

Archaeoastronomy at the Ames Plantation Mound Site

Elizabeth A. Hook

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Professor Moreland

The Ames Mound Complex, located near Grand Junction, Tennessee, contains four earthwork mounds. These mounds are spectacular in and of themselves, but are also indicative of a phase of mound construction that was sweeping the eastern, and specifically the southeastern, part of the country. In addition to the fact that mound sites were striking to behold, they also took a great deal of time and effort to construct. Mounds were made by the basket load: individuals would carry woven baskets full of dirt and dump them on the mound. It is the case that many mound sites show archaeological evidence of this, and that the dirt within the mound is different colors in areas, correlating to each individual basket. A factor that seems to contribute to the interest in these mound sites is their relevance to archaeoastronomy, and the information that can be gathered from learning about astronomy and how it was significant to ancient cultures.

Archaeoastronomy combines the workings of archaeology with astronomy to gather more information about a site or culture. In 1894, J. N. Lockyer published *Dawn of Astronomy*; this text is considered to be the beginning of the movement to mesh archaeology and astronomy. However, his practices eschewed archaeology entirely and he attempted to use only astronomical data to date structures. The lack of scientific data drew a great deal of criticism and laid the foundation for the general opinion around the field of archaeoastronomy: that, as a field, archaeoastronomy is unreliable and that the people in the field have no scientific credibility. In 1968, Gerald Hawkins published *Stonehenge Decoded*, and archaeoastronomy began its climb back to notability. Hawkins brought astronomy of ancient cultures, and their astronomical cultures back into the mind of scholars.

Archaeoastronomy struggles with its popular image in that many people associate archaeoastronomy with a relative grasp on sanity. Since archaeoastronomy is a field dealing with celestial alignments, it attracts more than just scholars. People of a less than reputable nature publish books on aliens and their supposed influence on ancient culture, as well as 'popular' books based on theories and little scientific proof because the topic is sensational. Slowly, the field is gaining some of its reputability back as more scholars get involved, and it becomes easier to distinguish credible work from other disreputable sources (Kelley, Milone 1).

The fields of archaeology and astronomy both benefit from the relationship archaeoastronomy provides them. With thousands of stars visible to the naked eye on a clear night, astronomy plays a significant role in many human cultures. Records of stellar phenomena in the past can contribute to astronomy in the present on the evolution of stars and nebulae in our galaxy. An excellent example is of a supernova in 1054 that was recorded in many cultures, such as Chinese and Japanese writings. We can infer that this supernova, known as the "Crab" supernova, lasted for twenty-three days because of recovered drawings and records. Also, in many ancient cultures the cluster of stars known as the Pleiades was referred to as the seven sisters – indicating the visibility of seven stars. In the modern sky, however, only six of the Pleiades are visible. Scientists and historians can use this information to note that the skies of ancient cultures have changed from what we see now. Archaeology also benefits from using astronomy to date or give purpose to sites, as well as using astronomy to enhance the archaeological and anthropological record (Kelley, Milone 332-335).

Almost every ancient society valued astronomy as a cultural importance. In addition to the sky being visually captivating, astronomy was used for marking the seasons, as well as an aid in mythological teachings. Many cultures used stories of people and their histories in the stars to teach lessons and morals. In Africa, Ancient Egyptian culture heavily incorporated astronomy into their mythology. Pyramids, which were frequently aligned to cardinal directions, also sometimes included shafts inside the tomb that would lead to specific stars. The cultural belief that rulers would ascend to the heavens from these shafts demonstrates just how important a role astronomy played in their mythology and culture. Some research hypothesizes dynastic turnovers in Ancient Egyptian cultures have some correlation to solar eclipses. Considering that the pharaoh was thought to be “the son of the Sun, one would expect solar eclipses to be regarded as extremely bad omens” (Kelley, Milone 262). In addition to using stars, planets, and the moon to supplement mythology, Ancient Egyptian culture used astronomy as a basis for telling time and a calendar system. Sundials and shadow clocks were used to tell time, as well as evidence suggesting that the Ancient Egyptian calendar was based on both lunar and solar movements.

The Indian and Middle Eastern region also included astronomy in the culture’s mythology. Some Hindu temples are built so that their centers can trace the movement of the sun, in addition to sculptures and other artifacts that mimic or symbolize various aspects of the sky. There is a collection of 28 Buddhist temples, which match the tradition in the area of the moon passing through 28 asterisms, a

prominent pattern or group of stars (typically smaller than constellations), and similar to the official constellations we use today (Kelley, Milone 279-313).

In an early Chinese legend, a king commissioned astronomers to follow the sky and to “calculate and delineate” the sun, moon, and stars (there is also a later story where these astronomers were later decapitated for failing to predict an eclipse). One reason that this legend is particularly interesting is that it not only speaks prominently of astronomers, but that it shows them as having an extremely significant purpose. The Chinese traditionally had names for the 28 asterisms and used their more complicated system of asterisms to help them predict the behavior of stellar phenomena, as well as provide a frame of reference for stars. Texts from the 2<sup>nd</sup> and 4<sup>th</sup> centuries B.C. indicate that the Chinese had years of 360 days divided into five seasons that were then divided into 60-day cycles. The five seasons were matched with the five elements, all understood to have associations with various planets: wood being Jupiter, fire being Mars, earth being Saturn, metal being Venus, and water being Mercury (Kelley, Milone 314-316).

In Korea, some royal tombs had constellations painted on the ceiling, a trait that began in China and moved into Korea. Korea also holds a ‘Star Tower’ that may have been used as an observatory. As in China, astronomical records were kept of supernovae, meteor showers, and eclipses. Japan, however, developed in a slightly different manner. Japan also holds structures with astronomical alignments, especially stone circles. In a practice that also developed in the Plains of North

America, they used stones that created shadows to indicate solstices<sup>1</sup> and other astronomical events. As Japan, originally very isolated, interacted more with other cultures historically Korean astronomical practices began to appear in Japanese culture.

Perhaps where archaeoastronomy is best known is in Mesoamerica. Hundreds of sites and buildings have astronomical alignments, and, in addition to that, hold numerous records and inscriptions about astronomy. While there have been discoveries of codices<sup>2</sup> that present various astronomical information, specifically on the phases of Venus and the Moon, a great deal remains unknown about the history of astronomy in the Mayan culture. Like in many cultures, the Maya culture developed calendars using astronomy – but they created several, very complex calendars. Their calendars consisted of three large components: “an era count (with one normal base and several alternatives), a 365-day year, and a 260 day-period [...] functionally equivalent to the much shorter western week” (Kelley, Milone 355). Many Mayan buildings are oriented to winter and summer solstices, the equinoxes,<sup>3</sup> and zeniths.<sup>4</sup> At Yaxchilán, an area of many ruined buildings, there are “more solar alignments than any other ancient Maya city” (Barnhart 33). Most

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<sup>1</sup> A solstice is when the sun reaches either its highest point or its lowest point in the sky at noon. The Summer Solstice occurs when the earth’s tilt is closest to the sun, and the Winter Solstice occurs when the tilt is farthest from the sun.

<sup>2</sup> It is interesting to note that the Maya had several (perhaps hundreds of) books, or codices, centuries before Europeans made contact.

<sup>3</sup> An equinox is when the sun is centered with the plane of the earth’s equator. It is also where, on a celestial sphere, the celestial equator (equal to earth’s equator) and the ecliptic (the path the sun appears to take across the sky) intersect. Best known for the fact it makes day and night of equal length on this event.

<sup>4</sup> The zenith is the point in the sky that is directly over the observer, it is also the highest point in the rise of a celestial object.

of the buildings faced east, and almost all of them would be able to see the sunrise at any time of the year. A stunning alignment is at the main temple of Chichén Itzá: the building was constructed so that, at the summer equinox, a shadow is cast on one of the stairs so that a snake's body appears to wind down them, terminating at a stone snakehead at the base of the stairs ("Archaeoastronomy").

In America north of Mexico, astronomy played a similar but still unique role in culture. Shadows were used to tell the seasons in the western area of North America, and in some areas used to mark the solstices and equinoxes. One thing that makes the usage of light and shadow so notable is that the light and shadows would be manipulated to strike various carvings and symbols at certain times of the year. In the North American Southwest, rock art is especially prominent and, according to Boma Johnson, serve three major purposes: at sacred areas, at intersections of trails, and as a communication tool to groups that were usually separated by great distances (Kelley, Milone 412).

In the Plains region of North America, the Skidi Pawnee Indians created extremely accurate star maps.<sup>5</sup> Von del Chamberlain speculates that the maps were likely used for ceremonial and educational purposes, and likely not drawn at night – but still included all the stars of great importance to the Pawnee (Chamberlain 203). Ronald Goodman uncovered that the Siouan Indians also had at least two star maps, though one was lost during a battle and the other has not been published (Kelley, Milone 425).

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<sup>5</sup> A projection of the night sky (usually on a piece of paper or other flat surface) that has usually been placed in a grid so that an observer may know where astronomical objects are in the sky.

Also present in North America are large earthworks. Carrying in basket loads of dirt from the area and slowly piling them on top of each other made these mounds. The mounds were used for burials, especially early on in their cultural development. Archaeologists have excavated mass graves where mounds were full of elite members of bodies, and frequently these large burials were accompanied by a great deal of artifacts. Some mounds contain only one burial, an especially important member of society, but some contain members of the lower class. Mounds were not just used for burials; with the construction of large, flat-topped mounds especially, mounds began to have a more ceremonial purpose. Frequently these mounds would be built on an area of land that was already sacred. Some mounds show indications that structures were originally on the site, and then the mound was constructed on the exact same location, and often in the same shape, as the original structure.

Flat-topped mounds were prime candidates for ceremonial events. Large garbage pits indicate that some mounds were used for feasts and enormous, organized parties where people would come in from the outlying region to celebrate. In many cultures, these mounds held the houses of the elite, and some mounds seem to have ceremonial structures placed on them. Whether these structures were occupied full time or only at certain intervals, they still held importance in the culture and mythology of the people. Something all of these uses have in common is the contribution to the mythology of the people, and astronomical alignments with these mounds can only further increase their contribution. Instances of sites where an open structure was built on a mound and

on the summer solstice the sun would rise through the structure, illuminating a chief or other important figure would have been especially awe inspiring. Using astronomical alignments continues to tell us more about the practices and traditions of the people.

Many of the earthworks in the eastern half of the country (with varying degrees of accuracy) line up along the cardinal direction lines, and some appear to have no other astronomical alignment. The Indians of the Great Plains, however, often built mounds in pairs to “mark time in the solar cycle” (Aveni 303). In the Midwest, there are a series of effigy mounds constructed: long and low, and frequently in the shapes of animals. These animal-mounds often reflect animals that are indigenous to the area and were likely important to the Native Americans of the region. In the Pacific Northwest, special viewing seats for group elders were established for sunrises on solstices.

Archaeoastronomy can be used for more than learning about an ancient group’s cultural practices, but can also be used to specifically date sites or artifacts. For instance, astronomical methods helped determine the time period around the fall of Babylon. Knowing that there were archaeological records describing lunar eclipses,<sup>6</sup> Dr. Vahe Gurzadyan used these records to give a more accurate timeline to the fall of Babylon. Knowing when an eclipse occurred, Dr. Gurzadyan compared known eclipses to records of another ancient city. By dating the time in that city, he was able to extrapolate when the fall of Babylon was (Gurzadyan).

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<sup>6</sup> A lunar eclipse occurs when the moon passes into the earth’s shadow, so that the sunlight cannot hit the moon because the earth blocks it.

In 1900 an excavation of an underwater shipwreck in the Mediterranean uncovered many artifacts, including fragments of a bronze device. Fifty to seventy years later, Dr. Derek de Solla Price determined that the device was actually used as an advanced astronomical calendar. After much skepticism about Dr. Price's work, the device was re-analyzed in the late 1990s and much more detailed information was revealed. The date of origin of the device, known as the Antikythera Mechanism, was placed at 150-100 BC. The mechanism has dials for the zodiac<sup>7</sup>, the solar calendar, markers for the Sun and Moon, as well as dials that attempts to correlate the lunar months and solar years (Charette 551-52). While some scholars suggest that this mechanism may have been used to teach astronomy, it is an extremely complex mechanical device nevertheless. In fact, "nothing else close to its complexity shows up in archaeological records for more than 1200 years, when mechanical clocks appeared in medieval Europe" (Marchant 13).

Perhaps the most famous archaeological site known for being associated with astronomy is Stonehenge, in England. Whatever purposes the monument may have served, there are significant astronomical alignments. There have been suggestions that Stonehenge contains both equinox and solstice alignments. Like many sites, knowing the solstice alignments exist does not necessarily enlighten scholars to the significance of the alignments. Many scholars purport that Stonehenge was an observatory, but many scholars do not agree with this assessment. In a report on a joint meeting of the Royal Astronomical Society and the

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<sup>7</sup> The zodiac is a belt shaped region around the ecliptic (see footnote 3) divided into 12 constellations.

Prehistoric Society, Sue Bowler states that many of the attendees agreed that saying Stonehenge was an observatory is a meaningless supposition.

This highlights a common problem with archaeoastronomy in that in the past, ancient cultures wouldn't have viewed astronomy and the sky as we view them today; to suppose that they would is to make a mistake. Sue Bowler contributes in her report on the Royal Astronomy Society and Prehistoric Society meeting, "No ancient peoples would think in the way that we think of an observatory: a place for the systematic observation and interpretation of the skies. Events in the sky appeared to be well known, important and to be taken into account in the [setting] and orientation of monuments that had some – largely unknown – cultural significance" (Bowler). Modern societies also think of time as being singularly linear. Many ancient societies had multiple, complex calendars that are sometimes difficult for modern scholars to conceptualize. It is easy to assume ancient societies viewed time as we do now, but in evaluating the data through modern perceptions, the integrity of the culture is compromised.

Similar to Stonehenge in North America are structures referred to as Woodhenges. Most likely used for calendars or other seasonal markers, Woodhenges were usually large circles that consisted of wooden posts. Figure 1 (see Appendix A) shows an example of the different alignments a Woodhenge may have. Woodhenges seem to have been constructed with a central pole. This pole allowed an observer standing in the center of the circle to observe astronomical events in relation to the posts (Aveni 304). So while the Woodhenges could be used to mark the seasons, they "would no doubt have had more ritual than practical

significance since people knew perfectly well when to plant and harvest their crops” (Milner 134). P. Clay Sherrod and Martha Ann Rolingson argue in *Surveyors of the Ancient Mississippi Valley* that these Woodhenges, specifically at the Cahokia site in Illinois, would have served more than one purpose, as the posts appear in heavily populated areas and seem to have remained there for several hundred years.

Sherrod and Rolingson also state that data published previously on the Woodhenge site (including Figure 1) are misleading and that only one such complete circle has been found; that all the others have more irregular spacing and are perhaps only half circles or otherwise partial circles. Furthermore, only four posts are required for solstice and equinox alignments, yet the most commonly referenced Woodhenge has 48 posts; the other 44 posts have not been sufficiently explained by contemporary archaeologists.

The mound complex at Cahokia is located in southwestern Illinois and has the largest mound north of Mexico (see Appendix A: Figure 2). Likely occupied for nearly 600 years, Cahokia “is the major site of the Mississippian culture and reflects the presence of a large, concentrated population and a substantial sociopolitical ranking system” (Sherrod 85). Built in the Mississippian time period, Cahokia boasted as many as 20,000 to 25,000 inhabitants in its prime, covered over 15 kilometers, and included over 100 mounds. The largest mound at the site, Monks Mound, is the largest mound north of the Rio Grande. Cahokia has features typical to mound sites in the Southeast: location near a river, different styles of mounds, and similar mound placements.

Cahokia is one of the more common sites for studies in archaeoastronomy, though there are complications. Mainly, the mounds are so large and irregularly shaped, as well as badly preserved, in many instances that it is difficult to choose an exact point to use to make astronomical measurements (Sherrod 100). Usually, however, Monks Mound – the highest mound on the Cahokia site – lends itself to being the marker for measurements. It stands around 100 feet tall and has a base of around 14 acres. It is also constructed with four terraces that lend a step-like appearance to the mound (“Indians created...”). Archaeologists speculate Monks Mound held a building where a member of the elite, possibly a chief, either lived permanently or inhabited for ceremonial purposes. Using Figure 2, when looking at the site of Cahokia as a whole, it becomes apparent that there are alignments to the cardinal directions.

A point on Monks Mound, commonly referred to as Fowler’s Point, serves as an east-west axis on the Equinox for sunrise and sunset. In addition to several mounds falling along this axis, there is also a north-south alignment of mounds, lending some credibility to the fact that these alignments are not accidental. Cahokia also has an alignment that falls across the edge of Monks Mound that aligns mounds along the Winter Solstice Sunset and the Summer Solstice Sunrise. There are also various other, smaller mounds at Cahokia that indicate alignments with solstice sunrises.

Also important in alignments at Cahokia is Mound 72, located almost due south of Monks Mound. Mound 72 is aligned both for the Summer Solstice Sunrise and Sunset. Interestingly, from Mound 72, the intercardinal directions can be

established. With the Summer Solstice Sunrise establishing the Northeast direction, Winter Solstice Sunrise establishing the Southeast, the Winter Solstice Sunset establishing Southwest, and the Summer Solstice Sunset establishing the Northwest direction. Also interesting is that Mound 72 serves as a burial mound, and that there is evidence to suggest the burials of the individuals inhumed there were delayed until a specific time relating to a solstice (Sherrod 98).

The mounds at Cahokia were clearly placed intentionally, with thought as to their location and purpose instead of randomly being built. The mounds clearly had cultural significance, and it is interesting that 'urban planning' was clearly considered. The city was occupied for several hundred of years, but by the year 1400 AD all of its inhabitants had abandoned the site. While the current Cahokia Mounds State Historic Park preserves as many as 68 of the mounds, there might have been as many as 120 when the city was occupied. Consistent with the period, there are no records of the city from other regions near Cahokia, and the enormous city was not heavily incorporated in any common legends. The name 'Cahokia' is an artifact of the French arrival in the 1600s and likely has nothing to do with the original title of the city.

There is a lot written about the site at Cahokia, and on the Southwest. The most common articles and texts on mounds relate to the (many) sites in Ohio. Even specifically relating to archaeoastronomy, publishing concentrates on most of North America: except the Southeast. Comparatively, there is not a great deal published on mound sites in the Southeast, and when looking for publications on archaeoastronomy in the Southeast the number shrinks even faster. For instance, in

the publication of *Surveyors of the Ancient Mississippi Valley*, Sherrod and Rolingson devote 43 on the already well-documented Cahokia site, but only 35 pages on the lower Mississippi Valley. Possibly the site that is written about most in the Southeast next to Cahokia is the Pinson Mound Complex, south of Jackson, Tennessee.

Pinson is dated as a Middle Woodland site – earlier than Cahokia and several other mound sites. Pinson also dates much earlier than Cahokia, at around 100 to 200 A.D. The largest mound at the Pinson complex is debatably the second tallest mound north of Mexico at 72 feet, minimum. Dr. Charles McNutt and Dr. Robert Mainfort are two experts that have published heavily on the Pinson site. There are approximately 30 mounds at the Pinson site – more than several other sites, but notably less than at Cahokia. Pinson’s ‘discovery’ is well documented and there is much oral history regarding the mounds. Something Cahokia and Pinson have in common, along with an unfortunately high number of mound sites, is that they were damaged by agriculture and road construction.

Dr. McNutt published a paper, *The Pinson Observatory*, regarding the astronomical alignments of Pinson Mounds. He begins by pointing out something important that must be kept in mind regarding astronomical alignments at mound sites: “all previous observations, as well as my own which follow, assume that the site had been cleared” (McNutt 146). While mounds are elevated, if the area around them is not cleared, it would have been extremely difficult for Native Americans to make astronomical alignments. Native Americans of the time period frequently burned areas for hunting purposes, so they were familiar with the process of

burning undergrowth. The most likely way these sites were cleared would have been further use of fire, and it is not unreasonable to assume mound sites would have been cleared in the same way as hunting and planting sites. Most of McNutt's work focuses on the popular method of aligning mounds from other mounds; that if you stand on one mound and observe an astronomical phenomena over another mound it is an astronomical alignment. McNutt reports summer solstice and equinoctial alignments with sunrises and sunsets.

Another type of alignment McNutt includes is lunar standstills: "Lunar cycles are characterized by sequent rises that move consistently in one direction, either north or south depending on the part of the cycle being observed. Rising in the eastern sky, extreme northeastern and extreme southeastern points will eventually be reached, at which point the risings will gradually reverse their course" (McNutt 148). These points where the moon appears to reverse its course are known as lunar standstills. While useful and interesting astronomical alignments, lunar standstills are difficult to calculate and often discounted as being unimportant - mostly because the ancient Maya saw no particular interest in these sorts of alignments. The Maya have been well studied, and their culture placed little to no importance on lunar standstills, so many archaeoastronomers discount lunar standstills of being significant in North American complexes, despite the fact that they are both different cultures and different types of structures.

In the calculation of astronomical alignments, the Milky Way remains one of the most difficult calculations. Archaeologists from several mound sites have remarked upon alignments with the Milky Way, claiming that it was an aspect of

their astronomical orientation. The Milky Way, however, slowly changes configurations within a year, and then changes more dramatically with every passing year. This makes it difficult to assume galactic alignment without a very specific date or record of a significant event that would mark a certain position of the Milky Way as significant.

McNutt also mentions the value of exploring the significance of stellar alignments as well as planetary alignments. Stellar alignments are interesting but as McNutt points out, it is always the case that some stellar alignment will happen. By virtue of the fact that there are so many stars in so many positions, some stars will undoubtedly appear to align with any given mound site: the trick is determining if it is an intentional alignment. This is not a problem unique to stellar alignments, but most astronomical alignments.

In addition to Pinson, the Southeast contains several other sites with astronomical alignments that are also public parks. Moundville, in Tuscaloosa, Alabama, is an extensive site that includes possible solstice and equinoctial alignments. Their occupation period was 1000 – 1450 AD, fitting it squarely with many Mississippian time period sites. At its largest occupation, the village was approximately three hundred acres with approximately 26 mounds of varying styles and uses (Knight).

Arkansas features the Toltec Mounds State Park, which includes possible solstice, equinoctial, and north-south orientation alignments (Lafayette Natural History...). The Toltec Mound site has become notable because it seems the mound builders had a set unit of measurement at the site. Once containing 18 mounds, only

three mounds currently remain at the state park, as well as parts of an embankment that are as tall as eight to ten feet (“Archaeological...”).

Florida is host to many shell mounds (similar to earthwork mounds only made from discarded shells), and also contains the Crystal River Archaeological State Park that includes the same possible alignments as the Toltec Mound site but also incorporates stone pillars and structures, in addition to six mounds. Georgia features the Kolomoki Mounds State Park, which was occupied from 350 – 750 AD.<sup>8</sup> Kolomoki has seven mounds, the tallest of which is 57 feet tall, which have solstice and equinoctial alignments, as well as pottery artifacts that could be related to the motions Mercury or Venus (“Kolomoki...”). Also in Georgia is the Ocmulgee National Monument, a site with burial and ceremonial mounds, as well as defensive trenches (“Ocmulgee...”). Ocmulgee has slightly different astronomical alignments: a center lodge (that has been reconstructed) has cardinal direction alignments as well as a solar alignment that may have to do with growing seasons (Lafayette Natural History...).

The Marksville State Historic Site is located in Louisiana, with six mounds, the largest being a 30 foot tall burial mound, and two embankments constructed at a rather early time: 0 – 400 AD (“Marksville Mounds”). This site has possible alignments with the solstices, equinoxes, the Milky Way, and holds the extremely unique supposition that some of the mounds may represent the sun, moon, and the earth. Poverty Point is a site also located in Louisiana, and is a site that was

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<sup>8</sup> Kolomoki Historic Park once had hundreds of artifacts, but in the 1970s the on-site museum was red, and all the artifacts were stolen. While most of the artifacts have been recovered, well over 70 are still missing

constructed and inhabited extremely early on, from 1650 – 700 BC, and has some very unique mounds. The mounds at Poverty Point are six concentric ridges facing a river, the largest diameter spanning three quarters of a mile, and these mounds have possible alignments with the winter solstice, the lunar standstills, and a north-south line (Lafayette Natural History...). The Winterville Mounds in Mississippi were occupied from 1000 – 1450 AD, which makes them contemporary to many Mississippian sites. Winterville had as many as 23 mounds at one time, the largest being 55 feet tall, and these mounds have possible solstice and equinox alignments (Lafayette Natural History...).

A site of specific interest is the mound site at the Ames Plantation in Grand Junction, Tennessee (Appendix A: Figure 3). The mounds themselves are fairly well preserved, and are located fairly close to each other. The accepted date for the mound site is that construction began around the year 1000 AD and was completed by 1250 AD. Three of the mounds are low, rectangular top platform mounds, similar in some respects to some of the mounds at the Pinson complex. The original inhabitants purposefully built the four mounds around a bluff. When viewed from the creek bed below, the mounds appear a great deal taller than they actually are. This additional height made the inhabitants look stronger, and acted as a deterrent against attack from the creek. It is common for mound sites to be located near water, and the Ames mound complex is located along the North Fork of the Wolf River. This could be both for easy access to the site, as well as for trade possibilities. Compared to sites like Pinson and Cahokia, the mounds at the Ames Plantation appear small.

Two of the mounds (Mounds A and D) are about 20 meters in diameter and 2-2.5 m high. Mound C, which is the mound with the largest base, is about 75m long and 25m wide, with a variable height: Mound C is higher on the north side of the mound than the south side, but it still only reaches a height of 1.5-2m on its highest side. Mound B is the largest mound at the complex and has a height of about 5.5m and a diameter of about 35m. While Mounds A and D are low, platform mounds, Mound B is an odd geometric shape of some sort. Mound B also has a curious ditch running around the southern portion of the mound, and Mound C is an oblong mound inconsistent with the others (Mickelson 206-07).

Known alignments of these mounds are for the Summer and Winter solstice. Mounds A, B, and D all align with the solstice. These three platform mounds line up along a 60° angle with the azimuth.<sup>9</sup> When an observer is standing on Mound B, the sun would rise directly over Mound D on the summer solstice, and if the observer was still standing on Mound B during the winter solstice, the sun would appear to set directly over Mound A. As shown previously, this alignment seems to be common for sites of this time period.

In the process of looking for more astronomical alignments, the first step was to check the angles of the mounds with respect to each other (Appendix B: Table 1). After completing that step, the solstice alignments were verified, and then equinoctial alignments were checked. For the year 1000 AD the Vernal Equinox occurred on March 15, with the sun rising at an angle of 89° with the respect to the azimuth and setting at 271° with respect to the azimuth. Neither of these angles

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<sup>9</sup> When something makes an angle with the azimuth, it is the angle made from the north (or south) point on the horizon to the point of interest.

translates to aligning with the mounds; these angles represent the sun practically rising due east and setting due west. The same is true for the Autumnal Equinox of 1000 AD, occurring on December 15, with a rise angle of  $89^\circ$  and a setting angle of  $270^\circ$ . These angles are going to be similar for every equinox: given what an equinox is, where the celestial equator and the ecliptic intersect, the sun will rise and set around the same place every year.<sup>10</sup>

The next step in evaluating alignments was to check stars. Choosing the list of the ten brightest stars in the night sky, only eight are visible from the Northern Hemisphere. Another pleasant thing about checking stellar alignment is that usually the stars rise consistently on the same location on the horizon every day, which makes alignment with them very easy compared to other alignments. The eight stars that were evaluated were Arcturus, Betelgeuse, Canopus, Capella, Procyon, Rigel, Sirius, and Vega. Also included in the evaluation were the Pleiades, a very bright and tightly grouped bunch of seven (now visibly six) stars that have been remarked upon by several ancient cultures.

Findings concerning stellar alignments showed Canopus, Capella, Procyon, and Sirius had rise and set angles with respect to the azimuth nowhere near the mounds at the Ames Complex. The stars that had anything approaching an alignment included the rise angles of Vega, Capella, Arcturus, Rigel, and the Pleiades, as well as the set angle of Betelgeuse. One contributing factor to the trend for rise angles aligning better than setting angles is the relationships the mounds have with

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<sup>10</sup> See Appendix A: Figure 4 for visual explanation.

each other: most of the alignments create angles that would be favorable to the northeastern quadrant of the sky, which is where many stars rise.

The three most convincing stellar alignments include that when an observer is standing on Mound D, it appears that Betelgeuse sets directly over Mound C. Betelgeuse is not only interesting because it is a bright star,<sup>11</sup> but also because it is a red supergiant, and appears as a reddish colored star from earth. Betelgeuse is also located in a very distinct constellation that today is known as Orion. While the Native Americans of the time would not have referred to the constellation in this way, it would still be an interesting configuration. However, when considering the area around Betelgeuse, it is not the brightest star; that distinction belongs to Rigel. Rigel has an unconvincing alignment whereupon if an observer stands on Mound C, Rigel will rise off an edge of Mound D.

Vega appears twice in the process of looking for astronomical alignments. An extremely bright star, it appears to rise directly over the center of Mound C when an observer is standing on Mound A. It also appears to rise over the edge of Mound C when an observer is standing on Mound B. In addition to being a very bright star, Vega was a northern pole star<sup>12</sup> earlier in the history of earth and frequently cuts very close to the sky's zenith in this part of the world. Vega is also very close to an annual meteor shower called the Lyrids that has been well recorded for more than 2000 years (Sinnott). These meteor showers would have been extremely impressive, and would have been memorable experiences.

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<sup>11</sup> See Appendix B: Table 2 for apparent magnitude, rise and set angle charts of these stars.

<sup>12</sup> Commonly referred to as the North Star.

Capella is also an extremely bright star: Vega is only slightly brighter than Capella. When standing on Mound B Capella appears to rise directly over the center of Mound C. While Capella seems to be one star to an observer, it is actually four stars, made up of two binary star systems.<sup>13</sup> Capella also has a yellowish tint to it when viewed with a naked eye, and rises relatively close to the north. Furthermore, Capella sets almost exactly opposite from the north at the same angle it rises. During the wintertime, Capella appears overhead consistently in the morning, which is a contrast to Vega, which displays the same behavior in the summertime (Kaler).

The weaker alignments include the Pleiades and Arcturus, which both appear to rise over the edge of Mound D when an observer is standing on Mound B. The Pleiades are especially visually interesting because it is a large group of bright stars and the Pleiades are frequently remarked upon in ancient cultures. Arcturus is the third brightest star in this hemisphere, following only Sirius and Canopus.

As previously mentioned, calculating stellar alignments remain an imperfect and somewhat subjective science. Dr. McNutt notes, "An obvious difficulty in positing stellar alignments is the fact that [...] *some* stellar alignment can always be suggested" (McNutt 149). This is a complication with any astronomical alignment: knowing how significant an alignment was in the construction. There are alternatives that include if alignments are just a unique happenstance of the construction, or if the alignments are purely coincidental and only significant to modern scholars trying to force the topic.

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<sup>13</sup> A binary star system is where two stars orbit each other closely.

The most complicated calculation in the process of determining astronomical alignment is in the calculation of Venus. Next to the moon, Venus is the brightest object in the night sky with an apparent magnitude<sup>14</sup> as large -4.6. Many, many ancient cultures have included Venus in records of astronomy, and it is intriguing for many reasons. Venus appears as both a 'morning star' and 'evening star' in the sense that at various times of the year it rises in the morning either right before or after the sun, and then it switches to rise during the evening before or after sunset. Because Venus is located between the earth and the sun, it never strays far from the sun in the night sky. Around 1032 AD it is also the case that Venus would have crossed the Sun for about seven hours, which is visible on the earth as a small, dark disk crossing the sun (Espenak). This phenomenon is not easy to predict, and the events repeat on a cycle taking several hundred years.

The most notable alignment that Venus has with the Ames mound complex is with Mounds A, B, and D. On the summer solstice, Venus rises consistently over those three mounds over the course of one to two months every year. This alignment is not terribly surprising because the sun rises over the Mounds at this time every year, and Venus is not far from the sun. When Venus does rise over Mounds A, B, and D, at one point during this time it appears to turn around and sweep back over the mounds. A more interesting Venusian alignment is that twice a year, Venus appears to rise over Mound D to an observer standing on Mound C,

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<sup>14</sup> The apparent magnitude of an object is the brightness that it appears to be to an observer on earth. It is rated on a scale where the smaller the number the more bright. For example, the moon is rated to have an apparent magnitude as large as -12.9, while the faintest stars (just barely visible to the human eye) have a magnitude around 6.

something that is not necessarily predictable in a way the solstice alignments are. Data collected from 1000, 1025, and 1050 AD all show that Venus rises between  $85^{\circ}$  and  $100^{\circ}$  from the azimuth twice a year, once in the first half of the year, and again in the second half of the year. Venus continues to rise between these angles for at most 30 days and at least 24 days in each event.

Mounds obviously have some cultural significance to the people that constructed them. Mounds across the country have astronomical alignments, and the alignments seem to be consistent across multiple time periods. It is undoubtedly the case that the people that built the Ames Mound Complex were interested in the night sky and its happenings, but the question remains whether or not the mounds were built in specific locations that have astronomical significance. The fact that many mound sites in the area have astronomical alignments indicates that astronomy was important at the time to the people constructing the mounds. By continuing to collect data on astronomical alignments and other significances at mound sites, scholars can continue to use that information to expand on their knowledge of what was important to the people at that time.

## Appendix A: Figures

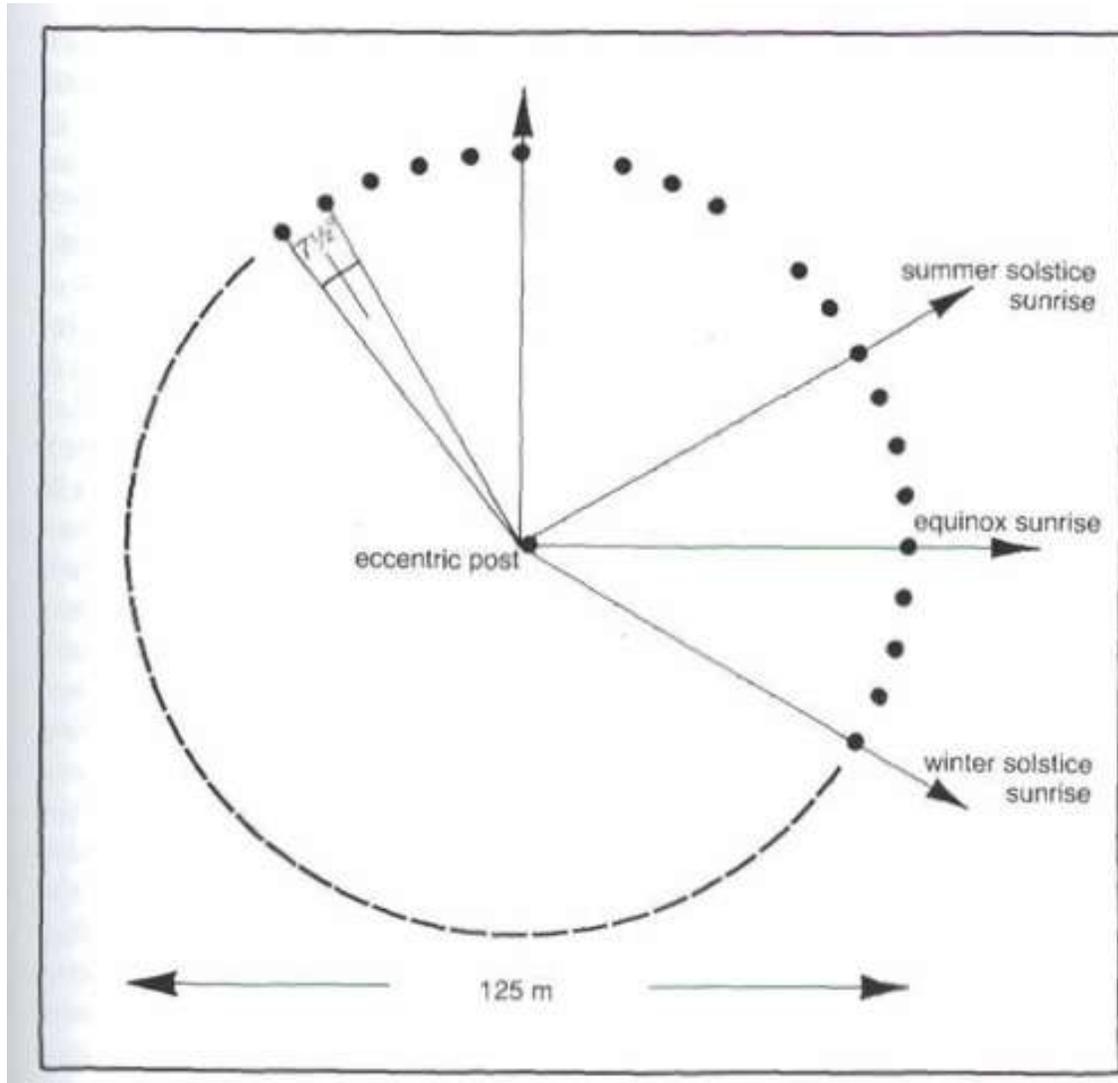


Figure 1: "An American Woodhenge (Diagram by P. Dunham after Wittry 1964)"  
(Aveni 305)

An example of different alignments that a Woodhenge at the Cahokia site has, and the different placing of the posts involved in the Woodhenge (also notes the angle between each post).

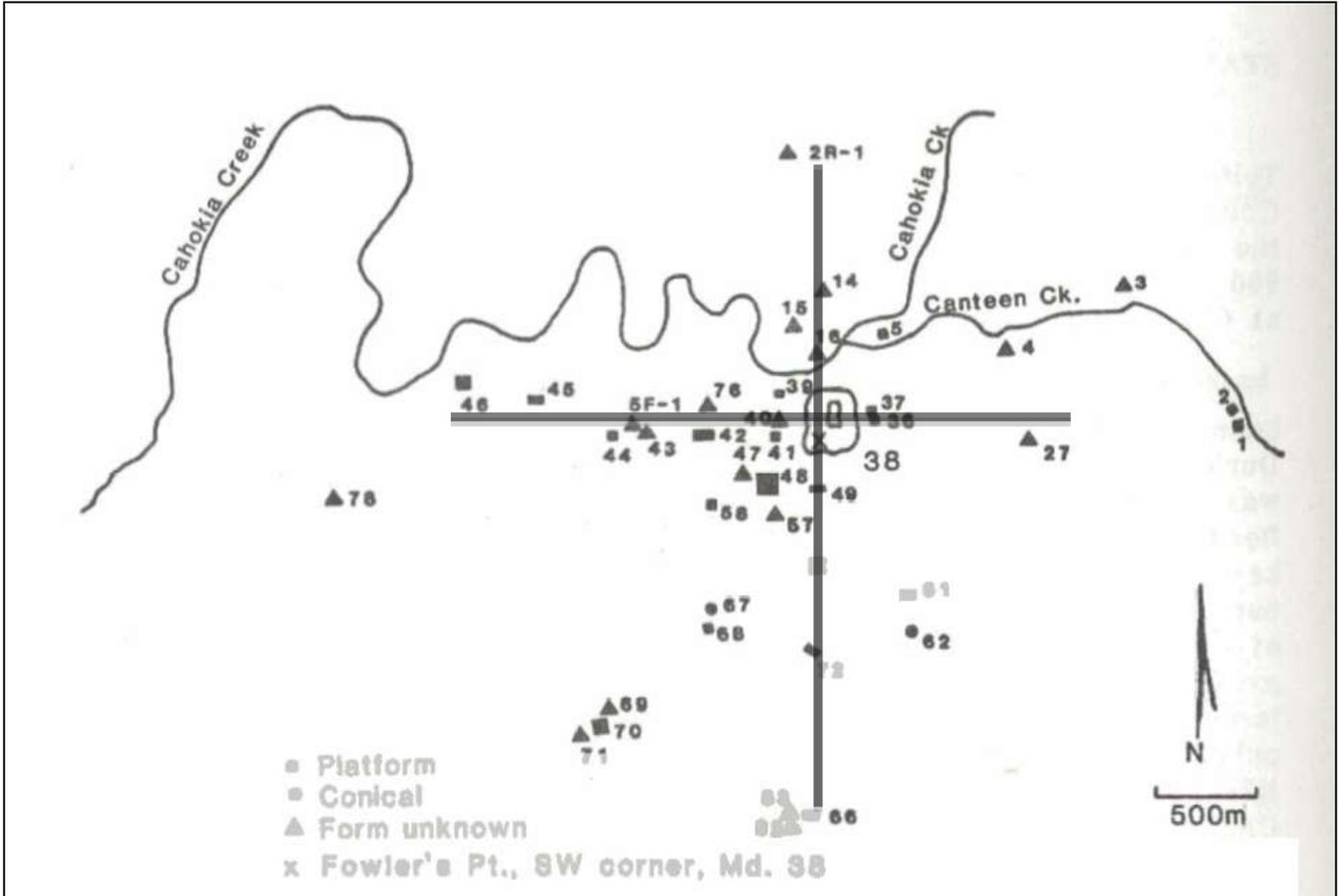


Figure 2: The Mound Complex at Cahokia, illustrating the North-South, East-West alignments at the site, as well as showing many of the mounds that are on the site (Sherrod 100).

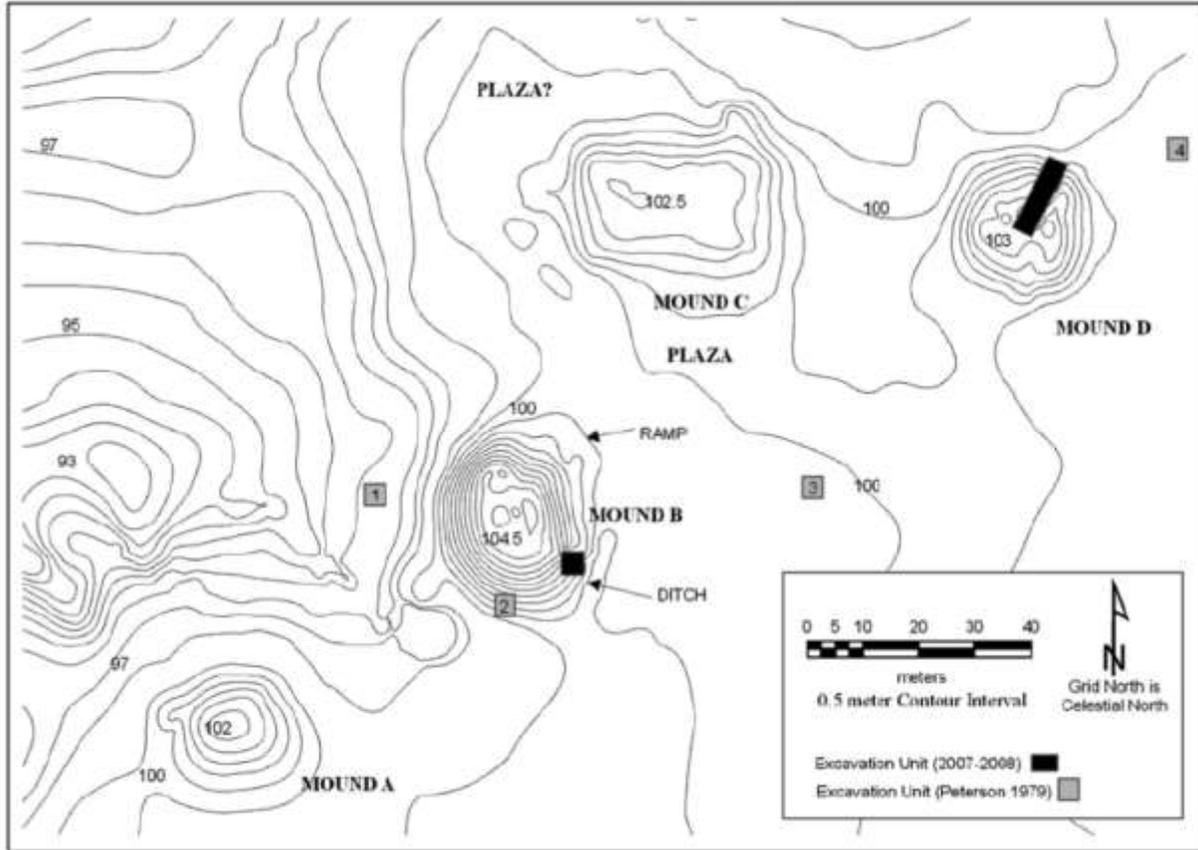


Figure 3: A topographic map of the Ames Mound Complex (Mickelson 204).

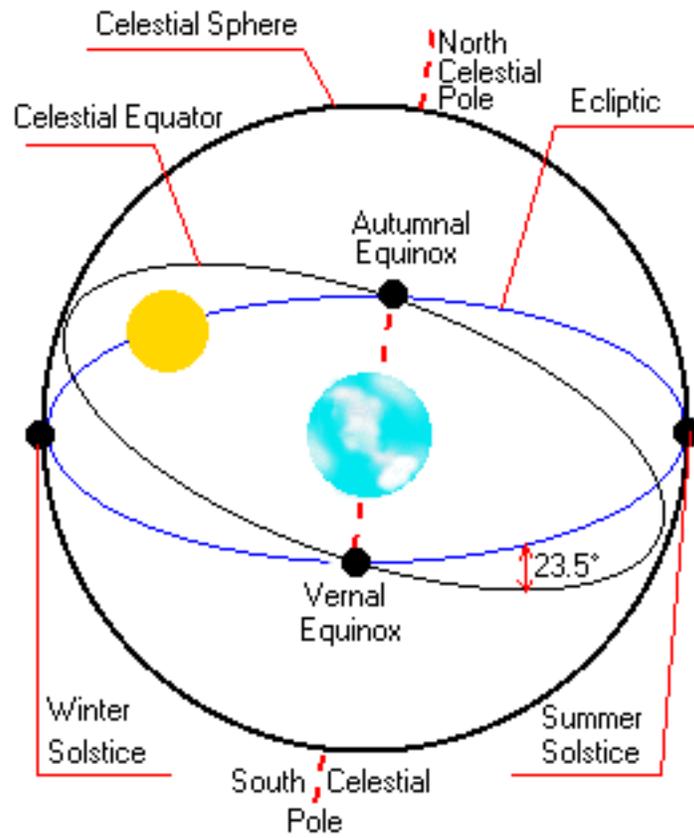


Figure 4 (: A visualization of the celestial sphere, showing the Vernal and Autumnal Equinoxes, as well as the Winter and Summer Solstices.

## Appendix B: Tables

Mounds	Angles (in Degrees) from Azimuth
A - B	53
A - D	59
B - D	61
C - D	96
C - B	206
C - A	220

Table 1: Table of the angles (from the azimuth) taken between the respective mounds.

Star	Apparent Magnitude	Rise Angle (Degrees)	Set Angle (Degrees)
Betelgeuse	.2 - 1.2	80	279
Rigel	0.18	101	258
Vega	0.03	40	319
Pleiades	2.86 - 5.65	64	295
Capella	0.08	30	329
Arcturus	-0.06	65	294
Canopus	-0.72	164	195
Sirius	-1.46	109	250

Table 2: Table of stars and their apparent magnitude and rise and set angle (from the azimuth). In regards to the apparent magnitude, the smaller the number the brighter the star appears, so it is the case that Sirius appears as the brightest star on this table, and the Pleiades are the dimmest.

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