Chapter 14

Compositional Categories of Some English and American Pottery of the American Colonial Period,[1,2]

Jacqueline S. Olin[3] and Edward V. Sayre
Brookhaven National Laboratory

As students of maritime enterprise are aware, there are some curious gaps in the story of one of the most famous exploits in English history—Sir Francis Drake's circumnavigation of the globe. Drake's ships left England on the 13th of December 1577 from Plymouth, England which is on the southwestern coast between Cornwall and Devonshire. Drake is reported to have arrived at the coast of Brazil on the 6th of April 1578 and to have made a landing on the coast of California in July 1579. He returned to England on September 26, 1580. Evidence in the form of artifacts would be expected to be unlikely in connection with historical questions such as those involved here. Nevertheless, there might be such evidence, and excavations have taken place in the area of Drake's Bay, California. Among the artifacts which have been found there are two earthenware potsherds which in some aspects of appearance resemble Devonshire pottery of the time of Drake. These sherds have been examined as possible artifact evidence of the landing of one or more of Drake's ships at Drake's Bay. In the course of the investigation it was necessary to look in comparison at the compositional categories of some English and American pottery of the American Colonial period.

As early as the first half of the sixteenth century, there was an important center of earthenware manufacture in north Devon, England. (See Reference 1.) Clay for the potters working there at Bideford and Barnstaple came from three similar deep clay deposits in a valley running parallel with a river called the River Taw and lying between the two towns. (See Reference 3.) The potters of north Devon made several types of wares; "coarse" or common earthenware comprised the bulk of their product. They also made a sgraffito ware. An example of each of these is shown in Figures 14.1 and 14.2. The potsherds excavated at Drake's Bay are examples of a tempered coarse ware (Figure 14.3). In view of the close geographic association of Plymouth and the north Devon pottery manufacturing centers and the fact that a coarse earthenware was made by the north Devon potters, a possibility did exist that the potsherds found at Drake's Bay had been made in north Devon.

[1]Research carried out under contract with the U.S. Atomic Energy Commission.

[2]Subsequent to the original calibration, the concentrations in the standard glass were compared to U.S. Geological Survey standard rock specimens AGV-1, BCR-1, GSP-1, and G-2 by Dr. Pieter Meyers and small corrections in concentrations were made to bring our absolute calibrations into agreement with these widely used standards. See Gordan et al, *Geochimica et Cosmochimica Acta*, **32**, 1968, pp. 369–396 for resumé of data for these standard samples.

Experimental Procedures

Numerous methods of physical or chemical analysis could be used in studying this question and further investigation would be reasonable and useful. The method we have worked with to date is that of neutron activation analysis with high-resolution gamma-ray spectroscopy obtained through the use of lithium drifted germanium diode detectors. This is a technique which has been applied to groups of archaeological artifacts from a given site with the objective of deriving internal correlations on the basis of the concentrations of the elements present. (See Reference 2.)

To our knowledge, no analytical data on north Devon pottery had been collected before this time. We began therefore by collecting together a group of pieces of north Devon pottery. Ten such pieces were available. These specimens, which we will describe in greater detail later, included seven sherds which are described as fine ware and three which are gravel-tempered ware. The data which have been collected on these ten specimens will now be available for future comparisons to other sherds in addition to the two from Drake's Bay. We have begun to make some of these comparisons on specimens from colonial American sites which are evidence of a trade between the potteries of north Devon and the colonies during the seventeenth century. (See Reference 4.)

The sherds from north Devon included the following (the number used is that which was assigned during analysis.):

1. Sherd from the Northwalk pottery site, Barnstaple, North Devon.

2. Tile from Bideford thought to have been made in Barnstaple.

3. Sgraffito sherd found in Bideford.

4. Sgraffito sherd found in Bideford.

5. Sgraffito sherd found in Bideford.

6. Sgraffito sherd found in Bideford.

7. Sgraffito sherd found in Bideford.

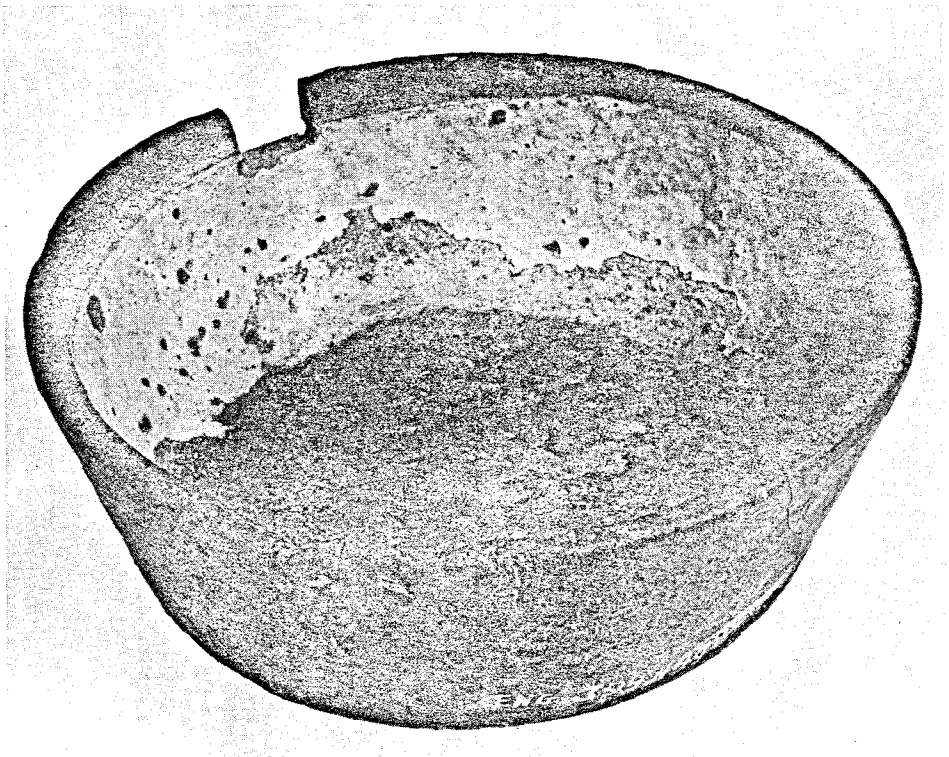
8. Gravel-tempered sherd from Bodmin Moor, Cornwall.

9. Piece of pottery oven from Bideford.

17. Gravel-tempered pan from Bideford, probably of nineteenth century origin.

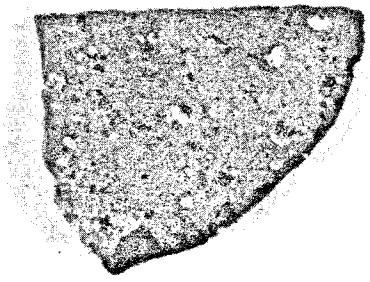
In the case of the pottery sherds from colonial American sites which are believed to have come from north Devon, the artifact evidence preceded the historical evidence. The evidence which has been un-

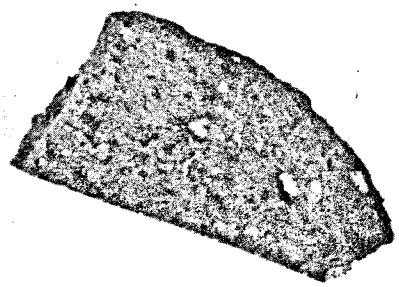
[3]Research Collaborator from the Smithsonian Institution, Washington, D.C.



14.1
Gravel-tempered pan from Bideford, probably of nineteenth-century origin.

14.2
North Devon harvest jug used in Sussex County, Delaware. This jug, 11 inches high and dated 1698, is in the collection of the Winterthur Museum. The inscription reads: "Kind Sr: i com to Gratifiey your Kindness Love and Courtisy and Sarve youre table with Strong beare for this intent i was sent heare: or if you pleas i will supply youre workmen when in harvist dry when they doe labour hard and swear good drinke is better far then Meat."





14.3
Samples from potsherds excavated at Drake's Bay, California. The gravel temper appears as white areas within the sample.

covered to show that there was a large and important commerce in north Devon earthenware between Bideford and Barnstaple and the colonies remained unnoticed until the pottery sherds found in the colonial sites at Jamestown, as well as elsewhere, prompted investigation. Since the first discovery of the two types of pottery, a sgraffito ware and a gravel-tempered ware at Jamestown, examples have been uncovered revealing widespread distribution. Numerous examples of sgraffito ware and gravel-tempered ware have been included in our studies. These have come from Virginia, Maryland, Maine, and Massachusetts:

10. Gravel-ware pan section excavated at Jamestown by the National Park Service, 1934–1935.

11. Gravel-ware sherd from Angelica Knoll, Maryland.

12. Gravel-ware sherd from the site of a house at Plymouth, Massachusetts. The site is referred to as the "R. M." site.

13. Sgraffito sherd excavated at Jamestown by the National Park Service, 1934–1935.

14. Sgraffito sherd found near the shore of Kent Island, Maryland. The sherd is one of a small collection of late seventeenth century and early eighteenth century material which was given to the United States National Museum.

18. Gravel-ware pan rim excavated at Pemaquid, Maine (from a site antedating 1676).

19. Slip-coated pan rim excavated at Pemaquid, Maine (from a site antedating 1676).

20. Sherd of sgraffito ware excavated at Jamestown by the National Park Service in 1956.

The two specimens from Drake's Bay, California were as follows:

15. Gravel-ware sherd, Drakes Bay, California.

16. Gravel-ware sherd, Drake's Bay, California.

We considered it necessary to look at specimens from colonial sites at Jamestown which on the basis of comparison to yellow-glazed sgraffito ware or gravel-tempered ware did not appear to have come from north Devon to ascertain that in such pottery one would not encounter an accidental agreement in composition with north Devon ware. Eleven sherds of this nature were analyzed. In addition we analyzed one specimen from a kiln site in Massachusetts which again is not considered to have come from North Devon:

22. Thumb-impressed rim sherd from a jar, excavated at Jamestown from a supposed kiln site.

23. Foot of a three-footed cooking pot excavated at Jamestown from a supposed kiln site.

24. Sherd of a pot lid excavated at Jamestown.

25. Sherd excavated at Jamestown.

26. Sherd excavated at Jamestown.

27. Sherd from the Bayley kiln site at Newburyport, Massachusetts. This site is dated 1750–1790.

29. Sherd from site of Green Spring Plantation, James City County, Virginia.

30. Sherd from site of Green Spring Plantation, James City County, Virginia.

31. Sherd from site of Green Spring Plantation, James City County, Virginia.

32. Sherd from site of Green Spring Plantation, James City County, Virginia.

33. Sherd from site of Green Spring Plantation, James City County, Virginia.

34. Sherd from site of Green Spring Plantation, James City County, Virginia.

The experimental procedures used in this research were essentially those described in some detail in Chapter 12 of this volume on the activation analysis of Mayan pottery by Sayre and Chan with the exception that only the longer lived activities were measured in this instance. Rather than repeat these details, we shall only summarize our methods here.

In brief, therefore, small plates cut from the interior of our pottery specimens, approximately 1 cm^2 in area and 1mm thick, were leached overnight in distilled water, dried, wrapped in aluminum foil and exposed to a flux of neutrons, 1.0×10^{13} n/cm^2 sec, for a period of 24 hours. These samples were accompanied in activation by similar plates of a standard glass which contained previously determined quantities of all of the elements measured and permitted an element by element flux monitoring of the neutron exposure and subsequent counting. The induced activities were counted by lithium drifted germanium detectors at times from 8 to 35 days after activation. Half-life measurements confirmed that at the times of counting interfering activities were insignificant.

The individual photopeaks measured were the 1600-keV gamma of lanthanum-140, the 890-keV gamma of scandium-46, the 1172-keV gamma of cobalt-60, the 1290-keV gamma of iron-59, the 122-keV

gamma of europium-152, the 144-keV gamma of cerium-141, the 312-keV gamma of the protactinium-233 daughter of thorium-233, and the 321-keV gamma of chromium-51. The chromium-51 activity was corrected for the component within it arising from the n, α reaction of iron-54.

Interpretation of Data

The data presented in Tables 14.1 and 14.2 include the results of analysis of the ten north Devon specimens. In the north Devon fine ware, the evidence that the standard deviation is a relatively small percent of the mean in every case has led to the conclusion that this can be taken as a group. The mean values have all been calculated as geometric means. The evidence that led to the decision to calculate a geometric mean was gained in the analytical study of ancient glass. This evidence showed that the deviations from the mean concentration values for a group of related archaeological specimens tends to be of a fractional rather than an absolute amount, because it was observed that the distributions of concentrations of a group shows a normal chance, i.e., Gaussian distribution when the occurrence of specimens is plotted against the logarithm of concentration rather than against concentration itself.

The results of the analysis of the north Devon gravel ware show a somewhat higher coefficient of variation, but the specimens still form a related group for which the mean concentration for each element is approximately 0.85 of that in the north Devon fine ware. This strongly indicates that the north Devon gravel ware was made using the same clay as that used for the north Devon fine ware and contains in addition a temper which contains relatively little of the elements being analyzed. It would appear that the addition of temper approximately just diluted the pottery in the concentrations of the elements measured. Figure 14.4 graphically illustrates this point. The relationship of the concentrations of all the elements in the gravel ware to those in the fine ware can be seen to be approximately the same.

If a specimen has indeed been diluted with a relatively pure material so that the concentrations of many of its components all have been reduced to the same fraction f of the values they otherwise would have had, it is obvious that division by this fraction f would correct the measured concentrations to what they would have been had the dilution not occurred. The extent of relative dilution between one specimen and another or between a specimen and a group for which means have been determined can be estimated by some reasonable mean of the ratios of the individual elements. The best dilution fraction to use if N separate elements are being determined is the Nth root of the product of the N individual ratios. At least division by this fraction brings the individual concentrations of the specimen being corrected into an overall least squares closest agreement with the data to which it is being compared. This process has been called *obtaining the best relative fit* between specimens.

The values in Table 14.3 result from first obtaining a best relative fit concentration using the means of the north Devon fine ware for each concentration value for the north Devon gravel ware. The best fit values for the three gravel-ware specimens and the actual concentration values for the seven fine-ware specimens were then used to obtain a set of geometric means. Since best fit concentration values were obtained because of the presence of a gravel temper and since the fine ware itself appears to have some silica inclusions on visual examination, it was decided to use the geometric mean concentrations which were obtained for the ten north Devon sherds to obtain concentrations that best fit these means for every specimen in the group. These are given in Table 14.3. Also given in Table 14.3 are the ratios of the best fit concentrations to the mean concentrations and a set of 95 percent confidence limits for these ratios for each element of the total north Devon group. In all instances, statistical confidence limits have been estimated by means of "Student's" distributions for small numbers of samples. Figure 14.5 shows the 95 percent confidence limits for the ratios and the values for the ten specimens of north Devon ware. With one exception the plotted values lie within the confidence limits. The exception is not unexpected as this probability does exist.

Our specimens include one other related group of sherds. This is a group of six specimens (Figure 14.6) from a kiln site at Green Spring Plantation, James City County, Virginia. The data for these sherds are given in Table 14.4. The differences between the geometric means of the two groups, north Devon fine ware and the specimens from the Green Spring Plantation, appear to be great enough to distinguish the two groups. This was tested statistically by performing a t test of significance between the two sample geometric means for the logarithms of the concentrations of each element. The values obtained for t were as follows: Sc_2O_3, 4.64; La_2O_3, 12.43; Eu_2O_3, 12.04; CeO_2, 3.20; ThO_2, 0.30; Cr_2O_3, 3.27; Fe_2O_3, 5.50; CoO, 6.02. The value of t for $N_1 + N_2 - 2$ degrees of freedom when $N_1 + N_2 - 2$ is equal to 11 is 2.201 at a 95 percent confidence level. All of the values of t calculated are greater than 2.201 except ThO_2, hence the differences can be stated as significant for all other elements.

A second t test was performed to test the significance of the resolution of the groups. This enables one to determine the extent to which the separation of the geometric means for each element of the

Table 14.1
North Devon Fine Ware (Concentration in percent of oxide)

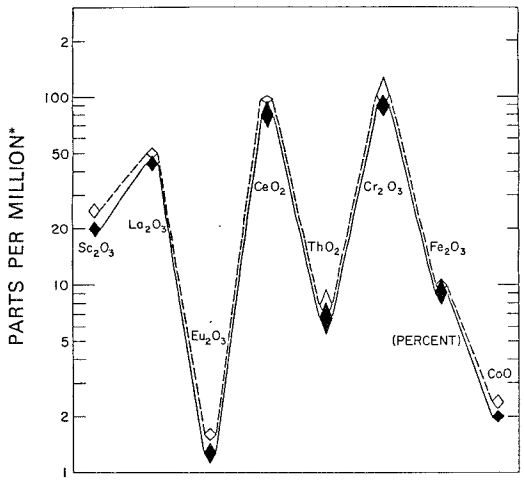
Table 14.2
North Devon Gravel Ware (Concentration in percent of oxide)

Table 14.3
North Devon Ware (Concentration in percent of oxide)

Analytical Specimen No.	Scandium Sc_2O_3	Lanthanum La_2O_3	Europium Eu_2O_3	Cerium CeO_2	Thorium ThO_2	Chromium Cr_2O_3	Iron Fe_2O_3	Cobalt CoO
1	0.0025	0.0035	0.000118	0.0056	0.00098	0.0116	5.6	0.00190
2	0.0024	0.0036	0.000107	0.0057	0.00100	0.0073	5.2	0.00179
3	0.0027	0.0040	0.000123	0.0053	0.00079	0.0097	6.1	0.00200
4	0.0025	0.0040	0.000127	0.0055	0.00084	0.0108	6.1	0.00220
5	0.0028	0.0037	0.000123	0.0056	0.00070	0.0109	6.2	0.00204
6	0.0024	0.0038	0.000117	0.0053	0.00076	0.0082	5.5	0.00191
7	0.0029	0.0043	0.000132	0.0060	0.00126	0.0148	6.2	0.00221
Mean of Group	0.0026	0.0038	0.000121	0.0055	0.00089	0.0102	5.8	0.00200
Standard Deviation as Percent of Mean	8.2	7.1	7.1	4.8	22.0	26.5	7.5	8.1

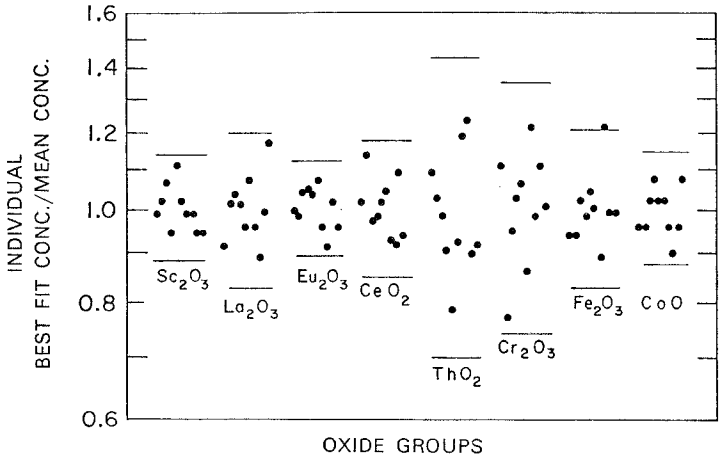
Analytical Specimen No.	Scandium Sc_2O_3	Lanthanum La_2O_3	Europium Eu_2O_3	Cerium CeO_2	Thorium ThO_2	Chromium Cr_2O_3	Iron Fe_2O_3	Cobalt CoO
8	0.0022	0.0030	0.000093	0.0043	0.00095	0.0086	6.3	0.00156
9	0.0023	0.0035	0.000111	0.0055	0.00075	0.0105	5.4	0.00178
17	0.0019	0.0035	0.000087	0.0040	0.00064	0.0081	4.6	0.00165
Mean of Group	0.0021	0.0034	0.000097	0.0046	0.00077	0.0091	5.4	0.00166
Standard Deviation as Percent of Mean	11.1	10.0	13.0	18.0	22.0	14.6	17.2	7.0
Ratio of Gravel-Ware Mean to Fine-Ware Mean	0.80	0.88	0.80	0.82	0.87	0.89	0.92	0.83
Average Ratio	0.85							

Analytical Specimen No.	Scandium Sc_2O_3	Lanthanum La_2O_3	Europium Eu_2O_3	Cerium CeO_2	Thorium ThO_2	Chromium Cr_2O_3	Iron Fe_2O_3	Cobalt CoO
1	0.0025	0.0035	0.000118	0.0056	0.00098	0.0116	5.34	0.0019
2	0.0026	0.0039	0.000117	0.0062	0.00109	0.0079	5.33	0.0019
3	0.0027	0.0040	0.000124	0.0053	0.00080	0.0098	5.79	0.0020
4	0.0024	0.0039	0.000124	0.0054	0.00082	0.0106	5.59	0.0022
5	0.0028	0.0037	0.000123	0.0056	0.00070	0.0109	5.90	0.0021
6	0.0026	0.0041	0.000126	0.0057	0.00083	0.0089	5.67	0.0021
7	0.0025	0.0037	0.000113	0.0051	0.00108	0.0126	5.02	0.0019
8	0.0025	0.0034	0.000108	0.0050	0.00111	0.0100	6.91	0.0018
9	0.0025	0.0038	0.000120	0.0060	0.00082	0.0114	5.54	0.0019
17	0.0024	0.0046	0.000113	0.0051	0.00083	0.0105	5.61	0.0026
Fitted Means of Group	0.00256	0.00384	0.000119	0.00550	0.000895	0.01035	5.65	0.00200
Ratios of Best Fit North Devon Ware Concentrations to Fitted Means of Total North Devon Ware								
1	0.98	0.91	1.00	1.02	1.09	1.12	0.94	0.96
2	1.02	1.02	0.98	1.13	1.22	0.77	0.94	0.98
3	1.07	1.04	1.05	0.97	0.90	0.95	1.02	1.02
4	0.95	1.01	1.05	0.99	0.92	1.02	0.99	1.08
5	1.10	0.95	1.04	1.02	0.79	1.06	1.04	1.03
6	1.01	1.08	1.07	1.04	0.92	0.86	1.00	1.04
7	0.97	0.95	0.95	0.93	1.20	1.22	0.89	0.95
8	0.99	0.90	0.91	0.91	1.24	0.97	1.22	0.91
9	0.97	0.99	1.01	1.08	0.91	1.10	0.98	0.97
17	0.95	1.18	0.95	0.94	0.93	1.01	0.99	1.07
σ Range 95%	1.051–0.952	1.085–0.922	1.053–0.950	1.071–0.933	1.172–0.853	1.145–0.874	1.088–0.919	1.058–0.945
Confidence Limits	1.118–0.894	1.203–0.832	1.123–0.891	1.168–0.856	1.432–0.698	1.357–0.737	1.211–0.826	1.137–0.880

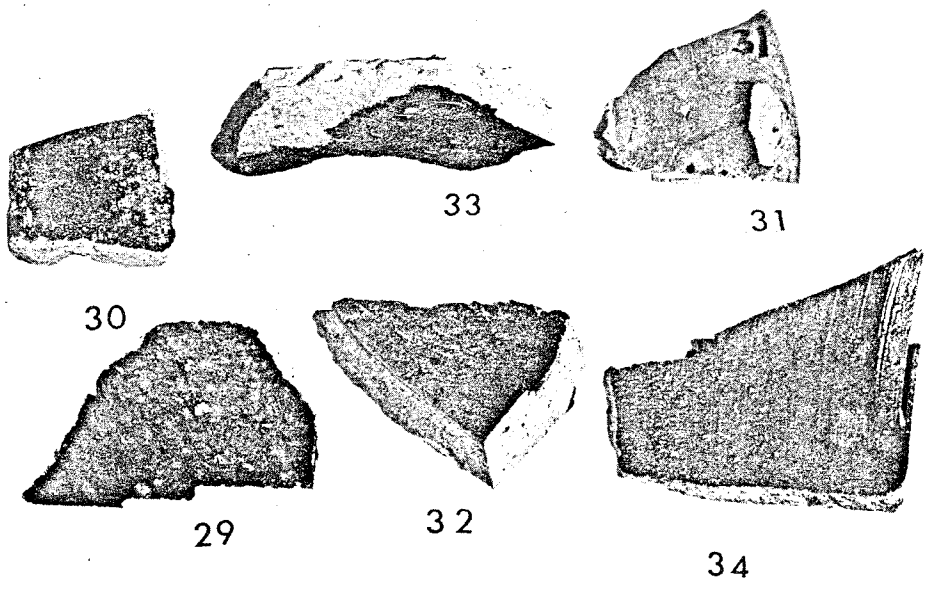


14.4
Comparison of mean concentrations in north Devon fine ware (◇) and north Devon gravel ware (◆)

14.5
Ratios of best fit north Devon ware concentrations to fitted means of total north Devon ware



14.6
Sherds from kiln site at Green Spring Plantation, James City County, Virginia. (Specimens 29–34)

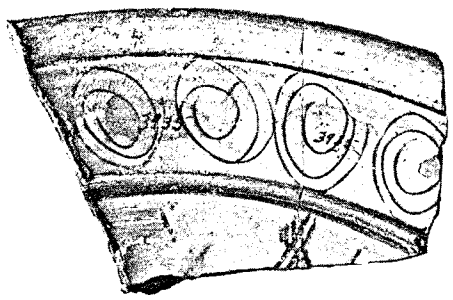


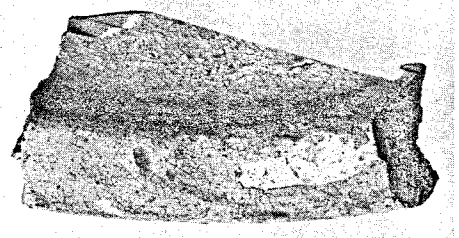
14.7
Sgraffito sherd excavated at Jamestown by the National Park Service, 1934–1935. (Specimen 13)

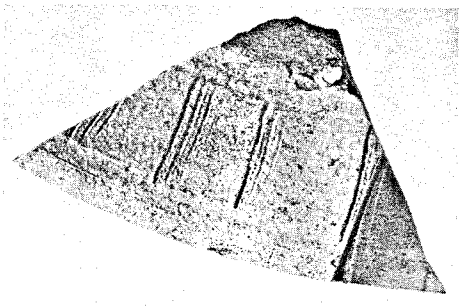
14.8
Sgraffito sherd found near the shore of Kent Island, Maryland. (Specimen 14)

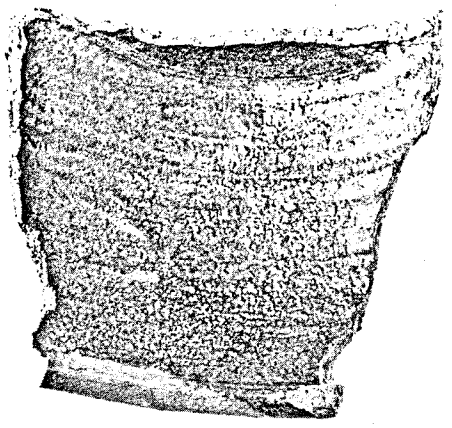
14.9
Slip-coated pan rim excavated at Pemaquid, Maine from a site antedating 1676. (Specimen 19)

14.10
Sherd of sgraffito ware excavated at Jamestown by the National Park Service in 1956. (Specimen 20)





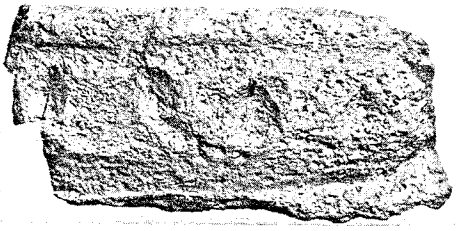


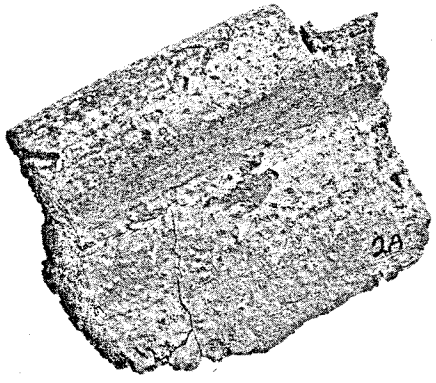


14.11
Gravel-ware pan section excavated at Jamestown by the National Park Service, 1934–1935. (Specimen 10)

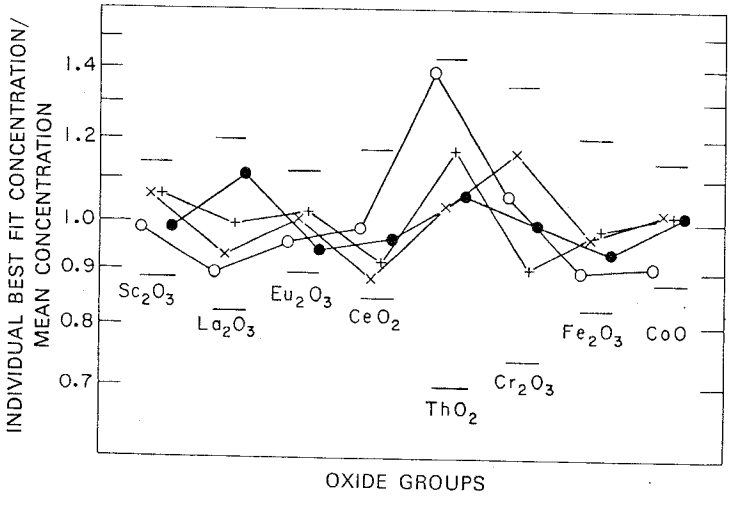
14.12
Gravel-ware sherd from Angelica Knoll, Maryland. (Specimen 11)

14.13
Gravel-ware pan excavated at Pemaquid, Maine from a site antedating 1676.





14.14
Ratios of best fit concentrations to the fitted means of total north Devon ware for gravel ware from American sites.



groups is significant with respect to the standard deviation of the groups. In this case the values obtained for t were: Sc_2O_3, 1.81; La_2O_3, 4.91; Eu_2O_3, 4.82; Ce_2O_3, 1.23; ThO_2, 0.12; Cr_2O_3, 1.32; Fe_2O_3, 2.16; and CoO, 2.39. In the cases of La_2O_3, Eu_2O_3, Eu_2O_3, and CoO the value calculated for t is greater than 2.201. One would say therefore that upon the basis of these three elements one could identify a given sample with one group or the other.

Ten of the sherds which were analyzed were for comparison to the north Devon group. These included four sherds (Figures 14.7 to 14.10) which had been found at colonial American sites on the eastern coast and were stylistically comparable to the sgraffito ware of north Devon. Four other sherds (three are shown in Figures 14.11 to 14.13), from similar American sites, are examples of gravel ware which could be from north Devon. The last two are the two specimens from Drake's Bay, California. These are also gravel-ware sherds. All concentration values have been adjusted to best relative fit to the north Devon ware.

The data in Table 14.5 for the four specimens which are stylistically comparable to north Devon fine ware contain some interesting information. Specimens 13 and 14 each have one ratio value lying just outside the north Devon confidence limits. In Table 14.5, and the following tables, ratios equal to or exceeding the confidence limits for north Devon ware have been underlined. It is obvious that if a number of elements are being determined (although there is only a 5 percent anticipation that any specific element will exceed a 95 percent confidence limit of deviation from the mean of a related group of specimens) there is a considerably greater probability that one element unspecified among the number determined might exceed the confidence limit. In fact if twenty elements were determined, one would intuitively expect one out of the twenty to be at or beyond a 95 percent confidence limit. It has seemed reasonable to us that if M independent elements have been determined the probability that the concentrations of any N of them might equal or exceed a deviation limit which includes $0.X$ fraction of the determinations could be estimated by $P_M^N (0.X)^{M-N} (1 - 0.X)^N$ in which P_M^N is the number of permutations of the N exceeding values among the M elements determined. Upon the basis of such an estimate, one concludes that the concentrations of at least two elements out of eight should exceed a 95 percent confidence limit before the overall deviation should be considered truly significant. If only one out of the eight elements exhibits a marked deviation, it should exceed a 99 percent confidence limit if the group of analyses is to be considered nonmatching. Specimen 20, however, has four elements for which the values of the ratios lie outside the confidence limits. This specimen is very probably not from north Devon and the specimen, as shown in Figure 14.10, is an example of sgraffito ware that does not look like the north Devon sgraffito ware.

In Table 14.6 the values are given for the four pieces of gravel ware from colonial American sites on the eastern coast. All of the ratios fall within the 95 percent confidence limits of the north Devon ware. Figure 14.14 is a plot of the values for these four specimens. Both the stylistic and analytical evidence indicates north Devon to be a likely source for these specimens.

Table 14.7 gives the values for a set of miscellaneous sherds (Figures 14.15 to 14.19). Five of these sherds come from Jamestown and the sixth is from a site of Daniel Bayley pottery, Newburyport, Massachusetts (1764–1799). (See Reference 5.) In order to compare these specimens to the north Devon group, the concentrations for each specimen were adjusted to a best relative fit to the north Devon mean concentrations and a set of ratios to the north Devon mean concentrations was calculated. None fit the north Devon mean closely but only specimens 24, 25, and 26 could be definitely excluded from the north Devon group on the basis of these data. Specimen 27 is of special interest since it is known to be from a source other than north Devon. The value of the ratio of only one element falls outside the confidence limits of the north Devon group.

Table 14.8 gives the data for the two specimens from Drake's Bay, California and the ratio values are plotted in Figure 14.20. As a better test of the comparability of the concentrations to those of north Devon gravel ware, best relative fit concentrations were again calculated. As can be readily seen from Figure 14.20, these specimens do not fall within the limits of the north Devon ware. For Specimen 15 there are six values which lie outside, and for Specimen 16 there are four. It is probable that Specimens 15 and 16 do not come from north Devon, and that they do not both come from the same pottery group. The data we have obtained to date have been, in a sense, only preliminary. We have not identified the source of the sherds from Drake's Bay; we have only presented evidence that they do not appear to belong to the group of north Devon ware which we have analyzed.

We have employed a number of steps in our investigation which are of some significance, however. We have looked further at the problems presented by the presence of temper in a piece of pottery and found further evidence that in some cases of pottery there are elements whose con-

Table 14.4
Samples From Green Springs Kiln Site, Jamestown, Virginia (Concentration in percent of oxide)

Table 14.5
Sherds From American Sites Which Have Been Compared Stylistically to North Devon Fine Ware (Concentration in percent of oxide)

Table 14.6
Sherds From American Sites Which Have Been Compared Stylistically to North Devon Gravel Ware (Concentration in percent of oxide)

Analytical Specimen No.	Scandium Sc_2O_3	Lanthanum La_2O_3	Europium Eu_2O_3	Cerium CeO_2	Thorium ThO_2	Chromium Cr_2O_3	Iron Fe_2O_3	Cobalt CoO
29	0.0029	0.0059	0.000165	0.0062	0.00090	0.0067	7.0	0.0023
30	0.0030	0.0069	0.00018	0.0072	0.00138	0.0071	6.8	0.0025
31	0.0028	0.0057	0.00018	0.0061	0.00079	0.0059	7.0	0.0024
32	0.0032	0.0060	0.00019	0.0057	0.00089	0.0079	8.0	0.0027
33	0.0035	0.0060	0.00018	0.0060	0.00085	0.0079	6.9	0.0026
34	0.0027	0.0060	0.00019	0.0064	0.00082	0.0081	7.8	0.0028
Mean of Group	0.0030	0.0060	0.00018	0.0062	0.00092	0.0073	7.2	0.00254
Standard Deviation as Percent of Mean	10.1	6.7	6.7	9.2	22.4	13.1	7.3	6.5

Analytical Specimen No.	Site	Scandium Sc_2O_3	Lanthanum La_2O_3	Europium Eu_2O_3	Cerium CeO_2	Thorium ThO_2	Chromium Cr_2O_3	Iron Fe_2O_3	Cobalt CoO
13	Jamestown	0.0025	0.0041	0.000122	0.0049	0.00085	0.0127	4.8	0.00198
14	Kent Island, Md.	0.0026	0.0040	0.001256	0.0058	0.00126	0.0142	5.1	0.00196
19	Pemaquid, Maine	0.0023	0.0040	0.000120	0.0038	0.00068	0.0093	6.1	0.00213
20	Jamestown	0.0027	0.0037	0.000103	0.0046	0.00056	0.0109	6.1	0.00160
Best Fit Concentrations Adjusted to Fitted Means of Total North Devon Ware									
13		0.0025	0.0041	0.000123	0.0049	0.00085	0.0128	4.53	0.00199
14		0.0024	0.0037	0.000114	0.0053	0.00115	0.0129	4.41	0.00178
19		0.0025	0.0043	0.000131	0.0041	0.00074	0.0101	6.27	0.00231
20		0.0028	0.0039	0.000108	0.0048	0.00459	0.0177	6.31	0.00167
Ratios of Best Fit Concentrations to the Fitted Means of Total North Devon Ware									
13		1.06	1.08	1.03	0.89	0.96	1.24	0.80	1.00
14		1.00	0.96	0.97	0.96	1.29	1.25	0.78	0.90
19		1.06	1.12	1.10	0.74	0.82	0.97	1.11	1.16
20		1.19	1.01	0.91	0.88	0.66	1.71	1.12	0.84

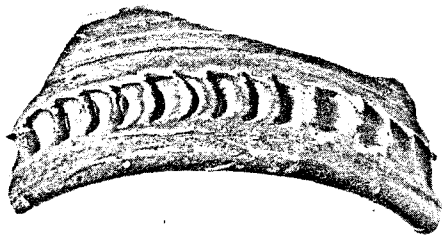
Analytical Specimen No.	Site	Scandium Sc_2O_3	Lanthanum La_2O_3	Europium Eu_2O_3	Cerium CeO_2	Thorium ThO_2	Chromium Cr_2O_3	Iron Fe_2O_3	Cobalt CoO
10	Jamestown	0.0022	0.0033	0.000108	0.0051	0.00108	0.0104	4.8	0.00168
11	Angelica Knoll, Md.	0.0021	0.0031	0.000102	0.0042	0.00079	0.0103	4.7	0.00170
12	Plymouth, Mass.	0.0018	0.0028	0.000089	0.0040	0.00077	0.0068	4.1	0.00143
18	Pemaquid, Maine	0.0022	0.0040	0.000105	0.0050	0.00091	0.0098	5.0	0.00188
Best Fit Concentrations Adjusted to Fitted Means of Total North Devon Ware									
10		0.0023	0.0034	0.000114	0.0054	0.00125	0.0111	5.1	0.00178
11		0.0025	0.0036	0.000119	0.0049	0.00093	0.0121	5.4	0.00199
12		0.0025	0.0038	0.000122	0.0050	0.00105	0.0093	5.6	0.00195
18		0.0023	0.0043	0.000111	0.0053	0.00097	0.0103	5.3	0.00199
Ratios of Best Fit Concentrations to the Fitted Means of Total North Devon Ware									
10		0.99	0.90	0.96	0.99	1.40	1.06	0.89	0.89
11		1.05	0.93	1.00	0.88	1.04	1.16	0.97	1.00
12		1.05	1.00	1.03	0.91	1.17	0.90	0.99	0.98
18		0.99	1.11	0.94	0.97	1.07	1.00	0.94	1.00

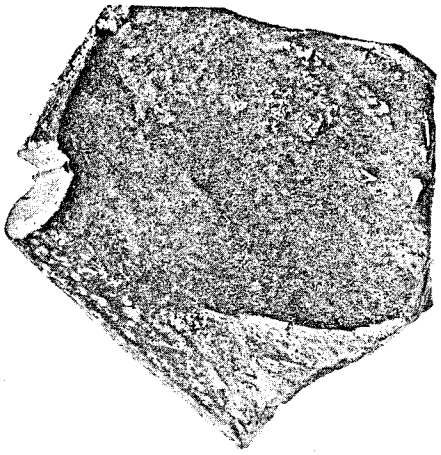
Table 14.7
Sherds Which Are Stylistically Unlike North Devon Sgraffito Ware or Gravel Ware (Concentration in percent of oxide)

Analytical Specimen No.	Site	Scandium Sc_2O_3	Lanthanum La_2O_3	Europium Eu_2O_3	Cerium CeO_2	Thorium ThO_2	Chromium Cr_2O_3	Iron Fe_2O_3	Cobalt CoO
22	Jamestown	0.0024	0.0047	0.000141	0.0064	0.00078	0.0098	6.8	0.0031
23	Jamestown	0.0020	0.0040	0.000117	0.0052	0.00068	0.0071	4.4	0.0018
24	Jamestown	0.0020	0.0050	0.000132	0.0057	0.00074	0.0077	3.2	0.0075
25	Jamestown	0.0022	0.0044	0.000124	0.0052	0.00086	0.0081	4.1	0.0018
26	Jamestown	0.0023	0.0044	0.000121	0.0066	0.00107	0.0113	3.9	0.0019
27	Bayley Kiln Site, Newburyport, Mass.	0.0019	0.0045	0.000129	0.0060	0.00107	0.0093	5.0	0.0018
Best Fit Concentrations Adjusted to Fitted Means of Total North Devon Ware									
22		0.0021	0.0042	0.000126	0.0057	0.00070	0.0087	5.7	0.0028
23		0.0023	0.0047	0.000135	0.0061	0.00079	0.0082	5.2	0.0021
24		0.0025	0.0063	0.000165	0.0071	0.00092	0.0096	3.9	0.0009
25		0.0024	0.0047	0.000135	0.0057	0.00094	0.0088	4.4	0.0019
26		0.0023	0.0043	0.000119	0.0065	0.00105	0.0111	3.9	0.0018
27		0.0019	0.0045	0.000130	0.0061	0.00108	0.0094	5.1	0.0018
Ratios of Best Fit Concentrations to the Fitted Means of Total North Devon Ware									
22		0.91	1.10	1.06	1.03	0.78	0.84	1.01	1.38
23		0.99	1.20	1.14	1.10	0.88	0.79	0.92	1.04
24		1.07	1.63	1.39	1.28	1.03	0.93	0.70	0.48
25		1.02	1.24	1.14	1.03	1.05	0.86	0.78	0.95
26		0.96	1.11	1.00	1.17	1.17	1.07	0.68	0.94
27		0.82	1.18	1.10	1.10	1.20	0.90	0.89	0.89

Table 14.8
Sherds From Drake's Bay, California (Concentration in percent of oxide)

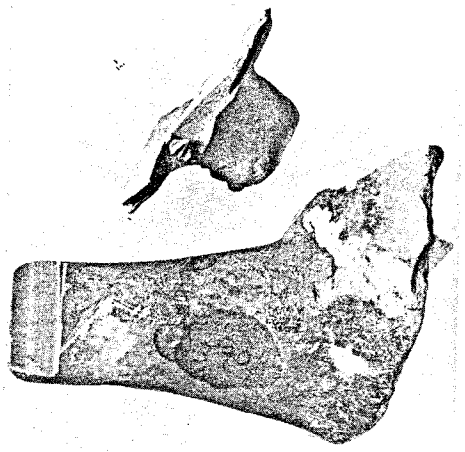
Analytical Specimen No.	Scandium Sc_2O_3	Lanthanum La_2O_3	Europium Eu_2O_3	Cerium CeO_2	Thorium ThO_2	Chromium Cr_2O_3	Iron Fe_2O_3	Cobalt CoO
15	0.0023	0.0023	0.000090	0.0035	0.00093	0.0014	6.6	0.00200
16	0.0018	0.0034	0.000077	0.0054	0.00129	0.0076	2.9	0.00139
Best Fit Concentrations Adjusted to Fitted Means of Total North Devon Ware								
15	0.0035	0.0034	0.000134	0.0052	0.00138	0.0020	9.8	0.00297
16	0.0023	0.0043	0.000097	0.0068	0.00163	0.0096	3.6	0.00177
Ratios of Best Fit Concentrations to the Fitted Means of Total North Devon Ware								
15	1.45	0.88	1.13	0.95	1.54	0.196	1.63	1.49
16	0.98	1.11	0.82	1.24	1.82	0.927	0.61	0.89

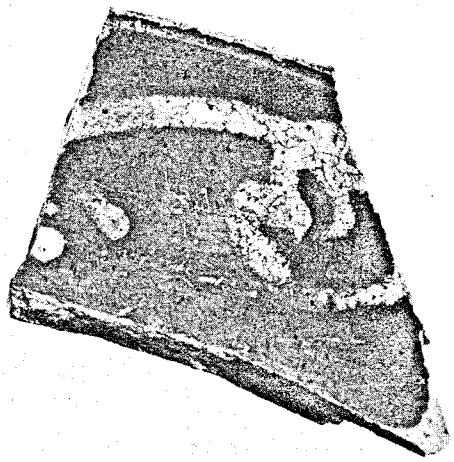


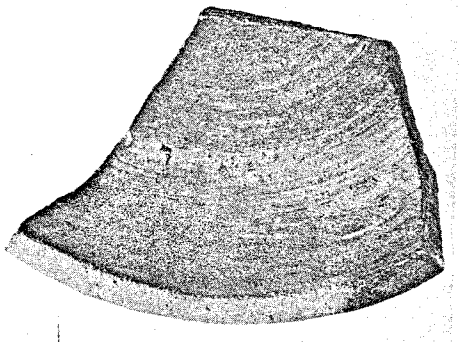


14.18
Sherd excavated at Jamestown. (Specimen 26)

14.19
Sherd from Bayley kiln site at Newburyport, Massachusetts. This site is dated 1750–1790. (Specimen 27)



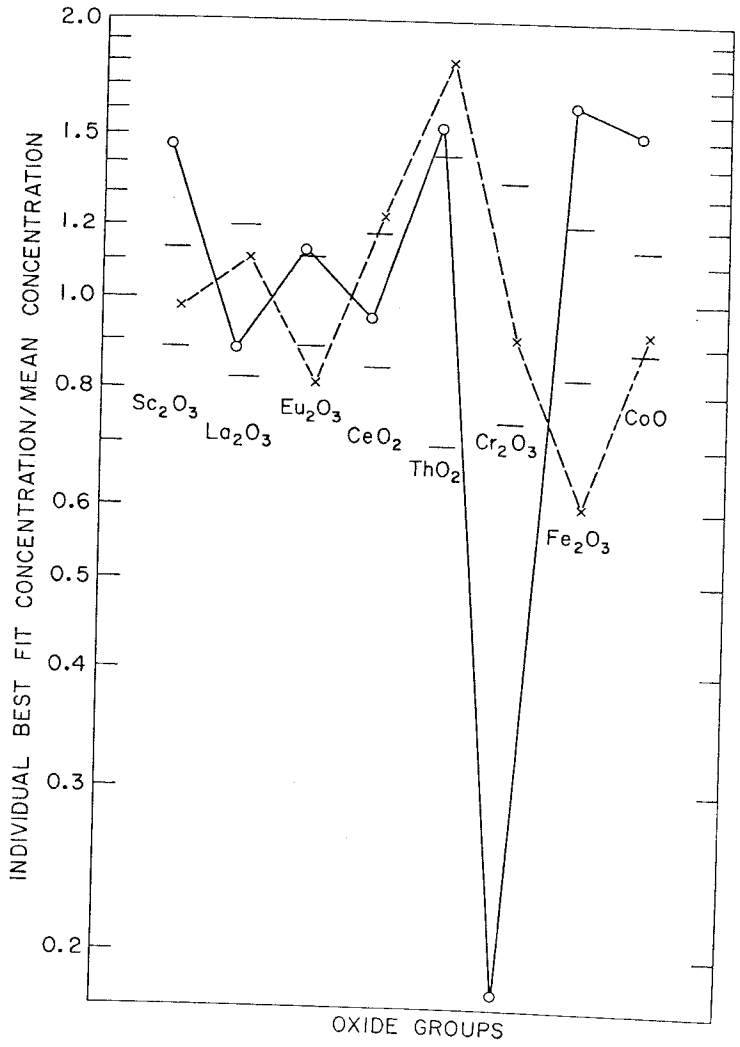




14.15
Thumb impressed rim sherd from a jar excavated at Jamestown from a supposed kiln site. (Specimen 22)

14.16
Foot of a three-footed cooking pot excavated at Jamestown from a supposed kiln site and another sherd excavated at Jamestown. (Specimens 23 and 25)

14.17
Sherd of a pot lid excavated at Jamestown. (Specimen 24)



14.20
Ratios of best fit concentrations to the fitted means of total north Devon ware for Specimens 15 (o) and 16 (x) from Drake's Bay, California.

centration in the clay decisively predominate over those in the temper. We have also shown that it is possible to identify pieces of pottery with their source of origin despite the fact that they have been buried for several hundred years. This is the case with the sgraffito ware and gravel temper ware found in colonial American sites for which there is strong historical evidence that they did come from North Devon. We have also shown that for some elements one could clearly distinguish in the case of the north Devon fine ware and the specimens from the kiln site at Green Springs, Virginia, to which group an unknown specimen appears to have belonged. We have not developed compositional categories for any but two groups of pottery, but this work will be continued to that end.

Acknowledgments

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