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CHRISTOPHER DAVIS

University of Illinois, Chicago, USA

Archaeoastronomy at Monte Alegre, Pará: a Research Problem and Research Strategy

The current research being conducted in Monte Alegre in the state of Pará (Fig. 1) examines painted images that have long been believed to have astronomical significance. Rock art sites in Brazil are beginning to gain more attention as more research is being conducted at popular tourist sites such as the Pleistocene paintings at Serra da Capivara in Piaui, the petroglyphs at Campeche in Santa Catarina. Although many images depicting nature, humans, or geometric shapes are consistently found at archaeological sites throughout Brazil, the plethora of celestial images at Monte Alegre is what distinguishes its unique character from other known sites thus far in South America. Among the most intriguing finds include a panel of images that possibly depict a solar eclipse at Serra da Lua (Fig. 1b), as well as distinct solar images facing the summer and winter solstices (Fig. 4a,b), all in Serra do Ereré; and a grid-like image possibly representative of an early lunar calendar at Painel do Pilão in Serra da Paituna.

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 *cuias* created by an Indian woman from the Indian village of *Surubiju* near Serra da Lua, he did not write on the art of the Serra (Agassiz 1868:167,361-4). In 1870-1871 the geologist Charles Frederick Hartt, who was part of Agassiz's previous group, returned with the Morgan expedition, whence he 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 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, initializing 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 1879:346,371-97), 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 1879:586,541-87). In 1924, Curt Nimuendaju 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 Espeleógico do Pará (Silveira, Pinheiro, and Pinheiro 1984) and in 1986 by the Uruguay archaeologist Mario Consens, who assessed the archaeological potential of the region (Consens 1989). In 1996 and 2003 Edithe 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 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 et al. 1996:376-9, Roosevelt 1999:26, Roosevelt, Douglas, and Brown 2002:190-2). 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.

My current research, which began in 2008, measures the astronomical alignments of the images and their possible interrelated meanings. This is first done by establishing and maintaining consistent definitions of images/motifs to their cosmic representatives. Next, the relative positions of the artistic images are referenced with the celestial positions of their cosmic counterparts, basing the theoretical assumption on the notion that Paleoindians depicted images onto the rock surface directly facing or directly below the position of their celestial counterparts (Krupp 1983:41, Hudson 1982). Exact coordinates of the images are established by careful hand measurements and the angles between one image and the other using tape-measures and protractors. Additionally the images are photographed using the Gigapan robot to take fine-detailed panoramas that are canvassed on a grid using MapViewer software. The measured images help to properly align the panoramic photos to an accurate grid, allowing the rock surface to be mapped onto a digital screen.

Furthermore, the perspective of the sky from the earth appears to rotate and celestial bodies change position through time, the computer program-Starry-Night™- is used to observe the ancient sky where celestial bodies were positioned in the past. Using these methods I have so far achieved some success correlating the possible depiction of a solar eclipse to three possible dates in

history when an eclipse took place either directly in front of, or directly below the artistic image (see Fig. 2a,b,c).

In addition to unique cosmic events such as eclipses, I have also investigated the position of images as demarcations of annual celestial events. For example, the first potential sun disc image at Serra da Lua is the southernmost disc image and appears to be facing the direction of the winter solstice when the sun sets at its southernmost point on the horizon (Fig. 4a). This significance is perhaps emphasized by a pedestal image located directly below the disc. The last disc image is the largest disc image (~ 1meter diameter) located at the northernmost point at Serra do Sol (Fig. 4b) and is facing the direction of the summer solstice when the sun sets at its northernmost point on the horizon.

Neither of these disc images are rayed but they are concentric and most likely signify the sun, not the moon as surmised by Hartt. The path of the moon wanders a bit further in the sky than the sun and therefore does not fall in alignment with the paintings as the sun does. Additionally, the position and time of day that the moon sets changes daily, and Serra da Lua lacks clearly discernible images of the moon's different phases. Furthermore, the sun can appear to form a halo when its light shines through clouds very high in the atmosphere that contain ice crystals. The observed effect has the appearance of concentric circles and red is often the prominent color (Fig 3a,b).

Rayed disc images probably also signify the sun but they are usually smaller in size. Where they appear in panels, they have a perspective that seems to be high in the sky, and thus they possibly represent the high day-sun (Fig. 3c,d). The significance of rayed discs being smaller in size was perhaps purposeful, as this is a true aberration that occurs when viewing the sun. Although it always maintains the same arc width, the sun (as does the moon) *appears* to be larger but less intense when it is closer to the horizon, and of course it appears redder. Hence, we have the larger, red-dominant disc images representing the setting sun, and the smaller rayed-discs representing the daytime sun.

By analyzing images within the context of a panel, we can gain a greater relational understanding and implication for a given image. The implied significance is then applied to areas where the image appears alone. This method allows for a consistent analysis of images between the different sites at Monte Alegre. Using this method we can say with more certainty that the majority of disc images, whether rayed or not, most likely represent the different intensities of the sun. The moon, in contrast, is significantly less represented.

The difference in intensity and size of the sun also appears in the myths of many native tribes in the region north, south, and west of the Amazon (for example Reichel-Dolmatoff 1996:32). Interestingly, the myths of the sun and moon are typically the earliest myths in terms of cosmological order (Civrieux 1980:19-32, Reichel-Dolmatoff 1971:24, Roth 1915:254, Wilbert and Simoneau 1987:32-73). We don't know when the

myths first originated but they speak of the earliest creation times, often before people, when the Sun and Moon were hunters roaming the world in search of food and other adventures(Villas Boas and Villas Boas 1970:57-93). Most tribes near the Amazon region have myths detailing a long period of darkness and relate eclipses to fights between the sun and moon (Wilbert and Simoneau 1987:94, also revisit Smith 1879:392). Some myths along the Xingu River say the Sun was killed, casting the world in a period of darkness, and the Sun's three sons resume the responsibilities of the father Sun. None of the sons can do the entire task alone, but each endure the heat and light of the sun at different times of the day or when it is at different intensities (Villas Boas and Villas Boas 1970:94-7).

Plans for future research, which resumes in the autumn of 2009, consists of conducting test pit sampling and excavation at the base of three locations where images are positioned very low on the rock-wall in relation to the current floor, and perhaps where more images are currently submerged by more recent stratigraphic layers. Two of these locations are at Serra da Lua, and the third is at Gruta 15 de Março. Excavations at these locations will provide further evidence to check the Terminal Late Pleistocene date obtained by Roosevelt at Pedra Pintada in 1992, further pinpoint the date of the eclipse event, and possibly reveal additional images created by the ancient inhabitants at this important Paleoindian site.

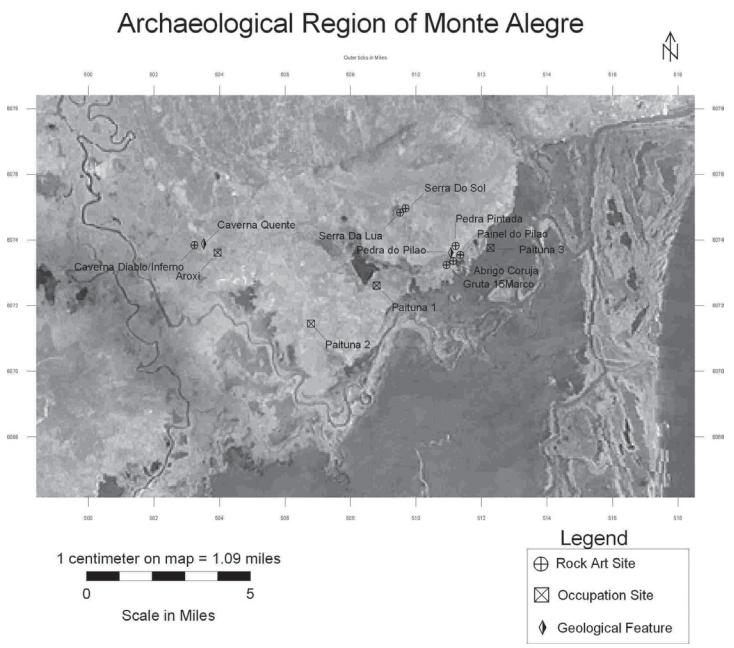

Figure 1a - Research Area, Monte Alegre, showing Amazon River to the east and south

Figure 1b - Serra da Lua from afar- taken from the peak of Serra do Bode. (Photographed by Christopher Davis)

Figure 2a - Possible solar eclipse images; actually two sets, the personified forms to the left and the yellow and red discs to the right. (Photographed by Leonard Grala)

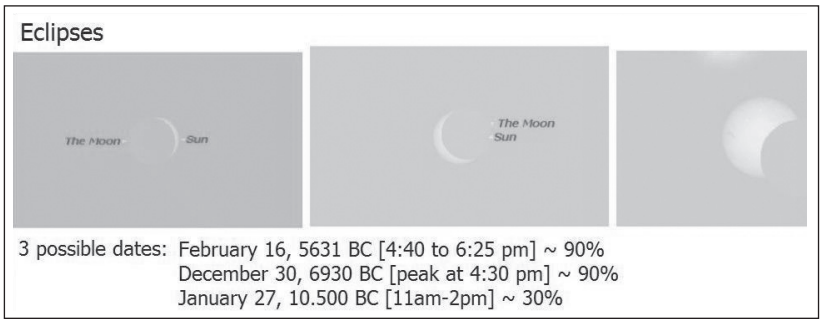

Figure 2b - Another possible solar eclipse image; located near 2a at Serra da Lua, this image appears to be intentionally lacking a spot of red paint on the left side where the natural rock also appears to be missing a piece. It is universally common for rock art to be applied at a specific location in order to enhance the feature of the rock surface.
Alternatively this image might depict a phase of the moon, but as such, neither accurately portraits the correct orientation of a gibbous moon, nor the correct proportion of a crescent moon. (Photographed by Christopher Davis).

Figure 2c - Possible eclipse dates as seen using StarryNight software at Serra da Lua. These images depict how the solar eclipse would have looked from in front of the painted images (2a) at Serra da Lua during the dates indicated in the past.

Figure 3a - Sun halo observed over Mirante. A sun halo is a meteorological effect occurring when the sun shines through clouds containing ice crystals really high in the atmosphere. This effect can be rare is some regions but common in others, depending on cloud formation patterns. (Photographed by Carmen Trindade)

Figure 3b - Painted sun halo image at Serra da Lua using red and yellow concentric circles. (Photographed by Christopher Davis)

Figure 3c - Sunray and halo observed at Monte Verde, Colorado summer 2008. A hawk is also in the photo. (Photographed by Christopher Davis)

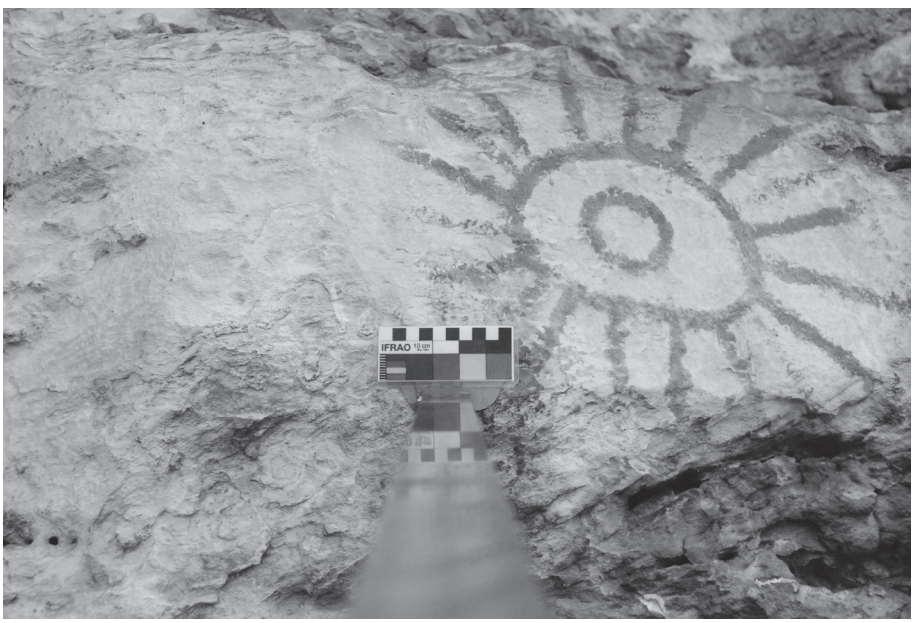

Fig 3d - Painted sun image at Serra da Lua, showing halo and sunray. (Photographed by Christopher Davis)

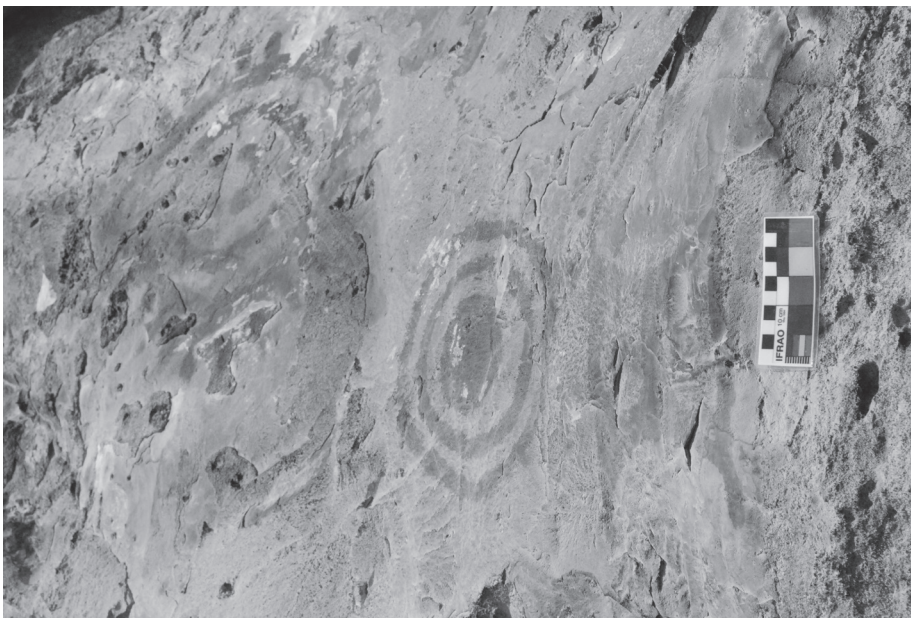

Figure 4a - Painted winter solstice image: setting sun on pedestal, above is high daytime-sun image. (Photographed by Christopher Davis)

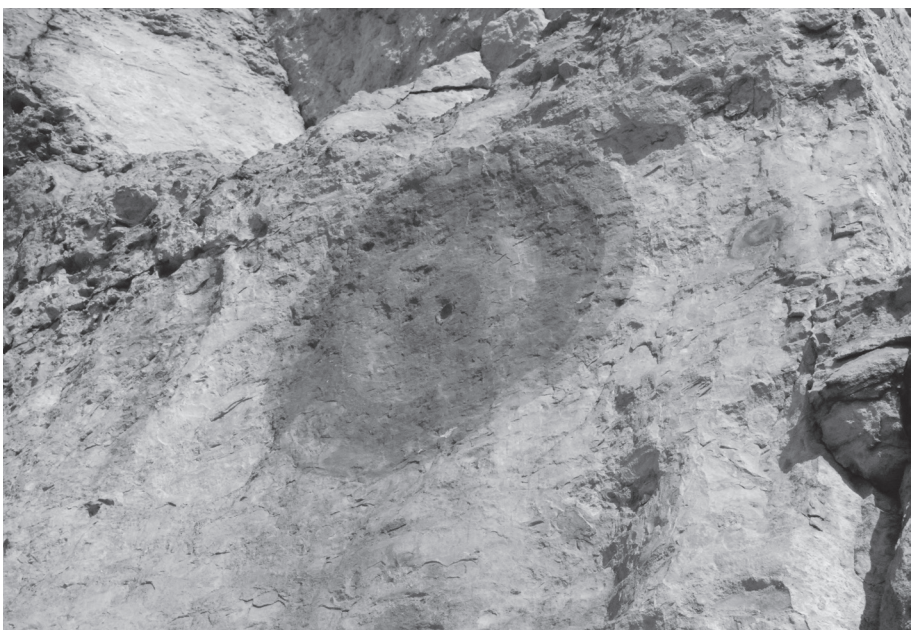

Figure 4b - Painted summer solstice image: largest known sun image at Ererê. (Photographed by Christopher Davis)

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