ARCHEOASTRONOMY OF THE CHACOAN PUEBLO

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ABSTRACT

There are many celestial events that can be studied at Chaco Canyon such as the supernova of AD 1054, the solar eclipse of 1097, and the possible viewing of the coronal mass ejections visible around the lunar limb. This paper, however, will focus on using the archeological evidence left by the ancestral Puebloan peoples in the area of Chaco Canyon, New Mexico, comparing and contrasting data for solar alignments and observing sites with the evidence for lunar alignments and observing sites.

To achieve an acceptable sampling, I have chosen to rely on three major archeoastronomy teams/authors: Malville, the Solstice Project, and Zeilik, with numerous additional references as supporting documentation. Analyzing the available research data, I will discuss the findings and explain the differences in demonstrated intent and use of various observing sites within Chaco Canyon, versus their plausible intent and use. Dependent upon the source, there are between nine and fourteen major dwellings in Chaco Canyon and numerous smaller ones [Lekson, Malville and Yankosky, Sofaer 1997, NPS, and Charbonneau, White and Bogdan].

1. BACKGROUND

Major dwellings in Chaco Canyon are referred to as Great Houses and several, such as Pueblo Bonito, Una Vida, Peñasco Blanco and Chetro Ketl contain as many as seven hundred rooms and numerous kivas [Sofaer 1997].

Kivas are predominantly found within the Great Houses and are uniquely recognizable by their circular form. Kivas are semi-subterranean structures that may be small or large. Some scholars believe kivas were used only as ceremonial chambers and cite as evidence the modern pueblo's use of them. Other researchers contend they were used in a more routine manner, as shown by the large number of round rooms found in the great house sites. In any case, kivas were an important architectural feature in Anasazi structures and are still important components of modern pueblos [NPS]. When a kiva is considerably large it may be referred to a Great Kiva, such as Casa Rinconada, which is located approximately 0.6 kilometers (km) south of Pueblo Bonito and Chetro Ketl.

Humans have inhabited Chaco Canyon for at least 8,000 years [NPS], but the canyon did not become a major Puebloan cultural center until AD 850. This coincides with the construction of the first of the great houses such as Pueblo Bonito and Chetro Ketl. Chaco Canyon Puebloan peoples, or "Anasazi" flourished there until AD 1250 [NPS].

During AD 850 and 1250, the Anasazi built large great houses, which are theorized to incorporate solar and lunar alignments.

As we'll discuss, the Anasazi's ability to anticipate the solstices and other celestial events is due in no small part to their attention and understanding of cardinality, which is well documented in their buildings. For example, we see it in the precise north-south-east-west alignments of walls, the sun's rays illuminating parts of walls and the general cardinal layouts of the great houses. We should note that during the period AD900-1200, the pole star Polaris subtended an angle greater than 5º from true celestial north [Malville and Putnam 1993] and most construction took place in the canyon after AD 1080, with the exception of Pueblo Alto's north wall, which was constructed prior to AD 1080 [Lekson, Malville and Yankosky]. Therefore, the Anasazi had to develop some other means to cardinally align their structures, such as a gnomon[1]. The gnomon was used by several cultures around the world for determining the length of the year and the time of the solstice and can be used in determining true north. Of course, to avoid the problem of parallax, it is preferable for the observer to use features on the horizon far away. This type of observing forms the basis of horizon calendars, which also represents the most common practice of Pueblo people today, and to some degree their ancestors the Anasazi [Lekson, Malville and Yankosky, Charbonneau, White and Bogdan].

To ensure the correct dates, or period of time for celebration, a calendar with some degree of accuracy would have been necessary. It is possible that for important events such as festivals and other rituals, a solar-lunar based calendar would have been developed [Lekson, Malville and Yankosky]. The primary motivator for the calendar was probably the monitoring of the seasons, and the return of the growing season.

There is one last item that needs addressing to fully understand the debates surrounding the hypothetical intent of the Anasazi in applying the system of solar or lunar shadows to the solstices or equinoxes. The terms predictor or anticipatory, versus calendar and calendrical are used throughout documents by scholars to denote a pending event, such as the winter solstice. Definitions and explanations are provided [Squires 1999] in various documents for terms such as anticipatory observations, calendrical sites, horizon calendar, sun watching stations, sun shrines and sun portals, to mention a few. Primarily, it comes down this: a calendrical marking may be associated with a mountain range where an observer can absolutely state that the sun is only at the notch or mountain peak at a certain time of the year. These dates can be spread out along the mountain range to provide dates leading up to the solstice; thus, the mountain range serves as a calendar. When the solstice approaches, the sun's movement along the mountain range is much smaller (discussed later), so a more refined method is used, such as the spiral petroglyph on Fajada Butte (also to be discussed later) to predict or anticipate the solstice in the coming weeks leading up to the solstice.

Both Malville and Zeilik [Malville and Putnam 1993, Squires1999, Zeilik 1983-1984 and Wijiji] have applied these terms as I just described and I will do likewise. The various

[1] A shaft or pole placed vertically in the ground. The shadow cast by the gnomon at various times of the year could be used to determine the length of the year or geographic north.

authors and research teams have used the terms interchangeably [Sofaer 1994 & 1997, National Geographic, Public Broadcasting System , Sofaer-Cambridge, Zinser and Sinclair 1979] and I believe this leads to some confusion when rendering conclusions.

2. SOLAR AND LUNAR ALIGNMENTS

The Chacoans, like many agrarians, set their ceremonial and planting calendars by the solar cycles. To monitor the seasons and the solar progression, the Anasazi established observation posts throughout Chaco Canyon. Some of the observation posts were located adjacent to or within the major dwellings, while others, such as Fajada Butte, were located well outside the great houses [National Geographic Magazine].

Of all the individuals and groups who have studied the Chacoan Pueblo, one of the most visible is the Solstice Project, founded by artist Anna Sofaer. The documentation that this group has amassed since starting in 1978 [Sofaer 1994 & 1997, NPS, Public Broadcasting System, Sofaer, Zinser and Sinclair 1979] is considerable. The largest amount of research by the Solstice Project has been on Fajada Butte and the phenomenon referred to as the Sun Dagger, a phrase coined by Sofaer.

2.1 FAJADA BUTTE, SUN DAGGER

Fajada Butte is a large promontory located in the southeast area of Chaco Canyon, approximately 1.5 km south of the great house Una Vida. The main items of interest to archeoastronomy are the three stone slabs located approximately 10m from the top of the butte. Early studies supported the theory that the stones were placed in their current positions by humans [Sofaer, Zinser and Sinclair 1979], but this theory has been dismissed by most subsequent studies. Each stone has been calculated to weigh 1,000 kg [Charbonneau, White and Bogdan].

Fig. 1. *Aerial view of Fajada Butte. Note the circle identifies the three slabs used to mark the solstices, equinoxes and lunar standstills. March 5, 1999(Rice University)*

The Solstice Project asserts that three rock slabs near the top of the butte collimate light so that markings of shadow and light on two spiral petroglyphs indicate the summer and winter solstices, the equinoxes, and the lunar major and minor standstills (Fig 2). Studies conducted since the discovery by Sofaer, et al., support the interactions of shadows on the spiral petroglyphs. As to dating the petroglyph, there is a presence of the Mesa Verdeans on Fajada Butte, so dating the age of the Sun Dagger petroglyph is difficult and leaves open the question whether or not the Sun Dagger is contemporary to the phenomenon of Chaco Canyon [Malville and Putnam 1993]. Pottery shards excavated at the base of the butte indicate Fajada Butte was at least visited as early as the start of the 10th century, which predates the Chimney Rock Pueblo, discussed later, by two centuries [Charbonneau, White and Bogdan]. I mention this because there is evidence that attention given to the lunar standstills at Fajada Butte were inspired by the moonrises at Chimney Rock [Malville and Putnam 1993].

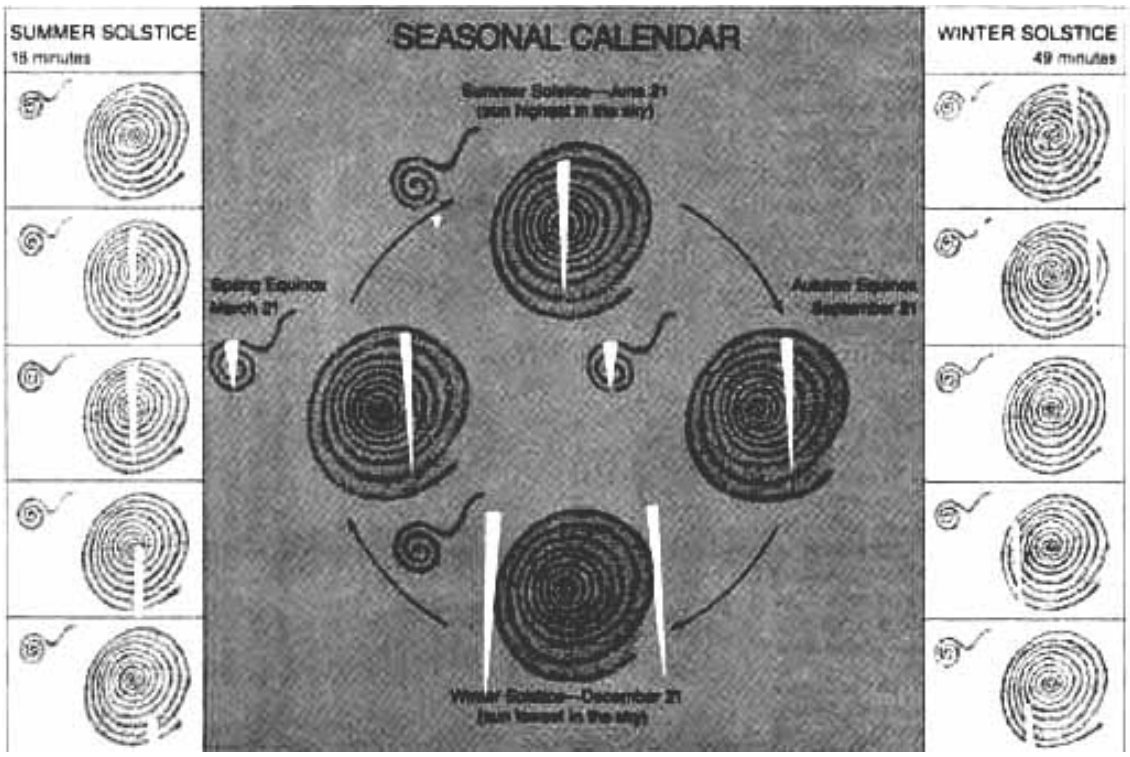

Fig. 2.
Schematic showing hypothetical seasonal calendar. At top moving clockwise depicts Summer solstice, Autumn equinox, Winter solstice and Spring equinox. (Solstice Project)

The phenomenon of the Sun Dagger occurs during the solstices and equinoxes. In addition, the shadow cast by the moon during the major and minor lunar standstills on the petroglyph is quite remarkable [Sofaer 1997]. The complete lunar cycle of 18.61 years, which corresponds to successive major standstills, may be reflective in the spiral petroglyph's 19 grooves (Fig 3). Standstills are when the moon will be at its highest and lowest position in the sky over this approximately 19 year period, reaching declination 28º +/- (north/south). Also, the First and Last Quarter Moons around the time of the

equinoxes can be seen at their highest and lowest declinations. It takes the moon 9.3 years between the minor and major standstill. During the major standstill, the shadow of the moon touches the left outer groove of the petroglyph, while the lunar shadow bisects the spiral during the minor standstill. Therefore, the three-slab site serves as an anticipator of the coming standstills. [Malville and Putnam 1993, Sofaer/Cambridge Press]

It is also possible that the Anasazi's knowledge of the 19-year lunar Metonic cycle may be reflected in the 19 grooves of the petroglyph. [Malville and Putnam 1993] There is a small groove cut in the place where the moon's shadow bisects the spiral during the minor standstill and a groove on the left edge of the petroglyph where the moon's shadow touches the spiral during the major standstill. Both groves are cut parallel to the moon's shadow and at such an angle as to accommodate the shadow. The angle of these two grooves differs from the groove of the spiral petroglyph [Malville and Putnam 1993].

Unlike the sun with its annual cycles of solstice and equinox, anticipatory observations for standstills would have to be carried out several years ahead of the event [Zeilik 1983], and even then, the moon's movement along the horizon would be very small as the standstill approached. This makes using the Sun Dagger site to monitor the lunar standstills more accurate and user friendly.

Fig.3.
Photograph of the spiral petroglyph on Fajada Butte, June 23, 1978. Note the 19 grooves counted l-r. (Solstice Project)

Some scientists have pointed out that while the modern Pueblo show great interest in the lunar phases for time-keeping and annual calendrical purposes, they have little or no interest in the longer lunar cycles [Charbonneau, White and Bogdan]. We do know that the moon is important to the Pueblo [Malville and Putnam 1993]. I would counter-argue that present-day Pueblo are victims of the modern information age and it is possible that ancient practices, such as observing the lunar standstills, have been either lost or have become more diluted with each generation.

According to a paper attributed to Rice University, Zeilik is quoted as saying, "average daily motion of this light image during the month prior to the summer solstice is about 1mm --the thickness of a dime. The shaft moves horizontally a total of only 2mm in the four days centered on the summer solstice." This website appears afflictive in its comments regarding the sun dagger and Sofaer, while trying to give the appearance of validity. However, the quote attributed to Zeilik appears to be correct regarding the amount of the sun's movement closer to the solstice. [Squires 1999] Sofaer comments that a shift of the light shaft during the solstice of 2mm can be detected by comparing photographs [Sofaer, Zinser and Sinclair 1979].

There is little doubt about the correlation of the sun's ray onto the spiral petroglyph during the solstices and equinoxes, but I question whether or not the combination could have been used as a pure calendrical marker for the solstice using the naked eye. As Malville points out, due to the difficulty in ascending the Butte, the three-slab location with sun dagger phenomenon is more likely a shrine than a place of calendrical purposes. He states further that aids used in determining the solstices and planting cycles are usually kept near populated areas for easier monitoring [Malville and Putnam 1993]. It is possible that shelter was available at the base of the butte [Charbonneau, White and Bogdan, Sofaer, Zinser and Sinclair 1979] for the priest to use during the weeks prior to the solstice.

2.2 CASA RINCONADA

The great kiva of Casa Rinconada has been referenced and studied for more than 70 years and is a good example of a Chacoan structure whose cardinal alignments have been associated with the summer solstice. As with other major structures in Chaco Canyon, the building's alignment to the four major cardinal directions of north, south, east, and west were probably intentional and not coincidence. When the north axis is extended, it connects with the great houses of Tsin Kletzin and Pueblo Alto [NPS].

With Casa Rinconada there are four features which play a possible role in astronomy: (1) the opening in the northeast corner of the wall, labeled 'A' in Figure 4; (2) the adjacent rooms just outside the wall; (3) the six large niches on the inside of the wall, labeled A-F; and (4) the four holes for the support post labeled A-D. In its present day configuration, Casa Rinconada can be used as a calendrical predictor for the summer solstice [Zeilik 1984].

During the summer solstice, sunlight enters through opening 'A' and illuminates niche 'E'. As a predictor of the coming solstice, sunlight enters opening 'A' about seven weeks prior to the solstice illuminating the wall near niche 25. Over the coming weeks, the sun tracks south until it illuminates niche 24 approximately four weeks prior to the summer solstice. [Zeilik 1984]

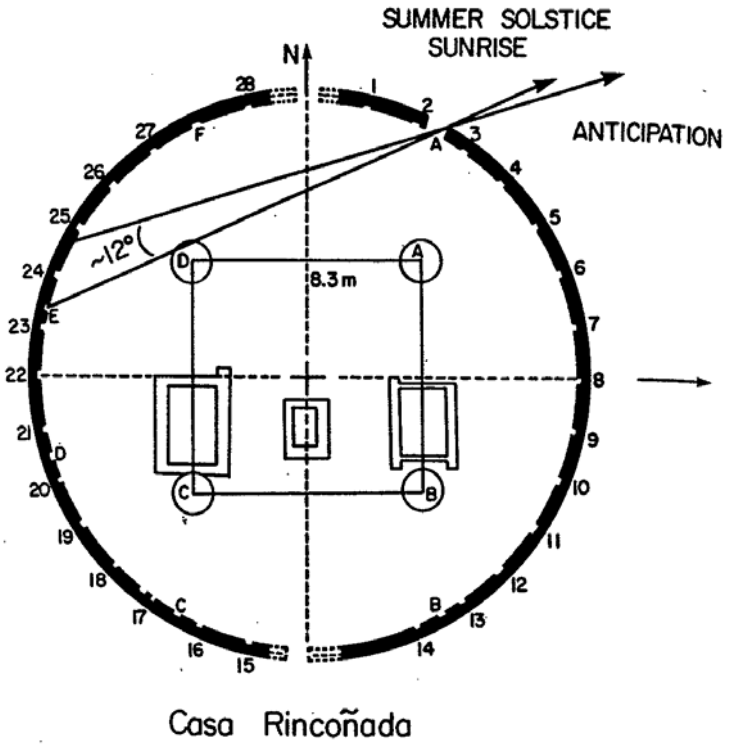

Fig. 4
Schematic drawing of the ground plan showing the sunlight path approximately 10 weeks prior to the summer solstice. (Zeilik adopted this drawing from Williamson's study in 1982.)

However, the U.S. National Park Service restored the northeast opening and wall in the 1930's, so the original size and placement of the opening is unknown. Early photographs and drawings from the 1930's and 1965 show eight large gaps in the wall, two of which are the north and south entrances. Prereconstruction photos show the west wall intact, but the east wall (vicinity of niche 'A') has been completely rebuilt (Vivian & Reiter 1965) [ORACLE]. The width of the opening 'A' would be extremely important. If the opening were only half its size, no sunlight during the summer solstice would enter and illuminate the northwest wall. [Charbonneau, White and Bogdan]

In addition to the questions concerning the opening 'A', it is uncertain whether a wall existed outside the window. According to Zeilik, a previous study conducted by Vivian and Reiter (1962) refers to the opening 'A' as a window or door leading to an adjacent room on the northeast. Such rooms exist in the great kiva in Chetro Ketl and, at Aztec, it is completely surrounded on the periphery by rooms, allowing no sunlight to enter. Other studies indicate there was a room constructed outside the opening, but it was not known if the room existed throughout the kiva's use [Malville and Putnam 1993]. While Zeilik credits Williamson (1982) with finding field notes of Casa Riconada prior to reconstruction, he does take issue with Williamson's [Williamson, Fisher and O'Flynn 1977] assertion that the northeast window served as a sacred showing of the sun, but also as a calendrical marker [Zeilik 1984]. The artist Anna Sofaer of the Solstice Project references Williamson as support for the solstice alignment. Also, she references Zeilik as a source for the solstice alignment [Sofaer 1997], however, Zeilik's 1984

Archeoastronomy article [1984] makes a counter argument to Williamson' assertion, therefore, does not support either Williamson or Sofaer.

Even if the opening 'A' was not obstructed by another room and the reconstruction of the window opening were in concert with the original layout, the roof post 'D' (Fig. 3) would have obstructed the sunlight from striking the northwest wall. The roof post would only need a diameter of 16-inches or larger to have blocked incoming sunlight. Considering the posts used in Chetro Ketl were over 26-inches in diameter [Malville and Putnam 1993], this is not unreasonable. [Charbonneau, White and Bogdan]

As a sidebar, during the winter solstice, sunlight enters through the south entrance and illuminates the southeast wall in the area of niches 24 and 'D' (Fig 3), in a similar manner as previously mentioned regarding opening 'A' and niche 'E'. This is a direct result of the reconstruction and no roof covers the south entrance, as it did originally, thus reinforcing the suggestion that the light display is also an artifact of reconstruction. [Zeilik 1984]

2.3 WIJIJI

At the eastern most location of Chaco Canyon is probably the last of the great houses built by the Anasazi, called Wijiji [Malville and Putnam 1993]. In relation to another prominent terrain feature, it is 3.25 km east by northeast of Fajada Butte. Research over the years has identified several solar observing sites within the great house and in the proximity of the settlement [Ancient Observatories]. Of particular interest is a ledge approximately 1 km east of the main settlement of Wijiji that may have been used by Anasazi priests to anticipate the winter solstice [Zeilik 1983].

On the ledge are not only Anasazi symbols, but also Navajo sun symbols and other sacred images, suggesting that the Navajo also may have used the site to anticipate the sun's renewal [National Geographic].

According to Zeilik [1983], in December 1982 his team placed observers at various points on and below the ledge to observe the winter solstice and noted from what position the sun was observed rising from behind the rock pillar some 500 meters further east on an azimuth of 119^{o}. What they found was that any position along the ledge between the petroglyphs at both ends of the ledge would place the sun in the desired position behind the rock pillar, marking the winter solstice. Due to the obliquity of the ecliptic, the position of the observer in AD 1100 would have shifted approximately 2m north toward the large boulder with the petroglyph. Zeilik points out that research conducted by Williamson (1983) identifies the sun rising behind the rock pillar as viewed from the area of the pictograph on the ledge some 16 days prior to the solstice [Zeilik 1983].

It would be almost impossible for the observer to establish the solstice based on horizon markers. The azimuth of the sunrise shifts daily by 10 arcmin, twenty days before solstices, then 5' per day ten days later, and finally less than 1' per day the last three days

before solstice. Some studies have suggested that the smallest change in displacement detectable to the eye is at the most 4', which would have occurred about 8 days prior to the solstice; therefore establishing the solstice day on the day of occurrence with the naked eye would not have been possible. The best application would have been to use the sun's displacement on the horizon as a predictor two to three weeks prior to the solstice. [Charbonneau, White and Bogdan] The Wijiji site supports a sun watching station for sunrise and sunset used by Anasazi priests to anticipate the winter solstice, but not an exacting use as a calendrical marker. While the Pueblos observed equinoxes, they were not celebrated and were considered less important than the solstices [Squires 1999].

Zeilik's team also witnessed the solstice sunset in the very bottom of the 'v' formed in the rock face. The 'v' notch is about 100m to the southwest of the observer's ledge. They noted that any movement by the observer moved the sun's disk outside the 'v'. There is a narrow 5m range of the ledge where the winter solstice sets in the notch of the 'v'.

For the priest to observe the winter solstice from the ledge, he would have to have traveled 1 km from Wijiji in darkness during winter, across a desert landscape and climbed a staircase leading to the ledge from where he could have made observations. All this seems unlikely at best; remembering that there were no REI outfitting stores or Starbucks back then. Unlike Fajada Butte, there is no evidence of small dwellings near the ledge for the priest to seek shelter in the weeks leading up to the solstice.

2.4 CHIMNEY ROCK

The Chimney Rock Puebloan structures have been identified as a Chacoan outlier, with its buildings similar to those found in Chaco Canyon. The twin pinnacles of Chimney Rock are quite remarkable and frame the moon during the major northern standstill. [Malville and Putnam 1993]

In August 1988, a team of researchers confirmed their predictions that the major lunar standstill rose between the gap of the two pinnacles of Chimney Rock. Furthermore, the major standstills of the latter part of the eleventh century were AD March 1057, October 1075, and June 1094. The last two dates correspond to the construction dates of the Chimney Rock Pueblo [Malville and Putnam 1993].

When the Great House Pueblo was built on the mesa in AD 1076, the moon was rising between the rock towers. Also, it is estimated that in AD 1077 the moon appeared between the twin pinnacles more than 40 times. The Great House was expanded in AD 1093-94 when the moon was again rising between the rock towers. Some have suggested this may be nothing more than a coincidence, but archeoastronomers, such as Malville, et al., have demonstrated the lunar alignment during the standstills [Malville and Putnam 1993, Sofaer 1994]. Furthermore, during AD 1076 and 1093-94, lunar standstills occurred. I believe the evidence shows the Puebloan celebrated these events as suggested by Malville [Chimney Rock]. Two of the major standstills of the latter part of the

eleventh century were AD October 1075 and June 1094. An addition a second floor was added to the kiva in 1093. The logs used have been dated to the summer of 1093 and it was very unusual for construction to be undertaken during the growing season. From the roof tops of the kivas people could have observed the moonrise between the twin pinnacles [Malville and Putnam 1993].

As stated earlier, predicting the solar solstice and equinox required the priest to anticipate several weeks in advance of the event, and to anticipate a lunar standstill required several years advance planning. Malville tells us that anticipatory lunar observations at the start of each northern standstill were possible and the advance yearly planning would not have been necessary. Furthermore, even though the lunar standstills were clearly marked on the three-slab site of Fajada Butte, there was skepticism as to its validity since no other lunar marker was available. With the discovery of the lunar observing site of Chimney Rock, there have been suggestions that Chimney Rock inspired the markings on Fajada Butte. [Malville and Putnam 1993]

3. CRITIQUE OF FINDINGS

With regard to the Sun Dagger on Fajada Butte, there is no doubt that the solstices, equinoxes and standstills are well marked by the three-slab observation port. This has been observed by many research teams and individuals on the exact dates and documented. What is more difficult to explain and interpret is the reason for the 19 grooves in the spiral petroglyph. If the spiral had been cut with any number of grooves other than 19, and positioned on the rock face so the shadows of the sun and moon bisected or touched the edge or bracketed the spiral, it would serve the same purpose. If the Anasazi did have an understanding of the Metonic cycle or the standstills, it would have been remarkable. With the existing evidence, I choose to believe they understood the basics of the lunar standstills and the halfway point between minor and major standstills.

But was the three-slab site used as a calendrical instrument, anticipatory site or neither? I believe the site was used to predict the coming of the solstices during the final 2-4 weeks. The amount of movement of the sun's shadow on the spiral during those final weeks is very small, resulting in less than 2mm movement within the last week. The human eye cannot detect this small displacement. For the sun priest, the horizon calendar would have provided the annual date to within a month of the solstice and the three-slab site would have refined that down to the final weeks. The Fajada Butte as a solar site is an excellent predictor for the solstice.

When considering Casa Rinconada as a predictor of the summer solstice, it is easy to speak of demonstrated use. Year after year, the summer sunshine projects its rays onto the wall and moves to the specific niche on the day of the solstice. However, an in-depth review of documents concerning Casa Rinconada tells us that there was significant reconstruction to the great kiva, enough that size and adjacent surrounding of opening 'A' are in question. And even if there were no obstructions to the opening, then the roof post

'D' would have blocked the light from illuminating the west wall. While the cardinality of Casa Rinconada is precise in its north-south and east-west alignments, I believe there is enough evidence against its use as a solstice marker.

During the research on Wijiji, I found at least three teams or institutions that had conducted either on-site research or academic appraisals of available material. All concluded that the ledge served as a sun watching station to predict the winter solstice. As previously mentioned, the eye could not have detected the small displacements of the sun as it approached the solstice on the horizon at sunrise. The more logical and demonstrated use would have been as a predictor two to three weeks prior to the winter solstice.

The Chacoan outlier of Chimney Rock is unique in that it is over 160 km from Chaco Canyon, it is built high above the canyon floor using the same construction techniques, and it required the same large amounts of labor as Chaco Canyon Pueblo. Chimney Rock is one of the few settlements that seem to emphasize the major lunar standstill. It has been demonstrated that during the major standstill, the moon rises between the twin pinnacles as viewed from the Great House Pueblo. In AD 1057 there was a major standstill with the moon rising between the pinnacles. The next two standstills correspond to construction of the Great House in AD 1075 and 1094. When the Great House Pueblo was built in AD 1076, the moon was rising between the twin pinnacles and it is estimated that the moon appeared between the pinnacles at least 40 times in AD 1077. In 1093-94, the Great House was expanded, which also coincided with the moon rising over Chimney Rock. From Chimney Rock, anticipatory lunar observations were possible, negating the need for planning several years in advance. It is plausible that the standstills at Chimney Rock inspired the markings on Fajada Butte.

The ancestral Pueblo had no written language and left no clear records of their thoughts of beliefs. We have to ask ourselves, did the Anasazi keep track of the lunar standstills because of some spiritual significance, or was it just a beautiful celestial event occurring in the sky?

4. SUMMARY

Many research teams and individuals have demonstrated that the Sun Dagger on Fajada Butte marked the solstices, equinoxes and standstills. The evidence also shows that the combination of spiral petroglyphs and the three-slab stone structure captured the rays of the sun or moon at the exact dates of those celestial events. Quite the opposite holds true for Casa Rinconada. The alignment created by a window opening and the summer solstice sunlight creates the impression of a solstice marker. While at present day this is easily demonstrated and observed during the summer solstice, analysis casts a different light on the plausible intent and use by the Anasazi. Prereconstruction evidence shows that another room existed outside the opening used to allow sunlight to enter and the size of the opening itself is uncertain. Combining this with the roof posts blocking the

sunlight from illuminating the niche, I seriously doubt the use of the kiva as a solstice marker.

It has been demonstrated that the two sites, Wijiji and Chimney Rock, served as observing ports for the winter solstice and the major standstill. From the ledge close to Wijiji, the priest would make his observations looking east toward a large rock pillar, and determine the approximate time for the winter solstice. While the survey of the Wijiji site demonstrates it may be used in this fashion, the specific location the observer or priest placed himself could vary several feet and still place the sun in the particular spot relative to the rock pillar, therefore, the accuracy as a calendar is extremely low. Thus, the site was probably used as a sun shrine and an anticipator of the winter solstice. Chimney Rock is a Pueblo site that captures the major lunar standstills between twin pinnacles. Not only has this been demonstrated, but also the construction dates of the Great House Pueblo correspond to two successive standstills. From this site, the Anasazi could not only observe the standstill, they could also predict the event, which would have been remarkable for these prehistoric people.

In today's technologically developed societies, general populations are not aware of heavenly cycles such as the lunar phases, longest and shortest days of the year, etc. As astronomers, we may have friends, neighbors or relatives ask, "What is that bright star I see in the evening after sunset?" When we ask if the star is in the west, more often than not they can't answer because they are uncertain of the cardinal directions of the compass. When confronted with the idea that ancient Anasazi were not only familiar with the celestial heavens, but were also versed in predicting the winter and summer solstices, our puzzled pals are amazed and even skeptical. With our cultural biases affected by our "advanced" society, it is difficult for some to accept that peoples of the Chacoan Pueblo were accomplished sky watchers.

When we study prehistoric people and their interactions with the celestial sky, it would serve us to bear in mind that after all of our research, we must still hypothesize. Zeilik said, "Archeoastronomy will always be an uncertain area of study, for we can never ultimately know the intentions of a preliterate, prehistoric people."

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