An Early Glass Bead from Tel Dan

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IN THE 1977 season of archaeological excavations at Tel Dan, a glass bead was recovered in Tomb 1025 of the MB I (= MB IIA) period, apparently the earliest glass find recorded so far in Israel.[1] It was studied at the Conservation Analytical Laboratory of the Smithsonian Institution in Washington, D.C.

The archaeological context (Fig. 1).[2] Tomb 1025 abuts, and therefore post-dates, a massive battered stone structure underlying an earthen embankment. Limited probes indicate that this structure contains only EB material, and should be dated to the EB III or very early MB I. The earthen embankment layers cover the battered stone structure and the tomb, which seems to have belonged to a pre-embankment MB surface belonging to Stratum XII. Following the placement of the first embankment layer (perhaps a collapsed debris layer rather than an intentional deposit), the tomb's shaft entry was re-excavated from the embankment surface. This entry was eventually covered by a second, pebbly, embankment layer.

Typologically, the latest material contained in the earthen embankment dates from the MB I (= MB IIA); types indicative of the MB II (= MB IIB) at Tel Dan — e.g. flared-rim carinated bowls or Monochrome Painted Cream Ware — are absent. The assemblage of Tomb 1025 clearly belongs to the MB I (= MB IIA) cultural horizon.[3]

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1 We would like to thank Dr. A. Biran, director of the Nelson Glueck School of Biblical Archaeology at the Hebrew Union College and of the Tel Dan Expedition for permission to publish this find. We are grateful to the Israel Antiquities Authority for extending permission to send the bead to the Smithsonian Institution for analysis. The drawing is by Leticia Barda and the photographs by Z. Radovan.

Tomb 1025 was first discovered and excavated in the 1972 season, see A. Biran: Tel Dan, Notes and News, *IEJ* 23 (1973), pp. 110–112. The MB chronological nomenclature adopted here is that used by W.G. Dever: The Middle Bronze Age: The Zenith of the Urban Canaanite Era, *BA* 50 (1987), pp. 148–177, i.e. MB I (= MB IIA), MB II (= MB IIB), MB III (= MB IIC).

2 For more on the stratigraphic position and chronological attribution of Tomb 1025, see A. Biran: *Dan — 25 Years of Excavation at Tel Dan*, Tel Aviv, 1992, pp. 49–53 (Hebrew); *idem*, The Middle Bronze Age Ramparts at Tel Dan, *EI* 21 (1990), p. 59 (Hebrew). A more extensive analysis is to appear in D. Ilan: The Middle Bronze Age Tombs, in A: Biran *et al.*: *Dan* I (*Annual of the Nelson Glueck School of Biblical Archaeology in Jerusalem*), in press.

3 See a partial inventory in Biran (above n. 2, 1992), Figs. 24:2–3, 5–6, 7, 11; 25:5, 8–9, 11; 31–32; and in Ilan (above, n. 2).

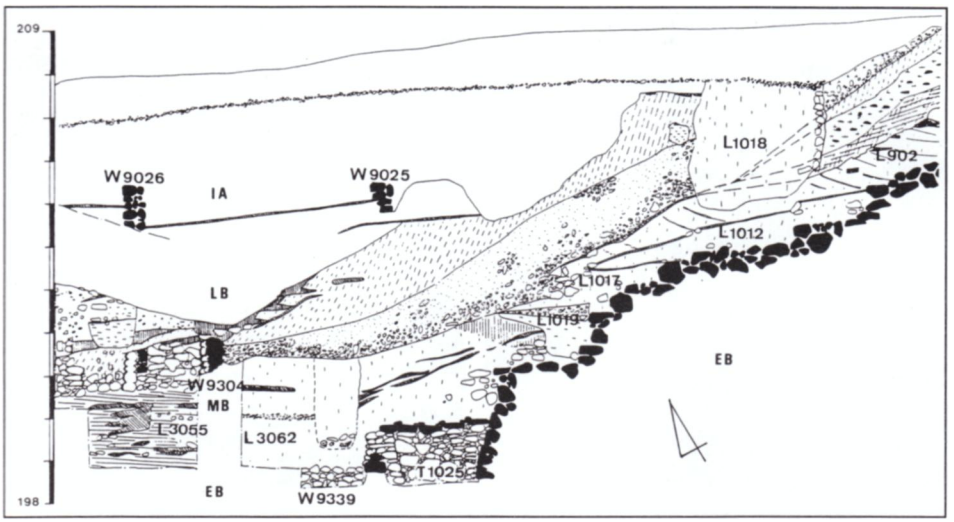

Fig. 1. Tel Dan: part of the north baulk section of Area Y, showing Tomb 1025 at the base of the battered stone structure.

A note of caution should be voiced regarding the bead's archaeological context. The bead was recovered in 1977, after the tomb had been exposed to debris — through a small aperture — from the sides of the Area Y trench opened in 1971–1974. Later intrusion is, therefore, possible, although unlikely, since the bead was found embedded some 15 cm. beneath the surface of the tomb's interior deposit.

The bead: analytical findings. The spherical bead (Figs. 2, 3) measures 13 mm. in length and 19 mm. in diameter, and corresponds to Beck's classification: 'Circular short barrel, Group IB1b'.[4] The perforation, a constant 4 mm. in diameter, is off-centre, leaving a thick side of 9 mm. and a thinner side of 5 mm. The bead is of a translucent, light green glass, which has a strongly weathered, unevenly striated surface, partially covered with a white, crusty layer with some iridescence. The microstructure was examined by scanning electron microscopy, and the composition was determined by wavelength-dispersive electron microprobe analysis.

The pattern of bubbles, striae and weathering suggests a method of manufacture whereby a lump of viscous glass was wound around a rod and fused with very little further working or finishing of the shape. Our reconstruction of this rapid process is further corroborated by the off-centre perforation.

The unweathered part of the glass is translucent, rather than transparent, due to the internal scattering of light from the surfaces of small bubbles. No quartz

4 H.C. Beck: Classification and Nomenclature of Beads and Pendants, *Archaeologia* 77 (1928), pp. 1–76.

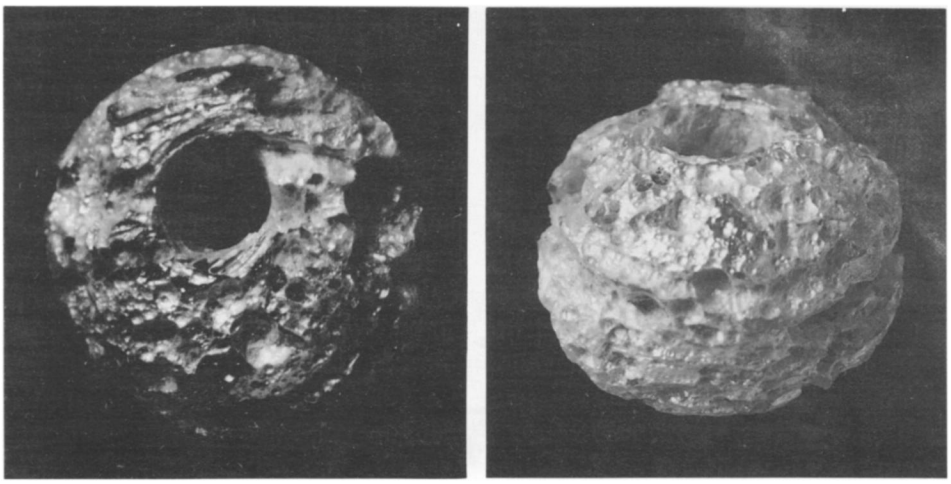

Fig. 2. The MB I (= MB IIA) glass bead from Tel Dan, Tomb 1025, Field No. 13561 (IAA 91-2350).

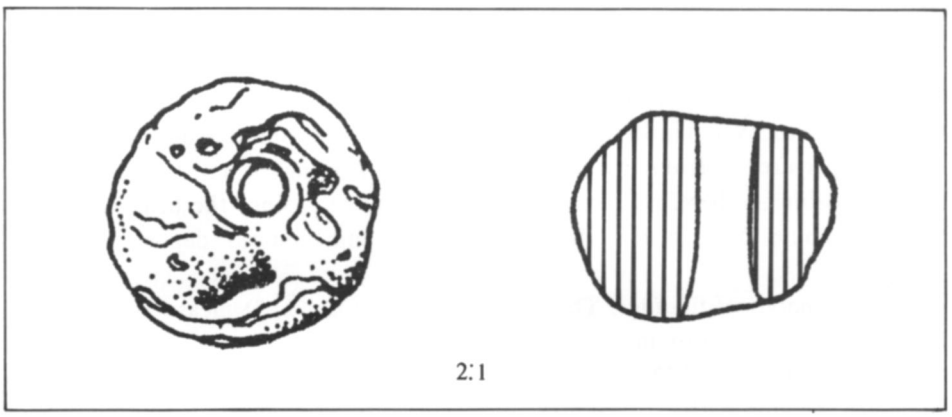

Fig. 3. Drawing of the glass bead from Tel Dan.

or other crystalline particles, which might have added opacity, were found under microscopic examination. The optical effect indicates that the glass was well melted, so that all raw materials were incorporated. The presence of bubbles, however, indicates that it was not well 'fined' (a later stage, in which the glass is held at a high temperature until the bubbles rise to the surface). Such bubbles may also occur when a powdered glass is remelted.

Analysis of the glass yields a soda-lime-silicate coloured with iron and copper oxides. Fairly high concentrations of magnesium and potassium oxides are present. Composition, based on 30 analyses of volumes measuring 10 × 10 × 3 to 5 microns in depth, is summarized in Table 1.

High potassia and magnesia values show this composition to be unlike most of the published second-millennium B.C.E. Egyptian ones. The source of alkaline earth

Table 1. Composition of the glass.

Mineral	% Average	% Range	Standard Deviation
SiO_2	69.4	67.8 — 71.56	1.0
Al_2O_3	0.8	0.65 — 0.98	0.1
CaO	7.1	6.63 — 7.17	0.13
MgO	4.54	4.39 — 4.86	0.13
Na_2O	14.88	14.79 — 16.0	0.26
K_2O	2.42	2.27 — 2.57	0.11
P_2O_5	0.15	0.07 — 0.22	0.15
CuO	0.20	0.06 — 0.36	0.07
FeO	0.41	0.37 — 0.51	0.44
Total	99.8		

is probably dolomitic, as the MgO/CaO ratio is 0.64. The phosphorus pentoxide concentration is quite low, but may correlate with the potassia concentration and indicate a possible plant ash source for this alkalai.

The light green colour is caused by a mixture of iron and copper oxide in solution: the amount of copper oxide is twice that of iron oxide. It is unlikely that the 0.2% of copper oxide would have been introduced as an impurity in the raw materials (sand, dolomitic lime, ash or salt), but it is also too low to have been added intentionally as a colourant. A concentration of 1.5% or more would have been required to intentionally induce a bluish-green colour. This bead possibly contains some glass remelted from a composition originally higher in copper. The heterogeneous weathering observed here is common in remelted products with a compositional variety of this sort. Titanium dioxide, chlorine and sulfate concentrations were not found by energy dispersive x-ray analysis, which has a detection limit of about 0.5 % in similar glasses. One can assume that high chlorine and sulfate concentrations would correlate with a salt source used as an alkalai.

Discussion and conclusions. The advent of a developed glass industry, producing a variety of objects in a range of colour by various techniques, is by consensus to be dated to the late sixteenth century B.C.E. Intentionally-made glass existed, however, long before, at least since the later third millennium B.C.E.[5] Other vitreous materials

5 On glass predating the Late Bronze Age, see *idem, Glass before 1500 BC, Ancient Egypt and the East*, London, 1934, pp. 7–21; A. Lucas: *Ancient Egyptian Materials and Industries* (4th ed., revised and enlarged by J.R. Harris), London, 1962, pp. 179–182; R.J. Forbes: *Studies in Ancient Technology* V, Leiden, 1966, pp. 120–132; C.A.R. Andrews (based on material collected by A. Wilkinson): *Catalogue of Egyptian Antiquities in the British Museum* VI, *Jewellery* I, London, 1981, e.g. Nos. 213, 268, 303, 329; G.T. Martin: *Egyptian Administrative and Private-name Seals, Principally of the Middle Kingdom and Second Intermediate Period*, Oxford, 1971, Nos. 441, 1199; D. Barag: *Catalogue of Western Asiatic Glass in the British Museum*, London, 1985, p. 35; P.R.S. Moorey: *Materials and Manufacture in Ancient Mesopotamia: The Evidence of Archaeology and Art* (*BAR International Series* 237), Oxford, 1985, pp. 194–199; P.E.

— glaze on soft stone, faience and frit — are known to have existed even earlier, at least since the fifth millennium B.C.E.[6]

Glass predating the Late Bronze Age is rare. The pieces recorded are, as a rule, single finds of small size — mainly beads, but also amulets, seals and inlays — and do not include vessels. These finds usually come from sites excavated many years ago with insufficient control over provenance, adding to the uncertainty about the beginnings of glass. However, two glass beads found separately in recent excavations at Nippur in southern Iraq, in an Akkadian context of *c.* 2300 B.C.E., have confirmed the existence of glass in the third millennium B.C.E.[7] These finds also reinforce the assumption that Mesopotamia, rather than Egypt, was the birthplace of glass. Glass remains are still rare in the Middle Bronze Age, although more numerous than before. Again, the evidence comes chiefly from Mesopotamia and Egypt, although scattered finds have been reported from Iran, Asia Minor and Syria.[8] Very few beads have been recorded locally; those found are principally from Jericho, possibly the result of its dry climate, which favours preservation.[9]

The archaeological evidence indicates that the Tel Dan glass bead can be dated to the first or second century of the second millennium B.C.E., and may have been imported from Mesopotamia or Syria. Egyptian material is absent at the site. In contrast, there are other Mesopotamian/Syrian characteristics in the Tel Dan MB material culture, such as Monochrome Painted Cream Ware (probably related to the Amuq/Cilician Ware) and burial practices.[10] The compositional data bolster this view, while the microstructure analysis, which indicates that the bead was formed in a viscous state by the simplest possible method, with little subsequent finishing, supports an early date.

McGovern *et al.*: The Beads from Tomb B10a B27 at Dinkha Tepe and the Beginnings of Glassmaking in the Ancient Near East, *AJA* 95 (1991), pp. 395–402.

6 The identification of various vitreous materials in excavation reports is not always reliable. On these problems and on vitreous materials other than glass, see Moorey (above n. 5), pp. 133–193, 231, with extensive references. See also M.S. Tite and M. Bimson: Identification of Early Vitreous Materials, in J. Black (ed.): *Recent Advances in Conservation and Analysis of Artifacts*, London, 1987, pp. 81–85.

7 The excavations were carried out by the Chicago Oriental Institute, see Mc. Gibson: Nippur, 1990: The Temple of Gudea and a Glimpse of Things to Come, *The Oriental Institute Annual Report* (1989/1990), p. 23. The beads are to be published in P.B. Vandiver. Mc. Gibson and A. M^{c}Mahon: The Origins of Glass Manufacture in the Late Third Millennium B.C.: Evidence from Nippur, Iraq (submitted to *Science).*

8 Moorey (above n. 5), p. 199.

9 Kathleen M. Kenyon: *Excavations at Jericho*, I, London, 1960, pp. 368, 406; *idem*, *Excavations at Jericho*, II, London, 1965, pp. 138, 295; see also P.L.O. Guy: *Megiddo Tombs*, Chicago, 1938, pp. 179–180, Pl. 110:17d; G. Loud: *Meggido* II, Chicago, 1948, Pl. 209:24.

10 D. Ilan: Archaeological Criteria for Determining Culture Transfer by Means of Immigration, in M. Kochavi (ed.): *Material Culture — National Culture: Proceedings of the Aharoni Memorial Symposium of 1992*, Tel Aviv (forthcoming).