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Archaeological inferential classification considered over fixed attribute fields using various quantitative models

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ARCHAEOLOGICAL INFERENTIAL CLASSIFICATION CONSIDERED OVER FIXED ATTRIBUTE FIELDS USING VARIOUS QUANTITATIVE MODELS

By

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Recent research into the multivariate analysis of artifactual material in archaeology suggests that when data fields are coded with the appropriate spatial and formal attributes, the artifacts then can be classified into an appropriate number of "types" or classes as suggested by the multivariate model. These results have been interpreted as supporting the notion that the artifact makers may possess some preferences for certain attribute combinations. In other words, the variability in a collection of archaeological units, reflecting the technological and stylistic preferences of tool makers, can be represented in a multivariate space that represents those essential dimensions or preferences.

The present study was designed to investigate four techniques of inferential multivariate classification when considered across fixed artifact attribute fields. The artifacts were defined as houses in the Clear Creek drainage. The attribute field was defined by 93 formal and spatial attributes that were most likely to be affected by changes in style and technology. These artifact attributes were assumed to represent meaningful units of behavior. A total of 33 houses were recorded and coded across this attribute profile. The coded information list was then transformed into units of data defining two sets of relations for each occurrance coefficient. One set defined relations between artifacts (O-mode), and the other defined relations between attributes (R-mode). No attempt was made to mathematically examine the relationships between attributes and artifacts (joint space). For all analyses each provided a set of classes, such that the classifications were judged to reveal essentially the same space in all cases. Hypotheses were presented to account for the obtained variability in the artifact record. Extensive interviews with architects and resident informants suggested that changes in technological innovations and style accounted for this variability.

The results showed it was possible to relate the changes in the artifactual form to human behavior, indicating that with knowledge of potentially analogous behavior, it is possible to stimulate adequate explanations using these techniques of multivariate analysis. Thus, the hypotheses of change in preferred houseform was mildly supported relative to the available data. The results were also interpreted as suggesting that the artifacts studied, essentially varied in minimal amounts according to their location across the landscape.

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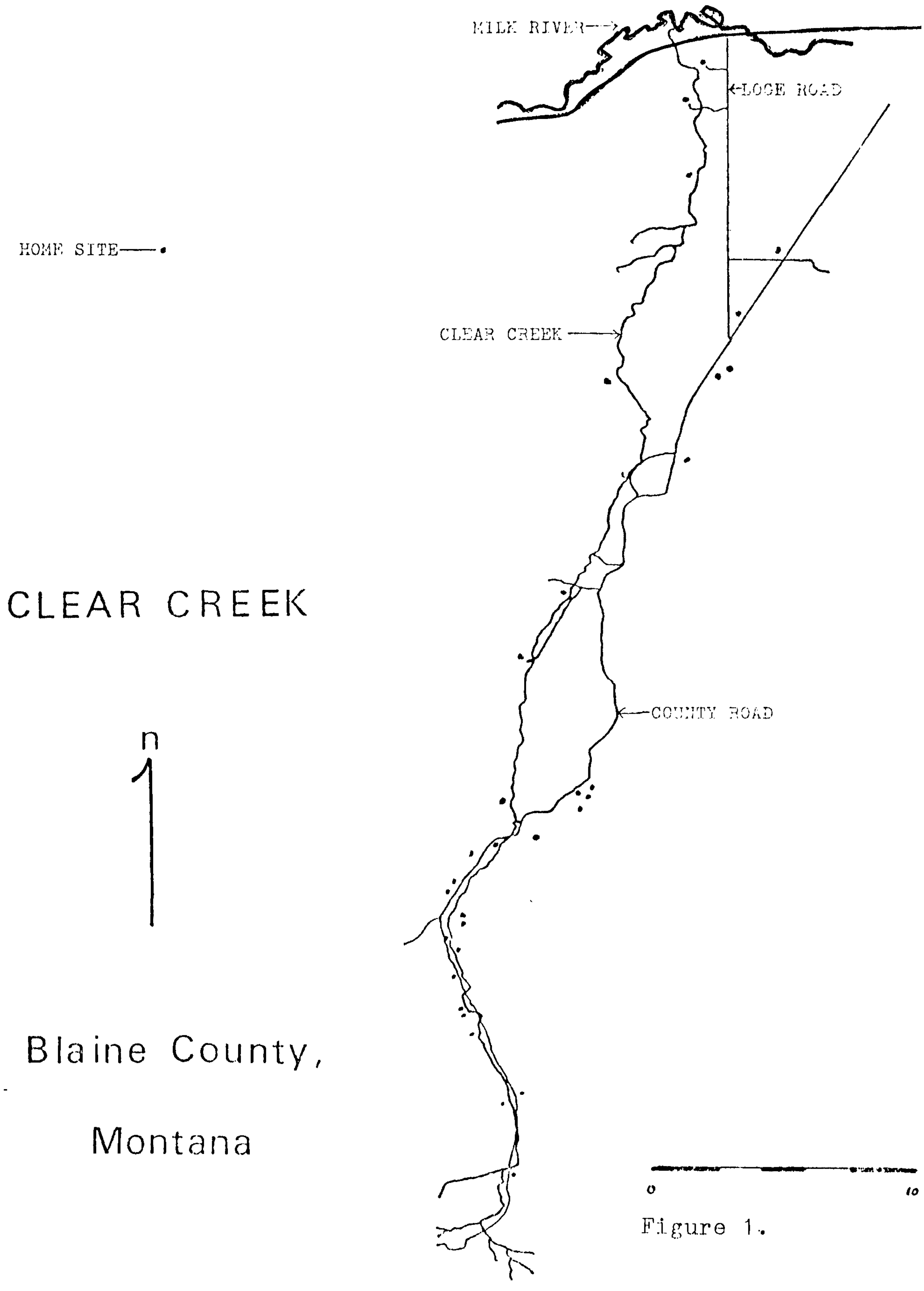
MILK RIVER
LOGE ROAD
HOME SITE
CLEAR CREEK
CLEAR CREEK
COUNTY ROAD
n
Blaine County,
Montana
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Figure 1.

Chapter 1

INTRODUCTION

During the last two decades, there has been a marked increase in the acceptance of numerical presentation and analysis in archaeology. One approach archaeologists have frequently adopted has been the use of methods of multivariate analysis for transforming the large and unwieldy mass of individual units that form the basic archaeological record into a coherent body of information. Multivariate methods of analysis have been particularly useful in the definition of artifact "types" because the methods force archaeologists to specify their data and procedures. The work of Spaulding (1953) on contingency table analysis has typlified this method of analysis.

The formal problem is one of discovering whether or not there is any "sturcture" (i.e. natural arrangement of the archaelogical units of observation into cultural types) inherent in the data themselves. Recent work along these lines in archaeology has gone under the name "attribute analysis" (Doran and Hodson, 1975:167-168). Also, in archaeology there is an increasing interest in identifying those groupings or clusterings of the units of observation under study that best represent certain empirically measured relations of similarity. For example, often large arrays of data are collected, but strong guiding theoretical structures are lacking.

Archaeologists may measure a number of attributes on the units of observation and analysis and combine them to form a single measure of similarity (White and Thomas, 1972; True and Matson, 1970). Various kinds of measures of "attribute profiles" can be used for this purpose (e.g. Pearson's r, or Jaccard's coefficient) calculated between corresponding components of the profiles.

A major problem, of course, is that if the number of observational units is large, the resulting array of similarity or proximity measures can be so enormous that the underlying pattern or structure is not evident; since such an array would contain one value for each pair of objects.

Archaeology by convention, is concerned with artifacts. Borrowing from A.C. Spaulding (1960), an artifact is defined in its broadest sense as "any material expression of cultural activity." On an analytical level, the artifact is viewed here as a bundle of attributes (e.g. the coocurrence of grit tempering and red painting on a pot) from which the archaeologist selects several for study. We generally wish to measure those attributes that express culturally conditioned behavior.

An artifact type is a class of artifacts which is distinctive in some sense or another and has a distinctive use or set of uses. The concept of an archaeological type is based on the notion of class. A class is a constellation of objects possessing similar attributes. We delineate classes through the process of pattern recognition. Our minimal definition of pattern is the sharp association of two or more attributes. If archaeological units exhibit patterns of difference, we call them types. We can conclude then, that a type includes an association of attributes in one sense or another.

Methods

Typological and taxonomic operations are basic to archaeology (Krieger, 1944; Brew, 1946; Spaulding, 1953; Ford, 1954; Childe, 1956; Rouse, 1960). Chang suggests that 80 to 90 per cent of the archaeologist's time is consumed in classifying the archaeological materials (Chang, 1967:71). Archaeologists are not alone in their difficulties with classificaiton. Some recent classificatory work in the biological sciences has gone under the rubric "Numeric Taxonomy" (Sokal and Sneath, 1973). Simply put, numerical taxonomy consists of procedures for grouping units of observation into classes, the members of which are more similar to each other than they are to a member of any other class.

Often the archaeologist visually recognizes a pattern, but he conventionally class this a type -- and is probably correct. That is, intuitive classifications by archaeologists are not necessarily invalid. However, this intuitive expertise that the archaelogists acquire is rarely controlled sufficiently in order for logical, internally consistent classifications to result.

In light of this problem, mathematical classification serves two purposes for archaeologists.

First, it forces archaelogists to specify their data and procedures. Two examples of this are 1) forcing the archaeologist to define his classificatory universe and 2) presenting the need to make precise the definition of "type." These two operations must be made explicit before any rigorous classification is to be accomplished.

Second, mathematical classification provides classifications in those areas where data sets are too complex or too large to consider or propose through unaided pattern recognition.

The literature reviewed below will cover studies of the main numerical approaches that have been used to divide archaelogical entities into classes. The literature chosen is highly selective and illustrates those principles of numerical taxonomy that have particular importance to the present investigation.

The foundation of numerical typology was constructed by A.C. Spaulding in 1953. He modified Krieger's (1944) definition of the type sufficiently to allow compatibility with both archaeological and mathematical theory. Spaulding's primary definition of an artifact type was a "Group of artifacts exhibiting a consistent assemblage of attributes whose combined properties give a characteristic pattern"(1953). Spaulding's initial challenge was to define an algorithm to segregate archaeological units of observation into appropriate types -- for as Spaulding continues (1953:305) "this implies that, even within a context of quite similar artifacts classification into types is a process of discovery of combinations of attributes favored by the makers of the artifacts, not an arbitrary procedure of the classifier."

The first technique Spaulding selected was the simple Chi-square test for significance using pairs of nominally scaled dichotomous variables. The Chi-square test allows the archaeologist to test the hypothesis that any observed association between two independent and randomly sampled archaeological variables is the result of sampling variation from a parent population in which the association is zero at a given level of significance. Chi-square is the test of significance for the discrepancy between the observed frequency. If the test shows the variable attributes are independently distributed, there is no type.

The obvious utility of this approach is that the proposed attribute associations define the intuitive concept of type in a logical, consistent manner. Spaulding notes that this approach:

- Provides an unambiguous and relatively complete description of an artifact class.
- Assembles and appraises the evidence needed to make plausible inferences on the kinds and stringency of the rules followed in the making of artifacts.
- Provides a broader base for comparison of assemblages.
- Makes more explicit the intuitive concepts of "characteristic pattern" and "artifact type." (Spaulding, n.d.)

Recent methods developed by mathematical statisticians which offer a systematic method of examining contingency tables with three or more variables have been proposed by Spaulding (n.d.). He is particularly concerned with log-linear multivariate contingency table analysis (Feinberg, 1970; Goodman, 1971; Read, 1974; Spaulding, n.d.). This is a method of analysis "which will bring out the various interrelationships among classifactory variables" (Kendall, 1968). This is a decision model, not an intuitive model. Keeping with Spaulding's spirit of analysis, the relationship between attributes is discovered through hypothesis formulation and statistical testing of the hypothesis.

The next way of analyzing associations of attributes was proposed by James Sackett (1966). This method of analysis was presented as "attribute cluster analysis." Sackett demonstrated this method with a sample of end scrapers from the Aurignacian period of the Upper Paleolithic. He split the range of several continuous measurements into nominal divisions and considered each division as an unordered attribute of a multistate variable (i.e. front contour and body contour). The remaining variables were considered as simple unordered nominal categories (i.e. marginal retouch). Sackett departed from Spaulding's technique in the use of a statistic of association. Sackett required a suitable nonparametric statistic of association that would accommodate all forms of composite frequency distributions regardless of whether continuous (quantitative) variables or qualitative attribute states were considered. He resolved this problem by employing a nonparametric measure called Cramer's V, a pleasing measure since it is based on the Chi-square distribution:

$$V = \sqrt{\frac{\chi^2}{N \min (r-1)(c-1)}}$$

This equation is verbalized as the square root of the Chi-square score divided by the product of the number of artifacts in the sample multiplied by one less than the number of rows or columns in the contingency table, whichever is smaller. Using Cramer's V and Spaulding's method of analysis, Sackett found the following types:

- Retouched and round narrow convergent, or with any two of the following -- round, narrow, or convergent.
- Unretouched and medium shallow-wide-parallel, or with any two of the following -- medium,

shallow, wide or parallel.

. All attribute classes not mentioned in types onè or two.

Sackett's data were reexamined in light of Spauldings proposed multivariate contingency table model by Dwight Read (1974). Read's model proposed the following types:

. Round-narrow-converged-notched.

. Round-parallel and retouched.

. All other combinations.

The discrepancy can be explained by the incomplete interaction design employed by Sackett. The multivariate contingency table model assumes an additive effect of the different interactive levels of the variables considered, which as Read states, "corresponds precisely to the concept of the total assemblage" (Read, 1974:241).

Principal components analysis was used by White and Thomas (1972) as the major technique in investigating the variables of flint knapping. Where "m" is the number of variables, each of the m variables in the artifact profile is considered a linear combination of the same smaller set of values giving the position of that profile as a point in a to-be-recovered coordinate space. Correlation coefficients were first calculated between every two observed profiles. The variance-covariance structure of the data is shown as vectors. These vectors can be expressed as an m x m matrix. The elements in this matrix can be regarded as defining points lying on an m-dimensional ellipsoid. Latent roots and vectors for the matrix can then be extracted by standard user library programs available at most computer centers. The eigenvectors of the matrix yield the principle axes of the ellipsoid and the eigenvalues represent the lengths of the axes. Because variance-covariance matrices are always symmetrical, these m eigenvectors will be orthagonal, or oriented at right angles to each other.

Algebraically, an axis is represented by a linear equation relating it to each of the original variables. Consider two original variables X_1 and X_2. These would be referred to axes or components by two equations:

$$P = aX_1 + bX_2$$

$$Q = dX_1 + dX_2$$

Where a and b are elements of the first eigenvector; c and d are elements of the second eigenvector; and P and Q are the principal axes' projections.

The variance in the sample would be redistributed so that it is concentrated in the first component. The elements of the eigenvectors used to compute the scores of the observations are called loadings. The computations maximize the combined weights for each axis. The eigenvalue is an expression of how much variance the eigenvector represents (represented as a percentage of total variance).

Using Principal Components Analysis, we can examine the interactions between the measured variables and find the most efficient linear combination of them (that which accounts for the most variance).

White and Thomas (1972) isolated three independent variables:

- Fluctuations of tool morphology in tools manufactured by the same craftsman (idiosyncratic variations).
- Fluctuations between craftsmen (group normative patterns).
- Functional variation (functional differences).

The problem was to determine which pattern of variation could be isolated and measured in the stone artifacts. The results of the analysis is valuable for two reasons:

- To provide an insight into the cultural variability of prehistoric artifactual assemblages using ethnographic materials that are within our realm of experience.
- To provide information about the ethnography of flintknapping among the Duna as relates to their cultural system of norms.

In this analysis White and Thomas used over 9,000 artifacts. Six variables were emically (i.e. variables perceived as important by the Duna) solicited and measured (i.e. length, width and edge angle). A Principal Components Analysis indicated that of the two Duna groups, one group manufactured blades that were longer, wider, and thicker than the other.

The next analysis was an R-mode analysis. The variables were grouped into significant patterns. This analysis suggested that the tools differed in size. Edge angles, on the other hand, constituted a relatively independent variable interacting little with the size variable. The same could be said about blade width.

The Principal Components Analysis considered within each community suggests that each craftsman possesses mental template which directed how each artifact should be made. This provided information about the source of variation within and between workers.

The most important feature of Principal Components Analysis is that there is only one solution for a given set of data. Principal Components analysis is not, strictly speaking, a statistical procedure. It is basically a mathematical manipulation. It is computed through an iterative process which requires that each new variable accounts for as much of the total variance as possible. Factor analysis, a related techniques, has usurped Principal Components analysis as one of the most frequently used multivariate methods in archaeology.

Factor analysis is somewhat different because it relies on a set of assumptions about the nature of the parent population from which the samples are drawn. In Factor analysis each of the m observed values in each profile is merely a monotone function of a linear combination of that profile in a to-be-recovered space. The relationships within a set of m variables reflects the correlation of the p underlying factors where the p common factors are less than m.

The factor model may be expressed as:

$$x_i = l_{i1}f_1 + l_{i2}f_2 + \ldots + l_{ik}f_k + b_i s_i + e_i$$

Where f_k is the kth common factor. k is the specified number of factors and e_i is random variation unique to the original variable s_i. Because there are m original variables, s_i, there are m random variables, e_i, considered as a whole, these constitute the "unique factor." The coefficient l_{ik} is the loading of the ith variate on the kth factor (equivalent to the Principal Component's loadings). The specified score is calculated by multiplying the specific value, s_i, for the attribute for that unit by an associated weight b_i.

The best known application of Factor Analysis in archaeology is that of Binford and Binford (1966) in which "kits" of tools, where tools were the variables under study, were the interpreted clusters of attributes. The relationships were judged by their co-occurrence in 16 Mousterian assemblages of Levallois facies selected for their availability of tool counts, a large number of tools (where large means greater than 100), and their general quality of reporting.

The Binford's study was concerned with the variability in these selected Mousterian assemblages attributable to functional differences. The differences traditionally had been attributed to inter-regional or chronological variability by Francois Bordes (1953).

The Binfords selected 40 of the types as defined by Bordes as possessing attributes describing the assemblages.

A "Factor analysis" was performed and the factor loadings for each of the 40 attributes on five factors were reported. These five factors were reported as groups of artifacts that exhibited high mutual covariation with shared common determinates for the variation of the relative quantitative measurements on the artifacts. The "kits" of tools suggested by Factor analysis indicated the following two points to the Binfords:

- The use of Factor analysis allowed the classification of Mousterian assemblages into sub-classes of artifacts. This suggested tool kits for the performance of different tasks.
- These subclasses varied independently of each other and could be combined in several ways.

The Binfords further suggest that correlations are not necessarily contained in the total assemblages; but further analysis will indicate that correlations must be sought in terms of these independently varying factors.

In most archaeological cases, Factor analysis has been used explicitly to find clusters of attributes. Two examples are Hill's classification of pottery types related by their co-occurence in rooms at the Broken K

Pueblo (1968) and Rowlett and Polnac's classification of Iron age Marnian sites into zones judged by their shared cultural characteristics (1971).

A current tendency shown by students doing archaeological taxonomy is agglomerative hierarchical classification (cluster analysis). The objective of cluster analysis is to find groups of objects or entities whose similarity between each pair of entities to be classified is construed to mean some global measure over the whole set of variables. The archaeologist wishes to separate entities into groups so that each entity is most like other entities in its group than it is to entities outside its group.

The typical archaeological application of the clustering procedure results in the assignment of each and every object under investigation to one and only one class. The assumption is that the underlying structure of the data involves an unordered set of discrete classes. Archaeologists generally view these classes as heirarchical in nature with classes and subclasses.

Clustering heirarchies will vary according to the algorithm used for cluster formation. The first procedure considered here is the simplest one and is known as the "single linkage" method (Sokal and Sneath, 1973:216;

Johnson, 1967). At each successive step of the procedure, a search is made for the closest pair of previously unlinked units and they are combined or clustered. If the units are already members of a cluster, then the clusters themselves are joined. The underlying proposition is clear - at every level of the hierarchy every unit contained in a cluster is more like one other member of that cluster than any member of any other cluster.

An objection to this procedure is that a member of a cluster may be similar to its neighbor but not necessarily similar to any other members.

Hodson, Sneath and Doran (1966) used this procedure to cluster 109 brooches from Münsingen, an Iron Age site in Switzerland. The LaTene brooches were described in terms of the presence, absence or inapplicability of a large number of variable characteristics (e.g. fibula or pins on the brooches). The second stage was the calculation of a similarity coefficient between each pair of brooches. The coefficient used was that described by Sokal and Sneath (1975:132), their Simple Matching coefficient or S_{sm}. It is calculated as the proportion of character agreements, both negative and positive, out of the number of possible agreements.

The brooches were analyzed with a library program that used the single linkage method. The investigators concluded that this technique was unsatisfactory for use in archaeology because the "chain clusters were not necessarily homogenous in the empirically required sense-a comparison between the clusters and the inferred date shows a definite correlation at the highest levels of group formation...however, this cohesion falls off dramatically...as large numbers of brooches are drawn into this main group (1966:321)." They conclude: "The lack of marked discontinuities in the range of material, the presence of transitional forms, is a regular phenomenon in archaeology, and, with single link clustering any transitional type between distinct sets will automatically link them together as one (1966:322)." Similar unsatisfactory results were reported by Cahen and Martin (1972) in a later study. They clustered African stone cleavers using the minimum method and reported the same "chaining" effect.

A clustering procedure that avoids the above dilemma has been extensively used in archaeology (Hodson, Sneath and Doran, 1966; Johnson, 1972; Hodson, 1970; 1971; True and Matson, 1970). This procedure avoids the "chaining problem" by allowing clusters to accept a unit only if its average similarity with all existing members reaches a specified level. This method is called the "average linkage" cluster method (Sokal and Sneath, 1973: 228-229).

The first step in this procedure is to find the mutually highest values in the proximity matrix to form the center of the clusters. Next, the proximity matrix must be recomputed, treating grouped or clustered elements as a single element. New proximities between all clustered and unclustered elements are recalculated by simple arithmetic averaging. The clustering procedure is repeated; mutually high pairs are sought out and clustered. Then the process is continued until all clusters are joined together. The final proximity matrix will be a 2 x 2 matrix between the remaining two clusters.

True and Matson used the hierarchical agglomerative average linkage cluster analysis for intersite comparison (True and Matson, 1970). The investigators were interested in recovering a classification that was consistent with their intuitive evaluations of four site types. These included:

- Lithic workshops,
- Seasonal campsites A,
- Seasonal campsites B, and

. Inadequately described sites.

Seventy-four variables were selected for 20 pre-ceramic sites along the Arroyo Tarapaca in northern Chile. Jaccard's coefficient of association was calculated to depict the similarity between all pairs of the 20 sites. This coefficient computes similarity on the basis of characters unique to each site in a pair. Characters that are mutually absent from a pair are not included in the calculation. The average linkage clustering method produced four main clusters that reflected the classes proposed in the original traditional evaluation. The authors concluded that the distribution of the 20 Chilean sites agreed remarkably well with the intuitive evaluations of the same site relations.

The final method of analysis we will discuss is nonmetric multidimensional scaling. This method has currently found wide use and favor in Archaeology (Doran and Hodson, 1966; Hodson, Sneath and Doran, 1966; True and Matson, 1970; Ammerman, 1971; Kruskal, 1971; Johnson, 1972; True and Matson, 1970).

Multidimensional scaling deals with relations on entities or pairs of entities. The entities can be variables or archaeological units of observation. The descriptive term non-metric means that the input data consist only of ordinal relations on the pairs of entities. The output information is metric, or intervally scaled.

The broad objective of multidimensional scaling is to begin with a set of proximities between data points in some type of multidimensional metric space. The archaeologist is interested in both the dimensionality of that space and the configuration.

It was the psychometrician, Shepard (1962), who devised and generalized the non-metric method. This method combines the best of fully metric and fully nonmetric techniques (i.e. rank order input data and metric solutions).

Another goal of nonmetric multidimensional scaling is to find a configuration whose rank order of ratio-scaled distances, in a specified dimensionality, best reproduces the original rank order of the input data. For a specified dimensionality, the procedure attempts to find a configuration of points whose interpoint distances are monotone (given rank order scaled input data). The interpoint distances have the same (or inverse) ranks as the input data. The problem is to find the lowest dimensionality for which the monotonicity constraint is closely met. In other words, the analyst may wish to trade off the objective of perfect monotonicity for a solution of lower dimensionality whose distances are almost monotone with the original rank order data.

Hodson, Sneath and Doran (1966) used the nonmetric multidimensional scaling procedures to analyze 30 LaTene brooches selected from the Münsingen collection. Configurations were computed in 4, 3, 2, and 1 dimensions. The simple matching coefficient was used in the original proximity matrix. The stress value indicated the best configurations were in two and one dimensions.

The two dimensional solution reproduced a definite temporal zoning of contemporary groups of brooches. These computed configurations were compared with an intuitive analysis by four trained archaeologists. The investigators concluded the computed configurations came out as well or better than the best of the intuitive analysis. Thus, the computation procedure was congruent with the traditional analysis and the archaeological relationships. The derived configuration in two dimensions improved the interpretation. This was enhanced by the use of an average linkage clustering procedure.

Chapter 2

INTRODUCTION TO THE PROBLEM

The studies presented earlier suggested that there are two dominant modes of inferential classification used in archaeology: (viewing data geometrically as relations between points in space), we may consider the cultural milieu through variable space or unit of observation space (object space).

A variable space is one in which the data consist of relations between pairs of points, the members of which are all identified with a single set of elements called variables. The objects themselves are not mapped into points in the space, only the variable attributes are, and each replication ideally tells us exactly the same thing as every other. Replications are obtained by measuring different objects. This model seeks the common or predominent attributes characterizing all the objects. Binford and Binford (1966) represented this model with their factor analysis on Mousterian tool kits. The functional variability was the inferred attribute space; 40 of Bordes tool types were the variables comprising the variable space, and the units of observation were the 16 sites.

It should be noted that these two means of classification are ones in which the points are identified with the elements of a single set: objects only or variables only.

The data for object spaces correspond in every way to the data for variable attribute spaces, except that the characteristics and the function of the variables and the objects are exchanged. This means that in the analytical/classificatory context we must reverse the roles of variables and objects as they are found in variable spaces in order to obtain "object" spaces. In the variable space, the analyst - object pair determines the attribute space in which the individual points are to be localized. The example of this is Hodson, Sneath and Doran's (1966) study of La Tene brooches. In a similar manner, this study considered the brooches from Munsingen as the plotted objects, 70 nominally scaled attributes as the variables; and inferentially classified the object space in the space of time.

The present study was designed to determine if one of four classificatory procedures was superior to the others in discovering cultural patterns of variation in a contemporary artifact. The historical house in the Clear Creek drainage of Blaine county, Montana was selected as a representative artifact. If cultural patterns could be isolated in the contemporary and historical sample, collected under strict control, then similar procedures can be postulated as being appropriate for prehistoric assemblages where such external controls are lacking.

This artifact analysis diffuses the operational boundary between ethnology and archaeology, and should find applications in both.

To determine whether the same cultural patterns can be discovered by different procedures, we will examine four procedures that employ the following three step algorithm:

. Description of the unit of observation (artifact).

. Calculation of a similarity/proximity coefficient.

. Analysis procedure.

The four analysis procedures are:

. Principal Components Analysis.

. Factor Analysis.

. Hierarchical Clustering.

. Non-Metric Multidimensional Scaling.

The first step in the above algorithm is to describe the artifact. The result of the initial step consists of the raw data matrix, a rectangular array of numerical entries whose informational content is to be summarized and portrayed in some manner. This problem is concerned with two operations on the raw data matrix. The first is to group the rows of artifacts into similar subsets (based on their correspondence over the whole profile of variables) (Hodson, Sneath and Doran, 1966). The second operation is to portray the column space of the data matrix in terms of a smaller number of new variables which retain most of the information in the original data matrix (Binford and Binford, 1966). The successful execution of these two operations is the first of our primary concerns in this paper.

Table 1 shows a conceptual illustration of a data matrix. The array consists of a set of objects (m rows) and a set of variables (n columns). The (i,j)th cell entry represents the value of object i on variable j. The objects may be any archaeological unit of observation. The variables are characteristics, properties or attributes of the objects presented later in this thesis. In this study, cell values consist of nominally scaled variables as we go across the columns. The complete (row) vector is called an artifact profile. An important contribution to the quantification of artifacts is the individual description of artifacts so that cultural types can be deduced or inferred from such

Table 1.

ILLUSTRATIVE DATA MATRIX

Objects	1	2	3	Variables	j		n
1	X_{11}	X_{12}	X_{13}	...	X_{1j}	...	X_{1n}
2	X_{21}	X_{22}	X_{23}	...	X_{2j}	...	X_{2n}
3	X_{31}	X_{32}	X_{33}	...	X_{3j}	...	X_{3n}
.	.	.	.		.		.
.	.	.	.		.		.
.	.	.	.		.		.
i	X_{i1}	X_{i2}	X_{i3}	...	X_{ij}	...	X_{in}
.	.	.	.		.		.
.	.	.	.		.		.
.	.	.	.		.		.
m	X_{N1}	X_{N2}	X_{N3}	...	X_{Nj}	...	X_{Nn}

descriptions (using either object or variable space) (e.g. Tugby, 1958; Clarke, 1962; Sackett, 1966; Doran, 1971; Hodson, 1970; 1971; Cahen and Martin, 1972).

The archaeologist uses the resulting data matrix to judge the relative similarities or differences between data points in either the artifact (object) or the variable (attribute) space. The choice of proximity, similarity, associational, resemblance (all four form terms will hereafter be referred to as proximity measures) and correlation measures play a prominent role in the quantitative analysis of archaeological remains. The coefficient selected provides the basis for the analysis of the material and plays a prominent role in the interpretation of the final data sets.

Proximity measures usually are viewed in relative terms. For example, two artifacts are similar, in terms of the group, if their profiles across variables are "close" or they share "many" aspects in common in relation to those which other pairs of artifacts share in common.

Most hierarchical clustering and non-metric multidimensional scaling procedures use pairwise measures of proximity. The choice of which artifacts and variables to use in the first place is largely a matter for the "intuitive expertise" of the archaeologist. While these prior choices are important ones, they are strictly problem oriented and beyond the scope of this thesis. Even assuming that such choices have been made, however, the possible measures of pairwise priximity are many.

There is an increasingly large number of proximity measures in the literature of intuitive classification. Most of these have been used only once or twice. We will consider the two coefficients most widely used in archaeology: the simple matching coefficient and the coefficient of Jaccard.

A proximity coefficient is a pair-function that measures the agreement of two objects or variables over an array of nominal or multistate characters. Intuitively speaking, two profiles are viewed as similar in the extent to which they share common attributes.

In the most common model, association coefficients are computed with two state characters, coded 0 or 1. The 0, 1 code generally represents the presence or absence of a variable or variable state. When states are compared over pairs of columns or rows in our data matrix, the outcome can be summarized in the form of a 2 x 2 frequency matrix such as Figure 2. Formulas a, b, c and d represent frequencies in the two-way table where the plus sign indicates the occurrence and the negative sign indicates the non-occurrence of a variable. An additional requirement is that a+b+c+d all add up to n. We note that there are four possible conditions:

. a - The mutual occurrence of attributes.

. b - The mutual non-agreement of attribute states.

. c - Another mutual non-agreement of attribute states.

. d - The mutual non-occurrence of attributes.

The simple matching coefficient can be stated as:

$$S_{sm} = \frac{m}{n} = (a + d)/(a + b + c + d)$$

This is one of the oldest and simplest coefficients used. As an illustration of this point, consider two artifacts and their variable profiles:

		Attributes
Artifacts	A	1 0 0 1 0 1
	B	0 1 1 1 0 1

Each of the above artifacts is characterized by possession or non-possession of each of six attributes, where a "1" denotes possession and a "0" denotes non-possession. The number of matches -- either (1,1) or (0,0) are counted, totaled and divided by the total number of attributes. This insures that the simple matching coefficient will always lie between 0 and 1.

The simple matching coefficient gives equal weight to mutually absent and to mutually present scores. The

	+	–
+	a	b
–	c	d

FIGURE 2. 2 x 2 CONTINGENCY TABLE

coefficient of Jaccard omits consideration of mutual absences (Jaccard, 1908). The computational formula is:

$$S_j = a/(a + c + b)$$

Whether mutual absence of a variable attribute should be incorporated into a proximity coefficient is a moot point. True and Matson used a coefficient of Jaccard to estimate similarity between preceramic sites in Chile. It was argued that basing similarity between two archaeological units of observation on the mutual absence of a certain character was improper. However, it could also be argued that the mutual absence of, for example, Poverty Point objects could be important in a classification of middle Mississippi sites.

The final coefficient we will consider here is the product moment correllation coefficient "r" for the data coded 0,1 (also known as the point correllation coefficient and Phi coefficient). It also can be shown that:

$$S_{phi} = (ad - bd)/((a + b)(a + c)(c + d)(b + d))1/2$$

and like Person's r, the squared value of Phi allows intermediate coefficients between -1, 1 and 0 to be given a clear direct interpretation. The basic meaning of a large positive Phi value between two variables will be that they tend to be well or poorly represented on the same unit of observation. High negative correlation means that where one attribute is frequent the other will be rare and vice versa. A high positive Phi value, of course, implies only that the relative rarity or frequency of correlated types is the same, not the absolute rarity or frequency.

An aspect of this paper will be an evaluation of the ability of these three measurements to reproduce the cultural variability found in a culturally produced artifact.

Chapter 3

METHOD USED IN THE STUDY

An artifact was selected that would probably reflect cultural variability as measured by attributes of provenience and form. The contemporary house was selected as an artifact meeting this criterion. It was hoped that from the ethnographic data base, certain analytical generalizations might be advanced which would be of use to the archaeologist in making inferences about prehistoric cultures. The house is the most commonly built structure on the cultural landscape. The importance of the rural house can be illustrated by three observations on houses from Clear Creek, Montana:

- The Clear Creek houses are semi-isolated from all of the other homestead buildings.
- The front of the house always faces the road and projects the initial image of the farmstead.
- The farmhouse is the closest building to the road.

The Clear Creek drainage was chosen because it represented a natural region defined by the extent of the creek's first order drainages (Horton, 1945). Also, because of environmental factors defined below, the drainage possesses a broad range of fundamental ecological variations.

The Clear Creek drainage straddles the following townships in North Central Montana:

Township	Range
33N	18E
32N	17E, 18E
31N	17E, 18E
30N	17E, 18E
29N	17E

A road, running north-south, the entire length of the drainage, preceded historic settlement. All of the homesites are of the late nineteenth through the mid twentieth centuries. The Federal government of the United States of America opened the Clear Creek drainage for homestead settlement on May 1, 1888. "Bearpaw" Jack Griffin and Alexander Ross were the first two settlers filing their claims that first day. They staked their claims on two of the three natural springs located in the valley.

Three of the homes in the study area were originally built as school in the early twentieth century. Each housed a resident teacher.

Fifty-five per cent (18) of the houses are occupied by families directly involved in agricultural production. Eighteen per cent (6) of the houses are now used by non-agricultural families for various purposes (i.e. recreation). Twenty-seven per cent (9) of the farm-houses are empty; as far as I have been able to ascertain, all of these have been empty since the farm consolidations of the 1940's and the 1950's.

The diversity of cultural patterns in houses is obvious even to the most casual observer. Such diversity presents a challenge in the making of a critical evaluation and classification of the elements responsible for the differences. One logical approach would appear to be the quantitative and qualitative consideration of the houses by the "new" archaeologist's method, analogous to that employed by the numerical taxonomist.

The importance of houses is self-evident. They usually represent the most elaborate and costly possessions within a given culture. House form is not simply the result of physical form or any single causal factor, rather it is the consequence of a whole range of socio-cultural factors seen in their broadest terms. It may be said that form is a response to climatic conditions, methods of construction, materials available and technology. It is rarely possible to describe houses as mere shelters, for, as Amos Rapaport (1969,2) remarks, "Given a certain climate, the availability of certain materials, and the constraints and capabilities of a given level of technology, what finally decides the form of a dwelling, and molds the spaces and their relationships, is the vision that people have of the ideal life".

The literature dealing with houses as artifacts and types of houses is extensive. Studies include those that emphasize floor plans and external form (Dias, 1949; Weiss, 1959; Cresswell, 1960); studies of the component features of houses as well as complete units (Spencer, 1945, 1947; Gritzner, 1974); studies that consider function and emphasize form and materials (Demangeon, 1920; Raglan, 1964); and studies that deal with the evolution, origin and distribution of types (Kniffen, 1936; Schofield, 1936).

The house as an artifact is one component of the rural landscape. The rural landscape contains two other components:

. The nature of the land forms.

. The plant cover.

The house is a part of that class of cultural phenomena we call artifacts. Artifacts, landforms, hydrology and plants are variables or factors which influenced the rural inhabitants' decisions; in the case of Clear Creek housing, these may be thought of as factors which create agricultural regions. The study area was delimited under the assumption that within an agricultural region of more-or-less similar conditions the majority of farmers, being rational men, will tend to make more-or-less similar decisions, thus to create an agricultural region.

A historic characteristic of the Northern Plains agricultural region is the homestead. An essential artifact of the homestead is the farm house. It is suggested that no other artifact provides better insight into the cultural variability in an agricultural region, yet no other theme is more complex, because the form of the house may be completely divorced from its functions. The maker can demonstrate artistry, advertise his beliefs, and flaunt his wealth. All of this combines to provide a formidable task to the researcher seeking to classify house types. Fred Kniffen (1936:) reminds us that the task of the cultural taxonomist differs from that of the biological taxonomist when he notes: "The biologist never finds the tail of a lion grafted to the body of a cow; the classifier of culturally produced artifacts has no such assurances."

We may discriminate between two classes of attributes: environmental and external stylistic characteristics.

The first class of artifact attributes are included as to measure the relationship of the house to the remainder of the cultural landscape. This enables the investigator to minimize the effect of the environment on the formal/stylistic variability of the artifact under study.

We simply defined the study region as the Clear Creek drainage. This spared us the agonies that rack archaeologists whose regions are ephemeral and transitory. The river basin is describable -- it is united by water; and it is relatively constant. Yet, it is clear that, while the creek drainage is a hydrologic unit, it is not a physiographic one; and if one seeks a more finite division of land, the physiographic region offers this character to a great degree. We assume that some knowledge of physical and biological process is essential to understand the cultural landscape. The basic goal then, is that it is necessary to understand natural variables as interacting processes and these can be interpreted as proffering opportunities for human use -- but also revealing constraints. The environmental parameters include:

- Climate: Holdridge Life Zone Classification
- Vegetation
- Groundwater resources
- Bedrock Geology
- Soils
- Physiography

Climate. The topography of Clear Creek has the usual effects on the climate. The coldest extremes are recorded in the valley bottom; the earliest warming following a cold spell is on the hillsides, and the heavier precipitation is in the higher portions of the drainage in the mountains.

The general Köppen climatic classification is continental (Spencer, 1968). The exception is, of course, the chinook winds (from whence we get the name of the town 10 miles west of Clear Creek).are regionally significant, for when these winds blow, they give almost immediate relief from the cold temperatures. Winter temperatures generally reach -37° C. at least once in an average winter. The warming trends occasionally are unable to penetrate the layer of cold air on the valley bottom. In these instances, the warming winds will only reach the hilltops or mountain slopes.

Summers are generally pleasant and warm. Most rain comes as thundershower activity which occurs in the late afternoon or evening. Temperatures reach above 32° C. on fewer than 25 days in an average year. The average warmest daily temperature in July generally is around 30° C. The late afternoon relative humidity ranges around 35 and 40 per cent for the middle and late summer.

Recorded data is scarce. However, reasonably accurate sources indicate that precipitation varies considerably over the drainage. In general, there is less rain over the rolling land in the northern section of the drainage than over the hills and mountains to the south. Annual amounts up to 562 mm. have been recorded in the southern end of the drainage, while the northern part averages about 270 mm. per year. This generally would classify the northern end as semi-arid, but between 70 and 80 per cent of this annual average precipitation falls during the April 1 to September 1 growing season. The most critical plant growing month, June, averages nearly 67.5 mm. Available data suggest the annual snowfall averages 832.5 mm. in the northern area, and 2,150.0 mm. in the southern mountainous area (U.S.D.A.S.C.S.).

Frost free periods vary considerably from the south to the north. At the northern end, the average frost free period lasts 119 days. In the valley bottom of the southern area, the average is only a 105-day season.

Stormy weather occurs, but most troublesome is the summer thunderstorm which produces heavy precipitation that may wash out bridges on the southern end of the drainage. When hail damage which infrequently accompanies thunderstorms is sustained by a crop, the loss is considerable.

Holdridge Life Zone Classification. It has long been recognized that there is an association between the climatic regime of a region, the type of vegetation in that region, and patterns of cultural land use. Consequently, considerable attention has been given to correlation of the distribution of plants on the basis of physical climatic factors. This discussion has been carried on under the rubric of "life zone ecology," which is based on the notion of "zones of tolerance." A zone of tolerance is that space or "niche" throughout which a particular species or community can live. Outside of this zone there are marginal zones in which the species will not successfully reproduce. All together, these zones will define a particular habitat.

Geographers have shown that, among the various methods used by ecologists to explain the distribution of particular plant communities, the best available is by Holdridge (1964). This system has been used to predict stream orders in the mountains of Colorado, (Thompson, 1966); it was used to explain urban settlement in South America (Tosi, 1964); and provided a reasonable model for the distribution of vegetation in the Bitterroot valley, Montana (Foor, 1971).

I have selected Holdridge's method to model the interaction of climate and vegetation in the Clear Creek drainage. This system is based on the following assumptions and corresponding corrolaries:

- Any particular association of plant species is primarily determined by three factors: heat, precipitation and moisture, the last directly dependent on the first two. This will allow us to predict and define plant associations on the basis of these three climatic variables.

- The three critical variables are expressable in equivalent, relevant units. Mean annual biotemperature is the index used for heat. This is defined as those temperatures falling in the range where vegetation growth occurs (from 0 to 30^{o} C.). This value is obtained by adding up all the mean daily biotemperatures and dividing the sum by 365. The precipitation is expressed as annual amount in millimeters. These two numbers, precipitation and biotemperature, are sufficient to determine the position of a group of plant associations that express the relation between types of plant formations and their climatic determinants.

- The effects of temperature, precipitation and potential evapotranspiration on plants is a function defined by the logarithm of the measured value of any of those variables.

- Latitudinal regions and altitudinal belts have equivalent effects on the vegetational assemblages.

- The type of plants growing in any particular site is not uniquely determined by the life zone. Within the zone units, Holdridge proposes a nested tier called associations. He recognized three types of associations: atmospheric, edaphic and hydric.

Clear Creek drainage can be characterized by four of Holdridge's biological units. The region encountered at the mouth of the drainage is classified as a semi-arid cool temperate montaine steppe transitional zone. This region is cross-cut by an edaphic association, the creekside area. The vegetational modifications appear to correlate with differences owing to topography, drainage and the origin of the soil. This "creek-side" association becomes further modified as it extends up into the elevationally higher region which is characterized in the Holdridge scheme as a semi-arid cool temperate sub-alpine steppe transitional zone.

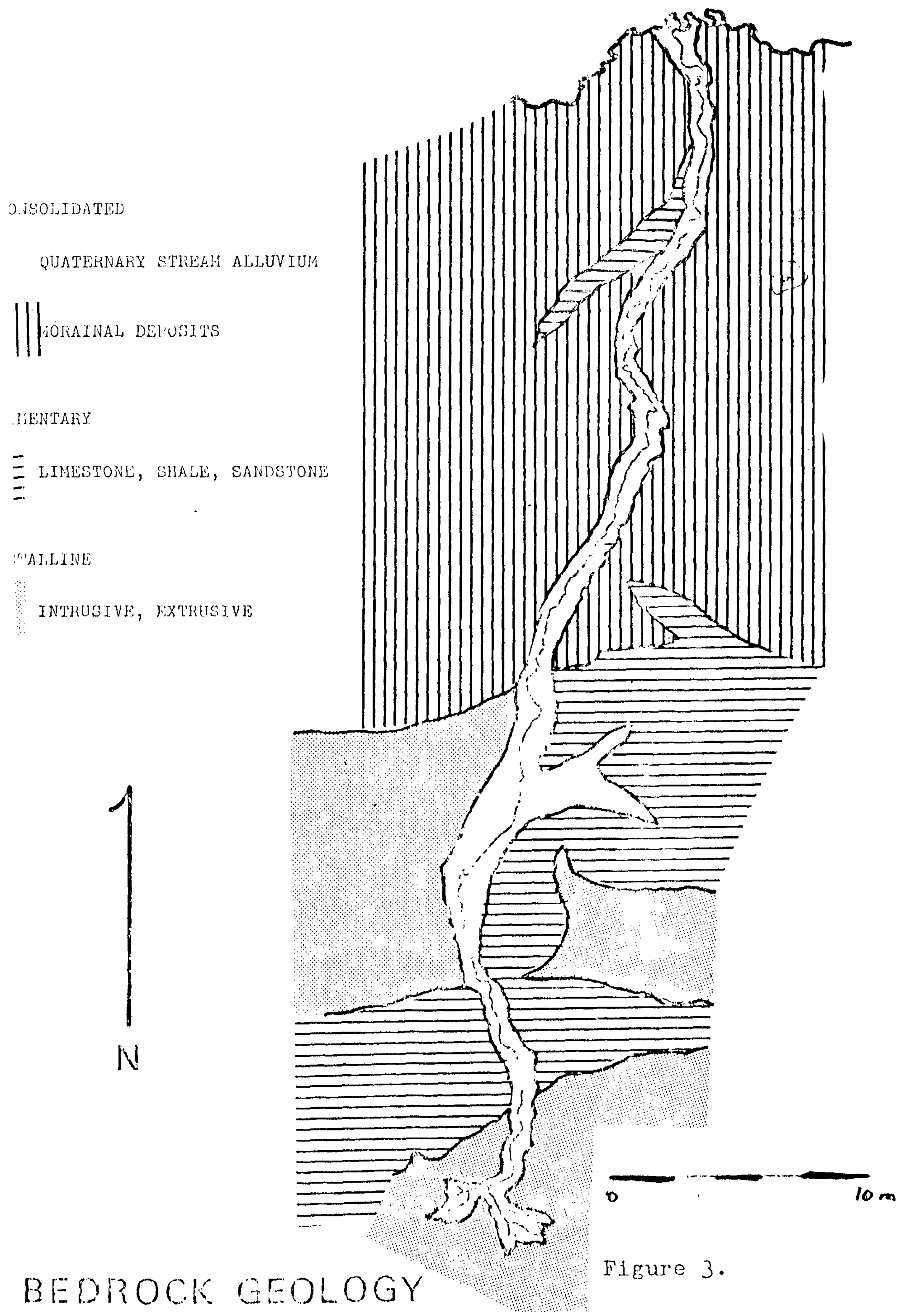
Vegetation. As a floral unit, the Clear Creek drainage is characterized by its altitudinal zonation and creekside associations. Increasing altitude produces temperature reductions except as reported in the climate section, in the case of inversion caused by cold air drainage. This occurs at night when air from rapidly cooling ridges settles and flows down valleys under the warm air rising from them.

The result is lower night temperatures in the valley bottom with warmer upper slopes. The thermal belts are sharply defined and may be distinctively marked by the vegetation they support (Oosting, 1956). Precipitation and humidity also increase toward higher elevations. We have, then, a series of vegetational zones that are responses to moisture and heat related to elevation. Species diversity increases from high elevations to low.

A list of the floral zones and some characteristic plants is located in appendix 1.

Geology. Glaciers flowed out of the north about 50,000 years ago. At that time the Milk River occupied the old Missouri River bed, and a new tributary system is still in the process of adjusting the physiography of the glacial plain.

The material carried into Montana and deposited by the continental glaciation consisted of unsorted fine-grained clastic sediment having poor to no permeability. The mantle of till and moraines in the



BEDROCK GEOLOGY

Figure 3.

Clear Creek area includes outwash deposits. These are mixtures of sands, gravels and boulders left behind in meltwater channels that originated as tunnels or cracks in the ice, and also are in marginal ridges deposited at the edges of the ice. The coarse material was deposited in the shape of ribbons and terraces. The overall thickness of the glacial mantle varies from a thin patchy veneer to about 200 feet.

The major direction of ice movement in Blaine County was from northwest to northeast, over gently rolling plains, river terraces and valleys and low hills. Traces of glacial movement has been detected at elevations of almost 4,000 feet above sea level, and erratic debris has been reported at even higher elevations in the Bearspaw Mountains.

The unglaciated portion of the area is characterized by sedimentary and igneous structures. The regional sedimentation in Paleozoic and Mesozoic times was primarily marine in character. In the Cretaceous period, it was almost entirely non-marine. Transgressive and regressive sedimentation occured in the Cretaceous times; the sea had permanently receded by the Paleocene period. The regional sedimentation ceased in the early Eocene with the deposition of beds of channel boulders, composed of material derived from the Rocky Mountains to the west.

This long interval of sedimentation was followed by regional uplift and by introduction volcanism in the middle and late Eocene. The first major structural feature to form was the Bearspaw Mountains arch. Its uplift was accompanied by magmatic activity.

The arch and bordering areas were intruded by dikes, sills, plugs and stocks, culminating in volcanic eruptions which covered the arch and the bordering plains area with lava flows and pyroclastic rocks. The complex doming and folding of the arch occured during this period of magmatic activity, and apparently, the arch was an active structural element during the middle Eocene time. Collapse faulting in the sedimentary floor beneath and along the margin of the volcanic fields, and in the adjacent plains area, began sometime before the period of volcanism and continued into late Eocene time, after volcanism had ceased.

Erosion during the rest of the Tertiary period and during the early part of the Quaternary period produced the present topographic configuration and established a drainage pattern that was adjusted to the late Tertiary - early Quaternary Missouri River system.

Table 2.

Clear Creek Historical Geology

Age and Stratigraphic Unit.

Quaternary:
- Alluvium
- Ground moraine
- Terrace gravel

Tertiary:
- Eocene:
  - Pediment gravel
  - Porphyritic latite
  - Syenite
  - Shonkinitic rocks
  - Felsic flow rocks
  - Mafic flow rocks
  - Wasatch formation equivalent
- Paleocene:
  - Fort Union formation

Cretaceous:
- Late Cretaceous:
  - Hell Creek formation
  - Fox Hills sandstone
  - Montana group:
    - Bearpaw shale
    - Judith River formation
    - Claggett shale
    - Eagle sandstone
  - Colorado shale:
    - Telegraph Creek formation equivalent
    - Niobrara and Carlile shale equivalents
    - Greenhorn limestone equivlanet
    - Belle Fourche shale equivalent
- Early Cretaceous:
  - Colorado shale:
    - Mowry shale equivalent
    - Newcastle sandstone and Skull Creek equivalents
    - Fall River sandstone equivalent
    - Kootenai formation

Jurassic:
- Late Jurassic:
  - Ellis group:
    - Swift formation
    - Rierdon formation
- Middle Jurassic:
  - Ellis group:
    - Sawtooth formation

Mississippian:
- Madison limestone

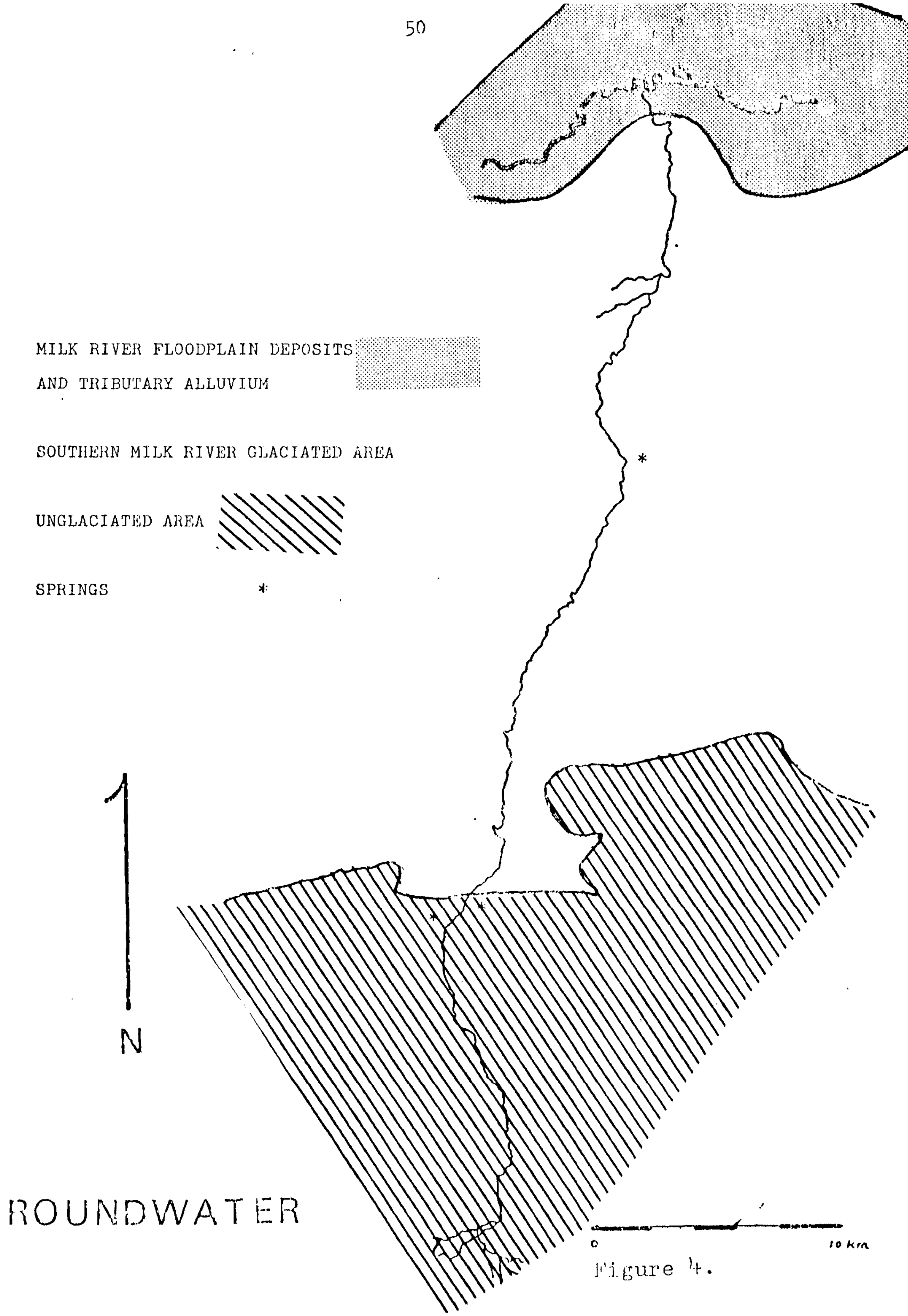

MILK RIVER FLOODPLAIN DEPOSITS
AND TRIBUTARY ALLUVIUM
SOUTHERN MILK RIVER GLACIATED AREA
UNGLACIATED AREA
SPRINGS *
N
ROUNDWATER
0
10 km

Figure 4.

Groundwater - Hydrology

The groundwater resources of Clear Creek are closely related to the geologic history and to the events that took place during the advance and retreat of the Pleistocene ice sheets. The groundwater sources of the region are either water table or artesian aquifers. Generally, the unconsolidated rocks are water table aquifers and the bedrock formations are artesian.

Quaternary Alluvium. The stream deposits are composed of gravel, sand silt and clay in the valley and undrained depressions. This is normally unconsolidated or only weakly cemented. Water can be obtained from the sand and gravel from depths of 20 to 200 feet. Shallow water above 50 feet is considered "bad." The Clear Creek alluvium has a relatively high percentage of gravel and usually yields sufficient water for stock and domestic use.

Quaternary Glacial Till. This is seldom an aquifer because it contains a high percentage of fine impervious material. Outwash and ice-margin deposits within the till are generally more coarse and often provide a source of water if sufficient opportunity for recharge exists.

Other. Other sources of groundwater are scarce in the Clear Creek drainage. Small supplies can be obtained from the Judith River, Fox Hills and Hell Creek formations of Cretaceous age. However, these resources are severely limited in terms of supplying a domestic user.

Soils. The soils of Clear Creek generally fall into three types: alluvial, glacial and mountain. We will be concerned with the dynamics of the first two.

The major geologic event in the development of the Clear Creek soils was continental glaciation. Local rock formations supplied the material that was picked up and deposited in the form of glacial till. The soils are generally underlain by glacial till in the northern area. There soils cover the northern three-fifth's of the drainage.

The glaciated area in Clear Creek and its topography is quite rolling in nature with glacial erratics and smaller cobble deposition over the surface terrain. Dryland farming areas have been cleared of these obstructions. The stone heops characteristic of the work invested in Montana rural landscape are found in almost every field.

The soils of Clear Creek are dark grayish-brown with three essential layers. The loose powdery surface layer may range in thickness from 25 mm. to 100 mm. and forms a sticky muck. An underlying silty layer

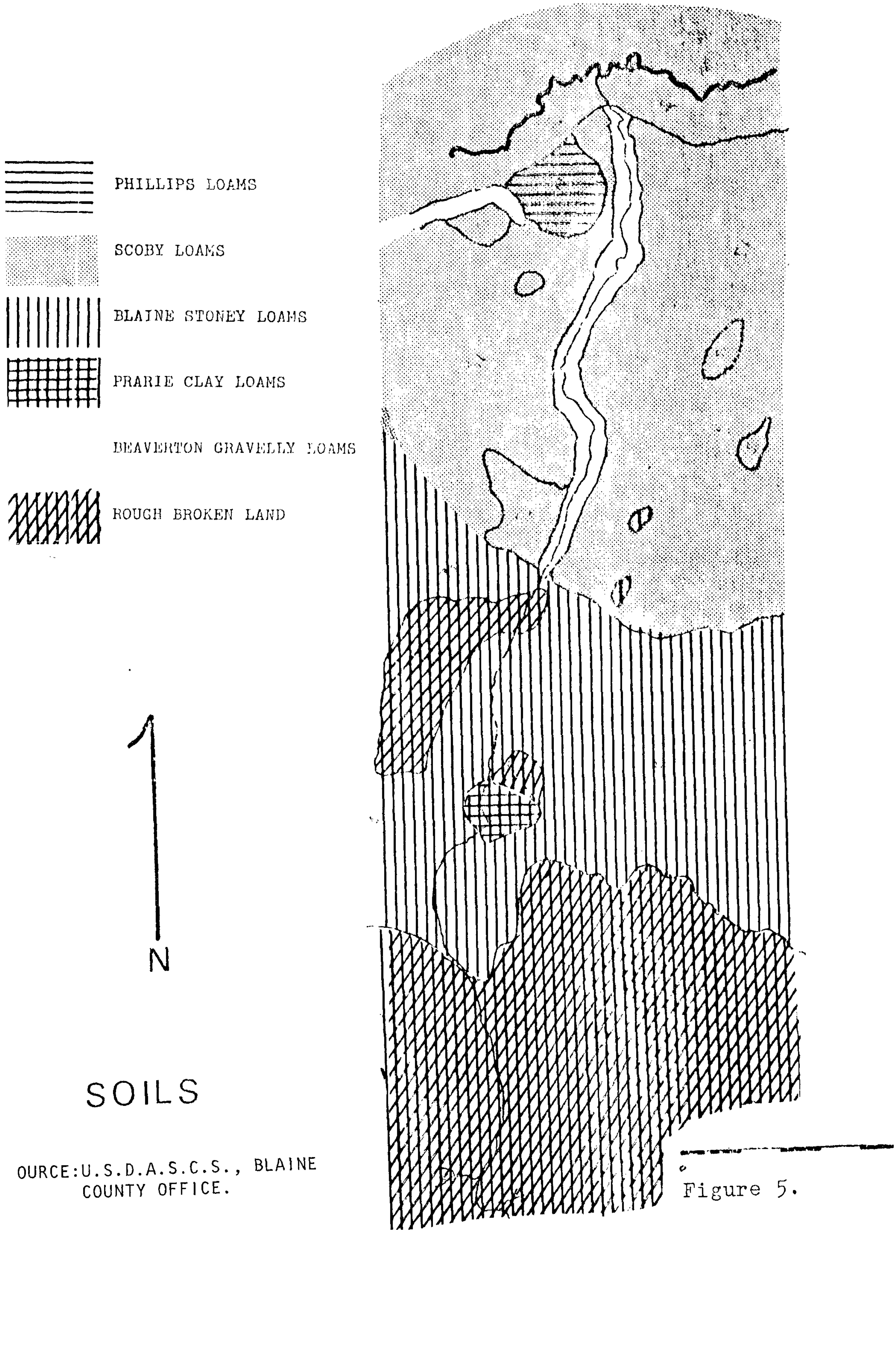

PHILLIPS LOAMS
SCOBY LOAMS
BLAINE STONEY LOAMS
PRARIE CLAY LOAMS
BEAVERTON GRAVELLY LOAMS
ROUGH BROKEN LAND
N
SOILS
OURCE:U.S.D.A.S.C.S., BLAINE
COUNTY OFFICE.

Figure 5.

varies from 180 to 340 mm., is a rich dark brown color, is compact and usually possess a well-defined columnar structure. Below this structure is a layer of high carbonate accumulation underlain by the parent material of grayish-brown calcareous glacial drift. The texture of the glacial drift varies but generally is of a heavy, tight compact nature and restricts drainage.

Alluvial soils occur along the stream. They owe their distinctive characteristics mainly to the influence of their parent material, but also to the degree of development under the soil forming processes. The material below the surface is essentially the same as it was at the time of deposition. The alluvial soils range from very dark colored loam to clay loams which are relatively free of salinity.

Physiography. This dimension of landscape may be used to represent clearly, accurately, and in detail the surface form of the Clear Creek drainage. One goal of any landform description should be the measurement of the actual characteristics of the existing surface rather than error-prone and often ambiguous genetic interpretations. Modifying Hammond (1969) we shall measure the diagnostic characteristics of surface through the headings of relief, slope and profile type.

Local relief was ascertained by measuring the maximum difference in elevation at several spots along the drainage. Slope was determined by the fraction of the selected area which has an inclination less than a given value. The profile from the mouth of the drainage to the head is indicated by where the flatland lies in the region. These are then grouped into a few generalized classes to separate distinctive kinds of terrain found in Clear Creek drainage.

This classification is only a tool for our analysis and is not an end in itself. The landform dimension is a reasonable approximation that is made on the basis of the data available. Additional data would probably permit more refinement of detail; however, it would not reasonably alter the basic pattern.

The data classes that generate the classification are:

- Local Relief
  0-100 meters.
  100-200 meters.
  200-300 meters.

- Slope
  50-80% gently sloping.
  20-50% gently sloping.

- Profile Type
  50-75% of gentle slope in upland.
  50-75% of gentle slope in lowland.
  Greater than 75% of slope in lowland.

These classes were used to generate three physiographic regions.

The second class of artifact attributes relate to the artifact's form (in the sense of the artifact's physiochemical properties). The formal attributes are described and analyzed into a number of discrete attribute systems.

It is presupposed that these attributes represent units of meaningful behavior. They are indicative of the factors which influence the decisions of the individual who made the artifact. Ten primary structural parts most likely to be affected by changes in style and methods of construction were distinguished. They include:

. Roof
. Walls
. Chimneys
. Dormiers
. Windows
. Doors
. Overall size
. Floor plan
. Appendages
. Entrance-way.

A list of the formal attributes is located in Appendix 2. The selected variable attribute field serves as the linking constant from artifact to artifact. It is this field that contributes to the similarities or dissimilarities.

The first and most time-consuming aspect of classification is the initial attribute inventory. A survey was made of the Clear Creek drainage. For the entire area delimited as the drainage, five photographs were taken and a coding sheet was filled out for each house (See Appendix 2).

Chapter 4

RESULTS

Principal Components Analysis. Correlation coefficient matrices were calculated, first producing a 33 x 33 symmetrical correlation matrix. (see Appendix 3) Eigenvalues and Eigenvectors then were extracted using the SPSS (Statistical Package for the Social Sciences) computer library program (Nie *et al*, 1975).

Each column in Table 3 represents a component. Our model specified a total of two components. The lower rows on the table indicate the proportion of overall variance reflected by the components. It will be seen that the first accounts for 53.8 per cent of the overall variance and the second for 46.2 per cent. Two distinct groups can be identified from this analysis--one group loading high on each component. They are:

A. 29 13 25 28 07 31 27 01

B. 19 12 05 06 14 23 10 11 16 18 08 20 03 09 07 02 29

Figure 6 is a plot of variable loadings on the two components. It is obvious from the plots that the first principal component essentially represents the B Class. The second represents the A Class. These two components alone are sufficient to account for all the original data set, without redundancy of membership in the classes. The differences between the attributes can be almost com-

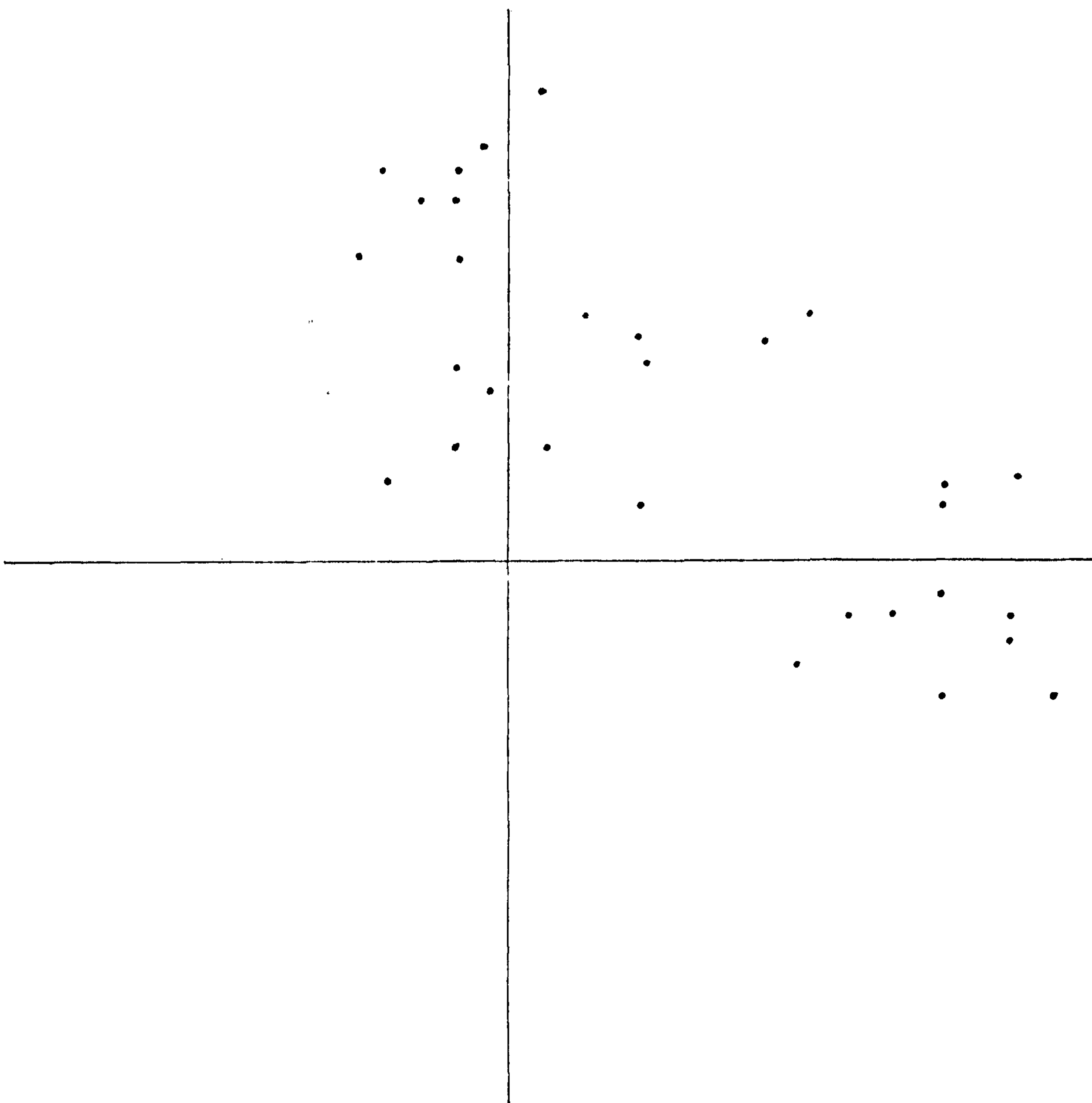
Table 3.

List of Variables Arranged According to a Descending Order of Principal Components Loadings--Loadings ≥ |.40|..(Q-mode)

Name	I	II
19	.66	
12	.64	
05	.63	
06	.59	
14	.59	
23	.59	-.57
10	.53	
11	.53	
16	.51	
18	.51	-.44
08	.50	
20	.48	
03	.47	
09	.47	
07	.46	.52
17	.44	-.45
02	.43	
20	.42	.64
13		.60
31		.57
25		.54
28		.52
27		.50
01		.40
EIGENVALUE	6.108	5.241
PCT OF VARIATION	53.8	46.2

Figure 6.

Plot of Principal Components Loadings



pletely described by two house classes.

Factor Analysis. The 33 x 33 correlation matrix was used as the input data matrix. Then, a factor analysis with varimax rotation was performed. Our model specified that we retain two factors for rotation. The varimax orthogonal rotated factor loadings for each of the 33 houses are given in Table 4. Looking at the factor loading for each of the houses in turn, it will be seen that most are closely associated with just one factor (i.e. #31).. This varimax model suggests the following two groups:

A. 29 07 31 13 28 33 01 25 04 15 30 10 27 32 22

B. 23 19 18 05 17 06 03 14 09 16 12 11 26 20

Cluster Analysis. It should be recalled that our proximity matrices were calculated for two coefficients, namely Jaccard's and the Simple Matching measures. Also, in the q--mode we considered the 33 houses across a 91 attribute profile. Appendices 3 and 4 portray the symmetric matrices of Jaccard and Simple Matching coefficients respectively. Appendices 5 and 6 portray the hierarchical clustering schemes obtained by applying the unweighted average linkage method to the two proximity matrices.

Table 4.

List of Variables Arranged According to a Descending Order of Factor Loadings--Loadings ≥ |.40|. (Q-mode)

Name	I	II
23	.81	
19	.76	
18	.68	
05	.67	
17	.63	
06	.61	
03	.60	
14	.57	
09	.56	
16	.55	
12	.47	
11	.44	
26	.43	
20	.41	
29		.77
07		.69
31		.69
13		.68
28		.50
33		.50
01		.49
25		.49
04		.44
15		.44
30		.43
10		.42
27		.41
32		.41
22		.40
EIGENVALUE	6.416	4.284
PCT OF VARIATION	60.0	40.0

The minimum significant clustering for the coefficient suggested two significant clusters whose memberships were in exact agreement with the model constructed using the various coefficients. The difference between the methods is confined to the splitting off of house #32 to form its own "cluster." This gives a three-cluster representation using the single linkage model. The two clusters for the unweighted average linkage method are:

A. 01 04 07 29 13 15 21 22 31 33 32 25 28 27 30

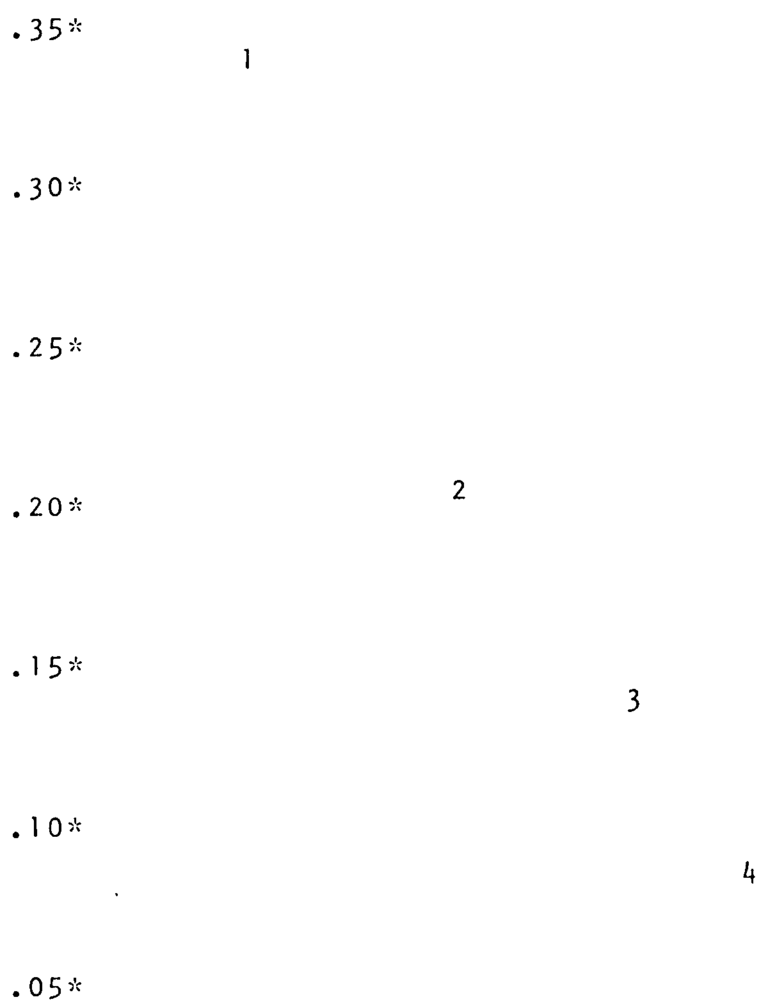
B. 02 20 08 12 14 10 11 03 16 05 09 06 19 23 17
18 24 26

Multidimensional Scaling. The nonmetric multidimensional scaling analysis yielded solutions to the Jaccard's and Simple Matching proximity data in one, two, three and four dimensions for Euclidian spaces. Figure 7 shows the stress values for the Euclidian solutions. The break at the stress values between one and two dimensions and significant departures of these values from what has been called the critical cut-off point (.32 for m=2) initially argued for a two dimensional Euclidian representation.

However, the "C" shape of the configuration suggested a lower dimensional solution. In the analysis

Figure 7.

PLOT OF STRESS VERSUS DIMENSION



of many different sets of data that were known to be basically one dimensional, Roger N. Shepard (1973) has found that two dimensional solutions, can characteristically assume either the simple "C" shape (Figure 8) or the inflected "S" shape.

In light of these facts, we propose that the possibility of a one dimensional solution is extremely feasible because of the potentially undetected occurrence of a merely local minimum (which is quite likely in a one dimensional solution). This would make the one dimensional solution appear to yield an unacceptably poor monotone fit. In order to achieve the maximum advantage of the multidimensional model, we will recognize the advantages of stability and interpretability and seek a solution in one dimension.

Table 5 portrays the values for the 33 objects and their rankings for the Simple Matching proximity data (which was in <u>total</u> agreement with Jaccard's coefficient).

Specifying two types in one dimension, we search the positive and negative vectors. The obtained solution essentially delineated two groupings:

A. 27 25 28 13 01 29 31 32 07 33 30 22 15 04 21 10

B. 02 20 08 12 14 11 03 16 05 09 06 19 23 17 18 24 26

Figure 8.

Scaling Configuration

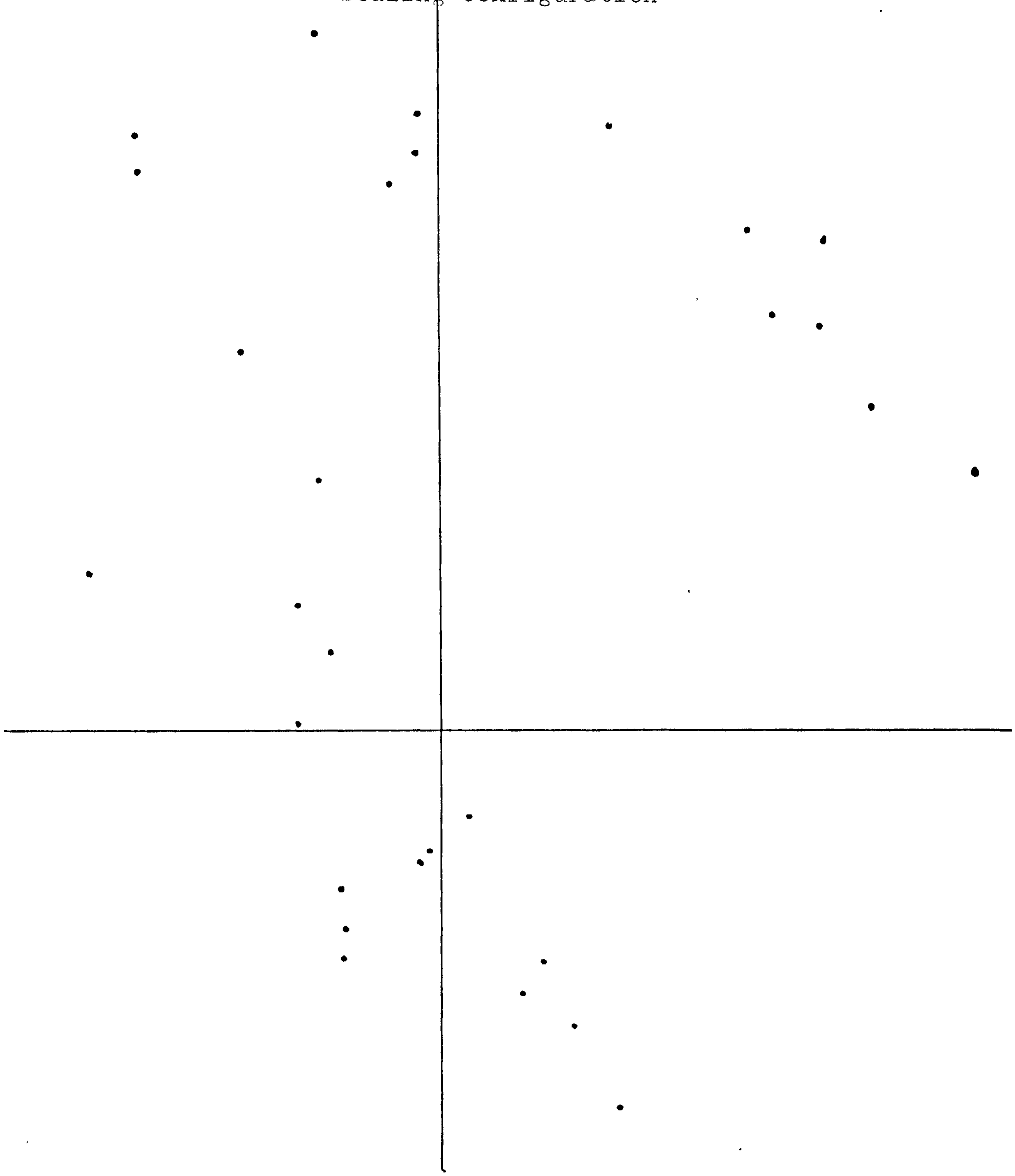


Table 5.

Q-MODE ONE DIMENSION
MULTI DIMENSIONAL SCALING

17	-1.52
18	-1.46
03	-1.41
09	-1.37
23	-1.22
16	-1.12
05	-1.06
19	-1.00
26	- .99
14	- .82
24	- .78
06	- .63
11	- .40
20	- .29
12	- .23
08	- .17
02	- .002
10	.02
21	.28
04	.32
15	.46
22	.55
30	.68
33	.79
07	.84
32	.96
31	1.08
29	1.11
01	1.15
13	1.23
28	1.52
25	1.58
27	1.85

Principal Components Analysis.- R--mode. Two independent axes were defined for the set of 91 attributes using the Principal Components method. The intercorrelation of the 91 attributes across the 33 houses produced a 91 x 91 symmetric correlation matrix (Appendix 7). The model specified a solution in two components. The loadings greater than the absolute value of .40 are presented in Table 6. Given the negative and the positive loadings for each component, we can identify two groupings for each component yielding a total of four groups:

Factor Analysis. The matrix of correllation coefficients among the 91 attributes was factor analyzed by means of the "principal factors" method. Using a varimax rotation, we again extracted two factors. Of the total variance, 59.2 per cent is accounted for by the first factor and 40.8 per cent by the second factor. The extreme loadings may again be mapped into four classes of attributes as shown in Table 7.

Cluster analysis. The results yielded by cluster analysis for the single linkage and unweighted group average methods using Jaccard's coefficient add very little information and will not be presented here. The relevance of the priximity measure can best be judged only

Table 6.

List of Variables Arranged According to a Descending Order of Principal Components Loadings--Loadings .40.

Name	I	II
Large window area	.80	
Large floor area	.76	
Paint wall covering	.68	
Scallop shingle roof material	.64	
Timber walling with wide weatherboard cladding	.63	
Glass around door	.61	
Brick chimney material	.53	
Basement	.52	
1/3 window	.50	
Asphalt/tar roof materials	.49	
Wide roof molding width	.47	
Natural stone chimney material	.41	
Wood roof material	-.40	
Rectangular floor plan	-.49	
Wood foundation	-.50	
No celler	-.50	
Rectangular shingle roof	-.51	
Log walling materials	-.58	
Narrow roof molding width	-.62	
Pitch walling covering	-.63	
High roof pitch angle	-.63	
No entrance	-.66	
Multiple pane windows	-.73	
Small floor area	-.76	
Small window area	-.80	
Morainal plain bedrock		.84
Rolling physiography		.84
Holdridge morainal plain association		.84
ii vegetation		.84
Scoby loam soils		.84
i vegetation		-.42
Holdridge lower stream association		-.62
Quaternary alluvial bedrock		-.82
EIGENVALUE	12.658	6.58
PCT OF VARIATION	59.6	40.4

Table 7.

List of Variables Arranged According to a Descending Order of Factor Loadings--Loadings .40.

Name	I	II
Large window area	.78	
Large floor area	.77	
Scallop shingle roof	.65	
Glass around door	.64	
Timber walling with wide weatherboard cladding	.62	
3/1 window	.60	
Asphalt roofing material	.57	
Paint wall covering	.56	
Wide roof molding width	.56	
Basement	.55	
Stoop with roof entrance	.48	
Asphalt roof ridge roll	.47	
Natural stone chimney material	.40	
"L" shaped floor plan	.40	
One chimney	-.40	
Metal roof ridge roll	-.47	
Wood roof material	-.49	
Log walling material	-.51	
Narrow roof molding width	-.54	
No celler	-.55	
Wood foundation material	-.55	
Pitch wall covering	-.55	
Rectangular shingle roof	-.61	
High roof pitch angle	-.61	
Multiple pane windows	-.71	
No entrance	-.73	
Small floor area	-.77	
Small window area	-.78	
Quaternary alluvial Bedrock		.92
Mountain physiography		.59
Holdridge lower stream association		.50
Morainal plain bedrock		-.92
Rolling physiography		-.92
Holdridge morainal plain association		-.92
ii vegetation		-.92
Scoby loam soils		-.92
EIGENVALUE	13.103	9.015
PCT OF VARIATION	59.2	40.8

in terms of the theoretical model(s) that the investigator has in mind or in terms of the practical purposes for which the classification is intended. Although we have used Jaccard's coefficient to differentiate between populations of houses, the mutual absence of a trait on a house is judged in this case to lead to a much more trivial solution when considered over a total profile of only 33 houses. We turn, therefore, to the hierarchical clustering schemes derived from the Simple Matching coefficient.

In view of the relatively large number of elements concerned, the uncertain number of clusters likely to be required and, at the same time, the small size of the sample (33 units), the simplest procedure seemed to be to use average likage cluster and single linkage cluster analysis with the level of interpretation at n=4, where n is the number of significant clusters. There is no guarantee that these results are in any way optimal. The factor analysis did not classify all the attributes, this suggests a residue will exist. The H.C.S (hierarchical clustering scheme) plots are presented as appendices 8 and 9.

Multidimensional Scaling. A non-metric multidimensional scaling program (Kruskal, 1968) was applied to the 91 x

91 Simple Matching and Jaccard proximity matrices. Solutions were obtained in one, two and three dimensional representations for the Euclidian metric. The stress values for the Simple Matching solutions, were always smaller than the corresponding values for the Jaccard solutions.

First, considering the stress values for the mean proximity data, we note a sharp break between m=1 and m=2 (where m denotes the dimensionality of the space). The stress values suggest that the house attributes can be adequately represented in two dimensional space (Kruskal, 1964). However, as has been previously mentioned, the configuration may represent only one dimension of house attributes as it approximates the "C" solution. Tables 8 and 9 contain the final solutions for two and one dimensions respectively. The one dimensional solution and the first dimension of the two dimensional solution suggest two highly developed groups.

Table 8.

R-MODE TWO DIMENSIONS
MULTI DIMENSIONAL SCALING

Small window area	1.30	.14
Rolling physiography	1.18	.78
Multiple pane windows	1.17	-.14
Small floor area	1.17	-.05
Narrow roof molding width	1.06	.002
Timber walling with narrow cladding	1.02	-.17
Rectangular floor plan	1.02	.72
Metal roof ridge roll	.93	1.06
Rectangular shingle roof	.91	-.58
Lower Milk River flood plain	.90	.59
Wood foundation	.90	-.25
No celler	.90	-.25
High roof pitch angle	.73	-.54
Pitch wall covering	.71	-.40
Wood roof material	.63	-.63
Quaternary alluvial bedrock material	.58	1.50
Upper-stream Holdridge association	.50	-.66
Log walling materials	.44	-.54
Metal pipe chimney	.44	.73
Natural rock chimney material	- .44	.52
Stoop with roof entrance	- .47	-.24
1/2 Horizontal slide window	- .47	-.48
"L" shaped floor plan	- .53	-.37
Chimney within the house avoiding the ridge	- .54	-.58
Brick chimney material	- .60	-.34
1/3 window	- .61	-.24
Concrete foundation	- .74	.85
Asphalt roof ridge roll	- .78	.04
Asphalt/tar roof material	- .84	1.12
Timber walling with wide weatherboard cladding	- .86	-.32
Basement	- .90	-.27
Wide roof molding width	-1.05	.006
Paint wall covering	-1.05	.97
Large floor area	-1.06	-.05
Large window area	-1.07	.45
Scallop shingle roof material	-1.09	.26
Glass around door.	-1.13	.51

Table 9.

R-MODE ONE DIMENSION
MULTI DIMENSIONAL SCALING

Paint wall covering	-1.70
Asphalt roof covering	-1.60
Large floor area	-1.51
Cement foundation	-1.40
Glass around door	-1.34
Large window area	-1.33
Scalloped shingle roof	-1.24
Wide roof molding width	-1.00
Asphalt roof ridge roll	- .93
Basement	- .89
Timber walling with wide weatherboard cladding	- .88
1/3 windows	- .73
Brick chimney material	- .71
Stoop with roof entrance type	- .64
Chimney position within the house avoiding ridge	- .62
"L" shaped floor plan	- .59
1/2 horizontal slide window	- .52
Upperstream Holdridge association	.45
Log walling materials	.50
Wood roofing material	.60
High roof pitch	.66
Pitch wall covering	.72
Wood foundation	.77
No celler	.91
Rectangular shingle roof	.91
Timber walling with narrow weatherboard cladding	.95
Narrow roof molding width	1.00
Multiple pane windows	1.10
Small floor area	1.10
Lower Milk River flood plain	1.21
Small window area	1.32
Rolling Physiography	1.42
Metal roof ridge roll	1.65
Rectangular floor plan	1.75
Alluvial flood plain bedrock.	1.93

Chapter 5

DISCUSSION

Briefly recapitualting the main results of the preceeding section, we note that attribute and artifact spaces are taken with house attributes and houses as respective points in them. An incidence matrix is constructed for each house by measuring the occurrence of selected attributes on each house. Correlating the attributes and correlating the artifacts gives rise to two matrices which are analyzed by the Principal Components and Factor methods. The Euclidian distances of the same two spaces are used to construct genotypic spaces using multidimensional scaling and hierarchical clustering schemes in both the "R" and "Q" modes. Our quantitative model specified two distinct types and in all cases we were able to discriminate two classes.

Principal Components and Factor analysis suggested two more classes of attributes in the "R" mode. These classes loaded on the polar extremes of component/factor II, which is interpreted here as a residual factor/component. This factor/component was required by our model to fit the following grouping of intercorrelated attributes that cross-cut the housing types:

- Morainal plain bedrock,
- Rolling physiography,
- Holdridge morainal plain association,
- ii vegetation, and
- Scoby loam soils.

Because these five attributes are intercorrelated at the 1.00 level, but not correlated with the two classes of attributes described on the first factor/ component, we specified another vector space to account for them.

The "R mode" hierarchical clustering scheme also is interpreted as a four class structure. Again, this interpretation allows us to isolate two "residual classes" that essentially agree with the factor and principal component results.

The independent structure of the "R mode" clustering scheme is more difficult to interpret. In this case, it will be used to support the postulated association of attributes within a single cluster rather than as a means of direct interpretation.

Two-by-two contingency tables were constructed comparing all the analyses as to their agreement in the various spaces. The methodological similarity of the four analyses was verified for the typological problem presented. The methods tended to uncover similar attributes and artifact spaces. This tendency was suggested through a comparison of the methods using the chi-square test with Yate's correction. Table 10 is a presentation of the results of the two-way comparison.

The chi-square tests allowed us to test the hypothesis that any association we observed between the methods and their classifications was the result of sampling variation from a population in which the association was zero.

Our null hypothesis for each test was that there was no relationship between the respective methods of analysis. Given a .01 significance level and 1 defree of freedom, the rejection level for our null hypothesis lies at the value of 6.64.

Using our rejection criterion, it was suggested that we accept the alternative hypothesis of association between methods of analysis in all cases. From these results, we may conclude that the various methods uncovered equivalent space in this study.

We sought to interpret the variation in the two

	FACTOR-R	P.C.A.-R	M.D.S.-R	H.C.S.-R	FACTOR-Q	P.C.A.-Q	M.D.S.-Q	H.D.S.-Q
FACTOR-R		20.141	22.154	22.154				
P.C.A.-R			16.736	21.154				
M.D.S.-R				37.040				
FACTOR-Q						17.204	22.446	19.697
P.C.A.-Q							22.378	25.483
M.D.S.-Q								41.371
H.C.S.-Q								

Table 10.

Two-way Comparison of Analysis Techniques Using Chi-squared (1 d.f.)

proposed artifact classes in the traditional archaeological sense. The variation in the artifact form was considered in terms of human behavior. This type of consideration is what makes archaeologists anthropologists; namely, we infer the behavior of people from the relics we have to deal with (Spaulding, personal communication). Archaeologists seek to explain the differences in cultural units using four models:

- Differences in age (evolutionistic).
- Differences in geographical environments (different resources require different techniques for survival).
- Products of long separate traditions (isolation for long periods of time).
- Products of different physical or psychological types.

It is clear in this context, that a limited spatial area was selected for a specific purpose - to hold the third and fourth explanatory models relatively constant.

The Q mode analysis suggested two house types:

<u>B</u>	<u>A</u>
17	21
18	04

B	A
03	15
09	22
23	30
16	33
05	07
19	32
26	31
14	29
24	01
06	13
11	28
20	25
12	27
08	

The attribute classes presented in our analysis are proposed to model a formal change through time in the manufacture of these two classes of houses/artifacts. As time is not a directly observable dimension in archaeology, the inference here, on temporal ordering, is drawn by application of three principles of temporal ranking:

- All things being equal, the degree of similarity between two artifacts varies inversely with separation in time (principle of serial correlation).

- All things being equal, people choose to use more efficient ways of doing things.
- All things being equal, there is a tendency to refinement and elegance in form. (We are not often "fooled" by degeneracy).

Armed with these principles and a higher abandoment index for type B (.46 versus .13 for type A), we were able to develop a model reflecting changes in manufacturing behavior for the Clear Creek housing artifact.

House Foundation Variability.

Two changes were noted in the construction of the house foundation. The first is the appearance of subterranean excavation. Basements, cellars and half-cellars were present in the later class of houses, but absent from the earlier. It would appear this is related to the increasing mechanization of the construction process. Earth moving equipment became reasonably available, an easy way to move large quantities of earth fast. Informants related that, in effect, "it was just too difficult to build a basement by hand and farm horse." A full cellar for a modestly-sized house could take the better part of a season to excavate by hand. Today, using machines, a full cellar can be excavated in a matter of days.

The second change occurred in the material used for foundations. Associated with the change to subterranean excavation, there was a shift from brick and wood foundations to poured concrete foundations. This reflects the development and accessibility of concrete technology. It was cheaper in initial and maintenance cost and it was easier to pour concrete for subterranean walls and the foundations than to use either brick, stone masonry, or wood.

Floor Space Variability.

Three changes were noted in the floor space. First, there was an increase throughout time in total floor space area. Class A houses are 620 square meters in average size, and Class B houses are 312 square meters. This increase indicates several trends: There was more available capital and labor for each farmstead; and, with the advent of subterranean excavation, there was a central basement heating system. Central heating allowed the homebuilder to expand.

The second source of variability is in the actual floor plan. The "L" shaped floor plan and the split level home are absent from the Class B homes and are present in the Class A homes. These reflect several building processes; one concerns addition. As the early Clear Creek home owner of the late 1800's and early 1900's perceived the need for additional space he would build a new, larger house or add to the existing structure. If the builder decided to add, the new rooms most generally would yield an "L" shaped floor plan.

Another change in the building process was the use of shorter and thinner lumber for house framing. This made more efficient use of the tree, but made it more difficult to build large square or rectangular structures.

The split level structure is suggested to reflect changes in the homeowners perceptions of style. This is shown in the architectural record. For example, the California "ranch" style split-level home, which has spread across the United States has encountered wide stylistic acceptance (William Kuhr, personal communication).

External Walling Variability.

The change from pitched log or painted narrow weatherboard walling to a painted wide weatherboard motif reflected the fact that suitable trees for log houses became scarce and that wide weatherboarding was cheaper to install than narrow boarding. In the early 1900's narrow weatherboarding was readily available. It was desired for its thinness, small scale and light delicate effect. But as milling techniques refined and improved the lumber yield of trees, it became less expensive to produce and install wide weatherboarding. Painting was the most efficient way to protect the lumber and decorate the house's exterior.

Roof Variability.

The roofs of the Clear Creek houses underwent considerable change. First, the pitch of the roof dropped from the first to the later proposed class. The average pitch of Class A houses was 25°, while the average pitch of the Class B houses was 37°.

Reasons for this decrease in roof pitch were changes in style and a lower cost in building. The informants generally agreed that high pitched roofs became like "last year's chrome." A low pitched roof uses relatively less lumber in trussing than a high pitched roof. It also presents less area to be covered by roofing material.

The second source of variation was in the roofing material itself. Square wood shingles predominated until the late 1800's. At that time sculpted shingles were produced and marketed as possessing a decorative superiority. The more expensive sculpted roof shingles were soon followed by the introduction of asphalt shingle materials. It was not long before the "scalloped" asphalt shingles and asphalt ridge roof roll completely replaced wooden shingles and the metal ridge roll.

The asphalt material possessed some major advantages: They were more weathertight; they seem to have been thought of as decorative as the wooden shingles without the added production cost of sculpting; and the close distinctive diagonal pattern in which asphalt materials better resisted the often heavy Bearspaw winds.

The final source of formal variation for the roof is found in the roof molding. It became wider in the Class A houses. This may be stylistic decorative phenomenon complementing the widening of the weatherboard walling materials.

Chimney Variability.

Three formal attributes were identified as contributing to the variation in our artifact record of the chimney. As can be expected, two of these are related to the devleopment of basement heating systems. In our Class A houses we note the appearance of multiple chimneys, chimneys projecting from the gable instead of from within the house, and the adoption of stone as a building material.

The multiple chimneys occurred as the homebuilder began to differentiate between heating and ornamentation in his home. The same could be said for the position of the chimney. The smaller, earlier homes generally had one source of heat that also was used for cooking. It was placed as close to the center of the building as possible for the most effective heat dissemination. The advent of central basement heaters made it necessary to vent the stove through a separate chimney or pipe. If the homeowner desired a fireplace, it was considered stylish to build it and the chimney against an external wall. The actual change in the position of the chimney thus may be expressed as a symbol of status and as a decorative feature.

Quarried stone has recently come into vogue in the Bearspaw as a decorative chimney material. There is no natural stone in the local area that is suitable for fireplaces. Imported granite stone has only recently become competitive in price with other building materials.

Window Variability.

The window area (both total and relative) was enlarged in the later houses. A better heating system made insulated walls a less crucial commodity. Class A houses had a window/wall area index of .225; while the Class B houses had an index of .120.

A change from multi-paned windows in class B to single paned windows in class A was suggested. Glass was produced in larger sizes and relatively cheaper quantities. It also became easier to transport these items as they became less brittle and as methods of packing improved. Glass companies advertised the larger panes as giving a more unobstructed view and as being easier to clean and maintain, thus appealing to maintenance and asthetic factors.

Horizontal slide windows replaced the vertical hinge an d slide windows. These simply represented a better way of making a window. It was difficult to make the early windows weathertight. The development of aluminum/alloy window frames and strip molding made the horizontal slide window practical.

Entrance Variability.

In most cases the farmstead was the closest building within the settlement to the road. Thus, despite the fact that rural people seldom use the entranceway, it remains an important part of the house. This is because it is generally the first part of the settlement visible to visitors.

Two variable attributes were noted regarding the entranceway. First, there was an introduction of the covered stoop to the Class A houses. This was necessitated by the raised foundation that accompanied the building of the basement. It is an easier way to get into the door. The covered stoop is a stylistic phenomenon that occured in the 1930's and persists today.

Second, the introduction of glass around the door suggests a response to ornamentation, the availability of relatively inexpensive glass, and security needs.

Environmental Variability.

The environmental attributes were included so as to examine the logistics of house location. No consistent theory of site as a form determinant has ever been proposed. However, there have been attempts to explain houseform--in terms of terrain, lack of land, and so on. There is the ecological determinism of Evans-Pritchard and others regarding the Nuer of the Sudan (1940) and the work of Brockman in Switzerland which attach great importance to this aspect. On some occasions siting had a direct effect on the inhabitants and their houses. Carl Sauer (1963 : 5) reports the following on the Ohio Borderland homesteaders: "The location of house and farm, cultural preferences of different colonizing groups, micro-climatic drainage and sanitation were unrecognized, the toll paid in typhoid and summer complaint."

Plants and landforms have historically dominated siting studies. The presence and abundance of plant species express a set of environmental factors more or less unique to each species. A plant community fairly well summarizes all of the ecologically relevant factors and interactions. Pioneer settlers, in assessing site quality, used the landforms and vegetation, in settlement in Rush County Indiana (Kiefer, 1972). The southeastern portion of the county is underlain by a sheet of older Wisconsin till that has been subjected to considerable weathering and stream dessication, and has a well drained rolling surface, whereas the newer till in the northwest is still level and poorly drained. Differences in the natural drainage of the two till sheets were reflected by differences in vegetation which were well known and clearly understood by the settlers. Sugar maple and oak trees were indicators of the better drained area. Beech trees indicated the more poorly drained swampy ground. "We cannot be certain that every purchaser used the forest cover as an index of land quality, but there is good reason to believe that they were justified in doing so (Kiefer, 1972: 491)."

The effect of climate on house form has been widely accepted in architecture. "We build houses to keep in a consistent climate, and to keep our predators. We grow, gather and eat food to keep our metabolism on an even keel (Archer, 1964:2)." However, examination of the differences in house types within our single area, suggests that they are to be more related to culture than to climate, and does not support the extreme determinist position.

The fact that no single environmental attribute was associated with a particular class of houses or house attributes suggests:

- that locational preferences did not change but remained relatively constant through time and technological advances; and
- there was not an association (i.e. causual relationship) among a combination of formal attributes and environmental variables.

In one sense we may treat the effect of the site as a cultural phenomena since the ideal site depends on the goals, ideals and values of a people or a period, and the choice of a "good" site depends on this cultural definition. Our model is concerned with explaining variability in the artifactual record--not homogeneities. The homogeneous patterns and processes reflect another very attractive and hardly investigated field of study, as is, indeed, the whole question of quantitative artifactual analysis. However the homogeneniety-variability question and the study of the homogenieties in particular is beyond the scope of this thesis.

Chapter 6

SUMMARY

This study employed data recovery methods designed to recover formal and contextual information from the artifacts under study. The information is sought to interpret variation in the archaeological record. The study was designed for three purposes relative to this record:

- To maximize on information retrieval.
- To develop interpretive models to account for the variation.
- To define parameters for future analysis.

Our design was satisfied by the statistical and descriptive methods chosen. From this design we were able to generate two clusters, sets, classes or types of objects.

Information collection and data analysis followed methods developed by prehistorians for the study of archaeological remains. The present study introduced quantitative data that could be used toward the definition of ecological adaptation. We believed these variables would help provide a basic understanding of the structural relationships between elements of the ecosystems and the elements in the cultural systems that generated artifactual variability. We were unable to demonstrate the coexistence of certain environmental conditions with certain artifacts and artifact attributes.

The full potential of this study can be realized only if similar studies are made for other areas. Comparisons and contrasts could be made. Census statistics indicate that the types of social changes which have occured in the study area are representative of the types of change which occurred elsewhere.

But, what have we done to solve the fundamental problem of describing our assemblage variability? So far as the attributes considered are concerned, we have made substantial progress. In the case of our data set, we showed that there is indeed association of attributes and artifacts and that this association is a matter of the interaction of technological innovation, stylistic variability and the preferences of the home builder.

So far as our evidence goes, the Clear Creek house builders were anything but rigorous typologists, although they did exhibit some mild preferences for certain attribute combinations. Our method is useful when essentially directed to the question of what kinds of attribute association are exhibited by the artifact collection under study.

Finally, this study was designed to illustrate some of the aspects of several conditions of multivariate analysis likely to provide archaeologists with analogies to their own data. One concept is made explicit; namely, only if we have evidence about a wide range of association and relevant behavior is there a possibility of working from the archaeological analysis to the cultural preferences and mores held by people within that culture.

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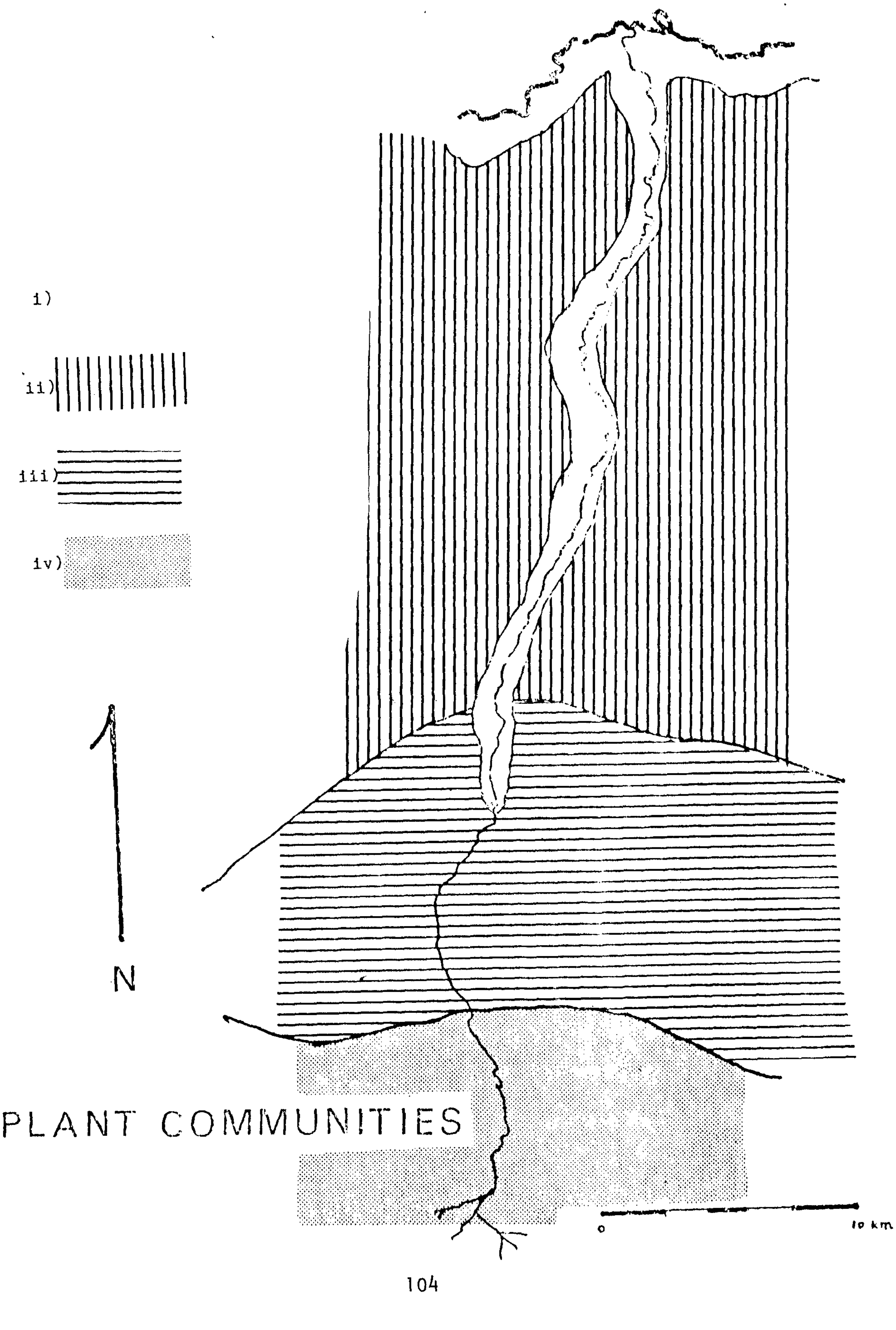
APPENDIXES

APPENDIX 1

CLEAR CREEK FLORAL COMMUNITIES



PLANT COMMUNITIES

CLEAR CREEK FLORAL COMMUNITIES

i) Acer negundo
Avena sativa
Corangana arborescens
Franxinus pennsylvanica
Linium
Medicago sativa
Populus deltoides
Prunus americana
Prunus virginiana
Rosa woodsii
Rubus idaeus
Salix amygdaloides
Syringa
Ulmus americana
Ulmus pumila

ii) Agropyron smithii
A. spicatum
Andropogon scoporius
Artimisia fridgida
Avena sativa
Boutelouma gracilis
Carex filifolia
Chysopus villosa
Coragana arborescens
Gutierrezia sarothrae
Hordeum distichum
Kaeleria cristata
Liatris punctata
Linium
Medicago sativa
Mulenbergea cuspidata
Poa secunda
Prunus americana
Rubus ideasis
Sporobalus cryplondrus
Stipa comatata
S. viridula
Syringa
Triticum Aestivum
Ulmus pumila

iii) Achillea millefolium
Agropyron smithii
A. spicatum
Artimisia frigida
Avena sativa
Boutelouma gracilis
Carex filifolia
Erigonum flavum
Festuca idahoensis
F. scabrella
Kaeleria cristata
Medicago sativa
Pentstemon procerus
Poa secunda
Stipa comatata
Zea mays

iv) Larix occidentalis
Picea glauca
Pinus contorta
P. ponderosa
Populus Tremuloides
Pseudotsuga menziesii
Rosa woodsii
Rubus idaeus

APPENDIX 2

LIST OF FORMAL ATTRIBUTES

FORMAL ATTRIBUTES

Timber walling with narrow weatherboard cladding.
Timber walling with wide weatherboard cladding.
Log walling.
Timber walling with cinderblock nogging.
Timber walling with tongue and groove.
Metal over wood frame.

Paint wall covering.
Asphalt paper covering.
Pitch wall covering.

High roof pitch.
Medium roof pitch.
Low roof pitch.

Gabled roof shape.
Pyramid roof shape.
Single pitched roof.
Hipped roof.

Exposed eave rafters.

Metal roof ridge roll.
Asphalt paper roof ridge roll.

Asphalt/tar roofing material.
Metal roofing material
Wood roofing material.

Scallop shingle roofing material shape
"Sheet" roofing material shape.
Rectangular shingle roofing material shape.

Dormiers

One chimney.
Two chimneys.
Three chimneys.

Chimney within the house through the ridge.
Chimney within the house avoiding the ridge.
Chimney projecting from the gable.

Chimney brick material.
Chimney metal pipe.
Chimney natural stone.

Wide roof molding width.
Narrow roof molding width.
Medium roof molding width.

Stone foundation
Brick foundation.
Concrete foundation.
Wood foundation.

Crawl space celler.
Half celler.
Basement.
Full celler.

One storied house
Two storied house.
Split level house.

Door facing view of road.

Glass around the door.

Stoop entrance.
Stoop with roof entrance.
Enclosed porch entrance.
Porch with rail entrance.

Windows - 1/3.
Windows - 1/2; horizontal slide.
Windows - 1/2; vertical slide.
Multiple pane windows.

Large window area.
Small window area.

Square floor plan.
"L" floor plan.
Rectangular floor plan.

Large floor area.
Small floor area.

Associated recreational structures.

Associated external appendeges.

APPENDIX 3

SYMMETRIC MATRIX--JACCARD'S COEFFICIENT--

Q-MODE

IDENTIFICAT[illegible]

	COL00001	COL00002	COL00003	COL00004	COL00005	COL00006	COL00007	COL00008	COL00009	COL00010
COL00001	1.000									
COL00002	0.637	1.000								
COL00003	0.593	0.648	1.000							
COL00004	0.747	0.648	0.626	1.[illegible]						
COL00005	0.626	0.659	0.769	[illegible]	[illegible]					
COL00006	0.615	0.692	0.670	[illegible]	0.747	[illegible]				
COL00007	0.714	0.659	0.659	[illegible]	[illegible]	[illegible]	1.000			
COL00008	0.681	0.714	0.648	[illegible]	[illegible]	0.670	0.769	1.000		
COL00009	0.626	0.637	0.769	[illegible]	[illegible]	[illegible]	[illegible]	0.703	1.000	
COL00010	0.703	0.714	0.626	[illegible]	[illegible]	0.692	0.681	0.714	0.615	1.000
COL00011	0.648	0.681	0.725	[illegible]	[illegible]	0.637	0.692	0.813	0.692	0.813
COL00012	0.659	0.670	[illegible]	[illegible]	[illegible]	0.670	0.747	[illegible]	0.747	0.758
COL00013	0.791	0.648	0.560	[illegible]	[illegible]	0.582	0.835	0.670	0.637	0.714
COL00014	0.626	0.659	0.725	[illegible]	[illegible]	0.725	[illegible]	0.791	0.758	0.615
COL00015	0.582	0.725	0.659	[illegible]	[illegible]	0.615	0.692	0.659	0.626	0.681
COL00016	0.560	0.637	0.813	[illegible]	[illegible]	[illegible]	0.626	0.725	0.780	0.637
COL00017	0.549	0.582	0.758	[illegible]	[illegible]	0.592	0.615	0.648	0.791	0.670
COL00018	0.560	0.593	0.769	[illegible]	[illegible]	0.791	0.626	0.703	0.714	0.659
COL00019	0.604	0.703	0.813	[illegible]	[illegible]	[illegible]	0.626	0.681	[illegible]	0.659
COL00020	0.626	0.813	0.593	[illegible]	[illegible]	0.769	0.648	0.637	0.626	0.747
COL00021	[illegible]	0.648	0.604	[illegible]	[illegible]	0.670	0.703	0.670	0.571	0.648
COL00022	0.615	0.714	0.626	[illegible]	0.549	0.643	0.681	0.560	0.637	0.692
COL00023	0.505	0.692	0.780	[illegible]	0.769	0.780	0.549	0.648	0.747	0.758
COL00024	0.484	0.648	0.604	[illegible]	0.615	0.780	0.549	0.626	0.571	0.626
COL00025	0.670	0.615	0.527	[illegible]	0.516	0.527	0.714	0.637	0.516	0.615
COL00026	0.473	0.615	0.681	[illegible]	0.582	0.681	0.538	0.637	0.648	0.659
COL00027	0.549	0.648	0.495	0.582	0.505	0.473	0.681	0.604	0.484	0.582
COL00028	0.659	0.604	0.538	0.670	0.571	0.538	0.681	0.648	0.549	0.626
COL00029	0.703	0.670	0.604	0.736	0.681	0.604	0.857	0.714	0.637	0.648
COL00030	0.670	0.659	0.593	0.615	0.670	0.637	0.714	0.681	0.626	0.659
COL00031	0.703	0.692	0.604	0.676	0.637	0.604	0.791	0.670	0.659	0.692
COL00032	0.571	0.648	0.582	0.648	0.615	0.648	0.725	0.736	0.571	0.582
COL00033	0.692	0.637	0.593	0.703	0.648	0.571	0.692	0.593	0.626	0.637

IDENTIFICATION:

	COL00011	COL00012	COL00013	COL00014	COL00015	COL00016	COL00017	COL00018	COL00019	COL00020
COL00011	1.000									
COL00012	0.791	1.000								
COL00013	0.659	0.670	1.000							
COL00014	0.736	0.813	0.615	1.000						
COL00015	0.670	0.681	0.659	0.604	1.000					
COL00016	0.736	0.747	0.593	0.582	0.670	1.000				
COL00017	0.637	0.648	0.538	0.747	0.659	0.769	1.000			
COL00018	0.648	0.681	0.549	0.750	0.582	0.758	0.657	1.000		
COL00019	0.648	0.747	0.615	0.736	0.648	0.736	0.769	0.602	1.000	
COL00020	0.648	0.681	0.637	0.670	0.782	0.626	0.615	0.670	0.736	1.000
COL00021	0.571	0.648	0.648	0.615	0.769	0.527	0.648	0.615	0.725	0.681
COL00022	0.593	0.626	0.648	0.593	0.769	0.549	0.582	0.527	0.637	0.637
COL00023	0.769	0.692	0.516	0.703	0.659	0.725	0.602	0.791	0.635	0.725
COL00024	0.615	0.560	0.495	0.681	0.615	0.615	0.670	0.703	0.681	0.661
COL00025	0.538	0.637	0.659	0.604	0.692	0.582	0.549	0.560	0.495	0.560
COL00026	0.692	0.659	0.527	0.692	0.648	0.648	0.703	0.692	0.758	0.626
COL00027	0.615	0.582	0.670	0.505	0.703	0.549	0.451	0.464	0.484	0.637
COL00028	0.637	0.648	0.692	0.615	0.637	0.571	0.516	0.527	0.527	0.549
COL00029	0.681	0.714	0.846	0.681	0.725	0.659	0.582	0.615	0.615	0.637
COL00030	0.604	0.747	0.681	0.736	0.648	0.648	0.703	0.670	0.648	0.648
COL00031	0.615	0.736	0.758	0.703	0.725	0.659	0.582	0.593	0.637	0.659
COL00032	0.615	0.692	0.648	0.703	0.703	0.659	0.604	0.681	0.593	0.615
COL00033	0.626	0.703	0.769	0.648	0.670	0.648	0.615	0.626	0.648	0.626

IDENTIFICATION:

	COL00021	COL00022	COL00023	COL00024	COL00025	COL00026	COL00027	COL00028	COL00029	COL00030
COL00021	1.000									
COL00022	0.714	1.000								
COL00023	0.604	0.604	1.000							
COL00024	0.604	0.626	0.736	1.000						
COL00025	0.615	0.637	0.462	0.659	1.000					
COL00026	0.593	0.615	0.791	0.857	0.626	1.000				
COL00027	0.592	0.560	0.473	0.626	0.791	0.659	1.000			
COL00028	0.538	0.648	0.495	0.646	0.813	0.681	0.758	1.000		
COL00029	0.626	0.692	0.538	0.560	0.703	0.593	0.736	0.802	1.000	
COL00030	0.659	0.659	0.593	0.593	0.670	0.604	0.549	0.659	0.725	1.000
COL00031	0.670	0.802	0.538	0.560	0.791	0.593	0.670	0.758	0.824	0.769
COL00032	0.692	0.626	0.516	0.626	0.659	0.592	0.648	0.626	0.758	0.747
COL00033	0.593	0.637	0.593	0.527	0.648	0.560	0.615	0.659	0.791	0.780

IDENTIFICATION:

	COL00031	COL00032	COL00033
COL00031	1.000		
COL00032	0.736	1.000	
COL00033	0.725	0.703	1.000

**** ELAPSED TIME IN THIS STEP IS 0.0225 MINUTES. TOTAL ELAPSED SYSTEM TIME IS 0.1247 MINUTES (1, -9)

APPENDIX 4

SYMMETRIC MATRIX--SIMPLE MATCHING

COEFFICIENT. Q-MODE

	COL00001	COL00002	COL00003	COL00004	COL00005	COL00006	COL00007	COL00008	COL00009	COL00010
COL00001	1.000									
COL00002	0.267	1.000								
COL00003	0.196	0.233	1.000							
COL00004	0.452	0.289	0.244	1.						
COL00005	0.227	0.244	[illegible]	[illegible]	1.000					
COL00006	0.271	0.349	0.302	0.378	0.410	[illegible]				
COL00007	0.350	0.244	0.225	[illegible]	[illegible]	[illegible]	1.000			
COL00008	0.293	0.316	0.200	0.256	0.343	[illegible]	0.362	1.000		
COL00009	0.227	0.214	0.400	[illegible]	[illegible]	[illegible]	[illegible]	0.270	1.000	
COL00010	0.372	0.366	0.227	0.364	0.222	[illegible]	0.243	0.333	0.205	1.000
COL00011	0.289	0.310	0.359	[illegible]	[illegible]	[illegible]	0.303	0.500	0.300	0.541
COL00012	0.279	0.263	0.351	0.244	0.410	[illegible]	0.381	0.455	0.361	0.421
COL00013	0.500	0.256	0.130	0.487	0.214	[illegible]	0.545	0.250	0.214	0.366
COL00014	0.227	0.244	0.324	0.172	0.455	[illegible]	0.263	0.424	0.071	0.205
COL00015	0.208	0.375	0.262	0.279	0.230	[illegible]	0.303	0.244	0.209	0.326
COL00016	0.167	0.233	0.500	[illegible]	[illegible]	[illegible]	0.190	0.324	0.429	0.250
COL00017	0.146	0.156	0.339	0.167	0.224	[illegible]	0.167	[illegible]	0.441	0.286
COL00018	0.149	0.159	0.400	0.250	0.455	[illegible]	0.171	0.270	0.297	0.262
COL00019	0.217	0.325	0.500	0.295	0.315	[illegible]	0.190	0.256	0.471	0.279
COL00020	0.277	0.541	0.196	0.326	0.385	0.468	0.256	0.233	0.227	0.439
COL00021	0.356	0.289	0.217	0.348	0.250	0.346	0.341	0.266	0.170	0.304
COL00022	0.255	0.366	0.227	0.224	0.128	0.304	0.295	0.130	0.233	0.349
COL00023	0.135	0.333	0.459	0.224	0.432	[illegible]	0.128	0.236	0.395	0.450
COL00024	0.112	0.273	0.200	0.176	0.205	0.509	0.128	0.209	0.152	0.261
COL00025	0.318	0.222	0.104	0.204	0.083	0.157	0.333	0.214	0.083	0.239
COL00026	0.077	0.205	0.275	0.163	0.282	0.325	0.037	0.195	0.220	0.279
COL00027	0.180	0.273	0.080	0.224	0.082	0.111	0.293	0.182	0.060	0.208
COL00028	0.295	0.200	0.106	0.318	0.133	0.160	0.275	0.220	0.109	0.244
COL00029	0.325	0.250	0.143	0.385	0.237	0.200	0.567	0.278	0.175	0.238
COL00030	0.286	0.244	0.140	0.222	0.231	0.250	0.297	0.237	0.171	0.262
COL00031	0.325	0.282	0.143	0.227	0.175	0.200	0.424	0.211	0.205	0.300
COL00032	0.152	0.220	0.116	0.256	0.146	0.256	0.306	0.314	0.093	0.156
COL00033	0.349	0.250	0.178	0.372	0.238	0.234	0.300	0.159	0.209	0.267

	COL00011	COL00012	COL00013	COL00014	COL00015	COL00016	COL00017	COL00018	COL00019	COL00020
COL00011	1.000									
COL00012	0.472	1.000								
COL00013	0.279	0.268	1.000							
COL00014	0.368	0.485	0.186	1.000						
COL00015	0.302	0.293	0.279	0.152	1.000					
COL00016	0.385	0.375	0.176	[illegible]	0.205	1.000				
COL00017	0.232	0.220	0.106	0.361	0.252	0.417	1.000			
COL00018	0.238	0.256	0.109	0.412	0.156	0.399	0.581	1.000		
COL00019	0.256	0.378	0.205	0.351	0.256	0.363	0.417	0.471	1.000	
COL00020	0.289	0.310	0.267	0.286	0.236	0.244	0.222	0.236	0.400	1.000
COL00021	0.204	0.273	0.289	0.222	0.475	0.140	0.273	0.222	0.390	0.356
COL00022	0.213	0.227	0.273	0.178	0.452	0.146	0.174	0.104	0.250	0.283
COL00023	0.462	0.317	0.120	0.325	0.295	0.375	0.500	0.472	0.571	0.405
COL00024	0.239	0.149	0.098	0.293	0.239	0.222	0.286	0.325	0.310	0.341
COL00025	0.143	0.233	0.279	0.182	0.333	0.174	0.128	0.130	0.080	0.164
COL00026	0.317	0.244	0.104	0.282	0.256	0.258	0.308	0.282	0.405	0.244
COL00027	0.239	0.174	0.302	0.082	0.357	0.146	0.038	0.060	0.078	0.283
COL00028	0.250	0.233	0.317	0.186	0.250	0.152	0.083	0.085	0.104	0.163
COL00029	0.275	0.297	0.563	0.237	0.342	0.225	0.116	0.146	0.167	0.233
COL00030	0.182	0.361	0.275	0.333	0.238	0.220	0.289	0.231	0.220	0.256
COL00031	0.186	0.333	0.339	0.270	0.342	0.225	0.116	0.119	0.195	0.262
COL00032	0.186	0.263	0.220	0.270	0.308	0.225	0.143	0.237	0.140	0.205
COL00033	0.244	0.325	0.447	0.238	0.302	0.256	0.205	0.209	0.256	0.261

IDENTIFICATION:

	COL00021	COL00022	COL00023	COL00024	COL00025	COL00026	COL00027	COL00028	COL00029	COL00030
COL00021	1.000									
COL00022	0.395	1.000								
COL00023	0.250	0.234	1.000							
COL00024	0.250	0.261	0.415	1.000						
COL00025	0.255	0.267	0.075	0.295	1.000					
COL00026	0.213	0.222	0.436	0.618	0.227	1.000				
COL00027	0.224	0.184	0.094	0.261	0.500	0.279	1.000			
COL00028	0.160	0.273	0.093	0.273	0.528	0.293	0.436	1.000		
COL00029	0.227	0.300	0.106	0.130	0.308	0.140	0.366	0.471	1.000	
COL00030	0.279	0.262	0.178	0.178	0.268	0.163	0.128	0.244	0.306	1.000
COL00031	0.286	0.486	0.106	0.130	0.457	0.140	0.268	0.389	0.484	0.382
COL00032	0.317	0.209	0.083	0.209	0.244	0.140	0.238	0.190	0.353	0.343
COL00033	0.229	0.267	0.213	0.140	0.273	0.149	0.239	0.279	0.457	0.444

IDENTIFICATION:

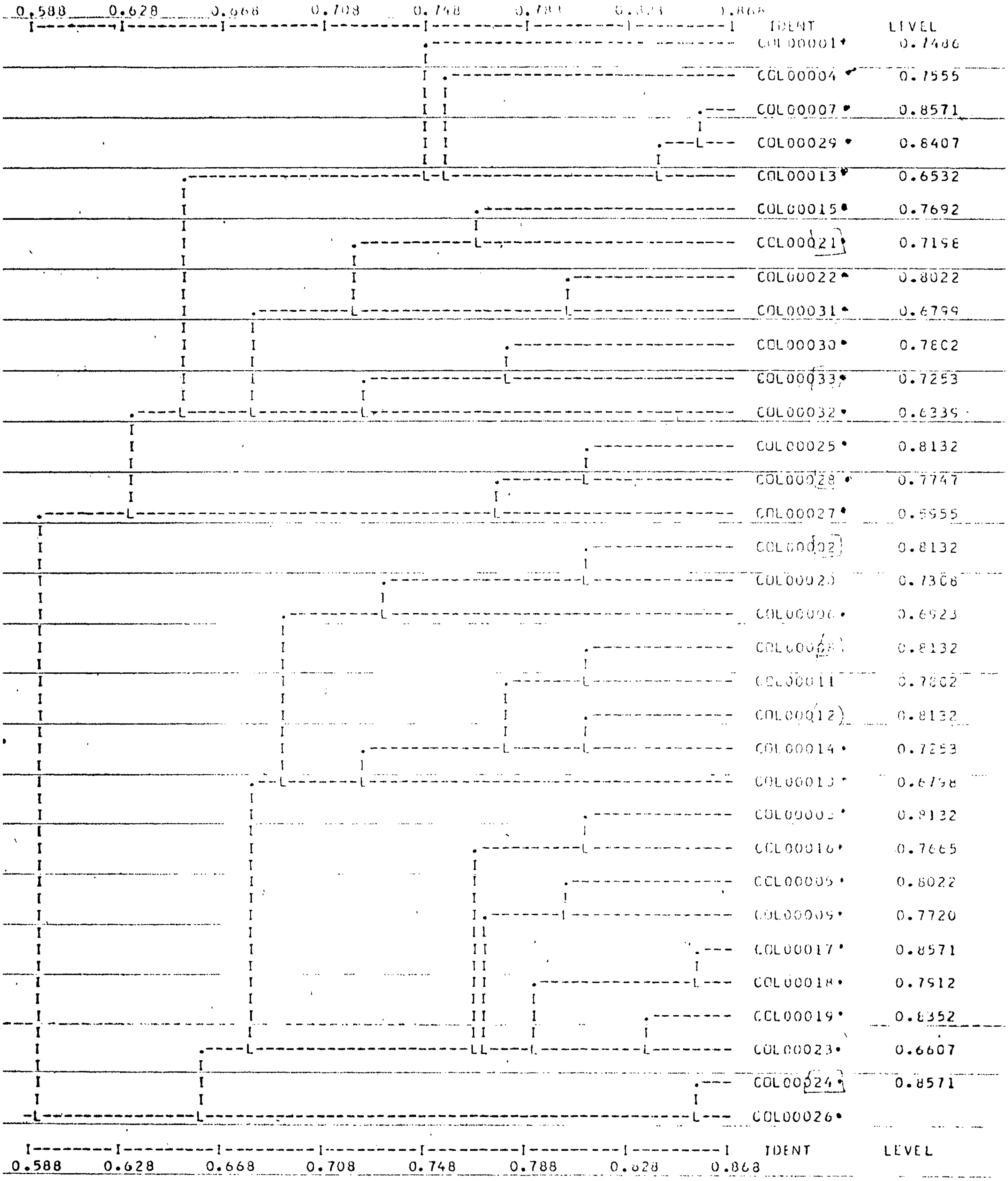
	COL00031	COL00032	COL00033
COL00031	1.000		
COL00032	0.314	1.000	
COL00033	0.342	0.308	1.000

**** ELAPSED TIME IN THIS STEP IS 0.0206 MINUTES. TOTAL ELAPSED SYSTEM TIME IS C.1478 MINUTES (1, -9)

APPENDIX 5

HIERARCHICAL CLUSTERING USING UNWEIGHTED AVERAGE LINKAGE AND THE COEFFICIENT OF JACCARD.

Q-MODE



* ELAPSED TIME IN THIS STEP IS 0.0364 MINUTES. TOTAL ELAPSED SYSTEM TIME IS 0.1611 MINUTES

APPENDIX 6

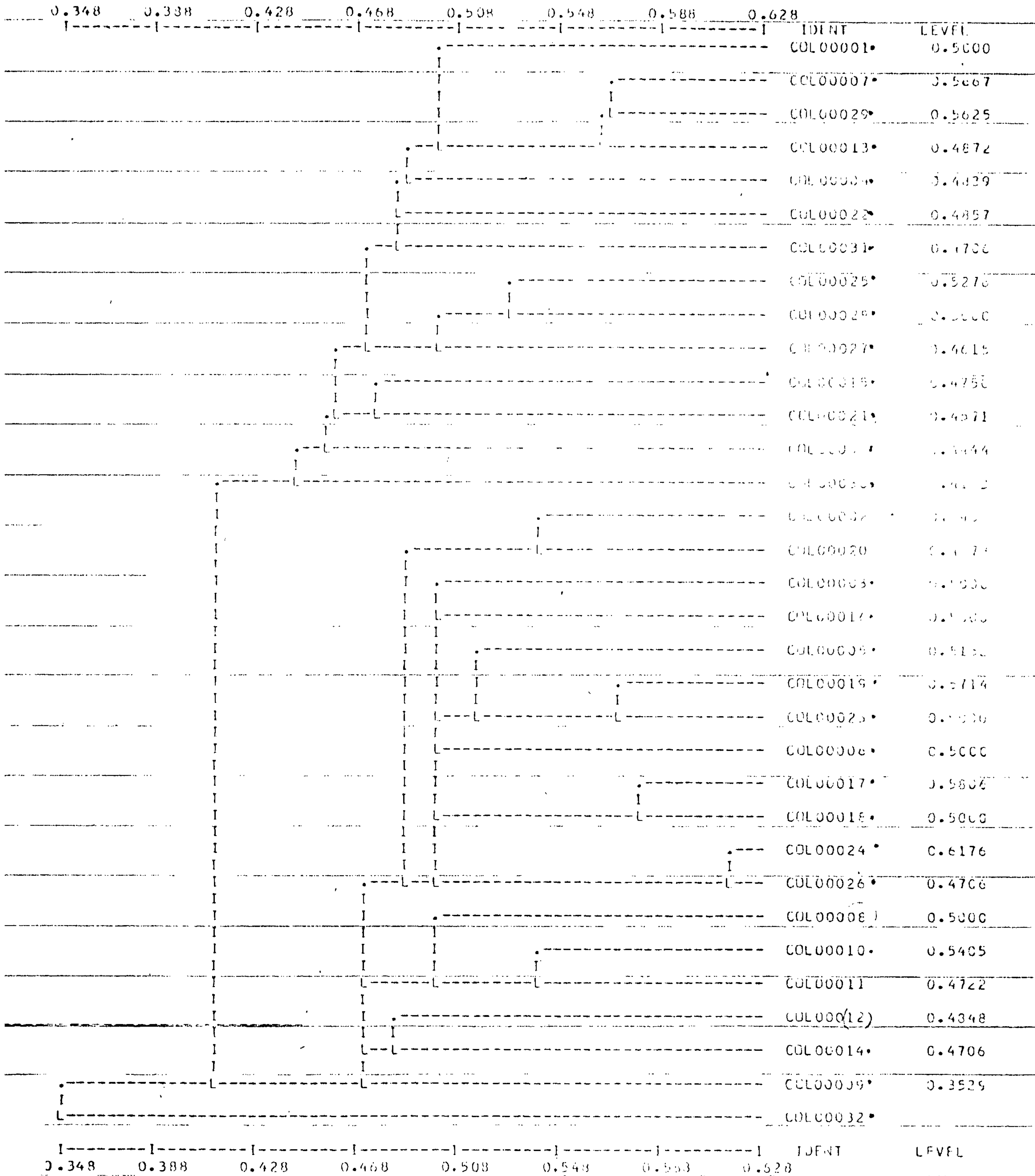
HIERARCHICAL CLUSTERING USING THE

UNWEIGHTED AVERAGE LINKAGE AND

THE SIMPLE MATCHING COEFFICIENT.

Q-MODE

PHENOGRAM FROM MATRIX SM 00



**** ELAPSED TIME IN THIS STEP IS 0.0414 MINUTES. TOTAL ELAPSED SYSTEM TIME IS 0.2055 MINUTES

APPENDIX 7

91 x 91 SYMMETRIC CORRELATION MATRIX

IDENTIFICATION:

	ROW00041	ROW00042	ROW00043	ROW00044	ROW00045	ROW00046	ROW00047	ROW00048	ROW00049	ROW00050
ROW00041	1.000									
ROW00042	0.435	1.000								
ROW00043	-0.224	-0.392	1.000							
ROW00044	-0.326	-0.318	[illegible]	1.000						
ROW00045	0.302	0.692	-0.271	-0.566	1.000					
ROW00046	0.105	-0.037	[illegible]	[illegible]	-0.445	1.000				
ROW00047	-0.401	-0.630	-0.020	0.735	-0.649	-0.342	1.000			
ROW00048	-0.289	-0.342	0.043	0.336	-0.250	-0.316	0.527	1.000		
ROW00049	0.157	0.058	-0.149	0.031	0.072	0.140	-0.192	[illegible]	1.000	
ROW00050	0.090	0.205	-0.090	-0.167	0.296	-0.132	-0.192	-0.156	-0.120	1.000
ROW00051	-0.250	0.022	-0.179	[illegible]	[illegible]	[illegible]	0.160	0.036	-0.053	0.153
ROW00052	0.157	0.053	0.124	-0.140	0.072	-0.052	[illegible]	[illegible]	-0.019	0.210
ROW00053	0.224	0.039	-0.100	-0.021	0.155	0.094	-0.239	-0.194	0.071	-0.080
ROW00054	0.333	0.380	-0.149	-0.311	0.390	-0.052	-0.356	-0.289	0.593	-0.120
ROW00055	-0.227	-0.219	0.0	0.233	-0.087	-0.210	0.267	0.722	-0.167	0.359
ROW00056	0.373	0.262	0.021	-0.241	0.058	-0.151	-0.224	0.040	0.202	-0.167
ROW00057	-0.187	-0.008	0.021	-0.004	-0.166	0.142	0.050	0.040	-0.140	0.385
ROW00058	-0.175	-0.238	-0.039	0.276	-0.150	0.037	0.164	-0.076	-0.058	-0.205
ROW00059	-0.224	-0.177	-0.100	0.250	-0.058	0.094	-0.020	-0.194	0.124	-0.080
ROW00060	0.0	-0.177	-0.100	0.250	-0.058	-0.164	0.199	0.043	-0.149	-0.080
ROW00061	0.090	0.205	-0.080	-0.167	0.296	-0.132	-0.192	-0.156	0.210	-0.065
ROW00062	-0.267	-0.422	0.199	0.324	-0.394	0.224	0.214	0.244	0.134	0.072
ROW00063	0.214	0.410	-0.096	-0.376	0.271	-0.058	-0.229	-0.136	-0.143	0.008
ROW00064	-0.224	0.039	0.267	-0.209	0.155	0.094	-0.239	-0.194	-0.149	-0.080
ROW00065	0.131	-0.081	-0.117	0.159	0.057	-0.193	0.105	-0.019	-0.175	-0.094
ROW00066	0.265	0.354	-0.194	-0.256	0.300	-0.151	-0.180	-0.069	0.064	0.130
ROW00067	0.060	0.168	-0.134	-0.095	-0.021	-0.013	0.032	-0.069	0.020	-0.107
ROW00068	-0.267	-0.422	0.199	0.324	-0.394	0.224	0.214	0.244	0.134	0.072
ROW00069	0.100	0.268	0.179	-0.396	0.056	0.121	-0.160	0.029	-0.283	0.144
ROW00070	0.0	0.255	-0.100	-0.209	0.368	-0.164	-0.239	-0.194	0.398	-0.080
ROW00071	-0.120	-0.524	-0.134	0.641	-0.363	-0.013	0.383	0.121	0.020	-0.107
ROW00072	0.134	0.164	-0.418	0.087	0.139	-0.373	0.179	0.180	0.030	0.192
ROW00073	-0.134	-0.164	0.418	-0.087	-0.139	0.378	-0.179	-0.180	-0.030	-0.192
ROW00074	0.300	0.211	-0.115	-0.152	0.465	-0.090	-0.401	-0.087	0.300	-0.008
ROW00075	0.167	0.380	-0.149	-0.311	0.390	-0.052	-0.356	-0.112	0.593	-0.120
ROW00076	0.131	0.109	0.206	-0.245	-0.131	0.262	-0.088	-0.019	-0.175	-0.094
ROW00077	-0.144	-0.063	-0.194	0.183	0.163	-0.151	-0.039	-0.069	-0.112	0.130
ROW00078	0.359	0.205	-0.080	-0.167	0.296	-0.132	-0.192	-0.156	-0.120	-0.065
ROW00079	0.500	0.380	-0.149	-0.311	0.390	-0.052	-0.356	-0.289	0.593	-0.120
ROW00080	-0.056	0.109	-0.117	-0.043	0.245	-0.193	-0.088	-0.019	-0.175	-0.094
ROW00081	0.0	-0.063	0.043	0.040	0.025	0.182	-0.190	0.236	-0.112	0.130
ROW00082	-0.347	-0.312	0.155	0.234	-0.409	0.005	0.498	0.025	-0.246	0.039
ROW00083	0.129	0.238	-0.077	-0.205	0.325	-0.027	-0.311	-0.149	0.201	0.023
ROW00084	-0.129	-0.238	0.077	0.205	-0. 25	0.027	0.311	0.149	-0.201	-0.023
ROW00085	0.0	0.255	-0.100	-0.209	0.159	-0.164	-0.020	0.043	-0.149	0.803
ROW00086	0.105	0.115	-0.154	-0.020	0.305	-0.269	-0.084	0.015	0.140	-0.132
ROW00087	-0.093	-0.262	0.209	0.148	[illegible]	0.242	0.087	-0.040	-0.031	-0.385
ROW00088	0.037	0.312	-0.155	-0.234	0.467	-0.155	-0.371	-0.163	0.246	0.218
ROW00089	-0.057	-0.312	0.155	0.234	-0.467	0.155	0.371	0.163	-0.246	-0.218
ROW00090	0.131	0.109	-0.117	-0.043	-0.319	0.262	0.105	-0.227	0.066	-0.094

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CONTINUATION OF

	ROW00041	ROW00042	ROW00043	ROW00044	ROW00045	ROW00046	ROW00047	ROW00048	ROW00049	ROW00050
ROW00091	-0.157	-0.008	0.021	[illegible]	0.151	[illegible]	-0. 87	0.040	0.031	0.109

	ROW00031	ROW00032	ROW00033	ROW00034	ROW00035	[illegible]	ROW00037	ROW00038	ROW00039	ROW00040
ROW00081	-0.375	-0.069	0.203	[illegible]	[illegible]	[illegible]	-0.019	-0.286	0.130	0.0
ROW00082	0.576	0.438	-0.316	-0.037	[illegible]	[illegible]	0.057	0.325	0.039	0.347
ROW00083	-0.422	-0.559	0.260	0.258	[illegible]	[illegible]	0.034	-0.344	0.023	-0.129
ROW00084	0.422	0.559	-0.260	-0.258	[illegible]	[illegible]	-0.034	0.344	-0.023	0.129
ROW00085	-0.194	-0.194	-0.039	[illegible]	[illegible]	[illegible]	-0.117	[illegible]	0.361	0.0
ROW00086	-0.151	-0.151	0.340	-0.210	[illegible]	[illegible]	[illegible]	0.122	-0.132	-0.105
ROW00087	0.256	0.256	[illegible]	0.047	[illegible]	[illegible]	0.245	[illegible]	-0.109	0.093
ROW00088	-0.438	-0.576	0.316	0.217	[illegible]	[illegible]	-0.057	[illegible]	-0.039	-0.087
ROW00089	0.438	0.576	-0.316	-0.217	[illegible]	[illegible]	0.057	0.075	0.039	0.087
ROW00090	0.190	0.398	-0.299	[illegible]	[illegible]	[illegible]	0.147	[illegible]	0.295	-0.131
ROW00091	-0.256	-0.256	0.276	-0.047	[illegible]	[illegible]	[illegible]	[illegible]	-0.167	0.187

	ROW00031	ROW00032	ROW00033	ROW00034	ROW00035	ROW00036	ROW00037	ROW00038	ROW00039	ROW00040
ROW00031	1.000									
ROW00032	0.385	1.000								
ROW00033	-0.354	-0.494	1.000							
ROW00034	0.0	-0.433	-0.570	1.000						
ROW00035	0.227	0.227	0.109	-0.328	1.000					
ROW00036	-0.156	-0.156	0.055	0.090	-0.334	1.000				
ROW00037	-0.019	-0.227	-0.299	0.525	-0.147	-0.094	1.000			
ROW00038	0.398	0.124	-0.113	0.0	0.153	0.023	0.034	1.000		
ROW00039	0.130	0.130	-0.205	0.090	-0.255	-0.065	-0.094	0.023	1.000	
ROW00040	0.289	0.0	0.175	-0.182	-0.066	0.160	0.066	0.129	-0.090	1.000
ROW00041	-0.289	0.0	-0.175	0.182	0.066	-0.160	-0.066	-0.129	0.090	-1.000
ROW00042	-0.481	-0.203	0.142	0.044	-0.109	0.205	-0.271	0.113	0.205	-0.439
ROW00043	0.260	-0.194	-0.255	0.447	-0.200	[illegible]	0.528	0.135	-0.080	0.224
ROW00044	0.336	0.336	0.008	-0.325	0.245	[illegible]	-0.043	-0.235	-0.167	0.326
ROW00045	-0.388	-0.388	0.186	0.173	-0.337	0.039	-0.319	0.076	0.039	-0.303
ROW00046	-0.151	0.015	-0.115	0.105	-0.024	-0.132	0.262	-0.027	-0.132	-0.105
ROW00047	0.527	0.386	-0.094	-0.267	0.386	0.072	0.105	-0.056	0.072	0.401
ROW00048	-0.069	0.083	0.063	-0.147	[illegible]	0.130	0.190	-0.149	-0.156	0.289
ROW00049	0.064	-0.289	0.102	0.167	0.175	[illegible]	0.066	0.043	-0.120	-0.167
ROW00050	-0.156	-0.156	-0.205	0.359	-0.364	0.468	-0.094	0.025	0.468	-0.090
ROW00051	-0.029	-0.029	-0.022	0.050	-0.223	0.449	0.007	0.052	-0.144	0.250
ROW00052	-0.112	-0.289	0.102	0.167	-0.366	-0.120	0.306	0.042	0.210	-0.167
ROW00053	-0.194	-0.194	0.177	0.0	[illegible]	[illegible]	-0.117	-0.077	-0.080	-0.224
ROW00054	-0.112	-0.289	0.102	0.107	0.175	-0.120	0.306	0.201	-0.120	-0.333
ROW00055	-0.144	-0.144	0.068	0.045	-0.326	0.359	0.131	-0.129	0.090	0.227
ROW00056	-0.256	-0.404	0.143	0.233	0.245	-0.107	0.159	-0.072	-0.107	-0.373
ROW00057	-0.256	-0.256	0.143	0.093	-0.563	0.205	0.159	-0.205	0.365	0.167
ROW00058	0.481	0.620	-0.209	-0.307	0.259	-0.275	-0.299	0.250	-0.205	0.175
ROW00059	0.043	0.043	0.177	-0.224	0.117	[illegible]	-0.117	0.135	[illegible]	0.224
ROW00060	0.043	0.043	-0.339	0.0	0.117	-0.060	-0.117	-0.255	-0.050	0.0
ROW00061	-0.156	-0.156	0.055	0.090	0.094	-0.065	-0.094	0.025	-0.065	-0.090
ROW00062	0.244	0.163	-0.223	0.134	0.068	0.072	0.298	0.322	-0.192	0.267
ROW00063	-0.156	-0.050	0.211	-0.171	-0.197	0.000	-0.175	-0.155	0.262	-0.214
ROW00064	-0.194	-0.194	0.177	0.0	-0.206	-0.005	0.206	0.135	-0.080	0.224
ROW00065	-0.019	-0.019	0.271	-0.263	0.158	-0.044	-0.138	-0.103	-0.074	-0.131
ROW00066	-0.222	-0.375	0.063	0.289	-0.190	0.130	-0.227	-0.200	0.130	-0.289
ROW00067	0.121	0.500	-0.168	-0.259	0.157	-0.107	-0.157	-0.045	0.247	-0.060
ROW00068	0.244	0.163	-0.223	0.134	0.068	0.072	0.298	0.322	-0.192	0.267
ROW00069	-0.130	0.029	-0.268	0.250	-0.210	0.144	0.210	-0.194	0.144	-0.100
ROW00070	0.043	-0.194	0.177	0.0	0.117	-0.030	-0.117	0.345	-0.030	0.0
ROW00071	0.121	0.121	0.178	-0.299	0.157	-0.107	-0.157	-0.045	-0.107	0.120
ROW00072	0.039	0.180	-0.035	-0.134	-0.068	0.192	-0.298	-0.069	0.192	-0.134
ROW00073	-0.039	-0.180	0.035	0.134	0.068	-0.192	0.298	0.069	-0.192	0.134
ROW00074	-0.359	-0.359	0.152	0.171	0.011	-0.262	-0.011	-0.210	-0.008	-0.300
ROW00075	-0.112	-0.289	0.102	0.167	0.175	-0.120	0.066	0.355	-0.120	-0.167
ROW00076	-0.019	0.190	-0.109	-0.066	-0.147	-0.094	0.147	-0.153	0.295	-0.131
ROW00077	-0.222	-0.222	0.342	-0.144	0.019	-0.156	-0.227	-0.236	0.130	0.144
ROW00078	-0.156	-0.156	0.055	0.090	0.094	-0.065	-0.094	-0.232	-0.055	-0.359
ROW00079	-0.112	-0.289	-0.053	0.333	0.175	-0.120	0.066	0.043	-0.120	-0.500
ROW00080	-0.227	-0.227	0.271	-0.066	0.138	-0.094	-0.138	-0.153	-0.094	0.066

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	ROW00021	ROW00022	ROW00023	ROW00024	ROW00025	ROW00026	ROW00027	ROW00028	ROW00029	ROW00030
ROW00071	0.072	0.032	0.121	-0.192	0.239	-0.075	-0.107	-0.075	-0.060	-0.107
ROW00072	0.275	-0.083	-0.103	0.012	0.330	0.134	0.192	-0.234	-0.134	-0.072
ROW00073	-0.275	0.083	0.103	-0.012	-0.330	-0.134	-0.192	0.234	0.134	0.072
ROW00074	0.151	-0.779	0.458	-0.271	-0.329	0.171	-0.008	0.171	0.343	-0.008
ROW00075	0.300	-0.356	0.064	-0.087	-0.222	0.375	0.210	-0.083	0.167	-0.120
ROW00076	-0.197	-0.281	-0.227	0.057	0.066	-0.066	-0.094	0.476	0.066	-0.094
ROW00077	-0.087	-0.463	0.542	-0.250	-0.112	-0.103	-0.156	-0.103	0.144	0.130
ROW00078	-0.262	-0.192	0.130	0.039	-0.120	-0.045	-0.065	-0.045	0.180	-0.065
ROW00079	0.143	-0.356	0.241	-0.246	-0.222	0.375	0.210	-0.083	0.167	-0.120
ROW00080	-0.197	-0.281	0.398	-0.131	-0.175	-0.066	-0.094	-0.066	0.263	-0.094
ROW00081	0.186	-0.321	0.083	0.163	-0.289	-0.108	-0.156	0.289	0.289	0.130
ROW00082	-0.149	0.753	-0.526	0.132	0.549	-0.152	0.039	-0.152	-0.564	0.039
ROW00083	0.033	-0.564	0.534	-0.291	-0.430	0.194	0.023	0.194	0.516	-0.232
ROW00084	-0.033	0.564	-0.534	0.291	0.430	-0.194	-0.023	-0.194	-0.516	0.232
ROW00085	0.307	0.199	0.043	0.155	-0.149	-0.056	-0.080	-0.056	0.224	-0.080
ROW00086	0.058	-0.238	0.348	-0.145	-0.052	-0.092	-0.132	-0.092	0.210	-0.132
ROW00087	-0.244	0.087	-0.336	0.032	0.140	0.117	0.167	0.117	-0.326	0.167
ROW00088	0.149	-0.498	0.526	-0.256	-0.390	0.152	-0.039	0.152	0.564	-0.296
ROW00089	-0.149	0.498	-0.526	0.256	0.390	-0.152	0.039	-0.152	-0.564	0.296
ROW00090	-0.197	-0.088	-0.227	-0.319	0.306	0.476	0.295	-0.066	-0.328	-0.094
ROW00091	0.112	0.050	0.188	0.234	-0.311	-0.117	-0.167	-0.117	0.326	0.109

	ROW00021	ROW00022	ROW00023	ROW00024	ROW00025	ROW00026	ROW00027	ROW00028	ROW00029	ROW00030
ROW00021	1.000									
ROW00022	0.103	1.000								
ROW00023	0.050	-0.463	1.000							
ROW00024	0.219	0.243	-0.526	1.000						
ROW00025	-0.329	0.297	-0.289	-0.405	1.000					
ROW00026	0.171	-0.134	-0.108	-0.152	-0.083	1.000				
ROW00027	-0.008	0.072	-0.156	-0.218	-0.120	-0.045	1.000			
ROW00028	-0.182	-0.134	-0.108	-0.152	-0.083	-0.031	-0.045	1.000		
ROW00029	0.343	-0.401	0.433	0.217	-0.067	[illegible]	-0.359	0.125	1.000	
ROW00030	-0.262	0.072	-0.156	0.296	-0.120	-0.045	-0.065	-0.045	-0.259	1.000
ROW00031	-0.087	0.386	-0.375	-0.250	0.770	-0.108	0.150	-0.108	-0.722	-0.156
ROW00032	-0.223	0.386	-0.375	0.025	0.417	-0.100	0.130	-0.108	-0.577	0.130
ROW00033	0.038	-0.352	0.203	0.186	-0.219	-0.143	-0.205	-0.145	0.307	0.055
ROW00034	0.171	0.0	0.144	-0.217	-0.167	0.250	0.090	0.250	0.227	-0.180
ROW00035	-0.175	-0.105	0.019	-0.057	0.175	0.056	0.094	-0.476	-0.263	0.094
ROW00036	0.246	0.336	-0.156	0.296	-0.120	-0.045	-0.065	-0.045	0.180	-0.065
ROW00037	0.175	0.105	-0.227	0.057	-0.175	0.476	-0.094	0.476	0.263	-0.094
ROW00038	-0.039	0.196	-0.266	-0.045	0.201	0.154	0.276	-0.161	-0.367	0.023
ROW00039	-0.008	-0.192	0.130	-0.215	0.210	-0.045	-0.065	-0.045	-0.090	-0.065
ROW00040	0.036	0.267	-0.289	0.217	0.167	-0.250	-0.090	0.125	-0.227	0.180
ROW00041	-0.086	-0.267	0.289	-0.217	-0.167	0.250	0.090	-0.125	0.227	-0.180
ROW00042	-0.162	-0.422	0.215	0.065	-0.424	0.143	0.205	-0.219	0.219	0.205
ROW00043	-0.115	0.199	-0.194	-0.058	0.124	-0.056	-0.080	0.559	0.0	-0.080
ROW00044	0.244	0.324	-0.108	-0.032	0.373	-0.117	-0.167	-0.117	-0.233	-0.167
ROW00045	-0.026	-0.521	0.438	0.008	-0.405	-0.152	0.039	-0.152	0.347	0.039
ROW00046	-0.238	0.070	-0.151	-0.145	-0.052	0.341	0.179	0.341	-0.105	0.179
ROW00047	0.229	0.476	-0.321	0.116	0.460	-0.134	-0.192	-0.134	-0.267	-0.192
ROW00048	0.594	0.244	-0.222	0.575	-0.289	-0.108	-0.156	-0.108	0.289	-0.156
ROW00049	0.457	-0.193	0.241	-0.405	-0.019	0.375	0.210	-0.053	0.0	-0.120
ROW00050	0.246	0.072	0.130	0.039	-0.120	[illegible]	-0.065	-0.045	0.180	-0.065
ROW00051	0.549	0.160	-0.346	0.516	-0.067	[illegible]	0.153	-0.100	0.100	-0.144
ROW00052	0.143	-0.193	0.241	-0.067	-0.222	[illegible]	-0.120	-0.083	0.333	-0.120
ROW00053	0.307	-0.239	0.516	-0.271	-0.149	[illegible]	-0.080	-0.056	0.224	-0.080
ROW00054	0.143	-0.356	0.241	-0.246	-0.222	0.375	0.210	-0.083	0.167	-0.120
ROW00055	0.686	0.134	0.0	0.434	-0.333	[illegible]	-0.180	-0.125	0.364	-0.180
ROW00056	0.112	-0.361	0.336	-0.032	-0.311	[illegible]	-0.167	-0.117	0.466	-0.167
ROW00057	0.112	-0.087	0.188	-0.032	-0.140	-0.117	-0.167	0.268	0.326	-0.167
ROW00058	-0.211	0.422	-0.494	0.061	[illegible]	[illegible]	0.315	-0.143	-0.745	0.315
ROW00059	-0.115	-0.020	0.043	-0.058	0.124	[illegible]	-0.080	-0.056	0.0	-0.080
ROW00060	-0.115	-0.239	0.043	-0.055	0.124	[illegible]	-0.080	-0.056	0.0	-0.080
ROW00061	-0.008	-0.192	0.130	0.039	-0.120	[illegible]	-0.065	-0.045	0.160	-0.065
ROW00062	0.355	0.607	-0.321	[illegible]	[illegible]	[illegible]	0.172	-0.134	-0.134	-0.192
ROW00063	-0.272	-0.355	0.226	-0.067	[illegible]	[illegible]	[illegible]	[illegible]	0.043	0.262
ROW00064	-0.326	-0.239	-0.194	0.155	-0.149	[illegible]	[illegible]	0.559	0.0	0.361
ROW00065	-0.197	-0.088	-0.019	0.057	[illegible]	[illegible]	-0.094	[illegible]	0.066	-0.094
ROW00066	0.050	-0.321	0.542	-0.250	-0.269	[illegible]	0.130	[illegible]	0.269	-0.156
ROW00067	-0.097	-0.144	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-0.175	-0.239	0.247
ROW00068	0.355	0.607	-0.321	0.116	[illegible]	[illegible]	0.072	[illegible]	-0.134	-0.192
ROW00069	-0.124	0.134	-0.100	0.197	-0.100	[illegible]	-0.103	0.100	0.050	0.144
ROW00070	0.096	-0.239	0.043	-0.055	-0.149	[illegible]	[illegible]	[illegible]	0.0	-0.080

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	ROW00011	ROW00012	ROW00013	ROW00014	ROW00015	ROW00016	ROW00017	ROW00018	ROW00019	ROW00020
ROW00061	-0.144	0.232	-0.107	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-0.107	0.295
ROW00062	0.160	-0.196	0.032	0.297	[illegible]	[illegible]	-0.224	0.072	0.032	-0.261
ROW00063	-0.124	0.033	0.097	-0.143	[illegible]	[illegible]	[illegible]	[illegible]	0.097	0.197
ROW00064	-0.179	0.289	-0.134	-0.149	-0.117	[illegible]	[illegible]	[illegible]	-0.134	0.526
ROW00065	-0.210	0.153	0.102	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.102	0.147
ROW00066	-0.188	0.012	0.121	-0.112	-0.019	[illegible]	[illegible]	[illegible]	0.121	-0.019
ROW00067	0.353	-0.123	-0.179	[illegible]	[illegible]	[illegible]	0.273	-0.107	-0.179	-0.157
ROW00068	0.160	-0.196	0.032	0.247	[illegible]	[illegible]	-0.224	[illegible]	0.032	-0.261
ROW00069	-0.010	-0.232	0.239	[illegible]	-0.007	[illegible]	[illegible]	-0.153	0.239	-0.223
ROW00070	-0.179	0.077	-0.134	[illegible]	0.206	[illegible]	-0.209	[illegible]	-0.134	0.526
ROW00071	0.155	0.216	-0.179	[illegible]	-0.157	[illegible]	[illegible]	[illegible]	-0.179	-0.157
ROW00072	0.134	0.069	-0.032	-0.134	[illegible]	[illegible]	-0.350	[illegible]	-0.032	-0.105
ROW00073	-0.134	-0.069	0.032	0.134	[illegible]	[illegible]	0.350	[illegible]	0.032	0.105
ROW00074	-0.017	-0.033	0.072	-0.171	0.175	[illegible]	[illegible]	[illegible]	0.072	-0.011
ROW00075	-0.062	-0.043	-0.199	[illegible]	[illegible]	[illegible]	0.031	[illegible]	-0.199	0.206
ROW00076	0.223	-0.034	-0.157	0.306	-0.138	[illegible]	0.561	[illegible]	-0.157	0.147
ROW00077	-0.029	0.149	0.121	[illegible]	-0.019	[illegible]	[illegible]	[illegible]	0.121	-0.019
ROW00078	-0.144	-0.023	0.247	-0.120	[illegible]	[illegible]	-0.167	[illegible]	0.247	-0.094
ROW00079	-0.267	-0.043	0.020	-0.222	[illegible]	[illegible]	-0.140	[illegible]	0.020	0.066
ROW00080	-0.210	0.153	0.102	-0.175	[illegible]	[illegible]	-0.043	[illegible]	0.102	0.147
ROW00081	0.130	-0.124	0.121	0.241	-0.227	-0.267	0.188	0.130	0.121	-0.019
ROW00082	0.230	0.045	-0.192	0.072	0.057	0.303	-0.032	0.039	-0.192	-0.131
ROW00083	-0.374	0.222	0.123	-0.430	0.034	-0.129	-0.337	0.023	0.123	0.407
ROW00084	0.374	-0.222	-0.123	0.430	-0.034	0.129	0.337	-0.023	-0.123	-0.407
ROW00085	-0.179	-0.135	0.160	-0.149	0.206	0.224	-0.209	-0.080	0.160	-0.117
ROW00086	-0.121	0.027	-0.013	-0.052	0.034	-0.052	0.142	-0.132	-0.013	0.034
ROW00087	0.219	0.060	-0.089	0.140	-0.159	-0.093	0.004	0.167	-0.089	0.043
ROW00088	-0.230	0.078	0.021	-0.231	0.131	-0.043	-0.234	-0.039	0.021	0.319
ROW00089	0.230	-0.078	-0.021	0.231	-0.131	0.043	0.234	0.039	-0.021	-0.319
ROW00090	0.223	-0.034	-0.157	-0.175	0.431	0.328	-0.043	-0.094	-0.157	-0.138
ROW00091	-0.373	0.072	0.273	-0.311	-0.043	0.233	-0.291	-0.167	0.273	-0.043

	ROW00011	ROW00012	ROW00013	ROW00014	ROW00015	ROW00016	ROW00017	ROW00018	ROW00019	ROW00020
ROW00011	1.000									
ROW00012	-0.336	1.000								
ROW00013	-0.239	-0.463	1.000							
ROW00014	0.650	-0.516	-0.199	1.000						
ROW00015	0.007	-0.407	-0.157	-0.175	1.000					
ROW00016	-0.100	0.0	-0.299	-0.167	0.025	1.000				
ROW00017	0.242	0.072	-0.279	0.370	-0.245	-0.405	1.000			
ROW00018	0.449	-0.023	-0.107	0.210	-0.094	-0.180	-0.167	1.000		
ROW00019	-0.239	-0.463	1.000	-0.199	-0.157	-0.299	-0.279	-0.107	1.000	
ROW00020	-0.210	0.339	-0.157	-0.175	-0.138	-0.263	-0.245	-0.094	-0.157	1.000
ROW00021	-0.017	-0.155	0.072	-0.014	0.175	[illegible]	-0.234	0.246	0.072	-0.197
ROW00022	0.013	-0.069	0.032	0.134	-0.088	[illegible]	[illegible]	0.072	0.032	-0.261
ROW00023	-0.188	0.149	0.121	-0.239	-0.019	-0.144	-0.108	0.130	0.121	-0.019
ROW00024	-0.056	-0.201	0.150	0.231	-0.131	-0.067	[illegible]	0.039	0.150	-0.131
ROW00025	0.467	-0.043	-0.199	0.165	0.066	0.167	0.202	-0.120	-0.199	-0.175
ROW00026	-0.100	-0.194	-0.075	-0.083	0.476	[illegible]	-0.117	-0.045	-0.075	-0.066
ROW00027	-0.144	0.232	-0.107	-0.120	-0.094	[illegible]	-0.167	-0.085	-0.107	0.295
ROW00028	-0.100	0.161	-0.075	-0.033	-0.088	[illegible]	-0.117	-0.045	-0.075	0.476
ROW00029	-0.350	-0.129	0.299	-0.167	0.066	[illegible]	-0.283	[illegible]	0.299	0.066
ROW00030	-0.144	0.232	-0.107	-0.120	-0.094	-0.180	0.385	-0.085	-0.107	-0.094
ROW00031	0.447	0.012	-0.259	0.241	-0.019	0.144	0.040	0.130	-0.259	-0.019
ROW00032	0.447	-0.124	-0.069	0.241	-0.019	-0.144	0.336	0.130	-0.069	-0.227
ROW00033	-0.167	-0.011	0.005	-0.053	0.031	0.068	-0.127	0.035	0.005	0.061
ROW00034	-0.250	0.129	0.060	-0.167	-0.088	0.041	-0.107	-0.180	0.060	0.131
ROW00035	0.210	0.034	-0.102	0.175	-0.147	-0.151	0.245	0.094	-0.102	-0.147
ROW00036	-0.144	-0.023	-0.107	-0.120	0.295	[illegible]	-0.167	-0.085	-0.107	-0.094
ROW00037	-0.210	-0.034	0.102	-0.175	0.147	0.131	-0.245	-0.094	0.102	0.147
ROW00038	0.194	-0.022	-0.216	0.201	0.034	0.129	0.060	0.023	-0.216	0.034
ROW00039	0.153	-0.023	0.247	-0.120	-0.094	-0.180	0.109	-0.085	0.247	-0.094
ROW00040	0.250	0.129	-0.060	0.0	-0.131	0.091	-0.233	0.180	-0.060	0.263
ROW00041	-0.250	-0.129	0.060	0.0	0.131	-0.091	0.233	-0.180	0.060	-0.263
ROW00042	-0.268	0.011	-0.005	-0.102	0.109	-0.219	0.262	-0.315	-0.005	0.109
ROW00043	0.057	0.077	-0.134	0.124	-0.117	0.224	-0.209	-0.080	-0.134	0.206
ROW00044	0.242	-0.060	0.089	0.031	-0.043	0.093	-0.146	0.385	0.089	-0.245
ROW00045	-0.195	0.045	0.150	-0.087	-0.131	-0.347	0.101	-0.218	0.150	0.245
ROW00046	-0.121	0.027	-0.219	0.140	0.034	0.282	-0.020	-0.132	-0.219	0.034
ROW00047	0.307	-0.069	0.032	-0.030	0.105	0.134	-0.067	0.336	0.032	-0.261
ROW00048	0.289	-0.261	0.121	0.241	-0.019	0.0	-0.108	0.415	0.121	-0.227
ROW00049	-0.267	0.115	-0.199	-0.222	0.306	0.335	-0.140	-0.120	-0.199	0.066
ROW00050	-0.144	-0.023	0.247	-0.120	-0.094	0.090	-0.167	-0.065	0.247	-0.094
ROW00051	0.175	-0.194	-0.042	0.283	0.007	0.050	-0.065	0.153	-0.042	0.007
ROW00052	-0.083	-0.201	0.453	-0.222	0.066	0.0	-0.311	0.210	0.458	-0.175
ROW00053	-0.179	0.077	-0.134	-0.149	0.206	0.224	0.021	-0.080	-0.134	-0.117
ROW00054	-0.267	-0.201	0.239	-0.222	0.306	0.0	-0.140	-0.120	0.239	0.066
ROW00055	0.200	-0.129	0.060	0.167	-0.066	0.182	-0.137	0.359	0.060	-0.263
ROW00056	-0.219	0.072	-0.095	-0.140	0.159	0.093	-0.004	-0.167	-0.095	-0.043
ROW00057	-0.065	-0.060	0.273	-0.140	-0.043	-0.047	-0.148	0.109	0.273	-0.043
ROW00058	0.268	-0.011	-0.168	0.263	-0.109	-0.044	0.143	0.055	-0.168	0.081
ROW00059	0.067	0.077	-0.134	0.124	-0.117	0.0	0.021	-0.080	-0.134	0.206
ROW00060	0.067	0.077	-0.134	-0.149	0.206	0.224	0.021	-0.080	-0.134	-0.117

	ROW00001	ROW00002	ROW00003	ROW00004	ROW00005	ROW00006	ROW00007	ROW00008	ROW00009	ROW00010
ROW00051	0.042	-0.042	0.159	0.100	-0.124	-0.042	0.153	-0.050	-0.042	-0.123
ROW00052	-0.458	0.458	-0.143	-0.019	0.171	0.458	-0.120	-0.167	0.458	-0.263
ROW00053	0.134	-0.134	0.115	0.124	-0.307	-0.134	-0.080	0.224	-0.134	0.255
ROW00054	-0.239	0.239	-0.143	-0.222	0.014	0.239	-0.126	-0.167	0.239	0.058
ROW00055	-0.060	0.060	0.214	0.333	-0.171	0.060	0.090	0.091	0.060	-0.219
ROW00056	0.095	-0.095	0.020	-0.311	-0.112	-0.095	0.355	-0.093	-0.095	0.262
ROW00057	-0.273	0.273	-0.112	0.202	0.152	0.273	-0.167	-0.093	0.273	-0.143
ROW00058	0.168	-0.168	-0.035	0.102	-0.035	-0.168	-0.235	0.175	-0.168	-0.112
ROW00059	0.134	-0.134	-0.096	0.124	0.115	-0.134	[illegible]	[illegible]	-0.134	0.039
ROW00060	0.134	-0.134	0.115	-0.149	-0.096	-0.134	[illegible]	[illegible]	-0.134	0.029
ROW00061	0.107	-0.107	-0.246	-0.120	0.008	-0.107	[illegible]	[illegible]	-0.107	0.205
ROW00062	-0.032	0.032	0.275	0.450	-0.229	0.032	-0.192	0.267	0.032	-0.164
ROW00063	-0.097	0.097	-0.213	-0.300	0.272	0.097	[illegible]	-0.214	0.097	0.038
ROW00064	0.134	-0.134	-0.095	-0.149	0.115	-0.134	[illegible]	-0.124	-0.134	0.255
ROW00065	-0.102	0.102	-0.175	-0.175	0.197	[illegible]	[illegible]	[illegible]	0.102	0.109
ROW00066	-0.121	0.121	-0.186	-0.112	0.067	0.121	[illegible]	[illegible]	0.121	0.076
ROW00067	0.179	-0.179	0.097	-0.199	-0.072	[illegible]	[illegible]	[illegible]	-0.179	-0.178
ROW00068	-0.032	0.032	0.275	0.450	-0.229	0.032	[illegible]	[illegible]	0.032	-0.164
ROW00069	-0.239	0.239	0.124	0.085	-0.159	0.239	-0.153	[illegible]	0.239	-0.167
ROW00070	0.134	-0.134	-0.095	-0.149	0.115	[illegible]	[illegible]	[illegible]	[illegible]	0.255
ROW00071	0.179	-0.179	-0.072	0.320	0.097	-0.177	[illegible]	[illegible]	[illegible]	-0.005
ROW00072	0.032	-0.032	0.103	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-0.032	-0.094
ROW00073	-0.032	0.032	-0.103	[illegible]	0.147	[illegible]	[illegible]	[illegible]	[illegible]	0.094
ROW00074	-0.072	0.072	-0.329	-0.171	-0.029	0.072	[illegible]	[illegible]	[illegible]	-0.036
ROW00075	0.199	-0.199	0.014	-0.222	-0.145	-0.199	-0.120	[illegible]	[illegible]	0.219
ROW00076	0.157	-0.157	0.011	-0.175	0.011	-0.157	-0.094	[illegible]	-0.157	-0.051
ROW00077	-0.121	0.121	-0.050	[illegible]	0.097	[illegible]	[illegible]	-0.144	0.121	[illegible]
ROW00078	-0.247	0.247	-0.246	-0.120	0.262	0.247	[illegible]	[illegible]	[illegible]	[illegible]
ROW00079	-0.020	0.020	-0.143	-0.222	0.014	[illegible]	0.210	[illegible]	0.020	0.219
ROW00080	-0.102	0.102	-0.175	-0.175	0.197	0.102	[illegible]	[illegible]	0.102	[illegible]
ROW00081	-0.121	0.121	0.037	0.241	-0.050	0.121	-0.156	[illegible]	0.121	-0.203
ROW00082	0.192	-0.192	0.149	0.072	-0.097	[illegible]	[illegible]	0.347	-0.192	-0.051
ROW00083	-0.123	0.123	-0.399	-0.115	0.332	0.123	0.276	-0.216	0.123	0.258
ROW00084	0.123	-0.123	0.399	0.115	-0.332	-0.123	-0.276	0.516	-0.123	-0.258
ROW00085	-0.160	0.160	0.115	0.398	-0.096	0.160	-0.080	[illegible]	0.160	[illegible]
ROW00086	0.013	-0.013	-0.056	-0.245	-0.028	-0.013	0.179	-0.105	-0.013	0.115
ROW00087	0.089	-0.089	-0.020	-0.031	0.112	-0.089	-0.109	0.093	-0.089	-0.127
ROW00088	-0.021	0.021	-0.271	-0.072	0.219	0.021	0.215	-0.347	0.021	[illegible]
ROW00089	0.021	-0.021	0.271	0.072	-0.219	[illegible]	-0.218	0.347	-0.021	-0.186
ROW00090	0.157	-0.157	0.197	-0.175	-0.175	-0.157	-0.094	0.283	-0.157	-0.051
ROW00091	-0.273	0.273	-0.112	0.031	0.152	0.273	0.109	-0.233	0.273	[illegible]

	ROW00001	ROW00002	ROW00003	ROW00004	ROW00005	ROW00006	ROW00007	ROW00008	ROW00009	ROW00010
ROW00001	1.000									
ROW00002	-1.000	1.000								
ROW00003	0.410	-0.410	1.000							
ROW00004	-0.239	0.239	0.171	1.000						
ROW00005	-0.436	0.436	-0.341	-0.145	1.000					
ROW00006	-1.000	1.000	-0.410	0.239	0.436	1.000				
ROW00007	0.107	-0.107	-0.245	-0.120	0.262	-0.107	1.000			
ROW00008	0.598	-0.598	0.686	0.0	-0.729	-0.598	-0.359	1.000		
ROW00009	-1.000	1.000	-0.410	0.239	0.436	1.000	-0.107	-0.598	1.000	
ROW00010	0.524	-0.524	0.286	-0.102	-0.355	-0.524	0.205	0.088	-0.524	1.000
ROW00011	0.239	-0.239	0.017	-0.083	0.017	-0.239	-0.144	0.430	-0.239	-0.702
ROW00012	0.463	-0.463	-0.039	-0.043	0.033	-0.463	0.232	0.0	-0.463	0.634
ROW00013	-1.000	1.000	-0.410	0.239	0.436	1.000	-0.107	-0.598	1.000	-0.524
ROW00014	0.199	-0.199	0.171	-0.019	-0.143	-0.199	-0.120	0.333	-0.199	-0.424
ROW00015	0.157	-0.157	0.383	-0.175	-0.360	-0.157	-0.094	0.263	-0.157	0.109
ROW00016	0.299	-0.299	0.472	0.167	-0.429	-0.299	0.093	0.364	-0.299	0.307
ROW00017	0.279	-0.279	0.152	-0.311	-0.244	-0.279	-0.167	0.466	-0.279	[illegible]
ROW00018	0.107	-0.107	0.008	0.210	0.008	-0.107	-0.065	0.180	-0.107	-0.315
ROW00019	-1.000	1.000	-0.410	0.239	0.436	1.000	-0.107	-0.598	1.000	-0.524
ROW00020	0.157	-0.157	-0.360	-0.175	0.383	-0.157	-0.094	-0.525	-0.157	0.299
ROW00021	-0.072	0.072	0.213	0.457	-0.272	0.072	-0.008	0.000	0.072	-0.035
ROW00022	-0.032	0.032	0.149	0.297	-0.105	0.032	-0.142	0.207	0.032	-0.035
ROW00023	-0.121	0.121	-0.186	0.064	0.037	0.121	[illegible]	-0.144	0.121	0.076
ROW00024	-0.150	0.150	0.149	0.072	-0.397	0.150	0.039	[illegible]	0.150	-0.061
ROW00025	0.199	-0.199	0.014	-0.019	0.014	-0.199	-0.120	0.323	-0.199	-0.263
ROW00026	0.075	-0.075	0.182	-0.083	-0.171	-0.075	[illegible]	0.128	-0.075	0.143
ROW00027	0.107	-0.107	0.008	-0.120	0.008	-0.107	-0.065	-0.090	-0.107	0.235
ROW00028	0.075	-0.075	-0.171	-0.083	0.182	-0.075	-0.045	-0.250	-0.075	0.143
ROW00029	-0.299	0.299	-0.036	0.0	0.043	[illegible]	[illegible]	[illegible]	0.299	[illegible]
ROW00030	0.107	-0.107	0.008	-0.120	0.005	-0.107	-0.065	0.180	-0.107	0.235
ROW00031	0.259	-0.259	0.067	0.064	-0.050	[illegible]	[illegible]	[illegible]	-0.259	[illegible]
ROW00032	0.069	-0.069	0.037	0.084	-0.050	-0.069	-0.150	[illegible]	-0.069	-0.342
ROW00033	-0.005	0.005	0.036	-0.058	-0.038	[illegible]	0.055	[illegible]	0.005	0.142
ROW00034	-0.060	0.060	-0.171	0.0	0.066	[illegible]	[illegible]	[illegible]	0.060	[illegible]
ROW00035	0.102	-0.102	-0.011	-0.306	-0.011	[illegible]	[illegible]	[illegible]	-0.102	[illegible]
ROW00036	0.107	-0.107	0.252	0.210	-0.246	-0.107	[illegible]	[illegible]	-0.107	[illegible]
ROW00037	-0.102	0.102	0.011	-0.175	0.011	0.102	[illegible]	[illegible]	0.102	[illegible]
ROW00038	0.216	-0.216	0.210	-0.115	-0.155	-0.216	[illegible]	[illegible]	-0.216	[illegible]
ROW00039	-0.247	0.247	-0.246	0.210	0.262	0.247	[illegible]	[illegible]	0.247	[illegible]
ROW00040	0.060	-0.060	-0.214	0.167	0.370	-0.060	[illegible]	-0.241	[illegible]	-0.175
ROW00041	-0.060	0.060	0.214	-0.167	-0.300	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ROW00042	0.005	-0.005	0.038	-0.263	-0.086	-0.005	-0.055	-0.044	-0.005	[illegible]
ROW00043	0.134	-0.134	[illegible]	-0.147	[illegible]	[illegible]	[illegible]	[illegible]	-0.134	[illegible]
ROW00044	-0.089	0.089	[illegible]	0.373	0.020	0.089	[illegible]	[illegible]	[illegible]	-0.276
ROW00045	-0.150	0.150	[illegible]	-0.357	[illegible]	[illegible]	0.039	[illegible]	[illegible]	[illegible]
ROW00046	0.219	-0.219	[illegible]	-0.052	-0.058	[illegible]	-0.132	[illegible]	-0.219	[illegible]
ROW00047	-0.032	0.032	0.023	0.134	0.023	0.032	0.072	0.134	0.032	[illegible]
ROW00048	-0.121	0.121	0.057	0.064	-0.050	0.121	[illegible]	[illegible]	0.121	-0.342
ROW00049	0.199	-0.199	0.171	0.165	-0.300	-0.199	-0.120	0.167	-0.199	0.380
ROW00050	-0.247	0.247	0.308	0.539	0.308	0.247	[illegible]	-0.290	0.247	-0.055

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	ROW00051	ROW00052	ROW00053	ROW00054	ROW00055	ROW00056	ROW00057	ROW00058	ROW00059	ROW00060
ROW00051	1.000									
ROW00052	-0.267	1.000								
ROW00053	-0.179	-0.149	1.000							
ROW00054	-0.083	0.389	0.398	1.000						
ROW00055	0.650	0.167	0.0	-0.333	1.000					
ROW00056	-0.065	0.202	0.250	0.373	-0.047	1.000				
ROW00057	0.089	0.202	0.021	-0.140	0.373	-0.435	1.000			
ROW00058	-0.022	-0.380	-0.255	-0.219	-0.307	-0.532	-0.532	1.000		
ROW00059	-0.179	-0.149	0.267	-0.149	0.0	-0.209	0.021	0.177	1.000	
ROW00060	0.067	-0.149	-0.100	-0.149	0.0	0.250	-0.209	-0.039	-0.100	1.000
ROW00061	-0.144	-0.120	0.361	0.210	-0.180	0.109	-0.167	0.055	0.361	-0.080
ROW00062	0.160	-0.030	-0.020	-0.193	0.267	-0.037	-0.087	0.164	0.199	-0.239
ROW00063	-0.124	0.171	-0.096	0.171	-0.171	-0.112	0.284	-0.162	-0.307	-0.307
ROW00064	-0.179	-0.149	-0.100	-0.149	-0.224	-0.209	0.021	0.177	0.267	-0.100
ROW00065	0.007	0.066	-0.117	0.066	-0.066	0.361	-0.245	-0.109	-0.117	0.206
ROW00066	-0.029	0.241	0.043	0.241	0.0	0.040	0.336	-0.354	-0.194	0.043
ROW00067	-0.042	-0.199	0.160	0.020	-0.120	-0.095	-0.095	0.175	-0.134	0.160
ROW00068	0.160	-0.030	-0.020	-0.193	0.267	-0.037	-0.087	0.164	0.199	-0.239
ROW00069	-0.010	0.083	-0.313	-0.100	-0.050	0.065	0.065	-0.123	-0.559	-0.067
ROW00070	0.067	-0.149	0.267	0.398	-0.224	0.021	-0.209	0.177	0.267	-0.100
ROW00071	-0.042	0.020	0.160	-0.199	0.239	-0.095	0.089	0.005	0.454	0.160
ROW00072	0.281	0.020	-0.199	0.030	0.134	0.087	-0.187	0.094	-0.418	0.020
ROW00073	-0.281	[illegible]	0.199	-0.030	-0.134	-0.087	0.187	-0.094	0.418	-0.020
ROW00074	-0.017	[illegible]	0.307	0.457	0.043	0.376	-0.020	-0.235	-0.115	0.307
ROW00075	0.100	-0.014	0.395	0.393	-0.167	0.373	-0.311	-0.056	0.124	-0.149
ROW00076	0.007	-0.175	-0.117	-0.175	-0.066	-0.245	0.361	-0.109	-0.117	-0.117
ROW00077	-0.188	0.241	[illegible]	-0.112	0.144	0.040	0.188	-0.215	0.043	0.516
ROW00078	-0.144	0.210	-0.060	0.210	-0.180	0.365	-0.167	-0.205	-0.080	-0.080
ROW00079	-0.083	0.185	0.275	[illegible]	-0.333	0.544	-0.311	-0.219	-0.149	-0.149
ROW00080	0.007	0.066	-0.117	0.066	-0.066	0.361	-0.043	-0.299	-0.117	0.528
ROW00081	-0.029	0.064	0.043	-0.289	0.289	-0.255	0.336	-0.076	0.043	-0.194
ROW00082	0.087	-0.246	-0.271	-0.405	0.043	-0.433	-0.032	0.437	0.155	-0.058
ROW00083	-0.090	0.355	0.135	0.355	0.0	0.325	0.193	-0.467	0.135	0.135
ROW00084	0.090	-0.355	-0.135	-0.355	0.0	-0.325	-0.193	0.467	-0.135	-0.135
ROW00085	0.313	0.124	-0.100	-0.149	0.447	-0.204	0.480	-0.255	-0.100	-0.100
ROW00086	0.052	-0.052	0.332	0.332	-0.052	0.464	-0.181	-0.267	-0.164	0.094
ROW00087	-0.242	-0.031	-0.250	-0.201	-0.135	-0.278	-0.135	0.397	0.209	-0.021
ROW00088	0.056	0.246	0.271	0.405	0.087	0.433	0.166	-0.563	0.271	0.058
ROW00089	-0.056	-0.246	-0.271	-0.405	-0.087	-0.433	-0.166	0.563	-0.271	-0.058
ROW00090	-0.210	0.066	-0.117	0.066	-0.263	-0.043	-0.043	0.081	-0.117	0.206
ROW00091	0.089	0.202	0.250	0.202	0.223	0.252	0.139	-0.397	0.021	0.021

	ROW00061	ROW00062	ROW00063	ROW00064	ROW00065	ROW00066	ROW00067	ROW00068	ROW00069	ROW00070
ROW00061	1.000									
ROW00062	-0.192	1.000								
ROW00063	-0.246	-0.733	1.000							
ROW00064	0.361	-0.239	0.115	1.000						
ROW00065	-0.094	-0.281	0.197	-0.117	1.000					
ROW00066	0.130	-0.463	-0.359	-0.194	-0.227	1.000				
ROW00067	-0.107	-0.319	0.260	-0.134	-0.157	-0.259	1.000			
ROW00068	-0.192	1.000	-0.733	-0.239	-0.281	-0.463	-0.319	1.000		
ROW00069	-0.153	0.104	-0.317	-0.067	-0.023	0.020	0.042	0.134	1.000	
ROW00070	0.361	-0.239	0.115	0.267	-0.117	0.043	0.160	-0.239	-0.559	1.000
ROW00071	-0.107	[illegible]	-0.072	-0.134	0.361	-0.067	-0.179	0.332	-0.747	-0.134
ROW00072	-0.072	-0.087	0.103	-0.199	0.281	0.039	-0.032	-0.033	0.160	-0.199
ROW00073	0.072	0.087	-0.103	0.199	-0.281	-0.039	0.032	0.033	-0.160	0.199
ROW00074	-0.008	-0.401	[illegible]	0.069	-0.111	0.222	0.072	-0.401	-0.124	0.096
ROW00075	0.539	-0.030	-0.145	0.124	-0.179	0.064	0.020	-0.030	-0.263	0.071
ROW00076	-0.094	-0.201	0.350	0.207	-0.103	-0.014	0.351	-0.281	0.210	-0.117
ROW00077	-0.158	-0.321	0.067	0.013	0.100	0.238	-0.069	-0.321	-0.130	-0.194
ROW00078	-0.065	-0.192	0.260	-0.090	0.223	0.13	-0.107	-0.192	0.144	-0.080
ROW00079	0.210	-0.157	0.171	-0.143	0.06	0.241	0.020	-0.193	-0.100	0.398
ROW00080	-0.094	-0.231	0.011	-0.117	0.431	0.190	-0.157	-0.231	-0.037	-0.117
ROW00081	-0.156	-0.039	0.273	0.280	-0.237	0.303	-0.069	-0.039	0.029	-0.194
ROW00082	0.039	0.371	-0.342	-0.056	-0.131	-0.349	0.150	0.371	0.056	-0.058
ROW00083	0.278	-0.437	0.217	0.135	0.220	0.334	-0.386	-0.437	-0.194	0.135
ROW00084	-0.278	0.437	-0.210	-0.135	-0.220	-0.534	0.386	0.437	0.194	-0.135
ROW00085	-0.080	-0.020	0.115	-0.100	-0.117	0.357	-0.134	-0.020	0.179	-0.100
ROW00086	0.179	-0.238	0.090	-0.104	0.489	0.015	-0.013	-0.238	-0.225	0.094
ROW00087	-0.109	0.224	-0.152	0.209	-0.361	-0.183	0.095	0.224	0.089	-0.021
ROW00088	0.218	-0.243	0.097	0.058	0.131	0.335	-0.321	-0.243	-0.343	0.271
ROW00089	-0.218	0.243	-0.097	-0.058	-0.131	-0.338	0.321	0.243	0.343	-0.271
ROW00090	-0.094	0.105	-0.175	-0.117	-0.133	-0.227	0.361	0.105	0.210	-0.117
ROW00091	-0.167	0.050	0.020	-0.209	0.361	-0.255	0.069	0.050	-0.069	0.021

IDENTIFICATION:

	ROW00071	ROW00072	ROW00073	ROW00074	ROW00075	ROW00076	ROW00077	ROW00078	ROW00079	ROW00080
ROW00071	1.000									
ROW00072	-0.032	1.000								
ROW00073	0.032	-1.000	1.000							
ROW00074	0.072	0.149	-0.149	1.000						
ROW00075	-0.199	0.030	-0.030	[illegible]	1.000					
ROW00076	-0.157	-0.105	0.105	-0.011	-0.175	1.000				
ROW00077	0.311	0.039	-0.039	0.459	-0.289	-0.127	1.000			
ROW00078	-0.107	0.192	-0.192	[illegible]	-0.120	[illegible]	-0.156	1.000		
ROW00079	-0.195	0.193	-0.193	0.457	0.593	-0.175	-0.289	0.559	1.000	
ROW00080	0.102	-0.105	0.105	0.175	-0.175	[illegible]	[illegible]	[illegible]	-0.175	1.000
ROW00081	0.121	0.039	-0.039	0.322	-0.112	0.398	0.236	-0.156	-0.259	-0.227
ROW00082	-0.021	-0.116	0.116	[illegible]	-0.246	-0.131	[illegible]	-0.215	-0.405	-0.319
ROW00083	0.123	[illegible]	[illegible]	0.920	0.231	-0.153	0.359	0.270	0.359	0.407
ROW00084	-0.123	-0.056	0.056	[illegible]	[illegible]	0.153	-0.359	-0.270	-0.359	-0.407
ROW00085	-0.134	0.239	-0.239	[illegible]	[illegible]	-0.117	0.143	-0.030	-0.149	-0.117
ROW00086	0.194	0.084	-0.084	0.207	0.392	-0.173	0.182	-0.132	0.140	0.469
ROW00087	-0.089	-0.224	0.224	-0.112	-0.232	0.245	-0.128	0.167	-0.031	-0.361
ROW00088	0.192	-0.012	0.012	0.517	0.405	-0.245	0.250	0.216	0.405	0.319
ROW00089	-0.192	0.012	-0.012	-0.517	-0.405	0.245	-0.250	-0.216	-0.405	-0.319
ROW00090	-0.157	0.281	-0.281	-0.011	[illegible]	0.147	-0.019	-0.094	0.066	-0.138
ROW00091	0.089	-0.324	0.324	-0.020	-0.140	-0.245	0.138	0.109	0.031	0.361

IDENTIFICATION:

	ROW00081	ROW00082	ROW00083	ROW00084	ROW00085	ROW00086	ROW00087	ROW00088	ROW00089	ROW00090
ROW00081	1.000									
ROW00082	-0.526	1.000								
ROW00083	-0.012	-0.537	1.000							
ROW00084	0.012	0.537	-1.000	1.000						
ROW00085	0.043	0.155	0.135	-0.135	1.000					
ROW00086	-0.151	-0.295	0.122	-0.122	-0.164	1.000				
ROW00087	0.108	0.166	-0.193	0.193	-0.480	-0.787	1.000			
ROW00088	-0.025	-0.504	0.784	-0.784	0.271	0.295	-0.433	1.000		
ROW00089	0.025	0.504	-0.784	0.784	-0.271	-0.295	0.433	-1.000	1.000	
ROW00090	-0.227	0.245	-0.153	0.153	-0.117	-0.193	0.245	-0.245	0.245	1.000
ROW00091	-0.256	-0.032	0.060	-0.060	0.021	0.303	-0.283	0.166	-0.166	-0.245

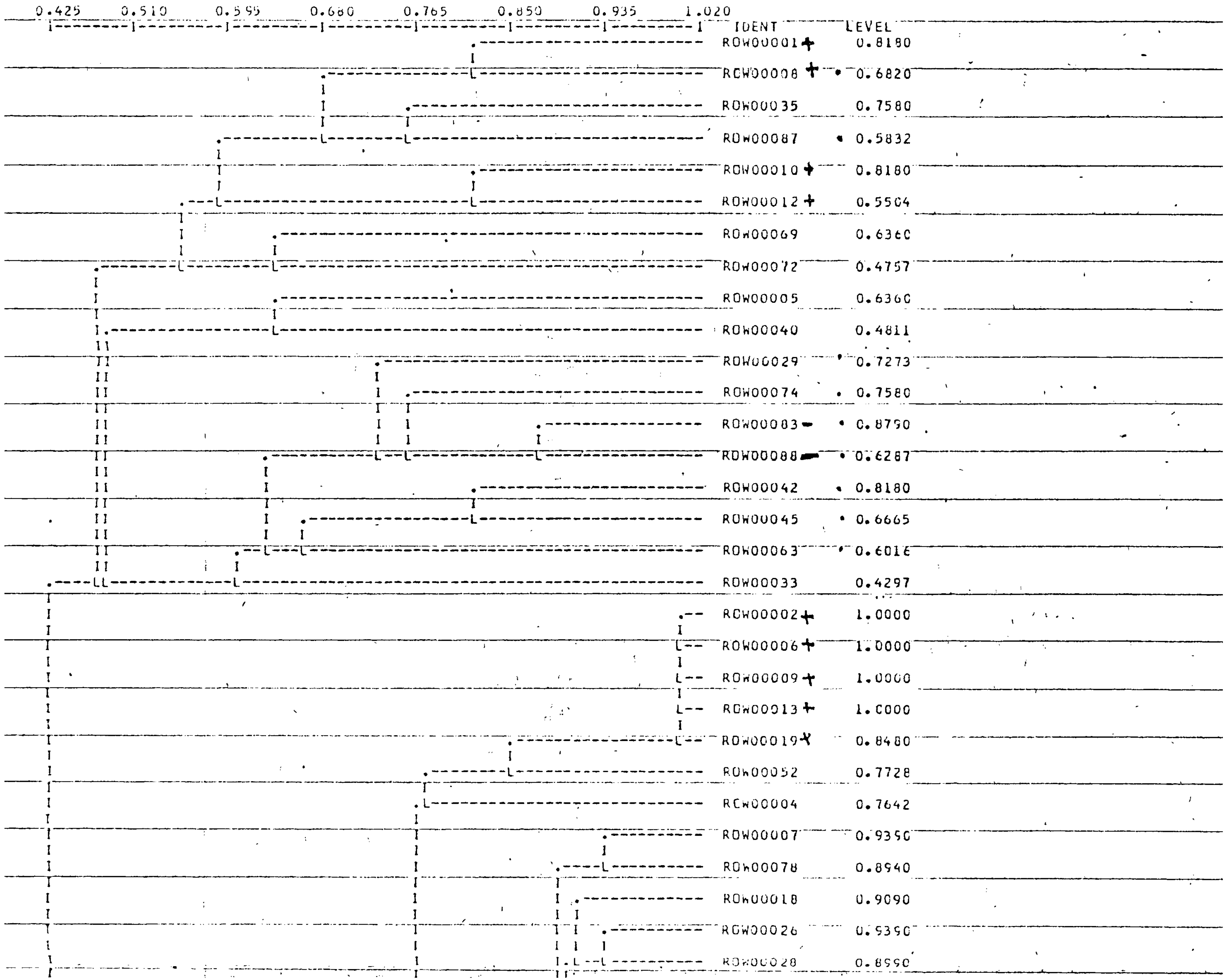
APPENDIX 8

HIERARCHICAL CLUSTERING SCHEME USING

THE SIMPLE MATCHING COEFFICIENT AND

THE UNWEIGHTED GROUP AVERAGE METHOD.

R-MODE



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ROW00035 0.7580
ROW00087 0.5832
ROW00010 0.8180
ROW00012 0.5504
ROW00069 0.6360
ROW00072 0.4757
ROW00005 0.6360
ROW00040 0.4811
ROW00029 0.7273
ROW00074 0.7580
ROW00083 0.8790
ROW00088 0.6287
ROW00042 0.8180
ROW00045 0.6665
ROW00063 0.6016
ROW00033 0.4297
ROW00002 1.0000
ROW00006 1.0000
ROW00009 1.0000
ROW00013 1.0000
ROW00019 0.8480
ROW00052 0.7728
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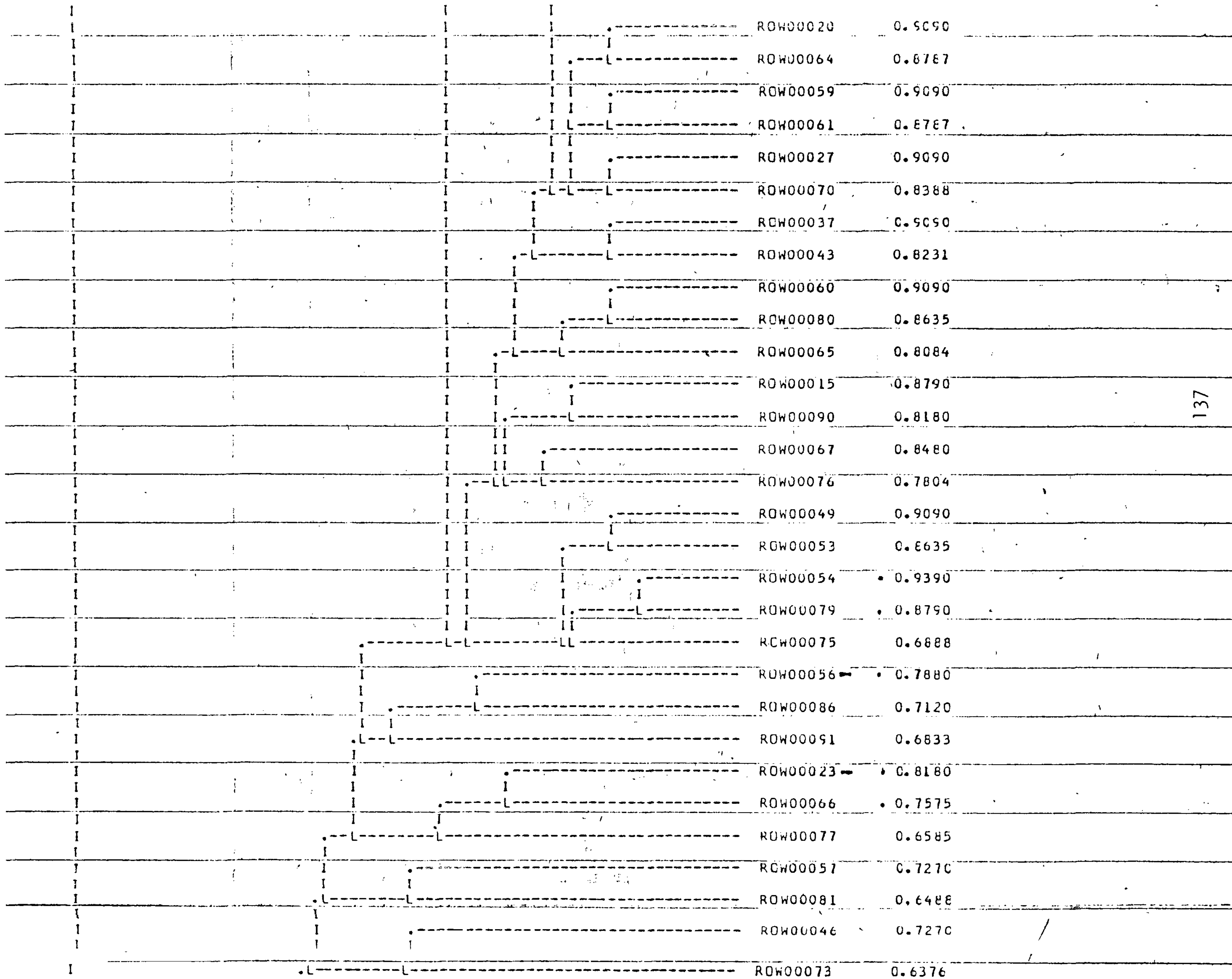
ROW00028 0.8990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ROW00060 0.9090
ROW00080 0.8635
ROW00065 0.8084
ROW00015 0.8790
ROW00090 0.8180
ROW00067 0.8480
ROW00076 0.7804
ROW00049 0.9090
ROW00053 0.8635
ROW00054 0.9390
ROW00079 0.8790
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ROW00086 0.7120
ROW00091 0.6833
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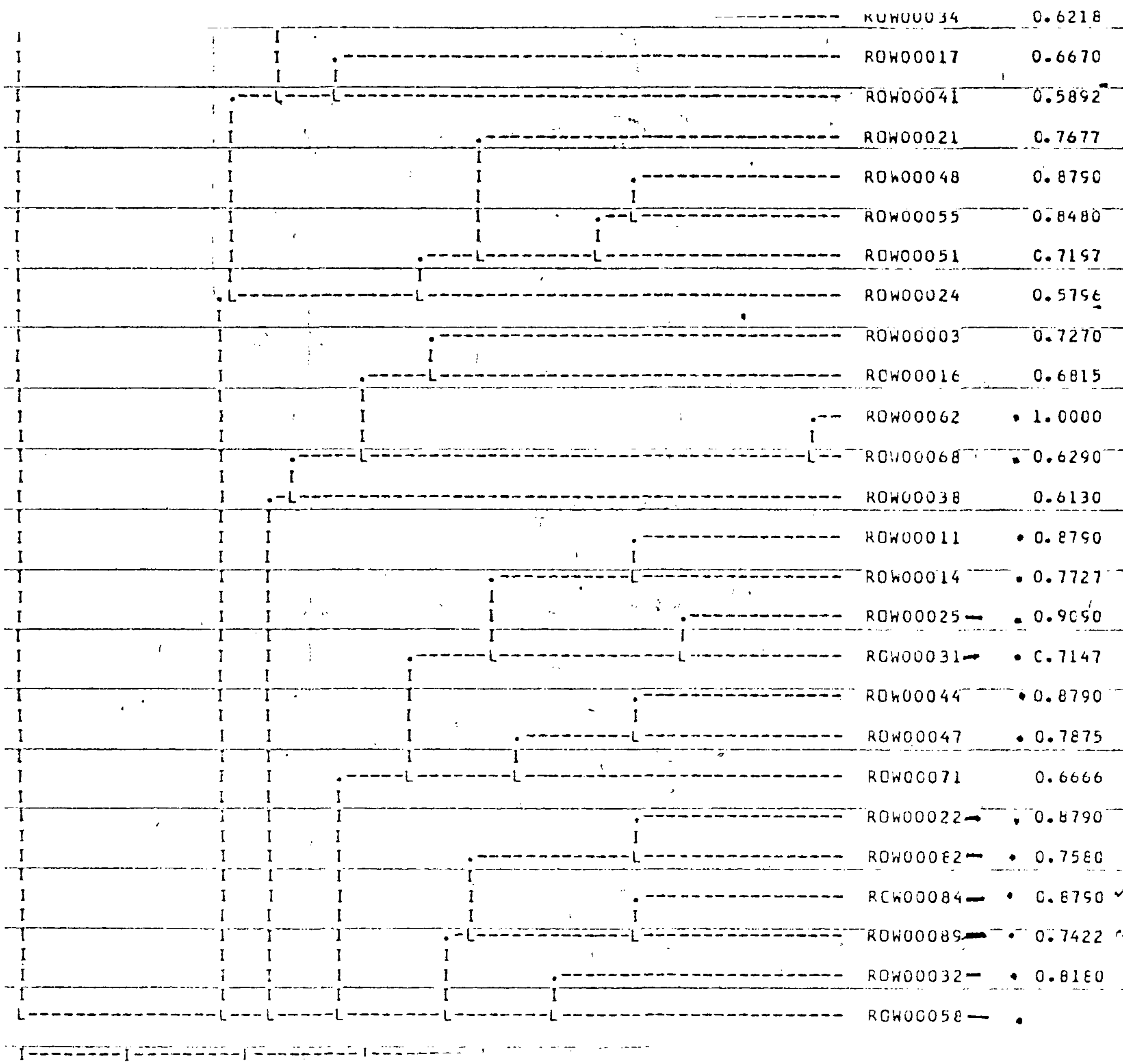
ROW00073 0.6376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ROW00024 0.5796
ROW00003 0.7270
ROW00016 0.6815
ROW00062 1.0000
ROW00068 0.6290
ROW00038 0.6130
ROW00011 0.8790
ROW00014 0.7727
ROW00025 0.9090
ROW00031 0.7147
ROW00044 0.8790
ROW00047 0.7875
ROW00071 0.6666
ROW00022 0.8790
ROW00082 0.7580
ROW00084 0.8790
ROW00089 0.7422
ROW00032 0.8180
ROW00058

APPENDIX 9

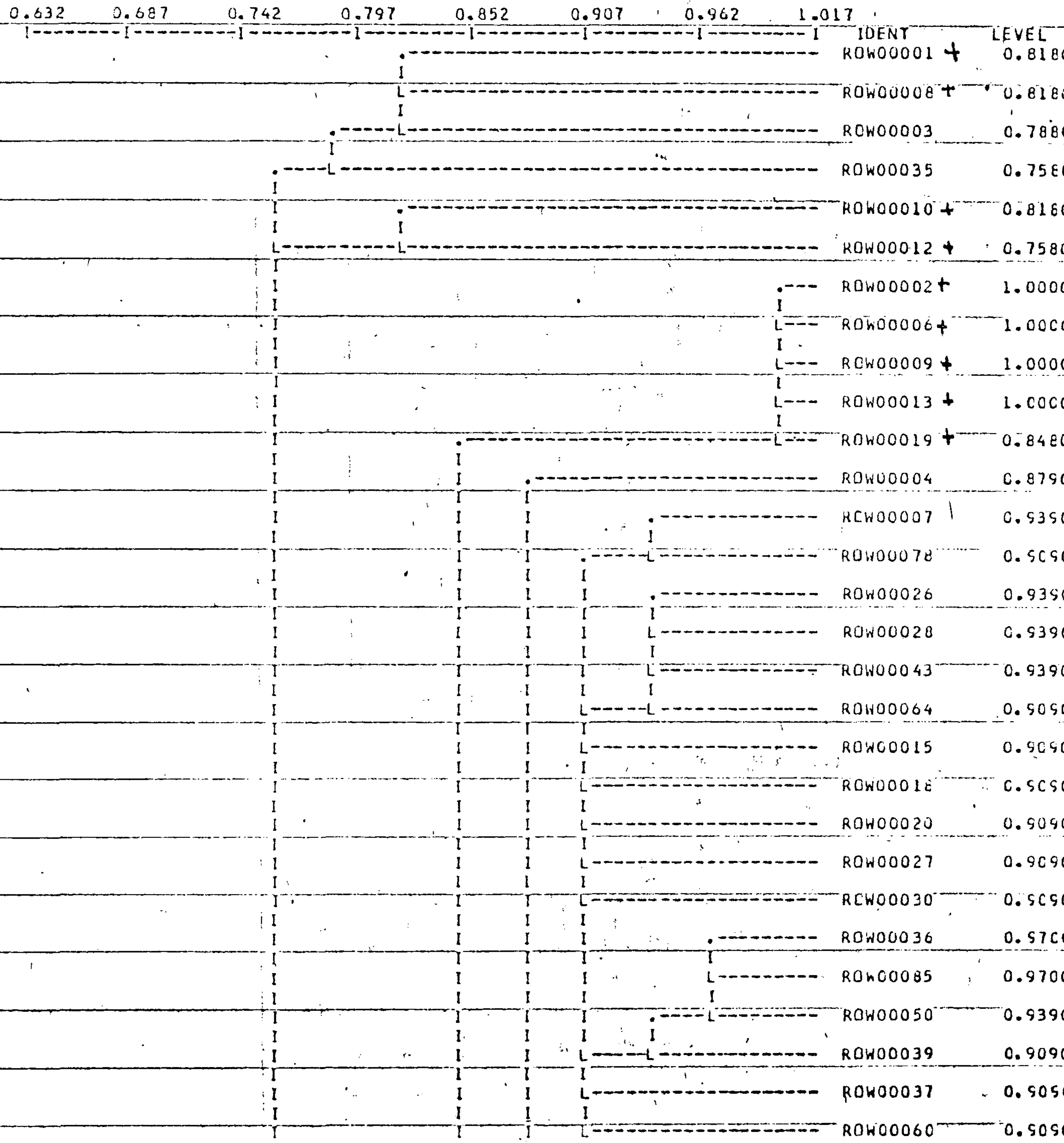
HIERARCHICAL CLUSTERING SCHEME USING

THE SIMPLE MATCHING COEFFICIENT AND

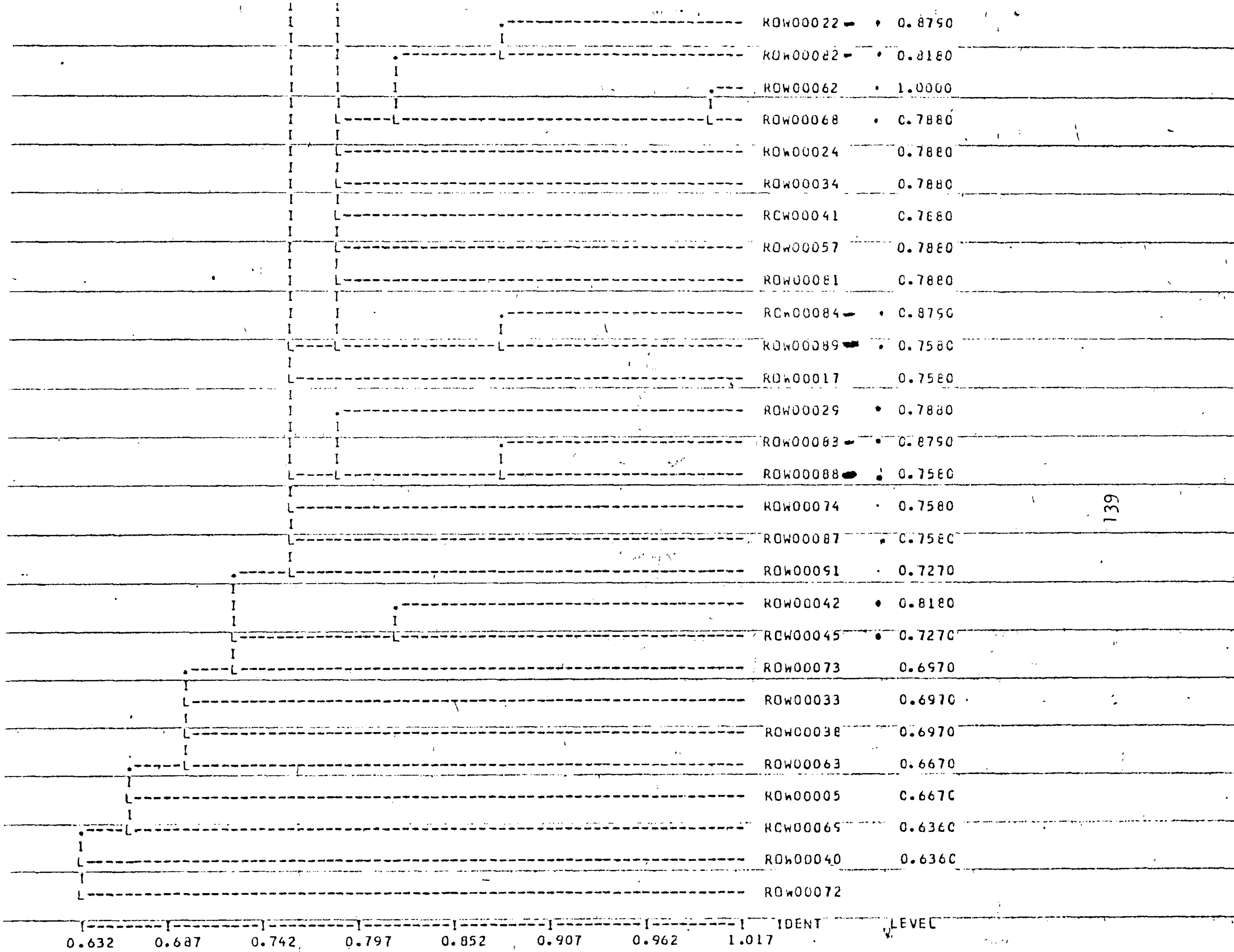
THE SINGLE LINKAGE METHOD.

R-MODE

PHENOGRAM FROM MATRIX SM 00



ROW00049	0.9090
ROW00053	0.9090
ROW00059	0.9090
ROW00070	0.9090
ROW00075	0.9090
ROW00076	0.9090
ROW00080	0.9090
ROW00090	0.8790
ROW00054	0.9390
ROW00079	0.8790
ROW00065	0.8790
ROW00071	0.8480
ROW00044	0.8790
ROW00047	0.8480
ROW00052	0.8480
ROW00067	0.8480
ROW00077	0.8480
ROW00086	0.8180
ROW00011	0.8790
ROW00014	0.8180
ROW00021	0.8180
ROW00048	0.8790
ROW00055	0.8480
ROW00051	0.8180
ROW00023	0.8180
ROW00025	0.9090
ROW00031	0.8180
ROW00032	0.8180
ROW00058	0.8180
ROW00046	0.8180
ROW00056	0.8180
ROW00016	0.7880



ROW00022 0.8790
ROW00082 0.8180
ROW00062 1.0000
ROW00068 0.7880
ROW00024 0.7880
ROW00034 0.7880
ROW00041 0.7880
ROW00057 0.7880
ROW00081 0.7880
ROW00084 0.8790
ROW00089 0.7580
ROW00017 0.7580
ROW00029 0.7880
ROW00083 0.8790
ROW00088 0.7580
ROW00074 0.7580
ROW00087 0.7580
ROW00091 0.7270
ROW00042 0.8180
ROW00045 0.7270
ROW00073 0.6970
ROW00033 0.6970
ROW00038 0.6970
ROW00063 0.6670
ROW00005 0.6670
ROW00065 0.6360
ROW00040 0.6360
ROW00072
IDENT
LEVEL
0.632
0.687
0.742
0.797
0.852
0.907
0.962
1.017

APPENDIX 10

SYMMETRIC CORRELATION MATRIX

Q-MODE

IDENTIFICATION:

	COL00001	COL00002	COL00003	COL00004	COL00005	COL00006	COL00007	COL00008	COL00009	COL00010
COL00001	1.000									
COL00002	0.155	1.000								
COL00003	0.040	0.139	1.000							
COL00004	0.433	0.193	0.129	1.000						
COL00005	0.111	0.157	0.414	0.412	1.000					
COL00006	0.137	0.295	0.233	0.315	0.412	1.000				
COL00007	0.323	0.157	0.134	0.359	0.208	0.201	1.000			
COL00008	0.238	0.287	0.095	0.169	0.341	0.272	0.396	1.000		
COL00009	0.111	0.103	0.414	-0.009	0.491	0.254	0.055	0.226	1.000	
COL00010	0.323	0.330	0.107	0.305	0.179	0.305	0.233	0.306	0.072	1.000
COL00011	0.191	0.245	0.336	0.124	0.303	0.174	0.249	0.544	0.249	0.566
COL00012	0.197	0.193	0.338	0.129	0.414	0.233	0.358	0.492	0.355	0.424
COL00013	0.517	0.157	-0.076	0.498	0.103	0.041	0.594	0.175	0.103	0.330
COL00014	0.111	0.157	0.302	-0.009	0.491	0.359	0.208	0.453	0.377	0.072
COL00015	0.039	0.349	0.176	0.073	-0.075	0.124	0.249	0.160	0.067	0.259
COL00016	-0.030	0.122	0.537	0.007	0.394	0.213	0.063	0.304	0.450	0.142
COL00017	-0.065	-0.023	0.393	-0.027	0.302	0.285	0.023	0.055	0.470	0.213
COL00018	-0.048	-0.007	0.414	0.149	0.491	0.517	0.038	0.226	0.264	0.179
COL00019	0.074	0.281	0.537	0.213	0.560	0.521	0.003	0.192	0.305	0.194
COL00020	0.155	0.568	0.040	0.236	0.376	0.432	0.164	0.130	0.111	0.423
COL00021	0.285	0.193	0.077	0.206	0.149	0.266	0.306	0.222	-0.009	0.205
COL00022	0.122	0.330	0.107	0.056	-0.088	0.205	0.233	-0.072	0.126	0.291
COL00023	-0.128	0.279	0.477	0.056	0.447	0.504	-0.068	0.145	0.393	0.443
COL00024	-0.179	0.175	0.055	-0.044	0.072	0.504	-0.083	0.091	-0.055	0.140
COL00025	0.242	0.088	-0.144	0.023	-0.183	-0.077	0.303	0.105	-0.183	0.106
COL00026	-0.237	0.068	0.210	-0.044	0.229	0.264	-0.159	0.080	0.118	0.194
COL00027	-0.028	0.175	-0.210	0.056	-0.195	-0.193	0.233	0.036	-0.249	0.038
COL00028	0.210	0.052	-0.130	0.244	-0.061	-0.061	0.212	0.120	-0.116	0.124
COL00029	0.291	0.176	-0.018	0.382	0.168	0.062	0.627	0.244	0.054	0.145
COL00030	0.217	0.157	-0.033	0.096	0.151	0.149	0.264	0.168	0.038	0.179
COL00031	0.291	0.231	-0.013	0.116	0.054	0.062	0.455	0.127	0.111	0.253
COL00032	-0.031	0.120	-0.075	0.169	-0.004	0.169	0.283	0.302	-0.119	-0.018
COL00033	0.292	0.140	0.016	0.325	0.141	0.023	0.249	-0.004	0.087	0.157

IDENTIFICATION:

	COL00011	COL00012	COL00013	COL00014	COL00015	COL00016	COL00017	COL00018	COL00019	COL00020
COL00011	1.000									
COL00012	0.496	1.000								
COL00013	0.192	0.193	1.000							
COL00014	0.357	0.526	0.048	1.000						
COL00015	0.226	0.230	0.192	0.033	1.000					
COL00016	0.369	0.374	0.015	0.505	0.211	1.000				
COL00017	0.123	0.118	-0.130	0.358	0.176	0.428	1.000			
COL00018	0.141	0.190	-0.116	0.434	-0.021	0.394	0.637	1.000		
COL00019	0.158	0.374	0.068	0.339	0.156	0.354	-0.428	0.505	1.000	
COL00020	0.191	0.249	0.159	0.217	0.059	0.126	0.092	0.217	0.384	1.000
COL00021	0.023	0.181	0.193	0.096	0.475	-0.095	0.181	0.096	0.367	0.285
COL00022	0.055	0.107	0.175	0.019	0.464	-0.067	0.002	-0.142	0.142	0.173
COL00023	0.464	0.266	-0.134	0.266	0.208	0.351	0.530	0.500	0.012	0.373
COL00024	0.106	-0.051	-0.186	0.233	0.106	0.089	0.213	0.286	0.246	0.273
COL00025	-0.033	0.123	0.192	0.033	0.278	0.0	-0.090	-0.075	-0.211	-0.012
COL00026	0.264	0.156	-0.145	0.229	0.158	0.136	0.265	0.229	0.408	0.126
COL00027	0.106	0.002	0.227	-0.195	0.511	-0.067	-0.315	-0.249	-0.224	0.173
COL00028	0.140	0.139	0.263	0.048	0.140	-0.038	-0.184	-0.170	-0.145	-0.046
COL00029	0.215	0.265	0.619	0.168	0.325	0.136	-0.075	-0.004	0.024	0.130
COL00030	0.033	0.358	0.212	0.321	0.141	0.118	0.246	0.151	0.118	0.164
COL00031	0.051	0.322	0.397	0.226	0.325	0.136	-0.075	-0.061	0.080	0.184
COL00032	0.051	0.209	0.120	0.226	0.270	0.136	-0.018	0.168	-0.032	0.076
COL00033	0.123	0.283	0.453	0.141	0.226	0.158	0.070	0.087	0.158	0.140

IDENTIFICATION: PAGE 3

	COL00021	COL00022	COL00023	COL00024	COL00025	COL00026	COL00027	COL00028	COL00029	COL00030
COL00021	1.000									
COL00022	0.354	1.000								
COL00023	0.106	0.089	1.000							
COL00024	0.106	0.140	0.393	1.000						
COL00025	0.124	0.157	-0.252	0.208	1.000					
COL00026	0.055	0.089	0.507	0.064	0.105	1.000				
COL00027	0.052	-0.012	-0.215	0.140	0.515	0.194	1.000			
COL00028	-0.061	0.175	-0.186	0.175	0.557	0.228	0.433	1.000		
COL00029	0.116	0.253	-0.126	-0.072	0.270	-0.032	0.362	0.508	1.000	
COL00030	0.201	0.179	0.019	0.019	0.195	0.008	-0.088	0.157	0.283	1.000
COL00031	0.222	0.525	-0.126	-0.072	0.489	-0.032	0.199	0.397	0.535	0.398
COL00032	0.276	0.091	-0.181	0.091	0.160	-0.032	0.145	0.065	0.360	0.341
COL00033	0.073	0.157	0.055	-0.098	0.175	-0.053	0.106	0.192	0.489	0.466

IDENTIFICATION: PAGE 4

	COL00031	COL00032	COL00033
COL00031	1.000		
COL00032	0.302	1.000	
COL00033	0.325	0.270	1.000

**** ELAPSED TIME IN THIS STEP IS 0.0244 MINUTES. TOTAL ELAPSED SYSTEM TIME IS 0.1606 MINUTES (1, -9)

I wish to thank the following people for the additional information I obtained from extensive interviews. They include Great Falls architects William Kuhr and Ken Sievert; and the Clear Creek drainage residents, including, G.C. Blackwood, Hulda Burns, Tom and Ethel Burns, Greg Jorgeson, Fred and Harry Olson, Harold Paulson, Ambrose Phelan, Roy Ramberg, Warren and Betty Ross, William Ross, Mrs. Joe Satleen, Harry Taylor, E.B. Williamsen, and Bill and Bob Young.