Willow Creek Observatory

A Solar Observatory at Willow Creek, California, USA

John H. Rudolph

1. Abstract:
This paper presents an ancient observatory situated on the rim of Willow Creek Canyon in northeast California which illustrates both the importance of the place of early man in the cosmos and also the importance of the specific site that ancient men chose to record events observed in that cosmos. The site includes natural chambers modified by the early astronomers, with deeply carved glyphs, symbols and inscriptions. At the Summer Solstice sunrise, a narrow beam of light forms a perfect equilateral triangle on the rear wall of the cave. At sunset, in the second chamber, a light pointer traces the outer of six half circle rings. On the Autumnal Equinox a vertical shadow matches the points of four stacked chevrons. At sunset, a pointed shadow moves across the six concentric quarter circles to the top of the outer ring. These and other effects and glyphs are dramatic indications that the site was used over a long period of time to mark the change of seasons using solar events.

Acknowledgements:

Credit for discovery of the sunrise alignment effect at Willow Creek (CA-LAS-32) belongs to Professor Robert E. Connick and his wife, Doctor Frances Connick of Berkeley CA who presented a paper at the AURA International Congress on rock art at Darwin, Australia in 1988. The Connicks had discovered this site in the 1960s but had not made their discovery public until the 1988 conference. They have produced two excellent papers on the site, one on the solar alignment event, "A Summer Solstice Petroglyph Site", the other focusing on the variety of petroglyphs in the area, "Varieties of Petroglyphs and Implications For Their Use and Chronology at Willow Creek Near Susanville (CA-LAS-32).

I further wish to acknowledge the support and encouragement of my wife, Carol Patterson-Rudolph for her constructive criticism and great assistance in preparing this paper.

2. INTRODUCTION

a. The Cosmos

At some very early time, ancient man realized that he was imbedded in the miracle and mystery of the cosmos, and he began to observe the phenomenon of the stars and the constellations, the sun, the moon, the planets and special celestial events. (Marshack 1972. Hudson 1980, Brennan 1984, Mayer 1973 'Slides: galaxy, milkyway,parallesl line glyph, star circle, concentric ring glyph, sun, nelical diagram, spiral glyph, constellation constel. glyph, moon, moon diagram, serpentine glyph, planets, planet glyph, supernova, nova glyph

between men about the month by the kind of beans left in the bag". (Voeglin, 1942)
The Middle Wintu determined two solstices. "Old men watch the sun. It oscillates for 3 days. Sun looks around finally decides to go north or south". The Southern Wintu mark the Winter Solstice only...don't bother about summer solstice. (Voeglin, 1942)

The Eastern Shasta made marks on the center pole of the assembly house with chalk. The Western Shasta noted the shadow on flat rocks around the center post of the assembly house". The Western Atsugewi watched where the sunlight strikes on the center post of living house or sweat house, but made no marks on the post. The Western Shasta watch when the sun rises or sets between trees. One man now uses a board by his door. Atsugewi West watch shadow from Soldier Mountain ("it goes to Jim Hunt's place for solstice"). The Mountain Maidu observed both summer and winter solstice by the sunrise only. (Voeglin 1942)

The above excerpts from Kroeber and Voeglin give the impression that the tribes of northeast California were unsophisticated about celestial events, Hudson 1984 and Mayer 1975 and 1977 present convincing evidence that these tribes, or their predessors were indeed very knowledgeable and sophisticated about astronomical observations. Hudson describes a complex philosophical and mythical framework involving celestial objects, people and other beings with rituals to maintain the cosmic balance involving the sun, the moon, certain stars and constellations. He sites evidence that eclipses could be predicted. An elite group developed to observe, record interpret and conduct ritual activities to assure proper interaction of the society and the gods. (Hudson 1984)
Mayer shows petroglyphs that match constellations and makes a convincing case for the acceptance of Miller's Hypothesis that petroglyphs thruout the southwest recorded the supernova event of 1054 A.D. (Mayer 1977)

c. Cultural Conclusion

The Various Indian tribes in the area of northern California (Atsugewi, Achamawi, Maidu, Wintu, Paiute and Shasta) seem to have kept track of the seasons in one way or another but there did not seem to be the obsession for observation indicated by the Willow Creek Observatory. This suggests that the indigenous people living in the area in the 1800s, while noting the change of seasons in a relatively informal way, did not carry on the intense and meticulous observations as indicated by the sophistication of the Willow Creek Observatory. It is possible that the tribes present at the time of the invasion of the Whites were late comers to the area, and other people were the ones who used and embellished the Willow Creek site, possibly at a very early time. Alternatively, the tribes in the 1800s could have been the direct decendents of the earlier people, but the traditions of acute astronomical observation could have been diluted over time due to the many visicitudes of life in those times and in that area.

Thruout California, according to Hudson, the hunter-gatherer tribes developed cultural, religious, mythic and practical envolvement with the celestial events with considerable sophistication (Hudson 1984)

It is curious to note that the most elaborate, carefully inscribed glyphs associated with alignments seem to be the oldest. This suggests the possibility that the knowledge and committment to astronomical observation and recording was brought into the area from elsewhere and over time, faded in practice and content.

c. Geographical Context

The site is situated in the northeast section of the State of California in the U.S.A. ´slides map of USA map of Cal`

d. Local Environment

The site is a well-known petroglyph site designated as CA-LAS-32 located in the northwest corner of the Great Basin area north of Susanville, CA at 40.469* N, 120.44* W, about 60 miles east of Mt. Lassen volcano. The site is marked on USGS topographical maps as "petroglyphs".

The country is high desert plateau with sage and rabbit bush mixed with sparse grass and occasional junipers and pines. The climate is dry, cold in the winter and hot in the summer. The desert floor is littered with basalt stones and boulders either weathered out of the underlying lava flow or dropped from the sky by volcanic eruption. Mt. Lassen , an active volcano last erupted in 1917. Honey Lake can be glimpsed to the south, still a considerable body of water, but much diminished from it´s size when the climate was wetter at the close of the last ice age when man perhaps first entered upon this area. Elevation is approximately 1300 meters (4275ft.)

The subject site is located on the eastern rim of Willow Creek Canyon in an outcropping of basalt which forms a ridge running north-south, rising about 30 ft. above the surrounding plateau and dropping about 200 ft into the canyon on the west side. ´slides: Willow Creek canyon`

3. Focus of this Paper

a. Two natural caves in the outcropping, one facing northeast and the other facing southwest are the main features of the site.
b. The main events to discuss are the Summer Solstice sunrise and sunset events and the Autumnal Equinox sunrise and sunset events.

4. The "Sunrise Chamber":

a. North end environs

The north end of the outcropping containing the "sunrise chamber"

is heavily embellished with petroglyphs, all diagramatic or symbolic in nature, no figures of humans and only one figure of an animal and one of a bird can be found in the area. ´slides: sunrise end; "signboard"; entrance ; concentric circles; serpentine, rake,`

b. Signboard

Note the glyphs above the entrance, some painted with red ochre. The crossed circle is an ancient symbol for "earth". There are two small circles adjacent to this glyph, could these symbolize the sun and the moon? The next symbol is unclear, but appears to be a vertical line rising from a circle with several horizontal lines branching out from it. A long horizontal line caps the stem which curls into a small circle at each end. Over this runs a horizontal serpentine. There then appear to be two vertical red ochre lines followed by a very prominent pecked and red painted oval pierced by a vertical line. This is similar to the sign in the center of the Harris map of ancient China (Cyr 1992) ´slide: signboard and rubbing` There is also a vertical red line over the chamber entrance. This panel of glyphs reads like a signboard announcing the importance and perhaps the authorship of the work at the site.

c. The approach to the "Sunrise Chamber"

On the approach to the entrance there is a "threshold" boulder with an inscription looking very much like a form of writing. ´slide: inscription and rubbing` An inscription similar in character is inscribed on a boulder wedged between the walls of the Sunrise Chamber at the floor. ´slide: rubbing of inscription`
Outside the entrance is a large (four ton) block of stone which has fallen over from it´s original position. We determined that this rock was originally upright but already separated from the larger block immediately to the south. Petroglyphs can be seen running down and underneath it where it would be impossible to peck them today. ´slide: fallen rock` Rubbings were taken of the glyphs on this rock and on the top of the adjacent one. Compare the photographs and the rubbings of these two stones. ´slide: fallen rock photo and rubbing, photo of south stone and photo of rubbing` There is a very unusual glyph on the top of the south stone in the far corner on the top. It appears to be a distinct dot in the center with lobes radiating around it. This is another unusual glyph for North America, but common in the Boyne Valley, Ireland.

To the right of the chamber entrance is a stone covered with carefully designed and deeply inscribed glyphs. ´slide: rock face` The concentric circles on each side of the rock ridge seem to me to say "here is the place that the sun turns the corner". ´slide: two sun symbols` The concentric circle connected to two small circles and three small circles seem to me to represent a constellation and is drawn the same way that both Chinese and Aztec constellations are drawn. (Moran and Kelley 1953 and Aveni 1980) Alternatively, this glyph could represent the sun and the five visible planets.

'Slide: constellation'

Below and to the right is a panel with a sinoid with twelve turnings or lobes connected to a circle. There is a line through six of these loops. This may represent the cycles of the lunar year as seen in similar glyphs at Newgrange (Brennan 1983) The other glyph in this panel is a circle connected to a wavy line from which extend lines leading to loops or circles. A small serpentine comes in from the right around the head of the first mentioned circle/serpentine. On top of the ridge, on a horizontal rock is carved exactly the same group 'slide: first group, second group'

The apparent age of these carvings seem to cover a great range as some are almost completely weathered away and cannot be seen unless the light strikes at a tangent to the rock face while others are very clear and seem to be younger. Some are thinly pecked thru the desert varnish and while they are crudely done, there or many of the same motifs as shown on the more ancient carvings.

Connick and Connick describe these variations and discuss the petroglyphs in the vicinity in their paper on them mentioned above. However, they make no attempt to interpret the meaning of the glyphs .They classify them as "Great Basin Abstract: VULGARIS, being lightly pecked thru the rock surface and hardly patinated; PROMINENT, being deeply carved and somewhat patinated; and CLASSIC, being deeply carved, carefully made and heavily patinated, weathered and eroded". (Connick and Connick 1988)

It is my belief that the petroglyphs at this site are associated with the use of the site and so are astronomical in content and meaning. Some seem to be markers and gages, some seem to be symbols of the sun, the moon, constellations and the planets.

d. Elements of the "Sunrise Chamber"

The first cave to describe is a narrow fissure opening to the northeast. It is about 3 ft. wide and 9 ft. high at the opening and extends about 21 ft. back into the rock. The floor of the chamber slopes upward toward the back. 'slide: plan and section drawings' The roof is formed by very large slabs of stone covering most of the fissure except for the rearmost portion which opens to the sky. There is a keystone shaped boulder almost concealing the entrance wedged between the sides of the chamber, this stone has been carved, inscribed and shaped. 'slide: keystone' Halfway back in the chamber the crevice narrows to 13 inches where another roughly triangular boulder is wedged between the walls at the ceiling. This "choke-stone" has been carved away on one side. 'slide: chokestone' The rear of the chamber becomes wider with side crevices providing somewhat more space. The rear wall consists of unmarked rounded boulders but the Connicks recall that when they first visited this site in 1964, there were several large stones in the rear of the room that have been removed, presumably lifted out thru the roof hole. One in particular is a 6 ft. long slightly bowed stone, triangular in section, now resting above the chamber. There is a

small boulder lying on the floor and wedged between the sides with a glyph which may have been the target stone. 'slide: rubbing' The corners of the walls of the chamber have been rounded off and can be compared to sharp corners of the naturally split rock elsewhere in the basalt ridge. Areas of the rock walls have been dressed prior to elaborate glyphs being deeply carved into the surface.

e. Petroglyphs inside the "Sunrise Chamber"

Inside the Sunrise Chamber are the boldest and seemingly the oldest of the rock carvings. The most prominent carving is on the east wall and is a long serpentine beginning at a small circle, passing thru a quadrified oval, rising and falling connecting a series of small circles and circles with dots, finally entering the lower left quadrant of a large diagram where after three loops or nodes it crosses the vertical centerline and loops back on itself. This suggests three lunar cycles in that quarter of the year. It is interesting to note that the ancient Chinese symbol for the sun is a circle with a dot in the center. (Moran and Kelley 1969) I believe that this petroglyph diagram shows the sun passing through the second quarter of the year, crosses the mid-line after which it turns and begins to move back towards the south. This large rounded quadrangle is divided vertically and horizontally and contains several circles with dots in the four quadrants. This looks at first like a mask, but may more properly be a diagram of the seasons of the year. This looping back is very similar to astronomical notations at Newgrange in the Boyne Valley, Ireland. (Brennan 1980 and 1983) 'slide: rubbing of sunrise glyph' The other major glyph is situated below and farther into the chamber and is a rounded square with a line beginning at the upper left corner running diagonally down thru two interior vertical lines and out the lower right hand edge. These glyphs are carved one to two inches wide and up to one inch deep into the basalt. Edges are very worn and smoothed and the patina is the same inside as outside. The carvings all give an impression of great antiquity. 'slide: photos of east glyphs'

There are other glyphs lightly pecked or abraded into the walls of the chamber which are barely 1/8 inch deep and while not new judging from the patina, are entirely different and apparently much younger than the "seasons diagram" glyph. This consists of three downpointing arrowpoints extending from a horizontal line which leads to the left and loops down and back on itself. This glyph expresses the idea of "middle" and the idea of "returning" thus recognizing that this is the middle place where there is a returning of the sun (Patterson-Rudolph 1992)

f. The Summer Solstice Sunrise Event

On the morning of June 21 the interior of the chamber is quite dark prior to actual sunrise. As one crouches in the cramped chamber watching the back wall of the cave, there is no hint of light until the edge of the sun peeps over the rim of the horizon which is

20.46 miles away and slightly elevated about 0.81 degrees. The azimuth at the instant of it´s appearance is 58.4* E of N (Connick and Connick calculations) . At this instant there appears on the back wall of the chamber a bright, crisp, red triangle of light approximately 6 inches on a side pointing up. It is difficult to convey the drama of this event in words. The sides of the triangle are formed by the top of the keystone at the entrance to the chamber which has been chipped and worked. The right side of the triangle is formed by the west wall of the cave which has been dressed to allow the light to pass thru. The left side of the triangle is shaped by the hanging chokestone halfway up the passage. It is evident that this last stone has been carved away on it´s west edge to make the light triangle work. One must ask whether this observatory is so old that it was necessary over the centuries to batter or grind away the chokestone to keep up with the change of position of the rising sun at the solstice due to the change of the obliquity. According to Connick´s calcualtions the sun was 0.51* further north in 1000 BC,and 0.94* further north in 4000 BC. This would have reduced the base of the triangle by 1.7 cm. and 3.1 cm. accordingly. The triangle may have been more of a dagger, or may have been smaller at the time the chamber was first used for observations (Connick and Connick 1988) ´slide: light triangle`

After the triangle first strikes the rear wall, the patch of light begins to move downward and to the right, getting larger and fuzzier as it grows. The combination of sunlight and projected shadows on the serpentine leading to the "seasons diagram" illuminates the loops and circles of the serpentine in sequence until this part of the glyph is completely illuminated and a shadow cuts across the top of the serpentine outlining the whole sequence in stark relief. ´slides: sequence of sunrise effect`
Because the moving sunlight strikes obliquely across the stone face, the changes in the light are very rapid, and only minutes are required for this dramatic display. Finally, the line dividing the light and shadow bisects the "Seasons Diagram" diagonally from upper left to lower right, cutting thru the upper left sun circle, thru the intersection of the two axis and thru the lower left sun circle touching the top of the larger circle in the same quadrant. This again seems to express the idea that half the year has past and recognizes that the summer solstice occurs off the true north-south axis, and off the east-west access. ´slide: shadow across seasons diagram`

Meanwhile, back at the cave entrance, the "vernier" of six small parallel lines on the east wall of rock on each side of a shallow vertical ridge has a shadow moving across them, cast by a notch cut in the overhanging lip above the glyph. As the sun moves high in the sky around mid-day, this shadow moves across this " vernier". ´slide: vernier`

g. West Wall Glyphs

On the west wall of the sunrise chamber is a complex panel of

glyphs which have some unusual characteristics. 'slide: photo and rubbing' The rubbing revealed that the tight serpentine seems to curl under itself in several places which is very unusual for petroglyphs found in North America. The stacked chevrons are another unusual feature and have a definite purpose.

h. The Autumnal Equinox Event at Sunrise

At sunrise on the equinox, the first point of light cast a vertical shadow which fell precisely along the points of the stacked chevrons. 'slide: chevron shadow'

5. The "Sunset Chamber"

a. Elements of the "Sunset Chamnber"

This chamber is another natural cave formed by the natural splitting away from the main mass of basalt a very large slab of rock which leans out toward the west overlooking Willow Creek canyon creating a passage about ten feet wide with a roof of large slabs of rock leaning from the outer slab to the mother rock on the east side of the chamber. This cave is oriented generally west. The chamber slopes downward as you enter. 'slide: view of entrance' At the entrance on the west wall is a greatly eroded and faint series of parallel zig-zags. This diagram is similar to multiple zig-zags at other solar sites including Newgrange 'slide: zig-zags'

On the right or west side is a glyph wrapped across the nose of a rounded vertical edge of the rock consisting of six concentric rings forming semi-circles on each side of the edge joining across the nose. The smallest inner circle on the right side is open at the top, the smaller inner circle on the left is closed at the top and looks very much like an eye. 'slide: sunset gage and rubbing'

Farther into the cave five parallel wavy but essentially vertical lines rise from a chaos of inscriptions below to meet the roof slab above. To the left of these lines is a short double serpentine with marks in the loop. This small glyph resembles the ancient chinese symbol for the moon. (Moran and Kelley 1969) 'slide: parallels and moon glyph' Farther into the cave there is a glyph like a stylized tree again too far up underneath a large boulder reached, photographed or inscribed. This boulder may have fallen from above. It was possible to make a rubbing of this glyph. 'slide: rubbing of tree glyph' There is some indication that the roof slabs have slipped or migrated downward over time but no marks of slippage or scraping can be seen. There is a large 5' x 5' x 3' rock which lies upside-down on the roof slab. It has been pried over the edge from it's original position above.

c.The Summer Solstice Sunset Event

At sunset, I observed a long pointer of light six inches wide coming to a point exactly like a pencil, projected from the conjunction of the roof slab and the outer support rock at the

mouth of the chamber. This pointer traced around the outer ring of the right concentrics until it reached the top of the ring, it then pulled away to the right as the sun set. This observation is my own I am happy to report. ´slides: sunset light pointer 1,2,3`

We asked ourselves if there might be some alignments on the occasion of the autumnal equinox, and we determined to return to the site on the equinox.

d Autumnal equinox sunset event

On september 19, 1992 accompanied by Rollin Gillespie and Nal Morris, both accomplished archeoastronomers, I visited the site again at the equinox. We were richly rewarded.

At sunset, a shadow cast by a knob of rock to the right of the concentric rings, formed first what looked like the profile of an Indian the nose of which moved up thru the rings changing as it moved to the form of a female breast. When the point of the shadow reached to the innermost ring, it then moved out along the top ends of the rings to the very top of the outermost ring where it held as the last limb of the sun sank beneath the horizon. ´slides: sequence of sunset effect`

I must say that this event moved us deeply. We had to ask ourselves if we had just seen a silhouette of the ancient astronomer himself, or perhaps herself.

e. Predictions

The equinox sunset event inspired us to investigate the possibility of an alignment involving the glyph to the left of the five parallel vertical lines, the three lobed double sinasoid. By stretching a string from the center lobe to the apparent intersection of the stones forming the solstice light pointer, we determined with Nal Morris´ expertise, that the 279.5* asimuth and 9*40´ elevation gave a prediction of 4-23-92 at 17:53 and 8-17-92 at 17:59 standard time for an alignment with the light pointer. This is close enough to the cross quarter date of August 8 to make a site investigation at that time worthwhile. ´slide: string stretching` The possibility that the glyph may indicate a lunar alignment should not be dismissed noting the similarity of the marker glyph to the Chinese sign for "moon".

6. Affinities:

There are too petroglyph stones in the Northwest which I mention here because they are unlike any of the petroglyphs of the Northwest Coast Tribes but which, to my eye, have a similarity and thus an affinity with the Willow Creek site.

First is the Wallula Petroglyph Stone, now standing upright at Portland, Ore. City Hall but originally found prone near the Columbia River near Wallula, Ore. The local native people at the

time it was discovered claim that it was done by people preceding them, but was used as a goal for daring right-of-passage rituals by young men. (Hill and Hill 1974)

Second is the Garrison Eddy Stone now lying near the Stevenson,WA Courthouse. (Hill and Hill 1974) 'slide: Walula and Garrison Eddy stones'

7. Conclusions

a. This site is an observatory for noting the Summer Solstice, the Autumnal Equinox and possibly other dates such as the cross quarter date.
b. The ancient people who used this site were probably hunter-gatherer people. They developed an elaborate and sophisticated method of noting, measuring and marking various celestial events.
c. The place, this site, is naturally integral with the cosmos. The ancient people found this place to lend itself to some unique alignments of sun and season and with a little modification and imbellishment, turned the natural rock caves into chambers to memorialize various events that they observed. The "little embellishment" is not meant to disparage the tremendous amount of work and long years of observation that left this ingenious observatory which still works today.
d. The oldest or "Classic" petroglyphs are very old, as evidenced by the depth of the carving, the similarity of patina to the untouched rock, and comparison with the other fresher, newer looking inscriptions. How old is yet to be determined, perhaps by cat ion ratio dating, or by determining the shift on alignments, or by measurement of the depth of weathering for bare rock compared to rock protected by being painted with red ochre, or other means unknown to this author or yet to be developed.
e. Certain affinities to old world sites, symbols and observations suggest themselves, but no definite conclusion can be drawn at this time as to any influence from other than indigenous cultures.
f. It can confidently be concluded that this site was used over a very long period of time and reasonably concluded that more than one culture inhabited the area and used the observatory or at least mimicked the inscriptions.
g. There is an affinity with old world sites and symbols. The observatory at Newgrange is similar in it's use and in the character of many of the symbols used. Most of the elements of Megolithic astronomical notation are found at Willow Creek. Certain glyphs are similar to Chinese symbols and the notations of constellations very much like those used by the Aztecs and the Chinese. The "sunset gage" is very much like a petroglyph a Mane Rethual in Brittany (Cyr, 1992) which intend to investigate further.

h.This PLACE, as a natural happening, could have made the events of sunlight penetrating the womb of the earth more magical, more significant to the ancient people who first witnessed them than if a mere human device or structure had been erected to accomplish the same ends of marking the change in the seasons. This was the COSMOS

itself envolving mankind in it's miracles. These people, immersed in nature, belonged to the cosmos and it's processes, and with ritual, could play a part, to maintain the balance , to preserve not only their fragile culture, the COSMOS itself.

If we can touch this reverence, if we can tap into the power and rhythms of the universe, perhaps we can be inspired to find a way to leave the world a better place.

John H. Rudolph
Bainbridge Island, WA USA
October 7, 1992

Bibliography:

Aveni, Anthony F. 1980 "Skywatchers of Ancient Mexico" U. Texas Press

Beckensall, Stan 1986 "Rock Carvings of Northern Britain" Shire Publications Ltd. Cromwell House , Church St. Aylesbury, Bucks HP17 9AJ, U.K.

Bowditch, Nathaniel,LL.D "American Practical Navigator" Vol I 1984 edition and 1966 Corrected Print edition, Defense Mapping Agency Hydrographic/Topographic Center

Brennan, Martin 1983 "The Stars and the Stones" Ancient Art and Astronomy in Ireland. Thames and Hudson Ltd. London

Brennan, Martin 1979 "The Boyne Valley Vision" The Dolmen Press

Cressman, L.S. PhD 1937 "Petroghlyphs of Oregon" U of Oregon Press, Eugene, OR

Cyr, Donald L. 1992 "Megalithic Adventures" Stonehenge Viewpoint, Santa Barbara, CA

Gatty, Harold "The Raft Book" 1943 George Grady Press, New York, N.Y.

Harris, Hendon Mason "Treasure Maps of Fu Sang" in "Dragon Treasures" Stonehenge Viewpoint edited by Donald L. Cyr

Hadingham, Evan 1974 "Ancient Carvings in Britain, A Mystery" The Gainstone Press Ltd. London SW3 1DS U.K.

Hadington, Evan 1984 "Early Man and the Cosmos" Walker and Co. New York

Heizer, R.F. and Whipple, M.A. 1951 1971 "The California Indians" a source book, U. of Cal. Press, Berkeley, CA

Heizer, Robert F. and Baumhoff, Martin A. 1962 "Prehistoric Rock Art of Nevada and Eastern California, U. of Cal Press, Berkeley, CA

Hill, Beth and Ray 1974 "Indian Petroglyphs of the Pacific Northwest" U. of Washington Press, Seattle, WA

Hudson, Travis 1980 "California's First Astronomers" in "Archeoastronomy and the Roots of Science" edited by E.C. Krupp 1984 Westview Press, Boulder CO. Papers presented at the AAAS Selected Symposium 1980

Hudson, Travis and Underhay, Ernest 1978 "Crystals in the Sky: An Intellectual Odyssey" Ballena Press

Kroeber, Alfred L. 1925 "Handbook of the Indians of California" Bur. of Amer. Ethnology Bul. 78, Washington

Lowell John and Blackburn, Thomas C. 1976 "Native Californians" a theoretical perspective. Ballena Press, Menlo Park, CA

Marshack, Alexander 1972 "Cognitive Aspects of Upper Paleolithic Engraving" in Current Anthropology Vol 13. No. 3-4 June - October 1972

Mayer, Dorothy 1975 "An Examination of Miller's Hypothesis" petroglyphs showing the 1054 supernova. in "Native American Astronomy" edited by Anthony F. Aventi, U. of Texas Press 1977

Mayer, Dorothy 1973 "Star Patterns in Great Basin Petroglyphs" Petroglyphs showing constellations. in "Archeoastronomy in Pre-Columbian America" edited by Anthony F. Aveni, U. of Texas Press 1975

McGlone, William R. , Leonard, Phillip M. and Gillespie, Rollin W. 1986 "Ancient Celtic America" Panorama West Books, Fresno, CA

Morris, Ronald W.B. 1981 "The Prehistoric Rock Art of Southern Scotland" BAR British Series 86

Morris, Ronald W.B. 1977 "The Prehistoric Rock Art of Argyll" Dolphin Press, Dorset

Morris, Ronald W.B. 1979 "The Prehistoric Rock Art of Galloway &

The Isle of Man" Blanford Press, Poole, Dorset

Moran, Hugh A. and Kelley, David H. 1969 The Alphabet and the Ancient Calendar Signs" second edition Daily Press, Palo Alto, CA

Saad-Cook, Janet 1985 Archaeoastronomy Vol VIII(1-4) 1985

Slocum, Captain Joshua 1900 "Sailing Alone Around the World, Vasval Institute Press, Annapolis, MD

Steward, Julian H. 1929 "Petroglyphs of California and Adjoining States" U. of Cal Press Berkeley, CA.

Taylor, E`G`R` 1971 "The Haven-Finding Art" American Elsevier Publishing Co. Inc. New York

Thompson, Gunnar 1989 "Nu Sun" Pioneer Publishing Co.

Voeglin, Ermine W. 1940 "Cultural Element Distribution Northeast California Records Vol 7, No2." U of Cal Press, Berkeley, CA

Waters, D`W` 1958 "The Art of Navigation" Yale University Press

Williamson, Ray A. 1981 "Archaeoastronomy in the Americas" Ballena Press

(Call name "Willow6")

LAST PAGE OF FAX