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A Statistical Analysis of the Prehistoric Ceramics from the Hacklander Site, Allegan County, Michigan

Robert G. Kingsley
Western Michigan University

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A STATISTICAL ANALYSIS OF THE PREHISTORIC CERAMICS
FROM THE HACKLANDER SITE, ALLEGAN COUNTY, MICHIGAN

by

Robert G. Kingsley

A Thesis
Submitted to the
Faculty of The Graduate College
in partial fulfillment
of the
Degree of Master of Arts

Western Michigan University
Kalamazoo, Michigan
April 1977
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individuals, the full responsibility for what appears on these pages
is, of course, mine alone.

Robert George Kingsley
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CHAPTER I

INTRODUCTION

The Site and Environmental Setting

The Hacklander site is located on the south bank of the Kalamazoo River, approximately 4.5 mi from the mouth of the river; the site lies in the north 1/2, center, of Section 23, Saugatuck Township, in Allegan County, Michigan (see Map 1, p. 2). A small unnamed creek flows into the river on the eastern boundary of the site.

The Michigan Department of Natural Resources owns a major portion of the northwest part of the site (Area I on Map 2, p. 3), and the rest of the site is owned by Mr. Fritz Boedecker. The DNR uses the area as a public access and recreation site, and has constructed access roads and a parking lot that lies just north of the site. This parking lot was constructed on land fill, and does not appear to have disturbed or buried any part of the site.

The present day topography at Hacklander is probably little changed from aboriginal times. Occupational areas at the site range from 177.5 m (582.34 ft) to 180.5 m (592.18 ft) in elevation above mean sea level. The land gets quite wet in some of the lower areas, especially near the creek.

The northern approximate 1/2 of the Hacklander site is covered by climax deciduous woodland. All undergrowth has been cleared out by the DNR with the exception of the lower areas near the creek. Near the southern boundary of Area I, the land has been planted in pines;
Map 1. Location of Hacklander site and sites mentioned in text.
Map 2. Location of excavation units.
the gentle slope indicated on Map 2 is Mr. Boedecker's lawn which is grass-covered and Boedecker's house would be located just off the top of the right half of Map 2. Between this high ground and the creek lies Area III. This area is densely covered by deciduous and coniferous growth as well as heavy underbrush.

The location of the Hacklander site is a favorable one for the exploitation of various natural resources, since riverine, creek, and woodland environments were all readily accessible to the inhabitants of the site (Baldwin 1976:4). The northern portion of the site is open to the westerly winds which makes this area favorable to warm weather occupation; the southern area is sheltered by high ground and would have made an ideal location for winter occupation. Faunal and botanical evidence is accruing that tends to support these hypotheses (ibid; Martin 1976).

History of Excavations

The first excavations at the Hacklander site were conducted in August of 1971 by the Kalamazoo Valley Chapter of the Michigan Archaeological Society under the direction of Dr. Elizabeth Baldwin of the Department of Anthropology, Western Michigan University. These and subsequent test excavations resulted in a total of 14 5x5 ft test pits which were placed over the total area of the site.

The first extensive excavations were undertaken during June of 1975. It had come to the attention of Dr. Baldwin that considerable attrition was taking place on the northern part of the site as a result of recreational use of the DNR public access site. Damage due to campfires, vehicle ruts, and general erosion was slowly stripping away the
land surface. In order to salvage as much information as possible from the site before damage got any worse, a matching funds grant from the Michigan History Division was applied for and received, as well as permission to excavate from the DNR. From June 2 through June 19, salvage excavations were thus carried out primarily on the area of the site owned by DNR, Area I on Map 2.

During the 1976 field season, the Western Michigan University archaeological field school conducted further excavations at Hacklander, again under the direction of Dr. Baldwin. Two additional sampling areas were opened up, Areas II and III, and further testing was conducted in Area I and across the access road (not shown on map). It is felt that the excavations at Hacklander have systematically sampled nearly the entire occupational area of the site.

General Description of Excavations

The 14 test pits which were placed in the site prior to extensive excavations were intended to cover all areas of the site and to gain information on number of components and period(s) of occupation of the site. Data from the test pits indicated, among other things, that Hacklander was a multi-component site, with occupations ranging in time from possibly the Middle to Late Woodland. No vertical stratigraphy was noted, which typifies most sites in southwestern Michigan, but lateral separation of components was observed (Baldwin 1976:1-2).

With these ideas in mind as well as the fact that the site was being damaged, the 1975 excavations were conducted. Since time, funds, and personnel were all somewhat limited quantities, a sampling design
that would maximize the information recovered from excavation was desired. A random sampling design was ultimately employed, since random sampling strategies effectively cover the entire area of the site to be sampled, and also permit statistical evaluation and probabilistic statements about the data so recovered. In 1975, the area designated Area I on Map 2 was excavated using a 5% simple random sample; in addition, excavations that have been termed judgement sampling were done, that is, areas where cultural or ecological materials occurred in high densities (e.g. refuse pits, hearths, heavy middens) were expanded to maximize the recovery of these data. The material from judgement excavations was recovered and processed separately from the random though, in order to preserve the rigor of the random sampling design. Trees frequently got in the way of the random pits, and as a result, 8 of the 76 random units could not be excavated, leaving a total of 68 randomly selected units, totaling 1700 ft². The judgement excavations totaled about 612.75 ft².

The boundaries of Area I are by necessity somewhat arbitrary, because they had to be determined with time and cost factors in mind. The northern boundary, the DNR parking lot, seems to be close to the original site boundary, since the land fill did not cover or destroy anything. The western boundary, the access road, seems now to be quite good; 2 test pits were placed across the road during the 1976 season and indicated that occupation in this area was sparse. Indeed, only a handful of chippage was recovered from 2 5x5 ft pits, so it is now assumed that the road runs through (and destroys) the actual western occupational boundary. The eastern boundary was arbitrarily set and
the area designated Area II was excavated in 1976 to extend the excava­
tions to the creek, which forms the natural boundary of the site.
To the south of Area I lies Area III and Boedecker's lawn. Four test
pits had been placed in the lawn area; the southernmost, test pit 14,
was culturally sterile, while the remaining 3 yielded small amounts of
material. It is felt that while the site probably extends a small dis­
tance in this area, the distance is not great, and this boundary is
thus close to the actual site limits. Test pit data also indicated a
rather heavy occupation in Area III, and this portion of the site was
sampled in 1976.

In general, the Area I part of the site can be characterized as a
rather thin sheet midden; depth of cultural levels rarely exceeded
12 in, though features often went lower. The hypotheses generated by
the test pit data from this area were confirmed, that is, that the site
lacks vertical stratigraphy but lateral separation of components is in
evidence, and a Late Woodland and probably a Middle Woodland occupation
are present.

Excavation during the 1976 season focused on extending the area
covered by Area I, and Areas II and III were thus designated. Both
areas were excavated by means of a 5% simple random sample and judge­
ment excavations. Twenty-three random 5x5 ft pits were dug in Area II
for a total of 575 ft\(^2\); 13 judgement 5x5 ft pits yielded an additional
325 ft\(^2\). In Area III 18 random pits totaled 450 ft\(^2\) of excavation, with
judgement units making up an additional 14 pits for 350 ft\(^2\). An ad­
ditional 237.5 ft\(^2\) of judgement excavation in Area I was also dug.
Since the 5% level of random units was adhered to consistently in all
3 sampling areas, statistical analysis of the site as a whole is permissible.

The boundaries of Area II are self explanatory, as this area simply extends Area I to the creek. Area III seems to reflect the reality of the occupation of this part of the site also; the eastern boundary of Area III slopes steeply downward to the creek flood plain, and 1 test pit on the slope, test pit 13, indicated that the slope was sterile of cultural material. Beyond the western boundary, the land slopes steeply upward and was not occupied, and the land to the south of Area III quickly becomes slope, which was also not occupied. The somewhat irregular shape of the southern end of Area III was necessitated by the desire to include the small promontory of land that juts out into the creek in the sampling universe.

Area II in most respects resembles Area I with regard to depth and nature of cultural deposits. In the northernmost part, however, the area in which the block of judgement excavations was placed, the situation is somewhat different. The nature of the deposition here is unusual. For example, in pit VV, the sherds of almost an entire single ceramic vessel were recovered, while the amount of material from the immediately surrounding pits could be held in one's cupped hands. Suspected cultural features in this area consistently were nondescript, with no apparent structure or distributional significance. In short, the nature of the cultural deposition here did not reflect the deposition on the rest of the site.

One possible explanation has been offered. This part of Hacklander is quite low in elevation; indeed in the early spring the ground in this area is always rather "soggy". It seems possible that periodic
innundation of this part of the site can account for the unstructured and apparently disturbed deposition here (Baldwin, personal communication). This phenomenon can potentially assist in the dating of certain component occupations of the site, and will be dealt with later on in this work.

The nature of the cultural levels in the southern end of Area III is also different from the site in general. While in most parts of the site cultural levels are relatively shallow, in the part of Area III where the block judgement excavations were done the deposition is very deep. Depths in these excavations ranged from about 24 in to 54 in. One of the major purposes of the judgement excavations here was to see if any vertical stratigraphy could be discerned. Unfortunately, it rapidly became apparent that this area had been highly disturbed aboriginally by the construction of hearths and refuse or storage pits. It was common to find 2 sherds which fit together widely separated vertically. There does not seem to be any vertical separation of lithic artifacts either. Buried "A" horizons were noted however, as well as the fact that the many features in this area were encountered at several different depths. It appears at this point that stratigraphically distinct occupations are present here, but the highly disturbed nature of the cultural remains due to the activities of the aboriginals may prevent any precise discernment of these levels. From the point of view of the ceramic data, such unfortunately appears to be the case.
General Remarks

While a detailed discussion of all aspects of the analysis of the Hacklander site is beyond the scope of this study, some general comments regarding the nature of the recovered data can be offered.

It was known from early on that Hacklander represented a somewhat unique site in this part of Michigan. To begin with, the site is relatively large, comprising about 2 acres, and is relatively undisturbed, i.e., it has never undergone plowing, unlike so many sites in southwestern Michigan. The site contains several component occupations, all of which overlap one another in their distributions. It is felt that Hacklander can play a key role in the further understanding of prehistoric adaptation and cultural dynamics in this part of the Great Lakes region.

A heretofore unknown ceramic ware was discovered which will be the subject of part of this report. At the risk of getting ahead of the discussion, it can be stated that the occupation represented by these unique ceramics indicates that the Late Woodland culture history of southwestern Michigan is more complex and more dynamic than has been believed in the past.

A detailed analysis of the faunal remains from Hacklander has been completed by Terrance Martin (1976). Martin's analysis indicates that the economic adaptation of the occupants of Hacklander (all components) did not include maize agriculture. Additionally, the makers of the distinctive ceramics mentioned above seemed to have relied to some extent on aquatic resources such as fish and turtle. Martin's analysis also demonstrated that the site was occupied intermittently the year
round. Cursory examination of the botanical remains recovered from the flotation process indicates that beech and hickory nuts, chenopodium, persimmon, and berries similar to blueberries were consumed by the aboriginal inhabitants (Baldwin 1976:17).

Lithic artifacts and debitage are plentiful at Hacklander, and several distinct tool classes are represented. Lithic analysis is currently being undertaken by Jerrel Sorensen, who has indicated that the lithic data will eventually permit the isolation of specific activity areas, which should aid in the determination of the component occupations of the site, as well as yield important information regarding the lithic technology of the aboriginal inhabitants (Sorensen, personal communication). In addition, the lithic analysis will deal with the imported lithic materials recovered from the site; analysis to date indicates the presence of Flint Ridge and Upper Mercer material from Ohio, Harrison County hornstone from southern Indiana, and Burlington and Avon cherts from Illinois. Michigan Norwood and Bayport cherts are also represented, as well as the plentiful glacially deposited local cherts.

The culmination of these analyses will yield important information and insights into the culture history and cultural dynamics of the Late Woodland period in the lower Kalamazoo River valley, and the Hacklander site will rank as one of the most intensively studied sites in Michigan. With these goals in mind, the following ceramic analysis was undertaken and can now be presented.
The purpose of this study is to formulate a typology for the ceramic assemblage from the Hacklander site. Before the details of that typology and the methods utilized in its construction are dealt with, a discussion of certain concepts and definitions should be provided to familiarize the reader with the theoretical basis upon which this analysis will rest.

Culture has been characterized by some anthropologists as a symbolic system, a system of shared codes of meaning (e.g. Geertz 1973). Culture can be seen as a "system of knowledge" which is shared in by individuals and orders social action (Keesing 1974:88-89). Stated somewhat more clearly, "Culture is best seen...as a set of control mechanisms - plans, recipes, rules, instructions...for the governing of behavior" (Geertz 1965:57).

While this view of what culture is may not be totally acceptable to every reader, it is felt that such a view is amenable to - indeed necessary for - the construction of an artifact typology of the kind attempted here. Following this line of reasoning, Deetz has stated that "The idea of the proper form of an object exists in the mind of the maker, and when this idea is expressed in tangible form in raw material, an artifact results" (Deetz 1967:46). Such a statement is much in line with the views of Geertz cited above. If it is felt that
material objects possess an inherent structure or patterning that is
governed by the cultural system of their makers, it logically follows
that the archaeologist should seek out these patterns from within the
material to form artifact types. These types so formed should thus be
a reflection of the culturally imposed structure within the material,
which represents the modal behavior of a given socio-cultural system
at a given point in time and space.

Krieger's definition of what a typology or type should represent
is in line with the reasoning set forth above. Krieger stated that a
type should be an entity that possesses demonstrable historical meaning
(Krieger 1944:271-288), and that the formulation of a typology requires
knowledge of how the material occurs in space, time, and cultural con­
text (Krieger 1965:143). Thus, the notion that artifacts are produced
by culturally patterned behavior or cultural "rules" allows one to
formulate a typology that will possess demonstrable historical meaning,
for differing cultural systems will obviously dictate differing cul­
tural rules for governing social behavior and the manufacture of ma­
terial goods.

The preceding discussion represents the principles behind the
typology presented here. The term type or typology will refer to a
set of entities that, so defined, will possess demonstrable historical
meaning: a ceramic type will represent a material manifestation of a
particular socio-cultural system at a particular point in time and
space. The term variant shall refer to groups of ceramic vessels with­
in a type that reflect variability within that type; thus, variants
can also possess demonstrable historical meaning. For purposes of this
study, typology is to be contrasted with taxonomy or classification, where taxonomies and classifications represent groupings and/or descriptions of material without particular regard for temporal/spatial/cultural context. Typology - as defined and used here - thus implies some form of classification, but classification and/or taxonomy does not necessarily imply or represent a typology. This distinction and the reasons for its being will become clearer in the following discussion.

Approaches to Typology

The generation of a typology (or a classification as well) can be accomplished by either of 2 approaches: monothetic subdivision or polythetic agglomeration. A typology or type can be considered to be monothetic if "...the presence of a single attribute or configuration of attributes is both necessary and sufficient for membership in the types or classes produced" (Brashler 1973:22). Subdivision refers to the procedure of dividing an original group into successively smaller groups as analysis progresses. Typologies or classifications are polythetic if the artifacts in the type "...possess a large but unspecified number of attributes...and no single attribute is both sufficient or necessary to the aggregate membership" (Clarke 1968:42). Agglomerative techniques are those that group individuals into larger and larger groups until all are incorporated into one group.

The principles of monothetic subdivision have been - either explicitly or implicitly - the basis of most typological analyses and formulations in archaeology. Artifacts belonging to types created by
a monothetic approach must, as stated above, possess certain attributes or sets of attributes to be included in that type. Types formed in this manner tend to be "all-inclusive", and display relatively little within-type variation beyond the variant or variety level. The advantages of such an approach are great, for types formed by this procedure are fairly easy to conceptualize, remember, and utilize; monothetically defined types are often named with reference to their important or "marker" attributes (in the so-called "binomial system"), e.g. Naples dentate-stamped, Ramey incised, Brewerton corner-notched.

The polythetic agglomerative approach to typology and classification, on the other hand, has not been so widely used in archaeology. This approach has been used fairly extensively in biology for the classification of natural phenomena. Clarke has been an advocate of the polythetic approach and states that "...the best model for most archaeological entities is a polythetic model of some kind" (Clarke 1968:38). He goes on to state why:

For the first time we can heartily admit the wide variation in attributes defining artefact types, assemblages, and cultures... The foolhardiness of emphasizing a single attribute or single type-fossil as the criterion for group membership can be recognized... There is no longer any need to sweep the untidy and unexplicable fringe of peripheral forms into unrealistic 'hybrid' heaps... (ibid).

Polythetic techniques do not yield the "all-inclusive" groups of the monothetic kind, i.e. group membership is not based on a set of attributes that is both necessary and sufficient for inclusion, and polythetic groups can display a wide range of variation. Thus, Clarke favors the polythetic approach because the full range of attribute variation can be accounted for and not be considered as variants or "hybrids".
Such a view of artifact typology is attractive, but it is not without some problems. In the first place, polythetic agglomerative analytical techniques ultimately produce taxonomies or classifications, not necessarily typologies, as defined in this study. There are some cases, however, where a polythetic taxonomy might be adequate to serve as a typology if it approximated a monothetic typology. In most cases though, polythetic methods and techniques form systems of artifact classification, but groupings produced by these means do not correspond to the concept of artifact typology as understood in this study. The groups formed include many diverse members - the "wide range of attributes" referred to by Clarke.

Thus another problem with polythetic approaches is pointed out. A polythetic group, or taxon, is difficult to conceptualize and use. Since polythetic groups can contain wide ranges of variation, they can be cumbersome to employ, particularly in an analysis of the kind attempted here, where ceramic types are intended to reflect temporal/spatial/cultural variability. While polythetic groups can be of utility for other kinds of analyses, they are not useful when employed as artifact types.

The typology formulated and used in this study is thus based on the principles of monothetic subdivision. This was done primarily for the following reasons: 1) a monothetic approach yielded the best and most usable results, given the stated objectives of this study; 2) the results so derived are comparable to established typology, which is also derived from a monothetic approach; and 3) monothetic typologies, with their variant groups and "hybrids" are not felt to be as useless.
or inaccurate as Clarke seems to feel they are, i.e. artifact variability can be dealt with successfully and meaningfully with a monothetic approach.

The following analysis employed 3 computerized statistical operations, the first two of which are monothetic subdivisive approaches and the final a polythetic agglomerative approach. Each will be discussed in turn.

Method - Introduction

As mentioned above, this analysis of the Hacklander ceramics was done statistically, with the aid of a computer. Statistical techniques, as opposed to the more common "eyeballed" or "manual" techniques, were chosen for a number of reasons, not the least of which was the high degree of objectivity achieved by these techniques. Statistical analysis provides both probabilistic statements as well as measures of confidence regarding the behavior of the data under study. The techniques used here yielded valuable insights as to the interrelationships of certain ceramic attributes and types that probably would have gone undetected otherwise; similarly, statistical methodology tended to minimize biasing of the results by preventing obvious interrelationships or similarities from assuming a false importance over the not-so-obvious.

Such considerations were deemed important because the Hacklander ceramic assemblage displays a marked degree of variability and heterogeneity of vessel form and style. Two and perhaps 3 distinct ware categories are represented, all of which, for the most part, show a rather large range of variation both within and between categories.
Much of the pottery belongs to types and/or wares heretofore unknown in southwestern Michigan (or in some cases, anywhere else). It was thus felt that an objective statistical analysis would provide the most reliable results and an unbiased and usable typology. It should be pointed out also that statistical analyses have been undertaken with considerable success elsewhere in the upper Great Lakes region (e.g. Brashler 1973; McPherron 1967; Stoltman 1973), and these successful analyses have provided considerable inspiration and impetus for the present study.

In some respects, the analysis of Hacklander pottery can be seen as a study in method - 3 different statistical computer analyses were undertaken, each with differing results. The first technique to be discussed has been termed chi-square cluster or association analysis, similar to that advocated by Spaulding (1953, 1960) and used by Stoltman (1973); the second is the monothetic subdivisive program TYPE which was developed and used by Whallon (1972); and the third is a University of Michigan computer program called CLUSTER, which is a polythetic agglomerative technique similar to that currently being experimented with by Brashler (personal communication). It should be stated at the outset though, that while the 3 techniques employed yielded valuable and heuristic - though different - results, the latter 2 analyses must be seen as exploratory and preliminary. Certain problems, the details of which will be discussed shortly, were encountered in these analyses which prevented satisfactory results from being obtained. Further experimentation with these programs was not feasible at the time of this writing, and re-analysis of the Hacklander data by these techniques will be the subject of a future study. These
techniques will be discussed here because they yield insights into cer­
tain aspects and problems of computerized ceramic analysis, despite the
fact that they have not been carried to their logical conclusions.
With these shortcomings in mind, the ceramics and analytical methods
will now be discussed more specifically.

The Pottery in General

At this point, some general comments regarding the Hacklander ce­
ramic assemblage as a whole are in order; these comments can serve as
an introduction to the following analytical procedures.

The majority of the pottery at the site has been maleated on the
exterior surface with a cord or fabric wrapped paddle, making it simi­
lar to the cord and fabric marked wares that are so common in Late
Woodland manifestations in the northeastern United States. These ce­
ramics are not particularly distinctive nor well made; most examples
are undecorated but cordwrapped tool impressions and punctations do
occur. All are grit tempered. Pottery somewhat similar to this has
been found in southeastern Michigan and has been called Wayne Ware
(Fitting 1965). The cordmarked ware at Hacklander is more appropri­
ately termed Allegan Ware, which is a cordmarked ware found in this
area that has been defined by Rogers (1972).

Another group of vessels present at the site is quite similar to
that described above but has a folded-over or collared rim. This type
of pottery is not uncommon to southwestern Michigan (Fitting 1968;
Betteral and Smith 1973). It is grit tempered and again is not par­
ticularly well made; laminate splitting and exfoliation are common
characteristics of both of the above groups of pottery.
In contrast to these rather drab ceramics, another, very distinctive group of pots was recovered at Hacklander. Elaborate decoration is the rule rather than the exception in this group, with applique strips, rocker-dentate stamping, circular punctation, and cordwrapped tool impressing being the most common forms. This group of pottery is very well made, has very compact paste, and most examples exhibit a distinctive striated or scraped interior surface treatment. These ceramics will come to be called Hacklander Ware, and shall henceforth be referred to as such. Hacklander Ware is probably the most interesting, yet puzzling group of ceramics at the site. For example, certain decorative modes thought to be late Middle Woodland in time (e.g. rocker-dentate stamping) and modes thought to be Late Woodland to proto-historic in time (e.g. applique strips) occur on the same vessels. It was originally believed that Hacklander Ware represented a Middle Woodland component at the site, but 2 radiocarbon assays and subsequent analysis now render this hypothesis highly unlikely.

A fairly large group of "miscellaneous" vessels rounds out the Hacklander assemblage. This group consists of vessels with scalloped and castellated lips, and an assortment of unusual cordwrapped tool impressed vessels.

Very few generalizations can be made about the pottery as a whole. Perhaps the only thing that can be said with certainty is that the ceramics obviously represent multiple occupations of the site by groups probably possessing differing social and cultural systems.
Vessel sorting

After initial washing, numbering, and cataloging, the first step in preparing the pottery for analysis was to sort the total number of rimsherds into minimal vessels. Pottery vessels, rather than individual rims, are used as the basic units of analysis here. It is felt that vessel counts as opposed to sherd counts are more amenable to statistical analysis. If individual rim sherds are used as the basic analytical units, attribute frequencies would be inflated and distorted, and a true picture of the behavior of 1 attribute with another vis a vis a particular vessel or group of pottery would be impossible to obtain.

The total sample of 513 rimsherds was sorted into 305 minimal vessels. Of this number, 70 vessels were omitted from the analysis because they were either too small or too fragmentary to be useful. Two of the computer programs employed could not make allowances for missing data; thus only those vessels upon which every attribute could be clearly observed or measured were used.

Two more vessels were omitted from the sample because they appear to be of Middle Woodland origin. One of the vessels has a cross-hatched rim with a row of semi-conical punctates bordering it, and resembles some of the pottery from the Summerville site (Quimby 1941:106-107). The other vessel is of indeterminate typology. At any rate, these vessels, being obviously unique, were withdrawn from the analysis because they could not contribute to the formation of a typology for the Late Woodland pottery at the site.
These omissions left 233 vessels that were used in statistical analysis. This number represents about 77% of the total vessel count. Though these 233 vessels formed the data base for analysis, 6 additional vessels were "lost" at various stages subsequent to the analysis; while great pains were taken to determine the exact number of minimal vessels at the time of initial sorting, these 6 pots were found to actually belong to other pots. It is not felt that the loss of these vessels has seriously affected the results, however, for the sample size is still sufficiently large enough to render negligible any deleterious effects the data from these pots may have had. These further omissions bring the vessel total down to 299.

Body sherds, unless positively assignable to a particular rim, were not used at this stage of analysis. The reason for this is because, as mentioned above, vessels with missing data were unacceptable. It might be borne in mind, then, that while the working minimal vessel count is 299, it is undoubtable that this figure is too low, allowing for the presence of vessels represented by body sherds only.

**Attribute list**

Perhaps the most important step in an analysis of this kind is the formation of an objective and comprehensive attribute list. In this study, an attribute will be defined as"...a logically irreducible character of two or more states, acting as an independent variable within a specific artefact system" (Clarke 1968:186). It is the attributes that essentially determine the results of analysis, for these attributes and their frequencies of concurrence with one another are
the object of statistical manipulation. For this important reason, every attempt was made to observe and record the full range of variation of attributes present in the Hacklander ceramic assemblage. The final list of attributes, along with their frequencies and percentages of occurrence, appears in Appendix A.

Before discussing the selection of attributes in more detail, it should be pointed out that certain classes of ceramic data were not used in statistical analysis. These data and justification for their omission should be dealt with at this point.

A. Hardness and color - These physical attributes are omitted from statistical analysis for largely the same reasons that McPherron (1967:49-50) chose not to deal with them, viz., they are not particularly useful attributes. Hardness, for example, which is usually measured using the Moh's scale, can vary considerably within an established type or indeed within a single vessel. Factors such as burnishing or weathering can also affect the hardness of a particular potsherd. Similarly, a plethora of factors, such as differential weathering and differing techniques of firing, can affect the color of pottery. Also, the determination of what color a particular sherd is is largely a subjective judgement, even when a Munsell color chart is used. It was not unusual to find within the Hacklander assemblage 2 sherds of very different coloration that fit together. For these reasons, then, the attributes of hardness and color were deemed not useful for the establishment of a pottery typology.

B. Method of manufacture - Method of manufacture can be a very important attribute for the definition of types or wares. Problems
arise, however, when one tries to determine methods of manufacture for pottery vessels in any consistent fashion, that is, it is often difficult, if not impossible, to determine how every vessel in a particular assemblage was made. Because of this difficulty this attribute was not used in statistical analysis. It is usually possible, though, to get a general idea or impression of the methods of manufacture of a type or ware group. This seems to be the case at Hacklander, and information concerning vessel manufacture will be provided in the type descriptions in Appendix B.

C. Vessel shape - This attribute was not used simply because it was impossible to determine. It is notable that not a single sherd that could really be called a base was present in the ceramic assemblage, possibly suggesting that most vessels were globular in shape with rounded rather than conoidal bases. Indeed, such is quite possibly the case with some of the Hacklander Ware vessels at least; partial reconstruction of some of these pots shows a tendency for the vessels to be quite rounded rather than elongate or squat. This is, of course, a general impression and cannot be stated with certainty. At any rate, suggestions as to vessel shape are presented in Appendix B.

D. Vessel function - Functional considerations were eliminated from statistical analysis because, again, they were impossible to determine. There are very few sherds at Hacklander that exhibit cooking residue on their surfaces. It is safe to assume that pottery vessels were used for cooking and storage, but this was impossible to objectively ascertain even at a general level, let alone for every vessel.

It should be apparent that the preceding attributes were omitted primarily on the basis of their difficulty in or subjectivity of
determination. Thus, the attributes that were selected for use in this study are just the opposite: every attribute had to be easily and objectively observed or measured. These attributes can generally be thought of as belonging to 2 groups - attributes relating to shape of lip and upper rim, and attributes concerning vessel surface finish and decoration.

The entire list need not be discussed here, but certain aspects of it should be explained. The attributes are of the discrete (presence/absence) kind, more properly termed multi-state nominal data. These attributes are grouped into classes (N=28) and states (N=123). Every vessel must possess only 1 attribute state from every attribute class; the presence of 1 attribute state from any given class precludes the presence of any other state from the same class.

A. Lip cross-section - Seven distinct lip cross-sections were observed on Hacklander pottery. Typical examples can be seen in Fig. 1 (p. 26). It might be suggested that certain of these states are rather similar (e.g. flat, splayed, beveled) and perhaps need not be treated separately. Some of these states, particularly those with small frequencies of occurrence, were indeed "lumped" in the final statistical analysis, but it was felt that it was advantageous to keep them separate at the outset.

B. Rim thickening - Types of rim thickening can be seen in Fig. 2 (p. 26). Some explanation is in order here. "Folded" refers to rims upon which the still-wet clay has been folded over to thicken the rim while "collared" shall refer to vessels with a thickening of the rim below the lip - either by application of additional clay or by pinching.
Figure 1
Typical Lip Cross-sections

| Flat   | Round | Splayed | Pointed or Wedge | Beveled | Thickened |

Figure 2
Types of Rim Thickening

| Folded | Collared | Folded and Collared |

The profiles and probably the methods of manufacture of each are quite distinctive. "Folded and collared" is a combination of both. Again, its profile is distinctive. It is notable that these vessels are generally better made than the other 2 kinds, i.e. the folding and collaring is always well and symmetrically executed, in contrast to the usual "sloppy" execution on the folded rim vessels.

C. Rim cross-section - Four varieties were noted (Fig. 3, p. 27).
D. Exterior surface preparation - No attempt was made to differentiate between "cordmarked" and "smoothed-over cordmarked". While such a distinction has often been made in past studies (e.g. Rogers 1972), the difficulty and subjectivity of deciding what is "smoothed-over" and what is not precluded the inclusion of a smoothed-over state. Further, the smoothing of cordmarking on a pot can be the result of a number of factors and can be accidental as well as deliberate and is thus of dubious typological significance. Any vessel upon which cord impressions were observed was considered cordmarked.

Another surface preparation not used here is "roughened". Fitting (1965:36) states that a roughened vessel surface is possibly the result of the washing of the vessel before firing, producing a rough, pitted surface. This surface treatment was noted by Rogers (1972:51, 79) in her analysis of Allegan Ware. While the criteria of just what a roughened surface is supposed to be are somewhat vague, it may be of significance that no roughened surfaces are present at Hacklander. There are 2 and perhaps 3 possible candidates for this state, but it was felt that they more probably belonged in the smooth state.
E. Exterior decoration, first and second tools - A number of pots in the assemblage exhibited decorative motifs that made use of more than 1 tool and, usually, more than 1 technique and orientation. For this reason, the distinction between 1 or 2 tools was made.

F. Paste - Paste was divided into 2 states: sandy and silty. It was usually rather difficult to determine whether a particular pot belonged to the sandy or silty category; indeed, the idea was toyed with of including an "other" or "in-between" state, but it was felt that this would be of little help. This is being brought up here because there was more than a small degree of subjectivity involved in dealing with paste. The paste class created some analytical problems that will be dealt with later on. Paste can be a very important attribute in the definition of types or wares, but in retrospect, it should probably not have been included in this analysis.

G. Rim diameter - Rim diameter was determined using the usual concentric circle method. Since it was impossible to accurately determine the diameter for small sherds, this class was not included in statistical analysis.

**Coding for computer use**

The final step preparatory to actual analysis was the coding of the vessels. Each vessel was numbered and individually examined, its 28 attribute states being coded on mark-sense sheets. The use of mark-sense sheets was much easier and more accurate than the tedious task of keypunching computer cards. The data was then entered via optical scanner into disk storage in the PDP-10 computer housed at
Western Michigan University. In addition, a set of keypunch cards was automatically produced by the optical scanner.

Once stored on disk, the raw data was printed out and inspected for errors, of which there were several. These errors were then corrected, and the corrected data file was thus ready for statistical manipulation.

Statistical Tests

Chi-square cluster analysis

This mode of analysis is the same as that outlined by Spaulding, who states that "...artifacts can be classified in terms of attribute clusters; this is accomplished by mathematical manipulation of the data... This process is referred to here as cluster analysis" (Spaulding 1960:442). It was this method that yielded the most satisfactory and usable pottery typology, and will thus be discussed in detail.

Cluster analysis - or association analysis, as it is sometimes called - utilizes the simple chi-square ($x^2$) statistic as a test of independence of variables. The variables in this case are the ceramic attributes, and, as Stoltman points out, "When two or more independent attributes...are found in association more often than could be expected by chance alone, we may logically conclude that it was the customary behavior of the past artisans that produced the non-random patterns" (Stoltman 1973:49). These non-random clusters of attributes are the basis for the establishment of pottery types. It follows, then, that the null hypothesis to be tested in this analysis can be stated thus:
there are no non-random associations of any 2 or more attributes in
the ceramic assemblage under study.

The chi-square statistic requires that certain assumptions re-
garding the data be met. These assumptions are that the data: 1) be
nominal scale, 2) be drawn by independent random sampling, and 3) be
of an appropriate sample size (generally $N = 40$) (Thomas 1976:282-283,
298). The first and third assumptions are easily complied with by the
Hacklander data. The second assumption, however, that the data be
drawn by independent random sampling, was not met quite so well. The
Hacklander site was excavated by means of a simple random sample as
well as judgement (i.e. non-random) excavations. At the outset of this
analysis, it was intended that only the vessels from the random sample
be used in statistical testing, with vessels from the judgement sample
being treated separately and non-statistically. This would have been
in full compliance with assumption "2" above. It was discovered, how­
ever, that of the 233 vessels actually used in the analysis, only 98
had been recovered from the random sample. The additional 135 vessels
were recovered from judgement excavations and surface collection.
Viewed in retrospect, this distribution should not have been totally
unexpected since judgement excavations were purposely placed in areas
with high densities of cultural material. By the same token, however,
that judgement vessels actually outnumbered random vessels came as
somewhat of a surprise, given the fact that random excavations outnum­
ber the judgement by just over 2 to 1. At any rate, a decision had to
be made at this point. It was felt that the larger sample size re­
fecting a greater range of ceramic variation and heterogeneity pro­
vided by the inclusion of the non-randomly sampled pots was the most
advantageous course to take, in spite of the fact that a bias was now being entered into the analysis. It should be pointed out, though, that the violation of the assumption of randomness of data is perhaps not particularly all that detrimental; there is considerable precedent in the archaeological literature for the use of statistics (particularly chi-square) with non-randomly drawn data. For the most part, these studies have been successful. This is not, of course, to be little random sampling strategies or the assumptions of the chi-square statistic (nor is this intended as an excuse), and it is still unfortunate that this criterion could not have reasonably been met in this analysis. The reader is thus advised to keep this shortcoming in mind.

Another problem that was encountered in using the chi-square statistic should be discussed here. Chi-square calculates the difference between frequencies of occurrence of variables actually observed in one's data (observed frequencies) and the frequencies that would be expected if one's variables were distributed within the data in a random fashion (expected frequencies). Problems can arise if the expected frequencies in the chi-square calculations are too low; expected frequencies that are too low tend to falsely accentuate the observed/expected deviation, resulting in an inflated chi-square value that only poorly reflects the chi-square distribution. An inflated chi-square statistic also increases the chances of obtaining statistically significant results. In short, the statistic generated in this manner is generally considered to be unreliable.

How does this situation come about? One way is if the sample size is too low (assumption "3" above). The problem with the Hacklander
data, however, arose as a result of too many empty cells in the contingency table. If a chi-square test is calculated for a contingency table in which there are many zeros or otherwise low observed frequencies, the expected frequencies that are generated are also low. It was often the case in the Hacklander data that observed frequencies of attributes were either quite low or highly skewed—which, incidentally, reflects the variability within the sample—which in turn created expected frequencies that were too low.

An explanation of just what is meant by "too low" is in order. Statisticians as well as archaeologists are in disagreement as to how low expected frequencies should be allowed to become. While 5.0 is the minimum value accepted by most statisticians (Downey 1975:260), it is felt by some that this may be a bit conservative. Blalock states that "...if only one or two cells have expected frequencies of 5 or less, then it is generally advisable to go ahead with chi-square tests..." (Blalock 1972:286). Brownlee accepts a value of 3.5 as a minimum (Brownlee 1965, quoted in Whallon 1972:20). Thomas feels that while 5.0 is ideal in contingency tables, chi-square is acceptable if "No more than about 20% of the cells have expected frequencies less than 5.0 and no expected frequency is less than 1.0" (Thomas 1976:298).

The chi-square statistic has been the subject of extensive experimentation by Whallon (1972). Whallon met similar problems of low expected frequencies in his analysis of New York Owasco ceramics. Several minimal expected frequencies were used in his analysis, and it was found that the best results were obtained when minimal expected frequencies lower than 5.0 were allowed. Whallon argues that this departure
from standard statistical practice is necessitated by the nature of archaeological data, which is often obtained in small samples. He states that

We have, therefore, a situation in which the necessities of dealing with very limited sample size and the consideration of including enough combinations of significant attributes in the analysis to make sense archaeologically must be balanced against the niceties of statistical rigor" (Whallon 1972:20).

Sample size was not a problem with the Hacklander pottery, though as many significant attribute combinations as possible were desired for the formulation of the typology. As much statistical rigor as possible was also desired, especially since a sampling bias was already present in the data. It was decided, then, that the only logical thing to do to try to determine which was the better approach was to do it both ways. Two cluster analyses were thus executed, one with the minimal expected frequencies being allowed to go as low as they would, the other following Thomas' guidelines as stated above. Happily, comparison of the 2 typologies showed that, while the low expected frequency analysis was somewhat more detailed, the 5.0 analysis was not seriously deficient or inferior. In fact, both were very similar, and will be discussed in detail below. So, while the problem of too low expected frequencies will not be resolved here, it was gratifying that a usable typology could be generated for the Hacklander ceramics using 5.0 as a minimal expected frequency, which maintains a high degree of statistical rigor.

Before chi-square tests could be calculated, a collapsing or condensing of the overall attribute list had to be done. The reason for this is that it was apparent that certain attribute classes and states
would be of little value in generating a typology. If a typology is to represent the way things were most often done in a given socio-cultural system, then those variables that occur together most frequently in the data should be examined, the assumption being that these variable combinations represent modal behavior on the part of the people involved. Put differently, variables that occur only sporadically or infrequently are not useful in defining types, since they obviously do not occur often enough to represent modal behavior. In terms of the Hacklander assemblage, those attributes that were not used can be considered to be the result of 1) idiosyncratic behavior, 2) "intrusion", or the occurrence of an atypical attribute(s) via the trading of pottery vessels, 3) a component occupation only lightly represented at the site, or 4) sampling error, though the latter seems the least likely possibility.

On this basis, the attribute list was "weeded out". This operation was performed with every attempt to remain objective, because it is here that subjectivity in judgement is likely to occur if one is not careful. To determine which attributes occurred only infrequently, the raw data was subjected to the computer program BARGR, which provided percentages and frequencies of occurrence for each attribute state, as well as a bar graph of the frequencies. An arbitrary level was chosen as a cutoff point, and an attribute was excluded from analysis if it occurred in less than 5% of the sample. This level proved to be quite satisfactory. Certain attribute states with frequencies of less than 5% were experimented with, but for the most part, these calculations proved to be not significant.
Another method was tried in an attempt to determine which attributes might or might not be of typological significance. Chi-square tests were run between the 28 attribute classes. This resulted in some 380 chi-square tables; the purpose of this was to observe which classes most frequently had statistically significant concurrence with other classes ("sum of significant chi-squares"), and thus determine the presumed more important attributes. It soon became apparent, however, that some, if not most, of the chi-square values derived from this operation were unreliable due to the problem of low expected frequencies as discussed above. For example, a particularly large contingency table that compared exterior decoration first tool with first technique yielded an astronomical chi-square value of 913.8367; the reason that this figure is so large is due to the fact that of the 72 cells in the contingency table, no less than 55 contained zeros. If nothing else, this exercise revealed the problem of what can happen with too low expected frequencies, and reinforced the idea that the attribute list should be collapsed for statistical use.

The lists that were ultimately used appear as Tables 1 and 2 (pp. 36-37). It can be seen that the list used in the 5.0 analysis is simply an even more collapsed version of the low expected frequency list. This further collapsing was necessary to insure that enough expected frequencies would be above 5.0, since the computer program used, called CHISO, did not provide an option for setting a specified minimal value. This list, then, represents the attribute states as almost totally dichotomized (presence/absence) variables.

Notice in the lists that certain attribute states have been grouped, as well as omitted. For example, in Table 1, all decorative states
### Table 1

Attribute List for Chi-square Analysis with Low Expected Frequencies

<table>
<thead>
<tr>
<th></th>
<th>Lip cross-section</th>
<th></th>
<th>Interior Surface Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lip cross-section</td>
<td></td>
<td>Flat and Splayed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Round</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pointed or Wedge</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Beveled</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Thickened</td>
</tr>
<tr>
<td>2</td>
<td>Lip Planview</td>
<td></td>
<td>Striated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Smooth</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cordmarked</td>
</tr>
<tr>
<td>3</td>
<td>Lip Surface Preparation</td>
<td></td>
<td>Smooth</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cordmarked</td>
</tr>
<tr>
<td>4</td>
<td>Lip Decoration - Tool</td>
<td></td>
<td>Absent</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dentate Tool</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cordwrapped Tool</td>
</tr>
<tr>
<td>5</td>
<td>Rim Thickening</td>
<td></td>
<td>Absent</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Folded and Folded/ Collared</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Collared</td>
</tr>
<tr>
<td>6</td>
<td>Rim Cross-section</td>
<td></td>
<td>Straight</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Slight and Pronounced Eversion</td>
</tr>
</tbody>
</table>

8. Exterior Surface Preparation

<table>
<thead>
<tr>
<th></th>
<th>Exterior Surface Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Striated</td>
</tr>
<tr>
<td>B</td>
<td>Smooth</td>
</tr>
<tr>
<td>C</td>
<td>Cordmarked</td>
</tr>
</tbody>
</table>

9. Exterior Decoration - First Tool

<table>
<thead>
<tr>
<th></th>
<th>Exterior Decoration - First Tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Absent</td>
</tr>
<tr>
<td>B</td>
<td>Rounded End</td>
</tr>
<tr>
<td>C</td>
<td>Cordwrapped Tool</td>
</tr>
<tr>
<td>D</td>
<td>Dentate Tool</td>
</tr>
</tbody>
</table>


Table 2
Attribute List for Chi-square Analysis
with 5.0 Expected Frequencies

<table>
<thead>
<tr>
<th></th>
<th>Lip Cross-section</th>
<th></th>
<th>Rim Cross-section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A. Flat and Splayed</td>
<td>6</td>
<td>A. Straight</td>
</tr>
<tr>
<td></td>
<td>B. Round</td>
<td></td>
<td>B. Everted</td>
</tr>
<tr>
<td></td>
<td>C. Other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Lip Planview</th>
<th></th>
<th>Interior Surface Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>A. Flat</td>
<td>7</td>
<td>A. Striated</td>
</tr>
<tr>
<td></td>
<td>B. Other</td>
<td></td>
<td>B. Smooth</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C. Cordmarked</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Lip Surface Preparation</th>
<th></th>
<th>Exterior Surface Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>A. Smooth</td>
<td>8</td>
<td>A. Striated</td>
</tr>
<tr>
<td></td>
<td>B. Cordmarked</td>
<td></td>
<td>B. Smooth</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C. Cordmarked</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Lip Decoration - Tool</th>
<th></th>
<th>Exterior Decoration - First Tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>A. Absent</td>
<td>9</td>
<td>A. Absent</td>
</tr>
<tr>
<td></td>
<td>B. Present</td>
<td></td>
<td>B. Present</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Rim Thickening</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>A. Absent</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. Present</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

dealing with corded tools have been lumped into an overall "cord wrapped tool" state; this was necessary because individually, these states had frequencies of occurrence below 5%. Notice also that regarding lip and exterior decoration, only the "tool" states were used. In most cases, a particular decorative tool possessed its own technique and orientation, e.g. all but 4 vessels possessing lip decoration had an impressed technique and oblique orientation. Similar situations occurred with exterior decoration. It was felt, then, that the use of the tool states only would be sufficient for statistical analysis and, most importantly, would not compromise or invalidate the results.

It should be pointed out at this time that the omission of certain ceramic attributes does not mean that the actual vessels upon
which the attributes are found were omitted. To omit the vessels that have attributes of infrequent occurrence is not, however, a bad procedure; indeed, this was done by Stoltman in his cluster analysis of Minnesota Laurel ceramics (Stoltman 1973:63-64). Since it is felt that attributes of minor occurrence are not useful in defining types, it is a logical next step to posit that the vessels possessing these attributes cannot be typed and may as well be removed from analysis. In the case of the Hacklander ceramics, however, the omission of actual vessels would have rapidly diminished the sample size to a point where it would have been undesirably low (Stoltman's sample was considerably larger than the present one). All 233 vessels were used, then, and vessels possessing unused attributes either 1) got typed anyway, due to the clustering of their remaining attributes, or 2) were sufficiently deviant that the remaining attributes did not cluster and were thus not typed. This procedure worked quite well, and within-type variation created by the presence of unused attributes will be discussed in the next section.

Finally, the actual statistical tests can now be dealt with. Since the 5.0 expected frequency analysis yielded the typology that was ultimately accepted, it will be discussed first. The low expected frequency analysis will be dealt with subsequently, and the substantive differences between the two will be pointed out.

Chi-square calculations were performed on all combinations of attribute classes in the collapsed attribute list. The .01 level of significance was used as the critical region of rejection for testing the null hypothesis. In addition to chi-squares, phi and contingency
coefficients were also calculated as measures of the strength of association of the attributes. These coefficients, however, were not especially useful in the construction of the final typology.

As expected, certain attribute classes occurred non-randomly with certain other classes. Some classes did not occur significantly with any classes; these were lip planview and rim cross-section. Since a statistically significant result was not obtained for these 2 classes, they could be dropped from further consideration.

One of the first non-random clusters of attributes to be noted involved lip attributes. Table 3 illustrates the results of the comparison of lip surface preparation and lip decoration. The value of chi-square, after correcting for continuity, is 20.3996, and is significant beyond the .01 level for 1 degree of freedom, indicating that this arrangement of attributes could be expected to occur by chance only once in 100 observations. It can thus be stated that these

Table 3

Chi-square Calculations
for Lip Surface Preparation vs. Lip Decoration

<table>
<thead>
<tr>
<th>(Observed)</th>
<th>(Expected)</th>
<th>(Deviation)</th>
<th>((0-E)^2/E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>E</td>
<td>0-E</td>
<td></td>
</tr>
<tr>
<td>Smooth Lip/Abs. Dec.</td>
<td>77</td>
<td>91.294</td>
<td>-14.294</td>
</tr>
<tr>
<td>TOTALS</td>
<td>228</td>
<td>228.000</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Corrected \(x^2\) (Yate's correction for continuity) = 20.3996
Probability < .01
1 degree of freedom Phi coefficient = +.299118

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attributes show a non-random association within the ceramic sample. Table 3 should be examined further, however, for it is important to determine not only that there is a non-random association here, but also precisely what this association represents.

The column "deviation" (O-E) shows the degree of positive and negative difference between the observed and expected frequencies. It can be seen that there is a marked tendency for smooth lips to be non-randomly positively associated with lip decoration, while cordmarked lips tend to be positively associated with an absence of lip decoration. In interpreting the chi-square tables, it was the positive deviation of observed frequencies from expected frequencies that formed the basis for determining attribute clusters. It is also important to note the negative deviations to observe which attributes are "avoiding" each other, but for purposes of defining a typology based on the positive associations of attributes the positive deviations are of the most immediate interest (c.f. Stoltman 1973:67-68).

Another factor that can be used in interpreting significant chi-square calculations is the value contributed by each cell to the overall chi-square value. In Table 3, the column (O-E)^2/E shows the value contributed by each cell; this value is a function of the expected frequency - the lower the expected frequency, the higher the value, regardless of the direction of the O-E deviation. These figures can be important in interpreting chi-squares if one is not concerned with direction of deviation, which is a major concern in this analysis. Because only positive deviations are of utility for the establishment of attribute clusters, the individual cell contributions were deemed
less useful than the positive O-E deviation as pointed out above. This will be discussed in somewhat more detail below.

While it is not of particular typological significance, the value of the phi coefficient is interesting. This statistic indicates the strength of the relationship of the variables in the chi-square table (phi is used with 2x2 tables, as in this case; a contingency coefficient is calculated for tables larger than 2x2, and serves the same function). The chi-square statistic only indicates that there is or is not a statistically significant relationship between the variables analyzed - it says nothing of the strength of that relationship. For this reason, phi and contingency coefficients were calculated. A value of phi +1.0 indicates a strong positive correspondence between variables (i.e. the variables are always associated); phi -1.0 indicates strong negative associations (never associated); and a value of 0.0 indicates no relationship whatsoever. Thus, the value of phi +.299118 in Table 3 is not particularly impressive. This is being brought up here because it will be shown that none of the phi or contingency coefficients calculated in this study demonstrated a really strong positive relationship. It is apparent that the variability and heterogeneity of the sample is responsible for this, for while statistically significant chi-square values were obtainable, the strength of these non-random arrangements was never strikingly strong.

Lip surface preparation is compared with lip cross-section in Table 4 (p. 42). The chi-square value is significant beyond the .01 level, and it can be seen that smooth lips most often tend to be round in cross-section while cordmarked lips tend to be flat. There is also
Table 4
Chi-square Calculations for Lip Surface Preparation vs. Lip Cross-section

<table>
<thead>
<tr>
<th></th>
<th>O</th>
<th>E</th>
<th>O-E</th>
<th>(O-E)^2/E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smooth Lip/Flat Lip</td>
<td>27</td>
<td>43.125</td>
<td>-16.125</td>
<td>6.0293</td>
</tr>
<tr>
<td>Smooth Lip/Round Lip</td>
<td>55</td>
<td>38.664</td>
<td>+16.125</td>
<td>6.9021</td>
</tr>
<tr>
<td>Smooth Lip/Other</td>
<td>33</td>
<td>33.211</td>
<td>-0.211</td>
<td>0.0013</td>
</tr>
<tr>
<td>Cord. Lip/Flat Lip</td>
<td>60</td>
<td>43.875</td>
<td>+16.125</td>
<td>5.9262</td>
</tr>
<tr>
<td>Cord. Lip/Other</td>
<td>34</td>
<td>33.789</td>
<td>+0.211</td>
<td>0.0013</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>232</td>
<td>232.00</td>
<td>0.0</td>
<td>25.6446=x^2</td>
</tr>
</tbody>
</table>

x^2 = 25.6446
Probability < .01
Contingency coefficient = .228855
2 degrees of freedom

A small tendency for "other" lip cross-sections to be cordmarked. With Tables 3 and 4, the first attribute cluster presents itself. Based around lip surface preparation, there is a statistically significant positive tendency for smooth lips to be round in cross-section and to be decorated. Cordmarked lips, conversely, tend to be flat and to be undecorated.

The attribute that displayed the highest number of significant associations was cordmarked exterior surface preparation, and this attribute formed the nucleus of the second major attribute cluster. Table 5, (p. 43) illustrates the results of a chi-square calculation between cordmarked exteriors (as opposed to all other exteriors) and interior surface preparation (all kinds). Note that for the former class, the states striated and smooth were combined into an "other" state for purposes of the test. This was necessary to assure that
Table 5

Chi-square Calculations
for Exterior Surface Preparation vs.
Interior Surface Preparation

<table>
<thead>
<tr>
<th></th>
<th>O</th>
<th>E</th>
<th>O-E</th>
<th>(O-E)^2/E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cord. Ext/Smooth Int</td>
<td>152</td>
<td>140.567</td>
<td>+11.433</td>
<td>.9299</td>
</tr>
<tr>
<td>Other Ext/Striat. Int</td>
<td>22</td>
<td>6.965</td>
<td>+15.035</td>
<td>32.4553</td>
</tr>
<tr>
<td>Other Ext/Smooth Int</td>
<td>33</td>
<td>44.432</td>
<td>-11.433</td>
<td>2.9413</td>
</tr>
<tr>
<td>Other Ext/Cord. Int</td>
<td>0</td>
<td>3.602</td>
<td>- 3.603</td>
<td>3.6020</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>229</td>
<td>229.000</td>
<td>0.0</td>
<td>51.3254=x^2</td>
</tr>
</tbody>
</table>

x^2 = 51.3254
Probability <.01
Contingency coefficient = .317446
2 degrees of freedom

enough expected frequencies would be above 5.0; when chi-square was calculated for these classes without combination of states, 2 of the 9 expected frequencies fell below 5.0 and 1 fell below 1.0. Since the relationship with cordmarked exteriors specifically was of interest here, it was legitimate to combine the other 2 states. The same procedure was used when striated and smooth exteriors were examined.

Table 5 demonstrates a positive non-random association between cordmarked exteriors and smooth interiors. Cordmarked interiors are also associated, but the deviation from expectation is not as pronounced. Particularly striking is the association between striated and smooth exteriors with striated interiors; indeed, when the contributions to the overall chi-square value are examined, this association yields more than half the value. This association will be discussed below, and for
present purposes, Table 5 indicates a non-random association of cord-marked exteriors and smooth interiors, despite the fact that the contribution of this cell to the overall chi-square value is low.

Table 6

Chi-square Calculations for Exterior Surface Preparation vs. Lip Surface Preparation

<table>
<thead>
<tr>
<th></th>
<th>O</th>
<th>E</th>
<th>O-E</th>
<th>((O-E)^2/E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cord. Ext/Smooth Lip</td>
<td>60</td>
<td>86.857</td>
<td>-26.857</td>
<td>8.3044</td>
</tr>
<tr>
<td>Other Ext/Smooth Lip</td>
<td>54</td>
<td>27.142</td>
<td>+26.857</td>
<td>26.5769</td>
</tr>
<tr>
<td>Other Ext/Cord. Lip</td>
<td>1</td>
<td>27.857</td>
<td>-26.857</td>
<td>26.8928</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>231</td>
<td>231.000</td>
<td>0.0</td>
<td>68.8664=x²</td>
</tr>
</tbody>
</table>

Corrected \(x^2 = 66.3233\)

Probability \(<.01\)

Phi coefficient = +.535820

1 degree of freedom

The chi-square value derived from the comparison of cordmarked exteriors and lip surface preparation was also significant at the .01 level. Table 6 demonstrates that there is a positive non-random association of cordmarked exteriors and cordmarked lips, and also of "other" exteriors and smooth lips. Note that, again, the "other" vs. smooth and cordmarked lip cells contribute the most to the chi-square value because their expected frequencies are lower. Notice also that the phi coefficient is +.535820; this is the highest phi value obtained in this analysis, and it can be concluded that the non-random associations represented in Table 6 are the strongest associations in the Hacklander assemblage.
Tables 7 and 8 (p. 46) were also significant beyond the .01 level, and further show relationships with cordmarked exteriors. Table 7, which compares cordmarked exteriors with exterior decoration, shows positive deviations from the expected for cordmarked exteriors and absence of decoration, and "other" exteriors and presence of decoration. Similarly, Table 8 shows positive relationships between cordmarked exteriors and presence of rim thickening, and "other" exteriors with an absence of rim thickening. With these 2 tables a second non-random cluster of attributes is in evidence. This cluster forms the basis of a number of types, and will be discussed presently.

The perceptive reader will have noticed by now that in all 4 tables presented above in which positive associations with cordmarked exteriors were observed, these associations consistently contributed little or least to the overall chi-square value. Though it was mentioned above that this figure is thought to be not as important as the positive deviation, one might still legitimately ask whether or not these low contributions affect the reliability or presumed importance of these associations. After all, in every case the largest contributors to the chi-square value were not the cordmarked exterior vs. whatever relationships, but some relationship between the "other" exteriors and something else.

In answer to this question, it is not felt that this situation compromises either the reliability or importance of the clusters. By way of clarification, consider again Table 8. The biggest contributor to the chi-square value is the "other" vs. presence of rim thickening comparison. Why is it the biggest? Because out of 38 vessels upon
### Table 7

<table>
<thead>
<tr>
<th></th>
<th>O</th>
<th>E</th>
<th>O-E</th>
<th>(O-E)^2/E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cord. Ext/Abs. Dec.</td>
<td>149</td>
<td>141.950</td>
<td>+7.05</td>
<td>.3501</td>
</tr>
<tr>
<td>Cord. Ext/Pres. Dec.</td>
<td>18</td>
<td>25.050</td>
<td>-7.05</td>
<td>1.9841</td>
</tr>
<tr>
<td>Other Ext/Abs. Dec.</td>
<td>38</td>
<td>45.050</td>
<td>-7.05</td>
<td>1.1032</td>
</tr>
<tr>
<td>Other Ext/Pres. Dec.</td>
<td>15</td>
<td>7.950</td>
<td>+7.05</td>
<td>6.2518</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>220</td>
<td>220.000</td>
<td>0.0</td>
<td>9.6894=x^2</td>
</tr>
</tbody>
</table>

Corrected x^2 = 8.3638  
Probability <.01  
Phi coefficient = +.194979  
1 degree of freedom

### Table 8

<table>
<thead>
<tr>
<th></th>
<th>O</th>
<th>E</th>
<th>O-E</th>
<th>(O-E)^2/E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cord. Ext/Abs. Thick.</td>
<td>139</td>
<td>147.047</td>
<td>-8.047</td>
<td>.4403</td>
</tr>
<tr>
<td>Other Ext/Abs. Thick.</td>
<td>54</td>
<td>45.952</td>
<td>+8.047</td>
<td>1.4091</td>
</tr>
<tr>
<td>Other Ext/Pres. Thick.</td>
<td>1</td>
<td>9.047</td>
<td>-8.047</td>
<td>7.1575</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>231</td>
<td>231.000</td>
<td>0.0</td>
<td>11.2436=x^2</td>
</tr>
</tbody>
</table>

Corrected x^2 = 9.8909  
Probability <.01  
Phi coefficient = +.206925  
1 degree of freedom
which rim thickening was observed, only 1 had an "other" exterior sur-
face preparation. This low observed frequency contributes to the low
expected frequency, which in turn creates a high value as the contri-
bution to the overall chi-square value. Conversely, all but 1 thickened
rim pot have cordmarked exteriors and the expected frequency for this
cell is thus not particularly low, and the contribution to the chi-
square is not high. What this means is that the skewed distribution
of vessels with rim thickening has created the high value in the for-
er comparison; this is the negative side of the skew as indicated in
the O-E column, and, as pointed out previously, a typology should con-
sider only positive attribute associations. To reiterate, then, it is
for this reason that the positive observed-expected deviations are
considered more useful than the overall contributions to the chi-square
value. In these 4 tables, what the large contributions made by the
"other" exterior surface preparations do indicate is that there are
other non-random associations of attributes in the assemblage that
need explanation.

One of these associations was with striated interior surface pre-
paration. A number of statistically significant associations occurred
with this attribute, and it thus formed the basis of another attribute
cluster.

It was noted in Table 5 above that a high positive non-random
correlation occurred between striated and smooth exteriors (the "other"
category in Table 5) and striated interiors. This correlation is re-
inforced by the calculation of a chi-square value for striated interiors
(as opposed to "other") and exterior surface preparation (all kinds).
Table 9
Chi-square Calculations for
Interior Surface Preparation vs.
Exterior Surface Preparation

<table>
<thead>
<tr>
<th></th>
<th>O</th>
<th>E</th>
<th>O-E</th>
<th>(O-E)^2 /E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Str. Int/Str. Ext</td>
<td>12</td>
<td>1.773</td>
<td>+10.227</td>
<td>58.9912</td>
</tr>
<tr>
<td>Str. Int/Smooth Ext</td>
<td>10</td>
<td>5.193</td>
<td>+ 4.807</td>
<td>4.4496</td>
</tr>
<tr>
<td>Other Int/Str. Ext</td>
<td>2</td>
<td>12.227</td>
<td>-10.227</td>
<td>8.5541</td>
</tr>
<tr>
<td>Other Int/Cord Ext</td>
<td>167</td>
<td>151.996</td>
<td>+15.034</td>
<td>1.4873</td>
</tr>
<tr>
<td>Other Int/Smooth Ext</td>
<td>31</td>
<td>35.807</td>
<td>-4.807</td>
<td>.6543</td>
</tr>
<tr>
<td>TOTALS</td>
<td>229</td>
<td>229.000</td>
<td>0.0</td>
<td>84.3855</td>
</tr>
</tbody>
</table>

\[ x^2 = 84.3855 \]

Probability \(<.01 \quad \text{Contingency coefficient} = .394453 \]

2 degrees of freedom

Table 9 illustrates the result of this calculation, which is significant well beyond the .01 level. A positive association between striated interiors and exteriors is evident, with a somewhat less pronounced association between striated interiors and smooth exteriors as well. Note also the high deviation from expectation resulting from the cell comparing cordmarked and smooth interiors and cordmarked exteriors that, as would be expected, closely correlates with the findings of the calculations in Table 5.

Table 10 (p. 49) shows the comparison of striated interiors and lip surface preparation. The chi-square value is significant and non-random positive associations are in evidence for striated interiors and smooth lips, and between smooth and cordmarked interiors and cordmarked lips. These associations nicely tie the first cluster in with this one.
### Table 10

**Chi-square Calculations for Interior Surface Preparation vs. Lip Surface Preparation**

<table>
<thead>
<tr>
<th></th>
<th>O</th>
<th>E</th>
<th>O-E</th>
<th>((O-E)^2/E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Str. Int/Smooth Lip</td>
<td>26</td>
<td>14.5</td>
<td>+11.5</td>
<td>9.1206</td>
</tr>
<tr>
<td>Str. Int/Cord. Lip</td>
<td>3</td>
<td>14.5</td>
<td>-11.5</td>
<td>9.1206</td>
</tr>
<tr>
<td>Other Int/Smooth Lip</td>
<td>89</td>
<td>100.5</td>
<td>-11.5</td>
<td>1.3159</td>
</tr>
<tr>
<td>Other Int/Cord. Lip</td>
<td>112</td>
<td>100.5</td>
<td>+11.5</td>
<td>1.3159</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>230</td>
<td>230.0</td>
<td>0.0</td>
<td>20.8730=x²</td>
</tr>
</tbody>
</table>

Corrected \(x^2 = 19.0974\)

Probability ≤ 0.01 1 degree of freedom  
Phi coefficient = +.288152

### Table 11

**Chi-square Calculations for Interior Surface Preparation vs. Lip Decoration - Tool**

<table>
<thead>
<tr>
<th></th>
<th>O</th>
<th>E</th>
<th>O-E</th>
<th>((O-E)^2/E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Str. Int/Abs. Lip Dec.</td>
<td>17</td>
<td>22.995</td>
<td>-5.995</td>
<td>1.5629</td>
</tr>
<tr>
<td>Str. Int/Pres. Lip Dec.</td>
<td>12</td>
<td>6.005</td>
<td>+5.995</td>
<td>5.9850</td>
</tr>
<tr>
<td>Other Int/Abs. Lip Dec.</td>
<td>163</td>
<td>157.005</td>
<td>+5.995</td>
<td>.2289</td>
</tr>
<tr>
<td>Other Int/Pres. Lip Dec.</td>
<td>35</td>
<td>40.995</td>
<td>-5.995</td>
<td>.8766</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>227</td>
<td>227.000</td>
<td>0.0</td>
<td>8.6355=x²</td>
</tr>
</tbody>
</table>

Corrected \(x^2 = 7.2723\)

Probability = .01 1 degree of freedom  
Phi coefficient = +.178986

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The arrangement of striated interiors and the smooth/round/decorated lip cluster is emphasized by the figures in Table 11, which compares striped interiors with lip decoration; it can be seen that there is a positive tendency for pots with striped interiors to also possess decorated lips, and, conversely, for "other" interior vessels to possess undecorated lips. Notice, however, that the probability of this arrangement occurring is only equal to, not greater than, the .01 level. Though still significant and thus acceptable, the associations in Table 11 are not overwhelming, and the very low phi coefficient suggests that, while these relationships may be statistically valid, they are, just the same, not strong relationships. Once again the heterogeneity of attribute combinations within the sample makes its presence felt.

Table 12

Chi-square Calculations for
Interior Surface Preparation vs.
Exterior Decoration - Tool

<table>
<thead>
<tr>
<th></th>
<th>O</th>
<th>E</th>
<th>O-E</th>
<th>(O-E)^2/E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Str. Int/Abs. Ext Dec.</td>
<td>16</td>
<td>23.819</td>
<td>-7.819</td>
<td>2.5667</td>
</tr>
<tr>
<td>Other Int/Abs. Ext Dec.</td>
<td>172</td>
<td>164.181</td>
<td>+7.819</td>
<td>.3723</td>
</tr>
<tr>
<td>Other Int/Pres. Ext Dec.</td>
<td>21</td>
<td>28.819</td>
<td>-7.819</td>
<td>2.1214</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>221</td>
<td>221.000</td>
<td>0.0</td>
<td>19.6830=x^2</td>
</tr>
</tbody>
</table>

Corrected x^2 = 17.2462
Probability < .01
1 degree of freedom

Phi coefficient = +.279351

The last calculations to be discussed here appear in Table 12. This table compares striped interiors and exterior decoration, and demonstrates positive non-random relationships between striped interiors.
and the presence of exterior decoration, as well as "other" interiors and an absence of exterior decoration.

The preceding 10 chi-square tables and the positive non-random attribute associations they illustrate formed the basis for the construction of the final pottery typology. It was shown that certain tables reinforced the findings of other tables which is, of course, the way one would expect it to be; had the results of similar calculations - for example, Tables 5 and 9 - been not mutually verifying and instead contradicted one another, one might begin to suspect that something was amiss. Several other statistically significant tables were not presented here because they merely reinforced the associations pointed out by these 10 tables.

With 4 major attribute clusters in evidence, the results of the cluster analysis can be summarized in Table 13 (p. 52). It should be pointed out that the first 2 clusters are actually incorporated into the last 2. Clusters 3 and 4, then, form the basis of the pottery types. A detailed discussion of the typology in cultural terms will be deferred until the next section; however, it is instructive to see how the arrangements of attributes are used to define types and variants.

The first thing that was done after the attribute clusters were statistically determined was, naturally, to see what pots belonged in the clusters. In cluster 3, for example, a total of 9 vessels possessed all 5 attribute states. In monothetic subdivisive terms, the 5 attributes are necessary and sufficient criteria for the inclusion of these 9 vessels into a monothetic group. One may now ask, what about the rest of the pots? Surely more than 9 vessels fit some combination

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Table 13
Summary of Non-random Attribute Clusters

<table>
<thead>
<tr>
<th>Cluster 1</th>
<th>Cluster 2</th>
<th>Cluster 3</th>
<th>Cluster 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Flat Lip</td>
<td>A. Round Lip</td>
<td>A. Cordmarked</td>
<td>A. Striated Interior</td>
</tr>
<tr>
<td>B. Cordmarked Lip</td>
<td>B. Smooth Lip</td>
<td>Exterior</td>
<td>Exterior</td>
</tr>
<tr>
<td>C. Undecorated Lip</td>
<td>C. Decorated Lip</td>
<td>B. Smooth Interior</td>
<td>B. Striated/Smooth Exterior</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. Flat Lip</td>
<td>C. Smooth Lip</td>
</tr>
<tr>
<td>D. Absence Exterior</td>
<td>E. Presence Exterior</td>
<td>Decoration</td>
<td>Decoration</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
of the 5 attributes in cluster 3. The procedure used to determine where/if the remaining vessels fit the attribute cluster is as follows. The opposites or correlates of the 5 attributes were examined; for example, the opposite of the attribute rim thickening present was inserted into the cluster, i.e. rim thickening absent. With this substitution, additional ceramics were grouped according to these criteria, that is, the attribute rim thickening absent has become, along with the other 4 attributes, a necessary and sufficient criterion for inclusion into a second monothetic group. This second group, along with all other groups formed in this manner, will be termed a subcluster of the original cluster. Pots in this subcluster possess 4 of the original 5 attributes, and the new fifth attribute is the opposite of the original fifth attribute. This procedure of forming what are here termed subclusters is consistent with monothetic subdivisive methodology, because the attributes in cluster 3 and/or their opposites or correlates form, in every case, criteria for group membership that are both necessary and sufficient for that membership. When the correlates and opposites of the attributes in clusters 3 and 4 were examined in this manner, subclusters of necessary and sufficient attributes presented themselves, and the various ceramic vessels could be grouped according to these criteria. These subclusters, based on the original cluster, constitute the actual types and variants.

The attributes within the 2 non-random clusters were examined and manipulated in this manner until no other vessels fit some combination of the attributes or their correlates. It might be added here that this "manual" manipulation of the attribute clusters does not invalidate the analysis or make it any less objective, because these
subclusters are based on combinations of the statistically determined non-random attributes and/or their correlates in the original clusters. If one were, however, to introduce an attribute other than one already present in the original clusters, the analysis would then indeed be quite invalidated.

With the foregoing cluster analysis concluded, attention can now be turned to the cluster analysis utilizing expected frequencies of unspecified value, or "low expected frequency analysis" as it has come to be called. This undertaking need not be discussed at length; rather, it would probably be more useful to simply point out what this analysis did that the 5.0 analysis did not do.

It will be recalled that both chi-square cluster analyses yielded similar results, with the low expected frequency analysis being somewhat more detailed. The additional detail was possible because fewer attribute states needed to be combined (see Table 1); most states were combined in the previous analysis to insure that enough expected frequencies would exceed the 5.0 limit, which is not a problem here.

To illustrate this added detail, consider Table 14 (p. 55). This table shows the results of the comparison of exterior surface preparation and exterior decoration. The chi-square value is significant well beyond .01, and the positive deviations show much the same arrangement as Table 7 above. Table 14, however, demonstrates not only that striated and smooth exteriors tend to be associated with the presence of decoration, but precisely what decorative tools are associated, i.e. rounded end and dentate tools. Further, Table 14 demonstrates that while the strongest tendency is for cordmarked exteriors to "avoid"
Chi-square Calculations for Exterior Surface Preparation vs. Exterior Decoration - Tool

<table>
<thead>
<tr>
<th></th>
<th>O</th>
<th>E</th>
<th>O-E</th>
<th>(O-E)^2/E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Str. Ext/Abs. Dec.</td>
<td>9</td>
<td>11.900</td>
<td>-2.900</td>
<td>.7067</td>
</tr>
<tr>
<td>Str. Ext/Round End</td>
<td>5</td>
<td>.445</td>
<td>4.555</td>
<td>46.6247</td>
</tr>
<tr>
<td>Str. Ext/Cord. Tool</td>
<td>0</td>
<td>1.209</td>
<td>-1.209</td>
<td>1.2090</td>
</tr>
<tr>
<td>Str. Ext/Dentate Tool</td>
<td>0</td>
<td>.445</td>
<td>.445</td>
<td>.4450</td>
</tr>
<tr>
<td>Cord. Ext/Abs. Dec.</td>
<td>149</td>
<td>141.950</td>
<td>7.050</td>
<td>.3501</td>
</tr>
<tr>
<td>Cord. Ext/Round End</td>
<td>1</td>
<td>5.313</td>
<td>4.313</td>
<td>3.5012</td>
</tr>
<tr>
<td>Cord. Ext/Dentate Tool</td>
<td>0</td>
<td>5.313</td>
<td>5.313</td>
<td>5.3130</td>
</tr>
<tr>
<td>Smooth Ext/ Abs. Dec.</td>
<td>29</td>
<td>33.150</td>
<td>-4.150</td>
<td>.5195</td>
</tr>
<tr>
<td>Smooth Ext/Round End</td>
<td>1</td>
<td>1.240</td>
<td>.240</td>
<td>.0464</td>
</tr>
<tr>
<td>Smooth Ext/ Cord. Tool</td>
<td>2</td>
<td>3.368</td>
<td>-1.368</td>
<td>.5556</td>
</tr>
<tr>
<td>Smooth Ext/Dentate Tool</td>
<td>7</td>
<td>1.240</td>
<td>5.760</td>
<td>26.7561</td>
</tr>
</tbody>
</table>

TOTALS 220 220.000 0.0 86.4884 = x^2

- x^2 = 86.4884
- Probability < 0.01
- Contingency coefficient = .247865
- 6 degrees of freedom

...
In nearly every case, the results of these chi-square tests mirrored the results of the 5.0 analysis, as exemplified by Table 14. In constructing a typology based on the attribute clusters generated by this analysis, it was possible to be more specific in determining which vessels fit the clusters. For example, instead of looking for vessels which possessed, say, striated interiors, smooth exteriors, and presence of exterior decoration, it was possible to look for vessels with striated interiors, smooth exteriors, and, specifically, dentate tool decoration. Nevertheless, this additional detail failed to produce types that were very different from the previous more rigorous analysis and on this basis was considered to be the less desirable of the 2.

Program TYPE analysis

The second computer analysis of the Hacklander pottery was done using a program specifically designed for creating ceramic typologies. Called TYPE, the program was developed and used by Robert Whallon (1971, 1972). Like the preceding cluster analyses, it is based on the principles of monothetic subdivision.

Program TYPE utilizes 2 underlying principles in statistically constructing pottery typologies, which are 1) a hierarchy of importance, or order of consideration of the attributes examined; and 2) the criteria for definition shift from 1 type to the next (Whallon 1972:15). Put somewhat differently, these principles state that certain attributes may be of more importance than others in defining types, and the criteria (i.e. attributes) for defining a type may shift from type to type.
The statistic used in the TYPE program is, again, the chi-square statistic. The program allows for the selection of a minimum allowable expected frequency which is specified by the user. Also specified by the user is the particular function of chi-square desired; the sum of significant chi-squares was chosen, following Whallon's (1972:19-20) experiments which showed this function to yield the most meaningful results. Initially, the program performs chi-square calculations for all combinations of attribute states excepting those that are redundant within each attribute class (e.g. flat lip vs. round lip). This having been done, the program sums the significant chi-square values for each attribute, and subdivides the entire sample on the basis of the attribute possessing the highest sum of significant chi-squares. Two groups are thus formed, one that possesses the particular attribute and one that does not. With this operation completed, the resultant 2 groups are subjected to chi-square tests again separately, which further subdivides the 2 groups into 4 groups (Whallon 1972:18-20, 24). The attributes that are selected for subdivision at the second level (and all succeeding levels) need not be the same. Which attributes are selected is determined by the highest sum of chi-squares within the groups. This procedure exemplifies the principles of hierarchy of importance and shifting criteria that were presented above.

What the program ultimately produces is a "tree-type" diagram which represents all the subdivisions that were made in the chi-square analysis. Examples of this tree-type diagram can be seen in Figure 4 (p. 61) and Figure 5 (p. 62). The tree begins with the entire sample subdivided according to the presence or absence of the one attribute that produced
the highest initial sum of chi-squares. Subdivision continues until no other chi-square calculations exceed the selected significance level (in this analysis, the .05 level). Ceramic types can be derived from the diagram at any level of subdivision, depending on the amount of discrimination one desires. Using this program, Whallon successfully typed the ceramics from a number of New York Owasco period sites (Whallon 1972).

The Hacklander ceramic data was subjected to TYPE analysis through the courtesy of Janet G. Brashler, who has also successfully used this program in ceramic analysis (Brashler 1973). The program was run on the IBM 360 computer at the University of Michigan.

The attribute list used in this analysis appears as Table 15 (p. 59). This list is somewhat different from the lists used in the chi-square cluster analysis. It was decided that initially, attribute states would not be lumped together as in the previous analysis. Depending upon the results of the analysis, states could be combined later on if this was necessary. Table 15 thus shows, for example, that cordwrapped decorative tools are not lumped together into an overall state, but are treated separately.

Note the inclusion in the list of the class paste. This class was not used in the previous analysis for reasons stated earlier; it was decided, however, to use paste in the TYPE analysis experimentally—more or less just to "see what would happen". This turned out to be a not-so-good idea, and paste should not have been used here or anywhere else. Paste created problems because it was a poorly defined class, and its presence affected the results of the program. This problem will be dealt with again shortly.
As mentioned above, program TYPE allows the user to specify the value he/she would like as the minimum allowable expected frequency. Whallon has pointed out that, in his experiments with TYPE, the best results were obtained when expected frequencies were allowed to fall below the conventional 5.0 (Whallon 1972:19-20). It was desired, however, that this analysis utilize the more rigorous 5.0 as a minimum to assure statistically valid results, and also to make the resultant

### Table 15

<table>
<thead>
<tr>
<th>Attribute List Used with Programs TYPE and CLUSTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lip Cross-section</td>
</tr>
<tr>
<td>A. Flat</td>
</tr>
<tr>
<td>B. Round</td>
</tr>
<tr>
<td>C. Splayed</td>
</tr>
<tr>
<td>D. Other</td>
</tr>
<tr>
<td>2. Lip Surface Preparation</td>
</tr>
<tr>
<td>A. Smooth</td>
</tr>
<tr>
<td>B. Cordmarked</td>
</tr>
<tr>
<td>A. Absent</td>
</tr>
<tr>
<td>B. Dentate Tool</td>
</tr>
<tr>
<td>C. Cordwrapped Stick</td>
</tr>
<tr>
<td>D. Cordwrapped Paddle-edge</td>
</tr>
<tr>
<td>E. Cordwrapped Cord</td>
</tr>
<tr>
<td>F. Other</td>
</tr>
<tr>
<td>A. Absent</td>
</tr>
<tr>
<td>B. Folded</td>
</tr>
<tr>
<td>C. Collared</td>
</tr>
<tr>
<td>D. Folded and Collared</td>
</tr>
<tr>
<td>5. Rim Cross-section</td>
</tr>
<tr>
<td>A. Straight</td>
</tr>
<tr>
<td>B. Slight Eversion</td>
</tr>
<tr>
<td>C. Pronounced Eversion</td>
</tr>
<tr>
<td>D. Other</td>
</tr>
</tbody>
</table>

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typology comparable to the 5.0 cluster analysis. The program was ultimately run both ways: once with 5.0 as the minimum expected frequency, and once with the minimum set at 1.0.

Figure 4 (p. 61) illustrates the tree diagram constructed by the 5.0 analysis. The attributes chosen for subdivision appear in parentheses, and the numbers at the ends of the branches are the numbers of vessels occurring in each "type". It is obvious that subdivision did not get very far here; the 5.0 minimum expected frequency did not allow it. Why does this happen? Recall the discussion above that stated if observed frequencies of occurrence are low, expected frequencies will be correspondingly low. In the TYPE analysis, once the original sample (N=233) was initially subdivided, the 2 resultant groups obviously possess fewer vessels than the parent group. The N for these groups is thus not 233, but somewhere around 1/2 that figure (N=117; N=116). When chi-squares are calculated for these groups, and for all subsequent groups, the N rapidly diminishes in size, producing low observed and expected frequencies. It is for this reason that Whallon chose to allow the minimum allowable expected frequency to fall below 5.0, because many more subdivisions are possible with a lower figure. To illustrate, see Figure 5 (p. 62), which shows the tree diagram resulting from the 1.0 minimum expected frequency analysis. More subdivisions were allowed here, because the lower minimum expected frequency allowed more chi-square calculations to enter into the analysis.

Figure 5, then, represents a somewhat better result than Figure 4 - the 1.0 analysis has yielded something approaching a pottery typology while the 5.0 analysis simply did not get far enough. The typology
Figure 4

Tree-diagram for 5.0 TYPE Analysis

ALL N=233

(Cord. Ext) (Cord. Ext)

(Not Flat Lip) (Flat Lip)
n=62 n=55

(Not Smooth Int) (Smooth Int) (Pres. Ext Dec.) (Abs. Ext Dec.)
n=21 n=33 n=15 n=44
Figure 5

Tree-diagram for 1.0 TYPE Analysis

ALL N=233

(Not Cord. Ext) (Cord. Ext)

(Not Smooth Int) (Smooth Int)

(Not Cord. Lip) (Cord. Lip)


n=16 n=6 n=28 n=6 n=9 n=17 n=27 n=6 n=9 n=17 n=27 n=50
created by the 1.0 analysis is still unsatisfactory, however, and the fault lies with the attributes chosen for analysis.

The 12 groups of pottery represented as the end result of the 1.0 analysis do not, for the most part, reflect the typology derived from the 5.0 cluster analysis. Groups formed at higher levels of subdivision also do not appear to be useful as types. One source of problems is the paste class. TYPE subdivided twice on the basis of paste. The groups representing these subdivisions must be considered as inaccurate because of the difficulty and subjectivity in determining what was sandy or silty paste. As stated above, it was a mistake to include this class in the analysis. Another problem apparently lies in the nature of the attribute list. It is believed that, had certain attribute states been grouped better, more usable results would have been gained. TYPE analysis of the Hacklander data with an attribute list with grouped states was not possible at the time of this writing, but is planned for a future study. As an example of the kinds of results that might be expected using grouped states, it seems possible that grouping the states dealing with rim thickening and cordwrapped tool decoration would result in these attribute classes assuming a more important role in the subdivision. Regarding rim thickening in particular, the prior chi-square cluster analysis indicated that statistically significant results could be obtained for this class only after the states had been grouped. In all probability, the same should hold true for the TYPE program as well, as the same statistic is used. As it stands now, Figure 5 shows that only 3 vessels were typed with regard to the presence of rim thickening, with the remaining vessels with rim thickening being dispersed throughout the other groups.
Perhaps the greatest single problem lies with the nature of the Hacklander pottery itself. Hacklander is a multi-component site, and several distinct wares or types are represented. Many of these types and/or wares possess attributes that are peculiar only to themselves. In general, however, the attributes display a tendency to "cross-cut" types, that is, a number of attributes can be observed on nearly every type in the assemblage. Some notable examples are flat and round lip cross-sections, cordmarked exteriors, and cordmarked lips. While the TYPE program should accommodate this kind of a situation with the hierarchy of importance and shifting criteria as discussed above, it apparently had some problems with the Hacklander data. Consider again Figure 5. The branch on the extreme right denotes a type that possesses flat lips, cordmarked lips, and cordmarked exteriors. These attributes are similar to an attribute cluster derived in the cluster analysis and at face value seem good enough; when the vessels assigned to this branch were inspected, though, it was found that TYPE had included vessels with exterior decoration and thickened rims as well as non-decorated and non-thickened rim vessels. Thus, the "type" included vessels that were obviously dissimilar, only because they all possessed the above 3 statistically significant attributes. The chi-square calculations indicated only those attributes that have statistical significance and, unfortunately, several attributes that previous studies have shown to have typological significance were only statistically significant in a minor way or not at all due to relatively low frequencies of occurrence (e.g. rim thickening, exterior decoration). The resultant typology is thus not a true reflection of the patterns inherent in the data.

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This problem does not seem to be insurmountable, however. As mentioned above, combining attribute states might help this situation. Another factor is the minimum allowable expected frequency; more chi-square calculations could enter into the subdivision if the minimal expected frequency was allowed to be infinitely small, though the negative ramifications of such a procedure have been discussed above. At any rate, it is apparent that in this case, a usable result was not obtained, indicating that further experimentation with this program using the Hacklander data in an attempt to deal with these problems could prove to be very interesting.

This discussion is not to state that the TYPE program does not do what it was intended to; rather it is perhaps closer to the mark to say that the data did not do what they were supposed to do! Some of these problems could be alleviated if the data were "cleaned up" a bit and the program rerun; for example, better results would be expected if certain attribute states were combined and others omitted. Another option would be to omit from analysis pots or groups of pots that are obviously dissimilar (e.g. the distinctive Hacklander Ware vessels), though omitting data from one's analysis for the purposes of obtaining better statistical results is generally not a good procedure.

At any rate, the TYPE program failed to produce usable results primarily due to problems in the data. It might be kept in mind, however, that this method of analysis might run into difficulty when large, heterogeneous, multi-component assemblages are analyzed within which attributes "cross-cut" types. It seems possible that the nature of the data in such a situation might cause the grouping of dissimilar vessels,
as has happened here. If for no other reason, this is being reiterated here because this potential problem would make an interesting subject for further research.

**Program CLUSTER analysis**

The third and final method of analysis to be discussed here is called program CLUSTER. This is a polythetic agglomerative approach to artifact classification and typology, and is unlike the monothetic analyses discussed above. This type of approach has been most frequently used in the biological sciences. In adapting this kind of analysis for use with cultural data, some problems can arise that are not at issue with the biologists. As pointed out previously, the most fundamental concern lies with one's concept of typology; obviously, polythetic methods can be used most profitably if one views a type as a polythetic group of attributes, i.e. where no 1 attribute or group of attributes is both necessary and sufficient for membership in the type. When utilizing a polythetic approach in an attempt to define a typology in the monothetic sense, obvious problems can arise, since these procedures form artifact taxonomies that may not conform to the monothetic type concept - the groups within the taxonomy will not contain certain attributes, all of which must be possessed by all artifacts for inclusion in a given group.

As an analytical procedure, the polythetic method approaches the data differently than the monothetic. Monothetic subdivision begins with the entire sample and, on the basis of some given criteria, subdivision the whole into several groups. Polythetic agglomeration, on
the other hand, begins with a single unit of the sample (e.g. 1 vessel out of 233) and, on the basis of some given criteria, groups each unit with other units to form 1 big group, or whole. The monothetic approach can be said to "start with the whole and work down", while the polythetic "starts with 1 and works up". This distinction is of great importance because, while the 2 approaches appear to be "opposites", the separate statistical means to the common ends are very different.

Another important difference between the 2 methods lies with the consideration of the attributes. The polythetic approach considers all attributes to be of equal importance in analysis. As analysis proceeds, every attribute of every vessel is compared with every attribute of every other vessel, without regard to attributes that one may feel have particular typological or cultural significance. This is obviously quite different from Whallon's hierarchy of importance of attributes as discussed previously and, depending upon one's typological and cultural views, can either be a detriment or an asset. In this study, this factor prevented the formulation of a usable typology, since the type concept used here is formed in monothetic terms which consider certain attributes to be of greater significance than others.

The device used to determine the similarity or difference of 1 unit with another is called a similarity or distance coefficient. This device mathematically assesses similarity in terms of the sharing of features (i.e. attributes) between entities and is expressed numerically as a coefficient of similarity (Dunnell 1971:99). The similarity coefficient used in this analysis is the coefficient of Jaccard (Sokal and Sneath 1963:133). The coefficient of Jaccard was selected because
it does not consider negative matches of attributes. The negative as well as positive concurrence of variables is an aspect of numerical taxonomy that has been of use to the biologists; it was felt, however, that in dealing with multi-state nominal data, where negative matches are inherent in the data, the most logical course to take would be to consider only the positive matches of attributes. In this study, positive - not negative - attribute associations are thought to be of primary importance in formulating a typology (or in this case, a taxonomy). In any case, the similarity coefficient treats the raw data as a matrix and examines the degree of similarity or dissimilarity between the units under analysis, and expresses these values mathematically.

A second device, usually called a clustering algorithm or clustering method, is used as the combinatorial strategy for interpreting the similarity coefficient matrix and ultimately to form the taxonomy. The incremental sum of squares method, sometimes called minimum variance or Ward's method (Clifford and Stephenson 1973:113-114), was selected for use here. The incremental sum of squares strategy has been described as an "intensely clustering" method, which means that the method tends to hierarchically cluster units rather than simply linking or "chaining" them; intensely clustering strategies are considered by some to have considerable conceptual value over other methods (Clifford and Stephenson 1973:106).

Utilizing the coefficient of Jaccard as a similarity measure and the incremental sum of squares as a clustering algorithm, the computer program CLUSTER produced a taxonomy of Hacklander pottery which was visually represented as a dendrogram (Figure 6, p. 69). To illustrate
Figure 6

Hypothetical Dendrogram
of the Type Created by CLUSTER

Steps: 10 9 8 7 6 5 4 3 2 1

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N=30

Distances: 5.6 5.8 7.2 7.7 8.0 8.2 9.1 9.3 9.8 10.0

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how the dendrogram is interpreted, a hypothetical example is provided in Figure 6; the actual Hacklander dendrogram is too large to reproduce here, and to condense or abridge it would be to render it almost meaningless.

Figure 6, though quite simplified, demonstrates how the dendrogram can be used. The "steps" indicated near the top refer to the number of clusters that are present at that point on the diagram, e.g. step 7 contains 7 clusters. The "distances" at the bottom of the diagram represent the measures of phenetic "distance" - of similarity/dissimilarity - between the clusters; these measures are determined by the incremental sum of squares clustering algorithm having grouped the individual vessels on the basis of the matrix of Jaccard coefficients. These distance measures - also called "objective functions" - are a unique feature of this particular clustering method (Sneath and Sokal 1973:241). To determine at which step the clusters might best approximate ceramic groups (or "types") one examines the distance measures to determine where within-group homogeneity and without-group heterogeneity is the greatest. In Figure 6, a line has been drawn at step 5, because the hypothetical distances indicate that the distance between steps 5 and 4 is .9 (9.1 - 8.2 = .9), which is the second highest "distance jump" in the dendrogram. The line at step 9 indicates an even greater difference: the difference between the distances at steps 9 and 8 is 1.4 (7.2 - 5.8 = 1.4), and is the greatest difference in the dendrogram. On the basis of the distance coefficients, then, one can determine at which step(s) the clusters are most likely to define ceramic groups within which similarity is high, and between which dissimilarity
is also high. In utilizing a clustering algorithm that does not provide these phenetic distance measures, one can draw arbitrary lines across the dendrogram, and simply observe where the groups appear to be optimal. These groups so determined can form the basis for conceptualizing and utilizing the pottery taxonomy. This procedure was followed in interpreting the Hacklander taxonomy, which can now be dealt with.

Like the TYPE program, CLUSTER was run by Janet Brashler at the University of Michigan. The attribute list used is the same as that used with program TYPE (Table 15).

Inspection of the dendrogram produced by the program revealed several "jumps" in the phenetic distance between clusters. At step 8, for example, the difference in distance read .9254. This figure was quite large in comparison to most, though part of the reason for this is that in the later clustering steps, the distances tend to be larger because cluster size is also large, which emphasizes between-cluster differences. At 8 clusters, the groups have become too large and encompass too much to approximate types, or even to be of use as polythetic groups. Some interesting patterns emerged, though, that are worthy of note. The second cluster at step 8 contained vessels all of which possessed cordmarked interiors; all but 2 of the pots in the sample with cordmarked interiors occurred in this group, and the other 2 possessed lip and exterior decoration that the rest did not. This was interesting since in both the statistical analyses described above this attribute consistently failed to produce significant results, and as a result this attribute is "dispersed" throughout the types that
were generated. CLUSTER, however, grouped these vessels together as a taxon, and illustrates the different kinds of results that can be obtained by this approach.

One group of vessels that formed most of the eighth cluster was considered very important. Cluster 8 contained almost all of the Hacklander Ware vessels, and this group thus demonstrates the distinctiveness of these vessels. It was noted with great satisfaction that the polythetic analysis corroborated the results of the chi-square cluster analysis by grouping the Hacklander Ware pots separately from the bulk of the assemblage.

At step 18, the jump in phenetic distance was .0916, and though this figure was not overwhelming, it was still higher than most distances in that area. At this step, the taxonomy approached usability. For example, within the Hacklander Ware vessels, groups emerged that would have been quite satisfactory for use as types as well as polythetic groups. Indeed, 2 groups duplicated types formed by the chi-square cluster analysis. Two nice groups of vessels with rim thickening emerged, and vessels with lip and exterior decoration began to form separate groups. Still, several groups were present that seemed to lack any kind of cultural or typological significance, which reflects the nature of this kind of an approach. Part of the problem, though, was due to the attributes used in the analysis, and will be discussed below.

At 33 clusters, the dendrogram displayed a tendency to split "too much", that is, seemingly trivial and non-usable groups were formed in this early step. Some of the groups that formed at 18 clusters that
were of utility are split into smaller groups that are less useful. At step 33, the clustering is still too refined to approximate a typology, or to be useful even as a taxonomy.

Mention was made that at 18 clusters, problems with the attribute list were encountered. These problems are the same as those that plagued the TYPE program, i.e. "non-lumped" attribute states and the presence of the paste class. Another oversight was the omission of the states castellated and scalloped lip planview; these were omitted from TYPE because it was known that their small frequencies of occurrence would prevent them from attaining statistically significant associations with any other attributes. In hindsight, however, they should not have been excluded from CLUSTER because statistical significance is not a problem here, and, as it stands now, these vessels are grouped on the basis of their other attributes and are dispersed throughout the taxonomy.

The biggest problem - or rather, drawback - of this analysis is not one of method but one of theory. What has been formed here is a taxonomy, of classification, not a typology. It is apparent that with the Hacklander data these are not the same. The polythetic taxa formed here do not approximate artifact types as defined in the beginning of this section; that is, they are not all-inclusive monothetic groups. Rather, the polythetic groups are not all-inclusive and there is thus overlap of attributes between groups. The clustering algorithm employed here keeps this overlap down to a minimum, but it is still present since this is precisely the nature of a taxonomy.

Further explanation is called for here. To illustrate how polythetic groups can overlap, consider the following. At step 33, the
33rd cluster contained 4 vessels, all of which possessed the following attributes: striated interiors and exteriors, flat lips, straight rim cross-section, and exterior punctates. The 32nd cluster contained 3 pots, 2 of which possessed these attributes: striated interiors and exteriors, flat lips, everted rim, and no decoration. One vessel, however, had the same attributes except it had exterior punctates, just like the pots in the 33rd cluster. Apparently, the CLUSTER program clustered the 1 vessel with punctation with the 2 vessels without punctation because of the everted rim, or because of the everted rim and some other attributes. What all this is intended to illustrate is that while, for purposes of defining a type, the presence of the punctates seems to be a more important criterion for typing than the everted rim (within this particular group of pots, anyway), the polythetic approach doesn't care what one may consider important and groups one's units on the basis of the total configuration of all attributes. No one attribute is necessary or sufficient for group membership. Thus, groups with overlap of attributes can be - and have been - created, the point here being that these polythetic groups are unable to approximate the monothetic type concept as currently understood and employed in this analysis, and, if a generalization may be permitted, in current archaeology in general.

The attitude taken here toward polythetic agglomerative approaches is not totally pessimistic though; quite the contrary, it is felt that this approach has considerable merit. Numerical taxonomic techniques of this kind can yield heuristic results, as Clarke (1968:512-546) has pointed out. A polythetic ceramic analysis is currently being undertaken by Brashler, the preliminary results of which appear quite
valuable and useful (Brashler, personal communication). Better results could be obtained using the Hacklander data with an improved attribute list. The fundamental theoretical differences between the polythetic and the more common monothetic approach should not be ignored though, and before polythetic analyses can achieve real usefulness in archaeology, the monothetic type concept may well have to be "revisited".
CHAPTER III

TYPOLOGY, INTRA-SITE DISTRIBUTIONS
AND CERAMIC CHRONOLOGY

The first task of this section will be to present the results of
the foregoing statistical analysis. The typology described and used
here is the result of the chi-square cluster analysis utilizing 5.0 as
a minimum allowable expected frequency. In addition to types generated
by statistical analysis, types and variants represented by body sherds
only will be described.

Middle Woodland Ceramics

Two vessels from the Hacklander site appear to be of Middle Wood­
land origin; these vessels did not undergo statistical analysis.

Summerville Type II-C (Plate 1a)

This vessel consists of 4 small rim sherds and several very small
body sherds. The upper rim is decorated with poorly executed fine­
line cross-hatched incising. A single row of hemi-conical punctates
borders the crosshatching, and below this the surface is smooth. The
rim cross-section shows a very slight channeling. The body sherds from
this vessel are very small and eroded; all sherds from this vessel ap­
pear to be water-worn. Decoration on the body sherds consists of fine
rocker-stamping over a smooth surface. No indication of zoning lines
is present, though some sherds are smoothed rather than decorated,
possibly suggesting zoned decoration. Tempering material is fine, white granitic rock.

This vessel most resembles the type Sumnerville Type II-C as defined by Quimby (1941:109-112) at the Hopewellian Sumnerville site located to the south of Hacklander.

Untyped vessel (Plate 1b)

This vessel consists of three rim sherds. The rim profile is slightly channeled and the upper rim has been smoothed. A row of hemi-conical punctates runs just below the smooth rim area, and the rest of the sherd is smooth.

Though it appears that this vessel cannot be accurately assigned to an established type, it is believed to be Middle Woodland primarily on the basis of paste and temper, both of which are very similar to the Sumnerville vessel. Also, the presence of hemi-conical punctations as a decorative device would argue for a Middle Woodland temporal position.

Late Woodland Ceramics

Allegan Ware

Allegan Ware was first defined by Rogers (1972) to refer to a group of Late Woodland ceramics in southwestern Michigan. The majority of the Hacklander assemblage belongs to this ware group; most of the types and variants described here duplicate Rogers' typology, but a few are somewhat different. Five types and 11 variants of Allegan Ware are represented at the Hacklander site.
1. Allegan Undecorated Cordmarked

This type was formerly called by Rogers simply Allegan Cordmarked (1972:59-60, 96), because it is an undecorated type with cordmarking up to the lip of the vessel. The qualifying term "undecorated" has been added here however; it is felt that this qualification of the type name is desirable for the sake of consistency of definition. Nearly all types and variants of Allegan Ware have exterior cordmarking. Allegan Cordmarked was a term used to denote undecorated cordmarked ceramics, but decorated Allegan Ware also possesses cordmarking. It was decided that since decorative attributes are used as the type/variant designations for decorated ceramics, undecorated types, whether cordmarked or not, should be designated as such. With this qualification, the type names possess consistency of definition.

The major attribute subcluster defining this type is as follows: cordmarked exterior, smooth interior, absent exterior decoration, absent lip decoration, and absent rim thickening. The lip attributes flat, round, beveled, thickened, and "aberrant" cross-section form the basis for defining variants. Cordmarked interiors were noted on several vessels of this type, and the cordmarking appears to be smoothed over. It is believed that interior cordmarking on Allegan Ware vessels is probably accidental rather than intentional, perhaps the result of incomplete or sloppy smoothing of the interior. Small frequencies of smoothed interior cordmarking were noted also by Rogers (1972:79).

Variants of this type are as follows:

A. Flat Lip (Plate 2) - Flat lip cross-section is by far the most numerous variant present in the type (N=43). Most examples have cordmarking on the lip, but some (N=7) have smooth lips. This situation parallels that described by Rogers for Allegan Cordmarked.
B. Round Lip (Plate 3) - Twenty-four vessels make up this variant, with 14 vessels displaying a smooth lip surface, with the rest cordmarked.

C. Beveled Lip (Plate 4a) - Five vessels make up this variant; all have cordmarked lips.

D. Thickened Lip (Plate 4b) - Ten vessels showed thickening of the lip, and all lips are cordmarked.

E. "Aberrant" or Other Lip - This variant is represented by only 4 pots, 2 of which have pointed lips and the other 2 have lips that are simply anomalous.

With the exception of beveled lip, all of the above lip cross-sections and surface preparations were noted by Rogers in her initial description of Allegan Ware. She chose not to differentiate between these attributes, since there was no apparent reason to do so, that is, all variants seemed to "behave" as a single type. At Hacklander, however, the beveled and thickened lip variants may have temporal or cultural significance, which will be discussed later in this section. For this reason, it was decided to split the type Allegan Undecorated Cordmarked into variants based on lip cross-section.

It should perhaps be mentioned here that further attempts to subdivide this type were made. These attempts, which made use of statistical as well as nonstatistical techniques, failed to produce variants that possessed any apparent cultural/spatial/temporal significance. These operations were done in an attempt to deal with paste and temper variability and in conjunction with distributional studies of the type, and will be dealt with later. This is being mentioned at this time because the variability in paste and temper seems to have some significance, and although attempts to deal with it were unsuccessful, the possible cultural and temporal implications of it will be discussed below.
2. Allegan Undecorated Smoothed (Plate 5a)

This is a poorly defined type in that it is difficult to determine the significance of it. That is, there is no strong relationship between smoothed vessels and any other vessels, so it is difficult to assign this type to any particular context. There is a possibility that this type may be very late in time, perhaps proto-historic, in which case it may not be correct to call it Allegan Ware. At any rate, 10 vessels possessing smooth lips, interiors, and exteriors fall into this type.

3. Allegan Undecorated Fabric Impressed (Plate 5b, c)

Two vessels represented by body sherds only and 2 vessels with rims make up this type. Fabric impressing, rather than impressing with a cord-wrapped object, is plainly visible on the exterior surfaces. Though this type is "undecorated", one vessel (Plate 5c) has poorly executed punctations around the rim. This decorated pot is included with the undecorated because it seemed undesirable to generate a new variant on the basis of a single vessel. Fabric impressing is an attribute that may have temporal significance at Hacklander - the body sherds of one vessel were found in direct association with the earliest dated feature, and will be discussed further below.

4. Allegan Decorated Lip (Plate 6)

This is a "new" type within the Allegan Ware group. Though lip decoration was noted by Rogers in her analysis of Allegan Ware, she did not consider vessels with decorated lips to be a separate type. Rather, lip decoration occurs on vessels within the type Allegan Cordmarked.

The situation at Hacklander seems to be different, however. Within Rogers' sample, most lip decoration occurred on vessels with flat lip
cross-sections, and Rogers has suggested that flat lips may have facilitated lip decoration better than other lip cross-sections (1972:57, 86, 94). At Hacklander, flat lips are the exception rather than the rule and all states of lip cross-section are present, with flat lip being a minority state. Since this situation differed from Rogers' definitions, it was decided that decorated lip vessels should be included in a separate type. Further, this type is believed to have chronological implications.

The major attribute subcluster for this type is the same as that for the Allegan Undecorated Cordmarked, with the state lip decoration present rather than absent. Twenty-four vessels comprise this type; 22 have cordwrapped tool impressions on the lip. Tool types include cordwrapped stick, cord, and paddle-edge, and all but 4 orientations are oblique angle with the remaining being vertical. One vessel showed oblique angle fine-line incising on the lip, and another possessed horizontal punctations apparently made with a flat object. The cordwrapped tool impressions range from shallow, well executed, symmetrically spaced impressions to deep, sloppy, poorly made applications. Paste and temper characteristics vary within this type, with crushed mixed granite being the most common tempering material. Paste and temper within this type closely resemble the characteristics of the Allegan Undecorated Cordmarked pots. Like the latter type, Allegan Decorated Lip vessels were subjected to further scrutiny on the basis of paste and temper and areal distribution, and will be discussed below.

While variation of paste, temper, nature of decoration, and lip cross-section are in evidence for these vessels, they have not been
further subdivided into variants. The reason for this is because it was impossible to find a good criterion for subdivision, e.g. it appeared that lip cross-section was not particularly important to the aboriginal potters since all states were used, and it was impossible to determine whether any particular cross-section had any kind of spatial or temporal significance different from any other cross-section. Attempts to deal with paste and temper were unsuccessful. It is felt that since meaningful variants could not be created within this type, it is best not to assign vessels to variant groups at this time.

5. Allegan Decorated (Plate 7)

Four of 5 variants of this type that were defined by Rogers are represented at Hacklander, and 1 new variant is presented here. The attribute subcluster for this type is cordmarked exterior, smooth interior, absent rim thickening, presence of lip decoration, presence of exterior decoration.

A. Allegan Punctate (Plate 7a) - A single vessel represents this variant. Though this variant is characterized by rounded punctation in Rogers' study, the example from Hacklander has a single row of punctates produced with a round, hollow tool, perhaps a reed. Light cordwrapped tool impressions appear on the lip of this pot. Paste is sandy and not well compacted; temper is fine granitic grit.

B. Allegan Corded Punctate (Plates 7b-e) - Five vessels make up this variant. Plate 7b shows a pot with a single row of corded punctates running around the lower rim or neck of the pot. The same tool was used to produce the impressions on the outer edge of the lip. Paste is sandy and poorly compacted, and most of the interior of the vessel has split off. Temper is fine grit.

Plate 7c shows a similar vessel, though the lip decoration was not produced with the same tool. Paste and temper are similar to the former vessel.

The vessel shown in Plate 7d is unusual. This pot has 3 rows of punctates on the rim. Rogers did not encounter
more than 1 row of corded punctation. This vessel is better made than the previous 2, and is tempered with coarse to fine grit. Lip decoration was produced with the same tool as the punctates, apparently a cordwrapped paddle-edge.

Plate 7e shows 2 more unusual examples of corded punctation. Two rows of knotted cord impressions characterize 1 pot, while a single row of "knots-on-a-stick" appears on the other. Though knotted cord decoration was not noted by Rogers, these 2 vessels most probably fit this variant. Both pots are grit tempered and rather poorly made.

C. Allegan Linear Cord-impressed (Plate 8a) - This variant is the same as Rogers' "cord-impressed" with the qualification "linear" added. At Hacklander, this variant is represented by body sherds only, and at least 5 vessels are present. Up to 3 rows of horizontal cord or paddle-edge impressions characterize these sherds.

D. Allegan Rocker-stamped (Plate 8b) - One body sherd comprising 1 vessel represents this variant. The rocker-stamping over a smooth background is somewhat sloppily executed; paste and temper characteristics resemble Allegan Ware generally rather than the rocker-stamped Summerville vessel.

E. Allegan Zoned Rocker-stamped (Plate 8c) - While zoning of pottery vessels is supposed to go out with the Middle Woodland, it is believed that an exception to the rule exists at Hacklander. This vessel, represented by body sherds only, is better made than the Allegan Rocker-stamped vessel, and has a distinct zone line separating the rocker-stamping from a smooth surface. Paste and temper are different from the 2 Middle Woodland vessels, though it seems to be finer and better compacted than most of the Allegan Ware at the site. This vessel was probably made by the same people as the Allegan Rocker-stamped pot.

F. Allegan Incised (Plate 8d) - Four vessels comprise this variant. The sherds in Plate 8d display horizontal, oblique, and apparently non-patterned incising. It is perhaps noteworthy that no examples of the variant Allegan Cross-hatched (Rogers 1972:96) were found at Hacklander; the only incising on Allegan Ware pottery are these 4 vessels.

6. Spring Creek Collared (Plates 9, 10)

This is a pottery type first defined by Fitting (1968). For purposes of this study, Spring Creek Collared is considered to be a type within the category Allegan Ware. Fitting did not assign this type to
any particular ware group, and Rogers is also ambiguous in assigning Spring Creek Collared to the Allegan Ware category. At the Hacklander site, it is apparent that the makers of Spring Creek Collared pottery were most closely socially and culturally "related" to the makers of Allegan Ware rather than any other group. For this reason, Spring Creek Collared will be treated as a type of Allegan Ware.

The attribute subcluster defining this type is cordmarked exterior, smooth interior, absence of lip and exterior decoration, and presence of rim thickening. The rim thickening on these pots occurs in the folded and folded-and-collared states, rather than the collared state. It follows that, as defined in this study, Spring Creek Collared should actually be called "Spring Creek Folded", since rim folding - not collaring - characterizes these vessels. The original type name will stand, of course, simply for convenience and because it has been extensively used in the literature.

In general, Spring Creek Collared ceramics (N=32) at Hacklander most closely resemble the Allegan Undecorated Cordmarked and Decorated Lip types with regard to paste and temper, which is quite variable. Rim cross-sections are straight to slightly everted. The predominant lip cross-section is flat, though thickened and some round lips do occur. This situation parallels that encountered by Fitting in his definitive analysis of this type. Fitting did not create separate variants on the basis of lip cross-section, and there is no apparent reason to do so at Hacklander either. That is, there is no indication that any lip cross-section has a spatial/temporal/cultural context different from any other.
All but 4 examples of Spring Creek Collared are undecorated. It was decided to not establish variants for the decorated pots, since all 4 are different and do not duplicate variants at any other sites. Plate 10d illustrates a well made vessel with extremely fine-line chevron incising below the fold (actually, the fold and collar). The chevron incising may well have been executed with a flint chip. Plate 10b illustrates the only example of corded punctation on a Spring Creek Collared vessel. Plate 10d shows the only occurrence of lip decoration on a vessel of this type, apparently made with a cordwrapped object. The pot in Plate 10e shows bold cross-hatched incising on the interior of the rim. This sherd is almost identical in every respect to a vessel illustrated by Rogers (1972:106, pl. 8a) from the Fennville site. The Fennville example may be castellated; this was impossible to determine for the Hacklander pot. The vessel in Plate 10c is unusual in that it is fabric impressed rather than cordmarked; it may be that this vessel should not belong to this type, but it seems unwise to form a new type on the basis of a single example.

It should be pointed out that the decorated examples of Spring Creek Collared found by Fitting (1968:19, 23) and Rogers (1972:59, 87) usually consisted of circular punctation in 1 row just below the fold. This mode of decoration was not employed on this ceramic type at the Hacklander site.

Hacklander Ware

Hacklander Ware is a term that refers to a group of pottery that is different from the Allegan Ware or miscellaneous ceramics at the Hacklander site. It is believed that the people who made the Hacklander
Ware and left its fragments at the site differed socially and culturally from the makers of Allegan Ware.

It is with some reluctance that this totally new ware group is defined here; the total sample of Hacklander Ware consists of only 34 vessels with rims and perhaps 5 others represented by body sherds only. It would be highly desirable to obtain a larger sample for the purpose of defining a ware group, but Hacklander is the only known site where these ceramics occur in any quantity.

These ceramics are obviously distinctive when visually compared to the Allegan Ware assemblage. Most examples are decorated, and all are very well made in contrast to most Allegan Ware types. Most importantly, the chi-square cluster analysis indicated an attribute cluster that differed significantly from the cluster that formed the basis of the Allegan Ware types and variants. That is, Hacklander Ware is defined on the basis of a different non-random cluster of attributes than the Allegan Ware. In addition, it was mentioned earlier that the distinctiveness of this pottery was pointed out by the polythetic CLUSTER program as well. Likewise, the program TYPE segregated most of these vessels in the early stages of subdivision. On the basis of statistical analysis, then, the group of pottery called Hacklander Ware will be defined, in spite of the fact that only a small sample of it is presently at hand.

It should be pointed out that it was usually quite difficult to assign these vessels to variant groups. That is, the procedure of designating vessels into variants based on mode of decoration was desired in order to be consistent with the Allegan Ware typology, but in
many cases vessels were completely unique, possessing their own configuration of decorative attributes, and in these cases there would be as many variants as vessels. To avoid this unwieldy situation, it was decided to assign vessels to variants based on their "primary" mode of decoration, or the mode of decoration that seemed to dominate the pot. For example, one vessel decorated with rocker-dentate stamping, circular punctation, and an appliqué strip is called simply Hacklander Rocker-dentate, since this attribute is dominant in the overall motif. All forms of lip decoration have been omitted from consideration, but will be noted where observable.

1. Hacklander Undecorated (Plates 11, 13)

This type was defined statistically by the following attribute subcluster: striated and smooth exteriors, striated interiors, smooth lip, absent lip and exterior decoration. Some decorated lips have been included, however, as well as a cordmarked exterior variant.

A. Hacklander Undecorated Striated (Plate 11) - This variant (N=9) exhibits striation of both interior and exterior surfaces; interior striation is always horizontal while exterior striations are horizontal, vertical, or oblique angle. Rim profiles are straight while 1 vessel displayed a slightly everted profile. One example each of dentate (Plate 11a) and cordwrapped stick (Plate 11b) lip decoration occur on 2 pots. The tempering material of these vessels characterizes Hacklander Ware generally; fine grained bits of black and white granitic rock were used, which is distinctive and different from all other pottery at the site. Paste is well compacted and laminate splitting and coil fractures are almost non-existent.

The striations on this variant - and on the interiors of almost all other variants - are unmistakable. A notched or toothed object has been dragged over the still-wet clay to produce the striated effect. Laboratory experimentation by Jerrel Sorensen has demonstrated that the tool used may well have been the same tool as that used to produce rocker-dentate stamping. Sorensen duplicated both rocker-dentate stamping and striations using a notched mussel shell. Held vertically and used with a scraping motion, striations were produced;
with a rocking motion, rocker-dentate stamping was produced. Plate 12 illustrates a single line of dentate stamping on the striated interior of a body sherd. These dentates are identical to dentate stamped exteriors, and it seems safe to conclude that they were produced, probably accidentally, in the act of striating the interior of this vessel with the same tool used to produce rocker-dentate stamping.

B. Hacklander Undecorated Smoothed (Plate 13a) - Five vessels make up this variant. One vessel has dentate stamping on the lip. Assignment to the Hacklander Ware category was done primarily on the basis of paste and temper; there are no striations on the interiors of these vessels. These rims are all quite small, however, and it was noted on several other variants that the striations did not come all the way up to the lip. This may explain the absence of striations on these pots.

C. Hacklander Undecorated Cordmarked (Plate 13b) - Three cord-marked vessels lacking decoration were noted. One has cord-wrapped tool impressions on the lip. Cordmarking is fairly well executed, and paste and temper resemble the variants described above. All interiors are striated with what appears to be the same kind of tool as the striated exterior pots.

2. Hacklander Decorated (Plates 14-22)

The attribute subcluster smooth/striated exteriors, striated interiors, smooth lips, presence of exterior and lip decoration defines this type. It will be shown though that cordmarked exteriors are also represented.

A. Hacklander Rocker-dentate (Plates 14-18) - Seven vessels with rims and 2 others represented by body sherds comprise this variant. Plate 14 illustrates a vessel with vertical rocker-dentate stamping, 1 row of horizontal circular punctates, and a dentate stamped appliqué shoulder strip. The lip is also dentate stamped; the interior is striated. Fine black and white grit is present in the well compacted paste. The rim profile is straight.

Plate 15 shows a similar vessel. This vessel, however, is better made than the former example; the dentate stamping is finer and more readily discernible and runs both horizontally and vertically. The appliqué strip is smaller, better applied, and is also dentate stamped. Punctuation is absent. The heavily striated interior of this vessel is illustrated in Plate 16. The rim profile shows a very slight eversion.
Plate 17 illustrates the remaining rocker-dentate stamped vessels that possess rims. All are very similar with regard to paste and temper. Vessel 17a is unique in that the interior is smooth rather than striated. Vessel 17b has what appear to be small knot punctations on the lip; the profile of this rim is slightly everted. Apparently, none of these vessels was decorated with an applique strip.

Typical examples of rocker-dentate and punctate decorated body sherds appear in Plate 18. Plate 18a shows a dentate stamped applique fragment that most likely belonged to a rocker-dentate stamped pot. Notice that the stamping is nearly always either horizontal or vertical; very few examples of oblique angle orientation are present. All of the illustrated body sherds have horizontally striated interiors.

B. Hacklander Cordmarked Applique (Plates 19, 20) - This variant consists of a single vessel. The exterior surface is cordmarked and the striated interior is shown in Plate 20. The cordmarking on this vessel is very nicely and symmetrically executed, in contrast to the usual sloppy or careless cordmarking on many Allegan Ware vessels. Paste and temper are typical of the Hacklander Ware group generally: fine, crushed, black and white granitic rock was used, and paste is well consolidated. The rim cross-section of this vessel is similar to the rocker-dentate vessel in Plate 15 - it is nearly straight but angles outward slightly from the neck. The applique strip occupied a position on the neck and was decorated with cordwrapped paddle-edge impressions; the lip was decorated with the same tool. Most of the applique strip has broken off, but the impression left by its application can be clearly seen.

C. Hacklander Punctate (Plate 21a-c) - Five vessels exhibit circular exterior punctation as the sole mode of decoration. Punctation on these vessels is identical to that which sometimes accompanies rocker-dentate stamping. The interiors and exteriors of these pots are striated, and in one instance the lip has been impressed with a dentate tool. Punctation is usually shallow, but one example showed pronounced nodes or bosses protruding into the interior of the vessel.

D. Hacklander Corded Punctate (Plate 21d) - The single vessel in Plate 21d comprises this variant. The exterior surface is evenly cordmarked; the interior is striated. A single row of corded punctates, apparently made with a cordwrapped stick, appears around the rim; the impressed lip decoration appears to have been produced with the same instrument. With the exception of the distinctive Hacklander Ware paste, temper, and striated interior, this pot resembles the variant Allegan Corded Punctate.

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E. Hacklander Cordwrapped Paddle-edge Stamped (Plate 22) - This rather cumbersome name denotes 2 vessels, which have been decorated with the horizontal impressions of a cordwrapped paddle-edge. The effect of this stamping is a "pseudo dentate stamped" appearance. Plate 22a illustrates a vessel with this decoration; stamping was done over a smooth surface, and a row of large, circular punctations runs just below the lip, which is also paddle-edge stamped. The interior is striated. This vessel appears to have been subjected to erosion, probably through inundation.

Plate 22b shows an unusual vessel. This pot has a straight rim profile, and the upper rim has been impressed with either a closely woven fabric or an extremely symmetrically bound cordwrapped paddle. The body sherds show the paddle-edge stamping like the former vessel. The lip is decorated with cordwrapped tool impressions, the interior lightly striated and an applique strip (Plate 22c) was present on the vessel somewhere below the fabric/cord impressing. The applique is also paddle-edge stamped. The resemblance between this vessel and the previous one is the paddle-edge stamping; this pot, with its unusual fabric or cord impressing should probably be its own variant. It is included here though because of the similarity of decoration, and there are already too many variants of Hacklander Ware represented by a single vessel. It is suggested, however, that this pot should indeed be assigned to a separate variant if and when further analysis warrants it.

F. Hacklander Cross-hatched (Plate 22d) - Again, a single vessel comprises this variant. It is cordmarked with striated interior, and paste and temper characteristics are typical. Making this pot distinctive is the presence of very fine-line diamond incising on the rim. This is the only instance of incising on a Hacklander Ware vessel.

Other Ceramics

Many vessels within the Hacklander site assemblage were not typed on the basis of the non-random clustering of their attributes. These pots will be discussed at this time; in certain cases, possible affinities to established types will be noted.

1. Moccasin Bluff Scalloped Lip (Plate 23a)

Four vessels comprise this type, which was defined by Betteral and Smith (1973:66). These sherds are smooth, with sandy paste and
and fine, light grit temper. The sherds are quite small, so it is not known whether the bodies were smooth also. A wide, rounded tool, possibly a finger, has been impressed into the wet clay at the lip to form the scalloped or "pie-crust" effect.

2. Moccasin Bluff Plain Modified Lip, Group 1 (Plate 23b)

One vessel represents this type, which was also defined by Bettarel and Smith (1973:63-64). The exterior edge of the thickened lip has been impressed, probably with the tip of a finger, producing a wide notching effect. The resultant lip planview is scalloped. This vessel was constructed from very sandy paste and coarse grit temper; it is smooth, but some indication of smoothed cord impressions is in evidence.

3. Moccasin Bluff Plain Modified Lip, Group 2 (Plate 23c)

A single sherd of this type (as defined by Bettarel and Smith 1973:63-64) is present at Hacklander. A small, rounded tool has been impressed into the outer edge of the beveled lip, producing a narrow notched effect.

4. Vase Corded-like (Plate 24a)

This single vessel most resembles the type Vase Corded (Fitting 1965:45). This example has a very silty paste, and is tempered with fine to medium grit. The tool impressions on the outer rim seem to have been produced with a cordwrapped paddle-edge; the impressions on the lip were made with a different, narrower tool. While this vessel resembles Vase Corded more than any Allegan Ware vessels, the resemblance is not identical and the type name is assigned here tentatively.

5. Unnamed Collared (Plate 24b)

These 4 vessels display "true" collaring as defined in this study. It seems unwise to include them in the type Spring Creek Collared
because they do not resemble those pots at Hacklander or anywhere else. The sherds vary among themselves as to paste and temper, and do not appear to be a homogeneous group. They appear to be rims from very large vessels.

6. Unnamed Castellated/Oblique Cord-impressed (Plate 25)

These may be the 2 most unusual vessels from the site. Both have folded rims, cordmarked exteriors, deliberately cordmarked interiors, and are castellated, with corded tool lip decoration. The vessel in Plate 25a has cordwrapped paddle-edge impressions in a chevron-left fashion on the fold. Plate 25b shows a similar vessel; this vessel possesses only oblique-right paddle-edge impressions, and is more carefully constructed and decorated than the former pot. Both vessels have poorly compacted, silty paste and both pots have a tendency toward laminate splitting. Notice that vessel 25a appears to have a rounded castellation, while 25b is peaked.

7. Unnamed Oblique Cord-impressed (Plate 26 a, b)

Two vessels have been assigned to this type. With regard to paste, temper, and mode of decoration, these pots resemble the castellated pots described above. Neither of these pots is apparently castellated though, nor do they possess lip decoration. The vessel in Plate 26b has a cordmarked interior, but is somewhat different from the castellated vessels. It is not possible to accurately determine the nature of the interior surface of the sherd in Plate 26a. In any case, these pots may have some affinity to the castellated pots in Plate 25.

8. Unnamed Corded-tool impressed (Plate 26 c-f)

Plate 26 c, d illustrates 3 vessels with cordwrapped stick or paddle-edge impressions on the exterior surface at an oblique angle to
the lip. The pot in 26c was also probably decorated with knot impressions below the lip. These vessels are all very similar with regard to paste and temper and are potential candidates for the type Allegan Decorated; however their distinctiveness prevents their inclusion in this type.

Plate 26e shows an unusual vessel. It is cordmarked and has 2 rows of linear cord impressions near the neck. On the upper rim, cordwrapped stick impressions have been applied in several rows; the same tool was used to decorate the pointed lip. This pot may also have been made by the makers of Allegan Ware.

Plate 26f shows 2 vessels decorated with lunate punctations, apparently applied with a rounded end tool. Both sherds have similar paste and fine grit temper, but probably represent 2 separate pots.

9. Unnamed Castellated (Plate 27)

This assortment of 6 vessels bears little resemblance to other ceramic types at the site or generally to each other. Vessel 27a appears to have a slight low castellation, though this is debatable. The rim has been collared. Paste and temper most resemble the castellated/oblique cord-impressed vessels; in addition, the interior has been deliberately cordmarked.

Vessel 27b is sharply castellated and has a collared rim as well. Tempering material is very coarse grit. Deep, corded punctations have been applied around the collar, which has been smoothed. Body sherds from this pot are cordmarked and display bold, wide incising in what appears to be a chevron-left or -right pattern.

Vessels 27c and d are somewhat similar: both possess "pointed" or "peaked" castellations. The exteriors of these vessels are smooth.
Paste is sandy and tempering material is very fine, light grit. These pots resemble some of the pottery from the Allegan Dam site, located on the Kalamazoo River upstream from Hacklander.

The collared vessel in Plate 27e also appears to be castellated, but the peak has broken off. This pot is cordmarked, rather well made, and has sandy paste and coarse grit temper.

Vessel 27f most resembles the castellated/oblique cord-impressed vessels with regard to paste and temper. The interior of this pot appears to have been brushed with some kind of fine fiber. The lip of the vessel is notched, and the exterior shows smoothed cordmarking. A row of what are probably finger impressions decorates the rim area.

**Miniature vessels**

Six examples of what appear to be miniature pots were recovered at Hacklander; they appear in Plate 28.

Vessel 28a is a temperless pot with silty, poorly compacted paste. The exterior is cordmarked, and decoration consists of 1 row of pointed, circular punctations on the lip and 1 on the shoulder.

Vessel 28b is decorated with a similar instrument. It is cordmarked, temperless, and very poorly made.

The remaining 4 pots are all very similar. All exteriors are smoothed cordmarked; none are decorated. All are rather poorly manufactured, and vessel 28c is somewhat warped - this pot may not have survived firing in 1 piece. Pot 28f is the only miniature pot with temper, which consists of 3 pieces of fine grit; the inclusion of temper may well have been unintentional.
Other Clay Artifacts

Pipes

One complete clay pipe and the fragments of 7 probable others were recovered from the site.

The complete specimen appears in Plate 29a. This artifact is probably the most carefully manufactured clay artifact at the site. The pipe has a shallow elbow bend and tapers evenly to the mouthpiece. The paste is very well compacted, and the exterior surface appears to have been rubbed or burnished. A small amount of extremely fine—almost powdered—grit temper is present in the paste. This pipe is almost identical to one illustrated by Ritchie (1965:plate 80, no. 18) that is attributed to the Kipp Island Phase in New York State.

Plate 29b shows a fragment of the dorsal side of a pipestem; this piece was apparently near the bowl, as indicated by the lump on the right end. This artifact is not as well made as the former specimen, and it is temperless.

Plate 29c shows another temperless pipestem. The bottom of the stem has been flattened; the exterior surface appears to have been burnished.

The bowl fragment in Plate 29d is heavily tempered. The shape of this sherd suggests a pipe bowl, though it may actually be a miniature pot.

The remaining 4 very small bowl fragments also appear to have once belonged to clay pipes. One example has a notched lip, while another exhibits a notched lip and oblique angle incising on the exterior.
Clay coils and lumps

About a half-dozen fragments of fired clay coils and "lumps" were recovered. It is believed that these are waste products of pottery manufacturing that were unintentionally fired.

Components and Distribution of Ceramics

Introduction and general remarks

The remainder of this section will address itself to 2 objectives: 1) to use the typology to determine different occupations of the site; and 2) to also determine the relative chronological positions of these components. As will be seen below, these tasks were not completed without some uncertainties as to placement of certain types and variants into a spatial and temporal framework.

Archaeological research throughout the last 3 to 4 decades has demonstrated that the best approach to take when trying to isolate components in a multi-component site (or in the study of archaeological materials generally) is an integrated or conjunctive approach. That is, it is most advantageous to utilize all artifactual and ecological data, not just one class of data. It is beyond the scope of this study to do so, however; in addition, detailed analyses of all artifactual and ecological materials have yet to be carried out (with the exception of the animal remains, Martin 1976). The sequence of occupations and chronology to be presented here are based primarily on the pottery, then, though data from faunal, botanical, and lithic analyses will be drawn upon where applicable/possible. The reader is thus advised that what
appears here is essentially a description of ceramic components and ceramic chronology.

It should be pointed out at the outset that in many cases it was very difficult to cogently interpret the distributions of certain ceramic types on the site. Though Hacklander is a relatively undisturbed site in that it has never undergone plowing or cultivation, most of the cultural deposits are shallow. It appears that disturbances of cultural remains in these shallow deposits has taken place here, quite probably by the aboriginal inhabitants as much as recent activities. That is, it is logical to assume that debris from a given component was trod upon and disturbed or displaced by successive occupants. It is believed that there is not one spot on the entire site that was occupied by only one group of people at only one point in time.

This situation brings up another point. No attempt to utilize quantitative spatial analysis was made to assist in the determination of components. Though statistical analysis of this kind can be very beneficial to this sort of endeavor, it was felt that the somewhat mixed, disturbed nature of the pottery distribution would prevent any meaningful results from being obtained.

Another problem in determining intra-site ceramic chronology is the fact that, out of the 56 features excavated in 2 seasons' work at Hacklander, very few have any really good artifactual or "ecofactual" associations with datable charcoal samples. It was not unusual to find well defined features with more than enough charcoal for dating but which lacked any artifactual associations. For this reason, only 3 radiocarbon dates have been determined for features at the Hacklander site.
Radiocarbon dates

Three radiocarbon dates were run on charcoal from the Hacklander site, the results of which are as follows: 1) wood charcoal from feature 25 - 1260 ± 110 B.P.: A.D. 690 (Gak - 5948); 2) wood charcoal from feature 15 - 930 ± 110 B.P.: A.D. 1020 (Gak - 5946); and 3) wood charcoal from feature 16 - 880 ± 880 B.P.: A.D. 1070 (Gak - 5947).

Feature 25, from which the earliest date was obtained, is a deep, symmetrical feature that may have functioned as a storage and/or refuse pit. The feature is located in Area I in square 1129 and 1129 extension (see Map 3, p. 99). The feature was first discovered at 18 in below surface, has a roughly conical cross-section, and extends to a depth of 27 in. The charcoal used for dating came from the center of the pit, below 18 in. Faunal analysis by Terrance Martin (1976:183) has indicated that 28 unidentifiable mammal, 8 soft shell turtle, and 1 Canis sp. phalange fragments were present in the fill, probably suggesting a warm weather seasonal placement for this feature. Ceramic associations consisted of 9 cordmarked body sherds and 5 fabric impressed body sherds; no rimsherds were encountered below 18 in directly within the pit. Three Allegan Undecorated Cordmarked, Beveled Lip variant rims were present in level 4 (9-12 in) directly above the pit and each rim represents a single vessel. The cordmarked body sherds directly associated with the charcoal and throughout the excavation unit generally appear to belong to at least 2 of these 3 vessels. No fabric impressed rims were found. Also present in units 1129 and 1129 extension is a single rim and at least 10 body sherds representing 1 vessel of Hacklander Undecorated Cordmarked. All the Hacklander Ware sherds were
Map 3. Location of aboriginal features.
found directly above or above and adjacent to the feature itself; no Hacklander Ware sherds were found in direct association with the dated charcoal. The Hacklander Cordwrapped Paddle-edge Stamped pot with the unusual fabric or cord impressed rim was also found in square 1129. None of the 2 rims and about 5 body sherds of this vessel were found associated with the feature. Finally, a single rim representing a vessel with a "true" collar was recovered from level 5 (12-15 in); again it is not associated with the feature.

Feature 25 seems to represent a deliberately dug storage and/or refuse pit. Faunal data suggest warm weather subsistence activities were carried out here, some of the remains of which were deposited in the pit. The pit was dug and used somewhere around A.D. 690 ± 110, and the people who made it also made Allegan Cordmarked and Fabric Impressed pottery.

Radiocarbon assays were also determined for features 15 and 16. Feature 15 is a large, structurally amorphous refuse pit or "refuse area"; the feature is approximately 6 ft across, is more-or-less circular in planview, and extends into the sterile subsoil to a depth of 15 in. The feature is located in squares B, C, and 624 (see Map 3). Feature 16 lies in square 624, approximately 3 ft from the edge of feature 15. Feature 16 appears to have been a hearth; it was encountered at 9 in below surface and ended at 12 in.

The faunal assemblages from these features are similar (Martin 1976:111-112) and include a large amount of large mammal, some fish, soft and hard shell turtle, raccoon, muskrat, and bird remains (Martin 1976:184-185). It appears from Martin's analysis that the features were utilized during warm weather.
Lithic debitage and artifacts are plentiful from the general area within and surrounding these features. Distinctive are several small corner- and side-notched projectile points. Unifacial artifacts are present also.

The ceramic assemblage from this area consists primarily of Hacklander Ware. Four Hacklander Rocker-dentate vessels were found; 2 from within feature 15, 1 from feature 16, and 1 from square C. The Hacklander Cordmarked Applique vessel was found adjacent to feature 15 in square B; 1 Hacklander Punctate vessel was found within feature 15; 2 Hacklander Undecorated Smoothed pots were found in square B, as well as 2 Hacklander Undecorated Striated pots, 1 of which came from the adjacent square 00 (see Maps 2 and 3). These 10 vessels represent nearly 30% of the entire Hacklander Ware sample.

As characterizes the heterogeneous nature of the ceramic distribution generally, other pottery types were found in the feature 15 and 16 area. One example of Spring Creek Collared was encountered in square B; 1 Allegan Punctate, 3 Allegan Undecorated Cordmarked, and 4 Allegan Decorated Lip vessels were found in squares B, C, and 624. One miniature vessel and 1 of the Castellated/Oblique Cord-impressed pots were found in squares B and 00 respectively. It is important that none of these non-Hacklander Ware rims were encountered within the confines of feature 15 or feature 16, though some of the related body sherds were present.

It was hypothesized at the time of excavation that the spatial arrangement and artifactual associations between these 2 features indicated a similar temporal placement. The resultant dates of

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A.D. 1020 ± 110 for feature 15 and A.D. 1070 ± 100 for feature 16 confirmed this hypothesis.

It should be stressed that, while there is pottery other than Hacklander Ware within both these features, it is firmly believed that the radiocarbon dates apply to the Hacklander Ware pottery. By far the bulk of the pottery within the features was Hacklander Ware; most of the Allegan Ware came from the levels above the dated charcoal. Feature 15, for example, was dated by a carbon sample from level 4 (9-12 in), and 90% of all pottery from this level was Hacklander Ware.

To summarize, the evidence indicates that feature 15, a large refuse pit, and feature 16, an associated hearth, were constructed and used during the eleventh century A.D. These features were used during warm weather; the people who made, used, and broke Hacklander Ware most probably also made the features.

Components

The earliest occupation of the Hacklander site took place sometime during the Middle Woodland period, perhaps within the first few centuries A.D. Two pottery vessels, 4 large corner-notched bifaces and/or biface bases, and a unifacially retouched blade, possibly made of Illinois flint (Jerrel Sorensen, personal communication), are the only material remains of this occupation. The Sumnerville pot and the lithics were found scattered throughout the block excavations in Area II generally, and the untyped vessel came from unit 594, level 7, in Area I. The sparse evidence of this occupation prevents any definitive statements regarding the nature of this occupation, except that it appears to have been neither intensive nor extensive.
It is believed that the radiocarbon date of A.D. 690 marks the earliest Late Woodland occupation of Hacklander. The ceramics manufactured during this occupation are as follows: Allegan Undecorated Cordmarked, the Flat, Round, and Beveled Lip variants; Allegan Undecorated Fabric Impressed; Allegan Rocker-stamped and Zoned Rocker-stamped; some of the Allegan Incised; Allegan Linear Cord-impressed; Allegan Corded-punctate; and some or most of the Allegan Decorated Lip. This component will be referred to as the Early Allegan occupation.

This component appears to have been the largest at the site. The identification of this component is based as much on faunal data and feature structure and presumed function as on the pottery. Map 4 (p. 104) shows the distribution of features and ceramics that are believed to relate to this component. Feature 25, from which the radiocarbon date was derived, appears to have been utilized during warm weather - the presence of soft shell turtle remains would suggest this. Several other features are similar in faunal content and/or feature structure. In Area III, feature 43 yielded soft shell turtle remains (Martin 1976:188) and is structurally similar to feature 25. Within the same unit is feature 37, which is an oblong pit about 6 ft long by 3 ft wide, extends to a uniform depth of 16 in, and is literally shaped like a bathtub. The nature and function of this feature are unclear. At the time of initial excavation, it was thought that this might be a burial pit; several wagers were lost when it promptly terminated at 16 in and failed to produce a skeleton. It is conjectured that aboriginal activities may not be wholly responsible for this feature, but its nature and function remain problematical. At any rate, the faunal
Map 4. Early Allegan component.
assemblage from the fill of the pit included soft shell turtle remains, similar to the adjacent feature 43 and to feature 25 (Martin 1976:187).

The Area III judgement excavations uncovered an abundance of features. Some may relate to this component, but this is difficult to ascertain. Four features, 33, 34, 38, and 49, were all encountered at a depth of approximately 24 in below surface and are for the most part structurally similar - they all appear to be small hearths. No definitive warm weather faunal remains were associated, however (Martin 1976:186-188), and the suggestion that these features may relate to this component is based primarily on their depth; these are the deepest features in this area, indicating an early temporal placement.

Ceramic associations with these 4 features are non-existent. That is, none of these features yielded any diagnostic material. Ceramics that are believed to relate to the Early Allegan occupation occur throughout the block excavations generally, though, and include Allegan Undecorated Cordmarked, Flat, Round, and Beveled Lip variants; Allegan Decorated Lip; and Allegan Linear Cord-impressed. The stratigraphic distributions of these pots seem to be disturbed, though the Flat, Round, and Decorated Lip pots extend to the greatest depth in the midden relative to other types, about 12-27 in.

In Area III, near the edge of Area I, ceramic associations are clearer. Associations with features 37 and 43 included Allegan Undecorated Cordmarked, Round Lip; Allegan Zoned Rocker-stamped; Allegan Linear Cord-impressed; and Allegan Incised. A sherd of the zoned vessel was found in the nearby square 163, as well as the single sherd representing the non-zoned rocker-stamped vessel. Square 219, located
to the south of features 37 and 43, contained an Allegan Undecorated Cordmarked, Flat Lip pot, as did square 82 to the north, which also yielded an example of Allegan Decorated Lip. A single example of Allegan Corded-punctate was recovered from the nearby square Z.

Further to the north in Area I, features 7, 8, and 9 are all structurally similar to features 25 and 43 — they are deep, symmetrical, and do not begin until well below the surface, approximately 12-15 in. Features 7 and 8 contained warm weather fauna while feature 9 contained no faunal material (Martin 1976:183). Features 2, 3, 5, and 23 are also probably related; feature 2 is a deep pit structurally similar to the above features with mammal remains associated, feature 3 is a small hearth with a single mussel shell associated, feature 5 is another deep pit with mammal remains (Martin 1976:183), and feature 23 is a similar pit with mammal and soft shell turtle remains, as well as *Canis* sp. phalange fragments, which were also found in feature 25 (Martin 1976:98, 185).

Ceramic associations with these 7 features range from excellent to absent. Allegan Undecorated Cordmarked, Flat Lip vessels are found with features 3, 8, and 23; the Round Lip variant of this type was found with features 2 and 23; and the unit containing feature 23 yielded an example of Allegan Corded-punctate. There are no pottery associations with feature 7, though the nearby square 847 yielded an example of Allegan Decorated Lip; no ceramic associations accompany features 5 and 9.

The western half of Area I also contained pottery from this occupation. Most vessels occurred in or near the block judgement pits; this area of the site was occupied at least 3 times by 3 different
groups of people, so the nature of the distributions in this area leaves something to be desired, especially regarding this early occupation. Several features were found in this part of the site, but none could be accurately assigned to this component.

Allegan Corded-punctate occurs in squares 1056, 624, and B, D, and E; this area of the site contains the highest concentrations of this variant. Allegan Decorated Lip is plentiful in the greater Area I judgement area, as well as the Allegan Undecorated Cordmarked variants. The single representative of the variant Allegan Punctate occurs in square C.

It should be evident from the foregoing that the distribution of pottery believed to be associated with the Early Allegan occupation is not ideal. The entire site was occupied to some extent, and it is impossible to draw a nice line on the site map to delimit the component. Faunal remains and feature structures are as important as the pottery in the definition of this component, though neither faunal nor ceramic associations with features show any real consistency. Certain ceramic types and variants seem to occur more often than others (though never always) in certain areas of the site or with features. Two variants of Allegan Undecorated Cordmarked, the Flat and Round Lip variants, occur literally all over the site and possess the strongest associations with features. Allegan Decorated Lip has a similar distribution, though this type is not as plentiful in numbers, and there is not a single instance of a Decorated Lip vessel associated with a feature.

It is believed that an explanation can be offered to account for this lack of distributional and associational consistency. The nature
of the features and ceramic distributions suggests something other than a single, intensive occupation. Rather, the differential distribution of pottery variants and types might indicate seasonal re-occupation of the site by the same or a culturally similar group of people. Three assumptions underlie this hypothesis: 1) different areas of the site were reoccupied, rather than the same spot; 2) changes in emphasis on and nature of ceramic decoration were taking place during this period; and 3) similar subsistence activities were being participated in by the occupants, as indicated by the faunal remains and feature structure.

If these assumptions can be accepted as correct, then the differential distributions of ceramic types and variants of this component might indicate seasonal re-occupation. For example, the variants Allegan Linear Cord-impressed, Rocker-stamped, Zoned Rocker-stamped, and Incised are found only in Area III. Allegan Punctate and Corded-punctate are found in Area I, with 1 Corded-punctate vessel in square Z just over the border of Area I in Area III. Fabric Impressed vessels occur only in the northwestern portion of Area I - squares XX, D, E, and feature 25. Allegan Decorated Lip occurs most often in the areas where Allegan Corded-punctate and Punctate occur, but not, with one exception, in the Rocker-stamped and Incised area. Allegan Undecorated Cordmarked, Flat and Round Lip variants occur with all other variants and, if this hypothesis is correct, show a greater degree of continuity over time than any other variant. Allegan Decorated Lip, though believed to be early in the Late Woodland sequence (Rogers 1972:91, 94; Betteral and Smith 1973:111), may also be temporally persistent. It should be added that all Allegan Ware displays a wide range of paste
and temper variability, further indicating that the pottery may not have been made all at the same point in time.

If differential areal occupation and ceramic change through time can be assumed, then it is apparent that the early Late Woodland occupants of the Hacklander site seasonally reoccupied the site during warm weather months during, possibly before, and probably after A.D. 690. A fairly long span of time may be in evidence here; lip decoration seems to persist into later periods, as well as flat lips (Rogers 1972:93-94), while rocker-stamping, zoning, and possibly corded-punctation are restricted to earlier periods (ibid). It does not appear that the actual seasonal occupations or their relative chronological positions can be determined with certainty, though the hypothesis that certain types or variants are earlier or later in time can be tested by the examination or excavation of other Allegan Ware sites.

The above discussion and the tentative conclusions reached are not based on the strongest of data. Further attempts to isolate this (and other) Allegan Ware components were made, none of which met with much success. These undertakings will be briefly summarized at this time, because they do demonstrate something of the nature of Allegan Ware in general.

The judgement block excavations in Area III tended to be quite deep in contrast to the rest of the site. The vertical distribution of ceramic types in this area was examined in an attempt to determine whether components could be isolated on stratigraphic grounds. Unfortunately, the distribution showed marked mixing of types, although the tendencies of some types and variants to occur above or below others were noted as
indicated above. Possible stratigraphic evidence for isolating other components will be presented below.

At the Moccasin Bluff site, located south of Hacklander on the St. Joseph River, Betteral felt that relatively earlier and later decorated and undecorated pottery could be discerned on the basis of paste and temper characteristics. The type Moccasin Bluff Cordmarked (analogous to Allegan Undecorated Cordmarked) and Moccasin Bluff Modified Lip (analogous to Allegan Decorated Lip) were both divided into 2 separate groups; Moccasin Bluff Cordmarked, Group 1a and Moccasin Bluff Modified Lip, Group 1 possessed coarse, dense black temper, possibly hornblende or magnetite, and rather sandy paste (Betteral and Smith 1973:52, 56). In contrast, Moccasin Bluff Cordmarked, Group 1b and Moccasin Bluff Modified Lip, Group 2 have fine to coarse temper consisting of granitic rock, including quartz grains, mica, and feldspar (Betteral and Smith 1973:53). The former types with the coarse black temper are believed to be earlier than the latter granitic grit types.

On the basis of Betteral's paste and temper criteria, the types Allegan Undecorated Cordmarked and Allegan Decorated Lip were subjected to subdivision to see if these ceramics duplicated the situation at Moccasin Bluff. They did not. While two groups were formed, each possessing (more-or-less) the above tempering characteristics, a larger third group was formed that did not fit either criterion. Since the pots possessing the Moccasin Bluff temper types varied somewhat among themselves (i.e., most sherds did not perfectly "fit" the criteria), and many vessels did not fit at all, this experiment was rapidly abandoned.
Along these same lines, another attempt to subdivide the two Allegan types on the basis of paste and temper was made. Chi-square tests were run between the vessels assigned to the Moccasin Bluff temper categories and temper size (largest observed particle). The chi-square value obtained was not significant at the .05 level, and the null hypothesis that there are no non-random associations between temper size and temper category was not rejected.

Finally, a chi-square calculation comparing the 4 Allegan Undecorated Cordmarked variants and the Allegan Decorated Lip pots with temper size was done; again a statistically non-significant result was obtained.

It has been pointed out that all Allegan Ware displays a wide range of paste and temper variability. This variability cannot be overemphasized, and it is unfortunate that attempts to deal with it objectively were inconclusive. Subjectively it is possible to intuit that the variability represents a group of pottery that was not all made at the same point in time by the same group of people or indeed, not all manufactured at the Hacklander site. It does not, however, seem possible to subdivide the Allegan Ware at Hacklander on the basis of paste and temper – the variability is just too pronounced to permit culturally or chronologically meaningful types or variants to be created.

After the Early Allegan occupation of the Hacklander site, the next occupants seem to have been the makers of the pottery called Hacklander Ware. The radiocarbon dates of A.D. 1020 ± 110 and A.D. 1070 ± 100 derived from features 15 and 16 respectively date this component. Map 5 (p. 112) shows the areal distribution of Hacklander Ware vessels across the site, as well as possible feature associations. Hacklander Ware
Map 5. Hacklander component.

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body sherds are found in differing quantities over much of Area I, though the greatest concentrations are in the northern half. One vessel of Hacklander Undecorated Cordmarked consisting of two rim sherds was found in Area III, as well as 3 striated body sherds and 1 rocker-dentate stamped sherd. This portion of the site appears to have been only lightly occupied by these people, or perhaps not occupied at all.

Because of the distinctiveness of the Hacklander Ware pottery and its rather circumscribed areal distribution, the Hacklander component is the easiest to deal with. Features 15 and 16, which are associated with this occupation, were described in detail above. Another feature that probably relates to this occupation is feature 56 in square XX, Area I. Though faunal associations do not directly indicate warm weather occupation (Martin 1976:190) like features 15 and 16, the plentiful Hacklander Ware pottery in and around this feature suggests contemporaneity. Feature 56 appears to have been a hearth or roasting pit of some kind. No other features can be assigned to this occupation with any certainty.

The distribution of Hacklander Ware types and variants is rather homogeneous across the occupied portion of the site. There are, however, a few distributions of variants that are worthy of note. Four of 7 rocker-dentate vessels occur in the area of features 15 and 16; squares B, C, and 624. Vessels with cordmarked exteriors (regardless of decoration) have the widest distribution: 1 in Area III and 3 near feature 25 and in test pit 2. Three of 5 Hacklander Punctate vessels were found in the greater feature 15 area: squares B, 00, and SS. This is interesting since 3 of 4 rocker-dentate pots in this area also possess punctation.
It would appear that the people who made Hacklander Ware occupied approximately the northern one-half of the site. Faunal evidence suggests a warm weather season of occupation. It does not appear that these people were at the site for any length of time. Unlike the previous occupation, the distribution of ceramics seems to indicate that the site was not seasonally reoccupied, and may have been occupied only once. Paste and tempering characteristics, in contrast to Allegan Ware, are remarkably homogeneous within Hacklander Ware, perhaps indicating that the pottery was made at the same point in time by the same group of people. In addition, Hacklander Ware ceramics are a relative rarity in comparison to the plentiful Allegan Ware. The Hacklander Ware occupation does not appear to have been very intensive.

The occupation succeeding the Hacklander component will be termed the Late Allegan component. This occupation is characterized by the Spring Creek Collared pottery, as well as some of the Allegan Ware variants. This occupation is difficult to delimit and describe accurately, i.e. the relationships of ceramic types are unclear. At the Spring Creek site, Fitting (1968:24, 26) found Spring Creek Collared ceramics in direct association with uncollared pottery, which he felt most resembled certain southeastern Michigan Wayne Ware types. Rogers encountered a similar situation at the 46th Street site (1972:59-59). It seems logical to assume that this would be the case at Hacklander also, but the relationship of collared to uncollared pots is difficult to ascertain, given the mixed nature of occupational debris.

The areal distribution of Spring Creek Collared ceramics is similar to that of the Hacklander Ware, although it is even more circumscribed (see Map 6, p. 115). On the basis of a similar distribution,
Map 6. Late Allegan component.
the Allegan variant Undecorated Cordmarked, Thickened Lip is believed to have been made by the same people. Lip thickening on non-thickened rim pottery is a characteristic of the Spring Creek assemblage (Fitting 1968:17-18); the heaviest concentration of this variant at Hacklander is in the greater Area I judgement area - paralleling the greatest frequencies of Spring Creek Collared. Both types also occur in minor frequencies in Area III. On the basis of these similar distributions, it is hypothesized that the Thickened Lip variant of Allegan Undecorated Cordmarked was produced by the Spring Creek Collared makers. Unfortunately, the characteristic variability in paste and temper of these pots does not indicate substantial similarities on these grounds.

Round lip cross-sections are not unusual on uncollared and Spring Creek Collared vessels (Fitting 1968:17-18); perhaps some of the variant Allegan Undecorated Cordmarked, Round Lip may also be related to this component. This association is purely conjectural, however, since as discussed above, the distribution of Round Lip vessels ranges over the entire site. A similar situation may be in evidence for the Flat Lip variant of this type also.

It may be that the Flat and Round Lip variants of Allegan Undecorated Cordmarked are forms that persist through a long period of time, i.e. from Early to Late Allegan. Both flat and round lip cross-sections were found at the 46th Street site, radiocarbon dated to A.D. 1180 and A.D. 1230 (Rogers 1972:49-50, 53-54). It is hypothesized here that these variants do indeed display this long time range. Allegan Decorated Lip is probably another type that persists into the Late Allegan; 1 Decorated Lip vessel possesses a thickened lip identical to the Undecorated
Thickened Lip pots. Also, some of the Decorated Lip pots in the Area I judgement area may relate to the Late rather than Early Allegan, though this is not possible to ascertain with certainty. Lip decoration is also present at the 46th Street site.

One example of Allegan Incised may have been made during this occupation. Although all other examples of Allegan Incised are believed to belong to the Early Allegan component, this vessel (which unfortunately lacked a rim) was found in level 1 above feature 15, placing it later than the Hacklander occupation. A rather large section of the shoulder of this pot was reconstructable and several other sherds from the vessel were found in levels 1 and 2, which would indicate that these sherds do actually post-date the Hacklander component, and were not "kicked-up" from the Early Allegan occupation. This pot, which exhibits horizontal incised lines on the shoulder, is the only decorated Allegan Ware vessel assigned to the Late Allegan occupation where decoration is a rarity, and it is notable that of the 4 Spring Creek Collared vessels that also possess decoration, 2 are incised.

An explanation regarding the temporal placement of this component later than the Hacklander occupation should be offered. The radiocarbon dates for collared pottery at the 46th Street site are not out of line with this occupation. The single date of A.D. 960 ± 75 from Spring Creek (Fitting 1968:10) is believed to date one of the earliest occurrences of thickened rims in southwestern Michigan; Spring Creek and 46th Street thus demonstrate a time depth of at least 250-300 years for this type.

Weak stratigraphic evidence also suggests a temporal placement later than the Hacklander component. In the deep midden area in Area III,
the 4 examples of Spring Creek Collared that were found here did not exceed a depth of 15 in, while certain Early Allegan pots reached a depth of 27 in. Three Allegan Undecorated Cordmarked, Thickened Lip pots did not exceed a depth of 12 in. This area of the site is disturbed, but this distribution suggests that the Late Allegan occupation at least post-dates the Early Allegan.

Squares E and RR in Area I produced the greatest frequencies of Madison and Levanna type projectile points on the site (Jerrel Sorensen personal communication). At Hacklander, as at Spring Creek (Fitting 1968:45), these lithic forms are believed to relate to the latter part of the Late Woodland. Nearly all these points were found in levels 1 and 2 (6 in). Sorensen has further suggested that this portion of the site may represent a lithic activity area. Indeed, few pottery vessels were found in square E; the bulk of the artifactual remains are lithics, and most of the ceramics (63%) in square E and the adjacent squares M, D, RR, PP, and NN are Spring Creek Collared, and Allegan Undecorated Cordmarked, Thickened and Round Lip.

The only feature that can be attributed with certainty to this occupation is feature 4 in square 399, Area I. Feature 4 is a hearth that was encountered only 1 in below surface and extended to a depth of 3 in. Two Spring Creek Collared pots were found in the hearth, and a third within the unit. Two additional vessels of this type came from the adjacent units TT and SS; 1 Allegan Undecorated Cordmarked Thickened Lip and 2 Round Lip pots came from the 3 units. It is believed that the shallow depth of this feature and the ceramic associations further support a later temporal placement relative to the deeper Hacklander component features, which lie nearby.
It has been mentioned in several places in the preceding pages that some pottery sherds from Hacklander appear to be water-worn, and that certain low areas on the site may have been inundated at certain times. This phenomenon may have some bearing on the relative chronology of the Late Allegan occupation.

While an accurate description of flooding at the Hacklander site must await a detailed geological report, the following evidence can be presented that suggests that flooding may have taken place prior to and during certain occupations. Martin (1976:94) suggested that the presence of freshwater snails in the lower levels of most of the units in Area II might indicate that this area was inundated at least to the present-day 179 m (587 ft) contour sometime prior to occupation of the site. It seems probable that while this particular flood stage pre-dates the Late Woodland occupations, the Middle Woodland occupation may pre-date the flooding; the Sumnerville vessel from Area II is definitely water-worn.

Later flooding is indicated by apparent erosion on Allegan and Hacklander Ware vessels below the 179 m contour; of the 4 Allegan Undecorated Cordmarked, Flat Lip vessels believed to be probably related to the Early Allegan component, 2 definitely show erosion, 1 is indeterminate, and 1 is debatable. This latter pot, from square VV, is nearly complete, and may relate to a different, more recent occupation, though precisely which occupation is unclear. The Allegan Decorated Lip vessels all appear to be water-worn. One Hacklander Rocker-dentate, 1 Cordwrapped Paddle-edge Stamped, 1 Smooth, 2 Striated, and the single Corded-punctate vessels all appear to have been water-worn, though to differing
degrees. In any case, all Hacklander Ware pots in Area II appear to have been wet for an extended period of time.

Further indirect evidence of flooding involves the total lack of well-defined features in Area II, perhaps suggesting water-reworking of the soil in this area. Or perhaps the soil in this area was always quite damp, as it is today, which would not facilitate the construction of features.

A study of pH content in Hacklander soil has been done by George Spero (1976). Spero's analysis showed that 4 units below 179 m in Area II tended to have average pH readings somewhat lower than the pits at the higher elevations in Areas II and I. If lower pH content in soil can be taken as an indication of inundation for a period of time, this analysis would further support the flooding hypothesis.

At the Schultz site in Saginaw County, Speth (1972:67, 72, 74), who studied the geology of that site, suggested that several periods of high water were in evidence there. The latest of these is believed to have occurred after the eleventh century A.D., when water levels at Schultz may have reached a height of as much as 586 ft MSL. Speth has cautioned that his conclusions are tentative pending corroborating evidence from other studies, but his last high water stage may be the same high water period that is in evidence at Hacklander. As mentioned, a detailed study by a geologist is needed to substantiate (or reject) the general evidence and impressions presented here.

How does this relate to the Late Allegan occupation? It relates in that only a single vessel (1 rim sherd) of a Spring Creek Collared vessel was found below the 179 m contour - the area believed to have
been affected by high water inundation. The tentative evidence presented above pointed out that Hacklander Ware in Area II below 179 m, dated to the eleventh century, appears for the most part to be water-worn and can be considered to pre-date the high water stage. Spring Creek pottery may have been deposited on the site during the high water stage, since only 1 sherd of this type occurs in the flood area, suggesting that this part of the site was not heavily occupied (or not occupied at all). In addition, no Allegan Undecorated Cordmarked, Thickened Lip occurs in this low area; 3 examples of Round Lip do occur, but this indicates more that the association of this variant with this occupation is in question, not that the area was occupied at this time.

From the foregoing, it is hypothesized that the Late Allegan occupation post-dates the radiocarbon dated Hacklander occupation; guess dates might be A.D. 1100-1300, which are similar to the 46th Street dates.

Ceramic evidence indicated that at least 1 and perhaps 2 more occupations of the Hacklander site occurred after the Late Allegan. One of these is represented by the various castellated vessels; most of these pots do not resemble one another, and attempts to stylistically associate these pots with any others were largely inconclusive. No feature associations are in evidence for any of these vessels. The 2 Castellated/Oblique Cord-impressed vessels and the 2 apparently uncastellated Oblique Cord-impressed vessels are similar, and may have been produced by the same group. These 4 pots are widely separated over Areas I and II - from unit 711 in Area I to unit 20 in Area II. Very
little can be said about the nature of the occupation represented by
the castellated pots, except that it (they?) is probably later than the
Late Allegan occupation.

Another occupation may be roughly contemporaneous with this one.
This component is represented by the 4 examples of Moccasin Bluff Scalloped Lip; all these pots occur in Area III, and the type Allegan Undecorated Smoothed may be related to the Scalloped Lip pots - most examples are also found in Area III, and are similar in paste and temper. Should this prove to be the case (and it seems unlikely that this can be determined at the Hacklander site), then these vessels should probably not be included within the Allegan Ware category. Scalloped and smooth pots are present at the unpublished Allegan Dam site, as well as castellated pottery similar to the 2 smooth "peaked" vessels from Hacklander. Most of this pottery at Allegan Dam is shell tempered, though. At Moccasin Bluff, Betteral (1973:118) felt that Scalloped Lip vessels belonged to the proto-historic period.

A final component at Hacklander appears to have been aceramic. In Area III, features 30, 40, and 46 yielded evidence of warm weather subsistence activities, possibly suggesting fur trapping (Martin 1976:122). Associated cultural material included 9 white seed beads, 2 green-brown gunflints, several green glass fragments (ibid), and a small metal fragment. Martin (1976:118), quoting Quimby (1966:90), states that the seed beads may indicate an occupation during the Late Historic period (A.D. 1760-1820). These occupants were probably participating in fur trapping activities in this part of the site. No apparent ceramic associations accompanied any of this faunal or artifactual material.
The cultural and chronological position of the pipes and miniature vessels is unclear. Several of the pipe fragments were recovered in or near feature 15, and may relate to the Hacklander component. The intact specimen resembles a Late Middle Woodland pipe from New York (Ritchie op cit), which may indicate a temporal placement in the Early Allegan component. This is uncertain because of the presence of Spring Creek Collared vessels within the same unit.

All but 1 of the miniature pots were found in Area III; 4 occurred at differing depths in the block excavations, and 1 came from square 219. The sixth vessel was recovered from square B in Area I. It seems probable that the Early Allegan occupants made these pots, though this cannot be stated with certainty. It does seem certain that the makers of the miniature pots were not the makers of Hacklander Ware.

Table 16 (p. 124) presents, in summarized form, the preceding discussion. All component occupations at Hacklander and the ceramic chronology are indicated. The chronology and temporal placement of pottery types and variants is, of course, tentative and subject to change in light of new data.
Table 16
Ceramic Chronology and Components of the Hacklander Site

<table>
<thead>
<tr>
<th>Dates</th>
<th>Component</th>
<th>Associated Ceramics</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.D. 1760-1620</td>
<td>Late Historic</td>
<td>None</td>
</tr>
<tr>
<td>Post-A.D. 1300(?)</td>
<td>Unnamed Component</td>
<td>Moccasin Bluff Scalloped Lip; Allegan Smooth(?); Unnamed Castellated pottery; Unnamed Collared pottery; Unnamed Oblique Cord-impressed(?).</td>
</tr>
<tr>
<td>c.a. A.D. 1100-1300</td>
<td>Late Allegan</td>
<td>Spring Creek Collared; Allegan Undecorated Cordmarked, Thickened Lip, and probably Flat and Round Lip; probably Allegan Decorated Lip; Allegan Incised.</td>
</tr>
<tr>
<td>A.D. 1000-1100</td>
<td>Hacklander</td>
<td>All Hacklander Ware.</td>
</tr>
<tr>
<td>(A.D. 1020, 1070 C-14)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.D. 600-900(?)</td>
<td>Early Allegan</td>
<td>Allegan Undecorated Cordmarked, Flat, Round, Beveled Lip; Allegan Undecorated Fabric Impressed; Allegan Decorated Lip; Allegan Decorated, all variants.</td>
</tr>
<tr>
<td>(A.D. 690 C-14)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.a. A.D. 0-300(?)</td>
<td>Middle Woodland</td>
<td>Summerville Type II-C; Untyped Middle Woodland vessel.</td>
</tr>
</tbody>
</table>
CHAPTER IV

CULTURAL AND CHRONOLOGICAL RELATIONSHIPS:
CULTURAL DYNAMICS IN THE LATE WOODLAND PERIOD
OF SOUTHWESTERN MICHIGAN

Introduction

Like the preceding section, the discussion of cultural and chronological relationships to be presented here is based primarily on information gained from the study of the Hacklander ceramics - not the Hacklander assemblage as a whole. Other classes of data, especially ecological and environmental data, will, however, be drawn upon where possible.

In addition to formal comparisons of the Hacklander ceramic assemblage with other sites, hypotheses and ideas derived from these comparisons will be offered at the end of the section. These hypotheses concern cultural dynamics and processes that may be in evidence in the lower Kalamazoo River Valley, and southwestern Michigan in general. It should be stated now that although few hard and fast conclusions can be drawn at this point, these hypotheses will be presented with the hope that subsequent analyses can put them to the test.

Allegan Ware Relationships

Allegan Ware has been characterized by Rogers as "an essentially conservative pottery style" (1972:94). In this respect, Allegan Ware resembles most aboriginal ceramics in southwestern Michigan, where
exterior cordmarking is the rule, and exterior decoration is not particularly plentiful. The Allegan Ware at Hacklander does, however, most resemble pottery from a few sites on the Kalamazoo River, rather than other sites outside the Kalamazoo Valley.

Sites within the Kalamazoo Valley

The ceramics from the Fennville site, located about 4 mi upstream from Hacklander, were reported on by Rogers (1972). The majority of the pottery is Allegan Ware, and Rogers has suggested that the site represents a single component that probably dates to around A.D. 700 (1972:90-91). The site may actually be multi-component, however, since this date seems rather early for the presence of Spring Creek Collared pottery, and one collared vessel with a cross-hatched incised interior may be castellated. In any case, the majority of the Allegan Ware pottery resembles the Early Allegan component at Hacklander, indicating an early Late Woodland temporal placement for these ceramics at least.

Present at Fennville are the types or variants Allegan Decorated Lip, Allegan Corded-punctate, and Allegan Rocker-stamped, all believed by Rogers to be early pottery, though Allegan Decorated Lip persists into later periods (1972:86-87, 94). Rogers has suggested that these motifs may be a stylistic carry-over from the Middle Woodland (1972:86-87); similarly, the variant Allegan Cross-hatched is believed to be a carry-over motif (ibid). Cross-hatching is not present on Allegan Ware from Hacklander, though incised lines are.

Possible zoned rocker-stamping is also present at Fennville, and probably belongs to the variant Allegan Zoned Rocker-stamped. Rogers
chose not to type these zoned sherds (1972:87), though with the recovery of the zoned rocker-stamped example from Hacklander, assignment as a variant seems warranted.

The variant Allegan Linear Cord-impressed appears to belong to the Early Allegan component at Hacklander. No sherds of this variant were recovered from Fennville however.

Undecorated variants of Allegan Ware at Fennville include the Flat and Round Lip Cordmarked variants, with Flat Lip by far the predominant cross-section. This parallels the situation at Hacklander.

Spring Creek Collared pottery is also present at Fennville and, as mentioned above, would seem to represent a later component, perhaps similar to the Late Allegan at Hacklander.

It is apparent that Rogers' guess-date of c.a. A.D. 700 for the earlier occupation of the Fennville site is substantiated by the A.D. 690 radiocarbon date from Hacklander. The ceramic assemblages are quite similar though some differences do occur, such as the absence of cross-hatching at Hacklander, and the absence of linear cord-impressing at Fennville. The presence of Middle Woodland-like decorative styles at both sites supports this temporal placement.

The 46th Street site was also reported on by Rogers (1972); this site lies about 6 mi upstream from the Fennville site. The 46th Street site has been radiocarbon dated: A.D. 1230 + 100 (M-2232) and A.D. 1180 + 100 (M-2333) (Rogers 1972:49-50).

The ceramics from 46th Street most resemble the Late Allegan ceramics from Hacklander. Spring Creek Collared is present at 46th Street, as well as Allegan Undecorated Cordmarked, Flat, Round, and Thickened
Lip variants. Circular punctation is present on the variant Allegan Punctate and also on 6 of the 13 Spring Creek Collared pots. Only 1 example of Allegan Punctate was found at Hacklander, and circular punctations do not occur on Spring Creek Collared pottery at Hacklander. Allegan Decorated Lip is present at 46th Street, though this type is not so prevalent as at the earlier Fennville site (Rogers 1972:57, 59).

One decorated variant, Allegan Linear Cord-impressed, is present at 46th Street but not at Fennville. This variant is believed to belong to the Early Allegan component at Hacklander, though its presence at the later 46th Street site and absence at the earlier Fennville site does not support this hypothesis. Either 46th Street is indeed multi-component, and at present it does not seem to be, or this variant is not restricted to an Early Allegan temporal placement.

The overall similarities of the 46th Street assemblage and the Late Allegan component at Hacklander indicate that these sites may be contemporaneous, or nearly so. The ceramic similarities and radiocarbon dates from 46th Street support the hypothesis that the Late Allegan occupation at Hacklander post-dates the Hacklander Ware occupation also.

It should be pointed out that the ceramic data from the above 3 sites supports Rogers' hypothesis that Allegan Ware is indeed a distinct ceramic group from southeast Michigan Wayne Ware, and should not be considered as a regional Wayne Ware variant, or variant group (Rogers 1972:57, 59). The presence of flat lip cross-sections, cordmarking on the lip, and lip decoration within Allegan Ware were considered by Rogers to be sufficiently different characteristics from Wayne Ware to
warrant the formation of a separate ware category, as well as the fact
that it did not appear to her that southwestern and southeastern Michi-
gan aboriginals were participating in the same cultural tradition during
the Late Woodland period (Rogers 1972:59, 59). Evidence to be presented
below supports this latter contention, and the long temporal persis-
tence of the above attributes of Allegan Ware support the Wayne/Allegan
Ware distinction.

Allegan Ware has been recovered from a number of other sites in
the lower Kalamazoo River Valley. These sites are unpublished, and the
cermics from them were studied at the Department of Anthropology at
Western Michigan University.

The DeBoer site is a small site located on the Rabbit River, a
tributary of the Kalamazoo, about 10 mi upstream from Hacklander. The
cermics most resemble the 46th Street Allegan Ware with regard to paste
and temper; paste and temper at both sites is homogeneous. Allegan
Ware variants include Allegan Undecorated Cordmarked, Flat Lip and Al-
legan Decorated Lip. Spring Creek Collared pottery is absent, sug-
gest ing that this site may pre-date 46th Street. Also present is an
unusual vessel that is cordmarked up to the pointed lip, is very well
made, and possesses a distinctive cambered rim profile. This vessel is
reminiscent of the type Crockery Cambered from the Spoonville site
(Flanders 1965:343, 347ff). This type is believed to be possibly Mid-
dle Woodland (ibid). Also unusual are 2 very large vessels, 1 of which
is cordmarked and the other fabric impressed. Both have a double row
of applique fillets or beading on the upper rim, and are more similar
to certain Late Woodland types in Upper Michigan (c.f. McPherron 1967: 86-116) than to any known pottery from the southern part of the state.

The Nordhof site has a small Allegan Ware component. This site is located about 2.5 mi upstream from Hacklander on the north bank of the river. Allegan Undecorated Cordmarked variants are present, as well as 2 examples of Allegan Decorated Lip. A small amount of shell tempered ceramics not unlike some of the pottery from Moccasin Bluff (Betteral and Smith 1973) and the Allegan Dam site is also present.

About 500 ft north of Hacklander on the other side of the Kalamazoo River is the Indian Point site. Allegan Ware variants at this site include Allegan Undecorated Cordmarked, Round Lip; Allegan Linear Cord-impressed, and Spring Creek Collared.

Sites outside the Kalamazoo Valley

Pottery somewhat similar to the Allegan Ware from the Early Allegan component at Hacklander has been recovered from the Spoonville site on the lower Grand River. Along with obvious Hopewell Middle Woodland ceramics, a predominantly cordmarked ware was found at the site; Flanders has called this cordmarked pottery Crockery Ware (1965:343). Similarities between Allegan and Crockery Ware are not particularly striking, but include rocker-stamping and zoned rocker-stamping, and lip decoration, as well as the general attributes cordmarked exteriors and smooth interiors. Zoned and apparently non-zoned rocker-dentate stamping is also present on some examples of Crockery Ware, which is lacking on Allegan Ware at Hacklander or the Fennville site.

Dr. Richard Flanders of Grand Valley State Colleges feels that the Crockery Ware and Hopewellian pottery are contemporaneous, that they
were both manufactured during the Middle Woodland. He states that paste and temper characteristics are very homogeneous within the entire assemblage, possibly indicating contemporaneity (1965:337). Two radiocarbon dates from features containing Crockery Ware of A.D. 110 ± 120 (M-1428) and A.D. 215 ± 110 (M-1427) also support this hypothesis. Several archaeologists have pointed to the similarities between Crockery Ware and several Late Woodland types, and the Middle Woodland placement of Crockery Ware is not generally accepted (c.f. Fitting 1970:105-106). In any case, the presence at Spoonville of higher frequencies of Middle Woodland motifs on Crockery Ware than on the Allegan Ware from Hacklander or the Fennville site would probably indicate a temporal placement earlier than A.D. 700.

The Zemaitis site is located on the Grand River 14 mi upstream from Spoonville, and has been extensively excavated since 1970 by Richard Flanders. No formal report on the site has yet appeared, but it is apparent that differences between the Zemaitis and Hacklander assemblages are more marked than the similarities. Personal inspection of this ceramic material indicates that rim cross-sections on Zemaitis pottery are predominantly everted, while the modal cross-section of Allegan Ware is straight. General similarities between the assemblages include lip and exterior cordwrapped tool decoration; corded tool exterior decoration appears to be more common at Zemaitis than at any Kalamazoo River Allegan Ware site. It may be incorrect to call the Zemaitis pottery an Allegan Ware assemblage; the configuration of attributes, primarily decorative attributes, does not strongly resemble the ceramics from Hacklander. In addition Brashler (personal communication)
is currently undertaking a statistical analysis of ceramics from a number of southern Michigan Late Woodland sites, and she has indicated that the Zemaitis pottery is significantly different from other southwestern Michigan sites including 46th Street and Fennville. Flanders has suggested that Zemaitis may represent a transitional Middle to Late Woodland site (personal communication), and Brashler's statistical evidence and the apparent dissimilarities between Allegan Ware and the Zemaitis assemblage seem to support this hypothesis. The major occupation of the Zemaitis site may be contemporaneous with the Early Allegan occupation at Hacklander, but it is suggested that these people probably differed socially and culturally and perhaps economically from the early Late Woodland inhabitants of the Kalamazoo Valley.

The Moccasin Bluff site is located to the south of Hacklander on the St. Joseph River, and has been reported on by Betteral and Smith (1973). This site has a long occupational history, from at least Middle Woodland to proto-historic. The Late Woodland ceramics, called Moccasin Bluff Ware, are similar to the Hacklander Allegan Ware. Variants of the type Allegan Undecorated Cordmarked have parallels with Moccasin Bluff Cordmarked variants, which, however, display more variation in lip cross-section than Allegan Undecorated Cordmarked (Bteral and Smith 1973:52-61). Lip decoration at Moccasin Bluff is also similar to the Allegan Decorated Lip at Hacklander (ibid). Collared pottery similar to Spring Creek Collared has been recovered from Moccasin Bluff. Exterior decoration on the pottery from these 2 sites is not similar, however; cordwrapped tool decoration is predominant at Hacklander and rare at Moccasin Bluff. Decoration on Late Woodland
Moccasin Bluff Ware involved modification of the lip and exterior edge of the lip, usually with some kind of smooth tool, perhaps a stick, or in some cases, a finger (Betteral and Smith 1973:57-62).

The futile attempt to group Allegan Ware from Hacklander on the basis of Moccasin Bluff paste and temper characteristics was described previously, and it can be concluded that, while similarities in paste and tempering material between these assemblages do exist, the variants of Moccasin Bluff Ware based on these criteria cannot be duplicated at Hacklander.

In general, it seems that similarities between the Allegan Ware at Hacklander and Moccasin Bluff Ware at that site are more in evidence than any similarities between Hacklander and the 2 Grand River sites discussed above. The sequence of cultural phases presented by Betteral (1973:149ff) are not duplicated, however. The early Late Woodland occupation at Moccasin Bluff, c.a. A.D. 700-800, has been called the Brems Phase (ibid), and is characterized by the types Moccasin Bluff Cord-marked and Moccasin Bluff Modified Lip, and by a subsistence system that apparently did not include the digging of storage or refuse pits. This latter characteristic differs markedly from the Early Allegan at Hacklander, where deep, roughly conical pits were constructed. The pottery types mentioned are similar, but exterior decoration is present at Hacklander and absent at Moccasin Bluff during this period. It is suggested here that the differences between the Early Allegan and Brems Phase indicate different groups occupied these sites during this period. These groups appear to have differed economically, and perhaps socially and culturally as well.
The Moccasin Bluff Phase and Berrien Phase succeed the Brems Phase at Moccasin Bluff. These phases mark the incipience of shell tempered pottery at the site, which differs from the situation at Hacklander, where there are no apparent strong Mississippian or Oneota influences. Some late Moccasin Bluff types from the Berrien Phase are present at Hacklander though, and will be discussed later in this section.

The Spring Creek site is located in Muskegon County on Spring Creek, a tributary of the Muskegon River. Fitting (1968) has reported on this site, and the ceramic assemblage from Spring Creek has similarities in the Allegan Ware from Hacklander. The most obvious similarity is the type Spring Creek Collared, which occurs at both sites. Undecorated vessels of this type are similar; some vessels with "folded and collared" rims have been included within this type at Hacklander. This cross-section seems to be present at Spring Creek also (Fitting 1968:18, Fig. 5). There is no similarity between decorated pots, as pointed out previously. Decoration of these vessels at both sites is, however, rare. The variant Allegan Undecorated Cordmarked, Thickened Lip is similar to the type Wayne Cordmarked variant No. 1 at Spring Creek (Fitting 1968:24-26); decoration on these vessels is also rare.

Fitting has suggested that a functional distinction can be made between the collared and non-collared vessels at Spring Creek; collared pots tend to be larger in size while non-collared pots tend to be smaller. Collared pots at Spring Creek tend to be found at a greater distance from the creek, the local water source, than the non-collared pottery, the implication of this distribution being that the larger collared vessels would necessitate fewer trips to the creek for water.
(Fitting 1968:29). At Hacklander, most Spring Creek Collared vessels seem to have been large in contrast to most uncollared pottery, but no such distributional relationship to water source was observed at Hacklander.

It would appear that the Late Allegan occupation at Hacklander most resembles the Spring Creek assemblage — indeed, comparison of the 2 assemblages was instrumental in the formation of this component at Hacklander. Fitting (1968:23, 67) has pointed to the widespread occurrence of thickened rims on cordmarked pottery during the period c.a. A.D. 800-1000, and has referred to this as a "collared cordmarked horizon" in the Late Woodland period of the Upper Great Lakes. The suggested date of the Late Allegan occupation at Hacklander, c.a. A.D. 1100-1300, is later than the incipience of this postulated horizon.

To conclude this discussion of Allegan Ware relationships, it is felt that a greater degree of ceramic homogeneity can be demonstrated within the Kalamazoo River Valley in comparison to sites outside the valley during the Late Woodland. This hypothesis is tentative, of course, since there is less published material on sites on the St. Joseph, Grand, and Muskegon Rivers with which to compare Hacklander and other Kalamazoo River sites.

Hacklander Ware Relationships

It is a rather simple task to compare and contrast the Hacklander Ware ceramics at Hacklander to assemblages from other sites: Hacklander is the only known site where this ware is found in any quantity. At the time of excavation, it was felt that some of this ware, e.g. the rocker-dentate stamped variant, was similar to some of the late Hopewell Middle
Woodland ceramics from the Illinois River Valley; the hypothesis was thus formulated that Hacklander Ware might represent a late Middle Woodland occupation at Hacklander, an occupation with possible cultural ties to the south. The radiocarbon dates of A.D. 1020 and A.D. 1070 were instrumental in the rapid abandonment of this hypothesis, and when the Hacklander Ware assemblage as a whole is viewed, the only real similarity to Illinois Hopewell is the presence of rocker-dentate stamping. The style of decoration of these pots is not similar, however; that is, rocker-dentate stamping occurs literally all over the vessels (except probably the bases) rather than only along the upper rim or in zoned areas on the body. This mode of "all-over decoration" is somewhat reminiscent of certain Lake Forest Middle Woodland pottery though, particularly certain Laurel Tradition types, e.g. Pseudo-scallop Shell Stamped and Dentate Stamped (Stoltman 1973:74-76). Applique strips are not known on Hopewelian pottery, nor on Middle Woodland pottery in the Northeast or Midwest in general. Other decorative attributes on Hacklander Ware are similar to Middle Woodland motifs but are by no means restricted to this period, e.g. circular punctation, corded punctuation, cordwrapped paddle-edge stamping. It is firmly believed, then, that Hacklander Ware does not represent a Middle Woodland component with false radiocarbon dates; the realization that Hacklander Ware is not Middle Woodland does not, however, elucidate any true cultural relationships this pottery might indeed represent.

Two sites in addition to Hacklander seem to have certain Hacklander Ware variants present in their assemblages. The Indian Point site, which has been tested by means of 6 test pits, is located immediately
across the river from Hacklander; the presence of Hacklander Ware at this site is thus not particularly surprising. Variants at Indian Point include 1 rimsherd of Hacklander Undecorated Striated, 3 interior/exterior striated body sherds, 1 unidentifiable rim with a dentate stamped lip, 1 rocker-dentate stamped body sherd, and a single split body sherd with a striated interior. These sherds are illustrated in Plate 30.

The Zemaitis site on the Grand River has yielded perhaps as many as 13 individual vessels of the variant Hacklander Rocker-dentate, but no other types or variants. The rocker-dentate pottery at Zemaitis is, in most respects, quite similar to the Hacklander Rocker-dentate: all examples display rocker-dentate stamping over a smooth or horizontally striated surface; interiors are striated; circular punctations occur on some examples; lips are frequently dentate stamped; most rims are straight but at least 1 example showed a slight eversion; lip cross-sections are flat, round, or thickened; and all vessels are very well made with a very compact paste. There are no apparent appliqué strips on any Zemaitis vessels however, and there are other differences. At Hacklander, stamping is always either vertical or horizontal in orientation. At Zemaitis, most vessels are stamped in an oblique fashion, often in "blocks" of oblique-right rocker-dentates alternated with "blocks" of oblique-left impressions. Dentate stamping on lips at Hacklander is always oblique angle; at Zemaitis it is most often vertical. One Zemaitis pot showed punctation with some kind of apparently carved tool. It is the position taken here that similarities between the Zemaitis and Hacklander rocker-dentate stamped vessels far outweigh the differences, and for purposes of this study the Zemaitis rocker-dentate
vessels will be considered variants of Hacklander Ware. This con-
tention is open to challenge, of course.

Absolutely no other types or variants of Hacklander Ware occur at
the Zemaitis site. This is a puzzling situation; there are no stria-
tions on the interiors of any other vessels from the site which might
indicate that these pots are related to the rocker-dentate pots (Flan-
ders, personal communication). Possible implications of and hypotheses
concerning this situation will be presented below.

Indian Point and Zemaitis, then, represent the only other sites
where Hacklander Ware has been found. Survey work on the Grand River
(Kingsley and Flanders 1975) and the Kalamazoo River (Baldwin 1976) has
failed to produce any Hacklander Ware sites.

While only the above 3 sites contain Hacklander Ware types or
variants, some of the attributes of this ware are found at other sites.
Rocker-dentate stamping, for example, is present at many sites, though
most of these appear to be Middle Woodland. Sites of the late Middle
Woodland Kipp Island Phase in New York have yielded rocker-dentate
stamped pottery in small frequencies (Ritchie 1965:211-212; Ritchie and
Funk 1973:164). This pottery does not strikingly resemble Hacklander
Rocker-dentate. The Spoonville site on the Grand River contains roc-
er-dentate stamped pottery that is probably attributable to a Middle
Woodland context (Flanders 1965:344). Similarly, the Goodall site in
northern Indiana has yielded rocker-dentate pottery of Hopewellian
origin (Quimby 1941:118ff).

Rocker-dentate stamped pottery resembling the Hacklander variant
has been recovered from certain Effigy Mound complex sites in north-
eastern Iowa (Beaubien 1953:56-66). This pottery is similar to the
Hacklander variant in that stamping is often executed in 2 vertical rows on the rim of the vessel, like some Hacklander pots; this pottery is dissimilar in that rocker-dentate stamping is usually used in conjunction with cordmarking or cordwrapped tool impressing, which never occurs at Hacklander. This pottery is believed to date to the early Late Woodland in Iowa. While these rocker-dentate vessels are not identical to the Hacklander Rocker-dentate, they are more similar than any other pottery, with the exception of the Zemaitis vessels.

Striations on the interiors and/or exteriors of pottery vessels is an attribute that occurs over a large area of the Northeast, though always in small frequencies. Striated or "channeled" interiors are present in the Kipp Island Phase in New York (Ritchie and Funk op cit); Flanders reports "scraping" on a small percentage of body sherds from the Spoonville site (1965:343).

At the Schultz site in Saginaw County, Fischer (1972:176-179) reports that horizontally striated interiors are common on the type Ruben Linear Cord-impressed. These striations are usually confined to the upper rim area. The exteriors of these vessels do not resemble Hacklander Ware as zoned decoration is characteristic.

In southeastern Michigan and southwestern Ontario, an exterior surface treatment called "simple stamped" has been noted by Fitting (1965:37) at the Riviere Au Vase site. This treatment is also found at the Middleport Village site (Wintemberg 1948, quoted in Fitting 1968:37) and at the Boys site (Ridley 1958, quoted in Fitting 1965:37) in Ontario. Fitting illustrates a single sherd of this type (1965:Pl. If) and the simple stamping closely resembles striation. Similar pottery occurs
in the Fort Ancient area in Ohio, where the type Madisonville Grooved Paddle appears to be a striated exterior type (Griffin 1966:188ff, Pl. LXVII, 9).

It would appear that the striation of interiors and exteriors of pottery vessels is a rather widespread occurrence in the Northeast. This kind of surface treatment always occurs in minor frequencies relative to other modes of surface treatment, and the significance of this situation is difficult to assess.

Finally, the appliqué strips found on certain Hacklander Ware vessels are unusual. These appliqué strips are neck or shoulder strips, and never occur on rims where they might be considered to be fillets or beading. Appliqué rim strips are found in the Berrien Phase component at the Moccasin Bluff site (Betteral and Smith 1973:65-66); beading is present on the rims of certain types at the Juntunen site on Bois Blanc Island (McPherron 1967:108ff). Appliqué lugs occur on the type Schultz Thick, an Early Woodland ceramic from the Schultz site (Fischer 1972:142-143), and appliqué rim strips were observed on late prehistoric pottery from the Mikado earthwork in Alcona County (Fitting 1966d; 1970:172-173). It is apparent that appliqué techniques have considerable time depth in the Northeast, and it is notable that Hacklander is apparently the only site where appliqués occur on vessel shoulders or necks rather than rims. It is also noteworthy that, with the exception of the Early Woodland pottery from the Schultz site, Hacklander appliqués are the earliest examples of this decoration in the state, and perhaps the greater Northeast as well.
It is evident that Hacklander Ware possesses decorative and surface treatment attributes that are not uncommon throughout the Northeast and Midwest; the configuration of these attributes on Hacklander Ware vessels is not common, however, and occurs only at Hacklander, Indian Point, and the Zemaitis site.

Relationships of Miscellaneous Ceramics

It was discussed above that certain miscellaneous vessels from Hacklander are similar to pottery from other sites. It was pointed out that the vessels with scalloped lips and the 2 exterior impressed lip vessels duplicated types from the Moccasin Bluff site. The 2 impressed exterior lip vessels are also similar to certain types from the Dumaw Creek site in Oceana County (Quimby 1966a). In addition, the scalloped lip vessels and the 2 Unnamed Castellated pots with "sharp" or "peaked" castellations are similar to certain shell tempered vessels from the Allegan Dam site. It is apparent that Moccasin Bluff and Allegan Dam may represent Mississippian or Oneota "influence" or actual people in southwestern Michigan; Allegan Dam has been radiocarbon dated to A.D. 1110 ± 100 (M-2231) and A.D. 1210 ± 100 (M-2330), which places this site earlier in time than the Mississipian/Oneota Berrien Phase at Moccasin Bluff. Perhaps the few rim sherds and about 5 indistinct shell tempered body sherds from Hacklander indicate a small or transient occupation by these people.

Little can be said regarding the rest of the Unnamed Castellated vessels. The vessel with the sharp castellation, deep corded punctuations, and heavy collar is somewhat reminiscent of certain Iroquois
pottery from New York State, though the resemblance is far from strong. The Castellated/Oblique Cord-impressed pots are not wholly unlike ceramic types from certain Lake Forest Late Woodland sites, where castellations and cord impressing are common, though again, the similarities are not striking.

The single example of Vase Corded-like was named because it resembled this type as defined by Fitting (1965) in southeastern Michigan. This similarity is not precise either, though the presence of this vessel at Hacklander might indicate some kind of "contact" with groups to the east, though just what kind of contact this might represent is unknown.

Some of the Unnamed Cord-impressed pottery may actually be variants of Allegan Ware, as indicated above. There is at present little evidence to indicate this, however, which is why they have been treated separately. Very little else can be said regarding the possible cultural or chronological relationships the remaining miscellaneous vessels may have.

Hypotheses Regarding Cultural Dynamics in the Late Woodland of Southwestern Michigan

The remainder of this section will deal with hypotheses concerning aboriginal culture, society, and economics in the Late Woodland period in southwestern Michigan. These hypotheses are presented in light of information gained by the analysis of Hacklander site pottery, as well as examination and comparisons of ceramics from other sites. These hypotheses are presented here with the idea in mind that future analysis
can substantiate or reject them; they are offered as possible guidelines for further research in this area of Michigan.

Fitting has characterized the shift from the Hopewell-dominated Middle Woodland period to the early Late Woodland in the Midwest as a shift in stylistic traditions and systems of settlement and land use (1968:143). The hypotheses presented below support Fitting's ideas, but it will be shown that these shifts may not have taken place quite so readily in areas that were not participants in the Hopewell Interaction Sphere.

The Early Allegan Phase

The term Early Allegan Phase is presented here to refer to cultural manifestations in the lower Kalamazoo River Valley dating to the early Late Woodland period, c.a. A.D. 600-900. It will be shown that similarities in ceramic styles and economic adaptation warrant this term.

It is unclear at this time whether or not one might speak of an "Allegan Tradition". This term might be applied to southwestern Michigan as a whole, but if applied at all, it would probably be more accurate if restricted to the Kalamazoo Valley. Overall similarities in ceramic styles are in evidence within southwestern Michigan, but there are also some notable differences.

Similarities can be demonstrated within the overall ceramic assemblage from southwestern Michigan: pottery is most frequently cord-marked with smooth interiors, is usually undecorated, and when decorated usually consists of cordwrapped object impressing or punctation. It would seem that of the sites examined in this study, the greatest
similarities can be seen within the Kalamazoo River Valley, i.e. assemblages in this area more resemble one another than sites outside the Kalamazoo Valley. Conversely, the greatest differences in ceramic style can be demonstrated between the Kalamazoo and the 3 other river valleys, i.e. the St. Joseph, Grand, and probably the Muskegon. As indicated above, this situation probably reflects biased sampling to some extent, since several sites within the Kalamazoo Valley have been examined in the above pages, while only a few sites outside the valley were examined. It is believed, however, that possible bias notwithstanding, the greater degree of ceramic similarity seen within the Kalamazoo Valley is a real phenomenon, as well as the greater degree of ceramic differences observed between the Kalamazoo and the other river valleys.

An hypothesis can be offered to account for this apparent similarity within the Kalamazoo River Valley and apparent differences between the Kalamazoo and other rivers. The hypothesis can be stated as follows: during the early Late Woodland period, c.a. A.D. 600-900, different groups of people possessing differing social/cultural/economic systems occupied the Kalamazoo River Valley as opposed to the St. Joseph, Grand, and Muskegon river valleys. This hypothesis rests on the assumption that a good data base has been obtained; that is, good data, primarily ceramic data, and good chronological control are at hand in southwestern Michigan. The null hypothesis can thus incorporate the assumption that there are indeed gaps in the ceramic data from the area, that the similarities and differences that are in evidence are merely due to chance and spotty sampling, as well as poor chronological control.
It has been pointed out that the Early Allegan Phase at Hacklander and the Fennville site differed ceramically as well as economically (at least in the case of Hacklander) from the early Late Woodland Brems Phase at the Moccasin Bluff site on the St. Joseph River.

It was also pointed out above that a difference in ceramics can be demonstrated between the Hacklander and Spoonville and Zemaitis sites. While Spoonville may represent a component somewhat earlier than the Early Allegan, Zemaitis is considered to be late Middle-early Late Woodland (Flanders, personal communication), and thus would be contemporaneous with the Early Allegan Phase at Hacklander. The ceramic dissimilarities between the Kalamazoo and Grand River sites are more pronounced than between Hacklander and Moccasin Bluff.

It is difficult to assess the degree of similarity or dissimilarity between the Kalamazoo River Early Allegan Phase sites and early Late Woodland sites on the Muskegon River. The Spring Creek site post-dates this period. Prahl has reported on the excavation of a number of Late Woodland mounds in the Muskegon Valley (1966). Ceramics were not plentiful in any of these mounds, and social and cultural relationships between the inhabitants of the Muskegon, Grand, or Kalamazoo Rivers is difficult to determine. One fact stands out: it is apparent that the aboriginals in the Muskegon Valley participated to a larger extent in mound building activities than the Early Allegan people of the Kalamazoo Valley, who may not have constructed mounds or earthworks at all. For purposes of the above stated hypothesis, it is speculated that the early Late Woodland inhabitants of the Muskegon River probably did not have social or cultural ties to the inhabitants of the Kalamazoo River.
This suggestion is tentative, but is an aspect of the hypothesis that can be tested.

Since ceramic and presumed social and/or cultural differences can be pointed out, it might be possible to hypothesize processes of development of the respective systems within and without the Kalamazoo Valley. It can be suggested that these differences may be the result, at least in part, of differing modes of economic adaptation. During the early Late Woodland, the inhabitants of the Hacklander site did not participate in agricultural pursuits, but rather were oriented toward hunting and collecting (Martin 1976:81ff); Hacklander appears to have been a seasonally reoccupied warm weather site during this period. Rogers (1972:47) has pointed out that the lower Kalamazoo River Valley has very sandy soil that is only submarginal for agriculture, even with modern methods. Veatch (1933, quoted in Rogers 1972:47) has referred to this area as a Pine Plain, characterized by unstable dry yellow sand that fosters Norway Pine, White Pine, and Oak forests. Thus, it may be that the aboriginal inhabitants of this area did not practice agriculture due to the fact that the environment is not well-suited for it.

The early Late Woodland subsistence system is poorly known at the Moccasin Bluff site (Betteral and Smith 1973:127) or in the St. Joseph Valley in general. It was mentioned above that the economic system at Moccasin Bluff differed from that at Hacklander in that the digging of pits was not practiced at the former site. In the absence of any hard data from Moccasin Bluff, it can only be surmised that the economic systems of the inhabitants of these 2 sites were different, though this difference does not, of course, necessarily indicate that the Brems Phase occupants of Moccasin Bluff were agriculturalists.
Cleland (1966:66ff) and Martin (1975:6-7; 1976:29ff) have suggested that, on the basis of the faunal assemblage from the Spoonville site, the practice of agriculture may have taken place here. That is, the faunal evidence suggests that a focal hunting economy is present here that may have augmented a primarily agricultural subsistence base. Cleland (1966:66) has pointed to the bottomland microenvironmental setting at Spoonville and argues that the site may represent the earliest appearance of an agricultural adaptive pattern in the lower Grand River Valley. Charred corn cobs have been recovered from the site; it is unfortunate that they were discovered by amateur diggers in a less-than-desirable manner, so the context of the corn is unclear. The Spoonville site may represent a Middle or early Late Woodland site with an agricultural adaptation, and the question of whether Spoonville is single or multi-component was discussed previously. At any rate, the important point here is that regardless of Middle or Late Woodland temporal placement, agricultural subsistence patterns are in evidence for the lower Grand River Valley. It is equally important that the microenvironmental setting at Spoonville differs markedly from that at Hacklander.

Martin (1976:53-54) has indicated that the faunal assemblage at the Zemaitis site also suggests a focal hunting economy. This situation is similar to that at Spoonville; there are, however, no recovered cultigens to date. Zemaitis is a large site with what appear to be at least semi-permanent structures present, and it can be speculated that perhaps an agricultural adaptation is in evidence at this site also. This cannot be stated with certainty at this point, but the size of this
site, the faunal assemblage, and a microenvironmental setting similar to Spoonville suggest this interpretation.

Whether or not agriculture was practiced by the aboriginal inhabitants of the Muskegon River Valley is unclear, although Prahl (1966:201) has suggested that horticulture may have been practiced during the Middle Woodland period. There is, however, no firm evidence to support this. Fitting (1968:68-69, 73) has suggested that the Spring Creek site, dated to A.D. 960, probably represents an agricultural adaptation in the Muskegon Valley. If this can be assumed to be so, then it is reasonable to assume that agriculture was also practiced sometime prior to the occupation of that site.

While the evidence for it is far from firm, it is suggested here that an agriculturally based, or at least augmented, subsistence system is in evidence in the lower Grand and Muskegon, and perhaps also the St. Joseph Valleys during much of the Late Woodland period. Much of the evidence presented here is indirect or tenuous, but the hypothesis can be tested by the recovery (or non-recovery) of actual cultigens or otherwise stronger indirect evidence of agriculture from the sites mentioned, or from other sites in these river valleys. This apparent agricultural adaptation is in contrast with the lower Kalamazoo Valley, where there is evidence that agriculture was not practiced. Differences in environment are believed to be responsible for this, for it has been pointed out that the environment of the lower Kalamazoo is not particularly conducive to agriculture. It is a reasonable next step to hypothesize that, if these economic differences can be demonstrated to be
real, then the social and cultural differences may also be substantiated, as indicated by ceramic style diversity.

A second major hypothesis concerning cultural processes during the early Late Woodland can be offered. If it is evident that the early Late Woodland aboriginals in the Kalamazoo Valley differed from the inhabitants of the other 3 rivers, an explanation for this differential cultural development can be offered. An hypothesis concerning this development can be stated thus: the Early Allegan Phase socio-cultural system of the lower Kalamazoo Valley is a development out of a non-Hopewellian Middle Woodland occupation in this area, while developments in the St. Joseph, Grand, and Muskegon Valleys are the result of developments out of Hopewell or Hopewell-influenced socio-cultural systems.

Middle Woodland sites (Hopewell or otherwise) are a notoriously sparse commodity in the Kalamazoo Valley, while Hopewellian sites - particularly mound groups - are present in the Grand (Quimby 1941; Flanders 1965; Griffin et al 1970; Fitting 1971a), Muskegon (Quimby 1941; Prahl 1966), and St. Joseph (Quimby 1941) Valleys. It is felt that an explanation can be offered to account for the lack of Hopewellian sites in the Kalamazoo Valley: it is apparent that the environment of the lower Kalamazoo was not conducive to the adaptational system of the Hopewell Middle Woodland people. By way of explanation, consider the following. Struever has characterized the Hopewellian subsistence mode in the lower Illinois Valley as being riverine oriented; he has described the practice of "mud flats horticulture" (1964) or "intensive harvesting mode" economy (1968) as being oriented toward the intensive collecting and/or actual cultivation of seed plants that occur on
annually inundated flood plain or mud flat areas along the Illinois River. This collecting economy is augmented by hunting activities. These annually inundated flood plain areas are common in the lower Illinois Valley, and are also characteristic—though to a lesser extent—of the St. Joseph, Grand, and Muskegon River Valleys, where Hopewell sites have been found. It has for long been known that the presence of Hopewell in Michigan is the result of movements of people and/or diffusion of ideas and interaction from Illinois—it is not surprising that these people settled or these ideas took root in environments not dissimilar to that of the lower Illinois, where presumably a similar subsistence mode could be practiced.

With regard to mud flat or flood plain environments, the Kalamazoo River does not resemble the Illinois, St. Joseph, Grand, or Muskegon. The environment here is different: for example, the area of the lower Kalamazoo from about the town of New Richmond to the mouth of the river, a distance of about 7 airline miles, is known locally as the "Saugatuck flats". These "flats" are characterized by a marked widening of the river—in one spot, the river is 2 mi wide, though the actual channel is much narrower. Peculiar to this area is the fact that very little seasonal flooding takes place. Water levels do rise each spring, but rarely if ever exceed the banks of the river. The resultant situation is one where there is little flooding of areas that are not already inundated anyway, i.e. in the "flats", there are no flood plains.

Upriver from the "flats" area, flooding reportedly does take place. There are, however, fewer flood plains or mud flats than other rivers, particularly the Grand. The reason for this is not known, though it
may be that the subsurface geology of the Kalamazoo River is responsible; the river still seems to be downcutting (rather than meandering) to a greater extent than the other 3 major rivers in this part of the state. At any rate, flooding does take place upriver from the "flats", but flood plains are not well developed here.

It is suggested here that this environmental difference might account, at least in part, for the absence of Hopewelian sites in the Kalamazoo Valley. This river environment apparently was not conducive to the kind of subsistence system practiced by the Hopewellians and, as a result, these people avoided the Kalamazoo River. No Hopewelian sites have been found here, though sporadic finds of Hopewell-like projectile point forms and occasional pottery (e.g. at Hacklander) have been made.

While the nature of the non-Hopewelian Middle Woodland occupation of the Kalamazoo Valley is at present almost unknown, there is some evidence supporting the contention that these people differed socially from the Hopewellians. The social/ideological practice of interment of high status dead in burial mounds with lavish grave goods is well known in Hopewell occupied areas. A Middle Woodland burial site within the Kalamazoo Valley has been reported on by Cauble (1971: 1-25). The Brainerd site is an ossuary burial situation, radiocarbon dated at A.D. 440 ± 130 (M-2237). There was no cultural material associated with these burials. Ossuary burials are the exception rather than the rule in the Hopewelian mortuary system, and it is believed that the Brainerd site represents a burial area used by non-Hopewelian Middle Woodland occupants of the Kalamazoo Valley. This site further
indicates that differing social and cultural systems are in evidence within vs. without the Kalamazoo Valley.

To briefly summarize, it has been hypothesized that the unique microenvironmental setting of the Kalamazoo River Valley did not facilitate the occupation of this area by Hopewell Middle Woodland people. Further, it has been suggested that the lack of a Hopewelian social/cultural/economic system in the Kalamazoo Valley permitted the development of an early Late Woodland system that differed from the early Late Woodland systems in the rest of southwestern Michigan; indeed, this system may actually be a carry-over of continuation of social and adaptive patterns practiced during the Middle Woodland, or even the Late Archaic. The apparently agriculturally oriented economies in the St. Joseph, Grand, and Muskegon Valleys can be seen as an outgrowth of Middle Woodland floodplain oriented horticultural or at least intensive collecting economies. Contact between the non-Hopewelian occupants of the Kalamazoo Valley and the Hopewelian occupants of the rest of southwestern Michigan is evidenced by the presence of small frequencies of Hopewell-influenced pottery styles at Hacklander and the Fennville site, e.g. rocker-stamping, zoned rocker-stamping, and perhaps corded-punctuation. The ceramic and economic evidence presented here suggests that some kind of social or cultural cohesiveness is in evidence in the Kalamazoo Valley throughout the Middle and early Late Woodland periods, and that this social or cultural cohesiveness did not extend far beyond the Kalamazoo Valley. It is for this reason, as mentioned at the outset of this discussion, that the term "Allegan Tradition" may be correct only when applied to the early Late Woodland of the lower Kalamazoo Valley.
The Late Allegan Phase

This term refers to the Late Allegan occupation of the Hacklander site and the 46th Street site, and should also probably apply to the later occupation of the Fennville site as well.

Cultural homogeneity or cohesiveness during this phase, which might date to c.a. A.D. 900-1100 to 1300-1400, is not as marked as in the preceding Early Allegan Phase. To begin with, certain ceramic styles of this period are found within all 4 major river valleys and are not found exclusively within the lower Kalamazoo. The type Spring Creek Collared or similar thickened rim types are found in all 4 areas, though to a lesser extent at Spoonville and Zemaitis (Flanders 1965; personal communication), indicating an earlier temporal placement for these sites.

The economic aspects of this phase at Hacklander are unclear, though agriculture was apparently not practiced, which presumably differs from the situation at the Spring Creek site. Maize agriculture was practiced at the Moccasin Bluff site, but the cultural context of this adaptation appears to be Mississippian or Oneota influenced; thus the term Late Allegan Phase should not include this site, where the terms Moccasin Bluff Phase and Berrien Phase denote this period (Bettermo and Smith 1973:153).

It should be pointed out also that the Allegan Dam site, dated at A.D. 1110 and A.D. 1210, should be included in the Moccasin Bluff or Berrien Phase rather than the Late Allegan Phase. This site is located upstream from Hacklander near the town of Allegan. Mississippian or Oneota ceramics very similar to those of the Moccasin Bluff and
Berrien Phases are present here. The presence of 2 distinct cultural groups within the Kalamazoo Valley during this period is in marked contrast to the situation in the Early Allegan Phase. It is evident that cultural "boundaries" that were present in the Early Allegan have been dissolved by this period, indicating a greater degree of movement of people or ideas than in the earlier period.

Direct evidence of maize agriculture is lacking at Allegan Dam, though if it can be assumed to have been practiced, it is interesting that this site is located upriver from the "flats" area. Annual flooding is more common in this upriver area, and it is noteworthy that the presumed agriculturalists of the Allegan Dam site chose the most favorable part of the river for agriculture to settle.

Very little can be said regarding the nature of the development of the Late Allegan Phase. Indeed, it is probably incorrect to use this term to refer to sites outside the Kalamazoo River Valley, even though there are similarities in ceramics. No clear developmental sequence can be discerned at Hacklander, since the occupation by the makers of Hacklander Ware separates the Early and Late Allegan Phases.

As mentioned above, Fitting (1968:24, 67) has referred to the widespread occurrence of thickening of vessel rims as a "collared cord-marked horizon" in the Upper Great Lakes region. This statement, however, says nothing of possible social or cultural implications of such a shift in vessel manufacture. Is this simply a stylistic shift that does not imply cultural changes, or does it represent some kind of cultural "assimilation" or greater degree of social integration and interaction on a widespread level? Though this study cannot address itself
to such a question because evidence supporting either suggestion is lacking at Hacklander, the latter idea seems the more attractive.

In any case, hypotheses concerning the nature of the Late Allegan Phase in the Kalamazoo Valley cannot realistically be offered, due to the lack of hard data regarding this occupation. It is suggested, however, that this phase does indeed represent a greater degree of social and cultural (and economic?) homogeneity throughout the Late Woodland of southwestern Michigan than the preceding phase. The lower Kalamazoo Valley does not appear to be as "culturally autonomous" or homogeneous at this time in contrast to the Early Allegan Phase.

The Hacklander "Phase"

The term "phase" appears here in quotation marks because it may be incorrect to base a cultural phase on only 1 site. That is, the Hacklander site and the nearby Indian Point site (which for all practical purposes can be considered to be the same site) are the only sites where Hacklander Ware ceramics have been found, with the possible exception of the Zemaitis site. In addition, information from other sites in the Kalamazoo Valley and southwestern Michigan in general indicates that different cultural manifestations that more resemble the Allegan Phases or Mississippian manifestations are contemporaneous with the Hacklander "Phase". Thus, the term is applied here tentatively, and can be accepted or rejected on the basis of finding additional Hacklander Ware sites, if indeed others exist.

It should be reiterated at this point that the position taken here toward the Hacklander component at Hacklander is that these ceramics
represent an occupation that differs socially and culturally from the Allegan peoples. Hacklander Ware should not be considered as some kind of elaborate "ceremonial pottery" made by the makers of Allegan Ware. If similarities and differences in pottery styles can be taken as a measure of social or cultural "distance" between aboriginal groups, then the notion that this is a different cultural group is well substantiated.

Hypotheses concerning the presence of this pottery and cultural group in the lower Kalamazoo Valley can be based around 2 obvious ideas, 1) that this group of people is intrusive into the lower Kalamazoo; or 2) that this group is in fact indigenous to the area and developed here in situ.

The former notion, that these people are not indigenous to the area, is the most attractive. There is little evidence to indicate any developmental sequence of this ceramic style in the area, though possible suggestions will be presented below. The fact that there are other sites rather close by that date to this period or nearly so, and that differ culturally from Hacklander, would further support the idea that these people came here from elsewhere. For example, the earlier date from the Allegan Dam site, A.D. 1110, just post-dates the later Hacklander "Phase" date of A.D. 1070; the standard deviations of these dates overlap. The earlier Late Allegan Phase date from 46th Street of A.D. 1180 presents a similar situation. At Moccasin Bluff, the Moccasin Bluff Phase, which marks the incipience of shell tempered pottery and possibly maize agriculture at that site, begins at A.D. 1060 (Betteral and Smith 1973:114). A very small sample of pottery from the
Whorely earthwork, located in Branch County near the Michigan-Indiana state line, more resembles the Late Allegan assemblage from Hacklander or 46th Street than any other assemblage; this site has been dated at A.D. 1080 (Speth 1966:219-220). This date also overlaps those of the Hacklander "Phase". Finally, the A.D. 960 date from the Spring Creek site also overlaps in standard deviation with the earlier Hacklander "Phase" date of A.D. 1020.

It is evident that many different cultural groups were occupying southwestern Michigan during the first few centuries of the second millenium A.D. It was suggested above that this period marks a greater degree of cultural "movement" during the latter part of the Late Woodland in comparison to the earlier phases. The situation at Hacklander during the Hacklander "Phase" further supports this hypothesis, since it seems evident that the makers of Hacklander Ware are intrusive into the lower Kalamazoo Valley.

This hypothesis is attractive, logical, and consistent with the hypotheses presented above. One problem remains however: if these people came from elsewhere, then precisely where is "elsewhere"? It was pointed out above that there is no pottery assemblage with which this writer is familiar that resembles Hacklander Ware. The closest similarities are at the Zemaitis site, which will be dealt with in a moment. The next closest similarities are found in northeastern Iowa, within the Effigy Mound complex. This pottery is not strikingly similar, though, and while an hypothesis can be formulated stating that the Hacklander "Phase" people actually came from the Effigy Mound area, there is not much support for it. While this notion cannot be rejected
out of hand, if the Hacklander people are actually culturally related to the Effigy Mound culture, one thing they definitely did not do once they arrived in the Kalamazoo Valley was build effigy mounds.

It might be suggested that the makers of Hacklander Ware came from the north, where ceramic styles include more elaborate decoration than southern Michigan. Hacklander Ware does not resemble any Lake Forest pottery though, so this hypothesis is just as tenuous. Indeed, if one views occurrences of individual Hacklander Ware attributes as an indication of from whence the Hacklander people came, then no point on the compass can be ruled out.

An indigenous development hypothesis can also be offered. The presence of the Hacklander Ware variant Rocker-dentate stamped at the Zemaitis site has been previously discussed. Flanders (personal communication) has felt that the rocker-dentate pottery at Zemaitis might represent a Middle Woodland style carry-over that was manufactured along with the cord-marked pottery at the site. Indeed, there is some indication that Zemaitis is a transitional Middle-Late Woodland occupation, or at least pre-dates the Hacklander "Phase" at Hacklander (Flanders, personal communication; Brashler, personal communication). The presence of a single Hacklander Ware variant at Zemaitis rather than an entire assemblage is a very curious situation. It might be suggested that the Hacklander Rocker-dentate at Zemaitis is indeed late Middle Woodland-early Late Woodland, and that by A.D. 1000 it had developed into the assemblage called Hacklander Ware. While this hypothesis is quite tenuous, it cannot be ignored.
One final hypothesis concerning Hacklander Ware can be offered. This hypothesis states simply that Hacklander Ware and the socio-cultural system it represents developed in situ in the lower Kalamazoo Valley. The microenvironmental uniqueness of this area has been discussed above; perhaps this unique environment fostered this unique development, just as it apparently did not foster Hopewellian occupation of the valley. Again, while this hypothesis cannot be dismissed out of hand, the bulk of the evidence does not support it. Further, it would be difficult to explain the presence of the variant Hacklander Rocker-dentate at Zemaitis, except perhaps that this pottery at Zemaitis is contemporaneous with the Hacklander Ware at Hacklander, and is not in fact earlier. How it might have gotten there is open to speculation, but trade might be suggested.

To conclude this section on the Hacklander "Phase", it is evident that the origins of this ware and the socio-cultural system it represents are totally unknown. The hypotheses presented above can be tested in an attempt to clarify this situation, and as it stands now, the notion that these people came to the lower Kalamazoo Valley from elsewhere seems the most likely possibility. The term Hacklander "Phase" should remain a tentative designation in the absence of data indicating that this occupation is indeed a cultural phase, and is not simply some sort of short term or transient occupation.
### Hacklander Site - Ceramic Attribute List

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<td>D. Pointed or Wedge</td>
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<td>E. Beveled</td>
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<td>F. Thickened</td>
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<td>G. Other</td>
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9. **Interior Surface Preparation**

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<td>K. Finger</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>L. Other</td>
<td>3</td>
<td>1.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>16. Exterior Decoration - Second Tool</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Absent</td>
<td>225</td>
<td>96.6</td>
</tr>
<tr>
<td>B. Rounded-end</td>
<td>5</td>
<td>2.1</td>
</tr>
<tr>
<td>C. Cordwrapped Paddle-edge</td>
<td>3</td>
<td>1.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>17. Exterior Decoration - First Tool Technique</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Absent</td>
<td>189</td>
<td>81.1</td>
</tr>
<tr>
<td>B. Impressed</td>
<td>18</td>
<td>7.7</td>
</tr>
<tr>
<td>C. Rocker-impressed</td>
<td>7</td>
<td>3.0</td>
</tr>
<tr>
<td>D. Incised</td>
<td>3</td>
<td>1.3</td>
</tr>
<tr>
<td>E. Punctate 90° Angle</td>
<td>10</td>
<td>4.3</td>
</tr>
<tr>
<td>F. Punctate Acute Angle</td>
<td>6</td>
<td>2.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>18. Exterior Decoration - Second Tool Technique</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Absent</td>
<td>225</td>
<td>96.6</td>
</tr>
<tr>
<td>B. Impressed</td>
<td>2</td>
<td>0.9</td>
</tr>
<tr>
<td>C. Incised</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>D. Punctate 90° Angle</td>
<td>4</td>
<td>1.7</td>
</tr>
<tr>
<td>E. Punctate Acute Angle</td>
<td>1</td>
<td>0.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>19. Exterior Decoration - First Tool, No. of Rows</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Absent</td>
<td>198</td>
<td>85.0</td>
</tr>
<tr>
<td>B. 1 Row</td>
<td>28</td>
<td>12.0</td>
</tr>
<tr>
<td>C. 2 Rows</td>
<td>4</td>
<td>1.7</td>
</tr>
<tr>
<td>D. 3 or more Rows</td>
<td>3</td>
<td>1.3</td>
</tr>
</tbody>
</table>
20. **Exterior Decoration - Second Tool, No. of Rows**

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Absent</td>
<td>225</td>
<td>96.6</td>
</tr>
<tr>
<td>B. 1 Row</td>
<td>5</td>
<td>2.1</td>
</tr>
<tr>
<td>C. 2 Rows</td>
<td>2</td>
<td>0.9</td>
</tr>
<tr>
<td>D. 3 or more</td>
<td>1</td>
<td>0.4</td>
</tr>
</tbody>
</table>

21. **Exterior Decoration - First Tool, Orientation**

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Absent</td>
<td>189</td>
<td>81.1</td>
</tr>
<tr>
<td>B. Chevron - Vertical</td>
<td>2</td>
<td>0.9</td>
</tr>
<tr>
<td>C. Chevron - Left</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>D. Chevron - Right</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>E. Oblique - Left</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>F. Oblique - Right</td>
<td>9</td>
<td>3.9</td>
</tr>
<tr>
<td>G. Cross-hatched</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>H. Vertical</td>
<td>4</td>
<td>1.7</td>
</tr>
<tr>
<td>I. Horizontal</td>
<td>24</td>
<td>10.3</td>
</tr>
<tr>
<td>J. Vertical and Horizontal</td>
<td>1</td>
<td>0.4</td>
</tr>
</tbody>
</table>

22. **Exterior Decoration - Second Tool, Orientation**

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Absent</td>
<td>225</td>
<td>96.6</td>
</tr>
<tr>
<td>B. Oblique - Right</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>C. Vertical</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>D. Horizontal</td>
<td>6</td>
<td>2.6</td>
</tr>
</tbody>
</table>

23. **Exterior Decoration - Location**

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Absent</td>
<td>189</td>
<td>81.1</td>
</tr>
<tr>
<td>B. On Fold or Collar</td>
<td>4</td>
<td>1.7</td>
</tr>
<tr>
<td>C. On Rim near Lip</td>
<td>5</td>
<td>2.1</td>
</tr>
<tr>
<td>D. Between Lip and Neck</td>
<td>20</td>
<td>8.6</td>
</tr>
<tr>
<td>E. Neck</td>
<td>5</td>
<td>2.1</td>
</tr>
<tr>
<td>F. Shoulder</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>G. Rim-Neck-Shoulder-Body</td>
<td>3</td>
<td>1.3</td>
</tr>
<tr>
<td>H. Rim-Neck-Shoulder</td>
<td>2</td>
<td>0.9</td>
</tr>
<tr>
<td>I. Rim-Neck</td>
<td>4</td>
<td>1.7</td>
</tr>
</tbody>
</table>

24. **Exterior Decoration - Applique Strip**

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Absent</td>
<td>230</td>
<td>98.7</td>
</tr>
<tr>
<td>B. Present</td>
<td>3</td>
<td>1.3</td>
</tr>
</tbody>
</table>

25. **Paste**

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Sandy</td>
<td>139</td>
<td>59.7</td>
</tr>
<tr>
<td>B. Silty</td>
<td>94</td>
<td>40.3</td>
</tr>
</tbody>
</table>
26. **Temper Size** (largest observable particle)  
<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. 0-1 mm</td>
<td>10</td>
<td>4.3</td>
</tr>
<tr>
<td>B. 1-2 mm</td>
<td>36</td>
<td>15.5</td>
</tr>
<tr>
<td>C. 2-3 mm</td>
<td>65</td>
<td>27.9</td>
</tr>
<tr>
<td>D. 3-4 mm</td>
<td>51</td>
<td>21.9</td>
</tr>
<tr>
<td>E. Over 4 mm</td>
<td>71</td>
<td>30.5</td>
</tr>
</tbody>
</table>

27. **Lip Thickness**  
<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. 2-5.99 mm</td>
<td>134</td>
<td>57.5</td>
</tr>
<tr>
<td>B. 6-8.99 mm</td>
<td>92</td>
<td>39.5</td>
</tr>
<tr>
<td>C. Over 9 mm</td>
<td>7</td>
<td>3.0</td>
</tr>
</tbody>
</table>

28. **Rim Thickness**  
<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. 2-5.99 mm</td>
<td>93</td>
<td>39.9</td>
</tr>
<tr>
<td>B. 6-8.99 mm</td>
<td>136</td>
<td>58.4</td>
</tr>
<tr>
<td>C. Over 9 mm</td>
<td>4</td>
<td>1.7</td>
</tr>
</tbody>
</table>
Type Descriptions:
Allegan Ware and Hacklander Ware from the Hacklander Site

**Allegan Ware**

**Type:** Allegan Undecorated Cordmarked (N=86)

**Paste/Temper:**
Poorly compacted sandy to silty clay; tempered with mixed, crushed grit; grit is usually granitic including quartz, feldspar, amphibole, and some biotite; possible hornblende is also present. Variation in amount of temper, size of temper, consistency of paste, hardness, and color is marked.

**Texture:**
Friable, coarse texture is predominant. Sherds have tendency toward laminate splitting and coil fracture; a few well made examples are present.

**Surface Finish:**
Exterior - Cordmarked, probably with cordwrapped paddle. Some cordmarking appears to have been smoothed-over. Modal orientations are vertical; some are oblique angle (n=11), few are random patterned (n=2), none are horizontal.

Interior - Most are smoothed; horizontal brushing occurs (n=1), as does smoothed cordmarking (n=8).

**Decoration:**
Absent.

**Form:**
Rim - Modal cross-section is straight (vertical); slight eversion occurs (n=13), as does pronounced eversion (n=2), giving these vessels constricted necks; 1 vessel is inverted.

Lip - Planview is flat; cross-sections form basis for defining variants (see below).

Body - Globular or rounded; elongate, squat or bowl forms do not occur.

Base - Probably rounded; conoidal forms do not occur.

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Variants:

Allegan Undecorated Cordmarked, Flat Lip (n=43)
Characterized by flattening of the lip at perpendicular angle to the sides; splayed cross-sections also occur (n=5); lip surface is cordmarked (n=36) or smoothed (n=7).

Allegan Undecorated Cordmarked, Round Lip (n=24)
Characterized by rounding of lip; surfaces are cordmarked (n=10) and smoothed (n=14).

Allegan Undecorated Cordmarked, Beveled Lip (n=5)
Lips are flattened at angle sloping outward from the rim; lips are cordmarked.

Allegan Undecorated Cordmarked, Thickened Lip (n=10)
Characterized by thickening of the outer edge of the lip by flattening with cordwrapped paddle; lips are cordmarked.

Allegan Undecorated Cordmarked, Aberrant Lip (n=4)
Aberrant lip cross-sections; pointed (n=2) or anomalous (n=2).

Geographical Range:

Chronological Position:
Beveled Lip variant - Early Allegan Phase, ca.a A.D. 600-900.
Thickened Lip variant - Late Allegan Phase, c.a. A.D. 900-1400.
Flat and Round Lip variants - Early through Late Allegan Phase, c.a. A.D. 600-1400.

Relationships:
Moccasin Bluff Cordmarked, Moccasin Bluff site; Wayne Cordmarked variant No. 1, Spring Creek site; Allegan Cordmarked, 46th Street and Fennville sites; other sites in Kalamazoo basin.

References:
Rogers (1972).

Type: Allegan Undecorated Smoothed (N=10)

Paste/Temper:
Same as Allegan Undecorated Cordmarked, but hornblende does not occur.

Texture:
Same as Allegan Undecorated Cordmarked.
Surface Finish:

Exterior - Surface has been smoothed; no remaining traces of former cordmarking (if any).

Interior - Smoothed.

Decoration:

Absent.

Form:

Rim - All are straight.

Lip - Planview is flat; cross-section is flat (n=8) or round (n=2). All are smoothed.

Body - Probably rounded.

Base - Probably rounded.

Variants:

None

Geographical Range:

Lower Kalamazoo River Valley; similar forms occur throughout southern Michigan.

Chronological Position:

Early to Late Allegan Phase at Fennville site and 46th Street site (Rogers 1972); may be post-Late Allegan at Hacklander.

Relationships:

May relate to scalloped and castellated lip vessels at Hacklander and Moccasin Bluff site; may relate to Allegan Smoothed at 46th Street and Fennville. Context within site is unclear.

References:

Rogers (1972).
Type: Allegan Undecorated Fabric-impressed (N=4)

Paste/Temper:

Same as Allegan Undecorated Smoothed.

Texture:

Same as Allegan Undecorated Cordmarked.

Surface Finish:

Exterior - Surface has been impressed with some kind of woven fabric; resultant surface is non-patterned.

Interior - Smoothed.

Decoration:

Poorly applied circular punctations are present on the neck of a single vessel.

Form:

Rim - Two rims are present; 1 is straight and 1 is slightly everted.

Lip - Planview is flat; lips are flat and fabric-impressed.

Body - Unknown, but probably rounded.

Base - Unknown, but probably rounded.

Variants:

None

Geographical Range:
Unclear; similar surface treatment occurs throughout southwestern Michigan.

Chronological Position:
Early Allegan Phase, possibly to Late Allegan.

Relationships:
Type is found at 46th Street and Fennville sites.

References:
Rogers (1972).
Type: Allegan Decorated Lip (N=24)

Paste/Temper:

Same as Allegan Undecorated Cordmarked.

Texture:

Same as Allegan Undecorated Cordmarked.

Surface Finish:

Exterior - Cordmarked (n=23), vertical (n=22), horizontal (n=1); some cordmarking is smoothed-over; 1 vessel smoothed.

Interior - Smoothed; 1 is cordmarked.

Decoration:

Present on lips; most tools are cordwrapped tools, e.g. stick, paddle-edge, cord; 2 tools are not cordwrapped; techniques are impressed; orientations are oblique (n=20), vertical (n=3), and horizontal (n=1).

Form:

Rim - Most are straight; some are slightly everted (n=5) giving those vessels a slightly constricted neck.

Lip - Planview is flat; cross-section is flat (n=10), round (n=7), beveled (n=3), thickened (n=2), pointed (n=2).

Body - Probably rounded.

Base - Probably rounded.

Variants:

None

Geographical Range:

Lower Kalamazoo Valley; similar types occur at Moccasin Bluff site, perhaps Spoonville site.

Chronological Position:

Early Allegan Phase, persists in decreasing frequency into Late Allegan.

Relationships:

Occurs at several sites in Kalamazoo Valley; companion type present at Moccasin Bluff; part of rather widespread occurrence of decorated lip types in Kalamazoo and St. Joseph Valleys (Betteral and Smith 1973; Rogers 1972), and possibly farther north.
References:
Rogers (1972); Betteral and Smith (1973).

**Type:** Allegan Decorated (N=16)

**Paste/Temper:**
Same as Allegan Undecorated Cordmarked.

**Texture:**
Same as Allegan Undecorated Cordmarked; Zoned Rocker-stamped vessel is much finer texture and better made, however.

**Surface Finish:**
Exterior - Vertical cordmarking; or smoothed (n=2).
Interior - Smoothed.

**Decoration:**
Forms basis for defining variants (see below).

**Form:**
Rim - Six rimsherds are present; all are straight.
Lip - Planview is flat; cross-section is flat (n=1), round (n=3), pointed (n=2).
Body - Probably rounded.
Base - Probably rounded.

**Variants:**

Allegan Punctate (n=1)
Round, hollow (reed?) punctations in a single row occur; corded tool impressions occur on lip.

Allegan Corded-punctate (n=5)
Corded-tool punctations occur in 1 row (n=3), 2 rows (n=1), 3 rows (n=1); all lips are similarly decorated.

Allegan Linear Cord-impressed (n=4)
Body sherds only, at least 1 and up to 3 rows of horizontal cord impressions present over cordmarked surface; some indication that cord impressing may run vertically or oblique angle also.
Allegan Rocker-stamped (n=1)
Plain rocker-stamping over smooth surface; orientation indiscernible.

Allegan Zoned Rocker-stamped (n=1)
Plain rocker-stamping over smooth surface; rocker-stamped surface is separated from smooth surface with bold incised lines.

Allegan Incised (n=4)
Horizontal (n=2), vertical (n=1), and non-patterned (n=1) incising; cross-hatched pattern is not present.

Geographical Range:
Lower Kalamazoo Valley; perhaps further north.

Chronological Position:
Early Allegan Phase; Incised variant persists into Late Allegan, Linear Cord-impressed variant may also; Punctate variant may be restricted to Late Allegan.

Relationships:
Variants found at 46th Street and Fennville sites; similar variants at Spoonville site; Rocker-stamped, Zoned Rocker-stamped, and Corded-punctate vessels are probably Middle Woodland influenced carry-over styles.

References:
Rogers (1972).

Type: Spring Creek Collared (N=32)

Paste/Temper:
Same as Allegan Undecorated Cordmarked.

Texture:
Same as Allegan Undecorated Cordmarked.

Surface Finish:
Exterior - Vertical cordmarking; 1 is fabric-impressed.
Interior - Smoothed.

Decoration:
Most (n=28) are undecorated; 1 example has a single row of corded-punctates; 1 has chevron-vertical incised lines below fold; 1 has corded-tool decorated lip; 1 has bold diamond incising on interior rim.
Form:

Rim - Most are straight; some slightly everted (n=5); all rims are thickened, most are folded, 3 are folded and collared.

Lip - Planview is flat; cross-section is flat (n=10), round (n=11), thickened (n=6), aberrant (n=5).

Body - Probably rounded.

Base - Probably rounded.

Geographical Range:
Southwestern Michigan; similar thickened rim types occur throughout Northeast.

Chronological Position:
Late Allegan Phase, Kalamazoo Valley; similar temporal placement (c.a. A.D. 800-1400) throughout Northeast.

Relationships:
Moccasin Bluff Collared, Moccasin Bluff site; Spring Creek Collared, Spring Creek site, 46th Street site

References:
Fitting (1968)

Hacklander Ware

Type: Hacklander Undecorated (N=17)

Paste/Temper:

Paste is sandy clay, very well compacted; temper is crushed granitic grit; modal temper color is black and white, indicating quartz or mica and biotite and amphibole. Paste and temper are homogeneous throughout ware.

Texture:

Hard, sandy, compact. Laminate splitting and coil fracture are rare.

Surface Finish:

Exterior - Forms basis for defining variants (see below).

Interior - Horizontal striations (n=12), smoothed (n=5).
Decoration:

Some variants possess lip decoration (see below).

Form:

Rim - Most are straight; 1 is slightly everted.

Lip - Planview is flat; cross-section is flat (n=6), round (n=9),
  thickened (n=2).

Body - Rounded; elongate, squat, or bowl forms are not present.

Base - Rounded; conoidal forms are not present.

Variants:

Hacklander Undecorated Striated (n=9)
  Striated exterior, horizontal (n=3), vertical (n=1), oblique
  (n=5). Dentate tool impressed lip on 1, oblique angle; cord­
  wrapped stick oblique impressed lip on 1.

Hacklander Undecorated Smoothed (n=5)
  Smoothed interiors and exteriors; dentate tool impressed oblique
  lip on 1.

Hacklander Undecorated Cordmarked (n=3)
  Vertically cordmarked exteriors; cordwrapped stick impressed
  oblique lip on 1.

Geographical Range:
  Hacklander site; striated variant occurs at Indian Point site.

Chronological Position:
  A.D. 1020-A.D. 1070; longer temporal span is unknown.

Relationships:
  Not known; possibilities discussed in text.

Type: Hacklander Decorated (N=17)

Paste/Temper:
  Same as Hacklander Undecorated.

Texture:
  Same as Hacklander Undecorated.
Surface Finish:

Exterior - Striated, oblique angle (n=2), striated, horizontal (n=4); vertical cordmarking (n=4); smoothed (n=7).

Interior - Horizontally striated (n=16); smoothed (n=1).

Decoration:

Forms basis for defining variants (see below).

Form:

Rim - Most are straight; few are slightly everted (n=3), causing a slight constriction of the neck.

Lip - Planview is flat; cross-section is flat (n=6), round (n=6), thickened (n=5).

Body - Rounded.

Base - Rounded.

Variants:

Hacklander Rocker-dentate (n=7)
Vertical (n=3), horizontal (n=3), and vertical and horizontal (n=1) rocker-dentate stamping over smoothed or horizontally striated (n=1) surface; 2 have applique neck or shoulder strips; strips are dentate stamped oblique; 1 or 2 rows of horizontal rounded punctates occur (n=3); lips are undecorated or dentate impressed oblique (n=2) and knot impressed (n=1).

Hacklander Punctate (n=5)
One row of rounded punctations between lip and neck occur; surfaces are horizontal (n=1), vertical (n=1), or oblique (n=3) striated; 1 lip is dentate impressed oblique.

Hacklander Cordmarked Applique (n=1)
Exterior is vertically cordmarked; applique neck strip present; strip and lip are cordwrapped paddle-edge stamped oblique.

Hacklander Corded-punctate (n=1)
Exterior is vertically cordmarked; lip is cordwrapped stick impressed oblique; 1 row cordwrapped stick punctate occurs between lip and neck.

Hacklander Cordwrapped Paddle-edge Stamped (n=2)
First vessel: upper rim and body is cordwrapped paddle-edge stamped horizontal; lip is oblique stamped with same tool; 1 row round punctates present.
Second vessel: body is cordwrapped paddle-edge stamped horizontal; lip is oblique stamped with same tool; oblique stamped appliqué shoulder strip present; upper rim is horizontal cord or fabric impressed.

Hacklander Cross-hatched (n=1)
Exterior is vertically cordmarked; lip is cordwrapped paddle-edge impressed oblique; fine line diamond incising on upper rim and shoulder.

Geographical Range:
Hacklander site; Rocker-dentate variant occurs at Indian Point site; also at Zemaitis site on Grand River.

Chronological Position:
A.D. 1020-A.D. 1070; Rocker-dentate variant may occur earlier at Zemaitis site.

Relationships:
Not known.
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Plate 1. Middle Woodland ceramics. a. Summerville Type II-C; b. Untyped.

Plate 2. Allegan Ware. Allegan Undecorated Cordmarked, Flat Lip.
Fig. 7. Rim profiles for Plate 1.

Fig. 8. Rim profiles for Plate 2.
Plate 3. Allegan Ware. Allegan Undecorated Cordmarked, Round Lip.

Fig. 9. Rim profiles for Plate 3.

Fig. 10. Rim profiles for Plate 4.

Plate 6. Allegan Ware. Allegan Decorated Lip.
Fig. 11. Rim profiles for Plate 5.

Fig. 12. Rim profiles for Plate 6.

Fig. 13. Rim profiles for Plate 7.
Plate 9. Allegan Ware. Spring Creek Collared, undecorated.

Plate 10. Allegan Ware. Spring Creek Collared, decorated. a. chevron incised. b. corded-punctate. c. fabric-impressed. d. decorated lip. e. cross-hatched incised interior.
Fig. 14. Rim profiles for Plate 9.

Fig. 15. Rim profiles for Plate 10.
Plate 11. Hacklander Ware. Hacklander Undecorated Striated. a. dentate lip. b. cordwrapped stick lip.

Plate 12. Dentate stamping on striated interior of body sherd.
Fig. 16. Rim profiles for Plate 11.
Fig. 17. Rim profiles for Plate 13.
Fig. 18. Rim profile for Plate 14.
Plate 15. Hacklander Ware. Hacklander Decorated, Rocker-dentate Stamped.

Plate 16. Interior of vessel in Plate 14.
Fig. 19. Rim profile for Plate 15.

Fig. 20. Rim profiles for Plate 17.

Plate 20. Interior of vessel in Plate 19.
Fig. 21. Rim profile for Plate 19.
d. Corded-punctate.

Plate 22. Hacklander Ware. Hacklander Decorated. a-c. Cordwrapped 
Fig. 22. Rim profiles for Plate 21.

Fig. 23. Rim profiles for Plate 22.

Fig. 24. Rim profiles for Plate 23.

Fig. 25. Rim profiles for Plate 24.

Fig. 26. Rim profiles for Plate 25.

Fig. 27. Rim profiles for Plate 26.
Plate 27. Miscellaneous Ceramics. Unnamed Castellated.

Fig. 28. Rim profiles for Plate 27.

Fig. 29. Rim profiles for Plate 28.
Plate 29. Other clay artifacts. Smoking Pipes.

Plate 30. Hacklander Ware. Hacklander Ware from Indian Point site.