THE ACHEULIAN OCCUPATIONS AT ‘UYŪN AL-QADĪM, AL-JAFR BASIN, JORDAN: A PROGRESS SUMMARY

Philip J. Wilke, Leslie A. Quintero, and Jason A. Rech

Introduction

Since its inception in 1997 the al-Jafr Basin Prehistory Project has focused research on Lower Paleolithic use of this arid and empty part of southern Jordan during the Middle Pleistocene. Fieldwork during 1999, 2004, and 2005 continued survey and surface collection of artifact assemblages at Lower Paleolithic sites in the basin. Major objectives of the current research explore several important issues:

(1) relationships between Middle Pleistocene site locations and ancient geographic settings and landforms;
(2) characterization of the assemblages, especially the well-preserved lithics, and the behavioral information they yield;
(3) character of the lithic assemblages, with special emphasis on the Acheulian handaxe industry to understand the complete reduction sequence and use-life history from acquisition of raw material to discard of exhausted tools;
(4) similarities and differences between the Acheulian assemblages of al-Jafr Basin and those of other regions, notably at sites in al-Azraq Oasis 150km to the north; and
(5) generalizations that can be drawn from information on site locations, ancient landforms, and lithic artifact assemblages about the ways Middle Pleistocene hominins adapted to the ancient landscape of what is now Jordan.

In our research conducted to date, all of the Lower Paleolithic sites and assemblages documented in the basin are assigned to the Acheulian complex, with most of the material attributable to the Late Acheulian. Current research focuses on ‘Uyūn al-Qadīm (‘Ancient Springs’), an important Acheulian locality centered on a box-canyon landform along the northeastern margin of the basin (Quintero *et al*. 2007; Rech *et al*. 2007; Quintero and Wilke n.d.). The locality includes a complex of seven surface archaeological sites, the assemblages of which are entirely lithic, dominated by large collections of handaxes, with lesser representation of Levallois cores and unstandardized cores and their respective reduction products. As used here, the terms Acheulian *handaxe* and *biface* are synonymous, and most of the handaxes are properly classified as *bifacial cleavers*, a form of large butchering tool.

The ‘Uyūn al-Qadīm site complex has yielded a rich body of information especially on the later Acheulian, the oldest widely distributed archaeological expression well documented in Jordan. Research carried out thus far suggests that the locality was an important focus of ambush hunting and butchering of large game species at an oasis setting by Middle Pleistocene hominins. Recent classification of Middle Pleistocene hominins has resulted in the claimed existence of several contemporaneous species across Eurasia and Africa. Nonetheless, in the absence of skeletal material, the hominin species represented by the Middle Pleistocene archaeological expressions discussed here is referred simply to *Homo erectus*.

The discussion that follows is a progress summary. It includes detailed geomorphological and paleohydrological evaluation of the landform to establish its Pleistocene character. Analysis of the lithic assemblages recovered from all of the sites at the locality is continuing. As in our earlier work in al-Azraq Basin, the major focus of the artifact analysis is studying the use-life history of individual handaxes in order to characterize overall site assemblages, and site char-

acter and function. The result of this research discloses much about the formal transformations these artifacts underwent during their use and maintenance, which in turn reveals their overall role in the everyday life of Middle Pleistocene hominins. Other important aspects of our work involve attempts to refit fragmentary bifaces because analysis of unconjoined fragments is otherwise severely constrained, and analysis of debitage to understand better the patterns of tool production and maintenance, and the technological activities that occurred.

Background: the Acheulian Complex in Jordan

So far as is now known, Acheulian technology originated in the Early Pleistocene of East Africa by 1.5 Ma (Ambrose 2001). It is attributed there to *Homo erectus*. The Acheulian represents the earliest known lithic technology to emphasize bifacial flaked-stone reduction and the production of large bifacial tools, or handaxes. Acheulian lithic assemblages were produced over a very long span of time, and are widely distributed in Africa, the Near East, southern Asia, and Europe. Thus, the region that is now Jordan and its neighboring countries constituted a crossroads for movements of *H. erectus*, probably in both directions, between Africa and the Eurasian landmass (Bar-Yosef 1987; Goren-Inbar and Saragusti 1996; Goren-Inbar *et al*. 2000; Bar-Yosef and Belfer-Cohen 2001; Saragusti and Goren-Inbar 2001; Quintero *et al*. 2004, 2007). Most of the known Acheulian assemblages in Jordan are believed to date to the later part of the Middle Pleistocene, probably to the interval ca. 0.35 - 0.45 Ma, and are assigned to the Late Acheulian. A few expressions are, however, believed to be older, and to represent the earlier Middle Acheulian, which otherwise is not widely documented in Jordan (Copeland 1998).

The stone-tool kit of *H. erectus* is dominated by the ubiquitous handaxe, a large cutting or butchering tool, of which there are several general forms (Bar-Yosef 1994; Copeland 1998; Copeland and Hours 1989; Goren-Inbar and Saragusti 1996; Goren-Inbar and Sharon 2006). A recent trend is to include all Acheulian handaxes in the functional category of large cutting tools ("LCTs"), recognizing that they must have had a common or generalized function.

Across much of North and East Africa (e.g., Biberson 1954; Balout *et al*. 1967; Isaac 1977), in the Jordan Valley (e.g., Goren-Inbar and Saragusti 1996; Saragusti and Goren-Inbar 2001), and in much of India (e.g., Petraglia 2006), many handaxe assemblages are much older and include or are dominated by cleavers made on large flakes detached from blocks of often coarsely grained, extrusive igneous rock ("lavas" including basalt, trachyte, andesite, etc.). Such cleavers have cutting edges that originated as sharp margins of the original flake blank from which the tools were fashioned. Once that edge was selected to become the intended cutting edge of the cleaver, the grip portion of the tool was simply formed around it. These cleavers thus consisted of a grip and an associated cutting edge, the whole made from a large flake. While the bit of such a cleaver was initially an effective cutting edge, it afforded only limited possibilities for resharpening because the grainy material could not readily be bifacially flaked to restore a sharp cutting edge. Most of the assemblages characterized by these coarse flake cleavers are quite ancient, among the oldest sites yet found in the Near East, notably Gesher Benot Ya'aqov, at 0.78 Ma (Goren-Inbar and Saragusti 1996; Saragusti and Goren-Inbar 2001) and 'Ubaydiyya, 1.2 - 1.4 Ma (Bar-Yosef and Goren-Inbar 1993) in the Jordan Valley.

In Jordan, sites with large assemblages of Acheulian handaxes were found at Fujayjah at the head of Wādī al-Bustān near Shawbak in the southern highlands (Rollefson 1981), various sites including 'Ayn al-Asad (Rollefson 1983; Copeland 1989a, 1989b), C-Spring (Copeland 1989c, 1991; Copeland and Hours 1989), and 'Ayn as-Sawda ('Ain Soda) (Rollefson *et al*. 1997; Quintero *et al*. 2004, 2005, 2007) in al-Azraq Oasis. Subsequently, they were found in al-Jafr Basin (Quintero and Wilke 1998; Quintero *et al*. 2004, 2005, 2007; Quintero and Wilke n.d.). While the ages of none of these sites have been determined chronostratigraphically, on typological grounds most of them are thought to date to the later part of the Acheulian tradition. Sites at al-Azraq Oasis (Rollefson *et al*. 2006) probably date to about 350-450 ka. It is likely that most of the Acheulian material at sites in al-Jafr Basin spans at least the older part of that

time range, but that occupation there extends farther back into prehistory, the handaxes there being, on the whole, significantly larger, more robust, and more coarsely flaked. A longstanding consensus among Near Eastern Acheulian archaeologists, based on cross dating of assemblages, is that, in the Levant, larger and more coarsely flaked handaxe forms generally are of greater age (e.g., Gilead 1970).

As so far represented in Jordan, Acheulian handaxes are not made on large flakes of coarse volcanic rock, but instead are nearly always bifaces made of flint, and are well-flaked on both faces. Very few of them are clearly made on flint flakes. Our technological examination of over 1,000 Acheulian handaxes from the butchery site of 'Ayn as-Sawda at al-Azraq Oasis revealed both the production strategy and the use-life history of these artifacts (Quintero *et al*. 2007). The vast majority of them are bifacial cleavers and, expectably, most of them are exhausted, having been discarded when no longer useful. They were formed from flint nodules or tablets with the goal of first creating not the bit, but the grip. Because these cleavers were intended to be resharpened distally, an expendable midsection was then configured. Finally, attention focused on the distal cutting edge, or bit. The bit was created, and subsequently resharpened as needed, by detachment of highly diagnostic transverse (*tranchet*) flakes inclined slightly through the plane of the cleaver. These tranchet flakes were detached, from either face of the cleaver, first to create, and thereafter to restore, a sharp, transverse, cutting bit. Each such detachment removed a small portion of the distal end of the cleaver, shortening its length. Detachment of tranchet flakes also usually narrowed the distal end of the cleaver. Distal width was lost by preparation of striking platforms for detachment of tranchet flakes, and often by overshot of such flakes when they were detached. Thus, resharpening altered the form of bifacial cleavers and, importantly, shortened their expected use-lives, until finally they were declared exhausted, and were discarded (Quintero and Wilke 1997; Rollefson *et al*. 1997, 2006; Wilke *et al*. 2005; Quintero *et al*. 2007). Discard size and degree of reworking are of course factors that relate to raw material availability.

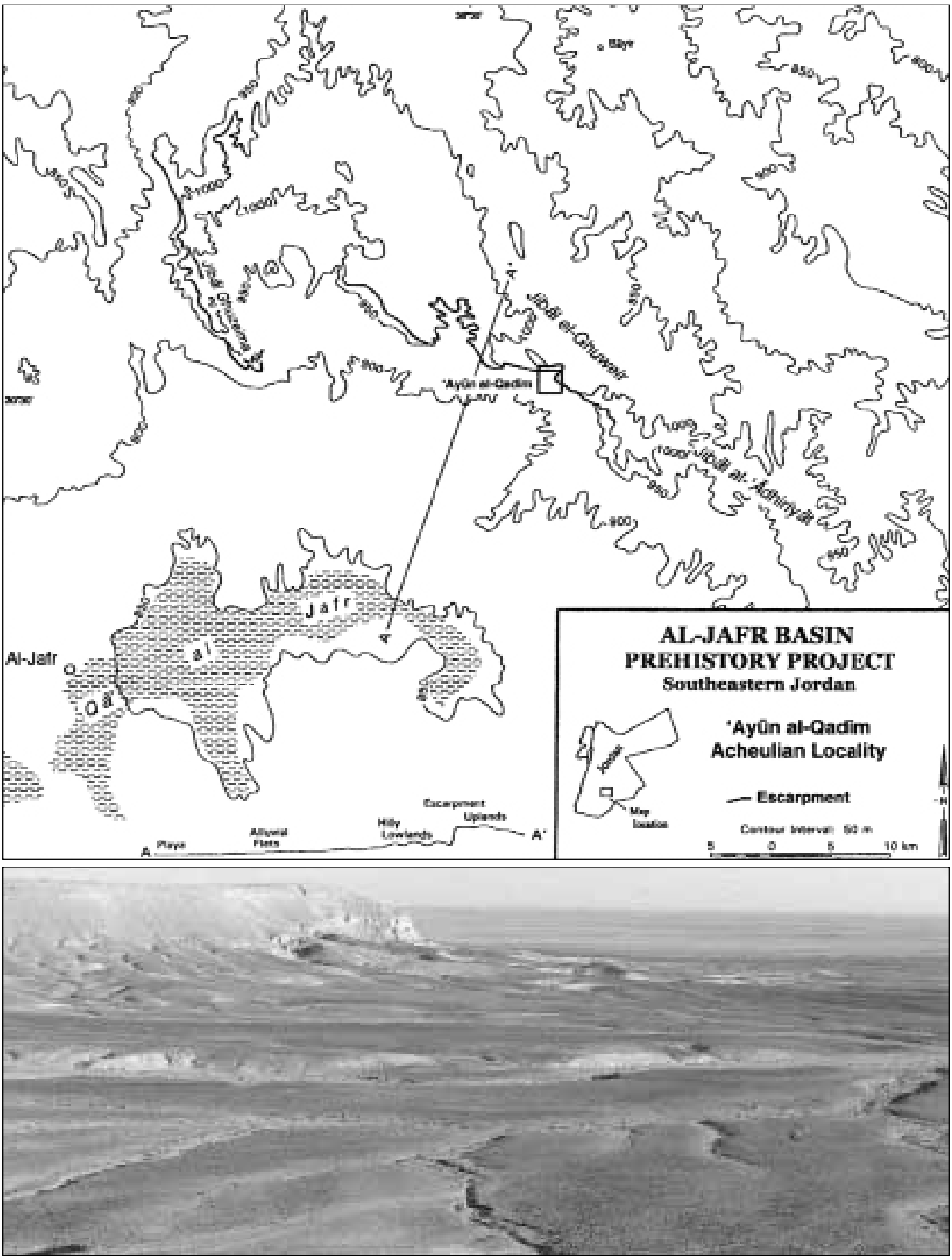
Thus, one can see the importance of envisioning most forms of Acheulian handaxes as tools that were not of static form, but rather were intended (as were many flaked-stone cutting tools around the world) to be resharpened as necessary. As a consequence, they were tools that changed their form and size during their use-lives. For that reason, studying the use-life history of individual handaxes is important for deciphering technological information at each reduction stage and, more importantly, for envisioning actions, concepts, and decisions involving production, use, maintenance, and discard of these tools. Using this approach, it is possible to understand the underlying cultural behaviors responsible for assemblage formation. This approach stands in stark contrast to traditional methods used in analysis of handaxe assemblages, in which these artifacts are, explicitly or implicitly, viewed as objects of generally static form of uncertain function.

In al-Azraq Basin the evidence is abundantly clear that the overwhelmingly dominant handaxe, the bifacial cleaver, is an implement intended for butchery activity. These artifacts occur in like form in a Late Acheulian butchery context at Boxgrove, Britain (Roberts and Parfitt 1999). There, following long tradition (Bordes 1961), they were generally classified simply as handaxes that were resharpened by tranchet-flake removal. Meticulous work there showed these handaxes to have been used to butcher large game animals.

The 'Uyūn al-Qadīm Locality

A few small handaxe sites were found in al-Jafr Basin during our initial reconnaissance, all seemingly in association with ancient water sources, but these assemblages consisted of only a few artifacts. The 'Uyūn al-Qadīm Acheulian locality (**Fig. 1**) was discovered in 1997, when it was tentatively named *Fossil Springs Canyon*. It became the focus of fieldwork in 1999. During that field season the box-canyon feature that dominates the locality was surveyed and extensive assemblages of handaxes were found on the floor of the canyon. Other sites were found outside the canyon that same year, and more were located in 2004 and 2005.

The box canyon, called *Juwit al-Ghuwayr* ('Inside Ghuwayr') by local Bedouin, is about a kilometer long and about that wide at



1. Location and setting of the 'Uyūn al-Qadīm locality. Site Jafr-83 extends from left to right across the center of the photo.

its mouth. It is overall somewhat V-shaped in configuration, and delineated by steep escarpments that rise to a height of 60m or more. Almost everywhere the lower part of the exposed bedrock consists of soft, Paleocene (and latest Cretaceous) chalk-marls of the Muwaqqar Formation, 25-40m thick. The upper part is hard and resistant, bedded, Eocene limestone of the Umm Rijam Chert-Limestone Formation, 25-35m thick (Kherfan 1987; Moumani 2008). This same sequence is exposed in an escarpment that extends along most of the northeastern flank of the basin. The upper formation contains extensive beds of flint nodules, many of considerable size, and these are abundantly available where they are weathering out of the escarpments and the talus slopes below. Sometimes a flint bed is expressed locally as a solid stratum formed by coalescence of individual nodules. The flint supplied raw-material needs for stone-tool production throughout the prehistory of al-Jafr Basin (Wilke *et al*. 2007).

The box canyon is drained by a northern headwater tributary of Wādī al-Ghuwayr, and is a distinctive landform in the locality. Early impressions were that the canyon was evacuated over a long period of geological time by headward erosion of that wadi which during the Middle Pleistocene was fed by discharge of spring waters from karstic conduits within the Tertiary limestones exposed in the escarpment. Further, the several spring heads at the base of the escarpment, and their tributary drainages, would have been sources of water during the Middle Pleistocene. The initial impressions proved to be essentially correct.

Also in 2005 attention focused on a thorough study of the geomorphology and paleohydrology to characterize the Lower Paleolithic landscape of 'Uyūn al-Qadīm (Rech *et al*. 2007). The results of that study are summarized below.

The Lower Paleolithic Landscape of 'Uyūn al-Qadīm

Archaeological sites are located on old pediment surfaces and fluvial strath terraces. Sites near the mouth of the box canyon of Juwit al-Ghuwayr and those along the base of the escarpment to the southeast all occur on dissected pediments. The site located within the canyon is situated on top of two different fluvial strath terraces just to the north of the main stream channel and partially on pediment surfaces to the south. Pediments and fluvial strath terraces of similar age, evident as surfaces with similar color on Landsat 7 TM satellite imagery, are common along the northern escarpment of al-Jafr Basin. However, our archaeological surveys only identified dense Lower Paleolithic assemblages in selected areas. We therefore interpret the location of these archaeological sites to be a primary feature associated with the focus of human activity and not a function of the preservation of geomorphic surfaces of a particular age.

Fluvial strath and pediment surfaces are all formed on the Muwaqqar Formation. This marl is extremely friable, and in most locations appears to be actively eroding by fluvial processes and eolian deflation. Any sedimentary units that may have encased Lower Paleolithic artifacts at 'Uyūn al-Qadīm have been removed. In a few locations, however, strath terraces contain a thin bed (<60 cm) of alluvium. All geomorphic surfaces are covered by a chert *hamada*, or desert pavement, that is moderately well developed and coated with desert varnish. Older geomorphic surfaces are identifiable in general by fewer limestone clasts, a greater number of 'pot-lid' flint spalls, vertically-oriented and fractured flint clasts, and a high degree of clast interlocking. However, in locations where resistant limestone is present just beneath the surface, there is a more advanced degree of desert pavement development and gypsic soil formation. Therefore, the relative degree of maturity for desert pavement appears to be a function of both age and the localized nature of the underlying Muwaqqar Formation. As such, the degree of desert pavement formation can be used to help guide the search for old landscape surfaces, but cannot be used quantitatively to discern the age of landscape surfaces.

Paleoenvironment and Paleohydrology

Paleoenvironmental investigation at 'Uyūn al-Qadīm began in 2005 with a thorough search for Quaternary sedimentary units that would provide insight into why this locality was such a focus of human activity during the Middle Pleistocene. However, our examination of the Juwit al-Ghuwayr canyon and surrounding region identified few Quaternary deposits, and

none that could provide detailed insight of the paleoenvironmental setting. Our search to place human activities at ʻUyūn al-Qadīm within a paleoenvironmental context then led us to examine the modern hydrologic system.

The surface hydrology atop the Umm Rijām plateau, the plateau atop the escarpment north of ʻUyūn al-Qadīm, is characterized by large intermittent stream channels that flow to the northeast as well as extensive areas of flat topography with flint *hamadas* that lack organized drainage systems. Flat topographic areas adjacent to Juwit al-Ghuwayr canyon contain small playas and sinkholes. Many of these sinkholes have clear openings, or conduits, that are 5 to 15 cm wide and are surrounded by concentrations of large gravels that were transported by surface water entering the subsurface at these locations. Surface hydrology atop the Umm Rijām plateau is also strongly influenced by structural faults and folds. Many of the small drainages on the southern margin of the Umm Rijam plateau are oriented along faults or small synclines. Moreover, the head of Juwit al-Ghuwayr canyon is centered along a small syncline that plunges to the southwest.

The limestone escarpment, demarcating the southwestern limit of the Umm Rijām plateau, and Juwit al-Ghuwayr canyon display several features indicative of groundwater seepage, sapping, and discharge (Higgins and Coates 1990). These features include a pronounced headwall at the upstream termination of Juwit al-Ghuwayr canyon with an amphitheater shape, as well as stream channels that initiate on the sides of the canyon at the contact between the Umm Rijam limestone and Muwaqqar chalk formations. Discrete point-source discharge conduits are present at the head of some of these stream channels, and most channels display evidence of seepage. Channel heads are generally incised a few meters into the Muwaqqar chalk, and some are deeply incised (~5-8m). The majority of these stream channels have no catchment area atop the escarpment. The main difference between Juwit al-Ghuwayr canyon and other canyons under the direct influence of groundwater sapping is that Juwit al-Ghuwayr does not have an active spring at the base of its headwall.

We interpret the hydrology of the Umm Rijām plateau as being a karstic system. Surface water infiltrates into the subsurface through sinkholes and fractures and flows through organized subsurface shafts, tunnels, and pipes. Stream channels that initiate near the contact between the Umm Rijam and Muwaqqar formations demonstrate that a significant amount of this subsurface water discharges episodically into Juwit al-Ghuwayr canyon and adjacent areas along the escarpment. Karstic conduits within the Umm Rijam limestone, which contain impermeable bands of flint that act as aquicludes, are strongly influenced by structural controls such as faults, fractures, and folds. Although the Umm Rijam limestone appears to have a well-defined subsurface drainage system (i.e., karstic), the underlying Muwaqqar Formation does not. The chalk-marl is not well-lithified and cannot support stable groundwater conduits. Therefore, groundwater flow in the Muwaqqar Formation is mainly through groundwater seepage and ephemeral groundwater conduits. We therefore interpret that the canyon of Juwit al-Ghuwayr formed as a result of groundwater sapping and discharge from karstic groundwater sourced from the Umm Rijam plateau, and likely was a source of perennial groundwater discharge (i.e., springs) during the Early and Middle Pleistocene.

We suggest that sometime near the end of the Middle Pleistocene, possibly during the Final Acheulian/Middle Paleolithic transition, groundwater discharge in Juwit al-Ghuwayr canyon switched from perennial or seasonal to intermittent. The cause for this change is unknown, but likely was related to a drop in the regional water table either due to climate change or more local geomorphic factors. Consequently, the springs within Juwit al-Ghuwayr canyon and the ʻUyūn al-Qadīm locality in general would have ceased being a reliable water source.

The Sites

ʻUyūn al-Qadīm was a major focus of activity by Middle Pleistocene hominins. Flint tool assemblages dominated by bifacial cleavers are clustered into seven known archaeological sites in, and within about 2km of the entrance to, Juwit al-Ghuwayr. All are deflated, as evident from surface observations, and from shallow test pits that merely removed the desert pavements and exposed the underlying Paleocene

sediments. No faunal remains were preserved. Artifacts occur on and within the desert pavement that armors the landscape in the area today, inhibiting its further deflation. Except for several items (bifacial flake cores that may be extensively reworked handaxes) of a high-quality orthoquartzite, or quartz arenite (Pettijohn *et al.* 1987: 176), all of the artifacts are made from the local Eocene flint. The amount of flint available for tool production in al-Jafr Basin is in unlimited supply.

Considerable effort was devoted during both the 2004 and 2005 field seasons to conducting repeated pedestrian surveys of the recorded archaeological sites in the locality to recover all artifacts, including diagnostic debitage. Artifacts were pin-flagged, mapped with respect to a series of datum points established at each site, and then labeled and collected for analysis. Many of the handaxes show pot-lidding, or thermal spalling in which distinctive circular flakes were ejected from their surfaces. Such damage is more prevalent on the undersides of the artifacts.

All of the Acheulian sites are surface artifact occurrences, having deflated substantially, but to an unknown extent, over time. Nonetheless, geomorphic analysis of the ancient land surfaces attest to the preservation of the essential configuration of the Pleistocene terraces and pediments. Thus, the overall horizontal distributions of artifacts generally reflect their original deposition on the landscape. Specifically, they have not been transported by fluvial action. The surface artifact assemblages at the respective sites are summarized in **Table 1**.

Beginning within the box canyon of Juwit al-Ghuwayr and proceeding to just outside the entrance to it, and then southeasterly along the escarpment for a distance of nearly 2km, seven Acheulian sites were located and studied.

Jafr-83. Site Jafr-83 lies entirely within Juwit al-Ghuwayr. Originally recorded as several smaller sites, it was later recognized as a fairly continuous surface scatter of Acheulian cleavers and other artifacts. It is long and linear, extending for about 800m along the main wadi draining the canyon. Along the right (north) bank of the wadi the artifact scatter occurred on flat terraces. The left bank is flanked almost continuously by low hilly terrain consisting of dissected pediments extending to the nearby escarpment. Site loci along the left bank of the wadi are accordingly characterized by variable relief. One of these loci had an assemblage of handaxes that were badly spalled away by pot-lidding and other natural fractures. The cause of this destruction is not known, but it may have resulted at some time in the past when a fire burned over the locus while the artifacts were exposed on the surface or lay just below it. An assemblage of 304 Acheulian handaxes was mapped and recovered at Jafr-83, along with a small sample of Levallois cores and reduction products and

Table 1: Site assemblages at 'Uyūn al-Qadīm.

	Sites and Isolated Artifacts								
	J-83	J-140	J-25	J-92	J-136	J-138	J-158	Isolate	**Total**
Artifacts									
Acheulian handaxes	304	1046	412	76	24	39	14	11	1926
Nonbifacial tools									
Scrapers	0	5	2	0	0	0	0	0	7
Levallois points	3	1	6	0	0	0	0	0	10
Other tools	1	2	3	0	0	0	0	0	6
Cores and debitage									
Lower Paleolithic flake cores	4	73	70	7	3	3	2	0	162
Lower Paleolithic debitage*	35	146	333	9	13	12	6	0	554
Levallois cores	27	120	73	9	3	8	0	1	241
Levallois debitage	13	15	19	3	1	0	0	1	52
Total	387	1408	918	104	44	62	22	13	**2958**

*Some of this material could have resulted from production and maintenance of Levallois cores. The total includes 20 tranchet flakes from creating or restoring the cutting edges on bifacial cleavers.

miscellaneous debitage.

Jafr-140. The largest scatter of Acheulian artifacts in the locality, Jafr-140 is a site of variable relief more than 500m long and half as wide, just outside the entrance to the box canyon at a major intersection of drainages. An initial phase of pedestrian survey, mapping, and surface collection has been completed. The assemblage so far recovered from this site includes 1,046 handaxes and fragments, as well as flake cores of several configurations, tranchet bit flakes and other types of debitage, and Levallois cores and reduction products. A more thorough search will be carried out to recover a larger sample of debitage from the rocky surface of the site and delineate its extent. That 00 will enable a better characterization of the range of lithic reduction that occurred there (e.g., initial handaxe production, handaxe maintenance, or both).

Jafr-25. Jafr-25, a dense scatter of Acheulian artifacts about 150 x 75m, occupies a low chalk-marl ridge just to the south of Jafr-140 and along a moderate-sized drainage. Many of the 412 handaxes recovered here were of substantial size, considerably larger than most of the examples recovered at the other sites and at ʻAyn as-Sawda (Rollefson *et al*. 1997, 2006). Levallois points, cores, and a sample of debitage were found here as well.

Jafr-92. This site occurs on either side of an incised drainage that originates at the escarpment and dissects eroded chalk-marl sediments. Its surface assemblage includes 76 Acheulian handaxes, a few Levallois reduction artifacts, and a few flakes in a linear pattern for about 100m along the drainage.

Jafr-136. Located adjacent to an inselberg that stands off a short distance from the escarpment, about a half-kilometer south of Jafr-92, this site is only about 40m across. Its surface assemblage was scattered over a low ridge along a drainage emanating from the escarpment, and includes 24 Acheulian handaxes, several Levallois cores, and associated debitage recovered from a badly deflated surface.

Jafr-138. Located about 200m south of Jafr-136, this site occurs on and around a low rise on terrain of otherwise little relief, crossed by a shallow drainage. Its surface assemblage included 39 Acheulian handaxes, a few Acheulian and Levallois flake cores and reduction products, and debitage over an area of about 60 x 40m.

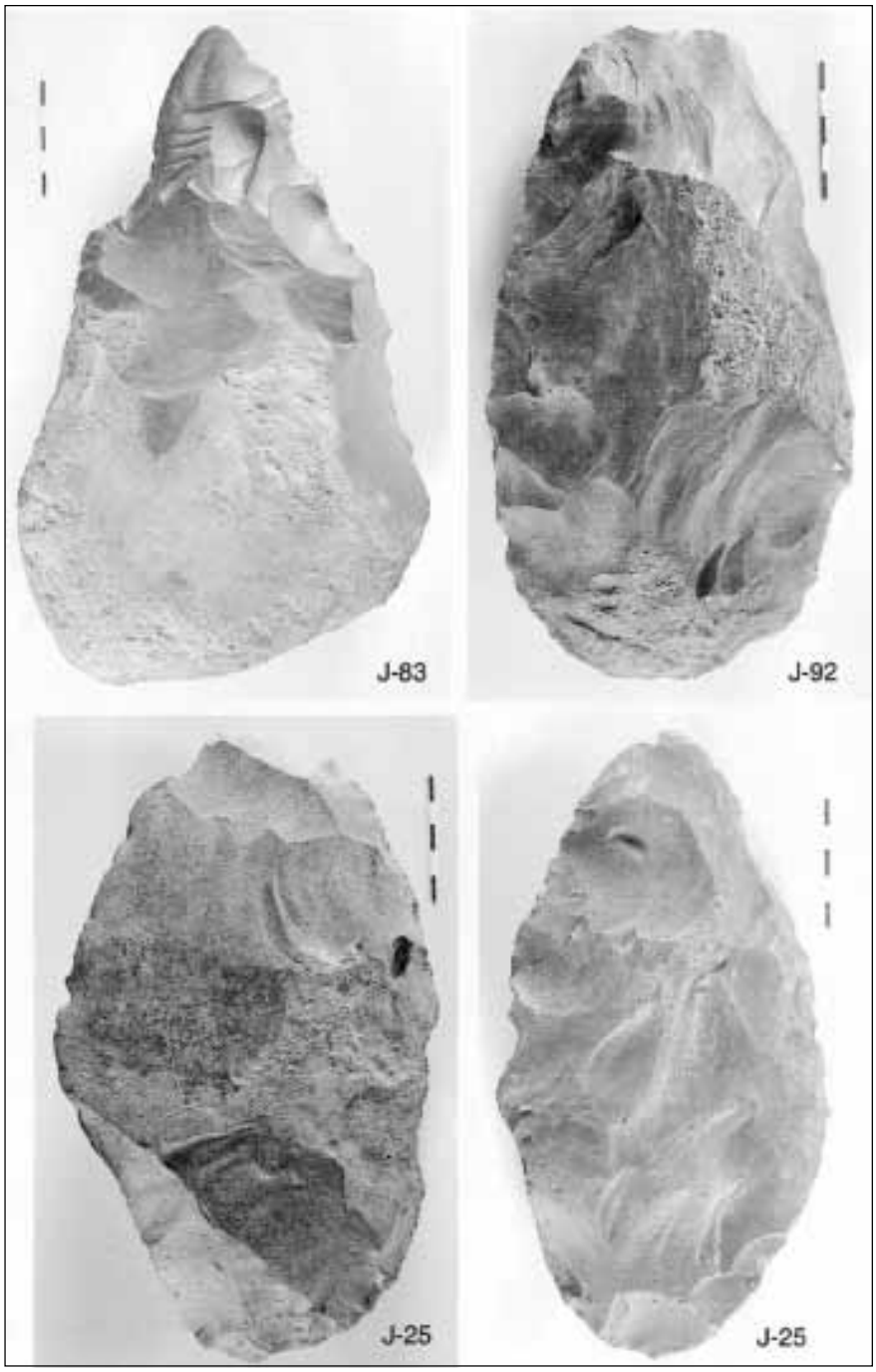
Jafr-158. In area, Jafr-158 is the smallest site with the smallest artifact assemblage. It lies close to the escarpment, just out from a small alcove, in an area of eroded chalk-marl sediments. The character of this erosional feature suggests a former point of groundwater discharge. Fourteen Acheulian handaxes were mapped and collected here, along with a flake core and a small collection of debitage distributed over an area about 30m across.

All of the sites at the ʻUyūn al-Qadīm locality thus conform to a basic pattern. They are located within the box canyon or near the escarpment. They also are located near points of spring discharge on what likely was a savannah or steppe landscape during the Middle Pleistocene, and their assemblages are dominated by handaxes to the exclusion of most other tool categories.

The Lithic Assemblages

The assemblages from the seven sites consist primarily of handaxes, which so far total 1,926 specimens, including a small number of still-unconjoined fragments (**Figs. 2-7**). Handaxes constitute well over 90 percent of the formed tools. The remaining tools include 10 Levallois points, a few large scrapers, flake cores possibly used as scrapers or choppers, and hammerstones. Levallois cores, flakes, and blades constitute a minor percentage of the artifacts in the site assemblages. Debitage in general is not well represented, and no small flakes were recovered, possibly due in large part to the difficulty of discovering them in the coarse desert pavements that cover most of the site surfaces. Among the debitage items recovered are 20 examples of the distinctive tranchet flakes from cleaver production and maintenance.

Because the assemblages were recovered from deflated surfaces where they had lain for indeterminable, but certainly enormous, stretches of time, the artifacts have sustained damage from natural agencies, possibly trampling by large animals, frost, etc. A number of handaxes are broken, most often into proximal and distal fragments, and the breaks usually display no bulbs of force. This fracture pattern may be the result of repeated freezing temperatures acting on moisture in marginal cracks, over vast periods of time. But differential patination on some

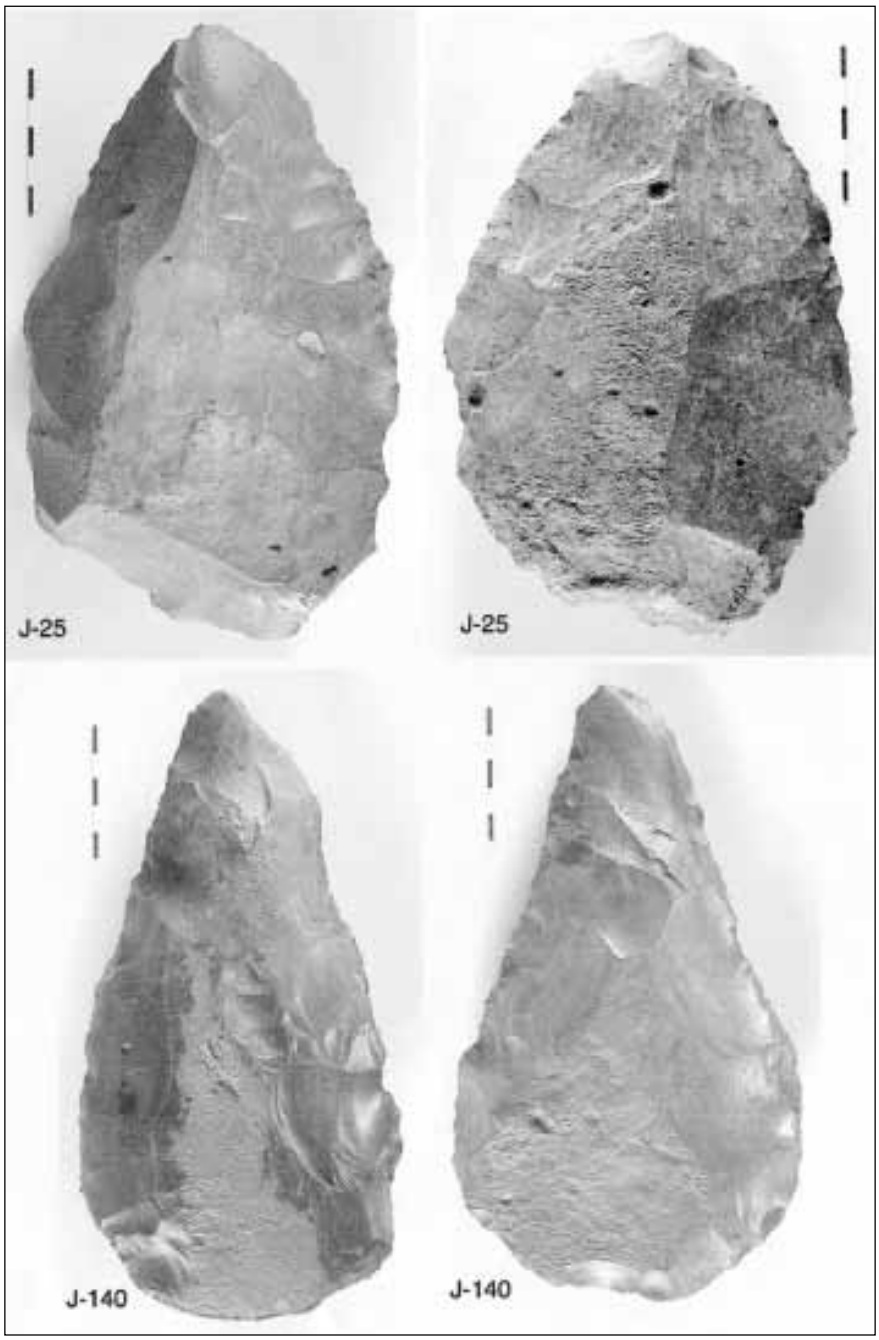


2. Very large handaxes. Upper left example with cortical grip (butt) resembles certain examples at the Early Acheulian site of ʻUbaydiyya. Others are provisionally attributed to the Middle Acheulian. Use of the tranchet technique for configuring and maintaining the bit was already in use. Here and elsewhere, scale increment 1cm.

specimens shows that the process has occurred in more recent times and probably continues today. Provenience information has enabled refits of some of these fragmentary pieces.

As in the case with the large assemblage of Acheulian handaxes analyzed at ʻAyn as-Sawda (Quintero *et al*. 2005, 2007), the vast majority of the these tools at ʻUyūn al-Qadīm are tranchet cleavers. At ʻAyn as-Sawda this figure is about 90 percent of all handaxes. Our analysis of the ʻUyūn al-Qadīm assemblages is not yet complete, but preliminary studies suggest the cleaver percentage will also be very high.

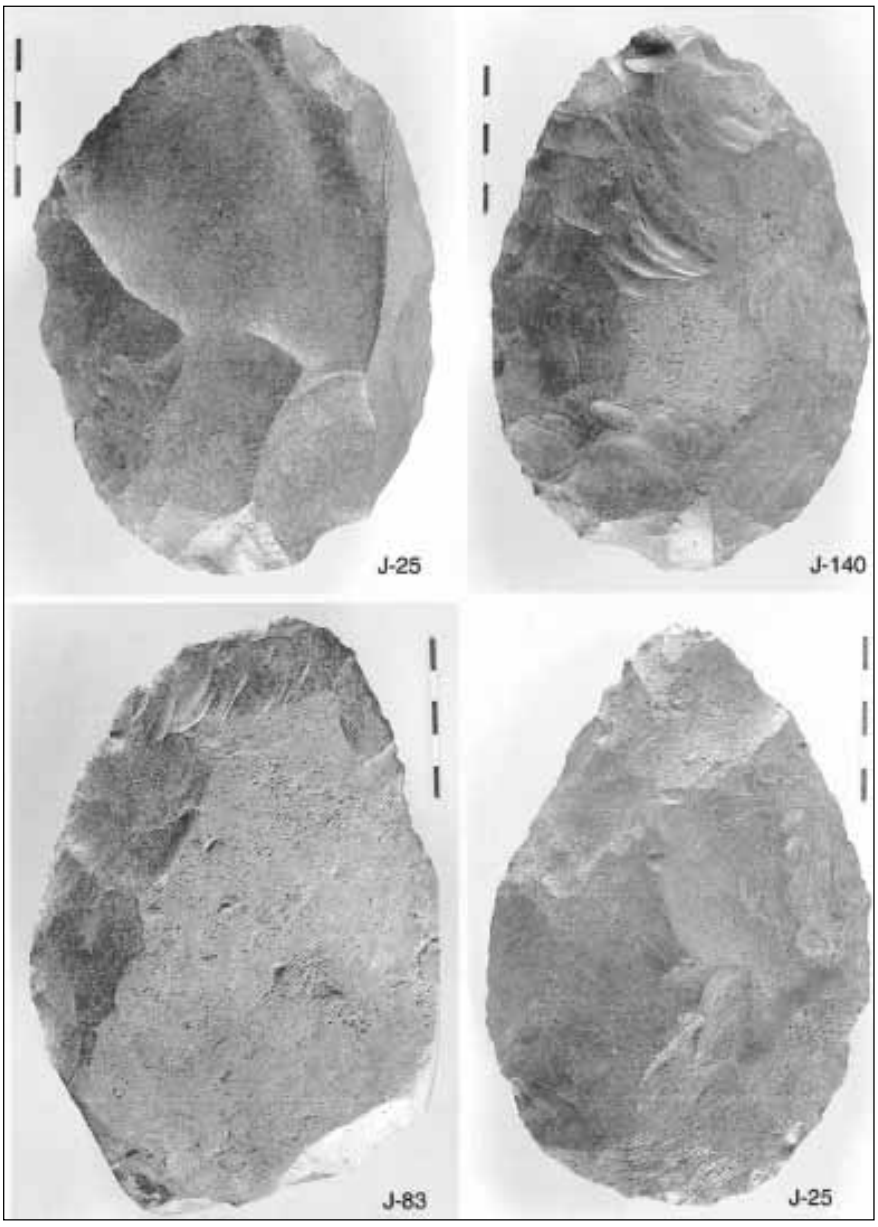
A few handaxes display clear tranchet flake scars from their original production. But a large proportion of them retain such scars from subsequent maintenance. Their identity as bifacial cleavers is clear and certain. On numerous oth-



3. Large handaxes, provisionally attributed to the Middle Acheulian.

ers the distinctive scar is partially obliterated by damage to the cutting edge, or by the user of a given tool having resorted to bifacial resharpening toward the end of its use-life when the shape of the distal end precluded further resharpening by tranchet flake detachment. In any case, as at ʻAyn as-Sawda, the ʻUyūn al-Qadīm assemblages are overwhelmingly composed of exhausted cleavers (**Fig. 7**). In a few instances, exhausted cleavers were recycled as flake cores, which greatly altered their forms. Only by careful interpretation of the remnant flake scars toward the distal ends of handaxes, and the grip attributes, was their identity as cleavers determined.

Resharpenable tools most often end their use-lives when they can no longer be resharpened and where they were last used. Some might have been abandoned when they could no longer be counted upon to be resharpened, or when they could readily be replaced, in anticipated fu-



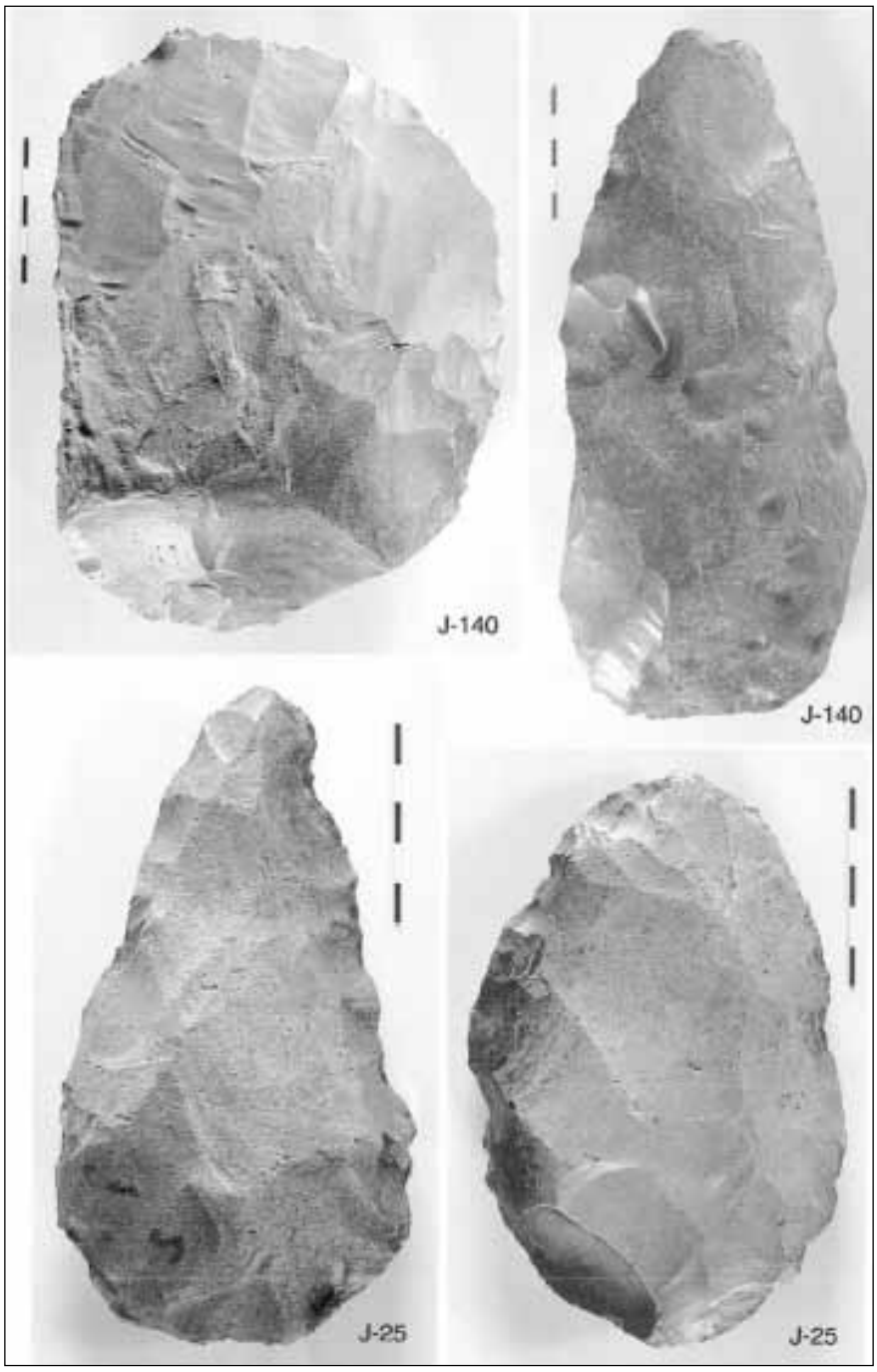
4. Large handaxes, provisionally attributed to Middle Acheulian, coarsely flaked, all tranchet cleavers.

ture contexts. So our analysis bears heavily on concepts of use-life, and the approximate stage between initial production and exhaustion at which any individual handaxe can be estimated to have entered the archaeological record. Our assessments of these use-life stages are based on analysis of more than 4,000 handaxes from al-Azraq, Tabun Cave near the Mediterranean coast, and al-Jafr Basin (Rollefson *et al*. 2006).

Levallois artifacts (**Table 1**), present in relatively small numbers at all but one site (Jafr-158), number 303 objects, of which nearly 80 percent are cores. They came mostly from sites within and near the entrance to the box canyon. By comparison, the 10 Levallois points and only 52 other debitage products suggest that many Levallois tools were removed from the locality, although some small flakes may still reside in the desert pavement.

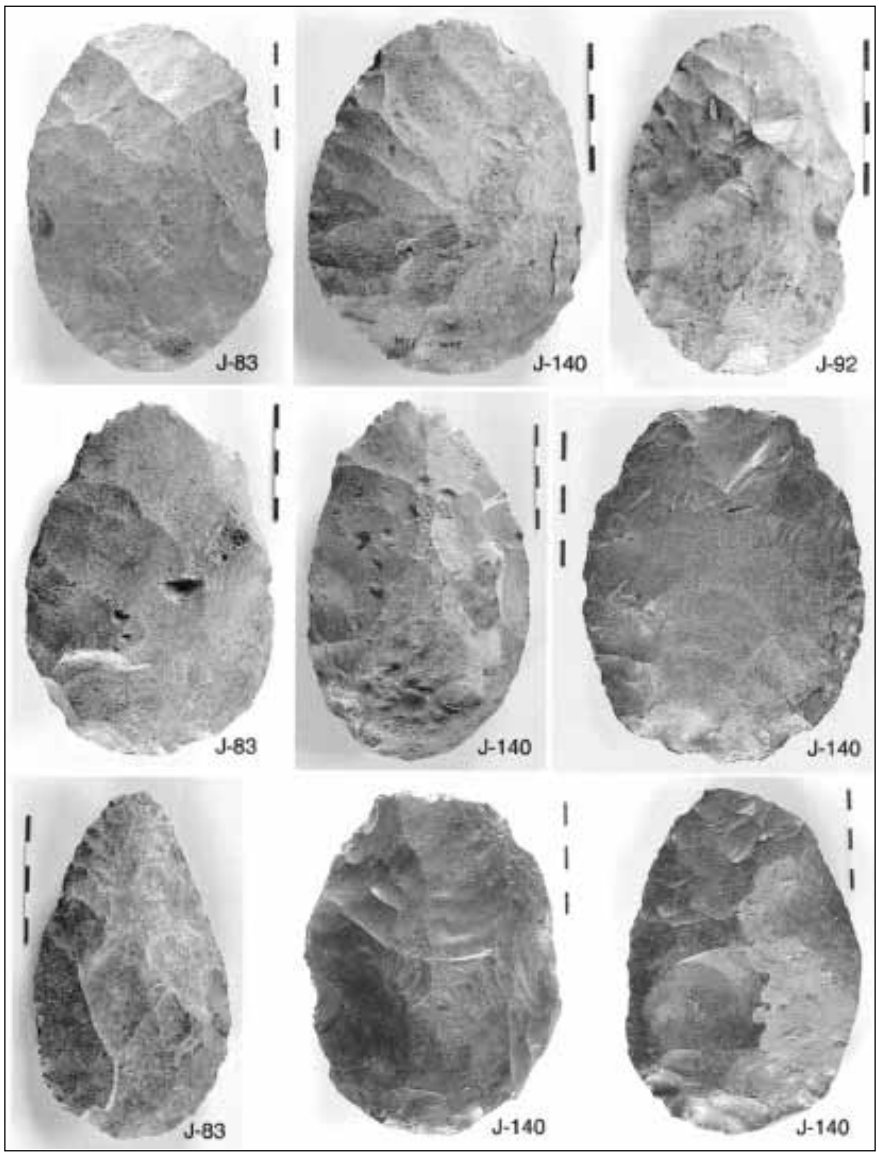
Chronology

In considering the chronological placement of the 'Uyūn al-Qadīm assemblages, the following discussion of Near Eastern sites (discounting occurrences of isolated specimens) draws on several of those with more substantial assem-



5. Large handaxes, provisionally attributed to the Middle Acheulian.

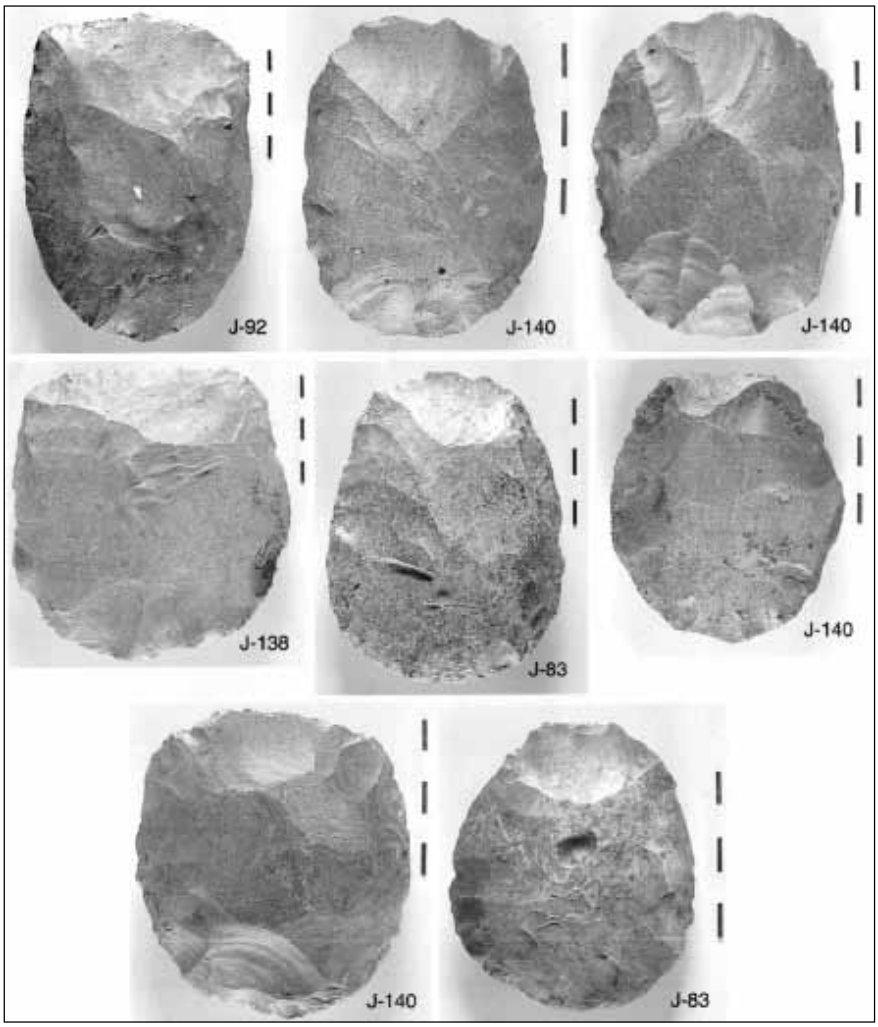
blages and for which the dating is reasonably well known. (For a detailed review of Jordanian Acheulian site data and their chronostratigraphic assignments see Copeland [1998]). Our comparison is made somewhat difficult and awkward because in general artifacts have been presented in the literature as static types, the forms and dimensions of the handaxes having been viewed as unchanging and unaffected by resharpening. Our approach continues to be a functional one in which Acheulian tool forms were the result of raw-material choices and stages of use-life alterations. Working edges of large cutting tools became dulled and damaged during use, and maintenance of those edges altered the forms of such tools throughout their use-lives. Individual tool dimensions and forms thus continually changed. Consequently, "large" and "primitive"



6. Tranchet cleavers, Late Acheulian. Mid- to late-stage in use-life, shortened by resharpening, and having lost distal width.

may indicate raw-material constraints or possibilities, or early stages of a tool's use-life, or may equate with the evolution of handaxe forms over hundreds of millennia. Nonetheless, comparisons of general assemblage characteristics can be informative chronologically.

Very large and coarsely flaked handaxes (**Figs. 2-5**), notably at sites Jafr-25, -83, -92, and -140, suggest that occupations at 'Uyūn al-Qadīm began during the Middle Acheulian, far back in the Pleistocene. The largest handaxe from 'Uyūn al-Qadīm (**Fig. 2**, upper left) has a massive, cortical grip (or butt) reminiscent of, but much larger than, Middle Acheulian flint examples at El-Meirah in the El-Kowm Basin of Syria, dated to 0.7 Ma (Boëda *et al*. 2004), and to examples made of basalt and dated to 1.2 - 1.4Ma at 'Ubaydiyya in the Jordan Valley (Bar-Yosef and Goren-Inbar 1993). These comparisons suggest that the 'Uyūn al-Qadīm specimen may date to the early part of the Middle Acheulian. There also are strong similarities between some of the other large al-Jafr handaxes and examples from the Middle Acheulian site of Latamne on the Orontes River in Syria (Clark 1967, 1968). Near Clark's excavations, Middle Acheulian artifacts in the modern gravel quarry of Miramil in the Latamne Formation overlay sediments dated by thermoluminescence to ~0.567 Ma, providing a rough estimate of the dating of the original Latamne site (Dodonov *et al*. 1993). The age of the Middle Acheulian site



7. Tranchet cleavers, Late Acheulian, resharpened down to the grip, fully exhausted, yet still retaining distal width.

of Joubb Jannine, Lebanon, is estimated by the investigators at ~0.5 Ma (Besançon *et al*. 1982), but perhaps may be contemporary with Latamne (Copeland and Hours 1993:90). Evron Quarry on the Mediterranean coast of northern Israel is sometimes compared technologically with Latamne (Gilead and Ronen 1977; Ronen 1991). It is now thought to date >0.65 Ma (Ron *et al*. 2003). So at present the ages of these Middle Acheulian sites and assemblages are estimated at a minimum of 0.5 Ma to well over 0.75 Ma.

The assignment of specific artifacts from al-Jafr Basin sites to the Middle Acheulian nonetheless remains problematic. Coarsely flaked, cortical-grip trihedral handaxes seen at several Middle Acheulian sites in the Near East are hardly represented in al-Jafr Basin. Two such implements were found at Mashāri‘ 4 in the lower member of the Ṭabaqat Faḥl Formation (~0.5 Ma) in the northern Jordan Valley (Macumber 1992). The essential absence of these tools in al-Jafr Basin assemblages may be due to the functions that different forms of handaxes served in different Middle Acheulian contexts. For instance, a point of divergence from this Middle Acheulian pattern is the use at ‘Uyūn al-Qadīm of the tranchet technique for creating and maintaining the cutting bit on large bifacial cleavers (**Fig. 2**, upper right). This Middle Acheulian (?) assemblage character reflects the butchering of large game. However, the number of well-characterized and dated Middle Acheulian assemblages in the Near East is still relatively few. Assemblage variation as dictated by site function, tool use-life history, and time is not yet well realized. At this point, based on the presence of the large and coarsely flaked handaxes, we think there is a significant, perhaps

distinctive, but undated, Middle Acheulian presence at several of the 'Uyūn al-Qadīm sites.

Handaxe forms we assign to the Late Acheulian equate well with those at several undated Jordan sites, including Fujayja, Wādī Qalkha J401 near the Rās an-Naqb (Henry 1995), and 'Ayn al-Asad, C-Spring, and 'Ayn as-Sawda in al-Azraq Oasis. The abundance of smaller handaxes (**Figs. 6, 7**) that clearly are bifacial cleavers typify this period, and their forms suggest that they have been extensively resharpened by tranchet and bifacial flaking, often to the point of exhaustion. But because the assemblages at 'Uyūn al-Qadīm are all confined to the surface, they cannot be segregated into the Late, Late Evolved, and Final stages of the Acheulian as others have done based on more discrete assemblages (e.g., Copeland and Hours 1993). Here we can only suggest the age of these artifacts in al-Jafr Basin is likely to be ~0.3 - 0.5 Ma. At some undetermined time Levallois technology was added to the Late Acheulian tool kit.

Discussion

The foregoing narrative suggests that the Acheulian occupations at 'Uyūn al-Qadīm reflect a pattern of repeated use of the same locality, for the same reason, over an immense range of time. We believe that pattern was specifically for ambush hunting and butchery of large game animals, and that most of the handaxes recovered there were designed as butchering tools. It seems likely that the presence of spring discharge from karstic channels within the Eocene limestone created an oasis setting on a savannah or steppe landscape that attracted large herbivores. *Homo erectus* hunters took advantage of this situation and used the landform for ambush hunting, both within the box canyon and in smaller alcoves and box canyons evacuated by former spring vents along the escarpment. Hunting weapons may well have been wooden throwing spears with self points, such as those found at Schöningen, Germany (Thieme 1997), that are dated to about 0.4 Ma. The substantial assemblage of bifacial cleavers at sites in the 'Uyūn al-Qadīm locality attests to the singular and persistent pattern of butchering large prey species that had to have been killed and butchered where they died at these locations. Thus the locality provides an enriched view of *Homo erectus* hunting strategies during the Middle Pleistocene of Jordan.

Numerous studies support these interpretations. Technological analysis of the lithic assemblages established the function of most of the handaxes as bifacial cleavers. Handaxes have been shown by use-wear studies to be used as butchering tools (e.g., Keeley 1980: 143-147). Technological and typological studies of the assemblages from 'Ayn as-Sawda reveal the formal transformations that result from the resharpening of these butchering tools (Wilke *et al*. 2005). The most clearly revealed behavioral analogy is with butchery contexts at Boxgrove (Roberts and Parfitt 1999). The focus by Acheulian hunters on Middle Pleistocene spring settings and other watering places in the Near East has several strong parallels. This situation prevailed at the al-Azraq Oasis sites of 'Ayn al-Asad (Copeland 1989a, 1989b; Rollefson 1983), 'Ayn as-Sawda (Rollefson *et al*. 1997; Quintero *et al*. 2005, 2007), and C-Spring (Copeland 1989c, 1991), and at Nadaouiyeh in El-Kowm Basin of Syria (Le Tensorer 1996; Le Tensorer *et al*. 1993).

At al-Azraq Oasis the fauna identified in firm association with Acheulian handaxes at C-Spring (Clutton-Brock 1989) includes aurochs (*Bos primigenius*, ancestor of modern cattle), hartebeest (*Alcelaphus buselaphus*), steppe rhinoceros (*Stephanorhinus* [*Dicerorhinus*] *hemitoechus*), Asiatic wild ass (*Equus hemionus*, onager), and an extinct equid (*Equus hydruntinus*). Of these, aurochs inhabited open forests and meadows of southern Asia, Europe, and North Africa. Historically, hartebeest, a large antelope, inhabited dry grasslands over much of North, East, and South Africa, and the onager ranged over dry landscapes from Palestine to the Gobi Desert (Nowak 1991). Fauna associated with the Acheulian at 'Ayn as-Sawda (Dirks MS; Dirks *et al*. 1998) include steppe rhinoceros (*S.* cf. *hemitoechus*) and elephant (*Elephas* of the *E. hysudricus-E. maximus* lineage). With the Levallois industry at 'Ayn as-Sawda were aurochs and the extinct equid *E. hydruntinus*.

Thus, the faunal remains from al-Azraq serve as proxy data and suggest that 150 km to the south at 'Uyūn al-Qadīm, Middle Pleistocene hunters of the Middle and Late Acheulian traditions exploited oasis settings on a savannah/

steppe landscape. There they hunted a broad range of large game animals that likely included aurochs, hartebeest, steppe rhinoceros, onager, extinct equid, and elephant.

Taken together, the information and interpretations gathered at ʻUyūn al-Qadīm establish southern Jordan as a premier region for learning about Middle Pleistocene human behavior. The record of evolving technology and culture revealed there apparently began by 0.75 Ma and prevailed, at the same locality, over at least the next 400 thousand years. During that time significant changes occurred in the ways stone tools were produced, but they always reflect the butchering, and the implied ambush hunting, of large and generally dangerous game species at this oasis setting. Evidence points to a broadly distributed life-way across the now-desert inland regions of the Near East, extending northward from at least southern Jordan through al-Azraq Oasis and on to the El-Kowm Basin of northeastern Syria (Quintero *et al*. 2007). The interpretations offered here provide a technological, natural historical, and behavioral framework within which to assess other Acheulian assemblages in the region.

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Philip J. Wilke
Leslie A. Quintero
Lithic Technology Laboratory
Department of Anthropology
University of California
Riverside, California 92521 USA
e-mail: wilke@ucr.edu, quintero@ucr.edu

Jason A. Rech
Department of Geology
Miami University
Oxford, Ohio 45056 USA
e-mail: rechja@muohio.edu

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