A STUDY OF MOUNDVILLE COPPER GORGETS

By

Jonathan J. Branch

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Approved By:

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Advisor: Vincas P. Steponaitis

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Donald C. Haggis

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John F. Scarry

ABSTRACT

Jonathan J. Branch

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(Under the direction of Vincas P. Steponaitis)

The topic of Native American copper working during Mississippian times has been included in research into regional iconographic similarities, once interpreted as the Southeastern Ceremonial Complex, as well as investigations into the changing procurement patterns that prehistoric miners and metalsmiths employed when sourcing the metal. Beyond this research that has pointed out iconographic and chemical similarities in copper artifacts, less work has been conducted to compare manufacturing evidence on artifacts from different sites. One exception is Jon M. Leader's research at Etowah which revealed distinct patterns of copper manufacturing, the most striking of which was the use of templates to construct certain types of ornaments. Using Dr. Leader's research as a reference point, I conducted an investigation of Moundville's copper gorgets to discover the manufacturing processes that went into their creation and to test the hypothesis that their similarities in design could be explained by the use of templates. After intensive study, a precise manufacturing sequence was determined for the gorgets but little evidence suggests that they were made with templates.

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Chapter I

INTRODUCTION

Copper smithing is one of the great Native American craft traditions of prehistoric times. Artists manipulated a material that is geologically rare and obstinate to work, from its raw nugget form into elaborate tools and regalia. This tradition of native copper working has long been a subject of intrigue to archaeologists and the artifacts left behind have become the subject of much inquiry. While the first to encounter these forms were so perplexed by their elaborate designs and meticulous construction that they assumed they could not have originated in North America, important research has since helped us to better understand the metal's provenience and the processes used in the artifacts construction.

We now have a fairly complete understanding of the repertoire of manufacturing techniques Native American metalsmiths had at their disposal (Cushing 1894, Leader 1988, Willoughby 1903). However, this narrative of artifact construction is continually being refined and nuanced through new scholarship. Our knowledge of copper working processes remains broad and nonspecific to a particular site or artifact assemblage. As a result, when comparing assemblages between sites, we can only examine similarities in the final artifacts, not the processes that led to those artifacts. I hoped to help remedy this in a small way by examining the copper artifacts from the Mississippian period site of Moundville, AL to create a detailed and comprehensive narrative of the steps the artifacts went through in their transformation from raw nugget to finished construction.

Moundville offers a unique perspective on Native American copper technologies. The Mississippian period was a time of artistic elaboration and cultural fluorescence, trends which are manifested in the copper artifacts of the time. Particularly intriguing are the copper gorgets which feature symbols tied to the cosmological beliefs of the society. Their relative abundance and repeated motifs prompted the study of standardized forms that may exist in the assemblage and the possible use of templates in the construction process. The use of templates has been noted at Etowah in the construction of symbol badges and headdress ornaments. This study hopes to discover if similar methods were at use in the construction of the Moundville gorgets, a different class of artifact from a contemporary Mississippian site.

I begin by discussing the cultural background from which these objects came and the site of Moundville itself followed by an overview of Native American mining, metalsmithing, and research into changing copper procurement patterns over time. Finally, I explore the manufacturing techniques that went into the creation of the gorgets and test the hypothesis that the artifacts were made using prefabricated templates to render the design onto the metal.

Chapter II

BACKGROUND ON MOUNDVILLE

Site Description

Moundville is one of the most prominent and most intriguing Mississippian chiefdoms. The site consists of 29 earthen mounds located on 75 hectares in Hale County Alabama, near Tuscaloosa (Knight and Steponaitis 1998:3). The site sits on a large flat terrace on a bluff above the Black Warrior River. The platform mounds form the perimeter of a large rectangular plaza with the largest mounds located at the north of the site and mound size decreasing to the south. These earthen formations are some of the largest in North America, second in size to only Cahokia in Illinois. Moundville's occupation lasted approximately 400 years from the early 12th century through the beginning decades of the 16th century C.E., during which time the site experienced several evolutions as it grew into a well-populated community, rose to predominance in the region, later transitioned into a depopulated political and religious center and was largely abandoned.

Mound Architecture

The earthen mounds that comprise the civic and ceremonial center of Moundville are large, closely spaced, and pyramidal in shape. The summits of these mounds are generally flat platforms though some were constructed with two or three levels of terracing. (Knight 2010: 349). Archaeologists have long assumed that the arrangement of the mounds at Moundville undoubtedly reflect deliberate planning and organization. The placement of mounds creates a fairly regular rectangle with an open interior courtyard void of mound monumental construction with the exception of a few interior mounds, most prominent of which is Mound A. The large rectangular plaza is bounded on by four rows of mounds. The north side is comprised of mounds R, B, and E, the east by mounds F, G, and H, the south by mounds L, K, J, and I, and the west by mounds Q,P, O, N, and M. (Knight and Steponaitis 1998:4). Mounds C, D, U, RQ, W, MI, X, F1, F2, and X lie outside this rectangular grouping and are on the whole smaller than the mounds forming the plaza. The pyramidal shaped mounds comprising the rectangular perimeter of the courtyard, for the most part, adhere to a common orientation, with the sides of each mound facing a cardinal direction. A few constructions break with this pattern however. Mound A, the large central mound of the interior courtyard faces the northeast and the smaller mounds F2 and F1 face northwest (Knight and Steponaitis 1998:5).

The mounds alternate in size between large and small as one moves around the perimeter of the courtyard. Excavations have revealed a trend of larger platform mounds containing buildings used for residential and ceremonial purposes while the smaller mounds contain burials. The clear ordering of the mounds, from largest in the north to smallest in the south is another trend that has stood out to archaeologists. Vernon Knight believes this pattern represents a sociogram where in each kin group is associated with a particular mound, the most important and powerful situated in the north (Knight 1998: 55-60). In this interpretation the site is not only a planned work but a physical inscription of the status of the community's constituent groups, with each's rank and status publicly written into the earthworks. Curiously, this inscribing of kin group hierarchies in the monumental projects of the site does not continue in the domestic buildings of the site. Gregory Wilson's study of the domestic structures contemporary with the building episodes of the mounds show no stark status differentiation in the house sizes between groups living at the bases of different mounds (Wilson 2008: 87).

At its pinnacle as a residential center, the site and all its mounds were enclosed in a curved palisade, constructed of wooden posts, that surrounded the west, south, and east sides of the communities. The exception is Mound X, one of the earliest mounds constructed at the site, which was divided by the palisade and already decommissioned at the time of its construction (Knight and Steponaitis 1998: 6). With the palisade encapsulating the southern, eastern, and western parts of the community and the Black Warrior River and its steep bluffs lying to the north, the entire mound center was fortified on all sides.

Considerable amounts of earth were required to construct these mound formations. Mound B, the largest of the mounds at the center, measures 17.9 meters in height with basal dimensions of 59 meters by 107 meters (Knight 2010:2). It is estimated that the 85,450 cubic meters of earth were moved to create Mound B (Knight and Steponaitis 1998:4). The other mounds of the site range from 1 meter to 8 meters in height (Moore 1905: 26). The construction of these mounds, which required the extraction of hundreds of thousands of cubic meters of clay, lead to the creation of large pits that later filled in with water and now appear as ponds in the Moundville landscape. Sourced clay from these pits was used not only in the building of mounds but also in filling low spots in the plazas to create a level public space (Knight 2010: 348-9).

Site History

Moundville's history has been presented through distinct phases of occupation which summarize the changes in its use and occupation, from regional consolidation and settlement at the mound center through to later stages of depopulation and ultimately abandonment. These episodes in Moundville's history are divided into five phases of occupation, the West Jefferson Phase and Moundville I-IV.

West Jefferson Phase (AD 900-1050). Moundville’s cultural predecessor in the Black Warrior Valley was a terminal Woodland culture known as the West Jefferson phase. The society was characterized by village settlement structure with large sites that featured extensive middens and considerable population density (Knight and Steponaitis 1998: 11). It is argued people of these villages employed a shifting seasonal settlement model where they occupied their floodplain villages in the warm months and relocated to smaller camps away from the river in the colder months when the area was prone to flooding. (Welch 1991: 121-123) The end of the West Jefferson period saw the transition from grog tempered pottery to the shell tempered pottery that would be the hallmark of Moundville in Mississippian times (Steponaitis 1983). The latter part of the West Jefferson period was also characterized by a microlith industry surrounding the production and trade of marine shell beads (Steponaitis 1986: 384). Coinciding with the production of shell bead industry was increased investment of maize agriculture. Both changes may be indicative of early elite strategies of using wealth to attract supporters (Steponaitis and Knight 1998: 10-12).

*Early Moundville I (AD 1050-1200).*The Moundville I phase saw the emergence of distinct Mississippian cultural characteristics and the initial centralization of authority at the Moundville site. Platform mounds, wall trench architecture, and shell tempered pottery became standard in the material culture from this time (Knight and Steponaitis 1998:12). Maize continued to dominate as the chief crop while other cultigens such as squash, chenopods, maygrass, and sunflower continued to supplement the diet. This period saw a noticeable decline in nut consumption (Scarry and Steponaitis 1997: 116-120).

Changes in settlement structure also occurred during the Moundville I phase. The densely populated villages that characterized the West Jefferson phase were replaced by smaller and much more dispersed farmsteads. Two mounds, Mound X and the Asphalt Plant Mound, were erected at the Moundville center during this phase. Elsewhere in the Black Warrior valley, no contemporary mounds existed, suggesting that during the Moundville I phase the leaders at Moundville had garnered significant political power and the site itself had developed preeminence even at the early stage in its history (Knight and Steponaitis 1998:13).

Late Moundville I- Early Moundville II (AD 1200-1300). During the Late Moundville I and Early Moundville II phases the site transformed into a paramount center with consolidated authority over a region spanning at least 40 kilometers along the Black Warrior Valley (Knight and Steponaitis 1998: 14) . The period of political consolidation is seen in extensive mound building as the site added dozens of platform mounds framing a plaza and took on the characteristic layout that we see today at the site. The construction of these monumental earthworks occurred roughly simultaneously, proving that the site layout and the structuring of space was fully developed from the onset, further underscoring the political centralization of the period (Knight and Steponaitis 1998: 15).

The construction of the wooden palisade around the mounds occured during this period. After its completion domestic activity moved inside the walls and people from the surrounding hinterland moved to the center (Steponaitis 1998: 39). At this point Moundville had taken on a completely new nature with a resident population of close to 1000 people living in a community with carefully planned and adhered to rules governing the structure of space.

Regional settlements outside of the mound center also changed dramatically during this period. Secondary mound centers with a single platform mound appeared around the Black Warrior Valley. Robin Beck sees these sites as another mechanism in the consolidation of authority at Moundville. These subsidiary sites were local administrative centers led by elites subordinate to the leaders at Moundville. The uniform limiting of these sites to a single mound and the relatively low population densities at these sites was part of a strategy of the Moundville elite to limit the authority of their local subordinates and squelch their ability to garner power to rival them (Beck 2003:653-4).

*Late Moundville II- Early Moundville III (AD 1300-1450).*The trend of migration from the countryside to the mound center during the early Moundville II phase is reversed in the subsequent period of the site's history. Moundville was vacated by its resident population and the palisade was never rebuilt with elites and their attached subjects serving as the only remaining residents (Steponaitis and Knight 1998:18).

This emptying of the site coincides with an increased emphasis on exotic grave goods in elite burial, bolstering the argument that the vacating of the community was part of an elite strategy to sanctify the site and thus increase their prestige as the sole occupants (Steponaitis and Knight 1998: 20). Intense strain on resources caused by the large population or the lessened threat of attack and the need for security behind a defensive wall may also be explanations for the change in settlement structure at this time (Scarry and Steponaitis 1997: 120-122). After the site's vacating it became a necropolis with spaces that were once residences now serving as cemeteries. Kin groups now living outside the center would return to inter their dead in cemeteries associated with the mounds and residencies of their ancestors (Wilson 2008: 90).

Late Moundville III-Moundville IV (AD 1450-1650). Beginning at the end of the Moundville III phase mounds in the southern part of the site begin to go out of use. Vernon Knight's view of the center as a sociogram would suggest that residents of the southern part of the community had been ascribed the lowest status (Knight 1998: 53-60). It reasons that they would have the least to gain from the participating in ceremonies and maintaining a connection to the site and were the first to depart. Mortuary ritual continued at a reduced scale at the several parts of the site though cemeteries were also established at some of the subsidiary mound centers (Welch 1991: 29-33). This increase in local burials as well as the continued growth of secondary centers shows that the hegemony of the Moundville center was broken and the subsidiary communities were enjoying increased independence. Eventually these secondary sites would be follow the pattern of the mound center and were largely abandoned by the middle of the 16th century (Steponaitis 1998: 39-43). The picture of Moundville society preceding European contact showed the majority of the population living in nuclear villages devoid of mounds and Moundville itself almost completely abandoned with a few flickers of activity taking place at the most important mounds (Knight and Steponaitis 1998: 22).

Economy

Subsistence. The nature of the relationship between the mound center and the nearby subsidiary communities has been a subject of great interest to archaeologist and one that can best be understood by gaining a more complete understanding of the community's economy. Fortunately much scholarship has been devoted to the various aspects of Moundville's economy, such as subsistence, craft production, and trade and together these lines of evidence help us understand the economic model of the settlement and the movement of food and goods within the community and beyond it.

Subsistence strategies utilized a variety of nuts, small grains, seeds, fleshy fruits, and greens but the largest investment was in the production of maize (Scarry 1986: 294). Margaret Scarry observed that the Black Warrior Valley is quite advantageous for the production of maize. The region experiences a long growing season between frosts and winter rains and floods provide moist soil at the start of the planting season. Plentiful summer rains ensure that droughts are a rarity, making the frequent spring flooding of the Black Warrior River a far greater challenge for farmers (Scarry 1986: 119).

Margaret Scarry found that the production of maize agriculture began in the West Jefferson phase and preceded the emergence of the chiefdom. By the beginning of the Moundville I phase, maize was the dominant agricultural product, comprising 40-60 percent of the calories consumed (Welch and Scarry 1995: 404). Margaret Scarry found that no single cultivar was sown exclusively but rather six varieties different varieties were utilized by Moundville farmers. Each type of maize was unique in its maturation rate and its susceptibility to formidable conditions. The use of multiple types may have allowed for different harvest times for each crop, with some being consumed in the summer while others were harvested later and stored for the winter (Scarry 1986: 123-124). The distribution of maize and nuts and the byproducts of their processing, namely cobs, cupules, and shell fragments, suggests that the majority of the agricultural and wild nut food production for the Mound center took place in the outlying farmsteads. The farmsteads showed greater concentration of maize and nut byproducts but flotation samples revealed no higher concentrations of the edible food parts themselves, suggesting these sites were processing more food but not consuming it. Instead it appears that the farmsteads were provisioning their elite counterparts at the secondary mounds centers and Moundville itself (Welch and Scarry 1995: 408).

Utilization of local game was also a significant component of Moundville's subsistence strategies. Fish contributed 25 percent of the protein in the Moundville residents' diet with white tailed deer, turkeys, turtles, squirrels, raccoons, and opossums also being hunted (Scarry 1986:404). Paul Welch studied the faunal remains from the Moundville center and one of the subsidiary centers, the White site, to examine the movement of meat between communities for evidence of elite provisioning. Although the corpus of faunal remains available to study is precariously small, Welch was able to make a few important observations. The White site, a secondary mound site showed a high proportion of deer limbs which represent the choice cuts and a low concentration of bones with little attached meat, such as the skull. Meanwhile faunal remains from farmstead sites were more representative of a complete skeleton suggesting that the butchering took place locally (Welch 1991: 78-100). Combined, these patterns suggest that the subsidiary sites provisioned the centers with the choice cuts of meat, a practice consistent with the provisioning of maize to the Moundville center that Margaret Scarry uncovered in her comparative study of agricultural byproducts and food remains.

Craft production. In addition to subsistence, the production and trade of crafts is the second realm to be investigated to understand an economy. The biggest question that often arises in discussions of craft production is the presence of specialists. Studies of ceramics recovered from Moundville that examined methods of construction and decoration for patterns and even signs of individual hands revealed interesting patterns. Some individuals, whose hand was distinct and recognizable in many vessels, produced more pots than would be expected for household production and consumption, suggesting that these potters were at least part-time specialists who produced for a greater market than just their household (Welch 1991:137-149).

This observation is corroborated by the existence of some ceramic types that were designed for scalable production. A class of subglobular jars was constructed by pressing clay into a bowl shaped mold to create two halves of the vessel. The edges of the two bowl shaped clay forms were joined together and a slab constructed neck was added to complete the vessel. While there is nothing proprietary about this process or the tools involved that would suggest specialized knowledge, the existence of a process designed for scalable production still speaks to the existence of ceramic specialists.

The concentration of firing areas at Moundville also suggests that some degree of specialization existed in the society. Six firing surfaces, distinct from hearths, were discovered clustered around Mound R (Moore 1905: 221). The concentration of these features seems suggestive of a workshop of sorts and further supports that ceramic production was an activity disproportionately practiced by a smaller group of specialists within the community. (Welch 1991:145)

Trade. Interpolity exchange of exotic goods was certainly another significant part of Moundville's economy. Both finished goods of non-local origin such as shell cups and foreign pottery as well as imported raw materials such as mica, copper, green stone, pearls, and stone paint pigments have been recovered from Moundville. The distribution of these items is restricted to the paramount mound center itself. Paul Welch interprets the absence of both foreign products and raw materials at secondary mound centers and farmstead sites as evidence of centralized control of nonlocal items by the paramount center and further evidence of craft specialization in the production of non-utilitarian goods (Welch 1991: 177). In his study of elite middens at Mound Q and Mound G, Vernon Knight found debitage and tools related to lapidary crafting, copper working, and painting suggesting that the Moundville elites not only traded in foreign goods and raw materials but also were producers of specialized crafts of non-local materials. Prestige goods such as the copper gorgets under investigation here were not only utilized by the elites but also perhaps produced by them (Knight 2004: 319).

Moundville was not only involved in the importation of foreign goods but the export of its own products as well. A red stone triangular pendant matching Moundville varieties was recovered along the Tennessee River at the Seven Mile Island site in northwest Alabama. Finely decorated stone paint palettes from Moundville were found at sites in northeast Tennessee, northwest Georgia, and along the Mississippi river valley

(Welch 1991:186).Moundville variety ceramics were also found along the Mississippi river valley and at several sites in northern Alabama as well (Welch 1991: 188-189).

Chapter III

NATIVE AMERICAN COPPER SMITHING

Mining

Fundamental to understanding the Native American copper industries is examining how copper was mined and removed from the geological deposits. Many of the copper deposits that were utilized by Native Americans have since been utilized by European and American miners, making direct study of many sites challenging.

To remove the copper from the veins, rocks were struck with large hammerstones, some small enough to be wielded single handedly; larger ones only with both hands. Some hammerstones were hafted with flexible hafts so they could be swung into the bedrock (Martin 1999: 91). At the Isle Royal site in Michigan, excavators recovered hundreds of hammerstones as well as wood ash and blackened cracked rock fragments in a shaft that was dug in prehistoric times to access a vein (Griffin 1961: 7). Fires constructed within the area to be mined were a means of fire cracking the stone to make it easier to separate the copper (Martin 1999: 94).

At a site in Agate Harbor, Michigan several cedar artifacts were recovered resembling canoe paddles. The wear patterns within the assemblage showed that most of the wear was concentrated at the blade end of the artifacts, confirming their use as shovels (Griffin 1961: 53). As veins of rock were hammered and debris accumulated, it was shoveled into baskets, the remains of which have since been uncovered by archaeologists, and carried out of the shaft (Trevelyan 2004: 13). Shafts created by native prospectors often reached great depths; one on Isle Royal was dug 14 feet into the ground.

At these depths, the shafts sometimes became flooded with ground water so drainage systems were constructed to empty these shafts (Martin 1999: 109).

The objective of mining activities was not to simply gather all copper fragments but to gather nuggets of workable size. Unlike modern gold miners who seek even fine flakes of metal, Native American metalsmiths and miners dealt with sizable, solid nuggets that by themselves could be transformed into artifacts without the addition of more copper. Smelting was never practiced in North America meaning that naturally occurring nuggets and not cuprous ores were, were the only accessible sources to Native Americans. It is also improbable that smaller pieces of metal could be joined together to form bigger masses through pressured welding by hammering and heating layered metal. Patterson sees this feat as theoretically improbable and unsubstantiated metallographically (Patterson 1971: 296). Matthew Chastain and his colleagues who studied copper assemblages from Cahokia have investigated this theoretical possibility further and contend that the rapid oxidation of copper that occurs once it is heated makes bonding separate layers of metal together effectively impossible using only the heat and pressure that could be generated using an open fire and hammerstones (Chastain et al 2011: 1729).

Sourcing Studies

In the United States, copper deposits are infrequently encountered and geographically very limited. They are produced in mafic lava intrusions, in the oxidized zone of exposed and weathered copper sulfide outcrops, and in clastic sedimentary rock composed of eroded mafic igneous rock (Patterson 1971: 286). Evidence from mining activity conducted by prehistoric Americans shows that miners sought exposed alluvial nuggets that were weathered from the mafic basalt as well as copper inclusions in the oxidized zone at and beneath the surface (Rapp 2000: 7). The copper available in clastic rock was not practical for North American metalworkers whose technology involved shaping complete nuggets rather than smelting metal from agglomerated sediments (Patterson 1971: 306). Due to the absence of smelting, which changes the composition of the copper, the nuggets and the subsequent artifacts formed from them are extremely pure and traceable only through the chemical reactions that occurred during their formation. When the copper deposits were formed, copper containing lava interacted with the compounds in the host rock to product a specific mixture of elements that is unique to that source (Rapp 2000:7). It is through the study of these trace element “finger prints”, that copper, removed from its source, can be effectively paired with is geological home.

There are only a handful of locations across North America where geological conditions produced copper deposits. These include southeast Alaska, the Yukon, British Columbia, Arizona, Lake Superior, Labrador, Nova Scotia, and the Appalachian Mountains (Rapp 2000: 7-8). The great distance separating the western deposits in Alaska, Canada, and Arizona from the cultures of the southeastern United States make them unlikely candidates as sources of copper for the people of the Eastern Woodlands. The likelihood that nuggets from either the southwest or northwest of the North American continent were utilized by peoples of the southeast is diminished further when the abundant copper deposits surrounding the Great Lakes are considered.

The region surrounding Lake Superior is the home of the largest copper deposits in the world and has been mined extensively by both historic and prehistoric period miners (Rapp 2000: 9). Kathleen Ehrhardt estimates that 5,000 tons of copper were extracted from the Great Lakes region by Native Americans (Ehrhardt 2009: 218). Although all attempts to estimate the extent of Native American mining are met with much scrutiny, studies of prehistoric mined copper pits and the long tradition of commercial mining that began in the region in the middle of the 19th century attest to richness of this source.

Most of the copper mining that occurred in both historic and prehistoric times centered on the vein that runs through the Keneewah peninsula and Isle Royal in northern Michigan and the east bank of Minnesota that borders Lake Superior (Rapp 2000: 11). Additional sources can be found in Wisconsin, southern Michigan, Indiana and Illinois (Rapp 2000: 12). Clair Patterson believes that the abundance of copper in the Great Lakes region played an important factor in the early development of copper metalworking in North America. She argues that because copper was so profuse in the region, it was a readily available raw material that Native Americans learned to manipulate earlier than cultures with smaller accessible deposits (Patterson 1971: 299)

Although the Lake Superior deposits in their primary context provide the greatest copper resource available to Native Americans, coppers from this region were also available in secondary contexts. This “float copper” was dislodged from its geological contexts around Lake Superior by glacial activity and relocated further south as the ice sheets expanded. Runoff from the subsequent period glacial melting and retreating as well as millennia of alluvial action pushed these copper nuggets even further from their source. Float copper has been found as far south as Illinois and Missouri and as far east as Connecticut (Trevelyan 2004: 12). A third source of copper that was accessible to Native Americans living on the east coast was deposits located in Labrador and Nova Scotia.

The single most prominent of the Canadian deposits are found at Cap d'Or in Nova Scotia which left a strong impression on 17th century French explorers who allegedly named the region after the copper whose glint at sunset reminded them of gold (Rapp 2000: 16).

While the abundance of copper available from the Great Lakes dominated discussions of Native American copper artifact provenance for decades, the importance of southeastern sources has been gaining recognition since the 1950s. Appalachian sources were largely ignored as potential sources of copper despite historical accounts, such as those given by Thomas Harriot of the Roanoke Colony, of Native Americans utilizing sources in western North Carolina (Goad 1978: 49). Copper sources in the Appalachia can be found in The Blue Ridge Mountains in North Carolina, Virginia, Maryland, and Pennsylvania (Rapp 2000: 13). Copper nuggets weighing several ounces have been recovered from Fanning County, Georgia and smaller grains occur in Polk County, Tennessee (Levine 1996: 42). While Great Lake copper sources can largely be narrowed down to a 70 mile wide hotspot on the Keneewah peninsula, the picture is much different in the southeast where the deposits span more than half a dozen states with no clearly dominant locale. It was assumed that because Appalachian deposits were smaller and more scattered they could not have met the demands of native cultures but research has since found that this assumption overstated the paucity of Appalachian copper and that the mountains were in fact a source of considerable abundance, although far from comparable to the Great Lakes.

Determining the source of artifacts has been a pursuit that has gained traction with improvements in chemical analysis technology. While native copper nuggets are extremely pure and comprised of 99% copper, they also contain small quantities of other elements (Patterson 1971: 301). These “trace elements” are specific to one geologic deposit form the basis of the copper sourcing studies. The difficulty in establishing trace element profiles of a source is summarizing the variability in the chemical composition of samples taken from that source. Sites that contain largely homogenous copper deposits produce “tight” profiles of their trace elements with little variation from sample to sample and a small standard deviation. These profiles provide the greatest predictability when comparing artifact to potential sources. Ambiguity arises when a source is heterogeneous and the composition varies greatly from sample to sample. These site produce broad profiles that may overlap with other sites, making narrowing down an artifact’s origin difficult or impossible (Levine 1971: 131-135).

Attempts to trace archaeological copper back to their source were undertaken by Mary Ann Levine as part of her Ph. D research at the University of Massachusetts Amherst. She examined a sample of 46 Late Archaic artifacts gathered from sites in northeast Canada, New England, and the southeast as far south as North Carolina and Tennessee (Levine 1996: 201). Levine’s study revealed that seven trace elements consistently appeared in the sample, cobalt, silver, europium, caesium, arsenic, mercury, and lanthanum. When compared to her native copper samples gathered from sources in the Great Lakes region she found chemical matches located in the Great Lakes region. Levine’s study suggests that across the eastern woodlands, copper was sourced principally from the Great Lakes during the Late Archaic (Levine 1996: 170).

Prior to Levine, Sharon Goad conducted similar research of 369 artifacts from the southeastern United State the dating to the Late Archaic, Middle Woodland, and

Mississippian periods. After comparing the chemical compositions of these artifacts to the ore samples which span from the Great Lake states and the Appalachian Mountains from Pennsylvania south to Georgia, Goad noticed the trend toward increasing exploitation of copper from southeast Appalachian sources beginning with the Middle Woodland (Goad 1978: 220-224). By Late Woodland times, regional trade of local copper replaced interregional exchange of Lake Superior copper, a pattern that continued into Mississippian times during which period southeastern deposits eclipsed the Great Lakes as the principal source of copper for Mississippian cultures. Copper artifacts from Etowah for instance appear to have originated in the Appalachian Mountains, not the Great Lakes (Levine 1996: 59).

Smithing Technologies

To construct an ornament, artisans began by flattening the native copper into sheets through a process of repeated annealing and hammering against a smooth, flat stone surface. According to Frank Cushing’s experiments this could be accomplished using textured stone maul. The coarse grain of the stone’s surface serves to expand the copper in many, small concentrations across the surface of the nugget (Cushing 1894: 99). This localized spreading in conjunction with repeated annealing prevents the copper from growing brittle and breaking. While native copper can be thinned to some degree without annealing, it requires much labor from the metalsmith and puts great strain on the metal, increasing the likelihood of stress cracks (Schroeder and Kuhl 1968:168). Once the crystalline structure of the nugget is compressed during hammering it becomes not only difficult to manipulate or thin further but prone to fracturing and delaminating, especially while being bent or folded by a metalsmith. Regular annealing of the metal mitigates this and keeps the piece in a workable state (Cobb and Evans 2009: 43).

Annealing of copper begins at 200 degrees Celsius, obtainable over wood fire under normal circumstances (Cobb and Evans 2009:43) though temperatures much higher, up to 800 degrees Celsius are common (Schroeder and Kuhl 1968: 168). Once hammering begins marginal thinning become increasingly difficult and additional annealing becomes increasingly fundamental. After thinned into a sheet, a smoother stone can be used to even out irregularities either by hammering, rolling, and pressured rubbing. The final smoothing can be accomplished by grinding the sheet with a sandstone abrader (Cushing 1894:103).

After a sheet of copper is formed a variety of items can be crafted. Requiring the fewest additional steps are those that are principally cut and embossed sheets, such as the gorget collection from Moundville that are the central focus of this research. Artifacts of this category include headdresses, symbol badges, gorgets, breast plates and plaques (Leader 1988: 111-128). Embossing designs is performed with a smooth tipped tool such as a bone or antler that would be pressed into the metal until the desired embossed line appears (Leader 1988: 112, Cushing 1894: 100-102). Frank Cushing's experiment utilized a mat of rawhide to support the metal during this stage of production (Cushing 1894:100). This sturdy yet pliable material allowed the metal to "give" as pressure was applied while still holding the piece in place. According to Cushing's experiments, the copper sheets, which as ranges from .05 mm to 1 mm in thickness, can be embossed with pressure from the artists upper body, unaided by a percussion instrument like a hammer stone or maul (Cushing 1894: 101).

Images pressed into the copper would next be cut out in the desired shape. Three techniques for cutting the copper sheets have been identified; grinding, bending, and cutting with a stone blade. In the first method, the desired shape to be removed is embossed and the raised area is ground with sandstone. By grinding just the raised area to be removed with a flat piece of sandstone the metal is gradually worn away to expose an opening. The edges of the metal surrounding the opening are now angled due to the original embossing but can be hammered flush with the rest of the piece (Cushing 1894: 100-101). It is this cutting technique that was used to achieve the cutout designs found on many artifacts. Alternatively, a piece of copper can be hammered along the desired line to be cut and then bent back and forth, stressing the piece and ultimately causing it to break. The final possible method is the use of a sharp stone blade to cut the sheet. All three have been conjectured and may have been used in tandem or at least contemporarily.

Jon Leader's experiments on creating cut out patterns showed that embossing and grinding alone could not produce sharp, clean corners without damaging the sheet so twisting, fatiguing and ultimately breaking off the metal was used in these areas (Leader 1988: 103). Studies of exterior shapes and dimensions as well as incised interior shapes and designs have revealed patterns of repetition that strongly suggest that some sheet ornaments, such as a selection of headdresses and symbol badges that Jon Leader examined from Etowah and Lake Jackson may have been constructed from a template (Leader 1988: 120, Ehrhardt 2009: 229). This observation prompted this investigation of the Moundville gorgets to discover if similar practices were being employed in the Black Warrior Valley.

A second class of artifacts is those that are copper clad with thin foils. These artifacts begin as copper sheets but are annealed and hammered until they reach a much thinner width. These foils are then applied to a carved wooden, bone, or stone form. Common examples of these copper-clad objects are wooden ear spools, rattles, and animal carvings. The foils are wrapped around the object, likely while in an annealed state, and carefully burnished to ensure the copper adheres to the carving. The use of multiple foils to cover a wooden form rather than a sheet thinned from a single nugget conserved more metal that objects made from heavier sheets or less reduced nuggets while also enabling craftsmen to utilize the scrap pieces from cut out sheets.

Beads are another type of artifact manufactured from sheets of copper which were usually strung alongside shell pieces. Although far from abundant, solid copper beads have been found in Mississippian sites (Trevelyan 2004: 233). While mostly an artifact common to woodland times, these solid beads have been found at Midwestern sites and their construction is fairly straight forward. A piece of native copper was likely pounded into a regular spherical shape and drilled through with a stone tool. Solid beads of this type are far less common than foil covered wood beads or hollow tube beads. Tube beads were constructed by cutting a hammered copper sheet into a rectangular sheet and then rolling in around a cylinder of wood or bone. After the metal began to curve and take on this cylindrical shape, the end could be hammered down with one overlapping the other (Schroder and Kuhl 1968: 168).

It is in this same fashion that tube rivets were manufactured. The use of rivets to join multiple sheets allowed sheet copper objects to grow larger in the Mississippian period. The majority of the rivets employed by Mississippian craftsmen are tube rivets though a few solid rod rivets have been found. The process of riveting began by punching or drilling a hole through the two sheets of copper to be joined and inserting the copper tube rivet. The clearance between the hole and the tube should be minimal as to allow the two sheets to become fixed and prevent lateral movement between the sheets. The two sides of the rivet are then hammered and flattened, securing the two sheets together. Kim Cullen Cobb noticed that the joining of sheets with rivets in Mississippian times was done to create a single sheet to later be embossed rather than joining succinct pieces that had been shaped and decorated independently (Cobb and Evans 2009: 48-49)

The final step in the production sequence is polishing. Wood ash and sand were likely used as polishing media to remove oxidation (Cobb and Evans 2009: 44; Leader 1988: 140). Their abrasive properties would suggest that this polishing medium was not used on more delicate wooden, bone, or stone objects clad in copper foils but rather embossed sheets and forged nuggets. In Leader's experiment, polishing intermittently over a series of days for a total of 8 hours on a sheet of copper embossed with a pattern produced measurable wear on the raised parts of the object (Leader 1988: 139-140). Repeated polishing over a series of years could thin the metal and leave it prone to cracking. Repaired ornaments are common and the repairs themselves can be extensive. The tube and rod rivets used to join sheets were also used to patch objects. These repairs often required a many rivets; an ornament fragment from Grant Mound Florida mentioned in Cobb and Evan's case study included 17 rivets (Cobb and Evans 2009: 45). Extensive repair would be a significant investment in labor to manufacture and install the rivets, underscoring the importance of these objects in both economic and social terms.

The nature of copper workshops has been another matter of much inquiry. Metalworking workshops have been identified at Cahokia on the northern part of Mound 34. At the site, excavators found several revealing features. Possible post molds are located far apart, separated by gaps approximately half a meter to one meter wide. The spacing of post molds may have allowed for ventilation of the room's hearth if the copper was heated and annealed inside the building. Large pits were also found that are believed to have once housed upright logs used as work surfaces and anvils. Smaller pits also exist which may be depressions caused by repeated kneeling while working (Brown, Kelly, and Kelly 2009: 37). The most striking aspect of the workshop is its location within the greater settlement. Situated on a mound, the workshop is viewed as a place of spiritual and social importance. While the copper ornaments themselves were obviously the accoutrements of the social and religious elite, the prominent location of the workshop suggests that the production of the artifact carried its own prestige.

The Cahokia workshop is a rare example of a clearly definable, distinct workshop. It is believed that workshops elsewhere likely existed in villages surrounding the mound complexes and have yet to be unearthed by archaeologists (Leader 1988: 163-164). That said, Mound 35 at Cahokia is not the only example of ceremonial copper working; Mound C at Etowah has produced evidence of "furnaces" used to anneal copper as well as scrap copper (Trevelyan 2004: 146). While the presence of ceramic workshops near Mound R at Moundville has been argued, the case for an identified copper workshop at the site is not as compelling as at Cahokia with much of the evidence coming in the form of scrap copper in elite middens, such the copper fragments covered by Vernon Knight from Mound Q (Knight 2004: 309). The long-known importance of copper artifacts and evidence of ritually prominent copper workshops provokes questions about the role and status of the metalsmith in the community during Mississippian times.

The amount of time workers spent manufacturing objects is another question drawing much consideration. Leader sees the use of templates and the volume of artifacts as strong indicators that the copper artists may have been full-time specialists (Leader 1988: 163). Based on his replicative experiments, the time required to produce and repair many of the ornaments may have supplied artists with regular work. This pattern unique to the Mississippian period contrasts with the assemblages from Adena times which show a great variety of items perhaps consistent with a model of ritual leaders producing copper items for their own consumption. Standardized forms, distinct workshops, and an abundance of artifacts suggest that by Mississippian times this model had been replaced by at least part-time specialists (Ehrhardt 2009:229).

Chapter IV

MOUNDVILLE GORGET SAMPLE

Excavations at Moundville have unearthed a wide range of copper artifacts. The Moundville copper assemblage includes such diverse items as axes, knives, gorgets, symbol badges, pendants, hair ornaments, cladded beads, cladded ear spools, and fishhooks. Wooden sculptures clad in copper depicting a canine tooth, a thunderbird, and a human mask have also been recovered.

The focus of my research is on a subset of this collection, focusing specifically on the copper gorgets. These objects were formed from sheets of copper decorated with embossed designs and perforated shapes. In my research, I investigated 21 artifacts which can be divided into five categories.

Oblong gorgets

These gorgets have a rounded top and a stem that narrows towards the base. They feature a series of concentric rings, usually three, that surround an incised swastika design. Below these rings, in the stem of the piece an isosceles triangle is cut out. Several tabular stone pendants and a copper gorget not available for study during this investigation display a hand and eye motif incorporating the triangle (Knight and Steponaitis 2011: 222). It has been observed that the swastika motif is commonly found on effigy pots and ceremonial objects believed to be associated with the underworld at several Mississippian sites (Knight and Steponaitis 2004: 170, Lankford 2004: 214-215, Reilly 2004:130). George Lankford interprets this symbol as a locative designed to communicate a reference to the Underwater Realm (Lankford 2004: 214). In total, 12 objects of this description were examined. One of those objects, artifact 170163 deviates slightly from this pattern with a swastika that is recessed into the metal rather than cut out (Appendix A, Figure 20). Artifact 170165 has an attached pearl at it top and is another slight variant within this category (Appendix A, Figure 19).

Round gorgets

The round gorgets appear very similar to the oblong gorgets in their design, both featuring concentric designs surrounding a cut-out swastika. Unlike the oblong gorgets, round gorgets are circular in shape and do not feature a stem or cut triangle. Three objects of this classification were studied, two of which had attached adornments. Artifact 170168 (Appendix B, Figure 21) has an attached pearl at top and artifact 170156 (Appendix B, Figure 23) has a string of shell beads.

Scalloped gorgets

The scalloped gorgets are similar to the round and oblong gorgets in that they display concentric rings around an incised swastika. The defining feature of this set of objects is embossed scalloping on the outside of the rings. The scallops are interpreted as feathers, giving the motif an association with the winged birds of the Above World in Mississippian cosmology. If the ringed swastika motif is a locative for the Underwater Realm, the scalloped version serves as a locative for the Above World (Reilly 2004: 129). Only one artifact of this type was investigated (Appendix C).

Rayed Circle

Vernon Knight and Vincas Steponaitis use the term “rayed circle” to refer to a round design with roughly congruent curved cut-outs evenly spaced around the interior that form a rim attached to a spoked interior (Knight and Steponaitis 2011: 219-221). This rayed circle motif has been interpreted as a representation of the sun by George

Lankford (Lankford 2004: 209). James Brown and David Dye offer another interpretation, reading the symbol as scalp stretched across a frame (Brown and Dye 2007: 284-286). Three gorgets of this variety were investigated (Appendix D, Figure 26, 27, 28).

Rayed Circle with Ogee

This category of gorget features the rayed circle motif characterized by an outer rim and curved incised shapes that form a spoked interior. Its defining feature is the addition of an embossed ogee (resembling two pointed arches abutted) at the center of the piece (Knight and Steponaitis 2011: 221). George Lankford notes that the ogee appears on several ritual objects and costumes and interprets it as a portal between the realms of the Above World, Middle World, and Underwater Realm (Lankford 2004: 130). One gorget featuring these design elements was investigated (Appendix E).

Chapter V

METHODOLOGY

The copper artifacts recovered from the various rounds of excavation are housed at the National Museum of the American Indian (NMAI) and the Moundville Archaeological Park. My research and analysis utilized only those collections housed at NMAI. In my studying of the objects, I sought two types of information, measurements of the artifacts and their design features and tool marks indicative of how these designs were created.

Measurement

First, basic metrics were gathered to better describe the shape of the artifacts and the variation within the collection. Length was taken by measuring across the oblong gorgets from the tip of the rounded top which houses most of the design elements to the tip of the opposite narrow base. Width was measured across the widest point of the top where the designs were concentrated. Thickness was taken at several points on the perimeter of each object, at the top, the base, the sides of the cut-out swastika designs found in the base, and on either side of the cut out triangle to determine if any part of the artifact was unevenly thinned. A diagram of where these measurements were taken is found in Appendix W. For round objects the measurements were taken using the orientation shown in the photographs with length and width representing perpendicular measurements of the objects' diameter. Thickness measurements for these objects were taken at four evenly spaced intervals around the perimeter. The design elements themselves, specifically the width of the embossed or recessed rings, were measured as patterns in these dimensions across artifacts might suggest standardization.

Microscopy

Evidence of the artifacts manufacture was examined under a microscope to better understand the specific processes the Moundville metalsmiths used and how standardized these techniques were from object to object. I sought clues to the objects' transformation at every stage of its life, thinning of the original nugget, cutting of the shapes, adding designs, grinding, and polishing. Evidence of the artifacts' evolution from nuggets into sheets is often obliterated by later manufacturing processes such as grinding and polishing. The biggest clue to the decisions made in this initial step of thinning the nugget is the artifacts' thicknesses which would betray uneven thinning across the sheets if it occurred. Differential thinning may be the product of carefully planishing the artifact in one area to extend the metal and form the stem of an oblong gorget.

After a sheet is formed by thinning, the rest of the steps in creating the gorgets involve embossing, scribing, and cutting. As Dr. Leader observed, subtracting design elements from the metal can be accomplished through cutting with an edged tool or grinding through raised parts of the sheet that were embossed. To examine these processes I looked for evidence of cutting or grinding which would produce single lines or groups of parallel striations in the metal. Evidence of percussive actions, such as puncturing holes or the chasing designs was also invested. Grinding and polishing of the artifacts would also be represented by striations in the metal, though in the case of polishing few would survive centuries of corrosion. Attention was also given to changes that occurred after the artifacts' deposition, most notably pseudomorphs which capture the texture of surfaces that touch the metal during its corrosion.

Chapter VI

ANALYSIS OF TRENDS

Motifs

Microscopic analysis of the Moundville copper gorgets revealed a few intriguing trends. The majority of the oblong gorgets and the round gorgets displayed the same motif, a cut swastika surrounded by a series of rings, rendered in two very distinct methods. The first technique uses a thin scribed line to define the edges of each ring. Tool marks in the grooves made by this scribing technique are narrow, single lines formed by a finely edged tool, likely of stone (Figure 1).

Figure 1: Scribed Rings on Oblong Gorget. The rings formed on Artifact 170225 were created by inscribing the metal with a narrow pointed stylus, likely of stone. The arrows show a place where the lines are disjointed, having been created by separate passes of the stylus.

The second method using in rendering this concentric ring motif involves embossing the outermost and innermost rings and recessing the middle ring. The absence of tool marks within the rings suggests that the tool used was rounded and smooth like that of bone or antler, producing striations in the copper that could be removed through polishing or would be obliterated by corrosion.

Cutting

Examination also revealed that eight of the artifacts exhibited small pieces of metal that remained attached to the edges or corners of cut out areas that will be referred to a “tags” henceforth. These metal tags form when copper is cut using a method of repeated scoring and then fatiguing and breaking through twisting. As the metal is scored, each pass of the blade cuts falls at a slightly different location causing the metal to be cut to different depths. The irregularities appear when the piece is twisted and broken, leaving behind attached tags of metal where the cuts were not clean (Figure 2). Eight of the artifacts contained tags left behind by this process.

Further proof of this process of scoring and twisting to cut metal is seen in scored lines that extend beyond the area to be removed. The technique of grinding of embossed areas to cut-out shapes that Jon Leader describes is admittedly harder to spot on the artifacts. This technique would produce curved edges at the cut out areas resulting from the embossing, however these could be flattened out and become unnoticeable. Evidence of the grinding could be erased by repeated episodes of polishing and by corrosion after deposition. This potential bias aside, the presence of eight artifacts using the scoring and twisting methods suggest that is was a popular technique with Moundville metalsmiths.

Figure 2: Copper Tags from Twisted Breaking. Arrows indicate “tags” or attached metal that remained on the gorget after the incised swastika was scored and broken away (Artifact 173103).

Holes

All of the gorgets exhibited holes, usually in pairs, at the top of the artifact. These holes all show indentations in the surrounding metal. This evidence in itself is not conclusive to determining how the holes were created as this depression in the copper sheet could be caused by puncturing the metal or by applying pressure while drilling through it. Several of the artifacts do show pieces of metal protruding through the sheet onto the reverse side which is consistent with the sheet being struck with a pointed object and punctured (Figure 3). This evidence combined with the absence of circular abrasions along the perimeters of the holes that would be caused by the rotary motion of drilling makes puncturing the preferred technique used.

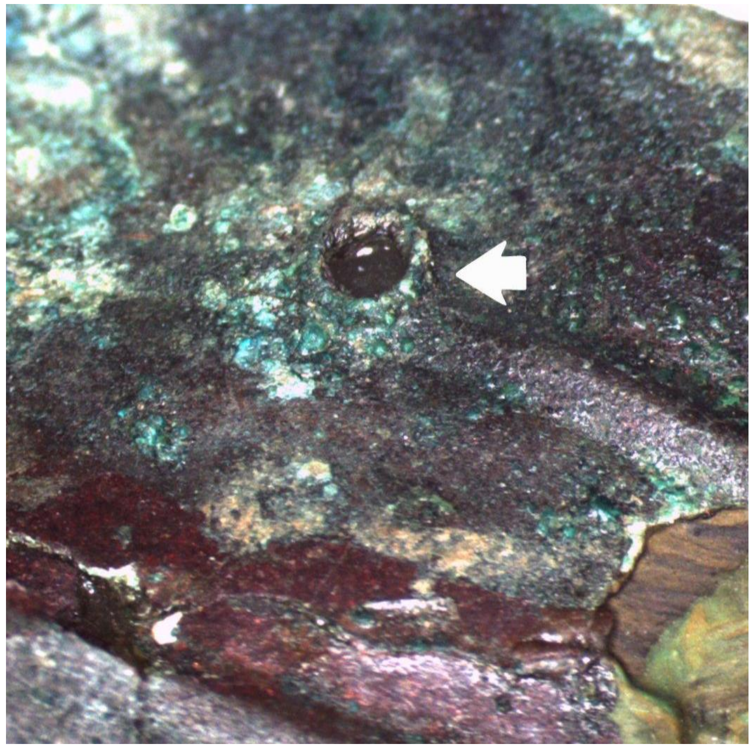

Figure 3: Punctured Hole. The hole in Artifact 170155 pictured shows the protrusion of copper from pressure exerted on the reverse side, most likely caused by puncturing.

Twine Wear

A technique used in the finishing and polishing of the gorgets was rubbing taunt twine back and forth in the difficult to access parts of cut out designs to remove burrs left from the cutting process. This technique is most visible in the cut isosceles triangle which shows smooth, rounded corners after the twine was used. Some of the incised swastikas also show evidence of twine wear used to clean the cut corners. While the majority of the artifacts do not show definitive signs of this process, either do to their actual absence or the obscuring effect of corrosion, three of the gorgets do exhibit clear evidence of twine wear proving that the technique was in the repertoire of the metalsmiths, albeit used infrequently (Figure 4).

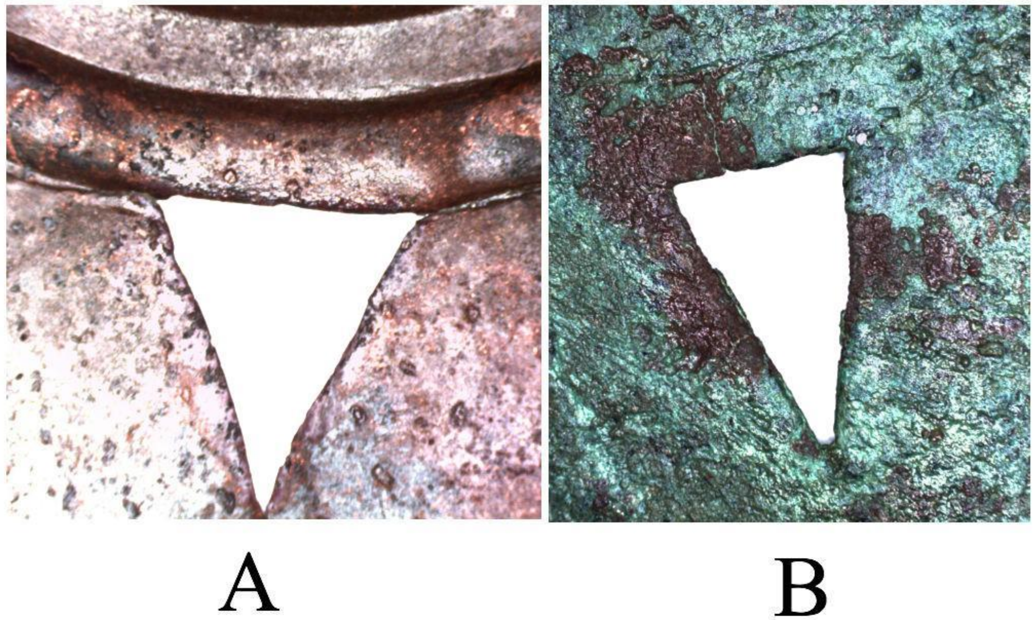

Figure 4: Comparison of artifacts with and without twine wear. The tight corners of Artifact 170200 (A) suggest that the piece was not finished using twine in contrast to the rounded bottom corner of Artifact 173104 (B).

Distributions of Measurements

A plotted distribution of the length and width measurements of the oblong gorgets shows some evidence clustering of the objects into three groups. The extremely small sample size of this distribution makes the results far from conclusive. Only 12 oblong gorgets were studied, three of which were incomplete and could not be measured for both length and width. Despite a sample of only 8 objects, there does appear slight clustering into small, medium, and large gorget sizes (Figure 5).

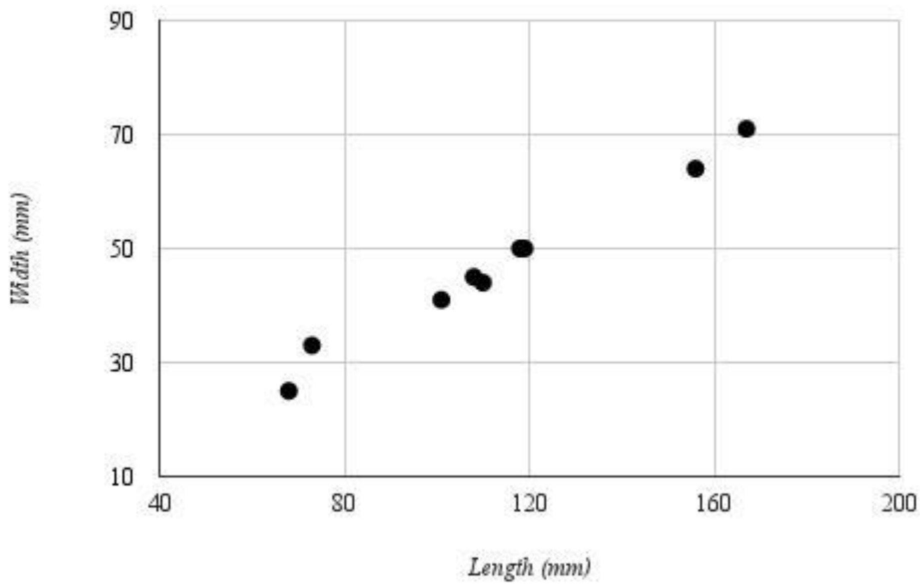

Figure 5: The Distribution of Oblong Gorgets. The dimensions of the eight complete oblong gorgets suggest three possible size categories.

Comparisons of the thicknesses of the oblong gorgets along their perimeter were also conducted. Measurements were taken at six locations at the top, upper right, lower right, upper left, lower left, and base of the objects (Figure 6). The goal of these measurements was to discern if the object was evenly thinned in all directions at to test the hypothesis that the stems of the gorgets were formed by thinning and elongating part of the metal in a single direction.

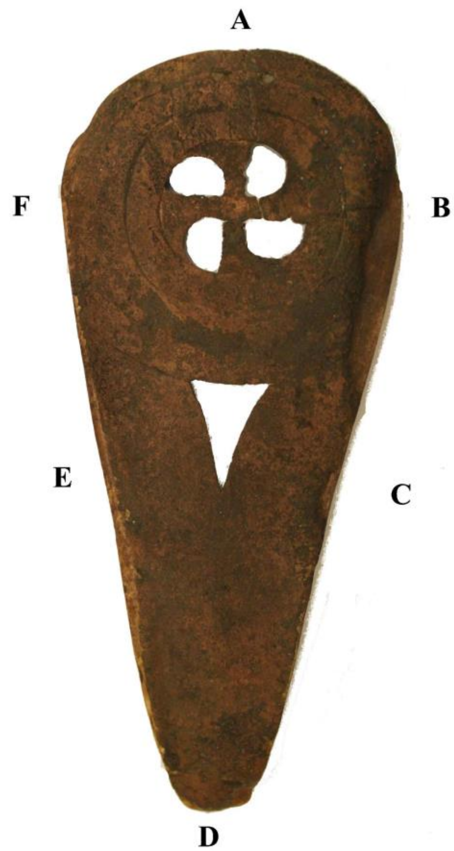

Figure 6. Guide to thickness measurements. The letters indicate the six locations where thickness measurements were taken on the oblong gorgets. Letter A represents the top measurement, letter B the upper right, letter C the lower right, letter D the base, letter E the lower left, and letter F the top left.

The frequency distributions of these six measurements are found in Appendix F. The means of the objects taken at each point varied from one another by only 0.052 mm while the small sample size obscured any noticeable skewing of the distribution. The high standard deviation found within the distribution of any given measurement combined with the biases or a small sample size, measurement error, and differential thinning due to corrosion make the subtle differences in average thickness found in the distribution of measurements insignificant. It appears that there is no meaningful patterned difference in the thicknesses of the objects at various points and that the stem was not created by hammering, thinning, and extending a single part of the sheet.

Chapter VII

CONCLUSION

Verdict on Template Use

One of the big questions this project sought to answer was if templates were used in the construction of the gorgets. It is reasonable to hypothesize that the oblong and round gorgets were produced by embossing or scribing the designs with the aid of a wooden or hide template given the repetition of the swastika and concentric ring motifs and how tightly adhered to the motifs are across the assemblage with little deviation.

The use of template is also not unprecedented for Mississippian times. As was mentioned earlier, Jon Leader observed their use in the construction of stepped symbol badges and bilobed headdresses at Etowah (Leader 1988: 111-113). Frank Cushing also referenced the possibility of their use in his experimental study of Zuni Indian metal technologies at the end of the 19th century. Cushing noticed remarkable symmetry in native copper artifacts that he believed could be created by constructing a leather pattern that could be used to trace one half of the design before being flipped and applied to the other half (Cushing 1894: 114). Copper sheets and breastplates have been recovered from Spiro that exhibit profound symmetry and repeated design motifs which certainly may have been produced using wooden templates. Many of these coppers were found with carved wooden backing that could be employed in the production of multiples if it were the artists' prerogative, though no complete identical forms have been noted.

The investigation of the use of templates in the construction of the Moundville gorgets was limited only to the oblong, round, and scalloped gorgets which share the swastika and concentric ring motifs. The disparate sizes of the rayed circle gorgets make it evident that a template was not used. Two of these gorgets measured less than 24 mm and 22 mm width while the third measured 97 mm wide, and while the similarity in size of the smaller two is striking, it is impossible to determine if a template was used with only two examples to study (Appendix D). Additionally, the fragmented gorget that displayed the ogee motif could not be compared to other like artifacts since it was the only one represented in the collection.

The use of templates in the construction of the Moundville gorgets could occur in two ways. The entire oblong gorget could be created from a single form, producing objects whose overall dimensions are roughly equivalent. A template could also be employed in the creation of only the central design motifs. If such a template was used in the Moundville collection, only the ringed swastika design would appear standardized, with objects from the same templates having rings of equal width.

Study of the measurements of the rings revealed two groups of artifacts that show similarities not only in the width of their rings but how the changes in ring width vary together. In other words, the artifacts in each group not only share the similar ring widths, but the changes in widths from the outer ring to the middle ring and the middle ring to the inner ring occur in the same pattern for all artifacts in that group. The first group consists of artifacts 173106, 173104, 170151B (Appendices A, Figure 11, 12, 14). Of these three gorgets, 173106 and 173104 share similar widths for the rings and the artifact on whole, as well as the same manufacturing evidence, both being scribed rather than embossed (Figure 7). These similarities make their construction from a template a strong possibility although the missing stem of artifact 173106 makes it impossible to know if this template extended for the entire body of the gorget or just the part that contained the design elements. The designs on artifact 170151B were embossed, rather than scribed, which casts extreme doubt that it was created using the same template as the other two objects.

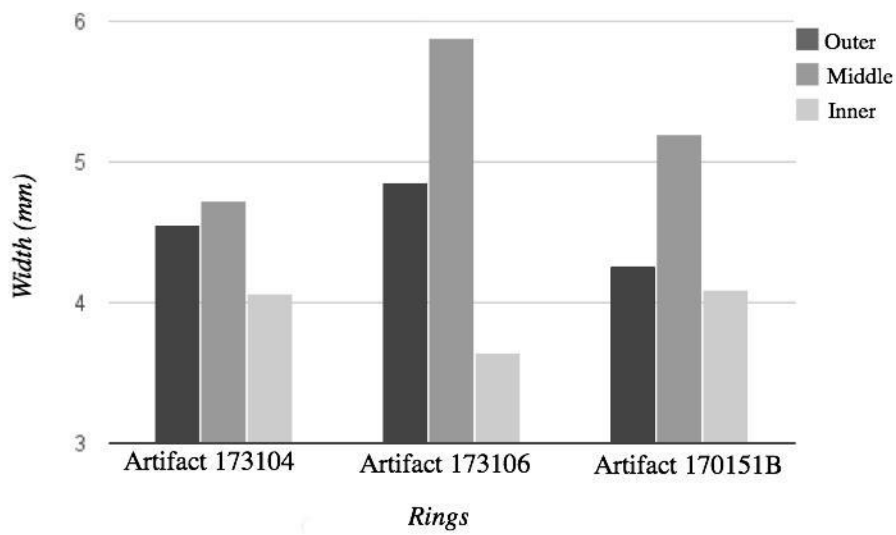

Figure 7: The widths of the concentric rings surrounding the incised swastikas.

The second group includes artifacts 173103, 170200 and 170155 (Appendix A, Figure 9 and 10, Appendix B, Figure 22). Two artifacts, 173103 and 170200 share not only similar ring widths but also nearly identical overall dimensions and design motifs that were rendered with embossing (Figure 8). These similarities in technique and dimensions make a compelling case for the use of template to create both the body and the design elements of the gorgets. Object 170155 is a round gorget with scribed lines. Just as was the case in the first group, it reasons that artifacts made using different embellishment techniques were not likely created on the same template. This reasoning and the significantly larger overall width of artifact 170155 suggests that it was not made from the same template as artifact 173103 and 170200.The similarities in objects 173103 and 170200 suggests that at least two objects recovered from the site were made from a template of some sort. Whether such a template was a constructed wooden or leather form of if one artifact served as a guide for the other cannot be determined.

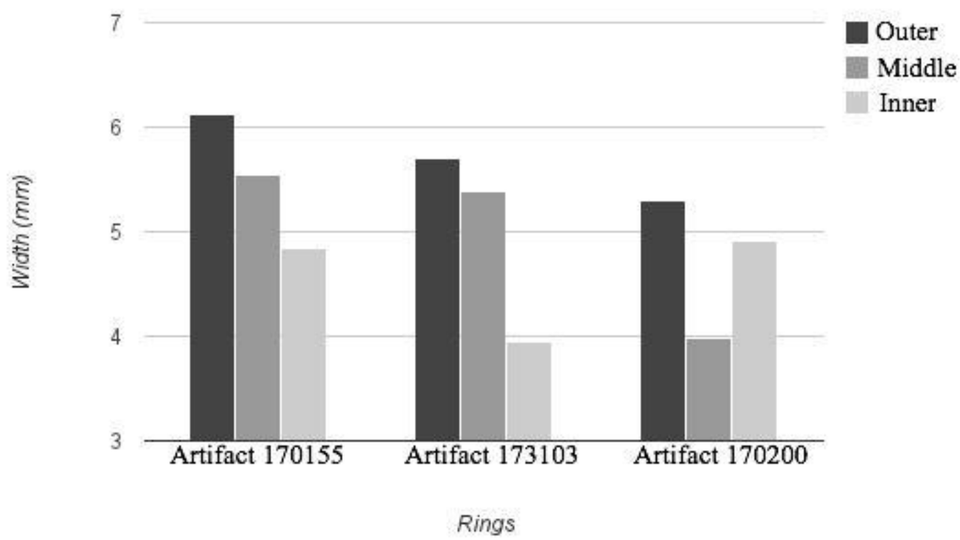

Figure 8: The widths of the concentric rings surrounding the incised swastikas.

Manufacturing Sequence

The manufacturing process of copper gorgets at Moundville followed a process of repeated annealing and hammering to reduce the raw nuggets into sheets which were ground smooth with an abrasive stone. All of the artifacts, with the possible exception of artifact 173093, which exhibits a possible rivet (Appendix B, Figure 24), were constructed from a single sheet of copper. Afterwards these were cut, either by embossing and grinding or by cutting with a sharp stone tool, into the desired shape. The absence of significant differences in the thicknesses of the artifacts along their perimeter seems to indicate that sheets were formed, from which shapes were then cut, rather than the shapes being constructed through the shaping of the nugget into an oblong form as it was being hammered thin. Incised pieces were removed from the interior of the object by repeated scoring, cutting, and twisting. In a few instances the artist chose to clean the cut areas by pulling twine back and forth to remove remaining burrs. A hole was then created using a small punch that would be used to suspend the object or attach shell beads.

Measurement of the design features and the object dimensions suggests that the majority of the artifacts were crafted individually without the use of templates. That said, the distribution of artifact sizes suggest that Moundville's metalsmiths did have a consciousness of artifacts sizes types and made objects that could loosely be sorted into large, medium, and small categories. Two pairs of oblong gorgets discussed above show that the Moundville coppersmiths rarely made artifacts from a "template", even it if that "template" was just a previously one-off gorget whose body was traced and design features were repeated referenced during the construction process.

The rare and extremely limited evidence for the use of templates in the construction of the gorgets situates Moundville's copper tradition as one quite different from that found at Etowah. Jon Leader observed the use of templates in the construction of two bilobed headdresses, 9 plain symbol badges, and 38 stepped symbol badges (Leader 1988: 110-118). Meanwhile only two pairs of gorgets, one of which contains a broken stem, show measurements suggestive of template use at Moundville, clearly showing that the use of templates in its copper manufacturing was a feature that Etowah did not share with its contemporary in the Black Warrior Valley.

These conclusions should not be extrapolated beyond the 21 gorgets examined here to other copper artifact all copper working practices at Moundville. Several projectile point shaped symbol badges that, like the gorgets, share tightly conscribed and uniform design motifs, were unavailable for study but should also be examined for evidence of their construction using templates to further our understanding of Moundville copper technologies.

APPENDICES

Appendix A. Description of the oblong gorgets

Artifact 173103. This oblong gorget has a length of 119 mm, a width of 50 mm, and a weight of 10.49 grams. The surface of the artifact was cleaned with acid and the corrosion and patination removed. The gorget displays a heavily embossed design of three rings surrounding an incised swastika. A cut triangle is found below the rings. The outermost ring and the innermost ring are embossed while the middle ring is recessed. Examination of the middle ring shows signs of deeper recession on the left side of the piece were the artist applied greater pressure. Two horizontal lines were also recessed in the center of the piece between the swastika cutouts, one in the space separating the upper left and upper right swastika cut outs and another between the lower left and lower right cut outs. The piece has two holes at the top with the surrounding metal depressed suggesting that the holes were punched rather than drilled. No wear marks indicative of drilling were observed. The cut out triangle below the embossed rings shows rounding in the lowest corner, suggestive of twine wear (Figure 9).

Figure 9. Oblong gorget, NMAI 173103.

Artifact 170200. This oblong gorget has a length of 118 mm, a width of 50 mm, and a weight of 6.81 grams. The surface of the artifact was cleaned with acid and the corrosion and patination removed. The gorget displays and heavily embossed design of three rings surrounding a cut-out swastika. A cut triangle is found below the rings. The outermost ring and the innermost ring are embossed while the middle ring is recessed. Two recessed horizontal lines are found in the center of the piece between the swastika cut-outs, one in the metal separating the upper left and upper right swastika cut-outs and another between the lower left and lower right cut-outs. Two holes are found at the top of the artifact, both punctured as evidenced by the metal producing through to the opposite side. Interestingly, each was punctured from a different side. The top corners of the triangle and several corners in the swastika cut outs are torn, likely from twisting the cut copper piece to be removed from the gorget. The tight angles and the absence of rounding suggest that twine wear was never a part of the finishing and polishing of the gorget (Figure 10).

Figure 10. Oblong gorget, NMAI 170200.

Artifact 173106. This oblong gorget has a length of 51 mm, a width of 46 mm, and a weight of 3.12 grams. The piece is highly corroded and is missing its lower stem and part of the upper edge. The gorget displays three rings surrounding a cut swastika. The rings are neither deeply embossed nor recessed but rather are formed by a scribed line that separates one ring from the next. The swastika shows two recessed horizontal lines, one on the metal between the upper left and upper right cut out pieces and one between the lower left and lower right pieces. Part of a cut triangle is present but is incomplete due to the missing lower half of the artifact. The right side of the remaining part of the triangle shows a piece of attached metal that may be a tag left from cutting away the shape. No holes are present as the upper portion of the artifact is lost to corrosion (Figure 11).

Figure 11. Oblong gorget, NMAI 173106

Artifact 173104 has a length of 108 mm, a width of 45 mm, and a weight of 11.34 grams. The gorget displays three rings surrounding a cut swastika. A cut triangle is found below the rings. The rings are not deeply embossed or recessed and are difficult to distinguish because of the surface corrosion. Each ring is separated by a thin scribed line. The piece exhibits a single hole that has been partially destroyed by corrosion. Without more of the hole remaining it cannot be determined if it was perforated or drilled. The long sides of the cut triangle contain tags of metal left behind after the triangle was cut and twisted off. The bottom corner of the triangle is slightly rounded, possibly the result of twine wear (Figure 12).

Figure 12. Oblong gorget, NMAI 173104.

Artifact 170151A. Two artifacts that were labeled under the same same catalog number. The one pictured in Figure 13 will be referred to as artifact 170151A. This oblong gorget has a length of 101 mm, a width of 42 mm, and a weight of 5.10 grams. The piece is heavily corroded, fragmentary, and bent. The design features three concentric rings, each separated by a faintly scribed line, surrounding a cut swastika. A pearl was attached with twine to the top of that gorget. This artifact is the only oblong gorget that lacks a cut triangle on the stem.

Figure 13. Oblong gorget, NMAI 170151A.

Artifact 170151B. The second of two artifacts labeled under the same catalog number will be referred to as artifact 170151B. This oblong gorget has a length of 101 mm, a width of 42 mm, and a weight of 5.10 grams. The top of the artifact is missing but it is clear that the gorget design motif was three rings surrounding a cut out swastika, the lower two portions of which are all that remain. The outermost and innermost rings were embossed while the middle ring was recessed. The lower right portion of the outermost ring on the reverse of the object shows a tool mark that deviated slightly from the ring. Below the rings an isosceles triangle was cut but the jagged corners suggest it was not abraded with twine (Figure 14).

Figure 14. Oblong gorget, NMAI 170151B.

Artifact 173105. This oblong gorget has a length of 110 mm, a width of 44 mm, and a weight of 12.76 grams. The artifact displays a cut swastika surrounded by a series of rings. The margins of only two are distinguishable by a thin scribed line. A cut triangle is found in the stem of the gorget with corners that were rounded, likely due to twine wear. Two holes at the top of the gorget appear indented, likely caused by puncturing (Figure 15).

Figure 15. Oblong gorget, NMAI 173105.

Artifact 170225. This oblong gorget has a length of 167 mm, a width of 71 mm, and a weight of 17.58 grams. The surface was cleaned and its patina removed. The gorget displays three rings surrounding a cut swastika. The rings are neither deeply embossed nor recessed and each is separated from the next by a scribed line. Two holes are present at the top of the gorget. The metal indents around the hole and partially protrudes on the reverse of the object, compelling evidence that the holes were punctured. The recessed line immediately below the two holes shows a disjunction were the marks left by the tool do not line up. This occurs again just below the top of the second line from the outside where the tool marks are not continuous or aligned. These markings were formed by two separate motions of the scribing tool, either by stopping the original motion and then continuing or making a second pass around the line to further recess it. The top of the cut triangle shows a cut mark where the artist dragged his cutting tool past the intersection with the other side of a triangle. This overshot is evidence that the cut-out pieces of the gorget were created with a sharp edged tool rather than grinding away an embossed surface. The two lower cut portions of the swastika show rips in their upper corners likely caused by twisting and ripping a piece of metal that was cut and mostly detached (Figure 16).

Figure 16. Oblong gorget, NMAI 170225.

Artifact 170164. This oblong gorget has a length of 102 mm, a width of 49 mm, and a weight of 6.21 grams. The piece is corroded and the top is not preserved. The pieces exhibits three rings, the outermost and the innermost embossed while the middle is recessed. Below the rings is a cut triangle. Corrosion along the edges of the triangle has obliterated evidence of its removal from the rest of the piece. A pseudomorph is found to the left of the lower part of the triangle showing overlapping fibers (Figure 17).

Figure 17. Oblong gorget, NMAI 170164.

Artifact 170167. This oblong gorget has a length of 156 mm, a width of 64 mm, and a weight of 16.73 grams. The surface of the artifact was cleaned with acid and the corrosion and patination removed. The gorget displays three greatly embossed rings surrounding a cut swastika. A cut triangle is found below the rings. The pattern of embossed rings alternates with the outermost ring and the innermost ring embossed and the middle ring recessed. A horizontal line was recessed into the metal connecting the lower, centermost corners of the upper left and upper right swastika cut-outs. These cut-outs also show remnants of the pieces that were removed from the sheets. These tags are in the corners of the right side cut outs. The left side cut-outs of the swastika show rounded corners which may be the result of twine wear. The cut-out triangle below the three rings containing the swastika exhibits rounded corners, also likely produced by twine wear. Another line parallel to it connects the upper corners of the lower left and right cut outs. Two holes exist at the top of the artifact, both of which show indentation in the surrounding metal (Figure 18).

Figure 18. Oblong gorget, NMAI 170167.

Artifact 170165. This oblong gorget has a length of 73 mm, a width of 33 mm, and a weight of 3.12 grams. The object is heavily corroded, severely fractured along the stem, and bent. The gorget displays two rings surrounding a cut swastika, instead of the usual three. Neither ring is embossed nor recessed and the outer ring is separated from the inner ring by a thin line, only discernible on the right side of the object. A pearl was attached with twine to the top of the artifact (Figure 19).

Figure 19. Oblong gorget, NMAI 170165.

Artifact 170163. This oblong gorget has a length of 68 mm, a width of 25 mm, and a weight of 1.98 grams. It displays the characteristic swastika motif surrounded by a series of rings with two important variations. The swastika design is recessed rather than incised and only two rings are present rather than the usual three. In the stem of the piece is a cut triangle. Two holes are at the top of the piece are indented from puncturing. The right side of the outer ring show tool marks that are not contiguous but caused by two separate motions by the artist when scribing a line to define the outer ring (Figure 20).

Figure 20. Oblong gorget, NMAI 170163.

Appendix B. Description of the round gorgets

Artifact 170168. This round gorget has a length of 79 mm, a width of 69 mm, and a weight of 6.24 grams. The piece was clean and removed of its patina. The gorget features three rings surrounding a cut out gorget with the outermost and innermost rings embossed and the middle ring recessed. Unlike the other gorgets where this design motif occurs, this gorget has no stem or cut triangle. Two parallel horizontal and recessed lines were found within the swastika, connecting the innermost corners of the top cut-outs and the innermost corners of the bottom cut-outs. A drilled pearl bead was attached to the piece with twine tied through two holes at the top of the piece. It is unclear how the holes were created (Figure 21).

Figure 21. Round gorget, NMAI 170168.

Artifact 170155. This round gorget has a length of 61 mm, a width of 54 mm, and a weight of 4.82 grams. The piece is bent, fractured, and heavily damaged, especially around the edges and perforated shapes at the center. The gorget exhibits the characteristic design motif of three rings surrounding a cut swastika though the outer ring is largely lost due to corrosion. Each ring is separated by a scribed line that is still visible. The artifact has a single punctured hole shown by metal protruding through to other reverse side.

Figure 22. Round gorget, NMAI 170155.

Artifact 170156. This round gorget has a length of 70 mm, a width of 61 mm, and a weight of 5.95 grams. The object is poorly preserved, bent, and highly fragmentary. The gorget displays three rings, the outermost of which is almost completely missing, surrounding a cut swastika that is also severely damaged. The rings are not embossed or recessed but rather formed by a scribed line separating each ring from the next. Two strands of shell beads were attached with twine to the top of the artifact. The two holes are heavily patinated which obscures the interpretation of their manufacture, but they appear slightly indented at the edges suggesting that they were punctured (Figure 23).

Figure 23. Round gorget, NMAI 170156.

Artifact 173093. This round gorget has a length of 163 mm, a width of 163 mm, and a weight of 45.36 grams. The piece is highly corroded and fractured with parts of the center and the edges missing. The object displays the characteristic design motif of a cut-out swastika surrounded by a series of rings. This piece departs from other round gorgets in its number of rings, exhibiting 11 rather than the typical three. The rings are not embossed but separated by a scribed line. The shape of the swastika cut-out is also different than the rest of the sample with each of the four arms exhibiting a more pronounced curve. One hole is present but its shape has been corroded and expanded making it impossible to determine if it was part of the original design or developed after deposition. The figure also displays an overlap in the copper at the center and a possible rivet on the reverse. Further research and x-ray analysis will be required to confirm or deny this (Figure 24).

Figure 24. Round gorget, NMAI 173093.

Appendix C. Description of the scalloped gorget

Artifact 173095. This scalloped gorget has a length of 63 mm, a width of 45 mm, and a weight of 4.69 grams. The artifact was bent and fractured at the time of excavation. When the artifact was conserved and protected with an acrylic backing, this bend was retained. The gorget consists of three rings surrounding a cut swastika, half of which has been lost to decay. Each ring is separated by a scribed line. These lines are well defined and distinguishable despite the poor state of preservation. Outside the rings are a series of scallops. Only five of these scallops remain mostly intact. Each petal was embossed with an outline along its edge. No holes were present (Figure 25).

Figure 25. Scalloped gorget, NMAI 173095.

Appendix D. Description of the Rayed Circle gorgets

Artifact 170202. This rayed circle gorget has a length of 101 mm, a width of 97 mm, and a weight of 17.86 grams. The surface was cleaned and the patina removed. The design shows an outer rim with eight interior cut out pieces of approximately equivalent size creating eight attached spokes, also roughly equal in size. A recessed line is apparent where the spokes meet the rim. The artifact displays two pairs of holes, two aligned horizontally at the top of the artifact in the rim and two vertically aligned holes in the middle interior of the artifact. Both sets appear to have been punctured due to the inward curve of the metal surrounding the hole. This effect is less pronounced in the two horizontally aligned holes in the rim because they have been exposed to greater deterioration. Two additional holes were found on the lower right interior of the object that were likely caused by deterioration due to their small size and irregular shape. The reverse side of the object reveals two lines that trace the inner and outer edge of the rim. The rim itself is slightly embossed giving it a curved profile. Overshot cut marks on the reverse of the object betray that a sharp tool was used to cut and removed the interior shapes rather than embossing followed by grinding (Figure 26).

Figure 26. Rayed circle gorget, NMAI 170202.

Artifact 173097. This rayed circle gorget has a length of 24 mm, a width of 25 mm, and a weight of 0.40 grams. The piece was not cleaned and the patina remains. The design shows an outer rim with six interior cut out pieces creating six attached spokes. A recessed line is apparent where the spokes meet the rim. A single hole is present but it cannot be determined if it was drilled or punctured. A tag of metal in the middle of the cut section immediately to the right of the hole is visible (Figure 27).

Figure 27. Rayed circle gorget, NMAI 173097.

Artifact 170148. This rayed circle gorget has a length of 22 mm, a width of 22 mm, and a weight of 0.31 grams. The piece was cleaned and the patina removed. The design shows an outer rim with six interior cut-out pieces creating six attached spokes. Three holes are present, two in the interior of the piece and one on the rim. All three are indented and appear to have been punctured. Several tags of metal left behind from twisting and breaking are still visible in the bottom, upper left and upper right cut-outs. The top cut-out also shows a scribed line where the artist overshot the cutout piece (Figure 28).

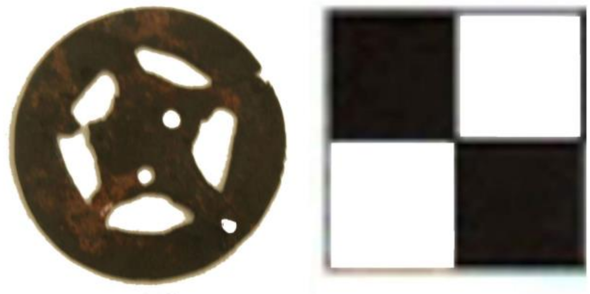

Figure 28. Rayed circle gorget, NMAI 170148.

Appendix E. Description of the rayed circle with ogee gorget

Artifact 173218. This fragmented gorget displays the rayed circle with ogee motif where the ogee is embossed within a spoked interior connected to an outer rim. Due to its fragmentary nature, length and width could not be measured accurately but weight was calculated at 8.50 grams. A pseudomorph capturing an impression of a strand of fibers is located on the inner edge of one of the rim fragments (Figure 29).

Figure 29. Rayed circle with ogee gorget, NMAI 173218.

Appendix F. Gorget thickness measurements

Thickness measurements were taken along the perimeter of the oblong gorgets in six locations. Fragmentation and corrosion prevented measurement in all locations for all artifacts. The mean thickness of the measurements taken from the tops of the artifacts was 0.507 mm with a standard deviation of 0.219 mm (Figure 30). The mean thickness for the upper right measurements was 0.455 mm with a standard deviation of 0.137 mm (Figure 31). Measurement of the lower right of the artifacts produced a mean thickness of 0.502 mm with a standard deviation of 0.221 mm (Figure 32). The upper left measurements had a mean thickness of 0.487 mm with a standard deviation of .207 mm (Figure 33). Measurements of the lower left thicknesses produced a mean of 0.495 mm and a standard deviation of 0.221 mm (Figure 34). At the base, the artifacts had a mean thickness of 0.478 mm with a standard deviation of 0.137 mm (Figure 35).

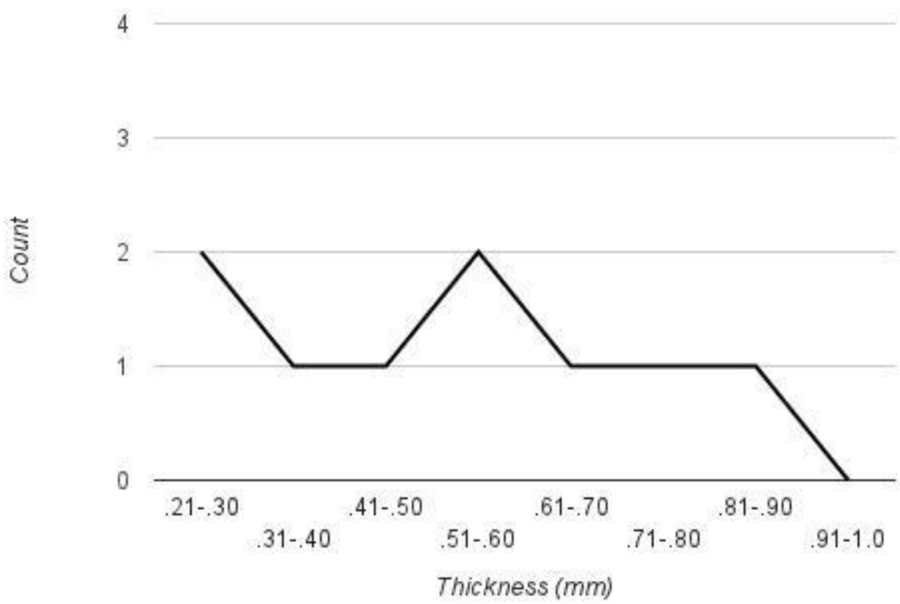

Figure 30. Frequency distribution of top thicknesses.

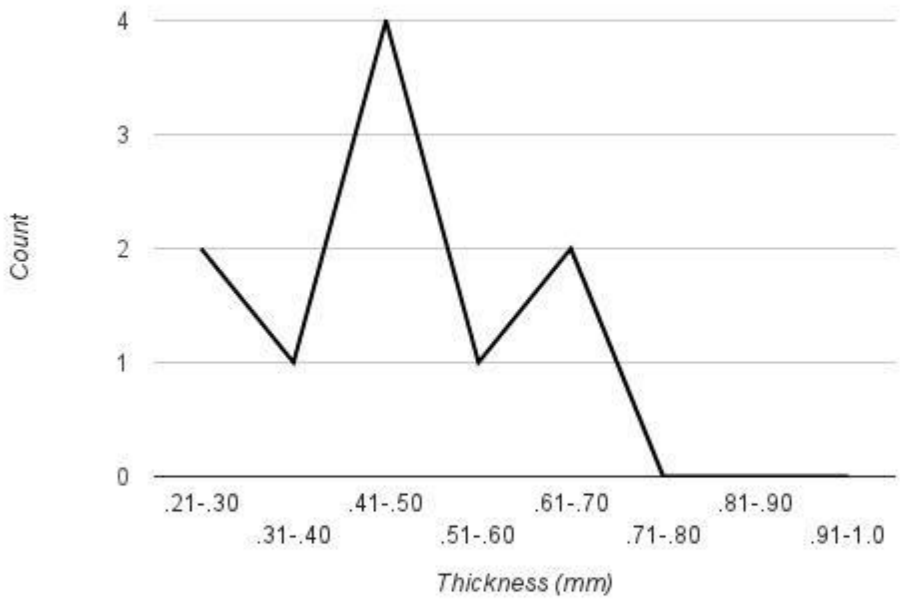

Figure 31. Frequency distribution of upper right thicknesses.

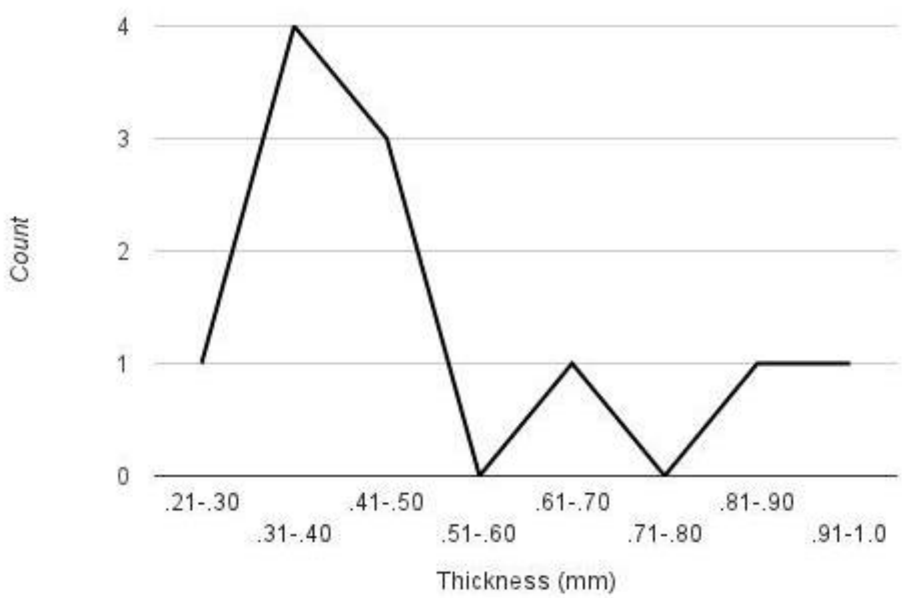

Figure 32. Frequency distribution of lower right thicknesses.

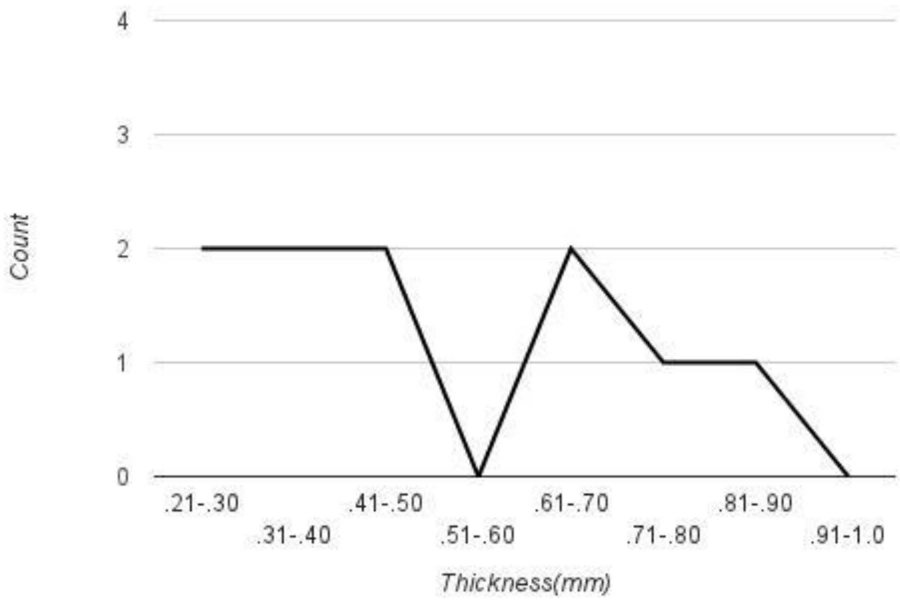

Figure 33. Frequency distribution of upper left thicknesses.

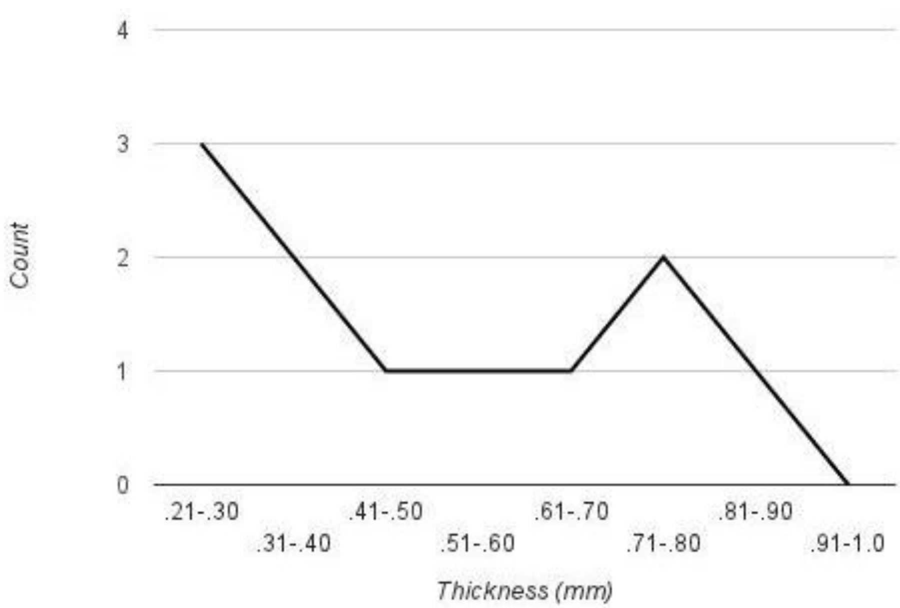

Figure 34. Frequency distribution of lower left thicknesses.

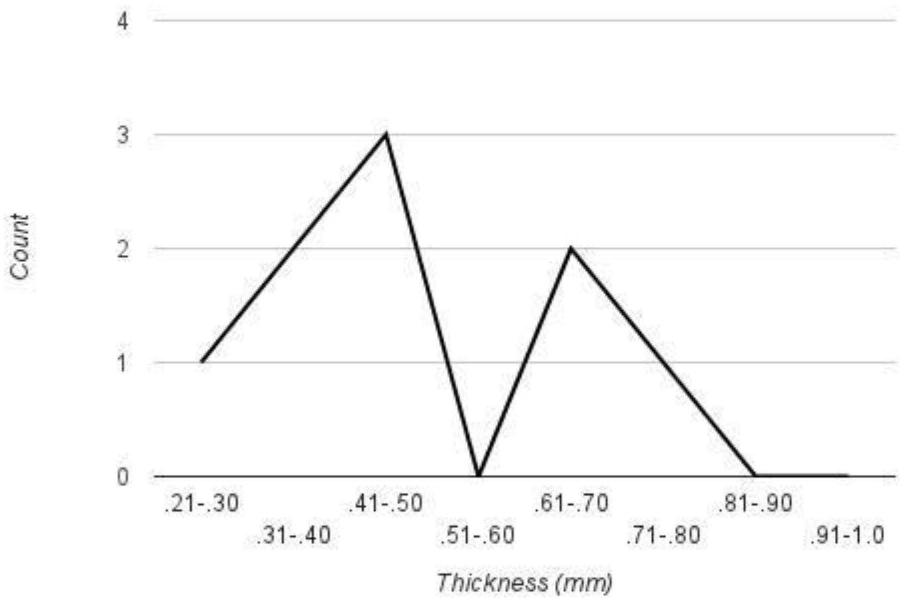

Figure 35. Frequency distribution of base thickness

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