Man and environment in the Palaeolithic
H. Ullrich (ed.), E.R.A.U.L. 62, 1995,Liège, pp. 247-263.

The Lower and Middle Palaeolithic in the Mediterranean Levant: Chronology, and cultural entities

Ofer Bar-Yosef *

Abstract
This paper aims at summarizing the main chronological framework and characterstics of the cultural entities recognized today within the Lower and Middle Palaeolithic in the Mediterranean Levant. The Lower Palaeolithic incorporates several of the oldest sites, such as 'Ubeidiya, that can be compared in part to Dmanisi in Georgia. Numerous assemblages and a few samples are recorded in Syria, Lebanon, and Jordan. The Upper Acheulian is better known and seems to date from the early Middle Pleistocene. The Acheulo-Yabrudian entity is a special culture known only from the northern and central Levant. The Levantine Mousterian is currently at the center of the debate over the origins of modern humans. New TL dates indicate that the early Mousterian manifestations may be 270 kyr old and that the latest are 50-48 kyr old. Middle Palaeolithic sites provide information concerning prehistoric diets, hearths, and human mortuary practices. Mineralogical studies decipher the differences in bone preservation in various caves.

Key words: Lower Palaeolithic, Middle Palaeolithic, Acheulian, Mousterian, Levant, hearths

Opening remarks

Human adaptation to new environments is a subject that receives renewed attention with every new discovery of a dated fossil that does not conform to pervious geographic distributions, or with the new dating of long known fossils that places them in an older time span. One may wonder how long it took humans to colonize the entire globe and whether this was an incremental process or was achieved by waves of rapid movements on the part of small bands. On a geological scale, the last 2.5 million years can not be considered a long period. During this time bipedal proto-humans, who gathered vegetal food-stuffs, scavenged and preyed animals, and made stone tools, became anatomically fully modern humans, efficient hunters and finally farmers. While we all know that the rate of change is not constant and are aware of the incompleteness of the archaeological record, we can now identify several main thresholds of colonizations. The earliest "out of Africa" is indicated by the 1.8 myr date for *Homo erectus* in Java that needs further confirmation (Swisher et al 1994). More secure is a date in the range of 1.6-1.3 m yrs from the faunal dated sites of Dmanisi (Georgia) and 'Ubeidiya (Israel, see below for details). By 55 kyr modern humans colonized Australia (Roberts et al 1990) and by 30/15 kyr penetrated into the New World.

The changes during the Lower and Middle Palaeolithic dispersals events seem to have been slow. This impression is gained, however, from observing the formal variability among the stone tools and draws very little upon evidence concerning other aspects of human behaviour. Proposed hypotheses often did not take into account the possibility that human dispersals were also marked by numerous extinctions which are reflected in archaeological gaps.

* Professor Dr. Ofer Bar-Yosef, Departement of Anthropology, Peabody Museum, Harvard University, 11 Divinity Avenue, Cambridge, MA 02138, U.S.A.

In my view, the current tendency to use the results of the archaeological investigations in order to create gradual cultural and often regional sequences obscures important technological and biological changes. No doubt, numerous uncertainties concerning the reconstruction of past environments or the accuracy of the dates as obtained by various methods hamper a better understanding. In our drive to create a complete story of human evolution we tend to extrapolate the information from different regions into a united narration. When each geographic region is examined in the light of information from adjacent regions, the story seems more complicated.

In the following pages I will discuss the Lower and Middle Palaeolithic of the Mediterranean Levant, a small region characterized by environmental diversity. During the entire Pleistocene this region provided the necessary resources for survival for prehistoric foragers. During glacial ages, the Mediterranean vegetational belt dominated the coastal hilly ranges. While there was a stress season was the cold wet winters (often November to February), a large number of mammals, birds, reptiles and over 100 species of trees, bushes and annuals provided meat, seeds, fruits and leaves most of the year round. These woodland hills and small intermontane valleys were neighbored by the steppic Irano-Turanian belt on the east and south. Adjacent regions such as the Taurus-Zagros mountain ranges, the Anatolian or Iranian plateaus, and the Caucasus mountains, had more limited areas for permanent survival, with the exception of the lowlands near the Black and Caspian seas, the coastal plain of Turkey, the Taurus-Zagros hilly flanks and the inter-montane valleys.

The Levant is a continuous terrestrial corridor between Africa and Eurasia. It is expected that human movements took place with more ease than did movements of animal and plant species, and were often facilitated during the wetter periods (pluvials). In addition, this region forms an elongated finger-like "island" during dry and warm periods (interglacials and interstadials), connected only to the Taurus mountains and the Turkish coast. Thus human survival with simple food acquisition technology was always possible in the coastal Levant, but not in the semi-arid and arid belts. The Sinai and the Syro-Arabian deserts were occupied by humans only during the drier period of the Terminal Pleistocene (e.g., Bar-Yosef 1992).

The Lower Palaeolithic and *Homo erectus* lithic industries

The traditional term "Lower Palaeolithic" designates the various industries thought to be pre-Mousterian and until recently also pre-Last Glacial (pre-Würm). However, it now seems that the Mousterian in Europe and the Near East should be dated to about 250/200 kyr while some late Acheulian assemblages are of later age. Thus it is more practical to deal with the Lower Palaeolithic sequence as bracketed in time, without any cultural connotations. This is even more obvious when the African sequence is taken into account. The earliest industries, or the Oldowan, emerge some 2.5 myr ago while until recently the first Early Acheulian manifestation was dated to 1.4 myr (Asfaw at al. 1992). It is true that without better dating of possibly earlier Acheulian sites, it is premature to suggest older ages. However, such claims could be made by recalculating new ages for the Developed Oldowan A and site EF-HR in Bed II in Olduvai Gorge on the basis of the new dates for the Olduvai subchron in Olduvai (Walter et al. 1991). Similarly, the Acheulian of Peninj (Lake Natron) situated in the Humbu formation (Isaac and Curtis 1974), hints to an earlier age. While the reader may feel that these proposals are based on the assumption that *Homo erectus* can be identified as the manufacturer of the Acheulian industries, this is not so. Rather, the premise held in this paper is that different groups of essentially contemporary *Homo erectus* made different industries, with or without bifaces. In the past it was wrongly assumed that the movement out of Africa of *Homo erectus* was done by the bearers of the Acheulian industry. Therefore, there is no need to archaeologically support the early arrival of *Homo erectus* in southeast Asia by stating that they were producers of core-chopper industries and thus older than those who invented the bifaces as tool type (Swisher et al. 1994). The current archaeological evidence indicates that probably since 1.7 myr, *Homo erectus* populations produced both Acheulian and core-chopper industries in various times and divergent environments.

We can therefore trace the multiple sorties of *Homo erectus* groups by looking at the stone industries which resulted from their rigid pattern of behaviour, indicating low cognitive abilities. Such demonstrations are possible at the sites of Dmanisi in Georgia (Dzaparidze et al. 1989) and at 'Ubeidiya in the Jordan Valley.

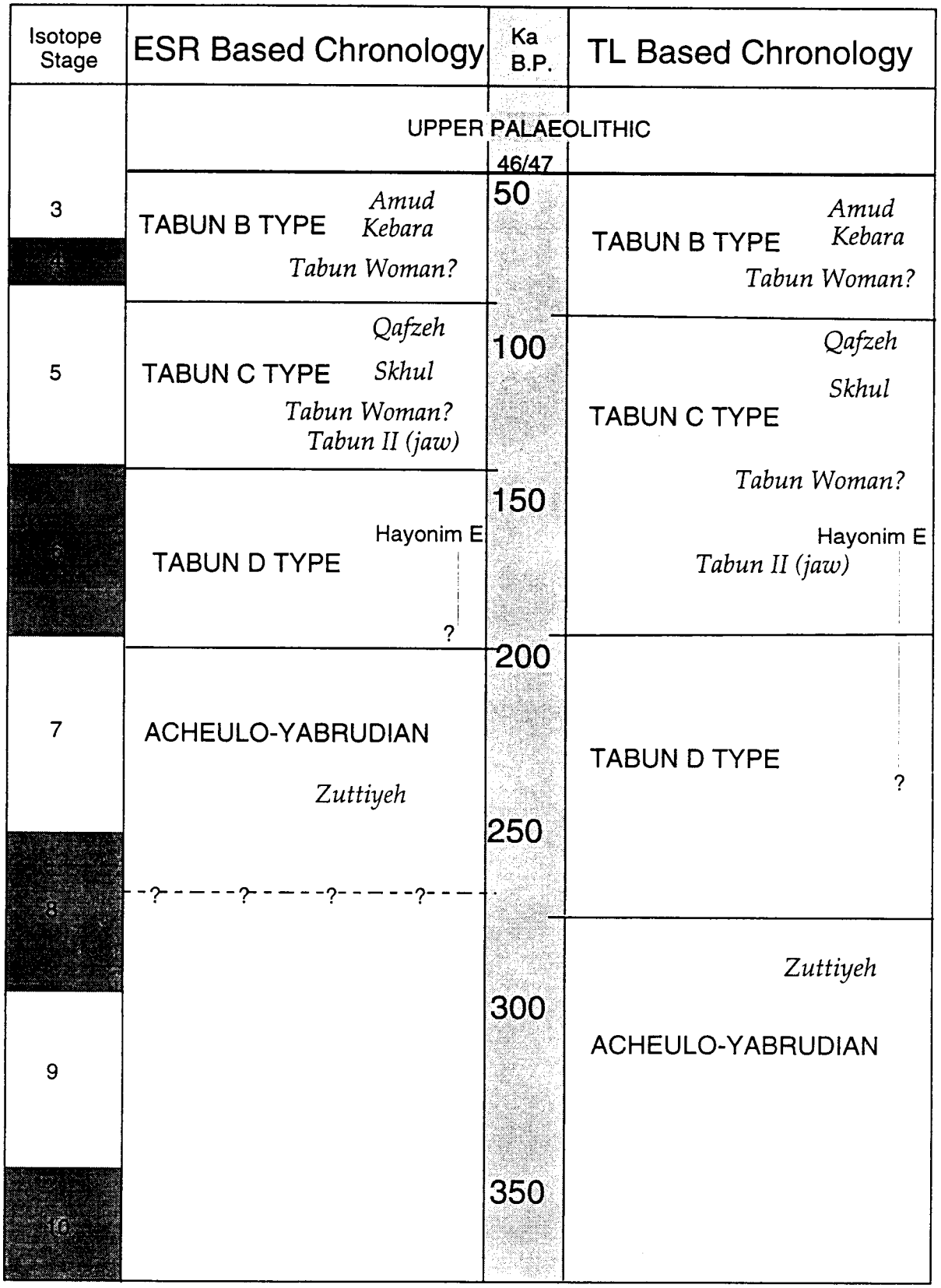

Fig. 1. The chronology of the late Lower Palaeolithic and Middle Palaeolithic as based on ESR and TL readings (for references see text).

The Jordan Valley sites - 'Ubeidiya and Erq el Ahamar

The excavations at 'Ubeidiya uncovered a series of faunal assemblages with numerous species of mollusks, reptiles, birds and mammals (see Tchernov 1986 and 1992 with references). This fauna is essentially Late Villafranchian with a few Galerian elements. The biogeographic origins of the mammalian species demonstrate a mixture with a clear Palearctic stamp but including a few Ethiopian, Saharo-Arabian and North African species. The overwhelming majority of the species originated in Eurasia and the eastern Mediterranean. Endemic species (mainly rodents and one hippopotamus) indicate that the 'Ubeidiya fauna was already isolated from other regions. It seems that western Asia was cut off from Africa with the development of the arid Saharo-Arabian belt (Tchernov 1992). This probably resulted from rapid uplift of the Tibetan Plateau around 2.5 myr (Zhongli et al. 1992) that established the late Pliocene-Pleistocene pattern of atmospheric circulation.

The sequence in the Jordan Valley begins with the Erq el Ahmar Formation in which perhaps a few artefacts were found (Verosub & Tchernov 1991). However, a detailed stratigraphy with the available paleo-magnetic readings is required before a firm claim for an occurrence earlier than the 'Ubeidiya Formation is accepted.

The 'Ubeidiya Formation that is at least 150 m thick and was deposited following a tectonic movement that contorted the earlier Erq el Ahmar lacustrine formation (Bar-Yosef & Tchernov 1972). On the basis of long distance faunal correlations and the reversed paleomagnetic situation that indicates an age within the Matuyama chron (Opdyke et al. 1985), 'Ubeidiya is cautiously dated to 1.4-1.0 myr with high probability that the older date is more accurate (Tchernov 1992). A possible better chronological resolution will be reached if the search for microscopic volcanic ash will be resumed. Such ashes could be matched with known events of eruptions in the Near East as was done in East Africa (Brown et al. 1992).

The earliest layers (K/III-12, II-23,24, III-20-22) contain numerous core-choppers, polyhedrons and spheroids and flakes but lack bifaces. If this assemblage configuration is not the result of sampling error due to the environmental location of the excavated units, then they indicate the presence of an early group of *Homo erectus*. In the younger layers (II-25 to III-34) of this long sequence, bifaces occur in various frequencies and the assemblages can be defined as "Developed Oldowan B" or Early Acheulian (Bar-Yosef & Goren-Inbar 1993). There is considerable similarity in the basic knapping techniques between the non-Acheulian and Acheulian assemblages. If these similarities are solely the characteristic of a rigid pattern of core reduction strategy held by various groups of hominids, then the presence of bifaces is taken to designate the arrival of additional people.

Dmanisi - the Georgian site

Additional light on the scenario of early human movements is cast by the recent discoveries at Dmanisi (Dzaparidze et al. 1989). The stratified faunal assemblages in the lower part of the site that immediately overlie a lava flow contain a lithic industry primarily consisting of core-choppers, without bifaces (Dzaparidze et al. 1989; except perhaps for one piece in Fig. 38). Among the reported flakes there are retouched pieces that can be classified as scrapers. In addition the excavators describe a few worked bone objects. Pollen from coprolites indicate that the area was forested with tree species such as *Abies, Pinus, Fagus, Alnus, Castanea, Tilia, Betula, Carpinus,* and rare *Ulmus* and *Salix,* and bushes such as rhododendron, corylus and myrtle, as well as herbaceous vegetation dominated by Cyperaceae, Graminae and Polygonaceae. In the given topography, this association reflects an environment of high mountains with well watered woodland of an inland basin (Dzaparidze et al. 1989). The fauna included essentially Palearctic species such as the following: *Struthio dmanisensis, Ursus etruscus, Canis etruscus, Pachycrocuta* sp., *Homotherium* sp., *Megantereon* cf. *megantereon, Archidiscodon meridionalis, Equus* cf. *stenonis, Equus* cf. *altidens, Dicerorhinus etruscus etruscus, Sus* sp., *Dama* cf. *nestii, Cervus* sp., *Dmanisibos georgicus, Caprini* gen., *Ovis* sp., *Leporinae* gen., *Cricetulus* sp., *Marmota* sp. The assemblage is considered as slightly earlier than 'Ubeidiya (Vekua 1987; Gabunia & Vekua 1990; Dzaparidze et al. 1989), and contemporary with the Odessa fauna from southern Russia, that is often tentatively dated as somewhat earlier than faunas of Senèze and Le Coupet. Gabunia (in Dzaparidze et al. 1989) estimates that the site should be dated to the

Olduvai subchron, although only one K/Ar date of 1.8±0.1 myr (for the lava flow under the site) is available.

Other early Levantine Palaeolithic contexts

Sites of uncertain age within the Lower Pleistocene of Israel are found in the coastal plain (Horowitz 1979). The oldest is Kefar Menachem where numerous core-choppers, flakes, and flake-tools (classified as end-scrapers, side scrapers, burins, notches, and denticulates) and a few crude ovate handaxes were found (Gilead & Israel, 1975). Tentatively, the excavators attributed this industry to the "Early Acheulian" that would fall within the African Early Acheulian.

In Lebanon and Syria on the terraces of Nahr el Kebir, the Orontes River and the Middle Euphrates (e.g., Hours 1981; Sanlaville 1988) there are occurrences (often not in primary contexts) of Early and "Middle" Acheulian. In many cases the artefacts were rolled and heavily patinated. Only a few outcrops, subject to many years of systematic collections, yielded large samples. Such are the cases of Ouadi Aabet and Ras Beyrouth, both on the Lebanese coast and the sites of Latamne and Joub Jannine II (Hours 1975; Besançon et al. 1982).

Several find-spots such as Borj Qinnarit contained only core-choppers and flakes while others, like Sitt Markho, had bifaces. The non-biface industrial facies was originally named "Para-Acheulian" by Hours (1975) but later, recognizing the sampling biases, he grouped all the earliest find-spots and scatters under the term "Early Lower Palaeolithic" (Hours 1981). The main characteristics of these assemblages are the high frequencies of core-choppers with some crude large handaxes exhibiting large scars and twisted edges. While the exact dating is not well established, their attribution to the Lower Pleistocene and early Middle Pleistocene indicates the presence of hominids in the Near East throughout this long period of time.

The site of Latamne, in the Orontes valley, contained an *in situ* assemblage affected by a low energy water flow (Clark 1967, 1968). The faunal assemblage is of early Middle or late Lower Pleistocene age. Most of the artefacts were made of flint, with a few rare ones of limestone and basalt. Large flint cobbles, shaped into bifaces and heavy duty tools, retouched flakes classified as light duty scrapers, and a few spheroids were recovered. The handaxe group contain a few trihedral picks, similar to those found at 'Ubeidiya. Spheroids, like at 'Ubeidiya, were made of limestone and basalt.

Other Early or "Middle" Acheulian sites are Joub Jannine II and Berzine, and do not require detailed description. Their assemblages were surface collected (Besancon et al. 1982). The lithic assemblage of Joub Jannine II comprise of high frequencies of bifaces and picks along with polyhedrons and core-choppers. The spheroids, again, resemble those of 'Ubeidiya.

An early occupation in the Israeli coastal plain is Evron-Quarry. The stratigraphy, artefactual material, and fauna from this site are described elsewhere (Ronen 1991). The Acheulian artefacts, including handaxes, core-choppers and a variety of flakes, appear to have come from both alluvium and grey and reddish clayey soil units. The excavators noticed the use of different raw material for the production of bifaces and the smaller components. No doubt a part of the assemblage was brought into the site from elsewhere, presumably in the hilly Galilee. The presence of a few mammalian species, such as the rhinoceros, hippo and horse indicates a mixed marshy environment amid steppic landscape.

In sum, most of the early occurrences called "Early Palaeolithic" that includes the non-biface assemblages (such as the Tayacian/Tabunian from Tabun G), the Early Acheulian and the so-called "Middle Acheulian" in the Near East, could fall within the time range from 1.7 to 0.9/0.8 myr. Unfortunately, apart from faunal correlations, there are no means to reach a better chronological resolution. Humans seem to have exploited essentially lowlands but there presence in southern Lebanese mountains reflects a mobility pattern that does not differ from what is known from the later Middle Palaeolithic sites.

The Upper Acheulian

The later part of the Acheulian sequence of the Levant provided material that was called Upper Acheulian (Tabun F, Umm Qatafa D, Ma'ayan Baruch; see Bar-Yosef 1975; Hours 1975). Assemblages were retrieved from both open air sites and caves. While these occurrences are mostly poorly dated, it is known that they are earlier than the Acheulo-Yabrudian (Bar-Yosef 1989) that is currently TL dated to earlier than 270 kyr (Mercier & Valladas 1994). Thus the Upper

Acheulian could be placed between ca. 800 and ca. 400 kyr.

During this time period we see the first manifestations of the Levallois technique as recorded in Berekhat Ram (Goren-Inbar 1985). The exact age is unknown except that it is prior to 233 ka. Products of this technique were noted by other scholars in in several Upper Acheulian contexts (Hours 1981).

A special phenomenon within this Acheulian sequence is the site of Gesher Benot Yaa'qov. This site provided a unique African-type assemblage (Bar-Yosef 1987; Goren-Inbar et al. 1991, 1992), and reflects human activities on the shores of an expanding lake that flooded the Jordan Valley gorge, south of Lake Hulah. The early layers contain an industry dominated by the production of cleavers and bifaces from basalt. The cleavers were fabricated by the African Kumbewa technique (Goren-Inbar et al. 1991). The upper layers in the earlier Stekelis excavations contained bifaces made of flint, similar in form to other known Upper Acheulian assemblages in the Levant (Stekelis 1960). Although the site lies on the eastern edge of a vast basalt plateau, no similar sites are known from other areas of the Levant that are also covered by lava flows. On the contrary, in numerous Acheulian occurrences, even when situated on basalt plateau such as the Golan, flint nodules derived from isolated limestone and chalky outcrops, often of Eocene age, served as raw material for making bifaces.

The archaeological horizons of Gesher Benot Ya'aqov have normal polarity and are later than the dated 0.9±0.15 myr lava flow (Goren-Inbar et al. 1992a). The fauna supports this later age which indicates that such an industry was contemporary with other Acheulian assemblages. Thus the lava industry from Gesher Benot Ya'aqov, with the high frequencies of cleavers, is interpreted as produced by a new group of hominids who just migrated out of Africa.

In my view this move was triggered by environmental changes around the time of the Jaramillo subchron or the Brunhes/Matuyama boundary. Palaeoclimatic 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). Increasingly colder periods in the northern latitudes enhanced periods of aridity on the African continent. These changes probably led to intense competition for resources by *Homo erectus* groups and forced some populations to search for and move into new foraging territories. These foreign groups could have later intermingled with local inhabitants who continued to produce the Levantine Acheulian industries such as those uncovered in Umm Qatafa (Neuville 1951) and Tabun F (Garrod & Bate 1937) or Ma'ayan Baruch (Stekelis & Gilead 1966). However, the alternative interpretation is also feasible, namely, that the group of Gesher Benot Ya'aqov was exterminated by the locals.

The Acheulo-Yabrudian entity

The new TL dates for Tabun Cave (Mercier & Valladas 1994; see Fig. 1) indicate a possible range of 400-270 kyr for the Acheulo-Yabrudian complex or the Mugharan Tradition (Copeland & Hours 1981; Jelinek 1981) and differ from the results of the ESR dating. The Acheulo-Yabrudian sites are known only from the northern and central Levant. In spite of intensive surveys, the easily recognizable characteristic artefacts were not found in the Negev and Sinai or the desert region of southern Jordan. Following the new excavations in Tabun cave Jelinek (1981) defined the Acheulo-Yabrudian as the Mugharan Tradition with several lithic "facies".

Three lithic "facies" that perhaps a few scholars would still see as independent industries, have been defined on the basis of typological quantitative studies. The "Yabrudian facies" contains numerous side-scrapers, often made on thick flakes (resulting in relatively high frequencies of Quina and semi-Quina retouch), a few Upper Palaeolithic tools, rare blades and a few or total absence of Levallois products (Copeland & Hours 1983; Jelinek 1982a). The "Acheulian facies" was identified by Jelinek (1982a,b) as having up to 15 % bifaces with numerous scrapers fashioned in the same way as the Yabrudian ones. The "Amudian facies" with end scrapers, burins, backed knives and rare bifaces represents the evidence for a limited practice of Levallois technique (Jelinek 1982a). According to Jelinek the use of this technique increased rapidly during the time of the Transitional Unit (X) in Tabun cave. However, the depositional circumstances in this cave indicate a possible natural admixture with Mousterian deposits.

In sum, the Acheulo-Yabrudian is an archaeological entity with a distribution from the northern Levant to the central Levant. The

absence of similar industries in the Negev or Egypt indicates that this is a typical Western Asian entity and that it's distribution is probably related to social rather than ecological boundaries. If similar assemblages are identified in eastern Turkey or the Caucasus (e.g., Koudaro I; Liubin 1989), we may be able to delineate its overall distribution and perhaps identify contemporary but different entities around it. For example, it is possible that some of the Late Acheulian occurrences, yet not well dated from the Negev and southern Jordan, were actually contemporary with the Acheulo-Yabrudian.

The Levantine Mousterian

In recent years, the sequence of the Levantine Mousterian has attracted a lot of attention. The human fossils seems to reflect a considerable morphological diversity (Vandermeersch 1989, 1992) and were physically capable of producing modern speech (Arensburg et al. 1988, 1990). The relationship between the Levantine hominids, those from Shanidar, and the European populations is still debated among bio-anthropologists. Without taking a stand on the controversial issues, their temporal position is crucial for each of the feasible evolutionary models. There is no doubt that the Near Eastern Mousterian hominids are contemporary with the European Neanderthals (Trinkaus 1989, 1993). The current TL and ESR dates indicate that those that are classified as Mediterranean or Near Eastern Neanderthals (Shanidar, Tabun, Kebara, Amud) are not necessarily contemporary with those of the Qafzeh-Skhul group (Fig. 1).

Beyond the study of the morpho-types of the Levantine Mousterian other questions were raised. These include the proper chronological position of the assemblages and the associated human fossils, the geographic distribution of the different industries and their interpretation, the identification of behavioral attributes apart from the lithics, the evaluation of mortuary practices and the reconstruction of the subsistence strategies. I will try to deal briefly with each of these aspects.

Based on the sequence of Tabun Cave the Levantine Mousterian has been subdivided into three phases termed "Tabun D", "Tabun C", and "Tabun B" (Copeland 1975). However, only additional publications of various sites and secure radiometric dates will be able to support of refute the use of Tabun's cultural stratigraphy as a yard stick.

The basic technological and morphological characteristics of the industry of each phase and the probable place of the hominids (Meignen & Bar-Yosef 1991; Bar-Yosef & Meignen 1992), are as follows:

1. "Tabun D" - the blanks, blades and elongated points were predominantly removed from unipolar convergent cores as well as bi-polar cores with minimal preparations of the striking platforms. Although Levallois technique is present, it seems that part of the industry was manufactured through a different core reduction strategy. Elongated retouched points, numerous blades, racloirs and burins are among the common tool types. This industry is found in Tabun D, Abu Sif, Sahba, Rosh Ein Mor, Nahal Aqev 3, Jerf Ajla, Douara layer IV and Hayonim cave. No hominid remains were reported from this phase.

In El-Kowm another lithic industry which occupies the same stratigraphic position as Tabun D was found and named by the excavator "Hummalian" (Copeland & Hours 1983). The Hummalian shares with the "Tabun D" industry a proliferation of blades and points produced, in this case, without employing the Levallois technique.

2. "Tabun C" - the blanks, often ovoid and large flakes, were struck from Levallois cores, with radial or bipolar preparation. Triangular points appear in small numbers. This industry is common in Qafzeh (layers XVII-XXIV), Tabun layer C and Skhul. Hominids were found in Qafzeh, Skhul and Tabun C. In the latter site it seems that only the jaw (Tabun C II) is securely placed in this layer while the skeleton of the woman could have been from Tabun B (Garrod & Bate 1937, p. 64).

3. "Tabun B" - the blanks were removed from mainly unipolar convergent Levallois cores. Broad based Levallois points, often short, thin flakes and, some blades are characteristic traits. Examples are Kebara units VI-XII, Tabun B, Amud, Tor Faraj and Tor Sabiha (a different interpretation from the one adopted by Henry & Miller 1992). Radially prepared cores were also used and their products are mainly found in the upper contexts of this entity (e.g., Kebara VIII-VII), and in Biqat Quneitra (Goren-Inbar 1990).

The Levantine Mousterian differs markedly from the Mousterian facies in the Zagros (which in some sites is of non-Levallois character). In the Mousterian of the Taurus mountains, following

the new excavations at Karain (Yalçinkaya et al. 1993), Levallois technique was used, mostly with radial preparation. Finally, Mousterian industries that partially resemble those of the Levant can be found in the Middle Stone Age of South Africa, in Egypt and in Cyrenaica. However, interpretation of such resemblances in terms of human movements is controversial (e.g., Marks 1990, 1992).

Adaptations to desertic areas

The distribution of the various industries was recently employed by Marks (1992) to test the "out of Africa" model. While Tabun D and Tabun B were identified in the marginal, possibly semi arid areas, Tabun C, conventionally associated with the Qafzeh-Skhul hominids, is reported solely from the Mediterranean coastal ranges.

The semi arid areas of El Kowm in northern Syria, the Palmyra oasis, the Negev highlands, and the plateau of southern Jordan were recently studied in some detail (Besancon et al. 1982; Marks 1977, 1983; Munday 1979; Henry and Miller 1992; Akazawa 1987). All provide some clues to possible human adaptations in what is now a desertic region but which was in the past a more lush area with inland lakes (e.g. El-Kowm and Palmyra). A similar picture of wetter climatic conditions emerges in the Negev.

The original chronostratigraphy of the Negev Mousterian sites indicates that they were occupied before the deposition of a terrace with massive, well rounded gravels. The latter is interpreted as the result of higher and more sustained discharges under a climatic regime wetter than today's (Goldberg 1986). On the basis of the current chrono-cultural interpretation held in this paper, the main accumulation could have taken place during Isotope Stages 6, 8 or 10. The U-series dates of fossil travertines from the Ain Aqev area (Schwarcz et al. 1979, 1980) suggest a different dating for the Ain Aqev site but the exact stratigraphic and thus chronological relationship between the spring deposits and the site are unknown. The few pollen samples from the Mousterian sites (Horowitz 1979) indicate a wetter period with vegetation supportable by a minimum of 400 mm of rainfall. Thus, sites like Rosh Ein Mor would be better placed in Stage 6 or 8, due in part to their overall lithic resemblance to Tabun D (Munday 1979).

The sites of Tor Faraj and Tor Sabiha were occupied during a relatively dry period, probably correlating to Isotope Stage 4. The topographic situation of the sites and the low arboreal pollen in the samples (Henry & Miller 1992) differs little from the cold periods in the Hula Valley (Horowitz 1979). In addition the site of Tor Faraj is seen as a base camp while Tor Sabiha lends the impression of having been occupied ephemerally.

The site of Fara II (Gilead 1988) in Nahal Besor, is attributed to a somewhat later time. There the wadi terraces, an erosional phase (or perhaps several phases) was covered by silts that suggest (Goldberg 1986) a return to slightly wetter conditions, perhaps immediately after Isotope Stage 4. The lithic industry is made of cobbles and shaped by predominantly unidirectional convergent preparation. Animal bones indicate that inspite of the paucity of retouched pieces the site was used as a hunting and/or scavenging station.

Mousterian settlement pattern

In interpreting settlement pattern, it is often the expectation of archaeologists to be able to differentiate between seasonal camps and base camps. The notion that hunter-gatherers were mobile is deeply embedded in the archaeological literature. The pioneering systematization of mobility patterns offered by Binford (1980) was sometimes rigidly interpreted as the need to identify logistical versus residential sites, despite the fact that these were actually the two extremes. Comparisons based on analogies with modern hunter-gatherers clearly demonstrate the variability of settlement patterns across environments. Sites which were once used by a task group could, under a different territorial arrangement, become a base camp.

In addition to the use of models derived from modern hunter-gatherers, one needs to figure out ways to test whether particular archaeological assemblages can be explained as reflecting a settlement pattern that results from residential moves or as a series of stations occupied by a or more special task groups. For example, the archaeological remains should provide evidence for seasonal occupation through such aspects as cementum analysis, carbonized plant remains, or deposition according to a dominant wind direction. Then one would be justified in concluding how the excavated site falls within a territorial settlement pattern. Alternative interpretations should take into account the potential variability, formed by a mixture of both residential and logistical moves through the annual cycle. These may be expressed

archaeologically in different assemblage types that do not correspond to a simplistic, direct ethnographic analogy. In brief, the same variability that prevailed in a world of Upper Palaeolithic hunter-gatherers, depending on their environment (geography and climate combined), could have existed in earlier times. Thus building models for the Middle Palaeolithic situations is not an easy task.

Marks (1993) while reviewing the transition from the Middle to the Upper Palaeolithic offers insights in retrospect. He suggests that with the increasing information, the previous reconstruction of Mousterian settlement pattern (Marks & Freidel 1977) that viewed people as exploiting a small area logistically by having some sort of base camps (the radiating model) should be revised. Thus late Mousterian groups in the semi arid region seem to have been moving around (circulating model), meaning that the entire group was relocated. Originally the shift from one pattern to the other was seen as the marker of the cultural-economical transition from the Middle to the Upper Palaeolithic. It seems that most scholars who study Levantine Upper Palaeolithic sites or assemblages would agree that a more mobile subsistence strategy is reflected in the distribution of the various sites, especially in the steppic belt. The existence of what seem to have been base camps is undeniable when one considers the evidence from a site like Ksar Akil (e.g. Bergman 1987; Ohnuma 1988). There is an urgent need to consider the role of aggregation sites in the Levantine Upper Palaeolithic and to synthesize the data as available from the different vegetational belts, but this subject is beyond the scope of this paper.

The environmental and dietary interpretation of the Mousterian faunal assemblages

Animal bone collections from Middle Palaeolithic sites were often considered sources for reconstructing environmental changes. Taphonomic aspects received attention especially with respect to the natural agencies involved in deposition, such as birds of prey and scavengers. It seemed that, as in most European sites, the surrounding environments are reflected in the distribution of animal species.

Reservations concerning palaeoenvironmental reconstructions as based on faunal collections should be expressed clearly. The habitats occupied by various mammals in the past are seen as similar to habitats currently used by the same species. However, there is an unknown degree of behavioural changes which could have occurred within the species that characterize Quaternary faunas. One such example is the faunal assemblage from Douara cave (Payne 1983; Akazawa 1987, 1988). The site is located in the rainshadow of a mountainous ridge over 1,000 meters above sea level. Carbonized plant remains collected in the excavation reflect a mixture of Mediterranean and Irano-Turanian steppic associations. The microvertebrates, brought in by barn owls represent desertic surroundings, while the bones of mammals resulted from human activities. These, including the *Camelus* sp., indicate a steppic environment. However, bones of wild camel were found in small numbers also within the coastal Mediterranean hills such as in Tabun, Qafzeh and in Fara II in the northern Negev. Wild camels have an ecological amplitude which ranges from a region receiving 100/150 mm to 400 mm a year. Similar comments can be made concerning the *Gazella gazella*. Thus, by choosing the arid edge of the ecological amplitude for Mousterian faunas we may get the wrong impression of human adaptation to life in an arid belt from animals which in at present are adapted to the desert, but during the Upper Pleistocene (and no doubt in earlier periods) favoured wetter, more lush habitats.

The question of hunting or scavenging during the Mousterian is dealt with in an earlier paper (Bar-Yosef 1989). Current studies by Speth (in Bar-Yosef et al. 1992) indicate that the Mousterian occupants of Kebara cave were hunters. I therefore view the earlier faunal assemblages, such as in Acheulo-Yabrudian contexts (Masloukh cave, Abri Zumoffen and Tabun E) and especially the remains of *Bos primeginius* and rhinoceros, as having been scavenged, while the smaller mammals (deer, gazelle, etc.) as hunted. Large mammals are also predominant in the two open-air Mousterian sites – Fara II (Gilead & Grigson 1984) and Biqat Quneitra (Davis et al. 1988) and perhaps reflect a mixed strategy of hunting and opportunistic scavenging. The bone collection from Quneitra is dominated by large mammals such as *Bos primigenius* and equids (about 80%) with rare rhinoceros, some deer and gazelle (about 20%). A considerably low frequency of bones exhibit cut marks and even fewer bear gnaw marks. These were interpreted as reflecting hunting activities followed by rapid burying in a marshy environment (Rabinovitch 1990). Therefore, it seems that hunting techniques developed at

least during Mousterian times, but perhaps even earlier during the Late Acheulian and Acheulo-Yabrudian times. Not surprisingly the evidence from the Levantine Mousterian is in accordance with similar situation in a Mediterranean environment in coastal Italy (Stiner 1990).

Behavioural attributes as expressed in the archaeology of the Levantine Mousterian sites

One of the major issues in the debate concerning the emergence of modern humans are so-called signs of 'modern behaviour'. Stringer & Gamble (1993) provided a list of markers for modern behaviour but without an explicit explanation of how we go about identifying them in the archaeological record. The literature indicates that even intentional burials are open to different interpretations (Belfer-Cohen & Hovers 1992). It is thus imperative that we devise the tools that will enable us to compare between what is generally accepted as 'modern behaviour', often meaning the residues of Upper Palaeolithic cultures, and similar remains of earlier periods. The following are preliminary descriptions and discussions of a study currently under systematic investigation.

Hearths

The excavations at Kebara Cave, where Mousterian deposits are well preserved, exposed a series of rounded and oval hearths. Similar small hearths were found in Qafzeh, in the lower levels, in Hayonim cave, and in Douarah cave (Akazawa 1988) where a large fireplace was uncovered. Field observations at Kebara indicate that the fire-builders scooped into the sediments and made the fire by burning large quantities of wood. In addition the carbonized seeds of parched wild peas were retrieved from the blackened portion of the hearth, as well as from the hearth's surroundings (Lev & Kislev 1993). Firewood was collected in the immediate locality of the cave and was mainly Tabor oak (Baruch et al. 1992). Stones were not employed in the process of parching or using fire as a source of warmth. The small number of burned bones (Speth, in Bar-Yosef et al. 1992) indicates that only a few bones were calcined or partially burned and this number is not different from modern archaeological contexts.

The study of diagenetic processes in Kebara Cave clearly indicates that leaching water was the main factor contributing to the chemical alteration of the deposits, the disappearance of bones, and the reduction in the thickness of the hearths (Weiner et al. 1993). Current studies at Hayonim cave are aimed to provide a formula for calculating the amount of anthropogenic deposits that vanish due to these processes through time. We should always keep in mind that in all the Levantine sites south of the Taurus Mountains, there are no sterile layers. This means that human activities were the major factor in building up the cave sediments that later, through diagenetic processes resulted in "concentrated" layers. Thus further information that would shed light on human behaviour is lost forever.

The distribution of bone accumulations in cave sites

An additional feature uncovered in Kebara cave were the bone accumulations that were located in the central area of the cave. They were originally seen as oval in shape and thought to be hearths (Schick & Stekelis 1977). Mineralogical analyses (Weiner at al. 1993) demonstrated that the bones and most of the artefacts are spatially separated from the hearths and that this pattern of behaviour lasted for a very long time and resulted in considerable thickness of deposits (over one meter in each case). Analysis (Speth in Bar-Yosef et al. 1992) indicates that animal bones bear cut marks while gnawed pieces are extremely rare. While comparing this assemblage to the Upper Palaeolithic it was found that hyena activities were more frequent during the latter time period and that the cave was more often abandoned than during the Mousterian period.

Burials

The issue of Middle Palaeolithic burials has recently been re-examined with a proliferation of cautionary remarks (e.g., Chase & Dibble 1987; Belfer-Cohen & Hovers 1992). Observations demonstrate that for a skeleton to remain in anatomical articulation in the dynamic environment of a Levantine cave-site where the rate of sedimentation by natural agencies is extremely slow and intermittent occupations between scavengers, birds of prey and humans are well established, it must be buried. The four meter thickness of the Mousterian sequence in Kebara cave dates to 60-48 kyr. This means an accumulation of ca. 4 meters over *ca.* 12,000 years, about

33 cm for a 1,000 years or 0.33 mm a year. Assuming the presence of short gaps in the stratigraphy and a doubled or tripled rate of sedimentation, it would still take quite a long time to let natural agencies cover up an adult burial. Sedimentological and micromorphological analyses indicate that no flowing water were involved in the deposition processes during the accumulation of the Mousterian layers (Laville & Goldberg 1989; Goldberg & Laville 1991). In addition, the preservation of the ribs of the Kebara hominid indicates that a narrow pit, at least 20 cm deep, into which the corpse was introduced, was excavated by the prehistoric inhabitants. The burial in Tabun, those of Qafzeh, Skhul and Amud caves provide a repetitive pattern that can not be explained by natural site formation processes and therefore reflect intentional human activities. What kind of symbolic value was attributed to these burials remains speculative as in the mortuary analysis of Epi-Palaeolithic or Neolithic burials. Grave goods, except for the deer antlers in a Qafzeh grave and the wild boar mandible with the Skhul V burial, are not found. The same is true for many Epi-Paleolithic and Neolithic graves. Thus the absence of grave offerings from Mousterian burials has no implication for the intentionality of the mortuary practices.

Minerals and marine shells

Red ochre was used by Mousterian humans in the Levant as indicated by the scraped lump found in Qafzeh, the stained flint artefacts from Hayonim cave, and the various reports of ochre's presence in Mousterian deposits.

In addition marine shells in small numbers were reported from Skhul and Qafzeh caves. It should be stressed that the south-eastern corner of the Mediterranean is the saltiest and warmest and therefore it is not surprising that there is no evidence for shellfish eating, not even in Holocene times. Thus the presence of sea shells can be related to other activities than food acquisition.

Concluding remarks

Survival of Lower and Middle Pleistocene hominids, even in a hospitable region such as the Mediterranean Levant, was not always guaranteed. Spatial distribution, predictability, and reliability of seasonal food resources in this region, secured in most cases the viability of human groups while at the same time attracting other groups who lived in neighbouring areas in Western Asia, especially when these became impoverished due to climatic fluctuations. Thus, Acheulian or Mousterian groups, who survived on the ecological edges of the Levant, faced several choices during stress periods. Their options included accepting population decrease due to decrease in newborn females (Groenman van Waaterringe 1988), investing efforts in improving food acquisition techniques, or relocating by migration over short or long distances. It seems that this set of considerations caused the "Levantine Corridor" to become a two-way traffic area as well as a refugium.

One of this region's most abundant resources are the flint/chert outcrops and gravel formations. For those scholars who attribute a great importance to the availability and accessibility of raw materials, we need only stress that the abundant nodules for the production of artefacts characterize the immediate environment of sites in Mount Carmel, Western Galilee, the Lebanese mountains as well as most of the Negev highlands, certain areas in southern Jordan, the Palmyra basin and the El-Kowm basin, to mention only well investigated areas. These hard rock resources are often located within half an hour to a few hours walk from the site itself. One may justifiably wonder to what extant lithic tool production was affected by the abundance of nodules and the role of technical behavioural templates for the kind of activities represented by the abandoned artefacts.

Careful studies of Acheulian industries indicate the presence of some sort of operational sequence although perhaps less sophisticated than those of the Middle Palaeolithic. In addition, the knowledge of the foreign Kumbewa technique, present in Gesher Benot Ya'aqov, is taken to indicate the presence of an immigrant group. Little can be said about social organization or labour division among early hominids in the Western Asia.

Microwear and edge damage analysis (Shea 1989) provide the evidence for the use of Levallois points as spear points, an interpretation supported by conclusions of Speth (in Bar-Yosef et al. 1992; also Rabinovitch 1990) concerning hunting. In addition, butchering, wood working, cutting soft vegetal tissues and other actions are recorded. Differences between assemblages from Qafzeh and from Kebara (units IX-XI) result mainly from the paucity of points in the first (Shea 1989). More intriguing is the evidence for

the use of wood which is also reported from European Middle Palaeolithic contexts.

The information concerning plant food gathering is still meagre. Thus if we assume that similarly to modern hunter-gatherer societies, males were responsible for hunting and females for gathering, we can say very little about women's activities. Two Near Eastern sites provide a glimpse on gathering. In Douara cave the fruits of the *Celtis* sp. (Akazawa 1987) were collected. In Kebara, among the carbonized remains retrieved in floatation were lentil, (Lens sp. 247 seeds), as well as unidentified large and medium size legumes (over 2,000). In addition shell fragments of *Quercus* sp. (43) and *Pistacia atlantica* (503) were identified (Lev & Kislev 1993). Analysed wood charcoal indicates that typical trees were the common and Tabor oaks (*Quercus calliprinos* and *Quercus ithaburensis*). Less frequent in the carbonised remains were *Crataegus, Salix* and *Ulmus* (Baruch et al. 1992).

Field experience in the Near East and other regions indicates that in order to get a more complete picture of gathering activities we need to search for water-logged sites, as shown by the example of Gesher Benot Ya'aqov (Goren-Inbar et al. 1992). Potential locations are the rapidly shrinking lakes in Anatolia or other regions where the global warming results in lower levels.

Intra-site organization is indicated by the research done in Kebara Cave where dumping zones seem to have been reserved for areas towards the rear part of the cave. The spreading of ashes may reflect the need to form warm sleeping grounds. The occupation of the site, based on the availability of the carbonized plant residues and the growth pattern of cementum increments in gazelle teeth (Lev & Kislev 1993; Lieberman 1993), took place in parts of the winter/spring and summer/fall. This is of course not a claim for year-round occupation but for a return to the site during numerous occasions. Somewhat similar "sedentism" was suggested by Stevens & Hietala (1977) for the site of Rosh Ein Mor on the basis of spatial analysis of the artefacts. On the other hand in the Taurus and Zagros mountains one may expect the exploitation of different ecological habitats according to altitude. A somewhat similar pattern is already emerging in southern Jordan (Henry & Miller 1992).

Although the discussion of the transition to the Upper Palaeolithic is beyond the scope of this paper it should be stressed that major technological and cultural changes are reflected in the nature of Upper Palaeolithic sites as well as in the inter-assemblages variability. It seems that these resulted from social changes. While it is still difficult to demonstrate the details of the changes, it is assumed that the loose, open, flexible social networks which characterized the Middle Palaeolithic constantly became more restricted and territorially-bounded as the result of steadily growing populations of modern humans. This process, coupled with rapid development of domestic and food acquisition technologies, food preparation techniques, such as the use of the grinding stone, and communication systems, enabled a better seasonal if not perennial exploitation of marginal zones (Bar-Yosef 1992).

References

AKAZAWA, T., 1987: The ecology of the Middle Palaeolithic occupation at Douara cave, Syria. In: T. Akazawa & Y. Sakaguchi (eds.), *Paleolithic site of Douara Cave and paleogeography of Palmayra basin in Syria, Part IV: 1984 excavations*, 155-166. Tokyo (Bulletin of the Tokyo University Museum, vol. 29).

AKAZAWA, T., 1988: Ecologie de l'occupation de la grotte de Douara, Syrie, au paléolithique moyen. *L'Anthropolgie* 92, 883-900.

ARENSBURG, B., SCHEPARTZ, L.A., TILLIER, A.M., VANDERMEERSCH, B. & RAK, Y., 1990: A reappraisal of the anatomical basis for speech in Middle Palaeolithic hominids. *Amer. J. Phys. Anthrop.* 88, 137-146.

ARENSBURG, B., TILLIER, A.M., VANDERMEERSCH, B., DUDAY, H., SCHEPARTZ, L. & RAK, Y., 1988: A Middle Palaeolithic human hyoid bone. *Nature* 338, 758-760.

ASFAW, B., BEYENE, Y., SUWA, G., WALTER, R.C., WHITE, T.D., WOLDE-GABRIEL, G. & YEMANE, T., 1992: The earliest Acheulean from Konso-Gardula. *Nature* 360, 732-735.

BARUCH, U., WERKER, E. & BAR-YOSEF, O., 1992: Charred wood remains from Kebara cave, Israel: preliminary results. *Bull. Soc. Botan. France* 139, 531-538.

BAR-YOSEF, O., 1975: Archaeological occurrences in the Middle Pleistocene of Israel. In: K. W. Butzer & G. L. Isaac (eds.), *After the australopithecines*, 571-604. The Hague (Mouton Publishers).

BAR-YOSEF, O., 1987: Pleistocene connections between Africa and Southwest Asia: An archaeological perspective. *The African Archaeol. Review* 5, 29-38.

BAR-YOSEF, O., 1989a: Upper Pleistocene cultural stratigraphy in Southwest Asia. In: E. Trinkaus (ed.), *The emergence of modern humans*, 154-180. Cambridge (Cambridge University Press).

BAB-YOSEF, O., 1989b: Geochronology of the Levantine Middle Palaeolithic. In: P.A. Mellars & C.B. Stringer (eds.), *The human revolution: Behavioral and biological perspectives on the origins of modern humans*, 589-610. Chicago (University of Chicago Press).

BAR-YOSEF, O., 1992: Middle Paleolithic human adaptations in the Mediterranean Levant. In: T. Akazawa, K. Aoki & T. Kimura (eds.), *The evolution and dispersal of modern humans in Asia*, 189-216. Tokyo (Hokusen Sha).

BAR-YOSEF, O. & GOREN-INBAR, N., 1993: *The lithic assemblages of 'Ubeidiya: A Lower Palaeolithic site in the Jordan Valley.* Jerusalem (Qedem Monographs of the Institute of Archaeology 34: The Hebrew University of Jerusalem).

BAR-YOSEF, O. & MEIGNEN, L., 1992: Insights into Levantine Middle Palaeolithic cultural variability. In: H. Dibble & P. Mellars (eds.), *New perspectives on the Middle Paleolithic*, 163-182. Edinburgh (Edinburgh University Press).

BAR-YOSEF, O. & TCHERNOV, E., 1972: *On the paleo-ecological history of the site of 'Ubeidiya. The Pleistocene of the Central Jordan Valley.* Jerusalem (Israel Academy of Sciences and Humanities).

BAR-YOSEF, O., VANDERMEERSCH, B., ARENSBURG, B., BELFER-COHEN, A., GOLDBERG, P., LAVILLE, H., MEIGNEN, L., RAK, Y., SPETH, J.D., TCHERNOV, E., TILLIER, A.-M. & WEINER, S., 1992: The excavations in Kebara Cave, Mt. Carmel. *Curr. Anthrop.* 33, 497-550.

BEFER-COHEN, A. & HOVERS, E., 1992: In the eye of the beholder: Mousterian and Natufian burials in the Levant. *Curr. Anthrop.* 33, 463-471.

BERGMAN, C.A., 1987: *Ksar Akil, Lebanon: A technological and typological analysis of the later Palaeolithic levels of Ksar Akil.* Oxford (B.A.R. International Series 329).

BESANCON, J., COPELAND, L., HOURS, F., MUHESEN, S. & SANLAVILLE, P., 1982: Prospection géographique et préhistorique dans le basin d'El Kowm (Syrie). Rapport Préliminaire. *Cahiers de l'Euphrate* 3, 9-26.

BINFORD, L R., 1980: Willow smoke and dogs' tails: Hunter-gatherer settlement systems and archaeological site formation. *Amer. Antiquity* 45, 4-20.

BROWN, F.H., SARNA-WOJCICKI, A.M., MEYER, C.E. & HAILEAB, B., 1992: Correlation of Pliocene and Pleistocene tephra layers between the Turkana Basin of East Africa and the Gulf of Aden. *Quaternary Internat.* 13/14, 55-67.

CHASE, P. & DIBBLE, H., 1987: Middle Palaeolithic symbolism: A review of current evidence and interpretations. *J. Anthrop. Archaeol.* 6, 263-296.

CLARK, J.D., 1967: The Middle Acheulian site at Latamne, northern Syria. *Quaternaria* 9, 1-68.

CLARK, J.D., 1968: The Middle Acheulian occupation site at Latamne, northern Syria. *Quaternaria* 10, 1-72.

COPELAND, L., 1975: The Middle and Upper Palaeolithic of Lebanon and Syria in the light of recent research. In: F. Wendorf & A.E. Marks (eds.), *Problems in prehistory: North Africa and the Levant*, 317-350. Dallas (SMU Press).

COPELAND, L. & HOURS, F., 1981: La fin de l'acheuléen et l'avenement du paléolithique moyen en Syrie. In: J. Cauvin & P. Sanlaville (eds.), *Préhistoire du Levant*, 225-238. Paris (C.N.R.S).

COPELAND, L. & HOURS, F., 1983: Le Yabroudien d'El Kowm (Syrie) et sa place dans le Paléolithique du Levant. *Paléorient* 9, 21-38

DAVIS, S.J. H., RABINOVITCH, R. & GOREN-INBAR, N., 1988: Quaternary extinctions and population increase in Western Asia: The animal remains from Biq'at Quneitra. *Paléorient* 14, 95-105.

DZAPARIDZE, V., BOSINSKI, G., BUGIANISVILI, T., GABUNIA, L., JUSTUS, A., KLOPOTOVSKAJA, N., KVAVADZE, E., LORDKIPANIDZE, D., MAJSZRADZE, G., MGELADZE, N., NIORADZE, M., PAVLENISVILI, E., SCHMINCKE. H.-U. & SOLOGASVILI, D., 1989: Der altpaläolithische Fundplatz Dmanisi in Georgien (Kaukasus). *Jahrb. Röm.-German. Zentralmus. Mainz* 36, 67-116.

GABUNIA, L. & VEKUA, A., 1990: L'évolution du paléoenvironnement au cours de l'anthropogène en Géorgie (Transcaucasie). *L'Anthropologie* 94, 643-650.

GARROD, D.A. & BATE, D.M., 1937: *The Stone Age of Mount Carmel. Excavations at the Wadi el Mughar. Vol. I.* Oxford (Clarendon Press).

GILEAD, I., 1988.: Le site moustérien de Fara II. *L'Anthropologie* 92, 797-808.

GILEAD, I. & GRIGSON, C., 1984: Far'ah II: A Middle Palaeolithic open air site in the northern Negev, Israel. *Proc. Prehist. Soc.* 50, 71-97.

GILEAD, D. & ISRAEL, M., 1975: An early Palaeolithic site at Kefar Menahem: preliminary report. *Tel Aviv* 2, 1-12.

GOLDBERG, P., 1986: Late Quaternary environmental history of the southern Levant. *Geoarchaeology* 1, 225-244.

GOLDBERG, P. & LAVILLE, H., 1991: Étude géologique des dépôts de la grotte de Kébara (Mont Carmel): campange 1982-1984. In: O. Bar-Yosef & B. Vandermeersch (eds.), *Le squelette Mousterien de Kébara 2*, 29-42. Paris (Editions C.N.R.S.; Cahiers de Paléoanthroplogie).

GOREN-INBAR, N., 1985: The lithic assemblage of the Berekhat Ram Acheulian site, Golan Heights. *Paléorient* 11, 7-28.

GOREN-INBAR, N. (ed.), 1990: *Quneitra: A Mousterian site on the Golan Heights.* Jerusalem (Qedem 31. Monographs of the Institute of Archaeology; Hebrew University).

GOREN-INBAR, N., BELITZKY, S., GOREN, Y., RABINOVICH, R. & SARAGUSTI, I., 1992a: Gesher Benot Ya'aqov – the 'Bar': an Acheulian assemblage? *Geoarchaeology* 7, 27-40.

GOREN-INBAR, N., BELITZKY, S., VEROSUB, K., WERKER, E., KISLEV, M., HEIMANN, A., CARMI, I. & ROSENFELD, A., 1992b: New discoveries at the Middle Pleistocene Acheulean site of Gesher Benot Ya'aqov, Israel. *Quatern. Research* 38, 117-128.

GOREN-INBAR, N., ZOHAR, I. & BEN-AMI, D., 1991: A new look at old cleavers--Gesher Benot Ya'aqov. *J. Israel Prehist. Soc.* 24, 7-33.

GROENMAN VAN WAATERRINGE, 1988: Interaction between the environment and social subsystems. In: J.L. Bintliff, D.A. Davidson & E.G. Grant (eds.), *Conceptual issues in environmental archaeology*, 278-282. Edinburgh (Edinburgh University Press).

HENRY, D.O., 1986: The prehistory and paleoenvironments of Jordan: an overview. *Paléorient* 12, 5-26.

HENRY, D.O. & MILLER, G. H., 1992: The implications of amino acid racemization dates on Levantine Mousterian deposits in southern Jordan. *Paléorient* 18, 2: 45-52.

HOROWITZ, A., 1979: *The Quaternary of Israel.* New York (Academic Press).

HOURS, F., 1975: The Lower Paleolithic of Lebanon and Syria. In: E. Wendorf & A. E. Marks (eds.), *Problems in prehistory: North Africa and the Levant,* 249-271. Dallas (S.M.U. Press).

HOURS, F., 1981: Le paléolithique inférieur de la Syrie et du Liban. Le point de la question en 1980. In: P. Sanlaville & J. Cauvin (eds.), *Préhistoire du Levant,* 165-184. Lyon (Maison de l'Orient).

ISAAC, G.L. & CURTIS, G.H., 1974: Age of early Acheulian industries from the Peninj Group, Tanzania. *Nature* 249, 624-627.

JELINEK, A., 1981: The Middle Palaeolithic in the southern Levant from the perspective of the Tabun cave. In: J. Cauvin & P. Sanlaville (eds.), *Préhistoire du Levant,* 265-280. Paris (Editions du C.N.R.S.).

JELINEK, A., 1982a: The Tabun cave and Palaeolithic man in the Levant. *Science* 216, 1369-1375.

JELINEK, A., 1982b: The Middle Palaeolithic in the Levant. In: A. Ronen (ed.), *The transition from Lower to Middle Palaeolithic and the origin of Modern Man*, 57-104. Oxford (B.A.R. International Series 151).

LAVILLE, H. & GOLDBERG, P., 1989: The collapse of the Mousterian sedimentary regime and the beginning of the Upper Palaeolithic at Kebara. In: O. Bar-Yosef & B. Vandermeersch (eds.), *Investigations in South Levantine prehistory*, 75-95. Oxford (B.A.R. International Series 497).

LEV, E. & KISLEV, M.E., 1993: *The subsistence and the diet of the "Neanderthal" Man in Kebara cave, Mt. Carmel.* (Ramat Ha'nadiv Project Research Report Series Publication 9).

LIEBERMAN, D.E., 1993: *Mobility and strain: the biology of cementogenesis and its application to the evolution of hunter-gatherer seasonal mobility in the southern Levant during the Quaternary.*Cambridge/Maass. (Harvard University. University Microfilms, Ann Arbor).

LIUBIN, V.P., 1989: *Palaeolithic of Caucasus*. Leningrad (Academy of Sciences of USSR).

MARKS, A.E. (ed.), 1977: *Prehistory and paleoenvironments in the Central Negev, Israel. Volume II.* Dallas (SMU Press).

MARKS, A.E., 1983: *Prehistory and paleoenvironments in the Central Negev, Israel. Volume III.* Dallas (SMU Press).

MARKS, A.E., 1990: The Middle and Upper Palaeolithic of the Near East and the Nile Valley: the problem of cultural transformations. In: P. Mellars (ed.), *The emergence of modern humans*, 56-80. Edinburgh (Edinburgh University Press).

MARKS, A.E., 1992: Upper Pleistocene archaeology and the origins of modern man: a view from the Levant and adjacent areas. In: T. Akazawa, K. Aoki & T. Kimura (EDS:), *The evolution and dispersal of modern humans in Asia*, 229-252. Tokyo (Hokusen-Sha).

MARKS, A.E., 1993: The early Upper Paleolithic: the view from the Levant. In: H. Knecht, A. Pike-Tay & R. White (eds.), *Before Lascaux: The complete record of the early Upper Paleolithic*, 5-22. Boca Raton (CRC Press).

MARKS, A.E. & FREIDEL, D.A., 1977: Prehistoric settlement patterns in the Avdat/Aqev area. In: A.E. Marks (ed.), *Prehistory and paleoenvironments in the Central Negev, Israel. Vol. II, The Avdat/Aqev Area, Part 2 and the Har Harif*, 131-158. Dallas (SMU Press).

MEIGNEN, L. & BAR-YOSEF, O., 1991: Les outillage lithiques moustériens de Kébara. In: O. Bar-Yosef & B. Vandermeersch (eds.), *Le squelette moustérienne de Kebara 2, Mt. Carmel, Israèl*, 49-76. Paris (Editions CNRS).

MERCIER, N. & VALLADAS, H., 1994: Thermoluminescence dates for the Paleolithic Levant. In: O. Bar-Yosef & KRA, R.S. (eds.), *Late Quaternary chronology and paleoclimates of the eastern Mediterranean*. Tucson (Radiocarbon and the Peabody Museum).

MUNDAY, F.C., 1979: Levantine Mousterian technological variability: a perspective from the Negev. *Paléorient* 5, 87-104.

NEUVILLE, R., 1951: *Le paléolithique et le mésolithique de Désert de Judée.* Paris (Archives de L'Institut de Paléontologie Humaine Mémoire 24. Masson et Cie, Editeurs).

OHNUMA, K., 1988: *Ksar Akil, Lebanon: A technological study of the earlier Upper Palaeolithic levels at Ksar Akil: Vol. III: Levels XXV-XIV.* Oxford (BAR International Series 426).

OPDYKE, N.D., LINDSAY, E. & KUKLA, G., 1985: Evidence for earlier date of 'Ubeidiya, Israel hominid site. *Nature* 304, 375.

PAYNE, S., 1983: The animal bones from the 1974 excavations at Douara Cave. In: K. Hanihara & T. Akazawa (eds.), *Palaeolithic site of Douara cave and palaeogeography of Palmyra Basin in Syria*, 1-108. Tokyo (Bulletin of The University Museum 21; The University of Tokyo).

RABINOVITCH, R., 1990: Taphonomic research of the faunal assemblage from the Quneitra Site. In: N. Goren-Inbar (ed.), *Quneitra: A Mousterian site on the Golan Heights*, 189-219. Jerusalem (Qedem 31. Monographs of the Institute of Archaeology, Hebrew University).

ROBERTS, R.G., JONES, R. & SMITH, R.A., 1990: Thermoluminescence dating of a 50,000 year old human occupation site in northern Australia. *Nature* 345, 153-6.

RONEN, A., 1991: The Lower Palaeolithic site Evron-Quarry in western Galilee, Israel. *Sonderveröff. Geol. Inst. Univ. Köln* 82, 187-212.

RONEN, A., BENTUR, A. & SOROKO, I., 1991: A plastered floor from the Neolithic village, Yiftahel (Israel). *Paléorient* 17, 149-155.

SANLAVILLE, P., 1988: Synthèse sur le paléoenvironnement. *Paléorient* 14, 2: 57-60.

SCHICK, T. & STEKELIS, M., 1977: Mousterian assemblages in Kebara Cave, Mount Carmel. In: B. Arensburg & O. Bar-Yosef (eds.), *Eretz-Israel,* vol. 13, 97-149. Jerusalem (Moshe Stekelis Memorial Volume; Israel Exploration Society).

SCHWARCZ, H., BLACKWELL, B., GOLDBERG, P. & MARKS, A.E., 1979: Uranium series dating of travertine from archaeological sites, Nahal Zin, Israel. *Nature* 277, 558-560.

SCHWARCZ, H., GOLDBERG, P. & BLACKWELL, B., 1980: Uranium series dating of archaeological sites in Israel, *J. Earth Sci.* 29, 157-165.

SHEA, J., 1989: Tool use in the Levantine Mousterian of Kebara Cave, Mount Carmel. *Mitekufat Haeven, J. Israel Prehist. Soc.* 22, 15-30.

STEKELIS, M., 1960: The Palaeolithic deposits of Jisr Banat Yaqub. *Bull. Research Council Israel* 9G, 2-3, 61-90.

STEKELIS, M. & GILEAD, D., 1966: *Ma'ayan Barukh. A Lower Paleolithic site in the Upper Galilee.* Jerusalem (Mitekufat Haeven 8; Israel Prehistoric Society).

STEVENS, D.S. & HIETALA, H.J., 1977: Spatial analysis: Multiple procedures in pattern recognition. *Amer. Antiquity* 42, 539-559.

STINER, M.C., 1990: The use of mortality patterns in archaeological studies of hominid predatory adaptations. *J. Anthrop. Archaeol.* 9, 305-351.

STRINGER, C. & GAMBLE C., 1993: *In search of the Neanderthals.* London (Thames and Hudson).

SWISHER, C.C., CURTIS, G.H., JACOB, T., GETTY, A.G., SUPRIJO, A. & WIDIASMORO, 1994: Age of the earliest known hominids in Java, Indonesia. *Science* 263, 1118-1121.

TCHERNOV, E. (ed.), 1986: *The Lower Pleistocene mammals of 'Ubeidiya (Jordan Valley).* Paris (Mémoires et Travaux du Centre de Recherche Français de Jérusalem 5. Association Paléorient).

THUNELL, R.C. & WILLIAMS, D.F., 1983: The stepwise development of Pliocene-Pleistocene paleoclimatic and paleoceanographic conditions in the Mediterranean: Oxygen isotopic studies of DSDP sites 125 and 132. *Micropaleont. Bull.* (Utrecht) 30, 111-127.

TCHERNOV, E., 1992: Eurasian-African biotic exchanges through the Levantine corridor during the Neogene and Quaternary. *Courier Forschungsinst. Senckenberg* 153, 103-123.

TRINKAUS, E. (ed.), 1989: *The emergence of modern humans: Biocultural adaptations in the later Pleistocene.* Cambridge (Cambridge Univ. Press).

TRINKAUS, E., 1993: Femoral neck-shaft angles of the Qafzeh-Skhul early modern humans, and activity among immature Near Eastern Middle Paleolithic hominids. *J. Human Evol. 25, 393-416.*

VANDERMEERSCH, B., 1989: The evolution of modern humans: Recent evidence from Southwest Asia. In: P.Mellars & C.B. Stringer (eds.), *The human revolution: Behavioural and biological perspectives on the origins of modern humans,* 155-164. Edinburgh (Edinburgh University Press).

VANDERMEERSCH, B., 1992: The Near Eastern hominids and the origins of modern humans in Eurasia. In: T. Akazawa, K. Aoki & T. Kimura (eds.), *The evolution and dispersal of modern humans in Asia,* 29-38. Tokyo (Hokusen-Sha).

VEKUA, A.K., 1987: Lower Pleistocene mammalian fauna of Akhalkalaki (Southern Georgia, USSR). *Palaeontographica Italica* 74, 63-96.

VEROSUB, K.L. & TCHERNOV, E., 1991: Résultats préliminaires de l'étude magnétostratigraphique d'une séquence sédimentaire à industrie humaine en Israèl. In: E. Bonifay & B. Vandermeersch (eds.), *Les premiers européens*, 237-242. Paris (Editions du CTHS).

WALTER, R.C., MANEGA, P.C., HAY, R.L., DRAKE, R.E. & CURTIS, G.H., 1991: Laser-fusion $^{40}Ar/^{39}Ar$ dating of Bed I, Olduvai Gorge, Tanzania. *Nature* 354, 145-149.

WEINER, S., GOLDBERG, P. & BAR-YOSEF, O., 1993: Bone preservation in Kebara cave, Israel using on-site Fourier transform infrared spectrometry. *J. Archaeol. Sci.* 20, 613-627.

YALÇINKAYA, I., OTTE, M., BAR-YOSEF, O., KOZLOWSKI, J., LÉOTARD, J.-M. & TASKIRAN, H., 1993: The excavations at Karain Cave, south-western Turkey: An interim report. In: D.I. Olszewski & H.L. Dibble (eds.), *The Paleolithic prehistory of the Zagros-Taurus*, 100-106. Philadelphia (The University Museum, University of Pennsylvania).

ZHONGLI, D., RUTTER, N., JINGTAI, H. & TUNGSHEN, L., 1992: A coupled environmental system formed at about 2.5 Ma in East Asia. *Palaeogeography, Palaeoclimatology, Palaeoecology* 94, 223-242.