

What Type of Bronze was Ancient Egyptian *ḥsmn*?

by

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KEYWORDS. — *ḥsmn*; *bj3*; Tin Bronze; Arsenical Copper; Bronze Age Egypt.

SUMMARY. — This paper deals with the correct lexicographic identification of the word *ḥsmn*, which was in Egyptology usually translated as “(tin) bronze”, if denoting metal. The departure point is the discussion and arguments presented in 1961 by John R. Harris in his monumental work *Lexicographical Studies in Ancient Egyptian Minerals*. Previous work on the subject and Harris’ arguments are revisited. The weak points are detected as the identification of the colour of the metal and quite peculiar categories of material culture denoted by *ḥsmn*. Moreover, *ḥsmn* appears to be originally an adjective of the semantically broader word *bj3* denoting copper, iron, and other phenomena. *Ḥsmn* can be translated as tin bronze and/or arsenical copper, although *bj3* can be used for the same metals throughout the Egyptian Bronze Age. In other words, we cannot expect modern scientific precision in naming alloys from the ancient languages.

Introduction

John R. Harris in his monumental work, *Lexicographical Studies in Ancient Egyptian Minerals*, proposed real-world identifications for the ancient Egyptian words denoting minerals, stones, ores, and metals (Harris, 1961). Large part of these lexical identifications was sustained by further research and is still used today, learned by students, used by professionals in the field. However, some of the identifications need to be revisited under the spotlight of the improved understanding of ancient evidence. Elsewhere, I have argued at length a case for *bj3* as the correct reading of the ancient Egyptian word for copper, contrary to the conclusions of Harris and his reading of this particular word group.

An outstanding question (*cf.* Odler, 2023) remained the correct identification of the word *ḥsmn*, especially since the New Kingdom texts were out of the scope of the referred work. Herein, I would like to continue the argument, exactly where it was left open, noting that the recently published ‘Notebook of Dhutmose’ does use the word *ḥsmn* quite seldom, especially where it should use it always, according to our current understanding of its translation (Odler, 2023, p. 82). Thus, the aim of this text is to reassess Harris’ equivalence of the ancient Egyptian word *ḥsmn* to the

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Egyptological research of the ancient Egyptian texts and iconography resulted in the most likely and most frequent identification of the specific sign group, rendering metal, and written mainly with the sign N34 of Gardiner's sign list, as "copper". Harris proposed reading of this group as *ḥmty*, after a long discussion of the available evidence. Often the sole used sign of the group is N34, and the reading is sustained also for these single occurrences (Harris, 1961, pp. 50-62). This conclusion was supported by most of the Egyptologists publishing after Harris. Steadily, a few dissenting voices proposed the reading *bj3*, e.g. Lalouette (1979), lately Herslund (2011, 2015), and most recently Odler (2023, pp. 67-83). Reading *bj3* as copper, nevertheless, is complicated by the rich semantic connections of the word, representing also other metals, most frequently iron, and even other non-metal materials, such as fossilized wood (Almansa-Villatoro, 2019; Graefe, 1971). The crux of the questions revolves around the real-world identification of the hieroglyphic sign N34 and its various specific forms, which has been repeatedly demonstrated to be a crucible (Claes, Davey & Hendrickx, 2019; Herslund, 2015; Odler, 2023). If it denotes metal, I have argued at length that it should be read *bj3*; if it denotes an artefact, the crucible itself, I proposed the reading *bd3.t*, feminine form of the word *bd3* for various moulds, including bread moulds (Odler, 2023, pp. 67-83). Different opinions on its reading might endure, nevertheless, as they are based on long research traditions.

Hieratic writing of the sign provides further context. More detailed versions of the N34 sign, with higher number of strokes, likely renders the crucible on fire with a tuyère. At the same time, simpler versions, a combination of a horizontal pen stroke on the base and vertical stroke in the middle, above the horizontal line were used (Odler, 2023, pp. 92-94, figs. 31, 38). And already G. Möller illustrated in his hieratic palaeography that the hieratic signs N34 for "crucible" and U28 for "fire-drill" were written with similar number and directions of strokes (see fig. 1). Some scribes omitted the smaller strokes, also rendering the crucible, and thus the signs were written identically, with two pen strokes only (Möller, 1909, p. 37: sign 391, 56: 589). The simpler writing is ubiquitous, e.g. in the papyrus Reisner II, where the sign group *bj3* was used constantly and thus the scribe was saving time in rendering again and again this oft-repeated word (Simpson, 1965). On figure 1, New Kingdom's hieratic examples of the writing, as gathered by Möller (1909), are represented.

Therefore, the frequently used and read group *d3*, featured in the words for crucible and mould, *bd3* and *bd3.t*, as well as the profession of metalworker *bd3.ty*, was *pars pro toto* represented actually by a form of the sign U28 (see fig. 1). N. Davies and A. Gardiner translated this word as a "fire-stick apparatus"/"fire-drill". It is known only from the *Tale of the Shipwrecked Sailor* (Golenischeff, 1908; Spiegelberg, 1923; Ungnad, 1906) and then from the papyrus Brooklyn 47.218.84, from the reign of Psammetichus I in Dynasty 26 (Meeks, 2006). Nevertheless, in papyrus Reisner II (and elsewhere), numerous occurrences of the sign can be clearly translated as *bj3*.

In case of *ḥsmn* metal, the sign U32, representing mortar and pestle in this sign group, has an established reading since Erman (1892). Here, the semantic field is again wider: the same word denotes and is translated as both “natron” and “amethyst”. In most cases, the particular word group and meaning of the specific named material category, which was intended by ancient Egyptians, can be identified by the determinatives of the specific sign groups. Harris discussed both *bj3* and *ḥsmn* as separate categories; let us revisit his argumentation and the publications on which it was built.

Harris’ Predecessors and his Arguments

Arguments of Richard Lepsius, interconnecting *ḥsmn* and iron are for long and justifiably antiquated (Lepsius, 1872). In the same year, François Chabas reached different conclusions, comparing the occurrences and the artefacts produced out of the *bj3* and *ḥsmn* sign-group. Chabas stated that both are “deux variantes du même mot”, which can be translated as either copper or bronze (Chabas, 1872, p. 50). Published white and red colours of the objects made of *ḥsmn* led also Swedish Egyptologist Karl Piehl to doubt Lepsius’ translation as “iron” (Piehl, 1890, p. 19). Further reassessment, albeit not followed by others, came from Gsell (1910, pp. 51-52), who proposed that *ḥsmn* was “zinnbronze oder bronze im allgemeinen”, while *ḥmt* (in this text read as *bj3*) could have been brass.

But the final author to reject Lepsius and propose reading of *ḥsmn* and the translation as bronze was Adolf Erman (1892). His paper remained the main reference point until Harris, as he stressed “since Erman’s article, *ḥsmn* has generally been translated bronze, [...] and there can scarcely be any doubt that this is correct” (Harris, 1961, p. 63). Although the reading of metal *ḥsmn* as such was established by Ludwig Stern, noticing the same determinative U32 in the writing of the material “natron” (Ebers & Stern, 1875). Erman (1892, p. 32) simply supported this reading. The different reading of material *ḥsmn* as metal was identified because it occurs in the materials’ listings among other metals, where neither the meaning “natron”, nor the meaning “amethyst” was appropriate. Erman mentioned again Piehl’s argument (1890) about the artefacts of white and red colouring. The specific artefacts — signet rings, vessels and temple furniture, as well as weapons — pointed for Erman in the direction of “bronze”, rather than iron. Erman even consulted the matter with Swedish archaeologist Oscar Montelius, who was of the same opinion. In the end of the article, he cited iron rings of the Late Bronze Age from Mycenae, but neither earlier rings, nor iron vessels of the 2nd millennium BC were known to him (Erman, 1892, p. 35), thus iron as a translation seemed unlikely.

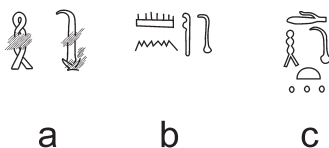
As Harris observed in the evidence, *ḥsmn* appears more often before *bj3*, and seldom after it. The determinative for the word *ḥsmn* was a “crucible”, sign N34,

denoting semantic closeness to the *bj3* group, and confirming that a metal melted in crucibles was meant. In the Middle Kingdom medical Papyrus Ramesseum V, more usually used *bj3* group in medical texts, was in a word collocation of “scrap metal” replaced by *hsmn* (Lefebvre, 1958). Again, this signified closeness of the words and metals, and at times its mutual replaceability, also for Harris.

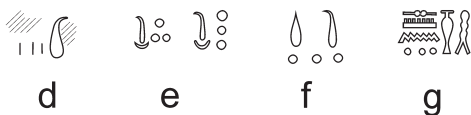
Writing of *hsmn* as Metal in Detail

The mentions of the metal *hsmn* are gathered on figures 2 and 3, and the sources of the writing are listed in table 1. For the periods before the New Kingdom, they are based on Odler (2023, fig. 34), where a complete listing of all mentions was attempted. For the New Kingdom and Late Period, gathered evidence is based on what J. R. Harris used to support his arguments about the identification of *hsmn*. An attempt was made to add further mentions from *Urkunden*, which Harris omitted. But there might be references in the literature that escaped my attention. Selected sources published after Harris (1961) are discussed in a separate chapter, although included in both figures. The aim was not to find the exact form of the hieroglyphs in all cases; if published, the renderings by Sethe’s handwriting from *Urkunden* provide enough evidence of the presence of specific hieroglyphs in the words’ writing and distinction of the use of either N34 or U32.

Old Kingdom



Middle Kingdom



h



Second Intermediate Period



Fig. 2. — Mentions of the metal *hsmn* before the New Kingdom, updated after Odler (2023, fig. 34).

New Kingdom

n	o	p	q	r	s	t	u
v	w	x	y	z	aa		
bb	cc	dd	ee	ff	gg		
hh	ii	jj	kk	ll	mm		
nn	oo	pp	qq	rr	ss	tt	
uu	vv	ww	xx	yy	zz		

Late Period

aaa	bbb

Fig. 3. — Mentions of the metal *hsmn* in the New Kingdom and Late Period, based on Harris (1961), updated with other mentions in the *Urkunden* (Blumenthal *et al.*, 1984; Cumming, 1982, 1984a,b; Helck, 1957, 1961; Sethe, 1905, 1906, 1907, 1908, 1914).

The metal *ḥsmn* is either listed among other metals, or, more frequently, as a substance from which certain types of the artefacts are made. It is impossible to make a frequency statistics out of rather limited mentions, but certain preferences of writing can be identified in specific periods and in particular text genres.

The main categories of writing the metal *ḥsmn* are clear from figures 2 and 3. The briefest form has only the sign U32 of a pestle with mortar, either with three mineral signs or a mineral sign and three plural strokes (fig. 2: d, e, f, l, m?; fig. 3: u-ee, ll-nn, pp, qq). The longer versions contain both the sign U32 and a crucible N34, either before or after the sign U32. If it is located after U32 (fig. 3: n, ff-hh, oo, ss-bbb), N34 likely served only as a determinative, narrowing down the categorization of the sign into the compartment of a “metal” (Herslund, 2011). According to our current understanding of hieroglyphs, if the N34 would come before U32 (fig. 2: h-k; fig. 3: o-s), the whole group would be read as *bj3 ḥsmn*, *ḥsmn* serving as an adjective of the broader “metal” or “copper” word. This use is analogical to a similar case of the so-called “Asiatic copper” (Posener-Kriéger, 1969) and the “black copper” (Giumlia-Mair & Quirke, 1997). Then, there are a few peculiar cases, when the word *ḥsmn* was inscribed also by other phonetic signs (fig. 2: a, b, g). Two of these writings are datable to the Old Kingdom, thus they might reflect early, non-standardized rendering of the word. By the reign of Amenemhat II in Dynasty 12, the writing appears to be established in the official version of annals as *bj3 ḥsmn*. This “classic” writing will reappear at times also in the New Kingdom, and, intriguingly, even in the Dynasty-25 sources (fig. 3: aaa, bbb).

Unless new Early Dynastic or Old Kingdom texts are uncovered, it thus seems that the writing of the metal was not established normatively in the Old Kingdom, similarly as the word for metal *dh.t / dh.t*, which could be either tin or lead (Harris, 1961, pp. 67-68). It also shared the same sign for mortar with *ḥsmn*, thus it is represented on figure 2: c, h (furthest on right side), and was most probably connected in the perception of ancient Egyptians to *ḥsmn*. The version established in the annals of Amenemhat II represents *ḥsmn* as a semantically subordinate category to the wider one of *bj3*. But gradually, *ḥsmn* came to be written also as a standalone metal, even if sometimes determined by the N34, a crucible.

Table 1

Mentions of the material *hsnm* as metal in Egyptian Bronze Age (abbreviations: OK = Old Kingdom; MK = Middle Kingdom; SIP = Second Intermediate Period; NK = New Kingdom; LP = Late Period; D = Dynasty)

Figures 2, 3	Site	Structure / text	Period	Locus	Artefact	Reference
a	Abu Ghurab	Sun temple of Nyuserre	OK, D 5, reign of Nyuserre	Festival Offerings Calendar of the sun temple of Nyuserre, inscription A, "Große Festdarstellung". Block 247	Nemset vessel	Kees (1928, taf. 28: block 427); Posener-Krieger (1969, p. 422, fig. 3); Herslund (2011, p. 46)
b	Saqqara	Mastaba XIV: tomb of Khabaukhnum, called Bau	OK, D 6, reign of Pepy II		Washing set of spouted jar and wash basin	Jéquier (1940, p. 65, pl. 55)
c	Saqqara	Biography of Iny	OK, D 6, reign of Pepy II		<i>dh.t</i> material	Marcolin & Diego Espinuel (2011)
d	Elephantine	Heqaib sanctuary	MK, D 11, reign of Mentuhotep II	Stela 9: x + 18	Offering vessels (<i>wz/hw</i>)	Franke (1994, p. 157, taf. I: 18)
e	Heliopolis	Fragment of Annals of Senusret I	MK, D 12, reign of Senusret I		Heset and aperet vessels	Altenmüller (2015, p. 206); Postel & Régen (2005, pp. 235-276, figs. 5-6)
f	Tod	Inscription of Senusret I	MK, D 12, reign of Senusret I	Column 25	Vessels	Barbotin & Clère (1991, p. 9, fig. 1, col. 25)
g	Unknown	Unknown	MK, D 12, reign of Senusret I		New sealing	https://www.britishmuseum.org/collection/object/Y_EA586
h	Memphis	Temple of Ptah, Annals of Amenenhat II	MK, D 12, reign of Amenenhat II	M5, M6	Censers of <i>hsnm</i> and copper	Altenmüller (2015)
h	Memphis	Temple of Ptah, Annals of Amenenhat II	MK, D 12, reign of Amenenhat II	M27	Vessels and censer arm	Altenmüller (2015)
h	Memphis	Temple of Ptah, Annals of Amenenhat II	MK, D 12, reign of Amenenhat II	M16, M17, M18, M19, M20	Razors, chisels, knives, saws, daggers, sickles, axes, spears of two types	Altenmüller (2015)

i	Memphis	Temple of Ptah, Annals of Amenemhat II	MK, D 12, reign of Amenemhat II	M21	Mirror of <i>hsmn</i> , gold and ivory; daggers of <i>hsmm</i> , gold and silver; daggers of <i>hsmm</i> and ivory	Altenmüller (2015)
j	Abydos	Temple of Osiris, stela of Mentuhotep	MK, D 12, reign of Amenemhat II		Gifts of copper and <i>hsmm</i> “without end”	Lange & Schäfer (1908, p. 155, taf. 42)
k	Memphis	Temple of Ptah, Annals of Amenemhat II	MK, D 12, reign of Amenemhat II	Farag fragment	Axe “opener of ways” is <i>bj3 hsmn</i>	Altenmüller (2015); Odler (2023, fig. 276)
l	Karnak	Second stela of Kamose	SIP, D 17, reign of Kamose		Battle axes	Habachi (1972, p. 37, fig. 23)
m	Edfu	Stela of Khonsemwaset (Cairo, JdE 38917)	SIP, D 16 or D 17, reign of Dedumose	Line 5	Collar made of gold and <i>hsmn</i>	El-Sayed (1979, pp. 168-170, pl. xlviii: line 5)
n	Qurna	TT 285 (Tomb of Iny)	NK, D 18, reign of Amenhotep I	Urk IV, 54	Unknown	Sethe (1914, pp. 28-29)
o	Dra Abu en-Naga	Tomb TT 11 of Djehuty, overseer of the treasury, “Northampton Stela”	NK, D 18, reign of Hatshepsut	Urk IV, 423 and 425	Door inlays	Blumenthal <i>et al.</i> (1984, p. 65)
p	Karnak	<i>Texte de la Jeunesse</i>	NK, D 18, reign of Thutmose III	Urk IV, 170	Door inlay, on it king’s name in gold	Sethe (1914, p. 81)
q	Karnak	<i>Texte de la Jeunesse</i>	NK, D 18, reign of Thutmose III	Urk IV, 168	Part of temple door	Sethe (1914, p. 80)
r	Karnak	<i>Texte de la Jeunesse</i>	NK, D 18, reign of Thutmose III	Urk IV, 172	Milk vessels of silver, gold, <i>hsmn</i>	Sethe (1914, p. 82)
s	Karnak	<i>Texte de la Jeunesse</i>	NK, D 18, reign of Thutmose III	Urk IV, 173	Vessels of silver, gold, <i>hsmn</i> and copper	Sethe (1914, p. 82)
t	Abydos	Temple of Thutmose III	NK, D 18, reign of Thutmose III	Urk IV, 204	Vessels	Sethe (1914, p. 96)
u	Abydos	Temple of Thutmose III	NK, D 18, reign of Thutmose III	Urk IV, 206	Vessels	Sethe (1914, p. 97)

v	Kamak	Dedications to Amun	NK, D 18, reign of Thutmose III	Urk IV, 639-640	Altar and vessels	Blumenthal <i>et al.</i> (1984, pp. 185-186)
w	Kamak	Annals of Thutmose III	NK, D 18, reign of Thutmose III	Urk IV, 664	Battle tunics	Blumenthal <i>et al.</i> (1984, p. 195); Redford (2003, p. 35, fig. 4, col. 97)
x	Kamak	Annals of Thutmose III	NK, D 18, reign of Thutmose III	Urk IV, 667	Vessels	Blumenthal <i>et al.</i> (1984, p. 197); Redford (2003, p. 38, fig. 4, col. 102)
y	Kamak	Annals of Thutmose III	NK, D 18, reign of Thutmose III	Urk IV, 686	Vessels	Blumenthal <i>et al.</i> (1984, p. 202); Redford (2003, pp. 38, 41, fig. 10, col. 5)
z	Kamak	Annals of Thutmose III	NK, D 18, reign of Thutmose III	Urk IV, 705	Weaponry	Blumenthal <i>et al.</i> (1984, p. 210); Redford (2003, p. 79, fig. 8, col. 34)
aa	Kamak	Annals of Thutmose III	NK, D 18, reign of Thutmose III	Urk IV, 711	Helmets and battle tunics	Blumenthal <i>et al.</i> (1984, pp. 212-213)
bb	Kamak	Annals of Thutmose III	NK, D 18, reign of Thutmose III	Urk IV, 718-719	Battle tunics	Redford (2003)
cc	Kamak	Annals of Thutmose III	NK, D 18, reign of Thutmose III	Urk IV, 722	Axes	Blumenthal <i>et al.</i> (1984, p. 218)
dd	Kamak	Annals of Thutmose III	NK, D 18, reign of Thutmose III	Urk IV, 726-727	Battle tunics, swords with axes, spears	Blumenthal <i>et al.</i> (1984, p. 220); Redford (2003, fig. 10, col. 5)
absent	Kamak	Annals of Thutmose III	NK, D 18, reign of Thutmose III	Urk IV, 738	Tips of flagposts	Blumenthal <i>et al.</i> (1984, p. 224)
ee	Kamak	Annals of Thutmose III	NK, D 18, reign of Thutmose III	Urk IV, 744	Listing of metals, black copper, <i>ksmn</i> , copper as offerings for Amun	Blumenthal <i>et al.</i> (1984, p. 227); Redford (2003, p. 139)
ff	Semma	Temple inscription	NK, D 18, reign of Thutmose III	Urk IV, 817	Libation vessels made of silver, gold, <i>ksmn</i> and Asiatic copper	Blumenthal <i>et al.</i> (1984, p. 266)

gg	Wadi Halfa	Stela for temple at Wadi Halfa	NK, D 18, reign of Thutmose III	Urk IV, 821	Statue made of electrum, silver, <i>hsmn</i> and Asiatic copper	Blumenthal <i>et al.</i> (1984, p. 268)
hh	Karnak	Statue of Nefertit	NK, D 18, reign of Thutmose III	Urk IV, 1020	Vessels	Blumenthal <i>et al.</i> (1984, p. 391)
ii	Armant	Blocks from temple of Thutmose III	NK, D 18, reign of Thutmose III	Urk IV, 1249	Gates	Mond & Myers (1940, pl. C: 7)
jj	Qurna	TT 82 (stela in the tomb of Amenemhat)	NK, D 18, reign of Thutmose III	Urk IV, 1046	Vessels made of silver, (gold), copper and <i>hsmn</i>	Blumenthal <i>et al.</i> (1984, p. 407)
kk	Qurna	TT 82 (stela in the tomb of Amenemhat)	NK, D 18, reign of Thutmose III	Urk IV, 1047	Statues made of copper and <i>hsmn</i>	Blumenthal <i>et al.</i> (1984, p. 408)
ll	Qurna	Tomb TT 75 of Amenhotep, Son of Sa, second prophet of Amun	NK, D 18, reign of Thutmose III	Urk IV, 1213	Listing of materials worked in workshops	Davies (1923); Blumenthal <i>et al.</i> (1984, p. 495)
mm	Qurna	TT 85, biography of Amenemhab	NK, D 18, reign of Amenhotep II	Urk IV, 891	13 bronze axes, plated with gold	Blumenthal <i>et al.</i> (1984, p. 311)
nn	Amada	Stela from Amada and Elephantine of Amenhotep II	NK, D 18, reign of Amenhotep II	Urk IV, 1296	Vessels, silver and <i>hsmn</i>	Helck (1961, p. 31); Cumming (1982, p. 27); Der Manuelian (1987, pp. 47-51)
nn	Elephantine	Stela from Amada and Elephantine of Amenhotep II	NK, D 18, reign of Amenhotep II	Urk IV, 1296	Vessels, silver and <i>hsmn</i>	Helck (1961, p. 31); Cumming (1982, p. 27); Der Manuelian (1987, pp. 47-51)
Figure 4	Qurna	Tomb TT 93 of Qenamun	NK, D 18, reign of Amenhotep II	Urk IV, 1393	Weapons: daggers/knives and throwsticks	Davies, Hoggood & Davies (1930, pl. xviii); Cumming (1984b, p. 102)
oo	Qurna	Tomb TT 95 of Mery, first prophet of Amun	NK, D 18, reign of Amenhotep II	Urk IV, 1571	Listing of materials, from which craftworks are produced	Helck (1961, p. 157)

pp	Kamak	Third Pylon of Amun temple, Building inscription of Amenhotep III	NK, D 18, reign of Amenhotep III	Urk IV, 1728 (Harris has mistakenly 1729)	Listing of metals	Helek (1961, p. 230)
qq	Qasr Ibrim	Stela of the viceroy User-satet, MFA Boston 25.632	NK, D 18, reign of Tutankhamun	Urk IV, 1344	Battle axe of electrum with <i>/ismn</i> hafting = “thongs”	Helek (1961, p. 50); Cumming (1982, pp. 45-46); Darnell (2014, pp. 253, 255)
rr	Kamak	Restoration stela of Tutankhamun	NK, D 18, reign of Tutankhamun	CG 34183, 18	Listing of metals as offerings	Legrain (1907, p. 165); Harris (1961, p. 64)
ss	Unknown	Papyrus BM 10068	NK, D 19 and D 20	Papyrus BM 10068, recto, pp. 2, 19	Vessel, <i>kb</i> -vase	Peet (1930, p. 88)
tt	Unknown	Papyrus BM 10068	NK, D 19 and D 20	Papyrus BM 10068, recto, pp. 2, 29	Vessel, spit-bowl	Peet (1930, p. 89)
uu	Unknown	Papyrus BM 10068	NK, D 19 and D 20	Papyrus BM 10068, recto, p. 6	Vessels	Peet (1930, p. 92)
vv	Valley of the Kings	Ostrakon CG 25509	NK, D 19, reign of Sethi II		Pick, <i>ib</i> and <i>mgj.t</i> chisel	Černý (1930, p. 4, pls. IV, V)
ww	Medinet Habu	Papyrus Harris I / Great Harris Papyrus	NK, D 20, reign of Ramses IV	41a, 11	Metal	Grandet (1994, pp. 74, 126)
xx	Unknown	Papyrus Mayer B	NK, D 20, reign of Ramses X	Papyrus Mayer B	Bracelet, vessels of <i>/ismn</i> ; bed and vessels of copper	Peet (1920, p. 20)
yy	Unknown	Papyrus BM 10053	NK, D 20	Papyrus BM 10053, recto, p. 4	Mirror	Peet (1930, p. 107)
zz	Unknown	Papyrus Turin PR 102, magical text	NK, D 20	Pl. CXXIV, l. 14	Mountain	Rossi & Pleyte (1869, pp. 189, 247, pl. CXXIV: 14)
aaa	Kamak	Inscription of Montuem-hat	Late Period, D 25, reign of Taharqa		Listing of offerings in various metals	Mariette (1875, pl. 42: 16)
bbb	Gebel Barkal	Victory stela of Piye / Piankhi	Late Period, D 25, reign of Piye	Urk III, 1-56, line 57	Listing of metals as gifts	Schäfer (1905, pp. III, 20, line 57)

Lists containing *ḥsmn* as Metal

The most numerous writings of *ḥsmn* as a standalone metal are datable to the reign of Thutmose III (Cline & O'Connor, 2006; Redford, 2003), which is just a coincidence caused by accidental preservation of the texts. It does not mean that the frequency of use of *ḥsmn* was higher in this particular reign. The writing from the early reign of Thutmose III, so-called *Texte de la Jeunesse* (Laskowski, 2006, p. 184), is peculiar to the New Kingdom, the metal is written as *bj3 ḥsmn* (fig. 3: p-s). In the diligent listings of artefacts and materials in the Annals of Thutmose III and associated dedications to Amun (Laskowski, 2006, pp. 199-201; Redford, 2003), the shortest version of the writing of the metal was chosen, with solely two signs (fig. 3: v-ee). *Ḥsmn* was listed after black copper and before copper in the offerings brought to the god Amun and Amun temple by the king. Each entry in the list was clearly ended by the sign of three mineral pellets (fig. 3: ee). But, for example, temple inscription from Semna opted for a longer version with added N34 sign as a determinative (fig. 3: ff), as well as the stela from Wadi Halfa (fig. 3: gg).

The building inscription of Amenhotep III listed black copper, *ḥsmn*, and copper, as reconstructed by Sethe (fig. 3: pp). The restoration stela of Tutankhamun from Karnak temple listed *ḥsmn* and copper (fig. 3: rr). This writing was preserved also in the material for vessels in the list from the early reign of Amenhotep IV / Akhenaten (Saad & Manniche, 1971, p. 71, pl. XXI), which was published after Harris could take it into consideration.

Similar records were present in private tombs, e.g. at Qurna, in the tomb of Amenhotep, son of Sa, second prophet of Amun in the reign of Thutmose III. *Ḥsmn* was here reconstructed by Sethe, recognizable is copper and “copper from the (foreign) hilly land” (fig. 3: ll), among the materials worked in the Amun temple workshops. Another list, with *ḥsmn*, black copper, and copper from the hills occurred in the tomb of Mery, first prophet of Amun in the reign of Amenhotep II (Der Manuelian, 1987, pp. 106-107), within the context of the inspection of the Amun temple workshop:

Inspecting the workshops of the temple of Amun and the working procedures of all (kinds of) craftsmanship in silver, gold, lapis lazuli, turquoise, bronze, black copper and raw copper which his Majesty offered to his father Amun, lord of the thrones of the Two Lands, (pre-eminent in) Karnak, by the prince and count and first prophet of Amun, Mery, justified (Cumming, 1984b, p. 271).

The reason of such listing is clear, it represents all the main minerals and metals processed in the workshops (fig. 3: oo).

The same use is evidenced by the inscription from the reign of Taharqa from Karnak (fig. 3: aaa) and the victory stela of Piye from Gebel Barkal (fig. 3: bbb). The Karnak inscription, commissioned by Montuemhat, spoke about the restorations in the Karnak temple after the incursion of Assyrians. In the victory stela,

ḥsmn is among the material tribute brought to Piye by Nimlot, king of Khenemu, for his treasury. Although R. Morkot opted for a translation as “copper”, *ḥsmn* was clearly written here (Morkot, 2000, pp. 187-188). Intriguingly, both monumental inscriptions return to the “traditional” form of writing, with N34 sign as a determinative.

Artefacts made of *ḥsmn*

The objects produced out of *ḥsmn* are predominantly vessels. Others represent door cladding, statuary, offering tables, mirrors, and a few other specific objects. But by far, the most numerous artefacts produced from *ḥsmn* in the lists were the vessels. They appeared for the first time in the Old Kingdom (fig. 2: a, b) and continued in the Middle Kingdom (fig. 2: d, e, f, h). Nevertheless, the largest corpus of the mentions of *ḥsmn* is datable to a single reign of Thutmose III. It is impossible to discuss each and every occurrence of the vessels in the annals and dedications of this king. But for illustration, even milking vessels for cows were made of silver, gold and *ḥsmn* (fig. 3: r).

Provenance of the objects could have been from the royal storage (fig. 3: jj, kk):

The vizier Useramun made a large withdrawal from the royal house (*per nesu*), consisting of [...] silver and bronze vessels, [...] Vizier Useramun made numerous statues for the royal house consisting of silver, bronze, ebony [...] (Bryan, 2006, p. 73).

A milk jar of *ḥsmn* (fig. 3: hh) was part of the booty that royal butler Neferperet brought from the Levant and dedicated to the mortuary temple of Thutmose III (Bryan, 2006, p. 95), *i.e.* clearly an artefact of a foreign provenance and production.

Sometimes the combination of materials was described, as Thutmose III recorded the doors to the Amun temple, made of cedar wood, covered with *ḥsmn*, and the royal name on it in gold (fig. 3: p). On the “Northampton” stela, Djehuti wrote too about the doors of cedar covered with *ḥsmn* (fig. 3: o). Monuments like these in the biography of Djehuti appear to have been mentioned also in other biographies of the era (Bryan, 2006, p. 86; Shirley, 2014, pp. 195-198).

Harris argued that in the New Kingdom, bronze would be preferably used *e.g.* for weapons and tools. However, a detailed look at the evidence demonstrates a low frequency of this metal for either of the artefactual categories in the texts themselves. The only New Kingdom exception listing *ḥsmn* as a metal of tools is the late New Kingdom ostrakon CG 25509 from the Valley of the Kings, a list of entries for fifty-eight days of work on the tomb of King Sethi II, dated to his first regnal year. Among the tools listed are *ḥ3* and *md3.t* chisels and *ḥrdn* stone-mason pick (Černý, 1930, p. 4; Daressy, 1927, pp. 172-174). The last term, *ḥrdn*, is sometimes translated as an “axe”, but the evaluation of all written sources on axes rather points to the correct translation as a “stone-working tool”, likely a heavy metal

pick (Davies, 1987, pp. 68-69, tab. D). These are all tools that would be expectedly made of tin bronze in the New Kingdom and represent clearly a stone-working tool kit. But, in much larger part of the inscribed ostraca corpus from Deir el-Medina, apart from another dubious case, scribes of Deir el-Medina tended to prefer the word *bj3*, when denoting the metal for tools (Valbelle, 1977, p. 15).

In case of weapons and body armour, they are systematically named as made of *hsmn*, especially in the Annals of Thutmose III (Redford, 2003) and in a few other texts, where battle axes were mentioned, the best-known being the second stela of King Kamose (fig. 2: 1) (Habachi, 1972). The only other source is the wall painting from the tomb of Qenamun (Davies *et al.*, 1930, pl. xviii; see also fig. 4), and as translated by B. Cumming: “d. Bronze 140. (This refers to swords) e. Bronze 20. (This refers to throwsticks with heads of cranes) f. Of gold, ivory and ebony, 220 whips, Of Bronze, 60 scimitars” (Cumming, 1984a, p. 102). Qenamun was king’s chief steward during the reign of Amenhotep II and accompanied the king to the Levant (Der Manuelian, 1987, pp. 159-160). This is conspicuously the only occurrence of a *hsmn* weaponry in a private Theban tomb of a high official. Another one, from the same reign, is on a royal stela.

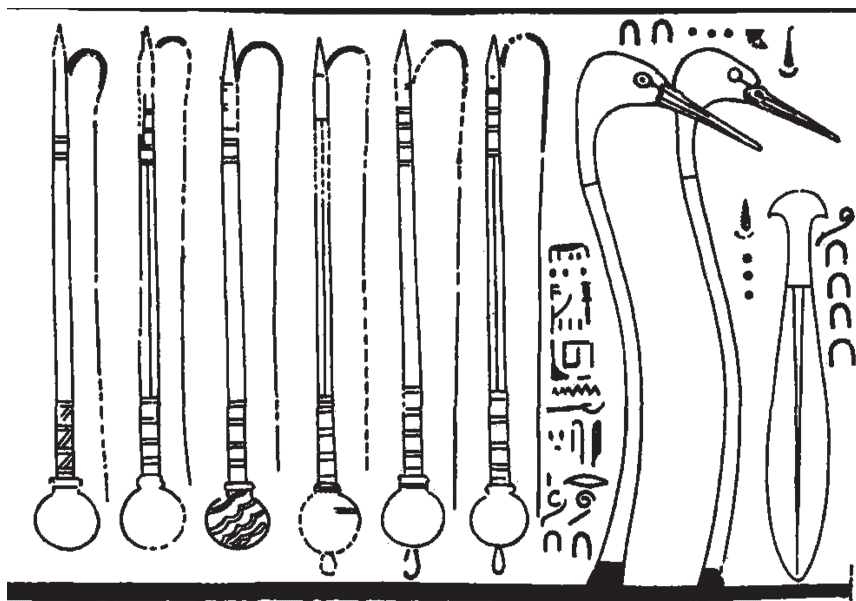


Fig. 4. — Detail of the decoration and inscriptions from the tomb TT 93 of Qenamun with artefacts made of *hsmn* (drawing after Davies *et al.*, 1930, pl. xviii).

In a letter of Amenhotep II to the Nubian viceroy Usersatet, presumably reflecting colloquial use of language (Der Manuelian, 1987, pp. 154-158), a proverb was mentioned, as translated by Darnell: “For lack of battle axe of fine gold, the hafting of bronze, the one *tisw*-staff is reliable in the place of the flood,

the other (is reliable) in the *b^cr*-water of acacia” (Cumming, 1982, pp. 45-46; Darnell, 2014, pp. 253, 255). The word *jkḥw* is specifically used for battle axes (Davies, 1987, p. 67). The elaborate axe can be read as a reference to the weapons held by the king or provided by the king to the viceroy, and metaphorically to the king himself, Amenhotep II (Darnell, 2014, pp. 265-268). The selection of the referred metal (fig. 3: qq) thus points to the royal context and to the provision of an axe specimen made of precious material (Focke, 2013).

However, these are all mentions available of the *ḥsmn* as the metal used for New Kingdom’s weapons. A letter from Dynasty 20 even states clearly that daggers and battle axes were made of copper, although this already counts among the texts that were unknown to Harris at the time of the publication of his book.

Ancient Texts published after Harris (1961)

The most important newly-found and published ancient text with mentions of *ḥsmn* are the fragments of the Annals of Amenemhat II from Memphis (Altenmüller, 2015; Altenmüller & Moussa, 1991). In them, the metal is usually written as *bjḥ ḥsmn*, specific category of the metal *bjḥ*, “copper”. The objects made of this metal are numerous, referred to in table 1, they were from the booty from the towns Iwai and Iasy and from the trade/exchange with Lebanon, as well as tools and temple ritual tools, again especially vessels (Altenmüller, 2015, p. 207). The translation assumed by Altenmüller is “bronze”, equating the word with Hebrew *ḥašmal* and Akkadian *ešmaru*. And of the targets of the military, or rather pirate raid of the towns of Iwai and Iasy, is supposed to be Cyprus (Altenmüller, 2015, pp. 300-306). Recent analyses of the Early and Middle Bronze Age metalwork from Cyprus demonstrated presence of both arsenical copper/bronze and tin bronze in the Middle Bronze Age contexts, each alloy used for specific object categories (Charalambous & Webb, 2020; Webb, Frankel, Stos & Gale, 2006). But not exclusively, thus under the label of *bjḥ ḥsmn* in the annals might be both arsenical copper and tin bronze, as well as an intermediate group of tin bronze with arsenic. Therefore, trying a translation by a single word in a modern language might be misleading, or outright futile.

Recent publication of the late New Kingdom notebook of Dhutmose, apparently originating from Deir el-Medina, has led me to question the pervasive use of *ḥsmn* in the New Kingdom. This source was not available for instance to Harris and could not play any role in Egyptological debates before its discovery. Even though most of the entries deal with the production and transactions with the objects that were predominantly made of tin bronze in the New Kingdom, the sign used is a simple form of N34/U28 most of the time, with just two exceptions of U32 (Hölzl *et al.*, 2018; Müller, 2020) (for the detailed list see table 2). The Notebook of Dhutmose was used for almost everything made of metal,

“copper”, N34/U28 sign, and we can observe how its writing can differ even with a single scribal hand (fig. 5).



Fig. 5. — Examples of different writings of the sign N34 for *bj3* metal, all by a single scribe Dhutmose from Dynasty 20 (drawn after Hölzl *et al.*, 2018).

Another New Kingdom's source is also from personal archive. Bronze vessel of *g3y* type (Janssen, 1975, pp. 426-428), worth two and half *shatys*, rings, figured in the transaction in papyrus Berlin 9784, not mentioned by Harris (Gardiner, 1908, pp. 31-32). The entry is dated to Year 3 of the reign of Amenhotep IV and is a purchase of two-day service of a female slave (Muhs, 2016, p. 130). Since the transaction was performed by the herder Mesi, and the document is from his personal archive, it gives an interesting information about the distribution of bronze vessels and their value. Janssen equates the listed weight of the vessel with $21 \frac{2}{3}$ deben, which would represent in New Kingdom's deben weight of ca. 2 kg, *i.e.* a rather substantial artefact (Janssen, 1975, p. 428).

Curiously, a letter from the reign of Dynasty-20 Ramesse IX lists as metal of the production of knives and axes copper, while a vessel is mentioned as made of *hsmn* (Helck, 1967, p. 143; Janssen, 1975, p. 408). It is so-called Text D, which, with Text C, are letters of the high priest of Amun at Karnak, Ramesse-nakht, to the troops of Nubians, sent to defend against enemies, perhaps in the Eastern Desert (Muhs, 2016, p. 135). Ramessenakht lists provisions, and among those are twenty-five bronze vessels, twenty-five knives and five axes. The word for knife, *sft*, would rather indicate slaughtering or food-processing knife, and originally would denote a lithic artefact, but could less probably also mean “sword” or “dagger” (Herslund, 2011, pp. 124-125; Janssen, 1975, p. 324). Although the word *mjnb* was used for axe, usual in context of the artisan and peaceful application as a tool, Davies opted for a translation of “battle axe” here (Davies, 1987, p. 66). Since twenty-five specimens of linen shirts and other pieces of textile were sent, as well as a number of vessels, the provisions were clearly for a troop of twenty-five men. Only five of them were given axes, nevertheless. Although we can presume that such artefacts would have been made of (tin) bronze in the late New Kingdom, copper is written down here. In other words, the ancient sources are less precise than we wish them to be in naming of the materials and metals specifically, even in the New Kingdom. Let us step further away and look at the broader picture.

Table 2

Mentions of metal artefacts in the Notebook of Dhutmose (use of “bronze” specifically indicated; the rest of artefacts is indicated to be made of copper)

<i>Locus</i>	Source of metal	Recycled into	Reference
Recto, col. 2-3	Tools (22 deben), spear (1 deben), spike (1 deben)		Hözl <i>et al.</i> (2018, pp. 13-14, pl. 2, 3)
Recto, col. 8	Altar (12 deben) + 4 other deben	Spouted jar (2 deben), wash basin (7 deben), pole-end (4 deben)	Hözl <i>et al.</i> (2018, p. 16, pl. 6)
Recto, col. 9	Door of the slaughterhouse (16 deben)	Spear (1 deben), spear (5 deben)	Hözl <i>et al.</i> (2018, pp. 16-17, pl. 7)
Recto, col. 11	Door of <i>pr-mstr?</i> (? deben)	Spear (4 deben)	Hözl <i>et al.</i> (2018, p. 18, pl. 9)
Recto, col. 12-13	Second door (31 deben)	<i>nty</i> chisel (1 deben), spear (1 deben); adze (1 deben), axe (5 deben)	Hözl <i>et al.</i> (2018, pp. 18-19, pl. 10-11)
Verso, col. 1	Adze (3 deben)		Hözl <i>et al.</i> (2018, p. 19, pl. 12)
Verso, col. 2-3	38 deben	Spear (6 deben), drinking cup (6 deben), wash basin + 2 spears (10 deben), wash basin not made (7 deben), 2 spears half-made (7 deben)	Hözl <i>et al.</i> (2018, p. 20, pl. 13-14)
Verso, col. 4	Spear (1 deben), spear (3 deben), spear (1 deben)		Hözl <i>et al.</i> (2018, pp. 20-21, pl. 15)
Verso, col. 5-7	Bronze: 1 <i>kb</i> -vase, 2 <i>krht</i> -vases with base-ring, 2 <i>mnty</i> -bowls (?), 2 big mirrors, 1 small, total 3, 1 big razor, 1 small, total 10		Hözl <i>et al.</i> (2018, pp. 21-24, pl. 5-7)
Verso, col. 7a	Of bronze: 1 <i>tbw</i> -vase makes 5 deben, 1 knife makes 1 1/2 deben, 12 deben scrap copper		Hözl <i>et al.</i> (2018, p. 24, pl. 19)

What Sort of Bronze?

Due to the scarcity of tin bronze before the New Kingdom, Harris assumed that the distinction between copper and tin bronze might not have been perceived clearly in the Middle Kingdom. The highest number of mentions of *hsmn* were from the New Kingdom; therefore in the sources of this dating, it could refer to (tin) bronze. The prevalence of tin bronze in the New Kingdom was, indeed, confirmed by several independent archaeometallurgical studies of the contemporary artefactual evidence, although arsenical copper seldom occurs as well (Odler & Kmošek, 2020; Rademakers, Rehren & Pernicka, 2017; Rademakers *et*

al., 2023; Stos-Gale, Gale & Houghton, 1995). But the question remains: what sort of bronze was represented by *ḥsmn*?

Fundamental terminological imprecision exists among the fields of Egyptology, archaeology and archaeometallurgy. The problem arises because of the term “Bronze Age”, without specifying the term “Bronze”. Most Egyptologists and archaeologists understand that the term “bronze” usually means “tin bronze”, but this is for the understanding of archaeometallurgists. The word “bronze” requires further and more precise qualification, as tin bronze is only one of the possible results of alloying two or multiple metals together with copper being the base metal. Material with intentionally added arsenic ought to be called arsenical bronze, for example, and leaded tin bronze could have been used for the production of statuary and vessels. Just a fraction of Egyptologists and a supposedly slightly larger group of archaeologists realize this terminological vagueness. The imprecision causes a problematic overall framing of the “Bronze Age”, where the advent of the “proper” (tin) bronze is treated as a technological advancement, while the use of arsenical copper/bronze is seen in such narrative as a technological “dead-end” or of no importance at all (Kienlin, 2016). The question of what sort of bronze must be answered within the constraints of both the emic perception of the past culture and etic perception of the current scientific discourse. For Bronze Age metallurgy, this was studied for instance by Kuijpers (2018a,b) and Mödlinger, Kuijpers, Braekmans & Berger (2017), who have defined categories of the alloys that could have been perceived by ancient craftspeople and ancient people in general. Such general categories can be sought for in the vocabularies of ancient languages, *e.g.* ancient Egyptian. But if we are unable to be precise in our contemporary language and texts produced in different fields of humanities and sciences, why should we expect the material naming precision from ancient scribes? They might have had equally superficial and imprecise ideas about the metal alloying processes or the resulting metals.

Generally, we can observe major trends across the Chalcolithic, Early, Middle and Late Bronze Age, as described initially by Eaton & McKerrell (1976), based on the collection of the Ashmolean Museum, Oxford. In the Chalcolithic and Early Bronze Age the most frequent metal is arsenical copper/bronze. In the Middle Bronze Age, up to half of the analysed artefacts is represented by tin bronze, the other ones being usually of copper, or still of arsenical copper/bronze. In the Late Bronze Age, the major alloy is tin bronze, yet the knowledge and production of arsenical copper/bronze was not lost, as such artefacts continue to occur, albeit infrequently. While the big picture is clear, large datasets, produced for example by McKerrell (1971) and Riederer (1978) need to be reassessed and recontextualized with the original archaeological contexts in which they were found and could be dated. Then we can comprehend the local differences within the major lines of development.

I have proposed recently the translation of *ḥsmn* as arsenical copper with higher contents of arsenic (Odler, 2023, pp. 87-89). The reasoning was led by the closeness of the words for natron and amethyst. Natron is a carbonate mineral, white in colour, although it may range from grey to yellow. Amethyst is a purple variety of quartz,

but when worked, it can be reduced into white powder. The appearance of arsenical copper with c. 10 % of arsenic was a cool, whitish-grey colour. Copper alloys with high arsenic were called “white coppers” in Mediaeval times, forming a specific cognitive category of metals (Kuijpers, 2018b, p. 98). Yet, it is difficult to find ancient Egyptian objects with such high contents of arsenic, the weight percentage analysed is usually much lower, and that is the weakest point of my argumentation.

It is difficult to explain a connection between tin bronze, natron and amethyst, three different material denotations of the likely same sounding word in ancient Egyptian. The lexical connection among these three seemingly unrelated words can be explained by referring to some of their perceptible properties. Among the most likely, but also the most disputable ones, could be presumed a colour. The connection between natron and amethyst can be substantiated by the white colour of some of their forms, but the “gold” hue of tin bronze is well known to the present day and has nothing to do with white colour; nor does the colour of tin minerals, especially cassiterite, which is grey or black.

The etymology of the word can be, nevertheless, connected to a different concept, to the ritual cleansing. J. Cooper explains the etymology of the word *ḥsmn* as “to purify” (Cooper, 2020, p. 181). This word denoted also a spouted jar, type of vessel named *ḥsmny*, which was used in the purification, and thus being consequently used for the metal of which some of these vessels were made (Hannig, 2003, p. 887; 2006, p. 1775). The concept of “cleansing” can be arguably earlier than the use of metals, but our sources for the early religious rituals are simply insufficient to make a strong case in one or the other direction, whether the material or the vessel was named the first. And, after further deliberation, it seems likely that lexicographical distinction between *bj3* and *ḥsmn* was not at all clear cut.

Furthermore, their alloying element might be identified as another presumed metal, *ḏḥ.t* / *dh.t*. In Dynasty 6, the material *dh.t* was chiselled out in the biography of an official Iny (see fig. 2: c). Since the hieroglyphic sign for “pestle”, U32, is the same as the one used for the writing of *ḥsmn*, *ḏḥ.t* might have been used in production of the *ḥsmn*. And a similar writing, *ḏḥ(.t)*, appeared later, in the Middle Kingdom, in the Annals of Amenemhat II. The word *ḏḥ.t* is usually translated as lead, but it might have also been confused with tin (Cooper, 2020, pp. 203-204; Harris, 1961, pp. 67-68). Since the properties of tin and lead alloys differ markedly, the metals were hardly confused by the metalworking specialists who used the ores but could have been confused by the authors of the texts. The mention of the material in the text of Iny denotes *ḏḥ.t* as being brought from Byblos, presumably obtained from Ebla. But this could be both arsenic for arsenical copper, tin for the tin bronze, or perhaps lead for leaded tin bronze, depending on what interpretation we choose. Evidence is insufficient for a final decision.

Harris’ argument that the colour of *ḥsmn* was established to be “chestnut-brown”, “marron” was at best misleading. Intriguingly, this is not the colouring of the true tin bronze, which has gold-like appearance. To quote A. Hauptmann: “If the tin contents are below 10 wt. %, then the bronzes are reddish to tombac coloured. If

they rise to >10 wt. %, bronzes are coloured orange to yellow-gold-like. This is the usual colour of archaeological bronzes” (Hauptmann, 2020, p. 396), while in case of arsenical bronze: “4-12 % of arsenic gives the alloy ‘golden tint’ (Hauptmann, 2020, p. 388). Gold-like hue of the practically used arsenical copper and tin bronzes could have been virtually indistinguishable to the non-specialists, unacknowledged with the metalworking recipes used to produce tools and weapons. Thus, the apparent lack of distinction between *bj3 / ḥsmn* as arsenical copper and *bj3 / ḥsmn* as tin bronze can be understood. Both arsenical copper and tin bronze could have been subsumed under one term of *ḥsmn*, especially in the Middle Bronze Age, when both metals were used for specific artefacts. Just compare the parts of the original surface of two mirrors from the Louvre collections, both having ca. 7 weight % of arsenic (fig. 6) and tin (fig. 7) respectively (Vandier d’Abbadie & Michel, 1972; Vandier d’Abbadie, 1972). Both have distinct, slightly “golden” hues of alloyed copper.

However, any substantial reassessment of the chemical composition in comparison to written sources is impossible for the earlier parts of the history of Egypt and Nubia, as can be seen from the figure 8 with the total counts and percentages of the already analysed artefacts. Many of these are, moreover, antiquated analyses from a century ago and need to be re-evaluated as well.



Fig. 6. — Dynasty-6 mirror disc from Edfu, Mastaba of Isi, Shaft XIX, inv. no. E 25973, made of arsenical copper, with 7.5 weight % of arsenic and 1.06 weight % of antimony (according to Vandier d’Abbadie & Michel, 1972, cat. no. OT 781, 7). © 2004 Musée du Louvre / Christian Décamps.



Fig. 7. — Dynasty-18 mirror disc with handle from Deir el-Medina, tomb 1370 of Maya, inv. no. E 14465, made of tin bronze, with 8.22 weight % of tin (according to Vandier d'Abbadie & Michel, 1972, cat. no. OT 764, 20_1). © 2004 Musée du Louvre / Christian Décamps.

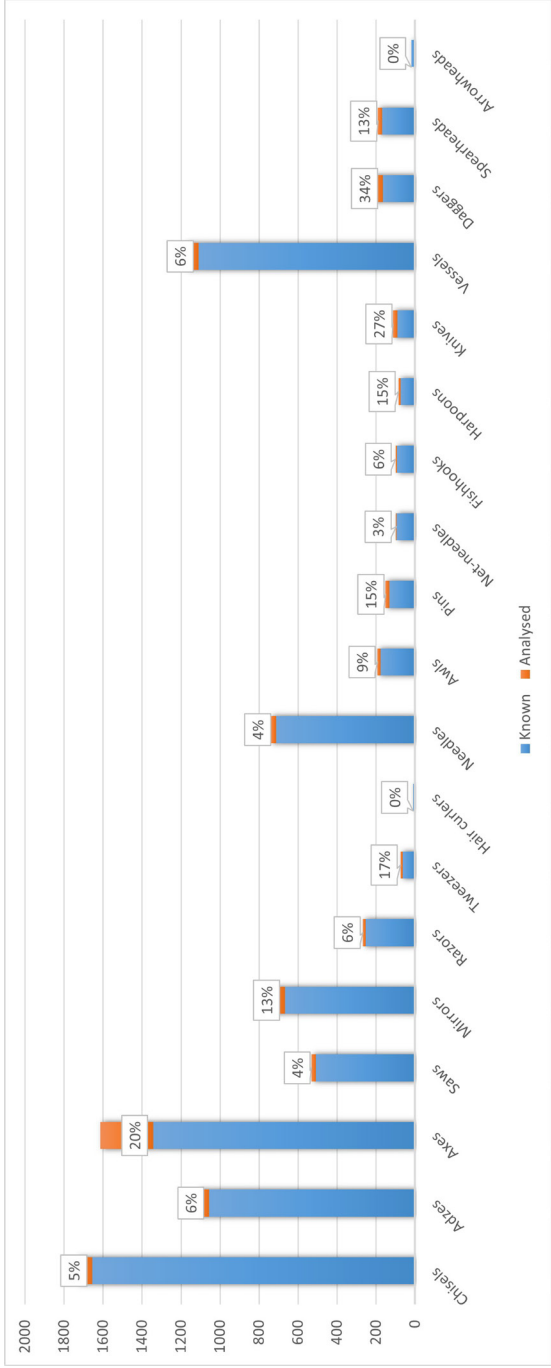


Fig. 8. — Total counts of the artefacts preserved from the Chalcolithic, Early and Middle Bronze Age Egypt and Nubia, with a subset of the artefacts already analysed. The percentage of each artefact category is indicated. Edited version of fig. 138 from Odler (2023).

Another level of perception that is at play is the perception of colours, ancient vs. modern. In case of copper alloys, the best-known case is of a “black copper” (Giulia-Mair & Quirke, 1997). But gold, silver, and its natural or intentional mixing in electrum, could have exhibited a range of colours, e.g. for electrum described as “... from pale yellow to greyish-white...” (Harris, 1961, p. 35). The colour properties of ancient Egyptian gold can be understood only quite recently based on sufficient analytical data (Guerra, 2023). Any comparisons of modern vs. ancient perceptions run into risk of assuming something that might not have been in the mind of the ancient user of the language and writing. Thus, again, our conclusions must be based on a statistically representative number of analyses, equally for gold, silver, and electrum, and this has hardly been the case so far. Therefore, I cannot provide any definitive solution to the problems described in the paper, only in the case of general categories used.

Distinction between *bj3* and *ḥsmn*

The number of occurrences of *ḥsmn*, rather low overall for the Bronze Age of Egypt, might potentially even point to a rarer metal, perhaps, beyond arsenical copper with high contents of arsenic, also arsenical copper with nickel. Only statistically representative analyses of all preserved New Kingdom metal vessels would provide us with a definitive answer on what alloys can be documented in them, the most frequent artefacts named as made of *ḥsmn*. And within the sphere of the mundane papyri, for the practically used metal, in the New Kingdom “tin bronze”, the word and sign *bj3* were used often instead of *ḥsmn*, the categorization of specific metals being blurred or unclear to some users of ancient Egyptian. Thus, the term, as Harris wrote, “...includes both copper and bronze...”, but not only for later periods, also for the Bronze Age Egypt, and stemming from the use of the word since the Chalcolithic.

An explanation for the general categorization of *ḥsmn* is provided by the papyrus Mayer B (fig. 9), in which the interrogated tomb robbers, among others metalworker Pentahutnakht, described what they looted and how they had split it. The looted tomb was of King Ramesse VI, KV 9 in the Valley of the Kings, while the papyrus itself is likely datable to the Year 9 of Ramesse IX (Peden, 1994, pp. 259-264). The categories are clear from the original English translation by Peet, and thus could have been understood well since the 1920s:

We opened the tomb and we entered it. We found a basket (??) lying on sixty ... chests (?). We opened it. We found [...] of hands, of bronze; a bracelet (?) of bronze; three wash-bowls of bronze; a wash-bowl, a *nw*-vase (for) pouring water over the hands, of bronze; two *kb*-vases of bronze; two *pwnt*-vases of bronze; a *kb*-vase, a *jnk*-vase [...] of bronze; (12) three *jrr*-vases of bronze; eight beds of ornamented copper; eight *b3s*-vases of copper. We weighed the copper of the objects and of the vases, and found (it to be) [500 *deben*?] of copper, (13) 100 *deben* of copper falling to the share [of each man?] (Peet, 1920, p. 20).

The loot altogether was between 45 and 47.5 kg of copper, depending on the interval of the weight of New Kingdom's deben between ninety and ninety-five grams. This must have been a substantial haul for five men looting the tomb, thus they have been undisturbed for a longer time, while emptying its contents. The fragmentarily preserved papyrus provides evidence that they were eventually caught, interrogated and, apart from the metal, they looted also fine textile from the tomb. Nevertheless, for us it is important that they treat metal *ḥsmn* as a specific category of *bjḥ*. Even in Dynasty 20 and in an official document, the distinction between *bjḥ* and *ḥsmn* was made, but the semantically broader word *bjḥ* is clearly indicated as an overarching concept in the document. A similar approach is confirmed by the Notebook of Dhutmose, where in verso, col. 7a, both *ḥsmn* and scrap copper were counted into twenty deben units altogether. But in many other places, Dhutmose preferred to write *bjḥ* instead of *ḥsmn*.

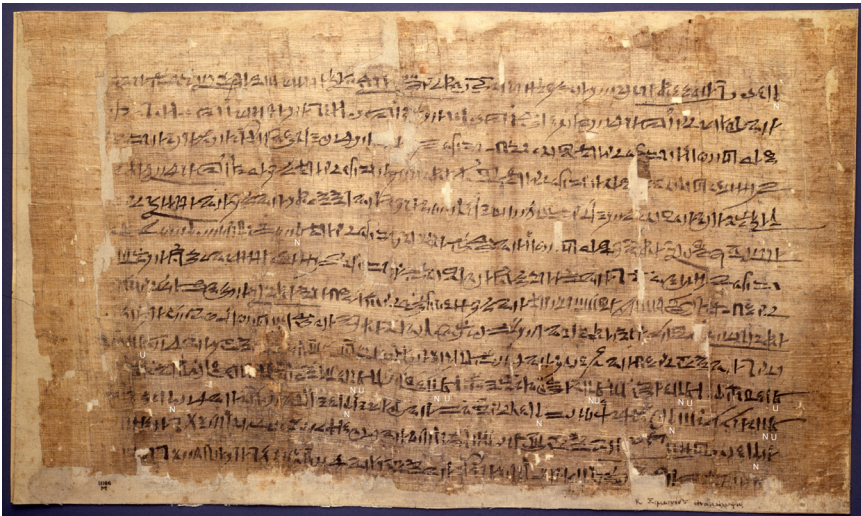


Fig. 9. — Papyrus Mayer B with the mentions of *ḥsmn* and *bjḥ* metals, inv. no. M11186. Inserted letter N marks the occurrences of the sign N34, letter U marks the occurrences of the sign U32 (courtesy of the World Museum Liverpool).

Broader insight to be gleaned from the presented evidence is that the Bronze Age Egyptians likely did not perceive the alloying of different metals as a major technological change and used interchangeably different words. That is in discrepancy with the perception of alloying as the major advancement in the presumed “evolutionary” view of the early technology, although such views are assessed critically in recent literature (Kienlin, 2016).

Harris explained the absence of *ḥsmn* from the Graeco-Roman Period in this manner: “It seems, therefore, possible that in later texts *ḥmty* includes both copper and bronze, [...]” (Harris, 1961, p. 64). And that is, actually, the argument

this text is making: the distinction between *bj3* and *ḥsmn* was blurred for some writers of the ancient Egyptian texts, and they liberally used either this or that word, depending on context and also on choices, which might be unclear to us at present. That was a conclusion of other Egyptologists dealing with the actual ancient evidence (Valbelle, 1977, p. 15). And despite the research done in Egyptology, archaeology and archaeometallurgy, we will have to wait for definitive and statistically representative answers. Until then, the translation of this particular word appear to be tentative.

Conclusion

This paper deals with the correct lexicographic identification of the word *ḥsmn*, which was in Egyptology usually translated as “(tin) bronze”, if denoting metal. Broad overview of the evidence demonstrates that the word was used sparingly and in many texts, another word, specifically *bj3*, was used for objects that can be presumed to be made of tin bronze and were identified as such by archaeometallurgical analytical work. *Ḥsmn* can be translated as tin bronze and/or arsenical copper, although *bj3* can be used for the same metals throughout the Egyptian Bronze Age as an overarching category for a copper-base metal and/or alloy. In other words, we cannot expect modern scientific precision from ancient languages when denoting materials. The distinction between *bj3* and *ḥsmn* was blurred for some writers of the ancient Egyptian texts, and they liberally used either this or that word, depending on context and also on choices, which might be unclear to us at present. Despite the current importance of the concept of metal alloying, it does not seem to be perceived as an important step by the authors of Bronze Age texts, if they use the words and categories interchangeably.

Ancient texts were not produced by artificial intelligence, but by humans. The choices they made in producing the texts might not be always clear, and they appear to be scientifically less rigorous that we wish them to be. It does not mean that we should abandon researching them, just that we should be aware of moving among the different categorizations and discourses between Egyptology, archaeology and archaeometallurgy.

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