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THE MOUSTERIAN SEQUENCE OF HUMMAL AND ITS TENTATIVE PLACEMENT IN THE LEVANTINE MIDDLE PALEOLITHIC

Thomas C. HAUCK
Institut für Ur- und Frühgeschichte der Universität zu Köln, Germany, thomas.hauck@uni-koeln.de

Introduction

Next to well-known sites, such as Tabun Cave, Qafzeh Cave or Kebara Cave, recent excavations in the open-air site of Hummal show that this locality offers one of the rare possibilities to examine a long sequence of deposits which were left behind by successive occupations over a considerable time span (Hauck 2010; Le Tensorer *et al.* 2011). Initial investigations of the Mousterian sequence were made on collapsed sediments at the lower part of the well (Besançon *et al.* 1981, 1982; Copeland 1983). The undisturbed Mousterian deposits are nowadays found in the section between 5 to 10m below datum and comprise the major part of the Hummal sequence. Systematic excavations since 2002 were carried out in the western and southern part of the well and revealed an exceptional succession of more than 30 archaeological levels (Hauck 2010). Today, more than 10´000 lithic artifacts and faunal remains were unearthed. In addition, human remains were discovered in levels 5a4 and 5b1. Find densities vary considerably between levels, which is the result of differential degrees of preservation and/or site function (tab. 1).

levels	excavated surface m²	find density per m³	fauna N	lithics N	lithics >2cm N
5AII	53	24.8	1	315	138
5AIII	53	4.7	-	114	58
5AIV	53	264.7	8	916	384
5AV	18	57.9	3	301	41
5AVI	10	24.7	10	71	69
5a2	11	2965.5	-	1631	584
5a3	36.5	173.8	268	1436	518
5a4	8	2319.7	75	1044	269
5b1	10	173.5	45	363	107
5b2	20	564.2	78	599	149
5BII	17.5	151.9	77	89	89
5b3	20	660.9	325	1916	679
5b5	20	289.2	53	714	345
5b7	3	803.3	34	448	107
5DV	6	411.1	19	55	51
5E	6	265	75	242	211
5e	6	73.4	1	140	62
5f1	6	408.3	1	195	45
5f2	6	162.5	2	193	43
5g	6	100	4	62	48

Table 1 - Selected Mousterian levels of Hummal: size of excavated surface per level, find densities and respective counts of faunal and lithic items. N.B. find density includes faunal remains.

Hummal is not the only deeply stratified Mousterian site in the El Kowm region and several surveys revealed an abundance of stratified as well as surface sites within a relatively restricted area of 120 km² (e.g. Cauvin *et al.* 1979; Cauvin 1983; Le Tensorer *et al.* 2001). The wealth of Paleolithic sites in the El Kowm region lead to a revision of former assumptions about the presence of Middle Paleolithic humans and their migrations within the Near East. It is now clear that these people not only settled within the Mediterranean coastland with its high diversity of resources, but also penetrated into the ostensibly unfavorable arid interior. As Hummal is situated in the northern steppe region, its comparison with sites within different environmental settings delivers valuable information about the adaptive strategies of Mousterian hominids and, apart from functional considerations, the spread of their technological traditions. Although a relative chronological positioning of the Hummal Mousterian is possible on the basis of lithic data, their absolute dating is still far from definitive. However, the detailed analysis of all lithic remains and their comparison with data from other sites in the El Kowm region and beyond already enables a tentative but convincing placement of the Hummal Mousterian in the context of the Levant. In the following, the Mousterian sequence of Hummal will be briefly described and compared with artifact assemblages of other Levantine key sites. For this purpose, we chose only a handful from the pool of known Middle Paleolithic find spots on the demise of others. This is due to the limited scope of this paper and the fact that a preliminary comparison of the Hummal assemblages is reasonably done with

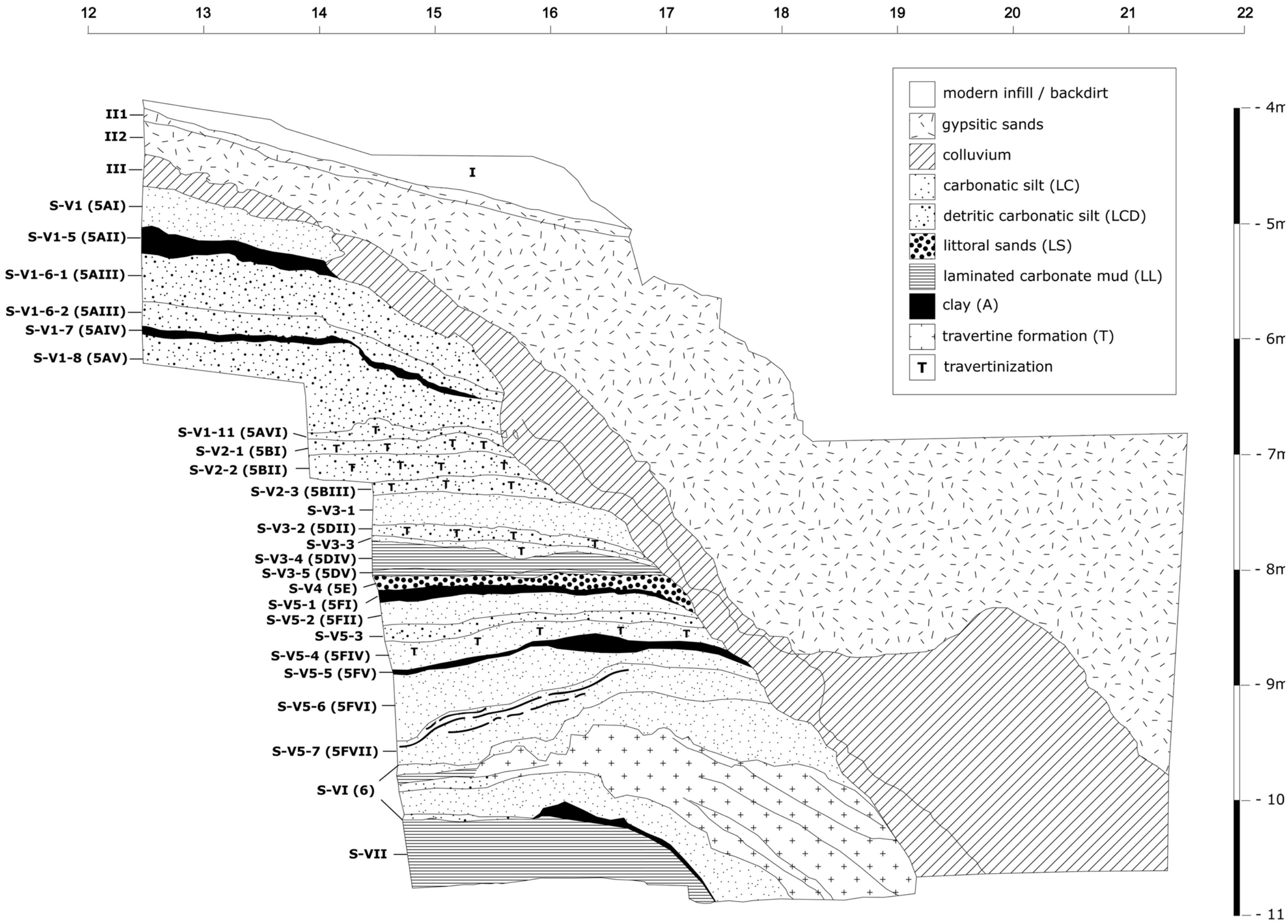

Figure 1 - Profile 59 showing the southern Mousterian Sequence and the contact between the *in situ* Pleistocene deposits, colluviated deposits and the modern infill (complex II2).

sites being geographically and/or chronologically close or from which first hand data is available.

The Mousterian Sequence of Hummal

The Mousterian levels are found in the context of typical spring deposits, such as freshwater carbonates, evaporitic clay-gypsum accumulations and travertines (Hauck 2010; Le Tensorer *et al.* 2007). Pure carbonates are rare and the dominating sediment type is a detrital carbonate often of palustrine type. The alternation between limnic and terrestrial deposits mirrors a steady shift between water transgressions and regressions, which caused the development of a broad ecological spectrum ranging from extended, oxygen-rich lake systems to marshy ponds or water-depleted depressions filled with aeolian sands (fig. 1). Colluviated deposits show evidence of recurring sediment collapses and erosion processes that were caused by instabilities in the karstic bedrock, water flows and weathering.

Regarding these taphonomic factors, the archaeological material was exposed to different degrees of weathering or destruction. Nevertheless, micromorphological analysis, preliminary refittings and the exceptional preservation of lithics indicate that the majority of archaeological levels were rapidly buried by fine-grained sediments. Minor post-depositional movements were principally caused by water flows, desiccation and subsidence effects due to a considerable and rapid lowering of the groundwater table in modern times (Schuhmann 2011).

The techno-typological characteristics of the Hummal sample

Depending on the range and duration of activities which were carried out at Hummal, and hence occupation length, the supply with raw material and the temporal as well as spatial organization of core reduction were differently organized (Hauck 2010; Hauck *et al.*, 2010). Rich flint outcrops are located along the Jebel Bishri and Jebel Mqebra mountain ranges in about 10 to 15 km distance of Hummal (Le Tensorer *et al.* 2011). The range of organizational patterns goes from a nearly exclusive production of blanks at the site to a strong reliance on imported implements (see for example variation of debitage to nodule core ratio in table 2). Off-site as well as on-site core reduction saw a systematic application of the Levallois method to obtain standardized blanks. Corresponding features are high Levallois and facetting indices in each level (tab. 3). Apart from the preponderance of Levallois blanks, some other common features can be found across the whole sequence, irrespective of flaking strategy. To mention first is the marked elongation of Levallois blanks, which is expressed by relatively high mean

	levels	analyzed sample N	retouched tools %	blanks N	cores N	Levallois cores %	cores on flakes %	debitage to nodule core ratio
HM-A1	5AII	115	13	53	3	33	67	44.0
	5AIII	22	6	8	4	0	25	12.5
	5AIV	288	9	146	14	14	64	25.4
	5AV	31	11	8	6	33	33	4.8
	5AVI	58	21	29	6	0	50	8.0
HM-A2	5a2	385	7	86	18	17	56	28.7
	5a3	349	9	89	21	19	67	19.7
	5a4	152	10	36	9	11	33	27.7
	5b1	69	16	20	5	0	80	18.8
	5b2	95	15	28	5	0	80	27.0
	5BII	83	9	38	4	50	50	20.3
	5b3	518	9	37	28	14	29	22.3
	5b5	201	5	64	22	9	50	13.7
	5b7	58	4	23	4	25	50	19.4
	5DV	35	4	10	4	0	100	0.0
	5E	143	8	54	11	9	82	15.7
HM-B	5e	34	14	10	4	50	50	10.6
	5f1	32	18	15	1	0	100	0.0
	5f2	29	30	19	3	0	100	0.0
	5g	25	10	11	0	0	0	0.0

Table 2 - Selected Mousterian levels of Hummal: assemblage composition; a) excluding fragments and chips (<2 cm).

length width ratios (LWR) for each assemblage (tab. 3). Another feature to be found in all assemblages is the scarcity of Levallois types within the group of cores (tab. 2). This is probably due to several reasons, such as the possible export of Levallois cores to other sites for further reduction, the opportunistic exploitation of Levallois cores during the final stage of blank production and sample size error. In some levels, Levallois core exportation is indirectly evidenced by a low frequency or even absence of small Levallois flakes with a size below 4 cm. The arrangement of scars on the few Levallois cores reflect either a serial production of points, flakes and blades or the removal of one final preferential flake just before their discard. Having reached a certain size threshold between 4 and 5cm, a significant number of Levallois cores were completely reworked by applying an opportunistic reduction method with the aim to obtain very small flakes and bladelets. Table 2 shows that the number of nodule cores is equal to or even outweighed by the number of cores on flakes in the majority of levels. The core on flake phenomenon in Hummal has been studied in detail to better understand its technological nature and the behavioral significance of this recycling strategy (Hauck 2010). Depending on which blank surface was exploited, three core types can be defined: dorsal cores (including Nahr Ibrahim types), ventral cores (including Levallois cores on flake, Kombewa and Janus types) and multiple cores.

The high frequency of Levallois points and blanks with a convergent scar pattern in the majority of analyzed assemblages shows that the upper two thirds of the Hummal sequence can be characterized as a point-dominated Mousterian (tab. 3). Contrastingly, the lowermost assemblages 5e to 5g present a radically different picture with a marked under-representation of Levallois points and a significant variability of core reduction patterns. This difference lead to a division of the Hummal Mousterian into an upper and lower industry, called HM-A and HM-B respectively.

Two basic variants of Levallois point technology are identified which call for a split of the upper industry HM-A into two successive sub-types. Regarding the uppermost industrial subtype, HM-A1, the Levallois points of Mousterian levels 5AI to 5AVI show a bundle of technological features which reflect one of the two varieties of recurrent Levallois point production in Hummal. These points exhibit a broad base, large-sized butts with a *chapeau de gendarme*, and frequently more than three strongly converging negatives on their dorsal face (plate 1). The angles of these overlapping scars demonstrate that during reduction, striking platforms were often expanded to the lateral sides of the core to allow converging or even perpendicular removals, which often occur in combination with strongly bent dorsal planes forming a prominent central ridge. Together with the pronounced longitudinal curvature of many flakes, it can be inferred that cores had a slightly domed flaking surface. Within one reduction sequence, preferential and recurrent Levallois points were produced on the same core, whereby larger preferential pieces were frequently struck at the end of a recurrent series. The impression we have for the moment is that of a strong standardization in blank manufacture focussing on the described Levallois point types.

A higher degree of variability is visible in the second industrial sub-type HM-A2 in respect to core reduction patterns, relative proportions of Levallois blades, flakes and points, and metrical blank attributes. No linear trend towards one preferred blank type is discernible across the sequence 3. Between the lowest level, 5E, and uppermost level, 5a2, blade percentages range between 30% and 50%. The disparity between Levallois blade and flake proportions is minimal, and may in many cases be due to sample size error. Levallois points generally comprise 20% to 30% of all blanks, except for levels 5b1 and 5b5 where they are rare or even absent. Even when all blanks with a convergent scar pattern are considered, the frequency of these point-related blanks is lower on average compared to HM-A1. Given the fact that many assemblages in the middle part of the Hummal sequence contain a significant number of blades which are not related to Levallois point production and that the mean length width ratios of all blanks are found in the range between 2.0 and 2.5, the HM-A2 industry can be characterized by a laminar tendency; some blade-rich assemblages, such as 5b7, 5DV and 5E, at the bottom of the middle sequence show extremely elongated Levallois points with mean length width ratios of 2.5 to 2.8 (tab. 3). Levallois blades and

	N	IL	IF	Ilam	L/W mean Levallois blanks	L/W mean Levallois points	Levallois blanks (%)			Unidirectional convergent scar pattern (%)
							Levallois flakes (%)	Levallois blades (%)	Levallois points (%)	
Hummal 5AII (HM-A1)	315	43.7	84.6	54.7	2.2	2.3	31.1	42.2	26.7	56.0
Hummal 5AIV (HM-A1)	916	57.7	78.6	33.6	1.9	1.9	41.3	23.2	35.5	70.0
Hummal 5a2 (HM-A2)	1631	24.4	89.5	34.9	1.8	1.7	41.3	30.7	28.0	40.0
Hummal 5a3 (HM-A2)	1436	27.8	83.9	53.9	2.0	1.9	31.1	36.5	32.4	47.0
Hummal 5a4 (HM-A2)	1044	27.9	86.1	61.1	2.2	2.3	38.2	35.3	26.5	35.0
Hummal 5b3 (HM-A2)	1916	32.4	86.1	47.7	2.0	1.9	39.0	37.5	23.5	43.0
Hummal 5b5 (HM-A2)	714	40.6	81.3	40.6	2.1	2.1	50.0	37.5	12.5	34.0
Hummal 5E (HM-A2)	242	44.2	88.9	63.0	2.3	2.6	32.0	44.0	24.0	40.0
Yabrud level 2	277[a]	30.0[b]	71.4	48.1	2.1	2.1	40.1	37.0	22.9	27.2
Tabun unit I, Beds 1-17[c]	107[a]	36.0	60.0	64.0		2.3	53.0	18.7[d]	28.0	
Kebara IX[e]	2440	11.8	79.3	9.6	1.8		63.2	22.4	14.4	67.8
Kebara X[e]	2295	20.0	75.4	13.3	1.7		59.3	22.6	18.1	48.5
Kebara XI[e]	3427	22.6	70.2	20.2	2.0		61.1	30.5	8.4	43.6
Kebara XII[e]	393	30.5	87.5	22.9	2.2		59.0	29.9	11.1	51.4
Amud B1[f]	1344	31.3	49.3	27.1		2.0[g]	56.3	35.8	8.2	50.0
Amud B2[f]	2318	40.8	37.1	25.4			43.4	22.7	34.0	10.0
Amud B4[f]	457	34.7	52.0	16.2		2.5[g]	31.3	30.2	38.4	40.0
Tor Faraj level C[h]	13286	15.5	49.7	28.2	1.7	1.4	57.0	18.8	24.2	around 50% of flakes and blades
Tor Sabiha[h]	6663	4.0	38.0	37.0	1.7	1.9	11.8	51.6	36.6	

Table 3 - Comparison of selected Mousterian assemblages of Hummal with other Late Levantine Mousterian sites (IL = Levallois index; IF = faceting index; Ilam = blade index; L/W = length with ratio). a: blank counts only; b: data taken from Solecki & Solecki 1995: c; Jelinek 1982a: d; "prismatic blades" only, Jelinek 1982a; e: Meignen 1991. Meignen & Bar Yosef 1982, note that for subtriangular flakes and atypical points were subsumed in the flake group; f: Hovers 1998, Ohnuma & Akazawa 1988; g: mean length width ratio of elongates points only; h: Henry 1992, 2003.

flakes are mainly polygonal or rectangular in shape, with parallel or diverging edges (plate. 1). A considerable variability in point morphology characterizes the HM-A2 industry. In some levels, narrow, "leaf-shaped" specimens predominate, whereas others are characterized by many broad-based types. This is probably a reflection of a changing frequency in the application of the lineal vs. recurrent method, and of core volume. Many small Levallois points and flakes in the range between 2 and 3cm evidence an intensive core exploitation which reflects the strategy of obtaining fresh edges by producing new flakes instead of retouching existing ones.

Technological analysis of the lowest Mousterian levels is limited by small sample sizes (tab. 1). Many artifacts found in backdirt deposits around the well can be tentatively allocated to the HM-B industry on the basis of specific technological attributes (plate 3). Their frequency indicates the potential for a better definition of the HI-B facies with ongoing excavation in *in situ* levels. Scar pattern analysis reveals that a bidirectional flaking method working with two opposed striking platforms and the unidirectional method were frequently applied to obtain large sized Levallois blades and elongated flakes (plate 2). To produce broad and long Levallois flakes, the Mousterian knappers prepared huge cores in a centripetal fashion, and detached one single end-product before re-preparing the surface. Thus, investment in core trimming was often intense. Corresponding waste cores show that the lineal method was applied throughout the reduction sequence until exhaustion of the cores, and was confined to Levallois flake production. This aspect clearly distinguishes HM-B from above-lying variants, where recurrent blank production dominates. Most end-products are Levallois blades and flakes, whereas the points did not play a significant role in the tool kits' repertoire, as they did during later Mousterian occupations.

In all levels, the frequency of retouched tools is low, whereby it seems that at least in some of the lowest layers slightly more blanks underwent edge modification than in the upper industries (tab. 2). On average 20% of Levallois blanks exhibit edge modification, whereas only around 5% of core trimming elements were chosen for that purpose. Due to small sample sizes, differences in tool counts between levels are not to be

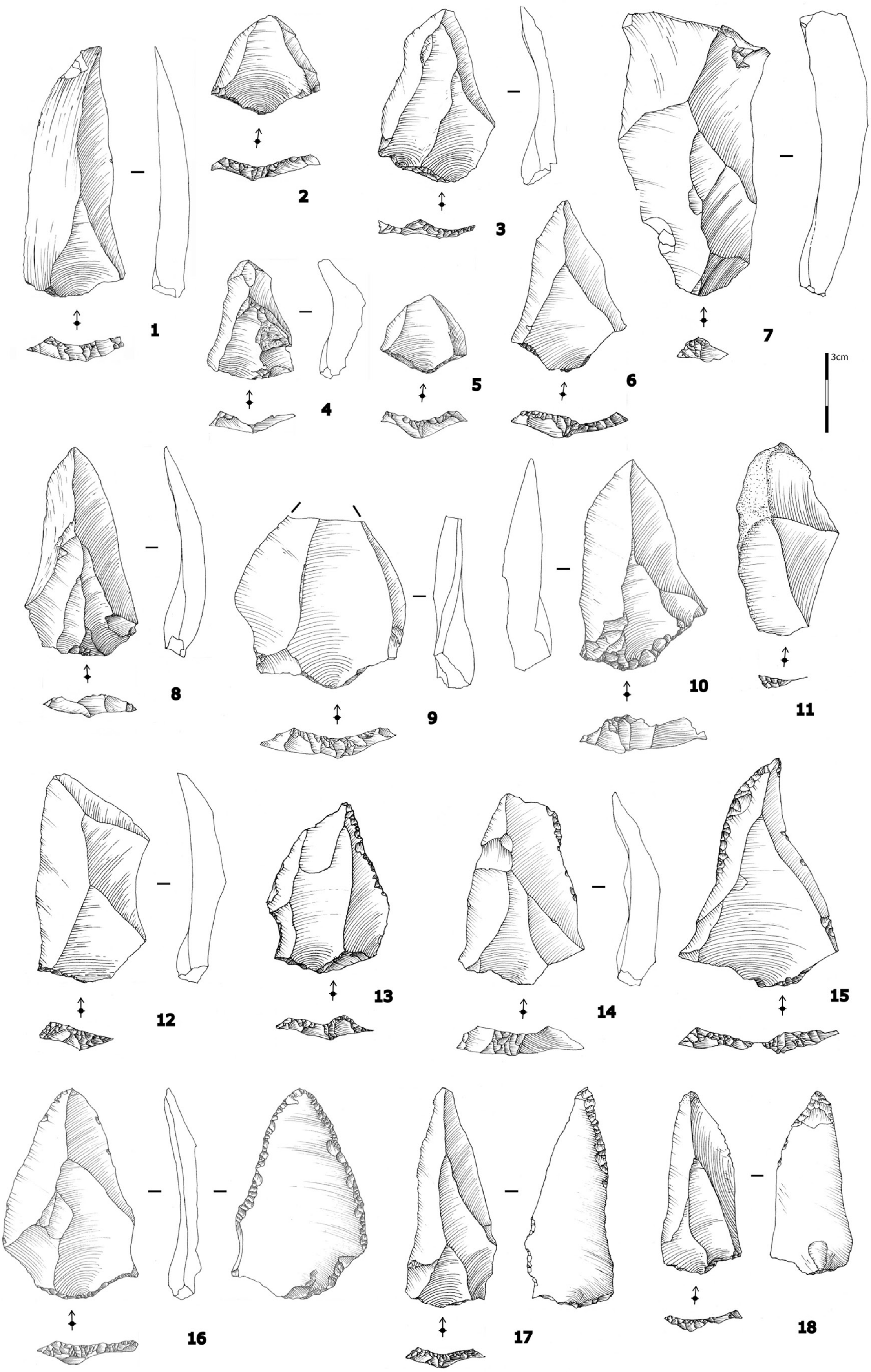

Plate 1 - Selected artifacts from the upper Mousterian industry HM-A1. Nr.1: "Janus-type" Levallois point; Nr.2-6: Levallois points; Nr. 7: plunging blade; Nr. 8: Levallois point; Nr. 9: broken Levallois blank; Nr. 10: Levallois point; Nr. 11: naturally backed knife; Nr. 12: Levallois flake; Nr. 13-14: partially retouched Levallois blanks; Nr. 15: retouched Levallois point; Nr. 16: scraper with ventral retouch; Nr. 17-18: Levallois points with partial retouch on ventral face.

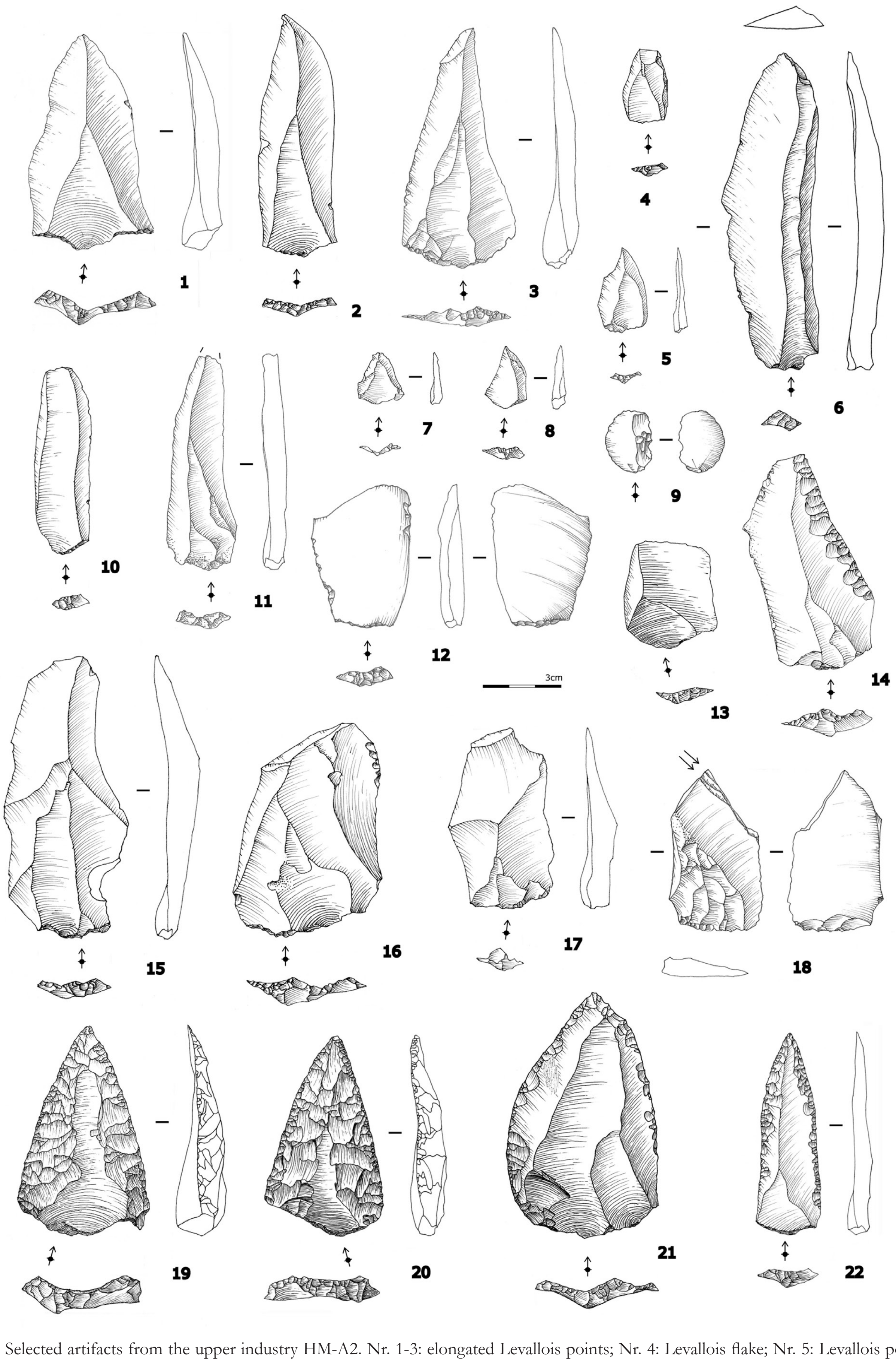

Plate 2 - Selected artifacts from the upper industry HM-A2. Nr. 1-3: elongated Levallois points; Nr. 4: Levallois flake; Nr. 5: Levallois point; Nr. 6: Levallois blade; Nr. 7-8: Levallois points; Nr. 9: retouched Kombewa flake; Nr. 10-11: Levallois blades; Nr. 12: Kombewa flake; Nr. 13: Levallois flake; Nr. 14: single convex side scraper; Nr. 15: Levallois blade; Nr. 16-17: Levallois flakes; Nr. 18: multiple burin with thinning on proximal part; Nr. 19-20: Mousterian points; Nr. 21: convergent side scraper; Nr. 22: elongated Mousterian point.

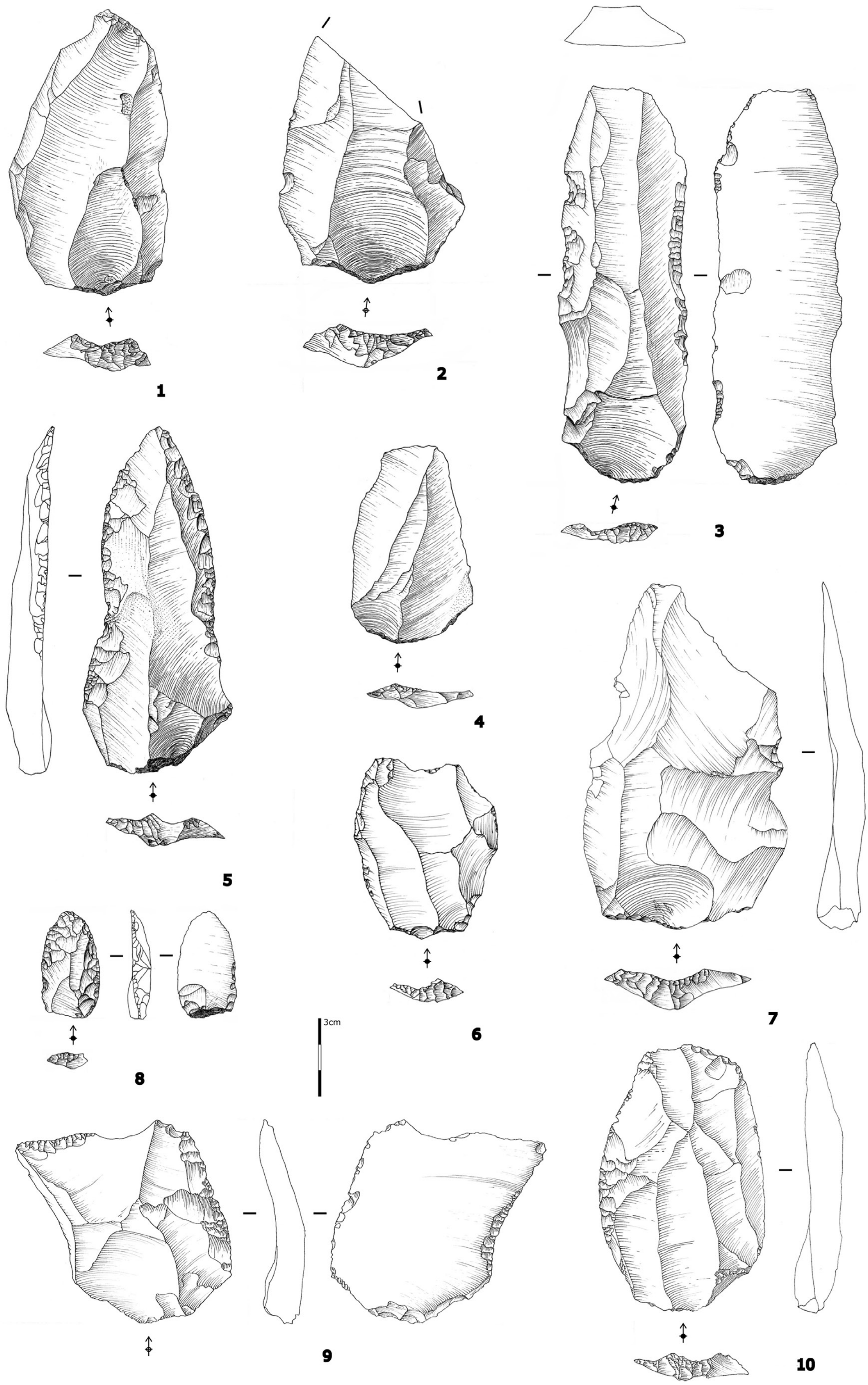

Plate 3 - Selected artifacts from the lower industry HM-B. Nr. 1: Levallois flake; Nr. 2: broken Levallois blank; Nr. 3: Levallois blade with alternate retouch; Nr. 4: Levallois flake; Nr. 5: double scraper made on Levallois blade; Nr. 6-7: preferential Levallois flakes; Nr. 8: convergent double scraper; Nr. 9: preferential Levallois flake with alternate retouch (backdirt); Nr. 10: single convex side scraper made on preferential Levallois flake (backdirt).

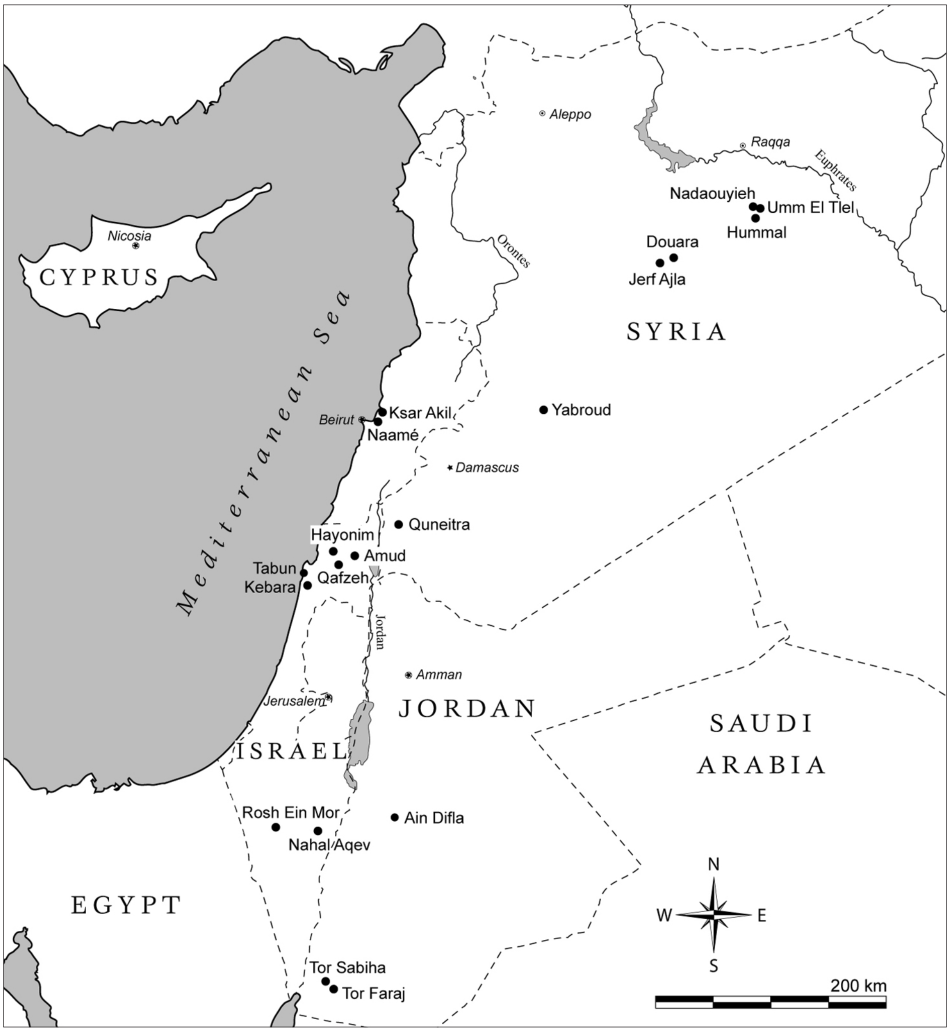

Figure 2 - Map showing the position of Levantine Mousterian sites mentioned in the text.

regarded as significant; in fact no major discrepancies exist. The most common retouched tools are partially retouched pieces, simple side-scrapers, and double side-scraper types, including convergent types and Mousterian points, some of which can be interpreted as curated items (plate 2:19&20). Noteworthy is the frequency of ventrally retouched pieces in HM-A1, setting it apart from the underlying industries. Ventral retouch may occur along one or both edges or may be confined to the distal end (plate 1:18). Other tool types are rare and in many cases appear in an atypical form.

The comparison of Hummal with other Levantine Mousterian sites

It is not our aim to present a new and comprehensive synthesis of Levantine Mousterian variability in this paper. The aim of the following section is to compare the Hummal Mousterian assemblages with other published sites that were chosen for similar techno-typological traits or with sites from which raw data is to hand, to enable a check for similarities as well as differences (fig. 2). Although future work with a larger sample size to hand will certainly lead to a refinement of the techno-typological aspects, the Mousterian sequence of Hummal already offers further data for the still fragmentary picture we possess of the Levantine Mousterian.

On a smaller scale, many gaps also remain in the regional database for the Middle Paleolithic in El Kowm. This is all the more regrettable as many of stratified well sites and surface scatters contain Mousterian artifacts (Le Tensorer *et al.* 2001), and this density underscores the enormous potential for future investigations. Preliminary observations made at different sites point at a considerable intra-regional variability in terms of core reduction methods and technological organization during the Mousterian (Hauck 2010).

Current models of Levantine Mousterian variability

Typically, the identification of major shifts in Levantine Mousterian technology in the Tabun sequence leads to a tripartite division of this period into succeeding phases D, C, and B. Since its definition by Lorraine Copeland (1975), this 3-stage model serves as an analytical framework for inter-site comparisons (e.g. Bar-Yosef 1998; Bar-Yosef & Meignen 1992; Copeland 1981; Jelinek 1981; Shea 2003). However, the accuracy of the phase model is tenuous. Reliable results for radiometric dating of Middle Eastern sites are still sparse, and the age of the Tabun sequence itself is still debated. In addition, discovery of new assemblages and re-analysis of older collections disclose a significant variability within the proposed stages (Bar-Yosef *et al.* 2005; Henry 1995a, 2003; Lindly & Clark 2000; Meignen 1998a, 1998b; Monigal 2002; Munday 1979).

A significant techno-typological variability is observed among Early Mousterian assemblages from sites which have been dated between 260 and 180ka BP (Bar-Yosef 1998; Bar-Yosef & Meignen 2001; Meignen 2007; Munday 1979). Dated key sites are Tabun unit IX, Rosh Ein Mor and Hayonim F / Lower E (Grün & Stringer 2000; Mercier *et al.* 1995, 2007; Mercier & Valladas 2003; Rink *et al.* 2003, 2004); sites with chronological uncertainties but technological affinities are Hummal layers 6-7, Nahal Aqev 3, Douara IV, Jerf Ajla E-F, Yabroud KS 8-10 and Ksar Akil XXVIII (Marks & Volkman 1986; Munday 1979; Nishiaki 1989; Schroeder 1969; Solecki & Solecki 1995; Wojtczak 2011). Several core reduction systems coexisted and inter-assemblage variability is mainly characterized by a shift between non-Levallois vs. Levallois methods (Monigal 2002). Given this variability, a precise definition of the Early Levantine Mousterian is problematic if not impossible. In the present state of research, it seems that in some sites the exploitation of prismatic cores was the principal means for blade production (e.g. Hummal, Hayonim), whereas in other sites this aim was preferentially achieved with the Levallois method (e.g. Yabrud, Tabun IX). However, there are no clear-cut differences in the technology, and the interrelationship between these reduction methods needs to be clarified. Layers 6 and 7 of Hummal bear evidence for an equal importance of prismatic blade and Levallois flake production. Analysis of cores and core trimming elements shows that a technological convergence between both methods is possible (Wojtczak 2011). A common aspect of all Early Mousterian assemblages is the abundance of blades, elongated points and Upper Paleolithic tool types. The problem is that high blade proportions and elongated points are equally found in much younger sites, which stimulates discussion as to their chronological position and the meaning of Levantine Mousterian variability in general; one such example is the site of Ain Difla, which revealed extremely elongated points and evidence for non-Levallois blade production (Clark *et al.* 1997; Lindly & Clark 1987). Moreover, some point-dominated Late Mousterian assemblages show a considerable overlap with Early Mousterian sites in respect to certain techno-typological features, as will be shown with reference to the Hummal Mousterian.

The younger phase or phases of the Levantine Mousterian are equally problematic in terms of defining clear-cut stage successions or a linear technological trend (Goren-Inbar & Belfer-Cohen 1998; Hovers 1998). Based on Tabun level C, Copeland (1975, 1981) proposed a second Mousterian phase characterized by relatively broad, oval-shaped Levallois flakes, which were removed from centripetally prepared cores, and a replacement of Upper Paleolithic tools by side scrapers. Although Copeland did not postulate a chronological ordering of her stages, she subsumed assemblages containing broad-based Levallois points within a third phase in analogy to level B at Tabun. Jelinek saw the Tabun C and B type Mousterian as different facies responding to specific environmental settings, and not as a succession of separate cultural entities (Jelinek 1992). Contemporary thought about the phylogenetic position of both Mousterian variants is inconclusive, with several researchers favoring a temporal succession of the two complexes (e.g. Bar-Yosef 1998; Bar-Yosef & Meignen 2001) and others pertaining to Jelinek's facies idea (e.g. Lindly & Clark 2000). As is the case for the earlier Mousterian phase, some Tabun C-like sites, such as Tabun unit I, Skhul B and Qafzeh, seem to cluster in a delimitable time frame of 170 to 80ka BP (Grün & Stringer 2000; Mercier & Valladas 2003; Mercier *et al.* 1993; Schwarcz *et al.* 1988; Valladas *et al.* 1988), whereas others, such as Quneitra, are much younger despite similar technological traits (Goren-Inbar 1990).

It is not our intention to cut the Gordian knot surrounding the question of which assemblage belongs to which Mousterian complex and whether it is reasonable to expect a coherence of technological patterns and chronometric results in the sense that different traditions follow each other in time. The confusion concerning Levantine Mousterian variability is largely a result of conflicting dating results, varying theoretical approaches and inconsistency of analytical systems. It is fairly reasonable to assume that a complex and region-specific interplay of technological traditions, subsistence strategies, mobility and land-use patterns is responsible for the apparent lack of a distinct techno-typological trajectory over time (see also Hovers 2001, 2009; Marks 1992; Munday 1976). Nevertheless, some general tendencies can be defined. The final Mousterian period is placed in the time-range of around 80 to 50 ka BP and saw an increase in point-dominated assemblages; this seems to be the case in the coastal region as well as in the arid steppe of the interior and the desert areas of the southern Levant (Hovers 2009). A characteristic feature of the Late Levantine Mousterian is the nearly exclusive use of the Levallois method and a marked standardization of the convergent flaking concept for Levallois point production. However, morphological variability among the point assemblages is stronger than is often claimed.

Preliminary age determinations of the Hummal Mousterian

Exacerbating uncertainties about the chronological position of the Hummal Mousterian is the fact that only preliminary dating results are available at present (Richter *et al.* 2011). Thermoluminescence (TL) dating of heated flint from levels 5b3 and 5g gives only a rough idea of the possible age of these levels. Dating of level 5b3 delivered a minimum age of 36 ka ± 5 ka years BP, whereas the age of lowest level 5g is placed between 98 ka ± 16 ka and 128 ka ± 18 ka years BP. These dates are far from definitive, and techno-typological features are a better means for comparing Hummal with other sites in the region and beyond.

Hummal within the Late Levantine Mousterian

The observed focus on Levallois point production in the upper two thirds of the Hummal sequence warrants a tentative placement of the HM-A industries into the pool of other Late Mousterian assemblages which equally exhibit a high frequency of Levallois points and similar standardized core reduction strategies to produce this blank type. For this purpose, the point-dominated levels of Hummal can be compared to complexes V and VI of the neighboring site of Umm El Tlel (Al Sakhel 2004; Boëda & Muhesen 1993; Boëda *et al.* 1998, 2001, 2007, 2008), the upper layers of Yabrud I rock-shelter (Rust 1950; Solecki & Solecki 1995 and own observations), layers IX to XII of Kebara Cave (Meignen & Bar-Yosef 1991, 1992; Meignen 1995), layer B of Garrod's excavation in Tabun (Garrod & Bate 1937), the Amud B assemblages (Hovers 1998; Ohnuma & Akazawa 1988), and the Southern Negev samples of Tor Faraj and Tor Sabiha (Henry 1995a, 1995b, 2003). Although the Yabrud deposits are not dated yet, we regard the level 2 assemblage as of a Late Mousterian based on techno-typological characteristics (Hauck 2010). In this respect, we disagree with Solecki & Solecki (1995), who attributed it to an Early Levantine Mousterian of Tabun D type (see also Copeland 1975).

A strikingly good accordance between Hummal and the sites mentioned above is given for the uppermost HM-A1 industry, despite certain differences in the frequency of core reduction methods, blank types and tool forms as well as blank metrics. Of crucial importance in this respect are the clear focus on triangular shaped blanks and the presence of classic Levallois points. These pieces exhibit an Y-*arrête* scar pattern, *Concorde* shaped cross section, platform faceting and *chapeau de gendarme* shaped butts. A significant number of the points are broad and rather short exhibiting the highest width at their base. The reoccurrence of these attributes points at a standardized blank production. In fact, the Levallois point samples of Hummal HM-A1, Kebara IX-XII, Amud B4, Tabun B and Tor Faraj C are nearly identical regarding technology and artifact morphology. Furthermore, blanks produced from one single striking platform are dominating in all these assemblages. This strong technological similarity is insufficiently reflected by the technological data in table 3 which can be due to sample size error but more probably because of the inconsistency between observers as regards the definition of blank categories. This aspect is especially pertinent to the differentiation between Levallois and non-Levallois blanks, as well as true Levallois points and triangular shaped flakes and IL calculation (Copeland 1983; Hauck 2010; Meignen 1995). For example, the frequency of Levallois points given for the Kebara samples is strikingly low compared to other sites because of a strict definition of this blank form. A better measurement of the importance of Levallois point production is the frequency of the unidirectional convergent scar pattern on the dorsal face of all blanks, which falls in between 40% and 60% for levels IX to XII of Kebara, and is therefore closely comparable to the frequencies observed for Hummal HM-A1, Amud levels B1 and B4 and Tor Faraj. The convergent method of core exploitation also seems to have been systematically applied in many levels of complex V and VI of Umm El Tlel and Jabrud level 2, however, the significant number of points which exhibit bidirectional removals constitutes a difference to the Hummal material. It is interesting to note that Umm El Tlel is situated closer to the El Kowm flint outcrops than Hummal, and that the bidirectional Levallois method was mainly executed during the initial phase of core reduction. Therefore, it is possible that the scarcity of corresponding blanks in Hummal is due to a distance-decay relationship. In other words, if the bidirectional production of Levallois blanks required large cores, their frequency would decrease as soon as transport costs increased. Other factors, such as raw material size and functional requirements, can explain the variability of flake / blade proportions and the chosen methods to produce them. While the centripetal method of core reduction seems to have been frequently applied for Levallois flake manufacture in some point-dominated assemblages of Umm El Tlel and Amud, evidence for it is scarce in Hummal, Kebara and Yabrud, where the unidirectional method was the preferred flaking strategy.

Aside from the presence of some classic Levallois points in levels 5a2 to 5E, the Hummal HM-A2 industry does not show a comparable similarity to the mentioned sites as do the uppermost levels of Hummal, except for Amud levels B1 and B2. This is due to the marked inter-level variability in terms of blank type frequency, intensity of core exploitation and the strong laminar aspect of many assemblages, which is also reflected by the presence of "leaf-shaped" points in the middle part of the Hummal Mousterian sequence. While many blades in point-dominated assemblages can be seen as by-products of Levallois point production (Demidenko & Usik 2003), a significant part in HM-A2 are to be seen as distinct end-products (Hauck 2010), resulting in very high laminar indices for some assemblages (tab. 3). As in Hummal HM-A2, a characteristic element of Amud levels B1 and B2 is the abundance of atypical, mostly elongated Levallois points and rectangular blades and flakes with unidirectional parallel scar patterns. In both sites the first stages of core preparation occurred off-site. The typical by-products of initial recurrent point production are elongated, semi-cortical removals with unidirectional scar patterns. The elongated asymmetrical points with only slightly converging scar patterns in levels B1 and B2 in Amud, are reminiscent of the "leaf shaped" points in the HM-A2 complex in Hummal. Moreover, the significance of elongated flakes and blades with unidirectional scar patterns in Amud B1 and in Hummal levels 5a2 to 5E reinforces this technological resemblance, although blades are much more common in the Hummal samples (tab. 3). Evidence for the production of centripetally prepared preferential flakes in the final stage of core reduction is found in both sites.

A phenomenon which is shared by all Levallois point assemblages from Hummal and other Late Mousterian sites is the scarcity of retouched implements and the dominance of retouched points and side scrapers in the tool sample. It is interesting to note that ventrally retouched pieces are a characteristic typological element in Hummal HM-A1 and complex VI3 of Umm El Tlel. The same holds true for Tor Faraj and Tor Sabiha, the samples of which exhibit a concentration of retouch on mesial and proximal point edge sections. It is conclusive to assume that this pattern reflects hafting facilities (Henry 1995a). Interestingly, we observed a reverse pattern in the Hummal assemblages in which the majority of points show retouch at the distal tip. This could be due to a differential use of points in both sites or differences in hafting technology; in this respect, it is possible that the access to natural bitumen usable as mastic in the El Kowm region reduced the need for proximal edge regulation. (Boëda *et al.* 2008).

Concerning Levallois points, little effort in core preparation is needed for a serial production, and the cores' flaking surface was repeatedly reshaped with elongated and often plunging core edge flakes. Whether it is possible to differentiate between a recurrent and lineal method of point production is a controversial issue (see discussion in Bar-Yosef *et al.* 1992). Nevertheless, the intrinsic relationship between the two reduction modes which is postulated for the Hummal HM-A1 industry seems to be equivalent in Kebara levels IX and X and certain levels of Umm El Tlel. In Tor Faraj, the core reduction strategy was probably more rigid, which is mirrored by the preference for the lineal method (Demidenko & Usik 2003). The technological rigidity seen in Tor Faraj probably explains the higher proportion of Levallois flakes and the lower length-width ratio of points in comparison with Hummal, where the unidirectional recurrent method was frequently chosen to obtain elongated blanks; however, it has to be stressed that in both sites, a significant quantity of blades are by-products of Levallois point core reduction. Moreover, preliminary refittings in some Hummal levels indicate a rather strong affinity with the technical gestures applied for Levallois point production in Tor Faraj (Demidenko, personal communication). Some of the mentioned Late Mousterian assemblages reflect an intensive core reduction for Levallois point production. (e.g. Henry 2003; Hovers 1998; Meignen & Bar-Yosef 1992). The extensive production of Levallois points until a very low size threshold of the cores is also visible in most of the Hummal assemblages. The majority of waste cores, the size of which clusters around 5cm, are extremely reduced and their totally reworked state with multidirectional removals closely resembles the core sample of Tor Faraj (Demidenko & Usik 2003). Indirect evidence for extensive Levallois point production in Hummal is given by the presence of small points in the range between two and three centimeters. A further element which corresponds with the aim of obtaining small points is the frequent recycling of broken blanks or tools. In many cases, subtriangular flakes were struck from the cores on flakes, the number of which is outstandingly high in most of the Hummal assemblages (tab. 2). A high frequency of secondary cores, to which most so called "truncated faceted pieces" can be added (Hauck 2010), is also reported for Amud levels B1 and B4 (Hovers 2007), Kebara (Bar-Yosef *et al.* 1992), Tor Faraj (Henry 2003) and Umm El Tlel level VI3a' (Bourg 2007). Recent analysis of Hummal levels 5a2, 5a3 and 5b3 revealed a striking resemblance to the secondary point production methods observed in the Tor Faraj material, including the removal of points from the ventral surface of flakes and the exploitation of extant Y-arrête scar patterns on points with burin-like spalls.

Searching for the factors which explain the importance of this recycling strategy, one has to examine the technological organization at a given site. In this respect, it is interesting to note that the technological organization reflected in the two Jordanian rock-shelter sites Tor Faraj and Tor Sabiha corroborates observations that were made for the Hummal Mousterian. The fact that Tor Faraj, which is located far away from raw material, was provisioned with complete nodules and prepared cores, whereas the Tor Sabiha site saw an import of blanks and low on-site core reduction, despite its proximity to raw material sources, affirms our observation that provisioning strategies do not necessarily follow a distance-decay relationship (Hauck 2010; Henry 1995a, 1995b). Tor Sabiha probably served as a transitory camp; raw material procurement was rather embedded in other subsistence activities, and provisioning the site with stock was unnecessary. Contrastingly, Tor Faraj was a regularly visited, long-term encampment, and hence, a wider range of activities required a considerable amount of raw material. Although the rock shelter is 17 to 22 km away from suitable raw material sources, a targeted procurement and a provisioning of place strategy was applied, which necessitated the transportation of considerable loads. To economize on raw material use, core reduction was pushed to the extreme and many flakes were secondarily used as cores. The same behavioral pattern is observable in Hummal, and it is certainly no coincidence that the humans at Tor Faraj and Hummal had to cope with equal distances to raw material outcrops. Combining the evidence of both sites, the importance of the secondary flaking method can be seen as positively correlated to transport distance; a similar observation was made for Mousterian sites in the Central Negev (Munday 1976).

A Tabun C type Mousterian facies in Hummal

The scarcity of Levallois points and the distinct features of Levallois flake and blade production in the lowest Mousterian levels of Hummal represent a totally different technological tradition compared to the overlaying HM-A industries. Important in this respect is the presence of large flakes and blades which were principally produced with the unidirectional, bidirectional and centripetal method of core reduction (plate 1 and tab. 4). This technological profile warrants a correlation of the Hummal HM-B industry with so called Phase 2 / Tabun C type Mousterian assemblages, such as Qafzeh levels V-XXI (Hovers 2009), Tabun unit I Beds 18-26 (Jelinek 1981, 1982a, 1982b and own observation), Douara layer III (Akazawa 1974, 1979) and Ksar Akil levels XXVI-XXVII (Marks & Volkman 1986), Naamé and Ras El Kelb (Copeland & Moloney 1998).

Although the Hummal samples are tool small to be conclusive, the combined percentage of centripetal and bidirectional scar patterns in Hummal levels 5e to 5g falls into the same 60% to 80% range, which is also observed across the Qafzeh sequence (Hovers 2009). In Tabun Beds 18-26, Douara level III and in Hummal HM-B, the Mousterian knappers followed a twofold strategy by removing quadrangular or oval shaped flakes from centripetally prepared cores and elongated flakes and blades from cores with one or two opposing platforms. Despite these similarities, the Hummal samples seem to exhibit idiosyncractic

level	analyzed sample[a] N	Levallois blanks N	Levallois flakes %	Levallois blades %	Levallois points %	bidirectional and centripetal scar pattern %	LWR	Ilam
5e	54	9	4	3	2	85.7	2.0	50.0
5f1	43	12	6	5	1	60.0	2.0	40.0
5f2/3	38	17	7	9	1	73.3	2.2	68.4
5g	47	11	5	5	1	77.8	1.9	36.4

Table 4 - Composition of the lowest Mousterian assemblages of Hummal (HM-B industry), a) roral debitage sample excluding debris <2cm, fragments and cores.

features which set them apart from the mentioned Phase 2 assemblages. First, there is no indication for a recurrent centripetal flake production in Hummal, such as off-set axis flakes and *débordant* elements. In the present state of analysis it seems that all Levallois flakes were obtained by the lineal method. Second, while the mentioned Tabun C type assemblages are clearly dominated by rather squat flakes, the frequency of elongated blanks is very high in Hummal and respective blade indices are found clearly outside the range of other Tabun C type assemblages (tab. 4). Concerning Hummal, a larger sample is required to test the significance and meaning of these differences.

Conclusions

Levallois point dominated assemblages are found in the upper two third of the Hummal Mousterian sequence. Two industry types, namely HM-A1 and HM-A2, can be distinguished based on differences in Levallois point technology and on the technological attributes which are exhibited by accompanying flakes and blades. Both industries show strong similarities with other point-dominated Late Levantine Mousterian sites, such as Umm El Tlel, Yabrud, Kebara, Amud, Tabun or Tor Faraj. Due to the persisting dating problem of the Hummal deposits, a chronological positioning can only be done based on techno-typological grounds. Given the similarity between Hummal levels 5AI to 5E and the mentioned Late Levantine Mousterian sites, it is reasonable to allocate the major part of the Hummal Mousterian sequence somewhere in the timeframe between 80ka and 50ka BP. The inter-site comparisons make clear that Hummal levels 5AI to 5E reveal idiosyncratic features, such as the marked laminar tendency in many levels, which can be partly explained by the access to large, high-quality flint nodules. However, the presence of broad Levallois points with an Y-*arrête* scar pattern and faceted and *chapeau de gendarme* shaped platforms and the removals' strong convergence on the core surface in Hummal HM-A1 are in good accordance with the technological profile of Kebara levels IX-XII, Amud level B4, Tabun B, Jabrud level 2 and Tor Faraj level C. Regarding assemblage composition, the Hummal HM-A2 industry is more variable showing a high amount of elongated flakes and blades in many levels and a systematic unidirectional parallel removal of blank together with the convergent method. The only Late Mousterian which shows comparable assemblages is Amud, notably levels B1 and B2.

The techno-typological variability, inherent in the Late Mousterian industries of Hummal, clearly echoes the complexity which characterizes this period in the Levant. Moreover, the bundle of techno-typological differences between the El Kowm Mousterian sites of Hummal and Umm El Tlel indicates that a considerable variability in core reduction strategies and tool manufacture exists even within a relatively restricted area. Besides the complexity of technological organization patterns, variability in the Late Levantine Mousterian can be expressed by inter-assemblage and inter-site differences in core preparation and reduction methods, blade vs. flake proportions, and point morphologies. Admittedly, the techno-typological variability of the Late Levantine Mousterian cannot be comprehensively described with these parameters alone. In our view, future research has to focus on parameters of technological organization, such as raw material provisioning and site function, to better understand the meaning of the observed variability.

The allocation of the lowermost Hummal levels 5e to 5g to the Levantine Mousterian of Tabun C type is tentative. Based on the mentioned technological aspects, Douara levels IIIA and IIIB and Tabun unit I were placed into the Middle Middle Paleolithic or Phase 2 / Tabun-C phase of Copeland's tripartite division of the Mousterian (Copeland 1975; Akazawa 1987; Shea 2003). Despite the sample size and dating problem in these sites, this general correlation would allow it to tentatively place the lowest Mousterian levels of Hummal into the middle part of the Levantine Mousterian. This period shows the same degree in variability of technological gestures as the Late Levantine Mousterian. Although broad similarities in terms of centripetal core reduction methods and scarcity of Levallois points are detectable in Hummal, Douara and Tabun unit I, many differences exist in terms of assemblage composition and alternative flaking technologies. Reinforcing this picture is the variability which is recorded between the levels of the Qafzeh sequence (Hovers 2009). Hence, we can no longer describe the Middle Levantine Mousterian as a facies which is dominated by "broad oval" flakes. Provided that the allocation of Hummal levels 5e to 5g to the Middle Levantine Mousterian proves to be correct, a chronological placement of these levels into MIS 5 would be in agreement with the preliminary TL dating results for level 5g (Richter *et al.* 2011). Current theory states that the geographical extension of the Tabun C facies is restricted to woodland areas along the eastern Mediterranean coast (Copeland 1981; Henry 1995a; Lindly & Clark 2000). The discoveries in the lowest Mousterian levels of Hummal contradict this assumption. It is possible that the Tabun C assemblages reflect the exploitation of different resource types compared to the following point-dominated Mousterian. Their evidence in the interior arid part of the Levant shows that these activities were not restricted to a specific environment. Whether the significant variability visible in the Early, Middle and Late Levantine Mousterian was triggered by ecological or merely cultural factors is an urging question, from which we are far from providing an answer. However, ongoing research in the Mousterian sequence of Hummal and neighboring sites will certainly provide further information for a better understanding of Levantine Mousterian variability.

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