Archaeoastronomy of the Southwest

Arizona Archaeological Society

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PURPOSE

This class will review the current literature on archaeoastronomy in the American Southwest, discuss important issues relating to the naked eye observation of celestial objects in the night sky, and cover basic recordation techniques and methods. This class will sample a small portion of a large body of literature on archaeoastronomy. Mesoamerican archaeoastronomy will be included because of the influence of Mesoamerican cultures on the Southwest and because of the advanced state of archaeoastronomy studies in Middle America.

Archaeoastronomy is most productive when undertaken as an anthropological study that uses archaeological and astronomical methods and theories. It should include the study of both the landscape and the night sky surrounding an archaeoastronomy site or location, as well as the cultural context in which the ancient/historic astronomy took place. Thus, ethnographic information, when available, should be used to develop research designs and for assisting interpretation; archaeological methods should be applied to the recordation and measurements of alignments; and knowledge of naked eye astronomy is essential.

Three types of archaeoastronomy phenomena in the Southwest will be studied in class and in the field: (1) ***Alignments*** of petroglyphs, buildings, cairns, or trails with celestial phenomena (sunrise, sunset, moonrise, moonset, planets, constellations or star clusters, etc.); (2) ***light and shadow*** interaction with rock art panels during certain times of the year; and (3) recorded oral traditions, songs, poems, and other ***ethnographic data*** that provide cultural context for understanding prehistoric astronomy.

Students in this class will create a notebook that summarizes the main points covered in the readings and in class, and will prepare a field journal describing field observations made by the student during the class. In addition, students will prepare a short (5-7 page) research paper that covers reading materials not assigned in class (see bibliography for additional references).

COURSE OBJECTIVES

At the conclusion of the course, students are expected to:

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1. Understand the issues involved in observation of celestial objects with the naked eye
2. Understand the ethnographic basis of astronomical observation
3. Be able to use basic recordation techniques and methods
4. Appreciate the importance of research designs in archaeoastronomy studies
5. Be able to understand and describe alignments of various man-made structures with astronomical objects and events.
6. Observe and describe solar interactions with rock art panels
7. Understand how and why astronomical observation was used in various significant cultures related to the American Southwest: Mesoamerican, Hohokam, Pueblo, Navajo, Apache, and others

PREREQUISITES

The only requirement is the completion of Prehistory of the Southwest I or permission of the instructor.

COURSE FORMAT

The course is designed to be presented in approximately 34 hours, with 20 hours of lecture (as indicated under the Classroom Instruction Section) and 14 hours of laboratory/field experience. Classroom instruction occurs from 6:30 to 9:00 pm once a week for eight sessions. Field observations take place during the week and on weekends.

FIELD WORK

Visits by individual students or groups of students to local sites for observation will be determined during the course. Some field observations will be required for individual students on their own and some will be done together as a class under the supervision of the instructor.

LABORATORY/FIELD MATERIALS

All students will be required to create a journal that records their field observations.

REQUIRED READING

A package of articles and book chapters.
Optional book: *Skywatchers.* Revised Edition, Anthony F. Aveni (2001).

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COURSE OUTLINE (Classroom and Field Work Assignments)

I. Introduction to Archaeoastronomy Issues

Topics covered in this class session include the classification of celestial phenomena based on the strength of impression on a naked eye observer, the celestial sphere, charting the sun's movement, and moon and eclipse cycles.

Reading for this session:

- Sinclair, Rolf (2006) "The Nature of Archaeoastronomy," In *Viewing the Sky Through Past and Present Cultures.*
- Ruggles, Clive (1999) "Wider Issues." In *Astronomy in Prehistoric Britain and Ireland*.
- Williamson, Ray and Claire Farrer (1992) "The Animating Breath," In *Earth and Sky*.

Field Exercise No. 1 (Night Sky):
Students will examine the night sky and plot the most obvious star clusters (constellations) as they see them using graph paper. Position the polar star in the middle of the page. Record time, date, and location. In addition, find a location to place a stick about 1 foot (30 cm) in height that will cast a shadow and then record that shadow over the course of the class, both at the same time and at different times of the day, if possible.

II. Ethnographic Studies in Southwest Astronomy

This class session reviews ethnographic information on astronomy for the Pueblos, Eastern Pueblos, Zuni, Hopi, Navajo, Mescalero Apache, Jicarilla Apache, Seri, Tohono O'odham, Pima, Maricopa, Cocopa, Havasupai, Walapai, and Yavapai.

Reading for this session:

- Zeilik, Michael (1988) "Astronomy and Ritual: The Rhythm of the Sacred Calendar of the U.S. Southwest."
- Miller, Dorcas S. (1997) "Chief of the Night: Stars of the Southwest," In *Stars of the First People.*
- Chamberlain, Von del (2006) "On the Trail of Dinetah Skywatchers: Sun and Moon," In *Viewing the Sky in Past and Present Cultures*.

Field Exercise No. 2 (Sunrise and Sunset):
Select an archaeological site or prominent natural feature which has a view of the horizon; observe the sunrise over part of the site or

natural feature. Find a comfortable and/or obvious location (e.g., open or cleared area, rock seat, etc.) to make this observation. Sketch the sun's location on the horizon, record its azimuth, and note the direction/angle in which the sun moves up into the sky. Fill out the field form. Repeat this exercise for the sunset from the same observation location.

III. Recordation Techniques and Issues 1

This class session examines naked eye astronomy and recording techniques and forms, including determinig azimuths.

Reading for this session:

- Aveni, Anthony (2001) "Astronomy with the Naked Eye," In *Skywatchers.*
- Johnson, Clay (1992) "A Uniform Technology for Description of Solar Interactions with Rock Art Panels."
- Archaeoastronomy Site Forms

Field Exercise No. 3 (Night Sky):
Observe the helical rise and set of several major constellations to help determine the ecliptic and celestial equators. Chart their movement across the sky in your journal, record dates and times. Note the movement of the star clusters you observed in field exercise no. 1.

IV. Recordation Techniques and Issues 2

Recordation is discussed further in this class, including methodological issues, the development of archaeoastronomy research designs, criteria for determining if a site is an observatory, and web-based reporting. There also will be a demonstration of the Redshift Star Chart Computer Program.

Reading for this session:

- Bates, Bryan (2005) "A Cultural Interpretation of an Astronomical Calendar (Site #WS 833) at Wupatki National Monument," In *Current Studies in Archaeoastronomy.*
- Owen, Ann E. (2006) "Archaeoastronomy Test Plan 06-04," Gila National Forest
- Hardman and Hardman (1992) "Linear Solar Observatory: The Development of Concepts of Time and Calendar."
- *www.sinaguasunwatchers.com*

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Class Demonstration:
Redshift Star Chart Computer Program

Field Exercise No. 4 (Shadow Interactions):
Record a mid-day shadow on a rock art panel in your journal. Sketch the shadow's shape and its relationship to the petroglyph(s). Observe changes in the movement and shape of the shadow over a period of at least an hour. Fill out field form.

V. **Mesoamerican Archaeoastronomy**

This class session discusses the Mayan 584-day Venus calendar (Dresden Codex), the 260-day calendar, the 365-day calendar, Venus star wars, and astronomy temples. In addition, the class examines the conceptualization of geographic latitude by Mesoamerican groups through solar zenith observations and a complex calendar system, as well as the expansion of the Teotihuacan state during the first millennium A.D. based on archaeological data such as pecked circle crosses, building and site orientations, and culturally modified underground caves illuminated with beams of light during certain times of the year.

Reading for this session:

- Broda, Johanna (2006) "Zenith Observations and the Conceptualizaton of Geographic Latitudes in Ancient Mesoamerica," In *Viewing the Sky Through Past and Present Cultures.*

- Aveni, Anthony F. (1997) "Power From the Sky: Ancient Maya Astronomy and the Cult of Venus," In *Stairways to the Stars.*

Field Exercise No. 5 (Venus):
Locate Venus in the night sky; in your journal plot its general location in the sky (cardinal direction and low or high in the sky). Record location (UTMS), date, and time.

VI. **Archaeoastronomy of the Pueblos**

This class session discusses evidence of archaeoastronomy at Chimney Rock in southwestern Colorado and Chaco Canyon in northwestern New Mexico, as well as the apparent responses among the ancient Pueblos to known solar eclipses during prehistoric times.

Reading for this session:

- Malville, J. McKim (1999) "The Calendars of Chimney Rock and the Origins of Chacoan Astronomy."
- Sutcliffe, Ron (2006) "Evaluating the Chimney Rock Pueblo with Respect to Observing the Major Lunar Standstill Moonrises," In *Viewing the Sky Through Past and Present Cultures.*
- Masse, W. Bruce, and Robert Soklow (2005) "Black Sun and Dark Times: Cultural Responses to Solar Eclipses in the Ancient Pueblo Southwest," In *Current Studies in Archaeosatronomy*
- Soafer, Anna (1997) "The Primary Architecture of the Chacoan Culture: A Cosmological Expression," In *Anasazi Architecture*.
- Wolf, Virginia, and Edward Wheeler (2004) "Two Archaeoastronomical Solstice Techniques Utilized in Manco Canyon, Colorado."

Movie: "The Mystery of Chaco Canyon" by Anna Soafer, narrated by Robert Redford (1999).

Field Exercise No. 6 (Lunar Observation):
Examine lunar charts to determine the location and shape of the moon one evening. Observe the night sky from an archaeological site or prominent observation location and observe the rising of the moon. Sketch the moon and its movement in the sky. Record location (UTMS), date, and time.

VII. Hohokam Archaeoastronomy

Examples of Hohokam archaeoastronomy are discussed in this class session, including Casa Grande, the Shaw Butte Hilltop site, and the Hole-in-the Rock at Papago Park in Phoenix.

Reading for this session:

- Bostwick, Todd W., and Stan Plum (2005) "The Shaw Butte Hilltop Site: A Prehistoric Hohokam Observatory," In *Current Studies in Archaeoastronomy.*
- Mixon, Benjamin, and Raymond E. White (1991) "Skywatchers of the Salt River Valley Hohokam"
- Malloy, J.P. (1969) *The Casa Grande Archaeological Zone.*

Field Exercise No. 6 (Sunrise and Sunset, again)
Return to the archaeological site or prominent natural feature which has a view of the horizon that you previously recorded; observe the sunrise again over the same part of the site or natural feature. Sketch the sun's location on the horizon (record azimuth) and note the direction/angle in which the sun moves up into the sky. Fill out field form. Repeat this exercise for the sunset from the same observation location. Note changes in the location of the sun from your previous observations.

VIII. Conclusions

Students will turn in their research paper and journal, and provide a 5-minute oral presentation on their paper to the class.

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Bibliography

Ambruster, Carol W., and Tony Hull
2005 "Evidence for Early Navajo Horizon Astronomy in Chaco Canyon," In *Current Studies in Archaeoastronomy: Conversations Across Space and Time*, edited by John W. Fountain and Rolf M. Sinclair, pp. 205-220. Durham: Carolina Academic Press.

Aveni, Anthony F., ed.
1982 *Archaeoastronomy in the New World*. Cambridge: Cambridge University Press.

1997 "Power From the Sky: Ancient Maya Astronomy and the Cult of Venus," In *Stairways to the Stars: Skywatching in Three Great Ancient Cultures*, pp 83-133. John Wiley and Sons, New York.

2001 "Astronomy with the Naked Eye," In *Skywatchers,* pp. 49-74. Revised Edition. University of Texas Press, Austin.

2003 "Archaeoastronomy in the Ancient Americas," *Journal of Archaeological Research,* 11 (2): 149-191.

Bates, Bryan
2005 "A Cultural Interpretation of an Astronomical Calendar (Site #WS 833) at Wupatki National Monument," In *Current Studies in Archaeoastronomy: Conversations Across Space and Time*, edited by John W. Fountain and Rolf M. Sinclair, pp. 133-150. Carolina Academic Press, Durham.

Bates, Bryan, and Leah Coffman
2000 "Potential Astronomical Calendars and A Cultural Interpretation Thereof Along the Palat'kwapi Trail of North Central Arizona," In *Astronomy and Cultural Diversity: Proceedings of the Oxford VI International Conference on Archaeoastronomy*, edited by Cesar Esteban and Juan Antonio Belmonte, pp. 125-131. Tenerife: Museum de la Ciencia y el Cosmos.

Bohrer, Vorsila L.
1994 "Maize in Middle American and Southwestern United States Agricultural Traditions." In *Corn and Culture in the Prehistoric New World*, edited by Sissel Johannessen and Christine A. Hastorf, pp. 459-512. Boulder: Westview Press.

Bostwick, Todd W.
2002 "Saluting the Sun: A Hohokam Calendar," In *Landscape of the Spirits: Hohokam Rock Art at South Mountain Park,* pp.173-203 . Tucson: University of Arizona Press.

Bostwick, Todd W., and Bryan Bates
2000 "Issues in Archaeoastronomy Methodology," in *Astronomy and Cultural Diversity: Proceedings of the Oxford VI International Conference*, edited by Cesar Esteban and Juan Antonio Belmonte, pp. 147-156. Tenerife: Museo de la Ciencia y el Cosmos.

Bostwick, Todd W., and Stan Plum.
2005 "The Shaw Butte Hilltop Site: A Prehistoric Hohokam Observatory," In *Current Studies in Archaeoastronomy: Conversations Across Space and Time*, edited by John W. Fountain and Rolf M. Sinclair, pp. 151-160. Durham: Carolina Academic Press.

Brandt, John C., Stepehn P. Maran, Ray A. Williamson, Rpnert S. Harrington, Clarion Cochran, Murial Kennedy, William J. Kennedy, and Von Del Chamberlain
1975 "Possible Rock Art Records of the Crab Nebula Supernova in the Western United States," In *Archaeastronomy In Pre-Columbian America*, edited by Anthony F. Aveni, pp. 49-58. Austin: University of Texas Press.

Britt, Claude, Jr.
1975 Early Navajo Astronomical Pictographs in Canyon de Chelly, Northeastern Arizona, U.S.A.," In *Archaeoastronomy in Pre-Columbian America*, edited by Anthony F. Aveni, pp. 89-108. Austin: University of Texas Press.

Broda, Johanna
2006 "Zenith Observations and the Conceptualizaton of Geographic Latitudes in Ancient Mesoamerica: A Historical Interdisciplinary Approach," In *Viewing the Sky Through Past and Present Cultures: Selected Papers from the Oxford VII International Conference on Archaeoastronomy*, edited by Todd W. Bostwick and Bryan Bates, Pueblo Grande Museum Anthropology Papers No. 15, Phoenix.

Carlson, John B.
1987 Romancing the Stone, or Moonshine on the Sun Dagger," In *Astronomy and Ceremony in the Prehistoric Southwest,* edited by John B. Carlson and W. James Judge, pp. 71-88. Maxwell Museum of Anthropology, Anthropological Papers No. 2, Albuquerque.

Carlson, John B., and W. James Judge, eds.
1987 *Astronomy and Ceremony in the Prehistoric Southwest*. Maxwell Museum of Anthropology, Anthropological Papers No. 2, Albuquerque.

Carrasco, David.
1997 "Star Gatherers and Wobbling Suns: Astral Symbolism in the Aztec Tradition," *History of Religions* 26: 279-294.

Chamberlain, Von Dell, William R. Latady, and Todd Prince
2006 "A Sunrise Calendar at a Kayenta Anasazi Village," In *Current Studies in Archaeoastronomy: Conversations Across Space and Time*, edited by John W. Fountain and Rolf M. Sinclair, pp. 161-168. Durham: Carolina Academic Press.

Chamberlain, Von Dell, and Hugh Rogers
2005 "Tracking Stars in Dinetah: Astronomical Symbolism in Gobernador Phase Rock Art," In *Current Studies in Archaeoastronomy: Conversations Across Space and Time*, edited by John W. Fountain and Rolf M. Sinclair, pp. 221-242. Durham: Carolina Academic Press.

2006 "On the Trail of Dinetah Skywatchers: Sun and Moon," In *Viewing the Sky Through Past and Present Cultures: Selected Papers from the Oxford VII International Conference on Archaeoastronomy*, edited by Todd W. Bostwick and Bryan Bates, pp. 155-168. Pueblo Grande Museum Anthropology Papers No. 15, Phoenix.

Childrey, Don
2004 *Star Trails Navajo: A Different Way to Look at the Night Sky*. Victoria, Canada: Tarfford.

Digby, Adrian
1974 "Crossed Trapezes: A Pre-Columbian Astronomical Instrument," In *Mesoamerican Archaeology: New Approaches*, edited by Norman Hammond, pp. 271-283. Austin: University of Texas Press.

Ellis, Florence Hawley
1975 "A Thousand Years of the Pueblo Sun-Moon-Star Calendar," In *Archaeoastronomy in Pre-Columbian America*, edited by A. F. Aveni, pp. 59-87. Austin: University of Texas Press.

Ellis, Florence Hawley, and Laurens Hammack
1968 "The Inner Sanctum of Feather Cave, A Mogollon Sun and Earth Shrine Linking Mexico and the Southwest," *American Antiquity* 33 (1): 25-44.

Fairchild, Gary, J. McKim Malville, and Nancy J. Malville
2006 "Chimney Rock as a Ceremonial Center and Port-of-Trade Within the Chaco System," In *Viewing the Sky Through Past and Present Cultures: Selected Papers from the Oxford VII International Conference on Archaeoastronomy*, edited by Todd W. Bostwick and Bryan Bates, pp. 259-274. Pueblo Grande Museum Anthropology Papers No. 15, Phoenix.

Fewkes, Jesse Walter
1898 "The Winter Solstice Ceremony at Walpi," *American Anthropologist* 9 (3 and 4): 65-87, 101-115.

Fountain, John W.
2005 "A Database of Rock Art Solar Markers," In *Current Studies in Archaeoastronomy: Conversations Across Space and Time*, edited by John W. Fountain and Rolf M. Sinclair, pp. 101-108. Durham: Carolina Academic Press.

Griffin-Pierce, Trudy
1992 *Earth is My Mother, Sky is My Father: Space, Time and Astronomy in Navajo Sandpainting*. Albuquerque: University of New Mexico Press.

Haile, Berard
1947 *Starlore Among the Navajo*. Museum of Navajo Ceremonial Art, Santa Fe.

Hardman, Clark, Jr. and Marjorie Hardman.
1992 "Linear Solar Observatory: The Development of Concepts of Time and Calendar," *North American Archaeologist* 13: 22, 149-172.

Heim, Dan
1997 *Easy Field Guide to The Southwestern Night Sky*. Phoenix: American Traveler Press.

Hoskinson, Tom
2005 "Calendric Investigations of a Complex Petroglyph Panel at a Gila River Archaeological Site in Arizona," In *Current Studies in Archaeoastronomy: Conversations Across Space and Time*, edited by John W. Fountain and Rolf M. Sinclair, pp. 169-179. Durham: Carolina Academic Press.

Jett, Stephen C.
1984 "Making the Stars of Navajo Planetaria," *The Kiva* 50 (1): 25-40.

Johnson, Clay
1991 "Accuracy and Declination: Using Panel Activity to Answer Rock Art Questions," In *Utah Rock Art* 9: 8.1-8.46.

1992a "Establishing A Uniform Technology for Description of Solar Interactions with Rock Art Panels," *Utah Rock Art* 10: 33-45.

1992b "Methodology for Identifying, Observing, Recording, and Reporting Solar Interactive Rock Art Panels," *Utah Rock Art* 10: 46-57.

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Kriss, Victor
1989 "Mimbres-Mogollon Archaeoastronomy: Another Connection Between Mesoamerica and the Southwest," *Rock Art Papers* 6, edited by Ken Hedges, pp. 25-28. San Diego: San Diego Museum of Man.

Krupp, E.C.
1983 *Echoes of the Ancient Sky.* New York: Harper & Row, Publishers, Inc.

1987 *Skywatchers,, Shamans, and Kings: Astronomy and the Archaeology of Power*. New York: Wiley Popular Science.

2000 "Rock Art and Astronomy in Baja California," In *Astronomy and Cultural Diversity: Proceedings of the Oxford VI International Conference on Archaeoastronomy*, edited by Cesar Esteban and Juan Antonio Belmonte, pp. 133-139. Tenerife: Museum de la Ciencia y el Cosmos.

Lekson, Stephen H.
1999 The Chaco Meridian: Centers of Political Power in the Ancient Southwest. Walnut Creek, CA.: AltaMira Press.

Malloy, J.P.
1969 The Casa Grande Archaeological Zone. Ms. on file, Pueblo Grande Museum, Phoenix.

Malville, J. McKim
1999 "The Calendars of Chimney Rock and the Origins of Chacoan Astronomy," *Southwestern Lore* 65 (1): 4-18.

2004 "Ancient Time and Space in the Canyons," In *Canyon Spirits: Beauty and Power in the Ancestral Puebloan World*, Stephen H. Lekson and J. McKim Malville, pp. 65-86. Albuquerque: University of New Mexico Press.

Malville, J. McKim, and Claudia Putnam
1989 *Prehistoric Astronomy in the Southwest.* Boulder: Johnson Books.

Maryboy, Nancy, and David Begay
2006 "Finding the Thunderbird in Navajo Astronomy," In *Viewing the Sky Through Past and Present Cultures: Selected Papers from the Oxford VII International Conference on Archaeoastronomy*, edited by Todd W. Bostwick and Bryan Bates, pp. 149-154. Pueblo Grande Museum Anthropology Papers No. 15, Phoenix.

Masse, W. Bruce, and Robert Soklow
2005 "Black Sun and Dark Times: Cultural Responses to Solar Eclipses in the Ancient Pueblo Southwest," In *Current Studies in Archaeoastronomy: Conversations Across Space and Time*, edited by John W. Fountain and Rolf M. Sinclair, pp. 47-68. Carolina Academic Press, Durham.

Mayer, Dorothy
1977 "An Examination of Miller's Hypothesis," In *Native American Astronomy*, edited by Anthony F. Aveni, pp. 179-201. Austin: University of Texas Press.

McCluskey, Stephen C.
1977 "The Astronomy of the Hopi Indians," *Journal for the History of Astronomy* 8:174-195.

1982 "Historical Astronomy: The Hopi Example," In *Archaeastronomy of the New World*, edited by Anthony F. Aveni. Cambridge: Cambridge University Press.

1988 "The Probability of Noontime Shadows at Three Petroglyph Sites on Fajada Butte," *Archaeoastromomy* 19: S70-72.

1990 "Calendars and Symbolism: Functions of Observation in Hopi Astronomy," *Archaeoastronomy* 15: S1-S16.

Miller, Dorcas S.
1997 "Chief of the Night: Stars of the Southwest," In *Stars of the First People: Native American Star Myths and Constellations*, pp. 173-214. Pruett Publishing Company, Boulder.

Miller, William C.
1955 "Two Possible Astronomical Pictographs Found in Northern Arizona," *Plateau* 27(4): 6-13.

Mixon, Benjamin L.
1998 A Mogollon Star Map at Roudy Crossing AZ:P:12:22. Ms on file, Pueblo Grande Museum, Phoenix.

Mixon, Benjamin, and Raymond E. White
1991 "Skywatchers of the Salt River Valley Hohokam," *The Astronomy Quarterly* 8: 245-259.

Preston, Robert, and Ann Preston
1987 "Evidence for Calendric Function at 19 Prehistoric Petroglyph Sites in Arizona," In *Astronomy and Ceremony in the Prehistoric Southwest*, edited by John Carlson and W. James Judge, 191-203. Maxwell Museum Anthropological Papers No. 2.

2005 "Consistent Forms of Solstice Sunlight Interactions with Petroglyphs throughout the Prehistoric American Southwest," In *Current Studies in Archaeoastronomy: Conversations Across Space and Time*, edited by John W. Fountain and Rolf M. Sinclair, pp. 109-119. Durham: Carolina Academic Press, 2005.

Reddy, Francis, and Greg Walz-Chojnacki
Celestial Delights: The Best Astronomical Events Through 2010. Berkeley: Celestial Arts.

Reyman, Jonathan E.
1988 "Site 29SJ427, Chaco Canyon, New Mexico: Review and Reevaluation," In *Reflections: Papers on Southwestern Culture History in Honor of Charles H. Lange*, edited by Anne Van Ardsall Poore, pp. 211-226, Papers of the Archaeological Society of New Mexico, No. 14.

Ruggles, Clive
1999 *Astronomy in Prehistoric Britain and Ireland*. New Haven: Yale University Press.

Schaafsma, Polly
2005 "Feathered Stars and Scalps in Pueblo IV," In *Current Studies in Archaeoastronomy: Conversations Across Space and Time*, edited by John W. Fountain and Rolf M. Sinclair, pp. 191-204. Durham: Carolina Academic Press.

Soafer, Anna
1997 "The Primary Architecture of the Chacoan Culture: A Cosmological Expression, In *Anasazi Architecture and American Design*, Baker H. Morrow and V.B. Price, eds., pp. 88-132. Albuquerque: University of New Mexico Press.

Soafer, Anna, and Rolf Sinclair
1986 "An Appraisal of Michael Zeilik's 'A Reassessment of the Fajada Butte Solar Marker'," *Archaeoastronomy* 10: S59-69.

"Astronomical Markings at Three Sites on Fajada Butte," In *Astronomy and Ceremony in the Prehistoric Southwest*, edited by John B. Carlson and W. James Judge, pp. 43-70. Maxwell Museum of Anthropology, Anthropological Papers No. 2, Albuquerque.

Soafer, Anna, Voler Zinser, and Rolf Sinclair
1979 "A Unique Solar Marking Construct," *Science*, Vol. 206, No. 4416.

Soafer, Anna, Rolf M. Sinclair, and L.E. Doggett
1982 "Lunar Markings on Fajada Butte, Chaco Canyon, New Mexico," In *Archaeoastronomy in the New World*, edited by Anthony F. Aveni, pp. 169-180.

Sinclair, Rolf
2006 "The Nature of Archaeoastronomy," In *Viewing the Sky Through Past and Present Cultures: Selected Papers from the Oxford VII International Conference on Archaeoastronomy*, edited by Todd W. Bostwick and Bryan Bates, Pueblo Grande Museum Anthropology Papers No. 15, Phoenix.

Sutcliffe, Ron
2006 "Evaluating the Chimney Rock Pueblo With Respect to Observing the Major Lunar Standstill Moonrises: Potential Architectural Encoding of Astronomic Knowledge," In *Viewing the Sky Through Past and Present Cultures: Selected Papers from the Oxford VII International Conference on Archaeoastronomy*, edited by Todd W. Bostwick and Bryan Bates, pp. 275-286. Pueblo Grande Museum Anthropology Papers No. 15, Phoenix.

Talayesva, Don, and Robert V. Hine (Leo W. Simmons, ed)
1963 *Sun Chief: The Autobiography of a Hopi Indian*. New Haven: Yale University Press.

Wetherill, Chris
1991 "Astronomical Imagery in Navajo Weaving," *The Astronomy Quarterly* 8: 37-46.

Williamson, Ray A.
1984 *Living the Sky: The Cosmos of the American Indian*. Norman: University of Oklahoma Press.

1981 *Archaeoastronomy in the Americas*. College Park, MD.: Center for Archaeoastronomy.

Williamson, Ray A., and Claire R. Farrer
1992 *Earth and Sky: Visions of the Cosmos in Native American Folklore*. University of New Mexico Press, Albuquerque, 1992.

Williamson, Ray A., and M. Jane Young
1979 "An Equinox Sun Petroglyph Panel at Hovenweep National Monument," *American Indian Rock Art* 5: 71-75.

Wolf, Virginia S.
"McElmo Rockshelter: An Anasazi Time-Depicting Site." In *Rock Art Papers* 15, edited by Ken Hedges, pp. 83-90. San Diego Museum of Man.

Wolf, Virginia S., and Edward A. Wheeler
2004. "Two Archaeoastronomical Solstice Techniques Utilized in Mancos Canyon, Colorado," *Southwestern Lore* 70 (2): 33-48.

Young, M. Jane
1986 "The Interrelationship of Rock Art and Astronomical Practice in the American Southwest," *Archaeoastronomy* 10: S43-S58.

1992 "Morning Star, Evening Star: Zuni Traditional Stories," In *Earth and Sky: Visions of the Cosmos in Native American Folklore*, edited by Ray A. Williamson and Claire R. Farrer, pp. 76-100, Albuquerque: University of New Mexico Press.

Zeilik, Michael
1985a "The Ethnoastronomy of the Historic Pueblos I: Calendrical Sun Watching," *Archaeoastronomy* 8.

1985b "A Reassessment of the Fajada Butte Solar Marker," *Archaeoastronomy* 9:S69-85.

1885c "Sun Shrines and Sun Symbols in the U.S. Southwest," *Archaeoastronomy* 9: S86-S96.

1988 "Astronomy and Ritual: The Rhythm of the Sacred Calendar in the U.S. Southwest," *New Directions in American Archaeoastronomy*, BAR International Series 454: 183-199.

1989 "Keeping the Sacred and Planting Calendar: Archaeoastronomy in the Pueblo Southwest," In *World Archaeoastronomy*, edited by Anthony F. Aveni, pp. 143-166. Cambridge University Press, Cambridge.

1991 "Historic Lunar Calendar in the Pueblo Southwest: Examples from Zuni and Hopi," *The Astronomy Quarterly* 8: 89-.

Zoll, Kenneth J.
2006 *Sinagua Sunwatchers: An Archaeoastronomy Suvery of the V-V Heritage Site*. Privately published.

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Archaeoastronomy Forms

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Archaeoastronomy Field Notes

Site No./Name_____ **Other** _____

Recorder: _____ **Date:** _____

Comments:

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ARCHAEOASTRONOMY AND ROCK ART PANEL/ELEMENT
LIGHT AND SHADOW CONDITION REPORT
FOR THE SOLAR DAY AND YEAR

Site No./Name_____**Recorder(s)**_____
Panel No._____ **Element No.** _____ **Other** _____ **UTMS**_____
Date(s) of Observations [enter date]
Summer Solstice (SS):_____**August Crossquarter(Acq):**_____
Autumn Equinox (AE):_____**November Crossquarter(Ncq):**_____
Winter Solstice (WS):_____**February Crossquarter(Fcq):**_____
Vernal Equinox (VE):_____**May Crossquarter(Mcq):**_____
Other Days_____

Light and Shadow Movements

	AM								PM							
Hour	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
SS																
Acq																
AE																
Ncq																
WS																
Fcq																
VE																
Mcq																
Other																
Other																

[X] Dark (Shadow) [O] Lit [--]Both Shadow and Light on Element(s) [No] No observation

Sketch Map North?

Light and Shadow Shapes on Petroglyph(s): [see form terminology] (enter date/time)
_____ ( )_____( )_____( )
_____ ( )_____( )_____( )
_____( )_____( )_____( )

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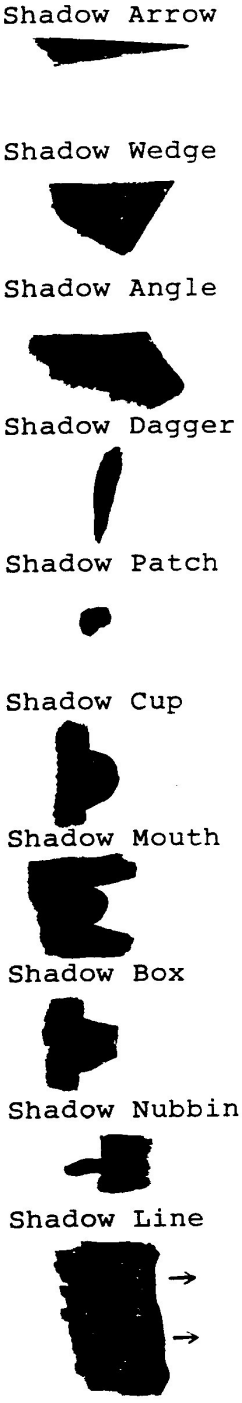
Released September 2007

Sunlight and Shadow Form Terminology
(From C. Johnson, *Utah Rock Art* 10, 1992)

Sunlight	*Shadow*
Sun Arrow	Shadow Arrow
Sun Wedge	Shadow Wedge
Sun Angle	Shadow Angle
Sun Dagger	Shadow Dagger
Sun Patch	Shadow Patch
Sun Cup	Shadow Cup
Sun Mouth	Shadow Mouth
Sun Box	Shadow Box
Sun Nubbin	Shadow Nubbin
Sun Line	Shadow Line



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ARCHAEOASTRONOMY
EASTERN HORIZON SUNRISE RECORD

Site No./Name_____
Recorder(s)_____

Dates Recorded_____ **UTMS**_____
_____

Panels/Elements_____ **Time(s) of Event**_____

Azimuth (Compass Bearing) from Place of Observation to Horizon Event
_____

Comments:
_____
_____
_____
_____
_____

Sketch Map

Eastern Horizon

Summer Solstice Sunrise	Equinox Sunrise	Winter Solstice Sunrise

Describe Horizon:_____
_____
_____

Describe Place of Observation: _____
_____
_____

TWB Horizon Map East 7/7/2006

ARCHAEOASTRONOMY
WESTERN HORIZON SUNSET RECORD

Site No./Name_____
Recorder(s)_____

Dates Recorded_____ **UTMS**_____
_____

Panels/Elements_____ **Time(s) of Events:**
_____

Azimuth (Compass Bearing) from Place of Observation to Horizon Event
_____

Comments:
_____
_____
_____
_____

Sketch Map

Western Horizon

Summer Solstice Sunset	**Equinox Sunset**	**Winter Solstice Sunset**

Describe Horizon: _____
_____
_____

Describe Place of Observation:
_____
_____

ARCHAEOASTRONOMY
ROCK ART/ARCHITECTURE
NIGHT SKY RECORD

Site No./Name_____
Recorder(s)_____

Dates Recorded_____ **UTMS**_____
_____

Panels/Architecture_____ **Time(s) of Event**_____

Azimuth (Compass Bearing) from Place of Observation to Star Cluster
_____

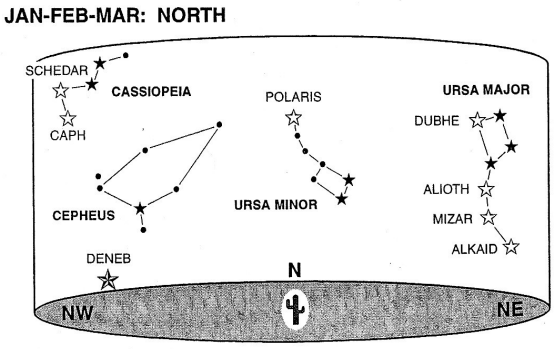
Describe Star Cluster(s) [Constellation] and Alignment(s) with Archaeological Feature(s):

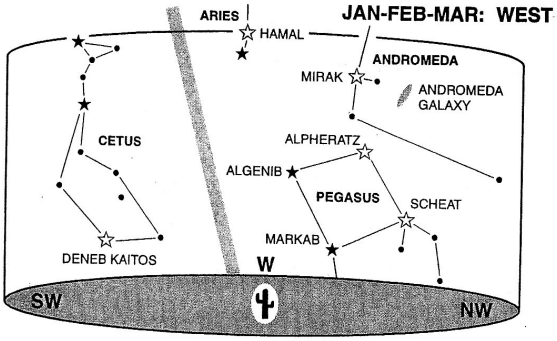
_____
_____
_____
_____
_____

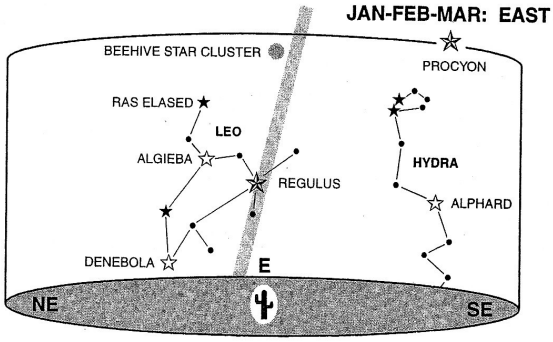
Sketch Map of Night Sky

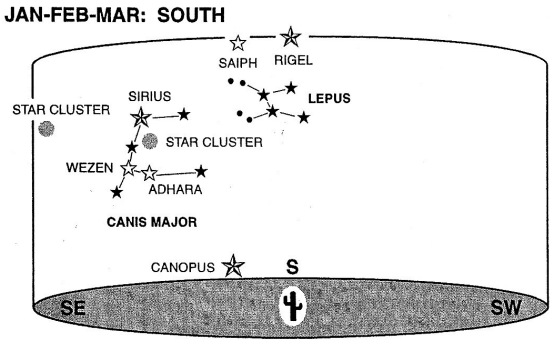
Describe Place of Observation: _____
_____
_____

The Southwestern Night Sky
(Dan Heim 1997)









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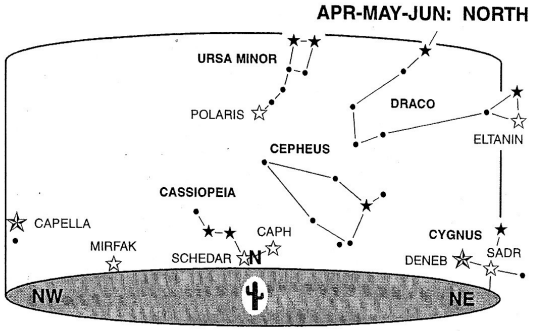

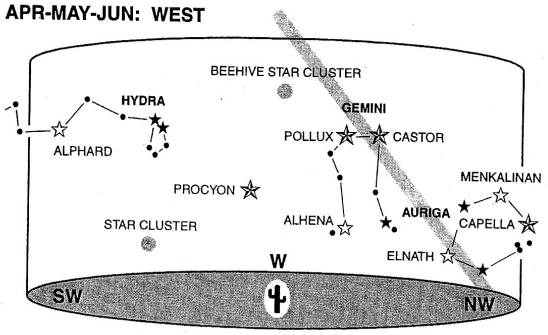

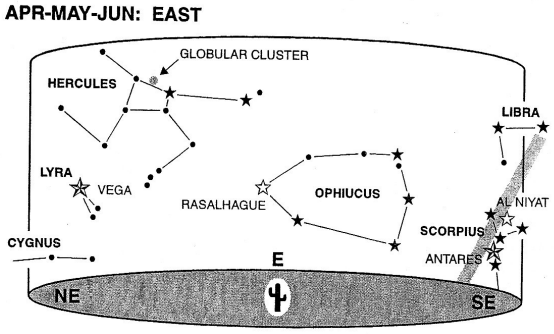

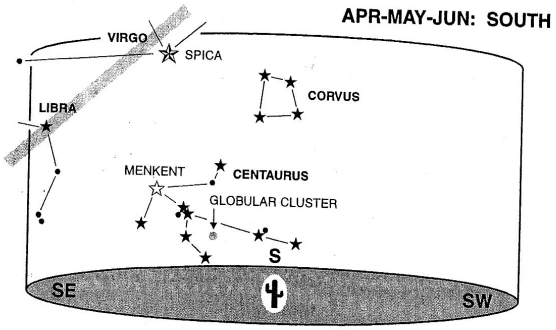

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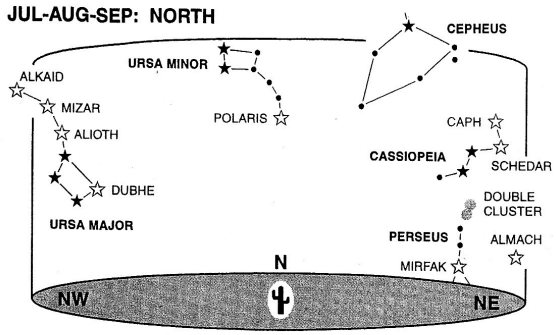

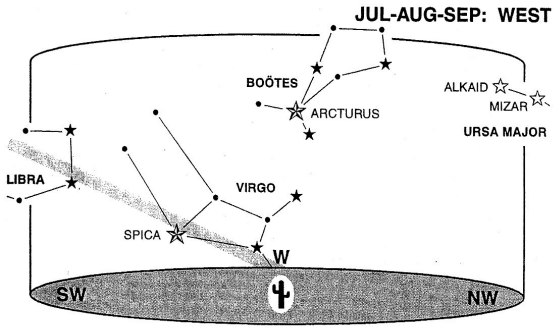

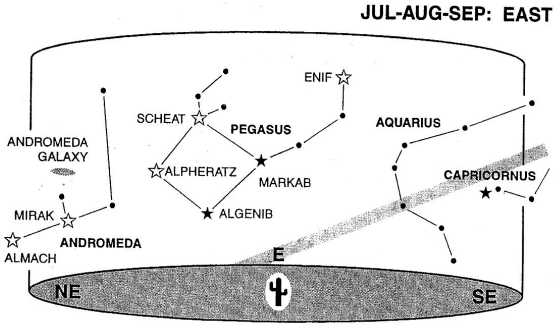

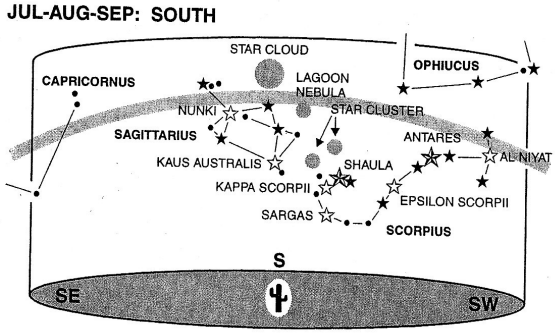

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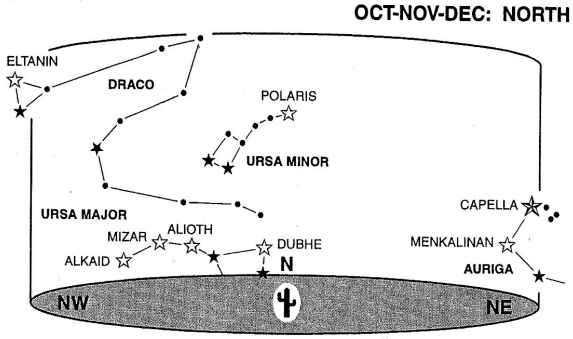

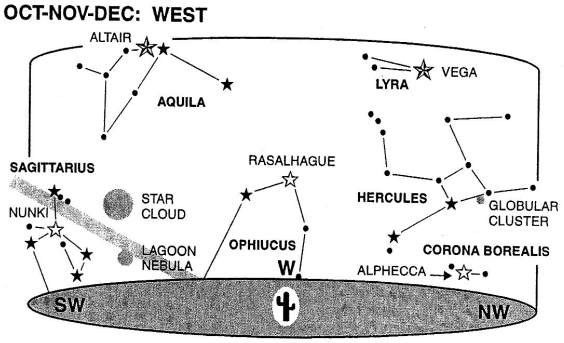

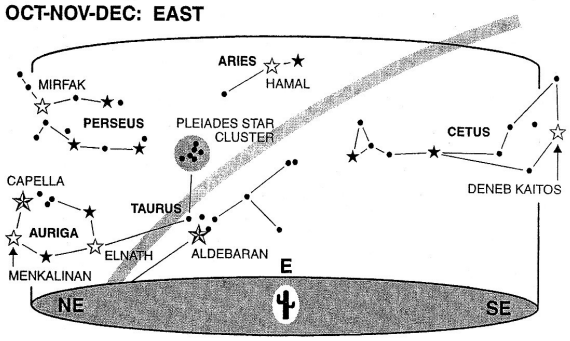

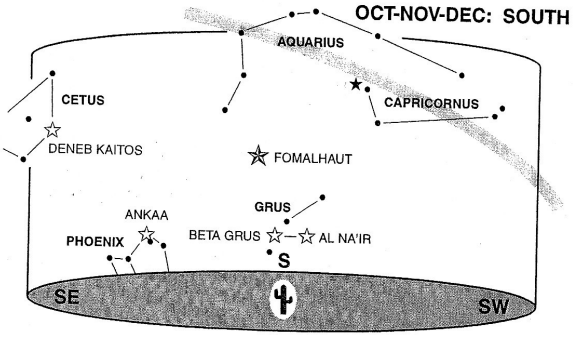

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