MISSISSIPPIAN TEXTILES AT BECKUM VILLAGE (1CK24), CLARKE COUNTY, ALABAMA

by

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ABSTRACT

The primary goal of this thesis was to determine the original functions of the textiles that were used to make saltpans at the Beckum Village site (1Ck24), a Clarke County saline in southwest Alabama. While organic material, such as yarn and cloth, rarely survive in archaeological contexts in the humid Southeast, information about Native American textile knowledge, skills, and traditions are preserved in the impressions of prehistoric textiles impressed into the surfaces of saltpan pottery. Based on the analysis of such impressions, the Beckum Village textiles appear to have been made for a variety of purposes, all of which had to do with personal use rather than salt production. The conclusion that the Beckum Village textiles were not intentionally made for production of saltpan pottery suggests that these saltmakers were families or individuals who were making salt for their personal use rather than a group that participated in the specialized craft production of salt and the creation of the textile and ceramic tools that would have been necessary for such an enterprise.

The textile impressions recovered from Salt Creek (1Ck222), another Clarke County saline site, also were analyzed for this research project. Beckum Village and Salt Creek, two Early Mississippian sites within ten kilometers of each other on the Tombigbee River, might be expected to produce similar textile-related artifacts. Kimmswick Textile Impressed, *var. Langston,* ceramics were recovered from both sites, but when the impressions of the textiles on those ceramics were analyzed for this thesis, it became apparent that the groups that used these two sites had different textile traditions and practices. The textile data provided by the Beckum Village and Salt Creek saltpan sherds provide new information about the varied and complex cultures of the Late Woodland and Early Mississippi periods.

INTRODUCTION

With easy access to industry-produced clothing, it is difficult for modern men and women to imagine the complex decision making processes and the wide variety of skills involved in the creation of yarn and cloth during prehistoric times. Between the moments when a good stand of mulberry sprouts was found and when a Southeast Indian woman wore the skirt made from that mulberry fiber, a time-consuming and complicated process took place. That process encompassed many steps and many decisions, each based on training, skill, tradition, and the understanding of how a choice made at one step in the process would affect the choices that would be available in future steps.

From archaeological evidence and historical documents, we know that the Southeast Indians carried on a long and rich textile tradition. Eight thousand years ago, Paleoindians left impressions of woven materials (possibly basketry or matting) in clay floor surfaces in Dust Cave in north Alabama (Sherwood 2001:99). Two-thousand years ago, Woodland Indians used handspun yarn and handmade fabric to decorate pottery in the Tennessee River Basin (Dunlevy 1948:55; Knight 1990; Spanos 2006). Five hundred years ago, Mississippian Indians left behind textile artifacts that included garments, bags, footwear, fabric impressed pottery, and images of textiles on copper ceremonial objects (Drooker 1992:58-94; Kuttruff and Kuttruff 1996:161-172; Schreffler 1988:124-130). Two hundred years ago, just prior to their removal from the Southeast, Indians were wearing traditional handmade textile accessories with their newly traded European clothing and were assembling cotton cloth "factories" to gin, spin, and weave the cotton they were raising (Wickman 1991:135-136; Carson 1999:79). The items they left behind show that for centuries Southeast Indians knew what plants and animals produced usable fiber, how to harvest and prepare those fibers for spinning, how to create a wide variety of yarns, and how to make every type of fabric they needed.

This thesis contributes to the record of Southeastern prehistoric textiles through the analysis of a collection of textile artifacts excavated in 1940 by the Alabama Museum of Natural History and the Federal Works Progress Administration (WPA) at the Beckum Village site (1Ck24), located in Clarke County, southwest Alabama (Figures 1 and 2). Since that excavation this collection has been included in several research projects. In 1960, Steve B. Wimberly documented the pottery type descriptions and frequencies along with other artifacts recovered by this and similar archaeological digs in Clarke and Mobile counties from 1940 to 1941 (1960:vii, 30-32, 185-187). In 1992, Penelope B. Drooker used Wimberly's data to include Beckum Village in a comparison of Mississippian textile attributes gathered from sites across the Southeast (1992:180,

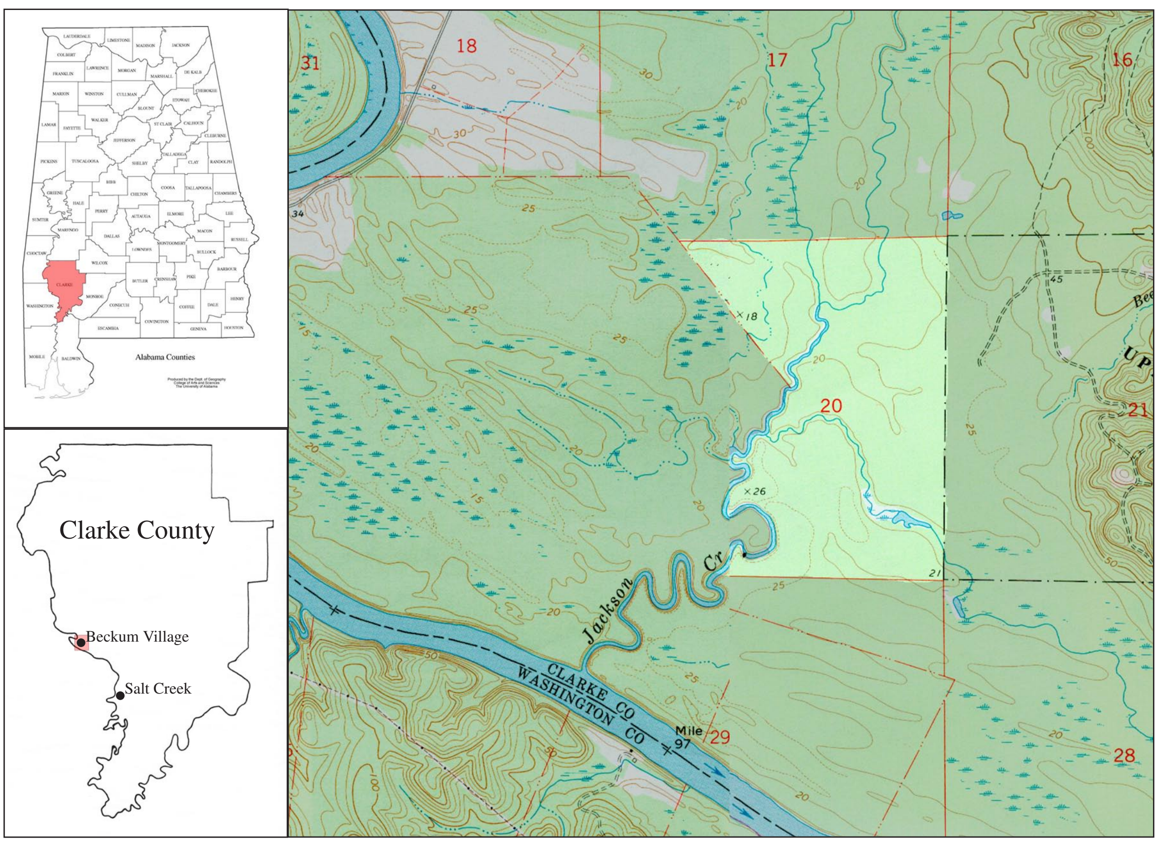


Figure 1. The location of the Beckum Village site. As documented by excavation map coordinates, the site should occur somewhere within the highlighted section of the topographic map at right.

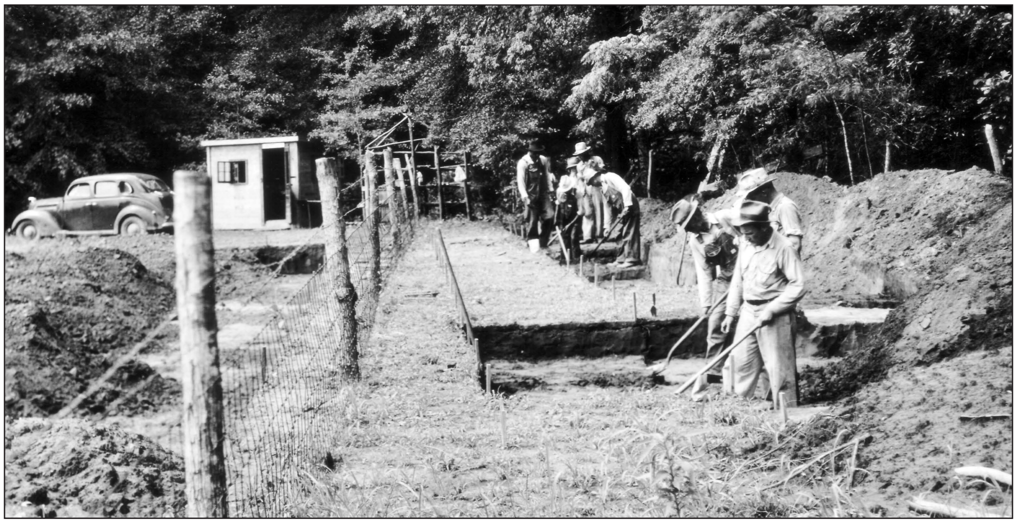


Figure 2. 1940 WPA excavation of the Beckum Village site (courtesy of the Alabama Museum of Natural History).

195, 198, 206-222). In 2005, Ashley A. Dumas included Wimberly's description of the Beckum Village collection in a pottery analysis of Clarke County saline sites that focused primarily on the E. Bruce Trickey collection from the Lower Salt Works (1Ck28) and Salt Creek (1Ck222, Dumas 2005:13-15). The present study presents new data from a detailed analysis of the Beckum Village textile impressed potsherd collection to investigate the possibilities for what this data can contribute to the present knowledge of the Beckum Village saltmakers and to lay a quantitative foundation for future textile studies.

It is generally accepted that the occupants of Beckum Village used fabrics and netting to line molds to create large shallow ceramic vessels. These vessels, called saltpans today, were used to evaporate the moisture from salt brine that occurred naturally in the nearby swampy salt seeps, a salt-water version of an artesian well. By evaporating the water to make dietary salt, the Beckum Village residents produced a transportable product that they needed for their own dietary use and, possibly, a valuable trading commodity (Brown 1980:3-7, 32-33).

At the time of the excavation, two periods of occupancy by groups with different ceramic traditions were noted. The excavator's report noted that shell-tempered saltpan sherds were found primarily in the upper layers of the site and sand-tempered bowls and jars were found in the lower, older layers (Alabama Museum of Natural History 1940:4). This thesis focuses on the later period and the shell-tempered textile impressed saltpans. These ceramic artifacts have been typed as Kimmswick Fabric Impressed, *var. Langston,* which date the occupation that produced them to the Late Woodland and Early Mississippi periods, A.D. 500-1250 (Dumas 2005:7). Finding such a high percentage of this type of vessel, with a consistent shape, is thought by some scholars to be evidence of "directed craft production" of the saltpans and the salt (Brown, Kerber, and Winters 1990:253).

The fabric impressed saltpan sherds from another Clarke County site were analyzed to provide a comparison with the Beckum Village data. The Salt Creek site (1Ck222), also referred to as the Central Salt Works, is approximately ten kilometers south of the Beckum Village site. The collection examined here was excavated by Trickey in 1957. The Salt Creek Trickey excavation included a surface collection and multiple layers within two test pits. Kimmswick Fabric Impressed, *var. Langston,* ceramics were recovered from both the Beckum Village and the Salt Creek sites. While the ceramics from these sites are similar, the textiles impressed into those ceramics are significantly different.

Actual textiles, like all organic materials, are rare archaeological finds in the humid Southeast. The 1940 Federal Works Progress Administration (WPA) excavation of Beckum Village produced a collection of nearly 1,500 textile impressed pot sherds that can act as a substitute for, or a recorded image of, the original yarns and fabrics (Figure 3). The images on these sherds provide a view that is almost as informative as the original textiles would be, were they available. When extant textiles are found in the archaeological context, they are typically altered by the deterioration of time and their environment. Although the clay sherds often suffer from deterioration caused by erosion of the materials within the clay or abrasion to the clay surface, what remains of the textile

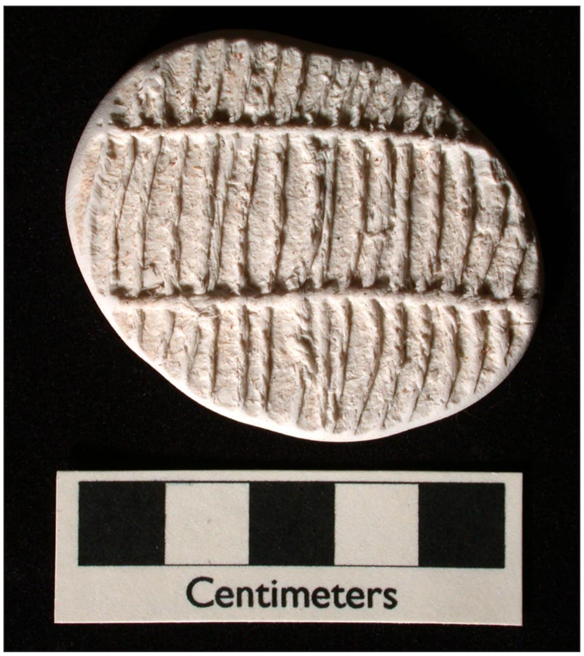


Figure 3. Above, Beckum Village saltpan textile impressed sherds (provenience 1420.21.401). Left, a cast of the sherd's textile impressed surface provides a positive image of the original yarn and fabric.

image provides a view of the yarns and fabrics as they were on the day they were pressed into the soft clay of the new pot. This perspective must be estimated and inferred when analyzing fragments of actual prehistoric textiles, which are affected by the passage of time.

While textile impressed potsherds provide information that would have otherwise been lost, there are some aspects of the yarns and fabrics that are rarely available from a potsherd impression. Just as a sherd presents only a piece of the original pot, a textile impressed sherd shows only a piece of the original cloth. Important information regarding construction processes and tools is found in the edges of a piece of fabric. For example, how it was mounted on a loom or frame can only be seen in the edges of the fabric that were affixed to the loom or frame. The fiber content and use of applied color, by painting or dyeing, can only be speculated from an image in a potsherd. A ceramic impression, although typically deep in textile impressed saltpan sherds, only provides one face of the fabric. The researcher can not look between closely set yarns or turn the fabric over to see what the other side looks like.

Another aspect of textile technology has not been previously addressed is whether the production of the Beckum Village textiles was women's work or men's work. The question of gender roles surfaces in any research of textile production and a short discussion will show why this topic is beyond the scope of this research project. Journals of early explorers provide several descriptions of women spinning and weaving (Le Page 1972:344; Williams 1930:453-454).

An ethnohistoric description of early 19th century Choctaw life shows that women were the primary horticulturists, raising textile crops along with foodstuffs. Choctaw men objected to the European attempts at acculturation that encouraged them to become farmers, because they considered that women's work. Prior to the removal of the Choctaw from the Southeast in the 1830s, the women raised and processed the fiber producing plants, spun yarn, and wove cloth for sale (Carson 1999:79). If this behavior could be used as an analogy for earlier Southeast Indians, we might assume that in the prehistoric Southeast horticultural activities associated with textiles and textile production were performed by women. But one example of gender roles does not provide adequate evidence to make assumptions for the people who produced the textile artifacts found at Beckum Village, even though the Choctaw were, "an amalgamation of remnant Mississippian groups" (Carson 1999:10-11). Variation in gender roles and textile production has been documented between Native American groups that lived in close proximity. Among the Navajo, textile work has traditionally been performed by women while among the Hopi, whose land borders Navajo land, the men were the spinners and weavers (Kent 1957:471, 1985:8). In addition to gender roles, the textile traditions of the Beckum Village residents would have been affected by environmental factors such as the social setting of the Woodland and Mississippian stages and the natural ecology of the Southeast region and, in particular, Southwest Alabama.

"The Gulf Coastal Plain stretches from the Fall Line Hills to the edge of the continental shelf and from the Mississippi River to the Apalachicola" (Brown 2004:574). The Beckum Village site is in the part of the Gulf Coastal Plain known as the pine barrens, but it is less than a mile north of the Tombigbee River, near the Jackson Creek Swamp. While the pine barrens are generally thought of as not providing adequate resources for permanent residences, the environment of the Tombigbee River floodplain and the Beckum Village site, would have been quite different. In prehistoric times the forests in Clarke County contained more deciduous trees, such as oak and hickory, than they do now. Oak and hickory trees would have provided nuts, a food source for the Indians, and shelter for deer and turkey, which were also a food source for the Clarke County Indians (Brown 2002:3-5). The forests supported smaller animals such as squirrels, raccoon, opossum, and cottontail, which would have been attracted to the food sources available in the flood plains and swamps (Larson 1980:52-53). The Tombigbee River and its tributaries provided fish and shellfish (Brown 2002:5).

Archaeobotanical and zooarchaeological studies of the Bottle Creek site (1Ba2), a Gulf Coastal Plain Mississippian mound site in the Mobile-Tensaw Delta, provided the archaeological evidence of food choices around the time of the Beckum Village occupation. Bottle Creek people ate mostly corn, clams, mussels, snails, and fish, with a very small percentage of their diet made up of nuts, wild plants, reptiles, birds, and mammals. It appears that these particular representatives of the Pensacola culture subsisted primarily on agricultural produced plants and protein foods gathered from the rivers (Brown 2003:1; Quitmyer 2003:138-139; Scarry 2003:113).

Evidence of limited occupancy at the Beckum Village site was found during the 1940 excavation, which included a single burial, that of a young child, an absence of hearths, and a lack of post holes for homes (Figure 4). Typical Mississippian homes were

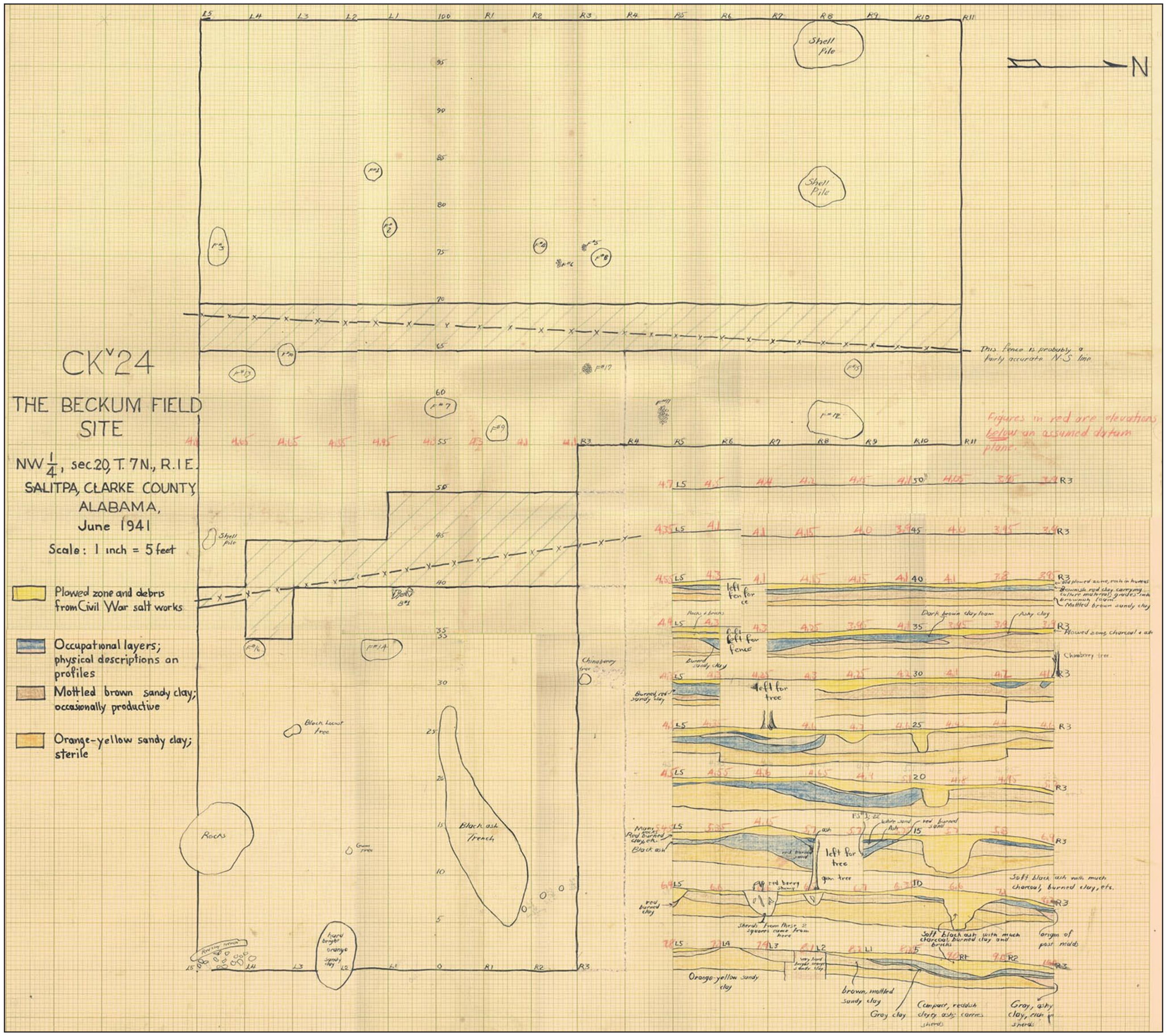


Figure 4. The excavation map from the WPA dig at Beckum Village. The lower right hand portion diagrams the six-inch levels of the eastern area of excavation, shown at lower left on the map (courtesy of the Office of Archaeological Research, Alabama Museum of Natural History).

square or rectangular single set post houses with steep thatched roofs (Brown 2004:584; Walthall 1990:187-189). Since the ceramics date the site to sometime in the Late Woodland (A.D. 500-1100) and Early Mississippi period (A.D. 1100-1250), the lack of post hole features may either be more evidence of seasonal, short-term habitation or it could indicate an early occupation that predates the building of Mississippian houses.

As the Woodland period ended, the growing populations living in the Southeast riverine areas, such as the Tombigbee Valley, the Guntersville Basin, and the Alabama River Valley, experienced growing stress on food resources and increased warfare. Subsistence patterns changed, with the use of cultivated crops increasing and the use of wild food remaining constant (Knight and Steponaitis 1998:10-11). Hunting and gathering was slowly replaced by farming crops like maize, squash, beans, pumpkins, and sunflowers. Hunting, fishing, and gathering wild plant foods, like fruits and nuts, supplemented the domesticated crops (Walthall 1990:190).

While the Woodland Southeast presented a homogeneous landscape of hunting and gathering bands following seasonal paths to exploit natural resources, the Mississippian landscape included a variety of settlement types from densely populated areas to dispersed farmsteads. The Mississippi period has been characterized as a more sedentary life focused on cultivated foods. There was an increase in population density, a focus on ceremonial areas, an increase in social stratification, the emergence of chiefdoms and fortified settlements, the construction of ceremonial or civic mounds, and long distance trade. With the new focus on agriculture, most Mississippian settlements were built where fertile soils existed, often within alluvial riverine valleys (Walthall 1990:185-191).

Mississippian society stratified into the social classes of common people, elites, and chiefs, and developed craft specialization. A function of the chief was to manage the flow of goods and services between the ceremonial centers and the agricultural producers and tribute payers through trade networks, which covered large areas, and through the payment of tribute paid in labor or products by commoners to elites (Blitz 1993:179-180;

Zschomler and Brown 1996:7-8). Trade in exotic goods or limited resources, such as salt, between prehistoric communities were the basis for forming political, economic, and social alliances.

The Beckum Village residents could have been active in a wide region across the Southeast landscape (Figure 5). They may have been small groups or bands of people traveling between seasonal camps, pursuing the natural subsistence resources they needed. While pottery production is not typically associated with hunter-gatherer bands, so

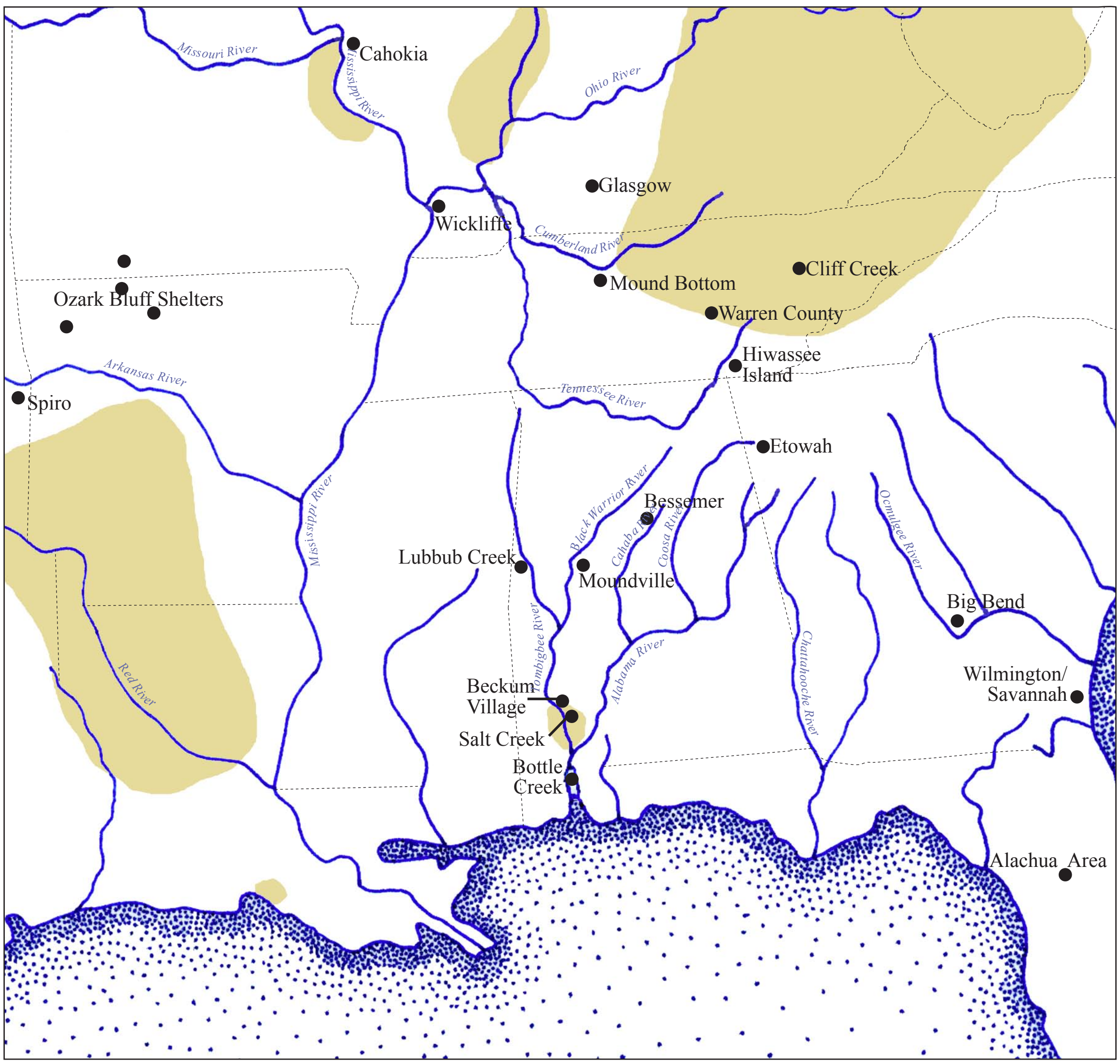


Figure 5. Southeastern Mississippian and related sites discussed in this paper. Main saline areas shown in gold.

the fact that pottery production appears to have played a primary role in the activity at Beckum Village suggests that these salt makers may have been sedentary people with a permanent home who traveled to Beckum Village to make salt. They may have used the salt that they produced for their own dietary needs or they may have produced enough salt to use it as a trading commodity.

In addition to providing quantitative textile analysis data for future research, this research project will attempt to provide a thorough analysis of the textiles found impressed in the Beckum Village pottery to describe more fully the culture that was directly involved in their production. The Beckum Village textiles contribute to the definition of the prehistoric Southeastern textile complex.

A discussion of any prehistoric technology, such as textile production, is unavoidably complex. In addition to the analysis of time, location, and culture, must be added descriptions of technological processes and discussions of how the analysis of that technology adds to our understanding of the culture being studied. In the second chapter of this thesis a description of textile processes will provide a technical foundation for the discussions in the remaining chapters. Analyzing North American prehistoric textile products based on ceramic impressions is not a new concept and the research that laid the foundation for this thesis will be reviewed in the third chapter. The fourth chapter presents the methods used to measure and analyze the Beckum Village textile impressions. The fifth chapter describes an experimental test of these methods that included the creation of a reproduction textile impressed saltpan, thus providing sherds to compare to the fabric that was used in its production. The results of the Beckum Village and Salt Creek data collection will be presented in the sixth chapter. Concluding thoughts on this research will be discussed in the final chapter. An appendix provides the rim drawings that were made during the sherd analysis and their frequencies by fabric structure type.

TEXTILE PRODUCTION PROCESSES

Investigating the process that transforms a bundle of sticks into a feather robe or a fringed skirt leads one to wonder how and when humans figured it out (Figure 6). Early examples of North American Paleoindian netting and matting (Frison et al. 1986:352-361; Sherwood 2001:99) suggest that some of the textile production processes—those that include preparing fibers for spinning, spinning yarn, and making netting—predate the current estimated dates for the development of both horticulture and pottery. While the how and when of the development of spinning and weaving may be beyond our grasp, we can approach an understanding of the prehistoric processes themselves. This chapter provides a description of how yarn and cloth are made by hand, and a summary of what is known about the prehistoric textile processes of the Southeast. The process flows included in this chapter are a modified version of a common computer industry tool, which is used to graphically describe complex processes, called a flow chart. The information presented in the process flows are based on a combination of ethnographic descriptions of Native American processes and this researcher's experience preparing fibers, spinning yarn, and making cloth. The illustrations are based on this researcher's reproductions of yarns and textiles as seen on the Beckum Village textile impressed sherds.

Along with its many other intricacies, the study of textiles offers an additional difficulty in the realm of terminology because research into textiles can be approached from different perspectives, which include the industrial production of textiles, the study of textiles as fine art, and anthropological research into ethnographic and prehistoric

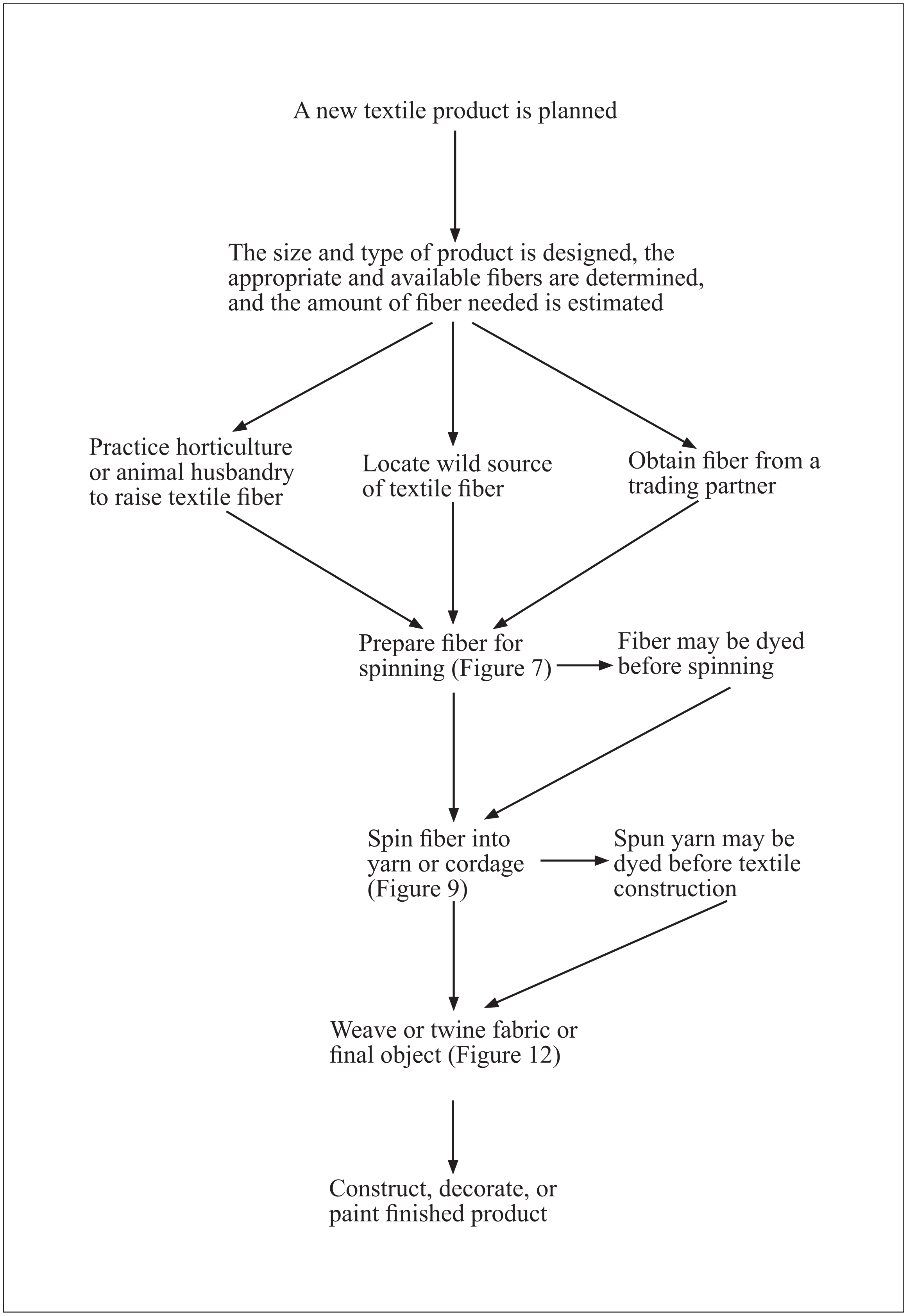


Figure 6. The textile production process.

textiles. Students, scholars, and professionals in each "subfield" of textile research have tailored their own vocabularies; while craftspeople and textile artists, who study textiles from a hands-on perspective, also have developed their own conventions for the use of textile terms. The modern textile industry has comprehensive standards defined and maintained by ASTM International (originally known as the American Society for Testing and Materials) that encourage the consistent use of terms and definitions, which is essential to the interrelated nature of the worldwide textile industry. While the adoption of this standard in the world of anthropological textile research may, or may not, be beneficial to the anthropological academic community, it has not yet been generally accepted.

For the terminology used in this thesis, I relied primarily on Emery, whose illustrated classification of fabric structures provides the current standard for discussions about the details of fabrics (Emery 1995), and Drooker, who provided an archaeologically-focused glossary of textile terms in *Beyond Cloth and Cordage* (2000:267-277). When more information was needed than could be found in those sources, I turned to the ASTM International standards and Hatch's *Textile Science* (1993), a textbook for students preparing for careers in the textile industry.

The basic terms of *textile*, *fabric*, *yarn*, and *cord* have common, or conventional, definitions but they also have specific technical definitions. Emery defined *textile* as a woven fabric that must have at least two sets of elements, such as yarn. The longitudinal elements are called *warp* and the elements that traverse the longitudinal elements are called *weft* (1995:74). The warp and weft elements cross at more or less right angles to each other. Textiles, with their perpendicular elements, are a type of *fabric*, a term derived from the Latin word for fabricate and includes all "fibrous constructions" (Emery 1995:xvi). Cloth and basketry are two other types of fabrics. *Cloth* differs from *textile* in that it may exhibit a construction method other than perpendicular warp and weft elements. Alternatively, in the textile industry and in most causal conversation the term *textile* is used as the superset name for all fabric, basketry, and matting that are made from yarns or fibers (Hatch 1993:6). Fortunately, the Beckum Village collection simplifies this issue of terminology in that the impressions only include textiles, with the prerequisite perpendicular warp and weft elements, knotted netting, and cord marking techniques that used cords to make designs in the clay. For this thesis, only textiles, and their warp and weft yarn elements, will be analyzed.

Yarn, thread, cordage, and cord are often used interchangeably in casual conversation but, like textile and fabric, they have distinguishing differences. Emery defined *yarn* as, "the general term for any assemblage of fibers or filaments which has been put together in a continuous strand suitable for weaving, knitting, and other fabric construction" (1995:10). *Thread* is used to join pieces of fabric together (Hatch 1993:264). The term *cordage* has different definitions in different settings; it is a rope making term and, in archaeological contexts, it refers to yarn that has not been made into anything. In other words, cordage is yarn that is not an element in a textile (Drooker 2000:268). The difference between yarn, thread, and cordage is not intrinsically structural, samples of each may look exactly the same. The difference is in how they are used. When analyzing impressions in potsherds, the term *yarn* is used when describing a structural element of a fabric or textile (i.e. a warp yarn or weft yarn). The term *thread* is used to describe the element used to join pieces of fabric together, and the term *cordage* is used to describe that visibly similar yarn element when it is not found in the construction or assembly of a textile. Cordage is seen in cord-marked impressions and it is the yarn element found in netting, unless that netting was made from strips of leather. This leaves the term *cord*, which, unlike yarn, thread, and cordage, is, in fact, a structurally different thing. Cord is made up of multiple plied yarns that have been twisted or plied together (plying is described in the upcoming section on spinning). There is a visible, structural difference between cord and cordage, as well as a difference in production labor.

Understanding the Beckum Village textiles may require us to challenge common modern notions about handmade clothes, often referred to as *home-made* and *home-spun.*

People living in industrialized societies often think that industry has improved the quality of the fabrics and clothes that are available to us, when, in fact, making textiles plentiful and inexpensive typcially requires the sacrifice of quality. The chemicals and machinery that clean, process, spin, and weave modern fibers into modern fabrics often damage and degrade those fibers and create a more fragile end product. When fiber producing plants and animals are cared for in order to produce quality fibers and when those fibers are processed by hand, the end product is different from what modern men and women are accustomed to. While the prehistoric Southeast did not create the type of hand-made textile regalia depicted in portraits of kings and queens of Europe, the Southeastern yarns and fabrics would have been different than our own in more than just appearance. Their hand processed fibers, hand spun yarn, and hand made fabrics would have been stronger and more resilient than the modern clothes that we replace seasonally and carefully dry clean.

Textile Fibers

The creation of textiles begins with finding a source of usable fiber. The term *fiber* is used extensively in discussions of textiles. A fiber is a single strand of animal hair, plant material, or insect extruded material, and it is the basic component of yarn. Prior to industrial production of synthetic fibers, textile fibers were either protein (animal hair or silkworm extruded silk fibers) or cellulose (plant material), with the exception of the Roman's early use of asbestos as textile material. A single hair from a buffalo is a fiber, as is a single strand of fiber from the inner layer of *Apocynum androsaemifolium,* L., a plant that is also known as dog bane.

Not everything that looks like a fiber is acceptable for use in textiles. Typical textile fibers used in garments have a very small diameter, from 10 to 50 micrometers (a micrometer is one millionth of a meter). Thicker fibers are not considered comfortable next to the skin for modern textile consumers but they are useful in non-garment products. To be long enough to be spin-able, a fiber must be at least 15 millimeters long (Hatch 1993:85). Textile fibers have a physical structure that creates friction when they are twisted together. It is this friction that turns a bundle of fibers into a cohesive strand of yarn (Tiedemann 2001:29). These fibers must have adequate elasticity so that they can return to their original dimensions after being stretched (Hatch 1993:109-111). Textile fibers have the proper balance of size, strength, and elasticity in order to remain intact through the activities of being prepared for spinning, spun into yarn, made into cloth, and then provide an adequately long use life to justify the time spent producing the end product. Given the evidence that Southeast Indians created usable yarns and fabrics, they must have known which plant and animal resources possessed these characteristics and which did not. It can be surmised that as they moved across the landscape, hunting and gathering, they knew how to determine whether a newly discovered plant or animal fiber could be exploited for textile production.

Using scientific tools and technology, fibers can be tested and analyzed to determine whether they are protein or cellulose and which animal or plant produced them (Goodway 1987:24). When examining textiles through impressions on ceramics it is not possible to identify what fiber sources were used. The researcher is limited to considering the plants and animals that have been documented in the archaeological record and ethnohistoric journals, as well as the fiber analysis of extant prehistoric textiles. These sources provide some evidence of the natural resources that might have been available to the Southeast Indians who made the Beckum Village textiles.

Whitford (1941:7-13) compiled a catalog of plant materials found in Native American textiles in Eastern North America that included all known fibers from both pre- and post-Columbian artifacts. Whitford's list is considered incomplete for Southeast Indian textile fibers because of the limited availability of actual prehistoric textiles that have survived in the unfavorable preservation conditions of the Southeast. The following abbreviated version of Whitford's original list contains the fibers found in pre-Columbian artifacts recovered in the Southeast. *Apocynum androsaemifolium,* L.*,* also called dog-bane, and *Apocynum cannabinum,* or Indian hemp, have been found in fishing nets, bags, and straps. Four species of *Asclepia,* namely *tuberose, pulchara, incarnate,* and *syriaca,* which are members of the milkweed family, have been found in aboriginal textiles in all areas of Eastern North America where milkweed grows (the textile fibers come from the stem of the plant and not the fluffy seed head). *Asimina triloba,* L., also called pawpaw, has been found in the form of prepared fiber in a cave in Kentucky, as well as in cordage and textiles found in Arkansas. Three genera of the nettle family, *Boehmeria, Urtica,* and *Laportea,* appear to have been widely used throughout Eastern North America. *Eryngium yuccaefolium,* Michx., was found in sandals and cordage in caves and rockshelters as far south as Kentucky and Tennessee. When Whitford compiled his list, saw palmetto fibers, *Sabal palmetto,* Walt., had only been found in northern artifacts, used in cordage and straps, but it is a prevalent plant in south Alabama. The moss, *Tillandsia usneoides,* L., was found in yarn that was still wound on a spindle and in a blanket that were recovered from a Koasati Indian site. *Typha latifolia,* L., from the cat-tail family, was found in mat-ting recovered from a cave in Tennessee. Yarns made with a combination of fibers have been found, including the combination of plant material that was local to the area where an artifact was recovered mixed with plant material from a great distance.

According to Holmes, the hair of "many species of quadrupeds, the buffalo, the opossum, the rabbit, etc." were used by Indians in Eastern North America (1896:36). Bushnell believed that buffalo fiber was used extensively by all North American Indians, "and especially by those living east of the Mississippi…from the Illinois to the Natchez". It was spun into yarn and cordage to make bags, belts, garters, scarves, sashes, leggings, girdles, and rope (1909:401-405). Bushnell reported one instance where buffalo fiber was cut from hides rather than being sheared from live animals (1909:412).

Eighteenth-century explorers and traders wrote about Southeast Indians several hundred years after Beckum Village was occupied. Their journals record a period when the trade of textiles between Europeans and Indians already had affected the Indians' need to produce handmade yarn and cloth to satisfy their textile requirements. Penicault and Le Page described Natchez women preparing mulberry fiber for spinning (Le Page 1972:344, McWilliams 1988:85). James Adair, a British trader who lived among the Chickasaw between 1735 and 1769, described the Indians using wild hemp (Williams 1930:453). This may have been dog bane, which is also referred to as "Indian hemp." Even if this is only a partial list of prehistoric textile fibers, as Whitford suggested, then the Southeast Indians utilized as great a variety of natural resources for textiles as the modern industrial textile industry does today. Regardless of what fiber the Indians chose for a new textile project, once the fiber was gathered there was often considerable work required to prepare the fiber to be spun.

Fiber Preparation

The fiber preparation step transforms the bundle of plant stems or pile of animal hair into a form of material that can be spun into yarn (Figure 7). Different types of fiber require different processing. Our knowledge of prehistoric Southeast Indian fiber processing is limited, but we know a great deal about the Western European methods of processing flax, the plant that produces linen fibers (Baines 1989:19-32). Bast fiber plants, such as flax and mulberry tree sprouts, consist of bundles of usable textile fibers and unwanted plant material (Figure 8). Le Page described how Indians separated the fiber bundles growing inside the mulberry plant stems from the rest of the plant material by alternating between beating the stems and then letting them decompose (1972:344).

With flax, several factors can affect the quality of the prepared textile fibers that a plant may produce: the quality of the plant itself, whether the plant was harvested before or after it went to seed, and the quality and amount of processing performed. The amount of processing affects the end product, because the more time that is spent processing the fibers, the more the fiber bundles separate into smaller and finer bundles. The final

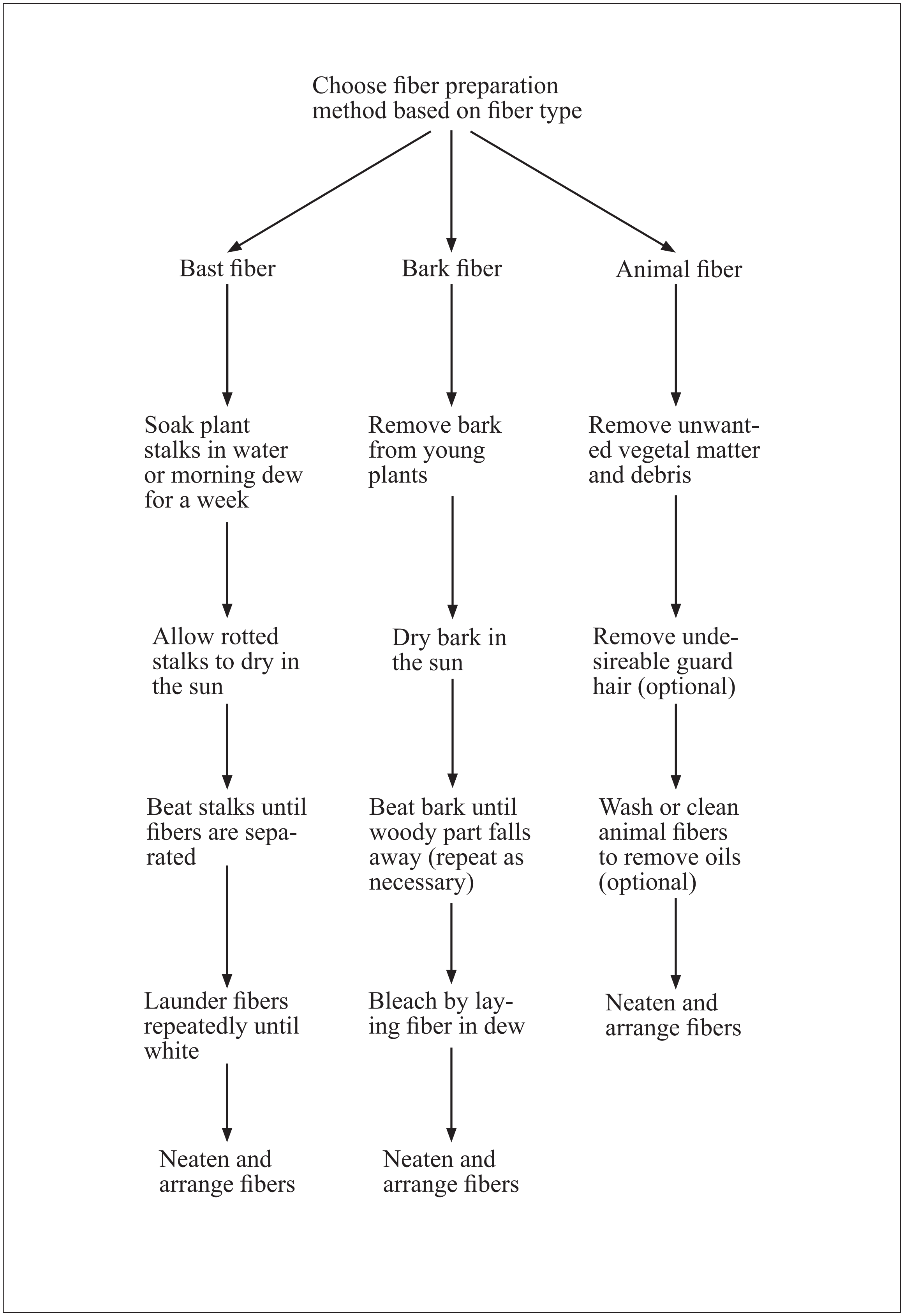


Figure 7. The fiber preparation process (Le Page 1972:344, McWilliams 1988:85).

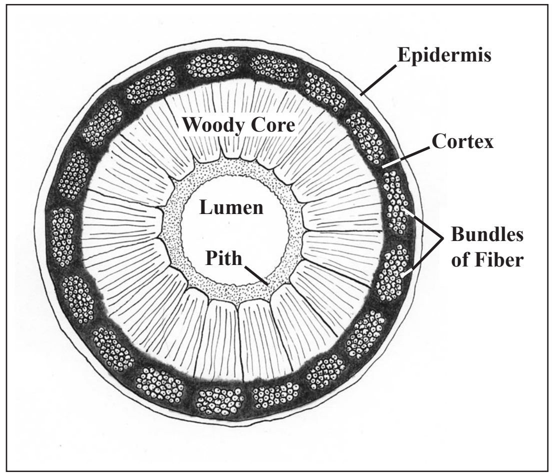


Figure 8. A cross section of a stem of flax.

diameter of the individual fibers affects the yarn that can be spun from those fibers: thick fibers can not be spun into fine yarn. This suggests that when bast fibers were used, producing thinner yarns required additional labor during the fiber preparation step.

Protein fibers also required preparation prior to spinning. After the hair was removed from an animal or a hide, the processes employed in preparing it for spinning would have been affected by the condition of the fleece. If the animal excreted so much oil that the fleece was too sticky to spin, then some sort of cleaning would be desirable. If the animal's activities resulted in twigs, leaves, or cockle burs being caught in the fleece, then those would have to be removed. After the fleece was cleaned, if that step was necessary, the next step would have been to transform the mass of hair fibers into an arrangement where the fibers were more neatly aligned. Using modern tools, this process is similar to brushing one's own hair. The cleaner and neater the animal fibers were, the easier it would have been to spin a consistent yarn.

Given the lack of ethnographic or archaeological evidence for protein fiber preparation in the prehistoric Southeast, ethnographic descriptions of how Southwest Indians cleaned and prepared sheep's wool suggest processes that could have been used by the Southeast Indians to prepare buffalo hair. Navajo hand-spinners sometimes cleaned sheep's wool prior to spinning by washing it in yucca-root "suds," but more often they simply held it up and shook it to dislodge dirt and vegetation (Kent 1985:33). Buffalo hair or sheep's wool were not like human hair; due in part to the natural oils that cover each fiber and in part to the shape and surface texture of the fibers, they stuck together, so it is possible to hold a fleece up as though it were a small blanket and shake it. A Navajo method for cleaning wool in areas where water was limited and the wool was too dirty to simply shake clean, involved laying the wool in the sun and sprinkling sand on it. After two or three days in the sun, the sand would absorb some of the oils and the sand could be shaken out (Muller 1992:44).

Most ethnographic information on Native American processing of animal fibers includes the use of a tool called hand-cards, which are wooden paddles covered with a cloth that is embedded with wire teeth. These tools were imported early in the protohistoric period and are mentioned in many ethnographic textile accounts (Kent 1985:33). But the people who made the Beckum Village textiles would not have had a similar tool made of stiff metal wire. The only available description of a Native American processing technique for animal fiber, which did not involve the use of tools, was in my own records from a class that I attended in 1993, at a national conference for hand-spinners in Lake Junaluska, North Carolina. I attended a workshop taught by Sarah Natani, a Navajo spinner and weaver. She demonstrated how she prepared sheep's wool for spinning by holding raw, unwashed fleece between her hands and gently tugging it to straighten the fibers and create a long, neat, fluffy, un-spun rope, which she called a roving. (The term roving is used in modern craft and industrial settings, such as the conference described here, and should not be considered an Native American term.) As she made a length of roving she used her large spindle (about 75 centimeters long with a heavy wooden whorl at one end) to put just enough twist into the roving so that it would hold together. She pulled new lengths of roving from more raw fleece and attached them to the end of the old roving, added more twist, and wound the new roving onto the shaft of the spindle. When the spindle was full, she unwound the roving from the spindle into a ball and the prepared wool was ready to be spun.

Spinning Yarn

The craft of spinning fibers into yarn appears to be simple, but requires considerable practice to produce yarn that is consistent in size and appearance (Tiedemann 2001:181). The goal of spinning is to make a pliable strand of a desired thickness, length, and density (Figure 9). When spinning, the density of the fibers within the yarn affects whether a yarn will be soft and appropriate for clothing or firm for netting.

It is well known that spinning involves controlling the amount of fibers and the amount of twist allowed into those fibers. As the fibers are twisted together, the surface friction of the fibers causes them to hold together. As the ends of some fibers are reached, more fibers must be added to keep the diameter of the yarn consistent. Spinning a single strand of yarn is a repetition of the actions of adding twist and adding fibers.

A spinner chooses which direction to twist this single strand, either clockwise or counter-clockwise. In spinning terminology, these twist directions are referred to as *S* and *Z*. The diagonal strokes of those two letters mimic the slant of the twisted fibers (Figure 10). Some researchers have proposed that a significant preference for one twist direction can be used to distinguish separate culture groups by indicating different craft traditions (Maslowski 1996:89; Minar 2001). While a significant preference for one twist direction could contribute to the identification of a particular culture group, I believe that it should not be viewed singly or given more priority than a comprehensive comparison of all textile attributes for the collection in question.

The functional requirements for the final yarn determine the amount of twist that the handspinner chooses to put into the yarn while spinning (Spanos 2003:44). More twist usually creates a stronger, firmer yarn that resists abrasion and works well in products like bags and nets. Less twist results in a softer and more pliable yarn that may be less durable, but it is more comfortable for clothing.

It is generally known that when single strands of yarn have been spun, the spinner can choose to twist two or more strands together to create what is known as plied

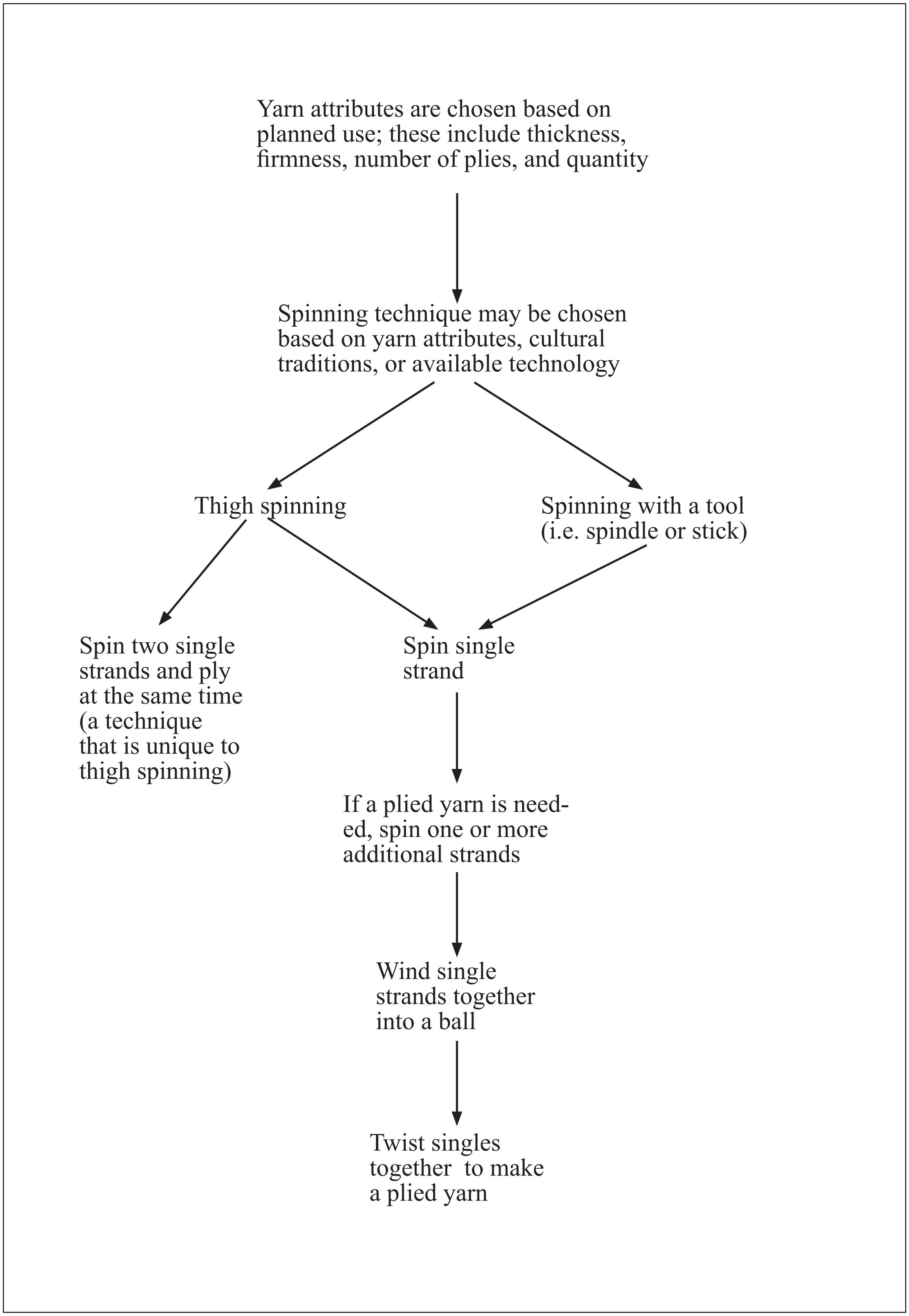


Figure 9. The spinning process.

yarn. Plied yarns generally have greater tensile strength than single strands spun from the same fibers. Plying can also “balance” the twist in the single strands, making the finished fabric less likely to skew out of shape as the single yarn tries to relax its twist. When plying, the single strands are twisted in the opposite direction to that used when the original strands were spun. While it is physically possible to ply in the same twisting direction that the singles were spun, it creates a kinky mass of over-twisted tangled singles. Therefore, when the final plying twist is visible in an impression on a pottery sherd, it can generally be assumed that the original twist of the single strands within that plied yarn were the opposite of the twist direction of the plied yarn. For example, if a two-ply yarn in an impression displays an *S* twist, then the single strands were spun in the *Z* direction. The number of single strands used to make the final yarn are indicated by the terminology: a two-ply yarn is made by twisting two single strands of yarn together (Figure 11).

The plying process results in a certain amount of untwisting of the original single strands. A handspinner plans for this when he or she is spinning the original strands. If the single strand is to be used without plying, the spinner will put in the amount of twist that is needed to produce the type of finished yarn required for the construction of the end product. If single strands will be plied, then the handspinner puts enough twist into the single strands so that when they are untwisted during the plying process, the final yarn will contain the proper amount of twist.

Figure 10. Twist direction is designated as either *S* or *Z* in reference to the diagonal stroke of those letters.

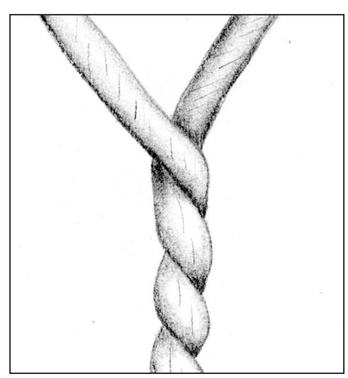


Figure 11. Two single strands are twisted together to make a two-ply yarn.

Making Textiles

When the yarn is ready, the final product can be constructed (Figure 12). Much of the fabric that is seen impressed on Southeast Indian potsherds is a structure called twining (Figure 13). This structure is seldom seen in contemporary textiles, because it can only be handmade, it can not be produced by industrial looms. Modern mechanical looms create a different type of cloth called interlaced (Figure 14), which is the fabric commonly referred to as woven. Both of these apparently simple structures can produce an infinite variety of fabric types with variation created by the type of yarns used and by the spacing of those yarns. Just as modern looms can produce interlaced fabric for everything from boat sails to baby garments, Southeast Indians produced a similar variety of fabrics by twining.

I evaluated the Beckum Village and the Salt Creek collections prior to this analysis (Dumas and Spanos 2005) and knew that the structures included a limited variety of twined fabrics, weft-faced fabric, netting, and cane matting (only the twined and weft-faced fabrics were analyzed for this thesis). Describing these fabric structures can be facilitated by the use of common names for the perpendicular yarn elements that perform two distinctly different roles in the construction process, one set of yarn elements is twined, or twisted, around the other set of yarn elements, which is essentially passive. Twined fabric can be created by twining the weft yarns around the warp yarns or by twining the warp yarns around the weft. An examination of the edges of the fabric will usually provide the necessary information to determine which technique was used to make a particular twined textile. Since edges of textiles are rarely available in impressions on potsherds, I followed the common practice of referring to the yarns that actively twine as the weft yarns and referring to the passive yarns around which the weft yarns twine as the warp yarns (Frazer 1989:3).

The textiles used to make saltpans at the Beckum Village and Salt Creek sites included spaced plain twined fabric, spaced alternate-pair twined fabric, and weft-faced

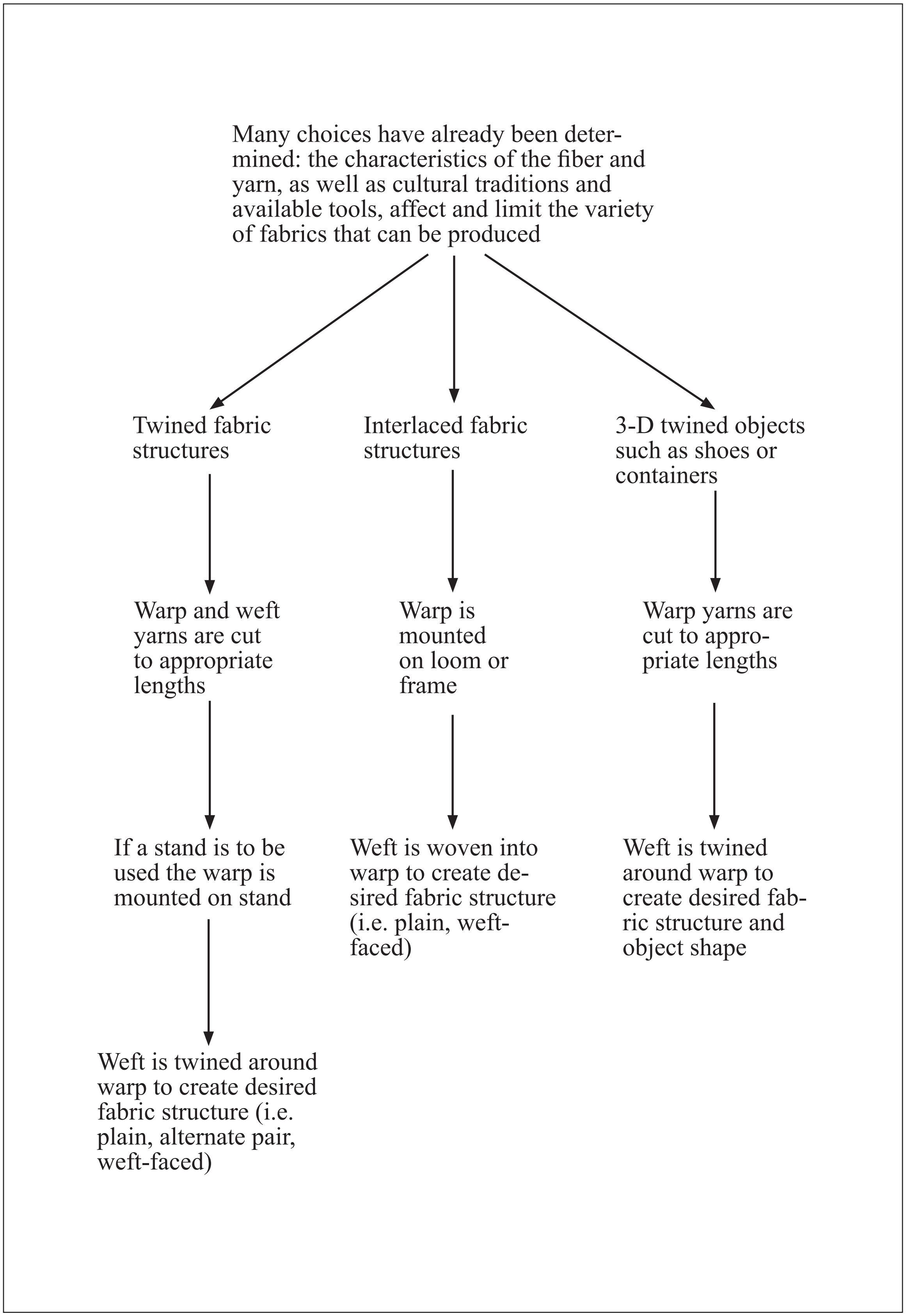


Figure 12. The fabric construction process (i.e. twining or weaving).

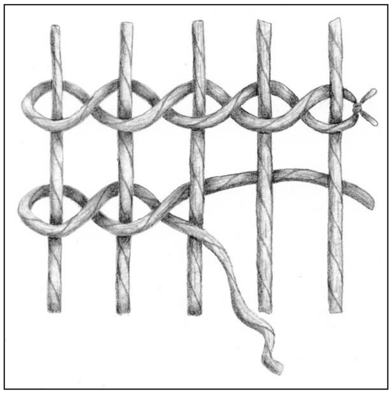


Figure 13. Plain twined fabric.

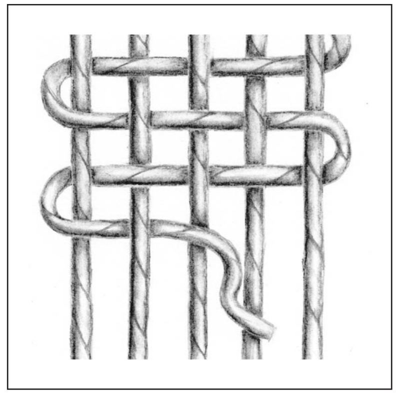


Figure 14. Interlaced fabric.

fabric. Spaced plain twined fabric (Figure 15) is the simplest form of twined fabric, the weft yarns twist a half-turn around each warp yarn and the weft rows are not compacted and close to each other, but spaced far enough apart so that the warp yarn is visible. In spaced alternate-pair twined fabric (Figure 16) the weft rows are also spaced apart, but the weft yarns twine around a pair of warp yarns at a time. On subsequent rows, the warp yarn "move" left and right, participating is alternating pairs of warp yarn. Weft-faced fabric (Figure 17) can be produced by either twining or interlacing techniques. The term weft-faced refers to a weaving technique that results in only weft yarns being visible because they completely cover the warp yarns. In fact, this particular structure presents a problem when it is found impressed on potsherds because without holding the actual fabric in one's hands and looking between the threads it is difficult, if not impossible, to tell which structure, twining or interlacing, produced the weft-faced impression.

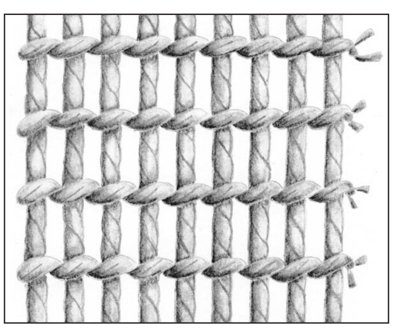


Figure 15. Spaced plain twined fabric.

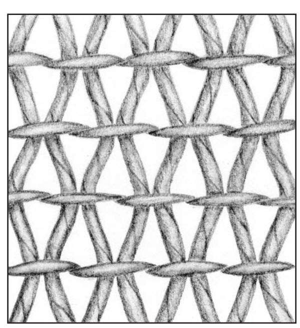


Figure 16. Spaced alternate-pair twined fabric.

Figure 17. Weft-faced fabric (Salt Creek 1990.15.293).

Twining can be done with or without the use of some sort of a tool to hold the warp yarns, such as a stand, a frame, or a loom. A stand would provide horizontal support for the warp yarns, which would hang free. Both a frame and a loom would hold both ends of the warp yarns secure and taut, and the loom would also provide a method of raising some warp threads to allow for the easy insertion of the weft yarns. The reason that the twined fabric structure allows for such flexibility in tools is due to the fact that the weft yarns are actually twisted around the warp yarns. They are essentially tied together, thus making the textile as stable during construction as it is when the fabric is completed. This is not true for interlaced fabrics, the type of construction found in most modern woven fabrics. While interlaced fabrics are being created, the warp yarns must be held taut on some sort of frame or loom device because as the weft yarn is being passed through the warp yarns, the yarns can move, slide, and unravel.

There is a functional difference between frames and looms. A frame can be any sort of tool, usually mounted on a stand to hold it upright, which facilitates the construction of a textile by holding one or both ends of the warp yarns. If it has any moveable parts they are limited to providing a means of tensioning or tightening the mounted threads. A loom, at the very least, provides a method of raising some of the warp yarns. For example, the fabric in Figure 14 would have had every other yarn raised. The part of the loom that provides the ability to raise some warp yarns, to allow the easy insertion of weft yarns, are called the heddles.

Archaeologists have not found evidence of frames or looms in the Southeast. Since early explorers recorded the use of stands for twining, it is likely that the lack of evidence is due to the fact that wooden tools suffer the same fate as the organic material of cloth in the southeastern archaeological context. Le Page described the frame in use in Louisiana in the 18th century, “they plant two stakes in the ground about a yard and a half asunder, and having stretched a cord from the one to the other, they fasten their threads of bark double to this cord, and then interweave them in a curious manner into a cloak of about a yard square with a wrought border round the edges" (1972:344). His description of "doubling" the threads may indicate that the warp yarns were cut twice as long as needed, folded in half, and then hung over the cordage that was stretched between the two stakes. This would have held the warp yarns upright to let the ends hang freely, which would have facilitated the twining process (Figure 18).

Each choice that the textile worker makes affects the cloth that is produced. If a fine, soft textile is needed for a garment, then the fibers that can produce a soft yarn must be carefully prepared, the appropriate amount and type of yarn must be spun, the fabric structure with the appropriate yarn spacing must be chosen, and a textile of the correct size must be constructed. Making textiles by hand requires the ability to imagine the desired qualities of the finished product and plan for all of the processes and decisions that must be coordinated in the long sequence of steps that are executed to successfully create those qualities. The Southeast Indians who made the textiles that were impressed into the Beckum Village ceramics had the knowledge and skill required to turn a good stand of mulberry tree sprouts into a chief's ceremonial robe.

This discussion of textile terms and processes provides a foundation for the remaining chapters of this thesis. With an understanding of the attributes of hand-spun yarn and hand-made cloth, we can begin to appreciate the results of previous research into Mississippian textiles.

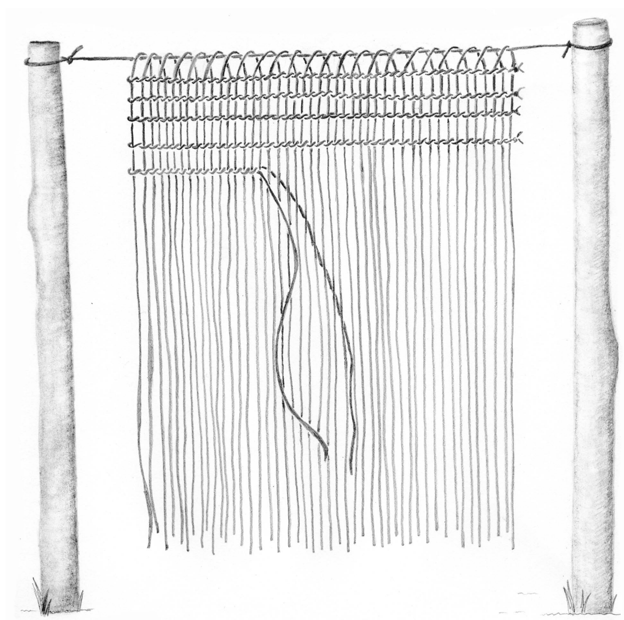


Figure 18. Twining stand based on 18th-century description by Le Page (1972:344).

MISSISSIPPIAN TEXTILE RESEARCH

This survey of Mississippian textile research begins with the earliest investigations into the textiles of the "mound builders" in 1884 and continues to 2004 and the analysis of textile impressions on stone palettes from Etowah. This discussion is restricted to the research into the Mississippi period, but it includes more than analyses of pottery impressions, which is the basis for this thesis. Actual textiles, charred fragments, and mineralized images of textiles, called pseudomorphs, have all contributed to the body of Mississippi period research. This review of current literature is organized chronologically to emphasize the progress of textile research as it has been applied to the Mississippian Culture. As a result, some sites will be discussed more than once, which reflects the fact that research is ongoing at complex sites such as Etowah and the Ozark Bluff shelters.

Archaeological research into textiles recovered in Eastern North America began with the work of William Henry Holmes in the late 19th century. Holmes wrote about the textile work of the mound builders, the cultures that came to be referred to as Mississippian. Although his research predates the current focus on quantitative methods, his descriptions, illustrations, and photographs provide valuable information for modern scholars. Holmes recognized the possibility of using textile impressed potsherds to study prehistoric textiles. He suggested that when fabrics were used in pottery production the fabrics were removed prior to the clay vessel being fired because he had "observed in many cases that handles and ornaments have been added, and that impressed and incised designs have been made in the soft clay *after* the removal of the woven fabric" (Holmes 1884:398). He compared the work of such groups as the Apache, the Paiute, and the

Yakima, with baskets and fabrics found on the Northwest Coast, as well as in Peru and British Guiana to show that decorative elements from other art forms, such as house building or tool making, are often copied or "seized upon and remodeled" in designs found in textiles (Holmes 1888:202-250).

Holmes argued for the value of studying prehistoric textile art through impressions on pottery and recommended making castings or molds of those impressions with clay, wax, or paper (Holmes 1896:11). He also noted the existence of prehistoric textile information in charred textile remains and in association with copper or "preservative salts" (Holmes 1896:29). Holmes included matting, basketry, sieves, strainers, and even fish weirs in his inventory of prehistoric textile products; anything made with the structures of textiles, primarily twined structures, was included (Holmes 1896:13-14). Holmes suggested that the mound builder textile artisans did not create lengths of cloth out of which pieces for one or more products would be cut and then assembled. Instead, they made cloth into the shape of the final product so that no cutting and minimal assembly was required (Holmes 1896:22). He noted that the only spinning and weaving tools that had been recovered from archaeological sites up to the time of his writing were a few "rude" spindle whorls (Holmes 1896:29).

Holmes documented and photographed a cloth found in 1811 in a cave in Warren County, Tennessee. It was found with the burials of a man and woman (flesh on) that were placed in baskets and then covered with a mat. The woman was wrapped in a dressed deer skin and placed next to a woven rug. The rug was described as being made from spun yarn that was wrapped with feathers. This rug was about one meter wide and two meters long. The feathers appeared to be different shades of green, blue, yellow and black depending on the direction of the lighting (Holmes 1896:29-30). Holmes described more mortuary cloths that were found in a saltpeter cave in Glasgow, Kentucky, in 1815. These were made of plied yarns that had been from plant material. One cloth was covered entirely with large brown feathers (Holmes 1896:30).

Two cloths were found in 1885 in a rock shelter on Cliff Creek, Morgan County, Tennessee, and curated at that time by the Bureau of Ethnology, where Holmes worked and was able to study them. He provides photographs and illustrations of two pieces of space twined cloth; one was 46 inches by 24 inches, and the second was 34 inches by 20 inches (Holmes 1896:31 and plate III). From the details visible in his photograph (Holmes 1896:Plates 3 and 4), these textiles could have been constructed using a stand similar to that shown in Figure 18 on page 30. Holmes describes both textiles as having a drawstring on one of the long edges. This could have been the cordage stretched between the two stacks over which the warp yarns were hung. There was also a twined bag stored with these cloths that measured, "20 inches in length and 13 inches in depth" and multiple skeins or hanks of prepared vegetable fiber, that were identified as *Cannabis sativa,* wild hemp (Holmes 1896:34).

In addition to his descriptions of Mississippian textiles, Holmes asserted that textiles were older than ceramics and that the potter, being surrounded by textiles, "borrowed" designs from them when making pots (Holmes 1901:397). Holmes thought that the use of textiles in pottery production went beyond an imitation of the esthetics and that maleating the surface of pottery with fabrics or cordage improved the strength of the clay, "the more complex the imprintings, the more tenacious becomes the clay" (Holmes 1901:400).

Lewis and Kneberg first published their report on the 1930s excavations at Hiwassee Island, Tennessee, in 1946. Since this early work, other researchers have estimated that the site component named the Hiwassee Island component, was occupied by Mississippian culture people between A.D. 900 and 1100 (Lewis and Lewis 1995:xx). All of the textile impressed potsherds recovered from this component were associated with the early Mississippian occupation period (Lewis and Kneberg 1993:107). Since their research predates the use of Emery's textile terminology, I have attempted to assign Emery's terms based on Lewis and Kneberg's descriptions and illustrations. The fabric structures found impressed on the Hiwassee Island Mississippian ceramics included plain spaced twined, alternate pair twined, and interlaced, which appears to be an impression of matting rather than a textile. The frequencies of the twined fabrics included 1,451 plain twined (57.4%) and 1,076 alternate pair (42.6%). Lewis and Kneberg noted that open-textured textiles were more numerous than were textiles with closely spaced wefts and warps. It was their opinion that the presence of thin, fine yarns and closely twined textiles showed that the people who made the Hiwassee textiles were capable of “producing cloth of good quality” (Lewis and Kneberg 1993:108).

Willoughby reported that at the time of his writing in 1952, the production of “primitive” cloth by North American Indians had stopped with the exception of a few, scattered groups. He noted that the quality of the native pieces found in museum collections provide only “a meager idea of the quality and extent of the textile craft as it undoubtedly appeared in later prehistoric times” (Willoughby 1952:108). As with Holmes’ writings, this is an example of anecdotal descriptions of textiles rather than quantitative reports of metrics. The Spiro artifacts presented in this manuscript were from the Peabody Museum at Harvard and the collection of H. M. Trowbridge in Bethel, Kansas. Willoughby described yarns that contained combinations of rabbit hair and buffalo hair, spun by themselves and combined with vegetal fibers. He also described yarns that were made by wrapping rabbit hair yarn around stronger vegetal fiber yarn.

In 1975, Scholtz analyzed the textiles, yarns, nets, and baskets recovered from Ozark Bluff shelters in northwest Arkansas and southwest Missouri. The cases in her sample lacked a clear provenience, so while Mississippian textiles are assumed to be included in this study, it is not possible to confidently distinguish them from Woodland or Archaic items (Scholtz 1975:1-6). While this is a limitation in comparing these artifacts to other Mississippian textiles, the clear photographs and precise illustrations make this research educational and useful.

More recently, in 1988, Schreffler compared variation in textiles recovered from Etowah burials to variation in other grave goods to show that the higher status burials contained the finer, more complex textiles. The fifty-one burials surveyed from Mound C included male, female, and multiple interments; twenty-three of these burials included fiber, yarn, or textiles among the grave goods. The majority of the textile-related artifacts were fiber and yarn, some of which were partially mineralized, and there were eleven actual pieces of cloth. The fibers were examined with a scanning electron microscope and were determined to be plant and animal hair fibers. Given the deteriorated condition, more specific identification was not possible (Schreffler 1988:141). The yarns within this sample included single strand yarns, two-, three-, and four-ply yarns, as well as actual cord, which is made by twisting plied yarns together. With the exception of two *Z* twist plied yarns, the final twist direction among the yarns in this Etowah sample was *S* twist. Most yarns showed a plying twist angle of thirty degrees. The sample included a minimum angle of twist of fifteen degrees and a maximum of sixty (Schreffler 1988:148-151). The Mound C burial textiles included three examples of wrapped cane, where yarn was wrapped around cane that were then used to weave matting. The fabric structures in the Etowah sample included braiding, oblique interlacing, and spaced twining, which showed an *S* twining twist direction (Schreffler 1988:153-154).

Later that same year, Kuttruff investigated the hypothesis that textile complexity could be used as an indicator of Mississippian social status differentiation by analyzing textile burial goods recovered from Caddoan culture sites: the Spiro site in Oklahoma and eight Ozark bluff shelters in Missouri and Arkansas. The artifacts analyzed in this research included nearly complete textiles as well as fragments. The fragments were restricted to specimens that were at least two square centimeters in size and that "exhibited observable interworking of elements (yarns)" (Kuttruff 1988:70). Seventy-one specimens from the Spiro site and forty-eight specimens from the Ozark bluff shelters were analyzed. Kuttruff developed an index for quantifying the many factors that contribute to the production of a textile, the Textile Production-Complexity Index, which has been used and modified by other textile researchers (Drooker 1992:51-52; Dumas and Spanos 2005). Looking at the entire sample, of the twined textiles, 66.7 percent were plain twining, 12.9 percent were alternate pair twined, and 18.3 percent were other forms of twining, such as diverted, transposed, interlinked, radiating, and twined tapestry (Kuttruff 1988:97). Within the Spiro sample 49.3 percent displayed more than one type of structure, while only 8.3 percent of the Ozark sample showed this level of complexity (Kuttruff 1988:93). Sixty-four percent of the yarns within the entire Caddoan sample were two-ply yarns, 8.6 percent were single strand yarns and 11.6 percent were wrapped yarns. The remaining cases were either unspun yarns or cords. The wrapped yarns were two-ply yarns that had been wrapped with either strips of fur or split feather quills. The final twist for single strand yarn was found to be equal proportions of *S* and *Z*, while the final twist for two-ply yarns was 74 percent in the *Z* direction and 26 percent in the *S* direction (Kuttruff 1988:119-124).

These Caddoan textiles may provide the majority of the current coloration information for Mississippian textiles. The analysis was done by visual comparison to a standard color reference. The colors as they were observed at the time of analysis, without attempting to estimate any change over time, were recorded as various hues of black, gray, brown, red, and yellow (Kuttruff 1988:113-118). Fiber samples from 86 Spiro artifacts and 111 Ozark artifacts were examined under magnification and determined to be 37.3 percent animal (mostly hair with some feather fiber) and 62.7 percent vegetal, which included bast fiber, leaf fiber, and seed hair fiber that appeared to be cotton. Almost 92 percent of the hair fiber and the one case of cotton fiber were found in the Spiro or high-status burials. Twelve percent of the 154 yarns analyzed were made of multiple fiber types combined into one yarn.

In 1989, Sibley and Jakes used the analysis of a partially mineralized fabric from Mound C at Etowah to test a new theoretical framework and model for, “inferring cultural context from archaeological textile remains" (Sibley and Jakes 1989:37). They proposed that the culture context of a textile is the product of, at least, three stages of existence: the biological or ecological stage during which the fibers are produced in nature, the cultural or systemic stage during which humans harvest the fibers to create and use the textile product, and the archaeological stage during which the textile lies *in situ* until excavated (for more on this methodology see Ericksen et al. 2000). For the textile artifact that they analyzed, they determined that in the ecological stage people gathered the stems of the nettle plant (*Urticaceae Boehmeria* or *U. Urtica*), an indigenous plant that was not domesticated or cultivated. In the cultural stage, the stems were processed to produce spin-able fiber, spun into two-ply yarn, and twined into a fabric, using a variety of twined fabric structures, and then braided into a four-strand braid fringe. Because the fragment was found under the skull and showed no evidence of seams or assembly, Sibley and Jakes suggest that this textile was used as a mantle, shroud, turban, or other garment, as opposed to a belt or a bag. The analysis of the archaeological context of this textile showed that this fragment was the earliest example of these structures found in a burial at Etowah. This may be due to loss of earlier textiles through complete deterioration, or it may suggest that this structure could have been introduced from some other area where it was prevalent during the time this piece was made. They suggest Mesoamerica or the Southwest North America (Sibley and Jakes 1989:40-44).

In 1991, Drooker analyzed nine saltpan sherds from Salt Creek (1Ck222), which is the second site included in my thesis research. This sample was not drawn from the Trickey collection, which was used for this thesis, but was part of a surface collection that was gathered some years after the Trickey excavation. Drooker's sample included two weft-faced twined or interlaced fabric impressions, five interlaced matting impressions, and two "chevron weave" matting impressions. The yarns in the weft-faced textiles are two-ply with a final *S* twist. While the twined and woven structures are typical of the Southeast in the Mississippi period, the materials in these Salt Creek textiles and mats appear to have been relatively stiff. They may not have been flexible enough to line a deep mold to make a deep pan. The apparent stiffness of the impressed fabrics suggests that the Salt Creek saltpans would have been shallow vessels (Drooker 1991a:1-4). In this research, textile analysis provided insight into pottery production.

The term *lace* typically describes textile designs that create patterns by intentionally making stable holes. Mississippian lace has been found impressed on saltpan pottery at the Stone site (38Sw23), Tennessee, where 13 of 229 textile impressed sherds were impressed with a complex lace textile that included a concentric-circle motif, similar to those found in ceremonial garments at Spiro. The two-ply yarns appeared to be very consistent with a mean diameter of 0.79 millimeters, spun from highly processed plant fiber with a final *S* twist direction (Drooker 1991b:82). Based on the large size of the lace textile that can be seen in the ceramic impression and the complexity of the lace structure, Drooker suggested that this was originally an elite garment that was re-used in the pottery production process (Drooker 1991b:92). The apparent investment in labor as well as the expertise and skill required to create this textile suggests that its production may have required specialist artisans and the textile may have been used in a special context such as ritual exchange at the highest levels of Mississippian society (Drooker 1991b:94).

In 1991 at Etowah, Sibley, Swinker, and Jakes used experimental reproduction of prehistoric textiles to test the hypothesis that multiple textile fragments found in Burial 57, Mound C, were part of a single textile. Based on the grave goods, which included copper axes, copper plates, pearls, and conch shell bowls, Burial 57 is considered to be a high-status burial. The textile artifacts were highly mineralized fragments that appeared to be constructed of similar yarn and fiber. The fabric structures found in the fragments and reproduced in one textile were compact alternate-pair twining, oblique interlacement and twining, two- and three-strand compact twining, and variations on these structures. Experimentation showed that a variety twining and interlaced structures could be constructed into a single textile (Sibley et al. 1991:180-187). Therefore, the fragments could have originally been part of a single fabric.

The following year, Sibley and Jakes published their analysis of the coloration evident on two textile fragments recovered from the same Etowah Burial 57. Although they had expected to find evidence of coloration on these fragments, the visible colors were the original coloration of attached feathers and not the residue of dye or pigmentation. The fiber used in one fragment was found to be nettle (*Urticaceae sp.*) and the feathers used in the second fragment were red and yellow down from the *Anseriformes* order, which includes ducks, geese, and swans (Sibley and Jakes 1992:395-400).

In 1992, Drooker published a study of the Mississippian textile impressed pottery recovered from the Wickliffe Mounds (15Ba4) in Kentucky. This site consists of a village and ten mounds (two large rectangular mounds and eight smaller round mounds) and lies five kilometers east of the confluence of the Ohio and Mississippi rivers. Wickliffe is considered to be a moderate-sized Mississippian village with an estimated occupation of 250 or fewer people (Drooker 1992:21-23). Archaeological excavation at Wickliffe began in the 1930s and continued on and off into the 1990s. Features and artifacts recovered include postmolds, hearths, a cemetery, human remains, grave goods, projectile points, stone tools, disks, discoidals, conch-shell effigies, ceramics, one extant textile fragment, and several charred textile fragments. The majority of the textile artifacts at Wickliffe were textile impressed potsherds, of which 1,559 were analyzed. Three sherds presented textile impressions on the interior vessel surface, while the rest showed textile impressions on the exterior surfaces.

The textile attributes found on the Wickliffe ceramics represented a wide range of yarns and fabrics. Yarns varied from very coarse to very fine and fabrics ranged from simple to complex (Drooker 1992:98). Ninety-eight percent of the fabrics were twined and of those two-thirds were plain spaced twined and one-third was alternate-pair twined. The remaining fabric structures were weft-faced, interlaced using flat elements rather than spun yarn (probably basketry or matting), and knotted netting. Variations of these structures included: striped patterns created by spacing some twining rows close together, usually groups of two close rows of twining separated by a wide space; plain spaced twining with diagonally diverted warps; a transposed crossed warp structure created by twisting two warp yarns around each other in between the weft twining rows to create a design, which was named by Miner (1936:182) as octagonal openwork. Fabrics with two or more structures in one textile were considered to be complex cloth. None were found in the earlier periods at Wickliffe, but examples were found in the later occupation layers. From the early period to the later period the percentage of weft-faced fabrics decreased and the percentage of alternate-pair fabrics increased (Drooker 1992:143). The Wickliffe yarns were predominately *S* twist. Of the five yarns that had a final *Z* twist, one was a single strand yarn and the others were two-ply yarns. The eight visible starting edges that were found appeared similar to the upper edge in Figure 18 on page 30 (Drooker 1992:133). Twenty-one percent of the textile impressions exhibited "worn" textiles. There was no correlation between damage and the fineness or coarseness of the yarn and fabric (Drooker 1992:138).

From the Wickliffe textile data gathered from ceramic impressions, Drooker inferred that these textiles had originally been made for some purpose other than saltpan production. This conclusion was based on the determination that these textiles would have required more labor than the other aspects of pottery production, that the fabrics were not standardized or simple, and a significant number of these textiles did not appear to have been originally designed to be particularly sturdy (Drooker 1992:147-152). It appeared that the Wickliffe textiles would have been rectangular with straight edges and would have been skirts, mantles, decorated garments, blankets, hunting and fishing nets, and matting (Drooker 1992:146,158). "The extent of the diversity and expertise that is displayed in Wickliffe fabrics impressed on pottery argues for an extensive, sophisticated total textile complex, with a significant place in the village economy" (Drooker 1992:158).

In 1996, Kuttruff and Kuttruff published an analysis of 345 textile impressed potsherds from Mound Bottom (40Ch8), Tennessee, which is a Mississippian culture site dated to between A.D. 900 to 1250. Mound Bottom was a large civic, ceremonial, and residential site located in a horse-shoe shaped bend in the Harpeth River near its confluence with the Cumberland River. All of the ceramic pans excavated from Mound Bottom were typed as Kimmswick Plain or Kimmswick Fabric impressed, which is the ceramic type applied to the large, heavy, shallow vessels typically called saltpans (Kuttruff and Kuttruff 1996:162). The unusual thing about this collection is that in modern times there are no known saline springs in the Mound Bottom area. The presence of Mississippian saltpan ware in this area suggests that prehistoric salines may have dried up when water patterns changed. This collection produced 76.8 percent spaced twined textiles, 17 percent alternate-pair, 2 percent weft-faced, and 5 percent complex structures or combinations of two or more of the previously mentioned structures. Most of the Mound Bottom yarns were used as single strand yarns rather than being plied (97.7 percent of the weft yarns and 87 percent of the warp). In both the single and plied yarns the twist was in the S direction and the mean twist angle was between 10 and 25 degrees, which is considered a medium twist angle (Emery 1995:12). Kuttruff and Kuttruff suggest that if the textiles impressed on the Mound Bottom pottery were originally made for some other purpose, then the textile attributes that can be collected from those pottery impressions reflect the preference of potters for certain types of fabrics.

That same year Sibley, Jakes, and Larson returned to Etowah and used a clay encrusted textile fragment from Mound C, Burial 103, to infer human behavior and fabric function (Sibley et al. 1996:74). This fragment appeared to be composed of two layers of textiles separated by a layer of cane matting. A complex yarn was visible that consisted of a core of two or more yarns wrapped by a fibrous material and a third element that could not be determined. The core yarns were two-ply yarns spun with a final *S* twist that appear to have been spun from bast fibers. They did not appear to be twisted together: they did not spiral around each other. The fibrous wrapping material appeared to include a combination of materials: feather barbules, or “feather-like entities,” and possibly animal hair or fur. The wrapping material was not a plied yarn, and no twist direction was visible. When analyzed, some of the feather material appeared to be similar to that of the order *Falconiformes,* which includes the golden eagle and the sparrow hawk (Sibley et al. 1996:75-78). While it was difficult to analyze the fabric structure of the clay covered fragment, it appeared to be a plain space twined textile. The researchers concluded that it was likely a garment, possibly a mantle.

In 1999, Alt looked at a different aspect of Mississippian textiles at Cahokia while investigating evidence of ceremonial activity at the Halliday site, a village near Cahokia. Alt hypothesized that an increase in ceremonialism would involve an increase in the production of ceremonial cloth and a corresponding increase in the number of spindle whorls used to spin the yarn to make the cloth. Spindle whorls can be difficult to identify with certainty because they occur in many shapes, from a disk to an orb with a hole in the center. A perforated disk or orb could be a spindle whorl, a gaming piece, or a large bead used for adornment. This research included a test of the functionality of the perforated ceramic disks, which appeared to have been made from broken pieces of pottery. Alt inserted a shaft into the Halliday whorls and spun both rabbit and linen fibers and found them to function well as spindles (Alt 1999:125). Alt’s analysis found a clustered distribution of spindle whorls at certain sites around Cahokia and an increase in their occurrence during the period when Cahokia is believed to have undergone political consolidation. Alt concluded that the distribution and frequency of spindle whorls at Halliday was evidence of craft specialization, that textile production intensified in certain villages, and that the increase in spindle whorl frequency at the time of Cahokia’s political consolidation could correlate with an increased desire for textiles, which are often used as a visible symbol of social rank or status (Alt 1999:132).

Minar (2001) addressed what has been a controversy over the use of twist direction in the identification of culture groups. As mentioned in the previous chapter, twist direction can be either *S* or *Z*, which denote the direction in which a yarn was spun. She compared textile attributes recorded in cord-marked impressions in pottery found at sites from the Alachua culture area in Florida, the Ocmulgee Big Bend region in Georgia, and the Wilmington/Savannah area on the Florida and Georgia coast. The components at these sites that contributed to the samples were dated from the Woodland and extended through the Mississippi Period to contact. Radiocarbon dates did not exist for these cord-marked pottery collections to date them more accurately. Minar compared the twist direction data for these sites with past archaeological studies. Her analysis suggested that if "culture-historical divisions were made based on cordage attributes, final twist direction in particular, much of Florida and Georgia would be grouped into one cultural entity demonstrating continuity over a long period of time and over a wide area" (Minar 2001:105). These results show the limitations of using a single attribute with only two variations to define culture groups. Minar worked with contemporary hand spinners to understand better the aspects of learning theory that may contribute to the persistence of textile attributes that are created by repetitive hand motion activities, such as spinning. Minar went on to compare the distribution of ceramic types to the distribution of cordage attributes, including twist direction, and concluded that for the sites in her sample there is no correlation between these two sets of data over space and time. This suggests that where textile information is available, it could further refine assumptions based on ceramic types.

In 2003, Drooker published an analysis of 259 textile impressions on saltpan sherds recovered from Bottle Creek (1Ba2), a large ceremonial Pensacola culture site in south Alabama. In addition to the potsherd impressions, there were also impressions found on other forms of clay: two in fired clay, and one in clay daub (the clay used to pack against the wattling in house walls). Drooker found that the potters making saltpan ware at this site did not appear to be recycling discarded garment fabric. The textile impressions in the saltpan sherds that she analyzed showed coarse, heavy fabrics and matting (Drooker 2003:180). The non-saltpan, fired clay impressions presented significantly finer twill matting or basketry than was found on the saltpan sherds. While this small sample showed that the Bottle Creek people had the skill and knowledge to create finer matting and basketry than those found on saltpan sherds, a larger sample of similar non-saltpan impressions was needed to show an intentional preference for choosing the coarser materials for saltpan production (Drooker 2003:185).

The following year, Drooker looked at images of textiles found on four stone palettes from Etowah, three of which were associated with burials. The images on the palettes appear to have been left by textiles that the palettes were wrapped in. These images produced a sample of five fabrics. While the marks were faint, they provided useful data. The fabric structures found included alternate-pair twining, octagonal openwork twining, and plain spaced twining. Where visible, yarn appeared to be two-ply with a final *Z* twist on one palette and a final *S* twist on two others. Twining twist was in the *S* direction. All of the fabrics, though varying in other ways, were twined so that they provided a fairly open fabric that would have been see-through. The textile impressions on the palettes cover the bottoms and the edges, but there is no evidence that these textiles were shaped bags. Of this sample, the finer and structurally more complex textile was found impressed on the palette from the burial with the fewest grave goods, although the absence of grave goods could be due to organic deterioration (Drooker 2004a:1-6).

Prehistoric textile research, which began in the late 19th century, has benefited greatly from the work of experts and professionals in the fields of archaeology and textile science. Textile research has provided an essential body of information and data for the prehistoric cultures on which it has focused. It is unfortunate, however, that within this time no generally recognized subfield has been christened for textile archaeology, similar to the subfield of zooarchaeology. While a special interest group within the Society for American Archaeology (SAA), the Fiber Perishables Interest Group, hosts a symposium and special events at the annual SAA conference, the support and contact it provides outside of the annual SAA conference appears to be limited to a seldom-published newsletter. Compiled volumes such as *A Most Indispensable Art, Beyond Cloth and Cordage, Fleeting Identities,* all of which have been referenced here, along with *Perishable Material Culture in the Northeast* (Drooker 2004b) have provided an expansive view of textile research for the textile research and the archaeology communities, but more is needed.

Textile researchers should consider defining a subfield within archaeology or anthropology that promotes and defines the importance of textiles within the cultures that produce them. Just as archaeobotanists have benefited from organizing and labeling themselves a subdiscipline, so too could textile archaeology. This new subfield needs to increase the variety of theoretical frameworks developed for textile research and promote increased publication of textile research through a regularly published peer-reviewed journal. Archaeological research into prehistoric textiles has matured in the past 130 years as has the field of archaeology, which now focuses more on quantitative, comparable data, and embraces the use of new scientific testing systems. Following the path of the scholars mentioned in the previous paragraphs, the next chapter will describe the analysis methods and the metrics used to analyze the Beckum Village textiles as recorded in potsherd impressions.

METHODS OF ANALYSIS

The Beckum Village excavation findings included one human burial and midden material of animal bones, potsherds, and other debris (Wimberly 1960:32). For this study, only the potsherds were examined. Of the estimated 5,852 potsherds stored in plastic re-sealable clear plastic storage bags organized by provenience, grid block, and level, there were 1,490 that appeared to have been impressed or marked with some form of a textile, a cloth constructed of interacting and perpendicular warp and weft elements. Every textile impressed sherd was not deemed usable for this research. A sherd was included in this analysis only if its fabric structure could be determined, regardless of whether other attributes could have been measured. Of the 1,490 textile impressed potsherds, only 1,055 impressions presented an identifiable fabric structure and qualified for this study. I chose to restrict the sample in this way so that at least one attribute could describe the entire sample.

This chapter will provide descriptions of the attributes that were measured and collected, the methods used to make those measurements, and the calculations used to produce additional data, such as minimal textile size. The measurement techniques and tools will be discussed, then fiber attributes, yarn attributes, fabric attributes, and ceramic attributes. Finally, explanations of the statistical analyses that were performed will be presented.

Measurement Techniques and Tools

Physical analysis and measurements of each sherd were performed on a temporary impression created by pressing brown modeling clay into the sherd surface to produce a cast of the original textile. When I found a unique textile impression, I made a permanent cast of that impression by using white Sculpey® polymer clay. It is these white molds that were included in many of the photographs of sherds included in this thesis. While care was taken to minimize leaving modern clay residue on these sherds, it has been pointed out to me recently, since the Beckum Village data collection, that the residual modern clay left on the surface of these artifacts can affect future chemical analysis of the clay composition (Drooker personal communication 2006; Rieth 2004:135). I have provided the Office of Archaeological Research, the curator of the Beckum Village and Salt Creek collections, with an explanation of this concern and a list of the modern clays that were used so that should such a chemical analysis for these collections be performed in the future, that researcher can be informed. While institutions need to be made aware of the effect of making modern clay impressions to analyze pottery surfaces, this remains a common and useful practice.

Attributes of the Beckum Village and Salt Creek textiles and sherds were measured under magnification using 3x magnification, a digital caliper, a common protractor, and, when helpful, a microscope (3.5 to 210x stereo-zoom American Optical) with an internal protractor reticle that provided angle measurements. Each measurement that was recorded for this project was taken from a single site on the sherd or mold being analyzed. Producing a mean of multiple measurements for each attribute would have produced a more representative measurement for each attribute on each sherd. Given the constraint of the project schedule, when I chose a site for measurement I attempted to choose one that appeared to be typical for that attribute on that particular sherd. The data gathered included yarn attributes, fabric attributes, and ceramic attributes.

Fiber Attributes

Devising a repeatable system for classifying fibers was difficult. Previous classification schemes have been designed for actual extant textiles (Kuttruff 1988:202). While it may be possible to ascertain some aspects of fiber preparation when analyzing actual fibers, looking at impressions of fibers in clay provides limited information. Because it was important to include a fiber measurement in the Beckum Village analysis, I was concerned with the need to be able to apply a metric consistently from work session to work session and for other researchers to be able to reproduce my measurements. The solution that I devised is based simply on visibility using natural eyesight and magnification. I classified the fiber as coarse if I could distinguish individual fibers in the impression without magnification. The fiber was classified as fine if I could see it with 3x magnification. If fibers could not be discerned in the clay with 3x magnification I classified it as not visible (Figure 19). This leaves the question of why some fibers would not be visible in a ceramic impression to be answered when either more evidence or more knowledge is acquired. Fibers that were not visible could be so fine and so densely spun that they did not leave an impression in the grainy clay, or the yarn could have been made with something other than individual fibers. Long, pliable leaves could have be twisted and used like textile fibers to produce a product that looks similar to yarn. Also, the yarns could

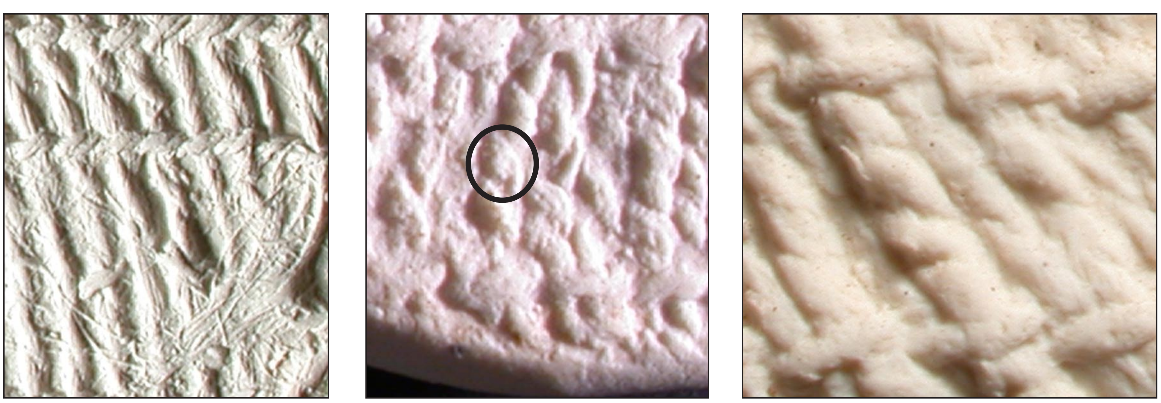


Figure 19. Fiber classified as coarse at left, fine fiber center (circle indicates visible fibers), and not visible at right.

have been coated with a liquid, to improve strength or add color, that would have reduced the appearance of individual fibers.

Yarn Attributes

Yarn attributes were recorded separately for warp and weft yarns for each measurement. As discussed previously, the warp yarns were designated to be those yarns around which other yarns were twined and the weft yarns were designated to be the yarns that twined around the warp yarns. Yarn diameter (Figure 20) provides an approximate yarn size measurement (Emery 1995:12). The number of plies denotes the number of separate strands that were originally spun and then plied together to create the final yarn. The twist direction, *S* or *Z,* of the final yarn was recorded.

The tightness of twist provides an estimation for the amount of labor invested, or time spent, making both the original single strands and the plied yarn, i.e. more labor is required to spin tightly twisted yarn than to spin loosely twisted yarn. Two metrics were used to provide an estimation of tightness of twist: twists per centimeter and twist angle (Emery 1995:11). To produce a twists per centimeter metric, twist length was measured (Figure 21) in millimeters and the twists per centimeter was calculated within the SPSS software using the formula: *twist-per-centimeter = 1 / (twist-length-mm * 10).* Twist

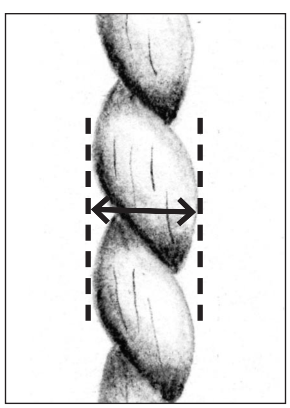


Figure 20. Measuring yarn diameter.

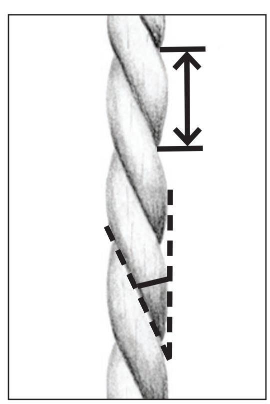


Figure 21. Measuring twist length, above, and twist angle, below.

angle was recorded in degrees using a protractor and a protractor reticle in the microscope, depending on the visibility of the twist angle being measured.

Fabric Attributes

The determination of fabric structure type was based on visual comparisons to photographs in published research on fabric structures (Emery 1971) and was recorded as plain spaced-twined, alternate pair twined, and weft-faced. Variations on these structures also were recorded. The directional twist of the weft yarns around the warp yarns was recorded as *S* or *Z* direction, similar to yarn twist direction.

Threads per centimeter represents the number of yarns per centimeter in the warp or weft. It may seem inconsistent to use the term *thread* rather than *yarn* for these data items, but threads per centimeter and threads per inch are the common terms in weaving and textile discussions and that convention is followed here. The number of horizontal and vertical threads per centimeter is used to compute the density of the fabric, which is based on threads per centimeter and yarn diameter. In twined fabric, the weft rows are constructed with two or more yarns. When analyzing twined fabrics in ceramic impressions it may not always be possible to accurately determine the number of yarns within a weft row. Therefore, the use of *weft rows per centimeter,* which describes the number of weft rows rather than the number of yarns, provides a visual description of twined fabric while weft yarns per centimeter provides a quantitative estimate, based on the apparent number of weft yarns, which can be used to calculate the fabric density. In this research, weft rows per centimeter is reported most often. When a weft yarn count was needed, it was assumed that the weft rows were constructed with two yarns and the weft-rows-per-centimeter was multiplied by two.

Measuring the warp yarns and weft rows per centimeter, while a seemingly simple process, proved to be problematic. In order to explain the problem, two different methods of performing this measurement will be presented. These will be referred to here as methods A and B (Figure 22). In method A, the warp yarns and weft rows per centimeter are measured based on the quantity of yarns or rows within a whole centimeter space, using the largest whole centimeter space that the sherd will provide. For consistency of measurement, the calipers were always held to the outside edge of the first yarn or row that was included in the measurement. The number of whole yarns, the number of whole rows, and the number of centimeters used for each count were recorded. After data entry, statistical software was used to calculate the threads and rows per centimeter. For the A example in Figure 22, the warp threads per centimeter were calculated to be 3.2 and weft rows per centimeter measurements were calculated to be 0.6.

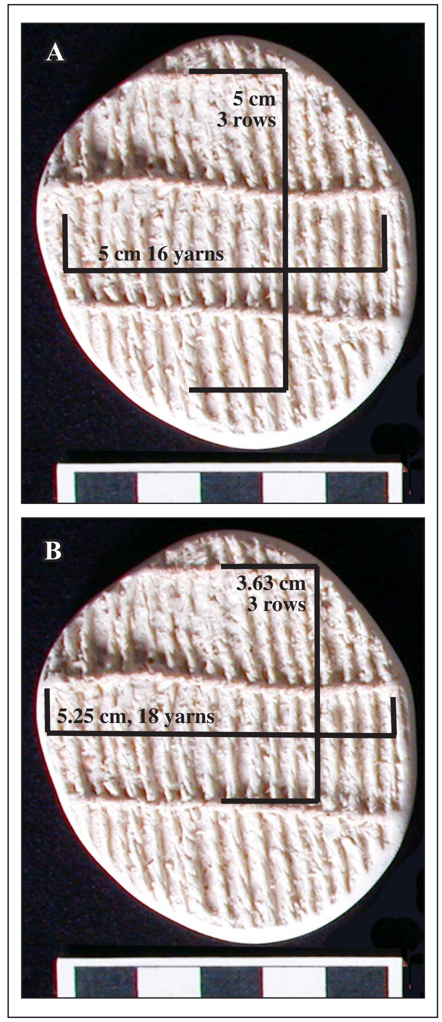


Figure 22. Two methods for measuring warp yarns per centimeter and weft rows per centimeter.

Method B is based on a measurement of the physical distance between edges of yarns or twining rows over the maximum space provided by the sherd. One side of the calipers is held at an edge, either top or bottom, of the warp yarn or weft row near an edge of the sherd and the calipers are opened until the other side reaches the same edge of the warp yarn or weft row at the opposite edge of the sherd. Both the number or yarns or rows and the distance were recorded. For sample B in Figure 22, the warp threads per centimeter were calculated to be 3.4 and the weft rows per centimeter were calculated to be 0.8.

Method A, which is commonly used by textile researchers, was used in gathering data for this thesis. However, it should be noted that method B provides a more accurate measurement of yarn elements per centimeter, and is particularly appropriate for coarse fabrics (less than about five warps or weft rows per centimeter). Further research into the measurement methods and practices used among textile scholars could prove to be beneficial to this subfield of archaeological investigation.

Fabric density can estimate whether a textile is opaque or transparent, which can suggest fabric uses, and it is sometimes used to estimate and compare labor requirements (Drooker 1992:51). For this thesis, fabric density was calculated as *(warp-yarns-per-centimeter x warp diameter) + (weft-rows-per-centimeter x 2 x weft diameter)*. Fabric count, also referred to as thread count, is sometimes confused with fabric density. Fabric count is intended to measure the coarseness or fineness of fabric and is the sum of the number of warp yarns and weft yarns within a square inch (Hatch 1993:319). Fabric count does not consider yarn diameter.

Additional qualitative data were collected to produce a description of the textiles found impressed on the Beckum Village potsherds. If the Beckum Village textiles had originally been made for some other purpose and then later reused or recycled in the pottery production process, then evidence of damage might be seen in their impressions. Damage was recorded as yes, no, or frayed. A textile was classified as frayed when many individual fibers appeared to be loose and not secured within the yarn. If the cloths used in the pottery production process were larger than the pots, then few of the cloth edges would be seen in the impressions. Therefore, each sherd was examined for evidence of overlaid cloths and for a visible selvedge (an outer edge of a fabric).

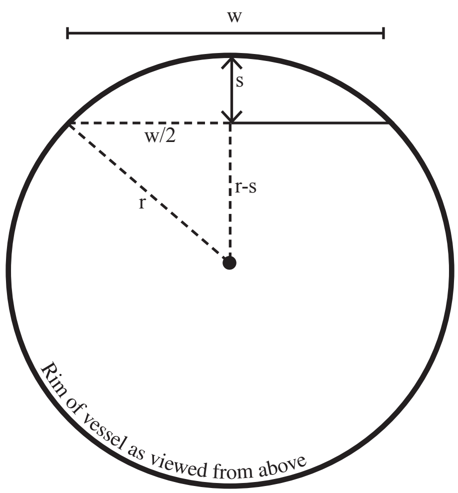
Ceramic Attributes

Ceramic attributes were collected to address the question of how large the cloths would have been. If the cloths were as large as the saltpans, then the rims could provide an estimate of the diameter of the pans. To produce an estimate of saltpan diameter required taking several measurements and then using those measurements to calculate the diameter, which was done formulaically within SPSS (Figure 23). This seemingly

Measurements taken from saltpan rim:

w = width measurement from rim sherd

s = distance of width measurement from rim



Calculate the radius (r) of the saltpan by imagining the original rim of the vessel as at left.

1. $r^2 = (w/2)^2 + (r - s)^2$ (Hogman 1946:264)

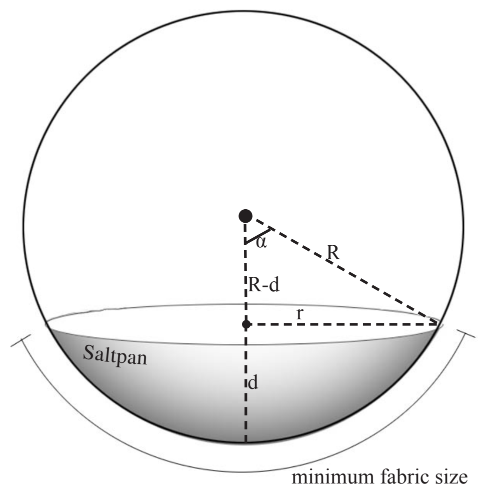
   $r^2 = w^2/4 + r^2 - 2rs + s^2$

   $2rs = w^2/4 + s^2$

2. $r = w^2/8s + s/2$

   Diameter of the saltpan = 2r

Calculate the minimum size of the fabric, or the surface area of the saltpan, by imagining the area of a sphere of which the saltpan is but a piece, as at right. R is the radius of the sphere, r is the radius of the saltpan as calculated above, and d is the depth of the saltpan, which for this study is a constant 20 cm.



3. $R^2 = r^2 + (R - d)^2$

   $R^2 = r^2 + R^2 - 2dR + d^2$

4. $R = r^2/2d + d/2$
5. sine (α) = r/R (Hogman 1946:261)
6. $\alpha = \arcsin(r/R)$
7. length or width of fabric = $f = (\pi R(2\alpha)) / 180$ (Hogman 1946:256)

   $= R(2\alpha)$

   Minimum size of fabric required to cover saltpan = f^2

Figure 23. Formulas used to calculate saltpan rim diameter and minimum fabric size based on measurements taken from rim sherds (developed by Michael Spanos for this research).

complex method of estimating rim diameters was chosen over the more generally used "arc mat" method in an effort to reduce the effect of a preconceived opinion of saltpan differences at Beckum Village and Salt Creek. An arc mat is a large piece of paper on which a sequence of labeled arcs have been drawn. The researcher moves the rim sherd across the drawn arcs until a match is found. Prior to this analysis I believed that the Beckum Village saltpans were generally larger than the Salt Creek saltpans. Using a measurement technique, rather than the somewhat subjective comparison of an arc mat, reduced the effect that this opinion could have on the rim data gathered for this thesis.

The radius of a circle can be calculated if two measurements are known: the width of any straight line within the circle and the depth of the center of that line from the edge of the circle. These measurements were taken from the interior of the rim sherds, so thickness measurements also were taken of the rim and body sherds to develop a mean thickness. The mean sherd thickness was used to modify the calculated diameter because if the fabrics were impressed on the exterior surface, the measurement of the interior must be modified to reflect the thickness of the sherds in order to produce an exterior diameter measurement. The occurrence of sherd breaks along weft rows was noted.

A second formula was used to estimate the cloth dimensions based on the calculated diameter and an estimated pan depth. Given the limited size of the Beckum Village rim sherds it was not possible to find the actual pan depth from the sherds. Therefore, I chose to use a constant for the depth variable so that an approximate minimal textile size could be calculated. Ashley Dumas, an archaeologist and Ph.D. candidate at the University of Alabama of who studies Mississippian saline sites, estimated that a typical Mississippian saltpan would have been between 50 and 80 centimeters in diameter and 20 to 30 centimeters in depth (Ashley A. Dumas, personal communication 2004). I arbitrarily chose twenty centimeters as the saltpan depth constant for this thesis.

Analysis Statistics

The nature of investigating a craft technology without access to the actual artifacts of that craft offers a challenge when choosing statistical tests. For example, statistical tests for determining how accurately a sample represents its population would in this case test how closely this sample of Beckum Village textile impressed potsherds represents the entire population of Beckum Village textile impressed potsherds and not the population of all textiles made by the people that used the Beckum Village site for salt production. The goal of this research is to better understand and document the textile technology of these people even though no samples of this technology remain. Therefore, statistical tests for differences in independent means will only be used to test whether the differences between the Beckum Village means and the Salt Creek means are significant (Figure 24). This type of test is somewhat misleading in that it actually asks about the populations of textile impressed sherds and not the textiles themselves, but it at least provides a quantifiable comparison of means and their standard deviations.

The primary statistics used in the analysis of the Beckum Village and Salt Creek textiles were frequencies, percentages, means, and standard deviations. These were calculated for fiber types, yarn attributes, textile attributes, and for the vessel attributes that were used to determine fabric size. The textile and yarn attribute percentages and means were calculated for each excavation level at Beckum Village in order to look for variations at the different excavation depths.

Part of the purpose of analyzing ceramic impressions of textiles is to compare impressions from difference sites and different times. Another purpose is to attempt to create an accurate description of the original fabrics. This leads to the question of whether an impression in a potsherd can provide accurate dimensions of the yarns and cloth that made the impression or whether the pottery firing process affects and somehow changes

The t Test for Independent Sample Means

The null hypothesis states that the independent population means are equal:

$$H_0: \mu_{BV} = \mu_{SC}$$

where μ_{BV} represents a Beckum Village population mean and μ_{SC} represents a Salt Creek population mean.

The alternative hypothesis asserts that the sample means are not equal:

$$H_1: \mu_{BV} \neq \mu_{SC}$$

The standard error of the difference between the two sample means, $\bar{X}_{BV}$ and $\bar{X}_{SC}$:

$$s_{\bar{X}_{BV}-\bar{X}_{SC}} = \sqrt{\frac{(n_{BV} - 1)\, s_{BV}{}^2 + (n_{SC} - 1)\, s_{SC}{}^2}{n_{BV} + n_{SC} - 2}\left(\frac{1}{n_{BV}} + \frac{1}{n_{SC}}\right)}$$

where n_{BV} and n_{SC} are the sample frequencies and $s_{BV}{}^2$ and $s_{SC}{}^2$ are the standard deviations for the Beckum Village and Salt Creek sample means being presented.

The confidence interval indicates the low and high boundaries of the critical region which is expected to contain the difference in the population means:

$$(\bar{X}_{BV} - \bar{X}_{SC}) \pm t_{df}(s_{\bar{X}_{BV}-\bar{X}_{SC}})$$

where t is found in the Student's t Distribution Table based on a two-tailed test with an α of .02, and df, or degrees of freedom, of $n_{BV} + n_{SC} - 2$.

Because the null hypothesis, $\mu_{BV} = \mu_{SC}$, can be interpreted as $\mu_{BV} - \mu_{SC} = 0$, then if zero exists within the confidence interval (CI) I will assume, with a probability of 98% (α = .02), that the reported difference between the two sample means does not indicate a significant difference in the population means. If zero does not exist within the CI, then I will assume that the difference between the sample means may indicate a difference in the population means of the attribute being reported (Lomax 2001:124).

Figure 24. The calculations used to compute confidence intervals to test the difference between Beckum Village means and Salt Creek means.

the physical nature of in the impression. Before addressing the results of the analysis of the Beckum Village and Salt Creek collections, an experiment that investigates the relationship between a potsherd impression and the textile that made that impression will be presented.

EXPERIMENTATION: COMPARING A REPRODUCTION TEXTILE TO ITS CERAMIC IMPRESSIONS

During the summer of 2005, I worked with a small team of researchers to reproduce a textile impressed saltpan. The other two members of the team were Ashley Dumas, a University of Alabama Ph.D. candidate studying prehistoric salt usage, and Betsy Gilbert, a scholar and a potter with experience reproducing Southeast Indian pottery. We did not approach this experiment with any presumptions as to our ability to accurately reproduce prehistoric processes or to duplicate a prehistoric textile or ceramic vessel. Rather than looking for answers from this limited experimentation, our goal was to find new questions or avenues of inquiry for our individual research projects. This chapter presents the processes and conclusions involved in the reproduction of a twined textile, the use of that textile to form a saltpan, and the firing of the saltpan. Because it is a description of experimental activities undertaken at the time of the thesis research, the presentation of these activities may be less formal than the preceding chapters.

I had hoped that comparing an actual twined cloth to its impression in a fired ceramic vessel might provide additional insight into the fabrics that were impressed into the Beckum Village ceramics. The variation in the spacing of warp yarns and weft rows, and the variations in the warp and weft yarn diameters found in a twined cloth was a primary interest. Comparing these measurements to the similar measurements from the sherds could indicate that the process of firing the ceramic causes the dimensional attributes that are presented in a sherd impression to vary from those of the textile that made the impression. In addition, I wondered if comparing the variations across a single textile would provide a means of statistically associating multiple sherds that were impressed with the same cloth.

Fortunately, I have experience reproducing textile tools, yarns, and fabrics from photographs and this proved valuable in reproducing a fabric from an impression on a potsherd. Based on that previous experience, it seemed that it would be easier to manage the many loose warp yarns if the piece was suspended during the twining process. Using Holmes' drawing as inspiration (Figure 25), Michael Spanos and I went to the hardware store and designed a "PVC tree" that could be used in the air-conditioned comfort of a modern Southeastern home (Figure 26).

Reproducing the Textile

When reproducing a textile from photographs, in other words, without guidance or training from an expert, it has worked best for me to begin with a simplified version of the process and then introduce complexity in subsequent projects. So, for this first twined cloth, I used commercially spun yarn and the simplest fabric structure, spaced plain twin-

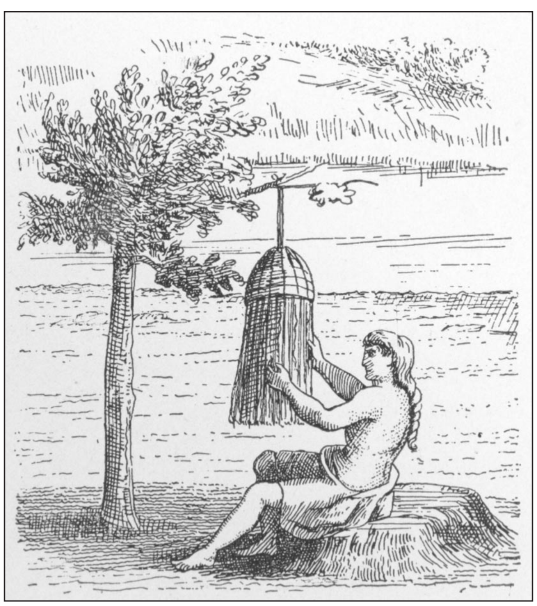


Figure 25. An Indian working with warp suspended from a tree limb (Holmes 1896: Plate 1).

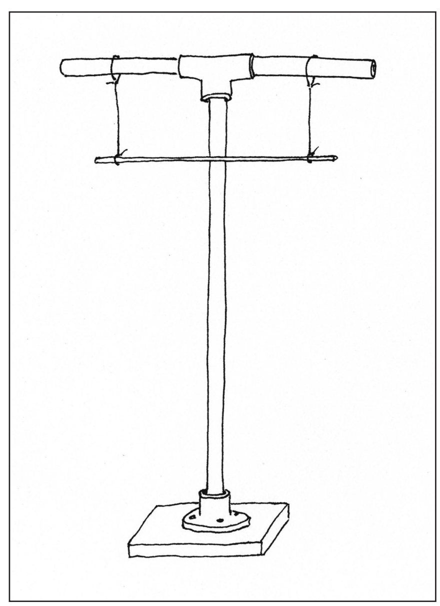


Figure 26. PVC stand to provide tree-like support for twining in an indoor environment.

Figure 27. The Beckum Village sherd that inspired the reproduction textile (1940.21.401, feature 2).

ing. A large, clear, impression on a Beckum Village saltpan sherd was my guide for this project (Figure 27). Plans for subsequent projects will include handspun yarn using commercially prepared fiber, and handspun yarn made from mulberry or nettle fibers. Each project can recreate a different fabric structure.

I found a serviceable yarn at a local craft store labeled as 100 percent hemp, which is a bast fiber similar to flax, mulberry, and nettle. This commercial yarn, which felt hard and dense, looked like the Beckum Village yarn. The yarn in the Beckum Village impression had not collapsed when it was pressed into the clay, it was a firm yarn that maintained much of its original round shape. There were two sizes of yarn available, the thicker yarn was a four-ply yarn and the thinner was a three-ply yarn. I chose the thicker yarn for the warp and the thinner yarn for the weft.

This particular Beckum Village sherd clearly documented the yarn attributes and fabric structure and provided one of the few examples of two fabric edges that had been sewn together. It was evident from those edges that lengths of yarn had been folded to create two warp yarns, as mentioned before in Le Page's description of the twining stand.

The first step toward reproducing the textile in the impression was to decide on the dimensions of the fabric. At that time, I had not analyzed the Beckum Village collection and did not have estimates on the actual sizes of the saltpans. Based on her research, Dumas estimated that a typical saltpan would have been between 50 and 80 centimeters in diameter and 20 to 30 centimeters in depth. With that in mind, I decided to make a cloth that had a finished size of 75 centimeters square. To create a join down the middle, like the join on the sherd, two pieces of twined cloth would be needed, both 37.5 centimeters long by 75 centimeters wide.

The cloth impressed in the Beckum Village sherd had 2 warp yarns within a 1 centimeter space, so to make a 75 centimeter wide cloth, 150 warp yarns were needed (*75 x 2 = 150*). Because the edge of the cloth in the sherd showed the warp folded over, what I actually needed was 75 warp yarns that were twice as long as the final cloth. That information allows the necessary amount of warp yarn to be calculated and purchased. At a similar point in the prehistoric process, the cloth maker would have known how much fiber to gather and how much warp yarn to spin.

With the purchased yarn in hand, the next step was to measure and cut 75 pieces of hemp yarn. When modern scholars contemplate the labor and time required to create cloth, they rarely include this type of preparation work. Like many other aspects of craft production that leave no evidence in the archaeological record, we do not know exactly how this task was accomplished but we do know that it was part of the process of making cloth. Measuring and cutting 75 pieces of yarn that were 75 centimeters long took over an hour using a yard stick and modern scissors. The prehistoric method of measuring may have been at least as efficient, but the use of a stone tool to cut the thick, stiff yarn would surely have been more laborious. With the yarn cut to length and folded in half, I had 150 warp yarns and the twining could begin.

I found it easier to create the first two rows of twining with the warp lying in my lap because until these foundational rows were complete, the warp yarns were floppy and unwieldy. To begin the first twining row I measured and cut a length of weft yarn, estimating how much would be needed to twine across the 150 warp yarns. I folded this first weft yarn in half, laid the first warp yarn in the fold and twisted (twined) the weft yarn around it. I continued placing new warp yarns and twisting the weft yarns around them so that the order or pattern of the folded warp yarns and the twisting weft yarns matched the visible yarns on the saltpan sherd (Figure 28). I twined from the left side of the cloth toward the right side and rotated my hand clockwise to twist the two weft yarns together. These choices were made instinctively and without thought, possibly because I am right handed and this created comfortable hand motions for me. When all 150 warp ends had been twined with the first weft yarn it was obvious that the cloth was not going to be 75 centimeters wide. This was due to either the commercial yarn having been smaller than the yarn in the impression or perhaps because my twining was different than the twining in the impression. Consequently there were more warp yarns per centimeter, which resulted in a narrower piece of fabric. To correct this problem, I cut more lengths of warp and continued twining across that first weft row until the fabric was approximately 75 centimeters wide. The final piece of twined fabric has 112 folded lengths of yarn in the warp or 224 warp ends. This meant that 8,400 meters of yarn were required for the warp. At the end of the twining row I made an overhand knot using both weft ends, and trimmed the ends so they were both approximately one inch long.

Figure 28. Creating the first row of twining was easier to accomplish with the yarns laying on my lap.

After the first row of twining was complete, the actual amount of yarn needed for the warp turned out to be 112 strands that were 75 centimeters long, or a total of 84 meters of yarn. Spacing the twining rows similarly to those in the impression, approximately 1.5 centimeters apart, would result in 24 twining rows that each required 275 centimeters of weft yarn. The total yarn needed for the weft twining rows was estimated at 66 meters. Therefore, one 75 by 37.5 centimeter wide cloth would require 150 meters of yarn (84 meters of warp yarn + 66 meters of weft yarn = 150 meters of yarn). To make two cloths that could be sewn together to make a 75 by 75 centimeter cloth would require 300 meters of yarn. In consideration of such, if I had to cut yarn with a sharp stone, I probably would have cut all of the weft yarns to length at one time. I myself chose to cut several at one time, use them up, and then cut more.

When the first two twining rows were complete, I used more hemp yarn to lash or sew the newly twined warp yarns to a thin rod (Figure 29), which was then suspended from the PVC stand. This suspended rod allowed the yarns to be raised or moved from side to side as the twining progressed. Twining across 224 warp ends took approximately one-half hour. Although I've done a lot of different textile work in the past, these hand motions were new to me and I probably worked slowly and inefficiently compared to the Beckum Village textile crafts people. Working with the stiff yarn was hard on my hands and after a couple of hours, I had to give them a rest. Regardless of the coarse and stiff yarn, twining the fabric was like so many repetitive motion textile tasks, very pleasant and soothing.

Figure 29. The warp was lashed to the support stick after the first two twining rows were complete, and suspended on the PVC-tree stand.

The actual time spent creating this saltpan textile occurred over many months, due to the demands of graduate school. The total time needed for the individual steps to create the two cloths included 3 hours for preparing the warp and 24 hours to twine the

Table 1. Estimated Time Required to Reproduce a 75 x 75 cm Twined Textile Using Commercial Yarn.

Activity	Hours
Prepare warp	3
Twine weft rows	24
Sew cloths together	0.5
Estimated Time Required	*27.5 hours*

Figure 30. Completed twined fabric in shallow saltpan mold.

weft rows (*0.5 hours x 24 twining rows x 2 cloths = 24 hours*). Sewing the two cloths together required approximately 30 minutes, so the total amount of time invested in making a 75 by 75 centimeter cloth using commercial yarn, modern scissors, and a stand that suspended the work was approximately 27.5 hours (Table 1). The newly assembled cloth seemed very stiff and I was concerned that it would not be flexible enough to take the conical shape of the saltpan mold (Figure 30), so I washed it on the gentle cycle in the washing machine. Later, after seeing the cloth in the mold, the cloth appeared to be more than flexible enough to assume the shape of the mold without washing.

Reproducing the Textile Impressed Saltpan

Soon after completing the reproduction textile, Dumas, Gilbert and I met to make the saltpan. At this point, my role was primarily that of photographer and note-taker. Dumas used a shovel to create the rough shape for the saltpan mold and then a trowel to refine it. Gilbert and Dumas roasted the freshwater shells by wrapping them in aluminum foil and placing the foil package in an outdoor fire. The purpose of placing the shells in aluminum foil was to keep them together and make it easy to remove them from the fire. If the Southeast Indians roasted their shells, they could have thrown them into the fire, kept the fire going for as long as was needed, and then waited for the fire and coals to cool before digging through the ashes to recover the roasted shells. Gilbert judged that the shells were “done” when they smelled like a tooth being drilled at a dentist’s office. After the shells cooled, the remaining pieces of shell were crushed with a rock to create the temper material. Gilbert said that the shells would have been very difficult to crush if they had not been roasted.

The next step in the process was called “wedging the clay” and consisted of kneading the clay like bread dough to incorporate the roasted shells, the temper material, and adjust the moisture. The small, sharp pieces of shell, along with the stiffness of the clay, made this process slightly painful. Gilbert, an experienced potter, judged when the clay had enough moisture and enough temper material. She estimated that at this point the clay was 20 to 25 percent shell. The clay appeared stiffer and dryer than I had expected (Figure 31).

Working on a flat board, Dumas and Gilbert pounded the big ball of clay into a flat round shape. They carried the board to the fabric lined mold, lifted the large pancake-like clay, and placed it in the mold. Gilbert said that, given the moisture in the ground, she did not think that it would make any difference whether the fabric were wet or dry when the pan was formed on top of it. They flattened and pressed the clay into the mold and formed the rim with their hands. Gilbert and Dumas used a metal scraper to smooth the inside of the pan (Figure 32). At this point, only a few minutes after the pan was

Figure 31. Kneading stiff clay to incorporate shell temper and water.

Figure 32. Dumas scraped the newly formed pan to create a smooth interior surface.

placed into the mold, Dumas and Gilbert grabbed the corners of the cloth and lifted the new saltpan from the mold, just to see what would happen. The pan held its shape and when it was replaced into its mold it showed only a few small cracks, which were quickly repaired by pressing. We covered the pan to protect it from birds and animals that might find the cool, clean clay attractive, and left it to dry.

Driving home, Dumas and I estimated the amount of time required for three untrained saltpan makers to make their first saltpan. We did not attempt to include the time required to find and gather the clay or the shells. Digging and shaping the mold in the ground took 15 to 20 minutes, roasting the shell took 45 minutes, crushing the shell took 10 minutes, wedging the clay took 35 minutes, shaping the clay into a pan shape took 10 minutes, pressing the clay into the mold and forming the rim took 15 minutes. The total working time to complete these activities was about 2 hours and 15 minutes (Table 2). The obvious conclusion is that the knowledgeable and experienced Beckum Village potters would have made saltpans faster than we did, but it is also possible that based on their expertise, they may have included additional steps or processes to refine or improve the end product that we do not know about.

After a couple of days of outdoor air-drying, our saltpan was caught in a sudden summer rain storm. Gilbert picked up the pan by lifting the fabric and placed it in a large iron pot that she covered completely, but the rain still manage to soak half of the pan. Gilbert and Dumas re-used the clay from that first pan, began again at the wedging stage in the process, and re-created a second pan following the same steps. Rain must have been a problem for the Beckum Village potters. Not only did they need dry weather to evaporate the liquid from the salt, they also needed dry weather to

Table 2. Estimated Time Required to Reproduce Textile Impressed Saltpan

Activity	Minutes
Dig mold	20
Roast temper shell	45
Crush temper shell	10
Wedge clay	35
Create pan shape	10
Press clay into mold and form rim	15
Estimated Time Required	*2 hours 15 minutes*

dry the saltpans to the state potters refer to as leather hard, when the clay is ready to be fired.

We enlisted the help of a Native American potter to fire our saltpan at a conference for Southeastern Indian pottery enthusiasts at Moundville Archaeological Park in July, 2005, which occurred a few days after the second pot was made. John Jansen began the firing process early in the morning by building a fire where our saltpan and his pots would be fired in order to warm the ground (Figure 33). Although there were visible cracks in the saltpan, Jansen hoped that it would make it through the firing process without a problem. Jansen stacked additional pots on top of the large saltpan and then placed ceramic shields, which he had made for this task, around the stack to ensure that none of the un-fired vessels came into direct contact with the fire (Figure 34). He built the fire up slowly, gradually adding logs and limbs closer and closer to stack of ceramics. Eventually the fire completely covered the pottery (Figure 35). During the firing process, Dumas heard two pops and saw the stack of pottery sink. After the firing process was completed and the ceramics were cool, we could see that our saltpan had shattered (Figure 36). Firing the saltpan began early in the morning and was completed by mid-afternoon.

Figure 33. Un-fired saltpan placed on heated ground and spacers, which provided air-flow inside the vessel during firing.

Figure 34. The saltpan was at the bottom of this stack of pots and ceramic fire shields.

Figure 35. At the end, the fire completely covered the stack of pottery (photograph courtesy of Ashley Dumas).

Figure 36. The reproduction saltpan shattered in the fire, conveniently creating reproduction saltpan sherds.

Comparing a Textile to its Impression in Fired Clay

A sample of fifteen new saltpan sherds were chosen for analysis by looking through the box of sherds and attempting to choose sherds that appeared to be from different areas of the saltpan. The sample size was arbitrary. I cleaned the very dirty saltpan textile by hand washing, which became more and more vigorous in an attempt remove the rust stains, which had resulted from the time spent in the iron pot. This washing may have caused the saltpan fabric to shrink, as is common for freshly woven linen fabric. If measurements had been taken before and after washing, shrinkage could have been verified. However, any possible shrinkage at this point may have been reduced due to the fabric having been washed prior to being used in the first saltpan mold in an attempt to ensure adequate flexibility.

With the sherds in hand and the fabric washed and dried, the measurements from an actual twined textile could finally be compared with the measurements from its impressions in potsherds. I was primarily interested in the spacing of warp yarns and weft rows and the warp and weft yarn diameters in the actual cloth. I wanted to know how those measurements varied within a single textile and how that related to the variations in the measurements taken from a group of sherds that were impressed with that cloth.

The measurements of the reproduction twined textile were taken from five different locations spaced diagonally across the cloth, so that each location included different warp yarns and different weft twining rows, which is the procedure for checking fabric density in the textile industry (Kadolph 1998:121). Yarn diameter was also measured at the same five locations on the cloth.

The yarn diameters appear to be larger in the textile than in the impressions (Table 3). This could be caused by the yarn being compressed when the clay was pressed into it. A *t* Test for Independent Sample Means for these means suggests that this difference is not significant. The threads-per-centimeter measurements would not be affected by this compression. While the mean warp yarns per centimeter were 3.5 in the textile and 3.2 in the impressions, the *t* Test indicates that the differences in the warp and weft threads-per-centimeter do not appear to be significant.

While this experiment showed a significant difference in the textile and saltpan impressions of yarn diameters and not the fabric measurements of warp yarns and weft rows per centimeter, the sample size was too limited to consider the results dependable.

Table 3. Reproduction Textile Measurements Compared to Impression Measurements

	Textile (n = 15)	Impressions (n = 15)	*t* Test Results
Warp Yarn Mean Diameter	2.2	1.4	CI = (0.51, 1.09) difference is significant
Standard Deviation	*0.1*	*0.1*	
Weft Yarn Diameter	1.8	1.3	CI = (0.08, 0.92) difference is significant
Standard Deviation	*0.3*	*0.1*	
Warp Yarns per Centimeter	3.5	3.2	CI = (-0.06, 0.66) difference is not significant
Standard Deviation	*0.1*	*0.2*	
Weft Rows per Centimeter	0.8	0.9	CI = (-0.46, 0.26) difference is not significant
Standard Deviation	*0.2*	*0.1*	

Note: The confidence interval (CI) is calculated with 98% probability ($\alpha = 0.02$), see Figure 24, page 54.

An unexpected result of this experiment is the idea that a bast fiber twined textile, even one produced by a novice, can be surprisingly resilient (Figure 37). The experiment textile has been in the ground twice, it sat through a rainstorm between wet clay and a rusty iron pot, and it has been washed and scrubbed multiple times. The yarn appears to be slightly fuzzy, but otherwise unaffected, and the fabric still feels sturdy. Using such a textile in a similar pottery production process may have affected it less than is often assumed. The textile created for this experiment could be used to line many more saltpan molds. If it had been produced for some other purpose and momentarily used to make saltpans, it could go back to work in its original function with little effect from the pottery process.

Figure 37. A close-up view of the reproduced cloth after two salt-pans and vigorous washing. The seam is visible in the center of the cloth.

BECKUM VILLAGE TEXTILE ANALYSIS

The results of the Beckum Village textile analysis include the measured and calculated attributes for fiber, yarn, cloth, and the ceramic attributes that contribute to an estimate of the minimum size of the Beckum Village saltpan textiles. The Beckum Village collection will be compared to textile impressions recovered from the Salt Creek site, which was analyzed following the same procedures. Because every attribute was not visible on every sherd, frequency counts vary for each measurement or attribute reported. The primary criteria for being included in the analyzable sample was a discernible fabric structure. Applying this restriction to the textile impressed sherds at Beckum Village resulted in a sample of 1,055 sherds. From the Salt Creek Trickey collection (catalog numbers 1990.15.285 through 1990.15.301), 349 sherds were able to be analyzed. Both collections were curated at the Erskine-Ramsey Archaeological Repository at the Moundville Archaeological Park in Moundville, Alabama. The Beckum Village collection includes catalog numbers 1940.21.1 through 1940.21.657.

The Beckum Village excavation was extensive by today's standards. Almost 1,400 square feet of this site were dug in five-foot squares that were excavated in seven 6-inch layers, a total depth of 3.5 feet. The Beckum Village artifact provenience labels indicated that areas were excavated that were not shown on the excavation map. The map did not show a row 100 or columns R11 or R12, and it did not extend the R3 column below grid row 55. Figure 38 provides a revised excavation grid that includes the additional rows and columns from which textile impressed potsherds were recovered. In this figure, the grey squares indicate where textile impressed sherds were found and provides the frequencies of those sherds. The squares with an asterisk show where ceramics were

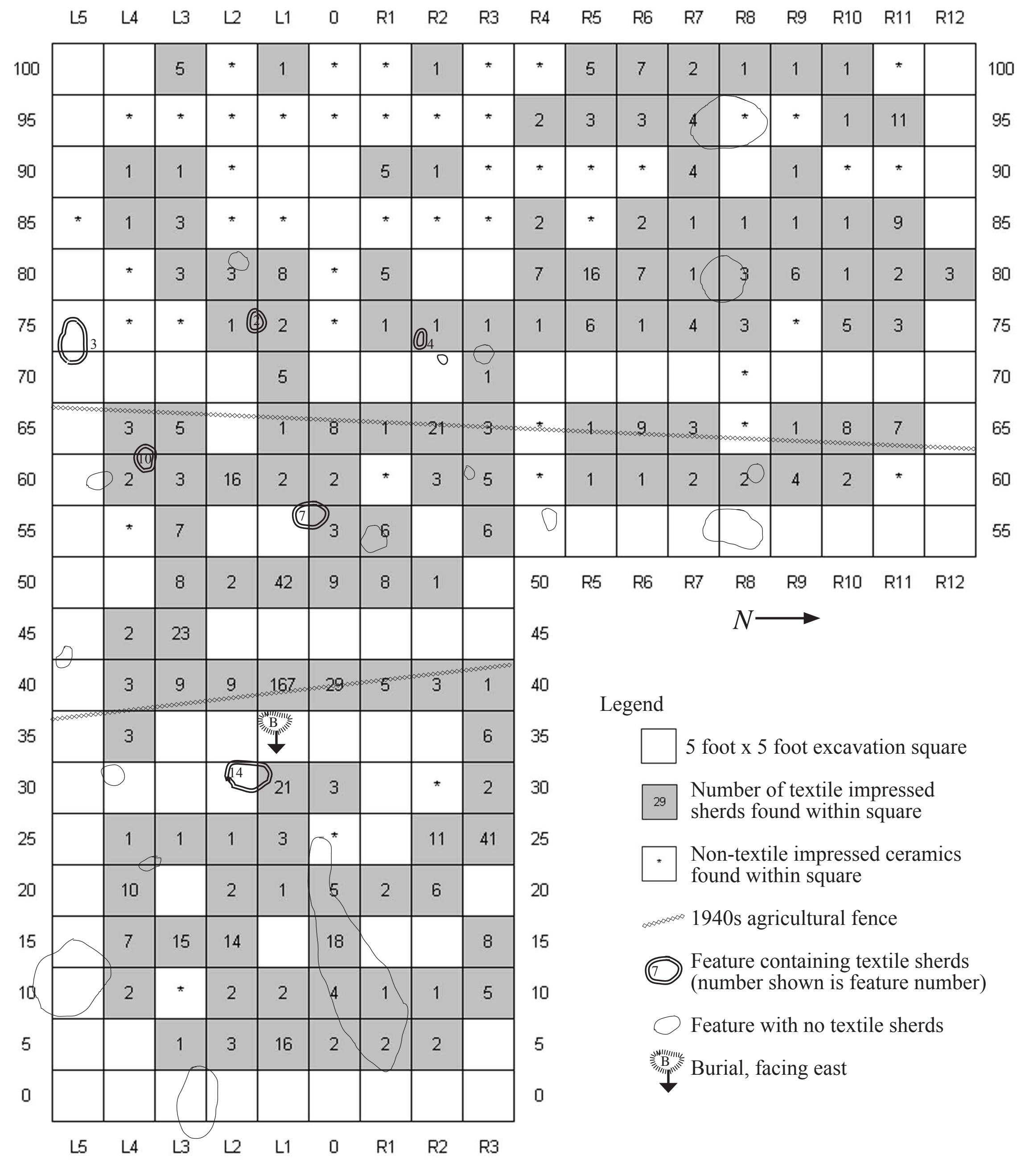


Figure 38. The Beckum Village excavation grid with the location and frequencies of textile impressed sherds.

found that did not include textile impressed sherds. The drawn circles with doubled outlines show the features that contained textile impressed sherds; both the feature number and the sherd frequency are given. The circle labeled with a "B" indicates the one Beckum Village burial of the flexed body, facing east, of a young person. Some features, trees, and rocks are shown as finer outlines. The two hashed lines show the location of agricultural fences that existed at the time of the excavation.

While it appears that the analyzable textile impressed potsherds were scattered over the entire site, one particular grid square, adjacent to the square where the single burial was found, provided 167 analyzable textile impressed sherds, which is almost 16 percent of the total sample. There was no recorded feature within that grid square, but its proximity to the grave seems significant. Along with their textile and salt production traditions, the Beckum Village saltmakers could have passed on to subsequent generations the location of the single grave and perhaps the tradition of placing pots or potsherds on the grave as a protection for the young person buried there (Ian W. Brown, personal communication 2006).

Fiber

The Beckum Village textile data was limited to what could be seen in an impression in clay, therefore the available fiber information was minimal. Most of the Beckum Village fibers were classified as fine (65.9 percent), the not-visible group came next (21.7 percent), and coarse fibers made up the smallest group (12.4 percent, Table 4). The

Table 4. Fiber Type Frequencies.

		Coarse	Fine	Not visible	Total
Beckum Village	Frequency	85	453	149	687
	Percentage	*12.4*	*65.9*	*21.7*	*100*
Salt Creek	Frequency	117	18	29	164
	Precentage	*71.3*	*11.0*	*17.7*	*100*

difference in fiber diameter could have been due to the amount of processing, the quality of the available plants in certain years due to climate or horticulture practices, or it could indicate the use of different plants. The visibility of fibers could have been effected by different properties, such as grain size, of the various clays that were used to make salt-pans. The not-visible fiber yarns may have included animal or seed fibers (if seed fibers such as cotton were available to the Beckum Village spinners), which could have produced yarns that were so fine and firmly spun that they did not create identifiable impressions in the ceramic clay.

Salt Creek fibers presented a different distribution, the greatest frequency was in the coarse fibers (71.3 percent) with the smallest frequency in the fine fibers (11.0 percent). At both sites, there was a clear preference for a particular and different fiber type. This preference may indicate a difference in the natural resources available, a difference in the type of textiles desired and produced, or it may indicate a difference in textiles or chosen for use in the pottery production process.

Yarn

The Beckum Village yarns were predominately two-ply yarns that were twisted in the *Z* direction when the single strands were spun and then twisted in the *S* direction when the two singles were plied together (Table 5). Of the 739 sherds on which the twist direction of warp yarns could be seen, 738 yarns displayed a final, plying twist direction of *S* and only 1 sherd was plied in the *Z* direction. Of the 637 sherds that provided a clear

Table 5. Yarn Ply and Twist Direction Frequencies.

		Single Strand Yarn	Two-Ply Yarn	*S* Twist Direction	*Z* Twist Direction
Beckum Village	Warp (n = 739)	0	739	738	1
	Weft (n = 637)	2	635	636	1
Salt Creek	Warp (n = 24)	1	23	23	1
	Weft (n = 91)	3	88	76	15

impression of weft yarns, 636 weft yarns were spun in the *S* direction and 1 was spun in the *Z* direction.

The mean diameter of the Beckum Village warp yarns was 1.8 millimeters and included a wide range of sizes from 0.6 to 4.5 millimeters (Table 6). The mean diameter of weft yarns was 1.4 millimeters, with an even broader range of sizes from 0.5 to 16.3 millimeters. While a yarn diameter of 16.3 millimeters could appear at first glance to be an error, the warp yarn in this impression was also one of the thickest recorded, 4.0 millimeters, and the fiber was classified as not-visible. This case may represent a yarn made from twisted leaves rather than from spinning prepared fibers. Among the Beckum Village thick yarns, the next two thickest weft yarns (measuring 10.3 and 10.0 millimeters in diameter) were classified as fine fiber yarns, therefore the thick yarn with not-visible fiber may be an anomaly for this collection.

Table 6. Warp and Weft Mean Diameter, Twist Angle, and Twists per Centimeter.

			Beckum Village	Salt Creek	*t* Test Results
Yarn Diameter (mm)	Warp	Mean	1.8	2.6	CI = (-0.43, 2.09) difference is not significant
		Standard deviation	*0.7*	*1.1*	
		Sample size	*745*	*36*	
	Weft	Mean	1.4	3.1	CI = (-1.96, -1.44) difference is significant
		Standard deviation	*0.86*	*1.5*	
		Sample size	*684*	*106*	
Twist Angle (degrees)	Warp	Mean	29.3	32.7	CI = (-4.94, -1.86) difference is significant
		Standard deviation	*7.0*	*7.0*	
		Sample size	*445*	*20*	
	Weft	Mean	30.8	19.0	CI = (9.69, 13.91) difference is significant
		Standard deviation	*12.1*	*6.3*	
		Sample size	*12*	*73*	
Twists per Centimeter	Warp	Mean	3.9	2.7	CI = (0.44, 1.96) difference is significant
		Standard deviation	*1.7*	*1.2*	
		Sample size	*430*	*20*	
	Weft	Mean	5.0	1.7	CI = (1.18, 5.42) difference is significant
		Standard deviation	*1.7*	*0.6*	
		Sample size	*6*	*3*	

Note: The confidence interval (CI) is calculated with 98% probability ($\alpha = 0.02$), see Figure 24, page 56.

The short lengths of weft yarn that were visible on the impressions of the Beckum Village twined fabric were rarely adequate to allow for the measurement of the twist angle or the twists per centimeter for the weft yarns. Therefore the frequencies for these measurements are very low. For the Beckum Village warp yarns, the average twist angle was 29.3 degrees (ranging from 9 to 52 degrees) and 30.8 degrees for weft yarns (ranging from 15 to 55 degrees). The mean twists per centimeter for warp yarns was 3.9 and 5.0 for weft yarns. Using Emery's standards, the Beckum Village yarns, on average, were tightly twisted yarns (1995:12).

The analysis of the Salt Creek yarns showed a similar preference by Salt Creek individuals for two-ply yarns with a final *S* twist direction. One notable difference is that out of 91 weft yarns analyzed, 15 (16.5 percent) displayed a final *Z* twist direction. The mean diameter of the Salt Creek yarns was much larger than the Beckum Village yarns, with an average 2.6 millimeter warp yarn and an average 3.1 millimeter weft yarn. The Salt Creek warp and weft yarns showed significantly different mean twist angles to that of the Beckum Village yarns. The Beckum Village warp yarns presented a lower twist angle than the Salt Creek warp yarns, while the weft yarns were the opposite. The Salt Creek mean warp and weft yarn twists per centimeter were significantly lower than the Beckum Village means.

It appears probable that Beckum Village weft yarns were smaller in diameter and more tightly twisted than the Salt Creek weft yarns. This suggests that more labor was invested in the weft yarns seen in ceramic impressions found at Beckum Village. If the textiles impressed into ceramics are representative of the population of textiles at the Beckum Village and Salt Creek sites, then the differences in yarn diameter and tightness of twist, along with the difference in the occurrence of *Z*-twist yarns, suggest that Beckum Village and Salt Creek were occupied by groups with different textile traditions. While the occurrence of predominately *S*-twist yarns at Beckum Village does not indicate where the Beckum Village saltmakers had a permanent residence and where they learned to spin and make textiles, it does suggest that they followed different textile practices and traditions than those in areas that have produced textile artifacts with predominately *Z*-twist yarns, such as the Alachua area, the Big Bend area of the Ocmulgee River, or the Wilmington and Savannah area on the Florida and Georgia coast. The difference in the percentage occurrence of single strand weft yarns suggests that the Beckum Village spinners produced different yarns than those found at Mound Bottom, Tennessee. The Mound Bottom textile impressed ceramic collection showed a strong preference for the use of single strand yarns in both the warp and the weft, while the Beckum Village collection produced only two single strand yarns. Wickliffe Village and Etowah also showed a much greater use of single strand yarns than did Beckum Village. The distinguishing features for the Beckum Village yarns found impressed in ceramics may be the almost exclusive use of two-ply *S*-twist yarn, which usually had a very high twist.

Fabric

Seventy-eight percent of the Beckum Village fabric structures found in the textiles impressed on potsherds were plain spaced-twined, 21.9 percent were alternate pair twined, and 0.2 percent were weft-faced (Table 7). The statistics might lead one to imagine a very homogeneous collection of fabrics, but this is not the case. Although the complex lace patterns found at Etowah and Wickliffe have not been found at Beckum

Table 7. Fabric Structure Frequencies.

		Plain Spaced-Twined	Alternate Pair Twined	Weft-faced	Total
Beckum Village	Frequency	822	231	2	1,055
	Percentage	*77.9*	*21.9*	*0.2*	*100*
Salt Creek	Frequency	28	4	317	349
	Percentage	*8.0*	*1.2*	*90.8*	*100*

Table 8. Twining Direction Frequencies.

		S Twist Direction	Z Twist Direction	Both S & Z	Total
Beckum Village	Frequency	807	1	2	810
	Percentage	*99.7*	*0.1*	*0.2*	*100*
Salt Creek	Frequency	33	1	0	34
	Precentage	*97.0*	*3.0*	*0.0*	*100*

Village, there was a notable range of cloth made with the fabric structures they did use, much like in contemporary cloth where the plain interlaced structure is found in everything from baby blankets to automobile upholstery.

The direction that the weft yarns were twisted when twined around the warp yarns was predominately in the S twist direction (Table 8). This was true for both Beckum Village and Salt Creek. At both sites, only one sherd showed all twining rows had been twined in the *Z* twist direction. Only at Beckum Village were examples found of both *S* and *Z* twining twist directions in a single fabric impression (Figure 39). In this example, the three visible twining rows alternate, *S*, *Z*, and *S*. In twined cloth where the twining rows are close to each other, alternate twisting directions are often used in order to keep

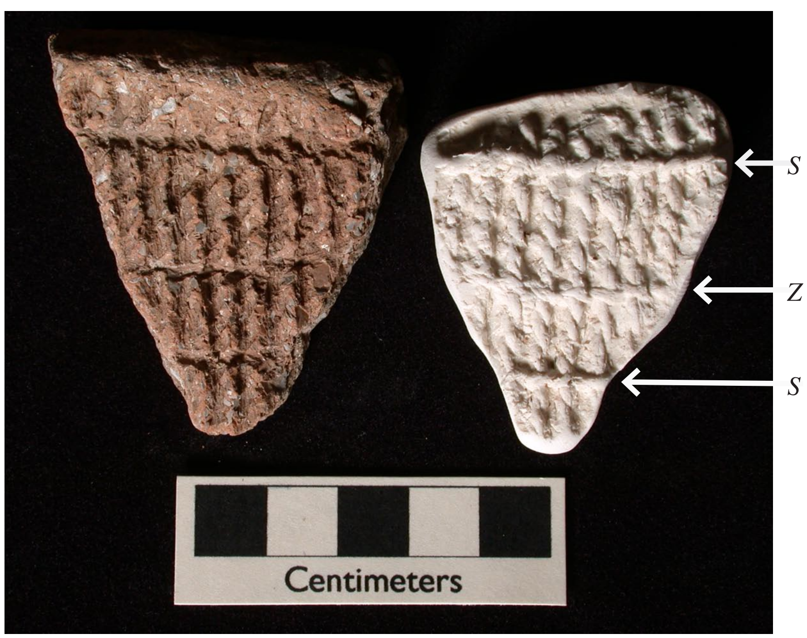


Figure 39. One of the few examples of the use of multiple twining twist directions in the Beckum Village collection (1940.21.266).

Table 9. Frequencies of Damage, Overlaid Fabrics, and Visible Textile Edges.

		Beckum Village	Salt Creek
Damage	Frequency	236	13
	Percentage	*22.8*	*7.2*
	Sample size	*1037*	*181*
Frayed Yarns	Frequency	10	119
	Percentage	*1.0*	*65.7*
	Sample size	*1037*	*181*
Overlay	Frequency	7	0
	Percentage	*0.7*	*0.0*
	Sample size	*1036*	*177*
Visible Edges	Frequency	3	0
	Percentage	*0.3*	*0.0*
	Sample size	*1036*	*177*

the cloth from skewing in the direction of the twining twist. But when the twining rows are spaced so far apart, the reason for the choice to alternate the twining twist direction is not obvious.

Out of 1,037 Beckum Village textile impressions, 236 (22.8 percent) fabrics appeared to be damaged (Table 9). Due to its prevalence in the Salt Creek collection (which was analyzed first), one specific type of damage, frayed yarns, was recorded separately. While only 10 frayed yarn cases were found at Beckum Village, most of the Salt Creek damage, 65.7 percent of the entire sample, was due to frayed yarns. One possibility that is often discussed when looking at textile impressions in saltpans, is that the textiles were originally made for some other purpose and then, when they could no longer fulfill that purpose, they were recycled for use in pottery production. Such damage could be limited a single area of the textile so that a limited number of the sherds from a saltpan impressed with that damaged cloth would show evidence of the damage. Alternatively, a form of damage such as frayed yarns due to abrasion or wear, could affect the entire cloth. There is a noticeable difference between the amount and type of damage in the textiles impressed at Beckum Village and Salt Creek. The Beckum Village collection, with less than

24 percent visible damage, may suggest that only some of the fabrics used at Beckum Village were recycled after being made and used for some other purpose.

Seven Beckum Village impressions showed signs of multiple fabrics overlaid on top of each other and two samples included an edge of the fabric (Figure 40). Three Beckum Village impressions provided a glimpse of the edge of the impressed textile. This low percentage suggests that the typical method for making a saltpan was to use a cloth that was at least as large as the mold. The size of the cloths will be explored further in the discussion of the ceramic attributes.

One interesting feature, which was consistent throughout both the Beckum Village and the Salt Creek fabric impression collections, was that neither the warp yarns or the weft yarns exhibited any knots or visible joins. To produce a twined cloth in which none of the warp or weft yarns had to be extended required that only yarn of adequate length

Figure 40. One of six Beckum Village impressions that showed the use of multiple or layered fabrics (1940.21.13). The circled areas indicate the weft row of the second fabric. The visual similarity of the two overlaid fabrics could indicate that this was a single fabric that had been folded, doubled, before being placed in the saltpan mold.

was used for each individual warp yarn and each individual weft yarn. This suggests that these yarns were accurately measured and that the ends of skeins or balls of yarn that were not long enough were not used. Although these unused short lengths would likely have been useful in some other capacity, the choice to have no knots in the body of the cloth required planning, calculating, and the decision to prepare more fiber than was needed and to spin and ply more yarn than was strictly needed for that cloth. These textile crafts-people may have chosen to avoid knots for aesthetic reasons or for utilitarian reasons; knots and other types of joins are common points of failure and can be uncomfortable to wear. Regardless of the reason, the fact that it was so consistently applied suggests that it was important to these people. This seemingly small detail was worth extra labor in both fiber processing and spinning, which may suggest that the simplicity of the fabrics found at Beckum Village and Salt Creek was a matter of choice rather than a limitation of skill.

Two distinct forms of spaced plain twined fabrics were found, which will be referred to here by terms coined during this research as *wrapped-warp* and *doubled-warp*. In the wrapped-warp fabrics the warp yarns had been constructed from two separate yarns that were wrapped with a third element. Because it is the yarn that distinguishes this type of fabric and it may have been appropriate to include this in the yarn section of this chapter, the purpose of the unusual yarn appeared to be to create a particular type of fabric. Therefore, its description has been included in the fabric section. Doubled-warp spaced twining was created with two warp yarns used together as though they were an individual warp yarn. Spaced plain twined, wrapped-warp spaced twined, doubled-warp spaced twined, alternate-pair twined, and weft-faced fabric attribute data will be discussed separately below.

Although this thesis is restricted to the potsherd impressions that were created with textiles that exhibited warp and weft yarns, other impressions of yarn and woven elements were found at both sites. The Beckum Village collection included 67 impressions of net impressed potsherds and 32 cord marked potsherds. The Salt Creek collection included 21 net impressed sherds, 35 cord marked potsherds, and 107 cane matting impressed sherds.

Spaced Plain Twined Textiles

The spaced plain twined fabrics ranged from fine garment weight fabric to coarse, utilitarian fabrics (Figures 41 and 42). Two of the primary attributes that affect fabric characteristics and determine the nature and appropriate use of a fabric are type and size of yarn and how close those yarns are to each other (Table 10). In plain spaced-twined textiles found at Beckum Village, the mean warp yarns per centimeter was 2.7 and the mean weft rows per centimeter was 0.6. As mentioned earlier in the discussion of research methods (on page 50), weft rows per centimeter, rather than weft yarns per centimeter, are reported here because when analyzing ceramic impressions, it may not always be possible to accurately determine the number of yarns used to construct a weft row. While many techniques of twining incorporate more than two weft yarns within a weft row, neither the Beckum Village nor the Salt Creek collection provided visible evidence that more than two weft yarns were used in a row. Therefore, weft yarns per centimeter are assumed to be twice the number of weft rows per centimeter.

Figure 41. One of Beckum Village's finest spaced plain twined textiles (1940.21.91).

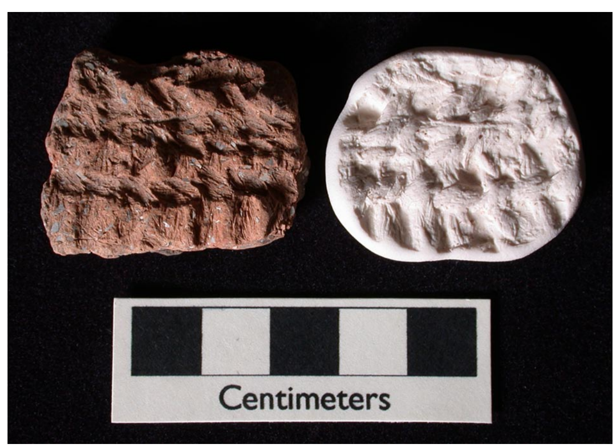


Figure 42. One of Beckum Village's coarsest spaced plain twined textiles (1940.21.446).

Table 10. Spaced Plain Twined Mean Yarns per Centimeter, Yarn Diameters, and Fabric Density.

		Beckum Village	Salt Creek	*t* Test Results
Warp Yarns per Cm	Mean	2.7	2.2	CI = (0.12, 0.13) difference is significant
	Standard deviation	*0.9*	*0.7*	
	Sample size	*597*	*23*	
Weft Rows per Cm	Mean	0.6	0.7	CI = (0.22, 0.42) difference is significant
	Standard deviation	*0.3*	*0.5*	
	Sample size	*490*	*17*	
Warp Yarn Diameter	Mean	1.9	2.5	CI = (-1.0, -0.91) difference is significant
	Standard deviation	*0.7*	*0.8*	
	Sample size	*532*	*24*	
Weft Yarn Diameter	Mean	1.5	1.9	CI = (-0.82, 0.02) difference is not significant
	Standard deviation	*0.6*	*0.3*	
	Sample size	*452*	*19*	
Fabric Density	Mean	6.6	7.2	CI = (-1.48, 0.28) difference is not significant
	Standard deviation	*1.8*	*1.4*	
	Sample size	*375*	*13*	

Note: The confidence interval (CI) is calculated with 98% probability ($\alpha = 0.02$), see Figure 24, page 56.

The mean Beckum Village warp and weft yarn diameters were 1.9 and 1.5 millimeters, respectively. The mean fabric density, an index used for comparison purposes, for the Beckum Village spaced plain twined textiles was calculated to be 6.6. These statistics show that the average spaced plain twined fabric at Beckum Village was made with slightly finer warp and weft yarns than the same fabric structures at Salt Creek, and the warp yarns were set, on average, slightly closer together, although the frequency of this type of fabric found at Salt Creek may be too small to provide a valid comparison.

Out of 752 spaced plain twined impressed sherds, 221 sherds (29.3 percent of the total) displayed a broken edge that was broken along a weft ridge. This is particularly evident in the large sherds in Figure 3 on page 5. Only 11 sherds (6.2 percent) in the Salt Creek sample were broken on a weft ridge and all of these were spaced plain twined sherds. The Salt Creek potters could have chosen to reduce their use of spaced plain twined textiles in an attempt to limit saltpan breakage.

Figures 43 through 47 show impressions that range from fine textiles to coarse, based on warp yarn diameter and warp yarns per centimeter. While the size of the sherds

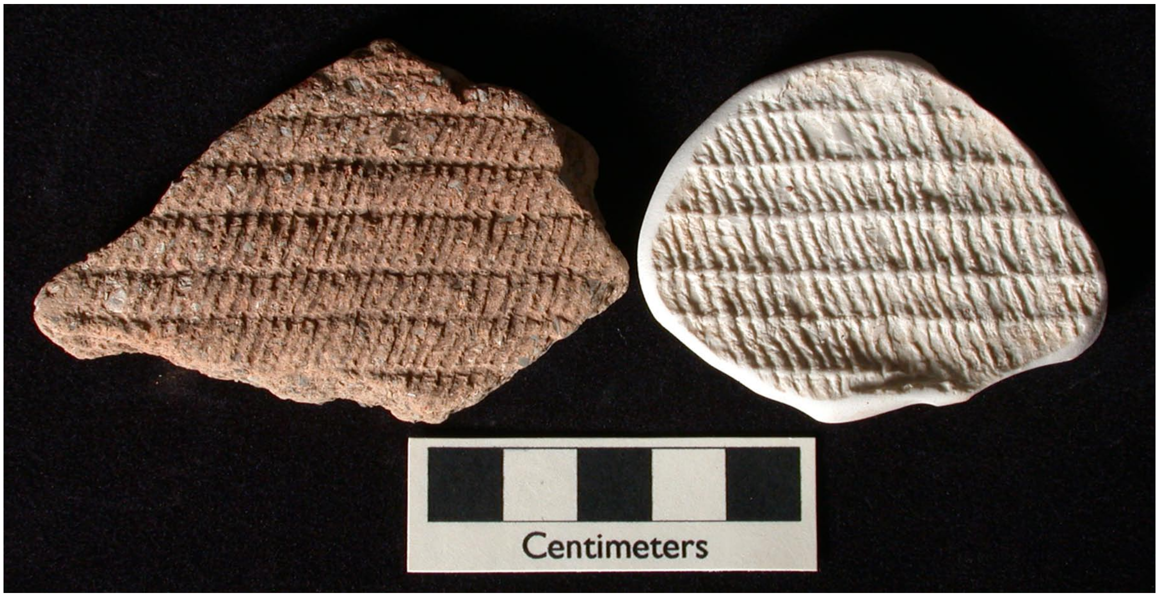


Figure 43. An impression of a Beckum Village fine spaced plain twined fabric (1940.21.285).

vary, they are shown approximately life-sized, so these images of yarns and fabrics are much like the originals . Although the finest Beckum Village fabric is presented in Figure 41, the impression in Figure 43 provides a clearer and larger view of fine two-ply, high twist yarns with close warp yarn spacing. The fabric impressed into the sherd in Figure 44 incorporated yarns that were slightly thicker and spaced a little farther apart. At first the fabric impressed in the sherd shown in Figure 45 may appear to be damaged due to one or more missing weft rows, but because there is no other evidence of damage, we should consider the possibility that this fabric may have been intentionally made like this. The fabrics impressed into the sherds shown in Figures 46 and 47 are examples of what appear to me to be utilitarian textiles. This assumption is biased

Figure 44. A Beckum Village spaced plain twined textile impressed sherd, with fine to moderate yarn diameters and warp spacing (1940.21.446).

Figure 45. A Beckum Village spaced plain twined textile impressed sherd with average yarn diameters and extreme weft twining row spacing (1940.21.285).

by modern standards for comfort. While either fabric could function as a skirt, mantle, or gathering bag, the spacing of the warp yarns in Figure 46 and the thickness of the warp yarns in Figure 47 might make them uncomfortable to sit on or lean on were they garments. The last and coarsest fabric (Figure 48) shows thick, frayed yarns that look more

Figure 46. A Beckum Village spaced plain twined textile impressed sherd (1940.21.55).

Figure 47. A Beckum Village spaced plain twined textile impressed sherd with yarn diameters slightly larger than the average (1940.21.298).

like those used at Salt Creek than the typical yarns found on Beckum Village sherds. The frayed fibers look like loose hairs laying over the fabric.

Figure 48. A Beckum Village spaced plain twined textile impressed sherd with very coarse yarns and some visible damage to the weft twining rows (1940.21.369).

Wrapped-warp Spaced Plain Twined Textiles

Fifty-three cases of wrapped-warp spaced plain twined cloth were recovered at Beckum Village and one case was found at Salt Creek (Table 11). This group of spaced plain twined textiles were distinctive in two ways. The amount of visible damage was much higher for this group than for the Beckum Village sample as a whole. More than half of the wrapped-warp impressed textiles (54.7 percent) appeared to be damaged. Two typical types of damage included broken and unwrapped wrapping material and broken and loose weft yarns. The primary characteristic of this cloth was the construction of the warp yarn. Where it was visible due to damage, the wrapped yarns were made by completely encasing two 2-ply yarns with a third element (Figure 49). It was not possible to determine exactly what that third element was and there seemed to be a variety of wrapping materials used, none of which showed evidence of being spun yarn. As mentioned throughout the review of textile research in a previous chapter, wrapped yarns have been reported at Wickliffe, Spiro, Etowah and sites in Tennessee and Kentucky. Another Beckum Village example (Figure 50) shows visible fibers that could be fur or feathers,

Table 11. Wrapped-warp Spaced Plain Twined Mean Yarns per Centimeter, Yarn Diameters, and Fabric Density.

		Beckum Village	Salt Creek
Warp Yarns per Cm	Mean	1.9	1.5
	Standard deviation	*0.5*	
	Sample size	*45*	*1*
Weft Rows per Cm	Mean	0.9	1.0
	Standard deviation	*0.2*	
	Sample size	*37*	*1*
Warp Yarn Diameter	Mean	3.0	3.5
	Standard deviation	*0.5*	
	Sample size	*43*	*1*
Weft Yarn Diameter	Mean	1.6	2.0
	Standard deviation	*0.4*	
	Sample size	*41*	*1*
Fabric Density	Mean	8.7	9.3
	Standard deviation	*1.8*	
	Sample size	*33*	*1*

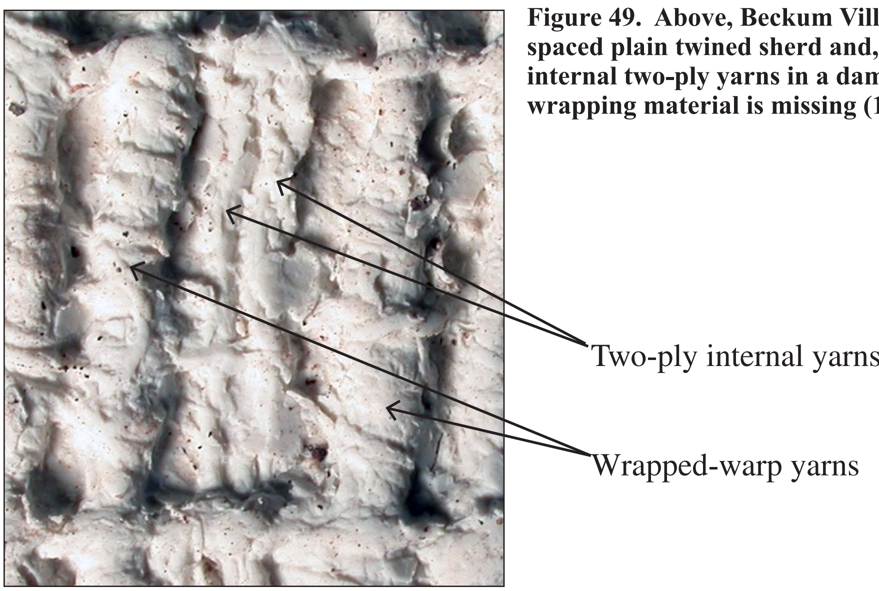


Figure 49. Above, Beckum Village wrapped-warp spaced plain twined sherd and, at left, a close-up of internal two-ply yarns in a damaged area where the wrapping material is missing (1940.21.1).

which have been associated with this yarn structure at other sites. In a third example the warp yarns appear to be wrapped with a flat material that could have been thin pieces of an animal skin (Figure 51).

Figure 50. Beckum Village wrapped-warp spaced plain twined example with visible fibers visible in close-up above (1940.21.285).

Figure 51. Beckum Village wrapped-warp spaced plain twined textile impression in which wrapping material appears to be flat strips (1940.21.286).

Figure 52. Above, large portion of a Beckum Village saltpan impressed with a wrapped-warp spaced plain twined textile with cast of the textile at right (1940.21.652).

A group of mended sherds provides a larger view of wrapped-warp plain spaced-twined fabric (Figure 52). Even though this textile was very damaged, it was still useful in pottery production.

Double-warp Spaced Plain Twined Textiles

The three double-warp version of spaced plain twined textiles was constructed with two warp yarns used as one. These two yarns were not twisted together, but lay next to each other in the impressions as though they had been used in the construction of the cloth as one yarn rather than two. No similar textiles were found in the Salt Creek collection. Counting the warp yarn pairs as separate yarns, there were on average 5.3

warp yarns per centimeter (0.6 standard deviation) and 0.5 weft rows per centimeter (0.0 standard deviation). The individual warp yarns were 1.0 centimeters and the weft yarns were 1.1 centimeters in diameter.

Alternate-Pair Twined Textiles

There were 197 alternate-pair twined textiles in the Beckum Village collection (21.9 percent), but only 4 in the Salt Creek collection (1.2 percent) and, therefore, the statistical comparison of the two sites may be of limited value (Table 12). On average the yarns were thinner and spaced more closely together in the Beckum Village alternate-pair textiles than in the plain spaced-twined cloths. The most extreme Beckum Village textile in yarn size and yarn spacing was an alternate-pair twined fabric (Figure 53). Some of the yarns in this group appeared to be softer yarns because they had flattened to some extent when they were pressed into the clay. The fabrics that were made with soft, closely spaced yarns seemed to be appropriate for garment fabrics more than any of the other fabric types. In the example in Figure 54, the warp yarns look more flexible than those

Table 12. Alternate-Pair Twined Mean Yarns per Centimeter, Yarn Diameters, and Fabric Density.

		Beckum Village	Salt Creek	*t* Test Results
Warp Yarns per CM	Mean	5.6	7.0	CI = (-2.81, .01) difference may not be significant
	Standard deviation	*1.4*	*3.4*	
	Sample size	*197*	*4*	
Weft Rows per CM	Mean	1.0	0.6	CI = (-0.51, 1.31) difference may not be significant
	Standard deviation	*0.6*	*0.2*	
	Sample size	*196*	*4*	
Warp Yarn Diameter	Mean	1.1	1.2	CI = (-0.74, 0.54) difference may not be significant
	Standard deviation	*0.3*	*0.2*	
	Sample size	*167*	*4*	
Weft Yarn Diameter	Mean	1.2	1.2	CI = (-1.33, 1.33) difference may not be significant
	Standard deviation	*1.3*	*0.3*	
	Sample size	*187*	*4*	
Fabric Density	Mean	7.8	10.3	CI = (-4.34, -0.66) difference may be significant
	Standard deviation	*2.4*	*2.7*	
	Sample size	*150*	*4*	

Note: The confidence interval (CI) is calculated with 98% probability ($\alpha = 0.02$), see Figure 24, page 56.

Figure 53. The thinnest yarns and closest yarn spacing of any Beckum Village textile impression was recorded from this impression of an alternate-pair twined fabric (1940.21.352).

Figure 54. Soft yarn in an alternate-pair textile from Beckum Village sherd and cast, below, and close-up view of cast at right (1940.21.296).

found in the Beckum Village spaced plain twined textiles because there are visible bends in the warp along the length. Beckum Village alternate-pair twined textiles exhibited a slightly lower percentage of damage (24.9 percent) than the spaced plain twined fabrics.

This group of fabrics showed more variation in weft row spacing than did the Beckum Village spaced plain twined textiles. In one case, a design was created by varying the spacing of weft rows (Figure 55). Other examples presented stripes or bands made with areas of closely spaced weft rows (Figures 56 and 57). These stripes could

Figure 55. Beckum Village alternate-pair twined mended sherds, at left, and cast, above, showing a pattern created with weft row spacing (1940.21.152, 1940.21.154, 1940.21.156).

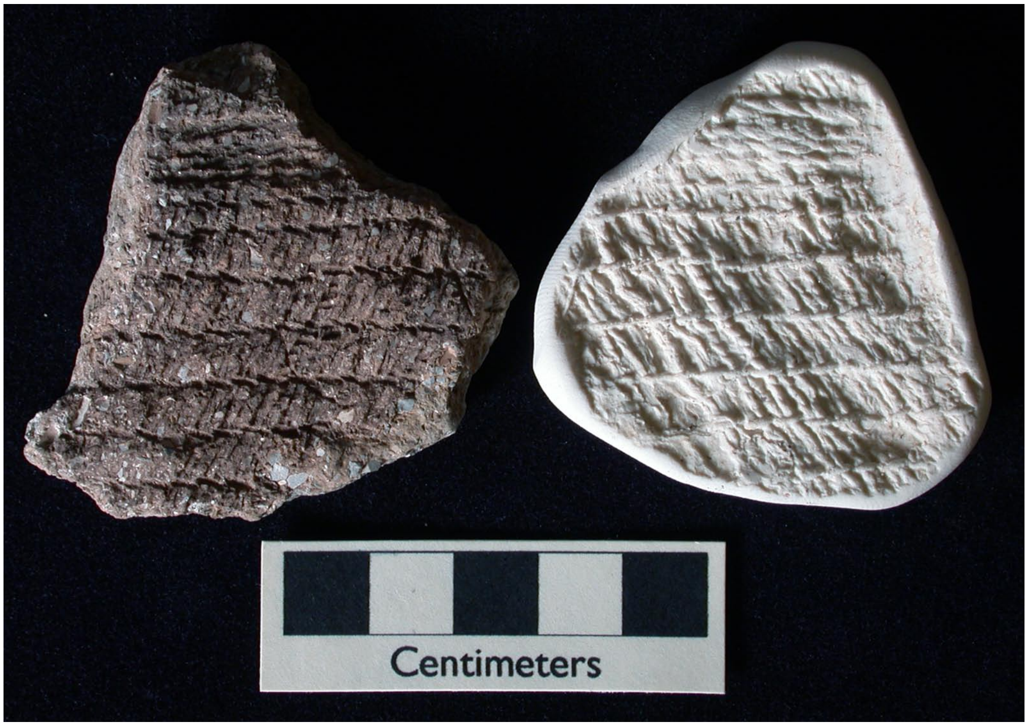


Figure 56. A Beckum Village alternate-pair twined impression with a compact, or weft-faced, band that is twined in the *Z* direction, while the remainder of the visible twining is in the *S* direction (1940.21/156).

Figure 57. Another Beckum Village alternate-pair twined impression with a compact band (1940.21.40).

have been made to create a sturdy edge, but the edges are not visible in any of these cases and the sherds were not rim sherds. While many of the alternate-pair twined textiles appeared to be fine, soft garment fabrics, there were also examples of utilitarian looking textiles. One such textile was found on a discoidal sherd (Figure 58). Another of the coarser Beckum Village alternate-pair twined is shown in Figure 59.

Figure 58. The only recovered Beckum Village textile impressed discoidal sherd was impressed with an alternate-pair twined fabric (1940.21.516).

Figure 59. An impression of a fine alternate-pair twined textile recovered from Beckum Village (1940.21.369).

Weft-faced Textiles

Only four weft-faced textile impressions were found at Beckum Village. All appeared similar to the example shown in Figure 60, although this impression was the only one clear enough to be measured. This one example shows 1.5 warp yarns and 5 weft rows per centimeter, and the weft yarn diameter is 1.6 millimeters. While few examples of this fabric structure were found at Beckum Village, this was the primary structure found impressed on ceramics at Salt Creek (Table 13). The

Table 13. Salt Creek Weft-faced Mean Yarns per Centimeter, Yarn Diameters, and Fabric Density.

		Salt Creek
Warp Yarns per Cm	Mean	0.8
	Standard deviation	*0.2*
	Sample size	*67*
Weft Rows per Cm	Mean	4.4
	Standard deviation	*1.9*
	Sample size	*77*
Warp Yarn Diameter	Mean	3.6
	Standard deviation	*1.1*
	Sample size	*7*
Weft Yarn Diameter	Mean	3.5
	Standard deviation	*1.5*
	Sample size	*82*
Fabric Density	Mean	27.9
	Standard deviation	*4.1*
	Sample size	*7*

Figure 60. One of only four weft-faced impressions recovered at Beckum Village (1940.21.369).

low frequency of fabric density measurements is due to the low frequency of measurable warp yarns, which is required to compute fabric density.

The Beckum Village textiles ranged from rugged and coarse utilitarian fabrics to soft and flexible garment fabrics. Although the fabric structures seen in the ceramic impressions were limited, they provide evidence of the wide range of yarns and fabrics created by the textile crafts-people who made the textiles used by the Beckum Village potters. The finest yarns were used in the doubled-warp plain spaced twined and alternate pair twined textiles (Table 14), which also produced the highest number of warp yarns per centimeter and highest fabric density. An additional feature of the Beckum Village textiles is that the warp yarn diameter and twist angle measurements are normally distributed with single mode values, when viewed as the entire collection or by fabric structure. This may indicate that while these attributes have a broad range of values, as suggested by their standard deviations, there are no obvious subsets or groups within the collection. These metrics, along with twist direction, were suggested by Minar as

Table 14. Yarn and Fabric Attributes by Fabric Structure.

		Spaced Plain Twined (SPT)	Wrapped-Warp SPT	Doubled-Warp SPT	Alternate-Pair Twined	Weft-faced
Warp Yarns per Cm	Mean	2.7	1.9	5.3	5.6	1.5
	Standard deviation	*0.9*	*0.5*	*0.8*	*1.4*	
	Sample size	*597*	*45*	*3*	*197*	*1*
Weft Rows per Cm	Mean	0.6	0.9	0.5	1.0	5.0
	Standard deviation	*0.3*	*0.2*	*0.0*	*0.6*	
	Sample size	*490*	*37*	*3*	*196*	*1*
Warp Yarn Diameter	Mean	1.9	3.0	1.0	1.1	
	Standard deviation	*0.7*	*0.5*	*0.2*	*0.3*	
	Sample size	*532*	*43*	*3*	*167*	
Weft Yarn Diameter	Mean	1.5	1.6	1.1	1.2	1.6
	Standard deviation	*0.6*	*0.4*	*0.1*	*1.3*	
	Sample size	*452*	*41*	*3*	*187*	*1*
Fabric Density	Mean	5.7	7.2	5.9	7.8	
	Standard deviation	*1.5*	*1.6*	*1.3*	*2.4*	
	Sample size	*375*	*33*	*3*	*150*	

characteristics to be considered when looking for what she called "persistent communities of practice" (Minar 2001:109). Now that we know what the Beckum Village yarns and fabric structures looked like, we can consider how large these textiles might have been.

Ceramic Attributes

The primary purpose of the ceramic data that was collected for this project was the calculation of the vessel size in order to calculate the size of the textiles. While a ceramics scholar may have found many interesting features in the Beckum Village and Salt Creek collections, the primary ceramic characteristic that was evident to this textile researcher was that the vessels appeared to have been constructed using a slab technique similar to that shown in the experiment discussed earlier. Many sherds were missing interior or exterior layers that had flaked off in sheets and the broken edges did not show signs of clay coils (Figure 61), which is another common technique for prehistoric pottery production.

One ceramics measurement that was needed to estimate the size of the saltpan textiles that was unavailable, was the depth of the saltpans. Few sherds were large enough to indicate the actual depth of the vessels (Figure 62). A constant of 20 centimeters was used for the depth in every calculation in place of an actual measurement. The minimum fabric sizes represent an estimate of the smallest square that would have lined a mold the

Figure 61. The broken edge of this Beckum Village textile impressed sherd does not show evidence of the pottery coiling technique (1940.21.266).

Figure 62. A typical Beckum Village saltpan textile on an unusually large sherd with views of the sherd as it might have been when part of the original saltpan (1940.21.512).

size of the estimated saltpan diameter. The minimum fabric size measurement is the length in centimeters of one side of a square. The actual fabrics could have been any size or shape that would have satisfied the minimum requirement.

Based on the rim measurements that were available, the Beckum Village saltpans may have been large with a mean rim diameter of 56.0 centimeters (Table 15). Assuming an average saltpan depth of 20 centimeters, then the average minimum fabric size needed

Table 15. Estimated Rim Diameter and Minimum Fabric Size by Fabric Structure

		Spaced Plain Twined	Wrapped-warp SPT	Alternate-Pair Twined	All Fabric Structures
Rim Diameter (cm)	Mean	57.0	66.0	50.3	56.0
	Standard deviation	*17.1*	*18.0*	*20.1*	*18.1*
	Sample size	*92*	*6*	*28*	*126*
Minimum Fabric Size (cm)	Mean	59.9	68.7	54.0	58.9
	Standard deviation	*17.8*	*17.2*	*18.9*	*18.1*
	Sample size	*92*	*6*	*28*	*126*

to line an average saltpan mold, leaving no visible fabric edges in the clay, would have been a square piece of cloth that was 58.9 centimeters on a side. At Salt Creek, the average rim diameter was estimated to be 46.6 centimeters, in a samples size of 17 the standard deviation was 14.8. The estimated minimum fabric size was 50.6 centimeters along one edge, with a standard deviation of 13.4 and a samples size of 17. Utilizing, once again, the *t* Test for Independent Sample Means (which produced a computed confidence interval of 5.9, 10.7), the difference in the minimum fabric sizes at these two sites is significant (with a 98 percent probability).

Although it may appear from the data presented in Table 15 that a correlation exists between fabric structure and minimum fabric size, in fact, the correlation is not statistically significant due to the standard deviations of the minimum fabric size estimates. No rim sherds were found for the doubled-warp plain spaced-twined textiles or the weft-faced textiles so minimum fabric sizes could not be estimated for those fabric structure groups.

The analysis of the textile impressed potsherds recovered from the Beckum Village and Salt Creek sites showed many differences in the textiles used in the production of saltpans. Some of these differences, such as twist direction of weft yarns, may indicate a choice or a tradition of the textile workers. Other differences, such as frequency of textile damage, may be more descriptive of the saltpan production techniques. One thing is certain, if these two sites were compared on the basis of the ceramic type of Kimmswick Fabric Impressed, *var. Langston,* rather than on the analysis of the textiles impressed into those Kimmswick sherds, few of the differences presented here would be evident.

CONCLUSIONS

The primary goal of this research was to determine the original functions of the textiles that were used to make the Beckum Village saltpans. Based on the data analysis, these textiles appear to have been made for a variety of purposes, all of which had to do with personal use rather than salt production. From the fragments of textiles visible in the potsherd impressions, this collection included skirts, mantles, bags, and other utilitarian fabrics. The Beckum Village textiles were a varied collection of fine, medium, and coarse fabrics, as well as elegant feather and fur fabrics. Some damaged textiles were recycled into the production of saltpans, while others were temporarily used as saltpan mold linings and then returned to their original functions. The conclusion that the Beckum Village textiles were not intentionally made for saltpan production suggests that these saltmakers were families or individuals who were making salt for their personal use rather than a group that participated in the specialized craft production of salt and the creation of the textile and ceramic tools that would have been necessary for such an enterprise.

The textile impressions recovered from Salt Creek (1Ck222), another Clarke County saline site, also were analyzed in this thesis. Beckum Village and Salt Creek, two Early Mississippian sites within ten kilometers of each other on the Tombigbee River, might be expected to produce similar textile-related artifacts. Kimmswick Textile Impressed, *var. Langston,* ceramics were recovered from both sites but when the impressions of the textiles on those ceramics were analyzed, it became apparent that the groups that used these two sites had different textile traditions and practices. Three yarn attributes that have been used to identify textile traditions are mean yarn diameter, tightness of twist, and a significant preference for one yarn twist direction. Applying this to these two saline sites, the average Beckum Village yarns were smaller in diameter and the weft yarns were more tightly twisted than those impressed in Salt Creek sherds. While the Beckum Village sample of 1,376 yarns only produced two *Z*-twist yarns (0.1 percent), the Salt Creek collection contained fifteen cases of *Z*-twist yarn (16 percent). Twist direction is considered by textile researchers to be a conservative cultural trait due to the nature of the repetitive hand motions that produce the twist direction during the spinning process; once those motions are learned there is little incentive to change them. In fact, there is a strong incentive to continue using these hand motions once learned in order to maintain one's efficiency and proficiency at yarn production. Therefore, significant differences in the frequencies of twist direction, especially when supported by yarn diameter and the amount of yarn twist, suggest a difference in the textile conventions and social practices of the groups at those sites.

Along with yarn attributes, fabric attributes also showed differences between the traditions and choices made at Beckum Village and Salt Creek. Both sites produced evidence of similar textile structures: plain spaced-twined, alternate pair twined, and weft-faced fabrics. They both displayed a significant and different preference for only one of those structures. Within the Beckum Village collection, 77.9 percent of the sherds were impressed with the plain spaced-twined fabric structure, while 90.8 percent of the Salt Creek collection were weft-faced. Although a strong preference for the use of one fabric structure in the saltpan production process may suggest similar motivations at both sites, additional fabric and ceramic attributes suggest otherwise.

One possible explanation for the difference in the fabric structure preference at these two sites could have been related to saltpan breakage. The weft row in the spaced twined fabrics can create a deep impression into the clay and a weaker area in the saltpan, while the close spacing of the weft-faced rows does not allow the clay to form these same deep ridges. At Beckum Village, 35.9 percent of the textile impressed sherds showed at least one of the broken edges was broken along a weft row, while at Salt Creek only 6.2 percent were broken on a weft row and none of those were impressed with Salt Creek's preferred weft-faced fabric. If the Beckum Village saltmakers were less aware or concerned with saltpan breakage rates and causes than the Salt Creek saltmakers, then the reason for their fabric preference may be one of fabric availability. The Salt Creek preference for weft-faced saltpan textiles may indicate the production of a more durable saltpan in an attempt to decrease the labor and time required for salt production.

The preferred fabric choice of the Beckum Village saltmakers may have also been affected by the concept of labor cost. However, for this group the interest may have been in terms of textile damage or replacement rather than saltpan breakage. Of the fabrics found in the Beckum Village potsherd impressions, the spaced plain twined textiles required the least amount of labor to produce (as suggested by a lower fabric density index). While this would be a good choice for the craft production of saltpan textiles, the prevalence of this "low cost" fabric could be an indicator that it was the most common fabric within a group's belongings. The less valuable and most easily replaced cloth may have been the first choice when a new saltpan was needed to be made. If damaged textiles were available then they were used; if not, then the least valuable, most common, fabrics were used.

Additional paths of inquiry within this thesis showed the interconnected relationship between textile attributes and ceramics attributes. Another instance in which the ceramic attributes may assist with answering questions about the textiles was the difference in the amount of damage visible in the textiles used to make saltpans at Beckum Village and Salt Creek. Less than 24 percent of the fabrics on Beckum Village textile impressed potsherds appeared to be damaged, while more than 72 percent of the Salt Creek saltpan textiles showed signs of damage. The subject of textile damage was an unanticipated outcome of an experiment that involved reproducing a twined textile, using that cloth to make a textile impressed saltpan, and then comparing measurements from the cloth with those on the fired vessel. The reproduction textile showed little visible effect after being used to create two saltpans. Although this was a limited test, it suggests the possibility that fabrics that were produced for any purpose could have been temporarily used to make a limited number of saltpans and then put back to work in their original functions with minimal effect. Therefore, at Beckum Village damaged fabrics may have been used when they were available and when they were not, any serviceable fabric could have been set to the task. Further experimentation could provide greater insight into the effect of intensive use of textiles in the ceramic production process. Tests could show if the abrasive nature of the clay and the crushed shell, along with the corrosive nature of the lime within the crushed shell, could explain the damage found on the Salt Creek textile impressions.

Few examples of multiple fabrics impressed on a single sherd were found in the Beckum Village collection and none were found in the Salt Creek collection. It appears that at both sites a single fabric typically was used to line a saltpan mold. A mathematical formula was developed to estimate rim diameters and minimum saltpan textile sizes based on the measurements of rim sherds. The minimum fabric sizes assumed a square piece of cloth. These estimates and calculations suggest that the Beckum Village saltpan textiles would have to be, on average, significantly larger than those used at Salt Creek. This could suggest that while the Beckum Village garments and utilitarian fabrics allowed for the creation of larger saltpans, the salt production requirements at Salt Creek did not necessarily require large saltpans or large textiles. If larger groups of people were involved in salt production, it may have been more efficient to either produce or use a greater quantity of smaller saltpans. This also could have required a greater reuse of the specialty saltpan fabrics, which could have contributed to the increased evidence of textile damage.

A particular type of plain spaced-twined fabric was found in greater quantity at Beckum Village than at Salt Creek, which incorporated an unusual type of wrapped yarn. This yarn comprised some sort of internal material that was completely wrapped with another material. Where it was visible due to damage, which was significantly more frequent for this group of textiles, the internal material consisted of two 2-ply yarns. Such wrapped yarns have been documented by previous researchers as having been used in feather and fur mantles. Wrapping the warp yarn with feathers prior to constructing the fabric was an alternative technique to tying feathers onto an existing structure such as netting. Magnified images of the Beckum Village wrapped-warp yarns show fibers that appear to be feathers and strips of skins. Feather mantles are often associated with Mississippian ceremonial and elite cultures. Further research into the production and use of these labor intensive textiles could provide additional insight into the Beckum Village culture.

Further research could also test the hypothesis that Beckum Village was used for the production of salt by families or individuals as opposed to groups of craft specialists. A statistical model could be developed to identify sherds that were likely impressed with the same cloth. The location of those sherds within a limited area of the Beckum Village site could present a pattern that has been found in ethnographic studies of salt sites used by family groups. An argument could be made that when families process brine into salt they work within limited space adequate for maintaining the few saltpans they use. Currently, a research project is underway that will use the data gathered for this thesis, along with similar data from additional sites, to investigate the possibility that Beckum Village and Salt Creek provide evidence of a series of changes in salt production at Clarke County salines, from family production to craft production.

The textile data provided by the Beckum Village and Salt Creek saltpan sherds contribute not only to the body of data on Mississippian textiles and prehistoric salt production, but to our understanding of these prehistoric peoples as highly skilled artisans who commanded a broad knowledge of how to exploit their environment to fulfill their needs and desires. Their utilitarian textiles provided functional containers for hunting and gathering, their garment fabrics would have been soft and cool, and their feather mantles and fur blankets were luxurious accessories that would know few parallels in modern fashion. The new data provided by the Beckum Village and Salt Creek textile artists and ceramicists grant exciting new insight into the varied and complex cultures of the Late Woodland and Early Mississippi periods.

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