THE UNIVERSITY OF MANITOBA

ATTRIBUTE ANALYSIS OF TULPETLAC RIMSHERDS

by

JOSEPH ORLANDO PALACIO

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ABSTRACT

This study is based on 543 rimsherds obtained from a stratacut and surface collections from Tulpetlac, Valley of Mexico. The method used is attribute analysis. Through the use of quantitative techniques demonstrated in tables, graphic aids in the form of a frequency distribution table, and tabular form percentage histograms, relationships are observed among the attributes.

The first objective is to attempt a reconstruction of the processes used in the formation of the Tulpetlac ceramic vessels. This is done through the observation of associations between attributes which reflect systematic patterns in ceramic technology.

The second objective is a brief assessment of the ten selected attributes as tools in archaeological analysis.

A third objective is to note similarities and differences between this exercise and others undertaken on ceramics. This is discussed from the viewpoints of the study as an attribute analysis and as an exercise on ceramic technology.

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CHAPTER I

INTRODUCTION

This study is based on 543 rimsherds obtained near the town of Tulpetlac in the Valley of Mexico (see Fig. 1, p. 2). The provenience is a stratacut and two adjoining surface collections.

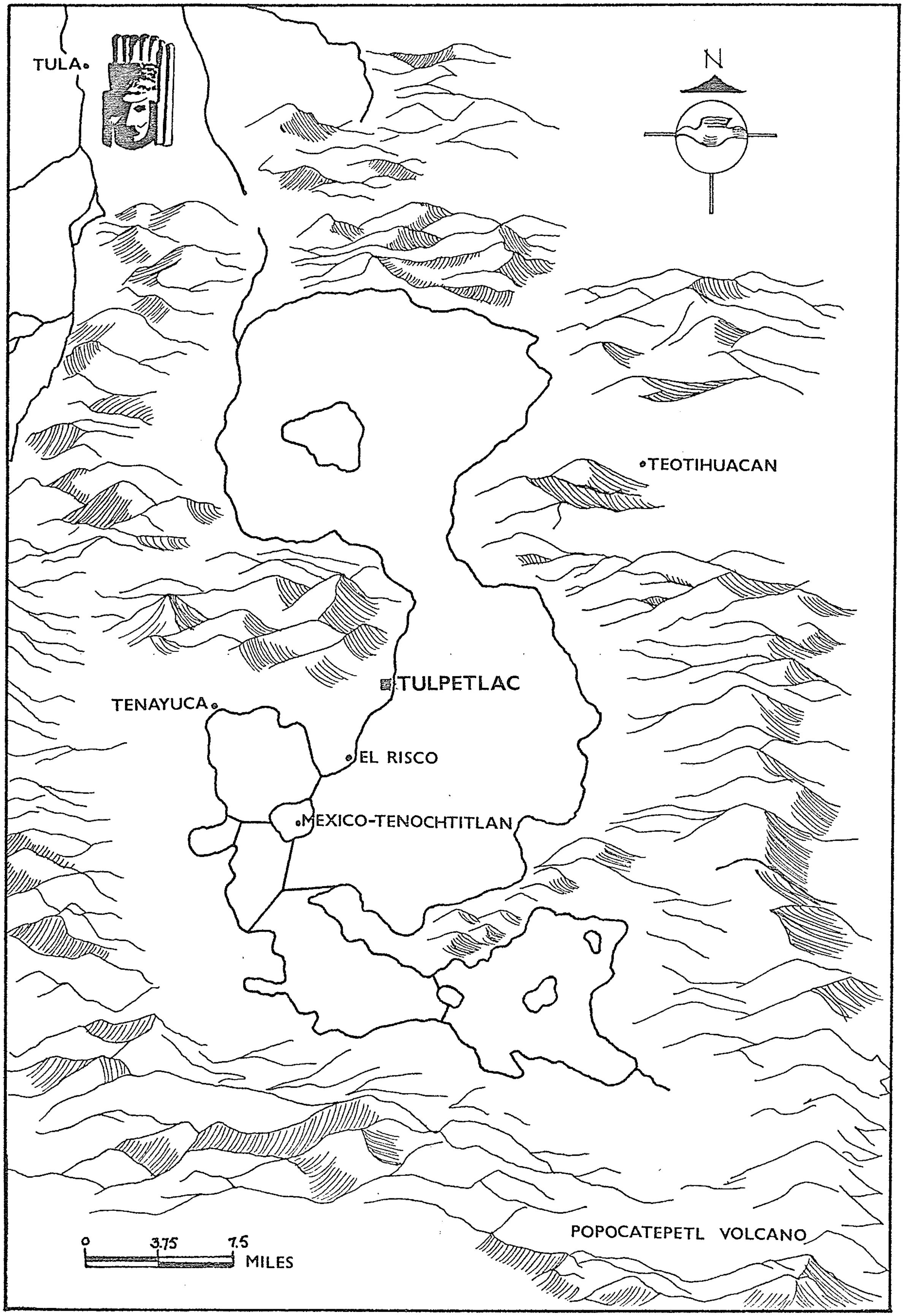
An attribute list (see Appendix A, pp. 69-71) was compiled at the Laboratory of Anthropology, University of Manitoba, for the study of rimsherds from three sites in the Valley of Mexico, including those from Tulpetlac. Codes on the attribute sheets, each of which correspond to a rimsherd, were also entered. The raw data consisted of the coded attribute sheets of the Tulpetlac rimsherds, and a schematic illustration of the rim profiles and vessel forms, Figure 3, pages 13 and 14. The rimsherds were also inspected, briefly. Additional information was derived from short discussions with Dr. W. J. Mayer-Oakes, who had excavated the stratacut and collected the sherds in 1960.

Objectives and Scope of the Study

The objectives of this exercise are twofold. The first is to attempt a reconstruction of the processes used in the formation of the Tulpetlac ceramic vessels. This is done through the investigation of associations among attributes that reflect patterns in ceramic technology.

The second objective is a brief assessment of the attributes selected for study as tools for archaeological analysis.

The following ten attributes were selected from the thirty-five



MAP I. VALLEY OF MEXICO

FROM: MAYER - OAKES, 1958: 333

on the attribute list: temper, temper size, temper proportion, texture, firing, rim thickness, rim classification, interior surface treatment, exterior surface treatment and vessel form. The basis for the choice of these attributes is the assumption that they best represent processes in ceramic technology. Ceramic technology is defined herein as the combination of items and procedures in the formation of ceramic vessels from the stage of the intermixing of raw materials to that of firing.

IBM cards, containing coded information from the attribute sheets, were sorted on a card sorter. Co-occurrence of states within each of paired attributes from the entire collection was tabulated. The vessel form attribute was omitted from the IBM card and was, therefore, manipulated manually. Paired variables were presented in bivariate, contingency format.

Graphic aids consisted of a frequency distribution table (see Table 1, pp. 20-23) and graphs illustrating the overall distribution of each attribute state (see Appendix B, pp. 72-77).

Ceramic Study in Pre-contact Mesoamerica

Ceramic study in Mesoamerican archaeology has been conducted, primarily, through the agency of typological analysis. Ritchie and MacNeish (1949: 98) define a type as a group of objects exhibiting interrelated similar features which have temporal and spatial significance. The emphasis in typological analysis is upon the grouping of artifacts into types and not on a detailed synthesis of attributes, as subparts of artifacts, into analytic groups.

The studies of Tolstoy (1958) and Mayer-Oakes (1959) on ceramic material from the Valley of Mexico represent typological analysis. Tolstoy arrived at types through the seriation technique performed upon surface sherds collected from the Northern Valley of Mexico. Mayer-Oakes, on the other hand, used sherds excavated in a stratacut at El Risco. Almost identical criteria were used in both studies. The criteria were surface finish, slip color, decoration (when present), temper, texture, and features of vessel form. The distribution of these criteria over space and time constituted the type analysis of Mayer-Oakes and Tolstoy.

Relatively little study has been done on the materials and processes of ceramic technology in Pre-contact Mesoamerica. R. H. Thompson (1958) studied ceramic technology of modern Yucatan for the primary purpose of investigating the nature of archaeological inference. On the basis of the vessels produced, he attempted to trace the mental processes that an archaeologist would go through in arriving at conclusions on the behaviour of the artisan and the function of the vessel. One of the methods he considered useful for such a reconstruction was typological analysis.

The following reports represent the investigations of Pre-contact Mesoamerican ceramic materials and processes. N. Castillo Tejero (1968) has studied assorted decorative techniques. J. L. Franco and F. A. Peterson (1968) discussed the structure and application of designs. A general survey of ceramic materials has been published by E. Garcia _et al_ (1968). L. Alvarez de la Cadena _et al_ (1967) have published on a chemical analysis of pottery. J. B. Griffin (1947) studied the intrusions of ceramic techniques into Central Mexico. None of these studies has emphasized the articulation of Pre-contact items and procedures. Attempts to treat Pre-contact items and procedures within the framework of the culture history of a particular site or collection are also lacking.

Attribute Analysis of Ceramics

J. V. Wright has discussed the advantages of attribute analysis over typological analysis in archaeology (1967: 99-100). The three advantages of attribute analysis lie in the fact that it contributes more to continuity, invariability and accuracy in ceramic study.

A. Spaulding (1960) and D. L. Clarke (1968) discussed the archaeological attribute and the rationale of its use in analysis in greater detail. Clarke relates the following issues: (a) definition of the archaeological attribute; (b) the place of attributes in an hierarchical model of archaeological entities; and (c) the selection of attributes for analysis (1968: 131-184).

Attribute analysis has been performed on various kinds of archaeological material. The studies of J. Deetz (1965) on stylistic change in Arikara ceramics and J. R. Sackett (1966) on Upper Paleolithic material are representative. The following three points are common to both studies. First, the analysts define an attribute precisely and objectively early in the studies. Second, both analysts attempt to incorporate attributes into units which are more complex in the hierarchy of analytic units. Deetz was interested in discovering the association of attributes. Sackett studied attribute clusters. Finally, both analysts used quantitative techniques including data processing and statistical aids.

Format of Presentation

The format of the presentation is as follows. The theoretical framework, problem orientation, and data are presented. Some cultural interpretations on the basis of the data are put forward. Finally, an assessment of the selected attributes and a comparison with other studies are discussed.

CHAPTER II

THEORETICAL FRAMEWORK, PROBLEM ORIENTATION, AND DATA PRESENTATION

Processes in ceramic technology can be presented schematically in the form of a flow chart. Fig. 2, p. 8 , represents a diagram of the sequence of events in the application of ceramic materials and procedures by Pre-Contact potters. The concepts on which this chart is based have been obtained from Shepard (1968) and Hodges (1964).

Ceramic technology is depicted as consisting of four consecutive steps. They are: (1) the formation of paste texture; (2) the formation of the vessel; (3) the formation of surface texture; and (4) firing.

The four stages are regarded as consecutive decision-making events for the potter. At each stage he has to make decisions along certain guidelines. The event requiring a decision can be equated with an archaeological attribute and the variables, from which the potter has to choose, correspond to attribute states.

The end result of the procedures in pottery production is pottery vessels. The field archaeologist may find whole vessels, but more frequently he may find only potsherds.

In the chart, the box containing ceramic technology is within a larger one which represents the culture and physical environment. On a higher level of abstraction, the whole sequence of decisions is subject to the dictates of the potter's culture and the conditions in his physical environment.

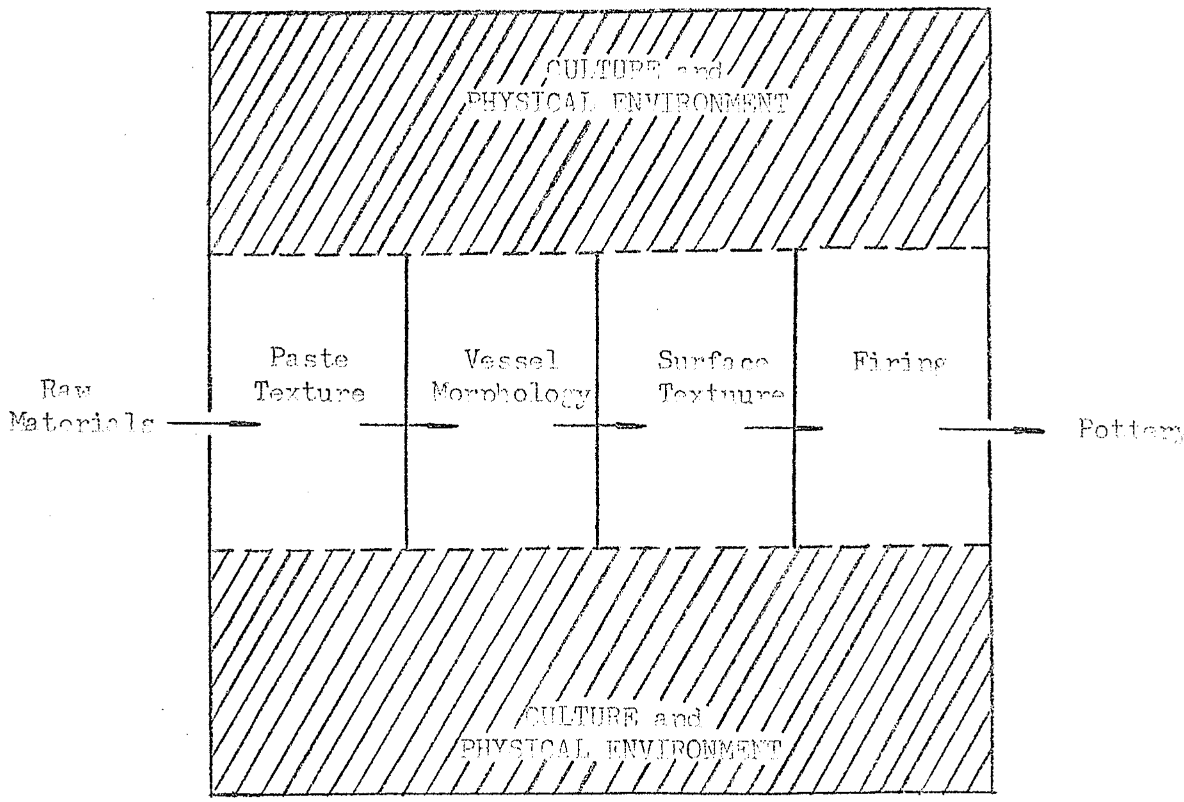


Figure 2. A flow chart of four stages in pottery production within a box representing the culture and physical environment.

Reconstruction of the processes involved in the formation of the Tulpetlac pottery vessels has been attempted through observation of patterns in the rimsherds. Pattern, in this context, is defined as the systematic use of materials and procedures over repeated selections by the potters. An attempt is made to discover whether there are adequate indications of cultural homogeneity and temporal continuity in the Tulpetlac material. Further investigation has been concerned with the presence of any distinct patterns in the formation of the pottery vessels. The first problem is treated at length in the discussion of the frequency distribution table and percentage histograms. The second is discussed after the introduction of the contingency tables.

Definition of Analytic Units

The analytic units utilized are attribute state, attribute, attribute system and artifact. The definitions presented by D. L. Clarke (1968: 131-186) are as follows:

> "State -- attribute state; alternative values or qualities of an attribute which may be found at that attribute's locus." (p. 181)

> "Attribute -- artefact attribute; a logically irreducible character of two or more states, acting as an independent variable within a specific artefact system. An epistemically independent variable." (p. 180)

An attribribute system is a set of attributes repeatedly found on individual artifacts within populations of artifacts. It is an arbitrary grouping of attributes for analytic purposes. (This is an adaptation of Clarke's definition of attribute complex, p. 145).

> "Artefact -- any object modified by a set of humanly imposed attributes." (p. 180)

In the case that several states of an attribute are considered within an analysis, the attribute is referred to as a multistate attribute. It should be noted that the above order, namely from attribute state to attribute system, is one of an increasing heirarchy of analytic units.

Description of Analytic Units

In describing the analytic units the order is from artifact through an attribute system to its component attributes, and finally to the attribute states. Although the attributes and attribute states were determined during the formulation of the attribute list, the descriptions are mine. The attribute systems were also formed for this study.

An attribute system is an arbitrary grouping of attributes that are found repeatedly on artifacts. The attributes within each attribute system are found on all the rimsherds and there is an interrelationship among them appropriate to this study. The interrelationship is plainly seen, as each attribute system corresponds to a stage in pottery production. As there are four stages in ceramic technology, so there are four attribute systems (see Fig. 2, p. 8). The correspondence can be stated in the following tabular form:

Stage in Ceramic Technology	Attribute System
formation of paste texture	paste texture
formation of vessel morphology	vessel morphology
formation of surface texture	surface texture
firing	firing

Paste Texture. The use of the term "paste texture" is borrowed from Shepard (1968: 117). The attributes within the paste texture attribute system are those that contribute to the arrangement of the constituent parts of the paste - its malleability and consistency during the kneading process. This attribute system includes the following attributes: temper, temper size, temper proportion and texture.

Temper is the non-plastic factor which is applied to clay to counteract shrinkage and facilitate uniform drying. The states of the temper attribute are sand, calcite and other

Temper size is divided into the following states: fine, medium and coarse. There is no indication from the attribute list what criteria were used to distinguish size.

The attribute of temper proportion refers to the proportion of temper material to the overall amount of clay in the paste. The states are in the percentage ranges of (1) 0-10%, (2) 10-20%, (3) 20-30%, (4) 30-40%, (5) 40-50% and (6) 50-100%.

Texture, as used in the attribute list, refers to the consistency of the paste. The states are granular, compact, laminated and Tepeyac paste. Whereas the first three states are self-explanatory, a word should be said about Tepeyac paste. Its distinctive characteristics are described by Tolstoy as being "...poorly fired, light in color, soft, friable, laminated, and with conspicuous cavities probably caused by fiber tempering." (1958: 37).

Vessel Morphology. After the formation of the paste texture, the next stage in pottery production is the formation of the vessel. Attributes that refer to the potter's action in this respect are incorporated under the vessel morphology attribute system. They are rim

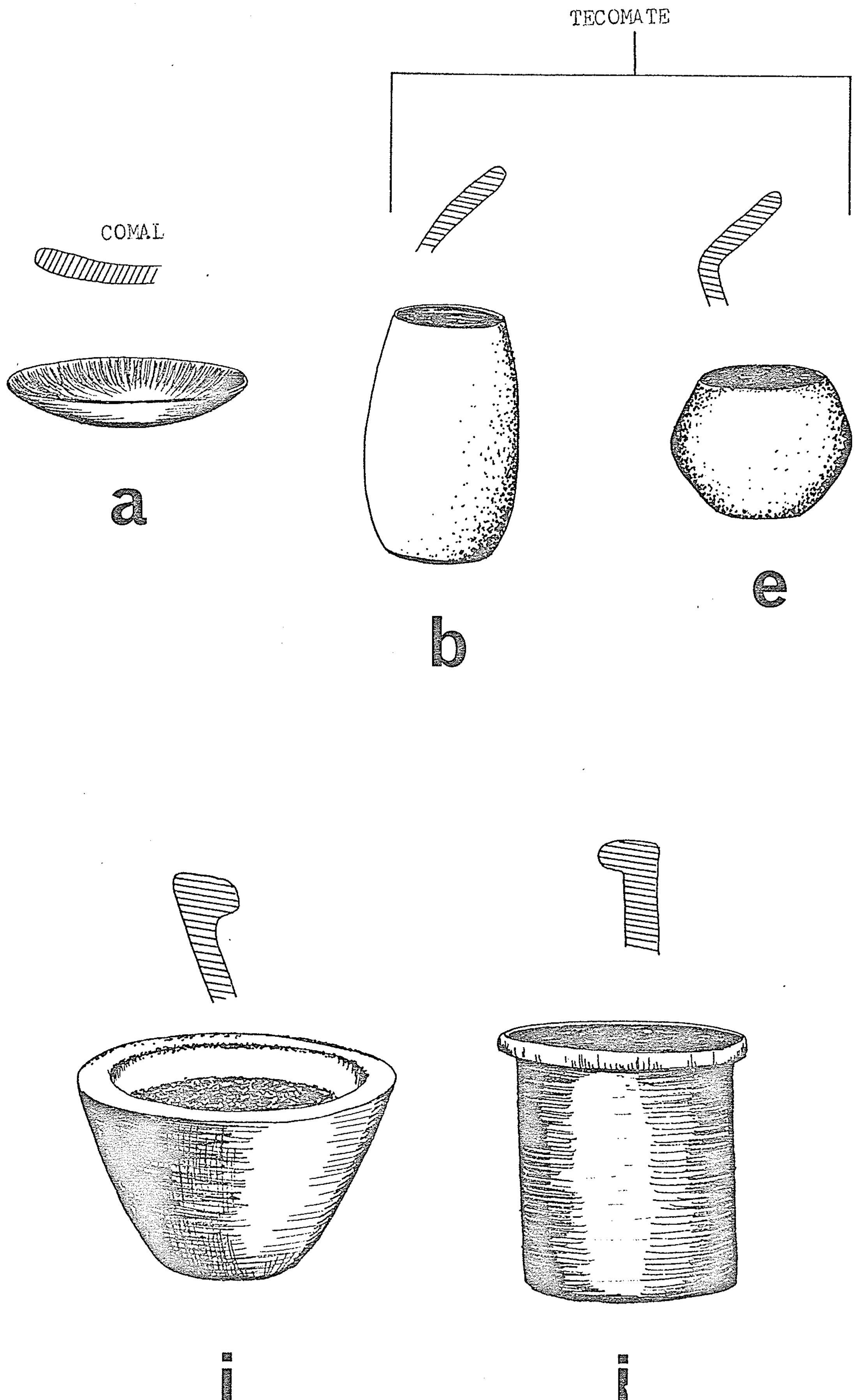


Figure 3. Schematic Illustration of Rim Profiles and Vessel Form.

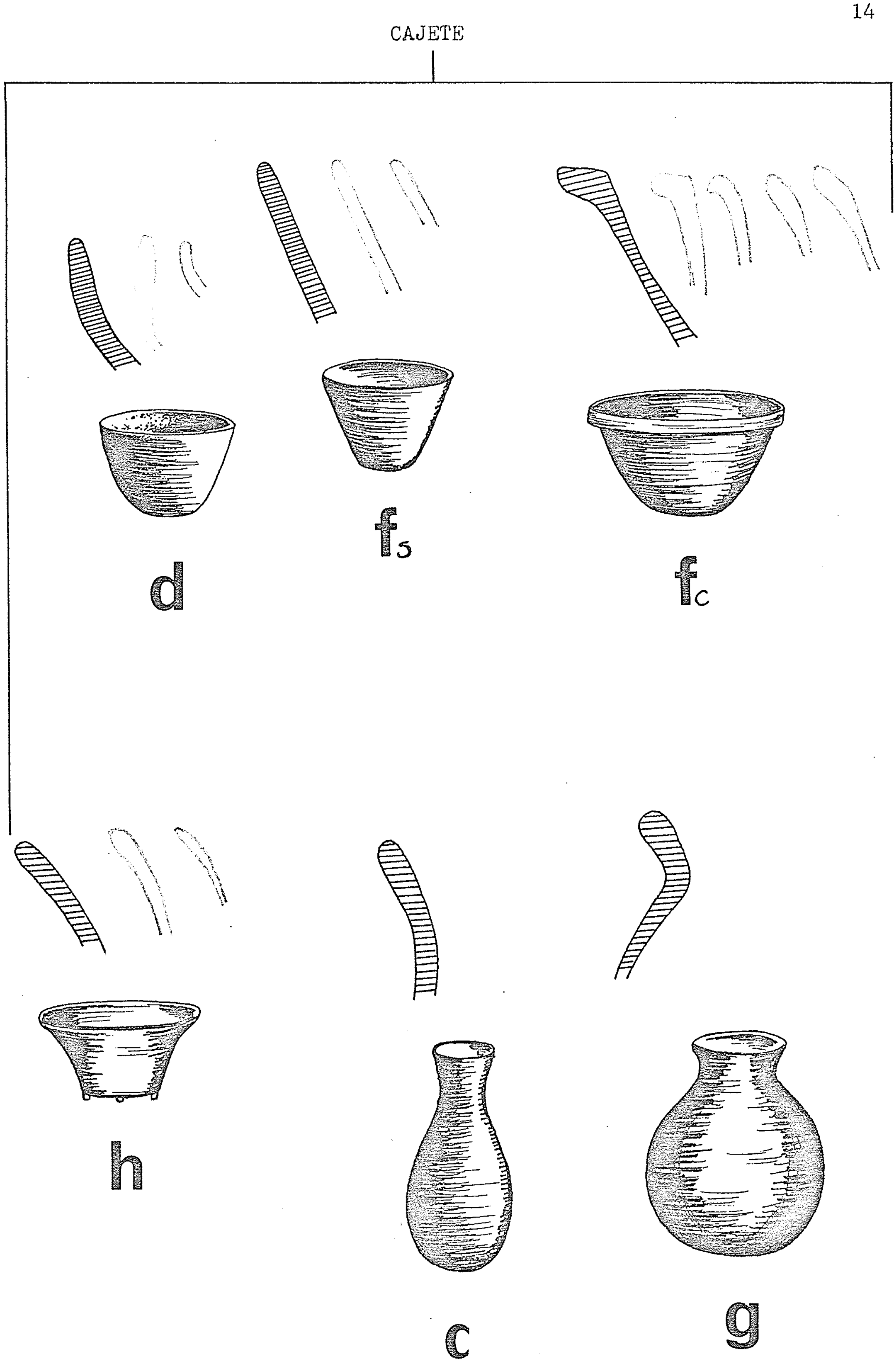


Figure 3. Continued.

Rim classification states B and E refer correspondingly to the *tecomate* and *cazuela* vessel forms. The chief characteristics of these are inverted lips. A *tecomate* may have a greater vessel height/width proportion than a *cazuela*.

Rim classification states D, Fs, Fc and H refer to the *cajete* generic class of vessel forms. Under this class, I would include the *cajete* and *molcajete* states of vessel form. These vessels are characterized by wide rims, which may be everted with a high rim diameter to vessel height ratio. The base is normally flat.

Rim classification states I and J refer to the hemispheric bowl and cylindrical jar vessel forms respectively. The hemispheric bowl is larger in size than any of the *cajete* forms. Its rim diameter/vessel height ratio may also be larger than that of the *cajete*. Both the hemispheric bowl and cylindrical jar have distinctive flattened rims, which in profile, create a ledge effect. The cylindrical jar has a larger proportion of vessel height to diameter. Its base is also flattened.

The rim classification states C and G also refer to jarlike vessel forms as well as to the *olla*. Both of these have restricted necks with rims that may be either straight or slightly flared.

Surface Texture. The surface texture attribute system consists of the attributes involved in the application of surface treatment. As in the case of paste texture, use of the term "surface treatment" is borrowed from Shepard (1968: 120). Surface treatment can be loosely described as the finishing touches applied by the potter to his vessel, after it has been formed and before it is fired. The purpose of surface treatment would seem to be twofold: (1) to erase the weaknesses in the paste texture, such as outstanding grains of temper and those resultant from the shaping techniques used to form the vessel; and (2) to assure maximum function from the completed vessel. After clearing away the obvious faults, there may be attempts to smooth the surface through burnishing. Finally, a slip can also be added as additional surface treatment.

The two attributes within the surface texture attribute systems are interior surface treatment and exterior surface treatment. The attribute states for both are identical. They are plain, burnished and partially burnished, fabric marked, slipped, eroded, other and multiple. These states are described below.

The plain attribute state signifies that no surface treatment was applied. This is actually an overstatement. As Shepard indicates, the initial steps in evening occur while the vessel is being shaped and the surface is being worked over with hands and tools to obtain uniformity (1968: 188). Plain can thus be seen in contradistinction to burnished and partially burnished insofar as specialized procedures and tools are used to obtain a desired effect on the burnished and partially burnished.

The purpose of burnishing, according to both Shepard (1968: 186-192) and Hodges (1964: 31), is to even the surface and improve its quality by rubbing or smoothing. The basis for the burnished/partially burnished distinction during the compiling of the attribute list is unknown.

Fabric-marked results from the imprinting of fabrics on the vessel surface, leaving distinctive impressions. For a discussion on fabric-marked ware see Charlton (1969) and Mayer-Oakes (1959).

Slipping represents a definite refinement in ceramic techniques. "It is an effective means of improving surface color and texture and it also renders pottery less permeable, since it fills the pores with finer material." (Shepard, 1968: 181). Slip itself is clay, usually of a finer quality than that used in the vessel, mixed with water to form "an even colloidal solution of pea-soup consistency" (Shepard, p. 33). It is applied either by dipping the vessel into the slip, or by pouring the slip over the vessel. It is usually distinctive as it forms an added layer on the original surface which may be of a different colour.

The other states in the interior and exterior surface treatment attributes are eroded, other and multiple. The other and eroded states are self-explanatory. The multiple state refers to the application of two or more surface treatment attribute states. Such a combination could be either burnishing and slipping or fabric-marked, burnishing, and slipping.

Firing. Firing is the procedure whereby the ingredients in the paste coalesce into the body of the finished product through the application of heat. The effect of heat on pottery is controlled by the following variables: the type of clay, the temper, the firing atmosphere, the amount of heat and the intensity of its application. Another variable that should be mentioned is the type of fuel; it may have a clear or sooty flame; burn quietly or snap.

The attribute states of firing are complete, dark core, dark interior, dark exterior and other.

The complete and dark core states refer to the quality of firing. The state of complete firing is observed when the paste texture is compact and homogeneous in colour, most probably red, yellow or buff.

Improper firing due to the shortage of firing time or low heat results in the accumulation of unburned carbonaceous material in the core which is of a dark colour. This produces the dark core state. Besides, a decrease in the level of oxygen could cause local reduction, which would also be darkish in colour.

Shepard offers possible explanations for the cause of the dark interior and dark exterior states. They may reflect defects in firing, such as uneven application of heat. They may also be the results of chance events during the firing process, such as the wind, localized discoloration caused by the deposition of soot, or a jet of gas from a smoky flame (1968: 74-93).

Frequency Distribution Table and Percentage Histograms

As a means of providing graphic aids for the analysis of the Tulpetlac rimsherds, a frequency distribution table and percentage histograms were drawn.

The purpose of the frequency distribution table (Table 1, pp 20-23) is to present a holistic view of all the attributes and attribute states as they are distributed level by level.

The structure of the Table can be described vertically and horizontally. Vertically it is arranged in the order of surface collections and subsurface levels. In the column entitled "Surface Collections and Levels", 11 and 12 refer to two surface collections and 14 to 20 to seven stratified levels. The levels were excavated at intervals of six inches. There was no data available for 13, which is a surface collection, among the attribute sheets. Thus, it is not included in the Table.

The attributes are arranged horizontally on the Table. The numbers immediately under each attribute designation refer to the attribute state codes as listed in Appendix A (pp. 69-71). Below the code number is the total frequency count for the respective attribute state. The number below the frequency count is the percentage. The pattern of the frequency count with the appropriate percentage immediately below is followed for each attribute state. The universe out of which the percentage is calculated for each state is the number of rimsherds in each level and surface collection. States with no representation are excluded.

In the column "Number of Rimsherds", the number of rimsherds for each surface collection and subsurface level is stated.

The percentage histograms are found in Appendix B (pp. 72-77). They indicate, in a diagrammatic form, any changes that may have taken place over time in all attribute states from level 20 to the surface collections. The rationale is that a change in the use of one attribute would be reflected in corresponding changes in the other states of the same attribute or those of related attributes.

The percentage (for each level and surface collection) is calculated out of the total frequency count for an attribute in a given level or surface collection. The percentages used in the histograms

Table 1

Frequency Distribution Table

Surface Collection and Levels	Number of Rimsherds	Temper			Temper Size			Temper Proportion						Texture			
		1	2	3	1	2	3	1	2	3	4	5	6	1	2	3	4
		519 95.6	4 0.7	20 3.7	322 59.3	213 39.2	8 1.5	15 2.8	118 21.7	208 38.3	119 21.9	62 11.4	21 3.9	11 2.0	524 96.5	1 0.2	7 1.3
11	25 100.0	24 96.0	1 4.0	0	12 48.0	12 48.0	1 4.0	0	2 8.0	6 24.0	9 36.0	5 20.0	3 12.0	2 8.0	23 82.0	0	0
12	180 100.0	176 97.8	1 0.6	3 1.7	98 54.4	82 45.6	0	7 3.9	22 12.2	54 30.0	52 28.9	36 20.0	9 5.0	4 2.2	171 95.0	1 0.6	4 2.2
14	32 100.0	30 93.8	0	2 6.3	23 71.9	9 28.1	0	3 9.4	9 28.1	12 37.5	7 21.9	1 3.1	0	0	32 100.0	0	0
15	42 100.0	40 95.2	0	2 4.8	40 95.2	2 4.8	0	1 2.4	13 31.0	16 38.1	7 16.7	4 9.5	1 2.4	1 2.4	41 97.6	0	0
16	31 100.0	26 83.8	0	5 16.1	17 54.8	12 38.7	2 6.5	2 6.5	2 6.5	19 61.3	8 25.8	0	0	0	29 93.5	0	2 6.5
17	57 100.0	55 96.5	0	2 3.6	52 91.2	5 8.8	0	0	22 38.6	27 47.4	8 14.0	0	0	0	57 100.0	0	0
18	86 100.0	82 95.3	1 1.2	3 3.5	54 62.8	30 34.9	2 2.3	0	30 34.9	40 46.5	8 9.3	8 9.3	0	0	85 98.8	0	1 1.2
19	85 100.0	81 95.3	1 1.2	3 3.5	31 36.5	51 60.0	3 3.5	1 1.2	16 18.9	33 38.8	19 22.4	8 9.4	8 9.4	4 4.7	81 95.3	0	0
20	5 100.0	5 100.0	0	0	3 60.0	2 40.0	0	1 20.0	2 40.0	1 20.0	1 20.0	0	0	0	5 100.0	0	0

Table 1 (continued)

Surface Collection and Levels	Number of Rimsherds	Firing 1	Firing 2	Firing 3	Firing 4	Rim Thickness 1	Rim Thickness 2	Rim Classification 1	2	3	4	6	7	8	9	10	11
		416 76.6	114 21.0	7 1.3	6 1.1	325 59.9	218 40.1	28 5.2	4 0.7	6 1.1	54 9.9	141 26.0	134 24.7	16 2.9	152 28.0	2 0.4	6 1.1
11	25 100.0	17 68.0	8 32.0	0	0	17 68.0	8 32.0	3 12.0	0	1 4.0	2 8.0	5 20.0	3 12.0	1 4.0	10 40.0	0	0
12	180 100.0	132 73.3	43 23.9	4 2.2	1 0.6	93 51.7	87 48.3	19 10.6	4 2.2	1 0.6	17 9.4	42 23.3	55 30.6	3 1.7	35 19.4	1 0.6	3 1.7
14	32 100.0	26 81.3	6 18.8	0	0	23 71.9	9 28.1	1 3.0	0	1 3.0	2 6.2	11 34.3	5 15.6	2 3.0	10 31.3	0	0
15	42 100.0	34 81.0	7 16.7	0	1 2.4	32 76.2	10 23.8	4 9.5	0	0	7 16.7	18 42.9	6 14.3	0	7 16.7	1 2.4	0
16	31 100.0	27 87.1	4 13.0	0	0	24 77.4	7 22.6	1 3.2	0	1 3.2	5 16.1	10 32.2	7 22.6	1 3.2	5 16.1	0	1 3.2
17	57 100.0	47 82.5	9 15.8	1 1.8	0	39 68.4	18 31.6	0	0	2 3.2	4 7.2	14 24.6	12 21.1	1 1.8	23 40.4	0	1 1.8
18	86 100.0	62 72.1	19 22.1	1 1.2	4 4.7	48 55.8	38 44.2	0	0	0	4 4.7	28 32.6	17 19.8	2 2.3	34 39.6	0	1 1.2
19	85 100.0	67 78.8	17 20.0	1 1.2	0	44 51.8	41 48.2	0	0	0	10 11.7	13 15.3	29 34.1	6 7.1	26 30.6	0	1 1.2
20	5 100.0	4 80.0	1 20.0	0	0	5 100.0	0	0	0	0	3 60.0	0	0	0	2 40.0	0	0

Table 1 (continued)

Surface Collection and Levels	Number of Rimsherds	Interior Surface Treatment 1	2	3	4	5	7	8	Exterior Surface Treatment 1	2	3	4	5	7	8
		239 44.0	176 32.4	19 3.5	65 12.0	2 0.4	37 6.8	5 0.9	78 14.4	150 27.6	19 3.5	246 45.3	1 0.6	44 8.1	5 0.9
11	25 100.0	1 4.0	13 52.0	0	0	0	10 40.0	0	0	8 32.0	0	9 36.0	0	8 32.0	0
12	180 100.0	50 27.8	68 37.8	9 5.0	34 18.8	2 1.1	15 8.3	3 1.7	12 6.7	48 26.7	8 4.4	94 522	1 0.6	14 7.8	2 1.1
14	32 100.0	19 59.4	9 28.1	1 3.1	1 3.1	0	2 6.2	0	5 15.6	13 40.6	1 3.1	9 28.1	0	4 12.5	0
15	42 100.0	26 61.9	8 19.0	1 2.4	4 9.5	0	3 7.1	0	7 16.7	9 21.4	2 4.8	20 47.6	0	4 9.5	0
16	31 100.0	19 61.3	5 16.1	0	6 19.4	0	0	1 3.2	9 29.0	12 38.7	0	7 22.6	0	1 3.2	3 9.6
17	57 100.0	31 54.4	10 17.5	3 5.3	7 12.3	0	6 10.5	0	12 21.1	13 22.8	2 3.5	24 42.1	0	6 10.5	0
18	86 100.0	37 43.0	41 47.7	3 3.5	5 5.8	0	0	0	12 14.0	23 26.7	2 2.3	49 57.0	0	0	0
19	85 100.0	53 62.3	20 23.5	2 2.4	8 9.4	0	1 1.2	1 1.2	18 21.2	24 28.2	3 3.5	33 38.8	0	7 8.2	0
20	5 100.0	3 60.0	2 40.0	0	0	0	0	0	3 60.0	0	1 20.0	1 20.0	0	0	0

Table 1 (continued)

Surface Collection and Levels	Number of Rimsherds	Vessel Form 1	2	3	5	6	7	8	9	11
		29 5.3	370 68.1	23 4.2	25 4.6	4 0.7	63 11.6	4 0.7	10 1.8	15 2.8
11	25 100.0	3 12.0	17 68.0	3 12.0	2 8.0	0	0	0	0	0
12	180 100.0	21 11.6	112 62.2	18 10.0	6 3.3	4 2.2	13 7.2	3 1.7	3 1.7	0
14	32 100.0	0	24 75.0	2 6.2	3 9.4	0	2 6.2	0	1 3.0	0
15	42 100.0	4 9.5	29 69.0	0	0	0	8 19.0	0	1 2.4	0
16	31 100.0	1 3.2	19 61.3	0	2 6.5	0	6 19.4	1 3.2	2 6.5	0
17	57 100.0	0	43 75.4	0	3 5.3	0	8 14.0	0	0	3 5.3
18	86 100.0	0	63 73.3	0	3 3.5	0	15 17.5	0	0	5 5.8
19	85 100.0	0	61 71.8	0	5 5.9	0	10 11.8	0	2 2.4	7 8.2
20	5 100.0	0	2 40.0	0	1 20.0	0	1 20.0	0	1 20.0	0

correspond to those for the attribute states in the frequency distribution table.

Contingency Tables

The contingency tables show the association between paired attributes, the chi-square for each cell, and the accumulative chi-square for the table. In describing the associations the following states, whose overall distribution is less than three percent of the entire collection, were omitted: (5) multiple, (6) other, and (8) fabric marked of the interior and exterior surface treatment attributes and (2) B, (3) C, (5) E, (8) G, (10) I, and (11) J of rim classification.

In arriving at decisions on associations, the accumulative chi-square in all but one of the contingency tables could not be used because twenty percent or more of the expected frequencies were less than five. The validity of chi-square obtained in tables with such low expected frequencies can be thwarted (Huntsberger, 1967: 248). In two instances where it was possible to combine some of the attribute states to overcome the problem of low expected frequencies, the resultant chi-square was acceptable. In most of the tables the differences between the observed and expected frequencies in each cell were the major indicators of the presence of association.

Temper, Firing, and Texture

The contingency tables which include any of these attributes are Nos. 17-37, Appendix C. The frequency distribution of these attributes is heavily skewed in favour of one of their states. The predominant states are the following: temper-sand (95.6%), texture-compact (96.5%), firing-complete (76.6%). There are no significant associations between any of these attributes and the other attributes.

Temper Size

The temper size states are (1) fine - 59.3%, (3) medium - 39.2%, and (3) coarse - 1.5%. It was decided to combine the medium to the relatively few coarse states so that new contingency tables including two categories in temper size with the following attributes were drawn: temper proportion, rim thickness, interior and exterior surface treatment. In describing the associations of temper size with these attributes the tables containing the combined medium-coarse states are taken into consideration. The other contingency tables of temper size with these attributes are Nos. 38-41, Appendix C.

Temper proportion. The accumulative chi-square obtained in Table 2 is 117.77. This exceeds the theoretical chi-square of 11.1 at the .05 level of probability for five degrees of freedom. This is an indication of association between temper size and temper proportion. The suggested association is the more frequent occurrence of coarser temper size with higher temper proportions and finer temper size with lower temper proportions.

Table 2

Contingency Table between Temper Size and Temper Proportion

Temper Size	Column	Temper Proportion 1	2	3	4	5	6	Row Total
1	Ob.	14	104	136	48	19	1	322
	Ex.	8.90	69.97	123.34	70.57	36.77	12.45	
	x^2	2.92	16.55	1.30	7.22	8.59	10.63	
2	Ob.	1	14	72	71	43	20	221
	Ex.	6.10	48.03	84.66	48.43	25.23	8.14	
	x^2	4.26	24.11	1.89	10.51	12.51	17.28	
Column Total		15	118	208	119	62	21	
Grand Total		543						
Accum. x^2		117.77						

Rim thickness. The chi-square for Table 3 is 73.96. This exceeds the theoretical chi-square of 3.84 at the .05 level of probability for one degree of freedom. The association suggested is one of the more frequent occurrence of finer temper size with thinner vessels and coarser temper with thicker vessels.

Table 3

Contingency Table between Temper Size and Rim Thickness

Temper Size	Column	Rim Thickness 1	2	Row Total
1	Ob.	241	81	322
	Ex.	192.73	129.27	
	x^2	12.08	18.02	
2	Ob.	84	137	221
	Ex.	132.27	88.73	
	x^2	17.61	218	
Column Total		325	218	
Grand Total		543		
Accum. x^2		73.91		

Rim classification. There are significant differences between the observed and expected frequencies in columns 6 and 7 of rows 1 and 2 in Table 4. The rim classification states referred to in columns 6 and 7 are Fs and Fc respectively. Fine temper size is found in greater association with Fs than with Fc. On the other hand, the medium temper size occurs more frequently with the Fc than with Fs. The classes A, D, and H shown in columns 1, 4, and 9 occur more frequently with fine temper size.

Table 4

Contingency Table between Temper Size and Rim Classification

Temper Size	Column	Rim Classification 1	2	3	4	6	7	8	9	10	11	Row Total
1	Ob.	20.	3	0	40	110	36	6	104	0	3	322
	Ex.	17.20	2.37	3.56	32.02	83.61	79.46	9.49	90.14	1.19	3.56	
	x^2	.45	.16	3.55	1.98	8.32	23.77	1.28	2.13	1.19	.08	
2	Ob.	8	1	6	14	31	93	10	47	1	0	213
	Ex.	11.38	1.57	2.35	21.18	55.31	52.58	6.28	59.62	.78	2.35	
	x^2	.49	.20	5.66	2.43	10.68	31.11	2.20	2.67	.06	2.34	
3	Ob.	0	0	0	0	0	4	0	1	0	3	8
	Ex.	.42	.06	.09	.79	2.08	2.08	.24	2.24	.03	.09	
	x^2	.42	.00	.11	.78	2.08	1.77	.25	.68	.00	94.11	
Column Total		28	4	6	54	141	134	16	152	2	6	
Grand Total		543										
Accum. x^2		200.95										

<u>Interior and Exterior Surface Treatment</u>. The pattern of relationship between these two attributes and temper size is similar. Some associations are indicated in columns 3 and 4 of rows 1 and 2 of Tables 5 and 6. Columns 3 and 4 respectively refer to the slipped and plain surface treatment. The observed frequency of the contingency between the slipped and fine temper is more than the expected. This pattern is reversed between the slipped and the coarser temper sizes. Fewer of the plain occur with the fine temper size than is expected, whereas more occur with the coarser temper size than is expected. The burnished and partially burnished associate more with the fine temper size.

Table 5

Contingency Table between Temper Size and Interior Surface Treatment

		Interior Surface Treatment							
Temper Size	Column	1	2	3	4	5	7	8	Row Total
1	Ob.	145	105	15	30	0	23	4	322
	Ex.	141.72	104.37	11.27	38.55	1.19	21.94	2.97	
	x^2	.07	.00	1.23	1.89	1.19	.05	.35	
2	Ob.	94	71	4	35	2	14	1	221
	Ex.	97.23	71.63	7.73	26.45	.82	15.04	2.04	
	x^2	.10	.00	1.79	2.76	1.69	.07	.52	
Column Total		239	176	19	65	2	37	5	
Grand Total		543							
Accum. x^2		11.71							

Table 6

Contingency Table between Temper Size and Exterior Surface Treatment

		Exterior Surface Treatment							
Temper Size	Column	1	2	3	4	5	7	8	Row Total
1	Ob.	47	109	15	123	1	26	1	322
	Ex.	47.44	89.54	10.67	147.06	.59	24.31	2.37	
	x^2	.00	4.22	1.75	3.93	.28	.11	.79	
2	Ob.	33	42	3	125	0	15	3	221
	Ex.	32.56	61.46	7.33	100.94	.41	16.69	1.63	
	x^2	.00	6.16	2.55	5.73	.41	.17	1.15	
Column Total		80	151	18	248	1	41	4	
Grand Total		543							
Accum. x^2		38.96							

Temper Proportion

The distribution of the temper proportion states is as follows: (1) 0-10% - 2.8%, (2) 10-20% - 21.7%, (3) 20-30% - 38.3%, (4) 30-40% - 21.9%, (5) 40-50% - 11.4%, and (6) 50-100% - 3.9%. The six temper proportion states were reduced to three categories in the contingency tables between temper proportion and the interior and exterior surface treatment attributes (Tables 9 and 10). The first two states form one category, the third and fourth the second category, and the fifth and sixth the third category. The tables containing the six temper proportion states and the surface treatment attributes are Nos. 42 and 43, Appendix C.

Rim thickness. The accumulative chi-square in Table 7 is 57.75. It exceeds the theoretical chi-square of 11.1 at .05 level of probability with five degrees of freedom. This indicates an association between these two attributes. The relationship is one of the greater occurrence of lower temper proportion states with thin and heavier temper proportion states with thick vessels.

Rim classification. Some associations are indicated in columns 4, 6, and 7 of all the rows of Table 8. The rim classification states which these columns refer to are D, Fs, and Fc respectively. There are by far more of the D states associated with the 0-10% than expected. The D and Fs states occur more with lower temper proportion states. The reverse of this is seen in the case of Fc. In column 9, H is found more frequently with the 20-30% and 30-40% temper proportion states. In column 1, the A rim class is distributed almost as randomly expected among most of the temper proportion, although it would tend to occur more with higher temper proportion states.

Interior and Exterior Surface Treatment. The patterns seen in Tables 9 and 10 between the two surface treatment attributes and temper proportion are similar. Columns 1, 2, 3, 4 and 7 refer respectively to the burnished, partially burnished, slipped, plain, and eroded states. The burnished and partially burnished states associate more frequently with the 0-40% temper proportion states than the 40-100%. The slipped are only found in association with the 0-40%. The plain and eroded are more associated with the 20-100% than the 0-20% states.

Table 7

Contingency Table between Temper Proportion and Rim Thickness

Temper Proportion	Column	Rim Thickness 1	2	Row Totals
1	Ob.	12	3	15
	Ex.	8.98	6.02	
	x^2	1.01	1.51	
2	Ob.	94	24	118
	Ex.	70.63	47.37	
	x^2	7.73	11.52	
3	Ob.	137	71	208
	Ex.	124.50	83.51	
	x^2	1.25	1.87	
4	Ob.	52	67	119
	Ex.	71.22	47.76	
	x^2	5.18	7.75	
5	Ob.	21	41	62
	Ex.	37.11	24.89	
	x^2	6.99	10.42	
6	Ob.	9	12	21
	Ex.	12.57	8.43	
	x^2	1.01	1.51	
Column Total		325	218	
Grand Total		543		
Accum. x^2		57.75		

Table 8

Contingency Table between Temper Proportion and Rim Classification

Temper Proportion	Column	Rim Classification 1	2	3	4	6	7	8	9	10	11	Row Total
1	Ob.	0	1	0	8	6	0	0	0	0	0	15
	Ex.	.77	.11	.17	.50	3.90	3.70	.44	4.20	.06	.17	
	x^2	.76	7.18	.17	112.5	1.13	3.70	.43	4.20	.00	.17	
2	Ob.	2	2	0	18	40	10	2	43	0	1	118
	Ex.	6.09	.87	1.30	11.74	30.64	29.12	3.48	33.03	.44	1.30	
	x^2	2.74	1.47	1.30	3.33	2.85	12.55	.62	3.0	.43	.06	
3	Ob.	14	1	3	12	66	35	3	71	2	1	208
	Ex.	10.73	1.53	2.30	20.69	54.01	51.35	6.13	58.23	.77	2.30	
	x^2	.99	.18	.21	3.65	2.66	5.19	1.59	2.80	1.96	.73	
4	Ob.	7	0	3	10	15	51	3	26	0	4	119
	Ex.	6.14	.88	1.32	11.83	30.90	29.37	3.51	33.31	.44	1.32	
	x^2	.12	.87	2.13	.28	8.2	15.92	.07	1.60	.43	5.43	
5	Ob.	4	0	0	4	7	31	5	11	0	0	62
	Ex.	3.20	.46	.69	6.12	16.10	15.30	1.83	17.36	.23	.69	
	x^2	.20	.45	.69	.73	5.14	16.11	5.49	2.33	.21	.69	
6	Ob.	1	0	0	2	7	7	3	1	0	0	21
	Ex.	1.09	.16	.23	2.09	5.45	5.18	.62	5.88	.08	.23	
	x^2	.00	.18	.21	.00	.44	.63	9.12	4.04	.12	.21	
Column Total		28	4	6	54	141	134	16	152	2	6	
Grand Total		543										
Accum. x^2		260.59										

Table 9

Contingency Table between Temper Proportion and Interior Surface Treatment

Temper Proportion	Column	Interior Surface Treatment 1	2	3	4	5	7	8	Row Total
1	Ob.	66	44	6	9	1	7	0	133
	Ex.	58.54	43.11	4.65	15.92	.49	9.06	1.22	
	x^2	.95	.01	.39	3.00	.53	.46	1.22	
2	Ob.	145	102	13	43	1	18	5	327
	Ex.	143.93	105.99	11.44	39.14	1.2	22.28	3.01	
	x^2	.00	.15	.21	.38	.03	.82	1.31	
3	Ob.	28	30	0	13	0	12	0	83
	Ex.	36.53	26.90	2.90	9.94	.31	5.66	.76	
	x^2	1.99	.35	2.90	.94	.32	7.10	.76	
Column Total		239	176	19	65	2	37	5	
Grand Total		543							
Accum. x^2		23.82							

Table 10

Contingency Table between Temper Proportion and Exterior Surface Treatment

Temper Proportion	Column	Exterior Surface Treatment 1	2	3	4	5	7	8	Row Total
1	Ob.	21	54	9	38	0	11	0	133
	Ex.	19.10	36.74	4.65	60.25	.24	10.78	1.22	
	x^2	.18	8.10	4.06	8.21	.25	.00	1.22	
2	Ob.	48	83	10	155	1	26	4	327
	Ex.	46.97	90.33	11.44	148.14	.6	26.50	3.01	
	x^2	.02	.59	.18	.31	.26	.00	.32	
3	Ob.	9	13	0	53	0	7	1	83
	Ex.	11.92	22.93	2.90	37.60	.15	6.73	.76	
	x^2	.46	4.30	2.90	6.30	.13	.01	.07	
Column Total		78	150	19	246	1	44	5	
Grand Total		543							
Accum. x^2		37.87							

Rim Thickness

The two states of rim thickness are thin - 59.9% and thick - 40.1%.

Rim classification. There are significant indications of associations in Table 11. In columns 1, 4, 6 and 9 of the first row the observed frequencies are more than the expected. This shows an association of the A, D, Fs, and H rim classes with thin vessels. Similarly, in column 7, row 2, there is a significant association of the Fc with thick rims.

Interior and Exterior Surface Treatment. Similar patterns are observed between interior and exterior surface treatment with rim thickness in Tables 12 and 13. The observed frequencies in columns 1, 2 and 3 of the first row are more than the expected. In the second row the observed frequency in column 4 is more than expected. Thus, the indications are that the burnished, partially burnished, and slipped occur more frequently with the thin; whereas the plain occurs more frequently with the thick.

Rim Classification

The distribution of the five rim classification states that are being discussed is as follows: (4) D - 9.9%, (1) A - 5.2%, (6) Fs - 26.0%, (7) Fc - 24.7% and (9) H - 28.0%.

Interior surface Treatment. In Table 14 the excess of the observed frequencies over the expected in the following cells is worth mention: row 1,column 1; row 4, column 2; row 6, column 2; row 7, column 4; row 9,

Table 11

Contingency Table between Rim Thickness and Rim Classification

Rim Thickness	Column	Rim Classification 1	2	3	4	6	7	8	9	10	11	
1	Ob.	25	3	2	47	115	28	3	99	0	3	325
	Ex.	16.76	2.39	3.59	32.32	84.39	80.20	9.58	90.98	1.20	3.59	
	x^2	4.05	.15	.70	6.66	11.10	33.97	4.51	.70	1.20	.09	
2	Ob.	3	1	4	7	26	106	13	53	2	3	218
	Ex.	11.24	1.61	2.41	21.68	56.61	53.80	6.42	61.02	.80	2.41	
	x^2	6.04	. 2	1.04	9.94	16.55	50.64	6.74	1.05	1.80	.14	
Column Total		28	4	6	54	141	134	16	152	2	6	
Grand Total		543										
Accum. x^2		157.29										

Table 12

Contingency Table between Rim Thickness and Interior Surface Treatment

		Interior Surface Treatment							
Rim Thickness	Column	1	2	3	4	5	7	8	Row Total
1	Ob.	152	108	16	17	2	25	5	325
	Ex.	143.05	105.34	11.37	38.90	1.20	22.15	2.99	
	x^2	.55	.06	1.88	12.32	.53	.36	1.35	
2	Ob.	87	68	3	48	0	12	0	218
	Ex.	95.95	70.66	7.63	26.10	.80	14.86	2.01	
	x^2	.83	.10	2.80	18.37	.80	.55	2.00	
Column Total		239	176	19	65	2	37	5	
Grand Total		543							
Accum. x^2		42.50							

Table 13

Contingency Table between Rim Thickness and Exterior Surface Treatment

		Exterior Surface Treatment							
Rim Thickness	Column	1	2	3	4	5	7	8	Row Total
1	Ob.	65	108	14	105	0	30	3	325
	Ex.	46.69	89.78	11.37	147.24	.60	26.34	2.99	
	x^2	7.18	3.69	.60	12.11	.60	.50	.00	
2	Ob.	13	42	5	141	1	14	2	218
	Ex.	31.32	60.22	7.63	98.76	.40	17.67	2.01	
	x^2	10.71	5.51	.90	18.06	.90	.76	.00	
Column Total		78	150	19	246	1	44	5	
Grand Total		543							
Accum. x^2		61.52							

columns 1 and 3. In the first row, the A rim class occurs most with the burnished. In the fourth row the D rim class occurs most with the partially burnished. In the sixth row the Fs occurs most with the partially burnished. In the seventh row, the Fc occurs most with the plain. In the ninth row, the H rim class occurs most with the burnished and slipped.

Exterior surface treatment. Significant indications of patterns are seen in the following cells of Table 15: row 1, column 4; row 4, column 2; row 6, column 3; row 7, column 4; row 9, columns 1 and 2. The following associations between rim classification and exterior surface treatment are suggested: A with plain, D with partially burnished, Fs with the slipped, Fc with plain, H with burnished and partially burnished.

Interior Surface Treatment

Table 16 indicates that the same surface treatment was often applied both internally and externally. The observed frequencies significantly exceed the expected in the following cells: row 1, column 1; row 2, columns 2 and 4; row 3, column 3; row 4, column 4; row 7, column 7.

Table 14

Contingency Table between Rim Classification and Interior Surface Treatment

Rim Thickness	Column	1	2	3	4	5	7	8	Row Total
		Interior Surface Treatment							
1	Ob.	20	8	0	0	0	0	0	28
	Ex.	12.32	9.08	.98	3.35	.10	1.91	.26	
	x^2	4.78	.12	.97	3.34	.10	1.91	.26	
2	Ob.	1	0	2	1	0	0	0	4
	Ex.	1.76	1.30	.14	.48	.02	.27	.04	
	x^2	.32	1.30	24.71	.56	.00	.25	.00	
3	Ob.	2	2	0	1	0	1	0	6
	Ex.	2.64	1.95	.21	.72	.02	.41	.06	
	x^2	.15	.00	.19	.11	.00	.85	.00	
4	Ob.	21	31	1	1	0	0	0	54
	Ex.	23.77	17.50	1.89	6.46	.20	3.68	.50	
	x^2	.32	10.41	.41	4.61	.20	3.67	.50	
6	Ob.	53	58	7	11	1	11	0	141
	Ex.	62.06	45.70	4.93	16.88	.52	9.61	1.30	
	x^2	1.32	3.31	.86	2.04	.44	.20	1.30	
7	Ob.	40	51	0	30	0	12	0	134
	Ex.	58.98	43.43	4.69	16.04	.49	9.13	1.23	
	x^2	6.10	1.31	4.69	12.14	.48	.90	.04	
8	Ob.	6	5	0	5	0	0	0	16
	Ex.	7.04	5.19	.56	1.92	.06	1.09	.15	
	x^2	.15	.00	.55	4.94	.00	1.09	.13	
9	Ob.	94	21	9	10	1	13	4	152
	Ex.	66.90	49.27	5.32	18.20	.56	10.36	1.40	
	x^2	10.97	16.21	2.54	3.69	.33	.67	4.82	
10	Ob.	1	0	0	1	0	0	0	2
	Ex.	.88	.65	.07	.24	.01	.14	.02	
	x^2	.01	.64	.00	2.41	.00	.14	.00	
11	Ob.	1	0	0	5	0	0	0	6
	Ex.	2.64	1.95	.21	.72	.02	.41	.06	
	x^2	1.01	1.94	.19	25.44	.00	.41	.00	
Column Total		239	176	19	65	2	37	5	
Grand Total		543							
Accum. x^2		173.45							

Table 15

Contingency Table between Rim Classification and Exterior Surface Treatment

Rim Classification	Column	1	2	3	4	5	7	8	Row Total
1	Ob.	1	0	0	26	0	1	0	28
	Ex.	4.02	7.73	.98	12.69	.05	2.27	.26	
	x^2	2.26	7.72	.97	13.96	.00	.70	.26	
2	Ob.	2	0	2	0	0	0	0	4
	Ex.	.57	1.10	.14	1.80	.01	.32	.04	
	x^2	3.57	1.10	24.71	1.80	.00	.31	.00	
3	Ob.	0	1	0	4	0	1	0	6
	Ex.	.86	1.66	.21	2.72	.01	.49	.06	
	x^2	.86	.26	.19	.60	.00	.53	.00	
4	Ob.	8	32	2	10	0	2	0	54
	Ex.	7.76	14.92	1.89	24.46	.10	4.38	.50	
	x^2	.00	19.55	.00	8.54	.10	1.29	.50	
6	Ob.	15	44	8	57	0	17	0	141
	Ex.	20.25	38.95	4.93	63.88	.26	11.43	1.30	
	x^2	1.36	.65	1.91	.74	.26	2.71	1.30	
7	Ob.	9	18	0	96	0	10	1	134
	Ex.	19.25	37.02	4.69	60.71	.25	10.86	1.23	
	x^2	5.45	9.77	4.69	20.51	.24	.06	.04	
8	Ob.	2	2	0	12	0	0	0	16
	Ex.	2.30	4.42	.56	7.25	.03	1.30	.15	
	x^2	.03	1.32	.55	3.11	.00	1.30	.13	
9	Ob.	41	53	5	38	1	13	1	152
	Ex.	21.83	41.99	5.32	68.86	.28	12.32	1.40	
	x^2	16.83	2.88	.01	13.83	1.85	.03	.11	
10	Ob.	0	0	0	2	0	0	0	2
	Ex.	.29	.55	.07	.91	.00	.16	.02	
	x^2	.27	.54	.00	1.30	.00	.18	.00	
11	Ob.	0	0	2	1	0	0	3	6
	Ex.	.86	1.66	.21	2.72	.01	.49	.06	
	x^2	.86	1.66	15.23	1.08	.00	.48	144.0	
Column Total		78	150	19	246	1	44	5	
Grand Total		543							
Accum. x^2		347.05							

Table 16

Contingency Table between Interior Surface Treatment and Exterior Surface Treatment

Interior Surface Treatment	Column	Exterior Surface Treatment 1	2	3	4	5	7	8	Row Total
1	Ob.	72	72	0	84	0	11	0	239
	Ex.	34.33	66.02	8.36	108.28	.44	19.37	2.20	
	x^2	41.33	.54	8.36	5.44	.43	3.61	2.20	
2	Ob.	1	61	3	101	0	8	2	176
	Ex.	25.28	48.6	6.15	79.73	.32	14.26	1.62	
	x^2	23.31	3.16	1.61	5.55	.31	2.74	.08	
3	Ob.	1	0	15	1	0	2	0	19
	Ex.	2.73	5.24	.66	8.61	.03	1.54	.17	
	x^2	1.09	5.24	311.57	6.72	.00	.13	.17	
4	Ob.	1	5	1	52	0	3	3	65
	Ex.	.12	17.96	2.27	29.45	.12	5.27	.60	
	x^2	6.41	9.35	.70	17.26	.08	.97	9.60	
5	Ob.	0	2	0	0	0	0	0	2
	Ex.	.29	.55	.07	.91	.00	.16	.02	
	x^2	.27	3.81	.00	.91	.00	.18	.00	
7	Ob.	2	6	0	8	1	20	0	37
	Ex.	5.31	10.22	1.29	16.76	.06	3.00	.34	
	x^2	2.06	1.74	1.28	4.57	14.66	96.33	.35	
8	Ob.	1	4	0	0	0	0	0	5
	Ex.	.72	1.38	.17	2.27	.01	.41	.05	
	x^2	.11	4.97	.17	2.26	.00	.41	.00	
Column Total		78	150	19	246	1	44	5	
Grand Total		543							
Accum. x^2		602.04							

CHAPTER III

INTERPRETATION OF DATA

Stratification of the stratacut is one factor which can be taken as a possible argument for temporal continuity in the Tulpetlac material. Stratification has been useful for providing inferences on relative dating in archaeology, the assumption being that there is a distinct time lapse between two artifacts, one of which is found above the other.

However, it should be noted that if stratigraphy provides inferences about temporal succession, by itself it does not provide sufficient argument for cultural continuity. The mere state of being superimposed does not argue for any cultural relationship between two artifacts. Pyddoke (1961: 116-123) and Hole and Heizer (1966: 49-60) have urged the careful interpretation of stratigraphic information in archaeological analysis.

Another argument may be raised against the sole use of stratigraphy for the Tulpetlac material. Some of the sherds are not from the excavated strata. There are 250 sherds or 37.9% of the total collection, that are from two surface collections near the stratacut.

Thus, the inadequacy of stratigraphic information means that it is necessary to inspect the sherds themselves to see whether they present any information on cultural homogeneity and temporal continuity.

Frequency Distribution Table

Strong evidences for cultural homogeneity and temporal continuity are seen in the Frequency Distribution Table (Table 1, pages 20-23).

There are attributes in which one state is most frequently occurring in all the levels and surface collections. Examples of these are temper, texture, firing, and vessel form. The following are their predominant states, in corresponding order, along with their percentages over the other states for the entire collection: sand 95.6%, compact 96.5%, complete 76.6%, and cajete 68.1%.

In the remaining attributes the two or three most frequently used states are invariably the same for all the levels and surface collections. The two attributes which differ slightly from the norm are interior surface treatment and exterior surface treatment. The three most frequently used states in interior surface treatment in order of frequency are burnished, partially burnished, and plain. This pattern is maintained steadily except in surface collection 11 and level 14. For exterior surface treatment the most frequently used states, in order, are plain, partially burnished, and burnished. This pattern is maintained within the entire collection except in surface collections 11 and 12 and level 20.

It would seem that such a high frequency in the use of distinct attribute states for the entire collection could not have occurred by coincidence at Tulpetlac. There was some cultural and temporal succession.

Percentage Histograms

The above information suggests that there was not too much cultural and temporal disparity among the Tulpetlac rimsherds. The percentage histograms (Appendix C, pp. 72-77) present evidence on changes that took place within the time span of the collection.

There are two types of patterns which the histograms illustrate. One consists of few marked changes in the use of attribute states over time. The other type reflects a pattern of a relatively consistent rise and fall in the use of an attribute state.

The histograms that fall under the first pattern are Nos. 1, 6, 14, 16, 17, 18, 29, 31, 35, 39, 42, 48, 50, 51 and 52. Graph Nos. 1, 14, 17 and 48 refer respectively to the "sand" temper state, "compact" texture state, "complete" firing state, and the cajete vessel form state. We have seen that these states are distributed almost evenly for the entire collection. The states whose percentages are plotted in the other histograms are also similarly distributed.

The histograms not already mentioned fall under the second pattern. For example, Nos. 4, 5, 9, 10, 21, 22, 27, 28, 33, 34, 36, 41 and 43 show the pattern sharply. Others are further removed from the ideal of the pattern of consistent rise and fall.

The percentage histograms not only provide some indication of changes among the sherds but also, substantiate the likelihood that the Tulpetlac material represents some cultural homogeneity and temporal continuity. They do so by presenting the changes in the use of the attribute states. The change in some of the states is hardly noticeable, while in others it is plainly seen in the form of a pattern. Hardly any of the histograms portray a distribution which would be so erratic as not to represent a meaningful cultural pattern.

Patterns in Ceramic Technology

In discussing the cultural interpretation of attribute associations, the following order is taken. First, there are summary statements on the associations of attributes in each attribute system. These statements are based on associations in contingency tables that have been described in detail in Chapter II. This is followed by a brief discussion of some interrelationships among the attribute systems. Finally, an attempt is made to reconstruct the procedures in the formation of some vessel classes.

Paste Texture. The attributes that compose the paste texture attribute system are temper, temper size, temper proportion, and texture. The temper used predominantly at Tulpetlac was sand. There was an attempt to apply finer temper in lower proportions and coarser temper in higher proportions. The resultant paste formed by the mixture of all the ingredients was compact in texture.

Vessel Morphology. The attributes in the vessel morphology attribute system are rim thickness, rim classification, and vessel form. Omitted from this discussion are the vessel form attribute and the rim classification states B, C, E, G, I and J whose associations were not taken into consideration.

The formation of the thickness of the rim was partly dependent upon the form of the vessel. The forms represented by rim classes A, D, Fs, and H were usually made thin, while the Fc included mostly thick vessels.

In discussing the interrelationship between the paste texture and vessel morphology attribute systems, some patterns can be seen. The size of the vessel rim varies directly in proportion to the size and proportion of its temper. Coarser temper, which is applied in higher proportions, is found more frequently with thicker vessels. The associations between temper size and temper proportion with rim classification substantiates the more frequent occurrence of the D, Fs, and H rim classes with temper that is finer and applied in lighter proportions in contrast to Fc which is markedly associated with coarser temper. These patterns suggest that the potters selected a particular paste when producing a given vessel form, the criteria being the size and proportion of the temper.

Surface Texture and Firing. There are indications of strong association between the states of the two surface treatment attributes. The same surface treatment was frequently applied both internally and externally to the same vessel.

An examination of the interrelationship of the surface texture and vessel morphology attribute systems can provide suggestions on the criteria for the application of particular surface treatment techniques. A vessel that is burnished, partially burnished, or slipped is more often thin; whereas the plain were mostly thick.

Vessel forms are distinctive with respect to surface treatment. The A vessel class is more frequently plain externally but burnished internally. D and Fs vessels are frequently partially burnished internally and externally. Some of the Fs and H vessels are slipped internally and externally. The H vessels are associated with burnished and partially burnished treatment. The Fc are more frequently plain.

Most of the vessels at Tulpetlac were well fired.

Reconstruction of Vessel Formation. So far we have seen a generalized reconstruction of the ceramic technology used at Tulpetlac by observing attributes and their interplay among attribute systems.

We can go one step further. By careful examination of the contingency tables we can attempt to reconstruct the formation of some of the vessel classes as defined by the rim classification attribute.

In forming the Fc type, there was a deliberate effort to use coarser temper and in lower proportions than was done for the other classes. A high proportion of the Fc vessels are thick. Finally, Fc also received the least surface treatment. This reflects a distinct pattern on the part of the artisans from the beginning of the formation of the paste texture to that of the surface texture of a particular class of vessels.

In the formation of the D, Fs and H classes, items and procedures that were the antithesis of those of the Fc were used. Finer temper size, applied in lighter proportions, was shared by these three classes. They are predominantly thin. They are also frequently associated with burnished and partially burnished surface treatment. Fs and H contain most of the vessels that are slipped. Thus, D, Fs, and H reflect the fine end of the workmanship spectrum in Tulpetlac ceramics as Fc reflects the rough end.

A word should be said about the A class. With respect to paste texture, A would seem to be found more frequently with heavier temper proportion states. However, it is remarkable that it occurs frequently with internal burnishing while externally it associates more frequently with plain surface treatment. This reflects an effort by the artisans to apply a relatively high quality external finish to a vessel class whose temper proportion tends to be heavy and is plain internally. The pattern used in the formation of the A class is unusual among the Tulpetlac classes. Different surface treatment is applied on the interior and exterior of the rim. Besides, a paste with a temper applied in relatively heavy proportions is found in association with a burnished exterior surface.

Predominant States

The Frequency Distribution Table shows that the complete, compact, sand, and *cajete* states predominate among the other states of the firing, texture, temper, and vessel form attributes respectively. In describing the association of the first three attributes with other attributes in the previous chapter, it was found that they are distinctive in lacking any significant associations with other attributes. This would seem to suggest that the predominant states were held relatively constant by the Tulpetlac potter.

There are two conclusions that one can arrive at from the information provided by the Frequency Distribution Table and the contingency tables about the states of these attributes. One is that in the formation of these attributes, the potters aimed at acquiring the most predominant states. The other is that in the formation of the vessels these states were most frequently used.

Some suggestions can be proposed for the first conclusion. First, let us look at the firing attribute. The fact that the "complete" is the most predominant state means that firing was done at a high standard. It is normally accepted by ceramic experts that firing is a major test of the formation of a vessel (Shepard, 1968: 74). The usefulness of a vessel is directly dependent, to a large extent, upon its firing state. Thus, the fact that a high standard of firing was achieved at Tulpetlac goes to prove that the potters knew their art and were using it to obtain maximum returns.

As in the case of firing, in texture we see uniformity in the maintenance of a relatively high standard in the ceramic technology of Tulpetlac. The most predominant state in texture is "compact". This would seem to indicate a high standard of paste preparation. Uniformity in the texture can also mean a consistency in the choice of clay(s).

On the basis of information available on Tulpetlac, it is difficult to suggest possible reasons for the predominance of states in the temper and vessel form attributes. However, speculations suggest themselves which have ramifications on related cultural processes at Tulpetlac.

Without a knowledge of the geology of the area, it is difficult to discuss the prevalence of sand as temper. It is, however, possible to suggest that due to the marked uniformity in the use of one type of temper, there was little use of trade ceramic pieces at Tulpetlac. The one objection to this suggestion could, of course, be that there were trade items, in the formation of which sand was also predominantly used. A microscopic examination of the clay used, along with a knowledge of its components, would especially be useful here.

The predominance of the vessel form, cajete, which is 68.1% over ten other clsses, is remarkable. This may be a function of any of three possibilities: (a) that this vessel form was one that lent itself for a variety of utilitarian purposes, (b) that it was purposely produced for trade, or (c) that this site represents an activity at which this form was especially useful.

Some suggestions can be proposed for the second conclusion mentioned above, namely uniformity in the application of the "complete" state of firing and "compact" state of texture in the formation of most of the Tulpetlac vessels.

One plausible reason that can be suggested for uniformity in firing is that vessels were probably fired together. Foster (1948: 89) presents ethnographic evidence for the fact that in the state of Michoacan, central Mexico, vessels were packed to capacity in kilns for firing, with smaller vessels being placed in larger ones. The procedure of firing can take a fairly long time, up to four hours, whether using open firing (Fontana _et al_., 1961: 73) or a kiln (Foster, op. cit.). It can also consume a substantial amount of fuel. Thus, no doubt potters would take the opportunity of firing as many vessels as possible at one time.

In the case of texture, it is reasonable to assume that the paste was formed for most vessels according to a standard, which would have withstood the test of time. In describing the procedure of paste formation, ethnographers say that the paste is prepared until it has reached a "proper plasticity" (Diaz, 1966: 142) or use other synonymous terms (Foster, 1948: 81; Shepard, 1968: 182).

CHAPTER IV

ASSESSMENT OF ATTRIBUTES AND SIMILARITY WITH OTHER STUDIES

The assessment of the attributes selected for study can be done in either or both of two ways. The first concerns the analytic definition of an attribute. The other concerns the subject matter of the attribute. I find it difficult to take up the first type of critique with respect to the attributes used in this study. The reason is that the analysis upon which the attribute list is based was done before I undertook this study. On the other hand, it is possible to do a critique of the other type as I am sufficiently aware of the subject matter of the attributes. Associated with this type of critique are such issues as the appropriateness of the methods used in compiling the attributes.

The critiques of the following attributes are based on the proposition that these attributes incorporate assumptions which are difficult to justify on the basis of the subject matter of the attribute list and its means of definition.

Vessel Form

The idea of producing schematic models from rim profiles is itself commendable as an analytic technique. The value of the use of rim sherds in schematic models stems from the fact that the vessel's edge is traditionally one of its most sensitive indicators of change. Unlike the other parts of the vessel, it is that which is most easily shaped, reinforced, and elongated. Besides, the rim gives information on the vessel lip and points of articulation with the neck and shoulder.

Apart from "rim classification", there is a "vessel form" attribute, No. 31 on the attribute list (see Appendix A, pp. 67-69). It is worth asking on what basis the vessel form states were determined. The answer would seem to be rim classification. Tolstoy also formed rim profiles and assumed vessel form from them, but he warns that whole-vessel dimensions must be considered impressionistic and very approximate. "Even rimsherds cannot be always expected to differentiate between forms which could easily be distinguished in complete museum specimens." (Tolstoy, 1958: 18-19).

The distinction should be made that the attribute list is concerned with the study of rimsherds. Should the analyst wish to speculate on vessel form on the basis of conclusions arrived at through work on the attribute list, that is his prerogative. It does not seem that there are appropriate attributes on the list to warrant such speculation. The overall vessel form incorporates parts of the vessel other than the rim. These are the shoulder, body, and base, all of which may be subjected to contours and angles not reflected in the rim form. Thus, it is difficult to suggest what purpose the vessel form attribute has on the list.

Temper Proportion

On the attribute list, temper proportion is a quantitative statement expressed in percentage form on the relationship between temper and paste texture. I would suggest some alterations in this attribute. The reason is that on the basis of the methods used to identify the temper proportion states, it is difficult to justify their number and the percentage range of each. In my opinion the estimating of these six states by sight although done by one individual over a period of time, as was the case in the compiling of the attribute list, is too precarious for accuracy.

To obtain measurements for the estimates used on the attribute list, more sophisticated techniques would have to be used. These would involve the use of petrographic microscope with a micrometer eyepiece or a recording micrometer stage focused on a thin-section of the rim.

A more appropriate subdivision of temper proportion should be strictly qualitative as, for example, in temper size. The states would be in the following form, "low", "medium", and "high". Using the percentage scale of the attribute list, the following rough correlations could be drawn, low (0-30%), medium (30-50%), and high (50-100%).

Explanatory Statement

There is a need for an explanatory statement to be attached to the attribute list. Such a statement could describe attributes and attribute states which are not sufficiently self-explanatory. For example, under firing the dark interior and dark exterior states need some description. What criteria were used for the dark colour?

The interior and exterior surface treatment attributes have burnished and partially burnished states. It is not too clear how one was distinguished from the other.

The measurement of the thin state of the rim thickness attribute is less than 7 mm. That of the thick state is greater than 7.5 mm. The question could be asked under what designation a rimsherd falls whose measurement is between 7 mm. and 7.5 mm.

Finally, it is unfortunate that more accurate means of obtaining data from the rimsherds had not been used when the attribute list was being compiled. The binocular microscope, for example, is easy to handle and would not slow down the process immeasurably. It would be especially invaluable for temper identification and estimating temper proportion.

Comparison With Other Studies

The Study as Attribute Analysis. The following points can be described as some of the characteristics of a study in attribute analysis:

a) definition of attribute
b) application of quantitative techniques
c) the establishing of an hierarchical ordering of archaeological units

It will be recalled that these points were found to be common to the two studies which were cited on page 5 as using attribute analysis. An attempt is made below to see what similarities there are in the way I have incorporated these points within the study and the way they are treated in other examples of attribute analysis.

Although I did not define the attributes I selected to study, I described them as precisely as I could. In doing the description, I referred to two authorities on archaeology and ceramic technology Shepard (1968) and Hodges (1964).

The very number of attributes in a study invariably enforces upon the analyst the necessity of the use of data processing and sophisticated mathematical concepts. The enumeration of attributes serves as an introduction to the use of quantitative techniques.

The frequency distribution table and percentage histograms were helpful in the discussion of relative cultural and temporal continuity. The contingency tables formed the basis of associations among attributes. My use of statistical aids was elementary compared to that in other studies, for example Binford and Binford (1966) and Sackett (1966). One reason for this is the large proportion of attributes with very few states, the rim classification, surface treatment, and vessel form being particularly outstanding. Within the hierarchy of archaeological units, this study went from the attribute state to the attribute system. An attribute is manifested in the form of one of its states on a sherd. The attribute system, as the final stage, consists of groups of attributes. The significance of each attribute system lies in that it corresponds to a stage in pottery production.

Clarke (1968: 186), Deetz (1965: 45-54), and Sackett (1966) also form hierarchical units. The stage that is one step removed from the attribute is an "attribute complex" for Clarke, "attribute association" for Deetz, and "attribute cluster" for Sackett.

<u>Ceramic Technology</u>. There has been little study on procedures in Pre-contact ceramic technology in Mesoamerica. In suggesting reasons for the predominance of some states in the previous chapter, pages 52 and 53 I had to resort to analogies from ethnographic studies.

Some earlier studies have been cited on pages 4-5. However, I would consider most of these studies as being more introductory in nature. They are fragmentary and lack both depth and a sound methodological approach to problems in the formation of patterns in pottery production.

The application of attribute analysis to ceramic technology can be helpful as can be seen from this study. The use of attribute analysis on ceramic technology in Mesoamerica, where some corroborative evidence could be had from ethnographic analogy, would be invaluable.

CHAPTER V

SUMMARY AND CONCLUSION

This study is based on 543 rimsherds gathered from Tulpetlac, Valley of Mexico. The first objective was to attempt a reconstruction of the processes used in the formation of the Tulpetlac ceramic vessels. A flow chart was drawn which represented stages in pottery production from the formation of the paste texture to the firing stage.

Before attempting the reconstruction, a frequency distribution table and percentage histograms were discussed which strongly indicated the existence of a certain amount of cultural and temporal continuity among the rimsherds. This conclusion confirmed that a search for patterns in the formation of the vessels was warranted. Attributes were grouped into attribute systems,each representing one of the stages in the flow chart. The relationship among the attributes was produced in contingency tables. An interpretation of the contingency tables, indicated patterns that the potters had followed. Attempts were also made to reconstruct patterns used in forming some vessel classes.

The second objective was to assess the usefulness of the attributes selected for study as tools for archaeological analysis. This is the first time that the attribute list has been used in a major study; beforehand only term papers had been based on it. Thus, in this first study, the usefulness of the attributes selected was being tested. The fact that by using them I was able to arrive at conclusions which are culturally meaningful shows that these attributes are viable for certain types of analysis. The critique on the attributes was based primarily on the subject matter of each attribute. The attributes I discussed were vessel form, temper proportion, rim thickness, firing, interior surface treatment and exterior surface treatment.

The third objective was a comparative study with others in ceramic analysis. This was done on the study as an attribute analysis and as an exercise on ceramic technology. As an attribute analysis this study is similar to others in so far as it covers three characteristics of studies using attribute analysis. These are definition of attributes, use of quantitative techniques, and the use of an hierarchy of analytic archaeological units. As an exercise on ceramic technology in Pre-contact Mesoamerica, this study is unusual compared to others that were cited. Very little work has been done on ceramic technology in Mesoamerican archaeology. None of the works mentioned uses the method of attribute analysis to reconstruct the items and procedures used by the Pre-contact Mesoamerican potters.

Conclusion

In conclusion, I would like to discuss briefly some topics related to this study, which have not yet been mentioned.

In my use of attribute analysis, I have been overwhelmingly concerned about the attribute as an archaeological analytic unit involved in ceramic technology. I have not discussed the fact that as an archaeological unit and item of technology, the ceramic attribute demonstrates the result of human activity using natural resources. As topics related to the subject matter of this study, a word should be said about ceramic technology as a product of people in social systems working on the resources obtained from the physical environment.

The fact that we do not know what culture(s) produced the Tulpetlac material does not prevent a discussion of the general role of ceramic technology in culture. The immediate group of people who produce pottery can be regarded as forming a pottery sub-culture. The sub-culture is subject to the political and economic controls that are exerted upon it by a larger, more encompassing socio-cultural group. The larger group may correspond to any of the levels of the integration of social systems outlined by Service (1962).

The importance of the larger group is that it dictates the place of pottery production as an economic activity. Suggestions have been put forward for the existence of a socio-economic organization in Classic-Postclassic Valley of Mexico. Mayer-Oakes has suggested the presence of an urban-peasant-folk continuum there (1959: 365-368). El Risco, among other "peasant" sites, was one in which there could have been some ceramic specialization. Possible indications of the coordination of economic enterprises, including pottery production, have been found by Millon at Teotihuacan (1970: 1080-1081).

We have seen some regularities in the association of certain attributes in the Tulpetlac material. Although both the sample of sherds and the quantitative techniques used in the analysis were limited, we could ask whether certain cultural situations were responsible for the regularities. Could it have been based on the function of the vessels, whether it be for utilitarian purposes in the vicinity of Tulpetlac, or for use as trade items?

The purpose of this brief survey is to indicate that pottery, as an item of technology, is an economic activity that has a place within the overall political and economic systems. An analysis of the

Tulpetlac material aimed at answering questions related to this issue could be attempted.

Natural Resources. Pre-contact potters relied upon natural resources which were extracted from the physical environment. The resources include clay, temper, water, tools used in burnishing (for example wood, shell, and bone) and fuel for use in firing.

The item of temper was taken up in this study. Studies on clay, as well as on other natural resources, could be undertaken to answer questions on components and availability. Research in these areas could tell us to what extent the natural resources controlled the pottery technology of Tulpetlac.

Attribute Analysis. As defined on page 9, an attribute is a logically irreducible character. Most archaeologists will agree with Spaulding when he says, "...archaeologists are concerned only with culturally relevant attributes." (1960: 61). In determining archaeological attributes the main question is to know what is culturally relevant.

Familiarity with one's material is obviously an asset in this regard. However, it does not necessarily provide all the answers to the problem. With what level of human activity should the attribute correspond? In the case that an activity involves several variables, some of which are out of the control of the artisan, for example firing, could this be regarded as an attribute? In the event that an activity is caused through the use of a tool or tools, as in the case of burnishing, how does the analyst decide what will be an attribute?

The fact that the above questions are open-ended does not mean that an attribute analysis cannot be undertaken. Rather, the questions are general in nature and as a result need to be constantly reviewed by theoretical archaeologists. They also suggest very strongly the need for precise definitions in attribute analysis.

REFERENCES CITED

Alvarez de la Cadena, Laura, F. Franco and S. Escobar
1967 Analysis Quimico de Ceramicas Arqueologicas. Instituto Nacional de Antropologia e Historia. Mexico City.

Binford, L. R. and S. R. Binford
1966 A Preliminary Analysis of Functional Variability in the Mousterian of Levallois facies. American Anthropologist, Vol. 68, Part 2, 238-239.

Castillo Tejero, Noemi and J. Litvak
1968 Algunas Tecnicas Decorativas de la Ceramica Arqueologica de Mexico. Instituto Nacional de Antropologia e Historia, Mexico City.

Charlton, T. H.
1969 Texcoco Fabric-marked Pottery, Tlateles, and Salt-Making. American Antiquity, Vol. 34, pp. 73-76.

Clarke, D. L.
1968 Analytical Archaeology. Methuen and Company, London.

Deetz, J.
1965 The Dynamics of Stylistic Change in Arikara Ceramics. Illinois Studies in Anthropology, No. 4, Illinois

Diaz, M. N.
1966 Tonala -- Conservatism, Responsibility and Authority in a Mexican Town. University of California Press, Berkeley.

Fontana, B., W. J. Robinson, C. W. Cormack and E. Leavitt, Jr.
1962 Papago Indian Pottery. University of Washington Press, Seattle.

Foster, G. M.
1948 Empire's Children -- The People of Tzintzuntzan. Smithsonian Institute of Social Anthropology Publication No. 6. Imprenta Nuevo Mundo, S.A., Mexico City.

Franco, J. L. and F. A. Peterson
1957 Motivos Decorativos de la Ceramica Azteca. Instituto Nactional de Antropologia e Historia, Mexico City.

Garcia, Enriqueta, Federico Mooser, A. Sotomayor, J. L. Lorenzo and T. Alvarez
1968 *Materiales para la Arqueologia de Teotihuacan*. Instituto Nacional de Antropologia e Historia, Mexico City.

Griffin, J. B.
1947 Notes on Some Ceramic Techniques and Intrusions in Central Mexico. *American Antiquity*, Vol. 12, pp. 156-168.

Hodges, H.
1964 *Artefacts*. John Baker Publishers Ltd., Great Britain.

Huntsberger, D. V.
1967 *Elements of Statistical Inference*. Allyn and Bacon, Boston.

Mayer-Oakes, W. J.
1959 A Stratigraphic Excavation at El Risco, Mexico. Proceedings of the American Philosophical Society, Vol. 103, No. 3.

Millon, R.
1970 Teotihuacan. *Science*, Vol. 170, No. 3962, pp. 1077-1082.

Sackett, J. R.
1966 Quantitative Analysis of Upper Paleolithic Stone Tools. *American Anthropologist*, Vol. 68, Part 2, pp. 356-392.

Spaulding, A. C.
1960 Statistical Description and Comparison of Artifact Assemblages. In *The application of Quantitative Methods in Archaeology*, edited by F. R. Heizer and S. F. Cook, pp. 60-83. Quadrangle Books Inc., Chicago.

Shepard, Anna O.
1968 *Ceramics for The Archaeologist*. Carnegie Institution of Washington Publication No. 609, Washington, D.C.

Thompson, R. H.
1958 Modern Yucatan Maya Pottery Making. Memoirs of the Society for American Archaeology, No. 15, *American Antiquity*, Vol. 23, Part 2.

Tolstoy, P.
1958 Surface Survey of the Northern Valley of Mexico: the Classic and Post-classic Periods. Transactions of the American Philosophical Society, Vol. 48, Part 5, Pennsylvania.

Wright, J. V.
1967 Type and Attribute Analysis: Their Application to Iroquois Culture History. In Iroquois Culture History and Prehistory, Proceedings of the 1965 Conference on Iroquois Research, pp. 99-100, New York State Museum and Science Service, Albany, New York.

APPENDIX A

VALLEY OF MEXICO SHERD ATTRIBUTES

1.	Rim Number:	(1) -------
2.	Site:	(1) Tecoalapan (2) Tulpetlac (3) El Corral
3.	Level:	(1)-(10) Tecoalapan 1-10 (11)-(20) Tulpetlac 1-10 (21)-(31) El Corral 1-11
4.	Sherd Type:	(1) rim (2) shoulder (3) body (4) base
5.	Paste Color:	(1) black (2) brown (3) tan (4) orange (5) gray (6) mauve
6.	Temper:	(1) sand (2) calcite (3) other
7.	Temper Size:	(1) fine (2) medium (3) coarse
8.	Temper Proportion:	(1) 0-10% (2) 10-20% (3) 20-30% (4) 30-40% (5) 40-50% (6) 50-100%
9.	Texture:	(1) granular (2) compact (3) laminated (4) Tepeyac paste
10.	Firing:	(1) complete (2) dark core (3) dark interior (4) dark exterior
11.	Rim Thickness:	(1) thin (less than 7 mm) (2) thick (greater than 7.5 mm)
12.	Rim Classification:	(1) A (2) B (3) C (4) D (5) E (6) Fs (7) Fc (8) G (9) H (10) I (11) J (12) other (13) indeterminate
13.	Rim Curve (I):	(1) concave (2) convex (3) straight (4) indeterminate
14.	Rim Curve (II):	(1) slight (2) moderate (3) extreme (4) rounded angular (5) sharp angular (6) not applicable (7) indeterminate
15.	Rim Slope (I):	(1) insloping (2) outsloping (3) vertical (4) indeterminate
16.	Rim Slope (II):	(1) slight (2) moderate (3) extreme (4) not applicable (5) indeterminate
17.	Rim Form:	(1) tapered (2) thickened (3) parallel sided (4) indeterminate

18. Lip Form (I): (1) simple (2) complex (3) indeterminate

19. Lip Form (II): (1) squared (2) rounded (3) flattened horizontally (4) flattened non-horizontally (5) indeterminate

20. Interior Color: (1) black (2) brown (3) red (4) white (5) orange (6) yellow (7) gray (8) other (9) eroded

21. Exterior Color: (1) black (2) brown (3) red (4) white (5) orange (6) yellow (7) gray (8) other (9) eroded

22. Interior Surface Treatment: (1) burnished (2) partially burnished (3) slipped (4) plain (5) multiple (6) other (7) eroded (8) fabric marked

23. Exterior Surface Treatment: (1) burnished (2) partially burnished (3) slipped (4) plain (5) multiple (6) other (7) eroded (8) fabric marked

24. Lip Surface Treatment: (1) burnished (2) partially burnished (3) slipped (4) plain (5) multiple (6) other (7) eroded (8) fabric marked

25. Interior Surface Decoration: (1) engraved (2) incised (3) punctate (4) trailed stick (5) fingernail incised (6) painted (7) painted and incised (8) other (9) absent (10) grooved (11) multiple

26. Exterior Surface Decoration: (1) engraved (2) incised (3) punctate (4) trailed stick (5) fingernail incised (6) painted (7) painted and incised (8) other (9) absent (10) grooved (11) multiple

27. Lip Decoration: (1) engraved (2) incised (3) punctate (4) trailed stick (5) fingernail incised (6) painted (7) painted and incised (8) other (9) absent (10) grooved (11) multiple

28. Location of Interior Decoration: (1) rim (2) neck (3) shoulder (4) body (5) absent

29. Location of Exterior Decoration: (1) rim (2) neck (3) shoulder (4) body (5) absent

30. Appendages: (1) filleted strip (2) strap handle (3) loop handle (4) stroop handle (5) lug (6) castellation (7) other (8) none

31.	Vessel Form:	(1) comal (2) cajete (3) molcajete (4) cazuela (5) olla (6) tecomate (7) hemispheric bowl (8) cylindrical jar (9) saucer (10) basin (11) indeterminate
32.	Rim Diameter:	(1) 0-2 cm ----------- (18) 34.1-36 cm (19) greater than 36 cm (20) indeterminate
33.	Painted Decoration: (interior)	(1) red (2) white (3) black (4) brown (5) other (6) absent
34.	Painted Decoration: (exterior)	(1) red (2) white (3) black (4) brown (5) other (6) absent
35.	Painted Decoration: (lip)	(1) red (2) white (3) black (4) brown (5) other (6) absent

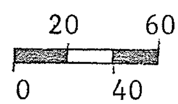
APPENDIX B

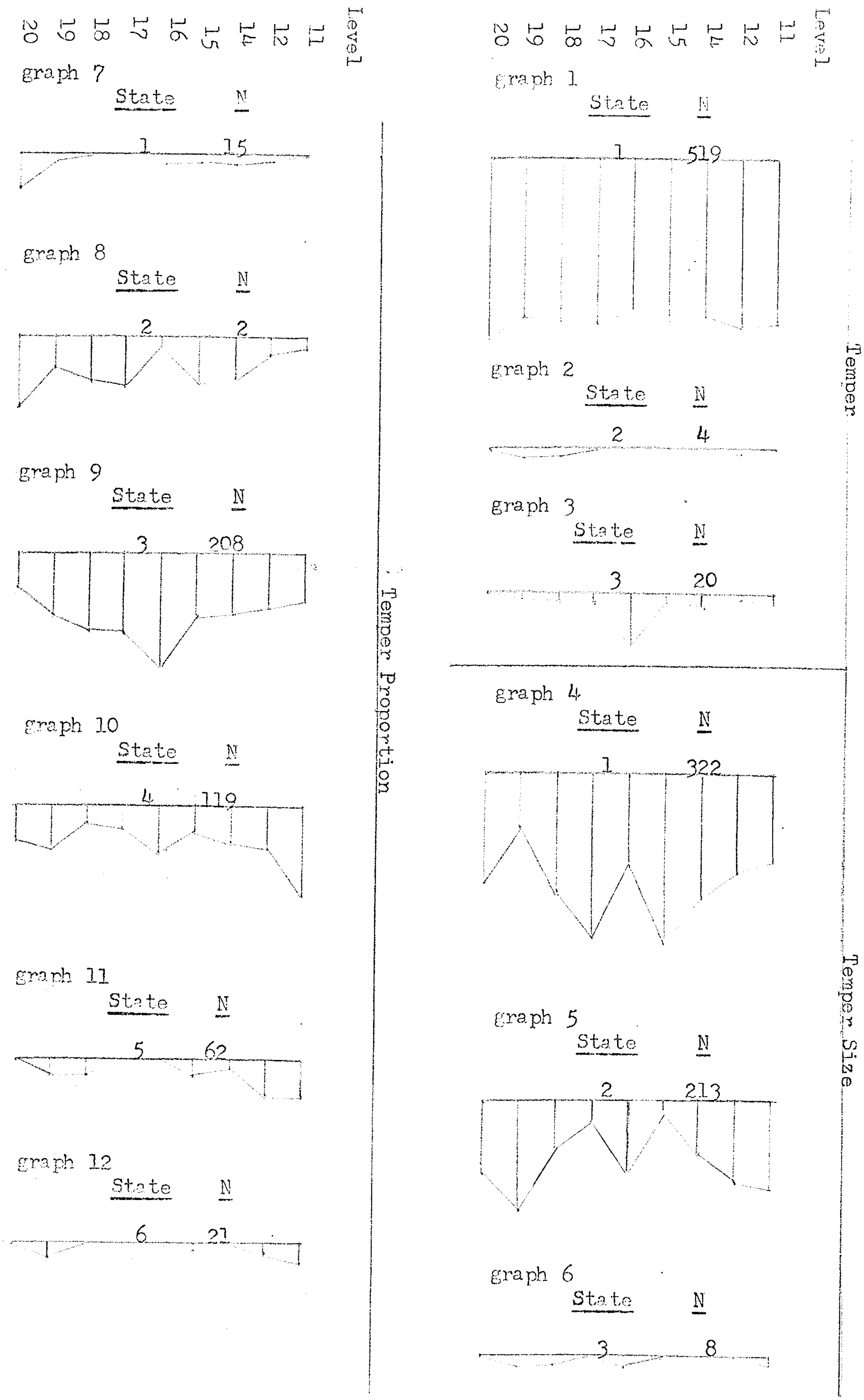
PERCENTAGE HISTOGRAMS

There are fifty-five percentage histograms, each representing one attribute state. The states are placed under the appropriate attributes.

The percentage of each level or surface collection is calculated out of the total number for that state in the entire collection. For further discussion, see page 19.

Percentage Scale




Level
11
12
14
15
16
17
18
19
20
graph 1
State N
1 519
graph 2
State N
2 4
graph 3
State N
3 20
graph 4
State N
1 322
graph 5
State N
2 213
graph 6
State N
3 8
Temper
Temper Size
graph 7
State N
1 15
graph 8
State N
2 2
graph 9
State N
3 208
graph 10
State N
4 119
graph 11
State N
5 62
graph 12
State N
6 21
Temper Proportion

Level 11 12 14 15 16 17 18 19 20

graph 13

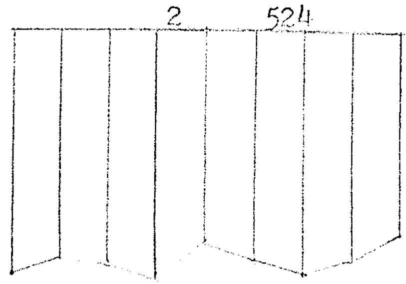
State N

1 11

graph 14

State N

2 524



graph 15

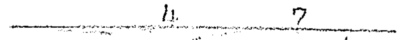
State N

3 1

graph 16

State N

4 7

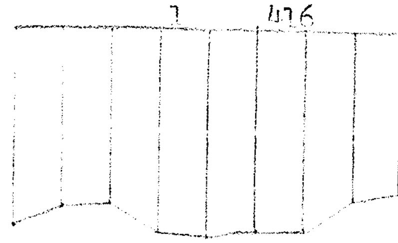


Texture

graph 17

State N

1 416



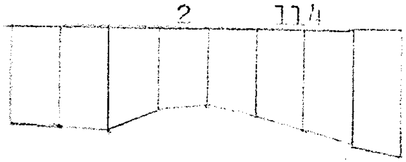
Firing

Level 11 12 14 15 16 17 18 19 20

graph 18

State N

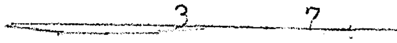
2 114



graph 19

State N

3 7



graph 20

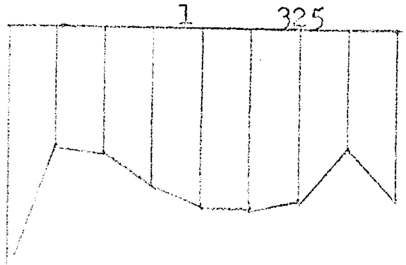
State N

4 6

graph 21

State N

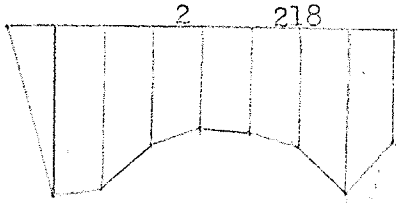
1 325



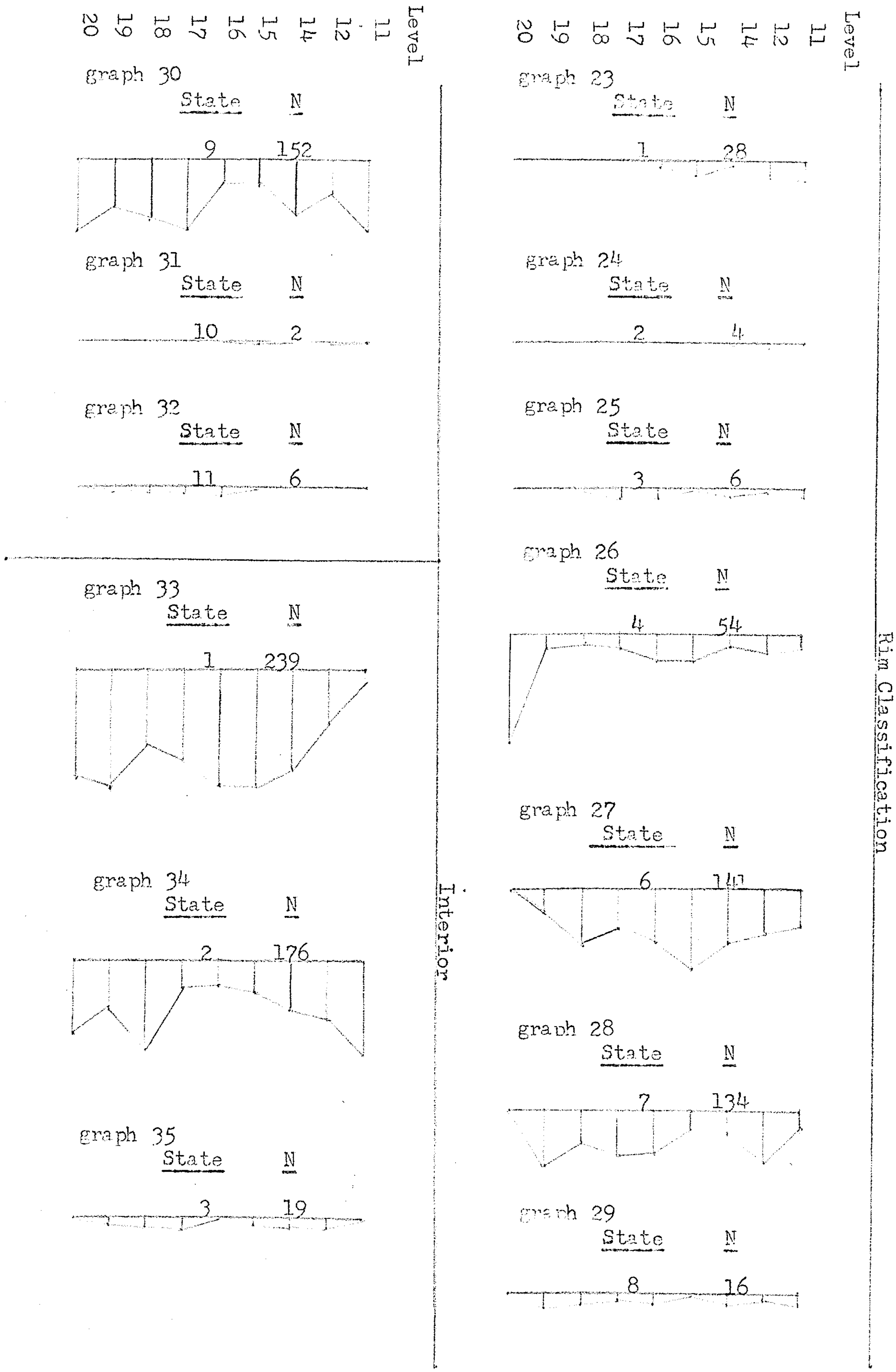
graph 22

State N

2 218



Rim Thickness


Level
20 19 18 17 16 15 14 12 11
graph 23
State N
1 28
graph 24
State N
2 4
graph 25
State N
3 6
graph 26
State N
4 54
graph 27
State N
6 140
graph 28
State N
7 134
graph 29
State N
8 16
Rim Classification
Level
20 19 18 17 16 15 14 12 11
graph 30
State N
9 152
graph 31
State N
10 2
graph 32
State N
11 6
graph 33
State N
1 239
graph 34
State N
2 176
graph 35
State N
3 19
Interior

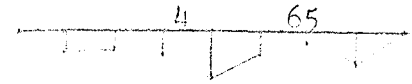
Level 11 12 14 15 16 17 18 19 20

Surface Treatment

graph 36

State N

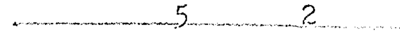
4 65



graph 37

State N

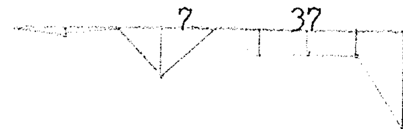
5 2



graph 38

State N

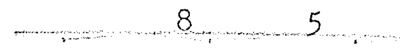
7 37



graph 39

State N

8 5

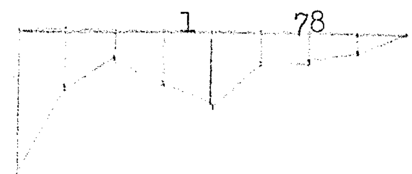


Exterior

graph 40

State N

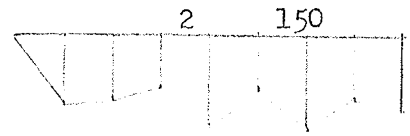
1 78



graph 41

State N

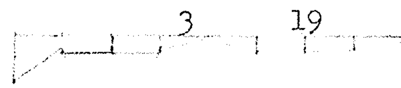
2 150



graph 42

State N

3 19



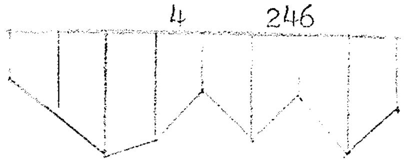
Level 11 12 14 15 16 17 18 19 20

Surface Treatment

graph 43

State N

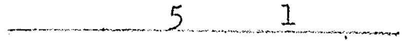
4 246



graph 44

State N

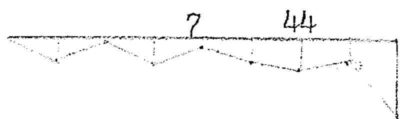
5 1



graph 45

State N

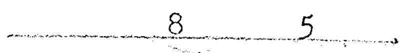
7 44



graph 46

State N

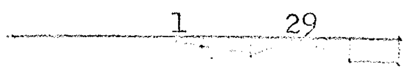
8 5



graph 47

State N

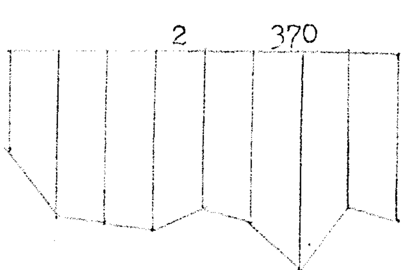
1 29



graph 48

State N

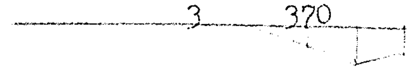
2 370



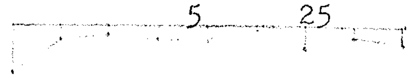
Vessel Form

Level 11 12 14 15 16 17 18 19 20

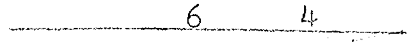
graph 49
State N
3 370



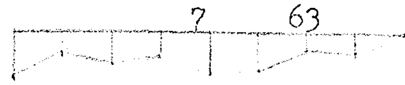
graph 50
State N
5 25



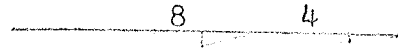
graph 51
State N
6 4



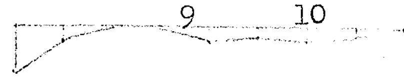
graph 52
State N
7 63



graph 53
State N
8 4



graph 54
State N
9 10



graph 55
State N
11 15

APPENDIX C

Appendix C consists of contingency tables not discussed in detail in the text (see pages 24-43).

Table 17

Contingency Table between Temper and Temper Size

		Temper Size			
Temper	Column	1	2	3	Row Total
1	Ob.	314	201	4	519
	Ex.	307.78	203.59	7.65	
	x^2	.12	.03	1.74	
2	Ob.	0	4	0	4
	Ex.	2.37	1.57	.06	
	x^2	2.37	3.75	.00	
3	Ob.	8	8	4	20
	Ex.	11.86	7.85	.30	
	x^2	1.25	.00	45.63	
Column Total		322	213	8	
Grand Total		543			
Accum. x^2		54.89			

Table 18

Contingency Table between Temper and Temper Proportion

		Temper Proportion						
Temper	Column	1	2	3	4	5	6	Row Total
1	Ob.	15	117	203	111	58	15	519
	Ex.	14.34	112.78	198.81	113.74	59.26	20.01	
	x^2	.03	.15	.08	.06	.02	1.25	
2	Ob.	0	0	0	0	1	3	4
	Ex.	.11	.87	1.53	.88	.46	.15	
	x^2	.09	.87	1.52	.87	.63	54.13	
3	Ob.	0	1	5	8	3	3	20
	Ex.	.55	4.35	7.66	4.38	2.28	.77	
	x^2	.54	2.57	.92	2.99	.22	6.45	
Column Total		15	118	208	119	62	21	
Grand Total		543						
Accum. x^2		73.39						

Table 19

Contingency Table between Temper and Texture

		Texture				
Temper	Column	1	2	3	4	Row Total
1	Ob.	9	508	1	1	519
	Ex.	10.51	500.84	.96	6.69	
	x^2	.21	.28	.00	4.84	
2	Ob.	2	1	0	1	4
	Ex.	.08	3.86	.01	.05	
	x^2	46.12	2.11	.00	18.00	
3	Ob.	0	15	0	5	20
	Ex.	.41	19.30	.04	.26	
	x^2	.41	.95	.00	86.42	
Column Total		11	524	1	7	
Grand Total		543				
Accum. x^2		159.34				

Table 20

Contingency Table between Temper and Firing

		Firing				
Temper	Column	1	2	3	4	Row Total
1	Ob.	398	108	7	6	519
	Ex.	397.61	108.96	6.70	5.73	
	x^2	.00	.00	.01	.01	
2	Ob.	4	0	0	0	4
	Ex.	3.06	.84	.05	.04	
	x^2	.28	.84	.00	.00	
3	Ob.	14	6	0	0	20
	Ex.	15.32	4.20	.26	.02	
	x^2	.11	.77	.26	.00	
Column Total		416	114	7	6	
Grand Total		543				
Accum. x^2		2.28				

Table 21

Contingency Table between Temper and Rim Thickness

		Rim Thickness		
Temper	Column	1	2	Row Total
1	Ob.	305	214	519
	Ex.	310.63	208.36	
	x^2	.10	.15	
2	Ob.	4	0	4
	Ex.	2.39	1.60	
	x^2	1.08	1.60	
3	Ob.	16	4	20
	Ex.	11.97	8.02	
	x^2	1.35	2.01	
Column Total		325	218	
Grand Total		543		
Accum. x^2		6.29		

Table 22

Contingency Table between Temper and Rim Classification

Temper	Column	Rim Classification 1	2	3	4	6	7	8	9	10	11	Row Total
1	Ob.	26	4	6	46	135	132	16	150	2	2	519
	Ex.	26.76	3.82	5.73	51.61	134.77	128.08	15.29	145.28	1.91	5.73	
	x^2	.02	.00	.01	.60	.00	.12	.03	.15	.00	2.42	
2	Ob.	0	0	0	2	2	0	0	0	0	0	4
	Ex.	.21	.03	.04	.40	1.04	.99	.12	1.11	.01	.04	
	x^2	.19	.00	.00	6.40	.88	.98	.08	1.10	.00	.00	
3	Ob.	2	0	0	6	4	2	0	2	0	4	20
	Ex.	1.03	.15	.22	1.99	5.19	4.94	.58	5.60	.07	.22	
	x^2	.91	.13	.22	8.08	.27	1.74	.58	2.31	.00	64.95	
Column Total		28	4	6	54	141	134	16	152	2	6	
Grand Total		543										
Accum. x^2		92.17										

Table 23

Contingency Table between Temper and Interior Surface Treatment

		Interior Surface Treatment							
Temper	Column	1	2	3	4	5	7	8	Row Total
1	Ob.	225	170	19	62	2	37	4	519
	Ex.	228.44	168.22	18.20	62.13	1.91	35.36	4.78	
	x^2	.05	.01	.03	.00	.00	.08	.12	
2	Ob.	4	4	0	0	0	0	0	4
	Ex.	1.76	1.30	.17	.48	.02	.27	.04	
	x^2	2.85	1.3	.17	.47	.00	.25	.00	
3	Ob.	10	6	0	3	0	0	1	20
	Ex.	8.80	6.48	.70	2.40	.07	1.36	.19	
	x^2	.16	.03	.7	.15	.00	1.36	3.47	
Column Total		239	176	19	65	2	37	5	
Grand Total		543							
Accum. x^2		11.20							

Table 24

Contingency Table between Temper and Exterior Surface Treatment

Temper	Column	Exterior Surface Treatment 1	2	3	4	5	7	8	Row Total
1	Ob.	71	143	19	241	1	43	1	519
	Ex.	74.60	143.37	18.16	235.13	.95	42.06	4.78	
	x^2	.17	.00	.03	.14	.00	.02	2.98	
2	Ob.	3	0	0	1	0	0	0	4
	Ex.	.57	1.10	.14	1.81	.01	.32	.04	
	x^2	10.35	1.10	.14	.36	.00	.31	.00	
3	Ob.	4	7	0	4	0	1	4	20
	Ex.	2.87	5.52	.70	9.06	.04	1.62	.18	
	x^2	.44	.39	.70	2.82	.00	.23	81.05	
Column Total		78	150	19	246	1	44	5	
Grand Total		543							
Accum. x^2		101.23							

Table 25

Contingency Table between Temper Size and Texture

Temper Size	Column	Texture 1	2	3	4	Row Total
1	Ob.	1	319	1	1	322
	Ex.	6.52	310.73	.59	4.15	
	x^2	4.67	.22	.28	2.39	
2	Ob.	8	203	0	2	213
	Ex.	4.31	205.55	.39	2.74	
	x^2	3.16	.03	.38	.20	
3	Ob.	2	2	0	4	8
	Ex.	.16	7.72	.01	.10	
	x^2	21.18	4.23	.00	152.10	
Column Total		11	524	1	7	
Grand Total		543				
Accum. x^2		118.84				

Table 26

Contingency Table between Temper Size and Firing

Temper Size	Column	Firing 1	2	3	4	Row Total
1	Ob.	239	77	2	4	322
	Ex.	246.69	67.60	4.15	3.56	
	x^2	.20	1.30	1.11	.05	
2	Ob.	174	32	5	2	213
	Ex.	163.18	44.72	2.74	2.35	
	x^2	.71	3.61	1.86	.05	
3	Ob.	3	5	0	0	8
	Ex.	6.13	1.67	.10	.09	
	x^2	1.59	6.64	.10	.11	
Column Total		416	114	7	6	
Grand Total		543				
Accum. x^2		17.33				

Table 27

Contingency Table between Temper Proportion and Texture

Temper Proportion	Column	Texture 1	2	3	4	Row Total
1	Ob.	0	14	0	1	15
	Ex.	.30	14.48	.03	.19	
	x^2	.30	.01	.00	3.47	
2	Ob.	1	117	0	0	118
	Ex.	2.39	113.87	.22	1.52	
	x^2	.80	.08	.22	1.51	
3	Ob.	1	205	1	1	208
	Ex.	4.21	200.72	.38	2.68	
	x^2	2.44	.09	1.00	1.05	
4	Ob.	2	113	0	4	119
	Ex.	2.41	114.84	.22	1.53	
	x^2	.07	.02	.22	3.98	
5	Ob.	1	60	0	1	62
	Ex.	1.26	59.83	.11	.80	
	x^2	.05	.00	.09	.05	
6	Ob.	6	15	0	0	21
	Ex.	.43	20.27	.04	.27	
	x^2	72.13	1.37	.00	.25	
Column Total		11	524	1	7	
Grand Total		543				
Accum. x^2		89.20				

Table 28

Contingency Table between Temper Proportion and Firing

Temper Proportion	Column	Firing 1	2	3	4	Row Total
1	Ob.	11	4	0	0	15
	Ex.	11.49	3.15	.19	.17	
	x^2	.02	.22	.21	.17	
2	Ob.	85	31	0	2	118
	Ex.	90.40	24.77	1.52	1.30	
	x^2	.32	1.56	1.51	.37	
3	Ob.	157	43	4	4	208
	Ex.	159.35	43.67	2.68	2.30	
	x^2	.03	.01	.64	1.25	
4	Ob.	98	19	2	0	119
	Ex.	91.17	24.98	1.53	1.31	
	x^2	.51	1.43	.14	1.31	
5	Ob.	47	14	1	0	62
	Ex.	47.50	13.02	.80	.69	
	x^2	.00	.07	.05	.69	
6	Ob.	18	3	0	0	21
	Ex.	16.89	4.41	.27	.23	
	x^2	.22	.45	.25	.21	
Column Total		416	114	7	6	
Grand Total		543				
Accum. x^2		10.21				

Table 29

Contingency Table between Texture and Firing

		Firing				
Texture	Column	1	2	3	4	Row Total
1	Ob.	10	1	0	0	11
	Ex.	8.43	2.31	.14	.12	
	x^2	.29	.60	.14	.08	
2	Ob.	403	108	7	6	524
	Ex.	401.44	110.01	6.76	5.79	
	x^2	.00	.03	.00	.00	
3	Ob.	1	0	0	0	1
	Ex.	.77	.21	.01	.01	
	x^2	.06	.19	.00	.00	
4	Ob.	2	5	0	0	7
	Ex.	5.36	1.47	.09	.08	
	x^2	2.10	8.47	.11	.12	
Column Total		416	114	7	6	
Grand Total		543				
Accum. x^2		12.33				

Table 30

Contingency Table between Texture and Rim Thickness

		Rim Thickness		
Texture	Column	1	2	Row Total
1	Ob.	5	6	11
	Ex.	6.58	4.42	
	x^2	.37	.56	
2	Ob.	317	207	524
	Ex.	313.63	210.37	
	x^2	.03	.05	
3	Ob.	1	0	1
	Ex.	.60	.40	
	x^2	.26	.40	
4	Ob.	2	5	7
	Ex.	4.19	2.81	
	x^2	1.14	1.70	
Column Total		325	218	
Grand Total		543		
Accum. x^2		4.51		

Table 31

Contingency Table between Texture and Rim Classification

		Rim Classification										
Texture	Column	1	2	3	4	6	7	8	9	10	11	Row Total
1	Ob.	0	0	0	2	4	1	1	3	0	0	11
	Ex.	.57	.08	.12	1.09	2.86	2.72	.32	3.08	.04	.12	
	x^2	.56	.12	.08	.76	.45	1.08	1.43	.00	.00	.08	
2	Ob.	24	4	6	51	135	132	15	149	2	6	524
	Ex.	27.02	3.86	5.79	52.11	136.06	129.31	15.44	146.68	1.93	5.79	
	x^2	.33	.00	.00	.02	.00	.05	.01	.03	.00	.00	
3	Ob.	0	0	0	0	1	0	0	0	0	0	1
	Ex.	.05	.01	.01	.10	.26	.25	.03	.28	.00	.01	
	x^2	.00	.00	.00	.10	2.11	.24	.00	.28	.00	.00	
4	Ob.	4	0	0	1	1	1	0	0	0	0	7
	Ex.	.36	.05	.08	.70	1.82	1.72	.21	1.96	.03	.08	
	x^2	36.80	.00	.12	.12	.36	.30	.19	1.95	.00	.12	
Column Total		28	4	6	54	141	134	16	152	2	6	
Grand Total		543										
Accum. x^2		47.69										

Table 32

Contingency Table between Texture and Interior Surface Treatment

		Interior Surface Treatment							
Texture	Column	1	2	3	4	5	7	8	Row Total
1	Ob.	2	5	0	3	0	1	0	11
	Ex.	4.84	3.57	.39	1.32	.04	.75	.10	
	x^2	1.66	.57	.38	2.13	.00	.08	.10	
2	Ob.	234	171	19	58	2	36	4	524
	Ex.	230.64	169.84	18.34	62.73	1.93	35.71	4.83	
	x^2	.04	.00	.02	.35	.00	.00	.14	
3	Ob.	0	0	0	1	0	0	0	1
	Ex.	.44	.32	.04	.12	.00	.07	.01	
	x^2	.43	.31	.00	6.41	.00	.00	.00	
4	Ob.	3	0	0	3	0	0	1	7
	Ex.	3.08	2.27	.25	.84	.03	.48	.06	
	x^2	.00	2.26	.24	5.55	.00	.47	14.66	
Column Total		239	176	19	65	2	37	5	
Grand Total		543							
Accum. x^2		35.80							

Table 33

Contingency Table between Texture and Exterior Surface Treatment

		Exterior Surface Treatment							
Texture	Column	1	2	3	4	5	7	8	Row Total
1	Ob.	2	2	0	5	0	2	0	11
	Ex.	1.58	3.04	.39	4.98	.02	.89	.10	
	x^2	.11	.35	.38	.00	.00	1.38	.10	
2	Ob.	75	148	19	236	1	42	3	524
	Ex.	75.27	144.75	18.34	237.39	.97	42.46	4.83	
	x^2	.00	.07	.02	.00	.00	.00	.69	
3	Ob.	0	0	0	1	0	0	0	1
	Ex.	.14	.28	.04	.45	.00	.08	.00	
	x^2	.14	.28	.00	.66	0	.12	0	
4	Ob.	1	0	0	4	0	0	2	7
	Ex.	1.01	1.93	.25	3.17	.01	.57	.06	
	x^2	.00	1.92	.24	.21	.00	.56	62.66	
Column Total		78	150	19	246	1	44	5	
Grand Total		543							
Accum. x^2		69.89							

Table 34

Contingency Table between Firing and Rim Thickness

		Rim Thickness		
Firing	Column	1	2	Row Total
1	Ob.	248	168	416
	Ex.	248.99	167.01	
	x^2	.00	.00	
2	Ob.	72	42	114
	Ex.	68.23	45.77	
	x^2	.20	.31	
3	Ob.	0	7	7
	Ex.	4.19	2.81	
	x^2	4.19	6.24	
4	Ob.	5	1	6
	Ex.	3.59	2.41	
	x^2	.55	.82	
Column Total		325	218	
Grand Total		543		
Acc. x^2		12.13		

Table 35

Contingency Table between Firing and Rim Classification

		Rim Classification										
Firing	Column	1	2	3	4	6	7	8	9	10	11	Row Total
1	Ob.	24	2	5	41	102	109	13	116	2	2	416
	Ex.	21.45	3.06	4.60	41.37	108.02	102.66	12.26	116.45	1.53	4.60	
	x^2	.30	.36	.03	.00	.33	.39	.04	.00	.14	1.46	
2	Ob.	3	2	1	12	35	20	3	34	0	4	114
	Ex.	5.88	.84	1.26	11.34	29.60	28.13	3.36	31.91	.42	1.26	
	x^2	1.40	1.60	.05	.03	.98	2.34	.03	.13	.42	5.96	
3	Ob.	1	0	0	0	1	3	0	2	0	0	7
	Ex.	.36	.05	.07	.70	1.82	1.73	.21	1.96	.03	.08	
	x^2	1.13	.00	.00	.70	.36	.93	.19	.00	.00	.12	
4	Ob.	0	0	0	1	3	2	0	0	0	0	6
	Ex.	.31	.04	.07	.60	1.56	1.48	.18	1.68	.02	.06	
	x^2	.32	.00	.00	.26	1.32	.18	.16	1.67	.00	.00	
Column Total		28	4	6	54	141	134	16	152	2	6	
Grand Total		543										
Accum. x^2		23.93										

Table 36

Contingency Table between Firing and Interior Surface Treatment

		Interior Surface Treatment							
Firing	Column	1	2	3	4	5	7	8	Row Total
1	Ob.	193	134	13	45	2	25	4	416
	Ex.	183.10	134.84	14.56	49.80	1.53	28.35	3.83	
	x^2	.53	.00	.16	.46	.14	.39	.00	
2	Ob.	41	37	6	17	0	12	1	114
	Ex.	50.18	36.95	3.99	13.65	.42	7.77	1.05	
	x^2	1.67	.00	1.01	.82	.42	2.30	.00	
3	Ob.	1	3	0	3	0	0	0	7
	Ex.	3.08	2.27	.25	.84	.03	.48	.06	
	x^2	1.40	.23	.24	5.55	.00	.47	.00	
4	Ob.	4	2	0	0	0	0	0	6
	Ex.	2.64	1.95	.21	.72	.02	.41	.06	
	x^2	.70	.00	.19	.72	.00	.41	.00	
Column Total		239	176	19	65	2	37	5	
Grand Total		543							
Accum. x^2		17.81							

Table 37

Contingency Table between Firing and Exterior Surface Treatment

		Exterior Surface Treatment							
Firing	Column	1	2	3	4	5	7	8	Row Total
1	Ob.	62	113	12	194	0	34	1	416
	Ex.	59.76	114.92	14.56	188.46	.77	33.71	3.83	
	x^2	.08	.03	.44	.16	.76	.00	2.09	
2	Ob.	14	35	7	43	1	10	4	114
	Ex.	16.38	31.49	3.99	51.65	.21	9.24	1.05	
	x^2	.34	.39	2.27	1.44	2.95	.06	8.28	
3	Ob.	0	0	0	7	0	0	0	7
	Ex.	1.01	1.93	.25	3.17	.01	.57	.06	
	x^2	1.00	1.92	.24	4.62	.00	.56	.00	
4	Ob.	2	2	0	2	0	0	0	6
	Ex.	.86	1.66	.21	2.72	.01	.49	.06	
	x^2	1.51	.07	.19	.19	.00	.48	.00	
Column Total		78	150	19	246	1	44	5	
Grand Total		543							
Accum. x^2		30.07							

Table 38

Contingency Table between Temper Size and Temper Proportion

Temper Size	Column	Temper Proportion 1	2	3	4	5	6	Row Total
1	Ob.	14	104	136	48	19	1	322
	Ex.	8.90	69.97	123.34	70.57	36.77	12.45	
	x^2	2.92	16.57	1.30	7.22	8.59	10.63	
2	Ob.	1	14	71	68	40	19	213
	Ex.	5.88	46.29	81.59	46.68	24.32	8.24	
	x^2	4.05	22.52	1.37	9.74	10.11	14.05	
3	Ob.	0	0	1	3	3	1	8
	Ex.	.22	1.74	3.06	1.75	.91	.31	
	x^2	.22	1.74	1.39	.89	4.80	1.54	
Column Total		15	118	208	119	62	21	
Grand Total		543						
Accum. x^2		119.63						

Table 39

Contingency Table between Temper Size and Rim Thickness

Temper Size	Column	Rim Thickness 1	2	Row Total
1	Ob.	241	81	322
	Ex.	192.73	129.27	
	x^2	12.08	18.02	
2	Ob.	82	131	213
	Ex.	127.49	85.51	
	x^2	16.23	24.19	
3	Ob.	2	6	8
	Ex.	4.79	3.21	
	x^2	1.62	2.42	
Column Total		325	218	
Grand Total		543		
Accum. x^2		74.56		

Table 40

Contingency Table between Temper Size and Interior Surface Treatment

Temper Size	Column	Interior Surface Treatment 1	2	3	4	5	7	8	Row Total
1	Ob.	145	105	15	30	0	23	4	322
	Ex.	141.72	104.37	11.27	38.55	1.19	21.94	2.97	
	x^2	.07	.00	1.23	1.89	1.19	.05	.35	
2	Ob.	93	68	4	33	2	13	0	213
	Ex.	93.75	69.04	7.45	25.50	.78	14.51	1.96	
	x^2	.00	.01	1.59	2.20	1.91	.15	1.95	
3	Ob.	1	3	0	2	0	1	1	8
	Ex.	3.52	2.59	.28	.96	.03	.55	.07	
	x^2	1.80	.06	.28	1.12	.00	.36	12.28	
Column Total		239	176	19	65	2	37	5	
Grand Total		543							
Accum. x^2		28.49							

Table 41

Contingency Table between Temper Size and Exterior Surface Treatment

Temper Size	Column	Exterior Surface Treatment 1	2	3	4	5	7	8	Row Total
1	Ob.	47	109	15	123	1	26	1	322
	Ex.	47.44	89.54	10.67	147.06	.59	24.31	2.37	
	x^2	.00	4.22	1.75	3.93	.28	.11	.79	
2	Ob.	33	42	3	120	0	15	0	213
	Ex.	31.38	59.23	7.06	97.28	.39	16.08	1.56	
	x^2	.08	5.01	2.33	5.30	.38	.07	1.55	
3	Ob.	0	0	0	5	0	0	3	8
	Ex.	1.18	2.22	.27	3.65	.01	.60	.06	
	x^2	1.17	2.22	.25	.49	.00	.60	144.00	
Column Total		80	151	18	248	1	41	4	
Grand Total		543							
Accum. x^2		174.53							

Table 42

Contingency Table between Temper Proportion and Interior Surface Treatment

Temper Proportion	Column	Interior Surface Treatment 1	2	3	4	5	7	8	Row Total
1	Ob.	9	2	2	2	0	0	0	15
	Ex.	6.60	4.86	.53	1.80	.06	1.02	.14	
	x^2	.87	1.68	4.07	.02	.00	1.01	.14	
2	Ob.	57	42	4	7	1	7	0	118
	Ex.	51.94	38.25	4.13	14.13	.44	8.04	1.09	
	x^2	.49	.36	.00	3.59	.70	.13	1.09	
3	Ob.	102	54	13	23	1	10	5	208
	Ex.	91.55	67.42	7.28	24.90	.77	14.17	1.92	
	x^2	1.19	2.67	4.49	.14	.06	1.22	4.94	
4	Ob.	43	48	0	20	0	8	0	119
	Ex.	52.38	38.57	4.16	14.25	.44	8.11	1.10	
	x^2	1.67	2.30	4.16	2.32	.43	.00	1.10	
5	Ob.	18	22	0	11	0	11	0	62
	Ex.	27.29	20.10	2.2	7.42	.23	4.23	.57	
	x^2	3.16	.17	2.20	1.72	.21	10.83	.56	
6	Ob.	10	8	0	2	0	1	0	21
	Ex.	9.24	6.81	.74	2.51	.08	1.43	.2	
	x^2	.06	.20	.74	.10	.12	.12	.20	
Column Total		239	176	19	65	2	37	5	
Grand Total		543							
Accum. x^2		62.22							