

BEADS

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Bead Researchers



2021

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Cover. Beads, production tubes, and rods recovered during construction work on the south side of the Walcheren Canal, Middelburg, the Netherlands (photo: Hans van der Storm).

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KARLIS KARKLINS, editor

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INFORMATION FOR AUTHORS

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INSIGHT INTO THE 17TH-CENTURY BEAD INDUSTRY OF MIDDELBURG, THE NETHERLANDS

Hans van der Storm and Karlis Karklins

During the first half of the 17th century, several beadmaking establishments operated in the city of Middelburg in the southwestern corner of the Netherlands. Bead wasters recovered from several find sites in the old part of the city reveal the diversity of the product line which featured beads decorated with straight and spiral stripes. Several chevron types were also produced. There are similarities with wasters found at contemporary beadmaking sites in Amsterdam, indicating that both production centers made similar bead varieties. Few of the bead varieties represented have correlatives in the areas of North America that were under Dutch control, leaving one guessing what market the Middelburg beads were destined for. In that the city was a major center for the Dutch East India Company, it may be that their market was in that part of the world. Unfortunately, comparative material from South and Southeast Asia is currently lacking.

INTRODUCTION

During the 17th century, a number of glassworks in Holland produced drawn glass beads for the international market (Hudig 1923; Karklins 1982). These were located in Amsterdam, Haarlem, Rotterdam, Zutphen, and Middelburg, and likely elsewhere as well. While the Amsterdam industry and its products have been well studied (e.g., Baart 1988; Gawronski et al. 2010; Karklins 1974, 1982, 1985; van der Sleen 1963, 1967), this is not the case with the other beadmaking centers, primarily due to a lack of material evidence. Fortunately, a sufficient quantity of production tubes, beads, and rods have been uncovered at several sites in the old part of Middelburg, a walled and moated city located in the Province of Zeeland in the southwest corner of the Netherlands, providing insight into what was being produced there.

HISTORICAL BACKGROUND

Govaert van der Haghe, a native of Antwerp, appears to have been the first beadmaker in Middelburg (and

Holland for that matter), establishing a glassworks there in 1581. The establishment was suitably situated between the city wall and the harbor on the “Cousteynschen Dijk” near the Segeerspoort, the city gate (Figure 1). Its purpose was to produce glassware in the manner of Antwerp (Hudig 1923:23). The business flourished and, in 1597, van der Haghe petitioned the city for a larger lot because he intended to produce long colored glass tubes for the manufacture of beads (*lange coleure wercken van getten*) and similar items, and to employ more workers. He was granted the requested property; construction involved tearing down the round of the old city gate which had lost its importance due to the expansion of the city at this time (Hudig 1923:24).

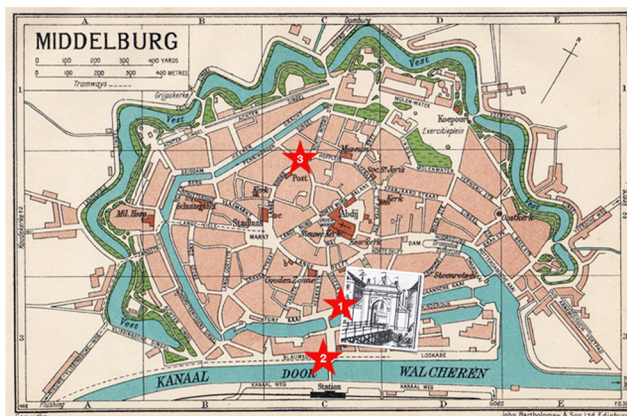


Figure 1. The old part of Middelburg showing the location of: 1) the Segeerspoort, the city gate near which the early glassworks were erected, 2) the Blauwedijk/Kousteense Dijk find site, and 3) the Blindenhoek and Noordstraat find sites (after Muirhead and Muirhead 1933).

Van der Haghe died in 1605 and was succeeded by Anthonio Miotti, a capable Venetian who was descended from a long line of glass and bead manufacturers (Hudig 1923:25). Business was such that in 1618 he purchased additional land behind his property to erect three new dwellings (Hudig 1923:26). Then, in 1623, for reasons unknown, he abandoned the Middelburg factory and

established glassworks in Namur and Brussels (Hudig 1923:27).

With the Zeeland patent now vacant, Wilhelmus Wynants of Amsterdam requested permission in 1626 to build a new glassworks to practice the art of glass blowing in the same manner as the Miotti works. It was constructed near the old one at the Blauwedijk between Oude Segeerstraat and Vlissingsche Poort. The business apparently operated until around 1642 when Willem Verpoort took over the glassworks from the city. That same year, the city signed a contract with Joannis Francisco Promontorio, a Venetian, to “perform glass blowing and making in the same way as Wynants and Minjottes [Miotti].” This undertaking seems to have failed. Additionally, in 1646 the Blauwedijk works reverted to the city, which sold it to a Nathaniel Oudermerk. There is no mention of beadmaking in Middelburg after this date (Hudig 1923:27-28).

THE FIND SITES

The material discussed in this article was recovered from a number of find sites in Middelburg (Figure 1). Several hundred beads and beadmaking wasters were recovered from several areas in the Blauwedijk/Kousteense Dijk area on the south side of the city near the Walcheren Canal. Around 200 specimens are in the collections of the Rijksdienst voor het Oudheidkundig Bodemonderzoek, Amersfoort, and 49 are in the possession of Hans van der Storm. All of the van der Storm specimens and 48 representative specimens from the Rijksdienst assemblage (Karklins et al. 2001) were examined for this study.

Another principal find spot is situated on Blindenhoek near its intersection with Noordstraat, two streets on the northwest side of the old circular city center. A large quantity of glass tubes and some rounded beads was found there, along with pieces of raw blue glass (Figures 2-3). Similar material was found nearby on Noordstraat (Figure 4).

Some beads and wasters were obtained from diggers who did not want to divulge the location of find sites and these are marked as “unspecified” in the descriptions that follow. It is, however, likely that they came from the Blauwedijk/Kousteense Dijk area.

THE MIDDELBURG FINDS

The Middelburg bead study collection consists of 133 tubular beads and bead production tubes, 6 malformed rounded beads, and 11 glass rod segments. Since it is difficult in many cases to differentiate actual tubular beads from production tube remnants, they are considered to be tubular



Figure 2. Some of the beads, tubes, and raw glass as recovered from the Blindenhoek find site in 1998 (courtesy of Zeeuws Archeologisch Depot, Middelburg).

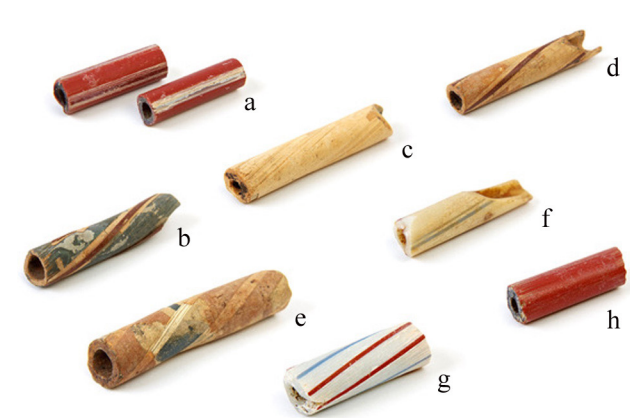


Figure 3. A selection of the Blindenhoek beads or production tubes (photo: Hans van der Storm).



Figure 4. Examples of the beads or production tubes from the Noordstraat find site (photo: Hans van der Storm).

beads for the purposes of classification. This is based on the system developed by Kenneth E. Kidd and Martha A. Kidd (1970) as expanded by Karklins (2012). Varieties and types that do not appear in the Kidds' lists are marked by one (*) or two (**) asterisks, respectively, followed by a sequential letter for ease of reference. Colors are generally designated using the names and codes provided in the *Munsell Bead Color Book* (Munsell Color 2012). Diaphaneity is described using the terms opaque (op.), translucent (tsl.), and transparent (tsp.). Opaque beads are impenetrable to light except on the thinnest edges. Specimens that are translucent transmit light but diffuse it so that an object (such as a pin in the perforation) viewed through them is indistinct. A pin in the perforation of a transparent bead is clearly visible. Regarding measurements, L=length and D=diameter.

Despite the relatively small size of the collection, there are 53 varieties, most of which are decorated with stripes (Figure 5). Not all varieties are illustrated.

Ia – Tubular, Single Layer, Undecorated

Ia1. Tubular; op. barn red; n=1. L: 20.1-21.5 mm; D: 4.9-6.0 mm. Source: Blauwedijk.

Ia2. Tubular; op. black; n=1 (Figure 5, e3). L: 21.5 mm; D: 4.9 mm. Source: unspecified.

Ia15. Tubular; tsl. bright blue; n=1. L: 43.7 mm; D: 5.8 mm. Source: Blauwedijk.

Ia*(a). Tubular, op. medium shadow blue; numerous linear bubbles in the glass; n=1 (Figure 6). L: 14.1 mm; D: 2.7 mm. Source: unspecified.

Ia19. Tubular; tsp./tsl. bright navy; n=4 (Figure 5, a1-2, j2). L: 20.1-39.3 mm; D: 2.8-14.1 mm. Source: unspecified.

Ia20. Tubular; tsp./tsl. dark navy; n=4 (Figure 5, a3-5). L: 20.4-33.7 mm; D: 3.0 mm. Source: unspecified.



Figure 5. A sampling of the beads or production tubes recovered from find sites in Middelburg (photo: Hans van der Storm).

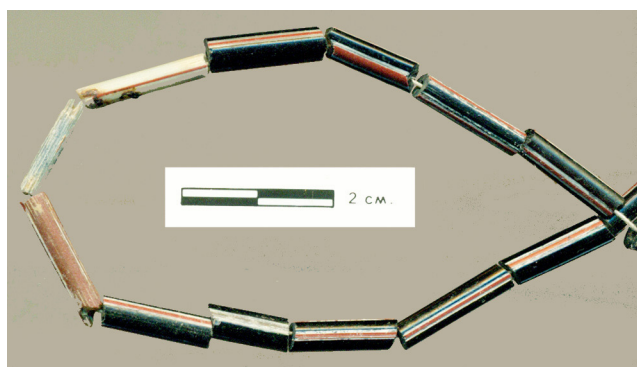


Figure 6. Tubular beads from an unspecified find site in Middelburg (photo: Karlis Karklins).

Ia21. Tubular; tsl. rose wine; n=1. L: 42.1 mm; D: 3.3 mm. Source: Blauwedijk.

Ib – Tubular, Single Layer, Straight Simple Stripes

Ib*(a). Tubular; op. barn red; 12 op. white stripes; n=1. L: 27.7 mm; D: 15.5 mm. Source: Blauwedijk.

Ib*(b). Tubular, op. barn red; six op. light orange stripes; n=2 (cover, upper left). L: 17.-18.4 mm; D: 9.6-10.7 mm. Source: unspecified.

Ib4. Tubular, op. black; three op. white stripes; n=1 (Figure 5, f5). L: 8.2 mm; D: 4.4 mm. Source: unspecified.

Ib10. Tubular, op. white; three thin red stripes; n=1 (Figure 6). L: 17.9 mm; D: 3.1 mm. Source: unspecified.

Ib*(c). Tubular; op. light blue; eight red stripes; n=1 (Figure 5, c1). L: 16.6 mm; D: 9.2 mm. Source: unspecified.

Ib*(d). Tubular; tsl. dark navy; 10 red and 10 white stripes; n=1 (Figure 5, j3). L: 12.3 mm; D: 7.1 mm. Source: unspecified.

Ib*(e). Tubular; op. dark navy; 12 white stripes; n=1 (Figure 5, f3). L: 26.9 mm; D: 8.2 mm. Source: unspecified.

Ib' – Tubular, Single Layer, Spiral Simple Stripes

Ib'*(a). Tubular; op. white; two op. barn red and two tsp. bright navy spiral stripes; n=1. L: 28.3 mm; D: 5.3 mm. Source: Blauwedijk.

Ib'*(b). Tubular, op. white; two sets of one red spiral stripe alternating with two light blue spiral stripes; n=4 (Figure 4, d-e; Figure 5, g1). L: 21.5-27.0 mm; D: 5.5-7.0 mm. Source: Noorderstraat, Blindenhoek; unspecified.

Ib'*(c). Tubular, op. white; two sets of one light blue spiral stripe alternating with two red spiral stripes; n=1 (Figure 3, g). L: 18.9 mm; D: 5.9 mm. Source: Blindenhoek.

Ib'*(d). Tubular, op. white; two red stripes alternating with two, closely spaced, light blue spiral stripes; n=1 (Figure 3, f). L: 25.6 mm; D: 6.0 mm. Source: Blindenhoek.

Ib'*(e). Tubular; op. bright copen blue; three spiral white stripes; n=3 (Figure 3, e; Figure 5, h1, i1-2). L: 21.4-33.0 mm; D: 5.4-7.6 mm. Source: unspecified.

Ibb – Tubular, Single Layer, Straight Compound Stripes

Ibb1. Tubular; op. barn red; three blue-on-white stripes; some specimens are flashed in greenish glass; n=4 (Figure 5, k2-3). L: 15.1-34.7 mm; D: 5.2-5.8 mm. Source: unspecified.

Ibb2. Tubular, op. black; three red-on-white stripes; n=18 (Figure 4, f; Figure 5, e2, f2, 4, 6-7; Figure 6). L: 11.1-26.1 mm; D: 3.1-5.0 mm. Source: unspecified.

Ibb*(a). Tubular, tsl. green; three red-on-white stripes; n=1. L: 11.9 mm; D: 4.1 mm. Source: Blindenhoek.

Ibb*(b). Tubular; op. medium turquoise blue; three white-on-red stripes; n=1. L: 38.6 mm; D: 6.3 mm. Source: Blauwedijk.

Ibb*(c). Tubular, op. light blue; three red-on-white stripes; n=5 (Figure 5, g4). L: 11.0-18.9 mm; D: 4.2 mm. Source: unspecified.

Ibb*(d). Tubular, op. bright navy; three red-on-white stripes; n=1 (Figure 5, j1). L: 42.2 mm; D: 5.8 mm. Source: unspecified.

Ibb*(e). Tubular, op. dark navy; three red-on-white stripes; n=6 (Figure 5, j4-5). L: 14.1-14.4 mm; D: 4.1-5.2 mm. Source: unspecified.

Ibb' – Tubular, Single Layer, Spiral Compound Stripes

Ibb'*(a). Tubular; op. black; three spiral red-on-white stripes; n=1 (Figure 5, f1). L: 19.6 mm; D: 5.7 mm. Source: unspecified.

Ibb'*(b). Tubular; op. white; three spiral blue-on-red stripes; n=1 (Figure 5, g5). L: 19.6 mm; D: 5.6 mm. Source: unspecified.

Ibb'*(c). Tubular; op. light blue; three red-on-white spiral stripes; n=18 (Figure 3, b-d; Figure 4, a-c, g-h, j-k; Figure 5, g2-3, i3-4). L: 25.8-49.0 mm; D: 5.0-7.5 mm. Source: Noorderstraat, Blindenhoek; unspecified.

Ibb'*(d). Tubular; tsl. sky blue; three red-on-white spiral stripes; n=1. L: 38.7 mm; D: 6.2 mm. Source: Blauwedijk.

IIIa – Tubular, Multi-Layered, Undecorated

IIIa1. Tubular; op. barn red exterior/op. black core; flashed in clear glass; n=4. L: 32.3-39.0 mm; D: 2.2-4.8 mm. Source: Blauwedijk.

IIIa3. Tubular; op. barn red exterior/tsl. green core; n=7 (Figure 3, h; Figure 4, i; Figure 5, b1-5). L: 9.0-43.7 mm; D: 3.3-6.6 mm. Source: Noorderstraat, Blindenhoek; unspecified.

IIIa7. Tubular; tsl. light gray exterior/op. white middle layer/tsl. light gray core; n=1. L: 52.7 mm; D: 2.7 mm. Source: Blauwedijk.

IIIa12. Tubular; tsp./tsl. bright navy exterior/op. white middle layer/tsp./tsl. bright navy core; n=3. L: 27.4-54.4 mm; D: 3.1-6.0 mm. Source: Blauwedijk.

IIIb – Tubular, Multi-Layered, Straight Simple Stripes

IIIb*(a). Tubular; op. bluish-white exterior/tsp. dusty aqua blue core; three red and three bright navy stripes; flashed in clear glass; n=2. L: 25.3-50.7 mm; D: 2.8-3.3 mm. Source: Blauwedijk.

IIIb*(b). Tubular; op. white exterior/tsp. dusty aqua blue core; four red and four bright navy stripes; flashed with tsp. light gray glass; n=1. L: 25.2 mm; D: 4.4 mm. Source: Blauwedijk.

IIIb*(c). Tubular; tsp./tsl. bright navy exterior/op. white middle layer/tsp./tsl. bright navy core; six white stripes; n=2. L: 27.5-28.5 mm; D: 4.2-6.2 mm. Source: Blauwedijk.

IIIb*(d). Tubular; tsp./tsl. bright navy exterior/op. white middle layer/tsp./tsl. bright navy core; 14(?) white stripes; n=1. L: 18.0 mm; D: 16.3 mm. Source: Blauwedijk.

IIIb9. Tubular; op. bright navy exterior/op. white middle layer/op. bright navy core; 10 white stripes; n=1 (Figure 5, c3). L: 16.3 mm; D: 14.6 mm. Source: unspecified.

IIIbb – Tubular, Multi-Layered, Straight Compound Stripes

IIIbb1. Tubular, op. barn red exterior/op. black core; three black-on-white stripes; n=1 (Figure 6). L: 18.9 mm; D: 3.5 mm. Source: unspecified.

IIIbb4. Tubular, op. barn red exterior/tsl. green core; three black-on-white stripes; n=3 (Figure 3 a; Figure 5, b2). L: 14.3-15.7 mm; D: 4.2-4.6 mm. Source: Blindenhoek; unspecified.

IIIbb5. Tubular, op. barn red exterior/tsl. green core; three blue-on-white stripes; n=1. L: 13.6 mm; D: 3.5 mm. Source: Blindenhoek.)

IIIbb' – Tubular, Multi-Layered, Spiral Compound Stripes

IIIbb'*(a). Tubular; op. barn red exterior/tsl. green core; three spiral blue-on-white stripes; n=2 (Figure 5, k4-5). L: 15.7-29.1 mm; D: 5.4-5.5 mm. Source: unspecified.

IIIk – Tubular, Multi-Layered, Chevron, Undecorated

IIIk*(a). Tubular; chevron bead with four layers: tsp. bright navy exterior/op. white/op. redwood /tsp. light gray core; the ridges of the second layer show through as straight stripes; n=2 (Figure 5, h3; Figure 7). L: 21.0-53.9 mm; D: 3.6-5.0 mm. Source: unspecified.



Figure 7. Two chevron bead production tubes (photo: Hans van der Storm).

IIIIm – Tubular, Multi-Layered, Chevron, Rounded by Grinding

IIIIm*(a). Oval; chevron bead with seven layers: tsl. bright navy exterior/op. white/op. barn red/op. white/tsp. bright blue/op. white/tsl. bright blue core; n=1 (Figure 8). L: 36.0 mm; D: 17.3 mm. Source: stray find near Middelburg.



Figure 8. Oval seven-layer chevron bead found near Middelburg (photo: Hans van der Storm).

IIIInn – Tubular, Multi-Layered, Chevron (Porcelain Appearance), Straight Simple Stripes

IIIInn*(a).** Tubular; chevron with four layers: op. white exterior/op. red/op. white/op. red core; six red and six bright

navy stripes; n=9 (Figure 5, c2; Figure 7). L: 16.1 mm; D: 12.8 mm. Source: unspecified.

IIIⁿⁿ*(b). Tubular; chevron with five layers: op. white exterior/op. red/op. white/op. red/tsp. turquoise green core; six red and six bright navy stripes; n=1. L: 17.4 mm; D: 16.4 mm. Source: Blauwedijk.

III^p – Tubular, Multi-Layered, Chevron, Straight Simple Stripes on Second Layer

III^p*(a). Tubular; chevron with five layers; thin tsp. light gray exterior/op. white/op. barn red/op. white/op. barn red core; six op. barn red and six tsl. bright navy stripes; n=1. L: 17.4 mm; D: 11.3 mm. Source: Blauwedijk.

III^p*(b). Tubular; chevron with five layers; thin tsp. light gray exterior/op. white/op. barn red/op. white/tsp. light gray core; six op. barn red and six tsl. bright navy stripes; n=1. L: 21.9 mm; D: 15.3 mm. Source: Blauwedijk.

III^p*(c). Tubular; chevron with five layers; thin tsp. bright turquoise exterior/op. white/op. barn red/op. white/tsp. bluish core; six op. barn red and six tsl. bright navy stripes; n=1. L: 17.0 mm; D: ? mm. Source: Blauwedijk.

IV^b – Non-Tubular, Multi-Layered, Straight Simple Stripes

IV^b34. Barrel shaped; tsp./tsl. bright navy exterior/op. white/tsp./tsl. bright navy core; 16(?) op. white stripes; n=1. L: 17.5 mm; D: 12.8 mm. Source: Blauwedijk.

IVⁿ – Non-Tubular, Multi-Layered, Chevron, Straight Simple Stripes

IVⁿ*(a). Barrel shaped; chevron with four layers; tsl./op. dark navy exterior/op. white/op. barn red/tsl. medium turquoise blue core; four op. barn red, four op. white, and four op. sunlight yellow stripes; n=1. L: 16.7 mm; D: 14.0 mm. Source: Blauwedijk.

IVⁿⁿ – Non-Tubular, Multi-Layered, Chevron (Porcelain Appearance), Straight Simple Stripes

IVⁿⁿ4. Barrel shaped; chevron with four layers; op. white exterior/op. barn red/op. white/op. barn red core; six op. barn red and six tsl. bright navy stripes; production error (one flat side); n=2. L: 12.5-15.0 mm; D: 13.0-15.3 mm. Source: Blauwedijk.

IV^p – Non-Tubular, Multi-Layered, Chevron, Straight Simple Stripes on Second Layer

IV^p*(a). Barrel shaped; chevron with five layers; tsp. blue-tinted exterior/op. white/op. barn red/op. white/tsp. turquoise core; six op. barn red and six tsl. bright navy stripes; n=2. L: 13.5-16.2 mm; D: 15.7-19.4 mm. Source: Blauwedijk.

Glass Rods

These may have been used to create stripes on beads or to decorate hollowware. Some may represent the sealed ends of production tubes where the bubble forming the hole did not extend.

1. Op. barn red; n=2. L: 21.9-59.8 mm; D: 3.9-9.6 mm. Source: Blauwedijk.

2. Op. barn red exterior/tsl. green core; n=1 (Figure 5, c4). L: 59.8 mm; D: 9.6 mm. Source: unspecified.

3. Tsl. white exterior/tsl. light gray core; n=1 (Figure 5, d1). L: 47.4 mm; D: 3.3 mm. Source: unspecified.

4. Tsl. oyster white exterior/op. red/tsl. oyster white/tsp. light gray core; flashed in clear glass; n=3 (Figure 5, d2-3, e1). L: 35.3-41.7 mm; D: 4.4-4.9 mm. Source: unspecified.

5. Op. light gold; n=1. L: 33.7 mm; D: 3.4 mm. Source: Blauwedijk.

6. Tsl. dark navy; three spiral white stripes; n=1 (Figure 5, h2). L: 35.4 mm; D: 7.9 mm. Source: unspecified.

7. Melted white, red, and blue glass; n=1 (Figure 5, k1). L: 16.3 mm; D: 5.1 mm. Source: unspecified.

DISCUSSION

Beads with straight and spiral stripes dominate the Middelburg bead study collection, comprising 80% of it. Undecorated varieties make up the remaining 20%. Chevron beads with four to seven layers are represented by 10 varieties and constitute 8.2% of the assemblage. Most are decorated with stripes, either on the surface or on the second layer under a layer of clear glass.

Regarding color, specimens with blue bodies predominate (42%) with white (22%), red (18%), and black (18%) making up the rest. Green and purple beads are each represented by a single specimen.

It is noteworthy that almost all the tubes are more than 4 mm in diameter, suggesting that the glassworks involved did not produce seed beads but only larger beads rounded using

the *a speo* method (Karklins 1993). The few tube segments that are under 4 mm in diameter appear to be actual beads (bugles) rather than production tube remnants (Figure 6).

The presence of only six beads malformed during the heat-rounding process is unusual as such rejects are numerous among the wasters at other contemporary European beadmaking sites, such as Kg9-10 in Amsterdam (Karklins 1985) and the Hammersmith Embankment in London (Karklins, Dussubieux, and Hancock 2015). Is this due to careful rounding procedures or were the tubes chopped into bead lengths at one place and the rounding done at another with wasters from each process going to different dumps? Some beads with minor defects were certainly exported along with the good ones as such beads have been recovered in small quantities at a number of sites in the northeastern United States that would have been within the Dutch sphere of influence (Karklins 1993).

Comparing the Middelburg bead assemblage to those from other contemporary beadmaking sites, there are quite a few correlatives (28 varieties) in the Kg9-10 collection (Karklins: pers. obs.) which is attributed to the first Two Roses glasshouse that operated on the Keizersgracht from 1621 to around 1657, when the operation was moved to a new site on the Rozenstraat (Baart 1988:69, 71). There are far fewer correlatives (8 varieties) with those recovered from wasters associated with the Carel-Soop works which was in operation on the Kloveniersburgwal from 1601 to 1624, but the sample size is much smaller (Bradley 2014:56-57). Similarly, there were equally few matches with varieties recorded at the second Two Roses glassworks (Gawronski

et al. 2010:44, 112-121). Thus, while all three glassworks produced some similar varieties, the closest correlation to the Middelburg assemblage is Kg10 and that the two assemblages likely date to about the same time period.

At the Hammersmith glassworks, which operated in London during the second quarter of the 17th century, there are only five correlatives – all common undecorated seed bead varieties (Karklins, Dussubieux, and Hancock 2015). While some of the tubular striped varieties are superficially similar, they differ in the number of stripes or the color of the different layers.

While there are correlatives at Native American sites in regions under Dutch control during the 17th century, it is currently impossible to differentiate those that might have originated in Middelburg from those which were produced in Amsterdam.¹ It is noteworthy that there are few examples at aboriginal sites of beads with spiral stripes, whereas they are so common in the Middelburg assemblage. Similarly, an examination of the beads excavated at the former Dutch colony of St. Eustatius in the Caribbean revealed only one striped bead, one which is not replicated in the Middelburg collection (Karklins and Barka 1989:62). If these beads were not sent to New Netherland or the Caribbean, where did they go? In that Middelburg was an important center of the Dutch East India Company (VOC) during the 17th century (Figure 9), likely destinations are South Africa and South and Southeast Asia. Unfortunately, there is presently no comparative material available from that period to confirm this.

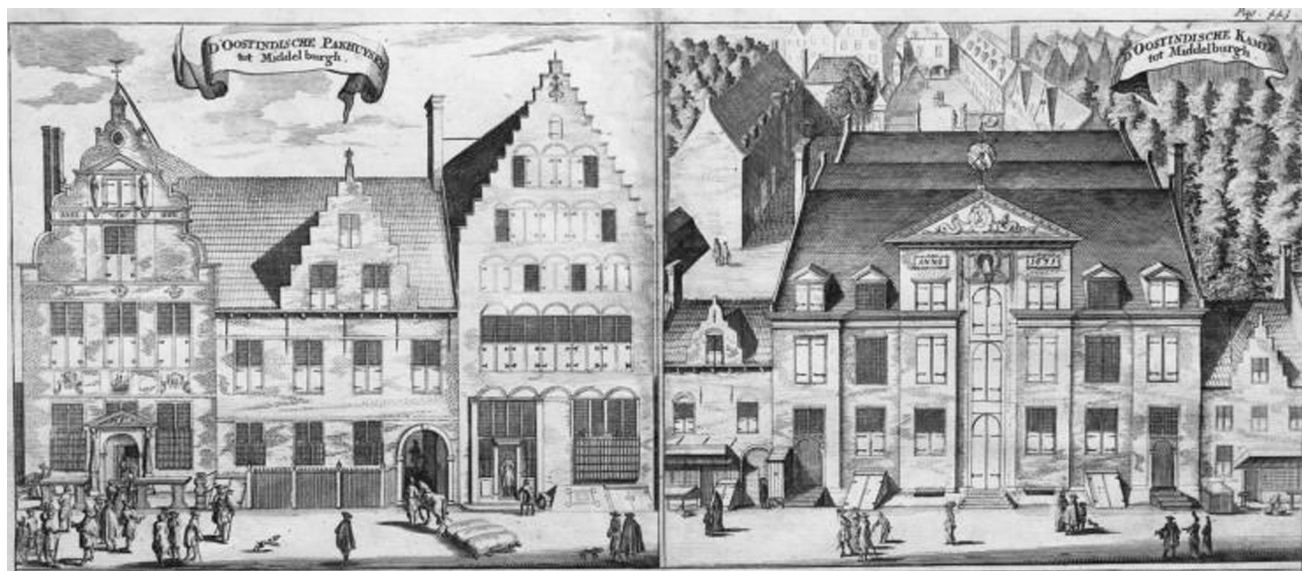


Figure 9. Two of the main VOC structures in Middelburg: left: warehouses; right: the main office building (Smallegange 1696:443).

CONCLUSION

While the Middelburg finds greatly increase our knowledge of the Dutch bead industry, much remains to be learned. In that the Middelburg study sample is small compared to what has been excavated in Amsterdam, there is no way to determine how the Middelburg glasshouse production output compared to that of Amsterdam. We also know nothing of the products of the other Dutch beadmaking centers. Questions also remain concerning the relatively brief span of the Dutch beadmaking industry which only lasted about three quarters of a century. Was it that it could not compete with the prolific Venetian beadmakers, or those in France, or were there other reasons? Only further archaeological and archival research can answer these questions.

ENDNOTE

1. Neutron activation (INAA) and laser ablation (LA-ICP-MS) analysis of production tube wasters from the Middelburg collection held by the Rijksdienst voor het Oudheidkundig Bodemonderzoek, the Kg10 material in the collections of Bureau Monumenten & Archeologie (BMA), Gemeente Amsterdam, and the Hammersmith material at the Museum of London Archaeology revealed that practically all the samples were composed of soda-lime-silica glass, but exhibited differences in their trace elements. This suggests that while the beads at all three sites were made using very similar recipes, all likely based on Venetian formulas, they were made using raw materials from different sources (Karklins, Dussubieux, and Hancock 2015:21; Karklins et al. 2001). Further study of the trace elements in the various bead glasses may eventually allow us to more accurately source glass beads.

REFERENCES CITED

Baart, Jan

- 1988 Glass Bead Sites in Amsterdam. *Historical Archaeology* 22(1):67-75.

Bradley, James W.

- 2014 Glass Beads from Champlain's *Habitation* on Saint Croix Island, Maine, 1604-1613. *Beads: Journal of the Society of Bead Researchers* 26:47-63.

Gawronski, Jerzy, Michel Hulst, Ranjith Jayasena, and Jørgen Veerkamp

- 2010 *Glasafval op het achtererf: Archeologische Opgraving Rozenstraat, Amsterdam (2006)* [Glass Debris from the Backyard: Archaeological Excavations on the Rozenstraat, Amsterdam (2006)]. Gemeente Amsterdam,

Bureau Monumenten & Archeologie, Amsterdamse Archeologische Rapporten 50. Amsterdam.

Hudig, Ferrand W.

- 1923 *Das Glas*. Vienna.

Karklins, Karlis

- 1974 Seventeenth Century Dutch Beads. *Historical Archaeology* 8:64-82.
 1983 Dutch Trade Beads in North America. In *Proceedings of the 1982 Glass Trade Bead Conference*, edited by Charles F. Hayes III, pp. 111-126. Rochester Museum and Science Center, Research Records 16. Rochester.
 1985 Early Amsterdam Trade Beads. *Ornament* 9(2):36-41.
 1993 The *a Speo* Method of Heat Rounding Drawn Glass Beads and its Archaeological Manifestations. *Beads: Journal of the Society of Bead Researchers* 5:27-36.

Karklins, Karlis and Norman F. Barka

- 1989 The Beads of St. Eustatius, Netherlands Antilles. *Beads: Journal of the Society of Bead Researchers* 1:55-80.

Karklins, Karlis, Laure Dussubieux, and Ron G.V. Hancock

- 2015 A 17th-Century Glass Bead Factory at Hammersmith Embankment, London, England. *Beads: Journal of the Society of Bead Researchers* 27:16-24.

Karklins, K., J. Kottman, R.G.V. Hancock, M.L. Sempowski, A.W. Nohe, J.-F. Moreau, S. Aufreiter, and I. Kenyon

- 2001 On the Chemical Variability of Middelburg Glass Beads and Rods. In *Australasian Connections and New Directions: Proceedings of the 7th Australasian Archaeometry Conference*, edited by M. Jones and P. Sheppard, pp. 187-195. Department of Anthropology, The University of Auckland, Auckland, New Zealand.

Muirhead, Findlay and L. Russell Muirhead

- 1933 *The Blue Guides - Holland and the Rhine*. Ernest Benn, London.

van der Sleen, W.G.N.

- 1963 Bead-Making in Seventeenth-Century Amsterdam. *Archaeology* 16(4):260-263.
 1967 *A Handbook on Beads*. Musee du Verre, Liege.

Smallegange, Mattheus

- 1696 *Nieuwe cronyk van Zeeland, eerste deel*. Joannes Meertens, Amsterdam.

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FROM QUALITATIVE TO QUANTITATIVE: TRACKING GLOBAL ROUTES AND MARKETS OF VENETIAN GLASS BEADS DURING THE 18TH CENTURY

Pierre Niccolò Sofia

Translated by Brad Loewen

The Venetian glass bead industry has its roots in the Late Middle Ages. The development of Atlantic trade and, particularly, the slave trade from the second half of the 17th century increased the demand for glass beads. The 18th century would be the heyday of this industry, when Venetian beads attained a significant global diffusion. While scholars have long known the global exports of beads from Venice, this paper contributes new quantitative data on their precise routes and markets in the 18th century, toward the Orient and toward the Atlantic. Using beads as a case study, this paper shows how a niche product allowed a Mediterranean city such as Venice to stay connected with the Atlantic world and how the Atlantic slave trade influenced Venetian glass bead exports to the West.

INTRODUCTION

For most of its history, Venice has been a major manufacturing city. Beginning in the Middle Ages and increasingly so in the modern era, the glass industry played a crucial role in the lagoon city's economic life. Building on its medieval origins, the glass bead sector expanded significantly in the 17th century, stimulated by growing international demand, especially from the Atlantic. The Venetian *conterie* (drawn beads) and *manifatture a lume* (lampworked wound beads) industry broadened in the 18th century as its products gained a global diffusion that would continue into the 20th century.

This study presents an overview of the Venetian glass bead industry in the 18th century, and identifies the Mediterranean destinations, commercial routes, and global markets for its products. As well, by looking especially at the Western trade of Venetian beads, it is clear that beads solidly linked the Venetian economy to the Atlantic trade, notably that in slaves.

We consulted both archival and secondary sources. Regarding the former, we present results of a cross-analysis between quantitative data, from Venetian (*Registri*

dei Cinque Savi alla Mercanzia or ship's manifests leaving Venice) and international (Portuguese balance of trade, TOFLIT18, Trans-Atlantic Slave Trade Database) sources, and qualitative data drawn from Venetian consular dispatches and the records of the Glass Arts magistrates. As for scholarly literature, we rely on Italian and international historiography, as well as publications in anthropology and archaeology.

THE VENETIAN GLASS BEAD INDUSTRY IN THE 18TH CENTURY

The commercial success of Venetian glass beads rests, in large part, on the production phase of this product. By the 18th century, the Venetian glass industry had organized as an integrated production system that included five artisanal guilds or Arts (Panciera 1998:537-547; Trivellato 2000:131-134). The Art of Murano regulated the first production phase of glass beadmaking, that of making glass, while the guilds of the *paternostri* or *margariteri* and of the *suppialume* or *perleri* regulated the second phase of transforming glass into beads. On the island of Murano, the site of furnaces since 1291, the "mother" Art of the Venetian glass industry transformed raw materials into cane of two types: hollow tubes for the work of the *margariteri*, and solid rods for the *perleri*. In the city of Venice itself, the two "daughter" Arts used tubes and rods to make glass beads, following two production techniques. The *margariteri* produced drawn beads called *conterie*. After sorting and chopping the tubes into bead lengths, they were rounded using one of two heat-rounding techniques, depending on the size of the tubes. The smaller sizes (*margarite*) were heated in copper pans called *ferrazze* (hence the bead group called *conterie a ferrazza* in the Venetian dialect). Larger beads were mounted on spits called *spiedi* (hence the bead type called *conteria a speo*) which were inserted into a furnace and rotated until the tube segments became rounded (Karklins 1993).

As for the *perleri*, the workers who filled the orders placed by the guild's traders fashioned glass rods into beads at the lamp (*a lume*). The beads were often decorated with various applied designs such as floral pattern, dots, spirals, or stripes using various enamels. Women strung the *conterie* and the *perle a lume* into hanks of various sizes which were tied together into bunches and packed in bundles. The latter were then placed in barrels or boxes for stowage in the holds of merchant ships for export (Trivellato 2000:177-178; Zecchin 1987:90-91).

Since the second half of the 20th century, Italian historians have taken an interest in Venetian glassmaking. More recently, they have reevaluated the role of guild institutions in European history (Ago 2018; Caracausi, Davies, and Mocarelli 2018; Epstein and Prak 2008; Guenzi, Massa, and Piola Caselli 1998; Massa and Moioli 2004; Prak et al. 2020; Prak and van Zanden 2013). Within this field, glass beadmaking has attracted the attention of historians such as Francesca Trivellato, Anna Bellavitis, Barbara Bettoni, Nadia Maria Filippini, and Maria Teresa Sega. In particular, Trivellato's work has become a reference for any study of Venetian glass in the 17th and 18th centuries. Among other aspects, she has studied the role of conflict within and between the different Venetian glassworking guilds, as well as the industry's relative openness to technical innovation and its conversion to "mass" production in response to foreign demand, especially in the 18th century (Trivellato 2000, 2006). This body of research confirms the popularity of Venetian glass beads in the world market from the second half of the 17th century through the 18th century. In fact, beads are a prime example of how the Venetian manufacturing system specialized and reconfigured in response to international competition, notably from France (Trivellato 1996, 2000).

Several studies have focused on women's work in the bead industry from the 18th to the 20th century (Bellavitis 2016; Bellavitis, Filippini, and Sega 1990; Filippini 1996; Trivellato 1998, 2000). They not only show women's importance in the production of *conterie* – in the tasks of sorting, cutting, and stringing – but also in the production of lampworked beads. In the 18th century, several hundred women workers, officially excluded from membership in the Venetian Arts, were often exploited by the glassworks' owners and bead merchants. In particular, hiring a workforce outside the guild structure lowered the cost of labor, and thus, of production. Bellavitis and Trivellato have documented a hierarchy within the female workforce, where "mistresses" (*mistre*) organized the work of women stringers (*impiraresse*) and lampworkers. Moreover, Venetian records reveal the rise of an illegal female production system that escaped the guild structure: women bought cane, oversaw

its transformation, and directly sold glass beads¹ (Bellavitis 2016:47-48; Trivellato 2000:179-181).

In her work on the Venetian *perle a lume* sector, Bettoni (2017) shows how it broadened and diversified its product line in the 18th century through a process of product innovation that responded to consumer taste and adopted new materials, such as enamels, thus building on centuries of artisanal knowledge. Bettoni underscores the remarkable ability of Venetian glass beadmaking to adapt to the dynamics of international demand, suggesting that the success of this product did not rest only on reducing production costs through workforce exploitation.

Our approach here (and elsewhere) builds on the work of these previous researchers while seeking a broader analytical framework.² There is a need, in fact, for combined study that links the production and trade of glass beads within the wider industrial and commercial context of 18th-century Venice, using a "commodity chain" approach (Figure 1) (Gereffi and Korzeniewicz 1994; Hopkins and Wallerstein 1977).

The production aspect is beyond the scope of this paper, but we may briefly synthesize some observations. Archival sources reveal the Venetian Republic's efforts to find substitutes for ash imports, as well as increasingly strict oversight by the Arts or individuals from the glass industry in the management of raw materials (manganese) and lamp fuel (bovine fat). We see differences between women who worked with *conterie* and those who produced beads at the lamp, while noting the symmetry of legal and illegal workplaces. Over the course of the 18th century, we see the emergence of elite merchant beadmakers who profited from their increasing dominance within the organization of the two bead Arts to gain absolute control over production. The most dynamic merchant beadmakers ventured into foreign trade, especially in the western Mediterranean and Atlantic Europe, undertaking voyages to England, France, Portugal, and Morocco, and building links with international traders (Figure 2).

Previous work has not considered the commercial aspect of the glass bead "commodity chain" in detail. As we shall see, the routes and markets of Venetian glass beads in the 18th century provide a fundamental understanding of this universe.

ROUTES, NODES, AND MARKETS IN THE 18TH CENTURY

"These *conterie* serve the usages of the farthest regions of Africa and the Indies, where they are transported by the most industrious trading Nations."³ "They [the beads] are diffused to Holland, England, Spain, Portugal, Alexandria,

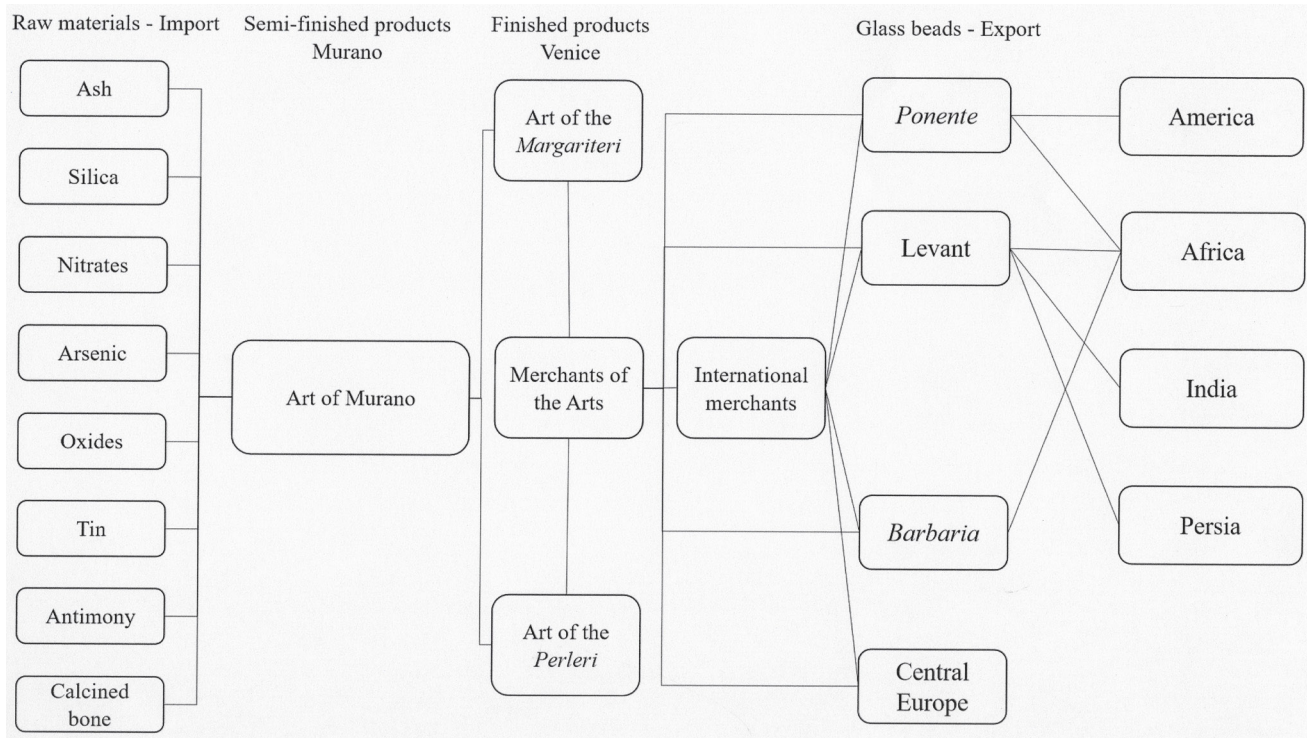


Figure 1. Venetian glass bead commodity chain (graphics by the author).

for all of Barbary, penetrating even the East Indies, thanks to the navigation on the Red Sea, and from Barbary, they pass into the vast western and southern provinces of America.”⁴

These two quotes, reflecting the written words of beadmakers, provide a relevant starting point for our analysis. They describe, in general but evocative terms, the intermediaries and markets for Venetian glass beads in the 18th century. They identify three major overseas markets: Africa, India or the East Indies, and the Americas. They mention an intermediate navigation in the Red Sea where beads transited to the Orient. These citations combine several basic aspects of the Venetian glass bead trade toward the end of the modern period, but do not present its essential traits in detail. In fact, no global systematic study describes the routes followed by Venetian beads, although some studies present useful general data (Guerrero 2010; Trivellato 1996, 2000:230-231). Different primary sources contain quantitative and qualitative data that allow us to move beyond these stereotypical descriptions, and to retrace the routes and quantify the flows of Venetian beads in the 18th century.

The 18th Century: A Period of Growth?

Qualitative sources create the impression of success and growth for the Venetian bead trade in the 18th century. We

may ask an initial question: do quantitative sources confirm this impression? Before attempting to provide an answer, we must reiterate that statistical knowledge was still nascent during the Ancien Régime, and that available quantitative data from this period show a certain order of magnitude, rather than precise figures. We must exercise attentiveness and caution in the study of quantitative sources from the modern era. Nevertheless, by the 18th century, states including the Venetian Republic produced proto-statistical documentation that grew increasingly rich and detailed. We find several indicators that seem to confirm an expanding Venetian bead industry and bead trade over the century.

Figure 3 presents two quantitative measures of the evolution of the Venetian glass bead universe: the number of crucibles in Venice/Murano that made glass cane and enamels, and bead exports according to Venetian customs records.⁵ Despite sharp fluctuations, both data groups show the 18th century to be a time of growth. After a drop from 1700 to 1709, the number of crucibles in use increased throughout the century, peaking in 1755 and 1789. In terms of value (ducats), bead exports increased 88% from 1739 to 1789. This growth trend ran into turbulent times in the late 1790s, as international wars and the demise of the Venetian Republic, among other factors, undercut the bead trade.⁶ These difficulties at the end of the century do not erase the extremely positive trend for most of the 18th century.



Figure 2. Trade card of the *manifattura a lume* producer Giorgio Barbaria (BCMC, P.D.:Ms. PDc 42).

Other data show the importance of *conterie* and *manifattura a lume* in Venetian industry and trade. In terms of value, they equaled 43% of glass exports and about 12% of the city's exports manufactured under the privilege system between 1773 and 1790.⁷ Quantitative sources thus confirm the importance and expansion of Venetian bead production and trade during the 18th century.

EURO-MEDITERRANEAN DESTINATIONS AND GLOBAL MARKETS

Venetian primary sources identify the Euro-Mediterranean markets for beads in the 18th century. Particularly useful in this regard are the *Registri* of the *Cinque Savi alla Mercanzia*, a kind of balance of Venetian trade (Sambo 2012). This statistical source lists two categories of beads: *conterie*, made by the Art of the *Margariteri*, and *manifattura a lume*, fabricated by the Art of the *Perleri*, making a detailed analysis possible.

Campos (1936) and Trivellato (2000:130) have already presented data on bead export regions, based on a part of the *Registri*. A full extraction of data from this source, and a re-tabulation of research results, allow us to generate a list of the ten principal destinations of *conterie* and *manifattura a lume* in 1769-1800, in terms of quantity and value (Table 1).

These figures confirm the general destination indicated by our qualitative citations. During these years, most Venetian beads headed to two major destinations: Atlantic Europe (*Ponente*) and the Ottoman Empire.⁸ The former received, by direct voyages, 27% of *conterie* and 17% of *manifattura a lume*, and another 8%-10% by indirect routes via Bologna, Livorno, and Genoa. In total, between a quarter and a third of the beads headed for the Atlantic. The Ottoman Empire likely absorbed another third of Venetian exports. Alexandria in Egypt was the hub of the Levantine bead trade, while Syria, especially, received *corniole*, lamp-wound beads that imitate carnelian (Costantini 2001). Venetian customs records thus indicate that 50%-60% of beads headed for these two large regions. The improbably high figures (17%-18%) for Istria, a region of 90,000 inhabitants in the Serenissima domain, may reveal a thriving re-export trade to the Balkans, Eastern Europe, and other Euro-Mediterranean destinations. A small quantity (3%-5%) went to the Barbary Coast from whence the beads transited into the African interior. The remainder flowed into continental Europe.

The Euro-Mediterranean destinations were not, however, the beads' final consumption markets. Once unloaded at Alexandria or Atlantic ports, most *conterie* and *manifattura a lume* were still at the beginning of a much longer voyage. These Mediterranean and Atlantic ports were nodes that mediated Venice, the place of production, with markets in Asia, Africa, and the Americas. Can we go beyond this general statement and reconstruct, with reasonable precision, the complete routes followed by Venetian beads? Can we identify their final destinations in the 18th century?

Trade routes across the Ottoman Empire were crucial vectors for the transport of Venetian beads. At the end of the modern period, Middle Eastern and African caravans, as well as coastal and regional navigation in the Red Sea, the Indian Ocean, and the Persian Gulf, still thrived and prospered, despite competition from oceanic options (Raymond 1973). Two routes, radiating from Egypt and Syria, stand out for their importance in the oriental trade of Venetian glass beads. In the 18th century, the Venetian Republic maintained a strong institutional and commercial presence in the Ottoman Empire. Consular dispatches sent to Venice from Cairo and Aleppo reveal the bead trade of these regional hubs.⁹ They show that *conterie* and *manifattura a lume* were important items in the commerce of Venetian traders established in Egypt and especially in Syria (Costantini 2001).

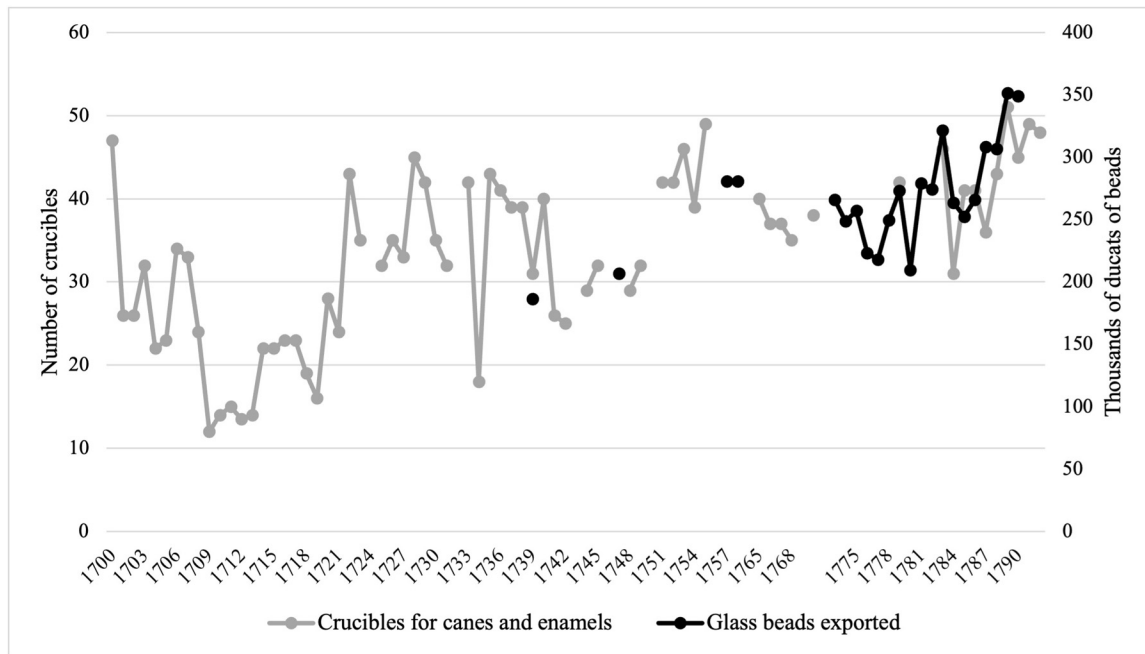


Figure 3. Evolution of the Venetian glass bead industry and its exports, 1700-1790 (Trivellato 2000:228; BCMC, Morosini Grimani: 496:174; Archivio di Stato di Venezia [ASVe], V Savi alla Mercanzia [VSM], Registri: 13, 18, 23, 29, 35, 41, 47, 52, 57, 63, 67, 72, 76, 80, 85, 90, 95, 100.7).

In Cairo, traders redirected beads to the Arabian Peninsula and Sudan. The route to Jeddah was a vital

commercial artery for Egypt and several tons of Venetian glass products departed Suez for the Hejaz Coast each

Table 1. Venetian Glass Bead Destinations, 1769-1800 (Average of Annual Figures).

<i>Conterie</i>			<i>Manifatture a lume</i>		
Destination	Tons	%	Destination	Tons	%
<i>Ponente</i>	124	26.7	Alexandria	24	23.1
Alexandria	123	26.6	<i>Ponente</i>	18	17.4
Istria	72	15.7	Istria	17	17.2
Genoa	27	5.7	Syria and Cyprus	11	11.1
Trieste	14	3.0	Bologna	5	5.4
Tripoli	13	2.8	Tripoli	4	3.8
Syria and Cyprus	11	2.3	Leghorn	3	2.9
Leghorn	9	1.8	Genoa	3	2.6
Mestre	8	1.8	Trieste	2	1.6
Coasts of France	6	1.2	Germany	1	1.2
Total (top 10 destinations)	406	87.7	Total (top 10 destinations)	88	86.2
Source: Archivio di Stato di Venezia (ASVe), V Savi alla Mercanzia (VSM), Registri: 3, 7, 11, 18, 21, 27, 34, 45, 51, 55, 62, 66, 71, 76, 79, 86, 89, 99, 108, 115, 116, 117, 122, 123, 128, 130, 131.					

year. Most were not retailed at Jeddah, but sold to shipping merchants and stowed in the holds of English, Arab, French, Indian, Dutch, and Malayan ships that crisscrossed the Arabian Sea and Indian Ocean. These intermediaries carried Venetian beads to their consumers in Gujarat, the Malabar Coast, Bengal, and likely, the Indonesian archipelago. European records thus show the circulation of Venetian beads in a vast portion of the Asian continent, but archaeology and anthropology also buttress the idea of a wide diffusion in Asia (Francis 1989-1990; Janowsky and Ingraio 1996). While we lack quantitative data for the 18th century, in the 19th and 20th centuries India bought between 20% and 40% of all Venetian bead exports, while Java and Sumatra purchased just one percent (Filippini 1996:6; Francis 1988:17; Zecchin 2010:59). In the 18th century, we

may imagine that 80%-85% of beads shipped to Alexandria continued on to Jeddah and India, or the equivalent of 115-125 tons per year between 1769 and 1800. The rest traveled to Darfur and Sennar on African caravans that arrived in Egypt (Holt 1975:40-52; Raymond 1973:157-165; Walz 1975). These convoys hauled and resold Venetian *conterie* and *manifatture a lume* to a vast region extending from Chad to Ethiopia, and beyond to Central Africa as far as regions north of the Zambesi River (Pallaver 2016:205-208).

What bead types did Venice export to Egypt? A statistical extract from a 1762 consular dispatch provides an indication (Table 2).

By weight, most beads arriving in Egypt fall in the *conterie* (drawn bead) category, produced by the *margariteri*.

Table 2. Venetian Glass Beads Arriving in Egypt in 1762.

Name	Translation	Production Process	Value in <i>Paras</i> *	%
<i>Contaria</i>	Seed beads	<i>a ferrazza</i>	689,268	39.9
<i>Rubino 1, 2, et 3</i>	Ruby 1, 2, and 3	<i>a lume</i>	620,900	36.0
<i>Rubino 4</i>	Ruby 4	<i>a lume</i>	285,645	16.5
<i>Puntine</i>	Wheat shaped	<i>a lume</i>	21,600	1.3
<i>Grani</i>	Barleycorn beads	<i>a lume</i>	14,080	0.8
<i>Corniola tonda</i>	Round carnelian	<i>a lume</i>	13,800	0.8
<i>Contaria a speo</i>	Large drawn beads	<i>a speo</i>	12,960	0.8
<i>Foglietta</i>	Small with foliage	<i>a lume</i>	12,200	0.7
<i>Tavelle rubino</i>	Rectangular ruby	<i>a lume</i>	12,000	0.7
<i>Cannette</i>	Small canes (bugles)	<i>a ferrazza</i>	9,224	0.5
<i>Agate nere</i>	Black agate	<i>a lume</i>	6,000	0.3
<i>Rosetta</i>	Chevron beads	<i>a speo</i>	5,720	0.3
<i>Corniola</i>	Carnelian	<i>a lume</i>	4,800	0.3
<i>Rubino a bisce</i>	Ruby with spirals (?)	<i>a lume</i>	3,600	0.2
<i>Lapislazzuli</i>	Lapis lazuli	<i>a lume</i>	3,000	0.2
<i>Olive bianche e rosse</i>	White and red olives	<i>a lume</i>	2,520	0.1
<i>Finto corallo</i>	Imitation coral	<i>a lume</i>	2,400	0.1
<i>Sente 4</i>	?	?	2,000	0.1
<i>Turchine 4</i>	Deep blue 4	<i>a lume</i>	1,920	0.1
<i>Ramina</i>	Coppery ?	<i>a ferrazza</i>	1,500	0.1
<i>Olivette bianche</i>	Small white olives	<i>a lume</i>	960	0.1
Source: ASVe, VSM, Prima serie: 605. *Ottoman currency in Egypt.				

Bead varieties made by *perleri*, however, had a higher value. In 1762, *contarie* and rubies dominated all other categories of Venetian beads.

The *manifatture a lume* made by *perleri* were even more central to the Venetian trade at Aleppo. According to archival sources, they accounted for at least 25% of the value of all Venetian commerce in the Syrian city¹⁰ (Costantini 2001). Caravans from Aleppo took the beads to Armenia, Baghdad, Persia, and especially Basra, the hub that linked Syria and Mesopotamia to the Indian subcontinent. Although the Persian trade flourished in peacetime (Perry 1991) and despite examples found along the east coast of the Arabian Peninsula (Andersson 2016), in the 18th century, most Venetian glass beads transshipped at Aleppo headed for Basra and, from there, to Surat, Bombay, and Bengal.¹¹ Again, India emerges as the principal Eastern consumption market for Venetian glass beads.

As for Aleppo, what bead types did Venice export to the Syrian hub in the 18th century? Consular dispatches provide a detailed view of this flow in 1784-1786 (Table 3).

Not surprisingly, in terms of value in the Aleppo trade, lampworked beads outpriced those made by the *margariteri*. The bulk of Venetian exports to the Syrian city consisted of *corniole*, beads that imitated carnelian, also called

“imitation coral.” These beads were a Venetian innovation, a semi-precious item sold in strings of 120-140 beads for those of the finest quality. Their price in Aleppo ranged from 27-61 Venetian lire for a bunch weighing 2.7 kg in the 1760s-1780s.¹² Conversely, a cane maker at a Venetian furnace earned between 5 and 7 lire per day in the 1780s.¹³

In sum, beads were central to Venice’s Levantine trade in the 18th century. As soon as they arrived in Cairo or Aleppo, they continued onward to a vast part of the Asian continent, especially India, and to central and eastern Africa.

Having followed the oriental trade of Venetian beads in the 18th century, we may now turn to their routes in the Atlantic sphere.

VENETIAN GLASS BEADS, SUGAR, AND SLAVES

The Western trade of Venetian glass beads is interesting for several reasons. The Atlantic ports were hubs that transmitted Venetian merchandise to African and American markets and, to a lesser extent, the Indian Ocean. *Conterie* and *manifatture a lume* were crucial to Venice’s trade to the *Ponant*. These beads were among hundreds of items in the Atlantic slave trade and thus participated in a vast Atlantic commercial network. Guerrero (2010) and Zecchin (2013)

Table 3. Venetian Glass Beads Arriving in Aleppo, 1784-1786.

Name	Translation	Production Process	Value in Piasters*	%
<i>Corniola di 120 e 140 grani</i>	Carnelian, 120 and 140 beads	<i>a lume</i>	40,662	39.3
<i>Corniola di 280 grani</i>	Carnelian, 280 beads	<i>a lume</i>	39,836	38.5
<i>Rubino n° 2 et 3</i>	Ruby no. 2 and 3	<i>a lume</i>	7,434	7.2
<i>Rubino n° 4</i>	Ruby no. 4	<i>a lume</i>	5,823	5.6
<i>Contaria ferrazza e pippiotti</i>	Seed beads and small bugles	<i>a ferrazza</i>	5,412	5.3
<i>Granata</i>	Garnet	<i>a ferrazza</i>	1,141	1.1
<i>Agate tre bisce</i>	Agate with spirals	<i>a lume</i>	864	0.8
<i>Zojetta</i>	?	<i>a lume</i>	513	0.5
<i>Grana a puntine</i>	Wheat shaped	<i>a lume</i>	470	0.5
<i>Olivette</i>	Small olives	<i>a lume</i>	462	0.4
<i>Smaltini</i>	Enamel beads	<i>a lume</i>	393	0.4
<i>Contaria smaltini</i>	Drawn enamel beads	<i>a ferrazza</i>	304	0.3
<i>Mandole verdi e rosse</i>	Green and red almonds	<i>a lume</i>	219	0.2
<i>Mandole de Muran</i>	Murano almonds	<i>a lume</i>	32	0.03

Source: ASVe, VSM, Prima serie: 604:25.11.1785, 10.05.1787. *Ottoman currency.

have studied the Venetian bead trade in England. Here, we will look at four aspects: 1) the place of beads in Venetian trade to Western Europe in the 18th century, 2) their destinations and reshipment by English, French, Dutch, and Portuguese merchants, 3) links between the Atlantic slave trade and Venetian bead exports, and 4) the types of beads that Venice exported to the West.

Trade Between Venice and the Atlantic in the 18th Century

In Venetian records, *Ponente* or *Ponente Alto* (High Ponant) designates an immense region extending from the western Mediterranean as far north as Saint Petersburg. This region supplied 18th-century Venice with a vast array of products, as shown by customs records.¹⁴

Foodstuffs formed the key group of imported goods (about 40% of value), essentially raw sugar and cocoa from Portuguese and French colonies. Sugar refined in Venice found consumer markets within the city, in the wider Republic, and throughout northern Italy. In this manner, the lagoon city positioned itself as a center for the transformation and reshipment of Atlantic colonial foodstuffs for part of the Mediterranean. Two other commodities, salt fish and metals, were central to Venetian imports from the West. Tin, lead, iron, and salt fish were the main goods obtained from England, in exchange for raisins and olive oil from the Ionian Islands that belonged to Venice (Fusaro 1996; Grendi 1992:266). Other major imports that Venice drew from Western Europe were pepper, raw flax, furs, brass buttons, chemical products, and textiles.

In exchange, in addition to raisins and olive oil, Venice offered manufactured goods and, when harvests were good, cereal grains. Glass provided more than a third of export values to the *Ponant*; chemical products and textiles, while still important, had a lesser value. *Conterie* and *manifatture a lume* formed the mainstay of Venetian manufactured exports to Western Europe, likely worth more than 30% of the value of this flow and more than 80% of the value of all glass exports.

Atlantic Ports, Atlantic Markets?

Venetian customs records do not name the Western destinations of beads in the 18th century, specifying only “Ponant” or “High Ponant.” Other sources, such as export manifests and other documents, mitigate this limitation and enable us to quantify bead shipments to Atlantic ports, identifying the cargo and destination of ships leaving Venice (Figure 4). We have created a database of these precious bits

Manifesto di Mercanzie Caricate qui di Londra, sopra il Brigantino nom.^o Armonia, Cap.^o Luigi Tarabocchia, Ven.^o

15. GENNAIO. 1796.

L	Carica di Gio. ^o Batt. ^o Camossi, suddito Ven. ^o , per Co. e nischio proprio	
19 a 20	Per consegnare al Sig. ^o Zaccaria Levi, sudd. ^o Ven. ^o	
	Dodici Bar. ^o Cremo di Tartaro, d. 12778 Grasse Ven. ^o	12.
G.C.R	Carica di Gio. ^o Conrado Reck, sudd. ^o Ven. ^o , per Co. e nischio proprio	
1 a 6	Per consegnare al suddito Levi, sudd. ^o Ven. ^o	
	Sei Bar. ^o Cremo di Tartaro, d. 6375 Gr. ^o Ven. ^o	6.
S.L	Carica di Moisé David Serfati, sudd. ^o Ven. ^o , per Co. e nischio proprio	
1 a 17	Per consegnare al Sig. ^o Angelo Levi, sudd. ^o Ven. ^o	
	Diciassette Botte, Contarie Divoce d. 16230 Gr. ^o Ven. ^o	17.
F.S	Caricano di Fratt. Nager, sudd. ^o Ven. ^o , per Co. e nischio proprio	
9 a 15	Per consegnare a M. ^o Carlo e Gio. ^o Pietro Nager, sudd. ^o Inglese	
	Sette Bar. ^o Cremo di Tartaro, d. 8230 Grasse Ven. ^o	7.
G.V	Carica di Federico Affari, sudd. ^o Ven. ^o , per Co. e nischio proprio	
12 a 22	Per consegnare a M. ^o Natale e Giacomo Zaccaria, sudd. ^o Inglese	
	Undici Botte Cremo di Tartaro, d. 11890 Grasse Ven. ^o	11.
A	Caricano di Simon Carminati e Fig. ^o , sudd. ^o Ven. ^o , per Co. e nischio proprio	
73 a 92	Per consegnare al Sig. ^o Gio. ^o Nij, sudd. ^o Inglese	
	Venti Barilli Cremo di Tartaro, d. 19790 Gr. ^o Ven. ^o	20.
P	Carica di Gio. ^o Vanoutgarden, sudd. ^o Veneto, per Co. e nischio proprio	
1 a 27	Per consegnare al Sig. ^o Tommaso Powell, sudd. ^o Inglese	
	Ventisette Botte Tartaro d. 18326	
P	Dodici Botte Detto d. 8450	
1 a 12		
		d. 26778
		39.
D.P	Carica di Suddito, sudd. ^o Ven. ^o , per Co. e nischio proprio	
1 a 12	Per consegnare a M. ^o David Powell e Fig. ^o , sudd. ^o Inglese	
	Dodici Botte Tartaro d. 8433	
D.P	Tre Botte Detto d. 2110	
1 a 3		
		d. 10540
		15.

Coli. Num.^o 127.

Figure 4. Manifest of the Venetian ship *Armonia* headed to London, 1796. The third entry mentions 17 barrels of *conterie* being exported by the Venetian Jewish merchant Moisé di David Serfati (ASVe, VSM, Prima serie: 918:15.01.1796).

of macro- and micro-economic information, individually collected and analyzed. We generated macro data by normalizing the weights of different shipping containers (casks, boxes, etc.). We then added up these data by destination. For the Western trade, we find such information for 1764-1769 and 1781-1796 (Table 4).

This analysis shows the centrality of Lisbon, by far the principal destination of Venetian glass beads shipped to the western Mediterranean and beyond the Strait of Gibraltar. The Lusitanian port's preponderance, which strengthened over time, is not surprising when we recall that one type of Venetian glass bead bore the name of *contaria da Lisbona*.

At a much lower level, second place belongs to English ports including Gibraltar, the destination of 10%-15% of beads shipped to the West during the second half of the

Table 4. Western Destinations of Venetian Glass Beads, 1764-1769 and 1781-1796 (%).

Destination	1764-1769	1781-1796
Alicante	0.18	0.00
Amsterdam	12.68	1.98
Barcelona	0.00	0.31
Bristol	2.02	0.00
Cádiz	4.99	6.51
Gibraltar	9.45	0.00
Hamburg	0.12	0.83
Lisbon	60.95	69.11
Liverpool	4.12	0.00
London	1.52	11.53
Marseille	3.95	9.31
Porto	0.01	0.00
Saint Petersburg	0.00	0.16
Santa Cruz de Tenerife	0.00	0.01
Szczecin	0.00	0.26
Total	100.00	100.00
Source: ASVe, VSM, Prima serie: 913-918.		

century. To these, we must add most of the cargos sent to Livorno by sea or land (via Bologna), for another 9%-14% of the westward bead flow. In total, about a quarter of Venetian glass beads sent west in these years likely went to English ports. The slaving centers of Liverpool and Bristol received shipments directly from Venice in 1764-1769, while London controlled English destinations between 1781 and 1796. Liverpool owes its mention in the 1760s to a short-lived arrangement for the direct supply of beads from Venice (Guerrero 2010), while London was a long-standing hub for trade into Africa as well as Hudson Bay in Canada.

In the 18th century, Portugal and England were the principal destinations of *conterie* and *manifatture a lume* shipped westward from Venice. Amsterdam was a lesser market that diminished over time, likely because of competition from beads made locally or obtained from Bavaria or southern Bohemia. Cádiz and Marseille occupied niches that expanded at the end of the century.¹⁵

These ports, however, were not the final destination of Venetian beads. Can we clearly identify their Western

consumption markets? Unfortunately, Venetian sources speak only in general terms of Africa, the Americas, and the West Indies (Trivellato 1996). To further our analysis, we turned to other sources. In light of Lisbon's centrality for Venetian bead exports, Portuguese balance of trade books appeared a logical choice.¹⁶ This record series covers the period 1775-1831 (Moreira 2015), but data on beads are limited to 1776-1801. Items that we can identify as beads are *contas de vidro* (glass beads), *conterie* (drawn beads), and *granadas* (garnets), as well as *missanga* and *avelórios* (small seed beads). During this period, Lisbon acquired nearly all its beads from Venice (96% on average in 1776, 1777, and 1789), the rest coming from Genoa and Hamburg. The record series also shows the reshipment of glass beads from Portugal in 1776-1801 (in value), thus revealing their consumption markets (Table 5).

Not surprisingly, the west coast of Africa received most glass beads shipped from Lisbon (55.4%). Angola alone received a third of the value of Portuguese export beads, while the other West African destinations lay at the mouth of the Geba River in present-day Guinea-Bissau. It seems possible that a large part of these cargos served to purchase African captives.

Table 5. Portuguese Glass Bead Export Markets, 1776-1801.

Destination	Region	%
Angola	Africa	36.2
Asia and Eastern Africa	Indian Ocean	10.0
Azores	Atlantic Ocean	1.0
Bahia	Brazil	8.3
Bissau	Africa	13.4
Cacheu	Africa	5.8
Cape Verde	Atlantic Ocean	0.5
Capitania de Santos	Brazil	<0.1
Maranhão	Brazil	1.9
Parà	Brazil	3.1
Paraíba	Brazil	<0.1
Pernambuco	Brazil	7.1
Rio de Janeiro	Brazil	12.6
Source: ANTT, Projecto Reencontro: 103, 105, 108, 110.		

Brazil was the second largest market for Portuguese bead exports (33.1%), a finding that provides solid evidence for the circulation of Venetian beads in the Americas. This commercial flow may reflect a local Brazilian consumption of these items or Brazil's role in the African slave trade, which expanded greatly in the last decades of the 18th century.

Finally, a portion of the beads shipped from Lisbon went to the Indian Ocean (10.0%), to Mozambique or Goa. Venetian archives preserve the record of a *conterie* shipment to Goa via Lisbon, while the use of Venetian beads in Mozambique is also attested¹⁷ (Pallaver 2016). England also likely reshipped Venetian beads to final markets in African regions such as the Gold Coast and the Gulf of Guinea. In the 1760s, Venetian merchants supplied William Davenport and Co., a firm involved in the slave trade, and the African Company of Merchants¹⁸ (Guerrero 2010). Some Venetian beads imported by England went on to North America, especially to the distribution centers of the Hudson's Bay Company (HBC) at the mouths of the Churchill and Albany Rivers, at Fort Churchill, Fort Albany, and especially York Factory (Karklins and Adams 2013; Spector 1976). Carlos and Lewis (2010:96-105) have shown that after 1750, the HBC noticed the European popularity of Venetian beads and chose them as new varieties for its trade with the Assiniboine, Ojibwa, and Cree. While limited in quantitative terms – a few hundred kilograms of beads shipped annually to Hudson Bay – this commercial flow reaffirms the planetary diffusion of Venetian glass beads in the 18th century.

Venetian Glass Bead Export and the Atlantic Slave Trade

In the 18th century, a considerable quantity of Venetian glass beads found its way to Africa, probably in the context of the Atlantic slave trade which was managed by Europeans. Beginning in the early 17th century, the growing plantation economy of Brazil, the Caribbean, and North America absorbed a massive flow of captives plucked from Africa and transported to the Americas. Plantation owners forced millions of slaves to work in the production of exotic foodstuffs for a booming European market (Eltis and Engerman 2011; Klein 1999; Pétrel-Grenouilleau 2004; de Vries 2008:157-158). The 18th century saw the apogee of the Atlantic slave trade. From 1576 to 1600, about 6,000 captives embarked on European slaving ships each year, about 29,000 per year between 1676 and 1700, and more than 80,000 per year from 1776 to 1800.¹⁹

Europeans purchased captive Africans in exchange for various items such as textiles, alcoholic beverages, guns, tobacco, iron and copper bars, and various manufactured

products (Eltis and Jennings 1988:948), including glass beads (Alpern 1995:22-23; Eltis and Jennings 1988:952; Rawley 1981:34-35), and we know that Venetian beads served to purchase African captives (Trivellato 1996:28-29).

Can we measure the links between the flows of beads and slaves? Did fluctuations in the Atlantic slave trade influence Venetian bead exports toward the West? To answer these questions, we compared Venetian customs data and African slave figures. The Venetian sources allow a comparison for the last thirty years of the 18th century (Figure 5).

Aside from inter-annual fluctuations, we see that Venetian bead exports to the *Ponant* mirrored cycles in the slave trade. In mathematical terms, we find a correlation between the two flows of 0.56 (triannual average). The American War of Independence (1775-1783) had an obvious effect on the slave trade, provoking a parallel downturn in Venetian bead exports to the *Ponant*. After the initial drop, we see a slow but steady recovery from 1779 to 1783, followed by stability from 1784 to 1793. Venetian bead exports recovered briefly in 1781, followed by another drop. A new growth phase in bead exports in 1785-1786 resulted in a plateau until about 1793. Subsequently, the War of the First Coalition (1792-1797) hit international trade hard. While the slave trade quickly stabilized, bead exports fell deeper under the effects of the French invasion of Venice and the fall of the Venetian Republic in 1796-1797. Despite this troubled context, the end of the century saw a resilient Venetian bead sector ready to profit from the renewed slave trade. Thus, glass beads linked Venice to the Atlantic and to the 18th-century slave trade.

Beads, Beads, Beads... But Which Ones?

Finally, we may look at the Western trade of Venetian glass beads from a material culture perspective. We have seen that *corniole* (imitation carnelian beads) were central to the Venetian bead trade in Aleppo, while in Egypt the most important bead types were *conterie* and lampworked imitation rubies. What bead types headed for the Atlantic ports in the 18th century?

Venetian archival sources offer some interesting details. For example, in 1757, the Lisbon trading houses Albertini Frisoni and Juvalta sent an order to the Venetian traders Antonio Milletch and Francesco Bersacina for 550,000 *libbre* (about 165 tons) of *conterie* in three colors: white, red, and dark blue.²⁰

A more precise view of Venetian bead types exported to the Atlantic comes from the case of Isach dalla Man, a Jewish Venetian merchant, and his trade with the West, including detailed orders (Figure 6) (Trivellato 1996:28; Zecchin 2013). In 1763, initially via his trading house at

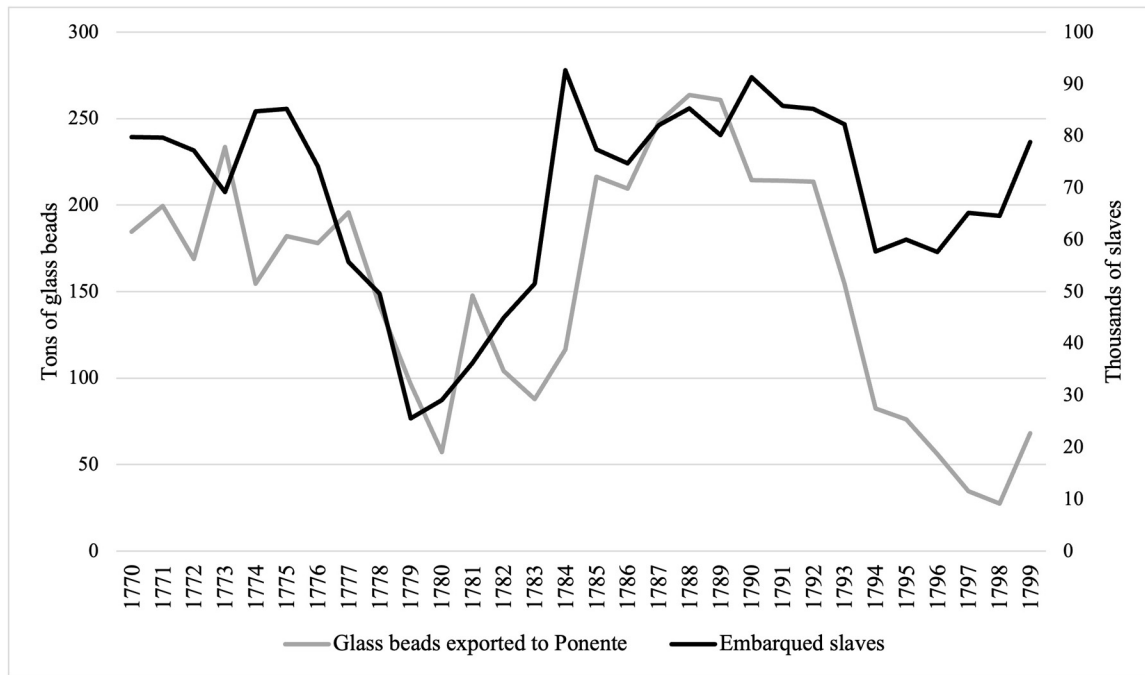


Figure 5. Venetian glass bead exports to the West and the trans-Atlantic slave trade (ASVe, VSM, Registri: 3, 7, 11, 18, 21, 27, 34, 45, 51, 55, 62, 66, 71, 76, 79, 86, 89, 99, 108, 115, 116, 117, 122, 123, 128, 130, 131; TASTD).

Livorno, he arranged to supply Venetian glass beads to the African Company of Merchants of Liverpool. Dalla Man's English commerce thrived for five years until the Venetian senate barred his trade in 1768 (officially because of a bad lot of beads) and recommended that English traders deal with Christian houses in Venice.²¹ The English orders handled by the Jewish trader were considerable; between 1763 and 1768, he shipped beads to Liverpool having a value of more than 120,000 ducats. The sources specify the cargoes' composition (Table 6).²²

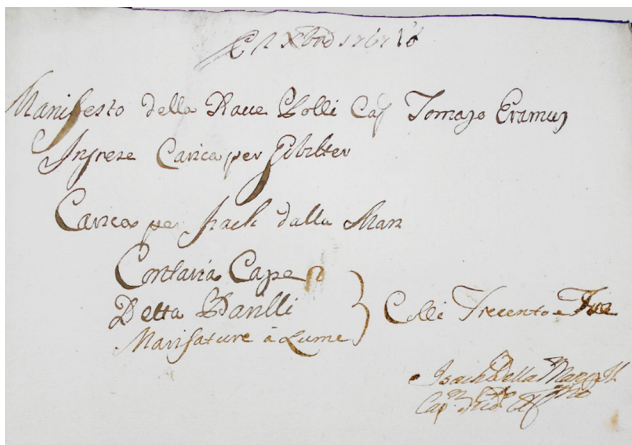


Figure 6. Manifest of the English ship *Polly* headed to Gibraltar, 1767. Dispatched by Isach dalla Man, the cargo is composed of 303 barrels and boxes of *conterie* and *manifatture a lume* (ASVe, VSM, Prima serie: 910:02.12.1767).

Obviously, the case of Isach dalla Man does not necessarily reflect the typical composition of Venetian glass bead exports to the West in the 18th century. Nonetheless, we have an interesting sample of beads shipped to England and Holland in the late 1760s. First of all, in terms of the number of bunches, 69.8% were lampworked beads, 14.8% were *conterie*, 8.5% necklaces, and 6.9% *cannette* (small tubes known as bugles). Within the lampworked category, half were olive beads and a third were barleycorn beads. The colors and decoration varied according to bead type, but their diversity is impressive. As for the *conterie*, more than half the bunches were black or white; these colors apparently found a high demand on the coast of Angola (Savary des Bruslons 1723, 2:1273). Black, white, and red beads made up more than half the necklaces, while small bugles were most often requested in dark blue, lavender, or lemon yellow. As for lampworked beads, enamel decoration dominated the olive category, a finding consistent with a great increase in the use of enamel ingots in the 18th-century Venetian bead industry (Bettoni 2017). Interestingly, the orders included 200 bunches of black olives called *avventurina*, the celebrated Venetian enamel with sparkling inclusions of copper filings (Bova, Junck, and Migliaccio 2004). In the barleycorn bead category, alongside a notable quantity of black wheat-shaped beads (*grani a punti neri*), two thirds consist of shiny faceted beads imitating diamonds, a style perfected by the Bohemian beadmaking industry (Zecchin 2013:155).

Table 6. Major Glass Bead Groups Ordered from Isach dalla Man, 1765-1767.

Name	Bunches	%	Name	Bunches	%
Conterie	17,900	100.0	Olives	40,800	100.0
White	6,300	35.2	Enamel	24,000	58.8
Black	4,000	22.3	Light lavender	4,000	9.8
Lavender	2,000	11.2	White	4,000	9.8
Red	1,100	6.1	Turquoise	3,000	7.4
Dark lavender	1,000	5.6	Black	2,000	4.9
Lemon yellow	1,000	5.6	Lavender	1,000	2.5
Transparent green	1,000	5.6	Lemon yellow	1,000	2.5
Dark blue	800	4.5	Ruby	1,000	2.5
<i>a speo</i>	500	2.8	<i>Zajel</i>	600	1.5
Leek green	200	1.1	Black with aventurine	200	0.5
Small Bugles	8,400	100.0	Barleycorn (<i>Grani</i>)	27,700	100.0
Dark blue	2,450	29.2	Faceted (36 facets)	10,000	36.1
Lavender	1,500	17.9	Faceted (30 facets)	10,000	36.1
Lemon yellow	1,500	17.9	Wheat shaped	6,000	21.7
White enamel	1,050	12.5	White	1,000	3.6
Red	1,000	11.9	Striped	200	0.7
Turquoise	500	6.0	Blue	100	0.4
White with red stripes	200	2.4	Yellow	100	0.4
Leek green	200	2.4	Green	100	0.4
Necklaces	10,300	100.0	Red	100	0.4
Black	2,200	21.4	Other	100	0.4
White	2,200	21.4	Carnelian (<i>Corniola</i>)	4,000	100.0
Red	1,500	14.6	Coarse	3,000	7.0
Leek green	1,200	11.7	Fine	1,000	25.0
Lemon yellow	1,200	11.7	Flattened	4,750	100.0
Dark blue	1,000	9.7	White	3,750	78.9
Dark lavender	1,000	9.7	Ruby	1,000	21.1
Source: ASVe, VSM, Prima serie: 463.					

CONCLUSION

Our study confirms the growth of Venetian glass bead production and trade in the 18th century, and reveals the importance of this export product for the city of Venice.

Glass beads flowed to the Levant and the *Ponant*, to key transshipment nodes in the commercialization of these products in Asia, Africa, and the Americas. We also see minor flows to the Barbary Coast, Germany, Italy, Eastern Europe, and the Balkans.

In the Ottoman Empire, glass beads formed an important group of Venetian commodities. They followed terrestrial and maritime routes in a major flow to Gujarat and Bengal, and southward to the Wadai Empire, Darfur, the Sennar region, and the Horn of Africa. *Conterie* and imitation rubies were the most popular items sent to the transshipment node in Egypt at the beginning of the 1760s, while lampworked beads had the greatest value. From the Syrian trade hub of Aleppo, oriental caravans transported Venetian beads to the Armenian-Persian Plateau, but especially to Basra where they continued on to Gujarat, the Malabar Coast, and Bengal. In Syria, the Venetian bead trade emphasized lampworked beads, especially *corniole* (70%-80% of exported beads), while imitation rubies were important as well.

Study of the Atlantic bead trade has revealed some interesting aspects. In the 18th century, a good part of the trade from the Atlantic to Venice consisted of colonial foodstuffs including sugar, the fruit of slave labor in the Americas, while glass beads sent in exchange entered considerably into the slave trade.

The Western destinations of beads were the Atlantic ports of Europe. Lisbon received the majority of Venetian exports (about 60%), while English ports absorbed about a quarter, shipped by direct and indirect routes. On a lesser scale, we find Amsterdam (decreasing over time), and Cádiz and Marseille (growing over time). These ports were transshipment nodes for overseas destinations. Study of the Portuguese case shows that Venice was the principal supplier (96%) of beads to that country. Beads re-exported from Portugal went mainly to West Africa, especially Angola, while a significant portion (30%-40%) headed to Brazil, possibly to maintain the Brazilian slave trade. A lesser but not insignificant portion (10%) headed to the Indian Ocean, to Mozambique and Goa. In the English case study, Africa also appears to have been the principal market, considering the direct links between Venetian traders and the African Company of Merchants and William Davenport and Co., both heavily involved in the Atlantic slave trade and commerce with Africa. The English case also reveals a North American market for Venetian glass beads, traded to Indigenous people living within the Hudson's Bay Company's sphere of influence, and likely elsewhere in the English colonies. In sum, both the oriental and occidental trade data confirm the global scale of the Venetian glass bead trade in the 18th century.

The sources studied and compared for the 1770-1800 period show a strong correlation between the evolution of the Atlantic slave trade and that of Western bead exports from Venice. Fluctuations in the slave trade deeply influenced bead exports, especially during international conflicts. We may suggest that this strategic part of the Venetian economy

closely mirrored the fortunes of Atlantic commerce.

Finally, the orders received from England and Holland by trader Isach dalla Man provide a sample of the most requested bead types for the English/Dutch trade to Africa during the second half of the 1760s. From a material perspective, this specific case shows a great variety of types and styles, a sign that the industry could adapt to diverse consumer tastes. These orders favored white, black, and dark blue colors for *conterie*, necklaces, and small tubular beads, while the most requested varieties of olives and barleycorn beads were decorated with enamel or faceted like diamonds.

Venetian glass beads were crucial for the Venetian economy and trade at the end of the Early Modern Period. Far from being cheap goods, beads were key products that connected a Mediterranean city to the global market in the 18th century. In fact, sources show that Venetian *conterie* and *manifatture a lume* reached almost every region of the world, from Hudson Bay to the Bay of Bengal and from Brazil to western Russia. A fundamental connection existed between the Western trade of Venetian glass beads and the Atlantic slave trade; the latter deeply influenced the former.

This study has revealed the potential of a cross analysis of qualitative and quantitative sources from different European archives. In this regard, a more accurate image of the Venetian glass bead trade could be achieved by comparing Venetian, French, and Portuguese trade data with that of England, Genoa, and Spain. For the Levant trade, Ottoman sources or those from the English East India Company or Dutch East India Company would be relevant. Additionally, a closer collaboration between anthropologists, archaeologists, collectors, historians, and material culture experts would be a good way to improve our knowledge of the history of glass beads.

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ENDNOTES

1. Archivio di Stato di Venezia [ASVe], Inquisitori di Stato: 820:Z:09.07.1741; ASVe, Censori: 31:05.02.1766.

2. The production and trade of Venetian glass beads in the 18th century are the subject of my doctoral dissertation at the Centre de la Méditerranée Moderne et Contemporaine, Université Côte d'Azur (Nice).
3. "Servono esse contarie agl'usi delle più remote regioni dell'Africa, e dell'Indie, somministrate le sono col mezzo delle più industrie Nazioni commercianti;" ASVe, Censori: 21, 262-28r.
4. "Si estendono le medeme per l'Olanda, per l'Inghilterra, per la Spagna, per il Portogallo, per l'Alessandria, per tutta la Barbaria, inoltrandosi colla navigazione per il Mar Rosso persino nell'Indie Orientali, e dalla Barbaria passano nelle vaste provincie sì occidentali, che meridionali dell'America;" ASVe, Censori: 38:15, "Scritture de margariteri presentate al Tribunal degl'Illu.mi & Ecc.mi SS.ri Capi dell'Ecc.so Cons.o di X.ci."
5. The value of exports is measured in ducats, at prices that were current at the end of the 1730s (Sambo 2012:400). Venetian authorities mechanically calculated this value by assigning a fixed price to exported quantities; the figures thus also reflect exports by weight.
6. According to Venetian customs documents, bead exports dropped from 770 to 270 tons per year between 1792 and 1799.
7. ASVe, V Savi alla Mercanzia [VSM], Registri: 13, 18, 23, 29, 35, 41, 47, 52, 57, 63, 67, 72, 76, 80, 85, 90, 95.
8. Other sources confirm the centrality of these destinations (ASVe, VSM, Prima serie: 913-918; ASVe, Censori: 21:21:11.08.1790; ASVe, Inquisitori di Stato: 821).
9. ASVe, VSM, Prima serie: 603-604, 639-642.
10. ASVe, VSM, Prima serie: 604:25.11.1785, 10.05.1787; ASVe, VSM, Diversorum: 396:113.
11. ASVe, Censori: 40.
12. ASVe, VSM, Prima serie: 603:09.09.1769, 18.03.1769, 20.12.1770, 24.10.177; 604:25.11.1785, 10.05.1787.
13. ASVe, Censori: 21:11.01.1789.
14. ASVe, VSM, Registri: 13, 18, 23, 29, 35, 41, 47, 52, 57, 63.
15. The TOFLIT18 database confirms the presence of Venetian beads in Marseille commerce. The database is the product of an ANR project coordinated by Loïc Charles and Guillaume Daudin (<https://toflit18.hypotheses.org/>). I thank Guillaume Daudin for sharing the data on glass beads in the French trade.
16. Archivo Nacional da Torre do Tombo, Projecto Reencontro: 103, 105, 108, 110.
17. ASVe, VSM, Prima serie: 186:66.
18. ASVe, VSM, Prima serie: 463.
19. Trans-Atlantic Slave Trade Database (TASTD); <https://www.slavevoyages.org/>.
20. ASVe, VSM, Prima serie: 186:66.
21. ASVe, VSM, Diversorum: 371:25; Prima serie: 549:17.09.1768, 22.06.1773.
22. ASVe, VSM, Prima serie: 463.

REFERENCES CITED

Ago, Renata (ed.)

- 2018 *Storia del lavoro in Italia. L'età moderna. Trasformazioni e risorse del lavoro tra associazioni di mestiere e pratiche individuali*. Castelveccchi, Rome.

Alpern, Stanley B.

- 1995 What Africans Got for Their Slaves: A Master List of European Trade Goods. *History in Africa* 22:5-43.

Andersson, Ann

- 2016 Trade Beads of Furayhah. Evidence of Trade and Connections of Qatar in the Eighteenth and Nineteenth Centuries from a Small-Finds Perspective. *Proceedings of the Seminar for Arabian Studies* 46:1-8.

Bellavitis, Anna

- 2016 *Il lavoro delle donne nelle città dell'Europa moderna*. Viella, Rome.

Bellavitis, Anna, Anna Maria Filippini, and Maria Teresa Sega (eds.)

- 1990 *Perle e ispiraperle: un lavoro di donne a Venezia tra '800 e '900*. Arsenale Editrice, Venice.

Bettoni, Barbara

- 2017 *Perle di vetro e gioie false. Produzioni e cultura del gioiello non prezioso nell'Italia moderna*. Marsilio, Venice.

Bova, Aldo, Rossella Junck, and Puccio Migliaccio

2004 *L'avventurina, l'oro di Murano*. Cicero, Venice.

Campos, Giordano

1936 Il commercio esterno veneziano della seconda metà del 1700 secondo le statistiche ufficiali. *Archivio Veneto* XIX:145-83

Caracausi, Andrea, Matthew Davies, and Luca Mocarelli (eds.)

2018 *Between Regulation and Freedom. Work and Manufactures in European Cities, 14th-18th Centuries*. Cambridge Scholar Publishing, Cambridge.

Carlos, Ann M. and Frank D. Lewis

2010 *Commerce by a Frozen Sea*. University of Pennsylvania Press, Philadelphia.

Costantini, Vera

2001 Il commercio veneziano ad Aleppo nel Settecento. *Studi Veneziani* N.S. XLII:143-211.

Eltis, David and Lawrence C. Jennings

1988 Trade between Western Africa and the Atlantic World in the Pre-Colonial Era. *The American Historical Review* 93(4):936-959.

Eltis, David and Stanley Engerman (eds.)

2011 *The Cambridge World History of Slavery. Vol. 3. AD 1420-AD 1804*. Cambridge University Press, Cambridge.

Epstein, Stephan R. and Maarten Prak (eds.)

2008 *Guilds, Innovations and the European Economy, 1400-1800*. Cambridge University Press, Cambridge.

Filippini, Nadia Maria

1996 Un filo di perle da Venezia al mondo. *La Ricerca Folklorica* 34:5-10.

Francis, Peter, Jr.

1988 *The Glass Trade Beads of Europe. Their Manufacture, Their History, and Their Identification*. The World of Beads Monograph Series 8. Lake Placid, NY.

1988- Glass Beads in Asia, Part 1: Introduction. *Asian*

1989 *Perspectives* 28(1):1-21.

Fusaro, Maria

1996 *Uva passa: una guerra commerciale tra Venezia e l'Inghilterra (1540-1640)*. Il Cardo, Venice

Gereffi, Gary and Miguel Korzeniewicz (eds.)

1994 *Commodity Chains and Global Capitalism*. Praeger, Westport, CN.

Grendi, Edoardo

1992 Sul commercio anglo-italiano del Settecento: le statistiche dei Customs. *Quaderni storici* N.S. 79(1):263-276.

Guenzi, Alberto, Paola Massa, and Fausto Piola Caselli (eds.)

1998 *Guilds, Markets, and Work Regulations in Italy, 16th-19th Centuries*. Ashgate, Aldershot.

Guerrero, Saul

2010 Venetian Glass Beads and the Slave Trade from Liverpool, 1750-1800. *Beads: Journal of the Society of Bead Researchers* 22:52-70.

Holt, Peter M.

1975 Egypt, the Funj and Darfur. In *The Cambridge History of Africa. Vol. 4: c. 1600-c. 1790*, edited by Richard Gray, pp. 14-58. Cambridge University Press, Cambridge.

Hopkins, Terence K. and Immanuel Wallerstein

1977 Patterns of Development of the Modern World-System. *Review* 1(2):111-145.

Janowsky, Monica and Chiara Ingrao

1996 Perle, prestigio e vita tra i Kelabit di Sarawak. *La Ricerca Folklorica* 34:43-53.

Karklins, Karlis

1993 The *a Speo* Method of Heat Rounding Drawn Glass Beads and its Archaeological Manifestations. *Beads: Journal of the Society of Bead Researchers* 5:27-36.

Karklins, Karlis and Gary F. Adams

2013 Beads from the Hudson's Bay Company's Principal Depot, York Factory, Manitoba, Canada. *Beads: Journal of the Society of Bead Researchers* 25:72-100.

Klein, Herbert S.

1999 *The Atlantic Slave Trade*. Cambridge University Press, Cambridge.

Massa, Paolo and Angelo Moiola (eds.)

2004 *Dalla corporazione al mutuo soccorso: organizzazione e tutela del lavoro tra XVI e XX secolo*. Franco Angeli, Milan.

Moreira, Maria Cristina

2015 Portugal, 1775-1831. *Revue de l'OFCE* 4(140):319-334.

Pallaver, Karin

2016 From Venice to East Africa: History, Uses, and Meanings of Glass Beads. In *Luxury in Global Perspective. Objects and Practices, 1600-2000*, edited by Hans Bernd-Stefan Grewe and Karin Hofmeester, pp. 192-217. Cambridge University Press, New York.

Panciera, Walter

- 1998 L'economia: imprenditoria, corporazioni, lavoro. In *Storia di Venezia dalle origini alla caduta della Serenissima, VIII. L'ultima fase della Serenissima*, edited by Paolo Preto and Piero Del Negro, pp. 479-555. Istituto della Enciclopedia Italiana, Rome.

Perry, John

- 1991 The Zand Dynasty. In *The Cambridge History of Iran. Vol. 7: From Nadir Shah to the Islamic Republic*, edited by Peter Avery, Gavin R.G. Hambly, and Charles Melville, pp. 63-103. Cambridge University Press, Cambridge.

Pétre-Grenouilleau, Olivier

- 2004 *Les Traités Négrières: essai d'histoire globale*. Gallimard, Paris.

Prak, Maarten, Clare Haru Cowston, Bert de Munck, Christopher Kissane, Chris Minns, Ruben Schalk, and Patrick Wallis

- 2020 Access to the Trade: Monopoly and Mobility in European Craft Guilds in the Seventeenth and Eighteenth Centuries. *Journal of Social History* 54(2):421-452.

Prak, Maarten and Jan Luiten van Zanden (eds.)

- 2013 *Technology, Skills and the Pre-Modern Economy in the East and the West*. Brill, Leiden.

Rawley, James A.

- 1981 *The Transatlantic Slave Trade. A History*. W.W. Norton, New York.

Raymond, André

- 1973 *Artisans et commerçants au Caire au XVIIIe siècle*. Vol. I. Institut Français de Damas, Damascus.

Sambo, Alessandra

- 2012 La balance de commerce de la République de Venise: sources et méthodes. *Cahiers de la Méditerranée* 84:381-410.

Savary des Bruslons, Jacques

- 1723 *Dictionnaire universel du commerce*. Chez Jacques Estienne, Paris.

Spector, Janet D.

- 1976 The Interpretative Potential of Glass Trade Beads in Historic Archaeology. *Historical Archaeology* 10:17-27.

Trivellato, Francesca

- 1996 Echi della periferia. Note sulla circolazione e la produzione delle perle di vetro veneziane nei secoli XVII-XVIII. *La Ricerca Folklorica* 34:25-34.
- 1998 Out of Women's Hands: Notes on Venetian Glass Beads, Female Labour and International Trades. In *Beads and Bead Makers: Gender, Material Culture and Meaning*, edited by Lidia D. Sciana and Joanne B. Eicher, pp. 47-82. Berg, Oxford.
- 2000 *Fondamenta dei vetrai. Lavoro, tecnologia e mercato a Venezia tra Sei e Settecento*. Donzelli, Rome.
- 2006 Murano Glass, Continuity and Transformation (1400-1800). In *At the Centre of the Old World: Trade and Manufacturing in Venice and the Venetian Mainland, 1400-1800*, edited by Paola Lanaro, pp. 143-184. University of Toronto, Centre for Reformation and Renaissance Studies, Toronto.

de Vries, Jan

- 2008 *The Industrious Revolution*. Cambridge University Press, New York.

Walz, Terence

- 1975 *The Trade between Egypt and Bilād as-Sūdān*. Ph.D. dissertation. Boston University, Boston.

Zecchin, Luigi

- 1987 *Vetro e vetrai di Murano: studi sulla storia del vetro*. Vol. I. Arsenale Editrice, Venice.

Zecchin, Paolo

- 2010 L'Arte vetraria a Venezia negli anni del Portofranco (1830-1873). *Studi veneziani* LX:487-617.
- 2013 Il commercio delle conterie (anche corniola) in Inghilterra nel Settecento. *Journal of Glass Studies* 55:153-166.

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A BEADED HAIR COMB OF THE EARLY MING DYNASTY

Valerie Hector

This article describes an unprovenanced artifact: a 700-year-old beaded hair comb probably entombed with a woman who died between 1405 and 1446 during China's early Ming dynasty. It is intended to establish basic facts and stimulate further research. The comb may be the first intact example of mainland Chinese beadwork to undergo radiocarbon dating as well as laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) analysis. The lead-potash (Pb-K) composition of the comb's glass coil beads resembles that of coil beads recovered from jar burials of the 15th-17th centuries in Cambodia's Cardamom Mountains. Thus, the comb links glass coil beads ostensibly made for use within China to coil beads exported to Southeast Asia.

INTRODUCTION

In a previous publication, I noted that beadwork has been produced in China since at least the early first millennium BCE (Hector 2013:42-43). Beadwork was also exported from China (Hector 2016). I have also discussed two impressive pieces of beadwork ascribed to the Ming dynasty (1368-1644): a calligraphic panel and a multi-part lantern (Hector 2017: Figures 1-5). Ming emperors wore bead-tasseled crowns (Yang Xiaoneng 2006: Figure 1), while empresses wore elaborate phoenix crowns or *feng guan* embellished with pearls and pearl-bead tassels (Gao Chunming 2001: Figure 478; Hong Kong Heritage Museum 2002: Figure 80). Paintings of the era memorialize the variety of beading techniques used to create these delicate arrays (Figure 1).

Beaded hair combs such as the one featured in this article have not fared as well (Figure 2). Measuring 11.5 cm wide x 5.3 cm high x 1.4 cm thick, the comb assumes the semicircular shape common to many ancient Chinese combs known as *shu*. Depending upon prevailing fashions, women wore one or more *shu* in their hair (Hong Kong Heritage Museum 2002: Figures 47, 50, 57). Modern-day experts have never seen fully beaded examples nor examples having glass beads (Simon Kwan, Yang Jing, Wu Yi Shuan 2021: pers. comm.). A cursory search of the Chinese internet yielded no new insights (Jeff Keller 2021: pers. comm.).



Figure 1. Anonymous portrait of Ren Xiao Wen (1362-1407), consort of the third Ming Emperor Yongle (r. 1402-1424) and, from 1402-1407, third empress of the Ming dynasty; painted between the 15th and 17th century (courtesy of Palace Museum, Beijing).

In this article, we begin to write the biography of this beaded hair comb, one of many hair ornaments produced in China over the last 6000 years (Yang Jing 2006). The comb was probably entombed with a woman who died between 1405 and 1446 during China's early Ming dynasty. Who she was, where she lived, and what else her tomb contained, we do not know; properly excavated tombs of the era may give a sense. Yet, she must have belonged to a family of means sufficient to acquire such a comb from a shop,



Figure 2. Beaded Chinese hair comb, ca. 1405-1455; 11.5 cm long (private collection) (photo: Ekaterina Shvedova).

artisan, or itinerant merchant (*see* Clunas 2007: Figure 30). Alternatively, the comb might have been a gift or a family heirloom. In any case, the comb was deemed special enough to accompany the woman into the afterlife.

While objective details may be surmised, subjective details elude us. Scholars have long agreed that objects may express or transform their owner's personal or social identity (Thomas 2021). What the comb meant to the woman and how others viewed her possession of it, we will never know. For instance, did she prefer glass to pearl or gemstone beads, or vice-versa? Possibly, glass beads were more novel or affordable. Many are the questions we cannot answer. Thus, we move on to other concerns.

THE COMB'S BIOGRAPHY

Kajetan Fiedorowicz-Bittner, a collector of hair combs based in Australia, purchased the beaded comb discussed here in China during the late 1980s along with a comparable example (Kajetan Fiedorowicz-Bittner 2021: pers. comm.). No provenance was available. Like many ancient Chinese artifacts, the combs may have been looted from a tomb. The extent of looting in China is well documented (Branigan 2012). By one estimate, between 1998 and 2003, some 220,000 Chinese tombs were robbed (chineseantiques.co.uk 2015) despite the Chinese government's long-standing laws to the contrary (Rong Chai and Hao Li 2019). Looting cannot be condoned, but looted artifacts merit research.

In its 14 June 2011 auction, Mossgreen Auctions of Melbourne, Australia, offered both beaded combs for sale in its online catalogue. Neither sold. After the auction, Mossgreen sold the beaded comb featured in the present article to its current owner, a private collector. The collector was disturbed to discover short strands of black human hair and small vegetal roots attached to the back of the comb, an indication of probable looting.

Fiedorowicz-Bittner (n.d.a) provides a photo of the beaded comb along with a second example which he

also dates to the Liao dynasty (907-1125). Apparently, both combs are also reproduced in another manuscript by Fiedorowicz-Bittner (n.d.b) (Barbara Steinhardt 2021: pers. comm.).

While Fiedorowicz-Bittner (n.d.a-b) associates the combs with the Liao dynasty's nomadic Khitan people who for centuries roamed across what is now eastern Inner Mongolia, scholar and collector Simon Kwan (2021: pers. comm.) disagrees, noting the Khitan or "Liao people did not have the habit of wearing combs because they were nomadic in origin." Kwan's observation notwithstanding, the Liao dynasty produced at least one spectacular example of beadwork: a model house, 100 cm tall, densely encrusted with "pearls, jade, rock crystal, amber, and coral beads" united in a variety of techniques (Hansen 2011: Figure 3). The house was discovered in the upper repository of the North Pagoda in Chaoyang, a city in China's coastal northeast Liaoning province (Hansen 2011). Moreover, beaded earrings, necklaces, amulets, and other items recovered from the tomb of Princess Chen (d. ca. 1018) prove that Liao royalty did possess small personal ornaments. That some of these were imported from afar is another matter (Hansen 2011:41).

In order to possibly date the comb, radiocarbon tests were performed on samples of the hair by the University of Arizona's AMS Laboratory in April of 2021. This produced a calibrated date range of 1405-1446 with a 95% probability (Cruz 2021). Thus, the woman who was buried with the beaded comb likely lived in the late 14th or early 15th century, though the beaded comb itself could be older. Thus, Fiedorowicz-Bittner's Liao dynasty attribution might be plausible. Unfortunately, sampling the wood for radiocarbon dating would damage the comb's appearance and possibly its structural integrity.

RELATED EXAMPLES

In China, plain, semicircular wooden hair combs are common archaeological finds in tombs of various centuries (Yang Jing 2006:68-9; Zhou Di Ren, Zhou Yang, and Yang Ming 1992:7, Figure 5). For example, in 2019, an intact tomb dating to the Yuan dynasty (1206-1368) was discovered in Changzhou, a city in southern Jiangsu province. A well-preserved lacquer coffin held items including five combs of wood and two of bamboo (Xinhua 2019). For more than a thousand years, Changzhou has been a locus of comb manufacture, and the city hosts a small comb museum that apparently does not have a website (Jeff Keller 2021: pers. comm.).

As noted above, combs decorated with beads are rare. Several wooden combs with spines sparingly studded with

pearls serve as precedents. They were recovered from a set of tombs dating to the 12th-13th centuries of the Song dynasty (960-1279) in east-central China's Jiangsu province (Yang Jing 2006:68, Figure 40). Exactly how the pearls were attached to the wood is unclear; they may have been inlaid.

THE COMB COMPONENTS

The wood used to make the comb has not been identified. Christopher Buckley (2021: pers. comm.) observes that “for making the tines of a comb,” the wood “would have to be something fine-grained” such as “boxwood” or bamboo (Yang Jing 2006:68-69).

Fiedorowicz-Bittner (n.d.a) suggests that silk thread was used to connect the beads on the comb. After seeing a detail image, Christopher Buckley (2021: pers. comm.) concluded that a bast fiber thread such as ramie or hemp is more likely, with hemp being the most probable.

All of the glass beads on the comb are opaque blue, highly irregular in size and shape, and formed by the winding or coiling method common in China for centuries (*see* Francis 2002:76-78, Plate 16). Ranging from 3.5 mm in diameter by 3 mm in length to 1.5 mm in diameter by 1.0 mm in length, most of the beads on the top and front of the comb have relatively smooth surfaces (Figure 3). Periodically, seemingly at random, a bead with visible coils appears. Beads with visible coils are far more numerous on the back of the comb, especially at the center (by “back,” I mean the side to which human hair was attached). Averaging 2-3 pronounced coils, the back beads range in size from 2 mm by 2.5 mm to 1.5 mm by 1.5 mm (Figure 4). Their relatively smaller sizes might have helped effect a tapering strategy that shaped the panel to the curve of the comb, something only an experienced artisan could have done. That more visibly coiled beads proliferate on the back of the comb might indicate an aesthetic preference for smooth beads.

Using laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS), Laure Dussubieux of Chicago's Field Museum analyzed one of the comb's beads, finding



Figure 3. The beads on the front of the comb (photo: Ekaterina Shvedova).



Figure 4. The beads on the back of the comb (photo: Ekaterina Shvedova).

it to be high in silica ($\text{SiO}_2=58.34\%$), lead ($\text{PbO}=14.1\%$), and potash ($\text{K}_2\text{O}=14.9\%$), with copper as the likely coloring agent ($\text{CuO}=2.46\%$) (Dussubieux 2020: pers. comm.). Thus, the bead belongs in the silica-lead-potash (Si-Pb-K) compositional group; in China, lead-potash glasses appear to have been made from about the 6th century to the Ming dynasty (Fuxi 2009).

After preparing a 3D scatterplot following a principal components analysis (Figure 5), Alison Carter concluded that the bead analyzed by Dussubieux is most compositionally analogous to Chinese lead-potash glass coil beads recovered from jar burial sites of the 15th-17th centuries in Cambodia's Cardamom Mountains (Carter and Beavan 2014; Fuxi 2009). The beads on the comb are, however, lower in lead

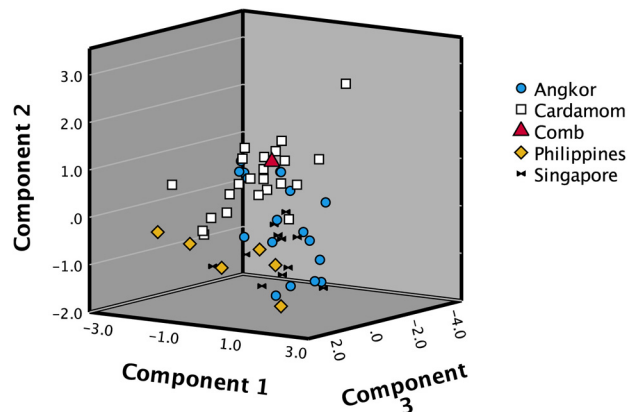


Figure 5. 3D scatterplot showing the first three components of a principal components analysis (66% of the total variation) comparing the bead from the comb with comparative datasets from the Cardamom Mountains, Cambodia (Carter, Dussubieux, Beavan 2016); Angkor Thom, Cambodia (Carter et al. 2019); Fort Canning, Singapore (Borrell 2010; Dussubieux 2010), and unpublished data from the Philippines provided by Laure Dussubieux (graphic: Alison Carter).

and smaller in size than the Cardamom Mountain finds (Alison Carter 2021: pers. comm.). The smaller size of the comb beads is consistent with Peter Francis' observation that from the 12th through 15th centuries, Chinese coil beads tended to average 3 mm or less in diameter whereas in the 16th century, their size increased (Carter, Dussubieux, and Beavan 2016:406, citing Francis 2002).

Assuming the beaded comb was indeed made in China, we may conclude that in the mid-2nd millennium, Chinese glass coil beads made for indigenous use were in some cases compositionally similar to beads produced for export. After additional examples are found, research may proceed (Alison Carter, Laure Dussubieux 2021: pers. comm.).

THE BEADWORK TECHNIQUE

The beading technique creates a distinctive pattern of octagons and diamonds (Figure 6). While the beads forming each octagon are internally connected with a ring of thread, the beads forming each diamond are connected not to one another but to four adjacent octagons. Beadworkers might call such techniques "angle weaves;" mathematicians might call the patterns they produce "periodic polygonal tilings of the plane" (Fisher and Mellor 2012:141).

Such an octagon-diamond pattern could have been produced with a netting technique entailing a single thread or a plaiting technique entailing two or more working thread ends (*see* Hector 2016:68 ff.). The former makes the most

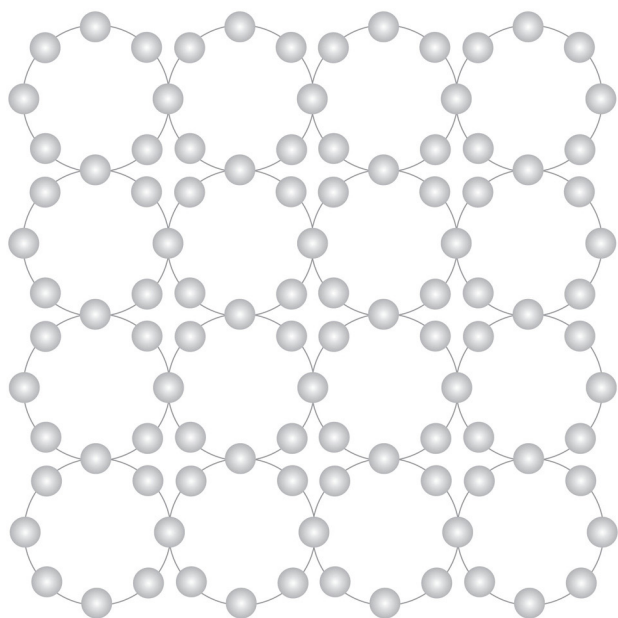


Figure 6. The octagon-diamond bead netting or plaiting technique (graphic: Carrie Iverson).

sense in that manipulating a single thread is generally faster and easier than manipulating multiple threads. The neat finishing of the beaded panel's edges supports this hypothesis. If the beads had been plaited, thread stubs would likely be present. The panel of beadwork might have been created first, then attached to the comb, or partially worked and finished over the comb. Long stitches secure the beaded panel to the comb.

Simon Kwan (2021: pers. comm.) has suggested that the comb's makers might have intended the beadwork to simulate the decorative effect of hand-forged gold bosses on other, more costly, wooden combs of the era (Gao Chunming 2001: Figures 128-129; Kwan and Sun Ji 2003:391-393). Yang Jing (2021: pers. comm.) notes that "wooden combs of the same shape with gold pieces and precious stones inlaid on their backs are common in ancient China from the Song to the Ming."

There is one earlier precedent for the octagon-diamond beading technique, also involving a hair ornament, a small beaded scent bag that once dangled from a U-shaped metal hair stick or *chai* (Zhou Di Ren, Zhou Yang, and Yang Ming 1992:6, Figure 3) (Figure 7). Such an ensemble would have been known as a *buyao* or hair ornament with movable parts to catch the eye or the light. The *buyao* was one of the many items recovered from a woman's tomb unearthed in southeast China's Jiangxi province and dating to the end of the late Southern Song dynasty (1127-1279). The scent bag was enclosed in a net or plait of tiny seed pearls united in an octagon-diamond pattern (pers. obs.)¹ (Figure 8). Probably first invented in China, such an octagon-diamond beading technique might have resonated with the affinity for geometric pattern that motivated wooden window lattice designs, where octagons were sometimes combined with diamonds (Dye 2013:53 ff). The woman who owned the *buyao* went to her tomb wearing a wide pearl-beadwork band in her hair, still visible on her mummy (Zhou Di Ren, Zhou Yang, and Yang Ming 1992:1, Figures 2-3). The technique used to create the hairband is difficult to discern but might be an open diamond-patterned net or plait (pers. obs.; *see* Hector 2016: Figures 2, 5). Three plain wooden hair combs or *shu* were also found in the woman's tomb, all semicircular in shape (*see* Zhou Di Ren, Zhou Yang, and Yang Ming 1992:7, Figure 5). It is possible that the scent bag and hair band are the earliest intact published examples of Chinese hair ornaments incorporating bead netting or plaiting.

The octagon-diamond beading technique continued into the Qing dynasty (1644-1911), forming part of a heavily beaded canopy above a bejeweled lapis-lazuli statue of the Buddha in the Forbidden City collection (Xu Qixian 2004:



Figure 7. Two-part hair ornament or *buyao* from a woman's tomb dating to 1279 in China's Jiangxi province (courtesy of Zhou Family Museum, Jiujiang, Jiangxi).

Figure 182). The technique was also in use in China in the early 21st century (pers. obs.).

CONCLUSION

The foregoing paragraphs invite several conclusions. First, a great deal remains to be learned about mainland Chinese beadwork. By the first half of the 15th century, however, small glass coil beads were being used to embellish small personal objects such as the comb. Coil beads might have been used on larger objects as well. Second, that the comb's beads belong to the lead-potash group links them to lead-potash coil beads exported to Southeast Asia. Third, in China, beading techniques persisted from century to century. Dating to at least 1279 of the late Southern Song dynasty, the octagon-diamond technique recurs in the Ming dynasty, the Qing dynasty, and present-day China. Fourth, the complexity of the octagon-diamond technique as well as techniques on other pieces ascribed to the Ming dynasty reveals that beadwork was well advanced by that time, if not the earlier late Southern Song or Liao dynasties.



Figure 8. The scent bag of the hair ornament showing seed-pearl beads forming an octagon-diamond net or plait (courtesy of Zhou Family Museum, Jiujiang, Jiangxi).

Institutions permitting, scholars might analyze the chemical compositions of the glass beads assumed to be Chinese in the calligraphic panel and multipart lantern mentioned above. Results might yield additional information about glass recipes used in China during the Ming dynasty.

Chinese beaded ornaments for the hair and head also offer new vistas of research for scholars of glass beads and beadwork. Published examples of Qing dynasty imperial beaded hair ornaments hint at considerable riches, but pearls and gemstones tend to outnumber glass beads (*see* Li Yuhua et al. 1992; National Palace Museum 1986; Yuan Hongqi 2006). Vernacular beaded hair combs, though largely unpublished, hold far more potential (*pers. obs.*). For a start, scientific study of 20th-century examples might reveal the variety of glass recipes used in a single century as well as bead sizes and shapes. Further, some of the bead sizes and shapes might correlate with early 20th-century Chinese glass bead nomenclature (Hector 2013:66, no. 13). Finally, the presence on some examples of what appear to be European glass beads bespeaks global connections in material and visual culture as well as commerce and trade.² It might also be productive to search Chinese literary and pictorial records as well as global museum holdings. Surely more beaded Chinese hair combs exist. If so, I hope to find them.

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ENDNOTES

1. The scent bag's beading technique has twice been misdrawn as a diamond grid (*see* Gao 2001: Figure 266; Zhou Di Ren, Zhou Yang, and Yang Ming 1992:15, Figure 23).
2. For vernacular hair ornaments that likely include Chinese glass beads, glass cabochons, and possibly glass pearls, *see* the ca. 1901 hair ornaments housed at the American Museum

of Natural History (AMNH) as cat. nos. 70/2397, 70/2398 a, b. The AMNH offers a searchable online database for its anthropology collections. For hair ornaments that include beads resembling the hollow glass beads shown in Neuwirth (1994: Plates 315-316) plus other hollow beads, *see* the ca. 1900 hair ornaments housed at the AMNH as cat. nos. 70/1574 a, b; 70/1579-80; 70/1581 a, b; 70/1582.

REFERENCES CITED

Borrell, Brigitte

- 2010 Glass from China and from India: Finds of Vessel Glass from Fourteenth Century Singapore. *Archipel* 80:139-196.

Branigan, Tania

- 2012 China's Tomb Raiders Laying Waste to Thousands of Years of History. <https://www.theguardian.com/world/2012/jan/01/china-tomb-raiders-destroy-relics>, accessed 18 August 2021.

Carter, Alison K. and Nancy Beavan

- 2014 Glass Beads from the Jar Burials of the 15th-17th Centuries in the Cardamom Mountains of Cambodia. *Beads: Journal of the Society of Bead Researchers* 26:9-21.

Carter, Alison K., Laure Dussubieux, and Nancy Beavan

- 2016 Glass Beads from 15th-17th Century CE Jar Burial Sites in Cambodia's Cardamom Mountains. *Archaeometry* 58(3):401-412.

Carter, Alison K., Laure Dussubieux, Martin Polkinghorne, and Christophe Pottier

- 2019 Glass Artifacts at Angkor: Evidence for Exchange. *Archaeological and Anthropological Sciences* 11(3):1013-1027.

Chineseantiques.co.uk

- 2015 Chinese Tomb Looters – "To be rich dig up an ancient tomb; to make a fortune open a coffin." <https://www.chineseantiques.co.uk/chinese-tomb-looters-to-be-rich-dig-up-an-ancient-tomb-to-make-a-fortune-open-a-coffin/>, accessed 18 August 2021.

Clunas, Craig

- 2007 *Empire of Great Brightness: Visual and Material Cultures of Ming China, 1368-1644*. University of Hawai'i Press, Honolulu.

Cruz, Robert

- 2021 Radiocarbon Analytical Report. Report on file. AMS Laboratory, University of Arizona, Tucson.

Dussubieux, Laure

- 2010 Glass Material from Singapore. *Archipel* 80:197-209.

Dye, Daniel Sheets

- 2013 *Chinese Lattice Designs with Over 1200 Illustrations*. Dover, New York.

Fiedorowicz-Bittner, Kajetan

- n.d.a Combing for Masterpieces: Presentation of the World's Largest Collection of Ancient and Ethnic Hair Combs and Hair Pins. Vol. 1: Asia. Manuscript.
n.d.b China: Ancient Combs of the World. Vol. 4: China. Manuscript.

Fisher, Gwen and Blake Mellor

- 2012 Using Tiling Theory to Generate Angle Weaves with Beads. *Journal of Mathematics and the Arts* 6(4):141-148.

Francis, Peter, Jr.

- 2002 *Asia's Maritime Bead Trade 300 B.C. to the Present*. University of Hawai'i Press, Honolulu.

Fuxi, Gan

- 2009 Origin and Evolution of Ancient Chinese Glass. In *Ancient Glass Research along the Silk Road*, edited by Gan Fuxi, Robert Brill, and Tian Shoutun, pp. 1-40. World Scientific, Singapore.

Gao Chunming

- 2001 *Zhongguo fushi mingwukao* [Study of Chinese Dress and Personal Adornment]. Shanghai wenhua chubanshe, Shanghai.

Hansen, Valerie

- 2011 The Khitan People, The Liao Dynasty (916-1125) and Their World. *Orientalism* 42(1):34-43.

Hector, Valerie

- 2013 Chinese Bead Curtains, Past and Present. *Beads: Journal of the Society of Bead Researchers* 25:40-71.
2016 Bead Netting and Plaiting Techniques in the Peranakan World. *Beads: Journal of the Society of Bead Researchers* 28:66-91.
2017 Mainland Chinese Export Beadwork. *Beads: Journal of the Society of Bead Researchers* 29:59-75.

Hong Kong Heritage Museum

- 2002 *Images of Females in Chinese History*. Leisure and Cultural Services Department, Hong Kong Heritage Museum, Hong Kong.

Kwan, Simon and Sun Ji

- 2003 *Chinese Gold Ornaments*. Muwen Tang Fine Arts Publications, Hong Kong.

Li Yuhua, Chu Chia-sen, Chao Yu Liang et al.

- 1992 *Jewelry and Accessories of the Royal Consorts of Ch'ing Dynasty Collected by the Palace Museum*. Forbidden City Publishing House, Beijing.

National Palace Museum

- 1986 *Catalogue of the Exhibition of Ch'ing Dynasty Costume Accessories*. National Palace Museum, Taipei.

Neuwirth, Waltraud

- 1994 *Perlen aus Gablonz: Historismus, Jugendstil / Beads from Gablonz: Historicism, Art Nouveau*. Self published, Vienna.

Rong Chai and Hao Li

- 2019 A Study on Legislation for Protection of Cultural Relics in China: Origin, Content and Model. *Chinese Studies* 8:142-147.

Thomas, Julian

- 2021 Assembling Ornament and Assembling Identity. In *Personal Adornment and the Construction of Identity: A Global Archaeological Perspective*, edited by Hannah V. Mattson, pp. 201-214. Oxbow, Philadelphia.

Xinhua

- 2019 Rare Well-Preserved Coffin Discovered in Jiangsu. Xinhuanet, http://www.xinhuanet.com/english/2019-03/14/c_137894663.htm, accessed 18 August 2021.

Xu Qixian

- 2004 *Treasures of Imperial Court: The Complete Collection of Treasures of the Palace Museum*. The Commercial Press, Hong Kong.

Yang Jing

- 2006 *Zhonghua shubi liaoqiannian* [Six Thousand Years of Chinese Combs]. Zijincheng chubanshe, Beijing.

Yang Xiaoneng

- 2006 Ming Art and Culture from an Archaeological Perspective. Part 1: Royal and Elite Tombs. *Orientalism* 37(5):40-49.

Yuan Hongqi

- 2006 Qing Palace Head Ornaments Worn by the Court Ladies. *Arts of Asia* 36(5):89-97.

Zhou Di Ren, Zhou Yang, and Yang Ming

- 1992 *Jiangxi De'An Nansong Zhoushi mu qingli jianbao* [Brief Report on the Excavation of the Zhou Tomb of Southern Song Dynasty in De-An County]. Jiangxi renmin chubanshe, Nanchang.

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BEADMAKING DURING THE 17TH AND 18TH CENTURIES IN EU COUNTY, NORMANDY

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Translated by Brad Loewen

This paper reconstructs the history of a family of French beadmakers in Eu County, Normandy, from 1687 to 1747, as well as the context of their migration from the urban beadmaking center of Rouen. While Normandy had produced windowpane and bottles since the Middle Ages, artisans who made “crystal” soda glass – the glass of beads – were newcomers from Italy and Languedoc. They founded glassworks in Paris and Rouen in the late 16th century. Conflicts with Rouen artisans and merchants led the Mediterranean glassworkers to migrate to Eu County in 1634, where their crystal factories spun off a rural beadmaking trade. The present research builds on 19th-century archaeological reports of beads and beadmaking wasters in the villages of Aubermesnil-aux-Érables and Villers-sous-Foucarmont. We have identified three generations of the Demary family of beadmakers in the Eu Forest. Using genealogical methods, we have traced their migration from Rouen, their family history, and their links to Mediterranean crystal glassmakers. The example of the Demary patenôtriers sheds light on a transitional period of beadmaking in Normandy, characterized by its ruralization and its proximity with forest glassmaking in the second half of the 17th century.

INTRODUCTION

Glass beadmaking is known in Paris from about 1560 to 1610 (Vanriest 2020) and in Rouen from about 1590 to 1660 (Karklins and Bonneau 2019). Many family and professional ties welded the Paris and Rouen trades into a common industry. In each city, the trade was organized around one or two furnaces that made soda “crystal” glass, including one founded by Italian artisans under royal privilege, and a loose community of *patenôtriers* who transformed colored glass tubes and rods into small objects in their home workshops. Some of these artisans made large quantities of rosary and trade beads for export (Loewen 2019; Vanriest 2020, 2021). In the 1630s, following conflicts related to the royal privilege, some Mediterranean soda-glass makers migrated from Rouen to a rural forested area of northeastern

Normandy, inland of Dieppe, where a potash or forest glass (*Waldglas*) industry flourished since the 15th century. In their new setting, they recruited other crystal glassworkers from Italy, and attracted experienced beadmakers from Rouen. This paper, based on historical sources, documents crystal glassmaking and beadmaking in Eu County during the late 17th and early 18th centuries.

The tradition of forest glassworking in Eu County, northeastern Normandy, arose in the late Middle Ages, with the first records of glassworks in the Lower Eu Forest appearing in the 15th century.¹ The Eu counts governed this industry by granting privileges to manufacture window glass, known as *gros verre*, to four noble families.² Windowpane accounted for most of the county’s glass production until the French Revolution, and only a few furnaces in Eu Forest produced crystal glass for tableware and other fine objects.³ In this context, 19th-century authors mention beadmaking in three villages grouped in a four-kilometer stretch of the upper Yères valley, at Foucarmont, Villers-sous-Foucarmont, and Aubermesnil-aux-Érables. These authors described “archaeological” findings of beads and an oral tradition of their origin, but found no historical record of their producers. While glass beadmaking clearly relates to the presence of glassworks in the Eu Forest, many questions remain unanswered: when did this production occur and how can we explain the presence of these beads in the upper Yères valley?⁴

ROUEN AND THE ORIGINS OF CRYSTAL (SODA) GLASSMAKING IN NORMANDY

Beadmakers used a particular quality of soda glass called crystal, and the origins of crystal glassmaking in Normandy lie in Rouen. In his 1873 history of glassmaking in Normandy, Onésime Le Vaillant de la Fieffe mentions a glassworks at La Mailleraye, in the Brotonne Forest west

of Rouen, which produced glass for use by *patenôtriers* or beadmakers. The establishment existed in the 16th century but later information is lacking (Le Vaillant 1873:266). We know much more about a crystal glassworks located in Rouen itself. In 1598, two Italian artisans received authorization to build a plant in the suburb of Saint-Sever, on the left bank of the Seine. Vincent Buson and Thomas Bartholus of the duchy of Mantua obtained an exclusive privilege to make “crystal glass, gilded glass, enamels, and other works like those made in Venice and other foreign places and countries, and others that they could invent themselves.”⁵ Buson and Bartholus worked under Jacques Sarode and Horace Ponte, master glassmakers from Altare in northwest Italy who also ran a crystal plant in Paris (Vanriest 2020:161-163). The Saint-Sever privilege included a monopoly over crystal glassmaking throughout Normandy, which quickly became a source of jealousy and conflict.

In 1605, the Norman parliament abruptly transferred the privilege to François de Garsonnet, *gentilhomme provençal*, who would operate the Saint-Sever plant until 1619, though not without difficulties.⁶ In 1613, he sued a Rouen beadmaker, Mathieu Delamare, who operated a small furnace in the Cauchoise suburb to make soda glass for use by *patenôtriers*. In his request to the Norman parliament, Garsonnet demanded that the furnace be demolished, arguing that he alone had the right to make glass and enamel tubes (Le Vaillant 1873:278). Delamare, supported by the *patenôtriers*’ guilds of Rouen and Paris, countered with the guild’s patent letter from 1595 that stated, “the masters of the said *métier* can make beads and buttons from enamel and glass, chains, necklaces and bracelets, using fire and a furnace.”⁷ The case exposed a legal rift between Rouen beadmakers and the Saint-Sever glassworks, obliging the Norman parliament to issue a statute to reconcile the belligerents. Delamare could keep his furnace, provided he used it only to make enamels (opacified colored glass) for use by Rouen *patenôtriers*, and forbade him from selling his products outside the city (Le Vaillant 1873:278).

Tensions remained high between Rouen beadmakers and the Mediterranean operators of the Saint-Sever glassworks. In 1619, Garsonnet ceded his privilege to Jean and Pierre d’Azémar, glassworkers from Languedoc.⁸ The newcomers partnered with a Rouen merchant, Antoine Girard, who looked after sales while the Azémar brothers manufactured glass items (Le Vaillant 1873:279). After Girard’s death in 1624, the brothers ran the enterprise on their own. The Norman parliament renewed their privilege in 1627, then granted it in perpetuity to their descendants in 1635 (Le Vaillant 1873:285). In the meantime, the brothers ceded the Saint-Sever works to a Rouen merchant named Nicolas de Paul in 1634, while retaining their monopoly for

the rest of Normandy. The brothers died a few years later, leaving the privilege to Pierre’s widow, Anne Girard, who used it to suppress prospective crystal producers outside of Rouen. This was the case for a glassworks set up by Nicolas de Paul and a certain Delamare at Petite-Couronne, about 5 km downstream of the city (Le Vaillant 1873:287). It is not known if the plant’s co-owner was Mathieu Delamare or a member of his family. This restricted period ended when a court ruled against the Saint-Sever monopoly in 1659, confirmed by an appeals court in 1664. In the wake of these rulings, several crystal glassworks sprang up in rural Normandy (Le Vaillant 1873:290). As a subsidiary trade of soda glassmaking, beadmaking in Normandy followed a similar course (Loewen 2019).

The turbulence at Rouen led to the founding of crystal glassmaking in Eu County, which lay outside the territory of the Saint-Sever monopoly. The instigators were two artisans, the sieur de Barniolles and Henri de Virgille, who had worked under the Azémar brothers at Saint-Sever since the 1620s (Le Vaillant 1873:285). The Barniolles were an Italian family from Altare; a relative named Bernardin de Barniolles worked at the Paris glassworks as early as 1602 (Vanriest 2020:170). As for Henri de Virgille, he was from Languedoc, like the Azémar brothers. Barniolles and Virgille left Saint-Sever in 1634, and the Azémar brothers helped them to found crystal glassmaking in Eu County.

THE GLASS INDUSTRY IN EU COUNTY

Glassworks making flat or window glass appeared in Eu County in the 14th and 15th centuries. They produced forest glass using potash or mixed alkali as a flux, and five are known to have operated in the Eu Forest in the 16th to 18th centuries. Called *grosses verreries* (Figure 1), these establishments and their privileges belonged to members of four noble families – Brossard, Bongars, Caqueray, and Le Vaillant – who alone enjoyed the right to produce windowpane and bottles in Normandy.⁹ These five plants formed the traditional glassmaking industry of the Eu Forest (Figure 2).

The oldest operation was at Saint-Martin-au-Bosc, run as early as 1441 by Richard Brossard and his son Colart. Another glassworks existed in the 15th century in the hamlet of Grand-Val in Rétonval parish. In 1676, its owner, François de Bongars d’Apremont, relocated the operation to Val-d’Aulnoy in the Commune of Saint-Riquier-en-Rivière (Le Vaillant 1873:163).

Next in age is Varimpré, at the edge of the Lower Eu Forest, run in 1582 by Jean Le Vaillant de Sainte-Beuve (Le Vaillant 1873:140).¹⁰ This *gentilhomme* previously operated



Figure 1. A *grosses verrerie* at Guerville, Eu Forest, apparently built in the 18th century. This view likely dates to the late 19th century.

a glassworks at Sainte-Beuve-aux-Champs, in Landes parish (now within the commune of Caule-Sainte-Beuve), whose

origin was said to date to the reign of Philippe de Valois in 1328-1350 (LeVaillant 1873:140).

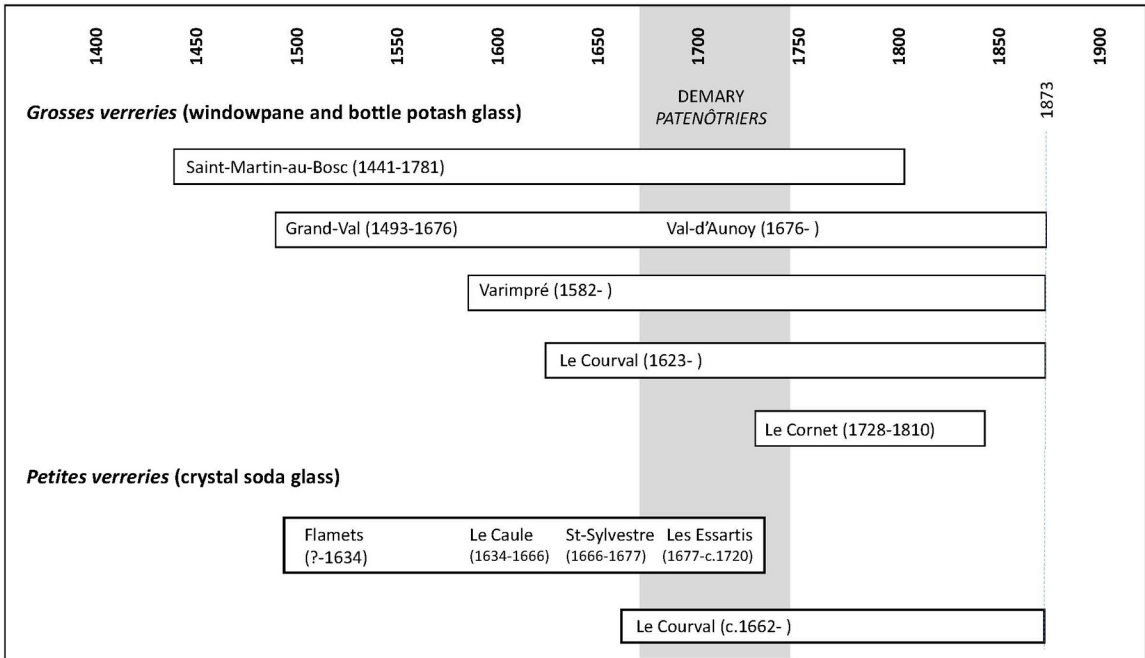


Figure 2. Chronology of potash and soda (crystal) glassworks in the Eu Forest (graphic: Brad Loewen).

In 1623, François Le Vaillant, sieur du Courval, obtained permission to establish a glassworks in the Lower Eu Forest at a place called Le Courval, near Guimerville parish (Le Vaillant 1873:184). This plant would later expand to include crystal making. Finally, a glassworks founded in 1728 in the Upper Eu Forest, in the hamlet of Le Cornet in Rieux parish, was operated in 1731 by Nicolas-Robert de Caqueray, sieur de Valolive (Le Vaillant 1873:203).

In addition to making windowpane, these *grosses verreries* produced bottles in a commoner's workshop using the same furnace but a different crucible. Window glass required special raw materials to ensure its transparency, as opposed to bottle glass that had a dark tint. None of these *grosses verreries*, however, produced colored soda glass for beads. Thus, beadmakers in the upper Yères valley would have used glass made by smaller crystal glassworks that arrived in the region in the 17th century.

Only two crystal glassworks or *petites verreries* (Figure 3) are known in Eu County in the 17th century (Figure 4). They belonged to Italian and Languedocian

artisans previously associated with crystal glassworks in Paris and Rouen (Vanriest 2021). Their arrival in northern France was part of a larger movement of migrant glassmakers from Altare, near Savona, that set up soda or crystal glassworks at various locations in France (Maitte 2012). The oldest crystal privilege in Eu County, according to Le Vaillant de la Fieffe, was exploited in four successive locations under different but closely related holders. The original privilege existed since the 15th century for a location at Flamets (now Flamets-Frétils). It was likely dormant when François de Barniolles acquired it in the early 17th century, along with the right to make crystal (Le Vaillant 1873:194). Barniolles transferred the privilege to Henri de Virgille and Jean d’Azémar, the glassmakers from Languedoc who operated the Rouen plant. The owners built a new factory in 1634 at Le Caule, at the edge of the Lower Eu Forest (Le Vaillant 1873:193). In 1666, Henri de Virgille exploited the same privilege at Saint-Sylvestre in the parish of Saint-Riquier-en-Rivière, in the heart of the Upper Eu Forest (Le Vaillant 1873:195). His son Charles and son-in-law Jean de la Mérye held the privilege in 1673. Four years later, the plant relocated to a

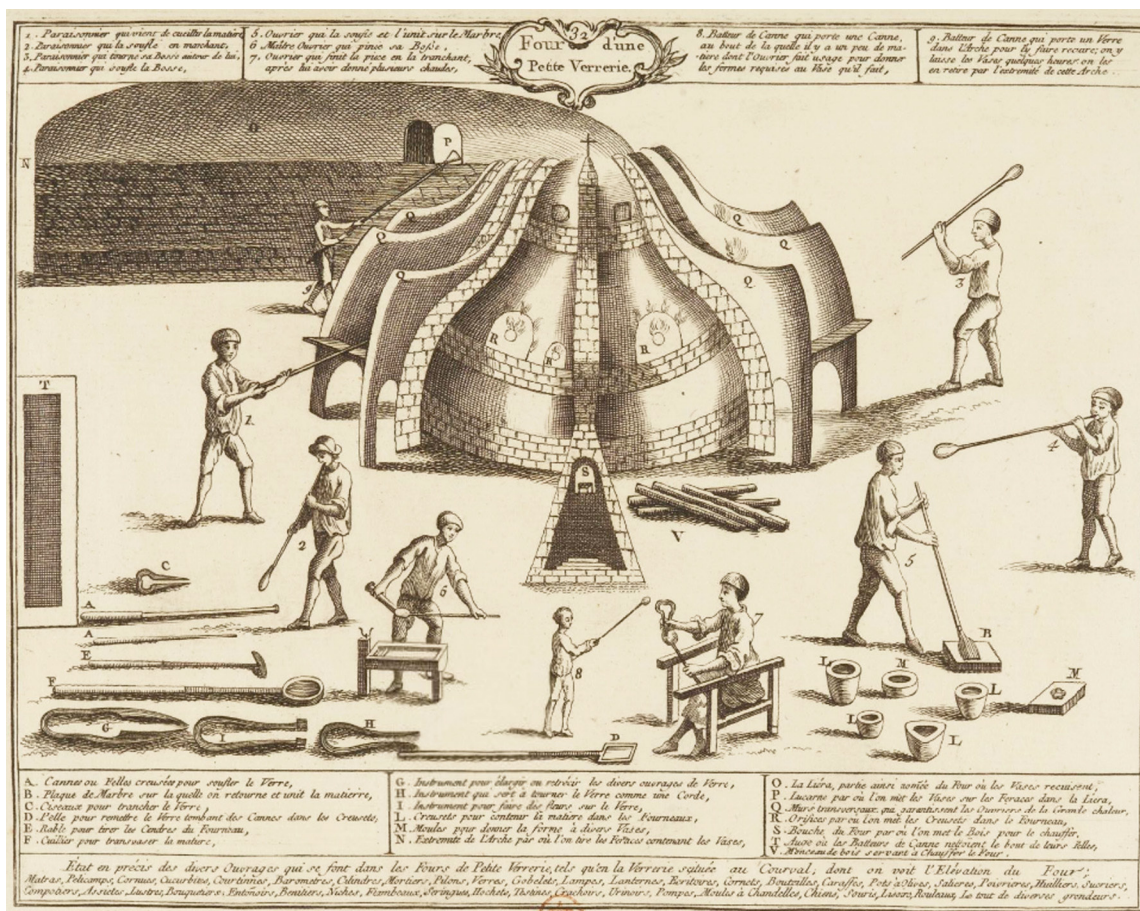


Figure 3. Glass furnace (*petite verrerie*) (Estancelin 1768).

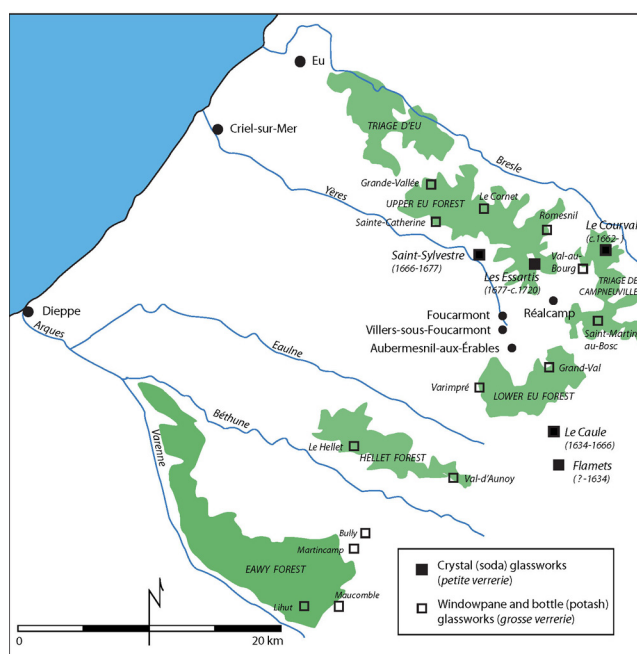


Figure 4. Potash and soda (crystal) glassworks in Eu County prior to 1873, based on Le Vaillant (1873) (graphic: Brad Loewen).

clearing called Les Essartis near Réalcamp parish, where Charles de Virgille and his brother François operated it (Le Vaillant 1873:195). Operations at Les Essartis ceased at an unknown date between 1716 and 1723.

The second *petite verrerie*, associated with the forest glassworks of Le Courval, began operations in 1662. It belonged to Jean de la Mérye, the former co-owner of the other crystal glassworks while it was at Saint-Sylvestre, and two Barniollles brothers – Honorat, sieur de Drizancourt, and Léonard, sieur de Blains (Le Vaillant 1873:187-188). Honorat and Léonard were likely descendants of François de Barniollles, who had acquired the Flamets privilege. The 1660s rejuvenated crystal glassmaking in the Eu Forest. Construction of Le Courval and Saint-Sylvestre in 1662 and 1666, respectively, followed the dissolution of the Saint-Sever monopoly and formed part of the rural expansion of crystal glassmaking in Normandy.

Many of the artisans associated with these crystal glassworks were noble *gentilhommes*, but none had any ancestral relation to the four Norman glassmaking dynasties. The Virgille and Azémar families came from Languedoc, while the Barniolle (Bormioli) clan originated in Altare, a major glass center near Savona in northwest Italy (Maitte 2012:127). Other Altarese also worked at Les Essartis. Parish records show the Ponte, Perrot, and Massary families who formed a tightly knit community. In 1716, the plant master, François de Virgille, became the godfather of François-Auguste Ponte (Ponta), son of François-Vincent Ponte and

Margueritte-Anthoinette Perrot (Perrotti), both of whom had noble titles.¹¹ These titles likely came with hereditary glassmaking privileges granted by the counts of Eu. Several such titles were on display at the wedding (14 June 1715) of François de Virgille esquire, sieur de Romesnil, son of dame Marie de Monsure and the late master François de Virgille of Les Essartis hamlet. The bride was demoiselle Marguerite Alexis de Massary of Réalcamp parish, daughter of dame Anne de Beaulieu and Jean-Baptiste de Massary esquire, sieur de Grands-Maisons.¹² The bride's name, Massary, was a francization of Massaro, a line of Altarese glassworkers like the Bormioli, Ponta, and Perrotti (Maitte 2012:125-127). Few artisans in Eu County were able to make soda glass or crystal in the Venetian manner, and most were Italians from Altare (LeVaillant 1873:277). This cell of Altarese crystal glassmakers was one of about a dozen that set up operations in various places in France in the 16th and 17th centuries, greatly abetting the northward spread of soda glassmaking. Altarese cells had hereditary members who reinforced the inheritance of glassmaking privileges. Thus, the Eu Forest cell was the same that had founded works in Paris and Rouen in 1598. While Altarese cells initially set up near urban markets, in the 17th century, many moved to rural locations where fuel and living costs were lower. In this ruralization phase, they targeted traditional forest glassmaking regions where they adroitly identified dormant privileges that they could request and reactivate, as in the case of Flamets (Maitte 2012; Vanriest 2020). The presence of Altarese glassmakers in Eu County in the late 17th and early 18th centuries is significant in that they could have produced soda glass tubes and rods for fabricating beads.

This background suggests that the most likely source for the tubes and rods used by beadmakers in the upper Yères valley was the crystal glassworks at Les Essartis, located 5-6 km from Foucarmont, Villers-sous-Foucarmont, and Aubermesnil-aux-Érables.

BEADMAKING IN EU COUNTY: THE LITERARY SOURCES

Several 19th-century publications mention the discovery of glass beads within the village limits of Aubermesnil-aux-Érables and Villers-sous-Foucarmont, located within 10 km of all the 17th-century crystal glassworks (Figure 5). This literature appears to stem from a local historian, the abbot Jean-Eugène Decorde, who published a history of Blangy canton in 1850.¹³ He mentions the finding of a considerable number of glass beads in Aubermesnil-aux-Érables, and later adds that beads also peppered the soil of Villers-sous-Foucarmont and Foucarmont communes (Decorde 1850:20, 25). The beads were yellowish and blue,



Figure 5. Glassworks and villages in Eu County, 1768: A) Les Essartis, B) Saint-Sylvestre, C) Le Caule, D) Flamets, E) Le Courval, and F) La Grande Vallée (Estancelin 1768).

mixed with vitreous slag, and accompanied by drawn rods of various lengths and the same colors as the beads (Decorde 1850:25). The abbot's precise description suggests he had examined the beads and, in fact, he pinpointed their location on three properties at Aubermesnil-aux-Érables (Decorde 1850:20).¹⁴ He initially presumed they were Merovingian, but a comparison with examples held at the Musée des Antiquités de Rouen, and conversations with residents of Aubermesnil-aux-Érables, convinced him of their production in the 16th or possibly the 15th century (Decorde 1850:25). He ultimately submitted his questions to André Pottier, curator at the Musée départemental des Antiquités de Rouen, who suggested the beads were destined for the slave trade (Decorde 1850:26). An elderly man of the region told Decorde (1850:25) that the beads were made in very small ovens that occupied two or three persons, usually a father and his children.

In 1871, the abbot Jean Cochet published an archaeological inventory of Seine-Inférieure Department and included a notice on Aubermesnil-aux-Érables.¹⁵ He wrote that yellow and blue glass beads could be found in "many gardens and yards" along with vitreous slag and drawn rods (Cochet 1871:175). Like Decorde, he wrote that the beads likely emanated from workshops in village houses, but he dated their production slightly later, to the 16th and 17th centuries. A tireless field researcher, Cochet doubtlessly saw some of these artifacts.

The most frequently cited source on beads in the Eu Forest is the history of the Normandy glassworks and glassmakers by Onésime Le Vaillant de la Fieffe (1873).¹⁶ Himself one of a noble line of glassmakers, Le Vaillant (1873:235-236) describes the work of *gentilhomme* glassmakers in the Eu Forest who made tubes and rods that certain inhabitants of Aubermesnil-aux-Érables and Villers-sous-Foucarmont fashioned into *patenôtres* (beads) around the middle of the 18th century. The beadmakers worked with small ovens set in the fireplaces of their houses. That the tubes and rods came from crystal glassworks is important since it greatly limits the number of glassworks in Eu County that could have supplied them. Finally, Le Vaillant (1873:236) states that the *patenôtres* corresponded to the *rocaille* that, according to Jean Haudicquer de Blancourt (1697, II:132-134), were traded into the Indies and Africa.

Comparison of these sources makes it clear that abbot Cochet and Le Vaillant de la Fieffe knew about the information collected by abbot Decorde. Taken together, these sources allow us to define three aspects of beadmaking in Eu County. First, this production took place in the upper Yères valley at Foucarmont, Villers-sous-Foucarmont, and Aubermesnil-aux-Érables. Second, beadmaking occupied several families working in their homes at some time between the 16th and the mid-18th century. Third, as reported by Le Vaillant, beadmaking directly related to the presence of crystal glassworks in Eu County – an important detail since the great majority of glassworks in the county were *grosses verreries* that made window glass.

A BEADMAKER'S MOVE FROM ROUEN TO EU COUNTY

The details presented above guided our research in the parish registers in the upper Yères valley, resulting in the identification of three generations of Demary beadmakers who lived in these villages and were associated with nearby crystal glassworks. A key reference is the burial record of Jean Demary who died at Les Essartis on 29 June 1707 at the age of 88. The record identifies him as a bourgeois of Rouen and *maître patenostrier*, meaning that he owned real estate in Rouen, and that he operated a workshop and could train and supervise employees.¹⁷

Combing through the Rouen archives, we find Jean Demary in Saint-Maclou parish on 26 November 1646 at his marriage to Anne Le Vaillant, along with his parents Élie Demary and Marie Girel and the bride's mother Marguerite Fontaine.¹⁸ Jean was about 27 years old. The couple had 13 children from 1647 to 1665, all born and baptized in Saint-Maclou. Parish records reveal little else about Jean Demary or his parents, and nothing about his profession. He must have practiced the art of beadmaking in Rouen, where a Rue des Patenôtriers ran through Saint-Maclou parish. This dead-end street, extending from Rue du Ruissel, disappeared in the 19th century with the construction of Rue d'Amiens.¹⁹ Its name confirms the importance of beadmaking in Rouen. To ply this trade, Jean Demary and possibly his father Élie, must have obtained their tubes and rods from a crystal plant near the Norman capital, so they doubtlessly knew Henri de Virgille who worked at Saint-Sever and built the *petite verrerie* at Le Caule in 1634.

Just when Jean Demary joined the Virgille glassworks in the upper Yères valley remains unclear. He may have become associated with the enterprise at Saint-Sylvestre as early as 1666, when he was 48 years old and his known children ranged in age from one to nineteen years. However, records mentioning Demary and his children as adults only confirm his presence at Les Essartis beginning in 1687, when he was already 68 years old. Moreover, we find only three of Demary's 13 known children in parish records of the upper Yères, including two of the youngest born in 1660 and 1665, suggesting that the older children may have remained in Rouen or returned there. We find Élisabeth, christened on 1 April 1660 at Saint-Maclou, who was 33 years old when she died at Les Essartis in September 1693, and was buried in the abbey cemetery at Foucarmont.²⁰ Jean-Baptiste, baptized as Jean on 4 May 1665 at Saint-Maclou, also moved to Eu County with his parents.²¹ After his marriage in 1700, he settled at Villers-sous-Foucarmont. Finally, a woman named Angélique Demary lived at Réalcamp in the late 17th century; while her name is not among the baptized

children of Jean Demary and Anne Le Vaillant, we know she was Jean's daughter. Possibly, she was baptized as Marie on 5 November 1651, or was born after the family left Saint-Maclou parish in Rouen. Angélique married Jacques Grignard, a furnace stoker at Les Essartis, and their first son, Simon, arrived in 1687.²² Her brother Jean-Baptiste was godfather of another son born in 1695.²³ Jean-Baptiste Demary and his father Jean attended Jacques Grignard's funeral in 1701 at Foucarmont.²⁴ Parish records thus show three of Jean Demary's children established in the Eu Forest by 1687.

Jean Demary and Anne Le Vaillant still resided in Les Essartis hamlet at the end of their lives.²⁵ Anne died on 9 October 1696, three years after Angélique, and her burial record at Foucarmont names her husband as "Master Jean De Mary, bourgeois of Rouen, master *patenôtrier* residing at the glassworks of Les Essartis."²⁶ Jean Demary died at Les Essartis on 29 June 1707 at the age of 88. At his burial the next day in Foucarmont, the priest again recorded that he was a bourgeois of Rouen and *maître patenostrier*.²⁷ Having begun his career in Rouen, Jean Demary moved to Eu County at an unknown time between 1665 and 1687, and lived in the glassmaking hamlet of Les Essartis for at least 20 years before his death. Two of his sons would settle in the nearby village of Villers-sous-Foucarmont. The Rouen *patenôtrier's* migration to Eu County thus followed the breakup of the Saint-Sever monopoly between 1659 and 1664, and coincided with the ensuing ruralization of crystal glassmaking in Normandy.

BEADMAKERS IN THE EU FOREST

The study of parish registers and tax rolls reveals additional information about glassworkers and beadmakers in Eu County. Tax rolls for Réalcamp parish in 1694, 1695, and 1696 shed light on people and activities at the Les Essartis crystal glassworks.²⁸ François de Virgille was the master and his brother-in-law, Jean de La Mérye, co-owner of the glassworks at its previous location, had a house in Les Essartis hamlet. Jacques Grignard, Alexandre Tuterel, and Jacques Varlet were employed as furnace stokers (*tiseurs au four*). François Leroux and Guillaume Armand worked as yardman (*manouvrier*) and assistant (*valet*), respectively. We also find a certain Jean Demary, "rosary worker" (*ouvrier de chapelet*), who rented a house at Les Essartis taxed at 115 sols, confirming the presence of a beadmaker in the Eu Forest at the end of the 17th century.²⁹

Parish records show Jean Demary and his family in the social life of Réalcamp parish, and provide glimpses of his beadmaking activity in the upper Yères valley. On 13 December 1691, he was in Réalcamp at the funeral of

Anthoinette Moret, wife of Alexandre Tuterel who worked as a stoker at Les Essartis.³⁰ On 26 November 1697, he and his son “Baptiste” witnessed the wedding of Jacques Frete and Marie Pruvost, daughter of a Réalcamp shoemaker.³¹

On 23 March 1700, Jean Demary attended the wedding of his son Jean-Baptiste at Villers-sous-Foucarmont, an event that reveals the following generation of beadmakers in Eu County.³² The parish record identifies the groom as a 30-year-old enameller residing at Les Essartis, and the bride, Anne, as the daughter of the late Hugues Louiller, a plowman at Villers-sous-Foucarmont.³³ Thus, we learn that a son of Jean Demary worked as an enameller at Les Essartis glassworks, presumably trained and supervised by his father.³⁴ The young couple’s first child was born on 15 December 1700 at Villers-sous-Foucarmont in the home of the bride’s mother, Marie Vassel. Baptized Marie-Anne on 20 December, the infant’s godparents were Marie-Françoise de Bongard and chevalier Joseph de Virgille, son of François de Virgille, master of Les Essartis glassworks.³⁵ At this time, Jean-Baptiste Demary still lived in Les Essartis. Another child arrived on 15 January 1702. Jean-Baptiste junior’s godfather was his grandfather Jean, “enameller residing at Les Essartis,” and his godmother was Marie-Charlotte Roussel of Villers-sous-Foucarmont parish.³⁶ Four more children followed, whose names widen our knowledge of the Demary family: 1) Nicolas (1703-1713), whose godparents were Nicolas Lhuillier and Angélique Demary, his aunt; 2) François-Joseph, born in 1706, whose godparents were messire François de Bongard, Sieur du Val-Danois, master of the Val d’Aulnoy glassworks (Le Vaillant 1873:169), and demoiselle Marie-Anne-Charlotte de Virgille;³⁷ 3) Antoine-Élie, born in 1708, whose godparents were the parish priest and demoiselle Marie-Marguerite Poulter;³⁸ and 4) Marie-Rose, born about 1716, known from her marriage in 1735 at Villers-sous-Foucarmont to Nicolas Lecompte of Dancourt parish, witnessed by her parents and brothers Jean-Baptiste and François-Joseph.³⁹

Around the time his second child was born in 1702, Jean-Baptiste Demary moved from Les Essartis hamlet to Villers-sous-Foucarmont. He may have equipped his residence with an enameling workshop, which would explain the archaeological discovery of glass rods and beads in this village. We know that two of his sons, Jean-Baptiste junior and François-Joseph, attended their sisters’ marriages in Villers-sous-Foucarmont, Marie-Anne’s in 1732 and that of Marie-Rose in 1735.⁴⁰ While Jean-Baptiste junior remained single, François-Joseph married Elisabeth Varambault at Dieppe in 1733 and Marie-Catherine Delagrave at Croixdalle in 1736.⁴¹ At his second marriage, François-Joseph was identified as a merchant, his wife as an innkeeper, and both lived at Foucarmont. Jean-Baptiste

junior attended the wedding and signed as a merchant enameller residing at Villers-sous-Foucarmont.⁴² Thus, we know three generations of Demary patenôtriers: Jean who lived at Les Essartis, his son Jean-Baptiste who lived and worked at Villers-sous-Foucarmont, and Jean-Baptiste junior who doubtlessly worked with his father. As for François-Joseph, the marriage act only identifies him as a merchant and we do not know if he specialized in beads or other enamelware. Jean-Baptiste senior died on 16 May 1741 at Villers-sous-Foucarmont, and his son François-Joseph two years later in 1742 at Foucarmont at the age of 36.⁴³ Jean-Baptiste Demary junior witnessed both funerals and died on 16 May 1747 without leaving any descendants, marking the end of the Demary line of *patenôtriers* at Villers-sous-Foucarmont.⁴⁴

THE END OF BEADMAKING IN THE EU FOREST

By 1725, the crystal-making furnace at Les Essartis had fallen into disuse and no longer produced beadmaking tubes (Le Vaillant 1873:197). Joseph de Virgille was therefore the last to make glass at Les Essartis before retiring to his estate of La Vicogne in Picardie. His son and inheritor, François-Ovide de Virgille, was at Réalcamp in 1740, but he seems not to have restarted the plant. François-Ovide died at La Vicogne in 1748.⁴⁵ Thus, from the closure of Les Essartis prior to 1725 until the death of Jean-Baptiste Demary junior in 1747, we have no indication of the production of crystal beadmaking tubes in the Eu Forest.

Possibly, the small crystal works at Le Courval, near Guimerville, supplied tubes and rods for fashioning beads. This plant still operates today. A descendant of Italian glassmakers, François-Vincent Ponte, who was at Les Essartis in 1716, worked at Le Courval in 1723.⁴⁶ Two glassmakers from Languedoc, Louis de Gabet of Aix-en-Provence and a certain sieur de Virgille des Fieffes, worked at Le Courval in 1727.⁴⁷ Some employees from Les Essartis gravitated toward Le Courval. Simon Grignard, son of Angélique Demary, worked at Le Courval as a laborer after Les Essartis shut down, while Jean-Baptiste Demary junior was at Guimerville in 1742 for the marriage of Simon Grignard’s daughter.⁴⁸ In 1769, the daughter of François-Ovide de Virgille de la Vicogne obtained permission to transfer the dormant Les Essartis privilege to a place called La Grande Vallée in the Upper Eu Forest. Marie-Louise-Angélique de Virgille built a new furnace that began producing bottles in 1778, but for unknown reasons she did not exercise her hereditary right to make crystal (Le Vaillant 1873:198). Other small glassworks appeared in the last quarter of the 18th century, but evidence of beadmaking in the upper Yères valley ceases in 1747 with the death of Jean-Baptiste Demary junior, without any descendants to pursue his *métier*.

CONCLUSION

While this study is limited to a single beadmaking family, it has greater significance for the history of this craft in northern France. Beadmaking was dependent on crystal or soda glassmaking, an industry contested by Mediterranean and Norman artisans within the restricted privilege system. The Saint-Sever crystal works may have supplied materials for Rouen *patenôtriers*, but its monopoly for all of Normandy prevented crystal making and beadmaking from expanding outside of Rouen. A change of ownership in 1634 pushed the former staff of glassmakers from Languedoc and Altare out of Normandy. These artisans founded a crystal glassworks in Eu County, outside the monopoly territory, in the Altarese tradition of setting up soda glassmaking cells in France. About 30 years later, in 1659-1664, the breakup of the Saint-Sever monopoly and the ensuing expansion of crystal glassmaking into rural Normandy rejuvenated crystal glassmaking in Eu County. The same ruralization may have affected Rouen *patenôtriers* and motivated Jean Demary's move from Rouen to Eu County, where he joined the Altarese cell which left Saint-Sever in 1634.

Three generations of Demary beadmakers and enamellers worked in the Eu Forest from the late 17th century to the middle of the 18th century. Jean Demary, a master beadmaker and Rouen bourgeois, moved to Eu County at some time between 1665 and 1687. He lived for at least 20 years at Les Essartis where he made tubes, rods, and beads. In migrating to Eu County, Jean Demary may have followed the advice of Henri de Virgille, a former glassmaker at Saint-Sever who founded a crystal glassworks in the Eu Forest in 1634. The Virgille family still owned this plant at its later locations at Saint-Sylvestre and Les Essartis. Jean Demary's son Jean-Baptiste made beads after 1702 in his own workshop at Villers-sous-Foucarmont, likely using tubes and rods from Les Essartis. After this crystal works closed around 1723, Jean-Baptiste may have obtained his materials from a new plant at Le Courval until his death in 1741. Finally, Jean-Baptiste junior continued the *métier* in Villers-sous-Foucarmont until 1747.

The activity of Jean-Baptiste Demary senior and junior at Villers-sous-Foucarmont elucidates the mystery of glass beads and tubes found in this village in the 19th century. Nevertheless, questions remain about the origin of beads reported at Aubermesnil-aux-Érables and Foucarmont by abbot Decorde.⁴⁹ As well, we do not know if there were other beadmaking or enameling workshops in the Eu Forest, e.g., at Le Courval glassworks for which we have no material evidence. Finally, we may ask whether beadmaking took place in Eu County before the last quarter of the 17th century. According to Onésime Le Vaillant de la Fieffe, the Flamets glassworks began producing crystal in the 15th

century and beadmaking could have occurred by the late 16th century. Unfortunately, we have no archival sources for this period, and only archaeological study can verify this hypothesis.

ENDNOTES

ADSM: Archives départementales de la Seine-Maritime, Rouen.

ADS: Archives départementales de la Somme, Amiens.

1. Onésime Le Vaillant de la Fieffe cites the cession of the Saint-Martin-au-Bosc glassworks in 1441 to Richard and Colart Brochart (Brossard) (Le Vaillant 1873:154).
2. Glassworks that made window glass.
3. Commonly called *petites verreries* as opposed to *grosses verreries*.
4. The Yères River flows into the Channel, and rises in the Lower Eu Forest in the territory of Aubermesnil-aux-Érables.
5. Vincenzo Buzzone and Tommaso Bertoluzzi (Maitte 2012:105); "...*verre de cristal, verres dorés, émaux et autres ouvrages qui se font à Venise et autres lieux et pays étrangers, et autres qu'ils pourront de nouveau inventer*" (Gerspach 1885:234).
6. François de Garsonnet, esquire (*écuyer*) of Aix, officer of the Master of Ports, Bridges, and Passages of Provence, ceded his office to his brother Charles in 1599 and learned the art of glassmaking. He then left for Rouen where he obtained royal letters on 27 April 1605, granting him permission to found a crystal glassworks in the Saint-Sever suburb. Destroyed by fire the following year, the establishment was quickly rebuilt. Garsonnet ceded his enterprise on 19 January 1619 for the amount of 7,500 *livres tournois* and 22,000 *livres* of material, and returned to Aix where he died in 1638.
7. Edouard Gerspach (1885:234): "*les maistres du dict mestier pourront faire patenostres et boutons d'esmail et de verre, chaisnes, colliers et braceletz passantz par le feu et fourneau.*"
8. Jean and Pierre were the sons of Thibault d'Azémar and Jeanne des Roys in Uzès diocese. They belonged to an old noble family of Languedoc, a branch of the Viscounts of Toulouse (Aubert and Badier 1863:145-153).
9. Glass blown *en couronne* or *en plateau*, also known as the Norman technique.

10. The former village of Essarts-Varimpré, within the commune of Callengeville.
11. ADSM, 3E-111, parish registers of Réalcamp, 1710-1721.
12. ADSM, 3E-111, parish registers of Réalcamp, 1710-1721.
13. Jean-Eugène Decorde (1811-1881) was a priest in the diocese of Rouen (ordained in 1835), at Bures (1836-1870), and at Notre-Dame-d’Aliermont (1870-1881). Blangy-sur-Bresle is the *chef-lieu* of the canton of Aubermesnil-aux-Érables and Villers-sous-Foucarmont.
14. Decorde cites the names of MM. Cahingt, Dubois, and Desvaux. The 1846 census of Aubermesnil-aux-Érables names a certain Cahingt, farmer, owner of lot number 93, and Joseph Déveaux, owner and annuitant at number 124. ADSM, 6M-76, population census of Aubermesnil-aux-Érables, 1846.
15. Jean-Benoît-Désiré Cochet (1812-1875) was a priest assigned to Saint-Jacques de Dieppe, but notably an archaeologist, prehistorian, and inspector of historic monuments. Many consider him a founder of archaeology as a scholarly discipline in France.
16. Onésime Le Vaillant de la Fieffe (1802-1875), royal notary, descended from the families of *gentilhomme* glassmakers who enjoyed the right to make flat glass.
17. ADSM, 3E-999, parish registers of Fromentel abbey, Foucarmont, 1700-1709.
18. ADSM, 3E-999, parish registers of Rouen Saint-Maclou, marriages, 1646-1650.
19. The City of Rouen declassified the Impasse des Patenôtriers in 1853 (Tanguy 2013).
20. ADSM, 3E-999, parish registers of Rouen Saint-Maclou, baptisms, 1660-1662; ADSM, 3E-999, parish registers of Fromentel abbey, Foucarmont, 1680-1693.
21. The name Baptiste certainly served to differentiate him from his father; ADSM, 3E-999, parish registers of Rouen Saint-Maclou, baptisms, 1665-1667.
22. The stokers were in charge of the furnace. A team of four worked under the master stoker. The under-stoker (*sous-tiseur*) assisted the master, while the stoker (*tiseur*) looked after the smelting of glass raw materials. The day stoker (*tiseur de journée*) and the relay stoker (*tiseur de relais*) controlled the furnace’s heat, the former during the day and the latter at night. ADSM, C-2095, tax rolls of the parish of Réalcamp 1695-1696.
23. ADSM, 3E-111, parish registers of Réalcamp, 1691-1698.
24. ADSM, 3E-999, parish registers of Rouen Saint-Maclou, baptisms, 1700-1703.
25. The name seems common in Normandy and we find no relation between Anne Le Vaillant and the glassmaking family.
26. ADSM, 3E-999, parish registers of Fromentel abbey, Foucarmont, 1695-1699: “*Maître Jean De Mary, bourgeois de Rouen, maître patenôtrier demeurant en la verrerie des Essartis.*”
27. ADSM, 3E-999, parish registers of Fromentel abbey, Foucarmont, 1700-1709.
28. ADSM, C-2400, tax rolls of the parish of Réalcamp, 1694; ADSM, C-2095, tax rolls of the parish of Réalcamp, 1695-1696.
29. ADSM, C-2095, tax rolls of the parish of Réalcamp, 1695-1696.
30. ADSM, 3E-111, parish registers of Réalcamp, 1691-1698.
31. ADSM, 3E-111, parish registers of Réalcamp, 1691-1698.
32. Jean-Baptiste also appears as Baptiste or Jean in the acts.
33. ADSM, 4E-1410, parish registers of Villers-sous-Foucarmont, 1700-1709.
34. Denis Diderot (1765:168) defines *patenôtrier* as follows: “Patenotrier, s. m. (Enameler). Worker who makes & sells *patenôtres*. In Paris there are three different communities of *patenôtriers*, one of which is called *patenôtriers* and button makers in enamel, glass & crystal; they are ordinarily called enamellers; in 1706 they joined the community of master glassmakers and faience merchants” (our translation).
35. ADSM, 4E-1410, parish registers of Villers-sous-Foucarmont, 1700-1709.
36. ADSM, 4E-1410, parish registers of Villers-sous-Foucarmont, 1700-1709.
37. Known as Charlotte de Virgille, wife of Jean de La Mérye.
38. ADSM, 4E-1410, parish registers of Villers-sous-Foucarmont, 1700-1709.
39. ADSM, 4E-1410, parish registers of Villers-sous-Foucarmont, 1730-1739.

40. ADSM, 4E-1410, parish registers of Villers-sous-Foucarmont, 1730-1739.
41. ADSM, 3E-999, parish registers of Dieppe Saint-Rémy, 1733; ADSM, 3E-230, parish registers of Croixdalle, 1723-1739.
42. ADSM, 3E-230, parish registers of Croixdalle, 1723-1739.
43. ADSM, 4E-1410, parish registers of Villers-sous-Foucarmont, 1740-1751.
44. ADSM, 4E-964, parish registers of Foucarmont, 1736-1769; ADSM, 4E-1410, parish registers of Villers-sous-Foucarmont, 1740-1751.
45. ADS, 5MI_D664, parish registers of La Vicogne, 1602-1768.
46. ADSM, 3E-109, parish registers of Guimerville, 1722-1739.
47. ADSM, 3E-109, parish registers of Guimerville, 1722-1739.
48. ADSM, 3E-109, parish registers of Guimerville, 1740-1750.
49. Due to the Covid-19 epidemic, many Departmental Archives in France interrupted their service in 2020-2021, making it impossible to carry out the complementary research needed to fully develop some of the points raised in this paper.

REFERENCES CITED

Aubert de La Chenaye-Desbois, François-Alexandre, and Jacques Badier

1863 *Dictionnaire de la noblesse*, Vol. 2. Schlesinger, Paris.

Cochet, Jean-Benoît-Désiré

1871 *Répertoire archéologique du département de la Seine-Inférieure*. Imprimerie Nationale, Paris.

Decorde, Jean Eugène

1850 *Essai historique et archéologique sur le canton de Blangy*. Chez A. Lebrument, Rouen.

Diderot, Denis

1765 *Encyclopédie ou dictionnaire raisonné des sciences, des arts et des métiers par une société de gens de lettres*, Vol. 12. Chez Samuel Faulche, Neufchâtel.

Estancelin, Joseph

1768 Collection de cartes concernant les forêts, triages et bois taillis du comté pairie d'Eu. Gravé par [Gobert-Denis] Chambon. Archives nationales de France; <https://gallica.bnf.fr/ark:/12148/btv1b8452137f/f1.item>, accessed 10 June 2021.

Gerspach, Edouard

1885 *L'art de la verrerie*. Maison Quantin, Paris.

Haudicquer de Blancourt, Jean

1697 *De l'Art de la verrerie*. Chez Jean Jombert, Paris.

Karklins, Karlis and Adelphine Bonneau

2019 Evidence of Early 17th-Century Glass Beadmaking in and around Rouen, France. *Beads: Journal of the Society of Bead Researchers* 31:3-8.

Le Vaillant de la Fieffe, Onésime

1873 *Les verreries de la Normandie. Les gentilshommes et artistes verriers normands*. C. Lanctin, Rouen.

Loewen, Brad

2019 Glass and Enamel Beadmaking in Normandy, Circa 1590-1635. *Beads: Journal of the Society of Bead Researchers* 31:9-20.

Maitte, Corine

2012 *Les chemins de verre. Les migrations des verriers d'Altare et de Venise (XVIe-XIXe siècles)*. Presses de l'Université de Rennes, Rennes.

Tanguy, Jacques

2013 *Les rues et les places de Rouen*. www.rouen-histoire.com, accessed 10 June 2021.

Vanriest, Elise

2020 Verre et verriers à Paris et en Île-de-France dans la seconde moitié du XVIe siècle (1547-1610): Production, commerce, usages. PhD dissertation. École nationale des Chartes, Université de Paris, Paris.

2021 Glass Beadmaking and Enamel Lampwork in Paris, 1547-1610: Archival and Archaeological Data. *Beads: Journal of the Society of Bead Researchers* 33:45-53.

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GLASS BEADMAKING AND ENAMEL LAMPWORK IN PARIS, 1547-1610: ARCHIVAL AND ARCHAEOLOGICAL DATA

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Translated by Brad Loewen

This article presents beadmaking in Paris during the second half of the 16th century as seen through period documents and artifacts. Parisian archives document beadmaking by artisans called patenôtriers who made a wide range of glass buttons and jewelry, including beads. Records of the patenôtriers' guild provide an idea of the number of artisans engaged in this activity, while notarial contracts and estate inventories reveal individual careers and the material dimension of beadmaking in Paris. Patenôtriers obtained their materials – soda glass and enamel supplied as tubes, rods, or ingots – from glassmakers in rural France, Altare in Italy, and a small glassworks that operated in the suburb of Saint-Germain-des-Prés in 1598-1608. They exported rosary beads to Iberia and trade beads to North America. In European terms, Paris was a major beadmaking center during the 16th century and we know its products from a small number of archaeological finds and museum holdings.

INTRODUCTION

Glass beadmaking in Paris developed considerably from the middle of the 16th century. This activity gained a professional stature in 1566 with the creation of the “enamel and glass beadmakers and buttonmakers guild” (*patenôtriers et boutonnières d'émail et de verre*), with statutes that defined the skills and the products made and sold by these artisans. Other related artisans, described by Laurier Turgeon (2001, 2019), specialized in working other materials such as coral, jet, horn, and bone. The production of glass beads and buttons was not a new activity in Paris, as archives show enamellers and button makers there before 1566 with apparently the same skills, but the trade greatly expanded thereafter. At the end of the 1580s, elections for the four guild officers, which elected two master artisans at a time, attracted from 28 to 37 voters, giving us an idea of the size of the community of enamel *patenôtriers*.¹

Patenôtriers were producers, but their statutes also allowed them to sell glass merchandise, notably bottles covered in wicker that had a good market. This activity

put them in competition with merchant glassworkers specializing in wickering bottles (*marchands verriers couvreurs de bouteille en osier*), a separate but related guild that obtained its statutes in 1583. Conflicts erupted during the second half of the 16th century as these guilds opposed each other in court over the right to sell glass products. Despite these frictions, the artisans formed a common “glass community.” *Patenôtriers* and merchant glassworkers were frequently friends, neighbors, and even relatives.

This article builds on Laurier Turgeon's study of 16th-century beadmaking in Paris and the export of these objects to North America. It presents new information gathered for my doctoral dissertation, “Verre et verriers à Paris et en Île-de-France dans la seconde moitié du XVI^e siècle (1547-1610): production, commerce, usages” (Vanriest 2020). It uses postmortem inventories available in print or manuscript form, and notarial contracts, as well as archaeological finds from the Cour Napoléon and the Cour Carré at the Louvre Museum, which complement the beads found nearby at the Jardins du Carrousel that Turgeon studied. These three sites have yielded the vast majority of post-medieval glass beads presently known in France (Dussubieux and Gratuze 2012).

THE PRODUCTS OF THE *PATENÔTRIERS*

The guild statutes of 1566, promulgated by Charles IX, regulated the activity of the Paris enamel beadmakers and buttonmakers and listed the products they could make. Article 15 states that they could fabricate and sell in Paris “all kinds of beads, enamel buttons, gilded glass and enamel” and more generally, “all other kinds of works belonging to and depending on the said *métier* passing through fire and ovens, made in enamel, *canon*, crystal, and all other kinds.”² Article 16 further stipulates that “the masters of the said *métier* may string all kinds of belts, chokers, chains, necklaces, bracelets, beads, drawstrings, rosaries, and all other sorts of products resulting from the said *métier* of *patenostrier*.”³

Thus, the guild members were more than mere makers of beads, buttons, and rosaries. All lampworked glass objects – that is, fashioned at the flame of a lamp equipped with bellows, to melt rods of colored glass – were subject to their knowledge and skills.

In the vocabulary preserved in the archives, “enamel” includes opaque glass, while “glass” and “crystal” refer to transparent glass, colored or uncolored. A 16th-century book of Venetian glass recipes explains that the main difference between enamel and glass lies in the presence or absence of *lattimo*, i.e., white glass opacified with tin oxide (Moretti and Toninato 2001:32). Crystal (*cristallin*, from *verre cristallin*) made in the manner of Venetian *cristallo* was glass of superior quality. It was colored or uncolored, and made with soda flux that imparted the greatest purity and transparency to the vitreous material. Its quality was reflected in its price. In Jeanne Gourlin’s boutique, crystal tubes and rods sold at 10 *sous* a pound, whereas enamel tubes and rods were five times cheaper at only 2 *sous* a pound.⁴

We will begin by revisiting bead types, the *patenôtriers*’s main product that went into the assembly of jewelry, rosaries, and clothing adornments. Laurier Turgeon (2001) noted several in the postmortem inventories of *patenôtriers*. Tubular beads called *canons* were round or square in section, and *grains* were barleycorn beads. *Olives* had an oval form, while “blackberries” (*mûres*) were rounder in form and covered with small nodes. Among the beads we may consider “teardrops” (*larmes*) and “flames” (*flamines*, *flambes*) inventoried in the shops of Dominique Le Sencier and Benoît Vincent.⁵ Examples were found at the Cour Napoléon (Figure 1). They were sewn onto clothing, as shown by an order sent by Marguerite de Valois to her mercer, Robert Foussart, in 1577.⁶ She purchased “a thousand teardrops and flames of black enamel” to decorate a dress and, a few months later, “nine dozen bunches of enamel tubular beads (*canons*), flames, and teardrops also to put onto the said dress.”⁷ Glass *paillettes* (small flat beads pierced in the middle) and *canetilles* were also embroidered onto clothing.⁸ Turgeon (2001:70) suggests that the enamel *patenôtriers* organized their guild and prospered during the second half of the 16th century precisely because of the fashion of decorating clothing with glass ornaments.

Paradoxically, few *patenôtriers* sold their products in their own shops. We see great quantities, however, passing through the hands of mercers. These merchants purchased glass and enamel beads (sometimes gilded or silvered) from *patenôtriers*, assembled them in lots, or combined them with other materials for sale. At his death in 1552, the mercer Claude Bobie possessed a stock of glass merchandise including 25 “cords of glass beads highlighted with gilded



Figure 1. Teardrop pendants of dark blue glass from excavations at the Cour Carrée, Paris (Louvre Museum, CC 0085) (all photos by author).

wooden beads,” and “thirty-six cords of enamel *patenostres* of several kinds and makes alternating with profiled jet and gilded *grains* of several kinds.”⁹ Beads were worn on strings or hooked onto belts, but only rosary beads were combined with a cross (Figures 2-3). Claude Bobie sold many “rosaries both in enamel and crystal of several kinds and colors, decorated with tassels and interspersed with gilded seed beads.”

Mercers also assembled glass beads and buttons onto *passementeries* (decorative trimming) and *boutonnieres* (decorative lapels). Alexandre Bardin’s boutique had “two packets of *boutonnieres* embroidered with tubular glass beads (*canon*)” and “fourteen lots of enamel *passementerie*, both lacy and plain, each lot containing four dozen.”¹⁰ Bernard Palissy, a Renaissance ceramicist known for his animal moldings and his research on enamel, took a dim view of glass buttons: “men today are embarrassed to wear them and say they are for fops, since they are so cheap”¹¹ (Palissy 2010:481).

Patenôtriers created jewelry, rings, earrings (Figure 4), necklaces called *carcans* worn high on the neck like chokers, as well as belts and bracelets (Figure 5). Not least, they made imitation gemstones. We find false garnets of



Figure 2. Devotional use of bead strands; detail of *Au Juste poids véritable balance* (1519) (courtesy Musée de Picardie, Amiens).

different colors in the boutiques of Dominique Le Sencier (green and yellow) and Jeanne Gourlin (green and red).¹² Benoît Vincent's production included "two and a half hundreds of imitation enamel agates" and "enamel chains made to look like lapis lazuli," as well as imitation pearls.¹³ These products recall the Venetian art of imitating agate and chalcedony as early as the mid-15th century, when Angelo Barovier is said to have perfected a glass recipe called *calcedonio* (Moretti and Toninato 2001:72).

Although enamel and glass were relatively inexpensive, the aristocracy did not disdain jewelry made from these non-precious materials. Mary Stuart, queen of Scotland and widow of the French king François II (d. 1560), owned several chokers and belts that alternated glass beads and crystal grains. She offered James Stuart, regent of Scotland from 1567 to 1570, a belt of green glass garnished with gold and porcelain grains (Robertson 1863:87, 120). An inventory of items in the deceased king's cabinet at Fontainebleau in January 1561 lists beads, including "three of blue glass," "a [pair] of enamel *turkins*," and "another ten of enameled crystal."¹⁴

Patenôtriers expanded their skills at the end of the 16th century and their product range diversified accordingly. In



Figure 3. Detail of the wedding of Macée and Gombaut showing the use of strands of beads (*Histoire de Robin et Marion, Gombaut et Macée*, Jehan le Clerc, Paris, 1581-1599).

1599, Pierre Ponchet the younger, king's counselor, placed an order with Louis Coufiat for a fountain "in the shape of a rock, made of several things including enamel, glass, shells, and others" to decorate the garden at his residence in Sèvres.¹⁵ The *patenôtrier* Benoît Vincent created glass and enamel figurines, including "eight gross of little enamel cupids" and "eight gross of small images of Our Lady, also in enamel."¹⁶ Excavations in the Cour Napoléon unearthed fragments of glass figurines; their opaque material fits the term "enamel" in records of the 16th and 17th centuries (Figure 6).



Figure 4. Acorn-shaped earring excavated in Paris (Louvre Museum, CN 1390).



Figure 5. Bracelet or necklace plates from the Cour Napoléon, Paris (Louvre Museum, CN 2503).

Finally, *patenôtriers* had the right to sell all kinds of glass merchandise, a prerogative they shared with bottle wickerers. These sales brought a considerable income and the most affluent *patenôtriers* all sold glass goods. Despite their differences in wealth, makers and merchants had many business and family ties that bound them into a single community. They lived and worked in the same neighborhoods around the parish churches of Saint-Nicolas-des-Champs and Saint-Sauveur, and along Rue Saint-Denis (Vanriest 2020:59 ff).



Figure 6. The head of a glass figurine, Cour Napoléon (Louvre Museum, CN 9564).

THE ORIGIN AND COMPOSITION OF ENAMEL

Most *patenôtriers* did not make the enamel they used to create beads and other objects. They purchased this raw material from glassworks in the form of rods, tubes, or ingots. One Parisian *patenôtrier* obtained his raw materials from at

least two suppliers and regions. In 1579, Claude Poissetz placed an order with Sébastien de Pelouze, a glassmaker at Plessis-d'Orin in Perche County, for 1500 pounds of enamel tubes or rods (*canon*) of five kinds: streaked white crystal, clear crystal, green, violet, and black.¹⁷ Two years later, he contracted Bernard Perrot, a glassmaker in Altare in northern Italy, for 2000 pounds of enamel tubes or rods (*canon*): 500 pounds of blue, 500 pounds of white striped, 500 pounds of solid white, 500 of green.¹⁸ Poissetz provided the Altare glassmaker with a sample of blue tubing with the desired size and color. His orders reveal the range of colors used to make beads in the last quarter of the 16th century.

Italian glassmakers installed in the Paris region likely supplied enamel to beadmakers. A glassworks founded in 1551 by Venetian artisans at Germain-en-Laye, near the royal residence, made enamel tubes and rods. In its final years, from 1572 to 1585, this operation had French owners and operators (Vanriest 2020, 2021). In the 1580s, two small workshops in the suburb of Saint-Germain-des-Prés, run by the Venetian Jean Marie (Zuan Maria) and the Italian Jacques Brambille, created enamels that they sold, in part, to goldsmiths.¹⁹

Our most extensive evidence is for a glassworks in Saint-Germain-des-Prés, operated by the Altarese glassmaker Jacques Sarode (Jacopo Saroldo) and his family from 1598 to 1608. Altare was the second glassmaking center in Italy, after Venice. Many Altarese glassworkers emigrated, principally to France, during the second half of the 16th century (Maitte 2009). The plant in Saint-Germain-des-Prés produced enamel ingots and its clientele included *patenôtriers*.²⁰ Sales mention black and blue enamel colored with *safre* (cobalt). We learn the composition of glass made in Saint-Germain-des-Prés from a large number of contracts for the purchase of raw materials. The plant's main product was soda glass, fluxed with barilla from Alicante in Spain, which arrived in Paris via Rouen and Saint-Malo (Girancourt 1886:71). The silica source was sand, stored in casks, although we do not know its precise origin. White sand often arrived in Paris by boat from Fontainebleau and by cart from Étampes, south of the city (Vanriest 2020).

Indirect evidence suggests that Venetian glass ingots might have been used to make some Parisian beads. In 1573, Jeanne Gourlin, the wealthy widow of merchant *patenôtrier* Bonaventure Morel, possessed "37 pounds of enamel marked with a siren." Glassworks stamped their mark on the ingots they made and sold, and it turns out that one Venetian glassworks specializing in fabricating enamels had a siren mark, "*alla Serena*" (Zechin 1987:186-187, 210). Its artisans created filigree glass and crystal *piastre*. We know that Jeanne Gourlin imported wares from Venice since her inventory lists 100,000 "glass imitation pearls from Venice" and 43,000 "*turquins façon de Venise*".

Some *patenôtriers*' workshops contained varying amounts of raw materials, suggesting the occasional on-site production of enamel. Jean Delamare had a stock of five tons of "Pieregot" rock, also called *pierre de Périgord*. This is manganese, added to glass in different amounts to produce colors from violet to black (Moretti and Toninato 2001:71). Delamare's workshop also stocked 22 pounds of violet tubes, 150 pounds of black tubes, and 2000 black and violet tubular beads, all made by him.²¹ The workshop had a mortar and pestle for crushing enamel. Dominique Le Sancier stored enamel wasters and colorants in his workshop: "sixteen hundredweight of rejected works as well as cobalt and manganese."²² In 1573, Jeanne Gourlin stocked large quantities of cobalt, including some in powder form.²³ The same year, Pierre Rogeret, a glass merchant, possessed 290 pounds of *piéregot* and 684 pounds of soda, for unknown purposes.²⁴ These are substantial amounts and Rogeret may have sold these raw materials to *patenôtriers* with whom he often did business, or to the Saint-Germain-en-Laye glassworks, the only furnace known to use soda flux at this time in the Paris region (Vanriest 2021).

Early references confirm that some *patenôtriers* made rods in their own workshops, without substantial glassmaking infrastructure. In 1552, Germain Gayant agreed to draw enamel tubes or rods (*canon*) of two different diameters for Bonaventure Morel.²⁵ In 1578, Jean-Baptiste de Calcano hired *patenôtrier* Nicolas Delahaye to build a furnace for making crystal and garnet tubes and rods, as well as violet, black, and white enamel.²⁶ This furnace must have been larger than the small clay ovens listed in *patenôtriers*' postmortem inventories (Figure 7). In 1572, Perrette Laboucle, widow of the merchant Zacharie Delahaye, hired a mason for several days to demolish and rebuild a "glassworks furnace to melt enamel."²⁷

Archival data suggest that most beads were monochrome. The most frequent colors were black (violet or very dark blue), violet, blue, and *turquin*, i.e., a turquoise color obtained through the addition of copper oxide (Dussubieux and Gratuze 2012:34). Claude Poissetz also made beads or buttons with a striped decoration. Some buttons had complex decoration, as in a contract drawn up by Marin Gosse and Sébastien Amaus for buttons "à

la moresque" and "à la damasquine."²⁸ Such Moorish and inlaid decoration with stylized floral motifs drew on Islamic themes that also influenced other 16th-century decorative arts, such as bookbinding, ivory carving, and goldsmithing (Gruber 1993:277-299).

Patenôtriers were authorized to add gilding and silvering to the objects they created. We find a clue to the gilding material from a goldsmith named Georges Jollivet who died in 1575.²⁹ Jollivet supplied his products to enamel *patenôtriers* Jacques Cottard, Germain Duval, and Marin Tournant. A list of goods sold by merchant mercer Alexandre Bardin includes chains of purple enamel "covered with gilded azure" and glass chains covered with "imitation silver."³⁰

BEAD AND BUTTON EXPORTS

Certain merchant *patenôtriers*, notably Jeanne Gourlin, sold their wares to dealers from Auvergne living in Thiers, Mauriac, Anglars, Drugeac, and other localities.³¹ In this region, Le Puy-en-Velay was a major pilgrimage center and a starting point on the Road to Santiago. It apparently had a thriving bead and rosary business. Patents held by Paris *patenôtriers* specify that their Auvergnat dealers traded into Spain, indicating that this country was an outlet for beads and rosaries made in Paris. As early as the 1560s, archives contain commercial contracts with Spain. In 1561, Marie Fleurette, the widow of Gilles Poissetz, sold enamel buttons made by her husband to Robert Petit, a merchant living in Spain.³² Diego Ratina, a merchant from Vitoria in Biscay, bought goods from Jeanne Gourlin in 1571.³³ Biscay was an important entry point for French merchandise into Spain until the 1570s and 1580s, when the Seville trade developed (Casado Alonso 2000:37).

Glass merchandise found its way to Spain by way of merchant houses that assembled lots of various goods made in Paris and shipped them to Basque merchants, who forwarded them to Portugal or Spain. In December 1605, the hardware dealer Hugues Beroult sold twelve gross of glass buttons to Vincent Cabannes, a Lisbon merchant.³⁴ The buttons, packed with guns, locks, rosaries, scissors, combs, mirrors, and other goods, were to be sent on to Spain. A few days later, a group of engravers, pinmakers, spectacle makers, mercers, and *pasementiers* consigned their wares to a Béarn merchant, Bernard Allonce, also for shipment to Spain. The goods formed a heterogeneous lot: pins, brass thimbles, pig-bristle brushes, etc. One of the producers was Guillaume Sornet, a *patenôtrier* in Rue Saint-Denis who contributed "eighty gross of glass enamel buttons," while the mercer Pierre Le Gendre placed "two gross of glass earrings" in the shipment.³⁵

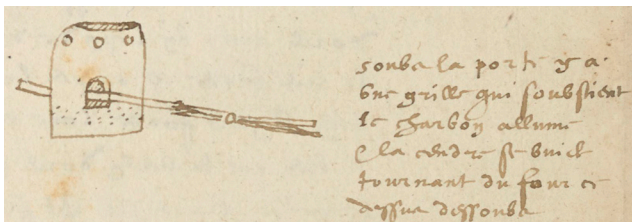


Figure 7. Small clay oven listed in the postmortem inventory of a Paris *patenôtrier* (B.N.F., ms. fr. 640, fol. 6v).

Some of these goods went on to Spanish colonies, like the lot of Parisian glass beads shipped to New Spain in 1590 (Martins Torres 2019:120). Parisian beads reached North America in the hands of French explorers and merchants. Jean Ribault and René Laudonnière, who established forts on the coast of Florida, Georgia, and South Carolina in 1562-1565, offered knives, axes, combs, mirrors, and glass beads to the Indigenous people (DePratter and Smith 1987:52, 54). In his study of notarial archives in Bordeaux, La Rochelle, and Rouen, Laurier Turgeon noted a dozen trading ships between 1558 and 1574 heading for the “coast of Florida” – which in this case possibly meant the Gulf of Maine. Marvin T. Smith and Mary Elizabeth Good (1982: Figures 6-7) have classified glass beads exported to Central and South America during the early Spanish colonial period. Many of these beads belong to a square-sectioned type called Nueva Cadiz, traded by Spanish merchants since the early 16th century. Their origin remains uncertain, and archaeologists have reported no examples in Spain, despite its major glass centers in Catalonia and Andalusia (Martins Torres 2019:136). Nor can we be certain that Venetian beadmakers made Nueva Cadiz beads, despite their production of chevrons called *rosettes* in notarial acts.³⁶ French workshops may have fabricated Nueva Cadiz beads in the early 17th century, based on an example found on the site of a *patenôtrier* workshop in Rouen (Karklins and Bonneau 2019: Figure 7). Similarly, the *canon bleu* (blue tubes or beads) that are often seen in contracts, while imprecise, may refer to the Nueva Cadiz beads found in the Americas and at the Cour Napoléon (Figure 8). While archaeology has not confirmed the fabrication of square-sectioned or Nueva Cadiz beads in Paris, archival sources raise this possibility.

Relations between Paris and Rouen *patenôtriers* were very close, and the goods made in each city were not very different. In 1593, Claude Poissetz supplied Dominique Le Sencier with enamel tubes or rods (*canon*) he had



Figure 8. Square-sectioned blue bead with a light gray core and ground corners, Cour Napoléon.

obtained from Rouen.³⁷ The Paris guild defended the Rouen *patenôtrier* Mathieu Delamare in 1613 in a lawsuit brought by the crystal glassmaker, François de Garsonnet, who argued that he had a monopoly over the production of enamel tubes and rods in Rouen. In his defense, Delamare cited the statutes of the Rouen *patenôtriers*, promulgated in 1593 and copied from those of Paris. The Paris *patenôtriers* affirmed “that since all time they had seen their predecessors make enamel and glass tubes of different colors, or made into rods and ingots for their use” (Girancourt 1886:74-75). The court ruled that Delamare could continue to make enamels for use by Rouen *patenôtriers* (Loewen 2019).

Canada appears as a market for French and Parisian beads. In the first half of the 16th century, the explorer Jacques Cartier gave beads to the Indigenous people he met in Canada. Returning from an excursion up the Saguenay River in 1541-1542, one of his captains offered knives and glass *patenôtres* to the inhabitants of Stadacona (Cartier 1545:14v). In 1565, the La Rochelle ship *L'Aigle* left with a load of trade goods including white glass beads called *marguerites* and blue tubular beads (*canons*) to trade with the First Nations (Turgeon 2001:75). Basque and Breton commerce in the Saint Lawrence estuary burgeoned in the 1580s. The Basque merchant captain Johannes Hoyarsabal bought 50,000 blue *turquin* beads – made in Paris, as we have seen – specifically for trade in Canada in 1587 (Turgeon 2019:196). The Paris merchant Charles Chelot supplied glass beads to merchants involved in the Canada trade, including Guillaume Delamare of Rouen, Samuel Georges of La Rochelle, and Pierre Bore of Bordeaux³⁸ (Turgeon 2019:190). Turgeon (2001:76-77) noted similarities between beads from the Jardins du Carrousel and about 400 examples (which he attributed to the Basque trade) from two Indigenous funerary sites at Pictou, Nova Scotia. These data reveal Paris as a major European beadmaking center that could compete with Amsterdam or Venice. Many aspects, however, need further clarification, such as the network of bead imports from Venice to France, or the final destination of French beads shipped to Spain.

CONCLUSION

Archival data show beadmaking in Paris within a larger industry of glass and enamel arts exercised by *patenôtriers* who prospered during the second half of the 16th century. In seeking a chronology of beadmaking in Paris, we see that records from the 1550s to about 1590 reveal several sources of tubes, rods, and ingots. We find Perche County west of Paris, small and medium-sized furnaces in Paris, Altare in northwest Italy, possibly Venice, and possibly a

soda glassworks known at Saint-Germain-en-Laye from 1551 to 1585. Glass merchants acquired soda, manganese, and cobalt from distant sources, and supplied these raw materials to local *patenôtriers*. Colors mentioned during this time include white, striped white, blue, violet, black, and green; we also find “garnets” in red, green, and yellow. Fancy “blackberries” had molded nodes. Other than striped white, we find no mentions of polychrome beads, although many references lack details. As for bead exports, Laurier Turgeon noted shipments via French ports to the Gulf of Maine and the Saint Lawrence estuary, and we find reference to French beads distributed from the Carolinas to Florida.

Beginning in the 1590s, the data highlight a diversity of products including beads to decorate clothing and for jewelry. From 1598 to 1608, an Altares glassworks in Saint-Germain-des-Prés produced soda glass and enamel. After 1590, records rarely note simple colors as in earlier decades, but mention imitation agates, pearls, lapis lazuli, and chalcedony made using elaborate recipes. At the same time, soda glassmaking and beadmaking appear in Rouen as outgrowths of the Paris industry. Paris *patenôtriers* found new outlets for their products as the pilgrimage market for rosaries blossomed. Large volumes of beads went to Iberia by way of dealers based in Auvergne, Béarn, and Biscay, or were shipped directly to Lisbon and Seville. While we cannot tell to what extent these archival trends reflect real changes, they appear to show an evolution in supply chains, products, and markets. We need more research to understand the continued evolution of Parisian *patenôtriers* in the 17th century.

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ENDNOTES

1. Registres d’élection du métier, Archives nationales de France (A.N. hereafter), Y 9306 A and B.
2. In 16th-century Parisian records, *canon* can denote rods, tubes, or tubular beads, depending on the context. *Canon* usually appears in singular form, as in a stock of rods, tubes, etc. Often, we can translate it as tubes. Where the context seems to indicate that *canon* signifies rods or tubular beads, we include *canon* in parentheses after our translation.

A.N., Y/6, 13 avril 1566: “...toutes sortes de patenostres, boutons d’esmail, dorreures sur vouaire et esmail;” “... toutes autres sortes d’ouvrages appartenans et deppendans

dudit métier passant par le feu et le fourneau, faictes tant d’esmail, canon, cristalin, que toutes autres sortes.”

3. “...pourront les maistres dudit mestier enfiller toutes sortes de saintures, carcans, chaisnes, colliers, braceletz, patenostres, cordelieres, chappeletz et toutes autres sortes d’ouvrages dependant dudit mestier de patenostrier.”
4. A.N., min. cent., IX/154, 20 octobre 1573.
5. A.N., min. cent., I/52, 4 septembre 1591; I/41, 3 May 1603.
6. Marguerite de Valois, daughter of King Henry II and Catherine de Médicis, became the Queen of Navarre with her marriage to the future King Henry IV in 1572.
7. A.N., KK/162, fol. 465 and 623 verso: “...ung millier de larmes et flambes d’esmail noir;” “...neuf douzaines de bouquets de canons, flambes et larmes d’esmail aussi pour mettre sur ladite robe.” The plural *canons* appears to mean a bunch of tubular beads strung for sale.
8. A.N., min. cent., XCI/130, 7 avril 1584; I/41, 3 May 1603.
9. A.N., min. cent., LIV/215, 6 octobre 1552: “...cordes de canon de verre marquées de bois doré... trente six cordes de patenostres d’esmail de plusieurs sortes et fassons marquées de getz profilez et grains dorés de plusieurs sortes;” “... chappeletz tant d’esmail que cristalin de plusieurs sortes et couleurs garnis de houppes et marques et grains dorés pourfillez.”
10. A.N., min. cent., XXIV/123, 16 février 1606: “... deux paquetz de boutonnières en broderie de canon de verre;” “quatorze pieces de passemens d’esmail tant dentelle que plain contenant chacune piece quatre douzaines.”
11. “...qu’aujourd’huy les hommes ont honte d’en porter et disent que ce n’est que pour les belistres, parce qu’ils sont à trop bon marché.”
12. A.N., min. cent., I/52, 4 septembre 1591; IX/154, 20 October 1573: “...deux cens et demy d’agattes fausses d’esmail;” “chesnes d’esmail fasson de lapis.”
13. A.N., min. cent., I/49, 3 mai 1603.
14. B.N.F., ms. fr. 4732, n° 808: “...troys de verre bleu;” “...une [paire] d’esmail turquin;” “...ung autre [dizain] de cristalin esmaillé.”
15. A.N., min. cent., III/462bis, 17 septembre 1599: “...en forme de rocher et ce, de plusieurs sortes, tant d’esmail, verre, coquilles que aultres choses.”

16. A.N., min. cent., I/41, 3 mai 1603: "...*huict grosses de petitiz cupido d'email*;" "...*huict grosses de petites ymaiges de notre dame aussy d'email*."
17. A.N., min. cent., IX/96, 22 septembre 1579. Plessis-d'Orin is located 100 km southwest of Paris, in the glassmaking region of Alençon duchy.
18. A.N., min. cent. I/6, 1 avril 1581.
19. A.N., min. cent., LIV/205, 1 août 1581, and LIV/225, 19 janvier 1583.
20. A.N., min. cent., XLIX/234, 7 juillet 1598, fol. 362.
21. A.N., min. cent., IX/155, 22 novembre 1573.
22. A.N., min. cent., I/52, 4 septembre 1591: "...*seize cens livres pesant, tant œuvres en dechet que saffre et pierregot*."
23. A.N., min. cent., IX/154, 20 octobre 1573.
24. A.N., min. cent., XCI/124, 11 mars 1573.
25. A.N., min. cent., XCI/29, 11 août 1552.
26. A.N., min. cent., CXXII/1472, 27 septembre 1578.
27. A.N., min. cent., IX/75, 10 avril 1572.
28. A.N., min. cent., CXXII/1355, 1 avril 1565.
29. A.N., min. cent., XCI/126, 16 avril 1575.
30. A.N., min. cent., XXIV/143, 16 février 1606.
31. A.N., min. cent., IX/154, 20 octobre 1573.
32. A.N., min. cent., IX/141, 17 janvier 1562 [n.s.].
33. A.N., min. cent., IX/154, 20 octobre 1573.
34. A.N., min. cent., XV/15, 19 décembre 1605.
35. A.N., min. cent., XV/15, 31 décembre 1605.
36. In 1601, the Flemish merchant Carlo Helman shipped 1415 pounds of *rosettes* from Venice to Cadiz, among other types of glass beads (Brulez 1965:400, no. 1211).
37. A.N., min. cent., I/21, 28 août 1593.
38. A.N., min. cent., X/13, 21 juin 1610.

REFERENCES CITED

Brulez, Wilfred

- 1965 *Marchands flamands à Venise, Vol. I: 1568-1605*. Institut historique belge de Rome, Rome.

Cartier, Jacques

- 1545 *Brief recit de la navigation faicte ès ysles de Canada*. Roffet and LeClerc, Paris.

Casado Alonso, Hilario

- 2000 Le commerce des 'marchandises de Bretagne' avec l'Espagne au XVI^e siècle. *Annales de Bretagne et des Pays de l'Ouest* 107(2):29-50.

DePratter, Chester B. and Marvin T. Smith

- 1987 Sixteenth Century European Trade in the Southeastern United States: Evidence from the Juan Pardo Expeditions (1566-1568). *University of South Carolina, Institute of Archeology and Anthropology, Notebook* 19(1-4):52-61.

Dussubieux, Laure and Bernard Gratuze

- 2012 Chemical Composition of 16th- to 18th-Century Glass Beads Excavated in Paris. *Beads: Journal of the Society of Bead Researchers* 24:26-38.

Girancourt, Alexandre de

- 1886 *Nouvelle étude sur la verrerie de Rouen et la fabrication du cristal à la façon de Venise aux XVI^e et XVII^e siècles, précédée d'une introduction*. Imprimerie d'Espérance Cagniard, Rouen.

Gruber, Alain (ed.)

- 1993 *L'Art Décoratif en Europe. Renaissance et Maniérisme*. Citadelles and Mazenod, Paris.

Karklins, Karlis and Adelphine Bonneau

- 2019 Evidence of Early 17th-Century Glass Beadmaking in and around Rouen, France. *Beads: Journal of the Society of Bead Researchers* 31:3-8.

Loewen, Brad

- 2019 Glass and Enamel Beadmaking in Normandy, circa 1590-1635. *Beads: Journal of the Society of Bead Researchers* 31:9-20.

Maitte, Corine

- 2009 *Les Chemins de verre. Les migrations de verrier d'Altare et de Venise (XVI^e-XIX^e siècle)*. Presses universitaires de Rennes, Rennes.

Martins Torres, Carla Andreia

- 2019 Lo que cuenta un abalorio: reflejos de unas cuentas de vidrio en la Nueva España. Ph.D. dissertation. Facultad de Geografía e Historia, Universidad Complutense de Madrid, Madrid.

Moretti, Cesare and Tullio Toninato

- 2001 *Ricette vetrarie del Rinascimento, trascrizione da un manoscritto anonimo veneziano*. Marsilio, Venice.

Palissy, Bernard

- 2010 *Discours admirable de l'art de terre, de son utilité, des esmaux et du feu*. Honoré Champion, Paris.

Robertson, Joseph

- 1863 *Meubles de la Royne d'Escoce, Douairiere de France. Catalogues of the Jewels, Dresses, Furniture, Books and Paintings of Mary Queen of Scots, 1556-1569*. The Bannatyne Club, Edinburgh.

Smith, Marvin T. and Elizabeth E. Good

- 1982 *Early Sixteenth Century Glass Beads in the Spanish Colonial Trade*. Cottonlandia Museum Publications, Greenwood, MS.

Turgeon, Laurier

- 2001 French Beads in France and Northeastern North America during the Sixteenth Century. *Historical Archaeology* 35(4):58-82.

- 2019 *Une Histoire de la Nouvelle France: Français et Amérindiens au XVIe siècle*. Belin, Paris.

Vanriest, Élise

- 2020 Verre et verriers à Paris et en Île-de-France dans la seconde moitié du XVIe siècle (1547-1610): production, commerce, usages. Ph.D. dissertation. Université de Paris, École nationale des Chartes, Paris.
- 2021 La Verrerie de Saint-Germain-en-Laye. In *Emailler le verre à la Renaissance*. Musée national de la Renaissance, Château d'Écouen, Écouen.

Zecchin, Luigi

- 1987 *Vetro e vetrai di Murano*, Vol. 1. Arsenale Editrice, Venice.

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A CHEMICAL COMPARISON OF BLACK GLASS SEED BEADS FROM NORTH AMERICA AND EUROPE

Danielle L. Dadiego

Analysis of the elemental composition of glass has gained traction over the past few decades. The growing interest and utilization of non-destructive and micro-destructive analytical techniques has allowed for a more in-depth understanding of glass production, distribution, and consumption. The analysis of glass trade beads in particular has led to the development of a chronological sequencing for non-diagnostic seed beads opacified with metal oxides as well as ore sourcing for cobalt-blue and red beads. There is deficient research on 18th-century glass bead composition, especially of black glass beads. This article explores the elemental composition of 149 black seed beads from three 18th-century sites in Pensacola, Florida, and compares the assemblage to a small sample of similar glass beads (N=11) recovered from two sites in the United States as well as three potential glass production centers in Europe.

INTRODUCTION

Glass beads were a major commodity for Native Peoples and are ubiquitous at European and Native archaeological sites in the southeastern United States. Analysis of glass bead assemblages has been used by archaeologists to construct basic temporal sequences, as well as to interpret aspects of Indigenous sites, such as traditions of adornment, value systems, social standing, exchange, group and personal identity, consumption, daily practice, and the nature of colonial entanglements (Francis 1988:292; Walthall 2015:259).

Among the great variety of glass bead forms, drawn glass seed beads are the most common and abundant. They are of either simple, compound, or complex construction and generally less than 4 mm in diameter, making them ideal for sewing onto clothing and other personal items or worn as adornment in the form of necklaces, wristlets, or anklets (Avery 2008:57; Blair 2015:91; Deagan 2002:131). Unfortunately, glass seed beads offer no physical diagnostic features to accurately assign them an origin of manufacture. Moreover, the common production of simple seed beads throughout Europe over a vast time span does not allow for

much interpretive insight into the trade and distribution of this bead form.

In recent years, research has shifted towards not only looking at the structure, manufacture, and morphology of beads, but also analyzing their chemical composition, opening avenues of inquiry into various aspects of their production and consumption that would normally be unattainable through physical analysis alone. These techniques can even give physically undiagnostic beads (like seed beads) much more data potential and could even evidence regional distribution based on the identification of compositional groups both within and between coeval archaeological sites. In terms of chemical variability, the wide distribution of glass trade beads makes them a useful indicator of participation in specific trade networks (Walder 2013:120).

The characterization and patterning of primary glass ingredients can also be used to identify the place of manufacture, the source of raw materials, and the evolution of glass recipes used (Blair 2017:32). The chemical composition of glass is an important source of information about the provenience of a single object, but it can also support knowledge about the technological history of glassmaking obtained from the technical literature and other historical documents in archives and libraries (Wagner et al. 2008:415). In recent studies, element chemistries of glass beads were used to sort beads into groups, using elemental concentration fingerprints (Karklins et al. 2001:188). These fingerprints can relate to glass recipes because they reflect not only batch composition, type of applied raw materials, or their source and method of preparation, but also the various technological conditions of glass production (Wagner et al. 2008:416). Additionally, ingredients and their shifting ratios to one another can function as temporal markers (Walder 2013:138).

In general, laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) is extremely useful for

analyzing any vitreous material (glazes and glasses). An abundance of chemical research has been conducted on white (Blair 2017; Hancock, Aufreiter, and Kenyon 1997), red (Sempowski et al. 2001), blue/turquoise (Hancock, Chafe, and Kenyon 1994; Walder 2018), and other colored beads (Burgess and Dussubieux 2007) recovered from archaeological sites in the United States and elsewhere using LA-ICP-MS and other methods like portable X-ray fluorescence (pXRF) and instrumental neutron activation analysis (INAA). There is, however, a dearth of information concerning the chemical composition of black glass, with the exception of a pXRF study by Robert B. Templin III (2017).

THE COMPOSITION OF BLACK GLASS

Common colorants in glass are transition metal compounds of iron, lead, tin, copper, and cobalt (Dussubieux 2009:101). In most cases, black glass is saturated with blue, green, brown, or violet pigment that gives it the appearance of opaque black (Dussubieux and Gratuze 2012). Violet glasses contain on average 1% manganese, but dark-glass samples have high concentrations of manganese ranging from 3.4% to 13% (Dussubieux 2009). In general, glasses high in manganese are also high in strontium, slightly elevated in barium, and lower in chromium and vanadium (Bertini et al. 2011). Barium is found in barium-manganese ores associated with pyrolusite which was used in glassmaking in the 17th century. The relationship between manganese and barium may also help identify the geographical region where the ore was sourced (Templin 2017). Another way to create black glass is to use nickel with cobalt, which also opacifies the glass. Adding nickel to heavily leaded glass or glass with potassium creates a violet to deep violet color, respectively (Weyl 1959). Iron concentrations are sometimes high in black glass especially for dark green or brown (Veritá and Zecchin 2008:112). For dark green, a raw tartar (potassium tartrate) decomposer is present in the glass melt and also acts as a reducing agent.

In addition to metal oxide colorants, several elements were used to opacify glass, including tin, antimony, arsenic, and lead. Using the chemical analysis of white glass beads from relatively well dated archaeological sites of the 17th-19th-centuries, researchers have been able to establish time periods during which the opacifying elements tin, antimony, and arsenic were used successively (Blair 2017; Hancock, Aufreiter, and Kenyon 1997; Hancock et al. 1999; Sempowski et al. 2000). Research suggests that early 17th-century tin-rich drawn beads were replaced sometime later in that century by antimony-rich beads, and this pattern is emulated in glass workshops all over Europe signifying an economic reason for the shift. This argument

has been strengthened by two studies of opacifying agents used in opaque white and black glass beads from a 17th-century Spanish site (Blair 2017; Templin 2017). The use of colorants and opacifiers facilitates the identification of chemical groups and subgroups within glass samples. Finer chemical groupings could come from a single batch of glass or from batches of glass made with similar proportions of ingredients, over a short period of time (Kenyon, Hancock, and Aufreiter 1995:329; Sempowski et al. 2001:513). Although little is known about black glass recipes, there is growing knowledge of the nature of bead production in major beadmaking centers in Europe.

THE SAMPLE SITES AND THEIR BEADS

The United States

During the 18th century, three presidios (fortified towns) were established as outposts of New Spain to protect the western extent of Spanish Florida from French and British encroachment and housed Spanish soldiers and residents. By the 1740s, two missions had been established for the Spanish-allied Apalachee and Yamasee Native groups living in the region (Figure 1). The Spanish missions of San Antonio de Punta Rasa and San Joseph de Escambe were both peripheral to direct Spanish control and proximal to French and British settlements. Their locations allowed them to act as trading hubs that moved supplies indirectly into presidios via access to Upper and Lower Creek trade networks. The Creek Native factions allied with the French, British, and Spanish depending on the benefits of the relationship. While the black glass beads from the Pensacola sites were made in various shapes using several production techniques, only drawn seed beads recovered from two presidios and one mission are reported here (Figure 2).

Presidio Santa Rosa de Isla (1722-1756) was the second iterative attempt by the Spanish to settle Pensacola Bay. Over 90% of the entire bead assemblage consists of drawn, monochrome, circular, heat-rounded seed beads. The most common colors are black, white (25.8%), and blue (24.2%). A sample of 41 black beads (Kidd and Kidd [2012] variety IIa7) was analyzed.

The occupation of Presidio de San Miguel de Panzacola (1740-1763) overlaps that of Santa Rosa. Over 80% of the entire bead assemblage consists of drawn, monochrome, seed beads. The principal colors are black (33%), white (24.2%), red (15.3%), and blue (12.5%). Thirty-eight black seed beads (IIa7) were sampled.

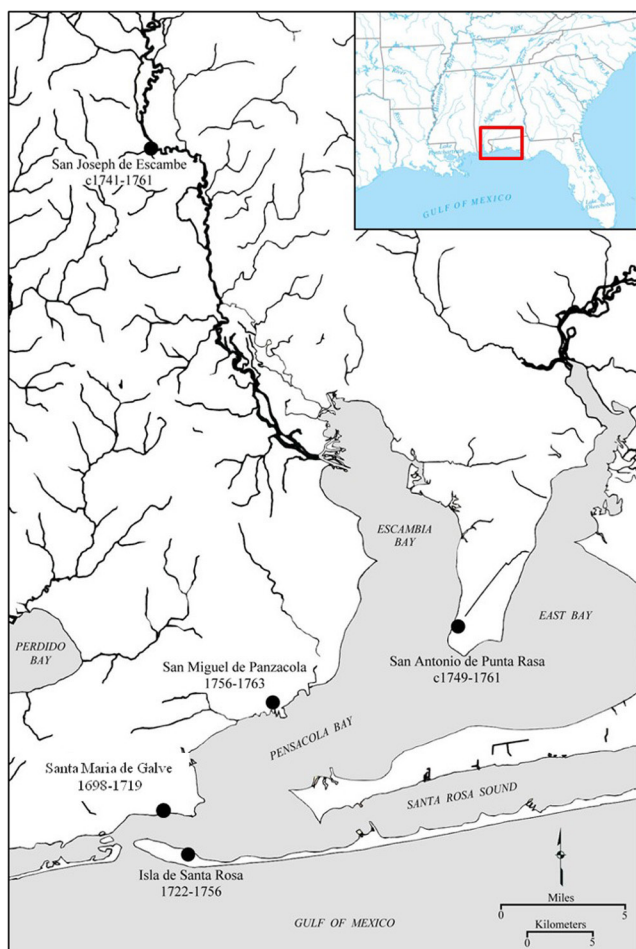


Figure 1. Locations of archaeological sites on Pensacola Bay, Florida (all images by author).

Mission San Joseph de Escambe was established upriver from San Miguel in 1741. Documentary sources imply that this was the new Apalachee mission under Chief Juan Marcos and lasted until 1761 when it was attacked by Creek raiders (Worth 2021). The entire glass bead assemblage (over 90%) is comprised of monochrome seed beads. Three colors dominate the assemblage and are equal in quantity: white (32.5%), blue (32.2%), and black (31.8%). Seventy black beads (IIa7) were sampled.

Chemical studies have also been conducted on drawn black beads from two late 17th-century French sites. Explorer Robert Cavalier Sieur de La Salle built a small fortification in the upper Illinois Valley in 1682 to establish a French foothold in the area (Walthall 2015). From 1680 to 1700, La Salle's mercantile system was the major source of goods, including glass beads, in the Illinois Country. The glass trade bead assemblage, dating to the 1682-1691 occupation of Fort St. Louis by La Salle's men, is dominated by very small and small monochrome beads in blue, white,

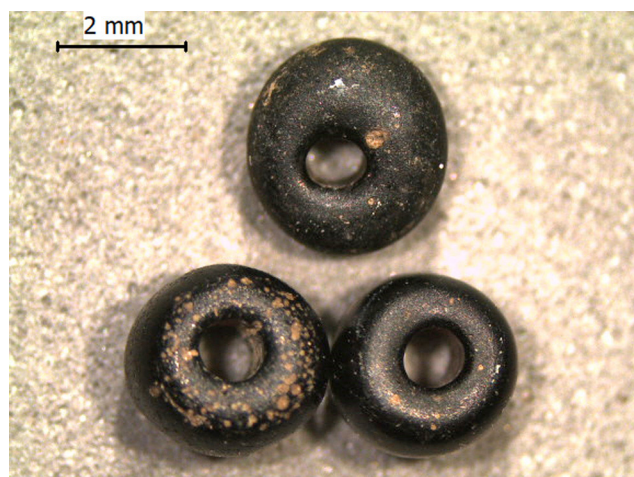


Figure 2. Black seed beads recovered from Pensacola sites (Prov #423-16).

and black (Walthall 2015:274). Walder (2015) sampled a black glass bead (IIa7) from Fort St. Louis during her dissertation research on opaque white and blue glass beads in the Upper Great Lakes region.

Another archaeological site within the French sphere is the wreck of *La Belle*, located off the Texas coast. During La Salle's expedition to establish a colony and a shipping port at the mouth of the Mississippi River, *La Belle* became stranded and was abandoned in February 1686 in Matagorda Bay (Bruseth 2017). There are roughly equal amounts of white, blue, and black beads, with very small quantities of green, yellow, and red (Avery 2008:59). The shipwreck yielded over 200,000 black seed beads, most described as Variety 2 (small, circular, simple, opaque black, Kidd and Kidd IIa7). Three black beads were analyzed using LA-ICP-MS and their chemical compositions were averaged and presented in parts per million (Perttula and Glascock 2017:522). Additionally, Walder (2015:648) sampled five black beads (IIa7) from the Upper Great Lakes region. Since her sample is presented in wt. % and ppm for each individual bead, her data will be used for comparisons.

Europe

Three archeological sites in Europe that have yielded black or dark-colored beads provide comparative compositional data. All three sites date to the 17th century, but only two have ICP-MS chemical data suitable for comparative analysis. While INAA analysis was conducted on 11 black beads (IIa6 and IIa7) recovered from beadmaking wasters in Amsterdam at site Asd-Kg10, now attributed to the period from 1621 to 1657 (Hulst 2013:28), black glass is difficult to analyze using this technique since

the manganese isotope (^{56}Mn) degrades the sensitivities of calcium, cobalt, and tin (Karklins et al. 2002:119). Due to this fact, and that only 11 elements were recorded, this study was not included in the comparison. Three of the total glass samples chemically analyzed with ICP-MS in a later study were drawn black beads (IIa7) (Dussubieux and Karklins 2016:578).

Two sites in France (Espace du Palais and Cours Napoléon) also yielded black glass beads that were chemically analyzed. Glass wasters recovered from Espace du Palais came from a small workshop that used oil lamps to make various ornaments from glass rods or tubes produced by other specialized shops (Dussubieux 2009:97). Two of the six dark-glass samples are round or barrel-shaped drawn beads (Dussubieux 2009:99). Formerly living quarters, Cours Napoléon is located where the glass pyramid of the Louvre Museum now stands (Dussubieux and Gratuze 2012:26-27). Most of the beads are small monochrome drawn beads with black specimens being the most common, followed by turquoise, colorless, and dark blue. Sixty-three beads and wasters from this site (and one other not reported here) were sampled using ICP-MS to determine their place of origin (Dussubieux and Gratuze 2012:26-27). Of the total artifacts sampled, three were black drawn beads. Only the two beads from Espace du Palais have full chemical data reported for comparative analysis (Dussubieux 2009:103).

COMPOSITIONAL ANALYSIS

Methods and Materials

The chemical composition of the black beads was determined using a Teledyne CETAC Analyte Excite 193 nm excimer laser ablation system attached to a Thermo XSERIES 2 inductively coupled plasma mass spectrometer located in the Plasma Analytics Laboratory at the University of California Santa Cruz. Analysis was conducted by the author and analytical protocols and calculation methods were adapted from Gratuze (1999). The isotope ^{30}Si was employed as an internal standard, and the standard reference materials NIST610 and NIST612 were used for external standardization, along with Corning glass standards B (soda-lime-silica glass), C (lead-barium glass), and D (potash-lime-silica glass). Two spots of 110 μm were tested on each bead and averaged against a gas blank. Data were collected on 55 elements.¹ The results obtained for each artifact were normalized to 100% (Gratuze, Blet-Lemarquand, and Barrandon 2001). All trace elements are presented in parts per million (ppm) and accuracy ranges from 5% to 10%, depending on the elements and their concentrations.

Analysis Results and Comparisons

Very little comparable chemical data exist for black beads in the current literature. Of the data that are available, the analytical methods and/or elements reported differ greatly, making it difficult, if not impossible, to provide a full comparison of bead compositional groups. Additionally, sometimes only one bead was sampled from a particular site making any comparisons highly speculative and not statistically significant. Another substantial drawback is the lack of contemporary comparative samples. Most of the reported black-glass samples in the literature range from the Roman period to the 17th century. The following discussion represents a preliminary comparison of the Pensacola beads to similar colored beads from other sites in the United States and Europe.

Fluxes and Stabilizers

A total of 149 black beads were sampled from presidios Santa Rosa and San Miguel, and mission Escambe. The beads from the Pensacola sites cluster in one broad compositional group based on their fluxes and stabilizers (Table 1) (Figure 3). They have magnesium, potassium, and alumina levels higher than 1.5%, indicating a soda ash derived from halophytic plants rather than a mineral-soda or wood-ash source. Furthermore, both titanium and uranium are under 0.5%, and zirconium levels are under 100 ppm (most are under 50 ppm). In summary, the Pensacola beads contain silica most likely obtained from Spanish or Italian beaches, are fluxed with soda derived from littoral plant ash, and stabilized with calcium. This composition tentatively attributes their manufacture to Italy based on Venetian soda-lime-alumina glass recipes.

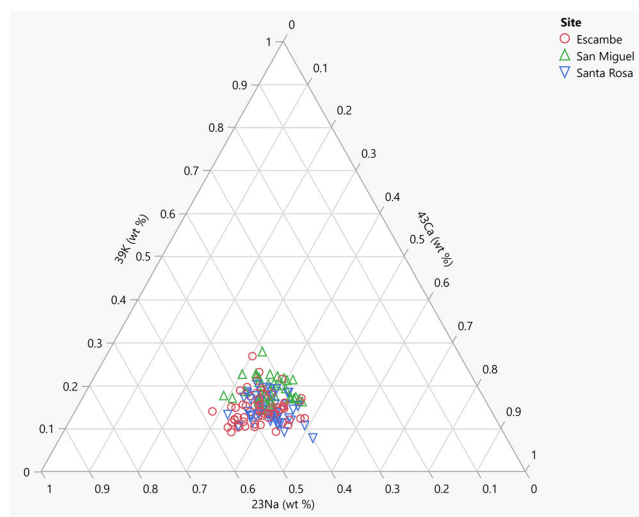
The black beads from San Miguel show less variation than those from Santa Rosa or Escambe. They contain less than 3% alumina, magnesium, and iron, whereas only a portion of the beads from Santa Rosa or Escambe show similar compositions (Figure 4). The San Miguel beads are well within the range of variation typical of Venetian soda-lime glass, but the tighter clustering indicates a single shipment of beads or perhaps a shift in the sand used to make the glass. The shift in materials could have become standardized by the 1740s, possibly indicating tighter trade restrictions for the Spanish presidio since the Escambe beads have more chemical variability in impurities associated with different silica sources.

The glass beads from *La Belle*, Espace du Palais, and Asd-Kg10 (with the exception of one bead) all cluster within the Pensacola bead assemblage, signifying a similar

Table 1. Means and Standard Deviations of Chemical Analyses.

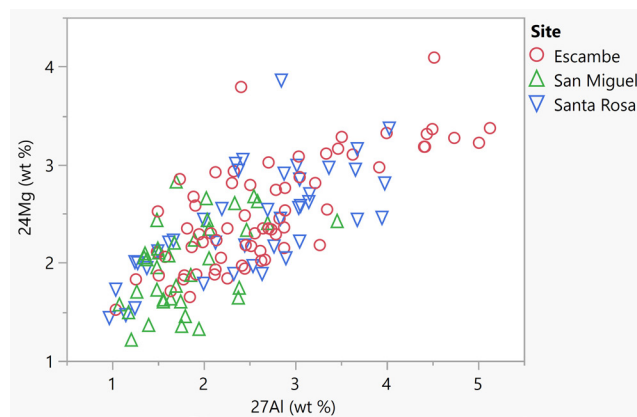
Means	Santa Rosa	San Miguel	Escambe	Standard Deviations	Santa Rosa	San Miguel	Escambe
Na ₂ O	10.69	10.06	10.79	Na ₂ O	1.16	1.02	0.77
MgO	2.42	1.98	2.51	MgO	0.53	0.43	0.55
Al ₂ O ₃	2.52	1.82	2.67	Al ₂ O ₃	0.86	0.50	0.94
SiO ₂	61.74	64.78	62.82	SiO ₂	3.33	2.04	2.44
P	0.65	0.75	0.62	P	0.11	0.19	0.10
K ₂ O	3.44	4.41	3.40	K ₂ O	0.92	0.77	0.90
CaO	9.35	8.78	8.78	CaO	1.02	1.13	1.33
Mn	6.26	5.48	5.74	Mn	2.89	1.90	1.59
Fe ₂ O ₃	1.53	1.17	1.62	Fe ₂ O ₃	0.61	0.40	0.62
Sb	0.43	0.11	0.20	Sb	1.09	0.08	0.14
PbO	0.41	0.19	0.31	PbO	0.40	0.22	0.34
n	41	38	70	n	41	38	70

chemical composition of soda-lime-alumina glass (Figure 5). The beads from these sites also have similar amounts of iron, magnesium, and aluminum compared to the Pensacola beads, which further corroborates their shared production origins. A closer inspection of the black beads from *La Belle*, Fort St. Louis, and Asd/Kg10 reveals all have slightly elevated soda and lime content in comparison with the Pensacola beads (Figure 6). This variation could be a result of changes in recipes over time or obtaining the same raw materials but from different sources.

**Figure 3.** Ternary plot of flux and stabilizers in the glass beads from Pensacola (wt. %).

Colorants and Opacifiers

The concentration of manganese and/or cobalt oxides delineates four separate compositional glass groups within the Pensacola beads (Figure 7). Most of the black beads were colored with manganese (2%-11%) with under 100 ppm of cobalt. They comprise Group 1 which has a small sub-group in the beads from San Miguel that have high zinc concentrations (1000-1600 ppm) not associated with cobalt. Pyrolusite and other common manganese ores are not known to have zinc impurities, making this sub-group unique in its composition (Figure 8). The other manganese-colored beads have a positive correlation with barium with the San Miguel specimens having a slightly lower positive correlation (Figure 9). This strengthens the argument that

**Figure 4.** Biplot of manganese and alumina concentrations in the Pensacola glass (wt. %).

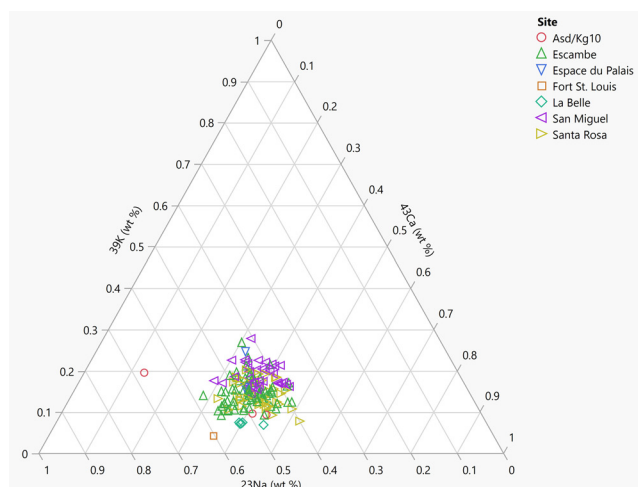


Figure 5. Ternary plot of flux and stabilizers used in the beads from all sample sites (wt. %).

the beads from San Miguel may represent a reduction in ingredient variance after 1740. The glass beads from *La Belle* site are compositionally similar to Group 1, suggesting they were colored primarily with manganese (Figure 10). The other dark-glass samples from Espace du Palais (not IIa7 beads) contain high amounts of manganese, ranging from 3.4% to more than 13% (Dussubieux 2009:106), and eight purple beads from Cours Napoléon contain high amounts of manganese oxide with concentrations of 4%-11% (Dussubieux and Gratuze 2012:34).

Group 2 beads are the most varied in composition with mixed manganese and cobalt concentrations. Manganese ranges from 3%-9% and cobalt is equally variable, ranging from 150-400 ppm. The glass beads from Asd/kg10, Espace du Palais, and Fort St. Louis all fall within this group. It would be possible to distinguish sub-groups within Group 2, but a larger sample is needed. For the most part these beads have low amounts of arsenic associated with the cobalt.

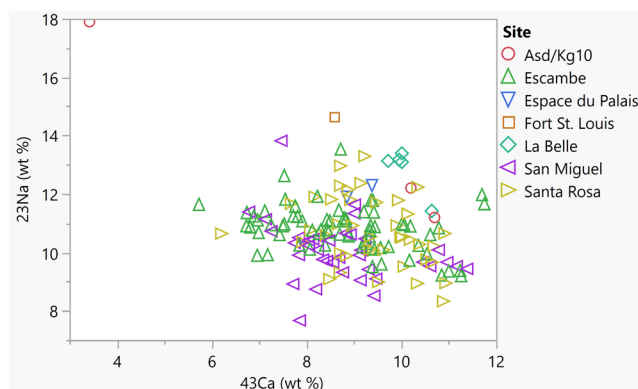


Figure 6. Biplot of soda and lime concentrations in the glass beads (wt. %).

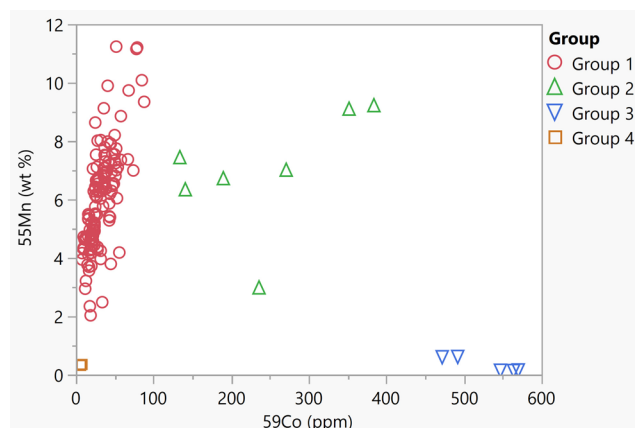


Figure 7. Biplot of manganese and cobalt concentrations in the Pensacola beads (wt. % and ppm).

Unfortunately, there is not enough chemical data to infer the origin of the cobalt ore.

Group 3 beads are colored primarily with cobalt and contain less than 1% manganese. These beads are from Santa Rosa and Escambe, and contain trace amounts of nickel (200-400 ppm), bismuth (200-400 ppm), and arsenic (600-1000 ppm). Studies by Gratuze et al. (1995) were able to identify four compositional groups of cobalt-colored glass based on trace elements, including a cobalt-zinc-lead-indium glass, a cobalt-nickel glass, a cobalt-arsenic-nickel-bismuth glass (smaltite), and a cobalt or cobalt-antimony glass. Smaltite is a cobalt ore found in the Schaeberg-Erzgebirge mining district in Saxony and was used from the 16th to the 18th century, primarily by Bohemian glassmakers (Dussubieux 2009; Gratuze 2013; Gratuze et al. 1995). Smalt was invented in Bohemia and made its way to the Netherlands sometime during the 16th century (Müthlethaler and Thissen 1969).

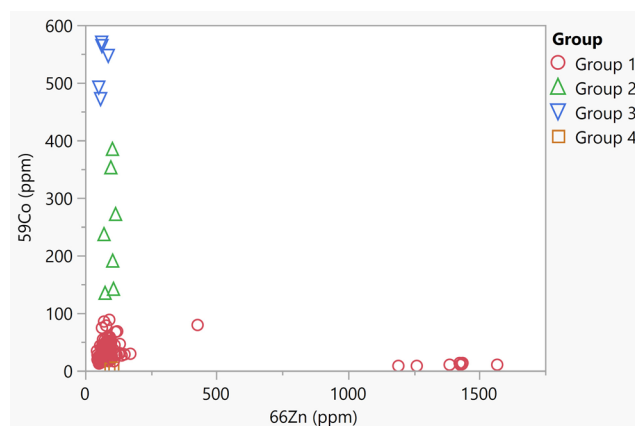


Figure 8. Biplot of cobalt and zinc concentrations in the Pensacola beads (ppm).

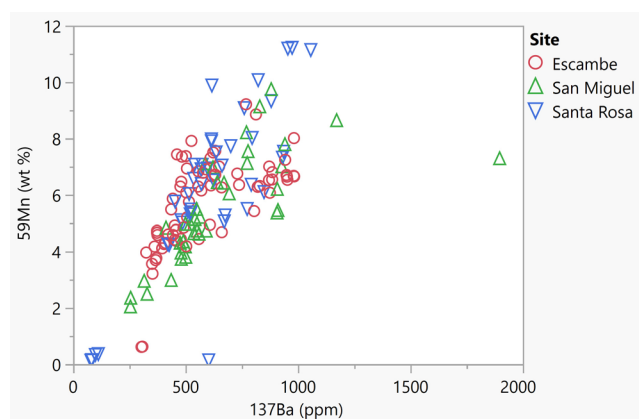


Figure 9. Biplot of manganese and barium concentrations in the Pensacola beads (wt. % and ppm).

Group 4 contains no significant amounts of manganese, barium, or cobalt. It is represented by two beads from Santa Rosa that are the only two beads in the Pensacola assemblage with significant amounts of antimony (see next section for further discussion). These beads also have low iron and copper, making it unclear as to what was used to obtain the black color of the glass.

The Pensacola black beads were partially opacified with trace levels of antimony (Figure 11). The two beads from Group 4 contain 5%-6% with all other groups containing antimony in quantities less than 3500 ppm. Groups 1-3 have trace amounts of tin (0-200 ppm), which correlates with the use of antimony well into the 18th century. The occupations at Pensacola significantly post-date the use of tin as an opacifier. The glass beads from Espace du Palais, Fort St. Louis, and *La Belle* have slightly higher traces of tin, but the Espace du Palais beads are the only ones without any antimony. The beads from the other two sites also contain trace amounts of antimony, suggesting that these beads were opacified during the tin/antimony transitional period.

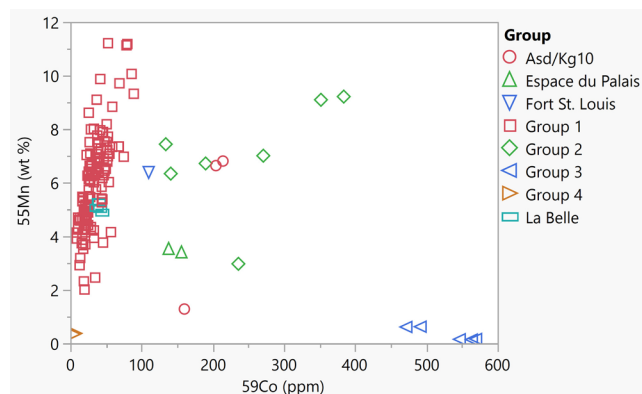


Figure 10. Biplot of manganese and cobalt concentrations in all beads (wt. % and ppm).

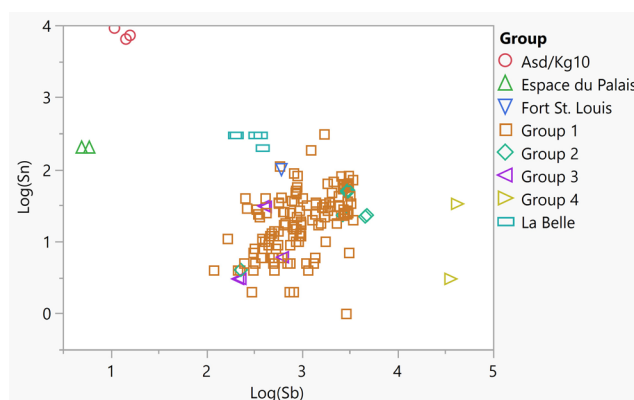


Figure 11. Biplot of tin and antimony concentrations in all beads (log10, ppm).

It could also indicate glass recycling (see discussion below). Furthermore, the beads from Asd/Kg10 have almost no antimony and close to 1% tin. Since this site dates to the 17th century, the data align with previous studies on white beads. The replacement of tin by antimony appears to occur within any opaque bead color, indicating that the switch was likely due to economic pressures rather than ingredient preference (Templin 2017).

Generally, in black glass, traces of other elements – such as lead, tin, copper, and antimony – are present in the glass, but are sometimes unrelated to its color (or opacity). This indicates that the glass was made by remelting or recycling cullet of different colors (Verità and Zecchin 2008:112). The black beads from Pensacola have trace amounts of lead, copper, tin, and antimony which may indicate recycling. Some samples from France also contain small amounts of the following oxides (up to): copper 0.4%, tin 1.3%, arsenic 0.5%, and lead 1% (Dussubieux and Gratuze 2012:34). This also indicates recycling, which seems to be a common technique for making black glass. Although this analysis is based on small sample sizes and differing analytical strategies, it offers insight into the potential of chemically comparing both synchronic and diachronic datasets.

CONCLUSION

The research presented here represents the starting point for a much larger undertaking. Previous analyses of beads recovered from archaeological sites in North America have focused on the 16th, 17th, and 19th centuries, primarily sampling white, blue, turquoise, and red beads.² There is a dearth of information concerning compositional analyses of glass beads from the 18th century, even more so with black glass beads. Chemical analysis of blue and opaque white beads in the Southeast and Great Lakes region has created a foundational dataset with which to compare glass beads

from other archaeological sites, both in North America and Europe. Chronologies based on metal oxides have the potential to be refined using a combination of historical data and an overall larger chemical dataset for comparison (Dadiego, Gelinas, and Schneider 2021). Additionally, since some polychrome glass bead varieties were manufactured and traded for short periods of time, elemental analysis of those beads would allow researchers to sort out similarities and differences in their glass chemistries, contributing significant data to established chronologies (Hancock 2005:52).

Based on this preliminary analysis and comparison, the beads from Pensacola, as well as those from the other sites in the United States, are all soda-lime-silica glass which may be attributed to Venice. The glass beads from Amsterdam and France show a similar composition, and it seems that they were manufactured following similar recipes but acquired raw materials from different locations. A larger sample, as well as data from other glass production centers, is needed to add to the conversation on bead provenience. For the most part, the beads discussed in this study are all colored with manganese, with some beads also containing small amounts of cobalt which could have contributed to their coloring. The preliminary explanation for the presence of trace amounts of tin, antimony, lead, and arsenic is that the black color was also obtained by mixing or recycling different colors of glass cullet.

The chemical analysis from Pensacola, Florida, represents the largest dataset to date of glass seed beads recovered from 18th-century Spanish contexts (Dadiego 2020). Preliminary analysis of the black beads recovered from the Pensacola sites reveals that although they are primarily colored with manganese, the results are more nuanced. These beads deserve a more in-depth analysis to determine the intricacies of coloring, opacifying, and provenience beyond a blanket interpretation of recycled glass. Just as it is possible to determine where the cobalt ore came from based on minor and trace impurities, the same can be done for manganese and manganese-barium ores. Much more chemical analysis of the present collection, as well as beads from contemporary French and English contexts, is needed to fully unravel the complexity of glass bead distribution and consumption in this region. The chemical analysis of the glass bead assemblage from Santa Maria de Galve (Pensacola's first presidio, not reported here) would make an excellent dataset for the comparison of late 17th-century and early 18th-century glass beads from Spanish and non-Spanish contexts discussed in this article. This research has barely scratched the surface and much more work is needed to understand how glass beads in general, and black glass beads in particular, fit into the colonial narrative.

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ENDNOTES

1. Morphological and chemical data are available from the author upon request.
2. See Templin's (2017) M.A. thesis for an analysis of over 900 black glass beads from 17th-century mission Santa Catalina de Guala using pXRF.

REFERENCES CITED

Avery, George

- 2008 Seed Bead Color Patterns from Colonial Period Sites in Texas and Louisiana. *Journal of Northeast Texas Archaeology* 28:57-63.

Bertini, Martina, Andrew Shortland, Karen Milek, and Eva M. Krupp

- 2011 Investigation of Iron Age North-Eastern Scottish Glass Beads Using Element Analysis with LA-ICP-MS. *Journal of Archaeological Science* 38:2750-2766.

Blair, Elliot

- 2015 Glass Beads and Global Itineraries. In *Things in Motion: Object Itineraries in Anthropological Practice*, edited by Rosemary A. Joyce, pp. 81-99. SAR Press, Santa Fe.
- 2017 An XRF Compositional Analysis of Opaque White Glass Beads from 17th-Century Mission Santa Catalina de Guala, Georgia. *Beads: Journal of the Society of Bead Researchers* 29:31-48.

Bruseeth, James E.

- 2017 Background. In *La Belle: The Archaeology of a Seventeenth-Century Vessel of New World Colonization*, edited by James E. Bruseeth, Amy Borgens, Bradford M. Jones, and Eric D. Ray, pp. 3-25. Texas A&M University Press, College Station.

Burgess, Laurie E. and Laure Dussubieux

- 2007 Chemical Composition of Late 18th- and 19th-Century Glass Beads from Western North America: Clues to Sourcing Beads. *Beads: Journal of the Society of Bead Researchers* 19:58-73.

Dadiego, Danielle L.

- 2020 Beads, Bullets, and Brokerage: Exploring Economic Agency in Eighteenth-Century West Florida. Ph.D. dissertation. Department of Anthropology, University of California, Santa Cruz.

Dadiego, Danielle L., Alyssa Gelinas, and Tsim D. Schneider

- 2021 Unpacking the Bead: Exploring a Glass Bead Assemblage from Mission Santa Cruz, California, Using LA-ICP-MS. *American Antiquity* 86(2):413-424.

Deagan, Kathleen

- 2002 *Artifacts of the Spanish Colonies of Florida and the Caribbean, 1500-1800. Vol. 2: Portable Personal Possessions*. Smithsonian Institution Press, Washington, DC.

Dussubieux, Laure

- 2009 Chemical Investigation of Some 17th-Century French Glass Personal Ornaments. *Journal of Glass Studies* 51:95-110.

Dussubieux, Laure and Bernard Gratuze

- 2012 Chemical Composition of 16th- to 18th-Century Glass Beads Excavated in Paris. *Beads: Journal of the Society of Bead Researchers* 24:26-38.

Dussubieux, Laure and Karlis Karklins

- 2016 Glass Bead Production in Europe during the 17th Century: Elemental Analysis of Glass Material Found in London and Amsterdam. *Journal of Archaeological Science: Reports* 5:574-589.

Francis, Peter, Jr.

- 1988 *The Glass Trade Beads of Europe: Their Manufacture, Their History, and Their Identification*. The World of Beads Monograph Series 8. Lake Placid, NY.

Gratuze, Bernard

- 1999 Obsidian Characterization by Laser Ablation ICP-MS and its Application to Prehistoric Trade in the Mediterranean and the Near East: Sources and Distribution of Obsidian within the Aegean and Anatolia. *Journal of Archaeological Science* 26(8):869-881.
- 2013 Provenance Analysis of Glass Artefacts. In *Modern Methods for Analysing Archaeological and Historical Glass*, edited by K. Janssens, pp. 311-343. John Wiley, Chichester.

Gratuze, Bernard, M. Blet-Lemarquand, and J.N. Barrandon

- 2001 Mass Spectrometry with Laser Sampling: A New Tool to Characterize Archaeological Materials. *Journal of Radioanalytical and Nuclear Chemistry* 247(3):645-656.

Gratuze, Bernard, Isabelle Soulier, Jean-Noel Barrandon, and Daniele Foy

- 1995 The Origin of Cobalt Blue Pigments in French Glass from the Thirteenth to the Eighteenth Centuries. In *Trade and Discovery: The Scientific Study of Artefacts from Post-Medieval Europe and beyond*, edited by Duncan R. Hook and David R. M. Gainster, pp. 123-133. British Museum, Department of Scientific Research, London.

Hancock, R.G.V.

- 2005 Elemental Analysis of North American Glass Trade Beads. *Beads: Journal of the Society of Bead Researchers* 17:52-57.

Hancock, R.G.V., S. Aufreiter, and I. Kenyon

- 1997 European White Glass Trade Beads as Chronological and Trade Markers. In *Materials Issues in Art and Archaeology V*, edited by P.B. Vandiver, J.R. Druzik, J.F. Merkel, and J. Stewart, pp. 181-191. Materials Research Society, Pittsburgh.

Hancock, R.G.V., S. Aufreiter, Ian Kenyon, and Martha Latta

- 1999 White Glass Beads from the Auger Site, Southern Ontario, Canada. *Journal of Archaeological Science* 26:907-612.

Hancock, R.G.V., A. Chafe, and I. Kenyon

- 1994 Neutron Activation Analysis of Sixteenth- and Seventeenth-Century European Blue Glass Trade Beads from the Eastern Great Lakes Area of North America. *Archaeometry* 36(2):253-266.

Hulst, Michel

- 2013 Glazen met maskerons en leeuwenkopstammen uit Amsterdamse bodem. *Vormen uit Vuur* 221:20-39.

Karklins, Karlis, Laure Dussubieux, and Ron G.V. Hancock

- 2015 A 17th-Century Bead Factory at Hammersmith Embankment, London, England. *Beads: Journal of the Society of Bead Researchers* 27:16-24.

Karklins, K., J. Kottman, R.G.V. Hancock, J. Baart, M.L. Sempowski, J-F. Moreau, D. Baham, S. Aufreiter, and I. Kenyon

- 2002 Analysis of Glass Beads and Glass Recovered from an Early 17th-Century Glassmaking House in Amsterdam. In *Archaeological Chemistry*, edited by Kathryn A. Jakes, pp. 110-127. American Chemical Society, Washington, DC.

Karklins, K., J. Kottman, R.G.V. Hancock, M.L. Sempowski, A.W. Nohe, J-F. Moreau, S. Aufreiter, and I. Kenyon

- 2001 On the Chemical Variability of Middelburg Glass Beads and Rods. In *Australasian Connections and New Directions, Proceedings of the 7th Australasian Archaeometry Conference*, edited by M. Jones and P. Sheppard, pp. 187-195. Department of Anthropology, The University of Auckland, Auckland, New Zealand.

Kenyon, I., R.G.V. Hancock, and S. Aufreiter

- 1995 Neutron Activation Analysis of AD 1660-1930 European Copper-Colored Blue Glass Trade Beads from Ontario, Canada. *Archaeometry* 37(2):323-337.

Kidd, Kenneth E. and Martha A. Kidd

- 2012 A Classification System for Glass Beads for the Use of Field Archaeologists. *Beads: Journal of the Society of Bead Researchers* 24:39-61.

Mühlethaler, Bruno and Jean Thissen

- 1969 Smalt. *Studies in Conservation* 14(2):47-61.

Perttula, Timothy K. and Michael D. Glascock

- 2017 Glass Beads. In *La Belle: The Archaeology of a Seventeenth-Century Vessel of New World Colonization*, edited by James E. Brusey, Amy Borgens, Bradford M. Jones, and Eric D. Ray, pp. 509-530. Texas A&M University Press, College Station.

Sempowski, M.L., A.W. Nohe, R.G.V. Hancock, J.-F. Moreau, F. Kwok, S. Aufreiter, K. Karklins, J. Barrt, C. Garrar, and I. Kenyon

- 2001 Chemical Analysis of 17th-Century Red Glass Trade Beads from Northeastern North America and Amsterdam. *Archaeometry* 43(4):503-515.

Sempowski, M.L., A.W. Nohe, J.-F. Moreau, I. Kenyon, K. Karklins, and R.G.V. Hancock

- 2000 On the Transition from Tin-Rich to Antimony-Rich European White Soda-Glass Trade Beads for the Senecas of Northeastern North America. *Journal of Radioanalytical and Nuclear Chemistry* 244(3):559-566.

Templin, Robert B. III

- 2017 Black Glass on the Georgia Coast: The Utility of Black Glass Trade Beads in Refining Site Chronology and Detecting Color Preference at Seventeenth Century Mission Santa Catalina de Guale. M.A. thesis. Department of Anthropology, University of Alabama, Tuscaloosa.

Veritá, M. and Sandro Zecchin

- 2008 Scientific Investigation of a Venetian Polychrome Goblet of the 16th Century. *Journal of Glass Studies* 50:105-115.

Wagner, Barbara, Anna Nowak, Ewa Bulska, Jerzy Kunicki-Goldfinger, Olivier Schalm, and Koen Janssens

- 2008 Complementary Analysis of Historical Glass by Scanning Electron Microscopy with Energy Dispersive X-Ray Spectroscopy and Laser Ablation Inductively Coupled Plasma Mass Spectrometry. *Microchim Acta* 162:415-424.

Walder, Heather

- 2013 Stylistic and Chemical Investigation of Turquoise-Blue Glass Artifacts from the Contact Era of Wisconsin. *Midcontinental Journal of Archaeology* 38(1):119-142.
- 2015 "...a Thousand Beads to Each Nation:" Exchange, Interaction, and Technological Practices in the Upper Great Lakes c. 1630-1730. Ph.D. dissertation. Department of Anthropology, University of Wisconsin, Madison.
- 2018 Small Beads, Big Picture: Assessing Chronology, Exchange, and Population Movement through Compositional Analyses of Blue Beads from the Upper Great Lakes. *Historical Archaeology* 52:301-331.

Walthall, John A.

- 2015 Seventeenth-Century Glass Trade Beads from La Salle's Fort St. Louis and the Grand Village of the Kaskaskia. *Midcontinental Journal of Archaeology* 40(3):257-281.

Weyl, Woldemar A.

- 1959 *Coloured Glasses*. Dawson's of Pall Mall, London.

Worth, John E.

- 2021 Exploring an 18th-Century Refugee Mission in West Florida: Archaeological Investigations at Mission San Joseph de Escambe. In *Unearthing the Missions of Spanish Florida*, edited by Tanya M. Peres and Rochelle A. Marrinan, pp. 131-166. University Press of Florida, Gainesville.

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THE CHEMISTRY OF NUEVA CADIZ AND ASSOCIATED BEADS: TECHNOLOGY AND PROVENIENCE

Brad Loewen and Laure Dussubieux

Dating to about 1500-1560, Nueva Cadiz and associated beads comprise the earliest glass bead complex found in the Americas, and many questions regarding their technology and provenience surround them. Analysis of 10 beads from the namesake Nueva Cádiz site in Venezuela and 33 beads collected from an unknown site or sites near Tiahuanaco, Bolivia, provide chemical compositions of their turquoise, dark blue, white, red, and colorless glasses. We analyze the composition of the sand, flux, and colorants that went into their fabrication. The two collections show a common beadmaking tradition and provenience, except for three beads made of high-lime low-alkali (HLLA) glass. Colorants and opacifiers are cobalt for blue, a tin-based agent for white, and copper for turquoise and red. Trace elements associated with cobalt indicate a variable source for this colorant. By comparing the layers of compound beads, we discover technological aspects of bead design and workshop organization. To investigate provenience, we compare the levels of key elements with other glasses of proven origin. There are chemical similarities with glasses made in Venice, identifying it as a candidate to consider when searching for the origin of Nueva Cadiz beads.

INTRODUCTION

Nueva Cadiz and associated beads occur archaeologically from about 1500 to 1560 in regions of Spanish colonial trade from Bolivia to Tennessee. They owe their name to the site in Venezuela where archaeologists first described them. Their place of origin in Europe remains unknown, and some aspects of their technology are unique in the history of beadmaking (Allender 2018; Deagan 1987; Donnan and Stilton 2010; Liu and Harris 1982; Smith and Good 1982). This paper presents an LA-ICP-MS study of beads from the namesake site in Venezuela and an unknown site or sites likely at Tiahuanaco in western Bolivia. After introducing Nueva Cadiz beads, we present the inferred chemical composition of their sand, flux, and colorants, and discuss their fabrication technology and European provenience.

WHAT DO WE KNOW ABOUT NUEVA CADIZ BEADS?

“Nueva Cadiz” refers to drawn tubular beads with a square cross section, found in regions of 16th-century Spanish colonial influence in the Americas. Some are monochrome, but many have three layers of laminated glass. These include Kidd and Kidd (2012) varieties IIIc1-3 and IIIc’4. The latter has a twisted body. In the most widespread varieties, the core is dark blue or gray, the middle layer is white, and the outer layer may be dark blue but often has a characteristic turquoise hue. Size typically varies in the range of 3-10 mm in width and 10-70 mm in length. On some larger specimens, beveled corners reveal the inner layers; this feature is more frequent on more recent examples (Deagan 1987:162-164; Smith and Good 1982). Deagan (1987:163) dates these beads to the first half of the 16th century, and notes their absence at later 16th-century sites. The oldest well-dated examples come from the Nueva Cádiz site in Venezuela, occupied from 1498 to 1543. At present, the youngest tightly dated specimens where we can rule out heirlooms come from the 1559 Tristan de Luna settlement in Pensacola, Florida (John Worth 2021: pers. comm.). These sites frame the circulation of these beads in the Americas between 1500 and 1560.

Nueva Cadiz beads appear in the Americas with other glass beads such as five- and seven-layer chevrons and striped, light gray, olive-shaped “gooseberry” beads. Small dark blue beads that exist in pre-1550 contexts include a ca. 1541-1543 French colony near Québec City (Cooper 2016:262; Delmas 2016:97). The namesake site in Venezuela has square-sectioned monochrome beads that are unknown elsewhere.

Some archaeologists apply the Nueva Cadiz name to square-sectioned tubular beads found on early 17th-century sites in northeastern North America. A style called Nueva Cadiz Twisted – Red Variety (Kidd IIIc’1-3) incorporates a layer of red glass and occurs about 1625-1665 in the French

and Dutch colonial trade sphere of New York state and southern Ontario (Bradley 2007:43; Little 2010:224-225; Liu and Harris 1982; Walder et al. 2021). We need further study to understand their relation to archetypal Nueva Cadiz beads.

Smith and Good (1982:1, 46-47) have mapped discoveries in the Americas, but Nueva Cadiz beads have also been excavated in Europe. Divers found 12 production tubes on a 16th-century site in the Venice lagoon (Canal 2013; Zecchin 2005:82-83). In Rouen, a bead and two production tubes came from a ca.1600 beadmaking workshop (Karklins and Bonneau 2019). Antwerp has 30 beads from the house of a 16th-century merchant with ties to Venice (Karklins and Oost 1992). Seville also has one specimen (Deagan 1987:164; Martins Torres 2007:155).

In Portugal, Martins Torres (2007) has inventoried Nueva Cadiz and chevron beads that survive as decorative elements embedded in architectural tiles called *azulejos*. Known examples are in eight buildings from before 1640, notably a chapel at Alcáçovas. At least 30 Nueva Cadiz beads have been recovered from archaeological sites, especially in Lisbon, in contexts from the 16th century, before 1640, and in debris from the 1755 earthquake (cf. Rodrigues 2003, 2007:281-283; Veiga and Figueiredo 2002). Martins Torres also mentions bead collections in Portuguese museums that may include Nueva Cadiz examples.

African varieties tend to differ from their American counterparts. In Angola, archaeologists have reported Nueva Cadiz beads as funerary goods assigned to the 15th or 16th century (Gutierrez 2001:46-50; Gutierrez and Valentin 1995; Rodrigues 1993, 2003:230; 2007:298). The Musée du quai Branly holds 53 examples, about 4 mm wide and long, from Vohémar in Madagascar (inv. no. 71.1961.60.50; Schreurs and Rakotoarisoa 2011). Large type IIIc specimens, 14-20 mm wide from the Lake Chad and Timbuktu regions, likely date to the 19th century (Karklins 2004:43; Liu and Harris 1982:7; Picard and Picard 1993:106).

We find various hypotheses for the place of manufacture of Nueva Cadiz beads. Fairbanks (1968), followed by Smith and Good (1982:12-13), suggested an origin in Andalusia. Karklins and coauthors did not exclude the “tail end” of their production in Rouen or elsewhere in northern France (Karklins and Bonneau 2019; Karklins and Oost 1993:27). Venice is a recurring hypothesis, inspired by its production of similar beads in the last century (Martins Torres 2019:7; Picard and Picard 1993:107; Rodrigues 2007:280, 298; Zecchin 2005:83). As early as 1600, Venetian archives show exports of unspecified bead types to Seville, Lisbon, and Antwerp (Brulez 1965:118, 400, 428). Archaeologists

have found Nueva Cadiz production tubes in the Venetian lagoon; however, a cargo of beads likely from Venice, from a 1585 shipwreck at Gnalić, Croatia, has no Nueva Cadiz or chevron styles at all (Delmas 2016:105-106; Jackson 2006:92; Zecchin 2005:82-83). In light of the many finds in Portugal, we may ask whether this country produced Nueva Cadiz and chevron beads. We know that Portugal produced soda glass as early as 1439, but we find no record of its use for beadmaking (Coutinho et al. 2016; Medici 2014:75-79, 108, 507-508). In sum, hypotheses for the origin of Nueva Cadiz beads include Andalusia, Antwerp, northern France, Venice, and Portugal, among others.

PREVIOUS CHEMICAL STUDIES

Lewis (1979) included a colorless square-sectioned bead from the namesake Nueva Cádiz site in the first-ever chemical study of trade beads, but did not comment on the findings. Liu and Harris (1982:8-9) reported another early study that interpreted the presence of soda glass in Nueva Cadiz beads found in Africa and North America, and potash glass in those from Peru. Twenty years later, Portuguese researchers used X-ray fluorescence (XRF) to identify soda glass in all three layers; copper colorant assigned to the turquoise layer and tin opacifier to the white layer (Rodrigues 2003:222-224; Veiga and Figueiredo 2002). They modelled the copper colorant to suggest it derived from chalcantite ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$), a copper sulfate mineral used to color ancient Egyptian faience (Veiga and Figueiredo 2006).

A subsequent XRF study of beads from a pre-1640 context in Lisbon analyzed six Nueva Cadiz beads, three chevrons, and a blue tubular bead with four red stripes (Rodrigues 2007). This study detected some elements missed previously. Nueva Cadiz and chevron beads contained copper and cobalt colorants, tin opacifier, and lead, while Nueva Cadiz beads also had zinc and high manganese. As for the red-striped bead, its opacifier was antimony, indicating its origin in a different beadmaking tradition or region.

THE PRESENT STUDY

The Venezuela Sample

The first collection in the present study is held by the Florida Museum of Natural History and comes from the site of Nueva Cádiz on Cubagua Island, Venezuela (Figure 1). Christopher Columbus visited the island in 1498 and reported the existence of rich pearl beds. The next year, Spanish

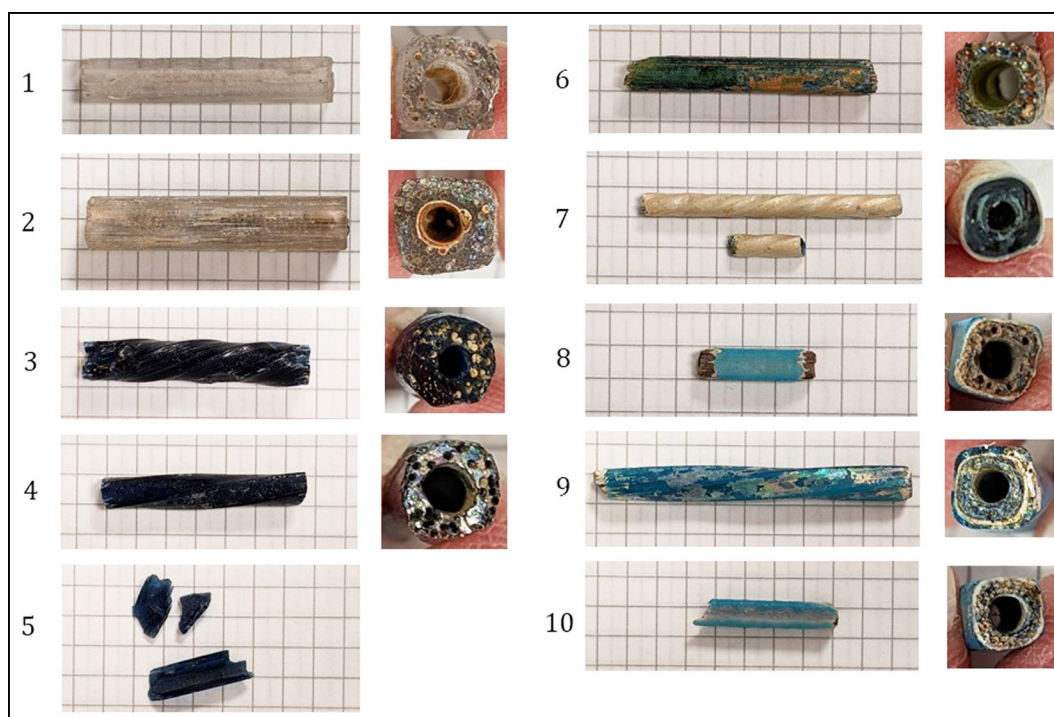


Figure 1. Sampled beads from the Nueva Cádiz site, Venezuela. The grid units are 5 mm (all photos by Brad Loewen unless otherwise noted).

traders acquired 40 kg of pearls from Arawak divers, and settled on the island in 1502. The pearl fishery burgeoned and the settlement expanded to 700 Americans and 223 Europeans by 1527. The pearl beds ran out, however, and the town shrank to 50 residents by 1539. A hurricane destroyed buildings in 1541, and corsairs drove out the last inhabitants in 1543 (Antczak et al. 2019; Romero 2003).

Venezuelan archaeologist Josep María Cruxent excavated the site from 1954 to 1958. Most of the resulting collection resides at the Museo de Nueva Cádiz in La Asunción, but John Goggin, who worked with Cruxent, took some artifacts to the Florida Museum of Natural History and the Yale Peabody Museum. The Florida Museum of Natural History lent 10 beads for this study (Table 1), four of which

Table 1. Bead Samples from the Nueva Cádiz Site, Venezuela.

No.	Length (mm)	Width (mm)	Kidd code	Layer 1 (exterior)	Layer 2	Layer 3	Comments
1	43	8	Ic	Colorless			
2	41	7	Ic	Colorless			
3	37	7	Ic'	Dark Blue			Twisted
4	34	5	Ic13	Dark Blue			Hexagonal section
5	20	5	Ic	Dark Blue			3 fragments
6	42	7	Ic	Greenish			
7	58	4	IIIc'	White	Dark Blue	White	2 fragments; twisted
8	17	6	IIIc	Turquoise	White	Dark Blue	
9	52	6	IIIc'4	Dark Blue	White	Turquoise	Twisted
10	24	4	IIIc	Dark Blue	White	Turquoise	

have three layers, making 18 glass samples in all. These are the oldest archaeologically dated Nueva Cadiz beads known. The associated styles are rare and they shed additional light on the incipient years of the transatlantic bead trade.

The Tiahuanaco Sample

The second bead assemblage lacks an archaeological provenience, but we know part of its history (Figure 2). In 1978, Marvin T. Smith acquired the beads from Liza Wataghani, a dealer in Santa Monica, California, who said they came from Tiahuanaco in western Bolivia. At the time, dealers had only general information on bead provenience, as illustrated by Smith's notes on a different lot: "Excavated in Tiauanaco [sic], but the strings were designed with beads from other sites." While most Nueva Cadiz beads for sale came from Peru, Tiahuanaco was a regular source (Marvin T. Smith 2021: pers. comm.). In 1986, Smith gave the beads to James Bradley, a fellow bead specialist, who transmitted them to Brad Loewen in 2019 for this study.

The 33 beads (Table 2) yielded 72 compositions, three of which turned out to be stone or ceramic (nos. 1, 2, 4). The remainder are typical square-sectioned Nueva Cadiz beads, and are likely more recent than the Venezuela assemblage. They form five groups:

- Group 1 (nos. 3, 5). Two patinated beads, 4.3 and 5.0 mm wide, appear monochrome, but chemical readings show a tin-rich layer sandwiched between two dark blue layers.
- Group 2 (nos. 7, 14, 15). Three monochrome dark blue beads that are 2.7 mm wide and 4–7 mm long exhibit unique bulging sides. The beads have a distinctive high-lime low-alkali (HLLA) composition.

- Group 3 (nos. 6, 8–13, 16–21). Sixteen small beads, about 3 mm in width, have three layers. The outer layer and core are dark blue; the middle layer is white. Due to their small size, only five beads yielded data for all three layers.
- Group 4 (nos. 22–31). The sample includes 10 large beads. With a turquoise outer layer, seven have a dark blue core, three have a core that is blackish, while another two have weakly colored bluish- or greenish-gray cores.
- Group 5 (nos. 32, 33). Two tubular chevron beads with flat ends (IIIp*) exhibit five layers: thin colorless outer layer/white with 10 blue stripes/dark blue/red/colorless core. We did not sample the outermost white and colorless layers.

GLASS ANALYSIS

Methodology

Sampling took place at the Elemental Analysis Facility of the Field Museum in Chicago, using standard procedures for laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) (Dussubieux, Robertshaw, and Glascock 2009). For each sampled glass, we recorded 14 oxides (% of weight) and 43 elements (ppm).

To characterize and compare the base glasses, we calculated the "reduced compositions" that represent their sand and flux components. Following Brill (1999), we included SiO_2 , Al_2O_3 , and Fe_2O_3 for the sand, and Na_2O , MgO , K_2O , and CaO for the flux. This method eliminates

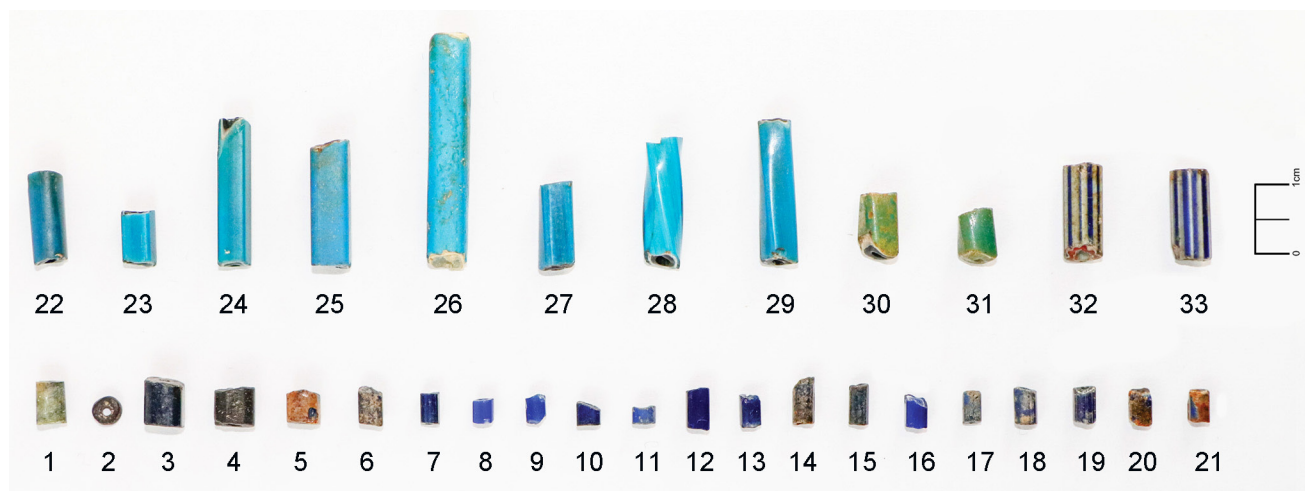


Figure 2. Sampled beads from Tiahuanaco, Bolivia (photo: Saraf Barreiro Argüelles).

Table 2. Bead Samples from Tiahuanaco, Bolivia.

No.	Leng. (mm)	Width (mm)	Kidd code	Grp.	Layer 1 (exterior)	Layer 2	Layer 3	Layer 4	Layer 5
3	7	5.0	IIIc	1	Dark blue	White	Dark blue		
5	4	4.3	IIIc	1	Dark blue*	White*	Dark blue		
6	4	3.0	IIIc	3	Dark blue	White*	Dark blue		
7	4	2.6	Ic	2	Dark blue				
8	3	3.0	IIIc	3	Dark blue	White	Dark blue		
9	3	3.0	IIIc	3	Dark blue	White	Dark blue		
10	3	3.0	IIIc	3	Dark blue	White	Dark blue		
11	3	3.0	IIIc	3	Dark blue*	White	Dark blue		
12	5	3.0	IIIc	3	Dark blue	White	Dark blue		
13	4	3.0	IIIc	3	Dark blue*	White*	Dark blue		
14	7	2.7	Ic	2	Dark blue				
15	6	2.7	Ic	2	Dark blue				
16	4	3.0	IIIc	3	Dark blue	White	Dark blue		
17	4	3.0	IIIc	3	Dark blue	White*	Dark blue*		
18	5	3.0	IIIc	3	Dark blue*	White	Dark blue		
19	4	3.0	IIIc	3	Dark blue	White*	Dark blue*		
20	4	3.0	IIIc	3	Dark blue*	White*	Dark blue		
21	4	3.0	IIIc	3	Dark blue*	White*	Dark blue		
22	13	4.5	IIIc	4	Turquoise	White	Dark blue		
23	8	4.0	IIIc	4	Turquoise	White	Dark blue		
24	22	4.0	IIIc	4	Turquoise	White	Dark blue		
25	18	5.1	IIIc	4	Turquoise	White	Dark blue		
26	34	5.1	IIIc	4	Turquoise	White	Bluish		
27	13	4.2	IIIc'4	4	Turquoise	White	Dark blue		
28	21	4.5	IIIc'4	4	Turquoise	White	Dark blue		
29	21	4.5	IIIc'4	4	Turquoise	White	Dark		
30	9	4.8	IIIc'4	4	Turquoise	White	Dark blue		
31	8	4.7	IIIc'	4	Turquoise	White	Greenish		
32	14	5.2	IIIp	5	Colorless	White w/ 10 blue stripes	Red	White	Colorless
33	14	5.2	IIIp	5	Colorless	White w/ 10 blue stripes	Red	White	Colorless

* Non-sampled glass.

Table 4. Average Reduced Compositions for Glass Colors from Tiahuanaco.

	HLLA	Small beads (18)			Large Nueva Cadiz beads (10)					Chevron beads (2)			
	Blue	Blue	White	Bluish	Greenish	Dark	Blue	White	Turquoise	Colorless	Blue	Red	White
n=	3	23	7	1	1	1	7	10	10	4	2	2	2
SiO ₂	65.8%	68.8%	69.4%	72.9%	69.6%	66.7%	69.3%	70.2%	70.6%	68.5%	69.8%	65.4%	68.8%
	2.4%	1.5%	0.9%				1.0%	1.7%	1.7%	0.5%	0.5%	0.7%	0.7%
Na ₂ O	4.5%	12.2%	13.6%	11.8%	13.8%	13.7%	13.6%	13.6%	13.4%	14.3%	13.0%	13.6%	13.9%
	1.8%	2.3%	0.7%				1.1%	1.0%	1.3%	1.2%	1.1%	1.1%	1.6%
MgO	2.7%	3.2%	3.3%	2.0%	3.2%	4.1%	2.8%	3.0%	2.9%	3.3%	3.2%	3.1%	3.3%
	0.4%	0.2%	0.3%				0.2%	0.5%	0.6%	0.2%	0.1%	0.0%	0.0%
Al ₂ O ₃	3.4%	1.4%	1.0%	0.8%	1.1%	1.7%	0.9%	1.0%	1.0%	1.1%	1.3%	1.3%	1.3%
	0.8%	0.9%	0.1%				0.2%	0.2%	0.3%	0.2%	0.2%	0.4%	0.1%
K ₂ O	3.5%	2.6%	2.5%	5.4%	5.2%	3.1%	3.2%	3.7%	3.7%	2.2%	2.6%	2.6%	2.5%
	0.6%	0.4%	0.1%				1.0%	1.4%	1.5%	0.5%	0.5%	0.8%	0.7%
CaO	18.3%	10.3%	9.8%	6.8%	6.6%	9.9%	7.6%	8.1%	7.8%	9.9%	9.0%	8.8%	9.5%
	3.5%	2.0%	0.8%				1.2%	1.4%	1.4%	0.1%	0.7%	0.1%	0.1%
Fe ₂ O ₃	1.7%	1.6%	0.5%	0.3%	0.5%	0.8%	2.4%	0.5%	0.6%	0.6%	1.1%	5.2%	0.7%
	0.5%	0.5%	0.1%				1.6%	0.1%	0.3%	0.2%	0.1%	0.6%	0.3%
Standard deviations are in the white cells, when there was more than one analyzed sample.													

Mediterranean (Sayre and Smith 1961). The pale bluish and greenish glasses from Tiahuanaco have lower soda and lower lime but higher potash, but we note that only one sample of each color was analyzed. Alumina below 2% indicates access to a rather pure source of silica (Cagno et al. 2012).

HLLA Glasses

Three small dark blue beads from Tiahuanaco contain a different glass type characterized by high lime (CaO) averaging 18.3% and low alkali (Na₂O + K₂O) totaling only 8.0% in reduced composition. Alumina at 3.4% is higher than in the soda-lime glasses. The combination of high lime and alkali below 10% defines “high-lime low-alkali” (HLLA) glass (Dungworth and Cromwell 2006). The beads containing this glass are also visually distinct, being the only monochrome specimens from Tiahuanaco, and having a smaller section (nos. 7, 14, 15). They exhibit bulged sides, a feature not seen in the other square-sectioned beads (Figure 3). The HLLA glasses also stand out for their high phosphorus oxide concentrations (P₂O₅) in the range of 1.5%-2.0%, compared to other samples at 0.1%-0.5%. According to

Stern (2017), phosphorus content of 0.2%-1% indicates the use of soda plants to make the flux, while 1%-3% identifies wood ash. Two of the HLLA beads (nos. 7, 14) have low strontium (185 and 275 ppm), about half the average for soda-lime glasses (508 ppm), also denoting a different flux material (Degryse and Shortland 2020; Dungworth 2013; Dungworth, Degryse, and Schneider 2009).

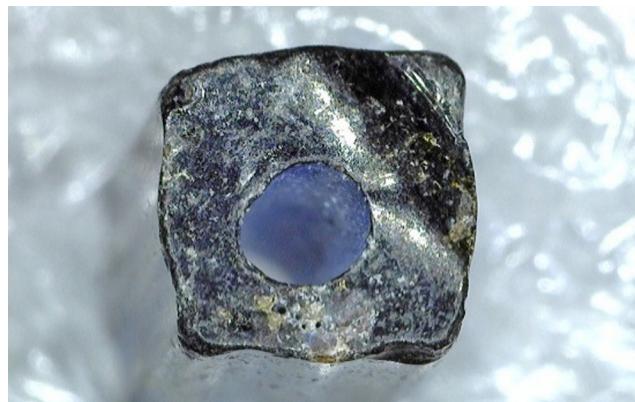


Figure 3. Tiahuanaco blue HLLA bead no. 7 with atypical bulging sides; 2.7 mm wide.

Usually found in bottles, HLLA glass is a sub-type of potash glass that appeared in Germany, and spread to northern France and England in the 16th century (Historic England 2018; Mortimer 1995; Schalm et al. 2007). In these regions, noble families controlled the production of potash-glass windowpane, while commoners made HLLA bottles. To reinforce these social distinctions, some glassworks had separate furnaces for these glasses (Dungworth and Cromwell 2006:162; Klaës 2021). We find few examples of HLLA glass in southern Europe. Researchers have reported isolated artifacts in Altare and Portugal, but none in two large Venetian assemblages (Cagno et al. 2012; Jackson 2006; Medici 2014:418-420; Palamara et al. 2017). The HLLA beads appear to show a northern European influence in the Tiahuanaco assemblage.

Sand Composition

Silica (SiO_2) is the major constituent of glass. Quartz sand consists almost entirely of silica, but it also contains other elements that enter glass involuntarily – principally aluminum and iron in the form of Al_2O_3 and Fe_2O_3 . Ratios of silica, alumina, and iron allow us to characterize the sand that went into the Venezuela and Tiahuanaco beads.

The sand used for the Venezuela glasses shows a high silica content: 96.2%-98.6% of a hypothetical sand containing only SiO_2 , Al_2O_3 , and Fe_2O_3 . Accordingly, these glasses have low levels of impurities. High iron in the greenish bead, no doubt added voluntarily, explains its tint. Aluminum levels are low (0.6%-1.6%). Slightly higher iron (0.7%-1.1%) in dark blue and white glasses may reflect coloring and opacifying additives.

The Tiahuanaco beads (excepting the HLLA beads) also have low levels of sand contaminants. The sand used to make the white and turquoise layers in Nueva Cadiz beads has silica purity attaining 97.7%. Aluminum is generally low (0.8%-1.7%), especially in Nueva Cadiz beads. Iron is slightly elevated (1.1%-2.4%) in dark blue glasses, and particularly in the red glass of chevron beads (5.2%). Iron above 0.8% probably results from coloring processes (Jackson 2005). When we account for this added iron, we estimate the silica purity of sand in Tiahuanaco soda glass beads at ~97% SiO_2 , and only ~91% in HLLA beads.

In both collections, Nueva Cadiz beads have low aluminum levels in all glass colors (0.9%-1.1%), consistent with a source of very pure sand. Iron is consistently very low in the white and turquoise layers (0.1%-0.2%), but some differences appear in the dark blue layer. Fe_2O_3 is moderately high in Venezuela dark blues, and very high in Tiahuanaco samples. The standard deviation for Fe_2O_3 in dark blue is high in Nueva Cadiz beads, indicating wide

variations among beads. This variability likely betrays a diversity of coloring recipes, and not different sand sources.

In the Italian tradition of soda glassmaking that spread through much of Europe, artisans accorded great value to sand purity. Venetian glassmakers preferred crushed river cobbles to make *cristallo*, the clearest soda glass attainable in the 15th-17th centuries, which shows 97%-99% silica in sand (Janssens et al. 2013). Glass beads, despite their exuberant palette of colors, often contain similarly pure sand, a feature that identifies beadmaking as a subsidiary of the soda-glass industry on which it relied for base glass.

Flux Composition

In soda-lime glass (soda glass) of the 15th-18th centuries, plant ash had both a fluxing and a stabilizing function. The ash usually derived from sodic plants that thrive in saline soils on the Mediterranean coast. Syria and Spain were major producers and exporters. Syria sold its soda to Venice, while Alicante shipped its barilla to glassmakers throughout Western Europe (Ashtor and Cevdalli 1983; Girón-Pascual 2018; Jacoby 1993; Verità 2021).

While soda glass comprises most trade beads, it co-existed with an array of glass types in Europe in the 15th-18th centuries. Gratuze and Janssens (2004:672) developed a ternary graph to sort glasses by flux type using three-way ratios of CaO , Na_2O , and $\text{K}_2\text{O}+\text{MgO}$, which are the principal flux components in glass. Four major glass types fall in different areas of the graph: 1) natron glass from the Roman period, 2) soda glass from medieval and early modern Europe, 3) mixed-alkali glass from northern France in the 16th-18th centuries, and 4) potash or “forest” glass from northern Europe in medieval and modern times. Our review of published data finds that 95% of analyzed beads from 1580-1780 fall in the soda-glass area (Figure 4, area 2), generally in its “lower” half where Na_2O contributes 30%-50% of the principal flux components. The remaining analyzed beads contain potash or mixed-alkali flux, or they consist of lead glass; these glasses occur in beads made after ca.1670.

The Venezuela beads are made of soda glass, with relatively high Na_2O (40%-64%) compared to published compositions (Figure 4). We see that the samples form several clusters of two or three similar glasses. In fact, each Nueva Cadiz bead forms a cluster to itself. All the colors of a bead have near-identical flux compositions, but each Nueva Cadiz bead is distinct from the others. The different colored glasses in a bead may derive from a single batch of base glass, but no two Nueva Cadiz beads come from the same batch. The two colorless beads likely came from the same glass batch, as did the three dark blue specimens.

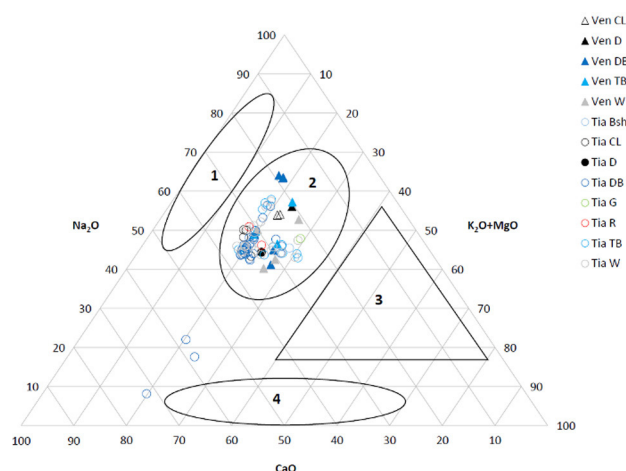


Figure 4. Ternary graph of flux compositions, following the glass typology of Gratuze and Janssens (2004): 1) Roman natron glass; 2) soda-lime glass, 14th-18th centuries; 3) medieval and post-medieval mixed-alkali glass; and 4) medieval and post-medieval potash or “forest” glass (all graphics by Laure Dussubieux).

The Tiahuanaco glasses also fall in the soda-flux area of the ternary graph, except for three HLLA glasses. The close clustering of most samples indicates the use of a homogeneous plant ash (Figure 5). Each Nueva Cadiz bead shows nearly identical flux composition in all three colored layers, indicating the use of a single base glass batch to make all the colors. Three beads may come from the same glass batch (nos. 23, 24, 28) and three other beads from another batch (nos. 25, 27, 30), but each remaining Nueva Cadiz bead comes from its own glass batch.



Figure 5. Detail showing dispersed pairs and triplets of glasses in beads from Venezuela, tight clustering of dark blue and white glasses in small beads from Tiahuanaco, and the wider distribution of glasses in Nueva Cadiz beads from Tiahuanaco.

Of the 15 small three-layer beads from Tiahuanaco, the majority likely emanate from a single glass batch, and the others show only slight differences (Figure 6). Remarkably,

beads from the same glass batches stayed together as lots until our time.

Colorant and Opacifier Compositions

Most of the glasses in this study are dark blue, white, or turquoise, but colorless, red, bluish gray, greenish gray, and blackish glasses are also present. Reduced compositions show no significant differences of base glass among colors.

Dark Blue Glass

We recorded seven compositions of dark blue glass from Venezuela and 33 from Tiahuanaco. They include the three monochrome HLLA beads from Tiahuanaco. Most dark blue glasses form the inner and outer layers of small Nueva Cadiz beads from Tiahuanaco ($n=21$), while 10 samples form the inner layer of large Nueva Cadiz beads. Other dark blue samples, all from Venezuela, come from three large monochrome beads and the white/blue/white bead.

The main coloring ingredient is cobalt that imparts a deep blue when present in a few hundred to a few thousand ppm. Cobalt is also a source of information on beadmakers' supply networks, as cobalt ore contains additional elements that help determine its provenience. Gratuze et al. (1996) show an evolution of ores used to color European glass from Roman times to the 18th century. The sequence culminates with ore from the Schneeberg mine in the Erzgebirge region of Germany. This ore has higher Ni, As, and Bi that go hand in hand with higher cobalt. Exceptionally, cobalt pigments found in majolica glaze made in Aragon show other ore profiles with higher Cu or Mn, possibly from Pyrenean mines (Pérez-Arantegui et al. 2009).

Two Venezuela beads feature the Co-Ni-As-Bi profile associated with Schneeberg ores. The other Venezuela beads show a different profile, with low As and Bi and only Ni in higher concentration. We may infer that cobalt ores used to color these beads came from different sources (Figure 7).

In the Tiahuanaco beads, higher Co, Ni, As, and Bi in the dark blue soda-lime glasses all match the Schneeberg profile. These glasses also have higher iron and manganese concentrations than other glass colors. Since cobalt often occurs with iron and manganese in nature, it can bring these elements into glass involuntarily (Dehaine et al. 2021; Gratuze, Pactat, and Schibille 2018). The specific cobalt ore may explain MnO values above 0.6% and Fe_2O_3 above 1.0% in dark blue glasses. The three HLLA beads, however, reveal

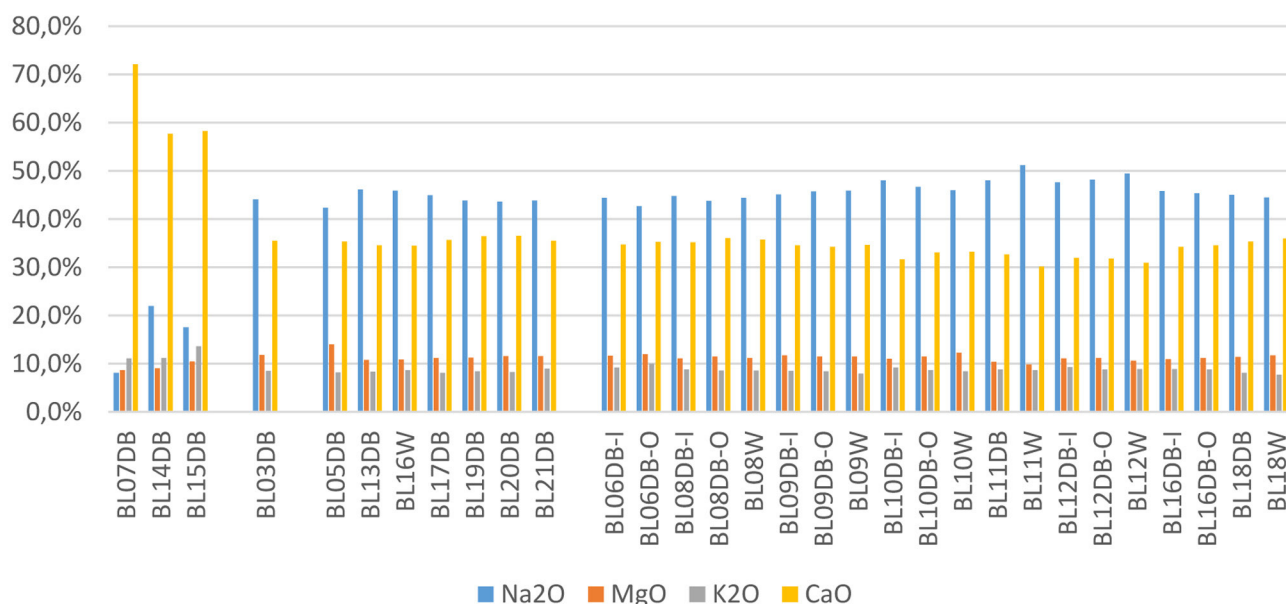


Figure 6. Principal flux components in glasses of small beads from Tiahuanaco, showing their ratios as % of their total. Most samples have near-identical flux compositions. DB = dark blue, W = white, I = inner layer, O = outer layer.

three different cobalt-related profiles. No. 7 has very low As, Bi, and Ni; no. 14 has very high As but low Ni and Bi; and no. 15 has low levels of all three elements. We suggest the use of three different cobalt ores for coloring the HLLA glasses, showing a diversity of cobalt sources in contrast to the soda-lime beads.

Most dark blue glasses contain traces of copper, usually below 0.6%, which are also compatible with impurities in cobalt ore (Figure 8). Copper in blue glass, however, attains 1.2%-3.8% in five Nueva Cadiz beads, one from Venezuela (no. 9) and four from Tiahuanaco (nos. 23, 24, 28, 30). We notice similar levels in turquoise glasses (2.0%-3.6%) where copper is the main coloring agent. Possibly, the beadmakers converted surplus turquoise stock into these copper-rich dark blue glasses, by adding cobalt colorant and tin-lead opacifier.

The majority of dark blue glasses also contain significant levels of tin and lead, as much as 9% of total glass composition (Figure 9). These elements partially opacify the glass and make it darker, as less light passes through. In white glass, these elements constitute the dominant opacifier and colorant. Their average level in dark blue glass (7.5%) is about 30% of that in white glass (25%). Since we have no previous layer-by-layer LA-ICP-MS studies of compound beads, or of the tin-lead combination itself, we considered whether these elements could have diffused from nearby white glass during the beads' fabrication or lifespan, or represent involuntary contamination during sampling.

We find, however, that there are similar levels of tin and lead in monochrome dark blue beads that have no white glass as a possible source of diffusion or contamination. The presence of tin and lead in dark blue glass was either purposeful to create opacity or resulted from recycling previously opacified glasses.

We believe these elements had a purpose because of a pattern seen in the small three-layer beads from Tiahuanaco (Figure 10). In these beads, the dark blue core has moderate tin and lead (4%-9%), whereas the outer dark blue layer has low levels (0.6%-2%). As well, the tin-rich core has low cobalt (820-3035 ppm), contrary to the outer layer that has lower tin and high cobalt (3296-6065 ppm Co). In the outer layer, high cobalt combined with low opacifier produced an intense, diaphanous blue that allows light to enter and reflect back from the middle white layer. A glassmaking treatise describes an analogous effect of tin in the manufacture of mirrors: "It is not the glass that makes the mirror, but the tin; because without the tin, it would be impossible to reflect objects held up to it" (Haudicquer de Blancourt 1718, 2:242). The judicious dosage of cobalt and opacifier in each bead layer similarly used tin to reflect light and create a shimmering effect.

White Glass

We analyzed 5 samples of white glass from Venezuela and 19 from Tiahuanaco. Most form the middle layer of small and large Nueva Cadiz beads (n=20). Two samples

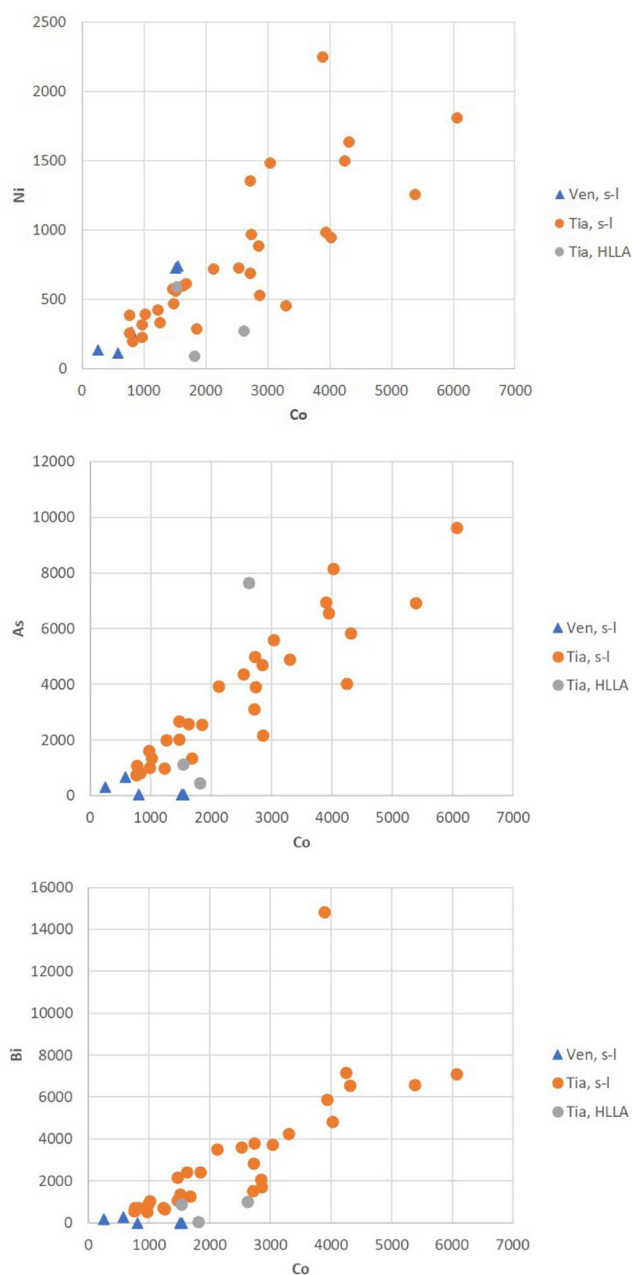


Figure 7. Cobalt ratios to nickel, arsenic, and bismuth in dark blue glasses. The outlier with high nickel and bismuth is Nueva Cadiz bead no. 25.

come from the white/blue/white Venezuela bead and two from the Tiahuanaco chevrons. All the white glasses contain both tin and lead that typically comprise 22%-28% of the glass matrix. The ratios of SnO_2 to PbO show three recipes ranging from 6:10 to 9:10 by weight (Figure 11). Higher indium (In) in these samples is typical of many tin ores (Benzaazoua et al. 2003; Comendador Rey et al. 2017; Lerouge et al. 2017; Wang et al. 2016).

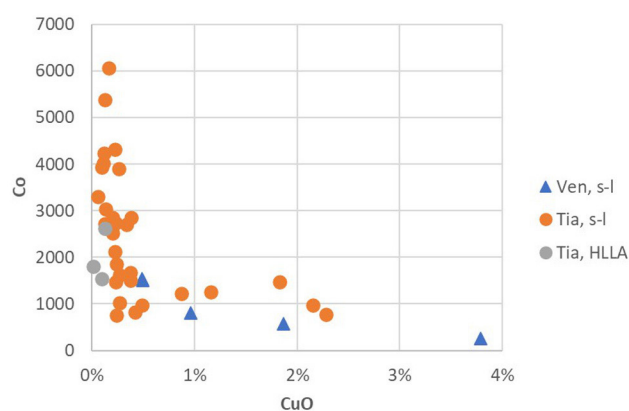


Figure 8. Cobalt and copper (CuO) levels in dark blue glasses. Copper levels below 0.6% are consistent with cobalt ore.

Tin as SnO_2 (cassiterite) forms white crystals that produce an opaque white aspect when dispersed in colorless glass (e.g., Matin 2019; Tite, Pradell, and Shortland 2008). Lead decreases the solubility of cassiterite in glass, thus favoring its crystallization (Molera et al. 1999). Starting in the early 15th century, Venetian glass recipes describe the creation of opaque white glass called *lattimo* (e.g., Moretti, Salerno, and Tommasi-Ferroni 2004; Verità and Zecchin 2009). Artisans made a white opacifier by calcinating metallic lead and tin, to make a white powder called calx. They mixed this powder into molten glass to impart an opaque white hue (Billeck and McCabe 2018; Matin 2019). Trade beads found in North America show a chronology of tin use for opacifying. Only tin was used before 1625, after which antimony appeared and soon became the exclusive opacifier. The tin-antimony shift happened ca. 1625-1650 in Dutch beads, and ca. 1650-1675 in French beads. Lead also vanishes from trade beads at this time, except for rare lead glasses, and yellow or amber colorants. Arsenic is the opacifier in beads from the late 18th and 19th centuries (Hancock 2013).

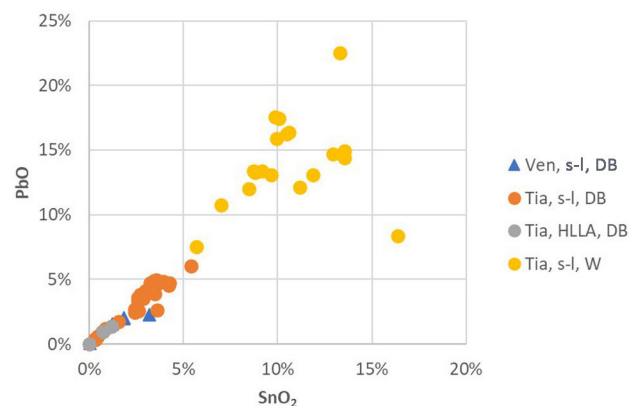


Figure 9. Tin and lead content, showing their consistent ratio in all glass colors.

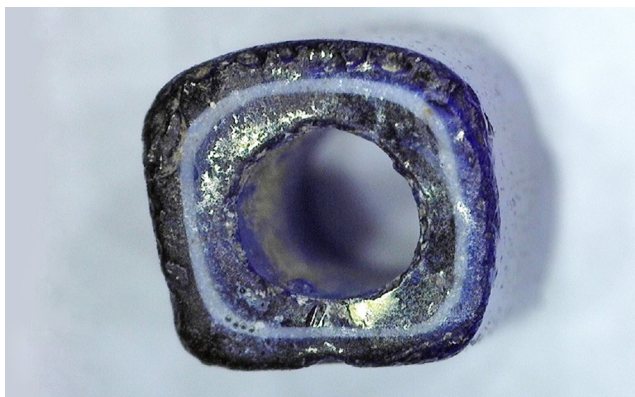


Figure 10. Tiahuanaco small bead no. 8.

Beadmakers used calx not only to create white glass, but also to slightly opacify other colors. Thus, bead layers have stepped levels of tin and lead. The opaque white middle layer has 25% on average, while the dark blue core has 7.5%. As for the outer layer, the small dark blue beads and five large turquoise examples have 0.6%-2.2% tin and lead, while eight turquoise glasses have insignificant levels of opacifier (Figure 9).

Turquoise Glass

We measured 3 turquoise glasses from Venezuela and 10 from Tiahuanaco, all from the outer layer of Nueva Cadiz beads. The turquoise color derives from copper in the form of Cu^{2+} that develops in a normal atmosphere requiring little technical expertise. Calculated as CuO , copper concentrations range from 3.0%-3.6% in the Venezuela samples and 2.0%-3.4% in those from Tiahuanaco. Much less copper can still produce a vibrant turquoise color in

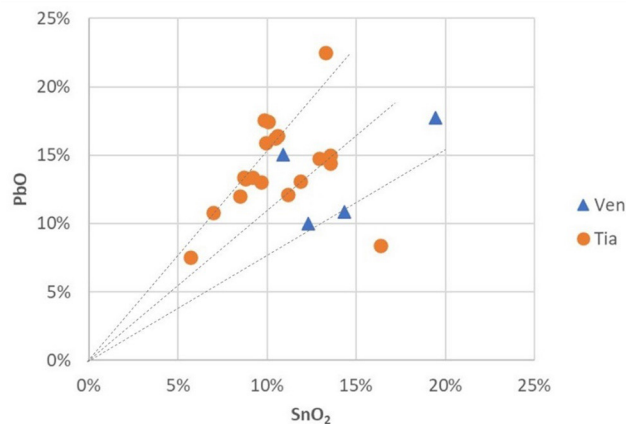


Figure 11. Tin and lead levels in the white glasses of small Nueva Cadiz and tubular chevron beads. The Tiahuanaco outlier (bottom right) is from a chevron bead. Diagonal lines show similar ratios of tin and lead in several beads.

glass. In three beads from Tiahuanaco (nos. 22, 25, 31), the turquoise layers have tin and lead combining for 1.4%-2.3% (Figure 12). This level is similar to the outer dark blue layer of small Nueva Cadiz beads ($\leq 2\%$), indicating a similar approach to adjusting the amount of light passing through the beads' outer layer (Figure 13). The compositions of these layers illustrate the beadmakers' use of opacifier levels to create different light effects.

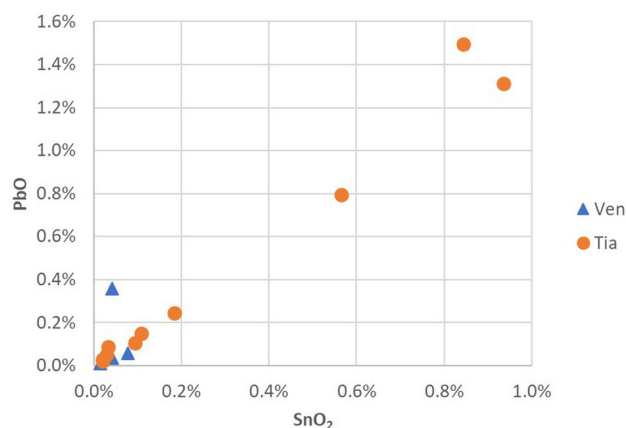


Figure 12. Tin and lead levels in turquoise glasses of Nueva Cadiz beads. Combined levels below 0.4% are the norm.

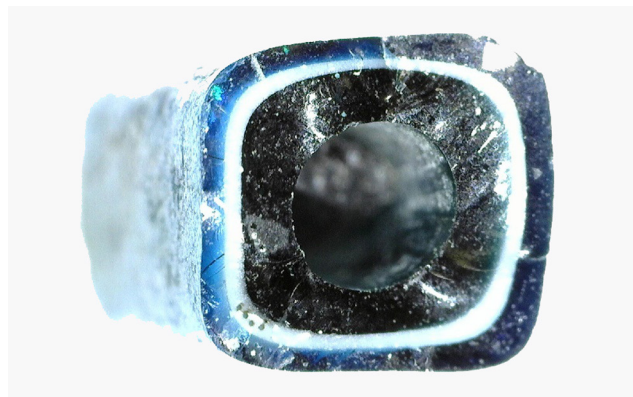


Figure 13. Nueva Cadiz bead no. 23 from Tiahuanaco.

Red Glass

We obtained two compositions of the red glass in the chevron beads from Tiahuanaco (Figure 14). Red is a color usually produced by the addition of copper either as metal scraps or as a prepared oxide. The red glass samples contain moderate amounts of copper ($\text{CuO} = 1.0\%$ and 1.6%). To obtain red, glassmakers needed to skillfully maintain a reducing atmosphere (depleted of oxygen) in the furnace. Iron found in significant concentrations ($\text{Fe}_2\text{O}_3 = 4.6\%$ and 5.4%) may have acted as an internal reducer that facilitated the precipitation of copper as metallic copper or cuprous



Figure 14. Five-layer chevron bead no. 32 from Tiahuanaco.

oxide crystals, which produce an opaque red color (Ahmed, Ashour, and El-Shamy 1977). “Of all colored glasses,” Cannella (2006:171) states, “red glass certainly gave the most trouble to master glassmakers over the centuries.” She cites recipes for red glass that used cuprous and ferrous ingredients variously described as kettle offcuts, iron filings, Saffron of Mars, Saffron of Iron, magnesium iron, and carbon-rich particles of iron slag that accumulated around a blacksmith’s anvil.

Colorless Glass

We sampled four colorless glasses: two colorless Nueva Cadiz beads from Venezuela and the colorless cores of two chevron beads from Tiahuanaco, one of which we sampled three times (no. 33). Glass has a natural bluish, greenish, or brownish tint due to the presence of iron in silica sand. Glassmakers had various ways of minimizing the intensity of this tint. They could choose a sand with the least amount of iron possible, they could control the atmosphere in the furnace to produce an iron species with the least tinting power, or they could add a decoloring element such as antimony, arsenic, or manganese to neutralize the ferrous tint (Meulebroeck et al. 2010).

Iron levels (measured as Fe_2O_3) are 0.2% in the colorless beads from Venezuela, and 0.4%-0.9% in the Tiahuanaco glasses. While these levels are among the lowest of all color categories, they are similar to those in white (0.3%-0.7%) and turquoise glasses from Tiahuanaco (0.3%-1.1%). We note, however, that the sample size for colorless glass is relatively small.

We may ask whether a decoloring agent such as antimony, arsenic, or manganese produced the colorless aspect. Antimony (Sb) does not rise above a few tens of ppm in any of our glasses, and colorless glasses show no

enrichment. Arsenic (As) is 3-4 ppm in colorless beads from Venezuela and 110-147 ppm in Tiahuanaco colorless glasses. This concentration is below the few hundred ppm in turquoise where arsenic enters as a copper impurity, and the few thousand ppm in dark blue where it is an impurity of cobalt.

As for manganese (MnO), it occurs at 0.3%-0.8% in the colorless glasses (Figure 15). Manganese has several possible pathways into glass, and its interpretation is complex. Soda plant ash can contribute ca. 0.02%-0.06% (Barkoudah and Henderson 2006; Occari, Freestone, and Fenwick 2021; Phelps et al. 2016; Schibille, Sterrett-Krause, and Freestone 2017). As a sand impurity, it can enter glass at levels below about 1%. Used as a colorant, manganese can create a spectrum of pink and purple hues, culminating with black when present at concentrations higher than about 3% (Hancock 2013). Finally, in its role as “glassmaker’s soap,” manganese can eliminate ferrous tints at concentrations of 1%-2%, if iron is found at similar levels in colorless glass (Jackson 2005, 2006:88; Sayre 1963). In our colorless glasses, MnO and Fe_2O_3 (0.2%-0.9%) fail to cross the threshold of the decolorizing hypothesis. In fact, manganese levels in colorless glass are no higher than in any colored glass, so we cannot infer its addition with the aim of washing a ferrous tint out of a glass batch. Thus, the colorless aspect of these glasses derives from the use of high-purity sand and a proficient control of furnace conditions.

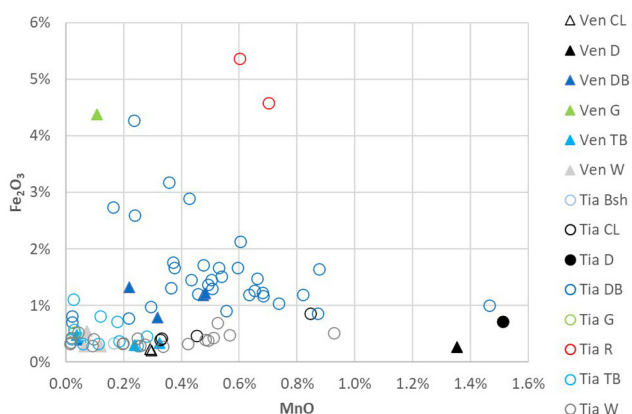


Figure 15. Manganese relative to iron is no richer in colorless than in colored glasses, so it did not serve as a decolorant.

Distinctive Inner Layer Colors of Nueva Cadiz Beads

In three Nueva Cadiz beads from Tiahuanaco, the core has a different color (Figure 16). Two with weak “bluish” and “greenish” tints (nos. 26, 31) have lower soda and lime but higher potash, and show no added colorant. The third has a “dark” blackish gray color (no. 29). It has higher lime and its color derives from added manganese (1.5%).

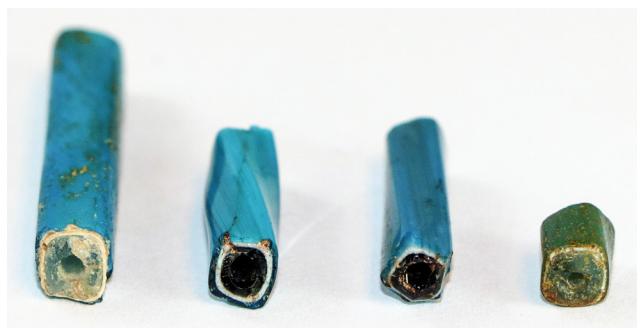


Figure 16. Color variants in the cores of Nueva Cadiz beads from Tiahuanaco: bluish, dark blue, blackish, and greenish (nos. 26, 28, 29, 31) (photo: Saraí Barreiro Argüelles).

PROVENIENCE ANALYSIS

In our approach to the origin of Nueva Cadiz and associated beads, we focused on elements that researchers have used as “tracers” to infer glass provenience. While flux compositions show some regional variations, trace elements in sand are most useful for differentiating glassmaking regions or centers. Among the most eloquent tracers are aluminum found in kaolinite and feldspar, zirconium and hafnium that co-occur in zircon, titanium in rutile, and the cortège of rare earth elements¹ (REE) that concentrate in monazite (Cagno et al. 2012; Coutinho et al. 2021; Degryse and Shortland 2020; De Raedt et al. 2001; Freestone 2005; Koleini et al. 2019; Wedepohl and Simon 2010).

We defined the “diagnostic range” of these elements in the Venezuela and Tiahuanaco beads, i.e., the concentrations that characterize them. The strictest range includes 28 out of 40 beads, and six other beads show a variant, so that our diagnostic ranges account for 85% of our sample. The Nueva Cadiz range falls at the low end of soda glasses of the 15th-17th centuries with proven provenience, so only its upper boundary required definition.

We then compared our diagnostic range with published data on soda glasses in hollowware of the 15th-17th centuries with proven provenience. De Raedt et al. (2001) and Cagno et al. (2012) distinguished Venetian glasses from those made in Antwerp. Similarly, Cagno et al. (2012) distinguished glasses made in Venice and in Altare, a glass center in Liguria, while Coutinho et al. (2016, 2021) separated glasses made in Portugal and Grenada, an Andalusian production center, from Venetian imports. These references cover several of the proposed origins of Nueva Cadiz beads.

Bead studies also provided comparative data. We established diagnostic ranges for glasses from early 17th-century beadmaking workshops in Rouen, Amsterdam, and London (Dussubieux 2009; Dussubieux and Karklins 2016). Interestingly, three Amsterdam samples correlate with

Venetian *cristallo*. We also consulted data on French beads of the 17th-18th centuries found around Lake Michigan (Walder 2015). Table 5 synthesizes these results.

Potash

As we have shown, ratios among flux ingredients identify different European glassmaking traditions (Coutinho et al. 2021; Gratuze and Janssens 2004; Šmit et al. 2004; Wedepohl and Simon 2010). Additionally, researchers have associated high phosphorus (1%-3%) with the use of northern European wood ash, while high strontium (> 1000 ppm) points to kelp ash, and chlorine (> 0.5%) denotes Mediterranean soda ash (Degryse and Shortland 2020; Dungworth 2013; Stern 2017; Verità and Zecchin 2009). In our sample, all indicators are consistent with the use of Mediterranean soda ash.

Within the range of Mediterranean soda-ash flux, potash (K_2O) levels of 1.5%-3.0% have been associated with Levantine soda-plant ash used in Venice, and 4.5%-7.5% with Spanish soda-plant ash or barilla used in western Europe (Cagno et al. 2012). The Venezuela beads fall between these ranges (1.9%-4.4%) and we cannot draw any conclusion. In the Tiahuanaco sample, however, small beads, chevron beads, and five large Nueva Cadiz beads (nos. 22, 23, 24, 28, 29) straddle the upper end of the Levantine range (2.1%-3.2%). In contrast, four large Nueva Cadiz specimens (nos. 25, 27, 30, 31) have potash at Spanish barilla levels (3.9%-6.4%). Another (no. 26) has higher potash (9.8%), and its low strontium and high phosphorus indicate the presence of some wood ash in its flux.

Titanium and Aluminum

In the last ten years, researchers have come to realize that each soda-glass center had preferred sources of sand or gravel that carried distinctive geochemical tracers into glass. Titanium is a tracer in studies of Italian and Iberian glasses (Biron and Verità 2012; Cagno et al. 2012; Coutinho et al. 2016, 2021). In our study sample, the diagnostic range for titanium is 113-521 ppm in beads from Venezuela, and 167-447 ppm in those from Tiahuanaco. This range is low, and excludes all our comparisons except Venice and low-titanium glasses from Rouen.

We explored the overlap with Rouen low-titanium samples, by comparing the ratio of titanium to zirconium (Ti/Zr). This ratio in our sample averages 16.4:1. In Rouen glasses, it averages 5.6:1 in samples with low titanium, and 4.0:1 in those with high titanium. This difference suggests different sand sources for the Rouen and Nueva Cadiz beads.

Table 5. Diagnostic Ranges for Compared Elements in Glasses from Venezuela, Tiahuanaco, and Proven European Proveniences.

	Al ₂ O ₃	Ti (ppm)	Zr (ppm)	Hf (ppm)	Nd (ppm)	K ₂ O
Venezuela (<i>diagnostic range</i>)	(0.5%-1.3%)	(113-282)	(5.8-31.4)	(0.18-0.89)	(0.99-2.97)	(1.9%-4.3%)
Colorless (nos. 1, 2)	0.5%-0.6%	113	5.8	0.18	0.99-1.03	2.7%
Blue (nos. 3-5)	0.9%-1.0%	197-206	10.8-11.0	0.33-0.34	1.68-1.74	3.0%-3.2%
Green (no. 6)	1.2%	255	14.8	0.46	2.47	2.9%
White/blue/white (no. 7)	0.9%-1.7%	240-521	19.1-31.4	0.57-0.89	2.27-2.97	4.1%-4.4%
Nueva Cadiz (nos. 8-10)	0.8%-1.3%	168-282	10.6-16.4	0.34-0.46	1.61-2.12	1.9%-4.3%
Tiahuanaco (<i>diagnostic range</i>)	(0.6%-1.3%)	(167-447)	(8.7-29.5)	(0.23-0.85)	(1.52-3.46)	(2.2%-3.6%)
Nueva Cadiz 1 (n=7)	0.6%-1.0%	217-331	8.7-16.2	0.23-0.48	1.52-2.30	2.2%-3.4%
Nueva Cadiz 1a (nos. 25-27)						4.0%-9.8%
Nueva Cadiz 2 (no. 22)	1.0%-1.2%	370-452	15.9-17.9	0.39-0.49	2.24-2.80	2.7%-3.3%
Nueva Cadiz 3 (no. 29)	1.4%-1.7%	632-771	23.8-29.5	0.68-0.85	2.64-3.46	4.1%-4.7%
Nueva Cadiz 4 (no. 31)	1.1%-1.3%	424-523	18.6-23.0	0.57-0.70	2.52-3.12	5.3%-7.1%
Small, 3 layers (n=17)	0.9%-1.3%	167-447	9.9-15.9	0.23-0.51	1.71-2.87	2.4%-3.6%
Chevrons (nos. 32, 33)	1.0%-1.6%	308-647	12.3-23.0	0.35-0.63	2.12-3.12	2.0%-4.0%
Round (no. 3)	1.3%	470	13.3	0.48	2.73	2.7%
Small, high-Al ₂ O ₃ (no. 5)	3.0%	871	33.4	0.84	4.30	1.9%
Small, HLLA (nos. 7, 14, 15)	2.9%-4.4%	583-1448	88.5-135.1	2.81-4.11	10.9-12.9	3.1%-4.3%
Glasses with known provenience						
Venice <i>cristallo</i>	0.6%-1.1%		~10-18	~0.2-0.3		2.5%-3.2%
Venice <i>vitrum blanchum</i>	0.8%-2.1%	< 600	~18-50	~0.4-0.7		1.9%-3.4%
Antwerp <i>cristallo</i>	1.4%-1.8%		~10-20	~0.8-2.1		2.5%-3.8%
Antwerp <i>vitrum blanchum</i>	1.2%-1.4%		~20-35	~0.25-0.45		1.8%-2.6%
Antwerp <i>façon de Venise</i>	1.3%-1.7%		~35-120	~1.2-1.3		4.3%-6.7%
Altare	2.1%-7.8%	~500-1500	~20-170			1.1%-7.5%
Grenada	2.1%-4.2%	~600-1350				5.7%-6.9%
Portugal	1.8%-6.1%	~370-750	225-232	5.8-5.9	7.1-32.3	2.0%-6.9%
Rouen 1 (n=9)	0.7%-2.0%	1147-2170	321-558	9.37-16.67	3.78-15.08	2.9%-4.7%
Rouen 2 (n=4)	1.0%-1.3%	328-383	44-68	3.03-3.89	1.24-1.94	3.0%-7.3%
Amsterdam 1 (n=13)	1.4%-2.9%	247-725	21.7-191.2	0.70-5.45	3.49-7.95	2.3%-6.4%
Amsterdam 2 (n=3) (cf. Venice)	1.1%-1.5%	124-189	9.6-12.1	0.33-0.42	1.76-2.19	2.7%-3.2%
London	1.2%-2.6%	248-943	55-139	1.39-4.34	3.94-18.06	3.2%-5.6%
French beads	~1.0%-3.0%	~28-1288	~11-48	≤ 2	~2.6	~2.0%-8.2%
Dilution effect due to the addition of colorants was corrected by dividing the concentrations by (SiO ₂ + Na ₂ O + MgO + Al ₂ O ₃ + K ₂ O + CaO + MnO + Fe ₂ O ₃) unless the glass was colorless. Values in gray and amber cells fall outside the Venezuela and Tiahuanaco diagnostic range. See endnote 2 for data sources.						

Alumina (Al_2O_3) levels in glass follow broad regional patterns. European soda glasses tend to have less than 4%, with regional variations that researchers use in provenience studies (Cagno et al. 2012; Coutinho et al. 2016; Dussubieux, Gratuze, and Blet-Lemarquand 2010; Koleini et al. 2019). At the lower end of the scale, Venetian *crystallo* has less than 1%. Other high-quality Venice and Antwerp glasses, known as *vitrum blanchum* and *façon de Venise*, have 1%-2%. At the upper end of the scale, glasses made in the western Mediterranean – in Altare, Grenada, and Portugal – attain 2%-4% alumina. Our references for Rouen and Amsterdam have wide brackets, due to a comprehensive sampling strategy. Glasses from Rouen show 1%-3% Al_2O_3 , while those from Amsterdam contain 2%-5%.

In our sample, the diagnostic range for alumina is 0.5%-1.3%, similar to that of Venetian *crystallo*. It partially overlaps the Antwerp and Rouen ranges of 1%-2%. Alumina levels are significantly higher in beads from Altare, Grenada, Portugal, Amsterdam, London, and France.

Neodymium, Zirconium, and Hafnium

Neodymium is a rare earth element (REE) whose concentration in glass is broadly proportional to REE levels in general. Its diagnostic range in Nueva Cadiz and associated beads (1.0-3.5 ppm) is significantly lower than available comparisons from Portugal, Rouen, Amsterdam, London, and unsourced French beads. We do not have a comparative value for Venetian glass, but the Nueva Cadiz range overlaps with three Amsterdam samples whose profile is otherwise consistent with Venetian *crystallo*.

Zirconium and hafnium are related elements that occur regionally in similar ratios, but in different concentrations. In the 34 beads that underpin the diagnostic range for Nueva Cadiz and associated beads, we see 6-31 ppm of zirconium and 0.2-0.9 ppm of hafnium. Among our comparative glasses, only Venetian *crystallo* matches these levels, as well as the Amsterdam subgroup resembling Venetian *crystallo*.

Ratios of zirconium to hafnium are also specific to regional sand sources. Nueva Cadiz and associated beads cluster around 34:1, while one outlier, a high-aluminum blue bead from Tiahuanaco, has a ratio of 40:1 (no. 5). This outlier also has very elevated titanium, and we may assign it to a distinct sand source.

HLLA Provenience

The three monochrome blue beads from Tiahuanaco containing HLLA glass show a different sand profile. Levels

of zirconium and hafnium are 6-8 times higher in HLLA beads than in the soda-lime glasses. In general, levels of 26 trace elements in HLLA beads are 3-10 times higher than in other samples in our study.³ High alumina (4.2%-6.8%) in these beads is typical of the western Mediterranean, reported in Altare (3%-5%), Grenada, and southern Portugal (2.6%-4%) (Cagno et al. 2012; Coutinho et al. 2021; Medici et al. 2015). We note that moderate alumina (3.0%-3.9%) also occurs in HLLA windowpane from northern Europe (Schalm et al. 2007). High phosphorus in HLLA beads indicates the use of wood ash as flux, a practice typical of northern Europe. All these indicators point to a separate provenience, but we need more research to identify the origin of these beads.

Provenience Summary

The elements of Nueva Cadiz and associated beads that we compared have diagnostic ranges at the lower end of their European spectrums. Potash levels in most Tiahuanaco beads fit the profile of Levantine soda used in Venice, and the exceptions indicate the use of Spanish soda. Potash levels in Venezuela beads, however, fall between the Levantine and Spanish ranges.

Titanium and alumina comparisons preclude a western Mediterranean origin for Nueva Cadiz and associated beads. While Antwerp alumina correlates with our beads, we lack data on titanium to confirm this. Venice stands out as the best match.

The zirconium and hafnium levels only match Venetian *crystallo* and the three Amsterdam samples whose profile is consistent with Venetian *crystallo*. Neodymium also matches the three Amsterdam samples, but we lack comparative data on this element for Venice, Antwerp, and several other glass centers.

Available data thus favor Venice as the best match for Nueva Cadiz and associated beads, but we emphasize the need for deeper analysis to verify our comparisons. We also emphasize the need for fuller data from Venice and Antwerp, and possibly from Paris that is missing from our list of comparative references.

CONCLUSION

Nueva Cadiz beads have fascinated researchers for their early arrival in the Americas, their disappearance about 1560-1585, their sophisticated technology, and their unresolved provenience. We have studied the chemistry of two collections, one with a solid archaeological context

and the other taken from a site with little regard for its documentation. Both collections emanate from the same beadmaking tradition. While the Venezuela sample provides an early view of Nueva Cadiz and associated beads (ca. 1500-1540), the Tiahuanaco sample shows its later 16th-century development.

Contrary to the perception that colored glasses did not require high-quality sand, these beads were made using sand with a 97%-98.5% silica content. Such purity is typical of many glass beads, which casts beadmaking as a branch of the refined soda-glass industry that arose in Italy and spread throughout Europe in the 15th-17th centuries. Despite their reliance on soda glassmakers, Nueva Cadiz beadmakers controlled many steps of the manufacturing process. They divided each glass batch into three lots to color them turquoise, dark blue, and white, and assembled the colored glasses into production tubes before starting a new glass batch. They did not practice an economy of scale by coloring an entire glass batch the same color, which would have resulted in a different glass batch for each color of a bead. They made the most of their raw materials, as shown by surplus turquoise stock converted to dark blue. A similar workplace organization underlies both collections.

The beads shed light on the use of tin and lead as an opacifying agent. By preventing tin from dissolving in molten glass, lead favors the formation of tin crystals that perform the opacifying role. Beadmakers adjusted opacifier doses in different bead layers to create a mirror-like effect, allowing light to reflect off the white middle layer. They used tin and lead at 25% concentration to create the reflecting white middle layer, at 7.5% to opacify the dark blue inner layer, and at 0.6%-2.2% to create shimmering in the outer layer. The prismatic planes of the square-sectioned bead diffract light and enhance its shimmering effect.

Beadmakers used cobalt from several mines to create the dark blue color in the Venezuela beads, but only cobalt from Schneeberg for the Tiahuanaco beads. Together with the Schneeberg cobalt monopoly, the presence of HLLA glass shows a northern European influence in the Tiahuanaco sample. The HLLA beads reveal a previously unknown 16th-century beadmaking tradition, characterized by high-alumina sand, high-phosphorus flux, cobalt colorant from unidentified mines, and a peculiar shape with bulging sides. Despite their northern European influences, HLLA beads entered the same transatlantic networks as Nueva Cadiz beads.

Regarding the provenience of Nueva Cadiz and associated beads, the flux in Venezuela beads falls between Levantine and Spanish diagnostic ranges. Most Tiahuanaco beads contain Levantine soda-plant ash but some have Spanish

barilla. In Europe, only Venice had access to Levantine soda ash. As for sand-related elements, levels of alumina, titanium, zirconium, hafnium, and neodymium exclude a western Mediterranean origin, and cast doubt on Amsterdam, London, Rouen, and other French bead origins. In Europe, Venice stood out for its selective use of crushed river cobbles as a silica source. In the absence of full comparative data, however, we cannot exclude Antwerp or Paris as possible origins. Based on available data, Venice stands as the best candidate as the source of Nueva Cadiz and associated beads, but we emphasize the need for more analyses.

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ENDNOTES

1. The rare earth elements, mostly found in the lanthanoid group at the bottom of the periodic table, are Y, Sc, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu.
2. Venice, Antwerp: De Raedt et al. 2001; Venice *vitrum blanchum* titanium: Biron and Verità 2012; Altare: Cagno et al. 2012; Grenada: Coutinho et al. 2021; Portugal: Coutinho et al. 2016; Rouen: Dussubieux 2009, data for 13 of 28 glasses; Amsterdam, London: Dussubieux and Karklins 2016, data for 16 out of 19 glasses; French beads, Walder 2015.
3. Trace elements, including rare earth elements, occurring at high levels in these three beads are Li, B, Ti, V, Rb, Zr, Cs, Ba, La, Ce, Pr, Ta, Y, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, and Th. Titanium (Ti) deviates somewhat with a high level in bead no. 5 and average in no. 7.

REFERENCES CITED

- Ahmed, A.A., G.M. Ashour, and T.M. El-Shamy
 1977 Effect of Melting Conditions on the Crystallisation of Cuprous Oxide and Copper in Glass. In *Proceedings of the XIth International Congress on Glass, Prague, Czechoslovakia, 4-8 July 1977*, edited by Jiří Götz, pp. 177-187. North Holland Publishing, Amsterdam.

Allender, Mark

- 2018 Glass Beads and Spanish Shipwrecks: A New Look at Sixteenth-Century European Contact on the Florida Gulf Coast. *Historical Archaeology* 52:824-843.

Antczak, A.T., M.M. Antczak, O. Antczak, and L.A. Lemoine Buffet

- 2019 *Rancherías*: Historical Archaeology of Early Colonial Campsites on Margarita and Coche Islands, Venezuela. In *Material Encounters and Indigenous Transformations in the Early Colonial Americas: Archaeological Case Studies*, edited by Corinne L. Hofman and Floris W.M. Keehnen, pp. 146-174. Brill, Leiden.

Ashtor, Eliyahu and Guidobaldo Ceviddali

- 1983 Levantine Alkali Ashes and European Industries. *Journal of European Economic History* 12(3):475-522.

Barkoudah, Y. and J. Henderson

- 2006 Plant Ashes from Syria and the Manufacture of Ancient Glass: Ethnographic and Scientific Aspects. *Journal of Glass Studies* 48:297-321.

Benzaazoua, M., P. Marion, A. Pinto, H. Migeon, and F.E. Wagner

- 2003 Tin and Indium Mineralogy within Selected Samples from the Neves Corvo Ore Deposit (Portugal): A Multidisciplinary Study. *Minerals Engineering* 16(11), supplement 1:1291-1302.

Billeck, William T. and Kendra McCabe

- 2018 pXRF Analysis of Opacifiers Used in White Drawn Glass Beads in the 17th to 19th Century in the Plains and Mid-West. Paper presented at the 76th Plains Anthropological Conference, San Antonio.

Biron, Isabelle and Marco Verità

- 2012 Analytical Investigation on Renaissance Venetian Enamelled Glasses from the Louvre Collections. *Journal of Archaeological Science* 39(8):1707-2713.

Bradley, James W.

- 2007 *Before Albany: An Archaeology of Native-Dutch Relations in the Capital Region, 1600-1664*. New York State Museum Bulletin 509. Albany.

Brill, Robert H.

- 1999 *Chemical Analyses of Early Glasses*. Corning Museum of Glass, Corning.

Brulez, Wilfrid

- 1965 *Marchands flamands à Venise. Volume 1: 1568-1605*. Institut historique belge de Rome, Brussels.

Cagno, Simone, Maria Brondi Badano, François Mathis, David Strivay, and Koen Janssens

- 2012 Study of Medieval Glass Fragments from Savona (Italy) and their Relation with the Glass Produced in Altare. *Journal of Archaeological Science* 39:2191-2197.

Canal, Ernesto

- 2013 *Archeologia della laguna di Venezia, 1960-2010*. Cierre edizioni, Venice.

Cannella, Anne-Françoise

- 2006 *Gemmes, verre coloré, fausses pierres précieuses au Moyen Âge. Le quatrième livre du «Trésorier de Philosophie naturelle des pierres précieuses» de Jean d'Outremeuse*. Droz, Geneva.

Comendador Rey, Beatriz, Emmanuelle Meunier, Elin Figueiredo, Aaron Lackinger, João Fonte, Cristina Fernández Fernández, Alexandre Lima, José Mirão, and Rui J.C. Silva

- 2017 Northwestern Iberian Tin Mining from Bronze Age to Modern Times: An Overview. In *The Tinworking Landscape of Dartmoor in a European Context – Prehistory to 20th Century*, edited by Phil Newman, pp. 133-153. Short Run Press, Sowton, Exeter.

Cooper, Martin

- 2016 "In order to bring them trade": Neutral Exchange in the Sixteenth Century. In *Contact in the 16th Century: Networks among Fishers, Foragers and Farmers*, edited by Brad Loewen and Claude Chapdelaine, pp. 257-267. University of Ottawa Press and Canadian Museum of History, Ottawa.

Coutinho, Inês, Isabel Cambil Campaña, Luís Cerqueira Alves, and Teresa Medici

- 2021 Calle Horno del Vidrio – Preliminary Study of Glass Production Remains Found in Granada, Spain, Dated to the 16th and 17th Centuries. *Minerals* 11:688-707.

Coutinho, Inês, Teresa Medici, Susana Coentro, Luís C. Alves, and Márcia Vilarigues

- 2016 First Archaeometric Study on Medieval Glass Found in Beja (Southern Portugal). *Journal of Medieval Iberian Studies* 8(2):148-175.

Deagan, Kathleen

- 1987 *Artifacts of the Spanish Colonies of Florida and the Caribbean, 1500-1800. Volume 1: Ceramics, Glassware, and Beads*. Smithsonian Institution Press, Washington, DC.

Degryse, Patrick and Andrew J. Shortland

- 2020 Interpreting Elements and Isotopes in Glass: A Review. *Archaeometry* 62(S1):117-133.

Dehaine, Quentin, Laurens T. Tijsseling, Hylke J. Glass, Tuomo Törmänen, and Alan R. Butcher

- 2021 Geometallurgy of Cobalt Ores: A Review. *Minerals Engineering* 160, art. 106656.

Delmas, Vincent

- 2016 Beads and Trade Routes: Tracing Sixteenth-Century Beads around the Gulf and into the Saint Lawrence Valley. In *Contact in the 16th Century: Networks among Fishers, Foragers and Farmers*, edited by Brad Loewen and Claude Chapdelaine, pp. 77-115. University of Ottawa Press and Canadian Museum of History, Ottawa.

De Raedt, Inc, Koen Janssens, Johan Veeckman, Laszlo Vincze, Bart Vekemans, and Te Jeffries

- 2001 Trace Analysis for Distinguishing between Venetian and Façon-de-Venise Glass Vessels of the 16th and 17th Century. *Journal of Analytical Atomic Spectrometry* 16(9):1012-1017.

Donnan, Christopher B. and Jill Silton

- 2010 Sixteenth-Century Glass Beads from Chotuna, North Coast of Peru. *Beads: Journal of the Society of Bead Researchers* 22:12-26.

Dungworth, David

- 2013 Innovations in the 17th-Century Glass Industry: The Introduction of Kelp (Seaweed) Ash in Britain. In *Les innovations verrières et leur devenir. Actes du dixième colloque international de l'Association Verre & Histoire, Nancy, 26-28 mars 2009*, edited by Sophie Lagabriele and Corine Maitte, pp. 119-123. INHA, Paris.

Dungworth, David and Tom Cromwell

- 2006 Glass and Pottery Manufacture at Silkstone, Yorkshire. *Post-Medieval Archaeology* 40(1):160-190.

Dungworth, David, Patrick Degryse, and Jens Schneider

- 2009 Kelp in Historic Glass: The Application of Strontium Isotope Analysis. In *Isotopes in Vitreous Materials: Studies in Archaeological Sciences*, edited by Patrick Degryse, Julian Henderson, and Greg Hodgins, pp. 113-130. Leuven University Press, Leuven.

Dussubieux, Laure

- 2009 Chemical Investigation of Some 17th-Century French Glass Personal Ornaments. *Journal of Glass Studies* 51:95-110.

Dussubieux, Laure, Bernard Gratuze, and Maryse Blet-Lemarquand

- 2010 Mineral Soda Alumina Glass: Occurrence and Meaning. *Journal of Archaeological Science* 37:1646-1655.

Dussubieux, Laure and Karlis Karklins

- 2016 Glass Bead Production in Europe during the 17th Century: Elemental Analysis of Glass Material Found in London and Amsterdam. *Journal of Archaeological Science: Reports* 5:574-589.

Dussubieux, Laure, Peter Robertshaw, and Michael D. Glascock

- 2009 LA-ICP-MS Analysis of African Glass Beads: Laboratory Inter-Comparison with an Emphasis on the Impact of Corrosion on Data Interpretation. *International Journal of Mass Spectrometry* 284:152-161.

Fairbanks, Charles H.

- 1968 Early Spanish Colonial Beads. In *Conference on Historical Site Archaeology Papers, 1967* 2(1):3-21.

Freestone, Ian C.

- 2005 The Provenance of Ancient Glass through Compositional Analysis. In *Materials Issues in Art and Archaeology VII*, edited by Pamela B. Vandiver, Jennifer L. Mass, and Alison Murray, pp. 8.1.1-8.1.13. Materials Research Society Symposium Proceedings 852. Pittsburgh.

Girón-Pascual, Rafael Maria

- 2018 Cenizas, cristal y jabón. El comercio de la barrilla y sus derivados entre España e Italia a finales del siglo XVI (1560-1610). *eHumanista: Journal of Iberian Studies* 38:215-232.

Gratuze, Bernard and Koen Janssens

- 2004 Provenance Analysis of Glass Artefacts. *Comprehensive Analytical Chemistry* 42:663-712.

Gratuze, Bernard, Inès Pactat, and Nadine Schibille

- 2018 Changes in the Signature of Cobalt Colorants in Late Antique and Early Islamic Glass Production. *Minerals* 8, art. 225; <https://www.academia.edu/36713626/>.

Gratuze, Bernard, Isabelle Soulier, Maryse Blet, and Lucy Vallauri

- 1996 De l'origine du cobalt: du verre à la céramique. *Revue d'Archéométrie* 20:77-94.

Gutierrez, Manuel

- 2001 Découverte d'un rite funéraire inconnu – La Sépulture de Caotinha. *Revista Arqueologia* 377:46-50.

Gutierrez, Manuel and Frédérique Valentin

- 1995 Archéologie et anthropologie des tumulus de Kapanda (Angola). *Journal des Africanistes* 65(2):145-169.

Hancock, Ron G.V.

- 2013 European Glass Trade Beads in Northeastern North America. In *Modern Methods for Analyzing Archaeological and Historical Glass*, Vol. 1, edited by Koen Janssens, pp. 459-471. John Wiley, Chichester.

Haudicquer de Blancourt, Jacques

- 1718 *L'art de la verrerie*. Claude Jombert, Paris.

Historic England

- 2018 *Archaeological Evidence for Glassworking: Guidelines for Recovering, Analysing and Interpreting Evidence*. Historic England, Swindon.

Jackson, Caroline M.

- 2005 Making Colourless Glass in the Roman Period. *Archaeometry* 47:763-780.
2006 Compositional Analysis of the Gnalić Glass. In *The Glass from the Gnalić Wreck*, edited by Irena Lazar and Hugh Willmott, pp. 87-106. Založba Annales, Koper, Croatia.

Jacoby, David

- 1993 Raw Materials for the Glass Industries of Venice and the Terraferma, about 1370-about 1460. *Journal of Glass Studies* 35:65-90.

Janssens, Koen, Simone Cagno, Ine De Raedt, and Patrick Degryse

- 2013 Transfer of Glass Manufacturing Technology in the Sixteenth and Seventeenth Centuries from Southern to Northern Europe, Using Trace Element Patterns to Reveal the Spread from Venice via Antwerp to London. In *Modern Methods for Analysing Archaeological and Historical Glass*, edited by Koen Janssens, pp. 537-562. Wiley, Chichester.

Karklins, Karlis

- 2004 The Levin Catalogue of Mid-19th-Century Beads. *Beads: Journal of the Society of Bead Researchers* 16:39-50.

Karklins, Karlis and Adelphine Bonneau

- 2019 Evidence of Early 17th-Century Glass Beadmaking in and around Rouen, France. *Beads: Journal of the Society of Bead Researchers* 31:3-8.

Karklins, Karlis and Tony Oost

- 1992 The Beads of Roman and Post-Medieval Antwerpen, Belgium. *Beads: Journal of the Society of Bead Researchers* 4:21-28.

Kidd, Kenneth E. and Martha Ann Kidd

- 2012 A Classification System for Glass Beads for the Use of Field Archaeologists. *Beads: Journal of the Society of Bead Researchers* 24:39-61.

Klaës, Guillaume

- 2021 Beadmaking during the 17th and 18th Centuries in Eu County, Normandy. Translated by Brad Loewen. *Beads: Journal of the Society of Bead Researchers* 33: 34-44.

Koleini, Farahnaz, Philippe Colomban, Innocent Pikirayi, and Linda C. Prinsloo

- 2019 Glass Beads, Markers of Ancient Trade in Sub-Saharan Africa: Methodology, State of the Art and Perspectives. *Heritage* 2(3):2343-2369.

Lerouge, Catherine, Éric Gloaguen, Guillaume Wille, and Laurent Bailly

- 2017 Distribution of In and Other Rare Metals in Cassiterite and Associated Minerals in Sn ± W Ore Deposits of the Western Variscan Belt. *European Journal of Mineralogy* 29:739-753.

Lewis, Tyra Lee

- 1979 Neutron Activation Analysis of Glass Trade Beads. Unpublished manuscript. Troy, Michigan.

Little, Keith

- 2010 Sixteenth-Century Glass Bead Chronology in Southeastern North America. *Southeastern Archaeology* 29(1):222-232.

Liu, Robert K. and Elizabeth Harris

- 1982 *Nueva Cadiz and Associated Beads: History and Description*. Archaeological Research Booklets 17. Lancaster, PA.

Martins Torres, Carla Andreia

- 2007 Contas exumadas na intervenção arqueológica do palácio dos marqueses de Marialva - uma tipologia usada no trato colonial. *Anais de História de Além-Mar* 8:181-237.

Matin, Moujat

- 2019 Tin-Based Opacifiers in Archaeological Glass and Ceramic Glazes: A Review and New Perspectives. *Archaeological and Anthropological Sciences* 11(4):1155-1167.

Medici, Teresa

- 2014 Vidros de terra. O vidro tardomedieval e moderno em Portugal (séculos XIV-XVII). O contributo da arqueologia. Ph.D. dissertation, Universidade de Coimbra, Coimbra.

Medici, Teresa, Inês Coutinho, Luís C. Alves, Bernard Gratuze, and Márcia Vilarigues

- 2015 Looking through Late Medieval and Early Modern Glass in Portugal. In *Annales du 20^e Congrès de l'Association Internationale pour l'Histoire du Verre, Fribourg / Romont 7-11 septembre 2015*, pp. 412-420. Romont.

Meulebroeck, W., K. Baert, H. Wouters, P. Cosyns, A. Ceglia, S. Cagno, K. Janssens, K. Nys, H. Terry, and H. Thienpont
2010 The Identification of Chromophores in Ancient Glass by the Use of UV-VIS-NIR Spectroscopy. *Optical Sensing and Detection* 77260D; <https://www.academia.edu/18325334/>.

Molera, Judit, Trinitat Pradell, Nati Salvadó, and Mariux Vendrell-Saz
1999 Evidence of Tin Oxide Recrystallization in Opacified Lead Glazes. *Journal of the American Ceramic Society* 82(10):2871-2875.

Moretti, Cesare, Carlo Stefano Salerno, and Sabina Tommasi-Feroni
2004 *Ricette vetrarie muranesi. Gaspare Brunoro e il manoscritto di danzica*. Nardini, Florence.

Mortimer, Catherine
1995 Analysis of Post-Medieval Glass from Old Broad Street, London, with Reference to Other Contemporary Glasses from London and Italy. In *Trade and Discovery: The Scientific Study of Artefacts from Post-Medieval Europe and beyond*, edited by Duncan R. Hook and David R.M. Gaimster, pp. 135-144. British Museum Press, London.

Occari, Veronica, Ian C. Freestone, and Corisande Fenwick
2021 Raw Materials and Technology of Medieval Glass from Venice: The Basilica of SS. Maria e Donato in Murano. *Journal of Archaeological Science: Reports* 37:1-14.

Palamara, Eleni, Nikolaos Zacharias, Sophia Germanidou, Konstantina Gerolymou, Dimitrios Palles, and Efstratios I. Kamitsos
2017 Technology and Provenance Analysis of Glass Fragments from an Ottoman Bathhouse (Hamam) in Kyparissia, Peloponnese, Greece. *STAR: Science & Technology of Archaeological Research* 3(2):376-390.

Pérez-Arantegui, Josefina, Beatriz Montull, Martin Resano, and J.M. Ortega
2009 Materials and Technological Evolution of Ancient Cobalt-Blue-Decorated Ceramics: Pigments and Work Patterns in Tin-Glazed Objects from Aragon (Spain) from the 15th to the 18th Century AD. *Journal of the European Ceramic Society* 29(12):2499-2509.

Phelps, M., I.C. Freestone, Y. Gorin-Rosen, and B. Gratuze
2016 Natron Glass Production and Supply in the Late Antique and Early Medieval Near East: The Effect of the Byzantine-Islamic Transition. *Journal of Archaeological Science* 75:57-71.

Picard, John and Ruth Picard
1993 *Chevron and Nueva Cadiz Beads*. Beads from the West African Trade Series VII. Picard African Imports, Carmel.

Rodrigues, Maria da Conceição
1993 Contribuição para o Estudo das Contas de Origem Mediterrânica recolhidas em Angola. In *Actas do 1.º Congresso Mediterrânico de Etnologia Histórica*, vol. 3, pp. 349-364. Instituto Mediterrânico, Universidad Nova de Lisboa, Lisbon.
2003 The Importance of the Long Glass Beads of Mediterranean Origin Collected in the “Baixa Pombalina,” Lisbon: Contribution to the Study of the “Nueva Cadiz” Type Beads. *Zephyrus* 56:203-233.
2007 Glass Beads as Identity Element of the African in the Cultural Past of Lisbon from the mid XV Century until the 1755 Earthquake – A Study of “Nueva Cádiz” and “Chevron” Type Beads. *Zephyrus* 60:279-301.

Romero, Aldemaro
2003 Death and Taxes: The Case of Depletion of Pearl Oyster Beds in Sixteenth-Century Venezuela. *Conservation Biology* 17(4):1-12.

Sayre, Edward V.
1963 The Intentional Use of Antimony and Manganese in Ancient Glasses. In *Advances in Glass Technology*, Part 2, edited by Frederick R. Matson and Guy Rindone, pp. 263-282. Plenum Press, New York.

Sayre, Edward V. and Ray W. Smith
1961 Compositional Categories of Ancient Glass. *Science* 133:1824-1826.

Schalm, Olivier, Koen Janssens, Hilde Wouters, and Danielle Caluwé
2007 Composition of 12-18th Century Window Glass in Belgium: Non-Figurative Windows in Secular Buildings and Stained-Glass Windows in Religious Buildings. *Spectrochimica Acta Part B* 62:663-668.

Schibille, Nadine, Allison Sterrett-Krause, and Ian C. Freestone
2017 Glass Groups, Glass Supply and Recycling in Late Roman Carthage. *Archaeological and Anthropological Sciences* 9(6):1223-1241.

Shreurs, Guido and Jean-Aimé Rakotoarisoa
2011 The Archaeological Site at Vohemar in a Regional Geographical and Geological Context. *Études océan Indien* 46-47:1-18.

Smith, Marvin T. and Mary Elizabeth Good

1982 *Early Sixteenth Century Glass Beads in the Spanish Colonial Trade*. Cottonlandia Museum Publications, Greenwood, MS.

Šmit, Žiga, Koen Janssens, Olivier Schalm, and Mateja Kos

2004 Spread of Façon-de-Venise Glassmaking through Central and Western Europe. *Nucl. Inst. Methods Phys. Res. B* 213:717-722.

Stern, Willem B.

2017 Phosphate: A Neglected Argument in Studies of Ancient Glass Technology. *Swiss Journal of Geosciences* 110:725-740.

Tite, Michael, Trinitat Pradell, and Andrew Shortland

2008 Discovery, Production and Use of Tin-Based Opacifiers in Glasses, Enamels and Glazes from the Late Iron Age Onwards: A Reassessment. *Archaeometry* 50(1):67-84.

Veiga, João Pedro and Maria Ondina Figueiredo

2002 Sixteenth Century Tubular Glass Beads: Non-Destructive Chemical Characterization Using Synchrotron Radiation XRF. *X-Ray Spectrometry* 31(4):300-304.

2006 Copper Blue in an Ancient Glass Bead: A XANES Study. *Applied Physics A* 83(4):547-550

Verità, Marco

2021 Venetian Glass. In *Encyclopedia of Glass Science, Technology, History, and Culture*, edited by Pascal Richet, Reinhard Conradt, Akira Takada, and Joël Dyon, pp. 1327-1340. The American Ceramic Society, Westerville, OH.

Verità, Marco and Sandro Zecchin

2009 Thousand Years of Venetian Glass: The Evolution of Chemical Composition from the Origins to the 18th Century. In *Annales du 16^e Congrès de l'Association Internationale pour l'Histoire du Verre, London, 7-13 September, 2003*, pp. 602-613. Nottingham.

Walder, Heather

2015 "...A Thousand Beads to Each Nation:" Exchange, Interactions, and Trade Practices in the Upper Great Lakes c. 1630-1730. Ph.D. dissertation. University of Wisconsin - Madison.

Walder, Heather, Alicia Hawkins, Brad Loewen, Laure Dussubieux, and Joseph A. Petrus

2021 Nueva Cadiz Beads in the Americas: A Preliminary Compositional Comparison. *Beads: Journal of the Society of Bead Researchers* 33:86-92.

Wang, Quanyu, Stanislav Strekopytov, Benjamin W. Roberts, and Neil Wilkin

2016 Tin Ingots from a Probable Bronze Age Shipwreck Off the Coast of Salcombe, Devon: Composition and Microstructure. *Journal of Archaeological Science* 67: 80-92.

Wedepohl, Karl Hans and Klaus Ernst Albert Simon

2010 The Chemical Composition of Medieval Wood Ash Glass from Central Europe. *Geochemistry* 70(1):89-97.

Zecchin, Paolo

2005 La nascita delle conterie Veneziane. *Journal of Glass Studies* 47:77-92.

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NUEVA CADIZ BEADS IN THE AMERICAS: A PRELIMINARY COMPOSITIONAL COMPARISON

Heather Walder, Alicia Hawkins, Brad Loewen, Laure Dussubieux, and Joseph A. Petrus

Nueva Cadiz and associated beads are among the earliest categories of European glass beads found in the Americas. Named after the site in Venezuela where they were first identified, these tubular, square-sectioned beads occur in regions of 16th-century Spanish colonial trade. A similar style occurs around Lake Ontario in northeastern North America in areas of 17th-century Dutch and French colonial trade. We compare the chemical composition of beads from South America and Ontario, Canada, to explore their provenience and technology. Differences in key trace elements (Hf, Zr, Nd) strongly indicate separate sand origins for the two bead groups. Comparison with soda-lime glass made in Venice and Antwerp reveals chemical similarities between the South American beads and Venetian glass, and between the Ontario beads and Antwerp glass. The analysis also sheds light on beadmaking technologies.

INTRODUCTION

Drawn glass beads described as “Nueva Cadiz” types are distinctive large tubular beads with a widespread distribution on 16th- and 17th-century colonial sites and come from diverse archaeological and historic contexts in the Americas (Little 2010; Liu and Harris 1982). These beads are square in section, sometimes twisted, and may have multiple layers of differently colored glass. In some cases, the name “Nueva Cadiz” has been used to refer to any tubular drawn bead with a square cross section, including compound examples with an opaque red exterior, and even those with a simple monochrome construction (e.g., Fairbanks 1968). The eponymous Nueva Cádiz site in Venezuela was a Spanish port town inhabited from 1498 to 1545. Beads from this and other early South American sites are associated with Spanish colonial trade (e.g., Donnan and Siltan 2010). Beads of Kidd and Kidd (1970) varieties IIIc1, IIIc2, and IIIc3, as well as twisted variety IIIc’4, are referred to here as “archetypal” Nueva Cadiz varieties. These beads generally have a blue/white/turquoise or blue/white/gray cross section, with the outer turquoise or robin’s egg blue color deriving from the

use of copper as a colorant (Figure 1). Such beads have been recovered from Portuguese (Veiga and Figueiredo 2006), Flemish (Karklins and Oost 1992), Norman (Karklins and Bonneau 2019), and possibly Andalusian (Deagan 1987:164; Martins Torres 2019:155) sites, and may have been manufactured in several European locations.

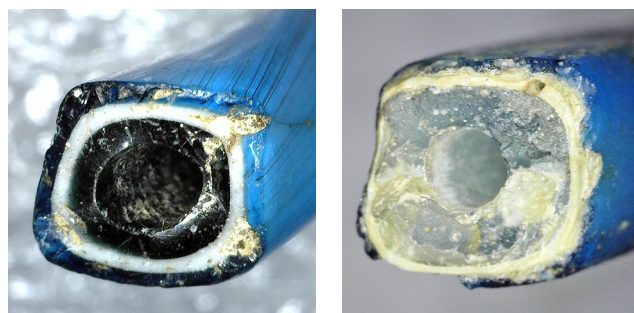


Figure 1. “Archetypal” Nueva Cadiz beads from 16th-century Spanish colonial contexts in South America with blue/white/blue and blue/white/gray layers (photo: Brad Loewen).

The “Nueva Cadiz” descriptor has also been applied to similar beads from later sites, particularly in the Northeast including southern Ontario, where French and Dutch traders were influential in the late 16th and early 17th centuries (Kenyon and Kenyon 1983; Smith 1983). These beads have a turquoise-blue outer layer with interior white and red layers and sometimes an additional innermost blue layer (Figure 2). They are categorized as type IIIc’3 and here are referred to as Nueva Cadiz Twisted – Red Variety (NCT-RV). Smith and Good (1982:51) argue that the red-core variety found in the Northeast could be considered a “revival” style that is not directly related to earlier Nueva Cadiz beads from Spanish contexts.

In this brief summary of ongoing research (Loewen 2021), we present a preliminary comparison of these two groups. The earlier blue/white/turquoise Nueva Cadiz beads from 16th-century Spanish colonial contexts are compositionally distinct from 17th-century varieties that



Figure 2. Nueva Cadiz Twisted – Red Variety. Two examples from the Huron-Wendat Le Caron site in Ontario. While these beads usually have three layers, these specimens have a fourth blue layer forming the core (scale in mm) (photo: Heather Walder).

include a red layer. Smith and Good (1982) and Karklins and Oost (1992:26) suggest that the term “Nueva Cadiz” only be used to describe those square-profiled tubular varieties associated with Spanish trade, which lack a red interior layer and may be identified by their blue/white/blue or gray cross section. The imprecise use of “Nueva Cadiz” as a descriptive category can lead to a loss of interpretive value.

By conducting compositional analyses, we hope to learn more about both the production processes used to make these technologically sophisticated polychrome beads and the European and Indigenous exchange networks that circulated these artifacts in the 16th and 17th centuries. Here we examine the white and turquoise layers of ten beads tentatively attributed to the site of Tiahuanaco in western Bolivia that were purchased by a collector in the 1970s (Loewen 2021), and six beads from controlled archaeological contexts on 17th-century Huron-Wendat occupations in Simcoe County, Ontario, Canada. The full compositions of all 16 beads are available on the Digital Archaeological Record (tDAR.org; tDAR Record ID: 463186) to promote further study of this important bead style.

PREVIOUS RESEARCH ON NUEVA CADIZ BEADS

Some research has examined the European origins of Nueva Cadiz beads in an effort to link their colonial contexts with centers of production such as Amsterdam, Venice, and other locations. Karklins and Oost (1992) describe Kidd and Kidd IIIc varieties at the Kaasstraat site in Antwerp, Belgium, from contexts dating to the 16th and 17th centuries. Several examples of “archetypal” Nueva Cadiz beads are also known from Dutch sites (Karklins 1974:75), but not NCT-RV (IIIc’3) (Karklins 2020: pers. comm.).

Karklins and Bonneau (2019) describe a broken archetypal Nueva Cadiz bead and a bead production tube (cerulean blue/white/cerulean blue) in an archaeological

collection from Rouen, France. Attributed to the early 17th century, these items indicate that Nueva Cadiz beads may have been fashioned at this location, but it is also possible that the production tube was made elsewhere. Karklins and Bonneau (2019:7) further propose that the NCT-RV beads found in Northeastern North America could have “originated in beadmaking workshops scattered over northern France.”

Martins Torres (2019:73) asserts that the Venetian Paternoster guild, established in the late 15th century, manufactured beads like Nueva Cadiz and chevrons, and Zecchin (2005:83) illustrates Venetian examples of production canes similar to those used to make Nueva Cadiz beads. The temporal and geographic data currently available suggest that archetypal Nueva Cadiz beads are distinct and were produced and distributed at an earlier date than NCT-RV beads. We have not done a comprehensive survey of the archaeological sites that have yielded archetypal Nueva Cadiz beads in Europe or the Americas, but many researchers (e.g., Deagan 1987; Fairbanks 1968; Little 2010; Smith 1983; Smith and Good 1982) associate them with Spanish colonial trade networks, whereas NCT-RV beads are associated with French and/or Dutch trade.

THE BEAD SAMPLE

The Nueva Cadiz samples from South America were analyzed in an ongoing collaborative effort by Loewen and Dussubieux at the Elemental Analysis Facility, Chicago Field Museum, using standard laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) procedures. In a brief note, Loewen (2021) describes the beads’ trajectory and purported origin at Tiahuanaco, western Bolivia. A total of 22 glass compositions from ten beads are included in this compositional comparison (BL22-BL31). In two cases, distinct compositions were obtained from two copper-colored blue layers in the same bead.

The analyzed beads from Ontario come from three archaeological sites: Max Oné-Onti Gros-Louis (formerly Thomson-Walker) (n=1), Le Caron (n=4), and Ellery (n=1). Although there is some variation in the age of the sites, they all date to the second quarter of the 17th century. Max Oné-Onti Gros-Louis is considered the earliest, straddling Glass Bead Periods 2 (1600-1625) and 3a (1625-1630) (Fitzgerald et al. 1995; Kenyon and Kenyon 1983). The glass bead assemblage contains both a significant number of monochrome navy and white beads, typical of GBP2, and a number of round red beads, commonly found on GBP3 sites. Both Le Caron and Ellery are dominated by red beads,

common on all GBP3 sites (1625/30-1650). At Le Caron, there are a large number of round red beads, including compound varieties such as IVa1 to IVa8, but few tubular red beads. This is typical of GBP3a (1625/30-1640). By contrast, Ellery, the latest site, has a significant proportion of tubular red beads, generally indicative of GBP3b (ca. 1640-1650).

All the beads were recovered through controlled archaeological excavations and their context and associations are considered solid. There is little doubt that they arrived in Ontario in the early to mid-17th century through either French or Dutch trade networks. The beads from the Le Caron site were analyzed at the Field Museum using the same procedures used for the South American beads. The beads from Ellery and Max Oné-Onti Gros-Louis were analyzed using LA-ICP-MS at the Harquail School of Earth Sciences, Laurentian University, Sudbury, Ontario. The data from analyses at these different facilities are comparable (Walder et al. 2021).

CHEMICAL COMPARISONS

We compared the two sets of beads in terms of both the base glass composition and in terms of trace element concentrations. Only the white and copper-colored blue (usually turquoise) layers are included in this comparison because these are the glass colors that are shared by both the archetypal Nueva Cadiz beads and those that include a red layer (NCT-RV).

Base Glass Composition

All six of the NCT-RV (Ontario) beads have similar base glass compositions for each color (Table 1). The relative standard deviations (RSD) for major components of glass (silica, soda, magnesia, lime, and potash) for both white and blue glass layers are reasonably low (0.7%-8.6%) (Table 2). These ingredients differ, however, *between* the turquoise and white glass (*see also* Hawkins and Walder 2022). Of particular note is the difference in soda and lime in the beads: the relative standard deviations for white glass are 5.4% and 7.9%, as compared with the values for turquoise glass: 2.9% and 2.2%. The homogeneity is demonstrated in tri-plots showing the relative contribution of potash, soda, and lime for the NCT-RV beads (Figure 3, left).

The base glass compositions for the ten archetypal Nueva Cadiz (South American) beads are distinct from the NCT-RV beads in two important ways. First, the archetypal Nueva Cadiz beads show a great deal more variation in the values of major constituents. For example, the relative standard deviations for potash values in the NCT-RV beads is 5.1% (white) and 4.1% (turquoise), while in the archetypal Nueva Cadiz beads, the standard deviations are 34.3% (white) and 37.5% (turquoise). Second, base-glass compositions for different colors within individual beads are similar. Figure 3 (right) shows that the relative proportions of soda, lime, and potash for white and turquoise glass in an individual bead are often nearly identical.

These data suggest that both colors of the white/turquoise tubes used to produce the archetypal Nueva

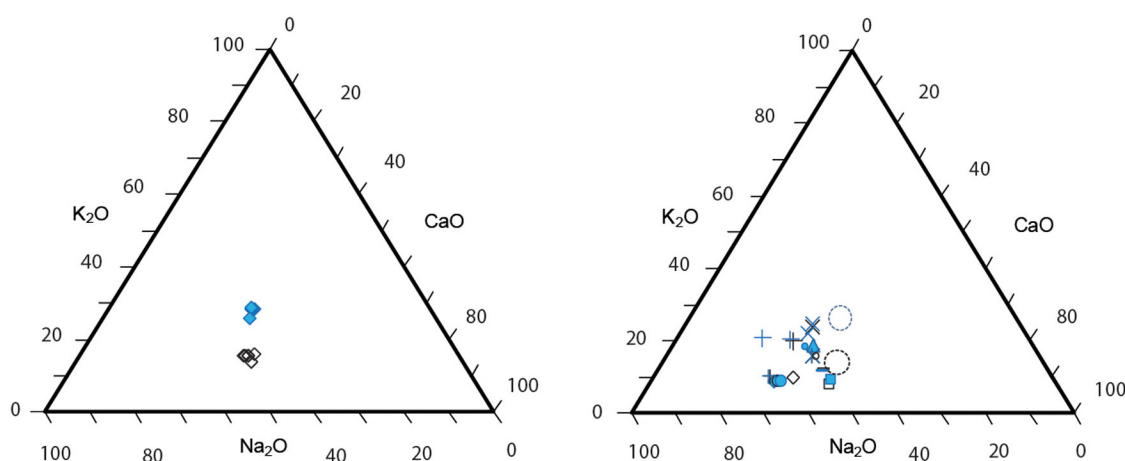


Figure 3. Triplots showing the relative contributions of soda, potash, and lime in white and copper-colored blue layers of Nueva Cadiz Twisted – Red Variety (left) and archetypal Nueva Cadiz beads (right). In the graph on the right, blue symbols indicate turquoise glass, whereas black symbols represent white glass. The ellipses in the right graph indicate the contributions of soda, potash, and lime in the NCT-RV beads for comparison (graphic: Alicia Hawkins).

Table 1. Summary of Mean Values and RSD of Important Elements in the Bead Samples.

Sample Source	Glass Color		SiO ₂	Na ₂ O	MgO	Al ₂ O ₃	P ₂ O ₅	K ₂ O	CaO
South America	Turquoise (n=12)	Average	67.8%	12.7%	2.8%	0.9%	0.3%	3.8%	7.3%
		RSD	3.3%	9.7%	20.2%	28.7%	32.3%	37.5%	16.7%
	White (n=10)	Average	51.8%	10.1%	2.2%	0.7%	0.2%	2.7%	6.0%
		RSD	6.9%	11.1%	20.2%	22.6%	27.6%	34.3%	20.4%
Ontario	Turquoise (n=6)	Average	68.3%	9.0%	3.2%	1.0%	0.3%	6.3%	7.2%
		RSD	0.7%	2.9%	8.6%	3.4%	11.0%	4.1%	2.2%
	White (n=6)	Average	48.3%	8.4%	2.6%	1.7%	0.4%	2.8%	6.8%
		RSD	4.9%	5.4%	7.7%	14.0%	32.3%	5.1%	7.9%

Sample Source	Glass Color		MnO	Fe ₂ O ₃	CuO	SnO ₂	PbO	TiO ₂
South America	Turquoise (n=12)	Average	0.1%	0.5%	2.4%	0.3%	0.4%	0.04%
		RSD	75.4%	47.4%	47.2%	121.4%	124.2%	38.8%
	White (n=10)	Average	0.1%	0.4%	0.1%	10.2%	15.0%	0.03%
		RSD	89.8%	22.3%	117.4%	19.1%	23.6%	34.5%
Ontario	Turquoise (n=6)	Average	0.0%	0.6%	3.0%	0.2%	0.4%	0.09%
		RSD	9.7%	12.1%	7.7%	17.9%	14.7%	6.5%
	White (n=6)	Average	0.5%	0.7%	0.1%	9.7%	17.5%	0.11%
		RSD	9.9%	11.2%	17.8%	36.2%	9.2%	13.6%

Cadiz beads were made in the same workshops, explaining the similarity in base glass composition within individual beads. Workers could have divided each batch of base glass into lots for coloring, then assembled the colors into the layered production tubes for each variety of bead being made. They finished with each batch of base glass as it came from the furnace before starting the next batch of base glass. Since glasses from a batch stayed together throughout the *chaîne opératoire*, we cannot infer the storage or shipping of base glass or colored tubes, which could have mixed batches prior to making beads. As well, since same-color glasses have variable compositions, we cannot infer

large-scale production of one glass color at a time. These considerations indicate a compact, small-scale mode of workshop organization. Further, it is possible that a number of workshops produced these beads independently or over a significant amount of time, explaining the variation in the base glass composition across the dataset of archetypal Nueva Cadiz beads (Figure 3, right).

By contrast, the NCT-RV beads may have been produced using a different glass batch for each color, explaining the distinct composition of the white versus turquoise glass within individual beads. This could mean

Table 2. Relative Standard Deviations for Major Glass Ingredients, by Bead Type and Glass Color.

Glass Sample	SiO ₂	Na ₂ O	MgO	K ₂ O	CaO
NCT-RV – white	4.9%	5.4%	7.7%	5.1%	7.9%
NCT-RV – turquoise	0.7%	2.9%	8.6%	4.1%	2.2%
Nueva Cadiz – white	6.9%	11.1%	20.2%	34.3%	20.4%
Nueva Cadiz – turquoise	3.3%	9.7%	20.2%	37.5%	16.7%

large-scale production of one glass color at a time. The high degree of similarity in the NCT-RV beads suggests that their constituent sand and plant ash came from closely related sources, and were combined according to the methods of a single workshop or local tradition. The form and degree of variability seen in the NCT-RV beads may indicate a larger scale of operation than for the archetypal Nueva Cadiz beads. We do, however, recommend expanding the study sample to include other beads from the Northeast.

Trace Elements

A comparison of trace elements present in the silica source(s) used to make the base glass is also useful for distinguishing production centers that utilized the same or similar glass recipes but different raw materials, especially the sands used as the main silica source. As with the major elements, there are some differences between trace elements in the white and the turquoise glasses, as well as differences between the examples from Ontario and those from South America (Figure 4).

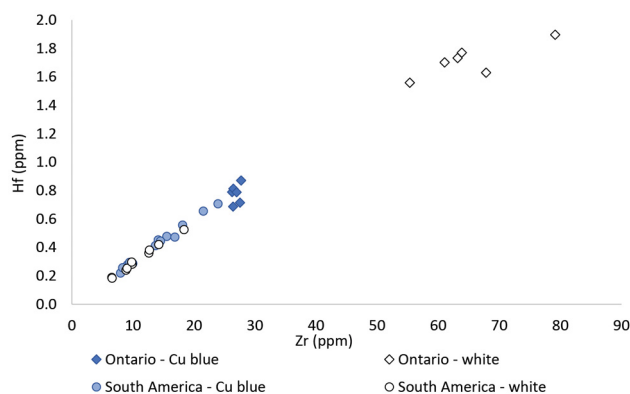


Figure 4. Concentrations of Hf and Zr in white and blue glass layers of archetypal Nueva Cadiz beads (South America) and NCT-RV beads (Ontario) (graphic: Heather Walder).

While quartz sands used to produce glass are mostly silica (Si), the mineral zircon is present in small quantities and contains, among others, the elements zirconium (Zr) and hafnium (Hf). These elements also have a positive correlation, indicating that they are related in their original glass ingredient. These elements can be diagnostic in identifying differences in the sources of sands used as the primary glass ingredient (Degryse and Shortland 2020; Wedepohl, Simon, and Kronz 2011). For a limited set of glass vessels, which were produced in both Venice and Antwerp in the 16th and 17th centuries, De Raedt et al. (2001) identified differences in Hf and Zr content associated

with the production source of the glass. For Venetian glasses, both Hf and Zr content was lower than in the Antwerp glasses (De Raedt et al. 2001:1015, Figure 2b). The element neodymium (Nd) may also be of interest and is included for comparison in Table 3, though it was not reported in that study, and was not analyzed for the two NCT-RV beads investigated at Laurentian University.

We see the same pattern in the present study of Nueva Cadiz and similar types from South America and Ontario (Figure 4). Elements Hf and Zr are positively correlated and show distinctions between glass layers as well as between archaeological contexts. The NCT-RV beads may have two different silica sources for the white and the turquoise glasses, with the white glass containing Hf and Zr in the “Antwerp” range as published by De Raedt et al. (2001), while the turquoise glass falls into a separate, tightly clustered group at the high end of the Venetian range identified in that study. This cluster of turquoise-blue glass compositions from Ontario sites overlaps neither the white nor the blue glass from the archetypal Nueva Cadiz bead samples. These trace element concentrations are more variable for the South American beads sampled, but the white and the turquoise glasses appear to have a similar sand source that contributed the Hf and Zr, with concentrations that comfortably fit the range of Venetian glasses analyzed by De Raedt et al. (2001). A Venetian origin for the archetypal Nueva Cadiz beads fits with the findings of Zecchin (2005).

Further work is needed to identify the chemical compositions of known, well-provenanced glass samples from European bead production centers. Nevertheless, this preliminary analysis suggests that the different glass colors were produced separately for NCT-RV beads in the 17th century, rather than in a workshop using only one silica source to produce glasses of all the colors needed to make the beads. The white glass composition fits a trace element group known for sand used for different types of glasses produced in Antwerp. The different colored glass layers of the earlier, potentially 16th-century, Nueva Cadiz examples from South America appear to contain glasses produced using the same silica source, which fits a trace element group reported for Venetian glass. The technological differences in production for the Ontario and the South American beads indicate that earlier typological distinctions between these groups, particularly Smith and Good’s (1982) argument that the two are unrelated, is supported by the compositional analysis.

CONCLUSION

Compositional analysis shows that the 16th-century archetypal Nueva Cadiz and the 17th-century NCT-RV beads

Table 3. Trace Element Comparison for Hf, Zr, and Nd.

Glass Sample	Hf	Zr	Nd
Colorless, Venice*	<0.5 ppm	<30 ppm	Not reported
Colorless, Antwerp*	>1.0 ppm	~30 to 80 ppm	Not reported
White, Tiahuanaco NC	<0.6 ppm	<20 ppm	~1.1 to 2.0 ppm
White, Ontario NCT-RV	>1.4 ppm	>55 ppm	~4.2 to 4.8 ppm
Turquoise, Tiahuanaco NC	~0.2 to 0.7 ppm	<25 ppm	~1.5 to 3.0 ppm
Turquoise, Ontario NCT-RV	~0.7 to 0.9 ppm	~25 to 30 ppm	~2.8 to 3.0 ppm
* De Raedt et al. (2001).			

are distinct and come from different production centers. Our analysis suggests that an earlier style was adopted or “revived” later, in a different manufacturing context. Why beadmakers revived this style, and what motivated the addition of a red layer, requires further research. How widespread was the 17th-century manufacture? If it was located in the Low Countries, why have we found no evidence of NCT-RV production tubes or beads in this region, while there is evidence of the earlier archetypal Nueva Cadiz beads from Antwerp and Amsterdam?

This study shows that compositional analysis of glass beads from unprovenienced archaeological contexts can provide insight into their production source, even if not informative about their archaeological origins. In this case, the more diverse compositional makeup of the South American beads hints that they may have come from multiple sites, ones with longer occupational histories than those in Ontario, or that production of these beads was less tightly controlled than that of the NCT-RV beads. In our experience of analyzing beads excavated around the Great Lakes and in Quebec, compositions of beads of the same type from tightly dated archaeological contexts tend to be more similar to one another than to typologically identical beads from other sites, even those that are geographically and temporally comparable. This is because beads that were made from the same glass batch and that traveled together to a site where they were deposited archaeologically will have more similar compositions than beads from the same production site but made from different batches a few days, months, or years apart. The present example highlights the critical importance of recording the provenience of beads, and shows how decades of careful work by museologists caring for collections, even those with unknown provenience, can contribute to ongoing studies. We hope that these preliminary results will be confirmed with additional analyses of archetypal Nueva Cadiz beads from narrowly dated archaeological contexts in both the Americas and Europe.

REFERENCES CITED

Deagan, Kathleen

1987 *Artifacts of the Spanish Colonies of Florida and the Caribbean, 1500-1800. Vol. I: Ceramics, Glassware, and Beads.* Smithsonian Institution Press, Washington.

Degryse, P. and A.J. Shortland

2020 Interpreting Elements and Isotopes in Glass: A Review. *Archaeometry* 62(S1):117-133; <https://doi.org/10.1111/arcm.12531>.

De Raedt, I., K. Janssens, J. Veeckman, L. Vincze, B. Vekemans, and T.E. Jeffries

2001 Trace Analysis for Distinguishing between Venetian and Façon-de-Venise Glass Vessels of the 16th and 17th Century. *Journal of Analytical Atomic Spectrometry* 16(9):1012-1017; <https://www.researchgate.net/publication/236862491>.

Donnan, Christopher and Jill Siltan

2010 Sixteenth-Century Glass Beads from Chotuna, North Coast of Peru. *Beads: Journal of the Society of Bead Researchers* 22(1):13-26.

Fairbanks, Charles H.

1968 Early Spanish Colonial Beads. *The Conference on Historic Site Archaeology Papers* 2(1):3-21.

Hawkins, Alicia and Heather Walder

2022 Characterizing Glass Recipes for Distinctive Polychrome Glass Bead Types in Ontario, Canada. In *Glass Bead Technology, Chronology, and Exchange: LA-ICP-MS Glass Compositions from the Field Museum's Elemental Analysis Facility*, edited by Heather Walder and Laure Dussubieux. Leuven University Press, Leuven. Forthcoming.

Karklins, Karlis

- 1974 Seventeenth Century Dutch Beads. *Historical Archaeology* 8:64-82.

Karklins, Karlis and Adelphine Bonneau

- 2019 Evidence of Early 17th-Century Glass Beadmaking in and around Rouen, France. *Beads: Journal of the Society of Bead Researchers* 31:3-8.

Karklins, Karlis and Tony Oost

- 1992 The Beads of Roman and Post-Medieval Antwerpen, Belgium. *Beads: Journal of the Society of Bead Researchers* 4:21-28.

Kenyon, Ian T. and Thomas Kenyon

- 1983 Comments on Seventeenth Century Glass Trade Beads from Ontario. In *Proceedings of the 1982 Glass Trade Bead Conference*, edited by Charles F. Hayes III, pp. 41-49. Rochester Museum and Science Center, Research Records 16. Rochester.

Kidd, Kenneth E. and Martha A. Kidd

- 1970 A Classification System for Glass Beads for the Use of Field Archaeologists. *Canadian Historic Sites: Occasional Papers in Archaeology and History* 1:45-89. Ottawa.

Little, Keith J.

- 2010 Sixteenth-Century Glass Bead Chronology in Southeastern North America. *Southeastern Archaeology* 29(1):222-232; <https://doi.org/10.1179/sea.2010.29.1.014>.

Liu, Robert K. and Elizabeth Harris

- 1982 *Nueva Cadiz and Associated Beads: History and Description and a New Look*. Archaeological Research Booklet 17. Lancaster, PA.

Loewen, Brad

- 2021 Nueva Cadiz Beads: A Chemical Approach. *The Bead Forum* 78:19.

Martins Torres, Carla Andreia

- 2019 Lo que cuenta un abalorio: reflejos de unas cuentas de vidrio en la Nueva España. Ph.D. thesis. Facultad de Geografía e Historia, Universidad Complutense de Madrid, Madrid.

Smith, Marvin T.

- 1983 Chronology from Glass Beads: The Spanish Period in the Southeast, 1513-1670. In *Proceedings of the 1982 Glass Trade Bead Conference*, edited by Charles F. Hayes, pp. 147-158. Rochester Museum and Science Center, Research Records 16. Rochester.

Smith, Marvin T. and Mary Elizabeth Good

- 1982 *Early Sixteenth Century Glass Beads in the Spanish Colonial Trade*. Cottonlandia Museum Publications, Greenwood, MS.

Veiga, J.P. and M.O. Figueiredo

- 2006 Copper Blue in an Ancient Glass Bead: A XANES Study. *Applied Physics A: Materials Science and Processing* 83(4):547-550; <https://doi.org/10.1111/arc.12531>.

Walder, Heather, Joseph A. Petrus, Laure Dussubieux, Ronald G.V. Hancock, and Alicia L. Hawkins

- 2021 Comparing Chemistries: Inter-laboratory Evaluation of Glass Bead Compositional Research in the Great Lakes. *Archaeometry*; <https://doi.org/10.1111/arc.12683>.

Wedepohl, Karl Hans, Klaus Simon, and Andreas Kronz

- 2011 The Chemical Composition Including the Rare Earth Elements of the Three Major Glass Types of Europe and the Orient Used in Late Antiquity and the Middle Ages. *Chemie der Erde* 71(3):289-296; <https://doi.org/10.1016/j.chemer.2011.04.001>.

Zecchin, Paolo

- 2005 La nascita delle conterie Veneziane. *Journal of Glass Studies* 47:77-92.

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THE TRADE BEADS OF FORT RIVIÈRE TREMBLANTE, A NORTH WEST COMPANY POST ON THE UPPER ASSINIBOINE, SASKATCHEWAN

Karlis Karklins

The archaeological investigation of Fort Rivière Tremblante, a North West Company post that operated from 1791 to 1798 in what is now southeastern Saskatchewan, Canada, yielded 20,119 glass beads representing 63 varieties, as well as seven wampum. While the bulk of the collection is composed of drawn seed beads, it also contains an exceptional variety of fancy wound beads. A comparison with bead assemblages recovered from other contemporary fur trade sites in western Canada reveals that both the North West Company and the Hudson's Bay Company carried much the same bead inventory in the region around the turn of the 19th century, with slight variations to accommodate local tastes.

INTRODUCTION

Fort Rivière Tremblante, also known as Grant's House and Aspin House, was established for the North West Company by Robert Grant in 1791 on the Lower Assiniboine River near what is now the town of Kamsack in southeastern Saskatchewan. Situated in an area rich in beaver and otter pelts, the post became the headquarters of the NWC's Upper Red (Assiniboine) River Department (MacKie 1968:102). As such, it was also an important provisioning post for the brigades heading north to Athabasca (Syms and Smith 1984:26). In 1793, Robert Grant was replaced by Cuthbert Grant, Sr. His better-known son, Cuthbert Grant, Jr., the noted Métis leader, was born at the fort that same year.

While the post prospered for the first few years, by around 1795 the trade had waned due to the incursion of the Hudson's Bay Company into the region. This forced the NWC to abandon the post in 1798 and move to a location further upriver (Smythe 1968: no. 101). It was destroyed by fire in 1800. When J.B. Tyrell of the Geological Survey of Canada visited the site in 1890, only a chimney pile and several cellar depressions were visible and, by 1938, all evidence of the post had been eradicated by plowing (MacKie 1968:101).

Under the direction of Hugh T. MacKie, a crew from the University of Saskatchewan relocated the site and excavated it in 1967 and 1968 (MacKie 1968). This work revealed that the fort had consisted of a sizeable compound containing several buildings enclosed by a palisade with a bastion in the center of each wall (Figure 1). It also uncovered a wide variety of artifacts, including a sizeable assemblage of glass trade beads.¹

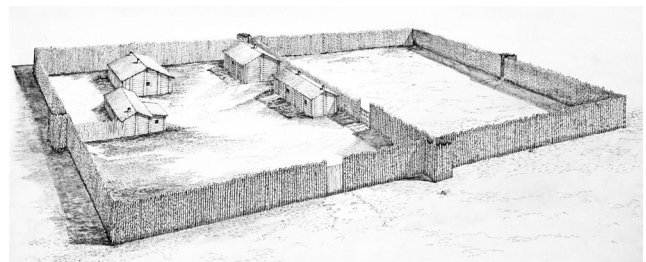


Figure 1. Conjectural reconstruction of the middle construction phase of Fort Rivière Tremblante (graphic: James Carson).

THE BEAD ASSEMBLAGE

Of both drawn and wound construction, the 20,119 glass beads are classified using the taxonomic system developed by Kenneth E. Kidd and Martha A. Kidd (1970) as expanded by Karklins (2012). Varieties that do not appear in the Kidds' lists are marked by an asterisk (*) followed by a sequential letter for ease of reference. The color names and codes correspond to those used in the *Munsell Bead Color Book* (Munsell Color 2012) (Table 1). Diaphaneity is described using the terms opaque (op.), translucent (tsl.), and transparent (tsp.). Opaque beads are impenetrable to light except on the thinnest edges. Specimens that are translucent transmit light but diffuse it so that an object (such as a pin in the perforation) viewed through them is indistinct. A pin in the perforation of a transparent bead is clearly visible. The size categories are based on bead diameter: very small (< 2 mm), small (2-4 mm), medium (4-6 mm), large (6-10 mm), and very large (> 10 mm).

Table 1. Munsell Color Codes.

Color Name	Code	Color Name	Code	Color Name	Code
Black	N 1/0	Light Gold	2.5Y 7/8	Medium Turquoise Blue	2.5B 5/5
Light Gray	N 7/0	Sunlight Yellow	5Y 8/8	Aqua Blue	2.5B 6/4
Oyster White	N 8/0	Dark Palm Green	10GY 4/4	Bright Blue	5B 5/7
White	N 9/0	Apple Green	10GY 6/6	Pale Blue	7.5B 8/2
Ruby	2.5R 3/10	Dark Green	2.5G 3/6	Shadow Blue	2.5PB 5/4
Light Red	5R 5/12	Bright Green	2.5G 5/10	Bright Navy	7.5PB 2/7
Redwood	10R 4/8	Turquoise	10BG 4/8	Rose Wine	10RP 4/6
Cinnamon	10YR 5/6	Bright Turquoise	7.5BG 6/8		

Drawn Glass Beads

Produced from segments of glass tubing drawn from a gather of molten glass, drawn beads comprise 97.7% (19,668 specimens) of the Rivière Tremblante bead assemblage. Thirty varieties are represented (Figure 2). In the case of the tubular beads, the ends range from unaltered breaks to well rounded.



Figure 2. Drawn glass beads. **Row 1** (l. to r.): Ia2, Ia4, Ia7. **Row 2:** Ia16, Ia19, Ia*(a), Ia*(b), Ia*(c), Ia*(d), Ib*(a). **Row 3:** IIa7, IIa12, IIa14, IIa17, IIa47, IIa56, IIa59, IIa*(a), IIa*(b), IIa*(c), IIa*(d), IIa*(e), IIa*(f), IIa*(g), IIb*(a), IIc*(a). **Row 4:** IIIa1, IIIa3, IIIa4, IVa6 (all photos by author).

Ia – Tubular, Monochrome, Undecorated

Ia2. Tubular; op. black; the glass appears tsl. rose wine on thin edges when held up to a strong light; small to medium; n=88.

Ia4. Tubular; tsl. oyster white generally flashed in clear glass; very small to large; n=862.

Ia*(a). Tubular; tsl. sunlight yellow; chalky patina; large; n=1.

Ia7. Tubular; tsl./op. light gold; most specimens exhibit a dull brown patina or have eroded surfaces; small; n=3.

Ia*(b). Tubular; tsl./op. dark palm green; small; n=1.

Ia*(c). Tubular; tsp. bright green; numerous linear bubble in the glass; very small to small; n=34.

Ia*(d). Tubular; tsp./tsl. medium turquoise blue; numerous linear bubbles in the glass; small; n=247.

Ia16. Tubular; op. shadow blue; small; n=5.

Ia19. Tubular; tsp. bright navy; very small to small; n=236.

Ib – Tubular, Monochrome, Straight Simple Stripes

Ib*(a). Tubular; tsp. bright navy; 11-13 op. white stripes; some specimens are slightly bent from heat rounding the ends; medium to large; n=19.

IIa – Non-Tubular, Monochrome, Undecorated

IIa*(a). Circular; tsp. ruby; the glass is patinated and decrepit; small; n=3.

IIa7. Circular; op. black; glass appears tsl. rose wine on thin edges when held up to a strong light; small to medium; n=333.

IIa*(b). Circular; tsp. light gray; small; n=103.

IIa12. Circular; tsl. oyster white; flashed in clear glass; shape ranges from oblate to short tube sections with rounded ends; very small to medium; n=9536.

IIa14. Circular; op. white; small; n=66.

IIa*(c). Tubular; tsp. sunlight yellow; specimens exhibit a thin brown patina or have eroded surfaces; small; n=8.

IIa17. Circular; tsl./op. light gold; most specimens exhibit a dull brown patina or have eroded surfaces; very small to small; n=514.

IIa*(d). Circular; tsl./op. dark palm green; a dull patina covers most specimens; very small to small; n=283.

IIa*(e). Circular; tsp. bright green; eroded surfaces; small; n=49.

IIa*(f). Circular; tsp./tsl. medium turquoise blue; shape ranges from oblate to short tube sections with rounded ends; numerous linear bubbles in the glass; very small to medium; n=5595.

IIa47. Circular; op. shadow blue; small; n=14.

IIa56. Circular; tsp. bright navy; shape ranges from oblate to short tube sections with rounded ends; small; n=238.

IIa*(g). Circular; tsl./op. bright navy; small; n=116.

IIa59. Circular; tsp. rose wine; small; n=31.

IIb – Non-Tubular, Monochrome, Straight Simple Stripes

IIb*(a). Circular; op. white; two op. light gold and two tsl. bright turquoise stripes; small; n=2.

IIc – Tubular, Monochrome, Surfaces Modified by Grinding

IIc*(a). Faceted circular; tsp. rose wine; surface exhibits one to eight random cut facets; small; n=79.

IIId – Tubular, Multi-Layered, Undecorated

IIId1. Tubular; op. redwood exterior; op. black core; medium to large; n=23.

IIId3. Tubular; op. redwood exterior; tsp. apple green core; small to large; n=115.

IIId4. Tubular; op. redwood exterior; tsp. bright blue core; medium; n=1.

IIIf – Non-Tubular, Multi-Layered, Undecorated

IIIf6. Circular; op. redwood exterior; tsp. apple green core; small to medium; n=1063.

Wound Glass Beads

Beads in this category were formed by winding a strand of molten glass around a metal mandrel until the desired size and shape were achieved. Decoration could be applied to the surface and marvered into it while the glass was still viscid. Thirty-three varieties are represented (Figures 3-4).

WIb – Monochrome Round

WIb*(a). Round; tsp. light red; the glass is patinated and eroded; small; n=3.

WIb*(b). Round; op. black; the glass appears tsp. dark green on thin edges when held up to a strong light; small; n=2.

WIb1. Round; tsp./tsl. light gray; most specimens have “frosted” surfaces and the glass is crackled; medium and very large; n=37.

WIc – Monochrome Oval

WIc*(a). Oval; tsp. ruby; eroded patinated surfaces; small to large; n=41.

WIc*(b). Oval; op. black; glass appears tsp. dark green on thin edges on some specimens and rose wine on others when held up to a strong light; surfaces are covered with iridescent patina or the glass is eroded; two beads are conjoined at the ends; small to large; n=56.

WIc1. Oval; op. white; wind marks evident; dull to shiny surfaces with many specimens exhibiting a dull brown patina; small to large; n=74.

WIc3. Oval; tsl. pale blue; dull surfaces; very large; n=2.

WIc*(c). Oval; op. cinnamon; dull surfaces; medium; n=6.

WIc*(d). Oval; op. light gold; dull to shiny surfaces; small to medium; n=31.

WIc*(e). Oval; op. dark palm green; small to medium; n=13.

WIc9. Oval; op. aqua blue; dull surfaces; most specimens exhibit a heavy brown patina; two beads are joined end to end; small to large; n=41.

WIc*(f). Oval; tsp. bright navy; most specimens exhibit an iridescent patina; small to very large; n=32.

WIf – Monochrome, Truncated Teardrop

WIf*(a). Truncated teardrop; tsl. light gray; dull, crackled surface; medium; n=1.



Figure 3. Wound glass beads. **Row 1** (l. to r.): W1b1, W1b*(a), W1b*(b), W1c1, W1c3, W1c9, W1c*(a), W1c*(b). **Row 2:** W1c*(c), W1c*(d), W1c*(e), W1c*(f), W1i*(a). **Row 3:** W111b*(a), W111b*(d), W111b*(e). **Row 4:** W111b*(h), W111b*(i), W111b*(j), W111b*(k), W111b*(l). **Row 5:** W111b*(m), W111b*(n), W111b*(o), W111b*(p). **Row 6:** W111b*(q), W111b*(r), W111b*(s), W111b*(t).

W111b – Monochrome, Simple Shapes, Inlaid Decoration

W111b*(a). Round; op. black body divided into eight squares by an op. light gold 2x4 grid; each square contains a ruby-on-white eye; large; n=2.

W111b*(b). Round; tsp. turquoise with an op. white wreath around the middle; covered with a dull or iridescent patina; very large; n=1.

W111b*(c). Round; tsp. turquoise decorated with ca. six floral elements set parallel to the perforation: ruby-on-white “blossoms” flanked by op. light gold leaves; very large; n=2.

W111b*(d). Round; op. aqua blue with five ruby-on-white and ten bright navy-on-white eyes; most specimens are patinated; large; n=11.

W111b*(e). Oval; op. black with a wavy stripe of op. white and a plain stripe of op. aqua blue spiraling around the bead; most specimens exhibit an iridescent patina; the black glass of this variety and the ones listed below appears tsl. rose wine on thin edges; large; n=4.

W111b*(f). Oval; op. black with a spiral band of aventurine and a spiral series of alternating op. white (bluish tint) and



Figure 4. Very large wound glass beads. **Row 1** (l. to r.): Wlb1, Wlc3 pigeon egg, Wlc*(f) pigeon egg. **Row 2:** WIIb*(b), WIIb*(c), WIIb*(f), WIIb*(g).

tsl. bright turquoise dots; dull to iridescent patina; very large; n=2.

WIIb*(g). Oval; tsp. light gray decorated with three “blossoms” composed of a ruby-on-white eye surrounded by six bright navy-on-white dots and three pairs of tulip-like flowers with ruby-on-white blossoms and op. light gold leaves; very large; n=8.

WIIb*(h). Oval; op. white with a tsp. ruby wreath around the middle (most of the inlay is now missing); large; n=3.

WIIb*(i). Oval; op. white with a tsp. bright navy wreath around the middle; large; n=9.

WIIb*(j). Oval; op. white with a medial wreath of alternating op. dark palm green and tsp. ruby; most specimens are patinated; large; n=19.

WIIb*(k). Oval; op. white with a tsp. ruby wreath around the middle and an op. dark palm green wavy line around either end; large; n=4.

WIIb*(l). Oval; op. white with a wavy op. dark palm green line around the middle and a wavy tsp. ruby line around either end; large; n=6.

WIIb*(m). Oval; op. white with a band of aventurine around the middle and a wavy tsp. ruby line around either end; large; n=1.

WIIb*(n). Oval; op. white with four tsp. bright navy wreaths set parallel to the perforation; large; n=3.

WIIb*(o). Oval; op. white with four wreaths set parallel to the perforation: two tsp. bright navy and two with bright navy stalks and tsp. ruby leaves; large; n=4.

WIIb*(p). Oval; op. white with two tsp. ruby and two tsl. bright turquoise stripes set parallel to the perforation; large; n=1.

WIIb*(q). Oval; op. white with two tsp. ruby and two tsl. bright turquoise dots alternating around the middle; large; n=1.

WIIb*(r). Oval; op. white with five pairs of tsl. bright navy dots alternating with five light gold-on-bright turquoise eyes around the middle and a wavy tsp. ruby loop around either end; large; n=1.

WIIb*(s). Oval; op. aqua blue decorated with a spiral band of aventurine and a spiral band composed of alternating op. white, tsp. ruby, and tsp. bright navy diagonals; patinated; large; n=6.

WIIb*(t). Oval; tsp. bright navy with nine op. light gold dots; most specimens are patinated; medium to large; n=24.

Wampum

Seven shell wampum beads (Figure 5) are in the collection: two white, four purple, and one gray (calcined). They are small and measure 5.8-6.4 mm in length and 2.8-3.6 mm in diameter. One specimen is gouged and irregular in outline. One side exhibits a 2-mm-long remnant of an unfinished drill hole revealing that an initial hole was begun but the bead split and a new hole had to be drilled.

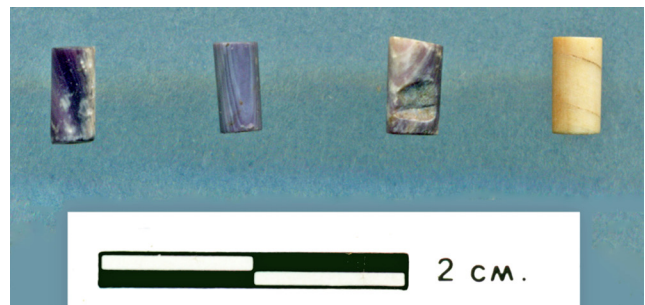


Figure 5. Purple and white wampum.

DISCUSSION

Small, undecorated seed beads dominate the Fort Rivière Tremblante bead assemblage. White (53% of the seed bead group) and blue (33%) beads predominate with opaque red beads a distant third (6%). The wound bead group is characterized by oval “barley corn” beads with white (28% of the wound group) and blue (26%) being the principal body colors with black (14%) in third place. This preference for blue and white has been noted at many other

sites in western Canada and the adjacent United States (pers. obs.).

Most of the bead varieties excavated at Rivière Tremblante are replicated in the assemblages recovered from other contemporary western Canadian fur trade posts, with the most correlatives noted at NWC Fort George (1792-ca. 1800; east-central Alberta) (Kidd 1970) and Rocky Mountain House (1799-1821; west-central Alberta) (Steer and Rogers 1978), as well as HBC Nottingham House (1802-1806; northeastern Alberta) (Karklins 1983), Buckingham House (1792-1800; east-central Alberta) (Nicks 1969), and York Factory (1791-1957; northeastern Manitoba) (Karklins and Adams 2013). In that these sites are spread over much of western Canada (Figure 6), the indication is that both the North West Company and the Hudson's Bay Company, and likely free traders as well, had similar bead inventories in the region around the turn of the 19th century, with regional variations to accommodate local tastes.

What distinguishes this bead assemblage from the others is the presence of an exceptionally high number of fancy wound beads decorated with various forms of inlaid decoration. While such beads are scarce at most sites, if present at all, there are 20 varieties represented by 112 specimens at Rivière Tremblante. Of the 17 fur trade sites canvassed for this study, only York Factory has anything comparable, yielding 24 varieties represented by 94 specimens (Karklins and Adams 2013). Only eight

of the varieties have correlatives at Rivière Tremblante. Considering the lengthy occupation of York Factory and the fact that some of the varieties found there likely date to a later period, the Rivière Tremblante assemblage provides the best representation of fancy beads in the western fur trade region around the turn of the 19th century.

While information concerning the trade value of beads at Rivière Tremblante is lacking, the rate of exchange at York Factory in 1776 was six beaver pelts for a pound of "round [or] barley corn [oval] white flowd. [flowered] red & green" beads while the "large, middling & small rod. [round] white [and] blue" beads went for just two pelts. By comparison, the cost of the fancy beads was quite steep in that seven pelts could purchase a pistol or a blanket (Karklins and Adams 2013:97).

CONCLUSION

It is unfortunate that no post journals or other documents survive that might reveal details concerning specific rates of exchange, the quantities of beads that were imported and traded, which varieties were the most preferred by the indigenous population, and how they were utilized by them. Nonetheless, the beads themselves do provide a snapshot of what passed through the fort's gates during a period of intense rivalry between the relatively new North West Company and the well-established Hudson's Bay Company.

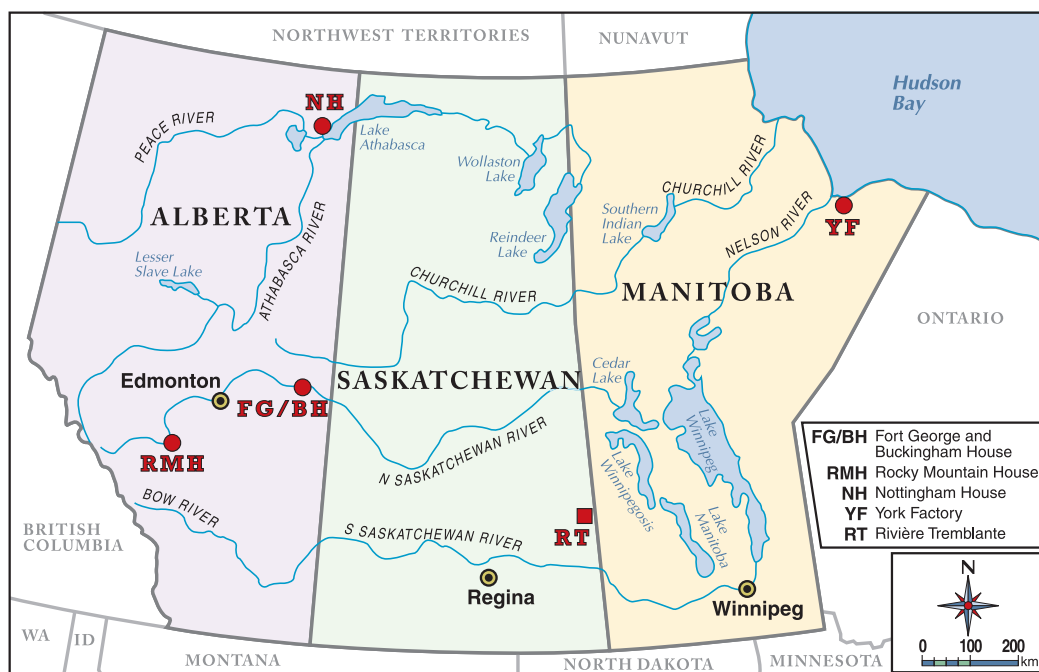


Figure 6. The Canadian prairie provinces showing the location of Fort Rivière Tremblante (RT) and other contemporary trading posts mentioned in the text (graphic: David Weisel).

ACKNOWLEDGEMENTS

My thanks to Kevin Brownlee of The Manitoba Museum, Winnipeg, for providing the image of the fort's conjectural reconstruction and to the Museum for permission to publish it.

ENDNOTES

1. The beads are now curated in the collections of The Manitoba Museum, Winnipeg, Manitoba, Canada.

REFERENCES CITED

Karklins, Karlis

- 1983 Nottingham House: The Hudson's Bay Company in Athabasca, 1802-1806. *History and Archaeology* 69:3-281. Ottawa.
- 2012 Guide to the Description and Classification of Glass Beads Found in the Americas. *Beads: Journal of the Society of Bead Researchers* 24:62-90.

Karklins, Karlis and Gary F. Adams

- 2013 Beads from the Hudson's Bay Company's Principal Depot, York Factory, Manitoba, Canada. *Beads: Journal of the Society of Bead Researchers* 25:72-100.

Kidd, Kenneth E. and Martha A. Kidd

- 1970 A Classification System for Glass Beads for the Use of Field Archaeologists. *Canadian Historic Sites: Occasional Papers in Archaeology and History* 1:45-89. Ottawa.

Kidd, Robert S.

- 1970 *Fort George and the Early Fur Trade in Alberta*. Provincial Museum and Archives of Alberta, Publication 2. Edmonton.

MacKie, Hugh T.

- 1968 Excavation of Fort Riviere Tremblante (N.W.C. 1791-98). *The Blue Jay* 26(2):101-105.

Munsell Color

- 2012 *Munsell Bead Color Book*. Munsell Color, Grand Rapids.

Nicks, Gertrude C.

- 1969 The Archaeology of Two Hudson's Bay Company Posts: Buckingham House (1792-1800) and Edmonton House III (1810-1813). M.A. thesis. Department of Anthropology, University of Alberta, Edmonton.

Smythe, Terrence

- 1968 *Thematic Study of the Fur Trade in the Canadian West, 1670-1870*. Historic Sites and Monuments Board of Canada, Agenda Paper 29. Ottawa.

Steer, Donald M. and Harvey J. Rogers

- 1978 Archaeological Investigations at an Early Nineteenth Century Fur Trading Fort: Rocky Mountain House National Historic Park, 1975-77. Parks Canada, Microfiche Report Series 35. Ottawa.

Syms, E. Leigh and Pamela Smith

- 1984 Unbuttoning the History of Fort Rivière Tremblante. *The Beaver* (Spring):26-30.

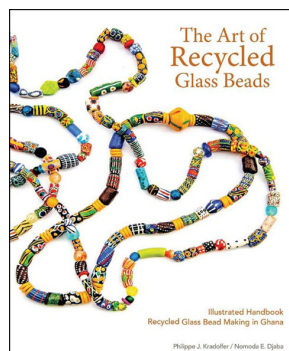
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BOOK REVIEW

The Art of Recycled Glass Beads.

Philippe J. Kradolfer and Nomoda E. Djaba. Ghana-Art Publications and EPP Book Services, North Salt Lake, UT, USA. 2020. 144 pp., 858 color figures. ISBN: 978-1-7923-2241-9. \$25.00 (hardcover).

Author and photographer Philippe J. Kradolfer and beadmaker Nomodo E. Djaba have partnered to document the process of beadmaking in Ghana. Djaba is best known by the name Cedi in the bead world and has been making beads for over 40 years. His work and experience are the main focus of the book. This could make one believe that the book is just an elaborate way to promote Cedi and his bead business, but it is quite the opposite. It is a comprehensive overview of beadmaking techniques. Many beadmakers prefer to keep this type of information to themselves, as we, for example, know from the history of Venetian glass. Instead, the authors have chosen to generously share Cedi's knowledge with anyone who wants to learn more or even try some techniques for themselves.



The first two chapters describe the history of beads in Ghana and the significance of beads in traditional Ghanaian culture. They are illustrated with wonderful images and documentation of the use of the beads locally. Many of the beads made in Ghana are inspired by the colors and patterns of lampworked trade beads that were made in Venice and the Czech Republic and, at first glance, they often resemble Venetian millefiori beads. On closer inspection, they are decorated glass beads made from recycled glass.

The book describes all the different types of recycled glass beads created by Cedi and his workshop in Odumase

Krobo, Ghana. Examples are beads from crushed glass, beads from melted seed beads, and beads with intricate patterns made from powdered glass. The amount of detail in describing the process is remarkable: how to make the molds from the right type of clay, shrinkage rates for the different glass types, making the kiln from the clay of termite mounds, using cassava stalks that burn away for the holes, and decorating the beads with different glazes.

The photography in the book is outstanding in explaining the details of the different production steps, but also showing the beads worn in a traditional way. Several pages are filled with a grid of close-up bead images, illustrating the variety of colors, techniques, and decoration in a gallery format. For example, chapter 13 on "Recycled Seed Beads" explains how modern seed beads from Asia and Europe are used to create a new type of bead. The seed beads are placed in a mold creating a wide range of color combinations. The gallery portion of the chapter contains two spreads of more than 50 close-up photographs of all the different beads made from seed beads, sometimes combined with crushed glass.

A point of contention concerns chapter 17, "Chevron, Rosetta or Star Beads." Chevron canes are generally created with the use of a glass furnace. Though Cedi has made beads with a chevron pattern by using recycled glass in a collaborative project with glass artist and chevron beadmaker Art Seymour, most of the chevron beads in the book are identified by bead collectors as being made from Chinese cane. Communication with Kradolfer has not clarified this issue.

By covering the entire 40-year career of beadmaking by Cedi, even including a chapter on his fairly recently acquired skill of making lampwork beads, it has become a great testament to the skill it takes to make glass beads, no matter which method is chosen. *The Art of Recycled Glass Beads* will be an asset for collectors and researchers with an interest in African bead production and bead culture, but also to those with an interest in beadmaking techniques.

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