CHEAM: A COMPUTER-ASSISTED STUDY OF THE POTTERY FROM A MEDIAEVAL KILN SITE

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Background

Cheam has been known as a source of the type of Mediaeval pottery called Surrey White Ware since the discovery of a kiln and wasters in 1923 (Marshall 1924). Further wasters were found in the 1930s (Marshall 1941) and in 1969 another kiln was found during the redevelopment of 15-23 High Street (Morris 1970; Orton 1979a, 1979b, 1982). A short excavation, directed by Morris for the Nonsuch Antiquarian Society, revealed the stone-built foundations of a large kiln of Musty type 2d (1924), and remains of what may have been an earlier kiln of type 2b, partly destroyed by the cut for a stokepit. Large quantities of pottery were associated with these kilns. In subsequent analysis it was found that they could be divided into three groups:

(i) white ware from contexts stratigraphically below the main kiln
(ii) white ware from contexts stratigraphically above the main kiln
(iii) red ware

Cataloguing of the pottery started in 1977 at the Sutton College of Liberal Arts, Surrey. It took a class of 6 - 8 students, working one evening a week, about two and a half years to record all the pottery on Pottery Summary Sheets as used at the Department of Urban Archaeology, Museum of London (Orton 1977, fig.4). The pottery was thus classified by form, fabric, context and (where appropriate) diameter. Forms were grouped into categories of vessel and contexts into phases.

In order to understand the pottery and its relationship to the site's stratigraphy, and so to answer our questions about the site, we needed to summarise the cataloque into tables which could be easily read and interpreted. These were envisaged as two- and three-way tables of quantities of pottery, classified by a selection of the above factors. A wide range of tables, of differing sizes and complexity, could in principle have been produced. The sort of questions to be asked of such tables seemed to lie in two areas:

(i) reconstruction of vessel forms from statistics of rims, bases, handles, etc., since much of the pottery was very broken and physical reconstruction was not generally possible;

(ii) description of assemblages in terms of proportions of different categories.

This second aspect was to prove crucial for the interpretation of the site.

Use of the computer

We estimated that it would have taken the class between two and three years to produce the required tables using desk calculators. Computer processing was, therefore, the obvious answer, and the data were transferred from the Pottery Summary Sheets to the University of Cambridge Computing Service's IBM 370/165. The format of the Summary Sheets enabled the data to be typed in directly via a V.D.U. at the Institute of

Archaeology. Two programs were written in PASCAL by the author. The first, CHEAMA, simply took the data as presented and summarised them so that all sherds of the same fabric, form, context, part of vessel and diameter were permanently stored. A specimen section of the data listing is shown as Table 1. The second program, CHEAMB, consisted of a basic section which sorted and summarised the data and several routines, each of which produced a different tabulation (see below).

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TABLE 1: Extract from the Cheam data listing.
        (i) grouping of form number into categories
WJAR  001 002 003
PITCH 103 111 112 117 118 119 120 121 123 125 126 136 138 139 140 141
SJAR  106 107 115 124 137 197
LJAR  108 109 110 113 114 116 127 128 129 135 170
DISH  005 007 049 051 052 060 068 080 094 144 145 146
SDISH 143 149 176
WSDIS 148 160
STJUG 006 015 019 020 021 022 023 024 025 026 027 030 041 059 070 082
BCJUG 008 010 017 057 084 085 086
COJUG 014
BSJUG 037 038 039 042 043 045 046 048 061 062 063 066 071 072 073 076
MIJUG 098
CUP   009
MUG   174 175
SAUCE 013 150
LID   036 050 054 055 056 074 075 077 078 093 161 163 164 165 166 193
SKILL 058 142 147
CTPOT 028 047 067 081 096 101 122 152
PIPKI 102 131 132 133 134 151 153 154 156 196
CHAF  069 158 159 171
WATER 157
LAMP  162
COSTR 167 169
MISC  029 064 083 095 172 177 178 194 195
+     (ii) grouping of context numbers into phases
PHA1: T1L4  T2L2  T2L12 T6L3  T1L11
PHA2: T1L7  T1L10 T2L8  T2L11 T4L3  T4L4  T8L4  T6L2  T6L4
PHA3: T1L1  T1L3  T1L5  T1L6  T1L8  T2L1  T2L4  T2L5  T2L6  T4L2  T8L1
PHA4: T1L2  T2L3
PHA5: TOLO
+     (iii) start of list of context TOLO
TOLO  W072R   3  60   3  40
 80   5  95
100   2  35
W001R   1 140   1   5
W103R   2  80   1  10
120   1   7
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An embarrassing abundance of tables could theoretically be produced: cross-tabulations by any (or all) of fabric, context and diameter, of rims or bases and of sherds or EVEs (see below). A selection had to be made, partly on the basis of archaeological usefulness and partly on the basis of statistical validity. The latter was approached by examining the average number (e.g. of sherds) per cell of a two- or more-way table. For example, if there are N rims sherds in all, a two-way table with n rows and m columns will have nm cells, and N/nm rim sherds per cell on average. The calculations can be simplified by taking logarithms (base 10), thus:

log(average sherds per cell) = log(total sherds) - 'score'

where the 'score' (or index of complexity) is:

log n + log m for a two-way table

or

log n + log m + log l for a three-way table

and so on.

TABLE 2: Factors by which the pottery could be classified and their 'scores'.

Factor	Level	Number of Values	Score
context	context	36	2
	phase	5	1
	whole site	1	0
form	form	160	3
	category	24	2
	whole site	1	1
fabric	fabric	2	1
	whole site	1	0
size	diameter	50	2
	whole site	1	0

The complexity of different tables can thus be easily compared by calculating their scores. In practice the calculation was further simplified by rounding the logarithms up to the nearest integer. The numbers of values of the factors, and the resulting factor scores, are shown in Table 2. The complexity of any proposed table can be calculated, on a scale from 0 to 8 (i.e. 2 + 3 + 1 + 2). On the basis of the total amount of pottery (over 4,000 rim or base sherds) it seemed reasonable to produce tables with a score of 4, or 6 if breakdown diameter was included. The following tables were produced:

Table C1: by fabric (columns) and context (rows), sub-totals for phases: score 3.

Table C2: by category (sub-tables), fabric (columns) and phase (rows): score 4.

Table C3: by fabric (sub-tables), diameter (columns) and form (rows), sub-totals for categories: score 6.

Table C5: by fabric (columns) and form, sub-totals by category: score 3.

Table C6: by phase (sub-tables), fabric (columns) and categories (rims): score 4.

TABLE 3: A specimen extract from computer table C2.

DISH	WHITE				RED				TOTAL			
	RIMS		BASES		RIMS		BASES		RIMS		BASES	
	SH	%	SH	%	SH	%	SH	%	SH	%	SH	%
PHA1:	3	21	3	22	0	0	1	14	3	21	4	36
PHA2:	7	40	1	10	43	192	9	140	50	232	10	150
PHA3:	23	130	13	146	105	563	37	365	128	693	50	511
PHA4:	0	0	0	0	0	0	2	25	0	0	2	25
PHA5:	10	49	1	8	29	162	2	10	39	211	3	18
TOTAL	43	240	18	186	177	917	51	554	220	1157	69	740

In the space available it is not possible to discuss the whole project, so just two aspects will be looked at in detail:

(i) the use of statistics in the reconstruction of vessel shapes

(ii) the quantitative description of groups of assemblages of pottery

Reconstruction of shapes

This part draws on lessons learnt in the experimental reconstruction of Romano-British pottery from Highgate Wood (Brown and Sheldon 1974; Orton 1974). There, some rather top-heavy reconstructions (particularly of the larger vessels) were produced because sherd counts were used as measures of the quantities of rims and bases. To overcome this problem the conditional expectations (conditional on the number of vessels and the overall fraction recovered) of the quantities of rims and bases must be equal, and must be independent of vessel size. Similar arguments to those already published (Orton 1975) show that the use of rim and base percentages as a measure of quantity satisfies this condition, while the use of sherd counts, weight, or number of vessels represented does not. In practice as well as in theory, this approach, which involves measuring each rim or base sherd as a proportion of a complete rim or base, gave very reasonable results.

A similar approach was used to answer questions about other features of the pottery, for example: do all 'jug' forms have handles? Comparing the total percentage of jug rims with the number of upper handle attachments failed, because handles were attached to the neck, not the rim, and breaks between rim and handle frequently occurred. Instead, a handle percentage was calculated, counting upper ends as 50%, lower ends as 50% and ignoring all 'middle' sections. Comparison of this with the rim percentage was valid because both had the same expectation (conditional on all jugs having handles). There were 158 rim-equivalents and 170 handle-equivalents, suggesting that all jugs had handles. This is not a totally trivial result, because the 1923 excavations yielded a class of vessel, called 'measures', which were of jug shape but did not have handles. This approach would not have been valid if, for example, fragments of handle had been counted.

Quantification of assemblages

A more significant excercise is the comparison of the percentages of different categories of pottery in different assemblages. Of special interest is the comparison between Group 2 (latest white fabric pottery) and Group 3 (red fabric pottery) (see Table 4). Superficially, the two assemblages are completely different. However, it seems likely that the white ware drinking jugs were replaced in London by German stoneware mugs in about 1480, and after this date there was no market for the Cheam drinking jugs, which comprised over 60% of Group 3. If the breakdown of Group 2 is re-calculated without drinking jugs, it appears much more similar to Group 3, and it has been argued from this (Orton 1982) that, freed from the constraint of needing to use white clay (traditionally associated with drinking vessels), the potter(s) switched to red clay, which was in fact more suitable for the other categories of pottery. Thus an apparent discontinuity can be seen as continuity under external stress when the figures are examined.

But this argument holds only if a comparison between the columns of Table 4 is statistically valid. In other words, the measure of quantity used should not be affected by factors such as differential breakage or differential retrieval, else differences in the figures could simply reflect differences in the post-depositional history and excavation of the Groups, and not necessarily in their original make-up. The only common measure which satisfies these conditions is the Estimated Vessel Equivalent or 'EVE' (Orton 1975), and this measure was therefore used. One can, therefore, have confidence in an argument based on such a comparison.

TABLE 4: Percentage of different categories of forms present in each Pottery Group.

	Group 1	present	drinking jugs excl.	Group 3
drinking jugs	63	64	-	2
other jugs & pitchers	33	23	65	39
all cooking pots	...	4	13	31
small jars	5	1	2	10
large jars	-	-	-	4
dishes (+ wall-sided)	...	2	4	4
lids	-	4	10	3
costrels	-	-	-	2
lamps	-	-	-	2
skillets	-	...	1	1
chafing dishes	-	...	1	1
other + unclassified	...	2	4	...
total EVEs	43	134	48	246

Conclusions

Only very simple statistics have been used in this project: totals and percentages. Nevertheless, they have been extremely useful in helping to interpret the site, indeed, the present interpretation would not have been reached without them. This interpretation is of wider relevance as it gives an alternative explanation of a type of change which could otherwise be seen as catastrophic (e.g. as an invasion). It must be stressed, however, that for any argument based on such figures to be valid, the measure of quantity must be such that the figures are comparable. In this instance, the 'EVE' is the only common unit of quantity which meets all the conditions. More generally it must be ensured that the measures used are:

(i) statistically compatible, in the sense of having equal conditional expectations

(ii) statistically invariant under distorting factors such as differential breakage and retrieval.

Otherwise, quantification is a futile excercise.

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