PARKER FESTOONED POTTERY AT THE LAWSON SITE:
TRACE-ELEMENT ANALYSIS

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ABSTRACT

Trace-element analysis clearly distinguishes Iroquoian-style pottery from the proto-Neutral Lawson site, in Middlesex County, Ontario, from Parker Festooned sherds from the Parker site, Lambton County, Ontario, which belongs to the Central Algonkian Sandusky Tradition. Parker Festooned sherds from the Lawson site form a third chemical grouping. This suggests that most of this pottery may have been brought to the Lawson site from one or more Sandusky Tradition sites rather than having been made locally by captive Algonkian women.

INTRODUCTION

When R.S. MacNeish (1952) defined regional variations in Iroquoian pottery types, he noted on most sites a small number of "aberrant sherds" that were stylistically typical of other tribal groups rather than of the local assemblage. Archaeologists have interpreted these sherds as evidence of trade or friendly visits between groups; occasional intermarriage, which would have introduced foreign women and their pottery styles; the arrival of refugee groups; alien women being incorporated into communities as prisoners of war; the copying of foreign styles; or all these processes going on simultaneously (MacNeish 1952:7; Wright 1972:90; Pendergast 1975:49; Ramsden 1977:287-293; Pendergast and Trigger 1972:361).

While there is historical evidence that Hurons carried pottery vessels with them when they made long journeys by canoe (Wrong 1939:59-60), it has generally been assumed that Iroquoians would not have transported pottery vessels overland for long distances. Although trace-element analysis cannot provide direct evidence of the social mechanisms that account for aberrant sherds (Hodder 1984), in many cases it can indicate whether these sherds were manufactured locally or brought from elsewhere. In a previous study (Trigger et al. 1980), we were able to demonstrate that samples of St. Lawrence Iroquoian-style sherds from the Waupoos, Benson, and Draper sites were chemically indistinguishable from the Ontario Iroquoian-style pottery from the same sites. On the other hand, some of the St. Lawrence Iroquoian-style sherds at the Sidey-Mackay and McKenzie sites appeared to have come from Ontario Iroquoian sites farther east.

THE PROBLEM

In the first half of the 17th century warfare is historically attested between the Iroquoian-speaking Neutral peoples in the Hamilton area and Central Algonkian peoples living to the west. In recent years additional evidence of this warfare has been found on some historical Neutral sites in the form of large numbers of aberrant sherds that are identical to those associated with what David Stothers calls the Indian Hills phase of his Sandusky Tradition in southeastern Michigan and northern Ohio (Fitzgerald 1982; Stothers and Graves 1982). Archaeologists have argued that there is similar evidence of warfare in late prehistoric times (ca. 1500) which involved the westernmost Iroquoian (presumably Neutral) groups living in Middlesex and Elgin counties in central southwestern Ontario and communities of an earlier stage of the Sandusky Tradition occupying Lambton, Kent, and Essex

counties in extreme southwestern Ontario (Fox 1980). This evidence includes Parker Festooned pottery of the Sandusky Tradition occurring on Iroquoian sites. It has been assumed that this pottery was produced by Algonkian women who had been captured by the Iroquoians. Hence it would follow that most of it was manufactured by these women with local material at the sites where it was found.

In clays, it is the concentrations of minor and trace elements that vary notably from one bed to the next and not the concentrations of the major constituents, which serve to define the materials as clays. Hence to determine whether or not the Parker Festooned sherds found at the Lawson site had been manufactured there, the following samples were subjected to trace-element analysis:

(1)   10 Parker Festooned sherds from the Parker site, located two miles east of the St. Clair River near Corunna, Ontario (Lot 26, Concession 11, Moore Township, Lambton County). This Sandusky Tradition site was investigated by David Boyle in 1901 (Boyle 1902), partially excavated by Thomas Lee in 1956 and reported by him in a paper published in the *Pennsylvania Archaeologist* in 1958. More work was done at the site in 1960 before it was partially destroyed by the Dow Chemical Company in 1976. The earthwork surrounding the site measured 100 by 53 metres and was elliptical in shape. Lee found only part of one longhouse 6.7 metres wide and of indeterminate length. There were no middens. No exact population estimate is possible but it appears that at most only a few hundred people could have lived at this site.

(2)   15 typically Iroquoian sherds and 25 aberrant Parker Festooned sherds from the Lawson site. This site is located along Medway Creek in the northwest corner of the City of London (Lot 20, Concession 4, London Township, Middlesex County). It is a large, 1.8 hectare prehistoric Iroquoian town that was occupied ca. AD 1500. It has been known since the 19th century and was excavated between 1921 and 1923 by W.J. Wintemberg (1939) and since 1976 by the Museum of Indian Archaeology (London)(Pearce 1980, 1984). There is evidence that the settlement, which began as a 1.4 hectare community, underwent one major expansion, probably as the result of another community joining it. Parker Festooned sherds constitute approximately 4.2% of all the ceramic rim sherds found throughout the site. The site is estimated to have contained 35 to 40 longhouses and to have had a population of 1500 or more people.

PROCEDURES

The concentrations of trace elements were determined in samples of the sherds by means of X-ray fluorescence and neutron-activation analysis.

Approximately 0.3 grams of pottery powder were extracted from the previously-cleaned edge or back of each sherd by drilling with a solid tungsten carbide bit. This powder was then passed through a 45-micrometer sieve and used for the sample preparation for both analytical techniques.

X-ray Fluorescence Measurements

About 10 milligrams of powder were deposited evenly on filter paper, covering a disc of 2.3 cm^2. A detailed description of this sample preparation can be found in Birgül, Dikšic and Yaffe (1979:203). The X-rays of 14 different elements were measured using a Si(Li)) detector and compared with the results obtained from samples of standard pottery (Perlman and Asaro 1969:21) prepared in the same way. Concentrations of K, Ca, Ti, Rb, Sr, Fe, Cu, Mn, Ni, Cr, V, Zn, As, and Pb were then obtained but only the first seven elements were judged suitable for statistical treatment since the other elements were frequently below limits of detection. The values of the concentration of iron kept for the statistical treatment were the results of neutron-activation analysis.

Neutron-Activation Analysis

Approximately 200 milligrams of the pottery powder were introduced into quartz tubes which were sealed before irradiation. These tubes were then irradiated for six hours in a neutron flux of about $10^{12} n \cdot cm^{-2} \cdot s^{-1}$ delivered by a SLOWPOKE reactor located at Ecole Polytechnique (Université de Montréal). After a "cooling" period of 2 or 3 days, the gamma rays were measured with a 45 cm³ Ge(Li) detector. Here again, samples of standard pottery, used as a reference, were prepared in the same manner and irradiated at the same time as the other samples. Samples of standard pottery did not have to be present for each irradiation since the neutron flux from the SLOWPOKE reactor is quite stable. After correction for radioactive decay between the irradiation and measurement times and also for differences in the weights of the samples, the concentrations of La, Lu, Ce, Co, Fe, Se, Th, U, Cs, Cr, Eu, and Hf were obtained. Only the first seven of these elements could be retained as part of the statistical analysis.

It has been found (Attas et al. 1984) that the drilling of the sherds with a carbide bit could contaminate the samples with tungsten which, after irradiation, can be seen from the presence of the [187]W isotope. Besides tungsten, cobalt is present in the drill-bit material and this can affect the apparent concentration. Contamination due to [187]W was detected in nearly 60% of the samples. However, the amounts of tungsten were so low that the corresponding correction in the cobalt concentration due to contamination would have been well below the experimental error in determining the cobalt content of the sample.

For the statistical treatment, we were thus in possession of 50 samples, knowing the concentrations of 13 different elements (six of them from X-ray fluorescence measurements and seven from neutron-activation analysis).

STATISTICAL TREATMENT

The concentrations of the 13 elements determined in the samples from the Parker site and in those from the Iroquoian-style sherds from the Lawson site were assumed to form multivariate normal swarms, each characteristic of it's site. They are referred to here as Groups A (Parker) and B (Lawson). The presence of the 13 trace elements in the samples in the Parker Festooned style from the Lawson site were then compared to those defined by these two groups. These operations were carried out using the programs BMDP3D, BMDP4M, and BMDP7M from the package *BMDP Statistical Software* (Dixon 1981), supported by the McGill University Computing Centre.

The samples making up groups A and B were first tested to discover any statistical outliers, i.e. data which should be rejected. The Hotelling T^2-test, a multivariate equivalent of Student's t-test, was applied:

$$T^2 = F_{p,N-p}(\alpha) (N-1)(p)/(N-p)$$

gives the test value of D^2, the Mahalanobis distance, for a significance level of α, for a distribution of N samples in p variables. The Mahalanobis distance, D^2, is the squared standardized Euclidean distance from the centroid of the group to the point in question, divided by the standard deviation in that direction, the multivariate equivalent of the univariate standardized variable. The test for outliers could not be applied directly to the 13-dimensional data. Group A includes only ten samples, and D^2 cannot be defined unless $p \geq N + 1$; group B does include 15 samples, but it is unwise to apply the test if $p \leq 3N$ (Harbottle 1976), as such groups are easily deformed by the addition or removal of even a single sample. Hotelling's T^2-test was, instead, applied to the principal components of each group, that is, to a smaller set of variables, each of which represents several of the original elemental concentrations which are correlated. In this case, the first four principal components account for most of the variance, and so contain most of the information inherent in the original data. At the 95% confidence level, no outliers were rejected from either group.
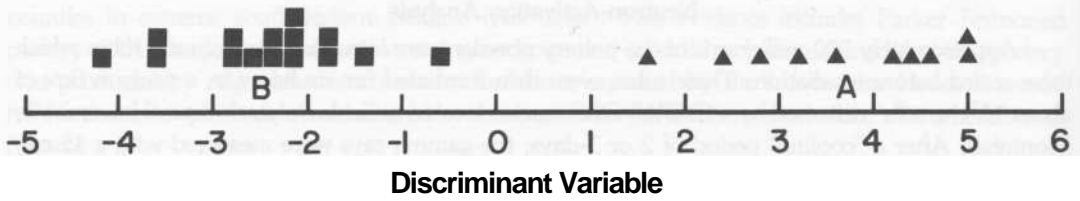
Discriminant Variable

Fig. 1. The samples making up group A (Parker) and group B (Lawson), against the discriminant variable given by (-0.9 K - 1.6 Ca - 25 Ti + 4.0 Fe - 0.8 Sc - 0.2 Co - 0.01 Cu - 0.02 Rb + 0.002 Sr - 0.15 La + 0.05 Ce -18 Lu - 0.3 Th + 30), where the element symbol represents the elemental concentration. The letters indicate the group centroids.

Hotelling's T^2-test can also be applied to detect significant differences between the means of multivariate normal groups (again this is equivalent to the application of Student's t-test in the univariate case). By this test, groups A and B are distinct at the 99.9% confidence level. Fig. 1 shows the result of a discriminant analysis performed on groups A and B. In this procedure a new variable is created from that linear combination of the original variables which gives the best discrimination between the two groups. The figure shows the compositions of the samples making up groups A and B
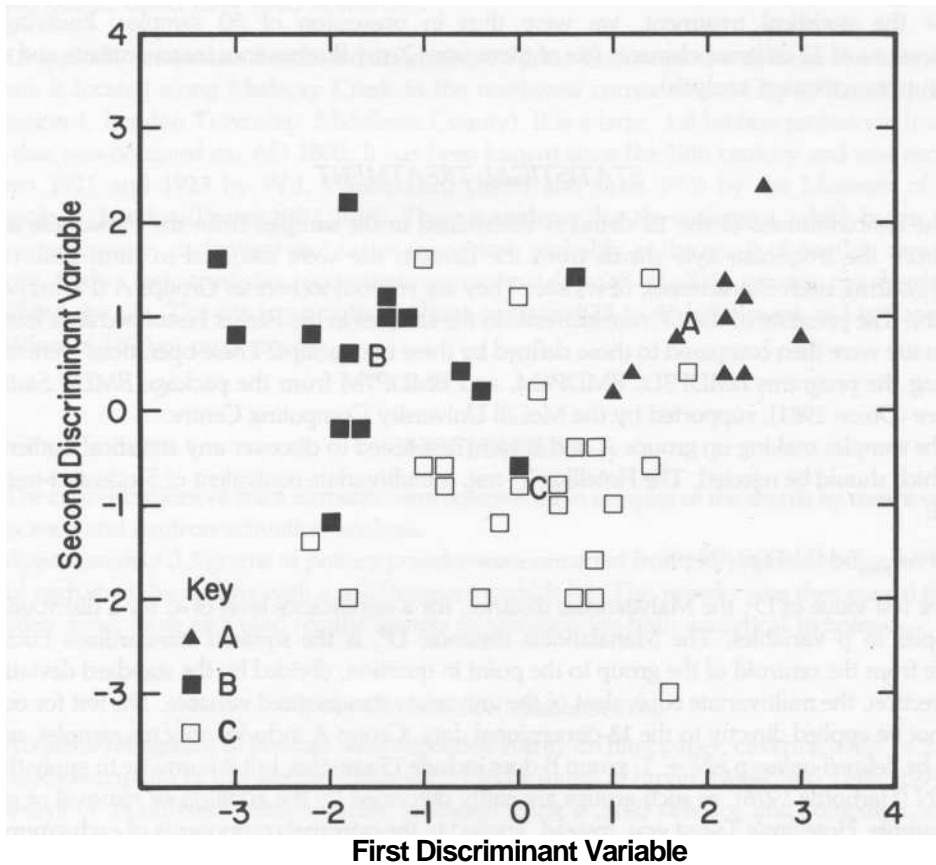

First Discriminant Variable

Fig. 2. The samples of groups A, B, and C, in the plane of the two discriminant variables. The letters indicate the group centroids.

plotted as a histogram against the discriminant variable adjusted so the pooled variance is 1 and the overall mean is zero.

The sample from each sherd in the Parker Festooned style from the Lawson site was tested as a possible match to either of the characteristic groups, A and B. Considered individually in this way, only six of the 25 samples could be rejected, at the 95% level of confidence, from group A, and only three of these from group B; however, when the compositions of samples were considered in the light of the discriminant function between groups A and B, it appeared that the test samples formed a third swarm of intermediate composition. These samples were therefore assembled as a separate group, C, from which two samples, one with very high concentrations of lanthanum, cerium, and lutetium, and the other with high concentrations of copper and strontium, were rejected as outliers. Group C defined thus is indeed distinct from groups A and B, at confidence levels of 96.7% and 90.8% respectively. Fig. 2 displays the result of a discriminant analysis of the three groups, showing each sample in terms of the two discriminant functions which define the plane in which the greatest discrimination is visible. Table 1 describes the compositions of the three distinct groups, giving the mean value and standard deviation of the concentration of each element in each group. From Fig. 2 it appears that group A is more tightly clustered (i.e., the samples are more alike) than either group B or group C. There is no single expression for the width of a multivariate swarm, which is typically a hyperellipse rather than a hypersphere. The best description of the size of such a swarm is given by the variance in the distribution of *each* of the variables (or each principal component). By this measure, of the ratios of the individual elemental variances, groups B and C are both about three times as large as group A except with respect to the concentrations of calcium, in which group C is considerably wider than group B.

Taking account of the possibility that calcium may vary according to depth in clay deposits in Ontario (Trigger et al. 1980) and that potassium and strontium may be chemically trapped in porous vessels that have been used for the cooking and storing of food, the groups were re-examined without these elements. Two other elements susceptible to entrapment, phosphorus and carbon, were not

TABLE 1

THE COMPOSITIONS OF THE THREE GROUPS

ELEMENT	A		B		C	
K (%)	2.7 ± 0.3		3.1 ±	0.7	2.8 ±	0.6
Ca(%)	1.3 ±	0.3	2.3 ±	0.8	2.8 ±	3.2
Ti (%)	0.38±	0.04	0.46±	0.13	0.40 ±	0.10
Fe (%)	3.6 ±	0.7	4.4 ±	1.2	3.8 ±	0.9
Sc (ppm)	15 ±	3	17 ±	4	15 ±	3
Co (ppm)	14 ±	4	21 ±	6	14 ±	7
Cu (ppm)	12 ±	5	14 t	5	14 ±	4
Rb (ppm)	140 ± 40		160 ± 30		140 ± 50	
Sr (ppm)	230 ± 40		320 ± 180		250 ± 60	
La (ppm)	30 ± 5		41 ± 12		40 ± 13	
Ce (ppm)	71 ± 15		89 ± 24		88 ± 30	
Lu (ppm)	0.30±	0.05	0.35±	0.08	0.33 ±	0.09
Th (ppm)	10 ± 2		10 ± 4		11 ±	5

measured by us (Sideroff 1980). Table 2 gives the confidence levels at which the group means can be considered distinct, as determined by the concentration of each element, by the entire suite of 13 concentrations, and by the suite of 10 concentrations excluding those of calcium, potassium, and strontium. The confidence in the distinctions between groups is essentially unchanged by the exclusion of the three elements, even though the lower concentration of calcium in the samples forming group A is a strongly distinguishing feature of that group.

The distinctions between these groups are clear, even though the variances in the determinations of the elemental concentrations are in some cases rather large. Data collected during an earlier study of Ontario Iroquoian pottery (Trigger et al. 1980) suggest that the inhomogeneity of the pottery itself accounts for a large part of the observed variance. Duplicate samples were taken from 20% of the sherds used for the determination by X-ray fluorescence of potassium, calcium, titanium, iron, and strontium, and the pooled variance among these samples compared to the variances of the groups formed by samples from selected sites. Both from the calculations based on sherds from one large site (Draper) and from pooled data on samples from several sites (Nodwell, Sidey-Mackay, McKenzie, Benson and including Draper), the differences between sub-samples from a single sherd accounted for at least 30% of the apparent variance among samples making up a group. It is not surprising that this material is not homogeneous at the 10-milligram level, but this inhomogeneity is not so large as to obscure the definition of separate groups. Similar data are not available to describe the effect of inhomogeneity on the measurements made by neutron activation, and there are too few samples in the present study to justify calculations here. While the size of the sample taken for neutron-activation is considerably larger than that used for X-ray fluorescence, this may not completely dispel the effect, particularly in the lowest range of concentrations.

TABLE 2

CONFIDENCE LEVELS FOR DISCRIMINATION BETWEEN GROUPS

Element	Confidence Level (%) Groups A and B	Groups C and A	Groups C and B
13 elements	99.94	96.7	90.8
10 elements (without Ca,K,Sr)	99.6	97.7	90.6
Ca	99.99	97.0	64
Co	99.8	0.7	99.7
La	99.5	99.8	7
Lu	99.3	96.5	60
Ce	97.1	96.6	4
Fe	96.6	38	90.0
Ti	96.5	56	88
Sr	92.5	68	86
K	88	40	75
Sc	78	24	88
Rb	77	10	89
Cu	68	74	3
Th	56	73	22

INTERPRETATION

These findings suggest the following interpretations:

(1)   The clear discrimination between groups A and B indicates that it is possible to distinguish between Sandusky Tradition pottery from the Parker site and Iroquoian-style pottery from the Lawson site in terms of their chemical composition.

(2)   Archaeologists might be tempted to interpret the tighter clustering of group A than of group B as reflecting the much smaller population of the Parker site. Because fewer potters were at work there, clay might have been drawn from a smaller number of sources and there may have been fewer differences in the way that it was processed into ceramic vessels than at the Lawson site. Yet data from other Iroquoian sites, including Draper, indicate that there is no direct mathematical relationship between site size and size of clusters. Moreover, it is clear that the size of each cluster is mostly due to the inhomogeneity present in each pot. Hence it appears that factors other than human population size determine the size of clusters.

(3)   It is less clear what is signified by the Parker Festooned sherds from the Lawson site forming a third group (C), which as a whole is distinguished from groups A and B, although most individual sherds cannot be. It is not surprising that there is a difference between groups A and C, since both Lee (1958:25) and Fox *(1980)* have tentatively dated the Parker site somewhat earlier than Lawson. It is possible that (a) the sherds belonging to group C were made at the Lawson site but from different local clay or by some different process of manufacture that made them chemically distinct from the Iroquoian-style sherds or (b) they come from one or more sites other than Lawson or Parker.

(4)   There is, however, no obvious evidence that the clay used to make the Parker Festooned vessels at the Lawson site was processed differently from that used to manufacture the Iroquoian-style vessels. Visual inspection does not indicate any differences in techniques. In particular, there is no evidence of shell-tempering. This is particularly important in view of the large amount of calcium found in group C by comparison with groups A and B and the early use of shell-tempering in the Sandusky Tradition. The Parker Festooned pottery at the Lawson site therefore seems likely to have originated at one or more sites of the Sandusky Tradition. It is also possible that some of this pottery could have been made at Lawson or (barring a possible discrepancy in date) at the Parker site.

(5)   Although an analysis of ceramic vessels, pipe styles, and projectile points suggests that the Lawson site and the Sandusky Tradition Weiser site, just east of Lake St. Clair, in Kent County, Ontario, are roughly contemporary and there is some archaeological evidence that the inhabitants of these two sites may have been interacting (Fox 1980), Leonard Kroon *(1973:9-10)* of the University of Windsor has noted that all of the Parker Festooned pottery from the Weiser site is distinguished by the presence of magnetite, which can be extracted from ground-up sherds by means of a magnet. No evidence of iron in such quantities was observed for any of our group C sherds. Moreover, *18% of the Weiser site sherds had shell temper, whereas the Lawson site sample contained none of this type of temper. This suggests that none of these sherds came from the Weiser site.

CONCLUSIONS

Trace-element analysis does not provide evidence to support the suggestion currently favoured by archaeologists that most of the Parker Festooned sherds found at the Lawson site came from vessels manufactured there by Central Algonkian women who had been taken captive and incorporated into that community. It appears more likely that most of these sherds are from vessels that came from one or more sites of the Sandusky Tradition. While this does not <u>nullify</u> other evidence that suggests intensive warfare between the inhabitants of the Lawson site and Algonkian-speaking groups located farther to the west, it does indicate a need to re-think the processes that may account for how such large quantities of Parker Festooned pottery arrived at the Lawson site. Even if these vessels were used by Algonkian captives to carry goods from their home villages to Lawson, it must be asked why they made little, if any, pottery of this sort after their arrival. Might the

Iroquoians themselves, rather than Algonkian captives, have brought this pottery back from conquered sites? But if so why did they bring so much of it? The possibility should not be ruled out at this point that this pottery may represent non-violent contact.

ACKNOWLEDGEMENT

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