zone of the Judayid Basin, while in the lowland study areas Chalcolithic sites consist of small (100–200 $m.^2$) thin lithic scatters. The large upland sites display curvilinear structures, fashioned from sandstone blocks. The structures are arranged in an agglomerative pattern with many sharing common walls. Excavations at one of these sites (J14) revealed a semi-subterranean dwelling, storage pits, and a large corral. The dwelling yielded a variety of material culture items (i.e. bone needles and awls, mullers, querns, geometric microliths, and large flint scrapers and choppers) that suggest a wide range of domestic activities. A trash pit also furnished a faunal assemblage dominated by sheep and goat remains. The stratigraphy of the site clearly shows numerous episodes of occupation separated by layers of drift sand. Although none of the lowland sites have as yet been excavated, the marked differences in the sizes, elevations, features, and artifact assemblages of the upland and lowland sites suggest a transhumant pattern.

The Judayid Basin sites may well reflect winter encampments in which family groups coalesced into larger social units and availed themselves of the winter runoff from the plateau and the seasonal abundant grasses of the piedmont. On the other hand the small shallow sites, discovered in the low elevation study areas, are most probably expressions of highly transitory spring–summer encampments by extended family groups. During the dry season, as today, the herding families would have divided into smaller units and dispersed over a quite large area in search of limited grasses, forbes, and surface water produced by the winter rains. In that the specific locations of forage and surface water would have varied widely from year to year, reoccupations of sites would have been minimal as reflected in the small occupation areas, low artifact densities, and absence of architecture at the sites. The settlement pattern, as proposed, closely resembles the ethnographic pattern of modern pastoralists of the region as described by Patai (1958, 164–165) and reported by Bedouin groups living in the study areas today.

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