Is there evidence for the observation and use of astronomy at the Harris Site in the Mimbres Valley?

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IS THERE EVIDENCE FOR THE OBSERVATION AND USE OF ASTRONOMY
AT THE HARRIS SITE IN THE MIMBRES VALLEY?

by

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Bachelor of Arts
University of California
2002

Master of Science
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2009

A thesis submitted in partial fulfillment
of the requirements for the

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ABSTRACT

Is There Evidence for the Observation and Use of Astronomy at the Harris Site in the Mimbres Valley?

by

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University of Nevada, Las Vegas

This thesis is an archaeoastronomical study of a Late Pithouse Period (A.D. 550-1000) Mimbres-Mogollon site in the American Southwest. It specifically examines whether there is an association between architecture and astronomy at the Harris Site in the upper Mimbres Valley in southwestern New Mexico. The hypothesis for the study is that Mimbres pithouse groups observed astronomical phenomena and used such phenomena to guide the construction of their structures and establish a calendar. The methods used in this investigation include evaluating whether the site placement, the orientation and alignment of structures/houses, and the presence of cultural features on surrounding ridge tops are related to astronomical sight lines, or the direction of celestial events. The results are that while the site placement is not significant, the orientations and alignments as well as the placement of cultural feature placements do show a connection to astronomy, likely related to the establishment of a calendar.
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CHAPTER 1
INTRODUCTION

The thesis presented here is an archaeoastronomical study of a Late Pithouse Period (A.D. 550-1000) Mimbres-Mogollon site in the American Southwest. It specifically focuses on the association between architecture and astronomy at the Harris Site, an archaeological site located in the upper Mimbres Valley in southwestern New Mexico. Its purpose is to fill in a gap in Southwestern archaeoastronomy research by investigating a little researched site type (pithouse village) in a little researched region (Mogollon homeland).

Reyman (1976: 958) describes archaeoastronomy as the “study of prehistoric systems of astronomy,” while Aveni (1997: 5) defines it as a discipline that aims at understanding the “role of astronomy in ancient cultures.” Unfortunately, archaeastronomers have difficulty finding unequivocal evidence of astronomical practice among ancient cultures when no written records are available, such as in places like the prehistoric American Southwest (Ruggles 1999). Therefore, many researchers have focused on studying building alignments that “indicate” at least one astronomically significant direction on the horizon (Krupp 1978: 7). A direction is considered astronomically significant if it is between 1 and 2 degrees of an important celestial event such as a solstice sunrise or sunset (Urton and Aveni 1983).

The Mimbres-Mogollon (or Mimbres) were a subset of the Mogollon, a prehistoric culture located in the southern and southeastern American Southwest, an area of the United States known for its arid environment and variable terrain and precipitation. The Mimbres-Mogollon were centered around the Mimbres River Valley in the southern
Southwest. They practiced agriculture and built pithouses, pueblos, and ceremonial structures like many of the other cultures of the Southwest. However they had many distinct qualities, in particular their black-on-white painted pottery. The designs with which the ceramics were decorated were quite elaborate, intricate, and unique (Haury 1986; LeBlanc 1986; Wheat 1955; Cordell 1997). However, despite the sophistication and complexity demonstrated in their iconography and other aspects of their society, few archaeoastronomical studies have been conducted in their area, unlike their neighbors to the north (Anasazi) and their proposed descendants (historic Western Pueblos).

This research project thus aims to determine whether the Mimbres occupants of the Harris Site observed and used astronomy during construction of their village. Evidence that is used in this investigation includes site placement in relation to the landscape, the orientation and alignment of structures/houses, and the presence of cultural features on surrounding ridge tops. All of these aspects are compared to astronomical sight lines, such as the position of sunrises and sunsets on the horizon during solstices and equinoxes, to see if there are any correlations. After completing the evaluation of their astronomical capabilities, the function of astronomy among the Mimbres-Mogollon will be ascertained.

One important function of astronomical observation among prehistoric cultures throughout the world was the establishment of an accurate calendar. Farming, in particular, required an accurate and precise calendar so that the farming year, which included the various steps of growing crops, could be planned. In arid environments such as the American Southwest, where the Harris Site is located, short growing seasons and inadequate rainfall were combated by effectively managing water and fixing the time of
planting and harvesting (Aveni 1997). Many of the historic Pueblos are documented as using a solar horizon calendar to regulate the year. A pueblo’s sun-watcher would observe the movement of the sun in relation to the horizon throughout the year in order to anticipate key dates. For example, witnessing the sun rise at a certain point on the horizon could signal when to start planting crops or when to start preparing for an important ceremony. The sun was usually observed at both sunrise and sunset, depending on the time of year and the direction of particular landscape features (Zeilik 1985c). It is likely that the ancestors of the various Puebloan cultures also used a solar horizon calendar, although direct evidence is difficult to obtain.

Evidence of ancient sky watching has also often found in the architecture of past societies, because many monuments are oriented in astronomically significant directions. Considerable research on the Southwest in regards to astronomy and architecture has been conducted. The Anasazi, for example, oriented buildings and portals, as well as overall sites, to key astronomical phenomena, in particular solstices and equinoxes. Buildings were also sometimes aligned to important agricultural dates, such as the time for planting and harvesting (Kelley and Milone 2005; Malville and Putnam 1993; Sofaer 1997).

The significance of the conducted research is that it will attempt to expand Southwestern archaeoastronomical research beyond its current focus. One problem with current scholarly research is that it has primarily focused on the Anasazi as can be seen in many of the overviews of Southwest archaeoastronomy, such as those found in Malville and Putnam (1993) and Kelley and Milone (2005). Little archaeoastronomical research has been directed toward the Mimbres-Mogollon culture. Architectural alignments in the
Southwest have primarily only been established for pueblos as well. Pithouse structures tend to be neglected in this research. The use of astronomy in both modern Pueblos, where some of the descendants of the Mimbreños live, and neighboring prehistoric areas makes it almost certain that astronomy played an important role among the Mimbres-Mogollon pithouse groups. Therefore, the goal of my study is to rectify the current state of affairs by showing evidence of astronomical observation at a Mimbres pithouse community (the Harris Site).
CHAPTER 2
ARCHAEOASTRONOMY BASICS

This chapter presents a discussion of basic astronomical principles that need to be understood in order to study archaeoastronomy. By knowing these principles, a researcher can determine what astronomical events might be strikingly visible, and thus significant, to prehistoric cultures. The meaning that such cultures instilled on these events, and how this meaning was expressed materially, can then be explored.

Annual Solar Cycle and Seasons

Knowing what causes the annual cycle and the seasons are of primary importance as they have a major effect on the natural environment such as weather, vegetation growth cycles, and faunal migration. The natural environment, in turn, greatly affects the lifeway of prehistoric populations such as those present in the America Southwest. Thus, by being able to predict seasonal changes, prehistoric Southwestern people could better predict changes in the natural environment.

The Earth is currently tilted at about 23 ½ degrees in relation to the plane of its orbit. The Earth also orbits the sun in 365.256 days. The tilt of the Earth as it revolves around the sun determines what part of the Earth gets more sun at certain times of the year. This tilt thus creates the seasons. During the northern hemisphere summer, the northern hemisphere is tilted toward the sun. During the northern hemisphere winter, the southern hemisphere is tilted toward the sun, causing it to experience summer at this time. Autumn and spring occur when the Earth is tilted toward the side when facing the sun, meaning no hemisphere gets more sun than the other (Freedman and Kaufmann 2002).
A common misconception is that summer occurs when the Earth is closest to the sun, at perihelion. While it is true that the Earth is on an elliptical orbit with the sun at one focus, its eccentricity (percentage away from being a true circle) is only about 0.017. This value means that the Earth-Sun distance only varies about 3% over the course of a year. This low eccentricity has little effect on the temperatures and seasons of Earth. In fact, the northern hemisphere summer occurs when the Earth is at aphelion, the point farthest from the sun (Freedman and Kaufmann 2002).

The sun does not travel along the celestial equator but instead on the ecliptic, which causes its declination to change with the season along with the mid-day altitude and time spent above the horizon. As a result of the sun’s variable declination during the year (due to the Earth’s tilted axis of rotation), rising and setting azimuths oscillate on the horizon. Altitude is the angle, measured in degrees, up from the horizon toward the zenith (direct overhead point) along a vertical circle to the object. Azimuth refers to the bearing where degrees are measured eastward from true north, causing the whole horizon to add up to 360 degrees. Declination is the angular distance an object is away from the celestial equator toward the celestial poles (marked in degrees) (Kelley and Milone 2005).

The apparent annual solar movement, which takes the form of a circle in the sky, defines the year (Krupp 1978). The sun reaches its maximum declination twice a year. These times are called the solstices. The summer solstice is when the sun rises and sets at the northern-most point (in the northern hemisphere) where it appears to standstill (stops in its tracks and doubles back). The winter solstice is when the sun rises and sets at its southern-most point causing this time of year to have the shortest daylight. Near the time of the solstices, the sun moves very slowly thus giving the solstice its name which
literally means stand still (Aveni 1997). The directions of the solstices on the horizon were often considered significant in prehistoric societies and would be commemorated in architecture.

The equinoxes are the times of year when the sun is on the horizon at the midpoint between the solstices. At these two times of year, the sun rises due East and sets due West. The sun is moving the fastest along the horizon at these times (Freedman and Kaufmann 2002).

The amplitude of the oscillation between maximum declinations (or half of the overall distance) varies according to latitude. The higher the latitude, the more oblique the rising and setting of the sun is in relation to the horizon. The formula for determining the amplitude, or $\Delta A$ measured in degrees, at a particular latitude (designated as $\phi$) goes as follows:

$$\Delta A = \arccos \left( \frac{\sin \delta}{\cos \phi} \right) - 90$$

where angles are measured in degrees and the maximum declination ($\delta$) of the sun is -23.5 degrees (Kelley and Milone 2005: 22).

**Daily Solar Cycle and Cardinal Directions**

Other important directions are the zenith, the meridian, and the cardinal directions. Such directions are often used as reference points among modern people for navigation purposes and so it is likely that prehistoric Southwesterners did as well. The zenith is the direct overhead point. Thus, a solar zenith passage occurs when the sun travels directly overhead, something that only happens in the tropics. In other zones, the sun never migrates far enough north or south to be directly overhead (Aveni 1997). A meridian is a
north-south circle on the celestial sphere that passes through the zenith and both celestial poles. When an object, such as the sun, passes the meridian, it is called a meridian transit. However, an object can pass the meridian without passing the zenith. It only has to cross the line. The sun passes the upper meridian around noon and the lower meridian (the one that cannot be seen) around midnight (Freedman and Kaufmann 2002).

The cardinal directions, sometimes referred to as the polar cardinal directions, are the four main directions located on the horizon: true north, true east, true south, and true west. While it is easy to figure out east and west by observing the sun on the equinoxes, north and south are more difficult. There are two methods to figure out the direction of north and south. One method involves using the shadow of a gnomon at midday to find north (if one is in the northern hemisphere). A gnomon is a rod on a sundial that shows the time of day by using the position of its shadow caused by the sun. In astronomy, a gnomon can refer to a column or pillar that is used to observe the sun’s meridian altitude, and can be used to determine the date of zenith passage, when the gnomon casts no shadow. The second method requires knowledge of geometry. This method involves drawing a perpendicular to the east-west line, which would point north and south. In fact, halfway between the rising and setting of any celestial object would be north in one direction and south in the other (Aveni 1997).

In Native North America, the solstitial directions (positions on the horizon of the sunrises and sunsets of both solstices) are often considered the “cardinal” directions, and are seen as sacred (Wilde and Soper 1999; Young 1989). However, unless otherwise stated, all references to the cardinal directions refer to the polar cardinal directions and not the “indigenous” ones.
The Horizon

The horizon is a good reference point for determining certain directions and marking celestial events and so likely had a significant purpose among prehistoric Southwesterners. In fact, many ancient cultures engaged in what has been termed horizon astronomy. The horizon is the “intersection with the celestial sphere of a plane through the observer and perpendicular to the line between the observer and the zenith” (Kelley and Milone 2005: 15). Put simply, the horizon is where the “earth meets sky” (Krupp 1978: 2). According to Aveni (1997: 22), the “rhythmic oscillation of the sunrise and sunset points along the local horizon over the course of the seasons afforded many ancient cultures a convenient method of establishing an annual calendar.” Therefore, the sun’s annual movement (oscillation) on the horizon helped ancient cultures tell time.

An important feature of the horizon is that it is often not flat but is obscured by foreground objects. Mountains, in particular, prevent one from seeing the true horizon. The visible horizon, then, causes what are called visible azimuths. These azimuths are the directions at which events appear to happen. Sensible, or actual, azimuths are the directions at which events would happen on a flat horizon (Sofaer 1997). For instance, the sun rises due east on the equinoxes. The sensible azimuth of this event would be at 90 degrees. However, if there is a mountain at this point on the horizon, the sun will move at a certain angle from this point until it clears the mountain. The azimuth at which this happens is the visible azimuth.

The Lunar Cycle

The sun was not the only celestial body used to determine time in prehistoric times.
The moon and stars were also used for such purposes.

Being that the lunar cycle approximates a month, the moon could be used to track time, although not necessarily the seasons unless a society developed a counting system. The solar year also does not consist of a complete number of lunar months, thus a lunar calendar eventually gets out of step with a solar one (Krupp 1978). The moon goes through all of its phases in one cycle, which is the time it takes for it to go around the Earth. The sidereal month, or period, is the amount of time it takes for the moon to make one full revolution around the Earth. In other words, that is the amount of time it takes for the moon to get back to a particular position among the stars in the sky. The synodic period, on the other hand, is the “time that elapses between two successive identical configurations as seen from Earth” (Freedman and Kaufmann 2002: 68), either from one opposition or one conjunction to the next. Conjunction means that an object rises at the same time as the sun, while opposition means that the object will be opposite the sun in the sky and will set as the sun rises and rise when the sun sets. The synodic month is thus the amount of time that passes between successive full moons or new moons (Freedman and Kaufmann 2002).

The synodic month is different from the sidereal month because while the moon is revolving, so is the Earth. Because the Earth is changing its position in the sky, it takes the moon longer to complete a full cycle than it does to simply orbit the Earth. A sidereal month is currently 27.322 days, while the synodic month is currently 29.531 days. This quantity has changed over the years because as the Earth’s rotation slows, the moon moves farther away. The moon orbits from east to west but its motion appears to be west to east. The moon actually appears to move eastward among the stars about 12.5 degrees
a day. Rotation combined with revolution also causes the sidereal day to be about 4 minutes shorter than the approximately 24 hour synodic day, which is what causes the positions of the stars (and the zodiac constellations) to change throughout the year (Freedman and Kaufmann 2002).

The horizon positions of the moonrise and moonset also change, like the sun, but on a different time scale. The earth “perturbs” the moon in its orbit and these gravitational forces cause the “line of nodes to precess.” Complete “regression” takes place every 18.61 years (Krupp 1978: 21). This period of shifting lunar nodes causes the lunar declination achieved to range from about +/-18.5 degrees to about +/- 28.5 degrees. The northern and southern moonrise extremes thus move from their maxima (28.5 degrees away from true east) to their minima (18.5 degrees away from true east) and back to maxima again in about 18.6 years. The maximum extremes are referred to as the major lunar standstills while the minimum extremes are the minor lunar standstills. Both maxima occur in the same year, while both minima occur 9.3 years later (Krupp 1978). The extremes have also been referred to as lunistices. The moon can migrate up to five degrees farther north and south when compared with the sun. Lunistices actually stretch even farther north and south from the east-west line the higher the latitude at which an observer is (Aveni 1997).

**Stars**

The stars and constellations present in the night sky are instrumental to the seasonal cycle as well because the sun, as a result of its apparent annual movement, actually appears to move slowly through the background stars along a well-defined path called the
ecliptic. When an object, such as a star, first becomes visible in the east in the morning sky, it is undergoing a *heliacal rising*. When an object is last visible in the west in the evening sky, it is undergoing a *heliacal setting*. Sometimes heliacal risings or settings of particular stars or asterisms are used to mark key calendar events. However, if the stars are faint such as the Pleiades, they must be at least five degrees above the horizon to be seen and the sun, at that time, must be at least ten degrees below the horizon (Kelley and Milone 2005).

**Precession**

To figure out how ancient Southwesterns may have used the stars to tell time, one must understand precession, as it has caused the night sky to change over the centuries.

Precession is caused by the Earth falling prey to gravitational forces. As the moon moves around the Earth, it, in concert with the sun, causes a slow change in the Earth’s rotation. The Earth’s rotation is affected because it is not a true sphere but is instead an ellipsoid. It is slightly more elongated (fatter) around the equator than around the pole, causing it to have an equatorial bulge. As a result, the Earth’s axis of rotation changes or wobbles, causing it to behave like a spinning top. The exertion of the gravity ends up causing the “top’s” axis of rotation to change due to the sun and moon spending half of their time below and half of their time above the equatorial bulge. The gravitational pull on the equatorial bulge, trying to twist Earth’s axis of rotation so it will be perpendicular to the plane of the ecliptic. However, since the Earth is spinning, the two actions (gravity and rotation) cause the Earth’s axis to trace out a circle in the sky instead. This motion is called precession whereby the orientation of the tilt changes but the degree
of tilt does not. Precession occurs on an approximately 26,000-year cycle. It causes the equatorial plane to change orientation. Because the plane defines the celestial equator’s position in the sky, the equator precesses as well, thus causing Hipparchus, a 2nd century B.C. Greek astronomer, to call it the precession of the equinoxes (Freedman and Kaufmann 2002). The vernal equinox actually is slowly moving westward in the sky at a rate of about 50 seconds of arc per year (Kelley and Milone 2005).

Precession also causes the celestial poles (points in the sky where the extension of the terrestrial poles would hit) to change position relative to the stars. As a result, the north celestial pole (the point in the sky that the stars in the northern hemisphere appear to rotate around) changes, causing the closest star to this pole, the pole star, to change as well. Stars that are close enough to the pole to never set, but just appear to mark out a circle in the sky, are called circumpolar stars. Those that do set are called non-circumpolar stars. The closer one is to either the north or south poles on the Earth (the higher the latitude), the more stars there will be that are circumpolar. Thus at the poles, all stars are circumpolar, while at the equator, none are. Star paths are closer to the vertical near the equator, as well, and become more horizontal at higher latitudes. At higher latitudes, one also sees more stars during one night but less stars throughout the whole year. In the tropics, stars appear to be centered on the observer, while in more temperate zones, the stars appear centered on a fixed point in the heavens (Aveni 1997).

Currently the pole star is Polaris, which is about ¾ of a degree off the north celestial pole (Freedman and Kaufmann 2002). In the past, this pole star was different. For example, during the time of the Ancient Egyptian Empire’s Old Kingdom, the closest pole star was Thuban (Krupp 1984).
Other Cycles

According to Urton and Aveni (1983: 221), while precession affects the positions of the stars, its “effect is negligible for the sun and moon.” In other words, precession causes little change to the sun’s and moon’s positions. However there are other cycles that do affect the sun and moon. The axial tilt, or obliquity, of the Earth is currently at 23.45 degrees, but it actually varies from 22.1 degrees to 24.5 degrees. This variation occurs on a 41,000 year cycle, and the current tilt is decreasing. While the Earth’s eccentricity is currently 0.0167, it actually varies from 0.0034 to 0.058. The variability of the Earth’s eccentricity is a result of gravitational attractions among the planets. There are two cycles over which the Earth’s orbit varies, a 100,000-year cycle and a 400,000-year cycle. Both of these cycles, obliquity and eccentricity, are quite variable, though, and the above descriptions are just approximations. These two cycles, plus precession, make the accurate dating of archaeological sites essential. The dates need to be taken into account if one wants to accurately describe the position of astronomical objects during the time of particular prehistoric cultures. However, since the Harris Site was occupied as recently as one thousand years ago, the obliquity and eccentricity cycles will have little to no effect on the positions of celestial objects and will thus not be taken into account.

Planets

The final objects that need to be considered are the planets, or wanderers. Generally planets move, or wander, eastward among the stars and thus stand out among them, a fact that did not escape ancient cultures. As a result, many prehistoric populations, including
those that inhabited the Southwest, deified the planets.

Superior planets are planets farther out from the sun. Inferior planets are planets closer to the sun. During the opposition of superior planets, the faster moving inferior Earth overtakes them causing them to appear to slow their eastward motion, stop, and start moving westward in a retrograde fashion. Inferior planets undergo retrograde motion half the time. The inferior planets to Earth, Mercury and Venus, always stay close to sun. Mercury completes its cycle three times a year while Venus does so in a little over a year and a half (Freedman and Kaufmann 2002).

The planet that has been attributed with the most significance during prehistoric times is Venus. While the orbital period is 224.7 days (Freedman and Kaufmann 2002), the synodic period of Venus is 584 days. This period includes approximately 263 days acting as the evening star, after which it disappears for 8 days. It then acts as the morning star for 263 days and then disappears for 50 days, after which the process repeats. However, due to the changing position and distance of Earth relative to Venus, this cycle (or amount of days attributed to each portion) varies significantly, but the overall period remains the same (Aveni 1997).

Any object that rises within a few hours before sunrise can be a morning star and any object that sets within a few hours after sunset can be considered an evening star. However, Venus is the preferred evening and morning star because it is the brightest object in the sky after the sun and moon, and because it appears to follow or stay close to the sun since it is an inferior planet. Venus undergoes phase changes due to this inferior status and combined with changes in angular size and distance, it is seen as waxing and waning in brightness (Kelley and Milone 2005). The Venus standstills are, like the
moon, spaced farther out than the solstices but are not as far as the lunistices (Aveni 1997).

**Implications**

Overall, the above sections indicate that in order to study archaeoastronomy, one must know the apparent motions of the sun, the moon, and the planets, as well as the positions of the stars. One must also know the various cycles that the Earth undergoes that cause changes in all of these aspects.
CHAPTER 3
RESEARCH DESIGN AND METHODS

The Harris Site

One of the sites the Mimbres inhabited during their occupation of the Mimbres River Valley was the Harris Site, a site that has undergone several decades of investigation by different researchers. The Harris Site (LA 1867) is located on a large, flat terrace that rises abruptly about 20 meters above the east bank of the Mimbres River in the north-central Mimbres Valley, which is located in southwestern New Mexico (Haury 1936; Wheat 1955). It sits at an elevation of 1850 meters, which puts it at the “lower fringe of the juniper-pinyon belt” (Haury 1986: 339).

Excavations were conducted at the Harris Site by Emil Haury in the 1930s. Haury (1936) excavated up to 34 pit structures at that time although he estimated that there were likely over one hundred pithouses present. He found that the occupation of the site is restricted to the Late Pithouse Period (A.D. 550-1000). The Classic Mimbres phase (A.D. 1000-1130/1150), on the other hand, is not represented at this site. The Classic Mimbres phase is the period of time during which the Mimbreños started building surface structures or pueblos.

While only a small portion of the site has been excavated, Wheat (1955: 13) argues that there is “no particular order in village layout, houses being scattered at random.” However, recent evidence suggests that there may have been some pithouse clusters that represent distinct kin groups (Barbara Roth, 2009, personal communication). Burials were also “indiscriminately scattered” although the heads usually roughly faced east (Haury 1986: 354).
Four of the structures excavated by Haury (1936) were communal, or ceremonial, pit structures. There is also one communal structure that remains unexcavated. Communal structures resemble houses but are larger in size. According to Creel and Anyon (2003: 67), communal pit structures are considered the “most enduring public architecture” of the Mimbres area. They are “large semi-subterranean or fully subterranean structure[s] with a floor area of over 30 square meters, often with special features” (Creel and Anyon 2003: 70). Communal structures are believed to have provided the “focal point” for the activities and gatherings of community members. They served to “integrate the settlement as a whole” and probably had a ceremonial function (Woosley and McIntyre 1996: 48). These structures, similar to great kivas in the Anasazi area, were public buildings used by the entire population of a settlement, or at least a subset of that population such as all adult males (LeBlanc 1983). In most Mimbres villages, communal structures tended to be “confined to a specific part of each community over long periods of time” (Creel and Anyon 2003: 81). The area set aside for these structures early remained the preferred place for similar structures that would follow.

Dr. Barbara Roth of the University of Nevada, Las Vegas has recently resumed investigations of the Harris Site (Roth 2008b). Haury’s excavation of the Harris Site was primarily restricted to the southern portion of the site. Roth’s current investigation has involved excavating portions of the undisturbed northern end of the site as well as mapping the site in detail. Future endeavors include more excavation of houses in the northern end of the site as well as of the unexcavated communal structure, more site mapping, and analyses of the artifacts, botanicals, and faunal remains. The purpose of the investigations is to ascertain how household organization was related to the social
changes that were occurring during the Late Pithouse Period. Specifically, the “interrelationship between sedentism, agricultural dependence, and household organization” will be addressed (Roth 2008b: 2). Data that will be examined include site structure, architecture, absolute dates, roof and floor assemblages, and extramural features. These data will hopefully reveal “differences in household activities related to gender, craft production, or differential access to goods” as well as any changes that occurred over time (Roth 2008b: 4). Other areas of inquiry include the relationship between domestic and communal structures and whether agricultural dependence and sedentism increased over time (Roth 2008b).

While Harris Site inhabitants may have only occupied the site during the Late Pithouse Period, it is likely that these family groups stayed in the area throughout the Mimbres occupation of the valley. According to Roth (2008a), kin groups occupied persistent places for generations in the Mimbres River Valley. Persistent places were not necessarily sites that were persistently occupied. Instead they were areas where groups, possibly mobile ones, came back to time and again. These places tended to be located in lush areas, close to both the river and good, arable land. Sites in the Mimbres Valley typically consisted of pithouse communities overlaid by pueblos, suggesting that such sites were persistent places. However, the Harris Site is an exception because it does not have evidence of a pueblo period occupation. There is a pueblo occupation present at the Mattocks ruin, though, which is located about a mile downstream. The Mattocks ruin, in turn, has evidence of only a minimal Pithouse period occupation. It is thus likely that the kin groups that inhabited the Harris Site during the Late Pithouse period occupied the Mattocks Site during the Classic Mimbres phase. As for the Early Pithouse Period (A.D.
200-550), there is an occupation dated to this period at the McAnally Site, which is located on a hilltop right above the Mattocks Site. The relative proximity of these three places along with their combined occupations spanning from the Early Pithouse Period through the Classic Mimbres phase suggests that they make up one persistent place (Roth 2008a).

The Harris Site has a rich and diverse collection of Late Pithouse Period structures and is relatively undisturbed. Most of its structures and houses have discernible entryways with variable orientations as well. In fact, most domestic pithouses and all of the communal structures (including the unexcavated one) appear to be oriented in an eastern or southeastern direction. The Harris Site is thus a good location for archaeological investigation, including an investigation focused on the search for astronomical use and observation in pithouse architecture and village layout.

**Hypothesis and Research Questions**

The hypothesis for the proposed research is that Mimbres pithouse groups observed astronomical phenomena and used such phenomena to guide the construction of their structures and establish a calendar. To evaluate this hypothesis, investigations were conducted at the Harris Site and its surrounding landscape. Prior to the investigations, a series of research questions were posed.

1) *Is the site in a location where certain visible astronomical sight lines correlate with particular landscape features?* Southwest puebloan sites are often located in places where the landscape features on the horizon could be used to anticipate certain dates of the year. According to Zeilik (1989), historic Pueblos had calendar watch centers, or
sun-watching stations (see Chapter 6). The main function of these stations was to allow for the anticipation of festival dates. Pueblo ceremonies had to be announced ahead of time so that the proper ritual preparations could be carried out. Historic pueblos also had sun-watchers who would use markers on the horizon to determine where the sun was in its annual journey. The sun-watcher would observe the movement of the sun in relation to the horizon at the appropriate sun-watching station throughout the year in order to anticipate key calendrical dates such as solstices and equinoxes, as their positions would correspond with certain landscape features or markers. Horizon markers could include notches as well as gradual upward and downward slopes; prominent features were not necessary. Observing stations were close to or within the pueblo since the sunwatcher needed to make observations quite often, sometimes even daily (Zeilik 1985c).

2) Is there evidence of astronomical alignments, either sensible or visible, in the architecture of the site? Many Southwest puebloan sites incorporate significant celestial site lines into particular structures, and sometimes even into the overall alignment of sites. According to Zeilik (1989), many historic Pueblos are located on featureless landscapes, where a horizon calendar is not useful. Therefore another method of observation was needed. This method involved incorporating celestial observation into the architecture of the site, whereby properly oriented portals (windows, doors, etc.) were constructed to take advantage of light and shadow on particular days. The rays of light or portions of shadow would interact with markers on the far wall of the structure, thus allowing for the anticipation of key dates. This method has also been seen archaeologically at such sites as Hovenweep, which is discussed in Chapter 5.

Alignments are not always for the express purpose of observation, as demonstrated by
a few archaeological sites in the Anasazi area. According to Sofaer (1997), Chaco Canyon, which is located in northwestern New Mexico, has many well-constructed multi-storied buildings and great kivas, and the site is quite symmetrical (see Chapter 5). Many buildings at Chaco are oriented to astronomically significant directions through wall alignments instead of properly oriented portals or markers that could interact with shadow and light. Thus, their orientations were not for observation purposes. There are also orientations to important but not visible directions, such as the cardinal directions. Astronomical alignments even exist between structures.

3) Are there human-made features at particular visible astronomical sight lines on the surrounding landscape? The architecture and placement of a site are not the only ways that Southwest puebloan peoples incorporated astronomy into their society. They sometimes placed features at particular locations on the landscape. According to Aveni (1993: 127), the Hopi saw the solstices as “‘houses’ where the sun stops in his travels along the horizon.” At these places along the high mesa, priests erected small shrines, and the Sun Priest would bury prayer sticks there. Prayer sticks were an “offering to welcome the sun and to encourage him on his celestial journey” (Aveni 1993: 127). These shrines were located at particular foresights of the sunwatching stations that served as backsights. These stations were sometimes simple stone piles (Aveni 1993).

The Zuñi also had mountain-top shrines, thirteen of which are located in the Mogollon cultural area to the south of Zuñi in the White Mountains of Arizona. These mountaintop shrines were in fact used by the Mogollon well before A.D. 1300. As late as the 17th century, the Zuñi were visiting and placing offerings at these shrines suggesting continued interaction with their old homeland. The Zuñi probably inherited the
knowledge of these shrines along with the spiritual responsibilities involved in using them from their ancestors who resided in the Mogollon area before migrating to Zuñi (Ferguson 2007; Schaafsma and Young 2007). As pointed out by Fewkes (1906), even when shrines and villages are abandoned, the shrines located there are still seen as sacred and while not visited frequently, pilgrimages are still made to them.

Thus, it appears as if the Mogollon in general, and probably the Mimbres in particular, put shrines on the top of ridges. Their distance would have prevented the Zuñi from using them in the same way as the Hopi used their solar shrines, though. Therefore, it is unknown if the Mogollon used these particular shrines for astronomical purposes.

**Methods**

To address these three research questions, four lines of evidence (placement, alignment, orientation, and survey and cultural features) were examined in the summers of 2008 and 2009 during Dr. Barbara Roth’s field schools, which were conducted at the Harris Site.

*Placement*

The first line of evidence is the placement of the site in relation to particular landscape features. The site is surrounded by ridges, thus preventing a clear view of a good portion of the flat horizon, examples of which can be seen in Figures 3.1 and 3.2. As a result, the actual (or sensible) azimuths of key celestial events, such as the solstices, may not be observable from the site. Instead, only the visible azimuths at which these events line up with certain landscape features (particular peaks, notches, slopes, etc.) can be established on-site. Therefore, the azimuths and angles of elevation of prominent
landscape features, of which there were 91, were determined from the five identified communal structures on the site using a transit. The prominent landscape features were any high or low spot along the ridge tops surrounding the Harris Site.

The communal structures were used because there was no way to identify any prehistoric sun-watching stations. Sun-watching stations tended not to be marked or if they were, such markings were not obvious (Zeilik 1985c). It is therefore unknown what they look like. Communal structures were used because, as seen in Chapter 5, there are many instances in the Anasazi area of the Southwest where kivas are astronomically aligned. Landscape features could be used to help align buildings with important celestial directions provided that there was a link between the two. Religious significance can also be placed on celestial events lining up with landscape features. Thus it is possible that communal structures were built with both the ease conferred to construction orientation and the religious significance in mind.

Based on the tilt of the Earth, one would likely assume that the solstices at the Harris Site would occur at azimuths that deviate from true east and true west by 23.5°. However, the 23.5-degree deviation only occurs at the earth’s equator. According to Aveni (1997), the farther away one is from the equator, the larger the angular separation between the solstices on the horizons. The formula for calculating this separation, found in Kelley and Milone (2005: 22), was used along with the latitude of the site to determine the sensible horizon azimuths of solstice sunrises and sunsets as well as the lunistices (standstills) for the site. The approximate latitude of the Harris Site is 32° 51’ 25.9”, or 32.8572 degrees (Matthew Taliaferro, 2007, personal communication). The formula is

\[ \Delta A = \arccos (\sin \delta / \cos \phi) - 90° \]
where $\Delta A$ is the change in degrees from true east or west in which the solstice sun (or standstill moon) rises or sets, $\delta$ is declination (which in this case is $-23.5^\circ$), and $\phi$ is the latitude of the site in degrees. $\Delta A$ for the solstices is 28.34 degrees. Thus the summer solstice sun rises on a flat horizon at $61.66^\circ$ and sets at $298.34^\circ$. The winter solstice sun rises on the horizon at $118.34^\circ$ and sets at $241.66^\circ$. $\Delta A$ for the major standstill moon is 34.6 degrees. The northern major lunar standstill moon rises at $55.4^\circ$ and sets at $304.6^\circ$. The southern major lunar standstill moon rises at $124.6^\circ$ and sets at $235.4^\circ$. $\Delta A$ for the minor standstill moon is 22.2 degrees. The northern minor standstill moon rises at $67.8^\circ$ and sets at $292.2^\circ$. The southern minor standstill moon rises at $112.2^\circ$ and sets at $247.8^\circ$. The lunar standstills are all about six degrees off of the solstices in either direction (as opposed to the five degrees that occurs at the equator).

However, the calculated azimuths are only valid for a flat horizon and do not take into account the landscape of the site. Therefore, transit observations of sunrise and sunset on the winter and summer solstices, as well as the days leading up to and following these events, were conducted at the site in order to determine the exact visible azimuths of the rising and setting sun on the solstices. The reason that observations were made during the days leading up to and following the solstices was in case bad weather hit and the sunrises and sunsets could not be observed on the solstice itself.

Aside from the solstices, no other celestial events were directly observed. Other events were instead simulated using Starry Night software. This software is similar to planetarium software but is restricted to the computer. By using the coordinates of a site, it can extrapolate where and when certain celestial objects rose and set at any moment in the past. Starry Night also compensates for the precession of the Earth (see Chapter 2).
To determine the azimuths at which key celestial objects rose and set when the communal structures were built, the latitude and longitude of the site was inputted into the software as well as the approximate time of construction of each communal structure.

As previously mentioned, of the 34 identified houses at the Harris Site, four of them were communal structures. Based on dendrochronology, pit structure 14 was constructed around A.D. 582, during the Georgetown Phase (A.D. 550-650) of the Late Pithouse Period, thus this year was inputted into Starry Night. Pit structure 8 does not have definite tree ring dates of construction, but based on the ceramic assemblage and shape of the structure, it was determined to have been constructed during the San Francisco phase (A.D. 650-750) of the Late Pithouse Period. Its construction was thus approximated to have occurred in the middle of the San Francisco phase, in A.D. 700. Pit structure 23 was built around A.D. 840, during the Three Circle phase (A.D. 750-1000) of the Late Pithouse Period. While Haury identified it as a communal structure, it was looted, thus its entryway cannot be defined and its identification is somewhat suspect. However, it was still included in this investigation. Pit structure 10’s construction has been confidently dated to A.D. 877, putting it in the Three Circle Phase (Haury 1986).

The unexcavated depression as seen on the site map has still not been excavated. However, on-site surface investigations have found that it is quite large and rectangular in shape, contrary to the map (which shows it being circular). Due to its size, shape, and nature, the depression has been tentatively identified as a late Three Circle communal structure, later than pit structure 10. However, because two Three Circle dates were already investigated using Starry Night, it was not deemed necessary to approximate a date for the construction of the unexcavated depression.
After the coordinates and dates were inputted, the direction and time of day that key celestial objects, such as the sun, rose and set throughout a particular year was determined. The lunar standstills, on the other hand, were hard to document as they do not occur every year. However since they are supposed to be about six degrees off from the solstices, they were estimated to be about six degrees away from the visible azimuths of the solstice sunrises and sunsets. Starry Night also does not incorporate the mountainous landscape around the Harris Site. As a result, the angles of elevation of landscape features measured with the transit were used. Therefore when “observing” a particular rise or set, I documented at what azimuth a particular object passed the altitude of the landscape in that particular direction. In that way, the azimuths of the calculated sight lines of the surrounding landscape were able to be compared to the azimuths of certain astronomical events such as solstices and equinoxes as well as the risings and settings of bright stars and prominent asterisms to see if any of them matched up with each other.

Alignment

The second line of evidence used to evaluate the research questions is the overall alignment of the site. The overall alignment of the site was determined using existing site maps in conjunction with recently created maps. The existing site maps include the one in Haury (1986: 360), seen in Figure 3.3, and Haury’s original housed at the Arizona State Museum. Haury also created a number of house maps, with several of the pithouses and structures drawn individually. Copies of Haury’s original site map and his house maps, as well as his field notes, were obtained during archival research conducted at the Arizona State Museum at the University of Arizona in Tucson in the summer of 2008.
The recent maps, of which there are two, were also created during the 2008 summer field season. Their purpose was to check the accuracy and orientation of Haury’s maps. One was created by mapping all identifiable features of the site using an EDM (see Figure 3.4). The other was created by Darrel Creel and Dale Hudler, who used a magnetometer to map a good portion of the site. They then overlaid Haury’s site map over their magnetometer readings, which can be seen in Figure 3.5. They found that the north on Haury’s map was off by 15 degrees, give or take a few degrees, which does coincide with the EDM map.

According to the NOAA Satellite and Information Service on the National Geophysical Data Center (NGDC) website (www.ngdc.noaa.gov/geomagmodels/Declination.jsp), the declination from true north in Mimbres, New Mexico in 1934 was 13.5 degrees (13°30’ East). This information and the findings of the magnetometer show that Haury mapped the site to magnetic north instead of true north. As a result, all orientations and alignments (see below) have to be corrected. Due to the approximate nature of the corrected azimuths, the complications when incorporating the landscape, and lack of instruments that allowed precise measurements among prehistoric inhabitants, any orientation or alignment between five degrees of an important event or direction is considered significant.

To measure the overall alignment of the site, lines were drawn through the centers of pairs of pithouses, and the directions/azimuths of those lines were determined. The pithouses were first separated by phase. Three copies of Haury’s (1986: 360) site map were used, one for each phase (see Figures 3.6-3.8). On each map, then, the houses for the particular phase represented were identified. Lines were then drawn between every
pithouse and every other pithouse of that phase. The azimuths to which each line pointed were then measured, corrected, and compared with the known azimuths of celestial events during that time frame such as solstices, equinoxes, and lunar standstills.

Afterwards, the communal structures were separated from the domestic structures and treated as their own “phase,” whereby lines were drawn between them and azimuths were measured, corrected, and compared (see Figure 3.9).

*Orientation*

The third line of evidence is the orientation of particular structures on the site. The orientation of structures was determined by the directions to which the entryways of both domestic and communal pithouses were pointing. These directions were ascertained using Haury’s corrected site and house maps. As another check on Haury’s maps, an attempt was made to re-excavate the entryways of the known communal structures with discernible entrances, of which there were three (8, 10, and 14). Two of the three entryways (10 and 14) were uncovered and their actual orientations were compared to their map orientations. Their actual orientations were determined by measuring their azimuths after they were uncovered, which was accomplished by placing a compass corrected for current magnetic declination on the floor of the entryways and pointing it in the direction of the entryways. The magnetic declination, according to the NOAA website, during the field schools in Mimbres, New Mexico was close to ten degrees off of true north. In June of 2008, it was 9°54’ East, while in June of 2009, it was 9°48’ East.

The entryways of three of the pithouses excavated during the 2008 and 2009 field seasons were also incorporated into the data set. The azimuths of the entrances of these pithouses (35/36, 37, and 38) were determined in the same way as the uncovered
communal structure entryways.

For the orientations, as with the alignments, the domestic houses were separated by phase to see if there are patterns present in any of the phases. It is possible that many of the entrances were oriented to particular directions by chance. It is also possible that pithouses were oriented to face a general direction, such as east, and not a precise one. To try to distinguish between chance and purposeful alignments, I used an approach similar to Creel and Anyon (2003). They determined the overall variation of the entrance directions, the average of the entrance directions, and how far this average was from an important sight line. With this method, Creel and Anyon (2003) were able to determine whether communal structures throughout the Mimbres Valley predominately pointed to a particular celestial event during a particular phase. (Their findings can be found in Chapter 5.) In my investigation, I took the domestic houses in each phase and then calculated the average orientation and standard deviation. I then compared these average orientations with the azimuths of the solstices, equinoxes, and lunar standstills to see if there were any correlations. The standard deviations were used to ascertain the likelihood that these averages were intentional.

When the domestic houses were separated by phase, six of them had to be excluded. While Haury (1936) supposedly excavated 34 pithouses, many of the houses were in fact only partially excavated or outlined. Six pithouses were not even put into a time period because they were not fully uncovered. These include houses 12, 26, 27, 30, 31, and 33.

One problem with Haury’s maps that could not be corrected with the new maps is seen when comparing his house maps with his site maps in regard to the domestic pithouses. Some do not match. Pithouses 24, 25, and 32 of the Georgetown phase,
pithouse 22 of the San Francisco phase, and pithouses 5, 7, 15, and 16 of the Three Circle phase have their entryways point in different directions on the site maps versus the house maps. Due to the detail and individual nature of the house maps, it is more likely that they instead of the site maps exhibit the correct orientations. However, both possible orientations (when present) must be considered when searching for astronomical alignments. There are also pithouses whose house maps are either missing or were never created. These include pithouse 29 of the Georgetown phase, pithouses 11, 18, and 28 of the San Francisco phase, and pithouses 9 and 17 of the Three Circle phase. Thus for these particular houses, when computing the statistics for entryway orientations, the site map orientation was also used for the house map orientation. None of these entryways were re-excavated and so cannot be checked.

Survey and Cultural Features

The fourth, and final, line of evidence is the presence of human-made, or cultural, features at key points on the surrounding visible landscape. To find possible cultural features, I surveyed the mountainous landscape surrounding the site. The survey involved hiking many of the ridge tops visible from the site with a GPS unit so that the UTM coordinates of any feature could be obtained. The datum used by the GPS unit was WGS 84. The possible features were numbered according to the order in which they were found or investigated.

UTM coordinates were not only taken for features found but also at various points along the route, primarily ridge tops, and at major points on the Harris Site. A map created from the coordinates can be seen in Figure 3.10a (with a close up of the Harris Site communal structures in Figure 3.10b). Thus if a point is not labeled it merely
corresponds to a significant landscape point such as a high or low spot, not a possible feature. The map has a dearth of points to the north as well as to the southeast. The entire visible landscape between northeast and northwest was surveyed except for a small portion to the southeast. The northern mountainous landscape along with part of the southeast was not surveyed due to their distances from the site being too great and the routes to them unknown.

I compared the coordinates of features found with the coordinates of the site in order to determine if there are any alignments with astronomical phenomena. To do this, I drew lines between the site and the feature, measured the azimuths of those lines, and compared those azimuths with the azimuths of celestial events.

**Relevance**

In sum, an archaeoastronomical investigation of Mimbres pithouse groups was conducted at the Harris Site, a Late Pithouse Period site located in the upper Mimbres Valley in southwestern New Mexico. The investigation involved four lines of evidence: placement, alignment, orientation, and survey and cultural features. These lines of evidence were used to answer three research questions: whether the site is in a location where astronomical site lines correspond with landscape features, whether there is evidence of astronomical alignments in the architecture of the site, and whether there are human-made features located on astronomical sight lines from the site along the surrounding landscape.

If the answers to any or all of these questions are yes, then one more research question will be posed, *why did the Mimbres pithouse people engage in astronomical*
observation? Astronomy was used in many locations in the historic Southwest to create a calendar to regulate the agricultural cycle. Regulating agriculture was necessary for survival among farming communities in arid regions (Aveni 1993; Kelley and Milone 2005; Malville and Putnam 1993; Zeilik 1985c). It is therefore likely that the Mimbres pithouse people used astronomy in this manner as well. However, such a link needs to be established.

To answer this final research question, the results of the field work and calculations were used in conjunction with a fifth line of evidence, an extensive literature review of existing archaeological and ethnographic data in the Southwest. This background research was used to establish the importance and possible purposes of astronomy during the Late Pithouse Period in the Mimbres region and is laid out in the following chapters.
Figure 3.1. View of landscape from Harris Site, facing north.

Figure 3.2. View of landscape from Harris Site, facing south.
Figure 3.3. Harris Site sketch map from Haury (1986: 360), drawn to magnetic north.
Figure 3.4. Harris Site map using arbitrary EDM coordinates.
Figure 3.5. Haury’s (1986: 360) map overlaying magnetometer map for Harris Site.
Figure 3.6. Harris Site Georgetown Phase (modified from Haury 1986: 360).

Figure 3.7. Harris Site San Francisco Phase (modified from Haury 1986: 360).
Figure 3.8. Harris Site Three Circle Phase (modified from Haury 1986: 360).

Figure 3.9. Harris Site Communal Structures (modified from Haury 1986: 360).
Figure 3.10a. Map created using UTM coordinates of surrounding landscape and accompanying features (human-made and natural).
Figure 3.10b. Enlargement of Harris Site portion of map created using UTM coordinates.
CHAPTER 4
THE SOUTHWEST UNITED STATES

The geographical and cultural area termed the “Southwest” has been described as extending from Las Vegas, New Mexico to Las Vegas, Nevada and from Durango, Mexico to Durango, Colorado. While the prehistoric peoples who lived in the Southwest United States were quite heterogeneous in both language and culture, their cultivation of corn, beans, and squash distinguished this area from the hunting and gathering areas of California and the Great Basin, and the bison hunting lands of the Great Plains (Cordell 1984). The prehistoric Southwest was united by its dry climate, making water a critical resource for all who lived there. A variety of indigenous techniques for cultivating soil and conserving water were used. The people also produced some of the most impressive architecture north of Mesoamerica. While the northern, eastern, and western boundaries are easy to define, the southern one is more difficult since Mesoamerican groups cultivated the same crops. However, Mesoamerica is considered to be one of the centers of American civilization, because there were complex prehistoric states and empires present there. Such a scale was not achieved in the Southwest. Therefore, the Southwest culture area has been defined by not only what was present, but also by what was absent (Cordell 1997).

It is believed that the Southwest came about from taking aspects of Mesoamerican culture such as their basic crops, pottery, irrigation, and perhaps even religion and adapting them to the “environmentally diverse” and “high-risk agricultural settings” of the Southwest (Cordell 1984: 5). Due to the lack of written records in the region, which would provide insight regarding the symbolic, religious, and intellectual aspects of the
prehistoric cultures present in the Southwest, archaeologists must define the various
cultures on material remains alone. These remains include houses, ceremonial structures,
and ceramics among other things. The four major defined prehistoric traditions of the
Southwest are the Anasazi of the Four Corners Region (extending from eastern Nevada to
eastern Colorado and New Mexico), the Hohokam in south-central Arizona, the Patayan
of the Far West (western Arizona, southern California, and northern Baja California), and
the Mogollon, which are geographically defined below (Cordell 1997).

**The Mogollon**

The term Mogollon derives from the major mountain range along the Arizona-New
Mexico border. The mountain range, in turn, was named after Don Juan Ignacio Florence
Mogollon, who was a Spanish colonial governor of New Mexico in the 18\(^{th}\) century. The
Mogollon tradition encompassed a quite extensive area that spanned from southwestern
New Mexico into southeastern Arizona. Some argue that the Mogollon area also
stretches considerably south into Mexico in the areas of Sonora and Chihuahua (Cordell
1997). Shafer (2003) specifically describes the Mogollon area as stretching from the
Mogollon Rim of east-central Arizona to the northern Chihuahua desert of Far West
Texas and northern Chihuahua, Mexico.

Wheat (1955: 6) characterizes the Mogollon homeland as being the “most maturely
dissected area in the Southwest” due to the number of streams and rivers that criss-cross
the area. He also calls it the most watered. Due to the height of many of the mountains,
rainfall can be near or even exceed twenty inches a year. Many streams also flow for all
or part of the year. The northern part of the region had a greater amount of rainfall than
the southern part. Despite the advantage of an adequate water supply in the north, though, Wheat (1955) states that much of the area is not suitable for agriculture due to the narrowness of the valleys and the lack of arable soils. The villages are thus concentrated where these valleys open up into broad alluvial flats. The south has more land available but less water so the presence of water becomes the dominant factor in choosing village sites there.

The typical settlement pattern of the Mogollon prior to A.D. 1000 was communities made up of loosely arranged pithouses. Pithouses are subterranean or semi-subterranean structures with a constructed roof (Cordell 1997). After A.D. 1000, the area saw the development of compact pueblo towns. These Classic Mimbres sites are made up of single-story masonry pueblos with central plaza areas, and ceramics are decorated with black paint on white slip (Cordell 1997). However, this chronology works more for western New Mexico than for the mountainous areas of central Arizona. There the transition to pueblos occurs later (Reid 1989).

The presence of pithouses, pueblos, and black-on-white pottery caused many archaeologists to initially believe that these remains were a “southern manifestation of the Basketmaker-Pueblo continuum” (Cordell 1984: 71). In other words, they were an offshoot of the Anasazi. However, earlier pottery (brownware, red-on-brown, and slipped-and-polished redware) appeared to indicate a connection with the Hohokam to the west (Cordell 1984; Haury 1936). There is also evidence that ceramics were used earlier in the Mogollon area than in the Anasazi area (Reid 1989). The pithouses are different as well, as Mogollon pithouses are relatively deep with lateral ramp entryways, and they lack certain floor features such as benches, deflectors, and sipapus that are
typical in Basketmaker pithouses (Cordell 1984; Rinaldo 1941; Haury 1936). Communal structures, or kivas, also changed from round to rectangular while Anasazi kivas remained round (Haury 1936). By comparing the differences in ceramics and architecture, as well as using stratigraphic principles, Emil Haury (1936) discovered that the developmental trends of the Mogollon area differed from both the Anasazi and the Hohokam and defined them as distinct from both their neighbors.

However, archaeologists then believed that while the Mogollon started out as a separate group, they were later usurped by the Anasazi, as evidenced by the presence of “seemingly Puebloan characteristics” such as pueblos and black-on-white pottery (Hegmon 2002: 309). Eventually researchers did manage to demonstrate that Mogollon styles in general, and Mimbres styles in particular, were indigenous developments and not the result of a “Pueblo incursion” (Hegmon 2002: 310). One method was to show the continuity between the pithouse and pueblo periods. Pueblo, or Classic, villages were often built directly on top of pithouse villages. Similar building techniques, such as roofing patterns and the construction of cobble walls, were present in both late pithouses and pueblos (LeBlanc 1986). The pueblos are constructed differently as well, being made of cobble and adobe (ground masonry) instead of just adobe. They are also considered by many to be poorly constructed in comparison to Anasazi pueblos, but only because they were made of inferior building material (Cordell 1997). Black-on-white pottery was present about 200 years prior to the transition to pueblos, a trend that does not mesh with an Anasazi takeover (Anyon et al. 1981). These differences show that the Mogollon are indeed unique in regards to their neighbors, even during the Classic Period, and should thus be considered a distinct cultural group.
The Mogollon has been divided into several “subcultural patterns.” The six branches or regional variants that have been defined by Wheat (1955) are the Mimbres, Black River, Forestdale, Cibola, Jornada, and San Simon. Wheat differentiates them because the timing of the periods/phases of these various Mogollon branches, which are based on ceramics with possible accompanying architectural changes, appears to differ. For the most part, these divisions have remained fairly intact to recent times.

In the north and northwest of the Mogollon area lie the mountainous areas of Reserve/Cibola in New Mexico and Forestdale and Point of Pines/Black River in Arizona (Anyon and LeBlanc 1984). Many archaeologists actually combine the Black River, Forestdale, and Cibola branches into a single adaptation referred to as Mountain Mogollon (Deihl and LeBlanc 2001). The San Simon of southeast Arizona and the northern Chihuahua of Mexico resided in the southern portion. The Jornada of southeast New Mexico and western Texas lived in the southeast of the Mogollon area (Anyon and LeBlanc 1984). The Mimbres region of the Mogollon lies fairly in the middle. It includes the majority of southwestern New Mexico and is centered on the Mimbres River and its tributaries. The area also encompasses the upper portion of the Gila River and the lower portion of the San Francisco River (LeBlanc 1986).

The Mimbres-Mogollon

The Mimbres area includes the Colorado Plateau transition to the north and the Basin and Range and Sierra Madre to the south. It encompasses parts of the Gila Wilderness, the Mimbres Mountains, and the grasslands of the Deming Plain. The northern part, in the Mogollon Plateau, consists of mountainous volcanic uplands (Shafer 2003). The
whole area is a semi-arid region with considerable “topographic relief” and an elevation range from 4000 to 10000 feet (Shafer 2003: 2). Due to the wide elevation range and uneven topography in the Mimbres area (and in the Mogollon region as a whole), the climate and precipitation in the region fluctuates quite a bit as does the variation in vegetation and faunal resources (Shafer 2003). The higher elevations have more water than lower elevations, but average temperatures and number of frost-free days are lower (Anyon and LeBlanc 1984). According to Anyon and LeBlanc (1984), the key to successful farming is to find a location with an adequate water supply, a workable temperature range, and enough frost-free days. The location also needs a good mix of wild food resources and raw materials.

Shafer (2003) states that the optimal environment for farming occurs between 4000 and 6000 foot elevation as those altitudes have the necessary conditions for farming: permanent water and a long growing season. This elevation range includes the grasslands of the upper Chihuahua desert as well as the pinyon-juniper zone in the mountain foothills. As a result, all major Mimbres towns are located in the Transitional Zone south of the Mogollon Plateau.

As previously mentioned, the Mimbres branch is centered on the Mimbres River. *Mimbres* is the Spanish word for willow, which grows alongside the river. This river drains the mountain foothills and desert plains of southwest New Mexico (Shafer 2003). It runs southeast from the Gila Wilderness area, then heads south in the middle part of the valley, and finally “empties” into the Deming Plain (Shafer 2003: 16). The Mimbres actually flows underground into the water table and drains into the “interior desert bolson” or basin south of Deming (Shafer 2003: 3). The Mimbres River Valley contains
rich fertile soil, a moderate-sized floodplain, and a dense forest consisting of cottonwood, ash, and walnut (Shafer 2003). Other Mimbres areas include the upper Gila area, which is relatively high, moist, and cool, and the eastern Mimbres area, which is relatively dry due to mountains preventing east-moving storms from reaching it (Hegmon 2002).

According to Anyon and LeBlanc (1984), river flow, which is subject to periodic flooding, is a limiting resource to habitation. Therefore large Mimbres sites are only found around permanent water (Shafer 2003). Anyon and LeBlanc (1984) also state that the middle Mimbres River is the best location for farming. The middle valley is actually the location of one of the major Mimbres villages, Galaz. Galaz is located where two major tributaries (Noonday Creek and Ancheta Creek) join the Mimbres River and where flooding is not a major issue. However, unlike other areas of the valley, Galaz is not located in a good area for irrigation and so the people there relied more on dry and floodplain farming (Anyon and LeBlanc 1984).

Most of the side drainages of the Mimbres are mountainous and rugged, making them not very productive. The lower valley too is a rather poor place for farming as it is a desert-like environment with low rainfall and high evaporation. However, the area does have a long growing season and so farming can occur in a few places where surface water flow allows for irrigation (LeBlanc 1983). While sites are clustered and some of the largest settlements are found in the middle part of the valley, Shafer (2003) finds that major Mimbres settlements are evenly spaced along the length of the river. They are spaced far enough apart (2-3 kilometers) in order to provide enough irrigation land for each settlement and to create a buffer zone between settlements so that they can also harvest other resources. Diehl and LeBlanc (2001) find that this pattern appears to start
early on, even before agriculture became important.

Diehl (2007) states that the Mimbres branch was similar to the Highland or Mountain Mogollon until the 9th century A.D. Wilcox and Gregory (2007) go so far as to say that the two groups were likely part of the same language community. However, during the 9th century, the Mimbres began to diverge from other Mogollon branches, primarily in their form of ceremonialism. They started constructing obvious kivas. They had elaborate mortuary treatments for humans and some animals. They used exotic trade goods such as macaws, shell, and copper bells (Diehl 2007). Their pithouses possessed a “formality and conformity of shape” that those of other branches did not (Diehl 2007: 156). They also started creating the pottery designs that have made them quite unique in regards to other Mogollon branches. The Mimbres are actually defined by the imagery and iconography on their black-on-white pottery (Shafer 2003).

**Mimbres Pithouse Occupations**

The Mimbres chronology was developed by Haury (1936) using data from two Mimbres sites, the Harris Site and Mogollon Village. While people were present in the Mimbres area in pre-ceramic times, the Mimbres branch does not officially begin until circa A.D. 200 with the Early Pit House Period. In fact, prior to A.D. 200, the Mimbres Valley was not occupied on a permanent or even semi-permanent basis.

At the onset of the Early Pithouse period (A.D. 200-550), populations, which were still quite low, moved to river valleys, at least on a more permanent basis (Shafer 2003; LeBlanc 1983). Groups stayed in one place longer and used local resources more intensively, although household locations often changed resulting in considerable site movement (Shafer 2003; Diehl and LeBlanc 2001). Wild foods still made up a large
proportion of the diet, but not as much as during the late Archaic period (Diehl and LeBlanc 2001). During this period, agriculture became more important as beans, which required deeper and well-watered soils, were added to the cultivated subsistence base that already included corn and squash. As a result, seasonal villages shifted to ridges and bluffs overlooking the river flood plain where agricultural land was located (Shafer 2003; Cordell 1997).

This period is characterized by the first use of ceramics, which took the form of thin plainware, or brownware, that resembled bottle gourds (Shafer 2003). Fugitive red and red slipped (but not highly polished) pottery was also made (LeBlanc 1986; Cordell 1984). The painted pottery during this time constitutes a very small portion of the overall ceramic assemblage, though (Diehl and LeBlanc 2001). Pithouses were circular to oval-shaped and had lateral entrances (LeBlanc 1986; Cordell 1984). The entrance ramps usually faced an easterly direction (Diehl and LeBlanc 2001). The roofs of the pithouses either had an “umbrella” type roof (central upright post) or were domed with beams supported by “marginal posts” (Cordell 1997: 204). A few sites had large structures or bean-shaped ones, which may have been incipient communal structures. Burials at this time were often placed in trash pits and possessed few grave goods (Diehl and LeBlanc 2001).

As previously stated, sites were often located on “high isolated knolls or ridges usually overlooking perennially watered river valleys” (LeBlanc 1986: 300). Diehl and LeBlanc (2001) point out that sites were in fact located in the highest elevation spots in an area, although the two authors disagree over the reason why. Because sites are located on elevated terrain and some sites have peripheral rock alignments, LeBlanc has argued
that house locations are defensive. They are hard to attack and the atlatls used at the time would have been hard to use uphill. The bow and arrow was introduced at the beginning of the Late Pithouse Period, which decreased the hilltop advantage, thus causing settlements to move to more productive locations. Diehl, on the other hand, argues that the link between elevated locations and defense is not strong, especially since there is no other evidence of warfare. There were no real fortifications and the advantages of elevation alone were not that great. The defense argument also does not sufficiently explain the move to river terraces during the early Late Pithouse period (Diehl and LeBlanc 2001). Diehl instead believes that villages were strategically located to “promote intervillage interaction” (Diehl and LeBlanc 2001: 32). These locations would do so by increasing visibility to travelers, which was needed in a time of low population when social ties that promoted trade, intermarriage, and hospitality were important. It is also possible that these locations were better for hunting, which was still an important element of the economy (Diehl and LeBlanc 2001).

Constructing such high villages was energetically costly as such places were difficult to reach. Therefore as populations increased, residences were constructed at lower elevations so that there was easier access to both fields and water (Diehl and LeBlanc 2001). Thus, the move to lower elevations was likely a result of increased agricultural dependence and sedentism (Anyon and LeBlanc 1984).

The Late Pit House Period started around A.D. 550 and lasted until A.D. 1000. It is divided into three phases: Georgetown (A.D. 550-650), San Francisco (A.D. 650-750), and Three Circle (A.D. 750-1000). As stated previously, at the beginning of the Late Pit House Period, many knolls in the river valleys were abandoned and the settlements were
moved to lower ground locations on river terraces next to arable land (Anyon and LeBlanc 1984). Upland settlements, though, had a somewhat different trajectory than those in the river valleys, with mobility lasting to a later date (Roth 2007).

The Georgetown phase was characterized by round pithouses with one flat side (D-shaped) and an inclined lateral entryway. Houses from this time period show little evidence of remodeling and have few interior features. Hearths tend to be ephemeral ash lenses on the floor or in shallow basins. On some sites, two sizes of pithouses were present. The larger ones had earthen lobes next to their entrances. Lobes are columns of earth that are located beside the rampway. They took the shape of beans or kidneys (Anyon and LeBlanc 1984). These structures are assumed to be communal structures, while the smaller ones are considered to be domestic structures (Anyon and LeBlanc 1980). There was also the production of plainware, or Alma Plain, and polished redware, or San Francisco Red (Cordell 1997). Population at this time was small and scattered (Diehl and LeBlanc 2001).

The San Francisco phase had sub-rectangular pithouses, or rectangular pithouses with rounded sides. While residential pithouses were rectangular, the shapes of the communal pithouses lagged behind and were still round at this point. They also had stylized lobing, which took the form of posts or flat rocks that flanked the entryway (Anyon and LeBlanc 1984). The communal pithouses increased in size considerably more than the residential structures (Anyon and LeBlanc 1980). This period had more pithouses than previously and hearths were more substantial, often being adobe-lined making them more permanent and well-prepared (Anyon and LeBlanc 1984). House floors, ramps, and sometimes walls were plastered while ramp entrances usually had one or more steps. Roofs were
usually supported by three main support posts along the middle as well as one at each
corner and one on each side of entryway (Shafer 2003). Houses also showed the first real
evidence of remodeling in the form of re-roofing and relocating rampways although few
features were present overall (Anyon and LeBlanc 1984). The decorated ceramics were
of the Mogollon Red-on-brown type (Cordell 1997).

Houses may have become rectangular during the San Francisco phase because the
population was increasing, inhabitants were becoming more reliant on agriculture, and
groups were becoming more sedentary. Robbins (1966) has found that cross-culturally,
round pithouses are usually associated with small communities, relatively impermanent
structures, and only casual practice of agriculture. Rectangular pithouses tend to be
associated with large communities, relatively permanent structures, and more intensive
use of agriculture. Rectangular houses also have space that can more easily be divided up
into distinct activity areas (Hunter-Anderson 1977). However, permanent facilities such
as storage bins, mealing bins, and looms were extremely rare in Mimbres pithouses
(Anyon and LeBlanc 1984).

The Three Circle Phase

The Three Circle phase has been seen as a time when significant social changes were
occurring. Diehl (2007) argues that prior to the ninth century A.D., ceremonial
architecture, residential architecture, material culture, and subsistence practices were
quite similar between the Mountain Mogollon and the Mimbres branch. However, the
late Three Circle phase (post-A.D. 900) is often characterized as a transitional phase
between the Late Pithouse Period and the Classic Mimbres phase, when semi-sedentary
pithouse villages transformed to fully sedentary, agriculturally dependent pueblo towns.
Localized developments during this time include changes in architecture, elaboration of white-slipped brownware, and formalized expressions of beliefs and symbolism. These developments are what distinguish the Mimbres from the other Mogollon branches (Shafer 2003). This development may be why the Mimbres trajectory, or timing of periods/phases, starts to differ from that of other Mogollon groups (Shafer 2003).

The major socioeconomic changes that started in the Three Circle phase have been attributed by some to increasing relations with other groups, in particular the Hohokam. Interaction with the Hohokam is seen in the introduction of both irrigation and cremation as well as the presence of Pacific Coast shell, which was the result of trade. Stone palettes, carved stone bowls, and Hohokam ceramic designs (naturalistic motifs) also begin to appear. The “sophisticated irrigation technology” introduced by the Hohokam led to “agricultural intensification, increased residential stability, and other cultural changes” (Creel and Anyon 2003: 69).

This interaction can also be seen in the presence of a Hohokam-looking pithouse courtyard group present at both Old Town and Wind Mountain (Creel 2006c; Woosley and McIntyre 1996). Old Town is located in the lower Mimbres Valley right above the point where the surface flow of the Mimbres River normally ends (during non-flood periods) (Creel 2006c). Wind Mountain is located on a ridge in the Mangas Creek drainage of the Upper Gila River in southwestern New Mexico. The courtyard group at Wind Mountain appears to have pithouses with gabled roofs, a Hohokam feature (Woosley and McIntyre 2006). During the height of Hohokam interaction (A.D. 900s), the Gila Mimbres also reached their peak likely due to their proximity to the Hohokam (Shafer 2003; Creel and Anyon 2003). However, toward the terminus of the Three Circle
phase and the beginning of the Classic Period, the Mimbres are characterized as becoming “inwardly focused, eschewing ritual and symbolic connection with other nearby societies” (Creel and Anyon 2003: 87). Thus, while interactions with neighbors pushed the Mimbres onto a unique path when compared with the rest of the Mogollon, eventually they would cut off these ties and continue their development in a somewhat isolated state.

Ceramics during the Three Circle phase were initially red-on-white, with the introduction of black-on-white (Boldface) occurring by the late A.D. 700s (LeBlanc 1986; Cordell 1984, 1997). Jars also increased in size, likely serving as storage containers as evidenced by the lack of subfloor storage pits (Shafer 2003). Figurative elements first started appearing on bowl designs, and pottery designs became more elaborate due to the “changing spheres” in which pottery was used (Shafer 2003: 39). Cooking and utility ware also started to be decorated with the introduction of neck-banded pitchers and neck-corrugated jars (Anyon and LeBlanc 1984).

Mortuary practices changed as well. Prior to the Three Circle phase, graves were primarily extramural and contained few grave goods. During the Three Circle, graves started becoming intramural, being placed beneath the floors of houses. These inhumations sometimes contained smashed jars/pitchers as well as kill pots (black-on-white pottery with a central “kill” hole, or hole punched through the bottom) placed over individuals’ heads. There were also some cremations during the later part of the phase, which contained elaborate and exotic grave goods (Shafer 2003).

This phase is also characterized by fully rectangular pithouses, with sharp corners and sometimes stone linings. The post pattern for these houses usually consisted of four
corner posts and three central axis posts, which suggests that the pithouses had flat roofs, a characteristic of rectangular pithouses (Anyon and LeBlanc 1984). Entrances were still primarily on the side, but by the late Three Circle, there were some roof entryways. The introduction of ceiling hatchways was accompanied by vented walls, which made deflector stones obsolete in such houses. Other late architectural changes include the building of early pueblo-style or “surface” structures with free-standing walls and shallow floors made of cobble or puddled adobe (Shafer 2003).

The communal structures were large and rectangular, and were more elaborate and formal than before. Their size was variable and correlated with village size, as they were the loci of community-wide ceremonial activity (Anyon and LeBlanc 1984). However, they were overall larger than communal structures from previous phases. Some of these structures also had features such as benches and sipapus (Anyon and LeBlanc 1980). While the orientation of rampways was variable, the majority faced an easterly (east or southeast) direction (Creel and Anyon 2003). During the pithouse phases in the Mimbres area, communal structures were ritually retired. This retirement included placing objects (dedicating them) into the “architectural fabric” of the structure followed by intense burning of the structure, toppling of walls onto the collapsed roof, and removal of central posts (Creel and Anyon 2003: 69). The deliberate burning of these structures became more intense during the late Three Circle phase as their retirement became a more significant event. Despite the retirement of the communal structures, though, the villages continued to be occupied (Creel and Anyon 2003).

Pithouses were being remodeled more often during this time period. New rampways were constructed while old ones were blocked, roofs were removed and rebuilt, and
floors were re-laid suggesting that pithouses were being used for longer periods of time than before or they were being re-occupied for a longer number of years (Diehl 1996, 1997). In fact, during the entire Late Pithouse Period, there was a general trend toward more durable, longer-lasting architecture and features, which involved a larger investment in construction but reduced maintenance costs. For example, hearths started becoming more formal and well-constructed, with many being slab-lined and rectangular (Shafer 2003). Plaster was applied more often as it reinforced walls, protected timbers from insects, and reduced dust and deterioration. Pithouses were made deeper to increase insulation. There was a higher density of posts to better support roofs (Diehl 1997). More elaborate storage facilities were constructed (Shafer 2003). Overall the trend towards more durable architecture shows that there was a gradual transition during the Late Pithouse Period towards decreasing residential mobility (Diehl 1997).

Over the course of the Three Circle phase, it is believed that agriculture became the principle means of subsistence, farming practices were intensified, and populations became “residentially stable,” or relatively sedentary (Diehl and LeBlanc 2001: 25). During the late Three Circle in particular, there was “greater sedentism and more pronounced ties to place” (Creel and Anyon 2003: 80). Not only were more durable houses built, but burned corn cobs, which last longer, were being stored instead of shelled corn (Shafer 2003, 2006). Even in the uplands, sedentism increased sharply during the Three Circle phase (Roth 2007).

Demographic studies conducted to ascertain population densities during the Late Pithouse Period have found that population increased significantly. This increase in population would have caused an increase in the competition for wild resources, which
would have likely stressed wild populations. Therefore the decrease in wild resources as well as the introduction of a new variety of maize likely caused an increase in maize consumption and dependence on maize agriculture. This new form of corn, introduced around A.D. 700 and called *Maíz de ocho*, supposedly had larger cobs as well as bigger and softer kernels, thus producing higher yields per plant. It may have also been easier to grind (Diehl 1996).

The evidence for increased maize consumption over the course of the Late Pithouse Period is seen in the increased efficiency of grinding tools and the slight increase in the ubiquity of charred maize in intramural contexts. The population increase also probably resulted in maize cultivation being undertaken in more marginal areas, which would have been made possible by higher-yielding corn (Diehl 1996).

*Social Organization.* According to LeBlanc (1983), by the early Three Circle phase, there were at least fourteen major villages in the Mimbres Valley proper, which had the highest population density, with many smaller ones in the side canyons. While villages were evenly spaced, there appears to be little formal planning in village layouts.

Despite the development of two large sites, Galaz and Old Town, villages are believed to have been autonomous as there is no evidence of supra-village organization (LeBlanc 1983). However, at many of the “village” sites themselves, there is evidence of the clustering of pithouses, which could perhaps represent extended family compounds. There was also the possible attachment of pithouses, as seen at NAN Ranch, where Shafer (2003) saw instances of contiguous houses based on floor remnants and wall base orientations. By establishing such residential spaces, family groups could establish lineages as well as property claims (Shafer 2003). There is little evidence of fortification
and warfare, although interaction between villages did occur in the forms of trade and intermarriage (LeBlanc 1983).

By the end of the Three Circle phase, the largest Mimbres sites appeared to have three levels of organization. The individual pithouse represented the lowest level, that of the household. This level consisted of single nuclear families. Courtyard groups, or pithouse clusters, represented the middle level, that of corporate or residence groups (described below) (Creel 2006b). The highest level of organization involved the “high-level integrative facilities” (Creel 2006b: 37). These facilities, or large communal pit structures, represent a “single overarching organizational unit at the village level” (Creel and Anyon 2003: 88).

Corporate Groups. One of the developments of the Three Circle phase, according to Shafer (2006), was the establishment of lineage, or corporate, groups in some communities. Shafer (2006: 15) defines corporate groups as “co-residential groups such as a lineage residence with common economic interests.” Corporate groups were extended or multiple-family households. They formed a segmented system, whereby each corporate group had a lineage cemetery, restricted access storage, and secret shrines (Shafer 2006). Lineage residences are extended family households that have been occupied for multiple generations. They developed when additional houses were added or incorporated onto already existing nuclear families over time (Shafer 2003). Evidence for family groups includes pithouse clusters, lineage cemeteries placed beneath certain houses at some communities, and even spacing of villages along the river. Residential space also appears to be fixed as houses were rebuilt over the same location in a community for many generations (Shafer 2006).
Shafer (2006) states that the formation of corporate groups was a result of irrigation agriculture. As population, and population density, increased, agricultural dependence and sedentism became more prevalent, but dry farming was also no longer a viable option as it cannot reliably feed many people. These changes led to the establishment of irrigation networks, which in turn led to the need for cooperative water management and land claims, which resulted in the development of corporate groups. Shafer (2006) states that competitive corporate groups were necessary for constructing and maintaining an irrigation system not only because irrigation agriculture was labor-intensive but, in the Mimbres Valley, it also depended on the cooperation of a network of villages as they were sharing the same water.

Despite the assertions of Shafer, there are debates over the existence of corporate groups. For example, Gilman (2006) in her examination of several excavated burials from the Mattocks Site, a Classic period pueblo in the upper Mimbres Valley, does not find evidence for status differences between families. While she is looking at the Classic period instead of the Three Circle phase, any corporate groups and ranking should have carried over from the previous era. The five major roomblocks, each occupied by a single family, all have at least one rich burial as well as prestige goods, rare or exotic items used to mark status. Examination of skeletons also found no evidence of differences in health, showing that there was no differential access to resources. Because rich burials, sufficient food, and prestige goods are distributed among all the families, it appears that no one family was wealthier or more important in leading communal activities than others. The only obvious social differentiation occurs within families not between them.
While corporate groups are not seen at Mattocks, they could have been present at larger sites. Shafer (2003) sees evidence of lineal ranking during the Classic Period at NAN Ranch. The south roomblock at NAN is composed of one household while the east one is a clustering of multiple households. At the south roomblock, burials are better prepared (all face east) and contain better and more grave goods. More social differentiation is also seen at Old Town and Galaz (Gilman 2006), probably due to their possible role as loci of special activities (see below). It is thus apparent that certain large sites were not composed of egalitarian families.

**Possible Social Hierarchy.** Diehl and LeBlanc (2001) state that during the Three Circle phase, there was social flexibility and that there were no obvious differences in access to wealth, power, or authority. Status was also achieved, not ascribed. However, Creel (2006b) states that as a result of the agricultural intensification during the 800s, there was a formalization of leadership roles and special responsibilities in the larger Mimbres villages by the 900s. Not only were there individual leaders, but some family groups or clans had more power, or influence, than others.

In fact, there is minimal evidence that some individuals were treated differently at death in certain Mimbres communities. For example, at Old Town, a man was reburied on the floor of a communal pit structure after the building was destroyed, suggesting that he may have been important in the community. Other unusually placed burials also suggest social differentiation. A small number of people were cremated for the first time and were interred in plazas in front of communal pit structures (Creel 2006b).

While subfloor interments in communal structures were rare, three have been found at Galaz and Old Town, the most prominent Mimbres towns. These individuals were
missing their crania and thus may have been ceremonially decapitated. Galaz, the largest site and the location of the largest communal structure, and Old Town were also the only Mimbres Valley sites where communal structures could have sipapus or floor grooves, features that were almost always present among the Gila Mimbres as well as the Mountain Mogollon. These two sites are also the only ones with evidence of macaws. It is thus likely that Old Town and Galaz were more important ceremonially than other villages, and that ceremonies at their communal structures may have attracted observers and participants from other communities (Creel 2006b).

Mimbres Chronology

While the chronology discussed above, along with accompanying architectural changes, has been the accepted chronology for lowland Mimbres settlements, deviations are seen in sites not investigated by Haury. For instance, Creel (2006c) has created a slightly different chronology for Old Town, which was occupied from the end of the Early Pithouse Period (A.D. 500) to the end of the Black Mountain phase (around A.D. 1300). One deviation is apparent in Creel’s placing of the end of the San Francisco and the beginning of the Three Circle phases at A.D. 800 instead of A.D. 750. It is possible that the Three Circle phase started later at this site.

One reason that dates at certain sites may not mesh with the official chronology is that the accepted dates may not be valid. In recent times, the dating of the Late Pithouse Period phases has been disputed. Based on new tree ring and radiocarbon dates, as well as reassessment of old dates, Diehl and LeBlanc (2001) have re-dated the phases. For them, the Early Pithouse Phase ends at A.D. 600, the Georgetown phase takes place from A.D. 600-700, the San Francisco phase occurs from A.D. 700-825/850, and the Three
Circle phase is from A.D. 825/850-1000. One problem with their chronology, though, is that throughout their book, Diehl and LeBlanc (2001) keep alternating between A.D. 550 and A.D. 600 for the start of the Georgetown phase. One reason the chronology may be in dispute is that many sites do not have good absolute dates. Therefore, they are relatively dated using ceramics and architecture and then placed in the accepted phase chronology. For example, Galaz, due to its heavily disturbed state, does not have good dates except for pithouses from the Three Circle phase. As a result it is hard to correlate or refine the architectural sequence. Many other sites, such as Old Town, are also disturbed and thus suffer from a similar problem (Anyon and LeBlanc 1984). For now, then, it might be better to just refer to the phases in general until more and better dates are obtained.

Post-Pithouse Occupations

The Classic Mimbres Period started around A.D. 1000 and ended around A.D. 1130 – 1150. This period saw organizational changes, specifically in the building of surface structures at the same sites as many previous pithouse villages including at Old Town, NAN Ranch, Swarts Ruin, Galaz Ruin, Mattocks Ruin, Cameron Creek, Wind Mountain, and Sauge-McFarland (LeBlanc 1986). The surface structures, or pueblos, were single, above-ground structures composed of multiple rooms. They did not have constructed foundations and walls were only one course thick, preventing them from being able to support a second story (Anyon and LeBlanc 1984). Black-on-white pottery became more intricate and fine at this time as well (LeBlanc 1986).

There was a significant population influx into the Mimbres Valley between A.D. 1050 and 1100 causing the Mimbres population to reach its peak at the end of the 11th
century. Outside people were likely attracted to the valley due to the periodic food surpluses created by irrigation. As a result, they migrated in and inflated the valley’s population (Shafer 2003). This steady growth in population caused pueblo room blocks to grow by accretion from smaller ones (Anyon and LeBlanc 1984). Villages were still evenly spaced apart along the Mimbres (about every three miles), but between them cropped up many smaller sites, some with only a single roomblock. They were less elaborately constructed and had few domestic features. They have thus been interpreted as summer field houses (LeBlanc 1983).

By the mid-12th century (A.D. 1130/1150), however, the Classic Mimbres society irrevocably changed. Shafer (2003: 187) states that by the end of the Classic Period, the population of the Mimbres Valley increased until “considerable nutritional stress resulted.” Minnis (1985) also attributes this stress to ecological and climatic changes including droughts in the late 11th and early 12th centuries separated by El Niño conditions, which would likely have resulted in floods. These floods would have caused severe channel cutting and erosion in Mimbres canals (Shafer 2003). Such events would have interrupted the irrigation systems causing crop failures, especially in the upper valley, which was at a higher elevation and had a shorter growing season (Shafer 2006). By A.D. 1130, when the carrying capacity of the Mimbres Valley may have been exceeded, such bad conditions could not be weathered. Thus, many settlements along the streams and rivers in the Mimbres area appear to have been abandoned (Shafer 2003). As a result, the end of the Classic Mimbres is postulated.

Archaeologists originally believed that the Mimbres area was completely abandoned after the Classic Period, but many now acknowledge that the region was not abandoned
entirely, at least not initially. In the upper and middle portions, there is no evidence of
room remodeling or post-Classic ceramics after A.D. 1150, suggesting these parts of the
valley were abandoned (Nelson and Hegmon 2001). However, the bulk of the
population, and settlement density, appears to have shifted to the lower valley and the
eastern Mimbres area. Previously presence in the eastern Mimbres area had been light
with smaller and more dispersed villages. However after A.D. 1130, the eastern Mimbres
area was seeing a population increase at the same time as the western Mimbres area’s
massive depopulation (Hegmon 2002). Creel (2006b,c) documents an occupation at Old
Town, in the southern Mimbres Valley, dating to what he terms the Terminal Classic
phase (A.D. 1120/1130-1150/1180), a brief phase following the Classic period. There is
evidence for major construction and a substantial occupation at this time (Creel 2006a;
Shafer 2006).

This Postclassic occupation would not last. Postclassic sites would be replaced by
large villages of the Black Mountain and Tularosa (Cliff) phases. These subsequent
occupations may or may not have been by Mimbres-related groups. Eventually the
Mimbres Valley would be abandoned completely until the arrival of the Spanish (Nelson
and Hegmon 2001). As for the fate of the Mimbrenos, many archaeologists believe they
migrated into other areas. Shafer (2006) argues that the Mimbrenos of the Mimbres
Valley went south into Mexico, becoming part of the Casas Grandes sphere. The Gila
Mimbres either accompanied them or joined the Mountain Mogollon in the Reserve area.
The eastern Mimbres (those east of the Black Range) joined either Rio Grande or Cibola
groups. Haury (1986) also believed that the Mimbres moved south. There is some
evidence of a Mimbres migration to Casas Grandes in north-central Chihuahua in
northern Mexico. Turner (1999) examined the tooth crown morphology of Casas Grandes burial populations. He finds that the population at Casas Grandes had close epigenetic connections with people living in Sinaloa (a prehispanic group living in western Mexico) and Mimbres areas. In fact, the relationship between these groups was closer than Casas Grandes was to other Chihuahuan populations.

Connection with the Historic Pueblos

While Haury (1986: 396) has argued that “no sure group can be identified as the living remnants of the Mogollon” and the only present representatives would be in Mexico where they were not replaced, other archaeologists believe that the Mimbres-Mogollon became incorporated and dispersed into the historic Western Pueblos (and maybe into the Eastern/Rio Grande Pueblos) both before and after their final abandonment of the Mimbres area. The Western Pueblo tradition extends from the Little Colorado south to Gila and west to the Verde River Valley. This tradition includes the modern Hopi, Zuñi, Acoma, and Laguna Pueblos (Cordell 1984).

Archaeologists have long surmised that modern Pueblos such as the Zuñi and Hopi were formed as a result of migration that occurred during the massive depopulation of particular areas of the Southwest (Cordell 1997; Creel and Anyon 2003; Ellis 1975; Wilde and Soper 1999; Zeilik 1985b, 1985c, 1986). One line of evidence actually demonstrates a possible link between the Mogollon and the western Pueblos, which is that the historic-era Hopi, Zuñi, and Western Keresan (Acoma and Laguna) all built rectangular kivas instead of circular ones (Lowell 1996).

A cultural continuity between the Mogollon and the Zuñi in particular has long been surmised, especially by the first Mogollon archaeologists (Dongoske et al. 1997). The
Zuñi area is described as the portion of east-central Arizona and west-central New Mexico that is drained by the Zuni River, which is a tributary to the Little Colorado River. The trajectory of population growth, settlement clustering, and cultural changes at Zuñi meshes with a Mimbres migration into Zuñi after the Classic Period (see below).

Ferguson (2007) uses Zuñi traditional history and cultural geography to deduce that the Zuñi must have descended from at least two or more peoples and are heirs of at least two cultures. One of the branches is aboriginal to the Zuñi area while the other(s) is/are intrusive, coming from the west or south (Dongoske et al. 1997). The Zuñi’s oral traditions speak of migration being an important element of their history (Dongoske et al. 1997). They believe that their ancestors consisted of wide-ranging migrating clans that eventually joined together in one spot, at their mythical “middle place” (Dongoske et al. 1997: 603). These clans or groups came from all the various Southwest prehistoric cultures: the Anasazi, Mogollon (including Mimbres), Hohokam, Salado, Cohonina, and Fremont (Dongoske et al. 1997).

The archaeological evidence also points to a massive influx of immigrants into the Zuñi area. Prior to A.D. 1125, the population was small and stable, only experiencing moderate growth. However, between A.D. 1125 and 1225, there was considerable population movement into the area, which resulted in a much higher population density. The mass migration coincides with the collapse of the Chacoan society, believed to have occurred around A.D. 1130 (Kintigh et al. 2004). It also coincides with the abandonment of the western portion of the Mimbres area (Nelson and Hegmon 2001).

Around A.D. 1175, an investment in communal architecture, in the form of kivas, is evident at the Zuñi pueblos, suggesting that there was an increase in the “local level of
social integration” (Kintigh et al. 2004: 433). Very few kivas existed prior to A.D. 1175. Thus the appearance of such integrative architecture in larger sites appears to have only become necessary when immigrants from various areas settled at Zuñi. During this time, small settlements were also built in close proximity to each other, forming clusters. Archaeological evidence shows that these room blocks were contemporaneous and the clustering was likely due to each cluster representing one social entity (Kintigh et al. 2004). Pueblo shapes (or site layouts) also showed an increase in variability, which probably reflects the “cultural diversity” of the immigrant populations (Kintigh et al. 2004: 445). In all, it is likely that both Chaco and Mimbres groups (and maybe others) migrated to Zuñi at this time.

It is possible that some Mimbres migrants also ended up at Hopi, as all historic Pueblos are known for their ethnic co-residence (Dongoske et al. 1997). There are some similarities between Hopi paintings and Mimbres figurative pottery. Yellowware from Homol’ovi, a staging area from where groups migrated into Hopi proper, also possesses similar damage patterns as Mimbres kill pots (Adams and Lamotta 2006, Bernardini 2005). The proximity of Zuñi does make it a preferred destination over Hopi for Mimbres groups, but that does not preclude some migrants joining the Hopi.

**Conclusion**

The Southwest has often been seen as a homogenous area where prehistoric people were united by the hardships of living in an arid environment and the difficulties in engaging in agriculture. However even the climate and ecology could greatly fluctuate throughout the region. The Mogollon (at least the Mountain and Mimbres Mogollon)
appeared to have lived in more elevated terrain and a “wetter” area than their Anasazi and Hohokam neighbors. The greater Southwest was not completely united either as it fissioned off into different cultural groups. The Mogollon were clearly a distinct prehistoric Southwest group as evidenced by their material goods as well as subsistence strategies (Haury 1936; Wheat 1955). After the ninth century, the Mimbres were a distinct subcultural group of the Mogollon, different from other branches, as evidenced by their historical trajectory and their religious ideology seen through such things as settlement patterns and decorated ceramics. The Mimbres started as quite mobile farmer-foragers, turned into semi-sedentary groups with some reliance on agriculture, and finally became fully sedentary, agriculturally dependent, highly religious, family-oriented people.
CHAPTER 5

SOUTHWEST ARCHAEOASTRONOMY AND ARCHITECTURE

Archaeological and ethnographic evidence of astronomical observation and use is quite prevalent in the Southwest. For example, it has been found among the historic Pueblos in their use of a solar horizon calendar. Astronomy was so important to these cultures that it was not just used to set their agricultural calendar, but also used in their mythology. Celestial objects such as the sun and moon were considered gods and goddesses, and there were set ceremonies throughout the year to commemorate and appease these deities (Malville and Putnam 1993; Aveni 1993; Williamson 1984; Zeilik 1985c, 1986). As for the prehistoric cultures, evidence of astronomical observation has been seen in architecture. Southwestern people oriented buildings and portals, as well as overall sites, to key astronomical phenomena, in particular solstices and equinoxes (Kelley and Milone 2005; Malville and Putnam 1993; Aveni 1993). The following discussion provides examples of such architectural alignments from the major prehistoric cultural groups in the Southwest: Anasazi, Hohokam, Casas Grandes, and Mogollon.

Anasazi

In regard to architectural alignments to astronomical phenomena in the Southwest, the Anasazi area has the most published examples. Evidence of archaeoastronomy has been found in three Anasazi regions: Chaco, Mesa Verde, and Kayenta. The Chaco region is centered on Chaco Canyon in the San Juan Basin in northwest New Mexico. At its height, Chaco encompassed much of the Colorado Plateau in the Four Corners area, including the surrounding uplands of northwestern New Mexico as well as southwestern
Colorado, southeastern Utah, and northeastern Arizona (Mills 2002). The Mesa Verde region is in the northern San Juan area that includes southwest Colorado and southeast Utah (Varien 2002). The homeland of the Kayenta, sometimes called the Western Anasazi along with the Virgin branch, covers northeastern Arizona and southeastern Utah (Cordell 1997).

**Chaco Canyon**

The architectural alignments at Chaco Canyon proper, along with some of its outliers, demonstrate that the Anasazi there engaged in astronomical observation. According to Lekson (2006) and Mills (2002), Chaco Canyon was primarily occupied and constructed during the Bonito phase, which includes all of Pueblo II (AD 900-1100) and parts of Pueblo I (AD 700-900) and Pueblo III (AD 1100-1300). The Bonito period includes the Early Bonito phase (AD 850-1040), the Classic Bonito phase (AD 1040-1100), and the Late Bonito phase (AD 1100-1140). Lekson (2006) describes Chaco Canyon as the center of a large regional system (approximately 80,000 square kilometers in size) with approximately two hundred Great Houses and their surrounding communities, roads segments, and supposed signaling stations. Even to the north, in the Mesa Verde area, there are many community centers (sites with both residential and public architecture) that have been interpreted as Chaco outliers (Varien 2002). Chaco Canyon has in fact been argued by many archaeologists to be the most complex society of the prehistoric Southwest (Nelson 1995).

Chaco Canyon is quite symmetrical with an “orderly grid-like layout of buildings” that suggests that “extensive planning and engineering were involved in their construction” (Sofaer 1997: 90). This orderly grid and extensive planning resulted in the
construction of several buildings with astronomical alignments. For example, many of the great kivas in Chaco Canyon proper were aligned north-south and “organized symmetrically about the cardinal directions” (Williamson 1982: 214). At the time of their construction, there was no star near the celestial north pole, so a north-south alignment could not have been built using visual cues, but would instead have to be constructed using other means (Sofaer 1997). According to Stein, Suiter, and Ford (1997), a cardinal direction-alignment is solar in nature because east and west coincide with sunrise and sunset on the equinoxes, while north and south coincide with the azimuth of the sun at the meridian (at midday).

One of these great kivas is Casa Rinconada. It is a circular building that is twenty meters in diameter and four meters deep and is located on a small hill in the southern end of the canyon. A tree ring specimen puts the construction of the structure between A.D. 1027 and 1054, putting it in the Classic Bonito (or late Pueblo II) phase (Zeilik 1984). Casa Rinconada is not only aligned north-south, but the corners of the postholes, when viewed from the center of the kiva, are located midway between the cardinal points. Williamson (1982: 212) claims that the “striking fact about these alignments is that they reflect no visible phenomena.” The kiva originally had a roof, which would have prevented observation of the equinox sunrise and sunset.

There is one possible observable orientation in the line between one of the large niches in the east wall (niche E) and the portal in the northeast wall. Around the time of the summer solstice (three weeks before until three weeks after), just after sunrise, the light enters the portal and lights up the niche (Williamson 1982). This phenomenon could have allowed the anticipation of the summer solstice, meaning the purpose of the
orientation was to predict the solstice (Zeilik 1987). Williamson (1987) speculates that there may have been a similar alignment to the winter solstice, but because the kiva was in ruins and had to be reconstructed, such evidence may have been erased.

One problem with the summer solstice alignment, however, is that the room outside the portal may have blocked the sunlight from coming in. There could have been a second portal in this room that would still allow light to enter, but it is unknown whether such a portal existed (Williamson 1982). These possible blockages along with the imprecise alignment suggest that the portal was “meant to celebrate the arrival of summer solstice, not to predict it” (Williamson 1982: 216). Zeilik (1987: 31) also points out because the niches of another great kiva, Chetro Ketl, were covered over, it is likely that Casa Rinconada’s were as well, which would make them unavailable for use as “calendrical markers.” It is also unlikely that solar observation was occurring inside the kiva, because no definitive instances of sun watching from a kiva have been documented among historic Pueblos (Zeilik 1987).

Pueblo Bonito is the canyon’s largest and best known site and is considered the epitome of Chacoan great houses. Pueblo Bonito’s construction began in the early Pueblo II or Early Bonito phase, but it was not completed until the Classic Bonito phase when the rooms of interest were built (Cordell 1997). According to Zeilik (1987), the corner doorways of rooms 225B and 228B in the complex face southeast and could have been used to confirm the winter solstice sunrise. The portal for 228B causes sunlight to enter the room weeks before the winter solstice. If markers were placed on the far wall, then the movement of the sunlight over those weeks could have been used to predict the winter solstice. However, there was an outer wall outside this portal. If this wall was
two stories high, then it would have blocked the sunlight from coming in. Due to the amount of disturbance that Pueblo Bonito suffered in both prehistoric and historic times, the height of the outer wall will probably never be known (Zeilik 1987). Williamson (1977) feels that the wall obstacle, mentioned above, could be overcome if, as argued for Casa Rinconada, there was a portal in the outside wall. This portal combined with the other could narrow the angular width and provide a precise alignment. In the end, Williamson (1977: 619) believes that “possible presence of an outside wall obstructing the view from the window fails to defeat the assumption of purposeful astronomical orientation for the windows,” as such an alignment could have been ritual instead of practical in nature.

Aside from the portal orientation, Pueblo Bonito was also aligned to the cardinal directions, and this alignment was present throughout the life of the structure. The western side of the straight south wall is aligned east-west. This alignment with the equinox, though, cannot be seen from the site, but would have been determined elsewhere. The canyon’s high mesa walls make it impossible to see the true sunrise and sunset (Williamson et al. 1977). Stein et al. (1997) and Sofaer (1997) also found many lines between Pueblo Bonito and other buildings that are oriented to important astronomical azimuths. For instance, Pueblo Bonito, Una Vida, and Peñasco Blanco are on a line that coincides with the axis of the lunar major standstill. These alignments could have made Pueblo Bonito the center of a sundial. However they could have also served a more religious function, because it is “unlikely that a structure such as Pueblo Bonito would have functioned to simply mark the passage of time” (Stein et al 1997: 141). Thus, despite possible practical alignments in Pueblo Bonito, it probably served
more as a ritual structure than as an observatory.

There are many other structures in Chaco Canyon that have astronomical associations. Wijiji, a large pueblo ruin located on the Wijiji Mesa at the eastern end of the actual canyon, contains approximately 100 rooms and was probably built in the mid to late 1000s. About two weeks prior to the winter solstice, the sun rises in a notch on the southeastern horizon as seen from the northwest corner of the house. Kin Kletso, built between A.D. 1125 and 1130, could be used to anticipate and confirm the winter solstice. From the north wall, the sun rises at the base of a prominent cliff in the southeast a little over two weeks beforehand. From the south wall, the sun rises at the same base on the winter solstice (Malville 2004). From Yucca House, the winter solstice sun sets over the “toe” of Sleeping Ute Mountain (Malville 2004: 89). Hungo Pavi is aligned with the equinox sunrise (Sofaer 1997). Two Great Houses, Pueblo Alto and Tsin Kletzin, around the center of the canyon have a connection to the cardinal directions, either being aligned to the meridian or the equinoxes (Sofaer 1997).

Examples of Chaco structures being aligned to key celestial phenomena other than those involving the sun include Chetro Ketl whose back wall was positioned just right so that the full moon would rise directly along it on the lunar minor standstill (Van Dyke 2004). Six other structures appear to be related to the moon as well, with four being roughly oriented to the lunar minor standstill (Chetro Ketl, Kin Kletso, Pueblo del Arroyo, and Pueblo Pintado) and the other two being roughly oriented to the lunar major standstill (Peñasco Blanco and Una Vida). The lunar standstill orientations of these six structures are not exact and are somewhat variable. Many factors could have contributed to these offsets. One could be small errors that occurred during observation, surveying,
or construction. Another factor could be the desire to incorporate both visible and sensible alignments into the architecture (Sofaer 1997). Sofaer (1997) finds that the alignments are offset from the visible azimuths by the same amount as they are offset from the sensible (actual) azimuths.

The orientations are not the only astronomical alignments in the canyon; the “internal geometry” and “geographic interrelationships” of various buildings are also astronomically related (Sofaer 1997: 88). For example, two rectangular buildings (Pueblo Alto and Pueblo del Arroyo) have one or both of their internal diagonals pointing to the lunar minor standstill or the cardinal directions. These internal alignments, as well as many of the wall alignments listed above, would not have served the same purpose as portals, and thus were probably commemorative in nature instead of being used for anticipatory observations (Sofaer 1997).

Astronomical alignments can also be seen in the overall layout of the canyon and not just in single structures. Four important buildings are “organized in a cardinal pattern” (Sofaer 1997: 107). Pueblo Alto and Tsin Kletzin are on a north-south line while Pueblo Bonito and Chetro Ketl are on an east-west line. Each cardinal line evenly divides the other. Other alignments involve the remote and isolated buildings of Pueblo Pintado and Kin Bineola, which are located on lines that originate at the central complex and head on bearings that coincide with the lunar minor standstill (Sofaer 1997).

There are many other instances of buildings being located on lines to important azimuths, in particular the lunar minor standstill. There are buildings associated with the lunar major standstill, but they are fewer in number, and were built earlier than the rest of the buildings. The switch could represent a changing focus in the overall society (Sofaer
What is significant about these alignments, if they indeed capture the azimuths that Sofaer (1997: 115) argues they do, is that most of the buildings are “related by astronomical inter-building lines [that] are not intervisible.” The canyon and other topographic features block the views between buildings, making the alignments unusable for astronomical observations or predictions. Due to the non-functional nature of such alignments, their purpose may have been ritual in nature (Sofaer 1997).

Chaco Canyon also has many pictograph/petroglyph sites that appear to mark or be near ideal sun-watching stations. Sun-watching stations are the locations from which sun-watchers (a special office in many historic pueblos) make their observations, which enables them to maintain a calendar (see Chapter 6). Some of these rock art panels are present near such sites as Peñasco Blanco and Wijiji. However, the symbols at Wijiji actually appear to be Navajo in origin. It is possible, though, that the Anasazi used this place for sunwatching and then the Navajo later used it in a similar way (Williamson 1984).

Chaco Outliers. Astronomical alignments have also been found in Chaco outliers. A Chacoan outlier is defined by the presence of a Chacoan architectural complex, which is a “cluster of architectural features that exhibit strong affinity to the same features found in Chaco Canyon” (Kantner and Kintigh 2006: 155). The central component, and most important attribute, is a Chacoan Great House which is an “unusually imposing structure ideally characterized by core-veneer masonry, multiple-story or exceptional single-story height, oversized rooms, and blocked-in or elevated kivas” (Ibid.). Almost all Great Houses are surrounded by small houses that make up an outlying community (Mills 2002). The complex also ideally includes one or more formal Great Kivas, earthworks
such as berms encircling Great Houses, and road segments. However outliers tended to have “varying suites of accompanying features,” meaning that few of the Great Houses and their surrounding communities had the complete set (Kantner and Kintigh 2006: 158).

The Chimney Rock Pueblo is located in the Chimney Rock Archaeological Area in southern Colorado. The communities in this area have been dated to the late Pueblo I and Pueblo II ages (A.D. 925-1125). While Chimney Rock is closer to Mesa Verde, it has been identified as a Chaco outlier due to its core-and-veneer masonry style and the kivas that have many Chaco-style features (Malville et al. 1991). Chimney Rock Pueblo is located high on the mesa, several hundred feet above the valley floor where agriculture was practiced. The pueblo contains thirty-five ground floor rooms, possibly twenty second story rooms, and two kivas. The postulated date of construction of the pueblo is A.D. 1076, which is the earliest tree ring date obtained from wooden poles in the East Kiva. No logs date later than A.D. 1093, and the kiva was destroyed by fire in A.D. 1125. It thus was not utilized for very long and did not survive past the collapse of Chaco (Malville et al. 1991).

According to Malville, Eddy, and Ambruster (1991), the pueblo was too remote or far from arable land, too high, and too isolated from other major communities, that it could not have been built for practical purposes. It was more likely constructed for religious purposes, specifically to “view and live near the double chimneys,” two great spires that lend Chimney Rock its name (Malville et al. 1991: S45). The spires are located too far north from the pueblo for the sun to have ever risen in the gap between. However, during the major northern standstill, the moon rises between the spires when viewed from the
pueblo. All of the logs used to construct the East Kiva were cut in years that coincide with major lunar standstills (A.D. 1076 and A.D. 1093). Malville and Putnam (1993) also state that during those standstill years, the moon reached the standstill around the time of the winter solstice and was in the full moon phase. Among one historic Pueblo tribe, the Zuñi, the importance of a full moon coinciding with the winter solstice was so great that they would sometimes celebrate the solstice days or even weeks in advance (Ellis and Hammack 1968). Therefore, Malville and Putnam (1993) conclude that the significance of a full moon rising between the spires (which it would do during the standstill seasons that occurred during the time of occupation) around the winter solstice could be the reason for building Chimney Rock Pueblo.

Many sites of the High Mesa Group, where Chimney Rock Pueblo is located, are aligned with the sun and the higher chimney during the summer solstice sunrise. The sun also rises along the north wall of the Chimney Rock great house on that day. To the west, across the valley below, on a ridge above the Piedra River, are twelve sites. These sites are located where the inhabitants could witness the sunrise between the spires at some point during the year. The largest site, 5AA8, could witness the sunrise between the spires around the equinoxes. Unlike Chimney Rock Pueblo, the Piedra River sites do not appear to be related to Chaco Canyon. The first occupation of some sites in the area also predates the Chacoan outlier by more than a century. Overall, it appears that the local people occupied the area around Chimney Rock and used it for both solar and lunar observations. Later on, the Chacoan Anasazi entered the area and built, or conscripted the locals to build, a pueblo near the landscape feature in order to take full advantage of watching the northern major standstill moonrise (Malville and Putnam 1993).
In summary, the planners of Chaco Canyon and its outliers appear to be greatly concerned with astronomy as evidenced by their kivas aligning to the cardinal directions, outliers being placed in areas to take advantage of alignments between the landscape and astronomical phenomena, walls aligning with important astronomical directions, structures lining up with each other, and portals being oriented to see the sun only on certain days of the year.

*Collapse.* As the power of Chaco started to wane, and Chaco society began to collapse in the late eleventh to early twelfth century, leadership appeared to reorganize and shift north to the great house sites of Salmon and Aztec along the San Juan River (Lipe 2004). The “replacement” sites, or new seats of power, also had astronomical alignments. The north wall of the great house at Aztec is oriented to the summer solstice sunrise while Salmon Ruin is oriented toward the lunar minor standstill azimuth (Sofaer 1997).

While construction continued at Chaco Canyon during the twelfth century, it was on a much smaller scale (Lipe 2004). Structures that resembled Mesa Verde structures, such as Kin Kletso and Wijiji, were built during this time, known by some as the McElmo phase (Judge 2004). Many Chacoan-era great houses were reoccupied at this time, but changes were made to the architecture, such as subdividing the large rooms and adding small Mesa Verde type kivas into unused rooms (Lipe 2004). The population in the Mesa Verde region also was growing during the late 1100s. The elaborate Mesa Verde sites, such as Cliff Place and Yellow Jacket, were at the peak of their occupation during the early to middle Pueblo III period (Thomas 2000). It appears that as Chaco power waned, Mesa Verde power grew.
Mesa Verde

Most of the astronomical orientations in architecture in the Mesa Verde region were built during the Pueblo III phase. While the Mesa Verde area saw some of the first constructed Pueblo villages and many Pueblo I sites were larger than Pueblo III sites, they were more dispersed and shorter-lived, suggesting they were not as organized or complex as the later sites (Schlanger 2007; Varien 2002). Population growth also reached its peak during Pueblo III possibly as a result of migration from the south (Varien 2002). Schlanger (2007) argues that starting around A.D. 1260, the population started retreating towards the southeast and the Rio Grande area, signaling the collapse of the Mesa Verde branch.

Mesa Verde National Park. Mesa Verde National Park is located in southwestern Colorado and is considered to be the center of the Mesa Verde Anasazi cultural area. Possible astronomical alignments occur between Cliff Palace, a major cliff dwelling located below the mesa, and the Sun Temple, which is located on a mesa top opposite Cliff Palace 288 meters away and is situated between Cliff Canyon and Fewkes Canyon. The Sun Temple is nearly symmetrical, but it has an addition on the northwest side that consists of a circular room and another circular structure that may have been a tower. Tree ring dates in the canyons surrounding the Sun Temple date from A.D. 1180 – 1279, which places the construction in the Pueblo III era (Malville and Putnam 1993).

According to Malville and Putnam (1993), a potential line of sight occurs between the T-shaped doorway in a fourth story room of the square tower at Cliff Palace and the two circular rooms of the Sun Temple. At the T-shaped doorway, one could witness the moon travel between the two circular rooms (if they had been towers) of the Sun Temple.
during the major southern standstill. There are four vertical lines in the Cliff Palace room, with each containing 17-20 tick marks. These could have been tally marks to record the lunar standstill cycles. The sun also sets over the center of one of the Sun Temple “towers” around the beginning of December if viewed from a pecked basin at Cliff Palace, and thus could have served as an anticipatory marker for the winter solstice. Malville and Putnam (1993: 92) actually argue that the Sun Temple was built to serve as an “artificial horizon marker for winter solstice.”

**Yellow Jacket.** Yellow Jacket Ruin is located in the Montezuma Basin of western Colorado. It falls within the northern fringes of the Mesa Verde Anasazi cultural area and is considered the largest Mesa Verde pueblo (Lekson 2004). This ruin is considered by Malville and Putnam (1993: 57) to have been an “incipient cosmic city.” The site sits at an elevation of about 2200 meters and is on a flat mesa above Yellow Jacket creek. It is close to both water and good agricultural land. This site also has the largest concentration of kivas in the Southwest (Malville and Putnam 1993). According to Lange, Mahaney, Wheat, and Chanault (1986), there is one great kiva, five kivas of intermediate size, and 124 small kivas. There are also many towers, or buildings with multiple stories.

According to Malville and Putnam (1993), most of the kivas are organized on lines running east to west. On the site, there is also a standing stone, or monolith, with a wedge-top. This top is aligned toward Wilson Peak near the location of the summer solstice sunrise. On that particular morning the shadow of the top of the monolith falls across the ruins of a wall of a room that is located west of the stone. The Great Kiva, in the heart of Yellow Jacket, is located on an almost north-south line (only half a degree
off) with the solar monolith. This line continues until it hits the northern mound. This line also includes the Intermediate Kiva, which lies 200 meters directly south from the Great Kiva. The Great Tower, on the other hand, lies due west of the Intermediate Kiva.

A second line originating from the solar monolith, which appears to have been the center of a seasonal sundial, heads at an azimuth of thirty degrees. This line connects the Great Tower to the Dance Circle, which is about 800 meters away. This line also crosses the southern mound, a row of eight kivas, and two towers. The winter solstice sunrise occurs at a line of sight that is almost perpendicular to this line. A third line heads out at an azimuth of approximately sixty degrees and points to the summer solstice sunrise (Malville and Putnam 1993).

There are other lines of sight at the ruin that do not include the solar monolith. The kiva rows and middens are on east-west lines. A line that connects from the Great Kiva to the Great Tower points toward the winter solstice sunrise. The southern mound is on an east-west line with a cave along the eastern perimeter known as the eastern cave. The eastern cave is a shrine located on the line between the solar monolith and the summer solstice sunrise. Solar shrines, which among historic Pueblos were placed on mesa tops at key locations on the landscape and were where offerings to the sun were made, have been identified at twelve places along the eastern perimeter of the site. Many of these shrines have their openings face due east (Malville and Putnam 1993).

Yellow Jacket’s kivas were constructed during Pueblo III (1100-1300) but were built upon the remains of Pueblo II (900-1100) jacal structures. Malville and Putnam (1993: 79) state that the “intensity of interest [at the site] went far beyond that of agriculturalists simply following the movement of the sun along the horizon.” Overall, the lines of sight
and the change in architecture over time have caused Malville and Putnam (1993) to conclude that the site evolved from a domestic to a ceremonial center that commemorated important astronomical directions.

**Hovenweep.** During the late 1100s and early 1200s, the Anasazi built tower-like structures and other buildings in what is now Hovenweep National Monument, a large expanse of mesa tops, canyons, and river valleys that straddle the southern portion of the Utah-Colorado border (Zeilik 1987; Williamson 1987). The area is also just above the northern periphery of the Kayenta Anasazi area. However, the architecture, masonry, and pottery styles link the former inhabitants of Hovenweep with Mesa Verde. In fact, even by Mesa Verde standards, the structures at Hovenweep were quite elaborate and well-built (Schulman 1950). It is thus likely that the Anasazi at Hovenweep were a combination of Mesa Verde and Kayenta peoples.

Many of the buildings at Hovenweep have portals that are “angled into the walls,” or, in other words, are not perpendicular to the walls (Zeilik 1987: 32). According to Zeilik (1987), none of the ruins at Hovenweep have been reconstructed, unlike at Chaco Canyon. As a result, their alignments are more reliable and valid.

Hovenweep Castle is at the south end of a D-shaped tower that many argue is a solar observation room. According to Zeilik (1987), two of the walls of the castle have oddly angled windows. One of the windows points towards the summer solstice sunset in the northwest. Light enters the window into the room starting seventy days before the summer solstice, so not only can the window be used to observe the event, but also to anticipate it. If markers were placed on the far wall, then the amount of time between the first light and the actual solstice can be tracked. The other window mentioned points
towards the winter solstice sunset, and also could have been used to both anticipate and
witness the event.

There is also a possible solar observation room in Unit Type House at Hovenweep. This
room contains four openings. According to Zeilik (1987), one of the openings lets
in the summer solstice sunrise, which hits the southwest corner of the room. This portal
could have been used to anticipate the event because light first enters the room twelve
weeks beforehand. Another portal faces the winter solstice sunrise, when light hits the
northwest corner of the room near a protruding wall. Light first comes through the portal
nine weeks ahead of time, once again allowing anticipatory observations. One of the
other two portals has also been described as pointing to the lunar major standstill in the
south, although this orientation is less certain. According to Malville and Putnam (1993),
a portion of the wall that is halfway between the southwestern corner and the protruding
wall is lit up soon after the equinox sunrise.

The Cajon Group ruins are located about ten kilometers south of Hovenweep Castle
on the southern boundary of Cajon Mesa (Zeilik 1987; Williamson 1987). Williamson
(1987) states that the Cajon Group is made of a set of ruins that are located on both the
east and west rims of the canyon. According to Zeilik (1987), there is a possible solar
observation room at this site that contains three openings. They all face west, meaning
they served a sunset function. One of the portals faces in the general direction of the
winter solstice, one to the summer solstice, and one to the equinox. According to
Malville and Putnam (1993: 42), two of the portals face the “setting solstitial sun” while
the other points to the equinox sunset. It would appear that the window orientations need
to be investigated more in order to determine whether they actually point to the purported
celestial events.

In summary, the Mesa Verde area, like Chaco, appears to have a strong astronomic tradition tied to architecture and site location.

Kayenta and Sinagua

While the Kayenta and Sinagua do not seem to have been as complex as Chaco or possibly even Mesa Verde, and they appear to have mostly escaped their influences, they still incorporated astronomy into their architecture. Unfortunately few sites have been investigated so far.

According to Chamberlain, Latady, and Prince (2005), there is a Kayenta village (Coombs site) on the slopes of Aquarius Plateau near Boulder, Utah that served as a sunrise calendar. This village was occupied during late Pueblo II to early Pueblo III. There is a line of storage rooms and two pit structures at this site that are aligned north-south. The walls of the habitation rooms are aligned east-west as are seven pit structures on the hill’s south slope. To the west of the village is a butte that Chamberlain et al. (2005) have dubbed the Sunwatcher Ledge. The eastern view from this ledge along with the nature of the landscape around it would make it ideal for a sun-watching station. A sunrise horizon calendar could thus have been used here.

Wupatki Pueblo is located north of Flagstaff in Arizona, and is considered to be Sinagua (characterized as a blend of Hohokam and Kayenta or Tusayan). It was occupied around A.D. 1100-1300. The remnant of a wall built around A.D. 1120, called the calendar wall, has three portals and is located near a kiva. According to Bates (2005), the sun rises in the southern portal around February 2 - 5. This date precedes the Hopi ceremony known as Powamu. If the Hopi are descended from this group, then this portal
could have been used to anticipate the ceremony. Powamu was a bean ceremony designed to promote fertility and seed germination as well as celebrate renewal. The sun rises in the middle portal around May 1 - 4 when soil temperatures would cause seeds to germinate. At this time another Hopi ceremony called Nevenwehe is performed which was also geared toward fertility. Seeds were planted shortly before this time. The sun rises in the northern portal in June 17 - 25 around the time of the summer solstice (which also coincided with the end of the Katsina season among the Hopi). After the summer solstice, Hopi sunwatchers watch the sunsets instead of the sunrises, which are not observable through the wall portals. By using ethnographic analogy, Bates (2005) was thus able to ascertain the probable function of the calendar wall and conclude that it was indeed astronomical in nature.

All major groups of the Anasazi, with the exception of the Virgin branch, have shown evidence of astronomical observation in the form of architecture. In fact, there are many examples of astronomically aligned architecture throughout the Anasazi area, showing that astronomy must have played an important role in this culture. It is likely that the Virgin branch engaged in similar practices as the other branches, but their sites have not been investigated in order to determine whether any astronomical orientations are present.

**Hohokam**

Like the Anasazi, the Hohokam also appear to have a strong tradition of astronomical observation, especially during the Classic Period (A.D. 1250-1325), although the evidence is not as strong due to a lack of investigation. One example of a well
investigated site is Casa Grande National Monument, which is located on the northern edge of Coolidge, Arizona about halfway between Phoenix and Tucson. It is made up of eighteen separate ruins that have been assigned to the Hohokam Classic Period (Evans and Hillman 1981). The site has two platform mounds, a “big house,” and a ball court. The “Big House” is a multi-story structure measuring 60 feet in length from north to south and 40 feet from east to west (Evans and Hillman 1981: 133). The walls are up to four feet thick and made of puddled adobe (Evans and Hillman 1981).

Several rooms in the Big House are aligned in an east-west or north-south direction. Some of the openings could have been used as “astronomical viewing ports” (Evans and Hillman 1981: 133). The summer solstice sunset, equinoctial sunrises and sunsets, and lunar extrema could all have been observed from these openings. One opening is designed to catch lunar and not solar events. During the northern-most extreme (the major northern lunar standstill), this odd-shaped northwest facing opening (circular on the outside but rectangular on the inside) framed the setting moon. A similar alignment was found for the southern-most extreme (Frazier 1979). Another opening frames the summer solstice sunset by casting a small spot of light along the south wall of the north room. A marker could have been placed on this wall but due to the plaster eroding, it is impossible to tell. A pair of openings in another section is almost lined up with the equinoxes. At sunrise, light that comes in through the east opening appears on the west wall and moves down and north until it disappears in the western opening. Only around the equinoxes (specifically two days after fall and two days before spring), about 45 minutes after sunrise, can the light from the rising sun pass through both holes (Evans and Hillman 1981). According to Frazier (1979: 91), oral traditions state that “early
Indians looked out of observation holes to salute the sun.”

Two other Classic Period platform mound sites have also been demonstrated to have astronomical alignments. Pueblo Grande in Phoenix has a room on top of one of its mounds with both a corner doorway and a doorway in the south wall that align to the summer solstice sunrise. Mesa Grande in Mesa, Arizona has a room on its mound with northern and eastern doorways that align with the winter solstice sunrise. It is unknown if other platform mound sites have special doorways, mainly because they have not been excavated or investigated, but the mounds do have significant orientations. Most platform mounds throughout the Sonoran Desert have their long axes oriented slightly east or west of north while a few are oriented east-west, showing that the cardinal directions played a role in their construction (Bostwick and Plum 2005).

There are also a couple other sites in the Salt River Valley that could have served as astronomical observatories, causing Mixon and White (1991) to argue that the Hohokam of the area were engaging in astronomical observation. One “observatory” is a Hohokam rockshelter dating to the Classic Period that demonstrates astronomical alignments. Hole-in-the-Rock is in Papago Park in Phoenix, Arizona near the Salt River. From the east-facing rockshelter, the equinox sun can be seen to rise in a notch created by the northern end of the Superstition Mountains and the mountains behind them. This rockshelter also has a hole in the roof that allows sunlight to fall on the shelter’s roof and walls. It travels from east to west during the day and from north to south and back again during the year. The east to west movement can be used as a type of clock or sundial. The north to south movement can be used to establish an annual calendar. In particular, when the sun enters this hole on the equinoxes and solstices, it hits particular features in
the rockshelter (Mixon and White 1991).

Many sites, including Classic period mound sites, are located along this portion of the Salt River, and all of these sites can be seen from Hole-in-the-Rock. Two sites are precisely located on a line that points to the winter solstice sunrise, two sites are on the equinox sunset line, and one site is on the equinox sunrise line. There is also a possible site on the summer solstice sunrise line, but it needs to be further investigated to be certain. A statistical test has shown that the observed distribution of sight-lines is not random (Mixon and White 1991).

Bostwick and Plum (2005) postulate the existence of another Hohokam observatory on the northeastern ridge top of Shaw Butte in the Phoenix Mountains in the northern end of the Salt River Valley. It is a “fortified” Hohokam ruin, which dates to the late Sedentary/early Classic period (A.D. 1100-1300) and consists of a “masonry compound with rooms” and a rockshelter among other things (Bostwick and Plum 2005: 153). The site is in a location where particular sunrise and sunset horizon positions were marked by architectural and landscape features. For example, in some rooms of the compound, the summer solstice sun can be seen to rise and set over mountains or features in the wall (Bostwick and Plum 2005). Downslope from the compound is an “artificially constructed” rockshelter where several large boulders appear to have been intentionally placed in the roof, which is a “naturally occurring crevice” (Bostwick and Plum 2005: 151-156). The placement of the boulders has created three openings in the roof that let sunlight come in. Around the solstices, these openings create unique light displays within the rockshelter (Bostwick and Plum 2005).

The Hohokam area possesses evidence of astronomical observation and use, even if
only a few sites have been investigated so far. Maintaining a proper irrigation system and timing crop planting was crucial in this desert environment. As a result, astronomical observation must have been necessary in order to maintain a precise calendar.

**Casas Grandes**

Van Pool (2003) defines the Paquimé area, or Casas Grandes Culture area, as encompassing northern Mexico, southern New Mexico, southern Arizona, and west Texas. Its heyday was during the Medio period, from A.D. 1200-1450. Very little archaeoastronomical work has been done in the Paquimé area, and what has been done has primarily focused on the main site of Casas Grandes, located in the northwestern Mexican state of Chihuahua. However, many doorways and windows on-site have not been investigated in relation to astronomical orientations. Di Peso, Rinaldo, and Fenner (1974) acknowledge that such openings served as light transmitters, allowing daylight to enter the plaza areas, but they do not go further than that.

One study that has focused on the entire Paquimé area is that of Harmon (2006). His investigation of Paquimé ball courts found that both I-shaped and T-shaped open courts have the same form as those in Mesoamerica ball courts. Like Mesoamerican balls courts, almost all Casas Grandes ball courts have a north-south orientation. For example, DiPeso et al. (1974) find that the two I-shaped courts at the site of Casas Grandes are roughly aligned north-south, although one is about 2-3 degrees off, and the other is about 8 degrees off. There are also a few exceptions to the north-south orientation in Mesoamerica. They include the ball court at El Tajin in Veracruz (along the northern Gulf Coast of Mexico), along with many others to the west, which was oriented east-
west. Another was the one at Chichén Itzá, which was oriented 17 degrees east of north, which may be related to the orientation of Teotihuacán (see below) (Cohodas 1975). Overall, the cardinal directions appear to be important in the construction of ball courts, thus adding credence to their ritual and astronomical importance.

According to Cohodas (1975), the ball game was known and played all over Mesoamerica. It has been speculated that the ball game started with the earliest known Mesoamerican civilization, the Olmec. Ball courts in Mesoamerica are often divided in half or into quarters, which represent the cardinal directions (Harmon 2006). Evidence suggests that ritual ball games were typically played on the equinoxes and that they were meant to “influence the ascent and descent of the sun” (Cohodas 1975: 108). The north-south oriented ball courts are believed to represent the earth’s surface while the east-west ones represent the underworld. The game also represented a battle between the sun and the moon/stars, which was indicative of the battle between night and day, good and evil, and life and death (Harmon 2006). Because the Mesoamerican ball courts have strong astronomical, and solar, undertones, the ball courts in the Paquimé area likely did as well.

Like the ball courts in the Paquimé area, the site of Casas Grandes appears to be aligned north-south, as can be seen in the map present in Di Peso (1974). The House of the Skulls, in particular, is oriented this way. This house also has a cross-shaped room where human trophy skulls were found, thus giving the house its name. The cross is the Mesoamerican symbol for the cardinal directions (Di Peso 1974).

The Montículo de la Cruz, or Mound of the Cross, is also significant. It is a central cruciform mound that has four circular mounds located near each point of the cross. The entire horizon can actually be seen from this mound. Despite its shape and general
orientation, though, it is not quite aligned to the cardinal directions (Di Peso 1974). Only the east and south mounds are on true cardinal points from the cross center. The eastern alignment is significant, because the equinox sun can be seen to rise directly over the center of the eastern mound from the center of the cross. From this mound, Sirius can also be seen to have its heliacal set over a tower on a mountain top (Cerro de Moctezuma) to the southwest (Di Peso, et al. 1974). There is no evidence to suggest that Sirius was significant in the Southwest, but it appears to have played some role in Mesoamerica. Building O at Caballito Blanco (a Zapotec site located 50 kilometers east of Monté Alban) is a mostly rectangular-shaped building with one side forming the shape of an arrow. This arrow points to the southwest horizon within ¼ degree of the setting position of Sirius during the early centuries B.C. At this time, the heliacal rise of Sirius occurred near the summer solstice while the heliacal set occurred near the winter solstice (Aveni 1975).

The north cross arm offset (eight degrees west of north) is also significant as it is equivalent to the offset of one of the ballcourts, which if built at an earlier time would have aligned with the pole star. Eight degrees west of north alignments that coincide with a pole star can be seen in the Mesoamerican sites of La Venta and Tikal. The Olmec site of La Venta was originally oriented to eight degrees west of true north. Around its time of construction, 1000 B.C., the closest thing to a pole star was Kochab, which was located near an azimuth of 352 degrees (Malmström 1997). Tikal, a major Maya capital built around A.D. 600 in the Petén Basin, had some temples/pyramids line up eight degrees west of north. Around this time, Polaris was the closest star to the pole and was located at the azimuth of 352 degrees (Malmström 1997).
While the buildings at Casas Grandes, and at other Paquimé sites, have not been investigated for astronomical alignments, it is probable that they exist. The little archaeoastronomical work conducted on other features has yielded positive results. The prevalence of astronomy present in the rest of the prehistoric Southwest, as well as in Mesoamerica, also makes it extremely unlikely that astronomical practices were not engaged in at Paquimé.

**Mogollon**

Compared to the Anasazi and the Hohokam, the Mogollon region has little evidence of astronomical observation or use, mainly because few investigations have been conducted. While Mimbres archaeological sites in particular, and Mogollon sites in general, have had few astronomical investigations associated with them, there are a few archaeologists who stress the link between architecture and astronomy and/or cosmology. As a result, a few sites, mainly in the Jornada and Mimbres areas, have been found to have astronomical connections.

**Jornada Mogollon**

The Jornada Mogollon, located east of the Mimbres area (and the Rio Grande) in southern New Mexico and western Texas, have architectural alignments to astronomical phenomena (Whalen 1994). While Jornada Mogollon pithouse sites have not been investigated for astronomical alignments, some pueblo sites have been examined. These sites are either astronomically aligned or are positioned in such a location as to be in a line with an important direction, such as a solstice event and a natural landscape feature such as a mountain.
According to Brook (1979), sixteen Jornada pueblo sites in the El Paso area are oriented east-west with portals in the middle of the south walls, just as at Old Town in the Mimbres area (see below). The hearths were also placed midway along the south wall.

All 118 rooms investigated at these sites had this layout except for one. Room One at the Hot Well Site, located near El Paso, had a doorway along the east wall instead of the south wall, an adobe step just below the doorway, and a raised hearth located to the west of the step. The site dates to between A.D. 1260 and 1340 (El Paso phase).

Room One is positioned so that if one stands in the middle of the room, the equinox sun can be seen to rise exactly through the center of the doorway. This sunrise also occurs over a low spot in the distant mountains. If one stands in the northwest corner of the room, the winter solstice sun rises over the northwest corner of the step in front of the doorway. This sunrise also occurs over a small depression in the eastern mountains. It is also possible that the summer solstice sunrise can be seen over the southwest corner of the step from the southwest corner of the room. However, this alignment has yet to be checked. The significance of the equinox sighting is that the last freeze of the season coincides with the vernal equinox. Therefore the equinox could be a marker of when to plant crops (Brook 1979).

Another Jornada site that appears to have astronomical connections is Wizard’s Roost. This “series of aligned dry-laid masonry features” is located in the Sacramento Mountains just below Sierra Blanca, the highest peak in the region (Eidenbach 1979: 103). Unfortunately, no datable material has been found on the site making Kriss (1989) question whether this site is even Mogollon. Eidenbach (1979) states that the sunrise and sunset on both solstices can be seen to occur from Wizard’s Roost over nearby peaks in
the region, two of them being Sierra Blanca and Pajarito Peak. Such alignments mean that Wizard’s Roost was placed at its location intentionally to take advantage of the connection between landscape and astronomy, although Kriss (1989) questions whether these alignments are intentional.

*Mimbres-Mogollon*

According to Shafer (2003), architecture often represents or replicates a culture’s cosmology, especially for sedentary peoples who, instead of merely viewing certain landscape features as sacred, will also actually construct their sacred landscape. This replication may be why many Mimbres-Mogollon pueblo sites were oriented along the cardinal directions. It was an effort to incorporate the astronomical realm, often seen as the sacred realm (see Chapter 6), into the everyday realm using architecture. For example, the pueblos at Wind Mountain and Old Town appear to be aligned to the cardinal directions.

Woosley and McIntyre (1996) describe Wind Mountain as being located on a ridge in the Mangas Creek drainage of the Upper Gila River in Southwest New Mexico. The map of the pueblo at Wind Mountain provided in Woosley and McIntyre (1996) shows that it is aligned to the cardinal directions, although it does not have a definite east-west or north-south alignment. This pueblo was built in the Early Classic period. Creel (2006c) describes Old Town as being located in the lower Mimbres River Valley, on the east side, above the point where the surface flow of the river normally ends. It is in the northern portion of Deming Plain in northwest Luna County. Most of the site is about 20 meters above the valley floor. It has a high water table and the extent of arable floodplain is quite large. The map of the pueblo at Old Town provided by Creel (2006c) shows that it
is oriented east-west, with most openings in the south walls. This pueblo is dated to the Terminal Classic from A.D. 1120-1180.

While pithouse sites may not have been laid out in such a way, individual structures, in particular communal structures, were often oriented toward directions of astronomical significance. Mimbres communal pit structures tend to differ from other Mogollon great kivas in wall construction, but they are similar in orientation. Creel and Anyon (2003) discovered that all Three Circle phase kivas (or communal pit structures) in the Mimbres Valley are predominately oriented to the east or southeast (if using the line/axis from the entryway to the hearth to the center post). While there is actually considerable variability in orientation, east (which includes southeast and northeast) is the most common direction. In fact, only one communal structure in the Mimbres Valley points to the southwest (Creel 2006c).

In the round communal structures of the Mimbres Valley, the orientation averages to an azimuth of 99 degrees (range 63 to 141) while in the D-shaped structures, it is 114 degrees (range 102 to 135). Three Circle rectangular structures averaged 124 degrees (range 110 to 138). The overall rectangle average, though, is 119 but the range is much greater (55 to 173). The “tighter cluster of orientation in most Three Circle phase rectangular structures [might be] a reflection of more focus at that time on the position of the winter sun at the winter solstice (119 degrees in the Mimbres area).” Thus, during the Three Circle phase, the variability decreased and structures averaged an orientation near the azimuth of the winter solstice sunrise. The “vast majority of non-tropical small-scale societies dependent upon subsistence agriculture pay close attention to this celestial event” (Creel and Anyon 2003: 74), including the historic Pueblos as discussed in
Chapter 6.

The winter solstice sunrise orientation may not have been used to record the event, but it could have been used to do so since the range of possible visual alignments through the entrances are only about a meter wide. Ethnographic evidence on the other hand would suggest that the solstice was observed from a “fixed outdoor location while viewing prominent topographic points” (Creel and Anyon 2003: 75). The communal structure orientations could thus be to commemorate the event instead of simply to observe it. The Three Circle orientations do show that the winter solstice was seen as more important at this time than at previous times.

Astronomical orientation is not just seen generally in communal pit structures but can also be seen in all structures at individual sites. Woosley and McIntyre (1996) found that there are a large range of pithouse orientations at Wind Mountain, from north by northwest (346 degrees) to south by southwest (208 degrees). Almost no structures were oriented between 208 and 346 degrees. However, despite this variation, most entries pointed in an easterly direction, as 85% of pithouses faced an azimuth between 1 and 179 degrees. The mean of orientations was towards the southeast (between 91 and 179 degrees). Three Wind Mountain structures were oriented close to the winter solstice, which occurred near 117 degrees. No pithouses pointed to the summer solstice sunrise (Woosley and McIntyre 1996).

The pithouses on the ridge were perhaps positioned to take advantage of early morning daylight and warmth in the cold winter months. The hearths were also located in line with the entries, suggesting that the houses might have also been positioned to take advantage of wind direction. A statistical test conducted by Woosley and McIntyre
(1996) showed that house orientation was not random but heavily biased toward the east. It also showed that communal structures were oriented a little differently from domestic structures. Communal structures averaged an orientation of 95.5 degrees while the means for the two types of domestic pithouses with lateral entries averaged around 120 and 110 degrees (Woosely and McIntyre 1996). It appears, then, that domestic pithouses at Wind Mountain pointed more to the winter solstice sunrise while the communal pit structures pointed more towards the east and the equinox sunrise. Thus, at Wind Mountain, domestic pithouses may have been built to take advantage of the winter sunlight while communal structures were built more to commemorate the sunrise in general.

Creel (2006c) found six communal structures at Old Town, three large ones, 2 small ones, and one large possible ceremonial one that resembles a Hohokam pit structure. The three large ones are almost aligned north-south with the centers of two aligned precisely north-south. Of the communal structure entryways, two are roof entries, one is not discernible, one is just south of east, and two point southeast (Creel 2006c). Thus all three discernible lateral entryways point roughly southeast, which could be related to the winter solstice sunrise.

The domestic structures at Old Town with discernible lateral entryways, of which there are eight, also primarily point in an eastern direction. One of them points south, one north, two east (although one originally faced south), one slightly north of east, and one slightly south of east. The last pithouse with a discernible entryway is an area where no other pithouses have been found. This pithouse is the only one to face west, which may be why it was isolated (Creel 2006c). Overall, the preference appears to be an easterly pointing entrance, which coincides with Wind Mountain and the Mimbres area in
general. However, it differs from Wind Mountain in that it is the domestic structures that point east, while the communal structures point southeast.

**Mesoamerica**

While Mesoamerica is not part of the American Southwest, the area had a strong astronomical tradition, which likely affected the Southwest. The ancient Pueblos are known to have “borrowed much from surrounding groups, but tended to mold what they adopted to their own particular cultural style” (Young 1989: 168), thus Mesoamerica probably played a key role in the manifestation of archaeoastronomy in the American Southwest. According to Young (1989: 167), there was “extensive although intermittent contact” between the Southwest and Mesoamerica in the form of trade networks. The Southwest obtained many items from Mesoamerica including maize and squash (and its cultivation) as well as many exotic goods. In addition to trade goods, cultural ideas, such as religion, were likely exchanged as well.

The similarities between religious stories and iconography between the two areas suggest that many of the religious practices and ideology of the Puebloan Southwest may have ultimately derived from Mesoamerica. For example, there are instances of Southwest iconography depicting certain Mesoamerican deities such as Tlaloc and the plumed serpent Quetzalcóatl (Van Pool 2003; Kriss 1989). There are parallels in the mythology as well. The story of the Twin War Gods, or Heroes, in the Southwest is similar to Quetzalcóatl’s story, and both entities have been equated with the planet Venus (Young 1989). The outlined cross, believed to be a Mesoamerican representation of Venus, is also present in the Southwest (Bostwick 2002).
Similarities between the astronomical practices of the Puebloan Southwest and Mesoamerica include a “common focus on observing the ordered motions of the sun, the moon, Venus, and various constellations which are central to the interlocking spheres of religion, ceremonial practices, and world view” (Young 1989: 177). Mesoamerican sites also possess many architectural alignments to key celestial phenomena (solstices, equinoxes, and cardinal directions) that were deemed important in the Southwest (Malmström 1997).

Aveni (2001) even found that present-day Maya groups use a solar horizon calendar. This practice is similar to the sun-watching conducted among the historic Southwest pueblos (see Chapter 6). Tate (1989) believes this practice also occurred among the ancient Maya as demonstrated by hieroglyphics at the site of Yaxchilan that depict astronomer-priests using the sunrise position on the horizon to dictate when important annual events would occur. Illustrations in the Maya codices have shown that astronomical observations were made from the interior of a temple, from its doorways, or out on the staircases that led up to them (Hartung 1975).

There are also a few differences between the astronomical practices of the Southwest and Mesoamerica. Two of these differences, observation of zenith passages and Venus standstills, did not occur in the Southwest but still may have had an influence there.

Zenith Passages

Mesoamerica was concerned with the same solar events as the Southwest with the addition of one. Due to Mesoamerica’s equatorial location, there were one or two days a year when the sun would pass directly overhead, known as a zenith passage. While these dates differed as a result of geographic latitude, links were seen between the zenith
passages, the rainy season, and agricultural cycles (Broda 2006).

Many Mesoamerican sites have buildings that demonstrate the importance of the zenith passages by either being aligned to sunrises or sunsets on these particular days or having a sighting tube that could directly witness the zenith passage. For example, building P at Monté Alban, the principal ceremonial center of the Zapotecs first constructed no later than 600 B.C., has an opening in the stairway that reveals a dark chamber inside. A small vertical tube through the stairs allows a view of the solar zenith passage (Aveni 2001). At Edzná in Campeche, one of the first Maya sites built in 150 B.C., there is a five story pyramid called Cinco Pisos that has a gnomon at its base. This gnomon takes the form of a tapered shaft of stone with a stone disk on top that has the same diameter as the base. On solar zenith passages, and on no other days, the disk casts the gnomon completely into shadow (Malmström 1997).

El Caracol at the Maya site of Chichén Itzá, which is in the northern part of the Yucatán Peninsula, also shows a preoccupation with the solar zenith passage. This building consists of a round tower on a roughly square base and has four outer doors that face the cardinal directions (Aveni and Hartung 1989). The main portion of this structure was constructed in A.D. 1000, although some of the lower sections were completed earlier. The northern portion of the platform is still in ruins while the rest was reconstructed in the early 1900s (Aveni et al. 1975). The reconstruction process allowed three of the possibly six original windows of the tower to be put back into place (Aveni 2001). On April 28th, the sun passes the midline of one of these windows. This date occurs around the beginning of the rainy season and the sun’s first zenith passage. The front of the Upper Platform faces the zenith sunset position. According to Ricketson
(1928: 443), the Caracol also possesses a “circular, stone-lined, vertical hole extending
down through the core of the building” which could have been used to observe meridian
passages of celestial objects, including the sun’s zenith passage.

The significance of the zenith passages becomes apparent at one of the first
Mesoamerican sites to show evidence of intentional astronomical concern, as pointed out
by Malmström (1997). This site is Izapa, which was built around 1300 B.C. and is
located on the right bank of Río Suchiate, which forms part of the modern-day boundary
between Mexico and Guatemala. Izapa was not directly controlled by the Olmec society,
but there is evidence of significant influence, including the presence of large stone heads
that are the hallmark of the Olmec civilization. The site was probably not a center of
population or trade but instead was a place of religious significance. Its zenith passages
occur on April 30 and August 13. These days are significant because April 30 marked
the start of the rains while August 13 was when the cultivated maize was ready to be
harvested. August 13 thus marked the beginning of the year as well as the beginning of
the 260 sacred day count, which ended on April 30 (Malmström 1997). August 13 would
end up being a significant date in many Mesoamerican sites, even in places where it did
not coincide with the zenith passage. Other, later, sites would have orientations or
alignments to the sunrise or sunset on August 13 regardless of whether it coincided with a
zenith passage. Examples of such sites include the second Olmec ceremonial center, La
Venta, and the Maya sites of Edzná, Copán, and Tikal (Malmström 1997).

The importance of August 13 is even seen at Teotihuacán. This site is famously
oriented 15.5 degrees off of true north. For many years, archaeologists could not figure
out why. Eventually, Malmström (1997) pointed out that the east-west orientation
coincides with the August 13 sunset. This date could not be related to its own zenith passages, as they occurred on May 17 and July 27 (Broda 2006). It would thus appear that the early Mesoamerican calendar was present at Teotihuacán.

**Venus**

Calendrical activities present in Mesoamerica but not in the Southwest did not just include marking the zenith passages of the sun but also marking Venus conjunctions (Zeilik 1989). Venus was deemed important to the Maya both in its appearance as Morning Star and Evening Star. It was equated with the god Kukulcan (Maya equivalent of Quetzalcóatl). Some of the Maya city-states would “incite wars,” referred to by some as star wars, that were timed to particular points of “the passage of Venus through the heavens” (Tate 1989: 416), points that could be ascertained from such observatories as the Caracol.

Aveni, Gibbs, and Hartung (1975) found that some of the diagonals between the remaining “intact” windows at *El Caracol* at Chichén Itzá point to the Venus extremes or standstills. The Lower Platform is closely aligned to the maximum northern Venus standstill as well (Aveni 2001). Another Maya site, Uxmal, located in the northern Yucatán also possesses alignments with Venus. A line from the House of the Magician goes through the exact centers of three consecutive structures (including the ballcourt) and hits the maximum southern setting position of Venus (Aveni 2001). The Palace of the Governor, which is skewed 20 degrees from the site’s axis, faces another site, Nohpat, and points to the northern extreme of Venus in its role as evening star (Aveni 1974).

Overall the evidence for Mesoamerican archaeoastronomy is quite extensive and shows that celestial phenomena not only played a key role in the formulation of their
calendar, but also played an important role in religion and society as a whole.

Considering that many elements of Mesoamerican mythology and the pantheon made their way to the Puebloan Southwest, then it is likely that astronomical knowledge went along with it. The two major types of astronomical observation presented here, solar zenith passages and Venus standstills, do not at first appear to have been a part of that migrating knowledge. However, as discussed in Chapter 8, they may have played a small role in Mimbres astronomy.

**Conclusion**

This discussion has shown that the Mimbres-Mogollon as well as their prehistoric neighbors throughout the Southwest (and Mesoamerica) incorporated astronomy into their architecture and saw certain astronomical dates and directions as important. However, while some archaeoastronomical investigations of architecture have been conducted at both pueblo and pithouse sites in the Mogollon area, much more needs to be done. Astronomy is quite prevalent in the Southwest so it is probable that there was a much stronger tradition of Mogollon astronomical observation than has been documented so far.

The archaeological evidence alone also does not show the reason for architectural alignments to astronomical phenomena nor the importance and use of astronomy in the prehistoric Southwest. Thus the ethnographic records of the historic and modern-day descendants have to be consulted in an effort to better understand Southwest cultural astronomy.
CHAPTER 6

SOUTHWEST ETHNOASTRONOMY

One method used by some archaeoastronomers to tease out the astronomical practices of prehistoric cultures is ethnoastronomy. Ethnoastronomy, according to Aveni (2008: 2), “deals with aspects of astronomical practice in contemporary cultures.” Specifically it uses ethnographic evidence instead of archaeological evidence to understand a culture’s astronomical traditions. The astronomical traditions of current and historic cultures are then extrapolated to the prehistoric ones through analogy.

Analogy

Ascher (1961) states that analogy, specifically ethnographic analogy, is one of the most extensively used tools in archaeological interpretation. Johnson (1999: 48) defines it as the “use of information derived from one context, in this case usually the present, to explain data found in another context, in this case the past.” Basically, ethnographic analogy uses observed and recorded present (or historical) behavior of a particular group in a particular environment to make inferences about the behavior of seemingly similar prehistoric groups. Archaeologists, in particular, use ethnographic and ethnoarchaeological material to interpret the archaeological record. The advantage of this method is that it can provide some insight into the practices and strategies of prehistoric groups, particularly those that never developed writing, that are hard to glean from the material record alone.

The idea behind ethnographic analogy is that cultural ideas affect people’s behavior and not just in major areas such as religious belief and burial practices. Culture also
influences “mundane” behavior such as household organization and refuse disposal (Johnson 1999: 62). Therefore culture and behavior affect archaeological deposition (Johnson 1999). Unfortunately, the “archaeological record does not consist of behavior but, at best, of the precedents and products of behavior” (Wobst 1978: 303). Thus in order to ascertain the practices and behavior of the “archaeological” culture, one must observe practices and behavior in present-day cultures that result in similar deposition and equate the two.

One major problem that many archaeologists, including Binford (1967), have with analogy is that it has been historically used to interpret archaeological phenomena without demonstrating the similarity between the modern/historic group and the prehistoric/archaeological one. Simply stated, this approach is used to infer prehistoric behavior without first demonstrating the appropriateness of the analogy.

Despite its problems, Ames (2004: 366) states that there is “no alternative” if one wants to “penetrate the past.” Analogy can actually be a useful tool as long as it is used appropriately and only under certain conditions, such as where there is “historical continuity” between the archaeological and ethnographic cultures (Binford 1967: 2). With historical continuity, it is likely that there is also continuity in cultural ideas and practices (Johnson 1999). In the case of the American Southwest, there is both cultural continuity and environmental similarity. As discussed in Chapter 4, the historical pueblos are widely believed to have descended from prehistoric Southwest groups, and they both manipulated a similar environment, an arid region with restricted access to water and short growing seasons. Therefore, ethnographic analogy or ethnoastronomy can probably be reliable used to ascertain the astronomical practices of prehistoric
Southwest cultures.

**Implications**

By using analogy, many archaeologists have argued that earlier Southwestern cultures, such as the Anasazi and the Mogollon, had a similar calendar as their descendants in the historic pueblos. While the ethnographies of note are all on pueblan groups, and, in this case, the analogies are being applied to a particular pithouse group (Mimbrenos at the Harris Site), cultural continuity lends validity to the comparison. According to Malville and Putnam (1993: 21), the historic Pueblos are “descended from a mix of prehistoric southwestern people and doubtless have absorbed traditions from all of them.” Young (2008) also states that the Southwestern Puebloans, in particular those in New Mexico, can trace their ancestry back through many years of residency in the same geographic area. Basically, the Pueblo groups are descendants of the earlier pithouse groups and likely inherited many of their traditions, including astronomical observation. Therefore, sun watching was likely the central activity of priestly prehistoric Southwestern astronomers who practiced horizon astronomy.

Zeilik (1985c: S1) states that the “Puebloan people hold the ‘ways of our ancestors’ in the highest regard, and they view change with suspicion and hostility.” In other words, the conservative nature along with the reverence for ancestors among Pueblo cultures likely causes the traditions of these cultures to have remained relatively unchanged over the centuries. However, Zeilik (1985) also believes that linking the two by analogy has definite faults because we do have historic evidence of changes in the Puebloan culture. Nevertheless, the Pueblos place a “major value on conservatism, holding strongly to the
tried ways of their ancestors” (Zeilik 1985a: S69). The “new” is considered “dangerous,” and the documented changes occurred as a result of disruption and pressures caused by European colonizers (Zeilik 1987: 25).

However, many changes also occurred during prehistoric times. Great kivas, elaborate masonry, and centralized roads are no longer constructed. The Western Pueblos are also different from the Eastern ones, and even each pueblo is unique. As Young (2008: 495) puts it, “[d]espite evidence for cultural continuity, … one cannot project the present onto the past as if cultural concepts were totally static over periods of hundreds of years.” Shafer (2003: 210) concurs by stating that there is a “historical distance” between Mimbres symbolism and that of modern Pueblo analogs, and it is probable that the meanings have changed over time. In fact, Lowell (1996: 82) states that due to the “passage of centuries and well-documented cultural upheavals,” differences between historic and prehistoric Pueblos in regard to social, and architectural, patterns are expected. There is also the problem that those who study particular cultures tend to influence them. There are many occurrences whereby natives incorporate scholars’ interpretations into their own world view (Young 2008). However, Shafer (2003) also states that although there may have been large cultural changes, the basic structure endures because religious beliefs tend to endure, as they are the most conservative of behaviors. Therefore, there are probably still enough similarities in overlaying themes and customs that many of the traditions and rituals of the historic Pueblos can probably be confidently correlated with traditions and rituals of the prehistoric ones (Malville and Putnam 1993).

The Zuñi and Hopi are most often used because the bulk of the information pertains
to them. They are perhaps also more “pristine” than their Eastern neighbors since they did not suffer as much disruption from the Spanish colonizers and missionaries as the more easterly Pueblos (Zeilik 1986). According to Zeilik (1985c: S1),

Even if the cultural heritage has discontinuities, the historic Puebloan society, at the very least, serves as a test case for the adaptive responses of people coping with an arid, high-plateau environment. Their survival was grounded in their ability to raise crops where a growing season’s success hinged on sufficient and timely rainfall and a lack of frosts at the start and end of the growing season.

The problems faced by historic Pueblos, an arid environment and short growing seasons, were the same as those faced by prehistoric Southwest groups, whether they lived in pithouses or pueblos. Thus, it is likely that both pithouse and puebloan groups used similar methods to make agriculture more successful.

One problem that cannot be resolved by the ethnographic record, though, is that sunwatching stations are unlikely to be found, as they tend not to be marked (see below). As a result, once a pueblo is no longer inhabited, this station will probably be impossible to find if it even gets preserved (Zeilik 1985c). There are exceptions, though, like the three described below (one at Zuñi, one at Jemez, and one in the Hopi area) and the possible ones at Chaco Canyon discussed in Chapter 5. Thus, while marking sunwatching stations appears to be unusual, it still occurs, allowing for the possibility that the Mimbres marked their sunwatching stations. However, if they did mark their stations, they probably are difficult to find. Marked stations tend to not be located within habitation sites but away from them somewhat (Zeilik 1985c).

Another problem with using analogy occurs in regards to stellar asterisms. Because the precession of the Earth changes their position and timing, the stars used by the historic Pueblos may not have been the best ones for the prehistoric Southwestern groups to have used. As discussed below, Orion and the Pleiades were of particular importance
because their first appearances in the night sky marked the coming of the winter and summer solstices. However, in the past, their first appearances came at a different time during the year and thus could not have been used to mark the solstices. Other stars or asterisms may have marked the solstices instead, and while Orion and the Pleiades may have still been important, it would have been for different reasons.

Therefore, while ethnographic analogy and ethnoastronomy can be used to inform on what to look for and interpret what is found, it may be unwise to equate specific present examples with those of the past.

**Cultural Astronomy in the Southwest**

Astronomy serves several purposes among native cultures. Zeilik (1988: 184) states that astronomy “establish[es] and validat[es] (1) sacred directions and cosmic patterns, (2) cosmic mythology, (3) certain ritual sites and shrines, (4) the ritual and planting calendar, and (5) times for hunting and gathering.” Kelley and Milone (2005) point out that even daily activities are still set by the movements of various celestial objects such as the Sun, Moon, planets, and stars. Many native cultures also use both a solar and lunar calendar. As a result, observations need to be carried out in order to calculate the right intercalation, or, in other words, to accurately synchronize solar and lunar ceremonies as well as the calendar year.

As mentioned, the calendar is based on both solar and lunar observations. It involves one ceremony following another in “fixed order,” and is adapted to the “economic round” (Parsons 1939: 493). The economic round includes the best times for farming, weaving, conducting war, hunting, and building (Parsons 1939). Ceremonies and other dates are
determined by the sunrise position on the horizon, when a certain moon appears, or by a
given number of days after the previous ceremony (Titiev 1992). This number of elapsed
days was counted using tally cords with knots to be untied, sticks into which notches
were cut, and marks on a floor or wall that could be erased as the days passed (Zeilik
1989). In fact, all ceremonies have “proper times” such as those surrounding agriculture,
hunting, weddings, initiations, and many other activities so that they keep in “harmony
with the cosmos” (Zeilik 1988: 184).

**Astronomy and Architecture**

One area where there is a definite similarity between prehistoric and historic
Southwest cultures is in architectural alignments to astronomical phenomena. Such
alignments can occur in a particular building or in the overall setup of a site. Buildings
with orientations to the solstice directions are quite common in the historic Southwest
(Zeilik 1989). One example of solstitial orientations occurs at Zuñi. According to
Cushing (1970: 105), who lived among the Zuñi for some time in the late 1800s,

> many are the houses in Zuñi with scores on their walls or ancient plates
> imbedded therein, while opposite, a convenient window or small port-hole lets in
> the light of the rising sun, which shines but two mornings in the three hundred
> and sixty-five on the same place. Wonderfully reliable and ingenious are these
> rude systems of orientation, by which the religion, the labors, and even the
> pastimes of the Zuñis are regulated.

Kivas, in particular, were often oriented to astronomical directions. For example, Rio
Grande kivas pointed east (even though most western Anasazi kivas were oriented to the
south). Whole villages and pueblos could also have astronomical layouts. Almost all
were oriented toward the cardinal directions with surprising accuracy except for Sandia,
Zia, Zuñi, and the Hopi village of Mishongnovi, which do not have particular orientations
Examples of astronomically-aligned architecture among the historic pueblos are not just found in currently occupied villages. Pueblo IV sites have also been known to have astronomical orientations. One of these sites is Tsiping Pueblo, which was built on a mesa top in the Chama Valley in north-central Mexico. It was occupied from A.D. 1250 to 1400. The significance of Tsiping Pueblo is that the Tewa consider it an ancestral home. At this site, there is a large kiva to the west of the main habitation rooms that has a low rubble mound on either side of it. All three are aligned east-west. 5.5 kilometers west of Tsiping is a mountain, Cerro Pedernal, while 300 meters south of the main ruin at Tsiping lays a stone ring on an adjoining mesa known as Pueblo Mesa. On the equinoxes, the sun sets to within one degree of Pedernal’s peak as seen from the stone circle (Zeilik 1984). 150 meters south of the pueblo, there is a “natural rock amphitheater” with a triangular-shaped opening above it on the west side (Zeilik 1984:73). Right before sunset on the equinoxes, sunlight enters this opening. Therefore, it appears that the inhabitants at Tsiping observed and marked the equinoxes.

These examples show that historic pueblos followed in their ancestor’s footsteps by orienting their architecture to celestial phenomena. As mentioned by Cushing (1970), many of these orientations served calendrical purposes.

**Sunwatching and the Horizon Calendar**

Among the historic Pueblos, Zeilik (1989) found that life is actually controlled by the sacred and planting calendars. It has been documented among many of these pueblos that an accurate calendar is maintained through sun-watching, usually in the form of a horizon
calendar. Sun-watching is actually undertaken by a particular religious officer in most Pueblo groups (Zeilik 1985c). According to the Puebloan people, the “Sun Father … makes his daily journey across the sky, at sundown reaching his house in the west … As he comes forth in the east, Sun should be greeted and prayed to” (Parsons 1939: 179). The Puebloan people also know that the sun’s “diurnal journey varies a trifle from day to day …” (Parsons 1939: 180). The sun’s apparent motion along the horizon from the north to the south and back again is known to cause the seasons (Ellis 1975).

A sunwatcher’s primary method of maintaining a calendar was using markers on the horizon in combination with the sun’s changing position throughout the year. Horizon markers can include notches as well as gradual upward and downward slopes; prominent features are not necessary. Calendar watch centers, or sun-watching stations, were established so that watchers can predict when particular celestial events will occur in an attempt to anticipate important festival dates (Zeilik 1989). Observing stations tend to be close to or within the pueblo since the sunwatcher needs to make observations quite often, sometimes even daily (Zeilik 1985c). Sun-watching stations tend not to be marked, though, or if they are, such markings are not obvious. The reason these spots do not need distinctive markers is that sun-watchers know where to stand, which they learned in their training (Zeilik 1985c). The sun is usually observed at sunrise since the “eyes find it easier to fix the horizon point of the sun at the first gleam of sunrise than at the last gleam of sunset” (Zeilik 1985c: 56). However, sunset can still be used, especially if there are good horizon markers in the west.

A horizon calendar serves two purposes. For one, it is agricultural in nature, specifically dictating the times of specific crop plantings (Zeilik 1985c). The other
purpose of a horizon calendar is the establishment of a religious/ceremonial calendar, also known as a civil/administrative calendar (Fagan 1991). Unfortunately, many sites are located on featureless landscapes, so, in those cases, another method is employed, the wall calendar. This type of calendar involves light and shadow coming through properly oriented openings (windows, doors, etc.) and interacting with markers on the far wall (Zeilik 1985c). In many pueblos, the sun is also used to tell time during the day. The shadow created by a small, upright stick in the ground changes position as a result of the changing position of the sun. This arc serves as a clock (Ellis 1975).

Zeilik (1985c: S3) states that the “anticipatory aspect of sun watching is the most important feature of the sun watcher’s job.” Anticipating important dates allows ceremonies to be announced ahead of time and makes sure that key days are accurately predicted, especially considering that bad weather can prevent observation around the actual relevant date. The “cyclic nature of the Puebloan space and time carries with it the security that the calendar repeats if the proper rituals are carried out to ensure order in nature” (Zeilik 1985c: S18). These rituals, however, require a certain amount of time in order to prepare offerings, which involve the manufacture of prayer sticks, special foods, altars, and costumes for dances (Zeilik 1985c). Songs and dances also need to be practiced and fasting and abstinence need to be observed (Zeilik 1987). Therefore, in order for ritual preparations to be carried out properly, ceremonies must be fixed ahead of time (Zeilik 1989). Thus the sunwatcher must begin his observations well in advance of such ceremonies.

Specific examples of sunwatching and horizon calendars, as well as light and shadow calendars, can be found in the ethnographic record, particularly among the Zuñi and the
Zuñi

Zuñi Pueblo is one of the Western Pueblos and is located in west-central New Mexico and east-central Arizona along the Zuni River. While today it is one village, during the 1500s it consisted of six villages in the Zuni Valley. These villages were abandoned during the Pueblo Revolt in 1680 and the survivors constructed a new village across the river from one of the old towns, Matsakya (Cordell 1997; Ellis 1975). At Zuñi Pueblo, a Pekwin (sun priest) was officially designated to follow the course of the sun as it shifted its position on the local horizon. He often built a special sun-watching station at the edge of his village where he would have a clear view. He also kept a calendar on the wall of his house in which he designated important dates by scratches indicating where shadows of the jamb of the sunrise-facing window fell at various times of the year (Aveni 1997: 23).

The pekwin, or Zuñi sunwatcher, is the “High Priest of the Zenith among the six directional priests” (Zeilik 1985c: S4). Pekwin literally means “speaking place.” He is the holiest and most respected man in Zuñi and is in charge of maintaining the welfare of the people there (Bunzel 1992). He also owns principle ceremonies, altars, and fetishes and controls the appointment of certain civilian leaders. He always comes from the Dogwood clan, which has held a disproportionate amount of the religious and political power at Zuñi for a long period of time. The pekwin’s main function is to monitor astronomical events and schedule ceremonies (Parsons 1939).

The pekwin memorizes every mountain peak and valley in the surrounding landscape through which the sun travels and uses this knowledge coupled with daily observations to determine the timing of important days (Aveni 1993). Not only does he keep a horizon watch, but he also keeps a wall calendar (Zeilik 1988). This wall calendar involves markers on the opposing wall from a portal. Sunlight coming through an east-facing
window falls on a horizontal line of scratches between the time of spring planting and the summer solstices. Sunlight falls on hanging strings of abalone shells during the time leading up to the winter solstice. The harvesting season is marked as well (Zeilik 1989).

The pekwin is also the crier chief, meaning that he announces the coming of the seasons as well as certain ceremonies. He makes his announcements from his house top. His most important role is perhaps the announcement of the solstices (Parsons 1939). Because the solstices help date the other ceremonies, he is considered the “keeper of the calendar” (Parsons 1939: 123).

After the summer solstice, but before the winter solstice, the pekwin makes his daily observations a few miles east from Zuñi at Ma’tsakya (Bunzel 1992). Matsakya is a Zuñi ruin that was abandoned prior to the arrival of the Spanish (Ellis 1975) and is located on a hill at the base of Thunder Mountain (Fewkes 1891), also known as Corn Mesa (Parsons 1939), which is next to a depression known as the Gate of Zuñi (Parsons 1917). In this ruin is a structure or shrine that has been termed the House of the Sun (Parsons 1917). The pekwin slowly enters this “square open tower” and sits down in an “ancient stone chair” before a marked pillar (Cushing 1970: 104-105). This pillar has the sun, the morning star (Venus), a crescent moon (considered the new moon), and a hand (the mark of a sunwatching station) carved into it. The pekwin then awaits the rising of the sun. As the sun rises, the pekwin blesses and exhorts the “father.” The warrior guardian (or Master Priest of the Bow), who accompanies him here, then cuts a notch into his calendar stick (Cushing 1970). A calendar stick is a pine stick that notches are cut into. These notches serve as tally marks and thus can be used to mark and count days (Marshack 1989).
A small, upright post of petrified/silicified wood in a cornfield east of the village serves as a type of gnomon for observations between the winter and summer solstices. It is in full view of the distant Tāyaolone (Thunder Mountain), which is connected to the tribe through mythology and history, as well as the Dowa Yalanne Mesa. Every morning after the winter solstice, the pekwin stands near this post and watches the sunrise from the foothills between the mountain and the valley (Fewkes 1891; Creel and Anyon 2003). His main concern is when the shadows of the gnomon, Thunder Mountain, and the “pillar of the gardens of Zuni” lay along the same line (Ellis 1975: 61). This event signals the coming of spring and informs the pekwin when to announce that farm work is to begin, which involves moving from the village to the field houses located near the cultivated plots (Ellis 1975).

_Hopi_

The Hopi are another Western Pueblo group. The Hopi consist of various villages and communities located on three mesas in the southern portion of Black Mesa in northeastern Arizona (Cordell 1997). The Hopi also have a Sun Chief or Sun Watcher, known as a Tawamongwi (Talayesva 1970), as well as different observing stations for the summer and winter solstices (Ellis 1975). Unlike the Zuñi, the crier chief (who announces the ceremonies) is a different office than the sunwatcher (who determines ceremonial dates). The sun chief sits in a certain place and watches the sun to see when it reaches its summer house while the Chief of the Flute Society guides the sun on its way (Talayesva 1970). For example, at Walpi (Hopi village on First Mesa), the Sun Chief observes the skyline of the San Francisco Mountains from a house roof in his village (Creel and Anyon 2003). At Hano, or Hopi-Tewa (the village established on First Mesa
by the Tewas from the northern Rio Grande during the early 1700s to avoid the Spaniards), on the other hand, the sun is observed from the edge of the mesa (Zeilik 1989; Ellis 1975). Prayer offerings are then made to the sun as well as to the moon and stars so that they will send rain and keep away bad winds (Talayesva 1970).

Hopi sunwatching stations are often simple stone piles that gave “convenient access to the expanse of the eastern horizon along which the sun would be seen to rise” (Aveni 1993: 127). One station described by an archaeologist at the beginning of the 20th century is marked by a flat stone with a sun face carved on top. The sunwatcher would sit on this rock while performing his sunwatching duties (Aveni 1993).

At Hano, the sunwatcher informs when to plant, which starts in late May (Parsons 1964a). Different cultigens are planted at different times, and the most appropriate times are announced by the sunwatcher. Planting does not end until around the summer solstice (Loftin 2003). The sunwatcher also announces the harvest and the ceremony to accompany it, which occurs in early to mid-October (Parsons 1964a). Farming for this group is reminiscent of the “second primordium” when the ancestors first planted seeds and cared for crops (Loftin 2003: 59). The first primordium is when the Hopi first emerged with the plants. According to the Hopi, they do not plant in order to maximize the short growing season (although this is the result) but instead according to custom (Loftin 2003). It is their way of “reactualiz[ing] the eternal era, when crops were first planted” (Loftin 2003: 6).

Other Puebloan Groups

There is not nearly as much information on other pueblos aside from the Hopi and Zuñi. The other Western Pueblos, the Keres-speaking villages of Acoma and Laguna
located east of Zuñi around Rio San Jose, were greatly disrupted by both American and
Christian influences as were the Eastern Rio Grande (or Tanoan) pueblos. However,
instead of incorporating European traditions, Eastern Pueblos kept their own traditions
secret. According to John Bourke, who lived among them in the late 1800s, they are
reluctant to reveal any information regarding their religion or customs (Zeilik 1986).
However, some astronomical practices have been discovered, such as the fact that most
Eastern pueblos do not have a specialist or separate office whose sole responsibility is to
engage in sunwatching. Instead sunwatching is conducted by the town chief (Parsons
1939), also known as the cacique (Hill 1982). The cacique has many duties including
setting the dates for solstice ceremonies as well as other ceremonies using solar
observation. Sunwatching is conducted by the cacique at Acoma Pueblo as well, even
though it is considered a Western Pueblo (Parsons 1939).

An example of a sun-watching station among the Rio Grande pueblos is found at
Jemez Pueblo located along the Jemez River (Cordell 1984). The station at Jemez was at
the western end of the pueblo and was a “solar monolith,” or a 2½ foot high white
outcrop with a star petroglyph (cross) on it (Zeilik 1985b: S88). This station was used for
summer solstice observations (Zeilik 1985b).

One of the Eastern pueblos where sun-watching is not even conducted by the town
chief is Santa Ana. Instead the Masewi, the war priest and one of the Twin War Gods,
tracks the approach of the winter solstice by watching the Sandia Mountains beginning in
September, which is when the sun begins to climb up the slope of the mountains (Zeilik
1989). The villagers also note when the “gold of turning aspens creeps down the western
slopes of a near-by mountain” (Ellis 1975: 71). San Ildefonso, a Tewa-village near the
Tsankawi Mesa, uses the Sangre de Cristo Mountains to anticipate and confirm the summer solstice (Zeilik 1989). Other pueblos without sun-watchers use wall calendars to establish dates and then send out representatives shortly beforehand to announce the coming ceremony (Ellis 1975).

**Solstices and Other Solar Ceremonies**

In Pueblo societies, ceremony permeates all other aspects of society (Zeilik 1985c). Key dates for the agricultural cycle, such as for irrigation, planting, and harvesting, are accompanied by ritual and ceremony, as are many celestial events such as the solstices (Parsons 1939). In fact, one of the most important roles of the sunwatcher was in announcing the coming of the solstices. Therefore, the practicality of observing the sun’s annual journey, crucial to survival in the desert, is inseparable from the religious significance of the observations, as in the celebration that surrounds the sun’s “decision” to return from its “winter home” and arrive at the northern extreme of its journey (Malville and Putnam 1993: 30). The ceremony surrounding the winter solstice is actually seen as crucial to the survival of the people. In fact, the most important date of the year among the Western Pueblos (Zuñi and Hopi) is the winter solstice, while the summer one is almost equally as important. Even the directions of the solstice sunrises and sunsets are considered sacred (Zeilik 1989). Many Pueblos, including the Hopi, view these solsticial points as the “cardinal” directions (Hardman and Hardman 1992). However, currently, the solstices are only important in the West among the Hopi and Zuñi, while in the East, among the Rio Grande pueblos, they are not as important and sometimes not even celebrated, although the reason is unknown (Parsons 1939).
Eastern Pueblos hold the polar or actual cardinal directions as more sacred than the solstice directions. Despite current differences, it is possible that the Eastern Pueblos were more like the Western ones before contact (Williamson 1984).

The anticipatory nature of sunwatching solves the problem that occurs while watching the sun during the solstices. Around the time of the solstices, the sun moves imperceptibly along the horizon so the exact day of the solstice is difficult to discern so close to the actual event (Zeilik 1985c; Hardman and Hardman 1992). According to astronomers, and as practiced by the Hopi, the sun rises and sets in the same spot for four days at these times (Titiev 1992). The sun must be watched, then, while it is still moving at a noticeable rate. Due to experience, the sunwatcher knows that the solstice will occur a certain number of days after the sun rises over a particular horizon feature. He can then count the days in order to predict when the solstice will actually occur (Zeilik 1985c).

The equinoxes tend not to be marked by any of the Pueblos unless, as with the Hopi, they tend to coincide with the times of planting and harvesting or, like with some Tewa-speaking pueblos, they mark the division between summer and winter and thus a transfer of power between different clans (Zeilik 1988). In fact, among the eastern Tewa, there are two moieties. The head of each moiety acts as the village chief, or cacique, during one half of the year (Lowell 1996).

Zuñi

The winter solstice ceremony at Zuñi is called Intiwanna, or the middle, which refers to the importance of this ceremony among the Zuñi (Bunzel 1992). The sun reaches his house in the middle place (which is what Zuñi is called), and the winter solstice marks the middle of the ceremonial year (Parsons 1939). The Zuñi also have great ceremonies
after the summer solstice since that is when the young corn crops are starting to break through the surface of the earth and thus desperately need rain. The rainy season typically starts around the first of July, but if it should be delayed for any reason, then “great hardship is suffered” (Bunzel 1992: 514). The summer solstice ceremony is thus designed to encourage the sun to remain north and high in the sky to provide light and warmth in the crops as well as to encourage the kachina spirits to bring rain (Bunzel 1992).

At Zuñi, the pekwin announces the winter solstice ten days in advance and the summer solstice eight days in advance (Zeilik 1985c). It is important that the sunwatcher is accurate, for even being two days off is too gross an error. According to Aveni (1997: 23), “the exact date of the solstice sometimes eluded even the most perspicacious Pekwin. In 1881 one sun priest was harshly reprimanded by the council of chiefs for erring by several days in fixing the winter solstice ceremonies.” However punishment can be even harsher than that. In 1896, the pekwin was replaced due to his inaccuracy. What these acts imply is that others observe the sun as well and possess the necessary knowledge for maintaining a solar calendar (Zeilik 1985c). As mentioned previously, many Zuñi houses are oriented so that they can ascertain certain dates, in particular the solstices, of the year. However, while everyone at the pueblo knows when the solstice is occurring, not everyone has the necessary knowledge to engage in anticipatory horizon observations (Zeilik 1987).

Despite this need for accuracy, the winter solstice ceremony often precedes the actual solstice by days or even weeks. The reason for this shifting date of the ceremony is that the Zuñi feel it is important that the winter solstice coincide with a full moon, two events
that often do not occur at the same time (Ellis and Hammack 1968). This desire stems from the belief that there should be a balance between a strong full moon and a weak winter sun. The opposite is true of the summer solstice, which is supposed to occur around the time of a new (crescent) moon so that a strong sun is paired with a weak moon (Zeilik 1986). The importance of the moon is evidenced by the Zuñi also planting prayer sticks for the moon on the solstices (Young and Williamson 1981). The desire to have the solstice coincide with a particular moon phase causes the calendar to be “disarranged” (Bunzel 1992: 512). If the celebration does not coincide, then the pekwin is, again, harshly criticized (Bunzel 1992).

Hopi

According to Beaglehole (1937), Hopi rituals have three main purposes: production of rain, fertilization and promotion of growth in humans and crops, and curing of sickness and disease. The winter solstice ceremony in particular is designed to promote crop growth. The winter solstice ceremony is called Soyal, and its purpose is to compel the sun to cease heading south and return to the north (along the horizon). If this northward turn did not occur, “the sun would roll off the edge of this world into the underworld,” and “this world would be plunged into darkness and death” (Zeilik 1985c: S12). By heading back toward its summer home, the sun brings warm weather that will allow the Hopi to plant their fields (Titiev 1992). The sun is male and is thus considered “unstable” and in need of help along his journey (Parsons 1939: 180). He is also old and “weary” during the winter solstice and needs assistance in “climbing from his home in the under-world to the sky” (Fewkes 1906: 358). That is why offerings sometimes are prayer sticks in the form of ancient ladders (Fewkes 1906). The winter solstice is an all-
inclusive ceremony that not only aids the sun in his journey but also serves as a war ritual as well as a fertility/strength/germination ritual. This ceremony also inaugurates a new season of kachina ceremonies (Titiev 1992) even though the Hopi year actually starts with the November moon (Parsons 1939).

The Hopi summer solstice ceremony, while not as significant, still has the important function of convincing the sun to “linger in its summer house so that frosts do not come too early” (Zeilik 1985c: S12). It is announced at the Walpi village when the sun enters a narrow corridor (Williamson 1984). While the sun has to turn back, it is hoped that he will not travel too fast and cause untimely frosts (Parsons 1964a). Niman, which occurs in early July just after the summer solstice, is designed to send the kachinas to their home in the San Francisco Mountains. No kachina dances occur between Niman and the Hopi new year (Titiev 1992).

Sun Shrines. Among the Hopi, the solstices are actually seen as “‘houses’ where the sun stops in his travels along the horizon.” At these far away places along the high mesa, priests erect small shrines, and the Sun Priest buries prayer sticks there (Aveni 1993: 127). The shrines on the mesa above are important because they allow the sunwatcher to know exactly “where to intercept the sun god so he could accept the people’s offering,” which is important since he controls the growth of crops and can tell the future, being that he is the only god to journey through the underworld (Aveni 1993: 128).

Hopi shrines do not serve as sites of sunwatching. Instead, shrines are defined as “any place which is visited habitually to pray and make offerings” (Parsons 1939: 307). They take the form of boulder shelters, rocky ledges, caves, rings/cairns of stones, small depressions, great crater pits, mini stone-slab houses, elaborately carved and painted
tabernacles, etc. (Parson 1939). The pile or ring of stones is one of the “simplest Pueblo shrines,” and it is designed so that it has an enclosure that serves as a receptacle for offerings (Fewkes 1906: 350).

Hopi sun shrines are located at particular foresights of the sunwatching stations that serve as backsights. In fact, shrines can be located along any line at which the sun appears to rise and set at an important calendrical position from the sunwatching station, although the winter solstice is most common (Williamson 1984). At the Hopi village of Oraibi (on the Third Mesa), though, offerings are placed at a sun shrine on top of a high mesa two miles to the northeast, the direction of the summer solstice sunrise (Talayesva 1970). Sun shrines typically have their east side open, causing them to face east towards the sunrise. Offerings made at shrines not only include prayer sticks and prayer feathers but also water, corn meal, and rocks (Zeilik 1985b). Even when shrines or villages are abandoned, the shrines located there are still seen as sacred and while not visited as frequently, pilgrimages are still made to them (Fewkes 1906).

Other Puebloan Groups

At the Tewa-speaking San Juan village along the Rio Grande, the winter solstice is called *t'at'aire* which means the “sun lives now” (Parsons 1964b: 175). However, the summer and winter divisions actually occur in February/March and November (Parsons 1964b). At Nambé village (also Tewa-speaking), the winter solstice is *tanta’* which means “the sun in his house rests” or “is still” (Parsons 1964b: 176). The date of the winter solstice is determined by how the sun strikes a deerskin in a ceremonial room (Parsons 1964b).

As noted above, there is no observance of the summer solstice in most of the Rio
Grande pueblos. However, Santa Clara Pueblo, a Tewa-speaking pueblo located on the Tewa Basin above the Rio Grande Valley, does celebrate both solstices, with the winter one being significantly greater in magnitude (Hill 1982). The solstice ceremonies there are considered “rites of world renewal” and ensure the “continuity of nature” (Hill 1982: 252).

**Moon and Stars**

The sun is not the only astronomical body of importance to Puebloan cultures. The annual calendar is maintained using observations of both the sun and moon (Zeilik 1989). For example, time can be measured by using the “periodic reappearance of a new moon,” which in Puebloan cultures is the first crescent moon (Ellis 1975: 63). In fact, the phases of the moon set the time for a large part of the ceremonial calendar. There is also one ethnographic source that states that religious officers at all Hopi villages but Walpi observed the horizon position of the rising moon, which travels from north to south and back in one month’s time. They then used lunar horizon markers to determine the date. Such observations suggest that the Hopi may have known about the 18.6-year lunar standstill cycle, however there is no firm evidence that the Hopi or any of the other pueblos knew about or tracked lunar standstills (Zeilik 1989).

Certain stars and asterisms, in particular Orion and the Pleiades, are also used to time night ceremonies. These two constellations were the best known among the Pueblos. The Pleiades make their first appearance right before the summer solstice and are thus called the summer stars. Orion, on the other hand, signals the approach of the winter solstice (Williamson et al. 1977). Both of these asterisms/constellations were watched by
town chiefs as they were considered supernaturals (Parsons 1939).

**Zuñi**

Lunar ceremonies are of particular importance to the Zuñi, even more so than among other Pueblos. At the end of the winter solstice ceremony, arrangements are made for the year-long *shalako* observances, which culminate in the first half of the following December (Green 1990). The beginning of *shalako* is announced by *Sayatasha*, who must observe the moon’s phases to anticipate the day of the full moon (Zeilik 1986). *Shalako* consists of prayer sticks and prayer feathers being deposited at one of the shrines surrounding Zuñi on every full moon (in sequence). Forty-eight days after the tenth full moon after the winter solstice, the *shalako* dance is performed. However, approximately every nine years, this dance is delayed by ten days in order for it to synch better with the solar calendar, which by this time is quite a few days off of the lunar calendar (McCluskey 1989). However, it is important that the beginning of *shalako*, whose date does change from year to year, does not interfere with *intiwanna*. Intercalation of the solar and lunar calendars was accomplished by either not counting all of the months in a particular year or by introducing a short month (Zeilik 1986).

Certain star groupings are also important for both ceremonial and agricultural purposes. Orion, the Pleiades, and the Great Dipper, along with the moon, all serve as time markers and help create definite divisions of the night. Orion’s belt, or *Ipi’lakhyah* (“be in a row”), in particular was used to measure time at night (Young and Williamson 1981: 189). The rising of these asterisms or their passage over kiva roof openings often marked the end of ceremonies or specific stages of those ceremonies (Young and Williamson 1981).
The Zuñi plant the first corn in the spring using the light of the “seven great stars,” which at that time are rising above them (Young and Williamson 1981: 184). The seven stars mentioned have been found to correlate with the Western asterism, the Big Dipper. Another asterism, *Kupa:lehweh*, has been identified with the Pleiades and means “piñon seed in a bunch” (Frazier 1979: 91). This asterism rises just before sunrise in late June, which is around the same time that the crops start to sprout (Young and Williamson 1981: 190). Another important Zuñi asterism is the Little Dipper. The Zuñi word for the Little Dipper translates to “those of the north,” which is interesting because the tip section of the Little Dipper handle is Polaris or the North Star (Young and Williamson 1981: 191). However, no recognition of the actual North Star has been found, probably because it is too dim to serve as an adequate northern marker (Ellis 1975).

**Hopi**

While solar ceremonies are determined by the Hopi sun chief, other society chiefs must determine the start dates for ceremonies put on by their clan (Titiev 1992). In fact, each Hopi ceremony is associated with a certain moon and day counts are kept by tally cords, tally sticks, or tally marks (Parsons 1939). However, lunar observations and lunar rituals do not play as important a role as they do among the Zuñi. Lunar ceremonies only take place over a small portion of the year and no effort appears to have been made to relate lunar and solar observations (McCluskey 1989). McCluskey (1989) speculates as to why the moon is more important at Zuñi than at the Hopi villages. The Hopi villages are located on top of mesas where horizon solar observations can be quite accurate. Both past and present Zuñi villages are in river valleys. As a result, the horizon is often not well suited for accurate and precise observations. In order to compensate for this
limitation, the Zuñi observed the monthly changes of the moon, whose phases were “analogous to the minute hand” (McCluskey 1989: 363). The Hopi are also “puzzled by the moon, which seems irrational because it did not have a house” (Zeilik 1985: S82). However, while the moon may not have been as important to the Hopi, it still played a crucial role, because while the sun dictated the seasonal cycle, the moon was used to time shorter durations (Zeilik 1986).

An important lunar (or more correctly luni-solar) ceremony, especially among the Hopi village of Oraibi, is Powamu, or the bean planting ceremony. This ceremony occurs in late winter, marks the beginning of the lunar ceremonials, and is designed to prepare the fields for the farming season (Parsons 1964a; McCluskey 1989). Powamu promotes fertility and germination by forcing crops to grow in kivas (Titiev 1992). The preparations for Powamu begin in late January when the Powamu chief prematurely plants beans in a kiva. In early February, this chief watches for the moon. At the appearance of the first February moon (or the first full moon after the close of the winter solstice ceremony), the chief makes prayer sticks (Parsons 1964a; Zeilik 1988). Near the end of winter, after this ceremony, the Hopi farmers clear their fields and break the ground with a special stick in order to prepare the ground for planting (Loftin 2003).

Another Hopi luni-solar ceremony is Palulukonti, or the equinox ceremony, that occurs in Walpi village around the time of the vernal equinox. The purpose of the ceremony is to prevent Palulukong (the plumed serpent) from interfering with the growth of young corn, which was first planted in late February, and to ensure the proper amount of spring rain (Williamson 1984). This ceremony also marks the end of the Hopi lunar ceremonials (McCluskey 1989).
Other Puebloan Groups

Among the northern Tewa pueblos in the Rio Grande area in north-central New Mexico, time-keeping is dictated by the heavens. The Great Dipper (or Great Bear also known as Ursa Major), Orion’s belt (“the three stars in a line”), and the Pleiades are used to tell the time at night (Ellis 1975; Parsons 1939: 182). In San Juan Pueblo, the three stars of Orion’s Belt, or wirini, are watched in late spring. If they first appear in early May, then it is known that the ground will not freeze and it will be a good summer. If the stars come out later, it will be a bad summer (Parsons 1964b).

Mythology

Aside from fixing a calendar, astronomy is also important in Southwest mythology and ritual. According to Parsons (1939: 182), the stars, the Galaxy, and the heavens, in addition to the Sun and Moon, have an “anthropomorphic divine character” and thus hold religious significance. The Sun, for example, is often the primary god and is known as the “giver of life” and the “father” of the People (Malville and Putnam 1993: 24). The Moon, on the other hand, is often seen as a liaison between the Sun and Earth and is thus able to “exert a favorable influence on the giver of life” (Ibid.).

Zuñí

For the Zuñi, the sun has always existed. He is the most powerful deity in a large pantheon of gods (Williamson 1984). According to Cushing (1988), the sun’s importance stems back to his involvement in creation. While his sons, the Twin War Gods, were the ones to create the world(s), it was the light of the sun (daylight) that allowed men to gain knowledge. The “sun is the source of all life” and is considered the
father (Bunzel 1992: 511) while the moon is either considered the sister of the sun or the mother. The connection between the sun and moon is further seen in that prayer sticks to the sun tend to be planted on or after the “new” moon (actually 1st visible crescent) or the full moon (Parsons 1917; Zeilik 1986) as well as in the coinciding of the winter solstice with a full moon, as described above. According to Benedict (1969), the sun only takes prayer sticks and offerings from those who are good. Those who make offerings to the sun with bad intentions will not have them taken and will instead become sick and lose their crops. The man who first went to the sun to check that he received the prayer sticks became the first pekwin. He was told to watch the sun closely, and for eight years he did so until he was able to accurately predict the solstices, or the turning of the sun. Once the first pekwin established the horizon calendar, it remained fixed and the knowledge of it could be handed down to subsequent generations (Zeilik 1987).

Hopi

For the Hopi, the sun is sometimes considered eternal, a being who traveled from the underworld to be in the present world, but he is also sometimes believed to have been created with each new creation of the world. Hopi tradition has their people passing through four underworlds in order to reach the fifth and present world. Once reaching the present world, the people had to wander to the four points of the compass before reaching the “Middle Place” or “Center” (Williamson 1984: 65). The center is the “proper place to be” (Ibid.). According to this latter belief, when the sun was “first placed in the sky, he came too close to the earth and scorched it” (Parsons 1939: 180), which is why the people believe they need to aid him in his journeys.


Other Pueblos

While many pueblos view the Sun god as the primary god, such as the Hopi and Zuñi, there are also many pueblos that instead consider the Sky God to be the all-powerful creator god. This god was once everpresent but has since “retreated to the farthest reaches of the heaven” (Malville and Putnam 1993: 24). The Milky Way, or “bridge between this world and the celestial realm,” may have been a symbol for this now-absent deity (Malville and Putnam 1993: 26). Where the Sky God once ruled, the Sun and Moon are the lesser gods, although they continue the Sky God’s work and interact with humans (Malville and Putnam 1993).

Conclusion

Overall, the Zuñi and Hopi have a strong tradition of observing certain celestial objects, in particular the Sun and Moon, and using those observations to plan the calendar, which includes dictating the times of both the ceremonies, such as the solstices, and the stages of the agricultural cycle. Their traditions and rituals, though, are somewhat different from each other. The Hopi also place more value on the Sun and less value on the Moon than do the Zuñi. In many of the less-researched pueblos, there is no specialist or separate office whose sole responsibility is to engage in sunwatching. There is also less value placed on the solstices. However, sunwatching still occurs and is used to plan the calendar and dictate ceremonies.

Not a lot of research has been conducted relating architecture to celestial phenomena. However the few studies that have been conducted find orientations to the solstices and equinoxes as well as alignments to the cardinal directions.
The archaeoastronomical investigation of the Harris Site found that three of the four lines of evidence point to astronomy playing a role in the construction of houses and cultural features. Architectural alignments and orientations as well as the presence of possible “shrines” on the far-off landscape in key directions demonstrate astronomical connections, while the placement of the site does not. Thus, the Harris Site provides evidence that Mimbres pithouse groups did observe astronomical phenomena. The results of the investigation are described below and are separated by the research question to which they pertain.

**Astronomy and Landscape**

*Is the site in a location where certain visible astronomical sight lines correlate with particular landscape features?* The first posed research question involved whether the location of the site was purposeful in that it took advantage of the relation between particular landscape features and astronomical sight lines.

The investigation found that the answer to this question is no. The angle and azimuth of every notch and peak, making for a total of 91 landscape points, was taken from each communal structure and no correlation between them and any obvious celestial phenomena was found. Not even Cooke’s Peak, a prominent mountain in the distance, was found to correlate with a celestial event. Obvious celestial phenomena include solstices, equinoxes, and lunar standstills as well as the heliacal rise and set of certain asterisms. The directions of these important astronomical events were determined with
two methods. The first method involved observing the solstice sunrises and sunsets at the site itself in 2008. The second method involved simulating all other events, the non-observed astronomical events, with Starry Night software.

My transit solstice observations, as described in Chapter 3, determined the visible azimuths of the solstice sunrises and sunsets from the Harris Site. In 2008, the summer solstice occurred at June 20 at 17:59 MDT. While the sunrise was set to occur at 6:07, it did not start to clear the mountainous landscape until 6:21. At 6:32, it fully cleared the landscape at an azimuth of 67-68 degrees depending on where one was standing on the site. Full visible sunset occurred at 20:00 at an azimuth of between 297.5 and 298.5 degrees. The winter solstice of 2008 was set to occur on December 21 at 5:04 MST. The winter solstice visible sunrise occurred between 7:23 and 7:26 (depending on one’s position) at an azimuth of 122.5-123 degrees. Visible sunset occurred between 16:42 and 16:45 at an azimuth of 241-241.5 degrees.

These results differ from the results obtained using Kelly and Milone’s (2005: 22) formula. Using the formula, the summer solstice sun should have risen on the horizon at 61.66° and set at 298.34°. The winter solstice sun should have risen on the horizon at 118.34° and set at 241.66°. The sunsets did not vary much, being less than 0.5° off. However, the sunrises varied from four to six degrees. The reason for this variation is that the formula was designed to calculate the azimuths of those events for a flat horizon. As repeatedly stated, the horizon around the Harris Site is quite mountainous, thus causing the directions of the sunrises to be quite different. The lunar standstills were not set to occur from 2008-2009 and thus could not be observed. However, the lunar standstills are calculated to be about six degrees off of the solstices in either direction (as
opposed to the five degrees that occurs at the equator), and thus are assumed to be similar
at the Harris Site. Therefore, the northern major lunar standstill moon was assumed to
rise at 61-62° and set at 303.5-304.5°. The northern minor lunar standstill moon was
assumed to rise at 73-74° and set at 291.5-292.5°. The southern major lunar standstill
moon was assumed to rise at 128.5-129° and set at 235-235.5°. The southern minor lunar
standstill moon was assumed to rise at 116-116.5° and set at 247-247.5°. None of the
azimuths listed above correlated with a low or high points of the horizon.

The investigated asterisms were Ursa Major (Big Dipper), Ursa Minor (Little
Dipper), Orion, and the Pleiades, which are significant asterisms among the Zuñi (see
Chapter 6). However, the azimuths at which the heliacal rise and set of these star
groupings occurred during the three phases of occupation of the Harris Site did not
coincide with the directions of any of the landscape points.

While my investigation did not find that landscape features were in the direction of
investigated celestial events, this does not preclude the possibility that they were in the
direction of non-investigated celestial events. As mentioned in Chapter 6, due to the
precession of the Earth, it is likely that the Mimbres revered different star groupings from
their descendants, and that Orion, Ursa Major, Ursa Minor, and the Pleiades held no
significance for them. Therefore, landscape features may have lined up with other
asterisms, ones that were not investigated.

Even though no landscape points lined up with important solar events, the
mountainous landscape could still have served as a workable solar horizon calendar. The
various notches and peaks could have been used in conjunction with sunrises or sunsets
to mark certain dates that were important to the calendar but did not coincide with solar
events. For example, perhaps a certain landscape marker was used to determine a date that was several days prior to a solstice, a method documented among historic pueblos. This marker would thus aid in preparing for the solstice. The number of high and low spots could also be used to track days as the sun’s movement along the horizon would be more noticeable than on a flat horizon and thus easier to mark.

**Astronomical Alignments**

*Is there evidence of astronomical alignments, either sensible or visible, in the architecture of the site?* The second posed research question involved whether the orientation and layout of the site could be correlated with important celestial events and directions. To answer this question, new maps were created (one using an EDM, the other using a magnetometer) and old maps were consulted including the one from Haury (1936: 360) and Haury’s original site map and house maps that are currently curated at the Arizona State Museum. The EDM map and the overlay of Haury’s map over the magnetometer map have shown that Haury’s maps are offset from true north by about 15 degrees due to Haury mapping the site to magnetic north (see Chapter 3). After correcting for this magnetic offset, lines were then drawn between pithouses using their central points, and pithouse orientations (entryway directions) were ascertained to see if they aligned or pointed to astronomically significant directions.

To measure the accurate directions of the alignments of structures and the orientations of the entrances of all pit structures with discernible entryways, all orientations and alignments had to be corrected by adding 15 degrees to any calculated sight line. These corrected sight lines were then compared to the azimuths of celestial events, in particular
the solstices, equinoxes, cardinal directions, and lunar standstills. There were a few alignments that appeared to not have solar or lunar connections but were still significant. The other alignments that appeared significant were ones that kept repeating (were present multiple times) or were related to the orientation of communal structures. These directions were plugged into Starry Night during the appropriate time and at the appropriate latitude and longitude to see if they correlated with anything astronomical that was not related to the solstices or lunar standstills (or cardinal directions).

Due to the approximate nature of the corrected azimuths, the complications when incorporating the landscape, and lack of instruments that allowed precise measurements among prehistoric inhabitants, any orientation or alignment between five degrees of an important event or direction was considered significant. If astronomical orientations and alignments exist, then it is clear that the Mimbres incorporated astronomy into their architecture.

Architectural Alignments

Important architectural alignments are seen between communal structures (see Figures 3.9 and 3.10b). One of these alignments occurs between the two large Three Circle communal structures, pit structure 10 and the unexcavated depression. The centers of these two structures line up with the summer solstice sunrise, which occurs at an azimuth of 68 degrees. This alignment was found during the observation of the summer solstice sunrise during the summer of 2008.

Other alignments between communal structures were found using Haury’s maps, and confirmed with the map constructed using the EDM. In one case, pit structures 8 (San Francisco phase) and 23 (Three Circle phase) line up almost north-south (~177/357
degrees). In another case, pit structure 23 and the unexcavated depression (both Three Circle phase) line up almost east-west (~95/275 degrees). The equinox sunrise at the site occurs around 92.5 degrees (as determined by Starry Night), so this alignment could be related to the equinox sunrise and sunset. In all, these two alignments appear to show that the Mimbres people were interested in the cardinal directions.

One last alignment is between pit structures 8 (San Francisco phase) and 14 (Georgetown phase). Pit structure 14 is 323 degrees from pit structure 8. This alignment does not coincide with any celestial phenomena. It does, however, point to an interesting feature (Feature 8) on the landscape. This feature was one of the eight features found along the ridge tops surrounding the Harris Site, although this particular feature could be seen from the site unlike the others (see Astronomical “Shrines” section below). 323 degrees is located right between two large rock outcrops on a nearby hill (Figure 7.1). Surface investigations of these outcrops did not find any evidence of prehistoric cultural modification or visitation. All that was present was a modern-day site, which may be a weather station. However, these outcrops are quite noticeable from the site and may have held significance to the Mimbres, which may be why two of their communal structures line up with them.

After completing the investigation of the communal structures, the domestic structures were examined and separated by phase (see Figures 3.6-3.8).

The lines drawn between the centers of two pairs of Georgetown pithouses (both of them having one pithouse in common) appear to align close to the winter solstice sunrise and summer solstice sunset. Pithouses 24 and 34 line up just north of both the winter solstice sunrise and summer solstice sunset at 120/300 degrees. Pithouses 24 and 29 line
up just south of the winter solstice sunrise (126/306 degrees) but even farther north of the summer solstice sunset so the summer solstice might not work for this alignment, although the northern major standstill could.

Three pairs of San Francisco structures appear to have significant alignments. The line between 18 and 28, as well as between 22 and communal structure 8, is north/south (0/180 degrees). The line from 28 to 22 points to around 67 degrees, which coincides with the summer solstice sunrise. Pithouse 18 falls near the line extending from pit structure 8 to pit structure 14. In fact from pit structure 8 to pithouse 18, the alignment is about 321 degrees, close to the rock outcrop. The line from pithouse 11 to pithouse 22 also points in this direction.

No significant solar or lunar alignments appear between Three Circle pithouses except for the ones that occur among the communal structures.

There is one alignment that occurs during all phases and does not coincide with any solar or lunar phenomena, as neither the sun nor the moon travels this far north. The alignments between the centers of four pairs of structures line up between 40 and 45 degrees. These pairs include the Three Circle communal structures 10 and 23, the communal structure 14 (Georgetown phase) and the unexcavated communal structure (Three Circle phase), Georgetown pithouses 34 and 25, and San Francisco pithouses 18 and 22. Using Starry Night to recreate that direction for all three phases found that around the summer solstice, Capella sets in this range during the night/early morning, as can be seen in Figure 7.2. (The telescopes are present in the picture, because the software automatically populates the landscape with the nearest modern-day landmark, which in this case is the Very Large Array in Socorro, New Mexico.) Thus, this “star” could have
been a possible marker for the summer solstice.

Capella, or $\alpha$ Aurigae, is the brightest star in the constellation Auriga and the third brightest star in the northern celestial hemisphere, after Arcturus and Vega. While it appears to be a single star to the naked eye, it is in fact a star system made up of two pairs of binary stars (binary stars are a pair of stars that orbit each other). The first, and brighter, pair involves two giant yellow stars in close orbit around each other. These two stars have a similar brightness to the sun but are much larger as they are on their way to becoming red giants. They are so close that even a telescope cannot distinguish them. The second pair of stars consists of two faint red dwarfs, which contribute little to the overall brightness of the Capella system (Kaler 2002; Schaaf 2008; Kelley and Milone 2005).

While Capella is a bright “star,” there is no ethnographic or archaeological evidence of its importance in the Southwest. However, there is archaeological evidence of its importance in Mesoamerica. The steps on one side of Building J at the Zapotec site of Monté Alban face the rising position of Capella at the time of its construction in 600 B.C. (Aveni 1975). Building P, which is in the central plaza and was part of the reconstruction that occurred during the 3rd century B.C., is also oriented toward the heliacal rise of Capella (Malmström 1997). Capella made its heliacal rise on the morning of the first solar zenith passage during at least the initial habitation of Monté Alban (Aveni 1975). Therefore, Capella’s importance seems to stem from its marking of the coming summer solstice (Southwest) or zenith passage (Mesoamerica). Unfortunately, there is no ethnohistoric evidence of Capella’s importance in the calendar in Mesoamerica either (Aveni 1975). Despite this lack of evidence, Capella still may have been important but
lost its status over the centuries due to precession. After changing its position, it no longer marks the zenith passage. Thus, as with the Southwest, ethnoastronomical sources are not useful in regard to stars in Mesoamerica.

Architectural Orientations

Not only were important alignments found between structures, but many individual houses and structures appeared to be oriented towards certain celestial phenomena.

Communal Structures. Regarding communal structures, the entryways of pit structures 8 (San Francisco phase) and 14 (Georgetown phase) appear to point almost due East on Haury’s site map, which would coincide with the equinox sunrise. Specifically their uncorrected azimuths are 91 degrees for pit structure 14 and 91.5 degrees for pit structure 8. However, their corrected azimuths are 106 and 106.5 degrees. The ~106-degree orientation does not coincide with any major celestial phenomena or landscape feature and, unfortunately, has no documented relevance in the Southwest. However, 106 degrees points to the sunrise around mid-October. This date could be a good marker of when to start harvesting crops, so perhaps the entrances were used as agricultural markers.

Another possible importance of the 106-degree orientation is found in a neighboring region, the Great Basin. Baker Village was a planned community that was built by the Fremont and occupied around A.D. 1220 – 1295. It is located in Central Eastern Nevada just west of the Utah border. It is composed of five or six pithouses and seven surface storage structures that are arranged around a Central Structure, a large square surface structure with mud walls (Wilde and Soper 1999). According to Wilde and Soper (1999), the center of the village was of prime importance. It directly overlays Pithouse 4,
which is a large formal pithouse that has plastered mud walls and a prepared floor, making it reminiscent of kivas in the Southwest and possibly serving as evidence of this site’s connection with the Southwest.

A diagonal through the Central Structure is aligned to the summer solstice sunrise and winter solstice sunset. The center point of the Central Structure connects with many other structures on the site on sight lines that match up with the sunrises and sunsets on both solstices. There are also alignments between structures that point to the equinoxes and one lunar month before the fall equinox (and after the spring equinox). Many of these times coincide with potential times for planting and harvesting, thus seeing the sunrise at these points could signal when to start such activities. One of these alignments, 105 to 108 degrees, appears quite often in the overall scheme of the site. This direction coincides with 2 lunar months before and after the winter solstice, and could have been used as an early predictor of the winter solstice (Wilde and Soper 1999). Therefore, the 106-degree orientation could have been used as either an indicator for harvesting crops or as an early warning sign of the impending winter solstice.

In the summer of 2009, an attempt was made to re-excavate the entryways for pit structures 8 and 14 in order to check their orientations. In regard to pit structure 14, two walls of a seeming entrance were uncovered. However they pointed in different directions. This complication could be the result of pithouse 29 being built within pit structure 14. Therefore it could be that each wall corresponded with a different pithouse. One wall pointed to an azimuth of 106 degrees, which would coincide with the calculated orientation of pit structure 14 from the site map. However the other wall pointed to 52 degrees, which does not coincide with pithouse 29, which is supposed to point to 68
degrees. There are a range of possibilities for this discrepancy. One possibility is that pithouse 29’s orientation was incorrectly drawn on Haury’s site map, which is likely considering the discrepancies in the entryway orientations of other pithouses. Unfortunately no house map for pithouse 29 exists to check for this discrepancy. Another possibility is that pithouse 29’s entryway was not uncovered and that another cause is needed to explain the one side’s divergence. One cause could be that the entryway for pit structure 14 opened out instead of opening straight. Another cause could be that a chunk of the entryway wall was previously removed by either formation processes or previous excavations. These last two possibilities could not be further investigated, though, due to the human bones that were uncovered in the entryway not far from where it entered the pit structure, forcing the excavation to be halted.

A block of plaster in the shape of a kidney bean was also found at the beginning of the entrance to pit structure 14 (where it enters the house) as can be seen in Figure 7.3. According to Anyon and LeBlanc (1984), earthen lobes in the shape of beans or kidneys are found in Georgetown phase communal structures next to their entrances. This feature lends credence to pit structure 14 being identified as a communal structure.

The attempt to uncover pit structure 8’s entryway was unsuccessful. While a feature, or features, was definitely found, it did not in any way resemble a pithouse entrance. Instead two partial (and likely not related) walls were uncovered, both of which resembled ends not openings, one squared off and the other more rounded. It is unclear whether the two walls are even part of a pithouse, as they do not resemble any pithouses in the vicinity of pit structure 8; they may instead be part of another type of feature, one that was not previously excavated or mapped. A plethora of pottery and lithics along
with one large metate were found during the excavation. A partially burned wood post was also found near the “wall” to the south along with surrounding pockets of charcoal.

The orientation of the entryway of communal pit structure 10 (Three Circle phase) is southeast and, when corrected, is around 140 degrees. Pit structure 10’s corrected orientation does not coincide with any solar or lunar phenomena as it is too far south.

During the summer of 2008, I re-excavated the entryway of pit structure 10. The entrance was not as perfect as the map would have one believe, which shows the two sides of the entryway being parallel. The south wall of the entryway actually points to 112 degrees, while the north wall points to 150 degrees. However, their convergence does indeed point to 140 degrees. While this azimuth does not coincide with any celestial phenomena, it appears to point directly at Cooke’s Peak (Figure 7.4), which is the major mountain in the distance and is thought to be significant among prehistoric people in the area.

At the base of Cooke’s Peak are some features that demonstrate astronomical connections. Among the many petroglyphs present there, one is of particular significance. The Sunman (Figure 7.5) has an interesting light display around sunrise during the solstices and equinoxes that is caused by the gap between the rocks near it. There is also a light box in the rocks located near the Sunman (Figure 7.6), which is positioned in such a way as to capture the light of the sun at particular times of the year (Marilyn Markel, personal communication, 2008). Overall, this shows that Cooke’s Peak was not just a prominent landscape feature but also held astronomical significance. Therefore while pit structure 10’s entryway is not directly related to a celestial phenomenon, it points to a mountain that is.
In sum, pit structure 10’s entryway is consistent with the Haury’s corrected site map, while pit structure 14’s entryway lends at least partial proof to its accuracy. The other feature uncovered neither confirms it nor denies it. Overall the EDM map, the magnetometer map, and the entryway orientation checks are consistent with Haury’s corrected site map.

Haury, in his field notes (obtained from the Arizona State Museum), stated that pit structure 23 (Three Circle phase) was looted, resulting in the inability to define its entryway. His site maps do not have an entrance indicated for this structure. However his house map for 23 (and 22, 30, and 31) shows a possible entrance for structure 23 that appears to have been obscured by the construction of pithouse 22. This possible entryway points to 147 degrees. If this orientation is indeed the direction of the entryway, it does not correspond to any features or celestial phenomena. It is too far south for any solar or lunar events.

The Three Circle phase pit structures 10 and 23 have other orientations besides those relating to their entryways. They are both rectangular and thus internal diagonal lines can be drawn through the structures. Using the magnetometer map, the diagonals of both communal pit structures point in similar directions. Pit Structure 10’s diagonals point to 87/267 degrees and 10/190 degrees. The latter direction is too far from north/south but the former direction is close to due East and West and the equinox sunrise and sunset. Pit Structure 23’s diagonals point to 97.5/277.5 and 12/192 degrees. While both of these directions are close to the cardinal points, they are too far to be confidently correlated with them. However the East-West line almost goes through the center of the unexcavated depression and could be said to “point” to it.
Domestic Structures. Solar and lunar orientations were observed in some of the domestic structures. However, as discussed in Chapter 3, the orientations of some pithouses on the site map do not match their orientations on the house maps. Pithouses 24, 25, and 32 of the Georgetown phase, pithouse 22 of the San Francisco phase, and pithouses 5, 7, 15, and 16 of the Three Circle phase have their entryways point in different directions on the site maps versus the house maps. While the house maps are more likely correct, both orientations were investigated when searching for astronomical alignments.

During the Georgetown phase, all of the pithouse entryways appear to be significant except that of 34, which was not uncovered during its original excavation. According to the house maps for pithouses 25 and 32, their entrances point to about 68 degrees. No house map for pithouse 29 was present, but, according to the site map, its entrance also points to about 68 degrees, although re-excavation of the area puts this orientation into doubt (see above). This azimuth coincides with the summer solstice sunrise. Pithouse 24’s house map has its entryway pointing to 89 degrees, which would coincide with the equinox sunrise. According to the site map, though, pithouses 25 and 32 point to 114 degrees, which could correspond with the northern lunar minor standstill rise, and pithouse 24 points to about 63 degrees. While 63 degrees could correspond to the summer solstice sunrise (it is within five degrees), its direction actually would more closely correspond with the northern major lunar standstill rise. The average pithouse orientation during the Georgetown phase is 73.25 degrees with a standard deviation of 10.5 according to the house maps. According to the site map, the average is 89.75 degrees with a standard deviation of 28.08. If using the site map, the average would be
significant, as it is almost due East and is close to the equinox sunrise. The standard deviation is also relatively low. However, because it is more likely that the house maps are the accurate ones, this eastern orientation is probably not correct. 73.25 degrees could correspond with the northern minor lunar standstill rise, especially since the standard deviation is even lower. However trying to correlate every pithouse with an event that occurs only once every nineteen years seems unlikely.

During the San Francisco phase, the entryway for pithouse 18 points to within five degrees of due East (93 degrees) and is quite close to the equinox sunrise (which occurs at 92.5 degrees). Pithouse 28 points to about 60 degrees, which could correspond to the northern major standstill rise. Pithouse 22, according to the house map, points to about 72 degrees, roughly corresponding with the northern minor standstill rise. According to the site map, though, it points to 89 degrees, which corresponds with due East and the equinox sunrise. The average domestic orientation during the San Francisco phase is 137.6 degrees with a standard deviation of 89.35 according to the house maps and 141 degrees with a standard deviation of 86.51 according to the site maps. Neither of these averages corresponds with an astronomical event. They do roughly point in the direction of Cooke’s Peak. However the standard deviation is so high that it is unlikely that this average was intentional.

During the Three Circle phase, pithouse 21 (94.5 degrees) points to within 5 degrees of due East and the equinox sunrise. The entryway of pithouse 17 points to within 5 degrees of due South (185 degrees). The entryway of pithouse 7 is a little too far off to correspond with the winter solstice sunrise. According to the house map, it points to 130 degrees, which could correspond with the southern major lunar standstill rise instead.
According to the site map, though, it points to 140 degrees, which corresponds with the direction of Cooke’s Peak. Pithouse 16, according to the house map, points to 129 degrees (80 degrees according to the site map), which again corresponds with the southern major lunar standstill rise. Pithouse 15, according to the house map, points to 130 degrees putting another tally mark in the southern major lunar standstill rise column. However, the site map puts it at 125 degrees, which is closer to the winter solstice sunrise. Pithouse 2 points to 117 degrees, around the southern minor lunar standstill rise. Pithouse 19 points to 75 degrees, around the northern minor standstill rise. Pithouse 4 points to 63 degrees, near the northern major lunar standstill rise and the summer solstice sunrise.

During the summer of 2008, a new pithouse, Pithouse 35/36, was excavated. It is actually one Three Circle house superimposed over another. The entryway was found to point to 67 degrees, which is right around the summer solstice sunrise. This pithouse was also quite large, especially for a domestic structure. It perhaps served an important function or housed a large, and important, family.

Pithouse 38 (Three Circle phase) was also excavated during the summer of 2008. It points to 230 degrees, which could correspond with the southern major lunar standstill set. Pithouse 37 (Three Circle phase), excavated during the summer of 2009, points to 105 degrees, which does not coincide with anything except for the mid-October sunrise, as discussed above for pit structures 8 and 14. However, pithouse 37 appears to open onto a common space with pithouse 38, thus the orientations of these two houses may be tied to pithouse groupings and not astronomical events (Barbara Roth, 2009, personal communication). Pithouse 39/40 was also excavated during the summer of 2009. It is a
Three Circle pithouse built over the top of another pithouse. This earlier one still needs further excavation and investigation, but it is believed that it could belong to the Georgetown phase. The top pithouse does not have a lateral entryway but instead shows evidence of a roof entry. However it still has an orientation seen through the line that connects the center post to the hearth to the ventilator shaft. This line points to 120 degrees, which is close to the winter solstice sunrise. It also points to the unexcavated depression.

The average orientation during the Three Circle phase (including newly dug houses 35/36, 37, and 38) is 110.25 degrees with a standard deviation of 53.52 according to the house maps. According to the site map, the average is 105.32 degrees with a standard deviation of 54.54. Neither of these directions relates to anything astronomical (although 110 could be just on the tip of the southern major lunar standstill rise) and the standard deviations are again quite high.

The overall average for all domestic pithouse orientations is 109.76 degrees with a standard deviation of 59.81 according to the house maps and 110.37 degrees with a standard deviation of 59.44 according to the site map. All pithouse orientations, averages, and standard deviations can be found in the table in the Appendix. The averages of the pithouse orientations do not appear to be significant. Only in the assessment of the individual pithouses do any important orientations appear to occur. This finding contradicts that of Creel and Anyon (2003), who found that communal pit structure orientations throughout the Mimbres Valley averaged an azimuth near the winter solstice sunrise, especially during the Three Circle phase. However, Creel and Anyon’s (2003) study may not be relevant here as they were examining communal
structures and the averages calculated above were for domestic structures. The number of communal structures with discernible entryways at the Harris Site is also too low to use in relation to their work. Regardless, the Harris Site orientation averages are closer to the winter solstice sunrise during the Three Circle phase than during other phases, but the evidence is not strong enough to argue for a correlation.

**Astronomical “Shrines”**

*Are there human-made features at particular visible astronomical sight lines on the surrounding landscape?* The third posed research question concerns whether there are features, or shrines, located on ridge tops along lines that correspond with important celestial events. Such shrines could have been used as places of offerings to a celestial being during such an event, as was done by the Hopi.

During the hiking of the surrounding landscape, a total of eight features were found and preliminarily investigated. Figure 7.7 shows these features in relation to the site with lines drawn to those that may be in astronomically significant directions. Items were labeled as features if they contained evidence of possibly being made or modified by human activities. There were also a few natural features that were included because they were in significant directions, they could have been used by humans, or they were a prominent part of the landscape as seen from the Harris Site like in the case of Feature 8 (discussed above).

Feature 1, a small stone circle (Figures 7.8-7.9), is located 87.5 degrees from the site, close to due East (and the equinox sunrise). The East-West diagonal running through Pit Structure 10 points close to this direction. Feature 2, a small rock cairn (Figures 7.10-
7.11), is located 128.5 degrees from the site, which is just over 5 degrees away from the winter solstice sunrise. It could perhaps be related to the southern major lunar standstill rise instead. There was a core not too far away from this feature, showing that there was a prehistoric presence here. Thus, the cairn could have been built by prehistoric people.

Feature 6, a small rock “shelter,” is located 178.5 degrees from the site or close to due South. It consists of a small opening in a boulder that is too small to provide shelter but could have been used to place things such as offerings (Figures 7.13-7.14). Its opening points to 114 degrees, which does not coincide with other features but possibly coincides with the southern minor lunar standstill rise, although the direction of this opening is probably unintentional.

Other features found include Feature 3, possible rock steps (likely natural in origin), Feature 4, a possible bedrock mortar/cupule, and Feature 7, a modern geocache. None of these features are at significant directions. There is also Feature 5 located at 167.5 degrees from the site. This strange rock feature (Figure 7.12) is likely natural but its opening faces north toward the general direction of the site.

Of the features found, the significant ones appear to be the rock circle (Feature 1) found at 87.5 degrees (east/equinox sunrise), the rock cairn (Feature 2) found at 128.5 degrees (possible southern major lunar standstill rise), and the rock “shelter” (Feature 6) found at 178.5 degrees (south). All of these features/sites could have been used as shrines and places for offerings. The position of these features, though, does not coincide with Hopi sun shrines, which were placed at solstice positions. While their positions are still significant, these features perhaps served a different function. They may still have been shrines, but not necessarily solar ones. There are examples of other types of shrines
among the Hopi. While sun shrines are the most common, many Hopi gods, such as Earth gods, sky gods, rain gods (kachinas), etc., have shrines dedicated to them as well (Fewkes 1906).

**Conclusion**

Overall, the data and results lend positive answers to two of the three research questions, thus indicating that the Mimbreños at the Harris Site incorporated both celestial phenomena (solstices, cardinal directions, possibly lunar standstills, etc.) and landscape features (Cooke’s Peak, rock outcrop) into their architecture. The first part of the hypothesis posed, that Mimbres pithouse groups observed astronomical phenomena and used such phenomena to guide the construction of their structures, has thus been confirmed. While the Harris Mimbreños do not appear to have placed their site in a location to correlate significant landscape features with significant celestial events, they did orient many of their domestic and communal structures to such events. They also lined up some of their structures in astronomically significant directions. They even possibly placed features or “shrines” at important azimuths. However, the question of why they incorporated astronomy into their architecture and site layout still needs to be answered.
Figure 7.1. Feature 8 (rock outcrop) from Harris Site.

Figure 7.2. Capella rising between 40 and 45 degrees during the Three Circle phase on the summer solstice at the Harris Site as simulated using Starry Night.
Figure 7.3.  Pit Structure 14’s entryway with bean-shaped lobe.

Figure 7.4.  Cooke’s Peak from Harris Site.
Figure 7.5. Sunman petroglyph at base of Cooke’s Peak next to gap in rocks that produces light displays.

Figure 7.6. Light chamber at base of Cooke’s Peak.
Figure 7.7. Ridge top features surrounding site with lines drawn to significant ones.
Figure 7.8. Feature 1—rock circle located on landscape 87.5 degrees from Harris Site.

Figure 7.9. Feature 1 (tape/ruler across center is 2 meters long; compass points north).
Figure 7.10. Feature 2—rock cairn on landscape located 128.5 degrees from Harris Site.

Figure 7.11. Feature 2 (segment of ruler 20 cm long; compass pointing north).
Figure 7.12. Feature 5—“opening” (and compass) pointing north.

Figure 7.13. Feature 6—rock “shelter” at 178.5 degrees from Harris Site.
Figure 7.14. Feature 6—opening pointing at 114 degrees (compass pointing north).
Chapter 8
Discussion and Conclusions

The architectural and landscape investigation of the Harris Site has confirmed that Mimbres pithouse groups observed astronomical phenomena and used such phenomena to guide the construction of their structures. Because the first part of the hypothesis has been confirmed, the final research question posed needs to be answered. Why did the Mimbres pithouse people engage in astronomical observation?

According to McCluskey (2004: 197), “astronomies develop historically in response to culturally defined concerns.” The final line of evidence, background research and literature review conducted in previous chapters, is used to figure out those culturally defined concerns in the Southwest in general and in the Mimbres area in particular and to determine the reason for incorporating astronomy into architecture.

Celestial Calendars

Astronomical observation was engaged in by prehistoric people for both ritual and secular purposes, although those purposes tended to be intertwined in ancient societies. Aveni (1997) states that chronology (setting up an ordered system of timekeeping to administer to the needs of the state) was one of the basic motives for ancient skywatching as a calendar allowed for the prediction of the arrival of future events as accurately as possible.

Observational calendars were typically the first type of calendars to be developed with key dates being associated with key celestial events. First, a sequence of observed events is recorded and communicated. When two or more sets of phenomena are
interrelated through correlation, a calendar is born (Aveni 1997). Later other important
dates would be added that were so many days after a different ceremony (Šprajc 2000).
Observations were then used to test the calendar and to aid in tightening correlation of
various components (Aveni 1997). Lunar calendars were typically the first type of
calendars to be created as the passage of time could be documented in the short term.
Phases of the moon were in fact used to track days in the Southwest, especially over short
periods of time (see Chapter 6). However, while they are good for day-to-day activities,
they eventually get out of step with the seasons. As a result, a solar calendar, which
required more long term observations, was created (Krupp 1978).

As discussed in Chapter 6, the historic pueblos of the Southwest used a solar horizon
calendar. Some of the pueblos also had special sunwatchers whose sole job was to track
the sun’s annual journey by observing sunrises and/or sunsets. Other pueblos had their
town chief perform sunwatching duties. In fact, horizon calendars remain “fixed for a
long time … and the knowledge can be handed down to others” (Zeilik 1987: 26). Thus
it is likely that solar horizon calendars were used for centuries, even during the time of
the proposed ancestors of the historic pueblos, such as the Mimbres-Mogollon.

Even certain stars and asterisms were used to establish the time of year as their
appearance, or heliacal risings and settings, could mark the coming of important dates.
Among the Zuñi, the Pleiades would mark the coming of the summer solstice while
Orion would mark the coming of the winter solstice (Young and Williamson 1981).

Celestial objects were also used to tell time of day. The sun was used during daylight
hours through a gnomon or sundial. Asterisms (such as the Pleiades, Orion, and the
Great Dipper) and stars helped mark time at night (Ellis 1975; Young and Williamson
In sum, one of the major secular, or practical, purposes of astronomy was the establishment of an accurate calendar and to mark time. Farming, in particular, required an accurate and precise calendar so that the farming year could be planned. A calendar also served a religious purpose too as it dictated the timing of ceremonies throughout the year.

**Agriculture**

Using the sun’s position on the horizon throughout the year, coupled with the change in night constellations, ancient people could figure out the season. Vegetation growth cycles are related to seasons, agricultural techniques are related to growth cycles, and agriculture provides food necessary for life (Krupp 1978). Thus a good calendar was essential to agricultural societies.

The historic Pueblos have been documented as needing a calendar to dictate the times of planting and harvesting and the move from villages to field houses (see Chapter 6). Field houses were also present among the Classic Mimbres (see Chapter 4), so they likely also had a set time when they inhabited them. According to Malville and Putnam (1993), the Anasazi and other prehistoric groups endured the uncertain life that was prevalent in the American Southwest due to climatic instability and unpredictable agriculture. The dates of planting there needed to be precise because there were severe frosts both at the end and the beginning of the fairly short growing season (Reyman 1976). Observational calendars were thus often instituted that allowed for the prediction of important seasonal changes and for the effective scheduling of the consequent agricultural changes (Šprajc 2000). Prehistoric Southwestern groups not only needed to know when to plant and
harvest crops, but also when to prepare irrigation systems for the summer rains and when to prepare for the winter months.

In the historic Southwest, at least among the Hopi, there was sometimes a correlation between a celestial event and an agricultural step. For example, at many of the Hopi villages, the equinoxes marked the beginning times for planting and harvesting (Zeilik 1988). At Hano (Hopí-Tewa), planting ended around the summer solstice (Loftin 2003). Many parts of the Southwest also have their rainy season start shortly after the summer solstice, which is why it is a good time to end planting (see Chapter 6). In Mesoamerica as well, key celestial phenomena often coincided with important agricultural dates. In Northwest Mexico, for example, the summer solstice and fall equinox mark the beginning and end of the rainy season (Aveni et al. 1982). In Izapa in southern Mesoamerica, the solar zenith passages, April 30 and August 13, marked the beginning of the rainy season and the onset of harvest (Malmström 1997).

Even for the agricultural dates that did not coincide with celestial phenomena, they were still determined using a solar horizon calendar. As mentioned in Chapter 6, sunwatchers throughout many pueblos would announce the dates of planting and harvesting. Thus, historic Southwest agricultural societies required an accurate calendar that was based on astronomy. As a result, it is likely that prehistoric Southwest agricultural societies did as well.

Religion

Many agricultural events tend to be accompanied by ceremony. The practicality of observing the sun’s annual journey, crucial to survival in the desert, is inseparable from the religious significance of the observations. The appreciation of this association is
demonstrated by many cultures through ritual. Holidays are thus tied to the seasonal round. They “define the calendar’s circuit, and the calendar is perfected to establish them” (Krupp 1978: 7). In fact, for many cultures, “the return of the Sun from its winter quarters and its return from darkness every morning were direct analogs of an endless cycle of death and rebirth,” and as a result, they became important religious events to be observed and celebrated (Kelley and Milone 2005: 25).

Many holidays, especially non-agricultural ones, occur at astronomically significant times, in particular during solar events. In the Southwest, ritual activities during solar ceremonials were meant to aid and guide the Sun in his daily and annual journeys. Solstices were particularly important. During the Pueblo winter solstice ceremony, for example, the sun needed to be encouraged to return north, because if it continued to travel south it would eventually disappear and create eternal darkness (Zeilik 1985c). For the Pueblo summer solstice ceremony, the sun was encouraged to remain north for awhile in order to provide warmth and light (Titiev 1992).

There were also many ceremonies that celebrated other astronomical objects such as the moon. For example, many historic Pueblos conducted lunar ceremonials on certain full moons. Positions and phases of the moon as well as stars played another role in ceremony as well in that they would mark the timing of night rituals (see Chapter 6).

According to Šprajc (2000: 413), the “anticipatory aspect of observational calendars” was of extreme importance, as discussed in previous chapters. Direct observations on the actual dates may have been hindered by bad weather (Šprajc 2000). The ceremonies that marked the onset of certain stages of the agricultural cycles (and other subsistence activities) and other events also needed to be announced prior so that there was sufficient
time to prepare for such ceremonies (see Chapter 6). Careful observation of the sun and other celestial objects allowed for such anticipation.

**Architecture**

Celestial calendars are not only seen in the practices of historic Pueblos, but are also manifested in the architecture of prehistoric (and historic) Southwest cultures. Ancient Southwest astronomers, after pulling patterns from the sky, would incorporate them into their architecture. These structures could then be used as observatories for witnessing, and predicting, celestial events, which were key components of the calendar. One way in which such specialized architectural buildings could be used for calendrical purposes was to have their portals mark the onset of a ritual (Aveni et al. 2003). For example, if a portal was positioned towards the direction of the winter solstice sunrise, the sunrise could then be observed through the portal on the winter solstice.

Even structures that do not appear to be observatories, as their portals are not used for framing, can still be used for observation. Edges, corners, centers, heads of ramps, and bases can be used as observation positions, where the sky observer stands, or markers, human-made or natural features used as foresights to establish the position of the sun on the horizon in relation to the time of year (Hardman and Hardman 1992). Such foresights are typically foreground objects that obscure the true or flat horizon (Krupp 1978).

Examples of such astronomically aligned architecture can be seen throughout the Southwest. In the historic Southwest, sunwatching tended to occur in fixed outdoor locations. However, some Pueblo villages are located on featureless landscapes. As a result, in order to determine the time of year, the people at those sites used building orientations coupled with wall calendars, which involved light and shadow coming
through properly oriented portals and interacting with markers on the far wall (Zeilik 1985c). Many buildings at historic Southwest pueblos are in fact oriented to the solstice directions (Zeilik 1989).

Many prehistoric Pueblo sites also were astronomically aligned. The Anasazi, in particular, have many well-documented astronomical buildings that could have been used for calendrical purposes. As laid out in Chapter 5, some of the kivas at Chaco Canyon had portals positioned just right so as to witness and/or commemorate solstice sunrises. Pueblo Bonito, in particular, had “exterior corner windows” in two rooms that Reyman (1976: 957) believes were “built to serve a particular adaptive function—to record the winter solstice sunrise.” He attributed these orientations with the need to establish an accurate solar calendar. The Mesa Verde Anasazi had a number of astronomically significant sites as well. Mesa Verde itself had structures aligned to the winter solstice, while Hovenweep had orientations to the solstice and equinox sunrises and sunsets. Even the Sinagua used astronomy by integrating the summer solstice sunrise and certain Hopi ceremonial dates into the architecture at Wupatki (see Chapter 5).

Other prehistoric Southwest cultures also had astronomically-aligned architecture that could have been used for calendrical purposes. The Hohokam of southern Arizona aligned portals at Casa Grande with the summer solstice sunset and the equinox sunrise. Pueblo Grande witnessed the summer solstice sunrise while Mesa Grande witnessed the winter solstice sunrise. In the Casas Grandes/Paquimé area, the Mound of the Cross was positioned so as to directly witness the equinox sunrise. The Jornada Mogollon pueblo of Hot Well had a doorway in the east wall that was used to witness the solstice and equinox sunrises (see Chapter 5).
In order to incorporate important celestial directions into buildings and structures, the actual direction of such events had to be determined first. Thus knowledge of astronomy and its use as a calendar came first and was then incorporated into architecture. Reyman (1976) states that the sequence of events for creating a calendar first involves observing the skies and noting when and where on the horizon certain celestial events occurred. Then, when “the pattern of celestial movement is recorded, a permanent record of this passage is usually made by aligning some architectural feature to the path of motion” (Reyman 1976: 959). Once astronomical directions were incorporated into a building, the building could then be used as an observatory to maintain the calendar already created.

**Mythology**

Mythology was another important aspect of ancient societies into which astronomy was incorporated. Mythology made deities out of the celestial phenomena and gave explanations for what occurred in the skies or heavens. As discussed in Chapter 6, the Sun, Moon, and Venus were considered deities among the historic Pueblos. The Sun was the father of all life. The Moon was its counterpart, often seen as an intermediary between the Sun and Earth. Venus represented the Twin War Gods and sons of the Sun. Evidence for astronomically-tied mythology and religion is not just seen in the ethnographies and oral histories of historic Pueblos, but also in prehistoric and historic Southwest architecture. Not all architectural alignments were designed for making observations. While many buildings align to important celestial directions, some of these alignments could not have been used to observe a celestial event because it was obscured
by either the horizon or an architectural feature such as a wall, ceiling, or intervening building (Williamson et al. 1975). Alignments can also be to directions that have no observable astronomical events, such as the cardinal directions, or to events that do not serve a calendrical purpose, such as lunar standstills.

Despite the inability to observe a celestial event, a “direction can be astronomically significant even though the structure which embodies it may present no visible phenomena when in the completed state” (Williamson, et al. 1977: 212). The reason for such architectural alignments is that, as Ruggles (1999) points out, they were not solely intended for practical purposes, but could instead serve a symbolic function, namely celebrating directions that have a religious significance. For example, sun shrines, or sites of offerings, were placed on ridge tops at important solar positions such as the solstices even though they served no observational purpose (see Chapter 6). Many of the historic Pueblo towns are also oriented to the cardinal directions (Ellis 1975).

Other examples of astronomical architecture in the Southwest that likely served a religious function are found among the prehistoric cultures, in particular the Anasazi. At Chaco Canyon, there are many astronomical alignments between buildings and structures. Such alignments pointed to the cardinal directions as well as the lunar minor standstill rise and the lunar major standstill rise. Many of the celebrated celestial events and directions could not even be witnessed in the canyon itself and thus any orientation to them had to be commemorative in nature. Yellow Jacket, a Mesa Verde site, also had astronomical alignments between structures, ones that lined up north-south, east-west, and with solstices. The Kayenta practiced this form of astronomy as well by incorporating east-west alignments at the Coombs site (see Chapter 5).
As for other prehistoric Southwest sites, Hohokam platform mounds were aligned east-west or slightly east or west of north. In the Paquimé area of northern Mexico, ball courts were typically oriented north-south just as they were in Mesoamerica. The premier Paquimé site of Casas Grandes was oriented to the cardinal directions. Mogollon pueblos tended to be aligned to the cardinal directions like their historic counterparts. They were specifically oriented east-west, such as a roomblock at Grasshopper Pueblo in the Mountain Mogollon area (Riggs 2005).

One purpose for such alignments is laid out by Malville and Putnam (1989: 6), who believe that, for the Anasazi, the regularity of the sun’s movements across the sky conflicted with the “uncertain chaos” of the land beneath. One strategy for dealing with this conflict involved building circular kivas that were topped with a dome and aligned to the four cardinal directions, thus serving as microcosms or miniature copies of their “heaven” that were meant to achieve harmony with the larger world. They also represented the sipapu, or place where the first humans emerged from the lower worlds (Malville and Putnam 1989). Therefore the religious component of astronomically-aligned architecture appears to be just as important as the calendrical component.

Overall, many astronomically-aligned structures in the Southwest appear to have served religious functions, either as places for offerings to the sun, as microcosms of the heavens above, or as commemorations of important directions such as the cardinal ones. The connection between mythology and religion is that mythology often served as the basis for a religion. Religious ideology, in turn, tended to keep people in line and could even be used to legitimize a special elite or priestly class.
Power

One last function of astronomy could be in its legitimization of power. Ruggles and Saunders (1993: 23) state that

From ancient Babylonia to China, Mexico, and Peru, from empire to city state to tribe, astronomical information was gathered, recorded, and used by those whose interests lay as much in spheres of status enforcement and political ideology as in predicting rainy seasons or planning agricultural schedules. By making natural phenomena appear liable to social manipulation in the form of cosmological myth, cleverly aligned architecture, and appropriately timed religious ritual, the elite used the predictive value of astronomical knowledge as an impressive display and justification of their power and prestige.

The Maya, for example, had systems of recording the motions of celestial bodies and the onset of astronomical events. Such recordation coupled with knowledge of the skies and a good system of mathematics allowed these cultures to predict phenomena, even eclipses. This knowledge of the heavens and ability to make predictions tended to be exclusive to ancient astronomers and often came from the use of buildings that had restricted access (Aveni 1997). The ability to predict events, and interpret them, likely afforded these astronomers a certain amount of prestige, respect, and authority as power was often bestowed upon those who possessed knowledge.

The question becomes whether such power was found in the Southwest, an area that was less complex and more egalitarian than Mesoamerica. Shaman-priests were quite powerful in Mesoamerica, because they were seen as divine and linked to the deities. However, in the Southwest, shamans were not very powerful, nor were they considered incarnations of deities. Religious ceremonies and structures (kivas) were also not restricted to a select few but were open to all initiated males (Van Pool 2003).

According to LeBlanc (1983: 148), the Mimbres-Mogollon were “essentially
egalitarian” but may have had an “incipient form of elite” starting at a few sites. In fact, the prehistoric and historic Southwest overall had few leaders, except for maybe at Chaco Canyon, Casas Grandes, and the Hohokam region. However, in places without leaders, there may still have been hierarchy and segmentation present in society, primarily between family groups or clans. Possible evidence for corporate kin groups and the establishment of restricted or private property (which may have housed restricted-access astronomical observatories) in the Mogollon region is first found at the largest Mimbres sites during the Three Circle phase of the Late Pithouse Period (see Chapter 4).

Historic pueblos also had ranking kin groups, or clans, which were likely carried over from their proposed ancestors. Pueblo sunwatchers (and town chiefs) always came from a particular clan, which was usually the clan with a large amount of religious and political power, and were associated with the main kiva at a village. For example, at Acoma, the cacique always came from the Antelope clan. There were seven kivas at Acoma, showing that there were seven clans, but the Antelope kiva was the only one with a floor resonance chamber or foot drum, demonstrating the importance of the clan from which the community leader came. Such community leaders and priests were considered too holy and important to engage in normal subsistence activities such as working fields, gathering and processing crops, and food preparation. Otherwise, though, they did not have a higher standard of living (Parsons 1939). They were not considered infallible or all-powerful either. For example, the Zuñi would check their sunwatcher’s work through wall calendars in their houses. If the sunwatcher, or pekwin, was too inaccurate, he would be replaced (Aveni 1997).

Such religious leaders may have been present at Mimbres villages, in particular the
large ones. If so, then they would have likely been treated differently upon death and interred in or near a communal structure (Creel 2006c). As discussed in Chapter 4, three subfloor interments were found at Galaz and Old Town in communal structures, suggesting perhaps that they were sun-watchers, town chiefs, or priests.

Therefore it seems that astronomy was probably used to create and legitimize some power in the Southwest, including among the Mimbres-Mogollon. However, it was not to the same degree as in Mesoamerica or even other areas of the Southwest such as Chaco Canyon, Casas Grandes, and the Hohokam region. Special, omnipotent elites did not exist among the Mimbres, or the later Pueblo cultures.

**Conclusions**

The functions of astronomy among prehistoric and historic societies of the American Southwest included identifying seasons to aid in devising subsistence and agricultural strategies and serving as a basis for mythology and religion (and possibly power). One of the manifestations of this use and observation of astronomy was the building of special architecture that was aligned to particular phenomena. The purposes of such astronomically-oriented architecture were to serve as timekeeping devices, commemorate religious traditions and ceremonies (as well as directions), and possibly provide restricted spaces where elites could gain knowledge and, with it, power.

As for the Mimbres-Mogollon, astronomical orientations are more often seen in religious/ceremonial structures than in domestic structures, at least according to Creel and Anyon (2003). While most houses in the Mimbres Valley faced an eastern direction, the variable orientation of communal structures was tighter and focused on the southeastern
direction. This orientation was more apparent during the Three Circle phase when a “new” religion appeared to be emerging (see Chapter 4). During this time, there were more communal structures, and they were even more closely aligned to the winter solstice sunrise. However orientations were more likely meant to commemorate events and directions, as sun-watching tended to occur at a set location outdoors (Creel and Anyon 2003). It therefore appears that as agriculture was becoming more intensive and society and religion was becoming more complex, as they were during the Three Circle phase, astronomy was becoming more important.

Woosley and McIntyre (1996) show that sites outside the Mimbres Valley do not necessarily follow the same trend. The average orientation of Wind Mountain’s communal structures was close to due East (or the equinox sunrise), while the domestic structures pointed more toward the winter solstice sunrise, making it opposite of the Mimbres Valley. There were also no structures that pointed to the summer solstice sunrise.

The Harris Site seems to differ from Wind Mountain and the rest of the Mimbres Valley in regard to orientation and alignments. More emphasis appears to be placed on the summer solstice sunrise as opposed to the winter one. In fact, the most significant finding is that the alignment between the two major Three Circle communal structures lines up with the summer solstice sunrise. The alignments with Capella, a summer solstice marker, also demonstrate the importance of this event. Creel and Anyon (2003) and Woosley and McIntyre (1996) did not look at alignments between structures, though, and thus may have missed something significant.

A few pithouses appear to be pointed toward the southern major standstill rise during
this time as well. In fact, a constructed rock cairn (Feature 2) is located in this general direction and is along the line that extends from one of the diagonals through Pit Structure 10 (Three Circle phase). Creel and Anyon (2003) and Woosley and McIntyre (1996) do not investigate the possibility of a relationship between orientations and lunar standstills.

There do appear to be changes in emphasis over time, but not the ones expected. It would appear as if the southern major standstill becomes more important over time as do other lunar alignments. There is only one possible one during the Georgetown and a couple during the San Francisco. However, the Three Circle phase has seven possible orientations to standstill positions. Solar positions on the other hand, such as equinoxes and solstices, appear to be equally important throughout the occupation of the site. It is possible that lunar standstills became more important as society became more complex for only the more complex societies of the Southwest (Chaco and Mesa Verde Anasazi and Hohokam) appear to have marked the lunar standstills.

There are also differences between domestic and communal structures at the Harris Site. Astronomical events are more often commemorated in the domestic structures while communal structures have more instances of marking other important directions such as important landscape features (Cooke’s Peak and the rock outcrop/Feature 8) and the cardinal directions. It would appear as if the domestic structures were more concerned with celestial events and important dates while communal structures were more concerned with the landscape. As a result, perhaps domestic structures were the ones used for maintaining and checking a calendar system. Such a practice could be similar to that of the Zuñi where the people of the pueblo would use portals and wall
calendars to check the sunwatcher’s work. The communal structures were less concerned with this timekeeping function as neither sunwatching duties nor calendrical checks were conducted there (see Chapter 6). Therefore they were more likely to commemorate important “ritual” directions, such as the cardinal directions and important landscape features. These directions also included the summer solstice sunrise and southern major standstill, two events that appear to be important at the Harris Site.

There are also instances of orienting or aligning things to the sunrise and sunset on the equinoxes. Marking the equinox, or the east-west direction, usually only occurs in more complex societies as this event/direction is not directly observable. The equinox is merely the halfway point between the solstices. If this direction is marked, then, it constitutes evidence of long-term observations and “more advanced knowledge and procedures” (Hardman and Hardman 1992: 153). Determination of the equinox is derived from either counting the days between solstices or measuring the distance between reference points (solstice points on the horizon). Therefore, marking the equinox directions, as well as the other cardinal directions, shows that astronomical knowledge among the Mimbres of the Harris Site was quite sophisticated.

Overall, preliminary findings indicate that the Mimbres occupants of the Harris Site may have differed from the occupants of other Mimbres sites. They possibly valued different astronomical events, and they placed more emphasis on astronomy in their domestic structures than their communal ones. However, few other investigations have been conducted, and they remain incomplete. Future research may find that the Harris Site does better coincide with the rest of the Mimbres-Mogollon area.

While the Harris Site shows evidence of alignments and orientations to all the major
lunar and solar events, the summer solstice and southern major standstill appear to be the most important. The cardinal directions also appear to be important, perhaps even as important as they were during the Classic Period and later. The importance of the cardinal directions is not just seen in building alignments but also in the position of two significant cultural landscape features, the rock circle (Feature 1) located almost due East of the site and the rock “shelter” (Feature 6) located almost due South of the site.

The marking of the summer solstice may not be as unusual in the Southwest as one might believe. In Mesoamerica, the summer solstice was the more important solstice as it occurred during the rainy season. The winter was not as harsh in the tropics either, making the winter solstice a less crucial ceremonial event. The summer solstice could also be related to August 13 (start of the Mesoamerican year) as it would provide a way to calculate when that day occurred (Malmström 1997). Mesoamerica, however, was actually more concerned with the sun’s zenith passages than the solstices (see Chapter 5). These zenith passages do not occur in equatorial environments such as the Southwest. The summer solstice thus may be the closest “event” to the zenith passages. Therefore it is possible that in the southern Southwest, which is closer to Mesoamerica than the northern part, an attempt was made to celebrate an event that was akin to celebrations in the more powerful and influential area of Mesoamerica.

A possible attempt to “celebrate” the zenith passage has actually been seen at Isleta Pueblo. This historic pueblo conducted ceremonies that involve “drawing down the sun and the moon” by using sunlight and moonlight during meridian passages, which are similar to zenith passages except that neither the sun nor the moon ever travels directly overhead (Zeilik 1989: 161).
The marking of the southern major lunar standstill, though, is unusual. While the moon and its cycle were considered important, there are few instances of the marking of the lunar standstills in the prehistoric and historic Southwest, or even in Mesoamerica. The only places where there is evidence of it being marked are possible architectural alignments in Chaco Canyon and the placement of Chimney Rock Pueblo, at Mesa Verde, and at Casa Grande in the Hohokam area. It thus seems unlikely that the Mimbres occupants of the Harris Site would repeatedly mark this event. The southern major standstill is only a few degrees off of the southern Venus standstill, so it may be that Venus was the object of desire (Kelley and Milone 2005). While no examples of marking Venus standstills are found in the Southwest, there are many instances of it being marked in Mesoamerica as Venus was a premier deity there (see Chapter 5). The southern major lunar standstill is also about six degrees off of the winter solstice, so it is possible that the apparent standstill markings are in fact very rough solstice markings. Therefore the Harris Site inhabitants may have been actually marking the winter solstice sunrise, which would be more in tune with the rest of the Mimbres Valley.

Overall, regardless of whether the specifics of the Harris Site differ from the Mimbres-Mogollon area as a whole or not, the occupants there more than likely engaged in similar observation and timekeeping practices. Mimbres pithouse groups did indeed observe astronomical phenomena and use such phenomena to guide the construction of their structures and establish a calendar. This calendar was used for both secular and religious purposes as it set the dates for both agricultural steps and important ceremonies. Astronomical observation, in particular sun-watching, and the knowledge gained from it also may have conferred some power on certain families or clans/corporate groups.
## APPENDIX

### PITHOUSE ORIENTATIONS

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<th>Pit Structure/ Pithouse by Phase</th>
<th>Uncorrected Azimuth from House Maps (Degrees)</th>
<th>Uncorrected Azimuth from Site Map (Degrees)</th>
<th>Corrected Azimuth from House Maps (Degrees)</th>
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