

**The Oases in the Desert:  
Mobility and Settlement in the Middle Paleolithic Record of Jordan**

**Melanie Poupart  
Department of Anthropology, McGill University, Montreal  
June 2009**

**A thesis submitted to McGill University in partial fulfilment of the requirements of the  
degree of Master of Arts**

**© Melanie Poupart 2009**

## Abstract

The Levantine Paleolithic record is central to understanding human migrations out of Africa and the relationship between Neanderthals and Anatomically Modern *Homo sapiens*. Lithic remains are the most plentiful source of information on these ancient peoples, and understanding how they can be used to infer cognitive abilities, mobility patterns and settlement strategies is essential to Paleolithic studies. A review of published Middle Paleolithic sites in Jordan demonstrates that currently accepted theories on Levantine Middle Paleolithic archaeology can be used as a framework only. Sites must be understood according to their specific contexts, and local Jordanian environments depend as much on tectonics and base water levels as they do on generalized climatic records. Lithic assemblages show that organizational flexibility was a key component to human adaptations and modern behavior is already present in Jordan early in the Middle Pleistocene.

Les données du Levant paléolithique sont indispensables pour l'étude des migrations humaines hors de l'Afrique et pour celle des relations entre les Néanderthaliens et *Homo sapiens sapiens*. Les vestiges lithiques représentent la source de renseignements la plus importante au sujet de ces populations anciennes. Il est essentiel pour l'étude du Paléolithique de comprendre comment l'on peut utiliser ces renseignements afin d'en déduire les capacités cognitives, les trajectoires de mobilité et les stratégies d'établissement de ces hommes. Une révision des publications au sujet des sites du Paléolithique moyen en Jordanie démontre que les théories archéologiques courantes s'y rapportant ne peuvent constituer qu'un cadre. En effet, les sites doivent être étudiés selon le contexte particulier de chacun. Ainsi, la tectonique et le niveau de la nappe phréatique produisent des environnements locaux en Jordanie qui diffèrent des données climatiques généralisées. En outre, l'on peut démontrer à l'aide d'assemblages lithiques que la souplesse organisationnelle représentait un élément clé de l'adaptation humaine. Le comportement moderne est déjà présent en Jordanie au début du Pléistocène moyen.

## **Acknowledgements**

I must first and foremost thank Dr. Michael Bisson for inspiring me to pursue research into human origins. Not only did he spark my interest as an undergraduate student, but his unending encouragement, support and friendship over many years have made my graduate career a rewarding and joyful experience. Many thanks also go to Dr. James Savelle who has shown infinite faith in my abilities and provided continued support. The confidence and knowledge gained from working with these two scholars has been invaluable to the person I am today, and I will be eternally grateful for the luck I have had in having them as mentors. Financial support was provided by the SSHRC CGS Master's scholarship, and many thanks go to Joanna Hobbins and Rosa Orlandini for their patience and expertise.

I would like to thank my friends and colleagues during my last years at McGill, Laura Chassaigne, Chris Ames and Dr. Julien Riel-Salvatore, who shared my research passions and many formative experiences, as well as my friends Marilou Jetté, Philippe Laflèche and Johanne Massicotte who provided warm and timely support during the last stages of my MA. Much love and heartfelt thanks go to my family – Guy and Jacqueline Poupart, for their continued belief in my endeavors, and Benoit Poupart, who always has the answers and has always been there for me with sound advice and love. Finally, much love and thanks go to Patrick Trudeau, who made me believe I could follow my dreams.

## **Table of Contents**

<b>Introduction</b>	<b>1</b>
<b>Chapter 1. Levantine Environments</b>	<b>4</b>
<b>Chapter 2. Levantine Paleolithic Research</b>	<b>11</b>
<b>Chapter 3. Lithics and Levallois Concepts</b>	<b>14</b>
<b>Chapter 4. Archaeological Signs for Mobility</b>	<b>22</b>
<b>Chapter 5. The Middle Paleolithic in Jordan</b>	<b>35</b>
<b>Conclusion</b>	<b>45</b>
<b>References</b>	<b>47</b>

### ***List of Figures***

<b>Figure 1. Environmental Zones of the East Mediterranean</b>	<b>5</b>
<b>Figure 2. Location of Sites Mentioned in Text</b>	<b>38</b>

### ***List of Tables***

<b>Table 1. Descriptions of Tabun types D, C and E</b>	<b>19</b>
<b>Table 2. Archaeological indicators of long term vs. short term settlement</b>	<b>28</b>

## Introduction

The Jordan Rift Valley, with its north-south topography, is an area of great importance in the study of human migrations out of Africa. Starting in ancient times, the continuous fresh water systems provided an attractive route for early hunter-gatherers allowing the spread from the repeatedly desiccated northern African regions into lush Mediterranean ecosystems. The permanent spring systems allowed continuous settlement in many regions, and the oasis basins of the Jordan interior have been shown by multiple surveys to hold archaeological sites spanning Lower Paleolithic to modern times. Many theories have been developed to attempt an understanding of early populations and their relationship to the environment, and the Middle Paleolithic is recognized as a period when two distinct populations were sharing the landscape.

Skeletal remain of Neanderthals, indigenous to the Eurasian continent but not the Levantine Corridor itself, have been found in the general area from c. 130 kya (thousand years ago) to c. 40 kya. Earlier dates have been attributed to Anatomically Modern *Homo sapiens* (AMHs), though it is unknown at present if they evolved there or migrated into the area from northern Africa. The earliest fossil humans in the Levant date to c. 110kya and are similar to early AMHs from northern and eastern Africa; no skeletal material is yet available for earlier archaeological assemblages.

One of the more puzzling finds has been the association of fossil remains from both groups with similar lithic assemblages. Previously recognized as a distinctly Neanderthal technology, the Mousterian as a typological category was conceived to describe European lithic assemblages. The use of this technology by early Modern Humans in the Levant has led some researchers to give a word of caution to those who would use a type of lithic assemblage as an indicator of a particular species, as has been routinely done in European contexts (D. Kaufman 1999). Efforts must now be made to understand what circumstances, be they social, environmental or other, led these populations to leave such similar assemblages as they exploited their surroundings.

As no fossil remains have been found in Jordan dating to Lower or Middle Paleolithic times, and the technology of Middle Paleolithic assemblages has been associated with both species in surrounding areas, it remains impossible to determine which species left the Levantine Mousterian lithics of the area. Nevertheless, studying the sites and their respective environments remains an important area of research for understanding the dynamics of early human population dispersals. Studies from Israel and other areas west of the Rift have allowed many theories to be developed, and by looking at the archaeology of Jordan these theories can be assessed to see if they can be applied to areas east of the Jordan Rift Valley as well.

Lithic remains are durable and are the key to understanding populations existing in the ancient past. How to extract information from these stone tools requires sound theories in reduction techniques, landscape management and mobility. Detailed paleoenvironmental information is necessary for a broad understanding of the past, and though techniques have been developed to gather this information, much has yet to be done before the record has sufficient resolution to understand local population dynamics and environmental pressures. Much

information has been acquired through archaeological research and will be developed here, showing that populations were tied to permanent water sources in an area prone to desiccation and inhospitable climes. Following a general review of Levantine archaeology, the Middle Paleolithic sites of Jordan will be explored in order to assess whether the major trends identified in the general region apply well to a site-by-site survey.

## **Chapter 1**

### **Levantine Environments**

The Levant is a bio-geographical area that alternatively had periods of contact and isolation from its neighbouring regions of Africa and Eurasia, affecting hominin species as well as the rest of the fauna (E. Tchernov 1998). Consequently, remains of both Neanderthal and early Modern Humans have been found in association with the archaeological sites of the area, and understanding the evolutionary relationship between these human populations has been the focus of research from many angles.

The East Mediterranean Levant covers modern-day Syria, Lebanon, Israel and the Palestinian territories, Jordan, and the Sinai Peninsula (see Figure 1). It has an environmental gradient between the Saharo-Arabian desert, Irano-Turanian steppe and Mediterranean woodland (D. F. Por 2004). The Middle Paleolithic climate would have been generally cooler than at present times, and lowered sea levels meant the coastline of the eastern Mediterranean would have been some tens of kilometres further west. This coastal environment would have been



welcoming to incoming human populations, though these potential sites are now submerged. The high topographic relief would have created, as it does today, extensive areas (“ecotones”) where resources from distinct environmental zones could be found in close proximity to each other (J.

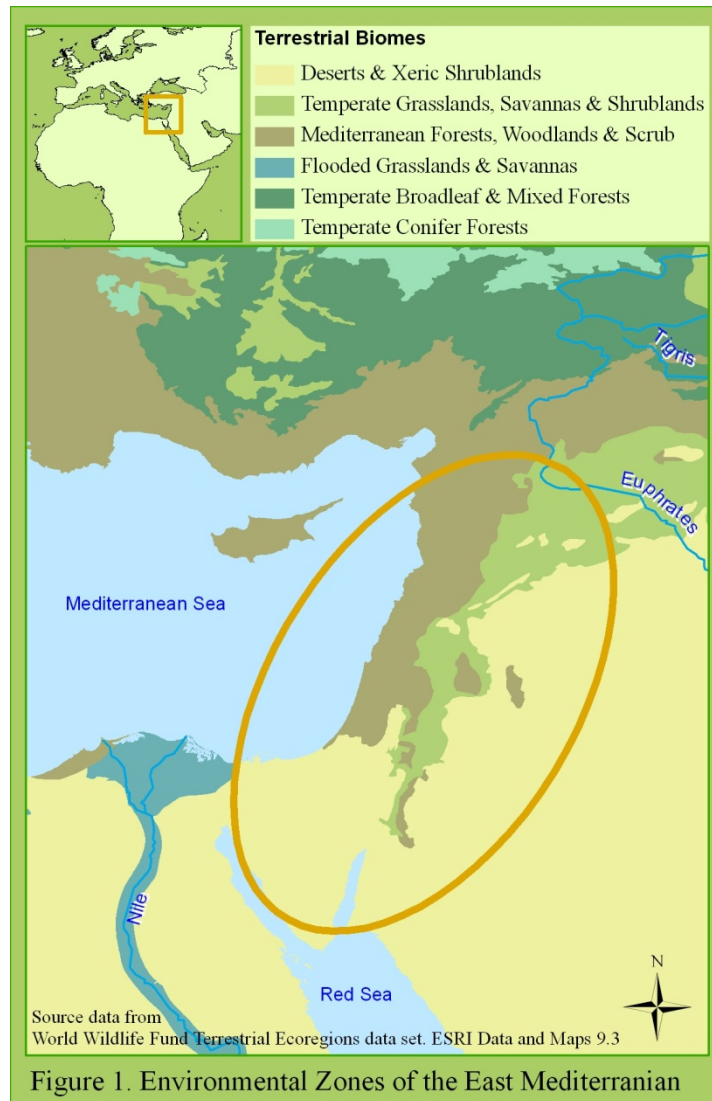


Figure 1. Environmental Zones of the East Mediterranean

Blondel and J. Aronson 1999). These ecotones would be particularly attractive settlement areas for human populations with their generalist feeding habits (J. J. Shea 2003a:317).

Following glacial cycles, the environment shifted between cold, dry periods and warm humid ones. The overall climate is under the influence of two major systems: The first originates in the NE Atlantic ocean, passing over Europe and Mediterranean Sea, while the second is the African/West Asian monsoonal system, originating in low latitudes of the Atlantic or Indian Oceans. These

systems covary, and cause warm humid conditions when they overlap during interglacials.

Heinrich events, when great quantities of fresh water are released from the arctic glaciers, cause major shifts to cold dry glacial maxima. In between the extremes are broad extents of warm, dry interglacials and more localized cool glacial intervals (Almogi-Labin 2004).

Sea bed cores, lake cores, palynological studies and cave speleothemes have been studied extensively to determine overall climatic shifts, and good correlations between them show that land and sea climates were interrelated and changed in tandem (M. Bar-Matthews and A. Ayalon 2001; M. Bar-Matthews, et al. 2003; M. Bar-Matthews, et al. 2000; M. Bar-Matthews, et al. 1999; S. Bottema and W. van Zeist 1981; P. A. Bull and P. Goldberg 1985; P. Goldberg 1986; A. Horowitz 1976; Weinstein-Evron 1988). Local environments cannot easily be deduced from the overall climatic sequence, however, as they depend much on topography and geological setting.

This can be demonstrated by studies of Israeli cave speleothemes. By comparing the records of Ma'ale Efrayim cave on the eastern slope of the central mountain ridge near the desert boundary to those of the well-studied Peq'in and Soreq caves, Bar-Matthews and Ayalon (2001) show that even within this small area local environments change differently from each other: During glacial periods, the records of Ma'ale Efrayim match those of the Peq'in and Soreq caves, but during interglacials there are signs of aridity in the east while Mediterranean climates dominate in the west, a discrepancy caused by the rain shadow from the mountain ridge. Despite good environmental sequences from the neighboring Levantine areas, therefore, detailed information cannot be extrapolated to the Jordanian sites. Local conditions will have to be studied for each area by future research in order to gain the resolution needed for the effects on hominin populations and how they adapt to their specific local environments.

Wide fluctuations between climatic extremes had the overall effect of reducing woodland cover in favour of steppe and desert conditions, and during Mousterian times the vegetation belts would have been approximately 250km further south (A. Horowitz 1976). Pollen samples show grasses and steppe vegetation, along with trees tolerant of dry conditions such as oak, olive and terebinth. These species shifted up and down the topographic terrain according to overall

climatic conditions, with the woodlands extending upslope in warmer times and reverting to steppic conditions in colder periods. Cold peaks are generally associated with Heinrich events and more localised Sapropel events, when high rainfall caused decreased salinity in the Mediterranean waters. (M. Bar-Matthews, et al. 2003; M. Bar-Matthews, et al. 2000; M. Bar-Matthews, et al. 1999; J. Blondel and J. Aronson 1999; S. Bottema and W. van Zeist 1981; P. A. Bull and P. Goldberg 1985; W. R. Farrand 1979; P. Goldberg 1986; Weinstein-Evron 1988)

Large mammals of the Levantine Middle Paleolithic assemblages include gazelle, red deer, fallow deer, wild cattle and aurochs, ibex and wild goat, wild boar, and many equids. These species are adaptable to a wide range of climates, and change little over the course of the Middle Paleolithic (J. Blondel and J. Aronson 1999; E. Tchernov 1976; 1992). Though assemblages differ in the proportions of each species hunted, a variety of animals both migratory and territorial are typically represented, attesting to Middle Paleolithic humans' advanced and flexible hunting capacities (D. Kaufman 1999; J. J. Shea 2001; 2003a; 2006).

Variation over time is however evident in the smaller fauna, which are more sensitive to climate change. Earliest Levantine Mousterian assemblages are associated with European microfauna during a cold and dry period. As the temperatures increased in OIS 5 these northern species became extinct in the area, replaced by an influx of Afro-Arabian species. The turnover repeated itself in OIS 4 with the European species coming to dominate once again. This alternating composition of European and African faunal species indicates the extent to which the area was a contact zone between the two environments, and hominin species may have been influenced by these same factors (J. J. Shea 2001; E. Tchernov 1998). It has also been argued that hominins, like the other large mammals they were dependent upon, were less sensitive to climate fluctuations and would not have been driven to and from a territory by changes in

temperature (M. C. Stiner 2006; M. C. Stiner and O. Bar-Yosef 2005; M. C. Stiner and E. Tchernov 1998). It is however unlikely that any fauna would continue to inhabit an area overtaken by desert and the most extreme fluctuations in climate must have had some effect on all populations.

Any migration of early humans from the African continent would have been sporadic, with windows of opportunity opening only during the wettest periods. Recent efforts have shown that unbroken arid conditions prevailed in the Negev Desert except during a humid period between 140 and 110 ka (A. Vaks, et al. 2007), corresponding with the earliest finds of AMHs at Skhul and Qafzeh. Furthermore, pollen samples from excavations conducted in now inhospitable, arid regions of southern Jordan indicate the sites were occupied during considerably wetter climates (D. O. Henry 1998a; 2003). So although hominins may not have been driven from lands alternating between woodland and steppe, they may well have been repeatedly isolated by surrounding desert during arid times. Tchernov (1998) describes the Levant as both a biotic corridor and a barrier to the species from 3 continents. Although the general north-south trends of the topography would pull species in those directions, the hyper-arid southern Levant would effectively isolate neighbouring environments for extended periods of time.

Once in the area however the Jordan Rift Valley system provided a continuous north-south zone of freshwater systems extending up into the Eurasian continent. Outpourings of basaltic flows during the early Pleistocene created the endorheic aquatic basins, opening the migration route to the North. Expansive areas equivalent to today's Dead Sea and the preceding Lake Lisan were probably inhospitable to human occupation due to salinity, restricting faunal

presence, and the migration route was more likely through Lake Jafr and the Azraq Oases. (Por 2004).

Artesian springs draining ancient aquifers accumulated during the last pluvial episodes rather than merely surface-collected water, and are much more stable in face of sea-level changes than springs dependant on rainfall. These permanent waterways and oases provided a rich variety of ecological resources attractive to hominids. Migrating birds from/to Africa used these permanent sources, adding an important resource for hominid groups. Levantine waterways create a two-way distribution path from south to north. Four biotic-climatic zones are easily covered in one day's walk, crossing from the sea, through the mountains, and down the valley, benefiting from mountain springs and brooks along the way (Por 2004). During the Plio-Pleistocene boundary this corridor was invaded by African species from the south. Though most of these species did not make it all the way into Europe, the Levant shows a mix of African and Eurasian fauna, including hominin species (B. Martinez-Navarro 2004; E. Tchernov 1992).

Landscape evolution shows great diversity in the small region of Jordan, and change is not uniform. Base water levels fluctuate more in the tectonically active west, while the Jafr and Azraq basins remain more stable. The spring-fed water flats in lower wadi systems provide a buffer against seasonal, short-term and long term aridity, and groundwater and tectonics are as important for landscape change as the overall climate sequences. As few studies have been conducted in Jordan, the data remains too fragmentary for a regional synthesis (P. G. Macumber 2001), and what small amount of data there is not consistent with prevailing notions of climatic succession (D. O. Henry 1998b).

There are three seasons in Jordan. The summer season, from mid June to mid September, is hot and dry, with no rain. The rainy season between mid October and mid April is cooler, and

between these are short transition seasons when desert storms are frequent (P. G. Macumber 2001). Bender (1974) describes 3 major climatic zones: the Mediterranean, ranging from sub-humid to semi arid; the semi-arid, east and south of the Mediterranean climates, a long transition zone; and the fully arid zone in the full east and south of Jordan (F. Bender 1974). The early Middle Paleolithic shows an overall tendency towards being cool and dry, though wetter than today, and the later is more warm and dry. Middle Paleolithic deposition occurs mostly during humid periods between 85 to 75kya, with much fewer sites found in the dryer period between 70 to 45kya. The arid climate likely sustained much lower population densities, and erosion and poor depositional circumstances have left little evidence of sites (P. G. Macumber 2001).

## **Chapter 2**

### **Levantine Paleolithic Research**

#### **Lithic Assemblages**

Research since the start of the 20<sup>th</sup> century has found Paleolithic artefacts throughout the Levant, and Garrod (D. A. Garrod and D. M. A. Bate 1937), having seen the need to differentiate the collections from those found further north, adapted the contemporary European taxonomy to describe the assemblages found at Mount Carmel. She remarked that the Levallois/Mousterian dichotomy did not hold in the Tabun assemblages. Recognizing distinct types of Levallois-dominated, Mousterian lithic assemblages, she divided them into Lower and Upper “Levalloiso-Mousterian” (today more commonly named the Levantine Mousterian). The Lower Levalloiso-Mousterian corresponds to her Level D at Tabun, while the C and B layers are part of the Upper Levalloiso-Mousterian.

Since her publications researchers have offered several new notations but these are all based on the original Tabun stratigraphy, which covers a large part of the Middle Paleolithic. There remains a consensus today to use that rich sequence as a “rough scale” to describe Levantine Middle Paleolithic assemblages (O. Bar-Yosef 1998:41). A “Tabun D-type” therefore

resembles the Tabun D assemblage and is generally chronologically older than a “Tabun C-type,” which in turn is older than a “Tabun B-type.” This is but an outline and many consider it possible that some Tabun C and B types (phases 2 and 3) could be contemporaneous, but the D-C-B chronology seems to hold up well at least for coastal sites (O. Bar-Yosef 1998; D. O. Henry 2003; D. Kaufman 1999; J. J. Shea 2003a).

### **The Fossil Hominins**

Though researchers disagree on the classification of some of the remains, most concur that there are two distinct types of humans represented in the Levantine record. Whether these groups represent one or two species has been debated in evolutionary literature for the better part of a century (see discussion in O. M. Pearson 2004 and references therein). Though some maintain the two populations were part of one, widely varying species (e.g. M. H. Wolpoff, et al. 1989), most agree today that the two were quite distinct (D. O. Henry 2003; J.-J. Hublin, et al. 2001; D. Kaufman 1999; J. J. Shea 2003a). Arguments towards this include that the groups retained recognizable physical distinctions differentiating members of each from the other, accompanied by the results of various genetic tests showing little connection between the groups after c. 500 ka (S. Paabo 2003; O. M. Pearson 2004).

There are no diagnostic human remains associated with the oldest assemblage type, Tabun D. Tabun C assemblages are associated with both Neanderthal and early Modern Human remains, and Tabun B assemblages are associated only with Neanderthals. The Tabun C associations at Tabun are problematic, as some of the Neanderthal remains may be intrusive from a later layer with a Tabun B assemblage (mandible Tabun II). The taxonomic affinity of the other Tabun C fossil hominins being under some debate as well, it is at present unknown if one



or both taxa are represented, and indeed, if only one, which. It is possible but not in any way certain that the Tabun C- and B-types differentiate and represent the two human groups (D. Kaufman 1999; J. J. Shea 2006; E. Tchernov 1998).

## **The Dates**

Advances in dating techniques have allowed refined absolute dating of the Pleistocene and the Levantine hominin record was found to be more convoluted than at first imagined. Rather than progressing up a simple ladder from archaic to modern humans, the sequence shows that early AMHs inhabited the area long before previously imagined, and represent some of the earliest specimens yet found. Populations including those of Skhul and Qafzeh are now dated at c. 100 ka and perhaps much older (H. Valladas, et al. 1998). The Neanderthals, who were indigenous to Europe but not the Levant (F. C. Howell 1998; E. Tchernov 1998), are dated as early as 130 kya at Tabun (R. Grün and C. Stringer 2000; N. Mercier and H. Valladas 2003). As only Neanderthal remains have been dated to the period between c. 80 and 50 ka, questions remain as to whether the local early AMHs had been displaced by their northerly cousins entirely, or cohabitated with them for an extended period of time (O. Bar-Yosef and B. Vandermeersch 1993; J. J. Shea 2001; 2003a; 2006).

The technology itself has been reassessed as well, with unexpected early dates (well over 200 ka) for the earliest Levantine Middle Paleolithic. These new dates put the beginnings of the Levantine Mousterian on par with the early dates for the European Middle Paleolithic and the African Middle Stone Age (O. Bar-Yosef 1998; L. Meignen 1998; H. P. Schwarcz and W. J. Rink 1998; H. Valladas, et al. 1998). As diagnostic fossils have yet to be found in association

with these early assemblages, it is impossible to know at this time what species of hominin possessed this earliest Levantine Mousterian technology.

## Chapter 3

### Lithics and Levallois concepts

#### Bordes, Boëda and the *chaîne opératoire*

The remains of the Middle Paleolithic having necessarily gone through much deterioration over time, information must be gleaned from what little is left. The assemblages consist mostly of lithics, as these survive the taphonomic processes far better than organic material. An agreement on how to describe and analyze lithic assemblages is therefore of great importance, and careful methodologies have been developed for the study of stone tools.

Though the function of relatively recent artefacts may often be deduced by form, the Middle Paleolithic presents more complications as the tools rarely have specific modern counterparts and their function is, beyond the most basic idea of a sharp edge, more speculation than fact. In an effort to standardize assemblage description, François Bordes (1967) developed a typology of the Middle Paleolithic tools of Europe that revolutionized lithic assemblage analysis with its statistical possibilities. Listing over sixty tool types in the European Middle Paleolithic assemblages, he provided methods by which assemblages studied by different authors could be described in ways that made them comparable across publications.

Gilead (1995) discusses the need for refining Bordesian typology using an example from his earlier studies in the Levant. Several assemblages had been published according to a Bordesian Levallois/non-Levallois typological classification, showing the ratio of Levallois versus non-Levallois artefacts (or “Levallois Index”). A plot of this simple ratio as reported for various sites clearly demonstrates that Levallois products have been found in much higher percentages in cave sites than in open-air sites. As the same standard data had been recorded for each of these assemblages, it was possible to achieve this cross-site comparison directly from the published literature with no need for first-hand re-analysis. At the time, this led Gilead to propose that finished artefacts had been transported to resident cave sites; open-air sites, often located close to raw material sources, would be more likely to show the full reduction sequence, swamping the final Levallois products. “The efficiency of the Bordesian method is clearly demonstrated here (I. Gilead 1995:83).”

Levallois indices, unfortunately, seem to differ from author to author *studying the same assemblages*. There is much ambiguity in identifying a Levallois product, and there are suggestions that some excavators, earlier in the 20<sup>th</sup> century, may well have discarded some non-Levallois products entirely and hence removed them from the statistical pool. That different traditions exist in the typological classifications of Middle Paleolithic artefacts shows that the problems Bordes attempted to resolve are not yet without complication. When two assemblages seem similar, “one cannot [...] escape wondering if such similarities are not induced by scholars who were trained to classify in the same tradition (I. Gilead 1995:84).” The Bordesian typology allows statistical analysis in a way previously inapplicable to Middle Paleolithic archaeology, in a user-friendly package, but Gilead concludes that the results are not necessarily sound and unequivocal (1995:86).

In the past 15 years paleoanthropologists have turned to the concept of the *chaîne opératoire* in hopes of resolving the issue of standardization and comparability of data, as well as that of equifinality. As defined by Bar-Yosef (1998:42), the *chaîne opératoire* “encompasses a detailed description of the various stages of tool production and use: from the procurement of raw material, to the shaping of the core and systematic production of blanks, and finally to secondary modification of selected blanks, their use, and discard.” In France, the early work of André Leroi-Gourhan (1964) on technique and the evolution of technology leads to the theory that socially-mediated technology acts on every aspect of human action on a given material. The social aspect appeals to archaeologists, as they use technology to infer behaviours of ancient people. If technology is a social production, the cultural patterns of a society can be reflected in technological items (F. Audouze 1999).

In this framework, “know-how” and “knowledge” are necessary elements of any finished product. In terms of Middle Paleolithic humans, “knowledge” is a knapper’s concepts of raw materials and ideal forms, as well as a catalogue of actions with their practical consequences. “Know-how” is what organizes these actions and evaluates the results at every step. Besides considering constraints like raw material availability, the existing repertoire of an ancient individual’s knowledge and know-how must be taken into account when analyzing technological assemblages. Knappers must choose what technical action to perform at every step, and they choose from an available body of knowledge and know-how that is culturally mediated (F. Audouze 1999; E. Boëda 1995; L. Meignen 1995).

The *chaîne opératoire* concept, then, takes into account the decisions taken at every step of tool production, rather than only the finished product. It also recognizes that certain steps of the *chaîne opératoire* are crucial to the success of the production, while others permit more

variability. Both these crucial and variable steps are culturally mediated (F. Audouze 1999), so while many different production sequences can be used to achieve a desired end, few may be passed on in any given culture.

The Middle Paleolithic record is particularly amenable to such methods, as the problem of equifinality has rendered many typological discussions moot. Levallois, which used to be defined as a particular product, is now considered a process (P. Van Peer 1995). No longer satisfied with identifying only Levallois blanks and Levallois cores, researchers now attempt to identify the typified products of the entire process of Levallois reduction. The different methods used to arrive at similar end products have become more useful in identifying distinct technological traditions than the products alone (O. Bar-Yosef 1998; E. Boëda 1995; L. Meignen 1995).

The entire Levallois method must be described in order to identify variants, as well as to differentiate it from other reduction technologies. The Levallois volumetric conception proposed by Boëda (e.g. 1995) is defined by six technical criteria:

1. The core must have two asymmetrical, convex, secant surfaces
2. The two surfaces are hierarchically related, where
  - i. One is for predetermined blanks
  - ii. The other is the striking platform
3. The flaking surface is maintained to ensure the predetermined shape
4. The fracture plane is parallel to the plane of intersection of the surfaces
5. The striking platform is maintained at right angles to the plane of fracture
6. Only direct hard hammer percussion is used

Some of these criteria can be satisfied by several options, and different Levallois *chaîne opératoire* can be found in the Levantine Paleolithic. The *chaîne opératoire* method is useful for describing the volumetric conceptions of non-Levallois reduction sequences as well. Though recognized early on as an important part of Levantine Middle Paleolithic knapping technology, Levallois is not the only type of reduction present in most assemblages; the Levallois/non-Levallois dichotomy is more a construct of Bordesian typology than technological fact. Other reduction sequences must be analysed as well to adequately describe an assemblage (E. Boëda 1995; I. Gilead 1995). The *chaîne opératoire* is a powerful tool with which to identify a package of technical knowledge and know-how in patterned remains, making it possible to address the historical trajectory and time-depth of cultural traditions (O. Bar-Yosef 1998).

Products which seem very similar can now be distinguished by their production methods, which in turn are recognized by the study of all products (and by-products) of a given *chaîne opératoire*. Each stage of production should leave a recognizable trace, debitage which until now may well have been considered “non-Levallois” but is in actuality part of the Levallois process. Products that look like ones made by Levallois methods may in turn be identified as non-Levallois. Moreover, as core reduction sequences often change over the life-use of a single core, the entire process must be studied in hopes of identifying reduction strategies prior to the last removal (L. Meignen 1995).

### ***Chaîne opératoire* and the Origins of Levallois Technology**

Armed with these new conceptual tools, authors have been re-evaluating the Levantine Mousterian assemblages. Leroi-Gourhan (1964; 1968), interested as he was in the evolution of techniques, was one of the first to comment upon the origins of Levallois technology. Noting that

the debitage from handaxe production consisted mainly of large, thin, sharp flakes, he argues that there is a gradual change from the bifacial tool with waste-flakes to the bifacial core with flake tools, or “un glissement imperceptible du biface-outil avec ses éclats-déchets au biface-nucléus avec ses éclats-outils (1968:112).” These conclusions are supported by Copeland’s work, who shows that the Levallois component recognized in Lower Paleolithic assemblages may well be

	<b><u>Tabun D-type</u></b> <b><u>Early MP</u></b>	<b><u>Tabun C-type</u></b> <b><u>Middle MP</u></b>	<b><u>Tabun B-type</u></b> <b><u>Late MP</u></b>
<b><u>Production Technology</u></b>	<i>Récurrent</i> unidirectional parallel <i>Récurrent</i> bidirectional parallel Unipolar convergent Some radially prepared Some prismatic laminar Also called “Abu-Sifian”	Radial, also called centripetal Some bidirectional Discoidal “Classic” Levallois	<i>Récurrent</i> unidirectional convergent Some tendency towards centripetal preparation in later phase
<b><u>Blank Morphology</u></b>	Elongated flakes, blades and points Little platform faceting Prismatic reduction results in keel-shaped, crested blades Highest laminar index	Large ovoid or subrectangular flakes Some points and blades High platform faceting Low laminar index	Broad-based, isosceles Levallois points, large and small Blades Small thin flakes High platform faceting High laminar index
<b><u>Typology</u></b>	Points, UP tool types (endscrapers, burins, perforators, backed knives) Few sidescrapers Higher ratio of retouched tools than C and B	MP tool types (sidescrapers, also transverse, double, convergent scrapers) Small number of triangular points in discrete horizons	Middle Paleolithic tool types (sidescrapers, Levallois points, denticulates, notches) Some UP tool types Common <i>Chapeau de gendarme</i> platform, with tip <i>en concorde</i>
<b><u>Approximate Dates<sup>1</sup></u></b>	270 – 170 ka Or 250 – 128 ka	170 – 90 ka Or 128 – 71 ka	90 – 47 ka Or 72 – 47 ka
<b><u>Associated Hominins</u></b>	No diagnostic human remains	Both early Modern Humans and Neanderthals	Only Neanderthals
<b><u>Climate and Environment</u></b>	Shift from warm/humid to cold/dry Extinction of many archaic microfauna Infusion of African fauna	Initially warm/humid, growing colder Wide fluctuations between warm/humid and cold/dry Reduced woodland cover	Establishment of cold/dry, followed by wide variations Domination of steppe-desert Formation of large lakes due to reduced evaporation

**Table 1. Descriptions of Tabun types D, C and B<sup>2</sup>**

<sup>1</sup> Different dating techniques result in widely varying “absolute” dates, with TL dates averaging much older than ESR dates for Tabun D and C. Tabun B dates cluster well around the younger end of the range, less well around the older end (Bar-Yosef 1998).

<sup>2</sup> (Bar-Yosef 1998; Henry 2003; Kaufman 1999; Meignen 1995, 1998; Shea 2003, 2006; Tchernov 1998)



incidental to biface preparation (L. Copeland 1995).

Rolland (1995) studies the patterns of African and European assemblages across the Lower/Middle Paleolithic and Early/Middle Stone Age transitions, concluding that the different continents' biface production each led to prepared-core technologies through different *chaîne opératoire*. A common ancestry possessing bifacial flaking techniques seems to have led to parallel prepared-core technologies in both African (Modern Human) and European (Neanderthal) human groups. When faced with similar resources in the Levant, they consequently developed similar stone tools (J. J. Shea 2006).

### **Refining the Levantine Typology**

Meignen (1998) uses the *chaîne opératoire* concept to demonstrate that the elongated products in Tabun D-type assemblages are sometimes made not by Levallois methods but by a prismatic volumetric conception, previously attributed to Upper Paleolithic technologies. She also includes the unidirectional assemblage at Kebara as being Levallois (L. Meignen 1995). Table 1 shows the characteristics of the different types of assemblages as many view them today.

The use of the tripartite Tabun sequence to describe Levantine assemblages has been severely criticized, however. Hovers (1998), Goren-Inbar and Belfer-Cohen (1998) warn that assemblages have routinely been attributed to a simple type as seen in Table 1 based on tenuous dominant characteristics, leading to analyses that are simplistic and insensitive to the true variation present. Each assemblage, though showing a distinct predominance of one type of *chaîne opératoire*, shows that most other possible reduction strategies were also employed. Meignen (1998) demonstrates this with a study of layers from Hayonim Cave, concluding:

This preliminary examination of Levantine Levallois flake core reduction strategies demonstrates the variability of the Levallois recurrent methods and the difficulty of establishing clear-cut categories. The more we recognize the details of the Levallois components, the more it becomes clear that it is impossible to organize them into completely separate facies. In fact, the Levallois technology is mainly characterized by this flexibility in core management, resulting not in a unique standardized blank production as in the Upper Paleolithic, for example, but in an array of products of controlled morphology. (p. 168-9)

A preference for one way of doing things despite knowledge of viable alternatives has been attributed to a cultural phenomenon. *Chaîne opératoire* analysis has demonstrated that Levantine Middle Paleolithic hominins were indeed transmitting technological information in a modern, culturally-based fashion (e.g. E. Hovers 2001; A. Ronen 1995).

## **Chapter 4**

### **Archaeological Signs for Mobility**

#### **Binford and Hunter Gatherer Theories**

Behavioural organization is a fundamental aspect of understanding the lifestyles of humans, today and in the past. Such information about Middle Paleolithic hominins would shed light on their adaptations, but extracting it from the scant material record requires structured methodology. Since the 1960's a renewed effort has been made to use archaeological data to understand land use, subsistence strategies and other behavioural adaptations (B. G. Trigger 2006). Lewis Binford (e.g. 1978; 1980; 1981; 1983; S. R. Binford, et al. 1968) marked the discipline with a rigorous scientific structure for conducting archaeology that endured the post-processual era and only improved with criticism (L. R. Binford 2001). Today, researchers into the Levantine Middle Paleolithic rely heavily on these hunter gatherer theories to deduce the subsistence and settlement patterns of ancient hominins, in hopes to find there the difference that led to the displacement of the Neanderthals.

Binford (1980) describes how different sites will be left over the landscape, depending on the length of stay at each and the activities taking place. He divides the typical remains into five categories of sites, following his ethnoarchaeological research with the Nunamiut:

- Residential base
- Location (or extraction site)
- Field camp (or hunting camp)
- Station (such as a lookout point)
- Cache

These sites will each have signature remains, corresponding to the activities taking place. Some will have little to no visibility (e.g. stations) and will be unlikely to be observed by the archaeologist. Factors such as size and tool variability will distinguish between residential bases and extraction points or field camps. A settlement system in this context is “a regional system of behaviour which is archaeologically visible as a set of related, contemporaneous sites in a landscape (P. Van Peer 2001:46).”

Binford (1980) also introduces the forager/collector dichotomy. Foragers are characterised by high residential mobility and low-bulk procurement, which both make for low archaeological visibility. The aggregation of resources may encourage re-use of a site, making it more visible after several uses, but there should not be any patterning as they are an accumulation of multiple, distinct and disconnected visits. These groups map onto resources through residential moves and group size adjustments. Collectors, on the other hand, are characterised by their logistical procurement of resources, meaning that only a small task force sets out to collect specific resources and brings them back to the residential base. This is generally accompanied by longer stays at residential bases, making them more archaeologically visible and more patterned. Collectors will typically leave all five types of sites listed above, while foragers leave only the first two kinds.

These categories are recognized as being endpoints on a continuum, and groups will typically practise some of one type of procurement and some of the other. Environmental conditions tailor where on the continuum a particular population will hover, because a rich environment will easily provide all necessary resources within range of a well-located residential base, and logistic planning will be less important. Harsh environments, like that of the Nunamiut, will tend to segregate resources spatially and temporally, making it impossible to forage for all resources within the area of the residential base. Logistic forces will be necessary to acquire distant or temporary resources, and the storing of these resources will in turn encourage a more sedentary lifestyle as the overall portability of a group's vital possessions diminishes. Changes in procurement and subsistence strategies within a group will often accompany seasonal aggregation and dispersal, as resources become more or less abundant over the year.

### **Design Options**

Since their elaboration these theories have been greatly influenced by a discipline which until then was reserved for the post-industrial world: design theory. Bleed (1986) suggests that archaeologists would benefit from design engineers' skills at determining the suitability of technical structures and relating them to the task at hand. A large part of what determines the suitability of a tool is the amount of time it is available to perform. One way to ensure availability is to make the tool reliable, meaning that it will function reliably for the task it was designed for. On the other hand, designers may choose to make the tool maintainable. This means that the tool can be quickly repaired when broken, and easily modified to perform a variety of tasks other than the one it was made for.

Following optimal theory, the costs of failure in each situation will greatly influence which strategy to follow, as will the timing of the events needing the tool. If the cost of failure is great, a reliable weapon will be preferred. It will also be favoured in a situation where repair and maintenance can be performed during a predictable downtime, when the tool would not be in use anyway. Reliable tools will therefore often accompany punctuated, predictable events, when the need for them is restricted to a known occurrence and there is predictable downtime during which to maintain and repair them.

Maintainable tools will be lightweight and portable, for “generalized undertakings that have continuous need but unpredictable schedules and generally low failure costs (P. Bleed 1986:741).” They will be easy to maintain by the user, while reliable systems will often be made by an expert. A maintainable tool will tend to be modular, with pieces that can be replaced out of a specialized repair-kit, whereas a reliable tool will have a general repair-kit often including raw materials.

Using these theories in Middle Paleolithic research, the different systems will help identify the technical strategies of ancient hominins. A sharpened stick may not be as reliable a weapon as a stone-tipped one, but it is easy to re-sharpen when broken and will soon be serviceable again; the stone-tipped stick, though it will perform the task better, will be much longer to repair. The wooden stick can become a digging stick without compromising its future use as a weapon, but a stone-tipped spear cannot. Experimental studies by Holmberg (1994) demonstrate the maintainability of the wooden stick, which necessitated little repair when compared to the stone tipped spear. Though he was able to find little statistical difference between the effective penetrating capacities of different tipped spears, ethnographic sources

indicate that the sharp, serrated edges of the stone point and its breakage in the wound add to the damage inflicted by a successful blow (C. Ellis 1997). While the stone tipped spear is more time consuming to manufacture and will probably only serve once or twice, it will be the more effective weapon; the wooden spear, reusable and dependably available, will also be less lethal.

Shea (1998b) suggests that environments that demand an encounter-based hunting strategy, like woodlands, will favour maintainable tools that are versatile and reusable. When the cost of failure is particularly high, however, reliable systems will be encouraged. Hunting large ungulates will benefit from the use of a reliable weapon, as great personal injury can be incurred without the stopping power of a stone-tipped spear. A steppic environment, with large, mobile (often migratory), gregarious animals is a likely candidate for such reliable weapons, as success depends on weapon performance within a specific window of opportunity (J. J. Shea 1998b). Optimal theory suggests that the need for stopping power of the weapon be weighed against the cost of transport, fabrication and repair.

### **Provisioning and Mobility**

Further refinements have been proposed by Kuhn's (1995) technological provisioning model. Humans, being highly dependent upon their technologies, will use different strategies when planning, designing and supplying tools, depending upon the nature of their needs. Kuhn's definition of design is that tools are made with properties appropriate to their intended use, and supply involves the availability of the tool when it is needed. The first strategy is to provision the activity; this is an expedient, now-we-need-it-now-we-make-it strategy. It will fail if there is no

raw material on hand with which to make the needed tool, and it will fail if there is no time for manufacturing the tool.

To counter these potential problems, either the people involved in the activity or the location where it will take place can be provisioned in advance. People will generally carry a basic portable toolkit, in hopes of being properly equipped when opportunity arrives, but they will be limited by how much they can carry. This strategy ensures that a tool will be available, but not that it will be the most effective one. If, however, the time and location of an activity is predictable, and weight and volume are not a factor, provisioning of place tends to become the optimal solution. Deciding between these strategies will greatly depend on a group's level of mobility.

A highly mobile group will not be able to carry many tools with them, so they will tend to have a lightweight, portable ("maintainable") toolkit. In a short duration camp, they will use their portable tools and then carry most away with them. Though the sites left are ephemeral, if any artefacts are to be found they will be fallout from the use, maintenance and occasional loss of this personal gear. As unshaped raw material is too costly to carry around, signature artefacts of a high mobility personal toolkit will be highly retouched tools, and perhaps preshaped cores. Groups with high mobility into unknown areas do not know where they will next find raw material; because it must be depended upon until the next raw material source is found, their portable gear is made for maximum repair potential and durability. As lithics can only be repaired so many times before they become too small to use, a recognizable feature of personal gear is that it is made larger than necessary, thus extending the use-life of the artefact.

Kuhn contrasts this with a long term occupation, in which members will still have a generalized toolkit, but in which they will also be prone to making more reliable weapons. As



most non-extractive maintenance activities occur at residential sites and are not time-sensitive, the location is predictable and can be provisioned with raw material. Thus, when a need arises, the proper tool for the job can easily be made from locally available (provisioned) raw material and the task carried out with efficiency. Repairing a tool will have consequences on its performance, and making a new tool is not much more time consuming. If the location is regularly provisioned with raw material and the tools do not have to be transported to another activity area, the tendency will grow to make expedient tools with short expected use-lives and little concern for portability, but with high immediate efficiency. Though the exact nature of the variety of tasks to be performed may not be known until each need arises, provisioning a site with raw material makes it possible to make the proper tool for each job.

The longer the duration of the occupation, the more the personal toolkit will get swamped by debris manufacture of expedient tools. These and other telltale signs of long occupations can be found in Table 2, along with corresponding attributes of short residential stays. It must be noted that repeated short visits to the same site in, for example, a yearly round may leave patterning very much like long occupations. As patterning is created by consistently organized use over time, it will be hard to distinguish between regular punctuated short visits and continuous occupations. The known history of use of a site will influence organization upon re-settlement, and a location that is going to be returned to will be provisioned differently from one that will never be visited again. Many signs of high-mobility land use will be masked by this re-use of space if a high-mobility strategy circulates within a territory small enough to be “knowable” by the group. It will be necessary to use other indicators to determine if the occupation was continuous; for example, signs of habitation by owls or hyenas interspersed with

the anthropogenic layers indicate that a site was intermittently free of human habitation (E. Hovers 2001).

Repeated/Long Occupations History of Site Use Known	Short Occupations/High Mobility No Known History of Site Use
Logistic Patterning	Opportunistic Patterning
Provisioning of place	Personal gear
Redundant spatial patterning	Little patterning
Thick deposits, high artefact densities, middens	Low artefact densities, low archaeological visibility
Complete onsite reduction	High ratio of blanks to cores
Local (if possible) good quality flint, few sources	High variability of raw materials
Un-exhausted cores	Long distance of transport of raw materials
Unused blanks	Curated artefacts
Low amounts of retouch	High amounts of retouch
Portable toolkit swamped	Portable toolkit well represented
Expedient technology	Formal technology
High artefact variability, wide range of tasks	Low artefact variability, specialized tools
Heavier, more reliable artefacts	Portable, maintainable artefacts

**Table 2. Archaeological indicators of long term vs. short term settlement<sup>3</sup>**

## Mobility Patterns in the Levant

These broad concepts form the foundation of settlement archaeology today, and they have been applied to the Levantine Middle Paleolithic in an attempt to describe the lifestyles of ancient people. Authors promote the use this framework to study patterns of mobility in the Levant, arguing that “these behaviors, reflective of planning depth and demographic flexibility, have received particular attention given that the anticipation of needs and the changes in mobility levels and group sizes are viewed as fundamental to the foraging strategies of modern humans (D. O. Henry 1995:185).” Indicators of mobility can be seen in sites themselves and, when the material record is complete enough, through the comparison of sites, focusing on such things as procurement and transport of raw materials, provisioning strategies, artefact uses, and inter- and intra-site patterning (D. O. Henry 1995).

<sup>3</sup> (Bleed 1986; Henry 1995, 1998, 2003; Hovers 2001; Kuhn 1995; Meignen, et al. 2006; Wallace and Shea 2006)

If humans became more cognitively adept as time went on, there should be a parallel development of site complexity through time during the Middle Paleolithic leading to modern behaviour in the Upper Paleolithic (D. Kaufman 1999). Studies show however that in the Negev, for example, intra-site patterning actually decreases over time, suggesting that earlier peoples led more settled lives. This has been correlated to the deterioration of the environment, which supported larger more complex settlements during the more humid, mid-Middle Paleolithic times and progressively became too arid to inhabit at all (D. O. Henry 1995; D. Kaufman 1999; A. E. Marks 1976; 1977). In the highlands of southern Jordan, an area that remained more humid, Henry (1995; 1998a; 2003) argues for transhumance and modern behavioural organization 20 000 to 40 000 years before previously recognized (e.g. R. G. Klein 1992; 1995; C. Stringer and C. Gamble 1993).

Other researchers have found similar evidence for inter-site variability in the Levant and surrounding areas, identifying debris-ridden workshops next to flint sources, open air settlements in hills, and large sites near springs (J.-M. Le Tensorer, et al. 2001). Sites in Northern Africa show variability according to activities as well during the Middle Paleolithic, and Van Peer (2001) reports not only regional land use patterning seen in workshops, domestic sites and special activity areas, but also high intra-site patterning indicative of division of labour. Such high inter- and intra-site variability are signs of a logistic, radiating strategy from a well settled residential base, commonly thought to be a sign of modern behaviour (D. O. Henry 1998a; 2003; D. Kaufman 1999).

Despite the scarcity of Middle Paleolithic sites, researchers applying these theories with modern excavation techniques have repeatedly found evidence for modern subsistence strategies long before classically recognized (e.g. D. O. Henry 1995; 2003; D. Kaufman 1999; J.-M. Le

Tensorer, et al. 2001; J. Speth 2006; P. Van Peer 2001; L. Wengler 2001). Though difficult to attribute to species, as few or no hominin fossils are associated with most sites, it has been demonstrated that Levantine Middle Paleolithic humans, whether early Modern Humans or Neanderthals, left sites largely indistinguishable from modern hunter gatherers. The behavioural adaptations of flexible group size and adjustments in logistical and opportunistic strategies were well in place in the Levant over 70 ka.

### **Trends in Early to Late Middle Paleolithic Mobility**

The scarcity of Middle Paleolithic material remains makes all but the most generalized conclusions impossible. Recent research has concentrated on attempts to evaluate general trends over large amounts of time while acknowledging that all Middle Paleolithic hominins were flexible in their organizational strategy. By comparing early sites such as Hayonim layer E and the early Tabun sequence with middle and late sites like Qafzeh, Kebara and Amud, researchers have identified a general trend toward more settled, logistic organization through time (E. Hovers 2001; L. Meignen, et al. 2006).

These studies have shown that earlier sites in the Levant tend towards larger home ranges, where specific sites were inhabited on an irregular basis and at long time intervals. The sites are ephemeral, especially as compared to thick late Middle Paleolithic accumulations. They have low densities of artefacts, introduced finished tools, little debitage and few cores. According to Table 2, these features strongly reflect the provisioning of individuals for short-term occupancy in the context of highly mobile procurement strategies by small groups. (E. Hovers 2001; L. Meignen, et al. 2006)

In later layers such as at Kebara or Amud, heavy patterns of redundancy hint at regular visits to the site by groups familiar with its history of use. These patterns can be recognized in distinct activity areas, middens, superimposed hearths and even burials. These all point towards groups moving regularly over familiar tracts of land; smaller territories require frequent returns to good sites. Provisioning of place occurs in nearly all later Middle Paleolithic sites, independently of the distance to the raw material sources, demonstrating clear anticipation of needs. Densities of artefacts increase over shorter time spans. These features support the hypothesis that provisioning of individuals was the predominant strategy in the earlier Middle Paleolithic, while the provisioning of places, indicative of much more settled occupations, grows in importance with time. That late Middle Paleolithic sites are more numerous, more densely occupied and multilayered may point to demographic increase. (E. Hovers 2001; L. Meignen, et al. 2006; J. Speth 2006)

Studies of core technologies have supported this conclusion, showing that early toolkits were more prone to be portable and maintainable (I. J. Wallace and J. J. Shea 2006). Levallois technology produces large, thin products with high retouch potential, and thus is very suitable for highly mobile groups. When the group has only temporary access to raw materials, it will make the largest possible flakes from the available resources for maximum use-life of the tools. Large thin flakes have the highest potential for rejuvenation, making their weight/use ratio ideal for maximum transport and durability. Not only has the overall dominance of Levallois products been shown to diminish over time, replaced by more expedient strategies; Wallace and Shea also demonstrate through core analysis that populations in rich, woodland areas needed to be less mobile and could depend more on expedient strategies than those in the arid interior.

Research into seasonality has also suggested a trend from circulating to radiating strategies. Lieberman (1998) demonstrates using cementum analysis how earlier faunal assemblages, tentatively associated with Modern Humans using a Tabun C-type technology, used sites on a single season basis suggesting high mobility; later sites, associated with Neanderthals using a Tabun B-type technology, are multiseasonal and more suggestive of long-term, logistic settlement strategies. He attributes this and signs of increased hunting as intensification of subsistence by Neanderthals. That complexity increases over time is supported by the generalized trends in mobility seen in the Levantine Middle Paleolithic, and is embellished by the chronology of the populations: It was the Neanderthals, not the earlier Modern Humans, who developed the earlier complex societies in the Levant.

Though the capacity for high logistic planning was used as an indicator of modern capacities by many researchers (D. Kaufman 1999), once such capacities are accepted in Neanderthals there is no reason to question the above conclusions about settlement. As previously mentioned, latitude typically plays a large role in the extent to which logistic strategy employed by a population (L. R. Binford 1980). While early Modern Humans would have been well-adapted to rich, diverse environments that were best exploited on a continuous, opportunistic basis, the European Neanderthals had to contend with glacial conditions making their resources only available in widely scattered packages. As no recorded modern populations have succeeded in inhabiting such an environment without logistic strategies, there is no reason to believe that the Neanderthals did not also have recourse to such behavioural organization. They would probably have had pre-adaptations to settled, logistic procurement strategies when they entered the Levant.

## **Competition and Avoidance**

With these new insights at their disposal, paleoanthropologists are addressing the material record with the tools to address precise and testable hypotheses. When assembled, these form a mosaic of possible pressures affecting the human populations of the Levantine Middle and Upper Pleistocene. The emerging picture is of environmental, technological and behavioural conditions evolving in response to each other.

That early Modern Humans and Neanderthals were in competition with each other is in little doubt (S. H. Ambrose 1998; H. Bocherens and D. G. Drucker 2006; J. J. Shea 2003b), as both were preying upon the same species, using similar technologies, and overlapping on the fringes of their respective territories. How they dealt with this competition – or how much direct interaction there was between the groups – is harder to determine. Though the fossil record suggests alternate presence of early Modern Humans and Neanderthals, it is hardly good science to base conclusions on a lack of evidence. Fossils of early Modern Humans may not have been found from the period between 80 ka and 50 ka, but this does not mean that they were absent.

Ecological studies suggest competition will occur on the individual group level over localized patches of resources, and that exclusion of one group from that patch leaves it open to colonization from neighbouring patches, whether by the original species or not (J. Blondel and J. Aronson 1999; E. Hovers 2006). As ethnographically recorded competition between hunter gatherers tends toward aggressive violence with great personal injury, it is likely that any sympatry between the Middle Paleolithic Levantine groups was of short duration (J. J. Shea 2003b). Such encounters would probably have been avoided by both populations. Indications seen above for increased site re-use may well be a consequence of territoriality, which would help avoid deadly encounters. Evidence for localized extinctions may not however indicate that

lineages as a whole were extinguished. Avoidance through territoriality could keep the groups from interacting too much, perhaps in a state of overall equilibrium in a rich environment capable of supporting both groups (E. Hovers 2001).

The record supports such localized extinctions and recolonizations through several recursive patterns (J. J. Shea 2006). Blade technology, symbolic expression and spear point production are examples of distinct capacities that appear sporadically in the record, and can be explained by populations repeatedly recolonizing areas from which they are periodically driven. The local arid environment, regularly changing from habitable to inhospitable, would encourage recursive occupations. Hominins would be drawn in during favourable times, then isolated there to dwindle to extinction. Renewed favourable conditions would then draw another population in. Whether cold-adapted Neanderthals or warm-adapted Modern Humans colonized each location during each period would depend on both local environments and historical contingency.



## **Chapter 5**

### **Middle Paleolithic in Jordan**

Middle Paleolithic assemblages are found in three main depositional contexts in Jordan: High wadi terrace sites, created by the infilling and re-incision of wadis, fluviolacustrine deposits, and deep soils on the plateaus (C. E. Cordova, et al. 2007). While sites with in situ, stratified horizons are rare, surface scatters referred to as “Middle Paleolithic smears” are found wherever red Mediterranean soils have been surveyed both in Jordan (M. Bisson, et al. 2006) and the Levant in general (J. J. Shea 2001). As these are not in their primary context, it is difficult to draw behavioral information from them and research has concentrated on identifying buried stratified sites. To date, only two of these sites have been studied in depth (Wadi Hasa and Jebel Qalkha), and these will consequently receive more attention here.

#### **Northern Jordan Rift Valley**

Tabaqat Fahl is a 10m<sup>2</sup> block of tufaceous limestone protruding into the Jordan Rift Valley, sitting about 125m above the valley floor. It was deposited by regional water discharge at

the edge of the rift into Lake Lisan. Its north and south limits are defined by the wadis Hammeh and Jirm al-Moz, and the incised deposits show 60m of continuous occupation horizons (P. G. Macumber 2001). They occur on spring-fed river flats adjacent to Lake Lisan and in ephemeral wadis for several kilometers upvalley. The presence of the freshwater snail *Melanopsis praemorsa* in the lower reaches, tapering off upstream, indicates the presence of permanent ancient spring outflow (P. G. Macumber 1992). Common association of archaeological sites with *Melanopsis Praemorsa* likely reflects occupation along flowing streams (P. G. Macumber 2001).

The artefacts are widely distributed in the deposits but show fresh edges, and were probably not transported very far. They include unidirectional Levallois point cores, Levallois points, flakes, blades and bladelets, burins, scrapers and shatter debris (D. O. Henry 1998b). The in situ upper Middle Paleolithic site WH35 dates to 35.3 kya and stratified layers below show at least 6 more Middle Paleolithic horizons, likely spanning the duration of Lake Lisan from c. 80 kya. Hominin populations were tied to the springs which provided a buffer against seasonal or even long-term aridity (P. G. Macumber 1992; A. McNicoll, et al. 1984; A. Walmsley, et al. 1993).

Just to the south in the lower reaches of Wadi az-Zagh and Wadi al-Yabis, 16 localities were surveyed and one, ar-Rasfa, was test excavated by Shea (J. J. Shea 1998a; J. J. Shea and P. Crawford 2003). The site is located near a seasonal spring that was likely perennial at the time of deposition, and benefits from a key position between the Mediterranean coastal lowlands and the steppic interior of the Transjordanian plateau. Shea (1998) interprets that “groups frequenting the lake margins, and/or groups making seasonal residential movements between lowland and upland foraging areas may have visited sites like ar-Rasfa to “stock up” on tools and tool

materials (49).” He recommends future research at equal and higher elevations to gain a better understanding of raw material economy.

He found no change in lithic characteristics over the stratigraphy or the test pits, and the assemblages show some affinities with both the Tabun D-type and B-type assemblages, in that they have both a low width over thickness ratio and a low length to width ratio. There is also a high percentage of faceted platforms and few elongated Levallois points or blades; most flakes are ovoid or sub-rectangular. The many blades are interpreted as core-trimming flakes rather than end-products in themselves, and the high incidence of cortical flakes confirms that primary lithic production was taking place. Truncated-faceted pieces are found to be consistent with the possibilities of hafting. Though the majority of the lithics are unidirectional-parallel (34%) and bidirectional-opposed (30%) (resembling D-type), there is a significant amount of radial/centripetal reduction (22%) and unidirectional convergent (13%). The assemblage can therefore not be adequately described using the simple Tabun sequence (J. J. Shea 1998a).

### **Central Plateau**

The central plateau area includes the Azraq and Jafr basins, where continuous fresh water was available throughout the Middle Pleistocene to present times, and the Black and Limestone Desert Plateaus. These last have been surveyed and Middle Paleolithic scatters have been identified, mostly in the south west around the edge of open gravel plains and the table mountains between Wadi Qattafi and Jebel Qurma. Larger scatters are found on the peaks overlooking open country and on the edge of the basalt massifs, as well as scree runoff on slopes of hills (A. Betts 1988). None have been studied further to date.

## Jafr and Azraq Basins

The endorheic systems of the Central plateau collect the drainage waters of many permanent springs, creating large marshes and lakes in the depression. The drainage occurs towards the east into the Jafr basin in the south, and towards Azraq in the north east. These basins have provided fresh water throughout the Middle Pleistocene and human presence is documented since at least 220 kya. At Azraq, large and small springs emerge from the base of

the low scarp at the periphery of the basalt flow, forming pools and marshes. Today's environment is strongly affected by urban siphoning of the ancient aquifers, but until recently the areas were characterized by an oasis environment welcoming to water fowl and large mammals. Paleolithic and modern settlement was tied here in areas



Figure 2. Location of Sites Mentioned in Text

of stability while the immediate surroundings were in constant flux, affected by even small changes in climate (P. G. Macumber 2001).

While Middle Paleolithic scatters and deposits have been identified in both the Jafr and Azraq basins (L. Copeland and F. Hours 1989; G. Rollefson, et al. 2005; 2007) little has been studied in depth to date. Ongoing research by Ames and Cordova (2009a; b) identifying the paleolake margins in the Azraq basin, as well as by Bisson et al. (2009) on the Middle Paleolithic deposits in Druze Marsh and Wadi Enqiyya should allow more resolution on the environmental adaptations of the Pleistocene hominins. To date the evidence confirms that areas of permanent fresh water systems from ancient aquifers provided a stable environment for continuous occupation in an area otherwise prone to severe dessication.

## **Western Highlands**

The Western Mountain Province forms the east limit of the Jordan Rift Valley, dropping steeply into the rift and gently sloping towards the interior central plateaus. The wadis are deeply incised due to rifting and lowered base water levels, intersecting the ancient aquifers and creating perennial springs. Periods of incision, backfilling and further incision create a variously terraced landscape revealing Middle Pleistocene deposits, and Middle Paleolithic scatters are found wherever red Mediterranean soils are surveyed (M. Bisson, et al. 2006).

The Upper az-Zarqa' region, just north of Amman, has revealed Middle Paleolithic presence of Levallois flakes and cores, most likely dating to the early Würm (J. Besançon, et al. 1984; L. Copeland and F. Hours 1988). In situ finds are rare, the assemblages are undoubtedly mixed and dating resolution is poor. The occupations nonetheless are once again tied to the

perennial springs where deep incisions intersect aquifers, showing the importance of these permanent water sources in an arid environment.

Extensive studies have however been conducted in the Wadi Hasa region of the Western Highlands (G. Clark 1992; G. Clark, et al. 1987a; G. Clark, et al. 1987b; G. Clark, et al. 1988; G. Clark, et al. 1992; G. Clark, et al. 1993; G. Clark, et al. 1997; J. M. Potter 1993; 1995).

Composed of 66 sites, the wadi shows again the importance of permanent sources of fresh water to the occupations in an area otherwise prone to desiccation. The areas studied consist of three terraces in the lower Wadi Hasa and along the Wadi al-‘Ali tributary. Paleolake Hasa, spanning approximately 18km by 4km, had a western limit c. 40km from the Dead Sea Graben, and Middle Paleolithic assemblages have been found associated with both the upper and lower regions. The lake was not a closed basin enduring environment like Jafr or Azraq, but was tectonically controlled and unlikely to have been as permanent a feature as those basins. It was situated inside deeply incised wadi systems and caused by a fault barrier separating upper and lower Hasa regions. The system flowed north before the barrier, and the lake survival and history is linked to this barrier (P. G. Macumber 2001).

Two sites in the Wadi Hasa have been extensively studied: WHS 621 and WHS 634 (also called Ain Difla). The first is an open air site on the shores of Paleolake Hasa, consisting of 4000m<sup>2</sup> of Middle Paleolithic surface scatter. It sits approximately 810 masl and appears to be a slightly derived Mousterian campsite, comprising about 6000 artefacts with little patination and fresh edges. It shows high blade production with a high faceting index and moderately high proportions of broad-based Levallois points (G. Clark, et al. 1988; D. O. Henry 1998b). Clark (G. Clark, et al. 1988) has difficulty placing the assemblage within the Tabun sequence, but Potter (1993; 1995) places it within the Tabun B-type and is tentatively dated to c. 60 to 40 kya.

The lack of cortical pieces suggests that initial shaping took place off-site. Though Levallois production forms a significant portion of the assemblage, 25% of tools are labeled “miscellaneous” and are attributed to deflation and “camel retouch”, meaning surface exposure has modified these artefacts considerably (D. O. Henry 1998b).

Ain Difla (WHS 634) a small pocket of sediment from a very large rockshelter in Wadi ‘Ali, located approximately 50m asl. It is not directly associated with Paleolake Hasa, but found today between two powerful permanent springs. It comprises 5m of stratified, in situ Middle Paleolithic deposits. It is roughly dated by TL and ESR dating to 90 to 180 kya and is thus the earliest Levantine Mousterian assemblage identified in Jordan. The pollen suggests moderately steppe conditions, which contrasts with the overall pluvial settings of Levantine climatic records. This demonstrates the importance of understanding local environments, which are often contradictory to generalized, low-resolution climatic sequences (D. O. Henry 1998b). Comprising nearly 20 000 artefacts, the assemblage is consistent with a D-type Tabun classification and has elongated, narrow-based Levallois points, mostly made from bidirectional reduction strategies. The laminar index is high at c. 42% and there is a variety of formal tool types. The high degree of core exhaustion along with a low proportion of tools to debris suggests intense occupation.

According to theories on mobility, the two sites should conform to certain expectations (J. M. Potter 1993; 1995). WHS 621 should show more signs of curated, mobile strategies as it is chronologically later and should resemble modern patterns. Among such expectations are a high degree of formal, retouched tools, many tertiary flakes (indicative of resharpening), and a high percentage of exhausted cores and tools. Ain Difla, on the other hand, should show signs of expediency such as a high percentage of waste material, less retouch, less core preparation, a

complete record of core reduction stages, and intense use of local raw materials. As WHS 634 is a rockshelter, however, and frequent visits to the site would encourage the re-use of tools.

Among the variables he tests for are the raw material types, the condition of the artefacts, the types of formal tools, the amount of platform preparation, signs of utilization, edge angle, size and percentage of cortical flakes.

WHS 621, the open-air short term locality, has flakes with steep angles, more retouch, more signs of utilization and a greater variety of raw materials. These results are consistent with efforts towards maintenance and high mobility. Ain Difla shows a high percentage of debris, many small, unbroken flakes and blades and a more limited set of raw materials. It cannot simply be called an expedient technology as the high blade content maximizes the cutting edge/volume of raw material. This is logically caused by the occupants being tethered to the site and maximizing the amount of cutting edge to carried raw material. This accounts for the small size at WHS 634, its blade-dominance, limited raw materials and the high frequency of prepared platforms. It is not necessarily more expedient, and Potter (1993) suggests the two sites show different solutions to the different pressures of tethered settlement patterns. The cycle suggests that the environmental models developed by Marks and Friedel (1976; 1977) are far too simplistic, and that the overall drying of southern Levant was likely punctuated by shorter fluctuations and much variation across time and space. The record will only be better understood when the paleoclimatic data becomes sufficiently detailed (J. M. Potter 1993).

### **Southern Mountain Desert Province**

Though demonstrating contemporaneity can be a daunting task, Henry (1995; 2003) contrasts two sites that he connects because of their inverse retouch, which only very rarely



appears in other assemblages. The Wadi Hisma drainage system from Jebel Qalkha has are controlled by fault lines and comprise numerous find spots with 8 sites considered in situ. All but one are tied to caves or rockshelters, the exception being Tor Sabiha which is at a considerably higher elevation and is interpreted as an ephemeral resource exploitation site.

The Levantine Mousterian assemblages are found in aeolian deposits accumulated in dry, steppic conditions, though cooler and wetter than today. The phytolith studies suggest permanent standing water nearby. The sites are dated by AAR, TL and Th/U dating to c. 45 to 69 kya. The lithics comprise 40-50% broad-based Levallois points, where unidirectional convergent reduction strategies predominate, though bidirectional and opportunistic methods are used on smaller, more exhausted cores. Cores-on-flakes also point to raw material economizing behaviors. The chert sources being c. 20km away, these intensive reduction strategies indicate re-use of materials to avoid distant transport.

Henry shows that Tor Faraj is a long-term, winter base camp while Tor Sabiha must be an ephemeral summer camp, determining the season of stay from their elevation and position which make one inviting and the other inhabitable in the colder seasons.

The indicators he uses for the length of stay are as follows. Tor Faraj, the winter camp, as compared to Tor Sabiha, shows:

- Longer reduction streams emphasizing initial processing
- Direct bulk procurement of distant chert (17-20km) → logistic provisioning
- Heavier, bigger, less portable artefact inventories
- Lower efficiency in edge production (mostly because of initial reduction stages being present)
- Less curation and high onsite Levallois production

Though there is a high level of retouch on the Tor Faraj tools, usually an indicator of a mobile toolkit, in this case it is more likely related to the distance of the raw material source. He proposes a system of transhumance, where groups would disperse in the highlands in the summer opportunistically hunting plentiful but dispersed plant and animal resources, and would aggregate in a warm, south-facing rockshelter at lower altitudes and with more predictable resources during the winter. Such transparency of data is remarkable considering the scarcity of Middle Paleolithic remains and only much research will serve to expand other data sets in hopes of gaining insight into settlement patterns in other areas as well.

## **Conclusion**

Close study of the Jordanian Middle Paleolithic archaeological sites has provided a renewed and diversified understanding of human adaptations during the Middle Pleistocene as they adapted to Levantine environments. Though early studies provide a good framework against which to relate these finds, local environments were diversified and prohibit simple generalized models. Olszewski (2001) concludes that “the adaptations of these hunter-gatherer groups were much more varied, flexible and dynamic than predicted by archaeological models developed in the western Levant (31),” and doesn’t believe that the Tabun sequence reflects a chronological model. Instead, different technologies seem to reflect local adaptations to different environments and ecologies, where mesic periods show logistical strategies tied the oases like Azraq and Jafr, while xeric periods show radial strategies tied to permanent spring systems. These flexible systems can vary according to season or over long periods and demonstrate the variable responses by humans according to their surrounding conditions.

As the dataset for Middle Paleolithic sites expands with current research, it becomes more and more evident that the populations at this time adapted to their surroundings in what is considered a modern fashion. Following rich environments, groups could vary their responses according to the expansion and retraction of favorable locals, and the presence of fresh water

systems invariably dictates the presence of human occupation. These systems changed not only with overall climatic sequences, defying simple correlations with specific records, but were highly influenced by tectonics and groundwater levels as well. Though future research will expand the data set and provide necessary information for specific, site-by-site analysis, the present study indicates that a modern flexible response to changing environments in Jordan was the norm as early as 100 kya, regardless of the species of human studied.

## References

- Ambrose, S. H.  
1998 Prospects for Stable Isotopic Analysis of Later Pleistocene Hominid Diets in West Asia and Europe. *In* Neanderthals and Modern Humans in Western Asia. T. Akazawa, K. Aoki, and O. Bar-Yosef, eds. Pp. 277-289. New York: Plenum Press.
- Ames, C. J. H., and C. E. Cordova  
2009a Geoarchaeology and Prehistoric Transitions in the Azraq Druze Basin, Jordan: a 4-dimensional approach to landscape reconstruction. Conference Paper, Jordan's Prehistory: past and future research, Department of Antiquities, Amman: May 25-28, 2009.
- 2009b Reconstructing lacustrine fluctuations and hominid/human occupations in the Azraq Druze Basin, Jordan: A geoarchaeological of glacials and interglacials. Conference paper, 2009 Annual Meeting of the Association of American Geographers, Las Vegas: March 22-27, 2009.
- Audouze, F.  
1999 New advances in French prehistory. *Antiquity* 73(279):167-175.
- Bar-Matthews, M., and A. Ayalon  
2001 Eastern Mediterranean Paleoclimate During the Last 250, 000 Years as Derived from the Petrography, Mineralogy, Trace Element and Isotopic Composition of Cave Deposits (speleothems), Israel: The Ministry of National Infrastructures Geological Survey of Israel.
- Bar-Matthews, M., et al.  
2003 Sea-land oxygen isotopic relationships from planktonic foraminifera and speleothems in the Eastern Mediterranean region and their implication for paleorainfall during interglacial intervals. *Geochimica et Cosmochimica Acta* 67(17):3181-3199.

- Bar-Matthews, M., A. Ayalon, and A. Kaufman  
2000 Timing and hydrological conditions of Sapropel events in the Eastern Mediterranean, as evident from speleothems, Soreq cave, Israel. *Chemical Geology* 169(1-2):145-156.
- Bar-Matthews, M., et al.  
1999 The Eastern Mediterranean paleoclimate as a reflection of regional events: Soreq cave, Israel. *Earth and Planetary Science Letters* 166(1-2):85-95.
- Bar-Yosef, O.  
1998 Chronology of the Middle Paleolithic of the Levant. *In Neanderthals and Modern Humans in Western Asia*. T. Akazawa, K. Aoki, and O. Bar-Yosef, eds. Pp. 39-56. New York: Plenum Press.
- Bar-Yosef, O., and B. Vandermeersch  
1993 Modern humans in the Levant. *Scientific American* 268(4):94-100.
- Bender, F.  
1974 *Geology of Jordan*. Berlin: Borntraeger.
- Besançon, J., et al.  
1984 The Lower and Middle Paleolithic in the Upper Zarqa/Khirbet Samra Area of Northern Jordan: 1982-83 Survey Results. *Annual of the Department of Antiquities of Jordan* 28:91-142.
- Betts, A.  
1988 The Black Desert Survey Prehistoric sites and subsistence strategies in eastern Jordan. *In The Prehistory of Jordan: The State of Research in 1986*. A.N. Garrard and H.C. Gebel, eds. Pp. 369-373. Oxford: British Archaeological Reports.
- Binford, L. R.  
1978 *Nunamiut ethnoarchaeology*. New York: Academic Press.
- 1980 Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 45(1):4-20.
- 1981 *Bones : ancient men and modern myths*. New York: Academic Press.

- 
- 1983 Working at archaeology. New York: Academic Press.
- 
- 2001 Constructing frames of reference : an analytical method for archaeological theory building using hunter-gatherer and environmental data sets. Berkeley: University of California Press.
- Binford, S. R., L. R. Binford, and American Anthropological Association.  
1968 New perspectives in archeology. Chicago: Aldine Pub. Co.
- Bisson, M., et al.  
2006 Human evolution at the crossroads: an archaeological survey in northwest Jordan. Near Eastern Archaeology 69(2):73-84.
- Bisson, M. S., et al.  
2009 The Middle Paleolithic of the Wadi Enqiqiyya Revisited. Conference paper; Jordan's Prehistory: Past and Future Research. Department of Antiquities, Amman: May 26, 2009.
- Bleed, P.  
1986 The Optimal Design of Hunting Weapons: Maintainability or Reliability. American Antiquity 51(4):737-747.
- Blondel, J., and J. Aronson  
1999 Biology and wildlife of the Mediterranean region. Oxford ; New York: Oxford University Press.
- Bocherens, H., and D. G. Drucker  
2006 Dietary Competition between Neanderthals and Modern Humans: Insights from Stable Isotopes. *In* When Neanderthals and Modern Humans Met. N. Conard, ed. Pp. 129-144. Tübingen: Kerns Verlag.
- Boëda, E.  
1995 Levallois: A Volumetric Construction, Methods, A Technique. *In* The Definition and Interpretation of Levallois Technology. H.L. Dibble and O. Bar-Yosef, eds. Pp. 41-68. Monographs in world archaeology, no. 23. Madison, Wis.: Prehistory Press.
- Bordes, F.  
1967 Typologie du paléolithique ancien et moyen: Imprimeries Delmas.

Bottema, S., and W. van Zeist

1981 Palynological Evidence from the Climatic History of the Near East, 50 000-6000 BP. *Préhistoire du Levant: chronologie et organisation de l'espace depuis les origines jusqu'au vie millénaire*, Paris, 1981. Éditions du C. N. R. S.

Bull, P. A., and P. Goldberg

1985 Scanning electron microscope analysis of sediments from Tabun Cave, Mount Carmel, Israel. *Journal of Archaeological Science* 12(3):177-185.

Clark, G.

1992 Wadi al-Hasa Palaeolithic Settlement Patterns: Negeb and South Jordan Models Compared. *In* *Studies in the History and Archaeology of Jordan IV*. Pp. 89-95. Amman: Department of Antiquities.

Clark, G., et al.

1987a A Diachronic Study of Paleolithic and Aceramic Neolithic Settlement Patterns in the Wadi Hasa, West-Central Jordan. *In* *Studies in the history and archaeology of Jordan III*. A. Hadidi, ed. Pp. 215-223, Vol. 3. Amman: Department of Antiquities of Jordan.

---

1987b Paleolithic Archaeology in the Southern Levant: A Preliminary Report of Excavations at Middle, Upper and Epipaleolithic sites in Wadi el-Hasa, West-Central Jordan. *Annual of the Department of Antiquities of Jordan* 31:19-78.

---

1988 Excavations at Middle, Upper and Epipaleolithic Sites in the Wadi Hasa, West-Central Jordan. *In* *The Prehistory of Jordan. The State of Research in 1986*. A.N. Garrard and H.C. Gebel, eds. Pp. 209-285. Oxford: British Archaeological Reports.

---

1992 Wadi Hasa Paleolithic Project-1992: Preliminary Report. *Annual of the Department of Antiquities of Jordan* 36:13-23.

---

1993 Survey & Excavation in the Wadi al-Hasa: a Preliminary Report of the 1993 Season. *Annual of the Department of Antiquities of Jordan* 37.

---

1997 Chronostratigraphic Contexts of Middle Paleolithic Horizons at the 'Ain Difla Rockshelter (WHS 634), West-Central Jordan. *In* *The Prehistory of Jordan II*:



Perspectives from 1997. H. Gebel, Z. Kafafi, and G. Rollefson, eds. Pp. 77-100. Studies in Early Near Eastern Production, Subsistence, & Environment. Berlin: Ex Orient.

Copeland, L.

1995 Are Levallois flakes in the Acheulean the results of Biface Preparation? *In* The Definition and Interpretation of Levallois Technology. H.L. Dibble and O. Bar-Yosef, eds. Pp. 171 - 184. Monographs in world archaeology, no. 23. Madison, Wis.: Prehistory Press.

Copeland, L., and F. Hours

1988 The Paleolithic in North Central Jordan: An Overview of Survey Results from the Upper Zarqa and Azraq 1982-1986. *In* The Prehistory of Jordan. The State of Research in 1986. A.N. Garrard and H.C. Gebel, eds. Pp. 287-337. Oxford: British Archaeological Reports.

—, eds.

1989 The Hammer on the Rock: Studies in the Early Palaeolithic of Azraq, Jordan. Volume 540. Oxford: B.A.R.

Cordova, C. E., et al.

2007 Geomorphological assessment of Middle Paleolithic sites on the Madaba Plateau. *Annual of the Department of Antiquities of Jordan* 51:329-337.

Ellis, C.

1997 Factors influencing the use of stone projectile tips. *In* Projectile technology. H. Knecht, ed. Pp. 37-74. New York: Plenum Press.

Farrand, W. R.

1979 Chronology and palaeoenvironment of levantine prehistoric sites as seen from sediment studies. *Journal of Archaeological Science* 6(4):369-392.

Garrod, D. A., and D. M. A. Bate

1937 The Stone Age of Mount Carmel. Oxford: Clarendon Press.

Gilead, I.

1995 Problems and Prospects in the Study of Levallois Technology in the Levant. The Case of Fara II, Israel. *In* The Definition and Interpretation of Levallois Technology. H.L. Dibble and O. Bar-Yosef, eds. Pp. 79 - 92. Monographs in world archaeology, no. 23. Madison, Wis.: Prehistory Press.

- Goldberg, P.  
1986 Late quaternary environmental history of the southern Levant. *Geoarchaeology* 1(3):225-244.
- Goren-Inbar, N., and A. Belfer-Cohen  
1998 The Technological Abilities of the Levantine Mousterians: Cultural and Mental Capacities. *In Neanderthals and Modern Humans in Western Asia*. T. Akazawa, K. Aoki, and O. Bar-Yosef, eds. Pp. 205-221. New York: Plenum Press.
- Grün, R., and C. Stringer  
2000 Tabun revisited: revised ESR chronology and new ESR and U-series analyses of dental material from Tabun C1. *Journal of Human Evolution* 39(6):601-612.
- Henry, D. O.  
1995 The Influence of Mobility Levels on Levallois Point Production, Late Levantine Mousterian, Southern Jordan. *In The Definition and Interpretation of Levallois Technology*. H.L. Dibble and O. Bar-Yosef, eds. Pp. 185 - 200. Monographs in world archaeology, no. 23. Madison, Wis.: Prehistory Press.
- 1998a Intrasite Spatial Patterns and Behavioral Modernity: Indications from the Late Levantine Mousterian Rockshelter of Tor Faraj, Southern Jordan. *In Neandertals and Modern Humans in Western Asia*. T. Akazawa, K. Aoki, and O. Bar-Yosef, eds. Pp. 127–142. New York: Plenum Press.
- 1998b The Middle Paleolithic of Jordan. *In The Prehistoric Archaeology of Jordan*. D.O. Henry, ed. Pp. 23–38. Oxford: B.A.R.
- 2003 *Neanderthals in the Levant : behavioral organization and the beginnings of human modernity*. London ; New York: Continuum.
- Holmberg, D.  
1994 Arrow Heads and Spear Points: an experimental study of projectile points. MA thesis, Simon Fraser University.
- Horowitz, A.  
1976 Late Quaternary Paleoenvironments of Prehistoric Settlements in the Avdat/Aqev Area. *In Prehistory and paleoenvironments in the central Negev, Israel*, Vol. I. A.E.

Marks, ed. Pp. 57-68. Reports of investigations - Institute for the Study of Earth and Man. Dallas: SMU Press.

Hovers, E.

1998 The Lithic Assemblages of Amud Cave: Implications for Understanding the End of the Mousterian in the Levant. *In* Neanderthals and Modern Humans in Western Asia. T. Akazawa, K. Aoki, and O. Bar-Yosef, eds. Pp. 143-163. New York: Plenum Press.

—

2001 Territorial Behavior in the Middle Paleolithic of the Southern Levant. *In* Settlement Dynamics of the Middle Paleolithic and Middle Stone Age. N.J. Conard, ed. Pp. 123-152. Tübingen: Kerns Verlag.

—

2006 Neandertals and Modern Humans in the Middle Paleolithic of the Levant: What kind of interaction? *In* When Neandertals and Modern Humans Met. N. Conard, ed. Pp. 65-85. Tübingen: Kerns Verlag.

Howell, F. C.

1998 Evolutionary Implications of Altered Perspectives on Hominine Demes and Populations in the Later Pleistocene of Western Eurasia. *In* Neandertals and Modern Humans in Western Asia. T. Akazawa, K. Aoki, and O. Bar-Yosef, eds. Pp. 5-28. New York: Plenum Press.

Hublin, J.-J., L. Barham, and K. Robson-Brown

2001 Northwestern African Middle Pleistocene hominids and their bearing on the emergence of *Homo Sapiens* *In* Human Roots: African and Asia in the Middle Pleistocene. Pp. 99-121. Bristol: Western Academic & Specialist Press.

Kaufman, D.

1999 Archaeological perspectives on the origins of modern humans : a view from the Levant. Westport, Conn.: Bergin & Garvey.

Klein, R. G.

1992 The archaeology of modern human origins. *Evolutionary Anthropology* 1(1):5-14.

—

1995 Anatomy, behavior, and modern human origins. *Journal of World Prehistory* 9(2):167-198.

Kuhn, S. L.

1995 Mousterian lithic technology : an ecological perspective. Princeton, N.J.: Princeton University Press.

Le Tensorer, J.-M., R. Jagher, and S. Muhesen

2001 Paleolithic Settlement Dynamics in the El Kowm Area (Central Syria). *In* Settlement Dynamics of the Middle Paleolithic and Middle Stone Age. N.J. Conard, ed. Pp. 101-122. Tübingen: Kerns Verlag.

Leroi-Gourhan, A.

1964 Le geste et la parole. 2 vols. Paris: Albin Michel.

—

1968 La Préhistoire. Paris: Presses universitaires de France.

Lieberman, D. E.

1998 Neandertal and Early Modern Human Mobility Patterns: Comparing Archaeological and Anatomical Evidence. *In* Neanderthals and Modern Humans in Western Asia. T. Akazawa, K. Aoki, and O. Bar-Yosef, eds. Pp. 263-276. New York: Plenum Press.

Macumber, P. G.

1992 The geological setting of palaeolithic sites at Tabaqat Fahl, Jordan. *Paleorient* 18:31-43.

—

2001 Evolving landscape and environment in Jordan. *In* The Archaeology of Jordan. B. MacDonald, R. Adams, and P. Bienkowski, eds. Pp. 1–30. Levantine archaeology ; 1. Sheffield: Sheffield Academic Press.

Marks, A. E., ed.

1976 Prehistory and paleoenvironments in the central Negev, Israel, Vol. I. Dallas: SMU Press.

—, ed.

1977 Prehistory and paleoenvironments in the central Negev, Israel, Vol. II. Dallas: SMU Press.

Martinez-Navarro, B.

- 2004 Hippos, pigs, bovids, sabertoothed tigers, monkeys and hominids: dispersals during Late Pliocene and Early Pleistocene times through the Levantine Corridor. *In* Human paleoecology in the Levantine Corridor. N. Goren-Inbar and J.D. Speth, eds. Pp. 37-51. Oxford: Oxbow Books.
- McNicoll, A., et al.  
1984 Preliminary Report on the University of Sydney's Fifth Season of Excavation at Pella in Jordan. *Annual of the Department of Antiquities* 28:55-86.
- Meignen, L.  
1995 Levallois Lithic Production Systems in the Middle Paleolithic of the Near East: The Case of the Unidirectional Method. *In* The Definition and Interpretation of Levallois Technology. H.L. Dibble and O. Bar-Yosef, eds. Pp. 361 - 380. Monographs in world archaeology, no. 23. Madison, Wis.: Prehistory Press.
- 1998 Hayonim Cave Lithic Assemblages in the Context of the Near Eastern Middle Paleolithic: A Preliminary Report. *In* Neanderthals and Modern Humans in Western Asia. T. Akazawa, K. Aoki, and O. Bar-Yosef, eds. Pp. 165-180. New York: Plenum Press.
- Meignen, L., et al.  
2006 Middle Paleolithic Settlement Patterns in the Levant. *In* Transitions Before the Transition: Evolution and Stability in the Middle Paleolithic and Middle Stone Age. E. Hovers and S. Kuhn, eds. Pp. 149-170. New York: Springer.
- Mercier, N., and H. Valladas  
2003 Reassessment of TL age estimates of burnt flints from the Paleolithic site of Tabun Cave, Israel. *Journal of Human Evolution* 45(5):401-409.
- Olszewski, D. I.  
2001 The Palaeolithic Period, Including the Epipalaeolithic. *In* The Archaeology of Jordan. B. MacDonald, R. Adams, and P. Bienkowski, eds. Pp. 31-65. Levantine archaeology 1. Sheffield: Sheffield Academic Press.
- Paabo, S.  
2003 The mosaic that is our genome. *Nature* 421(6921):409-412.
- Pearson, O. M.  
2004 Has the combination of genetic and fossil evidence solved the riddle of modern human origins?

Por, D. F.

2004 The Levantine Waterway, Riparian Archaeology, Paleolimnology, and Conservation. *In* Human paleoecology in the Levantine Corridor. N. Goren-Inbar and J.D. Speth, eds. Pp. 5-20. Oxford: Oxbow Books.

Potter, J. M.

1993 Middle Paleolithic Assemblage and Settlement Variability in West-central Jordan. Tempe: Dept. of Anthropology, Arizona State University.

—

1995 Lithic Technology and Settlement Pattern Variability within the Levantine Mousterian: A Comparison of Sites WHS 621 and WHS 634 from Wadi al-Hasa. *Studies in the History and Archaeology of Jordan V: Art and Technology throughout the Ages:497–504.*

Rolland, N.

1995 Levallois Technique Emergence: Single or Multiple? A Review of the Euro-African Record. *In* The Definition and Interpretation of Levallois Technology. H.L. Dibble and O. Bar-Yosef, eds. Pp. 333 - 360. Monographs in world archaeology, no. 23. Madison, Wis.: Prehistory Press.

Rollefson, G., L. Quintero, and P. Wilke

2005 The Acheulian industry in the al-Jafr Basin of southeastern Jordan. *Journal of the Israel Prehistoric Society* 35:53-68.

—

2007 Late Acheulian Variability in the Southern Levant: A Contrast of the Western and Eastern Margins of the Levantine Corridor. *Near Eastern Archaeology* 69(2):61.

Ronen, A.

1995 The Levallois Method as a Cultural Constraint. *In* The Definition and Interpretation of Levallois Technology. H.L. Dibble and O. Bar-Yosef, eds. Pp. 293 - 304. Monographs in world archaeology, no. 23. Madison, Wis.: Prehistory Press.

Schwarcz, H. P., and W. J. Rink

1998 Progress in ESR and U-Series Chronology of the Levantine Paleolithic. *In* Neanderthals and Modern Humans in Western Asia. T. Akazawa, K. Aoki, and O. Bar-Yosef, eds. Pp. 57-68. New York: Plenum Press.

Shea, J. J.

1998a Ar-Rasfa, a stratified Middle Paleolithic open-air site in Northwest Jordan: A preliminary report on the 1997 excavations. *Annual of the Department of Antiquities of Jordan* 42:41–52.

---

1998b Neandertal and early modern human behavioral variability - A regional-scale approach to lithic evidence for hunting in the Levantine Mousterian. *Current Anthropology* 39:S45-S78.

---

2001 The Middle Paleolithic: Early Modern Humans and Neandertals in the Levant. *Near Eastern Archaeology* 64(1/2):38-64.

---

2003a The Middle Paleolithic of the East Mediterranean Levant. *Journal of World Prehistory* V17(4):313-394.

---

2003b Neandertals, competition, and the origin of modern human behavior in the Levant. *Evolutionary Anthropology* 12:173-187.

---

2006 The Middle Paleolithic of the Levant: Recursion and Convergence. *In* *Transitions Before the Transition: Evolution and Stability in the Middle Paleolithic and Middle Stone Age*. E. Hovers and S.L. Kuhn, eds. Pp. 189 - 211. New York: Springer.

Shea, J. J., and P. Crawford

2003 Middle Paleolithic Northwestern Jordan, 1999 Season: Investigations in Wadi al-Yabis and Wadi Kufrinja. *Annual of the Department of Antiquities of Jordan* 47:431-441.

Speth, J.

2006 Housekeeping, Neandertal-Style: Hearth Placement and Midden Formation in Kebara Cave (Israel). *In* *Transitions Before the Transition: Evolution and Stability in the Middle Paleolithic and Middle Stone Age*. E. Hovers and S.L. Kuhn, eds. Pp. 171 - 188. New York: Springer.

Stiner, M. C.

2006 Middle Paleolithic Subsistence Ecology in the Mediterranean Region. *In* *Transitions Before the Transition: Evolution and Stability in the Middle Paleolithic and Middle Stone Age*. E. Hovers and S.L. Kuhn, eds. Pp. 213 - 232. New York: Springer.

Stiner, M. C., and O. Bar-Yosef

2005 The faunas of Hayonim Cave (Israel) : a 200,000-year record of Paleolithic diet, demography, and society. Cambridge, Mass.: Peabody Museum of Archaeology and Ethnology, Harvard University.

Stiner, M. C., and E. Tchernov

1998 Pleistocene Species Trends at Hayonim Cave: Changes in Climate versus Human Behavior. *In* Neanderthals and Modern Humans in Western Asia. T. Akazawa, K. Aoki, and O. Bar-Yosef, eds. Pp. 241-262. New York: Plenum Press.

Stringer, C., and C. Gamble

1993 In search of the Neanderthals : solving the puzzle of human origins. London: Thames and Hudson.

Tchernov, E.

1976 Some Late Quaternary Faunal Remains from the Avdat/Aqev Area. *In* Prehistory and paleoenvironments in the central Negev, Israel, Vol. I. A.E. Marks, ed. Pp. 69-73. Reports of investigations - Institute for the Study of Earth and Man ; 1. Dallas: SMU Press.

---

1992 Biochronology, Paleoecology, and Dispersal Events of Hominids in the Southern Levant. *In* The Evolution and dispersal of modern humans in Asia. T. Akazawa, K.-i. Aoki, and T. Kimura, eds. Pp. 149-188. Tokyo: Hokusensha.

---

1998 The Faunal Sequence of the Southwest Asian Middle Paleolithic in Relation to Hominid Dispersal Events. *In* Neandertals and Modern Humans in Western Asia. T. Akazawa, K. Aoki, and O. Bar-Yosef, eds. Pp. 77-90. New York: Plenum Press.

Trigger, B. G.

2006 A history of archaeological thought. Cambridge [England] ; New York: Cambridge University Press.

Vaks, A., et al.

2007 Desert speleothems reveal climatic window for African exodus of early modern humans. *Geological Society of America* 35(9):831-834.

Valladas, H., et al.



1998 GIF Laboratory Dates for Middle Paleolithic Levant. *In* Neanderthals and Modern Humans in Western Asia. T. Akazawa, K. Aoki, and O. Bar-Yosef, eds. Pp. 69–75. New York: Plenum Press.

Van Peer, P.

1995 Current Issues in the Levallois Problem. *In* The Definition and Interpretation of Levallois Technology. H.L. Dibble and O. Bar-Yosef, eds. Pp. 1-10. Monographs in world archaeology, no. 23. Madison, Wis.: Prehistory Press.

—

2001 The Nubian Complex Settlement System in Northeast Africa. *In* Settlement Dynamics of the Middle Paleolithic and Middle Stone Age. N.J. Conard, ed. Pp. 45-64. Tübingen: Kerns Verlag.

Wallace, I. J., and J. J. Shea

2006 Mobility patterns and core technologies in the Middle Paleolithic of the Levant. *Journal of Archaeological Science* 33(9):1293-1309.

Walmsley, A., et al.

1993 The Eleventh and Twelfth Seasons of Excavations at Pella (Tabaqat Fahl) 1989-1990. *Annual of the Department of Antiquities* 27.

Weinstein-Evron

1988 Middle Paleolithic sequence from the Hula Valley, Israel. *In* L'Homme de Neandertal. Pp. 207-222, Vol. 2. Liège: Service de Préhistoire Université de Liège.

Wengler, L.

2001 Settlements During the Middle Paleolithic of the Maghreb. *In* Settlement Dynamics of the Middle Paleolithic and Middle Stone Age. N.J. Conard, ed. Pp. 65-90. Tübingen: Kerns Verlag.

Wolpoff, M. H., P. Mellars, and C. Stringer

1989 The Human Revolution: Behavioural and Biological Perspectives on the Origins of Modern Humans. Edinburgh: Edinburgh University Press.