Hitching Post of the Sky

Did Paleoindians Paint an Ancient Calendar on Stone along the Amazon River?

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ABSTRACT

Painel do Pilão is an archaeological rock art site among the Serra da Paituna Mountains near the city of Monte Alegre, along the Amazon River in Brazil. It is just one of many sites with ancient red-painted images in a region dated by archaeological excavations to be as early as 11,200 to 10,500 years before the present era, at the end of the last Ice Age. However, this location has more than just anthropomorphic images, handprints, and spiral designs. The main attraction here is a large rectangular grid with categorical marks potentially representing a calendar-like system. A sky-marker perched at a summit above the panel provides further evidence to support this theory. The reference marker is in the shape of a hitching post that acts as a window to “capture” celestial objects as they move across the sky at a particular time, location, and day of the year. Although originally considered as a lunar calendar, this article presents evidence to suggest a solar-solstice calendar provides a more compelling case.

Keywords
Photography, Archaeology, Rock Art, Archaeoastronomy, Paleoindians, Amazon

INTRODUCTION

What can archaeologists learn from rock-art? Archaeologists are first and foremost Anthropologists- we are interested in studying humans, our cultures, customs, and experiences. Among the most common questions persisting in anthropological debate is when along our evolutionary trajectory did ancient humans resemble us as we are today. Physical anthropologists provide us with a time frame for the emergence of anatomically modern humans, beginning some 195,000 years ago (Grine, et al. 2009). They also claim that stone tools, which first appeared with our hominid ancestors some 2.6 million years ago, evolved steadily until it exploded into a wide panoply of stone implements beginning in the Upper Paleolithic, around 40,000 years ago (Andrefsky 2005). The tool revolution of the Upper Paleolithic also accompanied advanced cave art and long distance trade in what some anthropologists refer to as evidence of human behavioral evolution (Tattersall 1998). We can not know what ancient humans said to one another, how they spoke, learned and laughed. However, through their art we begin to access their minds (Alpert 2008). Through rock art we have the earliest glimpses of their world as they considered it, not merely artifacts that didn’t erode, but rather the subjects, figures, and associations on their minds that they decided to mark permanently on to stone.

Monte Alegre’s painting tradition is somewhat different from other Pleistocene rock art around the world. For example, the cave art in the Pyrenees Mountains between France and Spain has many images of mega fauna and animals that are believed to have ritual hunting (Henri Breuil in Straus 1992) or (contested) shamanic significance (Lewis-Williams 2002). Their art is highly figurative, showing artistic techniques of perspective (Clottes 2008). The Kakadu rock art in Australia references the mythological Dreamtime stories of the Aborigines. Other art there and at Arnhem Land displays morphological and characteristic details of animal viscera in a unique style called x-ray (Chippindale and Taçon 1998). The Tassili hunting and herding images from the Sahara desert in Africa are largely believed to depict subsistence activities and the migration of new herd animals into the region (Lhote and Colombel 1979). The images there are drawn in a naturalist perspective including details of costume and dress. While the art at Monte Alegre contains some similarities to these other sites, such as handprints, stick figures, and animal images (fig. 1), several designs here emphasize astronomical and cosmological phenomena (fig. 2), reflecting early archaeoastronomy and perhaps calendar marks- evidence indicating how this society perceived and recorded the sky.

HISTORY

This section from (Davis 2009:538-9)
The earliest written mention of rock art at Monte Alegre was by the English naturalist Alfred Wallace in 1849, who, in search of cave paintings, encountered and sketched images at Serra da Lua and an unidentified location near Pedra do Pilão—seemingly Painel do Pilão (Wallace 1889:103-5). A team led by Louis Agassiz traveled through the area in 1865, and although Agassiz wrote on the process of making paint and resin for *cuiás* (traditional bowls) created by an Indian woman from the Indian village of Surubiju near Serra da Lua, he did not comment on the art of the Serra (Agassiz 1868:167,361-4). In 1870-1871 the geologist Charles Frederick Hart, who was part of Agassiz’s previous group, returned with the Morgan expedition and recorded the rock art at Serra do Ereré in more detail. His description of many of the images led him to the conclusion that “the most important [images] among these appear to be representations of the sun, moon, and stars (Hartt 1871:142).” Hartt further explains, “I think that these figures point to a worship of the sun by the tribes which executed them . . . and in the vicinity of the rock tower at Ereré, seems to me that those places had something of a sacred character and were often resorted to (Hartt 1871:147).”

Shortly thereafter, Hartt became an integral figure of the Brazilian Geological Commission, initiating several other expeditions through the region to characterize the geological formations of the Serras (Hartt 1896). Herbert Smith conducted one such expedition to explore the Curupatuba drainage system which feeds into the Amazon River at Monte Alegre. Through Smith’s exploits, he described the Indians in the village of Ereré, commented on the endurance of some of their traditions (Smith 1879:346,371-397), and summarized some of the regional myths heard by previous explorers, including the Tupi belief that all things were created by either the sun or moon or a third water deity (Smith 1879:586,541-587). In 1924, Curt Nimuendajú copied paintings at Serra da Lua and Serra do Sol in Ereré, and paintings at Gruta do Pilão (Pedra Pintada) in Serra da Paituna (Pereira 2004). More recent archaeological expeditions were conducted in 1984 by the Grupo Espeleológico do Pará (Silveira, et al. 1984) and in 1986 by the Uruguay archaeologist Mario Consens, who assessed the archaeological potential of the region (Consens 1989). In 1996 and 2003 Edith Pereira contributed further significant discoveries and descriptions of images in the 14 different archaeological sites, and the most systematic and complete catalogue of the rock art in the Monte Alegre region to date (Pereira 2004).

In 1991/92 the first stratigraphic research was conducted at Caverna da Pedra Pintada located in Serra da Paituna by Anna Roosevelt and her team (Roosevelt, et al. 1996). The Roosevelt excavations yielded paint drops and lumps of pigment in stratigraphic layers dated between 11,200 and 10,500 years ago by 53 dates on plant remains and sediment associated with Paleoindian artifacts, black soil, and other food remains. The deposited paint samples were chemically consistent with that of the painted walls above the excavation. Further supportive evidence included some paintings located low on the wall surface today, which would have been at a more optimal viewing level in relation to the Late Pleistocene cave floor before the subsequent layering of Holocene sediment (Roosevelt 1999:376-9; Roosevelt, et al. 2002:26; Roosevelt, et al. 1996:190-2). Since only one pigment fragment was found in the subsequent Holocene layers, Roosevelt made the reasonable conclusion that much of the rock art was created in the Late Pleistocene.

In addition to the Paleoindian layer, Holocene, ceramic-age layers of dark gray sand were separated from the more ancient Paleoindian layer by a sterile, tan-colored sand layer. The Holocene deposits have a date range from 7,500 to 1,450 years ago- 5,550 BC to AD 500 (Roosevelt 1999:376-9; Roosevelt, et al. 2002:26; Roosevelt, et al. 1996:190-2).

**METHODS**

This presentation is part of a larger research project in the Monte Alegre region (see Davis 2009). For the past three years my broader research project has been to conduct archaeological excavations and photographic analysis of the rock art, and ancient human activity occupying two mountain ranges, Serra do Ereré and Serra da Paituna (see figs. 3a,b). The research area, which spans a roughly 5 x 5 km² area, consists of several caves with and without art, as well as open-air cliff walls that contain painted images. Broken pottery on the surface of the ground has been found in several concentrated areas in some caves as well as in open-air regions near the mountains and in the surrounding hinterland. Many lithic fragments were found strewn along the mountain path near much of the rock art on the open-air cliff walls at Serra do Ereré. The prevalence of stone and ceramic artifacts in and near the caves, as well as the art, suggests the region was well explored and utilized by ancient humans for quite some time.

In the context of the greater research area, Painel do Pilão is an open-air rock wall site located on the northeastern side of the Serra da Paituna Mountains. A small cave currently occupied by bats is located behind and a little beneath the rock wall. No art or artifacts have thus far been found in the cave or in the immediate vicinity of this panel of art, however, there is a sense that this site, which is not noticeable at a distance from the nearest road, is one of the older sites. The nearest excavated site to Painel do Pilão is about 400 meters away at Caverna da Pedra Pintada, whose art was dated to 11,200 to 10,500 B.C. as mentioned in the history section.
The methods utilized in this presentation include photos taken with a Nikon D80 SLR camera and panoramic photos from a Canon Powershot SD850 and Canon Powershot SX110 point-and-shoot cameras. The Canon was mounted on a Gigapan standard unit to take the panoramic images. Post-processing of some images was performed only to correct tilt and curvature of the images using Adobe Photoshop™ CS3 software.

One panoramic image was converted to a tif image file and imported into MapViewer™ [Golden Software]. In MapViewer, a grid was laid over the image and given dimensional measurements using geometry calculations and the field-of-view of the panorama from the gigapan stitcher notes. The field-of-view provides the full angular width and length of the panorama based from initial settings determined before photographing. Importing the image and its angular dimensions, the measurement tool was then used in MapViewer to determine the relative angular measurements of objects appearing in the image to the overall angular dimensions. Having one determined linear measurement (such as distance of camera to viewing plane, or in this image tape-measured dimensions of the grid pattern) was then used to translate angular measurements to linear measurements (of the viewing plane only).

For the purpose of this discussion however, the altimeter angle of the hitching post was determined directly as an angular measurement calculated as a percent of the field-of-view. This method was used to determine the angle of view from the location of the camera to the hitching post. Starry Night Pro Plus 6™ astronomy software was then used to verify sun angles and solar positions during solstices and equinoxes. The research team was on-location during the December Solstice of 2009.

For simplicity I refer to the December solstice as the winter solstice and the June solstice as the summer solstice, even though Monte Alegre is located 2° south of the equator and therefore its seasons would be reversed. However, being near the equator and having a tropical climate, it experiences neither winter nor summer but rather a rainy season and a rainier season, which spans roughly from December to May.

DISCUSSION

The grid-pattern image at Painel do Pilão is the focus of this presentation (fig 4). The theory that this image is a calendar is based on the number of different designs in the boxes (fig 5), the location of the grid in relation to the peculiar “hitching post” stones nearby (figs 6a,b and fig 7), and associative designs that suggest that the artists were recording sky objects and their movements (figs 8, 9). However, this theory lacks hard evidence to distinguish whether the calendar is based on the sun or the moon, and in what way. Either celestial body could be the potential subject of the calendar image. As the discussion progresses the sun emerges the more likely candidate.

We also currently lack additional archaeological evidence on-site, such as cultural artifacts like ceramics or lithics specifically at Painel do Pilão, though artifacts in the vicinity are numerous. The lack of artifacts on-site may be due to the lack of soft soil as most of the immediate area is hard stone. Additionally, no extensive search or excavation has been undertaken to unearth artifacts in the small bat cave. Usually if surface collections remain, they are an indicator that more artifacts might be interred, but the lack of surface collections may alternatively indicate the site was more of a sacred site than a habitation site. Sacred sites usually do not yield many artifacts because they would have been carefully tended to and debris continually removed.

The Grid

The grid image (fig 5) consists of a total of 8 rows and 8 columns, however, neither rows nor columns extend equally, therefore the resulting number of squares is only 49 in sum total. Of the 49 squares, 27 contain a full “x” marked in them, 12 contain part x’s, 6 contain a single vertical line, and 4 are empty. Apart from the main image is another faint column that was either decidedly not finished by the artists, or had been an original part of the grid but time faded the paint. The former theory seems more likely. If indeed unfinished at the far right, we can reasonably conclude the grid is meant to be “read” from left to right.

Although it is plausible that the grid indicates some sort of counting system, the different alterations of a single type of mark suggests the artists were counting a single object whose shape or integrity altered. The primary candidate for this theory is the moon. Based on the moon hypothesis, the full x’s might indicate full moons, ¾ or diagonal slashes might indicate a gibbous moon, a vertical line indicates a half moon, and an empty box indicates a new moon. Unfortunately these exact numbers are slightly subjective and might vary depending on how one argues a partial x or if some boxes were full x’s that faded. What is evident however, is that there are some boxes that are clearly x’s, three-fourths x’s, vertical lines, and empty.

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In addition to the marks in the boxes, many of those marks are grouped together. Most x’s are in the same columns, as are most vertical lines and empty boxes. Partial x’s seem the most dispersed but even they appear two in a row or two in a column. This grouping of marks can be further utilized to argue that they represent phases of the moon, as the phases take three to four days before changing. Add subjectivity to this theory and it is plausible that an ancient artist considered the moon to be gibbous for two days and full for six days.

However, the lack of full representation for the moon’s phases suggests that if this is a calendar of the moon, it is not a simple tally of the days exhibiting each moon phase. If this were the case we would expect to find ¼ x’s for crescent moons, and each mark would be relatively equally represented. Since that is not the case, perhaps the ancient artists recorded the moon and its phases in relation to a sky marker that it crosses, such as the “hitching post”. Yet, there is still the problem of the moon phases being represented.

Most people are well aware that the moon cycles through its phases in 29 days, not 49. However, what may be less well known is the time of night that the moon phases rise and descend across the sky. A new moon moves across the sky during the day and sets below the horizon before nightfall, rendering it unavailable for viewing at night. A waxing crescent moon begins to set below the horizon shortly after nightfall, making the moon visible low in the sky in the evening. It is waxing because it will appear higher in the sky and grow in percent fullness each night. A half moon waxing is called “first quarter” and it will appear for the first half of the evening but will have set for the rest of the night. A waxing gibbous moon becomes fuller each night and begins to stay in the night sky for most of the night, setting just before dawn. Full moons rise about the same time that night ensues, and they set close to morning, being observable the entire night. A waning gibbous moon begins to decrease in fullness and rise in the sky later each night. A waning half moon (last quarter) rises in the sky in the middle of the night whereas a waning crescent begins its rise in the last hours of night just before dawn.

Because the moon does not move across the sky consistently each night, its appearance near the “hitching post” is less likely during half, crescent, and of course new moons. This is because the “post” is to the southwest of the sky’s zenith. For the sun, the time of day it crosses the “post” is between 4 PM and 6 PM, depending on the season of the year. More accurate coordinates will be discussed later, but the significance for the moment is that the moon would have to have crossed the zenith at night. Therefore, a full moon would cross the “post” shortly after midnight. Both waxing and waning gibbous moons would cross the post but a waxing would do so earlier in the night, while a waning would do so toward the end of night. Half moons just barely reach the “post” either at the beginning of night for waxing or at the end of night for waning. Given the roughly three to four days that the moon sustains each phase, the half moon for some of those days will probably miss the “post”. Crescent moons will not cross the “post” at night, appearing too low in the sky. With this in mind, there should be more empty boxes in the calendar, unless the artists regarded crescent moons separate from new moons and simply did not indicate any reference for new moons. Also, the moon is usually still visible in the sky during daylight, and so the moon could still “technically” intersect the hitching post, but would a daytime intersection have meant the same for the moon?

In addition to this varied motion of the moon, the moon’s ecliptic has to be in line with the post in order for it to intersect. Although the moon’s ecliptic stays within a few degrees of the sun’s ecliptic, the variation in its phases as well as its appearance during the day as well as at night makes its motions more varied. The intersection of the moon and the “hitching post” would be much more sporadic for any sort of daily observation and record. Certainly each grid box could not symbolize subsequent days under this hypothesis.

Several other problems arise with the moon-phase theory as well. Why would the moon be represented by x’s instead of the phases as they really exist? In fact, nowhere in Monte Alegre has any rock art been found that clearly depicts all the different phases of the moon representatively or otherwise. Another problem with the moon theory is that the grid does not follow a consistent pattern for phase changes in a column or a row. Although most columns seem to progress from top to bottom, from full x to partial to vertical to empty, this pattern is not entirely consistent- as some full x’s progress to empty boxes. Why 49 in total and why so many full x’s grouped together? Sometimes the moon is visible during the day, would this have been recorded or did they only record the moon at night? These discrepancies make the moon theory highly dubious.

The “Hitching Post”

The grid being associated with the hitching post and the sky is not entirely in jeopardy, however. The sun and moon change in the angle they travel across the sky throughout the year, dipping more southerly in the fall and winter months, and more northerly in the spring and summer. This makes the crossing of the “hitching post” a seasonal cycle, not a daily cycle. Yet I must specify that such an alignment not only depends on the time of year but the position of the observer.
Due to the 23.44° tilt of the Earth’s axis, the path of the sun across the sky (the ecliptic) varies throughout the seasons. Monte Alegre is roughly 2° south of the equator, and so the sun’s ecliptic passes directly overhead at noon during the days surrounding the spring and autumn equinoxes, but travels a southerly path whose southernmost point is near December 21\textsuperscript{st}, and a northerly path that leans furthest north near June 21\textsuperscript{st}. The sun’s ecliptic path crosses the hitching post only in the months near December (see figure 10).

The location for viewing the sun crossing the hitching post would vary too because the observer’s view angle depends on his position in relation to the hitching post (see figures 11a,b,c). Theoretically, if the calendar image is a record based on the “post”, the observation location should be nearby to the calendar. Fortunately, Painel do Pilão has something of a stone platform that I theorize was the viewing platform. This stone area is visible in figure 12 and the red flashlight in the photo represents the edge of the platform. The Gigapan camera was positioned at the spot of the flashlight (fig 4) for the panoramic photo seen here http://share.gigapan.org/gigapans/45523/.

Note that figure 10 was taken on December 21\textsuperscript{st} at the location of the flashlight. From this spot the sun appears to dip too low to cross the hitching post, dipping below the horizon of the summit minutes beforehand. Figures 11 a,b,c shows the sun “captured” and were also taken on December 21\textsuperscript{st} but a few meters behind and below the stone platform in the sunlit area visible in figure 12. Although the ancient artists may have known this possibility, no marker was found to indicate the backfield area as a special viewing area. The stone platform with the flashlight still remains the best theoretical viewing location.

So, the research team next set out to discover when the sun intersection would be observable at the proposed viewing platform. Although the research team did not yet revisit the site to photograph the sun capture specifically at the viewing platform, using Starry Night software we can recreate the sky and simulate the sky at any time of the year. Using Starry Night I find that the angle of the sun’s ecliptic increases each day in reference to the platform (see appendix). On December 21\textsuperscript{st} the research team recorded the azimuth (cardinal direction) of the “hitching post” from the platform and found it to be 250° west. Until the research team can physically record the motion of the sun each day, we can only simulate the effect in our software. The sun has an apparent diameter of ½° (Williams 2004) in the sky. Using photometric analysis in MapViewer as discussed in the methods section, the dimensions of the hitching post window were measured and determined to horizontally lie between 247° and 253° (azimuth). Likewise, the altitude was determined to fall between 38° and 41° inclination. Despite potential errors in calculation, our effective error would only alter the date that viewing is observable by a few days. The integrity of the simulation remains valid.

**The Solstice-Sun Capture Theory**

Because December represents the lowest sun ecliptic in the sky, the sun’s altitude is slightly higher in November. In fact, the sun’s path is inversely mirrored from November to December 21\textsuperscript{st} as it is from December 21\textsuperscript{st} into February. Therefore, based on our software simulation, in November the sun dips into the hitching post each day until it dips too low in December. A few weeks later as the sun’s ecliptic rises again it is once again captured by the post for several weeks, until alas its angle is too high in the sky (see appendix).

As the sun appears to enter the hitching post window, an increasing percent of its light will intersect the post window each day until it is directly center, and then decline in percent until it dips too low in the sky, falling behind the shadow of the mountain. Our simulation shows this time frame at these coordinates today to begin on November 1\textsuperscript{st} until November 17\textsuperscript{th}, a period of 17 days. During most of December, as the sun’s ecliptic continues south to the winter solstice, it sets behind the mountain increasingly earlier than it crosses the hitching post. After December 21\textsuperscript{st} the sun’s ecliptic begins to climb again, reemerging from the shadow of the mountain and into the post window on January 24\textsuperscript{th}. The sun inversely mirrors the events of November, sliding in the opposite direction in the sky each day until it passes too high to intersect the post on February 10\textsuperscript{th}.

Today in 2010 AD, the solstice does not follow the same path across the sky that it did in the past. Due to the earth’s more subtle movements, there is a precession of equinoxes (axial precession). The winter solstice did not always fall on December 21\textsuperscript{st}. The further in the past we go, the further away from December 21\textsuperscript{st} the winter solstice (the southernmost ecliptic of the sun) occurs. However, this does not affect the number of days the sun is captured in the hitching post; it simply means our own calendar dates would shift.

Precession is a cyclical variation that renews itself every 26,000 years and is accounted for in the StarryNight software. However, another cyclic earth variation is obliquity, or the variation of the tilt of the earth. Earth’s current tilt is 23.44° but this varies by 2.4° in the course of 41,000 years. The tilt of the earth would affect the sun’s position through the post and the number of days of occurrence before or after the solstice. However, the current archaeological time span of
11,200 years ago for this region would indicate a change in the earth’s tilt by only 0.64°, slightly more than the apparent diameter of the sun. At best, this offers us ± a few days within any given dates. Accounting for all variables, our calibrated dates for ancient observation and recording of sun-capture at the hitching post should be November 1<sup>st</sup> to November 17<sup>th</sup> ± 1 to 3 days, and January 24<sup>th</sup> to February 10<sup>th</sup> ± 1 to 3 days.

The time frame of visibility in November and again from January to February is approximately 17 days each period, giving a total tally of about 34 (±1-3) days to observe the intersection event. Unfortunately this number does not match the total number of boxes (49) in the calendar. But if we count the boxes from left to right and from top to bottom, the first 17 boxes appear to be fully marked off. The next box beyond this is empty, which could support this theory, but then there is another full “x” box followed by several more partial “x” boxes. If this theory applies to the calendar, there should be many empty boxes representing days that the sun passes too low, too soon to enter the hitching post window. However, the last 13 boxes resemble the first 17 boxes as full “x”s, reminiscent of the idea that the sun-capture phenomenon is relatively symmetrical about the solstice, recurring again from January to February.

With this sun-capture theory the x’s in the boxes might represent full capture of the sun (seemingly full considering the intensity of the sun to the naked eye), partial x’s perhaps represent partial capture in the window, single lines may have represented capture of the sun’s rays but not the disc itself. Empty boxes might indicate the acknowledgement that the sun no longer intersected the window. Perhaps after two days no further recording was necessary, until the sun began to reemerge again. An alternative theory for the empty boxes is that they represented densely cloudy days where the sun’s position was not perceptible at all. The irregular shape of the hitching post could also affect the determination of a full or partial box, since the post is not a perfect circle but rather an irregular and jagged concave bowl-shape.

Also I should note the fact that the number of days the sun is too low, from November 17<sup>th</sup> to December 21<sup>st</sup> is 34 days and 34 again until January 24<sup>th</sup>, which adds up to about 69 days; far too many days to be a day to day representation on the calendar-like image (although November 1<sup>st</sup> to December 31<sup>st</sup> is 17 + 34 = 51, a much closer sum to the 49 definite boxes). With this information we cannot currently conclude that the grid-like image is a calendar, at least not a daily calendar. Yet there is still a sense that it perhaps notates phenomenon associated with the sky and the hitching post.

In regards to assumptions and speculations, if the grid-like image does somehow still represent the sun-capture or a calendar of sorts, we would expect it to be somewhat symmetrical, representing the similar capture phenomenon in November and January. Although not exact, there is a bit of symmetry to the calendar, with the majority of full x’s grouped together and in two clusters, and the fact that the empty and single line boxes are closer to the middle of the calendar further supports this theory. However, much speculation still remains. We can not know for certain which direction the ancient artists “read” the grid; we tend to read from left to right and top to bottom but perhaps they did not. Our only insight on this subject comes from the additional column to the right side of the calendar. If the column was indeed unfinished, not faded over time, we might reasonably conclude that they drew the calendar from left to right. Additionally, the sun-capture theory assumes the hitching post, which is a rocky outcropping, has maintained its current shape despite its susceptibility to erosion for the past several thousand years. Erosion as a force altering the shape of the hitching post can be further argued either for or against the sun-capture theory.

**Of Sun and Moon and Eclipses**

Somewhat of a footnote to the issue of the sun-capture calendar theory, but very intriguing, is the realization that came with seeing an intersection of the sun and the moon with the hitching post. Although the moon wanders across the sky at a much greater pace than the sun, only intersecting the hitching post for a day or two, where the sun crosses it’s path for at least 17 subsequent days, the sun and moon appear at the same location at the same time only during eclipses. An inquiry into the hitching post capturing an eclipse revealed something fascinating.

In Serra da Lua there is an image that many people suggest depicts an eclipse of the sun and moon. My previous article (see Davis 2009) focused mainly on this image. There I argued that if the image did indeed depict an eclipse and was painted in relation to the observed event, only three dates in the past 15,000 years were discovered using the StarryNight software. Two of those eclipse dates would have resulted in eclipses occurring in the direction of the horizon in front of the image: February 16<sup>th</sup>, 5631 BC from approximately 4:40 to 6:20 PM; and December 30<sup>th</sup> 6930 BC; which peaks at 4:30 PM. The third eclipse date, January 27<sup>th</sup>, 10500 BC from 11 AM to 2 PM would have experienced an eclipse occurring overhead Serra da Lua if the painter looked up.

None of the eclipses would have been total eclipses, as these seem not to occur often in that region of the sky. And so because they are not total eclipses it is difficult to argue that they would even have been noticeable, especially if it happened to be a cloudy day. Nonetheless, these three dates are the most probable events inspiring an eclipse image at Serra.
da Lua, if indeed that is what is depicted. Of those dates, one of those eclipses would have been “captured” at the hitching post!

On December 30th, 6930 BC, the precession of equinoxes was different from today, with the winter solstice occurring near February 4th. This meant the 17 days of sun-capture at the hitching post, which ends 34 days before the solstice and reinitiates again 34 days after the solstice, would have encompassed the dates from December 16th to January 1st of 6930 BC. In day 14 of the sun-capture as the sun began to dip through the hitching post, the solar eclipse had just begun minutes before. This date theoretically and intriguingly connects the possible eclipse image at Serra da Lua with the possible sun-capture calendar at Painel do Pilão.

For an observer at Painel do Pilão, the visual experience would have been that subsequently from 3:00 PM, the sky would have become progressively darker from the eclipse, with a peak eclipse of 50-70% cover occurring between 4:08 and 4:15 PM, and the moon entirely passing the sun by about 5:45 PM. The sun dipped into the hitching post on December 30th, 6930 BC beginning around 3:50 PM, and it fully dips below the hitching post by 4:06 PM. The effect that the observer would have seen was the sun’s intensity diminishing and reaching its darkest point shortly after it dipped beneath the hitching post.

Although intriguing, there are several issues with this hypothetical scenario. First, the date of 6930 BC coincides with the sterile layers of soil excavated at Pedra Pintada by Anna Roosevelt (Roosevelt 1999:376-9; Roosevelt, et al. 2002:26; Roosevelt, et al. 1996:190-2). This is a time period that presumably was unoccupied at the largest nearby cave to Painel do Pilão. Although it is possible that people were in the area but did not occupy the cave during this time, we are placed in a hypocritical situation to the earlier notion that people were in the area producing painted images between 11,200 and 10,500 years ago based on those same excavations at Pedra Pintada. The second major issue with this eclipse scenario is that the partial eclipse would have to have been visibly noticeable. Although the eclipse reached between 50 to 70% fullness, the sun is so intense that it is possible that there was no largely noticeable change in intensity. Other less critical issues with this scenario include the visibility of the sky? How cloudy was it that day? Certainly there are days when storm clouds block out a greater percentage of sunlight than a partial eclipse would. With these issues in mind, we would need to assume the ancient painters recognized and understood partial eclipses as solar events separate from other more common meteorological events. For now, this intriguing scenario remains untestable speculation.

Other Monte Alegre Sky Associations

Although I remain open to the possibility that the grid is not a calendar and has no association with the sun or the moon, additional rock art throughout Monte Alegre further supports the idea that the ancient artists were intent on drawing things associated with the sky. Figures 1, 2, 8 and 9 display some of these sky associations on the same wall as the calendar. Figures 13a and b and figure 14 show more direct sun and moon images at nearby Serra da Lua in Ereré.

The anthropomorph in figure 1 is bizarre with unknown significance but the head appears to have a beak and the hands and feet have a slight resemblance to those of raptors. The “tail” is again bizarre and the image lacks anything resembling wings, but an avian association seems implied. While just one of several humanoid shapes among the art here, this figure seems somewhat associated with the sky.

Figure 2 is located just below figure 1 on the panel and the primary central figure appears to be a flaming object moving or falling. The object resembles a fireball, meteor, or perhaps a comet. The other prominent images in the photo are those of the circles connected with vertical lines. These designs might reflect constellations, or perhaps they too are demarcations of the change in altitude of the sun and moon’s ecliptics through the course of the year as discussed above.

The sequence of images in figure 8 above the calendar is equally mysterious. The beginning of this sequence is not visible in the photo but begins with a similar “swimming” or “jumping” figure as that seen at the left side of figure 8. The sequence ends with an elongated sun image stretched along a ridge on the rocks to the right side of the photo. In the winter months the sun passes behind the cliff, keeping these images in shadow. I believe this sequence is associated with the summer sun, because as the ecliptic nears the summer solstice the sun’s rays will surpass the cliff’s shadow, bathing the ridge in sunlight. However, this theory has not yet been tested due to my research thus far occurring only in the winter months.

Figure 9 has several peculiar images. The image left of center has an angular shape that resembles a kite. There are two handprints on either side of it as well. That the image might represent a true kite is highly unlikely, but the location of the image is on part of the wall that curves horizontally, creating a narrow ceiling. The “kite” appears on the underside of this ceiling, forcing the observer to look up to see it. This physical manipulation of the viewer suggests an association of the object to a place of height, such as the sky. The image above the “kite” is also peculiar, but one common interpretation is that of avian features. Similar to figure 1, it seems to have a beak, but in this case there is also a resemblance of wings. There are
many vultures in the region and the image is somewhat reminiscent of their grandeur as they soar or sometimes perch with their wings spread wide.

While images at Painel do Pilão have vague references to the sky, numerous images at Serra da Lua are more explicit. The images in figures 13a,b appear repeatedly at Serra da Lua and Serra do Sol, both of which stretch along the west to northwestern cliff wall of Serra do Ereré. These images have long been considered representations of the sun and moon since the earliest European explorers were told so by the natives (whom similarly had no knowledge of the original artists) (Hartt 1871).

The largest images in all of Monte Alegre are the concentric circles at Serra do Sol and Serra da Lua, whose very names in Portuguese are “Mountain of the Sun” and “Mountain of the Moon” respectively. This research team recently confirmed that the southwestern most concentric circle image at Serra da Lua faces the setting of the winter solstice sun, when the sun’s ecliptic is at its southernmost point in the sky (Davis 2009). The northernmost concentric circle, located at Serra do Sol, might similarly face the setting of the summer solstice sun, but this research team has yet to verify that theory. (Serra do Sol panorama available at http://share.gigapan.org/gigapans/45526/ and http://share.gigapan.org/gigapans/45575/)

Although historic records have long claimed the concentric circles and rayed discs in Ereré were the sun and moon, it wasn’t until I observed the natural phenomena in the sky that I was certain the images were the sun and moon. The phenomena are known meteorological effects called sun and moon halos (Figures 14, 15). These appear in the sky when moisture high in the atmosphere forms ice crystals that refract the light of the sun or moon. The halo effect is more common near mountains whose orographic uplift pushes moisture higher. Additionally, the Coriolis Effect at earth’s equatorial region also forces moisture-rich warm air high in the atmosphere. Monte Alegre’s rainy season today begins within weeks of the winter solstice. The winter months at this mountainous region near the equator are therefore more likely to produce halo effects. Figure 14 was taken in November of 2008 and figure 15 was taken around the New Year from 2009/2010. There is also little coincidence that the Amazon River also begins to flood around this time, an event that would have been vital for the ancient artists, who were “riverine foragers (Roosevelt 1999)” living within the floodplain zone.

CONCLUSION

The Gigapan image at http://share.gigapan.org/gigapans/45523/ has been an important tool for researching the ancient rock art at Painel do Pilão near Monte Alegre, Brazil. The Gigapan was instrumental in correlating the altitude and azimuth of the hitching post to that of the sun’s ecliptic during the months surrounding the December solstice. The photometry methods tested the theory that a grid image on the cliff wall was the ancient artists’ recorded observations of the sun or moon as it intersected the “hitching post” at the top right corner of the panorama. The image, the observation platform, and the “hitching post” are too far apart to capture with any great detail from a single camera. The Gigapan provided the opportunity to capture all three locations to preserve their perspective reference points to each other. This enabled us to determine the angle with which the intersection could occur, and therefore what time of year one can observe the event.

However, research will continue in order to observe first-hand, and photograph the intersection of the sun with the “hitching post”. This current research also still lacks first-hand evidence of the summer solstice “path of the sun” in figure 8, and the potential representation of the summer solstice sunset at Serra do Sol discussed previously. The Gigapan image (http://share.gigapan.org/gigapans/45523/) can also be improved upon by taking a higher resolution HDR image. Finally, all archaeological research should include material evidence of artifacts and although such excavations were conducted at the next closest site at Pedra Pintada, exploratory excavations should be performed at Painel do Pilão to determine whether it was a sacred site with separate occupation dates from Pedra Pintada.

In conclusion, I have presented research arguing that the grid image at Painel do Pilão is a calendar-like record of a seasonal cycle. While I suspect the observations were based on the sun more so than the moon, the ecliptics of both remain within a few degrees of each other in the sky. Therefore the recording could be either of the sun or the moon, though the moon phases and day/night appearances make it a less consistent subject to track. The sun, on the other hand, is a more reliable annual marker of time, and the winter solstice indicating its southernmost advance might have been a strong symbolic marker for the renewal and assurance of the coming rainy season and rise of the Amazon River.

Yet, while I argue here that the grid is akin to a calendar, I believe the overall scope of the astronomical rock art near Monte Alegre more accurately represents evidence that the ancient artists were attempting to understand the movement of the sun rather than merely keeping a record of its movement. I believe the calendar is among the earliest evidence in the world showing that Paleoindians at the end of the Ice Age began formalizing methods for understanding their world. The archaeoastronomy art of winter solstices at Painel do Pilão and Serra da Lua indicate a more systematic approach to observations, which are the founding principles of science.
FIGURES

Figure 1. Anthropomorph in red, yellow handprints overlain- Painel do Pilão, Serra da Paituna, Monte Alegre- Pará, Brazil.

Figure 2. Celestial Images? - Fireball, constellations? - Painel do Pilão, Serra da Paituna, Monte Alegre- Pará, Brazil.
Figure 3a. Research Area

Figure 3b. Paituna sites

Figure 4. Gigapan at Painel do Pilão  
http://share.Gigapan.org/Gigapans/45523/
Figure 5. Calendar? Painel do Pilão, Serra da Paituna, Monte Alegre- Pará, Brazil.

Figures 6a and 6b. “Hitching Post”- hitchs the sun/moon- Painel do Pilão, Serra da Paituna, Monte Alegre- Pará, Brazil.

Figure 7. Perspective of “Hitching Post”
Figure 8. Path of the Sun - The upper images move from left to right in the same path as the sun does above the wall.

Figure 9. Ceiling images perhaps indicate flying or sky objects.
Figure 10. Sun approaching window at “Hitching Post”- Painel do Pilão, Serra da Paituna, Monte Alegre- Pará, Brazil.

Figures 11a,b,c. Sun Captured- Painel do Pilão, Serra da Paituna, Monte Alegre- Pará, Brazil. Taken December 21st 2009

Figure 12- Shadow cast by sun indicates where the sun capture can be observed.
Figure 13a Sun or moon images - all at Serra da Lua in Serra do Ereré, Monte Alegre - Pará, Brazil

Figure 13b rayed discs (sun): All at Serra da Lua

Figure 14 Star and planet images at Serra da Lua
Figure 15a Sun halo over Mirante in Serra do Ereré, Monte Alegre- Pará, Brazil (photo by Carmen Silvia Viana Trindade)

Figure 15b Moon halo dwarfing Orion- over village of Paituna eastern valley of Serra da Paituna, Monte Alegre- Pará, Brazil (10 second shutter speed- f 2.8- ISO 200- Canon Powershot SX110)
APPENDIX

Simulation Sun at Painel do Pilão (S 02.06208°/ W 054.16597°) at 3:34 PM; altitude 41°, azimuth 252°; November 1, 2009. Note sun tangential to inner circle, theoretically equivalent to “hitching post” (Starry Night Pro Plus 6™ software)

Simulation Sun at Painel do Pilão (S 02.06208°/ W 054.16597°) at 3:34 PM; altitude 40°, azimuth 247°; November 17, 2009. Each day from Nov 1 to Nov 17 sun intersects more to the left of the circle (Starry Night Pro Plus 6™ software)
Simulation Sun at Painel do Pilão (S 02.06208°/ W 054.16597°) at 4:00 PM; altitude 40°, azimuth 247°; January 24, 2010. Note sun begin to intersect inner circle again from left, reemerging (Starry Night Pro Plus 6™ software)

Simulation Sun at Painel do Pilão (S 02.06208°/ W 054.16597°) at 4:05 PM; altitude 41°, azimuth 253°; February 10, 2010. Note sun leaving circle intersection at right, sliding north daily toward summer solstice (Starry Night Pro Plus 6™ software)
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