

# THE GLASS FROM TARRHA

(PLATES 36–38)

**S**EVEN of the nine trenches dug at Tarrha produced more than four hundred fragments of glass. Nine-tenths of these are unidentifiable, probably from the walls of blown vessels. Most of the forms and techniques suggested by the remaining tenth appear to be the more ordinary sort, common in the Roman Empire during the first and second centuries after Christ. The purpose of this brief note is to list the recognizable types and to illustrate the unusual forms of deterioration common to much of the Tarrha glass.<sup>1</sup>

Although one complete vessel was found (No. 12), not a single object could be assembled from fragments. In addition, the forms and techniques represented by the identifiable fragments do not fall into a neat, chronologically limited pattern. The value of even this small group of recognizable bits is lessened by the fact that many are very small, frequently badly misshapen and heavily corroded. Some are from well known and well dated vessel types (for example, Nos. 1, 26) while others can be identified by technique of manufacture (for example, No. 19). In most cases, however, there is only a small section of rim or base or, more frequently, a tiny bit from the wall of a vessel, which makes it practically impossible to associate a specific fragment with a vessel type. Of the pieces discussed here to which parallels are cited, only a very small percentage can be safely identified with a known type.

Fragment No. 2, from a cored vessel, is probably the earliest specimen, either Hellenistic or—less likely—pre-Hellenistic. Among the latest found is No. 26, a fragment from a vessel embellished with flat, oval prunts or blobs of blue glass, probably of the fourth century after Christ. This indicates a span of about five hundred years, although most of the fragments appear to belong to the early Roman Empire, that is, between the first and second centuries after Christ, with the majority probably in the first century. The later examples are few and may either be intrusions (No. 26 was found on the surface near the west steps leading down to the river) or incorrectly identified. No. 23 represents a special problem as it has certain characteristics associated with goblets of the early Islamic period.

<sup>1</sup> I am indebted to my friends and colleagues, Dr. Axel von Saldern, Curator of the Museum, and Mr. Harrison P. Hood of the Corning Glass Works Research Laboratory. Mr. Hood has given much of his time to matters concerning ancient glass.

## CATALOGUE

## 1. Fragments of ribbed bowls. Pl. 36.

TG 1. Max. dim. 0.052 m.

Greenish tinge. Rim fragment with parts of three ribs. Rim polished inside and out.

TG 18. Max. dim. 0.042 m.

Misshapen fragment with parts of three ribs. Pale aquamarine. Deformed by fire, the breaks are clean, indicating it was broken after burning.

For the shape cf. C. Isings, *Roman Glass from Dated Finds*, Groningen, 1957, form 3, pp. 17 ff.; G. R. Davidson, *Corinth*, XII, Princeton, 1952, pp. 545 ff.; D. B. Harden in C. F. C. Hawkes and M. R. Hull, *Camulodunum, First Report on the Excavations at Colchester, 1930-1939*, London, 1947, pp. 294 ff.; J. W. and G. M. Crowfoot, *The Objects from Samaria*, London, 1957, pp. 403 ff.

First century after Christ or possibly earlier. Trench 1.

## 2. Fragment of cored vessel. Pl. 36.

TG 2. Max. dim. 0.023 m.

Blue matrix; yellow bands and turquoise zigzags. Probably from an amphoriskos or aryballos.

Cf. Poul Fossing, *Glass Vessels before Glass-Blowing*, Copenhagen, 1940, pp. 103 ff.

Probably Hellenistic. Trench 1.

## 3. Fragments of shallow bowls. Fig. 1.

TG 3. Max. dim. 0.027 m.

Colorless, appearing opal because of oxidation. Incised groove runs parallel with rim.

TG 63. Max. dim. 0.018 m.

Colorless, appearing opal. Perhaps part of a handle; no fire damage.

Cf. Isings, *op. cit.*, form 22, p. 38. To the same category appear to belong objects such as *Glass from the Ancient World*, R. W. Smith Collection, Corning, 1957, no. 173; see also Fremersdorf, *Römisches Buntglas in Köln*, Cologne, 1958, pl. XLVI. For the shape cf.

Oswald and Pryce, *Terra Sigillata*, London, 1920, pls. L, LI.

First century B.C.—first century A.D. Trench 1.

## 4. Fragment of handle. Pl. 36.

TG 4. Max. dim. 0.054 m.

Light greenish blue. Typical Roman handle construction, probably from a jug or amphoriskos.

Cf. Isings, *op. cit.*, form 15, p. 32; Morin-Jean, *La Verrerie en Gaule*, Paris, 1913, pls. 2, 3.

First-second century. Trench 1.

## 5. Fragments of unguentarium (?).

TG 7. Max. dim. 0.037 m.

Greenish blue tinge. Fragments of extremely thin glass, some misshapen by proximity to heat.

Cf. Isings, *op. cit.*, form 28a, p. 42; Olof Vessberg, "Roman Glass in Cyprus," *Opuscula Archaeologica*, VII, 1952, pp. 22 ff.

First or second century. Trench 1.

## 6. Fragment of cup (?). Fig. 1, Pl. 36.

TG 11. Max. dim. 0.023 m.

Light blue, iridescent. Two lathe-cut grooves about 0.005 m. apart flank a wide, shallow groove.

Cf. Isings, *op. cit.*, form 12, pp. 27 ff.; Vessberg, *op. cit.*, pl. I, pp. 18 ff.; *Corinth*, XII, nos. 590-591.

Probably first century. Trench 1.

## 7. Base ring fragment. Fig. 1, Pl. 36.

TG 13. Max. dim. 0.035 m.

Clear and colorless. Folded air trap base ring; bottom rises in center. Probably from a bowl.

Cf. Vessberg, *op. cit.*, p. 112, pl. I, where the base construction appears to be similar.

First or second century. Trench 1.

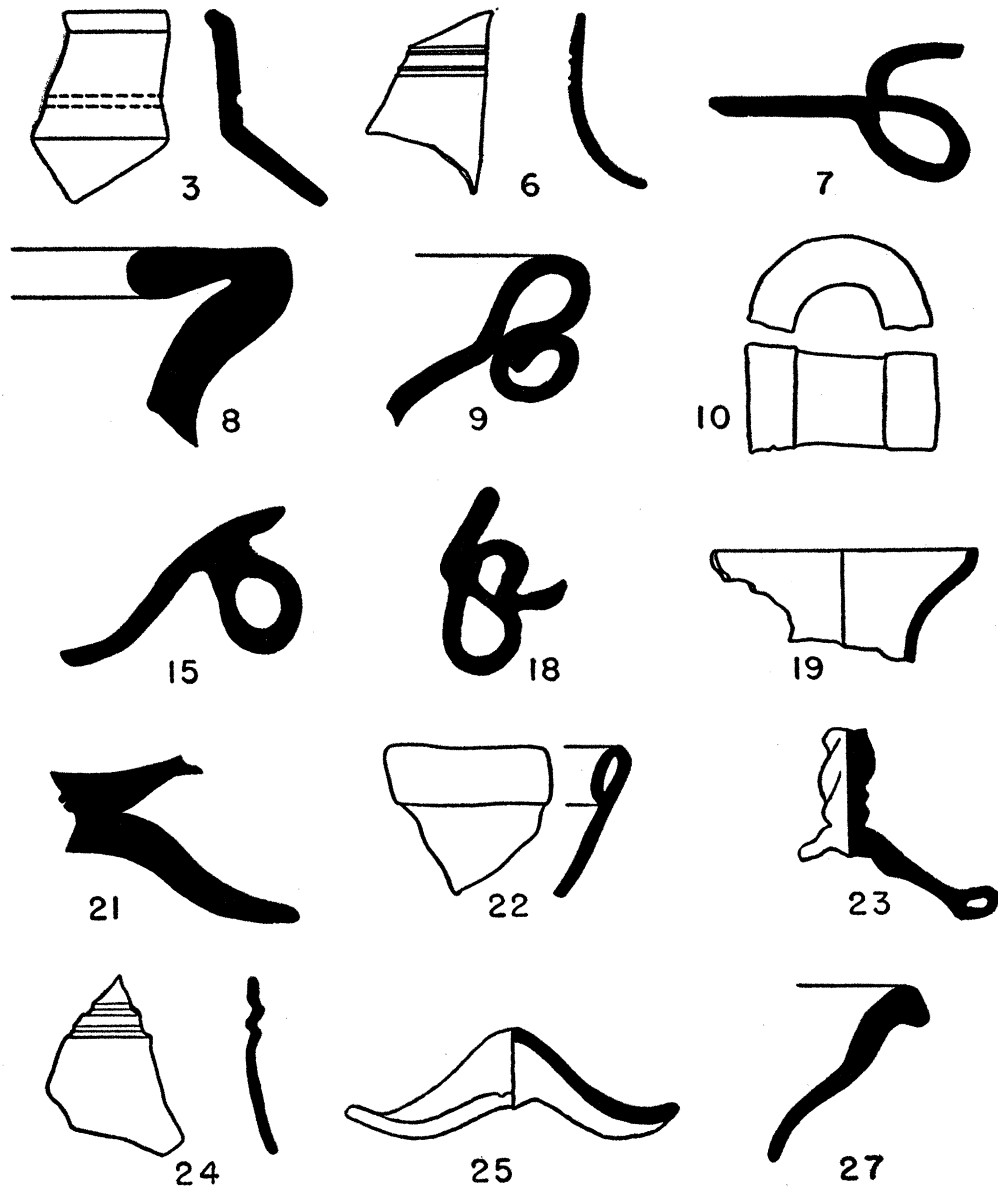


FIG. 1

## 8. Fragments of unguentaria. Fig. 1, Pl. 36.

TG 15. Max. dim. 0.027 m.; diam. of rim 0.038 m.

Aquamarine, with big bubbles. One fragment from the top of a thick-walled narrow-necked vessel with wide, flat rim; the other may be from the base of the neck where it joins the shoulder. Weathering occurred after the vessel was broken.

Cf. Isings, *op. cit.*, pp. 40 ff.

Probably first or second century. Trench 1.

## 9. Four rim fragments. Fig. 1, Pl. 36 (only three shown).

TG 17. Max. dim. 0.038 m.

Colorless, with iridescent brown weathering and signs of burning; the one unblackened specimen shows heat pocks at the edge. All the rims are folded, probably from bowls.

Cf. D. B. Harden, *Roman Glass from Karanis*, Ann Arbor, 1936, pls. XIV and XV.

Second-fourth centuries. Trench 1.

## 10. Fragment of bottle neck. Fig. 1.

TG 20. Max. dim. 0.029 m.; diam. 0.025 m.

Green, very thick glass, approximately half a cylinder. Probably neck fragment from a large bottle.

Cf. Harden, *op. cit.*, nos. 805 ff.

Probably Early Roman. Trench 1.

## 11. Fragment of bottle. Pl. 36.

TG 23. Max. dim. 0.063 m.

Pale aquamarine, badly burned. Thick bottom, thin walls; six loops of fine spiral threading. Probably from a bottle.

Cf. *Glass from the Ancient World*, p. 156, no. 319; Fremersdorf, *op. cit.*, pp. 12 ff.

First century. Trench 1.

## 12. Two unguentaria. Pl. 36.

TG 26. Max. dim. 0.042 m. Top and part of one side missing.

Pale aquamarine. Ripples on exterior, bubble pocks on interior.

TG 28. H. 0.07 m. Misshapen but intact.

Pale aquamarine. Flat, flaring rim; globular body. The rim seems to have broken from the neck and then re-fused during exposure to great heat.

Cf. Isings, *op. cit.*, pp. 42-43; Vessberg, *op. cit.*, pl. VII; Harden, *op. cit.*, nos. 819 ff.

First or second century. Trench 1.

## 13. Fragment of bowl(?). Pl. 36.

TG 35. Max. dim. 0.044 m.

Pale aquamarine. Applied base ring and threading above the base; deformed by fire.

Cf. Isings, *op. cit.*, pp. 56 ff. For base construction, cf. Harden, *op. cit.*, pls. XI, XII, XIV.

First-third centuries. Trench 1.

## 14. Fragment of bottle or jug. Pl. 36.

TG 40. Max. dim. 0.045 m.

Aquamarine. Two fragments fused together; probably a large object cracked from heat and then fused. Signs of mould-blown design, like the bottom of a square jug.

Cf. Isings, *op. cit.*, form 50, pp. 63 ff. For the date of this type cf. especially Harden in *Germania*, XXXVII, 1959, p. 339.

Probably first, possibly second century. Trench 1.

## 15. Two base ring fragments. Fig. 1, Pl. 36.

TG 46. Diam. ca. 0.105 m.

Colorless, amber discoloration.

TG 47. Max. dim. 0.027 m.; diam. probably less than 0.10 m.

Colorless. Both of these fragments were probably from bowls; for the shape cf. No. 7.

Trench 3.

## 16. Four rim fragments. Pl. 36.

TG 49. Max. dim. 0.05 m.

Colorless. Two fragments, possibly from the same vessel. Folded rims with crimped applications. Both were exposed to fire.

TG 85. Max. dim. 0.045 m.

Colorless, with yellow iridescence. Two folded rim fragments with crimped applications. May have been exposed to fire. All the fragments are probably from bowls.

For rims with applied crimped threads cf. S. Loeschcke, *Beschreibung römischer Altertümer gesammelt von C. A. Niessen . . .*, Cologne, 1911, nos. 78, 79, pl. XXXIV; *Corinth*, XII, nos. 612-613.

Second or third century. Trench 3.

**17.** Fragment of flask (?). Pl. 36.

TG 67. Max. dim. 0.025 m.

Pale amethyst, perhaps from manganese. Mould-blown, possibly from a flask resembling a bunch of grapes.

Cf. Isings, *op. cit.*, form 78e, pp. 93-94; G. A. Eisen, *Glass*, New York, 1927, p. 307, pl. LXVIII; Harden, *Karamis*, no. 628 (a head vase).

Third century(?). Trench 3.

**18.** Rim fragment. Fig. 1, Pl. 36.

TG 72. Max. dim. 0.07 m.

Pale aquamarine. Two pieces. Doubly folded rim, probably from a bowl or cup.

Cf. *Corinth*, XII, no. 653.

Second or third century. Trench 1.

**19.** Rim fragment. Fig. 1.

TG 73. Diam. of rim *ca.* 0.035 m.

Pale aquamarine. About half the mouth of a vessel, probably a bottle.

Cf. Isings, *op. cit.*, form 92 (?); Morin-Jean, *op. cit.*, form 40 (?).

Probably first century B.C. or A.D. Trench 1.

**20.** Two mosaic glass fragments. Pl. 36.

TG 84. Max. dim. 0.035 m.

Opaque brick-red matrix with opaque yellow

and transparent green inserts. Fragments probably from a bowl, badly misshapen by heat.

Cf. W. Froehner, *Collection Julien Gréau*, Paris, 1903, pl. XCVII, similar in pattern though not in color. For dated millefiori glass see Isings, *op. cit.*, pp. 15, 16.

First century B.C. or A.D. Trench 3.

**21.** Fragment of base. Fig. 1, Pl. 38.

TG 92. Diam. *ca.* 0.03 m.

Part of an unusually thick pedestal foot, possibly of a cup.

For similar foot construction, cf. Vessberg, *op. cit.*, pl. II, 20.

Probably first century. Trench 4.

**22.** Rim fragment. Fig. 1.

TG 100. Max. dim. 0.02 m.

Pale aquamarine. Fragment of folded rim, possibly a bowl or cup.

For rim construction, cf. Vessberg, *op. cit.*, pl. I; Harden, *op. cit.*, pl. XI.

Probably first or second century. Trench 5.

**23.** Fragment of goblet. Fig. 1, Pl. 38 (including other goblet fragments).

TG 112. P. H. 0.023 m.

Pale aquamarine. Twisted stem containing three vertical air traps; folded foot.

Cf. Isings, *op. cit.*, form 111; *Corinth*, XII, no. 720.

Probably fourth century. Trench 5.

**24.** Fragment of bowl. Fig. 1.

TG 115. Max. dim. 0.023 m.

Very pale aquamarine. Mould-blown, with two ridges 0.004 m. apart.

For a footed bowl with one mould-blown ridge, cf. Loeschcke, *op. cit.*, no. 1094, pl. L.

First or second century. Trench 5.

**25.** Fragment of base. Fig. 1, Pl. 38.

TG 116. Max. dim. 0.045 m.

Pale olive. Base of beaker or bowl.

Cf. Isings, *op. cit.*, form 30; Vessberg, *op. cit.*, pl. I, nos. 18 ff.

First or second century. Trench 5.

**26.** Fragment of vessel. Pl. 36.

TG 139. Max. dim. 0.022 m.

Shapeless fragment of colorless glass with blue blob applied, probably from a bowl.

Cf. *Glass from the Ancient World*, nos. 304, 304a; G. Caputo, *Mon. Ant.*, XLI, 1951, cols. 298 ff., color pl. III; Morin-Jean, *op. cit.*, pp. 218 ff.; *Corinth*, XII, nos. 615, 616. For color cf. color plate in *Glastechnische Berichte*, XXXI, 1958, opposite p. 19.

Ca. fourth century. Found on surface, near steps descending to river.

**27.** Fragment of rim. Fig. 1.

TG 145. Max. dim. 0.029 m.

Olive green. Very thick rim, very thin walls, probably of a bowl. Perhaps polished on the exterior.

Cf. rim profiles of early first century—Oswald and Pryce, *op. cit.*, pl. XLI; E. Gose, "Gefässtypen der römischen Keramik im Rheinland," Beiheft 1, *Bonner Jahrb.*, LVI, 1950, no. 123 etc.

First century. Trench 7.

One remarkable aspect of the Tarrha glass is not evident in the above list: more than two-thirds of all the fragments show evidence of proximity to heat and smoke. Half of the remaining third were strangely and heavily corroded, as were many of the burned fragments. The distribution by trenches is shown in the following table. Few burned fragments were on the surface but all three types were found at all layers.

	Tr. 1	Tr. 3	Tr. 4	Tr. 5	Tr. 7	Tr. 8	Church	Total
I no obvious weathering, no apparent fire damage	13	3	2	26	13	0	3	60
II heavy weathering and cor- roding, no apparent fire damage	18	2	3	11	34	0	2	70
III fire damage, frequently heavily corroded	151	78	28	20	0	3	1	281
Totals	182	83	33	57	47	3	6	411

Among the fragments there are five general types evidencing burning, and three showing corrosion:

## BURNING

### 1. Black deposit on outer surface

This may be a carbon deposit which has combined with the alkaline solution resulting from leaching on the surface of the glass. It is a scale-like layer, easily removable (Pl. 37, a).

### 2. Loss of Form

This varies from complete collapse (No. 11) to barely discernible sagging or twisting. In some instances (No. 17) the glass reached its melting temperature and began to "run" (Pl. 37, b).

### 3. Refusion

Separate fragments become fused together, often with little loss of form. In one case (No. 14) an object appears to have been broken either by physical or thermal shock and then partly re-fused.

### 4. Interior Bubbling

Bubbles are formed within the thickness of the glass by the expansion of infinitesimal pockets in the original matrix. These are frequently so numerous as to form an over-all texture (Pl. 37, c).

### 5. Cracking

This varies from the sharp separation of whole parts to extremely fine surface cracks. Both are generally caused by thermal shock, that is a sudden change in temperature as when cold water falls on a hot glass surface. In this case, the outer skin contracts, pulling in to flat sections surrounded by channels. The effect when magnified resembles a mud flat (Pl. 37, d).

## CORROSION

### 1. Layering

The cause of iridescence and most surface films, this form of decomposition is the result of the water-soluble alkali in glass leaching out, leaving a layer with a higher silica content than the glass matrix. These layers may continue to form one under the other. The alkaline solution formed by the leaching process may accelerate further leaching and may also combine with external elements to form a scum or layer of discoloration.

### 2. Pitting

This very common form of surface decomposition is little understood. It probably involves the leaching process, but why the pits are generally spherical is not known (Pl. 37, e). The bubble structure of the original glass does not seem to be a relevant factor, although interior bubbling from exposure to a fire might have bearing. Another possibility is pitting through some protective layer such as a carbon deposit by which the surface would be protected from leaching except where the layer had been removed. Plate 37, f is a remarkable example in which small craters have been formed below (or above?) a large one. In Plate 37, g pits have formed in such a way as to leave a raised plane along the left side.

### 3. Ploughing

This varies from shallow grooves in the surface (Pl. 38, a) to channels cutting all the way through (Pl. 38, b). These may be the result of leaching down from a scratch on the surface or the widening of a crack running through the glass (Pl. 38, c),

although why the sides of the channel remain perpendicular to the surface is inexplicable. This explanation seems even less reasonable in the case of Plate 38, d in which a tunnel appears on the left hand side running diagonally through the thickness of the fragment. The rim fragment in Plate 38, e shows a groove which tunnels into the glass, parallel to but not touching the interior of the folded rim. The most curious of this large group of ploughed fragments is shown in Plate 38, f where tunnels, grooves and channels pass through and over each other leaving a strange network of plateaus which must have once been the original surface. Spectrographic analysis showed this fragment to contain 16.4% of the water-soluble flux soda, not an unusually great amount.

Is there a relationship between these forms of corrosion and burning? How much time is required for craters and tunnels to form? Salt water will certainly hasten such decomposition, but does it have other effects? Is there such a thing as a glass worm? We know of the tiny radiolaria that make their own skeletons out of silicon dissolved in sea water.

The ways in which glass deteriorates may be able to describe physical conditions over long periods of time. Recognition of types of decomposition should throw light on quality of glass and its major constituents. It may very well be possible to determine age through weathering.

## CONCLUSION

There are several unusual factors about the glass found at Tarrha. First, in relation to other sites in Greece the number of glass fragments found is unusually large. Second, with one exception (No. 12), no intact objects were found, and not a single object could be reassembled from fragments. Third, glass fragments were found in widely separated trenches at all levels, with little apparent relationship to the purpose for which the area was used. And finally, five-sixths of the fragments show various signs of either exposure to great heat and/or unusually corrosive conditions.

Taking the evidence at hand—and its great inadequacies must be emphasized—there is as yet no reason to believe that glass was made at Tarrha. It is logical, however, to suppose that cullet (broken glass used in preparing the batch for a new melt) was brought here on its way to a glass factory. The objection to this theory is the wide distribution of glass over the site. One of many explanations may be derived from a study of the site plan (p. 92, Fig. 1) and the table on page 114. Allowing for a certain amount of breakage and discard in proximity to the trenches in which the fragments were found, there is a rough pattern of distribution with the greatest number closest to the sea and the least farthest from it. This might be accounted for if the glass cullet was stored in a place convenient to the shore and was



subsequently "washed" over the site. The condition of the fragments clearly indicates a fire—possibly in the storage place, although the fragments could have been exposed to fire before their arrival in Tarrha—and the amount of decomposition suggests unusual weathering conditions, possibly accounted for by long exposure to salt water. The thermal shock evidenced by several fragments suggests that the fire might have been terminated by the water. The rise of the south coast of Crete by some eight meters, supposedly in the sixth century after Christ,<sup>2</sup> may have terminated several centuries of partial inundation. None of the later fragments were badly corroded.

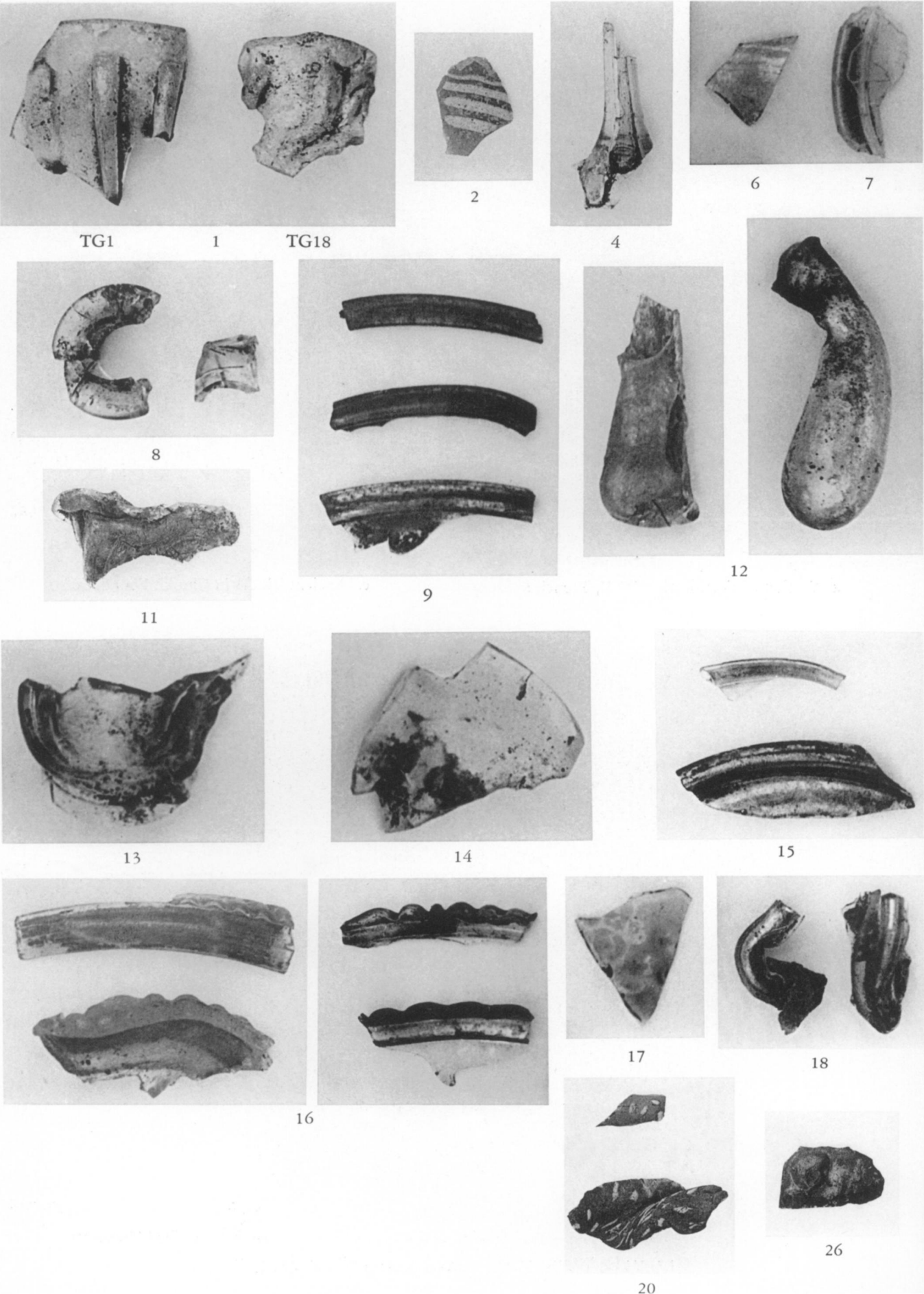
This suggested explanation, based on insufficient evidence, is only one of many possibilities and may be entirely incorrect.

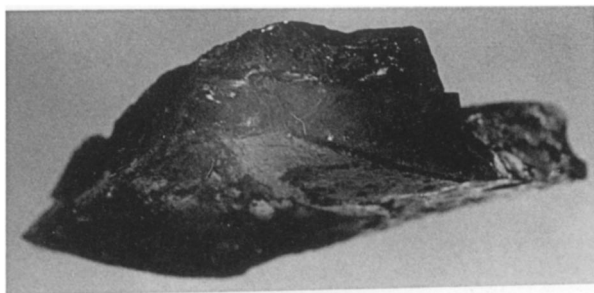
The value of the glass found at Tarrha lies in its physical condition. It is an unpretentious reminder of how little we know about glass decomposition and how much a thorough understanding of these phenomena might tell us. The study of these problems will be a major part of the Laboratory Research Program of The Corning Museum of Glass.

THOMAS S. BUECHNER

THE CORNING MUSEUM OF GLASS

<sup>2</sup> J. D. S. Pendlebury, *The Archaeology of Crete*, p. 3.

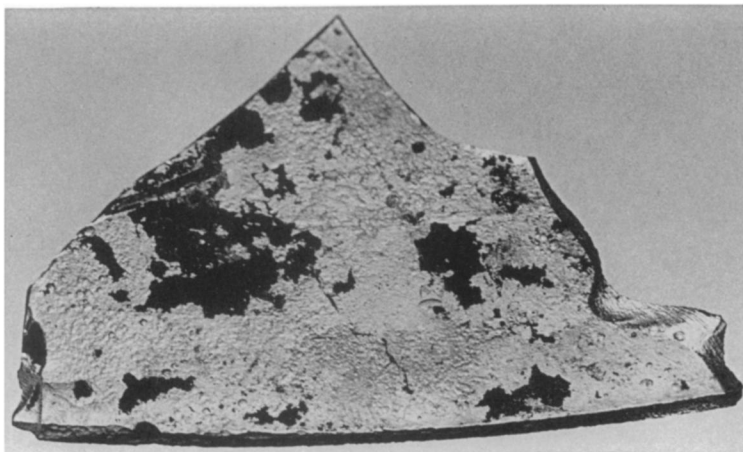




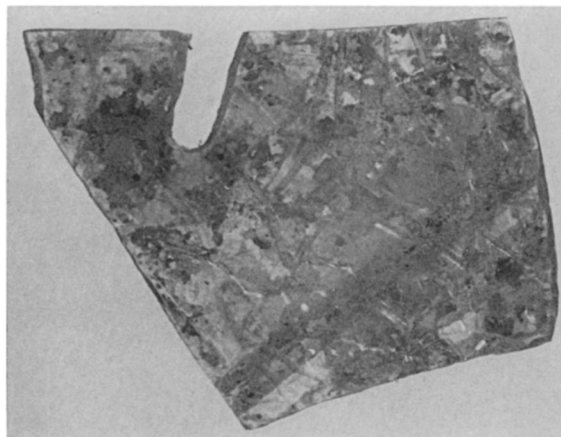
a. Black Deposit



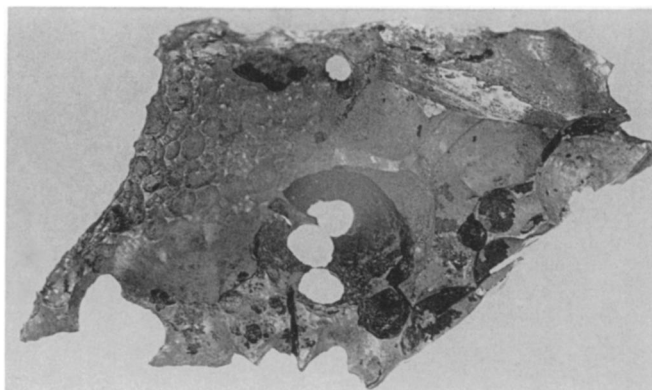
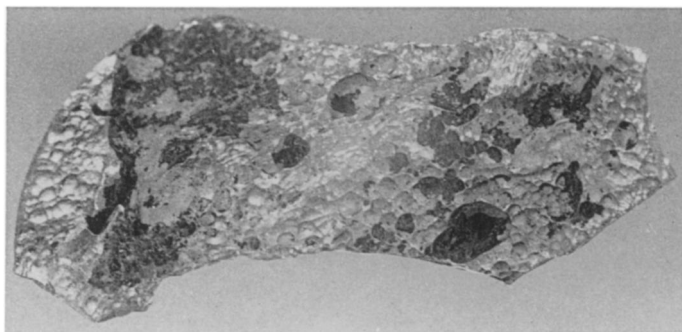
b. Loss of Form



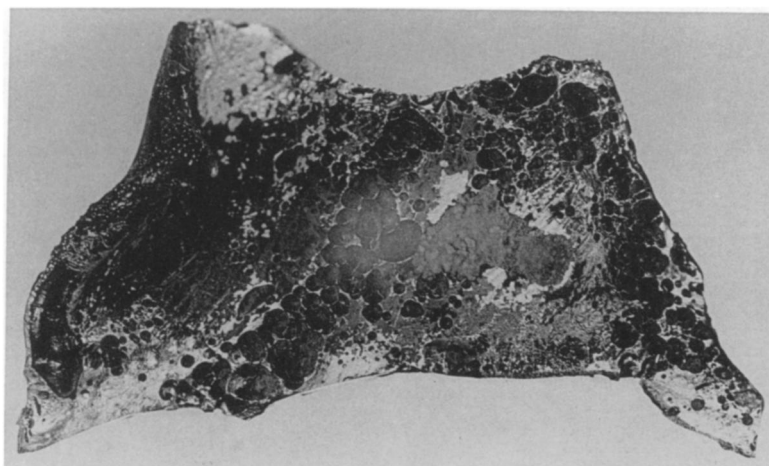
c. Interior Bubbling



d. Cracking



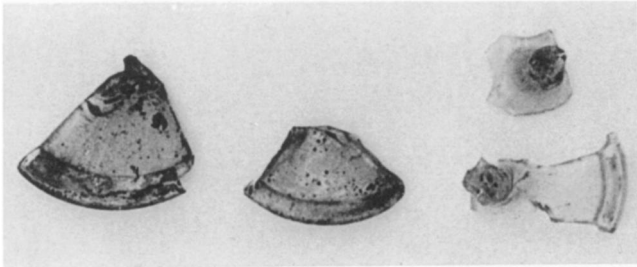
e. and f. Pitting



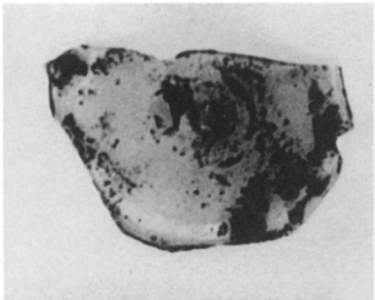
g. Pitting



21



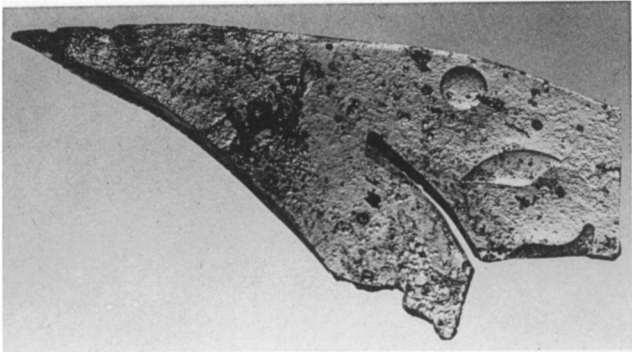
23



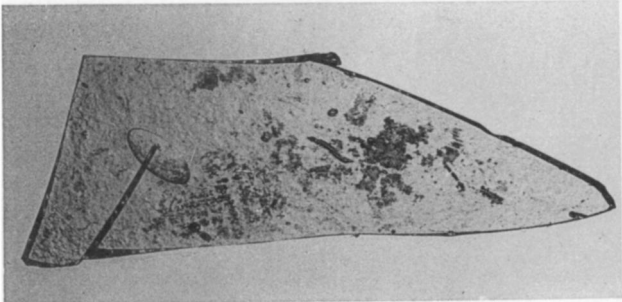
25



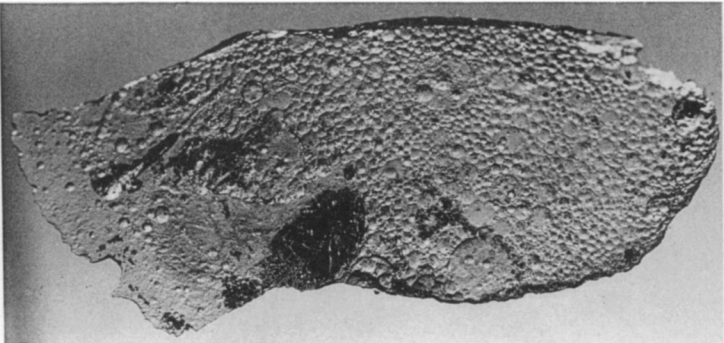
a.



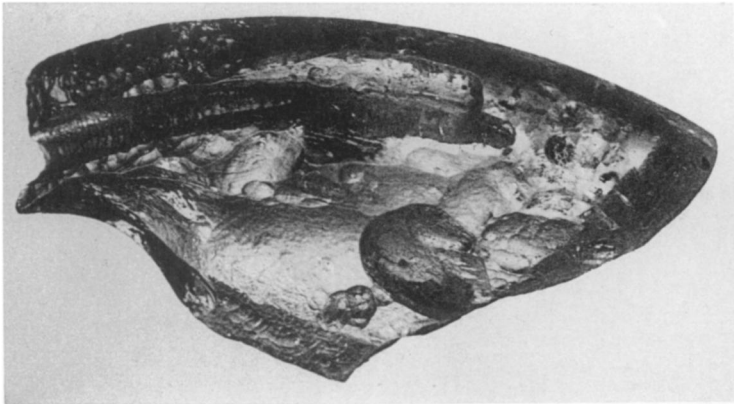
b.



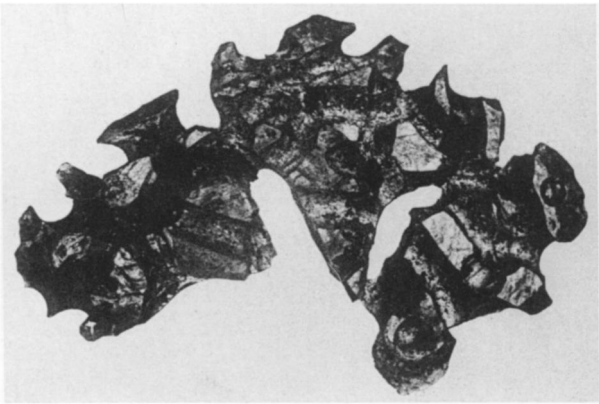
c.



d.



e.



f.

a.-f. Ploughing

THOMAS S. BUECHNER: THE GLASS FROM TARRHA