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APPROACHING FABRICS THROUGH IMPRESSIONS ON POTTERY

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Organic fabrics only rarely survive under archaeological conditions. Particularly in humid temperate or tropical zones, textiles and other fiber perishables rapidly decompose and disappear quite soon after deposition. A few remnants may be found in dry caves or anerobic wet sites, or as charred fragments or metal pseudomorphs, but these represent only a tiny proportion of regional prehistoric fabric production. Fortunately, though, the archaeological record does sometimes yield secondary evidence in the form of impressions on pottery of yarn, fabric, and basketry.

Following the theme of this year's TSA symposium, "Approaching Textiles, Varying Viewpoints," this paper focuses on methods and results of some recent projects involving fabric impressions on pottery. Non-archaeologists might or might not be familiar with the approach. Specialists in organic archaeological fabrics might be familiar with the methodology but see little or no incentive to use it. Even archaeologists who have used the analysis of fabric impressions to good advantage might not be familiar with some of the most recent developments in the field.

In the following pages, I briefly review what is involved in such an analysis, describe advantages and limitations of fabric data derived from impressions, discuss some recently developed analytical approaches and newly-recognized problems, and touch upon several recent case studies that take full advantage of this medium.

WHAT IS INVOLVED?

Impressions of fabrics, cordage, and basketry can be found on exterior or interior surfaces of pottery vessels and figurines, as well as on unfired clay such as from wattle-and-daub houses. Use of these impressions to investigate yarns and fabrics was explored by William Henry Holmes over a century ago (Holmes 1884, 1888, 1896 cited in Drooker 1992), with a few additional studies reported in the mid-twentieth century (e.g., McPherron 1967; Quimby 1961; Saylor 1978; and Miner 1936, Rachlin 1955a cited in Drooker 1992). In the New World, both European and indigenous fabrics have been investigated (e.g., Kuttruff 1980 cited in Drooker 1992). Until fairly recently, though, the wealth of data available on such sherds was extremely underutilized.

In the case of clear, firmly-marked impressions, all that is necessary to study the original fabric and yarn structures is some sort of malleable material with which to make a cast or "positive mold" from the negative mold on the pottery, plus a low power microscope or magnifier to observe and measure small-scale attributes, and side lighting to throw three-dimensional structures into higher relief. If a fine-grained casting medium is used, details can be amazingly clear, to the point that individual fibers are visible, and plant and animal fibers usually can be distinguished from each other. Below, I discuss some of the casting products currently being used, but first I want to summarize what attributes can and cannot be studied by this method.

FABRIC IMPRESSIONS VERSUS ORGANIC FABRICS: ADVANTAGES AND DISADVANTAGES

Casts of yarns and fabrics obviously do not reveal color, nor can they be turned over to see the reverse side or pulled apart to confirm structural intricacies. This makes structural analysis particularly difficult for warp-faced and weft-faced fabrics, for stretchy structures like linking that were impressed in the relaxed position, and for structures like three-element twining that appear different on each side of the fabric (Drooker 1992, 1998, 1999). Unless an impression includes a fabric edge, warp and weft usually cannot be distinguished with certainty, nor can single-element versus multi-element fabrication techniques that result in the same structure (King 1978:90-91 cited in Drooker 1992), such as oblique interlacing versus weaving. Faint impressions may emphasize one set of elements in a fabric over another, making accurate analysis difficult. For instance, open twining may have the appearance of parallel two-ply cords if only the twining rows, and not the passive elements, have been impressed. Similar, and even thornier, problems arise with patterns formed by multiple impressions of the same or different structures, such as occur when cord-wrapped or fabric-wrapped paddles are used in pottery production (Herbert 1999). In addition, because the ceramics on which the yarns and fabrics are impressed would have shrunk as they dried, the fabric replica never will exhibit the exact dimensions of the original (Hutcheson 2000).

To tease out the most accurate analysis, one must be familiar not only with methods of cord making and fabric production and embellishment, but also with a wide range of pottery making techniques. Intimate knowledge of any and all extant organic fabric fragments from a given region and time period aids tremendously in interpreting fabric impressions from the same area. In addition, one must keep an open and skeptical mind. The old saying, "When you have a hammer, everything looks like a nail," holds true for textile specialists as much as anyone: NOT every cast that looks like a fabric actually represents a fabric! But the reverse can be true as well: It is possible to identify real textile treasures if you search in the right places and know enough to recognize them when you see them.

For those of us who work in parts of the world where few actual examples of fabrics, cordage, or basketry survive, impressions on pottery not only can afford glimpses of many types of perishable constructions that otherwise never would have been known, but also can provide very large samples, of a size suitable for statistical analysis and comparison within and between sites and regions. Three mid- to late-twentieth century advances have made this possible.

First, large strides have been made toward standardization of structural analysis terminology, with the publication of Irene Emery's terminology for yarns, textiles, and some non-woven fabrics, William Hurley's for cordage, Hélène Balfet's and James Adovasio's for basketry, and David Fraser's compendium of weft twining structures (Adovasio 1977; Hurley 1979; and Balfet 1957, Emery 1966, Fraser 1989 cited in Drooker 1992). None is complete or perfect, but they greatly facilitate analysis and comparison of results. The development and adoption of a single, unified terminology, while highly desirable, has yet to be accomplished. Second, a suite of statistical techniques called attribute analysis or numerical classification, together with the development of a group of standardized, numerically defined fabric attributes, provided an objective means to define and compare groups of artifacts (e.g., Drooker 1992:37-58 ;

Hoyal 1997; Kuttruff 1988a cited in Drooker 1992; Kuttruff and Drooker 2001; Kuttruff and Strickland-Olsen 2000:Appendix; Rice 1987:275-288; Shennan 1988:190-240; see also Hamilton et al. 1996:Appendix 2). Third, the rapid development of computer technology and current wide availability of powerful personal computers and off-the-shelf statistical analysis programs has enormously facilitated the application of attribute analysis to very large groups of artifacts (cf. Adams, this volume).

Just as with the analysis of organic fabrics and basketry, the ultimate goal is more than merely detailed descriptions of the fabrics themselves. It is to discover, to the extent possible, how they were made and used, and their economic, social, and ritual significance to the people who produced and employed them. In the case of fabric and basketry impressions on pottery, because the ceramics and perishables co-occur, analyses can draw upon both media for insights into patterns of production, use, discard, and exchange within and between groups of people. I describe a few recent examples below. Before that, though, is a brief discussion of technical aspects of impressed fabric analysis, including a significant newly-recognized problem.

NEW APPROACHES AND NEWLY-RECOGNIZED PROBLEMS

A variety of materials have been used to make casts from fabric impressions. Holmes reported using "clay," and others employed "plasticine." I have employed a molding product called "Sculpey," which can be used and reused, then baked to hardness for a permanent record (Drooker 1992:251-253). Carol Rachlin pioneered the use of latex (Rachlin 1955b, 1955c cited in Drooker 1992), which she sometimes stretched to reveal structural details (see also Adovasio et al. 1988:345). William Johnson utilizes a product called Moldlene (pers. comm. 1999). Plaster of Paris also has been employed. More recently, analysts have used dental compounds (Berman and Hutcheson 1997; Stothert et al. 1991; see below).

Until lately, primary concerns in choosing a casting medium and process were (1) speed and ease of use (important when carrying out analyses on far-flung collections), (2) quality of reproduction, and (3) potential for shrinkage. The easiest products to use while "on the road" are those, such as Sculpey, that can be applied in one step. Latex and Moldlene, while providing fine-grained casts, must be applied in several layers, with drying time between applications, so are most feasible at one's home institution. Mary Jane Berman and Charlene Hutcheson use a quick-setting dental compound (Jeltrate® or Jeltrate Plus®) that can be transported as powder and hydrated on site (Berman and Hutcheson 1997). Its application, while not one-step, is fairly simple. However, shrinkage can be significant - up to 8% within 2 months - so measurements of fabric attributes need to be made immediately. Berman and Hutcheson use these casts to make replicas of the sherds in a more permanent medium (plaster, or Kerr® Velmix, another dental compound), which must be done within 24 hours (Berman and Hutcheson 1997; Hutcheson 2000). Karen Stothert and colleagues employ a different dental compound, Reprosil, which shrinks less than 0.01% (Stothert et al. 1991:770:771). In my work (using Sculpey), I take measurements from the cast immediately, with both sherd and cast in front of me. The cast is then baked and retained for a permanent record of the fabric structure, but not used again for measurement.

Information about fabrics obtained by these methods can be extremely valuable. However, in obtaining such data, the textile analyst can damage or obliterate other types

of information (Rieth 1999). Awareness of potential problems is the key to minimizing them. Some damage to sherds generally has been considered inevitable, but it is the analyst's responsibility to keep it to a minium.

Broken sherds, which result from not fully supporting the ceramic fragment while pressing the casting material against it, are easiest to guard against. Removal of surface material from poorly fired sherds, unfortunately, is difficult to avoid. Applying talcum powder before making a cast can alleviate this problem. Still-adhering dirt also can help, but chunks of dirt must be brushed off, or the fabric replication will be inaccurate. Sherds with unfired finishes such as paint, with applied substances such as red ochre, or with adhering materials such as food residues or soot ordinarily should not be used to make casts, because all could be physically removed from the sherd by the casting material.

A less obvious, but even more serious, problem recently has come to light through research by Christina Rieth and Jill Minar (Minar 1999; Rieth 1999). Many materials used to make casts, including plasticine, Sculpey, and Reprosil, contain organic compounds. These not only leave stains on ceramics (Stothert et al. 1991:770), but are highly contaminating. (Jeltrate® is said not to leave an oily residue (Berman and Hutcheson 2000), but it is unclear whether or not it still is a potential contaminant.) Sherds to which such substances have been applied, and even sherds that have been handled by a person who has handled such materials, will bias subsequent analyses of the sherd such as trace element identification or radiocarbon dating of adhering soot or food residue. Members of a Society for American Archaeology Working Group convened by Jill Minar (Minar et al. 1999) have begun to address the development of a protocol for use of potentially contaminating materials. At a minimum, analysts should provide complete information about the medium employed, should label or otherwise identify all sherds that have been cast, should bag these sherds separately, and should leave a portion of each sherd collection they study uncast, for use in other types of analysis.

In a number of projects, experimental replication has proved extremely useful. Joseph Herbert used it to investigate (for instance) whether particular surface textures on pottery from coastal North Carolina were formed by impressed fabrics or by multiple applications of cord-wrapped paddles (Herbert 1999). Hutcheson replicated basketry in a variety of local materials and impressed it on pottery. She was able to identify likely materials used in prehistoric baskety impressed on Bahamian pottery (Hutcheson 2000).

SELECTED APPLICATIONS

To give you a flavor of some of the current research employing data from cordage, fabrics, and basketry impressed on pottery, I briefly mention a number of ongoing or recently completed case studies. Most of them utilize data from pottery impressions in combination with data from other media, not as a stand-alone source of information.

Several recent projects (in addition to Herbert 1999 mentioned above) have provided new insights into ceramic technology. Studying fabric impressions on molded figurines, on their molds, and on associated platforms and house models from Ecuador, Stothert and colleagues concluded from the locations of the impressions that slabs of clay first were flattened on cloth-covered surfaces, then formed into the desired shape (Stothert et al. 1991). The impressions were present primarily in non-visible locations, having been smoothed away elsewhere. Hutcheson carried out a series of replication experiments to determine whether Palmettan Ostionoid pottery from the Bahamas was deliberately or

accidentally impressed with basketry mats (Berman and Hutcheson 1997). The former appeared to be the case. I investigated whether a specially-made, standardized fabric was employed to line molds for large, shallow salt evaporation pans at a late prehistoric site in Kentucky. The great diversity of fabric structures and scale, plus the presence of holes and other damage in a high percentage of examples, seemed to rule this out. Because these heavy vessels frequently were impressed with relatively fine and fragile fabrics, I also concluded that the fabrics more likely aided in separating the vessel from the mold than in lifting it out (Drooker 1992:146-152).

A number of recent studies using impressions on pottery have provided new information on fabric or basketry types, their temporal and geographical distributions, and socioeconomic implications. Some of the broader topics explored by means of these data include production technology, organization of production, exchange, subsistence strategies, horizontal group identity and interaction, and rank or class differences.

Some of the most exciting work, carried out by Olga Soffer, James Adovasio, and colleagues, has come from European assemblages. Among other things, they have shown that yarn and fabric were being produced far earlier than previously imagined. Impressions in clay from Upper Paleolithic sites in the Czech Republic, plus analysis of garments depicted on well-known Gravettian "Venus" figurines, demonstrated that twined fabrics, knotted netting, and interlaced basketry were being produced by ca. 26,000 BP or earlier (e.g., Adovasio et al. 1996; Soffer et al. 1999; Soffer et al. 2000). The popular press enthusiastically picked up on the notion that this assemblage provides potential evidence for cooperative hunting of small game by women, children, and men using nets, as opposed to the older archaeological paradigm for this time period, of spear-wielding men bringing down mammoths and other big game to feed their dependents (e.g., Pringle 1998).

Other recently excavated terminal Pleistocene assemblages, studied by David Hyland and colleagues, may provide evidence of links between Old World and New World fabric industries. Impressions of fabrics from ceramics at 13th-millennium BP sites in the Russian Far East include technological types congruent with the oldest fabrics recovered from western North America, dated several thousand years later (Hyland et al. 2000).

One of the hypotheses pursued by a number of archaeologists during the 1980s and 1990s, using evidence primarily from impressions on pottery, is that the predominant twist direction of cordage can be correlated with group affiliation or "ethnicity" (e.g., Hamilton et al. 1996; Johnson 1996, 1999; Maslowski 1984 [cited in Drooker 1982], 1996; Petersen 1996). Although it would be extremely risky to draw conclusions about group affiliation based only on small statistical differences in percentages of Z versus S twist in cordage samples from different communities or regions, James Petersen and colleagues, using ethnographic evidence from Amazonia, argue persuasively that when a sharp break in twist direction is apparent, it probably does represent a significant cultural divide (Petersen et al. 2001). This might or might not be a linguistic divide, however.

Jill Minar has drawn upon learning theory and experimental archaeology to show how this might work. She found that spinners tend to stick with whatever twist direction they first learned; this overrides such considerations as right- or left-handedness. Serious spinners produce yarn with a single consistent direction of spin and an opposite direction of ply, mainly for reasons of production efficiency (Minar 2000). They switch direction only for specific functional reasons, and when they do it slows them down. If most

teachers in a particular region tend to spin in a given direction, so will their students. However, only when there is a cultural rationale for spinning in a particular direction does an extremely consistent direction of twist become apparent over a large region. Minar has collected ethnographic examples of cultural twist preferences from Peru, Korea, and the North American Southwest (Minar 1999, 2000). My own findings, that yarns in eleventh-thirteenth century Mississippian western Kentucky, Tennessee, and portions of adjoining states have consistent (95-100%) final S twist whether they are 2-ply or single ply, almost certainly is a case of cultural preference (Drooker 1992:114-115, 123, 125, 176-207; see also Miner 1936 cited in Drooker 1992).

Another aspect of Minar's research is of great significance in researchers' attempts to assign bounded "ethnic" identity to archaeological groups. Using cord-marked pottery from Georgia, South Carolina, and Florida, she demonstrated that attributes of Southeastern ceramic vessels such as temper and decoration do not necessarily co-vary over space and time with attributes of cordage impressed upon them (Minar 1999, 2001). This calls into question the simplistic designation of archaeological "ethnic groups" based solely upon one medium or a restricted set of attributes.

However, when a variety of attributes do vary together - cordage twist, fabric type and attributes, vessel temper, manufacturing method, and/or style - then a geographical disjuncture or an oddball example can be significant and useful. For instance, Rieth found that in the upper Susquehanna River Valley, very similar fabrics were produced and used in ceramic manufacture between AD 800 and 1300 (Rieth 1997, 1999). When an atypical fabric was encountered, she carried out trace element analysis on the sherd to determine whether it was local or imported, using the data in a study of group movements over time. She found continuity between later and earlier archaeological culture groups (Owasco and Late Point Peninsula), suggesting that there was no mass displacement of local groups by in-migrating Iroquois populations. She also found greater variation at sites near the edge of the region, suggesting regular interaction with "foreign" groups.

In contrast, Petersen and Wolford (2000) demonstrated a rather sharp disjuncture, lasting over 2000 years, in impressed cordage twist direction between coastal and interior New England populations before AD 1000. After AD 1000, shell temper was adopted by coastal populations, and was consistently associated with the typical coastal Z-twisted cordage. Grit temper, and S-twisted cordage, persisted in the interior; when Z-twisted cordage impressions did occur there, they were typically associated with shell tempering. After AD 1300, Iroquoian style pottery, with predominantly Z-twist cordage impressions, entered the region from the west and north. Three separate populations do seem evident.

A study by Nathan Hamilton and colleagues of both impressed and organic fiber artifacts and related ceramics at the Juntunen site, in the Straits of Mackinac between Lakes Michigan and Huron, concluded that the data "suggest a combination of local development *and* regional exchange and contact" in the Upper Great Lakes during the period of interest, ca. AD 800-1300 (Hamilton et al. 1996).

In the Caribbean, Berman and Hutcheson are building a database of basketry attributes from impressions on pottery, along with developing a standardized descriptive methodology for the region (Berman and Hutcheson 1997, 2000; Hutcheson 2000). They, as others before them, note the power of complex basketry construction to convey cultural identities, and are beginning to recognize geographical differences in basketry techniques, patterns, and materials.

Karen Stothert and colleagues used textiles impressed on Ecuadorian figurines between 1000 BC and AD 800 to reconstruct the organization of production for both the ceramics and the fabrics among four different groups (Stothert et al. 1991). They not only used yarn and fabric attributes to infer local, domestic manufacture versus managed, standardized manufacture of cloth in diffent regions, but through the analysis of yarn consistency within a given fabric were able to show that in one of the groups, a number of different spinners probably contributed yarn to each weaver. Control by high-status managers within a relatively complex social system is hypothesized.

In my work with fabrics impressed on Mississippian pottery, I found that all fabric structures were consistent with production on free-hanging warps rather than a tensioned-warp frame or loom, in particular an emblematic type of structural decoration, plain twining with interlinked warps, that so far has not been found in pliable fabrics anywhere else in the world (Drooker 1990, 1992). The fabrics were the right size and shape to have functioned as skirts, mantles, or large bags; edge finishes were typical of garments. Through replication of typical yarns and fabrics, with the help of spinner Ella Baker I was able to determine production times for typical garments and containers, estimating that a Mississippian woman might spend on the order of three hours per day on fabric production for her family (Drooker 1992:164-171; cf. Ericksen et al. 2000). Skilled craftspeople who produced elaborate elite and ceremonial garments in twined tapestry and elaborate openwork similar to bobbin lace probably worked as part-time specialists. At the Wickliffe site in Kentucky, the few surviving organic fabrics, which came from mortuary contexts, were more complex (based on the Textile Production-Complexity Index developed by Jenna Kuttruff) than the average fabric impressed on pottery (Kuttruff and Drooker 2001). Yet the fabric assemblage impressed on pottery was remarkable for its diverse variety of fine and complex examples, implying that Mississippian women in general had the time as well as the skill to produce utilitarian fabrics of beauty and distinction.

Other recent analyses of Mississippian and contemporaneous fabrics and basketry impressed on pottery include work on assemblages from Illinois, Indiana, Kentucky, Tennessee, and Alabama (Brandon and Mainfort 1995; Drooker 1993; Henderson 1999; Kuttruff and Kuttruff 1996; Leslie and Simms 1991; Stathakis 1996). At least two of them were explicitly designed to investigate issues centering on social status. As more and more data are assembled, increasingly interesting region-wide anthropologically oriented investigations can be carried out.

I am very pleased that such important evidence of long-disappeared fiber artifacts is beginning to get the attention it deserves.

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