Visual Code in the Nahal Mishmar Hoard: The Earliest Case of Proto-writing?

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Summary: Visual Code in the Nahal Mishmar Hoard: The Earliest Case of Proto-writing?

Visual codes including three types of signs (logograms, phonograms and determinatives) are the earliest stage in the development of writing. Until recently, the oldest known visual code identified so far, the early precursor of the hieroglyphs, has been discovered in pre-Dynastic Egyptian context (Tomb U-j, near Abydos, 3320 BCE). An examination of artifacts from the Nahal Mishmar copper hoard (end fifth millennium BCE) suggests the development of a visual code that employs these three types of signs in Southern Levant, many centuries before its earliest expression in Egypt and in Mesopotamia. This visual code is tridimensional, and its encoded messages focus on metallurgical processes and their cultural significance. The implications for our understanding of the Ghassulian culture and the development of writing in the Ancient Near East are discussed.

Keywords: Visual Code – Ghassulian Culture – Nahal Mishmar Hoard – Proto-Writing – Rebus Principle – Proto-Semitic – Cultural Metallurgy.

Resumen: Código visual en el Tesoro de Nahal Mishmar: ¿El caso más antiguo de proto-escritura?

Los códigos visuales que contienen tres tipos de signos (logogramas, fonogramas y determinativos) son los estadios más tempranos en el desarrollo de la escritura. Hace poco, el código visual más antiguo conocido e identificado hasta la fecha, el precursor temprano de los jeroglíficos, ha sido descubierto en el contexto egipcio pre-dinástico (Tumba U-j, cerca de Abidos, 3320 a.C.). Un examen de los artefactos del tesoro de cobre de Nahal Mishmar (finales del quinto milenio a.C.) sugiere el desarrollo de un

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código visual que emplea estos tres tipos de signos en el sur del Levante, varios siglos antes de las primeras expresiones en Egipto y Mesopotamia. Este código visual es tridimensional, y sus mensajes codificados se focalizan en procesos metalúrgicos y su significado cultural. Se discuten aquí sus implicancias para nuestra comprensión de la cultura Gassuliense y el desarrollo de la escritura en el Cercano Oriente antiguo.

Palabras clave: Código visual – Cultura Gassuliense – Tesoro de Nahal Mishmar – Proto-Escritura – Principio rebús – Proto-semítica – Metalurgia cultural.

Introduction

That writing has been widespread for such a long time should not be taken as evidence that its emergence was a commonplace event. In fact, in the whole of known human history there are only four homelands where writing is considered as being elaborated independently of any pre-existing system: southern Mesopotamia and southern Egypt (both at the end of the fourth millennium BCE), China (end of the second millennium BCE) and Mesoamerica (mid-first millennium BCE).[1] The fact that writing emerged so rarely, while figurative representations and symbolism are extensively attested in human cultures from the Paleolithic period,[2] indicates that the essential principle of writing—a mode of communication that combines figurative symbols with representations of phonemes (spoken sounds) integrated into a single code—is far from self-evident.[3]

The principle guiding this singularity is the rebus, in which a reality that is difficult to symbolize is represented by another one which is easier to represent and pronounced quite similarly. Privileging the sound over the concept, the rebus principle is attested from the earliest stages in the emergence of writing both in Mesopotamia,[4] Egypt,[5] China[6] and

[1] Justeson 1986: 440; Woods 2010a; Stauder 2010: 142; Boltz 2000: 1–2.

[2] Grosos 2017: 91–126.

[3] C. Woods (2010a: 18) assumes that "the bond to the spoken word is prerequisite to any definition of writing."

[4] Woods 2010b: 43.

[5] See Kahl 2001: 104. A. Stauder (2010: 141) concluded: "It is precisely on the basis of such ad hoc explorations of the rebus principle, phoneticism, and semantic complementation that the later writing would develop, extending and systematizing their potential."

[6] For W. G. Boltz (2000: 7): "Chinese writing elsewhere, could not get along with just characters

Mesoamerica.[7] Regarding this, C. Woods[8] concluded: "The rebus principle is integral to writing, as it allows the writing of those elements of language that do not lend themselves easily to graphic representation."

Both in Mesopotamia and ancient Egypt, the previously existing repertoire of symbols and figurations is exploited in the earliest forms of writing.[9] However, writing cannot be approached in either case as a spontaneous evolution of representative symbols (seals, tokens, clay envelopes and other modes of registration of goods) that were already used from the 8th millennium BCE to transmit information.[10] The reason is the emergence, in addition to the "classical" symbolic figuration of specific realities (logograms) already attested before, of two new categories of signs: the phonograms (= symbols representing specific sounds); and the determinatives (= symbols used in classifying words) which confer a specific meaning to the signs from the two other categories (logograms and phonograms). These new signs, especially the phonograms, were generated through the rebus principle, in which "the existence of homonyms in the language is exploited in that the sound of one word, most often one with a referent that can be easily drawn, is used to write another word that is pronounced identically or similarly."[11]

If coherent writing systems truly emerged in Egypt and in Mesopotamia during the phase of centralization of political power,[12] this process was apparently preceded by an earlier phase in which the use of the rebus principle was explored without practical applications.[13] In

originating in pictographs, and soon resorted to both rebus and polyphonic use of characters."

[7] J. S. Justeson (1986: 453) assumes that, in development of writing in Mesoamerica, "rebus representation became a basis for generating simple phonetic sign values, sometime prior logograms and sometime via depictive signs that had not previously been in use."

[8] Woods 2010a: 20

[9] Woods 2010a: 19; Stauder 2010: 137; Fales and Del Fabbro 2017: 52–54. E. V. MacArthur (2010: 117) concluded: "Despite the fact that some of the signs that occur were later incorporated into the hieroglyphic system, there is no clear evolutionary relationship between certain pot marks and later, corresponding hieroglyphic signs."

[10] Mattessich 1987; Jasim and Oates 1986: 349; Topçuoğlu 2010: 29.

[11] Woods 2010a: 10.

[12] Woods 2010b; MacArthur 2010.

[13] Concerning the emergence of proto-Cuneiform, F. M. Fales and R. Del Fabbro (2017: 52)

Ancient Egypt, the earliest expressions of proto-writing were identified two centuries before the elaboration of a complete repertoire of hieroglyphs, which took place during the reign of the king Den. About 200 tags (mostly made of bone) bearing sequences of signs in various combinations, were discovered in the funerary complex of Umm el-Qa'ab, near Abydos (Tomb U-j, dated to 3320 BCE), together with ink-inscribed vessels, seals and ceramics.[14] Despite the relative simplicity of these signs, their analysis suggests that all the components of writing (logograms, phonograms and determinatives) were already present, thus transforming them into the earliest form of proto-writing identified so far.[15]

The limited number of signs and conventions found in tomb U-j's tags suggests that the people who inscribed them did not intend to reproduce language or to express a spoken reality accurately. Rather, these inscriptions should be approached as a visual code in which symbols and their phonetic expression are blended in various ways to denote things not easily represented by symbols alone, such as proper names, toponyms, specific processes and concepts.

Since visual codes are usually approached as precursors to the development of writing, they are systematically researched in inscriptions made on rock, ceramics, and other plane surfaces. However, when one approaches visual codes as self-sufficient, coherent realities, rather than archaic stages in the development of writing, these preconceptions fall away from the investigation thereby introducing the possibility that unique artifacts combining a series of signs in a specific fashion might also express a tridimensional visual code. This consideration is especially interesting given that the spatiality of an artifact provides the opportunity for protuberances to be combined in more ways than a schematic inscription on a surface will allow.

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assume that "writing was not a constituent factor of the complex bureaucracy of archaic Mesopotamia, rather—at most—one of its developments, as formalization of a series of systems for symbolic notation that were already in place and used for various purposes, from play to ritual and business."

[14] Dreyer 1998.

[15] Kahl 2001; Stauder 2010; MacArthur 2010.

The purpose of this paper is to show that a 3-D visual code including all the characteristics of writing (logograms, phonograms and determinatives) may be identified in the copper artifacts from Nahal Mishmar (southern Levant), about a millennium before the earliest expressions of a 2-D visual code in ancient Egypt and ancient Mesopotamia.

Preliminary Considerations

The Nahal Mishmar Hoard

A hoard of 426 metallic artifacts was discovered in 1961 in a cave from Nahal Mishmar (Southern Levant), wrapped together in a reed mat with ivory and stone artifacts.[16] This finding has stimulated great interest and curiosity, given the outstanding artistic value of the metallic artifacts, the diversity of shapes and uniqueness of many of them (**Fig. 1**). Most of these items (especially the non-utilitarian ones) were produced by means of the lost-wax technique, a process of high technical complexity.[17]

Fig. 1.
Miscellaneous artifacts from the Nahal Mishmar Hoard.

[16] Bar Adon 1980.
[17] Levy and Shalev 1989.

The hoard was initially dated to the first half of the fourth millennium BCE,[18] but subsequent analyses have revealed that it probably belongs to the second half of the fifth millennium BCE (*ca.* 4300 BCE).[19] The origin of the clay employed for the inner ceramic mold denotes a local production.[20] This premise is supported by the finding of similar items in the Ghassulian culture[21] and the metallurgical activity identified in the Beer Sheba valley at the end of the fifth millennium BCE.[22]

The nature, significance, and function of most of the items remain obscure.[23] They were interpreted as prestige artifacts possessed or exchanged as gifts by elite people among the Ghassulian society.[24] Alternately, they were approached as ritual artifacts involved in cults of fertility, life cycle, and wealth, and even as representations of the divine beings who personified them.[25]

The Nature of the Ghassulian Dialects

Investigating the existence of a visual code in the Nahal Mishmar hoard implies first of all that the language spoken by this people may be iden-

[18] *E.g.*, Moorey 1988: 172–174; Tadmor 1989: 250–251; Merhav 1993: 21.

[19] Aardsma 2001; Rowan and Golden 2009: 12–14; Gilead and Gošić 2014: 233–235. F. Klimscha (2017: 110, 113) dates the hoard to the 44th century BCE. Some scholars contest such estimation. For example, A. N. Shugar and C. J. Gohm (2011: 138) assume that "it would be very difficult to push the date of the hoard's deposition earlier than the first quarter of the 4th millennium BCE."

[20] Goren 2008.

[21] Similar items were found in many Chalcolithic sites from Southern Levant (Abu Matar, Bir es Safadi, Givat Ha-Oranim and others). See Levy and Shalev 1989: 355–357; Rowan and Golden 2009: 45. Especially interesting is the finding of similar implements in a foundation deposit of a large building from the Ghassulian site of Shiqmim (Levy *et al*. 1991: 34–35) and in a burial context in Peqi'in (Gal *et al*. 1997: 151).

[22] Shugar 2000; Gilead and Gošić 2014: 226.

[23] As noticed by D. Ilan and Y. M. Rowan (2012: 94), "Most researchers view the treasure as a ritual deposit, though none have attempted a comprehensive reconstruction of the assemblage's symbolic meanings or of the ritual actions that might be involved."

[24] *E.g.* Moorey 1988. Levy 1995: 241. The absence of artifacts similar to those from Nahal Mishmar in other cultures from the second half of the fifth millennium BCE indicates that the copper items from Nahal Mishmar were not produced for trade to distant destinations as "prestige" artifacts.

[25] Elliott 1977; Merhav 1993; de Miroschedji 1993: 216; Ilan and Rowan 2012: 103.

tified, at least approximately. Since only Semitic languages are known in this area, scholars assume that the dialects spoken in the southern Levant during the fifth millennium BCE belong to this family.[26] Others argue that Semitic speakers entered southwest Asia from north Africa during the late fifth or the early fourth millennium, and reached Mesopotamia by the late fourth millennium BCE.[27] Both premises authorize to hypothesize that the people who produced the Nahal Mishmar implements spoke a Semitic language.

The idea that Semitic languages were introduced in Canaan only from the Early Bronze Age (that is, after the collapse of the Ghassulian culture) is also defended today.[28] If so, it remains impossible to examine the hypothetical existence of a 3-D visual code in the Nahal Mishmar implements, because this Ghassulian language, of supposed non-Semitic nature, has left no traces. Few elements invite however to conclude that Semitic languages were probably spoken in Southern Levant long before the Early Bronze Age.

- The lack of common appellation of copper in the Semitic languages[29] suggests that these latter diverged before the age of domestication of metals, that is, before the fifth millennium BCE.
- In light of the outstanding achievements of the Ghassulian metallurgy,[30] the technical lexicon elaborated by this people is expected to survive, at least partly, the collapse of their culture. For this reason, the all-Semitic nature of the metallurgical lexicon in use in Southern Levant during the subsequent periods supports the assumption that the Ghassulians spoke Semitic dialects.

[26] Stieglitz 1993: 264–265; Diakonoff 1998; Dolgopolsky 1999: 2–12; Militarev 2000.
[27] Pat-El and Huehnergard, forthcoming.
[28] Vardi and Gilead 2013; Zohar 1992. This latter opinion is supported by phylogenetic analyses suggesting a differentiation of Semitic languages only from the fourth millennium BCE. See Kitchen *et al*. 2009.
[29] Diakonoff 1998: 213.
[30] Y. M. Rowan and J. M. Golden (2009: 41) claim that: "Though copper first appears during the Neolithic elsewhere in the ancient Near East (Iran and Anatolia), by the Chalcolithic the metallurgical techniques of the southern Levant are on a par with, if not surpassing, those of other contemporary peoples."

- The Southern Levant is not only one of the most ancient homelands of copper metallurgy in the ancient World, but also the hearth of emergence and development of furnace metallurgy from where it diffused at the end of the fifth millennium BCE.[31] Traces of the earliest stages of development of this process in Southern Levant are identifiable in the differentiation of the qayin superfamily of Semitic roots.[32] Again, this feature supports the assumption that the Ghassulians spoke Semitic dialects.
- The smooth transition between the Neolithic and Chalcolithic cultures in Southern Levant[33] suggests that the dialects spoken by the Ghassulians are in continuity with those previously in use during the Neolithic period. The Semitic nature of these latter is suggested by examination of the vocabulary of wild flora and fauna, agriculture and breeding common to Semitic languages. The data support the idea that the earliest Semitic languages differentiated in close association with the gradual emergence of agriculture and breeding in the Levant.[34]
- The transition between Chalcolithic and Early Bronze Age was less abrupt in Southern Levant than previously assumed.[35] For this reason, the dialects spoken by the Ghassulian are expected to influence those replacing them. But substantial non-Semitic influence on the Canaanite family of languages is not attested, a feature

[31] Amzallag 2009.
[32] Amzallag and Yona 2017.
[33] Tangri *et al.* 1994. Such continuity between the Neolithic and Chalcolithic populations is also observed in Northern Levant. See Haber *et al*. 2017.
[34] Diakonoff 1998: 217–219; Militarev 2002: 136; Diamond and Bellwood 2003: 601. Even the proto-Afrasian, the stem from which differentiated proto-Semitic (together with the Cushitic, Omotic, Egyptian and Chadic-Berber languages) is now considered by scholars as originating from the Levant, its diffusion following the earliest wave of diffusion of proto-agriculture, in the 9th millennium BCE. See Militarev (2009: 95–96; 2002: 135–136). This premise is also supported by evidences towards a gradual differentiation of proto-Semitic 3-C roots in close relation with the transition from hunter-gatherer to agriculture way of life. See Diakonoff (1998: 218); Agmon (2010); Agmon and Bloch (2013). These findings cohere with recent data revealing a genetic continuity between populations of hunter gatherers and earliest farmers in the Levant. See Lazaridis *et al*. 2016.
[35] Davidovich 2013; Golani 2013; Van den Brink 2013; Roux *et al*. 2013: 64; Klimscha 2017: 109.

pleading towards continuity between the Ghassulian dialects and the Semitic languages spoken from the Early Bronze Age.

- A recent analysis of human DNA from the burial cave of Peqi'in (Northern Galilee, second half of fifth millennium BCE) has revealed the coming of new population in Southern Levant at the Chalcolithic period. However, the data also support the assumption of global population continuity between the Neolithic and Chalcolithic periods.[36] Also the genetic closeness between the Ghassulians buried at Peqi'in and people buried at Sidon during the Bronze Age,[37] together with their geographical proximity, fit the premise of ethnic continuity between Chalcolithic and Early Bronze Age rather than the assumption of sudden disappearance of the Ghassulians and their replacement by a new population of Semitic-speaker migrants.[38]

These observations authorize the assumption that Ghassulians dialects belonged to the Semitic family of languages as working hypothesis for the present investigation. If the Neolithic peoples were proto-Semitic speakers, the dialects spoken by the Ghassulians should therefore be considered as forms of proto-West Semitic and even of proto-Canaanite languages.

[36] From their analysis of human DNA from the Peqi'n burial cave, E. Harney *et al*. (2018: 4) deduced that: "the Levant Chl [Chalcolithic] population is descended from a population related to Levant N [Neolithic], but also harbors ancestry from non-Levantine populations related to those of Iran or the Caucasus that Levant N does not share (or at least share to the same extent)." Such admixture may reflect contacts between populations inherent to the prospection, mining and transportation to Southern Levant of rare ores rich in arsenic and antimony originating from Anatolia, northern Euphrates and southern Caucasus (see Shugar 2018) and to the diffusion, in return, of techniques of metallurgy from Southern Levant to these areas and to southern Iran from the early fourth millennium BC (see Amzallag 2009: 504–506 and Fig. 2). This double flux may explain the parallel sudden closeness to South Levantine genetic pool of populations from the Iranian plateau, at the Chalcolithic period, evidenced by Harney *et al*. (2018, Fig. 3).

[37] Harney *et al*. 2018: 6.

[38] This conclusion is confirmed by current estimations concerning the genetic distance between Neolithic and Bronze Age human DNA from the Levant. See Lazaridis *et al.* 2016, Fig. 4. The results aim for global continuity of the populations, with a noticeable influence from Anatolia and Iran observed after the Neolithic period. Such ethnic continuity includes necessarily the populations belonging to the Ghassulian culture.

The Motif of Twined Ungulates

In Nahal Mishmar, the recurrence of specific shapes, and the similarity of figurative elements suggest that most, if not all of the implements belong to the same culture and express the same repertoire of signs, symbols and significances.[39] The first step in examining their use as a visual code is the identification of elements with a function other than decorative or purely symbolic. The motif of the twin ungulates, identified on the three main types of artifacts from Nahal Mishmar (mace heads, scepters and crowns) is one of them.

- *The copper mace head with Siamese ibexes*: The Nahal Mishmar hoard comprises a highly decorated mace head (**Fig. 2**) usually regarded as a prestige artifact.[40] One of its mostly singular features is the representation of a chimerical animal on its top, an ibex with a single body and two heads (= Siamese).
- *The scepter with twin ibexes*: Branching off from one of the standards from Nahal Mishmar are two pairs of ibex heads: a first pair is positioned on the upper ring, and a second pair, below it, emanates from the tubular body (see **Fig. 3A**).[41] A detailed view reveals that the upper ring constitutes a "common neck" for the two ibexes (**Fig. 3B**). This suggests homology between this upper pair of ibex's heads and the Siamese ibexes from the ornamented mace head from **Fig. 2**.
- *The four-headed scepter*: A scepter from Nahal Mishmar is characterized by four animals of similar size and shape, symmetrically positioned on its top (see **Fig. 4A**). The animals are not easy to identify, but the horn-like upper protuberances on their head suggest that they are ungulates with relatively small nose, a typical characteristic of juvenile stage in mammals **(Fig. 4B)**. The two

[39] This premise is valid even if we consider the hoard simply as a collection of individual gifts, of implements stocked for trade (as suggested by Moorey 1988: 182; Gates 1992: 132 and Tadmor 1989: 252) and even as a depot of ritual implements that had fallen into desuetude for whatever reason (Garfinkel 1994).

[40] Bar Adon 1980: 100–101; Beck 1989: 42; Merhav 1993: 24.

[41] Bar Adon 1980: 106–109.

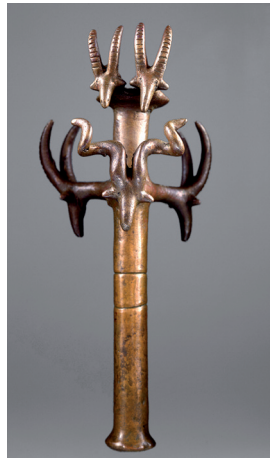
protuberances below the head have been interpreted as a split barb,[42] so that the element between the head of the animals and the top of the scepter becomes a neck. However, this "neck" is so disproportionate in regard to the size of animal's head that it looks rather like the representation of a thorax. By extension, the lower protuberances (the so-called "split barb") figurate the anterior legs of the animal. According to this interpretation, the terminal part of the four animals (including their posterior legs) is missing, transforming this tetrad in two pairs of Siamese individuals. A parallel emerges, therefore, between these bonded "half-animals" and the Siamese ibexes represented on the ornamented mace head (**Fig. 2**).

- *The crown with twin horned heads*: Two similar horned heads are positioned on a circular artifact from Nahal Mishmar defined as a "crown" (**Fig. 5A**).[43] Their most noticeable characteristic is the small size of their horns and their reduced facial protuberance (**Fig. 5B**), both elements indicating the juvenile character of the head of these ungulates. The two heads are not symmetrically

Fig. 2.
Mace head with Siamese ibexes. Israel Museum, item 61-11 (335 g).

[42] Bar Adon 1980: 111.
[43] Bar Adon 1980: 32–33.

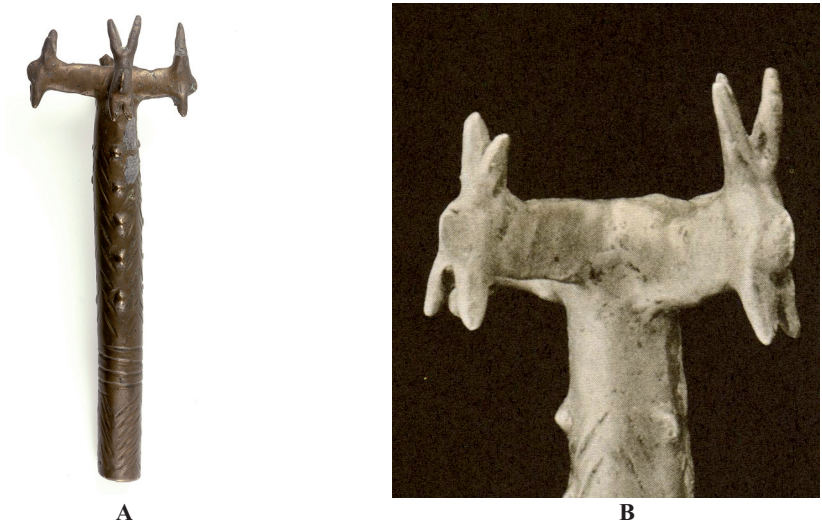
positioned on the upper circle, but adjacent like the two ibexes from the upper ring in the **Fig. 3** standard. The intersection between the base of the head and the width of the upper rim (**Fig. 5B**) invites us to consider the cylinder as their common neck/body. Here again, it transforms this item into a figuration of Siamese animals.



A

B

Fig. 3.
Scepter with ibex heads. A. General view. B: Detail of the upper elements. Israel Museum, item 61–88 (27.5 cm length, 1014 grams).
A: © Copyright Israel Antiquities Authority; B: Author photo.



A B

Fig. 4.
Four-headed scepter from Nahal Mishmar. A: *whole artifact*, B: *detail of the upper part*.
Israel Museum, item 61-86 (18.2 cm length, 249 grams).
A: © Copyright Israel Antiquities Authority;
B: from Bar Adon (1980), with permission of the Israel Exploration Society.

A B

Fig. 5.
Crown with two horned heads on the upper rim. A: *The whole cylinder*; B: *Detail of the two horned heads*. Israel Museum, item 61–175 (17.3 cm diameter, 1285 grams).
A: © Copyright Israel Antiquities Authority;
B: from Bar Adon (1980), with permission of the Israel Exploration Society.

The animal pairs identified on the four items examined here (**Figs. 2**–**5**) display similar characteristics:

- All are representations of young ungulates. This juvenile trait clearly appears on the heads represented on the four-headed scepter (**Fig. 4**) and on the crown (**Fig. 5**). The shape of the horns of the ibexes represented on the mace head (**Fig. 2**) and scepter (**Fig 3**) also fits the representation of juvenile animals.
- The young ungulates are not simply paired. This clearly appears in the mace head and the four-headed scepter (**Figs. 2**, **4**). An examination of the connections of the head with the upper ring, in both the crown and the scepter (**Figs. 3**, **5**) yields a similar conclusion. In all these instances, the animals are blended through their body.
- The twined young ungulates are positioned on the top of the item: upon the mace head, on the top of the standard, on its upper ring and on the upper ring of the crown.

These common features, together with the lack of naturalism in the representation of Siamese animals, suggest that the "mixed pair of young ungulates" is a defined motif with a specific meaning that remains to be identified.

The Mace Head with Siamese Ibexes

The ornamented mace head (**Fig. 2**) is composed of three interrelated elements: (i) the twin ibexes; (ii) a globular mass (similar in size and shape to the mace heads from Nahal Mishmar) on which the twin ibexes are set up; (iii) two flattened protuberances symmetrically attached to the smooth globular mass, in the same plane as the twin ibexes: one ending like a chisel, and the other shaped like a knife. The high level of symmetry of this implement is disturbed only by the small differences in shape between the tool-like appendices emanating from the globular mass. This effectively focuses the attention to this asymmetry and its significance.

Copper skeuomorphs of stone tools exist among the Nahal Mishmar's hoard (see **Fig. 6**). However, unlike them, the shape of the blades represented in **Figs. 2** and **7** is so distinct from that of lithic tools that they may be approached as original copper implements. Their representation refers therefore to a new reality: the production, made possible by metallurgy, of a new family of items previously unknown, such as those from Nahal Mishmar (**Fig. 7**).

A **Fig. 6.** **B**

Copper skeuomorphs of stone tools from Nahal Mishmar.
A. *Imitation of stone axe with leather ropes*; B: *Imitation of stone hammer*. Israel Museum, A: item 61–134 (10.4 cm, 248 g); B: item 61–150 (13 cm length, 836 g). Author photo.

A **B** **C**

Fig. 7.

Original metallic tools from the Nahal Mishmar hoard. A: *small chisel*; B: *long chisel*; C: *copper axe*. Israel Museum. A: item 61-141 (8.5 cm length, 244 g); B: item 61–145 (25.3 cm length, 325 g); C: item 61–123 (8 cm axe length, 240 g). A and B: From Bar Adon (1980) with permission of the Israel Exploration Society. C: author photo.

Fig. 8.
Standard with four chisel-like incurved elements. Israel Museum, item 61–87 (22.5 cm length, 476 grams). © Copyright Israel Antiquities Authority.

The chisels and the blade of copper axes from Nahal Mishmar (see **Fig. 7** for example) have a straight body which confers maximal efficiency to the tool, and especially to its terminal part. But this is not the case for the two tool-like elements represented in **Fig. 2**, a feature suggesting that the knife and chisel on this implement are not represented in their mature, functional status. Rather, their curvature gives an impression of fluency and softness typically associated with hot metal. The abnormal shape of the two tool-like elements and that they sprout from the globular mass suggests their production by casting (or even hammering?) from a bulk of raw copper.

The same representation of "immature tools" characterizes another implement from Nahal Mishmar, a scepter with four chisel-like protuberances (**Fig. 8**). Exactly as in the mace head from **Fig. 2**, the abnormal curvature of these four tool-like elements makes them inappropriate for any functional use. Here again, this peculiar shape, through its fluidity and softness, suggests the process of fabricating the tool, and more specifically its casting. And exactly as in the mace head from **Fig. 2**, the four chisel-like protuberances seem to sprout out from the globular mass positioned on the scepter.

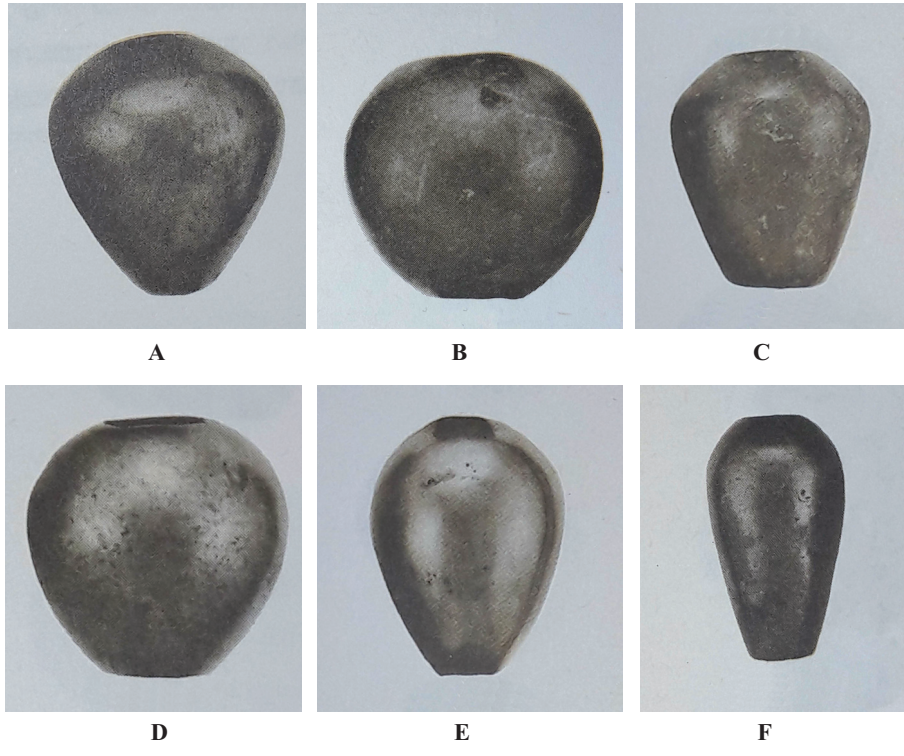


Fig. 9.
Diversity in shape of copper mace heads from Nahal Mishmar. Israel Museum. Items 61–358 (A), 61–203 (B), 61–297 (C), 61-344 (D), 61–284 (E), 61–391 (F). The variance among the masses is 4.3–5.5 cm in height; 3.1–5.5 cm in diameter, and 158–319 g in weight. From Bar-Adon (1980), with permission of the Israel Exploration Society.

Here again, the globular mass from which the tool-like elements sprout, both on the mace head and on the scepter, evokes the bulk of raw copper used to produce these implements.[44] Consequently, if the items are produced by casting, the maces become endowed of a significance beyond their primary identification as weapon: they become the symbol of raw copper molten in a crucible. Such superposition of

[44] Such metallurgical symbolism of the mace head is even reinforced by their ovoid shape—which reflects the inner shape and size of crucibles—as well as by their weight range—between 110 grams (item 61–256) to 619 grams (item 61–273)—corresponding to weight range of almost all the metallic implements from Nahal Mishmar. The main exception being the "crowns" (items 61–170 to 61–179), with a weigh range of 928–1971 g.

meanings is supported by the variations in shape, size and weight of this type of artifact (see **Fig. 9**), rendering improbable that some of them were designed to serve as weapons.

In light of these considerations, we expect the twin ibexes, by their upper positioning, to symbolize something that precedes the production of raw copper (= mace head) used for the casting of metallic items (= tool-like protuberances). This leads us to test whether the Siamese ibexes refer to the production of the raw metal (= mace head). Since native copper was absent in southern Levant, the metal produced locally had necessarily to originate from the smelting of copper ore in a furnace.

No obvious link exists between ibexes and metallurgy, except the fact that these animals are frequently encountered in the mountains surrounding the copper-mining areas of the Arabah Valley.[45] However, phonetic similarities exist between the West-Semitic designation of juvenile ungulates (*ǵpr*)[46] and the designation of dust (*ʿpr*),[47] in light of relative closeness between the pronunciation of *ǵhayin* (/ǧ/, voiced uvular fricative) and *ʿayin* (/ʿ/, voiced pharyngeal fricative).[48] Also, it seems that metallic ores were designated as *ʿpr* in Semitic languages spoken in the Southern Levant during the Bronze Age, this appellation probably expressing the need to crush the ores into fine dust before smelting them in a furnace.[49] Since this operation was already performed from the earliest stages of furnace metallurgy in Southern Levant,[50] we may guess that ores were already designated as *ʿpr/ ǵpr* by the Ghassulians, in the case they spoke a Semitic language. These considerations, together with the homonymy/phonetic closeness

[45] The ibex, however, is also present in other mountainous regions in the southern Levant (such as the Nahal Mishmar area), so that it may not be specifically associated with copper ore and metallurgy.

[46] Militarev and Kogan 2005: 67–68; Kogan 2011: 208.

[47] Wächter 2001: 257–258; Agmon 2010: 56; Kogan 2011: 191.

[48] This proximity is revealed by the use of the letter ʿayin to designate both in ancient Canaanite languages (see Guérinot 1936: 39; Blau 1982; Steiner 2005: 231) and by the interchanges, in Ugaritic, between ǵhayin and ayin in the vicinity of liquid consonants.

[49] Amzallag 2017a.

[50] Shugar 2000: 244–252.

between their names, suggest that the ibexes may designate the ores from which copper is produced. In this way, the artifact from **Fig. 2** represents the whole metallurgical process: from the production of metal (ibexes setting on the mace head) to the casting of new implements (the tool-like elements emanating from the mace head).

Even the Siamese joining of the young ibexes is part of this representation. This artifact (along with all the others from Nahal Mishmar produced by lost-wax technique) is not made of pure copper, but of an alloy combining copper with arsenic, antimony and/or nickel.[51] The preparation of such alloys necessitated the mixing of the local ore (which yields pure copper) with ores supplying the other elements, which were imported from distant mining areas (such as Anatolia, the upper Euphrates, or the southwest coast of the Red Sea).[52] If ore is depicted through a young ibex, the mingling of the two young animals into one Siamese entity reflects the need to mix ores of distinct origin and nature to produce the alloys used for casting complex artifacts. This metallurgical justification of the Siamese representation of the young ibexes strengthens their interpretation as a phonogram designating the ores.

The identification of a phonogram in the implement from **Fig. 2** stimulates a look for further ones. First of all, we observe that the word designating the number two (Proto-Semitic **θina*) bears a phonetic closeness to the verbal root *šnw/šny* (Proto-Semitic **snw*) which refers to realities that are different and should be distinguished.[53] This phonetic closeness is also reflected by the asymmetry between the two tool-like elements emanating from the globular mass (**Fig. 2**). By extension, it may be that the representation of a pair of young ungulates does not only evoke the mingling of ores, but also emphasizes their distinct nature. If so, the number two should be regarded as a phonogram evoking the difference in nature.

[51] Shalev and Northover 1993; Golden 2009: 291–292.

[52] Shugar 2000: 178, 232–235; Boscher 2016: 78–79.

[53] See *HALOT* 4: 1597 and 1605 for *šnw* and *šnm* respectively. The similarity is especially pronounced in Hebrew, where the Proto-Semitic phonemes *s and **θ* have merged, but on this basis, we may assume a closeness in the way these two phonemes were pronounced in the Semitic languages spoken in this region.

The hole (14.5 mm diameter) traversing longitudinally the globular mass in **Fig. 2** deserves special attention. It is similar to the longitudinal hole characterizing the copper mace heads from Nahal Mishmar (see **Fig. 9**). But this transverse hole cannot have been made for the purpose of setting this ornamented item on a pole, because the space between the legs of the twin ibexes is smaller than the diameter of the hole. Consequently, the function of this upper aperture is not to set the artifact on a pole.[54] This invites us to examine its possible function as a phonogram. The appellation of hole as *ḥor* (Hebrew), *ḫrt* (Ugaritic) and *ḫurru* (Arabic, Akkadian) suggests that it was already designated as *ḥr/ ḫrr* in early Semitic languages. As a parallel, in proto-Semitic *ḫrr / ḥry* has been identified as evoking an intense burning.[55] Consequently, in light of the phonetic closeness between the phonemes *ḫ* and *ḥ*, the hole with an upper aperture devoid of practical use in the artifact from **Fig. 2** may serve as a phonogram evoking the fiery process by which the ores (= Siamese ibexes upon it) are smelt into copper, and by which the raw copper (= the mace head) is melted in order to cast finished implements (= the tool-like elements).

All these observations combine to suggest the following interpretation of the "mace head" from **Fig. 2**:

> *Gather distinct types of ores (= the Siamese ibexes) first (= top position of the Siamese ibexes) and put them on/into intense fire (= the ibex legs positioned on the borders of the hole) to produce the raw metal (= the globular mass "growing" around the hole), from which (= continuity between the three elements of the artifact) various implements (= two distinct tool-like protuberances) are cast (= incurved shape of the tool-like protuberances).*

The artifact thereby summarizes the essential stages of the metallurgical process, beginning with the preparation of ores and terminating with the casting of metallic implements. This way of deciphering integrates the

[54] Furthermore, such wood protuberance would destroy the harmony of representation of the Siamese ibex upon the mass and the relationship between the two.

[55] Militarev 2010: 56–57. See also D. N. Freedman and J. Lundbom (1986: 171).

various elements in the representation of a whole coherent claim. It also generates syntax on the basis of interrelation between the elements, from which articulations of notions and causal relations are derived. Finally, the three types of components defining a visual code may be identified here:

- ***Logograms***: The two elements symmetrically attached to the mace head symbolize copper-made artifacts. Also the globular mace, in evoking a mass of copper (and even partly shaped like the inner space of a crucible), should be also regarded as a logogram, though its level of abstraction is higher than the two tool-like elements attached to it.
- ***Phonograms***: The representation of copper ore through an ibex (young ungulate) being founded on their phonetic closeness, this sign should be identified as a phonogram. The number two is apparently used (both in the pair of ibex and pair of tool-like elements) as a phonogram evoking a difference in nature. Also on the basis of phonetic closeness, the hole appears to designate here the action of intense fire.
- ***Determinative***: The relative position of the different elements of the item serve as determinative conditioning the 'syntax', the way they are articulated. This type of determinative is typically expected in a 3-D visual code. Copper is also a determinative here. It enables an identification of the globular mass not simply as a mace head, but also as a bulk of raw copper. Its nature of copper alloy coincides with an interpretation of the chimer animal as evoking a mixing of ores.

The interpretation proposed here may be tested by examining whether the 3-D visual code identified here yields coherent meanings in other implements with twin young ungulates (**Figs. 3**–**5**).

The Crown-like Artifacts

Crown with Two Heads

The item with two ungulate heads in **Fig. 5** belongs to a series of ten cylindrical pieces (items 61–170 to 61–179) from Nahal Mishmar, all having a similar diameter (15–19 cm) and wall height (8–10 cm). These artifacts, which have no equivalent in any other culture of the ancient Near East, were at first defined as "crowns."[56] However, their relatively small diameter, and the presence of small boss-shaped "feet" on the bases of some of them, indicate that they were designed to be set on a solid planar surface and not atop a head. Many alternative interpretations have been proposed. These cylinders were identified as miniature representations of houses, palaces or shrines.[57] Noting the lack of circular edifices in the Ghassulian culture, other scholars have identified them, or at least the simplest ones, as models of animal byres.[58] This interpretation being challenged by the absence of any door in their circular wall, these "crowns" were approached as miniature representations of silos,[59] as components of a "drum-like" altar,[60] as symbols of fertility or as signs of political power.[61] The present considerations invite us to reconsider the symbolic meaning of the "crown" represented in **Fig. 5**, in the perspective of the visual code here identified.

Two "signs" identified in the decorated mace head (**Fig. 2**) are observed in the crown from **Fig. 5**, in addition to the twin-ungulates motif. The first is the hole, the most prominent element of all these crown-like artifacts, interpreted above as a phonogram evoking intense (metallurgical) fire. The second is the metal itself, which, in a context of intense fire (hole) exerted on mixed ores (twin ibexes), may serve, as a determinative. Gathering these three signs (ores, fire of intense amplitude and copper) leads to the interpretation of this artifact as the repre-

[56] Bar Adon 1980: 24–39.
[57] Bar Adon 1980: 133; Tadmor 1990: 257; Merhav 1993; Drabsch and Bourke 2014: 1086.
[58] Moorey 1988: 179.
[59] Shalem 2015: 229–230.
[60] Amiran 1985.
[61] Epstein 1978: 29; Ziffer 2007: 54.

sentation of a furnace. This interpretation is supported by the similarity of shape between the "crowns" from Nahal Mishmar and the furnaces discovered in Beer Sheba dated to the late fifth millennium BCE. These furnaces were reconstituted as circular structures set upon a small pit and characterized by a wall 22–30 cm in diameter, 15–30 cm high, and 2–3 cm thick.[62]

Among the ten crowns from Nahal Mishmar, five do not present any ornamentation on their upper rim (items 61–170; 61–171; 61–172; 61–173; 61–174). This indicates that the symbolism of these items is fundamentally expressed by their cylindrical shape, their hole, their copper nature, their dimensions, and their setting on the ground. We may therefore deduce that the cylinder shape of the "crowns" from Nahal Mishmar is a logogram whose identification as a furnace is conditioned by the copper constituting its wall, which serves here as a determinative (the genuine furnaces had circular walls made from clay). In such context of interpretation, the twin ibexes identified on one of the ten copper "crowns," should be approached as a facultative element which confirms the identification of these artifacts as furnaces. This supplement provides additional information: it stresses the importance of mixing various ores for the production of copper alloys used in the process of casting through lost-wax (the process used to produce most of the artifacts from the Nahal Mishmar hoard).

Crown with Nose and Star

One of the crowns from Nahal Mishmar is characterized by two figurative elements easily identifiable on its ornamented circular wall (**Fig. 10**). The first element is a protuberance 7 mm long positioned just below the upper rim (**Fig. 10B**), identified as a nose by the two small circles flanking it. The absence of a mouth and further details suggests that the nose is the important feature here, the two lateral circles (the "eyes") probably serving to identify it unambiguously. Prominent noses are common in Ghassulian iconography and are generally approached as an

[62] Shugar 2000: 245–246

A B

Fig. 10.
Crown with nose and star on the circular wall. A: View from the sun/star side. B: Detail of the nose. Israel Museum, item 61–178 (18 cm diameter, 1295 grams).

artistic convention symbolizing life and vitality through the breathing organ.[63] This kind of breathing imagery, however, also evokes the most essential activity associated with metallurgy: the blowing of air over coals (through a blowpipe, bellows or even natural wind) required to boost combustion and reach the requisite temperature for smelting. This symbolism is especially appropriate to the interpretation of the crowns as representations of furnaces, in Nahal Mishmar.

The use of the nose as a symbol for air blasting is not trivial, however, because air is blown from bellows (hand or feet) or from the mouth, but not from the nose. If this is so, the use of the nose instead of the mouth was not inspired from any realistic situation. The nominative for nose in early Semitic languages is *ʾanp*, which is also a verbal root expressing the boosting of fire by air blasting in Levantine languages.[64] Consequently, it seems that the representation of the nose on

[63] Epstein 1978: 26; Gonen 1992: 76; Gal *et al*. 1999: 12.
[64] This is reflected, for example, by the fiery, blowing and metallurgical association attached to the verb *ʾnp* in biblical Hebrew (see Ps 2:12; 79:5). Exactly the same relationship is observed between nose designation of *ʾap* (Canaanite/Ugaritic *ʾap*; Aramaic *ʾapputa*, all derived from the

the cylinder wall should not be interpreted as only designating the breathing organ (logogram), but also, and mainly, as a phonogram designating active air blasting.

The other figurative ornament, the star, is represented on the opposite side of this cylinder wall (**Fig. 10A**). Although it is seven-branched, we suggest its homology with the well-known eight-branched star from Teleilat Ghassul, itself interpreted as a solar symbol.[65] This imagery is especially relevant here since the sun, in the ancient Near East, was regarded as a giant mass of molten metal, given that both emit similar intense heat and pale-yellow light.[66] This sun/molten metal symbolism of the star coincides with both the identification of the nose as a symbol of air blasting (required for bringing the metal to a melting point) and with the interpretation of the crown as a symbolic representation of the furnace. Beyond this symbolism, the designation of the sun as *ḥammâ* (Canaanite languages, Aramaic and late Akkadian dialects) is derived from the proto-Semitic verb **ḥm/ḥmm* evoking intense heat.[67] This means that the star symbol probably combines a logogram (the representation of the sun) with a phonogram (the expression of the notion of intense heat and radiance). Since the latter is engraved on the cylinder, it should be considered as a 2-D sign introduced in the 3-D visual code. In the present context of interpretation, this duality probably does not refer to the sun, but rather to molten metal, its terrestrial counterpart. The symmetrical positioning of the nose and the sun signs on the cylinder emphasizes their interrelation

protosemitic *ʾanp*) and *ʾpy/wpy*, the verb that denotes the action of baking in an oven (or in a hearth) in Hebrew, Ugaritic Aramaic, Arabic, and even Akkadian (see Cohen 1994: 26, 28). This relationship is confirmed in biblical Hebrew by the appellation of tuyeres and nozzles of a furnace as nose (*ʾap*), nostrils (*ʿappayim*) and derived substantives (*ʿopan*). See Amzallag 2017b.

[65] Elliott 1977: 11; Ilan and Rowan 2012: 90. This interpretation is corroborated by further indications about the importance of solar cults/rituals among the Ghassulians. See Gardner 2002: 60–64. Alternatively, some scholars suggest that the great eight-branch star from the Teleilat Ghassul fresco was a representation of the planet Venus rather than the sun (see Drabsch 2015: 154 and ref. therein).

[66] See Amzallag (2015: 86–89), for an overview. The yellow-to-red transition that occurs during the solidification of molten metal was also associated with the colors of the rising or setting sun.

[67] Kogan 2011: 195.

and supports the interpretation of the "crown" as a representation of a furnace.

INTERPRETING THE STANDARDS

The present identification of signs of the visual code invites us to re-examine the meaning of further implements, and among them, the standards already mentioned.

Standard with Four Chisel-like Elements

In the standard from Fig. 8, the four chisel-like protuberances emanating from the globular mass may be interpreted as their counterparts on the ornamented mace head (**Fig. 2**): the same abnormal curvature of these four elements evokes the casting process by which they were produced, and their emanation from the globular mass transforms them into a symbol for the raw copper used in their production. The continuity between the globular mass and the tubular part (hollowed) of the standard suggests that they should not be approached as distinct elements, but rather as a whole homogeneous entity. This confirms the opinion that the globular mass should not be regarded as the representation of a mace head set on a wooden pole and potentially separable from it. Rather, this continuity between the two potentially extends to the tubular part the interpretation of the globular mass as bulk of raw copper. If the standard symbolizes finished implements, their continuity with the mace head (symbolizing raw copper) emphasizes the potential to re-use the copper of finished implements by re-melting them. This interpretation is confirmed by the examination of another standard from Nahal Mishmar on which small elements are attached both on the globular mass and on the tubular part (see **Fig. 11**).

The elements attached to this standard are identical in size and shape, all being a short tubular structure with two circular protuberances. The first one, positioned at its top, is a small flattened disk that

Fig. 11.
Standard with similar protuberances branching from its globular mass and its tubular part. Israel Museum, *item 61–73* (*18.3 cm length, 325 grams*). The fourth protuberance emanating from the tubular part is missing. © Copyright Israel Antiquities Authority.

recalls the small rim terminating this standard as well as almost all the other similar artifacts found in Nahal Mishmar. The second circular element, larger in diameter, recalls the globular mass present in most of the standards from Nahal Mishmar (see **Figs. 1**, **3**, **8**, **11**). These characteristics promote their interpretation as miniature standards. By extension, they should be approached as symbols of prestige/non-utilitarian metallic artifacts, exactly as the chisel/knife like elements from **Figs. 2** and **8** evoke the utilitarian metallic tools.

In light of this interpretation, it seems that the standard from **Fig. 11** basically expresses the re-melting of already existing implements for the production of new ones. Here, the newly produced items emanate not only from the globular mass, as in the standard from **Fig. 8**, but also from the tubular part of the standard. From this perspective, the "mature" standard (of normal size) is approached as the "father" engendering new similar implements, whose small size relative to the "father" standard evokes their new-born status. In this implement, the generative dimension of copper metallurgy, inherent to the infinite possible use of

copper as raw material through its re-melting, is potentially inspired from biological reproduction. The homology between these two realities is confirmed by the analysis of the highly ornamented standard.

Standard with Ibexes and Ram's Head

In light of the proposed interpretation of the twin ibexes, their presence on the upper ring of the highly ornamented standard (**Fig. 3**) stresses the metallurgical symbolism of this implement. Furthermore, the designation of ores of these twin ibexes emphasizes the potential use of the standard itself in the production of raw copper from which new implements may be cast (as in the standard from **Fig. 11**). Such "reproductive" dimension of meaning is confirmed by the ram, positioned just below the twin ibexes on the top, in the same plane. The ram may be considered as the reproducer par excellence, being the male intentionally kept alive to inseminate the female sheep.

The position of the triad of heads (two ibexes and a ram) on the standard and their large size suggest that they are the central motif expressed through this item. And of the three elements, the ram, by its position on the front side of the standard (just below the twin ibexes on the upper rim), is probably the most important element.

Because of its specifically reproductive function, the ram was extensively used in the ancient Near East as symbol of male sexuality and especially of semen production.[68] Such symbolism is especially interesting in light of the widespread belief in ancient societies (including the Ghassulians) that semen was produced from bone/bone marrow melt by the heat generated from sexual activity.[69] This belief highlights a parallel between reproduction and metalworking, which is confirmed by the representation of embryo formation as the solidification of the semen into bones in the womb, attested in ancient Near Eastern sources.[70] Here the parallel between metallurgy and reproduction,

[68] Bardinet 1995: 141–143; Hermansen 1997: 333; Orrelle 2014: 60, 67.
[69] Amzallag, 2016: 196–197. For a general view about this belief, see La Barre 1984.
[70] Arnaud 1996: 133–135.

already suggested from the observation of the standards from **Figs. 8** and **11**, is extended to the casting process by the image of the ram. The combination of the motifs of the ram and of the twin ibexes, in the standard from **Fig. 3**, supports the parallel between these two processes. From this perspective, the scepter itself, as the source of copper for casting, becomes likened to bones. This parallel is further supported by the hollowed nature of the tubular part of the scepter from **Fig. 3**, whose terminal enlargements may symbolize the extremities of a long bone.[71]

This homology is confirmed by the branching of the ram's head on the standard together with two ibex heads, thereby grouped into a homogeneous triad. Accounting for the metallurgical symbolism of the pair of ibex heads, this common point of origin with the ram's head on the standard promotes an equivalence between semen production and metal production, and by extension, between metallic implements and bones. The scepter from **Fig. 3** expresses two symbolisms, that of reproduction and that of metallurgy, as well as the connections between them.

The Four-Headed Standard

If the Siamese young ungulates have the same significance in the four-headed scepter (**Fig. 4**) and in the highly ornamented mace head (**Fig. 2**), their presence on the top of the standard refers, here again, to the mixing of ore necessary for the production of the metal constituting this standard. This interpretation assumes that, exactly as in many of the artifacts analyzed here, the metal constituting it is of significance in understanding the statement expressed through the visual code.

A simple pair of Siamese young ungulates is enough, however, to express the production of an alloy. The presence of four Siamese animals may be a means of emphasizing the diversity of ores required for the production of such artifacts, through the identification of the number two as a phonogram expressing difference in nature. But the animals are not merely organized as two Siamese pairs, but also as a group

[71] Such symbolism of the bone as hollowed tube with two terminal enlargements has already been suggested in the Ghassulian culture. See Amzallag 2016: 192–194.

of four individuals positioned symmetrically. This invites us to look for a possible use of this number also as a phonogram. The number four (**rbʿ* in proto-Semitic) is close to the appellation of dust both in biblical Hebrew *robaʿ* (*robaǵ*?) and in Akkadian (*turbuʾu*).[72] This allows us to make the supposition that this tetrad of young ungulates refers both to the need to gather ores of distinct origin (Siamese representation of a couple of young ungulates) and thereafter, the need to crush them into dust (representation of a tetrad). This interpretation is confirmed by the subsequent analysis of the highly ornamented crown (**Fig. 12**).

A **B** **C**

Fig. 12.
Highly ornamented crown from Nahal Mishmar. A: whole artifact; B: detail of one rectangle with horns; C: detail of a bird. Israel Museum, item 61–177 (16.8 cm diameter, 1374 grams). A: © Copyright Israel Antiquities Authority. B and C: author photo.

THE HIGHLY ORNAMENTED CROWN

The highly ornamented crown from Nahal Mishmar (**Fig. 12**) deserves a special attention. This item has been interpreted as a miniature edifice of prestige (temple or palace),[73] as the representation of a mortuary area in which dead were eaten by vultures,[74] or as a ritual artifact involved in

[72] See Num 23:10, Ginsberg 1933: 309; *HALOT* 3: 1181; Klein 1987: 604.
[73] Beck 1989: 44; Ziffer 2007: 52–53; Bar Adon 1980: 132–133; Epstein 1978: 26.
[74] Moorey 1988: 179; Merhav 1993: 38.

the worship of a female deity.[75] The furnace symbolism identified in the other "crowns" invites us to re-examine its significance and that of the elements positioned on its upper ring and in its wall.

The Miniature Standard(s) and the Pair of Birds

Only one of the three elements positioned near the rectangular aperture (**Fig. 12**) has remained. Its shape similar to the miniature standard identified in **Fig. 11** suggests that it, as well as the two (similar?) missing elements, refers to the production of non-utilitarian (prestige) copper items. This triad is positioned across from a pair of birds, so that observing one group of elements systematically integrates the information carried by the other, positioned in front of it (see **Fig. 12C**). This promotes an association between the two groups.

Unlike the two ibexes positioned upon the crown from **Fig. 5**, the two birds are fully represented on the upper ring. Their presence, together with their representation at rest, evokes the image of nesting, itself reinforced by the nest-like shape of the cylinder. This association is especially interesting in light of the phonetic closeness between the term for nesting in early Semitic languages (*qen/qyin/qnn*) and *qayin*, the term identified as the archaic designation, in Canaanite languages, of metallurgy (from which comes the designation of the Canaanite metalworkers as Qenites).[76] Through a pair of birds resting on a circular structure (the cylinder), the nesting imagery becomes itself a new phonogram for general designation of metallurgy (= the activity leading to the production of finished metallic implements), signified through the three elements positioned face to the birds, on the crown.

[75] Amiran 1986: 86.
[76] Amzallag and Yona 2017: 318–319.

The Two Ornamented Gates

Most prominent on this ornamented crown is a pair of rectangular frame-like elements (inner size: 5.7 cm high and 2 cm wide) symmetrically positioned on the upper rim of the cylinder. This suggests that the message carried by these two elements is probably of central importance in understanding the meaning of this item.

Alignments of four protuberances are found on the longitudinal parts of these two rectangles, which have been interpreted as miniature gates with a fronton.[77] Two horns of young ibex emanate from each fronton, which may consequently be regarded as a stylized ibex head. The back-to-back disposition of the two stylized heads on opposed rectangles recalls the two Siamese ibexes positioned on the globular mass in **Fig. 2**. We may therefore expect these two ornamented gates to enclose information concerning the ore, the raw material that yields the metal necessary for production of the implements symbolized by the miniature standards. The multiplicity of signs identifiable here leads us to expect that they embody information more detailed than in the ornamented mace head.

The proto-Semitic term designating a gate/aperture, θʕr (Ugaritic *tġr*, Arabic *taġr*) is phonetically similar (and probably etymologically related) to the proto-Semitic root *θʕr, designating an action of destroying and separating.[78] Being the action required for preparing the ore before its introduction in the furnace, we may guess that the gates serve here as phonograms designating the action of crushing and selecting the highly mineralized elements (identified by their intense coloration). This interpretation is supported by further elements characterizing these gates.

Each rectangular element displays two alignments of four protuberances. Taking into account the previous identification of numbers two and four as phonograms, we may identify the composition as the instruction to crush (= the four elements) the ore (= the young ibex

[77] Bar Adon 1980: 24.

[78] Arabic *ṯaġara* = to break open, to destroy, but also to split, to cleave; Ethiopian *saʿara* = to tear down, to pull apart; Syriac *teraʿ* = to split. See *HALOT* 4: 1614.

head) into dust, and to separate the ore into two distinct parts (= the two parallel alignments of four protuberances). These two instructions combined express the need, during the course of the crushing, to inspect the ore fragments and to select the most mineral-rich parts (= to enrich in metal the ore to be introduced in the furnace). The two parallel alignments of four protuberances even suggest the parallel preparation of the two ores to be mixed in the furnace.

The Square with Two Protuberances

Among the ten "crowns" from Nahal Mishmar, the highly ornamented item in **Fig. 12** is the only one with an aperture on its wall. This latter is a square (5.5 x 5.2 cm) positioned just below the three miniature implements (two of them are missing), and together with them, it probably defines the front of the artifact. This square is flanked by two protuberances positioned just below the upper rim. Their similarity to the small protuberances on the gates suggests they all carry a similar meaning, that of crushed ore. This inference is supported by the similarity between the appellation for number four (*rbʿ*) characterizing of the sets of protuberances on the gate, and the appellation of square (*rbʿ*) in Canaanite languages. The significance of the square (*rbʿ*), in the context of this implement, may even be extended, this term being associated to the idea of fertilization / copulation / mixing / laying down, in biblical Hebrew, Aramaic and Arabic.[79] If at least some of these meanings already existed in proto-Canaanite, this square with two protuberances serves as a final instruction to mix the dust from the two types of ores very thoroughly before introducing them into the furnace (the cylinder). The integration of all these observations allows us to decipher the message of this artifact as follows:

> *For the successful production (= the two nesting birds symbolizing metallurgy) of fine artifacts (= those symbolized by the miniature standards, that is, cast through the lost wax technique): take the various types of ores (= the two ibex symbolic heads), crush*

[79] *HALOT* 3: 1180; Klein 1987: 603.

them gradually (= the gate) and at each step, select only those desired (= the two sets of four protuberances). Then, take the powder from the two enriched ores (= the two protuberances flanking the square condensing the meaning of the two gates and their signs), mix them thoroughly (= the square), and introduce them into the furnace (= the square aperture being in continuity with the hole of the cylinder). Then, [you will] obtain the metal (= the material the whole implement is made of) from which fine artifacts are cast (= the miniature standards upon the square).

DISCUSSION

Metallurgy as Figured Reality

The present study proposes a new interpretation of the significance of some of the copper artifacts from Nahal Mishmar, by evaluating the possible function of their components as signs of a visual code. This approach yields a coherent interpretation of the meaning of implements whose significance has remained obscure until this day. Furthermore, it reveals the complementarity and similarity of the messages carried by many of the artifacts. Even complex artifacts such as the ornamented mace head from **Fig. 2** and the crown from **Fig. 12** express similar messages, despite their difference in shape and ornamentation. Though the whole metallurgical process is similarly represented in both, these implements each emphasize different aspects of that process. The ornamented mace head (**Fig. 2**) devotes special importance to the casting process, whereas the ornamented crown (**Fig. 12**) focuses especially on the preparation of ores.

The metallurgical dimension identified in the items examined in this study indicates the great importance of metallurgy for the society that produced this hoard. It even reflects the fascination exerted by the smelting process itself, a feature already identified by Gošić and Gilead, who assumed that the Ghassulian metallurgy "introduced a new ritual behavior, starting with metal-smelting, through shaping of the

artifacts, to the use of the finished artifacts in rituals."[80] This conclusion is not surprising because, in absence of native copper in Southern Levant, the production of this metal from a sandstone was probably interpreted as a demiurgic activity.[81] Furthermore, in light of the meaning of the standards from **Figs. 3** and **11** proposed here, it seems that metallurgy became of central importance among the Ghassulians through its acquaintances with the phenomena of fertility, rejuvenation and vitality.[82]

The Visual Code in Nahal Mishmar

The visual code in Nahal Mishmar has been uncovered here through the interpretation of a recurrent motif, the pair of young ungulates, as a phonogram referring to the raw material (ores) from which metal is produced. This phonogram was identified first on the decorated mace head (**Fig. 2**), and its meaning was confirmed by examining other implements where this motif is encountered (**Figs. 3**–**5**, **12**). This first phonogram enabled a sequential identification of 16 more signs from the items analyzed here (see **Table 1**). Extending the present analysis to more items may reveal new signs, but already at this stage, the three types of signs characterizing a visual code (logograms, phonograms and determinatives) may be identified in Nahal Mishmar (**Table 1**).

[80] Gošić and Gilead 2015: 171. See also Gošić (2013: 254–280).
[81] A similar approach of metallurgy is attested in many other cultures, see M. Eliade (1962, chap. 9).
[82] A similar linkage is also attested in many other cultures. See D. Arnaud (1996) and Eliade (1962, chap. 2).

#	signal/sign	artifacts	meaning	principle of codification	function	comment
1	metal	**Figs. 2–5**, **8–12**	metal and its alloys	materiality	determinative	significance depends on the nature and composition of the metal
2	pair of metallic tools	**Fig. 2**	metal artifacts	figuration	logogram	
3	abnormally curved metallic tool	**Figs 2**, **8**.	casting / hammering process	symbolism	logogram	
4	miniature standard	**Figs. 11–12**	metallic non-utilitarian artifacts	symbolism	logogram	
5	hollowed cylinder	**Figs. 5**, **10**, **12**	furnace	figuration	logogram	conditioned by determinatives
6	ram/ram's head/horn	**Fig. 3**	semen production	symbolism	logogram	
7	scepter tubular part	**Figs. 3**, **4**, **8**, **11**	bone copper implement for re-melting	symbolism	logogram	conditioned by determinatives
8	globular mass	**Figs. 2**, **8**, **9**, **11**	raw copper	figuration (crucible inner shape)	logogram	conditioned by determinatives
9	sun	**Fig. 10**	radiant matter (molten copper)	symbolism and phonetic closeness *ḫmh* → *ḫmm* - *ḫmy*	logogram and phonogram	2-D element of a 3-D visual code
10	nose	**Fig. 10**	air blasting	symbolism and phonetic closeness *ʾanp* → *ʾnpy*	phonogram and logogram	
11	young ungulate	**Figs. 2–5**, **12**	ores for metal production	phonetic closeness *ǵpr* → *ʿpr*	phonogram determinative	the multiplicity of this sign is meaningful
12	two (number)	**Figs. 2–5**, **12**	separate realities	phonetic closeness *ṯnm*→ *šny*	phonogram determinative	

13	four (number)	**Fig. 4**, **8**, **12**	dust – action of crushing *(ʾ)rbʿ → rbʿ*	phonetic closeness	phonogram determinative	
14	square	**Fig. 12**	action of mixing	phonetic closeness *rbʿ → rbʿ*	phonogram	conditioned by determinatives
15	gate	**Fig. 12**	to cleave to crush	phonetic closeness *θʕr /tǵr → tǵr*	phonogram	conditioned by determinatives
16	hole	**Figs. 2**, **5**, **10**, **12**	intense burning	phonetic closeness *ḥwr → ḥry / ḥrr*	phonogram	conditioned by determinatives
17	nesting birds	**Fig. 12**	metalworking	phonetic closeness *qnn→ qny / qyn*	phonogram	the cylinder is integrated into the phonogram

Table 1
The signs of the visual code from Nahal Mishmar identified in the present study.

The interpretations developed in this study stimulate a series of comments regarding the visual code from Nahal Mishmar.

The 3-D Singularity of the Visual Code

With an exception (the sun in **Fig. 10**), the signs of the Nahal Mishmar visual code identified here are tridimensional, and their articulation yields the production of unique artifacts, each one with its own message. In most of the implements, the signs are not isolated but combined in a complex fashion. This is revealed by the association of phonograms with determinatives, but also by the relative positions of the signs in relation to one another. The pattern of spatial relationships between the elements functions as a determinative which is specific to a 3-D code. This also enables a representation of articulations of claims more complex than in a 2-D visual code, with a multiplicity of non-linear connec-

tions between notions and claims generating a multiplicity of readings and understandings. Consequently, deciphering the meaning of items such as those from **Figs. 2** and **12** may yield a claim that may approximate a verbal statement, but this is probably not the only possible interpretation. Thus, this visual code was probably not elaborated in order to transcribe speech, but rather to explore the possibilities of investigating the universe opened up by the interaction between symbols, figures, sensorial experience, biological reality and the spoken language. We cannot rule out the possibility that a further level of plasticity was given to this visual code through a spatial arrangement of many different artifacts (especially those carrying a basic information), each one regarded as a meme.

The Nahal Mishmar Phonograms

More than half of the signs (signs 8–17, **Table 1**) are elaborated through the rebus principle, but their occurrence is not random. Rather, this type of sign seems to be specifically introduced to express a reality that cannot be easily figured by a symbol, such as heat, air blowing, copper ores, liquid metal, metallurgy as an activity, the action of crushing, and so on. If this visual code developed in the context of metallurgy, as suggested by the meaning of the signs identified here, we may conclude that the use of the rebus principle resulted from the fascination exerted by metallurgy and the wish to understand it, to transmit the knowledge, to meditate on the process and to explore its cultural consequence, along with the inability to express all the aspects of this reality through figurative symbol.

Some signs (signs 9–10, **Table 1**) are identified here both as phonograms and as logograms. This ambivalence results from an etymological origin of the homonymy: the verb to blow has apparently a common origin with the nose designation in early Semitic languages, exactly as the sun and the verb evoking shining/radiating intense heat have a common etymology. Similarly, the nesting representation of metallurgy (**Fig. 12**) apparently reflects the way metallurgy was first

approached in Southern Levant.[83] This etymological affinity may have been exploited to elaborate the rebus principle, and the invention of the first phonograms.

Visual Code and Proto-writing

The parallel between metallurgy and reproduction/life-cycle, revealed here through two items (**Figs. 3**, **11**), corroborates substantial changes in rituals and burial customs characterizing the Ghassulian culture at about 4300 BCE, the probable period of production of the Nahal Mishmar hoard.[84]

Despite the probable diffusion of the cultural dimension of metallurgy beyond the small circle of metalworkers, no evolution of the visual code towards a coherent system of writing is observed among the Ghassulians. This situation may result from the tridimensional nature of this visual code, which renders its practical use especially difficult. But more essential causes may also be involved. Approaching the visual code as an archaic form of proto-writing predisposes the investigator to assume that the former is guided by the same motivations as the latter, the transcription of speech. But the present study suggests that the visual code from Nahal Mishmar was elaborated for another purpose: the manipulation of concepts relative to metallurgy, their interrelation and the meditation on their cultural implications. From this perspective, the elaboration and expression of a visual code are two sides of the same reality: the exploration of an extraordinary, previously unknown, metallurgical process of demiurgic nature and of its consequences. For this reason, the decomposition of the process into signs and their multiple combinations, expressed through the production of unique implements, should be regarded as an explorative phase of the cultural dimension of metallurgy, in which the universe of symbols and the phonetic network of the language are recruited and even combined.

[83] Amzallag and Yona 2017.
[84] Gošić 2013: 264; Gošić and Gilead 2015: 161–164.

The elaboration of a visual code in Nahal Mishmar coincides with the transformation from early to late Ghassulian culture, around 4300 BC.[85] It should not be excluded, therefore, that the development of the visual code attested in Nahal Mishmar is a part of the emergence of the cultural dimension of metallurgy that characterizes the late Ghassulian period. In such a case, and in light of the wide circulation of metallurgical knowledge in the Ancient Near East during the fourth millennium BCE,[86] the eventuality of a relationship between the visual code developed first among the Ghassulians and later in Egypt and in Mesopotamia should not be ruled out.

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[85] Gilead and Gošić 2014.
[86] Amzallag 2009.

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