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LOWER PALEOLITHIC SITES IN SOUTH-WESTERN ASIA – EVIDENCE FOR "OUT OF AFRICA" MOVEMENTS

ABSTRACT: This paper discusses the paleoanthropological and archaeological data on the lower Pleistocene hominid presence from Africa and Western Eurasia – especially the Levant and nearby Caucasus. Evidence from the dated sites, fossils, and artifactual assemblages in this region strongly suggests that the evolution of Homo erectus *in Eurasia included numerous migration, colonization, and extinction events, which resulted in various regional discontinuities of the paleoanthopological record.*

KEY WORDS: Homo erectus – *Colonization – Extinction – Re-colonization – 'Ubeidiya – Dmanisi – Benot Ya'aqov*

ISSUES IN THE STUDY OF THE EURASIAN LOWER PALEOLITHIC

The issue of human migrations from Africa into Eurasia is at the centre of the current debate concerning modern human origins. While the notion that modern humans were not the first to emigrate is well known, in most writings it is implicitly assumed that the movement of *Homo erectus* into Eurasia was an incremental and irreversibly successful colonizing process (Klein 1989, 1995, Stringer, Gamble 1993, Foley 1987, *Figure 1*). The sum of this process meant that *Homo erectus* populations crossed vegetational boundaries from tropical to temperate belts and succeeded in adapting to the variable environments of Eurasia, except for the sub-arctic (Groves 1989). Long term survival in the various regions of Eurasia was implicitly interpreted from the fossil and archaeological record, while the possibility that many extinctions of lineages and re-colonizations occurred was hardly taken into account in the past. This interpretation, that *Homo erectus* enjoyed successful colonization and adaptation, resulted in both biological and cultural models of regional continuity. The alternative, a minority view advocated herein, regards the archaeological evidence as the material remains of both successful and unsuccessful human groups. Small or large bands could have moved in various geographic directions depending on their level of food acquisition technology, options for opportunistic scavenging, availability of vegetal resources, competition with other predators and conflicts among human groups. Discontinuities in the archaeological sequences are therefore not solely related to inadequate sampling, (which is indeed still the situation in many countries), to poor preservation or limited recovery, but also to real time gaps marking regional and temporal extinctions of *Homo erectus* groups during the period from around 1.8 to 0.5 Mya (million years ago).

This paper elaborates the scenario that the evolution of *Homo erectus* in Eurasia was composed of numerous migration and colonization events. This goal is achieved by considering dated sites, fossils and assemblages, and by equating the lithic assemblages of particular techno-typological attributes with human groups.

Discussion of migratory events by different groups requires the identification of lithic assemblages as products directly reflecting specific learned human behaviour. I argue that the rigid learned behaviours of the Lower

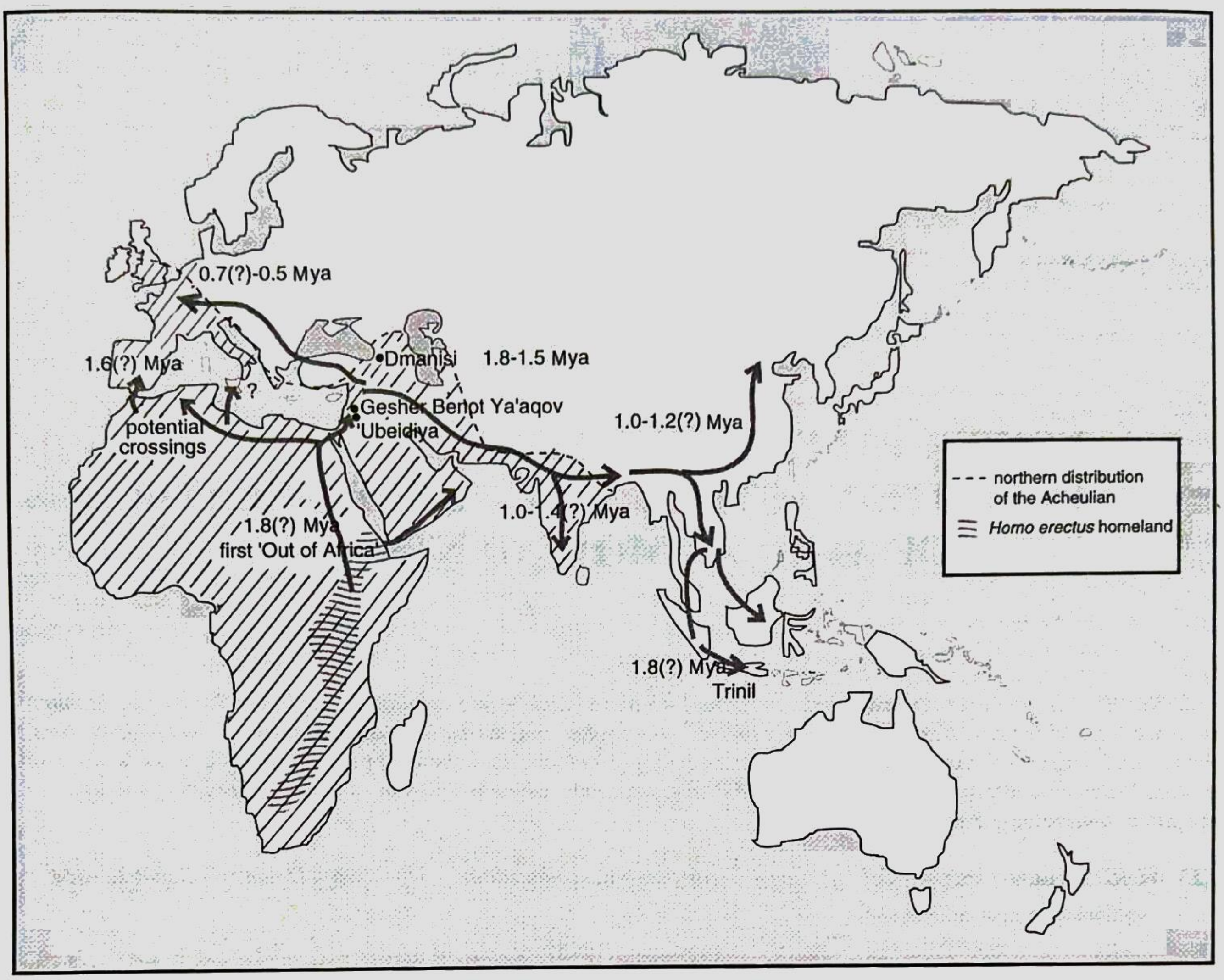

FIGURE 1. The world of *Homo erectus* and the known distribution of the Acheulian tradition.

Paleolithic lacked the mental flexibility attributed to archaic *Homo sapiens* and its descendants, and are therefore recognizable in the lithic assemblages. However, given the paradigm that views the artifacts as accidental products, with shapes dictated by the kind, availability, and accessibility of raw materials in any given region, a discussion of these aspects will precede the interpretation of the Lower Paleolithic assemblages from Western Asia and will rely, to a certain extent on recently published information from East Asia.

HOMO ERECTUS – CAPACITIES AND ARTIFACTS

We still possess only a limited knowledge of the behavioural aspects of the African populations of *Homo erectus*, most notably of the technical abilities that enabled them in their role as colonizers. The paucity of clear evidence for group size, inter- and intra-group social organization, elements of group identity (if they ever existed and/or can be detected from archaeological remains) derives in part from the nature of Lower Paleolithic sites. Our understanding of site formation processes, except for the most obvious results of natural agencies (i.e. lake level fluctuations, fluvial activities, accumulation of blown sand, *etc.*), is minimal. In particular, the absence of information gathered through micromorphology (Bar-Yosef 1993, Courty *et al.* 1989) hampers the identification of features such as used surfaces ('living floors'), or accumulations of plant remains (Goldberg *et al.* 1993). Thus, we offer only limited interpretations of excavated sites and a generalized knowledge of the level of technology of these early hominids. Food acquisition techniques are reconstructed from rare and poorly preserved wood remains, from interpretations of animal bone collections, and from the techno-typological studies of lithic industries (e.g. Binford 1980, Isaac 1986, Leakey 1971, 1975, Leakey, Roe 1995, Blumenschine, Cavallo 1992, Bunn 1991).

Beyond the debate concerning the origins of hunting that will not be discussed here, it seems that techno-typological investigations have been the main source of information for various behavioural explanations (e.g. Gowlett 1990, Wynn 1985, Wynn, McGrew 1989). However, it is well-known that lithic assemblages are prone to contradicting interpretations. For example, Binford suggested (1987) that assemblages with bifaces were made by male groups while core-choppers and flake tools were made by females. Thus, groups of *Homo erectus* could be seen as a certain primate society with subsistence and mating strategies in which males often moved by themselves across the landscape while females and juveniles stuck together. This interpretation does not hold for the East Asian sequences where there are almost no Acheulian sites, and therefore cannot be considered as a general rule. In addition, alternative interpretations can be based on the range of societal variability of primates that would allow different reconstructions of Lower Paleolithic social organizations. Other scholars interpret early hominids to resemble modern hunter-gatherers in their social structure (e.g. Isaac 1984). Within such divergent scenarios, one may view the Oldowan industry some 2.5–1.8 Mya (probably produced by *Homo habilis*) as made by hominids that little differed from chimpanzees (Wynn, McGrew 1989). Advocates of this model or a similar one would only see the change with the emergence of the Upper Paleolithic assemblages (e.g. Klein 1995). These are considered as manufactured by humans who were not much different from historically known hunter-gatherers. Within the two chronological ends of human cultural evolution lies a model that would enable us to investigate and reconstruct the pattern of behaviour of *Homo erectus* populations that do not fall in each category (Bar-Yosef 1994).

It is not clear whether *Homo erectus* had a syntactic language. Migrations of other mammals were successful without human-type language. However, a few scholars proposed that by the time early hominids had a brain volume of about 1,000 cm^3 they had the capacity for syntactic language (Deacon 1989), while others state that the archaeological remains do not reflect the presence of such an elaborate communication device (e.g. Chase 1991).

Except for the production of a variety of stone tools, discussed below, the evidence concerning their subsistence strategies is very poor. While it is currently believed that meat was obtained by scavenging, nothing is known about plant gathering, undoubtedly a major activity and perhaps the one that produced the essential nutritional sources in many phytogeographic belts.

The manipulation of raw materials other than hard rocks is indicated by the wood remains from various Lower Paleolithic sites such as Kalambo Falls (Clark 1992), Gesher Benot Ya'aqov (Belitzky *et al.* 1991), Lehringen (Adam 1951) and Clacton on Sea (Oakley *et al.* 1977) as well as the use of broken bones (e.g. Clark 1977).

Before presenting my approach to the study of lithics, it is appropriate to review the difficulties involved in reaching acceptable explanations of the Lower Paleolithic chipped stone industries. Disagreements over the interpretation of lithic assemblages began with the Bordes-Binford debate on the interpretation of the Mousterian assemblages from Western Europe, dubbed the "functional versus cultural" argument. In the 1960s, the proposal that morphological variability among lithic assemblages could have been the result of specific tasks, site utilization, availability and accessibility of raw material appeared to be a fruitful one. The view that function was the determining factor was considered closer to reality than the cultural explanations based on stylistic variability that led Bordes to recognize several different human groups (e.g. S. Binford 1968: 50, Bordes 1973, L. Binford 1973). It should be stressed that while elaborating on the functional arguments Binford (1973) did not reject 'ethnicity' as a component of human culture even in the Middle Paleolithic, but in his efforts to find out what the Bordesian taxonomy measured, he preferred the character of the activity as the factor behind the design of the tools. He rejected the frequencies of different tool types as reflecting social variability and justifiably suggested that group identity is expressed in variations of forms within the same class of artifacts (L. Binford 1973: 245).

While it seemed sensible to propose that human ancestors were efficient and shaped their tools to fit their needs in exploiting a given environment, function could not be determined solely by the form of the artifacts. It is worth mentioning that historically, the labelling of prehistoric tools was done on the basis of morphological correlations with ethnographic examples (e.g. Sollas 1915, MacCurdy 1926). Beyond the morphology that could have been of functional design, observable typological variability of prehistoric artifacts became the basis for intuitively creating the classificatory systems of periods and cultures, first by using the *fossile directeur* approach, and later with relative frequencies (Bordes 1961, Kleindienst 1961, Leakey 1971).

The impetus given by the English publication of Semenov's seminal volume (Semenov 1964), and the challenge proposed by the Binfords' (1966) motivated more than one generation of archaeologists to develop the study of the function of stone tools as evidenced by the microscopic pattern of polish or edge damage, by either high or low power magnifications or both (e.g. Keeley 1980, Odell 1979). While most microscopic analyses addressed the Upper Paleolithic and Neolithic only a small number of scholars dedicated their efforts to the earlier periods (Beyries 1988, Shea 1989). This was due to several reasons. First, most Lower Paleolithic assemblages in Africa were made of igneous or metamorphic rocks which are hardly amenable to the kind of microscopic study developed for flint and chert (Keeley, Toth 1981). Second, while reporting on the physical conditions of stone artifacts from Lower Paleolithic sites as "fresh," "lightly abraded," *etc.*, most scholars were satisfied with a naked eye examination (e.g. Clark 1968, Leakey 1971). In reality, most of these assemblages are slightly damaged for the purposes of microscopic examination. This is apparent in the naturally caused minute edge fractures that can be seen when a binocular microscope is employed for checking the edges of the pieces. The identification of the microscopic damage indicates that micro site formation processes, mentioned above, are rarely taken into account. Third, late prehistoric assemblages such as the European Upper Paleolithic were more attractive for micro-wear research because the lithic assemblages could be tied with the exquisite aspects of these cultures such as bone and antler industries as well as mobiliary and rock art.

With the advancement in edge wear analysis it became clear that during most prehistoric periods sharp and/or retouched edges were used for cutting, butchering, scraping, wood working, and so on, i.e. essentially maintenance and some procurement activities. Wooden points, similarly to stone projectile points, seem to have been used as spears during the Late Acheulian and the Mousterian. Although not all scholars agree on this issue, the presence of wooden spears (Clacton, Lehringen) supports the idea that thrusting spears were already invented by about 250/200 Kya (thousand years ago) (Shea 1992, Clark 1992 with references, see Gamble 1987 for a different interpretation).

A second approach to lithic studies was developed in the 1970s with efforts to examine the relationship between forms and raw material (e.g. Jelínek 1976). For example, Villa (1983, 1991), in explaining regional variability in France noted that the differences in biface typologies resulted from the use of different raw materials (quartz and quartzite instead of flint and chert).

Most scholars agree that the shape, size and mechanical properties of raw material nodules have determining roles in the production of blanks (flakes/blades with sharp edges). The debate concerns the role played by the knappers while facing the nature and size of the raw material. Would a certain kind and size of quartzite or flint cobble dictate the morphological attributes of the blanks? Or is it the learned operational sequence (*chaîne opératoire*) of knapping that results in the various shapes of the blank (Perlès 1992, Lemonnier 1992, Boëda 1995, Dibble 1991, 1995 with references)? Cross "cultural" comparisons are generally brought in by various authors in order to illustrate their preferred explanatory model. I do the same.

Let us first examine a case in which various raw materials were available to early hominids. The producers of the Oldowan and the Early Acheulian in Olduvai used quartzite and lava cobbles to shape core-choppers, while spheroids were almost solely made of quartzite (Leakey 1971). For the latter Schick and Toth (1994) suggest that the properties of the quartzite were more adequate for the formation of spheroids used as hammer stones, but sharp flakes could have been obtained from any kind of raw material, resulting in what is known as "core-choppers" (or "flaked pieces" as defined by Isaac 1986). When the category of bifaces is examined it is clear that large lava flakes or cobbles were most suitable. However, the so-called "Developed Oldowan C" in Upper Bed II at Olduvai is characterized by small bifaces which were made of quartzite pebbles (Leakey 1975). Later large, symmetrical bifaces from FLK IV, in Masek Beds at Olduvai, were shaped from the same quartzite that was available to their predecessors, the non-biface makers (Leakey 1971, 1975, Leakey, Roe 1995).

Another example is the site of 'Ubeidiya in the Jordan Valley, described below, where large lava and limestone cobbles as well as rare flint nodules were available and were all shaped into bifaces (Bar-Yosef, Goren-Inbar 1993). This strongly suggests that making bifaces, in addition to numerous flakes from core-choppers, polyhedrons, etc., was intentional. Was the choice dictated solely by the need for heavy stone tools? If the answer is yes, then why were spheroids, which are also heavy objects, only ever shaped from limestone at 'Ubeidiya?

The Lower and Middle Paleolithic of China, beyond the "Movius Line," provides supportive evidence for the presence of rigid patterns of learned behaviours (*Figure 1*). As shown by numerous authors (e.g. Clark 1992, Schick, Zhuan 1993), it is not the lack of proper raw materials in terms of size and quality that deterred the prehistoric stone knappers of east and south-east Asia from making bifaces. While good quality raw materials were available and accessible in many areas, bifaces, if present, are very rare in south-east Asia as demonstrated by rare occurrences such as Bossé in southern China (e.g. Huang, Wang 1995).

Experimental studies that replicate the production and use of Lower Paleolithic stone tools from various raw materials indicate that producers of Acheulian assemblages preferred large nodules. In many cases they shaped bifaces and picks with disregard for the degree of relative hardness. However, in the absence of large nodules, they settled for smaller ones (e.g. Leakey, Roe 1995). At the same time, flakes were obtained from every class of artifacts whether called "core-choppers," "polyhedrons" or "heavy duty scrapers" or "bifaces".

Similar conclusions concerning the pattern of learned behavior among the producers of Lower and Middle Paleolithic assemblages can be reached when we examine a regional sequence where the same kind of raw material was always accessible. The Levant is an area where good quality flint was and still is available, often within a distance of less than twenty kilometres. For example, the assemblages at Tabun cave with Upper Acheulian, Acheulo-Yabrudian (including the special Quina type thick scrapers) and the three facies of the Mousterian, currently dated to a time span of 350–50 Kya (Mercier *et al.* 1995) were essentially made from the same kind of flint that is available in the Wadi Mughara within a short distance (Jelínek 1991). However, these industries are considerably different from each other in core reduction strategies, blanks and frequencies of tool types (Jelínek 1982a,b, 1988, Dibble 1988, Bar-Yosef, Meignen 1992). These observations substantiate the conclusion that among Lower and Middle

Paleolithic populations there were often very rigid patterns of learned behaviour concerning the production of stone artifacts (Belfer-Cohen, Goren-Inbar 1994). This becomes even more obvious when the blank production of Middle Paleolithic assemblages is done under circumstances where there were small size nodules (e.g. Kuhn 1995).

While comparing the French Charentian (a Mousterian facies) and similar industries in the Zagros and the Levant, Dibble (1991) suggests that the overall resemblance within the heavily retouched scraper class is caused by excessive resharpening resulting from the intensity of occupation, which is related to climatic conditions, group mobility and site situation. Unfortunately, there is little in common in terms of climate and site situation (presumably in relation to procurement of food and raw materials) between the Taurus-Zagros and the Perigord. We must admit that little is known about long-distance group mobility in any of these areas. It seems that the a priori dismissal of any kind of stylistic behaviour by Middle Paleolithic humans is still premature. The possibilities for direct and indirect contact throughout the duration of the Middle Paleolithic between western European and Near Eastern populations should be considered. Similar industries in the region that occupies the geographic intermediate between western Europe and the Near East are known (e.g. Kozlowski 1988, Gabori 1976). Moreover, assuming that no long distance communications that could have been through incremental information transmissions, were possible, suggests cultural convergence and genetic drift.

I am fully aware that many will see the above discussion as a shift back to the idea that prehistoric humans, before the Upper Paleolithic, had mental templates that can be identified through technical style or "isocrestic style" in Sackett's (1982) terminology, whether among stone tools or core reduction strategies. I have argued above, admittedly in a brief presentation, that the hard evidence concerning the relationship between the distribution and accessibility of various raw materials, core reduction strategies (or even the entire *chaîne opératoire*), tool shapes (including change of forms due to resharpening), and interpretations of use-wear studies indicate that several issues raised by past research were confused.

Furthermore, assumptions concerning transmission of information between groups should take into account regions of continent size, as well as considerable time spans of many thousands of years. Reconstructions that claim regional continuity and allegedly constant adaptations should consider potential survivals as well as population extinctions due to maladaptions (Gamble 1987). The assumption that an Acheulian sequence in a certain region reflects continuous occupation is only an interpolation based on sites that could have been far apart in time. Successive re-colonizations of the same region by different Acheulian groups is no less a viable explanation than assuming that the unproved premise that morphological differences of stone artifacts reflect differences in functions and therefore shifts in adaptations. As long as the lithic samples are large and made on the same raw material and the nature of the occupation can be determined through various aspects such as fauna and paleo-ecological situation, the study of the operational sequence (*chaîne opératoire*) may enable us to gain an insight into the history of prehistoric groups. It is this reconstruction of paleo-history that will provide a better understanding of the major socio-economic shifts that composed human evolution during the Lower and Middle Pleistocene. Because of this I next examine the evidence of inconsistencies in the record of the Lower Paleolithic in western Asia with an eye towards documenting a number of movements out of Africa.

OUT OF AFRICA AND INTO THE NEAR EAST: ALTERNATIVE ROUTES AND VARIOUS HYPOTHESES

During the Lower Paleolithic, western Asia served as the safest terrestrial corridor leading from Africa and Eurasia. It was a two–way route for the movement of animals and thus was also open for use by humans (*Figure* 2). We therefore expect that the archaeological record preserved the evidence for at least a few of these migrations. This is not to say that crossings of the Mediterranean from North Africa could not have happened. The potential for human expansions through these routes will be briefly examined below.

A discussion of human migrations to and through western Asia by African *Homo erectus* populations cannot be divorced from questions that although not answered in full in this paper, still need to be considered: 1) Did a major climatic shift trigger environmental change that caused groups of *Homo erectus* to emigrate out of east Africa? 2) Was the migration an incremental move, driven by a slow increase of populations that continuously expanded beyond the geographic boundaries of *Homo habilis*, or was it a series of population bursts that generated movements of small, highly mobile, isolated groups of early hominids? 3) Did *Homo erectus* populations while in Africa develop the skills needed to colonize Eurasia or did they simply adapt by trial and error?

The first expansion of *Homo erectus* was into north Africa, but it is possible that this enlargement of their territories was concurrent with their movement into the Levantine corridor. There are several alternative routes for the movements of *Homo erectus* into Eurasia. The most secure one was through the Nile Valley to the shores of the Mediterranean with the alternative route along the Red Sea and the Arabian peninsula into the Levant or directly to the Persian Gulf and eastward. Other potential routes were from the Maghreb through the Strait of Gibraltar into Europe, or across the narrow waterways between Carthage, Sicily and Italy (Alimen 1979, Freeman 1975, Roe 1995).

Successful crossings and terrestrial colonizations faced climatic difficulties. The early glacials and interglacials of

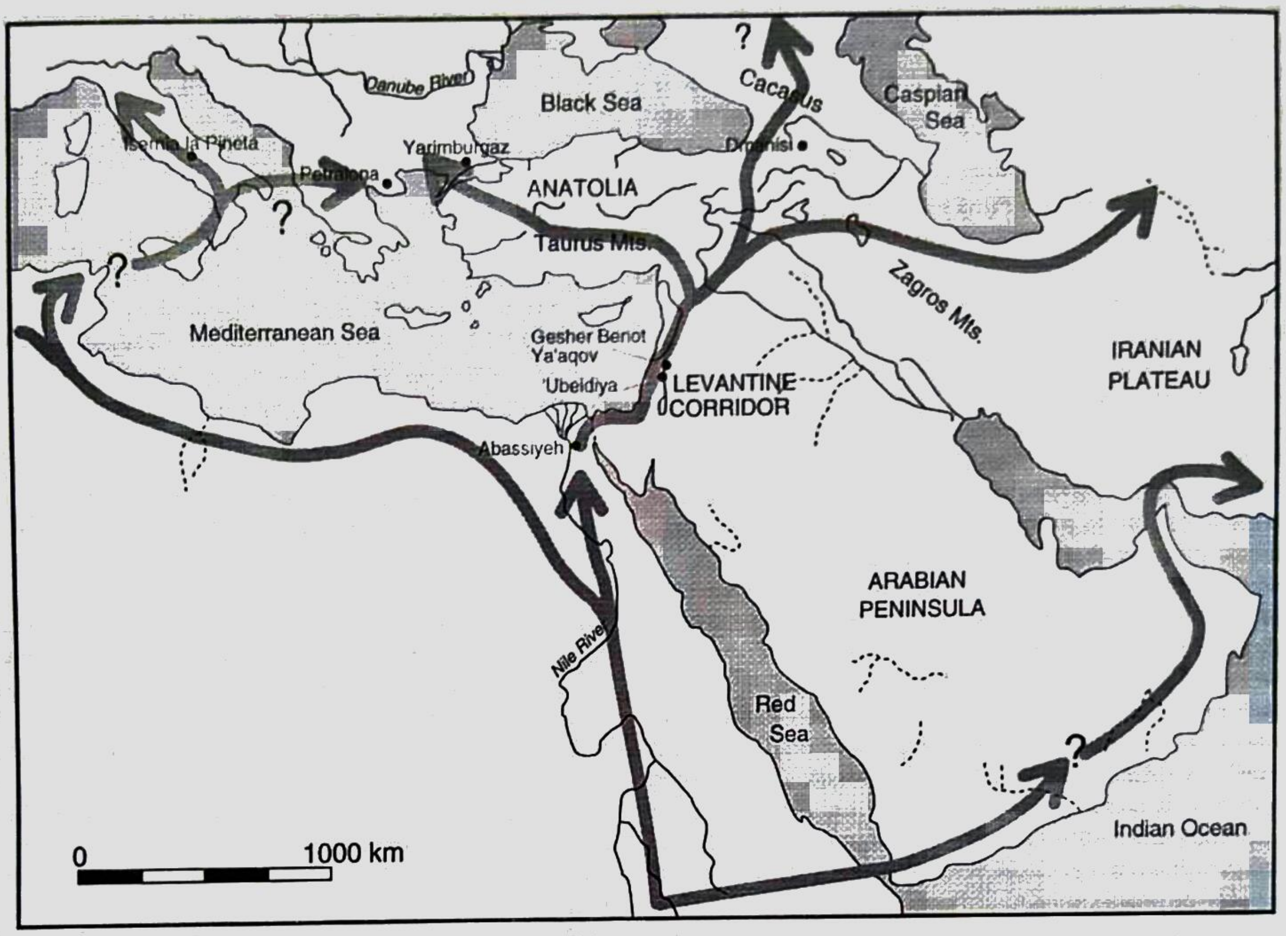

FIGURE 2. Alternatives routes of colonization in the Near East of *Homo erectus* groups.

the Lower Pleistocene were wetter than the glacials and early interglacial cycles of the Late Middle and Upper Pleistocene. During the Middle Pleistocene glacial periods became colder and drier and therefore harsher. Under these circumstances, even with the more efficient technologies of the Mousterian, isolation of populations was unavoidable and probably lasted for long periods (e.g. Bar-Yosef 1992).

Based on current knowledge of Pleistocene deposits, the Levantine Corridor seems to have formed the most secure terrestrial bridge for animals and humans moving out of or into Africa from the Miocene through the Pleistocene (e.g. Thomas 1985, Tchernov 1988, 1992a,b). Until convincing evidence for the crossing of early hominids through either Sicily, the Strait of Gibraltar or both is presented, it is safer to assume that the Near East was the only potential pathway for early migrations out of Africa.

Another question raised by the long distance migrations concerns the number of hominids involved. We can suggest that one pregnant female is sufficient to start a new colony, especially if advancement was only incremental. In such a situation, a fraction of the natural population growth would be moving ahead while still keeping its biological and social ties with the mother group. However, if early hominids migrated in small groups (30–40 people) without territorial continuity, they could have reached the edges of the continents in a few years. Rapid movements are difficult but not impossible to detect, although with current radiometric methods the precise age lies within a standard deviation of many thousands of years. Isolated groups, even if they became extinct, would have left behind assemblages of artifacts that were buried and could have been exposed recently either by nature or by construction activities. The alternative scenario is that the dispersal was incremental and involved periods of extinctions especially in temperate belts severely affected by periods of glaciation (Gamble 1987). In this case, certain regions would preserve only a fragmentary archaeological sequence. Thus an incomplete sequence could have been formed by several different groups subsequently occupying the same region, each following a time gap when the area was abandoned.

Human adaptations first to subtropical and later to temperate ecozones would have been easy if the movement was incremental, for example, the suggested average pace of 1 km per year for the colonization of Europe by Near Eastern farmers (Ammerman, Cavalli-Sforza 1984), even if the movement was in reality based on "leaping" from one suitable ecological niche to another. However, one can argue that *Homo erectus* groups had fewer technical and subsistence constraints than agriculturalists and therefore moved faster. On the other hand, a slow expansion by fissioned groups would have made it easier for these humans to acquire knowledge about plant and animal species. If *Homo erectus* populations were scavengers, as most scholars believe, techniques for obtaining animal tissues from kills of large predators would have been essentially the same in Eurasia as across the African landscape. The relatively poor plant food resources in the boreal and most temperate belts (excluding the Mediterranean type vegetation), however, would have forced humans to increase reliance on meat, especially carcasses of ungulates.

Chronological and spatial distributions of the large carnivores in Europe were examined by Turner (1992, this volume) in order to find out when early hominids enjoyed less competition from carcass destroyers. His conclusions tend to support Kurten's (1965) assertion that the presence of *Megantereon cultridens*, and the absence of two *Hyaenidae* species, would have made the period of approximately 1.5–0.5 Mya the best time for the first colonization of the Mediterranean basin. Archaeologically, the presence of Paleolithic occurrences from the middle part of this period (1.0–0.9 Mya) is rather dubious (for a current list of locations see Bonifay, Vandermeersch 1991) although additional earlier sites are under investigation in the Iberian peninsula (e.g. Gibert 1992, Roe 1995). Turner (1992, this volume) has argued that the optimal period for the colonization of Europe was after 0.5 Mya when the large guild of carnivores was essentially the same as that in east Africa since the beginning of the Pleistocene and the number of carcass destroyers decreased. This shift is also associated with the presence of late *Homo erectus* or early Archaic *Homo sapiens*, which, in addition to a brain volume nearly equal to that of modern humans, may also have had better technology, including the use of fire, and different social organization, than their ancestors did. Thus, the nature of the relationship between the carnivores and human dispersals into the temperate belt deserves re-examination.

GETTING INTO WESTERN ASIA

The routes along which early hominids moved into Eurasia, such as the Syro-African Rift Valley or the Mediterranean coastal plain, are essentially strewn with Lower Paleolithic sites and isolated artifacts (*Figure* 2). Unfortunately only a few archaeological contexts provide the kind of information that can be employed in this chapter.

It is important to note that, due to the regional history of field research, this summary presents an incomplete picture. Most of the work to date has been done in Syria, Lebanon and Israel, with only a few additions from Jordan, Saudi Arabia, Turkey and Iran. New discoveries in the Caucasus region reflect the yet unexplored potentials of this area.

The spatial distribution of Paleolithic remains, whether sites, find spots or isolated artifacts, can only be understood against the backdrop of the changing Lower and Middle Pleistocene paleo-ecology of the region. The geographic features extant in western Asia resulted in uneven distribution of biomass. Mountainous regions such as the Zagros, the Taurus and the Caucasus and the vast Anatolian and Iranian plateaus display a marked seasonal availability of food resources and would be less attractive than coastal areas. On the other hand, the inter-montane valleys provide ample supplies of plant food, animals and water resources all year round.

Unfortunately, the level of the technology from this period, except for what is generally gleaned from the stone tools of *Homo erectus* populations, is essentially unknown. Therefore, we can only use the location of the sites and scatters of lithics in relation to reconstructed environments to indicate the main subsistence strategies. Archaeological finds collected in well surveyed areas of the vast Syro-Arabian desert indicate that most of the region was probably uninhabitable during climatic conditions similar to today's. Only when the monsoonal system reached latitudes farther north than today, and/or when winter precipitation spread into southward latitudes, could portions of these deserts, especially oases, have been exploited by early hominids. The producers of Early Acheulian industries avoided the semi-arid region, and it was only during the wet spells of the Middle Pleistocene that we find Upper Acheulian sites located in today's deserts. This conclusion is based on the observation that, in spite of considerable erosion during the Plio-Pleistocene, surface finds which typologically can be attributed to Lower Paleolithic industries are detectable even if not found in situ. When such artifacts are collected in a region that is now a desert it means that occasionally the area enjoyed more lush conditions. Lithics accumulated, probably with bones, but later were removed by erosion. Numerous examples of this can be cited from the western Sahara (e.g. Chavallion 1964).

The Mediterranean coastal ranges and valley in the Near East as well as large river valleys farther north (e.g. the Kura river and its tributaries) maintained a high biomass of ungulates and a considerable array of plant resources. Thus these are the areas where we should look for the early sites. The prospective sub-regions include the coastal plain along the eastern Mediterranean and the plains around the Caspian and Black seas, valleys in the Caucasus, Taurus and Zagros, the Orontes and the Jordan Valley as well as the oases (Wadi Sirhan, El-Kowm). No doubt adequate environments around the southern part of the Arabian peninsula would also have been appropriate (Yemen, Oman), especially across the narrow and shallow Bab-el Mandeb straits and within eye-sight from the Afar Rift in Ethiopia (e.g. Amirkhanov 1991, this volume).

In the following pages the results from three excavations are briefly summarized, including 'Ubeidiya, Dmanisi and Gesher Benot Ya'aqov. These sites are presented as stations

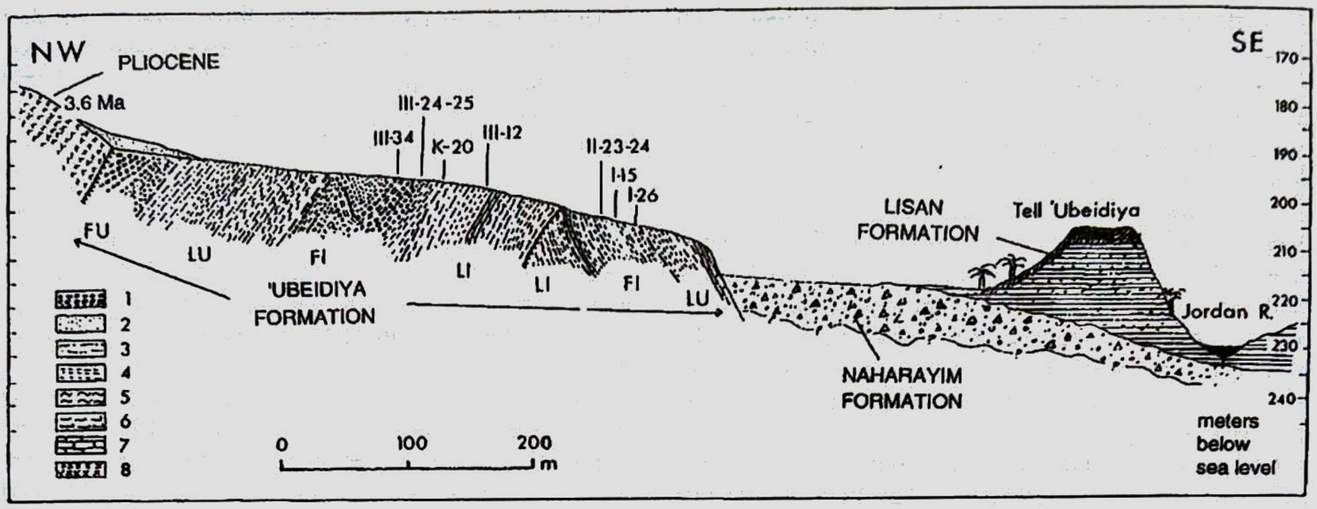

FIGURE 3. 'Ubeidiya: the geological sequence (after Bar-Yosef, Goren-Inbar 1993). Legend: 1 – conglomerate, 2 – sand, 3 – silt, 4 – clay, 5 – marl, 6 – chalk, 7 – limestone, 8 – basalt.

of various migratory groups within the on-going process of colonizing Eurasia. This is not to say that the first two are the earliest sites in Asia; rather, when compared to other claims for evidence for the presence of early humans on this continent, their sites reports proved the best available evidence.

'UBEIDIYA – AN EARLY SITE IN THE JORDAN VALLEY

The complex geology of the central Jordan Valley provided us with a series of lacustrine formations interspersed with lava flows and alluvial accumulations (e.g. Horowitz 1977, Bar-Yosef 1987, Heimann 1990, Shaliv 1991). The major tectonic activities which formed the Jordan Rift Valley postdate the deposition of the Cover Basalt. This complex basaltic formation was dated to 3.11±0.18 Mya (Mor, Steinitz 1982). This date supports the early determination by Curtis (1965) of 3.6 Mya obtained from a tilted late Pliocene block that overlies a portion of the 'Ubeidiya Formation (*Figure 3*).

The Erq el Ahmar Formation is the first lacustrine formation that indicates the presence of a pre-'Ubeidiya lake and is dated to the Late Pliocene on the basis of its malacological assemblage (Tchernov 1975) that contains two Pliocene species, *Hydrobia acuta* and *Dreissena chantrei* and eight extinct species not found in 'Ubeidiya or later formations (Picard 1943, Tchernov 1975, 1986). Paleomagnetically, this formation provided a spread from sometime within the Gilbert chron to the early Matuyama chron. A phase of normal polarity is tentatively correlated with the Olduvai subchron (Verosub, Tchernov 1991). Because the exact location within the Erq el Ahmar sequence of the rare surface collected core-choppers and flakes is unknown, it seems quite possible that they derive from the upper layers of the formation, which on the basis of malacological considerations, is considered as immediately preceding the 'Ubeidiya Formation. Thus, most probably, these artifacts are not earlier than the Olduvai subchron. If this observation receives additional supportive field evidence and a chronological placement, it would indicate the age of one of the earliest ventures out of Africa of *Homo erectus*.

The better known archaeological and faunal sequence was exposed at the site of 'Ubeidiya, 3 km south of the Sea of Galilee. Since the commencement of excavations in 1960, several geological trenches totaling a length of about 1100 m (Picard, Baida 1966a,b, Bar-Yosef, Tchernov 1972, Bar-Yosef, Goren-Inbar 1993) were dug with the aid of heavy machinery in order to provide a visible stratigraphy in the absence of natural exposures. The geological structure of the 'Ubeidiya Formation (*Figure 3*) is that of an anticline with several undulations interrupted by several faults. Such a structure could not have been created without a major tectonic movement. It is assumed that this diastrophic event was accompanied by lava flows in the Golan Heights and that a few reached the Yarmuk Valley. The lava flows, known as the Yarmuk Basalt, were K/Ar dated to either 0.6±0.05 and 0.64±0.12 Mya (Seidner, Horowitz 1974) or to 0.79±0.17 Mya, as an average of nine samples (Mor, Steinitz 1985).

The exposed layers at 'Ubeidiya were numbered from lowermost to uppermost and the composite sequence at the site comprises about 154 m. It was further sub-divided into four depositional cycles, two essentially limnic and two terrestrial (Picard, Baida 1966a,b, Bar-Yosef, Tchernov 1972) as follows (*Figure 3*):

A. The Li-cycle, characterized by clays, silts and limestone, terminates with laminated silts, rich in freshwater molluscs and fish remains. One layer (III–12) contained mammalian bones and a small assemblage of core-choppers and flakes (*Figures 3–6*). The maximum expansion of Lake 'Ubeidiya during this cycle possibly

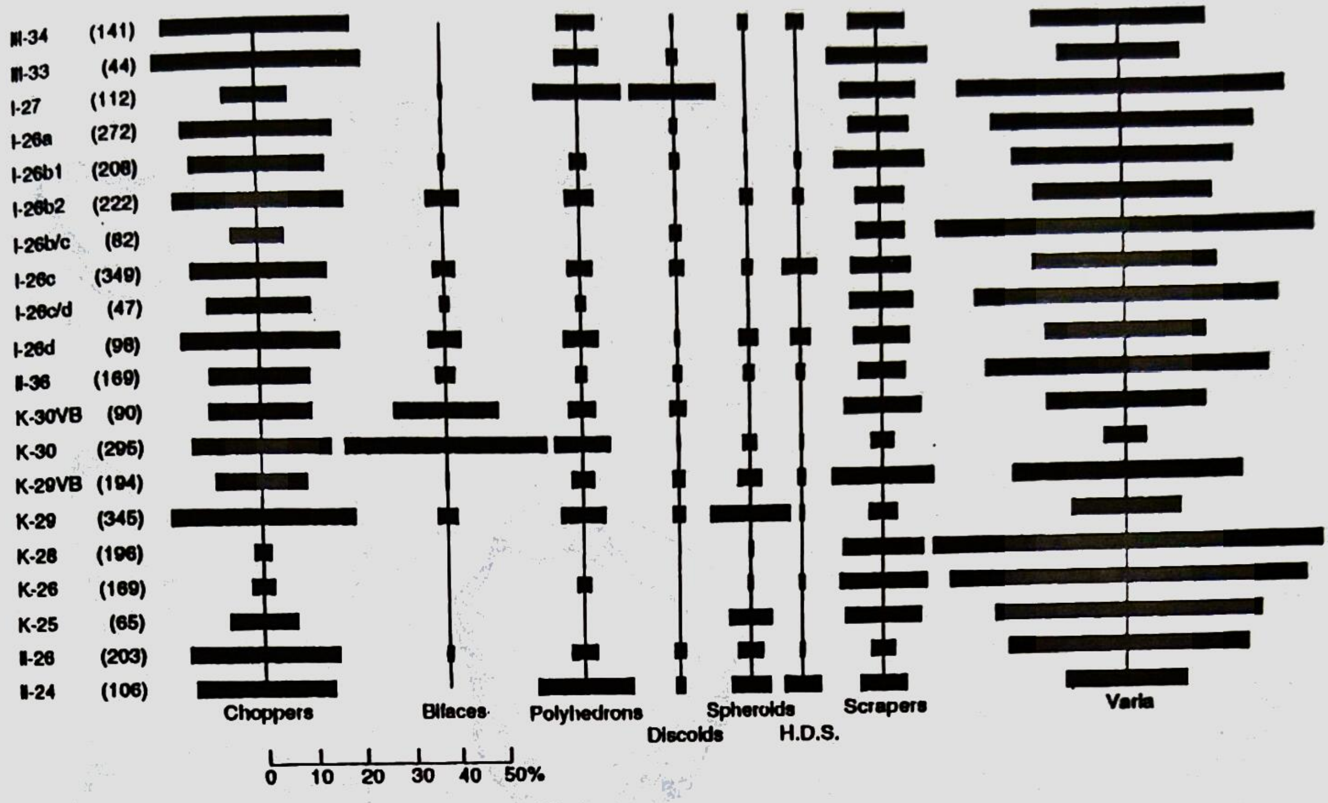

FIGURE 4. 'Ubeidiya: the distribution of main classes of artifacts (after Bar-Yosef, Goren-Inbar 1993).

reflects wetter climatic conditions and perhaps reduced evaporation. Correlation with a glacial or interglacial period remains uncertain. The Upper Pleistocene pollen record (Weinstein-Evron 1983) may indicate that dominance of oaks, recorded in the only pollen sample from the site (Horowitz 1979) characterizes glacial conditions.

B. The Fi-cycle is an accumulation of clays and conglomerates essentially beach deposits within a deltoid environment. The faunal remains demonstrate a prevailing Mediterranean climate wetter than today's. During this period the lake receded and early humans camped on the lake shore and at the edges of the alluvial fan and on mud flats that temporarily dried (Layers II–23 to II–36, I–15 to I–26 and their assemblages; *Figures 3–6*). From the hilly area, several lithic assemblages were washed and re-deposited within a wadi infilling (in particular layers K–29, K–30 and III–34, 35; *Figures 3–6*).

C. The Lu-cycle, the upper limnic member, consists of two parts; the lower is basically clays and chalks, while the upper part is a whitish-greyish-yellow silt series. Only a few artifacts were encountered in this unit. Lake 'Ubeidiya again reached its maximum area, probably leaving only a very narrow beach along the escarpments of the Jordan Valley.

D. The Fu-cycle consists mainly of wadi conglomerates, some of which contain large basalt boulders. No artifacts or molluscs were found in this member. Currently this accumulation is related to the onset of the tectonic movement which caused the disappearance of Lake 'Ubeidiya, the deepening of the Jordan Rift and the change in the micro-climate of the area that became generally drier.

The dating of 'Ubeidiya was the subject of considerable controversy. Horowitz (1989) suggested placing it around 0.8 Mya while Sanlaville (1988) proposed 1.4 to 0.8 Mya. Repenning and Fejfar (1982) based their opinion on the older classifications of the 'Ubeidiya fauna published by G. Haas (1966, 1968) and suggested a range of 2.6 to 1.7 Mya. Revised faunal studies by Tchernov and his associates concluded that the site should be dated to 1.4–1.0 Mya (Eisenman *et al.* 1983, Tchernov *et al.* 1986, Tchernov 1987, Guérin, Faure 1988, 1989) with higher probability of a date around 1.4 Mya (Tchernov 1992b). The 'Ubeidiya Formation cannot be dated directly as neither tuffs nor lava flows were incorporated. However, a microscopic search may uncover datable volcanic ashes. The reversed paleomagnetic situation, established in a few preliminary readings, only relates the site to the Matuyama chron (Opdyke *et al.* 1983).

The revised paleontological identifications of the 'Ubeidiya fauna is based on comparisons with the West European bio-zones as defined by Guérin (1980, 1982). The following is a list of species and their chronological distribution infrequently based on a few K/Ar readings:

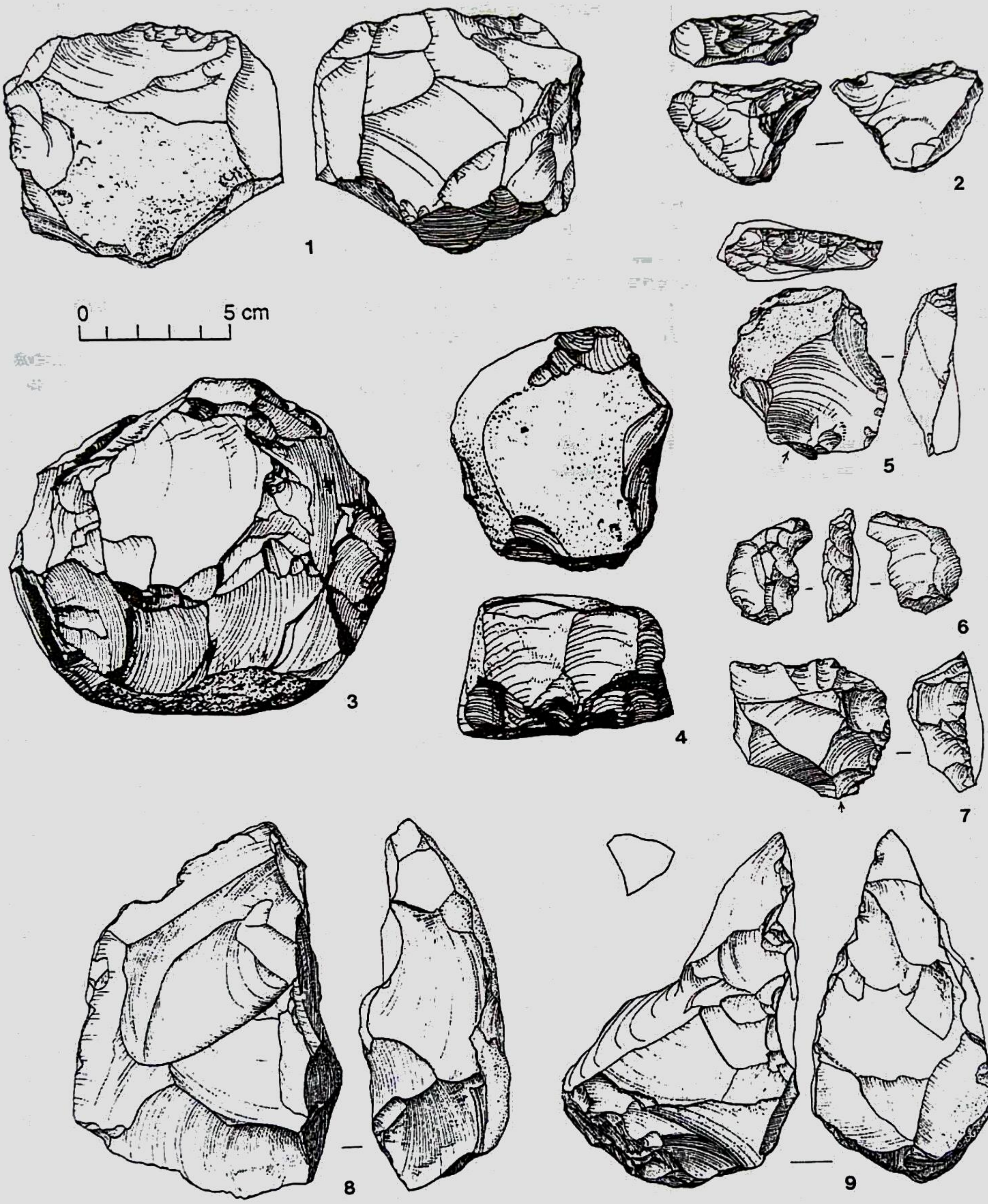

FIGURE 5. 'Ubeidiya: core-choppers, a polyhedron, retouched flakes and a trihedral (after Bar-Yosef, Goren-Inbar 1993).

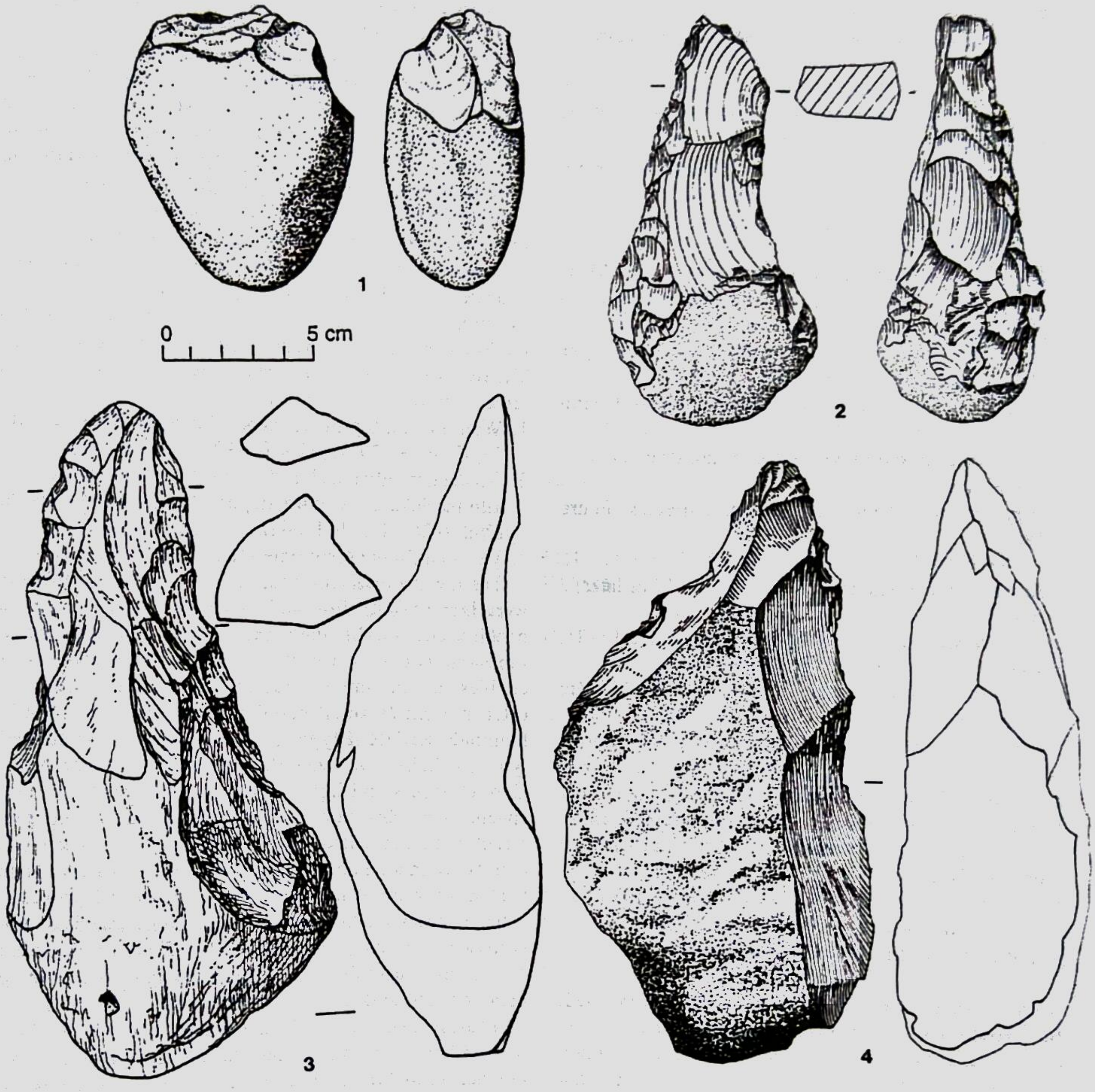

FIGURE 6. 'Ubeidiya: core chopper, quadrihedral pick and two bifaces (after Bar-Yosef , Goren-Inbar 1993).

(1) Younger species (Zone 19 and later, estimated age 1.5 Mya and younger)
Lagurodon arankae (Zone 19, Final Villafranchian)
Mammuthus meridionalis cf. *tamanensis* (Zone 19 and early 20, Final Villafranchian and earliest Mid-Pleistocene)
Praemegaceros verticornis (Mid-Pleistocene in Eurasia)
Canis arnensis (Zones 19–20)
Pelorovis oldowayensis (present from mid-Bed II through Bed III in Olduvai, 1.6–0.7 Mya)
Apodemus (*Sylvaticus*) *sylvaticus* (reached Europe by the Mid-Pleistocene from the Near East)
Apodemus flavicollis (same as *A. sylvaticus*)

(2) Older species (Zone 18 and younger or since 1.9 Mya)
Dicerorhinus etruscus (form of latest evolutionary phase; Guérin 1986)
Panthera gombaszoegensis (Zone 18–20, Upper Villafranchian to Mid-Pleistocene)
Kolpochoerus oldowayensis (in Shungura G and Olduvai I–IV)
Hippopotamus gorgops (present in the entire sequence of Olduvai)
Hippopotamus behemoth (endemic species; Faure 1986)

(3) Archaic species (Zone 16 through Zone 19 or later):
Hypolagus brachygmathus (Zone 16–20)
Allocricetus bursae (in Eurasia from Zone 17–21, seemingly survived later in the Near East)
Cricetus cricetus (since Zone 17, Middle Villafranchian)
Gazellospira torticornis (through the entire Villafranchian)
Sus strozzii (from Zone 16 through 20)
Ursus etruscus (through the entire Villafranchian)
Pannonictis ardea (through the entire Villafranchian into the Mid-Pleistocene)
Megantereon cultridens (Zones 16 through 19)
Crocutta crocutta (since Shungura B)
Herpestes sp. (since the Pliocene in Africa)

In these faunal correlations (Tchernov 1986, 1988, 1992, 1995) two species – *Lagurodon arankae* and *Dicerorhinus etruscus etruscus* – are the most significant ones. Comparisons with the European sequences indicate that the 'Ubeidiya assemblages fit best between the faunas of Il Tasso (Zone 18 or 19) and Farenta (Zone 19 or 20) in Italy. When compared to the French faunas from Le Coupet (Zone 17) and Senéze (Zone 18) it seems that 'Ubeidiya is younger than Senéze and precedes the Mid-Pleistocene. The correlations with the African faunas indicate that 'Ubeidiya is earlier than Ternifine and is perhaps of similar age as Ain Hanech in Algeria, which is considered to be of Upper Villafranchian age (*ca* 1.5–1.1 Mya) as well as of the same age as Upper Bed II at Olduvai (*ca* 1.6–1.1 Mya).

The validity of such long-distance bio-stratigraphical correlations depends on radiometrically dated European faunas, especially those of the Villafranchian sequence (Guérin 1982, de Lumley 1988). Unfortunately only a few dates are available and indicate that the Terminal Villafranchian, with which the 'Ubeidiya fauna has been correlated, lasted from *ca* 1.4–1.0 Mya.

The archaeological excavations at 'Ubeidiya uncovered over 60 layers with artifacts (Bar-Yosef, Goren-Inbar 1993). Based on field observations, the same layers could be traced on both sides of the main anticline. In order to avoid unfounded correlations, the layers were numbered separately in relation to each geological trench (Bar-Yosef, Tchernov 1986, Bar-Yosef, Goren-Inbar 1993). Only 15 major archaeological horizons were excavated more extensively in order to provide a sufficiently large exposure and adequate lithic and faunal assemblages. Most of these assemblages (except for III–12) lie stratigraphically within the Fi-cycle, but occur within various depositional facies. The reconstructed paleoenvironment of these occurrences are as follows::

1. Within or on top of a swampy layer (II–23, II–24, II–25, II–36, K–20, K–12 = III–12).
2. On the gravelly lake beach and where it passes laterally into the lake or swampy deposit (II–26 = I–15, II–28, I26d, I–26c, I–26b, I–26a).
3. Within a fluvial conglomerate (K–29, K–30, III–34).

The raw materials used for the manufacture of artifacts were lava (basalt), flint and limestone. Basalt occurs as pebbles, cobbles, boulders and scree components, while limestone is common in the beach and wadi deposits as cobbles, and the same is true for flint which, however, is often present as small pebbles and rare cobbles. Early hominids used these types of hard rocks for different tool types (Stekelis *et al.* 1969, Bar-Yosef, Goren-Inbar 1993). Core-choppers and light-duty tools were made of flint, spheroids mainly of limestone, and the handaxe group from basalt, with a few made of flint and limestone. There is a direct correlation between the size of the tool-category and the type of common raw material used. In every layer basalt is the common raw material while the most abundant tool-type is the core-chopper made of flint. This may have been due to flint's usefulness as a generally more stable sharp edge for cutting than basalt or limestone.

Thus, if 'Ubeidiya can be dated as early as 1.4–1.0 Mya it must have been one of the stations on route of *Homo erectus* out of Africa into Eurasia. The artifacts recovered, such as the bifaces, are similar to the handaxes of the Developed Oldowan B and Early Acheulian of Olduvai Bed II. These two ostensibly different industries in East Africa can be included within the same Acheulian tradition. The new dates for Bed I (Walter *et al.* 1991) probably indicate that the earliest Acheulian emerged around 1.70–1.65 Mya, thus preceding the early Acheulian from Konso-Gardula in the Ethiopian Rift (Asfaw *et al.* 1992). It is worth mentioning that as indicated by both the 'Ubeidiya assemblages and Acheulian sites in western Europe, the frequencies of bifaces cannot serve as the determining factor that define two separate traditions (Stiles 1979, Villa 1983). The quantitative approach advocated by Bordes is currently employed in order to determine the nature of the assemblages including the core reduction strategies, the kind of site, whether it was an ephemeral or base camp as demonstrated by the presence of expedient industry, identifiable curated artifacts and so on (e.g. Villa 1991). Clustering assemblages into entities is done more or less as in the past, on the basis of *fossile directeur*. Therefore, the way the 'Ubeidiya artifacts were fashioned, excluding determinant factors such as the properties of raw material, resemble those of the Olduvai Bed II industries and from Ain Hanech, in North Africa (Balout 1955). *Figure 4* demonstrates that the 'Ubeidiya assemblages can be divided into two kinds, with and without bifaces. Technologically, all the assemblages were fashioned in a similar way (Bar-Yosef, Goren-Inbar 1993), and it is also possible that humans fabricated a somewhat different array of artifacts in different locations. However, given the non-handaxe assemblage at Dmanisi (see below), it would be interesting to test the hypothesis that the 'Ubeidiya lithics were produced by two different groups of *Homo erectus*.

Little additional information is available about other lithic assemblages derived from Lower Pleistocene deposits in the Jordan Valley. The Abu Habil Series (Bender 1974) were reported to contain the so-called Abbevillian (Early Acheulian) handaxes (Huckreide 1966), but further investigations are needed in order to demonstrate whether these are generally contemporary with 'Ubeidiya or are of earlier or later age.

DMANISI – A LOWER PALEOLITHIC SITE IN THE CAUCASUS

This site in Georgia in the inter-montane valley of the Kura river was excavated in the course of paleontological investigations (Vekua 1987, Gabunia, Vekua 1990, Lordkipanidze, this volume). Excavations uncovered stratified faunal assemblages and an industry that seems from the first report (Dzaparidze *et al.* 1989) to consist mainly of core-choppers and to lack bifaces although one piece could have been a broken handaxe (Dzaparidze *et al.* 1989: Fig. 38). Among the reported flakes, there are retouched pieces that can be classified as scrapers and one burin. In addition the excavators describe a few objects of worked bone.

Preliminary study of the pollen as preserved in coprolites revealed the essentially forested nature of the area. The reconstructed paleoenvironment, as based on pollen and the faunal assemblage, consists of higher mountains with Alpine associations and the well watered woodland of the inland basin (Lordkipanidze, this volume).

The site is dated by two elements – a K/Ar reading of 1.8±0.1 Mya on the lava flow below the bone bearing beds and the faunal assemblage. Originally the fauna from Dmanisi was attributed to the Upper Apscheronian or the Upper Villafranchian as defined in the western Mediterranean basin (Gabunia, Vekua 1990). A re-evaluation of this evidence following the discovery of the human mandible, led the investigators to suggest that the Dmanisi assemblage is contemporary with the Odessa fauna (southern Russia), slightly earlier than Senèze and Le Coupet and thus earlier than 'Ubeidiya which was deposited above a lava flow dated to 1.8 Mya (Dzaparidze *et al.* 1989). Recent field work and paleomagnetic readings (Ferring, Swisher, personal communication) support the observation that the bone-bearing beds accumulated immediately after the Olduvai subchron, and thus Dmanisi can be considered as the earliest occupation in western Asia. The lithic industry, charcterized by cores and flakes, marks the kind of artifacts used by *Homo erectus* in this locality.

Considering the available evidence and chrono-stratigraphy of the lithic industries from Africa, it is suggested that the first movement out of Africa was triggered by the climatic changes that occurred around 1.8 Mya. The bearers of the core and flake tools preceded the following migration of Early Acheulian as evidenced at 'Ubeidiya.

THE ACHEULIAN FROM GESHER BENOT YA'AQOV

The third example for the probable archaeological residues of an African group that moved into the Jordan Valley during the Upper Acheulian is the lithic assemblage from Gesher Benot Ya'aqov. The site is embedded in a formation that bears the same name and outcrops in a series of exposures of both lacustrine and fluvial layers along the gorge of the Jordan River in the Hula Valley. Gesher Benot Ya'aqov Formation overlies unconformably the Yarda Basalt first dated to 0.64±0.12 Mya (Horowitz *et al.* 1973) and later by several K/Ar readings to 0.9±0.15 Mya (Goren-Inbar *et al.* 1992a). This lava flow covers the Mishmar Ha Yarden Formation, which on the basis of malacological correlations is considered to be contemporary with the 'Ubeidiya Formation (Tchernov 1973).

The site was first excavated by Stekelis (1960) on the right bank of the Jordan River, was later tested by Gilead in 1968, and is currently under systematic excavations on the left bank by Goren-Inbar (Goren-Inbar *et al.* 1991, 1992a,b, Goren-Inbar, Saragusti 1996).

During the 1930s excavations Stekelis identified the following stratigraphy: Layer (VI), the lowermost, contained large lava boulders, rolled lava handaxes and cleavers and numerous molluscs. Layer (V) consisted of a black sediment with a rich malacological assemblage, dominated by *Viviparus apameae* as well as numerous handaxes and cleavers made of basalt. The upper layers (IV–II) according to Stekelis (1960) contained only Upper Acheulian bifaces made of flint. These few objects are

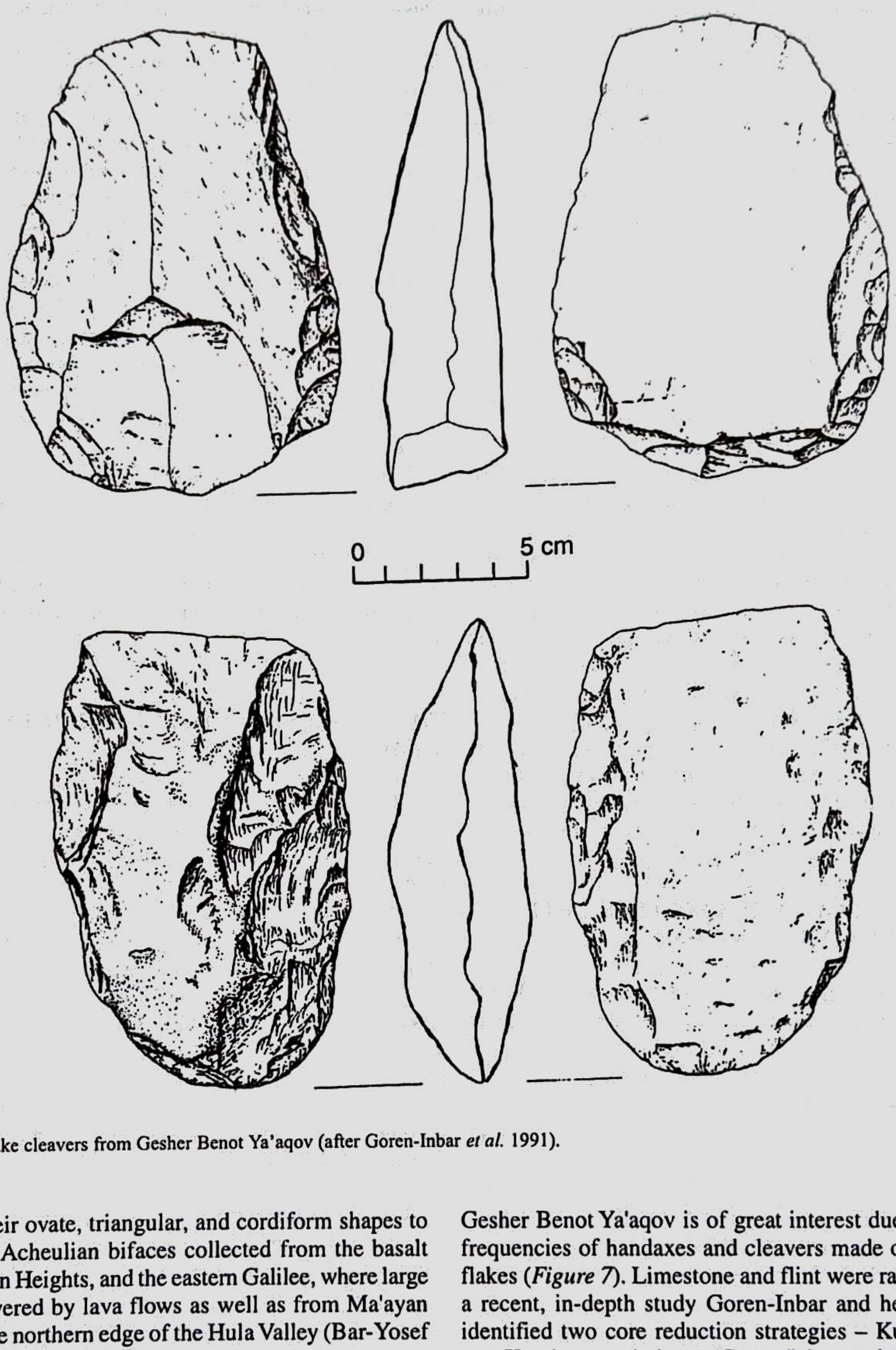

FIGURE 7. Flake cleavers from Gesher Benot Ya'aqov (after Goren-Inbar *et al.* 1991).

similar in their ovate, triangular, and cordiform shapes to other Upper Acheulian bifaces collected from the basalt covered Golan Heights, and the eastern Galilee, where large areas are covered by lava flows as well as from Ma'ayan Barukh, at the northern edge of the Hula Valley (Bar-Yosef 1975).

The current excavations are situated on the left bank of the Jordan River where the exposed layers are tilted by 40–45° (Goren-Inbar, Belitzky 1989). In this newly exposed sequence Layer II–6, a 1.5 m thick deposit, was the main subject of the excavations. It contained a large assemblage of bifacial tools that were recently published in detail (Goren-Inbar, Saragusti 1996). The lithic assemblage of Gesher Benot Ya'aqov is of great interest due to the high frequencies of handaxes and cleavers made on large lava flakes (*Figure 7*). Limestone and flint were rarely used. In a recent, in-depth study Goren-Inbar and her associates identified two core reduction strategies – Kumbewa and non-Kumbewa techniques (Goren-Inbar *et al.* 1991, Goren-Inbar, Saragusti 1996). The methods of obtaining flakes from large lava cores are reminiscent of those used in East and North African Acheulian assemblages (Balout *et al.* 1967, Biberson 1961, Stekelis 1960, Gilead 1970, Bar-Yosef 1975, 1987, Clark 1975). Although Gesher Benot Ya'aqov lies on the eastern edge of a vast area covered with basalt (Gebel Druz and the Black Desert) within southern Syria and northern Jordan, it should be stressed that in none of the surface surveys of these areas were lava-made Acheulian assemblages noted. On the contrary, in most cases, flint nodules derived from isolated limestone outcrops, often of Eocene age, served as raw material for fabricating handaxes (e.g. Goren 1979, Goren-Inbar 1985, Ohel 1991). Thus, one may conclude that the unique assemblage of Gesher Benot Ya'aqov was probably manufactured by a newly immigrating group of humans who came, perhaps along the Mediterranean coast, from north Africa into the Levant, although a potential origin in east Africa is not precluded.

Current paleomagnetic readings located the Bruhnes/ Matuyama boundary (0.78 Mya) within the archaeological sequence of the site (Verosub *et al.* 1998). The fauna also supports an early Middle Pleistocene age. The assemblage from the lower layers of the site includes the following species: *Stegodon mediterraneus* Hooijer, *Elephas trogontherii* Polhig, *Dicerorhinus merckii* Jäger, *Hippopotamus amphibius* L., *Dama mesopotamica* Brooke, cf. *Bison priscus* Bojanus; *Capra* sp., *Gazella gazella* Pallas (Hooijer 1959, 1960, Goren-Inbar 1992b). This is essentially a Galerian assemblage which replaced the Late Villafranchian association around 0.9–0.7 Mya (Azzaroli *et al.* 1988). In addition, two broken leg bones derived from either the Stekelis or the surface collections that were done through the years (1937–1955), were attributed to *Homo erectus* (Geraads, Tchernov 1983).

These data suggest that we see the special assemblage at Gesher Benot Ya'aqov as resulting from the activities of a late *Homo erectus* group that moved from Africa into the Jordan Valley. This move was perhaps triggered by environmental change that occurred around the Jaramillo subchron. Paleoclimatic conditions in the northern hemisphere, as recorded by deep sea cores and terrestrial fauna, indicate an increase in the intensity of the glacial cycles (e.g. Thunnell, Williams 1983, Azzaroli *et al.* 1988, Forsten 1988). This change seems to have caused increased periods of aridity on the African continent. Under such circumstances, an increase in competition for resources probably forced human groups to look for alternative foraging grounds. It is still premature to propose their origin within the African continent, although north Africa seems the most likely candidate. After a period of unknown length, the Gesher Benot Ya'aqov hominids either disappeared or intermingled with local populations who systematically made handaxes from flint instead of exploiting the basalt resources.

CONCLUDING REMARKS

The dating of Dmanisi and 'Ubeidiya to about 1.7/1.6–1.4 Mya seems to be the most secure for Western Asia. The spread of *Homo erectus* from Africa into Eurasia could have been triggered by environmental changes around 1.8 Mya. Since then, most probably, there were several waves of migrations although not all can be as yet recognized in the archaeological record. While it has been suggested that hominids crossed the Mediterranean Sea via the Strait of Gibraltar or through Sicily (e.g. Freeman 1975, Alimen 1979), land corridors were undoubtedly more suitable for long-distance movements. The rate of survival was not assured, and it is therefore not surprising that certain regions do not, despite their Pleistocene records, provide evidence for continuity. We expect different groups with different learned behavioral patters to have somewhat different sets of tools. Wooden elements are rarely preserved in the record. Broken bones employed as tools have been found for example in Gesher Benot Ya'aqov (e.g. Clark 1977). The uneven use of wooden and stone tools may account for the paucity of the latter in the *Homo erectus* Indonesian sites (unless the simple core-chopper industry is missed by field workers). It is unfortunate indeed that what was preserved from the set of objects used by early humans are the stone artifacts alone. We can reconstruct the technology used by *Homo erectus* only on the basis of evidence provided by excavated sites. With more elaborate techniques such as micromorphology, phytolith analysis, etc., we are bound to improve our body of knowledge. By dating sites and scrutinizing the causes behind the variability among the lithic assemblages, while attempting to control for the effects of raw material, we may be able to trace the paleo-history of human groups who colonized Eurasia with a better degree of resolution.

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