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**The Ghassanian Techno-Complex: Late PPNB lithic industries from the Ghassanian techno-complex: occupation sites related to the use of desert kites in Jibal al-Khashabiyeh, south-eastern Jordan**

Rémy Crassard, Juan Antonio Sánchez Priego, Fiona Pichon, Wael Abu-Azizeh, Mohammad Tarawneh

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# TRACKING THE NEOLITHIC IN THE NEAR EAST

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# TRACKING THE NEOLITHIC IN THE NEAR EAST

*Lithic Perspectives on Its Origins,  
Development and Dispersals*

*The Proceedings of the 9th International Conference  
on the PPN Chipped and Ground Stone Industries of the Near East,  
Tokyo, 12th–16th November 2019*

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*In memory of the late Ofer Bar-Yosef and Carole McCartney*



# The Ghassanian Techno-Complex

Late/Final PPNB Lithic Assemblages from Desert Kite-Associated Occupation Sites in Jibal al-Khashabiyeh, South-Eastern Jordan

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## Abstract

A series of eight dwelling sites were discovered recently in south-eastern Jordan, directly associated with eight mass-hunting structures: desert kites. These associated sites also share a clear chronological framework, as they are all dated to the end of the Pre-Pottery Neolithic B. The archaeological material, mostly made up of abundant lithic industries, is extremely homogenous and coherent at all the sites. The excavated lithic industries from three of the eight dwelling sites are studied here. They show similarities and consist of a blade and a bifacial component of small to large-sized artefacts, in association with a large assemblage of small arrowheads of various types. On the basis of the specific characteristics of the whole lithic assemblage, a new regional techno-complex, called the “Ghassanian”, is defined for these desert margins of the Fertile Crescent.

*Pre-Pottery Neolithic, Levant, arid margins, lithic technology, desert kites hunting traps, Ghassanian*

## 1. Introduction

Archaeological explorations have been carried out in the Jibal al-Khashabiyeh area by the South-East Badia Archaeological Project (SEBAP) since 2013. A set of eight “desert kites”, aligned in the form of a north-south chain and with the same orientation opening towards the east, have been identified in these desert margins of south-eastern Jordan. These structures are certainly among the most spectacular installations from the Late Prehistory in the Near East. They consist of several long stone walls (sometimes several kilometres long) converging towards an enclosure punctuated by circular structures. Their interpretation was widely debated before a general consensus was reached, linking the structures to the hunting of wild animals, presumably gazelles (Crassard *et al.* 2015, 2022). Dating data are only just beginning to emerge across their very wide distribution zone, ranging from the Near and Middle East to Central Asia (Abu-Azizeh *et al.* 2015, 2021;

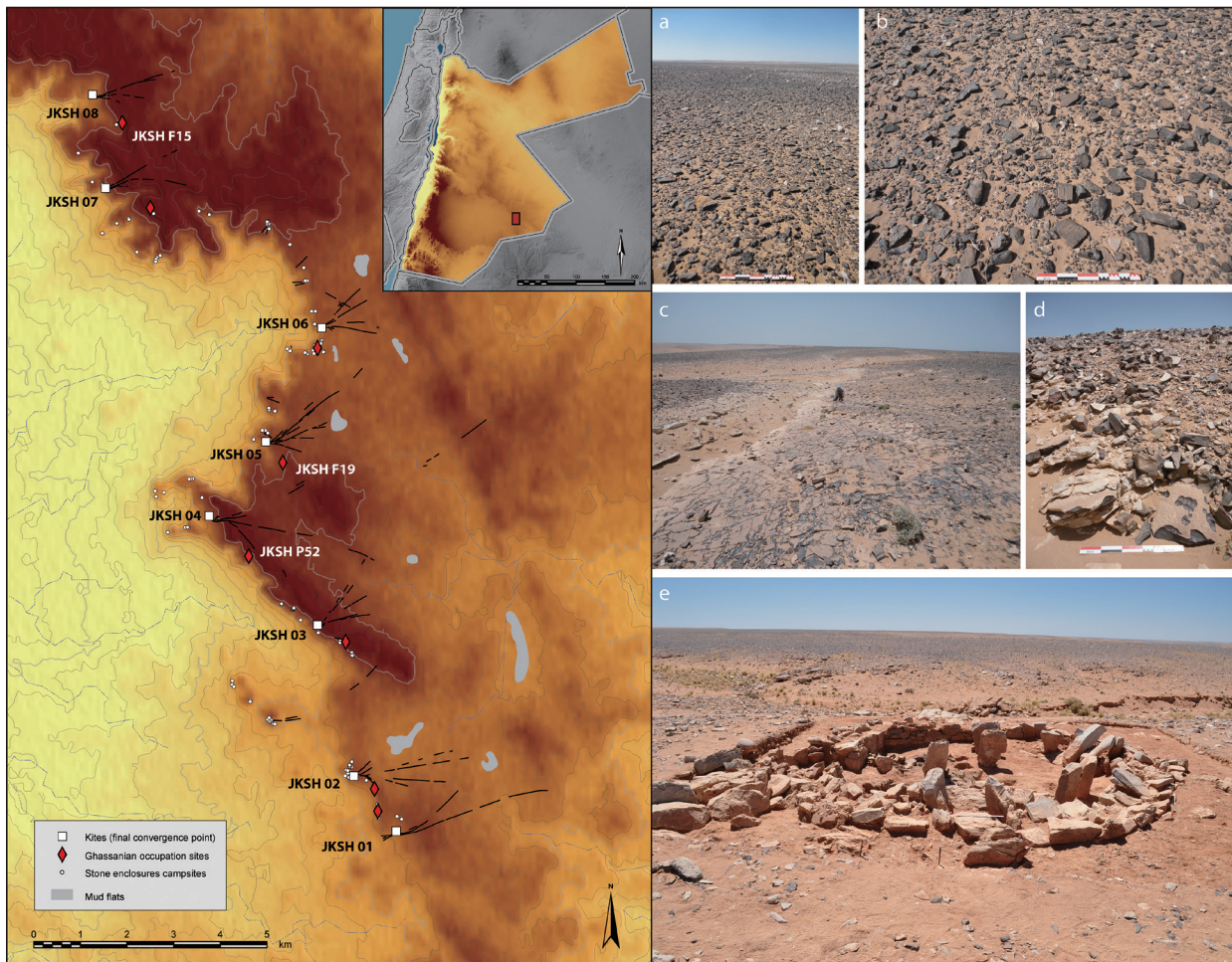


Fig. 1. Map showing the location of Jibal al-Khashabiyeh in south-eastern Jordan, desert kites and associated Ghassanian occupation sites. Photographs showing the landscape and sites on the right; a and b: desert pavement covered with chert; c and d: chert outcrop in a wadi bed close to JKSH F15 site; e: JKSH F19 site after excavation.

Al Khasawneh *et al.* 2019; Barge *et al.* in press). Kites are characteristic of desert occupation, and in Jordan, they were only known in the northeast of the country up until now. The study of these structures enables us to adopt a global approach to the question of the evolution of animal resource exploitation during recent prehistory. Indeed, the importance of hunting versus breeding activities is central to reflections on the development of subsistence processes throughout and beyond the Neolithic period. Radiocarbon dating traces the use of kites back to a transitional Late to Final Pre-Pottery Neolithic B chronological timeframe (Late/Final PPNB), around 7000 cal. BC (Abu-Azizeh *et al.* 2021). These are therefore the oldest kites currently known in the world.

A set of dwelling structures was discovered recently (Fig. 1) in the vicinity of the chain of kites. These occupations are characterized by the presence of a very specific material culture, in particular an exceptionally

rich lithic industry in a stratigraphy preserved in circular dry-stone dwelling structures. This group of sites appears to belong to a homogeneous techno-cultural facies, and fits perfectly into the chronological context of the Late/Final PPNB, as has been confirmed by radiocarbon dating. Each dwelling site is located in direct proximity to a kite and it has now been proven that these were the dwelling places of the hunters who used the kites (Abu-Azizeh *et al.* in press). Such kite-associated dwelling sites have never been identified anywhere else in the Near East to date, with such certainty (see however Betts 1998, for the site of Dhuweila which could constitute another possible kite related occupation site). Of the eight dwelling sites identified at Jibal al-Khashabiyeh, three have been excavated: JKSH F15, JKSH F19, and JKSH P52.

Abundant lithic material was found at all three sites. It is dominated by laminar production, as well as a more quantitatively limited bifacial component, but which

nonetheless constitutes a distinctive element of the assemblages. A variety of different types of arrowheads is also an important part of the assemblages. The homogeneity of this industry suggests that a marked techno-cultural constraint was at work, which leads us to define a techno-complex specific to this region and period, which we propose here to call “Ghassanian”. The recurrent production modes, the debitage economy and the tool typology attest to a very coherent complex. This consistency is entirely corroborated by the radiocarbon dating sequence compiled from the three studied sites.

The objective of this article is to define the main technological and typological features observed at the three excavated sites. A preliminary comparative approach is then presented for the neighbouring regions of the southern Levant. Finally, the study addresses the implications of these results in terms of cultural diffusion at the end of the Neolithic between a priori well-differentiated socio-economic and technical spheres by focusing on the specific cultural traditions of these populations on the desert margins.

## 2. The site setting

Jibal al-Khashabiyeh is the name of a series of mounts located 80 km to the east of the modern town of Al-Jafr in south-eastern Jordan. They mark the escarpments of a limestone plateau sloping towards the east with a maximum elevation of 1000 m above sea level. They border the eastern part of the Al-Jafr Basin, which was a former palaeolake, at least during the humid periods of the Pleistocene (Mischke *et al.* 2015; Davies 2005). An important hydrographical network dissects this escarpment towards the Al-Jafr Basin. The geology of the region is composed of chert bedded limestone and marl (Eocene-Paleocene) in the north and east, chalk marl, bituminous limestone and marl in the largest sector of the area, from the northwest to the southeast (Maastrichtian), known as the Muwaqqar Chalk-Marl Formation (Batayneh 2011), sandy and silicified phosphorites and marly limestones (Maastrichtian) in the southwest, and locally recent Quaternary deposits, alluvial sediments or aeolian sands in wadi beds (Bender 1968). The limestone bedrock is rich in chert. The latter covers the present-day surface of the rocky desert pavement and is particularly exposed along the upper parts of the escarpment slope. The eight desert kites were discovered on the top of the escarpment. They were built with whitish limestone blocks and piles of cherts, in order to visually mark the generally dark landscape (Abu-Azizeh *et al.* 2021).

## 3. The excavations

Eight kites have been clearly identified in Jibal al-Khashabiyeh. They form a continuous chain following an organization characteristic of these structures in the

desert regions of the Near East. Three of these eight kites present a well-conserved enclosure. Excavations focused on the three best-preserved kite enclosures (JKSH 01, JKSH 04, JKSH 07). The circular structures at the periphery of the enclosures were excavated. These were found to be pit-traps, where hunted animals may have been trapped, as observed during excavations of other kites in other parts of Jordan, the Middle East, the Caucasus and Central Asia (Crassard *et al.* 2022). The pit-traps were excavated in quarters or halves to preserve stratigraphic sections and to analyse filling processes, as well as to find elements for dating.

In parallel with these kite excavations, three associated dwelling sites were excavated, extensively for JKSH F19 (seasons 2015, 2016) and JKSH P52 (seasons 2016, 2018, 2019) and partially during the rescue excavation of JKSH F15 (season 2015). All the sediment was systematically sieved on a mesh of 0.5 to 1 cm. Some sediment samples were sieved on even finer mesh sizes in order to retrieve palaeobotanical, archaeozoological or other remains. In parallel with excavation operations, a survey of the whole Jibal al-Khashabiyeh sector was carried out in order to complete the archaeological map of the area, but also to carry out a study of the current environment (geology, topography, hydrography, flora). Finally, an ethnographic survey was initiated, based on interviews with the Bedouin populations present in the area, in order to obtain information on the nomadic pastoral way of life.

## 4. The sites and their dating

At the first excavated dwelling site, JKSH F15, preliminary pedestrian survey revealed that the site had been recently looted and did not seem to present sufficient potential for unearthing architectural and material remains in a secure archaeological context. A test excavation was nevertheless conducted over a period of a few days in order to evaluate its state of preservation and to define its chrono-cultural attribution through the study of the archaeological remains. Abundant lithic industries were found, attesting to the occupation of the site during the PPNB. However, studies were stopped following this test excavation, as the site appeared to be too disturbed to obtain precise information.

Not far from JKSH F15, the second excavated site is JKSH F19. After a first sounding in 2015, the extension excavation in 2016 uncovered a complete sub-circular unit with a diameter of 6 m, comprising numerous fireplaces, accompanied by relatively large quantities of burnt animal bones, mostly from gazelles. The radiocarbon dating of charcoal samples confirms the attribution of this occupation to a Late/Final PPNB context, strictly contemporaneous with the use of kites around 7000 cal. BC. The relatively simple organization of the structural remains points to possible seasonal occupations of these dwelling sites by hunters. A

single excavation campaign was sufficient to excavate the single occupation unit in its entirety.

The third excavated site, JKSH P52, is much more complex. Two first test trenches in 2016 revealed a stratigraphy more than a metre thick, and the extension excavation underway since 2018 (2018 and 2019 campaigns) yielded a similar lithic industry to that of JKSH F19, as well as comparable, although much more extensive architectural remains, confirming their affiliation to the same chronological complex. The JKSH P52 site provided extremely rich and diversified material remains (lithic tools, grinding and crushing equipment, ornamental objects, various figurines), which is unusual in a desert occupation context. It also yielded an exceptional quantity of faunal remains, composed of more than 99% of gazelle remains. JKSH P52 thus constitutes the first evidence of a site specialized in the exploitation of mass hunting by kites during the PPNB, where butchery activities were carried out.

An important series of radiocarbon dates was obtained for the occupation of the three sites. These consistent dates are concentrated around 7000 cal. BC (with maximum range of dates extending from 7451 to 6826 cal. BC at the [2 $\sigma$ ] confidence interval). These occupations are relatively short, and only span a few centuries, covering the end of the Late PPNB.

## 5. Raw materials

Local populations call the region of Jibal al-Khashabiyeh “Ardh as-Suwan”, which means flint (chert) land or territory. Chert is indeed omnipresent in the landscape and outcrops on the surface of the plateau, in escarpment sections, or in the eroded bottoms of certain wadis. Two main groups of deposits can be distinguished: tabular blocks in secondary position found on the surface and large nodules in primary position still integrated in the limestone substratum. The chert tabular blocks cover almost the entire surface of the study area with differences in density and dimensions. The excavated open-air dwelling sites (JKSH F15, F19 and P52) are therefore located in environments particularly rich in chert, mostly of very good quality for knapping operations. These chert materials were detached from the chalky substratum by deflation, runoff and other erosive processes, producing the plateau top reg, characteristic of the “desert pavement” found in many arid and hyper-arid regions of the Middle East. The local chert blocks are of plane morphology with dimensions varying from 10 to 40 cm long, 10 to 30 cm wide and 2 to 6 cm thick. In the areas around the JKSH F15, F19 and P52 sites, grey, black and varying tones of brown cherts are predominant. Up until now, two main categories have been identified depending on the texture and the macroscopic aspect of the grains (with the naked eye and a magnifying glass): a finer-grained chert and a second with coarser grains (“dry” chert). The composition of these

two varieties of local tabular chert is very homogeneous, which makes them very suitable materials for knapping, and they are the main lithic materials used at the observed sites. Large chert blocks and large nodules were observed in primary position in the sections and bottom of some wadis, trapped in a limestone gangue.

The dimensions of these nodules with flattened volumes sometimes reach more than 60 cm in length and 40 cm in width, with thicknesses varying from 5 to 20 cm. The blocks are fine-grained and homogeneous, grey or brown in colour, with very good physical properties for knapping. The three excavated sites also yielded rarer artefacts such as arrowheads, fine blades and bladelets obtained from yellow, grey, pink, often translucent, very high-quality allochthonous flints and from red and orange fine-grained orthoquartzites. This indicates the existence of distribution networks for all these types of materials. However, the distances and transfer modes of these networks still remain to be studied on a large scale in and beyond Jordan.

## 6. Technological analyses

### 6.1. Thick blades

The chert tabular blocks from Jibal al-Khashabiyeh are available in the immediate surroundings of the dwelling sites. Their shapes and volumes are suitable to large-scale blade production without elaborate preliminary core preparation. Indeed, the regular natural flanks with parallel edges do not require elaborate shaping before initiating the production of a significant number of blades. This production follows simple operating schemes: use of a natural surface as a striking platform or opening this striking platform by detaching a simple flake, then unidirectional (unipolar) *débitage* of cortical and lateral semi-cortical blades by direct hard stone percussion, then blades in parallel series along a single surface and in a semi-rotating (*semi-tournant*) mode. The obtained ridges guide the production of elongated, often relatively thick, and sometimes pointed blades. Reduction follows this pattern until the core is exhausted, without any particular preparation of the striking platforms, apart from removing the overhang and a little abrasion, or without any reorganization of the *débitage* surface by means of rejuvenation, for example. Sometimes, the location of the *débitage* surface may move around the original core volume, but the operation always remains unipolar. There are also cores with two opposed striking platforms, but which also remain unipolar. In these cases, the second striking platform is used sporadically for correcting *débitage* accidents or rebalancing the *carène* or distal curvature of the *débitage* surface from the distal part of the main unipolar striking platform. In this case, we cannot speak of predetermined bipolar (bidirectional)



Fig. 2. Blades from Jibal al-Khashabiye lithic assemblages, site JKSH P52. 1-9: thick blades; 10-14: light blades/bladelets.





Fig. 3. Tools from Jibal al-Khashabiyeh lithic assemblages. 1-6: bifacial pieces; 7-11: perforators.

reduction, but rather of unipolar reduction prolonged by readjusting axial convexity.

When the slab or block is more irregular, a few removals are made to eliminate possible problem areas and if there are significant irregularities, thicker flakes are removed in order to carry out preliminary preparation by cleaning and opening the block. It is also easy to clean the

debitage surfaces during operations. This can be seen on some cores and blades from the JKSH F19 and P52 sites. The scarcity or absence of shaping elements in this scheme should not be interpreted as a lack of know-how (expertise) but rather as an adapted economic management of the available ready to knap volumes. Small blocks are not shaped either, but are directly knapped lengthwise, from

a single, sometimes cortical striking platform. Nodules are only present in the form of large fragments or large flakes directly knapped lengthwise.

The analysis of the butts and proximal zones of hundreds of blades with pronounced bulbs shows that unipolar debitage was carried out by direct percussion with hard stone. Hard limestone hammers were found at all three sites, in occupation levels with abundant quantities of lithic objects. The blades are long and generally quite straight, sometimes with a distal curvature. Dimensions are variable (5 to 15 cm long and 2 to 4 cm wide), depending on the reduction phase of exploitation of the cores which, despite the abundance of chert on the site, are almost always exploited to exhaustion. Some full-debitage unipolar blades are thinner with better prepared butts, in particular by more intensive abrasion.

The intention of this debitage, which is quantitatively the prevalent production scheme at Jibal al-Khashabiyeh, is to obtain a large quantity of thick and wide blades (Fig. 2: 1-9). They are then used without further modification or sometimes retouched. Very few retouched tools come from excavations, apart from a few perforators (Fig. 3) and rare burins. Many non-retouched blades present use-wear traces, visible with the naked eye.

### 6.2. Thin blades and bladelets

Soft stone reduction for the production of thinner blades, small blades and straight, regular and pointed unipolar bladelets, coexists with the more expeditious hard stone hammer reduction (Fig. 2: 10-14). Some *plein-débitage* blades and bladelets present two or three facets and linear or punctiform, pecked and trimmed butts. This type of preparation corresponds to the use of direct soft stone percussion techniques. Two sandstone pebbles were found inside the structures of JKSH F19 and P52. They must have been used as hammers for this production and also for shaping some of the fine bifacial pieces.

The unipolar debitage of slender blades with a soft stone hammer was carried out on blocks with regular flanks, or prepared blocks. Some rare technical elements that could have been used in these processes were found (crested blades, opening crested flakes, overrun/*débordant* blades with perpendicular scars, typical of block shaping). In this *chaîne opératoire*, two striking platforms sometimes ensure surface maintenance, like for thicker blades. The first striking platform is used for the extraction of blades and the second to correct the convexity of the debitage surface and possible reduction accidents, but the analysed exhausted cores are still part of a unipolar management scheme. The blades are also extracted in juxtaposition, following a relatively simple operational scheme. Like for the more robust blades obtained with hard stone, only a tiny proportion of retouched tools was found, suggesting a possible use of these tools elsewhere. However, it is

important to note that traces of use were observed on at least a few non-retouched blades. These observations will be verified by a use-wear study.

A soft stone hammer production of unipolar bladelets is also attested on the studied sites. Bladelets were extracted from large prepared flakes, or small plaquettes or blocks, by direct percussion with a soft stone hammer, from a single striking platform. Some cores present two striking platforms, the second of which is plane. As is the case for blades, this second platform is used to correct the convexity of the debitage surface and to repair any possible accidents that occur during debitage. Like for the production of thick blades, the extraction of lateral semi-cortical blades indicates semi-rotating debitage on the edge of small thin slabs of flint.

### 6.3. Blades in chert and quartzite

In this standardised context of mostly unipolar flint debitage, a small production of fine flint and quartzite bipolar (bidirectional) blades and small blades is observed on the JKSH F15, F19 and P52 sites. In spite of its rarity, this *chaîne opératoire* is perceptible owing to the presence of a few naviform cores in quartzite, a few fragments of bidirectional blades (some of which are in very fine chert or quartzite), and in particular as a result of the presence of technical elements, especially epsilon blades, which are typical of the production of predetermined bidirectional blades during the PPNB. The technique used for this production is direct percussion with a soft stone hammer. Imported sandstone hammers, found on the studied sites, could have been used for such on-site production.

In sites F15 and F19, only technical elements and blade fragments suggested the presence of bidirectional blades. It was the extensive excavation of site P52 that clearly confirmed the presence of bidirectional reduction on small naviform or *postero-lateral* crested cores in red or yellow quartzite, in external and internal areas of the dwelling site. Chips, flakes and some technical products found in stratigraphy indicate in situ production on small blocks. The operational scheme is the same as for other sites in the Levant where cores are knapped using two opposite and symmetrical striking platforms. The objective of this production is to obtain small, straight, thin, predetermined blades, which were left as they were or transformed into small arrowheads. These cores are rare but show naviform know-how inherited from the technical traditions of the PPNB of the Levant.

### 6.4. Bifacial tools in chert

In Jibal al-Khashabiyeh, the bifacial industry is abundant and relatively homogeneous (Fig. 3). In both technological and typological terms, the bifacial pieces from the JKSH F15, F19, and P52 sites are quite similar, and are divided into several types: relatively thick ovoid tools, thin daggers, and “curved



Fig. 4. Bifacial "curved maces" from Jibal al-Khashabiyeh lithic assemblages.

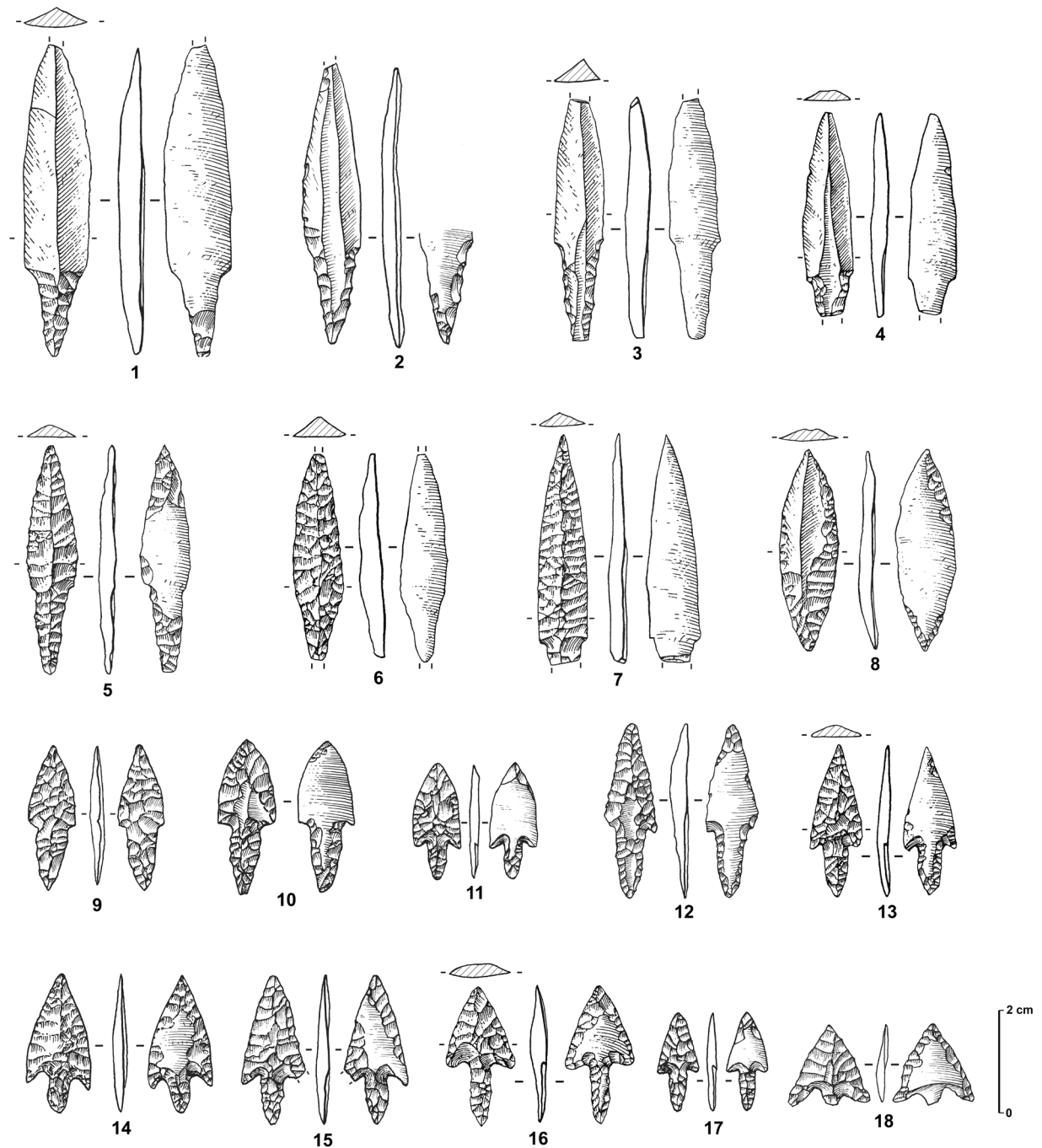


Fig. 5. Arrowheads from Jibal al-Khashabiyeh lithic assemblages. 1-8: elongated on blade with retouched tang (close to Byblos and Amuq types); 9-18: barbed and tanged (close to ha-Parsa and Nizzanim types).

maces". All of these bifacial tools are shaped on local cherts by direct percussion with soft stone hammers (sandstone or soft limestone), on plaquettes, large blades, or large flakes. Some of these bifacial pieces, especially the thinnest, are finished by pressure flaking, creating fine bifacial daggers. Flakes from bifacial shaping and from unfinished dagger preforms and the many fragments of bifaces broken during manufacture (especially in areas outside the JKSH P52 dwelling site) show that these tools were produced on site.

Another unusual case is that of "curved maces" (Fig. 4), which will have to be studied in more detail (manufacture, function and use), particularly through use-wear analysis. These tools are large bifacial pieces which generally display a curvature at one end, reminiscent of Amerindian, Polynesian or Melanesian clubs, hence their name. The shapes of these tools are variable in the different site assemblages, but they are systematically made on local materials, like the classic bifacial pieces.

### 6.5. Small arrowheads

Numerous arrowheads (Fig. 5) were discovered in all the occupation layers of sites JKSH F19 and P52, as well as F15. They are made on small fine-grained chert blades, some of which were probably imported, and some of them are in quartzite. The debitage of small fine-grained chert and quartzite blades thus seems to be at least partly reserved for this specific production. Blanks are shaped by direct, inverse, or bifacial retouch with a soft stone hammer at the preform stage, then by pressure flaking, covering the tool with final invasive retouch. From a typological viewpoint, these points from the sites of Jibal al-Khashabiyeh are similar to the types known in the Southern Levant in the Final PPNB (on single-stemmed blades, such as the Jericho, Byblos, Amuq types) and the Late Neolithic (unifacial or bifacial single-stemmed or barbed and stemmed, such as the ha-Parsa, Nizzanim, Herziliya types). The coexistence of these different types of arrowheads at the Jibal al-Khashabiyeh sites, some of which are generally attributed to differentiated chrono-cultural groups, is surprising. It could constitute another important characteristic of these assemblages and the defined techno-complex. A more in-depth study of the Jibal al-Khashabiyeh points will shed much needed light on the regional chronology and its comparison with other areas of the Levant for the same period.

## 7. Preliminary use-wear analyses

The use-wear study of the lithic toolkit from sites JKSH F15, F19 and P52 is currently in progress, combining macroscopic ( $\times 45$ ) and microscopic ( $\times 100$ ,  $\times 200$ ,  $\times 400$ ) observations and including the comparison of the use-wear traces with an experimental reference collection. The use-wear analysis focuses on the elements discovered in the occupation levels of the dwelling units which present manufacture or functional retouch related to their use as tools. The observation of the use-wear traces (rounding, fractures, scars, striations, micro-polish and residues) results in a functional interpretation based on the identification of the active parts (used areas=UA) and the kinematics of the tool (longitudinal, transverse, rotational movement or passive or active percussive movement), and of the worked material (type, hardness, condition). The tools are often well preserved with a low fragmentation rate. Some, often marked soil sheen is observed but does not prevent the functional interpretation of the objects. It is thus possible to envisage a promising study, as the material and traces have undergone little taphonomic alteration.

### 7.1. Blades and bladelets tools

At this stage of the study, 49 blade tools from the JKSH P52 site have been observed with a stereomicroscope. These consist of 10 arrowheads, five retouched blades, one retouched flake, four blades with retouch resulting from use, three unretouched blades, three end scrapers on

Types	1 UA	2 UA	3 UA	Total
Arrowheads	1	-	-	1
Retouched blade	-	1	-	1
Blade with functional retouch	1	-	-	1
End scrapers on blade	2	1	-	3
End scraper on blade /burin	1	-	-	1
Denticulated flakes	1	1	-	2
Burins	2	2	-	4
Denticulated blade	1	-	-	1
Perforators	1	-	1	2
<b>Total</b>	<b>10</b>	<b>5</b>	<b>1</b>	<b>16</b>

Table 1. Distribution of the used areas (UA) according to tool type.

blades, one end scraper on a blade opposed to a burin, 13 burins, three denticulated flakes, three denticulated blades and three perforators. All of them show macroscopic use-wear traces – rounding and scars – making it possible to affirm that they were used. Twenty-three of these tools were observed under a metallographic microscope (Table 1), resulting in the identification of a wide range of activities (corresponding to 16 different UA).

These observations show that the tools were used for diverse activities: working animal materials is well represented by hunting (one arrowhead – one UA), butchering (one blade with functional retouch – one UA), hide scraping (four end scrapers on blades and one burin on a blade – five UA; Fig. 6: A, B), cutting skin (one end scraper on a blade – one UA), scraping bone material (Fig. 6: C; one burin – one UA) and sawing bone material (one denticulated blade – one UA). Sawing rigid plant material (two denticulated flakes – two UA) and scraping rigid plant material (Fig. 6: D; one denticulate on a flake, one blade with functional retouch and one perforator – 4 UA) were also observed. Working mineral materials is represented by scraping (one burin – two UA) and perforation (two perforators or two UA). Finally, two burins and one perforator (three UA) were used to scrape indeterminate hard materials.

### 7.2. Daggers and curved maces

The bifaces are often quite large, around 20 to 30 cm in length, and are almost systematically shaped in a brown, slightly grainier flint than the flint used for the blades. This flint is also local, and is found in the form of medium-sized slabs on the surface of the current reg. On the JKSH P52 site in particular, many thin leaf-shaped daggers were found together in the exterior part of the habitat, in direct association with large quantities of flakes from bifacial shaping. These daggers presented several stages of completion, but most of

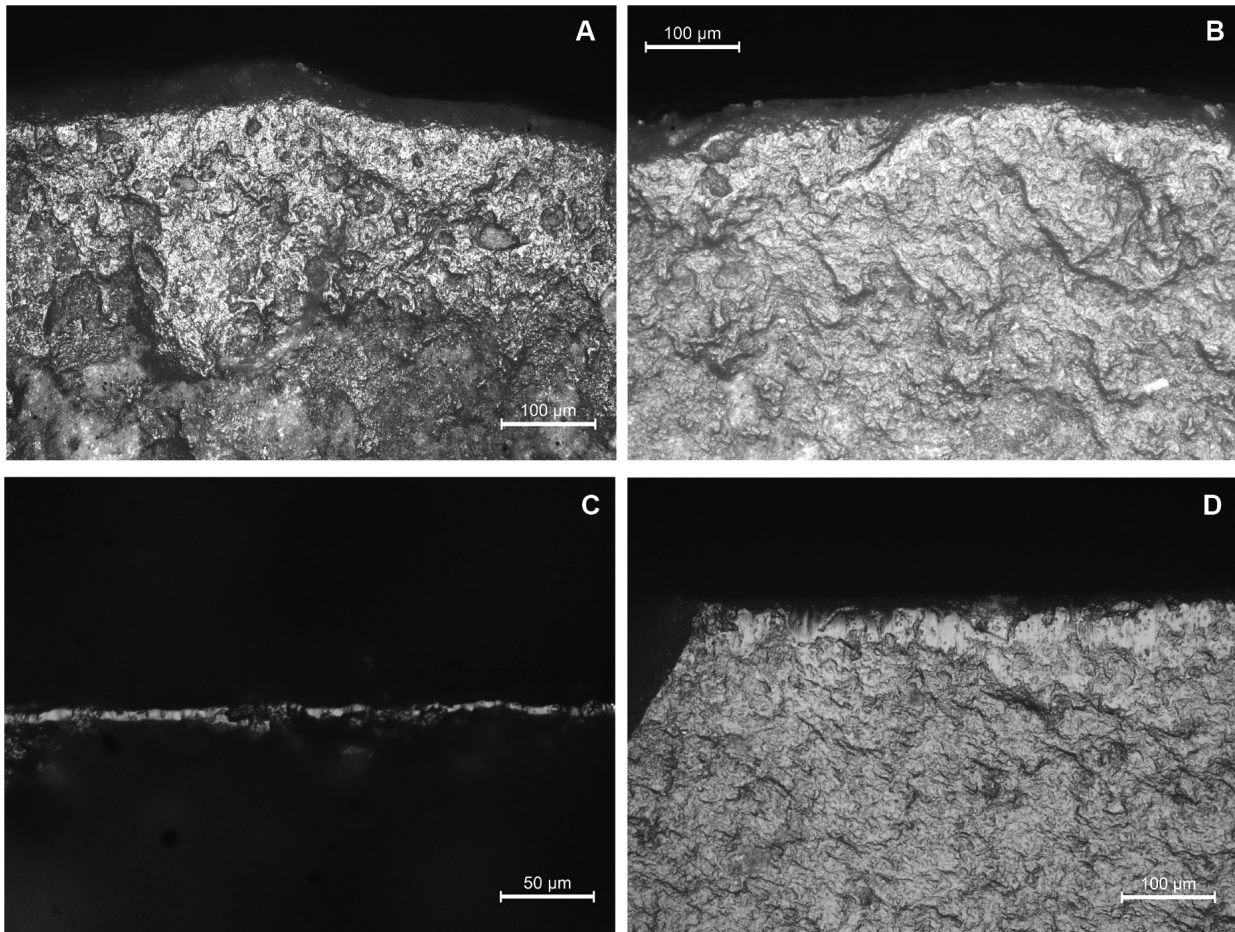


Fig. 6. Use-wear analysis on Jibal al-Khashabiyeh lithic assemblages. A and B: use-wear traces of dry hide scraping on two convex end scraper arcs; C: Use-wear traces of bone scraping on a burin facet ( $\times 400$ ); D: use-wear traces of plant scraping on the lateral edge of a perforator ( $\times 200$ ).

them seem to have been finished. Some most likely broke during the course of manufacture, probably in a specialized workshop area. It would be pertinent to compare possible traces of use on the bifaces and on the blades in order to assess whether specific functions are associated with each type of tool. The use of one and/or the other in connection with faunal remains appears to be a likely hypothesis. Curved maces in particular constitute a very specific class of tool at this occupation of Jibal al-Khashabiyeh, linked to the use of kite structures, and no parallels are known at the present time in the Near East. This specificity could suggest a functional orientation of these tools for processing hunting products. The micro-wear study will enable us to test this working hypothesis.

The preliminary results of the micro-wear study of the knapped lithic tools from site JKSH P52 open up interesting research perspectives with regard to our understanding of the occupation of the site and the social and economic organization of the hunting communities associated with

desert kites. Already, preliminary results show that, among the broad spectrum of activities represented, the various operations for processing animal materials appear to be particularly well represented. The continuation of the study will make it possible to 1) define the entire functional spectrum and the technical gestures carried out with this equipment; 2) enhance our understanding of animal carcass processing methods at the site, in connection with specialized gazelle hunting (butchery, hide tanning); 3) determine whether specialized activity zones can be identified within and between the different units.

## 8. Outlook and conclusion

The objects studied so far and the dating indicate that all of these dwelling sites were occupied in the Late-Final PPNB, around 7000 cal. BC, and that they are directly related to the massive hunting activities carried out in the nearby kite sites. These dates and the observed homogeneity in lithic production methods and tool types from the three

dwelling sites (tools on unipolar blades, small blades in fine-grained flint and quartzite, arrowheads, bifaces, curved maces, etc.) show that the lithic assemblages form part of the same tradition in the same chronological horizon. A lot of the lithic industry described here was undoubtedly designed for use in hunting activities and the transformation of animal resources.

The unidirectional laminar and bladelet debitage follows a relatively simple operational scheme. The presence of cortical and non-cortical debitage products in the same assemblage confirms on-site production, although cores are relatively poorly represented. The abundance of flint in its natural state immediately beside the site is the most logical explanation. These flints are generally of high quality and the plates, platelets and nodules used are propitious to the production of relatively large blades. The rather expeditious aspect of the laminar and bladelet operational schemes can be explained by raw material abundance immediately beside the site, allowing for large-scale lithic production, the use of blanks in a short period of time, and the possibility of cutting and scraping with non-transformed blanks for limited use.

The production of small blades from red orthoquartzite naviform cores, such as those at Jibal al-Khashabiyeh, is known at other Late PPNB sites, such as 'Ain Jamman (Wilke *et al* 2007), for example. The association of the same types of arrowheads as those found at Jibal al-Khashabiyeh with bifacial pieces is comparable to that observed at the Sha'ar Hagolan site (although Late Neolithic, Yarmoukian 6500-6000 cal. BC; Matskevich 2011), and at sites related to the Tuwailan in the Negev arid margins (Goring-Morris 1993; Goring-Morris *et al.* 1994; Sharon and Goring-Morris 2004), as well as at Dhuweila site in the Harra of northeastern Jordan (Betts 1998). Chronologically, and technologically speaking, Ghassanian lithic industries are part of a transitional context between the Late and Final PPNB. In future studies, it will be important to make more detailed comparisons with contemporaneous sites in the Southern Levant to identify possible similarities with the large contemporaneous sedentary villages and possible direct contacts or relationships between nomadic kite hunters and the sedentary populations of the more humid regions on either side of the Jordan Valley. Finally, the bifacial pieces constitute a relatively abundant and very characteristic assemblage and contribute to the definition of the typo-technological facies of the Jibal al-Khashabiyeh industries. The variability of the bifacial industry is also quite remarkable, ranging from relatively thick bifaces to thinner pieces to genuine daggers thinned by pressure flaking. Finally, the presence of curved maces is a specific local characteristic, since these objects remain unknown elsewhere in the region.

At JKSH P52, the exact methods adopted for dealing with unusually large quantities of products derived from

gazelle hunting remain to be clarified. It is nevertheless clear that these hunts go beyond mere group consumption, and are necessarily part of a large-scale production economy. Obvious parallels appear in the material culture of sedentary village populations of known contemporaneous sites in Southern Jordan. They suggest cultural links and/or exchanges, which may have revolved around these mass hunting strategies.

After the analysis of the lithic industries of Jibal al-Khashabiyeh, these different aspects, the presence of certain symbolic objects and also the geographical and ecological context, prompt us to propose the definition of a specific techno-complex that we will call "Ghassanian". The Ghassanian, at Jibal al-Khashabiyeh in any case, seems to be directly linked to the populations of hunters who used the kites. The particular typo-technological characteristics of the lithic industries are partly exclusive to this techno-complex, which will be further defined by studies of the rest of the archaeological objects, which also present distinctive features specific to these populations. These future studies will define the identity of these populations more clearly, as well as the extent of their influence or integration in a wider territory, and their provenance. The site of Khashm al-'Arfa, identified and excavated by S. Fujii and his team in the al-Jafr Basin, only about ten kilometres west of the Jibal al-Khashabiyeh sector, presents very comparable characteristics to the settlement group presented here, particularly in terms of the lithic component, but also in the architecture and the hearths, with the use of the same kind of materials and techniques of construction (Fujii 2017). We suggest that this site should be considered as an integral part of this Ghassanian techno-complex. The nature of this site will have to be reassessed in the light of these new findings.

The preliminary study of the lithic industries of Jibal al-Khashabiyeh thus contributes to the analysis of all the artefacts found in stratified and well-dated contexts, which is rare in a desert context. Correlating the lithic industries with the rest of the archaeological discoveries, such as domestic architecture, combustion structures and the use of fire, grinding, crushing and percussion tools, ornamental objects and symbolic and/or ritual objects, or again, the processing traditions of animals hunted in the giant desert kite hunting traps, will continue to hone our knowledge of an increasingly well-defined occupation context.

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