

Glass from *Nuestra Señora de Atocha*

By Corey Malcom

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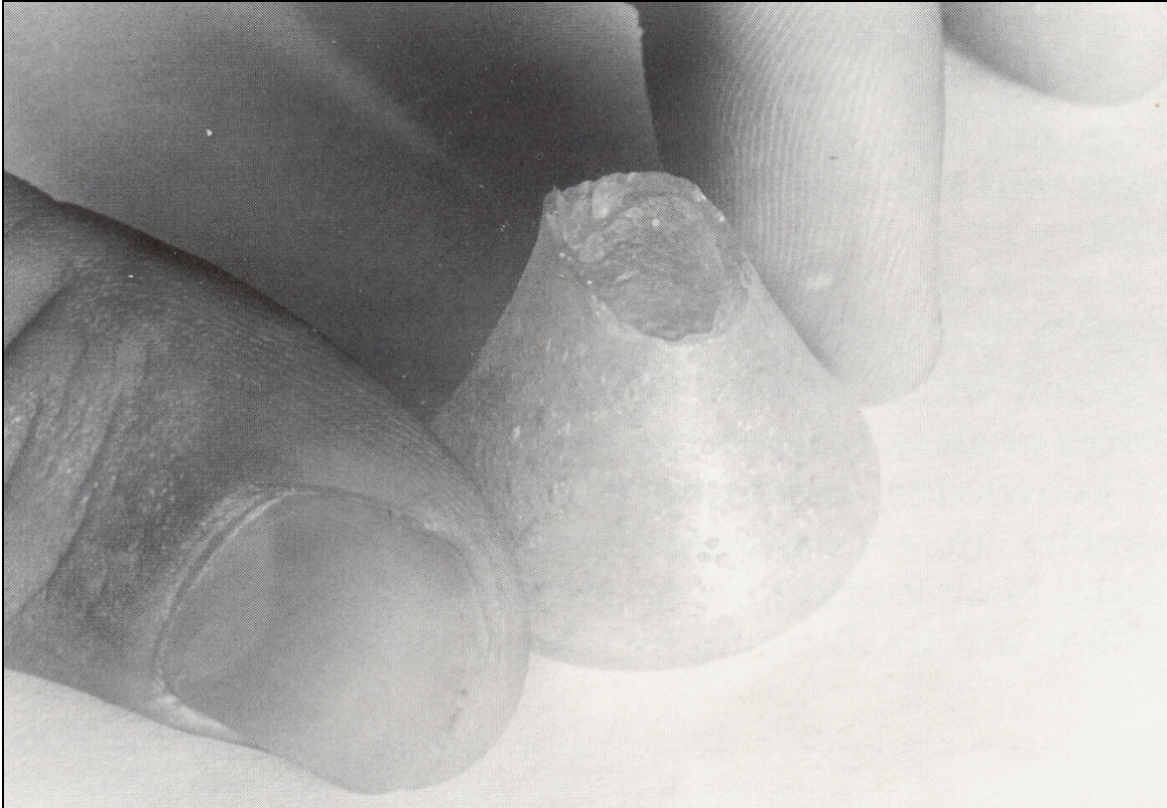


Fig.1 Small glass vial from the 1622 galleon *Nuestra Señora de Atocha*.

Nuestra Señora de Atocha was wrecked by a hurricane on September 6, 1622, two days into a voyage from Havana, Cuba to Seville, Spain. Archaeologically speaking, the wreck site is an exceptionally rich one, in large part because of the brevity of the voyage. The stores were not yet depleted, and items that would have been disposed of during the voyage were still on board and waiting to be used during the intended six to eight weeks of sailing. Virtually everything that might be expected to have been aboard a

Spanish galleon of the time, ranging from hull timbers to insect fragments, is represented among the recovered items.

Included in this wide array is a number of glass pieces. Although it is a relatively small collection when compared to the other material types that were uncovered, the pieces come from a variety of vessels and objects. Unfortunately, none of the vessels is complete and many of the fragments suffer from varying degrees of decomposition; however, the information they yield is important.

Utilitarian glassware, which comprises the majority of the *Atocha* collection, is a category poorly represented in the literature concerning early 17th century material culture.

The glass was found, unless noted, in 1985 and 1986 in the area of the lower hull structure, better known as the “main pile” discovered by Treasure Salvors, Inc. on July 20, 1985. During the excavation of this area all of the artifacts encountered were recovered and digging was from the surface of the seabottom to bedrock for the length of the structure, and beyond.

Glass of the early 17th century was most commonly composed of silica-soda-lime or silica-potash-lime (Jones and Sullivan, 1989, p.10-11). Silica is the primary ingredient; soda or potash (alkaline salts) act as flux by facilitating melting, and lime works to stabilize the glass. Silica was most readily found as sand although crushed was sometimes used. Alkalies came from two major sources: natural or deliberate evaporation of sea or river water, and the ash of burned plants. Either process can produce soda or potash, depending on local minerals (Frank 1982, 71-76). Crushed limestone was the major source of lime.

Venice is generally regarded as having been the premier center for glass production during the Renaissance period, although Spain produced its share of quality glassware. The Spanish glass was renowned because of the use of a local marine plant, *barilla*, which harbors small organisms. When it is burned the plant produces soda ash, and the animals produce lime ash (Deagan, 1988, p.127). Production also began at Almeria in the 13th century and in Cadalso (province of Toledo) by the 16th century (Barber, 1917). These were

major centers of production in Spain at the time of the *Atocha*'s sinking, and they provided glassware for all of Iberia. The colonies of the New World also demanded glassware and much of the product was imported from Spain via Seville. In 1535 a glass production center was established in Puebla, Mexico, to provide for some of this demand, and operations at the site continued into the 19th century (Deagan, 1988, p.129). Foreign influence gained strength in the early 1700's as Spain imported glassware that was then redistributed throughout the New World (ibid.).

The ocean has not been the kindest of environments for this glass. In addition to the mechanical damage caused to the glassware by the shipwreck and subsequent storms, chemical action has taken its toll on some of the *Atocha* collection. Although the process is not completely understood, the decay of some glasses is related to the proportion of monovalent and divalent ions within the alkaline flux. Basic oxides are relatively unstable in a marine environment when compared to acidic oxides. They are leached out and form new compounds (chiefly hydroxides) at the surface of the object. These compounds then degrade the silica structure and result in layering of the glass (Pearson, 1988, 101-102). This is an extremely simplified version of glass deterioration and it should be noted that many other factors affect this process, including: the proportion of stabilizer, metal oxide colorants, surface treatments, pH of the environment, and the presence of glass-reducing microorganisms (Davidson and Newton, 1989, pp. 140-164). From the varying degrees of deterioration among the *Atocha* examples, which shared a

common environment, it is obvious vastly different recipes went into the batches of glass used to make the different objects, although no analysis has yet been made to determine their chemical composition.

The largest component of the collection, the remains of square-sectioned bottles, is represented almost entirely by the bases and the pewter closures which were once fixed around the lips of these containers. Every glass piece of this collection shows some decomposition, with extensive layering and alteration of color. Cores of unaffected glass visible in two of the specimens show the original color to have been a clear light-green. The weathering of the pieces has caused them to turn an opaque black-green, with spots of extreme decay. The violence of the wreck and the relative thinness of the walls in combination with this decay are most likely the reasons why no intact bottles have been recovered from the site. Only the thickest pieces with greater strength have survived.

Of all the fragments of this bottle glass have required consolidative treatment to prevent the exfoliation of the layers. After desalination in freshwater baths, this was accomplished by immersing them in a polyvinyl acetate (PVA) solution under vacuum. This process allows impregnation of PVA beneath some of the layers and covers the entire piece in a thin, clear, bonding coat after drying.

Despite the decay, the glass does not appear to have distorted, allowing many dimensions to be recorded and a hypothetical reconstruction of some of the bottles to be made. Luckily, it was the bases that survived. This has allowed us to record the distance between the sides, showing us the “squareness.” The

missing factors are the height and curve of the shoulder. Illustrations of similarly styled bottles are available, and for our purposes a photograph of a German bottle of the same period, and provided by the Corning Museum of Glass (Lanmon, 1987) was used to extract proportions for reconstruction. The same form was used for all of the bases to better show their differing sizes. An intact square bottle was recovered from the Spanish galleon *Nuestra Senora de la Concepción*, wrecked on a reef northeast of Hispaniola (Peterson, 1980). This bottle appears to be the closest relative to the *Atocha* bottles that we have discovered; however, only a portion of it was shown and no dimensions given.

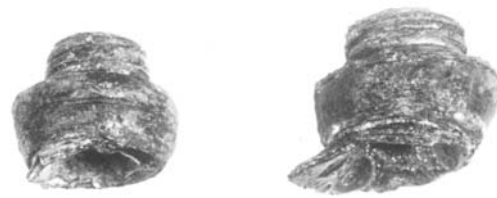


Fig.2 Lead bottle tops showing remains of glass necks.

To further aid us, two pewter closures with the remains of the necks protruding from their bases were found in our collection. This gives us a better idea of how they were situated on top of the bottle. By calculating from the known dimensions and proportions of the intact German bottle, the *Atocha* collection reveals specimens ranging from 6.6 cm square and 13.5 cm high, to 10.2cm square and 21.3 cm tall to the base of the cap. The volume of these reconstructed containers varies between approximately 300ml and 1500ml (Fig. 4).

Evidence of a greater number of square-sectioned bottles on board exists in the number of pewter closures

recovered over the years. These caps consist of a base, which was fixed over the lip and mouth of the bottle, and a true cap, which screwed onto the base. Thirty-five examples from the *Atocha* and *Santa Margarita* sites are in our collection. Eighteen “screw tops” were recovered from the *Atocha* site before 1985 (Mathweson, 1983). The current location of all but six of these pieces is unknown, and no photos or dimensions for those missing can be found. Those more recently recovered show a wide variety in size and style. Of those in our collection, the bases range in diameter from 1.5 to 2.9cm. The lack of uniformity suggests differing sources of manufacture. Whether this means the bottles were manufactured in varying glass-houses is another matter.



Fig. 3 Various lead bottle caps from *Atocha*.

Square-sectioned bottles were blown into four-sided molds to achieve the shape (noel-Hume, 1969, p. 33; Jones and Sullivan, 1989, p.24). The neck and opening were finished by hand, which required a pontil-rod to be attached to the base. When the piece was finished and cooled, it was snapped off the rod, leaving a circular scar at the point of attachment (Harrington, 1952, p.45).

Often called “case gin” bottles, these were more likely brandy or wine bottles as gin was not a popular drink in the early 17th century (McNulty, 1971), especially among the Spanish, though

there is some record of these bottles having been packed in cases of 12 (ibid.). These were a secondary container for the liquids they held. Wine, for instance, would be poured from a cask (or olive jar), the primary container, into these bottles, which would then be taken to the table to be placed in a cooling tray (ibid.). Other uses that have been suggested are as containers for ink, medical supplies, or perfumes (Holman, 1975, p.25).

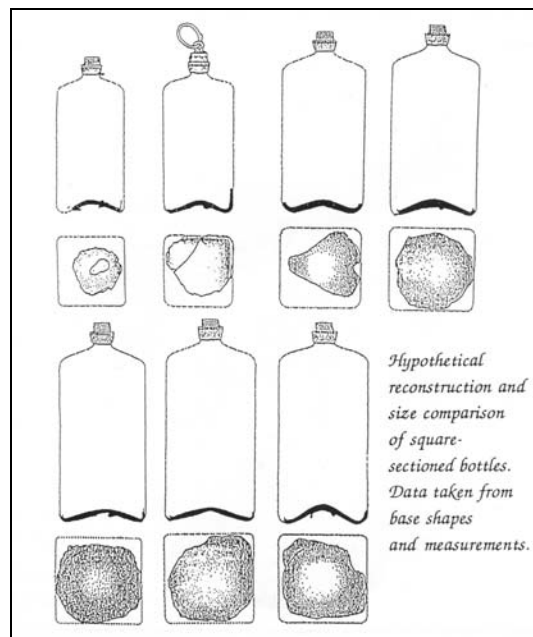


Fig. 4 Reconstructions of square-sectioned bottles.

Bottles of this type originated in Germany in the mid-16th century and were being made in the Netherlands by 1641 (McNulty, 1971). There is no record of when they were first made in Spain or the New World, and the *Atocha* examples appear to be the earliest recovered from a Spanish colonial context.

A surprising find was the remains of a tumbler-style drinking glass. The pieces are so well preserved that when they were recovered, many of the crew on board the salvage boat were skeptical of

their actually being from the *Atocha* and not some more recent intruder. This vessel is 9.4 cm tall and 6.2 cm in diameter. The glass is a clear, grayish amber color with few bubbles.



Fig.5 Glass tumbler

The interior surface is very smooth and the exterior is covered with very fine striations in a swirling pattern. The striations produce hundreds of tiny sharp edges that are capable of cutting if drawn across the skin. The rim has been ground smooth. Thickness is fairly uniform, varying between 2 and 3mm, except at the base where it is over 4mm.

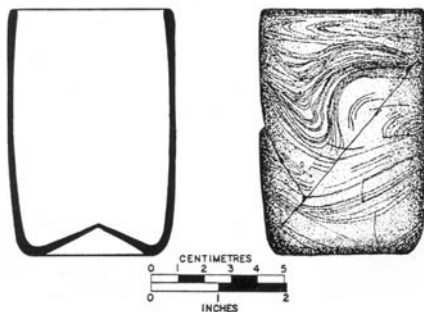


Fig. 6 Tumbler cross-section and side views

Two other fragments (one base and one rim) may also be from another tumbler. The basal fragment is from a vessel 7.3cm in diameter, and is 2cm tall. The wall of this piece tapers inward very slightly. The rim fragment was part of an opening 7.0cm in diameter. Both pieces are characterized by a very slight construction, with the base being 0.5mm at its thinnest, and the bottom of the rim fragment 0.25mm. There are other qualities these two pieces have in common. They are the same color, a translucent greenish-yellow; both are covered with the same swirling striation pattern of the other tumbler, small seed bubbles fill both pieces, and the patina – mostly on the interior surfaces – is identical.

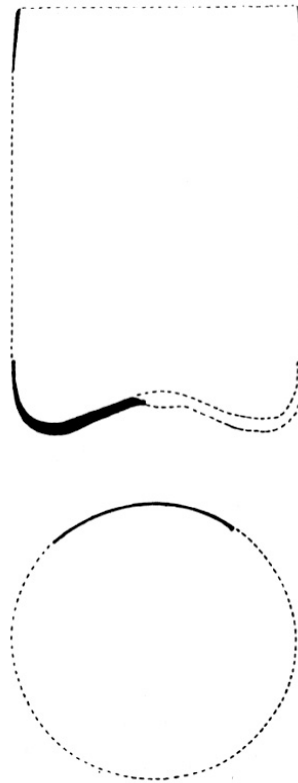


Fig.7 Reconstruction of possible 2nd tumbler

All these common qualities lead one to believe that they are from the same vessel. Though a definite form for these will probably never be determined, their simplicity and similarity to the tumbler suggests that they may be from the same vessel type, although a much more delicate one. Except for plain ceramic *escudillas* (see Marken, 1986), these tumblers would be the only non-metallic drinking vessels recovered from the 1622 wrecks.



Fig. 8 Light-green vial fragments

The striation pattern is present on another group of well-preserved fragments that piece together. A partial base and body fragments form what remains of a bulbous vessel. The glass is a transparent light green with no bubble inclusions. Also of the same color is a complete flared rim with an associated fragment of the neck attached. A series of slightly spiraling ridges cover the surface additional to the same striations as are on the base. Again, because of many common characteristics, most notably and exact color match, it is believed that this rim fragment is from the same vessel as the base. Although the two vessels do not share a common

face, a hypothetical reconstruction of a vessel incorporating both elements, and following their apparent lines of direction, has been drawn. It should be kept in mind that this is only a suggested form and there is nothing irrefutably linking these two pieces. The reconstruction resembles vial forms from 16th and 17th century Spanish colonial sites (Deagan, 1988, pp. 136-138). It is believed these vials were used for pharmaceuticals and perfumes (*ibid*).

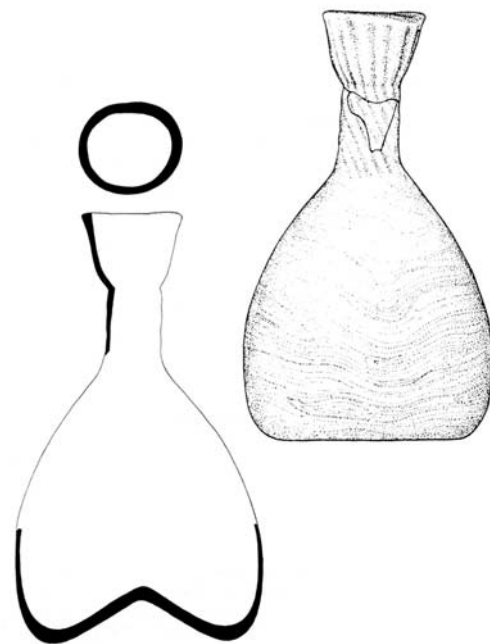


Fig.9 Hypothetical reconstruction of vial fragments.

A concretion filled cone has proved to be the major part of a small vial (Figs. 1 & 10). Made of thin, bubble-filled, clear glass, it was initially thought to be a knob handle, but comparison with similar Spanish artifacts (*ibid*) suggests a more probable function for this piece. Unfortunately, the mouth and upper neck, which, if present, would allow a definite diagnosis, are missing. The base diameter of 2.5cm and height of 2.4cm from the base to the constricted neck show that this was a very small

container. The glass thickness measures from 1 to 2mm.

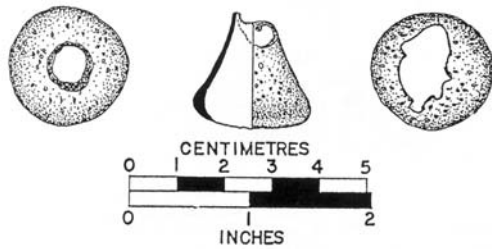


Fig. 10 Top, side and bottom views of small vial.

Doubtless stench would have been a problem onboard, and perfume would be a desired item for passengers with no bathing facilities, especially for those of a higher social standing presumably with a more acute sense of self. This vial would have made a highly portable way to carry small amounts of precious liquids. Another function of small vials from a Spanish context was for the collection of wept tears (Deagan 1988, p. 155). Called *lagrimarios* (after the Spanish *lagrima*, meaning “tear”) these small containers are not well defined in the archaeological record.

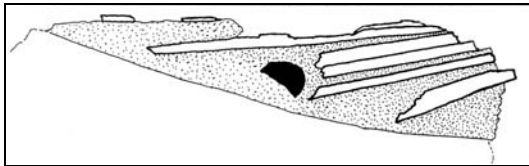


Fig. 11 Cross-section of flat glass in concretion.

An especially unusual and unexpected discovery was made in a piece of concretion removed from an iron spike, well after excavation. Five layers of small pieces of flat glass were apparently preserved by the concretion. They appear to be the remains of a stacked supply, which came into contact with the spike. The glass is clear, although degradation has caused some discolored scale formation. The pieces vary in

thickness, from 2 to 3mm, and this variation exists even within individual pieces. Another fragment similar to these was recovered separately. It is irregular in shape and measures 4.5 by 2.6cm and is 1.5 to 2cm thick. It is a transparent light green with many seed-bubble inclusions. It has one edge that appears to be cut straight.

The manufacture of flat glass at the beginning of the 17th century was most commonly achieved by spinning out a bubble of glass into a large disc. Panes or segments were then cut out of this. The piece in the center with the pontil scar was called the “crown,” giving the name “crown method” to this technique (Fisher, 1964, p.36).



Fig. 12 Piece of flat glass from *Atocha*.

The fact that the pieces trapped in the concretion are stacked leads one to believe that they were stored and intended for later use. What that use was is a tricky determination. The contract for the construction of the *Atocha* makes no mention of glass windows on board (Lyon, n.d.), although the traditional image of a Spanish ship from that time includes rows of windowpanes in the aftercabins of the sterncastle. If that view applies to the *Atocha*, then perhaps these fragments were stored replacement panes for repairs required during the voyage. Interestingly, stacked flat glass in a wet or damp environment is extremely susceptible to decay, and would be one of the least likely types to be recovered (Davidson and Newton, 1989, pp.136-139).

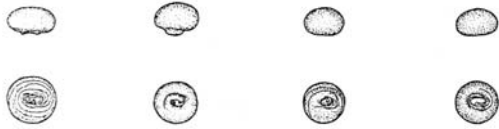


Fig. 13 Black glass buttons.

Eight black glass buttons were recovered from throughout the lower hull structure site of the *Atocha* and one from the *Margarita*. All of them were found loose and not in association with any sort of garment (no clothing was recovered from either wreck). They have a shape best described as “rounded-hemisphere,” and all have two holes in the backside where a wire loop was inserted. None of these loops remain, but corrosion products in some of the holes appear to be iron oxide, leading to the conclusion that an iron wire was dipped and twisted in molten glass and then drawn out, and the piece smoothed and allowed to cool.

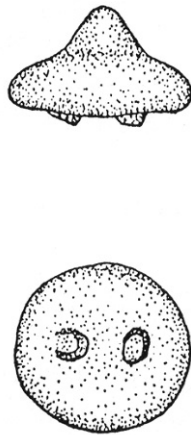


Fig. 14 Emerald-green button.

One other oddly-shaped piece also appears to be a button. A domed disc 7mm in diameter, with a prominent conical center is perhaps the best way to describe its form. Also notable, and

unique to the 1622 collection, is its emerald-green color. Two protrusions on the backside are likely to be the base of a glass loop. The surface of this button has a frosted appearance.

Although most of the glass fragments have been related to various vessel forms, some remain unidentified. They are for the most part small body shards that reveal very limited information about their origin. Nonetheless, this information does have value. Thickness, color, decoration and vessel counts are qualities that can be garnered from them and used for future comparisons.

One thin rim shard, clear in color with numerous tiny seed bubbles, resembles the rim from tumbler #2. It is somewhat thicker, varying from 0.5mm to 3mm. It comes from a vessel with an opening 9mm in diameter.

Another thin shard, clear with a slightly greenish tint, is a body shard from another vessel. It measures just under 2mm thick and contains small seed bubbles. Both surfaces are smooth.

Seven body fragments from a much thicker vessel were found broken into small pieces resembling fragments of tempered glass. All exposed surfaces of these pieces show the swirling striation pattern to some degree. They are a light green color, and the thickness ranges from 4.0 to 6.5mm. No accurate curvature can be recorded because of their small size.

By taking a look at a small and fragmented, but diverse, collection of glass artifacts recovered from the shipwreck of the *Nuestra Señora de Atocha*, we have been able to reveal many Spanish colonial glassware forms, and reach tentative conclusions about the likely function of these pieces on board a galleon of the early 17th century.

It should be remembered that glass was a luxury item at the time, and was most likely being used by officers and wealthy passengers. Square-sectioned bottles were used for serving drinks, and tumblers for drinking from. Vials, big and small, held precious liquids. Many unidentifiable fragments probably originated from similar forms.

To date, no intricate or highly decorated pieces have been discovered, indicating that perhaps the forms selected for the voyage were chosen with the Spartan and unstable environment of a ship under sail in mind. Variations of light green, clear and amber are the most common colors, although emerald green and black were found. A pattern of fine,

randomly swirled striations is a frequent surface decoration.

Not all of the glass found on the site was tableware or containers. A possible structural element, flat glass, was recovered along with glass buttons, a clothing element. As work continues perhaps other categories will be discovered.

Many of these artifacts are the oldest known examples yet discovered on new world sites and as such enhance the importance of the collection. Through their study, the role – however small – that glass and the objects made from it played in the early stages of the colonization of the Americas is clarified and expanded.

Photos and drawings:

All photographs in this paper are by Dylan Kibler. All drawings are by Katherine Amundson.

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