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ABSTRACT

Gold Embroidery

A Sophisticated Technique for Early Mycenaean Swords and Daggers

Eleni Konstantinidi-Syvridi – Nikolas Papadimitriou – Akis Goumas – Maria Kontaki

One of the advanced decorative techniques of the Late Bronze Age Aegean is so-called gold embroidery, restricted only to luxurious weapons of the Early Mycenaean period. The technique consists in the dense placement of minute twisted gold bars (or ›threads‹) next to each other in order to give the impression of a mosaic. In the final stage, the craftsman decorated the whole with engraved designs, usually spirals. The present paper presents a detailed discussion on the history of research, the context, chronology and typology of the known examples, and a technical analysis based on archaeometric and experimental data. It is suggested that the use of the technique, which extends across the LH I–IIIA1 period, was reserved for burials of the highest status and was associated with other exclusive metal-working techniques, like inlaid decoration. The technique is unknown in Minoan Crete and the Eastern Mediterranean and, so far, the only possible parallels are to be found in the Wessex and Armorican cultures.

KEYWORDS

gold embroidery, Early Mycenaean period, Mycenaean weapons, metal-working techniques

Gold Embroidery

A Sophisticated Technique for Early Mycenaean Swords and Daggers

1 For the students of Mycenaean archaeology, it is common grounds that the elite graves of the Shaft Grave period were furnished with masterpieces of advanced aesthetics and technical knowledge: repoussé, filigree, cloisonné and granulation applied on jewellery, weapons and utensils, indicate the high skills of the artisans who made them to honour the distinguished members of their community.

2 Among these techniques, there is one which is exceptionally delicate and demanding, yet little known so far: gold embroidery. The technique was used for the decoration of luxurious weapons and consisted in the application of minute (< 1 cm) L-shaped gold bars on the organic (ivory or wooden) hilt-plates and pommels of bronze daggers and swords.

3 Examples of the technique are known from a handful of sites in the Peloponnese (Table 1)¹. It is possible, however, that more examples lay unnoticed in museum storerooms: the gold particles of this technique are extremely small and not easily discernible without the use of a microscope. Moreover, sometimes they are covered by layers of copper corrosion.

4 The present paper is meant to provide a detailed archaeological and technological account of 'gold embroidery' and to offer a guide for the safe identification of the technique in future. It has five sections (history of research, contexts, technical analysis, discussion, catalogue) and an appendix on the conservation of gold embroidery. The greatest part of our work was conducted at the National Archaeological Museum of Athens, where the majority of finds are kept. We have also visited the Archaeological Museum of Nauplion to study the fragment DEND 2b, the National Museum of Denmark at Copenhagen to study the sword DEND 2a, and the Archaeological Museum of Chora

1 All tables are presented at the end of the paper, pp. 71–74. For the sake of convenience, throughout the paper the examined objects are referred to by their catalogue numbers, as listed in Table 1. Abbreviations: For the provenance of objects: DEND = Dendra; KAK = Kakovatos; MYC = Mycenae; PRO = Prosymna; PYL = Pylos; VAPH = Vaphio; UNP = unprovenanced. – For museums: AMN = Archaeological Museum of Nauplion, Ephorate of Antiquities of the Argolid; AMP = Archaeological Museum of Chora at Pylos, Ephorate of Antiquities of Messenia; NAM = National Archaeological Museum, Athens; NMD = National Museum of Denmark, Copenhagen. Illustration credits are to be found at the end of the paper. In the viewer format of the article, credits are given following each caption.

at Pylos to search for remains of ›gold embroidery‹ in weapons from Early Mycenaean tombs at Pylos, Peristeria and Routsí².

History of Research

5 The technique of gold embroidery was first noticed in 1897 by Christos Tsountas on the hilts of weapons from Mycenae and Vaphio³. Tsountas identified two versions of the technique: in the first version, minute L-shaped gold bars were used to create motifs on the surface of the hilt; in the second, the gold bars were placed densely next to each other, until they covered the entire surface of the hilt or pommel, and then were decorated by engraving. Tsountas suggested technical solutions for the manufacture of the gold bars and for their fitting on the surface of the hilt⁴. Since there were no known parallels from Crete or Egypt, he proposed that the technique was a Mycenaean invention.

6 Following Tsountas, other scholars published weapons with gold embroidery and discussed briefly the technique: in 1909, Kurt Müller from Kakovatos tholos tomb B (KAK 1)⁵; in the 1930s, Georg Karo from Mycenae Shaft Graves IV and V (MYC 1–10), and Axel Persson from Dendra tholos tomb (DEND 1)⁶. Both Karo and Persson agreed with Tsountas that the technique was Mycenaean in origin⁷. Persson further noted that it produced the same artistic effect as gold-sheathing but was much more demanding and time-consuming; for him, the technique expressed the mentality that »expenditure in labour increases the value of the product«⁸.

7 In 1960, Paul Åström and Nikolaos Verdélis, while excavating chamber tomb 12 at Dendra (the ›Cuirass tomb‹), discovered part of a pommel decorated with gold embroidery (DEND 2b)⁹. Åström suggested that the fragment belonged to a type C sword decorated with gold embroidery, which was later acquired by the National Muse-

2 We are grateful to the following institutions and colleagues for granting us permission to study material from their collections: the National Archaeological Museum of Athens and especially its Director, Dr Anna-Vassiliki Karapanagiotou, its former Director, Dr Maria Lagogianni-Georgakarakou, the Head of the Department of Prehistoric Antiquities, Dr Konstantinos Nikolentzos, and the Head of the Department of Conservation, Physical and Chemical Research & Archaeometry, Dr Georgianna Moraitou; the Ephorate of Antiquities of the Argolid and especially its Director, Dr Alkestis Papadimitriou; the Ephorate of Antiquities of Messenia and especially its Director, Dr Evaggelia Militsi-Kehagia; the National Museum of Denmark at Copenhagen, and especially its Director, Dr Rane Willersev, the Head of Research in the Department of Ancient Cultures of Denmark and the Mediterranean, Dr Lasse Sorensen, and the Curator of the same department, Dr Stine Schierup. We are also grateful to Dr Sharon Stocker and Prof Jack Davies for sharing with us information about weapons with gold embroidery decoration from the ›Griffin Warrior‹ tomb at Pylos and for giving us the opportunity to have a closer look at the sword. We would also like to thank Dr Liana Philipaki, Laboratory of Palaeoenvironment and Ancient Metals Studies, Institute of Nanoscience and Nanotechnology National Center for Scientific Research »Demokritos«, for the XRF analysis of weapons with gold embroidery, Mr Giorgos Kouros, Chemist at the Department of Conservation of the National Archaeological Museum of Athens, for the radiographies of the specimens listed, Mrs Kalliopi Theodoropoulou for the marvelous drawings, Dr Elina Stamatatou for making the microscopic views of the Dendra sword DEND 2a in the National Museum of Denmark at Copenhagen, and Dr Colin Macdonald for his valuable advice on questions concerning the handles of swords.

3 Tsountas 1897, 121–124 pl. 7, 3–6. For all the sites mentioned see <https://gazetteer.dainst.org/app/#!/home>.

4 Tsountas 1897, 123. Tsountas' technical suggestions have been tested experimentally by the authors and the results are discussed in Papadimitriou et al. forthcoming.

5 Müller 1909, 298 f. Xenaki-Sakellariou has proposed that some flat pieces of gold with bent ends from Tholos A may have also belonged to that technique, Xenaki-Sakellariou 1982–1984, 34.

6 Karo 1930–1933, cat. nos. 394, 396, 397, 408, 464, 483, 485, 435, 779; Persson 1931, 35 f. 62 f.

7 Karo 1930–1933, 314; Persson 1931, 62.

8 Persson 1931, 62 f.

9 Åström 1977, 18 cat. 28; Verdélis 1977, 55 cat. 12 b (erroneously identified as part of an ivory pyxis).

um of Copenhagen (DEND 2a); according to him, the sword had been removed from the tomb during a looting episode that took place shortly before the excavation¹⁰.

8 Nancy Sandars, in her 1960s' analyses of Aegean swords, made passing references to the technique¹¹. The first explicit study was made in the 1980s by Agnes Xenaki-Sakellariou¹². She made a useful catalogue of Mainland examples and classified them to one of Tsountas' two technical styles, dating the first one to ca. 1500 B.C. and the second one to ca. 1400 B.C.¹³. She also discussed Arthur Evans' mention of pieces of »gold plate with minute gold nails« from the Corridor of the Sword Tablets in the Mycenaean palace of Knossos, which nevertheless remains unverified (see below)¹⁴. She concluded that gold embroidery was invented in the Argolid, most likely at Mycenae¹⁵.

9 In 1993, Robert Laffineur mentioned the technique in his article on the art of the Shaft Grave period¹⁶ and in 1998, Thanassis Papadopoulos discussed gold embroidery as part of his study on Early Mycenaean daggers¹⁷. Papadopoulos was the first Aegean scholar to discuss possible links with a similar technique attested in the Wessex culture of Southern England and the Armorican culture of NW France¹⁸ – a topic which had been addressed by several specialists on the European Bronze Age¹⁹.

10 The most recent discovery was made in 2015 by Jack Davis and Sharon Stocker at the »Griffin Warrior« tomb of Pylos. Among hundreds of finds, two objects were decorated with gold embroidery: a well-preserved type C sword and a dagger²⁰. Finally, in 2020 Bernhard Steinmann associated a number of stray L-shaped gold bars from Prosymna chamber tomb 2 with other finds from the same tomb and attributed them to the hilt of a type C sword with gold embroidery²¹.

11 The authors started working on this technique in 2014. So far, they have published two brief papers, where they discuss technical matters and possible relations with Wessex and Armorican examples²². A longer paper describes the experimental reconstructions of the technique made by Akis Goumas, based on microscopic observations and archaeometric analysis of objects decorated with gold embroidery²³. Finally, they prepare a paper with archaeometric data deriving from XRF and SEM-EDX analyses of objects decorated with gold embroidery²⁴.

10 Åström 1967, 65; Åström 1972, 47. 49 f.; Dietz et al. 2015, 21 (cat. 10) fig. 1. Another sword in the Copenhagen Museum seems to come from Dendra chamber tomb 12 as well, Dietz et al. 2015, 22 (cat. 11).

11 Sandars 1961, 26; Sandars 1963, 120.

12 Xenaki-Sakellariou 1982–1984; see also Xenaki-Sakellariou 1984, 135–137.

13 Xenaki-Sakellariou 1982–1984, 31–34. The examples of the first version correspond to our MYC 1 and MYC 4. Six out of the seven examples of the second version correspond to our MYC 11, DEND 1, DEND 2, MYC 12, VAPH 1 or 2 (unclear) and KAK 1b (note that the KAK 1b gold bars come from Kakovatos tholos B, not tholos C as erroneously mentioned in Xenaki-Sakellariou 1982–1984, 34 cat. 6). The seventh example is a gold bar from Mycenae chamber tomb 93, which has been mentioned by Tsountas but never located since then. The »possible example« mentioned in Xenaki-Sakellariou 1982–1984, 34 cat. 1 corresponds to our MYC 3.

14 Evans 1935, 854.

15 Xenaki-Sakellariou 1982–1984, 36–38.

16 Laffineur 1993, 273 n. 104.

17 Papadopoulos 1998, 42 f.

18 Papadopoulos 1998, 43. 49.

19 E.g. Reinecke 1902, 110 f.; Piggett 1938, 95; Gerloff 1975, 88; Gerloff 2007, 137–139; Gerloff 2010, 629 f.; Gallay 1981, 118; Harding 1990, 148; for a recent summary, see Papadimitriou et al. 2021 (https://www.academia.edu/45636149/A_demanded_gold_working_technique_attested_in_Armorican_Wessex_and_Early_Mycenaean_funerary_contexts_2021_).

20 Davis – Stocker 2016, 635 for the sword; the discovery of a dagger with gold embroidery has not been officially reported yet but was kindly communicated to us by the excavators, to whom we are mostly grateful.

21 Steinmann 2020, 388 f.; see also Steinmann 2012, 150; the gold bars had been first identified as belonging to gold embroidery decoration in Xenaki-Sakellariou 1984, 136 n. 47.

22 Konstantinidi-Syvriddi et al. 2014, 341–343 (https://www.academia.edu/11889250/Goldworking_techniques_in_Mycenaean_Greece_17th_16th_12th_century_BC_some_new_observations); Papadimitriou et al. 2021.

23 Papadimitriou et al. forthcoming.

24 Filippaki et al. forthcoming.

Contexts

- 12 Gold embroidery has been identified on 6 sites and in 10 different contexts²⁵:
- Mycenae: Shaft Graves IV (MYC 1–8) and V (MYC 9–10), chamber tombs 78 and 81 (MYC 11–12)
 - Dendra: tholos tomb (DEND 1) and chamber tomb 12 (DEND 2)
 - Prosymna: chamber tomb 2 (PRO 1)
 - Vapheio: tholos tomb (VAPH 1–2)
 - Kakovatos: tholos tomb B (KAK 1)
 - Pylos: ›Griffin Warrior‹ tomb (PYL 1–2).
- 13 In addition, at the National Archaeological Museum there are two groups of detached L-shaped gold bars and small fragments with gold embroidery, which have no recorded provenance (UNP 1–2).
- 14 There are also two unverified contexts: Mycenae, chamber tomb 93, and the Corridor of the Sword Tablets at the Palace of Knossos. They are discussed below but not included in the contextual analysis.

Mycenae

Grave Circle A, Shaft Grave IV

- 15 Shaft Grave IV was the largest and richest tomb of Grave Circle A²⁶. It was built at a depth of ca. 8 m from the surface, with internal dimensions 6.55 m × 4.10 m and a height of ca. 2 m.²⁷ The tomb held the largest number of precious vessels, an abundance of swords, two inlaid daggers, gold jewellery and objects of faience and semi-precious stones, as well as three gold masks and a breastplate²⁸.
- 16 The five burials of tomb IV, i.e. three male and – possibly – two female burials²⁹, have been named by Stamatakis as Ξ , O, II, P and Σ ³⁰. Two of the weapons decorated with gold embroidery, namely a long type B sword (MYC 1, Fig. 1) and the famous inlaid dagger with the hunting scene (MYC 3, Fig. 3), belonged to the most grandiose burial (O), the youngest male, less than 20 years old, to whom are attributed over 50 swords, other weapons and precious vessels like the famous Siege Rhyton and the silver ›Battle crater‹ found with 14 lavish vessels inside it³¹.
- 17 More objects decorated with gold embroidery have been found in tomb IV: two tangless daggers with spiraliform motifs (MYC 4–5, Fig. 4. 5), the handle of a type B sword (MYC 2, Fig. 2), several detached rivets from at least 3 weapons (MYC 6–7, Fig. 6. 7) and a sword's pommel preserving remains of the tang and hilt underneath (MYC 8, Fig. 8). Unfortunately, none of them was attributable to a specific burial.

25 The catalogue items have been inventoried by the first letters of the provenance site (MYC for Mycenae, KAK for Kakovatos, VAPH for Vaphrio, PYL for Pylos, PRO for Prosymna, DEND for Dendra) and UNP for unknown provenance.

26 For the dating of Grave Circle I, see among others Dickinson 1977, 46–51; Graziadio 1991, 430–437; Dietz 1991, 247–250.

27 Karo 1930–1933, 17 n. 2.

28 Demakopoulou 1990, 98.

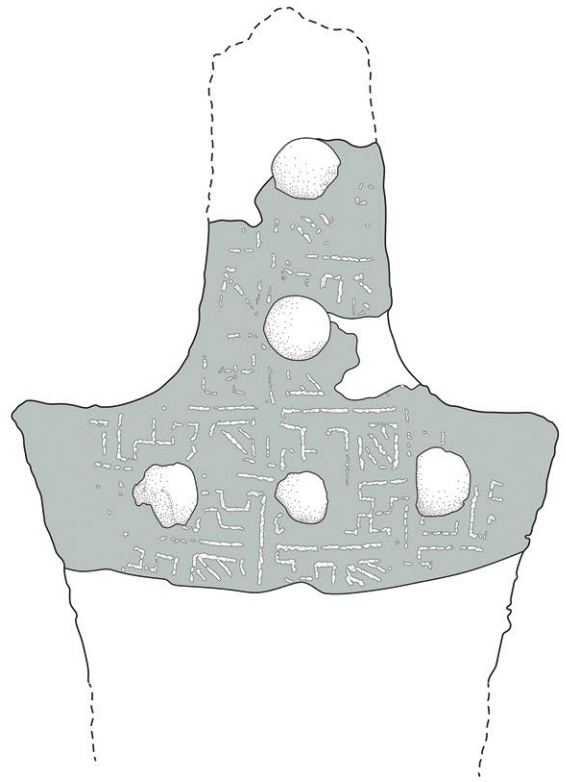
29 Papazoglou-Manioudaki et al. 2010.

30 Panagiotis Stamatakis, supervisor of Schliemann's excavations at Mycenae, has left an invaluable manuscript which forms part of the NAM's archives, Konstantinidi-Syvridi – Paschalidis 2019.

31 Konstantinidi-Syvridi – Paschalidis 2019, 120 f.



a

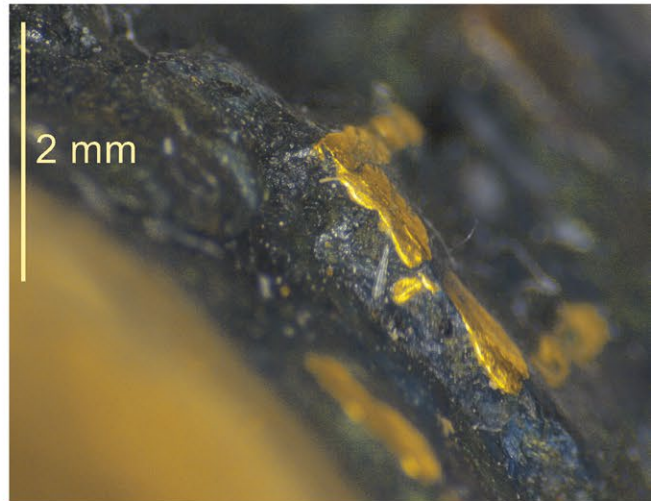


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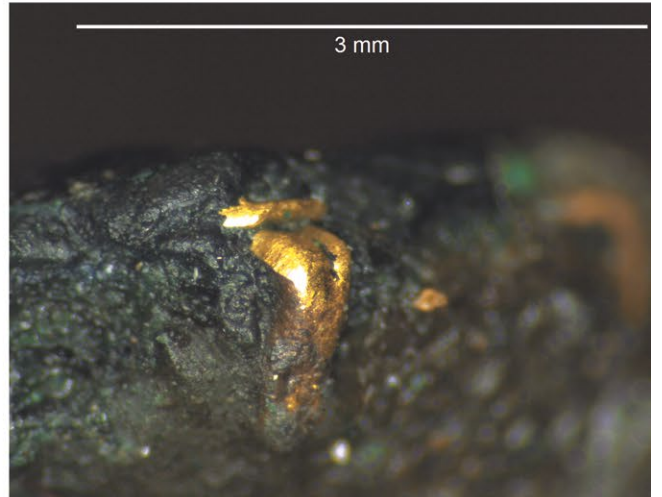
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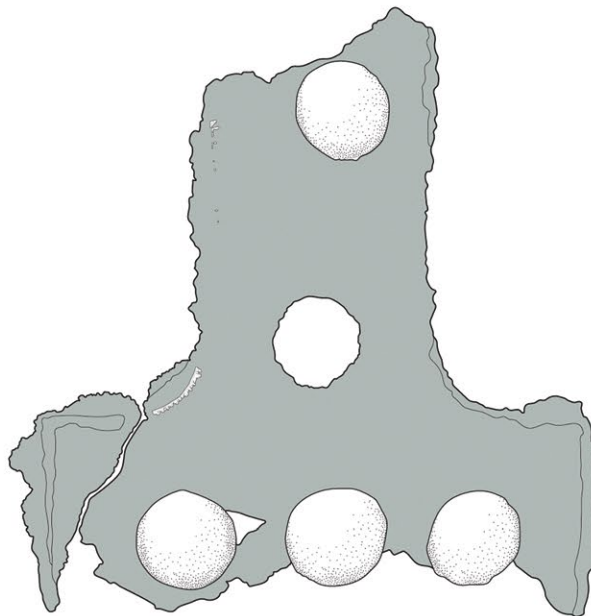


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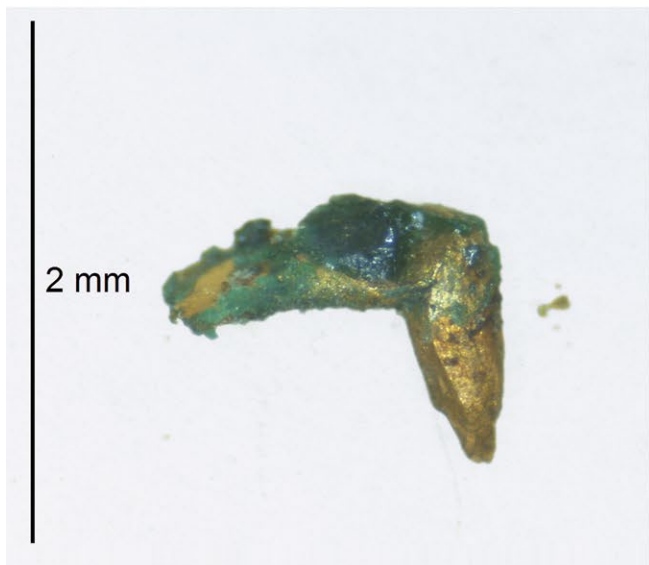
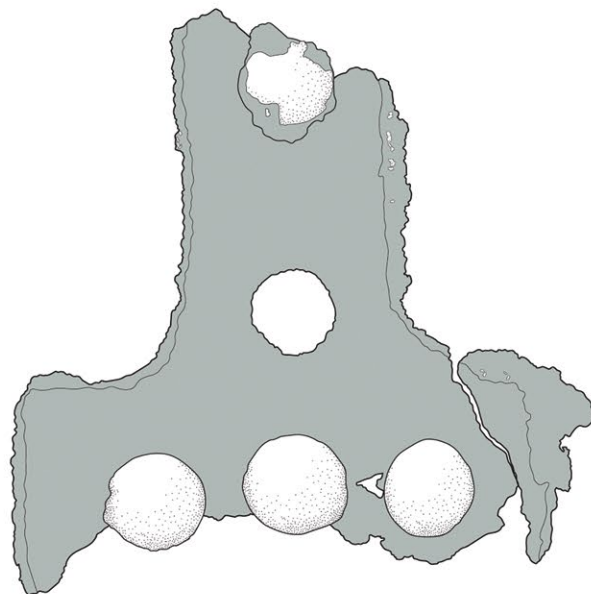
Fig. 1: MYC 1 (NAM 435), type B sword from Mycenae Shaft Grave IV: (a) photo; (b) drawing; (c-d) microscopic images of gold embroidery; (e-f) microscopic images of L-shaped gold bars in profile



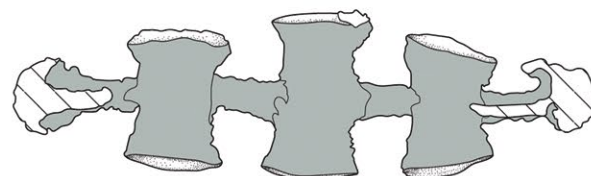
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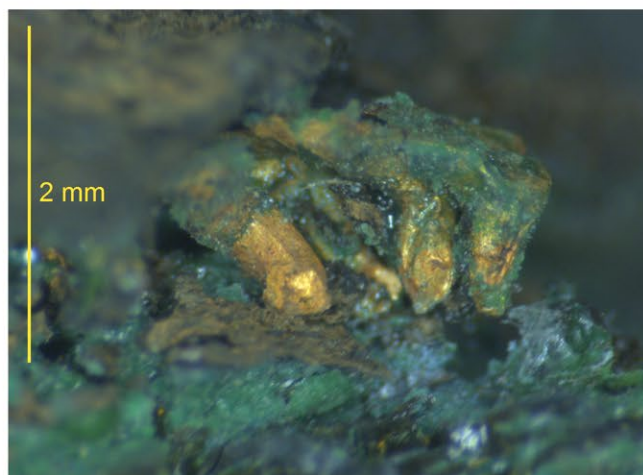


e



0 1 2 cm.

b



d

Fig. 2: MYC 2 (NAM 408), handle of type B sword from Mycenae Shaft Grave IV: (a) photo; (b) drawing; (c) X-ray; (d) microscopic image of gold embroidery at the edge of the tang; (e) microscopic image of detached gold bar

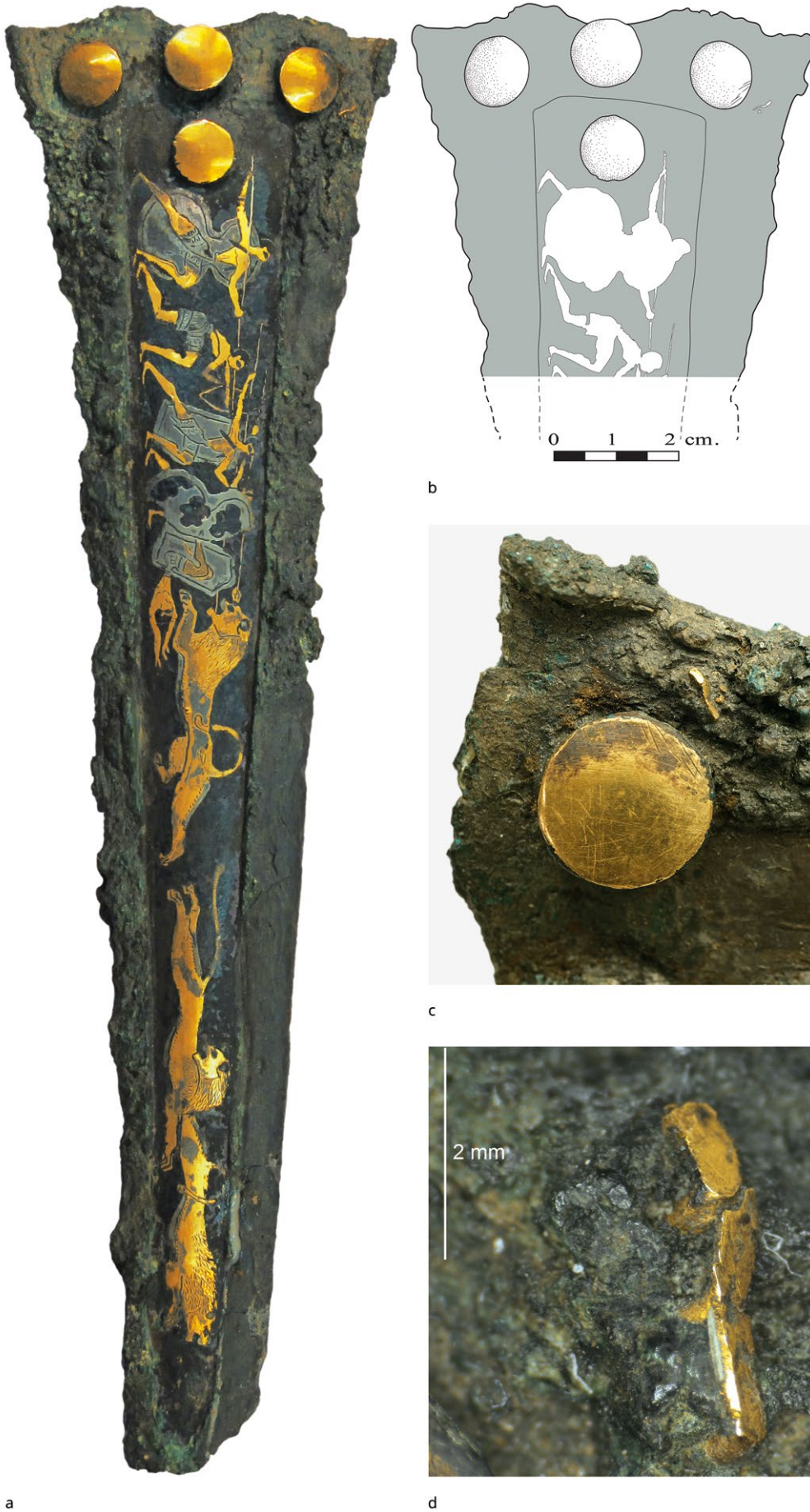
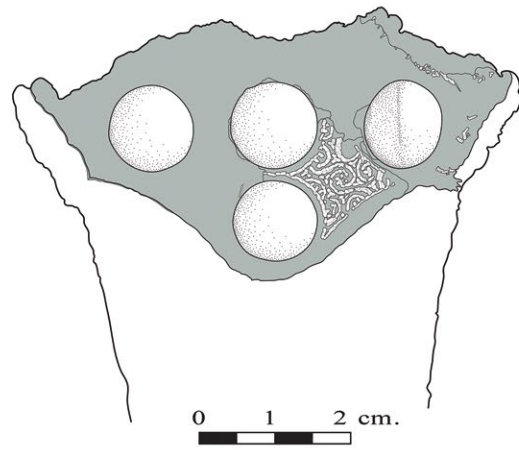


Fig. 3: MYC 3 (NAM 394), tangless dagger with inlaid decoration from Mycenae Shaft Grave IV: (a) photo; (b) drawing; (c) detail showing the remains of gold-embroidery on the butt; (d) microscopic image of the remaining gold bars



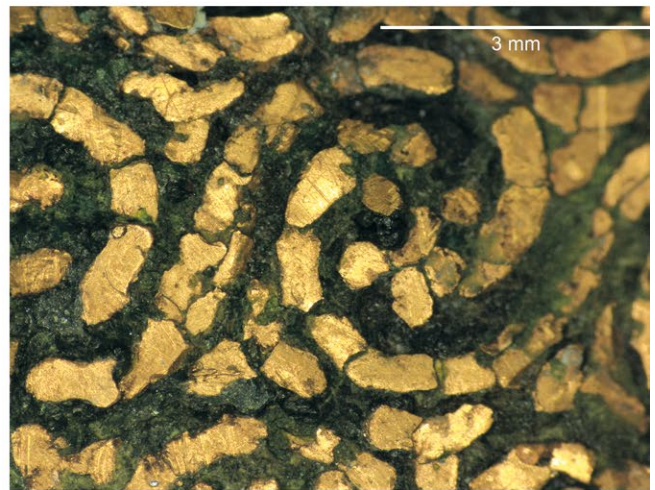
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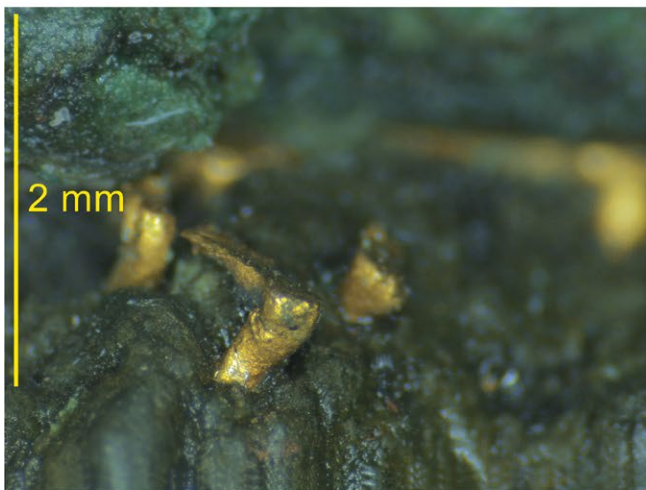
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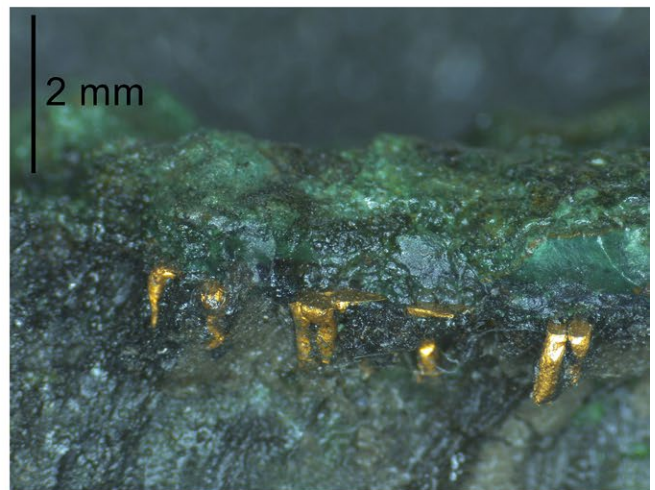
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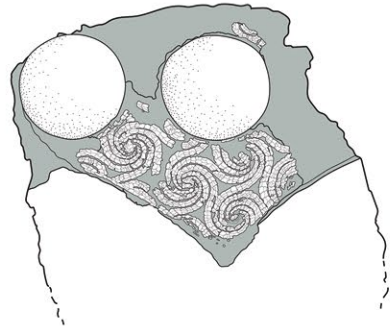


f

Fig. 4: MYC 4 (NAM 396), tangless dagger from Mycenae Shaft Grave IV: (a) photo; (b) drawing; (c-d) microscopic images of gold embroidery decoration from above; (e-f) microscopic images of L-shaped gold bars from the side



a

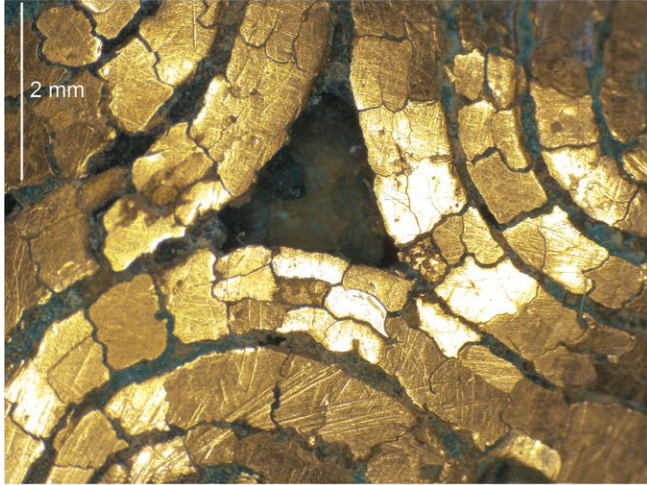


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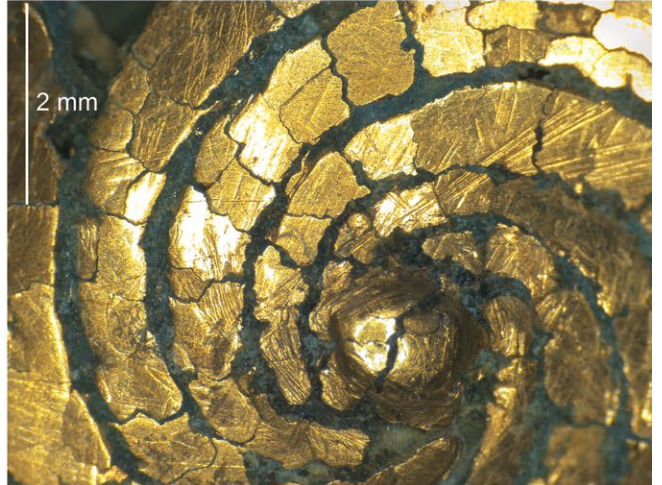
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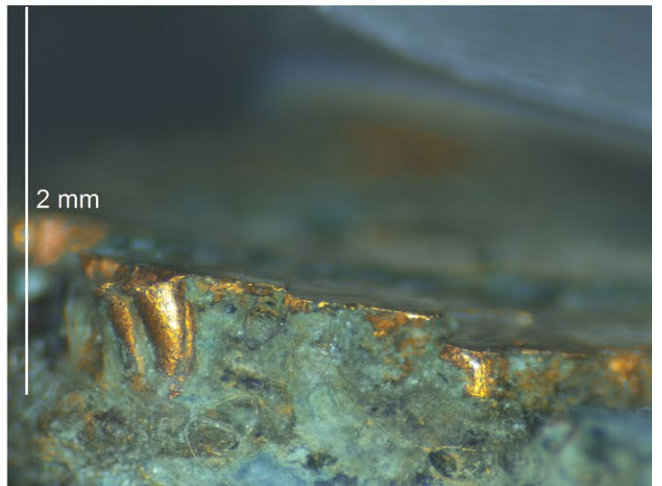
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Fig. 5: MYC 5 (NAM 397), tangless dagger from Mycenae Shaft Grave IV: (a) photo; (b) drawing; (c–e) microscopic images of gold embroidery decoration from above; (f) microscopic image of L-shaped gold bars from the side



a



b



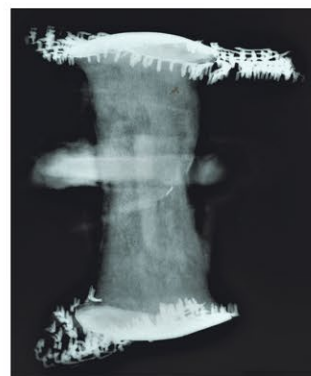
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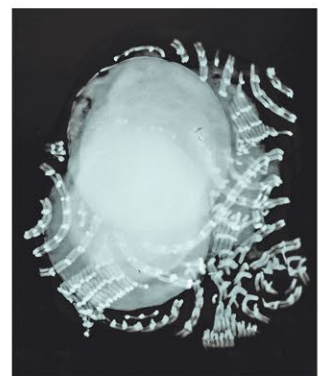
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Fig. 6: MYC 6 (NAM 464), detached double-headed bronze rivets from Mycenaean Shaft Grave IV: (a) photo of all rivets (7 decorated with gold embroidery); (b–h) photos and X-rays of three of the decorated rivets, which have the gold embroidery concealed under copper corrosion

f

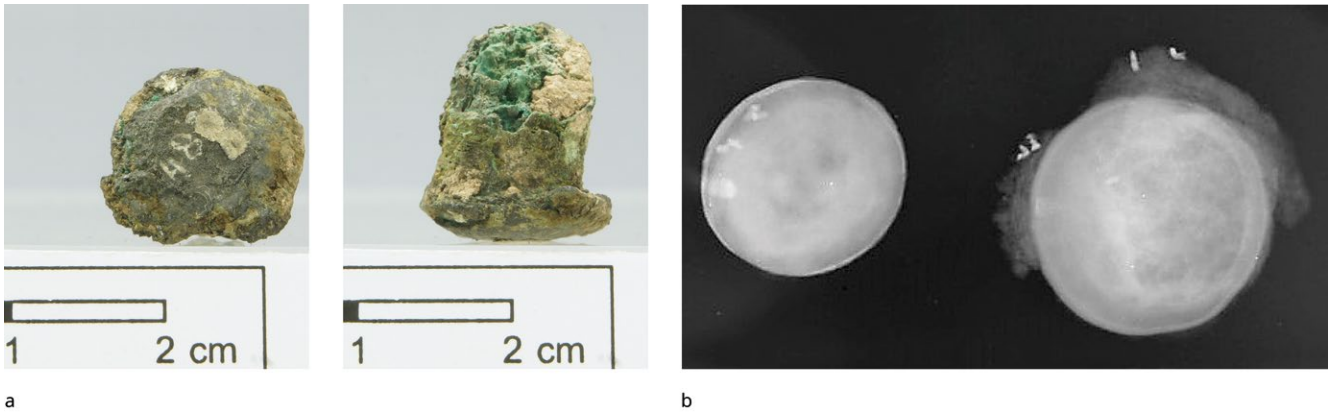
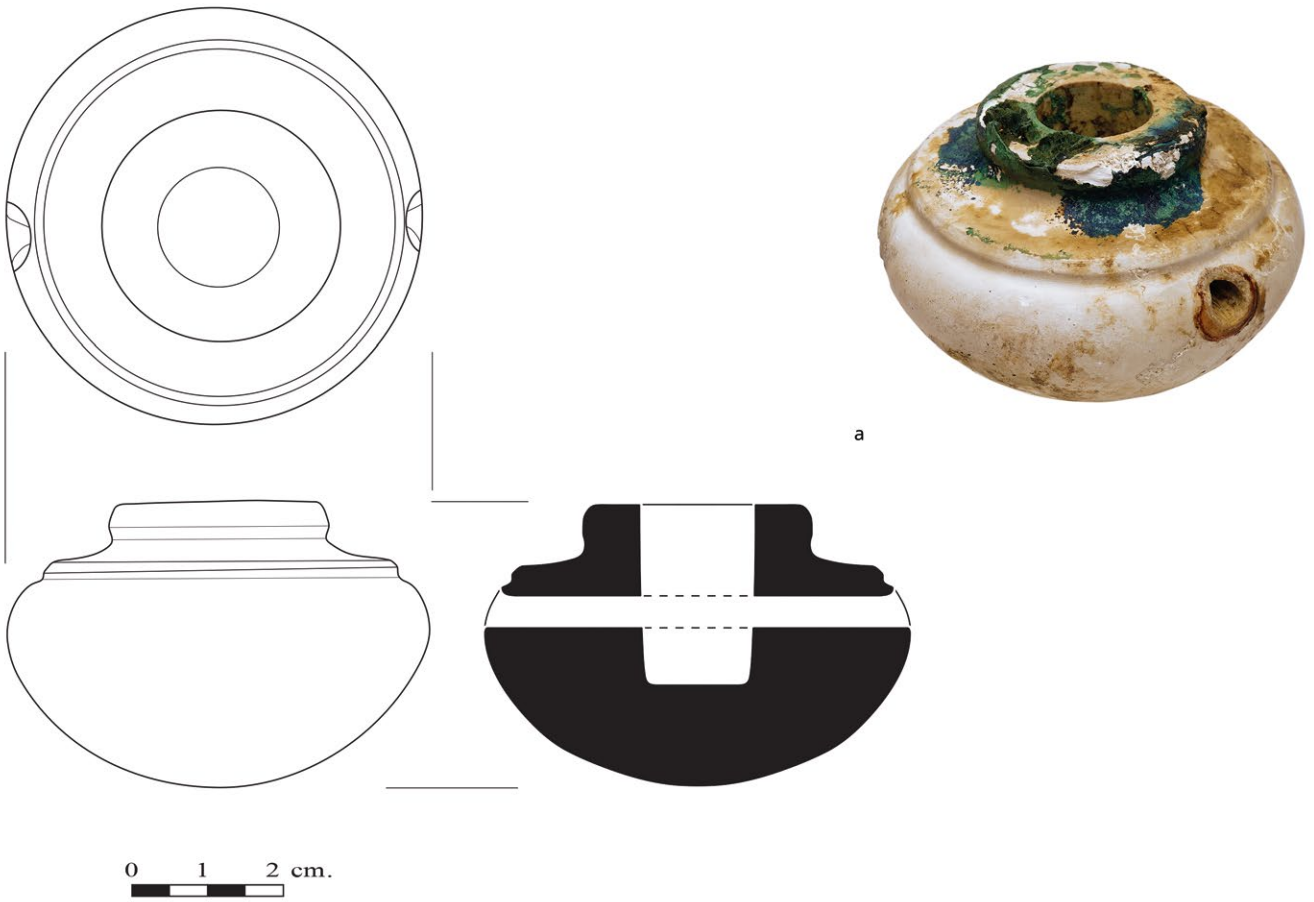


Fig. 7: MYC 7 (NAM 483), two gold-capped bronze rivets from Mycenae Shaft Grave IV: (a) photo; (b) X-ray showing remains of gold embroidery decoration on the larger rivet (right)



b



c

d

Fig. 8: MYC 8 (NAM 485), alabaster pommel from Mycenae Shaft Grave IV: (a) photo; (b) drawing; (c) close-up photo showing L-shaped gold bars on the oxidized remains of the tang; (d) microscopic image of gold bars from the side

Grave Circle A, Shaft Grave V

18 Shaft Grave V was the second richest sepulchre of Grave Circle A³²; its dimensions were 5.77 m × 2.85 m.³³ It held three male burials, named by Stamatakis as T, Y and Φ, who were furnished with two gold masks, two gold breastplates, a number of weapons, among which inlaid daggers, precious vessels, an ostrich egg rhyton, gold jewellery and plenty of amber beads³⁴.

19 The embroidered specimens found in the tomb include parts of a sword's handle decorated with spiral motifs on the shoulder (MYC 9a, Fig. 9), a tiny fragment possibly from the same sword (as it bears the same decoration) which preserves the impression of the wrapping cloth (MYC 9b, Fig. 10), and gold-capped rivets with decoration on the edges (MYC 10, Fig. 11). Unfortunately, none of them can be attributed to a specific burial.

Chamber Tomb 81 (Panayia Hill Cemetery)

20 Tomb 81 was one of the most elaborate and richest chamber tombs of Mycenae³⁵. Located at the Panayia hill cemetery (a burial ground reserved for rich families³⁶), it had a broad rectangular chamber 5.15 m × 6.85 m with plastered walls and benches. The entrance was monumental (doorway: H 2.50 m, W 1.40 m) and had decorated façade³⁷. No human bones are reported. The tomb had been plundered in antiquity, as objects were found in the dromos, the stomion and the chamber. A cruciform dagger³⁸ with gold embroidery on the wooden hilt (MYC 11a) was found in the area of the stomion (Fig. 12). A smaller piece, certainly from the same dagger (MYC 11b), has no recorded provenance (Fig. 13).

21 Other finds from the stomion include a bronze mirror disc, two perforated discs of unclear function, bronze arrowheads and gold ornaments³⁹. Finds from other parts of the tomb include a type C sword, a type A sword, parts of other bronze weapons, a replica of a sword handle made of stone, handles of two silver vessels and other silver pieces, an ivory comb and other ivory pieces, an alabaster vase, a lentoid sealstone made of lapis lazuli, glass and faience beads, and various gold ornaments and rivet caps⁴⁰. No pottery is reported from the tomb. Xenaki-Sakellariou believes that the tomb was dug in LH IIB but in all probability continued in LH III⁴¹. As, however, there are no artefacts that could be dated beyond LH IIIA⁴², we should take LH IIIA as a *terminus ante quem* for the dagger which was decorated with gold embroidery.

Chamber Tomb 78 (Kalkani Cemetery)

22 Tomb 78 was a relatively rich chamber tomb. Its shape and dimensions have not been recorded. We know that the façade was painted with greenish clay⁴³. Human skulls were found in the NW corner and along the western wall. Human skeletal material mixed with animal bones were found close to the eastern wall at a height of 40 cm

32 Papazoglou-Manioudaki et al. 2010, 163–166.

33 Karo 1930–1933, 17 n. 2.

34 Demakopoulou 1990, 98.

35 Xenaki-Sakellariou 1985, 224–231.

36 Xenaki-Sakellariou 1985, 320.

37 Architectural decoration, see Tsountas – Manatt 1897, 133 f. figs. 49, 50; Xenaki-Sakellariou 1985, table 12.

38 Cruciform dagger – variant B or C, Papadopoulos 1998, 19–24.

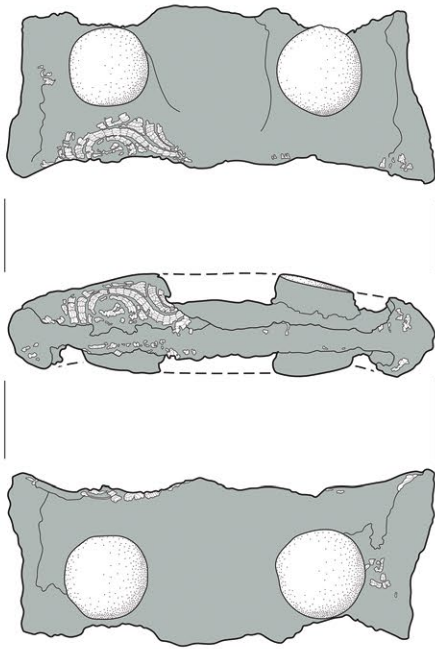
39 Xenaki-Sakellariou 1985, 224–231 cat. Xλ 3119–3120, Xλ 3116 and X 3217 respectively.

40 Xenaki-Sakellariou 1985, 224–231 cat. Xλ 3118, Xλ 3108, Xλ 3113, 3009, Λ 3110, A 3109, E 3117, A 3115, Γ 3117, 3217, Φ 3117, X 3217 respectively.

41 Xenaki-Sakellariou 1985, 318 f.; see also Steinmann 2020, 386, for the production of bronze arrowheads in LH IIB.

42 Steinmann 2012, 380 f. cat. 110; Kim Shelton, pers. comm.

43 Xenaki-Sakellariou 1985, 216.



0 1 2 cm.

a

b

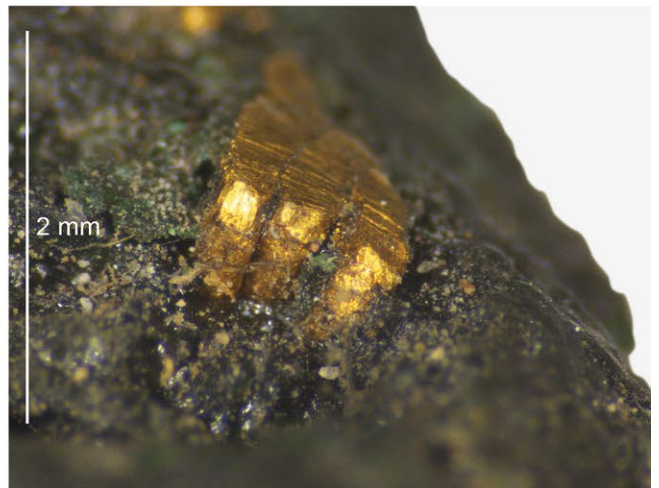


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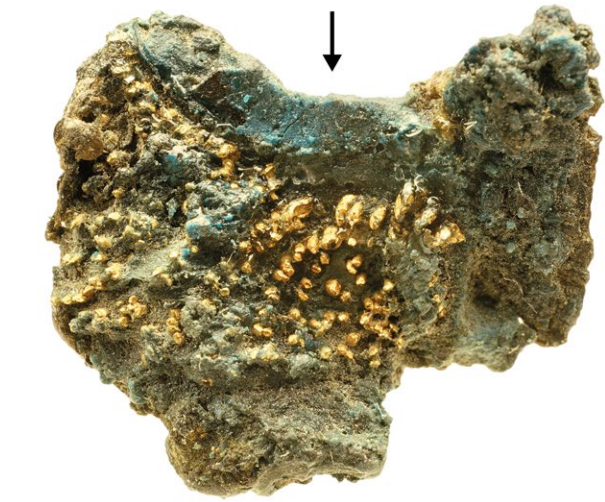
Fig. 9: MYC 9a (NAM 779b), fragment of sword or dagger from Mycenae Shaft Grave V: (a) drawing; (b) photo; (c) close-up photo of the shoulder decorated with gold embroidery; (d-e) microscopic images



d



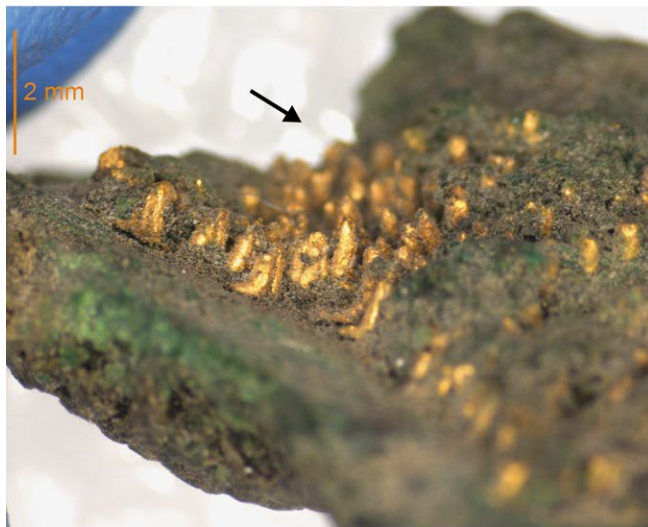
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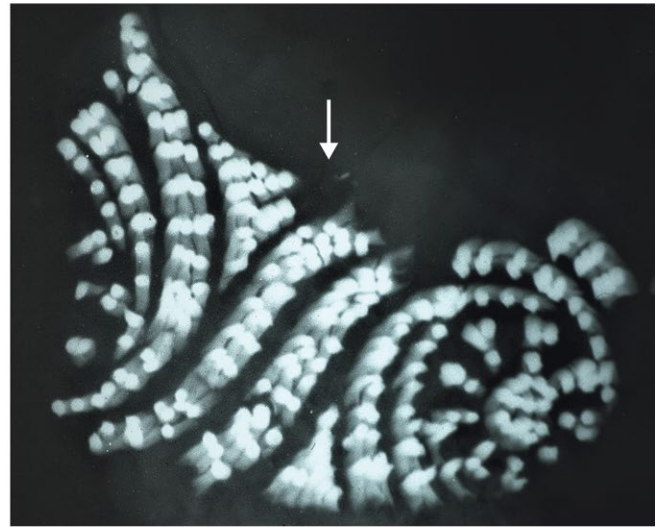
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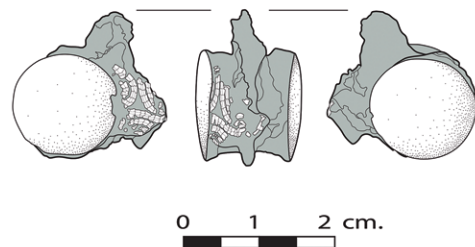


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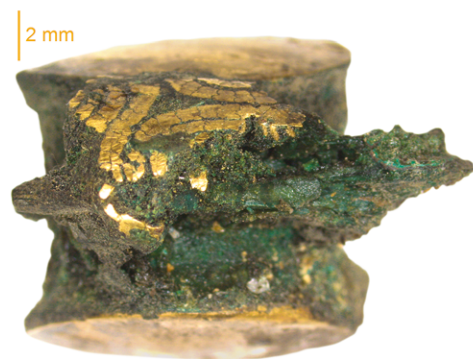
Fig. 10: MYC 9b (NAM 779b-bis), tiny fragment of sword or dagger from Mycenae Shaft Grave V with gold embroidery (same as MYC 9a): (a) side A, showing the tips of the nails; (b) side B with impressions of textile or leather; (c) side A, the underside of the L-shaped gold bars; (d) X-ray showing the decorative pattern created by the gold bars (compare with Fig. 9). The arrows show the same part of the fragment in the various photos



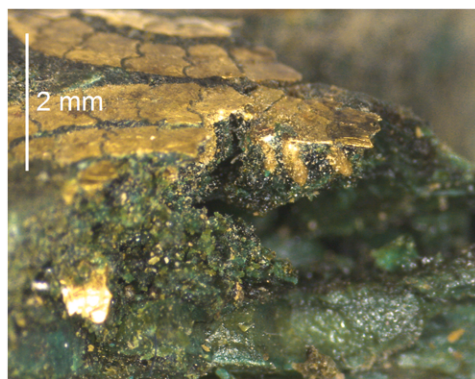
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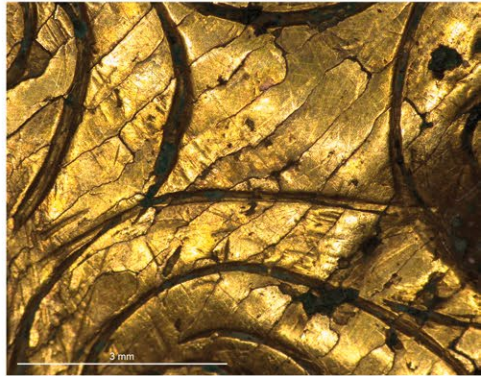
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Fig. 11: MYC 10 (NAM 779a), four gold-capped rivets from the hilt of a weapon from Mycenae Shaft Grave V: (a) photo from above; (b) drawing of the third rivet with remains of gold embroidery; (c-d) microscopic images of the same rivet



a

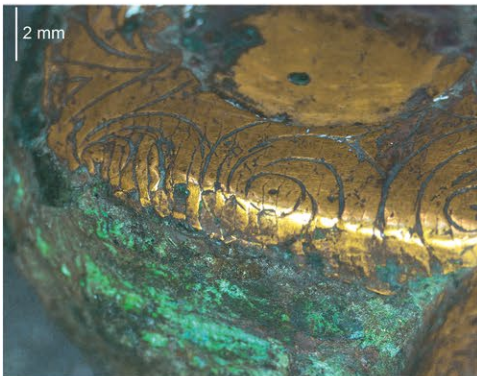
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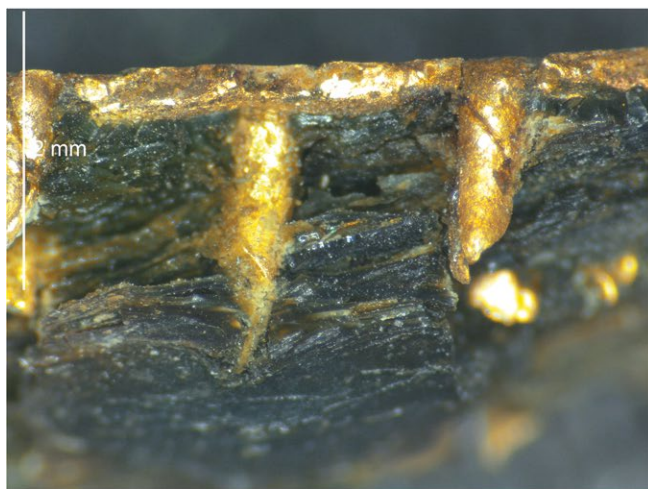
Fig. 12: MYC 11a (NAM 3111), cruciform dagger from Mycenae chamber tomb 81: (a) photos of both sides; (b) drawing of side A (showing also the small fragment MYC 11b on top right); (c–d) microscopic images of gold embroidery on the grip; (e–f) microscopic images of gold embroidery on the shoulder; (g) incised decoration on the flange of the handle



a



b



c



d

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Fig. 13: MYC 11b (NAM 3112), detached fragment of the dagger MYC 11 from Mycenae chamber tomb 81: (a) photo; (b–d) microscopic views from the side

above the floor. Numerous L-shaped gold bars (MYC 12, Fig. 14) were found close to a short type A sword (NAM 3081), which seems to have been associated with the skull on the NW corner; together with the sword, Tsountas found a gold ring with glass inlays from the bottom of the handle, gold nails with granulation and other detached parts of the sword⁴⁴. Other objects possibly linked with that skull included a type D1 sword, a silver vessel with a wishbone handle, a diadem of 58 gold lily-shaped beads and a bronze mirror disc⁴⁵.

23 Other finds from the tomb include a shallow silver cup with repoussé decoration, two bronze knives, a bronze plate with a hook, two lentoid sealstones of agate and a glass seal. No pottery is recorded. According to Xenaki-Sakellariou, the tomb may have been used since a late stage of LH II (probably implying LH IIB) but apparently continued in LH IIIA⁴⁶. Kilian-Dirlmeier believes that the type A sword, which was decorated with gold embroidery, can be dated to LH IIIA1 both by context and typologically⁴⁷.

44 Xenaki-Sakellariou 1985, 215–219 cat. X 3091 (L-shaped gold bars), Xλ 3081 (type A sword), X 3082 (various gold ornaments).

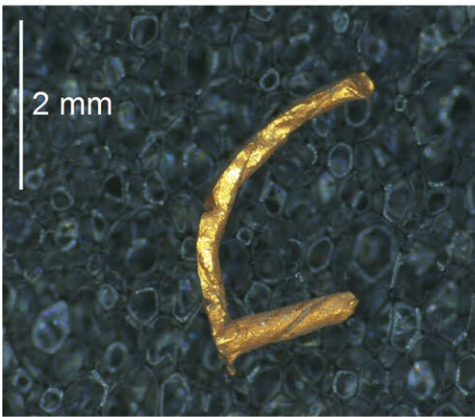
45 Xenaki-Sakellariou 1985, 215–219 cat. Xλ 3084, A 3122, X 3087 respectively.

46 Xenaki-Sakellariou 1985, 318 f.

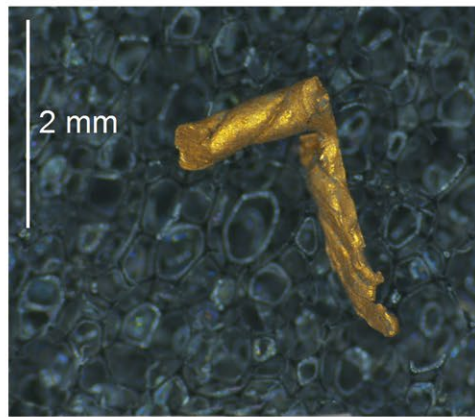
47 Kilian-Dirlmeier 1993, 36 f.



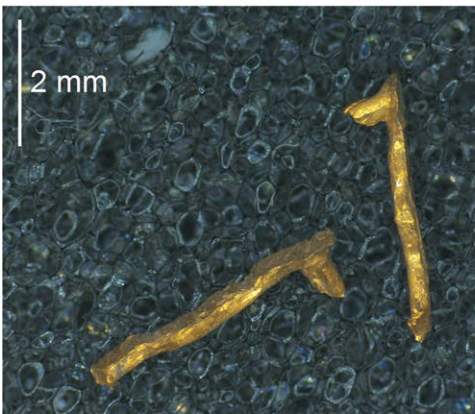
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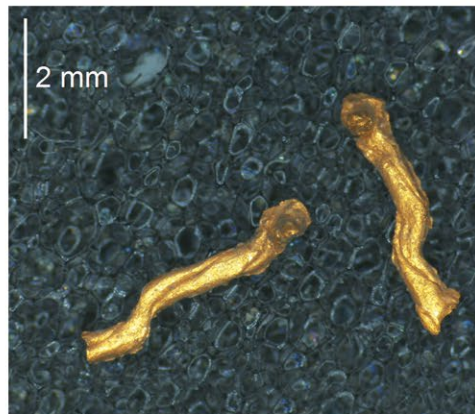
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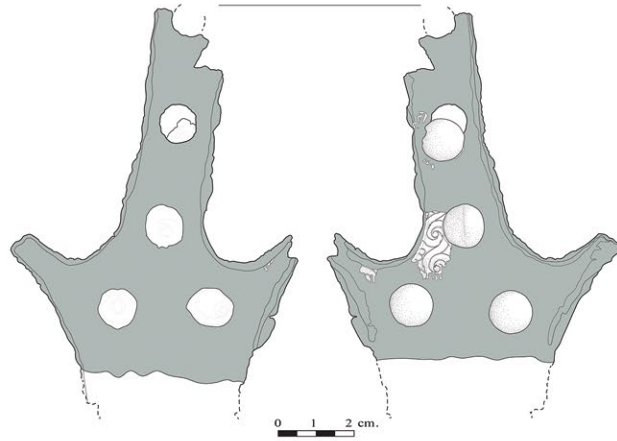
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Fig. 14: MYC 12 (NAM 3091), detached gold bars from Mycenae chamber tomb 78: (a) photo of all the bars found; (b) microscopic image of detached gold bar with curved stem (from curving part of the handle); (c-d) microscopic images of detached gold bars with straight stems

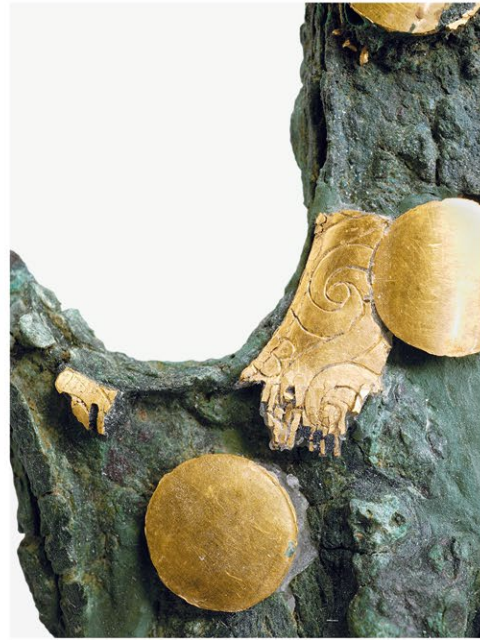
Dendra

The Tholos Tomb

24 The Dendra tholos is one of the wealthiest funerary contexts in Early Mycenaean Greece. The tomb had a diameter of 7.3 m, with a dressed dromos 17.90 m long. At the floor of the tomb four pits were discovered. One of them, along the west part of the



b



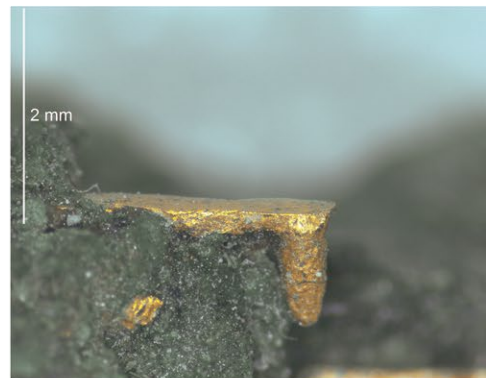
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Fig. 15: DEND 1a (NAM 7317), type Ci sword from the tholos tomb of Dendra: (a) photo; (b) drawing of the handle; (c) close up photo of the hilt with surviving parts of gold embroidery; (d) microscopic photo of the larger piece surviving in situ; (e-f) the morphology of gold bars preserved in situ

28

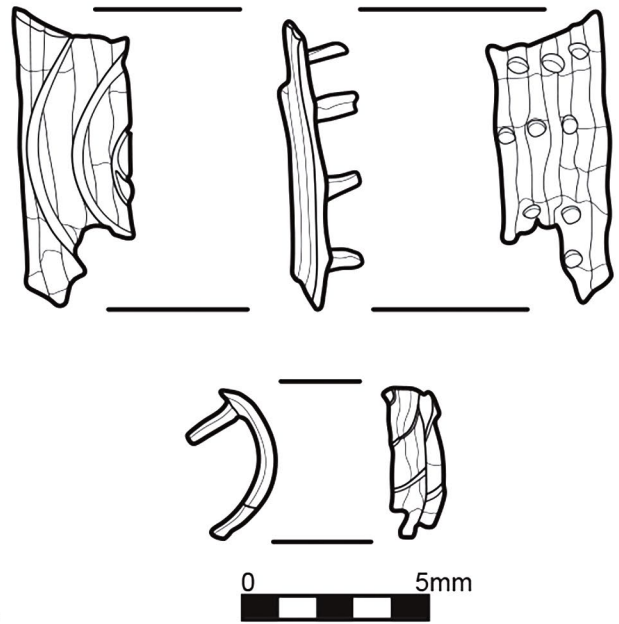
chamber (pit 1), held the articulated remains of a male and a female individual. Person conventionally called them »king« and »queen«⁴⁸.

25 Associated with the male burial was a type Ci sword decorated with gold embroidery (DEND 1) (Fig. 15. 16. 17). The sword was found on the left side of the skeleton. Only small parts of the hilt decoration remained in place (DEND 1a) (Fig. 15 a-c);

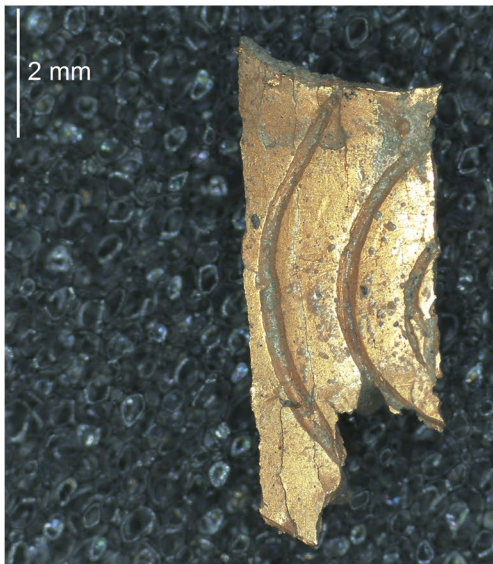
48 Persson 1931, 14-18 and pl. 7. For the identification of the sex of the skeletons, see Fürst 1930, 78-80 pl. 26.



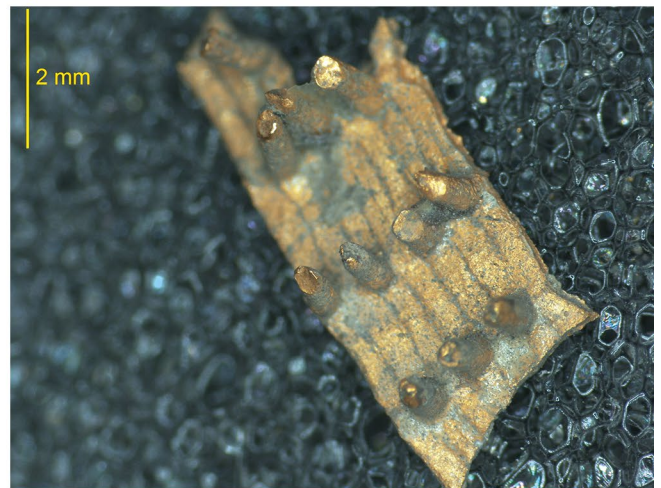
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the organic part had disintegrated and ca. 5,000 detached gold bars and fragments had spread around the sword (DEND 1b) (Fig. 16). Nearby, part of an ivory pommel with gold embroidery was discovered (DEND 1c) (Fig. 17 b), which probably came from the same weapon⁴⁹. Other offerings to the male burial included: four swords (1 type A⁵⁰, 2 type B, 1 type C), four spearheads, two knives, two lead horns, several glass plaques probably from a helmet, four gold and/or silver vessels, a bronze box, a wooden vessel, four metal rings and six lentoid sealstones and various small ornaments of glass, rock crystal and agate⁵¹. A decorated ostrich egg, a steatite lamp, and a necklace of 61 gold beads were found in the area between the male and the female burial and could have belonged to either⁵².

Fig. 16: DEND 1b (NAM 7349), detached gold bars and fragments of gold decoration from the type Ci sword DEND 1a, found at the tholos tomb of Dendra: (a) photo of all pieces; (b) drawing of the larger piece; (c-d) photos of the larger piece: the upper part and the underside

49 Persson 1931, 35 f. no. 12; 60 fig. 37. 38 and pl. 22, 2; 23, 1-3.

50 The type A sword bears similar spiral decoration on the blade to that seen on the handle of the type C sword with gold embroidery, see Persson 1931, 62.

51 For a full list, see Persson 1931, 31-37.

52 Persson 1931, 37 f.

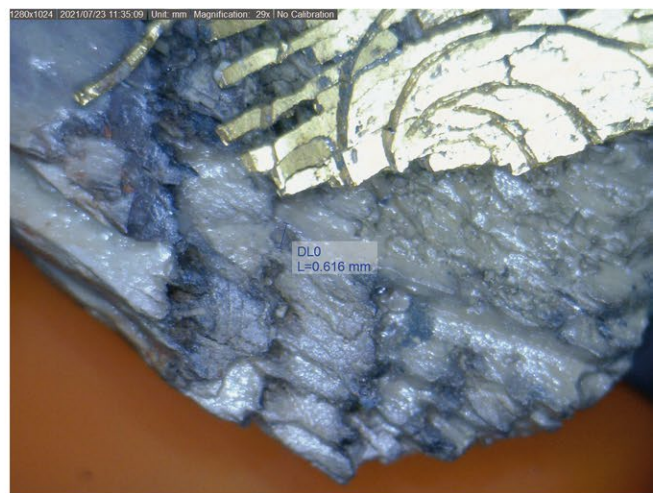
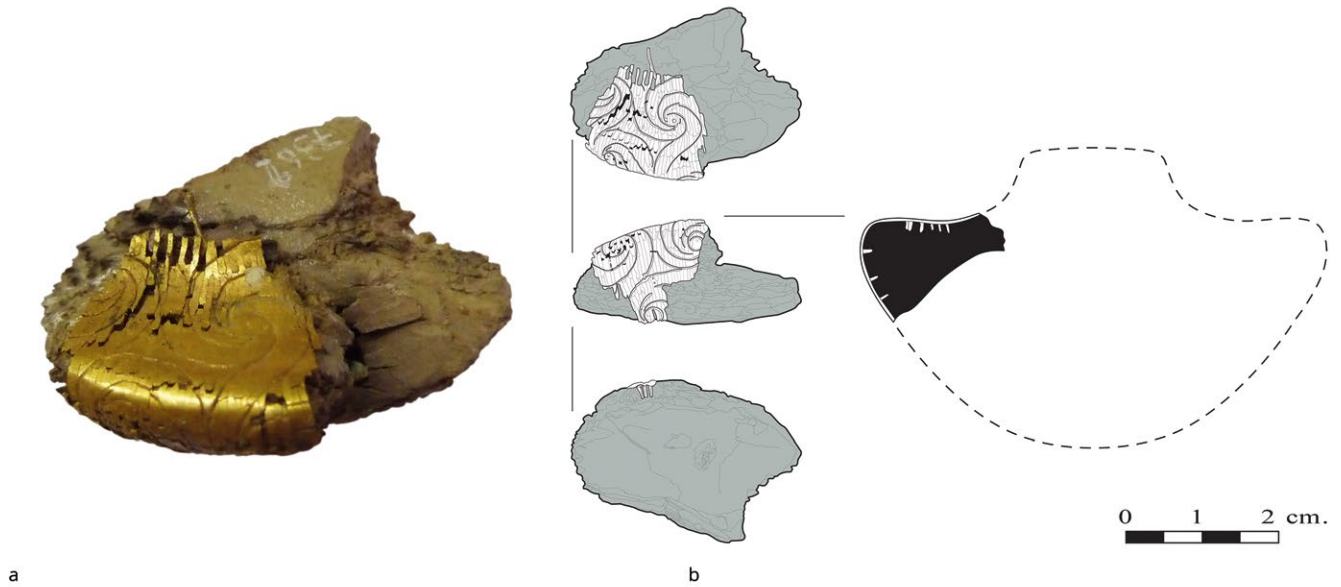


Fig. 17: DEND 1c (NAM 7362), part of the ivory pommel of the type Ci sword DEND 1a, found at the tholos tomb of Dendra: (a) photo; (b) drawing; (c) microscopic view showing the placement of gold bars in ›brickwork‹ pattern; (d–e) microscopic view showing the penetration of ›nails‹ in the organic substrate; (f) microscopic view showing the neat arrangement of pin holes

26 Pit 1 is considered as a typical LH IIIA1 (or IIB–IIIA1) funerary assemblage⁵³, but the recovered pottery is little, fragmentary, and has never been published in full. The LH IIIA1 date is based on a tall fragmentary stirrup jar (FS 164) decorated with running spirals, sherds of which were found in the pits, the floor and the dromos⁵⁴. Given that pit 1 was undisturbed, these fragments can only provide a *terminus post quem* for the pit (i.e. the vase must have been already broken when some fragments were sealed in the pit). Other fragmentary vases found in the tomb include possibly a stirrup jug with three handles (FS 150, 151?) and a carinated kylix (267), which may be dated to LH IIIA2⁵⁵. Most of the sealstones from pit 1 are stylistically dated to LM II–IIIA1 although a couple may be Neopalatial⁵⁶.

Chamber Tomb 12 (the ›Cuirass Tomb‹)

27 Chamber tomb 12 is the smallest among the known tombs of the Dendra cemetery. Its chamber measured 2.5 m × 2.35 m and instead of a dromos it had a vertical shaft for access in front of the west-facing entrance⁵⁷. The roof had collapsed and the tomb had been plundered prior to excavation. The looters had disturbed the eastern part of the chamber, including the only burial found in the tomb⁵⁸. The disturbed skeleton is described as belonging to a man ca. 1.75 m tall, but it is not clear if it was examined by a physical anthropologist⁵⁹.

28 Among the leftovers of the plundering, the excavators found tiny parts of an ivory pommel decorated with gold embroidery (DEND 2b), a ring made of gold foil and two bronze rivets with gold caps⁶⁰, apparently coming from one or more weapons (Fig. 19 a). Åström suggested that the fragments originally belonged to a type Ci sword with gold embroidery decoration, which is currently exhibited at the National Museum of Denmark (DEND 2a) (Fig. 18 a); the sword had first appeared in the art market in 1961 as »coming from the Argolid« and Åström believed that it was among the material taken by the looters who had plundered chamber tomb 12 on January 1960⁶¹. Another sword (D1 type) in the National Museum of Denmark seems also to come from chamber tomb 12⁶². The sword DEND 2a and the fragments DEND 2b were examined by the authors as part of the current research project and they fit well in terms of shape, size and technique (Fig. 19 d–e).

29 Chamber tomb 12 contained a full ›warrior gear‹, consisting of a complete bronze armour (with neckpiece, two epaulettes, breastplate and an articulated section with three straps to protect the rest of the torso⁶³), bronze greaves, a boar's tusk helmet with bronze cheekpieces, a bronze dagger with remains of its leather sheath, bronze knives and, of course, the aforementioned swords⁶⁴. In addition, it contained three well-preserved bronze vessels (lekane, oinochoe, laver), fragments of one or more silver cups, a bronze mirror, a silver toggle pin (perhaps part of the dressing gear), as well as fragments of bronze thread of unknown use. The pottery consisted of four LH IIB/IIIA1 vases: a three-handled jar

53 E.g. Hope-Simpson – Dickinson 1979, 40; Darcque 1987, 190.

54 Persson 1931, 66 fig. 46; Furumark 1941, 53; Furumark 1992, pl. 91; Mountjoy 1999, 65.

55 For FS 150–151, see Furumark 1992, pl. 85; Mountjoy 1999, 121 f.; for FS 267 see Furumark 1992, pl. 146; see also Drakaki 2008, 122 n. 244.

56 Drakaki 2008, 122–127.

57 Åström 1977, 10 f.

58 Åström 1977, 7 and 9 fig. 3.

59 Åström 1977, 18.

60 Åström 1977, 12 cat. 3 (rivet); 16–18 cat. 21 (gold ring); 23 (rivet); 28 (ivory pommel) and pls. 7, 3–4; 8, 2–3; see also Verdelis 1977, 55 cat. 12 b for the pommel fragment (erroneously identified as part of an ivory pyxis).

61 Åström 1967, 65; Åström 1972, 47. 49 f.; Xenaki-Sakellariou 1982–1984, 32 f.; cf. Dietz et al. 2015, 21 cat. 10 and fig. 1 pl. 3.

62 Dietz et al. 2015, 22 cat. 11 and fig. 1 pl. 3.

63 See Molloy 2012.

64 For the finds, see Åström 1977, 12–18; Verdelis 1977.



Fig. 18: DEND 2a (NMD 14417), type Ci sword, possibly from the «Cuirass tomb» (chamber tomb 12) of Dendra: (a) photo; (b) drawing of the ivory pommel; (c) close up photo of gold embroidery decoration surviving on the hilt; (d) the pommel, view from above



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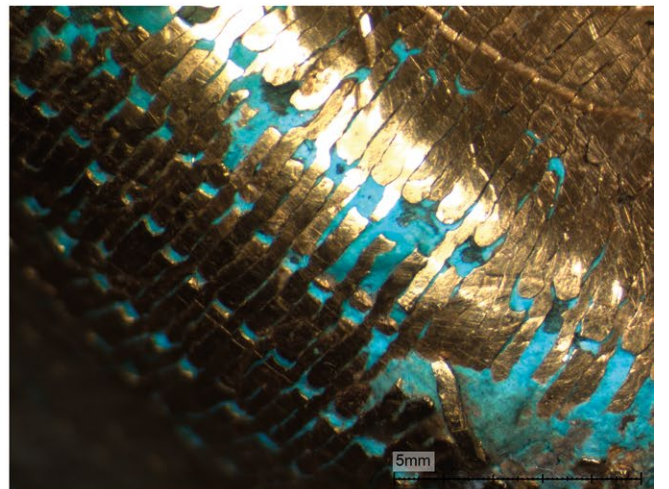
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Fig. 18: DEND 2a (NMD 14417), type C1 sword, possibly from the ›Cuirass tomb‹ (chamber tomb 12) of Dendra: (e–f) the pommel, microscopic images from the upper part showing the gold bars and the neat arrangement of pin-holes; (g–h) the pommel, views of the underside; (i) the pommel, detail of the upper part close to the large horizontal rivet; (k) the pommel, detail from the area of the shoulder



Fig. 19: DEND 2b (AMN 33098), fragments of the type Ci sword DEND 2a found in the »Cuirass tomb« (chamber tomb 12) of Dendra: (a) remains of the pommel and the gold ring placed at its base; (b–c) microscopic images of the pommel fragments; (d–e) comparative photos: part of the pommel of DEND 2a, at the National Museum of Denmark (d) and the fragment DEND 2b at the Archaeological Museum of Nauplion (e)

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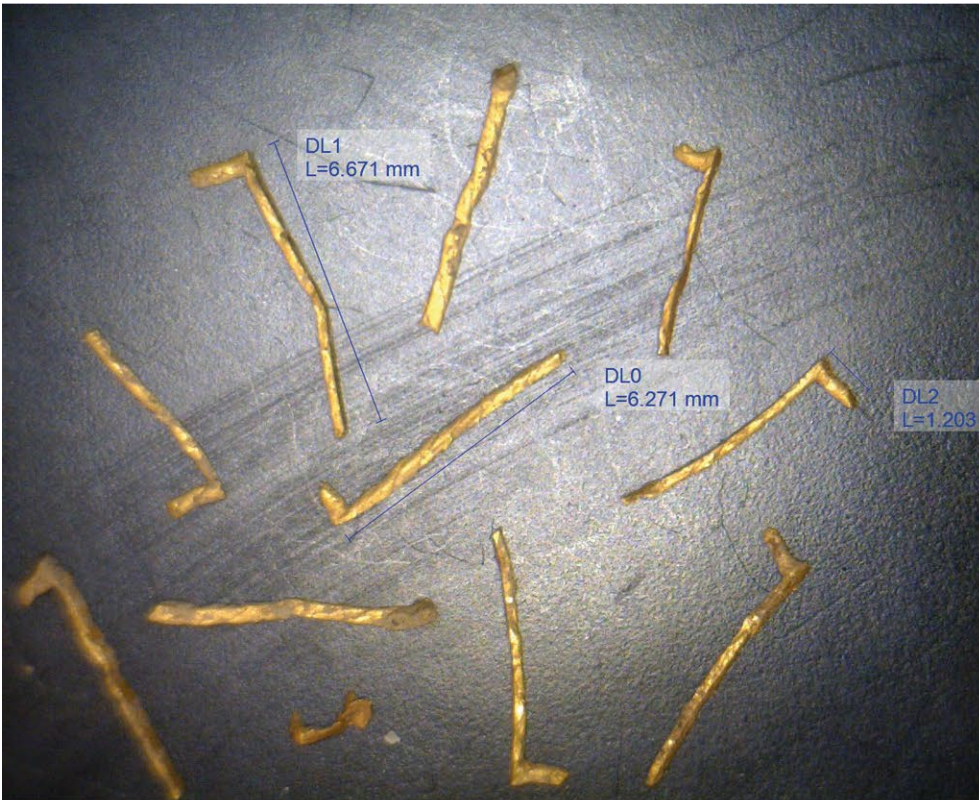
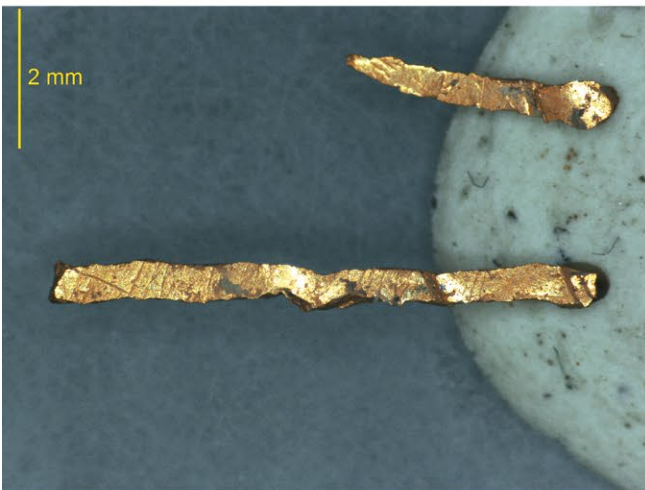
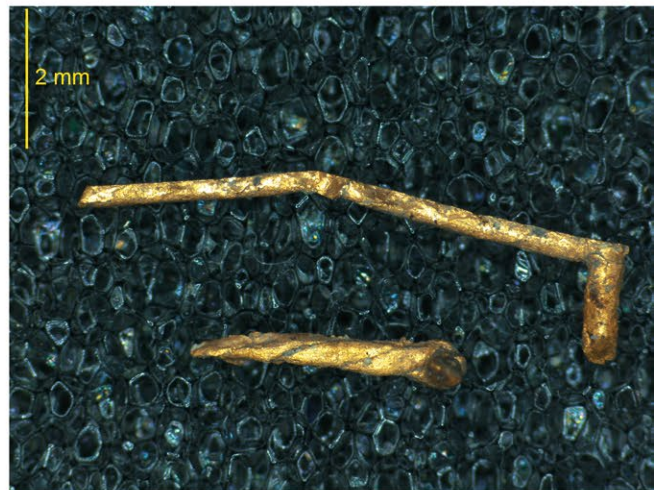


Fig. 20: PRO 1 (NAM 6407), detached gold bars found in chamber tomb 2 of Prosymna: (a) microscopic photo of selected gold bars with measurements; (b-c) two bars of unequal size seen from above and in profile; (d-e) the morphology of two bars of unequal size (microscopic image)

a



b



c



d



e

(FS 22) and three alabastra (FS 82, 84). If Åström is correct that the tomb was opened only once in antiquity⁶⁵, then we have a closed assemblage in which all objects belong to the same burial – although this is exceptionally rare in Mycenaean chamber tombs.

Prosymna

Chamber Tomb 2

30 This tomb was one of the largest and richest in the Prosymna cemetery⁶⁶. It was located in the eastern side of the East Yerogalero ridge in a cluster of comparably rich tombs, many of which contained weapons⁶⁷. The chamber was roughly circular, with a maximum diameter of 5.20 m and the dromos 17.25 m long, facing SE towards the settlement. The façade was decorated with running spiral motifs in polychromy⁶⁸.

31 Most of the precious grave goods were clustered in the inner right quarter of the chamber, where a single skull was found near the wall without other skeletal remains⁶⁹. Among the finds were dozens of L-shaped gold bars (»extremely delicate remnants of gold inlay«)⁷⁰, apparently detached from the decayed handle of a weapon decorated with gold embroidery (PRO 1)⁷¹ (Fig. 20). Recently, Steinmann associated these finds with six gold-plated rivets, a ring made of gold foil and a gold-sheathed fragment that looks like the horn of a type C sword and suggested that they originally belonged to such a sword⁷². This is an attractive suggestion, although one should bear in mind that Blegen mentioned only the L-shaped gold bars and four rivets as coming from this area⁷³. Other finds recovered from this part of the tomb (and thus probably associated with the same burial) include complete and fragmentary bronze arrowheads, part of a knife, a cylinder seal, two necklaces made of delicate gold beads, many ivory fragments and beads of carnelian and amber⁷⁴. A scale-pan and the fragment of a metal vessel may also belong to this burial.

32 The tomb yielded large amounts of pottery dating from LH IIA to LH IIIA1. The burial with the gold embroidery was accompanied by a dozen vases spanning the LH IIB–IIIA1 period⁷⁵.

Vapheio

The Tholos Tomb

33 The Vaphio tholos is one of the most impressive tombs in Mycenaean Greece, with a diameter of 10.15–10.35 m and a dressed dromos 29.80 m long. The tomb had been plundered and only scattered remains of offerings and burned bones were found on the floor⁷⁶. However, a large cist (2,25 m × 1,10 m) had escaped looting and contained an amazing array of finds, including a type A sword, at least two daggers with inlaid decoration, two spearheads, seven knives, one razor, a perforated axe, another axe,

65 Åström 1977, 11 f.

66 Blegen 1937, 173–180 pls. 38, 39; Steinmann 2020.

67 Steinmann 2020, 395–398.

68 Blegen 1937, 174; Steinmann 2020, 381–385.

69 Blegen 1937, 177 f. plan 38 (nos. 9–21 and skull 37).

70 Blegen 1937, 178 and fig. 442 top.

71 Xenaki-Sakellariou 1984, 136 n. 47.

72 Steinmann 2020, 388–399 and fig. 8.

73 Blegen 1937, 177 f. All the finds are depicted in fig. 442 together with fragments of gold leaf from other parts of the chamber.

74 Blegen 1937, 177 f. and figs. 444–447. 577. 595.

75 Shelton 1996, 3–9, esp. 5–6 for the burial with the gold embroidery (»Chamber, back, right side«); 168–172.

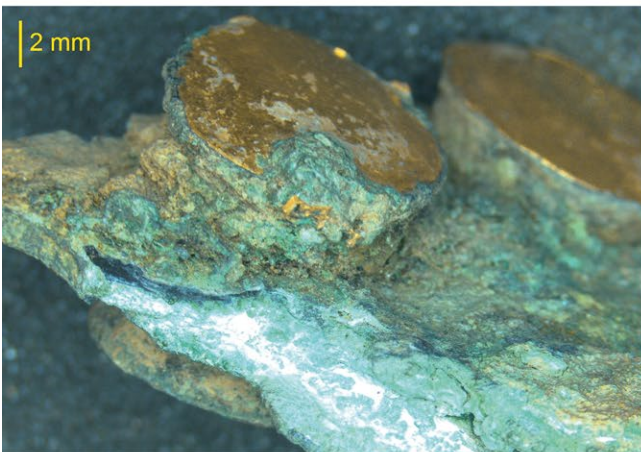
76 Tsountas 1889, 141 f.; Kilian-Dirlmeier 1987, 197 f. and fig. 1.



a



b



c



d



e

a bronze tube of unclear function, the famous gold cups with repoussé decoration, silver and bronze vessels, two alabaster and two ›stone‹ vessels, a bronze mirror, bronze scale pans, sets of lead weights, three signet rings made of gold, bronze and iron respectively, 24 sealstones, ca. 80 amethyst beads, small jewellery articles (silver ear scoop, bronze pins etc.) and a few ceramic vases⁷⁷. Close to the less well-preserved inlaid dagger (NAM 1816) large numbers of tiny golden pins, apparently coming from the decoration of the organic hilt, were found⁷⁸. Unfortunately, these pins have not been located at the NAM. Instead, we have identified two previously unpublished fragments of hilts decorated with gold embroidery, which are not mentioned by Tsountas or other scholars (VAPH 1–2) (Fig. 21. 22). The fragments do not seem to have belonged to the inlaid

21

Fig. 21: VAPH 1 (NAM 1820), fragment of the shoulder of a weapon (possibly a dagger) with remains of gold embroidery from the tholos tomb of Vaphio: (a–b) photos, side A and side B; (c–e) microscopic views of side A, profile with gold bars preserved under the copper corrosion of the left rivet

77 Tsountas 1889, 144–149 and pls. 7–10; Kilian-Dirlmeier 1987, 198–200.

78 Tsountas 1889, 146. 150 pl. 7, 2; Laffineur 1974, 11 no. 15; Xenaki-Sakellariou – Chatziliou 1989, 28 f. no. 15 and pl. 8, 3; Papadopoulos 1998, 14 no. 60 and pl. 9, 60.



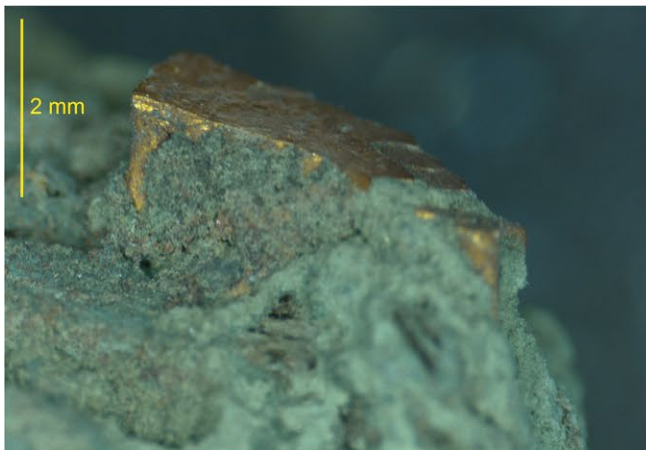
a



b



c



d



e



f

Fig. 22: VAPH 2 (NAM 1821), six gold-capped bronze rivets with oxidized remains of the organic hilt from the tholos tomb of Vaphio, the largest of which is decorated with gold embroidery: (a) photo of all rivets; (b–e) microscopic views of the profile of the largest rivet with the gold bars; (f) detached gold bars (microscopic image)

dagger NAM 1816, as they have different dimensions; however, they might come from one of the daggers represented by detached pieces of inlaid decoration found in the pit (NAM 1808, 1819, 1824)⁷⁹.

³⁴ Although no bones were found in the cist, Tsountas believed that it was used for the burial of a man; different theories developed with time (e.g. that the cist was a kind of treasury that held offerings from various burials), but when Kilian-Dirlmeier re-examined the tomb in 1987 she agreed that the cist must have been used for a single burial, perhaps of a male due to the weapons⁸⁰. Some scholars have gone further, suggesting that the occupant of the cist was a local ruler⁸¹.

³⁵ From the seven pottery vessels found in the cist, only a goblet has been published, and is dated by Furumark to LH IIA and by Mountjoy to late LH IIA⁸². Dickinson also dates the goblet to LH IIA but mentions »one or two fragments of later date«⁸³. Other scholars believe that the goblet, and thus the cist, may date to an early stage of LH IIB⁸⁴.

Kakovatos

Tholos Tomb B

³⁶ This is one of three tholoi discovered at Kakovatos, a major centre near the western coast of Elis and a hub of exchanges with the West in Early Mycenaean times⁸⁵. With a diameter of ca. 9.00 m, it was the smallest of the three⁸⁶. The tomb was very poorly preserved, but had its floor paved with limestone slabs. No skeletal remains are reported and the offerings were scattered in a thin layer of sand, just above the floor⁸⁷. The most important find was a bent type A sword, whose hilt was decorated with gold embroidery – a few gold bars were preserved on the hilt and many more were found detached around the sword (KAK 1a and 1b) (Fig. 23. 24)⁸⁸. Other finds included a marble lamp, a possible steatite vessel, parts of an open glass vessel with fluted decoration (an extremely rare find for this period), a bronze needle wrapped in gold, as well as numerous beads and other small ornaments made of gold, lapis lazuli and glass⁸⁹. Pottery consists of two Palace-Style jars found in a fragmentary state on the floor of the chamber and sherds of a third one in the dromos; all of them are dated to LH IIA⁹⁰. Mountjoy has suggested a late LH I construction date for tholoi A and B, although it is not clear on what grounds⁹¹. In terms of wealth, tholos B was overshadowed by the neighbouring tholos A, which has yielded impressive finds, including ca. 600 amber pieces⁹².

⁷⁹ Laffineur 1974, 11 no. 16; Xenaki-Sakellariou – Chatziliou 1989, 29 nos. 16–17 b and pls. 8, 3–4; 13, 3; Papadopoulos 1998, 14 nos. 61. 62 and pl. 9, 61–62.

⁸⁰ Tsountas 1889, 147–149; Kilian-Dirlmeier 1987, 200–202 with previous bibliography.

⁸¹ Banou – Hitchcock 2011.

⁸² Tsountas 1889, 154 and pl. 7, 19; Furumark 1941, 49; Mountjoy 1999, 246. 257 f. no. 34.

⁸³ Dickinson 1977, 90.

⁸⁴ Banou – Hitchcock 2011, 11.

⁸⁵ Dörpfeld 1908; for the importance of Kakovatos as a centre of exchange, see Sgouritsa-Polychronakou – Nikolentzos 2016.

⁸⁶ Dörpfeld 1908, pl. 17, 2; Pelon 1976, 220 f. and pl. 102, 1.

⁸⁷ Boyd has suggested that the thinness of the burial level may suggest that the tomb collapsed soon after its construction and was never reused, Boyd 2002, 190.

⁸⁸ Müller 1909, 298 f. and fig. 14. The practice of »ritual killing« (Harrell 2016) is also seen in other early tholos tombs in Messenia (Korres 1977, 311 f.) and a chamber tomb in Alpochori, Elis (Kokkotaki 1991, 43, a spearhead).

⁸⁹ Müller 1909, 294–299.

⁹⁰ Müller 1909, 307 f. cat. 6–7; 313 cat. 17 and pl. 19, 1–2; 22, 2; Lolos 1987, 213–215; Kalogeropoulos 1998, 135 f. and pl. 25 d; 27 a; 33 a–b.

⁹¹ Mountjoy 1999, 369.

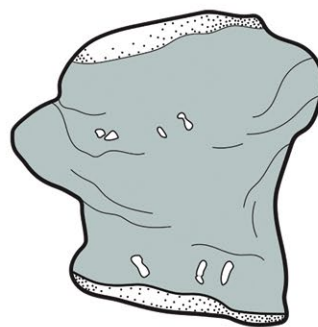
⁹² Müller 1909, 271–294.



a



b



0 1 cm.

c



d

Fig. 23: KAK 1a (NAM 5664), type A sword from the tholos tomb B at Kakovatos: (a) photo; (b) close-up of the tang with gold bars on one of the rivets' edge; (c-d) drawing and close-up photo of the rivet's profile



a
24



b

Fig. 24: KAK 1b (NAM 5564), detached gold bars from the tholos tomb B at Kakovatos, possibly from sword KAK 1: (a) microscopic image of all bars; (b) the morphology of a gold bar

Pylos

The ›Griffin Warrior‹ Tomb

37 The 2015 discovery of this tomb near the (later) palace of Pylos was sensational and at the same time puzzling⁹³. The grave was not conspicuous, i.e. a rectangular stone built shaft 1.10 m × 2.30 m⁹⁴, and held the skeleton of a male adult, 30–35 years old⁹⁵. It was the only single grave in an area with several monumental tholos tombs. Its wealth, however, was astonishing. The finds are still under study, but they include two weapons decorated with gold embroidery: a well-preserved type C sword placed to the left of the deceased (PYL 1)⁹⁶, and a poorly preserved dagger (PYL 2)⁹⁷. Among the hundreds of offerings, there are several bronze weapons, bronze tools, a bronze suit of armour, boar's tusks from a helmet, a bronze finial for a staff in the form of a bull's head, many metal vessels (including gold and silver cups), ivories (six combs, a pyxis lid and a plaque in the form of a griffin), a gold necklace of square box-shaped wire with two pendants decorated with ivy leaves, four gold signet rings, more than 50 sealstones, over 1000 beads, of amber, carnelian, amethyst, agate, gold and glass, and organic remains from the burial shroud⁹⁸. No pottery offerings had been deposited in the grave; based on sherds found in the lower fill of the tomb, the excavators have suggested a LH IIA date for the burial⁹⁹.

38 This is the only case of gold embroidery found in a single grave (but single burial was exceptionally rare in Mycenaean times). Dendra chamber tomb 12 contained a single burial, too, but the type of sepulchre was designed for multiple interments.

93 Davis – Stocker 2016.

94 Davis – Stocker 2016, 628.

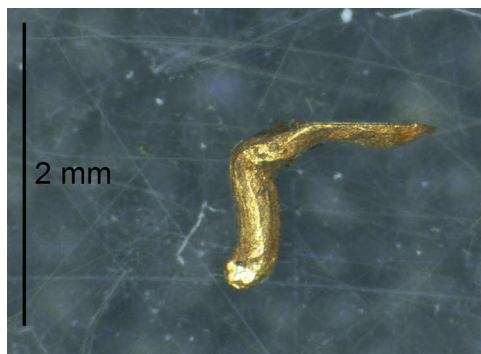
95 Davis – Stocker 2016, 630; bioarchaeological data is not yet published but the identification has been made by a physical anthropologist, see footnote 7 in page 630 of the publication.

96 Davis – Stocker 2016, 634. 650 fig. 14.

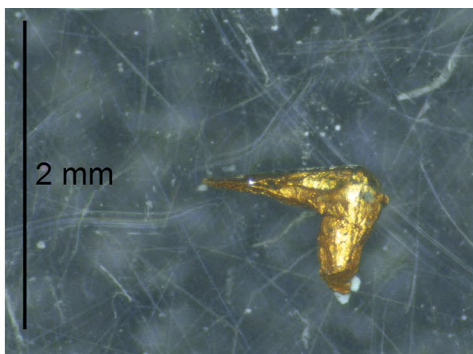
97 We thank Dr Stocker and Prof Davis for informing us about the dagger, which has not been illustrated or described so far.

98 Davis – Stocker 2016, 632–635; for specific finds, see Davis – Stocker 2016, 37–652; Stocker – Davis 2017; Davis – Stocker 2018; https://magazine.uc.edu/editors_picks/recent_features/warrior_tomb.html (last visited 14.02.2021).

99 Davis – Stocker 2016, 635 f.; Stocker et al. forthcoming.



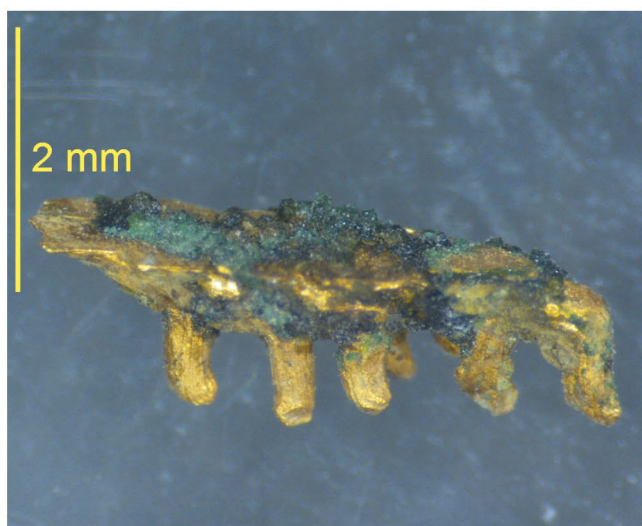
a



b



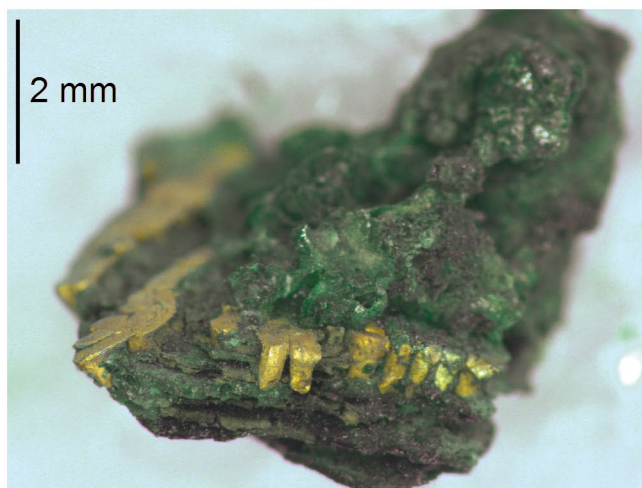
c



d



e



f

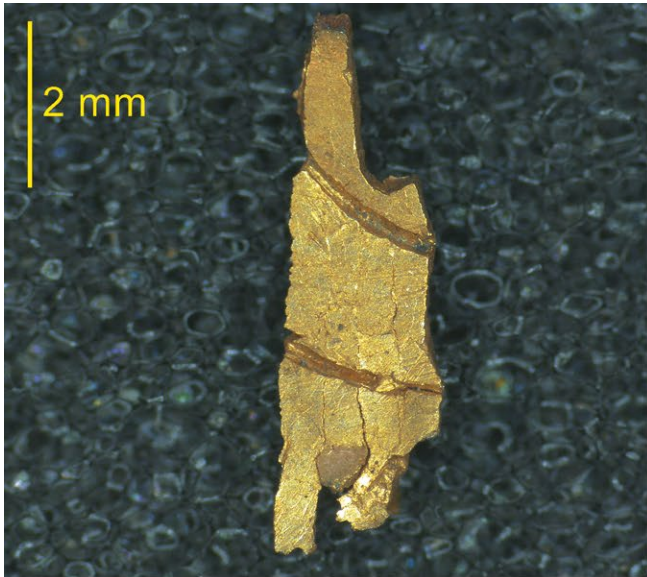
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Fig. 25: UNP 1 (NAM 23328), short gold bars and tiny fragments decorated with gold embroidery, of unknown provenance: (a–c) microscopic views of detached bars, showing their morphology which classifies them to style A; (d–f) fragments, microscopic views from above and profile

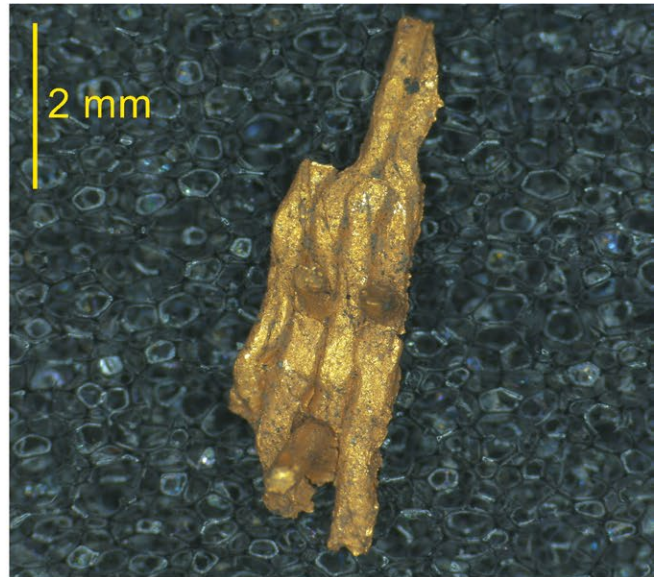
Unprovenanced Examples

39 Two groups of material have no recorded context. UNP 1 consists of tiny parts decorated with gold embroidery and of stray L-shaped bars (Fig. 25). The type of decoration and the morphology of the studs fits with style A decoration (see below), which is safely attested only at the Mycenae Shaft Graves and possibly at Vaphio. It is, thus, possible that this group comes also from Mycenae.

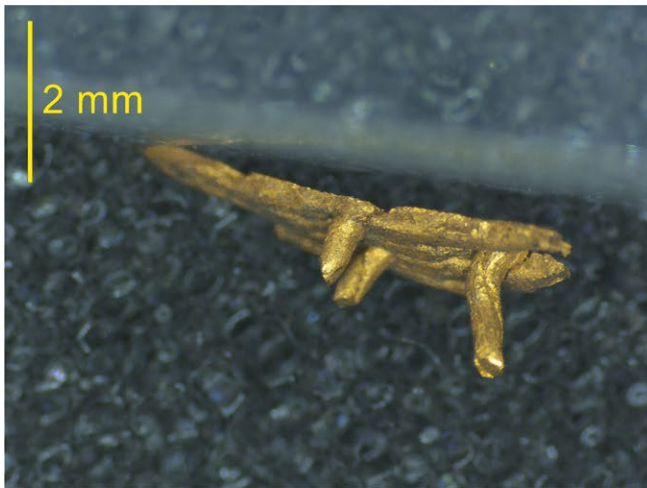
40 UNP 2 consists of detached parts of gold embroidery, as well as of gold bars mixed with soil (Fig. 26). The detached parts show remarkable similarities with those of



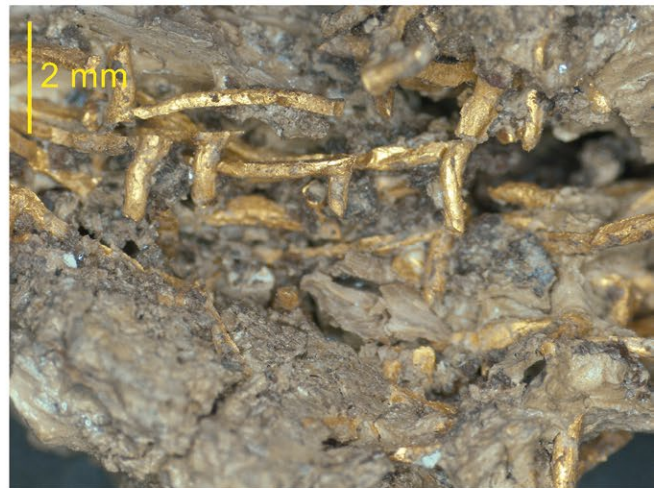
a



b



c



d



e



f

Fig. 26: UNP 2 (NAM 23329), detached fragments of gold embroidery and soil mixed with gold bars, of unknown provenance (but possibly from Dendra): (a–c) microscopic views of the larger piece (upper part, underside and profile), showing a remarkable similarity in morphology to DEND 1c (style B); (d) microscopic view of straight gold bars mixed with soil; (e) microscopic view of curving gold bars set in a brickwork pattern; (f) a piece of ivory (probably from the pommel) with visible pin-holes

DEND 1c, both in terms of style and technique. Therefore, it is possible that they come also from the tholos tomb of Dendra.

Unverified Cases

Mycenae Chamber Tomb 93 (Asprochoma-Agriosykia Cemetery)

41 The tomb was located in the Asprochoma-Agriosykia cemetery, which was less wealthy than other chamber tomb cemeteries at Mycenae¹⁰⁰. In the excavation notebook, Tsountas mentions an L-shaped gold wire, »possibly of the kind that covered the wooden hilts of weapons«¹⁰¹. The wire has never been published or illustrated and cannot be located in the National Archaeological Museum. Moreover, the inventory of tomb 93 contains no weapons. The find remains unverified and is excluded from our catalogue.

Knossos, Palace, Corridor of the Sword Tablets

42 Pieces of gold plate with minute gold nails »such as are otherwise associated with wooden handles of swords and daggers« were reported by A. Evans from the Corridor of the Sword Tablets in the palace of Knossos¹⁰². The context has been recently dated to LH IIIA2¹⁰³. Unfortunately, the pieces have not been published in detail or illustrated and are not traceable anymore¹⁰⁴. Although Evans had clearly read Tsountas's article¹⁰⁵, the identification of the technique cannot be verified. Therefore, the site is excluded from our catalogue.

Technical Analysis

The Typology of Weapons

43 Our catalogue features 22 entries (Table 1). 11 of them belong to sufficiently preserved weapons (MYC 1–5, 11; DEND 1–2; PYL 1–2; KAK 1). The remaining (MYC 6–10, 12; PRO 1; VAPH 1–2; UNP 1–2) are very fragmentary and need not represent a weapon each. Among them:

- PRO 1 and MYC 12 belong certainly to two distinct weapons, because they are the only examples from the corresponding graves.
- MYC 9 and 10 certainly belong to two distinct weapons, because they are the only examples from Mycenae Shaft Grave V and the number of rivets is too large for a single weapon.
- VAPH 1 and VAPH 2 from the Vaphio tholos most probably belong to two distinct weapons, because the size of their rivets differs considerably.
- The rivet of MYC 7 and one rivet of MYC 6 from Shaft Grave IV are much smaller than other rivets decorated with gold embroidery from the same tomb and must have belonged to a distinct weapon (possibly a type A sword, which is otherwise not represented in our catalogue from Shaft Grave IV).
- The 7 large rivets of MYC 6 have various sizes (and different decoration) perhaps corresponding to 2 or 3 different weapons.

100 Xenaki-Sakellariou 1985, 320 f.

101 Xenaki-Sakellariou 1985, 267.

102 Evans 1935, 854.

103 For the LM IIIA2 date of the Corridor, see Driessen 1990, 7 n. 22 and Firth – Skelton 2016, 199 f. 203.

104 It is therefore unfortunate that Sandars mentions this example as a safe case of gold embroidery, Sandars 1961, 26 n. 67; Sandars 1963, 120 n. 6.

105 Tsountas 1897, 121–124.

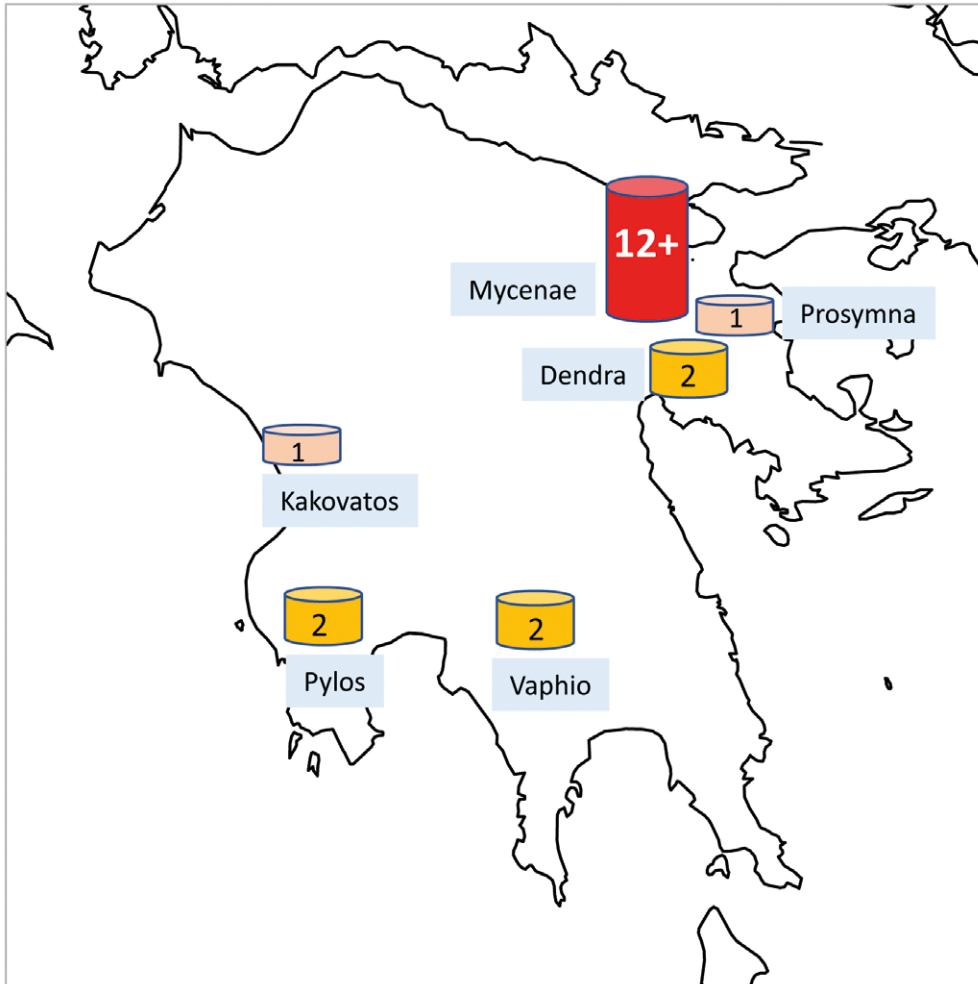


Fig. 27: Map showing the distribution of gold embroidery with the minimum number of objects per site

27

- The pommel MYC 8 might belong to one of the other weapons in Shaft Grave IV and the same is true for the fragments UNP 1 (see catalogue).
- UNP 2 most probably belongs to DEND 1 (see catalogue).

44 Thus, we can safely speak of a minimum of 9 (and possibly more) weapons represented by the small fragments. If we add this figure to the 11 sufficiently preserved examples, we have a minimum of 20 weapons in total. Geographically, they are distributed as shown in Fig. 27.

45 Among these weapons, 14 can be safely identified:

- 8 as swords (MYC 1–2; DEND 1–2; PROS 1; PYL 1; KAK 1; MYC 12 which, although containing only gold bars, has been associated by Tsountas with a short type A sword¹⁰⁶),
- 6 as daggers (MYC 3–5, 11; VAPH 1; PYL 2).

The remaining examples cannot be safely classified due to their fragmentary state.

46 Based on Sandars' and Kilian-Dirlmeier's typologies¹⁰⁷, the swords belong to the following classes (Table 2):

- 2 to type A (KAK 1; MYC 12)¹⁰⁸,
- 2 to type B – variant A (MYC 1–2),

106 The pommel MYC 8 most probably comes from a sword too.

107 Sandars 1961; Sandars 1963; Kilian-Dirlmeier 1993.

108 A rivet of MYC 6 may also come from a type A sword, but this is based only on the size of the rivets.

- 4 to type Ci (DEND 1–2; PYL 1; PRO 1); more specifically, DEND 1 belongs to sub-type 1a of Kilian-Dirlmeier's »Hörnerschwerter« and DEND 2 to sub-type 1b¹⁰⁹.

47 Type A swords range chronologically from MH/MM II to LH II and are concentrated in Crete and the Peloponnese¹¹⁰; one of our examples comes from Kakovatos (KAK 1) and dates to LH IIA; the second example, which comes from Mycenae chamber tomb 78 (MYC 12) and dates to LH IIIA1, belongs to a transitional type between type A and type C swords, which is common in LH II/IIIA1 and LH IIIA1¹¹¹. Type B swords date from MH III to LH IIIA and are concentrated mostly in the Argolid, especially at Mycenae, suggesting local manufacture¹¹²; both of our examples are from Mycenae (MYC 1–2) and date to LH I. Type Ci swords (Hörnerschwerter types 1a and 1b) date from LH I/IIA to LH IIIA and have a wide distribution in Mainland Greece and Crete¹¹³; our examples come from the Argolid (DEND 1–2, PRO 1) and Messenia (PYL 1) and date from LH IIA to LH IIIA.

48 The daggers belong to the following types, according to Papadopoulos' typology¹¹⁴ (Table 2):

- one to tangless type I variant A (MYC 5),
- two to tangless type II variant A (MYC 3–4),
- one is generic tangless (VAPH 1),
- one to cruciform variant B/C (Sandars' Ei/ii) (MYC 11),
- one is unspecified (PYL 2).

49 Tangless type I variant A daggers are mostly concentrated in the Argolid and Messenia and range in date from MH II to LH II–IIIA2, while tangless type II variant A daggers come exclusively from the Mycenae Shaft Graves and are probably of local manufacture¹¹⁵; all tangless examples with gold embroidery come from the Mycenae Shaft Graves (MYC 3–5) and date to LH I. »Generic tangles« daggers include examples which do not preserve sufficiently their butt and rivets, and cannot be attributed to type I or II; VAPH 1 falls into this category and dates to LH IIA¹¹⁶. The cruciform daggers – variant B/C (Sandars' Ei/ii) have a wide distribution with increased presence in the Argolid, and date mostly to LH II–IIIA¹¹⁷. Our example (MYC 11) cannot be closely dated but Xenaki-Sakellariou dates the context (Mycenae chamber tomb 81) to LH IIB and LH IIIA.

The Surface of Decoration: Hilts and Pommels

50 Gold embroidery was applied on the hilts and the pommels of bronze weapons. Structurally, hilts consisted of two parts:

- a metallic one, which included the butt and the tang (when present, for several daggers were tangless and type A swords had very short tangs),
- an organic one (made of wood or ivory¹¹⁸), which was fixed on the butt and the tang with rivets.

51 The organic part (on which gold embroidery was applied) could take two basic forms (Fig. 28)¹¹⁹:

109 Kilian-Dirlmeier 1993, 43. 46. The sword from Prosymna is very poorly preserved for further classification, and the sword from Pylos has not been published yet.

110 Sandars 1961, 25–27 and pl. 20; Kilian-Dirlmeier 1993, 26–34 and pl. 60.

111 Kilian-Dirlmeier 1993, 36 f.

112 Sandars 1961, 27 f. and pl. 20; Kilian-Dirlmeier 1993, 37–41.

113 Sandars 1963, 119–121 and map in page 118; Kilian-Dirlmeier 1993, 51–56.

114 Papadopoulos 1998.

115 Papadopoulos 1998, 51 and pl. 24.

116 Papadopoulos 1998, 14.

117 Sandars 1963, 132 f. and map in page 118; Papadopoulos 1998, 54–56 and pl. 26.

118 Animal bone would be another possibility, although it has not been safely attested in the examined examples.

119 The organic components of Aegean swords have been less systematically studied than the metallic parts, e.g. Karo 1930–1933, 202–205; Chapouthier 1938, 19–30; Xenaki-Sakellariou 1984; Kilian-Dirlmeier 1993, 20–26. 42. 50 f.; Papadopoulos 1998, 32 f. A detailed study is long overdue.

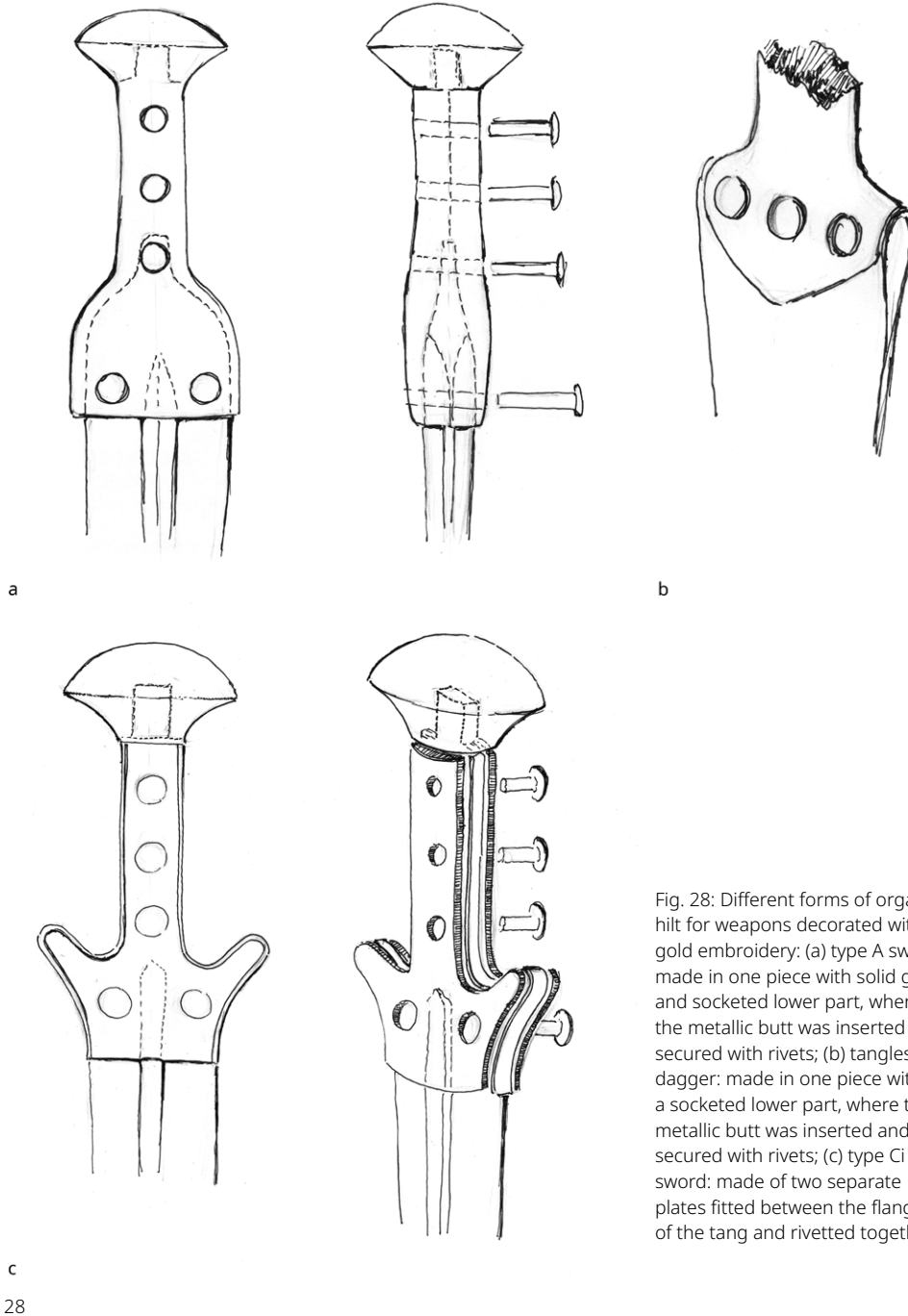


Fig. 28: Different forms of organic hilt for weapons decorated with gold embroidery: (a) type A sword: made in one piece with solid grip and socketed lower part, where the metallic butt was inserted and secured with rivets; (b) tangless dagger: made in one piece with a socketed lower part, where the metallic butt was inserted and secured with rivets; (c) type Ci sword: made of two separate plates fitted between the flanges of the tang and rivetted together

1. If the weapon had a long tang with side flanges (as in swords of type B and Ci and in various dagger types¹²⁰), the hilt consisted of two separate plates which were fitted in place and then rivetted (Fig. 28 c).
2. If the weapon was tangless (like most Early Mycenaean daggers) or had a short tang (like type A swords), the hilt could have been made in one piece, in the form of an inverted-Y, with a solid organic grip and a socketed lower part, in which the metallic butt was inserted and secured with rivets (Fig. 28 a. b). In type A swords and in most tangless daggers the entire shoulder would have been covered by organic material. Some tangless daggers had flanges on the side of the butt; in that case, only the upper part of the shoulder would have been covered by the organic material. The lower part of the hilt-plate could

120 For type B swords, see Karo 1930–1933, 204 f.; Sandars 1961, 22 and pls. 18. 19; Kilian-Dirlmeier 1993, 37 f. and pl. 9; for type Ci swords, see Sandars 1963, 119–121 and pl. 21; Kilian-Dirlmeier 1993, 42 f. and pls. 10. 11.



a



b



c

Fig. 29: Profiles of butts, showing the curvature of the organic hilt (thick in the middle, thin in the sides): (a) type B sword MYC 2; (b) sword or dagger MYC 9a; (c) X-ray of rivet MYC 10 (third rivet in Fig. 11 a)

take a triangular form with a pointed, flame-like end, or have a flat finish (see Fig. 3. 4. 5).

52 In some cases, detached double-headed rivets have been found close to type A swords (including KAK 1)¹²¹. This raises the possibility that the grip was made of two hilt-plates, fastened with rivets. However, such an arrangement would have weakened the strength of the handle, therefore the solution of a solid socketed grip is considered more likely.

53 Organic hilts presented a slight curvature in the area of the butt: they were thicker in the middle and thinner on the sides (Fig. 29). Their thickness varied from 0,5 to 2.3 cm, with most being ca. 1 cm. Those which preserve sufficient material for study have been identified as ivory (MYC 1, 4–5, 9–10; PVL 1; DEND 1–2; VAPH 1–2) and wood (MYC 8, 11). In one case, wood has been preserved in the area of the grip and ivory in the area of the butt (MYC 2). Mineralized organic material is preserved also in some

tiny fragments of unknown provenance (UNP 1), but it was not possible to identify it with certainty.

54 Pommels were made of organic materials (bone, ivory) or stone (e.g. alabaster, marble). They had domed upper part and almost flat underside with a circular or square socket for the tang and/or grip¹²². Gold embroidery is attested only on ivory pommels (DEND 1c, DEND 2a) (Fig. 17, 18). The alabaster pommel MYC 8 preserves gold bars close to the socket, but most likely they are leftovers from the decoration of the weapon's wooden grip (Fig. 8).

55 Because of their organic nature, hilt-plates and pommels are sensitive to the conditions of the burial environment and their co-existence with inorganic materials. Their preservation is quite poor and differs considerably from one case to another (see Appendix).

The Decorative Uses and Different Styles of the Technique

56 Gold embroidery was employed in two different ways, which produced distinct decorative effects. We call them **style A** (with subdivisions) and **style B**.

Style A

Objects: MYC 1–7, 9–10; UNP 1 and possibly MYC 8, VAPH 1–2

57 In this style the gold particles were used as decorative elements¹²³. This could take two forms:

- a. Gold particles were placed one after the other (lengthwise) in single rows to create linear motifs (e.g. meanders, zig-zag, parallel lines); large parts of the organic surface were left uncovered (Fig. 30).
- b. Gold particles were placed one after another in denser formation in single, double or triple rows, to create connecting spiral motifs; in some cases, rosettes were used to fill the centre of spirals, and smaller gold pieces to fill the triangular gaps created among the spirals; in that way, greater parts of the surface were covered (Fig. 31).



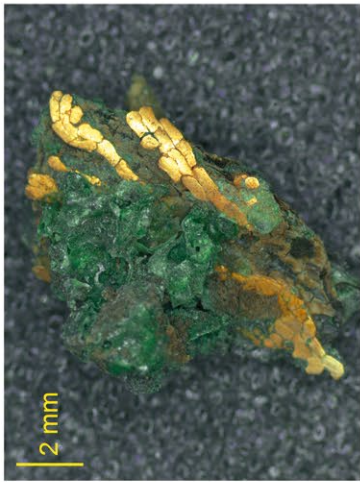
Fig. 30: Style Aa decoration (short gold bars placed in single rows to create linear or curvilinear motifs); top row: general view of the objects; middle row: details of the decoration; bottom row: microscopic views of gold bars in situ

122 For pommels with square socket, see Chapouthier 1938, 19–30; for round sockets, see Karo 1930–1933, 140 fig. 57 and pls. 76, 83.

123 Cf. Tsountas 1897, 122 f.; Xenaki-Sakellariou 1982–1984, 31.

STYLE Ab

UNP 1



MYC 9a



MYC 5



MYC 4



Fig. 31: Style Ab decoration (short gold bars placed in double or triple rows to create spiral motifs); top row: general view of the objects; middle row: details of the decoration; bottom row: microscopic views of gold bars in situ

Style B

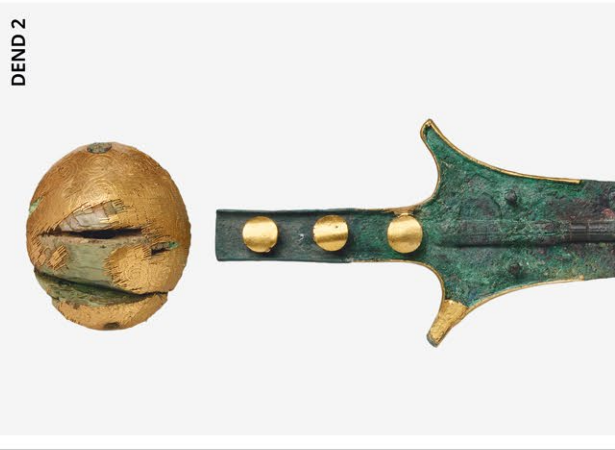
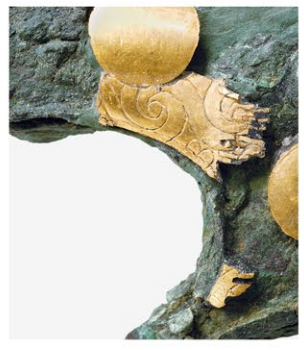


Fig. 32: Style B decoration (long gold bars placed next to each other in order to create a solid sheathing, which was then engraved with spiral motifs); top row: general view of the objects; middle row: details of the decoration; bottom row: microscopic views of gold bars in situ

58 Style A is safely attested at the Mycenae Grave Circle A (LH I) and perhaps in the Vaphio tholos (LH IIA). Sub-style Aa is attested on the type B sword MYC 1, and possibly on the dagger with the lion hunt scene from Shaft Grave IV (MYC 3) and on a detached rivet (MYC 6)¹²⁴. Sub-style Ab is attested on the sword MYC 2 and daggers MYC 4–5 from Shaft Grave IV, on swords or daggers MYC 9–10 from Shaft Grave V, and on detached rivets from Shaft Grave IV (MYC 6–7). Object UNP 1 includes fragments and detached bars which technically fit sub-style Ab; although their provenance is unknown, they might come from Mycenae, since the decorative style resembles closely that of MYC 9–10. VAPH 1–2 were also decorated in style Ab, but they seem more advanced technically (see below).

59 Style A is mostly attested on ivory hilts. Technically speaking, handles decorated in style A could be classed as early ›chryselephantine‹ works¹²⁵.

Style B

Objects MYC 11, DEND 1–2, PYL 1, UNP 2 and possibly MYC 12, PRO 1, KAK 1, PYL 2

60 In this style, the gold particles were packed tightly one next to another to create a solid sheathing over the entire surface of the hilt (pommel, grip and shoulder). This produced a smooth gold plateau, upon which interconnecting spirals were engraved¹²⁶ (Fig. 32).

61 The technique is safely attested on a dagger from Mycenae chamber tomb 81 (MYC 11) and on three type Ci swords: from the Dendra tholos (DEND 1), from the Dendra chamber tomb 12 (DEND 2), and from the ›Griffin Warrior‹ tomb at Pylos (PYL 1). To the same group belong certainly MYC 12, PRO 1 and KAK 1, the gold bars of which bear evidence of engraved decoration. UNP 2 has also pieces decorated in style B.

62 Style B decoration occurs in contexts dating to LH IIA (Kakovatos tholos B, Pylos ›Griffin Warrior‹ tomb) and LH IIB/IIIA1 or IIIA1 (e.g. Dendra tholos and chamber tomb 12, and Mycenae chamber tombs 81 and 78, Prosymna chamber tomb 2). Thus, it clearly postdates style A, although an overlap can be observed in LH IIA (when style Ab was in use at Vaphio).

Morphology of Gold Particles

63 The morphology of gold bars can only be studied microscopically. Unfortunately, the small number of items decorated in style A and the fact that often they are covered by layers of copper corrosion (e.g. MYC 6–7) makes it difficult to assess the morphology of gold bars in full detail. For that reason, we will start from style B, which has yielded more examples and numerous detached bars in a good state of preservation.

Style B (Fig. 33 a. b)

Dimensions of gold bars: L.: 2–8 mm; W.: 0.4–0.5 mm; L. of ›nail‹: 0.7–1.5 mm; Th.: 0.3–0.4 mm

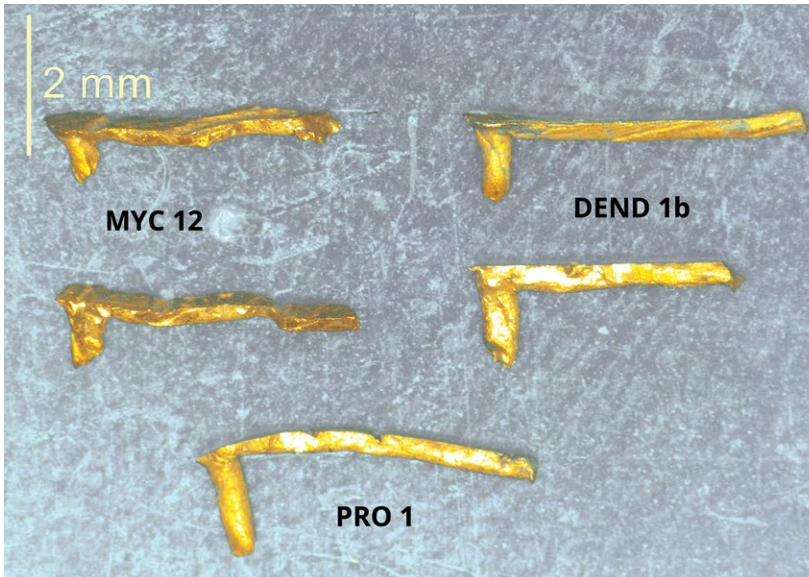
64 In this style, the gold bars had well-shaped L-form and standard size (in each object). As can be seen from detached pieces, the bent ›nail‹ was 1/3–1/5 of the horizontal stem in length and had pointed end. Helicoid marks running around the bodies of many bars (Fig. 13 d; 14 c. e; 20 c; 26 c. d; 33 b) suggest that they were made of twisted gold sheet, by the method of ›strip-twisting‹¹²⁷. In that method, a thin strip of gold sheet was twisted tightly into wire and then cut in pieces; one end of each piece was bent to

124 See Fig. 6 b. c.

125 For chryselephantine works of art in the Bronze Age and later period, see Lapatin 2001.

126 Tsountas 1897, 123; Xenaki-Sakellariou 1982–1984, 31–34; for a detailed description of the technique and experimental reconstructions, see Papadimitriou et al. forthcoming.

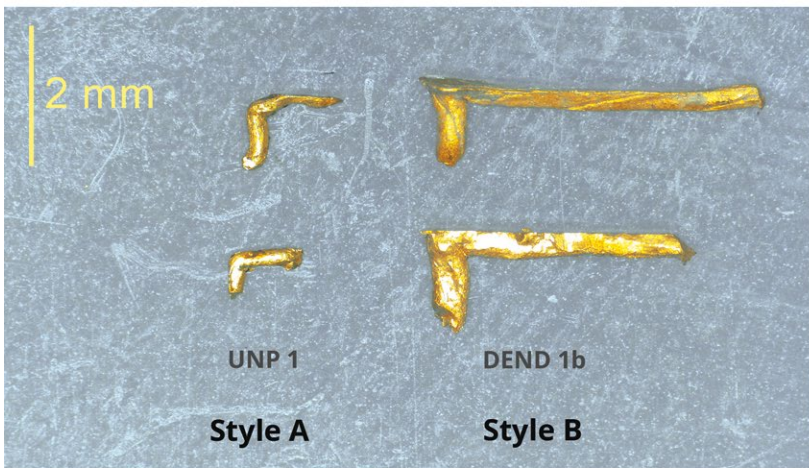
127 Oddy 1977, 85; Konstantinidi-Syvridi et al. 2014, 341–343 fig. 12.



a



b



c

33

create the ›nail‹¹²⁸. The thickness of twisted gold bars is 0.4 mm or less which means that the original sheet used for making the wire may have been as thin as 0.2 mm.

65 The upper surface of gold bars is always flat and bears the marks of engraving. By contrast, the underside has an irregular or rounded profile (Fig. 14 c. e; 15 e. f; 16 d; 20 c; 26 b; 33 a. b). This is because the original wire was roughly rounded in section and became flat through burnishing (see below).

Style A (Fig. 33 c)

Dimensions of gold bars: L.: 0.7–1.5 mm; W.: 0.4 mm; L. of ›nail‹: 0.5–0.6 mm

66 *Sub-style Aa*: The technique is known only from sword MYC 1 and perhaps from dagger MYC 3 and from a rivet in MYC 6. Microscopic examination shows that the bars had a bent ›nail-like‹ end (Fig. 1 e. f). However, no helicoid marks can be seen on their bodies. This raises doubts as to whether they were made of twisted wire or simply of gold foil, which was bent at one end.

Fig. 33: The morphology of gold bars: (a) style B bars (from MYC 12, DEND 1b and PRO 1); (b) helicoid marks of strip twisting around a gold bar from Mycenae chamber tomb 78 (MYC 12); (c) comparative view: golds bars of style A (UNP 1) and style B (DEND 1b)

128 For the details of the technique, see Konstantinidi-Syvridi et al. 2014, figs. 11. 12; Papadimitriou et al. forthcoming, fig. 9.

67 *Sub-style Ab*: This sub-style can be studied through a number of detached gold bars (Fig. 2 e; 22 f; 25 a–c; 33 c). The bars are L-shaped but have shorter stems than those of style B, and present significant variation in size and form (Fig. 25 c; 33 c). Some bars that were used to form rosette motifs in the centre of spirals are almost triangular in shape (Fig. 9 d; 10 d). The nail is 1/1–1/1,5 the length of the stem. Fragment MYC 9b preserves the underside of numerous gold bars and remains of the cloth in which the weapon was wrapped (Fig. 10). The densely packed ›nails‹ are shorter than those of style B but have pointed ends, which suggests that they were also made of twisted wire. The nails of VAPH 2 have slightly longer stem and seem more regular in construction (Fig. 22 d. f). As they are later in date (LH IIA) than the other examples (LH I), they may represent a transitional stage between style Ab and style B (which starts in LH IIA). All bars of style Ab have flat upper surface, which was the result of burnishing (see below).

Methods of Application

68 The method of application can be best studied on fragmented pieces. Style B has produced more examples and can be better documented, so we will start from that style.

Style B

69 The ivory pommels from Dendra (fragmentary DEND 1c and almost intact DEND 2a–b, Fig. 17. 18) show that the arrangement of the gold bars on the organic substratum was very symmetric. The pommel of DEND 2 has on its upper side (the dome) numerous parallel rows of tiny round holes, in which the nails were inserted (Fig. 18 d–f). The perfect placement of the rows suggests that the holes were pre-drilled. Profile images of DEND 1c show how the nails were embedded in holes drilled on curving surface (Fig. 17 d. e). On the underside of the pommel, the drilling of the holes was made not in parallel lines but in concentric circles (Fig. 18 h). The diameter of the holes can be measured in some cases at 0.6–0.7 mm (Fig. 17 f; 26 f).

70 Two detached fragments of grips, one from Dendra (DEND 1b) and one of uncertain provenance but probably from Dendra (UNP 2), demonstrate how the symmetry of design was achieved (Fig. 16 b–d; 26 a–c). In the underside of these pieces, we can see that the gold bars were placed one next to another in parallel rows, according to the ›brickwork‹ technique: the nails of every two rows were perfectly aligned, while the ones in between were set in the mid-length of the former. As a result, the projecting nails created a zig-zag pattern. In a fragment from the grip of MYC 11b we can see how the nails penetrated the wooden substratum (Fig. 13 b–d).

71 Decoration in the edges of the organic parts required different treatment. As can be seen in the underside of the pommel of DEND 2 (Fig. 18 g. h; 19 d. e), and at the finish of the decoration on the butt of MYC 11 (Fig. 12 f), the ends of the gold bars were carefully bent to follow the curvature of the ivory or wooden substratum; such bars have a characteristic curving profile (Fig. 14 b). But since bars were placed according to the ›brickwork‹ system, their perfect alignment at the edges meant that every second bar should be half the size of the other ones. Around rivets, the ends of the bars were bent to follow the curvature of the organic substratum and then pressed to create a kind of ›ridge‹ around the rivet (Fig. 12 c–d).

72 To keep the gold bars in place, it would be necessary to use some kind of adhesive. A resinous-like substance can be possibly observed in the pommel of DEND 2b (Fig. 19 c): at the bottom of an empty hole, we can see a circular feature which resembles the imprint of a nail. Such an imprint could have been made only if the material was still soft, i.e. if fresh resinous glue had been applied in the hole before the gold bar was set in place.

Style A

73 In this style, the system of placement was simpler. In sub-style Aa gold bars were placed in single rows, one after the other (Fig. 30). In sub-style Ab, they were placed in single, double or triple rows (Fig. 31). No ›brick-work‹ technique was used here; instead, the craftsmen aligned the nails of neighbouring bars as best as possible (Fig. 2 d; 5 f; 9 e; 11 d; 25 f). In fact, the parallel placement of nails should be used as a diagnostic feature of style Ab even if a tiny fragment is preserved.

74 The holes should have been pre-drilled in order to create the symmetric spiralfirm designs. Glue should have been also necessary, given that the nails which penetrated the ivory or wooden substratum were ca. 1 mm or less long (Fig. 10 c; 13 b–d; 17 d. e). Strangely, no empty holes have been found in objects with style A decoration.

Burnishing (Both Styles) and Engraving (Style B)

75 As mentioned earlier, the upper surface of the gold bars was burnished, probably with bronze or stone (e.g. agate) tools¹²⁹. The fine striations produced by that process are still visible in most examples (e.g. Fig. 1 e; 3 d; 5 d. e; 9 d; 12 e; 15 d; 20 b; 22 c). Burnishing flattened the upper part of the bars and helped their edges to coalesce into a homogeneous surface. In some style B examples, burnishing was so effective that no ›seams‹ were visible between neighbouring bars and the upper surface looked like gold foil (Fig. 15 d; 16 c. d; 22 c; 26 a. b).

76 The smoothed surface of style B weapons was then decorated by engraving. Engraving was made manually with bronze chisels¹³⁰. The quality varied considerably: in some examples we can see hasty work with shallow and irregular lines (Fig. 34 a), while on others the engraving is very neat, producing deep cuttings at even distances (Fig. 34 b).

Composition of Gold

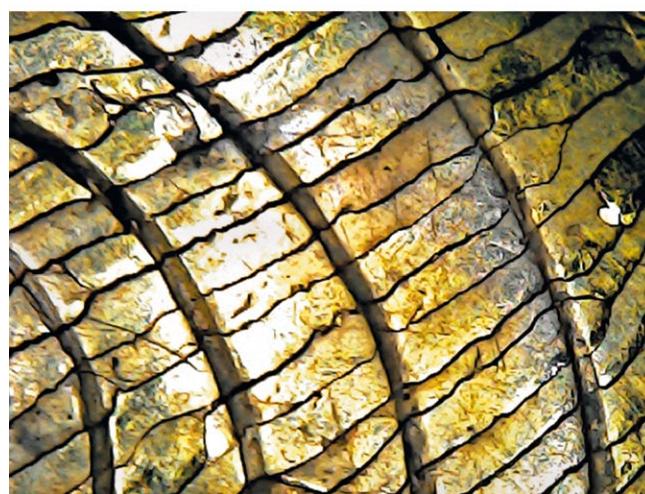
77 Eight weapons or parts of weapons decorated with gold embroidery were tested with XRF at the National Archaeological Museum by Dr Eleni Filippaki and Dr Yannis Bassiakos of the National Centre of Scientific Research ›Demokritos‹. They include:

- (weapons decorated in style A) MYC 1, MYC 4, MYC 5, MYC 9a, MYC 10
- (weapons decorated in style B) MYC 11a and 11b, MYC 12, DEND 1a, 1b and 1c.

78 Testing was made on remains of gold embroidery preserved on weapons, as well as on detached gold bars (MYC 12, DEND 1b). Measurements were also taken from gold-capped rivets for comparative purposes. The full analytical results are presented elsewhere¹³¹. Here we summarize the most crucial findings.



a



b

34

Fig. 34: The quality of engraving varied from one piece to another: (a) on MYC 11, the shallow and irregular lines show a hasty work; (b) on DEND 2, deep cuttings at even distances show a more careful work

129 See Papadimitriou et al. forthcoming.

130 See Papadimitriou et al. forthcoming.

131 Filippaki et al. forthcoming.

Objects with Type B Decoration

(MYC 11a and 11b, MYC 12, DEND 1a, 1b and 1c)

79 Nine impacts were taken from areas with gold embroidery and from detached gold bars. Six of them yielded gold content $\geq 98\%$, suggesting that the gold used was almost pure. MYC 11b (NAM 3112) yielded 90.11% and MYC 11a yielded 80.94% (with high percentages of copper), but this is probably due to the presence of copper oxidization from the bronze blade in these areas. The only impact on detached bars of MYC 12 yielded 94.9% gold and 4% silver, suggesting a different alloy.

80 We should note here that a measurement taken in the 1980s at the National Museum of Denmark from DEND 2a had also yielded gold content $> 98\%$ ¹³².

Objects with of Type A Decoration

(MYC 1, MYC 4, MYC 9a, MYC 10)

81 Six impacts were taken from areas decorated with gold embroidery but yielded diverse results. Gold varied from 26.09 to 74.36%, silver was always $< 3\%$, and copper varied from 24.69 to 72.43%. As in these objects the gold bars covered only part of the substrate, it is highly probable that impacts were affected by the oxidization of the underlying bronze. Therefore, the measurements should not be considered reliable.

Comparative Measurements on Gold-Capped Rivets

(MYC 1, MYC 4, MYC 5, MYC 9a, MYC 10, MYC 11a, DEND 1a)

82 Fourteen impacts were taken from the gold caps of rivets, for comparative purposes. All measurements taken from objects with style B decoration yielded gold content $> 98\%$, which means that the same type of gold was used as for gold embroidery. The impacts taken from objects with style A decoration yielded gold content 83.96–87.76%, with silver ranging 7.70–12.04% and copper 1.24–4.54%. Increased copper may be due to remnants of oxidized impurities from the blade. But the substantial quantities of silver suggest the use of a natural gold-silver alloy.

SEM-EDX Analysis

83 Subsequently, detached gold bars from two style A (VAPH 2, UNP 1) and three style B weapons (DEND 1b, PRO 1, KAK 1) were examined by Dr Filippaki and Dr Bassiakos with SEM-EDX. The results will be presented in detail elsewhere¹³³ but they largely confirm the observations made with XRF analysis: style B decoration was made of very pure gold ($> 95\%$) in all examples and sites (i.e. Mycenae, Prosymna, Dendra, Kakovatos), while style A decoration was made of a material with higher percentages of silver (8–12%) and a little copper ($< 3\%$).

84 It is thus clear that different types of gold were used in style A and style B decoration. In style A, a natural gold-silver alloy was probably used, while in style B the material was almost pure gold. As gold of such purity is not available in nature¹³⁴, it is probable that some kind of artificial enrichment took place before use. Gold-refining is unlikely, for the technique was unknown, or at least not used systematically before the 6th c. B.C.¹³⁵. However, there are other techniques of surface enhancement, such as depletion gilding, which were evidently used in the Bronze Age¹³⁶. Similar techniques may have been employed by Mycenaean craftsmen to produce the gold of style B weapons¹³⁷.

132 Hartmann 1982, 150 f. measurement Au 3249.

133 Filippaki et al. forthcoming.

134 Ramage – Craddock 2000, 10 f.

135 Williams – Ogden 1994, 14; Craddock 2000.

136 Craddock 2000, 27–31; see also Grimwade 1999; Sparavinga 2016.

137 See Filippaki et al. forthcoming for detailed discussion.

Quantities

85 At the Dendra tholos Persson found ca. 5,000 detached gold bars next to the type Ci sword DEND 1¹³⁸ (Fig. 16 a). A few more bars were preserved on the hilt and on a fragment of the pommel. In chamber tomb 78 of Mycenae, Tsountas found ca. 1,000 gold bars (MYC 12) (Fig. 14 a).

86 For the purposes of the present study, we have calculated the number of gold bars used on two well-preserved examples of gold embroidery decoration, namely the pommel from the sword of chamber tomb 12 of Dendra (DEND 2) (Fig. 18 d. g) and the hilt of the dagger from chamber tomb 81 of Mycenae (MYC 11), which preserves its grip and guard decoration almost intact (Fig. 12 a. b).

87 For DEND 2, it has been estimated that the underside of the pommel had a total of ca. 1,200 gold bars and the dome ca. 1,800 bars. This means that ca. 3,000 bars would have been needed for the decoration of a pommel of that size. In MYC 11, each hilt plate was decorated with ca. 750 gold bars, which means that ca. 1,500 bars would have been needed in total. Given that a type Ci sword was significantly larger than a dagger, and would probably require the use of more gold bars, it seems that Persson's calculation of 5,000 gold bars for a type Ci sword was more or less accurate.

88 The overall weight of detached gold bars for DEND 2 is 40.77 gr; the weight of detached bars for MYC 12 is 7.65 gr. The quantity is small and the overall price for the raw material must have been quite low. This suggests that the value of gold embroidery was not based on the volume of gold used but on the intricacies of the technique.

Comparanda

89 As noted by several scholars, there are no good parallels for gold embroidery in the Eastern Mediterranean¹³⁹.

90 The only known parallels come from very distant areas and cultures: the Armorican culture in NW France and the Wessex culture in South England¹⁴⁰. In these areas, daggers decorated with the ›gold-stud technique‹ or ›incrustation en or‹ were deposited in very wealthy tumuli¹⁴¹. The gold particles were tiny (< 3 mm) and looked like nails, i.e. they were cylindrical rather than L-shaped. They were inserted in tiny pre-drilled holes which formed zig-zag or chevron patterns on the wooden hilts¹⁴². Although there are differences in the details, the overall concept and the stages of manufacture are quite similar to the LH I Mycenaean style A¹⁴³.

91 According to ¹⁴C data, Armorican tumuli date from the 22nd to the 18th c. B.C.¹⁴⁴. Among Wessex contexts, Wessex I dates from the 21st to the 18th c. B.C., but transitional Wessex I/II (to which the latest example of gold-stud decoration belongs) may continue in the 17th or even the 16th c. B.C.¹⁴⁵. This allows for some overlap with the LH I and perhaps LH IIA in the Aegean¹⁴⁶. The geographical distance is vast, but we know that

138 Persson 1931, 35 f.

139 See above section ›History of Research‹.

140 See Eluère 1985; Corfield 2012; Papadimitriou et al. 2021.

141 Briard 1984, esp. 87–92; Corfield 2012; Nicolas et al. 2015, 127–130.

142 Papadimitriou et al. 2021, fig. 1.

143 Papadimitriou et al. 2021, 30 f.

144 Nicolas et al. 2015, 125 f.

145 Needham et al. 2010; Papadimitriou et al. 2021, 31 f.

146 Gerloff 2007, 137–140; Gerloff 2010, 622–633 and 607 fig. 3. We should note that the absolute chronologies presented here are based of ¹⁴C dates produced with the calibration curves valid at the time of the corresponding studies. The recent readjustment of the calibration curve for the mid-2nd millennium B.C. according to IntCal20 is expected to lower the absolute dates by a few decades, see various papers in *Radiocarbon* 62, 4 (September 2020).

the Mycenaeans probably imported amber from Southern England at the same time¹⁴⁷, so a case of technological transfer should not be excluded (note that gold embroidery occurs at both Mycena and Kakovatos, which are the sites with the greatest amounts of amber in Greece).

Discussion

Preservation

92 With the exception of MYC 11, DEND 2 and PYL 1, the preservation of hilts and pommels decorated with gold embroidery is poor to very poor. In several cases, only tiny gold bars survive (e.g. MYC 12, PRO 1). This poses a problem in identification. If many such bars are preserved (e.g. MYC 12), the excavator will certainly note their presence and distinct form. But if only a few of such bars are available, they may pass unnoticed – especially since they usually occur in rich tombs with quantities of gold and other impressive artefacts. What is more, the technique is difficult to identify even in relatively well-preserved items. For example, the piece on the grip of DEND 1 is very well burnished and looks like engraved gold sheet (Fig. 15 c. d), while in other cases gold bars are concealed in copper corrosion compounds (e.g. Fig. 2 a–d; 21 c–e; 23 b–d; 35 b). We hope that this paper will facilitate the identification of pieces with gold embroidery in future (see Appendix).

Contexts

93 Gold embroidery is safely attested in six Peloponnesian sites and ten contexts, including some of the most famous Mycenaean tombs: the Mycenae Shaft Graves IV and V, the Dendra and Vaphio tholoi and the Pylos ›Griffin Warrior‹ tomb. These tombs are usually described as ›chiefly‹ or ›royal‹ sepulchres. The Kakovatos B tholos may have originally been equally wealthy but was heavily disturbed and today its contents seem unimpressive compared to those of the neighbouring tholos A¹⁴⁸. In the Argolid, the technique occurs also in four chamber tombs: Mycenae 81 and Prosymna 2 were among the largest and wealthiest in the corresponding cemeteries and had decorated facades¹⁴⁹; Dendra chamber tomb 12 was small but very rich, while Mycenae 78 was the least wealthy of all.

94 Among the ten contexts, which contained weapons with gold embroidery, only in three do we have bioarchaeological data for the sex and age of the deceased, namely in Shaft Grave IV, the Dendra tholos tomb and the Pylos ›Griffin Warrior‹ tomb (Table 3). They were adult males at various stages of their life. In one case (Dendra chamber tomb 12), the skeleton has been identified as male by the excavator, but it is not clear if the bones have been examined by a physical anthropologist or not¹⁵⁰.

Chronology and Distribution

95 Based on the dating of contexts, gold embroidery was used between LH I and LH IIIA. Table 4 shows the chronological distribution of sites, context types and weapons. In LH I the technique was restricted both geographically (Mycenae) and so-

147 E.g. Harding et al. 1974, 153; Harding 1990, 141–143; Maran 2013, 149; Sgouritsa-Polychronakou – Nikolentzos 2016, 235.

148 Müller 1909.

149 Which is a rare feature in chamber tombs, see Kontorli-Papadopoulou 1987, 152 f.; Sgouritsa 2011, 743–747.

150 Åström 1977, 18.

cially (exceptionally rich graves). In LH IIA, weapons with gold embroidery continued to occur in tombs of very high status, but now also outside the Argolid (Vaphio, Kakovatos, Pylos). In LH IIB–IIIA, they became more widely available, at least in the Argolid, where they occur both in tholoi and in chamber tombs.

96 Mycenae has produced the majority of specimens (at least 12 out of a minimum of 20) and is the only site where the technique occurs in more than one periods and in all decorative styles (Aa, Ab and B). In other sites, there are only one or two examples dating to a single period (Fig. 27, Table 4). There can be no reasonable doubt that Mycenae was the main production centre and the place where the technique was invented (or introduced).

Technical Evolution

97 Our study suggests clear stages of technical evolution. Style A is attested in LH I at Mycenae (MYC 1–7, 9–10) and in LH IIA at Vaphio (VAPH 1–2). The earliest example is probably the type B sword MYC 1, which is decorated with sparse meandric motifs that »seem to expand indefinitely« (style Aa)¹⁵¹. This is soon (within LH I) replaced by denser and more elaborate spiraliform motifs (style Ab, MYC 2, 4, 5, 9, 10). The gold bars used in these examples are very small, with short stems and have no standard form (Fig. 2 e; 25 a–c; 33 c). This may be due to the fact that the artisans used a natural gold-silver alloy (ca. 84–88% gold with ca. 8–12% silver), which is quite hard and difficult to shape in such minute dimensions. At this stage, gold embroidery was most often applied on the hilts of dagger; we have no safe evidence for the decoration of pommels.

98 The same style continues in LH IIA (VAPH 1–2) but now the bars become slightly longer and more standardized (Fig. 22 f), and the artisans make an effort to coalesce the edges of neighbouring bars into a homogeneous surface via burnishing (Fig. 22 c–e).

99 These trends will crystalize soon into a new style B. Most evidence for this style comes from LH IIB/IIIA1 contexts (DEND 1, DEND 2, PRO 1, MYC 11, MYC 12), although there are also safe and probable LH IIA examples (KAK 1, PYL 1 and 2)¹⁵². Archaeometric analyses suggest that artisans start now to process the gold, most probably using techniques of surface enhancement, in order to acquire a pure content ($\geq 98\%$). Pure gold has a great advantage: it is very soft and facilitates work in microscopic dimensions (mainly the bending of nails¹⁵³). This allows for the standardization of gold bars (Fig. 33 a). Artisans start covering the entire hilt with such bars. Then they burnish them to homogenize the surface and add decoration with engraved spirals. In this stage, the technique is used mostly on type Ci swords (DEND 1, DEND 2, PYL 1, PRO 1) and is also applied to pommels (Fig. 17 c; 18 d. g). The technique does not seem to continue after LH IIIA.

Relation with Other Special Metalworking Techniques

100 Gold embroidery is sometimes associated with metal inlay. In MYC 3, the two techniques co-exist on the same surface (Fig. 3). In VAPH 1, the gold sheet seen on one side of the fragmentary blade and the deep cutting on the other side of the blade may be remnants of inlaid decoration (Fig. 21 a. b).

101 Quite often, daggers or metal vessels with inlaid decoration were deposited in the same tombs as gold embroidery (Mycenae Shaft Graves IV and V, the Vaphio

151 »αλείρωσ εκτατό κοσμήμα« according to Xenaki-Sakellariou 1982–1984, 31.

152 The Pylos »Griffin Warrior« tomb did not contain ceramic vessels, and the LH IIA date is based on sherds from the filling, therefore it should be considered as tentative Davis – Stocker 2016, 635; Stocker et al. forthcoming.

153 See Papadimitriou et al. forthcoming.

tholos, the Dendra tholos, and Dendra chamber tomb 12)¹⁵⁴. This may have not been a coincidence. Inlaid daggers have approximately the same chronological range as gold embroidery (LH I to the end of LH II or LH IIIA) and very similar geographical distribution (Mycenae, Dendra, Prosymna, Vaphio, Pylos, Routsis, Pharai, Akrotiri), with the majority of examples coming from Mycenae; and, like gold embroidery, in LH I, the technique of metal inlay was restricted to Mycenae¹⁵⁵. These facts make it very probable that the two techniques were performed in the same workshop(s). In fact, Papadopoulos considered gold embroidery as a variant of metal inlay¹⁵⁶.

Craftsmanship and Workshops

102 Gold embroidery required exceptional skills in handling minute pieces of gold, bending them, and setting them orderly on the organic surface, possibly with the help of some kind of organic glue. Efforts to experimental reconstruction suggest that standard tools would not suffice for these delicate tasks; it is probable that Mycenaean artisans had to produce custom-made tools for this purpose¹⁵⁷.

103 Excellent sight was another prerequisite. The gold bars of style A have the size of a mosquito. One would need perfect eyesight or visual aids (e.g. lenses) to work in that dimension. Given that evidence for the use of lenses in the Bronze Age is meagre¹⁵⁸, one should imagine artisans of young age who had trained for years as apprentices next to master goldsmiths.

104 Concerning the question of workshops, the chronological and geographical distribution of finds (Fig. 27, Table 4) suggests that the Argolid, probably Mycenae itself, was the main centre of production and dissemination both for style A and for style B.

105 Technical analysis supports the idea of one or two workshops. The technique used in style A is homogeneous among most examples (Fig. 30. 31). One may discern variation in design (e.g. with single, double or triple rows of gold bars) but the method of application is practically identical, at least among MYC 5, MYC 9, MYC 9, MYC 10, UNP 1. Only VAPH 2 differs considerably; it has more standardized gold bars and a well burnished flat surface (Fig. 22), which suggest either a different workshop or the same workshop at a developed stage of work.

106 The type Ci swords decorated with gold embroidery in style B present striking technical similarities. DEND 1, DEND 2 and perhaps PYL 1 are almost identical in form, with three gold-capped rivets on the grip, two on the butt, side flanges (gold-sheathed in the cases of DEND 2 and PYL 1), and fully decorated ivory pommels (Fig. 15. 16. 17. 18. 19)¹⁵⁹. PRO 1 may have also been very similar¹⁶⁰. The L-shaped bars of that stage are highly standardized (see Fig. 33 a). More importantly, the gold used in DEND 1, DEND 2 and PRO 1 had identical composition, amounting to $\geq 98\%$. If PYL 1 shares the same composition, then we can quite convincingly speak of a single workshop.

107 The dagger MYC 11 is less carefully made than the type Ci swords but shares the same composition of gold ($\geq 98\%$). This may mean that the dagger was made in the same workshop by a less skillful (or younger) craftsman, or that enriched gold circulated freely among goldsmiths working on that technique.

154 Laffineur 1974, cat. 1–2. 18 (Shaft Grave IV). 3–6 (Shaft Grave V). 14–17 (Vaphio tholos). 20 (Dendra tholos). 22? (Dendra chamber tomb 12); Xenaki-Sakellariou – Chatziliou 1989, cat. 1–2. 18 (Shaft Grave IV). 3–6 (Shaft Grave V). 14–17 b (Vaphio tholos). 20 (Dendra tholos). 22 a–22 b (Dendra chamber tomb 12).

155 Laffineur 1974, 27 f.; Xenaki-Sakellariou – Chatziliou 1989, 14.

156 Papadopoulos 1998, 42.

157 Papadimitriou et al. forthcoming; for a full reconstruction of the technique, see <https://doi.org/10.34780/3vj2-e292>.

158 Sines – Sakellarakis 1987; Plantzos 1997.

159 For PYL 1, see Davis – Stocker 2016, 634. 650 fig. 13.

160 See Steinmann 2020, 389 fig. 8.

108 The idea of a younger, less experienced artisan is attractive for one more reason: gold embroidery was used from LH I to LH IIIA, i.e. roughly for two centuries. This means that the technical knowledge was transferred across several generations. Such transfer cannot take place without sustained practice and without the training of apprentices.

Function of the Embroidered Weapons

109 The distinctive social role of the persons who owned weapons decorated with gold embroidery is emphasized by the large amounts of valuable offerings that furnished their burials (e.g. other prestigious weapons, metal and stone vessels, ornaments). Particularly important are finds that symbolized ownership of property or were associated with administrative or religious duties: metal signet rings (2 in Mycenae Shaft Grave IV, 3 in the Vapheio tholos tomb, 4 in the Pylos ›Griffin Warrior‹ burial), bezeled finger rings made of a combination of precious metals (4 with the ›king‹ in the Dendra tholos tomb), and sealstones (24 in the Vapheio tholos tomb, more than 50 in the ›Griffin Warrior‹ burial).

110 It has been suggested that weapons decorated with gold, like inlaid daggers and others (which would have been very fragile in handling), were status symbols, used as ceremonial equipment and not in actual battles¹⁶¹. The same applies to weapons decorated with gold embroidery. Their deposition in very rich graves suggests that they were perceived as prestige objects, which acquired value from the time and labour spent for their decoration¹⁶².

Epilogue

111 Like most of the specialized methods of metalworking, gold embroidery belongs to the ›golden era‹ of the Mycenaean art (the period before the formation of the palaces), when the most exquisite artifacts in all materials and media were produced¹⁶³ and deposited in exceptionally wealthy tombs in the Argolid, Messenia and Laconia¹⁶⁴. The luxurious weapons are found along with vessels of precious metals or stone, beads of gold and semi-precious stones and quantities of ivories (mirrors, combs etc.), while at the same time, pottery is either scarce or totally absent¹⁶⁵, indicating that the type and material of the artifacts that furnished elite burials was of major significance from the Early Mycenaean period onwards. Depositing such artifacts was a practice that aimed to highlight social power, among others through the withdrawal of precious materials from circulation, in order to honour the deceased and at the same time, ensure a ›family hoard‹¹⁶⁶.

161 Sandars 1963, 123; Xenaki-Sakellariou 1984, 129; Papadopoulos 1998, 47.

162 See Persson 1931, 62 f.

163 Poursat 2014, 66–68.

164 Konstantinidi-Syvridi – Paschalidis 2015, 408. 414 f.

165 E.g. Davis – Stocker 2016, 635; Demakopoulou – Aulsebrook 2018.

166 Paschalidis 2018, 464 n. 176. 177 for discussion and selected bibliography.

Catalogue

112 The catalogue focuses on the decoration of the hilts and the pommels. For full description of the weapons, the readers are referred to the original publication. Here we record only their dimensions and type.

Abbreviations:

- NAM = National Archaeological Museum, Athens
- AMN = Archaeological Museum of Nauplion, Ephorate of Antiquities of the Argolid
- AMP = Archaeological Museum of Chora at Pylos, Ephorate of Antiquities of Messenia
- NMD = National Museum of Denmark, Copenhagen
- D. = diameter; est. = estimated; L. = Length; pres. = preserved; Th. = Thickness; W. = Width

Typology:

- Sword type: according to Sandars and Kilian-Dirlmeier¹⁶⁷
- Dagger type: according to Papadopoulos¹⁶⁸

Mycenae

Grave Circle A – Shaft Grave IV

MYC 1

Bronze sword (NAM P 435) – Fig. 1

Dimensions: L. 54 cm; W. 7.4 cm. Sword type: B

Publication: Schliemann 1878, 282 f. fig. 449; Karo 1930–1933, 103 pls. 73. 74. 87; Xenaki-Sakellariou 1982–1984, 31 pl. 1 b; Andreadaki-Vlazaki – Balaska 2014, 81 (C. Paschalidis)

Dimensions of hilt: H. pres. 8.2 cm; W. 7.3 cm; Th. (of each plate) 1 cm. Material: ivory. Style of decoration: Aa

One hilt-plate is preserved in quite good condition (missing the upper end and a large piece to the right of the last rivet of the tang). The inner layers have disintegrated but the slightly curving surface, where gold embroidery was applied, has survived. The thickness of the hilt-plate can be calculated to be 1 cm. Its lower border is slightly arched. The other hilt-plate has dis-

integrated. Because of the conservations material that covers most of the organic substrate, it is not possible anymore to identify with certainty the original material. Karo describes it as ivory.

The surface of the hilt is decorated in gold embroidery with various linear motifs (lines, framed diagonal lines, zig-zags, swastikas) which create a meandric composition. The motifs are formed by minute L-shaped gold bars, which have been set one after the other in sparse rows. In a few places, where the bars can be seen in profile, the bent end of the L-shaped bars is visible. Decoration does not continue on the sides of the hilt, which were probably flanged.

MYC 2

Upper part of bronze sword (NAM P 408) – Fig. 2

Dimensions: L. 8 cm; W. 7.3 cm. Sword type: B

Publication: Karo 1930–1933, 100 and pl. 99

Dimension of hilt: H. pres. 8 cm; W. 7.3 cm; Th. (of each plate) 0.35–1.00 cm. Material: wood and ivory. Style of decoration: Ab

The hilt-plates have disintegrated almost entirely; remains of gold embroidery are preserved only close to the flanges and near a detached rivet, into the remains of the organic substrate and copper corrosion compounds. The X-ray shows the neat (and probably linear) arrangement of L-shape bars close to the edges (Fig. 2 c). Close to a rivet (Fig. 2 c, inset image) we can see a curving line, which probably indicates the inception of a spiral. The curving line is made of a triple row of gold bars, very much like the spirals in MYC 5. Karo describes the hilt-plate as being made of ivory and the grip (part of which is preserved in a detached nail) of wood.

MYC 3

Bronze inlaid dagger with hunting scene (NAM P 394) – Fig. 3

Dimensions: L. 23.7 cm; W. 6.3 cm. Dagger type: tangles type II variant A

Publication: Karo 1930–1933, 95–97 figs. 25–27 pls. 93. 94; Laffineur 1974, 7 no. 1; Xenaki-Sakellariou 1982–1984, 34 no. 1; Xenaki-Sakellariou – Chatziliou 1989, 25 f. no. 1 pl. 1; Papadopoulos 1998, 10 no. 37 pl. 5, 37

Dimension of hilt: H. unspecified; W. 6.3 cm. Material: corroded, unclear. Style of decoration: Aa?

167 Sandars 1961, 1963; Kilian-Dirlmeier 1993.

168 Papadopoulos 1998.

Very little of the hilt remains, only in the area of the butt, and it is strongly corroded. On the side of the hunting scene, close to the right edge of the butt, a row of three L-shaped gold bars is preserved among green copper corrosion compounds. The bars look like the bars of the sword MYC 1, and since no curvature is observed, it is possible that this dagger was decorated with the linear motifs of the style Aa technique.

MYC 4

Bronze dagger (NAM P 396) – Fig. 4

Dimensions: L. 26.1 cm; W. 6.9 cm. Dagger type: tangles type II variant A

Publication: Karo 1930–1933, 97 no. 396 pls. 89, 90; Xenaki-Sakellariou 1982–1984, 31 pl. 2 b; Papadopoulos 1998, 10 cat. 38 pl. 5.

Dimension of hilt: H. pres. 3.6 cm; W. max. 6.9 cm; Th. (of each plate) 0.5 cm. Material: ivory. Style of decoration: Ab

Part of the triangular hilt-plates are preserved on both sides of the butt with remains of gold embroidery. On one hilt-plate, a large section of gold embroidery is preserved among three rivets and smaller parts are preserved along the edges. The larger section has a rhomboid shape and depicts running spirals framed by straight or curving (close to the rivets) lines. The motifs are made with single rows of gold bars, and occasionally with double. The parts that lay along the edges are withing copper corrosion compounds. However, we can see that they are made of L-shaped gold bars and that in some cases double rows were used. On the other side, only a few gold bars along the flange of the shoulder are preserved.

MYC 5

Bronze dagger (NAM P 397) – Fig. 5

Dimensions: L. 18.3 cm; W. 5 cm. Dagger type: tangles type I variant A

Publication: Karo 1930–1933, 97, pl. 90; Papadopoulos 1998, 5 no. 13 pl. 1

Dimension of hilt: H. 3.5 cm; W. est. 5 cm; Th. (of each plate) 0.2–0.7 cm. Material: ivory. Style of decoration: Ab

One side of the butt preserves the upper (superficial) part of the triangular hilt-plate, which was decorated with gold embroidery (the lower parts have disintegrated). Decoration consisted of interconnecting spirals, both full and partial (close to rivets or the edge of the hilt plate). The spirals were created by placing gold bars of varied size in single, double or even triple rows. The gold bars were L-shaped, as can be seen at the edges of the decoration. The centre of each spiral was marked by a small knob. The triangular spaces among spirals were left undecorated, probably creating

an interesting contrast between gold and ivory. The decoration continued on the shoulder, as we can see by part of a spiral preserved over the central rivet.

MYC 6

Bronze rivets with oxidized remains of the grip (NAM P 464) – Fig. 6

Dimensions: large rivets: L. 2–2.8 cm; D. head 1.3 cm; small rivets; L. 1.2 cm; D. head 0.7 cm. Weapon type: unknown (the small ones probably belong to type A swords)

Publication: Karo 1930–1933, 105 no. 464 pl. 99

Dimensions of hilt: L. and W. unknown; Th. large rivets 0.9 cm; small rivets: 0.5 cm. Material: probably ivory. Style of decoration: A

Under this number 13 double-headed rivets of various dimensions are grouped. They are corroded and several of them preserve small parts of their ivory(?) hilts. Under X-ray it became evident that at least 7 large and 1 small rivets (see Fig. 6 a) preserved remains of gold embroidery decoration on the hilt. In two large rivets, it was possible to discern patterns of decoration: one was decorated with single rows of bars forming curvilinear (probably spiral) motifs (type Aa) (Fig. 6 b, c), and another with double rows forming spiral motifs (type Ab) (Fig. 7 f, h). Other examples preserved only a few bars not allowing to discern the motif (Fig. 6 d, e).

MYC 7

Small bronze rivet with corroded remains of the grip (NAM P 483) – Fig. 7

Dimensions: L. 1.6 cm; D. head 0.8 cm. Weapon type: unknown

Publication: Karo 1930–1933, 108

Dimensions of hilt: L. and W. unknown; Th. 1.2 cm. Material: ivory? Style of decoration: A

Group of 4 rivets from weapons (only two identified at NAM), one of which preserves part of the ivory hilt around the head. Under X-ray it became evident that the organic material was decorated with L-shaped gold bars. No motifs can be identified, but the bars seem to be arranged in single rows, which suggests decoration in style A.

MYC 8

Alabaster pommel with corroded remains of the tang (NAM P 485) – Fig. 8

Dimensions: H. 3.6 cm; D. 6.3 cm. Sword type: unknown

Publication: Karo 1930–1933, 109 no. 485 pl. 76

Dimensions of grip: D. 3.2 cm; L. unknown. Material: wood. Style of decoration: unknown

Due to its relatively large size, the pommel has been attributed by Karo to a sword rather than a dagger. It is made of alabaster and does not seem to have been decorated with gold embroidery. However, on the edge of the circular socket, i.e. where the pommel comes in contact with the tang, there are oxidized remains of the sword's hilt – identified as wooden by Karo. Within wood remains mixed with blue and green copper corrosion products, a couple of L-shaped gold bars are still visible. It is not possible to identify the style of decoration.

Grave Circle A – Shaft Grave V

MYC 9a and b

Fragments from the hilt of a dagger or sword (NAM P 779b, 779b-bis) – Fig. 9. 10

Dimensions: a) W. 5.6 cm; H. pres. 2.2 cm; D. pres. 1.4 cm. b) 1.7 × 1.5 × 0.6 cm

Publication: Karo 1930–1933, 142 no. 779 pl. 99

Dimensions of the hilt: W. 5.6 cm; H. pres. 2.2 cm; Th. (of each plate) 1.4 cm. Material: ivory? Type of decoration: Ab

a) The upper part of the butt of a dagger or sword with two horizontal rivets. On both sides, fragments of the hilt-plates are preserved, decorated with gold embroidery. The material is difficult to identify today due to corrosion, but Karo describes it firmly as ivory. The most extensive decoration can be seen between one rivet and the shoulder. It consists of interconnection spirals with rosettes in the centre and filling triangles. The spiral motifs are created by triple or (rarely) double rows of L-shaped gold bars. The petals of the rosettes are created by one long and two short gold bars. The piece reveals the morphology of the hilt-plates and demonstrates that, in order to adjust gold embroidery on the curving surface, the Mycenaean goldsmith had to work from different directions.

b) Tiny fragment preserving on one side the imprint of a cloth and on the other the ›nails‹ L-shaped gold bars. As no ivory or wood is preserved, the gold bars looked like randomly placed detached elements. But when the piece was x-rayed, it became clear that they were in order forming a motif of interconnecting spirals with rosettes in the centre and filling triangles among the spirals. The decoration is identical to that of MYC 9a and they should belong to the same weapon. The piece has a slight curvature, which suggests that it comes from the butt rather than the grip. Moreover, the preserved arc imprinted on the upper part of copper corrosion (see Fig. 10 a) suggests that it comes from the circumference of a rivet.

MYC 10

Four rivets from the hilt of a weapon (NAM 779a) – Fig. 11

Dimensions: H. pres. 1–1.7 cm; Diam. heads 1.3–1.4 cm. Weapon type: unknown, possibly dagger

Publication: Karo 1930–1933, 142 no. 779, pl. 99

Dimension of hilt: Th. max. 0.7 cm; L. and W. unknown. Material: ivory. Style of decoration: Ab

Five double-headed gold-capped bronze rivets, some of which are pressed on one side and thus probably from the edges of dagger hilts. Three of them (?) preserve remains of the organic hilt decorated with gold embroidery. In one of them, the decoration consists of interconnecting spirals and is similar to MYC 9 and MYC 5. For the technique of application, see MYC 9. The rivets are corroded and locally the decoration is covered with a layer of green copper corrosion products. The X-ray of the most extensively preserved fragment (Fig. 29 c) shows that gold embroidery extended to the edge of the butt, where the two hilt-plates met. Although the rivets share the same inventory number as MYC 9, they cannot come from the same weapon because their number is too large for a single sword or dagger. Moreover, they have tapered heads, which suggests that they were placed on the butt (not the grip) of at least two weapons.

Chamber Tomb 81

MYC 11a and b

Part of the hilt and blade of a bronze dagger (NAM P 3111, 3112 – Fig. 12. 13

Dimensions: a) pres. L. 12 cm; W. of shoulders 5.7 cm. b) L. 2 cm; W. max. 1 cm.

Dagger type: cruciform variant B/C (Sandars' Eii/ii)

Publication: Tsountas 1897, 109. 122 table 7, 4. 5; Xenaki-Sakellariou 1982–1984, 31 f. no 1 pl. 3 a; Xenaki-Sakellariou 1985, 228 f. pl. 107

Dimensions of hilt: L. 9.9 cm; W. of butt 5.7 cm; D. of grip 1.8 cm. Material: wood. Style of decoration: B

The hilt is preserved almost complete. Only the upper part (right above the upper rivet) is destroyed. The detached piece (b) comes from the destroyed area; its arched form suggests that it was originally placed along the grip axis, most probably just above the upper rivet. The hilt consists of two separate wooden hilt-plates attached to the flanged butt and the tang and secured with gold-plated rivets. The hilt plates are flat in the area of the butt but strongly curved in the area of the grip (where they have almost semi-circular section). Gold embroidery covers both sides. L-shaped gold bars are set on the wood in dense formation that forms a rough ›brickwork pattern‹ (see section ›Craftsmanship and Workshops‹) but with many irregularities: not

all bars have the same width (probably the result of imperfect burnishing) and quite often extra bars are added to fill gaps. Fragment (b) shows how the nails of the gold bars inserted the wood. The nails can be measured to be ca. 1.1 mm long and 0.4 mm thick. The bars created a homogeneous surface which was flattened with a burnisher (traces of burnishing are visible almost everywhere in the form of parallel striations) and then decorated with incised interconnected spiral.

Sakellariou suggested that the seams among the gold bars are seen today because of the swelling of the wood. This is possible, although we should note that the seams are more visible on the grip, which has a curving surface and burnishing was not easy, and less on the flat butt.

At the edges of the hilt-plates some bars were cut half in length in order to become level with the others. The end of edge bars was pressed inwards. Interestingly, the side flanges of the bronze grip are decorated with incised spirals or concentric circles (the motif is too corroded for safe identification but compare with DEND 2a).

Chamber Tomb 78

MYC 12

Detached gold bars (NAM P 3091) possibly associated with a sword (NAM P 3081) – Fig. 14

Dimensions of sword: L. 37 cm; W. max. 4 cm. Sword type: A

Publication: Tsountas 1897, 106. 121; Xenaki-Sakellariou 1982–1984, 33 no. 4 pl. 1 α; Xenaki-Sakellariou 1985, 218 pl. 101

Dimension of hilt: L. 5 cm; W. max. 4 cm. Material: unknown

Dimensions of gold bars: L. 1.3–4.3 mm; W. 0.4 mm; H. of ›nail‹ 1.2–1.3 mm. Type of decoration: B

Almost one thousand L-shaped gold bars were found close to a short type A sword, which seems to have been decorated also with cloisonné and other demanding techniques. The association is probable but not entirely safe since another sword of type D1 was found in the area. However, no other examples of type D1 swords with gold embroidery are known.

Based on other examples, we can assume that the bars covered the entire hilt plates in the area of the butt, and perhaps beyond that. The bars have long stems and relatively short ›nail‹. A few of them are bent as if they were applied on curving surface. They are flat on top and bear traces of engraving, which means that they belong to the decorative style B. Underneath they retain the original round profile. Several of them have diagonal marks along the body, suggesting that they were made of twisted gold sheet.

Dendra

Tholos Tomb

DEND 1a–c

Bronze sword (NAM P 7317, 7349 and 7362) – Fig. 15. 16. 17

Dimensions of sword: L. 109 cm; W. 7.64 cm. Sword type: Ci

Publication: Persson 1931, 35 f. no. 12. 62. 63 and 60 fig. 36. 37 pl. 22, 2; 23, 1–3; Xenaki-Sakellariou 1982–1984, 32 no. 2

Dimensions of hilt: L. est. 10.8 cm; W. 7.64 cm; D. est. 0.9–1.2 cm; Th. 0.3 cm. Material: ivory

Dimensions of gold bars: L. 4–5 mm; W. 0.4 mm; H. of ›nail‹ 1.2–1.4 mm

Dimensions of pommel: D. est. 5 cm; W. pres. 3.27 cm. Material: ivory. Style of decoration: B

a and b) The handle consisted of two hilt plates set among the flanges and secured with rivets. From the morphology of the rivet-heads it is apparent that the hilt plates were flat in the area of the butt and curved in the area of the grip. Although the entire hilt-plates must have been covered with gold embroidery, only small parts of the decoration are preserved in place: a rectangular piece with highly homogenized surface and incised spirals at the base of the grip between the lower rivet and the flange; a smaller piece attached to the flange of the left shoulder; some stray gold bars around the middle rivet of the grip. Next to the sword, Persson found ca. 5,000 detached gold bars and pieces preserving several rows of bars but no organic material. One of them (DEND 1 b, NAM P 7349) has a highly homogenized surface and an underside where one can see the bars set in an alternate (›brickwork‹) pattern.

c) Small fragment from the edge of the mushroom-shaped pommel. Very neatly placed gold bars in a ›brickwork‹ pattern. Some holes have been left empty and their diameter can be measured at 0.61 mm. The broken profile shows how the bars followed the contour of the pommel and how the nails were inserted in the ivory (certainly with pre-drilled holes). The pommel was also decorated with running spirals.

Chamber tomb 12

DEND 2a and b

Bronze sword (NMD 14417 and AMN 38098) – Fig. 18. 19

Dimensions of sword: L. (pres.) 30.8 cm, (restored) 43.3 cm; W. max 9.3 cm. Sword type: Ci

Publication: Åström 1977, 18 no. 28 and pl. 7, 2. 3; 8, 3; Åström 1972; Xenaki-Sakellariou 1982–1984, 32 f. no. 3 pl. 3 b; Dietz et al. 2015, 21 no. 10 fig. 1 pl. 3.

Dimensions: fragments:

Dimensions of hilt: W. butt 9.3 cm; D. grip 2.2. cm.
Material: ivory. Style of decoration: B

Dimensions of gold bars in DEND 2a: L. 5–8 mm; W. 0.5 mm; Th. 0.2 mm

Dimensions of gold bars in DEND 2b: L. 6–7 mm; W. 0.3–0.5 mm; H. of ›nail‹ 1 mm

Dimensions of pommel in DEND 2a: H. 4.7 cm; W. 7.6 cm; Th. 6.7 cm

Dimensions of pommel fragments in DEND 2b: 1 × 1–1.8 cm

For the association of DEND 2a (now at the National Museum of Denmark, Copenhagen) with chamber tomb 12, see section ›Contexts and Chronology‹. The examination of DEND 2b, three fragments from the ivory pommel found in the tomb and now at the Archaeological Museum of Nauplion, showed remarkable similarities in style. One of the fragments comes from the edge of the pommel, close to the socket, and fits well with the missing parts of DEND 2a. The size and style of the gold bars in DEND 2a and DEND 2b are almost identical. Finally, at Nauplion we found the gold-foil ring that decorated the base of the pommel¹⁶⁹ – a piece which is missing from the Copenhagen sword. For these reasons, we believe that DEND 2a and DEND 2b belonged to the same weapon.

The hilt is flanged. It had two separate hilt-plates, probably made of ivory, and secured through double-headed gold-capped rivets. Of the hilt-plates only small part of its decoration with gold embroidery survives on one side, between the lower rivet of the grip and the right flange. As usual, the gold was decorated with engraved spirals. It is not clear if gold embroidery continued in the lower part of the hilt. The left horn is covered with plain gold foil, and above the two horizontal rivets there is the impression of an oval opening known from several Mycenaean swords¹⁷⁰. The flanges are covered with gold foil; interestingly one of them is decorated with incised spirals (compare with MYC 11).

The oval ivory pommel is almost intact and preserves most of its decoration with gold embroidery. The gold bars cover entirely the upper dome. The holes for the placement of the bars were organized in parallel rows. The underside was also richly decorated. Gold embroidery covered most of it and stopped at the edge of the ›neck‹ that surrounded the socket of the pommel. One of the fragments of DEND 2b comes precisely from that edge. The holes for the placement of the gold bars were organized concentrically.

We have estimated that ca. 3,000 gold bars were used for the decoration of the pommel.

Prosymna

Chamber Tomb 2

PRO 1

Gold bars possibly from a sword (NAM P 6407) – Fig. 20

Dimensions: L. 1.5–8 mm; W. 0.4 mm; H. of nail 1.6 mm

Publication: Blegen 1937, 178 fig. 442; Steinmann 2020, 388 f. fig. 8.

Dimension of hilt: unknown. Material: unknown. Style of decoration: B

Almost a hundred of detached L-shaped gold bars had been illustrated by Blegen and were located in the National Archaeological Museum of Athens. They vary in length from 1.5 to ca. 8 mm. They belong to the decorative style B (with engraved decoration) because several of them bear traces of engraving on their surfaces.

Steinmann has suggested that the gold bars of tomb 2, together with a ring made of gold foil, gold-capped rivets and a gold-capped piece of ivory found in the same tomb belonged to a type Ci sword, which should be dated by context to LH IIB/IIIA1. The unusual length of the bars (up to 8 mm) may support his suggestion: gold bars exceeding 6 mm are only known from type Ci swords found at Dendra (DEND 1 and 2).

Vapheio

Tholos Tomb

VAPH 1

Fragment of bronze handle with remains gold embroidery (NAM P 1820) – Fig. 21

Dimensions: L. pres. 3.6 cm; W. pres. 3.74 cm; Th. max 0.76 cm. Dagger type: generic tangless

Publication: –

Dimensions of hilt: W. est. min. 5.1 cm; H. est. 2.3 cm.
Material: ivory. Style of decoration: Ab?

Fragments of two small handles, possibly from daggers, are listed under this inventory number. This one had three horizontal gold-capped rivets on the butt and was clearly tangless. On one side, gold foil is preserved at the beginning of the blade. Given that several daggers at the Vaphio tholos were inlaid, it is

169 For such rings see Steinmann 2020, 388 n. 48 with references.

170 E.g. Karo 1930–1933, 133 no. 725 and pls. 81, 82; Kilian-Dirlmeier 1993, pls. 5, 32; 6, 33; 11, 59; 12, 60, 61; 14, 72–74; 15, 80, 81.

possible that this piece belongs to the same technique. On the other side, there is a deep cutting, which might have also been related with inlaid decoration. Remains of gold embroidery have been found on the side of the gold foil. They are preserved under the oxidization that covers the lower part of the central rivet. The consist of short L-shaped bars, which are flat and probably undecorated on top. The size and style of the bars is reminiscent of bars of the decorative style Ab.

VAPH 2

Gold-capped bronze rivet with corroded remains of the organic hilt (NAM P 1821) – Fig. 22

Dimensions: D. 1.16 cm; H. 2.27 cm. Weapon type: unknown

Publication: –

Dimensions of bars: L. 1.00 mm; W. 0.3 mm; H. >nail<; 0.9 mm. Material of preserved hilt: ivory. Style of decoration: Ab

Six rivets from weapons are listed under this inventory number. The one with gold embroidery is the largest in size and preserves corroded remains of the ivory hilt. Gold embroidery is found on the side of the hilt, in right angles to the surface of the rivet. The decoration consists of tightly fitted L-shaped bars, which have been very well burnished so that the upper surface is entirely flat and homogenized, resembling gold foil. Since the surface is not incised, the dagger is classified in style Ab. However, two detached gold bars found in the same lot are longer and more standardized than other style A gold bars, therefore it is possible that this dagger represents a transitional stage from style Ab to style B.

Pylos

Tomb of the »Griffin Warrior«

PYL 1

Bronze sword (AMP – SN24-0028)

Dimensions: –. Sword type: Ci

Publication: Unpublished; brief reference in Davis – Stocker 2016, 634. 650 fig. 13

Dimensions on hilt: –. Material: –. Style of decoration: B

This is probably the best preserved example of gold embroidery. The entire hilt and the pommel are decorated with L-shape gold bars and survive in excellent condition. The weapon is under study by the excavators.

PYL 2

Bronze dagger (AMP – SN 24-0217)

Dimensions: –. Dagger type: –

Publication: unpublished; information provided by the excavators

Dr Sharon Stocker and Dr Jack Davis have kindly informed us that close to the sword PYL 1 remains of a dagger decorated with gold embroidery were found. The weapon is currently under study.

Kakovatos

Tholos Tomb B

KAK 1a and b

Bronze sword and detached gold bars (NAM P 5664 and 5663) – Fig. 23. 24

Dimensions: L. 92 cm; W. 5.7 cm. Sword type: A

Publication: Müller 1909, 298 f. fig. 14; Xenaki-Sakellariou 1982–1984, 34 no. 6; Steinmann 2018, 278 cat. 47 (entry by K. Nikolentzos)

Dimensions of hilt: H. pres. (from tang to lower rivets) 6.1 cm; W. 5.7 mm; Th. hilt 0.6–2.3 cm. Material: unknown. Style of decoration: B

Dimensions of gold bars: L. max. 5.8 mm; W. 0.3 mm; Th. 0.2 mm; H. >nail< 1.5 mm

Several L-shaped gold bars are preserved on the periphery of the three preserved gold-capped rivets (one at the tang and two smaller ones at the butt), hidden among green copper corrosion compounds. The gold bars once were attached to the now disintegrated organic hilt. Two dozen gold bars stored at the National Museum (KAK 1b) are labelled »Kakovatos B« and probably come from the same weapon (although they are not mentioned in the original report). Their form, size and the fact that they bear traces of engraving lines classify them with decorative style B¹⁷¹.

Unknown Provenance

UNP 1

Short gold bars and tiny fragments decorated with gold embroidery (NAM P 23328) – Fig. 25

Dimensions of gold bars: L. max. 1.3 mm; W. 0.2 mm; H. 0.9 mm

There are several tiny pieces (max. dim. 1 × 1 cm) of organic material (wood) which bear style A decoration. The motifs are created by L-shaped gold bars placed

171 Xenaki-Sakellariou has erroneously attributed the detached gold studs (KAK 1b) to a weapon found in tholos C, Xenaki-Sakellariou 1982–1984, 34 cat. 6.

one after the other in triple rows. There is also a dozen of very small gold bars, which vary considerably in form. Both the shape of the bars and the style of decoration are strongly reminiscent of MYC 5 and MYC 9. Since this type of decoration is known mostly from Mycenae (and possibly from Vaphio but in a technically advanced style), it is possible that these stray finds come from Mycenae too.

UNP 2

Detached fragments of gold embroidery, ivory and soil mixed with gold bars (NAM P 23329) – Fig. 26

Dimensions of gold bars: L. 4–5 mm; H. of nail 1.4 mm

Dozens of L-shaped gold bars found mingled with soil and small pieces of ivory. The bars are quite long

and standardized. Some of them are interconnected through burnishing and bear traces of engraved decoration. In length and morphology, they are similar to gold bars of DEND 1, DEND 2 and the longest of PRO 1. Some larger fragments preserve interconnected rows of gold bars without organic residues. They are flat on top with highly homogenized surface, which resembles closely DEND 1b. Underneath one can see the distinct gold bars (straight and curving ones, see Fig. 26 d. e) set in a ›brickwork‹ pattern. Like the bars of DEND 1b, they bear helicoidal marks around the body, which suggest manufacture from twisted gold strip. One piece preserves a fragment of ivory with successive tiny holes (ca. 0.7 cm wide), which resemble closely those of the ivory pommel of DEND 1 (compare Fig. 26 f with Fig. 17 f). It is probable that these stray pieces come from Dendra, possibly from the tholos tomb.

Appendix: Conservation of Gold Embroidery

113 The term ›conservation of gold embroidery‹ may sound controversial, since gold, as a ›*noble*‹ metal, is one of the least chemically active materials and withstands corrosion. But the term does not refer to gold as material, but to embroidery as a *structure*.

114 The embroidered hilt of a bronze weapon could be considered as a symmetrically multilayered structure, comprising of five or three (in the cases of tangless weapons) successive layers of different materials, depth and profile (Fig. 35 a). In the first case, the bronze tang is the core layer, on either side of which a layer of organic material is attached by rivets (e.g. Fig. 12 a; 11 a. d; 18 a. c; 28 c). In the second case (type A swords and tangless daggers) and also in pommels, the organic material itself is the core (e.g. Fig. 17. 18 d-i; 28 a. b). The surface of the organic material is covered by the L-shaped gold bars.

115 In both cases, the gold embroidery decoration is the outer, thinner and less solid layer of all, subjected to both outer and inner ›threats‹. The *outer* threats derive from the depositional environment and refer to any mechanical tension applied. The *inner* ones derive from the rate of preservation of the underlying layers. Since the gold bars are attached to the organic substrates of the hilt (e.g. Fig. 12. 28. 29), their survival is inextricably linked to the condition of these substrates.

116 The primary organic materials used in the construction of Mycenaean hilts are wood, ivory and bone¹⁷². Two of their common properties are that they are hygroscopic and anisotropic, which means that they absorb or release moisture during humidity and temperature changes and they contract or expand differently along the three planes. The changes in the volume of the organic materials and the absence or degradation of organic glue weaken the cohesion with the gold bars. Furthermore, these changes are irreversible, especially after long-term exposure, and are summarized to shrinkage and cracking for low values of relative humidity and warping and swelling for high values (e.g. Fig. 17 c-d; 18 d-h; 19).

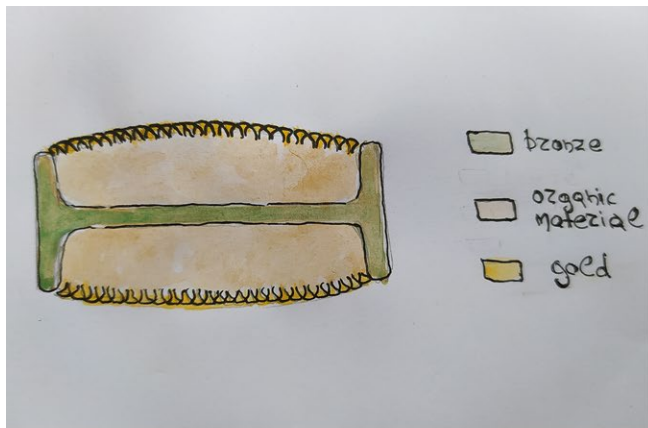
117 In many of the examined cases, the embroidery has been detached and/or lost due to the failure of the organic substrate, caused mainly by the relative humidity of the depositional environment during burial, or by the pressure applied by the swelling and disfiguration of the bronze part of the hilt (e.g. Fig. 14 a; 16 a; 20 a; 24 a; 25. 26). To ensure the longevity of the gold embroidery, where still preserved, the remaining substrates had to be treated properly.

118 Before any conservation treatment, the technical examination of the objects had to precede. First, each object was photographed and evaluated macroscopically, in terms of previous conservation treatments and current physical condition. The observations were documented digitally.

119 According to past treatments, the examined objects could be divided into three groups: (a) objects that have not been treated till today, (b) objects that were treated in the last decades (probably more than once), and (c) objects that were only treated in certain areas. The majority of the conserved objects belong to the second group.

120 In some objects, part of the gold embroidery could not be detected macroscopically, since it was covered by layers of green copper corrosion products, the thickness of which ranged between 0.3 to 1.63 mm (e.g. Fig. 35 b). In other objects, the embroidery was laying beneath polymerized varnishes or waxes that had been applied, during previous conservation treatments, as consolidation or surface protection materials (e.g. Fig. 1). In several cases, even the microscopic examination could not confirm the existence of embroidery underneath (e.g. Fig. 36 a, see also Fig. 6 b). So, to avoid any irreversible loss, it was decided to examine what was lying beneath through non-destructive analyses.

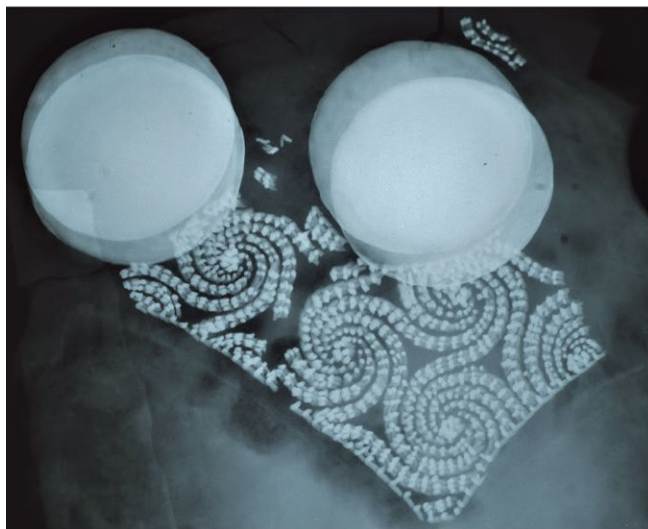
172 Although the latter is not safely attested in weapons decorated with gold embroidery.



a



b



c



d

35

Fig. 35: Gold embroidery conservation: (a) the structure of a hilt with bronze tang; (b–d) the dagger MYC 5 (NAM 397), before conservation, under X-ray before conservation, and during conservation (see also Fig. 5 for photos after conservation)

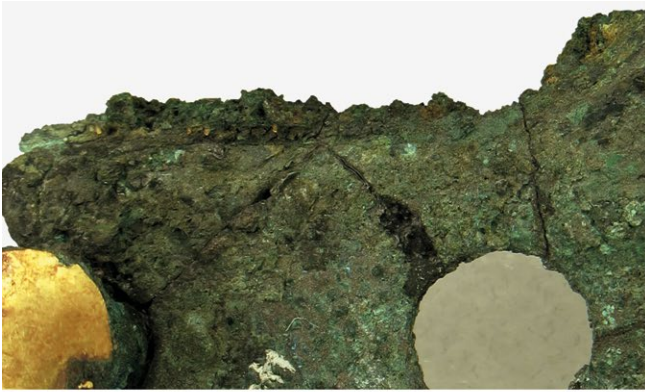
The method of X-ray analysis was undertaken at the Laboratory of Chemistry at the National Archaeological Museum. In X-ray images, the embroidery is pictured white while changes in brightness denote different materials (Fig. 35 c; 36 b; see also Fig. 6 b; 7 b; 10 d; 29 c). The main advantage of this method is that it can provide immediate and accurate images of the interior parts of the objects in real size, without causing any damage to them. The only disadvantage is the overlapping of the layers, i.e. the simultaneous picturing of all the layers, due to the high penetration ability of X-rays. This can be overcome by multiple images at different angles and comparison of the results.

121 Apart from revealing hidden areas or remains of embroidery, the X-rays detected cracks, cavities and other defects at the underlying layers, providing useful information and guidance for the proper conservation treatment.

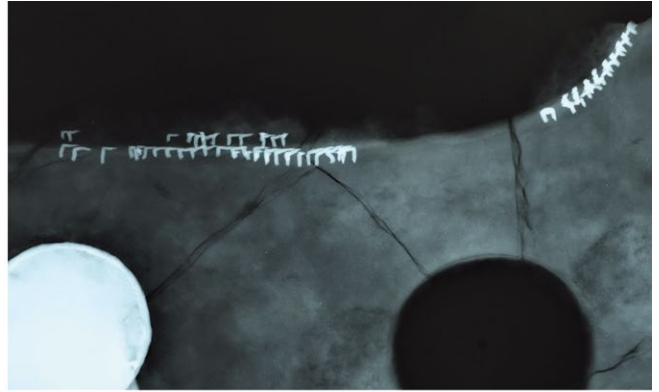
122 After the detection of the exact areas with embroidery, the cohesion of the gold bars to their organic substrate had to be evaluated. An inch-by-inch examination under the microscope was carried out. Almost all the remains proved to be firmly or, at worst, satisfactorily attached to the substrates, so there was no need for extra consolidation.

123 The first step of the conservation treatment required the removal of the materials applied in former conservation treatments. Materials such as consolidants and varnishes were removed from the surface with acetone applied with custom-made cotton swabs and soft brushes. Each step was digitally photographed and documented.

124 The surface of the gold decoration was cleaned gently under the microscope with ethanol on custom-made cotton swabs. The most challenging and intriguing part



a



b

36

of the cleaning was the removal of the copper corrosion layers that had covered areas with gold embroidery. These areas had to be treated in an efficient and non-damaging way to reveal the embroidery (Fig. 35 d). The whole procedure took place under the microscope since it should be carried out mechanically, with extra attention not to scratch the surface or put pressure leading to detachment of the gold bars. This took a long time and effort, but we were compensated by the joy of revealing decorated areas that have never been cleaned before.

125 After the cleaning, the dehydration of the metallic parts with acetone followed. For the stabilization of the bronze parts, a solution of 3% by weight benzotriazole in ethanol was applied with compresses or syringes in smaller areas. Finally, a superficial coating with a 10% by volume Incralac resin was applied to all the exposed bronze parts with soft brush, to form an effective barrier to further corrosion.

126 Standard conservation treatment combined with non-destructive analyses allowed us (a) to reveal and (b) to prolong the existence of gold embroidery, one of the most exquisite and unique decorative techniques of Mycenaean weaponry.



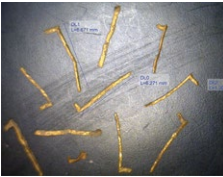


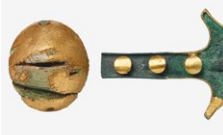

M. K.

Fig. 36: Forms of corrosion: (a) the hilt of sword MYC 2 (NAM 408) with barely visible signs of gold remains along the edge of the flange; (b) the same area under X-ray, showing L-shaped gold bars in place (before conservation)

Supplement

127 For an experimental reconstruction of the technique of gold embroidery see <https://doi.org/10.34780/3vj2-e292>.

Site/No	Context	Type of object	Style of decor.	Museum	Inv.	Photo	References
Mycenae							
MYC 1	Grave Circle A Shaft Grave IV	Sword type B	Aa	NAM	435		Karo 1930–1933, 103 no. 435 pl. 74, 2 and 87, 2; Xenaki-Sakellariou 1982–1984, 31 no. 2 pl. 1 b
MYC 2	(as above)	Sword type B	Ab	NAM	408		Karo 1930–1933, 100 no. 408 pl. 99
MYC 3	(as above)	Dagger type II variant A	Aa?	NAM	394		Karo 1930–1933, 95–97 no. 394 pls. 93, 94; Laffineur 1974, 7 no. 1; Xenaki-Sakellariou 1982–1984, 34 no. 1; Xenaki-Sakellariou – Chatziliou 1989, 25 f. no. 1 pl. 1; Papadopoulos 1998, 10 no. 37 pl. 5, 37
MYC 4	(as above)	Dagger type II variant A	Ab	NAM	396		Karo 1930–1933, 97 no. 396 pls. 89, 90; Xenaki-Sakellariou 1982–1984, 31 no. 1 pl. 2 b; Papadopoulos 1998, 10 no. 38 pl. 5, 38
MYC 5	(as above)	Dagger type I, variant A	Ab	NAM	397		Karo 1930–1933, 97 no. 397 pl. 90; Papadopoulos 1998, 5 no. 13 pl. 1, 13
MYC 6	(as above)	Rivets	Ab	NAM	464		Karo 1930–1933, 105 no. 464 pl. 99
MYC 7	(as above)	Rivet	Ab	NAM	483		Karo 1930–1933, 108 no. 483
MYC 8	(as above)	Alabaster pommel of a sword	?	NAM	485		Karo 1930–1933, 109 no. 485 pl. 76
MYC 9a	Grave Circle A Shaft Grave V	Sword or Dagger	Ab	NAM	779b		Karo 1930–1933, 142 no. 779 pl. 99
MYC 9b	(as above)	(same weapon as MYC 9a)	Ab	NAM	779b–bis		Karo 1930–1933, 142 no. 779 pl. 99
MYC 10	(as above)	Rivets	Ab	NAM	779a		Karo 1930–1933, 142 no. 779 pl. 99

Site/No	Context	Type of object	Style of decor.	Museum	Inv.	Photo	References
MYC 11a	Panayia hill cemetery, Chamber tomb 81	Dagger cruciform type, variant B/C (Sandars' Ei/ii)	B	NAM	3111		Tsountas 1897, 109. 122 pl. 7, 4; Xenaki-Sakellariou 1982–1984, 31 no. 1 pl. 3 a; Xenaki-Sakellariou 1985, 228 f. pl. 107
MYC 11b	(as above)	(same weapon as MYC 11a)	B	NAM	3112		Tsountas 1897, 109. 122 table 7, 5; Xenaki-Sakellariou 1982–1984, 31 f. no. 1
MYC 12	Kalkani hill cemetery, Chamber tomb 78	Gold bars	B	NAM	3091		Xenaki-Sakellariou 1982–1984, 33 no. 4 pl. 1 a; Xenaki-Sakellariou 1985, 218 pl. 101
Prosymna							
PRO 1	Chamber tomb 2	Gold bars (possibly from sword type Ci)	B	NAM	6407		Blegen 1937, 178 pl. 442; Steinmann 2020, 389 fig. 8 b
Dendra							
DEND 1a	Tholos tomb	Sword type Ci	B	NAM	7317		Persson 1931, 35 f. pl. 22, 2; Xenaki-Sakellariou 1982–1984, 32 no. 2
DEND 1b	(as above)	(same weapon as DEND 1a)	B	NAM	7349		Persson 1931, 35 f. 62 f. 60 fig. 36. 37 pl. 23, 1–3
DEND 1c	(as above)	(same weapon as DEND 1a)	B	NAM	7362		Persson 1931, 35 f. 62 f. 60 fig. 36. 37 pl. 23, 1–3
DEND 2a	Chamber tomb 12	Sword type Ci	B	NMD	14417		Åström 1977, 18 no. 28 pl. 7; Åström 1972; Xenaki-Sakellariou 1982–1984, 32 f. no. 3 pl. 3 b; Dietz et al. 2015, 21 cat. 10 fig. 1 pl. 3
DEND 2b	(as above)	(same weapon as DEND 2a)	B	AMN	33098		Åström 1977, 18 cat. 28 pl. 7, 3; 8, 3

Site/No	Context	Type of object	Style of decor.	Museum	Inv.	Photo	References
Vaphio							
VAPH 1	Tholos tomb	Dagger tangless type	Ab?	NAM	1820		–
VAPH 2	(as above)	Rivet	Ab?	NAM	1821		–
Pylos							
PYL 1	Griffin Warrior tomb	Sword type Ci	B	AMP	SN24-0028 (temporary number)		Davis – Stocker 2016, 634. 650 fig. 13
PYL 2	(as above)	Dagger	B	AMP	SN24-0217 (temporary number)		–
Kakovatos							
KAK 1a	Tholos tomb B	Sword type A	B	NAM	5664		Müller 1909, 298 f. fig. 14; Steinmann 2018, 278 cat. 47
KAK 1b	(as above)	(same weapon as KAK 1a)	B	NAM	5563		Xenaki-Sakellariou 1982–1984, 34 no. 6
Unprovenanced							
UNP 1	Unknown	Gold bars and small fragments	A	NAM	23328		–
UNP 2	Unknown	Gold bars and small fragments	B	NAM	23329		–

Table 1: List of objects with gold embroidery

Swords				
type A	type B	type Ci		
KAK 1	MYC 1	DEND 1		
MYC 12?	MYC 2	DEND 2		
		PRO 1		
		PYL 1		
Daggers				
tangless daggers			cruciform dagger	unspecified
type I	type II	generic		
variant A	variant A			variant B/C (Sandars' Ei/ii)
MYC 5	MYC 3	VAPH 1	MYC 11	PYL 2
	MYC 4			
unspecified				
MYC 6, MYC 7, MYC 8, MYC 9, MYC 10, MYC 12, VAPH 2, UNP 1, UNP 2				

Table 2: The typology of weapons decorated with gold embroidery

Site	Tomb	Burial	Sex	Age	References
Mycenae	Shaft Grave IV	Burial O (Myc 3, IV)	male	20–25 yrs	Papazoglou-Manioudaki et al. 2010, 162. 193–197
Dendra	Tholos tomb	›King‹	male	adult	Fürst 1930, 78–80
Pylos	›Griffin Warrior‹ tomb	›Griffin Warrior‹	male	30–35 yrs	Davis – Stocker 2016, 630

Table 3: Individuals buried with weapons decorated with gold embroidery, whose age and sex have been identified by physical anthropologists

Date	Sites	Contexts	No. of Weapons
LH I	1 (Mycenae)	2 (Shaft Graves)	10+
LH IIA	3 (Vaphio, Kakovatos, Pylos)	3 (tholos tombs, built grave)	5
LH IIB–IIIA1	3 (Dendra, Mycenae, Prosymna)	5 (tholos tomb, chamber tombs)	5

Table 4: Chronological evolution: the number of sites, contexts and weapons with gold embroidery per period

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