

A GLASS WORKSHOP AT THE MYCENAEAN CITADEL OF TIRYNS IN GREECE

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Ich erwähne weiter eine Perle von kobaltglas und einige kleine Gegenstände aus einer Glasmasse

These are the words Schliemann (1885/6, 176; 1886, 199) used to refer to glass he found in his excavations at the Mycenaean citadel of Tiryns, in the Peloponnese in Greece in AD 1884–1885. The ‘Perle’ of cobalt blue glass is exhibited in the National Museum in Athens together with decorative inlays: plaques, strips and knobs (COLOUR PLATE 5). More inlays exist in the Museum storerooms under the same Museum inventory number (1615–19) and there is no doubt that they come from Schliemann’s excavations at Tiryns. Though there are no proper excavation data, we believe that this material is what Schliemann called ‘einige kleine Gegenstände aus einer Glasmasse’. Closer examination of the material in the Museum storerooms by M. Panagiotaki proved that it comes from a glass workshop since glass waste exists alongside the finished products.

PRODUCTS OF THE WORKSHOP

Decorative inlays and beads seem to have been produced at the Tiryns workshop as far as we can tell from the surviving material. All the inlays are made of opaque, turquoise glass, the surface of which has now faded as a result of weathering, to off-white or a mixture of off-white and turquoise – the white surface layer is characteristic of weathered Late Bronze Age glass (Spaer 2001, 55). The beads comprise: a fragmentary spherical one of exactly the same turquoise glass of the inlays, another spherical example (inventory number 1599) of dark blue (cobalt blue) – maybe the one described by Schliemann, and finally an almond-shaped one (inventory number 1566) of an iridescent nature coloured a very dark blue, almost black (COLOUR PLATE 5, top row). The latter may be identified with the one Schliemann found in the longitudinal trench of the lower citadel (Schliemann 1885/6, 82, fig. 17; 1886, 92, fig. 17). A number of glass beads are also known from the more recent excavations at Tiryns (Haevernack 1979, 44–7). A lump of Egyptian blue (inventory number 1606) among the Tiryns glass material suggests that Egyptian blue was worked as well (COLOUR PLATE 5, top right).

The inlays comprise rectangular plaques, strips and knobs. The rectangular plaques have two flat surfaces and clear-cut edges. The strips are of three types: (a) elongated with two flat surfaces and clear-cut sharp edges, (b) elongated with two flat surfaces but no sharp edges (of a

more rounded section), (c) much shorter strips with a slightly raised upper surface, flat underside and clear-cut edges. The knobs are round, disk-like with a raised upper surface and flat or slightly concave underside.

GLASS WASTE

Glass waste was found together with the finished products: (a) elongated or pear-shaped drops of glass with the thread in position (often curled over at the end – COLOUR PLATE 6) and with a flat underside, the last feature indicating that the drops had fallen on a flat and cold rather than hot surface (when drops fall on a cold surface they do not adhere, though they will do so on a hot surface; on such technical details, see Lierke 2002, 182); (b) drops which have a rounded section (and the thread in position), suggesting that they either solidified in the air or they fell on a thick and yielding layer of ash; (c) round drops without a thread, but with a flat underside; they may have been formed accidentally by shards of raw glass melting near the fire (Lierke 2002, 181, fig. 3.4); (d) a rectangular plaque with a small pear-shaped drop (with thread attached) accidentally formed or stuck on one surface; (e) strips that are bent (the largest one may have been bent intentionally) or deformed, perhaps as they were taken out of the mould (COLOUR PLATE 7); (f) strips stuck together in a mass; (g) strips and drops stuck together; (h) strips, plaques and drops all amalgamated (COLOUR PLATE 8).

Some of the strips and plaques fused together seem to have been finished pieces. The fact that such objects are mixed up with both unfinished bits and waste-drops indicates maybe that something went wrong while they were being made and the craftsman, perhaps with an angry gesture, just pushed them all aside, causing them to stick to each other and be turned into a ‘mass’, in which nonetheless the individual components are still identifiable.

GLASSWORKING PROCEDURE

No objects found with our glass permit detailed inferences on the glass technology (compare with the glass workshops in north Italy, especially that of Frattesina, where besides finished products and waste, glass ingots, tools and fragments of crucibles were found, see Bellintani 1997, 126–7, fig. 8; Towle *et al.* 2002, 19–20, figs 1, 3.10, 5; and for the chemical analyses Angelini *et al.* 2002).

However, the clear-cut edges of the strips and plaques point to the use of moulds (open-face moulds would be more appropriate) and the existence of drops makes it clear that the raw glass was not placed in the moulds in the form of chips (Lierke 1999, 23–4, fig. 41) and subsequently heated, but it was rather softened in a crucible and the liquid/fluid glass was either poured into the moulds or transported from one to the other using a tool (on glassworking see Grose 1989, 31–3; Evely 2000, 445–56, fig. 179). The strips with the rounded section may have been made by pulling a cob of soft glass until it formed a strip – an action similar to forming a cane.

It is thus possible that in the Tiryns glass workshop two techniques were used to make the inlays: liquid glass poured into moulds and softened glass worked by pulling. The moulds could have been made of stone, clay, plaster or wood (on moulds see, Tournavitu 1997, 209–56; Chatzi-Spiliopoulou 2002, 70–7; Triantafillidis 2002, 45, n. 58; Panagiotaki forthcoming). Stone moulds have been mostly found in the Aegean world, although clay ones have recently been reported (Demopoulou 1997, 436, pl. clxxi.c). The knobs may have been made by heating shards of raw glass (perhaps recycled) on a flat surface; after solidifying, polishing may have followed to make their edges more regular (perhaps the same polishing techniques used for Mycenaean beads, see Nightingale 2002, 48–50).

No crucibles, ceramic platforms or glass ingots have been recorded in the Museum inventories nor were identified by the excavators: any such artefacts relating to glass production/working may exist elsewhere among the objects that were recovered at Tiryns. Pieces of clay were, however, recorded in the National Museum inventories (together with the glass material, inventory number 1619) and indeed small pieces of badly burnt clay were found among the glass waste; these may have been pieces from the clay lining of the kiln rather than from crucibles. A stone ‘rod’ with a pointed end (inventory number 1614), which Schliemann also mentioned (Schliemann 1885/6, 176; 1886, 199), may have been used as a tool, to take the liquid glass out of the crucible or to work it somehow (COLOUR PLATE 5, top right).

No direct evidence of glassmaking exists at Tiryns. This is not surprising. The workshop may have been using imported raw glass: an idea supported by the glass ingots discovered in the shipwreck of Uluburun (Kas) off the coast of Asia Minor (Bass 1986, 281–2). All the more so since the Uluburun glass ingots were found to be compositionally similar to both Mycenaean and Egyptian glass (Brill 2002, 11; see also Panagiotaki *et al.*, 2004, 174–5). It is important that two different kinds of glass were worked at Tiryns: dark blue (coloured by cobalt) and turquoise (coloured by copper), both kinds also found as ingots in the Uluburun wreck.

In the National Museum inventories together with the glass material (inventory number 1619) were also recorded two irregular pieces of gypsum, one of quartz stone, and three of bronze – all perfect ingredients for the production of glass! For a time we entertained the idea that we might actually have a glassmaking and glassworking workshop (on the distinction see Stern 1999, 23–4, 35). Alas, when we located the above potential raw materials they were but tiny fragments (whether they once belonged to bigger

objects that were indeed used for glassmaking cannot now be said). The Tiryns workshop would thus have to be seen as involved with glassworking rather than glassmaking.

LOCATION OF THE WORKSHOP

We do not know the exact findspot(s) of this material, but we know that Schliemann (1886, plan 1) excavated mainly on the upper citadel and dug only one trench in the lower. Iakovidis (1983, 15) suggested that Rooms 30–34 (in his plan 2 – of the upper citadel) may have been used as storerooms or workshops (‘since three cylindrical vessels, 0.30 m. in diameter and ca. 1 m. high, found in one of the smaller rooms (Plan 2, 33), would have had no place in a residential area’). Being near two courtyards, they could have been ideal for craft activities. It should be noted that Kilian (1984; 1988, 111) unearthed a bronze workshop in building XI (of LH IIIB2 date) and he also found evidence for bronze and leadworking in the lower citadel. Among the objects he found are gold foil and a piece of glass of indefinite shape (could this be explained as a piece of raw glass, part of a glass ingot?). If so, the possibility of glassworking in the lower citadel along with the other industrial activities cannot be ruled out (see also Rahmstorf 2001, 313–15).

But it seems that at present we have to be satisfied with just the industrial waste, which nonetheless identifies the earliest known glass workshop on mainland Greece. Within the Aegean the earliest glass workshops identified on the basis of finished products and glass waste are at Knossos, in a building by the Royal Road, immediately west of the palace and of LM IB date (Cadogan 1976), with another probable example at the palace itself where dark blue pieces of glass (cobalt blue) of indefinite shape (perhaps waste) were identified among unpublished faience material from the excavations of A. Evans (Panagiotaki 1997, 307; for the earliest glass objects from the same palace, see Panagiotaki 1999, 621); yet another has been suggested at Mycenae, on the basis of a large concentration of stone moulds that may have been used for glass relief beads (Nightingale 2002, 50). The Tiryns workshop seems to be the only one though with so much waste and so many misshapen pieces.

THE STONE RELIEF FRIEZE INLAID WITH GLASS FROM THE PORCH OF THE PALACE AT TIRYNS

The Tiryns workshop becomes even more important when we compare the finished pieces (plaques, strips and knobs) with the glass inlays embellishing the known stone relief frieze of half rosettes and triglyphs that decorated the west wall of the porch of the palace at Tiryns (FIG. 1; Schliemann 1886, pl. iv; Müller 1930, 139–43, figs 68–9, pl. 41; National Museum inventory number: 1744-6) – the shape, colour and the sizes of the items are certainly comparable.

The triglyph shows in its lower edge a row of rectangular pieces of glass, each 19 mm. broad and 24 mm. high; over it is a continuous strip of glass, 9 mm. broad. The upper part is divided by four vertical

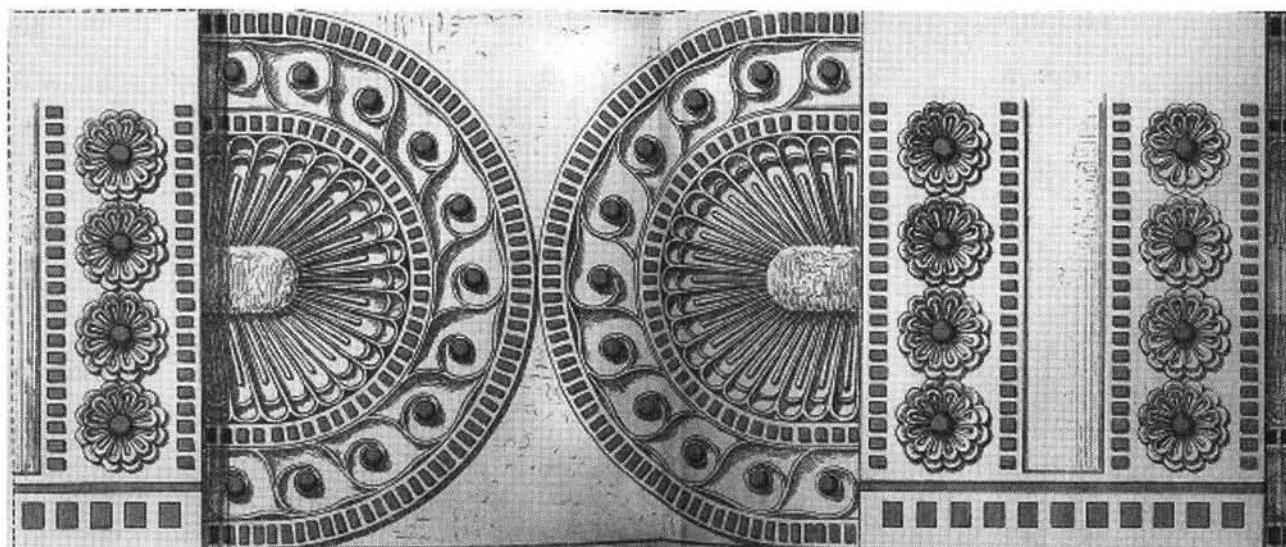


FIG. 1 The stone frieze from Tyrins (after Schliemann 1886, pl. iv)

rows of little pieces of glass (10–13 mm.) into three fields, of which the two outer ones are adorned with rosettes. ... The middle of each rosette is occupied by a round piece of glass of 26 mm. in diameter. ... The metopes are even more richly adorned than the triglyphs. Two semi-ellipses, which touch in the middle, occupy the whole field. ... The rosette is surrounded by a broad band, which consists of a band of spirals encompassed by two bands of inlaid pieces of glass. The pieces of glass of the inner row are rectangles, of 9 by 16 mm., the outer, 9 by 18 mm. The eyes of the spirals are also formed of round pieces of glass paste, inlaid. (Schliemann 1886, 285).

A similar frieze adorned with blue glass had decorated the palace of Alkinoos as described by Homer (*Odyssey* VII. 86–7: 'Χάλκεοι μὲν γὰρ τοῖχοι ἐρηρέδατ' ἐνθα καὶ ἐνθα, Εὐμυχὸν ἐξ οὐδοῦ; περὶ δὲ θριγκὸς κυάνοιο' ('bronze walls ran this way and that from the threshold to the inmost chamber, and round them was a frieze of *Kyanos*'). And similar coloured glass inlays were part of the architectural embellishments of the Greek temples, especially during the last decades of the 5th century BC. Pheidias made use of such inlays in both the Athenian Parthenon and the ivory statue of Zeus in Olympia (for drawings, by 19th-century travellers, of glass inlays decorating some of the stone friezes at the Athenian Acropolis, see Stern 2002, 355–6, figs 6–7, and for the glass drapery of the statue of Zeus at Olympia, *ibid.* 60–3).

The frieze inlays from the palace at Tiryns were analysed chemically by Professor Virchow: 'The glass-paste consists of a calcium-glass, which is coloured with copper; it contains no admixture of cobalt' (Schliemann 1886, 291) – the results are definitely comparable with the results of our scientific analysis (see below).

The date of the frieze is problematic since the excavators believed that it was transferred to the porch from elsewhere (Schliemann 1886, 291–2). If the results of more recent research on the porch and the palace in general are accepted – namely that they can be attributed to the end of the 13th century (to the third building period, Iakovidis 1983, 4–5) – the stone frieze was either made then or slightly earlier.

THE DATE OF THE WORKSHOP

As we do not know where exactly the glass material (beads, plaques, strips and knobs) and waste come from, it is tempting to date the workshop based on the clear similarities between them and the glass inlays of the above described stone frieze. An approximate date will thus be given. If the stone frieze *was* made during the last renovations of the citadel at the end of the 13th century and if it could be *proven* that the Tiryns glass workshop was producing inlays (at the time of its destruction) for this particular frieze or a similar one, then the end of the 13th century can be seen as the *terminus ante quem* for the workshop. It is, however, possible that the workshop material was found in a LH IIIB rubbish dump 'containing sherds, fresco fragments and other material deriving from a renovation of the palace after a fire' (Iakovidis 1983, 12–13), in which case the material could be given a slightly earlier date (fresco fragments are recorded together with the glass material in the National Museum inventories which is why we are considering the possibility of its being found in the above dump (inventory number 1619)).

CHEMICAL ANALYSIS

Six samples of glass from Tiryns were analysed using both atomic absorption spectrometry (AAS) and wavelength dispersive spectrometry (WDS) in an analytical scanning electron microscope (Jeol 8800) (TABLE 1). No regions of unweathered glass could be found for analysis by WDS in the two samples (1619a and 1619b) for which the soda contents as determined by AAS were low (~5% Na₂O). However, with the exception of the antimony oxide contents in sample 1617, there was reasonable agreement between the two methods of analysis for the other four samples, the differences probably being, in part, the result of some slightly weathered glass being included in the bulk AAS analyses. The compositions of the Tiryns glass indicate that they are of the soda-lime type, produced using plant ash, coloured with copper and opacified by calcium antimonate. Thus the Tiryns

TABLE 1 ANALYSES OF GLASS OBJECTS FROM TIRYNS

Sample	Description	Method	SiO ₂	Na ₂ O	K ₂ O	CaO	MgO	Al ₂ O ₃	Fe ₂ O ₃	CuO	Sb ₂ O ₃
1615a	roundel	AAS	70.1	13.1	3.7	6.9	4.4	1.1	0.6	0.97	0.93
		WDS	62.60	16.22	3.08	8.61	6.07	1.18	0.36	0.64	1.25
1615b	rod	AAS	77.2	11.4	1.2	5.5	3.1	0.4	0.4	0.44	0.46
		WDS	62.64	16.28	3.04	8.94	5.87	1.14	0.36	0.73	1.00
1616	roundel	AAS	67.6	15.5	3.0	6.9	5.0	1.1	0.4	0.86	0.88
		WDS	62.90	15.99	3.06	8.68	5.96	1.16	0.38	0.65	1.22
1617	rod	AAS	66.9	13.7	2.6	8.2	5.4	0.9	0.8	0.5	0.88
		WDS	61.44	20.00	2.74	8.53	5.83	0.81	0.33	0.32	0.00
1619a	rod	AAS	73.6	5.1	2.1	12.5	4.2	0.9	0.7	0.37	0.56
1619b	drop	AAS	78.7	5.4	1.2	8.2	4.8	0.4	0.4	0.29	0.56
Egypt (Av)	Copper blue	WDS	62.7	17.4	2.2	8.2	4.1	1.1	0.6	1.23	1.16

glass is comparable in composition to that of contemporary glass from Egypt and the Near East and, therefore, was probably imported into the Aegean as primary ingots. In view of the comparatively high potash and magnesia contents (TABLE 1), and low manganese, tin and lead oxide contents (<500 ppm MnO, <200 ppm SnO₂ and <350 ppm PbO), the Near East is a more likely source of these ingots than Egypt

TIRYNS PALACE: A GLASS PRODUCTION CENTRE – SOCIO-ECONOMIC AND POLITICAL INFERENCES

The existence of a glass workshop in the palatial centre of Tiryns (besides the ones at Knossos and the possible one at Mycenae) emphasizes the idea that glass, a precious commodity, was imported and worked by the elite or under the auspices of the elite (the actual palace). At the same time, because of its religious and magical connotations as a material it was available to all – as it is evident from the many items made from it discovered in tombs (Panagiotaki 2000, 158–60; 2004, 168–70). The Mycenaean elite concentrated on the production of glass embellishments (the case of the Tiryns workshop) and even more so on glass relief-beads which were in both material and shape connected with cult and magic (Hughes-Brock 2000, 123–6; Panagiotaki 2000, 158–60; 2002, 51–3) and they kept these beads close to their world – they were not exchanged with any other material from Egypt or the East. It was a Mycenaean product made for Mycenaeans/Aegeans.

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