Hohenberger, J.K.
1927 The Glass Bead Industry in the Fichtelgebirge. *Journal of the Society of Glass Technology* 11:A113-114. [Abstract by A.M. Jackson of a German-language article in *Diamant*, 1926.]

Karklins, K.
1985 The Levin Catalogue of Mid-19th Century Beads. In *Glass Beads*, 2nd ed., pp. 7-39. Parks Canada, Studies in Archaeology, Architecture and History, Ottawa.
1992 Identifying Beads used in the 19th-Century Central East Africa Trade. *Beads* 4:49-59.

Karklins, K. with C.F. Adams
1990 Dominique Bussolin on the Glass-Bead Industry of Murano and Venice. *Beads* 2:69-84.

Kidd, K.E.
1979 Glass Bead-Making from the Middle Ages to the Early 19th Century. *History and Archaeology* 30. Parks Canada, Ottawa.

Küçükerman, Önder
1988 *Glass Beads: Anatolian Glass Bead Making*. Turkish Touring and Automobile Association, Istanbul.

Lobmeyr, L.
1874 *Die Glasindustrie*. W. Spemann, Stuttgart.

Neuwirth, W.
1994 *Perlen aus Gablonz; Beads from Gablonz*. Selbstverlag Dr. Waltraud Neuwirth, Vienna.

Sackur, Dr.
1861 Über die Fabrication die massiven Glasperlen. *[Dingler's] Polytechnisches Journal* 159:214-215. [From the *Breslauer Gewerbeblatt* , 1860, No. 26.]

Weiss, G.
1971 *The Book of Glass*. Praeger, New York.

51. NEUTRON ACTIVATION ANALYSIS OF SOME 19TH-CENTURY FACETED GLASS TRADE BEADS FROM ONTARIO, CANADA, THAT HAVE CHEMICAL COMPOSITIONS RESEMBLING BOHEMIAN GLASS, by Ian Kenyon, Susan Kenyon, Ron Hancock, and Susan Aufreiter (1995, 27:4-9)

Introduction

Necklace-size faceted beads are widely distributed on 19th-century archaeological sites in North America and elsewhere. These faceted beads are usually made in two different ways. Some (Kidd types If and IIIf; so-called "Russian" beads) are drawn beads, fashioned from segments of six- or seven-sided tubes with ground facets on their corners; others are mold-pressed (or "mandrel-pressed") beads, which also have cut facets.

Glass beads with cut facets are considered to be characteristic of the 19th-century Bohemian glass industry (Ross 1990; Ross and Pflanz 1989). It is fairly certain that mold-pressed beads were made in Bohemia (Ross 1990; Ross and Pflanz 1989; Schubarth 1835:371). Less certain, however, is the origin of faceted drawn beads: Lester Ross (1990:38) states that they "may represent items manufactured in Bohemia, possibly Venice." One way of further assessing the origin of these beads is by considering their chemical compositions. This paper looks at the chemical compositions of 11 faceted beads from six archaeological sites in Ontario and compares them to the composition of Bohemian glass as reported in the 19th-century literature on chemical technology.

Bohemian Glass

By the 19th century, the Bohemian glass industry was known for the high quality of its tableware. Bohemia also had a good reputation for the manufacture of glass chemical apparatus; beads and other baubles were a significant sideline (Henrivaux 1883:312-318).

While in most parts of Europe fine tableware was usually made from lead glass (as in England) or soda glass (as in Italy), Bohemian crystal, in contrast, was potash glass. A typical 19th-century recipe for Bohemian glass calls for 100 parts of pulverized quartz (silica), 32 parts of refined potash (potassium carbonate), 17 parts of slaked lime (calcium hydrate), as well as small amounts of arsenic and manganese (Pelouze and Fremy 1865:890). In fact, the expression "Bohemian glass" came to denote this particular potassium-rich composition, even if not made in Bohemia itself. For example, Henrivaux (1883:318) reports that such "Bohemian glass" was also made in Prussia and Bavaria.

Results and Discussion

To determine their chemical composition, the 11 beads were analyzed by instrumental neutron activation analysis at the SLOWPOKE Reactor Facility, University of Toronto (Table 1). Based on manufacturing technique, the beads can be divided into two series: the first series (A) consists of drawn faceted beads; the second (B) of mold-pressed beads, which also have ground facets. Samples 1 to 9 are colored

Table 1. Selected Elements (in %) for Some 19th-Century Faceted Beads.

No.	Site	Kidd Variety	Ross	K	Ca	Na	Cl	Al
Series A: Faceted Drawn Beads								
1	Cayuga 1	IIIf2	Ir	13.0	5.7	0.5	0.1	0.4
2	Middleport	IIIf2	Ir	12.0	5.7	0.5	0.1	0.4
3	Mohawk Village	IIIf2	Ir	13.0	5.4	0.5	0.1	0.4
4	Croker	IIIf2	Ir	12.0	5.9	0.7	0.2	0.4
5	Fort Frontenac	If*	Ik	12.8	8.0	0.8	0.2	0.3
Series B: Mold-Pressed (“Mandrel-pressed”) Faceted Beads								
6	Moose Factory	MPIIa	IVz	11.0	4.9	1.9	0.1	0.5
7	Moose Factory	MPIIa	IVw	13.0	5.2	0.4	0.0	0.4
8	Moose Factory	MPIIa	IVw	11.0	5.6	2.0	0.2	0.4
9	Moose Factory	MPIIa	IVw	5.8	7.0	5.0	0.3	0.4
10	Moose Factory	MPIIa	IVs	13.7	5.9	1.2	0.2	0.4
11	Moose Factory	MPIIa	IVr	7.4	3.4	6.2	0.3	0.2

blue by the addition of between 55 to 430 parts per million of cobalt. Sample 10 is a clear, transparent glass; sample 11 is milky white. For further descriptive details, readers are directed to Ross’ (1990) paper on glass beads from Fort Vancouver: the column entitled “Ross” in Table 1 gives the color plate number of corresponding bead varieties in his study. Table 1 also lists the Kidd and Kidd system variety/type numbers (as revised by Karklins [1985]) as well as percentages of the elements potassium (K), calcium (Ca), sodium (Na), chlorine (Cl), and aluminum (Al).

Fig. 1 is a scattergram showing potassium and calcium contents for a variety of potash glasses, including the 11 beads. Information for 19th-century Bohemian glass (tableware and tubing) is taken from contemporary texts on chemical technology (Benrath 1880:28; Dumas 1830:538; Fehling 1878:381; Pelouze and Fremy 1865: 889). While in medieval times potash glass was widely manufactured in northern Europe, this earlier glass was made from poorly refined potash, often rich in other elements, especially lime. Such calcium-rich potash glass is represented in Fig. 1 by some Bohemian tableware dating around A.D. 1600, reported by Hetteš (1963). This early Bohemian glass contains about two to three times more calcium than 19th-century Bohemian glass, and is similar to the average for medieval potash glass given by Sanderson and Hunter (1981). Fig. 1 also shows a SLOWPOKE analysis of 13 early l8th-century wound beads (these results are consistent with

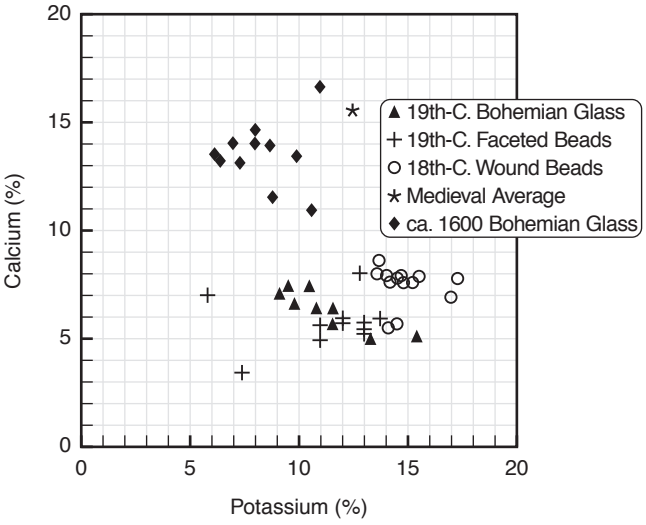

Figure 1. Potassium and calcium contents of some potash glasses.

those reported by Karklins [1983] for similar bead types). The 18th-century wound beads have about the same amount of calcium as 19th-century Bohemian glass but contain slightly more potassium. It is evident from Fig. 1 that all but two of the drawn and mold-pressed faceted beads from Ontario (samples 9 and 11) are made of a potash glass that is very similar in composition to 19th-century Bohemian glass. It is of note that, while almost 250 glass beads dating

from the late 18th through to the early 20th century have been analyzed at the SLOWPOKE Reactor Facility, of this reasonably large sampling, only the faceted beads listed in Table 1 have the potassium-lime composition so typical of Bohemian glass.

There may be slight differences between the drawn and mold-pressed beads (Table 1), although there are too few bead samples to permit firm conclusions. Drawn beads are very consistent in their chemistries; in contrast, the mold-pressed beads, even though all from the same site, are more variable, especially in their sodium content. Two beads (nos. 9 and 11) have nearly equal amounts of potassium and sodium alkalis. Such a mixed alkali composition was sometimes recommended for Bohemian glass because the resulting glass was easier to work (Lock 1881:1067). This property would be especially important for mold-pressed beads since they were largely produced by a cottage industry using primitive equipment. There is another possible source of variability in mold-pressed beads: they were made from glass rods sometimes produced from remelted factory scraps (Schwarz 1886:350). It is unlikely that such waste glass would be very uniform in its chemical composition.

This study, although brief and limited, confirms that the drawn-faceted and mold-pressed beads have chemical compositions similar to the potassium-rich glass characteristic of Bohemia. Such a similarity, however, can not be taken as conclusive proof that the beads are, in fact, from Bohemia since "Bohemian glass," as noted above, was also made elsewhere.

References Cited

Benrath, H.E.
1880 *Handbuch der Chemischen Technologie*: New Series. Vol. 2. *Die Glasfabrikation*. Vieweg und Sohn, Braunschweig.

Dumas, J.B.A.
1830 *Traité de Chimie*. Vol. 2. Béchet Jeune, Paris.

Fehling, H. von
1878 *Neues Handwörterbuch der Chemie*. Vol. 3. Vieweg und Sohn, Braunschweig.

Henrivaux, M.J.
1883 *Encyclopédie Chimique*. Vol. 5, Part 5, *Le Verre et le Cristal*. Dunod, Paris.

Hetteš, K.
1963 Venetian Trends in Bohemian Glassmaking in the Sixteenth and Seventeenth Centuries. *Journal of Glass Studies* 5:39-53.

Karklins, K.
1983 Dutch Trade Beads in North America. In "Proceedings of the 1982 Glass Trade Bead Conference," edited by C.F. Hayes III. *Rochester Museum and Science Center, Research Records* 16:111-126.
1985 Guide to the Description and Classification of Glass Beads. In *Glass Beads*, 2nd ed., pp. 85-118. Parks Canada, Studies in Archaeology, Architecture and History, Ottawa.

Lock, C.G.W.
1881 *Spons' Encyclopaedia of the Industrial Arts, Manufactures and Commercial Products*. Div. III. E.& F.N. Spon, London.

Pelouze, J. and E. Fremy
1865 *Traité de Chimie*. Vol. 2. Victor Masson et Fils, Paris.

Ross, L.A.
1990 Trade Beads from Hudson's Bay Company Fort Vancouver (1829-1860), Vancouver, Washington. *Beads* 2:29-67.

Ross, L.A. and B. Pflanz
1989 Bohemian Glass Beadmaking: Translation and Discussion of a 1913 German Technical Article. *Beads* 1:81-94.

Sanderson, D.C.W. and J.R. Hunter
1981 Major Element Glass Type Specification for Roman, Post-Roman and Mediaeval Glasses. *Revue d'Archéométrie, Actes du* XX *Symposium International d'Archéométrie*, Vol. III, Supplément, pp. 255-264.

Schubarth, E.L.
1835 *Elemente der Technischen Chemie*. Vol. 1. Part 1. August Rücker, Berlin.

Schwarz, H.
1886 Bohemian Glass. *Popular Science Monthly* 29:346-352.

52. EUROPEAN TRADE BEADS IN SOUTHERN AFRICA, by David Killick (1987, 10:3-9)

Archaeologists in southern Africa have long been interested in imported glass beads as a means of dating archaeological sites. The earliest study of which I am aware is that of Sir Hercules Read, who examined beads from David Randall-McIver's 1905 excavations in Rhodesia (Randall-McIver 1906). The next generation of archaeologists were able to call upon the expertise of Horace Beck, whose bead reports for the important sites of Zimbabwe (Caton-Thompson 1929) and Mapungubwe (Fouché 1937) were models of their kind. But the best efforts of Beck and his successors failed to establish bead studies as a dependable and precise means of dating archaeological sites. The first