Article: Four beakers or two beakers? Only your conservator knows for sure…
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Source: Objects Specialty Group Postprints, Volume Nine, 2002
Pages: 114-130
Compilers: Virginia Greene and Patricia Griffin
www.conservation-us.org

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FOUR BEAKERS OR TWO BEAKERS? ONLY YOUR CONSERVATOR KNOWS FOR SURE...

Stephen P. Koob

1. Introduction

This is an interesting story, and I should start with the title, which isn’t entirely correct. In 1964, the Corning Museum of Glass was given numerous fragments of what was thought to be a glass bottle (a base section), and fragments of a beaker, identified as such because of the conical shape and simple rim. In 1967, more similar fragments were given to the Museum, again of another beaker and bottle, or, at least, this is how they were first published (Megaw 1968; Fig. 1). At various times in the past 35+ years, researchers, curators, conservators and directors have looked at the pieces and thought they were anything from four beakers, to two beakers and a bottle, to two beakers.

After the fragments were assembled in 1967-1968, as best as possible, they were catalogued as four separate "Byzantine beakers, gilded and scratched-engraved". This is the way they remained, even through my first tenure at Corning, when I first looked at them at the request of the director, Dr. David Whitehouse, who is also curator of ancient and Islamic glass at the Corning Museum of Glass. At that time, I thought there wasn’t much more that could be done. I left Corning in 1994, but interestingly, when I came back to Corning in 1998, the Director asked if we could look at the fragments again, together. So we did, and we reviewed the 1968 publication by Peter Megaw (Megaw 1968), which states clearly that the two center sections have similar decoration, and the other (outer) two sections are similar to each other, and differ from the center sections only “in that the roundel borders are formed by three concentric lines” (Megaw 1968, 101; see Fig. 2). On the center two sections, the roundels are surrounded by 4 concentric lines, with dots in the middle (Fig. 3). This led to the question that we then discussed, “could two and two possibly go together?” Regardless as to the answer to that question, Dr. Whitehouse wanted me to “improve their appearance” and find some way to mount them, because he wanted to re-publish them. Putting two and two together sparked my interest, and after many trips to the microscope, I finally thought I could prove that there were just two beakers.

2. The Beakers

The beakers truly were magnificent, and it’s sad that we only have fragments and just a hint at the original decoration. They are made of transparent dark blue glass, the dark blue confirmed as cobalt, as analyzed by Dr. Robert Brill (Brill 1999), the research scientist at the Corning Museum of Glass. The fragments vary in thickness from 0.5 mm – 1.2 mm, and also vary in appearance because of that. The thinner areas are a much lighter blue, and the thicker areas, like the base and
rim, are almost black. Cobalt is an interesting colorant for glass, as it takes only minute amounts to impart the rich blue color that we are familiar with. Cobalt oxide (CoO), when added to a hot glass batch, goes into solution as individual cobalt ions within the glass. The resulting blue color, even when dark, is virtually transparent in transmitted light, and is very difficult to match with modern pigments or dyes. The modern cobalt pigment is a compound of cobalt and aluminum hydrate (CoO·Al₂O₃). This pigment only disperses in solution, thus giving a very different color, owing to light reflection. This was going to give me problems later on.

Both of the beakers were blown, as evident from the shape, and were also scratch-engraved, gilded (Fig. 4) and enameled (Fig. 5). The primary decoration consists of rows of medallions or “roundels” (Fig. 6), each of which contains a bird, but in three different postures, one facing left, one facing right (see Fig. 2), and the third bird, facing right, but with its head turned back (see Figs. 4 and 6). In close-up, it can clearly be seen that all the birds, the floral “filler” decoration, the dots, and framing borders all had gilding, applied as paste and not gold leaf. Even the fragments that appear visually to have no decoration left, under the microscope, can be seen to have traces of gilding present. The enamel, either yellow, or yellow and white, was used for the outer concentric line around the roundels.

Dr. Whitehouse now dates the pieces to the end of the 12th early 13th century (Whitehouse 2002), and the fragments may have come from a Byzantine castle in Paphos, Cyprus. There are comparable pieces from other sites around Paphos (Megaw 1959). Where they were actually made is unknown, but most likely Rhodes or Western Anatolia.

3. The Conservator as Detective

This leads me to one of my most important recommendations for the restoration of glass, which is to use a good binocular microscope. A microscope is useful not only for the joining of fragments, but also to see decorative elements as well as techniques and details of manufacture. It was through the use of the microscope that I determined two of these sections belonged together. Obviously the fragments and sections look similar, so much so that one would suggest that they were made and/or decorated by the same person. But let me review some of the indicative factors that can help us join fragments together. These are specifically for glass, but can also be transferred to other materials: shape, size, color, thickness, light transmittance (or not), curvature, decoration, surface wear or weathering. Blown glass also has air bubbles, which are often directional. Finally, for transparent glass, there are compositional anomalies, such as inclusions or seeds and the non-homogeneous mixing that one gets with colored glasses (Fig. 7). This is particularly true of early glasses, where the initial glass was most likely a clear batch, and a darker colored glass was ground up and mixed in to give the desired color. The darker glass rarely mixes in perfectly, and one sees streaking of the darker color, not unlike what you would see in a marble cake. This can be seen, using a microscope and transmitted light (Fig. 8).
Through the microscope it was fairly easy to see that two of the sections belonged together, even if the joining surface was not very convincing. Under magnification and transmitted light, it can be seen that the air bubbles match, and line up vertically from one broken fragment to the next. In addition, the streaking line of minute bubbles and lines of darker blue color continue across one fragment and in to the next (Fig. 9). The surface decoration (in reflected, incident light) lines up as well, and supports the microscopic findings.

In the end, I was convinced. I showed my discovery to Dr. Whitehouse, and he was also convinced. In fact, he wanted me to devise a way to display it. Well, I thought about mounting the two sections, one on top of the other, and then decided I would at least start by redoing the restorations.

4. Re-assembly/Re-treatment

The fragments really needed a better restoration, since the previous repairs were not perfect, and after 35 years the few fills had discolored and become loose. At some point tape had been added to hold the fragments together. The fragments were taken apart, cleaned and reassembled using B-72 adhesive. B-72 really works very well with glass (Koob 1986; Koob 2000), but again, a binocular microscope is very helpful. Under magnification, joins can be lined up absolutely precisely. For glass repair, I recommend that the B-72 adhesive is a little thinner than my original published recipe (Koob 1986), which can simply be done by evaporating off less solvent during the adhesive preparation, for example, evaporating off 40-42g of acetone from the original 100g (Koob 1996).

5. Loss Compensation

Losses were then filled using plaster of Paris, with the long range plan of later using the plaster fills to make detachable epoxy fills. This is a technique that I gave a paper on at the IIC Congress in Melbourne (Koob 2000). The plaster fills were easily detachable, since plaster does not bond well to glass. The plaster was then sealed with shellac in anticipation of later casting and molding. I felt the shellac would give a better surface, more approximate to the glass than B-72. The top and bottom sections were then joined together using plaster fills, and the “two” beakers were now one (Fig. 10).

Just about the time I finished this, Dr. Whitehouse came back and said, “Well, what about beaker number two?” He now added that not only did he want to republish them, but he wanted to put them up on display in our “Recent Acquisitions Case”, because, in his mind they were now two new acquisitions, and not four fragmentary research fragments. That was in January of 2001, and again I thought of just mounting those two sections, because so much more is missing, with only approximately 35-40% of the whole preserved. I began by making a large tubular section of
plaster and was thinking of mounting the fragments onto that, but it just was not a good idea. The plaster was much too heavy and it would have taken so much difficult chiseling and cutting. So, instead, I took the two sections apart and started reconstructing them. When I got both the top and the bottom sections completed, and fills done to the top of the preserved glass, I took another look at the completed beaker (#1), to see the pattern and order of the roundel decoration (Fig. 11). The birds in the top and bottom rows are in the order Right-Left-Back, and in the middle row are offset, Left-Back-Right.

Comparing beaker #1 to beaker #2, the sequence for the top and the bottom rows of roundels is identical, and it seems likely that the center row would have been the same as well. There is only one small bit of a bird preserved in the middle section, and that is a foot that joins to the bottom section. But enough of the roundel is preserved to show that the bird had to be facing left, which confirmed that the order of the birds was the same on both beakers. The final assembly was done similarly to the first beaker, using a paper cup as an interior backing (Fig. 12) and to keep the sections in the right position. Plaster was then applied to connect the two sections (see Fig. 12), and was then trimmed and finished. One side was done at a time, and it was even possible to float in some fragments (Fig. 13), because I knew exactly where they went, since the bird decoration is so distinct. Reconstructing a vessel that is missing 60% is quite a challenge (and a lot of plasterwork) but it does present the fragments in an understandable and stable order.

The second reconstruction took less than 2 weeks, whereas the first one took probably close to 10 times that. The main mistake I made in the first reconstruction was working solely from the bottom up, and in this case, it just didn’t work, because I really did not have a good idea of the center diameter, which is actually the main reason the sections were originally thought to all be different vessels. The diameter of the upper part of the beakers is dramatically larger than the bottoms, or even lower sections.

The beakers needed to go on display, so I painted the plaster a dark cobalt blue, which looked fine with incident light, but looked very purple in color photographs, especially in close-ups and under strong raking light (Fig. 14). Mounts were made for both beakers, and they went on display for 6 months.

6. Detachable Epoxy Fills

In November 2000, the beakers came off display and I had the chance to start redoing the fills in tinted epoxy. This was easier said than done, because I have been trying for years to get a good match for cobalt blue in glass, and had been generally unsuccessful. However, my last intern offered to bring me back some dyes that she had experimented with in France, and I did find one that worked perfectly (Macrolex Blue RR, by Bayer), with a little help from some red and black dyes (Fig. 15).
Briefly, the procedure is to take molds of the plaster fills, and then cast tinted epoxy into the molds (Fig. 16). I used Epotek 301 for all of the castings, primarily because of its faster setting time. I have found that single enveloping molds work the best for this, rather than trying to cast two-sided molds. As long as the silicone rubber is thick, you can cut it, remove the plaster fragment, and it retains its shape for the epoxy casting. The resulting “epoxy fragment” is only going to be as good as your plaster fill, because silicone rubber is very unforgiving, and it will copy every minute detail, scratch or flaw, and uneven surface. In addition, it’s virtually impossible to imitate smooth glass, much less smooth glass that also has the remnants of scratched, enameled and gilded designs.

So, I took the first beaker completely apart; which was easily accomplished thanks to the B-72 adhesive. All the blue overpaint was cleaned off and since I was disappointed with both B-72 and shellac as a coating, I decided to try Krylon spray, which worked extremely well. Still, there was quite a bit of unevenness from the differing thickness of my plaster fills, and from scratches and imperfections that I hadn’t sanded or worked out. I made up a big batch of colored resin (it helps to mix the dyes in at least 24 hours in advance anyway), and kept it in the refrigerator. The final results matched the original glass fragments very closely. A layout of original fragments with fills in reflected light (Fig. 17), and the same group in transmitted light. (Fig. 18) shows how successfully the casting and molding turned out.

7. Final Assembly

The fragments and epoxy fills were then assembled using B-72 adhesive, and the completed beaker is transparent (Fig. 19), without the unnatural appearance of opaque plaster fills. Only the first beaker has been completed, and stands in contrast to the second beaker that still has plaster fills (Fig. 20).

8. Conclusions

During the reconstructions, two new joins were found, one on each beaker; and only three fragments were not used. One fragment, incorrectly positioned on beaker # 2, now joins beaker #1, and one fragment not originally joined to beaker # 2 was joined. As noted above, beaker #1 is finished, and it is difficult to decide whether to redo all of the fills on beaker # 2, or just the areas in contact with the glass. The next tricky job will be to light the pieces on display effectively, and to show off the transparency of the glass as well as the decoration.

Finally, I’d like to say that this is not an easy process, but the results really can be spectacular. I molded all the plaster fills and cast the epoxy fragments all at once, and that took about two weeks. There was a little bit of touch-up and reworking of the epoxy fills after casting, but even with that, the final reassembly took less than two weeks.
Acknowledgments

I thank Nick Williams, Photographer, Corning Museum of Glass, and Andrew Fortune, Assistant Photographer, CMOG, for digitization of the images from slides. I also thank Dr. Robert Brill, Research Scientist, CMOG, for encouragement and advice.

Materials and Suppliers


Epotek 301, Epoxy Technology, 14 Fortune Drive, Billerica, MA 01821, Tel. 1-800-227-2201.


Macrolex Blue RR (dye), Bayer, Geschäftsverelch Farben, Marketing 3.3, 5090 Leverkusen, Germany.

References


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Figure 1. Fragmentary sections of “four” beakers, as catalogued in 1967.
Figure 2. Detail of roundel, showing three concentric lines.

Figure 3. Detail of roundel with four concentric lines, with dots between the middle two lines.
Figure 4. Detail of roundel with gilding (shows up as light areas).

Figure 5. Detail of roundel with enamel (lightest areas).
Figure 6 - Almost complete roundel, with bird.
Figure 7 - Dark inclusions in the glass and streaking of cobalt color.

Figure 8. Streaking of cobalt color across two broken fragments, with transparent fills in between.
Figure 9. Partially restored section showing vertical air bubbles and streaks of cobalt across glass fragments. Areas with no bubbles are fills.

Figure 10. Reconstructed beaker #1, with plaster fills.
Figure 11 - Drawing showing pattern and "order" of roundels and birds.

Figure 12 - Applying plaster over paper cup "backing" to join the two sections together.
Figure 13. Reconstructed beaker #2, with plaster fills and "floated" fragments.

Figure 14. Detail of beaker after painting. Under strong light the cobalt blue paint appears purple (much lighter).
Figure 15 - Mixing blue dyes in epoxy: tests and castings.

Figure 16 - Casting of tinted epoxy into silicone rubber molds.
Figure 17 - Rim fragments and tinted epoxy fills in reflected light (beaker #1).

Figure 18 - Rim fragments and tinted epoxy fills in transmitted light (beaker #1).
Figure 19. Beaker #1, completed, with transparent blue epoxy fills.

Figure 20. Two beakers with mounts. Beaker #1 on the left, has transparent blue epoxy fills; Beaker #2 on the right has painted plaster fills.