6. A Quest for Antecedents: 
A Comparison of the Terminal Middle Palaeolithic and Early Upper Palaeolithic of the Levant

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Introduction
The significance of the Upper Palaeolithic is one of the most intriguing questions for Palaeolithic researchers. Due to the Levant’s strategic location at a bottleneck between continents (sensu Sherratt 1996), a search for the geographic origins of the Levantine Upper Palaeolithic can play a more central role in determining the meaning and significance of the Upper Palaeolithic as a whole than in other regions (Fig. 6.1). Yet the importance of this research topic does not make it easier to address current methodological problems. Specifically, research on the origins of the Levantine Upper Palaeolithic has been hampered by methodological conflicts over how to characterize technological variability within and between assemblages. As the current approaches to characterizing intra-assemblage variability are unsuitable for determining degrees of difference and similarity between assemblages, not to mention identifying antecedents for Upper Palaeolithic flint knapping behaviour, these issues must be resolved before the importance of the Levant’s role can be appreciated. This paper advances an analytical structure whereby the characterization of intra-assemblage variability across the Middle to Upper Palaeolithic transition aids, rather than detracts from, evaluations of inter-assemblage variability. An example of the comparison of one of the last Middle Palaeolithic assemblages in the Levant, Kebara Cave Unit VI, and the earliest Transitional or Upper Palaeolithic assemblage, Boker Tachtit Level 1, is used to place these methodological considerations in perspective.

A Quest for Antecedents
In discussing the origins of material culture innovations, anthropologists and historians of science frequently use the presence of antecedents to identify the region of origin of an innovation. As Barnett states, ‘...any innovation is made up of pre-existing components...’ (1953:181). This principle is corroborated by social anthropology (Kluckhohn 1936; Kroeber 1940), history of science (Needham 1954; Basalla 1988:49, 55), and archaeological theory (Ford 1952:330; Deetz and Dethlefsen 1965; Dethlefsen and Deetz 1965; Willey et al. 1956:7; Renfrew 1978; Andrefsky 1987:19). Given the recognition by many disciplines that innovations take advantage of multiple, pre-existing elements in the construction of novel material culture, prehistorians are not alone in using the antecedent principle to source innovations in time and space. The antecedent principle has recently been applied to both Harrold’s (1989) and Hovers’ (1998) treatment of the Middle to Upper Palaeolithic transition in western Europe and the Levant, respectively. Despite its use in this context, however, the analysis of potential antecedents to the Upper Palaeolithic has been hampered by two serious problems.

First, there has been little connection between the analysis of the archaeological pattern of potential antecedents through time and space and a suitable body of anthropological theory that would explain the significance of the pattern. Tostevin (2000a, b) proposes one body of theory designed to distinguish archaeological examples of intra-regional innovation from inter-regional diffusion in an effort to fill this methodological gap. With this body of theory, it is possible to assess the goodness of fit between the archaeological record and model expectations, which predict how the record should appear given an in situ origin or an external origin for the Upper Palaeolithic.

The second problem, however, is potentially more difficult to resolve. There is as yet no consensus among lithic analysts on what constitutes an ‘antecedent’ or ‘pre-existing component’ for the lithic material culture of the Upper Palaeolithic. Is an antecedent in an assemblage the presence of one blade, many blades, a few Upper Palaeolithic retouch types, many Upper Palaeolithic retouch types, one prismatic core, or many prismatic cores? If all of these units are to be analysed as potential antecedents, how is each to be weighted in its importance to the question of the in situ origin of the Upper Palaeolithic in a particular region? These are fundamental questions, since an evaluation of whether or not a particular geographical region witnessed an in situ evolution of the...
Upper Palaeolithic requires a quantitative assessment of the number of antecedents present. For, as noted by Tylor (1896), Steward (1929), and Andrefsky (1987), the more antecedents present in a region, the greater the probability that the evolution occurred in situ in that region. Thus, in looking for antecedents to Upper Palaeolithic behaviour, we must structure our units of analysis to facilitate the final, quantitative evaluation of those units to answer our question. Unfortunately, little concern has so far been devoted to this necessity.

**Individual Precocious Artefacts as Antecedents**

Consider the potential role of individual artefacts as antecedents. One prismatic blade core found in the context of a Late Middle Palaeolithic assemblage may be considered ‘precocious’ in nature if the assemblage is composed almost exclusively of flakes. The prismatic blade core may thus be thought of as an ‘antecedent’ to the dominant use of blades in the subsequent Upper Palaeolithic. The same argument holds for the appearance of one blade in a similar context. In Vishnyatsky’s terminology, the blade or core would represent a ‘running ahead of time’ (1994:135). Despite the apparent logic of this type of argument, there are many reasons to avoid using anecdotal examples of single artefacts as antecedents.

First, individual precocious artefacts frequently appear in stratigraphic units of earlier periods for a plethora of reasons unrelated to the continuity of population-specific, learned traditions. Unfortunately, post-depositional alteration of artefact associations gives credence to the observation that the fewer the artefacts used to infer prehistoric behaviour, the more likely it is that the inference is based on intrusive pieces (see Courty et al. 1989; Goldberg et al. 1993; Karkansas et al. 2000). Thus, the very nature of deposits containing Palaeolithic artefacts makes it unwise to consider the presence of one or a few individual artefacts as evidence of behaviours representative of an entire assemblage.

Second, single or rare examples of an artefact type are more misleading than cumulative characterizations of variability. The principle of equifinality among many lithic operational sequences should render suspect the identification of a reduction strategy on the basis of a single precocious artefact. A single artefact, for instance, may represent ‘… the individual variability among flint knappers who were members of the same group; situations when expediency needs ruled over systematic core reduction; a short period (season?) of raw material shortage; training children as future artisans by using cores or thick flakes that adult knappers would consider to be unusable’ (Bar-Yosef 1998b:44). An over-emphasis on intra-assemblage variability based on a few artefacts which are unrepresentative of the rest of the assemblage risks...

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**Fig. 6.1 Map showing location of assemblages used in the present study.**
treat ing idsyncratic variation as antecedents, despite the lack of a relationship between the variation and the learned behaviours which constitute material culture traditions.

Third, even those individual artefacts that can be considered diagnostic of a particular operational sequence are problematic for use in an analysis of antecedents since such piece-by-piece representations often produce the same list of reduction strategies for many assemblages. For instance, in a survey of Levantine Mousterian intra-assemblage variability, Goren-Inbar and Belfer-Cohen (1998) point out that every assemblage contains some evidence of each of the Levallois reduction sequences known in the Levant. This intra-assemblage variability is present throughout the Levantine Mousterian despite the fact that each type of reduction sequence formed the dominant portion of the debitage during a different chronological period (Bar-Yosef 1998b; see Goren-Inbar and Belfer-Cohen 1998 for critiques of this scheme). The Tabun-type sequence demonstrates that if assemblage characterization is based on its constituent reduction strategies without considering how representative they are of the whole, one will always recognize the same list of reduction strategies despite major techno-chronological trends. If taken to an extreme, every lithic variable could be represented by an ‘antecedent’ in every period of prehistory.

While not entirely immune to the above problems, a quantified approach to characterizing intra-assemblage variability avoids, or at least lessens, problems with piece-by-piece characterizations of lithic assemblages. For instance, by using central tendency statistics to identify which knapping behaviours are representative of a lithic operational sequence, it is possible to recognize the anthropological significance of the presence of one blade core in a late Middle Palaeolithic context versus the presence of several or many blade cores. This is the scale at which analysts should search for antecedent lithic behaviours.

One final problem with the use of single, precocious artefacts as indicators of antecedents needs to be addressed. Even if post-depositional concerns and the equifinality of reduction strategies can be put aside, what does the fact that one prismatic blade core was made by a Late Middle Palaeolithic hominin tell the lithic analyst? Anthropologically, the fact means little, since the existence of that core does not signify that anyone but its knapper had the technical knowledge, i.e. the connaissance and savoir-faire, to produce that object. As Hovers (1998) points out in an excellent discussion of Renfrew’s innovation theory (1978), an invention becomes an innovation only when the majority of the group adopts it. A single new artefact form represents only an invention that failed as an innovation. The technical knowledge represented by that one artefact, perhaps because it was not compatible with the social milieu of the majority of the group’s population, died with the knapper. The implications of this point will be discussed later in this paper.

**Antecedents in Anthropological Theory**

Anthropological theory that distinguishes instances of independent innovation from inter-regional diffusion (Tostevin 2000a, b) relies upon the principle of ‘technological style’: material culture traditions can be described based on the variation in how artefacts are made (Kroeber 1940; Lechtman 1977; Hughes 1987; Pinch and Bijker 1987; Lemonnier 1986, 1992). Ethnoarchaeology and archaeology demonstrate co-variation of technological variability with population groups that share other learned traditions (Lechtman 1977; Hodder 1979; Longacre 1981; Braithwaite 1982; Wiessner 1990; Childs 1991; Aronson et al. 1994; Stark 1995). This makes the principle of technological style appropriate for identifying changes in the learned traditions of different populations through time. Thus, by quantitatively measuring the degree of similarity or dissimilarity between the technological styles of assemblages through time in one region, it is possible to characterize the continuity or discontinuity of the learned traditions in that region. This is the process by which antecedents are recognized between assemblages and counted to characterize inter-assemblage continuity. Parsimony, the concept that the simplest explanation is the most probable, can then be used to distinguish a diffusion event from an independent innovation event by testing the goodness of fit between the actual degree of continuity/discontinuity within a region through time and the expected continuity/discontinuity for each type of event.

When applying the technological style concept to the material culture of the Upper Palaeolithic, the lithic operational sequence becomes the characterization of the technological style for each assemblage. An inter-assemblage comparison of operational sequence variability then becomes the measure of similarity/dissimilarity between assemblages through time. The description of this inter-assemblage variability must therefore include comparable units between assemblages. The comparability of these units is difficult to achieve, however, given the research trajectories which separated characterization of ‘Middle Palaeolithic’ technological variability from that of ‘Upper Palaeolithic’ assemblages (see White 1982:169; Harrold 1978, 1989).

For example, during most of the twentieth century, the Upper Palaeolithic was defined against the Middle Palaeolithic based on a blade/flake dichotomy, allowing little evaluation of degrees of similarity between assemblages; an assemblage was either flake-based or blade-based. Unfortunately, the use of the *index laminaire* as a relative scale between flake and blade dominance has not resolved the problem, since the lack of an exclusive correlation between blades and the Upper Palaeolithic makes the dichotomy artificial (Conard 1990; Révillon and Tuffreau 1994; Vishnyatsky 1994; Meignen 1994). Thus blades *per se* cannot be considered as antecedents to the Upper Palaeolithic.

Fortunately, since not all blanks with lengths twice their widths are the same, the concept of ‘blade tech-
ology’ as an antecedent can be divided into appropriate units of analysis. A specific blade technology production sequence or chaîne opératoire may differ in many details from another that also produces blades (Tixier 1984; Pelegrin 1990a; Meignen 1998). Yet how are the two blade operational sequences to be characterized? Frequently, lithic technologists following the French school define each chaîne opératoire type by its ‘desired end products’ and ‘diagnostic’ debitage (Boëda et al. 1990). If an assemblage contains specific elements of a particular chaîne opératoire, that assemblage must fall within that type. If it lacks these elements, it falls within another, frequently its own unique chaîne. Yet no quantitative assessment is possible between types such as Levallois récurrent unipolaire and Levallois préférentiel centripète. Because analytical units defining each chaîne are unique, this characterization method produces a typology of technological types similarly unsuitable for evaluating degrees of similarity/dissimilarity as the blade/flake dichotomy.

A point must be made concerning the use of typologies. The above criticism of the chaîne opératoire approach does not constitute a total condemnation of this typological system. It must be recognized explicitly to be a typological system, however, just as is Bordes’ (1961a) tool typology. Both systems partition lithic variability into units or types for a particular function. As Adams and Adams (1991) note, every typological framework has particular functions and does not represent the end-all of possible analyses. A typology is just one way of dividing up variability for the purposes of a particular question. This point is frequently forgotten. Multiple typologies of lithic variability may, and perhaps should, be used concurrently to address multiple research topics (Andrefsky 2000). In searching for antecedents to the Upper Palaeolithic in the Middle Palaeolithic, the relevant anthropological theory requires an analytical system to structure description of intra-assemblage variability so as to facilitate comparison of inter-assemblage variability. The chaîne opératoire typological system is well suited to other research questions but, unfortunately, is not suitable for the task at hand.

What is needed to make the chaîne opératoire system more suitable to our needs is to define analytical units of categorical variables within each operational sequence that are comparable across assemblages. Assemblages must be recognized to consist of individual behavioural components that vary between (and within) assemblages through time and space. Yet definition and recognition of multiple components within an assemblage can be difficult. For instance, to what degree can a lithic analyst credit different reduction strategies as responsible for the debitage within a given assemblage? It is always possible to demonstrate that an assemblage contains debitage or cores of particular percentages with different dorsal scar patterns, say 60% unidirectional, 10% bi-directional, and 30% centripetal. But when can an analyst demonstrate that this pattern is a consequence of a dominant unidirectional strategy used on some cores and a subordinate centripetal strategy used on others? Unless different raw material types co-vary with technological attributes associated with different reduction strategies, a serious problem arises. How does one distinguish within an assemblage between two operational sequences which produce their own unique products (#1 producing products A, B, and C, while #2 produces D, E, and F) and one operational sequence which produces all of the products (#3 producing A, B, C, D, E, and F)? Refitting could resolve this problem, but the applicability of refitting is notoriously unevenly distributed in the archaeological record, making it a valued but inconsistent tool for comparisons of assemblages through time.

The striking disagreement between Boëda’s (1988a) lecture of the knapping technology of the French Middle Palaeolithic assemblage of Biache Saint-Vaast, Level IIA, and Dibble’s (1995a) technological attribute analysis of the same assemblage demonstrates the problem of the reliability of inferring multiple operational sequences within the same assemblage. Basing his conclusions upon an examination of the cores and debitage, Boëda inferred that three reduction systems were present: a unidirectional recurrent Levallois strategy (Schema A), a bi-directional recurrent Levallois strategy (Schema B), and a non-Levallois element. Boëda concluded that the two Levallois schemas were independently executed, i.e. each core was reduced unidirectionally or bi-directionally but never both. Dibble analysed the same debitage and demonstrated strong correlations between debitage length and the dorsal scar directions on the debitage. Longer debitage blanks are represented by a higher percentage of unidirectional dorsal scar patterns while shorter blanks are represented by a higher percentage of bi-directional, sub-radial, and radial scar patterns. A similar correlation was found between the amount of cortex on debitage blanks and dorsal scar pattern. As debitage blank length and percentage of cortex decrease as core reduction progresses, Dibble’s attribute analysis demonstrated significant evidence for a relationship between Boëda’s two schemas and the stage of reduction of the cores. In contrast to Boëda’s claims for the schemas’ independence, the most parsimonious explanation of Dibble’s analysis is that cores were reduced at the beginning of their use-lives by a unidirectional strategy (Schema A) but later on this was replaced by a bi-directional strategy (Schema B).

**Antecedents as Cumulative Behaviours Within the Operational Sequence**

The Boëda-Dibble example is nevertheless instructive. While the chaîne opératoire approach alone has methodological problems, a combination of the strength of attribute analysis with the practice of dividing the operational sequence into a series of behavioural steps has great promise. Frequently, attribute analysis character-
izes the sum of an assemblage’s technology rather than identifying the step-by-step knapping behaviours (Movius et al. 1968; Newcomer 1971; Collins 1975; Kozlowski and Gitter 1982; Sullivan and Rosen 1987; Johnson and Morrow 1987; Ahler 1989; Henry 1989b; Henry and Odell 1989). The American and French systems can productively be combined, since the theoretical basis behind the French technological school (Mauss 1936; Leroi-Gourhan 1943, 1945, 1964; Haudricourt 1987; Lemmonier 1986, 1989, 1992, 1993) agrees with the American ‘technological style’ approach to material culture variability. Both theoretical perspectives agree that different material culture traditions exploit different options within the manufacturing process for any given object. These options comprise the manufacturing behaviours observed, learned, taught, and disseminated among the group members. It is recognition of the anthropological significance of this step-by-step variability, combined with the use of attribute analysis to identify the variant used within each step, which provides the best analytical structure to search for antecedents to the Upper Palaeolithic.

The chaîne opératoire school frequently divides knapping into the following behavioural categories: raw material procurement, creation of striking platform(s), optional decortication, initial blank production, re-preparation of platform and debitage surfaces, late blank production, blank selection for tools, application of retouch, resharpening of tools, and discard of exhausted pieces. These categories can further be refined through experimental archaeology. Controlled experiments on flake fracture mechanics have demonstrated that a knapper controls a number of independent operational steps during the process of making stone tools (Speth 1972, 1974, 1975, 1981; Bonnichsen 1977; Cotterell et al. 1985; Dibble and Whittaker 1981; Cotterell et al. 1985; Dibble and Pelcin 1995; Pelcin 1996). Specifically, knapping steps related to platform treatment, dorsal ridge morphology, and subsequent placement of retouch are all functionally independent and together determine the morphology of each flake and tool (Pelcin 1996). The independence on a flake-by-flake basis of knapping behaviours enables division of the operational sequence into roughly independent behavioural domains:

1. core modification
2. platform maintenance
3. direction of core exploitation
4. dorsal surface convexity system
5. tool manufacture

Within each domain, several behavioural steps are present, each with its own set of equivalent options (sensu Sackett 1990:33). By compiling the analytical comparisons, tests, and attribute analyses according to the knapping behaviours for each step within the five independent knapping domains, a system is created to enable rigorous identification of specific knapping behaviours within each domain used to create a particular assemblage (Baumler 1988; Bergman 1987; Bordes 1961a; Crew 1975; Dibble 1995a; Dibble and Whittaker 1981; Géneste 1985; Henry 1989b; Hours 1974; Kuhn 1990, 1995; Meignen 1994, pers. comm.; Movius et al. 1968; Ohnuma 1986; Pelcin 1996; Speth 1981; Van Peer 1992, 1998; Volkman 1989). Most analyses are univariate tests and comparisons of pairs of flake and core attributes, using the principles of dimensional change during reduction (Holmes 1919; Frison 1968; Newcomer 1971; Collins 1975; Jelinek 1976; Stauble and Dunn 1982; Henry 1989b; Dibble 1987) and cortical change during reduction (Sullivan and Rosen 1985; Géneste 1985; Mauldin and Amick 1989; Baumler 1988; Ahler 1989; Dibble 1995a).

Table 6.1 summarizes the behavioural steps within the five knapping domains (and see Tostevin 2000b). The knapping steps within each domain are outlined as well as the specific analytical description to identify which option was used for each step. As noted earlier, the variability within each step requires quantitative characterization since almost every knapping option is used, if only to a small extent, in any given assemblage. Thus, these descriptions characterize the cumulative behaviours used by the knappers for each step of the process. The continuous variables frequently measure the central tendency of the variability within the particular knapping step. For discontinuous or categorical variables, the use of each option is quantified in order to gauge how representative it of the behaviours used within that step as a whole. Consequently, the analytical units in this methodology are quantifiable, replicable, and representative of the behaviours used to create an assemblage. As such, this methodology is structured to characterize intra-assemblage variability so as to evaluate regional inter-assemblage variability.

Comparison of the Terminal Middle Palaeolithic and Early Upper Palaeolithic of the Levant

The Temporal Framework

To begin a quest for antecedents to the Upper Palaeolithic within the Middle Palaeolithic of the Levant, it is necessary first to address the temporal framework in which to look for antecedents. The antecedent principle states that the probability that a new material culture was developed in situ in a region is directly proportional to the number of antecedents already present in that region and inversely proportional to the number of innovations that are needed to make the new material culture out of the old. Great importance is thus placed on the number of acts of innovation in evaluating the probability of an in situ development. As with Renfrew’s (1978) distinction between invention of an artefact and its adoption as an innovation, one must examine the continuity of the use of each innovation in order to evaluate the number of innovations within a block of time.
An archaeological example will help illustrate the importance of continuity for antecedents. In recognizing the volumetric conception of blade technology in the early Middle Palaeolithic industry of Hayonim Cave, Meignen (1998:178) argues that, ‘In sum, from the Middle Palaeolithic, when the laminar debitage was already known, through the Upper Palaeolithic, during which time this lithic production is overwhelmingly practiced, we can observe a change in the general trend rather than a real technical innovation.’ Meignen is implicitly citing the early Middle Palaeolithic blade examples as antecedents for blade industries in the Upper Palaeolithic to argue that blade technology was not innovated at the beginning of the Upper Palaeolithic but at the beginning of the Middle Palaeolithic. However, because neither the hominids of the middle nor late Middle Palaeolithic in the Levant continued the practice of making these same blade technologies, it is impossible to claim that the hominids of the early Upper Palaeolithic in the Levant would have had knowledge of the specifics of that earlier innovation, 200,000 years before. Oral tradition alone cannot have stored and preserved this technical knowledge. While powerful in the preservation of poetry such as the Iliad over several thousand years, oral traditions require constant application and performance of the stored knowledge to preserve the information for any length of time. In addition to the absence of blade technologies in the middle period of the Middle Palaeolithic, the application and performance of the early Middle Palaeolithic blade technologies is not continued in even those few late

<table>
<thead>
<tr>
<th>Behavioural Domain</th>
<th>Knapping Step</th>
<th>Analytical Description</th>
</tr>
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<tbody>
<tr>
<td>Core Modification</td>
<td>Core Orientation: Orientation of the raw material as a core: longitudinal vs. broad.</td>
<td>Core refits &amp; extant core morphologies.</td>
</tr>
<tr>
<td></td>
<td>Core Management: Strategic removals to rejuvenate surface convexities.</td>
<td>Core refits, extant core morphologies, débordant &amp; crested debitage.</td>
</tr>
<tr>
<td>Platform Maintenance</td>
<td>Platform Treatment: Reparation of platform surfaces: core tablet, faceting, etc.</td>
<td>Platform type for tools and debitage.</td>
</tr>
<tr>
<td></td>
<td>External Platform Angle: Tendency to use particular angles between debitage &amp; platform surfaces.</td>
<td>Continuous variable.</td>
</tr>
<tr>
<td></td>
<td>Platform Thickness: Tendency to place the point of percussion at a particular depth relative to platform edge.</td>
<td>Continuous variable.</td>
</tr>
<tr>
<td>Direction of Core Exploitation</td>
<td>Direction of Cortex Removal: Directionality of removal of cortical debitage, in both early and late reduction.</td>
<td>Correlation of percentage cortex with dorsal scar patterns on debitage &amp; tools.</td>
</tr>
<tr>
<td></td>
<td>Direction of Blank Removal: Directionality of removal of non-cortical debitage, in both early and late reduction.</td>
<td>Correlations of blank length with dorsal scar patterns on debitage &amp; tools.</td>
</tr>
<tr>
<td>Dorsal Surface Convexity System</td>
<td>Longitudinal Convexity: Tendency to use longitudinal ridge systems (for blade products) vs. dispersed ridge systems (for flake products)</td>
<td>Length/Width ratio for tools and debitage.</td>
</tr>
<tr>
<td></td>
<td>Shape of Convexity: Tendency to strike along parallel, convergent, expanding, or diffuse ridge systems.</td>
<td>Lateral edge type for tools and debitage.</td>
</tr>
<tr>
<td></td>
<td>Curvature of Convexity: Tendency to utilize flat, curved, or twisted longitudinal core surfaces.</td>
<td>Profile type for tools and debitage.</td>
</tr>
<tr>
<td></td>
<td>Lateral Convexity: Tendency to utilize one vs. two or more ridges as nervures guides.</td>
<td>Cross-section type of tools and debitage.</td>
</tr>
<tr>
<td></td>
<td>Vertical Convexity: Tendency to utilize greater or lesser vertical convexities per removal, quantifying the volumetric conception (sensu Boëda 1994) within an assemblage.</td>
<td>Width/Thickness ratio for tools and debitage.</td>
</tr>
<tr>
<td>Tool Manufacture</td>
<td>Selection of Blank attributes for Tools: Fourteen different blank attributes may be used as criteria for selecting pieces to be retouched as tools.</td>
<td>Statistical test (G² likelihood ratio) of deviation between tool and debitage sample for 14 given attributes.</td>
</tr>
<tr>
<td></td>
<td>Unique Retouch Types: Tendency to use idiosyncratic types of retouch: carinate, bifacial, etc.</td>
<td>Presence/absence of specific retouch types.</td>
</tr>
<tr>
<td></td>
<td>Tool Types: Tendency to place retouch on distal margins (UP) or lateral margins (MP) of blanks.</td>
<td>Tool kit dominated by MP or UP tool types, using a combination of Bordes’ (1961a) and Hours’ (1974) typologies.</td>
</tr>
</tbody>
</table>

Table 6.1 Analytical Description of the Knapping Process.
Middle Palaeolithic assemblages which have a relatively high laminar index, for instance Tor Faraj (Henry et al. 1996) and Amud B1 (Hovers 1998), as these blade technologies are not the same in their production details as those of Hayonim lower level E. Thus, unless the continuous practice of a specific blade production can be traced chronologically between the blade industries of the early Middle Palaeolithic and those of the early Upper Palaeolithic in the Levant, examples such as lower level E of Hayonim Cave (Meignen 1998) or Rosh Ein Mor (Marks 1992) will have little significance as behavioural antecedents to the Upper Palaeolithic.

The importance of the continuity of learned behaviours to the antecedent principle thus requires that antecedents to a specific assemblage must be sought in its immediate predecessor on the landscape. Just as it is inappropriate to look for antecedents for the early Upper Palaeolithic in the early Middle Palaeolithic without considering what happened in between, it is similarly inappropriate to look for antecedents for a 47,000 bp assemblage in a 70,000 bp assemblage, when a 48,000 bp assemblage exists for comparison. Whatever behaviours are evident in the 70,000 bp assemblages but which are not present in the 48,000 bp assemblages are thus not available as behavioural antecedents in the learned tradition of the hominids who created the 47,000 bp assemblages.

The consequences of this hard rule for chronological comparisons of learned behaviour are many. First, as new sites are excavated or re-dated, the most appropriate choice of assemblages for a pair-wise comparison between sites are excavated or re-dated, the most appropriate comparisons of learned behaviour are many. First, as new hominids who created the 47,000 bp assemblages. The importance of the continuity of learned behaviours to the antecedent principle thus requires that antecedents to a specific assemblage must be sought in its immediate predecessor on the landscape. Just as it is inappropriate to look for antecedents for the early Upper Palaeolithic in the early Middle Palaeolithic without considering what happened in between, it is similarly inappropriate to look for antecedents for a 47,000 bp assemblage in a 70,000 bp assemblage, when a 48,000 bp assemblage exists for comparison. Whatever behaviours are evident in the 70,000 bp assemblages but which are not present in the 48,000 bp assemblages are thus not available as behavioural antecedents in the learned tradition of the hominids who created the 47,000 bp assemblages.

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This second consequence of the chronological concept has disadvantages and advantages. Of the disadvantages, the most significant is the lumping of assemblages found in different environmental landscapes into one regional pool, from which only one assemblage (and thus only one environment) may be chosen to represent either the last terminal Middle Palaeolithic or the first early Upper Palaeolithic assemblage. This effect tends to confound material culture differences which might be due to differences between the Levantine environments of the Mediterranean zone, the Irano-Turanian steppe, the Saharo-Arabian Desert, etc. (Henry 1995a:130–132). As more assemblages are studied with the approach advocated here, it will be possible to eliminate this problem by running pair-wise comparisons for each sub-region and comparing the results. Such a research project would be worthwhile; in the meantime, however, the best choice for a single pair-wise comparison remains the closest dated assemblages on either side of the Middle to Upper Palaeolithic transition within a broad geographic locality.

Of the advantages, the most important is the fact that the chronological rule avoids the reification of the analytical categories of ‘Middle Palaeolithic’, ‘transitional’, and ‘Upper Palaeolithic’, by preventing the comparison of ensembles of assemblages combined to represent an analytical unit, such as the Middle or Upper Palaeolithic as a whole. Such characterizations of the transition do not elucidate how or why the transition occurred, just that one did. With the chronological comparison of temporally adjacent assemblages, however, one can study the changes in flint knapping behaviours at each temporal junction between dated assemblages. Multiple transitions may become apparent at this resolution.

**Sampling Considerations**

For the comparison of the terminal Middle Palaeolithic and early Upper Palaeolithic of the Levant, there are three requirements for selecting appropriate assemblages for study, in addition to the requirement that these assemblages immediately succeed each other in time:

1. Because technological studies of debitage are particularly vulnerable to problems with artefact associations, assemblages must have been excavated with rigorous collection and proveniencing methods in order to assure the association of artefacts with a common depositional period in the site. This requirement eliminates many potential assemblages.

2. The assemblages must be associated with adequate radiometric dates as well as geological data to assign them to a specific date between 60–30,000 bp, the period during which the Middle to Upper Palaeolithic transition occurred across Eurasia. While a narrower time period can be used, the larger time block places any transition in the context of the technological variability before and after the event.

3. The assemblages should represent each of the known industrial types within the region during the period in question.

Based on these three factors and the chronological rule above, the assemblage from Kebara Cave, Unit VI was chosen to represent the terminal Middle Palaeolithic in this pair-wise comparison. Although the stratigraphic unit that directly underlies the Upper Palaeolithic deposits at Kebara is Unit V, Unit VI was chosen because of stratigraphic uncertainties differentiating between Unit IV (Upper Palaeolithic), and the Middle Palaeolithic Unit V (Bar-Yosef et al. 1996:301). Unit VI yielded an AMS date of >48,000 bp (Gif-TAN-90029) and a TL date of 48,300 ± 3,500 bp (Valladas et al. 1987). The assemblage from Amud B1/6, possessing an ESR date range of 43,000 ± 5000 bp (early uptake) to 48,000 ± 6000 (late uptake)
(Schwarcz and Rink 1998), is also a likely candidate (Hovers et al. 1995; Hovers 1998). The possible inclusion of this assemblage alongside Kebara VI warrants further study.

To represent the Early Upper Palaeolithic, the assemblage from Boker Tachtit level 1 was chosen. Argued to demonstrate in situ development of Upper Palaeolithic blade technology from a Middle Palaeolithic technology (Marks 1990), the absence of a Middle Palaeolithic retouched tool kit has led to suggestions that basal Boker Tachtit represents a fully Upper Palaeolithic occupation (Bar-Yosef 1994; Bar-Yosef et al. 1996). This occupation produced several radiocarbon dates, of which 47,280 ± 9,050 bp (SMU-580) is the oldest.

The sampling protocols for the assemblages are described below.

**Kebara Cave, Unit VI**

Kebara Cave is situated at the western edge of Mt. Carmel, overlooking the Mediterranean coastal plain. First excavated by Turville-Petre (1932) and later by Stekelis (Schick and Stekelis 1977), the deposits contain a sequence from the Middle Palaeolithic to the Epipalaeolithic. The sample studied derives from the recent excavations headed by Bar-Yosef and Vandermeersch (1982–1990) (Valladas et al. 1987; Bar-Yosef et al. 1992; Meignen and Bar-Yosef 1988, 1991; Bar-Yosef et al. 1996). This unit is relatively rich in debitage and tools and a sample from 5m² was sufficient for the purposes of the technological study. This choice was influenced by proximity to the western profile of the excavation.

**Boker Tachtit, Level 1**

Boker Tachtit is an open-air site in the central Negev Desert of Israel. Excavated during the Southern Methodist University project in the Avdat/Aqev area in the late 1970s (Marks 1983b; Marks and Volkman 1983), four superimposed cultural horizons were identified, three of which were extremely rich in artefacts. Extensive refitting was conducted on the material, allowing the vast majority of the lithic operational sequences to be defined with great accuracy (Volkman 1983, 1989).

The published analyses of the refits serve as the substantive support for the following discussion of the Boker Tachtit level 1 operational sequence, since most individual artefacts themselves are currently almost impossible to study due to the refitting. Amongst the unrefitted items a sample of 100 artefacts from five squares was studied with the attribute analysis advocated here in order to produce comparable data for the study.

**Comparison of Kebara Unit VI and Boker Tachtit level 1**

Table 6.2 compares the operational sequences of the assemblages from Kebara Unit VI and Boker Tachtit level 1. This presents each knapping step in the sequence by behavioural domain and characterizes the cumulative behaviours used for each step of the sequence in the production of the two assemblages. Judgement of the significance of any difference between the assemblages' choice of option for each step in the operational sequence is also indicated. Thus, steps related to data taken from cores or refits are often qualitative, while steps related to data from flakes and tools are mostly quantitative. Unidentifiable variable states, such as crushed platforms, unreadable exterior platform angles, etc., were not included in the calculation of descriptive statistics used in this table. A 'p' value indicates the probability that the data obtained from the two assemblages were randomly derived samples from the same population (i.e., with the assumption that they were produced by the same cumulative behaviours). A significance level of 5% is used here for all statistical tests, including student’s t-test or G² likelihood ratio (approximating the chi-square distribution) (Sokal and Rohlf 1995).

If one instance of agreement exists between the two assemblages for a given knapping option used in a given behavioural step, then it is possible to argue that the earlier assemblage possesses an antecedent for the behaviour in that step in the later assemblage. It is thus possible to search for and count antecedents for Boker Tachtit 1 within Kebara VI on a step-by-step behavioural basis. Evaluation of the goodness of fit between the archaeological record and the continuity/discontinuity of behaviours expected given a diffusion event versus an independent innovation event can proceed based on this step-by-step counting of antecedents (see Tostevin 2000a for a discussion of the models and test expectations).

Any antecedents can also be treated quantitatively to evaluate the competing hypotheses. However, to produce a quantitative measure of the difference (or similarity) between assemblages, one cannot simply sum up the number of operational steps in which a significant difference exists between the two options, as this would bias the results through the interdependence of the units. Specifically, while flake fracture mechanics experiments show that knapping options are functionally independent between the five knapping domains, the possibility remains that options within each domain may affect subsequent options during core reduction, as experiments have not tried to control for this issue. It is thus necessary to avoid counting the same units twice, a situation known in statistics as Galton’s Problem (Tylor 1889 in Moore 1961; Thomas 1986:448). In order to quantify pair-wise assemblage comparisons, therefore, the knapping steps in which significantly different options were used between assemblages are first summed within their specific knapping domain and divided by the total number of steps within that domain. The resulting numerical values of all five domains are then summed up to produce a measure ranging from 0 (for assemblages with identical operational
sequences) to 5 (for entirely different operational sequences, *i.e.* without any antecedents). This procedure thus scales the measure of difference according to the variability seen between these five domains.

It must be noted that, although some interdependence has been avoided with the above methodology, this study introduces its own bias in the structuring of pair-wise assemblages’ comparisons. Specifically, as the number of steps within each of the five domains differs, the steps in different domains are not weighted evenly. This situation is intentional, in that the number of steps within a domain reflects the potential for functional constraints to affect the choice of knapping options within that domain. Thus tool manufacture is the most influenced by functional utility and has the largest number (16) of steps within the domain. Direction of core exploitation, on the other hand, has little or no effect on the functional utility of the resulting products and so, suitably, it has only two behavioural steps. This bias in the structure of the pair-wise comparisons should be kept in mind when evaluating the similarity/dissimilarity between assemblages traditionally grouped together based on tool typology alone.
Although both the degree of independence between the five domains and the intentional selection of particular domains as sensitive or insensitive to functional utility will likely generate debate among lithic analysts, it is important to stress that a rigorous and replicable analytical structure is essential for the comparison of lithic assemblages through time and space. Until more experimental studies are conducted in the tradition of Dibble and Pelcin (1995) and Pelcin (1996), contention over relative degrees of independence between knapping behaviours within the analytical structure advocated here is less important than the actual creation and implementation of an analytical structure. Just as the structure of Bordes’ typology (1961a) has aided Palaeolithic research while undergoing debate (Bordes 1961b; Binford and Binford 1966; Mellars 1969) and refinement (Debénath and Dibble 1994; Dibble 1995b), it is hoped that the present effort to structure technological comparisons of assemblages will facilitate further research.

The following discussion of the pair-wise comparison between Kebara Cave Unit VI and Boker Tachtit level 1 is based on the procedures advocated above. It does not present the description of the lithic data or the argumentation that led to these interpretations (see Tostevin 2000b).

**Core Modification**

The first step in the core modification domain, core orientation, represents the initial orientation and shaping of the raw material. This distinguishes between different core forms, based on extant core morphology and evaluation of platform locations during most of core exploitation. In Kebara VI, it is clear from the location of bulbar negatives on the different core surfaces that broad-faced surfaces were chosen exclusively over narrow-aspect surfaces. In the case of Boker Tachtit 1, both Volkman’s refittings and personal examination of the location of bulbar negatives on the different core surfaces indicate that most cores were oriented longitudinally to exploit the narrow core surface. Qualitatively different options were used for this step between the two assemblages. Kebara VI thus does not possess the antecedent for this step in the operational sequence.

For the second step in this domain, core management was also different between the assemblages. While the cores and debitage from both Kebara VI and Boker Tachtit 1 use the débordant option, the frontal crests to create and maintain dorsal surface convexities in Boker Tachtit 1 represent a significant deviation from Kebara VI.

**Platform Maintenance**

This domain includes three steps whereby the knapper modifies the platform surface and edge before each removal. In the case of the Kebara VI versus Boker Tachtit 1 comparison, only the tendency in the latter assemblage to strike closer to the platform edge, measured by debitage platform thickness, differed significantly. The use in both assemblages of platform faceting and equivalent exterior platform angles indicates that Kebara VI possesses antecedents for two of the three possible steps within this domain.

**Direction of Core Exploitation**

The first step in this domain, the direction of cortex removal, shows dissimilar choices by the knappers of these two assemblages. A cross-tabulation of cortex percentage and dorsal scar directions on debitage indicates that Kebara VI was reduced unidirectionally during initial cortex removal but gradually included more sub-centripetal reduction. A similar cross-tabulation of debitage data from Boker Tachtit 1 illustrates a different option: unidirectional removal of cortical pieces with no shift in strategy. The determination of the second step in this domain, the direction of non-cortical blank removal, relies upon a cross-tabulation of blank length with dorsal scar directions. For this step, Kebara VI shows no shift in strategy but continued unidirectional and bi-directional approaches. Cross-tabulation on Boker Tachtit 1, however, illustrates a clear shift from bi-directional reduction at the beginning of core exploitation to unidirectional reduction at the end of the lives of the cores. This interpretation, based on attribute analysis, is corroborated by Volkman’s refits (for instance, see Volkman 1989: Figs. 6.7, 6.8, 6.9, 6.13). Neither step within this domain demonstrates the existence of an antecedent behaviour for Boker Tachtit 1 within Kebara VI. It is interesting to note that Kebara VI, while recognized to be a Tabun B-type industry, does not possess a large amount of debitage with unidirectional-convergent scar patterns (only 17.8% compared to 27.1% unidirectional, 19.3% bi-directional, 10.3% crossed, 11.2% sub-centripetal, 4.7% centripetal, 2.5% crested, and 7.2% indeterminate, see Tostevin 2000b: Table 7.6).

**Dorsal Surface Convexity System**

The dorsal surface convexity domain includes the knapping steps that encapsulate the cumulative tendencies to use particular ridge patterns on the core exterior for the production of blanks. Of the possible five steps all options were statistically different between the two assemblages. The debitage and tools from Boker Tachtit 1 illustrate use of core convexities that are more longitudinal, more parallel sided, more curved in profile, dominated by single ridges, and less Levalloisian (width/thickness ratio of 4.43 compared to 5.18) in its use of vertical convexities than Kebara VI.

**Tool Manufacture**

For the tool manufacture domain, only retouch type and tool kit composition are comparable between these two assemblages due to the lack of blank selection criteria for Boker Tachtit 1, which was unavailable in published form and from the un-refitted debitage. While Kebara VI has predominantly Middle Palaeolithic tool types (114 tools out of 990 artefact sample) with no bifacial retouch, Boker
Tachtit 1 has the bifacial thinning retouch associated with Emireh points and a dominance of Upper Palaeolithic tool types (Marks 1983b: Table 5.9: Upper Palaeolithic types represent 75.3% of the retouched tools, excluding unretouched pieces and Levallois blank types). This final domain thus produced a measure of difference of 2/2.

**Final Measure of Difference**

The final measure of difference between the operational sequences of Kebara Unit VI and Boker Tachtit level 1, weighted by the five knapping domains, produces a value of 4.33 out of a possible maximum difference of 5.0. This value is the greatest witnessed in 22 pair-wise comparisons between 18 assemblages dated 60–30,000 bp over three regions (the mean value is 2.34; Tostevin 2000a, b). This value of 4.33 indicates that the operational sequences are in fact extremely dissimilar and that few antecedents for the behaviours that created Boker Tachtit sequences are in fact quite similar to each other. The pair-wise comparisons between Boker Tachtit level 1 and the Bohunician assemblage of Stranka skala IIIa–4 in central Europe (producing a difference value of 1.93) and between Boker Tachtit level 1 and the first non-Middle Palaeolithic assemblage in eastern Europe, Korolevo II Complex II (producing a value of 1.93), are extremely surprising given their geographical separation. The first comparison is less than twice as different as the value between the Stranka skala Bohunician assemblages themselves (IIIa level 4 and III, producing a value of 0.98) or between the directly stratified Levantine Aurignacian assemblages at Kebara Cave (Units II and I, producing a value of 1.51). Comparison of Boker Tachtit level 2 to Stransa skala IIIa level 4 produces a value (1.40), which is actually closer than the value between the European Aurignacian (Stransa skala IIIa level 3 and Ia level 4) and the Levantine Aurignacian assemblages (Kebara Unit I) (1.81), although Boker Tachtit level 2 shows fewer similarities with Korolevo II Complex II (2.26). These comparisons point to a common behavioural phenomenon appearing after the last Middle Palaeolithic assemblage in each region.

In order to use the antecedent principle to determine whether or not the Upper Palaeolithic appeared as an *in situ* innovation within a region or by diffusion between regions, it is important to investigate the contingency of the knapping behaviours beyond a simple comparison of the measure of difference between assemblages. This is vital, since the summation of assemblage differences condenses all of the variability between assemblages into one value, so that two different assemblages may appear equally similar to a third but not possess similar options between them. This is not the case, however, with the behavioural options employed in the different steps of the operational sequences of Boker Tachtit level 1, Stransa skala IIIa level 4, and Korolevo II Complex II. When examining the specific knapping options used in these three assemblages, their antecedents cannot be found within the details of the Middle Palaeolithic operational sequences in each region (Table 6.4). Further, the same specific options that make these assemblages so different from the preceding Middle Palaeolithic assemblages are in fact common to all three assemblages. Despite the
geographical distances separating them, the assemblages of Boker Tachtit level 1, Stranska skala IIIa level 4, and Korolevo II Complex II all possess a specific and unique cluster of knapping options (Table 6.5).

Parsimony favours the conclusion that all three assemblages share the same behavioural package which diffused from one region to another, appearing first in the Levant at 47/46,000 bp, next in central Europe by 42,000 bp, and finally in eastern Europe by 38,000 bp (Tostevin 2000a).

The entire operational sequence is not exactly the same in each assemblage but this variance is to be expected in any diffused set of behaviours. For instance, although the differences between Stranska skala IIIa–4 and Korolevo II–II are greater than the differences between these assemblages and Boker Tachtit level 1 (2.56 versus 1.93), the behaviours within the diffused package would have continued to deviate through time and space, a process Deetz and Dethlefsen (1965) called the Doppler Effect, as the package proceeded down two paths, one toward central Europe, and one to eastern Europe.

Further research is needed within each region to increase the sample of assemblages representative of the period between 60–30,000 bp. Yet, the current data supports the conclusion that these three assemblages (Boker Tachtit level 1, Stranska skala IIIa level 4, and Korolevo II Complex II) represent the diffusion of a phenomenon we may call the ‘Bohunician Behavioural Package,’ named after the central European industry marking its northwestern-most distribution (it does not appear to have reached western Europe). This appellation is only fitting given the fact that central and eastern European scholars (Valoch 1990; Kozlowski 1990; Ginter et al. 1996; Demidenko and Usik 1993a) were the first to notice morphological similarities among these disparate assemblages. The regional origin of this behavioural package should be sought in adjacent localities, including southeastern Europe, the Nile Valley, and Anatolia.

The ‘Bohunician Behavioural Package’ is the first of two diffusion events evidenced by this research, the second being the ‘Aurignacian Behavioural Package,’ introducing a new distinctive suite of knapping options to the Levant (Kebbara Cave Unit II) and central Europe (Stranska skala Iia–4 and IIIa–3) (Tostevin 2000a, b). As with its predecessor, the ‘Aurignacian Behavioural Package’ did not possess sufficient antecedents within any of the three regions studied to warrant an in situ appearance in these regions.

Discussion of the consequences of this research for
both the Levantine Middle to Upper Palaeolithic transition as well as the central and eastern European transitions is beyond the scope of this paper. Nevertheless, the example of the comparison of two technological styles at the Middle to Upper Palaeolithic transition in the Levant illustrates how the quest for antecedents can proceed and what fascinating results such an endeavour produces. As long as antecedents are sought by means of quantitative, cumulative characterizations of the contingent details within the technological styles of immediately successive lithic assemblages, the antecedent principle will light our way to a richer understanding of the origins of the Upper Palaeolithic, in the Levant and elsewhere.

Table 6.4 Operational Sequences for the first Pair-wise Comparisons in Each Region.

**The Levant**

**Kebara Cave Unit VI**
- **Core Modification:** Broad-face Orientation; Débordant Core Management
- **Platform Maintenance:** Prepared Platforms, ~87 degree External Platform Angle, ~5 mm Platform Thickness
- **Direction of Core Exploitation:** Unidirectional changing to Sub-centripetal Cortex Removal, Independent Unidirectional & Bi-directional Blank Removal
- **Dorsal Surface Convexity:** Varied Lateral Edges, Straight Profile, Length/Width Ratio of 1.78, Width/Thickness Ratio of 5.18
- **Tool Manufacture:** Levallois flakes & sidescraper tool kit

**Boker Tachtit Level 1**
- **Core Modification:** Longitudinal Orientation; Débordant & Frontal Crest Core Management
- **Platform Maintenance:** Plain & Faceted Platforms, ~88 degree External Platform Angle, ~4 mm Platform Thickness
- **Direction of Core Exploitation:** Unidirectional Cortex Removal, Bi-directional changing to Unidirectional Blank Removal
- **Dorsal Surface Convexity:** Parallel & Convergent Lateral Edges, Length/Width Ratio of 2.25, Width/Thickness Ratio of 4.43
- **Tool Manufacture:** Emireh points, Levallois points, endscraper & burin tool kit

**Kùlna Cave Layer 7a**
- **Core Modification:** Unifacial Discoidal with secant surfaces; Convexity Management by Centripetal Removals
- **Platform Maintenance:** Plain & Prepared Platforms, ~84 degree External Platform Angle, ~9 mm Platform Thickness
- **Direction of Core Exploitation:** Unidirectional Changing to Crossed Cortex Removal, Sub-centripetal changing to Unidirectional Blank Removal
- **Dorsal Surface Convexity:** Parallel & Expanding Lateral Edges, Trapezoidal Cross-section, Length/Width Ratio of 1.44, Width/Thickness Ratio of 2.83
- **Tool Manufacture:** Bifaces & bifacial sidescraper tool kit

**Stranska skala IIIa Layer 4**
- **Core Modification:** Longitudinal Orientation; Débordant, Frontal Crest, & Side Blade Core Management
- **Platform Maintenance:** Plain & Faceted Platforms, ~85 degree External Platform Angle, ~5 mm Platform Thickness
- **Direction of Core Exploitation:** Unidirectional Cortex Removal, Bi-directional changing to Unidirectional Blank Removal
- **Dorsal Surface Convexity:** Parallel & Convergent Lateral Edges, Length/Width Ratio of 1.71, Width/Thickness Ratio of 3.99
- **Tool Manufacture:** Levallois points & Upper Palaeolithic endscraper tool kit

**Eastern Europe**

**Molodova V Level 11**
- **Core Modification:** Broad-face Orientation; Core Management by Débordant & Centripetal Removals
- **Platform Maintenance:** Faceted Platforms, ~86 degree External Platform Angle, ~6 mm Platform Thickness
- **Direction of Core Exploitation:** Centripetal Cortex Removal, Sub-centripetal changing to Centripetal Blank Removal
- **Dorsal Surface Convexity:** Varied Lateral Edges, Length/Width Ratio of 1.78, Width/Thickness Ratio of 4.94
- **Tool Manufacture:** Mousterian points & sidescraper tool kit

**Korolevo II Complex II**
- **Core Modification:** Longitudinal Orientation; Débordant & Frontal Crest Core Management
- **Platform Maintenance:** Plain Platforms, ~90 degree External Platform Angle, ~8 mm Platform Thickness
- **Direction of Core Exploitation:** Unidirectional Cortex Removal, Bi-directional changing to Unidirectional and Crossed Blank Removal
- **Dorsal Surface Convexity:** Length/Width Ratio of 1.71, Width/Thickness Ratio of 4.10
- **Tool Manufacture:** Flatly-retouched Foliate points & Upper Palaeolithic endscraper tool kit
### Table 6.5 Knapping Behaviours Within the ‘Bohunician Behavioural Package’.

<table>
<thead>
<tr>
<th>Core Modification:</th>
<th>Longitudinal Orientation; Débordant &amp; Crested Blade Core Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platform Maintenance:</td>
<td>Plain &amp; Faceted Platforms, ~86 degree External Platform Angle, ~4 mm Platform Thickness</td>
</tr>
<tr>
<td>Direction of Core Exploitation:</td>
<td>Unidirectional Cortex Removal, Bi-directional changing to Unidirectional Blank Removal</td>
</tr>
<tr>
<td>Dorsal Surface Convexity:</td>
<td>Length/Width Ratio of 1.80, Width/Thickness Ratio of 4.25</td>
</tr>
<tr>
<td>Tool Manufacture:</td>
<td>Levallois point &amp; endscraper toolkit</td>
</tr>
<tr>
<td>Assemblages:</td>
<td>Boker Tachtit 1 &amp; 2, Stranska skala IIIa–III, Korolevo II–II, possibly Kulychivka lowest complex (Demidenko and Usik 1993b), possibly Temnata Cave Layer VI, Sector TD–II (Ginter et al. 1996), and possibly Korolevo I–2B (Demidenko and Usik 1993a).</td>
</tr>
</tbody>
</table>
Bibliography


Bate, D.M.A. 1937 Part II. Paleontology: the fossil fauna of the Natufian and Microlithic industries at Hayonim Cave (western Galilee, Israel). Qudemat 7, Monographs of the Institute of Archaeology, Hebrew University, Jerusalem.


Dayan, T. 1994 Carnivore diversity in the Late Quaternary of Israel. *Quaternary Research* 41:343–349.


Emeis, K.C., U. Struck, H.M. Schulz, R. Rosenberg, S. Bernasconi, H. Erlenkeuser, T. Sakamoto and F. Martinez-Ruiz 2000 Temperature and salinity variations of Mediterranean sea surface waters over the last 160,000 years from records of planktonic stable oxygen isotopes and alkaline unsaturation...
Bibliography

Garrod, D.A.E. and D.M.A. Bate 1937 The Stone Age of Mount
Bibliography


Goldberg, P. 1986 Late Quaternary environmental history of the southern Levant. Geoarchaeology 1:225–244.


Goodfriend, G.A. and M. Magaritz 1988 Paleosols and Late


Goren-Inbar, N. 1990


Goring-Morris, A.N. 1980a

Goring-Morris, A.N. 1987


Harmon, R.S., H.P. Schwarz and D.C. Ford 1978 Late Pleistocene paleoclimates of North America as inferred from stable isotope studies of speleothems. Quaternary Research 9:54–70.


Henry, D.O. 1992 Transhumance during the late Levantine
Bibliography


Henry, D.O. and G.H. Odell (editors) 1989 Alternative Approaches to Lithic Analysis. APSA, University of Tulsa, Tulsa.

Hietala, H. and A.E. Marks 1981 Changes in spatial organization


Horwitz, L.K., C. Cope and E. Tchernov 1990 Sexing the bones of mountain-gazelle (Gazelle gazella) from prehistoric sites in the southern Levant. Paléorient 16:1–12.


Hovers, E., L.K. Horwitz, D.E. Bar-Yosef and C. Cope-Miyashiro 1988 The site of Urkan-E-Rub IbI: a case study of subsistence and mobility patterns in the Kebaran period in the lower Jordan...
Bibliography


Martin, L.A. 1999 Mammal remains from the eastern Jordanian
Bibliography


Mellars, P. and J. Tixier 1989 Radiocarbon accelerator dating of Ksar Akil (Lebanon) and the chronology of the Upper Palaeolithic site in the Middle East. Antiquity 63:761–768.


Nadel, D. 1993 Submerged archaeological sites on the shores of Lake Kinneret, Israel. 'Atiqot 22:1–12.


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