

Some Solar Interactions at Grapevine Canyon, Nevada

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Introduction

Near the southern tip of Nevada, about ten miles northwest of Laughlin, lies Spirit Mountain, *Avikwaame*, the highest peak in the Newberry Range. Mohave legend identifies it as the first land to rise from the primordial ocean that once covered the earth. At the southeastern foot of the mountain, Grapevine Canyon is the terminus of the ancient *Xam Kwatcan* Trail which begins near Yuma, Arizona and roughly parallels the Colorado River. The trail was used for annual pilgrimages to the foot of the sacred mountain in remembrance of the Creator's bringing The People from the mountain to this world (Heizer and Baumhoff, 1975). Along this trail are numerous rock art sites, some with important solar interactions (White, 1994), and many large desert pavement geoglyphs (Johnson, 1985), some of which were apparently used to reenact their creation story. They include imagery seen in the rock art of Grapevine Canyon. Other cairn and stone assemblage geoglyph sites we have investigated (in preparation) near this trail show relationships to Grapevine Canyon. We believe that the rock art of Grapevine Canyon must be viewed in the context of these constructs.

A large granite porphyry breached dike forms the entrance to the canyon, and these walls contain the rock art. Above the entrance lies a permanent spring which exhibits unusual variability, uncorrelated with rainfall and not fully explicable by solid earth tides (Fink, 1994). Given the importance of water in this arid region, this enigmatic quality of the site likely contributed to the reverence given the area.

An eclectic assembly of glyph types suggests visitation from, or at least contact with, a broad geographical region. Abstract and geometrical forms dominate the petroglyph imagery; rectilinear imagery is abundant. Great time depth is suggested by the variation in patina. Stewart, 1929 reports excavation of the terrace surrounding the petroglyphs, revealing their extending to a depth of at least 20 feet. Reworking of the glyphs is often seen, and superimposition is not uncommon. The freshness of some glyphs suggest very recent execution or refreshment. Casual inspection suggest a difference in the frequency of glyph types on the north and south sides of the canyon. Only one small pictograph was noted near the canyon entrance. In spite of, or perhaps because of, heavy visitation, the site is remarkably free of molestation. Exfoliation is the primary cause of glyph destruction. Excavation of a nearby rock shelter yielded few artifacts; ethnographic and ceramic evidence suggest occupation from A.D. 900-1150, Maxon, 1970. Further archaeological investigations of the area are in progress. (Fox, 1995).

Observations

We visited the site at or near vernal equinox, the solstices, and the winter cross-quarter day (defined here as the mean day number of autumnal equinox and winter solstice) looking for possible solar interactions. While recognizing that other seasonal reckonings could have been used, the *astronomically defined* dates and times of these seasonal days are given in Table 1..

Table 1

Winter Solstice	December 21, 1993 13 ^h MST
Vernal Equinox	March 20, 1994 13 ^h MST
Summer Solstice	June 21, 1994 08 ^h MST
Winter Cross-quarter Day	November 06, 1994 21 ^h MST

North of the wash, a rock enclosure provides many apertures which allow sunlight to play across several abstract and zoomorphic glyphs pecked into a large flat rock inclined toward the east. Figs. 1 and 2 show some aspects of the winter solstice interaction. Sunlight moved across the abstract glyphs, joined another shaft of light and moved backward across a dendritic figure resembling a corn plant.

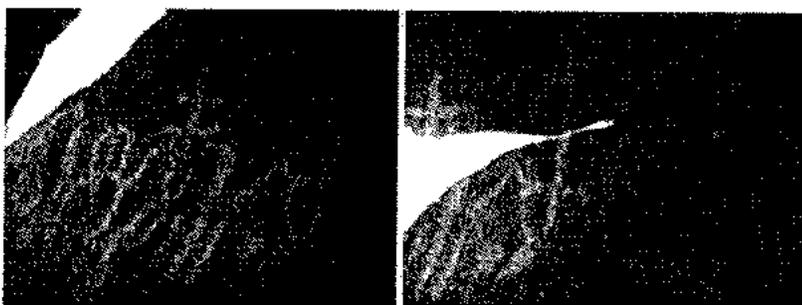


Figure 1 Early morning light on December 20, 1993 moved across abstract glyphs in a rock enclosure. Underlying, heavily repatinated glyphs suggested imagery of a different character.

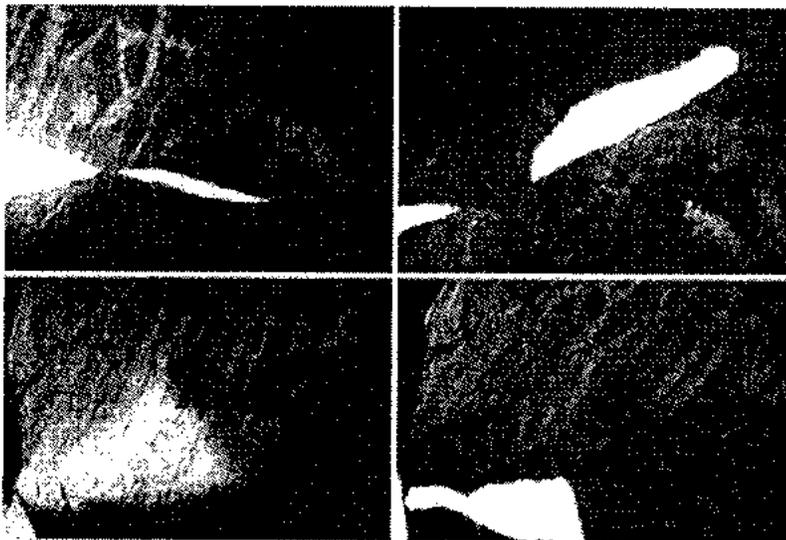


Figure 2 Later December 20 the light is joined by light from the upper horned zoomorph (Fig.3). Later the light moved downward enveloping a glyph suggestive of a corn plant.

Later a new spot of light formed on a grid and moved downward to engulf the body of a zoomorph, along the forelimbs, exiting at the foot onto the body of a richly horned animal, and enveloping the antlers before exiting the glyph, Figs. 3 and 4.

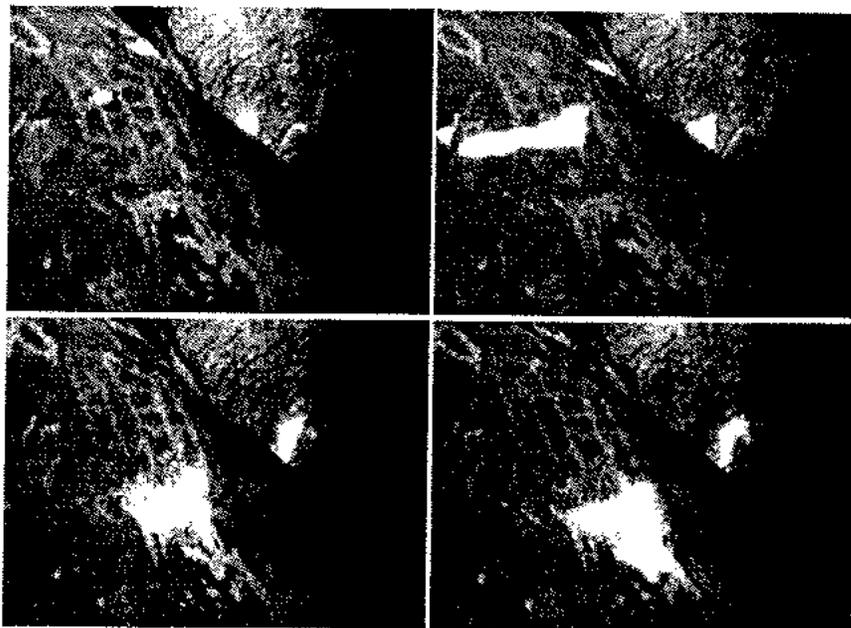


Figure 3. Recorded on December 19, a spot of light appeared in the upper left portion of a grid glyph. Expanding and moving downward, it covered and assumed the shape of the zoomorph.

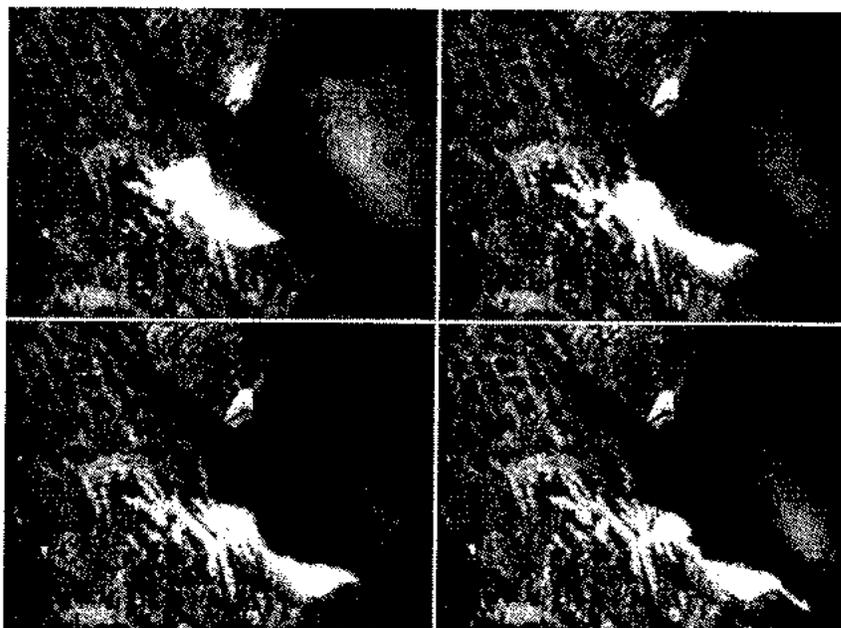


Figure 4. Moving downward through the forelegs onto the body of the large-horned zoomorph on December 19, sunlight exited by way of the forward end of the antlers.

Horns being a ubiquitous symbol of renewal (Gimbutas, 1989) and the life force sometimes being represented exiting the body by way of the extremities (Seely, 1993), such imagery is suggestive of the cyclic patterns in nature, highlighted at a time when the sunrise azimuth reverses its southward motion. It is interesting to note that these glyphs are superimposed over heavily patinated glyphs of an entirely different character. Using techniques discussed later, we are attempting to better discern the glyph forms and reconstruct the nature of the sunlight interactions with them.

In the same enclosure at vernal equinox, a west facing panel underwent the interaction shown in Figs. 5 and 6. The first image is suggestive of the many interactions described by Warner, 1992 as "seeing with light." We are reliably informed that on some equinoxes, the point of the triangle of sunlight passes directly through the center of the star (asterisk) glyph in Fig. 6. (Owing to Kepler's Second Law and the nonintegral number of rotations of the earth in a year, interactions will differ on successive equinoxes. See Hoskinson, 1985).

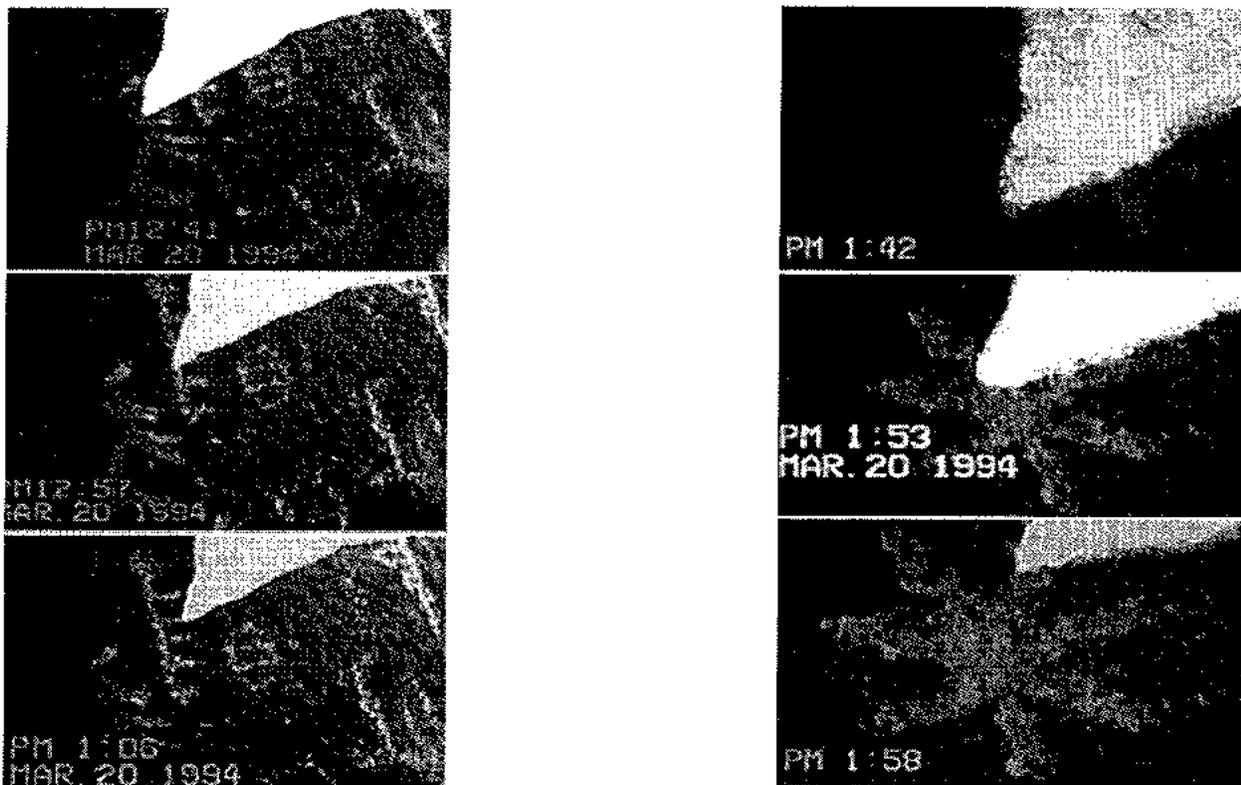


Figure 5,6. Near the entrance of the rock enclosure, a west-facing petrolyph group received a distinctive wedge of light on March 20, 1994. The circumstances are so sensitive that slightly different interactions have been observed at successive equinoxes.

South of the wash lying in a crevice, is a bighorn sheep glyph. Morning vernal equinox sunlight moved across the glyph, west to east, with the acute, forward part passing through the neck of the sheep and later moving back along the rear foot and through a small circle. Figs. 7 and 8.

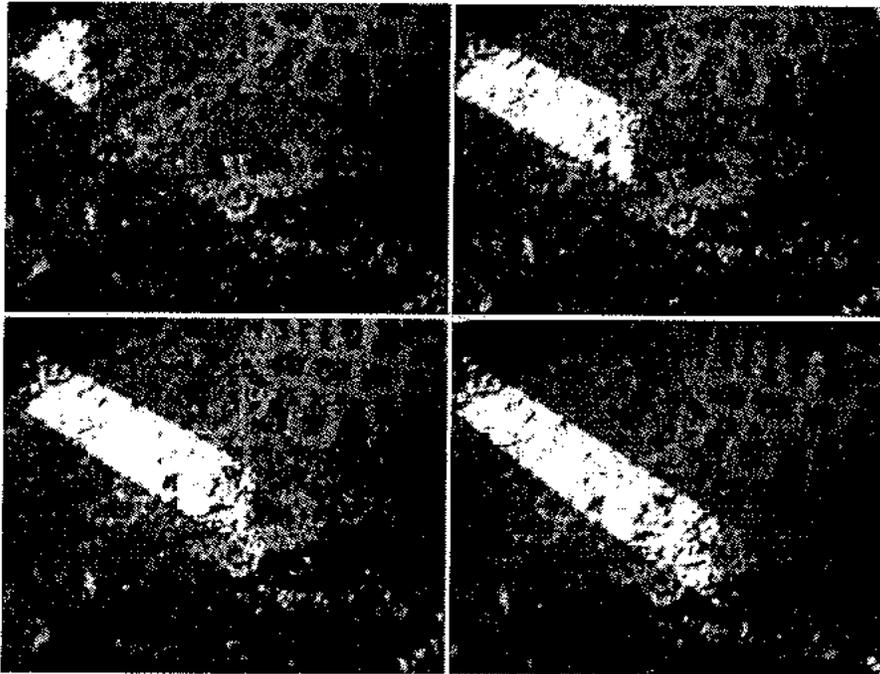


Figure 7. South of the wash, morning sunlight moved eastward through a chain of circles to the neck of a zoomorph on March 21.

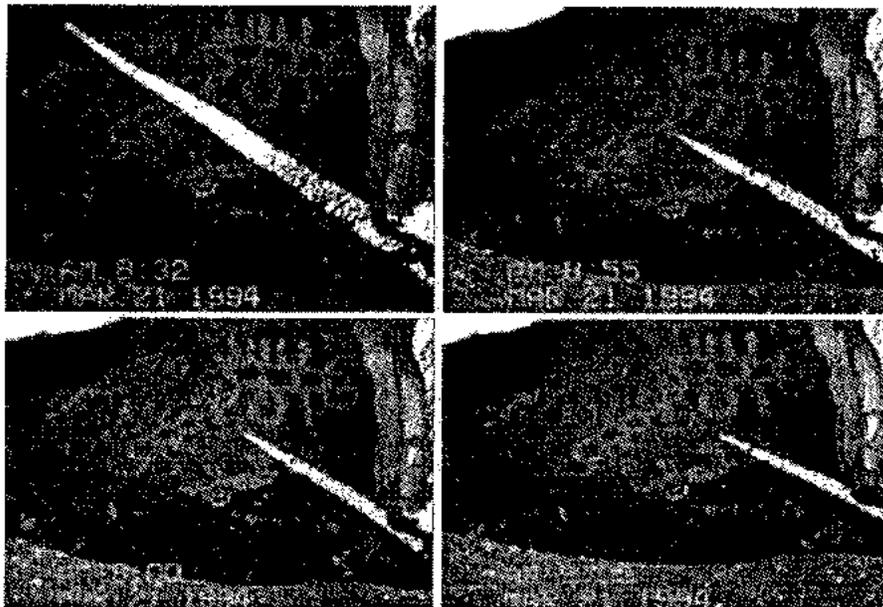


Figure 8. March 21. Avoiding the head of the animal, light filled the body and receded eastward, also missing the complex glyph in the upper right.

Nearby, at equinox the point of a triangle of light passed through the very center of an infinity sign simultaneously bisecting a star (asterisk) glyph, see Fig. 9. At summer solstice the minor interaction of the shadow of a small knob in Fig. 10 took place.

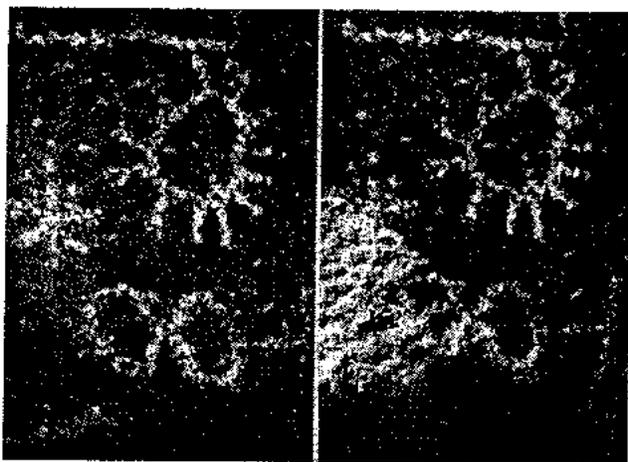


Figure 9. A triangle of light pointed to the center of an infinity-sign glyph on March 21.

In Figure 10, a small protrusion on a nearby rock casted a rounded shadow over the left lobe of the infinity sign glyph in Figure 9, on June 21.

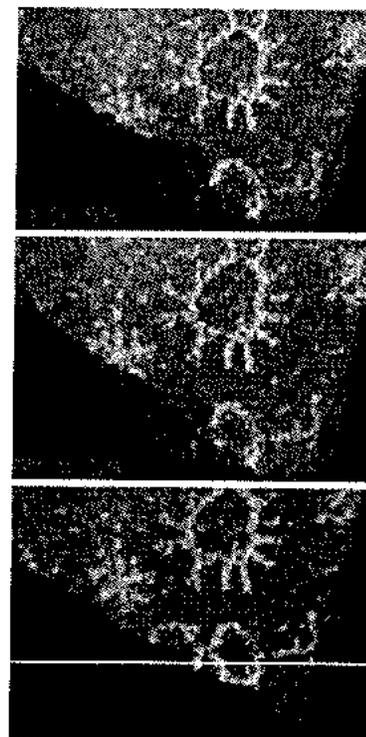


Figure 10.

In Fig. 11, near the winter cross-quarter day, the solar interaction with this glyph was observed. The triangle of sunlight pointing eastward (left) moved across the sun symbol, degenerating into a line tangent to the lower limb of the circle. Having three distinctive interactions with the same glyph-group at important times of the year strongly suggests these to be intentional seasonal markers.

A nearby meander with two circles on it also underwent an equinox interaction, though because of the albedo of the rock in the vicinity of the sunlight, pictures do not accurately represent the circumstances.

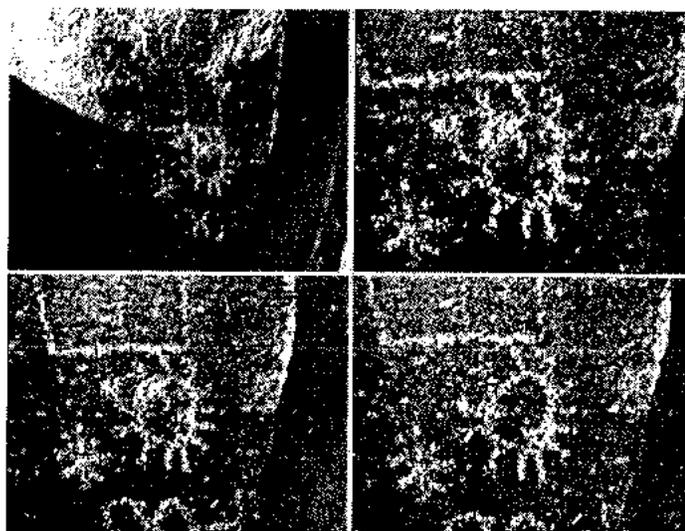


Figure 11. On November 11, 1994, light entered near the top of the sun symbol adjacent to the infinity sign in Figs. 9, 10. It expanded to engulf the sun circle and disappeared tangent to the lower left of the circle.

On a north facing wall of the rock enclosure north of the wash, a circle with a descending meander received two distinctive interactions at summer solstice. In the morning, a triangle of sunlight moved across the circle, becoming tangent to the ends of the meander as it moved across the rock. In the afternoon, a nearly symmetrical interaction took place with the *dark shadow*. See Figs. 12 and 13. This natural coincidence of light and shadow at summer solstice no doubt guided the form and placement of the glyph.

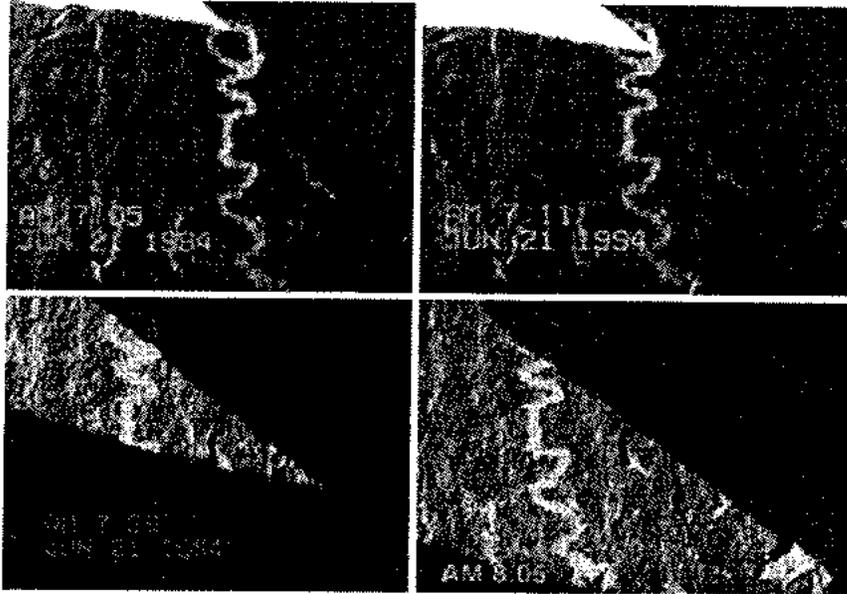


Figure 12. An arrow of morning light made contact with a north-facing circle on June 21. It moved across the circle in a fashion similar to the interaction in Fig. 11. The light then moved downward across the vertical meander, subtending its full extent.

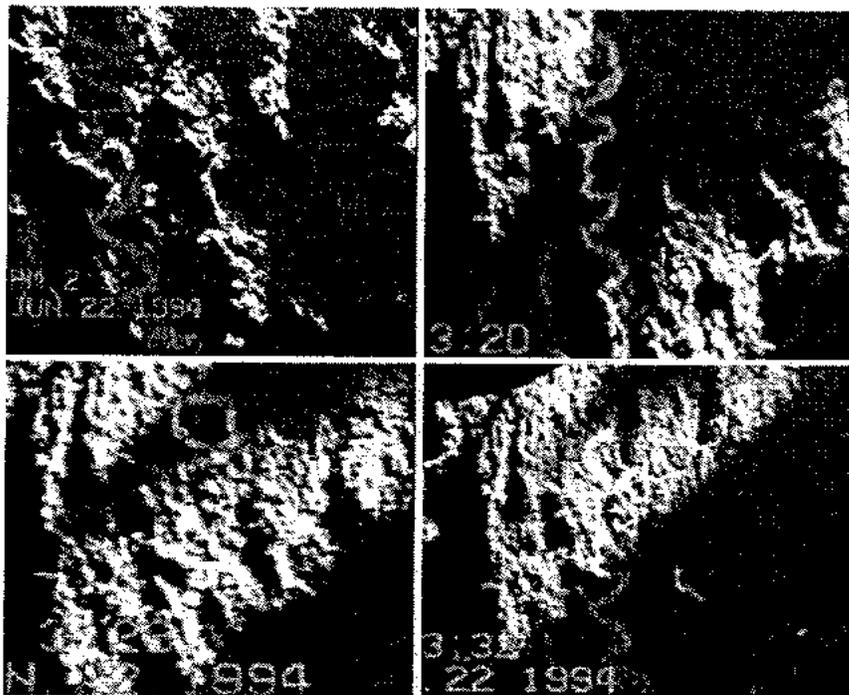


Figure 13. Mid-afternoon sunlight moved across the glyph on June 22. Careful comparison with Fig. 12 reveals the afternoon *shadow* mimics the morning *light* interaction with the glyph.

Figures 14 and 15 record the summer solstice sunlight corresponding to the winter solstice light pattern seen in Figs. 3 and 4. Notice that in summer the spot of light appeared lower in the grid and moved to the foot rather than to the antlers. It faded away entirely upon the foot.

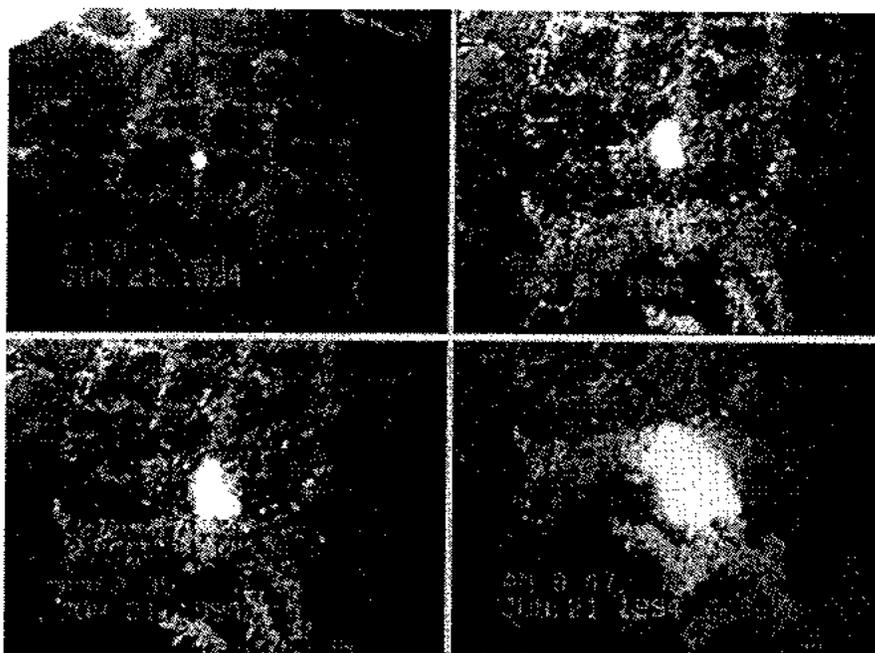


Figure 14. Light on June 21 took a somewhat different path across the glyphs than that of Figs. 3, 4. Appearing lower on the grid, it moves across the shoulders of the upper zoomorph and down its legs.

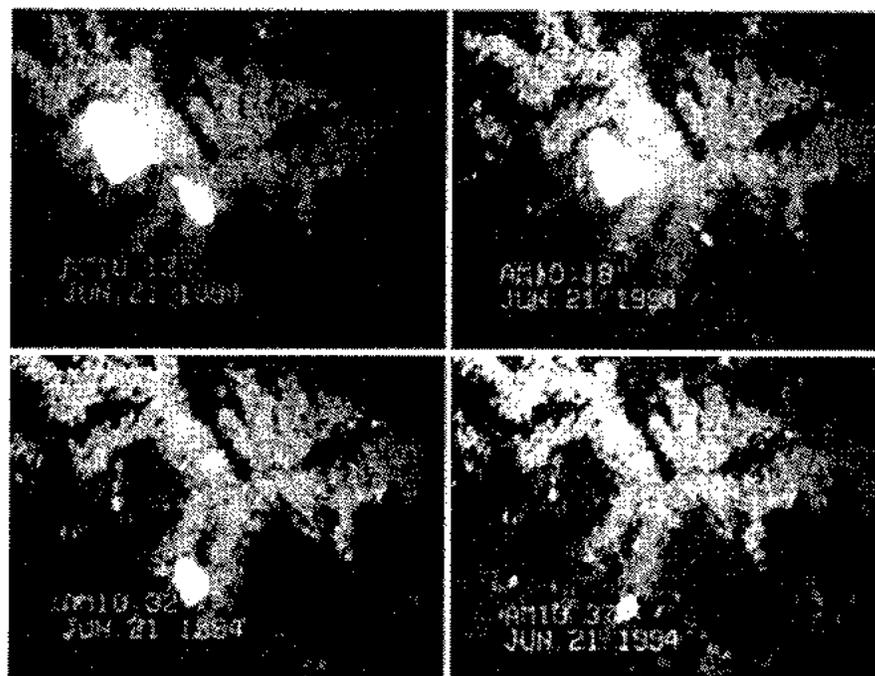


Figure 15. June 21. Moving across only the lower portion of the lower animal, the light disappeared precisely at the foot.

Comments on the Images and Image Processing

Most of the images were recorded on videotape with a VHS camcorder and transferred to image files with a video-capture card on a modest personal computer. Except as noted, image manipulation was restricted to contrast and brightness adjustment and insertion and enhancement of text.

The near winter cross-quarter day observations were quite faint because of the increasingly oblique sun angle at the glyph, so the following image processing was done on the images in Fig 11. Following the method of Moore, 1994 the hue components of the chrominance channels were separated into discrete images. This effectively isolated the colored sunlight from the essentially monochromatic albedo variations of the glyph. In order to see the sunlight *and* the glyph, we averaged these images with corresponding greyscale images, resulting in improved visibility of the sunlight relative to the glyph.

In an attempt to improve visibility of heavily repatinated glyphs, we found isolating the saturation component of the image and applying appropriate histogram equalization and palette selection to be useful, as seen in the greyscale rendition in Fig. 16.

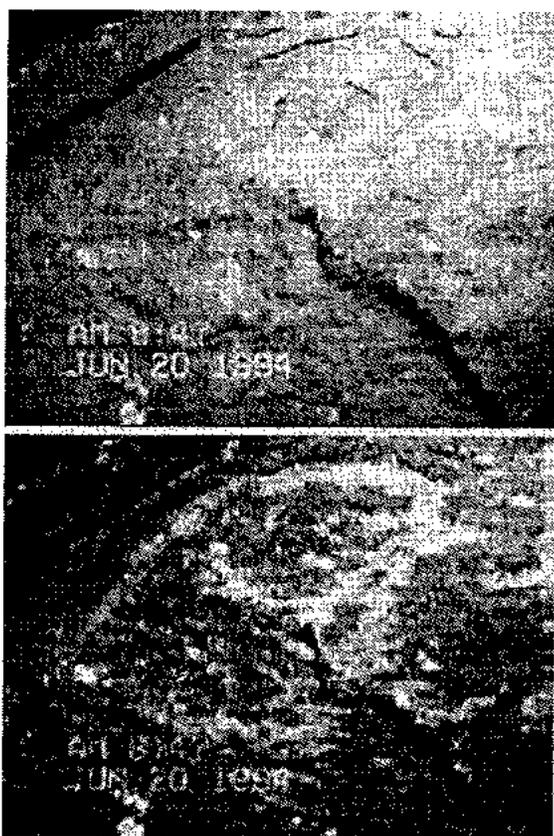


Figure 16. A video image of a heavily repatinated petroglyph (above) is processed to substantially improve glyph visibility (below).

Because of the variety of illumination, surface color, and texture encountered in rock art imaging, any given technique will have limited applicability. We encourage experimentation with a variety of image processing methods to improve the visibility of rock art when appropriate. Such techniques offer the attractive advantage of objectivity; however, the researcher bears the responsibility of fully explaining the methods used and insuring that the powerful techniques available do not produce misleading results.

Conclusions

Grapevine Canyon was an important spiritual focus spanning many centuries. Recognizing the fundamental importance that the motion of the sun held to mankind, ancient Native Americans represented significant points along the sun's path with petroglyphs positioned to interact distinctively with sunlight at corresponding times. Interaction with particular symbols and animal body parts suggests that the play of light may have intimated glyph form and placement. This rock art may well have been produced to depict significant seasonal stories in celebration of the (all too rare) reliably predicible cycles in nature.

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