The Origin of the Amber found at Tepe Marlik

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Among the artifacts found at Tepe Marlik[1] in northwestern Iran is a fragment which has the elemental composition of amber.[2] From the drawing[3] the piece appears to be a segment of an annular bead. The curvature suggests that the entire bead had a diameter of about 18–20mm and that the central opening measured about 7–8mm in diameter (Fig. 1).

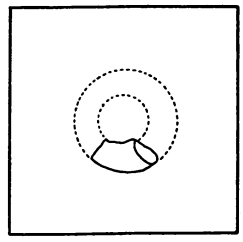

Fig. 1. Reconstruction of the Amber Fragment from Marlik as a Ring Bead.

Reconstruction from what must be less than a quarter of the original object is not without risks, but it is, in this case, the only way to connect the find to other amber artifacts. Ring-shaped beads or pendants are known from Iron Age Italy;[4] some had collars, with or without perforation, for suspension. Not all of these can be dated closely, but it is evident that amber in many forms, including such rings, was used extensively in the Italic cultures of the first half of the first millenium B.C. and that this use reaches back to the early phases (sub-Apennine and proto-Villanovan) of this period.[5]

Quite independent of any specific relationship the Marlik amber may have with Italic forms, it must be accepted since de Navarro's exhaustive study[6] that

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1 E.O. Neghaban, *Marlik*, Tehran, 1964.

2 T. Muroga, *Japanese Studies in the History of Science*, **9** (1970), 99–105.

3 Ref. 2, p. 101, fig. 5.

4 D.E. Strong. *Catalogue of the Carved Amber in the Department of Greek and Roman Antiquities* (British Museum), London, 1966, Nos. 93, 95, 96.

5 Ref. 4, p. 24.

6 J.M. de Navarro, *Geogr. J.*, **66** (1925), 481–507.

northern amber first appeared in quantity at the head of the Adriatic at the beginning of the Iron Age.

All this is consonant with the *floruit* of Tepe Marlik which Neghaban[1] puts at 900 B.C.

Such considerations, of course, will beg the question unless it can be established with certainty that the Marlik find is in fact amber and that it is specifically Baltic amber from northern Europe.

Muroga has reported[7] the results of elemental analyses which showed 70.35% carbon, 9.12% hydrogen, 19.16% of oxygen, 0.07% nitrogen, less than 0.0% sulfur and only traces of ash. These values are compatible with the composition of Baltic amber. The carbon content is lower and the oxygen content higher than would be the case in a well-preserved mineralogical specimen, but it is to be expected and has been demonstrated[8] that the carbon-oxygen ratio decreases markedly as a result of weathering:

Table 1. Elemental Composition of Baltic Amber after Helm[8].

	Transparent yellow interior	Firm red weathering crust	Friable brown weathering crust
% carbon	78.63	74.36	66.91
% hydrogen	10.48	9.94	9.16
% oxygen	10.47	15.34	23.67
% sulfur	0.42	0.36	0.26

The low sulfur in the Marlik sample remains shomwhat surprising.

While these analytical results make it highly probable that the Marlik find consists of some kind of amber, it cannot answer the question of its origin. There are deposits of amber-like fossil resins in southern and southeastern Europe, notably in Sicily and in Rumania, which have the same elemental composition and which might well have furnished the raw material for the Marlik artifact. The old method of identifying Baltic amber by its succinic acid content[9] is unreliable since Sicilian, Rumanian and other non-Baltic amber-like fossil resins may contain equal amounts of this acid.[10,11] The amount of amber available from the Marlik excavation would, in any event, be insufficient for such an analysis. However, it is now possible to recognize Baltic amber unequivocally by its infrared absorption spectrum, using only two milligrams

[7] Ref. 2, p. 104, Table 2.

[8] O. Helm, *Schriften der naturforsch. Gesellsch. Danzing.* N.F. 5, Nr. 3 (1882), 9–11.

[9] O. Helm, *Schriften der naturforsch. Gesellsch. Danzing*, N. F. 6, Nr. 2 (1885), 234–239.

[10] W. LaBaume, *Schriften der naturforsch. Gesellsch. Danzing*, Nr. 1 (1935), 5–48.

[11] C.W. Beck, *Archaeology*, **23** (1970), 7–11.

[12] C.W. Beck, E. Wilbur and S. Meret, *Nature*, **201** (1964), 256–257.

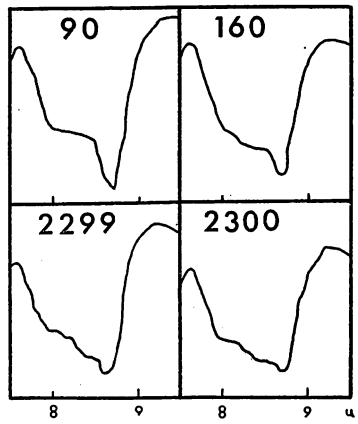

Fig. 2. Partial Infrared Spectra of Succinite (90 and 160) and of the Amber Fragment from Marlik (2299 and 2300).

of sample.[11,12] Baltic amber, and only Baltic amber among all the fossil resins of Europe and Asia, has a characteristic absorption pattern between 8 and 9 microns (1250–1110cm^{-1}) (Fig. 2, Spectrum 90) which may be distorted by weathering (Fig. 2, Spectrum 160), but which remains characteristic enough in all but a few extreme cases to be identifiable by a computer programmed for the purpose.[13] The spectra of two carefully selected interior samples of the Marlik find (Fig. 2, Spectra 2299 and 2300) leave no doubt that the object was made of Baltic amber.

Lest the appellation "Baltic amber" suggest too narrow a limit of geographic origin, it will be well to append a few words about the nomenclature of fossil resins. The occurrence of "Baltic amber" is not now restricted to the vicinity of the Baltic Sea. Rather, the term describes a variety of fossil resin which palaeontologists believe was *formed* in a forest which flourished some sixty million years ago in an area which is now partially covered by that sea. Since then, however, geological events, notably glaciation, have widened the natural distribution so extensively that today it is found along the east coast of England, the eastern part of Holland, throughout Scandinavia and northern Germany, in Poland and in Russia as far south as the northern shores of the Black Sea.[14] The overwhelming amount of the amber found in this large area is called succinite by mineralogists, but minor amounts of other varieties also occur in this region: some, *e.g.* glessite, are now known to have a different botanical

[13] C.W. Beck et al. in R.H. Brill, ed., *Science and Archaeology*, Cambridge, Mass., 1971, pp. 235–239.

[14] For a distribution map, cf. Ref. 11, p. 8 or Ref. 13, p. 237.

source than succinite,[15] others, *e.g.* beckerite, appear to be merely contaminated succinite.[16]

The spectroscopie identification of the Marlik amber shown it to be succinite. The raw material must therefore have come from within the large but well-defined area of natural distribution of this fossil resin.

Resume

An annular fragment of amber found at Tepe Marlik in northwestern Iran and dated to about 900 B.C. from its context has been identified as Baltic amber (succinite) by infrared spectrophotometry.

The object, or the raw material for it, is therefore an import.

Acknowledgment

The authors express their deep gratitude to Professor E.O. Neghaban, Tehran University for his offer of valuable samples.

[15] J.W. Frondel, *Nature*, **215** (1967), 1360–1361.

[16] K. Schubert, *Beih. Geol. Jb.*, **45** (1961), 109.