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17th century Huron village life: insights from the copper-based metals of the Ball site, southern Ontario, Canada

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ABSTRACT

Copper-based metal artifacts from the Ball site, a late 16th – early 17th century Huron (Wendat) village in southern Ontario that doubled in size during its estimated 20-year existence, were analysed by INAA. The goal was to assess the number of kettles that had reached the village, explore the chronology of their arrival and examine patterns in their discard within the site. Our results suggest that about two to three dozen European copper, red brass, and yellow brass kettles may have reached the village during its occupation; that copper kettles may have been traded to the inhabitants of the village before brass kettles; that the new inhabitants may have brought some kettles with them; and that differences in the discarding of copper and brass pieces inside and outside longhouses indicate that yellow brass was possibly of lower value than red copper.

1. Introduction and historical context

The Ball site (Knight, 1987) is located approximately 10 km west of the town of Orillia, Ontario, in an area known by early French traders as Huronia. It is approximately 13 km south of the Georgian Bay and 96 km north of Toronto, at the northwest corner of Lake Ontario. Twenty-five field seasons were spent exposing the village, which consisted of 72 longhouses and two separate palisades (Fig. 1). Archaeological evidence indicated that the original village probably began in the northwest corner with 34 longhouses, and covered approximately 1.6 ha (4.1 acres). House wall post densities suggest that the site was occupied for about 20 years (Warrick, 1988). In the latter ten years of its life, the village expanded, due to an influx of people, from the original size of 1.6 ha to 3.4 ha, adding 38 longhouses (Fitzgerald et al., 1995). Nothing in the recovered native ceramics, lithics, and smoking pipes, indicated that the newcomers were very different from the original inhabitants (Knight and Bain, 1993). According to seriation dating of glass trade beads, the Ball site was occupied between 1585 and 1609 C.E. (Fitzgerald et al., 1995).

The village that we now call 'the Ball site' was most certainly occupied by members of the *Arendarhonon* (Rock Nation), the easternmost nation of the Wendat confederacy in the 17th century. According to French historical accounts, the *Arendarhonon* joined the Wendat confederacy around 1590 C.E. and formerly lived in the Balsam Lake-Trent Valley area, east of Lake Simcoe. A number of 16th century Wendat sites in the Trent Valley are interpreted as ancestral *Arendarhonon* (Trigger, 1976: 156). One of the Trent Valley sites, the Benson site, occupied from about 1560 to 1580s C.E. is an ideal candidate for the founding community of the Ball site, being 1.5 ha in size and containing 23 longhouses (Ramsden, 2009). The original Ball village was 1.6 ha and had 28 longhouses; more, yet shorter, houses than the Benson village. If Benson is in fact the parent community of Ball, the difference in the quantity and type of European trade goods at Benson and Ball is quite remarkable. The

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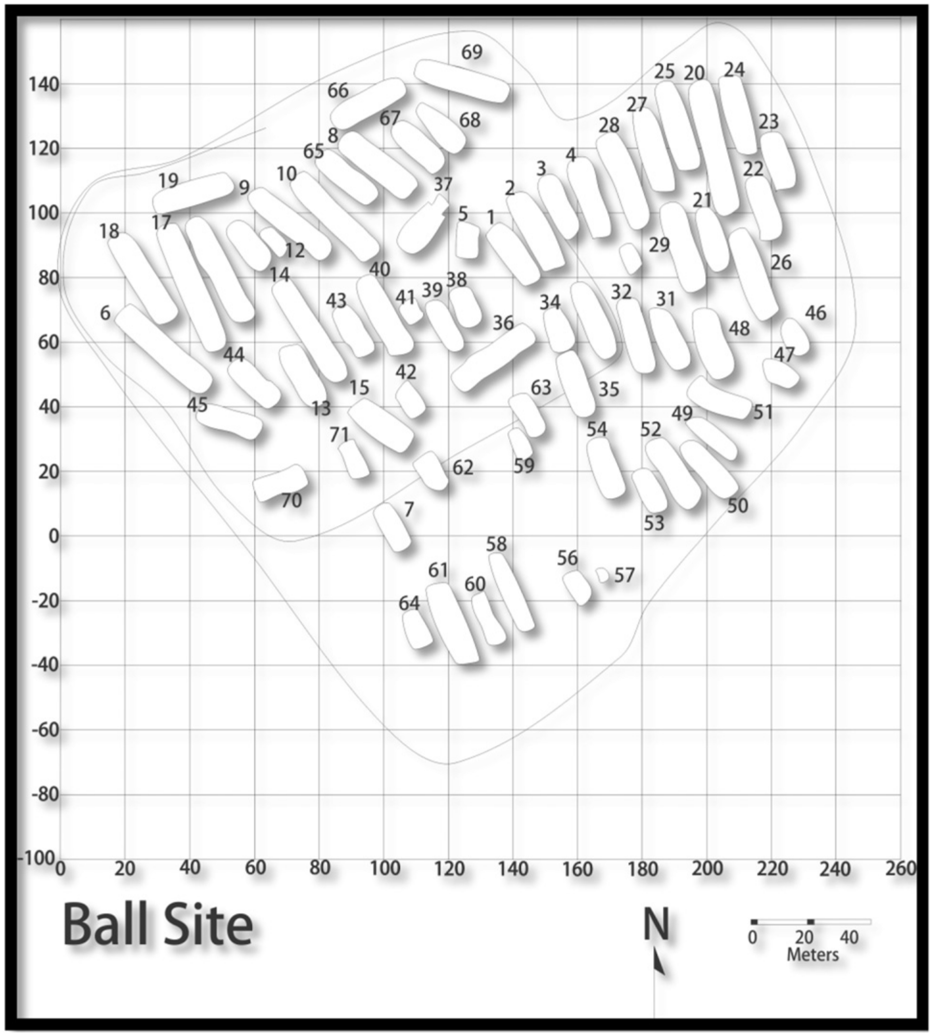

Fig. 1. Layout of the Ball site, southern Ontario (map courtesy of D.H. Knight).

Benson site yielded only one iron awl, one smelted copper bead, one brass bead, and one copper rivet from a kettle (Fitzgerald and Ramsden, 1988; Ramsden, 2009). The Ball site produced over a thousand European items – including glass beads, copper and brass tools, ornaments, and scrap, and iron knives, axes, awls and other items (Anselmi, 2004; Martelle, 2002: 678). While less than 25% of the Benson site and close to 100% of the Ball site was excavated, the relative scarcity of European trade items at Benson is striking. The 1.8 ha expansion of the Ball village ca. 1600 C.E. probably represents the arrival of an entire community from the Trent Valley. The Trent site, a 3.0 ha village in the Trent Valley dating to about 1580–1600 C.E. and containing some glass beads and other European items, is a possible contributing community. The Ball village population is estimated at 2200 people, given a hearth density of 63 hearths/ha and ten people per hearth (Warrick, 2008: 132). Almost 75% of the *Arendarhonon* (Rock Nation) would have lived there.

Numerous artifacts of European origin, including glass beads, iron pieces, and copper or brass pieces, were recovered from the site. Some of the metal objects were complete tools, such as brass/copper projectile points or iron axes, although the majority consisted of *debitage* from traded copper and brass kettles.

Relying on historical documents and archaeological materials from sites in Quebec and southern Ontario, Turgeon (1997, 1999) and Fitzgerald (1990) have concluded that there was no formal fur trade in northeastern North America prior to 1580 C.E. Aboriginal people in the Gulf of St. Lawrence were given a few axes, knives, and copper trinkets by cod fishermen and whalers, mostly Basque and French, in exchange for luxury furs (i.e. not beaver pelts). Only a small number of European items, mostly tiny scraps of copper and fragments of iron, would have filtered into Wendat villages and burials in south-central Ontario between 1540 and 1580 C.E. (Fitzgerald, 1990: 546) as ceremonial gifts. The earliest evidence of European artifacts in Wendat and Neutral sites in southern Ontario dates after 1540 C.E. (Anselmi, 2004; Fitzgerald, 1990). Archaeological work on mid-16th century Wendat and Neutral village and burial sites has yielded only one or two items of European copper, brass, or iron per site (Fitzgerald, 1990: 118–119). After 1580, European trade materials flowed up the St. Lawrence River valley and further inland into Ontario as a result of the beginning of professional fur trading for beaver pelts to feed the felt hat fashion craze in Europe (Turgeon, 1999; Fitzgerald, 1990: 77–81).

Between 1580 and 1600, there is a noticeable increase in the quantity and diversity of European trade goods (i.e. glass beads, copper and brass rolled tubular beads and scrap, and iron knife and axe fragments) in Wendat villages and burials. At the Ball site, most of the European items would have arrived probably as a result of professional Basque and Breton traders active in the St. Lawrence

River estuary between 1581 and 1587 (Turgeon, 1999). Between 1588 and 1605, European traders were not very active in the Gulf of St. Lawrence and there would have been a relative scarcity of European goods in Quebec and Ontario (Turgeon, 1999). In other words, the 25–30 kettles represented in the copper-based metal of the Ball site artefact assemblage (see Results and Discussion) may be mostly Basque iron-banded copper and brass kettles (Fitzgerald et al., 1993).

It is important to point out that there is no evidence of the *Arendarhonon* trading directly with Europeans in the St. Lawrence valley prior to 1609 C.E. In other words, all of the European trade items would have reached the Ball site inhabitants from intermediary aboriginal traders, probably the *Onontchatoronon*, an Algonquian nation living south and west of the confluence of the Ottawa and St. Lawrence rivers (Pendergast, 1999). In the early 17th century, the *Onontchatoronon* overwintered in *Arendarhonon* territory. In 1615, Samuel de Champlain observed an *Onontchatoronon* winter village adjacent to Cahiague, the main settlement of the *Arendarhonon* (Biggar, 1922–1936, 3: 94). Cahiague has been identified with the Warminster site, occupied from 1609 to the early 1620s according to glass bead seriation (Fitzgerald et al., 1995), and probably a relocation of the Ball site village, only 1.25 km distant. It is quite possible that some St. Lawrence Iroquoian refugees lived amongst the *Onontchatoronon*. Considering that as many as 800 St. Lawrence Iroquoian refugees joined the *Arendarhonon* between 1540 and 1580 C.E., when they lived in the Trent Valley (Warrick, 2008: 195–198), the close trading and co-resident relationship that existed between the *Arendarhonon* and *Onontchatoronon* is not surprising; the two groups likely shared St. Lawrence Iroquoian relatives (Trigger, 1985: 148). The *Onontchatoronon* were given preferential treatment by the French traders in the early 17th century, conferring a similarly privileged status on their *Arendarhonon* trading partners (Pendergast, 1999; Trigger, 1985). In the early 1600s, the *Arendarhonon* were considered by other Wendat nations as the rightful owners of the trade route to the French on the St. Lawrence River (Thwaites, 1896–1901, 20: 19; Trigger, 1976: 288–289).

In the 16th century, the Wendat trade networks extended east to the Ottawa River valley and the St. Lawrence River, probably via the Trent River and Lake Ontario (Trigger, 1985: 148). By 1580 the St. Lawrence Iroquoians had abandoned the St. Lawrence River valley, likely due to warfare with the Mohawk and Onondaga, the easternmost nations of the Five Nations Iroquois (Kuhn, 2004). The St. Lawrence River and Trent River trade route would have become prone to Iroquois ambushes and eventually abandoned in favour of the northern route, along the Ottawa River, Lake Nipissing and Lake Huron, used by Wendat traders in the 17th century. The establishment of the Ball village west of Lake Simcoe by the *Arendarhonon* ca. 1585 C.E. is historically important, motivated by shifting trade routes and a desire to join the Wendat confederacy (Trigger, 1985: 157–158).

Knowing how many trade kettles, or parts thereof, arrived at the Ball site over its lifetime would give us insights into the access its inhabitants had to such trade goods. Similarly, knowing whether certain metal types and/or chemistries were preferentially discarded in the earlier part of the village, would allow us to detect patterns in the chronology of the arrival of different metal types at the site and even to propose hypotheses about whether the inhabitants of the newer part of the village were culturally related and interacted closely with those of the older part. Finally, knowing whether the different metal types and/or chemistries were discarded in similar proportions inside and outside longhouses might allow us to infer whether the different metals were treated and valued in similar ways.

To explore the above issues we used the analytical data from a large sampling ($n = 424$) of metal artifacts from the Ball site with the proximate goal of answering the following questions: a) Was each European metal type represented by a single, or by multiple chemical groups, suggesting the initial presence of how many kettles?, b) Were all European metal types represented equally in both the older and the newer areas of the Ball site?, and c) Are there interpretable patterns in the discarding of metal artifacts inside and outside of longhouses?

2. Analytical procedure

Four hundred and twenty-five copper and brass samples were analysed in the early 1990s by instrumental neutron activation analysis (INAA) at the SLOWPOKE Reactor Facility at the University of Toronto (424 samples from the Ball site plus 1 probable Basque sample from Northport, NS). The individual samples were stored in 1.2 mL polyethylene vials. Samples were analysed as described by Hancock et al. (1991a,b), with minor modifications to account for individual samples of small size. Finger rubbing before they were inserted in the reactor was systematically performed to remove any surface dirt and corrosion (e.g. Moreau and Hancock, 1999).

Samples in the mass range of 8–52 mg were first irradiated serially for 3 min at a neutron flux of 2.5×10^{11} n cm^{-2} s^{-1} and assayed for 5 min after a delay of more than half an hour, using germanium (Ge) detector based gamma ray spectrometers, for copper (Cu), zinc (Zn), manganese (Mn), and indium (In). Elemental concentrations were calculated using the comparator method (Hancock, 1976). Medium and long half-life radioisotope producing elements were quantified by batch irradiating samples for 16 h at 2.5×10^{11} n cm^{-2} s^{-1}. After six days, samples were serially assayed for 800–3000 s looking for gold (Au), arsenic (As), antimony (Sb), and Zn. A final counting was made after 10–12 days, at which time the samples were counted for 2–16 h each, depending on sample size and relative purity, to try to determine the concentrations of tin (Sn), Au, As, Sb, silver (Ag), nickel (Ni), iron (Fe), Zn, and cobalt (Co). This analytical procedure produced replicate measurements of enough elements to guarantee no sample mix-ups. Analytical precisions ranged from ±1% to detection limits.

3. Sample description

The Ball site metals that were analysed by INAA included one native copper sample – that is not analysed further in this paper, but see Results and Discussion below –, 204 *European copper* samples, 90 *red brass* (high-Sn, lower Zn) samples, and 129 *yellow brass* (low Sn, high Zn) samples, for a total of 424 samples (Table 1). These samples account for 40% of the total of 1053 potential copper-based artifacts recovered from the site. Of the samples we analysed that were products of the dismemberment of trade kettles (all but one), fewer than 10% in any type of metal were from ornaments or

Table 1
Summary of sample descriptions of ornaments, tools and kettle fragments from the Ball site.

Category	European copper	Red brass	Yellow brass	Native copper
Rings	6	0	0	0
Beads	6	1	0	0
Pendants	2	1	0	0
Rods	1	0	0	0
Projectile points	3	4	2	0
Discs	2	2	0	0
Hooks	1	0	0	0
Sheets/fragments	183	82	127	1
Total	**204**[a]	**90**	**129**	**1**

[a] Plus one probable Basque copper artefact from Northport, NS.

tools (Table 1). The vast majority of artifacts was described as fragments and/or sheets, occasionally folded or rolled. The term 'fragment' was used commonly in the Ball site inventory (1975–1991), while the term 'sheet' was favoured by L.A. Pavlish at the time of his sampling of the copper-based metal collection from the Ball site. In this paper we follow Pavlish's descriptions and typology. Rare samples displayed hammering dimples, possibly as part of the kettle formation process.

Some samples had markings that were reminiscent of those on Basque kettles that reached the peoples of the east coast of what is now Canada, from Basque fishermen/traders. Since it is thought that Basque kettles were traded up to the end of the 16th century, the presence of such material at the Ball site is chronologically significant, suggesting an early dating for the site.

To explore this possibility, samples from a single copper artefact that was probably made of Basque copper, from the Mi'kmaq site of Northport in Nova Scotia (Whitehead et al., 1998), were added to the Ball site samples for analysis, raising our total number of samples to 425. Data for the brass samples from the Ball site were previously published (Hancock et al., 1999).

4. Results and discussion

4.1. Question a) Was each of the European metal types represented by a single or by multiple chemical groups?

Using bivariate plots and/or principal component analysis (PCA), each of the European metal types was sub-dividable into at least six different, multi-sample, coarse chemical groupings, together with up to nine more single- or double-sample chemistries.

4.1.1. European coppers

The 205 samples that were made of *European copper* formed a minimum of nine multi-sample chemical groups, and eleven single-sample chemistries. These chemical groups were initially established simply by plotting the ratios Au/As versus Au/Sb for all of the copper samples and selectively removing the collections of samples that were isolated from the majority (see Fig. 2a–d for a visual of the process).

Principal component analysis (PCA) was conducted using selected elemental concentrations, and was then repeated using elemental concentration ratios, since some of these ratios had been used in the bivariate plots (For the rationale and process of selecting elements and/or ratios see Michelaki and Hancock, 2011).

The attempt to produce chemical groups using PCA with only Ag, As, Au, and Sb concentrations produced partial group sorting (Fig. 3a). Groups E9 and E7 are clearly distinct from the others that fall along a long arc. When groups E7 and E9 were removed, as recommended by Baxter (1999), and the PCA was performed again, group E8 clearly separated from the rest. When the PCA was performed again without groups E7–E9, the result was Fig. 3b, showing that the other groups are starting to pull apart into clear clusters. Performing a PCA using selected elemental ratios, resulted in Fig. 3c, showing that groups E1, E2, and E3 follow a different trend line from the rest of the samples. With groups E1, E2, E3, and E7 removed, the new PCA plot (Fig. 3d) shows that groups E9, E8 and E6 are clearly separated from groups E4 and E5 which are themselves nearly separated from each other. Since both elemental concentration-PCA and inter element ratio-PCA approaches to chemical group sorting produced the same coarse groupings of samples as did the bivariate plotting of element ratios, we feel confident to use these groupings in the discussion that follows.

The group means and standard deviations of the nine multi-sample chemical groups are presented in Table 2. From chemical group E1 to group E9, the As and Sb concentrations stagger, non-linearly, higher and higher. The data for the single-sample chemistries can be found in Table 3.

Each of our chemical groups is a coarse chemical group, which may contain samples that could be further split into sub-groups using other element combinations. For example, group E7 contains

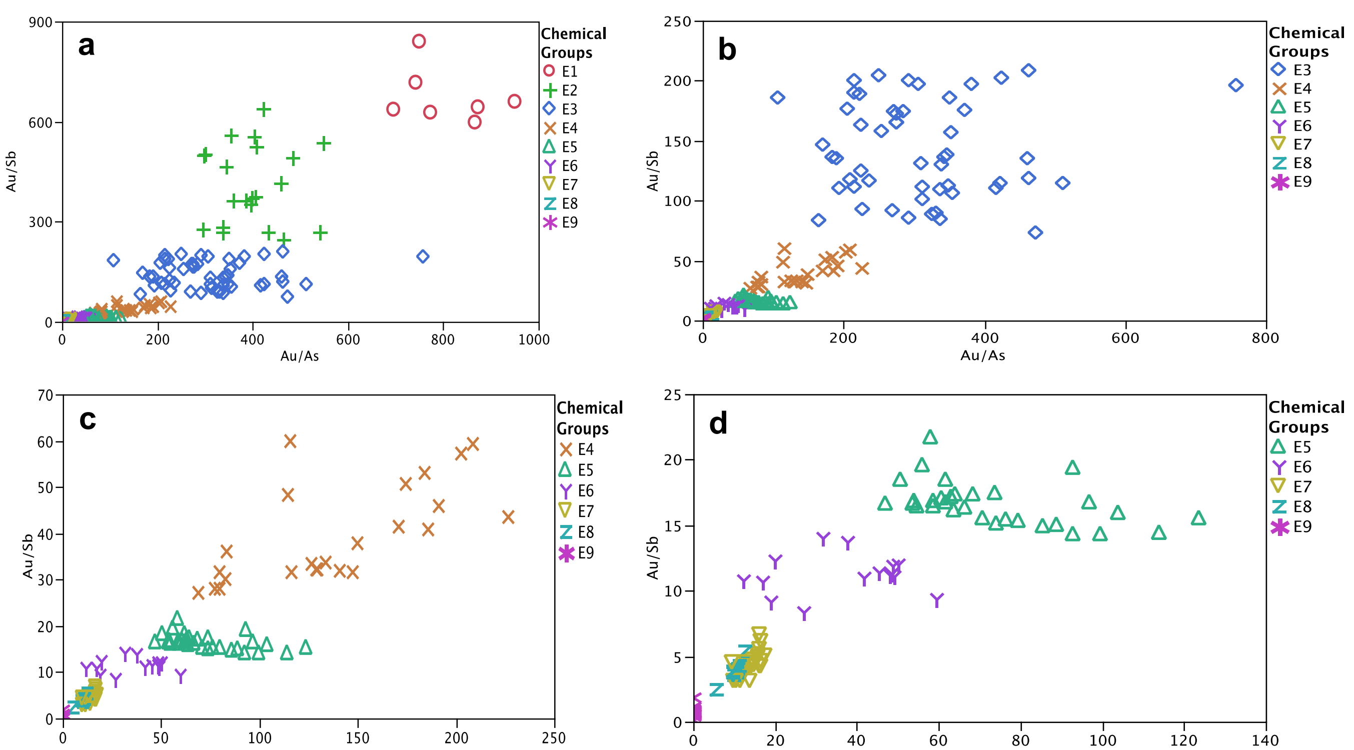

Fig. 2. Scatterplots of Au/As versus Au/Sb used to establish chemical groups among the Ball site metals. a. All samples present; b. E1 and E2 removed; c. E3 removed; d. E4 removed.

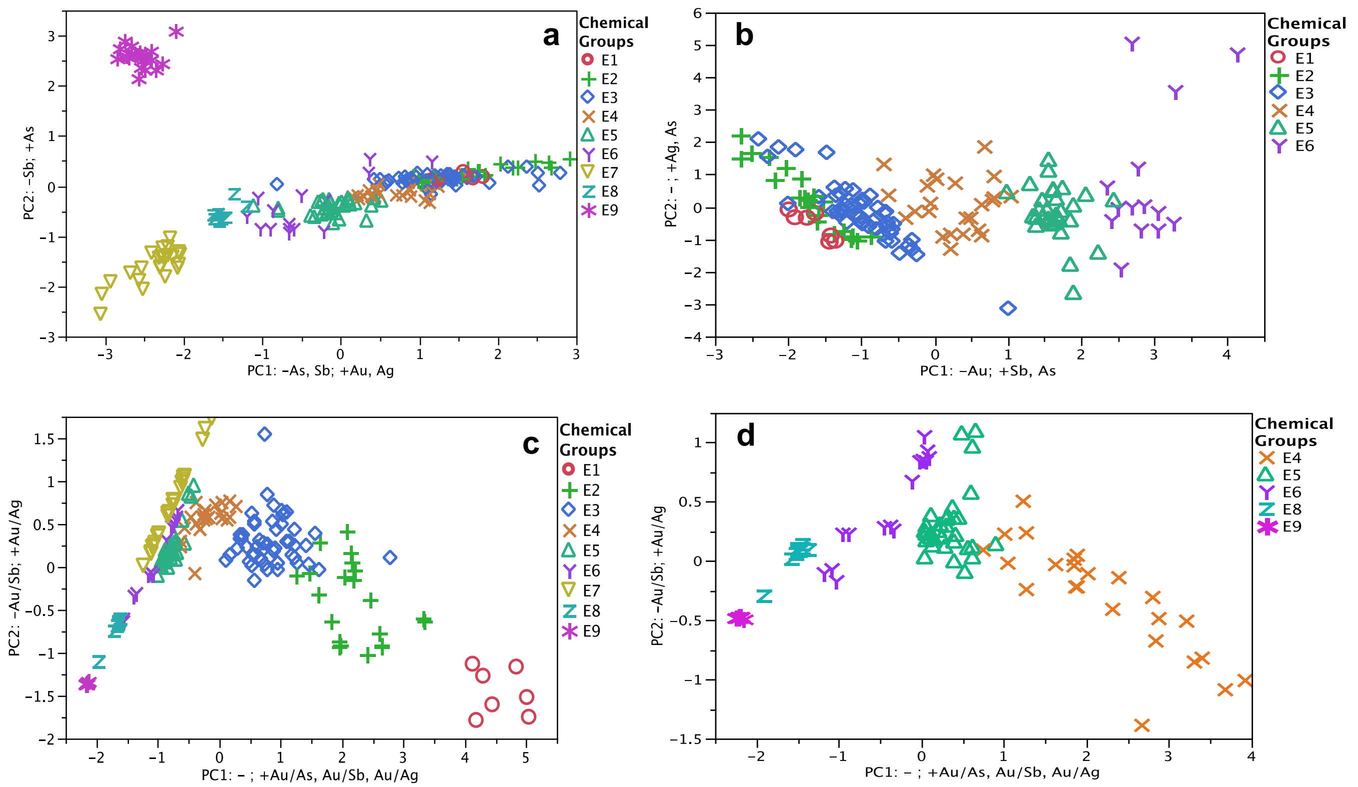

Fig. 3. Principal component analysis (PCA) of elemental data from the Ball site European metals. a. PC1 versus PC2 using only Ag, As, Au, and Sb; b. PC1 versus PC2 using Ag, As, Au, and Sb, but excluding groups E7-E9; c. PC1 versus PC2 using Au/As, Au/Sb, and Au/Ag; d. PC1 versus PC2 using Au/As, Au/Sb, and Au/Ag, but excluding groups E1, E2, E3, and E7.

two samples with In at 40 ppm, while the rest of the samples ($n = 22$) have <2 ppm of In. Similarly, group E6 contains 10 samples with In above 4 ppm and 5 samples with In <2 ppm.

4.1.2. The possible Basque copper connection

The probable Basque sample from Northport, NS, matched the group E2 chemistry. None of the eight suspected Basque artifacts from the Ball site were in this chemical group. Four of them were in group E3; two were in group E5; and one each was in group E6 and group E8. If the visual signs of Basque copper were interpreted correctly, then five of the nine chemical groups found in this study may indicate the presence of Basque copper. Such an interpretation would match Turgeon's (1999) and Fitzgerald et al.'s (1993) arguments for the inactivity of European traders in the Gulf of St. Lawrence.

4.1.3. Red brasses

Ninety of our analysed samples from Ball were made of red brass. The current definition of *red brass* is that the Sn content is ca. 1–6% and the Zn content is <20 ± 2%. Employing the same element ratio plots as were used for the *European copper* samples, we found that the *red brasses* gave seven different chemistries with more than two

Table 2
European copper group chemistries expressed as means and standard deviations. Means that include detection limit data are designated by ≤.

Group (n)		Ag (ppm)	As (ppm)	Au (ppm)	Co (ppm)	Cu (%)	In (ppm)	Mn (ppm)	Sb (ppm)	Sn (%)	Zn (%)
E1 (7)	x	960	55	44	24	95	26	≤15	66	≤0.05	≤0.02
	σ	90	6	3	10	1	5	8	9	0.01	0.01
E2 (21)	x	1096	118	45	53	95	43	≤19	119	≤0.06	≤0.03
	σ	194	29	5	64	2	51	18	33	0.05	0.04
E3 (53)	x	1015	138	39	26	96	25	≤14	306	≤0.05	≤0.01
	σ	176	41	6	18	2	11	8	114	0.03	0.01
E4 (24)	x	970	272	34	≤9.2	97	17	≤13	902	≤0.05	≤0.02
	σ	130	99	4	5.1	2	6	9	227	0.02	0.01
E5 (32)	x	886	354	24	≤5.0	96	9	≤11	1451	0.05	≤0.01
	σ	132	109	4	3.3	2	9	5	214	0.02	0.01
E6 (15)	x	918	636	20	≤6.4	96	8	≤11	1814	≤0.05	≤0.02
	σ	321	302	4	2.9	2	6	5	348	0.02	0.02
E7 (24)	x	459	1065	15	≤5.1	97	≤4	≤12	3390	≤0.06	≤0.02
	σ	114	287	2	1.1	2	11	9	680	0.03	0.04
E8 (8)	x	718	803	8.6	≤4.0	96	≤1.1	≤23	2119	≤0.06	≤0.04
	σ	60	83	0.8	0.9	2	0.4	17	198	0.05	0.04
E9 (20)	x	687	5029	0.26	≤3.3	97	≤0.9	≤14	390	≤0.05	≤0.01
	σ	89	391	0.12	1.9	2	0.3	12	44	0.03	0.01

Table 3
Data for single-sample chemistries.

LAP series #	Material	Ag (ppm)	As (ppm)	Au (ppm)	Co ppm	Cu (%)	In (ppm)	Mn (ppm)	Ni (ppm)	Sb (ppm)	Sn (%)	Zn (%)
B374	European copper	740	599	3	10	100	<0.7	6	900	1410	0.07	0.031
B202	Red brass	2030	4590	19.1	111	87	28	13	950	120	4.2	7
B515	Red brass	1840	4410	18.1	115	89	30	24	310	110	4.0	7
B308	Red brass	1710	300	67.7	26	80	36	30	850	210	1.9	14
B134	Red brass	2370	7200	12.8	111	86	28	12	300	1270	4.2	5
B206	Red brass	1220	3890	8.8	56	79	8	5	1430	400	3.4	14
B040	Red brass	940	2540	8.7	39	80	8	19	1090	570	3.8	14
B217	Red brass	390	880	2.5	8	80	3	26	1230	120	2.0	17
B309	Red brass	540	640	1.7	13	71	1	40	850	120	1.5	2.8
B779	Red brass	360	640	1.5	7	75	0.6	26	1580	91	2.3	22
B136	Yellow brass	2180	5120	11.4	107	69	5	45	520	79	0.1	29

samples (groups R2–R7b in Table 4), along with nine samples in three single- and three double-sample chemistries (Table 3).

4.1.4. Yellow brasses

One hundred and twenty-nine samples were made of *yellow brass*. The current definition of yellow brass is that the Sn content is ≤2% and the Zn content is >20 ± 2%. For these samples, we found that the *yellow brasses* gave a minimum of six different, multiple-sample chemistries (Table 5), along with a single-sample (Table 3).

4.1.5. Possible numbers of kettles traded to the village

Since we have uncovered 22 multi-sample chemical groups, plus three chemical pairs and five single samples, for a total of 30 different coarse chemistries, we could estimate the presence of a minimum of about two to three dozen *European copper*, *red brass*, and *yellow brass* kettles (or parts thereof) reaching the village during the roughly twenty year period it was inhabited. This is, of course, assuming that the inhabitants of the village arrived without any European copper-based metals, an assumption that may well be ill-founded for both the initial and later inhabitants of the village (see below).

The 25–30 kettles identified by INAA would amount to only one to two kettles per year entering the Ball village, probably into the houses of principal traders. According to the distribution of European goods at the Benson village site, the likely precursor to the Ball village, it appears that Wendat society in the late 16th century was developing status-based households based on access to or control of European trade (Ramsden, 2009). Presumably, households of traders commanded higher status than others. Nevertheless, Wendat social norms of equitability demanded that traders had to share their wealth, and kettles were valued for the metal rather than as functional cooking vessels in Wendat society.

There is no evidence that clay cooking pots were replaced by metal kettles in Wendat villages in 17th century Ontario (Martelle, 2006). There were simply too few kettles being traded in the first half of the 17th century. While some kettles were buried with the dead [there is only one small copper kettle in the ca. 1623 C.E. Warminster ossuary (Anselmi, 2004: 270)], most kettles were broken up into small pieces soon after acquisition and made into a variety of tools and ornaments (Anselmi, 2004). The dismemberment of a few kettles per year would be the only way to equitably distribute the valuable copper and brass metal amongst all Ball village households. Kettle pieces would have been redistributed as gifts at feasts, exchanged in gambling, and used in ceremonial and reparation payments (Ramsden, 1981, 2009), resulting in a relatively equitable distribution throughout the entire village. There is no apparent spatial clustering of copper-based metals at the Ball site (see Question b below), reflecting an equitable redistribution of kettle pieces over the life of the Ball village.

If it were possible in the future to ascertain the surface areas of each of the artifacts in a particular chemical group, and to estimate the surface areas of surviving trade kettles of each metal type, it might be possible to estimate the minimum size of each kettle, keeping in mind the fact that some tools and/or ornaments made from a kettle may have moved with the villagers to their next location. If combined metal areas are large, this procedure might allow future researchers to estimate the numbers of kettles of each chemistry that reached the village. This would, however, be a more sensible proposition if the rest of the Ball site metal samples could

Table 4
Summary data for red brasses. Multi-sample, chemical groups are defined by their means and standard deviations. Means that include detection limit data are designated by ≤.

Group (*n*)		Ag (ppm)	As (ppm)	Au (ppm)	Co (ppm)	Cu (ppm)	In (ppm)	Mn (ppm)	Sb (ppm)	Sn (%)	Zn (%)
R2 (7)	*X*	844	690	25	39	75	19	18	357	2.7	15
	σ	453	457	19	45	6	16	9	404	1.6	8
R3 (4)	*X*	998	1690	18	47	78	10	≤8	419	3.7	16
	σ	129	127	6	12	5	2	3	76	0.7	2
R4 (14)	*X*	750	1421	11	30	76	7	≤14	344	3.2	18
	σ	102	167	1	11	4	1	15	55	0.7	2
R5 (11)	*X*	1406	2735	19	61	81	16	≤10	450	4.0	12
	σ	113	275	2	8	1	4	5	38	0.4	2
R6 (31)	*X*	1357	2878	15	61	78	14	≤13	510	4.1	13
	σ	246	456	2	13	2	4	7	74	0.7	2
R7a (8)	*X*	1663	3069	7.9	53	79	9	≤26	409	3.4	13
	σ	406	1972	4.8	39	4	8	14	307	1.2	5
R7b (6)	*X*	777	1642	3.6	26	78	≤3	≤38	152	2.9	17
	σ	438	868	0.7	20	3	0.6	14	33	1.1	3

Table 5
Yellow brass chemistries, as defined by their means and standard deviations. Means that include detection limit data are designated by ≤.

Group (*n*)		Ag (ppm)	As (ppm)	Au (ppm)	Co (ppm)	Cu (ppm)	In (ppm)	Mn (ppm)	Sb (ppm)	Sn (%)	Zn (%)
Y1 (34)	*x*	666	299	23	16	72	16	≤23	83	1.0	25
	σ	176	131	4	5	4	5	11	27	0.7	4
Y2 (34)	*x*	585	675	15	16	71	9	29	152	1.1	26
	σ	88	65	2	3	3	2	7	29	0.2	3
Y3 (9)	*x*	567	916	9.0	21	72	7	≤26	162	1.3	26
	σ	107	126	2.9	13	4	3	12	38	0.4	4
Y4 (14)	*x*	405	805	3.9	8	71	≤2	≤20	181	1.5	27
	σ	67	169	0.0	4	2	1	8	52	0.4	2
Y5 (20)	*x*	375	625	1.4	8	71	≤1	32	132	1.0	27
	σ	81	65	2.6	5	3	0	14	63	0.4	3
Y6 (17)	*x*	310	717	1.8	≤4	71	≤1	51	71	≤0.7	28
	σ	73	172	0.6	3	4	1	17	27	0.8	4

be chemically analysed, so that the total inventory of samples could be measured and sorted.

4.1.6. Chemistries of tools and ornaments

The artifacts identified as tools and ornaments were made from many but not all of the chemical groups found (Table 6). In this sample suite, tools and ornaments were made from materials of chemical groups E2, E3, E4, E5, E7, E9, R2, R3, R4, R5, R7a, and Y6. The kettle (whole or partial) or kettles of chemistry E4 was/were used for 7 different tools and ornaments: a ring; four beads; a projectile point, and a pendant. Perhaps the relative paucity of brass tools and ornaments means that the villagers took most of them with them when they moved to a new location?

4.2. Question b) Were all European metal types represented equally in both the older and the newer areas of the Ball site?

The samples were collected for INAA in the late 1980s, and analysed in the early 1990s. Examination of intra-village metal chemistry distributions began in late 2011. As a first step in this latter process, the analysed samples were cross-checked with the original sample inventory for the Ball site excavations. We could only confirm the exact position of 154 European copper samples, of 73 red brass samples, and of 114 yellow brass samples, resulting in the loss of contextual information for 84 samples. With the information that we had for the 154 samples, we could check whether different chemistries were found predominantly in the older part of the village or predominantly in the expanded part of the village. Given the small numbers of samples in many chemical groups, the following interpretations should be seen as being semi-quantitative rather than quantitative.

Table 7 shows that the *European copper* samples were recovered, on average, 68% from the original part of the village, with most of the chemical groupings behaving this way. The only exceptions are the copper samples of chemical groups E1 and E8 both of which were found more often in the newer part of the village.

The *red brasses* were recovered at an average of 59% from the older part of the village (Table 8). Samples from groups R4 and R7 were found more in the older part of the village; samples from groups R3, R5, and R6 were evenly distributed; and only group R2 samples were found predominantly in the newer part of the village.

Similar to the *red brasses*, *yellow brasses* were found at an average of 61% in the older part of the village (Table 9), the only exception being group Y2 samples.

Table 6
Summary of the chemistries of tools and ornaments.

Tool/ornament	European copper	Red brass	Yellow brass
Ring	E2(2), E3, E4, E7		
Bead	E2, E3, E4(4)	R4	
Pendant	E4, E5	R7a	
Rod	E3		
Projectile point	E4, E5, E7	R2, R3, R4, R5	Y6(2)
Disc	E5, E9	R2, R5	
Hook	E5		

Table 7
Distribution of different copper chemistries between older and newer areas of the village.

Group	Number older + newer	% older	% newer
E1	6	17	83
E2	15	67	33
E3	37	62	38
E4	20	70	30
E5	26	85	15
E6	11	100	0
E7	17	65	35
E8	6	33	67
E9	15	67	33
	154	68%	32%
Wilcoxon sign rank		$Z = -2.58$; $p = 0.0098$	

Table 8
Distribution of different red brass chemistries between older and newer areas of the village. Italics indicate groups whose distribution differs between the older and newer parts of the village.

Group	Number older + newer	% older	% newer
R1a	1	100	0
R1b	1	100	0
R2	*5*	*40*	*60*
R3	4	50	50
R4	*13*	*69*	*31*
R5	8	50	50
R6	25	52	48
R7	*16*	*69*	*31*
	73	59%	41%
Wilcoxon sign rank		$Z = 2.38$; $p = 0.0170$	

4.2.1. Detecting patterns in the chronology of the arrival of different metal types

Nearly two decades ago, Hancock et al. (1994a) proposed a chemical seriation model for copper artifacts that they thought might be useful at some northeastern North American archaeological sites. They posited that the relative abundances of native copper, European copper and brass might provide a chronological indicator that could be used to resolve some late 16th and early 17th century site chronology problems, with native copper being followed by *European copper*, and then followed by what they called brassy copper (*red brass*) and brass (*yellow brass*). Using only 97 samples, they found that late 16th century sites from Ontario produced native copper, together with European copper and yellow brass, while 17th century, and later, sites produced mainly red and yellow brass.

If this concept holds, then the finding of only a single piece of native copper at the Ball site would tend to pull the chronology of the village towards the 16th century. But, if this native copper piece was a heirloom, a memento of times past, then it may not contribute to confirming a chronology for the village.

From the above, it is difficult to establish short-term, (<50–60 years), North American village chronologies using European trade goods. This is primarily because the trade goods belonged to the people, rather than to the villages that they lived in. Therefore, when groups of people moved from one location to the next, every 10–20 or so years, most of their valuable trade goods went with them.

This, in turn, implies that it is a lack of trade goods from a specific later period that probably marks the end-date of a specific village, rather than the presence of trade goods from earlier

Table 9
Distribution of different yellow brass chemistries between older and newer areas of the village. Italics indicate groups whose distribution differs between the older and newer parts of the village.

Group	Number older + newer	% older	% newer
Y1	21	57	43
Y2	*39*	*41*	*59*
Y3	8	75	25
Y4	12	58	42
Y5	19	84	16
Y6	14	86	14
Y7	1	100	0
	114	61%	39%
Wilcoxon sign rank		$Z = 2.43$; $p = 0.0152$	

periods. For example, some glass trade beads may be found at villages that were in use more than forty years after the beads first appeared in a particular village (e.g. Sempowski et al., 2000). So, earlier researchers into northeastern North American trade beads (e.g. Hancock et al., 1994b; Fitzgerald et al., 1995) may, or may not, have estimated village occupation periods appropriately.

If established glass trade bead findings translate to copper-based kettles, then one could expect tools and ornaments made from copper and brass trade kettles to be discarded or lost by villagers who moved to two, or even perhaps three, locations after the original village into which the kettles were first traded. If there were several trade kettles of the same chemistry, and they were recycled over time at different villages, then the finding of artifacts of a particular metal chemistry might occur at sequential villages. Even scrap metal samples, as were most of the samples from the Ball site, may have been discarded in up to one to two villages after they were acquired, depending on the working lifetime of each kettle.

This argument implies that both the original inhabitants and the newcomers to the village may have brought with them kettles, or parts thereof, and/or tools, and/or ornaments that individuals had acquired prior to their arrival at the village that became the Ball site. Some, or all, of any of these groups of items may have been discarded there.

Tables 7–9 show that the individual metal types (*European copper, red* and *yellow brass*) were discarded primarily in the older, rather than in the newer part of the village, and that this pattern is statistically significant for each metal type. Such a pattern might suggest that the village did not last long after it expanded, thereby supporting Fitzgerald et al.'s (1995) argument, which was based on glass beads from the Ball site.

However, it is worth noting the distributions of individual metal chemistries within each metal type (Table 10), since they did not all conform to the overall pattern. Artifacts from groups E1 and E8 of the *European coppers* were found predominantly in the newer part of the village, as were pieces of group R2 of the *red brasses* and Y2 of the *yellow brasses*. This pattern possibly indicates that these latter kettles – or parts of them – that produced the samples in these chemical groups came to the village along with the new arrivals.

Chemical group E6 (11 samples) is interesting in that it represents the only multi-sample kettle chemistry that was found solely in one section of the village. Since it was found in the older part of the village, perhaps this indicates that it was used and recycled prior to the arrival of the newcomers to the village. Artifacts of chemical groups E5 (26 samples), Y5 (19 samples) and Y6 (14 samples) were also found predominantly in the older section of the village. Perhaps the kettles from which they derived were recycled either just prior to, or at the time of arrival of, the newcomers to the village. Along the same line of thought, the kettle with chemistry E1 (six samples) may have been dismembered by the newcomers at, or very soon after, their arrival at the village.

The fact that group E6 artifacts were found solely in the older part of the village, may further indicate that copper was introduced to the village earlier than was brass, and was replaced by brass over time; a point in agreement with proposals of Fitzgerald and Ramsden (1988) and Fitzgerald (1990).

Table 10
Summary distributions of the chemical groups found in the village metals.

% in older section	Chemical group
>80	E5, E6, Y5, Y6
>60	E2, E3, E4, E7, E9, R4, R7, Y3
>50	R3, R5, R6, Y1, Y4
<40	E8, R2, Y2
<20	E1

In other words, the examination of individual group chemistries within each metal type shows that only five out of our twenty-one chemical groups were found predominantly in either the older or the newer part of the village. This means that the majority of the groups of copper and brass artifacts were spread relatively evenly between the older and newer parts of the village (Table 10), implying that the kettles from which they came were cut up and shared among old and new villagers. This, in turn, may imply that the village lasted for quite some time after the newcomers arrived, a point in conflict with that espoused by Fitzgerald et al. (1995) in their study of glass beads from the Ball site. Only the analysis of the complete sample of metal artifacts from the Ball site will allow us to evaluate which one of the two chronological proposals is more accurate [the dispersal of the village soon after the arrival of newcomers, as suggested by Fitzgerald et al. (1995) and by the overall pattern of each metal type, or the dispersal long after the arrival of newcomers, as the patterns of individual metal chemistries within each metal type suggest].

Ultimately, one should be careful with any of the patterns discussed above, since they all assume that chronology is the primary cause of such a pattern, when economic, or social reasons may have been responsible. For example, Knight (1987: 181) has noted that it is probably inappropriate to think of all the longhouse structures at the Ball village as actual houses. Differences in length, interior pit and post location and intensity of occupation suggest that these structures may have been used for different functions. Before more information becomes available about the nature and function of these structures in each side of the village, it is not possible to establish whether chronology or other factors affected the discard pattern of metals.

4.3. Question c) Are there patterns in the discarding of metal artifacts inside and outside of longhouses?

Examination of the same 341 samples used for question c) revealed that the number of *European copper* samples found inside and outside houses was relatively even on average (Table 11), and that there is no statistically significant difference in the discard of the different metal types between the interior and the exterior of longhouses.

However, it is again worth considering the individual metal chemistries within each metal type, since they do not all behave the same way. Of the *European copper* groups E1, E2, E3, E8 were found mainly inside houses, groups E6 and E7 were evenly distributed, while groups E4 and E9 were found mainly outside houses. Of the *red brasses*, with an average of 50% of the artifacts recovered from inside houses, groups R3, R4, and R6 were recovered mainly from inside houses, while groups R2, R5, and R7 predominantly from outside (Table 10). For the *yellow brasses,* where only an average of 39% of the artifacts were recovered from inside houses, group Y1 was found more inside houses than outside, groups Y3 and Y4 samples were evenly discarded, while all of the other groups (Y2, Y5, and Y6) were found predominantly outside the houses (Table 10).

Table 12 shows that there may be a pattern to the distributions of chemical groups. The *European copper* groups are mainly recovered from inside houses; the *red brass* groups are split between inside and outside; and the *yellow brass* groups are distributed mostly on the outside.

4.3.1. Is there evidence that the different kinds of metals were treated and valued similarly by the inhabitants of the Ball village?

It is very difficult to answer this question. One would have to assume that the materials we have recovered and analysed from the Ball site were actually at the same stage in their 'life histories',

Table 11
Distribution of the chemical groups inside and outside longhouses.

Copper groups (*n*)	Number inside houses	Number outside houses	Red brass groups (*n*)	Number inside houses	Number outside houses	Yellow brass groups (*n*)	Number inside houses	Number outside houses
E1 (6)	4	2	R1a (1)	0	1	Y1 (21)	12	9
E2 (15)	10	5	R1b (1)	0	1	Y2 (39)	17	22
E3 (37)	26	11	R2 (5)	1	4	Y3 (8)	4	4
E4 (20)	6	14	R3 (4)	4	0	Y4 (12)	5	7
E5 (26)	14	12	R4 (13)	8	5	Y5 (19)	2	17
E6 (11)	6	5	R5 (8)	3	5	Y6 (14)	5	9
E7 (17)	9	8	R6 (25)	17	8	Y7 (1)	0	1
E8 (6)	4	2	R7 (16)	3	13			
E9 (1)	1	14						
$N = 154$	81	73	$N = 73$	36	37	$N = 114$	45	69
	53%	47%		50%	50%		39%	61%
Wilcoxon sign rank	Not significant		Wilcoxon sign rank	Not significant		Wilcoxon sign rank	Not significant	

all having completed their use life and having been discarded deliberately. If some materials were deliberately discarded, while others were simply lost, then we could not assess relative treatment or value. Moreover, as mentioned above, not all longhouses had identical functions, meaning that our 'interior' category may be masking meaningful disposal patterns within longhouse structures.

For the time being, we can only highlight some patterns that should be further evaluated once information on the function of the Ball site longhouses and on the nature of the discard of the metal artifacts become available. On average, the lack of statistically significant differences in the discarding of each metal type inside and outside longhouses (Table 11) suggests that the different metal types were treated/valued in similar ways. However, observation of particular chemical groups within metal groups suggests the presence of a possible trend: of more and more scraps being discarded outside the houses, from *copper* (47%), through *red brass* (50%), to *yellow brass* (61%). This is accompanied by the fact that *copper* has only two out of nine (22%) of its chemical groups found mainly outside houses, while *red brass* has three out of six (50%) of its chemical groups found mainly outside, and *yellow brass* has four out of six (67%) of its chemical groups found mainly outside.

As ornaments, copper would have been preferred over brass by the Wendat for its red colour. Red held spiritual power for the Wendat and their ancestors, signifying physical, social and spiritual well-being (Hamell, 1987, 1992). This belief has great antiquity in the Northeast; native copper items were placed in aboriginal burials for 6000 years prior to European arrival (Hamell, 1987: 79). *Yellow brass* would have been avoided if copper was available. The colour yellow amongst the Wendat symbolized illness (Hamell, 1992: 462). As the 17th century progressed, aboriginal peoples were given less copper (red) and more brass (yellow), perhaps causing a slight shift in values attributed to certain colours. With the establishment of the formal French fur trade in the 1600s, fewer copper and more brass kettles and sheets were traded to aboriginal peoples because brass was cheaper than copper. By 1650, about 85% of all copper-based metals in aboriginal villages and burials in Ontario were brass (Fitzgerald, 1990: 412). In 1600, the tentative median date for the Ball village occupation, copper kettles would have outnumbered brass in a ratio of 3:1 (Fitzgerald, 1990: 412) so the Ball site inhabitants were still able to exercise their cultural preference for red over yellow coloured metal. This may account for the higher rate of discard of *yellow brass*.

Table 12
Summary distributions of chemical groups within longhouses.

% inside	Chemical group
>80	R3
>60	E1, E2, E3, E8, R4, R5, R6
>50	E5, E6, E7, Y1, Y2
<50	Y3, Y4
<60	E4, Y6
<20	R2, R7, Y5

5. Conclusions

Our elemental analysis via INAA of metal samples from the Ball site in southwestern Ontario showed that the bulk of the analysed copper-based kettle fragments were made of *European copper* (204 samples), rather than *red brass* (90) or *yellow brass* (129), along with only one sample of native copper. Fewer than 10% of the analysed samples were from tools or ornaments made from trade kettles. The ones that were indeed made from kettles were made from selected kettles.

The difference in the distributions of copper and brass samples in the older and newer parts of the village, may perhaps confirm that copper kettles were traded to these villagers before brass kettles. Also, the fact that not all chemical groups of each of the 3 copper-based materials were distributed in the same way indicates different arrival dates of specific kettles, or parts thereof, at the village, giving us a glimpse of a possible kettle-chemistry chronology within the village. This interpretation (*European copper* being earlier than *red brass*, which was in turn earlier than *yellow brass*) matches known symbolic preferences of the Wendat for the colour red, as well as changes in the availability of actual copper by 1600 (see above).

A minimum of about two to three dozen partial or whole kettles may have been traded to the occupants of the Wendat village at what is now the Ball site. The small number of kettles at Ball is reflective of the normal inventories of trade goods carried aboard French ships in the 1580s [e.g. 100–200 kettles versus 2000 knives per ship (Turgeon, 1999: 601)]. Trade kettles, unlike iron axes and knives, were not valued for their utilitarian form. In the Northeast, trade kettles were seldom used for cooking prior to 1650. Aboriginal-made pottery was far superior to metal kettles for cooking and serving the staple food of the Wendat and other Iroquoian groups – maize soup. In fact, copper and brass kettles, especially old and worn ones, would have imparted a bitter taste to the soup and would have been avoided as cooking vessels. While kettles could have been used for fetching water, they were overwhelmingly desired for the metal, especially copper (Martelle, 2006). In addition, after 1600, copper and brass kettles were manufactured with thinner walls and poorer craftsmanship. Brass kettles were notorious for splitting along the base and wall juncture and would have had short use lives as containers for liquid (Fitzgerald, 1990).

The small changes in the average distributions of copper and brass samples that were discarded or lost both inside and outside houses (about 53%–47% for copper; 50%–50% for red brass, and about 39%–61% for yellow brass), may reflect the relative value (or supply) ascribed to these similar, but different, materials by the villagers. In ornaments, copper would have been preferred over brass by the Wendat for its red colour, which signified physical, social and spiritual well-being (Hamell, 1987, 1992). Yellow brass would have been avoided if copper was available, since yellow symbolised illness (Hamell, 1992: 462). In 1600, the tentative median date for the Ball site occupation, copper kettles would have been common, outnumbering brass in a ratio of three to one (Fitzgerald, 1990: 412). The Ball site inhabitants would have been able still to exercise their cultural preference for red over yellow coloured metal.

Since there is only one (group E6) completely clear metal-discarding division between the older and the newer part of the village, it appears that the newer part of the village was not occupied by unrelated arrivals who brought their own, chemically-different, copper-based objects with them and did not share them with the original members of the village. This said, there are two copper (E1 and E8), one red brass (R2), and one yellow brass (Y2) sets of samples that appear to be associated more with the newer part of the village than with the older part. Perhaps the kettles from which they came were brought to the village by the newcomers.

A final analysis of the copper-based metal samples recovered from the Ball site, can only be achieved if funding and analytical time become available to convert all of the remaining samples collected by L.A. Pavlish into analytical data that could be added to the current database.

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