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Late Period Phases in the Central Mississippi Valley: A Cluster Analytic Approach

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ABSTRACT. When the de Soto *entrada* passed through the Central Mississippi Valley, a number of distinct polities were encountered. Many researchers have attempted to link these groups with protohistoric archaeological phases. The validity of the relevant phases is examined using cluster analysis. The results reveal some notable similarities and dissimilarities with existing phase formulations.

INTRODUCTION

The late period archaeological phases (*circa* A.D. 1400 - 1600) of the Central Mississippi Valley (Figure 1) are of considerable interest because of their potential relationship to several polities mentioned in the chronicles of the de Soto *entrada* (e.g., Morse and Morse 1983). In particular, the Kent, Nodena, Parkin, and Walls phases figure prominently in recent attempts to reconstruct the route of the Spaniards (e.g., Hudson *et al.* 1990; D. Morse 1990; P. Morse 1990; Morse and Morse 1990). Here I employ cluster analysis to objectively examine the validity of these phases as presently defined, as well as others proposed for the adjacent Mississippi River counties of western Tennessee (Smith 1990). My purpose is not to propose "new" or "better" phases, but rather to assess existing formulations.

Often considered to be the most "manageable" unit of archaeological study, the phase was defined by Willey and Phillips (1958: 22) as: "an archaeological unit possessing traits sufficiently characteristic to distinguish it from all other units similarly conceived, whether of the same or other cultures or civilizations, spatially limited to the order of magnitude of a locality or region and chronologically limited to a brief interval of time."

In his later areal synthesis, Phillips (1970: 523-524) discussed his formulation of archaeological phases in the Lower Mississippi Valley as follows:

Having by these regrettably non-objective procedures obtained approximate distributions of the several phases, pottery counts of the component assemblages of each phase were tabulated in parallel columns. By this means more acceptable, though certainly not final, definitions of the pottery complexes were obtained, with particular emphasis on "marker" varieties and modes. Armed with these, it was possible to go back and clean up the distributions, changing phase attributions of doubtful components or eliminating them altogether. In this operation the interplay of spatial-temporal and typological considerations gave rise to a general rule: that the greater the distance from the apparent geographical center of a given phase, the more exacting the requirements for the assignment of components to it. At or very near the center a very few occurrences of marker types are usually sufficient to establish a strong presumption in favor of assignment. On the peripheries this same small assemblage of markers may be attributable to trade or some other form of intrusion than to actual settlement and must be discounted accordingly. Having eliminated such dubious components, we are left with a geographically coherent group of site locations that one can now cautiously assume to have been occupied simultaneously or nearly so by local units of the same specific socio-political group.

At present, the phases under consideration (and many others, it should be added) are essentially intuitive constructs based on largely subjective impressions of extant artifact collections, Phillips' (1970) use of "cumulative frequency" graphs notwithstanding. Lacking a robust radiocarbon chronology, we are not in a position to state that any of these late period phases are limited to "a brief period of time" and, in fact, some are believed to have existed for over 200 years (e.g., D. Morse 1990). Even in the case of those regarded by Phillips (1970) as especially "strong" constructs (such as the Parkin and Nodena phases), much of our knowledge about the groups of sites in question derives from surface collections of potsherds, sometimes supplemented to varying degrees by assemblages of mortuary vessels excavated by amateurs (e.g., Phillips 1970). Information on site structure, house styles, and subsistence are virtually nonexistent for most of the sites under consideration here.

ARCHAEOLOGICAL BACKGROUND

Although some earlier studies included discussions of late period phases or foci in the Central Mississippi Valley (e.g., Griffin 1952; Phillips *et al.* 1951; Williams 1954), it is Phillips' (1970) broad areal synthesis that provides the baseline for late period phase definitions throughout the study area. Of the late period sites included in this study, most have been assigned to the Nodena, Parkin, Kent, Parchman, and Walls phases as defined by Phillips (1970), which are among the best-known and best-documented late period archaeological constructs in the Lower Mississippi Valley (House 1991; D. Morse 1989, 1990; P. Morse 1981, 1990); with the exception of the latter, these phases encompass a significant portion of eastern Arkansas. It seems virtually certain that some late period sites in eastern Arkansas were visited by the de Soto *entrada*, and there is a general consensus that the Parkin phase equates with the Spaniards' province of Casqui, while the Nodena phase represents Pacaha. Additionally, the Walls phase is a likely candidate for de Soto's province of Quizquiz, encompassing the point at which the *entrada* crossed the Mississippi River (e.g., Hudson 1985; Morse and Morse 1983, 1990; Young and Hoffman 1993).

Pacaha clearly was the dominant polity in the region, as the Spaniards refer to Quizquiz and Aquixo (the latter probably including sites variously placed in the Kent and Walls phases [Phillips 1970], the Belle Meade phase [Morse and Morse 1990], and Horseshoe Lake phase [Smith 1990]) as vassal polities of Pacaha.

Thus, the relation of the late period sites and phases of the Central Mississippi Valley to certain polities mentioned in the Spanish chronicles represents a problem of considerable anthropological and historical interest. Of great methodological interest is the degree to which "meaningful" groups of sites can be derived from pottery that is represented in surface collections.

Most of the western Tennessee sites considered here were not included in Phillips' (1970) synthesis. Smith (1990) has recently proposed several late period phases for western Tennessee, within which he includes the majority of the relevant sites used in this study; Smith also proposed new and/or modified phase definitions for portions of eastern Arkansas and northwest Mississippi. The following discussion of phases is based primarily on the work of Phillips (1970), with supplementary comments taken from Smith (1990) and other researchers as appropriate.

The Nodena phase includes a group of sites located primarily within the Mississippi River counties of northeastern Arkansas. Phillips (1970: 933-936) notes that "the outstanding feature" of this phase is "the low frequencies of Barton Incised and Parkin Punctated, which makes for a very different pattern from either the Parkin or Walls phases" (1970: 935), and goes on to state that "Nodena is no more in need of exact definition than are three-fourths of the other phases dealt with in this section." Phillips (1970) includes Carson Lake, Bell, Nettle Ridge, Notgrass, Upper Nodena, Turnage, Shawnee Village, Bradley, and Golightly in this phase. To this list, D. Morse (1989) adds Chickasawba/ Gosnell, Pecan Point, Golden Lake, Middle Nodena, and Knappenberger. Bradley, which actually includes at least three major sites (Morse and Morse 1983), is presently interpreted as representing the capital of Pacaha, as recorded in the de Soto chronicles (Morse and Morse 1990). Only Upper Nodena, Notgrass, and Carson Lake have produced sufficiently large ceramic samples (cf. Phillips 1970) to be used in this study (Figure 1).

Situated along the St. Francis River drainage in eastern Arkansas, the Parkin phase is characterized by very high frequencies of Mississippi Plain (75-90%), relatively large amounts of Parkin Punctated, Barton Incised, Kent Incised, and a "fair but erratic showing of Old Town Red (Phillips 1970: 932). Major sites include Parkin, Glover, Barton Ranch, Richard's Bridge, Rose Mound, Williamson, Vernon Paul, Neeley's Ferry, Twist, Cummings, Taylor's Shanty, Turnbow, Big Eddy, and Castile Landing (P. Morse 1981; Phillips 1970). The Parkin phase is believed to equate with de Soto's province of Casqui, with the Parkin site itself representing the capital (P. Morse 1981, 1990; Morse and Morse 1990). Ceramic samples from Parkin, Williamson, Barton Ranch, Rose Mound, Neeley's Ferry, Turnbow, and Castile Landing were used in this study (Figure 1). The relatively large sample from Vernon Paul was included in preliminary analyses; as discussed below, the site proved to be an extreme outlier, perhaps a result of non-representative collections, and was subsequently dropped from analysis.

The Kent phase subsumes a group of late period sites that are located primarily within the lower St. Francis basin of eastern Arkansas, although Phillips (1970) also includes two sites (Commerce and Hollywood) in northwestern Mississippi. More recently, House (1991) has advocated limiting use of the Kent phase to sites of the lower St. Francis, a suggestion supported by the analyses that follow. Ceramically, this phase is said to be distinguished by " notably higher frequencies of the *Kent* variety of Barton Incised, Old Town Red, and painted types . . . than either Parkin or Walls. There is a great deal more Bell Plain than in Parkin but nowhere near so much as in Walls" (Phillips 1970: 938); the percentages of Mississippi Plain and Bell Plain are roughly equal. In addition to the sites noted above, Phillips assigned Beck, Belle Meade, Kent, Clay Hill, Davis, and Starkley to the Kent phase. Smith (1990), like House, is more restrictive in his use of the Kent phase concept, and relegates Belle Meade and Beck to his Horseshoe Lake phase (additional sites include Pouncey, Mound Place, Young, and Rhodes). He also places Big Eddy and Castile Landing in the Kent phase, and proposes "early" and "late" subdivisions based on the relative amounts of Bell Plain. Sites with sufficiently large ceramic collections to be used in this study are Kent, Clay Hill, Starkley, and Davis of the Kent phase, and Beck, Belle Meade, Mound Place, and Young of Smith's Horseshoe Lake phase (Figure 1). Grant, another Kent phase site, proved to be an outlier.

Phillips (1970: 936) regards the Walls phase as "perhaps the most satisfactory phase dealt with in this entire study." The "core" of the Walls phase is a cluster of sites in extreme northwestern Mississippi (Cheatam, Dogwood Ridge, Irby, Lake Cormorant, Shannon, Walls, and Woodlyn). Chucalissa, located to the north in Tennessee, and at least four sites in eastern Arkansas (Rhodes, Mound Place, Pouncey, and Turner), are also included in the phase. In reference to the associated ceramic assemblages, Phillips (1970: 936) observes that: "Outstanding is the plurality of Bell over Mississippi Plain," while Parkin Punctated, Barton Incised, and Old Town Red are "common." Subsequent researchers have questioned the inclusion of sites west of the Mississippi River in the Walls phase and suggested that the virtually undocumented DeSoto Park mound group in Memphis represents the apex of the Walls phase settlement system (Lumb and McNutt 1988; Smith 1990; see also Mainfort 1991); Smith includes Jeter as the northernmost representative of the phase. Ceramic collections from Walls, Lake Cormorant, Irby, Woodlyn, Chucalissa, and Jeter were analyzed as part of this study (Figure 1).

Located south of the Walls phase area, the Parchman phase is one of Phillips' (1970) more tenuous formulations. Ceramically, the phase is characterized by a high ratio of Barton Incised to Parkin Punctated and possibly the occurrence of Walls Engraved, *var. Hull*. Collections from two sites assigned to the Parchman phase - Parchman and Salomon - were included in this study (Figure 1); as noted below, West Mounds represents a statistical outlier and was not included in the analysis presented here.

With only a few exceptions, western Tennessee was virtually ignored in Phillips' (1970) tome. A recent paper by Smith (1990) represents the first attempt to systematically describe the late period sites of this region. Smith's Tipton phase, which includes Rast (40SY75), Hatchie (40TP1), Richardson's Landing (40TP2), Wilder (40TP12), and 40LA3, is distinguished by very low frequencies of decorated ceramics. To the north (primarily in the Lauderdale County bottoms), the Jones Bayou phase is also characterized by small quantities of decorated wares; Porter (40LA2), Jones Bayou (40LA4), Sweat (40LA26), and several other sites are assigned to this phase. Moderately large ceramic collections are available from many of Smith's western Tennessee sites (Figure 1); several sites, notably 40LA3 and 40LA25, have produced no evidence whatsoever of late period occupations and were not used in the analyses discussed below (Mainfort 1991).

METHODS

Cluster analysis is a technique for exploratory data analysis that encompasses a variety of methods and algorithms that seek to objectively separate a set of patterns (objects) into consistent (natural) groups (classes, clusters), such that the resulting subsets have high intracluster resemblance and low intercluster similarity. The literature of many disciplines abounds with discussions of cluster analysis, and *The Journal of Classification* is entirely devoted to the methodology of clustering. Some major references include Anderberg (1973), Hartigan (1975), Jain and Dubes (1988), and Aldenderfer and Blashfield (1984).

A number of techniques for clustering data have been developed, which employ different criteria and different methodologies. The techniques themselves can be grouped (clustered) into three main categories: (1) purely heuristic methods; (2) graph theoretic methods, which include the familiar hierarchical clustering; and (3) partitioning, or non-hierarchical, methods based on the minimization of a specified objective function. The latter category of methods, which includes the K-means algorithm, is quite popular among researchers in a variety of fields, but has seen limited use among archaeologists, primarily as a tool for examining spatial patterning (Gregg *et al* 1991; Johnson and Johnson 1975; Ismail and Kamel 1989; Kintigh and Ammerman 1982; Rigaud and Simek 1991; Venkateswarlu and Raju 1992).

The use of various clustering algorithms enjoyed considerable popularity among archaeologists in the 1970s. It soon became obvious, however, that cluster analysis was not the simple classificatory panacea longed for by some researchers, and this discovery seems to have deterred application of clustering techniques to other archaeological problems. The seeming inability of cluster analysis to consistently reproduce, or approximate, intuitive artifact typologies (particularly in the case of projectile points) should not be seen so much as a failure of the algorithms, but rather viewed as a reflection of misunderstandings and unrealistic expectations on the part of archaeologists employing the algorithms (including inappropriate selection of attributes to be analyzed).

Although Read's (1989: 46) comment that "Cluster procedures do not 'work' in general" represents a minority viewpoint (e.g., Anderberg 1973; Dubes 1993; Jain and Dubes 1988; Milligan 1980; Rohlf 1985), several cautionary notes on the use of cluster analysis are appropriate. First, different clustering techniques can and do produce different groups (e.g., Anderberg 1973; Dubes and Jain 1976), but contrary to Read's (1989: 45) intended criticism in this regard, differences in results may also be viewed as revealing different kinds of structures within the data (e.g., Hartigan 1985). Second, most clustering algorithms will produce clusters for *any* data set, including randomly generated data lacking any structure (Jain and Dubes 1988; Jain and Moreau 1987; Milligan 1980); clustering algorithms are, of course, designed to find clusters.

Potential pitfalls notwithstanding, cluster analysis in its many forms and implementations has proven to be a useful, powerful, and fairly robust means for recovering structure from data sets. This point is underscored by Milligan's (1980) study of the effects of various error conditions on 15 clustering algorithms, in which it was demonstrated that virtually all of the algorithms produced mean recovery values above 0.90 in the error-free condition. Even with the addition of outliers to the data set, almost half of the algorithms produced recovery values above 0.90, and the non-hierarchical (partitioning) methods were virtually unaffected. Although the addition of random noise dimensions (typically associated with the selection of variables) caused marked decrements in performance by all of the tested algorithms, over half (N=9) produced recovery values above 0.82.

It is not my purpose to argue for the superiority of the specific clustering algorithms employed here. Nor do I claim that the structures obtained by clustering are statistically valid in the strictest sense; validation remains a problem needing further study, although a variety of techniques are available (Dubes 1993; Jain and Moreau 1987; *contra* Read 1989:

46). Moreover, I do not wish to imply that similar results could not have been obtained by some other method(s). Here, I use average linkage and K-means clustering largely as tools of discovery (Dubes 1993; Dubes and Jain 1976; cf. Read 1989). The use of methodologically contrasting techniques potentially offers a degree of validation if similar results are obtained, but my primary intent is simply to illustrate alternative ways of examining patterning within the data set under consideration.

Average linkage clustering is a commonly used hierarchical grouping algorithm (e.g., Fox 1992; Glascock 1992) that performed quite well in Milligan's (1980) simulation tests. Parenthetically, results comparable to those presented here were also obtained using single and complete linkage algorithms. Use of the generalized K-means partitioning algorithm provides a counterpoint to average linkage. A useful feature of K-means is that the user specifies the desired number of partitions. Moreover, at each level of partitioning the statistically best (using the parameters of the algorithm) group is separated, allowing the researcher to observe the progress of partitioning. Since assignment of members to clusters entails minimizing squared error on attributes (in this case, ceramic type percentages), not only can the attributes of greatest significance be identified, but also the characteristics of each cluster, i.e., the range of individual attributes within clusters, may be generated. This is potentially of considerable utility in exploring the basis for late period phase assignment in the Central Mississippi Valley because contrasts between phases are typically expressed in terms of variation in the relative frequencies of specific ceramic types (e.g., Phillips 1970). All cluster analyses utilized normalized Euclidean distances as input statistics, and were performed using *SYSTAT* (Wilkinson 1989).

DATA SET

As noted above, current late period phase definitions in the study area are based primarily on the contrasting relative frequencies of various ceramic types in collections (usually, but not exclusively "grab samples" from the surface) available for analysis. The analyses presented here also rely heavily on surface-collected ceramic samples, but relationships between sites (as represented by collections) are investigated using multivariate statistical methods.

It could be argued that such data are unsuitable for assessing the validity of the phases under scrutiny, and this issue clearly warrants some comment. First, I wish to emphasize that my use of surface-collected sherds in this study does not constitute advocacy of a research strategy that relies solely on such data for the definition of archaeological phases. Nonetheless, surface collections can be robust data sets and, hence, valuable indicators of past behavior. Second, I am using data comparable to those used by previous researchers in the formulation of late period phases, namely ceramic collections. It should be added that in light of the appalling loss of archaeological sites in the study area to agricultural practices, in some instances the original Lower Mississippi Valley Survey collections (Phillips *et al.* 1951) represent virtually the only material that will *ever* be recovered from some important sites.

Sample size was of critical concern in selecting collections for inclusion in this study. In the case of ceramic collections from late period sites in the Central Mississippi Valley, the relationship between sample richness and diversity and sample size is unclear (see various papers in Jones *et al.* [1983] for a general discussion of this problem). Phillips expressed concerned about sample size throughout has monumental Yazoo Basin report and felt that "50 rim and decorated sherds [equivalent to a total sample of 400-500]) is minimal" (1970: 246 and *passim*). Moreover, "since many minority types regularly occur in frequencies of less than one percent" (Phillips 1970: 4), infrequently occurring types may not be present in small samples. However, some small samples of sherds from late period sites exhibit both considerable richness and diversity (e.g., O'Brien 1994), although it has not been demonstrated that the specific samples are truly representative.

For the analyses presented here, I elected to include only sites from which there were relatively large collections. Sites from which less than 500 sherds were available were excluded, and all but a few of the sites included have ceramic assemblages that number in excess of 1,000 sherds (Table 1). As an example of the limitations imposed by the criterion of sample size, only three sites assigned by Phillips (1970) to the Nodena phase were included in this study, namely Upper Nodena, Notgrass, and Carson Lake; these represent only one third of the Nodena phase sites that Phillips (1970: 935) considered to have "provided samples of sufficient size for safe identification." Several sites in western Tennessee at which late period components are alleged to be present by G. Smith (1990) have also been excluded, not only due to small sample sizes, but also due to the complete absence of any late period diagnostic types in the extant collections.

A substantial amount of the data used here was taken from the Lower Mississippi Valley survey sherd counts made during the 1940s. Therefore, I employed the ceramic typology of Phillips *et al.* (1951) rather than more recent type-variety designations (e.g., Phillips 1970); the resulting information loss was minimal (e.g., Ranch Incised is now designated Barton Incised, *var. Ranch*). The specific types are familiar to all researchers in the area: Parkin Punctated, Barton Incised, Kent Incised, Ranch Incised, Old Town Red, Nodena Red and White, Rhodes Incised, Walls Engraved, Vernon Paul Applique, and Fortune Noded. Importantly, the frequencies of all these types were instrumental in the formulation of existing phase definitions (Phillips 1970; Smith 1990).

Although shell tempered plainwares (Mississippi Plain and Bell Plain) figure prominently in existing late period phase definitions (e.g., Lumb and McNutt 1988; Phillips 1970), undecorated ceramics were excluded from the analyses presented below. Within the study area, late period plainwares are subsumed within two "super-types" that are defined on the subjective judgments of researchers about the "coarseness" or "fineness" of crushed shell particles. If the tempering particles are considered to be "coarse," a sherd is classified as a variety of Mississippi Plain, while "fine" shell tempered plainwares are grouped within the type Bell Plain. But subjective assessments of "coarse" and "fine" shell temper can vary considerably among competent researchers. While common decorated types, such as Parkin Punctated, Barton Incised, and Old Town Red are easily and consistently sortable based on readily identifiable surface treatments, plainwares are far more difficult to consistently sort due to subjectivity inherent in type definitions. Since undecorated sherds constitute the overwhelming majority of late period ceramic assemblages, this problem undermines the utility of including plainwares as defining attributes of phases.

The raw data employed here are ceramic sherd counts from each site (Table 1), which were converted into percentage occurrences for input into *SYSTAT*. Since, as previously noted by Phillips (1970), the frequency of plainwares relative to decorated types may be of importance in isolating groups of sites, the percentages of each decorated type reflect frequencies within the entire ceramic assemblage for each site, not frequencies relative to the total number of decorated sherds (see Fox 1992 for an alternative approach).

Some comments about the collections that were employed is in order. For much of eastern Arkansas and northwestern Mississippi, the sherd counts from the original analysis sheets used by Phillips *et al.* (1951) were used, and in some instances, these represent the only available data. Additional data for the Kent phase area was obtained from John House's (1991) dissertation. Most counts for western Tennessee sites are based on collections housed by the Tennessee Division of Archaeology. Reanalysis of collections housed at the C.H. Nash Museum-Chucalissa (cf. Smith 1990) provided data for Walls, Beck, Belle Meade, and several other sites. Sherd counts from Chucalissa were taken from Lumb and McNutt (1988); counts for Parkin include material excavated during the mid-1960s (Davis 1966; Klinger 1977).

The discussion that follows is based on a sample of 41 late period Central Mississippi Valley sites. Several sites from which reasonably large collections were revealed to be extreme outliers (both intuitive and statistical) during the initial analyses and are excluded from the analyses presented here. In the case of Vernon Paul, the exceptionally high frequency of decorated types (almost 30%; N=2,595) suggests that the collection is not representative. The outlier status of Grant and West Mounds cannot readily be attributed to sampling error; these sites appear to have distinctive ceramic assemblages and were dropped from consideration here in order to highlight broader trends.

It should be noted that the elimination of outliers constitutes sound statistical practice when employing the techniques used here. In the case of K-means clustering "an outlier can force a partitional clustering algorithm to put two compact and well-separated groups into the same cluster. Thus it is best to identify an outlier and remove it from further consideration" (Jain and Dubes 1988: 98-99). In a similar vein, stress, a statistic that is fundamental to multidimensional scaling, weights large distances more heavily than small ones and thus allows a few outliers to seriously distort the resulting configuration (Jain and Dubes 1988: 51-52).

ANALYSIS AND RESULTS

Initial investigation of the data set employed K-means analysis to generate a two cluster solution for the purpose of examining the proposition that the ceramic assemblages of sites on the east side of the Mississippi River are distinct from those on the west side, as has been suggested by some researchers (e.g., Morse and Morse 1983). As illustrated in Figure 2, the proposition is generally supported, albeit with some notable exceptions.

One cluster includes virtually all of the western Tennessee sites, sites of the Walls and Parchman phases, Hollywood, and Commerce. Several sites assigned to the Nodena phase of northeastern Arkansas (Phillips 1970; Morse and Morse 1983) are also included in this cluster. The second cluster includes all of the Parkin and Kent phase sites from eastern Arkansas, as well as Chucalissa, which is located in Memphis, Tennessee. Chucalissa has traditionally been considered to be a Walls phase site (Lumb and McNutt 1988; Phillips 1970; Smith 1990), a view that is challenged by the analyses presented here.

The basis for distinguishing the two initial clusters is apparent, as shown in Figure 2. Sites in Cluster 2 exhibit higher overall percentages of decorated ceramic types (particularly Parkin Punctated and Barton Incised) than those in Cluster 1. The very low frequencies of many decorated types (Parkin Punctated, Barton Incised, and Old Town Red being exceptions) is noteworthy, and calls into question the utility of these types in defining late period phases.

The results obtained by the initial K-means analysis are mirrored by the two macroclusters obtained via average linkage clustering (Figure 3). The upper macrocluster includes the same sites grouped in the first cluster obtained by K-means partitioning. Similarly, the lower macrocluster in Figure 3 equates with the second of the initial clusters obtained by the K-means algorithm; with the exception of Chucalissa, all of the included sites are located west of the Mississippi River.

Other interesting intersite relationships are also suggested by the dendrogram. First, the "core" Walls phase sites (Walls, Irby, Lake Cormorant, and Woodlyn) comprise a distinctive subcluster, which is interesting because of the importance of plainwares (which were not included in these analyses) in Phillips' (1970) definition of the phase. The Nodena phase sites (Upper Nodena, Notgrass, and Carson Lake), with the addition of Richardson's Landing (located just across the Mississippi River from Upper Nodena) and Turnbow (a Parkin phase site [Phillips 1970]), also form a recognizable subcluster. Most of the western Tennessee sites, as well as Mound Place, are grouped together and appear to be closely related to Nodena phase cluster. Smith's (1990) Tipton and Jones Bayou phases in western Tennessee are unsupported by the dendrogram, as is the assignment of Jeter (40SY28) to the Walls phase. Also contradicted is Phillips' inclusion of Mound Place, an eastern Arkansas site, within the Walls phase. Hollywood and Commerce (a pair of putative Kent phase sites in northwestern Mississippi) are included in subcluster with the two Parchman phase sites (Parchman and Salomon) in the "eastern" macrocluster (Figure 3).

Sites of the Kent phase (Clay Hill, Kent, Starkley, Davis, and Soudan), particularly in the more restrictive sense used by House (1991), constitute a very distinct subcluster. The traditional Parkin phase is easily recognized in another subcluster, albeit with the addition of Young and Cramor. This is of considerable interest because, as noted above, one distinctive feature of the Parkin phase is considered to be the extremely high ratio of Mississippi Plain to Bell Plain (P. Morse 1981; Morse and Morse 1983; Phillips 1970). Plainwares were excluded from this study, yet sites attributed to the Parkin phase are grouped together here based on a fairly distinctive assemblage of decorated ceramics. Beck and Belle Meade, a pair of presumably sequent sites within arrowshot of each other, exhibit the expectedly close relationship and are the sole members of a subcluster.

A final subcluster distinguished in the dendrogram includes Chucalissa (a putative Walls phase site), Nickel, and Castile Landing. As seen in the initial K-means analysis, the Chucalissa ceramic assemblage does not closely resemble the assemblages of the Walls phase sites.

The validity of the subclusters in average linkage dendrogram is generally supported by an eight cluster K-means analysis (Figure 4), which produced very similar groupings, as well as providing insights into the basis of cluster formation. Most of the western Tennessee sites, as well as those of the Nodena phase, form a single, large cluster that is distinguished by relatively low frequencies of virtually all decorated types. The "Parkin phase" cluster of the dendrogram is reproduced, with the addition of Soudan; it seems appropriate that this cluster is distinguished by relatively high percentages of the type Parkin Punctated (8.4% to 10.9%). Kent, Starkley, Clay Hill, and Davis are again revealed to be a distinctive group; in fact, this subset was initially generated during a three cluster solution. The defining characteristics of the cluster are relatively high percentages of Parkin Punctated (5.7% to 10.1%), Barton Incised (7.0% to 8.3%), and Old Town Red (6.0% to 7.2%).

As in the dendrogram, Hollywood, Commerce, Parchman, and Salomon cluster together, with the addition of Turnbow (a northeastern Arkansas site); a high ratio of Barton Incised relative to Parkin Punctated distinguishes the group. Belle Meade and Beck again stand apart from virtually all other sites in the analysis; both exhibit very high frequencies of Parkin Punctated (12.5% to 13.2%) and the largest percentages of Barton

Incised (7.0% to 8.3%) of any sites included in this study. A cluster of three Lauderdale County, Tennessee, sites (Fullen, Jones Bayou, and Porter) was generated based primarily on high frequencies of Old Town Red (3.5% to 6.3%) and low frequencies of other types; two of these sites formed a minor subcluster during average linkage clustering.

The cluster consisting of Chucalissa, Nickel, and Castile Landing also was seen in the average linkage dendrogram and indicates that Chucalissa is not properly regarded as a Walls phase site. Moreover, the high frequency of decorated types also suggests that viewing the site as a "secondary center," as suggested by some researchers (Lumb and McNutt 1988; Smith 1990) is at best simplistic, and probably simply wrong. High percentages of Parkin Punctated (12.2% to 13.2%) are the most distinctive feature of this cluster.

Finally, sites of the Walls phase, including Lake Cormorant, Irby, Woodlyn, and Walls, comprise the final group generated by the eight cluster K-means solution, suggesting that the Walls phase is less distinctive than Phillips' (1970) characterization. With the exception of Parkin Punctated, decorated ceramic types occur in relatively low frequencies among these sites, although the types are somewhat more common than in sites of the Nodena phase.

How valid are the groups of sites generated by the analyses above? In treating this question, it is useful to consider a structure (cluster) to be *valid* if it cannot reasonably be assumed not to have formed by chance or to be an artifact of a clustering procedure (Dubes 1993). Validation may be objectively approached by applying statistical methods to test hypotheses about recovered structure. Such efforts often prove to involve considerable difficulty, and the issue of specific validation measures remains contentious among researchers (Jain and Dubes 1988).

As noted by Dubes (1993) and other researchers, formal testing for validation is not always necessary, for example, in the use of clustering in an exploratory manner, as I have done here. Moreover, the experience and judgment of a researcher is always of considerable importance in the interpretation of a clustering structure.

The degree of isomorphism between the results of what are essentially methodologically opposed (hierarchical versus partitional) clustering strategies serves, in itself, to partially validate the interpretations presented above, insofar it is clear that the resulting groups cannot be ascribed to serendipitous behavior by a single algorithm.

Further insights about structures in the data set were gleaned from the nonlinear representation technique of multidimensional scaling (Kruskal 1964) as implemented in *SYSTAT*. Through ordination, multidimensional scaling generates a configuration of points representing a proximity matrix. A two-dimensional representation of the data set is shown in Figure 5. The associated stress is 0.0941, which is slightly higher than Kruskal's (1964) rather arbitrary threshold of 0.05 for the stress of a "good" configuration (but see Jain and Dubes 1988).

The "east-west" division revealed by cluster analysis is apparent in the configuration. Of the groups produced by clustering, the most readily identifiable is the mini-cluster consisting of Beck (Z) and Belle Meade (o). The Kent phase sites of Kent (k), Starkley (e), Davis (n), and Clay Hill (l) also appear as a distinct grouping in two dimensional space, as does the Walls phase cluster (Walls [f], Irby [N], Lake Cormorant [J], and Woodlyn [Y]). Less obvious, albeit recognizable, is the Commerce (Q)-Hollywood (P)-Parchman (g)-Salomon (h) cluster. Chucalissa (i), Nickel (a), and Castile Landing (O) are arrayed in close proximity to a rather amorphous group that includes most sites assigned to the Parkin phase. As expected based on the results of clustering, the two dimensional configuration provides little basis for subdividing the remaining sites of the "eastern" macrocluster, although the "Nodena phase" cluster appears on the far right of Figure 5; a three dimensional configuration provided little additional information.

Multidimensional scaling, therefore, generally supports the validity of the structures revealed by cluster analysis, but the question of how many "true" clusters are present in the data set remains. This, of course, is a fundamental problem of cluster analysis in general. Following Dubes (1993), this problem can be recast by addressing the question of which of a few clusterings is best. Obviously, this implies consideration of several candidates and the use of an index for choosing the optimal number of partitions.

Of the 30 relative indices tested by Milligan and Cooper (1985) using a simulated data set in which the actual number of clusters was known, the Calinski-Harabasz index, *CH*(*K*), performed the best. The statistic is calculated as follows:

$$CH(K) = \frac{n - K}{K - 1}\left[\frac{E_1^2}{E_K^2} - 1\right]$$

where n is the number of patterns (sites), K is the number of clusters in the clustering being evaluated, and E_K^2 is the squared-error of the clustering. The index is always positive and is 0 for $K = 0$; its upper limit depends on the specific problem. An estimate of the number of clusters may be obtained by plotting the index as K varies and searching for a maximum, minimum, or "knee" in the curve.

Application of the *CH*(*K*) index to a series of K-means analyses, with K (the number of clusters) ranging from 1 to 10, revealed a rather pronounced upturn in the plotted curve at $K = 8$. Thus, to the extent that the *CH*(*K*) index is appropriate for this data set, the "true" number of clusters present is seven, only one less than the number proposed above. This does not, however, carry implications about the validity of individual clusters.

CONCLUDING REMARKS

Variation in the Late Mississippian archaeological record of the Central Mississippi Valley is immense. This study represents an attempt to delineate underlying structures in a portion of that archaeological record, namely ceramic sherd collections from sites generally considered to have components post-dating approximately A.D. 1400. Past attempts to order comparable data sets based on the dimensions of space and content (i.e., the grouping of sites into phases) represent subjective comparisons of similarity between assemblages. Cluster analysis suggests that some previously-defined late period phases represent relatively valid units, while others are much less robust, and some simply do not exist.

Importantly, the analysis presented here reveals variation that has escaped the attention of other researchers, and provides a useful benchmark for future systematic studies of late period archaeological sites and assemblages in the study. Moreover, the success of the clustering algorithms to consistently isolate interpretable structures within the data set suggests that these methods may find fruitful application to comparable archaeological problems elsewhere.

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SITE	Mississippi Plain	Bell Plain	Parkin Punctated	Barton Incised	Kent Incised	Ranch Incised	Old Town Red	Nodena Red and White	Rhodes Incised	Walls Engraved	Vernon Paul Applique	Fortune Noded	TOTAL
Porter	1047	515	64	5	1	1	83	1	0	4	1	7	1780
40LA7	686	133	20	4	0	0	25	0	0	0	0	0	898
Hatchie	373	388	32	6	4	4	9	0	0	0	1	1	814
Richardson's Lg.	492	514	8	2	0	1	23	1	1	3	0	0	1067
Wilder	520	650	34	5	4	6	22	3	2	3	0	0	1266
Jones Bayou	1423	1140	87	2	1	2	99	6	0	2	2	0	2828
Fullen	504	477	33	5	0	0	70	2	0	2	0	0	1107
Jeter	363	448	35	2	4	1	10	2	1	4	0	1	874
Rast	617	927	61	2	0	2	12	2	3	6	0	2	1639
Lake Cormorant	361	781	83	16	8	18	37	2	3	17	0	0	1382
Upper Nodena	1299	1675	5	3	2	3	25	3	1	3	1	0	3034
Notgrass	2580	552	10	6	4	2	9	3	0	3	0	3	3172
Sweat	481	425	33	1	0	2	24	0	0	0	0	0	973
Irby	439	2134	162	2	21	37	21	1	18	50	0	0	3000
Castile Lg.	1567	68	268	36	8	3	70	0	4	0	1	3	2037
Hollywood	671	589	61	67	6	2	34	21	2	8	0	0	1513
Commerce	655	314	35	51	14	0	12	8	1	2	0	0	1108
Rose Mound	1123	35	154	62	1	1	22	0	0	0	1	1	1410
Cramor	814	56	91	27	9	1	7	0	0	0	0	3	1016
Neeleys Ferry	5992	2	760	463	4	9	14	3	0	0	0	5	7275
Turnbow	2913	10	20	87	0	1	12	0	0	0	0	7	3061
Williamson	4237	12	425	212	0	0	12	0	0	0	1	17	4923
Barton Ranch	4056	8	395	207	0	4	6	0	0	0	0	16	4712
Parkin	11203	135	1298	579	48	43	118	5	44	2	9	34	13671
Woodlyn	275	922	109	12	4	13	11	0	5	10	0	1	1433
Beck	486	693	231	122	44	6	80	19	8	9	1	0	1747
Nickel	592	81	114	37	4	4	20	2	2	0	1	2	886
Carson Lake	2753	577	39	51	4	9	22	13	0	0	0	0	3524
Mound Place	1593	2546	146	64	1	0	21	0	6	9	7	1	4425
Young	850	804	208	90	0	23	12	0	0	8	0	1	2020
Starkley	922	135	77	83	14	1	89	1	1	3	0	1	1355
Walls	993	3215	300	71	30	21	22	2	14	21	0	5	4862
Parchman	572	312	5	65	0	0	13	10	0	2	0	1	1007
Salomon	1686	695	56	144	3	4	59	29	3	11	0	2	2737
Chucalissa	3190	2748	870	78	26	49	21	11	12	48	0	22	7129
Graves Lake	1514	995	51	19	11	30	46	4	3	1	3	1	2751
Kent	796	648	149	116	24	3	116	11	2	7	0	1	1920
Clay Hill	1638	92	190	124	1	0	166	0	2	4	0	0	2293
Soudan	1059	28	123	34	2	0	55	0	0	2	0	1	1311
Davis	536	137	87	28	2	0	57	4	0	0	0	0	861
Belle Meade	2957	1478	761	508	82	36	108	8	17	25	2	6	6087

Table 1. Ceramic sherd counts from sites used in analysis.

Figure 1. Late period sites in the Central Mississippi Valley.

TYPE	BETWEEN SS	DF	WITHIN SS	DF	F-RATIO	PROBABILITY
Parkin Punctated	503.339	1	161.671	39	121.421	0.000
Barton Incised	95.329	1	137.891	39	26.962	0.000
Kent Incised	0.854	1	9.582	39	3.475	0.070
Ranch Incised	0.026	1	5.312	39	0.192	0.664
Old Town Red	10.266	1	156.138	39	2.564	0.117
Nodena R and W	0.080	1	4.958	39	0.626	0.433
Rhodes Incised	0.002	1	0.814	39	0.087	0.770
Walls Engraved	0.196	1	4.564	39	1.671	0.204
Vernon Paul Appl.	0.000	1	0.096	39	0.009	0.926
Fortune Noded	0.059	1	0.397	39	5.788	0.021

CLUSTER NUMBER: 1

SITE	DISTANCE	TYPE	MINIMUM	MEAN	MAXIMUM	S.D.
Porter	1.02	Parkin Punctated	0.20	3.03	7.60	1.92
40LA7	0.56	Barton Incised	0.10	1.42	6.50	1.83
Hatchie	0.45	Kent Incised	0.00	0.25	1.30	0.32
Richardson's Lg.	0.85	Ranch Incised	0.00	0.30	1.30	0.40
Wilder	0.35	Old Town Red	0.30	1.77	6.30	1.44
Jones Bayou	0.70	Nodena R and W	0.00	0.25	1.40	0.38
Fullen	1.47	Rhodes Incised	0.00	0.10	0.60	0.14
Jeter	0.55	Walls Engraved	0.00	0.32	1.70	0.40
Rast	0.59	Vernon Paul Appl.	0.00	0.03	0.20	0.05
Lake Cormorant	1.08	Fortune Noded	0.00	0.06	0.40	0.09
Upper Nodena	1.04					
Notgrass	1.06					
Sweat	0.52					
Irby	1.08					
Hollywood	1.07					
Commerce	1.10					
Turnbow	0.98					
Woodlyn	1.51					
Carson Lake	0.72					
Mound Place	0.44					
Walls	1.09					
Parchman	1.82					
Salomon	1.31					
Graves Lake	0.51					

CLUSTER NUMBER: 2

SITE	DISTANCE	TYPE	MINIMUM	MEAN	MAXIMUM	S.D.
Castile Landing	1.31	Parkin Punctated	5.70	10.14	13.20	2.07
Rose Mound	0.48	Barton Incised	1.10	4.51	8.30	1.84
Cramor	0.96	Kent Incised	0.00	0.55	2.50	0.65
Neeleys Ferry	1.03	Ranch Incised	0.00	0.25	1.10	0.30
Williamson	0.98	Old Town Red	0.10	2.78	7.20	2.50
Barton Ranch	1.03	Nodena R and W	0.00	0.16	1.10	0.29
Parkin	0.65	Rhodes Incised	0.00	0.12	0.50	0.14
Beck	1.54	Walls Engraved	0.00	0.18	0.70	0.22
Nickel	0.90	Vernon Paul Appl.	0.00	0.02	0.10	0.04
Young	0.77	Fortune Noded	0.00	0.14	0.30	0.11
Starkley	1.93					
Chucalissa	1.50					
Kent	1.37					
Clay Hill	1.55					
Soudan	0.80					
Davis	1.28					
Belle Meade	1.47					

Figure 2. K-means clustering: 2 clusters.

Figure 3. Dendrogram generated by average linkage clustering.

TYPE	BETWEEN SS	DF	WITHIN SS	DF	F-RATIO	PROBABILITY
Parkin Punctated	614.241	7	50.769	33	57.037	0.000
Barton Incised	201.202	7	32.018	33	29.625	0.000
Kent Incised	6.117	7	4.318	33	6.678	0.000
Ranch Incised	2.546	7	2.792	33	4.299	0.002
Old Town Red	126.812	7	39.592	33	15.100	0.000
Nodena R and W	2.956	7	2.082	33	6.693	0.000
Rhodes Incised	0.541	7	0.275	33	9.280	0.000
Walls Engraved	2.724	7	2.035	33	6.310	0.000
Vernon Paul Appl.	0.016	7	0.080	33	0.920	0.504
Fortune Noded	0.155	7	0.301	33	2.421	0.041

CLUSTER NUMBER: 1

SITE	DISTANCE	TYPE	MINIMUM	MEAN	MAXIMUM	S.D.
40LA7	0.48	Parkin Punctated	0.20	2.28	4.00	1.36
Hatchie	0.54	Barton Incised	0.10	0.49	1.40	0.45
Richardson's Lg.	0.58	Kent Incised	0.00	0.17	0.50	0.19
Wilder	0.21	Ranch Incised	0.00	0.26	1.10	0.30
Jeter	0.58	Old Town Red	0.30	1.33	2.80	0.80
Rast	0.52	Nodena R and W	0.00	0.11	0.40	0.11
Upper Nodena	0.69	Rhodes Incised	0.00	0.07	0.20	0.07
Notgrass	0.72	Walls Engraved	0.00	0.15	0.50	0.17
Sweat	0.53	Vernon Paul Appl.	0.00	0.03	0.20	0.06
Carson Lake	0.54	Fortune Noded	0.00	0.03	0.10	0.05
Mound Place	0.52					
Graves Lake	0.33					

CLUSTER NUMBER: 2

SITE	DISTANCE	TYPE	MINIMUM	MEAN	MAXIMUM	S.D.
Rose Mound	0.47	Parkin Punctated	8.40	9.56	10.90	0.84
Cramor	0.56	Barton Incised	2.60	4.19	6.40	1.11
Neeleys Ferry	0.80	Kent Incised	0.00	0.21	0.90	0.29
Williamson	0.42	Ranch Incised	0.00	0.23	1.10	0.34
Barton Ranch	0.49	Old Town Red	0.10	1.06	4.20	1.27
Parkin	0.12	Nodena R and W	0.00	0.00	0.00	0.00
Young	0.42	Rhodes Incised	0.00	0.04	0.30	0.10
Soudan	1.12	Walls Engraved	0.00	0.08	0.40	0.14
		Vernon Paul Appl.	0.00	0.03	0.10	0.04
		Fortune Noded	0.00	0.18	0.30	0.11

CLUSTER NUMBER: 3

SITE	DISTANCE	TYPE	MINIMUM	MEAN	MAXIMUM	S.D.
Starkley	0.79	Parkin Punctated	5.70	7.98	10.10	1.57
Kent	0.40	Barton Incised	3.30	5.20	6.10	1.13
Clay Hill	0.32	Kent Incised	0.00	0.62	1.30	0.54
Davis	0.92	Ranch Incised	0.00	0.08	0.20	0.08
		Old Town Red	6.00	6.60	7.20	0.42
		Nodena R and W	0.00	0.30	0.60	0.25
		Rhodes Incised	0.00	0.08	0.10	0.04
		Walls Engraved	0.00	0.20	0.40	0.14
		Vernon Paul Appl.	0.00	0.00	0.00	0.00
		Fortune Noded	0.00	0.05	0.10	0.05

CLUSTER NUMBER: 4

SITE	DISTANCE	TYPE	MINIMUM	MEAN	MAXIMUM	S.D.
Hollywood	0.69	Parkin Punctated	0.50	2.08	4.00	1.37
Commerce	0.48	Barton Incised	2.80	4.72	6.50	1.21
Turnbow	0.87	Kent Incised	0.00	0.36	1.30	0.49
Parchman	0.76	Ranch Incised	0.00	0.04	0.10	0.05
Salomon	0.33	Old Town Red	0.40	1.44	2.20	0.69
		Nodena R and W	0.00	0.84	1.40	0.48
		Rhodes Incised	0.00	0.06	0.10	0.05
		Walls Engraved	0.00	0.26	0.50	0.17
		Vernon Paul Appl.	0.00	0.00	0.00	0.00
		Fortune Noded	0.00	0.08	0.20	0.07

CLUSTER NUMBER: 5

SITE	DISTANCE	TYPE	MINIMUM	MEAN	MAXIMUM	S.D.
Beck	0.56	Parkin Punctated	12.50	12.85	13.20	0.35
Belle Meade	0.56	Barton Incised	7.00	7.65	8.30	0.65
		Kent Incised	1.30	1.90	2.50	0.60
		Ranch Incised	0.30	0.45	0.60	0.15
		Old Town Red	1.80	3.20	4.60	1.40
		Nodena R and W	0.10	0.60	1.10	0.50
		Rhodes Incised	0.30	0.40	0.50	0.10
		Walls Engraved	0.40	0.45	0.50	0.05
		Vernon Paul Appl.	0.00	0.05	0.10	0.05
		Fortune Noded	0.00	0.05	0.10	0.05

CLUSTER NUMBER: 6

SITE	DISTANCE	TYPE	MINIMUM	MEAN	MAXIMUM	S.D.
Porter	0.15	Parkin Punctated	3.00	3.23	3.60	0.26
Jones Bayou	0.43	Barton Incised	0.10	0.30	0.50	0.16
Fullen	0.48	Kent Incised	0.00	0.03	0.10	0.05
		Ranch Incised	0.00	0.07	0.10	0.05
		Old Town Red	3.50	4.83	6.30	1.15
		Nodena R and W	0.10	0.17	0.20	0.05
		Rhodes Incised	0.00	0.00	0.00	0.00
		Walls Engraved	0.10	0.17	0.20	0.05
		Vernon Paul Appl.	0.00	0.07	0.10	0.05
		Fortune Noded	0.00	0.13	0.40	0.19

CLUSTER NUMBER: 7

SITE	DISTANCE	TYPE	MINIMUM	MEAN	MAXIMUM	S.D.
Castile Landing	0.52	Parkin Punctated	12.20	12.77	13.20	0.42
Nickel	0.60	Barton Incised	1.10	2.37	4.20	1.33
Chucalissa	0.72	Kent Incised	0.40	0.43	0.50	0.05
		Ranch Incised	0.10	0.43	0.70	0.25
		Old Town Red	0.30	2.00	3.40	1.28
		Nodena R and W	0.00	0.13	0.20	0.09
		Rhodes Incised	0.20	0.20	0.20	0.00
		Walls Engraved	0.00	0.23	0.70	0.33
		Vernon Paul Appl.	0.00	0.03	0.10	0.05
		Fortune Noded	0.10	0.20	0.30	0.08

CLUSTER NUMBER: 8

SITE	DISTANCE	TYPE	MINIMUM	MEAN	MAXIMUM	S.D.
Lake Cormorant	0.52	Parkin Punctated	5.40	6.30	7.60	0.81
Irby	0.48	Barton Incised	0.10	0.90	1.50	0.52
Woodlyn	0.45	Kent Incised	0.30	0.55	0.70	0.15
Walls	0.39	Ranch Incised	0.40	0.95	1.30	0.35
		Old Town Red	0.50	1.18	2.70	0.89
		Nodena R and W	0.00	0.03	0.10	0.04
		Rhodes Incised	0.20	0.35	0.60	0.15
		Walls Engraved	0.40	1.00	1.70	0.49
		Vernon Paul Appl.	0.00	0.00	0.00	0.00
		Fortune Noded	0.00	0.05	0.10	0.05

Figure 4. K-means clustering: 8 clusters.

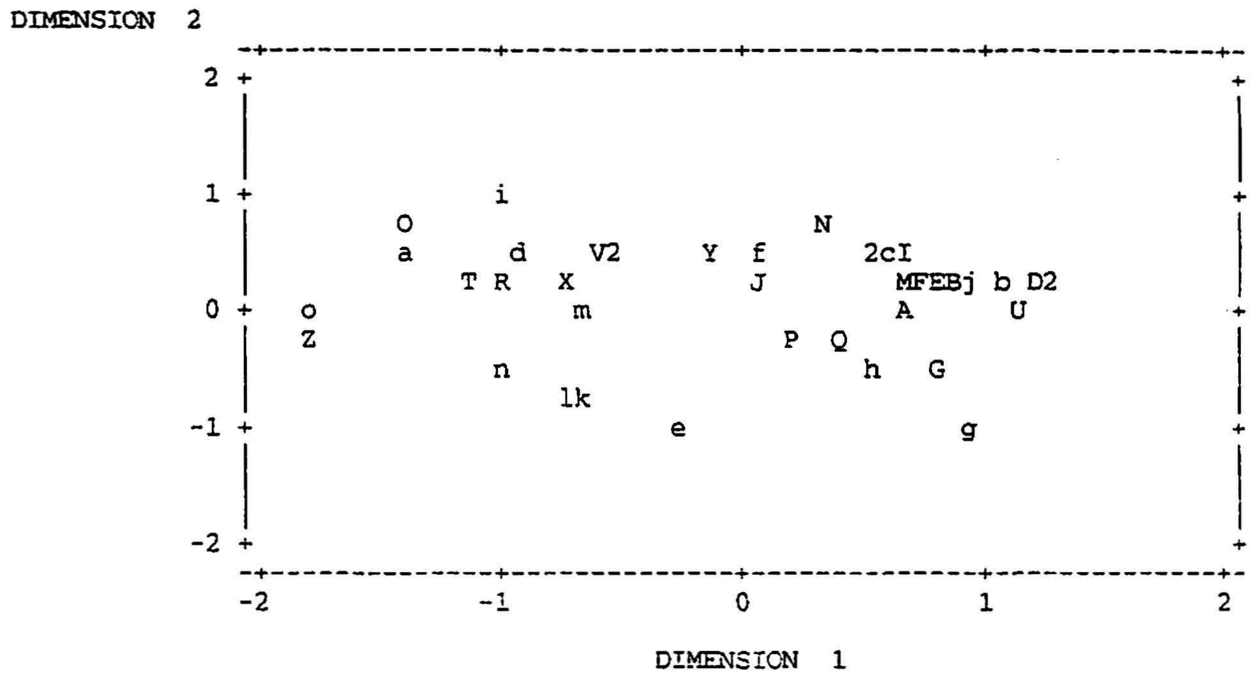
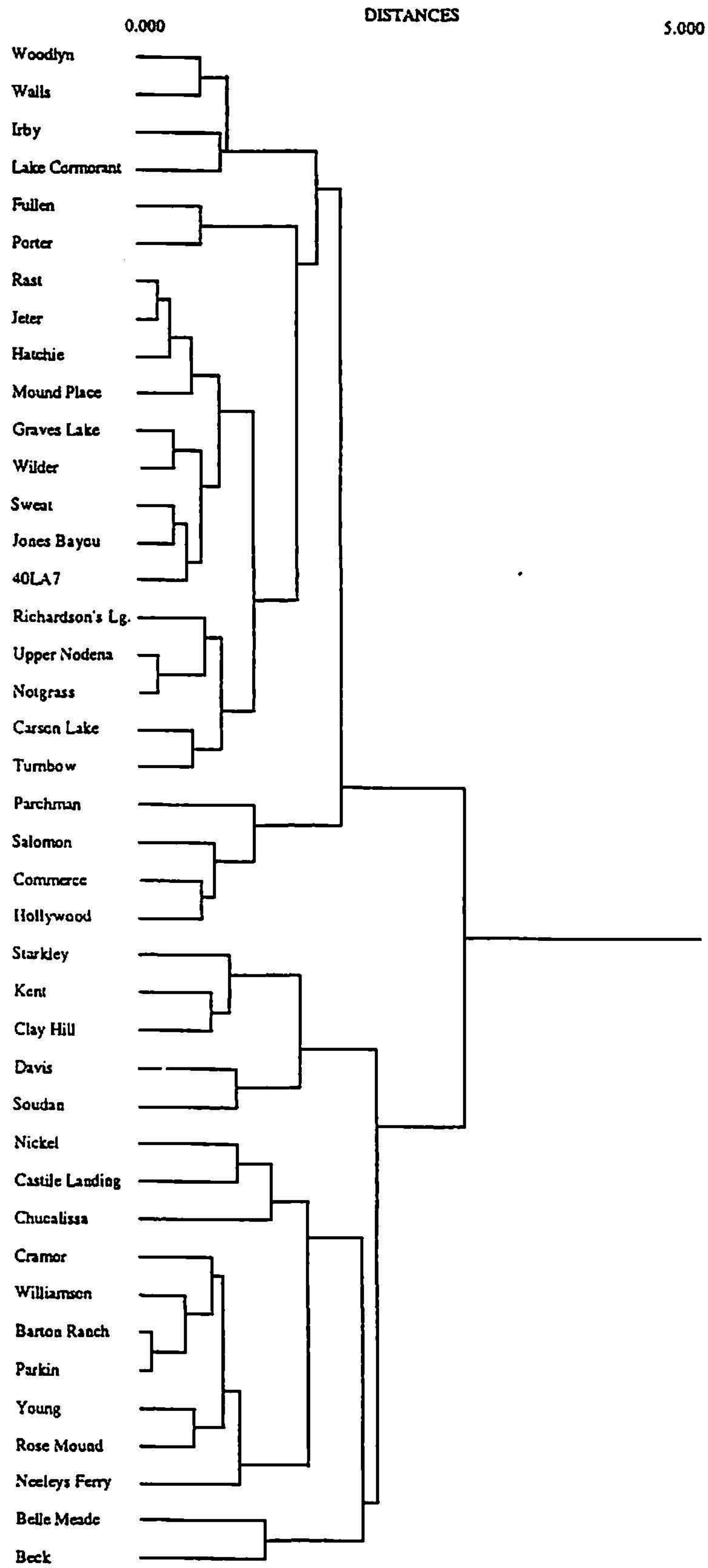
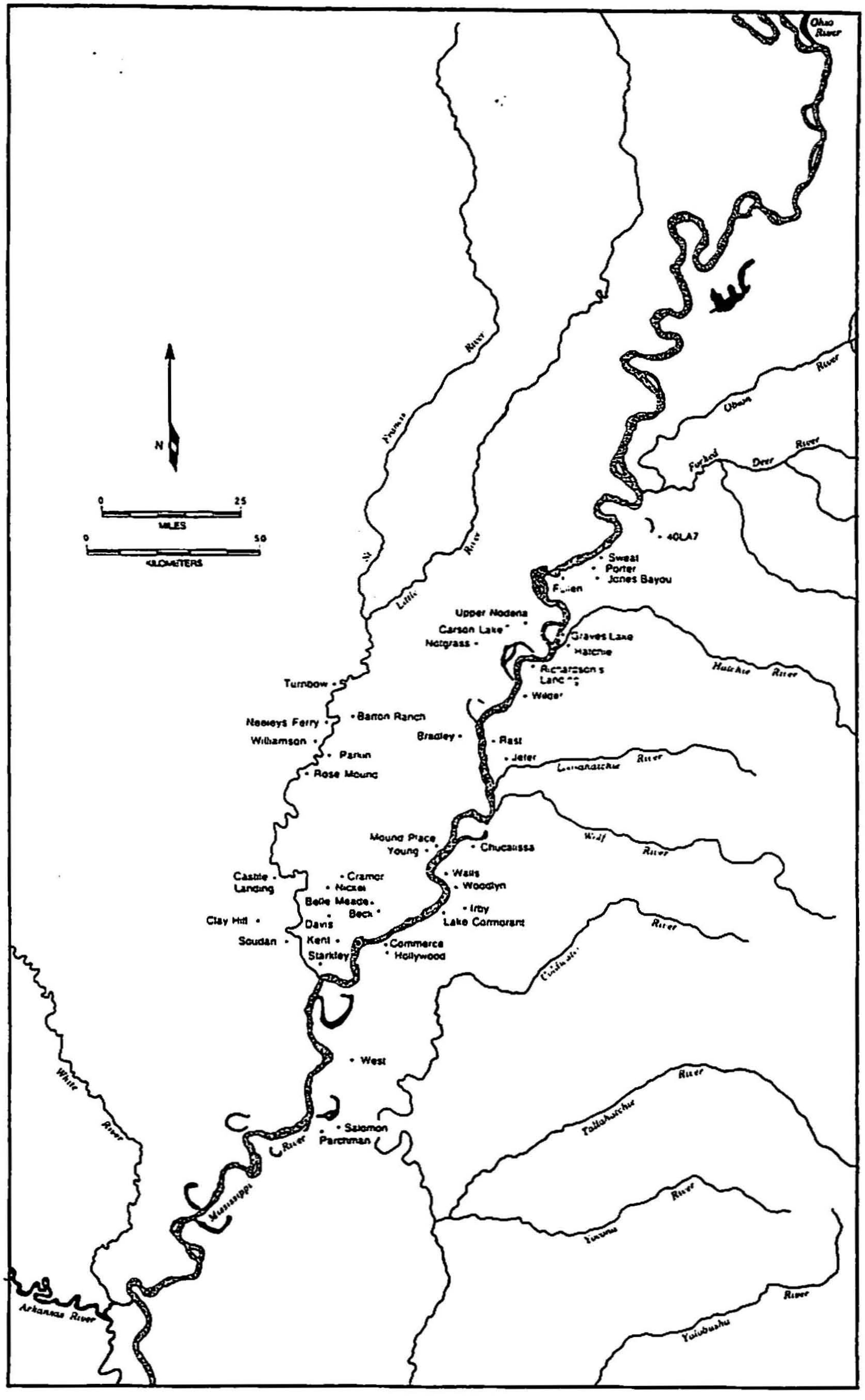
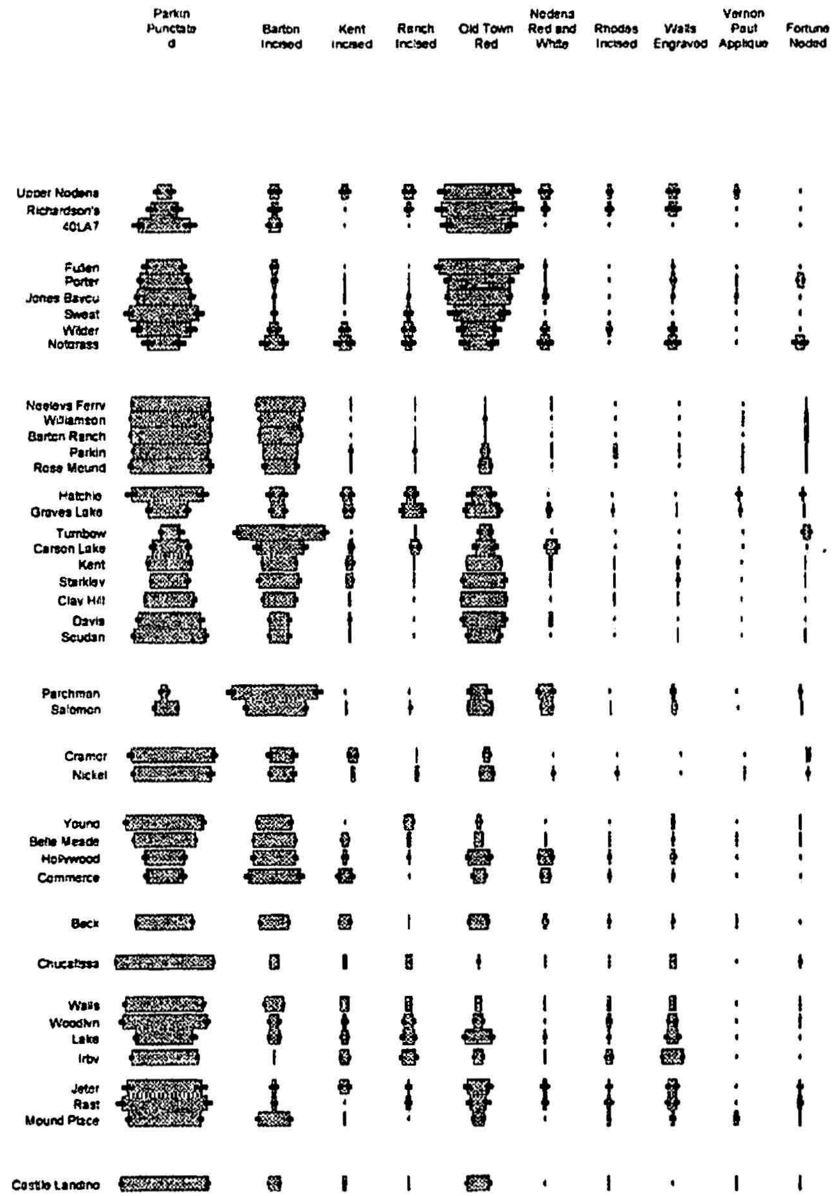


Figure 5. Multidimensional scaling representation of the data set. A - Porter; B - 40LA7; C - Hatchie; D - Richardson's Landing; E - Wilder; F - Jones Bayou; G - Fullen; H - Jeter; I - Rast; J - Lake Cormorant; K - Upper Nodena; L - Notgrass; M - Sweat; N - Irby; O - Castile Landing; P - Hollywood; Q - Commerce; R - Rose Mound; S - Cramor; T - Neeleys Ferry; U - Turnbow; V - Williamson; W - Barton Ranch; X - Parkin; Y - Woodlyn; Z - Beck; a - Nickel; b - Carson Lake; c - Mound Place; d - Young; e - Starkley; f - Walls; g - Parchman; h - Salomon; i - Chucalissa; j - Graves Lake; k - Kent; l - Clay Hill; m - Soudan; n - Davis; o - Belle Meade. Numerals indicate multiple sites in close mathematical proximity.

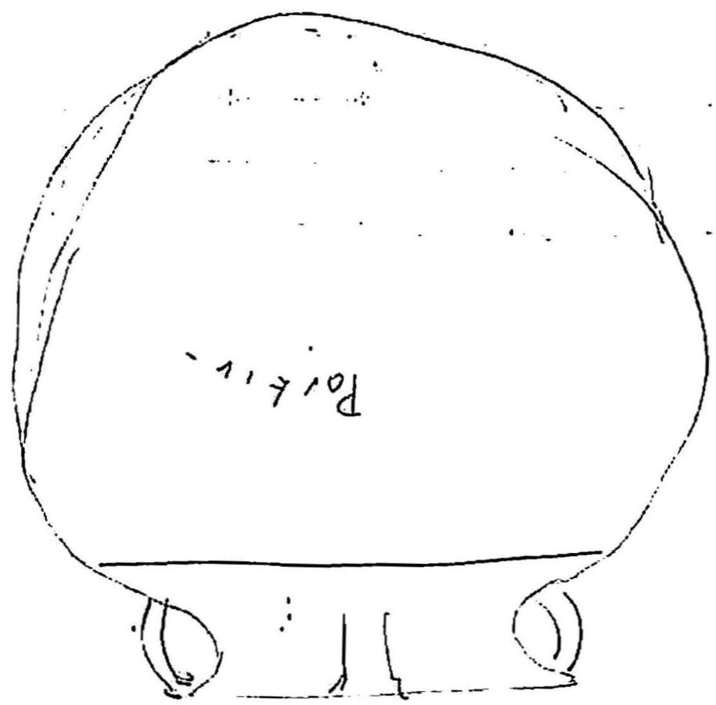

DISTANCES
0.000
5.000
Woodlyn
Walls
Irby
Lake Cormorant
Fullen
Porter
Rast
Jeter
Hatchie
Mound Place
Graves Lake
Wilder
Sweat
Jones Bayou
40LA7
Richardson's Lg.
Upper Nodena
Notgrass
Carson Lake
Turnbow
Parchman
Salomon
Commerce
Hollywood
Starkley
Kent
Clay Hill
Davis
Soudan
Nickel
Castile Landing
Chucalissa
Cramor
Williamson
Barton Ranch
Parkin
Young
Rose Mound
Neeleys Ferry
Belle Meade
Beck

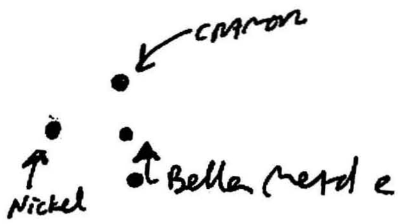


Ohio River
Obion River
Forked Deer River
Hatchie River
Loosahatchie River
Wolf River
Coldwater River
Tallahatchie River
Yocona River
Yalobusha River
St. Francis River
Little River
White River
Arkansas River
Mississippi River
N
0 25
MILES
0 50
KILOMETERS
40LA7
Sweat
Porter
Jones Bayou
Upper Nodena
Carson Lake
Notgrass
Graves Lake
Hatchie
Wider
Turnbow
Barton Ranch
Neeleys Ferry
Williamson
Parkin
Rose Mound
Bradley
Rast
Jeter
Mound Place
Young
Chucalissa
Castile Landing
Cramor
Nickel
Belle Meade
Beck
Walls
Woodlyn
Irby
Lake Cormorant
Clay Hill
Davis
Soudan
Kent
Starkley
Commerce
Hollywood
West
Salomon
Parchman



Parkin Punctate d
Barton Incised
Kent Incised
Ranch Incised
Old Town Red
Nodena Red and White
Rhodes Incised
Walls Engraved
Vernon Paul Applique
Fortune Noded
Upper Nodena
Richardson's
40LA7
Fuden
Porter
Jones Bayou
Sweat
Wilder
Notgrass
Neeleys Ferry
Williamson
Barton Ranch
Parkin
Rose Mound
Hatchie
Graves Lake
Turnbow
Carson Lake
Kent
Starkley
Clay Hill
Davis
Scudan
Parchman
Salomon
Cramor
Nickel
Young
Belle Meade
Hollywood
Commerce
Beck
Chucalissa
Walls
Woodlyn
Lake
Irby
Jeter
Rast
Mound Place
Castle Landing





Beck site?