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AN APPLICATION OF THE TECHNIQUES OF ARCHAEOASTRONOMY TO A SELECTION OF MISSISSIPPIAN SITES IN THE SOUTHEASTERN UNITED STATES

State University of New York at Stony Brook

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An Application of the Techniques of Archaeoastronomy To A Selection of Mississippian Sites In the Southeastern United States

A Dissertation presented

by

Ann Lupton Daniel

to

The Graduate School

in partial fulfillment of the requirements

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in

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Abstract of the Dissertation

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The possibility of contact between the prehistoric southeastern United States and Mesoamerica has been considered many times; however, the exchange of astronomical concepts has not been studied. Five major Mississippian ceremonial centers, Cahokia, Moundville, Etowah, Kincaid, and Angel, have been analyzed for evidence of common astronomical alignments. At Cahokia, the largest site, claims of several alignments have been made, though they are not well-supported by the published data. What can be substantiated is an interest in solar movement and knowledge of the cardinal points. Because of their altered states, the mounds at Moundville provide no clear man-made markers to use. Any man-made

markers at Etowah have also been destroyed. Old site maps, topographic maps and aerial photographs were used in this analysis. Ethnographic sources, early excavation reports and local histories were studied for evidence of interest in astronomy. The size and number of mounds at Moundville posed a problem; many alignments are possible, but only those to the cardinal directions can be accepted as intentional. With only three mounds remaining at Etowah, analysis was easier, but with the same results. Alignments to the cardinal directions appear to be intentional. Kincaid has been so modified that analysis is impossible. Angel has alignments to the cardinal directions.

Four sites have interest in the cardinal directions in common; the fifth has inconclusive evidence. Mesoamerican astronomy included interest in the cardinal directions; however, the orientation of their directions was not the same as that of the southeast: it was not based on the celestial pole. It would appear from the current data that contact between the two areas did not include transfer of astronomical knowledge.

This study is an attempt to establish a methodology for research in the field of archaeoastronomy. It involves use of ethnohistoric, ethnographic and

archaeological records, on-site measurements, accurate mapping and use of topographic maps, all applied to the support of a stated hypothesis. In this study the hypothesis was found to be unsupportable from the data available, but the method proved to be sound.

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CHAPTER I

INTRODUCTION

Archaeoastronomy, as with all relatively new disciplines, is undergoing constant development. While a recognized field for more than ten years, there have been few studies where a clearly defined method has been applied and tested uniformly. Studies have been made in the Old World, in Babylonia, Egypt, and Britain, and in the New World, in Mesoamerica, Peru and the southwestern United States, but not in the southeastern United States. For that reason this region was selected as a test area and the Mississippian sites chosen as a cultural period to study. The hypothesis to be tested is: Evidence of Mississippian knowledge of astronomy should appear in architectural alignments found in the remaining structures of this culture, the mounds, and that this knowledge was transmitted from Mesoamerica through some form of contact. This hypothesis is based on possible Mesoamerican-Mississippian contact. If the contact was made, a transfer of cosmic knowledge may have occurred. This research has two purposes: 1) to develop and apply a method that can be used universally;

and 2) to look for astronomy in the prehistoric southeastern United States structures still remaining.

The presence of astronomy would have socio-political implications; astronomy would be expected in a complex society, especially an agricultural one. Because only the mound architecture remains from the Mississippian period, mound alignments will be used in this study. Platform or truncated mounds are believed to be a trait brought to the southeast from Mesoamerica.

Positive comparison of Mississippian astronomy with that of Mesoamerica would indicate more than a casual contact between the two areas. Maize agriculture in the southeast is evidence of this contact; the transmission of abstract ideas, ideology or religion would mean a much stronger impact on the Mississippian peoples. In a transmission of cultural traits there would be a prolonged period of contact between the people involved: this could benefit both groups.

The absence of astronomy in the orientation of the structural remains could be interpreted in one of two ways: 1) there was no knowledge of astronomy; or 2) the evidence for this knowledge has been destroyed. A lack of interest in astronomy would be remarkable for a culture as complex as the Mississippian. As will be

seen later, the destruction of the mounds has obliterated most of the evidence for or against the knowledge of astronomy. The ethnographic and ethnohistoric data indicate an emphasis on the sun and moon in the religion of this region; a quadripartite division of the universe is found at each of the sites considered. This division was an independent invention and not a trait shared with Mesoamerica. If Mississippian astronomy does not compare with that in Mesoamerica it could mean only casual or indirect contact between the two areas.

The southeastern part of the United States, particularly the Mississippian culture region, was the most complex area of aboriginal socio-cultural organization north of the civilizations of Mesoamerica. This development is often attributed to Mesoamerican diffusion and evidenced in the form of such traits as human sacrifice, mound and plaza construction, iconographs, ceramic complexes, cultigens, games and personal ornaments. It is thought that with the exchange of material culture would come an exchange of abstract ideas. Such concepts might be in the form of religion, or explanation of the universe. The interest in astronomy demonstrated by the Mesoamericans may have also been transmitted to the southeast, along with truncated pyramids, vessels with tripod feet, plumed serpents, monolithic hatchets, seated human figures, sculptured idol heads, spool-shaped ear ornaments and long ceremonial swords shaped from flint. For these reasons it is thought that contact between Mesoamerica and the southeastern United States existed in some form.

To discover if this contact included exchange of cosmic knowledge, five major ceremonial centers were analyzed for evidence of astronomical interest. These centers, Cahokia, Illinois; Moundville, Alabama; Etowah, Georgia; Kincaid, Illinois; and Angel, Indiana, were the most influential centers of the Mississippian period, see Map 1. A sixth center, Spiro, Oklahoma, has been destroyed and insufficient information remains to study this site. What remains of these cermonial centers is the pattern of earthen man-made mounds. Other man-made structures have been destroyed, either by the elements, by man's activities in the area or through excavations. Dwellings and ceremonial structures built of wood, cane and grass are not durable in the climate and soils of the southeastern United States. Evidence of these structures, decayed posts remaining in the ground, was not always recorded during excavations. These post molds were often not even recognized;

Map 1. Location of the sites analyzed in this study:

1) Cahokia, Illinois; 2) Moundville, Alabama; 3) Etowah, Georgia; 4) Kincaid, Illinois; 5) Angel, Indiana

early excavators were more interested in the recovery of artifacts than in reconstructing the culture. For these reasons it is impossible now to study the remains of structures for evidence of astronomy. Because we have no written records from these people, we have no document of a calendrical system. Descendents of these people attend seasonal ceremonies such as the Green Corn Ceremony (Howard, 1968:19ff). Calendrical notation may be present in Mississippian art; however I do not have the background for this analysis.

The hypothesis that transmission of cosmic knowledge occurred during Mesoamerican-Mississippian contact is based on the spread of information and cultural traits from the South. The presence of corn in the southeastern United States is positive evidence of cultural diffusion.

> There is some evidence that the Mississippian development was stimulated by the introduction of concepts, ceremonial attitudes, and practices from Mexico. It was based on such improved agricultural procedures as the marked use of the flint hoe and probably of improved strains of corn, which resulted in large populations and a more sedentary societal organization. (Griffin, 1971:248-249)

Those improved strains of corn, specifically the eight-row Eastern Complex corns introduced into the Southeast about 800 A.D. were well adapted to the growing season

of the southern United States (Stoltman, 1978:724). Corn was popped, made into hominy, or ground to make a bread; "perhaps the most cheering and heartwarming use the Indians made of maize was the production of alcoholic beverages" (Paul Weatherwax as quoted by Heizer, 1973:98). Heizer (1973:30ff) suggested religious ceremonies as the origin of agriculture--seed offerings scattered over a field from which it had been gathered to appease the gods. It is possible that these ceremonies were continued and expanded as intentional cultivation developed. These ceremonies would be an integral part of the planting and perhaps the harvesting of the maize. These ceremonies, based on agricultural cycles which would coincide with seasonal changes, would be transmitted along with the seeds. Desire for the level of development in Mesoamerica may have prompted an emulation of their methods, including the use and knowledge of astronomy. "Civilization is a plant much more often propagated than developed" (Tylor as quoted by Harris, 1968:174). In considering the diffusion of cultural traits, two concepts must be recognized: first the main one of movement of the traits themselves, and second the human interaction with which the movement is associated (Clarke, 1979:128).

An analogy exists between trade or exchange and a communication system in which information may be conveyed either by the goods exchanged or the concepts associated with the goods or through direct communication (Benfrew, 1976:22-24). It is the exchange of these concepts which may have brought Mesoamerican concepts of astronomy to the southeastern United States.

The first step in the methodology is a thorough search of ethnohistoric, ethnographic and archaeological documents to provide a cultural background for an interest in astronomy. There are no recognizable written records from this time period; so what is available are the narratives of DeSoto's men as they traveled through the Southeast during the mid-sixteenth century and studies made in the late nineteenth and early twentieth centuries of those people remaining in this region. Early people believed the mound-builders were not the ancestors of these people. The mound-builders "had been exterminated by the treacherous, ignorant, murderous red-skinned savages who even now were causing so much trouble for the Christian settlers of the New World" (Silverberg, 1970:5). Perhaps for this reason, much of the knowledge of these people was not recorded. Records of house construction, food preparation and clothing can be found, but little is known of such things as cosmology, calendars or medicine. "Naturally, a tale recorded early in the sixteenth century by superstitious Spaniards from superstitious Indians would be dismissed as a mere creation of the undisciplined imagination" (Swanton, 1946:755). The Spanish did note the deification of the sun and moon; Swanton (1946:761ff) found this idea still in the Southeast. He (Swanton, 1946:767) also records the importance of the four quarters of the universe, or the four cardinal directions, in their myths and legends; however, there is no mention of the apparent motion of the sun, moon, and stars. Calendrical systems appear based on seasonal changes, rather than on the recognition of the sun as the cause for the changes.

> The great ceremony of the year, the busk or 'green corn dance', occurred usually in July or August and in any case when the first ears of the flour corn became fit to eat. It was sometimes preceded by three minor feasts or 'stomp dances', a month apart. It corresponded to the new year, and was regarded as involving a moral as well as an economic regeneration, typified by the extinction and relighting of fires, a general pardon of all crimes except murder, and preparation of medicines to preserve the general health throughout the year to come (Swanton, 1946:775).

The Handbook of North American Indians, Volume 15, is on the Indians of the Northeast; the editor says that while no Southern Cult material has been recovered in the Northeast, that calendrical ceremonies may have been inspired by those of the Southeast (Trigger, 1978: 803). A look at calendrical systems in the Northeast confirms the base as that of seasonal change, not solar motion. Major Iroquois calendrical ceremonies include the mid-winter, Seed Planting, Strawberry; Bean Green Corn and Harvest (Blau et al., 1978:497). The most confusing reference comes from the northern Iroquois. "Having taken to the woods to hunt for meat after the ingathering of the crops, hunters remained in camp until the Pleiades were observed to have reached the zenith at dusk, at the winter solstice, when they commenced the return home to their villages, packing the meat that had been smoked and dried" (Fenton, 1978:300). First, the Pleiades would not "reach the zenith" in the Northeast; they would appear on the zenith meridian. Second, they would not be at the zenith meridian at dusk on the winter solstice; they would have set long before then. Does the informant really mean winter solstice; does he really mean zenith? Exactly what has been conveyed? Is this evidence of European influence rather than inspiration from the Southeast or is it a misunderstanding? This is the type of problem found in the literature, and those doing research should be aware of this.

The Plains Indians held a celebration called the Sun Dance. It is the only ritualistic procedure that could be considered a tribal ceremony (Wissler, 1921:v). These people lived on a vast plain where winter winds were devastating, so the tribes separated into small groups for winter survival. The reuniting of the tribe came in the early summer in preparation for the tribal hunt at the Sun Dance (La Barre, 1972: 129). La Barre (1972:158) wrote that formative influence on the Sun Dance was provided by the bear ceremonialism, and Opler (1941:570) wrote that the Ute version of the Sun Dance was an adaptation combined with existing rituals. Early documentation of this ceremony appeared in 1833 with reference to a "looking at the sun" dance performed by the Dakota (Wissler, 1921:vii). Other names for the ritual include "thirsting-dance" and ceremonial structure (Spier, 1921:463). It appears to have originated with the Cheyenne and the Arapaho and spread to other Plains tribes, with variations such as torture or use of a symbolic object (Spier, 1921:491ff).

The Sun Dance appears to be a way of cultural revitalization among tribes affected by European intervention; these ceremonies were "inviolable retreats where their white neighbors cannot interfere" (Opler, 1971:285). With the advantage of the horse, entire tribes could gather annually for a form of cultural renewal. Because the ritual "teaches the same code of morality enjoined by the ten commandments" (Mooney, 1896:706) Indian agents did not interfere with its spread. The principal appeal of this ritual was to dreams and visions.

> For days and nights (usually four) the dedicated participants went without food or water and stared fixedly at the top of a central pole, where a red-painted buffalo skull or some other symbolic object represented the sun. The Sun Dance was scarcely a dance; the celebrants stood more or less in one place, rising up and down on their toes or shuffling a little backward and forward. They held eagle-bone whistles in their mouths, to sound with each breath. For those who lasted long enough, a vision might be granted. (Josephy, 1961:337-338).

Most of the tribes adopting some form of this ritual substituted a symbolic object for the sun, and very few referred to the sun in the ceremony. "Nevertheless, though the use of the term is thus misleading in that it implies sun worship as the basic concept in the ceremony, the name is so firmly fixed in literature and in current usage that it must be retained---" (Wissler, 1921:vii). So the Sun Dance does not appear to

influence the southeastern United States; it appears to have been developed later than the Mississippian period and was not directly involved with the worship of the sun.

With the knowledge that the sun, moon and cardinal directions were important in the Southeast, the second step is to visit each site to take sightings on the markers, in this case the mounds. A pocket transit was used as the need for precision was somewhat diminished by the poor conditions of the mounds being surveyed. Erosion and man and animal activities have created indistinct lines to be used for sighting--the sides of the mounds are no longer, if they ever were, straight and level, horizontally and vertically. The pocket transit measures angles based on magnetic north. To convert to a true north-based system, magnetic declinations, the difference between magnetic and true north, were taken from Federal Aviation Agency sectional aeronautical charts. These declinations vary from region to region through time and are constantly being updated for pilots. For more accurate sightings, a transit or theodolite should be used. Sun sightings can be used to correct for true north.

Sightings were taken in both directions. For example, if a ramp faces east, sightings were taken in a northerly and a southerly direction along that side of the mound as well as from the top center of the ramp. The horizon was scanned for possible prominent peaks. These peaks were also noted on the topographic maps of that region. The peaks were then included as possible markers for alignments.

At each site I visited the Museum and talked with the personnel. I also spoke with people in the area to learn the history of the site and local myths and legends. Museum collections, field notes and other pertinent material were also used in the analysis. For example, I learned that in periods of drought, the crops planted on top of Mound A at Etowah flourished, and that researchers had gone there looking for the Holy Grail. Site maps were helpful in locating important features.

Field work for this study was done at several times. In August 1976, I visited Cahokia, Illinois, for three days. I walked over as much of the site as possible and talked with the staff at the Museum and the Park. I returned in November 1977, for three days, to study the area where the circles had been found. Telephone poles had been erected in pertinent locations, marking the post pits of circle number two. This time I was able to observe the horizon marked by these posts. In August 1978, I visited Etowah, Georgia, for two days, and Moundville, Alabama, for four days. This was the wrong time to do field work as the heat was exhausting. To avoid the sun, I worked earlier in the morning and later in the evening, leaving two hours at midday for a rest in a cooler location. In November 1979, I spent two days at Kincaid, Illinois, and two days at Angel, Indiana. This time the weather was glorious, crisp and clear; the insects were gone and so was the humidity. I was able to spend most of the daylight hours in the field.

Maps of mound locations were made from this date, using topographic maps and aerial photographs. Aerial photographs can be obtained through the Agricultural Stabilization and Conservation Service of the Department of Agriculture. These maps are available to the public for a small fee and come in various scales. While there is some distortion in these photographs, it is minimal and does not affect the orientation of the mounds. The azimuths, or sightings, obtained with a pocket transit were used to correct the map and orient it towards true north.

From this map, measurements were made involving combinations of mounds, taking into consideration topographic obstacles such as intervening mounds and heights of the mounds involved. Possible alignments using the sides of the mounds or the diagonals were not considered because the mounds have been significantly modified so the sides can no longer be considered original. The center of each mound and the top center of each ramp, if one exists, were used as possible markers. United States Coastal and Geodetic Survey topographic maps were used to learn the height and distance to the peaks that might have served as markers. These peaks were then used in combination with the various mounds to determine possible alignments. Orientation of the site as a whole was also considered.

The azimuths for the visible planets, the stars, the sun and moon were taken from astronomical tables provided by Aveni (1972). These azimuths were then compared with azimuths, or measurements, obtained from the mounds. A reading error of 1° was accepted for sightings in this research.

As will be seen, the results were not conclusive. While there were no outstanding instances of alignments, there are hints of possible comparison with Mesoamerican

site orientation of satellite centers around each of these three sites.

To provide a better understanding of the question of contact, a description of the Mississippian in the southeastern United States and of Mesoamerican influence there will follow an explanation of archaeoastronomy and a synopsis of Mesoamerican astronomy.

ARCHAEOASTRONOMY

From the publication of Sir Norman Lockyer's DAWN OF ASTRONOMY in 1894 until the Stonehenge controversy of the sixties, archaeoastronomy has been an area of argument and debate, having roots neither in the social sciences nor in the physical sciences. As a cooperative interdisciplinary study among archaeologists, astronomers, engineers, art historians, mathematicians, and architects, archaeoastronomy has revealed much of prehistoric man's ideas of his universe. The knowledge he had of astronomy, mathematics and physics has been recorded in calendrical systems, rock art, architecture and monuments and in written documents. In the southeastern United States there are no buildings remaining from prehistoric times, due, perhaps to the unavailability of lasting materials. What has been left are the earthen mounds used to provide foundations for houses, temples and other public buildings. The relationships between the major mounds, and between the mounds and other markers will be considered here.

There have been many articles in the area of pseudoscience concerning the "wonderful secret knowledge our ancestors had and has been lost" (Mackie, 1977:7).

Such topics as prehistoric computers, ley lines, lost continents and contact with visitors from space have gained much popular support. This support has resulted in prejudice against reputable work in this field. In order to remedy this situation, a systematic, logical approach to archaeoastronomy must be developed, with concentration on the evidence and theories which best fit the realities of the specific area and time being considered. That is the purpose of this research.

Much has been written about the new archaeology (Binford and Binford, 1968; Mueller, 1975; Redman, 1973; Schiffer, 1976), the adaptation of mathematical and scientific techniques at the expense of the historical approach. Archaeological evidence consists of fragmentary pieces of material culture. Scientific evidence in other fields consists of self-explanatory data, which support the formulation of theories and hypotheses to suggest new areas of research and experimentation. Archaeological data itself contains little information; its interpretation is derived from comparison with historical or contemporary analogies, and with an understanding of the culture involved. As far as material remains of past human activities are concerned, the social complexities involving individuals and groups which led to the creation of these materials are lost and obscured.

The new archaeology utilizes mathematical and statistical techniques to analyze its data. The pitfalls of these applications are obvious. With the modern computer answers can be given to sixteen decimal places, evidence and implication of extreme accuracy. The inclination is to accept and depend on the answer as accurate without looking at the data or analysis procedure, but this acceptance can be misleading.

A good example of this is found in determining the length of the side of a cube 8 cubic meters in volume. The answer is found in the cube root of the volume. Yet there are other solutions to the $\sqrt[3]{8}$ which are also correct mathematically, $-1 \pm \sqrt{3}$. The appropriate correct answer must be determined through application to the situation, the real world. Thus the archaeoastronomer can find several correct answers; the best one is that which fits the real situation. Alignments may be found, but unless they fit in with the culture of that region and time, they cannot be fully accepted as intentional.

Prehistoric knowledge of astronomy would include recognition of fixed stars and planets; the realization that a fixed non-circumpolar star will rise and set at the same two places on the horizon, while the sun, moon and planets do not, that Venus is both the morning and the evening star. Perodicities of the sun, moon and the five planets visible to the unaided observer (Mercury, Venus, Mars, Jupiter and Saturn) would be noted and followed. When studying prehistoric astronomy, these are the asterisms to look for both in the literature of the culture as well as its material remains.

Given N objects, there are N(N-1) possible alignments. Many of these may be redundant or impractical; some may be impossible to view due to topology or man-made obstructions. For the measurement of alignments Hawkins (1968:48-50) has provided criteria by which to judge the accuracy of the data:

1. Construction dates should not be determined from astronomical alignments. This is essentially putting the cart before the horse.
2. Alignments should be restricted to man-made markers. There are many natural points of interest on the average horizon; there must be a specific reason for selecting the site or location of the horizon. The combination of natural and man-made markers is a reasonable one.

3. Alignments should be postulated only for a homogeneous group of markers. It is possible to find an alignment for every celestial object on the horizon, so care must be taken to determine intent, not accident. A further refinement would include chronology of the markers (this would eliminate confusion in regions where several occupations occurred).
4. All related celestial positions should be included in the analysis. It is unlikely that only one solstice or one equinox would be marked.
5. All possible alignments at a site must be considered. Because one is dealing with an unknown, all possibilities should be explored. Many alignments can be eliminated by inspection of the site and some knowledge of astronomy.

These criteria are excellent as initial steps in the analysis of a site. They should not be adopted as definitive, though. In doing archaeoastronomical research, one should remain flexible and adapt to the local situation. For example, while construction dates should not be determined from astronomical data, this data can be used to support other information concerning the date. While all related celestial positions should be included in the analysis, one should not expect to find both rising and setting positions marked. This need for symmetry does not necessarily apply to all regions for all time periods. All possible alignments should be considered for a thorough analysis; some of these alignments can be eliminated or identified through archival research prior to field work.

When considering possible alignments, the motions of the sun, moon and the five visible planets should be included, as well as stars of magnitude two or greater. These stars are the brightest in the sky, the ones most likely to be noticed and observed. Research into the literature of the particular culture and time period being studied should be done prior to field work. This would identify interest in specific celestial bodies and what knowledge of astronomy is available to the people.

One purpose for celestial observation would be to assist in the planning and execution of a successful agricultural cycle. Ethnographic data indicate that much, perhaps most, ceremonial activity took place in conjunction with seasonal changes (Howard, 1968; Parsons, 1936). The Egyptians were concerned with the Nile

River flooding (Parker, 1974); the southwest United States with temperature change for planting cycles (Reyman, 1975a). Planting cycles, based on seasonal changes, would be most important to an agrarian society. A second purpose would be to increase the power and prestige of the priestly class. Many societies (the Maya, the Egyptians, and the Natchez, for example) had special status for its priests/astronomers. Columbus was able to obtain supplies for his ships from native Jamaicans after threatening them with the destruction of the moon; he had a table of lunar eclipses (Hartmann, 1978:22). A third purpose would be for navigational purposes. The nomads crossing the desert would move at night to avoid the heat and would find the stars to be their guides. Micronesian and Polynesian travelers used star paths (the succession of stars that rise or set on the same azimuth) to steer their sea crafts (Lewis, 1974). A fourth purpose could be called the pursuit of scientific knowledge, that is, the understanding of the mechanisms on which the universe operates. This would include the development of a lunar ephemeris by the Babylonians (Aaboe, 1974), the division of time into hours by the Egyptians (Parker, 1974), and eclipse predictions by the Maya (Thompson, 1974). If man is placed at the center of the universe, then this purpose might be for the sake of religion, the explanation man derived for the world around him. He could then begin to understand his place in the universe and how he fitted into it.

Archaeoastronomy is a recently developed interdisciplinary field. Because of this some of its problems are still being solved. Field work is being done without sufficient knowledge of the culture or cultures that occupied the site. For this reason, alignments are being postulated for cultures which may not have had such a sophisticated knowledge of astronomy or had an interest in those particular celestial bodies. Reyman (1975a) has written an excellent analysis of the problems in archaeoastronomical research. He recognizes four major areas: 1) an inadequate conceptual scheme or theoretical approach; 2) an insufficient control of the relevant ethnohistoric, ethnographic, and/or archaeological data; 3) the failure to formulate specific field problems, hypotheses, and test implications; and 4) the lack of a consistant, systematic procedure for conducting field work, coupled with the possibility of unsuitable field equipment (Reyman, 1975a:205).

Independent field work is necessary to gather accurate data. Using site maps drawn by others may introduce undetected errors. Sometimes the site orientation is in error (for example, Thomas' 1894 map of Etowah, see figure 7); sometimes mound placement is in error (for example, Moore's 1905 map of Moundville, see figure 5). These maps do not always include necessary information concerning the surrounding region. To analyze natural markers a good topographic map is required; this form of mapping is not always included in archaeological documentation. Accurate on-site mapping is necessary, along with aerial photographs and topographic maps.

In addition to these criteria, consideration should be given to the field equipment used in determining alignments. A faulty instrument can introduce error. For some measurements, accuracy to within a few minutes may be required. Reyman (1975b) had this experience while taking measurements at the Sun Temple at Mesa Verde, Colorado. Fortunately, the error was discovered and a return trip to the field was possible.

A sophisticated instrument may imply accuracy that is non-existent or be a matter of overkill. The most common instrument is the compass, which measures

magnetic north. This is different from, though close to, true north on which the celestial alignments are based. Because magnetic north is not static, accurate dates are important and calculations are necessary to adjust from magnetic north to true north. The correction necessary for this adjustment can be obtained from sectional aeronautical charts published by the Federal Aviation Agency. These charts are updated periodically and are available locally. Asking for the magnetic declination from local airport personnel is not reliable and should not be done.

A transit is more desirable than a compass because angular orientations can be determined immediately and accurately. Magnetic variations within the site must be known and it must be used during daylight, thereby eliminating nocturnal observations. Transits come in various sizes and capabilities.

The most convenient and easily used is the pocket transit, or Brunton Compass as it is often called. It combines the principles of a compass, a clinometer (used for measuring the amount of slope), and a hand level, and can be mounted on a tripod. It is used to determine compass bearings (thereby measuring horizontal angles), to measure vertical angles, and inclination of objects, to run levels and measure the percent of slope. The instrument may be used in a horizontal or a vertical position, depending on the measurement being taken.

The most sophisticated instrument is the theodolite. Its use requires more space than some locations, the inside of a kiva or tower in the southwestern United States, may provide, and its accuracy may not be required in all instances. Because it is a more complex instrument, the user should be familiar with it prior to field work. There are publications available concerning field methods for a non-professional surveyor (Pugh, 1975; Reyman, 1978a).

To do archaeoastronomical research one must have knowledge of both astronomy and anthropology. The astronomy provides accuracy and the anthropology provides application. Knowledge of astronomy is necessary to understand movement of bodies through the universe and what would be visible where and when. Knowledge of anthropology is necessary to place the astronomy in a cultural context, why it was needed, how it was used, who developed and controlled the information.

> In summary, we must (1) ask what selective advantage accrues to those who watch the sky and record astronomical events? What celestial features are most useful for the purpose? and what are the best methods for permanently preserving such information? (2) use the relevant ethnographic, ethnohistoric, and archaeological data to support hypotheses generated from our observations, to formulate general research problems, specific hypotheses for testing, and the test implications for these hypotheses: (3) employ an ordered methodology and consistent field techniques to collect the data needed to evaluate the hypotheses. Explanation must result from the systematic testing and evaluation of problem-oriented hypotheses, not as an after-the-fact development from the haphazard discovery of alignments (Reyman, 1975a:214-215).

MESOAMERICAN INTEREST IN ASTRONOMY

Ancient Mesoamerican astronomy was the result of many centuries of thought and observation, developing and refining concepts. What is known of the Mesoamerican astronomy has been learned from documents written prior to or shortly after the Spanish conquest. While the Spanish systematically destroyed the Mesoamerican records, seventeen relatively complete codices survived. Of these, ten pertain to astronomy (Peterson, 1959:237-239). Spanish chroniclers (Sahagun, 1938; Landa, 1941) wrote little concerning the importance astronomy had in the Mesoamerican society.

Since the early nineteen hundreds, much has been written about this astronomy. For more detail several general sources can be consulted (HANDBOOK OF MIDDLE AMERICAN INDIANS; Baity, 1973; Collea and Aveni, 1978). For this study, a comprehensive synopsis is not required; however, a review of those regions which may have diffused knowledge north will be included.

It would appear that the Mesoamericans were interested in numerology and numerological relationships as well as the geometry of astronomy; the study of their architecture is adding to this knowledge. Their

calendar system can best be described as a set of intermeshing gears. The Sacred Count involved thirteen day numbers meshing with twenty day names; in such a system a given combination number-and-day name appears only once every 260 days. It should be noted here that the concept of "day" is ill-defined. Whether it was a 24-hour period is unknown. The concept of "hours" may have been unknown. Whether the day started at sunset, sunrise or noon is also unknown. The Vague Year is divided into 18 "months" of 20 number days; to this is added a five-day interval; this period was considered extremely unlucky. In fact, to be born during these five days was considered a dangerous omen. To create what we would consider a leap year, one theory suggests that every four years the Aztec would add a sixth day, and to keep the populace from noticing the addition, they were required to remain drunk during this period (Castillo, 1971:89). A day could then be specified by the ritual day number and day name from the Sacred Count and the day of the month and month name from the Vague Year, thus combining both systems. This specific day would occur once every 18980 days or 52 years, called the Calendar Round in recent times (Gibbs, 1975:24). The Aztecs celebrated the beginning of a new Calendar Round (every 52 years) with a fire drilling ceremony and a readjusting of the calendar based on the movement of stars unknown today (Castillo, 1971:88); the discrepancy created by the difference between sideral and solar time was not discovered because the Aztec empire did not last that long (Brotherston, 1975:16).

Then the Long Count was used. This third system involved a place value system based on the given times the place name, kin, uinals, tuns and multiples of tuns. All Long Count dates are related to the distant 4 AHAU 8 CUMKU, the day time began. So a date 3.0.12.11.4. 8KAN 12 CUMKU is 436544 days after the beginning date (1212 tuns and 244 days or 23 Calendar Rounds and 4 days after 4 AHAU 8 CUMKU). To correlate this calendar with the current Gregorian calendar is beyond the scope of this study, as there is disagreement among scholars on this process. The Calendar Stone of the Aztecs has been called the Market Stone of Mexico City (Nuttall, 1901:245), in that it pre-set the market dates and determined the positions of the people for each public appearance. The twenty-day signs inscribed on the stone constituted a native zodiac, with constellations represented on it. There are several theories as to the origin of the Mexican

calendrical system (Seler, 1904; Spinden, 1933; Thompson, 1932), each of which traces the systems back to the Maya. Jakeman (1947) found these theories unacceptable and devised his own theory, based on the development of the Toltec calendar directly from that of the Maya. The Sacred Round, the Long Count and the Calendar Round were retained until the Aztec system when it was lost.

Father Motolinia (as quoted by Maudsley, 1912: 175), heard an Aztec leader had a building destroyed and rebuilt to correct its astronomical alignment. Current ethnoastronomical data confirms the retention of the 260-day calendar among the present-day residents of the Guatemalan highland, along the cordillera up into southern Mexico and the Mazatec and Mive have retained the 18 x 20 day year (Nash, 1957:151; Remington, 1977: 76). Specific knowledge of the calendar is reserved for the shaman (Remington, 1977:76). Part of the calendar has changed, but Venus and the Moon remain important. A non-western concept of spatial orientation has remained along with the names of several stars and constellations. Much of what had been learned is irretrievably lost. When the chroniclers tried to record local knowledge, problems arose. The constellations were difficult to place, as the stars involved may not have been identical to those used by the western world. Communication between the informant and the interrogator must have been difficult, if not impossible or quite limited. The informant may have misunderstood what was being asked of him or which star or constellation the interrogator indicated. As astronomers died, a generation after the Conquest, this information was lost.

Caso (1967:77) and others have argued that the Mesoamerican calendars and hieroglyphs used to record them were first employed at Monte Alban in the Valley of Oaxaca, possibly as early as the sixth century, B.C. Stones from Mound J, Monte Alban, provide examples of an early glyph-style writing. Well-defined elements appear, often in vertical sequence. Dates and names of calendar signs and bar-and-dot numbers are present. The twenty signs, representing such mythical and mystical entities as Wind, Water, Death, Flint, Rainstorm, and Dog appear throughout Mesoamerica. Though the pre-Toltec signs vary somewhat, they remain similar elsewhere, among the Mixtecs, the Aztecs and other Nahua groups, the Maya from pre-Classic times, and even the Otomi. The discovery of such symbols carved on bones found in Tomb 7 at Monte Alban (Caso, 1965:956) provides a basis for a common origin for this notation. This would support the diffusion of the sacred and secular counts across the Isthmus of Tehuantepec from Izapa into the region of the Olmec, rather than vice versa.

Malström (1978:109) mapped the orientation of nearly fifty Mesoamerican centers and analyzed others, suggesting two main prongs of calendrical diffusion. A minor one leads south and east along the Guatemalan highlands and a major one leads north and west through the Tehuantepec gap to the Olmec region. From this prong, a secondary arm appears to bend eastward to Uaxactun and Tikal. Diffusion of architectural orientation is another process that has been documented. Orientation of the principal axes of Toltec-period buildings at Chichen Itza, in particular the Platform of Venus, the Great Ballcourt and the Tzompantli, is mirrored at Tula, Tenayuca, and Teotihuacan (Aveni et al., 1975:978). "It is likely that Teotihuacan served as a model for the other sites, and that architects copied the sacred direction by laying out an astronomical baseline at the model site and transferring it to the new ceremonial centers" (Aveni and Gibbs, 1976:510).

Malström (1973) also places the origin of the 260-day count at Izapa, on the Pacific coastal plain of Mexico and says it was a measure of the interval between zenithal sun positions. Thompson (1950:98-99) says it comes from a permutation of the numbers 13 and 20, both of which were important to Mesoamerican thought. Another theory is based on the Venus cycle (Nuttall, 1904:491). The yearly trip around the Sun requires 225 days and the synodic cycle is 584 days, neither of which contains the sacred number 260. Other explanations include the gestation period of the human female and the eclipse half year (a 173.5 day eclipse cycle) in a 3 to 2 ratio with the Tzolkin (Aveni et al., 1978:279). Some Maya sites are located near latitude 15°N where the two passages of the Sun through the zenith take place at an interval of 105 days. This 105-day period is also the interval between the two planting dates for this region (Coe, 1975:9). It is possible the 260-day cycle was an integral part of the agricultural year, and hence became a religious symbol. The idea that no rational explanation for that specific number could be found was expressed by Sahagun (1957:145). He also stated that no man could have invented this system because it has no foundation in nature or science.

The sun and moon were important in Mesoamerican astronomy. To the Maya, the sun was an old god; to the central Mexicans the sun was young, often represented in the form of an eagle. According to the Aztecs, the sun was fed the hearts of captives. References to solstices or equinoxes are missing in the remaining Mesoamerican literature. There are eclipse tables in the Dresden Codex, tables of predicted eclipses, not observed ones. It was believed the world would end during a solar eclipse (an idea still held by present-day Maya) or that frightening creatures would descend from the heavens, so prediction was necessary to schedule ceremonies to divert such disasters.

The moon was believed to be a female deity--changing from a beautiful woman at the waxing moon to an old crone with the waning moon. The Maya kept records of synodic lunations over a long period of time. According to Coe (1975:16), "In spite of claims to the contrary, the only astronomical calculations which surely are present on Maya monuments of the Classic period are lunar." There appears to be attempts at correlating lunar months with the solar calendar (Coe, 1975:17; Teeple, 1939:70-85). The beginning of a lunar month is still an unknown. Some Maya specialists have placed it at the full moon, some at new moon. Copan and Palenque have evidence, in the form of engravings, of these attempts. As the paths of the sun and moon (the line of nodes) cross every 173.31 days, an eclipse could occur three times in 519.93 days, just two hours short of two Sacred Counts. A motivation for these eclipse tables could be found in the activities in a thirteen-year period from 331 A.D. to 334 A.D. During this period five solar eclipses were visible to the Maya; a total eclipse in 331, a partial in 335, near total eclipses in 338 and 344, and an annular eclipse in 342 (Hartmann, 1978:29). In 495 A.D. two partial solar eclipses were visible in this region only thirty days apart, with a lunar eclipse in between.

Evidence of interest in lunar and solar movement may be found in Mesoamerican architecture. The Templo Mayor at Tenochtitlan appears to have been built to permit observation of equinoctal sunrise from the Temple of Quetzalcoatl (Aveni, 1978:177; Aveni and Gibbs, 1976:513-515). This was the building reconstructed by the Aztecs to improve its alignment. At Copan, alignments toward the solstice, zenith passage and equinox are marked along a baseline created by Stela 12 and Stela 10. These divide the tropical year into intervals based on the calendrical unit uinal (Aveni, 1977:9ff). Fuson (1969) drew solsticial and equinoctal alignments on maps of Chichen Itza, Uxman and Copan. As he did not refer to exact architectural features and did not use proper maps, his results cannot be relied upon. However, studies (Aveni, 1975; Aveni et al., 1975; Aveni and Hartung, 1978) done at the Caracol at Chichen Itza indicated window alignments with Venus and solar positions. The Caracol of Mayapan and the Castillo at Paalmul may also have solar alignments (Aveni and Hartung, 1978:136ff). The Group E structures at Uaxactun should also be included. From a vantage point on a pyramidal structure, one can look east to see three small buildings on a single platform. To the northeast the viewer can observe the summer solstice, toward the east, the equinoxes, and to the southeast the viewer can observe the winter solstice (Aveni, 1977:17). Even shadows are used to denote specific events. On both equinoxes, about an hour before sunset, an undulating line is produced by the shadow of the northwest corner of the Castillo at Chichen Itza, falling on the western side of the north stairway, which has a serpent head at the lower end of the balustrade, thus creating the image of the serpent. Hartung (1977:126) suggests a similar association at Tikal, with Temple II casting a shadow on the steps of Temple I. Two events occur at the setting of the sun at winter solstice at Palenque which are worthy of attention. The last direct sunlight of the winter solstice sun is seen to enter the earth over the approximate center of the Temple of Inscriptions (actually it goes behind a ridge), so that it appears to enter the underworld through the tomb of a dead leader, Pacal (Schele, 1977). The famous sarcophagus on the tomb of Pacal is engraved with a symbolic representation of this event.

Of the planets, Venus appears as the most significant to the Mesoamericans. Possible alignments have been found at Chichen Itza, Uxmal, Copen, Mayapan and Paalmul (Aveni, 1977; Aveni and Hartung, 1978). The Venus table from the Dresden Codex contains 65 synodic revolutions of the planet; that is from one heliacal rising after inferior conjunction to the next and averages 584 days.

$$65\times584 = 146\times260 = 104\times365 = 2\times18980$$

The synodic period is about 583.92, but this would throw the calendar out of synchronization. Through corrections given in the Codex, the Maya first made a four-day and

then an eight-day correction to restore the calendar to the proper order (Thompson, 1974). The Maya were interested only in heliacal risings and disappearances before conjunction, not in either inferior or superior conjunction (when lost in the glare of the sun). The Maya considered this a dangerous time for their world, and by predicting the day of heliacal rising, the priest/astronomer could instigate the proper precautions.

Alignments toward Venus are the most prominent in Mesoamerica. The Caracol at Chichen Itza, the Castillo at Paalmul, the Governor's Palace at Uxmal, the Temple of Venus at Copan are examples of the interest in Venus. The panels at the Ball Court at Tajin have been interpreted as various positions of Venus (Cook de Leonard, 1975), with Venus as the Evening Star, the Morning Star, in occultation, and the change from Evening to Morning Star. There are no other apparent planets toward which alignments have been constructed. Tables in the Dresden Codex have been interpreted as the synodic periods of Mars, Jupiter, Saturn and Mercury, but no two scholars agree as to which planet corresponds to a specific table. No studies of the literature or architecture have uncovered evidence of interest in planets other than Venus.

There are some 3000 stars visible to the naked eye. In the latitudes of Mesoamerica, many of these would have been seen. The Milky Way, the Big Dipper, Orion's Belt, the Pleiades, Castor and Pollux were among the constellations which may have interested the priest/astronomer (Coe, 1975:22). There are texts referring to the Pleiades, both in Aztec and Maya literature. Sahagun (1957:143-144) mentions a ceremony at the end of the 52 year cycle, during which the Aztecs went to the Hill of the Star to look for Pleiades. Another Sahagun constellation is the Fire Drill, which has been identified as Castor and Pollux, but Coe (1975:26) believes it was the Belt and Sword of Orion. A constellation, described by Sahagun as S-shaped stars in tne mouth of a trumpet, has been identified by Nuttall (1901:33) as the Little Dipper, but Seler (1904:358) says it is in the southern sky, so it probably is the Southern Cross. Both the Maya and the Aztec had a word for the Milky Way, though there does not appear to be a corresponding alignment or document to indicate more interest in it. Claims of alignments to Pleiades,

Aldebaran and the solstices have been made for the Pyramid at Tenayuca (Marquina and Ruiz, 1935:112).

At Monté Alban is an arrow-shaped building with an axis toward Capella, and a similarly shaped building at nearby Caballito Blance seems to point toward Sirius. Neither of these alignments is supported by the literature available, so the purpose of these structures is still a question. Pecked crosses in stone at Teotihuacan indicate a line toward the Pleiades and a window at the Caracol of Mayapan may align with them also (Aveni, 1975:168-169; Aveni and Hartung, 1978:140).

The cardinal points based on the celestial pole do not seem to be significant in Mesoamerica. In fact, they may not have been recognized. However, quadripartite division of the universe was important. It has been suggested that the Pleiades was the center of their sky, rather than Polaris. To start the universe the male-female deity produced four offspring, each of whom was assigned a direction and a color. Contemporary Maya consider the four directions to be those of the solstices, not the cardinal points based on the celestial pole (Coe, 1975:8-9; Remington, 1977:77). The Aztecs assigned colors to the cardinal points (Aveni et al., 1978:276; Caso, 1971:339), and represented the four corners of the universe as positions of the sun. Vernal equinox was east, winter solstice as south, autumnal equinox as west, and summer solstice was north (Carrasco, 1977:273).

Mesoamerican astronomy appears to have revolved around the sun and moon. Interpretation of architectural alignments indicates the solstices, equinox and zenith passage played a large part in Mesoamerican astronomy. Predictions of eclipses were recorded. Of the planets, only Venus was observed by the astronomers, at least as far as can be determined at this time. The Pleiades were watched throughout Mesoamerica, perhaps because heliacal rising occurred approximately on the same day as the passage of the sun through the zenith in the vicinity of Teotihuacan (Aveni, 1975:17). Other asterisms that may have been recognized are Castor and Pollux, the belt and sword of Orion, the Southern Cross (not visible in the southeastern United States), the Little Dipper, Capella and Sirius. An elaborate calendrical system was used throughout Mesoamerica; it involved the numbers 4, 5, 9, 13 and 20 and multiples of these. So when one looks at another region for comparable interest in astronomy, these are the important celestial bodies to watch for. However, one must be cautious while looking for this comparable interest. There is only one sun and one moon for the areas to view. With five planets visible to the unaided observer, the selection of Venus may be significant. With all the stars of the first or second magnitude, the selection of the Pleiades may also be significant. Comparison, then, with the southeastern United States will center on these particular celestial bodies.

MESOAMERICAN INFLUENCE IN THE SOUTHEAST

The process of Mesoamerican diffusion into the southeastern United States is presently unknown, though it is accepted as the basis of much of what is called the Mississippian cultural tradition. A possible Mesoamerican origin of numerous elements found in the southeast have been suggested by Moorehead (1929b:552). They include the truncated pyramid or temple mound, monolithic hatches, seated human figures, sculptured idol heads, plumed serpents as decorative or symbolic motives, vessels with tripod feet, certain engraved shells, spool-shaped ear ornaments and long ceremonial swords shaped from flint.

Fluted blades have been recovered in northern Mexico and some from Central America (M. Coe, as cited in Griffin, 1966:113). The Desert culture was found in the western United States before and during the Archaic period, and spread east through Texas and Oklahoma and into northern Mexico by 8000-6000 B.C. (W. W. Taylor, as cited by Griffin, 1966:113). Excavations near Tehuacan, Puebla, have uncovered projectile points related to the Plano forms of the Plains region; in Tamaulipas, projectile point forms and stone tools found

compare with those of the southeastern United States (Griffin, 1966:115). Agriculture was developing in Mesoamerica but not in the southeast at this point. "If up to this time one tends to see a general movement of cultural traits from north to south, this is clearly reversed in the 1500 B.C. - 1500 A.D. span of time, beginning with the introduction of agriculture into the United States" (Griffin, 1966:117).

It has been suggested that one of the predominant peoples of the eastern United States during the Woodland period, the Adena, were derived from Mesoamerica through migrations up the Mississippi River (Webb and Snow, 1945:328-335). While not accepted today, this idea was indicative of the importance given influence from Mesoamerica. Earspools used during the latter part of the Hopewellian period resemble those from Mesoamerica; clay figurines are similar to those of the La Venta - Olmec; the emphasis on green celts, the truncated mound at La Venta have supported the possibility of earth-mound building arriving in the eastern United States from Mexico. Burial mounds have been recognized in parts of Mexico (Adams, 1977:130-131), and in the West Indies (Rouse, 1949:127).

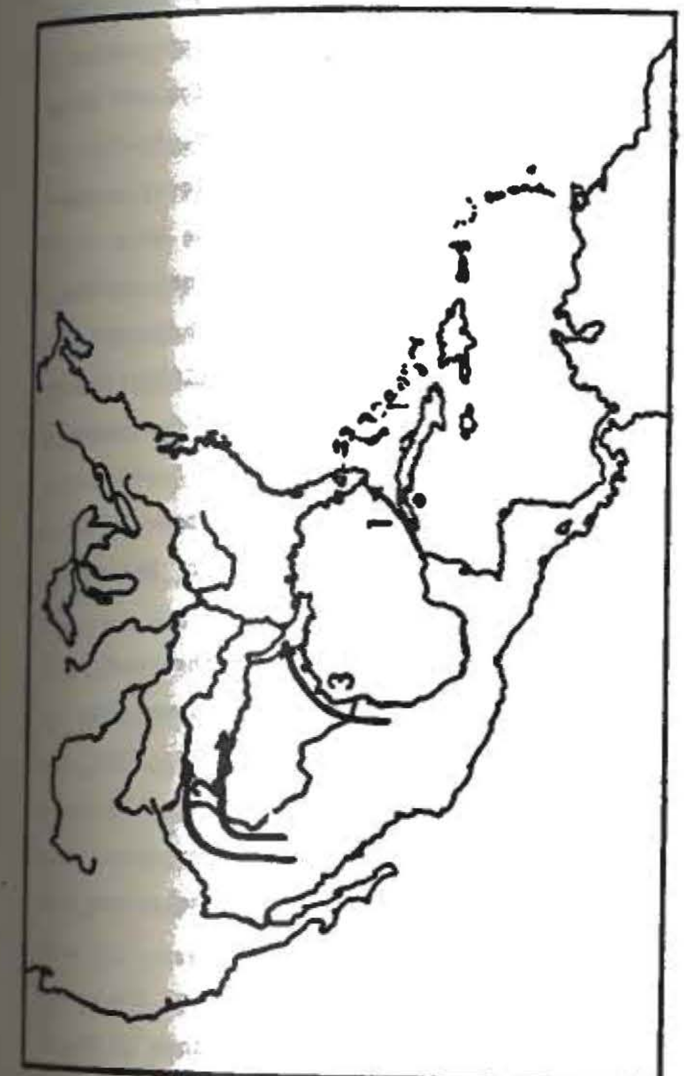
According to current literature, the earliest large-scale ceremonial mound building was in the Olmec region of Mesoamerica. At the San Lorenzo site, located on a small plateau above a branch of the Coatzacoalcos River, Coe et al. (1967) obtained C^{14} dates that ranged between 1200 and 800 B.C. Stirling described the mound as a conical structure, "...although it may originally have been a pyramid" (Stirling, 1955:9). The mound was about 7.5 meters high and was at the south end of a rectangular plaza, enclosed by earthen embankments.

The dates for La Venta indicate an occupation from 1100 B.C. or, essentially coeval with San Lorenzo. La Venta, located on an island in a swamp near the coast, was much larger than San Lorenzo, but followed the same basic plan. The principal feature was at first thought to be a flat top pyramid (Drucker et al., 1959:11), but recent research has proven it to be a large earth cone about thirty-two meters high with a small flattened summit, and ten pronounced "flutes" extending from the summit to the base along the sides of the mound (Heizer and Drucker, 1968). The arrangement of structures at La Venta is formal and complex; smaller features were symmetrically located on either side of a center line, running through the middle of the large pyramid northward measuring eight degrees west of true north. Aligned with the outer edges of the pyramid are two linear mounds that extend parallel for one hundred meters to the north. Between them is a third mound, lower than the other two, beyond which are two low platform mounds with enclosures formed by rows of columnar basalt. Shortly after the construction at La Venta, mound building was widely practiced along the Gulf Coast of Mexico. On the coast north of Veracruz, in the Valley of the Actopan River, there are dozens of impressive earthen structures (Ford, 1969:15ff).

About this same time mounds were constructed at Poverty Point, in northeastern Louisiana, not far from the Mississippi River. In association with the large bird effigy and a conical burial mound are six concentric arcs which may have been complete circles at one time. There were also several smaller mounds, now destroyed. These are the earliest mounds known along the Mississippi River region, dating to about 800 B.C. (Ford and Webb, 1956:116). A series of phases in the development of burial mounds in the Ohio and Upper Mississippi Valley began about 800 B.C. with small low mounds covering a few burials. Burial mounds dated to about 600 B.C. have been found in Michigan (Willey, 1978:522). Only later, about 200 B.C. to 200 A.D. were large multiburial mounds built by the late Adena and Ohio Hopewell (Griffin, 1952). Comparison of artifacts found (Meggers, 1973:115) and similar orientation of the effigy mound at Poverty Point and the grooved axe, and the ability to drill stone are all indications of Mesoamerican-southeastern United States contact (Griffin, 1966:120).

The introduction of maize agriculture, the appearance of the platform mound, the engraving technique of decoration, often with paint rubbed into the lines, and the pottery styles all speak of Mesoamerican influence during the Mississippian period. While there is no evidence of large migratory groups, there was some means of contact.

There are three possible routes by which Mesoamerican influence could have reached the southeast; via the Yucatan, Cuba, and Florida; along the Gulf Coast of Mexico and Texas; and up the Mexican Cordillera to the Pueblo region and then east, see map 2. At present the Antillean route is not well-supported. Antillean and mainland cultures differed greatly and there have been no artifacts found to indicate a pre-Columbian migration



Map 2 Possible routes of diffusion between Mesoamerica and the southeastern United State: (1) the Antillean route; (2) the southwestern route; and (3) the coastal route

(Mason, 1935:29). The monolithic axes mentioned by Moorehead should be considered at this point. There is the view which sees circum-Caribbean culture spreading eastward along the north coast of South America and then out into the Antilles (Alegria, 1951; Steward, 1947). Webb and DeJarnette (1942:299) list monolithic axes and ascribe their distribution to contact with the West Indies. Mason (1937:123-124) indicates that monolithic axes similar to those found in the Southeast have also been found in the Antilles. Further, Mason (1939:175) described axes found in the Tairona region of Columbia, many of which were comparable to those of the Southeast. The use of ball courts, dance plazas, large stone idols and small stone artifacts are characteristic of Meso-america (Lanning, 1974a:103).

The two stelae at Crystal River, on the Gulf Coast of Florida may be evidence of contact across the water (from 30 B.C. to 300 A.D.) (Bullen, 1966). The stelae do not contain hieroglyphics, so bear little resemblence to Mesoamerican stelae; they are engraved standing stones, perhaps marking equinox and solstices (Hardman, 1971:146ff).

The Crystal River site is also important for its abundance of negative painted vessels, unique in the

Southeast, both for its shape and design (Caldwell, 1958:62). There is no evidence to tie it to Mississippian styles, though other forms of negative-painted wares have been found at a number of Mississippian sites. The knowledge of this technique may have come into the Southeast from the Vera Cruz-Tamaulipas area (Bennett, 1944:41ff; Caldwell, 1958:64; Mason, 1935:33-43). Santa Rosa pottery from Florida has designs similar to those of the Southern Cult during the Mississippian period. However, the Santa Rosa period predates the Southern Cult by approximately 1000 years. The prototypes of cult symbols with pottery styles believed to have come from Mesoamerica, particularly the Vera Cruz-Tamaulipas region, gives substance to a common origin for both the Gulf Tradition and the Southern Cult (Caldwell, 1958:64). Caldwell dated the Mississippian as being formed prior to 1000 A.D. and the Southern Cult, about 1200-1300 A.D. That traits appeared in the Southeast as a part of the Gulf Tradition, and moved into a Mississippian tradition, that of the Southern Cult, and more limited geographically and temporally than the Mississippian culture is not easily accepted and has been opposed by archaeologists (see Kreiger in Griffin, 1960:48).

The theory that cultural development in the Southeast was under the influence of a circum-Caribbean culture was proposed by Sears (1954:339ff). He regarded the social structures in both areas to be similar and listed traits common to both regions, such as emphasis on war, palisaded villages, the priest-temple-idol cult, platform beds, pole and thatch house construction, retainer sacrifice, the blow gun, and litter carriers for the leader. Willey (1949a:108ff) lists dug-out canoes, the stone celt, basketry and ceramic ideas.

Contact between the West Indies and Florida appears with the Ciboney culture, who perhaps migrated to Cuba via the Florida Keys; shell gouges, flaked blades of flint, splinter bone awls, and the few examples of Ciboney art are similar to Florida artifacts (Rouse, 1949:126). Burial mounds in Cuba are similar to those of the Glades and Malabar traditions of Florida; cremation practices, secondary burials and red ocher also provide links between the Ciboney and the Glades tradition (Rouse, 1949:127). However, there are traits of Glades people not found among the Ciboney; for example, canals, earth works, and bone and flint projectile points are Glades traits not found in the Antilles. The more progressive Arawak were agriculturalists at the time of Columbus with large, permanent villages accompanied by ball courts, plazas and special ceremonial structures; they had artisans, pottery, status positions and little warfare (Rouse, 1949:117-119). Willey (1949a:111) proposed a connection between the group in Puerto Rico and Hispaniola with the Gulf tradition on the west coast of central and northern Florida, based on resemblances of pottery styles; urn burial may have also spread north into the Mississippian traditions. However, distances between these groups are great and the time interval is too short for much influence to have spread in one direction or the other. "With the probable exception of the original Ciboney migration, it does not seem to us that relationships between the Southeast and the West Indies were very close" (Rouse, 1949:134).

The route to the Southeast through the Antilles and Florida has, based on this evidence, a good but not a substantial case. As Gower (1927:46) stated, so far there are no satisfactory indications of Central American influence on the Antillean cultures. She did, however, recognize the Antillean influence on the Southeast--regarding that as too great to be purely fortuitous. At present there is insufficient evidence to support an Antillean route to the southeastern United States.

Another route by which cultural influences may have been passed from Mesoamerica to the Southeast is from the Pueblo Region of the Southwest to the Mississippi River Valley by the drainage of the Arkansas River, especially along its southern tributary, the Canadian River. The headwaters of these rivers lie in New Mexico, close to the easternmost pueblo, near Taos. The Canadian River was used by bison-hunting bands of the Pueblo Indians (Mason, 1935:30; 1937:127); perhaps previous cultures had used it as a highway. If this were so, one would expect to find evidence of Mesoamerican influence along this route. In the northern panhandle of Texas the presence of masonry buildings along the Canadian River points to cultural relationships between the Southwest and the central and southern Plains (Kreiger, 1947:141). Trade with the Puebloans is evidenced by the discovery of turquoise beads, obsidian and pot sherds; the time of these trade activities is about 1300 A.D. (Kreiger, 1947:143). South of the Canadian River numerous campsites have been found with pot sherds of common Puebloan types from central and southern New Mexico. Farther east there is no evidence of Puebloan occupation though evidence of trade may be traced to the Louisiana border. On the Neches River, running through the center of Texas to the Gulf Coast, is the Davis site, in central east Texas, location of the most southwestwardly point at which mound building has been recognized. Sherds found under the temple mound there may indicate connections with southern Mexico (Kreiger, 1947:147). If these were Mesoamerican cultures in transition, why would they have flourished again along the Mississippi River? Another route, the Northern Overland Route, from Zacatecas and Durango down the Rio Conchos to the Rio Grande and then overland across the Edwards Plateau to the Mississippi River Valley is a possibility. An elaborate system of trade, and diffusion, developed along the northeastern part of this route in the late prehistoric times--as documented by the wanderings of the Jumano Indian, Juan Sebeata (Kelley, 1955). Though late to have been significant in the early Woodland along the Mississippi, it may indicate earlier travel along this route. "Hence, in the Southwest, Plains, and western parts of the Southeast, the similarities were evidently due to late communications, rather than to the presence of a 'basic culture'. Or, if a 'basic culture' existed, it has yet to be recognized and defined" (Kreiger, 1947:148).

Connections with the Southwest are demonstrated in certain of the Mississippian pottery styles. The bottle form in the Southeast begins in the Basket Maker III period, and is common in Pueblo I. The bird or duck form also begins in the Basket Maker III and is common in Pueblo I and II. The basket handle bowl found in Pueblo I, Sedentary Hohokam, Casa Grandes, southeast Missouri is also represented in the Mississippi region. The "Chacmool" effigy bowl is found in Casa Grandes, southeast Missouri, central Tennessee, and the Mississippi region. Handles on jars, appearing suddenly in the Southeast are also represented in Basket Maker III.

Other traits are found in both regions which support contact between the Southwest and the Mississippi Valley; most of these traits "...appear to be better established in the Mississippi than in the Southwest. The whole effigy complex, both human and animal is a case point" (Phillips et al., 1951:453).

Southwestern contact with Mesoamerica would have been through trade with turquoise the most important trade item. Reyman (1971:279) has stated that turquoise

TABLE 1

MISSISSIPPIAN POTTERY STYLES FOUND IN THE SOUTHWEST

Style	Southeast	Southwest: Basket Maker III	Pueblo I	Pueblo II	Pueblo III	Casas Grandes
Bottle form	+	+	+	-	-	-
Bird form	-	-	-	-	-	-
Duck form	+	+	+	+	-	-
Baskethandle bowl	+	-	+	-	-	+
"Chacmool" effigy	+	-	-	-	-	+
Jar Handles	+	+	-	-	-	-
Human effigies	+	-	-	+	+	+

(Data from Phillips et al., 1951:453)

was the most important resource exchanged at Pueblo Bonito, New Mexico, and their trade was with Mexico. Riley (1975:138) also found trade in turquoise going south from the Zuni area. Pochteca, described as professional travelling merchants (Sanders, 1971:28), are thought to have been the method of conducting this trade. They dealt in rare resources, taking pyrite mirrors, salt, hides, and other items to Mexico and returning with copper bells, cultigens, and deities (Reyman, 1978b: 242-243). Analysis of grave goods found in high status burials at two Anasazi sites in New Mexico provided substantial evidence to indicate pochteca interments (Reyman, 1978b:259). Another interesting indication of contact between the Southwest and Mexico is the occurrence of musical instruments. Flute-like instruments found in the Zuni area were similar to those associated with the Mesoamerican god Tezcatlipoca (Riley, 1975:147). There was obvious Southwest-Mesoamerican contact, and possible-to-probable Southwest-Southeast contact.

A plausible route is through Texas, either along the Gulf Coast or further inland. There are difficulties in locating sites along the coastal region; along the southern end of the Texas Coast and the northern Tamaulipas Coast, the shorelines and adjacent lands are constantly undergoing change due to winds and tides. Hurricanes accelerate the process. It is quite likely that sites on the exposed shorelines have been destroyed. The accounts of Cabeza de Vaca and other early explorers emphasized again and again that the coastal peoples of Texas were warlike and unfriendly to all strangers, Europeans and Indians alike. The first reports of this region indicate its inhabitants were non-agricultural, cannibalistic people (Kelley, 1947:97; Mason, 1935:32). From de Vaca's description, it would appear likely that these were influenced by cultures south and east of them. Movement along the coast by boat is a possibility. One could navigate along the coast, never leaving sight of land, maneuvering between islands, through inlets and bays. Due to the constantly changing coast proof of this means of contact is unlikely.

There are many references to the use of the canoe in Mexico, including graffiti on a Maya building, mention in the codices and documentation by the Spanish chronicles (Thompson, 1949:70). The size of these canoes varies from a three-man size to one holding 40 to 50 men (Diaz del Castillo, 1927:29). Spanish chronicles also mention the use of sails along the east coast of the Yucatan and in the West Indies, along the

Pacific coast of Honduras and in Panama (Thompson, 1949: 71). Wharves may have been used at Coba, Quintana Roo (Thompson et al., 1932:fig. 31). Bishop Landa (1941:5) mentions the use of signs to mark navigation routes in the vicinity of Terminos Bay. Thompson (1949:69ff) also describes the possibility of rafts, double canoes and gourd rafts having been used. So travel by water was within the means of the Mesoamericans.

Swanton (1943:267) thought that the pre-contact agricultural region near Victoria, Texas, could have been more extensive earlier. Another route through Texas was further inland, the "Gilmore Corridor," a prairie belt between the low coastal plain and the Edwards Plateau uplift. This region would have been easy to travel; it is open grassland crossed by rivers and streams rising from springs. The streams are heavily wooded with oak, pecan, walnut, hickory, hackberry, and persimmon trees. Small animals, fish and water fowl would provide food. Many campsites have been found in the Edwards Plateau region and along the streams flowing towards the Gulf (Kelley, 1947). They are characterized by accumulation of burned limestone hearth rock, fractured by heat, flint artifacts, manos and milling stones, giving the appearance of use by seasonally sedentary people. It is known that a route, known in the days of the Spanish as the San Antonio Road, and today followed closely by a highway, began at Monterrey, Mexico, and moved northeast to San Antonio, where it turned east toward Nacogdoches, Texas. Probably such a route was known to pre-Columbian inhabitants. The road may have extended beyond Nacogdoches to Natchitoches, Louisiana, and to the Natchez towns of the Mississippi, or north to the mouth of the Red River (Kreiger, 1948). The Spanish appear to have used part of this route; Moscoso led a group southwestward through Caddoan territory to a river Swanton (1942:31-32; 1946: 58) identified as the Trinity, where the expedition was abandoned due to hostile tribes in the vicinity. This region appears to have been a pattern of overlapping territories, not settled by a specific culture, and this would not display influence felt by transient cultures through the "corridor." If the lower half of the Gilmore Corridor were moved east to the coastal prairies, another route, the Southern Overland Route, becomes available.

This route runs northward across the Gulf Coast Plain and eastward to the Mississippi River Valley, paralleling and overlapping the Gilmore Corridor on the southern end. This is the southern branch of the Camino Real, and is used today. This was the territory of the Coahuiltecan Indians and closely related groups, occupying overlapping territories. Archaeological evidence indicated that Huastecan-Mexican outposts to the south and the early Mississippian southeastern outposts on the northeast were actually in contact with this neighboring culture (Kelley, 1952:141). Why were they unchanged by this contact? The account of the Tejas, the Caddoan Indians of eastern Texas, given to the Spanish by the Coahuiltecan Indians provides an answer. They described the Tejas as having an organized government, wooden houses, a form of cultivation, and would not permit the Coahuiles to enter their territory.

MacNeish (1947:2ff) outlined the culture sequence of Tamaulipas, Mexico, noting the projectile-point forms from the Southeast were related to those from the Southwest, through Texas. The changes in style through time are parallel in the two areas, which implies no barrier existed in communication. Mounds are found as far north as Xicotencatl, Tamaulipas, 140 km north of Tampico (Muir, 1926:231).

In the Huasteca area T-shaped pipes were recovered similar to ones found at Spiro, Oklahoma, a large Mississippian center (Kreiger, 1953:502). It appears that pipe smoking moved from the Southeast to Mexico, through the Caddoan area, on a post-Hopewell to early-Caddo level, into the San Luis Potpsi-Tamaulipas region, where it was quickly accepted (Griffin, 1949: 129). Griffin (1966:129) says this was a result of the highly civilized status of Mesoamerica at that time. Ekholm (1944:475) found pottery and pipes in both conical and platform mounds in this region.

In 1929 Mason (1935) surveyed the Brownsville, Texas, area for evidence of Huasteca influence. He discovered a typical Huasteca "melon," olla, found in the side of a stream bed near the coast and about 130 km south of Brownsville. Since then five other vessels have been recovered, proving Huasteca influence at least to that point. North of Brownsville, near Rockport, Texas, Mason (1935:40ff) reported the recovery of pottery fragments with Huastecan characteristics, indicating influence this far north and east. Between Rockport and the mound region of Louisiana, there is little evidence of aboriginal activity. So far, the only known Mexican artifacts to be found were in east Texas (Kreiger, 1953:501; Griffin, 1966:127).

> Thus I believe we may state that a claim of contacts existed from the Huasteca in Mexico to the late temple-mound builders having the 'Cult' east of the Mississippi. The first link of the chain would be the Huasteca of Vera Cruz, San Luis Potosi, and the northern Tamaulipas coast. This link is well-evinced by the common ceramic tradition. The second link is between the Huasteca and the central Texas cultures (and an east Texas culture, if the Talco Triangular point is identified correctly). The third link is between the central Texas cultures and Alto focus. The connection of the Alto focus with the Sanders and Spiro foci is common to place all in the Gibson aspect. The connection of Spiro with the more eastern culture is based upon the fact that fifty-one ceremonial traits are held in common between Spiro and Etowah and Moundville (MacNeish, 1947:11).

In the New World, evidence indicates agriculture was developed later than in the Old World and appeared first in semi-arid hilly or mountainous country (Heizer, 1973:18). Heizer (1973:30) suggests that the first seed planting was a religious tribute to the gods. A pre-agrarian society would then observe the plants growing from this ceremony and would recognize the correlation, and intentional cultivation would result. Thus, religion, seasons and harvest would be tied together, giving support to interest in astronomy.

Whatever the path, cultigens arrived in the Southeast from Mexico; these included maize and squash.

Native domesticates in the Southeast include the sunflower and sumpweed. New data indicate the presence of a Mesoamerican strain of squash in Missouri and Kentucky about 2300 B.C., prior to the domestication of a native strain (Chomko and Crawford, 1978). In the Tamaulipas region, squash was the first domesticate, appearing about 7000 B.C. (Adams, 1977:66), with gourds, beans and chili peppers soon following (Griffin, 1978:63).

By approximately 3000 B.C., the domesticated plants in Tamaulipas included gourds, peppers, pumpkins, maize (nearly 2000 years after its appearance at Tehuacan), squash, red and yellow beans and cotton. The gourd is said to have been known in the southeastern Archaic, but none of the other plants were present (Griffin, 1966:116). The gourd was found in Salts Cave, Kentucky, and dated to the middle third of the third millennium B.C. (P. J. Watson as cited by Griffin, 1978: 63).

Squash from Mesoamerica found in eastern North America about 2300 B.C. predates the earliest known native domesticate, the sunflower, which does not appear until about 1500 B.C. (Chomko and Crawford, 1978). The route of the squash to this region is unknown. However, the earliest evidence for squash in the Southwest is at least 1000 years later than that in the East (Yarnell, 1976:261-267). Sumpweed, marsh elder, pigweed and chenopod were also grown for food (Griffin, 1967:180; Smith, 1978:102-111).

Corn has been found in rock shelters in Kentucky and Ohio, and in Georgia during the Early Woodland period (Griffin, 1967:183); however its route to the Southeast and its first appearance have not yet been determined (Griffin, 1952:357-358). The discovery of a number of burned maize cobs in Gordon County, Georgia, may provide an early Woodland date of about 100 B.C. for the use of maize in the East (Griffin, 1966:119). It has been reported from a few Hopewellian sites in Ohio and Illinois and dated at about 100 B.C. - 100 A.D. There is a scarcity of corn from the time of Hopewell to about the time of Mississippian emergence, roughly from about 300 to 800 A.D. This corresponds to the Georgetown phase (500 to 700 A.D.) in the Mongollon region of the Southwest, when the volume of corn produced decreased and the amount of wild plant material increased (Cutler and Blake, 1977:135). The need for good land for cultivation resulted in a settlement pattern where villages moved as the soil became depleted, creating expansion of the Adena and Hopewell cultures and internal reorganization (Dragoo, 1976:19). The oldest corn from Cahokia is small and 12-rowed, a very hard flint or pop corn similar to the Mexican strains, Chapalote, Reventador, and Nal-Tel (Ibid.), indicating transmission from Mesoamerica. Yarnell (1976:267) suggests that the difference between southwestern (squash-maize) and eastern (sunflower-sumpweed) plant husbandry indicates both were taking place without a direct relationship between them. "Furthermore, the new data indicate that the eastern horticultural complex was not an independent development but was a regional adaptation of the concept of plant husbandry with originated in Mesoamerica" (Chomko and Crawford, 1978:407). There is not conclusive evidence for diffusion from Mesoamerica through the Southwest to the Southeast.

Many of the traits found in the Southeast may be favorably compared with those of Mesoamerica, with the Vera Cruz southern Mexican region having the closest general similarities. Maize, squash, beans and other cultigens also spread north from Mesoamerica. Adaptations between the tropical Gulf Coast of Mexico and the more humid southeastern United States had to overcome a significant ecological barrier. How these traits and cultigens diffused northward is unclear. Of the three possible routes, at present the overland coastal route appears most likely. The possibility that all three played a part in the diffusion cannot be eliminated. Further research is required before answers can be found.

MISSISSIPPIAN DEVELOPMENT AND DESCRIPTION

In the southeastern United States during the period from approximately 700 A.D. to 1600 A.D., a culture system, labeled Mississippian because of its apparent origin, spread throughout the region. An increased dependence on agriculture for subsistence, the construction of platform mounds, plazas and fortified villages, increased trade and development of class distinction indicate the complexity of this system.

The Mississippian system, widespread throughout the southeastern United States, is recognized by the construction of large ceremonial centers, the largest of which are included in this study. Interest in astronomy is a natural development in an agricultural society and would be most apparent in religious or ceremonial centers. To better understand the position astronomy might hold in this system, an overview of the Mississippian follows. For a more detailed look at local interpretations, three sites are recommended for study; they have been well documented. Two are classed as secondary sites, Kincaid (Cole, 1951) and Angel (Black, 1967); the third is a tertiary site or hamlet (Smith, 1978a). Documentation for the Angel site also includes a thorough analysis of the preliterate and literate history (Black, 1967:491-551).

The term "Mississippian" was first used by W. H. Holmes (1903:21) to designate a ceramic tradition and its location. The term is used today by archaeologists to designate a cultural tradition which existed in the Southeast from about 700 A.D. to 1600 A.D. Major development of this culture was in the American Bottom region of the Mississippi River Valley near St. Louis, Missouri (Fowler, 1966; Griffin, 1967:189), and spread northward to Minnesota and Wisconsin, eastward into the upper Ohio River Valley, southeastward through Tennessee and Kentucky to Georgia and Alabama, and westward into the Plains. The period of greatest influence, Middle Mississippian, was from about 900 A.D. to 1200 A.D., with Late Mississippian beginning about 1200 A.D. for the Bottoms region. Further east these dates become later.

Though Mississippian origins are obscure, the influence of Mesoamerica was present in the construction of temple mounds built around plazas, large fortified towns, and certain art motives. While there were no apparent migrations into the southeastern United States from Mesoamerica, Caldwell (1958:64) describes the

developing culture as the result of influence from Mexico blending with some local cultural traits in the central Mississippi Valley. Fowler (1966:235) sees the Mississippian as an intrusion into an area occupied by Late Woodland people where they exist coeval for a period of time. Griffin (1967:189) defines the Mississippian as various adaptations by societies developing a dependence on agriculture for basic subsistence, resulting in a larger population, labor specialization, complex ceremonies based on cultigens and the construction of temple mound complexes. Shell-tempered pottery also became a characteristic of the Mississippian. Settlement patterns changed radically in size, complexity and evidence for ranking in early Mississippian period and continued in the direction of centralization through the Middle Mississippian period (Phillips et al., 1951:447). The most recent definition is based on adaptive strategies. Mississippian is defined as "a cultural adaptation to a specific habitat situation, and as a particular level of sociocultural integration" (Smith, 1978b:480). These habitats can be described as river floodplain zones containing oxbow lakes, natural levee ridges and seasonally flooded low lands, all containing various soils and having access to several floral and faunal niches. Smith (1978b:486) goes on to propose that Mississippian refer to prehistoric populations living in the eastern deciduous woodlands from 800 - 1500 A.D. with a ranked social organization and a specific complex adaptation to ecological niches. Adaptation to agriculture and utilization of selective floral and faunal groups are part of this definition. "From multiple and diverse starting 'states,' social groups sharing a common set of cultigens developed into similar Mississippian groups during the 600 years preceding European contact" (Clay, 1976:138).

The development and spread of the Mississippian can be correlated with the adaptation of maize agriculture, providing a secure subsistence base. This base included intensive and extensive maize agriculture, but also included exploitation of other ecological zones. The location of centers in floodplain regions is attributed to the more productive soil types (Bareis, 1964; Chmurny, 1973; Larson, 1972:389; MacKenzie, 1966:5; Ward, 1965). Settlements were located to provide the population with access to two or more ecotones. Central settlements appear to have been located in areas where density of resources were found (Shelford, 1974:57ff). Sites include Cahokia (Fowler, 1974), Etowah (Larson,

1972), Moundville (Peebles, 1975), Angel and Kincaid (Honerkamp, 1975), and Macon and Aztalan (Baerreis and Reid, 1974; Benchley, 1974).

> If the major sites of the Mississippi period are plotted on maps whereon there are also plotted physiographic provinces, forest regions, climatic areas, or other environmental distribution data, the sites, almost without exception, are found only on the boundaries of natural areas.....Thus they come to occupy positions that allowed access to two or more significant contrasting ecological zones. Apparently, as a consequence of this patterned distribution of Mississippi Period sites a factor other than agriculture was considered in the selection of the locations of these sites. While all were located on rivers, they were located only at those points where rivers flow out of one ecological zone into another (Larson, 1971b:21).

There is a high correlation between Mississippian sites and the occurrence of sandy and silt loam soils, the only soils that can be intensively and extensively cultivated with the hoe technique. These soils are found in riverine regions, and as a result of periodic flooding are kept fertile. The moisture of these regions is supplied by the rivers, a necessary factor in view of the low rainfall in the Southeast. As a result, these soils could be kept cultivated without a fallow period almost indefinitely. Because the soils of the Coastal Plain are unsuitable for the hoe form of cultivation, almost no Mississippian sites were located there (Ward, 1965:43). Mississippian communities were not totally dependent on agriculture. From archaeological and ethnographical data, it appears that time was spent equally on agriculture and on hunting and gathering. Double cropping (Larson, 1972:389; Peebles, 1978: 392) was utilized with crops in summer and hunting in the fall and winter.

Other plant foods include the squash, persimmon, sunflower, sumac, chenopodum, various tubers, nuts, and berries, and at a late date, beans. Smith (1978b:483) recognizes a "horticultural trinity," corn, beans and squash. Salt was a trade item throughout the Mississippian region to complete the nutritional needs (Griffin, 1967:190; Keslin, 1964; Swanton, 1911:78). Food sources from animals were varied--deer, small mammals such as squirrels, rabbits, and raccoons, elk, waterfowl, birds, fish and shellfish. The oppossum is notable for its absence. He is delectable, dimwitted and easily captured, so he may have been specifically avoided for cultural reasons (Chmurny, 1973:172). The white-tailed deer, raccoon, and turkey, the terrestrial trinity, were exploited intensively during this time (Smith, 1974:278ff) Exploitation of animal populations was selective, based on seasonal availability and concentrated on those regions of the biotic community that offered the maximum meat with minimum effort (Ibid.).

Cleland (1965:99) suggested that 80% of the total diet of the Middle Mississippian was derived from cultivated plant foods. Analysis of food remains at various sites does not support this statement. Fish and waterfowl may have been more important than previously recognized; recent research has indicated that perhaps 50% of the protein intake of the peoples along the Mississippi River came from these sources (Smith, 1978b:485). With double cropping or staggered cropping available, "reliance on secondary subsistence resources is negligible, but specialized exploitation of supplementary resources occurs on a selective basis" (Cleland, 1976:73). This emphasis on the agricultural subsistence concept may be a product of research strategies applied to Mississippian urban centers. "The relationship and implied ramifications of horticultural tools and equipment for harvesting natural products in the Cajokia Mississippian hinterlands have been previously discussed, and it has been concluded that wide differences existed between the subsistence patterns of the Cahokia area and those of the Mississippian frontier" (Harn, 1978:259).

In the north and western regions there appears a change from predominantly agricultural to a mixed bison hunting and farming economy during the late Mississippian period (Fowler, 1966:236). This may have resulted from climatic changes. On the eastern and southern boundaries, this change was not apparent. The point of this discussion is the question of importance that agriculture had in the development of the Mississippian system. It currently appears to depend on the research focus used in the field. Agriculture alone would not determine the need the community had for astronomy; migrations of animals and appearance of wild products could also be forecast seasonal change.

Porter (1977:137ff) suggests that an interaction sphere developed, based on the redistribution of foodstuffs in exchange for the rare resources. Later, central markets were established in which the production of the various communities, located in differing ecotones, were exchanged under the control of a centralized authority. Most of the evidence collected indicated the exchange of mineral resources rather than food resources, with the exception of trade in marine shells and exotic animals. Flint was traded in both raw and finished form; salt was an important item as

was copper (Griffin, 1967:190). Central settlements were located to control trade routes as well as resources--along major waterways or at the conjunction of rivers. Cahokia, Moundville, Angel, Kincaid, Etowah and perhaps Aztalan are so located.

The social organization of Mississippian groups is a source of many debates. Accounts from the Spanish, French and English chroniclers indicate a ranked socio-political system throughout the Southeast. Socio-political units with defined territories incorporated farming units--fields with habitation areas in their midst (Fowler, 1969a:374), villages with one or no mounds, town with a few mounds, and central settlements with numerous mounds, including a temple, or platform, mound and a plaza, along with palisades.

Green and Munson (1978:310) have proposed a sixfold hierarchy of Mississippian settlements: (1) towns which cover five hectares or more with numerous mounds present; (2) large villages, covering one to four hectares with mounds present; (3) small villages, from 0.25 to one hectare without mounds; (4) hamlets, about the same size and without mounds, but with perhaps one-quarter of the population of a small village; (5) farmsteads, covering less than 0.25 hectare, no mounds and perhaps a maximum of ten people; (6) camps, less than 0.25 hectare in size and probably only seasonally occupied. Black (1967:546), being more of a lumper, defines four categories based on a map of Maya sites drawn by Morley (Morley, 1946, plate 19). These include (1) centers of the first class or metropolises; (2) centers of the second class or cities, (3) centers of the third class or large towns; (4) centers of the fourth class or small towns. Mississippian settlements appear ordered around a system that balanced both internal pressures, that of social integration, and external pressures, need of and defense of fertile soil. This compromise system involved large, often fortified, centers centrally located for a dispersed settlement pattern of smaller farmsteads (Smith, 1978b:490). The local centers served as foci for the region, providing internal social cohesiveness and the location of public ceremonial areas, along with the residence of socio-politically important individuals; because only these people lived in the center permanently, it could provide refuge for the remaining population during times of hostility (Ibid.). Individuals living in the satellite communities would visit the local center for: (1) seasonal ceremonies; (2) rites of passage ceremonies; (3) for corvee labor, during which time they might have resided within the center; (4) for mutual defense, thus explaining the palisades (Smith, 1978b:491). This type of settlement pattern fits the description Lanning (1974b:112) gives for a Rural Nucleated pattern; in this type of society, the population is nearly all rural, living in scattered villages or farmsteads with the functions of church and state performed at ceremonial centers where select individuals, priests/astronomers, administrators and related assistants reside; markets and craft specialization are located in the rural areas. From the structure of mortuary rituals, settlement patterns and subsistence autonomy, and part-time craft specialization, it would appear that these communities represent chiefdoms (Peebles and Kus, 1977:433-445). It is possible that "one-level" chiefdoms existed in the rural settlements; these chiefs were only part-time administrators and may have participated in manual labor for subsistence (Steponaitis, 1978:420). More complex chiefdoms have a two- or three-level hierarchy with well-developed class structures, the top echelon living on goods provided by the commoners.

Griffin recognized Mississippian social organization as an "...advanced plateau of cultural development, with fortified towns, an organized priesthood, dominant hereditary chiefs, political and military alliances and a well-developed class system" (Griffin, 1967:191). Jennings (1968:217) has compared the Mississippian centers to the Hopewell and to those in Mesoamerica, stating they were supported by large populations providing military and corvee labor, dependent on a leader/priest.

Sears (1968:143-152) has proclaimed the Mississippian sites to be a series of developing states, ranging from village communities, through Priest states, to Military states. According to Sears, Etowah is a Priest state, identifiable by a major ceremonial center, minor ceremonial centers and villages or hamlets, and with a clearly recognizable ceramic-complex defining the state territory. The Military state is a Priest state with fortifications around the major centers and archaeological assemblages intrusive in their occupied region. Sears includes most Middle Mississippian sites in this category, including Cahokia and Moundville. To define a territory on the basis of a pottery complex and recognize it as a state is not an easily defended position; perhaps other criteria should be considered. Morgan, Durkheim, Fried, Service and others have defined state based on territorial rather than kin-based membership, but with more specific definitions such as a centralized government and the power to enforce corvee labor (Carneiro, 1970:733). Sanders and Price (1968:227) propose a stratified society as essential for civilization, with social class rather than kinship the principal means of social integration. Fried notes that in a state "the power of the society is organized on a basis superior to kinship" (Fried, 1967:229). Economic specialization, population density, complex communication and transportation systems, trade networks and food production are necessary to the definition of a state (Fried, 1967; Sanders and Price, 1968:74-75; Lanning, 1967:3). These factors are present to some extent in the large centers, and one or two may be present in the smaller settlements. However, to classify the Mississippian centers as developing states is overstating the situation.

Organization of the community reflected the local socio-political system with the community built around the plazas or courtyards. Surrounding these were the larger buildings, homes of the nobility, the leader/priest, with the dead and public buildings being placed on the top of platform mounds. This center may then have been enclosed by a palisade or wall. Placement of buildings, mounds and burials, even the orientation of doorways toward the east (Mochon, 1972:192) indicate an interest in astronomy (Fowler, 1969b:61; Benchley, 1974:36; Peebles, 1971:82).

Larger communities had several platform mounds, some in association with conical mounds used as burial mounds. The platform mound ranged in height from three to six meters, with some in the ten to twenty meter range, and a few taller exceptions. They were used for temple structures or for domiciliary purposes. Estimates of construction time based on a conical mound six meters high and thirty meters in diameter at the base, containing less than 1500 cubic meters of earth, built by fifty men carrying approximately twenty kilograms of earth twenty times a day, would require slightly more than one hundred days (Shetrone, 1930:41).

These mounds demonstrated a strong Mesoamerican influence. While not stone-faced as were some in Mexico, they had similar shape and ramps. It should be noted here that the Huasteca mounds in the alluvial land regions also had no stone facing. There was no stone locally and it was not imported (Ekholm, 1944:501). In the southeastern United States there was a rebuilding or renewal of mounds around a plaza (Cole, 1951:93ff; Jennings, 1952:264-265; Lewis and Kneberg, 1946:47; Mochon, 1972:6ff). This rebuilding is common in Mesoamerica; the pyramids at Cholula, Tenayuca, Tlatelolco and La Venta all show superimposed construction. Many of the mounds had ramps on the plaza side. As the major truncated mounds were usually on the west side of the plaza, facing east, their ramps ran from east to west (Griffin, 1952:232). There are many large pyramids facing east in Mesoamerica: Cholula, Tenochtitlan, El Tajin, Tlatelolco and Xochicalco (Marquina, 1951). Wick (1965:409ff) suggests that burial mounds were introduced to the southeast from Mesoamerica along with maize about 1000 B.C., that the lack of burial mounds in Mesoamerica is a function of the archaeological strategy, and that there is only a vague distinction between burial mound and the temple mound. Willey (1958:269) indicated a southern origin for burial mounds, even though many favored the northern region of Asia. The tradition of the burial mound continued in the Southeast into historical times; its origin extended back beyond the Adena-Hopewell periods; Michigan has burial mounds dated prior to 500 B.C. (Willey, 1978:522).

"Mound-building seems to have been as old as pottery-making in this part of the Mississippi Valley (i.e. the lower Mississippi alluvial valley), perhaps older, and since we have not yet found a village site or midden without pottery, the general scarcity of sites without mounds is perhaps not surprising" (Phillips et al., 1951:310). Most eastern archaeologists have assumed until recently that the rectangular mounds were a basic trait of the Mississippi culture as outlined by Deuel (Cole and Deuel, 1937). Platform or flat-topped mounds were constructed prior to the development of the Mississippian culture in such locations as western North Carolina, the Georgia piedmont and the lower Mississippi Valley (Stoltman, 1978; Phillips et al., 1951:310). It would appear the influence from Mesoamerica had reached the Southeast prior to 900 A.D., the Mississippian florescence.

The temple was not a place of community worship; it was a sacred building elevated on a mound housing the bones of deceased leaders and the eternal fire (Swanton, 1911:158ff). The eternal fire was watched constantly to keep it burning. These attendants were often buried outside the temple. They may have had a small house near the temple. The bones of ancestors and their attendants

were kept in baskets or buried in pits in the temple floor. The temple was rebuilt periodically, perhaps on a cyclic basis or when it was full of bones (Bartram, 1958:328).

The house of the leader was also on a platform mound, usually across the plaza from the temple. The house may have had a porch where the leader could sit and observe village activities. As the leader's food may have been cooked elsewhere and brought to him, this mound would have little habitational debris to indicate its use. At the death of the leader, his home may have been razed. Thus, the platform mounds were used for temples and domestic purposes. Distinguishing between the uses is difficult. The temple mound may have been larger, but both had ramps and fire pits. Burials in the floor of the house was the normal procedure. Neitzel (1965:15ff) revealed the difficulties involved in his work at a well-documented site, Fatherland, the Grand Village of the Natchez.

At some sites the temple mound is accompanied by accretional burial mounds, though some intrusive burials are found in the sides of temple mounds. There are also burials beneath house floors, in cemeteries and in urns. The burials may be flexed, semi-flexed or extended, cremation or bundle burials of bodies cremated or exposed on scaffolds. Village burials were accompanied with a few non-exotic goods, while the larger communities had rare goods in the burials. Many of these contained the elaborate artifacts of the Southeastern Ceremonial Cult or Southern Cult.

The Southern Cult, first defined and analyzed by Waring and Holder in 1945, is identified through art motives, ceremonial objects and elements of ceremonial costumes. Eight motives were recognized, including the Cross (the Greek Cross and the swastika), and the Sun Circles, which usually encloses the Cross. The Sun Circle included various forms of scalloped or rayed circles. There were also a number of anthropomorphic animals, including the rattlesnake with horns, man-eagle combination, and the feline form. The ceremonial objects gorgets, hair ornaments, ear spools, celts, effigy pipes, conch shell bowls and bottles. Many of these are inscribed with the motives associated with the Cult. The ceremonial costume elements appear on various god-animal representatives and were found in burials. These elements include hair knots, antlered head-dress, necklaces, a fringed apron and a knotted sash. All of the elements were found at a minimum of two sites, with the expectations of the Cat Pipe and the Forked Eye Plate (Waring and Holder, 1945:17).

The materials from Oklahoma differ in some ways from the materials found at Moundville and Etowah. The motives appear disproportionately from site to site, and their distribution varies from site to site. The quantity of Cult material varies with the rank of the site in the settlement system hierarchy (Brown, 1976:124). Yet, the wide distribution of similar material and its associations with the platform mounds does indicate a central cult complex prevailing throughout the Mississippian cultural region. This cult was synthesized by a community or communities at a late time in the Mississippian period and spread rapidly. Local variations were created as the cult was adopted regionally. It was believed to have been the product of influence from Mesoamerica by way of the Spanish explorers, but dating techniques have placed its spread several centuries before the DeSoto expedition. Griffin (1960) believed the Southern Cult had its beginning at Spiro, Oklahoma, and spread eastward. Other archaeologists do not accept this origin, based on dating of materials, the variations in motives and the variety of motives appearing at different sites. The Southern Cult is now accepted as a ceremonial complex at its peak, rather than a form of a Ghost Dance resistance. The basic motives of this cult may be descendents of Adena-Hopewell religious symbols (Webb and Baby, 1966:102-108; Webb and Snow, 1945:318ff).

Interpretation of the Cult motives, ceremonial objects, and costume elements indicate the importance of the Sun to these people. The concept of the sacred fire, identified with the Sun, and fed with four logs oriented toward the cardinal points, forming a cross, is the most basic, and the most widespread concept in the Southeast. Among Indian groups today this fire is significant. It is built in the center of the square area, a plaza, and most of the sacred dances are held around it. The fire is ritually rekindled on the last day of the Green Corn, or Busk, ceremony (Howard, 1968:19). The Greek, the Yuchi, who called themselves the "offspring of the Sun," the Chicksaw, the Choctaw and the Chitimacha believe in a Sun-deity and have ceremonies based on a sacred fire (Swanton, 1928a).

The word, Mississippian, has been used to define a culture, a time period, and an adaptive system. Three factors can be used to define the boundary conditions of

Mississippian: (1) adaptive niche, or ecosystem based on cultigens; (2) settlement system, based on a pattern of hierarchies; and (3) structure and level of complexity of the sociopolitical organization (Smith, 1978b:480ff). "...it is both a mode of adaptation--maize agriculture--plus a ranked form of organization that are the defining characteristics of Mississippian cultural system" (Peebles and Kus, 1977:435). This sociopolitical organization appears based on some form of a stratified system, as indicated by mortuary goods found in various burials. Cultigens, settlement patterns, the design of the individual settlement, along with art motives and even the leadership of the communities are similar to those of Mesoamerica, lending support to the diffusion theory. The spread of Southern Cult traits throughout the Southeast underscores the unity of these dispersed sites.

CHAPTER II

CAHOKIA

Latitude 38°39'05"N
Longitude 90°03'43"W

Cahokia is located in the large fertile alluvial valley known as the American Bottom, a region of land in the Mississippi River Valley just below the confluence of the Illinois, Missouri, and Mississippi Rivers on the banks of a now extinct channel of the Mississippi River. This region is bounded on the north by the mouth of the Illinois River on the east and the mouth of the Missouri River on the west side. The southern boundary of the Bottom is marked by the mouth of the Meramac River on the west and the Kaskaskia River on the east. Within this region are several archaeological zones, with Cahokia the largest of ten population centers and approximately fifty farming villages along this area (Fowler, 1975a:93). If all habitation sites are included, the entire American Bottom could be considered one large Mississippian site. Near the present town of Mitchell is a group of mounds called the North Group by Bushnell (1904:16), now known as the Mitchell site; at the south end of the Bottom is

the South Group, now known as the Lunsford-Pulcher site; these form the northern and southern boundaries of this region.

The soil here is extremely fertile sandy loam. In prehistoric times with hoe techniques, the terraces and ridges were apparently quite productive, providing a major reason for the location here of one of the largest prehistoric populations in the United States, with estimates ranging from 10,000 to 40,000 people (Gregg, 1975: 134). Here is an urban center with its satellite communities. Cahokia extends over an area with an east-west axis of nearly five kilometers and a north-south axis of three and one-half kilometers with mounds as limit markers. In all directions are isolated archaeological remains with resemblance to Cahokia, but none equal it in size, number of mounds, or apparent complexity (Porter, 1974:2). The largest prehistoric site in North America north of Central Mexico, it covers approximately 15 square kilometers and more than 100 mounds of various shapes and sizes (Fowler, 1977:1; 1978:462). Fowler (1975a:93) mentions 120 mounds, of which only two or three have been adequately excavated. Moorehead (1929a:13) counted 85 mounds.

The mounds take various forms; the most common is the platform mound; 28 square, oblong, or oval single platforms and four stepped or double platform mounds have been mapped. In some instances excavation has revealed wooden structures on top of the platform; so it may be assumed that these mounds were used as building sites. Whether the buildings were residential or ceremonial has not yet been determined. Perhaps the double platform mounds were used for more important structures. Another shape is the conical mound, of which seven have been identified at Cahokia, and interpreted as burial mounds. There are several pairings of platform and conical mounds, such as mounds 57 and 60 and mounds 67 and 68. Some of these pairs are connected by elevated areas, suggesting a common purpose, perhaps that of a charnel-temple on the platform where the bodies remained for a period of time, and then were buried in the conical mound (Adair, 1968:180; Swanton, 1931:177; 1946:719). A third type of mound is the ridgetop or lineal mound, some with square platforms. Six of these have been identified. These ridgetop mounds mark the city limits in three of the cardinal directions (Krupp, 1977:15). A fourth ridgetop mound, mound 72, is located at the edge of the largest borrow pit some 800 meters south of Monks Mound. Excavation

of this mound revealed an impression of the base of a large timber which may have been the north-south marker.

Monks Mound is unique, not only at Cahokia, but also north of Central Mexico (Fowler, 1974:6; 1975:93; 1977:1). It is the third largest prehistoric man-made structure in North America; the Pyramid of the Sun at Teotihuacan and the Pyramid at Cholula are larger. Recent maps indicate it is about 300 meters in north-south dimension, 250 meters in its east-west dimension and about 39 meters high. Core testing has indicated that it is entirely man-made and construction proceeded in fourteen stages, the earliest stage was about 900 A.D. and the final about 1200 A.D.

Within and adjacent to the American Bottom are a variety of biotic zones that would have produced many natural resources. The bottomland, bluff banks and the upland are some of the groups within these zones forming a diversity difficult to find elsewhere. Within the bottomland alone are saturated lowlands, various types of forested zones, and extensive wet prairie grasslands; such a range cannot be matched anywhere north of Cahokia and only equaled about 150 kilometers south of there (Gregg as cited in Fowler, 1974:3). Also to be considered are the physiographic provinces surrounding the American Bottom. North is the Central Lowland Province and the prairie peninsula; southeast is the Interior Low Plateau; south is the Mississippi Alluvial Plain section of the Gulf Coast Plain Province, and southwest is the Ozark Province (Fowler, 1974:3). All of these factors must have been important in the location of Cahokia here.

Chmurny (1973) analyzed the ecological potential of the bluff, bottoms, and uplands around Cahokia and the predictability of rainfall and floods. According to his study, the environment was unreliable and an adaptation was necessary for the settlement to survive. These adaptations included planting in both productive and less productive regions, broad-based hunting and collecting from a number of distinct biomes, and maintaining strong kinship ties with other areas to insure support in case of crop failure.

Porter (1977) defined a complex prehistoric exchange system based on a market economy. With a central location, Cahokia developed as a major market center, with foodstuffs as a major trade item, along with "Mississippian" traits. The chroniclers for DeSoto described the communities through which they passed as having a complex socio-political organization (Elvas,

1907:172ff). They were aware of moving from one political province to another and of going to each principal town. They met merchants who were traveling from community to community with trade goods. Long distance trade appeared early in the eastern United States--during the Archaic (3000-1000 B.C.) copper from the Lake Superior region and chert from the Ohio area were being traded as far south as the Poverty Point area (Ford and Willey, 1941:336; Bennett, 1952:110; Griffin, 1967:191; Kneberg, 1952:191, Rowe, 1952:204). This trade declined abruptly during the Woodland Period (300-900 A.D.), to be reestablished during the Mississippian times.

At Cahokia the evidence for long-distance trade is abundant. Black chert from Arkansas and Oklahoma, mica from North Carolina, copper from the Lake Superior region and conch shell from the Gulf Coast have been recovered (Fowler, 1975a:98). Trade between Cahokia, the Caddo in Oklahoma and the Lower Mississippi Valley is evidenced by pottery (O'Brien, 1972:195) and sherds recovered at Kincaid (Orr, 1952:250).

Population estimates for Cahokia range from 10,000 based on labor needed to construct the mounds (O'Brien, 1972:189) to 25,000 based on density per square mile (Gregg, 1975:134). Other estimates approach 43,000 people. Habitation debris has been found continuously along the Cahokian Creek from the Cahokia site west and south to the confluence with the Mississippi River, ten kilometers away. Social stratification is suggested by burial mound practices, particularly those of mound 72. In this mound artifacts of exotic materials, complexity of the burial sequence, the sacrifice of the fifty young women and four men, indicate the presence of an important individual (Fowler, 1974: 22). As Sanders and Price (1968:47) state, "The term urban--refers to economic, demographic and social processes--not to architecture and craft products." With a dense population center, specialized labor, monumental public works, social stratification, and long distance trade, there can be no question that Cahokia was a major urban center.

Major points of interest are located on figure 1, a map of Cahokia.

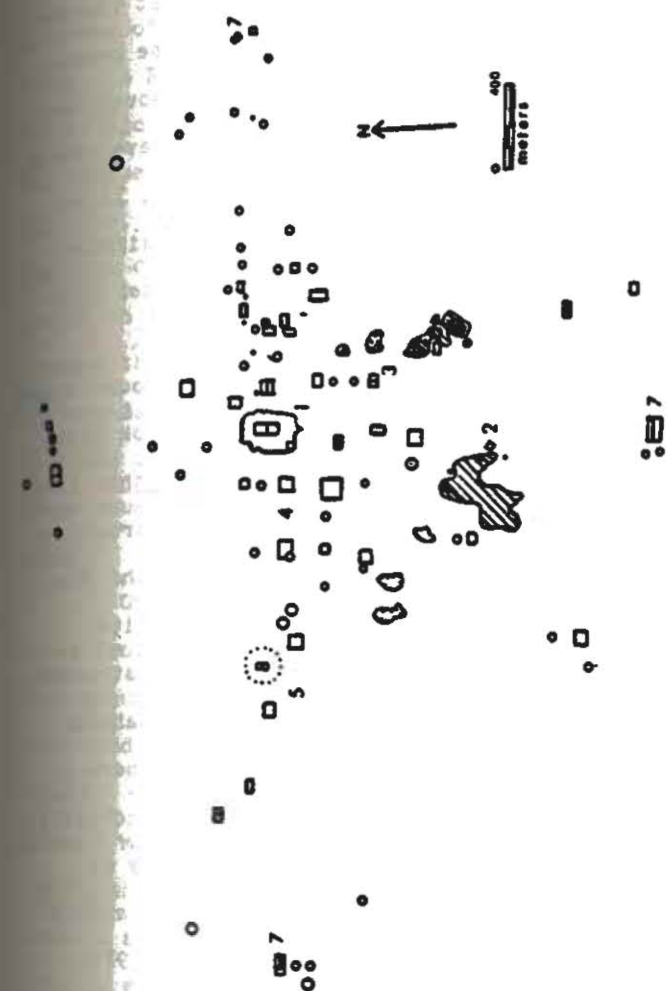


Figure 1 Cahokia site areas: (1) Monks Mound, (2) Mound 72, (3) Murdock Mound, (4) tract 15-B, (5) tract 15-A, (6) palisade area, (7) ridgetop mounds, (8) sun circles

History

The earliest evidence of occupation at Cahokia is dated about 600 A.D. It appears that these people were fully agricultural (Fowler, 1974:19), though they are placed in a Woodland phase prior to the development of the Mississippian cultural pattern (Fowler, 1975b: 2-3). The transition from Woodland to Mississippian is ill-defined and little evidence remains other than ceramics.

After 900 A.D. construction on Monks Mound began, the town was planned, and elaborate burials took place (Fowler, 1975b:3-4). It was during this time that long-distance trade was established, large public structures were built, the sun circles were erected, and the Mississippian traits developed and spread. Satellite communities were settled, other mounds were constructed and craft production increased. By 1200 A.D. Cahokia was at its peak. Changes began taking place; there is evidence of population decline and diminishing activity, until by 1500 A.D. there seems to be no activity at all, other than some burials in the eighteenth century on the first terrace of Monks Mound (Benchley, 1975) and in Rattlesnake Mound (Moorehead, 1928; 1929a:80).

Early European explorers through this region did not record visits to, or even acknowledge the presence of, Cahokia. DeSoto's men were south of this area; the French explorers, LaSalle, Marquette, and Tonti, did not mention the mounds. George Rogers Clark, who conquered this region in 1778, did not know about the site. The earliest detailed map of this area does not show Cahokia. This map, drawn by General George Collot in 1776, has a prairie shown between two creeks, perhaps the Cahokia and Prairie duPont Creeks, where the mounds should be located (Fowler, 1977:6). It is possible this omission is the result of acceptance of these mounds as natural phenomena, not man-made structures.

One of the earliest descriptions of the mounds comes from Brackenridge, who commented on the "stupendous monument of antiquity" (1818:154) that had gone unnoticed. He mentioned Trappist Monks farming on its summit. In 1819 an expedition under Major Stephen Long spent a month in St. Louis having their ship repaired. During that time members of the expedition visited the Cahokia site and recorded over seventy-five mounds, with an enormous mound so overgrown with bushes and weeds that accurate measurements could not be taken

(Long, 1905:120). A Mr. Amos Hill, an appropriate name, built his home on the summit of Monks Mound in 1831, living there for many years and was buried there (DeHaas as cited in Fowler, 1977:8). Featherstonhaugh (1844:264-272) made drawings of the site in 1834-1835 showing a conical mound on the third terrace of Monks Mound and a ridged area on the first terrace. Peet described the mound as disappointing at first, for "...it is not as imposing as some have represented it to be" (Peet, 1891:3). He recorded about sixty mounds at the site with the major mounds displaying an air of waste and ruin, deep gullies being created in their sides. His map of Monks Mound clearly defines four terraces. Factors other than erosion have been involved in the modification of Cahokia; urban expansion has destroyed many of the mounds. The interest in the American Bottom continued into the twentieth century as Bushnell (1904, 1922) published the first compilation of data from that area.

Most of the documentation of this period was based on travelogues and guides; after the middle of the nineteenth century interest changed to the archaeological aspects of this region. A drawing by a local archaeologist, William McAdams, showed the Hill house still on Monks Mound, along with information concerning his excavations there (McAdams as cited in Fowler, 1977:10). Dr. A. Patrick made a map of the entire site, the first map to show accurately the location and elevation of the mounds. The Patrick map was used until recently as the best map of the region. In 1925 the state of Illinois purchased the property around and including Monks Mound to create a state park. Since then, other pieces of property have been added to the part; however, many mounds have been destroyed as construction encroached on the site.

Archaeological excavations at Cahokia were started in the 1920's with Warren K. Moorehead directing the work. He excavated several mounds and provided the data indicating the mounds were actually man-made, not a natural phenomenon (Leighton, 1929). Work was done on a sporadic basis through the years until a federal highway program gave impetus to work in the early 1960's. This program allowed the salvaging of archaeological remains that would have been destroyed by highway construction. This resulted in the excavation of tracts 15-A and 15-B. This excavation has brought to the attention of the public the evidence of large circles interpreted as observatories. Even now part of this region is private property, and part has been used as landfill, so the preservation of the Cahokia site is not complete.

Analysis

During the salvage work done in the early 1960's, Dr. Warren Wittry uncovered a number of long oval pits slanting downward from one end to the other, which he called "bathtub-shaped" because of their general outline. These were determined to be post pits after comparison with similar features at the Mitchell site where a log was found in such a pit (Porter, 1974, figure 60). These pits were found in both tracts 15-A and 15-B and had been found on one of the terraces of Monks Mound (Benchley, 1974:146).

After the field work was completed, Wittry realized that some of the pits formed arcs of possible circles. Three small circles, each with a diameter of 24 meters, were discovered in tract 15-B. One was constructed of posts spaced 0.9 to 1.2 meters apart, and the remaining two were constructed of posts closely spaced and placed in trenches (Wittry, 1961:9). The pits in tract 15-A were interpreted as parts of four intersecting circles, ranging in diameter from 73 meters to 146 meters. The most interesting of the four, designated as the second circle, was 125 meters in diameter and constructed about 1000 A.D. At present, more than half of the circle has been excavated; the remainder, to the west, has been destroyed by a modern borrow pit.

Circle number two has been the focus of the astronomical research at Cahokia. From the data collected in 1961, the circle was determined to have had a total of 48 posts, evenly spaced, with four posts marking the cardinal points. The excavations conducted in the summer of 1977 uncovered more bathtub-shaped pits, leading to the theory that 47 posts marked the circle (Norrish, 1978:9-10). The excavations in 1963 uncovered a post pit, located five feet to the east of the center of the circle. From the center of the circle the angular distance between adjacent posts is $7^{\circ}30'$. From the off-center post, an observer would see slightly different angles while looking toward the east. Looking due east, the observer would see the post, but looking at the fourth post north from due east, the observer would be looking, not 30° north of east as would be done from the center, but rather at an angle slightly greater than 30°. Dr. Wittry (1964:47) has calculated this angle to represent the angle at which the observer, at about 1000 A.D., would see the sun at midsummer sunrise. Midwinter sunrise would be observed over the fourth post south of due east. He has also

suggested the elevation of the observer, situated on the off-center post to be thirty feet above ground level. This height is based on the size of the bathtub-shaped pits, averaging two meters long and 0.6 meters wide and over 1.2 meters deep. Impressions at the deep ends indicated a diameter of about 0.6 meters. During the fall and winter of 1977, Dr. Wittry climbed to the top of the eight-meter post he had erected in the appropriate post hole to observe the sunrise on the morning of September 23 (equinox actually occurred the previous evening), and on the mornings of December 19 through December 23 (solstice actually occurred on the eveing of December 21). According to his observations, on September 23 the sun rose exactly where he had anticipated, in the angle formed by the upper south slope of Monks Mound and the horizon created by the bluffs beyond the mounds. As equinox had occurred earlier, calculations were required to determine the correct position of the sun at that point. The solstice observation was not quite as fortuitous; clouds obscured the horizon. Sunrise on the 19th and on the 22nd was clear, and Wittry said the sun rose in line with the winter solstice post.

In an article, "An American Woodhenge," published in 1964, Dr. Wittry included a drawing of the circle of evenly spaced posts indicating those excavated (20) and those projected (28). In the article by Norrish in 1978, a similar drawing is published; however, this time there are two locations in the northern arc where two posts have been set about 1.5 meters apart, as opposed to the eight meters for the evenly-spaced posts. These have been interpreted as markers for the rise and set of Capella, when viewed from the center of the circle. There is no indication as to which posts are excavated and which, if any, are projected. It is unfortunate that at present these two articles contain the only published data of this significant site, and that these two articles do not agree. Assuming that all of the posts indicated by Norrish have been excavated, the reader will find there is no longer a straight line between the north post, the center of the circle and the south post of circle two; this does occur in Wittry's 1964 article and in the revision printed in 1977. Also the posts are no longer equi-distant; the space between the fifth and the sixth posts north of east is wider than between other posts shown.

Based on the measurements between the posts of the circle two, Wittry has found what he calls the Cahokia Yard, a unit of 3.425 feet, and he believes it to be the basic unit of measurement at Cahokia. Harriet Smith (1977:76ff), while working at Murdock Mound in 1941, found a repetition of 16.5 feet, and fractions of it, in its construction. This she called the ritual module because it was not used in residential structures; apparently it was used only in ritual construction. She compared this unit with dimensions of Mesoamerican structures from Stierlin's book (1968) and found twelve sites, varying from Olmec to Aztec architecture, based on the 16.5 foot measurement. The following table compares the diameters of the known circles from tracts 15-A and 15-B in feet, Cahokia Yards and the Cahokia Rod, Krupp's term (1977) for Smith's ritual module.

There does not seem to be a relationship between the Cahokia Yard and the Cahokia Rod. Further research must be done to determine if a standard unit of measurement was used throughout Cahokia, and if so, what it was and if it compares with a Mesoamerican unit.

Figure 2 is an enlarged section of the United States Geological Survey topographic map of Monks Mound, Illinois, on which has been located the excavated areas

TABLE 2

CAHOKIA CIRCLE DIAMETERS*

	Diameter, Feet	Diameter, Cahokia Yd.	Diameter, Rod
Circle 1	240**	65.401	14.545
Circle 2	410	119.708	24.848
Circle 3	480**	140.146	29.091
Circle 4	unknown	----	----
Circles in tract 15-b	80**	23.357	4.848

*Diameters of known circles in tracts 15-A and 15-B.

**Diameters from Wittry (1961)

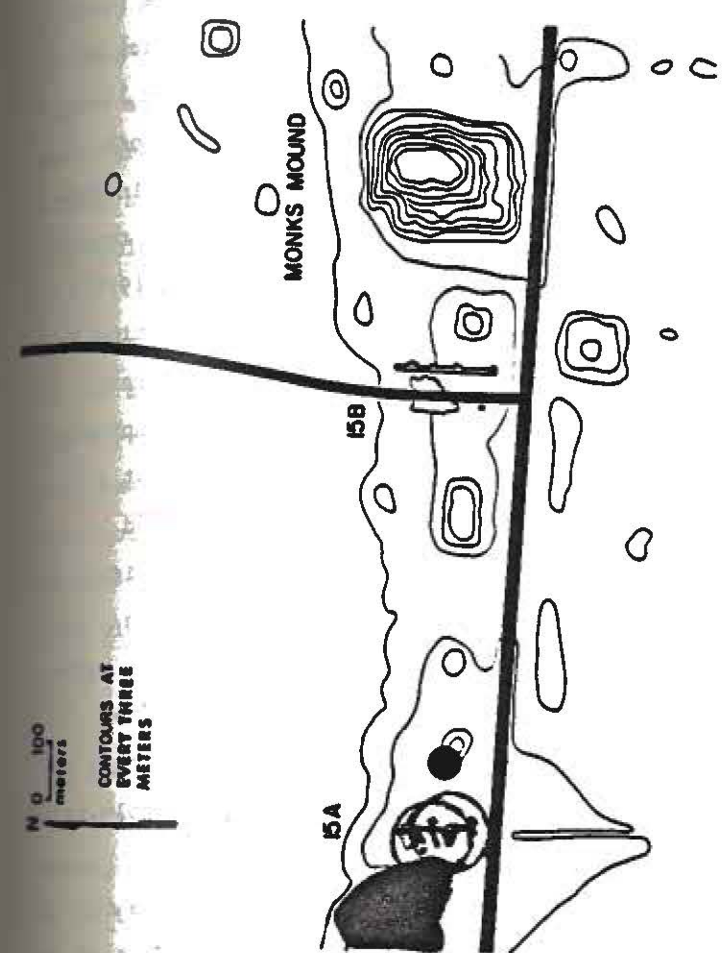


Figure 2 Enlarged section of the U. S. G. S. topographic map of Monks Mound, Illinois, showing the excavated areas.

of tracts 15-A and 15-B. Superimposed over tract 15-A are the circles suggested by the location of the post pits. Circle number four is not shown due to lack of data. It is now partially under highway 40, the line running east and west through the figure. Six post pits have been excavated in its north quadrant, including a large pit in with the winter solstice, but toward the center of the circle from its arc (Norrish, 1978). No center has been found for this circle, indicating that its size may have been miscalculated. In tract 15-B three complete circles were located, each approximately 24 meters in diameter. One had posts about a meter apart; the other two had more closely-spaced posts placed in trenches (Wittry, 1961:9). The significance of these circles is in their number; if in tracts 15-A and 15-B all or parts of seven circles were uncovered, what is remaining in the vast unexcavated areas. "It must be pointed out that only a few areas of this vast site have been excavated, so our sample is a very small one" (Wittry, 1977:45).

The circles as proposed for tract 15-A are non-concentric, though three overlap. The construction of four circles is difficult to explain if they were each intended to be an observatory. If the current one were

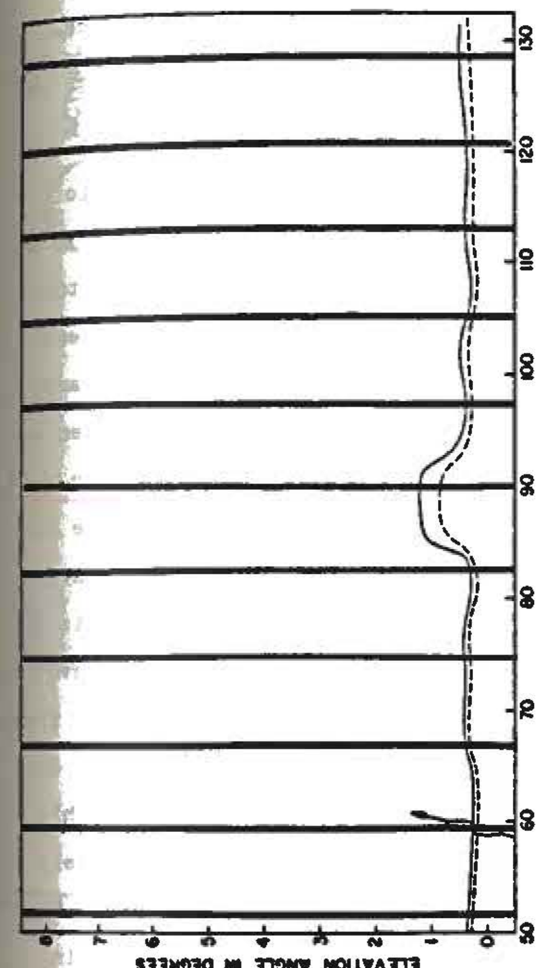
partially or completely destroyed, it could be rebuilt without moving the location. Circles are not necessary to have an observatory; all that are necessary are backsights and foresights. In this situation, only four posts are necessary--one for the observer, the backsight, and three for the foresights, the solstices and the equinox markers.

From the published data it appears that not all of the post pits lie on arcs of the proposed circles. Of the six posts found for circle four, one lies inside the circle and one outside the circle, and no center post has been found (Norrish, 1978:4). For circle three, only post pits in the eastern arc have been found. Circle two has posts falling on its arc but some are very close together, and it does not have a center post, if its present location is accepted.

The uncertainties of the post locations raise the question of the location of the center of the circles. For each post there is an uncertainty; for each three posts, determining an arc, there would be an uncertainty as to the center of the circle described by that arc. Thus, for each three posts, there is the possibility of a different center position. To determine the accuracy of the proposed circles, one needs the data concerning the post locations, and this data has not been published.

From the topographic map the eastern horizon as seen from the off-center post of circle two can be determined. In figure 3 the eastern horizon as seen by an observer standing on the ground and an observer on a nine-meter post has been drawn. Monks Mound is in the center; its present height was used in the calculations as its height in 1000 A.D. is unknown.

The off-center post of the circle was located on the topographical map. From this point a line was drawn to the highest point in that direction. The altitude of this point and the horizontal distance to it were used to calculate the tangent of the angle formed by the distance line and the line of sight from the off-center post to the highest point. From this data the angle can be computed; this angle represents the elevation of the eastern horizon. These elevations were then plotted to create the horizon an observer would see from circle two. On this horizon the posts were superimposed, 9 meters high and 0.6 meters wide; these posts are approximately 7.7° apart as seen from the off-center post, figure 3. Assuming the inclination of the ecliptic at 1000 A.D. to be 23°34'12", as



POSTS AS SEEN FROM 200 FEET AWAY ON THE GROUND

Figure 3 The eastern horizon (artificial) as seen from the off-center post of circle number two, with the thirty-foot posts, two feet in diameter, superimposed upon it.

stated by Wittry (1964), one can calculate the path of the sunrise at summer solstice. The observer is at latitude North $38^{\circ}39'5''$. With the use of spherical trigonometry and the formula $\frac{\text{sine A}}{\text{sine a}} = \frac{\text{sine B}}{\text{sine b}}$, it was found that the summer sun at solstice rises at an azimuth of 59.20° as seen on the natural or geometric horizon. The horizon the observer actually sees is an artificial one, created by man or by the earth's topography; in this case the artificial horizon is created by Monks Mound and the bluffs about 6 kilometers away. The azimuth of the solsticial sun is 59.76° as seen on the artificial horizon. Figure 3 shows the summer solstice behind the fourth post north. On this scale it is impossible to plot this accurately, but the sun does appear near the horizon behind the post. This region was enlarged to demonstrate the problems involved in claiming a solsticial alignment, see figure 4. There are two suns, the actual sun and the apparent sun, due to refraction. Refraction varying due to the earth's atmosphere has been assumed to be 0.5°, approximately the diameter of the sun as viewed from the earth. The apparent sun has been calculated to be an extreme in this figure. The sun's location may be between the two

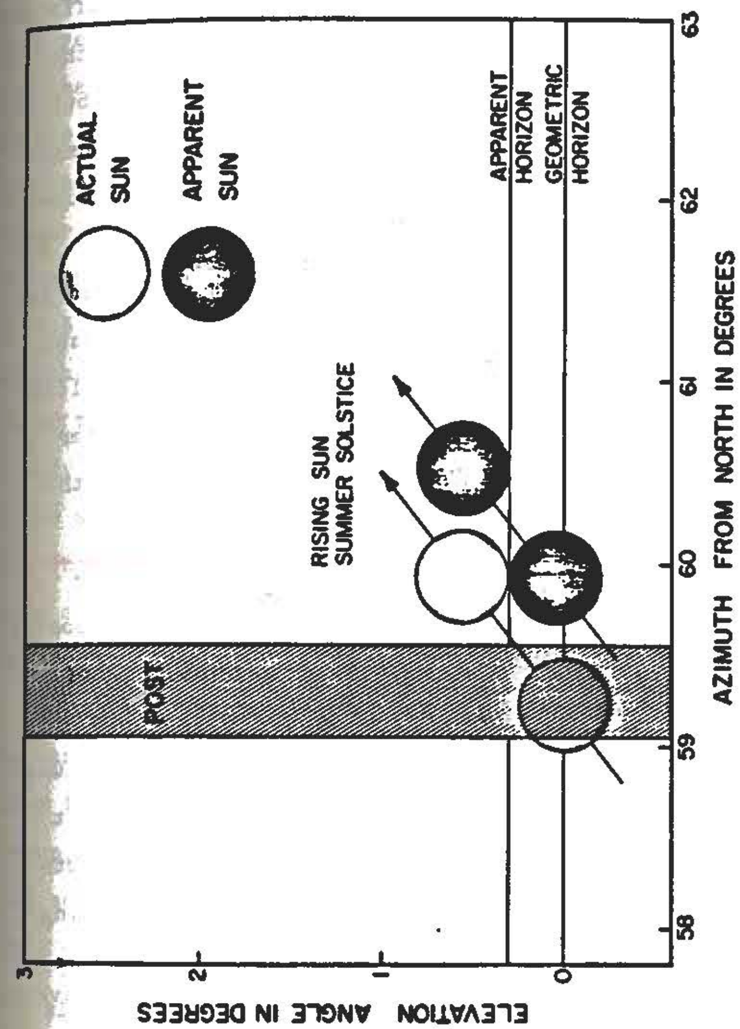


Figure 4 Enlarged section of the eastern horizon, with both the apparent artificial horizon, and the geometric horizon. This section has the post behind which the Sun at Summer Solstice rises. Both the actual and the apparent Sun are shown.

shown. There are two horizons created by the Bluffs and Monks Mound to the east. The actual diameter of the post is unknown; here it is assumed to be 0.6 meters, but its diameter is insignificant. Without knowing the moment defined as sunrise--first light, midway, or full sun--it is difficult to determine the use of the posts. An observer has the freedom to lean to one side to aid in sighting, even while sitting on top of a post. Also, the angle at which an observer would see the solsticial post changes by 0.7° as he moves from the off-center point to the center of the circle, enough to move the apparent position of the sun back behind the post.

The observer looking west would not see the setting sun marked by one of the evenly spaced 48 posts; however, with the data obliterated the importance of the setting positions will probably not be learned. The concept of 47 posts has been related to the 47 lunar months which approximate 51 draconic months, the unit representing the swing of the moon from north to south (Norrish, 1978:10). This period is used in indicating both solar and lunar eclipses, but requires knowledge of the synodic period as well, and no evidence of this knowledge has been recovered.

An alignment to Capella rising and setting has been recognized (Norrish, 1978:6ff). These alignments use the center of the circle as the backsight though no marker has been found for such a point. The foresights are the differently spaced posts discovered during the summer of 1977 in the northern part of the circle. If the posts were evenly spaced with an angular distance of 7.5° from the circle center, there are other possible alignments, see table 3. From this table it becomes clear that many possible alignments exist using the evenly spaced posts and the off-center post. If the posts are unevenly spaced as suggested by Norrish (1978: 8), then this table cannot be used. More data must be made available before alignments for unevenly spaced posts can be considered.

Intermound alignments would not be meaningful as many have been destroyed, and others modified. If a line is drawn from a ridgetop mound in the Rattlesnake group, extended northward past Mount 72, it will cross the southwest corner of the first terrace of Monks Mound. This corner is higher than the remaining terrace, and excavations have revealed there the location of buildings and posts which were not used for domestic type activities (Benchley, 1974:133).

TABLE 3

CAHOKIA ALIGNMENTS*

Perimeter Post Number	Azimuth from Off-center Post	Possible Alignment[1] (degrees)	
North 8	28.8	Deneb	30.6
7	36.4	Vega	37.2
6	44.0	Castor	44.8
5	51.6	Midwinter Moon (max. north decl.)	52.6
4	59.3	Supernova 1054	59.6
4	59.3	Midsummer Sun	58.8
3	66.9	Midwinter Moon (max. south decl.)	66.5
1	82.3	Betelgeuse	81.0
East	90.0	Equinox	90.0
South 1	97.7	Spica	96.9
3	113.1	Midsummer Moon (max. north decl.)	114.2
4	120.7	Antares	120.4
4	120.7	Midwinter Sun	120.3
5	128.4	Midsummer Moon (max. south decl.)	128.4
6	136.0	Fomalhaut	136.2
6	136.0	Supernova 827	135.1

*Possible alignments for evenly-spaced posts of circle 2 at Cahokia about 1000 A.D. as seen from the off-center post. (Assumed altitude = 122 meters, temperature = 20°C, and pressure = 1000 mb.)

[1] Data from Aveni, 1972

Monks Mound has a long axis running 5° east of north; similar orientations have been found in surrounding mounds, houses and the eastern stockade (Reed, 1977: 33). This may have been the magnetic north at the time of its original construction, an interesting point to pursue when data become available. Reed (1977) believes it may be a relationship with Cahokia Creek. Porter (1974:26) plotted the relationship between the Mitchell site, Monks Mound and a site in downtown St. Louis, now destroyed. The distances from Monks Mound to the Mitchell site and to the St. Louis site are almost equal, about 11 kilometers. The lines drawn to these sites form a right angle at Monks Mound, with the line to the Mitchell site 9° west of north. Two of the ridgetop mounds, the boundary mounds, are due east and west of a large post pit in the center of the fourth terrace of Monks Mound. Both the 5° east of north and the 9° west of north may mirror similar orientations in the Peten region of about 7° east of north; and Aveni (1975:167; 1977:4) has diagrams showing sites oriented on a 9° west of north axis.

Buildings in tract 15-B, constructed between 900 A.D. and 1050 A.D., were arranged in rows running north and south with the long axis running east and west.

Buildings in tract 15-A, from the same time period, were also arranged in north and south directions, but the long axis was either north-south or east-west (Benchley, 1974:36).

The mounds were not randomly scattered, but were constructed in a pattern which may represent community organization. The majority of mounds cluster along a natural ridge forming an east-west axis for the site; this is also the highest and driest land in this area (Fowler, 1978:462). Each of these mound clusters has its own plaza and platform and burial mounds, forming sub-urban areas within the metropolitan city limits. There does not seem to be any alignments in the buildings or mounds in the settlement planning other than orientation toward the cardinal directions.

Conclusions

If these circles or arcs are not celestial markers, what are they? One answer comes from ethnographic evidence concerning the use of large circles of wooden posts in the Southeast. John White, an Englishman, who came to the shore of North Carolina in 1585 to determine the suitability of the area for colonization, made drawings of the residents and noted their activities. He drew a village with a circle of tall wooden posts in the foreground. He included several Indians dancing around the posts. In another area there was a small circle with shorter posts indicated as a place of prayer. Another drawing depicts Indians dancing around seven posts, the tops of which are carved in the shape of human faces. In the center three Indians are in an embrace. Hariot, who accompanied White, wrote that "at a certain time of the year the savages hold a great and solem (sic) feast" (Lorant, 1965:260) after sunset and visitors came from neighboring towns. With a large population Cahokia would require a big circle.

The French artist, LeMoyne, drew pictures of the Florida Indians sitting in a circle before poles on which they have hung certain parts of fallen adversaries. Then their religious leader conducted a ceremony; this was their way of celebrating a victory over their enemies. Perhaps similar ceremonies were held at Cahokia. The presence of a palisade at Cahokia indicates the need to be protected from an enemy at present unknown.

The Indians in the southeastern United States today, descendents of the Mississippian tradition, meet annually for a Green Corn, or Busk, ceremony. Part of this ceremony is the concept of the sacred fire, identified with the sun, and built in a circular pit fueled with four logs forming a cross oriented toward the cardinal points (Howard, 1968:19). This fire is ritually rekindled each year on the last day of the festivities. The fire, focal point for ceremonies and dances, is built in a special area, the square ground. Swanton (1928b:176) thought the square ground was a summer substitute for the round hothouse or rotunda. Waring stated that to force a square ceremonial into a circular structure "...is like putting a square peg in a round hole" (Waring, 1968:54).

Swanton (1928b:179-180) quoted various earlier reports of rotundas built in the Southeast. Basically these were round enclosed structures, in varying diameters,

used by the men to discuss business or to conduct ceremonies. In the center of the rotunda was the sacred fire. Lewis and Kneberg (1946:70) found four of these structures at Hiwassee Island, Tennessee. Black (1967:312ff) found evidence of rotundas at the Angel site in Indiana. He questioned the location of two such structures at one site; if they were sacred in nature, they should also be rare. The same would be true for Hiwassee Island and for Cahokia. Circular wall-trenched structures have been found at Kincaid, but have been badly damaged by bulldozers and interpretation may be impossible (Muller, 1978:282). While it is difficult to envision a rotunda with a diameter of 125 meters, these references do indicate the ceremonial use of round structures. Thomas (1891:45-54) describes a number of circular earthworks and circular stone structures throughout the South. One, in Georgia, enclosed two acres with stone walls two feet high; another had stone walls nine feet high, a base 30 feet thick and a diameter of 240 feet.

Circular ceremonial structures have been found in the highlands of western Mexico (Weigand, ms.), and in the Southwest (Reyman, 1971:123ff). There are many references to large circular structures and their ceremonial nature in the South. To find these at Cahokia is no surprise; to classify them as observatories will require a great deal of evidence, evidence which at this date is missing. The claims for Capella markers and eclipse predictors are unsubstantiated, both in the field work and in the ethnohistoric literature.

Intermound and structural alignments are inconclusive at present. Location of structures on the mounds is not well known because of the limited field work and the amount of time required to excavate 100 mounds. The relationship between mounds may be lost as a result of the destruction of many of them to make way for modern urbanization.

One feature that should be studied is the interrelationship of nearby sites. Fowler (1978:468ff) divides these sites into four categories: (1) the largest site, Cahokia; (2) second-line communities, covering more than 50 hectares and having several mounds, such as Mitchell, East St. Louis, St. Louis, and Pulcher; (3) third-line communities are those with only one mound; five of these have been found in the Bottom; and (4) fourth-line communities are those without mounds, called by others hamlets or farmsteads. Some of these have burial mounds, others have conical

mounds referred to as signalmounds (Synder as cited by Fowler, 1978:471), suggesting perhaps celestial markers for calendrical purposes. A study of the sites in the American Bottom should be undertaken, comparing the sites to each other for possible patterns and orientations similar to those of Mesoamerica.

At Cahokia there does not appear an obvious knowledge of celestial bodies and their motion, at least with the current data. The evidence for knowledge of, and interest in, the cardinal directions based on the celestial pole is strong and fits the ethnographic data available. Intersite patterns may be present; further mapping is required for that analysis. From this study it would seem there is no apparent common interest in astronomy between Cahokia and Mesoamerica.

CHAPTER III

MOUNDVILLE

Latitude 33°00'N
Longitude 87°38'W

The second largest ceremonial center in the Southeast is located in Hale and Tuscaloosa Counties, about 24 kilometers south of Tuscaloosa, in the west-central part of Alabama. It has been called the most important and interesting mound group south of Ohio (Bushnell, 1968:44). Much of this center is now in Mound State Monument, an area of 121 hectares. It is possible that some of the site is outside this protected region and may have included as much as 50 hectares more (McKenzie, 1966:5; Peebles, 1978:408). The center is located on the outside of a bend on the southwest side of the Black Warrior River. At this point the river is about 100 meters wide and is navigable. The bank rises about 17 meters from the river up to the flat plateau of the site. Two ravines providing access to the river, are enlarging and endangering part of the site. These now contain springs, and a creek flows through the northeastern part of the site.

The soils here consist of loam and sandy loam (United States Department of Agriculture Soil Map, 1911); these soils are friable, well-drained and productive, typical of most Mississippian sites. Loams are easily worked with a digging stick or hoe. There is a close relationship between the soils and the flood plain of the Black Warrior River. Periodic inundation would renew and replace valuable soil. Within a two-kilometer radius of Moundville (the maximum range for efficient agricultural systems) the soils have a productivity potential of 45,000 bushels of corn (Peebles, 1978:407). Mean annual rainfall is 132 centimeters; snow is rare. The temperature is moderate, in the nineties in the summer and near freezing in the winter, well-suited for agriculture. "Given the low variability and high predictability of the hydrological and meteorological regimes at Moundville, the only crucial agricultural decision would have been when and how much to plant" (Peebles and Kus, 1977:433).

Moundville is located at the northernmost edge of the temperate deciduous forest biome. Here is the pine forest ecotone, with many fruit and nut trees. Just north of this area is the oak-hickory forest which spreads west to the Mississippi River. East of Moundville the oak-hickory forest changes to the pineland ecotone. North of the oak-hickory forest above Moundville, the forest changes to the mixed mesophytic forest of tulip trees, white oak, American and red oaks, beech and basswood. This is the habitat of the white-tail deer and the turkey, also bears, fox, raccoon, rabbit, squirrel and skunk (Shelford, 1974:59). The location of this site provided access to several ecotones and the two most abundant animal resources. Turkey thrived in the oak-hickory forest and deer reached their maximum density in the mixed mesophytic forest (Peebles, 1978:392). For oil, the residents had vegetable oils from nuts, which also provided flour, and animal oils from bears. South of Moundville, the river becomes swampy, habitat for waterfowl. Fresh water mollusks were available in the Tennessee River Valley, fish came from local waters, and salt water marine life could come up from the Gulf.

The Black Warrior River originates north of Moundville, near the Tennessee River, and flows southward to the Tombigbee River, which continues on to the Gulf. These rivers form two major systems; to the north is the Tennessee River, a link to the Ohio and the Mississippi Rivers; to the west and south is the Tombigbee,

linking Moundville with the South and the Gulf region.

The Moundville culture, first defined by DeJarnette (DeJarnette and Wimberly, 1941) based on ceramics from several sites, and then redefined as the Moundville phase by McKenzie (1964, 1965, 1966), is one of the most complex Mississippian societies in the Southeast. This phase was superimposed on indigenous cultures in one of several methods: (1) a result of Mississippian influence on the local culture, (2) a sudden influx of people from another area; or (3) a gradual migration of Mississippian people into the region. Local late Woodland people are represented by the McKelvey pottery series; McKelvey was a culture prior to the Mississippian development at Moundville (DeJarnette, 1966). Transition may have been through the West Jefferson phase; ceramics of this phase are typically early Mississippian forms made from clay-grit tempered late Woodland paste, probably that of the McKelvey phase (Peebles, 1978:372). The earliest Mississippian ceremonial center structure at Moundville may be a small burial mound at the southwest boundary of the site (Peebles, 1971, 1978:373). Evidence indicates an occupation of this site for almost 2000 years (McKenzie, 1966:6).

Relative dating made by comparison with other areas indicate that the Moundville phase began developing between 900 and 1200 A.D. Many technical artifacts found in this phase of the site are associated with the Southern Cult, thus providing an initial date not much earlier than 1100-1200 A.D. (the beginning of the Southern Cult). Pottery seriations of other sites within the sphere of influence of Moundville provide dates between 1200 and 1400 A.D. for similar styles. The decline began about 1500 A.D. and the subsequent period, from 1550 to 1700 A.D., is represented by the "Burial Urn Cultures" (Peebles, 1978:373). So the history of the Moundville phase encompasses the period from 1200 to 1500 A.D.

The influence of this phase extended from the Tennessee River Valley, south to the Tuscaloosa area in west-central Alabama. North of the Tennessee River Valley, there is little evidence of Moundville influence. North and east of Tuscaloosa there have been no sites found to date; however, this may be a function of research strategies. Some of the pottery sherds at Etowah show influence of Moundville; the Etowah Incised and Polished Block are similar to styles from Moundville. The "coffee bean" pipe at Moundville is similar to ones

from Etowah (McKenzie, 1966:40). Pottery from Fort Walton, Florida, can be traced to Moundville (Willey, 1949b:466). Moundville-style ceramics have been found along the Alabama Gulf Coast, and pottery from sites in southern Alabama and northwestern Florida have been classed as "Moundville-derived" (Sears as cited in Peebles, 1978:370). The Mississippi delta below New Orleans has also yielded similar pottery. Styles similar to those at Moundville have been recognized in the Natchez area, and along the lower Mississippi Valley.

Trade with other regions is evidenced in the presence of non-local materials. Copper, probably from the Great Lakes, galena from Missouri, pottery from other southeastern areas, and most frequently, marine shells from the Florida Gulf Coast indicate the widespread exchange system (Peebles and Kus, 1977:443). These materials were found in association with people of an "elite" status--in residential areas or burials. This differentiation would support the concept of a ranked society. Analysis of over 2000 burials at Moundville has revealed two patterns of interment. One can be associated with an elite, or chiefly, lineage into which one was born; the second appears to be associated with the age and sex of the individual (Peebles, 1978:

371). Within the first category, there are two groups, one appearing to have the highest status and buried in the platform mounds, the other was lesser officials who were buried in or near the platform mounds.

There are currently 18 mounds surrounding a large plaza. Two mounds, A and B, are within this plaza. Mound A is roughly rectangular and its base covers about 0.8 hectares. Mound B, the temple mound, is nearly square with a terrace to the north. A palisade and a ditch surround the site, though no evidence of warfare has been recovered (Jones and DeJarnette, 1936:1). However, evidence of scalping and use of trophy heads have been found (Snow as cited in Peebles and Kus, 1977:444). There are four small lakes around the edge of the plaza, perhaps the remnants of borrow pits filled with water. Excavation there has produced fishhooks. The mounds to the east, south and west were walled to separate them from the village. An interesting relationship between mounds, that they alternate between burial and domiciliary mounds, was pointed out by Peebles (1971:82). The mounds around the plaza alternate between those with large platforms and no burials and those with relatively smaller platforms and richly accompanied burials (Peebles, 1978:375). Generally, as the distance

from the northernmost mounds increases, the average status of the burials decreases (Peebles, 1978:381). He also noted a variation in the grave goods accompanying the burials. Those burials "...south of Mound D, west of Mound P near the shore of Lake 3, north of Mound R and near the base of Mound G have grave goods qualitatively and quantitatively richer than burials from other areas" (Peebles, 1971:83). There appears to be a distribution of effigy ceramics determined by location, with frog, turtle, and bats associated with the eastern side and the duck effigy associated with the west side, supporting a definite distinction between the two sides of the plaza (Peebles, 1971:83).

Village sites have been located to the west, south and east of the plaza. Specialized structures, such as charnel or sweat houses, were located on the periphery of the plaza. Remains of an elite residential area were found in the northeast corner of the site. Large public structures were located at the northeast and northwest corners of the plaza (Peebles and Kus, 1977:435).

Analyses of the distribution of artifacts at the site indicate several patterns of use. Most of the common, daily debris was thrown into the river and the ravines. Independent groupings of specific artifact types were recognized; shell-bead manufacture occurred north of Mound F and east of Mound E; bone awls and grooved sharpening stones were found only in the north-east quadrant of the site; ceremonial items such as copper fragments and paint pigments were near the public buildings at the northeast corner of the plaza; and pottery materials were found in an area west of Mound P (Peebles, 1978:381; Peebles and Kus, 1977:442).

Based on the number of burials found and the occupation time span, Moundville probably had about 3000 residents at any given time (Peebles and Kus, 1977:435). Estimates of the labor required to construct the mounds indicate a large population. The construction of Mound B would have taken 400,000 men days with 13 kilograms per basket per load, three round trips per hour for a ten hour day (Jones and DeJarnette, 1936:1).

"In summary, the Moundville phase was a structural moment in the development of native American societies in the Southeast" (Peebles, 1978:374).

History

Descriptions provided by DeSoto's narrative indicate that Moundville may not have been one of his stops. DeSoto crossed the Black Warrior River in the area of Moundville. Garcilaso (1951:397) described the crossing, but did not mention a major settlement. The Gentlemen of Elvas (1907:186-190) described the principle town of Tastaluca much as Moundville would have appeared then. However, this town is generally believed to be between the Alabama and Tombigbee Rivers. If DeSoto did not visit Moundville, it may have been abandoned or greatly diminished in importance. No evidence of historic material, other than a bead found at a nearby site, has been uncovered here. Thomas (1891) described a group of flat-topped, square and conical mounds known as the Prince mounds, about a kilometer from Carthage, the previous name for Moundville.

The first major excavation was made by Clarence Moore in 1905 and 1906. He tested most of the major mounds and excavated some of the adjacent areas. Though he documented his work in two publications (1905, 1907), he did not record the orientations of burials. In the 1905 publication, Moore published a map of the site showing 21 mounds, see figure 5. Peebles' maps (1971: 81; 1978:377ff) locate only 20; one mound has been lost to the river. Jones and DeJarnette (1936) mention 34 mounds in the central group, with 18 around the plaza. Shetrone (1930:391) found 19 square and oval flat-topped mounds arranged in a rough circle around two other larger mounds.

In 1929 the site was purchased by the Alabama Museum of Natural History, and excavations were begun under the direction of Tom, James and David DeJarnette, W. B. Jones and Maurice Goldsmith. The Civilian Conservation Corps provided man power for the work through the 1930's. The Museum continued this project until 1941. This work has been documented and reported by Peebles (Peebles as cited by Peebles, 1978:375). The care taken in both the excavating and the reporting of it place Moundville in an admirable position, that of being the best excavated of the major Mississippian ceremonial centers.

This project uncovered nearly 3000 burials in the area now paved as road around the park. Over one-half million square feet of excavation has taken place, though only about 5% of the surface area has been

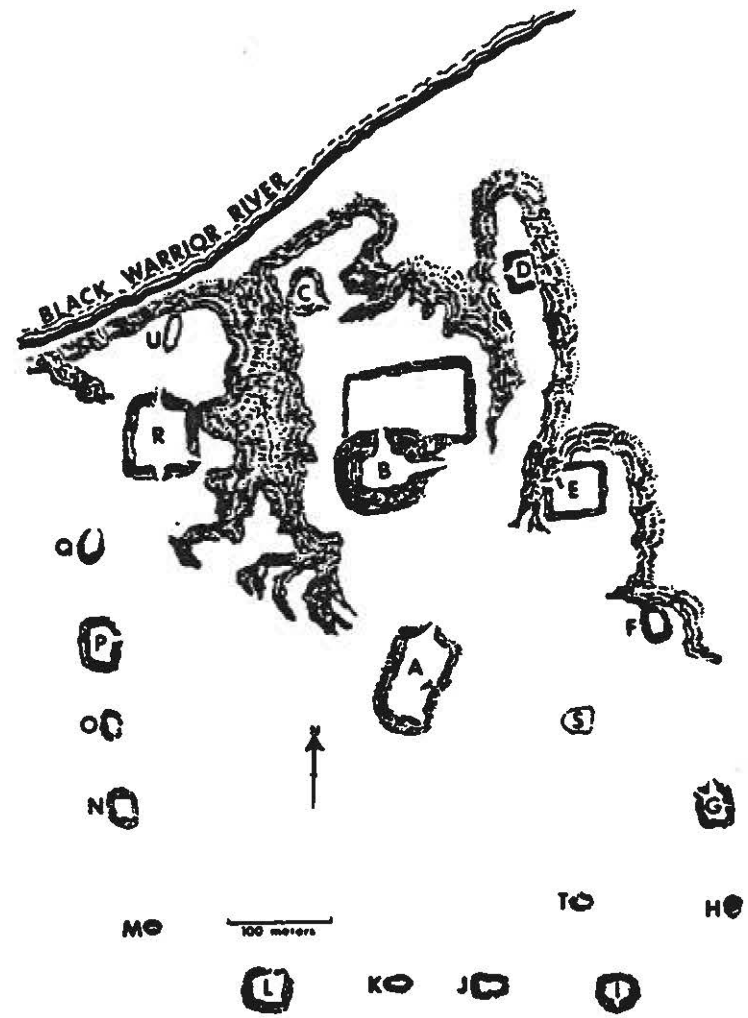


Figure 5 Map of Moundville, redrawn from Moore, 1905

excavated (Peebles, 1978:375). Work is still being done there in various corners of the site.

Approximately thirty Moundville phase sites have been located in this region. These sites vary in size from the 121 hectares of Moundville to the 0.8 hectares of site Tu-160. "An analysis of the soils in catchments (area around the site) of 0.6 miles (0.97 kilometers) radius around these sites shows that not only were they located on the best, most easily worked self-renewing corn soils, but also that site size (in acres) was positively and significantly correlated with the soil productivity" (Peebles, 1975:62). Three divisions can be made from these sites. Moundville is the only major ceremonial center. Minor ceremonial centers, each with a single platform mound, are next; ten of these have been identified (Peebles, 1978:410; Steponaitis, 1978: 437). The remainder form the third division, the hamlets or farmsteads with no mounds and little evidence of social status. These sites were located in a nonrandom manner; Moundville had only minor ceremonial centers as nearest neighbors, and all but one of the hamlets and farmsteads had a minor ceremonial center as their first nearest neighbor (Peebles, 1978:411). All the sites had immediate access to water, so communication

was not difficult, though the maximum distance between sites was 117 river kilometers, or 51.5 air kilometers (Steponaitis, 1978:440).

Analysis

Though Moore (1905, 1907) did not record the orientation of the burials he excavated at Moundville, some of those excavated from the roadbed were recorded. McKenzie (1965:170) stated that orientation of burials was random; however Peebles (1975:85) found there was a definite preference for the cardinal points; 30% were oriented with their heads toward the east. In analyzing data on burials from the Moundville phase at Kroger's Island, McKenzie (1965:171) determined that the orientation of the burials was parallel to the axis of the island. Peebles (1971:74) found a definite pattern with the majority of burials having the head to the east-southeast and the feet to the west-northwest. At Snow's Bend, a Moundville phase site, burials again seemed oriented along the east-southeast line (DeJarnette and Peebles, 1970:117).

There has been some analysis of the orientation of the mounds, starting with Jones and DeJarnettte (1936:1), who said the mounds were oriented close to the cardinal points, and the plaza enclosed by them also was similarly oriented.

> If a north-south line is drawn from Mound B through Mound A, and if a series of parallel

> lines are drawn from one mound to another across this north-south line and along the axis of the winter solstice, then the mounds along the east and west margins of the plaza can be paired up as follows: Mounds R and E burials not present; Mounds Q and F, burials present; Mounds P and G, burials not present; Mounds O and H, burials present; Mounds N and J, burials not present. Mounds C and D, to the north of the main plaza, both have burials included in them. These 2 mounds pair up on the axis of the autumnal equinox rather than that of the winter solstice....(Peebles, 1971:82).

Later, Peebles wrote that a "'fudge factor' of at least 5 degrees is necessary to make the mounds on the edge of the plaza fall into solstice and equinox alignments when viewed from the centrally placed Mound A" (1975:69).

To the south and east the area around Moundville is flat. West and north is a range of hills about 7 kilometers away; the highest peak, 124 meters, is 11.5 kilometers away. The nearest high peak, 112 meters, is 7.4 kilometers to the northwest. This peak rises only about 48 meters above the top of Mound B and would not be visible as a point on the horizon due to the small elevation angle and the probability of its being obscured by vegetation. Thus, there are no prominent markers on the horizon to be used as foresights for alignments.

Moore's map (1905) shows many mounds with ramps, figure 5. The aerial photograph flown in 1967 and the topographic map drawn in 1969 do not show most of these ramps (see Peebles, 1971:81). In fact it appears that between 1930 and 1967 the mounds have been reconstructed to conform with the ideal platform mound shape. In Table 4 the mounds are listed, according to Moore's labeling, with their elevations and ramp locations. The mounds have changed shape and ramps have been destroyed, perhaps as the result of excavation and restoration. However, this makes analysis almost impossible; the original orientations are irretrievable and only approximations are possible. There is no evidence of single markers, such as posts, to indicate an alignment; so for this study, the center of each mound, and the center at the top of each ramp were used as possible backsights. Each mound was considered in combination with each of the remaining mounds, whether a burial mound or not. If further excavations were conducted, structures might be found on the mounds to indicate those with burials were temple mounds, and those without burials were domiciliary mounds (Peebles, 1971:82). The position of each mound according to Moore's map, figure 5, was used for one analysis, as these positions are closest to the original. The position of each mound according to the aerial photograph, figure 6, was used in a second

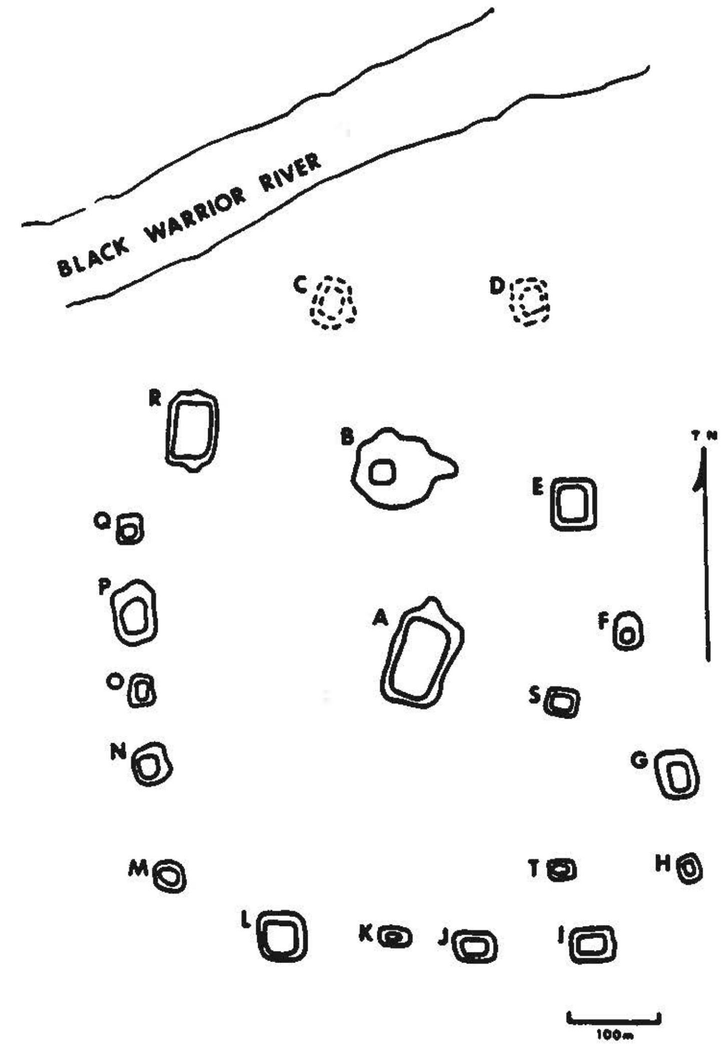


Figure 6 Map of Moundville drawn from an aerial photograph

TABLE 4

MAJOR MOUNDS AT MOUNDVILLE*

Mound	Approximate Elevation, meters	Ramp[1]	Ramp[2]	Ramp[3]	Burials[4]
A	6.4	NE	N,S	NE	No
B	17	E,N	E	N,E	No
C	6	SE	--	--	Yes
D	5	W	--	--	Yes
E	3	W	SW	--	No
F	5.5	--	SE	--	Yes
G	6.4	N,NW	E	--	No
H	2	Round	--	--	Yes
I	3	--	--	--	No
J	4	--	N	--	No
K	4	--	--	--	No
L	4	N	N	N?	No
M	4	--	Round	--	No
N	5.5	--	NW	--	No
O	4	--	E	--	Yes
P	8	E	--	--	No
Q	4	--	E	--	Yes
R	6	N,E,S	S	S	No
S	1.5	--	--	--	No
T	1.5	--	--	--	No

*The mounds at Moundville are in alphabetical order with elevations and ramp locations.

[1] Moore, 1907

[2] McKenzie, 1966:35

[3] Aerial Photograph in 1967

[4] Peebles, 1971

analysis. This posed a few problems; Mound U has been lost to the river and Mounds C and D are not visible due to vegetation growth. For Mounds C and D, location on the topographic map provided the necessary data. Elevations were important; a foresight should not be lower than the backsight. From Mound B, an observer would look down on other mounds. From Mound G, Mound Q is not visible because Mound A is between them. With these considerations in mind, azimuths were calculated for each combination.

From Mound A, Castor and Pollux rise over Mound E and set over Mound R; Venus and Mars rise over G and set over Mound N at maximum southerly declination; the winter solsticial sun rises over Mound G and sets over Mound N, and Alpha Centauri rises over Mound J and sets over Mound K. However, these measurements are approximations only. For example, Castor rises at an azimuth of 48°; the azimuth from Mound A to Mound E can vary as much as 23 degrees, from 37° to 60°, depending on where the measurements are made (see Table 5). The same situation occurs for each of the other alignments listed; if a tolerance of one degree is required, then no alignments could be made with confidence. The mounds around the plaza have the same problem. The possibility of

TABLE 5

RANGE OF AZIMUTHS AT MOUNDVILLE*

Mound	Azimuth as seen from the center of the mound	Azimuth as seen from the top center of the ramp
B	340 - 11	330 - 10
C	344 - 350	340 - 346
D	14 - 20	14 - 20
E	37 - 52	42 - 60
F	77 - 87	88 - 97
G	109 - 119	117 - 127
H	126 - 130	132 - 136
I	145 - 153	150 - 154
J	166 - 174	169 - 175
K	183 - 189	182 - 189
L	203 - 213	200 - 210
M	227 - 234	222 - 226
N	245 - 254	238 -246
O	261 - 268	253 - 260
P	274 - 286	266 - 279
Q	292 - 298	284 - 291
R	309 - 322	301 - 316

*Range of azimuths as viewed toward each mound from the center and from the center of the ramp, at its top, of Mound A.

an alignment is there, but because of structural modifications, no man-made markers can be identified.

An example of lines drawn without regard to specific markers is the map of solar alignments (Hardman, 1971:165). It has not been reproduced here because there are errors in the location and the orientation of the mounds. The solar alignments appear to have been placed on the map like a grid system without regard to their locations. Lines are drawn from a high mound to a lower one, across the corner of a mound, or from an off-center point on a mound. Without much study, one could be misled to believe there are intentional alignments to the solstices and the equinoxes. In actuality, this is not the case.

Reed (1977) analyzed a number of mounds in the Southeast for evidence of orientation or alignments; he used maps of these mounds rather than taking first-hand observations. As a result, the analysis of Moundville may be in error because the map was not accurate. The location of the mounds as shown in figure 6 indicates a predilection for the cardinal directions. The site itself appears constructed based on an orientation with the four quadrants. The exception is Mound A, but because of its size and location, it must have had a special meaning. The plaza is oriented along a north-south axis, not in parallel with any geographical phenomenon. The mounds around the plaza then reflect this pattern.

Conclusions

Worship of the sun is evident in the use of Southern Cult motives found on grave goods. The cross and the sun circle are quite common in Moundville phase art. The circle consists of several concentric circles which may encompass a scalloped circle or be encompassed by one. Inside the circles may be a cross or swastika, perhaps representing the cardinal points. While DeSoto was in the province of Tascaluza, his chroniclers reported the reference to the sun and moon as gods (Garcilaso, 1951:134). Early excavations at Moundville provided evidence of sun worship (Moore, 1907:405ff; 1923). As agriculturalists, the people would be interested in the movement of the sun for season determination.

> ....the only crucial agricultural decision would have been when and how much to plant. Therefore, we should expect that one of the duties of the chiefly establishment would include the maintenance of a calendar. There is limited, INCONCLUSIVE evidence for the lunar and solar orientations of the mounds at Moundville; therefore there is a limited possibility that calendars were part of the ritual cycle (Peebles and Kus, 1977:423).

There are other natural signs proclaiming the change of season, such as the migration of birds.

The data used in this analysis is presented in Appendix A. As can be seen, there appear to be alignments to the summer solstice and to the moon at both northerly and southerly positions. While this is in keeping with the ethnographic material, it is not conclusive evidence. There are uncertainties associated with the data. In the photograph of Moundville, the mounds appear well-formed. The map drawn in 1907, figure 5, shows different shapes for these mounds, so they have definitely been modified. Because of these modifications, there are uncertainties as to where the mound centers are located. In this analysis the centers were determined from the recent maps as accurately as possible. There are uncertainties associated with the accuracy of any map; Moundville map variations do exist. While difficulties with the accuracy of the maps used and the azimuth measurements can be controlled, it is too late now to recover the original shape of each mound. Thus, the mound center now may only approximate the original center of the mound, and the alignment possibilities are just that, possibilities.

The burials at the Moundville phase site and the orientation of individual mounds at the sites indicate an awareness of the cardinal directions. Even with the

variation of 5° suggested by Peebles (1975:69), the solstice and equinox alignments are vague and may have been accidental. The alternating pattern he suggests (1971:82) is intriguing. He stated that further excavations might reveal structures on these mounds and temple structures on the burial mounds. Perhaps analysis of these structures would indicate greater knowledge of astronomy, but at present all that can be proven is knowledge of the cardinal directions.

The location of mounds at the Moundville site around the plaza was not haphazard. "There is every evidence that the layout of the Moundville site was not random. Analysis of the features and artifacts suggests that there are areas for dwellings and areas for "public" buildings, areas for pottery and manufacturing and areas for other industrial activities" (Peebles, 1975:69). With its orientation toward the cardinal directions, the site must have had a definite organization, the meaning of which may be learned through further study.

CHAPTER IV

ETOWAH

Latitude 34°07'30"N
Longitude 84°48'27"W

Etowah is located on the north bank of the Etowah River, about four kilometers south of Cartersville, in Bartow County, Georgia. The mounds are located opposite the mouth of Pumpkinvine Creek, a sizable tributary to the river. At this point the river flows from the Piedmont west across the southern end of the Great Valley, into the Coastal Plain. The site thus controls access to the eastern valley of the river, a region broad enough for utilization of its flood plain with its alluvial soils. The river makes a bend to the south while the line of hills curves to the north, leaving a broad valley about two kilometers wide. The mounds are visible from these hills.

From Etowah to Rome, Georgia, where the Etowah River meets the Oostanaula to form the Coosa River, are many wide fertile bottoms where small settlements related to Etowah were located. Here the annual rainfall is about 60 centimeters, with a rare snowfall in the winter. Normal winter lows are above freezing and the summers are quite warm and humid. With a growing

period of at least 210 days, two crops a year were possible.

The soil here is fine sandy loam, found in a band varying in width along the river from half a kilometer to about a fifth of a kilometer. At Etowah, the bank is four kilometers wide, the widest strip of this soil. While it is subject to periodic inundations, this area drains well, and is especially desirable for growing corn (Fuller and Shores, 1926:54-55). The valley here has been flooded on the average of once every five years, renewing the soil fertility (Larson, 1972:389). This loam constitutes only about eight-tenths of one percent of the total surface soils of Bartow County and is the best soil for cultivation. The Etowahns were an agricultural people with corn their main crop.

Among the animals available to the residents were the beaver, rabbit, squirrel, raccoon, white-tailed deer, and the domesticated dog. Black bear was utilized both for food and for its skin, in which the fat was preserved; the bones were made into tools (Swanton as cited in Parmalee, 1960:50). Turkey was by far the most prevalent fowl, with the passenger pigeon second. Larson (1971c:28) notes that 95% of the identifiable bone fragments here were those of deer and turkey. The scarcity of water fowl suggests they were not available in this region. The Ivory-billed Woodpecker seems to have held a cultural significance (van der Schalie and Parmalee, 1960:51). Turtle remains indicate extensive use for food. Fresh-water mussels provided a large part of the food at Etowah; about two dozen species have been found, some coming from the Coosa River (Baker, 1932:146; van der Schalie and Parmalee, 1960:42).

> Fish identified from the bones are sturgeon or gar fish, large catfish, and a drum fish found today only in the Etowah River in north Georgia. Among the species of fish and riverine mammals are occasionally found fragments of human skulls and jaws, blackened and broken in much the same manner as the other bones -- a suggestion that cannibalism may have been an element in the orgiastic feasting which went on. The chance stranger who happened along at a critical juncture may have found his way into the 'Etowah Stew' (Kelly and Larson, 1954:46).

Fruit and nut trees supplemented their diet. This is the oak-chestnut deciduous forest with evergreens, such as white pine and hemlock. To the south is the magnolia-maritime forest with its local wildlife (Shelford, 1974:58). The Etowah and Coosa Rivers provided access to this region. This site location follows the pattern of other major Mississippian sites, an ecotone between major biotic provinces.

The Etowah Valley is bordered by low mountains with peaks up to 366 meters, providing possible foresights for alignments. These form the southern end of the Appalachian range that reaches from Georgia into Maine. These peaks range from 300 to 340 meters in elevation above Mound A, the tallest mound, and in distance from 3.3 to 7 kilometers away. These mountains form a natural defense line for the site.

The mountains were crossed for trade purposes, however. Evidence of contact with Moundville to the west has been found both at Etowah and at Moundville. Little evidence of influence is found further south than central Georgia. To the north, Etowahn culture reached the Tennessee and Cumberland Rivér valleys and as far as Nashville. This area borders on and in the Appalachian foothill, including the drainage of the Etowah. Chattachoochee and Savannah Rivers (Sears, 1962:114-115). How this influence was transmitted is not clear, though there was some trade for marine shells and other goods. The Southern Cult traits reached the Etowah River either by sudden invasion, gradual migration or by contact with areas to the west. Florida, southern Georgia, and Carolinas and the Mississippi regions had very little copper. Copper reached the greatest artistic development south of the state of Ohio at Etowah. Here it was worked into sheets and then engraved, usually with the Southern Cult motives. Engraved, or sculpted, shells are characteristic of the Etowahns. Human forms, birds and other life-like forms are realistically done; many are almost identical, as if made by the same person or family. These shells have been found in Illinois, Missouri, Alabama and Arkansas (Moorehead, 1932:166).

History

The first written record of the mounds may come from DeSoto's narratives (Garcilaso, 1951:335; Bourne, 1904:123). While in the Georgia area, DeSoto passed through a village where a mound was built with a ramp wide enough for six men to walk abreast winding up its side. Thomas (1894:689) believed this described Mound A at Etowah. Others (Willoughby, 1932:17; Moorehead, 1932:3) found other mounds to fit this description and thought DeSoto was east of Etowah.

The first record to be recognized describing Etowah was that of the Reverend Elias Cornelius (1819: 322-324). He found Mound A to be 23 meters high, but had little time to investigate the other two large mounds. Squier and Davis (1848:108-110) described the mounds, although they had never visited the site, and included an erroneous map of the site. Ten mounds and a moat six to nine meters deep were placed on a map by Stephenson (1873). Jones (1873:143) located seven mounds inside a moat; four of these were sepulchral mounds, and three mounds were located outside the moat.

In 1881 Whittlesey (1883) visited Etowah and found the moat partially filled through cultivation by the owners. He stated that Mound A was now 15 meters high, and the remains of four low mounds were 183 meters northeast of Mound A. Excavations were done in the 1880's by the Bureau of American Ethnology (Powell, 1887; Thomas, 1887, 1898). Several graves were uncovered; and the grave goods compared with Central and South American objects, as they were similar to Mesoamerican art. These objects are now considered part of the Southern Cult paraphernalia. The small mounds at the eastern end of the site were excavated; in one, burned animal bones were recovered, but no human bones were found in any of the little mounds.

The Phillips Academy, Andover, Massachusetts excavated in 1926-1927 under the leadership of W. K. Moorehead, who published the results of this work (Moorehead, 1932). He believed Etowah was the center of the Tennessee-Cumberland culture, and examined the artifacts for similarities with Mesoamerican art forms (Nuttall, 1932). Moorehead published cross sections of Mound C, the burial mound. His work there resulted in the removal of 3.5 to 4 meters of its height (Larson, 1971a:58).

An archaeological survey of northern Georgia was conducted by the Works Progress Administration during 1938-1940. When the survey reached Etowah, it was

spring, just before planting, so permission was given to dig in a small area at the downriver end of the ravine (Wauchope, 1966:255). The place had been subjected to flooding and did not provide new information.

When the Georgia Historical Commission acquired the Etowah site, it was decided to excavate Mound C again. In 1953 Sears made test excavations in the village area and found the village and mounds were built and occupied over a period of years beginning about 900 A.D. and ending about 1500 A.D. (Larson, n.d.). The Historical Commission and the University of Georgia conducted excavations from 1954 through 1958 under the direction of L. H. Larson. Excavation of Mound C, the temple mound, revealed burials not found by Moorehead. In fact, more than 200 burials were removed. It had been subjected to periodic rebuilding at least five times. The original structure was placed over an area which had a history of non-domestic use. Four structures, public buildings built one after the other, had occupied this location prior to Mound C. Evidence of a palisade, in the form of post poles, has been found surrounding the base of the last construction phase of the mound. Another palisade had encircled an earlier mound phase (Kelly and Larson, 1957:42). Excavations at Mound B uncovered stratified residential debris containing few ceremonial objects. The burials found came from cultures after the Etowahn. The Creeks, for example, lived here about the time of DeSoto. The Cherokees had built palisades on the top of Mound A as protection for women and children during war time (Cornelius, 1819; Willoughby, 1932:63).

At present the site consists of the two large mounds in eroded condition and Mound C, which has been reconstructed. Evidence of the moat and the borrow pits is visible, though they have been almost completely filled. The size of the borrow pits and the amount of fill required to construct the mounds show the amount of work necessary for such an undertaking. The labor for excavating and moving the earth for the mounds may have been done by forced labor. According to Willoughby (1932:66), Garcilaso mentioned slaves from many regions; he wrote that feet of the slaves were mutilated to prevent escaping. Bartram (1958:234) also wrote of slaves, but he may have meant servants.

Mound A, with an elevation of approximately 20 meters, covers an area of nearly 1.2 hectares, compared with 0.7 for Mound B at Moundville, and contains nearly

121760 cubic meters of fill compared with 85400 cubic meters of fill for Mound B at Moundville.

Mound C was about five meters above the original surface and 5.5 meters above the surface prior to excavation by Thomas. Mound B is slightly higher than Mound C. The three smaller mounds to the east were only about a meter high, circular in shape with a diameter of about 18 meters.

Analysis

Through the historical records the height of the ounds, the number of mounds and the length and width f the moat has varied. Even the size of the site has aried. Today the site covers 21 hectares and includes hree mounds and evidence of a moat and borrow pits. xcavation of the moat in 1962 revealed that it was oriinally about three meters deep with a flat bottom and early vertical sides (Larson, 1972:386). On the illage side of the moat was evidence of a palisade, erhaps a defense measure. The village was entirely ithin the confines of the moat and the river. The hree smaller mounds at the eastern end of the site have ot been rebuilt; they were destroyed by cultivation and xcavation.

Mound C has been excavated and rebuilt. Its resent orientation may approximate that of the original. he numerous burials recovered indicate its religious se. Mound B has been tested and found to be a domicilry mound with only domestic debris. Mound A has not een excavated; however, its size and its ramps indicate had a special use and was not a domiciliary mound.

Mound A was farmed until recently; the surface has been plowed to a depth of approximately 20 centimeters. Local stories say that in periods of draught the crops on Mound A flourished. This was evidence to support the legend that the fountain of youth existed under the mound, and a Cherokee myth reports the presence of a notch at the top of the ramp of Mound A aligned toward the summer solstice (Lewis Tumlin, personal communication). Because the top has been cultivated, evidence of any notch has been destroyed. None of the site reports or published documents record such a notch. The altered state of the three mound eliminates the possibility of recovering man-made markers. At the time of Moorehead's excavation, the southern side of Mound C had been eroded by floods. Early records (Whittlesey, 1883; Jones, 1873:624-627) mention a ramp from the ground level to the top of the east side. No trace remains of this ramp today. It may have been the victim of cultivation and erosion.

The maps of the site drawn by Thomas (1894) and Jump (in Moorehead, 1932) do not agree on location or size of the mounds. For these reasons these maps were not used in the analysis, and figure 7 is included here only to document the evolution of the mounds. For this

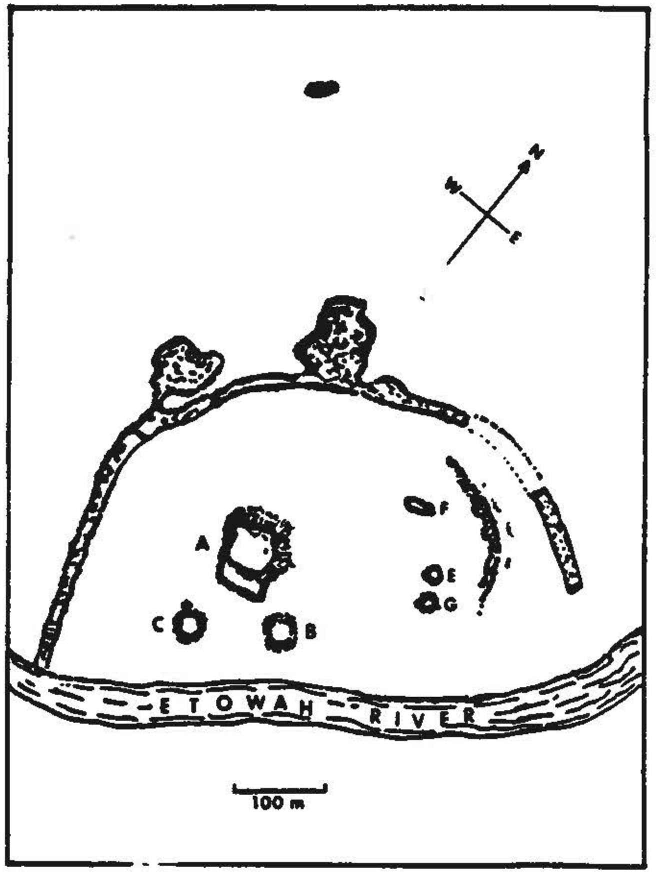
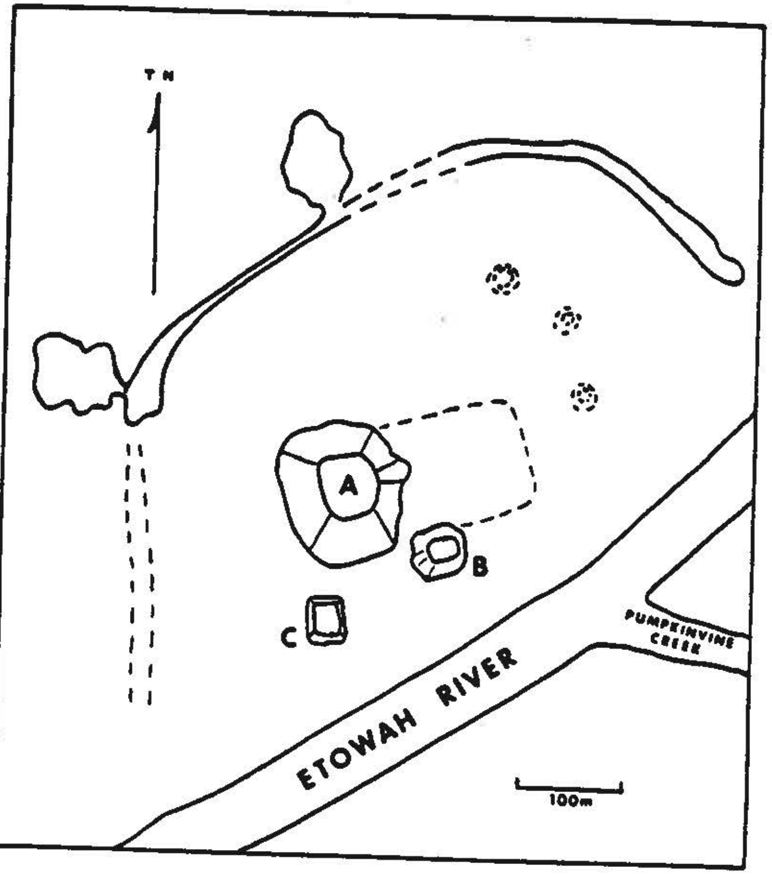


Figure 7 Etowah mounds, redrawn from Thomas, 1894, figure 182

study, the mounds as seen in the aerial photograph were used, figure 8. True north was drawn, using the topographic map and the azimuths determined in the field. At Etowah, for August, 1978, the magnetic declination was zero, so no adjustments were required. Lines were drawn from the center of Mound A to the centers of the other two mounds; and lines were drawn from the center at the top of the ramp at Mound A to the north face of Mound B and to the east side of Mound C. As Mound B apparently never had a ramp, access to the top may have been along the north side. Mound C had a ramp on its east side, according to documents found by Kelly and Larson (1957: 42). From the summit of Mound A there are two distant mountain peaks which stand out on the horizon to the east. These two peaks, at azimuths of 46° and 80°, were also included in the analysis. At a distance of 7.2 kilometers and an elevation of 335 meters, the peak at 46° creates an elevation angle of less than a degree; at a distance of 3.6 kilometers and an elevation of 360 meters, the peak at 80° azimuth creates an elevation angle of just under two degrees. Even with these adjustments there are no alignments within a degree in azimuth.

There were no alignments from either Mound A or Mound B. Mound B was considered even though it



igure 8 Etowah mounds as shown on the aerial photograph

was a domiciliary mound; it may have been a leader's residence.

For Mound A there is a possible alignment with Castor, with one of the peaks as a foresight and the top of the ramp as a backsight, possibly because Castor rises at an azimuth of 47.8° and the peak is at 46°. The one degree tolerance would eliminate Castor, but with cultivation and erosion, the center of the ramp is difficult to determine. Otherwise there was no correlation with any celestial body.

Mound B held no surprises; there is a possible alignment to the setting sun at winter solstice from the center of the mound to the center of Mound C. However, the summits of both mounds have been modified and Mound C is lower by three to four meters, so the original centers are difficult to locate. There is no apparent interest in the rising solsticial sun, so marking the setting sun is not supported elsewhere at Etowah.

The only possibility for Mound C is the record of a ramp on the east side. It may have pointed east and toward the sun at equinox. This is speculation now and cannot be proven one way or the other.

Intermound alignments were determined. Again, because of the changed condition of the mounds, nothing could be recognized.

Conclusions

Etowah has been considered the second largest ceremonial center in the eastern United States. Of course, this depends on the unit of measure. Mound A is larger than Mound B at Moundville; however, Moundville has more mounds and covers a larger area. Etowah appears to be later than Moundville, and was used by the Cherokees until 1833 when they were moved west.

The early excavations did not record burial orientations. In fact errors in recording the burials were admitted. "Since all burials were encompassed within a space of less than 200 feet diameter, it really does not matter if Skeleton K14 is entered on the map 4 feet away from the position in which he was originally placed by his friends" (Moorehead, 1932:72-73). The ground plan he drew of Mound C locating the burials indicate a random placement both horizontally and vertically (1932:figures 40 and 41). It would appear that interment was without special significance, though ceremonies may have accompanied it. Documents of the burials uncovered in the 1954-1958 seasons have not been published. If orientations were recorded, analysis might indicate a preference for a specific direction.

Until this is done, there appears to be no interest in the cardinal directions for the burials.

A fragment of a mantle cloth recovered by Moorehead (1932:64) is covered with the Southern Cult sun symbols. These symbols represent the world, the four directions and the sun in the natural light color of the nettle fiber combined with the dark red, against a background of the natural fiber color. The placement of the mounds and ramps also indicate a knowledge of the four directions.

If there were intentional alignments using the mounds, evidence of their existence has been destroyed. Claim for a single solsticial line has been noted, but no mention as to where this line is or which solstice it marked was made (Hardman, 1971:164). Perhaps there was a structure on Mound C or on Mound A that may have had astronomical significance. Again, evidence of such a structure is not recorded and is now lost.

The data for this analysis is presented in Appendix B. There are possible alignments to lunar setting positions, all associated with domicilary mound, Mound B, and there are no markers to rising positions. Due to the extreme modification of Mounds A and C, these alignments are only possibilities and are not conclusive evidence of astronomical knowledge.

Present day Cherokee and Creek tribes participate in the Green Corn ceremony, including the fire with logs marking the four directions and dancing around a sacred mound (Howard, 1968:19). Both these groups have lived in the Etowah area; it is possible that this ceremony is a survival of Etowahn practices. Other than recognition of the cardinal points, there is no evidence that astronomy played a part in the ceremonial life at Etowah.

CHAPTER V

KINCAID

Latitude 37°04'46"N
Longitude 88°29'35"W

Kincaid is a Mississippian ceremonial center along the Ohio River, with ten mounds located in Massac County and nine mounds in Pope County, along the banks of Avery Lake, which may have been part of the northern bank of the Ohio River. The site is now about a kilometer north of the river in southeastern Illinois. This region of Illinois, enclosed between the Ohio and Mississippi Rivers, has been a transition zone between the north and south during prehistoric and historic times. Physiographic maps divide this region almost equally among the central lowlands, Ozark plateaus, and interior low plateaus; some maps include the Mississippi-Gulf plain here, too. Vegetation maps place this region in the temperate-deciduous forest or in the river-bottoms forest, depending on the area assigned to the upland or the riverbottom zones. Geographically this region is a transitional zone between the north and the south (Bennett, 1944b:464).

The Kincaid archaeological region is located in the confluence of the Tennessee and Cumberland Rivers with the Ohio River. Further upstream the Wabash joins the Ohio and about sixty kilometers downstream the Ohio meets the Mississippi River. This area is called the Black Bottoms, and is approximately sixteen kilometers long and about five kilometers wide with ridges and low-lands subject to standing water or flooding. The soils here are very fertile with the most fertile closest to the river. They have a high yield of corn today and are resistant to drought (Muller, 1978:271). This region is subject to seasonal flooding with occasional floods reaching high levels. Cole et al. (1951:43) mentions a flood early in the construction of the Kin-caid site which deposited approximately two meters of sand and gravel over the site. Floods in 1913 and 1937 covered the site with five to six meters of water over most of the high ground with only the mounds above the water (Muller, 1978:271). On these ridges the early settlers constructed their villages and mounds.

Adjacent to the Bottom is the Hills, a rolling, terraced upland which is an extension of the Ozark uplift into Illinois, and provides different flora and fauna, soil fertility and to some extent climatic

differences. This higher land was distant from the waterways and provided little in the way of natural foods, so it is less attractive for habitation and only occasional camp sites appear. Today, this land supports dense growths of weeds, predominantly giant ragweed, when left unused (Cole et al., 1951:2). However, summer heat, humidity and insect life made the Bottom less attractive in contrast to the more temperate land of the Hills (Bennett, 1944:467). These environmental drawbacks may have had a limiting effect on the popula-tion. The abundance of infant burials at Kincaid indicate a relatively high death rate and all the Kin-caid-related sites nearby contain burials which uniformly display, by skeletal evidence, an unusually high disease rate (ibid).

Mississippian sites in the Black Bottom are almost totally restricted to the "cane bottoms" (so designated by Butler as cited by Muller, 1978:276) because of the extreme cane brakes which coincide with the Armiesburg silty clay loam soil types. This soil was selected over the Huntington soils because the con-centration of Huntington soils close to the river proved too great a risk. Mississippian habitation sites were located more than four meters above the normal river pool, which is the normal crest of seasonal flooding today (Muller, 1978:277). Flora of the Black Bottom are typical Southern Lowland vegetation with cypress and water tupelo trees; higher regions of the Bottom support a lowland forest of cottonwoods and oaks, hickories and sweet gum trees along with black walnut, maple and red bud. Trumpet vine and poison ivy are abundant, and with morning glory vines, honey vine and peppervine, they can form a mass so dense that passage is difficult (Shelford, 1974:96). While the people of Kincaid depended on agriculture, they had access to nuts, sunflower seeds, wild grapes, hackberries, elderberries and many edible roots and tubers. The people hunted deer, elk bear, fox beaver, rabbits, turkeys, turtles and fish; no buffalo bones were found and no skeletons of dogs were reported (Cole et al., 1951:156). Squirrel remains were extensive. It is possible that by killing squirrels, the inhabitants were supplementing their diet and reducing competition for nuts (Muller et al., 1975:51). Hemp was available for weaving; cane was available for construction. The proximity of Kincaid to stone outcrops in the Hills raises the question of its not being used for building materials. There are two possible reasons. One, the southeastern

cultural tradition did not include the use of stone, and two, the climate and frequent floods in this region required construction of lighter materials such as cane, wood and grass (Bennett, 1944a:334). It would seem that the Kincaid people were agriculturalists who used wild foods to their greatest extent. "Like so many other areas of Mississippian settlement, there is an incredibly diverse range of environments within a few hundred kilometers of the Kincaid site" (Muller, 1978:272).

The settlement pattern here follows that of other Mississippian centers. There are a number of very small sites, less than 0.01 hectares in size; then there are sites of approximately 0.3 hectares in size. This type of settlement may have from one to three structures occupied at any time (Muller, 1976:276). There are a few larger sites that come within the 0.9 to 1.0 hectare in size. Muller (ibid) calls these "farmsteads" and says they may be found in the center of an area of smaller sites. What is missing in the Black Bottom region is the secondary level site. A secondary site would have platform mounds and these have not been found outside the Kincaid ceremonial center (Muller, ibid). The closest one- or two-mound Mississippian sites are at least thirty to forty kilometers from

Kincaid (op. cit., p. 281). Kincaid extends over an area of seventy hectares. The existence of a palisade around the site had been questioned; "the search for palisades ended without convincing evidence" (Cole et al., 1951: 57). Yet, "the fortification at Kincaid encloses an area of roughly 60 to 70 hectares (depending on the interpretation of the aerial photographs as to the location of the palisade)" (Muller et al., 1975:140). So, the presence and location of such a fortification is now determined. Parts of the site may have been enclosed during the Middle Mississippian period but were soon covered as the settlement grew. The total habitational area was only about six hectares, or approximately 8% of the site (Muller, 1978:276). The first evidence of the Middle Mississippian people at Kincaid is small village sites found on high land near the waterways. One of the mounds, Mound Mx°7, was started at this time. A great flood apparently covered the area, including the large middens of this first group, with sand and gravel. After the inundation, the people returned to these villages but were soon to construct the ceremonial center from a series of small sites, including structures of great size and importance,

some surrounded by palisades, and a number of mounds (Cole et al., 1951:15).

Various forms of societal organization have been suggested for Kincaid; some stratification differentiated the people. Some form of central authority did exist; the size of the mound construction would imply central direction and control of labor. "Although it is probable that Kincaid was a chiefdom, it is primarily the long-term duration of the system that seems to suggest this, for the construction of a typical mound does not seem to be out of reach even for the 'Big Man' type social systems" (Muller et al., 1975:149).

Population estimates range from 1500 to 3000 people for the Black Bottom area, with about 400 at the Kincaid site (Muller, 1978:288). There are indications of a higher population count (Weigand, personal communication). Trade with other regions is evident in the pottery pieces from other areas. Pottery from Cahokia, the Moundville area, the Tennessee-Cumberland area and the Lower Mississippi Valley were recovered. With access to several major waterways, trading with and travel to Kincaid would be easy.

Several peoples have occupied this region. The first group were nomadic hunters who left few remains;

these have been called the Faulkner people (Cole et al., 1951:3). The next group is Baumer, with a more settled population using pottery. Bennett (1944b:465) places these people in the Black Bottom about 1000-1300 A.D. The last of the Woodland people in this area are known as Lewis; Bennett (ibid) gives 1300-1500 A.D. as dates for these people and Cole et al. (1951:12) says there is no evidence of agriculture during this time. Following these people, and perhaps overlapping slightly, were the Middle Mississippian people with a well-developed way of life based on agriculture. Bennett (1944b:465) gives a span of 1500-1630 A.D. for these people. Dendrochronological studies at Kincaid support this time range (see Bell in Cole et al, 1951). These dates have been challenged. Clay (1976:141) believes the area was inhabited between 1300 and 1650 A.D. Radio-carbon dates for Mississippian components have a mean of 1180 A.D. which may be adjusted to 1212 A.D. if two very early dates are excluded (Muller, 1978:275). Artifact evidence indicates a settlement coeval with other Mississippian settlements (ibid). For whatever reason or reasons the area was abandoned prior to European contact. Few traces of the Southern Cult have been found at Kincaid; either the Cult did not enter

this area at all or only after Kincaid had been abandoned (Cole et al., 1951:231).

History

Kincaid had been abandoned when the French came through this region. Early explorers do not mention the site. The first mention of the site appears in local records during the latter part of the nineteenth century. The first archaeologist to mention the site was Clarence Moore (1916), who sailed up the Ohio on his ship, the Gopher. He was not allowed to excavate, so the site remained farm land until it was brought to the attention of Fay-Cooper Cole in 1934. He was able to interest the University of Chicago in Kincaid and conducted work here until World War II interrupted the progress in 1942. For whatever reason, he excavated the western portion of the site, leaving the mounds in the eastern part alone except for one burial mound. Excellent documentation is available for this work (Cole et al., 1951). TNe site remained as Cole left it, except for the damage done to part of the site while clearing it for agricultural purposes. Recently, survey work done by Southern Illinois University has located over 500 sites in the vicinity of Kincaid (Muller, 1978:270). The state of Illinois was persuaded to purchase and preserve a portion of the site. The mounds are now overgrown with

weeds and trees. There is no fence or protection for the site. Parts of the area are still cultivated and features have been destroyed. While still unknown to many people in the region, this site has an attraction for collectors, and with nothing to hinder their activities, these people come and dig in the mounds or collect artifacts in nearby fields.

Analysis

Cole (Cole et al., 1951:1) counted nineteen mounds in the area, ten mounds in Massac County and nine in Pope County (see figure 9). The site extended almost two kilometers along Avery Lake and a series of sloughs that were once part of the northern bank of the Ohio River. The surrounding horizon consists of gently rolling countryside and contains no peaks that could be used as foresights.

> At first glance the mounds today appear to be of three types: steep-sided high conical; large steep truncates--one with a conical offset; and low circular dome shape. Excavation has shown, however, that all except the conical offset of Mx^{o}10 and the burial mound Pp^{o}2, which lies some distance from the 'plaza', are of the truncate variety and that the conical or domed appearance of some is due to weathering. (Cole et al., 1951:21)

Only four mounds in Massac County (the western part of the site) and four mounds in Pope County (the eastern part of the site) are still visible; a fifth mound Pp^{o}2, in Pope County is just a slight rise in the cultivated field and can be identified only if one knows where to look (see Table 6). The other mounds have been destroyed through excavation, cultivation or collecting.

The condition of these mounds prohibits a thorough analysis. Mound Mx^{o}7 was excavated by Cole and

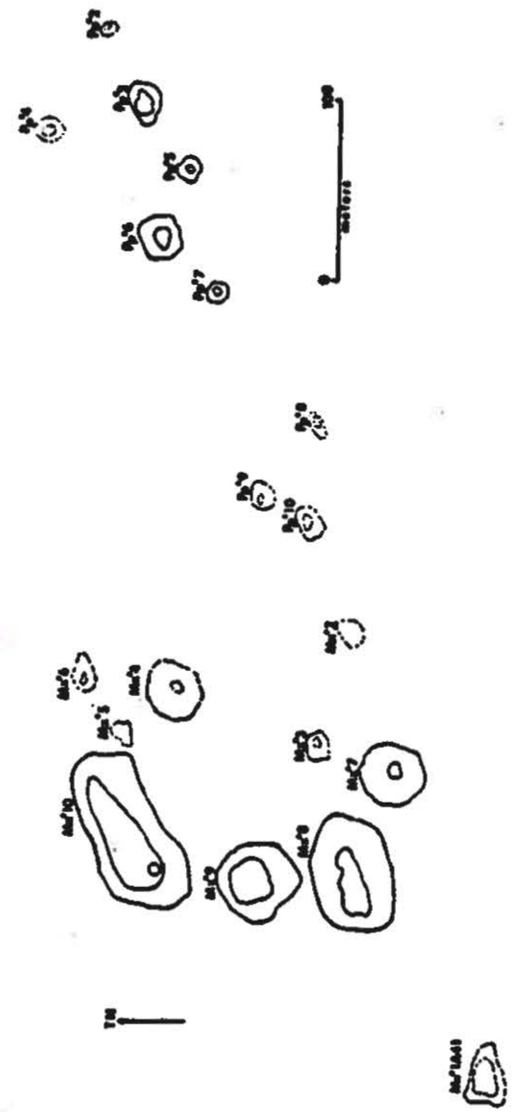


Figure 9 Map of Kincaid drawn from a ground survey. Extinct mounds are indicated by hatched lines. The size and shape of these mounds are not accurate.

TABLE 6

HEIGHT OF THE MOUNDS AT KINCAID
AS MAPPED BY COLE ET AL. 1951

Mound Massac	Approximate Elevation meters	Mound Pope Co.	Approximate Elevation, meters
Mx°2	0.3	Pp°2	0.6
Mx°3	0.6	*Pp°3	1.5
Mx°4	1.5	Pp°4	0.3
Mx°5	0.3	*Pp°5	3.4
Mx°6	0.6	*Pp°6	4.6
Mx°7	6.1	*Pp°7	0.9
Mx°8	9.1	Pp°8	0.9
Mx°9	3.4	Pp°9	0.9
Mx°10	6.1[1]	Pp°10	0.9
Mx°1A41	-0.3		

1 The cone on the southwest side is 4.5 meters above the terrace

* This mound is still identifiable

his group. At that time it measured approximately 48 meters by 42 meters at its base (Cole et al, 1951:74). The shape of the excavation trenches are still visible and a large hole exists at the top of this mound. It is impossible now to determine the shape or sides of this mound. It has been described as a "flat area at the top from which the sides slope off sharply, finally to end in an alluvial fan" (Cole et al., 1951:74). Burials found during the excavation were oriented east-northeast to west-southwest (op. cit., p. 76). Evidence of a rectangular structure was found below the burials, and about seven meters below the top of Mound Mx°7 was a small truncate pyramid about a meter in height (op. cit., p. 83). This was interpreted as the first evidence of Middle Mississippian at Kincaid.

Mound Mx°8 is the tallest mound at Kincaid and has a base of 61 meters by 91 meters, covering almost a hectare. In 1861 the land owners, the Kincaids, built a house on its summit and later added sheds along its east side (Cole et al., 1951:85). A road was built along the east side up to the house; this road still exists. The house is now gone but a large hole exists where the basement was. Because of the house only limited excavation could be done. Evidence of seasonal construction was found, with the original mound the same general shape but only five meters high (op. cit., p. 87). The original shape has been obscured and the mound is now overgrown with trees. The mound is oriented slightly east-west, but there is no ramp and no evidence of one has been found.

Mound Mx°9 is now a flat-top mound with a large abandoned barn on top and a road along its south side up to the top. It has a volume of approximately 3500 cubic meters (Muller et al., 1975:149). According to local stories when the Kincaids built a barn on this mound as much as the top two meters had been removed and dumped along the sides (Cole et al., 1951:88). When the present barn was built more of the surface soil was removed; it was rumored that several burials were uncovered at that time (ibid). Livestock had roamed over the mound. Excavation revealed a large structure nearly 1.5 meters below the surface in which there had been a large fire pit. This feature was labeled a fire pit for a temple (op. cit., p. 91). No burials were found during the excavations. Because it has been grossly altered, this mound cannot be used in this analysis.

Mound Mx°10 is the largest mound at Kincaid. It is approximately 150 meters long and 60 meters wide. On the southwestern corner there was a cone apparently added at a later time (Cole et al., 1951:98). Now there is a small barn on the south side with a road leading up to it. Excavation revealed evidence of a palisade and some structures; the few fire pits and lack of refuse indicate Mound Mx°10 may have been a ceremonial structure. A pattern of construction, destruction, and construction again is similar to the Mesoamerican custom (ibid). The mound is cigar-shaped with its long axis running nearly east-west. Reed (1977:36) believes that Kincaid was oriented along the path of the Ohio River, and that Mx°10 reflects this orientation. There is no ramp for this mound, though there may have been steps on the north slope of the cone (Cole et al., 1951:100).

The only other mound excavated at Kincaid was the burial mound, Pp°2. The excavators found it to be about 1.5 meters high, 30 meters long and 18 meters wide; now it is just a slight rise in a cultivated field. A cabin had been built on its surface; later the mound had been cultivated (op. cit., p. 104). Remains of 155 burials were recovered; extended burials with heads to the west were found throughout the mound (ibid). Because it has been so modified; mound Pp^{o}2 cannot be used in an astronomical analysis.

Three remaining visible mounds, Pp^{o}3, Pp^{o}6, and Pp^{o}7, now have structures on them. Mound Pp^{o}3 appears to have been leveled for construction of a farmhouse. What appears to be a barn or storage facility has been built on Mound Pp^{o}6. There is a barn on Mound Pp^{o}7; otherwise it would be difficult to identify. Mound Pp^{o}5 currently has no structure on it; however because of its height it must have had a structure on it. There was a large structure to the east of its top. These mounds have been modified; their original shape and sides cannot be determined without extensive excavation.

Conclusions

Kincaid is an extensive site with a number of satellite sites; it had been the major ceremonial center for the region called the Black Bottom. Now it is in poor condition, with no protection from collectors who come here to find or dig artifacts. The Ohio River often overflowed its banks and flooded this area. Local residents used the mounds for refuge and built on their summits for protection. Cattle and pigs have been permitted to roam over the mounds. As a result of these activities, the mounds have indefinite sides and their original shapes have been destroyed. The mounds are not clustered around a plaza; rather one group is at the western end of a plaza and the second group is clustered away from the plaza to the east.

The data for this analysis, presented in Appendix C, is based on the 1979 map, drawn from ground-based data and using the Cole et al. 1957 map, figure 69, to locate the original mounds. Because the shape of the remaining mounds has been modified, the mound centers are not precise. One alignment to the moon is a possibility, but due to the damage inflicted on the site, there is no conclusive evidence for this.

There is no apparent site orientation other than the construction of Mound Mx°10 parallel to Avery Lake. Mounds Mx°10 and Mx°8 may have had an eastward orientation; now the axis of each mound is north of due east. Other than this, there is no evidence of astronomy at this site now.

CHAPTER VI

ANGEL

Latitude 37°55'42"N
Longitude 87°30'30"W

The Angel site is located in Vanderburgh and Warrick Counties, in the southwestern part of Indiana, bordering the Ohio River. The south side of the site is bordered by a chute, or inlet, separating the mainland from an island called Three Mile Island. The river valley here is composed of a flood plain and two terraces. The lower terrace is approximately three meters above the current floodplain and four meters below the high terrace; there are no sharp divisions between these three features (Green and Munson, 1978: 298). The floodplain is subject to seasonal flooding; soils here are Huntington soils, fertile and well-drained. The uplands are low, undulating land with few sharp escarpments (op. cit., p. 299). Soils here vary in fertility. The region here can be described as broad alluvial valley merging with gently rolling hills. West of the site the floodplain is cut and scarred with the meandering of the Ohio River, leaving inlets, sloughs or ponds, which fill with water in flood time and are otherwise dry. To the east of the site are the hills of Newburgh along the west side of Cypress Creek and to the southwest about six kilometers are the Wolf Hills (Blace, 1967:572).

The vegetation in southwestern Indiana is southern in nature. Although this area falls within the deciduous forest region, there are several biomes present here. The upper terrace supports a biota that differs from that of the floodplain and the prairie is not far away. The upper terrace supports a forest of gum, hickory, ash and oak; the lower terrace is much the same with a greater variety of oak (Green and Munson, 1978:299). The floodplain, or bottom, had a great stand of cypress, now much depleted, sycamore and poplar trees, and great quantities of cane, now almost gone (Black, 1967:576ff). Grape vines were abundant here, as were wild cherries, walnuts, pecan and butternuts. The chief characteristic of the deciduous forest is its annual shedding of leaves; the understory growth is usually deciduous also (Shelford, 1974:17). These changes affect the animals living below.

The region around Angel supported an abundant and varied animal population. In a 25 square kilometer area of deciduous forest, Shelford (1974:27ff) states there would have been four hundred deer, one to three wolves, five black bear, many squirrels, and two hundred turkeys. In addition to these, there would also be opossum, raccoons, rabbits, beaver, mountain lion, red and grey fox. Black (1967:579) believes that bison, present here in the eighteenth century, were not there when Angel was occupied.

With the sloughs, ponds and marsh areas nearby waterfowl, fish eating birds and marine life would have been available. Cormorants, blue heron, and egret remains have been found at Angel, along with those of the prairie chicken, common loon, Canada goose, blue goose, snow goose, mallard, black duck, wood duck, quail and many others (op. cit., p. 482). Many fresh water mussel shells and a variety of turtle remains were found. Fish available included northern pike, channel catfish, freshwater drum and bullhead.

The subsistence base here was a broad one. Domesticated plants, with corn the most abundant, were important, but the natural flora and fauna supplemented the diet. Deer was the most common mammal and the wild turkey, the most common bird. This is typical of the deciduous forest. As has been shown, Angel residents had access to several biomes, including the prairie.

The climate in this area is mild; it may have been the same when Angel was occupied. The region is humid and precipitation averages 106 to 112 centimeters a year (Green and Munson, 1978:298). Snowfall averages twenty-five centimeters a year and there is a growing season of approximately 186 days (Black, 1967:586-587). Honerkamp (1975:331) has suggested that a climatic change caused the abandonment of Angel.

> Whatever the name applied, it is certainly obvious that there is little or no significant difference between the climate of Angel Site and those parts of the Mississippi Valley from which these folks originally came. When they settled behind Three Mile Island they were 'right at home' climatically and biotically. It was, for them, all 'peach and cane land'. (Black, 1967:587)

Southern Cult motifs are rare; the cross within a circle appears as does the bilobed arrow (op. cit., p. 475). Whether the motifs did not reach this area or were rejected by the residents is unclear. Green and Munson (1978:307-308) give dates for Angel from 1050 to 1450 A.D. Black (1967:549) believes the decline began about 1600 A.D. Honerkamp (1975:331) suggests a date of 1550 A.D. for its decline.

Trade is evidenced by copper from the Great Lakes region, fluorite and galena from southern Illinois, flint from Tennessee and a few marine shells (Black,

1967:483). Location on the Ohio River a few kilometers from Kincaid and the Cumberland and Tennessee Rivers provided access to many regions. Salt was available from the saline springs along the Saline River, not far from Angel. Cannel coal came from upriver, chert from west of the site, pitch from Green River, and the Ohio River provided stones for hammers and grinders and clay for pottery (op. cit., p. 582). These would have made excellent trade items.

Settlement patterns here follow the Mississippian plan with Angel the major center and related satellite sites. It is possible that Angel started as a satellite of Cahokia, not far away by land or by water, and as Cahokia declined, Angel grew in size and importance. Black (1967:546) placed Angel as a second class center, or city, with Cahokia as the metropolis. He (op. cit., p. 547) estimated a population at Angel of about one thousand people. Keller (1973:55) echoed this number, but Green and Munson (1978:311ff) feel this was a minimum figure and more reasonably three thousand people inhabited the site at its peak. Settlements within 25 kilometers of Angel lack evidence of permanency; thus there were no substantial populations near the center (op. cit., p. 322). It has been suggested that these people were involved in warfare and the population would fluxuate as a result (ibid). It is possible that warfare caused the decline of Angel. Whatever the reason, the site had been abandoned before European contact.

History

This region was included in the Louisiana Purchase, giving this territory to the Federal Government in the early nineteenth century. The first record of a mound in this area is in the original survey records; the surveyor mentioned a mound about eight meters high --this had been identified as Mound G (Fowler as cited by Black, 1967:4). In 1875 John Collett surveyed this region for the states; he noted large mounds in a section he labeled Angell (Thomas, 1891:81). Dr. Floyd Stinson reported his visit to the mounds to the Smithsonian (ibid) a few years later. Perhaps as a result of this report, Cyrus Thomas visited this area and mapped the site, figure 10. Others wrote of the site, including Shetrone (1930:414-415), but it was not until the Indiana Historical Society published a book on Indiana antiquities that the society became interested in the site and began professional excavations. Prior to their efforts there had been considerable digging by collectors. One avid collector even had a room added to his home to house his prizes (Black, 1967:18). The land had been part of the Angell, or Angel, farm. It was purchased by the Indiana Historical Society in

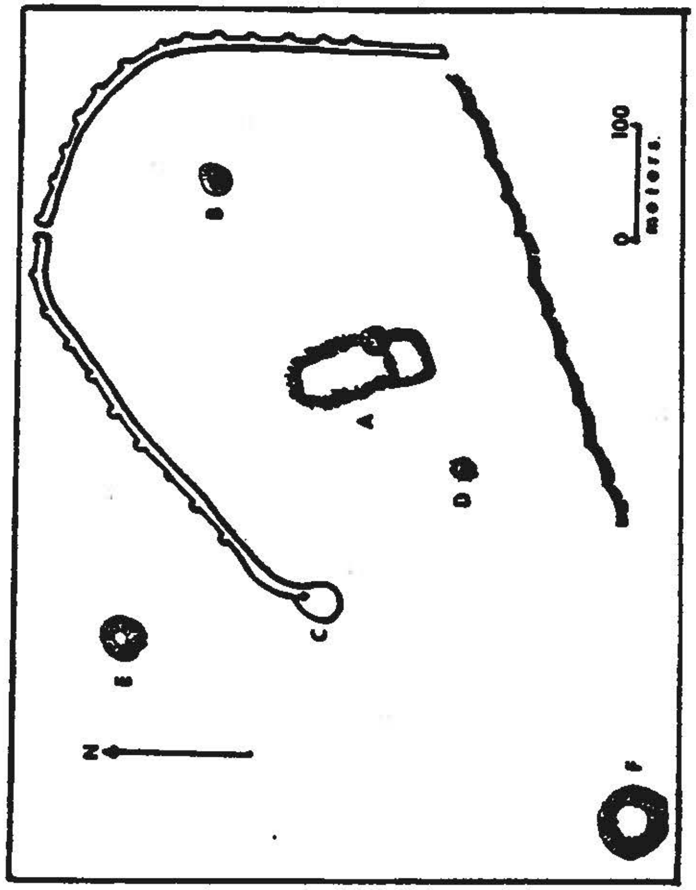


Figure 10 Angel Mounds, Redrawn from Thomas, 1894 pages 558-559

1938 and then given to the state in 1947. It is now well-protected.

From 1939 until 1964 work was done at the site, probably the most thoroughly studied site of the Mississippian centers, professionally done and documented by Glenn Black. Initially the work was done in cooperation with the Works Progress Administration. The site was surveyed accurately and mapped. The stories Black wrote (1967:22-25) about the efforts of these men document an interesting period of history that ended in 1942 as a result of World War II. In 1945 Indiana University sponsored a trial field school which was to continue until 1964. Compared with the large WPA crew, the small student body was not able to cover as much territory, but they did a more detailed study. No excavations have been made recently. Mound G, outside the palisaded area, has been purchased and is now protected by the state.

Analysis

The Angel site consists of approximately forty hectares enclosed in a palisade; it extends a little over one kilometer along the Ohio River Chute. Reed (1977:35) found the site to be in opposition to its environment, the major mound does not run parellel with the river. According to Thomas (1894:556-559) there were six mounds at this site, see figure 10. When doing his survey, Black retained Thomas' lettering and added six more mounds. There is a question as to whether some of these are man-made features or natural phenomena, see Table 7. The surrounding land consists of low rolling hills; there are no outstanding peaks that might have served as foresights. The land here is fertile and has been cultivated for many years. The two terraces of Mound A, the largest mound at Angel, have been planted many times and Mound F had also suffered from cultivation. Attempts had been made to destroy Mound A by tearing down the sides; however the sides proved too steep and withstood the efforts (Doran Cart, personal communication).

Mound A is about 200 meters long, 130 meters wide and about 10 meters high, with a cone 4 meters

TABLE 7

HEIGHT OF THE MOUNDS AT ANGEL
AS SURVEYED BY BLACK 1967

Mound	Approximate Elevation, meters	Mound	Approximate Elevation, meters
A	10[1]	G[3]	6
B[2]	1.5	H[2]	0.9
C[2]	1.5	I	0.6
D	0.9	J[2]	0.6
E	3.9	K[2]	0.6
F	3.9	L[2]	0.6

1 With the cone added, 14 meters

2 May be a natural feature, see Black 1967:54

3 Outside the Angel site; thought to be an Adena mound

high on the southeast corner of the upper terrace. The mound contains approximately 47,000 cubic meters of fill. At present trees surround it on three sides; the bare side is to the south. The trees have been left to preserve the steep slopes. According to Black, the long axis of the mound is canted east of north. "Magnetically, the bearing of the long axis is N 22°E along a midline which-----we had established upon the mound" (Black, 1967:46). Now the long axis approximately 27° east of true north, based on measurements I took in the fall of 1979; approximately because the long axis is difficult to determine, given the shape and condition of the mound, see figure 11. (It should be noted that Thomas' drawing of Mound A placed it canted west or north, see figure 10.) Capella would rise in 1000 A.D. at an azimuth of 26°49' and at an azimuth of 24°32' in 1500 A.D. The mound was built after 1000 A.D. and before 1500 A.D., so an alignment to Capella is difficult to establish. Capella does not appear in the ethnology of this area and is not significant in Mesoamerican astronomy. An alignment to Capella has been recognized at Monte Alban (Aveni, 1975:173), but this is the only identification at this time of an alignment to this particular celestial body. It is difficult to

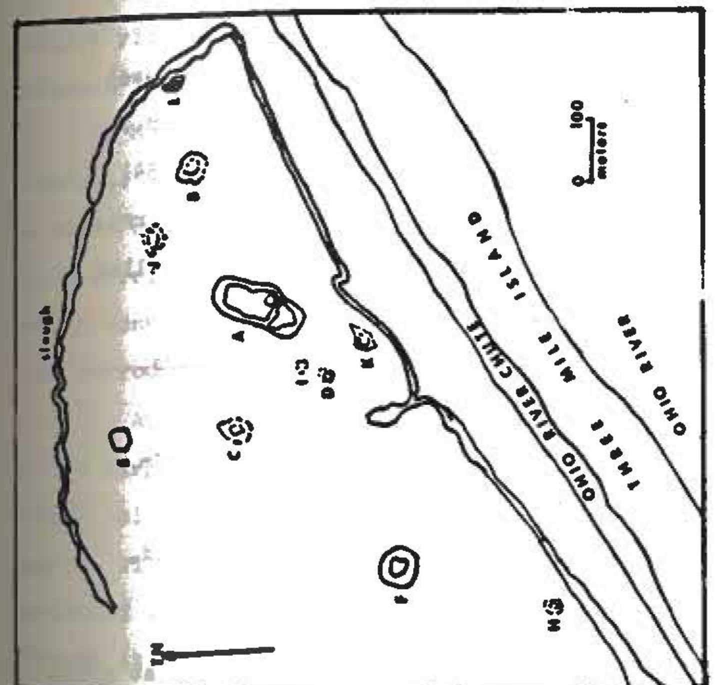


Figure 11 Map of Angel drawn from an aerial photograph

identify specific stars from records unless an informant can point to, and describe, which star is the "one". The horizon today at Angel provides no foresights to serve as markers; it is possible that a remarkable tree existed for a long time during the construction period and there is no longer evidence of this marker.

"Mound A, as an example, represents several building stages, in all probability, spread over the total time the site was occupied" (Black, 1967:541). The cone on the southeast corner of the upper terrace has not been satisfactorily explained. Black called to mind a ceremony performed by the Natchez.

> Every morning as soon as the sun appears, the grand chief stands at the door of his cabin, turns his face toward the east, and howls thrice, prostrating himself to the ground at the same time. A calumet is afterwards brought him, which is never used but upon this occasion; he smoaks and blows the tobacco first towards the sun, and then towards the other three quarters of the world. He acknowledges no master but the sun, from whom he pretends he derives his origin. (Charlevoix as quoted by Black, 1967:505).

This does not explain the construction of cones at similar Mississippian sites. The cone at Kincaid, for example, is built on the southwest corner of Mound $Mx^{o}10$, not a good position for facing east. There are no ramps for Mound A; in fact there are no ramps at all at Angel.

Mounds A and C may not have been man-made features. Both are composed of sandy soil and have not been excavated. Mound B was cultivated for many years and Mound C was cultivated for a period until a farm road was built over it. Both mounds now are just slight rises in elevation and would not be recognized without identification.

Mound D was explored in the late nineteenth century. Thomas (1894:558) reported the discovery of a stone cist containing thirteen skulls; twelve were in a circle and the thirteenth was in the center with thigh bones. The mound is now just a slight rise above the surrounding land, barely recognizable.

At an elevation of four meters Mound E is the third largest mound at Angel. It has been cleared of trees only within the last two years. "On the contour map it will be seen that it is squarish with the sides oriented with the cardinal directions" (Black, 1967:51). Though it has eroded some, it has not been cultivated. There was a Boy Scout structure on it at one time (Lilly as cited by Black, 1967:51). As the plaza was on the west side of Mound A between Mound E and Mound F, this must have been the ceremonial area, with the habitation area east of Mound A.

Mound F has been designated the temple mound. It has been used historically as a cemetary and had been cultivated. There was a summer cabin built on the mound in the mid-1930s which was removed when the mound was excavated. The top of the mound may have been leveled when the cabin was built. As a result of constant plowing the mound was rounded. "The square of the mound was not oriented with the cardinal points" (Black, 1967:232). A line drawn through the center was nearly parallel with the long axis of Mound A. Excavation revealed a primary mound here that was smaller, square, and oriented along the same line. Based on archaeological evidence, Black believed that Mound F was the location of the temple "on the west end of the square, opposite the house of the chief" (Black, 1967: 514). The mound has been excavated to the primary mound and then rebuilt. A temple was constructed on top to resemble the temple of the Mississippian people. However, the structure on the mound had been facing eastward toward the river and the reconstruction has been twisted more northward.

Mound G is outside the palisaded area. It is a cone-shaped mound with a square base. The base has formed by a square fence enclosing the mound to protect

it from the plow. It has not been excavated, but present interpretation has it labeled an Adena mound (Doran Cart, personal communication). Because it is about a kilometer from Mound A and because of its questionable origin, it has not been included in the analysis.

Mound I is "inconspicuous and barely shows on the contour map" (Black, 1967:345). Several burials were found in the area of Mound I along with a semi-subterranean structure with walls "definitely oriented with the cardinal points" (Black, 1967:356). A circular structure with a diameter of slightly more than ten meters was built above this. Evidence indicates this was a special area located just south of the plaza area. The remaining mounds H, J, K, and L, are possibly man-made features. Their size and elevation are interpreted as making them insignificant for this study.

The layout of the village area appears orderly and deliberately planned. The first house patterns uncovered had the corners oriented toward the cardinal points. "We ultimately concluded that erecting dwellings east of Mound A with the corners pointing to the cardinal points was a deliberate act on the part of the builders" (Black, 1967:501). "The few structure patterns found at Angel adjacent to the area we are assuming to have been the town square were different in some respects from those east of Mound A. The principal difference was orientation, the walls aligning with the cardinal points rather than the corners to north, south, east and west" (Black, 1967:521). So there was definite interest in the cardinal directions.

Conclusions

Angel is a well-documented site; Black noted many things other archaeologists did not. He thought to record the bearings and distances of each of the mounds from the top center of Mound A "on the remote chance that someone may be able to 'read' some significance into the relationship of the mounds" (Black, 1967:54). While the distances are not useful for this study, and it is best not to rely on measurements made by someone else, it is good to realize how thorough the documentation has been.

The significance of the orientation of Mound A and Mound F more than 20° east of north is not known. There is no obvious celestial body that might form an alignment, and the river flows in another direction. There are site alignments in Mesoamerica which fall in the 20° to 30° east of north range. The majority fall in the 15° to 20° east of north range, with the probability of the "existence of a 17° 'family' of orientations though no axial trend through time has yet been discerned" (Aveni, 1975:166). Is it possible that this family marked some specific celestial body or occurrence? Teotihuacan and ceremonial centers within a hundred kilometer vicinity of Teotihuacan fall within this 17° east of north "family" (Aveni, 1977:5-7). If there is a continuity of purpose, is Angel a northern outpost of this site alignment? We will not be able to pursue this idea until the reason for this "family" of alignments has been determined. This reason, perhaps alignment to a specific celestial body, can then be looked for at Angel. That this alignment of 20° east of north was important is indicated by the orientation of primary Mound F along the same line. The mound of the chief and the temple mound deliberately aligned similarly must have had meaning to the builders, but that meaning has been lost or is hidden at the present.

What is apparent at Angel is the importance of the cardinal directions. Houses were consistently oriented with corners directed to the cardinal directions east of Mound A, while to the west of the mound the house walls faced the cardinal directions. The semisubterranean structure under Mound I was oriented toward the cardinal directions. This interest is consistent with other Mississippian ceremonial centers and the concept the Mississippian people may have had of a quadripartite universe.

CHAPTER VII

SUMMARY

Interest in the sun and solar motion has been recognized throughout the Southeast during the Mississippian period. Because agriculture was so important to the development of large ceremonial centers, solar movement and the consequent seasons were significant. This interest and a quadri-partite division of the universe were unifying concepts at these major centers. Astronomical knowledge on a very limited scale was found at each of these sites, in varying degrees, depending on the size of each center and the intervening destruction. Knowledge of lunar and solar movement is fundamental and not necessarily the result of diffusion. Quadri-partite division of the universe would be a shared trait if based on the same orientation; Mississippian division is based on the cardinal directions, and Mesoamerican division is not. At this point the hypothesis cannot be proven. There is evidence of knowledge of astronomy found in Mississippian ceremonial centers, but this knowledge does not compare with that found in Mesoamerica. Destruction of the data, in the form of mounds, has made impossible the comparison between Mesoamerican astronomy and Mississippian astronomy.

At Cahokia, mounds were used to mark the four corners of the settlement. These corners coincide with the cardinal directions and center on Monks Mound. The relationship between mounds and between Cahokia and other sites in the American bottoms indicate definite selection of right angles and the cardinal directions.

Alignments to the sun and Capella are questionable. The suggested backsight for Capella is non-existent; the existing marker is east of the position necessary to indicate Capella rising or setting. The post suggested as the foresight may belong to a different structure altogether, or it may have been a guess for location of the post next to it. As shown in Table 2, there are several possible alignments using the off-center post as a backsight. The only ones supported by ethnographic data involve apparent solar motion. The existence of four large circles and three smaller ones in the excavated areas suggest the possibility of more undiscovered circles. Four overlapping circles of this magnitude do not indicate trial and error construction of an observatory. The ethnographic

data would imply only ceremonial use, not involving astronomy. What the evidence indicates is the construction of large circles, one of which has posts marking the cardinal points, for ceremonial use. Circular structures used for ceremonies have been documented throughout the South, the Southwest, and northwestern Mexico; at Cahokia they would be conspicuous only by their absence.

The mounds at Moundville have been modified, destroying any axial alignments that may have existed and changing or eliminating ramps that may have had astronomical significance. Analysis of the burial patterns at Moundville phase sites suggested the importance of cardinal directions. This concept is repeated in the prolific use of the Southern Cult sun circle on Moundville artifacts. Even the Museum at the site has this motif around the cornice on the outside of the building.

The situation is the same at Etowah; study of maps revealed a change in shape for each of the mounds, and prior to the mapping, flooding did some modifications. A major change is the destruction of the ramp at Mound C; as the temple mound, it would be the likely candidate for astronomical orientation. At present, it is an excellent example of our ability to reconstruct things as they should look. Burial patterns have not been analyzed for predominant orientations. From Moorehead's drawings (1932), they appear random, at least in two dimensions. Cardinal directions are not obviously marked here. The presence of the Southern Cult sun circle is the only recognizable evidence.

The mounds at Kincaid are in such a state of deterioration that their shape and size have been obscured. Because of their location in the Ohio River floodplain, the mounds provided refuge for man and animals when the river left its banks. What may have been the village area has not been thoroughly excavated, so the orientation of structures there is unknown. There are no examples of the sun circle motif of the Southern Cult here. With the data available today, it is difficult to find evidence of astronomy, or even knowledge of the cardinal directions here.

Angel Mounds have also been altered through cultivation and construction. Only three of the mounds are available for analysis; the remaining eight are either too slight to be useful or are not identifiable now without excavation. The twelfth mound, G, does not belong to this group culturally. Significant here

is the consistent use of the cardinal directions in construction. Houses were aligned in some way with the four points. Mound D was constructed with its sides aligned with the cardinal points, and the walls of a structure under Mound I were also oriented toward the cardinal points. The temple mound and the mound of the chief, Mounds F and A respectively, were built in parallel, but the significance of their orientation is lost for the moment.

For Moundville there were 444 azimuths with 105 alignments; 6 alignments are just outside the 1° limit permitted. There is an alignment to the northernmost and one to the southernmost setting position of Venus, but only one to a rising position. There are alignments to winter solstice sunrise and sunset positions, but only the sunrise position at summer solstice is marked. Not all of the moon's positions are marked, and there are four alignments to a supernova that occurred prior to the rise of the Mississippian ceremonial centers. Interestingly enough, there are more than twice as many alignments toward the East than toward the West. This is also true at Etowah and Angel, but not at Kincaid, see Table 8. There are alignments at Moundville to the most prominent positions marked in

TABLE 8

TABULATION OF ALIGNMENTS FOR MOUNDVILLE, ETOWAH, KINCAID AND ANGEL

Alignment	Moundville		Etowah		Kincaid		Angel		Total	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
Cardinal Direction	5		1		2		3		9	0
Solstice*	4	1				1			4	2
Equinox*	1		1						2	0
Moon*	7	3		1	1				8	4
Venus*	2	3	1			1			3	3
Jupiter	2	4	1						3	4
Mars	3	2							3	2
Pleiades*	1								1	0
Capella*							1		1	0
Sirius	1	1				2			1	3
Castor*	2	1							2	1
Pollux*	3	4							3	4
Rigel	3					1			3	1
Vega	2	1			1				3	1
Regulus	3								3	0
Spica	4	1							4	1
Supernova 185	4								4	0
Supernova 827	1	1							1	1
Supernova 1054	1	1							1	1
Epsilon Orionis	5	1				2			5	3
Canopus	4								4	0
Alpha Centauri	4	2							4	2
Beta Centauri	2	1							2	1
Alpha Crucis	1	1							1	1

TABLE 8 (continued)

Alignment	Moundville		Etowah		Kincaid		Angel		Total	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
Formalhaut	2	1							2	1
Altair	1				1	1			2	1
Deneb	1	1							1	1
Acturus	1	1							1	1
Alpha Antauri	1								1	0
Betelguese		1							0	1
Antares		1							0	1
Aldebaran	1								1	0

* Appears in Mesoamerican astronomy

Mesoamerica. This is not found at the other sites, so it would seem this is a result of the large number of azimuths at Moundville and not a deliberate act on the part of the builders and designers of the ceremonial center.

For Etowah there were 15 azimuths computed, with 5 alignments and 2 near-alignments, those just outside the 1° limit permitted. At Kincaid there were 66 azimuths, with 13 alignments and 4 near-alignments. There were 10 azimuths at Angel with 4 alignments, all to the cardinal directions, and 1 near-alignment. The larger the number of mounds available, the greater the possibility of alignments being found. Moundville, with the largest number of mounds extant, has the largest number of azimuths and the largest number of alignments. Etowah and Angel, with the lowest number of mounds, have the lowest number of azimuths and alignments. The larger the number of azimuths, the greater the probability that alignments will be found. Thus, the large number of alignments at Moundville is most likely a statistical result rather than an intentional result. The data for these sites is dispersed; it does not cluster around those celestial bodies recognized in Mesoamerican astronomy.

Comparison of the five sites finds the use of cardinal directions and construction of ramps on the east side of mounds as the only common elements. "...you would perceive that their (i.e. the Spanish) very lives and deeds reveal them to be sons of the devil rather than sons of our gods, the Sun and the Moon,..." (Garcilasco, 1951:134 recording the Cacique, or leader, speaking to his people in Florida). Worship of the sun documented in the Southern Cult art and in DeSoto's narratives is in agreement with agricultural traits. Cultivation and harvest are season-dependent; however there are other signs of weather change in addition to the solstices and equinox. Thanks and appeasement can be given to the sun without following its movement.

Knowledge of the cardinal directions, if not derived independently, did not arrive from the West. In the Southwest, only the Zuni recognized Polaris as the North Star (Reyman, 1971:123) and the Caddoan Indians had four directions but not correlated to North; Wedel (1977) calls them semi-cardinal directions. As Mesoamerican cardinal directions were oriented differently, this would argue for independent development. If so, the recognition and observation of other stars would be a logical development. Unfortunately there is no evidence of this. It may have been in the developmental stage when the catastrophe occurred that ended the Mississippian flourescence.

One hundred thirty one principal mounds from archaeological sites in the southeastern United States were examined for any pattern by Reed (1977). He found no obvious pattern or orientation other than a relationship with plaza and the surrounding environment; of 54 sites with adequate data, 45 were oriented with a river, slough or ridge. Cahokia and Kincaid were oriented this way; Moundville, Angel, and Etowah were not.

> The orientation of the large ceremonial centers is generally similar to that of the small, though the tendency toward an eastward orientation is perhaps not quite as pronounced, as may be seen in the follow-ng list.
> Principal mound faces across the plaza toward:
>
> | | | | |
> |---|---|---|---|
> | north | 0 | south | 2 |
> | northeast | 2 | southwest | 0 |
> | east | 1 | west | 1 |
> | southeast | 5 | northwest | 1 |
>
> (Phillips et al., 1951:325)

The mounds used in this study were in the lower Mississippi alluvial valley. Referring again to the study of 121 sites in the Southeast:

> Is there a normal pattern for principal mound-plaza relationship...? Of the 131 sites surveyed on this point, 102 lay in an arc SW-W-NW of their plazas, 16 were to the north, three to the south, ten on an arc NE-E-SE, and five were uncertain. The largest number, 37, were due west, the smallest number, 2, were due east. Of the 16 sites with mounds to the north, 13 were near the confluence of the Ohio and Mississippi Rivers. This might be a regional or temporal variation. In general, then, the trend was to place principal mounds to the west of the plaza with no effort at cardinal precision and other locations being acceptable. (Reed, 1977:35)

Monks Mound at Cahokia is centrally located, but possible ramps on its eastern side would indicate a plaza to the east. This plaza was moved sometime later, as a ramp was constructed on the southern side of the mound. The temple mound at Moundville, while in the northern region of the plaza, has a ramp to the east, and the temple mound at Etowah, with an eastern-facing ramp, is on the southwestern end of the plaza.

Caution must be used in accepting Reed's analysis. He used maps prepared by others and did not take his own sightings, thereby incorporating undetected errors. He also did not have information about the horizon. This underscores the necessity of individual field work.

These five centers were located in regions of fertile soil near several biotic zones. The selection of the site was based on considerations other than astronomy. At each of these sites, mound placement was in relationship with the plaza, rather than a celestial body.

At two of the sites, Kincaid and Angel, there are platform mounds with secondary or conical mounds added to them. Thomas (1894:591) described these secondary structures as conical mounds, small in proportion to the platform and not centrally located on the platform. Describing the secondary mounds as conicals has influenced other investigators, who also labeled the structures as conical, even if they were circular or oval, flat-top secondary mounds. At present the explanation for these mounds is not clear. Some did function as substructure mounds; the outlines of buildings have been found at the summit of secondary mound at Cahokia and at Kincaid (Benchley, 1974:268). The secondary mounds did not serve as burial mounds (Benchley, 1974:267ff), though this shape, conical, is often associated with burial mounds. In a study of Mississippian secondary mound loci, Benchley concluded that placement of these mounds is not related to the cardinal directions (1974:265). Because they would provide an excellent observation point, the secondary mounds at Kincaid and Angel were included as possible backsights in the analytical procedures used in this study, see Appendices C and D. At Kincaid one alignment with the star Vega was recognized; there were no possible alignments at Angel. In the study of Mississippian secondary mound loci, Benchley found that "secondary mounds on single level substructure mounds were located in the upper left hand corner of the mound in all cases considered" (1974:264).

Cultigens came from Mesoamerica, but burial practices, mound building and placement were local developments, based perhaps on Adena-Hopewell precedents. Whatever contacts may have been made they did not include the transmission of cosmic knowledge, based on current data from these sites. More research is required to determine definitely the presence of Mesoamerican influence in the area of astronomical knowledge. This is an area for future research.

The method described in the introduction has been applied to five major Mississippian ceremonial centers. First, a testable hypothesis was established: Evidence of Mississippian knowledge of astronomy should appear in architectural alignments found in the remaining structures of this culture, the mounds, and that this knowledge was transmitted from Mesoamerica through some form of contact. Ethnohistoric, ethnographic and archaeological literature for each site had been researched for possible clues to knowledge of astronomy. An application of this information was found in the type of society which constructed these sites; an agrarian community would use this knowledge in the planting and harvesting of crops and in associated ceremonies. It could have improved the subsistence strategy and increased the possibility of good harvests. Field work at each site provided the accurate orientation measurements required, along with azimuths for horizon peaks and notches. From this data, working maps of each site were made, using topographic maps and aerial photographs. Azimuths were measured using mounds, mounds and horizon markers, if any, and single features of each mound as possible reference points. Astronomical tables were consulted for possible correlation with azimuths of celestial bodies. Had the research been more positive, these celestial bodies would have been compared with those specifically identified in Mesoamerican astronomy.

While the results are not conclusive, the method applied provided a sound foundation for archaeological research and should be used in future work. Another approach would be to reword the hypothesis to test the iconography rather than the architecture for evidence of astronomical knowledge. This would need to be done by someone with a background in art history, art interpretation and symbolism. Southern Cult symbols interpreted as sun symbols and quadri-partite division of the universe form a basis for the hypothesis that iconography contains the evidence needed to establish a distinct Mississippian astronomy. It is possible that calendrical notation exists somewhere in the material culture of this period. This data could be compared with Mesoamerican iconography, perhaps with more positive results than has occurred in this study.

Another possible study would be to study one major ceremonial center and its related satellite sites. The centers discussed in this study presented sites oriented toward the cardinal directions; it is possible the minor centers reflect this orientation and the location of these centers has formed a meaningful pattern.

Since the publication of Christaller's formulations in 1933 (see Christaller, 1966), archaeologists have examined the structure of central place hierarchies in the Old World (Johnson, 1972; Rodder, 1972) and in the New World (Flannery, 1972; Marcus, 1973; Porter, 1974:22-32; Steponaitis, 1978). Christaller defined central place as a locus where goods and services are centrally located and available to the communities in the surrounding hinterland. This model assumes a hierarchy in which each lower-order center supplies certain services to the higher-order center. In this case, each hamlet or farmstead would supply goods and/or services to the nearby minor ceremonial center, which in turn would support the major center.

This approach has been applied in analyses of Moundville and its surrounding sites (Peebles, 1978; Peebles and Kus, 1977; Steponaitis, 1978) and to some extent at Cahokia (Porter, 1974:22-32). These studies were looking at the flow of goods and/or services to the major center. What is proposed here is a reverse study: what was returned to the lower-order centers? Are these centers built on the same plan as the major centers? Do they reflect the parent interest in the cardinal directions?

Many of the problems inherent in this study would affect the analysis of lower-order sites. Many of these sites are not recorded, or if recorded, not well-documented or only fragmentarily. They may have also been altered in some manner and existing maps may

be in error. A major effort would be required to survey the area surrounding the major center and map the discovered lower-order sites. This type of project is still far in the future.

Moundville may be the place to start this type of study. Many of its satellite sites have been explored; maps of these sites should be compared with maps of the remaining satellite sites. Similar orientations would be apparent and perhaps would parallel that of the major center. Another comparison to be made is that of the Winterville site in Mississippi with that of Moundville. Winterville appears at first glance to be mirror image of Moundville.

Archaeoastronomy is at present a fragile discipline, not fully accepted by all anthropologists and astronomers, and "at a crucial point is its development" (Reyman, 1979:11). In order to prove itself, there must be application of rigorous methods, techniques and research strategies in its studies. The preceding study is an attempt to establish a proper method and to apply it to a specific problem. Hopefully it will be just the beginning of many such studies.

APPENDIX A

Intermound alignment azimuths, in degrees for the mounds at Moundville, Alabama, as determined for 1000 A.D. from the 1905 map, page 128, and from the 1979 map, page 134, are shown in the following table. Azimuths from the 1905 map are given to indicate the need for on-site measurements.

- C = center of the mound top
- R_1 = top center of the north ramp or only ramp
- R_2 = top center of the east ramp or other
- R_3 = top center of the south ramp or other

	1905	1979	Possible Alignments
From Mound A to:			
Mound B			
C to C	0	12	
R_1 to C	351	344	
C to R_1	Not Visible	Not Visible	
R_1 to R_1	Not Visible	Not Visible	
C to R_2	6	354	
R_1 to R_2	358	352	
Mound C			
Not Visible Over Mound B			

	1905	1979	Possible Alignments
Mound D			
C to C	22	17	
R_1 to C	20	18	
C to R_1	19	--	
R_1 to R_1	18	--	
Mound E			
C to C	48	46	Castor at 48°
R_1 to C	50	52	Pollux at 53°12'
C to R_1	42	--	
R_1 to R_1	44	--	
Mound F			
C to C	84	83	
R_1 to C	95	96	Spica rises at 96°32'
Mound G			
C to C	119	116	Sun at winter solstice is 118°
R_1 to C	128	122	
C to R_1	117	--	
C to R_2	118	--	
R_1 to R_1	125	--	
R_1 to R_2	127	--	

	1905	1979	Possible Alignments
Mound H (Lower than Mound A)			
C to C	133	129	
R_1 to C	138	135	
Mound I (Lower than Mound A)			
C to C	154	150	
R_1 to C	159	154	
Mound J (Lower than Mound A)			
C to C	173	168.5	
R_1 to C	177	172	Alpha Centauri at 170°34'
Mound K (Lower than Mound A)			
C to C	190	187	
R_1 to C	192	183	Alpha Centauri set at 189°
Mound L (Lower than Mound A)			
C to C	213	208	
R_1 to C	211	202.5	
C to R_1	213.5	208	
R_1 to R_1	212	205	
C to R_2	211.5	--	
R_1 to R_2	209	--	

	1905	1979	Possible Alignments
Mound M (Lower than Mound A)			
C to C	235	228.5	Super nova of 827 A.D. set at 228°39'
R_1 to C	229	223	
Mound N (Lower than Mound A)			
C to C	254	249	
R_1 to C	246	241	Mars at maximum South set is 240°19' Antares set is 241°51' Sun at winter solstice is 241°44' through 242°06'
Mound O (Lower than Mound A)			
C to C	270	264	Spica set at 263°28'
R_1 to C	260	254	
Mound P			
C to C	284	281.5	
R_1 to C	274	273	
C to R_1	285	--	
R_1 to R_1	275	--	
Mound Q (Lower than Mound A)			
C to C	294.5	294	Pleiades set at 295°30'
R_1 to C	292	287	

	1905	1979	Possible Alignments
Mound R			
C to C	315	316	
R_1 to C	313	310	
C to R_1	325	--	
C to R_2	323	--	
C to R_3	317	311.5	Castor set at 311°30'
R_1 to R_1	316	--	
R_1 to R_2	312	--	
R_1 to R_3	308	306	Pollux set at 306°48'
Mound S (Lower than Mound A)			
C to C	111	106	
R_1 to C	128	122	
Mound T (Lower than Mound A)			
C to C	150	145	
R_1 to C	157	152	
Mound U			
C to C	333	No longer exists	
R_1 to C	327	--	

	1905	1979	Possible Alignments
From Mound B to:			
Mound A			
C to C	180	172	
R_1 to C	171	164	
C to R_1	179	Not Visible	
R_1 to R_1	Not Visible	Not Visible	
R_1 to R_2	186	174	
C to R_2	178	172	
Mound C			
C to C	344	341	
R_1 to C	340	337	
R_1 to R_1	342	--	
R_2 to R	Not Visible	Not Visible	
R_2 to R_1	Not Visible	Not Visible	
C to R_1	344	--	
Mound D			
C to C	40	41	
R_1 to C	43	57	
R_2 to C	35	33	
R_1 to R_1	41	--	
R_2 to R_1	33	--	
C to R_1	38	--	

	1905	1979	Possible Alignments
Mound E			
C to C	104	101.5	Rigel rises at 101°25'
R_1 to C	107	102.5	
R_2 to C	103	102.5	
R_1 to R_1	106	--	
R_2 to R_1	103	--	
C to R_1	102	--	
Mound F			
C to C	126	125	Moon rise at maximun north is 125° 12' through 125° 28'
R_1 to C	129.5	123.5	
R_2 to C	130	126	Same as C to C
Mound G			
C to C	142	137	
R_1 to C	134	134.5	
R_1 to R_1	133	--	
R_2 to C	135	138	
R_2 to R_1	134	--	
R_2 to R_2	135.5	--	
R_1 to R_2	134.5	--	

	1905	1979	Possible Alignments
Mound G (continued)			
C to R_1	140.5	--	
C to R_2	142	--	
Mound H			
C to C	148	143	
R_1 to C	149.5	142	
R_2 to C	150	144	
Mound I			
C to C	163	157	
R_1 to C	164	156	
R_2 to C	165	158	
Mound J			
C to C	174.5	172	
R_1 to C	176	172	
R_2 to C	178	176	
Mound K			
C to C	185	178	
R_1 to C	186	178	
R_2 to C	189	181	Alpha Crucis sets at 180°51'

	1905	1979	Possible Alignments
Mound L			
C to C	200	193	
R_1 to C	199.5	190.5	Alpha Centauri rises at 189°26'
C to R_1	199	192.5	
R_2 to C	202	194	
C to R_2	198	--	
R_1 to R_1	199	191	
R_1 to R_2	198	--	
R_2 to R_1	201.5	195	
R_2 to R_2	201	--	
Mound M			
C to C	214	207	
R_1 to C	212.5	205	
R_2 to C	216	208.5	
Mound N			
C to C	225	218	
R_1 to C	223	216	
R_2 to C	226	222	
Mound O			
C to C	233	227.5	Fomalhaut sets at 227°43'
R_1 to C	231	225	

	1905	1979	Possible Alignments
Mound O (continued)			
R_2 to C	235.5	230	
Mound P			
C to C	245	240	Jupiter at maximum south 240°12'
R_1 to C	242.5	237	
R_2 to C	247	240	Jupiter at maximum south is 240°12'
R_2 to R_1	246	--	
R_1 to R_1	241.5	--	
C to R_1	244	--	
Mound Q			
C to C	262	255	
R_1 to C	259	253.5	
R_2 to C	262	256	
Mound R			
C to C	285	277	
R_1 to C	281	277	
R_1 to R_1	289	--	
C to R_1	292	--	
C to R_2	280	--	
C to R_3	276	271	

	1905	1979	Possible Alignments
Mound R (continued)			
R_1 to R_2	275	--	
R_2 to C	282	--	
R_1 to R_3	273	270	
R_2 to R_1	290	--	
R_2 to R_2	278	--	
R_2 to R_3	275	272	
Mound S			
C to C	149	143	
R_1 to C	152	141.5	
R_2 to C	154	146	Supernova of 1054 at 146°50'
Mound T			
C to C	162	157	
R_1 to C	163.5	155	
R_2 to C	165	157.5	
Mound U			
C to C	309	No longer exists	
R_1 to C	306	--	

	1905	1979	Possible Alignments
From Mound C to:			
Mound A			
Not Visible Over Mound B			
Mound B			
C to C	164	161	
R_1 to C	164	--	
R_1 to R_1	162	--	
R_1 to R_2	Not Visible	--	
C to R_1	160	157	
C to R_2	Not Visible	Not Visible	
Mound D			
C to C	91	90	
R_1 to C	81	--	
C to R_1	91	--	
R_1 to R_2	81	--	
Mound E			
C to R	133	129	
R_2 to C	134	--	
C to R_1	134	--	
C to R_2	135	--	

	1905	1979	Possible Alignments
Mound F			
Not Visible Over Mound B			
Mound G			
Not Visible Over Mound B			
Mound H			
Not Visible Over Mound B			
Mound I			
Not Visible Over Mound B			
Mound J			
Not Visible Over Mound B			
Mound K			
C to C	179	170	Alpha Antauri rises at 170°34'
R_1 to C	180	--	
Mound L			
C to C	190	180	Due South
R_1 to C	190	--	
R_1 to R_1	190	--	
R_1 to R_2	189	--	
C to R_1	189	180	Due South

	1905	1979	Possible Alignments
Mound L (continued)			
C to R_2	188	--	
Mound M			
C to C	200	193	Beta Centauri sets at 193°15'
R_1 to C	201	--	
Mound N			
C to C	206	195	
R_1 to C	207	--	
Mound O			
C to C	210	198.5	
R_1 to C	211	--	
Mound P			
C to C	217	201.5	
C to R_1	215	--	
R_1 to C	218.5	--	
R_1 to R_1	216	--	
Mound Q			
Not Visible Over Mound R			

	1905	1979	Possible Alignments
Mound R			
C to C	230	214.5	
C to R_1	238	217.5	
C to R_2	221	--	
C to R_3	224.5	--	
R_1 to R_1	243	--	
R_1 to R_2	226	--	
R_1 to R_3	229	--	
R_1 to C	235	--	
Mound S			
Not Visible Over Mound B			
Mound T			
Not Visible Over Mound B			
Mound U			
C to C	258	No longer exists	
R_1 to C	264	--	
From Mound D to:			
Mound A			
C to C	202	197	
R_1 to C	199	--	

	1905	1979	Possible Alignments
Mound A (continued)			
C to R_1	200	198	
R_1 to R_1	198	--	
Mound B			
C to C	220	221	
C to R_1	223	237	
R_1 to C	218	--	
C to R_2	215	213	
R_1 to R_1	221	--	
R_1 to R_2	213	--	
Mound C			
C to C	271	270	
C to R_1	261	--	
R_1 to C	271	--	
R_1 to R_2	261	--	
Mound E			
C to C	172	171	
C to R_1	178	--	
R_1 to C	169	--	
R_1 to R_1	175	--	

	1905	1979	Possible Alignments
Mound F			
C to C	165	159	Canopus rises at 159°48'
R_1 to C	164	--	
Mound G			
C to C	166.5	160	Canopus rises at 159°48'
C to R_1	166	--	
C to R_2	167	--	
R_1 to R_1	165	--	
R_1 to R_2	166	--	
R_1 to C	165.5	--	
Mound H			
Not Visible Over Mound E			
Mound I			
C to C	178	174	
R_1 to C	177.5	--	
Mound J			
C to C	189	182	
R_1 to C	188	--	
Mound K			
Not Visible Over Mound A			

	1905	1979	Possible Alignments
Mound L			
Not Visible Over Mound A			
Mound M			
Not Visible Over Mound B			
Mound N			
Not Visible Over Mound B			
Mound O			
Not Visible Over Mound B			
Mound P			
Not Visible Over Mound B			
Mound Q			
C to C	243	241	
R_1 to C	243	--	
Mound R			
C to C	251	248	Moon sets south at 247°24' - 247°45'
C to R_1	255	242	
C to R_2	246	--	
C to R_3	248	--	
R_1 to R_1	255	--	

	1905	1979	Possible Alignments
Mound R (continued)			
R_1 to R_2	246	--	
R_1 to R_3	247	--	
R_1 to C	250	--	
Mound S (Lower than Mound D)			
Mound T			
C to C	180	173	
R_1 to C	180	--	
Mound U			
C to C	266	No longer exists	
R_1 to C	266	--	
From Mound E to:			
Mound A			
C to C	228	226	
C to R_1	230	232	
R_1 to C	222	--	
R_1 to R_1	224	--	
Mound B			
C to C	284	281.5	
C to R_1	287	282.5	

	1905	1979	Possible Alignments
Mound B (continued)			
C to R_2	283	282.5	
R_1 to C	282	--	
R_1 to R_1	286	--	
R_1 to R_2	283	--	
Mound C			
C to C	313	309	
C to R_1	314	--	
R_1 to C	314	--	
R_1 to R_1	315	--	
Mound D			
C to C	352	351	
C to R_1	349	--	
R_1 to C	358	--	
R_1 to R_1	355	--	
Mound F			
C to C	156.5	156	
R_1 to C	148	--	
Mound G			
C to C	164	151	
C to R_1	162.5	--	

	1905	1979	Possible Alignments
Mound G (continued)			
C to R_2	165	--	
R_1 to R_1	157	--	
R_1 to R_2	160	--	
R_1 to C	159	--	
Mound H			
C to C	167	163.5	
R_1 to C	163	--	
Mound I			
C to C	182	178	
R_1 to C	179	--	
Mound J			
C to C	197	194	
R_1 to C	193	--	
Mound K			
C to C	208	205	
R_1 to C	203	--	
Mound L			
C to C	219	216	
R_1 to C	Not Visible Over Mound A		
R_1 to R_1	Not Visible Over Mound A		

	1905	1979	Possible Alignments
Mound L (continued)			
R_1 to R_2	Not Visible Over Mound A		
C to R_1	219.5	217	
C to R_2	218.5	--	
Mound M			
Not Visible Over Mound A			
Mound N			
C to C	241	239	Venus sets at maximum south 239°42'
R_1 to C	240	--	
Mound O			
C to C	250	247	Moon sets south at 247°24' - 247°45'
Mound P			
C to C	258.5	256	
C to R_1	259	--	
R_1 to C	257	--	
R_1 to R_1	257	--	
Mound Q			
C to C	270	267	Epsilon orionis sets at 267°31'
R_1 to C	270	--	

	1905	1979	Possible Alignments
Mound R			
Not Visible Over Mound B			
Mound S (Lower than Mound E)			
Mound T (Lower than Mound E)			
Mound U			
	Not Visible Over Terrace Of Mound B	No Longer Exists	

From Mound F to:

	1905	1979	Possible Alignments
Mound A			
C to R_1	275	276	
C to C	264	263	
Mound B			
C to C	306	305	Moon sets at maximum north 304°28' - 304°49'
C to R_1	309.5	303.5	
C to R_2	310	306	
Mound C			
Not Visible Over Terrace of Mound B			

	1905	1979	Possible Alignments
Mound D			
C to C	345	339	
C to R_1	344	--	
Mound E			
C to C	336.5	336	
C to R_1	328	--	
Mound G			
C to C	168	162	
C to R_1	166	--	
C to R_2	171	--	
Mound H			
Not Visible Over Mound G			
Mound I			
C to C	193	190	Alpha Centauri sets at 189°26'
Mound J			
C to C	212	212	
Mound K			
C to C	222	221	

	1905	1979	Possible Alignments
Mound L			
C to C	233	233	
C to R_1	234	234	
C to R_2	233	--	
Mound M			
C to C	245	243.5	
Mound N			
Not Visible Over Mound A			
Mound O			
Not Visible Over Mound A			
Mound P			
C to C	275	Not Visible Over Mound A	
C to R_1	275.5		
Mound Q			
C to C	285	282	
Mound R			
C to C	297.5	294	
C to R_1	Not Visible	--	
C to R_2	297	--	
C to R_3	294.5	293.5	

	1905	1979	Possible Alignments
Mound S (Lower than Mound F)			
Mound T (Lower than Mound F)			
Mound U			
	Not Visible Over Mound B	No Longer Exists	
From Mound G to:			
Mound A			
C to C	299	296	
R_1 to C	297	--	
R_1 to R_1	305	--	
R_2 to R_1	307	--	
R_2 to C	298	--	
C to R_1	308	302	Venus sets at maximum north 301°07'
Mound B			
C to C	322	317	
C to R_1	314	314.5	
C to R_2	315	318	Vega sets at 318°04'
R_1 to C	320.5	--	
R_1 to R_1	313	--	
R_1 to R_2	314	--	

	1905	1979	Possible Alignments
Mound B (continued)			
R_2 to C	322	--	
R_2 to R_1	314.5	--	
R_2 to R_2	315.5	--	
Mound C			
Not Visible Over Mound B			
Mound D			
C to C	346.5	340	
C to R_1	345.5	--	
R_1 to C	346	--	
R_1 to R_1	345	--	
R_2 to C	347	--	
R_2 to R_1	346	--	
Mound E			
C to C	344	331	
C to R_1	339	--	
R_1 to C	342.5	--	
R_1 to R_1	337	--	
R_2 to C	345	--	
R_2 to R_1	340	--	

	1905	1979	Possible Alignments
Mound F			
C to C	348	342	
R_1 to C	346	--	
R_2 to C	351	--	
Mound H			
C to C	176	178	
R_1 to C	178	--	
R_2 to C	170	--	
Mound I			
C to C	215	209	
R_1 to C	212.5	--	
R_2 to C	210	--	
Mound J			
C to C	239	231.5	
R_1 to C	235	--	
R_2 to C	234	--	
Mound K			
C to C	248	242	Sunset at winter solstice is 241°44' - 242°06'
R_1 to C	245	--	
R_2 to C	244.5	--	

	1905	1979	Possible Alignments
Mound L			
C to C	254.5	249	
R_1 to C	253	--	
R_1 to R_1	254	--	
R_1 to R_2	252.5	--	
R_2 to R_1	253.5	--	
R_2 to R_2	252.5	--	
R_2 to C	251.5	--	
C to R_1	256	249	
C to R_2	255.5	--	
Mound M			
C to C	264.5	260	
R_1 to C	263	--	
R_2 to C	262	--	
Mound N			
C to C	277	272	
R_1 to C	275	--	
R_2 to C	276	--	
Mound O			
C to C	285	280	
R_1 to C	283	--	
R_2 to C	284	--	

	1905	1979	Possible Alignments
Mound P			
C to C	337	342	
C to R_1	337.5	--	
R_1 to C	339.5	--	
R_1 to R_1	339	--	
R_2 to C	339	--	
R_2 to R_1	338	--	
Mound Q			
Not Visible Over Mound A			
Mound R			
C to C	310	306	Pollux sets at 306°48'
R_1 to C	309	--	
R_2 to C	310	--	
R_1 to R_1	312	--	
R_1 to R_2	310	--	
R_1 to R_3	307	--	
R_2 to R_1	313	--	
R_2 to R_2	310	--	
R_2 to R_3	Not Visible	--	
C to R_1	314	--	
C to R_2	311	--	
C to R_3	Not Visible	Not Visible	

	1905	1979	Possible Alignments
Mound S (Lower than Mound G)			
Mound T (Lower than Mound G)			
Mound U	Not Visible	No Longer Exists	
From Mound H to:			
Mound A			
C to C	313	309	
C to R_1	318	315	
Mound B			
C to C	328	323	Deneb sets at 323°31'
C to R_1	329.5	322	
C to R_2	330	324	
Mound C			
Not Visible Over Mound B			
Mound D			
Not Visible Over Mound E			
Mound E			
C to C	347	343.5	
C to R_1	343		

	1905	1979	Possible Alignments
Mound F			
Not Visible Over Mound G			
Mound G			
C to C	355	353	
C to R_1	351	--	
C to R_2	356	--	
Mound I			
C to C	240.5	233	
Mound J			
C to C	258.5	251	Sirius sets at 251°25'
Mound K			
C to C	264	268	
Mound L			
C to C	267	261.5	
C to R_1	269	262	
C to R_2	268	--	
Mound M			
C to C	275	270	

	1905	1979	Possible Alignments
Mound N			
C to C	286	282	
Mound O			
C to C	293	288	
Mound P			
C to C	299	295	
C to R_1	300	--	
Mound Q			
Not Visible Over Mound A			
Mound R			
Not Visible Over Mound A			
Mound S (Lower than Mound H)			
Mound T			
C to C	277.5	271	
Mound U			
C to C	323	No Longer Exists	

	1905	1979	Possible Alignments
From Mound I to:			
Mound A			
C to C	334	330	
C to R_1	339	334	
Mound B			
C to C	343	337	
C to R_1	344	356	
C to R_2	345	338	
Mound C			
Not Visible Over Mound B			
Mound D			
C to C	358	354	
C to R_1	357.5	--	
Mound E			
C to C	2	358	
C to R_1	359	--	
Mound F			
C to C	13	10	
Mound G			
C to C	34.5	30	

	1905	1979	Possible Alignments
Mound G (continued)			
C to R_1	32	--	
C to R_2	31	--	
Mound H			
C to C	60.5	53	Pollux rises at $53^{\circ}12'$
Mound J			
C to C	279	271	
Mound K			
Not Visible Over Mound J			
Mound L			
C to C	277	272	
C to R_1	280	274	
C to R_2	279	--	
Mound M			
C to C	284.5	280	
Mound N			
C to C	297	293.5	
Mound O			
C to C	305	300.5	

	1905	1979	Possible Alignments
Mound P			
C to C	311	307	Pollux sets at $306^{\circ}48'$
C to R_1	311.5	--	
Mound Q			
C to C	317	313	
Mound R			
C to C	Not Visible	322	
C to R_1	Not Visible	--	
C to R_2	Not Visible	--	
C to R_3	325	320.5	
Mound S (Lower than Mound I)			
Mound T (Lower than Mound I)			
Mound U			
	Not Visible Over Mound A	No Longer Exists	

From Mound J to:

	1905	1979	Possible Alignments
Mound A			
C to C	353	348.5	
C to R_1	357	352	

	1905	1979	Possible Alignments
Mound B			
C to C	354.5	352	
C to R_1	356	352	
C to R_2	358	356	
Mound C			
Not Visible Over Mound B			
Mound D			
C to C	9	8	
C to R_1	8	--	
Mound F			
C to C	32	32	
Mound G			
C to C	59	51.5	
C to R_1	55	--	
C to R_2	54	--	
Mound H			
C to C	78.5	71	
Mound I			
C to C	99	91	

	1905	1979	Possible Alignments
Mound K			
C to C	279	279	Betelgeuse sets at 278°16'
Mound L			
C to C	276	273.5	
C to R_1	281	276	
C to R_2	280	--	
Mound M			
C to C	287	283.5	
Mound N			
C to C	303	301	Jupiter sets at maximum north at 300°37' Arcturus sets at 300°13' Mars sets at maximum north at 300°30' Venus sets at maxi- north at 301°07'
Mound O			
C to C	311.5	313	
Mound P			
C to C	317	315	
C to R_1	319.5	--	

	1905	1979	Possible Alignments
Mound Q			
C to C	324.5	322	
Mound R			
C to C	336	333.5	
C to R_1	337	--	
C to R_2	337.5	--	
C to R_3	335	331.5	
Mound S (Lower than Mound J)			
Mound T (Lower than Mound J)			
Mound U			
C to C	341	No Longer Exists	

From Mound K to:

	1905	1979	Possible Alignments
Mound A			
C to C	10	7	
C to R_1	12	3	
Mound B			
C to C	5	358	
C to R_1	6	358	
C to R_2	9	1	

	1905	1979	Possible Alignments
Mound C			
C to C	359	350	
C to R_1	0	--	
Mound D			
Not Visible Over Mound A			
Mound E			
C to C	28	25	
C to R_1	23	--	
Mound F			
C to C	42	41	Vega rises at 41°56'
Mound G			
C to C	68	62	Sunrise at summer solstice is 60°57' - 61°19'
C to R_1	65	--	
C to R_2	64.5	--	
Mound H			
C to C	84	88	
Mound I			
Not Visible Over Mound J			

	1905	1979	Possible Alignments
Mound K			
C to C	99	99	
Mound L			
C to C	275	273	
C to R_1	284	275	
C to R_2	282	--	
Mound M			
C to C	290	287	Aldebaran sets at $287^{\circ}04'$
Mound N			
C to C	309	306	Pollux sets at $306^{\circ}48'$
Mound O			
C to C	318	316	
Mound P			
C to C	326	322.5	
C to R_1	327	--	
Mound Q			
C to C	332	329	
Mound R			
C to C	343	340	

	1905	1979	Possible Alignments
Mound R (continued)			
C to R_1	344	--	
C to R_2	345	--	
C to R_3	342	337.5	
Mound S (Lower than Mound K)			
Mound T (Lower than Mound K)			
Mound U			
C to C	348	No Longer Exists	
From Mound L to			
Mound A			
C to C	33	28	
C to R_1	31	22	
R_1 to C	33.5	28	
R_1 to R_1	32	25	
R_2 to C	31	--	
R_2 to R_1	29	--	
Mound B			
C to C	20	17	
R_1 to C	19	12.5	
C to R_1	19.5	10.5	

	1905	1979	Possible Alignments
Mound B (continued)			
R_1 to R_1	19	11	
R_1 to R_2	21.5	15	
C to R_2	22	14	
R_2 to C	18	--	
R_2 to R_1	18	--	
R_2 to R_2	21	--	
Mound C			
C to C	10	0	Due north
C to R_1	10	--	
R_1 to C	9	0	Due north
R_1 to R_1	10	--	
R_2 to C	8	--	
R_2 to R_1	9	--	
Mound D			
Not Visible Over Mound A			
Mound E			
C to C	39	36	
C to R_1	Not Visible Over Mound A	--	
R_1 to C	39.5	37	

	1905	1979	Possible Alignments
Mound E (continued)			
R_1 to R_1	Not Visible Over Mound A	--	
R_2 to C	38.5	--	
R_2 to R_1	Not Visible Over Mound A	--	
Mound F			
C to C	53	53	Pollux rises at $53^{\circ}12'$
R_1 to C	54	54	Pollux rises at $53^{\circ}12'$
R_2 to C	53	--	
Mound G			
C to C	74.5	69	Regulus rises at $69^{\circ}46'$
C to R_1	73	--	
C to R_2	75.5	--	
R_1 to C	76	69	Regulus rises at $69^{\circ}46'$
R_1 to R_1	74	--	
R_1 to R_2	73.5	--	
R_2 to C	75.5	--	
R_2 to R_1	72.5	--	
R_2 to R_2	72.5	--	

	1905	1979	Possible Alignments
Mound H			
C to C	87	81.5	Altair rises at 81°37'
R_1 to C	89	82	
R_2 to C	88	--	
Mound I			
C to C	97	92	Epsilon Orionis rises at 92°29'
R_1 to C	100	94	
R_2 to C	89	--	
Mound J			
C to C	96	93.5	
R_1 to C	101	96	Spica rises at 96°32'
R_2 to C	100	--	
Mound K			
C to C	95	93	Epsilon Orionis rises at 92°29'
R_1 to C	104	95	
R_2 to C	102	--	
Mound M			
C to C	303.5	300	Jupiter sets at maximum north at 300°37'

	1905	1979	Possible Alignments
Mound M (continued)			
R_1 to C	297	296	Pleiades sets at 295°05'
R_2 to C	297	--	
Mound N			
C to C	328	324	
R_1 to C	324	323	
R_2 to C	323.5	--	
Mound O			
C to C	336	332	
R_1 to C	334.5	331	
R_2 to C	333	--	
Mound P			
C to C	341	337	
C to R_1	342.5	--	
R_1 to C	339	335	
R_1 to R_1	341	--	
R_2 to C	338.5	--	
R_2 to R_1	340	--	
Mound Q			
C to C	345	341	

	1905	1979	Possible Alignments
Mound Q (continued)			
R_1 to C	344	340	
R_2 to C	343	--	
Mound R			
C to C	356.5	353	
C to R_1	357	--	
C to R_2	358	--	
C to R_3	355	352	
R_1 to C	356	351	
R_1 to R_1	356	--	
R_1 to R_2	358	--	
R_1 to R_3	354	350.5	
R_2 to C	354	--	
R_2 to R_1	355	--	
R_2 to R_2	357	--	
R_2 to R_3	353	--	
Mound S (Lower than Mound L)			
Mound T (Lower than Mound L)			
Mound U			
	Not Visible Over Mound R	No Longer Exists	

	1905	1979	Possible Alignments
From Mound M to:			
Mound A			
C to C	55	48.5	Castor rises at $48^{\circ}30'$
C to R_1	49	43	
Mound B			
C to C	34	27	
C to R_1	32.5	25	
C to R_2	36	28.5	
Mound C			
C to C	20	13	
C to R_1	21	--	
Mound D			
Not Visible Over Mound B			
Mound E			
Not Visible Over Mound A			
Mound F			
C to C	65	63.5	
Mound G			
C to C	84.5	80	
C to R_1	83	--	

	1905	1979	Possible Alignments
Mound G (contiued)			
C to R_2	82	--	
Mound H			
C to C	95	90	
Mound I			
C to C	104.5	100	
Mound J			
C to C	107	103.5	
Mound K			
C to C	110	107	
Mound L			
C to C	123.5	120	Jupiter rises at maximum south at $119^{o}48'$ Venus rises at maximum south at $120^{o}18'$ Mars rises at maximum south at $119^{o}41'$
C to R_1	117	116	
C to R_2	117	--	
Mound N			
C to C	352	351.5	

	1905	1979	Possible Alignments
Mound O			
C to C	355	352.5	
Mound P			
C to C	356	354	
C to R_1	358	--	
Mound Q			
Not Visible Over Mound P			
Mound R			
C to C	8	5	
C to R_1	7	--	
C to R_2	11	--	
C to R_3	7	4.5	
Mound S (Lower than Mound M)			
Mound T (Lower than Mound M)			
Mound U			
	Not Visible Over Mound U	No Longer Exists	

	1905	1979	Possible Alignments
From Mound N to:			
Mound A			
C to C	74	69	Moon at north rises at 68°09' - 68°19'
C to R_1	66	61	Supernova of 1054 rises at 61°51'
Mound B			
C to C	45	38	
C to R_1	43	36	Deneb rises at 36°29'
C to R_2	46	42	Vega rises at 41°56'
Mound C			
C to C	26	15	
C to R_1	27	--	
Mound D			
Not Visible Over Mound B			
Mound E			
C to C	61	59	Mars rises at maximum south at 59°30' Arcturus rises at 59°47'
C to R_1	60	--	Jupiter rises at maximum south at 59°23'
Mound F			
Not Visible Over Mound A			
Mound G			
C to C	97	92	
C to R_1	95	--	
C to R_2	96	--	
Mound H			
C to C	106	102	
Mound I			
C to C	117	113.5	
Mound J			
C to C	123	121	Venus at maximum south at 120°18'
Mound K			
C to C	129	126	Moon rises at maximum south at 125°07' - 125°28'
Mound L			
C to C	148	144	
C to R_1	144	143	
C to R_2	143.5	--	

	1905	1979	Possible Alignments
Mound M			
C to C	172	171.5	Alpha Centauri rises at 170°34'
Mound O			
C to C	358	355	
Mound P			
C to C	358.5	354	
C to R_1	4	--	
Mound Q			
Not Visible Over Mound P			
Mound R			
C to C	12	8	
C to R_1	11	--	
C to R_2	18	--	
C to R_3	12.5	9	
Mound S (Lower than Mound N)			
Mound T (Lower than Mound N)			
Mound U			
	Not Visible Over Mound R	No Longer Exists	

	1905	1979	Possible Alignments
From Mound O to:			
Mound A			
C to C	90	84	
C to R_1	80	74	
Mound B			
C to C	53	47.5	Castor rises at 48°30'
C to R_1	51	45	
C to R_2	55.5	50	
Mound C			
C to C	30	28.5	
C to R_1	31	--	
Mound D			
Not Visible Over Mound B			
Mound E			
C to C	70	67	
C to R_1	67	--	
Mound F			
Not Visible Over Mound A			
Mound G			
C to C	105	100	

	1905	1979	Possible Alignments
Mound G (continued)			
C to R_1	103	--	
C to R_2	104	--	
Mound H			
C to C	113	108	Sirius rises at 108°35'
Mound I			
C to C	125	120.5	
Mound J			
C to C	107	103.5	
Mound K			
C to C	138	136	
Mound L			
C to C	156	152	
C to R_1	154.5	151	
C to R_2	153	--	
Mound M			
C to C	175	172.5	
Mound N			
C to C	178	175	

	1905	1979	Possible Alignments
Mound P			
C to C	2	354	
C to R_1	5	--	
Mound Q			
Not Visible Over Mound P			
Mound R			
C to C	15	12.5	
C to R_1	14.5	--	
C to R_2	23	--	
C to R_3	16.5	18	
Mound S (Lower than Mound O)			
Mound T (Lower than Mound O)			
Mound U			
C to C	Not Visible Over Mound R	No Longer Exists	
From Mound P to:			
Mound A			
C to C	104	101.5	Rigel rises at 101°25'
C to R_1	94	93	Epsilon Orionis rises at 92°29'

	1905	1979	Possible Alignments
Mound A (continued)			
R_1 to C	105	--	
R_1 to R_1	95	--	
Mound B			
C to C	65	60	First gleam of sunrise on summer solstice at 60°57'
C to R_1	62.5	57	
C to R_2	67	60	First gleam of sunrise on summer solstice at 60°57'
R_1 to C	66	--	
R_1 to R_1	61.5	--	
R_1 to R_2	64	--	
Mound C			
C to C	37	21.5	
C to R_1	35	--	
R_1 to C	38.5	--	
R_1 to R_1	36	--	
Mound D			
Not Visible Over Mound B			
Mound E			
C to C	78.5	76	

	1905	1979	Possible Alignments
Mound E (continued)			
C to R_1	79	--	
R_1 to C	77	--	
R_1 to R_1	77	--	
Mound F			
C to C	95	Not Visible Over Mound A	
R_1 to C	95.5		
Mound G			
C to C	157	162	
C to R_1	159.5	--	
C to R_2	157	--	
R_1 to C	157.5	--	
R_1 to R_1	159	--	
R_1 to R_1	158	--	
Mound H			
C to C	119	115	
R_1 to C	120	--	
Mound I			
C to C	131	127	
R_1 to C	131.5	--	

	1905	1979	Possible Alignments
Mound J			
C to C	137	135	
R_1 to C	139.5	--	
Mound K			
C to C	146	142.5	
R_1 to C	147	--	
Mound L			
C to C	161	157	
C to R_1	159	155	
C to R_2	158.5	--	
R_1 to C	162.5	--	
R_1 to R_1	161	--	
R_1 to R_2	160	--	
Mound M			
C to C	176	174	Supernova of 185 rises at 173°41'
C to R_1	178	--	
Mound N			
C to C	178.5	174	Supernova of 185 rises at 173°41'
R_1 to C	184	--	

	1905	1979	Possible Alignments
Mound O			
C to C	182	174	Supernova of 185 rises at 173°41'
R_1 to C	185	--	
Mound Q			
C to C	2	3	
R_1 to C	354	--	
Mound R			
C to C	23	18	
C to R_1	21	--	
C to R_2	33	--	
C to R_3	25	22	
R_1 to C	20	--	
R_1 to R_1	18	--	
R_1 to R_2	30.5	--	
R_1 to R_3	22	--	
Mound S (Lower than Mound P)			
Mound T (Lower than Mound P)			
Mound U			
C to C	Not Visible Over Mound R	No Longer Exists	

	1905	1979	Possible Alignments
From Mound Q to:			
Mound A			
C to C	114.5	114	
C to R_1	112	107	
Mound B			
C to C	82	75	
C to R_1	79	73.5	
C to R_2	82	76	
Mound C			
Not Visible Over Mound R			
Mound D			
C to C	63	61	Sunrise at summer solstice is 60°57' - 61°19'
C to R_1	63	--	
Mound E			
C to C	90	87	
C to R_1	90	--	
Mound F			
C to C	105	102	Rigel rises at 101°25'

	1905	1979	Possible Alignments
Mound G			
Not Visible Over Mound A			
Mound H			
Not Visible Over Mound A			
Mound I			
C to C	137	133	Fomalhaut rises at 132°17'
Mound J			
C to C	144.5	142	
Mound K			
C to C	152	149	
Mound L			
C to C	165	161	
C to R_1	164	160	Canopus rises at 159°48'
C to R_2	163	--	
Mound M			
Not Visible Over Mound P			
Mound N			
Not Visible Over Mound P			

	1905	1979	Possible Alignments
Mound O			
Not Visible Over Mound P			
Mound P			
C to C	182	183	
C to R_1	174	--	
Mound R			
C to C	39	32.5	
C to R_1	32	--	
C to R_2	55	--	
C to R_3	49	44.5	
Mound S (Lower than Mound Q)			
Mound T (Lower than Mound Q)			
Mound U			
C to C	Not Visible Over Mound R	No Longer Exists	
From Mound R to:			
Mound A			
C to C	135	136	
C to R_1	133	130	

	1905	1979	Possible Alignments
Mound A (continued)			
R_1 to C	145	--	
R_1 to R_1	136	--	
R_2 to C	143	--	
R_2 to R_1	132	--	
R_3 to C	137	--	
R_3 to R_1	128	131.5	Moon rise at maximum north at 125°7' - 125°28'
R_3 to R_1	128	126	
Mound B			
C to C	105	97	Spica rises at 96°32'
C to R_1	101	97	Spica rises at 96°32'
C to R_2	102	98	
R_1 to C	112	--	
R_1 to R_1	109	--	
R_1 to R_2	110	--	
R_2 to C	100	--	
R_2 to R_1	95	--	
R_2 to R_2	98	--	
R_3 to C	96	91	
R_3 to R_1	93	90	
R_3 to R_2	95	92	Epsilon Orionis rises at 92°29'

	1905	1979	Possible Alignments
Mound C			
C to C	50	34.5	
C to R_1	55	--	
R_1 to C	58	37.5	
R_1 to R_1	63	--	
R_2 to C	41	--	
R_2 to R_1	46	--	
R_3 to C	44.5	--	
R_3 to R_1	49	--	
Mound D			
C to C	71	68	North moon rise at 67°59' - 68°19'
C to R_1	70	70	Regulus rises at 69°46'
R_1 to C	75	--	
R_1 to R_1	75	--	
R_2 to C	66	--	
R_2 to R_1	66	--	
R_3 to C	68	--	
R_3 to R_1	67	--	
Mound E			
Not Visible Over Mound B			

	1905	1979	Possible Alignments
Mound F			
C to C	117.5	114	
R_1 to C	Not Visible	--	
R_2 to C	117	--	
R_3 to C	114.5	113.5	
Mound G			
C to C	130	126	Moon rise at maximum south at 125°7' - 125°28'
C to R_1	129	--	
C to R_2	130	--	
R_1 to C	134	--	
R_1 to R_1	132	--	
R_1 to R_2	133	--	
R_2 to C	131	--	
R_2 to R_1	130	--	
R_2 to R_2	130	--	
R_3 to C	Not Visible	Not Visible	
R_3 to R_1	127	--	
R_3 to R_2	Not Visible	--	
Mound H			
Not Visible Over Mound A			

	1905	1979	Possible Alignments
Mound I			
C to C	Not Visible	144	
R_1 to C	Not Visible	--	
R_2 to C	Not Visible	--	
R_3 to C	145	140.5	
Mound J			
C to C	156	153.5	
R_1 to C	157	--	
R_2 to C	157.5	--	
R_3 to C	155	151.5	
Mound K			
C to C	163	160	Canopus rises at 159°48'
R_1 to C	164	--	
R_2 to C	165	--	
R_3 to C	162	157.5	
Mound L			
C to C	176.5	173	Supernova of 185 rises at 173°41'
C to R_1	176	171	
C to R_2	174	--	
R_1 to C	176	--	

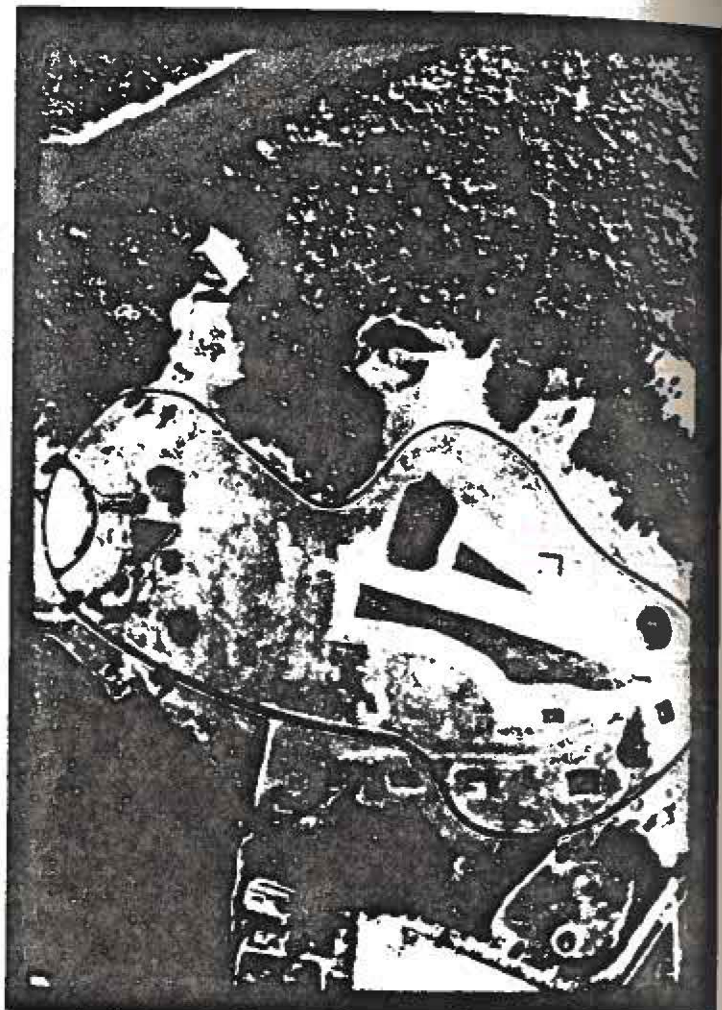
	1905	1979	Possible Alignments
Mound L (continued)			
R_1 to R'_1	176	--	
R_1 to R'_2	175	--	
R_2 to C	178	--	
R_2 to R_1	178	--	
R_2 to R_2	177	--	
R_3 to C	175	172	
R_3 to R_1	178	170.5	Alpha Centauri rises at 170°34'
R_3 to R_2	173	--	
Mound M			
C to C	188	185	
R_1 to C	187	--	
R_2 to C	191	--	
R_3 to C	187	184.5	
Mound N			
C to C	192	188	
R_1 to C	191	--	
R_2 to C	198	--	
R_3 to C	192.5	189	Alpha Centauri rises at 189°26'

	1905	1979	Possible Alignments
Mound O			
C to C	195	192.5	Beta Centauri rises at 193°15'
R_1 to C	194.5	--	
R_2 to C	203	--	
R_3 to C	196.5	194	Beta Centauri rises at 193°15'
Mound P			
C to C	203	198	
C to R_1	200	--	
R_1 to C	201	--	
R_1 to R_1	198	--	
R_2 to C	113	--	
R_2 to R_1	210.5	--	
R_3 to C	205	202	
R_3 to R_1	202	--	
Mound Q			
C to C	219	212.5	
R_1 to C	212	--	
R_2 to C	235	--	
R_3 to C	229	224.5	
Mound S (Lower than Mound R)			

	1905	1979	Possible Alignments
Mound T (Lower than Mound R)			
Mound U			
C to C	13	No Longer Exists	
R_1 to C	17		
R_2 to C	357		
R_3 to C	12		

Mounds S and T were not analyzed as they are not candidates for observatories.

Mound U was not analyzed as it no longer exists.



Aerial Photograph of Mounds at Moundville, Alabama

APPENDIX B

Inter-mound alignment azimuths, in degrees, for the mounds at Etowah, Georgia, as determined for 1000 A.D from the 1979 map, page 157, are shown in the following table. The ramp on Mound C has not be included as it is a recent addition.

C = center of the mound top

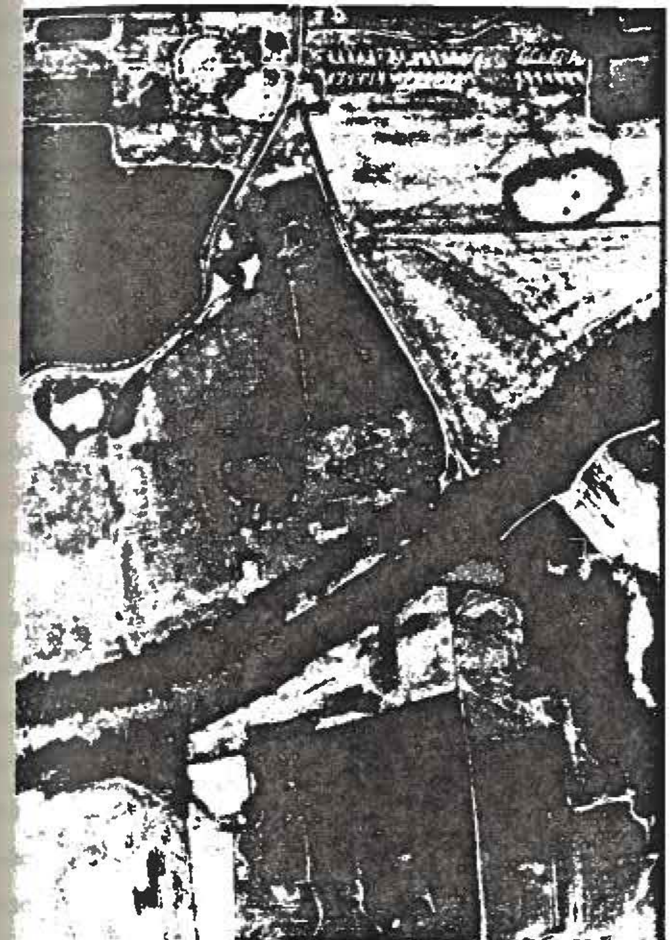
R_1 = top center of north ramp or only ramp

R_2 = top center of east ramp or other

R_3 = top center of south ramp or other

	1979	Possible Alignments
From Mound A to:		
Mound B		
C to C	123.3	
R_1 to C	136.5	
C to north front	120.0	
R_1 to north front	132.5	
Mound C		
C to C	187.5	
R_1 to C	198.0	
C to east side	181.5	
R_1 to east side	192.0	

	1979	Possible Alignments
From Mound B to:		
Mound A		
C to C	303.5	Moon set at maximum north 304°54'
C to R_1	316	
Mound C		
C to C	240	Winter solstice sunset 241°23' - 241°46'
C to C east side	234	Moon set at maximum south 234°02'
From Mound C to:		
Mound A		
C to C	87	
C to R_1	17.5	
Mound B		
C to C	58	Jupiter at maximum north 58°59' Mars at maximum north 59°06' Venus at maximum north 58°28'



Aerial Photograph of Mounds at Etowah, Georgia

APPENDIX C

Intermound alignment azimuths, in degrees, for the mounds at Kincaid, Illinois, as determined for 1500 A.D. from the 1957 map, Cole et al., figure 69; are shown in the following table. The measurements are taken from the mound center to mound center.

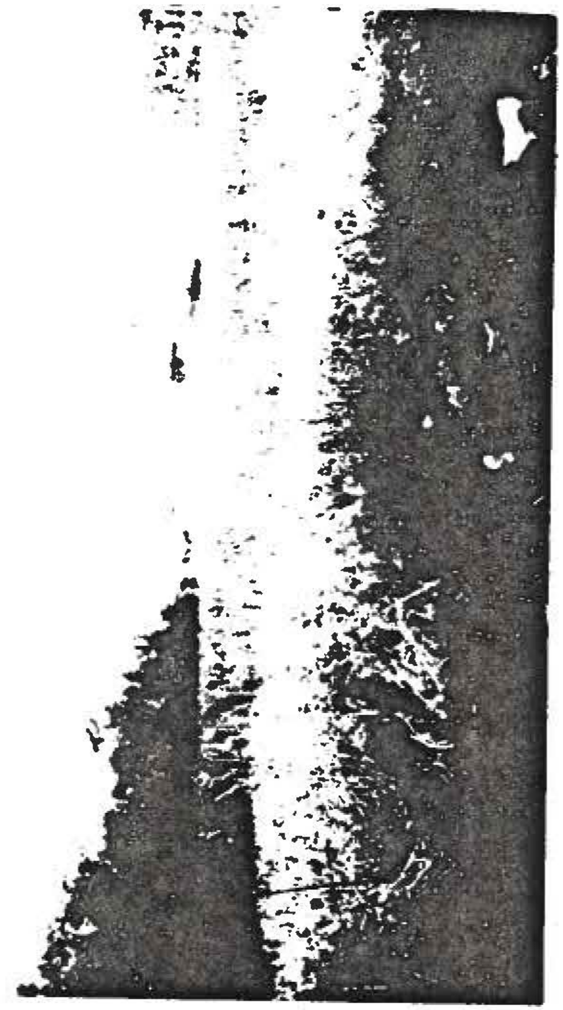
	1957	Possible Alignments
From Mound Mx°7 to:		
Mound Mx°8	291	
Mound Mx°9	323.5	
Mound Mx°10	348	
Cone Mx°10	339	
Mound Pp°3	70	
Mound Pp°5	72	
Mound Pp°6	68	
Mound Pp°7	Too Low	
From Mound Mx°8 to:		
Mound Mx°7	111	
Mound Mx°9	3.5	
Mound Mx°10	14	
Cone Mx°10	6.5	
Mound Pp°3	76.5	

	1957	Possible Alignments
Mound Pp°5	78	Altair rises at 79°59'
Mound Pp°6	75	
Mound Pp°7	78	Altair rises at 79°59'
From Mound Mx°9 to:		
Mound Mx°7	143.5	
Mound Mx°8	176.5	
Mound Mx°10	22.5	
Cone Mx°10	11	
Mound Pp°3	83	
Mound Pp°5	87	
Mound Pp°6	88	
Mound Pp°7	Too Low	
From Mound Mx°10 to:		
Mound Mx°7	168	
Mound Mx°8	194	
Mound Mx°9	202.5	
Cone Mx°10	230	
Mound Pp°3	92.5	
Mound Pp°5	96.5	
Mound Pp°6	97	
Mound Pp°7	Too Low	

	1957	Possible Alignments
From Cone on Mound Mx°10 to:		
Mound Mx°7	159	
Mound Mx°8	186.5	
Mound Mx°9	191	
Mound Mx°10	39	Vega rises at 38°17'
Mound Pp°3	Too Low	
Mound Pp°5	94	
Mound Pp°6	92	
Mound Pp°7	Too Low	
From Mound Pp°3 to:		
Mound Mx°7	250	Sirius sets at 250°05'
Mound Mx°8	256.5	
Mound Mx°9	Not Visible Over Mound Pp°6	
Mound Mx°10	272.5	
Cone Mx°10	270.5	
Mound Pp°5	236	
Mound Pp°6	263	
Mound Pp°7	249	
From Mound Pp°5 to:		
Mound Mx°7	252	
Mound Mx°8	256	

	1957	Possible Alignments
Mound Mx°9	267	
Mound Mx°10	276.5	
Cone Mx°10	274	
Mound Pp°3	56	Venus sets at 56°59'
Mound Pp°6	294	
Mound Pp°7	259	Rigel sets at 259°44'
From Mound Pp°6 to:		
Mound Mx°7	248	
Mound Mx°8	255	
Mound Mx°9	268	Epsilon Orionis sets at 268°21'
Mound Mx°10	277	
Cone Mx°10	277	
Mound Pp°3	83	
Mound Pp°5	114	Moon rises at maximum southerly declination 113°22' to 113°46'
Mound Pp°7	225.5	
From Mound Pp°7 to:		
Mound Mx°7	250.5	Sirius sets at 250°05'
Mound Mx°8	258	Rigel sets at 259°44'

	1957	Possible Alignments
Mound Mx°9	267.5	Epsilon Orionis sets at 268°21'
Mound Mx°10	280	Altair sets at 280°01'
Cone Mx°10	277	
Mound Pp°3	69	
Mound Pp°5	79	Altair rises at 79°59'
Mound Pp°6	45.5	Castor rises at 46°40'

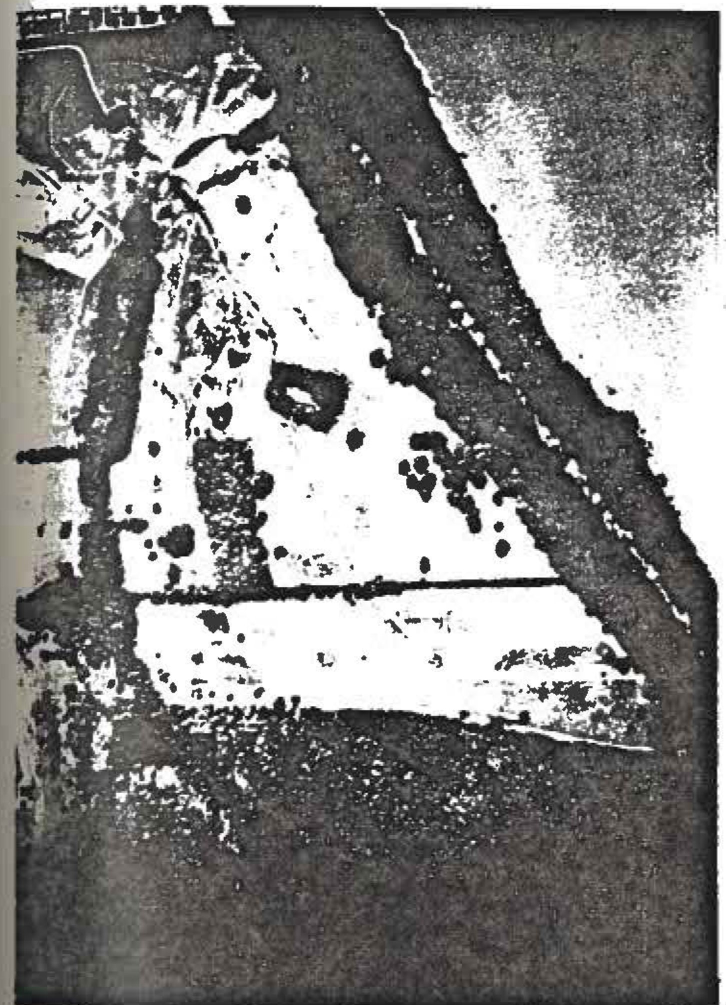


View of Western Portion of Mounds at Kincaid, Illinois

APPENDIX D

Intermound alignment azimuths, in degrees, for the mounds at Angel, Indiana, as determined for 1000 A.D. from the 1979 map, page 205, as shown in the following table. The measurements are taken from the mound center to mound center.

	1979	Possible Alignment
From Mound A to:		
Mound E	318	
Mound F	245	
From Cone on Mound A to:		
Mound E	330	
Mound F	253.5	
From Mound E to:		
Mound A	138	
Cone on Mound A	150	
Mound F	214	
From Mound F to:		
Mound A	65	Pleiades rise at 63°08'
Cone on Mound A	73.5	
Mound E	34	



Angel, Indiana

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