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Symbolic emblems of the Levantine Aurignacians as a regional entity identifier (Hayonim Cave, Lower Galilee, Israel)

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The Levantine Aurignacian is a unique phenomenon in the local Upper Paleolithic sequence, showing greater similarity to the West European classic Aurignacian than to the local Levantine archaeological entities preceding and following it. Herewith we highlight another unique characteristic of this entity, namely, the presence of symbolic objects in the form of notched bones (mostly gazelle scapulae) from the Aurignacian levels of Hayonim Cave, Lower Galilee, Israel. Through both macroscopic and microscopic analyses of the items, we suggest that they are not mere cut marks but rather are intentional (decorative?) human-made markings. The significance of this evidence for symbolic behavior is discussed in its chrono-cultural and geographical contexts. Notched bones are among the oldest symbolic expressions of anatomically modern humans. However, unlike other Paleolithic sites where such findings were reported in single numbers, the number of these items recovered at Hayonim Cave is sufficient to assume they possibly served as an emblem of the Levantine Aurignacian.

Upper Paleolithic | Levantine Aurignacian | Near East | bone tools | human symbolic behavior

The Aurignacian is one of the Upper Paleolithic (UP) traditions whose origins, definition, and diffusion are among the most debated topics related to modern human colonization of Eurasia. Far from being a homogenous entity, the Aurignacian *grosso modo* features a wide range of diversity, both diachronically (e.g., the Proto-Aurignacian, Early Aurignacian, and Evolved Aurignacian in Europe) and within each facies (e.g., refs. 1–3). According to the latest radiocarbon dates, the Levantine variety, termed “Levantine Aurignacian,” seems, at least in part, contemporaneous with the European Evolved Aurignacian (4–10). Still, linking the Levantine Aurignacian with any particular phase of the European Aurignacian facies is rather problematic, as, in fact, it shares certain features with both the Early Aurignacian and the Evolved Aurignacian. Those relate to the lithic techno-typology and the bone and antler industry (5, 6, 11).

The West European Aurignacian complex is quite well known *vis-à-vis* its lithic and bone industries (e.g., refs. 1, 2, and 12–20) and personal ornaments (21–23). Its chronology, although frequently debated, is currently based on absolute dating and relative dating (i.e., stratigraphy) as well as on comparisons of the material remains, mostly lithic techno-typology (e.g., refs. 9, 24, and 25). The Levantine Aurignacian has been defined mainly on the basis of the techno-typological characteristics of the lithics, e.g., nosed and frontal carinated items, retouched bladelets (Dufour), and el Wad points, among others, and on the basis of a rich bone and antler industry. Thus far it has been reported from cave and rock-shelter sites in the Mediterranean Zone (e.g., Hayonim, Kebara, Ksar Akil, Manot, Sefunim, el Wad, Yabrud) with only rare occurrences in bordering regions (e.g., el Quseir, in the Judean desert). Considered to be of a relatively short duration

(between ca. 37/8–34/5 ka cal. BP) (4), it interrupts a sequence of what is considered as locally evolved archaeological entities (for a detailed account of the Levantine Aurignacian, the history of its research, and its place in the Levantine UP sequence, see refs. 6 and 26–29 and references therein). We would like to suggest yet another characteristic feature, namely, a specific symbolic marker, pertaining to ritual dynamics which lie at the core of human self-definition as a group, society, or culture (12).

Evidence pertaining to human symbolic behavior in Europe dates from 40 ka onwards (23, 30–32), with that from Aurignacian contexts being rather prominent (e.g., refs. 33–37). Conversely, evidence of a symbolic nature from the Levantine UP is rather scarce (e.g., refs. 6, 27, 28, 38, and 39 and references therein).

Hayonim Cave

Hayonim Cave is situated in the Western Galilee, Israel, about 13 km from the Mediterranean coast, on the right bank of Wadi Izhar, some 50 m above the present Wadi channel (Fig. 1) (40). The Levantine Aurignacian occupation (stratum D, comprising three consecutive layers, D4, D3, and D1–2) is quite small in extent (15 m²) but rich in material culture remains, including hearths, ash spots, evidence of ochre use, and a dense faunal assemblage. The chipped stone industry shows a high Aurignacian

Significance

The emergence and diffusion of Upper Paleolithic (UP) techno-typological traditions are among the most debated topics related to anatomically modern humans' colonization of and establishment in Eurasia. The Levantine Aurignacian represents one of the UP cultural entities in the Near East, and its origins, spread, and interrelationships with other UP entities are central to the understanding of local UP dynamics. The data we present demonstrate that the notched bones from Hayonim Cave stratum D are unquestionably anthropic marks constituting an emblem of the Levantine Aurignacian. Assessment of data from Middle Stone Age and UP sites of Africa and Europe as well as other UP sites in the Levant supports the notion that this is indeed a unique feature of the Levantine Aurignacian.

Author contributions: J.-M.T. and R.R. designed research; J.-M.T., A.B.-C., and R.R. performed research; J.-M.T., V.G., and R.R. analyzed data; and J.-M.T., A.B.-C., O.B.-Y., and R.R. wrote the paper.

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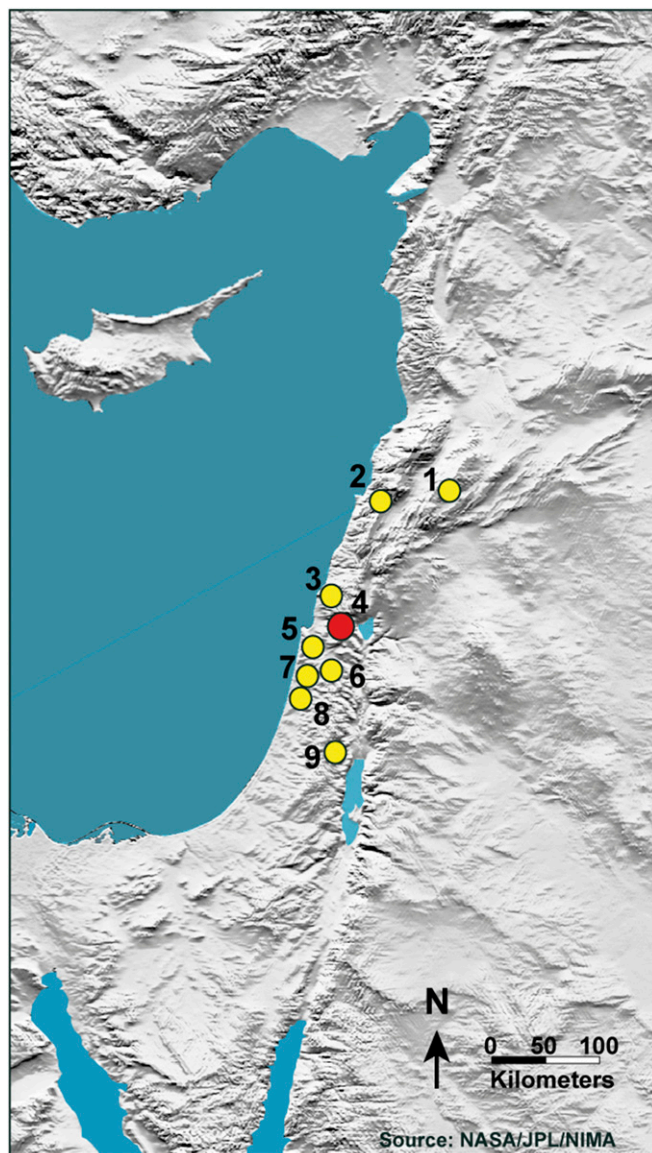


Fig. 1. Geographical location of Hayonim Cave (Lower Galilee, Israel); EUP sites with Levantine Aurignacian layers mentioned in the text. (1) Yabroud II, (2) Ksar Akil, (3) Manot Cave, (4) Hayonim, (5) Sefunim, (6) Raqefet, (7) El Wad, (8) Kebara, (9) El Quseir. Image courtesy of NASA/JPL/NIMA.

index. It also displays a number of specific traits such as a near absence of el-Wad points and a high percentage of microliths (*Hayonim Cave*) (41).

Results

The Notched Items. The notched items comprise eight scapulae and one hyoid of gazelle. The specimens were recovered throughout the entire stratum D (Table 1, *The Notched Items of Hayonim D and Other Levantine Sites, Spatial Distribution of the Notched Items, and Fig. S4*).

As the surfaces of the bones are well preserved, with little erosion and sediment concretions, detailed examination of the notches was possible. The scapulae and the hyoid alike each display a series of 3 up to 32 notches. Unfortunately, in only one case (scapula HD540) is the series complete, as all the others display postdepositional fractures. The location of the notches over the scapulae is repetitive, along the posterior border, over the costal aspect, the medial aspect, or near the posterior angle (Figs. 2 and 3). This location is probably dictated by the relative thickness of this part compared with other parts of the scapula and its convenient shape for producing incisions. The notches were 0.5- to 2.5-mm long; in each series they are separated by 0.5–7 mm and cover an area that varies between 12 and 52 mm in length. All the notches were made by one stroke, likely with the same lithic tool, on fresh bone, as seen in the resemblance that the notches show in their cross-section morphology (V cross-section) and angles (Fig. 4 I and J and Table S1) (e.g., refs. 37 and 42).

The notches were made on preprepared surfaces scraped perpendicularly to the notches' orientation. It is important to note that only the notched area on the bone is scraped; thus it is clearly related to the notch production (Fig. 4A). The notches were made by a to-and-fro sawing movement, most probably with the cutting edge of a lithic artifact. We failed to observe use wear similar to that noticed at the site of Klasies River Mouth (dated to the Middle Stone Age, MSA) (43) inside or outside the notches. There was fine sediment which was still adhering to some of them.

It is important to stress that, contrary to other Levantine Aurignacian objects made of bone, the notched scapulae were modified through a relatively complex process. The rest of the modified bone objects, mainly awls and “intermediate” pieces (chisels), most probably intended for domestic activities, were minimally modified, as in the case of the chisels, or modification was concentrated mostly at the active part, as in awls (i.e., modifying the pointed distal extremity to transform a bone splinter into an awl) (11, 18).

Notches and Cut Marks. The data pertaining to bone artifacts require detailed taphonomic research to identify the various agents and activities that modify bones, in particular butchery-related activities *contra* other, intentional bone modifications.

Surface modifications of the Hayonim D fauna remains were studied and described in detail (refs. 40 and 41 and *Supporting Information*). Cut marks were observed on the head, trunk, and limbs of gazelles, suggesting that the entire consumption process, from skinning to limb severing and meat filleting, took place on site in a repetitive, methodical way. In particular, the gazelle's scapulae exhibit signs of both filleting and dismemberment. Cut

Table 1. Hayonim D notched bones

Specimen ID	Location	Taxa	Anatomic element	Layer	Square	Elevation top (cm)	Elevation bottom (cm)
10,110	HUJI	<i>G. gazella</i>	Hyoid (great cornu, R)	D1-2	I22a	230	—
HD231	HUJI	<i>G. gazella</i>	Scapula	D3	F21	—	—
HD537	IMJ	<i>G. gazella</i>	Scapula (R)	D	—	—	—
R538	HUJI	<i>G. gazella</i>	Scapula (L)	D3	G19	240	260
R539	HUJI	<i>G. gazella</i>	Scapula (R)	D1-2	H21,d	220	225
HD540	IMJ	<i>G. gazella</i>	Scapula (L)	D1-2	I21 c+a	220	225
HD541	IMJ	<i>G. gazella</i>	Scapula (R)	D1-2	G21 c	230	235
R7049	HUJI	<i>G. gazella</i>	Scapula (R)	D1-2	G21 c	230	235
R7053	HUJI	<i>G. gazella</i>	Scapula (L)	D1-2	H19	210	214

HUJI, National Natural History Collections, Hebrew University of Jerusalem, Israel; IMJ, Israel Museum Jerusalem, Israel.



Fig. 2. Anatomical position of four notched gazelle scapulae from Hayonim D, plotted over complete gazelle scapulae from the comparative mammalian collection of the National Natural History Collections at the Hebrew University of Jerusalem.

marks are most common on the distal scapulae, encircling the glenoid cavity. Cuts appear on lateral and costal surfaces around the neck and over the neck's distal border, while short cutting marks are also noticeable over the posterior and anterior borders on the scapula blade (Figs. 3 and 4 B and D and Fig. S1). These marks are known to result from the dismemberment of the scapula from the humerus. Longitudinally oriented filleting marks were seen along the supra and infraspinous fossae and up and down the medial face of the scapula. Cut-marked scapulae are relatively abundant (D1–2: 27%; D3: 22%; and D4: 30%), with a few filleting marks observed over the blade of the scapula (D4: 1%; D3: 4%; D1–2: 1%) (Fig. S1) (44, 45).

Thus, we had the opportunity to compare the notches on the artifacts discussed herein with those on numerous modified bones of the same species. Notches were differentiated from cut-marks on the basis of three main criteria: (i) anatomical location on the bone; (ii) size of the marks; and (iii) mode of manufacture.

First, the two show a clear disparity regarding anatomical location. While the intentional notches on gazelle scapulae from Hayonim Cave D were always observed on the posterior border of the scapula, the butchery marks are variously located, depending on the specific activity performed. The notches are significantly

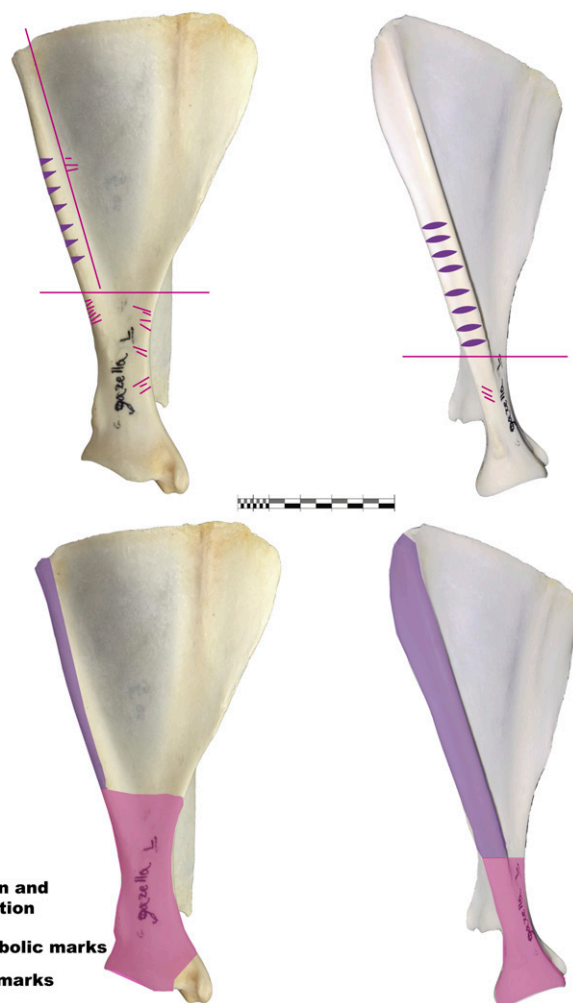
wider (1.2–1.5 mm vs. 0.3–0.5 mm) and longer (4–4.5 mm vs. 1.2–1.5 mm) than the cut marks (Fig. 4 E–H, Fig. S2, and Table S2).

The notches were made on prepared scraped surfaces by sawing motions (see above) markedly different from the production of the cut marks or hack marks (Fig. 4 C and E and Fig. S3).

The notches observed on the delicate gazelle hyoid also clearly indicate an intentional choice of a specific surface to produce the desired marking accurately (Fig. S3).

Discussion

What Do the Notched Bones Mean? Flat, notched bones may have conveyed certain information, thus serving as means of intra- and intergroup communication (46). Nevertheless, since the items from Hayonim (and from the other Levantine Aurignacian sites, Kebara and Manot Caves; see below) are not complete, it is difficult to evaluate their possible role. If we assume that these objects did convey some kind of information, they may have been worn as distinctive personal objects attached to clothes or as pendants. Indeed, pendants made of organic materials of a similar size-range and heavier than gazelle scapulae are still used by some African indigenous peoples, such as the Himba (Namibia), to indicate women's marital status (47). Be that as it may, it is unlikely that the scapulae were meant to be hung from their proximal end, as this part is thin and fragile. It is perhaps more likely that they



Location and distribution

Symbolic marks

Cut marks

Fig. 3. Anatomical position of the symbolic marks (notches, in purple) and cut marks (magenta) over gazelle scapula, reconstructed from the Hayonim D items.

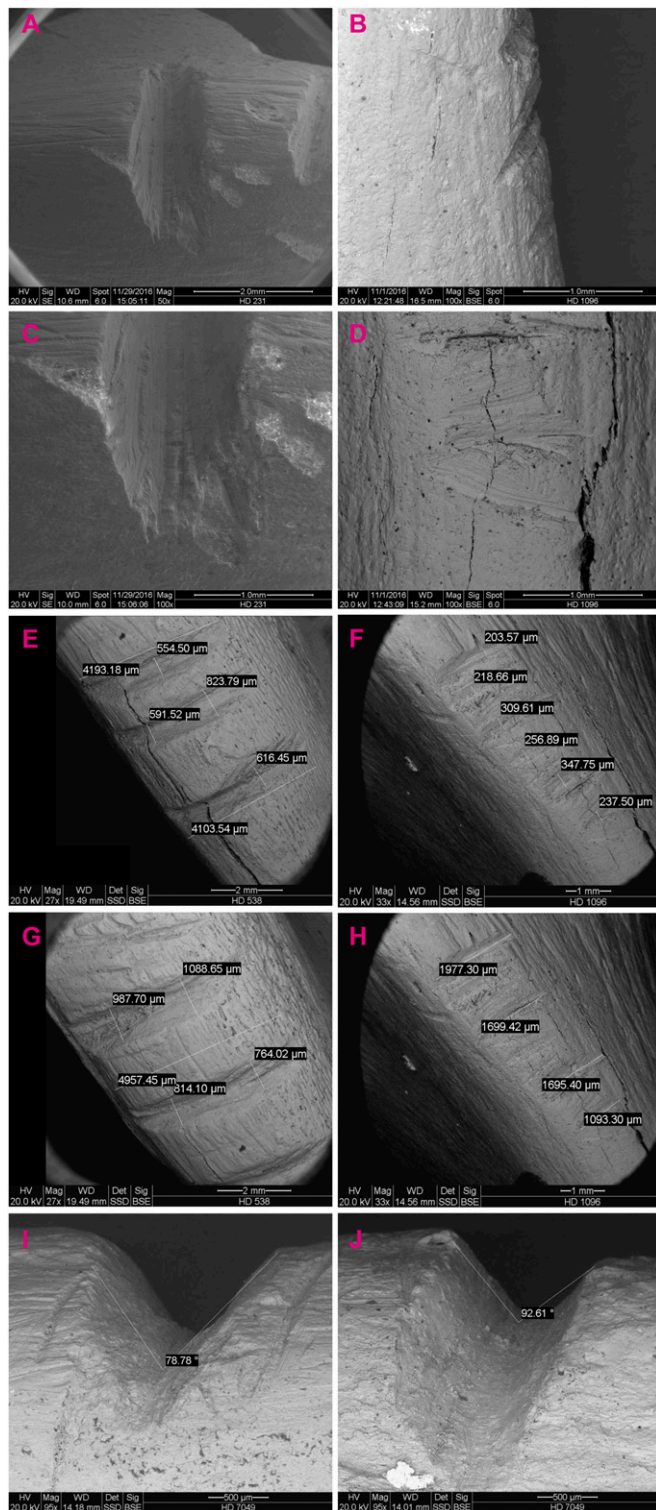


Fig. 4. Detailed scanning electron microscopy photographs of notches and cut marks from Hayonim D showing their morphology, size, and cross-section. (A) A notch cuts the scraping preparation marks (perpendicular striations). (A–D) Note the different morphology of notches (HD231) (A and C) in comparison with cut marks (HD1096) (B and D). (E–H) The difference in notch size (R538) (E and G) compared with that of the cut marks (HD1096) (F and H). (I and J) Scanning electron microscopy images of two notches' inner cross-section angles. Scanning electron microscopy images were obtained using a FEI Quanta 200 ESEM. (Magnifications: 27 \times –100 \times).

had pieces of string encircling the scapula at its neck (nearer to the distal end). However, microscopic analyses have not shown any use-wear traces for any such scenario.

Some authors suggested that this type of mark could be linked with a notation system marking lunar phases (e.g., ref. 48). However, the notches discussed here were most probably made in one session, on fresh bone, and likely by the same lithic tool; therefore this hypothesis is improbable (e.g., refs. 49 and 50; see *Further Discussion of Notched Bone Significance in the Levantine Aurignacian* for further discussion).

Notched Gazelle Bones as a Regional Entity Emblem of the Levantine Aurignacian. Notched flat bones are among the oldest symbolic manifestations of anatomically modern humans (AMH) (30, 32, 46, 51, 52). They have been documented from the MSA in Africa as well as from the Eurasian UP Aurignacian entities (Proto-Aurignacian, Early Aurignacian, and Levantine Aurignacian) (Fig. S5). Recently, a similar type of decorative pattern has been reported from a late Middle Paleolithic level at Zaskalnaya (Crimea) attributed to a Neanderthal occupation (37).

The Aurignacian symbolic manifestations, namely personal ornaments as well as graphic, mobile, and stationary art, of Eurasia seem to show a significant variability on a continental scale (23, 53). Indeed, Aurignacian groups do exhibit a broad similarity of graphic expression; however, at the same time, regional-specific characteristics do occur (54). Characterizing these diverse entities is thus crucial to understand the dynamics of the interrelationships between them, whether reflecting kin-ties or diachronic trends.

Three notched bones are known from the African MSA sites of the Klasies River Mouth and Border Caves (South Africa) (46). In Europe, Middle Paleolithic Micoquian and early UP Proto-Aurignacian contexts have yielded single examples found respectively in Zaskalnaya VI (37) and Riparo Mochi (Italy) (20). Early Aurignacian notched bones ($n = 11$) were reported from diverse regions of Europe (Belgium, southwest France, and Central Europe). Most sites have yielded only one or two items, and apparently the diversity is not related to regional variations, as it is observed both within sites (e.g., La Quina, Castanet, Princesse) and between sites in the same region (e.g., Castanet and Cellier in Dordogne; Brassempouy and Isturitz in southwest France) (Table S3 and references therein).

It is interesting to compare the diversity observed in the notched bones of the European Early Aurignacian with the uniformity of the Levantine Aurignacian ones. The diversity of the European items is evident in the type of raw material used, the animal taxa selected, the anatomical elements employed, and the types of decorated objects. The notched pattern is documented on bone, antler, and ivory pieces deriving from reindeer, red deer, bovid, and mammoth. The anatomical elements include antler beam, mammoth tusk, teeth, a hyoid, a metapodial, and other unidentified limb bones. Notches occur on antler and bone splinters, on personal ornaments (e.g., elongated bone pendants), and on domestic tools such as polishers (*lissoirs*) (Table S3).

To date, the Levantine Aurignacian record comprises 15 items. Contrary to the European evidence, the Levantine Aurignacian assemblage of notched bones displays evident homogeneity. One raw material is employed (bone), one taxon is selected (gazelle, *Gazella gazella*), and almost exclusively one anatomical element is chosen (scapula) (*The Notched Items of Hayonim D and Other Levantine Sites* and Table S3).

The notched items were retrieved from several Levantine Aurignacian cave sites (Hayonim, Manot, Kebara, and perhaps Emireh) (55, 56), implying the plausible notion that notched gazelle bones constituted an emblem of the Levantine Aurignacian entity.

The choice of gazelle bones is not surprising, as this is the animal most widely hunted and exploited by the inhabitants of Hayonim and Manot Caves (44, 45, 57, 58). Indeed, there is evident bias in the selection of bone, since only scapulae and hyoid—two very thin

and brittle bones—were chosen for notching. Use of other raw material for symbolic objects or decorations is evidenced in the five tooth pendants (of red deer, fox, and horse) recovered in the Aurignacian levels of Hayonim (*Hayonim Cave*) (41). We may perhaps assume that deer canines, horse and bovid incisors, and gazelle scapulae and hyoid had a particular significance for the Levantine Aurignacians. Nonetheless, while teeth were exhaustively exploited by the European Early Aurignacians, the notched gazelle scapulae and hyoid clearly constitute a particularity of the Levantine Aurignacian. These items were modified by a specific technique which included preparatory scraping of the surface before the meticulous notching. Such bone modification is barely known from Europe, where it was applied only in the production of polishers (59, 60), items which are rare in the Levantine Aurignacian (11, 41). Actually, throughout the entire duration of the Eurasian Aurignacian techno-complex, most of the bone items used were either unmodified fragments (e.g., retouchers) or fragments prepared expediently by simply scraping the distal (active) part of the tool (e.g., awls or chisels) (11, 16, 18, 59, 60).

It is probably not a coincidence that only two types of osseous items, the antler projectile points (*Hayonim Cave*) and the “symbolic” objects, show evidence of considerable technical investment: Both item types are involved in two critical aspects of the complex system of hunter-gatherer’s organization. While antler hunting tools were crucial for a stable meat supply that was of paramount importance for the survival of the group, the symbolic items (i.e., the notched scapulae) were equally important within the social intra- and intergroup ambit of these communities, probably embedded in a complex communication system.

The Levantine Aurignacians shared with their European counterparts some similarities regarding different spheres of existence involving bone and antler productions. Thus, they shared similar complex technical concepts of antler working as opposed to the simpler bone-working technological concepts and had in common a recurrent but limited variety of morpho-types (mainly awls and projectile points) (11). However, they differed in other particularities of their material culture, *vis-à-vis* both the bone/antler industries and the lithic ones (e.g., refs. 5–8, 26–29, 61, and 62). Some of these particularities, e.g., the preference for different deer taxa for antler exploitation (reindeer, red deer, and megaceros in Europe as opposed to Persian fallow deer and red deer in the Levant), can be safely attributed to the different ecological niches. Others, like the different types of hunting tools, need to be evaluated with regard to the cultural background. Such is also the case with the notched gazelle scapulae and hyoid, which seem to be of a special significance for the Levantine Aurignacians.

The items described above elucidate a facet of the Levantine Aurignacian and lend support to the hypothesis that, despite certain correspondences between the Early European Aurignacian and the Levantine Aurignacian, these two entities display some idiosyncrasies. It seems that, in contrast to the European Aurignacian facies, which represent a longer temporal sequence and a wide geographic spread and thus exhibit greater variability in their techno-complex, the unique and unified phenomenon of the notched bones reflects on both the homogeneity of the Levantine Aurignacian and the possibility of strong ties between its various communities; perhaps reflecting its limited geographic spread and its relatively short-lived presence in the region.

Materials and Methods

The study of the modifications of the bones from Hayonim D was done by R.R., and selected cases were reexamined by J.-M.T. Comparative taphonomic collections available at the National Natural History Collections of the Hebrew University of Jerusalem were the base for comparison. The entire medium-large mammals assemblage from the Hayonim D layers was identified to species (by R.R.), and the unidentified bone fragments were revised for this study by J.-M. T. The comparative corpus of gazelle scapulae with cut marks is composed of more than 10 specimens, while the comparative hyoid corpus includes 12 items. Anatomical description followed Sisson’s (63) nomenclature. We followed Villa and Mahieu (64) in assessing the nature of the fractures affecting the specimens, distinguishing between fresh fractures (straight or spiral fracture planes) and postdepositional fractures (saw-toothed, stepped, or irregular perpendicular) different from those observed on fresh bone.

Technological analysis was conducted using both a stereomicroscope (magnification: 10–40×) and a scanning electron microscope. The scanning electron microscopy images (The XPS Laboratory, The Unit for Nanocharacterization, The Harvey M. Krueger Center for Nanoscience and Nanotechnology, The Hebrew University of Jerusalem) were obtained by V.G. using an FEI Quanta 200 ESEM in low-vacuum mode without any preliminary treatment and with a chamber pressure of 0.38 Torr and acceleration voltages of 15–20 kV.

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Supporting Information

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Hayonim Cave

Hayonim Cave is situated on the right bank of Wadi Izhar, about 13 km from the Mediterranean coast and 50 m above the present Wadi channel, in the Western Galilee, Israel (1, 2).

The Faunal Assemblage. The faunal assemblage was first studied by Davis (3, 4) and later by Rabinovich, emphasizing the human mode of exploitation (5, 6). The distribution of species (NISP layer D4 = 1,479; D3 = 7,012; D1–2 = 5,077) is very similar in all occupation stages, with gazelle (*Gazella gazella*) being the most common species (more than 80% of NISP), followed by Persian fallow deer (*Dama mesopotamica*, 5–6%), while other species—red deer (*Cervus elaphus*), wild goat (*Capra aegagrus*), wild boar (*Sus scrofa*), aurochs (*Bos primigenius*), roe deer (*Capreolus capreolus*) and hartebeest (*Alcelaphus buselaphus*)—are represented by only several bones (5, 6).

Every bone was examined under the microscope, and every surface modification was noted (Figs. S1–S3 and Tables S1 and S2). Indeed, the fine preservation state of the bones and their relative density (more than 2,000 bones/m³) permitted a detailed reconstruction of the butchery process at what seems to be a “consumption station” where animal resources were processed and shared among the group members, i.e., a “kitchen midden” (1). It appears that animal-carcass processing was a major activity in the cave during the Aurignacian occupation. Based on the location of the cut marks and their shape, the main activity that took place in situ was disarticulation, followed by some filleting and skinning (5, 6).

The Flint Assemblage. There is a great techno-typological similarity among the flint assemblages of the three sublayers of layer D. On the other hand, there is pronounced heterogeneity in the overall typological components of the whole lithic assemblage (1).

Flakes are dominant among the debitage items (including “core trimming elements” and “primary elements”). Within the tool categories the picture is different, and tools were modified on blade/bladelet and on flake blanks equally. The character of the debitage is quite irregular. The number of cores is relatively high. Still, judging from the frequencies and types of debitage items, it seems that a large number of tools were made elsewhere, while some of the items produced at Hayonim were taken away.

The typological aspect shows that the Aurignacian assemblage of Hayonim Cave is dominated by the end-scrapers category. The second large category is the burin group. Together, these two categories constitute more than half of the total number of tools in layer D. Borers and backed pieces are scarce, while denticulates and notches are relatively well represented. The el Wad points are quite scarce, and there is a moderate presence of bladelets and bladelet tools (Dufour bladelets).

Another interesting phenomenon is the high percentage of tools with double patina. It is more pronounced in certain tool-groups, i.e., the end-scrapers, the burins, and the denticulates and notches. Most of the double-patinated artifacts clearly derive from the preceding Mousterian levels exhibiting the Levallois technique characteristics including faceted striking platforms. Most probably these Mousterian items were available on the surface of the cave and the terrace due to the post-Mousterian erosion (see refs. 1 and 7 for more details on the flint assemblage and double patination).

The Bone and Antler Tools Assemblage. The bone and antler tool assemblage from Hayonim D is unique in its number of tools and their variety and is comparable only to the assemblages of Manot

and Ksar Akil Caves (8–12). Such diversity calls for a detailed study incorporating new technological observations of the corpus. Indeed, a renewed study of the technology of the Hayonim D assemblage is currently under way. The majority of items are bone awls and antler projectile points. There are also several items, both bone and antler, which were most probably used in indirect percussion (namely as a chisel), as has been demonstrated through both technological and experimental studies (13–15).

The tools made of bone were modified in an expedient way using one simple technique, i.e., scraping. On the other hand, antler was exploited by a combination of techniques, namely a process defined by Averbouh as the “conjugation of several technical gestures, resulting in the use of various techniques with a precise purpose which is, concerning the osseous working, of transforming a raw material bloc into a particular object” (16, p. 55), implying a complex operational sequence.

This typological and technological dichotomy as regards bone and antler items is also observed in the Early Aurignacian of Europe (e.g., refs. 13 and 17–21) as well as in the Levantine Aurignacian assemblage of Manot Cave (12).

Whenever the base of the antler projectile point is preserved, it is a simple/massive point of the variety defined as “elongated objects with a pointed distal tip, a variable cross section (mostly elliptical) and a simple hafting system” (22). The projectile points that characterize the Evolved Aurignacian in Europe and the local Levantine Aurignacian are also known by various other names, including “pointed base points,” “biconical,” “massive base point,” or simply “not split based points” (e.g., ref. 22). We prefer to use the terms “massive base point” or “simple base point,” which relate better to the general morphology of these objects (23). Except for one split-based point from Kebara (24) [see also claims for a second specimen, from Hayonim Cave (25)], all projectile points from the Levantine Aurignacian (ca. 150 specimens so far) are simple/massive points (1, 9, 12, 26, 27). We attributed all broken specimens from Hayonim to this category according to the raw material, the cross-section extension of the worked surface of the object, and the morphometrics of the item. It seems that for all points are made from antler the cross-section is elliptical, the entire piece is worked, and they are fully compatible with the morphometrics of simple/massive points at other Aurignacian sites such as those from Manot Cave and Ksar Akil. The complete points measure 65–70 mm in length, 7–9 mm in width, and 6–8 mm in thickness.

Other Symbolic Items. In addition to the notched bones, some other items traditionally linked with the symbolic sphere of Paleolithic hunter-gatherer groups have been recovered from the Aurignacian layers in Hayonim Cave. Five are tooth pendants, one of which is unfinished. The pendants have already been described (1), but the preform (the unfinished piece) was identified only recently among the faunal remains.

The pendants were made from red deer vestigial canines (specimens HD157, HD179, and HD226, the unfinished item), a horse incisor (*Equus* sp.; specimen HD152), and a fox canine (*Vulpes vulpes*; specimen HD258). They were found in layers D1–2 (two items), layer D3, and D4 (one item in each layer) and in D sequence without exact provenience. No obvious spatial distribution in relation to other symbolic items was detected.

Two incised limestone slabs were uncovered in two different locations. The first item was found in D1–2 (square J21), while the second piece came from D4 (square I21) (1).

The incisions on the first object are clearer. One side depicts a linear figure that resembles the back of an ungulate, perhaps a horse, with some indication of a head. The other side of the slab has fewer incisions, hinting at some sort of a figure (an animal back?) in a diagonal direction and a series of descending lines (1).

The Notched Items of Hayonim D and Other Levantine Sites

Some of the notched gazelle scapulae (5) deriving from Hayonim D have already been published by Davis (28); however, during the revision of the bone and antler worked items from Hayonim D we observed four other notched specimens, i.e., three scapulae and one hyoid. The Levantine Aurignacian record so far comprises 14 items: nine from Hayonim Cave, four from Manot Cave, and one from Kebara. Although the one from Kebara was attributed by Davis to the Mousterian levels, the origin of this item is uncertain. In a recent revision of the archaeological material from Emireh Cave excavated by Turville-Petre and studied by D. Garrod (29), a notched bone was found (30). Emiran, Mousterian, Ahmarian, and Aurignacian occupation is suggested in the new revision of the lithic technology (30). However, the reassessment could not establish a clear stratigraphic sequence. We can assume that the notched piece originates from the Aurignacian occupation (Table S3).

Spatial Distribution of the Notched Items

The notched items are from the entire stratum of the Aurignacian occupation (D layers). Six pieces derive from layer D1–2, two from layer D3, and one from layer D (Fig. S4 and Table 1).

No particular spatial association is shown between the notched items and other nonlithic artifacts (pendants, ochre fragments, incised limestone slabs) or structures (namely hearths). Thus, of the five Aurignacian pendants made of teeth, only two (a horse incisor, HD152, and a fox canine, HD258) were found in the same square (I22a) at a similar depth with the notched hyoid (Fig. S4).

In D1–2, isolated patches of white ash suggested that, somewhere not far away, there was a fireplace (1). One of the scapulae comes from square H21, where there is clearly a hearth. Two notched specimens display marks of having been subjected to a combustion process. The surface of these specimens was burned, showing a homogenous color and patina (dark brown and soft brown, respectively). Since the pieces are broken and do not have a stratigraphic connection with combustion structures, it is not possible to speculate about the purpose (if any) of the thermic process. Alternatively, it could be merely incidental (e.g., broken pieces discarded into a fire).

It has been suggested that the archaeological occupations at Hayonim D could be reconstructed as a series of short but intensive sequences of occupations resulting in kitchen midden depositions. Therefore, the lack of precise association between the symbolic and other items might result from the continued tossing of debris at the same place during several occupation stages. Indeed, the repeated processing of meat and bone precludes the reconstruction of when and what was the role played by the symbolic items, but they clearly were part and parcel of the Aurignacian existence at the site.

Further Discussion of Notched Bone Significance in the Levantine Aurignacian

The emergence and diffusion of the Upper Paleolithic typo-technical traditions is among the most debated topics following the dispersal of AMH in Eurasia. It seems essential to examine and evaluate the variability among human groups when discussing the success and failure of this dispersal across new lands and the establishment of

regional territories (31). Human groups differ (32, 33), not only because of different external environmental circumstances (34) but also because of intragroup social rules, customs, and relationships (35). Thus, the variability observed in ritual and symbolic behavior undoubtedly played an important role and is a crucial aspect when researching Pleistocene groups and/or cultures. Beyond the technological skills, the variability in social and spiritual dynamics lies at the core of human self-definition as a group, society, or culture (31).

A key feature of the use of symbols is that their meaning is assigned by arbitrary, socially constructed conventions, allowing the storage and visualization of information external to the human brain (e.g., refs. 36–38). The objects impregnated with a symbolic meaning reflect the use of the symbolic concepts to link the individual or population with their material culture and their environment (36).

As pointed out by Wobst (39), one aspect of symbolic material culture, and possibly the most significant benefit of symbolical behavior in general, is its ability to link the individual or group with other individuals and groups through the inter- and intragroup transmission of information. The use of artifacts to transmit messages is advantageous when used to communicate information to people who are in “the middle distance,” that is, those people who are not so close to the sender that the messages are already known and not so distant that the meaning of the message cannot be deciphered (neighboring groups or other members of an alliance) (38–41). Such signals thus may include identification (class affinity, social group affiliation, rank, and so forth), authorship, and ownership. Temporal and spatial patterns of the symbolic material can be used to examine the volume and diversity of information flow within and between regions during the Paleolithic (Fig. S5) (38, 42–47).

In the absence of any functional purpose of the notched items, we suggest their use as distinctive personal objects attached to clothes or as pendants. Personal ornaments can be necklaces, pendants, or dress decorations (48). While the precise meaning of the message transmitted by such objects is lost to us, we can nevertheless assess its significance in a particular regional context. In this regard, it is interesting to note that, as in the Levantine Aurignacian, in other regions and material cultures a few specific types of raw materials with standardized shape were selected as personal ornaments. Examples are the selection of particular shell genus—*Nassarius*—to fabricate pendants from the African MSA to the beginning of the UP in both the Levant and Europe (48–51) and the particular shape of the so-called “basket beads” made mostly of ivory, characteristic of the Early Aurignacian in southwest France (45, 52, 53).

In the Levantine Aurignacian we witness the usage of a common available raw material but with a definite aim to create the desired shape. The technology applied, i.e., scraping bone surface and creating sawing-like marks, is not an innovation. The repetition is what suggests that the final use was the goal of the fabrication, and here we can only speculate. The regional variants of the graphic expressions of the Aurignacian could be rooted in the Paleolithic entities present in Eurasia before the arrival of the Aurignacian or could be linked with the dispersion of AMH groups across Eurasia (e.g., refs. 54–58). As pointed out by Bourrillon and colleagues (47), this pattern of regional variability matches the social geography models which focus on the material construction of identity at regional, group, and individual levels (38, 39, 43) that is expressed in personal ornaments and also in rock and mobile art, bone and antler industries, and lithic technology (e.g., refs. 12, 17, 42, 45, and 59–64). This could perhaps explain the differences in the graphic organization between the Levantine and the European Aurignacian varieties.

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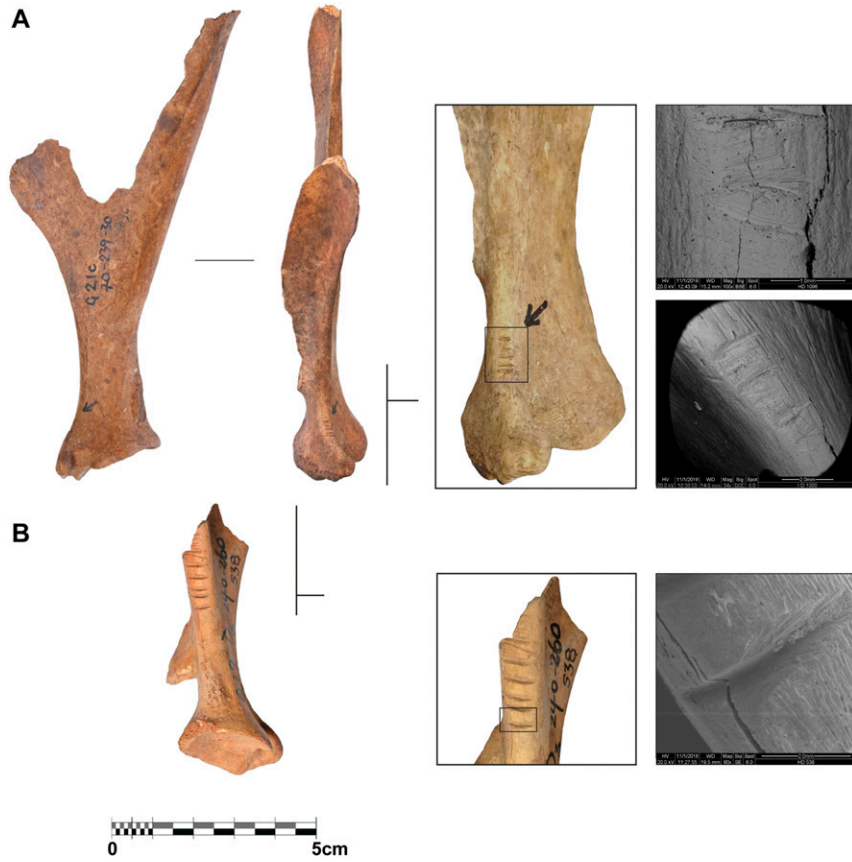


Fig. 51. (A) Scapula displaying cut marks (HD1096). (B) A notched scapula fragment (R538). Magnifications in scanning electron microscopy images: 100×, 34×, and 60×, respectively, from top to bottom. Image courtesy of Assaf Uzan (photographer).

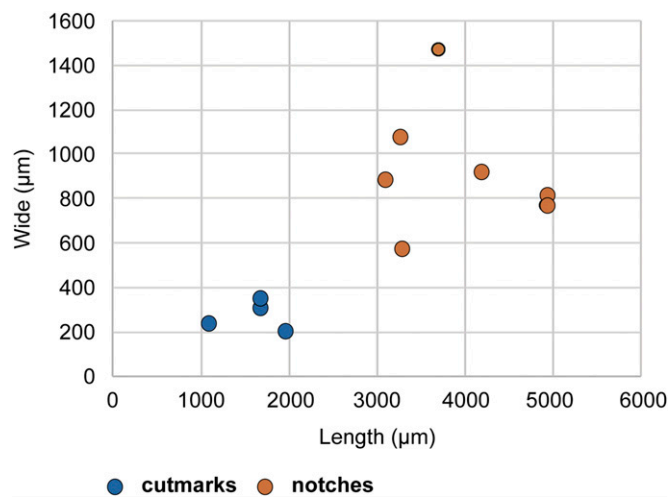


Fig. 52. Morphometrics (length vs. width in micrometers) of cut marks and notches.

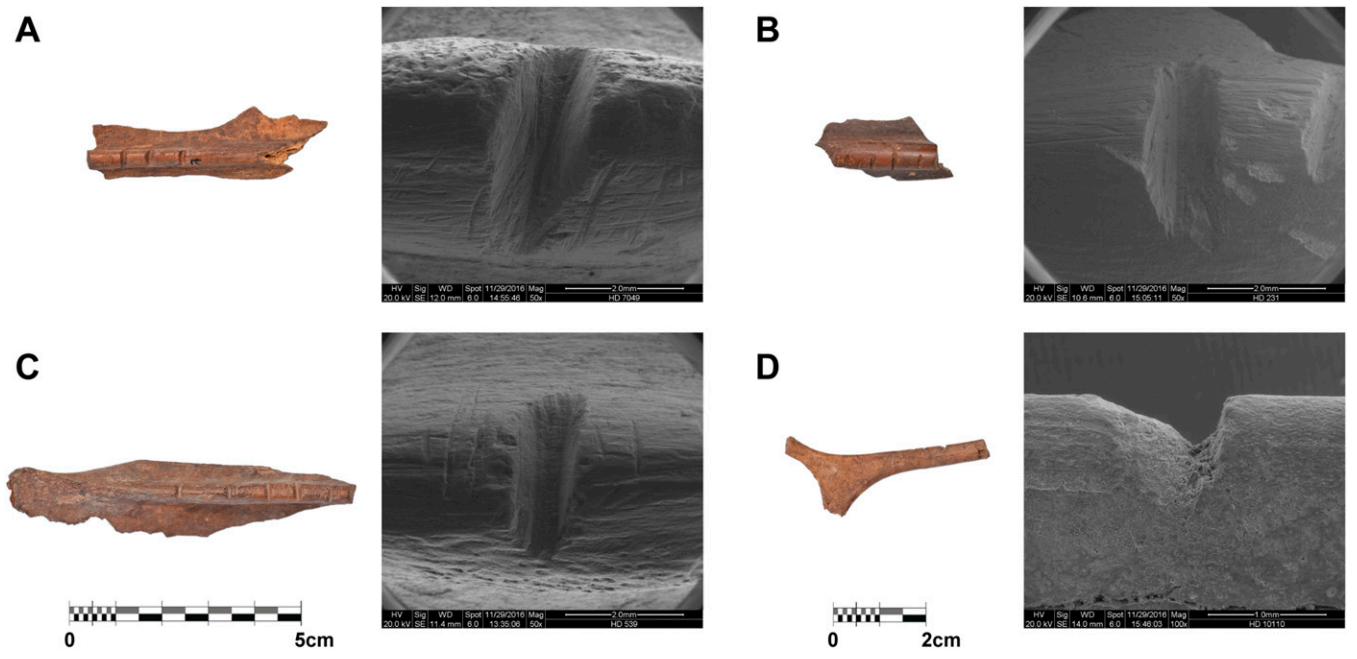


Fig. S3. Fragments of notched scapulae (A–C) and hyoid (D) from Hayonim D and detailed scanning electron microscopy images. Magnification of scanning electron microscope images: 50×–100×. Image courtesy of Assaf Uzan (photographer).

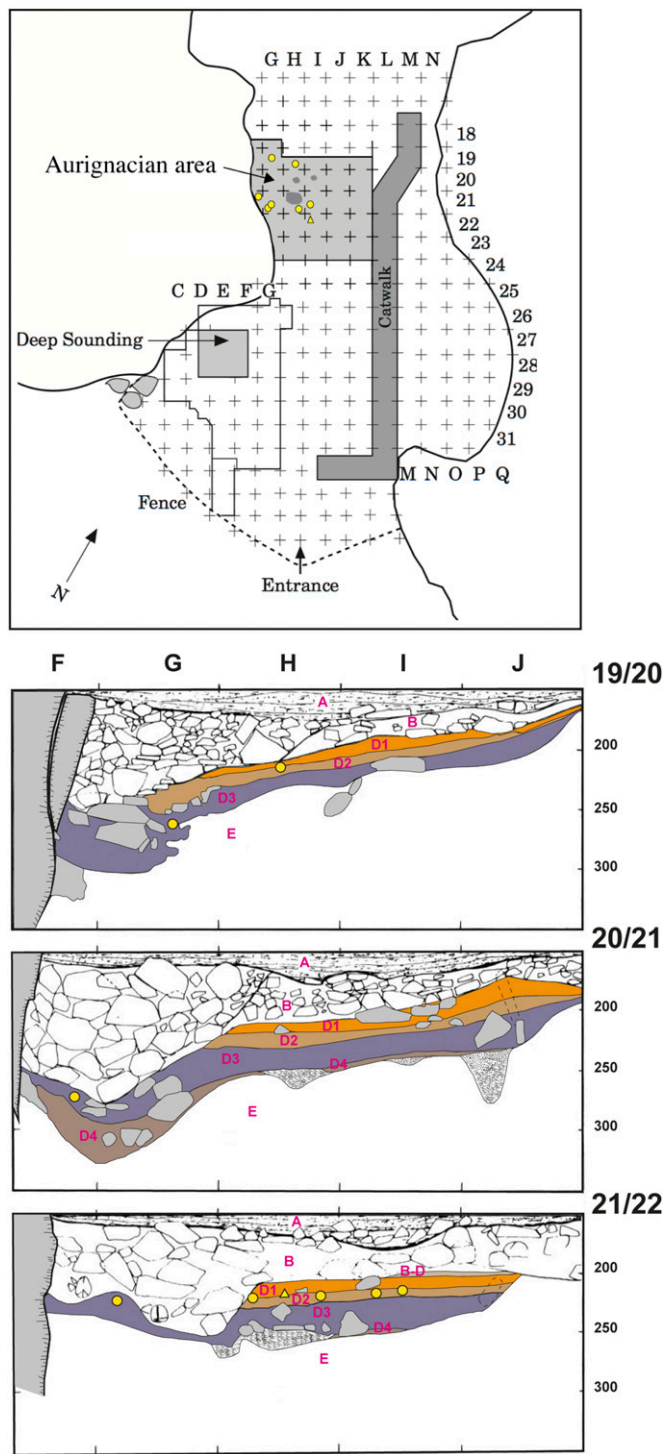


Fig. 54. Spatial distribution and stratigraphic location of Hayonim D notched bones (scapula: yellow circles; hyoid: yellow triangle) plotted over the West–East sections of stratum D. The Aurignacian area is shown in soft gray and hearths in dark gray in the cave plan. (Modified from refs. 1, 2.)

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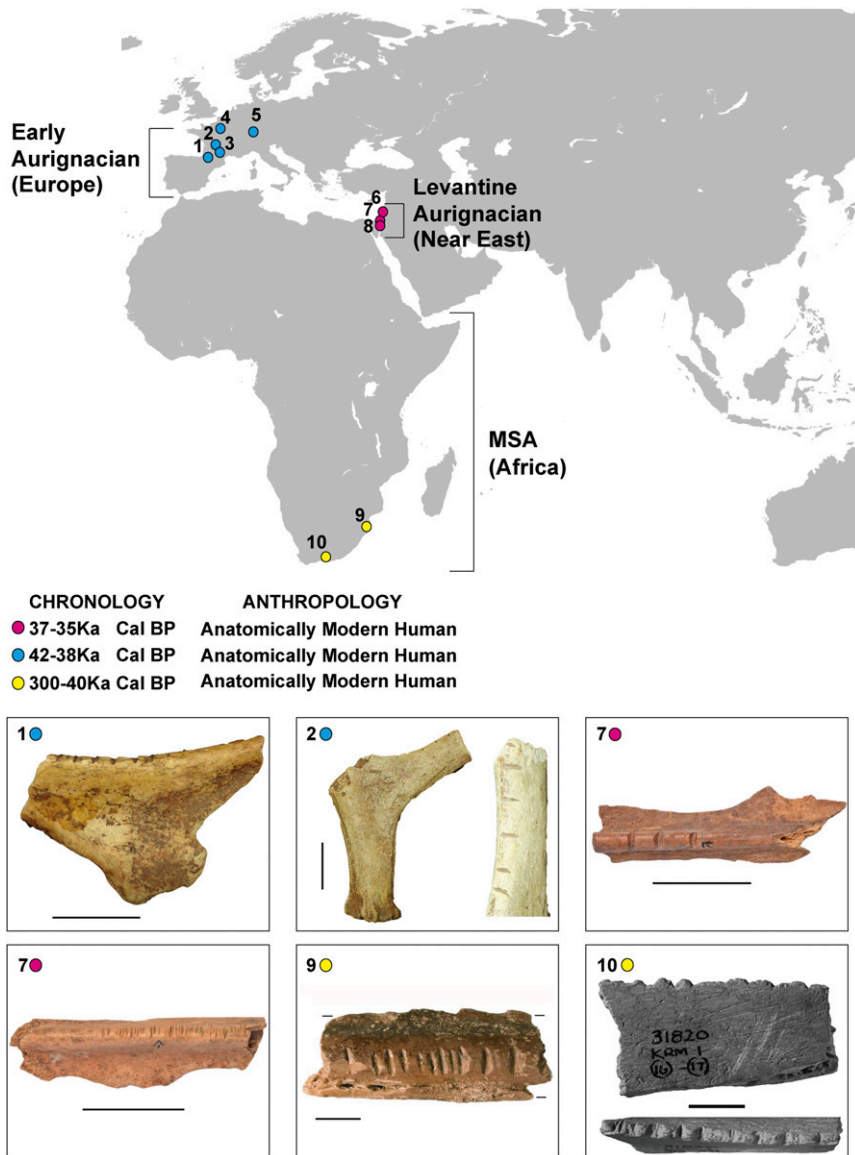


Fig. S5. Geographical distribution map and pictures of diverse notched flat bones referred to in the text and Table S2 from the Early Aurignacian of Europe, the Levantine Aurignacian, and the African MSA. (1) Isturitz (France) (courtesy of J.-M.T.); (2) La Quina-Aval (France) (reprinted with permission from ref. 1); (3) Castanet (France); (4) Princesse (Belgium); (5) Vogelherd (Germany); (6) Manot Cave (Israel); (7) Hayonim Cave (Israel) [image courtesy of Assaf Uzan (photographer)]; (8) Kebara Cave (Israel); (9) Border Cave (South Africa) (reproduced from ref. 2); and (10) Klasies River Mouth Cave (South Africa) (reprinted with permission from ref. 3).

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Table S1. Technological description of the Hayonim D notched bones

Specimen ID	Number of notches	Location of notches	Surface preparation technique	Area covered by scraping, mm	Notch technique	Area covered by notches, mm	Length of notches, mm	Distance between notches, mm	Notch cross-section
10,110	3*	Border	—		Sawing	12	0.5	1–2	V
HD231	7	Posterior border	Scraping	18	Sawing	18	3–4	1.5–3	V
HD537	16	Posterior border medial aspect	Scraping	44	Sawing	44	5	1.5–5	V
R538	6	Posterior border	Scraping	22	Sawing	18	5	1–2	V
R539	6	Posterior border costal end	Scraping	39	Sawing	52	3	2–7	V
HD540	6	Posterior border costal aspect	Scraping	11	Sawing	11	ca. 4	0.5–1.5	V
HD541	3	Posterior border	Scraping	16	Sawing	16	4–5	5	V
R7049	3	Posterior border near the posterior angle	Scraping	27	Sawing	13	3.5–4	3–6	V
R7053	32	Posterior border medial aspect	Scraping	32	sawing	32	2.5–3	0.5–1	V

*The third notch was not complete.

Table S2. Morphometrics of cut marks (specimen HD1096) and notched scapulae (R538, HD231, and R539)

Specimen ID	Marks	Length, μm	Width, μm
HD1096	Cut marks	1,977.3	203.57
		1,699.42	309.61
		1,695.4	347.75
		1,093.3	237.5
R538	Notches	4,193.18	554.5
		4,103.54	616.45
		4,957.45	814.1
		4,939.2	765.74
HD231	Notches	3,107.5	876.68
		4,208.52	921.44
		3,058.37	494.95
		4,037.28	747.68
R539	Notches	3,112.2	976.78
		3,309.1	568.66
		3,700.78	1,469.05
		3,289.7	1,068.87

Table S3. Notched items from Israel (Levantine Aurignacian), Africa (MSA), and Europe (Proto-Aurignacian and early Aurignacian) and an item from the Micoquian levels of Zaskalnaya (Crimea)

Type	Site	Chrono-cultural context	Chronology*	Dating reference	Raw material	Taxa	Anatomical part	Refs.
Notched bone	Hayonim	Levantine Aurignacian	28,980–29,900 Uncal BP	Hv-2675/OxA-2801/2802/2803/2804/2805/2806	Bone	<i>G. gazella</i>	Hyoid	1, 2 (C14 data), this paper
Notched bone	Hayonim	Levantine Aurignacian	Uncal BP		Bone	<i>G. gazella</i>	Scapulae	
Notched bone	Hayonim	Levantine Aurignacian			Bone	<i>G. gazella</i>	Scapulae	
Notched bone	Hayonim	Levantine Aurignacian			Bone	<i>G. gazella</i>	Scapulae	
Notched bone	Hayonim	Levantine Aurignacian			Bone	<i>G. gazella</i>	Scapulae	
Notched bone	Hayonim	Levantine Aurignacian			Bone	<i>G. gazella</i>	Scapulae	
Notched bone	Hayonim	Levantine Aurignacian			Bone	<i>G. gazella</i>	Scapulae	
Notched bone	Hayonim	Levantine Aurignacian			Bone	<i>G. gazella</i>	Scapulae	
Notched bone	Hayonim	Levantine Aurignacian			Bone	<i>G. gazella</i>	Scapulae	
Notched bone	Hayonim	Levantine Aurignacian			Bone	<i>G. gazella</i>	Scapulae	
Notched bone	Hayonim	Levantine Aurignacian			Bone	<i>G. gazella</i>	Scapulae	
Notched bone	Manot Cave	Levantine Aurignacian	38,000–34,000 Cal BP	RTD-7784-combine/RTD-7816/RTD-7194-combine/RTD-7195-combine/RTK-6305/6304/6624/6303/6307/6306/6308/RTD-7247/7246	Bone	<i>G. gazella?</i>	Scapulae?	3, 4–6 (C14 data)
Notched bone	Manot Cave	Levantine Aurignacian			Bone	<i>G. gazella</i>	Scapulae	
Notched bone	Manot Cave	Levantine Aurignacian			Bone	<i>G. gazella</i>	Scapulae	
Notched bone	Manot Cave	Levantine Aurignacian			Bone	<i>G. gazella</i>	Scapulae	
Notched bone	Manot Cave	Levantine Aurignacian			Bone	<i>G. gazella</i>	Hyoid	
Notched bone	Manot Cave	Levantine Aurignacian			Bone	<i>G. gazella</i>	Scapulae	7
Notched bone	Kebara Cave	Levantine Aurignacian	No data	—	Bone	<i>G. gazella</i>	Scapulae	
Notched bone	Emireh Cave	Levantine Aurignacian?	No data	—	Bone	<i>G. gazella?</i>	Scapulae?	8
Notched bone	Klasies River Mouth	MSA II	~60,000 Bp [†]		Bone	Indeterminate	Rib or scapula	9
Notched bone	Klasies River Mouth	MSA II			Bone	Large bovid	Rib	
Notched bone	Border Cave 2WA	MSA (post Howiesons Poort)	57,490–55,250 Uncal BP	ANUA-17303/ANUA-18626/ANUA-19010	Bone	Indeterminate	indet	10
Notched bone	Zaskalnaya	Micoquian	43,000–38,000 Cal BP	OxA-4772/KI-10894/KI-10609	Bone	<i>Corvus corax</i>	Radius	11
Notched bone	Riparo Mochi	Proto-Aurignacian	44,000–41,000 Cal BP	OxA-2000	Bone	<i>Red deer</i>	Limb bone	12, 13 (C14), 14

Table S3. Cont.

Type	Site	Chrono-cultural context	Chronology*	Dating reference	Raw material	Taxa	Anatomical part	Refs.
Pendant	Princesse	Early Aurignacian	No data	—	Ivory	<i>Mammuthus primigenius</i>	Tusk	15, 16
Pendant	Princesse	Early Aurignacian	—	—	Antler	<i>Rangifer tarandus</i>	antler beam	
Notched bone	Isturitz	Early Aurignacian	~32/32,400 Uncal BP [†]	No data	Bone	<i>C. elaphus</i>	Hyoid	17
Notched antler	La Quina	Early Aurignacian	38,892–34,998 Cal BP	OxA-6147 (Lyon-256)	Antler	<i>R. tarandus</i>	Antler tine	17, 18 (C14)
Notched bone	La Quina	Early Aurignacian	—	—	Bone	<i>R. tarandus</i>	Rib	
Grooved pendant	Castanet	Early Aurignacian	39,500–35,500 Cal BP	Gifa-99166/99,180/97,313/97,312/99,179/OxA-21559/21,560/21,564/21,563/21,566/21,562/21,642/21,558/21,664/21,643/21,561/21,645/21,641	Ivory	<i>M. primigenius</i>	Tusk	19, 20 (C14), 21
Polisher	Castanet	Early Aurignacian	—	—	Bone	Horse or large bovid	Rib	
Polisher	Brassempouy	Early Aurignacian	38,600–37,100 Cal BP	Gifa SM-11034	Bone	Horse or large bovid	Rib	19, 22 (C14)
Polisher	Brassempouy	Early Aurignacian	—	—	Bone	Horse or large bovid	Rib	19
Pendant	Cellier	Early Aurignacian	No data	—	Ivory	<i>M. primigenius</i>	Tusk	21
Pendant	Vogelherd	Early Aurignacian	38,274–36,384 Cal BP	KIA-8970	Ivory	<i>M. primigenius</i>	Tusk	23 (C14), 24

*C14 dates were obtained by recent methods (samples pretreatment) except for Hayonim D. New radiocarbon dating of Hayonim D is under process.

[†]U-TH and thermoluminescence.

[‡]Data from Szmidt (2005) (unpublished excavation report) cited in Soulier et al. (in press), p. 3, lacking laboratory code and type of sample. The data are cited as follow: "Deux (C4b1 et C 4b2) se rapportent à un Aurignacien ancien quelque peu différent de l'Aurignacien «typique» aquitain et ont livré plusieurs dates AMS aux alentours de 32,000/32,400 BP (Szmidt, 2005)", referred in Tejero 2014.

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