PRELIMINARY REPORT ON THE 1980 EXCAVATIONS AT AIN EL-ASSAD

by
Gary O. Rollefson

Introduction

In 1958 a water collection sump, approximately five meters by five meters in area, was excavated at Ain el-Assad in Jordan's eastern desert just south of Azraq. That this spring had had considerable economic value to inhabitants of the area for a very long time became evident when the excavations began to produce large numbers of stone tools, including some 400-700 handaxes of the Late Acheulian period (Harding 1958: 9; 1967: 155; Rollefson 1980). The sump excavation did not proceed according to archaeological methods, however, and consequently, beyond a selected sample of artifacts, no information regarding stratigraphy, time depth, horizontal associations, faunal data, or paleoclimatic evidence was obtained; even the collected artifacts eventually disappeared except for a small collection of bifaces and cores now on display at the archaeological museum in Amman.

Funding from the National Endowment for the Humanities as a fellowship through the American Center of Oriental Research in Amman, and the generous cooperation of Dr. Adnan Hadidi and the Department of Antiquities of Jordan, made it possible to excavate a series of soundings at Ain el-Assad in an attempt to recover as much as possible of the cultural history of the site, including the determination of the stratification of the cultural deposits, recovery of faunal material, the collection of fossil pollen and geological samples, and the determination, if possible, of the site boundaries. The excavations were carried out from July 28 to October 2, 1980.[1]

Site Setting

The Spring known as Ain el-Assad is located approximately two kilometers south of the village of Azraq Shishan and some 750 meters west of the tarmak highway leading towards the Shomari Game Preserve (Figure 1). The spring, at an elevation of approximately 505 meters above mean sea level (at Aqaba), sits on the western edge of the large mudpan expanses of the Qa el-Azraq. The horizon to the north is dominated by a peninsular ridge extending from Azraq Shishan, at ca. 510 m elevation, and rising to the northwest at increasing elevation. To the west and southwest the land rises slowly at first, but the steepness increases suddenly at Jebel Uweinid, which dominates the western horizon.

Massive basalt outcrops characterize the northern rim of the *qa* (approximately five kilometers north of Ain el-Assad), and smaller yet substantial basalt exposures lie approximately four kilometers to the west and southwest of the site. To the northeast are basalt covered heights that form the eastern rim of the Azraq Depression at Harrat es-Salahib and Jebel Umm Khushaisha, 50 and 70 kilometers away, respectively. To the south and southeast,

1. The crew this season was small, consisting of me, Mr. Gary Funkhouser (who was in charge of the West Trench), and Mr. Wa'il Rashadan, the Department of Antiquities inspector. The Department of Antiquities also furnished two workmen for the season (and a third for two weeks). In addition, Mr. Mujahed Muhaisen volunteered his fine talents for two weeks, and Dr. Ilse Köhler was an eager and very helpful volunteer for the first week of the season. I would like to thank all of these people for their very productive work.

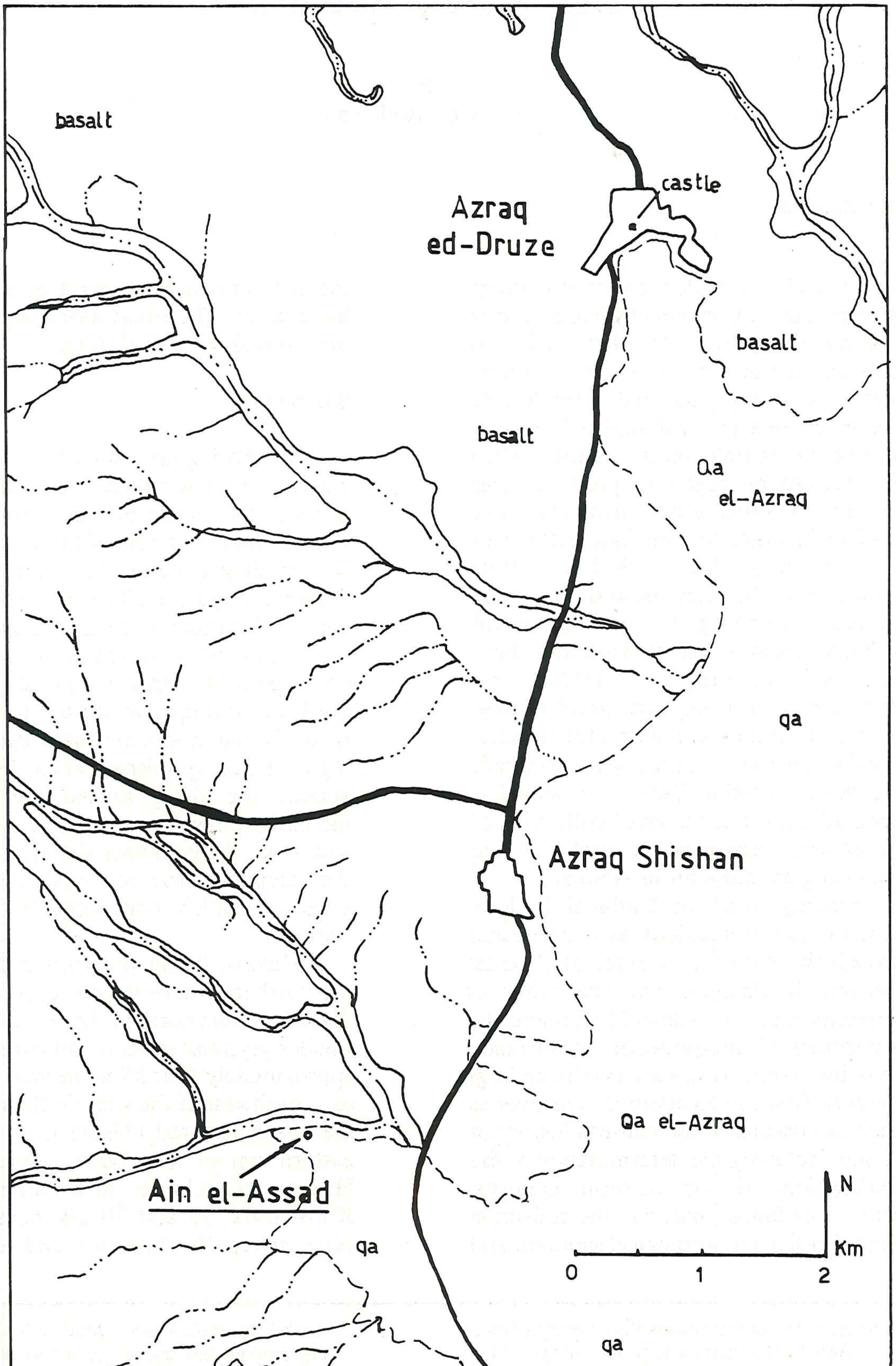


Fig. 1. Map of the Azraq area showing the location of Ain el-Assad in relation to the villages and the Qa' el-Azraq.

the horizon is very flat as it follows the shallow slopes of the broad Wadi Sirhan.

Ain el-Assad is only one of a series of emergent water sources on the northern, western, and southern edges of the Azraq Depression. Lower Tertiary chert-limestone formations and Neogene and Quaternary sandstones, sandy marls, and basalt formations form important aquifers to the Azraq Basin which drain at least 13,000 square kilometers of land around it (Garrard and Price 1977: 109). Consequently, for an area characterized by a mean annual precipitation of only 50-100 mm (Anon. 1971:11), the water table is quite high and stable.

Because of the relatively low elevation of the Azraq Basin in comparison to the surrounding terrain and the consequent drainage into it from areas which today have moderately abundant amounts of rainfall (especially to the north and west), it is not suprising that in earlier periods when regional precipitation was higher that the center of the basin was the scene of a vast lake. Van Liere contended that increased rainfall in the Syrian desert (including the Azraq Basin) during the Late Pleistocene probably was not sufficient to create a lake anywhere in the area because the clayey substrates "can easily store 350 mm of water" (Van Liere 1960-61: 66). In the case of the Azraq Basin, at least, it is not only the increase or decrease in local precipitation that governed the existence of a pluvial lake, but the regional precipitation in northern, western, and central Jordan, southern Syria, and parts of western Iraq and northern Saudi Arabia. Furthermore, recent work in the Syrian deserts has indicated that pluvial lakes did occur there in the Late Pleistocene (Endo 1978; Sakaguchi 1978).

Lacustrine beds which "floor the Azraq Depression" (Burdon 1959: 77) have been known for some time, and Huckriede and Wiesemann cite several examples wherein associated artifacts provide Late Pleistocene dates contemporary to and perhaps much earlier (Middle Pleistocene?) than the freshwater lake in the Jafr Depression (Huckriede and Wiesemann 1968:81; see also Bender 1974: 98). The Pleistocene Azraq lake would have been contemporary, at least in part, with the Late Pleistocene Lake Lisan in the Jordan Valley.

Although the catchment area of the Azraq Basin is only slightly larger than the ca. 12,000 sq km area for the Jafr Depression (Huckriede and Wiesemann 1968: 77), the maximum extent of standing water in the northern lake is estimated to have been 4,500 sq km (Garrard and Price 1977: 110), which is 2.5 to 4.5 times the maximum area of the Pleistocene lake at el-Jafr. The much larger catchment area of the Jordan Valley (ca. 40,000 sq km) fed the Pleistocene Lake Lisan which had a maximum surface area of 2850 sq km, less than two-thirds the size of the Azraq body of water. The area of the modern Dead Sea is 940 sq km, about one-fifth the projected size of the Azraq pluvial lake.

Farrand has noted that a body of water the size of Lake Jafr could have heavily affected weather patterns with the release of substantial amounts of water vapor into the atmosphere, with consequences not only for the immediately surrounding area, but for more distant regions as well (Farrand 1971: 544). The same circumstances must have been in effect in the region around the Azraq Basin as well.

The comparisons of the maximum areas of the pluvial lakes, while important on the surface, do not in themselves provide a profound insight into local responses to temporary and long term climatic changes. In a very broad sense, the Jafr and Azraq basins are similar in that the modern terrain of each is characterized by extensive expanses of low relief. In contrast, the Rift Valley terrain is a situation of comparative extremes in elevation of the surrounding landscape. With a mean depth of 135 m, the area of Lake Lisan probably did not vacillate to any great measure in response to short term reductions in rainfall as a consequence of its more or less bathtub-shaped basin. Similar drops in precipitation would probably have resulted in considerable contractions of the shorelines of the Azraq and Jafr lakes due to their shallower, plate-shaped foundations.

Current climatic conditions in and

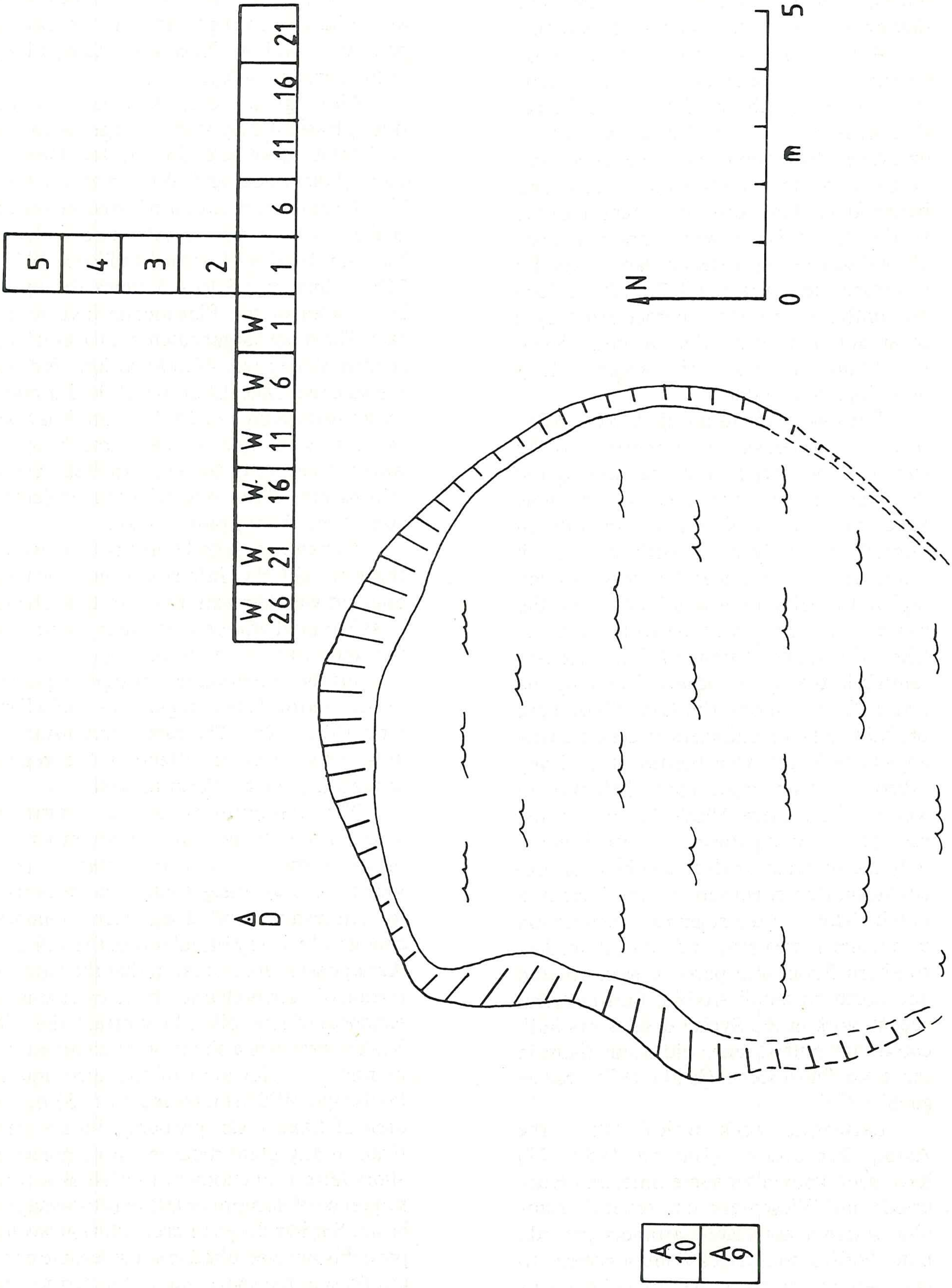


Fig. 2. Schematic map showing the relationship of the excavation trenches and the sump at Ain el-Assad. "D" indicates site datum.

near the Azraq Basin are fairly severe and account, in part at least, for the characteristics of the present soil cover and salt-loving vegetation (cf. Madany 1978). The mean annual precipitation falls between 50 and 100 mm, and this amount normally occurs in the months of December, January, and Feburary (Anon. 1971: 1-2, 10); in fact, most often the bulk of rainfall falls in one or two cloudbursts with consequent rapid runoff even in the shallower sloping parts of the basin in flash floods, and little of the water percolates into the barren soils of the surrounding countryside (cf. Garrard and Price 1977: 110).

Winds in the Azraq area blow consistently from west or northwest and are generally rather strong. Since for most of the annual cycle these winds are dry, they have a considerable dessicating effect. Occasionally the countryside is beset by hot, dry, and strong *sharkiya* conditions, when duststorms from the eastern and southeastern deserts of Saudi Arabia dominate the atmosphere for several days.

The mean temperatures at Azraq are high, relative to much of the rest of the Levant, with annual values ranging from 18-20°C. The hottest part of the year is in July, with a mean monthly temperature of between 28 and 30° C., although mean maximum daily temperatures reach 37° in both July and August. The coolest period occurs in January, when mean daily maximums range between 8 and 10° C. (Anon. 1971: 12-24).

Site Stratigraphy

The original excavation strategy for Ain el-Assad involved the sinking of three deep one-meter squares to the northeast of the spring (Sqs 1, 5, and 21 in Figure 2) to determine the nature and depth of the cultural and geological stratigraphy and to ascertain, if possible, the horizontal extent of the Acheulian site in this direction from the original location of the 1958 sump excavations. If the Acheulian occupations were located in any or all of these probes, excavations would be expanded to link these squares into an L-shaped trench and farther towards the northeast (to a hypothetical Sq 25, four meters east of Sq 5 and four meters north of Sq 21) if time allowed.

Excavation proceeded most rapidly in the SW corner of the original trench (Sq 1). Although unanticipated exposures of Neolithic and possibly later period artifact layers were encountered, by the time bedrock was reached at ca. -3.60 m, there was no indication that the obviously rich Acheulian layers evidenced in the 1958 backdirt piles existed in situ this far north and east of the spring. Excavations were therefore halted in the northern and eastern segments of the "L", and the trench was extended six meters to the west (Sqs W1-W26), where it was hoped that the northern limits of the Acheulian material might lie. At the same time that these excavations were proceeding in the westward extension of this trench (hereafter referred to as the North Trench), we decided to open another deep probe to the west of the spring, consisting of two one-meter squares (the West Trench; see Fig. 2) to increase the likelihood that we would find the Acheulian occupation layers.

Since the most complete sequence of the site stratigraphy was produced in Sq 1 (comparable depths were not reached elsewhere), and since the stratigraphic succession and geological features are redundant in the other parts of the trenches, the following descriptions will refer to the Sq 1 succession, with specific references to local anomalies in other parts of the excavation.

The surface of Sq 1 consisted of a thin veneer of a very recent (post-1958) layer composed predominantly of camel and sheep-goat dung mixed with sandy silt and characterized by patches of a saline crystalline crust. Immediately beneath this modern topping occurred deposits of reworked backdirt from the 1958 sump excavations which varied in thickness from a few centimeters in the southeast corner of the square to nearly a meter in depth in the western part of the square (Fig. 3). The identification of this as backdirt material was indicated by the sporadic occurrence of Acheulian artifacts as well as the swirled mixture of the variety of sediments visible in the backdirt piles.

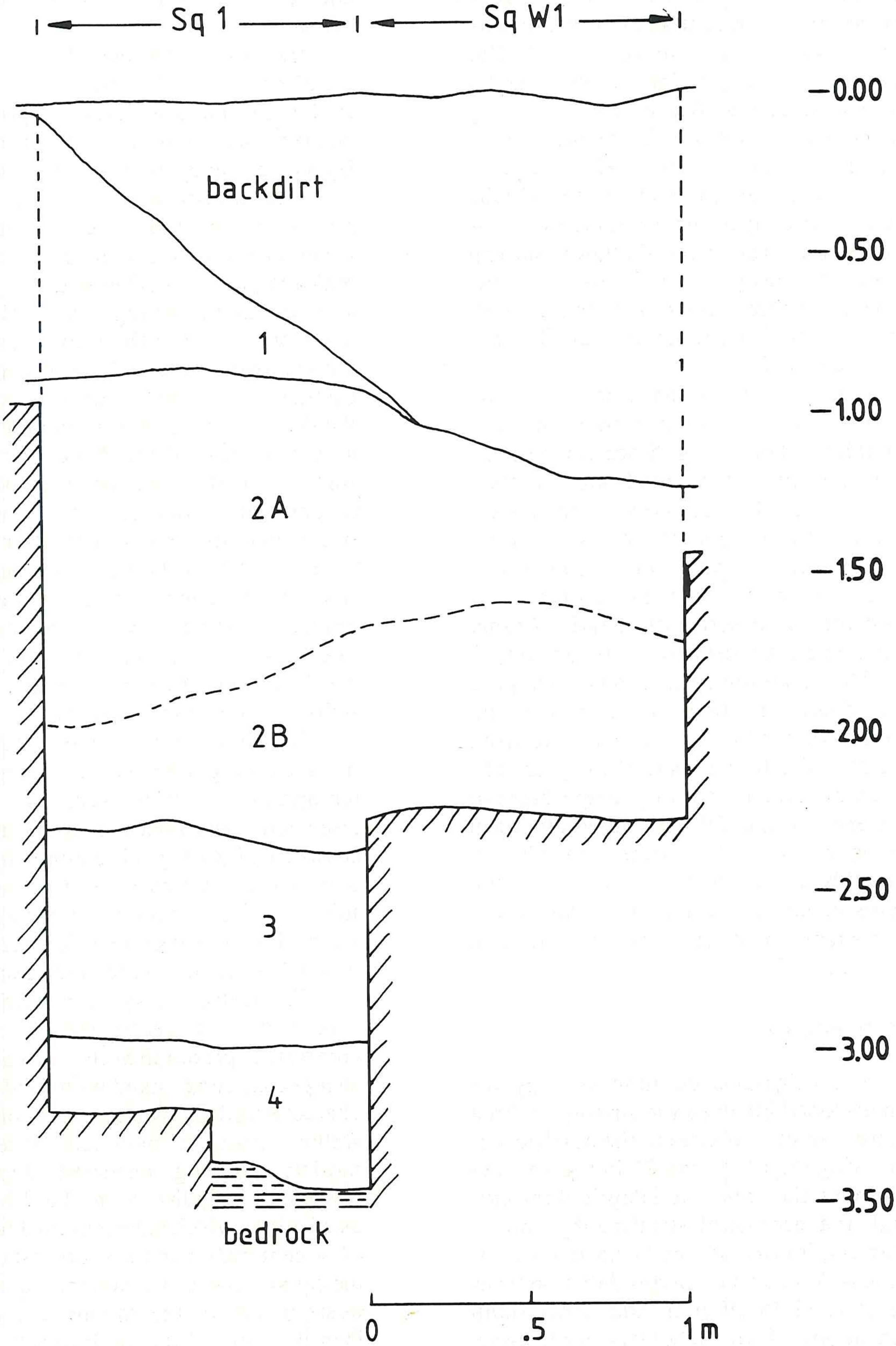


Fig. 3. Schematic representation of the south profile of Sq. 1.

Layer 1. Just beneath the backdirt layer lay Layer 1, a uniform tannish-brown soil characterized by a sandy silt texture. Just to the west of Sq 1, in Sq W1, Layer 1 is truncated (as it is in the rest of the western extension of the North Trench). During the 1958 excavation, a wide trench was evidently scoured from the northern edge of the spring in a northeasterly direction (Layer 1 is also truncated in Sq 3), thoroughly removing Layer 1 in its path as well as parts of the underlying stratum.

No diagnostic artifacts were found in Layer 1, although two minute and badly eroded potsherds and two fragments of an Omayyad (?) glass bracelet were found in the upper parts of the layer in Sq W26. In addition, there were sporadic occurrences of small basalt chunks, but none of these bore any evidence of use as grinding equipment. Tentatively, a range of Early Bronze Age to very recent is assigned to this layer.

The lower contact of Layer 1 is nearly horizontal, attesting to a very level landscape just prior to its formation. Layer 1 sediments are relatively dry.

Layers 2A and 2B. The underlying complex of Layers 2A and 2B is more complex due in great part to the unique character of changes in subsurface moisture content. In Sq 1 the material immediately below Layer 1 was in stark contrast to the overlying sediment. The color of Layer 2A is a dark grayish-brown, and the texture is a mixture of fine, compact, and moist sandy silt with numerous inclusions of angular, nodular travertine. With increasing depth is a correlated increase in moisture, and the colour changes to darker hues until at a depth of from -1.65 to -1.95 m the deposits are almost black. It is also at these depths that the deposits become completely saturated, to the point that standing water accumulated on horizontal excavation surfaces.

Regarding the roughly 30 centimeter variation in absolute elevation in the appearance of the black colored sediments, it is notable that the increasing depth of this saturation level is correlated with increased distance from the spring; i.e., the farther east from the spring in the excavation trench, the deeper one must go before the black color and saturation level is reached. This effect is also evidenced in the western parts of the North Trench, where comparable levels at the SW corner of Sq W26 occurred at ca. -1.25 m. Water level in the sump itself stood at -0.93 m below the site datum.

The change in color from increasingly dark gray-brown to an eventual black formed an obscure dividing line between Layers 2A and 2B, and it must be emphasized that the subdivision of this complex is probably more reflective of differences in relative moisture content than a change in geological development. However, these differences in moisture content may have affected differentially the organic components of the sediments, with less complete decay of the vegetational and microfaunal constituents in the 2B part of the complex. Odors reminiscent of putrifying elements were noticed well into the excavations of Layer 2B, although it should be recalled that salts of sulfur may characterize the mineral content of the groundwater, and this may have contributed to the odors.

Beyond the differences in colour, moisture content, and olfactory stimulii, the sediments of Layer 2B are not much different from Layer 2A. The texture remained a compact gritty silt, although small rootlet channels with fine clayey fills were perhaps more numerous in 2B than in 2A. The angular travertine nodules remained numerous until just near the base of Layer 2B.

Three arrowheads came from near the base of Layer 2B as well as a pressure-flaked knife or lance head from the middle reaches of this layer. As is discussed more extensively below, these four pieces are inadequate to establish a firm date, since they may indicate either PPNB or Pottery Neolithic periods.

Layer 3. The sediment layer beneath Layer 2B stands out in vivid contrast to the overlying deposits in all aspects of geological composition. Absent are the dense numbers of angular travertine nodules that characterize the 2A-2B complex, and the color of Layer 3 is grayish-green with occasional rust-colored mottling that appears to correspond with locally abundant rootlet cores. These rootlet cores, which are numerous throughout the layer, are often the minute sources of flowing water. The texture of the sediments is a uniform marl or clay of high elasticity, thoroughly saturated.

The contact between Layer 3 and Layer 2B is not as distinct as is indicated in Figure 3. A "transition zone" of some 10 cm or more separates the stark black 2B and the uniform gray-green of Layer 3. This subtle range of transformation could not be distinguished with precision in the field. As a consequence, some of the artifacts near this contact may have been incorrectly assigned in terms of the cultural/geological stratigraphy. However, if incorrect layer assignments were made, it is more probably that pieces from the lowermost parts of Layer 2B have been assumed mistakenly to come from Layer 3; the reverse case is less probable.

The reasons for the obscure contact are not clear, but they may all relate to the gradual change in the local environment over a fairly long period of time, as opposed to a persumed rapid change of environment between the formations of Layers 1 and 2A.

The grayish-green color of the Layer 3 sediments probably indicates accumulation during a period of relatively deep standing water: a lacustrine environment developing a slow sedimentation of marls. The black color of Layer 2B, on the other hand, suggests a situation of wet but periodically exposed soils (kept moist by the spring, as evidenced by the travertine inclusions) that supported consistent, dense stands of vegetation which became incorporated, along with associated microfaunal elements, into the sediments. The change from the climatic conditions that supported the Pleistocene and/or terminal Pleistocene lake, represented by the marls of Layer 3, to the swampy or marshy conditions of the swale near the spring which existed until the twentieth century (cf. Field 1960: Fig 73a) was probably gradual and reflected global (or at least regional) changes in weather patterns. On the other hand, the change in the local depositional environment from Layer 2A to Layer 1 probably represents more rapid and dramatic microtopographical developments in the immediate area of the spring. These relate, probably, to changes in wadi discharges of sediments along the northern fringes of the spring which appear to have created a dike through previous expanses of a marsh fed by Ain el-Assad.

Although this explanation for the gradual change from Layer 3 to Layer 2B times is speculative in view of the absence of specific paleoclimatic evidence from eastern Jordan, it is consistent with interpretations of climatic change for the Near East region (e.g. Farrand 1971; 1979). Another factor of less demonstrable or testable proportions, but one which may also have contributed substantially to a mixing of previously more discrete evidence of geological change, is the probable increased traffic of animals at the marsh and the disturbing effects of their trampling through the earlier phases of the development of Layer 2B. The relative frequencies of artifacts associated with hunting, especially the arrowheads in the lowest part of the layer, adds some support to this view.

In Sq 1, Layer 3 is culturally sterile below -2.35 m, although in Sq W26 several artifacts were found at ca. -2.60 m, and in Sq A10 artifacts came from as deep as -2.50 m. No artifacts definitely diagnostic of PPNB or Epi-Paleolithic times occur in Layer 3, although such occupations cannot be ruled out in view of the limited areal exposures of the excavations. Blades and blade cores from Layer 3 are reminiscent of the Upper Paleolithic, but which parts of this long period they may represent can't be determined. Of the four bifaces from Layer 3, one is a broken specimen typical of the Lower Paleolithic, but its abraded condition suggests that it was redeposited from earlier sediments. The Levallois pieces from Layer 3 also exhibit abrasion from probable redeposition.

Layer 4. At approximately -3.00 m, the clayey texture of Layer 3 suddenly gives way to the sandy matrix of Layer 4. The color of Layer 4 is a light olive-green, and the frequent rust-colored mottles of Layer

3 are not present. Also lacking in Layer 4 are visible traces of vegetation, at least in terms of clay-filled rootlet cores. Layer 4 was completely devoid of cultural material in Sq 1 (This layer was not reached in the other deep probes). Evidently Layer 4 represents an early fluviatile period in the history of this part of the Azraq Basin.

Bedrock. Finally, what appeared to be friable limestone bedrock was reached in Sq 1 at -3.63 m. The friability of the bedrock may explain, in part, the coarseness of the Layer 4 deposits.

The stratigraphic succession in Sqs W26 and A10 very closely followed that in Sq 1, although there are some specific variations in these disparate excavations. These anomolies concern differences in the color of Layer 2A in the deep probes, but since these are probably related to local moisture content, the similarities in texture, presence of travertine inclusions, and the presence of visible plant remains, as well as the position within the sequence, are strong support for correlating the layers.

It should be pointed out that in Sqs W26 and A10 a brief fluviatile interval in Layer 3 is indicated at ca. -2.25 to -2.65 m by patches of sandy sediments not seen in Sq 1. Additionally, a thin layer of small rounded gravels and a sparse "pavement" of artifacts occurred at -2.15 to -2.20 m in these squares, another phenomenon not witnessed in Sq 1. Both of these situations occur in the west and south parts of the excavations, but not to the east, suggesting that a lakeshore may have been close to the areas sampled by Sqs W26 and A10.

Faunal, Palaynological, and Geological Samples

A total of 96 faunal specimens was recovered from the excavations. Of this total 19 came from the backdirt layer, 20 from Layer 1, 21 from Layer 2A, 23 from Layer 2B, and 13 from Layer 3. In Layer 3, the deepest specimens come from -2.17 m in Sq 1, -2.13 m in Sq W26, and -2.25 m in Sq A10. The faunal material is currently under study and a full report will be forthcoming.[2]

Because Quaternary and early Holocene paleoenvironments are so poorly known for the eastern deserts of Jordan, it was one of the major obectives of the Ain el-Assad project to obtain as complete a pollen profile of the sediments as possible. In this effort 19 pollen samples were taken from the south face of Sq W26 and 17 samples from the eastern face of Sq A10. These two profiles provide comparative evidence for regional climatic change over the period of time represented by two meters of sediment accumulation (perhaps more than 100,000 years), as well as for variation in local pollen deposition across the ca. 12 meters that separate the two sample areas.

Three additional pollen samples were taken from outside the excavation trenches. Sample P37 consists of the matrix which enclosed a Late Acheulian biface from the backdirt of the 1958 sump excavation; the matrix is indistingquishable from the Layer 3 sediment in terms of apparent texture and color. It is hoped that the pollen spectrum from this sample may lead to a correlation of the Acheulian occupation layer with the pollen diagram from the two profiles.

Pollen samples 'NS" and "EW" were surface transect collections. Each transect was 50 meters long, with the north-south transect crossing the midpoint of the east-west transect. In these sample collections, "pinches" of surface soil were collected at every meter along the axes, and each transect produced a volume of approximately a quarter liter. The analyses of the surface samples will provide spectra of the modern pollen rain in the Azraq area. Anemophilous pollen, deriving from up to several hundred kilometres away, will provide a regional baseline for paleoclimatic interpretations, while non-anemophilous pollens will establish the foundation for the interpretation of changes in the local stands of vegetation at the spring.[3]

2. The faunal samples are currently being analyzed by Priscilla Turnbull, Field Museum of Natural History, Chicago.

3. Dr. Gerald Kelso, Department of Anthropology, Boston University, is presently conducting the analysis of the pollen samples.

Sedimentological analysis will also provide valuable information relating to not only regional and local climate, but also to indicate specific geological (physical and chemical) processes at work within the immediate area of the site. Five sedimentological samples, of approximately one kilogram (wet weight) each, were taken from the south face of Sq W26. One sample came from near the middle of the relatively thin Layer 1, one sample each from Layer 2A and Layer 2B, and one sample each from high and low in Layer 3.

Archaeological Samples

The 1980 excavations produced a total of 1,080 artifacts as well as an unmonitored number of natural chunks, nodules and tabular chunks, gravels, natural flakes, and heat spalls. Of the total number of registered material, 395 artifacts came from Layers 1-3 and the remaining 685 artifacts came from the backdirt layers.

Table 1 provides breakdown of the major artifact classes by layer. Among the tools, a distinction is made, following accepted tradition (Bordes 1961; Rollefson 1980) between flakes and blades which exhibit edge modifications of some sort (barring obviously recent breakage), including edge damage as the result of possible use ("use-wear") on the one hand (the *reel* counts), and those tools which exhibit only intentional reshaping of the edges (the *essentiel* counts). The reason for this distinction lies in the problems of determining whether the damage to an artifact edge is the result of its employment in some task(s) (true use-wear) or if some natural agency, unrelated to human activity, may have caused the visible alterations to the edge. In the following discussions, unless it is specifically mentioned otherwise, reference will be made only to the essential tool counts.

The relative frequencies of artifact classes in each layer in Table 1 show close agreement in the flake, core, and biface categories. None of these figures are significantly different in Chi-Square tests of significance. The only figures which do indicate that variations are not due solely to chance involve the *reel* tool counts. For example, the differences in the numbers of *reel* tools in Layers 2A and 2B are significant at the .05 level, suggesting that something other than chance is responsible for this disparity. Since the factors responsible for the "production" of 24 of the 61 *reel* tools in Layer 2B are uncertain. (Table 2), attempts to explain the reasons for the difference are not likely to be convincing. One possible factor is that the occupations in Layer 2B were more frequent and/or of longer duration. The increased traffic on the land surface may have caused damage by humans or animals stepping on previously discarded, unused flakes. It is notable, for example, that no significant differences exist among the *essentiel* tool counts of the layer samples.

Table 1. Absolute and relative frequencies of artifact classes in each of the layers from the 1980 excavations at Ain el-Assad.

	Layer 1		*Layer 2A*		*Layer 2B*		*Layer 3*		*Backdirt*	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Flakes	22	78.5	55	82.1	193	81.4	44	71.0	574	83.8
Cores	6	21.4	12	17.9	41	17.3	14	22.6	70	10.2
Bifaces		0.0		0.0	3	1.3	4	6.4	41	6.0
(Tools, reel)	(4)	(14.3)	(7)	(10.4)	(61)	(25.7)	(8)	(12.9)	(147)	(21.4)
(Tools, ess.)	(1)	(3.6)	(7)	(10.4)	(31)	(13.1)	(3)	(4.8)	(85)	(12.4)
Total	28	99.9	67	100.0	237	100.0	62	100.0	685	100.0

Table 2. Absolute and relative frequencies of implements from Layers 1, 2A, 2B, and 3 from the 1980 excavations at Ain el-Assad.

	Layer 1		*Layer 2A*		*Layer 2B*		*Layer 3*	
Type	*n*	%	*n*	%	*n*	%	*n*	%
Levallois flake	1	33.3	.	...	1	2.8	1	20.0
Atypical Levallois flake	1	33.3	.	...	3	8.3	1	20.0
Levallois point	.	...	.	...	1	2.8	.	...
Straight racloir	.	...	.	...	1	2.8	.	...
Convex racloir	.	...	1	16.7	2	5.6	.	...
Double racloir, straight-convex	1	33.3	.	...	.	...	.	...
Canted convergent racloir	.	...	.	...	1	2.8	.	...
Convex transverse racloir	.	...	.	...	1	2.8	.	...
Simple burin	.	...	.	...	3	8.3	.	...
Notch	.	...	1	16.7	1	2.8	.	...
Denticulate	.	...	1	16.7	2	5.6	.	...
End-notched flake	.	...	.	...	1	2.8	.	...
Chopping-tool	.	...	.	...	3	8.3	.	...
Endscraper	.	...	.	...	1	2.8	.	...
Atypical endscraper	.	...	.	...	.	....	1	20.0
Percoir-grattoir	.	...	1	16.7	.	...	.	...
Atypical borer	.	...	.	...	1	2.8	.	...
(Naturally backed flake/blade)	.	...	(6)	(50.0)	(15)	(29.4)	(4)	(44.4)
Wedge	.	...	.	...	4	11.1	.	...
Diverse	.	...	1	16.7	4	11.1	2	40.0
Fanscraper	.	...	.	...	1	2.8	.	...
Projectile point	.	...	.	...	3	8.3	.	...
Sickle blade	.	...	.	...	1	2.8	.	...
Subtotal	3	99.9	6	100.2	36	100.2	5	100.0
Flakes/blades with irregular retouch	1				24		3	
Unclassifiable			1		1		.	
Total	4		7		61		8	

Typology

The typological classification of implements from the artifact samples follows the well-defined typelists of de Sonneville-Bordes and Perrot for the Upper Paleolithic and later speciments (de Sonneville-Bordes and Perrot 1954-57) and of Bordes for tools from the Middle and Lower Paleolithic (Bordes 1961).

The figures in Table 2 demonstrate the extreme paucity of tools from the *in situ* deposits, and in some cases even these figures may represent some degree of exaggeration. In Layer 1, for example, the Levallois flake, the atypical Levallois flake, and the straight-convex double racloir (fashioned on a Levallois flake) all bear a black patina, a feature more characteristic of the older speciments in the backdirt piles (especially the Acheulian bifaces) and, to some extent, in Layer 3. Although all three of these pieces were found relatively deep in Layer 1 (from 40-80 cm beneath the reworked backdirt base), the technology of flake production appears out of place with the apparent age of the sediments. The evident age of these particular specimens, in

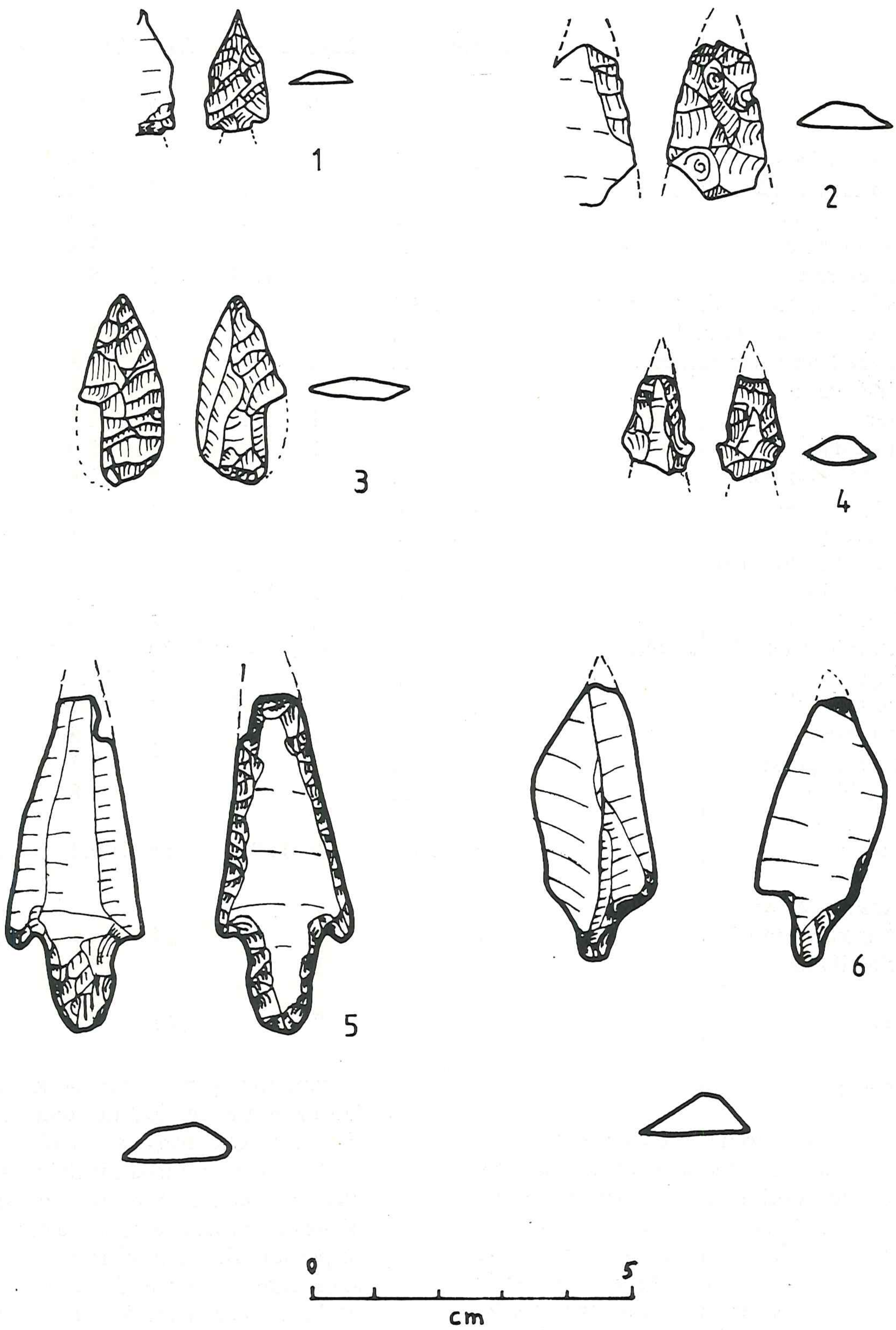


Fig. 4. Arrowheads and projectile points from Ain el-Assad. Nos. 1-3 are from Layer 2B; nos. 4-6 are from the backdirt layer.

view of the technology and patina color, suggest that they are intrusive in Layer 1. This leaves only a single flake bearing irregular and sporadic retouch, of dubious and possibly recent origin, as the sole candidate for a tool from Layer 1. The unclassifiable biface from Layer 1 (Table 5) is represented by a thick flake that derived from a very battered bifacially flake nodule and could represent either a chopper or utilized core.

The tools from Layer 2A, while few in number, are more straightforward. The convex racloir is well-made; the notch tool is on a core with one small area repeatedly retouched to form a deep concavity. A tabular piece, perhaps once a flake core, bears a well-retouched denticulate edge. On the percoir-grattoir, the blade bears a good endscraper but a poor borer, formed on the opposite end by two notches. The backed blade, partly cortical, exhibits well-formed blunting on one lateral edge. The "diverse" tool appears to be a core which was later utilized as a chopper. Finally, one flake apparently broke off some form of retouched tool, but the evidence is too fragmentary to say from which kind. Overall, the small number tools from Layer 2A is quite diverse and could represent, in spite of the small sample size, a relatively wide range of activities.

The Layer 2B sample contains the largest number of tools and obviously represents the widest range of functions to which they were directed. Of the four Levallois pieces (all flakes), one is abraded and is undoubtedly intrusive into the layer via water transport. One of the three remaining flakes (all of which are unpatinated) bears a punch-type platform which is not characterisitc of Lower and Middle Paleolithic periods. These three pieces may represent a later convergence of manufacturing technique similar to the specialized method that frequently occurs in the Post-Pleistocene. The "Levallois point" from Layer 2B could also represent a late product of normal blade production on a pyramidal core (Bordes 1980: 47).

The remaining components of the 2B sample are more typical examples of a Neolithic assemblage. Among the projectile points (Figure 4, nos. 1-3), one small example closely resembles a specimen from a recent survey of the Azraq Basin (Garrard and Price 1977: Fig. 2, no. 11); one piece may be a medial section of an Amuq-like point; and the third is a teardrop shape. Pressure flaking was the method used to retouch all of one or both surfaces. Among the diverse category of implements is a lanceolate piece bearing pressure-flaking over the entirety of both surfaces, and this may represent either a knife or lance point (Fig. 5, no. 2).

The sickle blade from this layer is not denticulated as is common for this tool type in the late Neolithic (Fig. 5, no. 1). The characteristic sheen is rather extensive on the exterior surface, but it is more restricted on the interior face. The blade was truncated at both ends.

For the other diverse tools from Layer 2B, two are scrapers of strange configuration, and another is a wedge (*piece esquillee)*. This last example is actually a bidirectional blade core evidently used later in some heavy duty task that resulted in heavy battering on opposed areas of the core.

The unclassifiable implement is represented by a fragment of an implement bearing scraper retouch, but there is too little of the piece to classify it properly. Among the biface tools from Layer 2B (Table 5), two are crude picks, one of which is disilicified and badly abraded, indicating probable redeposition from an earlier occupation. The remaining biface is badly broken (the distal end is missing), but the general configuration suggests that it may be a Lower Paleolithic handaxe washed into Layer 2B, an interpretation supported by its desilicified and abraded physical state.

The tools in Layer 3 mirror the total sample size in their small number. Both Levallois pieces (one flake, one blade) in this layer bear black patina, but unlike the case for Layer 1, much of the Layer 3 sample is black, so these artifacts are not necessarily intrusions from earlier occupations. The possible "reinvention" of the Levallois flake technique noted for Layer 2B may hold also for Layer 3.

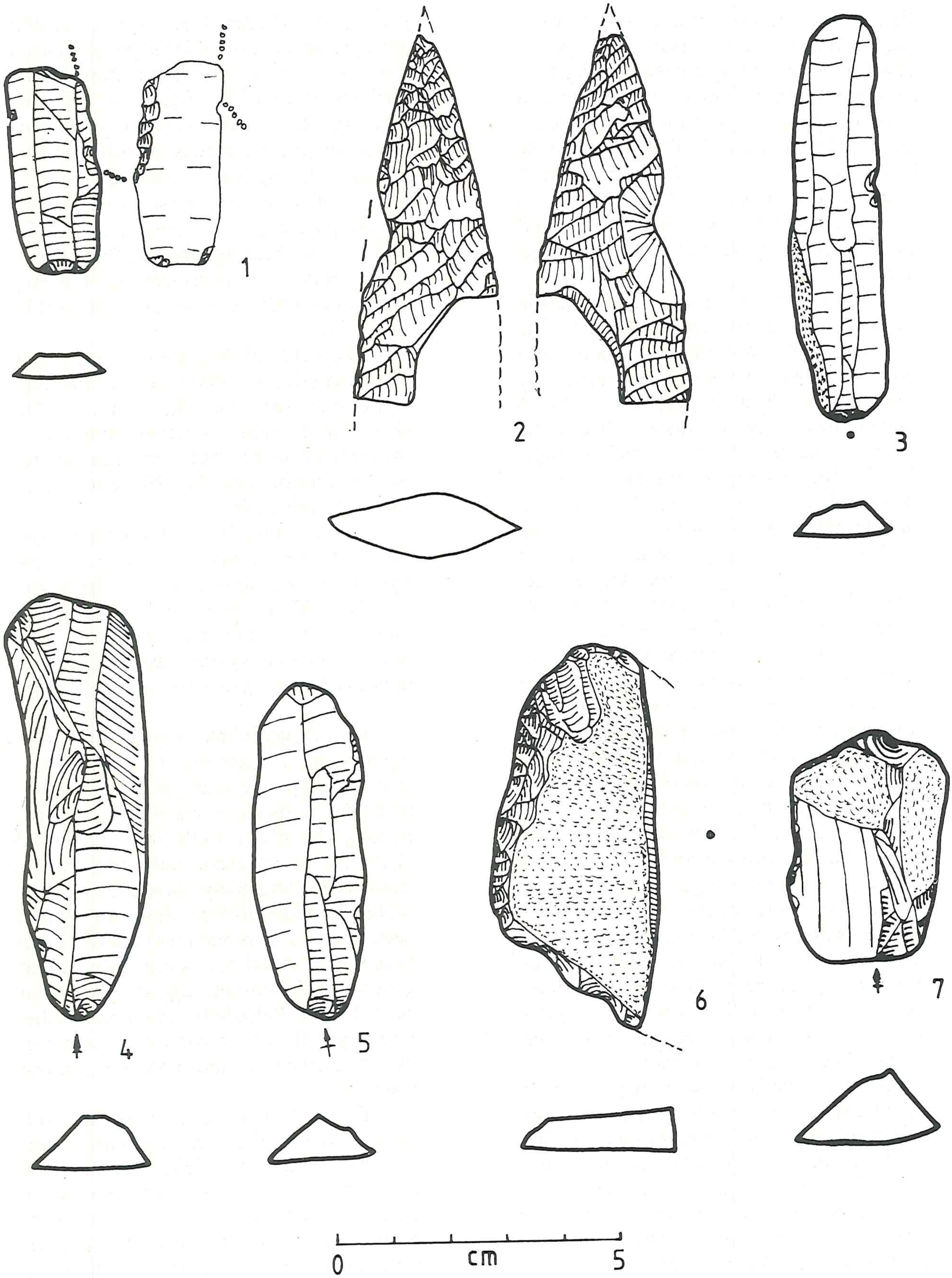


Fig. 5. Artifacts from Layer 2B. 1) sickle blade; (2) knife or lance point; 3) endscraper; 6) broken fanscraper; 4) and 5) punch blades; 7) atypical endscraper.

The remainder of the small implement sample includes two wedges and one endscraper on a flake. One of the diverse tools, a badly abraded flake (probably intrusive) may have been formed into a borer by interior retouch from both lateral edges, although the diagnostic tip is missing. The other diverse tool is an endscraper on a flake, with denticulation on one lateral opposed by a convex scraper on the other. The pick from Layer 3 (Table 5) is unifacially fashioned, although the tip bears evidence of heavy bifacial battering. The unclassifiable bifaces are indicated by two flakes: one removed a biface edge and the other took off a base.

For the backdirt tools, there is an obvious problem in distinguishing pieces from general occupational episodes (i.e., Lower Paleolithic vs. Middle Paleolithic vs. Neolithic) in view of the unknown original depositional contexts. Although variations in patination might be used to distinguish different time periods (cf. discussion in Rollefson 1980), the evidence from Layer 3, especially, indicates that this approach for Ain el-Assad artifacts involves a certain amount of uncertainty. While all but one of the Acheulian bifaces are black or dark gray in color, artifacts produced in later periods also occasionally bear these patina colors. Nevertheless, certain tool types which are distinctive or characteristic of Upper Paleolithic or later periods can be separated from the Lower and Middle Paleolithic forms. It must be admitted that some tool types, such as choppers, racloirs, simple burins, etc., can be found throughout the prehistoric record.

The implements which most likely come from Upper Paleolithic or later periods are tabulated in Table 3. For the two diverse tools, one is an unpatinated but heavily rolled chunk which bears some bifacial retouch at the tip; the remaining diverse tool is a large tabular flake with a battered transverse bit, and besides exhibiting denticulation, this piece may have been used as a heavy duty scraper or an adze. Among the projectile points, one is a small medial fragment, and its original shape is difficult to imagine (Fig 4, no. 4). The second point is a proximal protion bearing alternative interior/exterior retouch to produce a tang (Fig. 4, no. 6). Finally, the last projectile point is a typical PPNB specimen with barbs and a tang (Fig 4, no. 5).

Of all the 17 classifiable implements in table 3, only three have a black patina; two wedges and the "angle burin on a break". All the rest are either unpatinated (four pieces) or have other patina colors such as brown, tan, light gray, or white.

Table 3. Absolute and relative frequencies of Upper Paleolithic and later implements from the backdirt layers in the 1980 excavations at Ain el-Assad.

Type	*n*	%
Nucleiform endscraper	1	5.9
Canted dihedral burin	1	5.9
Angle burin on break	1	5.9
Core-burin	2	11.8
Oblique truncation	1	5.9
Convex truncation	1	5.9
Wedge	5	29.4
Diverse	2	11.8
Projectile point	3	17.6
Subtotal	17	100.1
Unclassifiable	11	
Total	28	

Regarding the 11 unclassifiable tools in Table 3, these are artifacts which, although manifesting evidence of intentional shaping, are too fragmentary to type accurately. Although some of them may derive from the Lower or Middle Paleolithic, they are all included in Table 3 for the sake of convenience.

The remaining tools from the backdirt appear to conform to expected implement types from the Middle or Lower Paleolithic. The frequencies of these tools are presented in Table 4. Among the diverse tools in this table, the only non-black patinated specimen is a wedge which has a good burin facet on it, although this may have resulted from the manner in which the tool was used. The other diverse tools, all black, include a core later converted to a wedge; a core with denticulation on one lateral edge opposed by steep scraper retouch on the other lateral; a flake with a notch and burin on one edge and a straight racloir on the other edge; and a

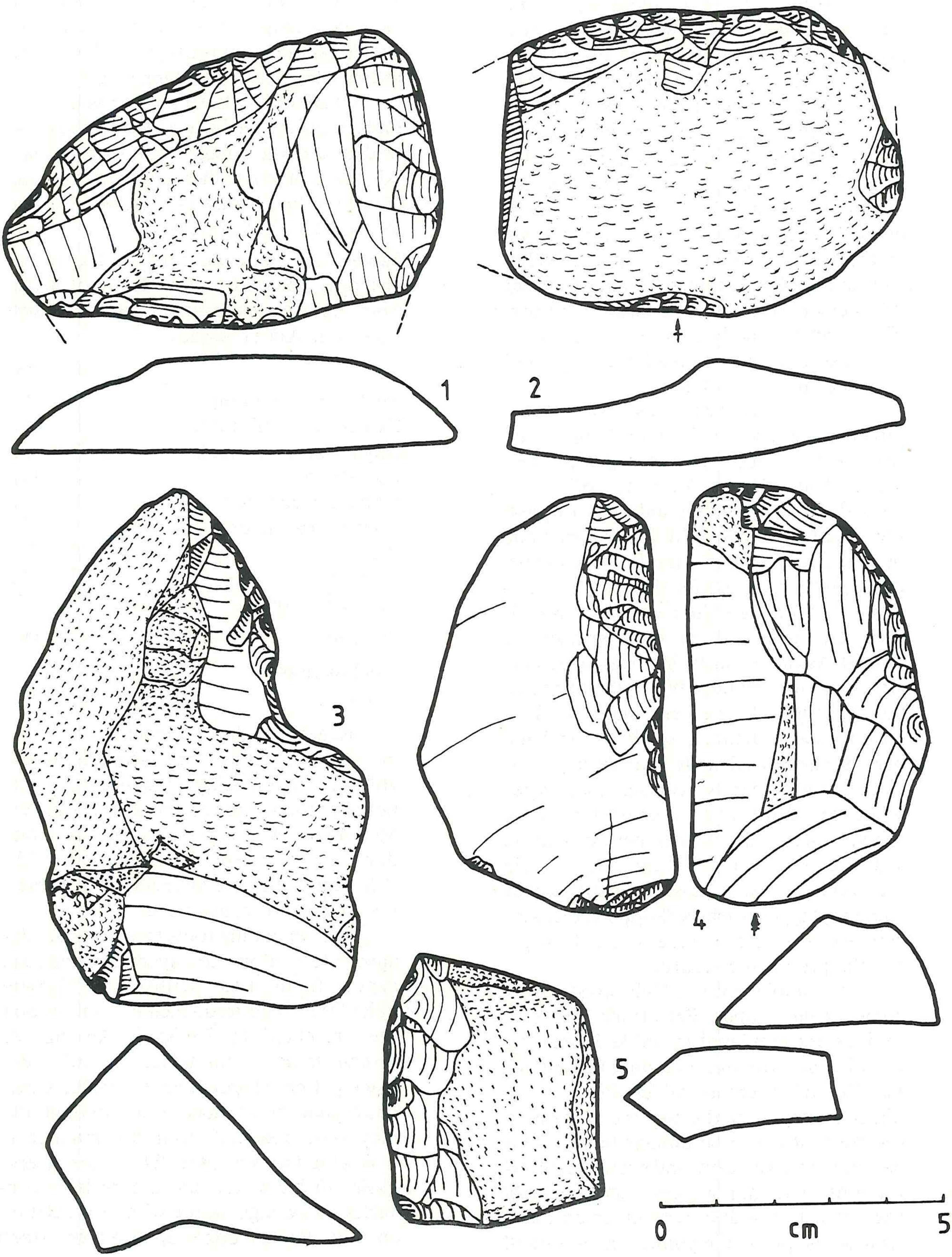


Fig. 6. Tools from the Ain el-Assad backdirt. 1) and 2) canted convergent racloirs; 3) and 5) steep racloirs; 4) alternating racloir.

blade with proximal bilateral retouch and possible interior thinning.

The unpatinated tools in Table 4 include a convex racloir, two steep scrapers, a denticulate, a chopper, and two chopping tools. Of the remaining 61 tools (excluding pieces with irregular retouch), 20 are patinated to brown, light gray, or white colors and 41 and black or dark gray.

One additional point remains to be discussed concerning the tools in Tables 2 and 4. For the Lower and Middle Paleolithic in western Europe, a least, flakes and blades with one sharp edge opposed by another that is perpendicular (or nearly so) and covered with cortex and considered to be implements by virtue of this configuration: they are termed "naturally backed knives" *(couteaux a dos naturel)*. These flakes/blades are indicated in the tables in parentheses because of the doubtful nature of their actual use as tools. (They do not, for example, bear any evident use-wear edge damage).

Biface types from the backdirt are presented in Table 5. The eight diverse types in the list constitute nearly a third of the classifiable speciments. Among the pieces, one is a broken biface subsequently used as a core. Another is a small chunky piece with extremely heavy battering at the tip, suggesting that its immediate functions as a

Table 4. Absolute and relative frequencies of Lower and Middle Paleolithic implements from the backdirt layers in the 1980 excavations at Ain el-Assad.

Type	*n*	% *reel*	% *ess.*
Levallois flake	9	7.8	
Atypical Levallois flake	3	2.6	
Pseudo-Levallois point	1	0.9	1.8
Straight racloir	1	0.9	1.8
Convex racloir	8	6.7	14.5
Concave racloir	2	1.7	3.6
Canted convergent racloir	1	1.7	3.6
Convex transverse racloir	1	0.9	1.8
Concave transverse racloir	1	0.9	1.8
Interior-face racloir	1	0.9	1.8
Steep racloir	3	2.6	5.4
Alternating racloir	1	0.9	1.8
Atypical endscraper	2	1.7	3.6
Simple burin	4	3.4	7.3
Atypical burin	1	0.9	1.8
Borer	2	1.7	3.6
Atypical borer	1	0.9	1.8
(Naturally backed flake)	(22)	(15.9)	(28.6)
Truncated piece	1	0.9	1.8
Notch	3	2.6	5.4
Denticulate	2	1.7	3.6
Tayac point	1	0.9	1.8
End-notched flake	1	0.9	1.8
Chopper	1	0.9	1.8
Chopping-tool	10	8.6	18.2
Diverse	5	4.3	9.1
Flake/blade with irregular retouch	49	42.2	
Total	116	100.3	99.5

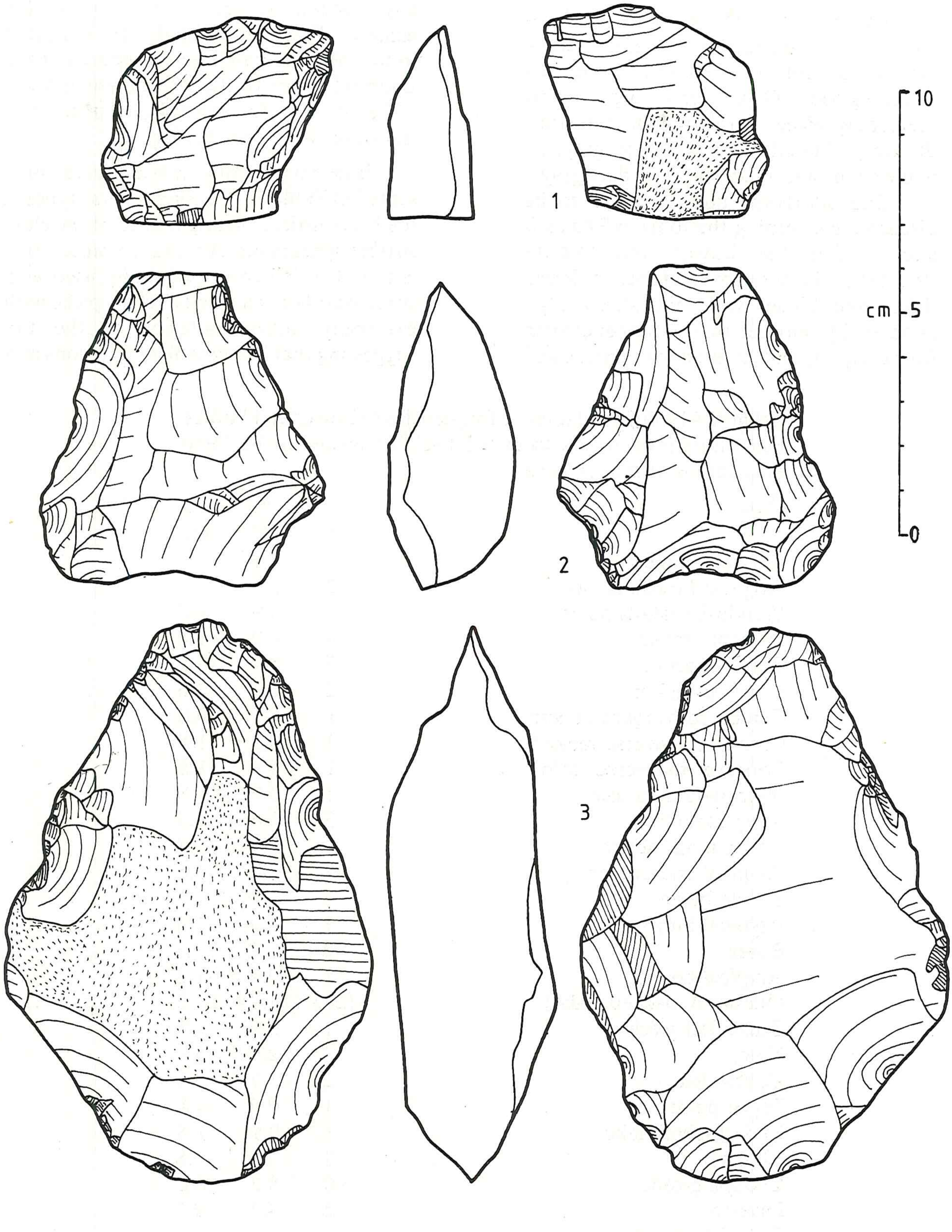


Fig. 7. Diverse bifaces from the Ain el-Assad; backdirt. 1) *biface-racloir;* 2) bifacial knife; 3) biface blank.

Table 5. Absolute and relative frequencies of biface types in the 1980 excavation samples from Ain el-Assad. percentages refer to classifiable types only (n 26).

	L1	*L2A*	*L2B*	*L3*	*Backdirt (all)*	
Type	*n*	*n*	*n*	*n*	*n*	%
Ficron	.	.	.	.	1	3.8
Amygdaloid	.	.	.	.	3	11.5
Subcordiform	.	.	.	.	2	7.7
Ovate	.	.	.	.	1	3.8
Cleaver	.	.	.	.	6	23.1
Flake Cleaver	.	.	.	.	1	1.3
Naviform	.	.	.	.	1	1.3
Diverse	.	.	.	.	8	30.8
Partial	.	.	.	.	3	11.5
Unclassifiable	1	.	.	3	14	(34.1)
Pick	.	.	2	1	.	.
Disc	.	.	.	.	1	(2.4)
Total	1	0	3	4	41	99.8

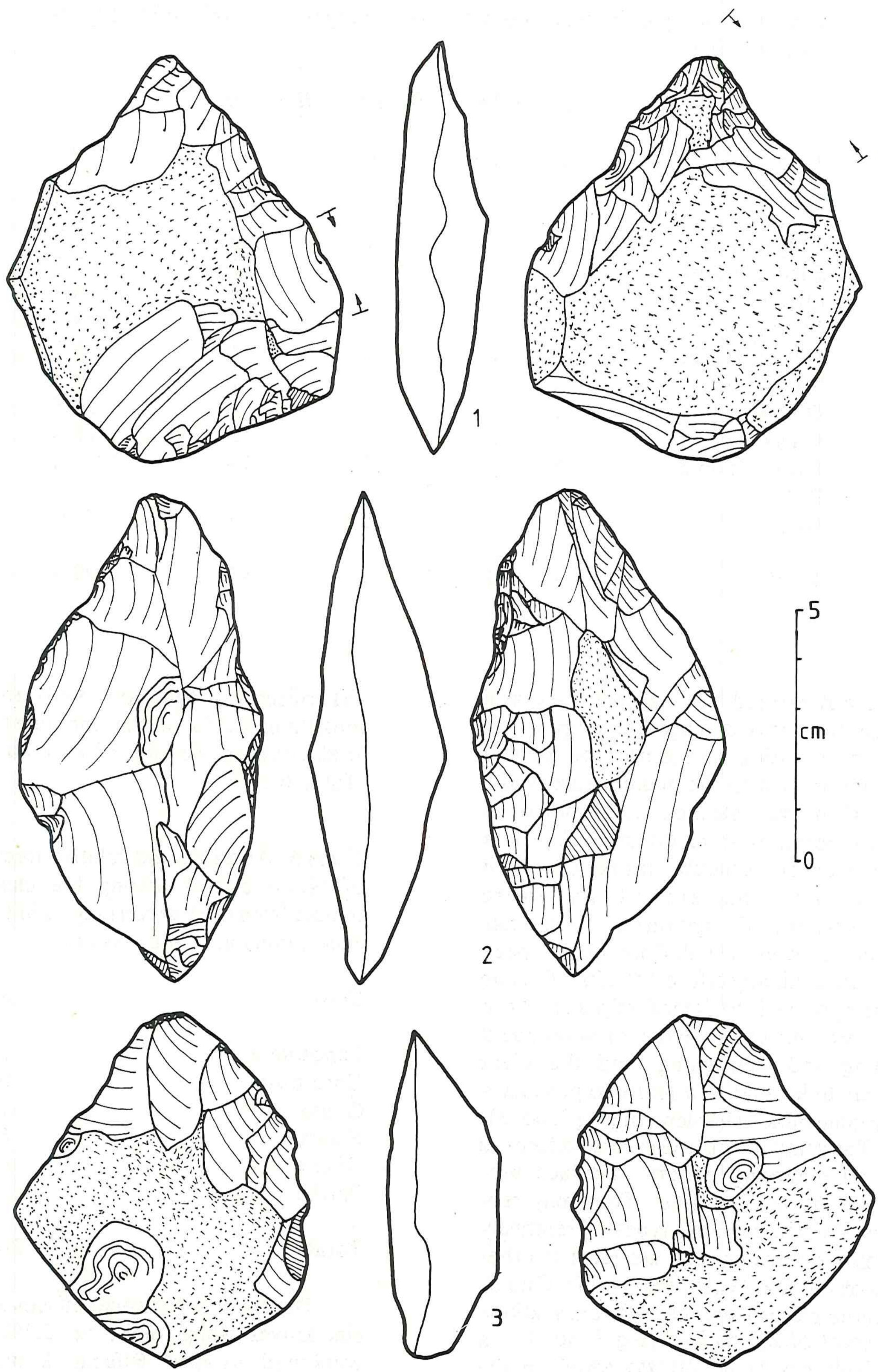
biface had expired and was later used as a wedge; the heavy damage to the tip, which in terms of patination seems to be roughly contemporary with the manufacture of the implement, prevents the classification of its original form. A third diverse biface is a large cleaver, crudely fashioned, with severe battering around its entire periphery, even though one of the laterals remained unretouched. Two other specimens are evidently biface "blanks". On one of them, one of the lateral edges seems to have become unamenable to subsequent shaping and sharpening, and the piece appears to be a failed attempt to produce a desireable bifacial implement (Fig 7, no. 3).

The remaining three diverse bifaces fit into an emerging pattern of biface production in the Near East. They may represent specific regional types of relatively common occurence that are rarer in other parts of the Old World Paleolithic. One of the three pieces from the 1980 excavations is a short *biface-racloir* (Fig 7, no. 1), a relatively common "diverse form" in the Tabun assemblages in Mt. Carmel (Rollefson 1978: 104-5). In addition to the three *biface-racloirs* from the 1979 backdirt collection (Rollefson 1980), this form constitutes 5.1% of the combined biface total, equal to the entire Lanceolate Class (Table 6).

Table 6. Absolute and relative frequencies of biface classes among the classifiable bifaces from the backdirt layers in the 1980 excavations at Ain el-Assad.

Class	*n*	%
Lanceolate	1	3.8
Cordiform	6	23.1
Ovate	1	3.8
Cleaver	6	23.1
Diverse	9	34.6
Partial	3	11.5
Total	26	99.9

The other two diverse bifaces are bifacial knives which make up 2.5% of the combined sample. Bifacial knives, also noted at Fjaje in west central Jordan (Rollefson 1981), formed another important component of the diverse types at Tabun.



· Fig. 8. Bifaces from the Ain el-Assad backdirt. 1) partial (area between the arrows indicates double patina); 2) naviform; 3) partial.

Flake Dimensions

The length, width, and thickness of each artifact was measured to the nearest millimeter. On flakes and blades, length was measured from the point of percussion along the flake axis, width was measured at a point halfway along the length measurement and perpendicular to it, and thickness was measured at the same point as width. On flakes where the axis of flaking could not be determined, the maximum dimension of the piece was adopted as the length measurement, with width and thickness measured orthogonally at the midpoint of the length measurement.

The mean dimensions and ratios of the means of analytically complete flakes are presented in Table 7. (Flakes and blades were deemed "analytically complete" if any edge damage on a specimen did not affect the original dimensions of the piece as defined in the preceeding paragraph). The figures in Table 7 reveal some temporal trends. In terms of length, there is a consistent decrease in size through time, and flakes and blades tend to become simultaneously somewhat thicker. As far as absolute widths are concerned, there is less patterning.

The ratios of the absolute dimensions, instead of concentrating on size, provide other aspects of the flake samples. The W/L ratio indicates a rough approximation of the outline shape of the artifacts, with values approaching .000 indicating extremely elongated shapes; at or near a value of 1.000 the shapes are roughly circular or square; and values increasingly larger than 1.000 indicate relatively shorter and broader outlines. Higher values of the T/L ratio indicate chunkier flakes, while lower values suggest more delicate long sections. Cross sections are broadly indicated by the T/W ratio, with higher values tending to reflect angular shapes and lower values mirroring more fragile pieces.

In Table 7 it is evident that through time the complete flake samples tend towards rounder or squarer outline shapes (despite the heavier reliance on blade techniques in Layer 2A), while becoming somewhat chunkier in terms of the T/L ratio at the same time. In contrast to the T/L development, however, flakes and blades become less angular in cross section, although the backdirt material has the lowest T/W ratio of all the samples.

While the information in Table 7 provides some insight on complete flakes, two factors should be kept in mind in assessing possible meanings. First, the sample size for most of the samples is very small, so the reliability of the patterns may be questionable; at least, the trends must be tested in the future by examining larger samples.

Second, it is probable that by measuring complete flakes, one is measuring what the flintworkers had rejected as unsuitable for use in the tasks at hand. In effect, then, the figures in Table 7 suggest that through time "rejects" became shorter, broader,

Table 7. Mean dimensions and ratios of mean dimensions of complete flakes from the excavations at Ain el-Assad, 1980.
L length, W width, T thickness, expressed in millimeters.

Layer	*L*	*w*	*T*	*W/L*	*T/L*	*T/W*	*n*
1	32.6	24.7	8.0	.758	.245	.324	6
2A	35.1	26.8	9.6	.764	.274	.358	21
2B	37.0	26.1	9.4	.705	.254	.360	81
3	41.6	24.7	9.2	.594	.221	.372	12
Backdirt	41.0	28.3	9.0	.690	.220	.318	201

chunkier, and generally less angular. Conversely, it is logical to assume that pieces selected for shaping into tools were longer, narrower, and more delicate. An obvious concomitant study to complement the information in Table 7 would involve the dimensions of implements that were produced. At Ain el-Assad, however, the quality of the tool samples is very severe: in Layer 1 there are no unbroken implements made on blades or flakes, only one in Layer 2A, 13 from the Layer 2B sample, and two from Layer 3. Investigations into this matter must await future excavations at the site.

Cores and Technological Features

Limited space prevents discussion at present concerning the cores that were recovered from the excavations as well as the technological features of lithic manufacture that were monitored during the analysis of the artifact samples. A thorough presentation and assessment of these aspects will appear in a later volume of the *Annual of the Department of Antiquities of Jordan.*

Discussion

The diagnositic elements from the stratified samples from Ain el-Assad are too few to provide a firm foundation for dating the occupations on a typological basis. In Layer 2B the projectile points could conceivably indicate a Late Neolithic period, although the fragmentary nature of two of them leaves considerable room for doubt. Moore notes that although pressure-flaking was well established as a method for retouching arrowheads in earlier Neolithic phases, the emphasis on delicate retouch and smaller size are definitive characteristics of Late Neolithic arrowheads. (Moore 1973: 46). These characteristics are present among the Layer 2B arrowheads and lend some support for the later date.

Moore also notes that, in Palestine at least, most arrowheads from earlier parts of the Neolithic were made on purplish or "honey-coloured" flint (Moore 1973: 47), suggesting that this is not the case for the Late Neolithic. The applicability of this "rule" must take into account the availability of local raw materials. At Ain el-Assad no cores of either color were recovered, nor did a large sample of natural flint nodules or chunks indicate the presence of these raw materials in the vicinity. Nevertheless, while small flakes of purple flint were found in Layer 2B, no points were fashioned in flint of this color. Instead, all three examples were made on what we termed in the field "butterscotch" flint, presumably resembling Moore's honey color. The pressure-flaked knife or lance point and the sickle blade were also of butterscotch flint.

In a recent survey of the Azraq region, Copeland notes that at Ain el-Assad there is a gray series of flint artifacts which includes several pressure-flaked tangs which she ascribes to the Late Neolithic (Garrard and Price 1977: 114). The only projectile points fashioned on gray flint from the 1980 season came from the backdirt layers, and while one of them may be a medial segment of a small winged Late Neolithic arrowhead, the other two appear to represent PPNB shapes (Fig 4, nos. 5 and 6; compared with Mortensen 1970: Figs 13, 14, and 17; Perrot 1952: Plate X; Cauvin 1972: Figs 5 and 6).

The bifacially pressure-flaked knife or lancehead is evidently unknown at Beidha, but similar forms are reported from Sha'ar Hagolan (Stekelis 1972: Plate 24-4). The sickle blade from Ain el-Assad is not denticulated as is the normal case for this tool type in the Late Neolithic (Moore 1973: 46, Fig 2), but instead is more like the unretouched sickle blades from Beidha (Mortensen 1970: Fig 37; Kirkbride 1966: Fig 12).

Moore mentions that a major distinction between the PPNB and Late Neolithic stone industries is the reliance on "double-ended, hogbacked" cores are absent in Late Neolithic occupations (Moore 1973: 51). Such bidirectional, single face blade cores account for 25% of the core inventory in the Ain el-Assad Layer 2B.

The PPNB assemblages from Beidha

resemble, in general technological terms, the evidence from Ain el-Assad. At Beidha blade cores of all kinds average only 6.2% of the total core inventory, ranging from 1.7 to 9.6% among the various levels (Mortensen 1970: 4, Table 1). At Ain el-Assad blade cores range from 8.3% in Layer 2A to 14.6% in Layer 2B (including core fragments, rejected cores, and unclassifiable cores). At Beidha blades constitute an average of 25.7% of the flakes (excluding chips), ranging from 3.4 to 32.3% in each level. At Ain el-Assad blades range from 12.0% in Layer 2B to 24.0% in 2A. Similar breakdowns of artifact classes are less directly comparable in other PPNB and Late Neolithic site reports.

In connection with techniques of flake production, Stekelis points out that the Sha'ar Hagolan cores characteristically exhibit steep platform angles of approximately 45° to the core axis (Stekelis 1972: 43). Similar platform configurations characterize the Beidha cores (Mortensen 1970: Fig 6). Although core platform angles were not monitored in the Ain el-Assad samples, the high percentages of high angle techniques on blades in Layers 2A and 2B indicate similar core platforms.

In summary, the general age of the *in situ* materials from Ain el-Assad remains obscure, with evidence pointing towards either PPNB or Late Neolithic for Layer 2A and 2B on the bases of typological and technological comprisons. It is not impossible that the deposits at Ain el-Assad represent a period of transition from the one to the other, but Moore notes that such sites in the Levant are either absent or poorly documented.

Whatever the age of the occupations in Layers 2A and 2B, which can be resolved only with a larger sample of diagnostics in future excavations, what is just as important as the kinds of artifacts which were recovered is the absence of other expectable artifact types. No grinding stones were found (with the possible exception of the basalt spheroid from Layer 2A), nor were there any axes, chisels, pottery, or housing constructions. Overall, the artifact inventories are consistent with a limited focus occupation of the site, with emphasis on hunting and butchering as evidenced by the arrowheads and utilitarian flint tools. The single sickle blade may indicate a restricted degree of harvesting, but this does not mean that either wild or domestic grain was harvested at the spring (cf. Moore 1973: 43). Relatively recent house construction in the Azraq villages still utilizes great quantities of cane reeds, especially for the roofs. Neolithic visitors undoubtedly utilized what must have been an abundant resource at Ain el-Assad, wielding sickles to disptach a task which would have been difficult to accomplish by hand in view of the massive root systems of *Phragmites* (cf. Anderson 1980: 183-8).

The preliminary sedimentary evidence lends support to the idea that the occupations sampled in the 1980 season were unlikely to have produced a wide variety of domestic artifacts. The color, texture, and travertine inclusions in the 2A-2B complex indicate that the artifacts found their way into marshy if not swampy conditions. While such a setting would have been a lucrative hunting focus, as a location of permanent or semi-permanent habitation, the Neolithic people must have had more comfortable options. Well-drained areas may have existed within a relatively close distance to the marsh borders.

If the temporal status for Layers 2A and 2B are in question, the situation is even more ambiguous for Layer 3, for typologically diagnostic artifacts were not found in the stratum. The lacustrine matrix of Layer 3 indicates a Pleistocene age, while the general technological aspects of the small artifact sample suggest an occupation near the end of this long period. Evidence from the Jafr Depression indicates that a period of dessication began sometime around 26,000 b.c. (Huckriede and Wiesemann 1968: 81-2), although how rapidly the dessication set in has not been determined. The lake at Azraq may have continued to exist until the end of the Pleistocene. Lake Lisan in the Jordan Valley was suddenly reduced in area and volume at approximately 18,000 b.c., but since the reduction was due primarily to tectonic activity, the temporal relationship of the demise of Lake Lisan with the contraction of the

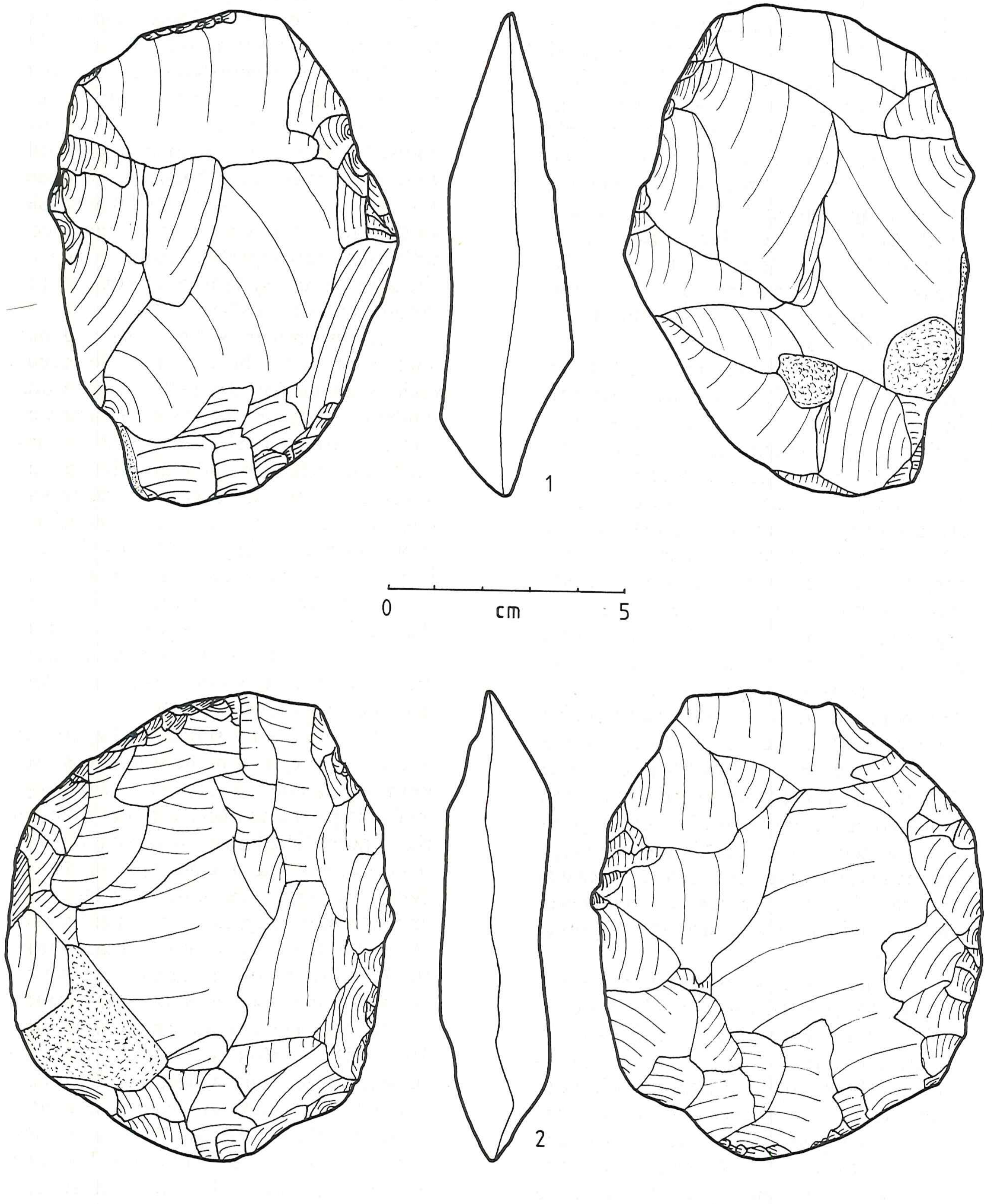


Fig. 9. Cleavers from the Ain el-Assad backdirt. Note: 1) is the only unpatinated biface found in the backdirt.

Azraq pluvial lake is spurious (cf. Farrand 1971: 542, 559).

Earlier occupations at Ain el-Assad are evidenced only in the backdirt, where the Late Acheulian is well represented by relatively large numbers of handaxes and cleavers. There remains the problem of whether any Middle Paleolithic occupations occured at Ain el-Assad, and because the tool types and general technological configurations are rather similar in the Lower and Middle Paleolithic, distinguishing them in the backdirt melange would be very hard to achieve. An extensive Levalloiso-Mousterian occupation is claimed at Spring C in Azraq Shishan (Clutton-Brock 1970: 19-20), and site Azraq 16 also appears to be a Middle Paleolithic site (Garrard and Price 1977: 116). Evidence for other Middle Paleolithic sites in the Azraq Basin is poor. There certainly was no major Levalloiso-Mousterian occupation at Ain el-Assad, testified by the small amount of Levallois material among the backdirt samples.

As was the case with the earlier analysis of bifaces from Ain el-Assad (Rollefson 1980), cleavers continue to play a very large role among the bifaces, emphasizing the butchering activities that took place at the spring/lake 100-150,000 years ago. The possibility that even earlier occupations, from the Middle Acheulian, may be represented among the backdirt artifacts is suggested by relatively crude retouch on a large number of bifaces (excluding almost all of the cleavers, which for the most part are very finely executed). Crude retouch is not unknown in the Late Acheulian, however, so the resolution of this possibility must await the location of in situ Acheulian layers.

Table 8 shows that the combined 1979-1980 biface sample is diversified in terms of biface types, with Cordiform, Ovate, Cleaver, and Diverse classes dominating the inventory. The 1980 sample was relatively higher among the cordiform, diverse, and partial biface types compared to the 1979 sample, with corresponding reductions in the importance of ovate and cleaver types. In the combined sample, the Cleaver class remains high, surpassed only by the site of Jisr Banat Yaqub, near Lake Tiberias, and unchallenged by any other Near East biface assemblage. As a consequence, relative frequencies of other classes (except Diverse) are reduced, and more extensive comparisons with other biface assemblages are difficult to effect. The average length of 49 complete bifaces from the combined sample is 96.6 mm, which may indicate that the material comes from a later part of the Late Acheulian (cf. Rollefson 1980).

In terms of the essential Bordes typelist, two major differences emerged in a comparison of the 1979 and 1980 samples. The more recent group included significantly lower numbers of scrapers (especially simple convex racloirs) on the one hand but a much higher incidence of choppers and chopping tools on the other.

The typological and technological features of the individual and combined backdirt samples are presented in Table 9. In terms of the essential counts, the combined sample is characterized as rich in scrapers, poor in denticulates and retouched Levallois elements, and moderately strong in the presence of the Upper Paleolithic group. Among the wealth of scrapers, the Charentian character is moderately strong with only a small contribution by canted convergent scrapers (which indicate the strength of the Yabrudian nature of the scraper complex). Convergent scrapers are generally few in number, and the representation of types 25-29 is comparatively strong. In terms of technique, the debitage is non-Levallois, with little facetting of platforms, and blade techniques are used only moderately.

In conclusion, the 1980 excavations at Ain el-Assad, while small in areal sampling, provide a foundation for a better understanding of the Late Pleistocene prehistoric occupations of a part of the Near East that has been effectively ignored by prehistorians in the past. Analysis of the palynological, geological, and faunal samples will provide valuable information concerning the changing local and regional climates and environment. For the Neolithic period, the areas sampled by the

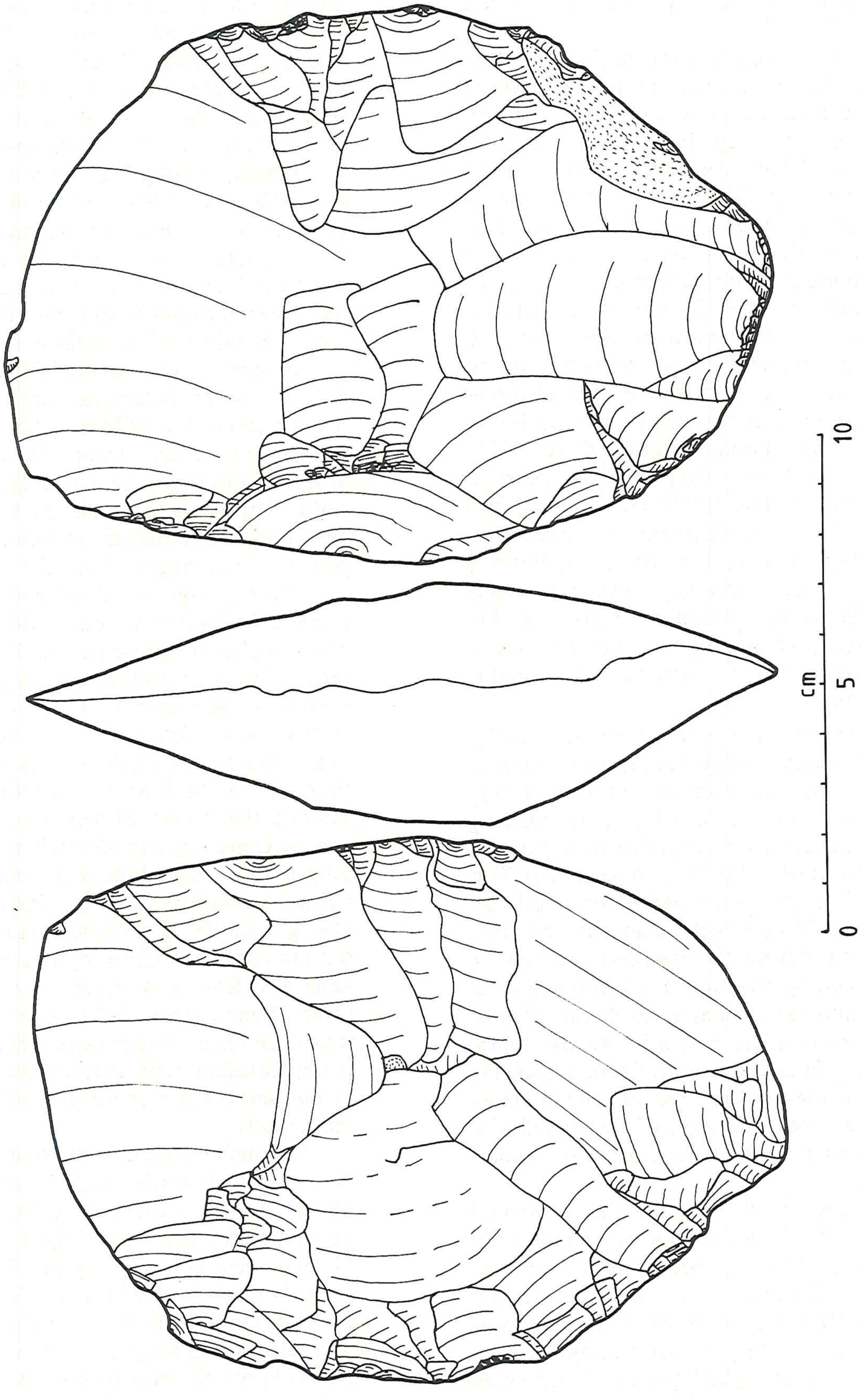


Fig. 10. Cleaver from the Ain el-Assad backdirt.

trenches suggest that the area around the spring was a marsh or swamp, a potentially lucrative hunting area for game which exploited local water and vegetational resources; no evidence of domestic habitation was produced. In contrast, earlier occupations took place near a large Pleistocene pluvial lake which had inundated the spring proper.

But whatever the 1980 season has contributed, much work remains to be done at the site, since so many questions are still unanswered and new ones have arisen. A much broader exposure of the Neolithic layers is called for, as well as more extensive sampling of the Upper Paleolithic-like parts of Layer 3. The elusive Acheulian layers are still a tantalizing goal for future

Table 8. Biface types and classes from the 1980 excavations and from the 1979 backdirt sample. Percentages refer only to the classifiable specimens.

	1980	*1979*	*Combined*	
Type	*n*	*n*	*n*	%
Lanceolate	.	1	1	1.3
Ficron	1	2	3	3.8
Cordiform	.	1	1	1.3
Anygdaloid	3	5	8	10.1
Subcordiform	2	2	4	5.1
Ovate	1	8	9	11.4
Discoidal	.	1	1	1.3
Cleaver	6	16	22	27.8
Flake cleaver	1	.	1	1.3
Naviform	1	.	1	1.3
Diverse	8	13	21	26.6
Partial	3	3	6	7.6
Abbevillian	.	1	1	1.3
Subtotal	26	53	79	100.2
Unclassifiable	14	8	22	
Disc	1	1	2	
Total	41	62	103	
Class				
Lanceolate	1	3	4	5.1
Cordiform	5	8	13	16.4
Ovate	1	9	10	12.6
Cleaver	7	16	23	29.1
Non-classic	1	.	1	1.3
Diverse	8	13	21	26.6
Partial	3	3	6	7.6
Abbevillian	.	1	1	1.3
Total	26	53	79	100.0

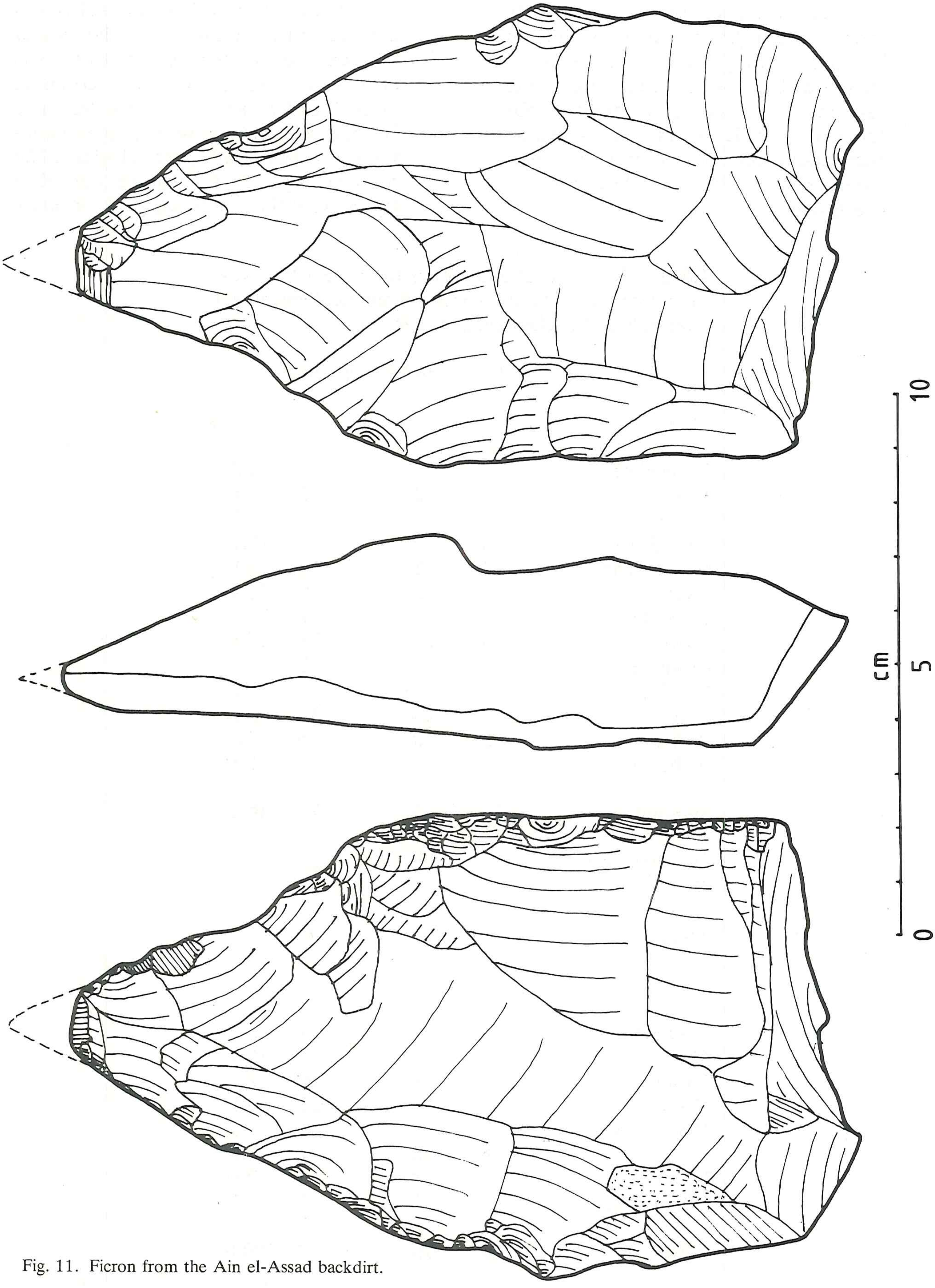


Fig. 11. Ficron from the Ain el-Assad backdirt.

excavations. A more complete set of pollen, geological, and faunal samples is also a primary goal of continued work at Ain el-Assad. Funding to achieve these aims has been raised, and another season of excavation will commence in October of 1981.

Table 9. Group indices, typological indices, and technological indices of the 1980, 1979, and combined backdirt samples. The group and typological indices for 1979 have been recalculated, excluding naturally backed flakes.

Group Indices

	1980		*1979*		*Combined*	
	reel	*ess.*	*reel*	*ess.*	*reel*	*ess.*
Group I	10.3	0.0	3.8	0.0	7.2	0.0
Group II	18.1	38.2	31.4	62.3	24.4	50.0
Group III	9.5	20.0	2.8	5.7	6.3	13.0
Group IV	1.7	3.6	3.8	7.5	2.7	5.5

Typological Indices (Essential)

	1980	*1979*	*Combined*
Racloir	36.4	58.5	48.1
Charentian	18.2	28.3	23.1
Yabrudian	21.8	32.1	26.8
Backed knife	0.0	0.0	0.0
Naturally backed knife	28.6	11.7	21.2

Technological Indices

	1980	*1979*	*Combined*
Levallois	2.1	1.0	1.6
Facetting (IF)	26.7	29.6	28.0
IF (strict)	11.9	10.4	11.3
Laminar	13.7	6.2	10.4

Acknowledgements

I owe many thanks to Dr. James Sauer and the ACOR staff for all their help and support prior to, during, and after the excavations. Dr. Adnan Hadidi, Director-General of the Department of Antiquities of Jordan, was very generous with help for the project, and Dr. Ghazi Bisha and the Department staff were very cooperative during my term in Jordan. I owe a special debt of gratitude to Dr. Albert E. Glock and his wife Lois for their kindness and generosity; through them I was provided with an excellent environment in which to write this report. I would also like to acknowledge my sincere thanks to Scott Rolston and Laura Hess for their support and generosity. I consulted with a large number of prehistorians during and after the field work, too numerous to name, whose comments and suggestions are warmly appreciated.

Gary O. Rollefson

BIBLIOGRAPHY

Anonymous

1971 *Climatic Atlas of Jordan.* Amman: Ministry of Transport, Meteorological Department.

Anderson, P.

1980 A Testimony of Prehistoric Tasks: Diagnostic Residues on Stone Tool Working Edges. *World Archaeology* 12(2): 181-94.

Bender, F.

1974 *Geology of Jordan.* Berlin: Gebruder Borntraeger.

Bordes F.

1961 *Typologie du paleolithique ancien et moyen.* Publications de l'Institut de Prehistoire de l'Universite de Bordeaux, Memoire 1.

1980 Le debitage Levallois et ses variantes. *Bulletin de la Societe Prehistorique Francaise* 77(2): 45-9.

Burdon, D.

1959 *Handbook of the Geology of Jordan.* Amman: Government of the Hashemite Kingdom of Jordan.

Cauvin, J.

1972 Sondage a Tell Assouade. *Annales Archaeologiques Arabes Syrienne* 22:85-103.

Clutton-Brock, J.

1970 The Fossil Fauna of an Upper Pleistocene Site in Jordan. *Journal of Zoology, London* 162: 16-29.

Endo, K.

1978 Stratigraphy and Paleoenvironments of the Deposts in and around the Douara Cave Site. Pp. 53-81 in K. Hanihara and Y. Sakaguchi, eds., *Paleolithic Site of the Douara Cave and Paleogeography of Palmyra Basin in Syria, Vol. I.* University of Tokyo Press.

Farrand, W.

1971 Late Quaternary Paleoclimates of the Eastern Mediterranean Area. Pp. 529-64 in K. Turekian, ed., *The Late Cenozoic Glacial Ages.* Yale University Press.

1979 Chronology and Paleoenvironment of Levantine Prehistoric Sites as seen from Sediment Studies. *Journal of Archaeological Sciences* 6: 369-92.

Field, H.

1960 North Arabian Desert Archaeological Survey., 1925-1950. *Papers of the Peabody Museum of Archaeology and Ethnology, Harvard University* 45(2).

Garrard, A. and Price, N.S.

1977 A Survey of Prehisotric Sites in the Azraq Basin, Eastern Jordan. *Paleorient* 3: 109-26.

Harding, G.L.

1958 Recent Discoveries in Jordan. *Palestine Exploration Quarterly:* 7-18.

1967 *The Antiquities of Jordan.* Amman: Jordan Distribution Agency.

Huckriede, R. and Wiesemann, G.

1968 Der jungpleistozane Pluvial-See von el-Jafr und weitere Daten zum Quatar Jordaniens. *Geologica et Palaeontologica* 2: 73-95.

Kirkbride, D.

1966 Five Seasons at the Pre-Pottery Neolithic Village of Beidha in Jordan. *Palestine Exploration Quarterly:* 8-72.

Madany, M.
1978 *An Ecological Framework for a Nature Preserve System in Jordan.* Bachelor of Science thesis, University of Illinois, Urbana.

Moore, A.
1973 The Late Neolithic in Palestine. *Levant* 5: 36-68.

Mortensen, P.
1970 Preliminary study of the Chipped Stone Industry from Beidha. *Acta Archaeologica* 41: 1-54.

Perrot, J.
1952 Le Neolithique a Abou Ghosh. *Syria* 29: 119-45.

Rollefson, G.
1978 *A Quantitative and Qualitative Typological Analysis of Bifaces from the Tabun Excavations, 1967-1972.* Doctoral dissertation, University of Arizona, Tucson.

1980 The Paleolithic Industries of Ain el-Assad ("Lion's Spring"), near Azraq, Eastern Jordan. *Annual of the Department of Antiquities of Jordan* 24: 129-44.

1981 A Lower Paleolithic Surface Site near Shobak, Wadi el-Bustan, Southern Jordan. *Annual of the Department of Antiquities of Jordan* 25: 151-168.

Sakaguchi, Y.
1978 Palmyra Pluvial Lake. Pp. 5-28 in H. Hanihara and Y. Sakaguchi, eds., *Paleolithic Site of the Douara Cave and Paleogeography of Palmyra Basin in Syria, Vol. I.* University of Tokyo Press.

Sonneville-Bordes, D. de and Perrot, J.
1954-1957 Lexique typologique du paleolithique superieur. *Bulletin de la Societe Preheistorique Francaise* 51: 327-55; 52: 76-9; 53: 408-12; 54: 547-59.

Stekelis, M.
1972 *The Yarmoukian Culture of the Neolithic Period.* Jerusalem: Magness Press.

Van Liere, W.
1960-1961 Observations on the Quaternary of Syria. *Berichten van se Rijksdienst voor* ¼ het Oudheidkundig Bodernonderzoek 10-11: 1-69.

Rollefson Ain el-Assad 1980