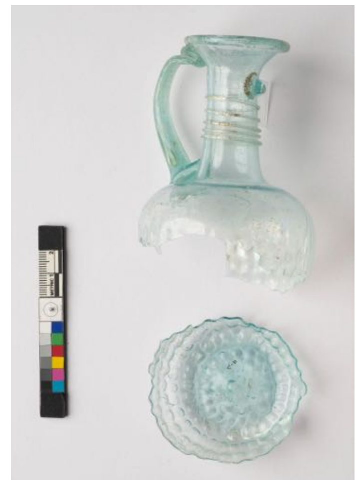
Winterthur/University of Delaware
Program in Art Conservation

Conservation Examination Report and Treatment Proposal



Owner: Bryn Mawr Art and Artifacts Collections
Accession #: G.11 (ACP 1968)
Object: Jug with Mold-Blown Decoration

Artist/Maker: Unknown, Asia (possibly Syria)

Object Date: ca. 4th - 6th century
Materials: Mold blown glass (non-leaded)

Dimensions: 11.3 x 7.2 x 0.1 cm (H x W x thickness, overall from record); Smallest fragment: 0.3 cm wide, largest fragment: 7 x 9.5 (H x W) cm.

Distinguishing Marks: None

Reason for Treatment: Reassembly and stabilization for the Bryn Mawr Art and Artifacts Collections.

Examined By: Daisy Diamond (Graduate Fellow, Winterthur/University of Delaware Program in Art Conservation [WUDPAC], Class of 2026)
Consulted: Lara Kaplan (Objects Conservator and Affiliated Assistant Professor, WUDPAC)
Lauren Fair (Conservator and Lab Head for Objects Conservation, Assistant Director of Conservation, Affiliated Associate Professor; WUDPAC)
Marianne Weldon (Special Collections Manager, Library & Information Technology Services at Bryn Mawr College)
Victoria Schussler (Objects Conservator, The Frick Collection)

Proposal Date: December 2, 2024

Description

This green-blue glass jug has a mold-blown, pomiform body with a honeycomb pattern of 0.5-cm circular depressions that span the walls and underside of the jug. The vessel's characteristics include, from top to bottom, a folded rim, a flaring funnel-shaped mouth, a slightly tapered centered neck with a thin thread wound five and one half times around the neck from left to right with the lowest ring transitioning into the handle, a broad shoulder, and a concave pushed-in base (Auth 1976, 7, 90). The handle is joined to the rim and the shoulder. On the body, the mold-blown design is composed of at least four alternating rows of sunken hexagons. On the underside of the base, there are five radial indentations.

The wall of the vessel is approximately 0.1 cm in thickness. The wall of the neck is approximately 0.3 cm in thickness and 5.5 cm in height. The glass is translucent and slightly green-blue in the thinnest areas, but more opaque and saturated in the thickest areas of the rim, handle, and base. There are no visible inclusions in the glass. Small elongated air bubbles are present in the mouth, neck, shoulder, and base. The air bubbles on the neck are elongated vertically. There are no visible mold seams. There is a 0.8-cm in diameter pontil mark on the underside of the base. The glass is currently in 21 associated fragments (see "Condition" for additional information).

Significance and Cultural Context

The earliest known glassmaking evidence is traced to over 2,000 years ago with the Mesopotamian Sumerians in Eridu and Eshnunna. From these worked lumps and rods, core forming techniques were developed and glass manufacturing continued to evolve into vessels and Hellenistic luxury glassware. The driving force of this production may have been the unique optical properties of glass and the ability to form shapes impossible to produce with other materials. During the Roman period (1st-4th century C.E.), glass products such as millefiori, blown, and molded glasses, were enjoyed by the middle class as well as emperors and aristocrats. During the mid 1st century B.C.E., glassblowing was discovered as a more efficient alternative to the laborious molding and core forming techniques and was developed particularly by glass makers on the Syro-Palestinian coast. With glassblowing, the translucency and thinness of glass became desired characteristics, in addition to the shape and surface decoration (Auth 1976, 15-18). This ancient glassworking tradition continued through the Byzantine period (5th-6th century C.E.) and the Moslem period with Islamic glass (early 7th century C.E.) (Auth 1976, 15-19, Brown 2024).

ACP 1968 (G.11) was noted to be likely Syrian in origin by Julie Pomerantz in 1990. Comparable vessels with mold-blown decoration and the scarcity of precisely dated objects with compatible mold-blown decoration makes this one difficult to date. Similar examples have been attributed to the late 3rd-6th century C.E., however similar examples continued to be produced in Persia until the 14th century C.E., but the vessels became less intricate over time (Marianne Weldon, email communication regarding Julie Pomerantz catalogue notes from May 1990, November 27, 2024). It is unclear what this object would have been used for, but it may have served a fine art or utilitarian function such as the storage and shipping of libations, oil, or perfume (Auth 1976, 17). This object was included in the 2007-2008 exhibition "Shifting Sands: Roman Glass in the Bryn Mawr College Collections" curated by Joelle Collins. Similar vessels made in ancient Rome have comparable mold-blown form, tooling, and applied handles (fig. 1) as well as threading on the neck (fig. 2). The applied threads were used to create individualized ornamental decoration, which became abundantly incorporated in late Roman and Byzantine glassworking (Auth 1976, 19).

Figure 1. Inverted Conical Jug. Ancient Rome, likely Palestine. Glass. Image courtesy Toledo Museum of Art (1923.1336).

Figure 2. Glass with elaborate looped handles. 5th-6th century. Ancient Rome, Syrian. Image courtesy The Metropolitan Museum of Art (X.21.154).

Materials and Manufacture

Materials

Glassware produced during the Roman empire was often natron-based and composed of approximately 67% silica, 18% soda, 8% lime, and 7% impurities. The silica would have been sourced from sand. Tin-based opacifiers could also be present as additives, although this is unlikely to be present in this highly translucent object. The exact composition of this glass cannot be definitely described without further analysis, but it is non-leaded based on its lack of fluorescence in shortwave UV.[1] The color of glass, in this instance translucent green-blue, is dependent on the oxidation state of metal oxides. The oxidation state is affected by the presence of other network modifiers and furnace conditions (oxidizing or reducing environment; temperature) (Brown 2024).

Molds

Two types of molds could have been used to create this piece: a dip-mold or a reusable mold. A dip mold, otherwise known as an optic mold, is a "cylindrical or truncated conical one-piece mold with a patterned interior" and an opening at the top so that a gob can be dipped into and then inflated (Corning Museum of Glass). A reusable mold with a finite

[1] Handheld Spectroline® Lamp, model number 177-ENF-280C with multiband UV at 254 nm and 365 nm; operates at 120 V, 60 Hz, and 0.2 amps; purchased in November 2018 from Krackeler Scientific, Inc., manufactured in Westbury, NY.

lifespan could have also been used. A reusable mold for this object would have been created from at least two parts with the design also carved into the mold in the negative. The mold would have been composed of a durable material which typically was baked clay but could have also been wood or metal. This hotworking process would eventually deteriorate the mold, or the mold would break and become discarded. A mold maker, who may or may not have been the same person as the glassblower, would obtain new molds by completely remaking one or taking a mold from one of the existing glass vessels, which would then create second- to fourth-generation duplicates which can be traced in surviving examples. Earlier molds can be noted as later-generations become smaller as the clay and glass shrink upon firing and annealing (Trentinella 2003; Hayes 1975).

Stepwise Glassworking Process

The invention of the blow pipe by Syro-Palestinian glassworkers transformed this craft, so artisans could achieve more translucent, lightweight, and thin vessels with greater decorative potential. To create ACP 1968 (G.11), a glassblower likely blew a gob of hot glass on a blow pipe briefly into a mold, so that the glass would inflate and acquire the pattern carved in the mold. This mold-blown form would have then been further inflated by free blowing, which explains the absence of mold marks and presence of elongated air bubbles (fig. 3).[2] The form would have then been transferred onto a pontil (fig. 4) to shape the neck and rim with metal and wooden tools before finally applying the threading and handle. The elongated bubbles in the neck as well as the pontil mark on the underside of the base are evidence of the manufacturing steps following blowing (Trentinella 2003, Brown 2024).

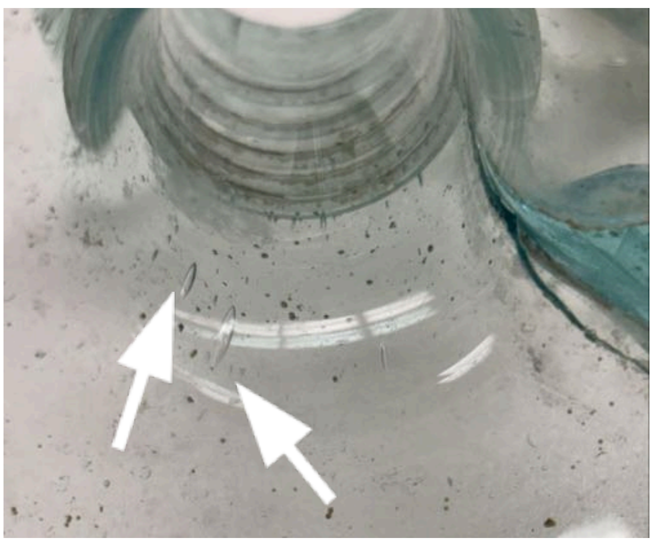


Figure 3. Elongated air bubbles on the neck, viewed from the interior of the largest fragment.

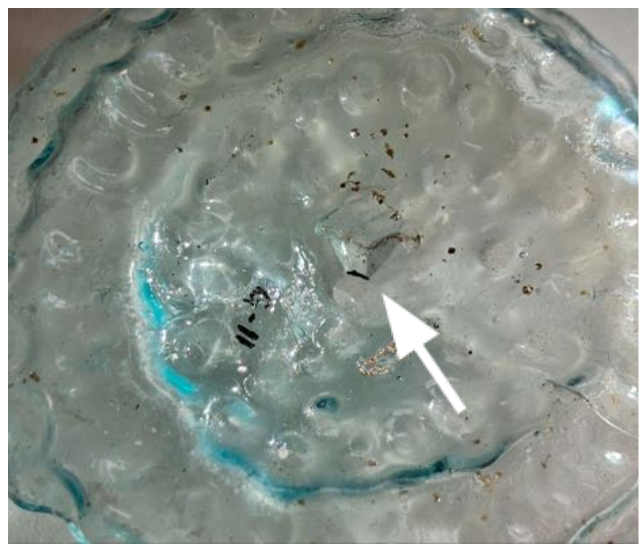


Figure 4. Central pontil mark on the underside of the base.

Condition

Overall

This glass jug is in poor aesthetic condition: the object is in twenty-one fragments and no longer legible as a singular, dimensional jug (fig. 5). Otherwise, the glass is structurally stable at present. There is no record of when this damage occurred, but presumably it was after the 2007-2008 exhibition in which ACP 1968 (G.11) was included.

[2] Figures 3-4 documented with an iPhone 15, ISO 25-32, f 1.6, 1/591-1/131s, November 2024.

Figure 5. Twenty-one fragments of the jug.

Body

The twenty fragments range from ¼ - 10 cm in length. The two largest fragments comprise the top and base of the jug. The smallest fragments come from the center of the body. The conchoidal break edges are fractured at predominantly perpendicular angles to the exterior and interior of the vessel. In most areas, the fractures occurred on the boundaries between concave design features, whereas in others the fracture intersects with them. There is also a ~4-cm blind crack on fragment 1 that extends from the break edge, behind the base of the handle, and to the lowest row of the applied decorative neck spiral. There is a second ~4-cm blind crack on fragment 1 that extends from the break edge to the shoulder on the opposite side of the handle. Fragment 3 has four ~1-3-cm blind cracks that extend from the edges of the base up the body. Fragments 1-2 and fragments 18-21 are joined together with wax (see "Previous Treatment" for additional information). There may be losses, but this is presently unknown.

Surface

The surface of the object is in good aesthetic and structural condition. Weathering covers approximately 15% of the fragment surface facing the interior of the vessel. This weathering is thin, hazy, translucent, and slightly pearlescent. The weathering on the exterior surface of the fragments is much more minor, potentially due to previous cleaning campaigns. The exterior surfaces have pale light tan <0.2-cm accretions with yellow or pink hues, depending on the light source. Weathering is more prominent at the intersection of the threading and neck of the vessel. Under magnification, shallow pitting is visible on the surface of the weathering (figs. 6-7).[3] As expected for an archaeological glass that was excavated whole and fractured in more recent history, weathering is not present on break edges. Some weathering has an opalescent appearance, particularly near the shoulder (fig. 8). There are some microcracks near the break edges (fig. 9). The glass is not crizzled and there is not a notable accumulation of dust or debris on the interior or exterior of the vessel. An accession number is inscribed ("G-11") on the center of the exterior underside of the base with a black colorant on top of a clear barrier layer.

[3] Figures 6-9 documented with an iPhone 15, ISO 80-125, f 1.6, 1/120-1/60s, November 2024.

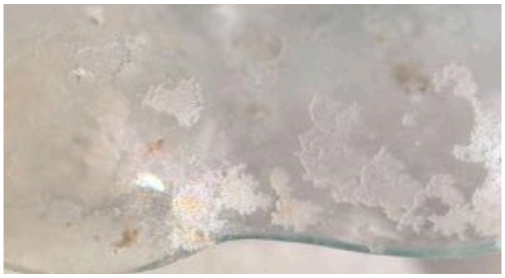


Figure 6. Weathering, fragment 15 interior, 160x magnification.

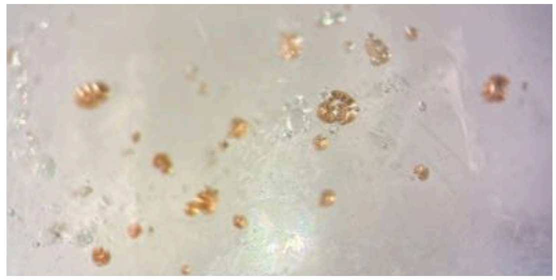


Figure 7. Pitting, weathering, and accretions; fragment 21 exterior; 160x magnification.

Figure 8. Opalescent weathering, fragment 2 exterior, 100x.

Figure 9. Microcracks near the break edge, fragment 2 exterior, 100x magnification.

Previous Treatment

In 2007, Leslie Guy removed a plastic resin fill (3.9 x 4.5 cm), cleaned the glass, and applied an accession number in preparation for exhibition. The vessel was soaked in dilute Triton XL-80N in warm tap water. While soaking, the vessel was swabbed with polyester batting. The vessel was rinsed with deionized water and air dried. The body was noted to have cracks associated with the loss and a large area below the handle was described as badly corroded. A previous campaign removed and did not replace an interior fill material (Guy 2007). Additionally, the glass was recorded to be ”partially encrusted” (Marianne Weldon, email communication, November 27, 2024). Fragments were previously reassembled with wax. There is evidence that a prior cleaning campaign removed weathering based on the two publicly available images (figs. 10-11).

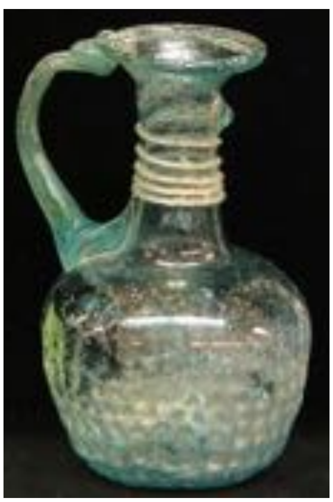


Figure 10. ACP 1968 (G.11). Image courtesy Bryn Mawr Art and Artifacts Collection (Jug with Mold-Blown Decoration, n.d.).

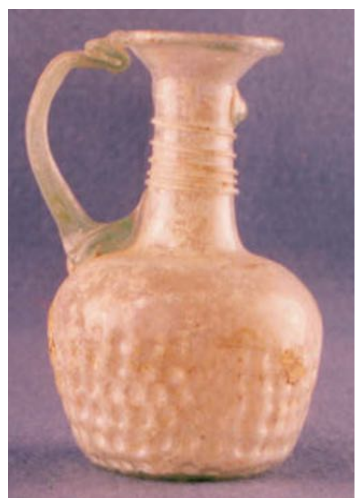


Figure 11. ACP 1968 (G.11). Image courtesy Bryn Mawr Art and Artifacts Collection (Jug with Mold-Blown Decoration, n.d.).

Purpose of Treatment

The primary goal of this treatment is to re-establish structural integrity and aesthetic legibility to support the accessibility of the Bryn Mawr Art and Artifacts Collections for students and researchers. Stabilization should be robust enough to withstand teaching and handling. The creation of long-term storage will facilitate the ongoing protection and accessibility of the object (Marianne Weldon, email communication, November 27, 2024).

Treatment Proposal

1. **Carry out pre-treatment examination and photo documentatio**n (*est. 2 hours*).

2. **Surface clean fragments** (*est. 0.5 hours).*
   - Dry surface clean with a cosmetic sponge. If wet cleaning is determined to be necessary, test a solution of 70:30 ethanol:deionized water applied with a cosmetic sponge or cotton swab.
   - Cleaning should focus on removal of surface dust, not accretions or weathering.

3. **Reverse prior interventions** (*est. 2 hours*).
   - Separate fragments 1-2 and fragments 4-7 by reducing wax following testing of ethanol, acetone, or Shellsol D-38.
   - Reverse existing joins on the object with similar methods.

4. **Reassemble fragments** (*est. 10 hours*).
   - Clean break edges with acetone.
   - Consolidate blind cracks with ~5% Paraloid B-72 in 1:1 ethanol and acetone.
   - Complete a dry-fit of the fragments to establish the assembly order.
   - Reassemble fragments with 50% Paraloid B-72 in acetone

5. **Complete loss compensation following reassembly** (*est. 0-8 hours*).
   - Fills should be robust enough for handling by students and researchers.
   - Fill materials could include the following options to achieve appropriate curvature and surface detail:
     - Cast Paraloid B-72 or HXTAL (if Paraloid B-72 is too brittle for larger areas)
       - Textured mold-making could involve taking a cast from a stable area of similar curvature with polyvinyl siloxane. Testing would be essential to ensure that no weathering is removed. Alternatively, a textured mold could be achieved by taking a polyvinyl siloxane cast from a sculpted modeling clay (i.e. plasticine) form. The cast polyvinyl siloxane from either of these methods could then be attached to a planar rectangle; in the case of a B-72 fill, the cast could then be slumped over a curved surface while flexible or with a hot air gun (van Giffen, Koob, and O'Hern, 2013, 3).
       - Alternatively, fills could be made by matching color and translucency, but not matching texture. This could be preferable because the dimples of a fill would not aesthetically integrate unless they lined up precisely (Victoria Schussler, consultation, October 25, 2024).
       - HXTAL may be a better option for larger fills, as B-72 can become brittle. Either option would be more robust for handling than B-72 coated papers (Marianne Weldon, personal communication, December 6, 2024).
     - B-72 coated Asian papers
   - Toning may be completed during the casting process with Orasol dyes and any necessary additional inpainting could be completed with Golden fluid acrylics.
   - Consider solubility parameters of reassembly adhesive and fill material when integrating fills.

6. **Construct a new housing enclosure** (*est. 3 hours*).
    - Materials used to construct the enclosure could include washed Tyvek, Ethafoam, Volara foam, lignin-free archival board (“blueboard”), and twill tape. An external image on the housing enclosure could additionally foster accessibility.
    - The housing should be as small as possible. Handlers should never tip the enclosure, but as this is a teaching collection, the design should account for this by including twill tape straps tied over the vessel to keep it in place within the box. Additionally, the enclosure should ideally be “something where the object could be placed in a delta cabinet inside the housing and removed and transported to a table for study [while remaining] within the housing” (Marianne Weldon, email communication, November 27, 2024).

7. **Carry out post-treatment photodocumentation and write the treatment report** (*est. 2 hours*).

Total estimated time: 19.5-27.5 hours

Daisy Diamond **Date:** 12/5/2024

Conservation Graduate Fellow

Lauren Fair **Date:** 12/5/2024

Supervising conservator

Marianne Weldon [See below] **Date:** 12/6/2024

Curator

M Marianne Weldon Dec 6, 2024, 7:11 AM (5 days ago)

to me, Lauren

Dear Daisy,

Thank you so much for this thorough examination and proposal. Please do proceed as proposed. My only comment is that I do feel that the cast B-72 or HXTAL would be more robust than the coated Asian papers for handling, but I would defer to you and Lara and what you determine is practical as the treatment gets going.

Sincerely,

Marianne

Treatment Summary

Reassembled fragments. Created three fills for areas of loss with B-72, mulberry paper, and epoxy. Created a housing enclosure.

Treatment Steps

1. **Carried out pre-treatment examination and photo documentatio**n (*8 hours*).

2. **Dry surface cleaned with a cosmetic sponge.[4] Wet surface cleaned with 70:30 ethanol:deionized water applied with a cotton swab** (*2.5 hours).*

3. **Separated fragments 1-2 and 4-7 with acetone applied on a swab** (*0.5 hours*).

4. **Reassembled fragments** (*6.5 hours*).

    - **Dry fit**: Identified the original locations of every fragment and established the assembly order (fig. 12). Fragments were temporarily held in place with cut pieces of painter's tape.

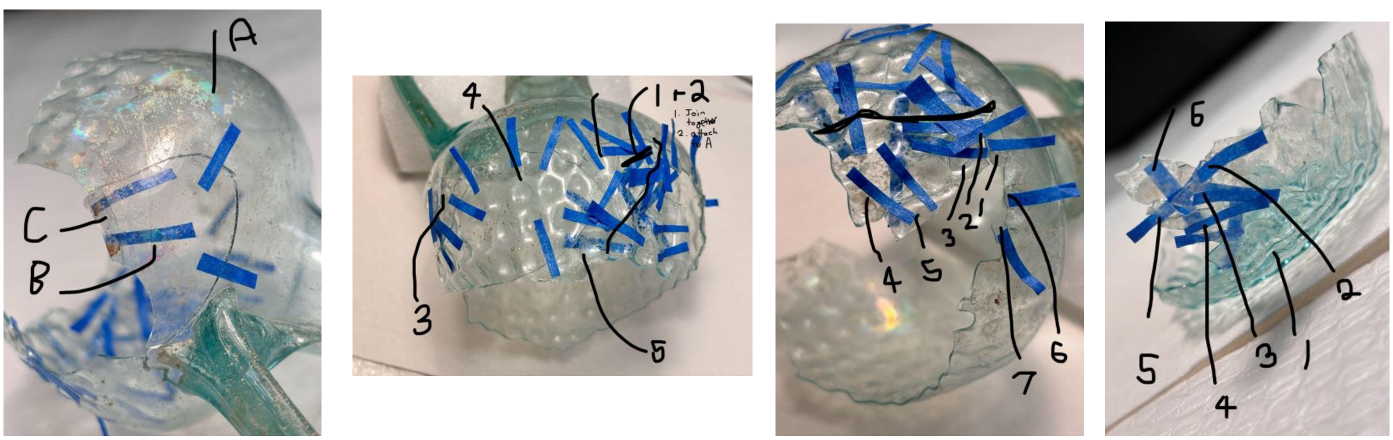


Figure 12. Dry fit of fragments. Four areas were assembled as discrete sections prior to joining the top sections (first three images) to the bottom section (last image).

    - **Reassembly**: Cleaned break edges with acetone. Reassembled fragments with 50% Paraloid B-72[5] in acetone with the guidance of Lauren Fair (fig. 13). While drying, fragments were temporarily held in place with hot melt glue dots and painter's tape, following testing of their impact on the weathering layers. Once reassembled, blind cracks were consolidated with 5% (w/v) Paraloid B-72 in acetone. Adhesive spill out was cleared from the exterior of the jug with a scalpel, dental pick, tweezers, toothpick, and a swab with acetone in areas away from the break edges (fig. 14).

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[4] Marketed as a make-up applicator, these soft sponges, made of non-latex polyurethane foam, are ideal for safely removing dust and dirt from fragile surfaces. Spot tests performed in 2015 showed the sponges in the objects lab at the time were insoluble in 10% KOH, indicating a polyurethane ether. Available from Qosmedix.

[5] Clear colorless thermoplastic acrylic resin composed of an ethyl methacrylate (70%) and methyl acrylate (30%) copolymer. Previously manufactured by Rohm & Haas, now produced by The Dow Chemical Co. and available from conservation suppliers.

Figure 13. Reassembly process. Image courtesy Leah Palmer.

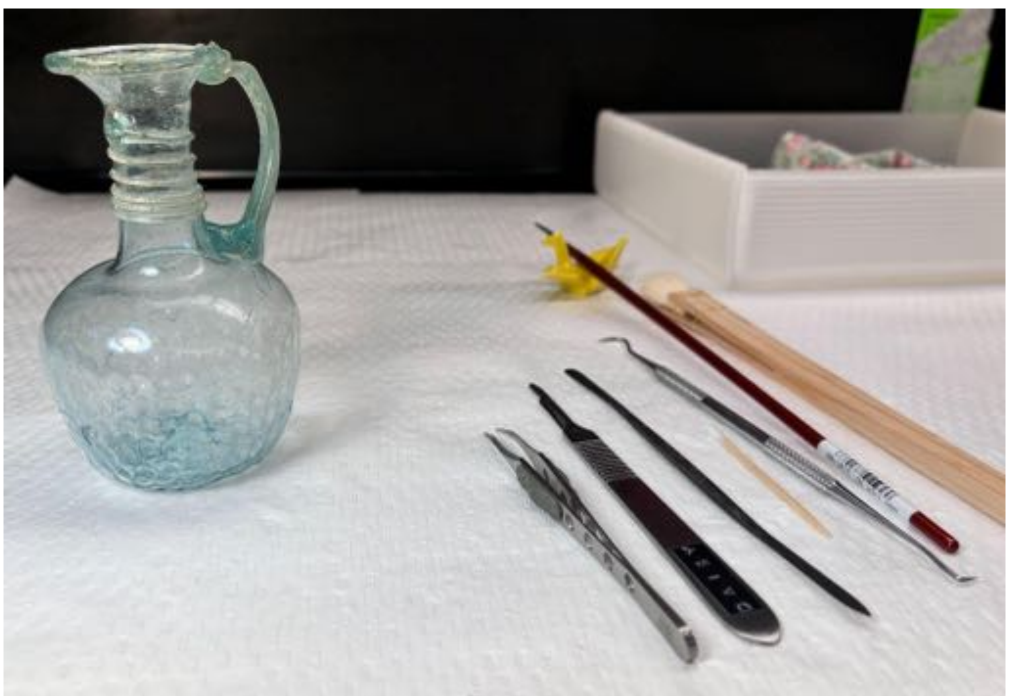


Figure 14. Reassembled jug and tools used for clearing adhesive spill out.

5. **Compensated losses** (*20 active hours, 12 days passive*).

    - **Approaches to loss compensation**: As this archaeological jug is part of a teaching collection, fills were required that would be robust enough for handling. Multiple approaches are necessary based on the three types of loss (fig. 15). The largest loss requires an epoxy fill, as a Paraloid B-72 or paper fill would be too brittle and too flexible, respectively. The two smaller losses could likely be filled with paper; however, for the sake of learning and to provide a more robust fill for the medium-sized loss, a Paraloid B-72 fill will be most appropriate. The smallest losses, which are only a snag risk for handling, will be filled with paper to bridge the small gaps.

Figure 15. Losses requiring a cast epoxy fill (left), cast Paraloid B-72 fill (center), and paper fills (right).

- **Paraloid B-72 fill**: A Paraloid B-72 fill was created by casting a film of 30% Paraloid B-72 in acetone (w/v) with Orasol Dye (Blue GL) dispersed in a few mL of ethanol in a mold of GI-311 Silicone rubber. Three tints were cast to provide options for color intensity. The films were removed when flexible and rigid, but no longer tacky, to cut the film to shape and match the surface undulations of the molded glass. This was completed prior to the epoxy fill, as access to the back of the fill was helpful for creating the correct shape. The fill was attached in place with acetone applied at the edges with a fine brush. Inpainting of the weathering was completed with Golden Fluid Acrylics.[6]

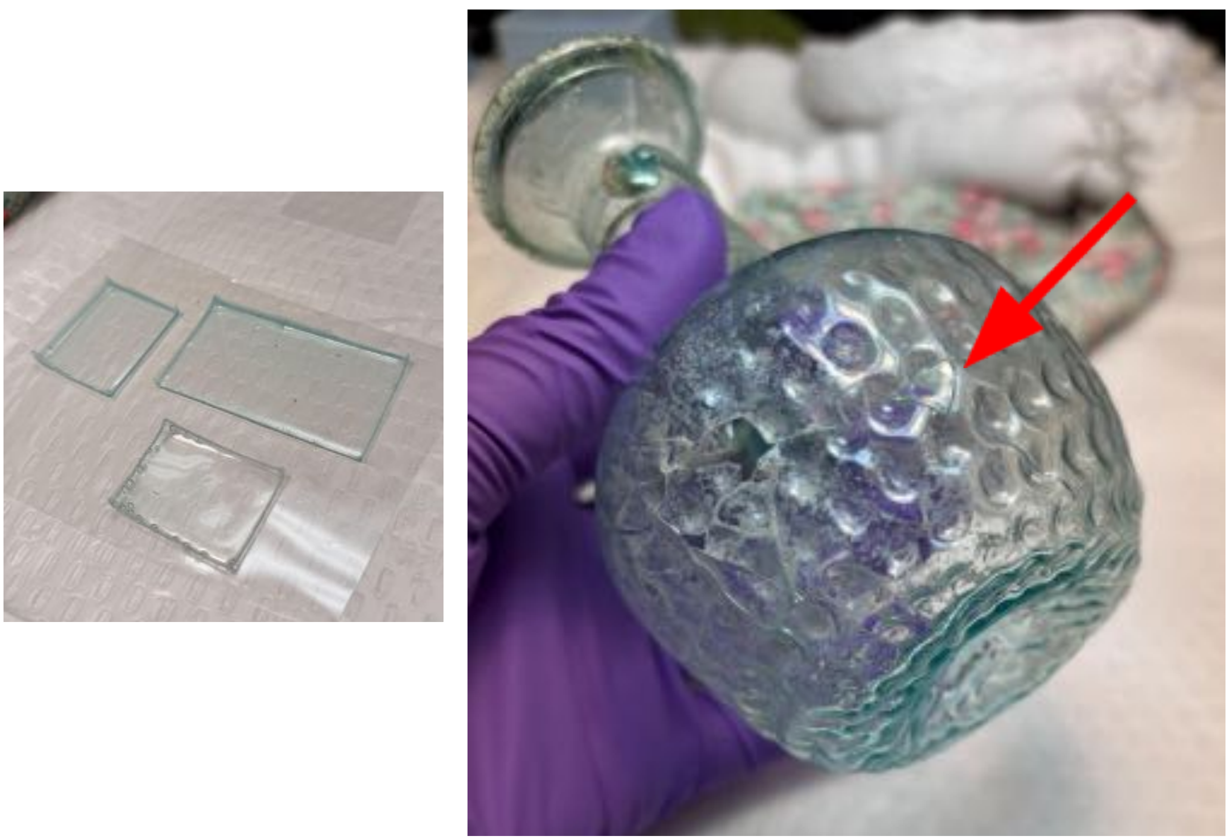


Figure 16. Cast Paraloid B-72 sheets (left) and completed fill with inpainting (right).

[6] Lightfast, low-viscosity acrylic paints with a high pigment load. Manufactured by Golden Artist Colors; available at art stores and from Golden Artist Colors.

- **Paper fills**: The smallest areas of loss were filled with long-fibered mulberry paper (tengucho).[7] The tissue was toned with Golden Fluid Acrylics and coated with two layers of 5% Paraloid B-72 in acetone (w/v). The fills were cut to shape with feathered edges and attached to the exterior of the glass with solvent reactivation.

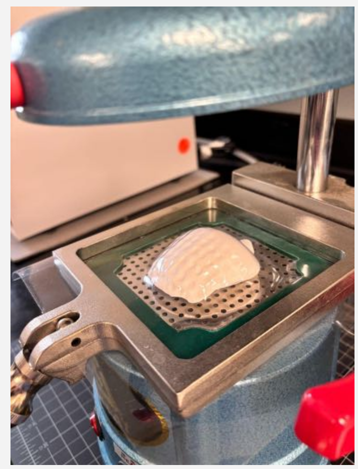
Figure 17. Toned tengucho paper (left) and completed fill (right).

- **Epoxy fill**: An epoxy fill was created through a multistep process to achieve a curved, undulating, thin, and colored fill that would be structurally able to withstand handling by students (Table 1). A limitation of this fill technique is theoretical discoloration (yellowing) after decades of environmental exposure. Process notes are indicated below in *italics.*

Table 1. Process to create an epoxy fill.

Step	Description	Materials/Supplies	Image
1	Created a mold of the intact side of the glass with a barrier layer of talc.[8]	Royal Dental Putty Super Impression Material[9]	

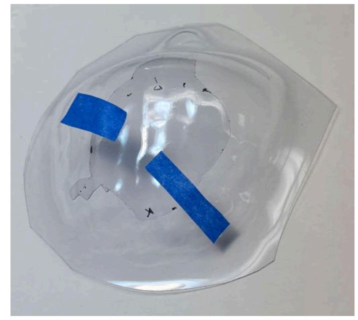
[7] Strong, stable hand- or machine-made papers made of long bast fibers (e.g. paper mulberry). Comes in several thicknesses, opacities, fiber types and lengths, etc. Available from Hiromi Paper, Inc. (http://store.hiromipaper.com/) or conservation suppliers.
[8] Naturally occuring powdered mineral, hydrated magnesium silicate, with the formula $Mg_3Si_4O_{10}(OH)_2$.
[9] Vinyl polysiloxane impression material putty. It is a two-part system that can be mixed and modeled by hand, is fast-setting, and yields detailed mold impressions with flexibility. Manufactured by Royal Dental Supplies. Available from dental suppliers.

2	Created a cast plaster positive from the mold.	Hydrocal White Gypsum Cement[10]	
3	Sanded the plaster positive to create a smooth surface with sufficient depressions onto which the polyvinyl chloride (PVC) sheet can be formed.	P600 3M wet/dry sandpaper, dremel tool	
4	Vacuum formed two sheets of PVC to the plaster positive. Longer heating time resulted in more uptake of surface topography.	Two sheets of PVC[11] sheeting, Vacuum Former[12]	
5	Cut the PVC in two identical shapes to match the outline of the loss. The depressions of the PVC were aligned with those of the original object as much as possible.	Sharpie, scissors	

[10] Plaster of paris (CAS 26499-65-0) designed for solid and hollow casting and is ideal for giftware and lamp base applications. It is compatible with numerous color pigments. Portable water between 70 °F (21 °C) and 100 °F (38 °C) should be mixed with the plaster for use. Once set and dry, the plaster has compressive strength up to 6000 psi. Manufactured by USG.

[11] Clear sheeting made of polyvinyl chloride plastic film; used for vacuum forming with a heated vacuum former to complete in-situ epoxy fills for glass based on the method first developed by Gorazd Lemajič (2007 ICOM-CC Glass and Ceramics Working Group Interim Meeting Pre-Prints).

[12] Portable vacuum forming machine, operating at 110V, with the ability to form PVC sheeting over a small three-dimensional form within a 5”x5” forming area.

			
6	Joined the two PVC shapes with museum wax to achieve a consistent thickness that matches the original object. Sealed the edges with adhesive to prevent the mold material from entering the fill. Cleared all adhesive and wax residue from the PVC fill to minimize the risk of casting imperfections. *Clearing residues was particularly important, as a small surface irregularity from insufficient cleaning resulted in imperfections on the final fill.*	Sticky Wax No. 09-100,[13] Jade 403N,[14] acetone	
7	Created the first part of a two-part silicone mold from the PVC fill to cast a replica. A Lego enclosure was built to slightly larger than the size of the PVC fill on a glass base. The base was filled with Plasticine with sculpting tools, and the PVC fill was depressed within the modeling material. Small plastic gems were used to create round "keys" for maintaining proper registration. Two toothpicks were cut to create a pour spout and vent hole. Petroleum jelly was used to seal the corners of the Lego enclosure before pouring GI-311 silicone into the mold.	GI-311 silicone,[15] Legos, Plasticine (Newplast),[16] sculpting tools, small "gems," toothpicks, petroleum jelly	

[13] Mineral wax used for positioning and earthquake stabilization of small objects. Composed of microcrystalline wax softened with petroleum jelly. Sourced from Benchmark (NJ).

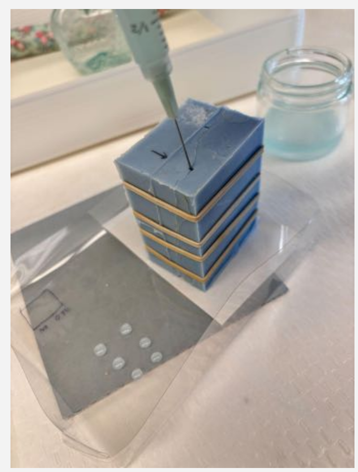
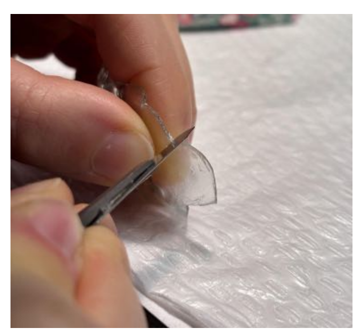
[14] White aqueous adhesive emulsion containing ethylene/vinyl acetate (20/80) copolymer; may also contain small amounts of plasticizers, dispersion aids, de-foamers and preservatives; emulsion has 50% solids, pH=6.5-7.2; dried film swells in water, ethanol, and toluene. Manufactured by Jade Adhesives, Chicago. Available from conservation suppliers.

[15] GI-300 series RTV silicone rubbers are two-component, tin-catalyzed systems that cure at room temperature. They are low viscosity compounds with a variety of hardnesses. Can be used to make molds for solvent-cast B-72 fills.

[16] Non-toxic, non-drying, reusable modeling material (plasticine) said to contain calcium salts, petroleum products, fats, and pigments. By Newclay Products Ltd., 1 Battle Road, Heathfield Industrial Estate, Newton Abbot, Devon TQ12 6RY United Kingdom www.newclay.co.uk. Available in 500g bars.

8	Created the second part of the two-part silicone mold from the PVC fill to cast a replica. Once the first part cured, the component was removed and cleaned. This was now placed in the Lego enclosure with the PVC fill in place on a glass base. The plastic gems were removed so that the key would be an interlocking feature. The same toothpicks were used again to ensure the pour spout and vent hole would be hollow spaces. All surfaces of the silicone mold were covered with petroleum jelly so that the two components could be separated. The corners of the Lego enclosure were again sealed with petroleum jelly. The PVC fill was not covered in petroleum jelly.	GI-311 silicone, Legos, toothpicks, petroleum jelly	
9	Prepared the mold to add epoxy. The mold was cleaned with acetone, with particular attention to ensuring no dust particles were present in the area where the epoxy would be poured. The edges surrounding the fill area were covered with petroleum jelly to minimize the risks of flashing.[17] For the scale of this fill, rubber bands were sufficient for maintaining contact between the two parts of the mold. *As this was an experimental treatment, multiple castings were required to successfully create a fill. It was noted that more casting errors occurred (i.e. air bubbles, flashing) in later pours, potentially indicating that these molds are best suited for 3 pours before they begin to degrade.*	Acetone, petroleum jelly, rubber bands	N/A
10	Prepared the toned epoxy. The Orasol dye was dissolved in ethanol before it was added to the epoxy part A and B	EPO-TEK 301-2 epoxy resin,[19] Orasol dye (Blue GL),[20] ethanol	N/A

[17] Note: this step is not recommended for future applications, as it may have contributed to epoxy cloudiness.
[19] Low viscosity epoxy that bonds well to most glass, metals, and plastics. RI=1.564; sets in 18-24 hours and can be sanded in 36-48 hours. Manufactured by Epoxy Technology. Part A required warming in a double boiler prior to mixing.
[20] Commercially available 1:2 pre-metallized dyes, soluble in organic solvents, that can be applied without acidic salts or peroxides, and require no rinsing; available in 17 colors. Manufactured by Ciba-Geigy and currently marketed by BASF. Available at conservation suppliers and Kremer Pigments.

	mixture. *Acetone and isopropanol were also tested as solvents for the dye and ethanol created the most clarity in this particular instance. HXTAL had issues with cloudiness, so testing was completed with EPO-TEK 301-2 epoxy resin.[18] Ultimately, the slightly cloudy HXTAL fill was most successful.*		
11	Removed bubbles from the toned epoxy prior to pouring. The epoxy was raised to a pressure of 20" Hg for 5 minutes before purging all bubbles.	Vacuum Oven[21]	
12	Injected toned epoxy into the mold. The epoxy was drawn in a syringe barrel before attaching the needle. Once assembled, the needle was turned upside-down and remaining bubbles were flicked out. The mold was filled by this syringe slowly through the pour spout until epoxy was forced out of the vent hole.	Syringe	
13	Prepared the cured epoxy to attach in place. Edges were shaped further with a scalpel. It was important to do this step as soon as the epoxy was cured to the extent that fingerprints wouldn't be impressed on the surface, as the fill could warp, harden fully, and become brittle if too much time elapsed. *Air bubbles were filled by placing the fill*	Scalpel	

[18] Low viscosity epoxy that bonds well to most glass, metals, and plastics. RI=1.564; sets in 18-24 hours and can be sanded in 36-48 hours. Manufactured by Epoxy Technology. Part A required warming in a double boiler prior to mixing.
[21] Fisher Scientific Model 281A Vacuum Oven. Operates at temperatures up to 280C, and has a vacuum range up to 30" Hg.

	in the mold, adding a few drops of tinted epoxy in air bubble gaps, and securing the mold shut with rubber bands or small clamps for the full cure time. *Further testing on removing surface imperfections could involve investigating plastic polishes or Micro-Mesh[22] sanding sheets.*		
14	Secured the fill in place with B-72, similarly as to how a glass fragment would be attached.	50% Paraloid B-72 in acetone	N/A
15	Inpainted weathering.	Golden Fluid Acrylics[23]	

6. **Constructed a new housing enclosure** (*3 hours*).

   - Lignin-Free Archival Board (or "blueboard")[24] was used to construct the lidded housing enclosure with extra support–twill tape and a removable blueboard barrier– in case the object is tipped (fig. 18). Ethafoam[25] padding created a stable recessed area for the glass to be housed. Additional support was created with Volara foam[26] and polyester batting underneath Tyvek.[27] Ethafoam was attached to the box with hot glue, Volara was attached to the Ethafoam with a heat gun, the polyester batting was held in

[22] Cushioned abrasive sheeting with abrasive material bonded to a cloth-backed latex ground (1500-6000-grit silicone carbide crystals; 8000-12000-grit aluminum oxide crystals); used for fine finishing. The crystals are held in a resilient matrix as opposed to a hard resin, which will allow the crystal to recede when subjected to contact pressure. Available from craft or conservation suppliers.

[23]

[24] Corrugated board made from bleached, lignin-free, alpha-cellulose pulp. It is required to be between a pH of 8.5-10.2, and contain alkaline sizing and an alkaline reserve (e.g. 3% calcium carbonate). Available from Conservation Resources.

[25] Closed-cell, low density polyethylene foam made by injecting halogenated gas (dichlorodifluoromethane) into the polymer melt. Some products may contain stearyl stearamide (1%) as a slip agent, as well as trace amounts of antioxidants and UV absorbers. Manufactured by Dow Chemical Co.

[26] Closed cell plastic foam made from polyethylene. It has a smooth surface that is resistant to water absorption and chemical reactions. Made in various thicknesses and colors. Manufactured by Voltek. Available from conservation and plastics suppliers.

[27] Spunbonded olefin fabric, 100% high density polyethylene with no fillers or binders. It has fine, white, continuous filaments that are bonded by heat and pressure. Manufactured by DuPont.

place by the Tyvek, and the Tyvek was tucked into Ethafoam gaps with a bone folder. Twill tape[28] was secured in place with a bone folder and the edges were sealed with Ethylene vinyl acetate copolymer (EVA)[29] adhesive to prevent fraying. An image of the glass was attached to the exterior of the box to improve object accessibility.

Figure 18. Housing enclosure (left) with object removed (right).

7. **Carried out post-treatment photodocumentation and completed the treatment report** (*3 hours*).

Total treatment time: 43.5 hours (12 days passive).

Billable Hours Exercise

I completed an exercise estimating how the proposed, actual, and billable hours would differ for this treatment (table 2).

Table 2. Billable hours exercise.

Treatment step	Proposed hours	Actual hours	Billable hours
1: Pretreatment examination and photodocumentation	2	8	2
2: Surface clean fragments	0.5	2.5	2
3: Reverse prior interventions	2	0.5	0.5

[28] Strong twill-woven cotton fabric tape commonly used for labeling art and artifacts and tying boxes. Available from conservation suppliers.

[29] Thermoplastic, elastomeric copolymer, commonly used in packaging applications replacing polyvinyl chloride as the most used resin. Depending on the proportions of each polymer, EVAs soften at about 70C. They are used in paper coatings, shrink-wrap, and hot-melt adhesives. As hot melts, EVAs have been used in the fabrication of storage and travel cases (Hatchfield 2002).

4: Reassemble fragments	10	6.5	6.5
5: Loss compensation	0-8	20	8
6: Construct a new housing enclosure	3	3	3
7: Post-treatment photodocumentation and write treatment report	2	3	2
Total	**19.5 - 27.5**	**43.5**	**24**

I slightly under/over estimated the hours for a few treatment steps. Generally, it balanced out in the end. If this were a real billable treatment, I would have checked in with the client prior to proceeding with fills. I was extremely excited to work on a new treatment method combining established techniques from different contexts with the guidance of Lauren Fair. If this was for a client, I would not have charged them for this experimentation time, but depending on my other demands, I would be inclined to spend these hours as a learning and research personal experience. Doing this exercise cemented how important ongoing communication would be with a client, and that efficiency with administrative tasks is essential.

Environmental and Handling Recommendations

Handle with clean, dry hands to maintain grip on the object. Avoid tipping the housing enclosure or pressing excessively on any surface of the glass. The fills are stable for careful handling, but attention should be made to avoid excessively abrading or pressing on fill areas. The glass should be kept out of direct sunlight, as excess heat can soften the Paraloid B-72 joins and fill. Maintain moderate and steady temperature and humidity levels, such as 70F (±2°F) and 45-55% relative humidity (±5%). Lighting levels should remain below 200 lux, and not exceed 180,000 lux hours annually.

Treated By: Daisy Diamond

Report Date: May 19, 2025

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Appendix I: Before Treatment Photography

Figure I-1. Before treatment overall, ½ top component and interior of base.[30]

[30] Figs. I-1 through I-3 documented with Nikon D850 device, Nikon D series 60 mm focal length, f/16 (f/14 for Fig. X), exposure 1/125. Post-processing included white balance adjustments and cropping.

Figure I-2. Before treatment overall, ½ top component and exterior of base.

Figure I-3. Before treatment, fragments.

Appendix II: After Treatment Photography

Figure II-1. After treatment.[31]

[31] Figs. II-1 through II-4 documented with Nikon D800 device, Nikon D series 60 mm focal length, f/18, exposure 1/125, ISO 100. Post-processing included white balance adjustments and cropping.

Figure II-2. After treatment.

Figure II-3. After treatment.

Figure II-4. After treatment.