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THE OXHIDE INGOTS PRODUCTION IN THE EASTERN MEDITERRANEAN

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Abstract

Cyprus was undoubtedly the main area of production of the copper oxhide ingots found in different Mediterranean countries. Recent research at Politiko Phorades and Maroni shows that the casting of the oxhide ingots required a complex process which involved both inland mining and coastal sites. Egyptian and Near Eastern written sources suggest that not only oxhide ingots but possibly other raw copper (ore, matte or other semi-processed material) were exported from Alashiya/Cyprus. However, lead isotope analysis of some ingots from Late Minoan I contexts and archaeological evidence from Ras Ibn Hani, in the Ugaritic kingdom, and Timna, in the political domain of Egypt, show that the oxhide ingots were not cast only in Cyprus, from at least the beginning of the Late Bronze Age to the last centuries of the second millennium BC. Leaving aside the copper oxhide ingots depicted in the well-known scenes of tribute of the Theban tombs, special attention is here paid to Egyptian foundry scenes, especially that depicted in Hepu tomb. A group of oxhide ingots is here displayed above the craftsmen who are represented in act of fanning a fire. A review of Egyptian scenes of various workshops shows that from the Old Kingdom the products of the working activities are generally displayed in the same way as in the Hepu tomb. It is therefore very likely that the aim of this scene is to epitomize the casting of the copper oxhide ingots displayed above. If this interpretation is right, the production of copper oxhide ingots should be admitted also in Egypt during the 15th-14th centuries BC, although on a far smaller scale than in Cyprus. The foundry scene in Nebamūn and Ipuki tomb is more ambiguous, but it may also depict the casting of a tin slab ingot.

Introduction

There is a general consensus that in the second millennium BC Cyprus played a primary role in the production and trade of oxhide ingots of very pure copper, at least after the LB I[1]. The strong arguments in favour of this assertion are well known. Most of them are provided by lead isotope analysis which shows that the isotopic characterisation of a large number of oxhide ingots from different Mediterranean countries, especially Cyprus, Greece, Sardinia, and Turkey, is fully consistent with their origin from Cypriot ores[2], although there are different opinions concerning the exclusive use of the copper from Apliki mine for all oxhide ingots from post-1400 BC contexts[3]. Whatever the nationality was of the two sunken ships at Cape Gelidonya

[1] For basic references, see KASSIANIDOU 2001, 98; PAPASAVVAS 2009, 83; CONSTANTINOU 2012, 11-12.
[2] See GALE 2011, 214, for a recent discussion with earlier references.
[3] For different points of view concerning the role of Apliki mine, see: STOS-GALE et al. 1997; GALE 2011;

and at Uluburun, the Cypriot origin of the copper of the oxhide ingots from the two shipwrecks also confirms that Cyprus was a key point in the seaborne trade in the Eastern Mediterranean[4], while the oxhide ingots of Cypriot copper from the Urfa region, in the south-eastern Turkey, provide new evidence that they were also distributed to the inland regions, possibly as prestige objects[5]. Moreover, unlike all the other contemporary countries, various artefacts (especially bronze stands, seals, and bronze statuettes) made in Cyprus show the representations of oxhide ingots clearly indicating how deeply they were rooted in the life and religion of Cypriots[6]. If Cyprus (or part of it) is equated with Alashiya, as accepted by most scholars[7], the close connection between Cyprus and copper is also historically confirmed, because Alashiya is the main exporter of copper mentioned in Egyptian and Near Eastern texts. Despite these arguments, there are perhaps some apparent contradictions in the Cypriot archaeological records. There is, for example, a relative scarcity of intact or fragmentary oxhide ingots from Cypriot contexts dating to the period from the 14th to the end of 12th centuries BC[8], but it should be taken into account that there are relatively few Late Bronze Age settlements excavated on the island and that many ingots were probably produced in Cyprus especially for long distance trade and for the diplomatic relationships between the rulers of different countries. Another apparent paradox is the lack of moulds for oxhide ingots. However, in Cyprus oxhide ingots may have been cast in sand moulds, which do not leave any archaeological traces[9], as recent experiments demonstrated was possible[10]. Another possibility is that metal workers used moulds of unfired clay, which is difficult to identify during excavations[11]. The use of sand and/or unfired clay moulds may indeed be confirmed by the fact that "no two of the Gelidonya ingots seem to have come from the same mold"[12]; the same is true of the overwhelming majority of the oxhide ingots from the Uluburun shipwreck, which were cast with Cypriot copper[13].

Although the primary role of Cyprus in the production and trade of oxhide ingots is certain, the ultimate object of this article is to identify additional places of production of oxhide ingots in the Eastern Mediterranean. A twofold line of research is here adopted. First an examination of textual and archaeological evidence will be performed in order to verify whether, in addition to oxhide ingots, Cyprus occasionally exported copper ore or semi-transformed material to different regions of the Eastern Mediterranean. Secondly (and consequently) it will be necessary to discuss the metallurgical finds from Ugarit and Egypt with a view to verifying the presence of signs of a local production of oxhide ingots in the archaeological evidence and in the Egyptian representational art of the 18th Dynasty.

Gale, Stos-Gale 2012; contra Kassianidou 2001, 103-104; Kassianidou 2009a, 62; Knapp 2012, 22-23.

[4] Stos-Gale et. al 1997, 109-112; Pulak 2001, 20-21; Gale, Stos-Gale 2005.

[5] Pulak 2011.

[6] For a recent review of overall evidence, see Papasavvas 2009.

[7] For a full discussion, see Knapp 1996, 3-11 with refs.; Knapp 2008, 307-341; Knapp 2011, 249.

[8] Kassianidou 2001, 98; Kassianidou 2009a, 43-45, 59; Papasavvas 2009, 83.

[9] Mangou, Ioannou 2000, 216; Kassianidou 2009a, 63; Constantinou 2012, 11.

[10] Kassianidou 2001, 101.

[11] Ben-Yosef 2012, 194-195.

[12] Bass 1967, 70.

[13] Constantinou 2012, 11.

The production of oxhide ingots in Cyprus

Recent research highlights the knowledge of the exploitation of copper resources in Cyprus. The earliest evidence for a Cypriot metallurgical technology dates back to the Chalcolithic period[14], but copper production and metalworking on the island substantially increased in the Early and Middle Cypriot periods[15], and major developments dated back to LC I, when the earliest oxhide ingots made of Cypriot copper were exported to Crete. An essential contribution for understanding the multi stage process to obtain copper metal from copper sulphide ores at the beginning of Late Bronze Age was given by the smelting site of Politiko *Phorades*, near the ore deposit of the Lower Pillows Lavas in the Troodos[16]. The discovery of "matte", an intermediate product in the production of copper, suggests that only primary smelting of copper ores took place there. If indeed this was the case, it would mean that the further steps of the metallurgical processes, such as secondary smelting and casting of copper oxhide ingots, were carried out elsewhere, particularly at the urban centres located on the southern and southeast coasts. Despite its preliminary character, a recent study by Kassianidou confirmed that this model is well-founded since it proves that the slag and other metallurgical finds from Quarter 1W at Enkomi dating to LC I can be related to secondary processes such as refining and casting[17], while the slag and smelting furnaces found at the contemporary workshop excavated at Politiko *Phorades* are evidence of primary smelting activities only. Probably in the Troodos there were many other undiscovered sites, which, like Politiko *Phorades*, supplied the coastal sites with matte or perhaps also "black copper", an intermediate product of the secondary smelting work, for further treatment[18].

In this connection, it should be recalled that the division of the various steps of the metallurgical processes between various distant locations is also well attested in Crete at least from the third millennium BC[19]. Therefore, no single model of copper processing can be distinguished in Crete during the third millennium BC. The same seems to be true for Cyprus in the course of the LBA. As a matter of fact, recent discoveries at Maroni suggest a different model from the *Phorades*-coastal sites model discussed above, at least in LC IIC. Not only do at least two oxhide ingot fragments dating to LC IIB provide early evidence for oxhide ingot production in Cyprus[20], but "the quantity of matte and copper in the slags themselves" found at Maroni is even more

[14] Knapp 2012, 14-17 with full refs. For the very beginning of metallurgy in Cyprus, also see Kassianidou 2008, 251- 252.

[15] Kassianidou 2008, 252-256; Papasavvas 2012, 117; Knapp 2013, 300-303 with refs.

[16] Knapp et al. 1998; Knapp et al. 1999; Knapp, Kassianidou 2008; Kassianidou 2008, 260-265.

[17] Kassianidou 2012, 100-101, 104, Fig. 10-9. More in general for metallurgical processes at Enkomi in LC I, see Kassianidou 2008, 258-260.

[18] Kassianidou 2009a, 62; Kassianidou 2012, 101; Knapp 2013, 413.

[19] At Chrysokamino, in Eastern Crete, three distinct steps have been suggested: mining in the north (Laurion and Kythnos), smelting at Chrysokamino itself, re-melting and casting and metalworking elsewhere (Betancourt 2006; Betancourt 2012). For a discussion on the smelting process in this site, also see Betancourt 2008. At Kephala Petras (Eastern Crete) in Early Minoan I period or possibly at the end of Final Neolithic "copper ore was brought to the settlement in order to be smelted for the extraction of the metal" (Catapotis et al. 2011) and in EM I and II, at Poros near Iraklion, raw material was imported possibly from the Cyclades to be worked and cast locally (Dimopoulou et al. 2007, 92, 94; Dimopoulou 2012, 136).

[20] Doonan et al. 2012, 52.

noticeable because they suggest that also matte smelting, i.e. primary copper production, was taking place on this site, near the LC IIC monumental buildings, before casting oxhide ingots[21]. In the light of this, excluding mining and primary smelting inland sites, it is clear that secondary (and even primary) smelting activities took place only at the coastal sites in order to cast oxhide ingots, although Kassianidou states that "whether the copper was then cast into ingots (of the oxhide or bun shape) for export or just ingots and artefacts for local use is an open question"[22].

The production of oxhide ingots outside Cyprus

Despite the primary role of Cyprus in the production and trade of oxhide ingots, we can state that Cyprus was not the only producer of oxhide ingots in the course of Late Bronze Age[23]. The earliest oxhide ingots matching the lead isotope composition of Cypriot ores made - the Apliki ores, according to Stos-Gale and Gale - have been found in Crete in LM IB contexts at Mochlos, Kato Zakro, Gournia and Kato Syme[24]. In contrast to these data, the lead isotope composition of the copper of other ingots from contemporary Cretan contexts - Kato Zakro (2), Tylissos (1), Mochlos and Ayia Triada (13) - is not consistent with Cypriot ore deposits[25]. The exact provenance of their copper is unknown (Anatolia, Iran, Southern Russia or Afghanistan?), but it is worth noting that lead isotope analysis distinguished at least two different groups[26]. It is therefore clear that a certain number of oxhide ingots were cast outside Cyprus at the beginning of Late Bronze Age since it is quite unlikely that Cypriot metalworkers used local copper as well as copper imported from distant regions for oxhide ingots to be exported to Crete.

The same meaning can be ascribed to the discovery of a unique stone mould for oxhide ingots in a context datable at the end of the 12th century BC in the North Palace at Ras Ibn Hani, in the Ugaritic kingdom[27]. This also confirms that "the metal working was a royal franchise" in the Eastern Mediterranean[28], in accordance with the Ugaritic documents concerning the distribution of copper to the metalworkers (*Sbrdn*) by the palace administration[29].

Finally, the latest evidence for a non-Cypriot production of copper ingots of oxhide shape is provided by a small mould from Timna Valley, in Sinai, where there was a large smelting camp for Egyptian use[30]. This mould, probably dating to the 11th century BC, was made of an

[21] Doonan et al. 2012, 54-55.

[22] Kassianidou 2012, p. 104.

[23] See, for example, also Mangou, Ioannou 2000, 215; Cluzan 2008.

[24] Stos-Gale et al. 1997, 112, Table 6, Fig. 11; Soles 2005, 434, Pl. XCIX: g; Liard 2010, 55-56; Gale 2011, 218; Stos-Gale 2011, 223, Table 22.1; Lo Schiavo et al. 2013, 54-55 with refs. Fig. 4.

[25] Stos-Gale 2011, 224 table 22.2; cfr. Liard 2010, 56, table 1. For additional discussions, also see Hakulin 2008, 203-204 (with a discussion also on their find contexts); Muhly 2008, 40. For the not-Cypriot provenance of copper used for ingots from Mochlos, although found along with ingot fragments made of Cypriot copper, see Soles 2008, 146-147 (Hoard 1).

[26] Stos-Gale 2011, 226; cfr. Liard 2010, 54, 56, Table 1: Sources A-D. Note however that the copper of a small ingot fragment found at Mochlos is from south-east Anatolia (Soles 2008, 146-147).

[27] Bounni et al. 1998, 43-45, Figs. 68-71; Dardaillon 2012, 172.

[28] Wachsmann 1987, 51.

[29] Zaccagnini 1970, 315-317.

[30] Ben-Yosef 2012.

extremely fragile unfired clay, and was probably intended for casting only one ingot of oxhide shape, which was, however, quite different in size from the common oxhide types.

To sum up, no doubt Cyprus acquired a prominent role in the production (and probably distribution) of oxhide ingots, but the different places of production as well as their wide distribution in the Mediterranean and beyond imply that, during the Late Bronze Age, they were everywhere considered the standard means of the international trade in pure copper, probably on account of their shape, which appears to be apt for many purposes: land and sea transport[31], hoarding[32] and, of course, various metallurgical activities since different fractions of these flat and relatively thin ingots could have been obtained rather easily[33].

Cypriot copper in the Eastern Mediterranean: Ugarit

As recently shown by Papasavvas, in the early Late Bronze Age, Eastern Mediterranean people had a greater interest in Cypriot copper as a raw material than in bronze Cypriot artefacts[34]. Many oxhide ingots are indeed mentioned in the diplomatic texts concerning Alashiya, although there is no reference to them in the most ancient (19th-17th centuries B.C.) texts from Mari, Alalakh and Babylonia, as shown by Knapp's thorough discussion[35]. No doubt this lack of reference matches the archaeological record because the earliest oxhide ingots appear in a much later period. The Alashyian copper recorded in some Mari tablets might have been of various qualities, if such is the meaning of the different qualifications (“copper”, “mountain copper” and “refined, quality copper”) used for it, but it should be acknowledged that the meaning of such terminological differences is unclear. It is however worth noting that Alashiyan copper was recorded there in terms of weight (talents, minas, and shekels), and it is reasonable to consider whether Cypriot copper was exported to the East also in the form of ore or matte or some other semi-processed material in the Middle Cypriot period. Only an Alashiyan dagger can be safely identified as a product accompanying the Alashiyan raw copper mentioned in the texts[36], but Knapp has appropriately noted that the earliest Near Eastern imports of objects to inland Cypriot sites date back just to these centuries, and they may therefore be indicative of the initial phase of trade in copper and tin with the Near East[37].

There is, of course, more evidence for trade in copper in the Late Bronze Age, especially between Alashiya/Cyprus and Ugarit, when the two countries were linked by close contacts and exchanged so many goods including, of course, raw materials[38]. On the one hand, reference is made to 15 “*talents*”[39] of copper in an Ugaritic text recording the cargo of an Alashiyan ship in the harbour of Atlg[40]. On the other hand, 33 *oxhide ingots* are mentioned

[31] For a general discussion, see: Pulak 1997, 238; Gale, Stos-Gale 2012, 76.
[32] For the hoards of oxhide ingots in Crete, see Liard 2010, 58-59; Constantinou 2012, 10-11.
[33] Liard 2010, 59-60.
[34] Papasavvas 2012.
[35] Knapp 2008, 307-308; Knapp 2011, 250; also see Charpin 1990, 125-127.
[36] Papasavvas 2012, 122.
[37] Knapp 2008, 308; Knapp 2011, 250.
[38] More in general, see: Wachsmann 1987, 116-117 with refs.; Yon 1999; Yon 2007.
[39] Ugaritic kkr: Zaccagnini 1986, 413.
[40] RS 18.119: 4: Walls 1996, 37, Text 50; Knapp 2008, 311.

in the tablet RS 94.2475 as a "greeting gift" sent to the king of Ugarit by Kusmeshusha, the king of Alashiya, in the 13th century BC[41], and it is here worth stressing that their weight (30 or 33 talents) is also expressed. This specification would be pleonastic if the terms for "talents" with "oxhide ingots" could always be equated, as suggested by some scholars[42]. As a matter of fact, oxhide ingots were probably not regarded as fixed units everywhere in the Mediterranean because there were not only differences in weight between the largest units of weight called "talents"[43], but the oxhide ingots themselves also varied in weight[44]. The two Knossian Linear B tablets OA 730 and OA 733, with scales and number, indicated that there was not a firm correspondence between talents and oxhide ingots, at least in the Aegean world, so that it was necessary to weigh oxhide ingots in order to perform the transaction of the raw material[45]. Therefore, on the basis of historical sources Zaccagnini was quite right when he stated that "…variety is to be observed in the methods used for reckoning operations: number of items (e.g. ingots), weight of metal (in talent, minas, shekels), number of items plus weight, weight plus specification of the kind of items"[46].

Dardaillon has recently published abundant evidence from Ugarit indicating that a noticeable metallurgical industry, particularly active in melting and/or recycling, was located in the Ugaritic kingdom[47]. Published finds included two fragments of oxhide ingots from a context dating to the mid 13th century BC, but the origin of the copper is undetermined so far. The discovery of a semi-transformed material such as matte on the acropolis of Ugarit is even more important since this may be evidence that, like in Cyprus, primary smelting took place at Ugarit itself or at Minet el Beida[48]. Assuming that copper was not available in the Ugaritic kingdom, however, the lack of lead isotope analysis prevents us from knowing whether such raw material was imported from Cyprus, or, if it was, it cannot be determined whether copper was imported in the form of ore, matte and/or ingots, although a semi-transformed product such as matte or "black copper" would have been the most convenient one for trade, since such materials are lighter than copper ore[49]. Given the proximity and the close trade, cultural and diplomatic contacts, Alashiya/Cyprus is of course the best candidate as supplier of raw copper to the Ugaritic kingdom. In this connection we must also recall that Cypriot raw copper was used to cast oxhide ingots at Minet el Beida a century later, as indicated by the copper prills associated to the stone mould found in the North Palace[50]. Therefore, while we cannot completely rule out the possibility that "talents" of raw copper were imported from Alashiya/Cyprus for local use, perhaps including the process of casting oxhide ingots, we

[41] Malbran-Labat 1999, 121; Knapp 2011, 250, no. 4; Bell 2012, 184.

[42] For the suggested equivalence in meaning between oxhide ingots and talents, see: Muhly 1973, 213; Muhly 1979, 95; Vincentelli 1976, 22; Arnaud 1967, 168.

[43] For a thorough discussion concerning this topic, see Zaccagnini 1986, 415-416.

[44] Bass 1967, 71; Knapp 2008, 310; Knapp 2011, 251, Table 24.2.

[45] Bass 1967, 71; Parise 1968, 128; Caloi 2006, 215.

[46] Zaccagnini 1986, 414.

[47] Dardaillon 2012.

[48] Dardaillon 2012, 172, fig. 18 no. 4. Also note that in 1936 C.F.A. Schaeffer (1936, 99) already published copper in form of matte from Ras Shamra.

[49] Dardaillon 2012, 173, 175.

[50] For the analysis results, see Gale 1989, 264-265.

cannot suggest that the Syrians generally played a predominant role in the oxhide manufacture and trade in oxhide ingots, as Bass and Wachsmann did some decades ago[51].

Cypriot copper in the Eastern Mediterranean: Egypt

Turning to Egypt, special emphasis should be placed on Akkadian texts from Tell el Amarna. Taking an Hittite inventory text as term of comparison, Zaccagnini has shown that there were differences in phraseology concerning copper in the correspondence between the king of Alashiya and the Pharaoh[52]. He suggested that the Akkadian terms *URUDU*, *GUN URUDU,* and *URUDU GUN* were used respectively for " (ingots) of copper", "talents of copper" and "(ingots of) copper (weighing 1) talent" (Table 1).

Akkadian terms	**Zaccagnini's translation**	**Documents**
URUDU	"(ingots) of copper"	EA 33: 16; EA 36: 6; EA 40: 7, 13
GUN URUDU	"talents of copper"	EA 33: 18; EA 40: 13
URUDU ina GUN *ina GUN URUDU*	"copper (ingots) weighing (one) talent"	EA 36: 6, 7; RS 94.2475

Tab. 1 - The meaning of the Akkadian terms for raw copper (in the relevant documents) according to Zaccagnini's translation.

If we accept Zaccagnini's translation, the specification "copper (ingots) weighing (one) talent" (EA 36: 6, 7; RS 94.2475) was probably regarded as necessary in particular circumstances since the Akkadian term for "(ingots) of copper" also appears in the same Amarna letter (EA 36: 6). Moreover, the terms for "(ingots) of copper" and "talents of copper" coexisted in the same letter (EA 33: 16, 18), suggesting that they were used for two different categories of raw copper. A further confirmation for this interpretation can be found in the letter EA 40: 13 where the *rabisu* of Alashyia communicates that he is sending copper in the form of "(ingots) of copper" and "talents of copper" to the *rabisu* of Egypt[53]. If we consider the contents of these letters more in detail, in EA 33: 16, 18 the Pharaoh lists the gifts received by the king of Alashiya when he ascended the throne[54]. Despite the fact that the gifts included 200 copper ingots, the Pharaoh stated that he himself was dispatching ten talents of copper to the king of Alashiya, although he was clearly aware that Alashiya was the main supplier of copper to Egypt. The only explanation is that this was a diplomatic "provocative gift" whose aim was to obtain an incremental return on the investment, as also appears from Liverani's discussion on the letter EA 40. In this text the *rabisu* ('minister') of Alashiya communicated that he was sending an elephant tusk to Egypt to be added to two others previously sent, and required a return shipment of ivory from Egypt itself, which in antiquity was considered

[51] Bass 1967, 76; Wachsmann 1987, 51.

[52] Zaccagnini 1986, 414. Such difference in phraseology were also accepted by B. Knapp: Knapp 2008, 309, Table 5; 2011, 250, 251, Table 24.1.

[53] For a different translation, see Moran 1992, 104-105 [EA 33], 113 [EA 40]).

[54] Cfr. Moran 1992, 105, note 5.

rich in ivory[55]. Although we can regard the copper sent from Egypt to Alashiya in EA 33 as indicative of the rule of the increased return in the second millennium BC diplomacy, one might wonder whether it was of local (Sinai or Eastern Desert) or foreign origin (a return gift from Cyprus iself?), but no certain answer is, of course, possible. In this connection it should however be recalled that one cannot exclude the possibility that some copper was exported to the Aegean from Egypt as a possible return on the Laurion copper[56]. A different diplomatic rule is implied in EA 35: 10. Here five hundred copper ingots are mentioned, but the king of Alashiya oddly apologizes for sending so few ingots to the Pharaoh, despite the fact they indeed are the largest amount of ingots sent to Egypt from Alashiya. This is a case of a "diplomatic excuse", possibly to be interpreted as a reply to a previous exorbitant request for copper by the Pharaoh[57]. In sum, leaving aside all the ancient diplomatic rules, it is clear that the main concern in these Amarna letters is the Alashiyan/Cypriot copper[58], whatever the method of reckoning may have been[59]. In most cases it was reckoned in terms of the number of ingots (EA 33, 35, 36, 37?, 40), but in some texts concerning copper sent from Alashiya (EA 34, 40), reference is made to the weight of copper in terms of talents. Leaving aside the diplomatic correspondence, Knapp noted that "the 2,400 *dbn* (about 200 kg) of copper listed for Year 34 [of Tuthmosis III] is most likely specified to denote copper in non-ingot form"[60], implying that Cypriot copper was sometimes reckoned in terms of units of weight. As a matter of fact, in this text the Alashiyan copper is called "(s)melted copper" and in the same texts 108.5 ingots are also mentioned[61]. Nor is there any reference to oxhide ingots that also appear in a text of the Ramesses II period where "silver and bronze in countless quantities, millions, hundreds of thousands" is repeatedly recorded from Alashiya[62], in contrast to some other hieroglyphic texts concerning "the Alashiyan tribute", where copper ingots are mentioned[63]. Although rejecting the equivalence between "talents" and "oxhide ingots", it is of course impossible to know which kind of Cypriot raw copper is referred to in the Egyptian texts, where Alashiyan copper was reckoned in terms of "talents", but the possibility that it was matte, "black copper" or some other semi-transformed product cannot be excluded, as in the case of Ugaritic metallurgy above discussed.

Egypt as a producer of oxhide ingots?

Turning to the representational evidence of oxhide ingots in Egypt, a primary distinction can be made between the tribute scenes, reviewed and thoroughly discussed by many scholars[64],

[55] For a full discussion on provocative gifts, see, Liverani 1972, 299-302. Also see Wachsman 1987, 118-119 with refs.

[56] Stos-Gale et al. 1995, 134, Isotope Group IG2.

[57] For the "diplomatic excuse", see Liverani 2008, 167. Also see Moran 1992, 108 n. 2.

[58] Papasavvas 2012, 122.

[59] Zaccagnini 1986, 415.

[60] Knapp 2008, 311-312; also see Knapp 2011, 251.

[61] Ockinga 1996, 42, Text 67.

[62] Ockinga 1996, 45, 47, Texts 77, 84; Knapp 2011, 251.

[63] Ockinga 1996, 42, Texts 67-69.

[64] For basic references, with earlier bibliography, see Bass 1967, 62-67; Wachsmann 1987; Papasavvas

and the representations of Egyptian craft activities, including the metal working scenes. It is well known that in the former scenes oxhide ingots are offered to the Pharaohs by men who are indicated in the accompanying hieroglyphic texts or are represented as Aegeans, Retenu (=Syrians) or hybrid figures. It should however be noted that "some of the ingot bearers might in fact have represented Cypriots", if Egyptian painters equated the iconography of Cypriots to that of the Syrians, as suggested by Papasavvas[65]. On the other hand, particular attention should here be paid to some foundry scenes with representations of oxhide ingots, generally regarded as a raw material used in foundry activities[66].

The 'display' in the Egyptian representations of craftsmen in action

It is however first necessary to discuss the expedient of the display in the scenes of craft activities, i.e. the common use of an open space above, between or around the figures of the workers, where the products of the work of the craftsmen are displayed (Figs.1-2). The function of such displays is, of course, to facilitate the comprehension of the meaning of the scenes by the beholder all at once, according to the principle of "association of ideas" in Egyptian art, as emphasized by Schäfer regarding a New Kingdom scene of cobblers[67]. The scenes here selected show that the expedient of the display had a long history in Egypt. For example, in the tomb of Ty of the 5th Dynasty at Saqqara a potter is manufacturing the vases of the same type as those showed above him, and a man is cutting the stomach of a fish, while some cut fishes and roes are displayed above and around him (Fig. 1: B, C)[68]). In the tomb of Iteti at Deshasha (6th Dynasty) some craftsmen are cleaving a tree trunk and splitting a log, but the meaning of the scene is made clearer by displaying many logs set out with care above the workers (Fig. 1: E)[69]. The expedient of display is particularly common in the tombs of the 18th Dynasty, when the foundry scenes discussed further below were depicted. For example, in the scene of baking loaves in the tomb of Nebamun at Thebes some disc-shaped and paddle-shaped loaves are displayed above (fig. 1: D)[70], and in the tomb of Rechmire an open animal skin is displayed above the workman who is scraping the skin on a diagonal board (Fig. 1: A)[71]. The use of the display is also clear in the bowyer's workshops represented in the tomb of Mencheperresonb (Fig. 2: A)[72]: on the left, a worker is holding a narrow hook-shaped ibex horn, while three well-finished ibex horns of similar shape for braced composite bows are displayed above him[73]; in the centre of the scene other workers are making and

2009, 108-109.

[65] Papasavvas p. 2009, 110-111.

[66] For earlier discussions on foundry scenes, in fact, see Wainwright 1943; Papasavvas 2009, 109. However, both of them suggested a different interpretation from that suggested below in this article.

[67] Schäfer 1986, 160-162.

[68] Nicholson, Shaw 2000, 126, Fig. 5. 3, 659, Fig. 25.3.

[69] Nicholson, Shaw 2000, 354, Fig. 15.8.

[70] Nicholson, Shaw 2000, 566, Fig. 22.14.

[71] Wachsmann 1987, 20, Pl. XX: B.

[72] Wachsmann 1987, Pl. IX: A.

[73] Wachsmann 1987, 78-92; contra Krzyszkowska, Morkot, in Nicholson, Shaw 2000, 328, Fig. 13.1: "scene possibly depicting an ivory workshop"

flexing wooden bows and, on the right, a craftsman is sighting along an arrow, while complete bows and two lots of arrows are displayed above them. Chariot workshops are represented in the same tomb as well as in the tombs of Puimre and Mery[74]. Here the single parts of the chariots are shown above the workers and it is also worth noting the presence, on the right, of a craftsman who is cutting a hockey stick-shaped leather strip on a diagonal work-board below three finished strips in the display (Fig. 2: B). The iconography of the latter worker is very similar to that of the man scraping the animal skin in the tomb of Rechmire (Fig. 1: A), but the finished products in the display are different, as in the scene of the men making leather straps, ropes of leather thongs, and sandals in the same tomb[75]. More rarely, in the scenes of working activities, such as those concerning the application of stucco on wooden boxes, the representations of a fire in the centre of the scene add some details[76].

'Displaying' metalworking activities

The principle of displaying finished products is also apparent in many foundry and metalworking scenes from the Old Kingdom. In the 6th Dynasty tomb of the Vizier Mereruka at Saqqara (c. 2350-2195 BC) six metalworkers are blowing on the fire on which two crucibles are placed, while finished metal vessels are shown above them; on a relief of the 4th Dynasty at Giza a craftsman is working sheet metal to produce libation vessels which have the same shape as that of the finished vase shown above him[77]. As for the 18th Dynasty, some phases in the process of melting and casting metal are depicted in the tombs of Puimre and Mencheperresonb[78]. Turning to the relevant foundry scenes, i.e. those with oxhide ingots, the detailed representation in the tomb of Rechmire, the "governor of town" and "Vizier" during the last years Thutmose III and the earliest years of Amenhotep II should be considered first. The Rechmire tomb is well known especially for the scene of second and fourth register on the south side of the western wall, where we see "the chiefs of the Keftiu land (and) the island which are within the Great Sea" and "the chiefs of Retenu and all the lands of Further Asia" bringing oxhide ingots as offerings for the Pharaoh[79]. Four additional whitish ingots of tin or lead (or electrum?) are represented in the pile of the objects made by the men of Keftiu and registered by a scribe[80]. In the same tomb some craftsmen are depicted in the act of annealing or polishing metal objects, and a display shows their finished products[81]. The scene on the south wall is more relevant for the issue addressed here (Fig. 3: A)[82]. In the western half of the scene four groups of bronze workers are melting metal using dish bellows and crucibles, probably to make the metal vessels of the same type as those displayed in the space between

[74] Wachsmann 1987, pl. X: B.
[75] Scheel 1989, 54, Fig. 59: b; Davies 1943, 50-51, pls. LII, row 1, LIII, row 1.
[76] Davies 1943, 51, pl. LV, row 1.
[77] Scheel 1989, 22, Fig. 13, 35, Fig. 34.
[78] Scheel 1989, 24, Fig. 16; Wachsmann 1987, 21, Pls. XI, XIV.
[79] Bass 1967, 63-65, Fig. 68; Wachsmann 1987, 35-37, Pls. XLII-XLIII.
[80] Bass 1967, 64, Fig. 69.
[81] Scheel 1989, 32, Fig. 31, 39, Fig. 37.
[82] Nicholson, Shaw 2000, 150, Fig. 6.1; also see Wachsmann 1987, Pl. XVIII.

them[83]. The process is represented synthetically, and not all the steps of the vase manufacture are represented. The scene in the eastern half of the painting is very interesting since this is the clearest iconographic evidence of melting an oxhide ingot in order to pour melted metal into a large mould. A man who is part of a processional group is bearing this oxhide copper ingot and is followed by two workers who are transporting baskets with small objects interpreted as "small ingots, probably of tin and lead"[84]; a man supervising the porters is closing the procession. These metalworkers are casting a large door, intended for the Great Temple of Amun at Karnak, possibly as part of one of the "special projects which required large quantities of metal at once"[85]. The results of all these working activities are represented by the two large finished leaves of the door that are displayed above the processional and mould scene. The accompanying inscription informs us that the ingot porter is "bringing Asiatic copper which His Majesty carried off from his victory in the land of Retenu"[86]. There is also a scene of casting a door in the tomb of Mencheperrensonb, but here the mould is smaller than that represented in Rechmire tomb[87].

In the tomb of Hepu (Tuthmose IV period), two groups of craftsmen are stoking up the fires (Fig. 3: B)[88]. The iconographies of these metal workers are also well known from other foundry scenes. As a matter of fact, the men blowing on the fire through reeds are represented, with a few changes, from the Old Kingdom[89]. Moreover, the basic iconography of the standing figure on the dish bellows occurs, sometimes duplicated, in nearly all the foundry scenes of the New Kingdom such as those in the tombs of Puimre, Mencheperrensonb, Rechmire[90], and Nebamun-Ipuky (Fig. 3: C). There are also some parallels for the objects with raised sides lying in the middle of the two groups of craftsmen[91], although they might have had different meanings according to their iconographic contexts[92]; in the tomb of Hepu, for example, they have been interpreted as a "sectional" image of a circular depression containing charcoal[93]. Wachsmann, who compared some Egyptian funerary paintings, discussed the occurrence of similar iconographies of human figures and objects in different tombs, tracing this phenomenon back to the principle of "transference", as a consequence of the use of pattern books that probably were the primary source for the stoking scenes[94]. Nevertheless, the originality of the foundry scene in the Hepu tomb is given by the presence of the oxhide ingots - represented

[83] For representations and archaeological evidence of pot bellows in the Eastern Mediterranean, see Davey 1979.

[84] Scheel 1989, 19-20.

[85] For a full discussion of special projects in the New Kingdom Egypt, in the light of evidence from Qantir-Pi-Ramesse, see Rehren, Pusch 2012, 219.

[86] Davies 1943, 54.

[87] Wachsmann 1987, 21, Pl. XIII: O.

[88] Bass 1967, 65, fig. 76.

[89] Schäfer 1986, 185, Fig. 183; Scheel 1989, 9-10, Fig. 2, 22, Fig. 13; Wachsmann 1987, 21.

[90] Scheel 1989, 23-25; Wachsmann 1987, Pls. XI: P, XIV: P, XVIII, respectively.

[91] See, for example, Scheel 1989, 24, Fig. 16.

[92] Schäfer 1986, 145.

[93] Schäfer 1986, 145, 146, Fig. 132.

[94] Wachsmann 1987, 11-26.

according to the principle of "partial overlapping"[95] - in the space above the metal workers. If the above considerations on the use of the displays in the Egyptian representations of different production activities are right and this scene is not an exception, the implications are clear: the oxhide ingots represented in the Hepu tomb might be the results of the work and not the raw material used by the metal workers.

This conclusion would seem rather surprising if we consider that the only oxhide ingot so far found in Egypt, in the bronze casting installations at Qantir-Pi-Ramesse, was manufactured with copper consistent with production from Cypriot ores and was, therefore, possibly imported from Alashiya/Cyprus[96]. However, in the light of the above discussion it is clear that oxhide ingots were also cast outside Cyprus during the Late Bronze Age, and the clay mould recently found in the Timna Valley indicates that ingots of the oxhide shape were also cast in an area under the political control of Egypt, although in a period dating to some centuries later than the foundry scene of the Hepu tomb[97]. If we therefore allow that the foundry scene in the Hepu tomb might be related to an Egyptian, albeit uncommon, production of oxhide ingots, we might wonder whether the copper was local, from Sinai or Eastern Desert, or was imported from Alashiya/Cyprus in the form of matte or other semi-transformed product, as the above reviewed Near Eastern texts and the Ras Ibn Hani mould might imply. Unfortunately, lead isotope analysis of a small number of copper-based artefacts from Tell el Amarna does not allow us to define the origin of all the copper used by Egyptian metalworkers, because the items of a first group show an isotopic composition consistent with Laurion in Greece, while the provenance of the copper of nearly all the other artefacts with high gold content (Group IG2) cannot be determined, although an origin 'within the "Egyptian" domain' cannot, nevertheless, be excluded[98].

There is a foundry scene seemingly similar to that of the Hepu tomb in the tomb Nebamūn and Ipuki at Thebes (period of Amenhotep III or IV)[99] (Fig. 3: C). Four metalworkers are here using bellows and another man is blowing through a reed on a fire in a semi-circular crucible. The iconographies of these figures can be easily paralleled with those of the workers depicted in other foundry scenes, while the shape and the function of the two objects depicted above the fire are difficult to identify. Despite the damage to the painting, the upper object was identified as a copper oxhide ingot because of its red filling[100]. Below, a smaller rectangular object of a different colour (white or blue) was identified as a lead ingot by Davies or as a tin ingot by Wainwright, who stated that the melting of copper and tin was here represented to obtain bronze[101]. Wainwright's interpretation, therefore, implies that the two objects in the display, assumed to be copper and tin ingots, were not the result of the working activities, but the raw

[95] Schäfer 1986, 177.

[96] For bronze working at Qantir see Pusch 1990, Table V: b; Rehren, Pusch 2012, 218, with refs. For analysis of the oxhide ingot, see Stos-Gale 2011, 222, Table 22.1.

[97] Ben-Yosef 2012.

[98] Stos-Gale et al. 1995, 129-130, Table 2, Fig. 1, 134.

[99] Bass 1967, 65-66, Fig. 77.

[100] Such is, in fact, the interpretation suggested by Bass (1967, 66) which was also shared by Coghlan (1975, 68).

[101] Davies 1925, 63; Wainwright 1943, 96-98.

material necessary in the bronze processing[102]. This would be contrary to the meaning of the objects usually represented in the displays in workshops scenes. However, it should be pointed out that this foundry scene was part of a three-register painting where other working activities were represented according to the usual iconographic convention, i.e. with the display of their works above the craftsmen[103]. Not only it is unlikely that this scene was an exception, but also this gives the idea of smelting activities rather than of the melting process to alloy copper and tin, since "a primitive bowl furnace", a type of smelting furnace used before the Ramesside period, seem to be represented here, if we accept Scheel's reconstruction of metal processing in Egypt[104]. The excavators of the stone mould at Ras Ibn Hani also seem to think that craftsmen are here smelting copper for the production of oxhide ingots[105]. Nevertheless, apart from the enigmatic object higher in the display (possibly a copper ingot), it is problematic to identify the rectangular object below. According to Bass, the use of different colours for the depiction of oxhide ingots in the Egyptian tombs is indicative of their constituent materials, and the white or blue colour for the filling of this rectangular object might suggest that it was made of tin, lead, silver or electrum[106]. One Amarna letter (EA 35: 19-22, 43) shows that silver was a metal much desired by the Alashiya king who invited the Pharaoh to send "silver in very great quantities" and "the very best silver" in exchange for copper and wood[107], but only tin ingots are archaeologically well known. As appears from the Uluburun evidence, most of the tin traded in the Mediterranean in the 14th century BC was cast in the same oxhide shape as that of copper ingots[108], and thus the identification of some blue or white oxhide ingots in Egyptian paintings as tin ingots is well grounded[109]. The repertoire of tin ingots of different shapes uncovered at Uluburun also included two complete slab ingots weighing 27-29 kilograms[110], and a few other unprovenanced ingots of rectangular slab form are known[111]. Bars of tin "on the neck of children of Alashyia" were also mentioned in Papyrus Anastasi IV, 17, 7-8, on the occasion of the arrival of Pharaoh Seti II[112].We can therefore admit that the rectangular object in this scene was a tin slab, and the possibility that it was cast by the Egyptian metalworkers cannot completely be ruled out, although there is no evidence of this activity in Egypt and or anywhere else in the Mediterranean. Most of the tin used in the Mediterranean was procured through indirect sources[113], but the Egyptians no doubt had the technical capacity to produce tin slab (and oxhide) ingots. In fact, Pigott recently noted that the process of casting tin metal into the standardized oxhide shape required "substantial foundry works… with ample fuel, workers,

[102] Papasavvas 2009, 109.
[103] Davies 1925, Pl. XI; Bounni et al. 1998, Fig. 116.
[104] Scheel 1989, 15.
[105] Bounni et al. 1998, 45, Fig. 116.
[106] Bass 1967, 70-71; also see Papasavvas 2009, 109.
[107] Kassianidou 2009b, esp. 48-49, 53-54.
[108] Pulak 1997, 239, Fig. 7; Pigott 2011, 275, Fig. 27.1.
[109] Bass 1967, 63 nos. 2-4, 65 no.9; also see Pulak 2000, 150-152.
[110] Pulak 2000, 151, Fig. 18; Pulak 2001, 22.
[111] Pulak 2000, 150 with refs.; Kassianidou 2003, 112-113, Figs. 3-4.
[112] Vincentelli 1976, 40-41; Ockinga 1996, 49, text 87.
[113] Pulak 2000, 153-155; Pulak 2001, 22-23; Pulak 2008, 293, 310 n. 10 with refs.; Pigott 2011; 2012, 225. Also see Soles 2008, 153, 156 with refs.

crucible and moulds…" of the same kind as the Egyptian casting installations excavated at Qantir[114]. Pigott also goes further, stating that "given the enormity of the effort involved in the task of ingot casting, one might suspect the industrial quarters of major urban centres along the Mediterranean coast as the most likely location for such an industrial act"[115].

Conclusions

Cyprus undoubtedly was the main producer of oxhide ingots from the beginning of the Late Bronze Age, and recent research on the island shows that a multi-stage process took place in different Cypriot sites to obtain metal from copper ores. It is well known that copper from Alashiya/Cyprus is frequently mentioned in Near Eastern written sources, but it should also be noted that in Ugaritic and Egyptian texts, Alashiyan copper is reckoned in terms of both "talents of copper" and "oxhide ingots". If such differences are not only indicative of a different phraseology, they may refer to two different types of raw Cypriot copper. Instead of referring to copper ore, the Ugaritic and Egyptian terms for "talents of copper" may therefore refer to matte, "black copper" or some other semi-transformed product, which can be related to the first steps of smelting in the multi stage process to cast ingots, as seems evident from recent discoveries in Cyprus. This suggestion may be substantiated by the discoveries in the Ugaritic kingdom where both matte and a mould for casting oxhide ingots with Cypriot copper were found, although belonging to different periods. The evidence from Egypt appears more complex and somewhat contradictory. The Amarna letters suggest that many oxhide ingots and talents of copper were sent from Alashiya/Cyprus to Egypt, but it should also be noted that, on one occasion, the Pharaoh is, in turn, sending copper to the king of Alashiya. The results of the lead isotope analysis of a few bronze artefacts from Tell el Amarna, although not conclusive, are even more surprising since their constituent copper is consistent with an Aegean origin, from Laurion, and with an undefined source, while none of the analyzed artefacts were made of Cypriot copper. On the other hand, the copper of the only oxhide ingot fragment found in Egypt so far, in the bronze casting installations at Qantir- Pi-Ramesse, is consistent with production from Cypriot ores, while a casting clay mould from Timna Site 30 indicates that copper ingots of oxhide type were cast in the Egyptian realm at least during the 11th century BC. Taking into account the iconographic conventions in the Egyptian representations of working activities, it is however possible to suggest that the foundry scene in the Hepu tomb at Thebes depicted the casting of copper oxhide ingots, while the foundry scene in the Nebamūn and Ipuki tomb, although more difficult to interpret, may represent the casting of a tin slab ingot as well of an object of undetermined shape (a copper ingot?). The production of copper oxhide ingots in Egypt in the 18th Dynasty period may therefore be regarded as additional evidence for the observation that Cyprus did not have an absolute monopoly in casting oxhide ingots during the Late Bronze Age, as also shown by the lead isotope analysis of some ingots found in LM I contexts in Crete, by the stone mould from Ras Ibn Hani and by the clay mould from Timna. However, given the current difficulties in achieving a full understanding of copper metallurgy in Egypt, only extensive archaeological and archaeometric research will be able to determine

[114] Pigott 2012, 224-225.
[115] Pigott 2012, 225.

the origin of all the copper used in Egypt in the second half of the second millennium BC, and any hypotheses concerning the provenance of the copper of the oxhide ingots locally cast could only be advanced at that time. However, it must clearly be stated that, as the Ugaritic evidence suggests, any Egyptian production of oxhide ingots was not comparable to the Cypriot one, and probably was not intended for trade.

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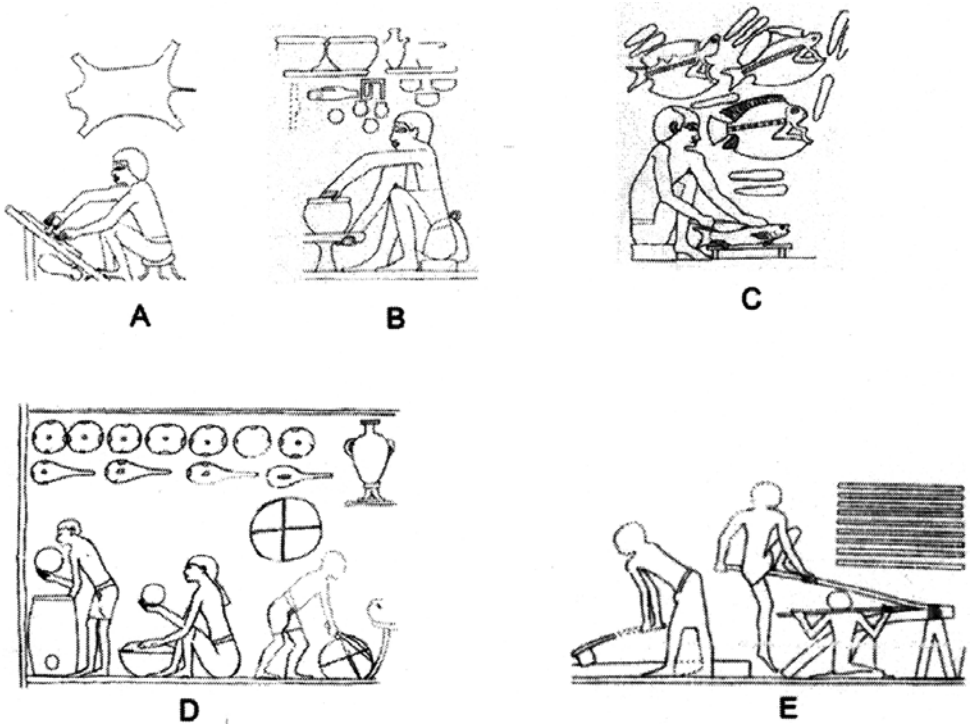

Fig. 1 - Working activities in some tombs of the Old (B, C, E) and the New (A, D) Kingdoms. Not to scale.

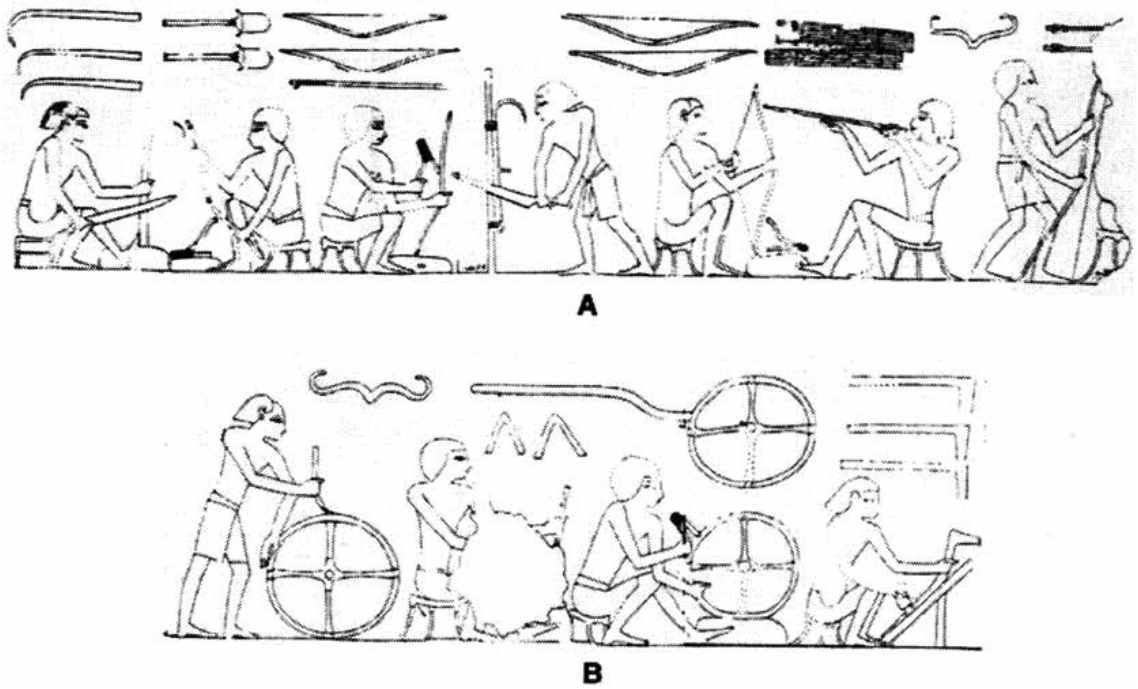

Fig. 2 - Working activities represented in the Tombs of Mencheperresonb (A) and in the Tomb of Puimre and Mery (B). Not to scale.

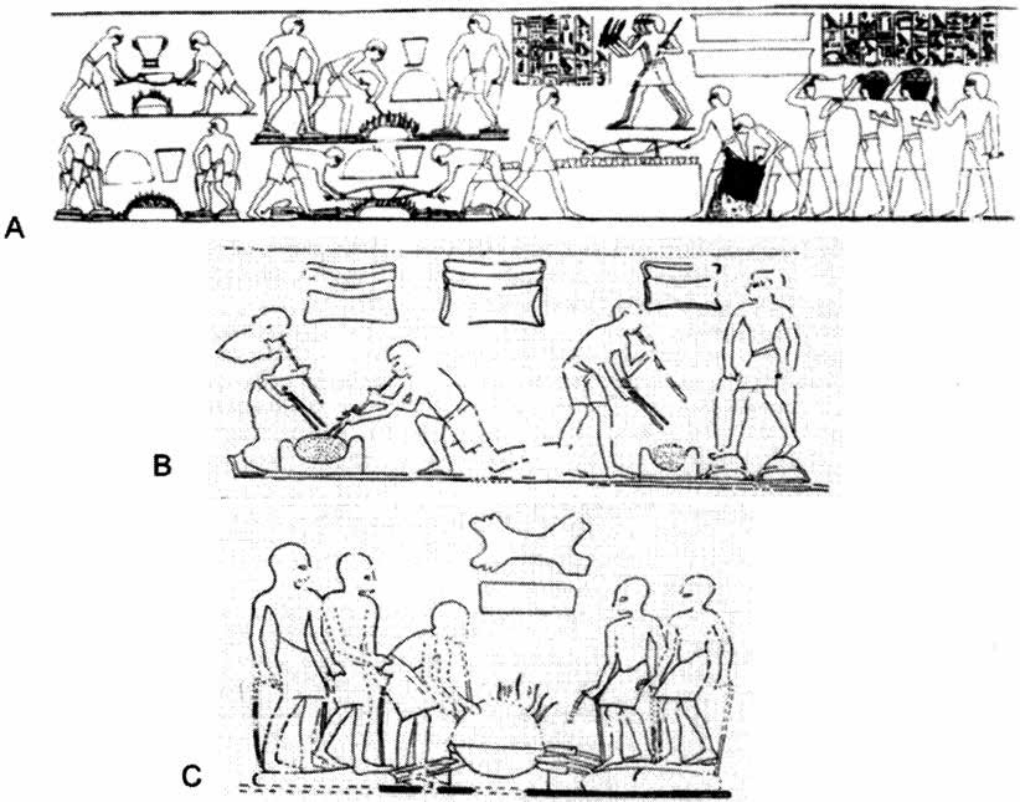

Fig. 3 - Foundry scenes from the tombs of Rechmire (A), Hepu (B), and Nebamūn and Ipuki (C). Not to scale.