

The Lower Paleolithic in Jordan

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Abstract

Although research on Jordan's Stone Age has been overshadowed by work on its spectacular Metal Age and early historic archaeological sites, surveys and excavations beginning in the 1980s have compiled a credible record of the Jordanian Paleolithic, and we are now in a position to make an assessment of more than 30 years of sustained fieldwork. Our presentation summarizes work on Jordan's prehistory during the Lower Paleolithic. Although work in the various subdivisions of the Stone Age has been uneven, real progress has been made in establishing the beginning of a reliable time-space grid, and in formulating and testing models for forager adaptations over the past 500,000 years. Work in the xeric, steppe-desert environments of Jordan is also put into the larger context of Lower Paleolithic research in the very different Mediterranean environments along the Levantine coast. Although both coast and interior were affected by the same succession of macroclimatic changes, the human response to them varied according to a mosaic of local geophysical, topographic and hydrological factors that affected the kinds and quantities of plants and animals distributed over the landscape, and the availability of surface water. To date, Jordan has few Paleolithic archaeologists. We close with some observations on the status of collaboration between foreign teams and Jordanian research institutions, and what might be done to train more Jordanian prehistorians.

Keywords: Prehistory of Jordan, Lower Paleolithic, Paleoenvironment, bifaces.

Introduction

For six million years, humans and their pre-human ancestors eked out a living by gathering wild plant foods, hunting a wide range of animals, and scavenging the kills of top predators like lions and leopards. An unimaginably long, slow, and

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irregular progression can be dimly discerned in the evolutionary history of our lineage from predation on small, sessile, easily collected species (e.g., tortoises, other slow-moving reptiles), with a heavy dependence on nuts, seeds, fruits and tubers (late Miocene-late Pliocene), to more active hunting of the more vulnerable age classes of medium-sized ungulates (juveniles, old and/or infirm individuals), supplemented by scavenging (basal Pleistocene-Middle Pleistocene), to the effective exploitation of prime-aged adults in the middle of the Middle Pleistocene (e.g., Boxgrove, dated at c. 500 kya; Schoeningen, c. 400 kya; Bilzingsleben, c. 400 kya) and thereafter. Every aspect of what makes us human – anatomy, development, life history, behavior, cognition, and psychology – evolved in the context of thousands of generations of small foraging groups, thinly distributed on the landscape, in constant competition with each other and with other species for access to the resources necessary for individual survival, and to the mates essential for individual reproduction. Darwin established more than 150 years ago that natural and sexual selection drive all evolution, and showed that we are only unique in the same way that any species is unique – by virtue of the possession of a unique evolutionary heritage. The hunting and gathering way of life thus constitutes more than 99.9% of our history, and shapes many aspects of our behavior, even today.

Jordan is extraordinary rich in the archaeological vestiges of the Old Stone Age, largely because deflation has concentrated stone artifacts derived from land surfaces that have long disappeared on the modern landscape, and because in many parts of the country Pleistocene land surfaces have not been buried by Holocene deposition, as is the case in Europe. The Levant (Belad el Sham) in general, and Jordan in particular, also lie on the cross-roads of Africa, Europe and Asia, so that the periodic range extensions or radiations out of Africa that characterize the human career passed through the region, leaving behind thousands of prehistoric sites spanning the period between c. 1.5 mya (e.g., Ubeidiya, on the west bank of the Jordan River south of Lake Tiberia) and extending up in time until the Neolithic and later (Rosen 1997). It is our intention here to review that record, and to offer an assessment of the current status of early Stone Age research.

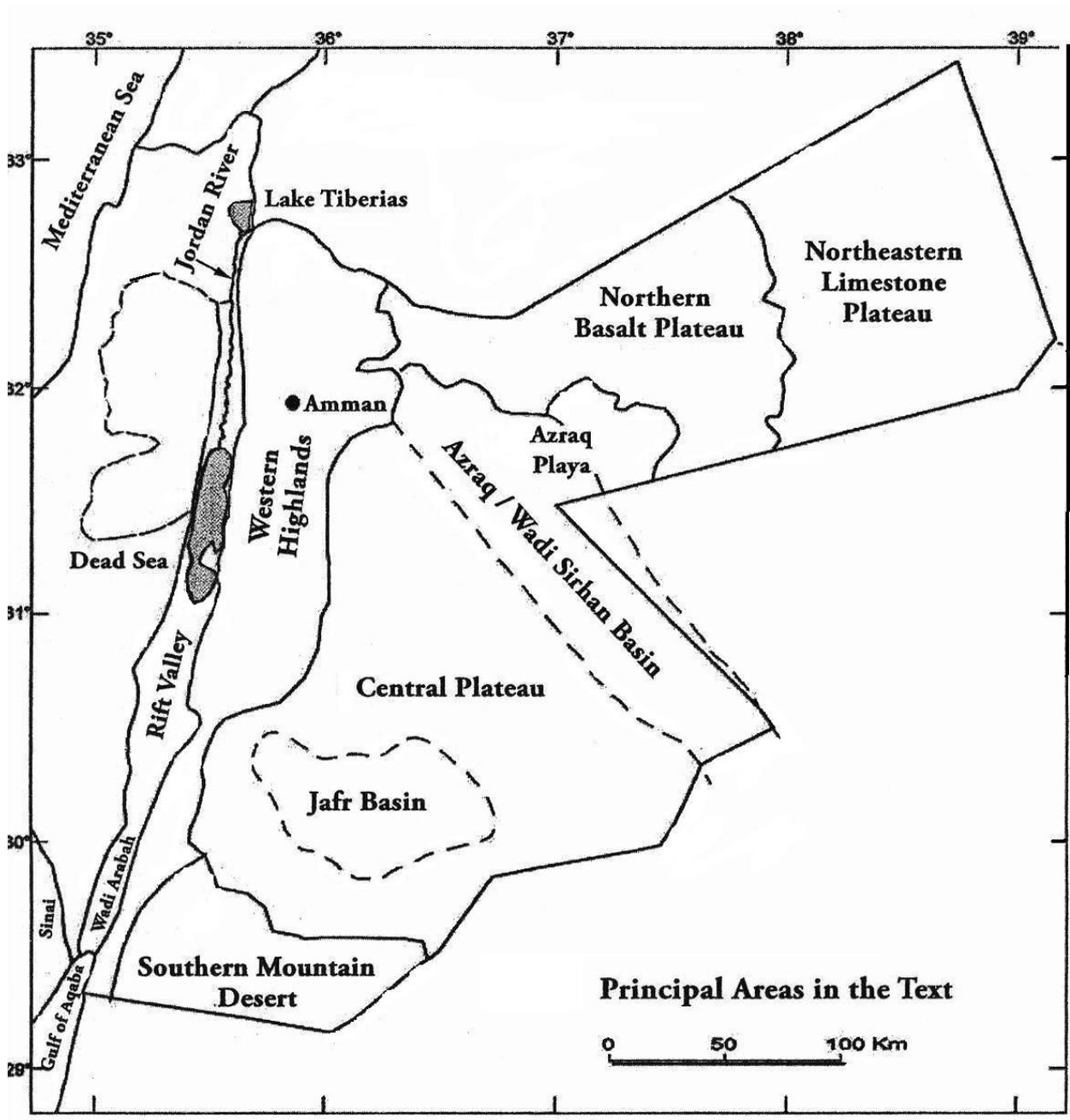


Figure (1). Five physiographic provinces of Jordan, and the locations of Lower Paleolithic archaeological sites (modified from Macumber 2008: 10).

The Physiography of Stone Age Jordan

Phillip Macumber (2008: 7-34, see also 2001) has published a physical

geography of Jordan that constitutes a useful organizational framework for this overview. Macumber divides the country into five physiographic provinces, in which remains of the Paleolithic are differentially distributed. Those provinces are (1) the Jordan Rift Valley (the Jordan River, the Wadi Arabah and the Dead Sea depression), (2) the Central Plateau (the Jafr and Azraq/Wadi Sirhan basins), (3) the Northern Basalt and Limestone Plateaux, (4) the Southern Mountain Desert (the Wadi Hisma, Judayid basin, Jebel Qalkha), and (5) the Western Highlands (Wadis Hammeh, Himar, Zarqa, Hasa and tributaries) (Figure 1).

Depending on the period of interest, some of these provinces are better investigated than others. Most sustained Paleolithic research is confined to the Western Highlands, the Southern Mountain Desert and the Azraq Basin. In most cases, early archaeological sites are associated with lakeshore environments in what were grassland savannas over much of the Pleistocene with East African flora and fauna. The best known and most enduring of these was the Samra/Lisan lake succession in the Jordan Rift Valley (e.g., Yechieli et al. 1993). Extensive lake beds have also been identified in the Jafr Depression (Huckriede and Wiesemann 1968), while the Azraq Basin sustained paludal swamps and marshes after about 45 kya, during the early Upper Paleolithic (Garrard et al. 1994). Henry also reports 'remnant Pleistocene lakes' in the Wadi Hisma, along the southern edge of the Jordan Plateau (1995: 38, 39). Most recently, the chronology of Pleistocene Lake Hasa has been reconstructed (Schuldenrein and Clark 1994, 2001, 2003; Schuldenrein 1998).

Although the Dead Sea depression represents a kind of 'ultimate base level' for the entire region, it is difficult to extrapolate from what is known about it to other, more ephemeral lakes located in different topographic settings and at different elevations. The fill of any catchment basin is the long-term product of numerous cycles of fluvial, colluvial, aeolian and lacustrine deposition, and episodes of accelerated downcutting or erosion caused by changes in the profiles of equilibrium of the wadis (and, in some cases, perennial streams) that drained into it. The Dead Sea depression is part of the Great Rift Valley system that extends from East Africa to Lebanon. It was created by tectonic activity beginning in the early Miocene, about 15 mya, with accelerated rift formation in the late Miocene

or early Pliocene, around 6 mya. Since first opening to inflow from what is now the Red Sea, the bottom of the basin has dropped some 7500 m, while at the same

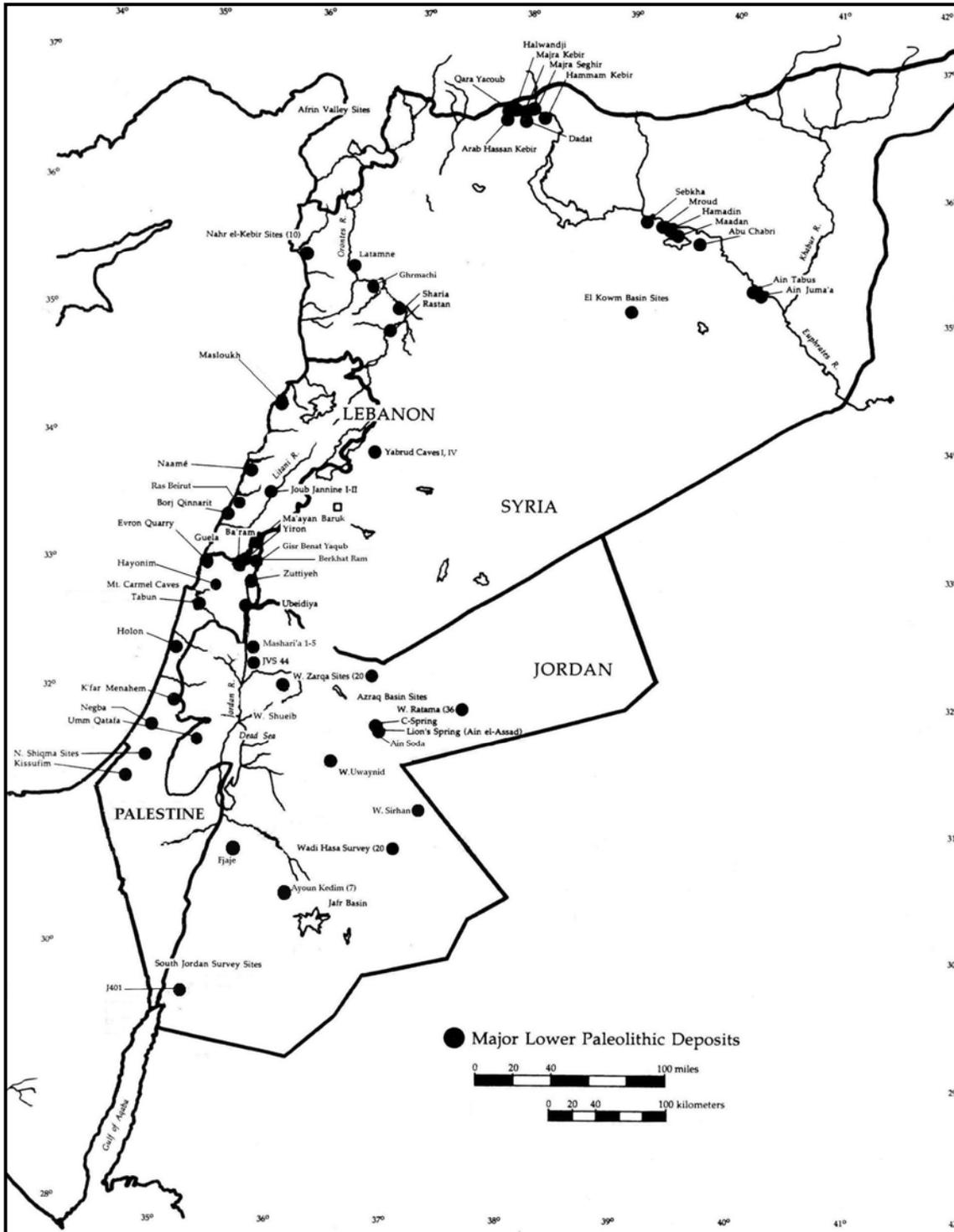


Figure (2). The Distribution of the better-documented Acheulean sites in the Levant.

time filling with enormous quantities of sands, silts, gravels and conglomerates deposited by the ‘ancestors’ of the various wadi systems that now feed into the depression (e.g., wadis Mujib, Hasa, Na’ur, Zarqa, and many others). Since the rate of deposition is slower than the rate of deepening of the *graben*, the Jordan Rift has become a canyon lying atop a stratified series of geological formations nearly 7 km thick.

Over its long geological history, many lakes occupied parts of the greater Jordan Valley, some of them stretching for more than 220 km from north to south. The earliest of these was Lake Usdom, which existed between 7 and 3 mya, and which accounts for most of the 4000 m thick Usdom Formation. Lake Usdom was not as low as the Dead Sea, and not as deep, but was the base level for drainage into the Rift, just as the Dead Sea is today. Although mostly so salty as to preclude any life, Lake Usdom was intermittently connected by broad, shallow channels to what is now the Mediterranean Sea. During these intervals, salinity was reduced and fish (*Mugil priscus*) were able to survive there. Although hominins were present in Africa during this time, there are no indications they had extended their ranges to the similar environments of the Middle East. The next body of water to occupy the depression was fresh-water Lake Shagour, located to the northeast of the present Dead Sea. It formed around 2 mya, persisted for an undetermined length of time, and coincides with the earliest relatively credible date (c. 1.4 mya) for a human presence in the region. Better known geologically is the fresh-water Samra Lake. Although its age is also uncertain, there is a weak consensus that it might have formed early in the Upper Pleistocene during a warm, wet interval possibly correlated with Marine Isotope Stage (MIS) 5 (128-71 kya). MIS 5 was followed by a short, sharply colder and drier episode (MIS 4, 71-59 kya), but whether the Samra Lake disappeared completely is not known.

The immediate predecessor of the Dead Sea is Lake Lisan, which probably began to fill around 70-60 kya, and likely persisted until some point between 15 and 11 kya (the age of disappearance is disputed). The Lisan Lake was originally very large (c. 225 km from north to south) and extended from Lake Tiberia to a point in the Wadi Arabah about 35 km south of the current Dead Sea. As it dried out, it eventually broke up into 3 smaller lakes, of which only Lake Tiberia and the

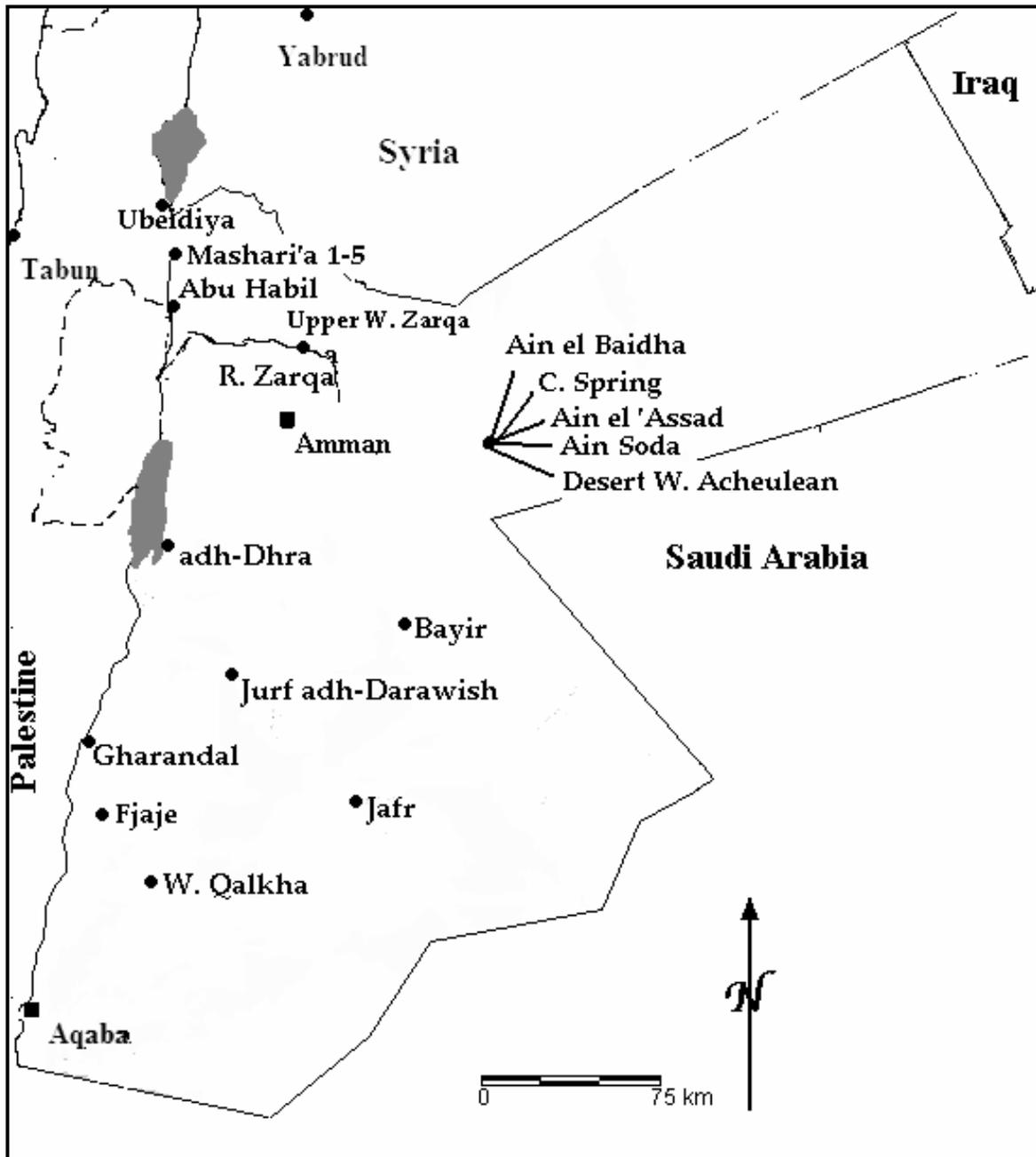


Figure (3). Map showing the distribution of the better documented Acheulean sites in Jordan.

north basin of the Dead Sea survive today. The highest still-stands of Lake Lisan were about 220 m above the present level of the Dead Sea (-430 m), and corresponded to the last two glacial maxima, at c. 72 and c. 18 kya. Lake Lisan

was, on average, fresher in its deep, northern basin than it was in the shallower southern basin. Both the Samra and Lisan lakes oscillated between weakly alkaline and fresh water during the considerable time they existed. On a macroscale, changes in the base level of the lakes affected the profiles of equilibrium of all wadis draining into it, but it is difficult to correlate local basin sequences upstream with those in the Dead Sea depression. Throughout their long history, the Western Highlands have been subjected to tectonic activity, volcanism, subsidence and faulting so that local basin sequences rarely, if ever, reflect those recorded in the Jordan Rift. That said, it is reasonable to suggest that, when the Samra and Lisan Lakes were at their highest still-stands (c. 75, c. 20 kya respectively), smaller lakes were also likely to have been most prevalent in the Jordanian landscape.

The Hasa and Lisan models suggest a very rough correlation between the age of Paleolithic flint scatters and that of lake still stands if the latter were of sufficient duration to be preserved, identified and dated. Each paleolake is somewhat unique in terms of its fluvio-limnic chronology because each lake basin is influenced by the size and geomorphological history of its catchment. Except in very general terms, it has not been possible to correlate temperature and moisture changes with degree of wind abrasion, rolling, patination or other forms of physical and chemical weathering (Walwer 1993).

The Lower Paleolithic of Jordan

(>1.5 million – c. 250,000 years ago)

The Lower Paleolithic comprises the interval of time from the appearance of the earliest unequivocal stone artifacts late in the Pliocene (c. 2.6 mya at Kada Gona, in Ethiopia) to a vaguely-defined terminus sometime late in the Middle Pleistocene (c. 150-100 kya). Three major technotypologically-defined units are commonly recognized: (1) the Oldowan (after Olduvai Gorge: non- or pre-bifacial flake and core industries with few or no formal tools, c. 2.6-1.6 mya), (2) the Acheulean (after St. Acheul: the classic bifacial handaxe industries of Africa and western Eurasia, c. 1.6 mya-150 kya) and (3) the Chopper-Chopping Tool Tradition of East Asia (a term created by Hallam Movius in 1948: crude, Oldowan-like core and flake industries with little bifacial reduction, c. 2 mya-100 kya). There is enormous

temporal and spatial variation within these broad classificatory units, and (other than the above) no consensus about how they are defined, nor what they mean, or represent, behaviorally. So great is the formal diversity within them that how they are interpreted is largely dependent upon preconceptions and assumptions about human biological evolution, and the presumed identity of their makers. The initial appearance of stone artifacts was taken to mark a major evolutionary divide (the 'Human Revolution' of Ashley Montagu [1965: 15]) between our lineage and those of non-human primates but, with the recognition that chimps, bonobos and even some Old World monkeys make and use tools, this has increasingly been viewed as an oversimplification. Three major obstacles confront the Lower Paleolithic specialist: (1) the definition of pattern in archaeological assemblages produced by creatures that pertained to different genera than ourselves (thus rendering problematic all kinds of baseline assumptions about what constitutes 'human' cognitive evolution, and how it might be identified in the archaeological record of the remote past), (2) very limited understanding of the selection pressures that are driving pattern changes, and (3) limited control of the myriad natural and cultural site formation processes that have intervened between the context of behavior (when the artifacts were made and used) and the context of discovery (the past 150 years). In the Levant (Belad el Sham), most Lower Paleolithic 'sites' consist of polished and wind-abraded, (sometimes) rolled scatters of artifacts and isolated finds derived from long vanished early Pleistocene landscapes and concentrated by deflation on the modern surface. Polygenic in origin, they typically preserve little in the way of site contextual integrity. A small number of in situ Lower Paleolithic sites have been discovered, however; several of them preserve (extremely rare) organic material (bone, wood), and have been tested or excavated in recent years.

The Oldowan

The only well-documented Oldowan site in the Levant is Ubeidiya (Oubeidiyah, Ubeidije, Ubaydiyah – spellings vary by language), located on the western escarpment of the Jordan Rift south of Lake Tiberia in Palestine. Ubeidiya consists of a series of steeply-dipping conglomerates and clays, now overturned

and eroded, containing sparse hominin remains and a long sequence of Oldowan and Acheulean archaeological sites. A total of 45 beds (many of them nearly vertical), numbered sequentially (Bed I is the oldest), are exposed at the three localities that make up the site. The beds are grouped into five major units, which reflect major paleoclimatic changes through time. Up through the end of the third unit, there is no evidence for hominins, either in the form of skeletal material or in the form of stone tools. The earliest evidence of a human presence occurs in the fourth unit, consisting of a complex series of silts, redeposited soils, sand, and clays totaling some 22-30 m in thickness. In general the sediments record fluviolittoral deposition in a delta at the edge of an early Pleistocene lake that transgressed and regressed twice during the Lower-Middle Pleistocene. The fauna reflect the transitional nature of the littoral environment known from the sedimentology. On the one hand, there are invertebrate genera (crustaceans, shellfish etc.) and the bones of about 20 genera of fish and amphibians, which record deposition offshore. On the other, there are terrestrial vertebrates in abundance, including insectivores, at least 12 species of carnivores (among them a sabre-tooth cat), archaic forms of elephant (*Archidiskodon* sp.) and rhino, five equids (including the Tertiary relic *Hipparion*, and *Equus*), several large and middle-sized bovids, a hare, porcupines, gerbils, a cercopithecoid monkey and a variety of murine rodents (which have formed the basis for a biostratigraphy). Hominin fossils tentatively attributed to *H. ergaster*/*H. erectus* come from this unit, as well as two Oldowan and a long series of Acheulean assemblages. These early strata have been compared with archaeological material from Middle and Upper Bed II at Olduvai; the proportional representation of types in the two series, as well as the general level of technological development, are argued to be closely similar. A transition from Oldowan to Middle-Upper Acheulean is documented. On the basis of the evolution of the rodent teeth, these sediments are dated biostratigraphically to c. 1.4-1.2 mya, and thus are coeval with Upper Bed II and Bed III at Olduvai (Tchernov 1988). Until the discovery of the Georgian site of Dmanisi, in 1994 (Gabunia & Vekua 1995), Ubeidiya was considered to mark the earliest excursion of hominins out of Africa. Biogeographically, however, it is simply an extension of the kinds of east African environments to which hominins

had been adapted for hundreds of thousands of years (see Bar-Yosef and Goren-Inbar [1993] for an analysis of the lithic industries).

Oldowan artifacts tend to be very crude and informal. While they exhibit most or all of the characteristics of humanly-broken stone (striking platforms, bulbs of percussion, striae, *erailure* scars, etc.), whether there are any formal tools in the Oldowan has been questioned. Although Mary Leakey (1975) thought that the 12-14 Oldowan tool types she defined were artifacts in the conventional sense of the term, produced to conform to design specifications as part of a mental template, Schick and Toth have argued that the morphological types overemphasize the formal aspects of Oldowan assemblages, and that a morphological continuum is actually present, divided up artificially by preconceptions about tool form in the minds of modern archaeologists (e.g., Schick et al. 1999). If this is true, it seems likely that the main objective of the makers of the Oldowan was simply to produce a range of sharp-edged flakes and that most of the heavy-duty 'tool types' are in all probability only discarded cores. Oldowan assemblages are remarkably uniform through time and across space. Most of the differences among them can probably be attributed to differences in the size and quality of the raw material available. Areas poor in large nodules (e.g., Koobi Fora) tend to have assemblages rich in 'light duty' flake tools; those where larger chunks of raw material are readily available (e.g., Olduvai) tend to have assemblages dominated by 'heavy-duty' cores and core 'tools'.

To date, no unequivocal Oldowan sites have been recognized in Jordan, although they almost certainly exist among the ancient, deflated surface scatters that litter the landscape. The best candidate for an Oldowan site is probably Shuwayhitiyah (site 201-49 of Parr et al. [1978]), located in the Wadi Sirhan, on the edge of the Central Plateau just over the Saudi border. Shuwayhitiyah consists of at least 15 dense surface scatters of choppers, polyhedrons, picks, cleavers, scrapers, and a few crude bifaces, all made of quartzite (Whalen & Pease 1990). As do other, later Acheulean sites in the area, Shuwayhitiyah lies at the base of an escarpment. The pieces are attributed to the early Lower Paleolithic based on their technology and the degree to which they are weathered and patinated. The location of the site is interesting. The excavators suggest it might lie on one of the major

inland corridors used by early hominins during the initial exodus from Africa after 2 mya (Whalen & Kolly 2001). In conventional techno-typological terms, these are indeed Oldowan artifacts, but much controversy presently surrounds what does or does not constitute the Oldowan. Recent work makes it clear that there is a lot of under-acknowledged variability in these assemblages, that ‘the’ Oldowan is not a single entity or analytical unit, and that Oldowan sites occur throughout the Lower Paleolithic (see papers in Hovers & Braun 2009).

The Acheulean

There is a vast literature on the large, bifacially-flaked handaxes and cleavers that define the Acheulean, how they might be described typologically and technologically; what they might mean behaviorally, symbolically and functionally, and what they might imply for local group size and composition, mobility, site types, raw material procurement and – most broadly – adaptation. Many also believe they encode information about the evolution of human cognition, especially when compared with the Oldowan. In contrast to the Oldowan, however, Acheulean sites are fairly common in the Levant, and some of the most important ones have been discovered in Jordan. Typologically, most are attributed to the ‘Middle’ or ‘Upper’ phases of the industry, although the prevalence of large nodules and cobbles of good-quality flint and basalt is probably driving assessments of the relative degree of refinement, rather than any implied chronological progression. Regarding this questionable practice, Muheisen (1993:164) and Copeland (1998: 6) remark that, whenever possible, it is much preferable to divide the Acheulean according to the geochronology of the findspot. Thus, ‘Early Acheulean’ would refer to the Early Pleistocene, ‘Middle Acheulean’ to the Middle Pleistocene, and so forth.

The Acheulean in Palestine, Lebanon and Syria is represented by about 20 sites that have been excavated, tested or collected, and at least preliminarily published (Figure 2). Most of them (14, 70%) are located in Palestine, or in the Golan Heights. Probably reflecting more intensive hominine use of Levantine coastal environments when compared with those of the interior. Both cave and rockshelter sites (e.g., Tabun, Yabrud), and open-air sites (e.g., Latamne) are represented, and

Table 1. Some Important Acheulean and Yabrudian Sites in Southern Levant (adapted from Horwitz & Chazan 2007: 183).¹

Site Name	Site Type	Elevation (ma/bsl)	Site Area (m2)	Area Excav. (m2)	Distance to fresh water	Site Reference
Latamne	open	c. 250	>5500	62	< 550 m	Clark 1966, 1967, 1969
Yabrud I	cave	1426	c. 150	c. 23	c. 8 m	Rust 1950
Gharmachi Ib	open	c. 265	c. 7700	c. 270	c. 750 m	Muhsen 1985
Nadaouiye I Ain Askar	open/sprg	465	1900	425 sect's.	near spring	Jagher 1993
Masloukh	cave	c. 40	400	16	?	Skinner 1970
Abri Zumoffen	cave	c. 12-14	c. 142	c. 18	c. 225 m	Roe 1983
Bezez C	cave	16	c. 210	c. 60	c. 250 m	Roe 1983
Evron Quarry	open	c. 20	> 20000	225 sect's.	riverbank	Ron et al. 2003
Zuttiyeh	cave	-148	c. 300	> 220	near wadi	Turville-Petrie 1927
Ma'ayan Barukh	open	250	>500000	surface col.	lakeshore	Stekelis & Gilead 1966
Yiron Plateau Sites (8)	open	600-700	14200	surface col.	playa	Ohel 1986
Berekhat Ram	open	1000	12000	30	playa	Goren-Inbar 1985
Gisr Benat Ya'aqub	open	70	>175000	c. 135	riverbank	Goren-Inbar 1992
Ubeidiya	open	c. -200	13 ha	c. 1530	c. 150	Bar-Yosef & Goren 1993
Tabun E/F	cave	63	400	80	c. 31 m	Jelinek 1981, 1982; Rollefson 1978
Qesem	cave	90	?	?	?	Weinstein-Evron et al. 1999
Holon	open	c. 40	c. 600?	c. 260	c. 1500 m	Chazan & Horwitz 2007
Revadim Quarry	open	70	2000	22	wadi junct'n	Marder et al. 1998
Oumm Qatafa F	cave	515	c. 180	30-47	c. 45 m	Neuville 1931, 1951
Oumm Zinat	open	36	c. 200	c. 50	near wadi	Gilead & Ronen 1977
Emeq Refaim	open	720-740	large	18	near River bed	Arensburg & Bar-Yosef 1963

organic deposits (bone, wood, vegetal matter) have been recovered from several of them. There are perhaps an additional 20-25 sites that have been reported, but which have so far been largely unanalyzed (see Goren-Inbar 1981, Muhsen 1985, Bar-Yosef 1994 for overviews of the Levantine Acheulean). In general, the Levantine Acheulean is poorly dated radiometrically, but fossil beach sequences, marine deposits, river terrace stratigraphies and paleolake deposits combine to form the basis for a fairly widely accepted relative chronology divided into Lower, Middle and Upper Phases dependent upon assessments of relative antiquity, and on technotypological considerations (Table 1). The appearance of non-biface.

assemblages like those from Europe (e.g., Tayacian, Clactonian) adds complexity to the picture, and there is no consensus whether or not they should be included in the Acheulean, the Oldowan, or in separate taxa. There is also the Acheulo-Yabrudian, or the Mugharan Tradition (Jelinek 1981), that falls in the latter part of the sequence and appears to be confined to the Levant. Efforts to refine the chronology based on biostratigraphy, techno-typology, and the relatively few ESR, TL and U-series dates available, have resulted in (1) an Early Acheulean dated to >1 mya and c. 850-800 kya, (2) a Middle Acheulean between c. 800 and c. 500 kya, (3) a Late or Upper Acheulean, that extends from about 500 to 400 kya, and (4) an Acheulo-Yabrudian, from 400-350 kya to the earliest Middle Paleolithic, around 270 kya (as, e.g., at Tabūn, Level D) (Bar-Yosef 1994, Barkai et al. 2003). These 'stages' must be viewed with caution, as there are many conflicting radiometric determinations with large error terms. Nevertheless, they offer a rough sequence, weakly supported by claims of increasing typological refinement, decreasing biface dimensions, and (contested) frequency shifts in biface shape through time.

The Acheulean in Jordan

Because of scarce karstic topography relative to the Levantine coast, no Acheulean cave sites are known in Jordan. Evidence for the Acheulean is confined mostly to derived surface scatters; sites with high contextual integrity are found only in the Azraq Basin. Acheulean sites in Jordan occur in many different environments, including denuded upland plateaux, around the shores of fossil

lakes, in terraces and mountain valleys, and in spring deposits and oases. Typologically, most Acheulean sites are classified as 'Middle' or 'Upper' on the basis of indices of refinement. If handaxe refinement can be correlated with time (which is arguable), most of the Jordanian Lower Paleolithic would post-date c. 500 kya, and possibly later. The more important Jordanian sites and site clusters are shown in Figure (3).

Sites in the Western Highlands and South Mountain Deserts include (1) the Mashari'a site cluster in the Tabaqat Fahl Formation, exposed in the Wadis Hammeh, Himar and Hammam, near Pella; (2) Abu Habil, some 15 km to the south; (3) the upper Wadi Zarqa, north of Amman; (4) Fjaje near Shobek, in the Wadi Bustan, and (5) the Judayid Basin below the Ras en-Naqb escarpment, north of the port city of Aqaba.

The Mashari'a Sites

Mashari'a sites 1-5 occur on the Tabaqat Fahl plateau. Two of them (Mashari'a 1, 3) are situated in the upper limestone member of the Tabaqat Fahl Formation toward the western end of the plateau. Mashari'a 1 is the more extensive of the two, outcropping from a tufaceous limestone for c. 400 m around the cliff face about 30 m below the surface of the plateau. The tufas suggest deposition in a freshwater marsh or lake near a strong, long-lasting spring, the kind of resource-rich microenvironment that would have attracted both humans and animals to the area. Macumber (1992) estimates an age of about 250-200 kya for the site, which has not been dated radiometrically. Given its secure stratigraphic context, the fresh condition of the artifacts and the fact that conjoinable pieces have been recovered, Mashari'a 1 is almost certainly archaeologically in situ. Excavations by an Australian team in the mid-1990s yielded a large lithic assemblage dominated by biface thinning flakes, shatter and debitage, suggesting that one of the activities conducted at M1 was the thinning of bifaces (Macumber & Edwards 1997). Bifaces were generally well-made cordiform or Micoquian types, retouched by the soft hammer technique. Few finished bifaces were recovered, however, which might mean they were carried, used and possibly discarded off-site. Notched flakes, invasively retouched pieces and other flake tools were also present in some

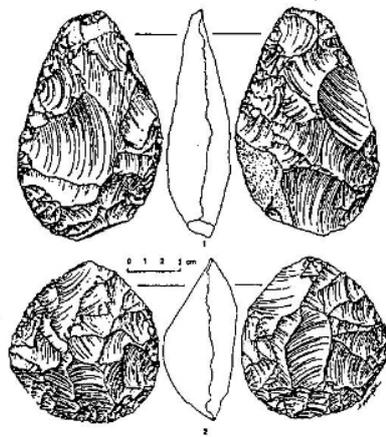


Figure 4: Wadi Qalkha (J-401): (1) amygdaloid biface, (2) cordiform biface (original drawing in Henry [1995: 46]; from Copeland [1998: 14]).

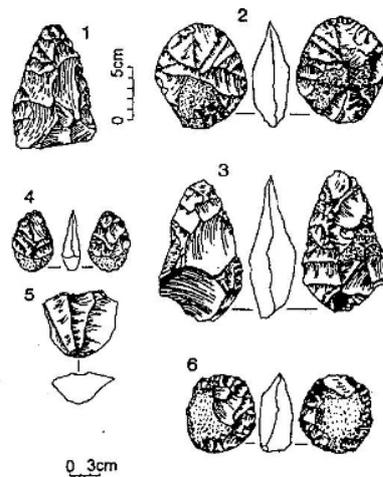


Figure 5: Acheulean of southwestern Jordan: (1) Wadi Jurdhan (original in Muheisen [1986: 6]; (2) Fjaje ovate biface, (3) amygdaloid biface, (4) small biface, (5) core, (6) chopping tool (original drawings in Rollefson [1985: 104]; from Copeland [1998: 14]).

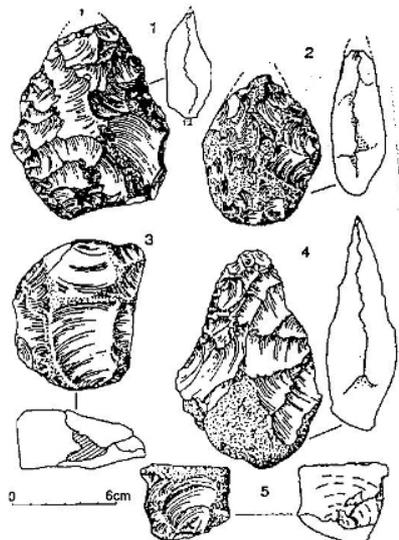


Figure 6: Upper Wadi Zarqa, Site KS 119b: (1) amygdaloid biface, (2) ovate biface (rolled), (3) Levallois-like core (rolled), (4) Site KS 30: amygdaloid biface with soft-hammer retouch; (5) flake with plain, wide-angle butt (original drawings in Copeland & Hours [1988: 287-309]; from Copeland [1998: 12]).

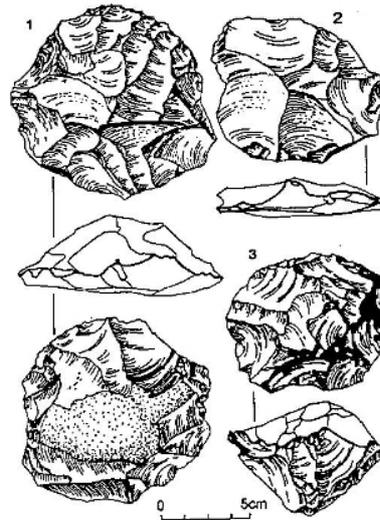


Figure 7: Azraq, C-Spring, Level R: (1) 3 views of Levallois core (unstruck?), (2) disk or Levallois core (exhausted), (3) biconical discoid core (original drawings in Copeland [1989b: 353-377]; from Copeland [1998: 17]).

quantity and indicate activities in addition to biface manufacture and reduction (Copeland 1998). These sites are Upper Acheulean, based on the age estimates and the biface metrics.

An additional three sites (Mashari'a 2, 4 and 5) outcrop from deep within the underlying lower conglomerate, on the north-central and eastern parts of the plateau, and are thus stratigraphically older than Mashari'a 1 and 3. How much older is uncertain, although Copeland (1998) remarks on similarities between two handaxes from M4 and those from the Middle Acheulean site of Latamne, in Syria's Orontes Valley. If handaxe form can be taken as an indication of chronological equivalency, M4 could be as old as c. 560 kya, the youngest age estimate for Latamne. The older Mashari'a sites would, therefore, date to the Middle Acheulean, an assignment in agreement with the biface metrics (they are larger than the bifaces from M1 and M3). M2, 4 and 5 are also undated. Given the geological context (a conglomerate), it is unlikely that they are archaeologically in situ.

Copeland (1998: 9) remarks that Villiers (1980) was the first to note the presence of Lower Paleolithic artifacts in the Pella/Tabaqat Fahl region. At Abu el-Khas, a consolidated gravel conglomerate yielded a small series of crude, white-patinated, rolled flakes and pebble tools, tentatively assigned (following Bender [1974]) to the Early Acheulean, but now regarded as Middle Acheulean because of reassessment of the age of the geological context.

Abu Habil

Abu Habil consists of a 16 m-thick vertical section of fluvial conglomerates exposed near Abu Habil village at the edge of the Jordan Rift about 15 km south of Pella. The site was first reported by Huckreide (1966), who attributed artifacts eroding out of the section to the Oldowan, an attribution subsequently questioned by Macumber (1992). In 1985, Muheisen re-investigated the site, and described a provisional stratigraphy comprising a lower cemented conglomerate of fluvial origin, and an upper, geologically disturbed, poorly consolidated conglomerate layer (1988). The age of the conglomerates is uncertain, but Macumber is of the opinion that the lower conglomerate is probably part of the Tabaqat Fahl

formation (rather than the underlying Abu Hamil Formation, or the still-older Ubeidiya Formation), and therefore dates to the Middle Pleistocene. The age of the upper unit is more equivocal; a date of c. 250 kya has been suggested (Macumber & Edwards 1997). Both strata yielded patinated and rolled choppers, cores, flakes, a trihedral pick, and a few crude and irregular bifaces made with the hard hammer technique. Macumber and Edwards (1997) remark on the presence of a significant Middle Paleolithic component (i.e., Levallois flakes, cores). While biface form and manufacturing technique suggest an early stage in the Acheulean, the geology indicates that the Abu Habil artifacts are at most about 500,000 years old, and probably considerably younger.

The Upper Wadi Zarqa

Acheulean artifacts in relatively well-understood geological contexts have also been reported in the Middle Pleistocene terraces of the upper Wadi Zarqa and its tributaries, north of Amman. A 4-5 part alluvial/colluvial terrace sequence was defined by Besançon and colleagues (1984) in the 1980s, and linked to terrace sequences in Syria (a correlation questioned by Macumber [1998] because of the confounding effects of tectonics in the Zarqa drainage and the distances involved). Terrace evolution is interpreted in terms of macroclimatic change, with aggradation the dominant geological activity during colder and/or drier phases, downcutting accelerating during warmer/wetter intervals. The oldest of these terraces, the Dauqara Formation, lies at 70-80 m above the modern valley floor, and consists of cemented conglomerates containing derived Middle Acheulean artifacts (but see below). These pieces, thought to date from the penultimate (Mindel) glaciation, could be as old as 500 kya, but are probably younger. The next oldest unit, the Bire Formation, has also yielded rolled bifaces, cores and flakes assigned on geological grounds to the Upper Acheulean, and tentatively dated to about 200 kya (Figures 4-7). Except where they contain redeposited older material, the lower terraces (Bire-Samra, Khirbat Samra and Sukhna Formations) have so far produced only Middle Paleolithic and later artifacts.

Subsequent work on the Dauqara Formation in the mid-1990s has called aspects of the preceding chronology into question (Parenti et al. 1997). The most

important finding was that the Dauqara Formation is probably polycyclic and polygenic (i.e., it contains erosional debris from more than one climatic episode) and might span the entire Early Pleistocene, rather than just the penultimate glacial cycle. Excavations at Sukhne North also showed that lithics and fauna might not be contemporaneous, and that sparse faunal remains from that locality (an elephant tooth assigned to *M. meridionalis*; an early equid, *E. cf. tabeti*; an auroch, *B. primigenius*) all indicate assignment to biozones 19-22, which would bracket the unit in time between c. 900 and c. 600 kya. The Dauqara artifacts are mostly non-diagnostic flakes, are not very numerous (c. 300 pieces), often heavily rolled, lack the distinctive bifaces, and like the sediments that contain them, are probably polygenic, prompting Copeland to remark that they might not be Acheulean at all (1998: 10). The Middle Acheulean in the Bire Formation has so far withstood critical scrutiny.

Fjaje

An enormous linear concentration of Late Acheulean artifacts, extending for about 20 km, has been reported from the western edge of the highland plateau at Fjaje, at an altitude of c. 1200 m overlooking the Wadi Bustan, near the town of Shobek (Rollefson 1981, 1985). Unlike the assemblages from the Wadi Zarqa, the collection from Fjaje is in its approximate original location on the landscape because its artifacts have been deflated in place, rather than transported by water and redeposited elsewhere. Fjaje is a palimpsest comprising the remains of thousands of campsites accumulated in one spot over tens of millennia; its location in the landscape can be used to address the question of why this particular locale was visited repeatedly by foragers (presumably *H. erectus*) over such a long period of time. Rollefson (1985) suggests that the escarpment at Fjaje might have been used to monitor the seasonal movements of gregarious herbivores (esp. gazelle; also horses, onagers, camels, other antelopes) as they passed through the Wadi Bustan from the warmer, more heavily vegetated Wadi Arabah lowlands to the western highland savannas during the spring migration. Confined to the wadi bed, they would have been relatively easily ambushed by hunters waiting along the rim at Fjaje. Prevailing westerly winds in the spring would have placed the hunters in a

downwind position relative to the animals, and the long climb up the Wadi Bustan from the Arabah might have tired and weakened them, perhaps making them more vulnerable to predation. In combination, the two factors would have increased the success rate of what might be the earliest known example of intercept hunting, and led to repeated use of the scarp edge over long periods of time (Olszewski 2001: 39). The artifacts themselves are described as ‘typical Late Acheulean’ ovate and lanceolate bifaces, choppers and chopping tools (sometimes made on pebbles), both Levallois and non-Levallois flakes, and cores. If Rollefson’s interpretation of the site is correct, it would constitute evidence for surprisingly modern cognitive behavior by pre-modern, Middle Pleistocene hominins using ‘archaic’ lithic technologies.

Wadi Qalkha

The Southern Mountain Desert Province contains only a single well-documented Late Acheulean site, Wadi Qalkha (J401), located on the western edge of the Judayid Basin, immediately south of the Ras en’Naqb escarpment (Henry 1995: 43-48). J401 consists of a light scatter of 59 artifacts eroding out near the top of a 30 m thick section of an alluvial fill overlying a calcareous conglomerate (the Qalkha Formation) in a deeply incised wadi draining Jebel Qalkha. Most of the pieces are fresh and unrolled, although lightly patinated. The collection is small, but reasonably diagnostic of the Late Acheulean. It consists of 10 well-made amygdaloid, cordiform and ovate handaxes, finely finished with the soft hammer technique; a small number of sidescrapers, a notch, 3 truncated and 6 continuously retouched flakes. An unusual aspect of the debitage component is a fairly high incidence (38%) of blades. Blades are absent in the retouched pieces, suggesting preferential selection of flakes for tool manufacture. Two Levallois flakes were also recovered. The appearance of fairly convincing sidescrapers raises the question of affinity with the Acheulo-Yabrudian, an industry or technocomplex arguably interposed between the Lower and Middle Paleolithic (Jelinek 1982). Whatever the case, the site is unlikely to be much older than c. 250ky.

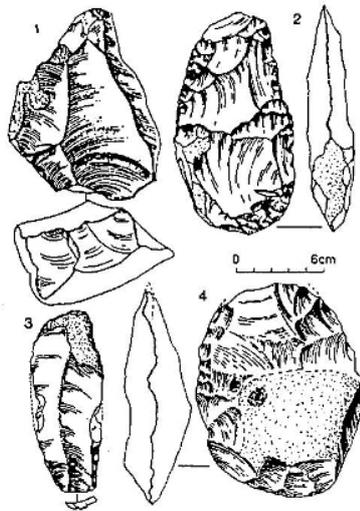


Figure 8: Azraq, Desert Wadi Acheulean: (1) Levallois-like core (rolled, AZ 121Q) (2) ovate biface (AZ 247A), (3) blade (rolled, AZ 121Q), (4) ovate biface or cleaver (heavily rolled, AZ 121Q) (original drawings in Copeland [1989a: 98-104, 109-122]; from Copeland [1998: 15]).

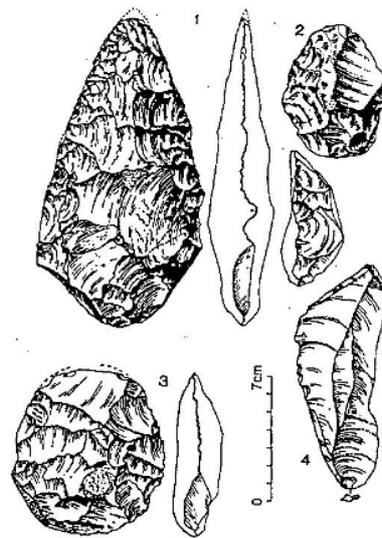


Figure 9: Azraq, Desert Wadi Acheulean: (1) lanceolate biface (AZ 121Q), (2) convex sidescraper on a thick flake (AZ 124B), (3) bifacial cleaver (AZ 247A), (4) retouched blade (AZ 247A) (original drawings in Copeland [1989a: 98-104, 109-122]; from Copeland [1998:15]).

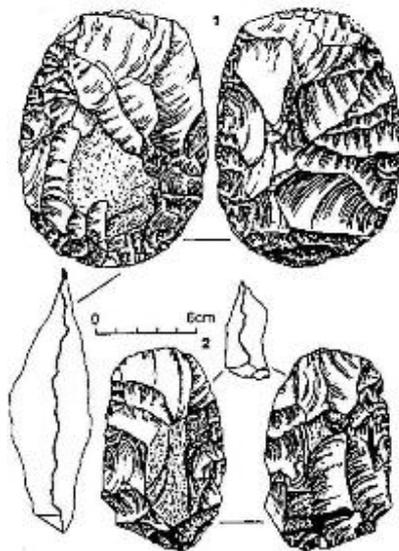


Figure 10: Azraq, Lion Spring, Kirkbride excavations: (1,2) bifacial (cleavers) (original drawings in Copeland [1989d:188-198]; from Copeland [1998:16]).

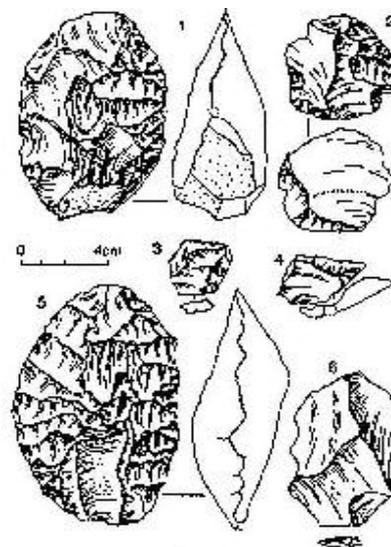


Figure 11: Azraq, C-Spring, Level R: (1) bifacial cleaver with thick butt, (2) side-struck cleaver flake, (3, 4) biface preparation flakes, (5) ovate biface, (6) Levallois-like biface preparation flake (original drawings in Copeland [1989b:353-377]; from Copeland [1998:18]).

The Central Plateau is the largest physiographic province in the nation and occupies much of central Jordan. It extends from the catchment of the Azraq and Wadi Sirhan depressions on the east and north, to the Western Highlands in the west, and to the Ras en'Naqb escarpment in the south (Macumber 2001). Acheulean on the Central Plateau is represented at (1) the Azraq Basin, some 75 km to the southeast of Amman; (2) the Wadi Sirhan, in east-central Jordan near the Saudi border, and (3) the Jafr and Bayir depressions, in the south-central part of the kingdom, some 100 km east of Petra. Numerous surface finds of isolated handaxes and other Lower Paleolithic artifacts have also been reported by various surveys in this region. By far the most important of the Acheulean sites on the Central Plateau are the spectacular discoveries in the Azraq Basin.

The Azraq Acheulean

The Azraq Basin is an irregular depression with elevations ranging between c. 1800 and c. 500 m, covering an area of about 13,000 km². Near the center of this large catchment, at an elevation of c. 500 m, are the spring-fed Azraq Marshes, known today for their relict floras and faunas. The basin contains a long record of paleolithic occupation, extending back to the late Middle and early Upper Pleistocene. Within the marshes, an area of c. 6-8 km² comprises the Azraq Oasis, an area of permanent wetlands, marshes and pools, fed by strong, perennial springs emerging from under basalt lava flows to the north and east of the modern city. The oasis is surrounded by a larger, seasonally wet *sabhka*, or playa lake, the Qa Azraq, which forms a catchment for a network of wadis to the south, east and west. The present environment is arid to hyper-arid, but was markedly wetter at intervals in the past, although even today the water table lies only some 1-2 m below the playa surfaces. Both the wadi systems and the central playa/spring area have a history of occupation that goes back to the Lower Paleolithic and extends up in time to the Neolithic and beyond. Both the geology and archaeology of the Azraq Basin have been extensively investigated, and the Lower Paleolithic has been published in considerable detail, notably by Copeland & Hours (1989a-c), and reprinted in anthologies (e.g., Henry 1998, MacDonald et al. 2001, Adams 2008) (Figures 8-11). The following account is drawn from these sources.

At Azraq, Acheulean artifacts have been recovered from two contexts: (1) the wadis to the south and west of the central marshes, and (2) the spring sites in the oasis area proper. The basin exhibits a radial network of intermittent watercourses that feed the central 'sink', and the better-watered western side of the catchment is rich in Acheulean surface scatters associated with a 3-terrace sequence first defined by Besançon and Sanlaville in the early 1980s (e.g., Besançon & Sanlaville 1988). Copeland (1998) notes that the western part of the basin contains hunting lodges dating to the Islamic period, so that its bleak appearance today is likely due to the combined effects of overgrazing and tree-cutting for firewood in the recent past. Acheulean sites are concentrated in the wadis Kharana, Janab, Butm and Ratama, and are all considered 'late' (i.e., post-dating 250 kya). Copeland coined the term 'Desert Wadi Acheulean' (DWA) to distinguish these sites from those in the springs, and the term has since acquired wider currency, being used to refer to Late Acheulean surface sites throughout the Levant. The DWA sites in the Azraq are derived to various degrees, but are reasonably consistent so far as typology and technology are concerned. They show up in terrace conglomerates considered by Besançon and Sanlaville to date to the penultimate glacial (now equated with MIS 6, 186-127 kya). The diagnostic pieces are generally well-made ovate, discoidal and lanceolate handaxes, and bifacial cleavers, marginally retouched by the soft hammer method, and sometimes accompanied by large blades with plain striking platforms and 'proto-Levallois' cores and flakes. Some of the DWA collections (e.g., Kharana 103) also contain truncation burins, truncations and endscrapers on blades, composite tools usually associated with the Upper Paleolithic, and typical Middle Paleolithic Levallois points, flakes and cores, suggesting a polygenic origin and subsequent mixing. Isolated handaxes also occur on interfluves, terrace remnants and in the wadi beds throughout the western and southern parts of the basin, but not, apparently, in the north and east, which is covered by an erosion-resistant basalt lava flow (the source of the blocks used to construct Q'asr Azraq). The DWA is usually taken to be the archaeological 'signature' of human exploitation of the grassland savannas and steppes that covered the central plateau during most of the Pleistocene. The concentration of Acheulean sites in the basin can probably be explained by the presence of an oasis in a landscape in which

surface water was relatively rare.

One of the DWA sites in the Azraq Basin might pertain to the Middle (rather than the Late) Acheulean. Rollefson (1984) reports a linear scatter of Acheulean artifacts along a 2 km stretch of the Wadi Uwaynid, about 15 km to the southwest of the marshes. Most of the artifacts are concentrated in a 750 m long oval, and appear to be eroding out of terrace remnants on both sides of the wadi. The pieces are derived, as indicated by heavy abrasion due to rolling. Most of the bifaces are relatively crude ovates and Abbevillian types, suggesting that they might be older than the Upper Acheulean commonly found in the area. Because the artifacts have been removed from their original contexts, about all we can conclude from them is that humans with Acheulean technologies might have been present in the area as early as 450-500 kya. Chronological assignments based on the notion of vectored technological and typological change are notoriously unreliable, and a secure date for the Wadi Uwaynid site must await a geological assessment of the context from which the artifacts are derived.

By far the most important Lower Paleolithic sites in Jordan, and among the most important in the Levant, is the 'Late Acheulean of the Azraq Facies', a term coined by Copeland (1989a) to refer to a cluster of spring sites located in Azraq esh-Shishan on the west edge of the Azraq Oasis, just south of the southernmost extension of the Jebel Druze basalts. Groundwater trapped beneath the lava emerges here to form strong, permanent springs that create pools surrounded by extensive tracts of wetland vegetation (now, unfortunately, shrinking rapidly because of falling water tables caused by pumping water to Amman and Mafraq). The existence of Lower Paleolithic artifacts in the springs was first noted by Harding (1959), when bull-dozing to expand irrigation canals at Lion Spring (Ain al'Assad) brought to light large numbers of handaxes. Lion Spring was subsequently excavated by Kirkbride (1989), and later by Rollefson (1983), and the combined collections were analyzed and published by Copeland (1989a, b). Eight spring sites are now known to contain Acheulean artifacts and fauna (Lion Spring; C, D and E-Springs, Ain Soda, and Ain al'Beidha 1-3). Excavation at the springs was limited by the constant necessity of pumping out rising ground water until 1996, when the water table began to decline, causing the Ain Beidha springs

to dry up completely, and allowing for more extensive excavation at the others. Although several spring sites were tested in the 1990s, only Lion Spring, C-Spring and Ain Soda have been published.

The combined collection from Lion Spring is the largest Late Acheulean assemblage known from Jordan (>700 handaxes and cleavers; picks, choppers, chopping tools; small numbers of flakes, several kinds of cores, a few small Yabrudian like scrapers). The bifaces exhibit about a dozen plans, with lanceolate, ovate and cordiform types the most common. A noteworthy aspect of the combined collection was a substantial number (12.3%) of cleavers; Rollefson's excavation yielded considerably more of them (33.3%) than the Kirkbride and Harding collections (7.8%). Typologically, the pieces are well-shaped and finely retouched; these features and size metrics were the basis for Copeland's definition of the Late Acheulean of the Azraq Facies. During wetter intervals in the Middle and Upper Pleistocene, spring and surface discharge probably formed a lake, a conclusion borne out by the stratigraphy (lacustrine silts overlain by alluvial sands and gravels, a peat layer) in a grassland savanna with an African fauna. Pollen spectra are dominated by grasses, sagebrush, amaranth and chenopods, all non-arboreal species consistent with a dry grassland environment. Low frequencies of oak, pine, and willow pollen were probably washed or blown into the lake from distant uplands. The site has not been dated radiometrically, but is believed to be about 200,000 years old, based on a TL date from one of the Ain al'Beidha sites (Macumber 1992). As it is today, Lion's Spring was an oasis throughout its long history, attracting animals and humans to water in a landscape where it was scarce or absent.

C-Spring is another natural pool in Azraq esh-Shishan first enlarged and deepened in the 1950s as part of the Princess 'Alia General Development Plan (Baker & Harza 1958). The project produced not only quantities of bifaces, but also organic remains (bones, fossilized wood). After a later effort to create a fishpond yielded a second handaxe bonanza, Garrard excavated a small test pit about 30 m from the spring to a depth of 3m, an effort that resulted in a stratified series of Lower, Middle, Upper and Epipaleolithic, and Neolithic assemblages (Garrard et al. 1987). In Level R, at a depth of 3.1-3.2 m below datum, an

extremely dense mass of handaxes, cleavers, cores, flake tools and thousands of flakes was recovered from a blue-grey silt consistent with deposition in a low-energy paludal environment. All the pieces were in pristine condition which suggested to Garrard that, if they were transported at all, they had not moved very far. As at Lion Spring, there were large numbers of bifacial cleavers and bifaces with rounded tips, the latter perhaps representing the reworking of a handaxe into a cleaver. Noting the high number of thinning flakes and convinced the artifacts were in situ, the extraordinary concentration of lithics in Level R was interpreted to represent a knapping floor (*taller*), situated on the edge of the spring (Copeland 1989). The sparse fauna from C-Spring consisted of rhinoceros (*Dicerorhinus hemitoechus*), camel (*Camelus* sp.), hartebeest (*Alcelaphus* sp.), aurochs (*Bos primigenius*), two equids (wild ass, zebra), and elephant (*Elephas* sp.), all indicative of a grassland steppe. C-Spring has not been dated radiometrically, but the Late Acheulean at all the spring sites is assumed to be roughly contemporaneous, and to date to the latter part of MIS 7, a warm interval extending from 242 to 186 kya.

The 1996 drop in the water table also exposed Acheulean artifacts at a third spring, Ain Soda, and in 1997 a team headed by Rollefson collected artifacts from new bulldozer cuts, mapped a stratigraphic section exposed on the north side of the pool, and collected two concentrations of bifaces exposed, apparently in situ, in a greenish-grey marl on the southern and western edges. The two short field seasons in July and August, 1996, allowed for preliminary definition of the stratigraphy exposed in the spring wall, and for a partial description of the pieces collected from its southwestern corner. A total of 411 bifaces were collected, of which 218 have been classified as Late or Final Acheulean. Some 279 flake tools are also reported, along with at least 127 cores and hundreds of pieces of debitage (Rollefson et al. 1997). Because a few diagnostics of later periods are included in the collections, the confidence that can be placed in the non-bifacial component is not as high as that of the bifaces. Nevertheless, it seems likely that most of the collection pertains to a single time interval late in the Middle Pleistocene.

A striking feature of the Ain Soda Acheulean is an extraordinarily high incidence of bifacial cleavers (62% of the biface total). It has been suggested that

cleavers were used for primary butchering of large animals, so one implication of their high frequency is that Ain Soda was an area where an unusually large amount of butchering took place. In this respect it differs from Lion Spring and C-Spring, which have relatively few cleavers (6-33%, 25% respectively). The condition of the cleavers indicates very heavy usage and much damage to, and resharpening of, the bit. In some cases use damage to the bit was so severe that the *tranchet* blow that defines the type was obliterated. Evidence for heavy usage implies a considerable degree of displacement (the ability to take future contingencies into account), which suggests that *H. erectus* was cognitively similar to modern foragers in its capacity to conceptualize specific activities in the future, and to curate the tools necessary to carry them out.

Well-made bifaces and other (presumably late) Acheulean artifacts were also exposed in sediments excavated by bulldozers deepening the so-far uninvestigated sites of E-Spring and D-Spring in the late 1980s. Three more springs were reported at nearby Ain el-Beidha, where a travertine deposit was TL dated at c. 200 kya (Macumber 1992: 7). All three springs are now dry. Copeland considers these pieces to be late Acheulean, and broadly similar to those from the other spring sites. One possibly Yabrudian side scraper type was also recovered (1989: 453). The Acheulean sites at Azraq have been exhaustively described by Lorraine Copeland in two monographs co-edited with Francis Hours (1989a, b), to which the reader is referred for details and relevant bibliography.

The Azraq Acheulean artifacts from the spring sites exhibit variable states of surface condition (fresh, abraded, rolled, chalky, etc.) and patination (none, black, grey, white, mixed, double, desert varnish, etc.) (Rollefson et al. 1997: 53-55). This indicates a degree of polygenesis in the accumulations of these pieces, which were evidently exposed on the surface for varying intervals before being incorporated in the spring deposits. That said, the overall condition of the Acheulean artifacts in the springs is considerably fresher on average than those from the DWA, with the 'river of flint' (level R at C-Spring) perhaps the best candidate for a pristine, relatively undisturbed Acheulean site (Copeland 1998: 16, 17).

The Wadi Sirhan

Acheulean surface scatters have also been reported at the south end of the Wadi Sirhan, a trough-like, linear depression along the Saudi border, where a claim has been made for an Oldowan assemblage at Shuwayhitiyah (see above). Although not extensively reported, these pieces are assigned, on typological grounds, to the Middle Acheulean (Whalen et al. 1984). This part of eastern Jordan is extremely arid today, and devoid of permanent settlement. However, just across the international line, at ad-Dawadmi/Saffaqa, Whalen reports a rich Middle Acheulean assemblage made primarily of andesite, with bifaces, cleavers and numerous flakes. The depth of deposits (c. 90 cm) indicates repeated use of the locale, where the presence of extensive lake deposits (even waterfalls) documents a much wetter climate in the remote past, and one capable of sustaining Acheulean foragers (Whalen et al 1984). Middle Acheulean sites broadly similar to those at ad-Dawadmi are also found further south along the Red Sea coast near Jeddah. Whether these typology-based chronological assignments are reliable has been questioned by a number of workers on both logical and empirical grounds. What is certain is that the region was well enough watered at intervals during the late Middle and early Upper Pleistocene to have sustained extensive savanna grasslands and the large ungulate populations adapted to them. No foragers could exist in the area today, nor throughout much of the Holocene despite the consensus that the Holocene is an interglacial. As a general rule, cold intervals during the Pleistocene were relatively dry, while warm ones were relatively wet, although local conditions can vary markedly (Cordova 2007: 124). Based on global climatic models, the last time the Wadi Sirhan depression might have been habitable for savanna-adapted foragers would have corresponded to the very wet, warm MIS 5e (127-113 kya), although all of MIS 5 (127-71 kya) is considered an interglacial (albeit one marked by a long-term cooling trend interrupted by moisture and temperature 'spikes' at roughly 98 kya [5c] and 80 kya [5a]). Archaeological assemblages dating to MIS 5 are usually considered to be Middle Paleolithic (Mousterian), rather than Lower Paleolithic (Acheulean). MIS 6 (186-127 kya) is a cold, dry interval during which the Sirhan depression probably could not have supported extensive savanna grasslands. MIS 7 is a warm, wet interval, dated from

242-186 kya. Keeping this in mind, and if biface technology gives an indication of relative age, the most likely date for the Wadi Sirhan Acheulean is MIS 7. By Copeland's criteria, this would indeed be a Middle Acheulean industry because it dates prior to 130 kya, and thus falls within the latter part of the Middle Pleistocene (1998: 6).

The Jafr Basin

The Jafr and Bayir Basins, located on the Central Plateau in southeast and south-central Jordan respectively, have produced impressive Acheulean surface sites, some of which exhibit relatively high contextual integrity. Both basins were apparently filled by shallow, brackish and fresh-water lakes surrounded by springs at intervals during the Lower and Middle Pleistocene, and this fact suggests that most of the evidence for a human presence there corresponds to the warm, wet intervals identified as MIS 21-9 (865-301 kya). Since most of the bifaces are typologically 'Upper Acheulean', and noting the broad consensus that most of the Jordanian Acheulean pertains to its later stages, these sites probably date to the last two warm, wet intervals during this period (MIS 11 [427-364 kya] and 9 [334-301 kya]). The Jafr Basin Acheulean has been the focus of sustained research by Leslie Quintero, Philip Wilke and Gary Rollefson (e.g., Quintero et al. 2007; Rollefson et al. 2006, 2005), and the paleolandscape of the region has also been reconstructed (Rech et al. 2007). Work in the Bayir Basin (Bayir Wells) is much more preliminary. Acheulean sites in the Jafr Basin have been known to exist for a long time (e.g., Zeuner et al. 1957, Harding 1959, Van Lière 1960, Garrard et al. 1987), but have only recently been extensively investigated.

At intervals during the Pleistocene, the Jafr Basin contained one of the largest lakes (Lake el'Jafr) known to have existed in western Eurasia (maximum extent c. 12000 km²). Although its chronology is poorly known, the Jafr lake was surrounded by savannas populated by herds of gregarious ungulates (mainly antelopes) that constituted the principal source of protein for the hominins who shared the landscape with them. The work in the Jafr Basin centers on a cluster of seven Acheulean sites in and around the mouth of a box canyon on the north edge of the basin that, during wetter intervals, was fed by springs. Named 'Ayūn al-

Qadīm (Ancient Springs) by Quintero and colleagues (2004), it lies at the foot of a 50 m high escarpment, and thus provided a relatively protected location used for millennia by hominins, principally to kill and butcher large animals. The sites consist of more or less discrete surface scatters that, although deflated, retain some degree of horizontal integrity (i.e., biface blanks, trimming flakes, and other production debris have been recovered). The location of the sites and the cul-de-sac configuration of the canyon suggest that the landform served as a natural trap for animals that came there for water and that could not escape to the headlands because of the steep-sided canyon walls (in this respect recalling Fjaje).

A singular aspect of the Jafr sites is the extremely high incidence of finished tools, consisting overwhelmingly of bifacial tranchet cleavers. Almost 1900 bifaces were collected and mapped at the 'Ayūn al-Qadīm localities, along with hundreds of the distinctive tranchet flakes that resulted from making and resharpening them. The production and rejuvenation of these objects have been extensively studied, and it has become possible to classify the cleavers into approximate use-life stages, from the selection of the tool blank, to initial shaping, through various stages of resharpening, to exhaustion and eventual discard. Although a small percentage of bifaces might have been intentionally shaped into pointed forms (e.g., ficrons), Quintero et al. (2007) argue that cleavers were designed from the start to accommodate multiple resharpenings, that production and rejuvenation comprise a single operational sequence that has widely generalizable properties and that, depending on the stage at which the artifact enters the archaeological context, encompasses virtually all handaxe formal variation taken by most workers to represent discrete types (e.g., ovate, cordiform, etc.). The handaxe types recognized by other workers thus become almost entirely the result of an individual artifact's 'life history,' rather than of its original design. Its conception, design, execution, and subsequent transformation are taken to be strong indications of planning depth (the ability to take future contingencies into account), and thus evidence for the extraordinary mental acuity of *Homo erectus*, which, so far as tool manufacture is concerned, is fully equivalent to our own. Functionally, cleavers are taken to be heavy-duty tools used almost exclusively for butchering large animals. The conceptualization of the cleaver and its use-life transformations were in the mind of

the maker from the beginning of the process of manufacture, when the raw material was selected. That they were curated and resharpened repeatedly (perhaps as many as 10 times) over long use-lives is good evidence for cognitive abilities that do not differ in any important respect from our own. Evidence for the effective hunting of large, prime-age adults in the Middle Pleistocene has grown stronger in recent years (e.g., Boxgrove, Schoeningen, Bilzingsleben) and appears to have been a major structural 'pose' of Middle Pleistocene hominins in general, not just those in the Levant. In the extent to which handaxe form can be considered to reflect directional change through time, there are a few large bifaces (notably from J-25 and J-92) that are considerably less refined and regular in form than those typical of 'Ayūn al-Qadīm. They might date to the Middle, rather than to the Upper Pleistocene. 'Ayūn al-Qadīm has not been dated radiometrically. An estimated age for the Jafr Acheulean is somewhere between 300 and 500 kya, with most sites probably dating to the more recent end of that interval.

Little is known of the Acheulean in the Wadi Bayir, the locus of a survey by Rolston and Rollefson in the early 1980s (1982). The survey focused on the Jebel er-Raha and its surrounding lowlands some 10-15 km northwest of Bayir Wells, an oasis located some 150 km due east of the city of Tafila at the head of the Wadi Bayir, in east central Jordan. Well-made Upper Acheulean bifaces had been noted there by Field (1960), and the survey recovered some more isolated artifacts of similar type and condition from the edges of the plateau. All were surface finds without any indications of contextual integrity, and were found along with later paleolithic artifacts. Whether the wells themselves preserve Lower Paleolithic artifacts is unknown, but remains a distinct possibility given the discoveries at Azraq, some 175 km to the north.

Summary and Discussion

The Lower Paleolithic in Jordan has been summarized before, principally by Lorraine Copeland (1997: 183-192, 1998: 5-22) and Macumber and Edwards (1997: 23-44), and has been extensively republished in anthologies and collected works (e.g., Macumber 2001: 1-30, 2008: 7-34). The only systematic, relatively detailed, multidisciplinary analyses published so far are the monographs on the

Table 2. Important Acheulean Sites in Jordan.

Site Name	Site Type	Elevation (ma/bsl)	Site Area (m2)	Area Excav. (m2)	Distance to Fresh Water	Site Reference
Mashari'a 1	open	-200	c. 400 long	<10	near lake/sprg.	Macumber & Phillips 1997
Mashari'a 2	open	-50	?	small	nr. lake/sprg.	Macumber & Phillips 1997
Mashari'a 3	open	c. -85	?	small	nr. lake/sprg.	Macumber & Phillips 1997
Mashari'a 4	open	0	?	small	nr. lake/sprg.	Macumber & Phillips 1997
Mashari'a 5	open	c. -35	?	small	nr. lake/sprg.	Macumber & Phillips 1997
Abu Habil Site 44	open	c. -200	16 m high	16 +	lakesh're/sprg	Muheisen 1988
Upper Wadi Zarqa	open	c. 500	c. 100 m sect's.	> 100	near wadi	Parenti et al. 1997
Fjaje Sites	open	c. 1200	c. 20 km	surf. coll.	above wadi	Rollefson 1981, 1985
Wadi Qalkha (J401)	open	c. 900	c. 2300	surf. coll.	above wadi	Henry 1995
Azraq DWA (14+ sites)	open	510-550	varies	surf. coll.	in/near wadi	Copeland & Hours 1989
Azraq Spring (5 sites)	open	505	?	undefined	spring/oasis	Copeland & Hours 1989
Azraq Ain Soda	open	505	?	c. 250	spring/oasis	Rollefson et al. 1997
Wadi Sirhan (2 sites)	open	c. 750-850	?	surf. coll.	near lake	Whalen et al. 1984
Jafr Basin (7+ sites)	open	870-900	varies	surf. coll.	lakeshore	Quintero et al. 2007
Wadi Bayir (2 sites)	open	c. 870	?	surf. coll.	oasis	Rolston & Rollefson 1982

early work at Azraq (Copeland & Hours 1989a-c), where geomorphology, fauna, pollen, site distributions and lithic collections available through the early 1980s are collected together. These studies, while foundational, are now somewhat dated, and we eagerly await the results of post-1996 excavations there, when dropping water tables made conventional excavation possible for the first time. Although only a single absolute date is available (the 200 ky TL date from Ain al'Beidha noted above), and no human fossils are known, certain generalizations based on geomorphology and techno-typological observations can be made that might help to put these data into a broader context (Table 2).

Jordanian LP sites are concentrated in three widely separated areas: (1) in the Jordan Rift Valley north of the Dead Sea are the Lower and Middle Pleistocene sites of Gisir Benat Yaqub and Ubeidiya (both just across the international line on the north and south shores of Lake Kinneret respectively); a cluster of three sites in the Middle Pleistocene Tabaqat Fahl Formation exposed in the cutbanks of the Wadis Hammeh, Himar and their tributaries (Mashari'a 1-5, Abu Habil 44) and in the Dauqara and Bire Formations exposed at the confluence of the River Zarqa and the Wadi Dhulail (Khirbet Samra [KS] sites 19, 22, 11L, 116, 119, 3D; Suhkne North); (2) in north central Jordan in the Azraq Basin (Ain el-Beidha, C-Spring, Ain el-Assad [Lion Spring], Ain Soda, AZ.21, AZ.147), and (3) in the Jafr Depression, an ancient lake basin in the southern part of the country between Ma'an and the Wadi Sirhan (Zeuner's sites 71, 72; a number of surface scatters of Acheulean artifacts reported by Quintero, Wilke and Rollefson). In addition to these site clusters, there are five 'sites' scattered over the East Bank highlands between Aqaba and the Wadi Hasa (Bayir, Fjaje, Jurf adh-Darawish, Gharandal, Wadi Qalkha).

The best candidates for future investigation are clearly the Azraq Basin sites of C-Spring and Ain Soda, where pavements of fresh Acheulean artifacts and, more important, organic remains (wood, fauna – equids, bovids, a rhinoceros, an elephant and two camelids) accumulated in the low-energy, anaerobic environments along the shore of a large Pleistocene lake (Rollefson et al. 1997, 2003, 2005, 2006; Quintero et al. n.d.). In addition, it is very likely similar sites are preserved in the Ain al'Beidha site cluster. Lakes and their associated springs

and marshes were important attractors for both hunters and their prey throughout the Pleistocene (1.7-.01 mya), and might extend as far back in time as the Pliocene (5.0-1.7 mya). Studies of lake cores in eastern Jordan show that paleolakes formed, expanded, shrank and disappeared repeatedly over a very long period of time, and that they reflect local, regional, and possibly even global patterns of climate change (Davies 2007: 79-86). Eventually it might be possible to link these sediment records to global marine isotope stages.

Typologically, most of the bifaces are argued to be 'Upper' or 'Late Acheulean', an assessment based on the relative refinement of the pieces (Copeland 1998), but one that is consistent with LP chronostratigraphies based on absolute dates, biochronologies and general typological features developed elsewhere in the Levant (Horwitz and Chazan 2007: 181-182). Organizing the Acheulean according to a temporal progression from 'crude and asymmetrical' (early) to 'refined and symmetrical' (late) has been questioned by some workers because contingent variables like the quality and 'package size' of raw material available, and the extent to which bifaces were reworked, resharpened, or reused as cores, can all have a profound effect on what is recovered archaeologically (e.g., Clark 2002). If such a progressive refinement over time actually occurred, it would suggest that most Acheulean bifaces in Jordan date between c. 500 and c. 250 kyr BP, and probably closer to the latter than the former. Since no 'Middle Acheulean' can presently be discerned on technological or typological grounds, it might be advisable to provisionally classify Acheulean collections into 'Early' and 'Late'. Copeland's distinction between the 'Acheulean of the Springs' and the 'Desert Wadi Acheulean' continues to be useful.

Although so far undated in Jordan, radiometric dates for the Levantine Lower Paleolithic have been accumulating slowly over the past 15 years. The grand mean of 14 technotypologically 'Upper' Acheulean sites (all methods combined) is 242 kya, precisely on the boundary between OIS 8 (301-242 kya) and OIS 7 (242-186 kya), and within the temporal span of the regionally-specific Acheulo-Yabrudian (or Mugharan Tradition) of Jelinek (1982). Only a few Acheulean sites (Latamne, K'far Menahem, Joubb Janine II, Ras Beyrou, El Meirah) seem to be much older than about 500,000 years (Horwitz & Chazan 2007). If the Acheulo-Yabrudian is a

distinct entity in its own right (which has sometimes been questioned), and if it exists in Jordan, it pertains to its 'Acheulean' facies (up to 15% bifaces, lots of thick sidescrapers), rather than to its 'Yabrudian' (few bifaces and Upper Paleolithic tools, many sidescrapers on thick flakes, high frequency of Quina retouch, rare blades) or 'Amudian' (Upper Paleolithic-like endscrapers, burins; backed knives, few bifaces) facies. Some Jordanian LP sites show some evidence of Levallois technology (e.g., Wadi Qalkha); some do not (e.g., Ain el'Assad, C-Spring). The Jordanian LP seems to be unique in its very high incidence of cleavers (up to 33% at some of the Azraq sites; perhaps nearly all them in the Jafr [Quintero et al., 2007]). If Quintero is correct in arguing that most Acheulean bifaces represent transformation stages in cleaver production and resharpening, and if they were used primarily for butchering large animals, as she contends, it would suggest that *H. erectus* was a proficient hunter of the vast herds of gregarious ungulates (mainly antelopes in the medium and large size classes) that populated the grassland savannas of the region throughout much of the Middle Pleistocene.

Given these observations, it is unfortunate that the Lower Paleolithic of Jordan has produced so little in the way of faunal remains, although that could change dramatically in the future with the publication of the recent work at Azraq. This scarcity of fauna (organic remains in general) is typical of the entire region, and limits our understanding of Acheulean subsistence economies largely to what might be inferred from the stone tools (cf. Quintero et al. 1997). Only at Ubeidiya, Gesher Be'not Ya'aqov and Holon have large LP faunas been recovered, although weakly quantified faunal data exists for about 4-5 other LP sites (Revadim Quarry, Abri Zumoffen, Masloukh, Tabun E/F) and presence/absence data for an additional half-dozen or so. Analyses of these faunas have not so far shed much light on subsistence, although they have been useful for environmental reconstruction. Although Middle Pleistocene foragers almost certainly depended heavily on plant resources (nuts, seeds, berries, fruit, tubers, roots), only a single site, Gissur Benat Yaqub in the north Jordan Valley, has yielded abundant remains of plants (Goren-Inbar et al. 2002).

* * *

Three continents converge on the Levant. The region experienced a complex series of dispersals, back migrations, regional diversification, isolation, reintegration, local extinctions, range extensions, displacements, replacements, radiations, continuity and discontinuity set against the backdrop of macroclimatic change and extending far back into the Miocene (20-5.5 mya). The initial hominin radiation out of Africa is one of the more recent of these events or processes, dating only to c. 2 mya at the earliest. Genetic evidence suggests that modern humans might also have evolved in Africa as recently as 100 kya. It appears that hominin populations expanded and contracted repeatedly throughout the Pleistocene, responding to climatic change, adapting to new environments, interacting with each other, and with earlier hominins, themselves the products of similar expansions.

Because of its location on the Jordan Rift Valley, modern Jordan lies athwart the migration routes likely used by early hominins as they dispersed throughout the middle latitudes of Eurasia. It has an important role to play in dating and documenting these dispersals in terms of expansion, demographic continuity and replacement, local adaptation, and a host of other evolutionary questions and problems. Yet, despite Jordan's obvious wealth of paleolithic sites, very few prehistorians appear to be interested in studying its early Stone Age. While there are various reasons for this (noting the many important early sites along the Levantine coast, one of the more important ones is a failure to locate and exploit cave sites), we attribute this lack of specialized interest to Jordan's rich archaeological heritage, and the fact that few Jordanian archaeologists are Stone Age specialists (notable exceptions are Mujahed Muheisen, Zeidan Kafafi). We are of the opinion that foreign prehistorians should do more to involve Jordanian students in this fascinating research area, and that the Jordanian agencies that fund archaeological research in the nation be made aware of the enormous potential of its rich Stone Age heritage. How we came to be the way we are today is one of the most enduring questions humankind has ever asked itself. While early archaeological sites do not attract the attention of tourists, they are nevertheless important stepping-stones along the road leading to ourselves.

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