FINAL REPORT TO

THE WENNER-GREN FOUNDATION FOR ANTHROPOLOGICAL RESEARCH

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SUMMARY OF RESEARCH

Introduction

The purpose of this project is to test a theory of the evolution of alliance mechanisms in egalitarian societies. The theory is based on general systems principles. It predicts that ordered sequences of alliance mechanisms of definable characteristics are enacted with increasing social and/or natural evironmental stresses. Research focused in particular on the ordered development of utilitarian and valuables exchange among prehistoric Ohio hunter-gatherer/horticulturalists. Utilitarian and finer pottery vessels from 13 archaeological compenents are being characterized as to whether they were made locally or traded, based on several kinds of materials-compositional and geological data which have been collected over the grant period. Some initial estimates of trade frequencies have been made and, thusfar, concur with the theory. A report of specific research activities and accomplishments made over the grant period follows.

Project Location and Personnel

Research was conducted from June, 1989 through December, 1990. Selection and preparation of ceramic vessel samples for physico-chemical analyses were carried out in the Departments of Anthropology and Geology, Arizona State University, by Christopher Carr, Sarah Horton, Catherine Johnson, and Charles M. Hoffman. Ceramic sample thin sectioning, in preparation for petrographic mineralogical analyses, was done by Mr. Ray Lund, of Quality Thin Sections, Tucson, AZ. Petrographic identification and measurement of rock temper inclusions within ceramic vessels were carried out in the Departments of Geology at Arizona State University and the University of Arkansas by Mary Louise Cotkin. Instrumental neutron activation analyses of the clay matrices of ceramic vessels were done by the University of Missouri, Research Reactor Facility, Columbia, MO, under the direction of Dr. Michael D. Glascock and Michael Elam. INAA and petrographic data were entered into computer files at Arizona State University by Sarah Horton and initial statistical analyses were made there by Christopher Carr. Data on the wet-chemistry of natural clays in Ohio, provided by the Ohio Geological Survey, were analyzed by Christopher Carr at Arizona State University.

Methodological Improvements

Compositional analysis of ceramics for the purpose of identifying trade vessels is typically achieved in archaeology by two means: petrographic analysis of the mineralogy of temper inclusions and bulk chemical analysis of the major, minor, and/or trace elements of the clay matrix and temper, combined. In this research project, standard petrographic procedures were used to analyze temper mineralogy, but new methods for chemical analysis were developed.

Bulk analytic methods for characterizing the chemistry of a vessel are not optimal, and sometimes misleading, because the separate chemistries of temper inclusions and clays are combined. Several problems can ensue from this procedure. (1) Vessels may be characterized as varying significantly in their chemistry, and may be inferred as having different sources of manufacture when, instead, their clays and tempers are similar in nature and only the volumentric

proportions of clay and temper vary. (2) Trade vessels may vary in only the nuances of their clay chemistry, not in their temper chemistry, in geologically uniform environments. In this circumstance, the tell-tale differences in clay chemistry can be masked by similarities in temper chemistry when bulk analytic methods are used. (3) Locally made vessels may vary in their temper chemistry in geologically diverse evironments, where a variety of tempering materials are available and equally suitable. Similarities in only their clay chemistry may indicate their similar location of manufacture, and these may be masked by temper chemical variation when using bulk analytic methods.

To overcome these problems, a procedure was devised for separating the paste and temper components of vessels. The chemistry of the paste could then be analyzed separately from the temper inclusions.

Sherds were gently broken into several millimeter pieces using a simple geological anvil-socket-hammer system. Care was taken to minimize the shatter of temper particles. Each broken sherd was then placed with deionized water in a glass beaker. The mixture was subjected to high frequency sound waves using an ultrasonic generator with an aluminum vibrating tip. Frequencies barely low enough to disaggregate the clays from temper particles were used, to minimize temper disintegration and contamination of the fine paste fraction. The mixture was then transfered to a settling cylinder, where it was allowed to settle over a distance of 23 cm for 1 minute. Finer silt and clay matrix particles remained in the 23 cm volume, whereas coarser natural or temper particles settled out of this volume. The 23 cm supernate mixture with fine particles was then extracted and oven-dried, producing a residue of paste particles in the silt to clay size range. This method is similar to standard hydrometer principles based on Stokes Law. After separation, the fine silt and clay particles, alone, were analyzed for their chemical composition by instrumental neutron activation analysis.

Ceramic Clay Compositional Analyses and Estimating Vessel Trade Frequencies

The silt and clay pastes of 204 Ohio Woodland pottery vessels from 13 archaeological components, which range from ca. 400 B.C. to A.D. 1300, were analyzed for their absolute concentrations (ppm) of 33 major, minor, and trace elements by instrumental neutron activation analysis (INAA). The elements that were determined are: As, La, Lu, Nd, Sm, U, Yb, Ce, Co, Cr, Cs, Eu, Fe, Hf, Ni, Rb, Sb, Sc, Sr, Ta, Tb, Th, Zn, Zr, Al, Ba, Ca, Dy, K, Mn, Na, Ti, V. The 13 components from which the samples were drawn, their approximate dates of occupation, and the number of vessels analyzed from each component are shown in Table 1.

Possible trade vessels in the sample from each component have been identified through a preliminary analysis of the INAA data using polythetic agglomerative cluster analysis. All 204 vessels were sorted into clusters, based on all 33 elements. The majority of vessels from each component usually clustered together in one or two groups, indicating their local manufacture from clays of one or two sources. Vessels from different components usually clustered into separate groups. Possible trade vessels were identified as those that clustered erroneously with vessels from other components or stood out as outliers from all of the groups.

The results of the analysis largely support the theory of an ordered sequence of development of alliance mechanisms in egalitarian societies. The

percentage of possible trade vessels identified for the Early Woodland, Middle Woodland, Early Late Woodland, and Late Woodland/Ft. Ancient periods are: 50 - 58% (13-15 out of 26 vessels), 13.33% (12 out of 90 vessels), 5.35% (3 out of 56 vessels) and 31.25% (10 out of 32 vessels). From the Early through Early Late Woodland, the percentage of trade of ceramic vessels appears to have decreased steadily. This is expectable from the theory. Initial adaptive responses to documented natural and social enviromental risks in Ohio prior to and during the Early Woodland would have been met by the trade of utilitarian items, such as lithic and ceramic artifacts. The trade of chert and/or chert artifacts is well documented for the Late Archaic and subsequent Woodland, and the high rate of exchange of ceramic vessels found here for the Early Woodland fits into this pattern. During the Middle Woodland, more complex mechanisms for consolidating and maintaining social alliances among local groups were developed, including mortuary rituals which may have involved the aggregation of multiple local groups, and the trade of elite items used in these rituals. With the evolution of these mechanisms, it is not unexpected that the rate of trade of ceramic vessels and other utilitarian items would have declined. During the Early Late Woodland, structural mechanisms stronger than alliances, including ethnic consolidation and/or sodality-based tribes, as evidenced in the appearance of large villages, may have developed. With the evolution of these integrative amechanisms, the importance of utilitarian trade, including ceramic trade, would have again decreased.

Cultural evolution during the Late Late Woodland/Ft. Ancient period involved the development of rank societies and is strictly beyond the scope of the theory of alliance development, which pertains to egalitarian social landscapes. However, the increase in utilitarian ceramic trade that has been found here for this period is concordant with documented increases in territoriality and warfare between local groups at this time. Increasing territoriality and warfare point to the inadequacy of ethnic and tribal organizational mechanisms in mediating local groups and a need to again rely upon continously negotiated exchange to overcome conflict.

CONCLUSION

Preliminary analysis of the clay chemistry and temper mineralogy of ceramic vessels from the Early Woodland through Late Woodland/Fort Ancient periods in Ohio has allowed the tentative identification of a number of traded vessels from 13 archaeological components. Rates of trade decreased steadily over time, in accordance with the proposed theory of evolution of alliance mechanisms in egalitarian societies. Further work on identifying trade vessels by petrographic means, on calculating the relative percentages of trade of utilitarian versus fine ceramic vessels, and on sourcing the locations of manufacture of traded vessels with data on the chemistry of nature clays in Ohio remains and should provide further insight into the validity of the theory of alliance development.