ESTTA Tracking number: **ESTTA835654**

Filing date: **07/26/2017**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE TRADEMARK TRIAL AND APPEAL BOARD

Notice of Opposition

Notice is hereby given that the following party opposes registration of the indicated application.

Opposer Information

Name	Regents of the University of Minnesota
Granted to Date of previous extension	07/26/2017
Address	200 Oak Street S.E. Suite 600 Minneapolis, MN 55455 UNITED STATES

Attorney information	Stephen R. Baird Winthrop & Weinstine, P.A. 225 South Sixth Street, Suite 3500 Minneapolis, MN 55402 UNITED STATES Email: trademark@winthrop.com, sbaird@winthrop.com, tchambers@winthrop.com, cclassen@winthrop.com Phone: 612-604-6585

Applicant Information

Application No	86840720	Publication date	03/28/2017
Opposition Filing Date	07/26/2017	Opposition Period Ends	07/26/2017
Applicant	Lee, Annette S. 10375 150th Ave. Foreston, MN 56330 UNITED STATES		

Goods/Services Affected by Opposition

Class 042. First Use: 0 First Use In Commerce: 0
All goods and services in the class are opposed, namely: Astronomy consultation; Database designand development; Database development services; Mapping services; Geophysial and astronmical mapping services, featuring maps of culturally important earth andcelestial objects and locations; Cartography and mapping; Design of geological surveys; Design of land surveys; Development, updating and maintenance of software and database systems; Digital transfer services for transferring home videos and film to DVD and the internet; Providing a web site allowing users to upload on-line videos for sharing with others for motivational and inspirational purposes; Providing a web site featuring temporary use of non-downloadable software allowing web site users to upload on-line videos for sharing with others for entertainment purposes; Providing a web site that gives computer users the ability toupload and share video-based scientificprotocols and other scientific-based videos; Providing a web site that gives computer users the ability to upload, exchange and share photos, videos and video logs

Applicant Information

Application No	86981387	Publication date	04/25/2017
Opposition Filing Date	07/26/2017	Opposition Period Ends	
Applicant	Lee, Annette S. 10375 150th Ave. Foreston, MN 56330 UNITED STATES		

Goods/Services Affected by Opposition

Class 016. First Use: 2012/05/00 First Use In Commerce: 2012/05/00 All goods and services in the class are opposed, namely: Art etchings; Art mounts; Art pads; Artpaper; Art pictures; Art pictures on canvas; Art prints; Charts in the field ofastronomy; Charts in the field of cultural astronomy; Charts in the field of indigenous science; Maps; Posters; Postersmade of paper; Story books; Framed graphic art reproductions; Geographical maps; Geophysical maps; Graphic art prints; Graphic art reproductions; Graphic fine art prints; Mounted posters; Plastic or paper bags for merchandise packaging; Printed stories in illustrated form; Printed matter, namely, paper signs, books, manuals, curricula, newsletters, informational cards and brochures in the field of indigenous science; Printed series of fictional short stories; Printed short stories in the field of astronomy, culture, indigenous science; Reference books in the field of astronomy, culture, indigenous science, art; Unmounted posters
Class 041. First Use: 2009/08/00 First Use In Commerce: 2009/08/00 All goods and services in the class are opposed, namely: Art exhibitions; Language instruction; Language interpretation; Language interpreting; Language translation; Planetariums; Video editing; Video tape recording for others; Audio and video recording services; Education services, namely, providing hands-on opportunities for children in the field of intuitive engineering through live, broadcast, and on-line classes, seminars, workshops, training and curriculum development for children, parents and educators; Education services, namely, training educators in the field of astronomy, culture, indigenous science, art and providing curricula in connection therewith; Education services, namely, training educators in the field of indigenous science and providing curricula in connection therewith; Educational services, namely, developing curriculum for educators; Educational services, namely, developing curriculum for others in the field of indigenous science; Educational services, namely, developing curriculum for teachers; Entertainment services, namely, an on-line activity where youcreate your own music videos; Entertainment services, namely, production of special effects including model-making services, computer-generated imagery and computer-generated graphics for the production of motion pictures, videos, and movie trailers; Film and video film production; Film and video production; Film and video production consulting services; Film and video tape film production; Musicvideo production; Photographic and video services, namely, photographic and video capture; Post-production editing services in the field of music, videos and film; Production and distribution of videos in the field of astronomy, culture, indigenous science, art; Production of visual effects for videos, DVDs, television and for internet web sites; Providing science educational mentoring services and programs; Providing a database featuring information about artists; Providinga web site featuring non-downloadable instructional videos in the field of astronomy, culture, indigenous science, art;Providing a website featuring non-downloadable videos featuring scientific information in the field of climate change; Providing a website featuring non-downloadable videos in the field of astronomy,culture, indigenous science, art; Providing education courses in the field of astronomy, culture, indigenous science, art offered through online, non-downloadable videos and instructor assistance; Providing educational information in the academic field of science for the purposeof academic study; Providing educational information in the academic field of astronomy, culture, indigenous science, art for the purpose of academic study; Providing on-line videos featuring astronomy, culture, indigenous science, art, not downloadable; Publication of online texts of interviews featuring scientists in the field of astronomy for educationalpurposes; Publishing audio books in thefield of astronomy, culture, indigenousscience, art; Publishing books in the field of astronomy, culture, indigenous science, art; Publishing e-books in the field of astronomy, culture, indigenous science, art; Research in the field of education; Research in the field of education via the internet; Television, video and movie filming services

Grounds for Opposition

The mark is merely descriptive	Trademark Act Section 2(e)(1)
The mark is generic	Trademark Act Sections 1, 2 and 45
No use of mark in commerce before application or amendment to allege use was filed	Trademark Act Sections 1(a) and (c)
No bona fide intent to use mark in commerce for identified goods or services	Trademark Act Section 1(b)
Failure to function as a mark	Trademark Act Sections 1, 2 and 45
The mark is not inherently distinctive and has not acquired distinctiveness	Trademark Act Sections 1, 2 and 45; and Section 2(f)
Applicant not rightful owner of mark for identified goods or services	Trademark Act Section 1

Attachments	20170726 Consolidated Notice of Opposition - NATIVE SKYWATCH-ERS.pdf(1154238 bytes) Exhibit 1-4 to Consolidated Notice of Opposition - NATIVE SKYWATCH-ERS.pdf(3047291 bytes) Exhibit 5-7 to Consolidated Notice of Opposition - NATIVE SKYWATCH-ERS.pdf(4681488 bytes) Exhibit 8 to Consolidated Notice of Opposition - NATIVE SKYWATCH-ERS.pdf(4338775 bytes) Exhibit 9 to Consolidated Notice of Opposition - NATIVE SKYWATCH-ERS.pdf(2445944 bytes) Exhibit 10-12 to Consolidated Notice of Opposition - NATIVE SKYWATCH-ERS.pdf(4848547 bytes) Exhibit 13-15 to Consolidated Notice of Opposition - NATIVE SKYWATCH-ERS.pdf(3925728 bytes) Exhibit 16-17 to Consolidated Notice of Opposition - NATIVE SKYWATCH-ERS.pdf(3426009 bytes) Exhibit 18-20 to Consolidated Notice of Opposition - NATIVE SKYWATCH-ERS.pdf(4266534 bytes) Exhibit 21-25 to Consolidated Notice of Opposition - NATIVE SKYWATCH-ERS.pdf(2374317 bytes) Exhibit 26-33 to Consolidated Notice of Opposition - NATIVE SKYWATCH-ERS.pdf(5075182 bytes)

Signature	/Tucker A. Chambers/
Name	Tucker A. Chambers
Date	07/26/2017

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE TRADEMARK TRIAL AND APPEAL BOARD

In the matter of Application Serial Nos.: 86/840,720 and 86/981,387
Filed: December 7, 2015
For the mark: NATIVE SKYWATCHERS
Published in the *Trademark Official Gazette* on March 28, 2017 and April 25, 2017

Regents of the University of Minnesota,
Opposer,

v. Opposition No. _____

Lee, Annette S.,
Applicant.

CONSOLIDATED NOTICE OF OPPOSITION

Regents of the University of Minnesota ("Opposer" or the "University"), a constitutional corporation organized and existing under the laws of the State of Minnesota, believes that it will be damaged by registration of the claimed NATIVE SKYWATCHERS mark ("Applicant's Claimed Mark") shown in Application Serial No. 86/840,720 (the "'720 Application") and Application Serial No. 86/981,387 (the "'387 Application") (collectively the "Applications"), both filed on December 7, 2015 ("Applicant's Filing Date"), and hereby opposes the same on a consolidated basis pursuant to TBMP § 305.01. The grounds for opposition are as follows:

Opposer

1. Opposer was established in 1851 and, pursuant to the Constitution of the State of Minnesota, holds all of the rights, immunities, franchises, and endowments conferred upon the University by the Territorial Laws. Opposer received land grant status in 1862 and currently serves over 67,000 students across five campuses in the State of Minnesota, located in the Twin Cities, Duluth, Rochester, Crookston, and Morris.

2. Opposer has been ranked consistently as one of the country's top research and innovation universities and is engaged in extensive research and product development programs and is regularly ranked among the top universities both in the U.S. and the world.

3. Opposer has standing in this proceeding and has a reasonable belief of being harmed by registration of Applicant's Claimed Mark because, among other reasons, Opposer provides educational services, publishes materials, seeks grants, and conducts research in the field and subject matter of native skywatching and astronomy, which employs use of the informational and generic term "native skywatchers." As such, registration of Applicant's Claimed Mark would improperly provide Applicant with a presumption of exclusive ownership of the term "native skywatchers" that Opposer and many third parties have a legitimate need and right to freely use without the need for Applicant's permission or license.

4. Among its many programs and courses, Opposer has offered and continues to offer through its Duluth campus an educational astronomy course, AST 1050, titled "Native Skywatchers: Indigenous Ethno- and Archaeo Astronomy," with instructor James Rock. In this University course, students are informed about native skywatching and astronomy, including the regional-historical, socio-cultural, philosophical and scientific-technical foundations of native skywatching and astronomy. A true and correct copy of a webpage describing this course from the website of Opposer is attached as Exhibit 1.

The Applications

5. Annette S. Lee ("Applicant") filed the '720 Application on December 7, 2015 seeking to register the claimed NATIVE SKYWATCHERS mark in connection with:

> "Astronomy consultation; Database design and development; Database development services; Mapping services; Geophysial and astronmical mapping services, featuring maps of culturally important earth and celestial objects and locations; Cartography and mapping; Design of geological surveys; Design of land surveys; Development, updating and maintenance of software and database systems; Digital transfer services for transferring home videos and film to DVD and the internet;

> Providing a web site allowing users to upload on-line videos for sharing with others for motivational and inspirational purposes; Providing a web site featuring temporary use of non-downloadable software allowing web site users to upload on-line videos for sharing with others for entertainment purposes; Providing a web site that gives computer users the ability to upload and share video-based scientific protocols and other scientific-based videos; Providing a web site that gives computer users the ability to upload, exchange and share photos, videos and video logs"

in Int'l Class 42 (the "'720 Application Services").

6. The '720 Application is filed under Trademark Act Section 1(b).

7. Applicant filed the '387 Application on December 7, 2015 seeking to register the claimed NATIVE SKYWATCHERS mark in connection with

> "Art etchings; Art mounts; Art pads; Art paper; Art pictures; Art pictures on canvas; Art prints; Charts in the field of astronomy; Charts in the field of cultural astronomy; Charts in the field of indigenous science; Maps; Posters; Posters made of paper; Story books; Framed graphic art reproductions; Geographical maps; Geophysical maps; Graphic art prints; Graphic art reproductions; Graphic fine art prints; Mounted posters; Plastic or paper bags for merchandise packaging; Printed stories in illustrated form; Printed matter, namely, paper signs, books, manuals, curricula, newsletters, informational cards and brochures in the field of indigenous science; Printed series of fictional short stories; Printed short stories in the field of astronomy, culture, indigenous science; Reference books in the field of astronomy, culture, indigenous science, art; Unmounted posters"

in Int'l Class 16 with a claimed first-use-in-commerce date of May 2012 (the "'387 Application Class 16 Goods"), and:

> "Art exhibitions; Language instruction; Language interpretation; Language interpreting; Language translation; Planetariums; Video editing; Video tape recording for others; Audio and video recording services; Education services, namely, providing hands-on opportunities for children in the field of intuitive engineering through live, broadcast, and on-line classes, seminars, workshops, training and curriculum development for children, parents and educators; Education services, namely, training educators in the field of astronomy, culture, indigenous science, art and providing curricula in connection therewith; Education services, namely, training educators in the field of indigenous science and providing curricula in connection therewith; Educational services, namely, developing curriculum for educators; Educational services, namely, developing curriculum for others in the field of indigenous science; Educational services, namely, developing curriculum for teachers; Entertainment services, namely, an on-line activity where you create your own music videos; Entertainment services, namely, production of special effects including model-making services, computer-generated imagery and computer-generated graphics for the production of motion pictures, videos, and movie trailers; Film and video film production; Film and video production; Film and video production consulting services; Film and video tape film production; Music video production; Photographic and video services, namely, photographic and video capture; Post-production editing services in the field of music, videos and film; Production and distribution of videos in the field of astronomy, culture, indigenous science, art; Production of visual effects for videos, DVDs, television and for internet web sites; Providing science educational mentoring services and programs; Providing a database featuring information about artists; Providing a web

site featuring non-downloadable instructional videos in the field of astronomy, culture, indigenous science, art; Providing a website featuring non-downloadable videos featuring scientific information in the field of climate change; Providing a website featuring non-downloadable videos in the field of astronomy, culture, indigenous science, art; Providing education courses in the field of astronomy, culture, indigenous science, art offered through online, non-downloadable videos and instructor assistance; Providing educational information in the academic field of science for the purpose of academic study; Providing educational information in the academic field of astronomy, culture, indigenous science, art for the purpose of academic study; Providing on-line videos featuring astronomy, culture, indigenous science, art, not downloadable; Publication of online texts of interviews featuring scientists in the field of astronomy for educational purposes; Publishing audio books in the field of astronomy, culture, indigenous science, art; Publishing books in the field of astronomy, culture, indigenous science, art; Publishing e-books in the field of astronomy, culture, indigenous science, art; Research in the field of education; Research in the field of education via the internet; Television, video and movie filming services"

in Int'l Class 41 with a claimed first-use-in-commerce date of August 2009 (the "'387 Application Class 41 Services") (collectively the "'387 Application Goods & Services"). The goods and services identified in both Applications are collectively referred to as "Applicant's Claimed Goods & Services."

8. The '387 Application is filed under Trademark Act Section 1(a).

9. All of Applicant's Claimed Goods & Services, whether expressly stated or not, relate to the field and subject of native skywatching and astronomy.

10. The '720 Application was published for opposition in the *Trademark Official Gazette* on March 28, 2017.

11. The '387 Application was published for opposition in the *Trademark Official Gazette* on April 25, 2017.

12. On April 26, 2017, Opposer filed a Request for Extension of Time to Oppose the '720 Application. The Board granted this request on April 26, 2017, extending the time to oppose until July 26, 2017.

13. On April 26, 2017, Opposer filed a Request for Extension of Time to Oppose the '387 Application. The Board granted this request on April 26, 2017 extending the time to oppose until August 23, 2017.

14. This Consolidated Notice of Opposition is timely filed.

The Meaning and Uses of Applicant's Claimed Mark by Others

15. The terms "native skywatchers," "native skywatching," "skywatchers," "skywatching," and similar terms in the subject and field of native skywatching and astronomy have been used for decades by many other persons or entities besides Applicant.

16. Applicant did not invent the terms "native skywatchers," "native skywatching," "skywatchers," or "skywatching."

17. The term "native" is an unregistrable component of Applicant's Claimed Mark, as concluded by the Examining Attorney's Office Action of March 26, 2016 for the Applications, and as conceded by Applicant's disclaimer of the term "native" in the Applications.

18. The term "native" is defined as "belonging to a particular place of birth" and "of, relating to, or being a member of an aboriginal people of North or South America," according to the Merriam-Webster Dictionary, https://merriam-webster.com/dictionary/native.

19. A true and correct copy of the definition of "native" from Merriam-Webster Dictionary, https://merriam-webster.com/dictionary/native, is attached as Exhibit 2.

20. The term "native" in Applicant's Claimed Mark refers to native peoples.

21. The term "skywatchers" is an informal and cultural term that is and would be understood by the public and relevant consumers to refer to those who watch, study, observe, and seek to understand the sky and astronomy.

22. Applicant's Claimed Mark "native skywatchers" is a term that would be understood by the public and relevant consumers to refer to native skywatching and astronomy.

23. The word "indigenous" is a synonym of and has the same meaning as "native."

24. The word "indigenous" is defined as "originating or occurring naturally in a particular place; native" for example, "indigenous peoples . . ." Oxford Dictionaries, https://en.oxforddictionaries.com/definition/indigenous.

25. A true and correct copy of the definition of "indigenous" from Oxford Dictionaries, https://en.oxforddictionaries.com/definition/indigenous, is attached as Exhibit 3.

26. The '387 Application Goods & Services are related to native skywatching and astronomy, including for example: "Production and distribution of videos in the field of **astronomy**, culture, **indigenous science**, art" in Int'l Class 41 and "Charts in the field of **cultural astronomy**; Charts in the field of **indigenous science**" in Int'l Class 16.

27. The word "indigenous" is used 16 times in the identification of the '387 Application Goods & Services.

28. The '720 Application Services are related to native skywatching and astronomy, including for example: "**Astronomy** consultation; . . . Geophysial and **astronmical** mapping services, featuring maps of **culturally important earth and celestial objects and locations**" in Int'l Class 42.

29. Attached as Exhibit 4 is a true and correct copy of excerpts from the book *Skywatchers of Ancient Mexico* (1980), by Anthony F. Aveni.

30. In Exhibit 4, the terms "skywatcher," "skywatchers" and "skywatching" are used as generic and/or informational terms to refer to native skywatching and astronomy.

31. Attached as Exhibit 5 is a true and correct copy of excerpts from a book review by Evan Hadingham, published in 1984, of the book *When the Stars Came Down to Earth: Cosmology of the Skidi Pawnee Indians of North America* (1983).

32. In Exhibit 5, the terms "skywatchers," "skywatching," "Native American skywatchers," and "native American astronomy" are used as generic and/or informational terms to refer to native skywatching and astronomy.

33. Attached as Exhibit 6 is a true and correct copy of excerpts from a book review by Stephen McCluskey, published in 1998, of the book *Skywatchers, Shamans & Kings: Astronomy and the Archaeology of Power* (1997).

34. In Exhibit 6, the term "native skywatchers" is used as a generic and/or informational term to refer to native skywatching and astronomy.

35. Attached as Exhibit 7 is a true and correct copy of excerpts from the book *Skywatchers, Shamans & Kings: Astronomy and the Archaeology of Power* (1997), by E. C. Krupp.

36. In Exhibit 7, the terms "skywatcher," "skywatchers," and "skywatching" are used as generic and/or informational terms to refer to native skywatching and astronomy.

37. Attached as Exhibit 8 is a true and correct copy of excerpts from a magazine article from *National Geographic* by John B. Carlson, published in March 1990, titled *America's Ancient Skywatchers*.

38. In Exhibit 8, the term "skywatchers" is used as a generic and/or informational term to refer to native skywatching and astronomy.

39. Attached as Exhibit 9 is a true and correct copy of excerpts from the book *Stairways to the Stars: Skywatching in Three Great Ancient Cultures* (1997), by Anthony Aveni.

40. In Exhibit 9, the terms "skywatchers," "skywatcher," "skywatching," and "sky watching" are used as generic and/or informational terms to refer to native skywatching and astronomy.

41. Attached as Exhibit 10 is a true and correct copy of excerpts from the book *Conversing with the Planets: How Science and Myth Invented the Cosmos* (1992), by Anthony Aveni.

42. In Exhibit 10, the terms "sky watcher" and "sky watching" are used as generic and/or informational terms to refer to native skywatching and astronomy.

43. Attached as Exhibit 11 is a true and correct copy of excerpts from the book *A Guide to Prehistoric Astronomy in the Southwest* (2008), by J. McKim Malville.

44. In Exhibit 11, the term "sky watchers" is used as a generic and/or informational term to refer to native skywatching and astronomy.

45. Attached as Exhibit 12 is a true and correct copy of excerpts from the book *Skywatching in the Ancient World: New Perspectives in Cultural Astronomy* (2007), edited by Clive Ruggles and Gary Urton.

46. In Exhibit 12, the term "skywatching" is used as a generic and/or informational term to refer to native skywatching and astronomy.

47. Attached as Exhibit 13 is a true and correct copy of a newspaper article published on June 15, 1992 in the *Asheville Citizen-Times*, titled "Take Look at Heavens," by Glenn Langhorst.

48. In Exhibit 13, the term "sky-watching" is used as a generic and/or informational term to refer to native skywatching and astronomy.

49. Attached as Exhibit 14 is a true and correct copy of a newspaper article published on August 30, 1992, in the *Aiken Standard*, titled "A Look At The Autumn Heavens," by Glenn Langhorst.

50. In Exhibit 14, the term "skywatchers" is used as a generic and/or informational term to refer to astronomy.

51. Attached as Exhibit 15 is a true and correct copy of excerpts from the book *The Skywatcher's Handbook: Night and Day, What to Look for in the Heavens Above* (originally published 1985), by Colin A. Ronan and Storm Dunlop.

52. In Exhibit 15, the terms "skywatcher," "skywatching," and "skywatch" are used as generic and/or informational terms to refer to astronomy.

53. Attached as Exhibit 16 is a true and correct copy of excerpts from the book *Out of the Blue: A 24-hour Skywatcher's Guide* (2002), by John Naylor.

54. In Exhibit 16, the terms "skywatcher," "skywatchers," and "skywatching," are used as generic and/or informational terms to refer to astronomy.

55. Attached as Exhibit 17 is a true and correct copy of a webpage from www.turtletrack.org/IssueHistory/Issues15/CO08_2015/CO_0815_Skywatchers.htm, which is an article from a newsletter *Canku Ota*, published in August 2015, entitled "Native Skywatchers Team Encourages Participants to 'Look Up' to Find Star Knowledge," by Joseph V. Sowmick.

56. In Exhibit 17, the terms "skywatcher" and "skywatchers" are used as generic and/or informational terms to refer to native skywatching and astronomy. For example, in Exhibit 17, the article states: "The skywatchers concluded the seminar with participants forming a circle with the afternoon star high in the sky."

57. Attached as Exhibit 18 is a true and correct copy of a webpage from https://advantagenews.com/news/digging-into-ancient-religion, which includes an article titled "Digging into Ancient Religion."

58. In Exhibit 18, the terms "skywatchers" and "Native American skywatching" are used as generic and/or informational terms to refer to native skywatching and astronomy.

59. Attached as Exhibit 19 is a true and correct copy of a webpage from http://articles.latimes.com/1987-01-11/news/mn-3966_1_astronomical-markers, which includes a newspaper article in the *Los Angeles Times* dated January 11, 1987, titled "Time Is of the Essence to Scientists in Ohio Studying Ancient Astronomical Markers."

60. In Exhibit 19, the term "sky watchers" is used as a generic and/or informational term to refer to native skywatching and astronomy.

61. Attached as Exhibit 20 is a true and correct copy of excerpts from the book *The Total Skywatcher's Manual* (2015).

62. In Exhibit 20, the terms "skywatchers," "skywatch," and "skywatching" are used as generic and/or informational terms to refer to astronomy.

63. Attached as Exhibit 21 is a true and correct copy of a webpage from www.astrosociety.org/publications/the-total-skywatchers-manual.

64. In Exhibit 21, the terms "skywatcher's" and "skywatching" are used as generic and/or informational terms to refer to astronomy.

65. Attached as Exhibit 22 is a true and correct copy of a webpage from www.pa.msu.edu/abrams/msta.

66. In Exhibit 22, the terms "skywatching," "sky watching," "skywatch," and "sky watches" are used as generic and/or informational terms to refer to astronomy.

67. Attached as Exhibit 23 is a true and correct copy of excerpts from a course catalog for Fond du Lac Tribal & Community College for the years 1995-1997.

68. Upon information and belief, an educational course titled "Native Skywatchers" was offered at Fond du Lac Tribal & Community College in Cloquet, Minnesota in approximately the years 1995-1997, with instructor Glenn Langhorst.

69. Attached as Exhibit 24 is a true and correct copy of excerpts from a course catalog for Fond du Lac Tribal & Community College for the years 1998-2000.

70. Upon information and belief, an educational course titled "Native Skywatchers" was offered at Fond du Lac Tribal & Community College in Cloquet, Minnesota in approximately the years 1998-2000, with instructor Glenn Langhorst.

71. Attached as Exhibit 25 is a true and correct copy of excerpts from a course catalog for Fond du Lac Tribal & Community College for the years 2001-2003.

72. Upon information and belief, an educational course titled "Native Skywatchers" was offered at Fond du Lac Tribal & Community College in Cloquet, Minnesota in approximately the years 2001-2003, with instructor Glenn Langhorst.

73. Attached as Exhibit 26 is a true and correct copy of excerpts from a course catalog for Fond du Lac Tribal & Community College for the years 2003-2005.

74. Upon information and belief, an educational course titled "Native Skywatchers" was offered at Fond du Lac Tribal & Community College in Cloquet, Minnesota in approximately the years 2003-2005, with instructor Glenn Langhorst.

75. Attached as Exhibit 27 is a true and correct copy of excerpts from a course catalog for Fond du Lac Tribal & Community College for the years 2005-2007.

76. Upon information and belief, an educational course titled "Native Skywatchers" was offered at Fond du Lac Tribal & Community College in Cloquet, Minnesota in approximately the years 2005-2007, with instructor Glenn Langhorst.

77. Upon information and belief, an educational course titled "Native Skywatchers" was offered in the year 2006 at Fond du Lac Tribal & Community College, in Minneapolis, MN, covering topics in the field of native skywatching and astronomy, with instructor James Rock.

78. Attached as Exhibit 28 is a true and correct copy of excerpts from a course catalog for Fond du Lac Tribal & Community College for the years 2008-2010.

79. Upon information and belief, an educational course titled "Native Skywatchers" was offered at Fond du Lac Tribal & Community College in Cloquet, Minnesota in approximately the years 2008-2010, with instructor Glenn Langhorst.

80. Attached as Exhibit 29 are true and correct copies of webpages showing information regarding the course "Native Skywatchers" at Fond du Lac Tribal & Community College in Cloquet, Minnesota, to be offered in Fall 2017, with instructor Glenn Langhorst.

81. Upon information and belief, an educational course titled "Native Skywatchers" is currently offered in the year 2017 at Fond du Lac Tribal & Community College in Cloquet, Minnesota, with instructor Glenn Langhorst.

82. Attached as Exhibit 30 is a true and correct copy of a syllabus for an educational course titled "Native Skywatchers: IEAA" offered in the year 2015 at Augsburg College in Minnesota, with instructor James Rock.

83. An educational course titled "Native Skywatchers: IEAA" was offered in the year 2015 at Augsburg College in Minnesota, covering topics in the field of native skywatching and astronomy, with instructor James Rock.

84. Opposer currently offers an educational astronomy course titled "Native Skywatchers: Indigenous Ethno- and Archaeo Astronomy," with instructor James Rock. *See* Exhibit 1.

85. The vast majority of the above-referenced uses of "native skywatchers," "native skywatching," "skywatchers," "skywatching," and similar terms in the subject and field of native skywatching and astronomy were made by other persons or entities besides Applicant, before Applicant's Filing Date for the Applications, and before Applicant's dates of first-use-in-commerce claimed in the '387 Application for Applicant's Claimed Mark.

Count I: Applicant's Claimed Mark Is Merely Informational and Incapable of Functioning as a Trademark (Trademark Act §§ 1, 2, 3, 45)

86. Opposer restates and incorporates by reference the allegations in Paragraphs 1-85 as if fully stated herein.

87. Applicant's Claimed Mark is merely informational and incapable of functioning as a trademark[1] under Sections 1, 2, 3, and 45 of the Trademark Act.

88. There is widespread use of the terms "native," "skywatchers," "skywatching," and "native skywatchers" by numerous third parties in related fields of goods and services to merely convey information about native skywatching and astronomy. *See, e.g.*, Exhibits 1, 4-30.

89. The term "native skywatchers" is a common phrase ordinarily used in everyday parlance in the field and subject of native skywatching and astronomy. *See, e.g.*, Exhibits 1, 4-30.

90. On information and belief, the relevant consumers of Applicant's Claimed Goods & Services are accustomed to seeing the term "native skywatchers" in connection with many different sources of goods and services related to native skywatching and astronomy, rather than identifying a single source for particular goods or services.

91. On information and belief, the relevant consumers of Applicant's Claimed Goods & Services would understand and use "native skywatchers" as a merely informational phrase

[1] Opposer uses the term "trademark" as a collective term that includes both trademarks and service marks pursuant to Trademark Act § 3, 15 U.S.C. § 1053.

regarding native skywatching and astronomy, rather than a single source identifier for any goods or services.

92. Because Applicant's Claimed Mark is merely informational in nature, Applicant's Claimed Mark is incapable of being viewed by relevant consumers as an indicator of source.

93. Applicant's Claimed Mark is merely informational and incapable of trademark function; therefore, registration is barred under Sections 1, 2, 3, and 45 of the Trademark Act.

Count II: Applicant's Claimed Mark Is Generic (Trademark Act § 1, 2, 3, 45)

94. Opposer restates and incorporates by reference the allegations in Paragraphs 1-93 as if full stated herein.

95. The term "native" in Applicant's Claimed Mark identifies a genus of educational, scientific, and research services and printed goods, namely, educational, scientific, and research services and associated printed goods that are related to native peoples.

96. The term "skywatchers" in Applicant's Claimed Mark identifies a genus of educational, scientific, and research services and printed goods, namely, educational, scientific, and research services and associated printed goods that are related to astronomy.

97. Applicant's Claimed Mark, "native skywatchers," identifies a genus of educational, scientific, and research services and printed goods, namely, educational, scientific, and research services and associated printed goods that are related to native skywatching and astronomy.

98. The '720 Application Services include scientific and research services related to native skywatching and astronomy.

99. The '387 Application Class 41 Services include educational services related to native skywatching and astronomy.

100. The '387 Application Class 16 Goods include printed goods related to native skywatching and astronomy.

101. On information and belief, the relevant consumers of Applicant's Claimed Goods & Services would understand and use "native skywatchers" as a generic term that refers primarily to the genus of educational, scientific, and research services and associated printed goods that are related to native skywatching and astronomy.

102. Because of the relevant consumers' understanding of the term "native skywatchers," Opposer and others have a legitimate need and right to freely use the term "native skywatchers" without Applicant's permission, to refer to educational, scientific, and research services and associated printed goods related to native skywatching and astronomy.

103. An alternative terminology other than "native skywatchers," for the genus of educational, scientific, and research services and associated printed goods related to native skywatching and astronomy, would be unwieldy, awkward, and not the primary or one of the most easily understood terms that relevant consumers use to naturally and instinctively identify and refer to that genus.

104. Opposer would be harmed by registration of Applicant's Claimed Mark, which would provide Applicant with a presumption of exclusive ownership of generic terminology that Opposer, third parties, and the relevant consuming public have a need to use.

105. Applicant's Claimed Mark is generic and therefore barred from registration under Section 1 of the Trademark Act.

Count III: Lack of Rightful Ownership by Applicant (Trademark Act § 1)

106. Opposer restates and incorporates by reference the allegations in Paragraphs 1-105 as if fully stated herein.

107. An application to register a mark filed in the name of a person is void *ab initio* if that person was not the rightful owner of that mark as of the filing date of the application pursuant to Section 1 of the Trademark Act and Trademark Rule § 2.71(d).

108. As alleged above, Applicant's Claimed Mark is a generic and/or merely informational term that is incapable of trademark ownership.

109. Upon information and belief, Applicant is not, and was not at the time of filing the Applications, the rightful owner of Applicant's Claimed Mark.

110. Upon information and belief, because Applicant was not the rightful owner of Applicant's Claimed Mark as of Applicant's Filing Date, the Applications are void *ab initio* pursuant to Section 1 of the Trademark Act and Trademark Rule § 2.71(d).

Count IV: Applicant's Claimed Mark Is Merely Descriptive and Has Not Acquired Distinctiveness (Trademark Act §§ 2(e)(1), 2(f))

111. Opposer restates and incorporates by reference the allegations in Paragraphs 1-110 as if fully stated herein.

112. In the alternative to Applicant's Claimed Mark being generic, merely informational, incapable of functioning as a trademark for Applicant's Claimed Goods & Services, and not being rightfully owned by Applicant, upon information and belief Applicant's use of Applicant's Claimed Mark merely describes a characteristic, feature, purpose, and/or use of Applicant's Claimed Goods & Services, namely, goods and services related to native skywatching and astronomy.

113. The characteristics, features, purposes, and/or uses of the '387 Application Goods & Services are related to native skywatching and astronomy, as shown throughout Applicant's identification of goods and services, including for example, among others: "Production and distribution of videos in the field of **astronomy**, culture, **indigenous science**, art" in Int'l Class 41 and "Charts in the field of **cultural astronomy**; Charts in the field of **indigenous science**" in Int'l Class 16.

114. The characteristics, features, purposes, and/or uses of the '720 Application Services are related to native skywatching and astronomy, as shown throughout Applicant's identification of goods and services, including for example, among others: "**Astronomy** consultation; . . . Geophysical and **astronomical** mapping services, featuring maps of **culturally important earth and celestial objects and locations**" in Int'l Class 42.

115. Attached as Exhibit 31 is a true and correct copy of a webpage from Applicant's website, http://www.nativeskywatchers.com/about-me.

116. The characteristics, features, purposes, and/or uses of Applicant's Claimed Goods & Services are related to native skywatching and astronomy, as shown by Applicant's website, attached as Exhibit 31, which states in part the following: "Annette Lee is mixed-race Dakota-Sioux who is an astrophysicist and artist who leads the Native Skywatchers research project, which seeks out and celebrates indigenous peoples' connection to the stars."

117. Attached as Exhibit 32 is a true and correct copy of the specimen submitted by Applicant to the USPTO on May 7, 2016, which was submitted by Applicant in connection with all of Applicant's Claimed Goods & Services, before the Applications were divided.

118. The characteristics, features, purposes, and/or uses of Applicant's Claimed Goods & Services are related to native skywatching and astronomy, as shown by the specimen submitted by Applicant, attached as Exhibit 32, which states in part the following: "Native Skywatchers is a non-profit, educational, native-led team of scientists, educators, artists, historians, language and cultural experts. We aim to revitalize, to remember and to create programming and resources related to the Ojibwe and D(L)akota star knowledge, primarily for native communities."

119. As alleged above, the term "native" in Applicant's Claimed Mark merely refers to native peoples. *See* Exhibits 2-3.

120. As alleged above, the term "skywatchers" in Applicant's Claimed Mark merely refers to astronomy. *See* Exhibits 1, 4-33.

121. As alleged above, Applicant's Claimed Mark, "native skywatchers" merely refers to native skywatching and astronomy. *See* Exhibits 4-33.

122. Upon information and belief, third parties commonly use the terms "native," "skywatchers," and/or "native skywatchers" to describe goods or services related to native skywatching and astronomy. *See* Exhibits 1, 4-30.

123. Opposer and many other third parties have a legitimate need to use the terms "native," "skywatchers," and "native skywatchers" to describe goods or services related to native skywatching and astronomy. *See* Exhibits 1, 4-30.

124. Upon information and belief, Applicant's Claimed Mark is not inherently distinctive.

125. Upon information and belief, Applicant has never been the substantially exclusive user of the term "native skywatchers" in connection with Applicant's Claimed Goods & Services, including educational services, scientific services, research services, and associated printed goods.

126. Upon information and belief, Applicant's Claimed Mark has not acquired distinctiveness.

127. Applicant's Claimed Mark is merely descriptive, is not inherently distinctive, and has not acquired distinctiveness, and therefore registration is barred under Section 1, 2, 2(e)(1), 2(f), 3, and 45 of the Trademark Act.

Count V: Lack of Bona Fide Use in Commerce (Trademark Act §§ 1(a))

128. Opposer restates and incorporates by reference the allegations in Paragraphs 1-127 as if fully stated herein.

129. Applicant filed the '387 Application without specifying whether the '387 Application was filed under Section 1(a) or Section 1(b) of the Trademark Act.

130. On May 7, 2016, in response to an Office Action refusal, Applicant clarified that the filing basis for the '387 Application was Section 1(a) of the Trademark Act.

131. Under Trademark Act § 1(a), Applicant was required to have made bona fide use in commerce of Applicant's Claimed Mark, in connection with the '387 Application Goods & Services, prior to Applicant's Filing Date.

132. Upon information and belief, prior to Applicant's Filing Date, Applicant had not made bona fide use in commerce of Applicant's Claimed Mark in connection with the '387 Application Goods & Services.

133. Upon information and belief, prior to May 7, 2016, Applicant had not made bona fide use in commerce of Applicant's Claimed Mark in connection with the '387 Application Goods & Services.

134. Upon information and belief, due to Applicant's lack of bona fide use in commerce of Applicant's Claimed Mark in connection with the '387 Application Goods & Services, the '387 Application is void *ab initio* pursuant to Section 1(a) of the Trademark Act.

Count VI: Lack of Bona Fide Intent to Use in Commerce (Trademark Act § 1(b))

135. Opposer restates and incorporates by reference the allegations in Paragraphs 1-134 as if fully stated herein.

136. Under Trademark Act Section 1(b), Applicant was required to have a bona fide intention to use Applicant's Claimed Mark in connection with the '720 Application Services, as of Applicant's Filing Date.

137. Upon information and belief, as of Applicant's Filing Date, Applicant did not have a bona fide intent to use in commerce Applicant's Claimed Mark in connection with the '720 Application Services.

138. Upon information and belief, due to Applicant's lack of bona fide intent to use in commerce Applicant's Claimed Mark in connection with the '720 Application Services as of Applicant's Filing Date, the '720 Application is void *ab initio* pursuant to Section 1(b) of the Trademark Act.

Count VII: Lack of Sole Ownership by Applicant—At Least Partial Ownership by Others (Trademark Act § 1)

139. Opposer restates and incorporates by reference the allegations in Paragraphs 1-138 as if fully stated herein.

140. An application to register a mark filed in the name of a person is void *ab initio* if that person was not the sole owner of that mark as of the filing date of the application pursuant to Section 1 of the Trademark Act and Trademark Rule § 2.71(d).

141. Assuming in the alternative that Applicant's Claimed Mark is a protectable mark capable of ownership, Opposer alleges that Applicant is not and was not the sole owner of Applicant's Claimed Mark as of Applicant's Filing Date for the Applications.

142. Attached as Exhibit 33 is a true and correct copy of excerpts from *D(L)akota Star Map Constellation Guide: An Introduction to D(L)akota Star Knowledge* (2014) (hereinafter the "Native Skywatchers Guide"), a joint work co-authored by Applicant, Jim Rock, and Charlene O'Rourke.

143. In the Native Skywatchers Guide attached as Exhibit 33, it states that "all text" is "by Annette S. Lee, Jim Rock, and Charlene O'Rourke."

144. In the Native Skywatchers Guide attached as Exhibit 33, the text states in part the following: "The goal of the Native Skywatchers programming is to build community around native star knowledge .... *Together, we* have created two astronomically accurate and culturally important star maps .... In addition, *we* have developed hands-on curriculum that combines astronomy, culture, language, and art." (Emphasis added.)

145. Upon information and belief, prior to Applicant's Filing Date, third parties used Applicant's Claimed Mark in connection with goods and services identified in Applicant's Claimed Goods & Services.

146. Upon information and belief, prior to Applicant's Filing Date, James Rock used Applicant's Claimed Mark in connection with goods and services identified in Applicant's Claimed Goods & Services.

147. Upon information and belief, prior to Applicant's Filing Date, Charlene O'Rourke used Applicant's Claimed Mark in connection with goods and services identified in Applicant's Claimed Goods & Services.

148. Upon information and belief, prior to Applicant's Filing Date, Glenn Langhorst used Applicant's Claimed Mark in connection with goods and services identified in Applicant's Claimed Goods & Services.

149. Upon information and belief, prior to Applicant's Filing Date, Fond du Lac Tribal & Community College used Applicant's Claimed Mark in connection with goods and services identified in Applicant's Claimed Goods & Services.

150. Upon information and belief, prior to Applicant's Filing Date, Opposer used Applicant's Claimed Mark in connection with goods and services identified in Applicant's Claimed Goods & Services.

151. Upon information and belief, as of Applicant's Filing Date, third parties had a least a partial ownership interest in Applicant's Claimed Mark.

152. Upon information and belief, as of Applicant's Filing Date, third parties, including but not limited to James Rock, had a least a partial ownership interest in Applicant's Claimed Mark.

153. Upon information and belief, as of Applicant's Filing Date, third parties, including but not limited to Charlene O'Rourke, had a least a partial ownership interest in Applicant's Claimed Mark.

154. Upon information and belief, as of Applicant's Filing Date, third parties, including but not limited to Glenn Langhorst, had a least a partial ownership interest in Applicant's Claimed Mark.

155. Upon information and belief, as of Applicant's Filing Date, third parties, including but not limited to Fond du Lac Tribal & Community College, had a least a partial ownership interest in Applicant's Claimed Mark.

156. Upon information and belief, as of Applicant's Filing Date, third parties, including but not limited to Opposer, had a least a partial ownership interest in Applicant's Claimed Mark.

157. Upon information and belief, because Applicant was not the sole owner of Applicant's Claimed Mark as of Applicant's Filing Date, the Applications are void *ab initio* pursuant to Section 1 of the Trademark Act and Trademark Rule § 2.71(d).

WHEREFORE, Opposer requests that the Trademark Trial and Appeal Board:

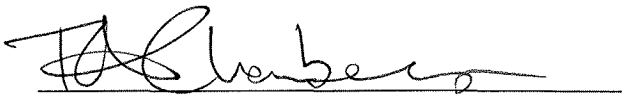
1) Sustain this Opposition;

2) Refuse registration of the claimed mark identified in Application Serial No. 86/840,720 and Application Serial No. 86/981,387; and

3) Grant Opposer any further relief the Board deems equitable.

Dated: July 26, 2017

WINTHROP & WEINSTINE, P.A.



Stephen R. Baird
Tucker A. Chambers
225 South Sixth Street, Suite 3500
Minneapolis, Minnesota 55402
(612) 604-6400 (Telephone)
(612) 604-6976 (Facsimile)

Attorneys for Regents of the University of Minnesota

13799939v1

Exhibit 1

UNIVERSITY OF MINNESOTA
Driven to Discover℠

Course Catalog Search

Catalog Search Results

Duluth | Duluth | Astronomy

Verify your Liberal Education or General Education Requirements

Return to Search

AST 1050 - Native Skywatchers: Indigenous Ethno- and ArchaeoAstronomy

Course Detail

Units:	3 units	
Grading Basis	A-F or Audit	
Course Components	Lecture	Required

Enrollment Information

Course Attribute	Cultural Diversity in the US

Description

Students are informed about the regional-historical, socio-cultural, philosophical and scientific-technical foundations of Turtle Island (American Indian) Indigenous astronomy in several contextual settings well enough to critically understand, in a conscientized manner, how to approach and address contemporary issues such as star knowledge preservation and transmission protocols, indigenous language and sacred site preservation, light pollution and dark sky preservation, telescope construction ethics and the implications for establishing and maintaining place-based, indigenous education standards in mainstream science at schools, universities, museums and parks.

Return to Search

Exhibit 2

Popularity: Top 40% of words

Examples: NATIVE in a Sentence

Tip: Synonym Guide

Definition of NATIVE

1 :
INBORN, INNATE • *native* talents

2 :
belonging to a particular place by birth • a *native* New Yorker

3 *archaic*
:
closely related

4 :
belonging to or associated with one by birth
• hailed in his *native* Sweden as an influential dramatist — William Peden

5 :
NATURAL, NORMAL • a generosity that was *native* to him

6 a
:
grown, produced, or originating in a particular place or in the vicinity
:
LOCAL • *native* fruits and vegetables
b
:
living or growing naturally in a particular region
:
INDIGENOUS • *native* wildlife of Australia

7 :
SIMPLE, UNAFFECTED
• our feeling still *native* and entire, unsophisticated by pedantry — Edmund Burke

8 a
:
constituting the original substance or source
• the way I must return to *native* dust — John Milton
b
:
found in nature especially in an unadulterated form • mining *native* silver

9 *chiefly Australia*
:
having a usually superficial (see superficial 2) resemblance to a specified English plant or animal

10 *capitalized*
:
of, relating to, or being a member of an aboriginal people of North or South America
:
NATIVE AMERICAN

—**natively** *adverb*

—**nativeness** *noun*

NEW!

WORD OF THE DAY

tristful

sad or melancholy

Get Word of the Day daily email!

Your email address SUBSCRIBE

TRENDING NOW

1 bona fide
Made in good faith

2 surrogate mother
From TMZ to the dictionary.

3 zealot
A fanatical partisan

4 stonewall
to be uncooperative, obstructive,...

5 scurrilous
Containing obscenities, abuse, or...

SEE ALL

BROWSE DICTIONARY

nation-state

nationwide

native

Native American

Native American church

Exhibit 3

Definition of *indigenous* in English:

indigenous

ADJECTIVE

Originating or occurring naturally in a particular place; native.

'the indigenous peoples of Siberia'

'coriander is indigenous to southern Europe'

More example sentences | Synonyms

Origin

Mid 17th century: from Latin indigena 'a native' (see indigene) + -ous.

Pronunciation

indigenous /ɪnˈdɪdʒɪnəs/

Exhibit 4

Skywatchers of Ancient Mexico

by Anthony F. Aveni

FOREWORD BY OWEN GINGERICH

University of Texas Press, Austin and London

The Texas Pan American Series is published with the assistance of a revolving publication fund established by the Pan American Sulphur Company.

LIBRARY OF CONGRESS CATALOGING IN PUBLICATION DATA

Aveni, Anthony F
Skywatchers of ancient Mexico.

(The Texas Pan American series)
Bibliography: p.
Includes index.
1. Indians of Mexico—Astronomy. 2. Indians of Central America—Astronomy. 3. Astronomy, Prehistoric. 4. Mayas—Astronomy. I. Title.
F1219.3.A85A9 520'.972 79-27341
ISBN 0-292-77557-1

I. Introduction: Archaeoastronomy and Its Components

". . . Maya astronomy is too important to be left to the astronomers."
—Sir Eric Thompson (1974, p. 97)

ALL DEVELOPING CIVILIZATIONS exhibit a reverence for the sky and its contents. The cyclic movement of the sun, moon, planets, and stars represents a kind of perfection unattainable by mortals. The regular occurrence of sunrise and moonset provided the ancients with something dependable and orderly, a stable pillar to which their minds could be anchored.

Today we no longer have need of practical astronomy in our daily lives. Unlike our ancestors, we spend most of our time in a regulated climate with controlled lighting; we are detached almost totally from the natural environment. Technology has created an artificial backdrop against which we play out our lives. Any need we once had to watch carefully for celestial events has become lost. Who knows the time the sun rose today or the current phase of the moon? The clocks by which we pace our daily activities give us a distorted view of the dependence of real time periods upon circumstances transpiring in the heavens.

Though we may try, we cannot really appreciate the degree to which the minds of the ancients were preoccupied with astronomical pursuits. Modern science and technology have flavored our way of thought so as to rob us of any real sensitivity to the nature of the ancients' relation to the cosmos. The heavens touched nearly every aspect of their culture; consequently, we find ancient astronomy woven into myth, religion, and astrology. So great was the reliance of the ancients upon the sun and moon that they deified them. Representations of these luminaries adorned their temples as objects of worship and they were symbolized in sculpture and other works of art. The ancients followed the sun god wherever he went, marking his appearance and disappearance with great care. His return to a certain place on the horizon told them when to plant the crops, when the river would overflow its banks, or when the monsoon season would arrive. The planning and harvesting of crops could be regulated by celestial events. The important days of celebration and festivity could be marked effectively using the celestial calendar. Equipped with a knowledge of mathematics and a method of keeping records, the ancients could refine and expand their knowledge of positional astronomy. After several generations, with the

advantage of a "written" record, they could learn to predict such celestial phenomena as eclipses well in advance. What a powerful advantage the priest-ruler would have over his followers with this bit of trickery in his repertoire.

We are continually amazed at the seemingly impossible accomplishments of our ancient ancestors. How did they erect the great pyramids, the statues on Easter Island, or the huge Olmec heads? In disbelief, some of us turn to extraterrestrial zoo keepers for the source of ancient wisdom and ability. According to one popular account, "the past teemed with unknown gods who visited the primeval earth in manned spaceships. Incredible technical achievements existed in the past. There is a mass of know-how which we have only partially rediscovered today" (Daniken, 1971, p. vii).

Though the last part is substantially true, such a statement is uttered in total ignorance of the ways of ancient people. One of the goals of this text will be to show that the sophisticated astronomical and mathematical achievements of the people of ancient Mesoamerica followed logically in the evolutionary development of a civilization which intensely worshipped the heavens and steadfastly associated the phenomena they witnessed in the celestial environment with the course of human affairs.

Since the ancients expended considerable effort paying tribute to their celestial deities, we should not be surprised to find that, in many instances, astronomical principles played a role in the design of the ceremonial centers where they worshipped their gods. Stonehenge is perhaps the most famous example of an ancient structure believed to have served an astronomical function. In 1964, astronomer Gerald Hawkins wrote *Stonehenge Decoded,* thus rekindling an idea made popular at the end of the nineteenth century by Sir Norman Lockyer. Hawkins hypothesized that the megaliths standing for five thousand years on the plain of southern Great Britain constituted a calendar in stone, each component situated deliberately and precisely to align with astronomical events taking place along the local horizon. Detailed works by Alexander Thom (1967, 1971) and a cultural synthesis by Euan MacKie (1977) have since solidified the basis of our understanding of ancient megalithic astronomy and have elevated it to a level of scholarly respectability.

The Stonehenge controversy has been responsible for the resurgence of interest in the interdisciplinary field of astroarchaeology, a term first coined by Hawkins (1966) to encompass the study of the astronomical principles employed in ancient works of architecture and the elaboration of a methodology for the retrieval and quantitative analysis of astronomical alignment data. An alternate term, "archaeoastronomy," embodies the study of the extent and practice of astronomy among ancient civilizations. Such a definition fits the discipline which classicists call the "history of astronomy," except that the latter has dealt traditionally with the literate Western society and focuses largely on analyses of notational schemes in the Western style (i.e., ancient scriptures, Egyptian hieroglyphs, cuneiform tablets). Being somewhat less confined by tradition and often handicapped by the sparsity of a written record, archaeoastronomy has developed into a broader in-

terdiscipline drawing upon the written as much as the archaeological and iconographic record. Consequently, discussions of astronomical symbolism and astronomical precision are often intermixed.

Though much emphasis has been placed on the megalithic sites in Europe, an increased interest has recently arisen in the study of astronomical building orientations in other parts of the world, particularly the Americas. Aerial photography has revealed that the remarkably straight lines etched across the Peruvian desert at Nazca continue up and down the steep sides of mountains for distances of several miles. Many of these lines are oriented to the rising positions of the sun at the solstices. Large figures at their intersection may have symbolized the constellations. In Central Mexico, the plan of the great ceremonial center of Teotihuacán seems to have been organized to harmonize with the positions of the sun and certain fundamental stars. Astronomical orientations have also been discovered in the Maya area of the peninsula of Yucatán. The so-called Group E structures at Uaxactún, Guatemala, represent the prototype of a series of sun watcher's stations found in that region. The Caracol at Chichén Itzá in Yucatán, an observatory in the shape of a round tower, contains horizontal sight tubes directed to positions of astronomical significance.

Anthropologists have become interested in studying relationships between the astronomical knowledge of civilizations of Mesoamerica and that of the native tribes of North America. Did cosmological ideas diffuse among the cultures and which concepts developed independently? Ceremonial mounds near St. Louis, Missouri, and in central Kansas probably functioned as solstice registers to mark the extreme positions of the rising sun. The Big Horn Medicine Wheel, a spoked wheel formed out of boulders in the mountains of Wyoming, also appears to have functioned as an astronomical observatory. Far to the south, the interconnected lines of the *ceque* system surrounding the ancient city of Cuzco in Peru may represent a calendar on the landscape which has astronomical, religious, and even political attributes.

In the Americas, a number of investigators from widely divergent fields have turned their attention to archaeoastronomical pursuits. As a result of the unique cooperation among them, there has been added to the literature an increasing body of evidence relating to the role of astronomy in the lives of the ancient people of this hemisphere. After a decade of progress on several fronts, it is time to begin the slow process of synthesis of the new material into the mainstream of human intellectual history.

This book is about the people of ancient Mexico and Central America and what we know of their system of astronomy. In studying them we have an enormous advantage over Thom, Hawkins, and their predecessors, for we know from the written record, the art, and the sculpture that the civilizations which developed in the New World before the arrival of Columbus were already highly advanced by the time of his arrival. Only within the last half-century have we begun to gain a full appreciation of the magnitude and sophistication of ancient New World civilizations. The ancient American calendric documents reveal that mathematics and astronomy were among their intellectual hallmarks; in fact, they were fanatically devoted to these disciplines. For

them, time was an intricate natural system, each day being ticked off in a complex maze of endless cycles. But quite unlike our modern astronomy, the raison d'être of Mesoamerican, particularly Maya, astronomy was ritualistic and divinatory in nature.

To have accomplished as much as they did, the ancient Americans must have been keen observers of the heavens. Were they also brilliant theoreticians? To answer such a question we must assemble, all in one place, the material which is relevant to an objective assessment of the depth and extent of their astronomical knowledge. I have set such a goal in the production of this volume. In attempting to achieve it, I have necessarily ventured a few steps out of my own field in different directions in order to form canals between pools of material in disciplines usually regarded as unrelated. Any true interdisciplinary synthesis requires that such steps be taken. In cutting the path, I have made a special effort to tread softly, accepting the generous guidance of interested colleagues in allied fields.

Because an interdisciplinary approach to archaeoastronomy has developed, the serious scholar must become acquainted with certain segments of established fields which border upon it. What are these segments of knowledge? It seems clear that an understanding of basic positional astronomy is indispensable if one wishes to master the complexities of ancient astronomy. Maya archaeologist Sir Eric Thompson once suggested that one could understand Maya astronomy only by getting into the skin of the Maya priest-astronomer. In other words, a knowledge of the history and culture of the Native American people is vital to an understanding of their astronomical systems. Input from the archaeological discipline is important since it represents a large part of the record which survives. Pre-Columbian astronomy was strongly wedded to astrology and religion. Those of us trained in the modern sciences must be careful not to slant our view too much toward the present. We cannot assume that the Maya were always looking for the same celestial events which matter to us. Some astronomers, with a poor grasp of pre-Columbian thought, have made assertions about the Maya calendar which are strongly at odds with the facts gleaned from the anthropologists' studies.

Too often discussions of ancient astronomical systems have been couched in one-sided dialogue. The twentieth-century Western scientists are accused of fashioning their ancestors after their own image; they frame their arguments in the scientific jargon of their profession. As a result, the anthropologists either blindly accept their propositions out of awe and reverence for the complexity of their language and scientific method or refuse to consider the argument because they cannot comprehend the intricacies of positional astronomy delineated in tracts that were never intended for the nonscientific audience. Conversely, many outrageous astronomical statements have been uttered by untrained anthropologists, who, with a little understanding of elementary astronomy, could have carried their theories a long way.

This volume, it is hoped, will introduce all readers to the basic components of the interdisciplinary field of archaeoastronomy. It is offered as a bridge connecting the established disciplines of astronomy, archaeology, culture history, and the history of astronomy and is in-

tended to serve as a platform for the exchange of ideas among students of these seemingly disparate fields. Since the synthesis is presented at an elementary level, the text should benefit the interested lay person as well as the informed visitor to the ruins.

We begin by staging a background for our studies with a brief chapter on the ethnological basis for ancient American astronomy. This chapter serves to give the reader a general orientation for how ancient New World people viewed the heavens around them. Because of the wanton destruction of pre-Columbian sacred documents by the Spanish invaders, we have relatively little to work with in this area: portions of four original Maya manuscripts and a handful of others from Central Mexico; statements (some more reliable than others) in the brief histories of the native people written by Spanish missionaries who traveled to the Americas shortly after the conquest; and bits of data gathered by ethnographers traveling among the survivors and progenitors of the conquered people, some of whom still practice ancient rituals.

William Bell Dinsmoor, the Columbia University archaeologist, stated that if one were to seek an explanation for the disrepute into which the study of building orientation had fallen by the 1930's it might be attributed to the "niceties of modern astronomical calculation. What would have been a simple process in antiquity, the mere observation of the point of rising or setting of the sun, or as some think, of a certain star, on a selected day in the then current year, must now be laboriously reconstructed" (1939, p. 102).

This problem might have been remedied if the astronomical community had provided anthropologists with a discussion of that portion of their discipline that was relevant to the orientation question. Chapter III, on positional astronomy, is intended to serve as a user's guide to the celestial sphere and its contents. Different from the treatment found in standard astronomy texts, this chapter is especially slanted toward naked-eye astronomy, particularly as it applies in the tropical latitudes where Native American civilization developed. The nonessentials found in most standard astronomy texts have been removed. Basically, the investigator wants to know: What are the significant astronomical events which might have been watched by the ancients? Given no technological aids, what are the possible procedures for determining the time and place of occurrence of such events, and with what accuracy can they be observed? How has the appearance of certain astronomical phenomena changed since the time ancient culture developed? How can we retrieve astronomical information from quantitative measurements obtained at the archaeological ruins? Questions of this nature are addressed in some detail, with an emphasis on cyclic phenomena, an aspect of the heavens which is most easily observed by naked-eye astronomers. A background in elementary geometry is assumed. For those already possessing a knowledge of practical astronomy, this chapter may be only briefly reviewed or, perhaps, considered as a reference appendix.

Chapter IV is devoted to a discussion of the most well treated, yet thoroughly isolated, subtopic in Native American astronomy—the Mesoamerican calendar, one of the most sophisticated timekeeping

systems ever conceived by ancient people. Though many scholars who have written about it have focused their attention on the decipherment of the hieroglyphs and the question of how to correlate Old and New World chronologies, the treatment accorded the calendar here will be weighted heavily toward practical astronomy. Serious readers will become familiar with the fundamental operation of the calendar, the decipherment of dates, and the elusive problem of the correlation of the Maya and Christian calendars. They will also be asked to reflect upon how the elements of the calendar relate to the naked-eye astronomy to which they have already been exposed and from which the calendar derived. How, as the inscriptions suggest, did the Maya predict eclipses and how did they determine the length of the Venus year and the lunar month to accuracies of less than a day in several centuries? What sort of observations were required and what was the modus operandi? When did the astronomy become "scientific"? Such questions apply to the astronomy of any ancient culture.

Chapter V, on astroarchaeology, discusses the role of astronomy in the design and arrangement of ceremonial centers. A survey of field studies on the arrangement of Mesoamerican cities and ceremonial centers will be presented. Beginning with a discussion of the curious systematic orientation of the principal axes of many ceremonial centers, the chapter continues with an analysis of certain specialized buildings possessing peculiar shapes and orientations. Other case studies of astronomical alignments in ancient New World architecture outside Mesoamerica will be surveyed for comparison.

The reader of this text ought to be able to draw definite conclusions about the mental accomplishments of our predecessors on this continent. This book is both a synthesis and a personal view, operating with no predisposition toward proving theories for which no evidence exists. Rather, it is intended to serve as a marketplace where the ideas and evidence on issues demanding increasing attention in the field of prescientific astronomy can be assembled. Out of such an assemblage, I hope, will come the gradual synthesis of our renewed understanding of the cosmic mental system with other elements of Mesoamerican culture. Only then can a meaningful comparison of Old and New World systems of thought be initiated.

II. The Historical and Ethnographic Background for Native American Astronomy

"Who were the builders of these American cities? They are not the works of people who have passed away and whose history is lost but of the same races who inhabited the country at the time of the Spanish conquest . . ."

—John Lloyd Stephens (1843, 2:307)

THE CIVILIZATIONS OF ANCIENT MESOAMERICA

The Western world did not become aware of the existence of an advanced civilization in the Americas until John Lloyd Stephens and Frederick Catherwood toured Central America in 1839–1840. Together, author and artist produced two sets of volumes, *Incidents of Travel* (Stephens, 1841, 1843), which became instant revelations for both layman and scholar. In words and pictures Stephens demonstrated that the achievements of the ancient Maya in the fields of art, sculpture, architecture, and writing were on a par with the Classical civilizations of the Western world. As the quotation heading this chapter suggests, Stephens correctly attributed all these accomplishments to an indigenous race of American people.

The historical and archaeological record tells us that Mesoamerica, the region bounded on the north by the Tropic of Cancer and stretching as far south as the northern border of Honduras, was originally populated by nomadic peoples from Central Asia who crossed the land bridge into Alaska late in the Pleistocene epoch, 30,000–50,000 years ago. These early people wandered with the seasons, hunting and gathering their food supply as they went, but by 2500–2000 B.C., which anthropologists call the Early Formative period, isolated pockets of sedentary civilization developed and an agricultural system based principally upon maize took hold. This period also saw the beginning of pottery making and the expansion of an organized pattern of village trading. The extent of the Mesoamerican world in space and time is illustrated in the map and Table 1.

It is impossible to state when the people of Mesoamerica attained that sophisticated condition of human society termed "civilization." So many factors are involved in the definition of that term, and the material evidence is very scant. What Mesoamerican archaeologists call the Pre-Formative period began about 2500 B.C. with the appearance of pottery. A settled village life developed in the "Olmec Heartland" with

Table 1. ***Old and New World Chronologies***

New World			*Old World*
Farming and the cultivation of corn		5000	
Settlements		3500	Sumerian civilization
Pottery		3000	First Egyptian pyramids
		2500	Stonehenge
		2000	
		1500	
		1200	Trojan War
		1100	
	Olmecs	1000	
		900	
		800	Homer
		700	Golden Age of Greece
		600	Etruscans in Rome
		500	Socrates
		400	Empire of Alexander the Great
	Late Olmec	300	
		200	Carthage falls to Rome
		100	Julius Caesar
		B.C.	
	Pre-Classic Maya	A.D.	
Zapotec civilization		100	
		200	
		300	Roman Empire
Teotihuacán civilization		400	
	Classic Maya (Tikal, Copán, Palenque, etc.)	500	
		600	Anglo-Saxon control of England
		700	
		800	Charlemagne
Toltecs		900	
	Toltec occupation of Yucatán	1000	Vikings in North America
			William the Conqueror invades England
		1100	Crusades begin
Mixtec civilization		1200	Magna Carta
		1300	Renaissance in Europe
Aztecs		1400	Crusades end Fall of Constantinople
Spanish conquest		1500	Spanish exploration of the Americas

farming based on corn, beans, and squash. By the Formative period (ca. 1500 B.C.), the great Olmec ceremonial centers of Tres Zapotes, La Venta, and San Lorenzo flourished.

In the Middle Formative period (1000–300 B.C.) settlements sprang up in the Valley of Mexico and Oaxaca. It is from about this time that the first concrete astronomical achievements can be documented. The end of this period saw the beginnings of hieroglyphic writing, a 365-day year, and the mysterious 260-day cycle on the first carved stelae (upright stone slabs). This period was characterized by rapid advances in the arts and sciences as well as great architecture and sculpture accompanied by increasingly complex political and social systems. The highly stylized Olmec art of the Gulf coast strongly influenced the nascent Maya civilization which was soon to grow up to the east in the Yucatán peninsula. Massive pyramids, like the one at La Venta (20,000 square meters at the base), began to serve as the focal points of sacred ceremonial complexes. Temples and pyramids emerged in greater numbers from the jungle as the people strove to get closer to their celestial gods.

The period of greatest sophistication in the civilizations of Mesoamerica occurred during A.D. 300–900, a time when Europe slept in intellectual darkness. Called the Classic, or Florescent, period, this era was characterized principally by the appearance of highly organized settlements, an advanced calendar, a complex religious pantheon, and the rise of a social elite class.

Nowhere were the qualities of advanced civilization and intellectual achievement more outstanding than in the land of the Maya. Tikal's incredible architecture, the delicate sculpture of Copán, and the exquisite stucco work of Palenque seem unsurpassed in the New World and rival the Old.

A combination of circumstances, among them mismanagement, a popular revolution, and possibly a change of climate, led to the precipitous decline of this culture by the tenth century A.D. Why the fall was so widespread and complete remains a mystery. The Maya gave up their obsession for carving calendar dates on stelae, entombing their dead kings, and continually refurbishing their massive architectural works. They fell back to a simpler existence. By the time the Spanish invaders arrived early in the sixteenth century, the native villages were generally decadent and in great disunity, a factor which complicated and prolonged the conquest. Twenty years earlier it was a simpler matter for Cortez, already hailed as the returning god Quetzalcóatl by prophecy, to break the bond of the ruling Aztec hierarchy and gain the day's advantage in short order. What little remained of one of the great civilizations of the world was thus almost totally muted in less than a single generation.

Excellent brief histories of the civilizations of the Americas are cited at the end of this chapter. The readers who avail themselves of the general historical background contained therein should better understand how the astronomical accomplishments of these ancient people fit into their total culture.

Diego de Landa, first archbishop of Yucatán, writing shortly after the Spanish conquest, proudly tells the sad tale of the fate of the written legacy of the ancient Maya. He refers to a great book burning which took place at the Yucatecan city of Maní: "We found a large number of books in these characters [hieroglyphs] and, as they contained nothing in which there were not to be seen superstition and lies of the devil, we burned them all, which they regretted to an amazing degree, and which caused them much affliction" (1941, p. 169).

The chronicler Juan de Acosta also refers to Maya books and what happened to them: ". . . there used to exist some books of leaves, bound or folded after a fashion, in which the learned Indians kept the distribution of their times and the knowledge of plants, animals, and other things of nature and the ancient customs, in a way of great neatness and carefulness. It appeared to a teacher of doctrine that all this must be to make witchcraft and magic art; he contended that they should be burned and those books were burned and afterwards not only the Indians but many eager-minded Spaniards who desired to know the secrets of that land felt badly" (1590, bk. VI, p. 6).

Fragments of only four original Maya manuscripts, or "codices," (the Dresden, Paris [Peresianus], Madrid [Tro-Cortesianus], and Grolier) survive today. All carefully painted on bark paper fashioned into a folded-screen document, the writing and pictures contain a wealth of information pertaining to the heavens: lunar and solar almanacs, even a Venus ephemeris usable for one hundred years. Though a few more codices survive from Central Mexico, the bulk of Mesoamerican written documents have been lost or destroyed. In many cases, we must rely on statements of the historians of the postconquest period, many of whom we wish had recorded their observations more carefully. (See Chapter IV for a full discussion of the codices.)

Fig. 1, taken from the Madrid Codex (1967), a Maya document written shortly before the conquest, reflects the central role of astronomy among the civilizations of Mesoamerica. An astronomer is observing the stars. Seated at his station, he seems to be plucking them out of the sky with his extended eyes. The skywatcher is surrounded by hieroglyphs and Maya numbers which presumably relate to his astronomical secrets.

Stargazing seems to have been a common occupation among the nobility. The Spanish historian Torquemada, writing a century after the conquest, tells of the astronomical pursuits of Netzahualpilli, the king of Texcoco: "They say he was a great astrologer and prided himself much on his knowledge of the motions of the celestial bodies; and being attached to this study, that he caused inquiries to be made throughout the entire extent of his dominions, for all such persons as were at all conversant with it, whom he brought to his court, and imparted to them whatever he knew, and ascending by night on the terraced roof of his palace, he thence considered the stars, and disputed with them on all different questions connected with them" (1969, vol. 1, bk. 2, chap. 44, p. 188).

FIG. 1. An astronomer in the Madrid Codex. (Courtesy of Akad, Druck-u. Verlag, Graz)

Torquemada goes on to tantalize us with a poorly worded statement about the astronomer's methods of observation (which he evidently did not understand): "I have seen a place on the outside of the roof of the palace, enclosed within four walls only a yard in height, and just of sufficient breadth for a man to lie down in; in each angle of which was a hole or perforation, in which was placed a lance, upon which was hung a sphere; and on my inquiring the use of this square space, a grandson of his, who was showing me the palace, replied that it was for King Netzahualpilli, when he went by night attended by his astrologers to contemplate the heavens and the stars; whence I inferred that what is recorded of him is true; and I think that the reason of the walls being elevated one yard above the terrace, and a sphere of cotton or silk being hung from the poles, was for the sake of measuring more exactly the celestial motions."

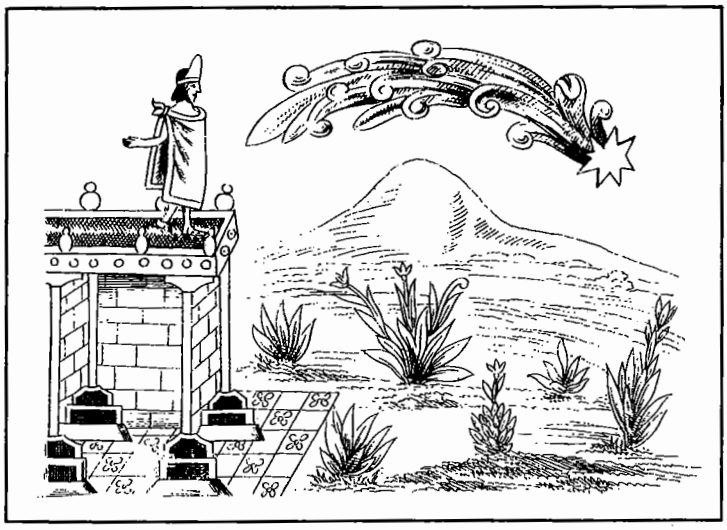


FIG. 2. A great comet was said to predict the fall of Moctezuma's empire. (Durán, 1951, fig. 24, courtesy of Editora Nacional, S.A.)

Further evidence of Netzahualpilli's careful attention to the heavens is exemplified in the episode of the great comet which was said to have presaged the fall of the Aztecs (Fig. 2). The chronicler Father Diego Durán tells us that Moctezuma, having observed the comet since midnight, went the next day to Netzahualpilli to seek its meaning. Replied the king of Texcoco, "Your vassals, the astrologers, soothsayers and diviners have been careless! That sign in the heavens has been there for some time and yet you describe it to me now as if it were a new thing. I thought you had already discovered it and that your astrologers had explained it to you. Since you now tell me you have seen it I will answer you that that brilliant star appeared in the heavens many days ago" (Durán, 1964, pp. 247–248). He goes on to give details of the frightful omens that soon after befall the unfortunate monarch.

From such statements about their astronomers it is difficult to grasp the cosmological viewpoint espoused by these ancient sky-watchers. We know, from reading other authors that the Mesoamerican priests conceived of a layered universe, each stratum containing one category of celestial body (Fig. 3). Above the layer of the earth, the moon traveled its heavenly course. Above this moved the clouds, the stars, the sun, Venus, comets, and so on, with the male-female creator god occupying the thirteenth and uppermost layer. The underworld consisted of nine divisions, if we count the earth as the first, stacked in an orderly fashion below earth. This view is quite in contrast with both the geocentric (earth-centered) and heliocentric (sun-centered) views of the universe which evolved in the classical Western world.

While the place of humans in the layered cosmology seems to be given some added importance over the rest of the system (the earth is counted twice), nevertheless, the concept of the earth as the center of the universe is not even suggested. The orbital theme which dominates

FIG. 4 Chronology represented one of the earliest demands made upon New World astronomers. These views from the Mendoza Codex illustrate the role of night-time observations in timekeeping. (Kingsborough, 1831)

the astronomy of the Classical World is not even hinted at. Instead, the hierarchical structure of the system becomes the basic theme of the picture.

The current cosmology of the Lacandon, among the few remaining survivors of the original Lowland Maya with their religion still somewhat intact, is strongly reminiscent of this layered-universe concept. Informants say that above the several layers of heaven occupied by various members of the Maya pantheon are three separate zones allocated to the sun, the moon, and the stars.

The statement about Netzahualpilli also reflects something more than a casual interest in celestial events. The astrologer-king was obviously engaged in some sort of celestial measurement. Torquemada has not provided us with enough detail to shed light on the methodology for gauging the stars. But if we look at the Central Mexican codices we find a number of pictures which serve to illuminate our understanding of the techniques and objectives of practical astronomy in Mesoamerica. The Codex Mendocino, or Mendoza (1831), a picture book produced shortly after the conquest, tells about various aspects of the lives of certain members of the Aztec noble class. Pictures (*a*), (*b*), and (*c*) of Fig. 4, taken from the Mendoza, contain adjoining captions written in Spanish. In picture 4*a* we learn about the primary role of the astronomer. The seated priest is "watching the stars at night in order to know the hour, this being his official duty." An inverted hemisphere studded with stars, symbolized by half-shut eyes, hangs over his head. In picture 4*b*, which appears adjacent to 4*a* in the Mendoza, another priest is beating on the *teponaztli*, to announce the time of night as determined from the observations of the first priest. Picture 4*c* informs the reader that the time of night is recognized as suitable for the performance of an obvious agricultural function. These drawings emphasize the utilitarian role of night-time skywatching. We have no evidence of

the use of water clocks or any other mechanical timekeeping devices in Mesoamerica. The celestial cycles seem to have been sufficient for marking the passage of time.

Other codices are more specific. Another series of pictures suggests that certain temples, in particular their doorways, were used as sighting stations to observe astronomical events at the local horizon (Fig. 5). In 1906, anthropologist Zelia Nuttall first proposed that the pair of crossed-sticks so prominent in many of the codices may have functioned as a sighting device. In Fig. 5*a*, from the Bodleian manuscript, we see a priest situated in a chamber within his temple. He peers out the doorway over a pair of crossed-sticks as if to mark the place of an astronomical event on the horizon. The outside of his temple is studded with star symbols, suggesting that it may have functioned as an astronomical observatory. Is the stick actually a measuring device? What horizon event is being witnessed? Does the star temple have a special orientation toward the object on the horizon?

Using a pair of notched-sticks, one as a foresight and the other as a backsight, an observer can determine the position of an object near the horizon with great accuracy, as we shall see in Chapter III. The sticks could be set in fixed locations to record the position of an astronomical body. When the body returned to its position between the notches, the astronomer could determine the length of its cycle. Perhaps a prominent feature in the landscape functioned as a natural foresight. In either case, the observatory edifice would have to be preferentially oriented so that it faced that part of the landscape where the event occurred.

We have no way of knowing whether the sticks were true measuring devices capable of giving angular measurements of, say, the separation of a pair of celestial objects or if they were intended simply as a guide to the observer in performing a ritual operation in connection with the object in question. We know that the observation of the rising and setting of certain celestial bodies was of extreme importance in Mesoamerica. Since these events take place along the horizon, we can make a strong connection between our priest and the horizon events.

Mary Elizabeth Smith (1973*a*,*b*) has studied "place signs" in the Mixtec codices. These books also tell of the adventure and exploits of members of the noble class. Often they confront places of worship where astronomical temples exist. Smith concludes that the "observatory place" referred to in the Bodley Codex was located in the city of Tlaxiaco. The eye and stick symbol, in fact, is equivalent to the Mixtec name of that city, which is given in the old dictionaries as *ndisi nuu*. This can be translated as "clearly seen" or "clearly visible"—an obvious reference to the location of the observatory.

As further support for this idea, Smith cites page 2 of the Codex Muro where there is shown a figure seated in a temple marked by his calendric name-day in the 260-day calendar. Above his name appears a sign consisting of an eye embedded in a flame resting on a bowl. The Mixtec gloss accompanying the drawing indicates that the person's name includes the phrase *ndisi nuu*. This eye motif in Muro is identical to the eye seen between two sticks placed on crossed legs in the "observatory" sign, and thus it seems likely that "observatory" is the

sign of *ndisi nuu*, or Tlaxiaco. The eye-stick symbolism is repeated in the other pictures in Fig. 5, which are sampled from various codices. In 5*b* the eye is placed over the stick and the observatory is reproduced again in miniature on the back of the animal at the left, while 5*c* shows some sort of hand-held device being employed by seated individuals. In 5*d*, also from the Bodley, an eye appears in a doorway and to the right we see an inverted eye implanted into the notch of a pair of inverted crossed-sticks. Here, according to Alfonso Caso (1960), the man 3 Dog, son of 4 House and 5 House, journeys to the hill of the serpent, represented by the building with the eye at the center. But no mention is made of the inverted crossed-stick. In 5*e* 13 Eagle makes war on 8 Jaguar, the man of the observatory. The eye and stick, nearly effaced, rest atop the building and, again, the structure is star studded. The eye and stick are connected with a ballcourt in 5*f*, the latter being symbolized by the capital-I-shaped configuration located on the same wall. Since Mesoamerican ballcourts possessed ceremonial as well as astronomical significance, it is possible that the "Tlachtli-instrumento astronomico" ("ballcourt instrument") identified by Caso was used to orient the structure. The magnificent ballcourt at Xochicalco is, indeed, oriented to within a few minutes of arc of the east-west direction. Here the sun rises and sets at the equinoxes, when days and nights are of equal length. The ceremonial ball game is well known to any visitor to the ruins of Copán, Chichén Itzá, or Monte Albán. The hard rubber ball driven back and forth along the ballcourt symbolized the cyclic motion of the celestial luminaries. As we shall see later, the game was also represented as the celestial ballcourt in constellation form. The astronomer of Fig. 5*g* wears the sign of his occupation as a headdress. (Or can we assume that the man comes from Tlaxiaco?) Picture 5*h* is one of several in which a pair of figures appears to be engaged in conversation on opposite sides of the eye-and-stick symbol. Two "stars" gaze out of a shaft in the side of a building shown in profile in 5*i*.

Fig. 5*j* is taken from a section of the Lienzo of Zacatepec (no. 1), a woven cotton cloth illustrated with black ink found in the town of Santa María Zacatepec, Oaxaca (see Smith 1973*a*, chap. 7). This time the entire head of a man is placed at the junction of a pair of sticks making the shape of an "X." To the right the exaggerated eye symbol above a spider weblike device appears beneath the face of a man.

Another astronomical instrument may be embodied in the year glyph, particularly as it is displayed at Xochicalco and Teotenango (Fig. 6). A. Digby (1974) of the British Museum believes the glyph represents a device which consists of a pair of crossed trapezes mounted on a circular plate used to observe the sun in the manner of a classical sundial. His conception of such a device is reproduced in Fig. 6. The right-angle intersection between the crossbars casts a moving shadow on the plate, the shadow taking different paths on different days of the year.

While the similarity between the year glyph and Digby's three-dimensional device is undeniable, there is little supporting evidence that such an instrument was actually employed to measure the time of day or year (though the one he has constructed certainly works).

The pictures in Fig. 7 refer to still other possible sighting schemes and devices. In the first four of these, a pair of crossed-legs seems to

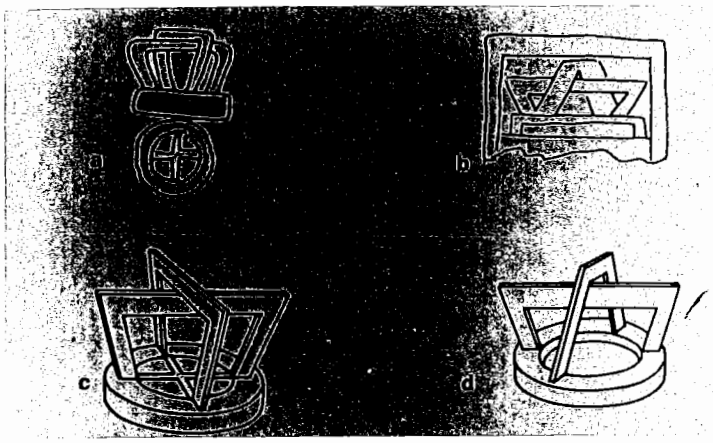


FIG. 6. *Top*, year glyphs on (*a*) the Temple of the Plumed Serpents at Xochicalco and (*b*) a stone at Teotenango; *bottom*, A. Digby's reconstruction of these as sundials. (Digby, 1974, p. 273; courtesy of Gerald Duckworth & Co. Ltd.)

function in the same manner as the sticks. (As we shall see in our discussion of the Maya calendar, the crossed-legs hieroglyph plays a role in the delineation of time in their cosmology.) The knee sign appears in the same kind of (stellar) temple in 7*c* as that which housed the priest with the sticks in Fig. 5*a*. Smith (1973*a*) states that the word *dzichi*, meaning legs, is being substituted for the homonym *ndisi* in the name of Tlaxiaco, while Nuttall (1906) suggests that the stars were literally sighted over the legs from a reclining position on certain ritual occasions. Both crossed-legs and crossed-sticks appear in picture 7*d*. In 7*e* through 7*h* the priests hold scepters in their hands. Stars are positioned on the tips or in-between. One of the three-pronged sighting devices is carved in low relief on the side of Building J, a well-known astronomical observatory (see Chapter V).

Given both the hypothetical Digby instrument and the many references to the eye-stick symbolism, we have exhausted all the evidence relating to Mesoamerican astronomical instrumentation. No artifacts of measuring instruments survive and few statements in the ethnohistoric record allude substantially to the practice of measurement. We must face the fact that any accuracy attained in Mesoamerican calendar and building orientation was accomplished without the use of calibrated devices. At least the contemporary evidence points us in that direction.

In many cases throughout the Bodley Codex, the story tells of offering and sacrifice performed at the building, or buildings, called "observatory." Never are we told what these priests are observing. But we can look to other pictures of star temples in the Vienna Codex (1974) for possible clues. In Fig. 8*a* we see a single star in the doorway of a temple appearing on a mountaintop. In the Vienna Codex, or Vindobonensis, this picture often occurs alongside three other temples, which Caso believes refer to the cardinal directions, the present exam-

ple representing east. This direction may have been determined by watching for a particular star appearing above the horizon in that direction. Smith (1973*b*, p. 84) cites glosses from the Mixtec codices that refer to horizon observations, for example, "the horizon with the Pleiades at the zenith" (*tnono* = horizon; *yucu* = Pleiades; *dzini* = zenith). In Fig. 8*b* the celestial reference seems to be a particular constellation, a curved configuration looking like the tail of a serpent. Bernardino de Sahagún (1950), a sixteenth-century Spanish missionary writing shortly after the conquest, refers specifically to a constellation having this shape in the Florentine Codex (1950–1970). He calls it the tail of the scorpion (see Fig. 10).

Figs. 8*c*, *d*, and *e* refer to the sun. J. L. Furst (1978) has recently given a full interpretation of solar events in the mythic context occurring in the Vienna. In 8*c* we see the sun rising in the doorway of the Temple of the Sun. The place where the sun rises and the sacrifices are practiced is depicted in 8*d*, the sun in this case appearing on a mountaintop, while 8*e* displays the solar disk in the upper portion of the picture with the solar image personified by the warrior Tonatiuh carrying arrows in his hands. This signifies that the sun is a celestial warrior who, on rising in the east, throws his arrows, or rays of light, at the stars, thus ending the night and establishing the day. The lower disk shows the Mexican calendar day 1 Flower in the center, identifying the sun with an older god. The sun is thus shown twice: in the upper portion as being young when he is born in the east and in the lower portion when he is old, dying in the west. At the left of the picture, in both representations, day and night are equally represented though reversed on the sun disk symbol. At the lower left a road divided into four parts signifies the path of the sun through the four quarters of the sky. It may be noteworthy that in the last two cases the sun is referred to a place on the horizon, namely, at the top of a hill. The light-dark theme of this picture has also been interpreted as eclipse imagery (D. Kelley, private communication).

Caso (1950) believes that Venus is the celestial object displayed in Figs. 8*f* through 8*i*; this seems logical in the last picture since Quetzalcóatl, the Venus God, is shown supporting upon his shoulders a sky studded with these symbols. But Nuttall (1906) suggests that 8*j* through 8*m* also represent Venus. Here it is displayed most often with a pair of "wing-like appendages representing its radiance or light, the intention being to depict the planet at its period of greatest brilliancy" (p. 296). In 8*j* and 8*k* the image appears in a temple doorway. The astronomical nature of the temple in 8*j* is exemplified by the stars which adorn its rooftop. The Venus sign appears on the east wall of a ballcourt in 8*l*, exactly where the eye and stick convention was located in Fig. 5*f*. In 8*m* we have Venus minus its winglike appendages depicted at a period of lesser brilliancy, according to Nuttall. A figure (ball with dotted matrix) bearing a strong resemblance to this symbol appears in the Florentine codex (Fig. 10) where it is labeled "Venus, the morning star." This document may have inspired Nuttall to equate the two. But compare Caso's (1950) commentary on Fig. 8*m*: he identifies it as an altar of burning copal, or a place of self-sacrifice. Thus, he interprets the

same symbol with the winged appendages to represent a piece of burning copal incense.

We should not be surprised to find Venus references in the codices, but they also occur in postconquest documents. One of these was produced by Sahagún. It is entitled the *General History of the Things of New Spain* (known commonly as the Florentine Codex). Of all the celestial bodies observed by the Mesoamericans, Venus was among those of greatest importance. Called the Great or Ancient Star and Lord of the Dawn, "it became brilliant and shone white; like the moon's rays, so did it shine," says Sahagún (1953, pp. 11–12). "Captives were slain when it emerged that it might be nourished. They sprinkled blood toward it, flipping the middle finger from the thumb; they cast the blood as an offering" (p. 12). Augustinian monk J. Román y Zamora says of the Central Mexicans that "so accurately did they keep the record of the days when it appeared and disappeared that they never made a mistake" (Seler, 1904*c*, p. 358).

The alleged precision is revealed on pages 46 to 50 of the Dresden Codex of the Maya (1976), where we have a complete record of the apparition of Venus as morning and evening star. These pages, which are somewhat more abstract and sophisticated than the pictures presented in this chapter, will be analyzed in some detail in Chapter IV on the Mesoamerican calendar. In the dot-and-bar mathematical symbolism of the Maya, several "Venus years" are recorded in that document. They represent the interval between successive initial appearances of the planet as morning star. The 584-day period is broken down into four subintervals representing the length of time Venus appeared as morning star and as evening star; the disappearance intervals in-between are also recorded. An added page of the Dresden was fashioned to serve as a table of corrections to alter the Venus observations to a later time. Pictures accompanying the tables show the Venus god, Kukulcan, the Maya equivalent of Quetzalcóatl, in several evil manifestations, spearing his victims. Evidently, the reappearance of Venus in different quarters after a prolonged absence carried various evil connotations for the people of Yucatán. Sahagún (1950) tells us that, when the morning star rose, people stopped up their chimneys so that no harm from its light could get into their houses. Obviously, they were deeply concerned about where and when Venus might appear to reverse their fortunes.

The codex pictures in Fig. 9 refer to other celestial events of importance in Mesoamerica. Fig. 9*a* depicts the great solar eclipse of A.D. 1496 (August 8), total in Central Mexico. It is represented in a combination of European and indigenous styles in the Codex Tellerianо-Remensis (1899). Later in this same document, the solar eclipse of A.D. 1531 is represented (Fig. 9*b*). The same eclipse is pictured in 9*c* from the Codex Vaticanus (1972), which document also shows other eclipse representations, for example, 9*d*, in which, curiously, the eclipse is pictured as taking place on the horizon.

In Book VII of the Florentine Codex (1950–1970) we sense the fear of the Aztecs upon witnessing the dramatic event of a total eclipse of the sun:

> When this came to pass he [the sun] turned red; he became restless and troubled; he faltered and became yellow. Then there were a tumult and disorder. All were disquieted, unnerved, frightened. Then there was weeping. The common folk raised a cup, lifting their voices, making a great din, calling out, shrieking. There was shouting everywhere. People of light complexion were slain [as sacrifices]; captives were killed. All offered their blood; they drew straws through the lobes of their ears, which had been pierced. And in all the temples there was the singing of fitting chants; there was an uproar; there were war cries. It was thus said: "If the eclipse of the sun is complete, it will be dark forever! The demons of darkness will come down; they will eat men!" (Sahagún, 1953, p. 12)

An eclipse of the sun and an eclipse of the moon are pictured in the Florentine Codex (Fig. 10). Evidently, the Aztecs were every bit as frightened of the latter phenomenon:

> When the moon was eclipsed, his face grew dark and sooty; blackness and darkness spread. When this came to pass, women with child feared evil; they thought it portentous; they were terrified [lest], perchance, their [unborn] children might be changed into mice; each of their children might turn into a mouse.
>
> And because they feared evil, in order to protect themselves, in order that this might not befall [them], they placed obsidian in their mouths or in their bosoms, because with this their children would not be born with mouths eaten away—lipless, or they would not be born with noses eaten away or broken off; or with twisted mouths or lips; or cross-eyed, squint-eyed, or with shrunken eyes; nor would they be born monstrous or imperfect. (Sahagún, 1953, pp. 8, 10)

Comets (*citlalimpopoca*, or the stars that smoke) are represented frequently in the surviving historical documents, usually by a stellar image on a blue background with emanating streams of smoke: Figs. 9*e* and *f* from Codex Vaticanus and 9*g* from Codex Telleriano-Remensis. These usually signify that a person of nobility will die; for example, picture 9*e* tells of the death of the ruler of Tenochtitlán following the apparition of a comet; later another comet occurs, then an earthquake, all of nature's events being connected in the Aztec cosmic view. The caption in 9*h* tells us that the star Venus is smoking. It is curious that, in this case, reference is being made to an image which appears slightly different from the usual representation of a comet. Perhaps a cometary object appeared near the planet. In 9*i* from Codex Telleriano-Remensis and 9*j* from Codex Vaticanus, the celestial reference may be a meteor or "shooting star." Of the animal wounded by the "shooting star" Sahagún says, "It hath received a worm—and was not to be eaten." Also, "by night all were well protected. All covered themselves, wrapped themselves in mantles and bound on their garments for fear of the shooting star" (1953, p. 13).

AZTEC CONSTELLATIONS

One of the problems of identifying the celestial percepts of vanished cultures is that we often make too many assumptions about what those people must have seen. Constellations or star patterns on the sky are derived as much from cultural tradition as from visual perception. While some celestial groupings (e.g., Orion's Belt and the Pleiades) might be universal, too often we force our own heavenly dippers and zodiacal signs upon a culture with little other supporting evidence. (For an excellent discussion of this problem, see Urton, 1978*a*, pp. 5–15.)

Foremost among the star groups accorded a place of prominence throughout Mesoamerica are the celebrated Pleiades, or Seven Sisters of the Classical World. This star group has been of such great importance to nearly every developing civilization that a digression of Pleiades observations in general may be worthwhile.

In his monumental work on myth, *The Golden Bough*, Frazer (1936–1937) lists page after page of documentation alluding to Pleiades observations among North, Central, and South American people, Africans, Polynesians, Australians, and even the people of Kamchatka, far north of the tropics. Nearly all these people observed the appearance and disappearance of this conspicuous group of stars to time the commencement of certain operations in the agricultural calendar. The Guaranis of Paraguay date the beginning of their year and time the sowing of their seed by the heliacal rising, or first annual predawn appearance, of the Pleiades in May (see Chapter III, Appendix B and n.16). For the tribes in Matto Grosso in the Amazon valley, the first appearance of the Pleiades signals the beginning of the rainy season and the migration of the birds: "While it is low, the birds and especially the fowls sleep on the lower branches or perches, and just as it rises so do they; it brings much cold and rain; when it vanishes serpents lose their venom; the reeds used in making arrows must be cut before the appearance of the Pleiades, else they will be worm-eaten" (Frazer 1936–1937, 1:309). The Blackfeet in North America use these stars to regulate their most important feast, which includes, in addition to a pair of sacred vigils to wait for their arrival, the blessing and the planting of the seed.

In the Society Islands in the South Pacific, the year is split into two seasons which are determined by the heliacal (see Appendix A, Chapter III) rising and setting of the Pleiades. The Sherente of Brazil employ the same concept, thereby creating a calendar which is even more complicated. According to Lévi-Strauss: "The year begins in June with the appearance of the Pleiades when the sun leaves Taurus. When these stars appear it is believed to be a sign of wind. Their heliacal rising is observed. Between two such risings they count 13 months and divide the year into two parts (four moons dry weather June–Sept., nine moons rain Sept.–May). In the first two dry months large trees of a piece of forest land are felled to free it for cultivation. In the following two months the ground is cleared by burning scrub" (1964, p. 217).

Among primitive societies, the Pleiades are often the only celestial group paid any attention. In Bali, the Pleiades and Orion's Belt are the only stars the people use to correct their lunar calendar. They

bring the lunar year (12 months of 29½ days = 354 days) into harmony with the tropical year by prolonging one of their months until the Pleiades become visible at sunset. The Caffres of South Africa regulate the lunar year as well as the agricultural calendar by the Pleiades. Any confusion about the solar year is always set right by their heliacal rise, and things function normally until "the moons get out of place, and reference has again to be made to these stars" (Frazer, 1936–1937, 1:316).

The Pleiades are also worshipped among aboriginal people who do not practice agriculture. This may be due to the coincidence of the first annual appearance of the group at the beginning of the rainy season. Developing civilizations could hardly fail to observe that wild fruits grew more plentifully and therefore that they would have more to eat after a heavy fall of rain than after a long drought. Hunters could learn of the migration of their prey as a function of the meteorological cycle. It would then be but a simple step to attribute the cause of certain terrestrial occurrences to these stars. Indeed, many of the aboriginal people of Australia regard the Pleiades not merely as a signal but instead as the cause of rain—an astrological rather than an astronomical function. They curse the Pleiades if their appearance in the sky is not immediately followed by a rainy period.

We might expect that any people who would strongly attach world affairs to the appearance and disappearance of the stars would also worship them with equal intensity. Among the Mocobis of Peru and the Navaho of Arizona, the Pleiades are both father and creator. Their image adorns the forehead of Black God, the principal Navaho deity. The Guaycurus of the Gran Chaco flayed one another upon their appearance so that they could be blessed with good health, good crops, and success in war.

The Pueblos begin a sacred nocturnal ritual when the Pleiades rise. According to Jesse Fewkes (1895), indefatigable archaeologist-explorer of the Southwestern United States at the turn of the century, an invocation was made to the gods who represented the quarters of the world. He concludes with the statement: "I cannot explain its significance, and why of all stellar objects this minute cluster of stars of a low magnitude is more important than other stellar groups is not clear to me" (p. 453).

Actually, the Pleiades are as easy to recognize as the brightest stars in the sky. Though each individual member is not bright, their combined light spreads over a considerable area of the sky resulting in an impressive phenomenon, easily recognizable by anyone who casually looks skyward.

The Pleiades, then, probably owe their prominence in myth and folklore to a combination of their conspicuousness in the heavens and the coincidence of their appearance and disappearance on either side of the sun during significant periods in the seasonal calendar. In Chapter III we will discuss the mechanics of the Pleiades' motion. As we shall demonstrate, their occurrence close to the ecliptic offers some exactitude in the timing of heliacal rise and set.

The foregoing statements represent but a fraction of the ethnohistorical evidence pertaining to the observation of a single star group.

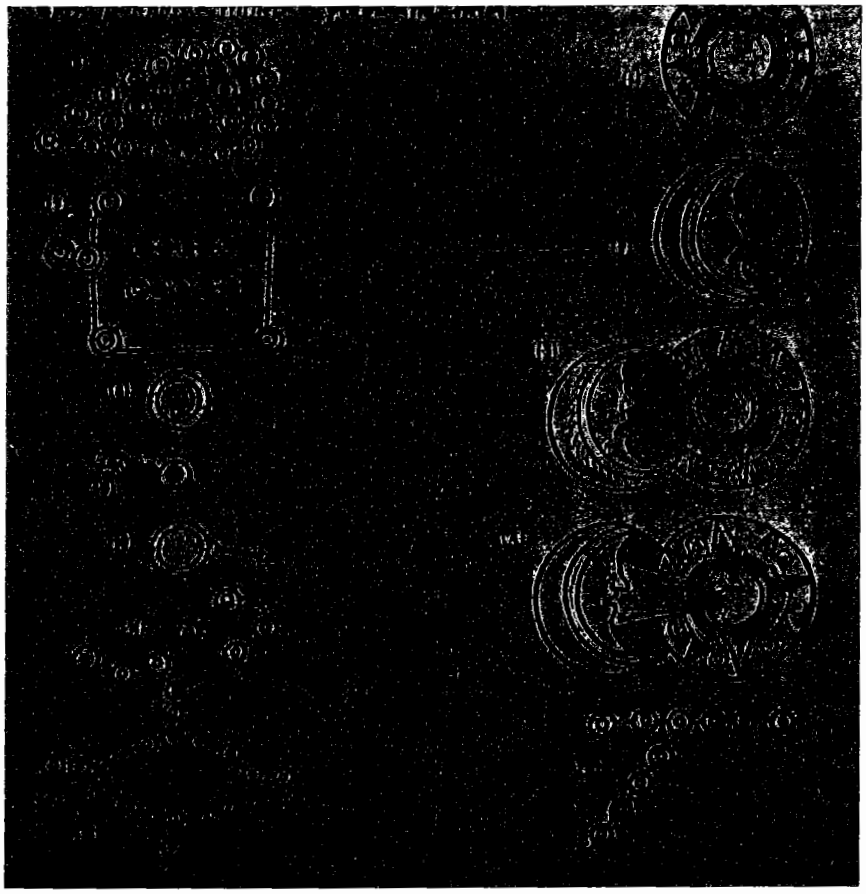


FIG. 10. Astronomy in the Florentine Codex of Sahagún: *left col.*, Tianquiztli, or market place (the Pleiades), Citlaltlachtli, or ballcourt (Gemini?), Citlalpol (Venus), Citlalpopoca, or smoking star (comet), Citlaltlamina (shooting star), Xonecuilli (Little Dipper?), Citlalcolotl (Scorpio?); *right col.*, Tonatiuh (sun), Meztli (moon), solar eclipse, lunar eclipse, Mamalhuaztli (Orion's Belt and sword?). (Sahagún, 1953, fig. 21; courtesy of School of American Research and University of Utah Press)

They serve to illustrate a deep and widespread bond between humans and cosmos in all developing civilizations.

The seventh chapter of the Florentine Codex, "Which Treats the Natural Astrology Attained by These Natives of This New Spain," gives a written and pictorial account of certain Aztec constellations (see Fig. 10). The manner of representing the stars as circles connected by lines is reminiscent of the constellation patterns which can be seen inscribed about the periphery of the Aztec calendar stone. At least one pattern, called the tail of the scorpion, is common to both (compare Fig. 11).

There has been some confusion over the attempted identification of these patterns with modern constellations (see Fig. 12); neverthe-

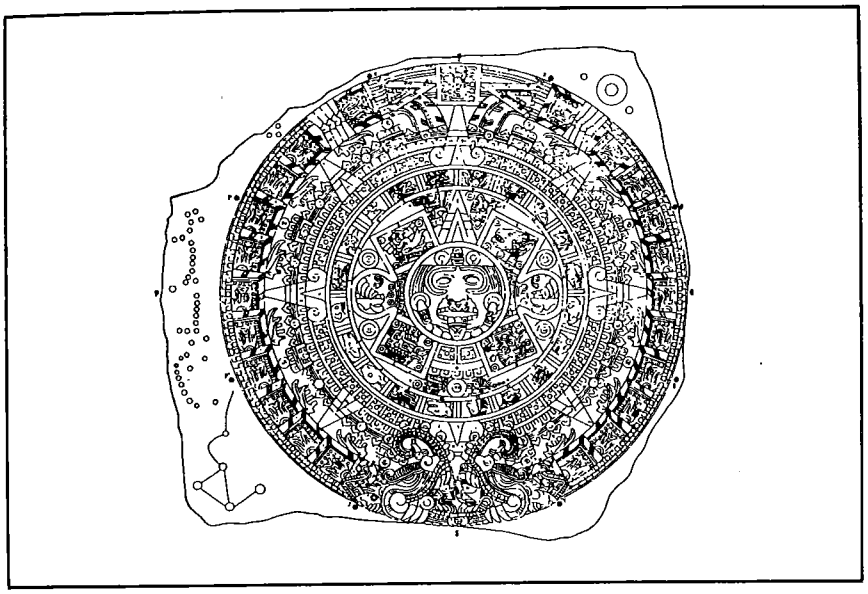


FIG. 11. The dotted patterns pecked into the edge of the Aztec calendar stone may represent constellations. The identification of Xoneciulli at the top is unmistakable, that of the others far less certain. In one case (Citlaltlachtli?) the stars are connected by lines as in the Florentine Codex (cf. FIG. 10). Is Citlalcolotl the group above this configuration? (Nuttall, 1901, fig. 56)

less, a few conclusions can be agreed upon. The constellation of Tianquiztli (so labeled in Fig. 10) surely represents the Pleiades. The Aztecs determined the occurrence of their most important feast day by the appearance of the Pleiades, which marked the fifth cardinal point. According to Sahagún (1953), the ceremony of the Binding of the Years took place every 52 years[1] and began when the Pleiades crossed the overhead position at midnight (about mid-November), a statement which suggests the Aztecs were marking the time of night. When the time approached, the priests ascended the Hill of the Star to watch the movement of the Pleiades with great anxiety: "And when they saw that they had now passed the zenith, they knew that the movements of the heavens had not ceased and that the end of the world was not then, but that they would have another 52 years, assured that the world would not come to an end" (Sahagún, 1957, p. 143). Broda (1979*b*) has tied these observations to a method for fixing the months of the Aztec calendar. Smith's (1973*b*, p. 84) translation of a Mixtec phrase on page seven of the Codex Muro as "the horizon [with] the Pleiades at the zenith," might be kept in mind here.

Although the arrowlike configuration representing them in the Florentine bears little resemblance to the Pleiades at first glance, the clustering of the nine stars inside the connected chain representing the outer boundary of the constellation bears a distinct resemblance to the Pleiades as they appear in the sky, as the enlargement of the group in Fig. 12 attests. Though we see only six or seven Pleiades without a

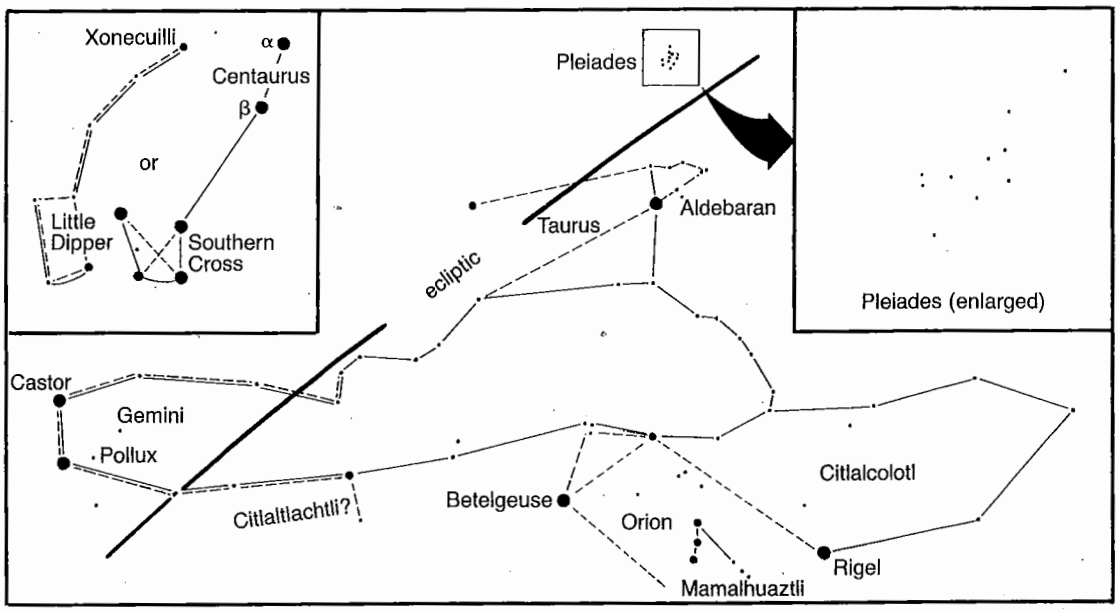


FIG. 12. Aztec and Western star patterns contrasted. In this winter sky scene, solid connecting lines form the constellations as the Aztecs imagined them. Dashed lines depict our modern versions. Some groups, like Orion's Belt (Mamalhuaztli) and the Pleiades (*enlarged at the upper right*), seem to be recognized universally. The Serpent's Tail constellation (*upper-left enlargement*) fits either our Little Dipper or the Southern Cross with Alpha and Beta of Centauri added. (Diagram by P. Dunham)

telescope in the northern latitudes, under clear sky conditions at high altitudes where the atmosphere is relatively tenuous the discerning eye may witness a few additional stars, especially when the group transits the zenith. As we shall see in Chapter V, these stars, above all others, may have had a direct influence on the orientation of ceremonial centers.

Today among the Chorti Maya of Guatemala the Pleiades, called "El Siete Cabrillas," or "Seven Kids," fix the day of the planting and the coming of the rains when they undergo heliacal rising in the morning sky on April 25. It is at this time that they announce the first annual passage of the sun across the zenith, a phenomenon said to be responsible for the fertilization of the seeds. "Rites and ceremonies are held in order to celebrate this fact" (Girard, 1948, p. 67). Among the ancient Maya the Pleiades were called *tzab*, "the rattlesnake's tail," a form by which this hieroglyphic representation is recognized at several places in the codices (Dütting, 1979).

The constellation of Mamalhuaztli, the "Fire Drill" or "Fire Sticks," is also labeled in Fig. 10 and may be represented on the periphery of the Aztec calendar stone by a pair of intersecting straight lines composed of stars.

> They name these stars *Mamalhuaztli*, and by that same name they call the sticks with which they drill a fire, because it

> seemeth to them that they somewhat resemble the stars and that from them there came to them this manner of producing fire. From this it was customary that the men make certain burns on the wrist in honor of those stars. They said of him who was not marked by those burns that, when he died, there in hell they would produce fire on his wrist, drilling it there as those do who here drill fire with the stick. (Sahagún, 1953, pp. 60, 62)

The ritual was carried out at the commencement of a 52-year cycle.

The same group is probably the one mentioned along with the Pleiades in an informative though somewhat confusing statement in the *Crónica mexicana*, written by the postconquest historian Alvarado Tezozomoc (1975). He gives an account of the formalities taking place upon the election of Moctezuma Xocoyotzin, king of the Aztecs. Following a long list of religious duties he is exhorted

> . . . especially to make it his duty to rise at midnight and to look at the stars: at *yohualitqui mamalhuaztli*, as they call the keys of St. Peter among the stars in the firmament, at the *citlaltlachtli*, the north and its wheel, at the *tianquiztli*, the Pleiades, and the *colotl ixayac*, the constellation of the Scorpion, which mark the four cardinal points in the sky. Toward morning he must also carefully observe the constellation *xonecuilli*, the "cross of St. Jacob," which appears in the southern sky in the direction of India and China; and he must carefully observe the morning star, which appears at dawn and is called *tlahuizcalpan teuctli*. (P. 574)

There is considerable confusion about the so-called Keys of St. Peter. According to Sahagún, they "walk in the area of the 'Siete Cabrillas.'" At this point we must be careful about accepting the old historians' descriptions as gospel. For example, Tezozomoc's discussion of ballcourts bears little resemblance to the game or the field on which it was played as we understand it from other sources. On medieval European maps the constellation of St. Peter included all of the zodiacal constellation of Aries and parts of Triangulum, Cetus, and Pisces; it was located immediately to the west of the Pleiades. The Keys seem to be composed of the faint stars 35, 39, and 41 Aries and 12 and 13 Triangulum. On the other hand, the editor of Tezozomoc's manuscript, J. M. Vigil, states that Alpha of Aries, 10° to the southwest of these stars and at the other end of the constellation, marked the location of the Keys. Even the most imaginative interpreter would have difficulty conjuring up a configuration similar to the Fire Drill shape shown in Fig. 10 out of stars in this area; however, an identification of the Fire Drill in the vicinity of Aries would put it on the ecliptic, a zone of celestial importance.

The Fire Drill constellation must be formed out of two rows of stars meeting at an acute angle. Both the Hyades group in Taurus and the Belt and Sword of Orion (bottom of Fig. 12) to the east of the Pleiades fulfill this condition and, accordingly, both have been suggested as possibilities. The latter seems more likely because Orion's Belt rose al-

most exactly at the east point, thus marking one of the cardinal directions which Moctezuma was supposed to watch. To solidify this argument, Michael Coe (1975, p. 26) notes that Sahagún refers to the group as the little sticks or little stars which, according to the native dictionaries, is synonymous with the name for Orion.

Because Sahagún never labeled it, we cannot be sure whether the box-shaped constellation in Fig. 10 represents Tezozomoc's Citlaltlachtli, or the Star Ballcourt, also called the north and its wheel. Actually the grouping bears little resemblance to stars around the pole. The two parallel rows of stars representing Gemini the Twins have also been suggested as a possibility (left side of Fig. 12), though on appearance the identification seems weak. On the other hand, Sahagún tells us specifically that Gemini was important to the Aztecs:

> These people paid particular reverence and (made) special sacrifices to Castor and Pollux, in the sky, which move near the Pleiades, which are in the sign of Taurus. They made these sacrifices and ceremonies when (the stars) newly appeared in the east after sunset. After having offered incense, they said: "Now (hath) *Yoaltecuhtli* come forth, and *Yacauiztli*. What will come to pass this night? Or what end will the night have—fortunate or adverse?" Three times they offered incense—the first time at the first quarter of the night, another time at ten, and the third (time) when it beginneth to be morning. (1953, p. 60)

The identity of the dipperlike configuration in the Florentine labeled "Xonecuilli" is also difficult. Though it resembles our Little Dipper, Tezozomoc places it in the southern part of the sky. There it can be identified with the Southern Cross (the four stars forming a square at the right side of the configuration) and a chain of bright stars in Centaurus, including Alpha and Beta of that modern constellation (see Fig. 12 for a sketch of the possibilities). It may be significant that, when Orion's Belt lay due west on the horizon in the skies of Central Mexico in A.D. 1500, the Southern Cross stood 15° above the horizon exactly over the south point. It is realistic to assume that the ancient Mexicans would place their key constellations at the cardinal points since the plans of their temples were often oriented this way. As we shall see when we discuss their calendars, the quadripartite division of the universe is central to any comprehension of Mesoamerican cosmology.

The Southern Cross has long been regarded as an important star group throughout Native America. It has been symbolized in the form of a mythical turkey-bird by the Warao people who live in Brazil, 9° south of the equator. According to anthropologist Johannes Wilbert (1973), a complicated Warao myth is associated with the orientation of this bird on the sky at different times. The basic astronomical elements emerging from the myth suggest that every evening at nine o'clock he rises in the southeast to fly to the meridian where one of his wings chants in order to protect all newborn females in the tribe. Old women of the tribe must chant back, encouraging the bird on his heavenly journey, lest he lose his feathers to his celestial pursuers, the hunters, who are represented by Alpha and Beta of Centaurus. He re-

turns at noon and later chants with his other wing, thereby protecting all the newborn males. Thus he is on the meridian at midnight for females and at noon for males. In the present context, it is interesting to note that Wilbert has traced the origin of the myth to the civilizations of Central Mexico or Yucatán (latitude 20° N, A.D. 1500) by duplicating in a planetarium the positioning of the Cross at different times with respect to related constellations, for example, the Northern Cross, as described in the Warao myth. He finds strong similarities between the cosmology of the Warao and that of the Aztecs and Maya.

An equally possible identification for Xonecuilli is the Big Dipper, which the pattern closely resembles, even down to the number of stars depicted. The bowl of the Dipper transited the celestial meridian of Tenochtitlán at the same time Orion's Belt set in the west; therefore, this obvious grouping could have served to mark the north cardinal point. But a *Little* Dipper designation (Fig. 12, inset at upper left) cannot be ruled out, especially since Sahagún specifically equates these stars with Xonecuilli (though they certainly are not as prominent as he indicates): "The stars which are in the Little Bear these people call Citlalxonecuilli. They represent them in the shape of an S, backwards (of) seven stars. They say they are by themselves, apart from the others, and that they are brilliant" (1953, p. 66). Only Polaris at one end and Kochab at the other end of the Dipper can be said to possess any brilliance, and they are of the second magnitude. The five stars in-between would hardly be prominent, especially at the low altitude attained by the Little Dipper in Mexico.

At the same time that Orion's Belt lay on the western horizon and the Southern Cross marked the south point, Antares, the brightest star of our constellation Scorpio, was in the opposite part of the heavens, rising 25° south of east. According to Coe (1975), both the ethnohistoric and the ethnological evidence strongly support the identification of the remaining Florentine constellation, Citlalcolotl, with Scorpio. The coiled tail at the right side of the figure is similar to the coiled tail of the modern constellation, but evidently the Aztecs saw the rest of the star group combined with portions of adjacent constellations in a different way, as Fig. 12 suggests. In the representation given there, Castor and Pollux are the mouth of the scorpion, Rigel the stinger at the tip of his tail. Since the region of our own Scorpio is crowded with stars of the Milky Way, identification of specific stars is impossible. As Coe stated: "Either this group naturally looks so much like a scorpion that it has received this name independently, or it was in some way diffused to the New World" (p. 26). A group of stars forming a rounded configuration visible on the Aztec calendar stone of Fig. 11 also may represent the scorpion. It is noteworthy that a number of the Sahagúntine constellations are situated close to the ecliptic. The patterns overlap with our zodiacal constellations: Gemini, Taurus, Scorpio. Our studies of the calendar in Chapter IV will reveal that the ancient Americans recognized a zodiac to mark the paths of the planets, though the constellation patterns comprising the zodiac were not identical to our own Western constellations.

Individual stars were recognized by the Mesoamericans. Lamb (1979) has been compiling evidence from the Maya dictionaries relat-

ing to star and constellation names. Polaris, called Xaman Ek by the Maya, was universally used by travelers to find their way. Merchants were supposed to burn copal incense to the North Star by a roadside altar in order to be protected. Among the modern Lacandon Maya, Rigel and Sirius are Woodpeckers and Betelgeuse is Red Dragonfly. The bright stars in Gemini (still) represent a turtle and Orion's Belt is a peccary. To no surprise, the Pleiades, the Southern Cross, and the Big Dipper are also recognized. Venus is by far the most important planet (Baer and Baer, 1971).

Regardless of identification, the pictures of star groups in the codices emphasize the use of celestial bodies to indicate both time and direction. They also suggest a strong connection between astrology and astronomy. Celestial events are constantly linked to the rise and fall of various rulers, battles fought, and great disasters which occurred. Repeated reference to the observatory and its contents underlines the bond between astronomical observing and the calendar in Mesoamerican culture. Nuttall's study of astronomical pictures in the codices led her to conclude that "the ancient Mexicans not only employed their carefully oriented temples and ballcourts as astronomical observatories, but also invented ingenious devices for accurately registering the periodical appearances or disappearances of important bodies" (1906, p. 298).

But as far as the people were concerned, the observatory served a divinatory and ritualistic function more than an astronomical one. It linked the stars directly to their lives through omen and prophecy.

Our discussion of the interpretation of the Aztec stars and constellations also illustrates some of the difficulties associated with the study of ancient astronomy. To begin with, the historical record often can be confusing. The investigator must comprehend not only the workings of positional astronomy, but also the view of the cosmos as perceived by the priests of the Spanish renaissance who compiled most of the record available for study today.

When we attempt to identify stars and constellations with actual star patterns, we must be careful to avoid our own cultural bias. Our Western star maps usually display an accurate one-to-one representation of the positions of the stars, their magnitudes being represented by circles of proportionate diameters. The Aztec informant who drew the Tianquiztli star group in the Florentine Codex clearly did not utilize these ground rules when he encompassed his version of the Pleiades in a ringed star border with a point at one end.

The documentation of the astronomical knowledge of the Aztecs in the Florentine Codex reflects the cultural chauvinism of Sahagún. Though he lived and worked in Mexico for more than sixty years, he was a missionary whose primary function was to civilize and Catholicize the inhabitants of the land recently conquered by Spain. The questions he asked and the answers he interpreted were likely to be quite different from those emanating from a trained anthropologist. As Alfredo López Austin, who has studied the conquest period, puts it:

> Sahagun asked about the nature of the sky with totally Occidental expectations, perhaps anticipating replies which might deal

> with celestial spheres, the density of strata, universal rotation, the origin of temperature variation in attractions and repulsions of cold and heat, explanation of climates in different latitudes and altitudes, chronometry—all this and more constituting the celestial science of his time. His intentions, however, were confronted with an unexpected cultural barrier. If he attacks the Indians for their low level of understanding, they must have felt the same way about his intelligence when confronted with questions they considered ingenuous in their lack of knowledge. If Sahagun had understood something about the clash of ideas, perhaps his book would be one of the best sources on the cosmic vision of the Nahuas, discussing the upper to lower floors, the course of the stars through them, the supporting trees—information that is seldom available from other sources. (1974, p. 135)

We can now understand why Sahagún makes such frightening statements about the deleterious effects of celestial phenomena upon humankind, providing little information about native prediction and observation of the events alluded to.

Sahagún blames much of the avowed inaccuracy of his seventh chapter on the ignorance of his informants and the language problem:

> The reader will have reason to be annoyed at the reading of this seventh book, and all the more so if he understands the language as well as the Spanish, because in Spanish the language gets very base, and the material touched on in this seventh book is very vulgarly treated. This is because the natives themselves related the things treated in this book in a vulgar fashion, the way they understand them, and in a vulgar language, and it was thus translated in Spanish in a vulgar style and with low level of understanding, pretending only to know and to write what they understood on this subject of astrology and natural philosophy, which is very little and very lowly. (Quoted from López Austin, 1974, p. 135)

Because the informants were most knowledgeable and talkative about the interpretation of the significance of astronomical events (the association of worming in animals with meteors or the fear that if a pregnant woman be exposed to a lunar eclipse her children would be turned into rats), Sahagún seems to have been content to collect and present this information.

But Durán gives a different reason for writing his chronicle (*The Book of the Gods and Rites and the Ancient Calendar*):

> Thus we terminate our brief and condensed version of the calendar. I understand, I realize, that I could have enlarged the book and described more things in a detailed way, but my sole intention has been to give advice to my fellow men and to our priests regarding the necessity of destroying the heathen customs which they will encounter constantly, once they have received my warning. My desire is that no heathen way be concealed (hidden,

> because the wound will grow rot and fester, with our feigned ignorance). Paganism must be torn up by the roots from the hearts of these frail people! (1971, p. 470)

Though we must be thankful for the storehouse of Aztec cultural concepts that Sahagún, Durán, and the other chroniclers have preserved for us, it is regrettable that so little is mentioned about how the Aztecs structured their universe and what tools they employed to watch it function. Astronomy, as it appears in the written record, was clearly not intended for the layperson, nor was it presented in the classical Greek tradition to be contemplated by philosophers for the sake of the betterment of their knowledge about the natural world. For the ancient Mesoamericans a vital cause-effect relationship existed between the events of daily life and motion in the heavens. The secret information was never intended to fall upon the ear of an outsider.

THE ETHNOGRAPHIC RECORD AND THE IMPORTANCE OF THE ZENITHAL SUN

Not only has a written historical record survived, but the people, their habits, and their customs have also persisted. Thus, a study of the contemporary ethnographic record pertaining to astronomical observations may be as important to our understanding of ancient astronomy as an examination of the codices and chronicles. This is the astronomy of the people. Here the body of material suggests that many native people still observe the heavens and that solstices, equinoxes, and, especially, solar zenith passages are significant for them. When discussing astronomical alignments in the architecture in Chapter V, we will pay particular attention to these events.

The passage of the sun across the zenith in the tropics and its connection with the 260-day calendar will be discussed in some detail in Chapter IV; we refer to the phenomenon only in an ethnographic context at this point. According to Girard (1948), many zenith solar observatories are still used by the Chorti Maya today, for example, at Tan Sha, Esquipulas, and Chiquimula near the Honduran border and at Nebaj in the Guatemala highlands. The days of zenith passage are marked by observing where the sun rises or sets relative to a prominent feature in the landscape. The Hopi of Arizona employ a similar technique. The nineteenth-century traveler Alexander Stephen (see Parsons, 1936) has supplied us with a map of the horizon showing the important sun positions marked by images of the solar disk (Fig. 13). Among the Chorti, the rise-set directions of the sun on the days of zenith passage are actually regarded as east and west, replacing two of the conventional cardinal points, which lie several degrees to the south.

In southern Mesoamerica, these zenith passages serve a practical purpose. The first one announces the rains at the end of April telling that it is time to clear the fields for a planting, and the second, about August 12 or 13 in Guatemala, also signals rain accompanied by wind. These events are attended by elaborate ritual. In the village of Chi-

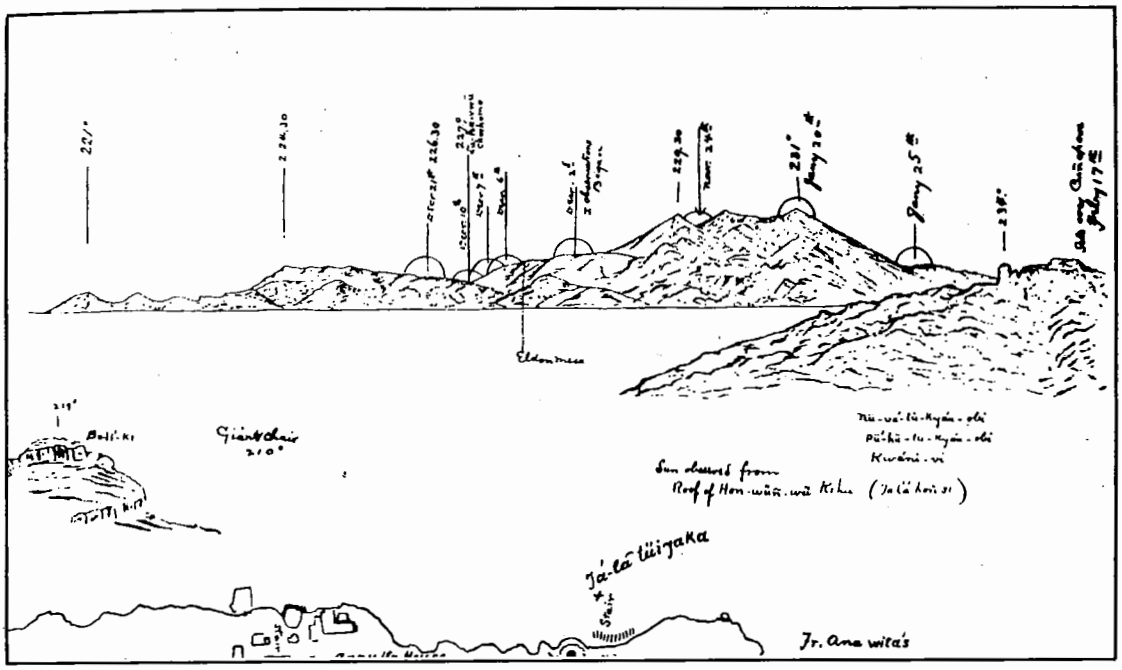


FIG. 13. Hopi observations of the sun at the horizon. The technique of using prominent features of the landscape to delineate a celestial solar calendar was common in ancient America and in some places survives to the present. (Parsons, 1936, 2:map 4; reprinted courtesy of AMS Press, New York)

quimula a parade proceeds from the house of the Virgin to the house of Santiago. The zenith passage dates are announced by the relative position of Orion's Belt, the Pleiades, and the Southern Cross in the night sky. In the evening twilight on the day of the first solar zenith passage in modern Guatemala, the Pleiades can be seen heliacally setting, while the Southern Cross begins to rise low in the southeast. Orion's Belt disappears in the west about two hours later. At sunset on August 12, the Southern Cross undergoes heliacal setting while at sunrise on that date the Pleiades can be found transiting the zenith (Girard, 1948).

Nuttall, in a number of early twentieth-century works (1901, 1906, 1928), refers to the widespread practice of the observation of two zenith passage dates in the calendar. She suggests that the appropriate times were marked by priests watching the noontime shadow of a gnomon, or vertical stick, planted in the ground. At the shadowless moment (high noon on the zenith passage day), the solar deity, symbolized by the Diving God so prominent on the sculptured friezes of many Mesoamerican buildings, would descend to earth portending the torrential rains that were sure to follow. Sometimes these gnomons took the form of stelae, thrones, altars, or even towers.

Believing it to be an integral part of the true Mexican heritage, Nuttall attempted to resurrect the old native practice of marking the zenith passage. In an unusual paper written in 1928, she proposed that all the elementary schools of Mexico should enact the ancient ritual on

the appropriate days. Accompanying a table listing zenith passage dates in the larger villages were these special instructions to the teachers:

I. Read this pamphlet before carrying out the ceremony, emphasizing to the students that the symbolism of the act is the gratitude of the earth to the sun, to whom she offers her flowers, fruits and seeds in an action of thanksgiving for having produced them; and also that the sun's zenith passage is an omen of copious rains which will fertilize the earth.
II. Tell the children to attend dressed in white and with a crown of flowers on their heads.
III. Instruct the children to bring baskets with flowers.
IV. Place a post in a vertical position which must be perfectly confirmed as such.
V. On the 17th of May, 15 minutes before 12:33 in Mexico City (or if the ceremony is to be carried out in some towns of different states, the teachers should see the accompanying list at the end of the pamphlet) bring the children to the place in which the post is located and initiate some dances that the teachers of physical education will have taught them previously.
VI. At the solemn moment the children must throw the flowers that they carry in the baskets and sing songs referring to that act.
VII. If it is possible, at the apex of the post place a bunch of ribbons which will be distributed among the children who, while executing the dance will wrap them around (the pole) until they can no longer do so; then they will undo the ribbons until they are again placed in their original state. This dance, called the Dance of the Ribbons, was executed by the native indians in such a way and can still be seen on religious days celebrated in San Juan Teotihuacan.
VIII. It is recommended that the teachers use this occasion as a guide of great interest in order to carry out some studies of historic, geographic or cosmographic character related to the act.
IX. Teachers are begged to read this pamphlet with the greatest of care and, during the ceremony, to develop according to their judgment those ideas which seem to them will make the solemn occasion its greatest success. (Pp. 3–4)

Evidently, rituals connected with the solar zenith passages enjoyed widespread use—a decree issued by King Philip II of Spain in 1577 states that in order to facilitate good government in the Indies the authorities of every city and town must give exact reports of their latitude and the dates of the sun's zenith passage. Knowing these dates, the Spanish civil and religious authorities would be able to foresee the occurrence of any demonstration linked to the ancient solar cult.

Appearing in the appendix to J. L. Stephens' *Incidents of Travel in Yucatan* (1843) is a document on the ancient chronology of Yucatán by

Don Juan Pío Pérez, a political chief of Yucatán at the time of Stephens' visit. The vague year and the 260-day cycle, both basic calendar units in ancient Mesoamerica, are among the recognizable elements derived from preconquest days. On the origin of the calendar, Don Juan refers specifically to solar zenith passage:

> To this day the Indians call this year Jaab or Haab, and, while heathens, they commenced it on the 16th of July. It is worthy of notice that their progenitors, having sought to make it begin from the precise day on which the sun returns to the zenith of this peninsula on his way to the southern regions, but being destitute of instruments for their astronomical observations, and guided only by the naked eye, erred only forty-eight hours in advance. That small difference proves that they endeavored to determine with the utmost attainable correctness, the day on which the luminary passed the most culminating point of our sphere, and that they were not ignorant of the use of the gnomon in the most tempestuous days of the rainy season. (1:280)

One need not employ the shadow cast by a gnomon to observe the zenith passage. At Xochicalco, an archaeological site in Morelos state, Mexico, we find a number of subterranean galleries partially hollowed out by human hands. In two of them, vertical shafts extend from the cave to the surface of the ground above. An observer situated beneath one of these openings 12 meters below ground level can see a small circular patch of blue sky overhead. On the occasions when the sun passes the overhead point, it throws a powerful ray of light into the darkened environment. Though these shafts have been called chimneys or ventilators by some investigators, they may have served as zenith solar observatories. A similar example of a zenith sight tube, in this case totally man-made, occurs in Building P, one of the principal edifices fronting the east side of the open plaza at Monte Albán, Oaxaca, Mexico (see Fig. 85). The placement of this building turns out to be astronomically related to other buildings at the site, as we also shall see in Chapter V.

The Ixil people of remote northwest Guatemala were still using a 260-day calendar in the 1940's when ethnologist J. S. Lincoln (1942) visited there. One shaman kept the count of 13 numbers while another specialized in the 20 day names; among these days the natives tallied Imux (Imix), I'q (Ik), and Akbal in order just as their ancestors had done before the conquest. The immutable 260-day cycle[2] was correlated with the 365-day year, and even year bearers (day names assigned to the start of the year) were designated along with attendant ceremonies. This remarkable twentieth-century survival is testimony to the tenacious conservatism of the Maya people.

A modern ethnographic record of the old Maya solar year (Haab) was recently discovered in Milpoleta, a remote Chamula Indian village in the Mexican state of Chiapas, where a calendar board (Fig. 14) made from an old door panel was found by anthropologist Gary Gossen (1974*b*). It had been inscribed by a local shaman with a series of charcoal marks corresponding to the days of the vague year. The tally

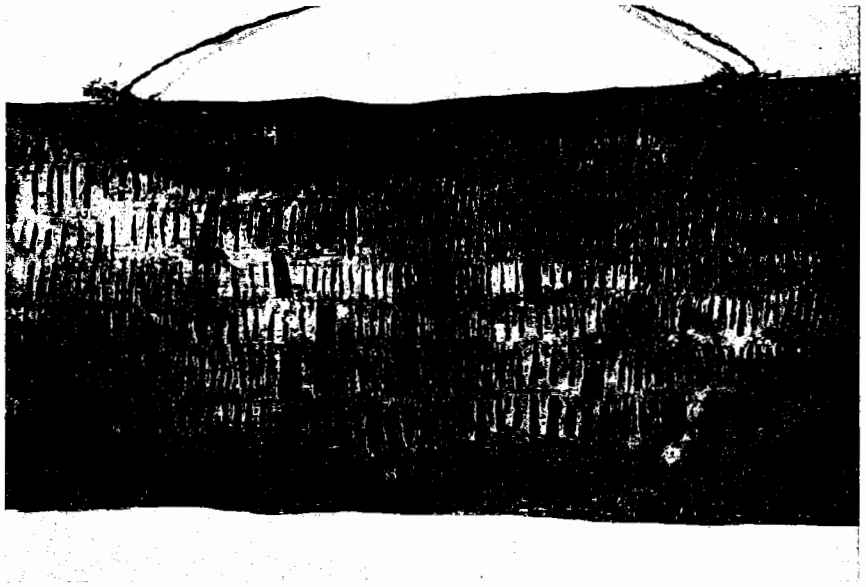


FIG. 14. The calendar board of Chamula. Every twentieth day records a heavy mark to stress completeness of a cycle, which, as we shall see in Chapter IV, was an ancient Maya temporal concern. (Marshack, 1974, p. 256; courtesy of Gerald Duckworth & Co. Ltd.)

marks can be read from left to right beginning at the top. Note that the twentieth mark in each series is heavier than the others. Altogether eighteen series of twenty marks and a single grouping of five marks fill the board—365 days in all. The unlucky 5-day month called C'ayk'in (instead of Uayeb as it was named by the Maya) appears at the middle of the second line for the particular vague year recorded. When Alexander Marshack (1974) of the Peabody Museum studied the board using infrared photography, he found that it had been erased and reused for over a century by the shaman's ancestors.

Further studies of the Chamula board and its users have revealed that these people, like their predecessors, are very interested in timekeeping. The sun appears to be the principal deity and the old solar calendar still functions for the purpose of regulating agricultural activity. It is also used to determine dates of civic and social significance as well as religious festivals.

Ethnologists J. A. Remington (1977) and G. Urton (1978*a*) are among the new breed of interdisciplinary scholars with a sound knowledge of positional astronomy. They have devoted considerable time to the study of current astronomical practices among Native American people. Residing in the highlands of Guatemala, Remington interviewed Quiché and Cakchiquel informants about their cosmological and astronomical beliefs. As the historical record predicted, she found a strong bond between the calendar and divination. The connection was particularly significant for the 260-day cycle, which is still utilized. Among the astronomical phenomena feared most were the prophetic eclipses. These seem to have been regarded almost exactly as Sahagún relates in Book 7 of the Florentine Codex. Venus is the most

important planet and certain constellations and stars (the Pleiades, the Hyades in Taurus, Castor and Pollux in Gemini, Regulus, Scorpio) are regarded with special importance because of the times they undergo heliacal rise or set.

On matters of astrology, time, calendar, and asterisms, the informants gave their interrogator few surprises, but when questioned, the Cakchiquel informants revealed the use of a curious non-Western orientation scheme. They say that the sun and the moon always follow separate paths and that each path changes with the season. The sun rises to the north when the nights are short (rainy season). Here there is some confusion since sketches accompanying their description imply that the sun always rises in the southeast but more to the north in the rainy season (March 22–September 22) than in the dry season (September 22–March 22). Three classes of stellar paths are recognized: (*a*) short arcs concentric about the Pole Star which describe the motion of the circumpolar stars (Ursa Major = "the car with a tail": belongs to this category); (*b*) short arcs to the south, including the Southern Cross; and (*c*) star paths which pass overhead—they make half circles on the sky and are often crossed by the course of the sun and moon. Orion is a member of this latter group.

In his orientation scheme, the Cakchiquel shaman clearly seems to be distinguishing among the celestial equator, the ecliptic, and the lunar orbit. He utilizes the celestial paths not only to keep the time of year but also to mark the time of day and night. When Remington queried an informant about where a star visible in the sky earlier in the year could be found *now*, the respondent replied by pointing downward at a 30° angle under the horizon to the east. He then pointed upward to where it would have been located at sunset. The response was corroborated by similar replies given in separate interviews by other medicine men. But as the ethnographer might fear, even the native population of the remote Guatemala highlands cannot escape Westernization. One day while interviewing a Quiché priest, Remington asked about a UFO sighting which had been reported there a few years ago. The shaman casually stated that it was probably an experimental aircraft of the Russians or the Americans. When the anthropologist suggested that the supposed technology seemed more advanced than that, the shaman, seeming indignant at the questioner's lack of faith in technology, proposed that any civilization able to land a man on the moon could surely develop such an advanced aircraft.

Urton's studies have concentrated on the astronomical habits and customs of the people of the remote Andean villages near Cuzco, the ancient Inca capital. He finds that in many cases they connect the orientation and arrangement of their villages directly with events in the heavens, particularly those near the horizon. They seem to be especially aware of the positions at which the sun rises and sets on the days it transits the zenith and the nadir. The sensitivity to horizon bearings may be a remnant of concepts employed in the design of the lineations on the Nazca Desert or the *ceque* system of Cuzco. Many of the modern Andean constellation patterns, no doubt derived from ancient ancestry, make use of dark areas of the southern Milky Way to form unique black constellations possessing animal forms (see Fig. 15).

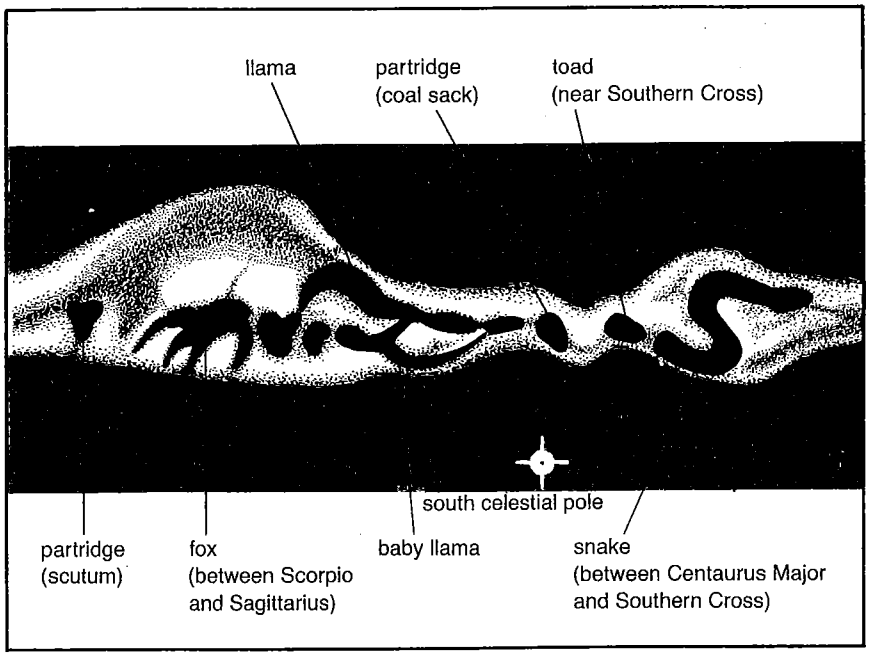


FIG. 15. Black constellations. (Diagram by P. Dunham; I am endebted to Gary Urton, 1979, for permission to adapt this figure)

These descriptive examples from cultural anthropology past and present reveal that we are separated from the ancient American mind by many centuries. We find ourselves further disadvantaged by the availability of but a small portion of the historical legacy which we view only after it has been filtered through Spanish eyes. Our Western cultural chauvanism, so difficult to suppress, often makes the picture even more hazy. In spite of these handicaps, we have seen that a rich historical and ethnographic base relating to ancient Mesoamerican astronomy awaits our considered interpretation. After acquiring the basic astronomical tools, it shall be our goal in the remaining chapters to examine the two most concrete cultural components to generate astronomical output in ancient America: the written calendars and the landscape and its architecture. The concepts gleaned from studies in each of these fields must be integrated with the work of the ethnohistorian and anthropologist who continue to provide us with the kind of knowledge reviewed in this chapter. Only then can we hope to learn the truth about the breadth and depth of ancient New World astronomy.

ADDITIONAL READINGS

The following general references on the civilizations of ancient Mesoamerica provide excellent background for the study of Mesoamerican archaeoastronomy:

Coe, M. D. 1962. *Mexico*. New York: Praeger.
———. 1966. *The Maya*. New York: Praeger.
Morley, S. G., and G. Brainerd. 1946. *The ancient Maya*. Stanford, Cal.: Stanford University Press.
Peterson, F. 1959. *Ancient Mexico: An introduction to the prehispanic cultures*. New York: Capricorn.
Sanders, W., and B. Price. 1968. *Mesoamerica: The evolution of a civilization*. New York: Random House.

Exhibit 5

Page 149

Page 150

Page 151

SAO/NASA Astrophysics Data System (ADS)

Title: Book Review: When the Stars Came Down to Earth: Cosmology of the Skidi Pawnee Indians of North America, by Von Del Chamberlain
Authors: Hadingham, E.
Journal: Journal for the History of Astronomy, Archaeoastronomy Supplement, Vol. 15, p.S149
Bibliographic Code: 1984JHAS...15R.149H

Complete bibliographic record | Other article options | Print this article

Previous article page | Print this page | Next article page

Archaeoastronomy, no. 7 (*JHA*, xv (1984))

BOOK REVIEW

Crystals in the Sky: An Intellectual Odyssey Involving Chumash Astronomy, Cosmology and Rock Art. Travis Hudson and Ernest Underhay (Ballena Press Anthropological Papers no. 10; Ballena Press, Socorro, New Mexico, 1978). Pp. 163. $8·95.

When Stars Came Down to Earth: Cosmology of the Skidi Pawnee Indians of North America. Von Del Chamberlain (Ballena Press Anthropological Papers no. 26, Ballena Press/Center for Archaeoastronomy, Los Altos, California, and College Park, Maryland, 1983). Pp. 270. $17·95.

Crystals in the sky and *When stars came down to Earth* are remarkable products of the recent wave of interest in native American astronomy. The scope of both studies extends far beyond the traditional targets of archaeoastronomical research, the investigation of aligned observing structures. The primary aim of the authors is to reconstruct the distinctive outlook or 'cosmic vision' of the skywatchers, and to understand the social purposes that their knowledge served. The study of ancient astronomy here yields striking insights into the values and beliefs of two highly developed Native American societies.

In *Crystals in the sky*, anthropologist Travis Hudson and astronomer Ernest Underhay of the Santa Barbara Museum of Natural History examine the Chumash, one of 300 or more indigenous groups or 'tribelets' of California. Before the arrival of Franciscan missionaries, as many as 10,000 Chumas inhabited the fringes of the Santa Barbara Channel, one of the most dense centres of population anywhere in the New World. Like the Skidi Pawnee who are the subject of Smithsonian astronomer Von Del Chamberlain's book, the Chumash were decimated by infectious diseases introduced by Europeans. Today only about twenty families occupy the tribe's small reservation near Santa Ynez, while several thousand other Chumash of mixed descent live elsewhere in Southern California. Best known for their vivid multicoloured rock paintings executed on the surfaces of remote caves and overhangs, the Chumash enjoyed a sophisticated culture without ever raising corn or other crops.

The Skidi Pawnee were also hunter-gatherers, but only for part of the year. Before their removal to Oklahoma towards the end of the last century, they engaged in nomadic seasonal buffalo hunts. At other times they grew corn and occupied substantial earthen and timber lodges grouped in villages along the Loup and Platte rivers in east-central Nebraska. Both the Skidi Pawnee and the Chumash possessed a complex ranked social order, with full-time priests and chiefs, who based much of their influence on the interpretation of astronomical phenomena. In California, an elaborate structure of provincial as well as local government existed, administered by an *élite* religious cult in which astronomer-priests played a prominent rôle.

These two societies are illuminated by unusually rich sources of ethnographic information, compiled by Smithsonian anthropologists in the early years of this century. For the Chumash, Hudson and Underhay draw on the work of the brilliant, eccentric linguist John Peabody Harrington, who devoted much of his

life from 1906 onwards to recording the reminiscences of elderly Chumash around Santa Barbara in extraordinary detail. Scholars have only recently realized the potential of the Harrington archive, as they continue to decipher some 800,000 pages of his handwritten notes. Another monumental Smithsonian resource, the information on the Pawnee collected by James Rolfe Murie, was finally published in 1981 after lying dormant for sixty years. As well as recording the recollections of Pawnee elders on a primitive phonograph, Murie also drew on his own cultural experience (his mother was a Skidi Pawnee). In 1915 he even conducted the celebrated Morning Star ceremony himself, though without the benefit of the traditional sacrifice of a female captive.

These sources provide abundant evidence that both the Pawnee and the Chumash were skilful observers of the night sky. They developed myths to explain the conjunctions and relative motions of the major planets, as well as the occurrence of eclipses, meteors and fireballs. The Pawnee identified some two dozen individual stars as well as about fifteen constellations, and commemorated this lore in a unique 'star chart', painted on a buckskin hide and preserved in the Field Museum of Chicago. Chamberlain's detailed study of the chart disposes of earlier erroneous identifications of the major stars and of previous suggestions that it accurately depicts their relative magnitudes and positions in the sky. Armed with Murie and other ethnographic material, Chamberlain convincingly argues that the map was not a scientific aid but a symbolic document which displayed the star groups of greatest religious and ceremonial concern to the Skidi Pawnee. His discussion perfectly illustrates the dangers of interpreting an archaeoastronomical artifact as if it was the product of a western mind.

Both studies reveal that the major drive of the astronomer-priests was not scientific understanding of the sky, but the prediction and justification of events on Earth. Celestial objects were cast in the rôle of powerful, competitive sky beings. Their struggles in the heavens obviously reflected the conflicts and insecurities that the Priests themselves experienced. The behaviour of the sky beings was believed to affect the outcome of human affairs and, indeed, the balance of the entire universe. These deities were frequently indifferent to man; for example, in both societies Mars was identified as an aloof and sometimes threatening being, invested with awesome supernatural power. (As the giant condor, Holhol, Mars and its retrograde motion probably inspired the Chumash belief that the bird-deity could travel quickly across the Upper World and seek out missing persons or objects.)

The reader of these books encounters an ambivalent quality in the outlook of the priests that is typical of Native American skywatchers. Dualistic notions figured prominently in their cosmologies. Pawnee star gods sat in council at the west, but their sources of creative power flowed from the east. The Chumash dramatized the twin aspects of Venus as separate beings with opposed benevolent and malevolent characteristics, though the situation was unstable and sometimes their qualities were reversed. Such details vividly convey the difference between a Native American outlook and our own habits of systematically classifying astronomical events.

At the same time, both *Crystals in the sky* and *When stars came down to Earth*

draw attention to unique aspects of the skywatching traditions in their respective cultures, cutting across some of the generalizations frequently made in archaeoastronomy. The rhythm of agricultural activity, so often cited as the incentive for the development of accurate observations, was obviously not a factor in the Chumash case, even though they apparently practised long-distance observations of the solstices similar to those proposed in megalithic astronomy. In contrast, the Skidi Pawnee had comparatively little concern for the Sun and Moon, or their motions along the horizon, because of their unusually strong interest in star lore.

Compared to the unexpected insights thrown open by the ethnographic sources, the archaeoastronomical field investigations are perhaps the least satisfying aspects of both books. Since *Crystals in the sky* appeared in 1978, at least fifteen possible solstice observatories have been identified in central and southern California (see T. Hudson *et al.* in *Journal of California and Great Basin anthropology*, i (1979), 39). So far the investigations have consisted solely of on-the-spot inspections at the solstices, rather than accurate transit measurements. Furthermore, some of the field evidence seems tenuous; even at Condor Cave, the solstice site described in detail in *Crystals*, the artificial origin of a "man-made observing hole" is open to doubt, since several other perforations are apparently in the process of being eroded into the sandstone wall of the cave. However, the solar associations of motifs painted at Condor Cave do reinforce the observatory hypothesis of Hudson and Underhay. Perhaps further efforts in the field will soon confirm the reality of this and other proposed Chumash Sun shrines.

Von Del Chamberlain reconstructs the geometry of a 'typical' Skidi Pawnee earth lodge to investigate the observations that would be possible through the east-facing entrance and through the smokehole overhead. He makes the interesting point that the layout of the lodge must have instilled an awareness of cosmology in Pawnee children at an early age. However, his reconstruction of an 'ideal' lodge adds little to the ethnographic data which he so ably presents elsewhere in the book.

In general, the authors of both books succeed in balancing due scholarly caution with a lively writing style that insures their discussion is accessible to a general reader. A further attraction of Chamberlain's book is his imaginative use of his own night-sky photographs, combined with sketches by contemporary Pawnee artists. In his conclusion, Chamberlain hopes that others will be inspired to examine ethnoastronomical materials from other cultures throughout the world. If future scholars meet the standards set by these two books, then the interest of archaeoastronomy will lie not merely in incidental information about ruined structures, for it will make a substantial contribution to understanding the experience of vanished peoples.

Cambridge, Mass. EVAN HADINGHAM

Exhibit 6

1998JHAS...29...89M

Page 89

Page 90

SAO/NASA Astrophysics Data System (ADS)

Title: Book Review: Skywatchers, Shamans &Kings: Astronomy and the Archaeology of Power
Authors: McCluskey, S.
Journal: Journal for the History of Astronomy, Archaeoastronomy Supplement, Vol. 29, p.S89
Bibliographic Code: 1998JHAS...29...89M

Complete bibliographic record | Other article options | Print this article

Previous article page | Print this page | Next article page

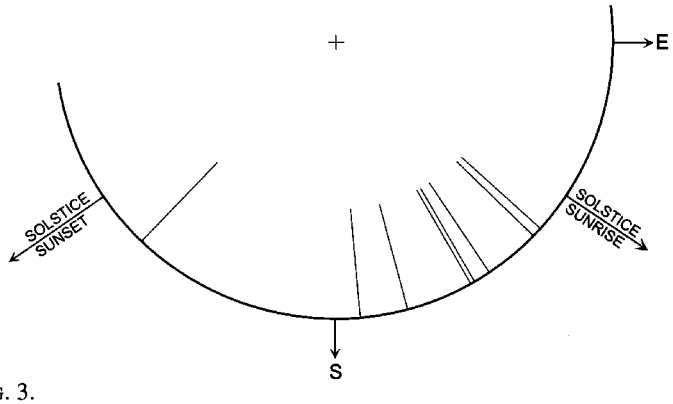


FIG. 3.

BOOK REVIEW

COSMOVISIONS AND POWER

Skywatchers, Shamans & Kings: Astronomy and the Archaeology of Power. E. C. Krupp (Wiley Popular Science, John Wiley & Sons, New York, 1997). Pp. xiv + 364. $27.95.

This book does not discuss ancient astronomical alignments or indigenous astronomical practices; Krupp has told us about these in his earlier books. This time the myths and rituals that he examines embody little astronomy, whether in the narrow sense of a predictive mathematical astronomy demanded by Neugebauer and Aaboe, or in the broader senses favoured in the archaeoastronomical community. Now Krupp has a bolder agenda only hinted at in his earlier works, to present what he sees as universal themes that characterize the relationships between visions of the cosmos and the manifold personal and institutional manifestations of power that these cosmovisions sustain.

Thus Krupp is not concerned here with how people use celestial myths and rituals to make their observations of the heavens intelligible; he wishes to tell us how they used the heavens as symbols to make their societies intelligible. Running through the book is Krupp's distinctive voice. In a masterful presentation he paints evocative pictures displaying the interplay of cosmic and political power in many different cultures.

Two crucial terms, 'shamanism' and 'power', lie at the core of his discussion. Yet both terms remain equivocal. Krupp himself recognizes the ambiguities of 'power'. Sometimes it is political power, sometimes spiritual, sometimes power flowing from knowledge of nature. The latter power is sometimes exercised as control over the entities that govern the natural world, sometimes by appeals to the cooperation of the gods. Were this review to catalogue fully the many different senses in which 'power' is used, it would fill many pages.

'Shamanism' has a similar ambiguity, sometimes referring narrowly to the ecstatic

spiritual experience of the shaman through which he gains spiritual power, sometimes to any experience of the sacred, and sometimes to the exploitation of religious ideas for political power. Although Krupp is careful to avoid the notion that shamans are cynical manipulators of an ignorant populace, his analytical framework tells us so little about shamanism as a religious experience that it comes close to being reduced to a mere way to obtain social, political, and economic power (p. 157).

By relating astronomy to the unifying theme of power, Krupp seeks to place these astronomies in a broader social framework, a framework that he finds repeating itself in many cultures. And yet the framework that treats power as the central factor in the study of the heavens is as much an outsider's analytical construct as is the almost universally rejected perception which would see all native skywatchers as the direct ancestors of modern astronomers. The manifold relationships between astronomy and power must also be discussed with caution.

Krupp seeks to define his theme of astronomy and power by presenting many diverse understandings of the cosmos. He draws examples from widely disparate cultures, seeking to demonstrate the universality of this theme. And here lies the problem. History and anthropology are grounded in the specifics of times and places, of individuals and cultures; I become suspicious when I read of the continual re-emergence of universal structures of thought (pp. 40, 174).

And yet, certain themes do re-emerge in the most widely separated places. Association of colours with directions that frame the cosmos and thereby define the cosmic order are noted in ancient China and contemporary Native America. It is not certain whether this is to be explained by the emergence of archaic structures of thought, by the diffusion of a fundamental cosmic framework to the New World at the time of the emigration of palaeo-Indians from Asia, or by a highly unlikely coincidence.

As is almost inevitable in such a wide-ranging study, there are occasional lapses in the author's grasp of his rich sources. Ironically, in discussing the role of the mother goddesses in ancient Anatolia, he asserts that the modern Turkish name for the region, Anadolu, means the "land of mothers", yet overlooks the original astronomical significance of the name. Perhaps the Turkish name later took on the maternal meaning, but in origin the name is clearly Greek and clearly astronomical. Like the Latin *oriens* and the English 'east', the Greek ἀνατολή refers to the rising of the Sun or another celestial body, and hence to the quarter of sunrise, the East.

I have mixed feelings after reading this book. The rich details that Krupp presents give the reader valuable insights into the manifold forms that knowledge of the heavens takes in various cultures. Yet I am not convinced of the book's overall interpretive structure. In the past decades we have seen many detailed examinations of the roles of astronomies in specific cultures; much investigation remains to be done in this area. Power, in many of its aspects, will most likely emerge from these studies as one important factor. It remains to be seen whether they will show it to play the dominant roles proposed in this important and wide-ranging survey.

West Virginia University STEPHEN MCCLUSKEY

Exhibit 7

"It requires rare skill to impart so much information in so vivid a manner… Krupp's knowledge is unrivaled." —*Modern Astronomer*

ASTRONOMY AND THE ARCHAEOLOGY OF POWER

SKYWATCHERS, SHAMANS & KINGS

E. C. KRUPP

This book is printed on acid-free paper. ♾

Published by John Wiley & Sons, Inc.
Published simultaneously in Canada.

Library of Congress Cataloging-in-Publication Data
Krupp, E. C. (Edwin C.)
Skywatchers, shamans, and kings : astronomy and the archaeology of power / E.C. Krupp.
p. cm. — (Wiley popular science series)
Includes bibliographical references and index.
ISBN 0-471-04863-1 (cloth : alk. paper)
ISBN 0-471-32975-4 (paper : alk. paper)
1. Astronomy, Ancient. 2. Astronomy. Prehistoric. I. Title.
II. Series: Wiley popular science.
QB16.K83 1996
520'.93—dc20 96-12997

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

Acknowledgments

Certainly some power was at work in bringing this book to the shelves of stores and libraries and to the hands of its readers. An honest acknowledgment of the real source of that power must inevitably track it past the author and back to those who influenced and sustained the effort. What power any of us may possess inevitably comes from somewhere else—genetics, friendship, education, and experience. Understandably, then, I acknowledge the support and assistance of family, friends, teachers, and colleagues.

Celestial power is only understood through the symbols that assert its presence and influence, and for that reason I have found it useful—actually, essential—to seek audiences with the sky in the cultural corridors of its power on earth. This means traveling to monuments and museums where relics of celestial power may still be seen. I have, by this time, seen more than 1,300 ancient and prehistoric sites in person. Not all of them involve the sky or reveal our ancestors' interaction with it, but enough of them possess celestial connotations to eradicate any doubt about the influence that zone of our environment has had upon us.

Getting to such places—Inner Mongolia, the indigenous lands of Chile's Mapuche Indians, off-trail ruins in Mesoamerica, or the landmine-encircled temples of Cambodia—isn't always easy, and I have had lots of help. Yvette Cloutier, who owns and operates ETA/Piuma Travel has, for many years now, taken my impossible itineraries seriously and gotten me where I need to go. Likewise, Mary Dell Lucas, the risk-taking tour-organizing proprietor of Far Horizons, has also found the untraveled paths through the jungles and the mountains and the deserts on behalf of my curiosity. Many of these trips have been developed under the auspices of U.C.L.A. Extension, and in particular, Dr. Eve Haberfield and Karen Prinzmetal have encouraged and defended the unlikely destinations these expeditions have included. These field study tours provide opportunities for research. They are subsidized by an audience of

adventurous travelers who accept adversity as a reasonable price to pay for uncommon experience and firsthand knowledge. We offered the first of these programs in 1976, and all of those who have enrolled and traveled with me over the years have my gratitude, sympathy, and respect.

Ted Pedas has continued to invite me to lecture for passengers on the unconventional cruise programs he contrives for Sun Line and Orient Lines. Without his willingness to include me in the successful rendezvous with the October 24, 1995, total solar eclipse in the South China Sea, I would not have been able to walk the grounds of Angkor Wat in time for this book, and I would have missed the meaning and importance of the cosmic metaphors of the Khmer royal temples.

I am also indebted to many professionals who, sharing this interest in ancient astronomy, have also helped me hit the road. Dr. Rolf Sinclair, Dr. Ray White, and Dr. George Coyne enhanced my understanding of ancient Rome through their invitation to participate in "The Inspiration of Astronomical Phenomena," a conference hosted by the Vatican Observatory in summer, 1994. A little earlier, Dr. Melvin L. Fowler, with assistance from the Cahokia Mounds Museum Society, got me back to west-central Illinois for the May 10, 1994, annular eclipse of the sun and for an update on recent research through participation in a special symposium, "The Ancient Skies and Sky Watchers of Cahokia: Woodhenges, Eclipses, and Cahokian Cosmology." In spring, 1992, Stanislaw Iwaniszewski, Arnold Lebeuf, and Mariusz Ziolkowski welcomed me to Poland as part of the international symposium, "Time and Astronomy at the Meeting of Two Worlds," and so kept me in touch with developments that might have otherwise eluded me.

Von Del Chamberlain's books and research papers are rich sources of information on American Indian sky lore, and his presentations at conferences are consistently informative and entertaining. The greatest pleasure, however, is hiking and riding horses with Von Del to the hard-to-get-to sites of the American Southwest. I have benefited from his knowledge of and enthusiasm for the land and its sky on three such campaigns and look forward to more.

For almost two decades now, I have been empowered by the advice and company of experts on ancient skywatching who also double as friends. Professor Anthony F. Aveni continues to drive the field forward through his commitment to genuine interdisciplinary study. John B. Carlson's recent insights on Mesoamerican astronomy reflect only a fraction of his varied interests as Director of the Center for Archaeoastronomy. David Dearborn came back, as near as anyone I know, from the dead to inject life and enthusiasm into the research community. He and the late LeRoy Doggett, beyond their own research, invested editorial energy in the quarterly news bulletin, issued at solstices and equinoxes by the Center for Archaeoastronomy. Alexander Marshack, well-known for his work on upper paleolithic symbolic systems, transformed archaeological perceptions of our Ice Age ancestors. He has readily encouraged my attempts to synthesize what is really at work in the cultural expression of celestial themes from the Stone Age to the New Age. With insight and originality,

Arlene Benson and John Rafter keep squeezing the astronomy out of ethnography and rock art in California and adjacent territory.

An unexpected invitation from Eleanor Cross Harrison and Dr. Stephen D. Siemens to contribute a paper to an American Anthropological Association session on "Configurational Approaches to Culture through Analogy" forced me to come to grips with an alien discipline of knowledge. That exercise in turn allowed me to appreciate an entirely different aspect of the sky's imaginative impact.

Dr. Richard E. W. Adams, Dr. Peter H. Keller, Nancy Cattell, and the irrepressible Gary Wirth all generously supplied photographs of places that even I regard as particularly remote ends of the road.

Once again, I am a privileged beneficiary of the graphic resources of Griffith Observatory in Los Angeles. I am beholden to Joseph Bieniasz for illustrations prepared for research papers, for Observatory programming, and for Observatory publications—especially the *Griffith Observer.* Their inclusion in this book enhances and clarifies otherwise arcane material. In addition, many of the photographs processed for the Observatory's extensive picture file were also available to me. The high technical standards of Anthony Cook, Daniel Marlos, and Lisa Auerbach ensure photographic professionalism at Griffith Observatory.

Cultivating an undergraduate's appreciation for the full spectrum of human endeavor, Pomona College, in Claremont, California, applies the power of its professors to humanize the sciences and put rigor in the humanities. They make a permanent investment in each generation of students and ask only for the interest, to be paid in an examined life. The principal on the debt I owe to all of my teachers at Pomona remains outstanding—even after 30 years, but I have tried to honor them with a high interest rate and continuous reinvestment. The late Dr. Robert J. Chambers, my astronomy professor and advisor, generously continued to extend my credit long past Pomona and graduate school and throughout the years of our continuing friendship.

At U.C.L.A., the late Dr. George O. Abell, like Bob Chambers before him, put the power of opportunity at my disposal and helped me negotiate the powerful currents of graduate school in astronomy. He, too, remained a good friend after the period of formal schooling ended and continued to endorse the curious niches my career has occupied.

More than 20 years ago, Dr. Gibson Reaves, Dr. John Russell, and the late Dr. Seymour Chapin exerted an unanticipated power on me through the informal meetings of the Los Angeles Society for the History of Astronomy. By example, they persuaded me to approach the cultural component of astronomy in a more formal way and helped set the stage for the archaeoastronomical inquiries that would follow.

There must have been times when both my agent Jane Jordan Browne, who owns Multimedia Product Development, Inc., in Chicago, and Emily Loose, my editor at John Wiley & Sons, Inc., wistfully embraced the philosophy of power so succinctly expressed by Choup Lorn, our guide at Angkor—"Trust is good, but control is bet-

ter." Despite their uncertainty about my timetable, the real power that propelled this book into publication resides in Jane's integrity and Emily's patience. Jane always acts as the vigilant guardian of everyone's interest and, playing no favorites, her real client is the finished product. As editor, Emily embraced a variety of unknown risks when she offered a contract, but with professional instinct and steely resolve, she allowed me just enough rope to lasso the beast stampeding through the original proposal and corral it for public view.

Probably the most formative power in each of our lives is exerted by parents. My late father, Edwin F. Krupp, and my mother, Florence A. Krupp, clearly knew how to express their influence, but their goal, of course, was relinquishing power to self-discipline. I prefer to credit them with success and regard this new book as additional evidence. My mother thinks I should give it a rest.

My chronic neglect of family affairs would justify censure by my in-laws, Margaret H. Rector and Dr. Robert W. Rector. Anyone else would be tempted to tap the power of guilt, but they operate with a light touch and have endured without complaint a never ending parade of projects. Commitments that consume evenings, weekends, and national holidays and an inventory of deadlines that brutalizes family priorities still have not jaded them. Hope springs eternal in the generous heart.

My son, Ethan H. Krupp, helped me explore many of the odd corners of the world cornered in this book and always understood my insistence on running on empty to collect one more destination and finish one more book. He has, however, at last had enough sense to evade parental power and get out of town. Establishing his own agendas as he moves through college and toward a career, he now carries the burden of freedom. It's right where it belongs. But I hope we get to travel together again.

The last salute properly belongs to my wife, Robin Rector Krupp, who often demonstrates her power by insisting I have usurped it all. But I am not deceived. She moves and shakes the world in her own time and style. And there must be some deep strength that allows her to reside under the same roof with a husband charmed by his own idiosyncracies. Such mysteries can only be understood through the balance of power. It's a pleasure doing business with her.

It may seem strange to illustrate the relationship between social complexity and astronomy with evidence from California. Most people are unaware of the California Indians. Even those who know something about them recognize that they don't fulfill the American Indian stereotype. They didn't wear bison robes and trailing war bonnets. They didn't build apartment villages like high-rises on the desert mesas of the Southwest. They didn't teach the Pilgrims how to farm the New World just in the nick of time for the first Thanksgiving. There is no Disney animated feature film about a California Indian princess. With the possible exception of the Mississippi Valley, however, California was the most populous region north of Mexico at the time of European contact. For all practical purposes then, the indigenous tradition of California is the mainstream for North America and not an obscure and marginal development.

In the sixteenth century, California's Indian population totaled about 300,000. Roughly 18,000 of them were Chumash, whose territory reached from San Luis Obispo to Malibu. The Chumash occupied the Santa Barbara Channel Islands, the mainland coast, and inland mountains and valleys to the western edge of the San Joaquin, California's great central valley. Essentially a maritime people, the Chumash took advantage of ocean resources, including fish, marine mammals, and shellfish. Wild acorns were the primary component of the Chumash menu, but other wild seeds and plants supplemented their diet. Like almost all of the rest of the California Indians, the Chumash were hunters and gatherers. They did not farm. Some hastily conclude that the absence of agriculture indicates less technical advancement. That may be so as far as cultivating plants is concerned, but the California Indians didn't farm the land because they didn't have to grow food. In California, nature was usually generous, and hunting-and-gathering was an effective strategy for survival. Settled villages, tribelet organization, and high population distinguish these California Indians, however, from small, nomadic hunting groups. It would be more accurate to say that the California Indians systematically harvested the landscape. They did it with the seasonal sophistication of farmers and herders but without the capital investment. In California, no down payment was required, but people there, like everywhere else, watched each month carefully and managed their interaction with the environment to keep food on the table.

The power of a Chumash chief was limited. Although wealthy by village standards, the chief did not control all of the wealth. Responsible for hosting guests, arranging ceremonies, planning intervillage skirmishes, and arbitrating disputes, the chief operated as an officer, not as a ruler, and shared power as a member of an elite group of known as the *'antap.* Craft specialization and a shell money economy contributed to social stratification in Chumash territory. At the top of the social pyramid, the *'antap* collectively managed most of the wealth and power.

Members of the *'antap* identified themselves with powerful aspects of nature, including the sun, the earth, the eagle, the condor, the swordfish, and the dangerous hallucinogenic beverage prepared from the datura plant. Visions induced by the consumption of *datura,* or jimsonweed, provided encounters with divine sources of super-

The triangular skirt around this stick figure painted at Ven-51, a Chumash pictograph site in southern California's Los Padres National Forest, resembles the ceremonial dance costume worn by Rafael Solares. Solares, it is known, was a member of the shamanic elite, and this image probably portrays a Chumash shaman. (photograph E. C. Krupp)

natural power such as the sun. Drug-inspired trances also facilitated the acquisition of a guardian spirit helper, an ally no shaman would want to do without. Chumash shamans used this power to cure disease, to defeat enemies, and to control the weather. They also presided over seasonal community ceremonies, instructed and initiated the youth, kept the calendar, and coordinated most aspects of village life. The shamans were themselves specialists. The *'alchuklash* was the skywatcher. He counted the cycles of the moon, established the times of the solstices, observed the seasonal appearances of stars, participated in the naming of newborn children, and read their destinies in the sky.

in Hohhot (Huhehaote), or "Blue City," the capital of Inner Mongolia, embellished the Wuta si, or Temple of Five Pagodas, with a star map carved in stone relief. The stars' names are inscribed in Mongolian, and nearby, another relief illustrates the traditional world axis of both shamanic and Buddhist tradition. This Mongolian Buddhist temple is no monument to the celestial power that authenticated the empire of Genghis Khan, but it is a demonstration that power in the sky continues to trickle down to sanctify the earth. Wherever God may actually reside, Eternal Blue Heaven always holds court overhead.

THE RISING SUN

Because most modern studies of shamanic activity involve marginal or frontier peoples—usually hunters and gatherers—we are used to thinking of shamanism as primarily the business of less complex societies, people who are perhaps more comfortable with circulating through the land than with settling in one spot. Uranian power and shamanic access to it also belong to the world of the nomadic herders of inner Asia. For that reason, shamans and skywatchers don't necessarily seem out of place in the framework of Mongol social order even after those same wandering horsemen turn into empire builders. Although shamanic knowledge of the sky and shamanic concepts of cosmic order were pervasive and explicit in Mongol applications of imperial power, we might just interpret the ideology of their expansionist state as an exaggerated and inflated variant of the normal behavior of people who are not moored to the land through agriculture. While accepting components of the shaman's cosmography in the ideology of chiefs, in divine kings, and even in an empire crafted by nomadic warriors, we may doubt the likelihood of an imperial agrarian state that recognizes the sources of its power in a cosmos confronted through shamanic techniques. By the middle of the third century B.C., however, rice technology transformed the economy of Japan with intensive agriculture, yet Shinto, the religious basis of Japan's imperial tradition, still adopts the shaman's world perspective and interacts with the spirit realm according to shamanic procedures. It also threads the emperor to the sky with a celestial lineage, for Amaterasu-omikami, the Sun Goddess, is the living divine ancestor of Japanese royalty.

Probably the ancient Chinese first called Japan the "Land of the Rising Sun" in recognition of the obvious—the Japanese islands are east of northern China and the Korean peninsula, across the Sea of Japan. In Chinese, *Jih pen,* or "Japan," is translated "source of the sun." Of course, for the Japanese, the sun rises east of Japan, but they adopted the name themselves late in the sixth century A.D., during the reign of Empress Suiko. Her son, Shotoku-taishi, was the crown prince. Although active in introducing Buddhism to Japan, he still belonged to the family line of the Shinto Sun Goddess. In a letter of introduction for a cultural and diplomatic mission to the Tang dynasty emperor of China, Shotoku identified himself as the "Emperor of the Ris-

in the Bighorn Medicine Wheel, high above the tree line on Medicine Mountain, near Sheridan, Wyoming. Subsequently, he identified alignments with Aldebaran, Rigel, and Sirius between the cairn on the west rim of the wheel and cairns on the north, east, and southeast sides, respectively. A similar set of stellar alignments, along with a summer solstice sunrise line, was also found in southern Saskatchewan's Moose Mountain Medicine Wheel. The age of the Bighorn Medicine Wheel is unclear, and it is possible it is no older than a few centuries. The Moose Mountain Medicine Wheel, on the other hand, is dated to the fifth century B.C. The presence of these and more than 130 other medicine wheels, most on the Great Plains, led Eddy and others to examine the possibility of a connection with surviving Plains Indian ceremonial tradition. A variety of explanations have been offered, and frequently the Bighorn Medicine Wheel, with its summer solstice sunrise dimension and its 28 radial spokes (originally they may have numbered 27), has been interpreted as a symbolic representation of the lodge many of the Plains tribes construct for the Sun Dance, which is held in conjunction with full moon near summer solstice. The Cheyenne know this as the *Oxheheom,* or New Life ceremony, which is concerned with world renewal.

By 1990, Canadian astronomer David Vogt had completed a study of all 135 known medicine wheels and concluded they comprise a disparate set of monuments with no overall pattern that would permit us to reach a comprehensive conclusion. Individually persuasive arrangements such as the Bighorn and Moose Mountain wheels may reflect the astronomical intentions of the builders, but it is impossible for us to know. Nevertheless, Vogt judged that most wheels were intentionally oriented commemorative monuments directed to symbolic or ceremonial use. Calendric observation at functioning observatories just doesn't seem to be part of the scheme.

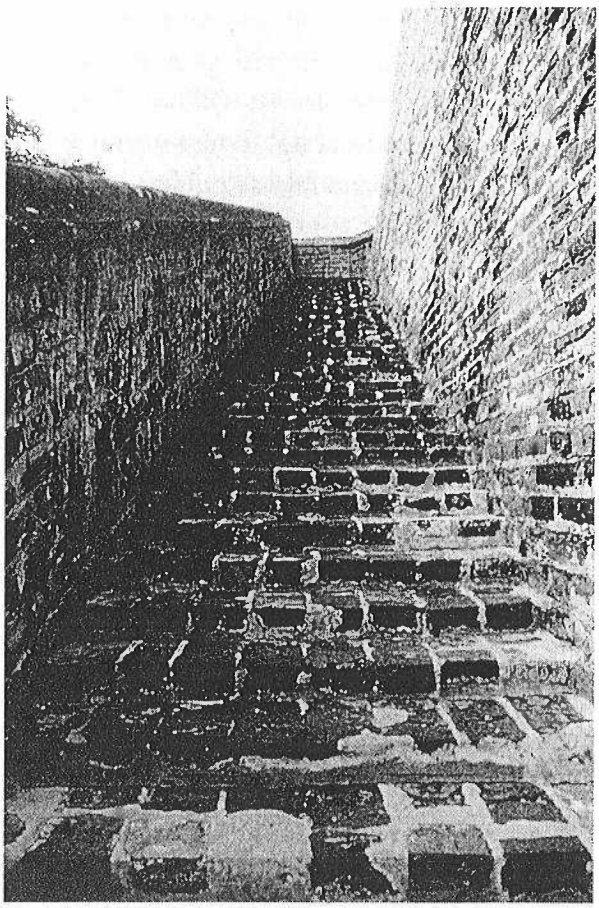
Without taking on the challenge of the entire medicine wheel catalog, Schlesier appropriates the Bighorn and Medicine Mountain wheels into Massaum ceremonialism. They are, he says, what the Tsistsistas/Cheyenne call *oxzemeo*—spirit wheels—made of stone and, as mountaintop monuments, aimed toward the sky. Shamans may have drawn protective celestial spirits to earth through them. As fingerprints of human presence, they may have marked rights to the territory as explicitly as the Massaum ceremony, and Schlesier associates them, through the stellar alignments, with the Massaum and the appearance of the Tsistsistas in these lands. Accordingly, he rejects the summer solstice sunrise line. It belongs instead, he argues, to the Oxheheom ceremony and has nothing to do with the formation of Tsistsistas culture.

Alignments in prehistoric monuments are inevitably circumstantial and usually problematic, and a thoughtful objection to solstitial alignment in the Moose Mountain Medicine Wheel has been raised. Even though the line between its southwest cairn (the backsite for the summer solstice line) and the central cairn (the foresite) is in the right direction, the elevation of the central cairn and the slope of the hilltop prevent a skywatcher from seeing the sun's first light. Instead it first shows up to the right of the central cairn and off the line. If all the celestial lines are symbolic, however, and not observational, this may not mean much. But whether the summer sol-

According to Diodorus Siculus, Chaldaean astronomers observed the stars from the summits of the high temples that towered from their cities. Diodorus traveled widely during the first century B.C. and synthesized his own knowledge and what he read in other authorities in the volumes of history he wrote. He may have correctly identified the old Mesopotamian observatories, but we have no independent evidence to confirm this. From this romantic nineteenth-century illustration from *Astronomical Myths* by John F. Blake, we would also conclude that the Babylonian skywatchers also anticipated the present fashion of large research teams.

ical dreams for the Chaldaean king in the sixth century B.C. The chief astronomer was called "chief of the month," a reflection of his calendrical responsibility. Other court credentials documented in tablets carry the official character of Mesopotamian astronomy to at least as early as the Akkadian period late in the second millennium. It probably relies on even earlier Sumerian precedent.

Remarks in Classical sources tell us the Greeks believed the Egyptians and Babylonians invented astrology. In the *Epinomis,* the Greek philosopher Plato specifically credits Syria, Assyria, and Egypt and confirms it belongs to an old tradition. Manilius, the Roman author of *Astronomica,* an astrological poem written in the age of Augustus, reported that astronomy's origins could be found in the lands of the Euphrates and the Nile, where the study of the stars was sponsored by kings. Macrobius, another Latin writer, also roots astronomy in Egypt in the *Commentary* he composed in the fifth century A.D. on *Scipio's Dream* by Cicero, the famous orator, lawyer, and politician. According to Diodorus Siculus, the Roman historian of the first century B.C., the observational foundation of Mesopotamian astrology was acquired at the top of ziggurats, high, pyramidal temples of brick that rose out of the heart of the city. In Chaldaean Babylon, the observatory was the temple of Marduk, the divine patron of Babylon and the king of the gods. The great tower was 300 feet high, and to the Babylonians, it was known



We may not be certain that the ancient skywatchers of Babylon climbed to the heights of the ziggurat to get a better look at the stars, but the astronomers of old China ascended this stairway on the west side of the Beijing Observatory for access to their bronze instruments and an unobstructed view of the heavenly vault. (photograph Robin Rector Krupp)

tion of Astronomy and Astronomers in Han China," help avoid excesses and abuses by limiting royal power with the belief system. Control over important elements of the belief system is relegated to advisory specialists—politician-astronomer-priests—who are not part of the chain of command. Ostensibly objective and independent witnesses of nature, the astronomers might not be able to manipulate economic and political resources directly, but their information influenced the stability and legitimacy of the sovereign.

As part of the educated elite, the royal skywatchers provided testimony in the court of public opinion. This "public" was not the democratized electorate we embrace today but the uppermost levels of the social pyramid. It included elevated officials, regional rulers, and high-status families. Their favors, fortunes, and failures all depended on the effectiveness and the fortitude of the king. As long as the ruler fulfilled his role in accordance with rhythms of nature and the order of the cosmos, he was "virtuous" and "worthy" for office. When he departed from good judgment and indulged personal whim, celestial gods could put a ruler on probation. If he tolerated improprieties in his subordinates, he could be called on the carpet of heaven. A Chinese imperial proclamation in 178 B.C., quoted by Eberhard, makes the process clear: "If the ruler of men has no spiritual power, if the exercise of government is not bal-

anced, Heaven shows portents in order to warn against bad government." As we already learned from the Amazing Spider-man in Chapter Two, with great power there must come great responsibility. Society cannot endure, and heaven will not abide, bad government indefinitely. In time, the skies become a celestial lighthouse warning of a dangerous approach to the reef of error or a supernal press release publicizing divine admonition for mistakes already made.

ROYAL CONFIDENTIAL

Power to modify the behavior of the king, no matter how well it may be contained, retains the risk of exploitation. A cynical or ambitious member of the astronomical elite—or even an advisor who has only the best interests of the country at heart—may be tempted to distort the celestial record and tilt the direction of decisions. Eberhard's analysis of the portents registered by China's royal interpreters of celestial signs verifies the presence of some fictional data entered into official annals on behalf of a political agenda. These were usually contrived by historians after the fact. We also know that celestial portents played a part in real time in some factional disputes.

Deliberate deception also occurred in Mesopotamia and is documented from the eighth century B.C. An astrological auditor on the payroll of Sennacherib, the Assyrian king, exposed the royal astrologer of Sargon, Sennacherib's father. Operating on the principle that equivocal news is better than bad news, Sargon's astrologer conspired with the other diviners. He persuaded them to conceal any sinister omens from the king, and instead, he lobbied, "If an untoward sign appears, let's tell the king: 'An obscure sign has appeared.' " According to the whistle-blower, "they systematically censored all unfavorable predictions." They seem to have been a crew that already knew the story about the wicked messenger.

The Bible's Book of Isaiah also had some choice commentary (47:13) about the celestial soothsayers. In his judgment of Babylon, Isaiah warns,

> Thou are wearied in the multitude of thy counsels: let now the astrologers, the stargazers, the monthly prognosticators, stand up, and save thee from the things that shall come upon thee.

Doom was on the march, and it had Babylon's name written on it. In Isaiah's mind, God's judgment made astrology obsolete.

The Book of Daniel also offers little solace to the king's skywatchers. Nebuchadnezzar II, the Chaldaean king of Babylon (605–562 B.C.), with measured royal skepticism, tested his magicians, enchanters, sorcerers, and Chaldaeans (astrologers) to tell him the contents and meaning of a troubling prophetic dream he said he had forgotten. Believing anyone with the powers they claimed to possess ought to be supernaturally informed of his private dreams, he threatened to cut them in pieces if they didn't

deliver. All of his prophets protested. The astrologer argued that no one but the gods could know what the king wanted them to reveal. Outraged by their response and their failure, he decreed that all of Babylon's wise men should be killed. Daniel, who had been brought to Babylon with the capture of Jerusalem, was trained by the Chaldaeans in astrological lore. Although he was able to save himself and the lives of his three companions from the king's fury by correctly revealing the dream, he relied on God's inspiration, and not on astrological skill, to do it. His story, then, is another biblical rejection of the value and validity of Mesopotamian astrology.

Astrology in ancient Rome also received short shrift from Cicero, the celebrated orator and author of *On Divination.* Although he was first converted to believe in the power of the stars by the philosopher Posidonius, Cicero's conviction steadily eroded, and he eventually insisted astrology is an "incredible mad folly which is daily refuted by experience."

There have also always been skeptics of prophetic powers. Wang Chong, a Han dynasty philosopher, also challenged the validity of omens in the sky. Disputing the assessment of a more ancient authority's gloomy commentary on comets and certain appearances of Mars, Wang Chong concluded there "can be no possible connection between celestial events and moral judgments."

Our personal experience with human nature persuades us that the special knowledge and special status of the palace skywatchers might encourage hypocrisy in any omen reader who understood the king's character better than the behavior of the sky. In *Pacing the Void,* an elegant and artfully crafted examination of astronomical imagery in the Tang dynasty, Edward H. Schafer mentions a poem in which Po Ju i, a ninth-century magistrate and internationally known author, criticizes the imperial star-watchers because "they approach their sovereign only with flattery and misleading talk about felicitous clouds and longevity stars, then, serenity guaranteed, back to their precious instruments." Po condemned the astronomers' superficiality and preoccupation with their tools, but not because he doubted the value of reading the sky. It was their lack of serious prophetic intent that troubled him.

Of course, true belief in celestial revelation does not extinguish personal priorities and professional conflict, and we find both in the astrological tablets of Mesopotamia. Michael Baigent repeats the vitriolic, but concise, criticism of a competitor by Akkulanu, an astrologer with high-performance standards: "This omen is nonsense: the king should disregard it." Simo Parpola's studies turned up another colorful example of the astrological pecking order. King Esarhaddon wrote to ask the chief astrologer Ishtar-shumu-eresh if a report he had received from another seer were correct. The king had been told that Mercury would rise from conjunction with the sun in the coming month, and he wanted to know if the prediction were accurate. Ishtar-shumu-eresh knew that Mercury was already visible and replied with the facts and with an editorial about professional incompetence: "An ignorant one frustrates the judge, an uneducated one makes the mighty worry." There is no substitute for good information, but additional comments about Venus in the critic's report confused Esarhaddon, who concluded that Venus had already

appeared. Always inclined toward independent corroboration, the king called in another astrologer and asked him about Venus. Venus, of course, was not yet visible, and the third skywatcher, without accurate knowledge of what Ishtar-shumu-eresh had really said, regressed to backbiting. After bringing Esarhaddon up to speed on Venus, he wrote that Ishtar-shumu-eresh was "a vile man, a dullard and a cheat" and asked, "Who is this person that so deceitfully sends such reports to the king.... Why does someone tell lies and boast about these matters. If he does not know, he should keep his mouth shut." One more astrologer joined the dispute, which culminated in an open argument in court that finally resolved the misunderstanding.

The court astrologers had to deal with ordinary obstacles and professional frustrations like everyone else. One of the same court astrologers who participated in Esarhaddon's Venus debacle also complained about the unnecessary inconveniences that subordinates have to bear thanks to policy at the top. Although he knew in one season no solar eclipse would occur, he had been directed to remain alert for it day after day. The useless waiting made him irritable and turned his official reports testy. Household headaches prompted other astrologers to petition the king for food, for a donkey to relieve aching astrological feet, for a doctor, and for help in retrieving a runaway handmaiden.

Evidence from the Mediterranean, Mesopotamia, and China shows that the political astronomers of antiquity didn't always command respect. Their knowledge and skill generally were valued, but they were only as infallible as their last accurate prediction. No doubt, there was astrological intrigue from time to time, but the soothsayers served the king, not vice versa. We have, then, manipulations of fact and of meaning, but neither of these manipulations dominate the discussion. Most of what we see reflects a more or less honest attempt to understand just exactly what bee was under nature's bonnet. Power and politics were the primary concern, but most of the time most of the participants were investors in the belief system.

Astronomical sincerity aside, the king had an interest in keeping some kind of lid on the flow of celestial information. Palace astronomy was a loaded situation for a king who could be compromised by the official astronomers and their information. Naturally, the ruler acted defensively.

At times, astronomical data were state secrets. Imperial China restricted access to the astronomical bureaux. Joseph Needham's monumental, multivolume *Science & Civilisation in China* quotes written evidence of the government's policy of astronomical discretion. In 840 A.D.,

> an imperial edict was issued ordering that the observers in the imperial observatory should keep their business secret. "If we hear," it said, "of an intercourse between the astronomical officials or their subordinates and officials of other government departments or miscellaneous common people, it will be regarded as a violation of security regulations which should be strictly adhered to. From now onwards, therefore, the astro-

version of the prophecies composed about two thousand years ago. It is known as *The Sibylline Oracle.* Perhaps contrived by a group of insubordinate Christians and Jews as competition for the official prophecies, it details celestial events at least as troubling as those that reputedly plagued Rome in 217 B.C. The sun was surrounded by stars in the daytime sky. The moon fired lightning. The heavens themselves were at war, and the Morning Star directed the battle from the back of Leo the Lion. The rest of the passage describes apocalyptic reversals of the places of the stars and ruptures of cosmic order. Libra displaced Orion. The Pleiades went dark. Aquarius the Water Bearer set fire to one of the planets. The entire sky was thrown into disarray, and finally the heavens themselves, in the form of Uranus, rose and flung all of the starry warriors to the earth. They sank in the oceans and ignited the land, and the night sky, now vacant of stars, went dark. By the time we encounter this kind of prophecy, the sky no longer signals just the fortunes of kings and personal destiny. It spells out in heaven the end of the world.

Until Christianity condemned the Sibyl's books as relics of the pagan past, they were kept under guard in an underground compartment in the foundation of the Temple of Jupiter on Capitoline Hill. A death sentence was the price of unauthorized use. Like astrology and other forms of prophetic revelation, they represented knowledge that could destablilize the structure of power. The curbs imposed on general access—in China, Mesopotamia, and Rome—all add up to a considered understanding of the relationship between power and the natural world. Nature, of course, is as visible as the sky, but knowing what it means is a route to power. For that reason, the knowledge of power is restricted. Those who acquire it through observation also possess power, but as the word gets out, they also risk conflict and competition. Hypocrisy, cynicism, and exploitation all may blossom in the garden of privileged information. The record shows that the officially appointed skywatchers were susceptible to such lapses, but careful review of the relationship between astronomy and power also tells us the real manipulators of celestial knowledge in organized states were just who we would expect them to be—the emperors, the nobles, and kings.

behavior in the sky conferred on the world, the Mississippians must have done more than worship the sun. They also probably paid close attention to it.

Systematic astronomical observations probably were performed at Cahokia to coordinate the complexities of urban life, to unify the community through public ceremony, and to maximize the yield of increasingly intensive cultivation. Archaeologist Warren Wittry realized he might have found Cahokia's solar observatory after he discovered, in 1961, several large rings and arcs of postholes in a field about 3,000 feet west of Monks Mound. The size of the holes—about a foot and half across—and the adjacent trenches that were used to prop the poles into place imply the use of tall posts, perhaps 30 feet high. One of the postcircles, now called Woodhenge 3 (or Circle 2), provided sunrise alignments for both solstices and the equinoxes between a post slightly offset from the center of the ring and posts on its perimeter. Another pair of posts defined the circle's north-south axis. Over the years, research on the "American Woodhenge" or "Sun Circle" continued to add details and modify our knowledge of the structure. At a special symposium, held at the Cahokia Mounds Museum in 1994, Wittry and several other experts reexamined the astronomical, cosmological, and symbolic potential of Cahokia's woodhenges. Wittry confirmed that Woodhenge 3, with a diameter of 410 feet, originally hosted 48 uniformly-spaced posts, and also explained that the insertion trenches were radially oriented toward the circle's center. The trenches not only clarified which holes were actually part of the ring, they underscored the significance of the circular figure to the builders.

With posts alone, Woodhenge 3 can't discern the date of solstice to better than a few days or even a week. As an astronomical instrument, it could indicate the turning points of the solstice sun and approximate seasonally important dates, but it would be calendrically challenged in any effort to establish something like the exact number of days in a year. That doesn't mean the skywatchers of old Cahokia didn't know the answer. It just means the woodhenge by itself couldn't tell them.

In most respects, Woodhenge 3 looks more like a ceremonial enclosure that incorporates astronomical and cosmographical alignments. It has been viewed as part of the monumental symbolic vocabulary that supplemented the mechanisms of political power. Competing interests of separate lineages and factions in the Mississippian chiefdoms likely put power in perpetual contention, but visible demonstrations of the authority of the elite and the hierarchy of power—great mounds, esoteric ritual, and astronomically tuned woodhenges—ordain political and social stratification and endorse its leadership. Matching the social pyramid with the architecture of the cosmos through the analogy of monumental and astronomical architecture, Cahokia's elite must have allied itself with celestial gods, primordial Creation, cosmic order, and the power of the sky.

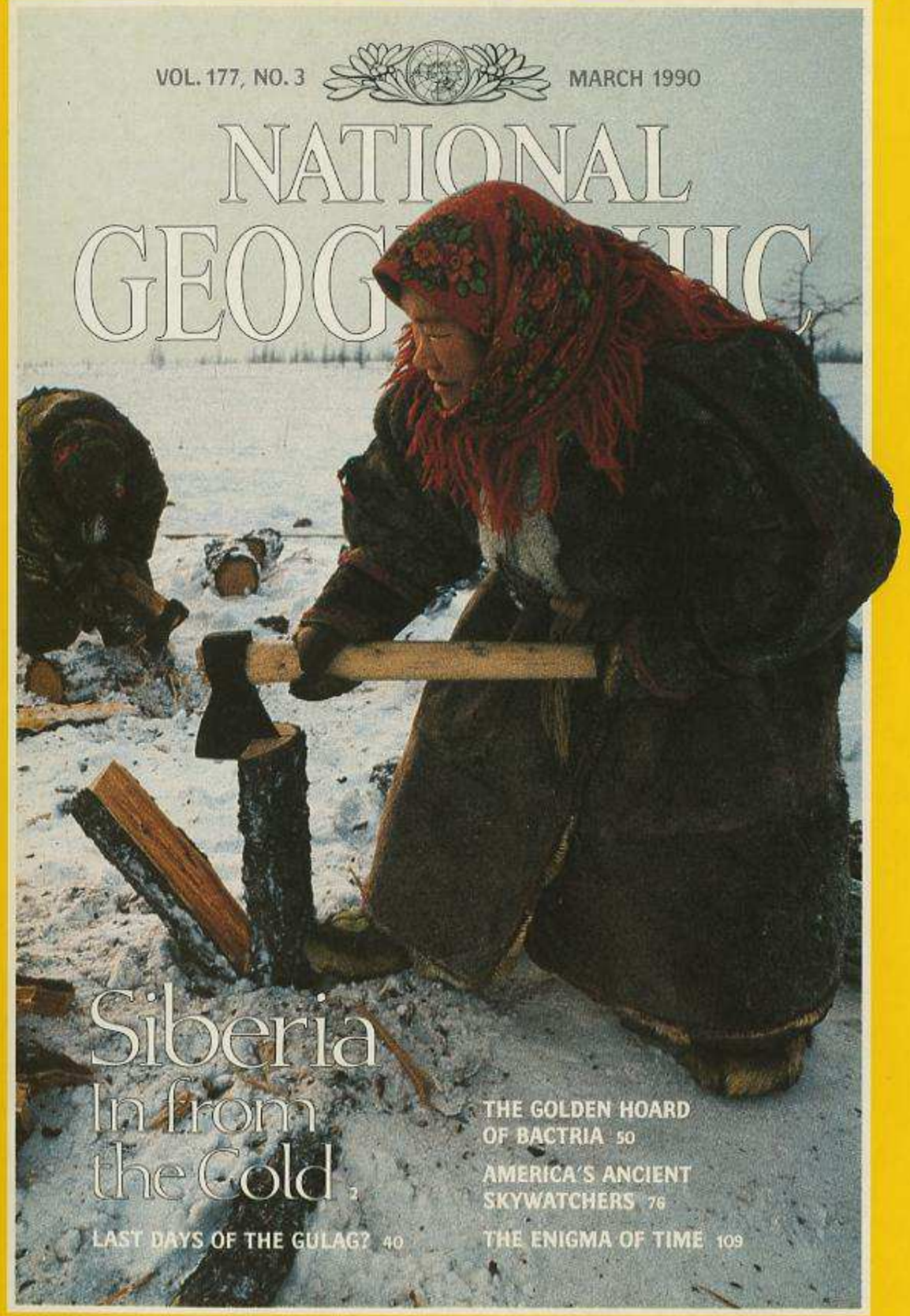
Melvin L. Fowler, the archaeologist who organized the 1994 Cahokia Woodhenge conference, found new support for the Sun Circle's place in Cahokia's symbolism of power. He reported his discovery of another, similar "woodhenge" to the south of Monks Mound and closely associated with Mound 72, a ridgetop mound in which

Exhibit 8

NATIONAL GEOGRAPHIC MARCH 1990 SOVIET UNION SIBERIA • THE GULAG • BACTRIAN GOLD • SKYWATCHERS • TIME

DOUBLE MAP SUPPLEMENT: SOVIET UNION

VOL. 177, NO. 3 MARCH 1990



NATIONAL GEOGRAPHIC

Siberia In from the Cold 2

THE GOLDEN HOARD OF BACTRIA 50

AMERICA'S ANCIENT SKYWATCHERS 76

LAST DAYS OF THE GULAG? 40

THE ENIGMA OF TIME 109

SEE "JOURNEY TO THE FORGOTTEN RIVER" WEDNESDAY, MARCH 7, ON PBS TV

NATIONAL GEOGRAPHIC

MARCH 1990

BUNDLED ON THE TUNDRA

Siberia: In from the Cold 2

Like a warming wind, glasnost—openness—sweeps across the Soviet Union's vast outback, and Siberians in unprecedented numbers speak out against the misuse of their rich storehouse of natural resources. From journalists to reindeer herders to local officials, they seek more control over the environment and destiny of this frontier, an area slightly larger than the United States. Mike Edwards and photographer Steve Raymer report.

SOUP TIME IN A GULAG CAMP

Last Days of the Gulag? 40

As the Soviets dismantle their notorious "correctional" labor camps and open their prison system to greater scrutiny by the world, French writer Jean-Pierre Vaudon and photographer Pierre Perrin visit Perm 35, a camp in the Ural Mountains.

The Gulag Remembered 48

From 1928 to 1953 Joseph Stalin sent millions to Soviet labor camps, where millions perished. Mike Edwards describes the brutal system, known by its Russian acronym gulag, and speaks to survivors.

GOLD IBEX

Soviet Union Map

A double supplement outlines the ethnic diversity of the Soviet Union and highlights the geography, people, and events that have shaped its history.

The Golden Hoard of Bactria 50

After a decade of excavating on Afghan hillsides, Soviet archaeologist Viktor Ivanovich Sarianidi in 1978 unearthed a trove of gold jewelry and other artifacts buried in 2,000-year-old graves; here he presents a selection of these masterpieces. With photographs by Leonid Bogdanov and Vladimir Terebenin.

CALENDAR ON A STRING

America's Ancient Skywatchers 76

Strange drawings on a desert floor, oddly aligned stone columns, a peculiar trough carved beneath a small window . . . what do they mean? John B. Carlson, a specialist who weds archaeology to astronomy, looks to the cosmos for answers to some age-old puzzles. Photographs by Bob Sacha.

TINY TIMEPIECE

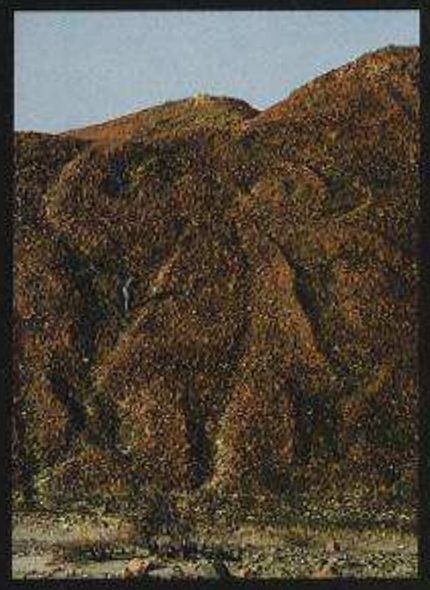
The Enigma of Time 109

While most of us are obsessed with keeping track of it, scholars debate what time actually is. John Boslough and photographer Bruce Dale tell the story of a concept that we think we understand until we try to define it.

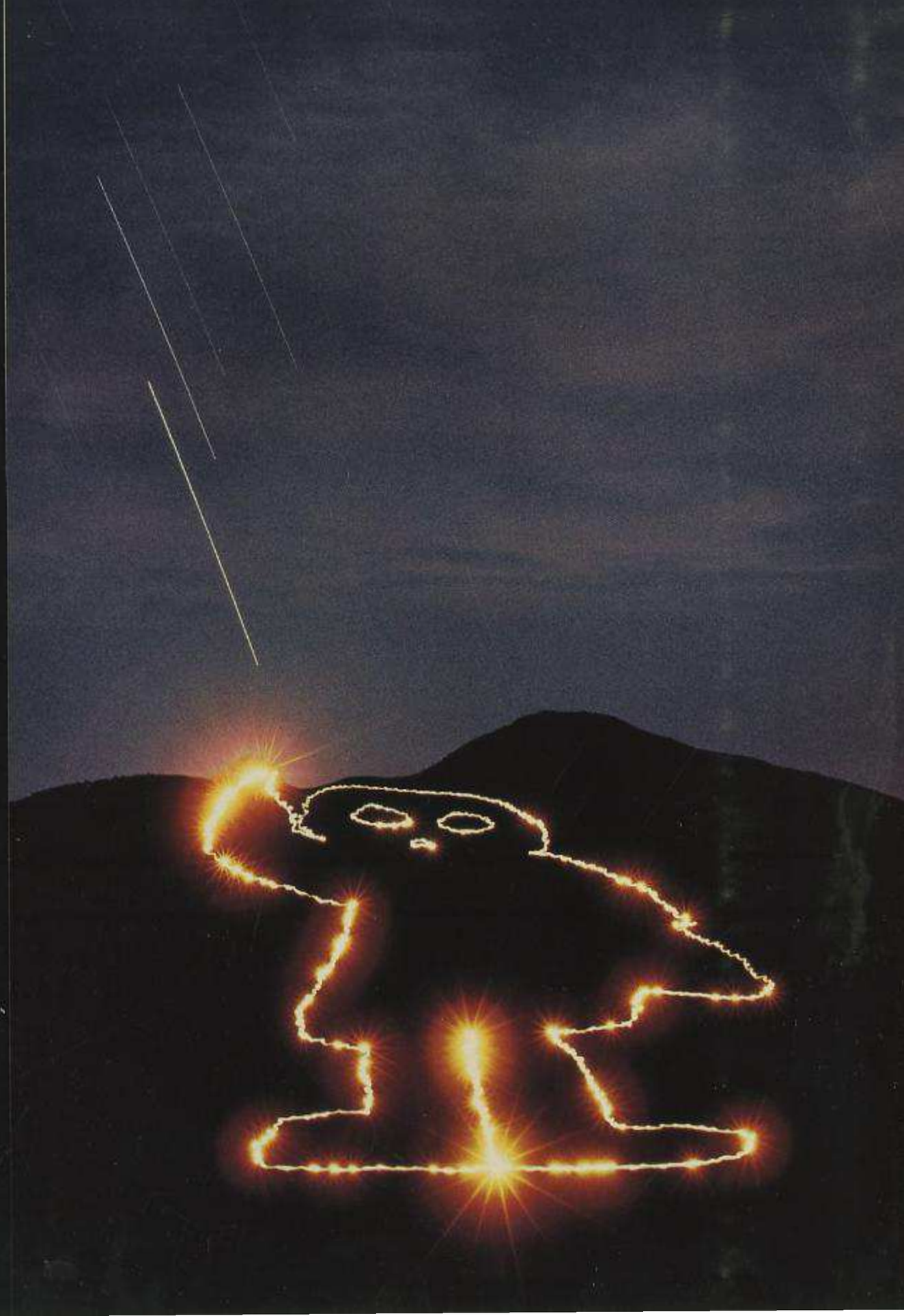
COVER: *At a campsite on the tundra a Nentsy woman chops wood. Nomadic reindeer herders, her people fight for a way of life as oil and gas development spreads above the Arctic Circle in Siberia. Photograph by Steve Raymer.*

America's Ancient Skywatchers

A gigantic figure called the Owl Man, still visible after 2,000 years on a dry hillside near Nazca, Peru, points one arm to earth, the other to heaven where the bright star Arcturus trails across the sky in May. Was he meant to be an intermediary between two realms, a role assumed by the owl and the owl shaman in Andean lore? Or were such effigies—and the adjacent arrow-straight Nazca Lines—used as ritual walkways for celebrants seeking communion with the divine? In the Andes today people tread such sacred paths with offerings to mountain and sky gods, an action duplicated by a flashlight-carrying walker in this time exposure. Intense observers of the stars and planets, ancient Americans developed elaborate rituals to assure their place in the cosmos and bring order to their lives—a field explored by the new discipline of archaeoastronomy.



By JOHN B. CARLSON
Photographs by BOB SACHA



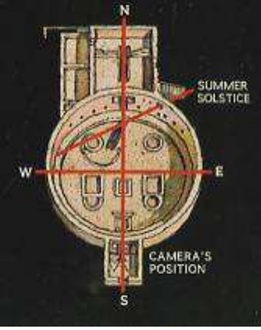
Anasazi astronomy

Symbol of the cosmos, the great kiva of Casa Rinconada in Chaco Canyon, New Mexico, reflects the concepts of Anasazi builders of the 11th century A.D. In shape it duplicates the circular sky. Its main door faces celestial north, that fixed spot in the nighttime sky around which all stars seem to revolve.

Once the kiva was enclosed by a heavy wood-and-mud roof supported by four huge pillars set in postholes, lighted here, which defined the cardinal directions (diagram below). According to stories told at Acoma Pueblo nearby, the First People emerged from the underworld by climbing four trees.

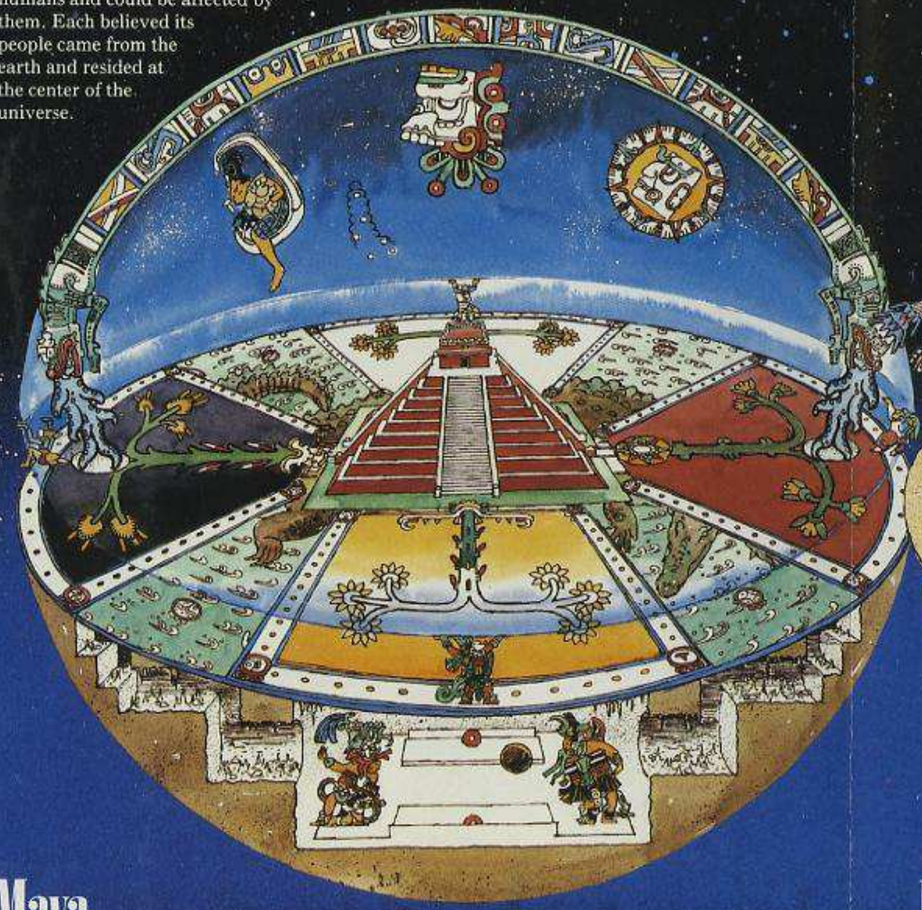
In this great chamber, fraternal groups likely sat on the wall ledge while masked dancers emerged from the underground chamber. At summer solstice, sun rays entered the window to the right of the north door and struck a niche on the northwest wall, dramatically marking the northernmost journey of the sun.

DIAGRAM BY KEN DALLISON



Mapping the cosmos

Pre-Columbian Americans left no definitive charts of their universe; clues from iconography, ethnology, and archaeology guided these reconstructions. To each culture the universe encompassed sky, earth, and underworld. Each saw celestial bodies as living beings that influenced humans and could be affected by them. Each believed its people came from the earth and resided at the center of the universe.



Maya

The Maya universe, here centered on a tiered pyramid, rested on a crocodilian in a cosmic sea. Each quarter of the earth was associated with a color; the center was a fifth direction. Four divine beings held up the dome of heaven, shown as a two-headed dragon whose body is a sky band of celestial symbols. It arches over the moon goddess—who holds the rabbit discerned in the moon's face—a skeletal Venus, and the sun god. The star cluster Pleiades is a rattlesnake tail. The creation of the sun and, probably, the planet Venus was explained by a tale of Hero Twins who vied with the Lords of Death in a series of ball games; the victorious twins became those celestial bodies.

Navajo

Portrayed as a sand painting, the world view of Diné—"the people," as the Navajo call themselves—centers on the family hogan. The first hogan was built at the place of emergence of ancestors who traveled through three previous worlds before rising through a hollow reed into this "glittering" place. Each quarter of the earth is characterized by a color, sacred mountain, time of day, and holy person. Guarded by a rainbow god, the sky sparkles with constellations and the Milky Way, represented by the band of crosses. Young warriors carry the blue sun and white moon. Beyond the sky lies a land ruled by the Big Wind (yellow) and Big Thunder.

Inca

The Inca king believed himself the son of the sun; his universe centered on the Temple of the Sun at Cuzco, Peru. In one origin myth the Inca people came from three caves; in another they rose from Lake Titicaca. The straight red lines shown are ceques, connections to sacred places. The major ceques formed borders of the quartered Inca world. The Milky Way flowed into the underworld and, returning, brought dark, fertile mud to the sky, formin resemble anima the snake (at to tinamou bird, baby llama, fox tinamou. The s as a male god, a female.

PAINTINGS BY KEN DALLISON. PRINCIPAL CONSULTANTS: JOHN B. CARLSON, CENTER FOR ARCHAEOASTRONOMY (MAYA); GRIFFIN-PIERCE, UNIVERSITY OF ARIZONA (NAVAJO); GARY URTON, COLGATE UNIVERSITY (INCA)

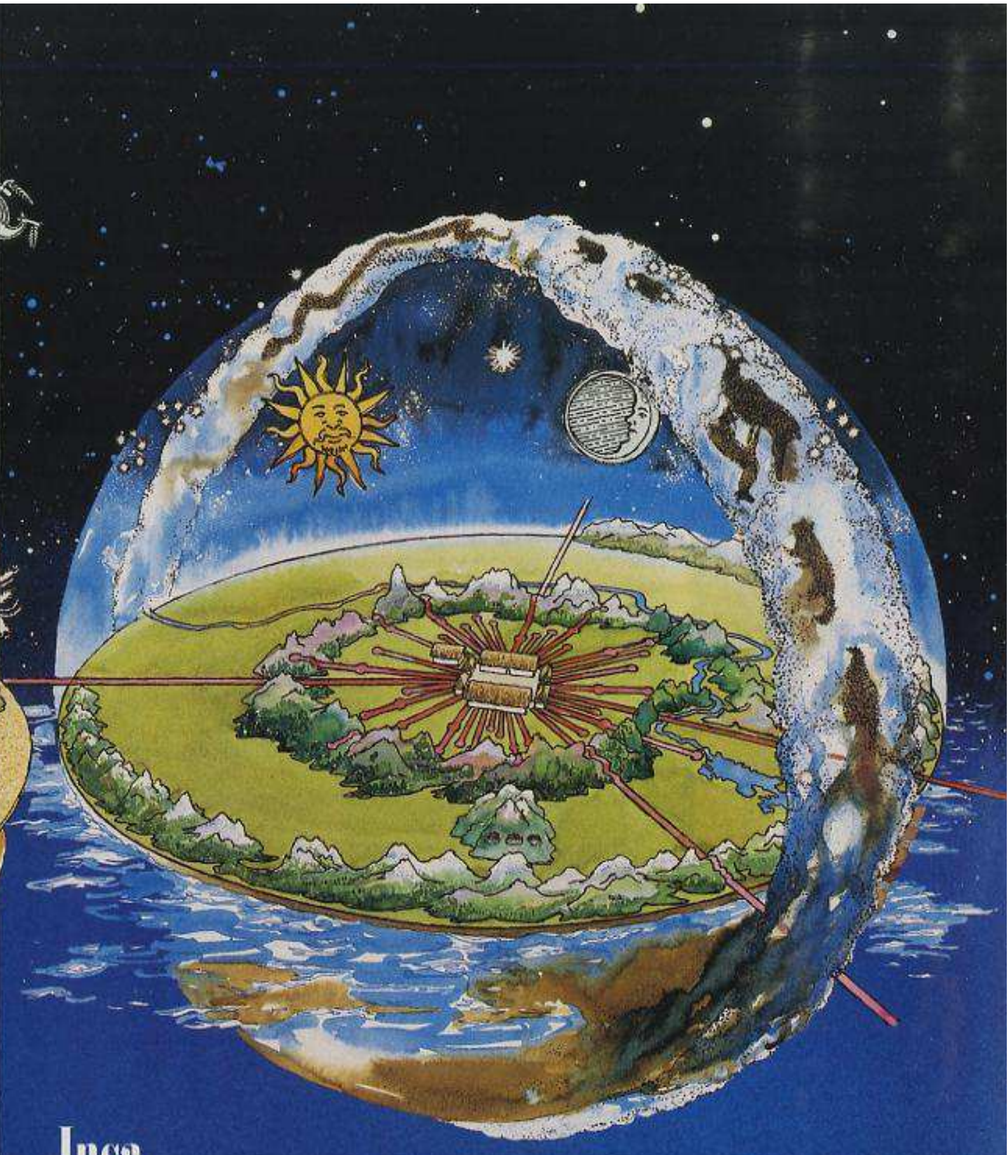
e cosmos

t no definitive charts of their
phy, ethnology, and archaeology
To each culture the universe
underworld. Each saw celestial
fluenced
by

heaven, shown as a two-headed dragon whose body is a sky band of celestial symbols. It arches over the moon goddess—who holds the rabbit discerned in the moon's face—a skeletal Venus, and the sun god. The star cluster Pleiades is a rattlesnake tail. The creation of the sun and, probably, the planet Venus was explained by a tale of Hero Twins who vied with the Lords of Death in a series of ball games; the victorious twins became those celestial bodies.

Navajo

Portrayed as a sand painting, the world view of Diné—"the people," as the Navajo call themselves—centers on the family hogan. The first hogan was built at the place of emergence of ancestors who traveled through three previous worlds before rising through a hollow reed into this "glittering" place. Each quarter of the earth is characterized by a color, sacred mountain, time of day, and holy person. Guarded by a rainbow god, the sky sparkles with constellations and the Milky Way, represented by the band of crosses. Young warriors carry the blue sun and white moon. Beyond the sky lies a land ruled by the Big Wind (yellow) and Big Thunder.



Inca

The Inca king believed himself the son of the sun; his universe centered on the Temple of the Sun at Cuzco, Peru. In one origin myth the Inca people came from three caves; in another they rose from Lake Titicaca. The straight red lines shown are ceques, connections to sacred places. The major ceques formed borders of the quartered Inca world. The Milky Way flowed into the underworld and, returning, brought dark, fertile mud to the sky, forming patches that resemble animals, such as the snake (at top), toad, tinamou bird, mother and baby llama, fox, and another tinamou. The sun appears as a male god, the moon as a female.

PAINTINGS BY KEN DALLISON. PRINCIPAL CONSULTANTS: JOHN B. CARLSON, CENTER FOR ARCHAEOASTRONOMY (MAYA); TRUDY GRIFFIN-PIERCE, UNIVERSITY OF ARIZONA (NAVAJO); GARY URTON, COLGATE UNIVERSITY (INCA)

WITH AN EXCITEMENT born in my first childhood visit to a planetarium, I gazed up at the star-filled dome of the Southern Hemisphere's early winter sky. The great square of Pegasus stood high in the north, while the red planet Mars coursed in Aquarius. Aquila the Eagle, with its eye the brilliant star Altair, bobbed in the spectral river of the Milky Way where it arched across the horizon.

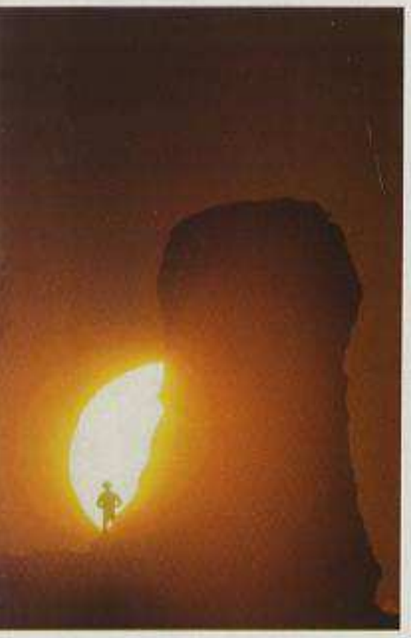
I had come to Machu Picchu, a sacred site thought to have been one of the estates of the Inca king Pachacuti, to watch the sun rise on the June solstice, shortest day of the year there. Four companions—guide Rita Barrantes, Inca scholars John Rowe and Pat Lyon, photographer Bob Sacha—and I were gathered to observe and record the astronomical conditions that governed timing of the Inca festival of renewal still known as Inti Raymi, or Sun Festival. On this day in ancient times, according to one of the early Spanish chroniclers, the king rendered homage to the sun. Offerings were made, and omens were read in the entrails of a llama sacrificed to the sun.

Now, in the predawn darkness, we groped along cut stones of the Inca road, bearing tripods and lights, transits and sighting compasses, our footfalls muffled by the cascades of the Urubamba River far below.

As we set up our gear by the temple called the Torreón, the halo of dawn was expanding behind San Gabriel peak. We watched the rays of the sun stream out like a fan, striking the ruins above us. Seconds later the rays poured through a window in the east-facing wall of the temple, falling parallel to the cleft hewn in a sacred stone. Inti the Sun had again entered his house as he had done silently, without witness, again and again over the centuries since the Inca worshipers had abandoned the site, until astrophysicist David Dearborn discovered the solstice alignment in 1980.

Observing that moment at Machu Picchu, I felt I had come full circle in a personal and professional quest that began in 1973. With two friends I had gone to the desert Southwest of the United States to measure alignments of Anasazi and Pueblo Indian ruins. The cliff dwellings of Mesa Verde, the towers in the canyons and on the mesas of Hovenweep, the great semicircular ruins of Pueblo Bonito, all seemed magical to me, a young physicist and radio astronomer. Within a few years—after a visit to Mexico with its great ruined city of Teotihuacan laid out like a vision of the universe—I began to stray from the study of galactic centers in the far reaches of space and joined an emerging field of study called archaeoastronomy.

This new discipline, numbering scholars from anthropology, archaeology, and art history as well as from astronomy, seeks to learn how and what ancient peoples observed about the regular and recurring motions of the sun, moon, planets, and stars. Equally important, we are trying to understand in what manner they

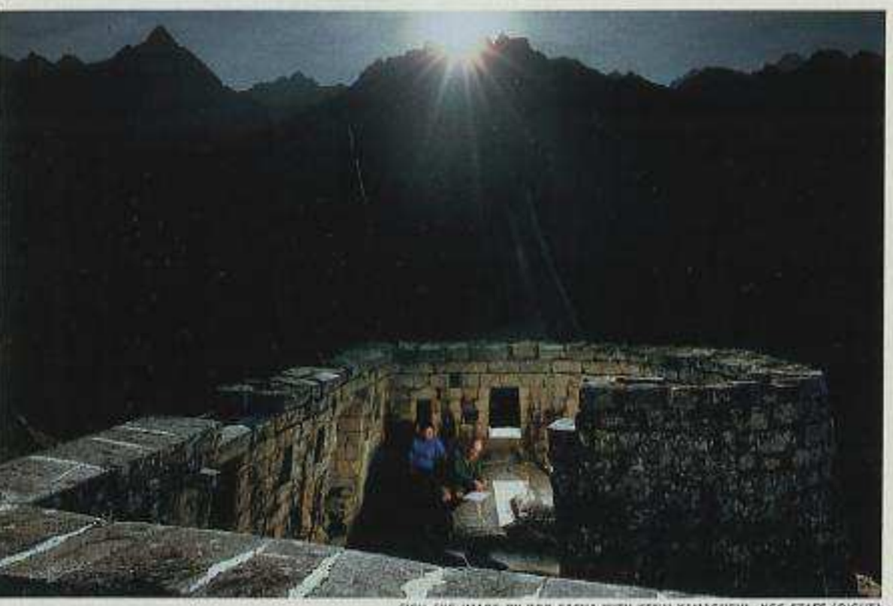


At winter solstice the sun rises near Wijiji Pueblo in Chaco Canyon behind a sandstone pillar that probably served as a calendar marker for the Anasazi and the Navajo. Rites assured that the sun on the shortest day would not disappear forever.

The sun passing directly overhead marked a key date in the tropics. At Xochicalco, Mexico, an eighth-century stone-walled shaft directs the sun at zenith on May 14 to the floor of an underground chamber (facing page), a phenomenon measured by Stanisław Iwaniszewski and his wife, Gabriela.

JOHN B. CARLSON is director of the Center for Archaeoastronomy in College Park, Maryland. BOB SACHA, a frequent contributor to this and other national magazines, is a free-lance photographer based in New York City.

In an eagle's view, Machu Picchu spreads magnificent cut-stone architecture across Peruvian heights. The spectacular city of the Inca, possibly built by the great king Pachacuti, includes the Torreón, an unusual curve-walled temple (below). Its east-facing window directs the first rays of the sun rising over San Gabriel peak on June 21—winter solstice in the Southern Hemisphere—parallel to a straight edge carved in a sacred stone.



FISH-EYE IMAGE BY BOB SACHA WITH KENJI YAMAGUCHI, NGS STAFF (RIGHT)

integrated this astronomical knowledge into their religion, mythology, art, and daily lives.

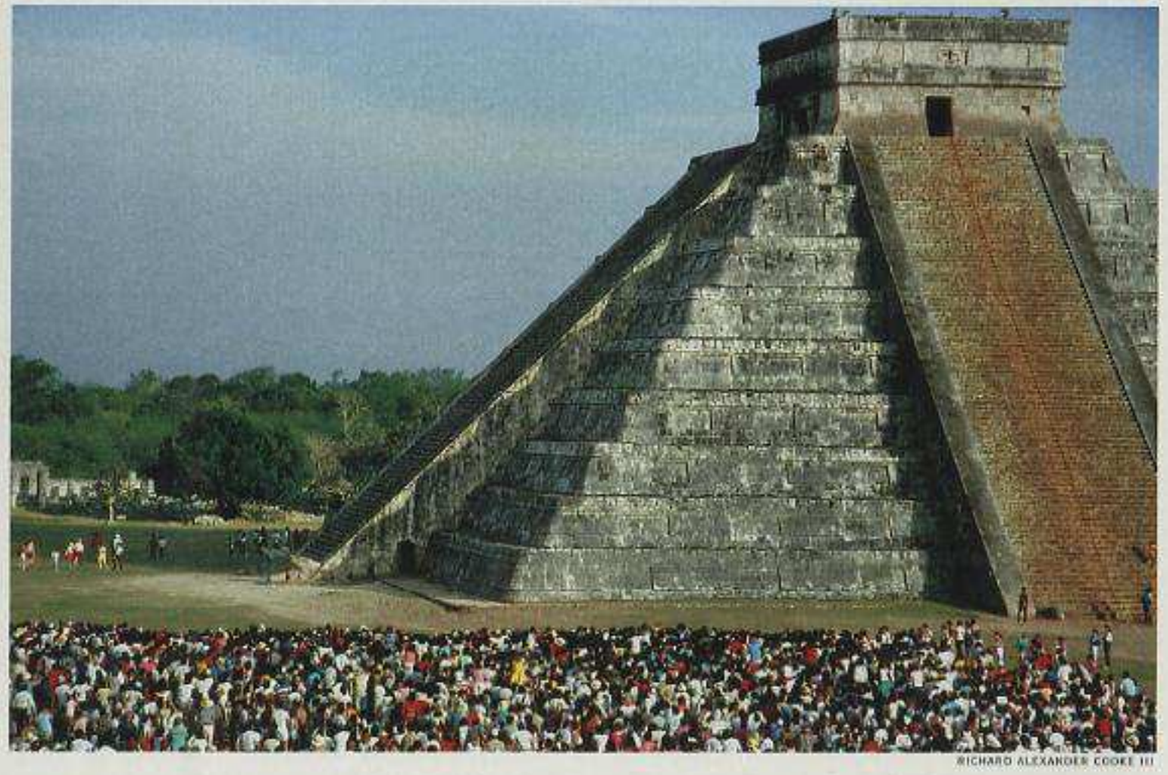
For many pre-Columbian Americans, whether Inca, Maya, Anasazi—or indeed many among their living descendants—astronomy was not a science as we who are schooled in the Western tradition tend to think of it. Rather, the movements of sun and moon were the journeys of gods personified. In Mesoamerica the stars and the bright planets in their intricate wanderings were often conceived of as gods moving through the night sky en route to rebirth each sunup. They wove an enormous celestial tapestry mirrored in the warp and weft of the lives of the people themselves.

To observe and predict the recurrent paths of divine lights was to know the fates of kings and empires, to discern the proper day for rituals, to forecast animal migrations, the season of the life-giving rain, and the time for planting. The power to foretell required that observers, probably specially trained shamans or priests, make accurate records and preserve them. The information must have been accumulated over generations and generations, the observers using naked-eye sighting techniques to discover the patterns of movement in the universe. Their knowledge reached a level comparable to that of ancient cultures of the Old World.

Their records were preserved in calendars made of wood, string, and stone or, in Mesoamerica, written in accordion-fold books of

animal hide or plaster-coated bark paper. Heavenly comings and goings were also recorded in the alignment of buildings and in city plans. These provided sight lines to mark significant risings and settings of celestial bodies. Such constructions often approached our own scientific astronomy in accuracy, but they had a sacred purpose. We might compare this combination of technical knowledge and religious motive to a church window so placed that sunlight passing through it will illuminate a saint's statue on the saint's day.

Earth too was invested with divinity. Many pre-Columbian American groups believed that their ancestors emerged from the underworld by way of a cave—the mouth of the earth. The earth's surface



RICHARD ALEXANDER COOKE III

The body of a serpent seems to descend the north stairs of the Maya Temple of Kukulcan at Chichén Itzá, Mexico, at sunset on spring and fall equinoxes. Perhaps the stepped pyramid was deliberately oriented so the shadow cast by its northwest corner would create the phenomenon, which today attracts thousands of viewers. The Maya may have considered this a sacred appearance of Kukulcan, the Feathered Serpent.

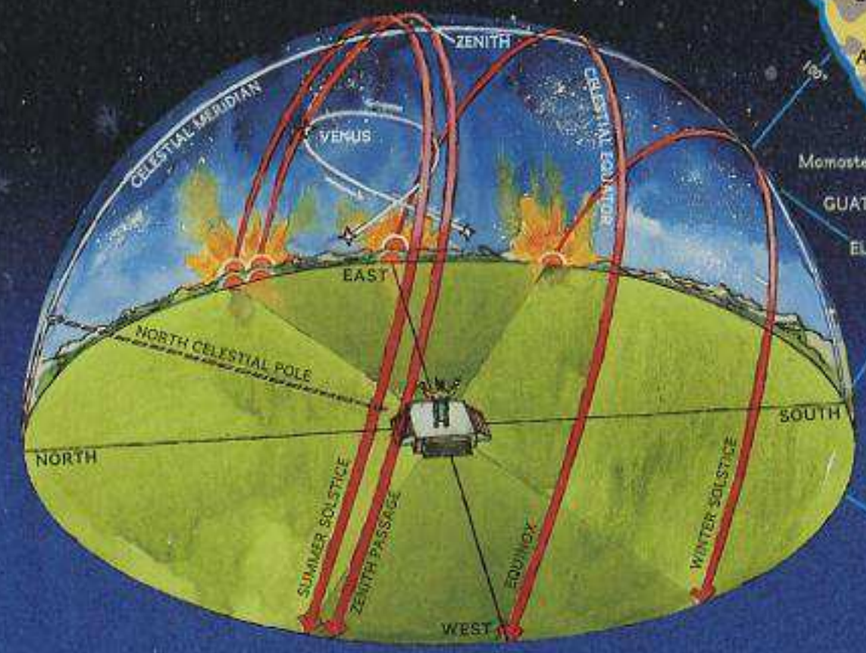
they divided into four quarters, often endowed with distinctive trees, animals, deities, periods of time, and colors. Just as they marked the sky, so they set down paths of pilgrimage on the sacred landscape.

The most notable—and controversial—of these routes may be the ground drawings made on the bone-dry desert of southern Peru. The geometric figures of animals and plants; the spirals, zigzags, trapezoids, triangles; and the straight lines that stretch as far as the eye can see—all these are called Nazca Lines for the culture that established itself in that forbidding terrain 2,000 years ago.

Many speculations, some reasonable, some fanciful, have been made about the significance of the lines. One explanation suggests that the straight lines were aligned to astronomical risings and settings. Another that at least some of the effigy figures represented constellations. Still another idea, recently investigated in depth by astronomer-anthropologist Anthony Aveni and anthropologists Gary Urton and Persis Clarkson, maintains that the long, straight lines connected sacred sites and marked ritual pathways walked by celebrants to make offerings at the far ends. These hypotheses

A skywatcher's primer

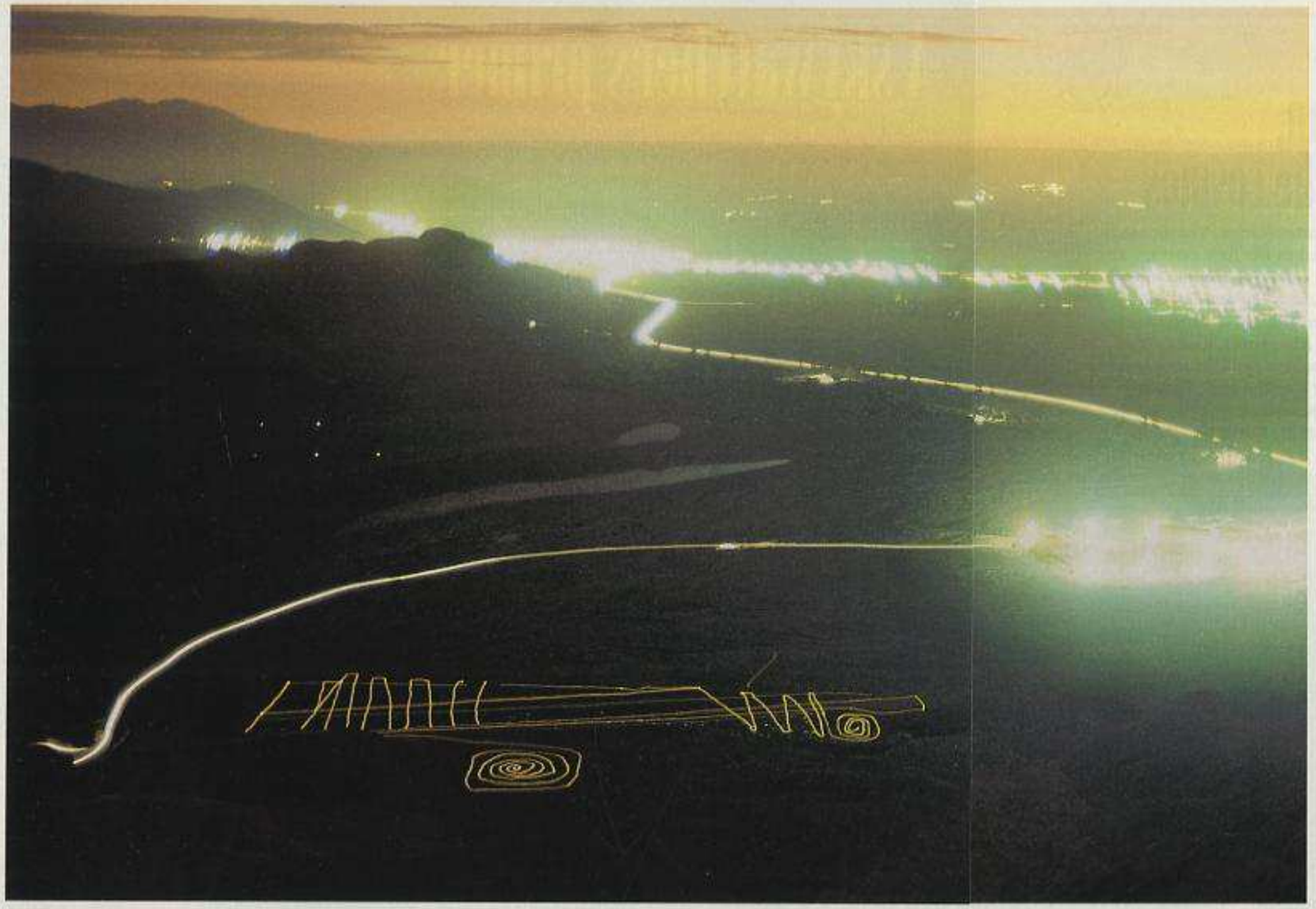
To astronomers of ancient American cultures (map) the sun traveled around the earth. Observing its shifting rise on the horizon, they were able to mark time and predict the future. Thus someone looking east from the Maya site of Uxmal could create a 365-day calendar by noting the swing of sunrise from spring equinox (usually March 20) to first zenith passage some 60 days later, to summer solstice on June 21, the sun's farthest northern reach. Moving south, the sun again hits the zenith, then the fall equinox (September 23), before its southern extreme, winter solstice (December 22). These maximum excursions laid out earth space into four parts.



The Maya based a 584-day ritual calendar on an idealized cycle of the planet Venus: After a 236-day appearance as the morning star, shown here, it disappears for 90 days before shining in the west as the evening star for 250 days. Eight days later it is in the east again.

Not until the 16th century—in Europe—would astronomers realize that the earth revolves around the sun (small diagram). Because of the 23½-degree tilt of its axis, the earth has seasons, which are reversed in Northern and Southern Hemispheres—the June solstice signaling summer in the north and winter in the south.

PAINTING BY KEN DALLISON. PRINCIPAL CONSULTANTS: JOHN B. CARLSON; LEROY E. DOGGETT, U. S. NAVAL OBSERVATORY



Illumined by a walking torch-bearer, an earth drawing called Needle and Loom near Nazca, background, recalls the Andean craft. Some pre-Columbian Americans saw the universe as a reflection of the weave of a fine textile.

A quipu, or knotted string record, kept calendar days and inventories for the Inca. The Spanish were amazed at how the state controlled the flow of goods, without losing "count of a single hen or load of firewood." One of the last of the Peruvian quipu makers, Nieves Yucra Huatta ties knots for festival days, his livestock, and his land.

are not mutually exclusive; all may have an element of truth.

Whatever the explanation, the Nazca puzzlement can at least serve to remind us that archaeoastronomy does not end at the horizon. Ancient Americans did not divide the cosmos into discrete disciplines for study, as is our habit.

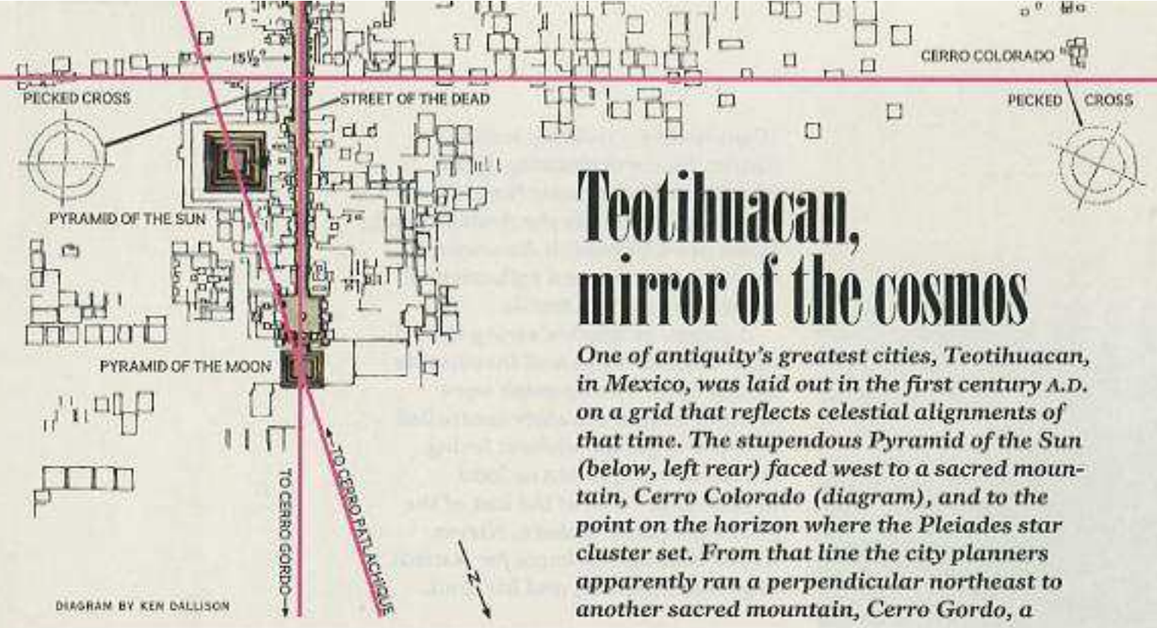
IN MY JOURNEYS of professional discovery and personal revelation, I have encountered ancient astronomy in many forms. Without fail each manifestation has comprised a bewildering array of gods, myths, cycles of time, and peoples—all tied together in a unified vision of sky and earth.

Nowhere is the bond between sky and earth more evident than at Teotihuacan in a high valley 30 miles northeast of Mexico City. Walk north along its Street of the Dead on a clear, dry-hot day; the air vibrates with the sound of insects singing in resonance with waves of heat that make you question the reality of the stepped structures looming before you. Is this a mirage, or are those mountains really massive man-made pyramids rivaling those of Egypt?

When the Aztec entered this city in the early 14th century, it had lain in ruins for almost 600 years. Those remains, filling the Valley of Teotihuacan with an immense four-quartered grid, inspired the Aztec to name it Place of the Gods. To them, this was the navel of the universe, where the gods had met to create a new world under a reborn sun.

When Teotihuacan was little more than a settlement, about the beginning of the first century A.D., its people must have discovered the remarkable alignment of a four-lobed cave with a lava-tube extension on the site. (Visualize something like a four-leaf clover with its stem lying flat.) Archaeologist Doris Heyden postulated in 1971 that the four lobes corresponded to the fourfold cosmos of the Teotihuacanos, and the stem of the cave pointed in the direction of a significant point on the horizon. This was the setting point of the star cluster we call the Pleiades—the prominent constellation that makes its first yearly appearance on the first of two days each year when the sun passes directly overhead.

As the settlement grew, people embellished this sacred cave site.



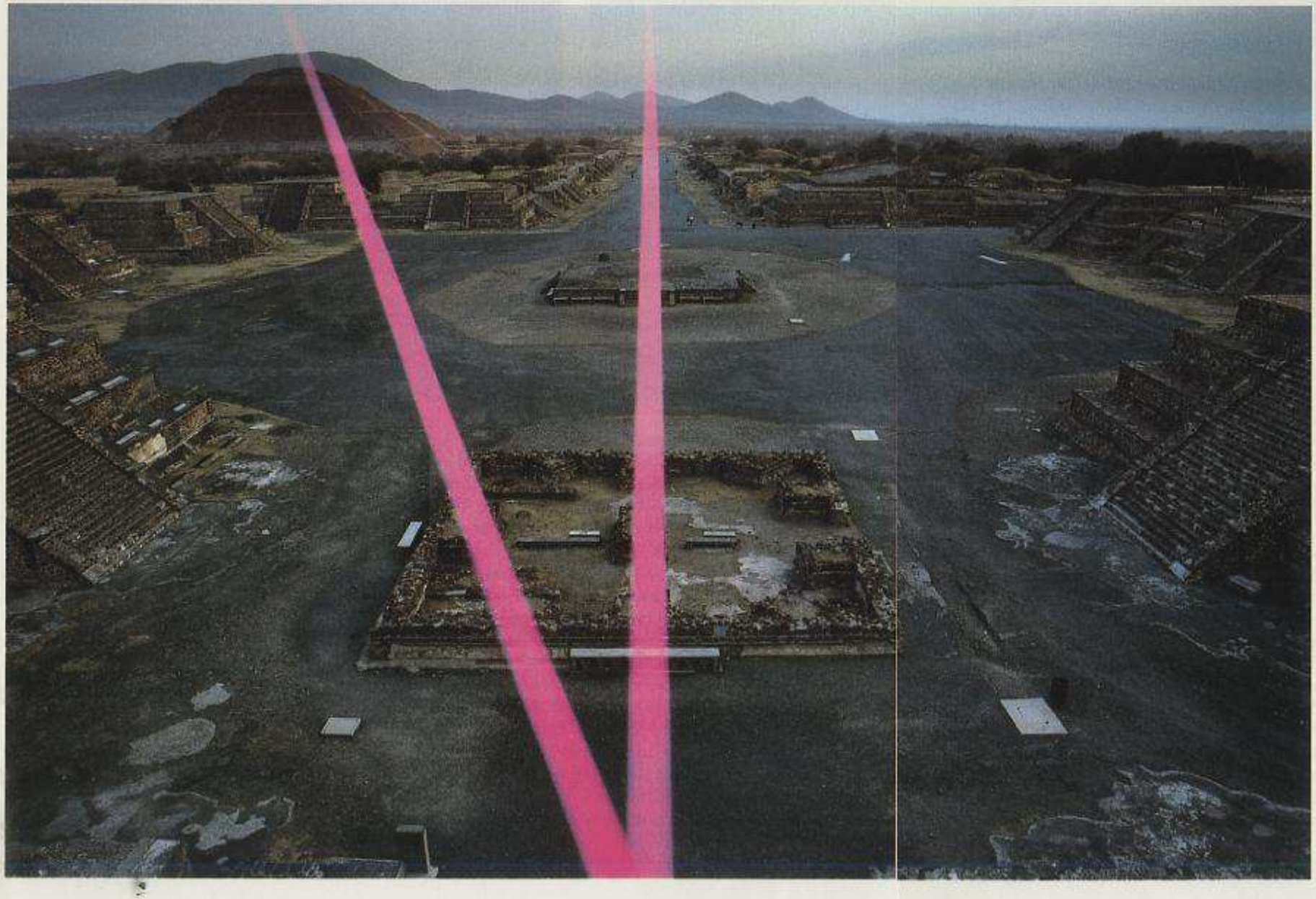
Teotihuacan, mirror of the cosmos

One of antiquity's greatest cities, Teotihuacan, in Mexico, was laid out in the first century A.D. on a grid that reflects celestial alignments of that time. The stupendous Pyramid of the Sun (below, left rear) faced west to a sacred mountain, Cerro Colorado (diagram), and to the point on the horizon where the Pleiades star cluster set. From that line the city planners apparently ran a perpendicular northeast to another sacred mountain, Cerro Gordo, a major source of the city's water. On this line they laid out their main avenue, now called the Street of the Dead, and on it built the Pyramid of the Moon, the photographer's vantage point.

To illustrate the city's alignment, he held two fishlines lighted by a red strobe before his lens. One line sights due south over the Pyramid of the Sun to pyramid-shaped Cerro Patlachique. The other, along the Street of the Dead, is 15½ degrees west of south, the basic alignment of the city.

Two so-called pecked crosses—one in a plaster floor southwest of the Pyramid of the Sun (below), the other on Cerro Colorado—may have served as surveyor's markers for the strict grid, which was maintained even to suburban barrios. Teotihuacan eventually expanded to eight square miles, an area larger than imperial Rome, before being abandoned about A.D. 750. But its influence had already spread. Some 70 known pecked crosses, possibly used in ritual, occur in ruins from northern Mexico to Guatemala. Likewise, the skewed alignment is found in many Mesoamerican sites.

A lava-tube cave with four lobes, suggesting the quarters of the universe, was discovered in 1971 under the Pyramid of the Sun. The chamber probably dictated the temple site and alignment, since, like many ancient peoples, the Teotihuacanos apparently believed caves were the places of emergence for their earliest ancestors.



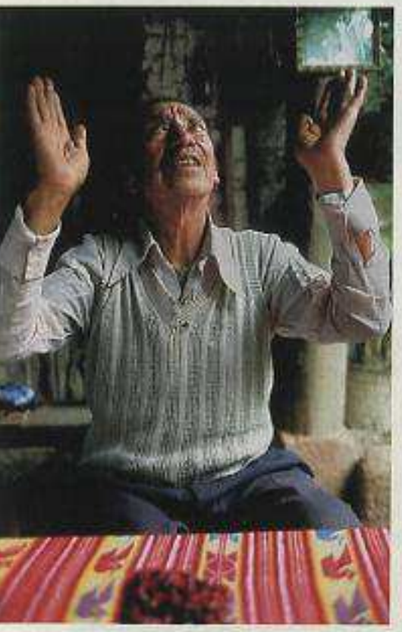
Finally they built a great pyramid over it. They placed stairs leading to the temple atop the pyramid in the same alignment as the cave's extension. The temple faced, and the stairs pointed to, the Pleiades' exact setting point. Thus earth, cave, sky, pyramid, and temple came together in perfect alignment and harmony.

The Teotihuacanos oriented avenues, streets, temples, and apartment complexes (preceding pages), even channeled the San Juan River, to conform to the fourfold layout, reflecting sensitivity to significant features in the landscape and the heavens. Thus Teotihuacan became the first planned metropolis known in the Americas.

From its founding until it was destroyed by fire of unknown cause in the eighth century, Teotihuacan became also the largest and probably the most powerful city of the Western Hemisphere. With a population that may have exceeded 200,000, the Teotihuacanos created a trading network across Mesoamerica, spanning an area that today comprises the U. S. Southwest, Mexico, Guatemala, and Belize, its southernmost influence extending into Honduras and El Salvador. Among the trade items: green obsidian, pottery, clay figurines of warriors, and—quite probably—certain deep-seated ideas of the cosmos and its physical expression on earth. All these found a ready audience in outlying regions.

Leaving the great, shimmering ruins, I traveled north to what seems to have been a Teotihuacan outpost built at latitude 23° 29′ N, almost precisely on the Tropic of Cancer—the northernmost latitude at which the sun will pass directly overhead one day of the year. The summer solstice, June 21, is, however, not the only significant day at Alta Vista in Mexico's Zacatecas state. The ruins there still show the layout of a square, colonnaded hall. From its southeast side a labyrinth leads to a road that points due east toward a mountain range with a prominent peak known as Picacho Pelón. Well before dawn on March 21, the day of the vernal equinox, I waited in the labyrinth with archaeologists J. Charles Kelley and his wife, Ellen, who had excavated the site, and several hundred tourists, ranchers, and townspeople come to witness the sunrise.

The day dawned cold and clear. A ruddy glow expanded to a white halo around Picacho Pelón's crest. Then the sun burst over its top to illuminate the ancient observatory, marking a new phase in the solar year and, with it, the start of the planting season—a crucial time in this semiarid region. A sense of renewal and participation in something greater than one's self touched me and the cheering pilgrims, whose numbers are increasing annually.



Praying to sky, then to earth, shaman Andrés Xiloj prepares for a divination based on the 260-day Sacred Almanac of the Maya. By this time count, still kept in the Quiché town of Momostenango, Guatemala, each day has special meanings. The Maya consult such respected elders before making business decisions or scheduling rites of marriage, birth, and death.

SOMETIME after the Teotihuacanos had passed from ascendancy in Mesoamerica, a Maya-influenced people moved onto a hill near the modern Mexican city of Cuernavaca. Today the site is known as Xochicalco, the House of Flowers. Just below the hilltop they dedicated a temple decorated with carved panels of the Feathered Serpent. Nearby they excavated and lined with stones a shaft that descends 30 feet to a cave-temple complex.

On May 14, two months after the equinox at Alta Vista, archaeologist Stanisław Iwaniszewski and I brought copal incense and a small clay *incensario* that had been given to him by a shaman. We needed its smoke to make visible the column of sunlight that would descend straight down the opening at noon, when the sun reached its zenith. We entered the chamber and waited. Clear skies—and crowds—were with us again as they had been at Alta Vista. Our main concern was that tourists would lean out over the hole above us and artificially eclipse the sun. As the seconds ticked down, we lit the incense. It swirled in air currents and rose. Creeping rapidly down the side of the shaft, the sun's rays soon touched the earth at our feet.

The moment was captured, then it was gone. Yet again I sensed that we had shared in an ancient manifestation of the sacred. We waited without speaking for a time before emerging into the blinding sunlight.

Despite their importance, it is well not to emphasize such architectural alignments as markers of solstice, equinox, and zenith without attempting to understand the cultural contexts in which they were created. When archaeoastronomy was new, enthusiasts rushed to plumb, align, and measure anything that looked halfway plausible—and tended to find significant celestial alignments everywhere.

Sacred places have drawn Momostenango villagers since ancient times. Here, on the day named 8 Monkey, celebrants enact a ritual of renewal at mountain shrines, each bearing a day number from the Sacred Almanac. They burn candles and incense as offerings to the sky, earth, ancestors, and lords of time.

Often it has proved more profitable to begin with relevant cultural traditions and work toward astronomy. For example, the ancient Mesoamerican view of life as a game played for mortal stakes is nowhere described more vividly than in the epic poem of the Quiché Maya of highland Guatemala, the *Popol Vuh*. This recounts the legendary journey of the Hero Twins Hunahpu the Hunter and Xbalanque the Jaguar Sun to the underworld called Xibalba, where they face many trials (including the house of cold, the house of knives, and the house of vampire bats) at the hands of the Lords of Death. There they play a series of ball games for their lives; their father had earlier lost such a game—and his head. The twins, however, prevail and, after sacrificing the Lords of Death, are themselves transformed into celestial beings.

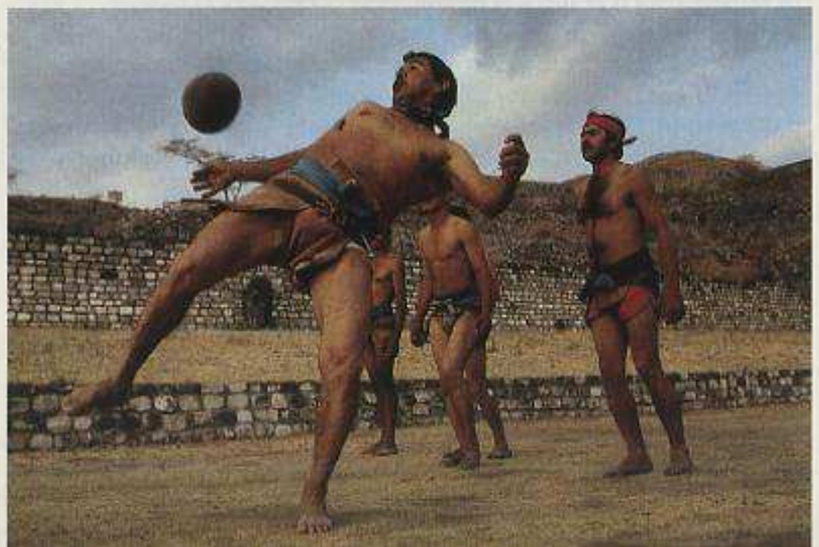
Good evidence indicates that the ancient Maya identified the twins

For the first time since pre-Columbian days the ball court at Xochicalco comes alive on the spring equinox as teams from Sinaloa play a game once common throughout Mesoamerica. In this version of the ceremonial contest—one of 15 local variations to survive Spanish repression—players may hit the hard rubber ball only with their hips as they attempt to keep it in play. For protection they wear cotton padding under a traditional deerskin loincloth.

Accustomed to playing on a flat, unfenced court, the Sinaloa teams discovered that the sloping sides of this ancient court made it easier to keep the ball in bounds. Remarked one: "Now we know how our ancestors played." The survival of such games rests in part on the enjoyment the players and audience derive from betting on the outcome.

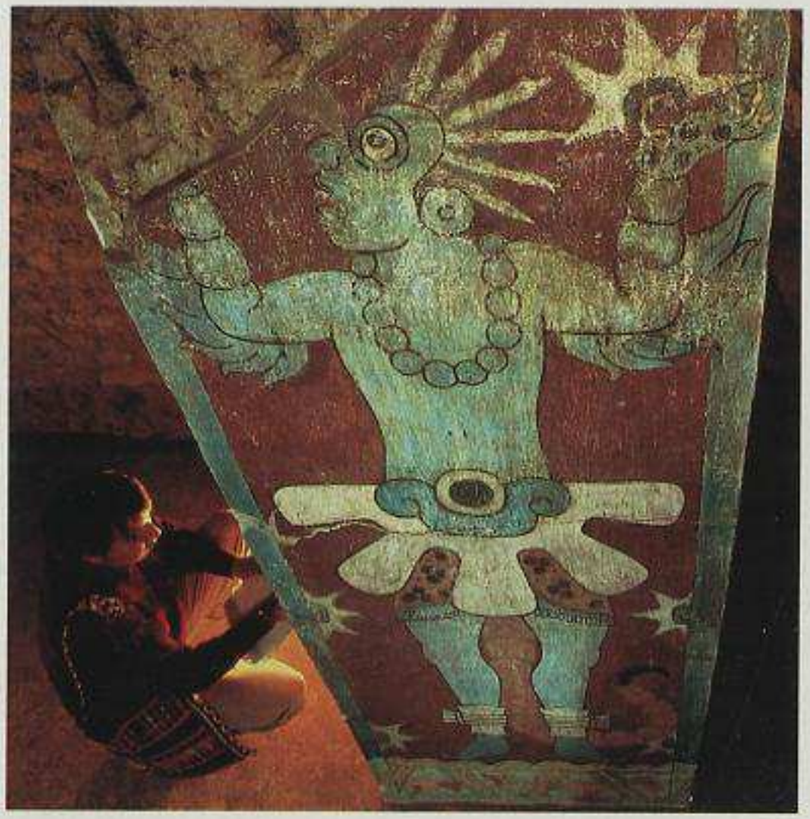
In antiquity players personified celestial beings, such as the powerful Tezcatlipoca, or Smoking Mirror, shown in east (red) and west (black) manifestations in the Borgia Codex (far left), an almanac from the central Mexican highlands. A striped sacrificial victim reveals the probable fate of defeated players.

AKADEMISCHE DRUCK-U VERLAGSANSTALT (BELOW)



Symbols of Venus, the bright planet associated with warfare and death in Mesoamerica, highlight this brilliant mural at Cacaxtla, Mexico, here examined by archaeologist José Eduardo Contreras. The distinctive belt identified Venus in a Maya style, while the five-pointed star with an "eye" was the central Mexican symbol for the death-dealing planet.

The standing male figure reflects aspects of the rain god in his goggle eyes and scorpion tail. The Maya sometimes painted their sacrificial victims blue, and this man may represent a battle captive prepared for sacrifice to appease the rain god.



with the sun and Venus. Astronomically, Venus (Hunahpu) behaves like a brother to the sun (Xbalanque), either rising before it at dawn or setting after it at dusk. The complete cycle takes 584 days.

The other twin, the sun, rises each day at a different point on the landscape and so, from solstice to solstice, apparently travels back and forth along the horizon. By astronomical coincidence, five 584-day cycles of Venus equal eight 365-day years. The Mesoamericans constructed an eight-year almanac based upon the interlocking Venus-sun cycles.

Mesoamericans were also deeply concerned with how that eight-year almanac resonated with the all-important 260-day Sacred Almanac. The latter almanac was a combination of two recurring cycles, one of 13 deified numbers and one of 20 named days.

Imagine putting the periods (260, 365, and 584 days) of the almanacs into a calendar computer set to account for a common arithmetic factor in their joint cycles. Set this computer in motion and behold: the great Venus almanac of 104 years (65 Venus cycles and 146 Sacred Almanacs), which has been tabulated in two of the four surviving ancient Maya books, the so-called Dresden and Grolier Codices.

But what was the great Venus almanac *for?*

To Mesoamericans the bright planet was the opposite of ancient Rome's Venus, the goddess of love; it incarnated warfare and blood sacrifice. Therefore, one purpose of the Venus almanac was apparently astrological—to determine a propitious time for ritual combat and sacrifice. Although we believe the stylized battles resembled the jousts of medieval Europe, the "knights" fought for their lives, and the losers were put to death—sacrificed with honor.

MUCH OF MY OWN RESEARCH in recent years has focused on the Grolier Codex, an almanac devoted exclusively to Venus. The Grolier is the only one of the surviving Maya bark-paper books that has remained in Mexico. Found in a dry cave about 1964, it was acquired by a private collector, though later exhibited. A few scholars were initially of the opinion that the Grolier was a modern forgery, although radiocarbon dates placed the paper in the 13th century A.D. But in 1982 I was able to help demonstrate its authenticity—for it contained information discovered by Maya scholar Floyd Lounsbury only the previous year—something no forger of the 1960s could have known.

This past year, aided by a National Geographic Society grant, I have been able to clarify the identities of two Venus gods portrayed on its pages. One sudden insight came while I was visiting a site in highland Mexico known as Cacaxtla. I looked down into a newly excavated chamber at murals buried for more than a millennium. There stood two life-size, blue-skinned figures, resembling rain gods of a hybrid Maya style, with Venus hieroglyphs on their belts. These figures relate to the themes of warfare, blood sacrifice, and fertility found in the other Cacaxtla murals. And, with their Venus symbolism, they can now be linked to astronomically timed ritual warfare and sacrifice—and to the pages of the Grolier Codex.

In Maya architecture the Venus connection runs particularly strong at the monumental House of the Governor (following pages), the royal palace of a Late Classic ruler of Uxmal in northern Yucatán. The king took his name from the Maya rain god, Chac, an identification made by art historian Jeff Kowalski.

The palace is skewed in orientation from the rest of the site plan. In the early 1970s Anthony Aveni and Mexican architect Horst Hartung discovered that an axis running from the palace's central

One of four known ancient Maya books, the Grolier Codex depicts different manifestations of Venus; the column of glyphs on the left of each panel records days in a 104-year Venus almanac. These plaster-coated bark-paper pages, carbon-dated to the 13th century, represent only half of the 20-page original.

Priests used the almanac to schedule battles. For example, panels 2, 6, and 10 show Venus's evening-star manifestation as skeletal figures carrying weapons; the first appearance of the evening star was a propitious time for war.

The god on panel 6 is decapitating a bound victim. Human sacrifices were needed to appease the gods, the Maya believed, to assure rain, fertility, and the perpetuation of the people and their universe.

ENRICO FERORELLI (ABOVE)

A RESEARCH PROJECT SUPPORTED IN PART BY YOUR SOCIETY

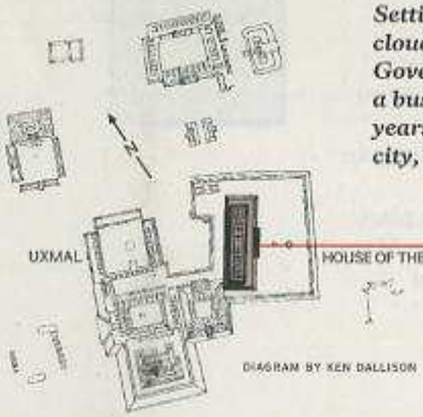


DIAGRAM BY KEN DALLISON

Setting sun confronts angry clouds over the House of the Governor at Uxmal, Mexico, a busy Maya city a thousand years ago. Unlike most of the city, which aligns roughly north-south, this great residence faces southeast. It sights across a pyramid three miles distant to the horizon spot where Venus would have risen at its maximum southern excursion as the morning star about A.D. 900, when the structure was completed.

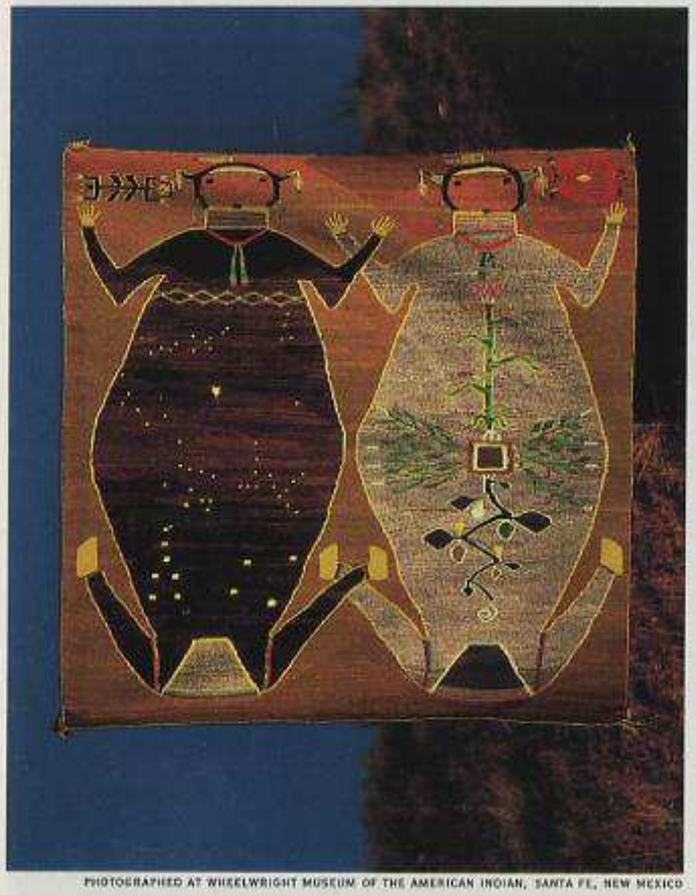
The importance of Venus to the ruler who constructed the palace is written on its face. He assumed the name and glyph of the rain god Chac and ornamented the facade with more than 200 stone mosaic masks of that long-nosed god. Such masks are common Maya decorative devices, but ruler Chac added a special touch. The lower eyelids of each mask are carved with a glyph representing Venus.

PYRAMID AT CEHTZUC

VENUS GLYPH

doorway to a distant pyramid marked the southernmost limit on the horizon of Venus's rising as the morning star during the eight-year almanac cycle. Just last September archaeologist Ivan Šprajc demonstrated that a 25-foot-tall pyramid at the site called Cehtzuc was positioned precisely at that point.

Might that alignment be merely a coincidence? That would be most unlikely, for—unique in Maya sculpture—all the scores of rain-god masks decorating the palace's upper facade bear Venus glyphs on their lower eyelids. Moreover, masks on two of the lower corners display the number eight! Surely the mighty Lord Chac must have stood before dawn in his palace doorway to watch the war god, Venus, rise before his twin brother, the sun—triumphant heroes of the *Popul Vuh* epic.



PHOTOGRAPHED AT WHEELWRIGHT MUSEUM OF THE AMERICAN INDIAN, SANTA FE, NEW MEXICO

***Mother Earth, Father Sky*—sacred Navajo figures—must be depicted as "identical in shape and size since they are the two halves of a whole creation," according to Navajo lore. In this 50-year-old tapestry, sacred plants grow from Mother Earth; stars and Milky Way embellish Father Sky, shown against his domain. The image is turned to display the figures upright.**

THERE IS A PLACE in the southwestern U. S. where four realms converge along perpendicular east-west, north-south lines on a single point. Visitors can hardly stop themselves from performing a common ritual. Each will put one foot in one realm and one in another, then one hand in the third and one in the fourth. Here at the Four Corners the realms are New Mexico, Colorado, Utah, and Arizona, with the lines being state boundaries laid down in the 19th century. But there is a much older fourfold realm here—the Dinétah, sacred homeland of the Diné, as the Navajo call themselves. Here is their place of origin, bounded by four "world mountains": the San Francisco Peaks (west), Hesperus Peak (north), Blanca Peak (east), and Mount Taylor (south).

With my friend Von Del Chamberlain, a specialist in the astronomy of native peoples, I was eager to travel back again into the far reaches of the Dinétah. Harry Walters, from Navajo Community College at Tsaile, Arizona, served as guide to the domain of his ancestors, a world of desert mesas and sagebrush canyons. Hiking along canyon trails, we found ruins left both by the Navajo and the Anasazi, the "ancient ones" who had lived here before the Diné.

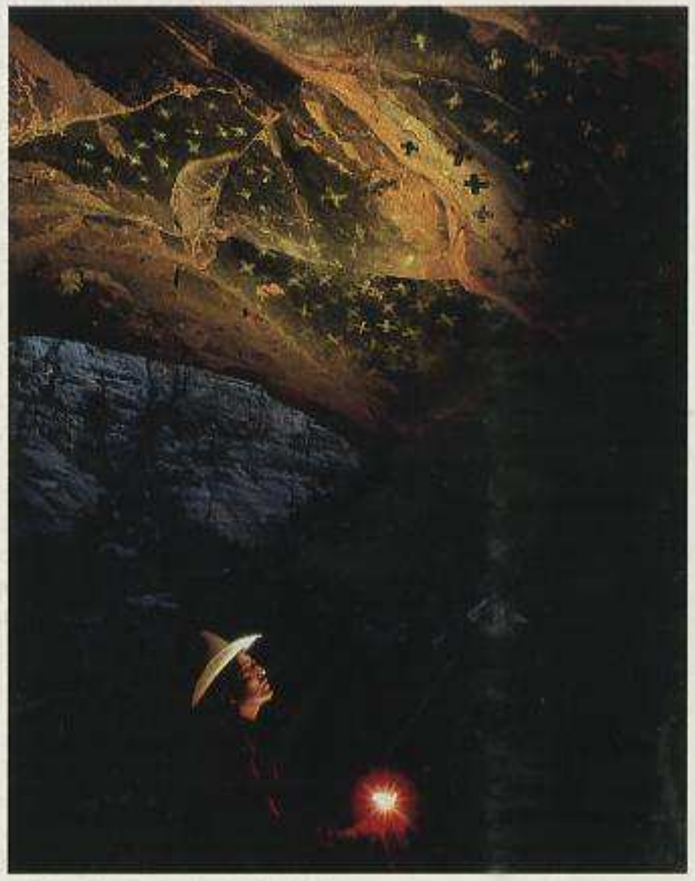
We also found images inscribed and painted on canyon walls and in rock-shelters. Among these were representations of the Yei, holy beings resident before the First People emerged into this, the Fourth World. One image, in the shape of an hourglass, was Child Born of Water. A bow-and-arrow figure nearby might well have represented his twin brother, Monster Slayer. This pair calls to mind the Hero Twins of Mesoamerica and other twins in pre-Columbian myths.

At day's end we came to the head of a blind canyon, where ancient images of power covering the rocks reddened in the fading sunlight.

We soon had a campfire of cottonwood branches blazing, and the smell of steaks, roasting corn, Navajo fry bread, and coffee mingled with the pungent odors of sage and earth. As we joked and told stories, moving closer to the dying embers, the unseen dimension of the Dinétah penetrated our consciousness. The great sparkling dome of the desert's night sky brought home an old but deep truth. To ancient Americans the night sky was brilliant, mysterious, powerful, a vital aspect of daily experience.

They carefully observed the comings and goings of its bodies. They peopled it with beings whose epic journeys affected the rhythms of their own lives, beings who wove human destinies into the fabric of eternity, like the finest Navajo blanket.

To most modern-day Americans, though, the night sky is routinely banished by our house lamps and all but erased by the lights of our cities and suburbs. There's not much magic—or even astronomy—in it now. We are, you might say, too enlightened.



This "star ceiling" was found in a rock-shelter in Canyon de Chelly National Monument, Arizona, by Navajo teacher Harry Walters. Such pictographs may represent a hero who traveled to the heavens to receive ritual knowledge from the stars. Another version from Navajo mythology: Symbols keep the rock ceiling from falling, as stars hold up the sky.

LATER, in Canyon de Chelly National Monument in Arizona, Harry, Von Del, and I climbed at midday to a broad-domed natural shelter recessed high on a red-rock canyon wall and filled with the remains of long abandoned dwellings. We looked up to an overhanging outcrop and saw a night sky. Overhead on the soot-darkened vault shone a spray of stars, four-pointed crosses as the Navajo draw them. Some might form Navajo constellations, but most seemed randomly placed. There is much speculation about the "star ceilings" (maybe five dozen are now known), how the stars were placed, and why. One Navajo legend has it that as the stars are seen to hold up the night sky, so these stars were painted to support the roof of the shelter and protect the people and dwellings below.

How, by the way, did the stars get into the sky? Early in the 20th century, the great Navajo *hatali,* or medicine man, Hosteen Klah told a story about First Woman and First Man beginning the task. First Woman decided to spell out all the laws needed by the First People. Laws could not be written in sand or on water, since few people would see them before they disappeared. But when the laws were written in the sky, everyone could look up and study them.

First Woman and First Man had all the stars laid out on a blanket and were setting each star in place when the trickster Coyote came along. Coyote wanted to help, but the work of placing and naming the stars was too slow for him. So he grabbed a corner of the blanket and flipped the remaining stars into the sky. This is why the sky, and perhaps the star ceilings too, are filled with such a confusing array.

Under the same high Canyon de Chelly rock-shelter where Harry, Von Del, and I had looked up at the star ceiling stands a half-buried kiva. This circular underground ceremonial chamber built by the Anasazi 700 to 800 years ago has counterparts that Pueblo Indians use today. Archaeologists find that kivas virtually always have a small hole in the floor, called the *sipapu* by the Hopi, the symbolic place of emergence from the underworld. They also have an entrance hole with a ladder in the center of the roof, symbolizing the final emergence into the world of the sun. Both emergence myths resemble those of the Mesoamericans, with whom the Anasazi traded.

From Canyon de Chelly a line running east across Arizona would intersect Chaco Canyon in the San Juan basin of northwest New Mexico. Chaco Canyon—with its great kivas, extensive ruins at Pueblo Bonito, and other Anasazi sites—is still special for me. It was the first place I went in 1973 with astronomer Ray Williamson to do field research in archaeoastronomy. With tape measure, surveyor's transit, and an old shortwave radio to pick up the time standard signal originating from the National Bureau of Standards, we combed the magnificent masonry of the ruins to survey and measure alignments of kivas and other notable structures. We found, for instance, that a great kiva in Pueblo Bonito aligned true north-south and that the town's massive southern wall ran east-west.

With its many great pueblos Chaco Canyon flourished between the 9th and 13th centuries as the center of a culture whose outposts were spread as far as 130 miles away. Chaco was the hub of an extensive road system, with segments radiating straight as arrows to outlying pueblos.

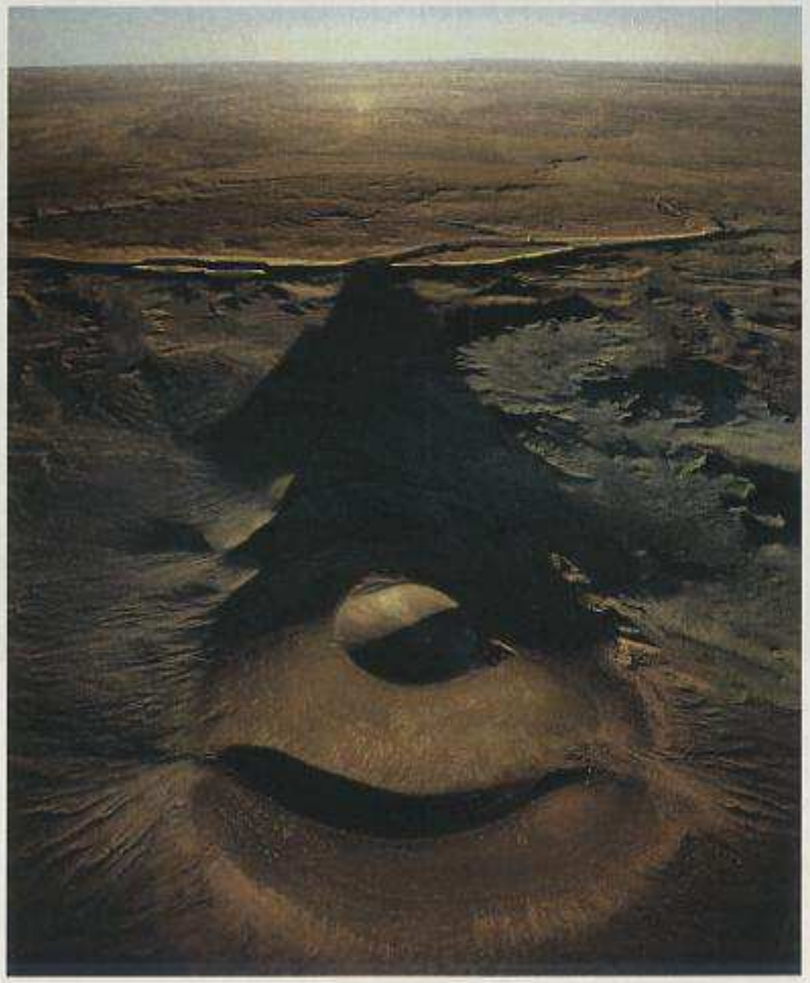
One of the longest segments, the Great North Road, ignores difficulties of terrain as it dips into gulches and rises over mesas 30 miles due north, then jogs to a place known as Salmon Ruins. Such direct connections bring to mind the Nazca Lines and the long, paved roads called *sacbes* that radiate from many lowland Maya centers. In fact, this tradition of straight lines between sacred places in a ritual landscape can truly be called pan-American.

ARCHAEOLOGISTS STILL DEBATE the nature of the huge complex at Chaco: Was it the hub of a trading network, a redistribution center, perhaps even a ceremonial center? We may never know. Yet most would now agree that at the heart of the Chaco system the great kivas such as Casa Rinconada served as the ceremonial gathering places for the Anasazi.

Casa Rinconada stands alone on the south side of the canyon, a kiva 63 feet across (pages 78-80). The massive roof, which must have collapsed centuries ago, is now all gone. What remains are four foundation holes dug to hold mighty wooden pillars that supported it. The holes form the corners of a square with sides oriented to the cardinal directions. This arrangement recalls a legend of Acoma Pueblo, one of the groups descended from the Anasazi. In the Acoma story four different trees grew up from the underworld to give the First People a way to climb to the surface.

Casa Rinconada's twin T-shaped entrances are aligned on a north-south axis. An unusual sipapu ramp enters from the north by way of a chamber below. From this entrance celebrants—probably looking much like kachinas, the dancing gods of the Pueblo Indians—might have made their dramatic emergence from the underworld into

BOB SACHA WITH GEORGE DULLECK



The subject is the universe for artist James Turrell, who is creating a monumental earth sculpture in the Arizona desert to give viewers a heightened perception of the cosmos—an experience common for early American skywatchers.

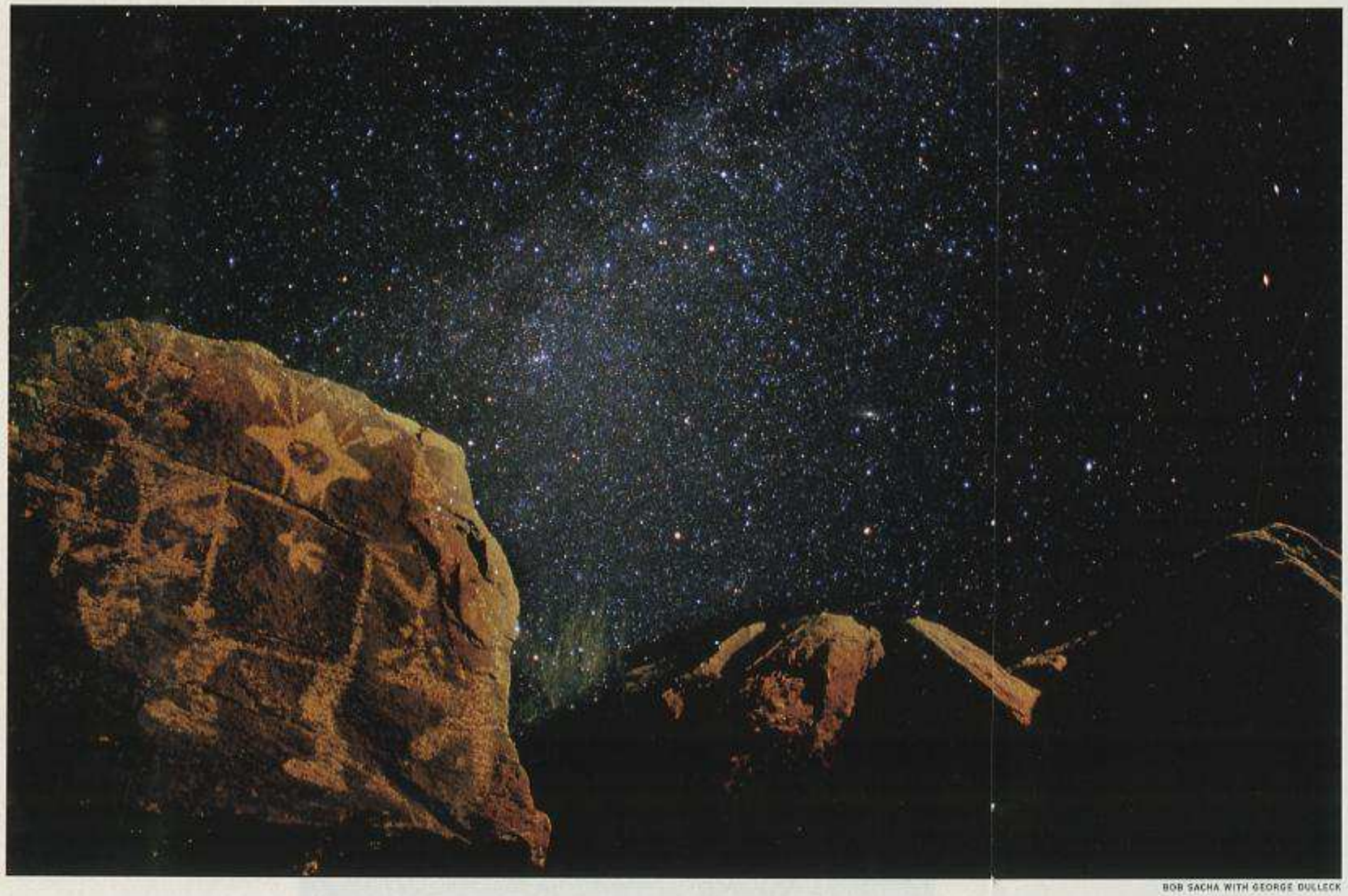
During visits to ancient Mesoamerican sites, Turrell had been inspired by the sense of power and presence in places "emptied of their use." In 1974 he located Roden Crater, an extinct volcanic cinder cone (lower), while flying a small plane near Flagstaff. He purchased the cone with its surrounding area, 1,100 acres in all, and has been reshaping spaces and sight lines with bulldozers and graders ever since.

When Roden Crater is open to the public, Turrell will encourage viewers to lie on their backs in the center of the crater to view the heavens as a vault outlined by the rim (top).

the dark chamber to the sound of a throbbing ceremonial chant.

I could imagine them when I arrived for sunrise at summer solstice one year and heard the plaintive sound of a flute being played by a young woman sitting alone in the ruins like the old hunchbacked flute player Kokopelli of Hopi myth. I waited to see the first rays enter a window on the upper northeast side and illuminate a niche across the room.

Up the canyon from Casa Rinconada, on the mesa near ancient Wijiji Pueblo, are the remains of one of the most compelling sun-watching sites of the Anasazi and of the Navajo who came there much later. From a rock ledge marked by a four-pointed,



BOB SACHA WITH GEORGE DULLECK

white-painted sun symbol, one can look across the canyon to a natural sandstone column rising above the horizon. According to astronomer Michael Zeilik, who has studied the site for years, an ancient sunwatcher making observations from that ledge could watch the rising sun move closer and closer to the column until the day it appeared directly behind it—the winter solstice.

The duty of the Pueblo sunwatcher was not just to announce the actual day of solstice, but to anticipate that day in order to initiate the ritual cycle at the appropriate time. As Ray Williamson has emphasized, the presence of Navajo sun symbols and other sacred images—including one or both of the mythical twins on nearby rock panels—suggests that Navajo sunwatchers as well as the Chaco Anasazi may have anticipated the sun's renewal at Wijiji.

Among the Navajo it is the hatali who is called upon to reestablish *hozho*—balance, harmony, and beauty—in the world when it has fallen out of kilter. When someone is ill, in need of physical and spiritual balancing, the hatali may be asked to perform a ceremony that includes making a sand painting on the floor of a traditional hogan.

I witnessed the creation of such a sand painting by a venerable hatali named Mike Mitchell. At my request it was the image of Father Sky, taken from the "Male Shootingway Chant."

After carefully preparing the fine sand brought to the center of his hogan, Mike sat down with his rainbow palette and brought Father Sky alive before us. The sun, moon, Milky Way, and constellations such as Rabbit Tracks adorned his celestial form. As soon as Mike completed the painting, he quickly erased it; the inherent power of such sacred images is not taken lightly. Gathering up all the sand in a cloth, he took it far from his hogan and scattered it to the four winds.

As I watched silently, I remembered the audacity of the hatali Hosteen Klah, who first dared to record such magical creations in the only permanent form he judged appropriate. That his sacred knowledge should not be lost, that the celestial relationship of Mother Earth and Father Sky should endure, he wove the fabric of the Navajo cosmos into a blanket with the shuttles of his loom.

And today I had witnessed his legacy still alive.

Sensing that my pilgrimage in American archaeoastronomy had come to the completion of a cycle, I heard in my mind a favorite passage from the Navajo "Nightway Chant":

With Harmony may I walk, / With Harmony behind me, may I walk, / With Harmony above me, may I walk, / With Harmony below me, may I walk, / With Harmony all around me, may I walk. . . . / It is finished in Harmony, / It is finished in Harmony. □

An ancient figure carries symbols of rain and fertility in this petroglyph pecked in the dark patina of a basalt boulder in northern New Mexico between 1300 and 1500. The four-pointed feathered symbol on the head may represent the morning star and identify the figure as Sotuqnangu, the Hopi god of sky, clouds, and rain. That deity bears striking resemblance to the Aztec god Quetzalcoatl, who discovered maize and invented the calendar. The connection seems likely, since trade networks linked the American Southwest to central Mexico. Mesoamericans had domesticated maize by 3500 B.C., and that technology spread to the Southwest by 1000 B.C., probably with the rituals and gods that would assure its success.

The Milky Way beyond recalls the practice of stargazing still followed by some Navajo to diagnose illness and locate lost objects. Their forebears, like other early Americans, believed in promoting reciprocal relationships with the cosmos to assure their very survival.

Exhibit 9

Stairways to the Stars

Skywatching in Three Great Ancient Cultures

Anthony Aveni

STAIRWAYS TO THE STARS

SKYWATCHING IN THREE GREAT ANCIENT CULTURES

Anthony Aveni

John Wiley & Sons, Inc.
New York • Chichester • Weinheim • Brisbane • Singapore • Toronto

Published by John Wiley & Sons, Inc.
Published simultaneously in Canada.

Library of Congress Cataloging-in-Publication Data:
Aveni, Anthony F.
Stairways to the stars : skywatching in three great ancient cultures / Anthony Aveni.
p. cm.
Includes bibliographical references and index.
ISBN 0-471-32976-2 (paper : alk. paper)
1. Astronomy, Ancient. 2. Astronomy, Prehistoric. I. Title.
QB16.A88 1997
520'.93—dc20 96-36517

tory, ethnology, ethnohistory, and the history of science. The study of astronomy has become a part of the study of human culture.

I designed *Stairways to the Stars* for readers interested in history and anthropology as well as science. I intend it to be a source of understanding how the art of skywatching developed in the Western tradition as well as in other major cultures of the world. To exemplify how archaeoastronomy has evolved over the past three decades, I have chosen to write about the remains of three well-documented, quite diverse culture areas that I believe best demonstrate the way we archaeoastronomers use unwritten evidence to understand the nature of astronomy and its role in the society that practiced it. The first, Stonehenge, represents a thoroughly preliterate culture in which the role of astronomy has proven to be quite controversial. Our second area, the Maya, emanates from a literate people known for their sophistication in calendrics and numeration. It also represents an area of the world where discoveries by archaeologists and script decipherers have unfolded at a staggering pace. Finally the third culture area, the Inca, represents a highly urbanized hierarchical society that developed an extensive empire. Their world has only recently begun to attract attention, thanks again to major archaeological findings.

To assist those who would like to be able to see the sky the way the ancients did, I have preceded the presentation of all the culture material with a lesson in simple naked-eye sky watching. For those who would reflect more deeply on the subject, a series of exercises, "Things to Think About," appears in Appendix A. Also, I have added a short description of archaeoastronomical field methods in Appendix B. Selected readings are recommended for readers who might care to pursue additional case studies. Finally, I have appended an annotated research bibliography for those who might wish to probe further the three cultures or to look into what we know about the astronomies of ancient cultures in other parts of the world.

My gratitude goes out to three very special people: Jacqueline D'Amore, Patricia Ryan, and Lorraine Aveni who assisted in the preparation of this manuscript and its illustrations, to Clive Ruggles for his advice, to Peter Tagtmeyer for his bibliographic search, to Jessica Deckard, who helped with proofreading, and to Ellen Walker, who did most of the drawings.

Thanks are also due Faith Hamlin, my agent, and Emily Loose and her staff at Wiley, especially Joanne Palmer, to David Golante, the eagle-eyed indexer, and to Jose Almaguer for the beautiful cover design.

Anthony Aveni

Though investigators were strongly attracted to the megalithic sites in Europe in the 1960s, by the 1970s they began to measure and map out astronomical building orientations in other parts of the world, particularly in the Americas. By the mid-1980s and 1990s, books dealing with the astronomies of ancient cultures of Italy, Mexico, and Peru had been published—a whole volume dealt with the Canary Islands alone. (See Appendix C for some of these references.) Though there is much chaff among the wheat in many of the treatises, more than enough new information and ideas remain to captivate the interest of those whose lifework is studying culture. In the past two decades many anthropologists and historians have become attracted to these new discoveries. They have become more seriously interested in just how important astronomy was and precisely where a people's knowledge of the sky fit into the picture.

Perhaps nowhere is the use of celestial knowledge more dramatic in its impact than in the world of the ancient Maya. Their rulers carefully tailored their pursuits, or so they tell us in their monumental inscriptions, after the comings and goings of particular celestial luminaries, Venus especially. After assessing the Bronze Age astronomy of Stonehenge, we turn to how and why the Maya's star-crossed destiny was rooted in celestial observation.

Archaeologist Sir Eric Thompson once suggested that to understand Maya astronomy one needed to get into the skin of the Maya astronomer. He meant that a knowledge of the history and culture of these Native American people was vital if we would ever hope to understand their celestial systems. Input from the archaeological discipline is important, too, because it represents a large part of the surviving record.

As an astronomer I became fascinated by the Maya because they seem to have been carried away with their celestial obsessions. The precision of the mathematical expression associated with their skywatching rivaled that of Babylonia and Greece and they managed all of it with a relatively low technology. They built skyscraper pyramids to penetrate the top of the jungle canopy that enveloped most of their culture for more than a thousand years. Another peculiarity (at least in our eyes) is that Maya astronomy was driven by astrology—using the stars to predict the future course of a ruling elite who believed they were the direct descendants of the gods. They even publicly offered their blood to the heavenly ancestors to reinforce their belief.

Once he became large and round like a skillet, the Aztec legend continues, observers could see that the moon has a rabbit stretched across his face (Figure 2.9a). One day when the gods were taunting him, the story goes, they flung a rabbit at him, dimming his face enough so that he could not be confused with the life-giving sun.

Compared with the annual oscillating motion of the sun, the moon's cycle of changes is far more complex. Yet the lunar disk, as the Aztecs long suspected, is the solar opposite, its darker counterpart imitating in mirror image whatever the sun does.

That the second brightest luminary in the heavens passes through phases was surely the most obvious lunar aspect to register in the minds of archaic observers. In Western lore the phase cycle depicts the career of the Man in the Moon (Figure 2.9a). He begins his adventure when the waxing crescent first appears by fighting off the devil of darkness, a dragon, who has eaten up his father, the old moon. No sooner does he reach the height of power at full moon than the old enemy, the devil of darkness who conquered his father, begins to attack and wear him away.

Like the sun and the stars, the moon also rises and sets at the same tilt relative to the local horizon; however, for over half its cycle, the moon is visible for longer periods in the day than in the night sky. Sometimes for a couple of days it is totally absent both day and night. But it is the inconstancy of the way the moon's face looks, the way it changes dramatically and repeatedly, that makes it unique as a celestial body: from a thin sickle to a D-shaped quarter, then to a bulgy egg, and finally, like the golden sun, to a full, if somewhat tarnished, silvery disk. Over the course of a number of days that you could tally on your fingers and toes, you could watch the moon pass through half of its phases from thin crescent to a fully illuminated disk in the sky around dusk. Then you could follow the other half cycle in reverse if you watched the skies just before dawn.

A persistent skywatcher could also chart from memory the course of the moon among the constellations of the zodiac. If you imagine the starry background to be held fixed, you will notice that the moon shifts about a handspan held at arm's length per night from west to east; in other words, it does what the sun does throughout the seasons, only much faster, moving opposite to the normal east-to-west daily motion of the stars across the sky in a month instead of a year.[9]

saros, which means repetition. As Table 2.1 indicates, counting forward 223 new moons from the time of a solar eclipse (column 3), we would expect another solar eclipse to occur, because the *saros* interval is also a whole number of draconic months, 242 to be exact (column 4). If the first eclipse took place exactly at the node, the second would occur shortly before the moon arrived at the node. This is because 242 draconic months is actually about one hour longer than 223 synodic months; therefore the new moon will be one hour (about ½°) short of arrival at the node on the occasion of the second eclipse. The third eclipse in the series, 223 synodic months later, would occur a full degree (two lunar diameters) west of the node. After about thirty-five eclipses, the moon would slide off the end of the region about the node within which eclipses are possible, thus terminating a particular series. The *saros* probably attracted further attention because it is also nearly equal to a whole number of years (column 2)—again two cycles that fit together perfectly. This means eclipses in the *saros* series are seasonal—that is, they occur at approximately the same time of year, backsliding an average of 11 days per cycle. Recognizing such long-term patterns of eclipses like those indicated in Table 2.1 would have called for far more attentive skywatching than that required to detect patterns of solar and lunar standstills. Consequently, many scholars argue that cultures that utilized these periods in their astronomical calendars also must have developed sophisticated notational systems—written records to pass such knowledge on to their descendants. This, too, will turn out to be a bone of contention in our study of ancient astronomies.

RETURNING WANDERERS

The Greeks called the planets "wanderers" after the Babylonians who characterized them as sheep who escape from the fold—presumably the rest of the stars. This is because they move against the natural grain of the east–west daily motion of the stars. Red Mars, bright white Venus, swift Mercury, and slower-moving Jupiter and Saturn—each possesses its own unique track across the zodiac. And each was a reigning deity endowed with human char-

indicated the time was right to plant the crops, that the nearby river would soon overflow its banks, or that the monsoon season was about to arrive. The planting and harvesting of crops could have been regulated by a whole series of celestial events, many of which were discussed in the preceding chapter.

We cannot overestimate the importance of predicting and following seasonal change among these people. For them, time was activity itself. It was *lived* rather than kept on a watch. Getting a sense of time from skywatching is difficult for us to appreciate because we no longer have need of practical astronomy in our daily lives; therefore we tend to pay little attention to the heavens, except maybe as an occasional diversion. We might catch a sunset, glimpse the Man in the Moon, or notice the evening star. But we would never think of such casual observations when setting up appointments or scheduling activities. The artificial clocks by which we pace our daily activities give us a distorted view of the dependence of human time on phenomena that happen in nature and in the heavens.

There was more to prehistoric astronomy than timekeeping. Skywatching influenced many different aspects of ancient cultures. We find the sun, moon, and stars woven into myth, religion, and astrology. Representations of deified celestial luminaries adorned their temples as objects of worship and they were symbolized in sculpture and other works of art. Believing they lived in an animate universe made up of component sky and earth deities who were in one way or another extensions of themselves—fighting endless wars, loving and hating, surviving life after death—many of our ancestors who followed the time-bearing luminaries attached rites or reenactments of life's vital functions to special days on nature's calendar. They would hold feasts and make offerings in order to pay their debts to the gods for a bountiful year or perhaps in anticipation of a better crop yield after hard times. The ancients literally would talk to the sun and moon, converse with the planets.

Given this scenario, staking out a set of markers in the landscape to graph the whereabouts of the gods would have been part of ancient common sense. (Try it in the example I give in Appendix A.) Devices that could predict sky phenomena well in advance would offer one group of people a powerful advantage over their uninformed neighbors. The space within which they followed the sky gods and conducted their discourse with them might well be regarded as hallowed ground, a sacred space administered by the wisest of the wise.

the solar extremes. He appears to have sought them out as a logical next step once he discovered that Stonehenge marked the solar horizon limits. Apparently, once he decided that he had achieved a positive lunar alignment correlation, he began to analyze the Aubrey Holes as a seasonal eclipse counter; it is only then that he proposed the eclipse-observatory hypothesis for Stonehenge, evidently believing that the lunar limits served as a tool for predicting eclipses.

Recall that Hawkins also considered it possible that Diodorus's statement about a temple on the island of the Hyperboreans may have referred to Stonehenge and that the 19-year period mentioned in the statement could be connected with the lunar standstills and the nodal regression period. But the last phrase of the quotation from Diodorus on p. 68 clearly identifies the 19-year period with the Metonic cycle and not with the nodal regression cycle. Alexander Thom also justified the search for ancient observations of the lunar standstills, but for a different set of reasons. He inferred that "men living on the coasts of the western ocean must have noticed the connection between the tides and the Moon."[19] He claimed that this was a major factor that compelled Megalithic people to study the movements of the moon. Eventually, the skywatchers of Stonehenge were able to predict which new or full moon would give rise to an eclipse of the moon or the sun. Building on progressive reasoning, Thom concluded that "The 18.6-year cycle would obtrude itself . . . and an analogy with a probably earlier study of the solstices would suggest the use of a horizon mark with a back-sight."[20]

These assumptions, taken together with the speculation that sooner or later someone would notice that eclipses happened at the new or full moon nearest the date when it reached its standstills, account for Thom's later discovery of minuscule variations in the moon's movements, which he argues the astronomers marked out via the arrival of the lunar disk at particular bumps and notches on the horizon. In both Thom's and Hawkins's views, the desire to predict seasonal eclipses is the *raison d'être* for paying attention to the lunar standstills. (Cycles of eclipses that fall at the same point in the solar year would more likely have been thought to be connected with seasonal change and perhaps be easier to detect.) Both Hawkins and Thom portray the megalithic builders as progressive people who were challenged by repeatedly witnessing these impressive phenomena—people who possessed a desire to master eclipse prediction.[21]

> the stars, and disputed with them on all different questions connected with them.[3]

Exactly what was this astrologer-king observing? What equipment was he using? How did he record his knowledge? These are all questions twenty-first-century students of astronomy are bound to ask, and sadly, none of them can be readily answered.

One text even goes so far as to mention specific native constellations. In the *Crónica Mexicana,* the post-Conquest historian Alvarado Tezozomoc gives an account of the formalities that took place upon the election of Montezuma Xocoyotzin, king of the Aztecs. Following a long list of religious duties, he was exhorted:

> especially to make it his duty to rise at midnight and to look at the stars: at *yohualitqui mamalhuaztli,* as they call the keys of St. Peter among the stars in the firmament, at the *citlaltlachtli,* the north and its wheel, at the *tianquiztli,* the Pleiades, and the *colotl ixayac,* the constellation of the Scorpion, which mark the four cardinal points in the sky. Toward morning he must also carefully observe the constellation *xonecuilli,* the "cross of St. Jacob," which appears in the southern sky in the direction of India and China; and he must carefully observe the morning star, which appears at dawn and is called *tlahuizcalpan teuctli* [see Figure 4.2].[4]

But the words of historians passed down to us about Maya sky watching are even more far-reaching than this, for they tell of a people who used mathematics and writing to explore the science of the sky, which seems to have been based on the precise timing of celestial events. Of the Maya astronomers, Bishop Diego de Landa, on the scene in Yucatán within a decade of the conquest, says:

> They have their year as perfect as ours. . . . They used as a guide by night, so as to know the hour of the morning star, the Pleiades and the Gemini . . . [and they made use of] certain characters or letters which they wrote in their books their ancient matters and their sciences. . . .[5]

The chronicler Jose de Acosta gives details about these texts, fashioned of lime-coated bark, describing them as:

> books of leaves, bound or folded after a fashion, in which the learned Indians kept the distribution of their times and the knowledge of plants, animals, and other things of nature and the ancient customs, in a way of great neatness and carefulness.[6]

In the central Mexican books called codices (a misnomer for folding screen documents made of deerskin), a number of pictures help to illuminate our understanding of the techniques and objectives of practical astronomy in Mesoamerica. For example, the Codex Mendocino, or Mendoza (1831), a picture book produced shortly after the conquest, tells about various aspects of the lives of certain members of the Aztec noble class in their capital city of Tenochtitlan. The first three parts of Figure 4.3 are taken from it. Figure 4.3a contains adjoining captions written in Spanish and based on interviews with native informants. The seated priest is said to be "watching the stars at night in order to know the hour, this being his official duty." An inverted hemisphere studded with stars, symbolized by half-shut eyes, hangs over his head. In Figure 4.3b, which appears adjacent to it, another priest is beating on the *teponaztli,* a wooden drum, to announce the time of night as determined from the observations of the first priest. Finally, Figure 4.3c informs the reader that the time of night is recognized as suitable for the performance of an obvious agricultural function. These drawings emphasize the utilitarian role of nighttime sky watching among urban highland people, a theme we will follow to a greater extent among the Maya of Yucatán.

One of the great mysteries of New World astronomy lies in comprehending just how these people could have charted their tropical sky. Theirs was a low-tech culture that possessed no calculating devices, telescopes, or measuring apparati. But some pictorials are more explicit; thus, in Figure 4.3d, from the Bodleian Codex, we find a picture that has been well established by epigraphers as a logo or place name representing the ancient town of Tilantongo, near modern Oaxaca. But the picture also may contain some insights into astronomy. We see the profile of a man situated in a chamber within a temple. He peers out the doorway and looks over a pair of crossed sticks, as if to mark the place of an astronomical event on the horizon. The

sun sets on the day of passage through the antizenith, for obvious agricultural reasons. Second, Inca timekeepers built a pair of pillars to mark the June solstice sunset point as viewed from Lacco, a complex of rock carvings on a hill north of Cuzco. And finally, they erected a pair of pillars to mark the December solstices as seen from Coricancha, the center of the *ceque* system.

If we feel uncomfortable accepting a system of alignments with three different centers of observation, perhaps we should reflect on Jacquetta Hawkes's statement (in Chapter 3) about "getting the Stonehenge we desire." Like Inigo Jones's or John Aubrey's reconstructions of Stonehenge, Garcilaso's and other chroniclers' descriptions of Cuzco need to be viewed through a Renaissance eye that perceived architecture as symmetrical. Moreover, given the low level of cosmological thought the chroniclers believed the Inca to possess, their record is likely to be quite incomplete. Indeed, when it came to scientific matters, those learned men seem to have turned a deaf ear to their informants.

Like Britain's Stonehenge and Uxmal's House of the Governor, which also were built with the sky in mind, the *ceque* system had many overlapping purposes. We can think of it as a mnemonic scheme that organized space, time, and social hierarchy in Inca society. At the same time hydrological principles and kinship also contributed to the structure of Cuzco's urban plan. Further complicating the problem is the issue of straightness. Where does this argument about straight *ceques* come from? That it is not a purely Euclidean idea rooted in the minds of modern Western researchers but instead is a genuine indigenous concept seems clear, as clear as the fact that our monthly calendar is ideally based on the phases of the moon, even though not a single one of the twelve months that make up the year has a length equal to the actual, measured phase cycle. In Quechua the word *ceque* (Spanish *raya*), the name given by Cobo's informants, means "straight" (ahead). Differences of opinion among investigators today seem to revolve around how close to straight the lines really were in practice. The work goes on, and the answer to the question How straight were the *ceques?* will have definite consequences, one way or the other, for future theories about astronomical alignments.

I think what stands out most about Inca skywatching is the way they used the natural order they perceived in the landscape as a means of structuring

their social order. The *ceque* system functioned like clockwork only when each particular class performed its assigned function in the proper place along its *ceque* line at the correct time of year. Thus, the people of Hanan-Cuzco were in charge of the June solstice observations and offerings, while those in Hurin-Cuzco took care of the December solstice.[26] In this confrontation between nature and culture, in a harsh, difficult, and changeable agricultural environment, the *ceque* system served to map out and prescribe proper human action based upon residence and kinship in a radial, subdivided geographic framework. It was, like Jorge Luis Borges's fictive description of cartography gone awry, a virtual map of itself:

> In that Empire, the craft of Cartography attained such Perfection that the Map of a Single province covered the space of an entire City, and the Map of the Empire itself an entire Province. In the course of Time, these Extensive maps were found somehow wanting, and so the College of Cartographers evolved a Map of the Empire that was of the same Scale as the Empire and that coincided with it point for point. Less attentive to the study of Cartography, succeeding Generations came to judge a map of such Magnitude cumbersome, and, not without Irreverence, they abandoned it to the Rigors of sun and Rain. In the western Deserts, tattered Fragments of the Map are still to be found, sheltering an occasional Beast or beggar; in the whole Nation, no other relic is left of the Discipline of Geography.[27]

"When Venus stands high, pleasure of copulation. When Venus stands in her place, upraising of the hostile forces. . . ."[5] So reads a Babylonian omen. As much as we might laud the Babylonians for their careful observations and their astronomical predictive skills, we must never lose sight of the fact that for them, just as for the Maya, the underlying motive for seeking intricate patterns in the heavens was astrology. A frustrated seventh-century-B.C. skywatcher in the royal court lamented:

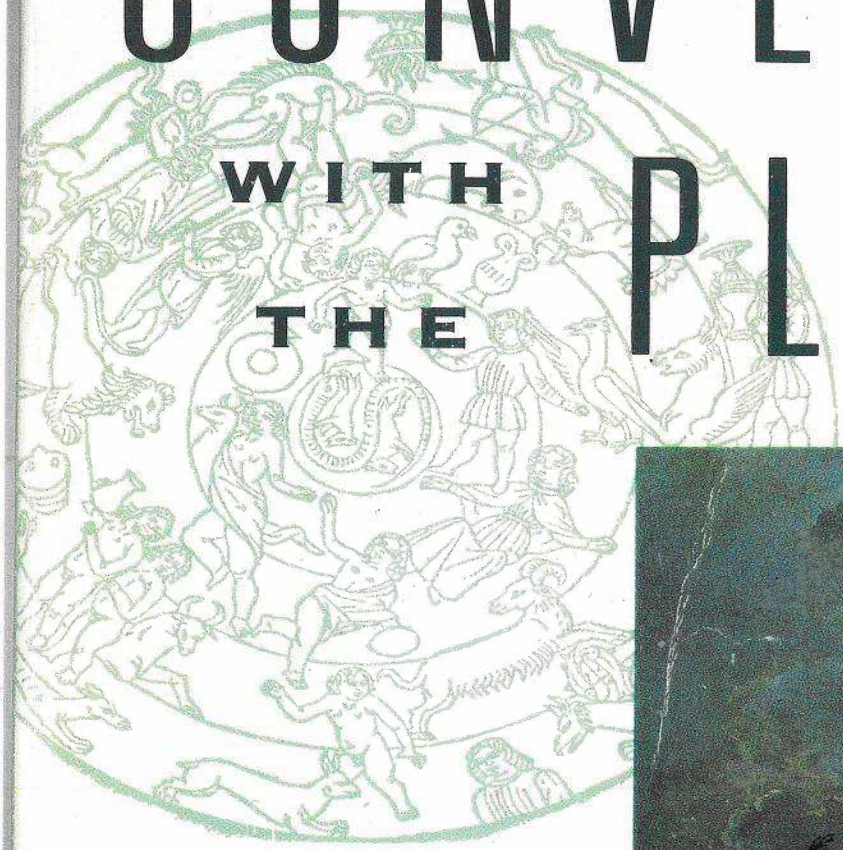
> The king has given me the order: Watch and tell me whatever occurs! So I am reporting to the king whatever seems to be propitious and well-portending [and] beneficial for the king, my lord [to know]. . . . Should the king ask, "is there anything about that sign?" [I answer], "Since it [the planet Mars] has set, there is nothing. . . ." Should the lord of kings say, "Why [did] the first day of the month [pass without] your writing me either favorable or unfavorable [omens]?" [I answer], "Scholarship cannot be discussed [heard] in the market place!" Would that the lord of kings might summon me into his presence on a day of his choosing so that I could tell my definite opinion to the king my lord![6]

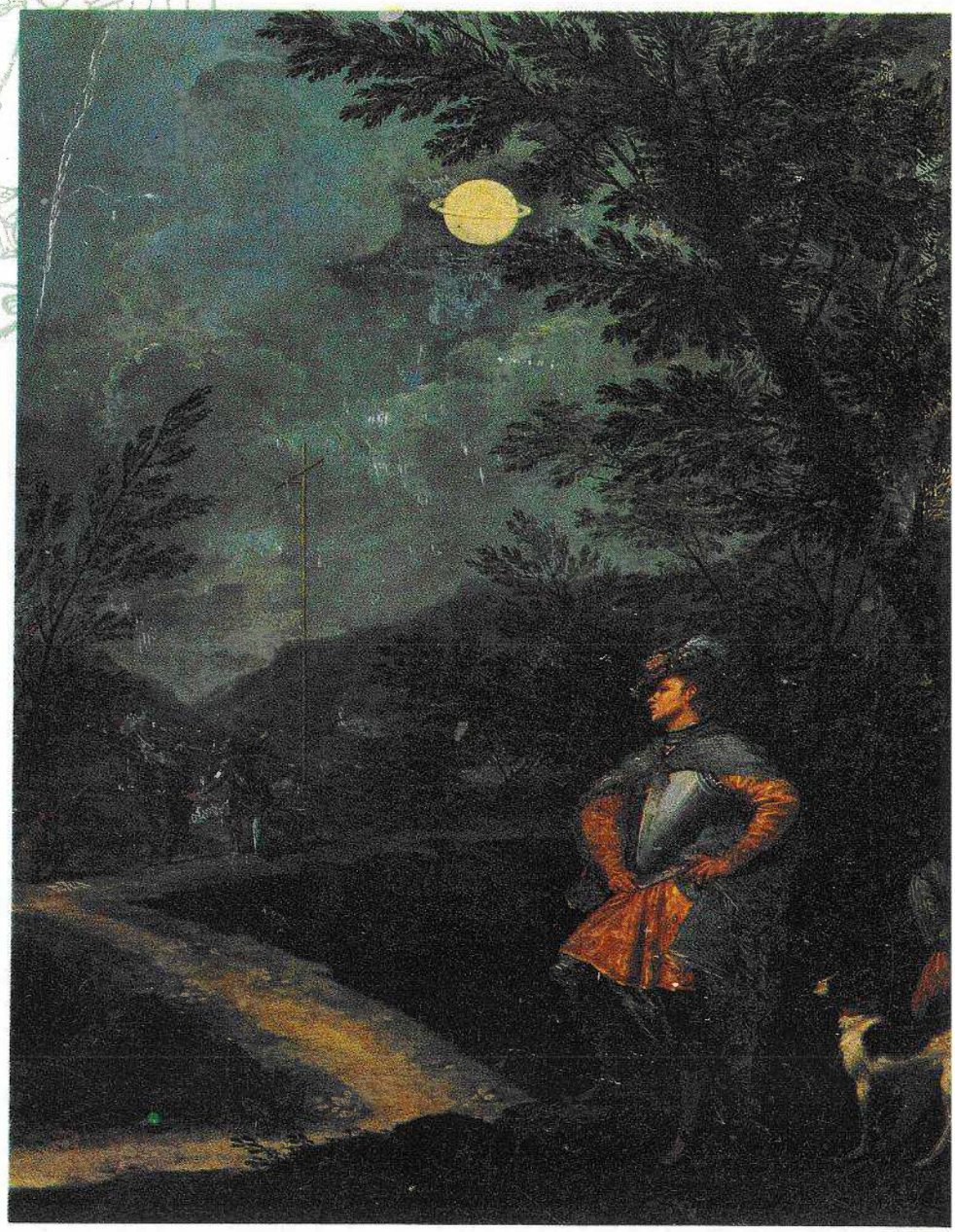
There is no getting away from it: In ancient times, belief in celestial deities wove our destiny so tightly, so intimately, that one could not avoid a preoccupation with their wanderings. The entire cosmos was an expression of wills imposed by animate anthropomorphized forces that made up the state, just like their kingdom here on earth. Every object in the sky was alive with a personality of its own, ready to unleash its power for good or evil on mortals below. That the tides, the wind, and the rain could be predicted by watching celestial events seems reasonable enough, but the health and wealth of kings and peasants? Hardly—at least for us!

Like the Maya, the Inca, and the architects of Stonehenge, worshippers of the heavenly abode of these deities would appeal to them by performing certain rites. The language comprising the dialog between mortal and transcendent consisted of offerings and incantations; the implements of communication were charm and amulet rather than compass and telescope. These people felt closely connected with what was going on around them.

Exhibit 10

CONVERSING WITH THE PLANETS





HOW SCIENCE AND MYTH INVENTED THE COSMOS

ANTHONY AVENI

CONVERSING WITH THE PLANETS

HOW SCIENCE AND MYTH INVENTED THE COSMOS

ANTHONY AVENI

TIMES BOOKS

Published in the United States by Times Books, a division of Random House, Inc., New York, and simultaneously in Canada by Random House of Canada Limited, Toronto.

Library of Congress Cataloging-in-Publication Data

Aveni, Anthony F.
Conversing with the planets : how science and myth invented the cosmos / Anthony Aveni.
p. cm.
Includes bibliographical references and index.
ISBN 0-8129-1975-0
1. Cosmology. 2. Cosmology, Ancient. 3. Cosmology, Babylonian. 4. Science fiction. 5. Anthropology. I. Title.
QB981.A99 1992
398'.362—dc20 91-51037

Design by Anistatia R. Miller
Manufactured in the United States of America

CHAPTER 2

THE IMAGES:
PLANETS AND SKY

> The mingled influences of the stars can be understood by no one who has not previously acquired knowledge of the combinations and varieties in nature.
> PTOLEMY, *CENTILOQUY*, QUOTED IN MCCAFFERY, P. 77

Modern astronomers direct their telescopes upward, but ancient watchers of the sky were far more likely to have set their eyes, unaided by technology, upon the horizon. Because celestial events were tied to ritual practice, the ancients might have been more concerned with how high one of their sky deities stood above a temple dedicated to its worship than with unanchored constellations wheeling above their heads.

But try to comprehend a natural event without presupposing the perspectives and patterns of organization modern science has taught us. Who can look at the moon and not think of it as a place where astronauts have walked? Or stars that are not blazing nuclear infernos at vast distances, or Venus not as a spherical body that, like earth, orbits a fixed sun? Because modern astronomers seek deeper causes that they believe underlie nature's superficial effects, they explain the celestial motions we witness directly by saying that what we see is only "apparent" to those of us who watch the sky from a peculiar vantage point—the earth—that we assume to be fixed. In this chapter we will be tempted constantly to ask: But what is really happening to make things move this way? This is a temptation that we must try to resist, although we will occasionally yield to it, because my goal is not to give explanations in that familiar sun-centered orbital framework but instead to explore pathways to somebody else's version of truth—whether we believe it or not.

So I begin this lesson in sky watching, not at the observatory's tele-

scope but out in an open field in clear air, under a pitch black sky filled with stars and limited only by a distant horizon. If you just stand and stare for ten to fifteen minutes, you will begin to see the stars move. The moon, sun, and planets move in the same way, executing a full cycle of motion all the way about the sky in a day. But how you see them move depends quite strongly upon where on earth you live as Figure 2-1 shows. If you happen to be situated in the middle latitudes (say 30° to 50° north or south), you will see stars in the east glide upward and off to one side while those in the west pass downward and toward the opposite side. Stars in the northern section of the sky circumnavigate the immovable North Star, moving round and round like the tips of so many hands on a clock, while the southern constellations make dome-shaped arcs centered on an imaginary point far below the horizon. From tropical latitudes (within about 20° of the equator), daily motion in the sky is very different—stars move more or less straight up and over the sky dome and plunge straight down into the western horizon. Turning to the north, we still see the daily motion pivoted about the North Star, except that it lies much nearer the horizon. If you spin around and look south, you will find that southern sky movement in the tropics is much the same. In fact, there is a kind of symmetry the tropical sky watcher can appreciate. It is as if he or she rather than a distant point on the sky's ceiling is the center of symmetry of the sky's motion.

Now return to the same place, clear night after clear night, at the same time of night, say, just after evening twilight has ended and it has become totally dark, and you will notice that the constellations will have changed positions in another way. Star patterns in the east will appear a little higher in the sky, those in the west a little lower. After a few weeks, the stars you originally saw close to the western horizon at dusk will have vanished behind the hills before the onset of darkness, already lost in the setting sun's glare. For example, Scorpio, which dips below the horizon at 8:00 P.M. in mid-November, will set at 7:00 P.M. by the beginning of December, by 6:00 P.M. at midmonth, and by 5:00 P.M. at the start of the new year. But if you turn around and look to the east, you will discover that replacements have arrived, rising above the horizon, stellar groups you might remember having seen there last year at this time and the year before, and the year before that.

If you return to that open field before dark and watch the sun go down, you might also note which constellation of the zodiac stands over the position where the sun disappears. In the middle latitudes in October, you will see Scorpio mark the spot; in November, Sagittarius will have nudged it aside. In December, when the sun's light swallows up Sagittarius, Capricornus moves in to take its place, then Aquarius in January. You will also notice that the point on the horizon where the sun sets shifts from night to night, like a pendulum on a clock, moving

CHAPTER 4

ASTRONOMY:
FOLLOWING THE IMAGES

> I am convinced that real progress in the study of the history of science requires the highest specialization. In contrast to the usual lamentation, I believe that only the most intimate knowledge of details reveals some traces of the overwhelming richness of the processes of intellectual life.
>
> —Otto Neugebauer, 1941, p. 13

PROCEED WITH CAUTION

Scientists delight in discussing the histories of their disciplines. Biologists admire Aristotle's careful description of the life cycle of a chick embryo, chemists the elegant construction of the periodic table of the elements, and astronomers the descriptions by their Greek counterparts of how the sun, moon, and stars turn about the sky. In these simple classification schemes, experiments, and rudimentary applications of mathematics and rational logic, we discover the roots of our modern way of knowing nature. But mention alchemy to a chemist or metallurgist, divination by hepatoscopy* to the medical researcher, augury to the ornithologist, or astrology to the astronomer and you will

* Hepatoscopy, or examining parts of the liver to tell the future, was so common a practice as to be licensed in ancient Greece. The largest organ in the body and the center of life was thought to reflect the state of the universe at the moment of sacrifice of an animal offered to the gods. But at a rational level an examination of the material processed by the livers of animals who grazed on a potential settlement site could tell a lot about the degree to which the health of an ambient community would profit from the local environmental conditions (for details, see J. Rykwert, *The Idea of a Town*, 41–54). Augury, or divining by observing the chatter or flight of birds, also was popular in ancient Greece. Today the word has survived and means simply "a foretelling."

likely be met with derision. Why? Because today we see these endeavors as wayward paths that detoured the human intellect on its evolutionary course of progress. Such occult practices are the rattling skeletons in the closet of modern science—aspects of our past worth shutting and bolting the door on because they do not belong on the upward trajectory of development we believe has led to our present understanding—the correct way to pattern the universe.

But this so-called nonscientific rubble we leave by the wayside can be revealing, for when we pick up the bits and pieces and study them closely, as historian of science Otto Neugebauer recommends in the epigraph I have chosen for this chapter, they offer up rich detail on alternative ways of thinking about the world.

In the previous chapter I showed that sky watching served everyday needs and concerns. Brought together under the umbrella of hope and desire, people wove celestial imagery with ideas culled from their imaginations to create fantastic tales called myths that were told around the campfire—stories concerned with how the human condition came about. In the present chapter I am going to demonstrate that in many cases myth passed well beyond basic function. Framed in an often elaborate mathematical context, its capacity to answer basic questions sometimes became more precise than it needed to be to keep society operating in an orderly manner. As I continue to explore the intersecting worlds of myth and science by examining ancient rudimentary forms of astronomy, it will become a bit easier to see these mythmakers as we see ourselves. The measure of mathematical precision I am going to unveil may surprise some readers, especially when they realize that, although we can label some of our forebears' considerations scientific, such efforts nonetheless served religious needs.

Let the reader beware. I am about to delve into some of the technical rigor behind the planetary imagery discussed earlier. Again the epigraph tells why. I shall explore some of the intricate celestial rhythms in an unfamiliar key, but such scrutiny offers rewards well worth attaining.

Take our modern calendar—a bundle of days stacked into weeks, all tucked neatly onto a twelve-page monthly musical score written in the key of "sun"—an annual packet of time. When we discard that list, around the time we make our New Year's resolutions, we set ourselves again upon the course of the sun, whose temporal signposts are marked by the cycle of the seasons as the earth makes its voyage around it. The sun has become the basic meter for charting both human and natural events. Now imagine instead the calendar of a fictitious culture that used the moon's cycle as a base. For them, planting and harvesting, hunting and gathering, even the course of the other lights that wander across the heavens, would march to a different beat. If such people composed their calendar, its musical score might sound very dissonant

to us. But what would it look like? Could we even recognize it? We need not resort to science fiction to find out. In the Islamic world, the religious calendar is still basically lunar. In fact, our own academic time word *semester*, originally a period of six months, may be connected with the cycle of eclipses, and it has a decidedly lunar origin.

To make the point—that myth and astronomy harmonize in a strange way—I am going to analyze in depth two celestial scores, written texts from cultures on opposite sides of the ancient world. One is said to have contributed substantially to the foundations of our own form of modern science, the other grew in total isolation from the Western world.

In the bark-painted Dresden Codex, written in Yucatán three hundred years before the Spanish invasion, about A.D. 1200, Mayan astronomers manipulated the observed motion of Venus and canonized it to march to a lunar beat in exactly the way we have maneuvered the calendar year marked by the course of the sun to keep it in tune with the seasons. The Maya deliberately distorted the intervals of Venus's presence in the morning and evening skies discussed in Chapter 1 to fit segments and multiples of the cycle of moon phases. Yet they were able to keep track of precisely when Venus would appear or disappear.

The second example, from seventeenth-century B.C. Babylonia, is popularly known as the Venus Tablet of King Ammizaduga. Its contents, carved in clay, bear a remarkable likeness to the information in the Mayan document, and scholars are hard-pressed to explain how cultures so remote that they never could have been in contact could create such intricate, nearly identical messages. Except for the day, the shortest, most easily recognizable time frame based on sky watching is the month. As the all-sky drawing in Figure 2-2 indicates, we can follow the moon through its full cycle of phases by looking in the west after sunset or in the east before sunrise. We quarter our months into weeks because we can see the division by seven-day intervals, for example, between half and full moons. Preliterate people who interact in the open environment would find it easy to say, "We will meet again when the moon looks like this" (gesturing its shape), or "two moons from now" (indicating the count with the fingers), or "when it appears in the celestial house of [one of the constellations of the zodiac]." Such visible reckonings would be convenient for measuring out the cycle of raising and selling crops or the duration of hunting and fishing trips. They provide a ready celestial response to simple human needs. Little wonder then that most early calendars are constructed about a lunar baseline rather than the more lengthy solar one. Still, as anyone who tends a garden year-round knows, plants as well as animal life respond to the seasons. Therefore, as I delve into ancient calendrical documents, lunar cycles will be seen to mesh with the year. Many hunter-gatherer as well as agrarian cultures give specific "activity" names to the twelve or thirteen full moons that fit into the seasonal

Still the logic for practicing astronomy in a basically theocratic state was quite simple: If the objects in the sky were associated with the ruler and the pattern of relations could be worked out, then he could know his future, not to mention the future of the market, of potential military undertakings, even whether a marriage ought to be consummated. This interest, coupled with the chronological demands of working out the length of the month and some sort of regular program for fitting months into the seasonal year, mostly for agricultural purposes, provided a twofold need for careful sky watching.

Archeologists excavating Uruk have unearthed the oldest of all the cuneiform tablets. Those at the deepest levels and consequently from the earliest times (they are dated to around 3000 B.C.) mention Inanna, Sumerian Queen of Heaven, and show a star symbol alongside the brief written text (Figure 3-4g). A tablet from a slightly higher level (dated ca. 2350 B.C.) refers to the Underworld Gatekeeper as the star near the rising sun, a likely reference to occasions on which offerings were presented to Inanna in her specific guise as Venus. The special tablets in the British Museum contain mostly astronomical records and omens from the first half of the second millennium B.C. One of them, Number 63 of the so-called series *Enuma Anu Enlil* ("When the Gods of Air and Sky" and named after the first three words of the inscription), is devoted exclusively to the planet Venus. In one spot the text refers to the "Year of the Golden Throne," which Babylonian epigraphers attach to the reign of Ammizaduga, a fairly nondescript seventeenth-century B.C. king of the first Hittite dynasty of Babylon. The Venus Tablet of Ammizaduga has come to be one of the most well studied ancient Middle Eastern documents.

The text, like that on all the tablets in the series, and not unlike the Mayan Venus Table, consists of a monotonous sequence, written in horizontal lines (Figure 4-2): "If X . . . , then Y." In other words, if a natural phenomenon should occur (X in the series can range from a celestial appearance of Venus to the birth of a deformed fetus), then there is a chance that Y will happen in the future. Crop failure, success in business, a military attack, are all appropriate Y's. To give an example from the tablet, "If on the 25th day of the 9th month the Queen of heaven disappears in the east, remaining absent in the sky two months four days, and on the 29th day of month 11, Venus appears in the west, the harvest of the land will be successful."[7]

Even the mathematical statements on Tablet 63, which runs unbroken for twenty-one years, are remarkably like those in the Mayan Dresden document. For example, the real, approximately fifty-day-long, disappearance period of Venus is curiously inflated to an interval that can be as long as ninety days (it is sixty-four days in the example just cited), and the shorter period of absence is equated to seven rather than eight actual days.

is a red spot in Jupiter which rotates mathematically." In his return letter to his Italian colleague, he pleads: "Please don't withhold the solution from me; you're dealing with an honest German."[13] Galileo's intended message was "*Cynthiae figuras aemulatur mater amorum*," or "The mother of love emulates the figures of Cynthia"; in simpler terms it means that Venus imitates the phases of the moon (Cynthia). Our twentieth-century science books are already unintelligible to so many people—imagine compounding the difficulty by communicating theories via anagrams written in a foreign language!

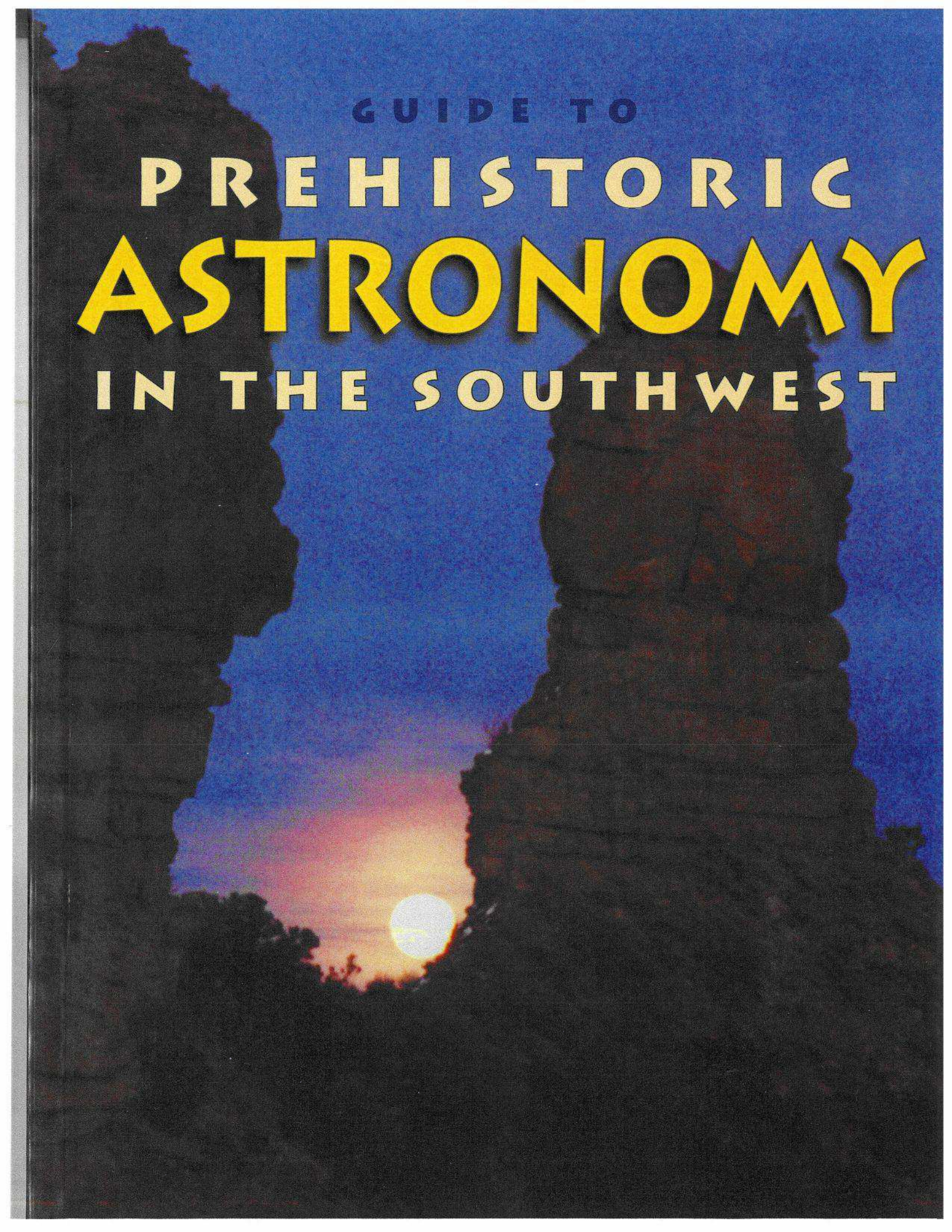
There were even deeper reasons for Galileo to veil his observations in secrecy, for, as did his other discoveries with the telescope, the visible revelation of the phases of Venus carried rather controversial implications, especially for the church, which, for reasons already obvious, opposed the ideology that the sun lay at the center of the universe.

Just why is this Venusian evidence so seminal in removing the earth from its fixed pivot? According to Ptolemaic theory, which had carried the day for more than a thousand years, Venus traveled on an orbit called an epicycle, the center of which revolved about the earth and also lay on a line between earth and sun. Assuming Venus receives its light from the sun, there is no way a terrestrial observer can account for the observed elongation or side-to-side motion of Venus relative to the sun and the full cycle of phases at the same time if the earth is placed at the center of motion. But what Galileo saw through the telescope with his own eyes *can* be explained by holding the sun fixed and putting the earth and Venus on different orbits about it, fast-moving Venus on the inside track and the slower earth on the outer orbit. This is the only sensible way Venus can expose us to all the phases from crescent to gibbous to full then back again to crescent, as Galileo had observed.

These simple facts of observation fit in an elegant way with Galileo's other telescopic revelations: that the moon, with its mountains and pitted surface, looks like another world; that Jupiter imitates our sun by serving as the center of its own family, consisting of several smaller bodies that orbit about it; that the hitherto unblemished solar deity could be thought of as simply another celestial sphere because now Galileo had seen spots upon its face. All these fresh facts uncovered with Galileo's spyglass conspired to weaken any belief in detaining the earth at the center of a universe filled with pristine fixed points of light. As Galileo sardonically put it to those stodgy professors he loved to taunt: What a powerful instrument the telescope is. The uncompromising evidence it brings to our eyes immediately explodes all the disputes that have tormented philosophers for ages.

Not only did Galileo bring technology to sky watching but he also altered its agenda. Now one could ask questions about the physical makeup of the celestial bodies, such as Jupiter and Mars, the sun and

Exhibit 11


GUIDE TO
PREHISTORIC
ASTRONOMY
IN THE SOUTHWEST

A GUIDE TO

PREHISTORIC ASTRONOMY IN THE SOUTHWEST

REVISED AND UPDATED

J. McKim Malville

JOHNSON BOOKS
BOULDER

Published by Johnson Books, a Big Earth Publishing company.
3360 Mitchell Lane, Suite E, Boulder, Colorado 80301
1-800-258-5830
E-mail: books@bigearthpublishing.com
www.bigearthpublishing.com

Cover photo: Full moon rise December 26, 2004, by Helen Richardson
Cover and text design by Rebecca Finkel

9 8 7 6 5 4 3

LIBRARY OF CONGRESS CATALOGING-IN-PUBLICATION DATA
Malville, J. McKim.
A guide to prehistoric astronomy in the Southwest / J. McKim Malville—Rev. and updated.
p. cm.
Rev. ed. of: Prehistoric astronomy in the Southwest / J. McKim Malville,
Claudia Putnam. c2003.
Includes bibliographical references and index.
ISBN 978-1-55566-414-5
1. Indian astronomy—Southwest, New. 2. Archaeoastronomy—Southwest, New.
3. Indians of North America—Southwest, New—Antiquities. 4. Southwest, New—Antiquities.
I. Malville, J. McKim. Prehistoric astronomy in the Southwest. II. Title.
E78.S7M135 2008
979'.01—dc22
2008003145

Printed in the United States of America

Contents

CHAPTER 4

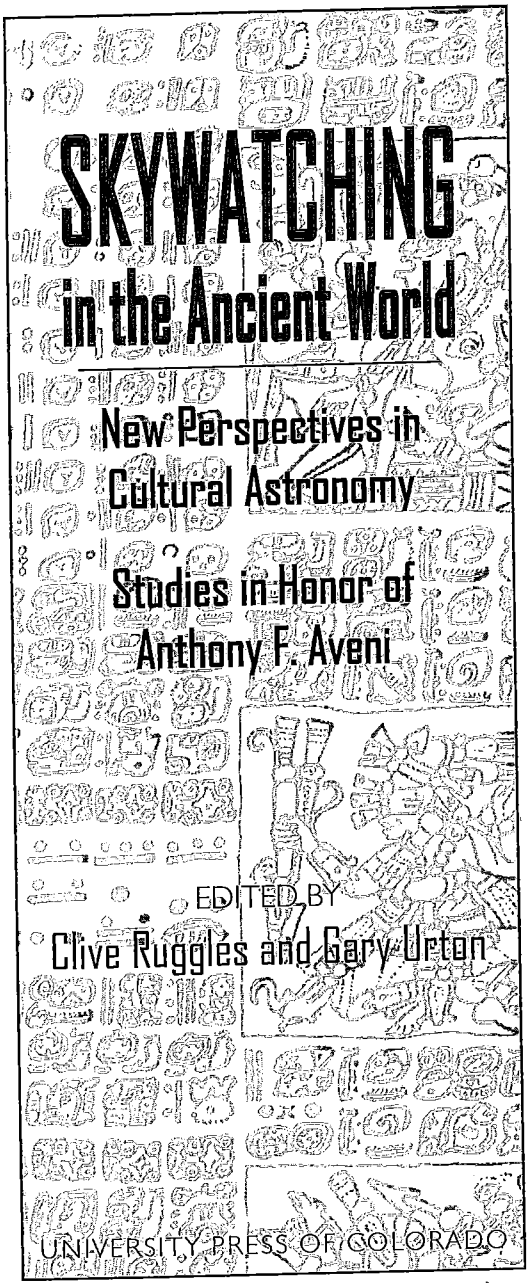
SKY WATCHERS

For clues to the techniques and meaning of Ancestral Puebloan astronomy, we turn to today's Pueblo Indians. It is reasonable to assume that some astronomical traditions have been carried on since Ancestral Puebloan times, although perhaps others have been lost. The modern Pueblos are descended from a mix of prehistoric southwestern peoples and doubtless have absorbed traditions from all of them. They have also experienced pressures, usually less than friendly, from nomadic Navajos, catholicizing Spaniards, and land-hungry Anglos that have resulted in cultural adaptations that the Ancestral Puebloans could not have imagined.

Some of the differences between the Ancestral Puebloan and the modern Puebloans are obvious. Great kivas have disappeared from Puebloan architecture, while the elaborate masonry of the Ancestral Puebloans has been largely supplanted by adobe bricks. The roadways and other features indicative of a centralized Ancestral Puebloan authority have also disappeared. Whatever traditions the modern Puebloans may have retained of their ancient ancestors—the culture responsible for the Mesa Verde cliff dwellings, the Hovenweep towers, and the Chaco great houses—have been transmuted into that rich mixture of past and present that are today's Pueblo societies.

Today, no two Pueblos are alike, and no single voice can speak for the past. Pueblo peoples speak variations of four distinct languages, and the largest linguistic group, Tanoan, has three subgroups. Western Pueblos, such as the Hopi and Zuni, tend to be organized by kinship groups, whereas eastern ones, such as the Tewa, are dual in structure, with

Exhibit 12


SKYWATCHING
in the Ancient World
New Perspectives in
Cultural Astronomy
Studies in Honor of
Anthony F. Aveni
EDITED BY
Clive Ruggles and Gary Urton
UNIVERSITY PRESS OF COLORADO

Published by the University Press of Colorado
5589 Arapahoe Avenue, Suite 206C
Boulder, Colorado 80303

Printed in the United States of America

The University Press of Colorado is a proud member of the Association of American University Presses.

The University Press of Colorado is a cooperative publishing enterprise supported, in part, by Adams State College, Colorado State University, Fort Lewis College, Mesa State College, Metropolitan State College of Denver, University of Colorado, University of Northern Colorado, and Western State College of Colorado.

The paper used in this publication meets the minimum requirements of the American National Standard for Information Sciences—Permanence of Paper for Printed Library Materials. ANSI Z39.48-1992

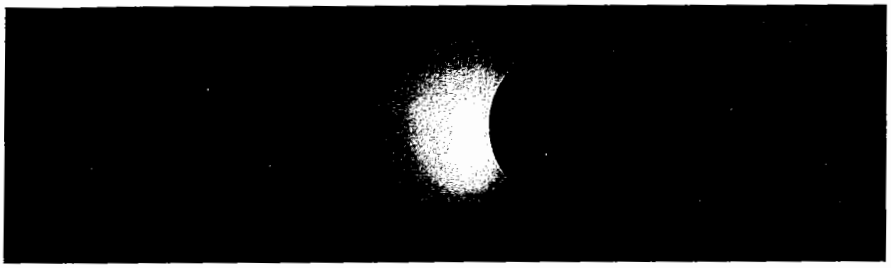
Library of Congress Cataloging-in-Publication Data

Skywatching in the ancient world : new perspectives in cultural astronomy studies in honor of Anthony F. Aveni / edited by Clive Ruggles and Gary Urton.
p. cm. — (Mesoamerican worlds)
Includes bibliographical references and index.
ISBN 978-0-87081-887-5 (hardcover : alk. paper) 1. Archaeoastronomy. 2. Astronomy, Ancient. I. Aveni, Anthony F. II. Ruggles, C. L. N. (Clive L. N.) III. Urton, Gary, 1946–
GN799.A8S59 2007
520—dc22

2007029308

Design by Daniel Pratt

16 15 14 13 12 11 10 09 08 07 10 9 8 7 6 5 4 3 2 1



Foreword

ANTHONY AVENI: A PIVOT OF MANY QUARTERS

I met Anthony Aveni in 1982 when he was visiting the University of Colorado to lecture on his recent book *Skywatchers of Ancient Mexico*. This book fascinated me because of its significance for my academic discipline, the History of Religions. At the time, scholars of religion and anthropology had been showing increased interest in the religious significance of the sky, sun, moon, stars, and celestial phenomena, spurred in part by the publication of Mircea Eliade's *Patterns in Comparative Religion*. Paul Wheatley's magisterial *The Pivot of the Four Quarters: A Preliminary Enquiry into the Origins and Character of the Ancient Chinese City* had posited that urban genesis in the seven areas of primary urban generation was undergirded by cosmo-magical thinking that integrated the mathematically expressible regimes of the heavens and the biological rhythms on earth. Aveni's work on the sky, stars, calendar rituals, alignments, and the close-knit relationship between ceremonial centers and celestial patterns seemed to advance the

work of these scholars by providing specific data on skywatching and archaeoastronomy, a new method for understanding the ways humans and their cities were oriented on celestial events. Aveni's work resonated with my own on Quetzalcoatl and a series of cities associated with the Feathered Serpent tradition in Mesoamerica. Through meeting Anthony Aveni my own work was "reoriented" in a productive direction.

Our initial conversation struck mutual chords and I invited Aveni to spend a semester at the University of Colorado working in the Moses Mesoamerican Archive so we could team teach a course and teach each other about archaeoastronomy and the study of religion. That fall in Colorado, Aveni and I held a series of public "conversations" about religion, ritual, astronomy, cities, and calendars in the Aztec, Inca, and Maya worlds, and these talks were turned into a small but appreciated publication titled "Conversations with Anthony Aveni: Archaeoastronomy and the History of Religions" published by the Mesoamerican Archive. Aveni's breadth of knowledge, engaging teaching style, and willingness to collaborate ignited a series of new questions about the relationship between science and religion, Old World and New World, calendars and cosmovision, and ritual and myth and also the similarities and differences *within* the archaeoastronomies of the Americas that helped shape the future research agenda of the Mesoamerican Archive and influence students at Colorado. This was the beginning of a career-long collaboration that has been deeply beneficial to my own scholarship and the overall productivity of the Moses Mesoamerican Archive and its publishing program.

What I then recognized about Aveni's particular form of genius has now become clear to scholars in many parts of the world as evidenced in this excellent book of essays. As Clive Ruggles and Gary Urton write:

> Tony Aveni is one of the world's great interdisciplinarians, having contributed to a variety of fields of study during his forty-year academic career. He is widely acknowledged as America's leading archaeoastronomer as well as the founding father of Mesoamerican archaeoastronomy. . . . Over the years, he has moved from studying "ancient astronomy" to broader issues of cosmology, perception, and indigenous concepts of space, time, number, and other related concepts. . . . Rather than remaining the astronomer working on the fringes of anthropology, he has constantly moved forward, ensuring that his work is increasingly contextualized in anthropological and archaeological theory and practice, with the result that he has created entirely new ways of comprehending ancient cultures through their knowledge and perceptions of the skies.

In other words, Aveni has become a "pivot of many quarters," a scholar who has achieved a powerful grounding in his own scientific/humanistic world view and is able to face in many cultural and academic directions and enter into productive dialogues with other people, places, horizons, and centers. Unlike James Thurber, who as a young student in chemistry class was only capable of seeing reflections of his own eye in the microscope, Aveni has increasingly been able to put on a variety of academic and cultural lenses and utilize them to help organize new knowledge about how human beings achieve sophisticated orientations in time and space.

This book is the first time the Mesoamerican Worlds series has included a festschrift, although this is no ordinary festschrift. The Aveni-liké contributions are outstanding. The stories told, the scope of cultural significances, the angles of vision, and solid case studies constitute a fine academic celebration in multidisciplinary terms. There is affirmation of the state of the art and innovation in the ways we are coming to understand the relationships between cultural astronomy, context, and historical change. We sense how Aveni has, to use a word penned by the editors of the volume, "propelled" these scholarly affirmations and innovations. This propulsion and its results are signaled in the titles and themes of the essays, which can serve as a chart of the fields of cultural astronomy and Aveni's astonishing publishing record. The chapter titles include such terms and names as "correlation" and "calendars" (Justeson and Tavárez), "Kirchhoff" and "Codex Borbonicus" (Calnek), "Dresden Codex" and "Venus Table" (Bricker and Bricker), "Moon Woman" and "lunar almanacs" (Tedlock and Tedlock), "Codex Borgia" and "astronomical cycles" (Milbrath), "measure" and "man" (Coggins), "Tukapu calendar" and "multi-year" (Urton), "solar and lunar" and "Inka" (Zuidema), "cosmology" and "temple orientations" (Ruggles), and "calendrical cycles" and "churches" (McCluskey).

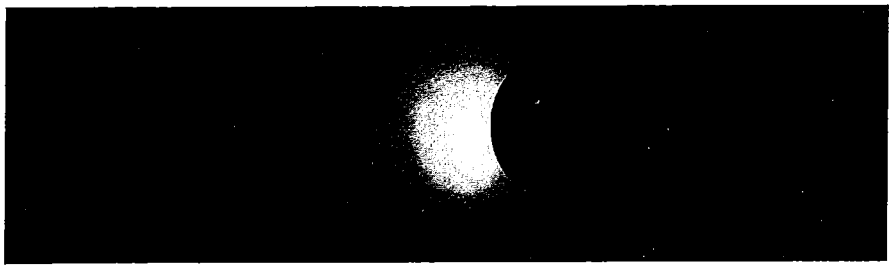
Perhaps Ed Krupp's title "High Fashion" says best how this collection of essays represents what we have come to think of Anthony Aveni as a teacher, friend, and colleague. The varieties of place and academic approach in these essays symbolize how Aveni has raised our levels of awareness and capacities for dialogue and collaboration, expanding our horizons of cultural astronomy and elevating our skills at interdisciplinary work way beyond where they were when he began his journey. His intellectual leadership, wonderful humor, and remarkable achievements have shaped how many of us approach the texts and enigmas of cultural astronomy. His life and work have shown us how other cultures found their ways to the stars, and he also has practiced methods for understanding how the stars were brought down to earth by various peoples

who struggled to shape their chaotic and shifting worlds into ordered forms. These essays carry that work forward in exciting and fruitful new directions and signal the ongoing transformations in our knowledge of how human beings seem to be forever waiting for the dawn and the night, measuring themselves against order and chaos, and correlating in texts, buildings, and horizons their earthly humanity and destiny with the stars. Anthony Aveni is indeed a pivot of many quarters.

David Carrasco
Mexico City
August 2007

Tony Aveni was once at
cultural astronomy have
unconventional paths in
perspectives that is a prer
in this field. And many of
firsthand have, at variou
stimulated by his exampl

My first encounter with
to-face, but rather thro
States. This occurred in
dissertation fieldwork i
his presence known in t
all realize later, he was



Preface

Tony Aveni was once at Stonehenge. He moved on. Many of us who work in cultural astronomy have, like Tony himself, followed challenging and often unconventional paths in order to assimilate the combination of disciplinary perspectives that is a prerequisite for making sensible and sustainable progress in this field. And many of us who have witnessed the evolution of Tony's ideas firsthand have, at various stages in our own development, been inspired and stimulated by his example. Gary Urton writes:

> My first encounter with Tony Aveni came not by way of meeting him face-to-face, but rather through the postal service—between Peru and the United States. This occurred in 1976, during the time I was carrying out my PhD dissertation fieldwork in Misminay, Peru. Tony was just beginning to make his presence known in the field of archaeoastronomy—in fact, as we would all realize later, he was *defining* the field—and I was in need of some good

advice on several problems in the interpretation of ideas about various celestial phenomena that I had become aware of when talking to and working in the field with people in Misminay. My advisor at the University of Illinois in Champaign-Urbana, R. Tom Zuidema, suggested that I write to Tony Aveni and ask him the questions that were perplexing me. I sat down at my typewriter in Cusco and wrote a long letter to Aveni, having very little hope that an even then well-known professor of cultural astronomy would have, or take, the time to write back to a lowly graduate student in the field. However, within a couple of weeks (rapid by Cusco postal standards of the time), I received a reply from Tony; it was a long, informative, and congenial letter answering most of my questions and asking several even better ones. Tony eventually joined my PhD committee and proved himself to be tireless in extending his support and encouragement during the year I wrote my dissertation.

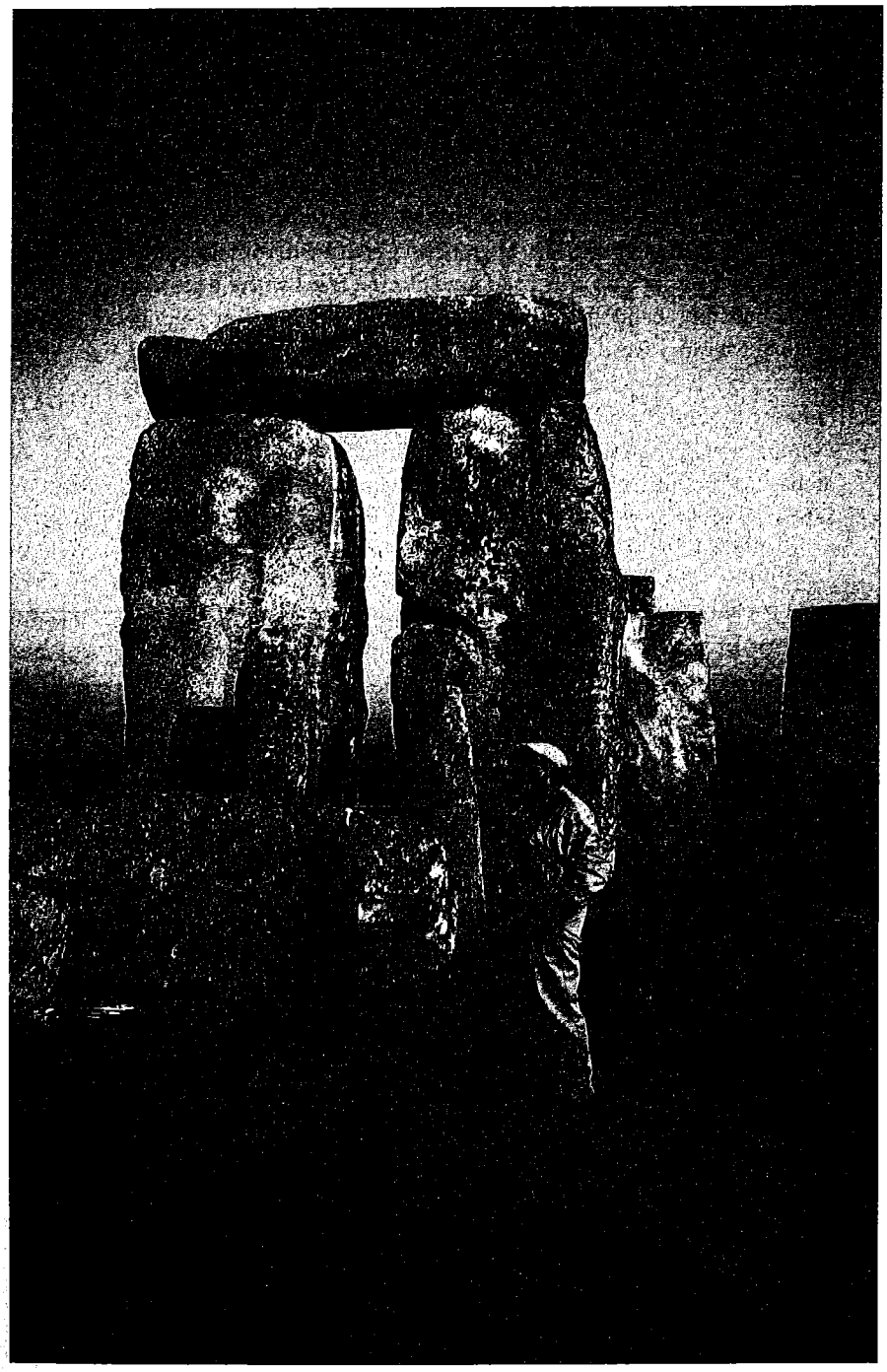
As I continued my own academic career, which I had the good fortune to be able to pursue as a colleague of Tony's at Colgate University, I saw my own earlier experience with Aveni repeated countless times. Tony was forever receiving letters from young scholars—whether from the United States or abroad, from the field or from a university—asking for help and advice. Tony always replied to those who sought his help even after he had long become the best-known and most highly respected archaeoastronomer in the world. His enthusiasm, optimism, and thirst for knowledge are unparalleled among academics, at least in my experience.

Tony and I went on to work together on a project in Nazca, Peru, bringing Colgate students and groups of Earthwatch volunteers with us to study and measure the famous Nazca lines. As anyone who knows Tony will understand, working with him in the field meant having the pleasure of his nonstop banter and good humor. Lest anyone else in the course of this volume fail to mention this perhaps most salient fact about him, Tony Aveni is one of the funniest people you will ever meet. He knows and tells masterfully a thousand and one jokes, each one—a part of the joke itself—numbered; among a group of friends, he will often shout out a number, evoking at the minimum giggles to those in the know. I have lost count of the number of times I almost, or in fact, fell off my chair laughing at one of Tony's jokes while dining at his and Lorraine's table (the two of them are gourmet cooks).

Few can have known and worked with Tony without collecting their own treasured portfolio of personal recollections and anecdotes. Thus Clive Ruggles writes:

I first met Tony at the first international symposium on archaeoastronomy held in Oxford in 1981, and it was not long before I had the pleasure of

Tony Aveni at Stonehenge, l



Tony Aveni at Stonehenge, literally, in 1996. (Photograph by Clive Ruggles.)

having him and Lorraine to stay in my terraced house in Leicester with the wonky front step, of which Tony was still fondly reminding me a few years later when he came again to help teach some sessions in my archaeoastronomy class. It may seem surprising that I was somewhat reticent about his teaching my class despite knowing that he had been awarded the highest national award in the United States for teaching (he had been voted 1982 Professor of the Year by the Council for the Advancement and Support of Education, Washington, D.C.). My reticence stemmed from a tale he had told my wife about a time he had found himself faced with a lecture-room full of uncomprehending astronomy students who would unthinkingly write down every word that he said. Spontaneously, he had decided to give an entirely ad-lib lecture about the reproduction of galaxies, describing in fantastic detail the gradual reshaping of male and female galaxies and their eventual amalgamation in the process of cosmic copulation. Fortunately, the archaeoastronomy students in my class remained alert, thus sparing themselves a megalithic yarn the likely content of which taxes the imagination.

Lorraine Aveni entertained us at the symposium with some of her own personal recollections, and it is with her permission that we gratefully append a transcript of some of them here. They benefit, quite obviously, from her unique "partner's perspective" and reflect the closeness of her involvement in all of Tony's activities, but in terms of the feelings they convey, they speak for us all.

Tony Aveni has given so much to his friends and colleagues over the course of his long (and continuing) career. With this volume, we hope to return to Tony a modest recompense for all he has given to those around him. The volume is dedicated to Tony with grateful thanks not only for his immense contribution to the field of cultural astronomy but also for making all of our lives, academically speaking as well as in other ways, a great deal richer.

CLIVE RUGGLES AND GARY URTON
LEICESTER AND HARVARD UNIVERSITIES

It isn't just the book
Big Picture from cosı
conferences, those cu
presenters of the top
ries. So, today I reme

Mostly in Mexic
Hartung, Tony's oth
tions, who participate
students.

At the old Palen
La Canada, sitting ne
Tedlocks, Coes and St
Hammond, Claude B
Floyd Lounsbury, Gill
an incomplete list! (I
a baby alligator wrig
the Hotel Ik.) The Br
ponder since those da
extended as they host
good works and deed

I recall David Ca
students of the many M
over other spaces and
museums and campu
the field and will follo

I'm remembering
mapping and measuri
the truck stop with liq
AM! We would let the
would also listen patie
and Gary was the voic
"arrest" the Colgate p
they said. Later, Tom Z

Exhibit 13

Asheville Citizen-Times (Asheville, North Carolina) · Mon, Jun 15, 1992 · Page 21

SCIENCE

Take look at heavens

By Glenn Langhorst
KNIGHT-RIDDER

On June 20, the sun reaches its summer solstice position, heralding the first day of a new season. Astronomically, the sun follows its highest path across the sky giving us the longest day of the year.

In my study of sky-watching knowledge among the native peoples of the Americas, I have found the observance and celebration of the summer solstice to be a near universal practice. The first Americans regarded the sun as giver and sustainer of life, seeing its rhythmic motions through the heavens powering the cycle of the seasons and creating their associated natural phenomena.

Besides the spiritual aspect of the solar deity, the sun provided a highly accurate timekeeping function. Many indigenous cultures developed ingenious methods of tracking the sun's repetitive annual motions. All of the sun-watching methods are based on the two most noticeable changes the sun exhibits through the year, its bobbing midday standing and shifting sunrise/sunset points.

The midday standing is the time when the sun appears due south, attaining its highest altitude above the horizon of the day. During the year, the midday sun will ping-pong between high and low extremes that occur at the respective summer and winter solstices.

Native astronomers realized that the length of a shadow cast by a fixed object grew and shortened in direct response to the sun's daily and annual courses through the sky. By observing the length of the midday shadow and comparing it to previously marked positions, an accurate calendar could be kept.

Glenn Langhorst is director of the Alworth Planetarium at the University of Minnesota-Duluth and an instructor at Fond du Lac Community College in Cloquet, Minn. Send your comments to the Alworth Planetarium, UMD, Duluth, Minn. 55812.

Asheville Citizen-Times (Asheville, North Carolina) · Mon, Jun 15, 1992 · Page 21

COMICS / FEATURES ASHEVILLE CITIZEN-TIMES MONDAY, JUNE 15, 1992 5C

BOUND & GAGGED / Dana Summers

ANDY CAPP / Reggie Smythe

HAGAR HORRIBLE / Chris Browne

WIZARD OF ID / Brant Parker, Johnny Hart

FRED BASSETT / Alex Graham

GASOLINE ALLEY / Jim Scancarelli

JUDGE PARKER / Harold LeDoux

REX MORGAN, M.D. / N.P. Dallis, Tony DiPreta

MARY WORTH / John Saunders

FAMILY CIRCUS / Bill Keane

"To conserve water I volunteer to take less baths."

KUDZU / Doug Marlette

CATHY / Cathy Guisewite

PHANTOM / Lee Falk, Sy Berry

JUMBLE / Arnold, Lee

SCIENCE

Take look at heavens

By Glenn Langhorst
KNIGHT-RIDDER

On June 20, the sun reaches its summer solstice position, heralding the first day of a new season. Astronomically, the sun follows its highest path across the sky giving us the longest day of the year.

In my study of sky-watching knowledge among the native peoples of the Americas, I have found the observance and celebration of the summer solstice to be a near universal practice. The first Americans regarded the sun as giver and sustainer of life, seeing its rhythmic motions through the heavens powering the cycle of the seasons and creating their associated natural phenomena.

Besides the spiritual aspect of the solar deity, the sun provided a highly accurate timekeeping function. Many indigenous cultures developed ingenious methods of tracking the sun's repetitive annual motions. All of the sun-watching methods are based on the two most noticeable changes the sun exhibits through the year, its bobbing midday standing and shifting sunrise/sunset points.

The midday standing is the time when the sun appears due south, attaining its highest altitude above the horizon of the day. During the year, the midday sun will ping-pong between high and low extremes that occur at the respective summer and winter solstices.

Native astronomers realized that the length of a shadow cast by a fixed object grew and shortened in direct response to the sun's daily and annual courses through the sky. By observing the length of the midday shadow and comparing it to previously marked positions, an accurate calendar could be kept.

Glenn Langhorst is director of the Alworth Planetarium at the University of Minnesota-Duluth and an instructor at Fond du Lac Community College in Cloquet, Minn. Send your comments to the Alworth Planetarium, UMD, Duluth, Minn. 55812.

BRIDGE

Answers to bridge quiz

With Omar Sharif and Tannah Hirsch

Q.1 – As South, vulnerable, you hold:
♠-K 6 2 ♥-J 6 2 ♦-A 9 7 4 3 ♣-7 4
The bidding has proceeded:

West	North	East	South
1♦	Dbl	1♥	?

What action do you take?

A. – With eight points in high cards you must certainly take some action, and the only sensible course is to bid one no trump. Note that action confirms a diamond stopper, not necessarily anything in hearts. Since partner's takeout double presumably promised something in hearts, you can afford to bid no trump with that suit unguarded.

Q.2 – Both vulnerable, as South you hold:
♠-A 10 ♥-A Q T 5 8 ♦-A Q 6 ♣-A 10 8
Your right-hand opponent opens three spades. What action do you take?

A. – An ugly hand. Four hearts is out – the quality of the suit leaves a great deal to be desired. The trouble with a takeout double is what do you do if partner responds with four of a minor? Best of the lot is to bid three no trump, although that is an underbid and might flounder when game in a suit is on.

Q.3 – Both vulnerable, as South you hold:
♠-A 9 7 ♥-A K 6 5 4 ♦-Q ♣-A 8 7 2
The bidding has proceeded:

West	North	East	South
2♠	Pass	Pass	?

The two spade bid is a weak response. What action do you take?

A. – Your hand is too strong and your suit too weak for a reopening bid of three hearts, and your unbalanced distribution and lack of a source of tricks bodes ill for a no-trump contract. We opt for a takeout double, intending to bid hearts should partner respond in a minor.

STUMPED? For answers to today's crossword, call 1-900-454-7377 (99¢ per minute, touch-tone / rotary phones - (18+ only.) A King Features service, NYC.

CROSSWORD / Thomas Joseph

ACROSS
1 Marshes
5 Region
9 French landscape painter
10 Center
12 Sempre-cious choice-dony
13 Malicious-ness
14 Overly fond
16 Boot and
17 James Bond's alma mater
18 Copier parts
21 Sailor
22 Supplies the party
23 Protest, of sorts
24 Agendas
25 Favorite
29 Whisk
30 Bo's "bye!"
31 Mother's command
32 "Be quiet!"
34 Pigs' digs
37 "There is ___" ("Julius Caesar")
38 Past or present
39 Copier need
40 Rx amount
41 Historic times

DOWN
1 Colom-bian capital
2 Speech maker
3 Was accepted by
4 British gun
5 Mornings: Abbr.
6 Shred
7 Magazine worker
8 Tycoons John Jacob and kin
9 West Pointer
11 Course aids
15 Kitchen tools
19 Singer Redding
20 Sawbuck
22 Quote
23 Used a stool
24 Acted the usher
25 Hispanic
26 Copper
27 Piano pieces
28 Candle
29 Most ideal
30 Student's aide
33 Despise
35 Slalom maneuver
36 Envision

Saturday's Answer

6-15

Exhibit 14

Ecoview

Whit Gibbons

Advertising Is Natural

Want to get some feeling for how close we really are to the natural biological world? Turn to the Yellow Pages in your phone book. How many services and products can you find that do not in some way mimic a plant or animal? You may find a few that are uniquely human, but not many.

Services Follow Yellow Pages: For example, under the A's you will find Airlines, Air-conditioning and Advertising. Each has its counterpart in the natural world. An airplane is simply a means of transportation. For centuries plants have depended on the airline service of insects to transport pollen from one flower to another. Air-conditioning is definitely not restricted to human use either. Honey bees will wave their wings in unison to fan a hive during extremely hot weather, lowering the temperature several degrees.

But the most widespread of the three is advertising. In the natural world we find false advertising as well as advertising directed toward a particular audience. And as with warning labels (and some of today's political messages) advertisement is often used to caution the audience.

Like humans, other organisms make effective use of color and sound in their advertisements. One obvious use of color is that of brightly colored flowers. Their customers are insects, essential for pollination; the advertised product is nectar for the insect. Male birds, frogs and katydids use sound to advertise to females their availability for mating.

Many animals rely on chemicals known as pheromones to advertise their location to members of the opposite sex. Pheromones are used by female moths to attract males prior to mating. Each species of moth produces a different pheromone, and the height of false advertising comes from bolas spiders that produce chemicals that mimic moth pheromones. To ensure a wide selection of mealtime choices, the spiders fill the night air with chemicals that include the critical ingredients of numerous moth species, a generic perfume guaranteed to attract male moths.

Animals Practice Scams, Too: Such advertising scams are practiced by many species in search of a meal. A baby copperhead has a bright yellow tail that contrasts with the rest of its body camouflaged among autumn leaves. Upon seeing the slowly waving tail, small lizards or frogs foresee a quick meal in the form of a worm. Instead, they become a meal themselves to the unseen con artist.

Humans rely heavily on light for advertising, as do some animals such as the lightning bugs seen in backyards across the United States. The males blink their lights in a code that indicates they are available for courtship. To attract the male, the female firefly, who also has a light, returns the signal from her location on the ground or vegetation. Because many species are often active at the same time and place, the fireflies obey that well-known advertising maxim: Know Your Audience. The codes of the different species vary, thus preventing mating mixups.

Bugs Can Be Misleading: Deception, or false advertising, is common among lightning bugs, especially in tropical areas where several different kinds occur in the same area. Some female fireflies as well as the larvae (which also have lights) eat other species of fireflies. When the male of another species is seen in the night sky, the imposter changes its own coded flashes to mimic the female of the same species as the flying male. When the male flies down, ready for courtship, he finds instead that he is expected for dinner — as the main course.

You have only to read the label of any medicine, cleaning agent, or appliance to realize that warning advertisements are a common phenomenon these days. Such notices are especially common among animals. The tail vibration of a disturbed rattlesnake creates the loud whirring sound that cautions an intruder. The bright red coloration of the red eft salamander of the eastern United States warns that it is poisonous to eat. A snarling bobcat or raccoon sends a pretty clear message that it should be avoided.

Although most human products and services are duplicated in nature, one heading in the A section of the Yellow pages is indeed uniquely human: Attorneys. Although some do make good friends and relatives, apparently nothing comparable exists among other animals and plants. As far as I can tell, lawyers are not a natural phenomenon.

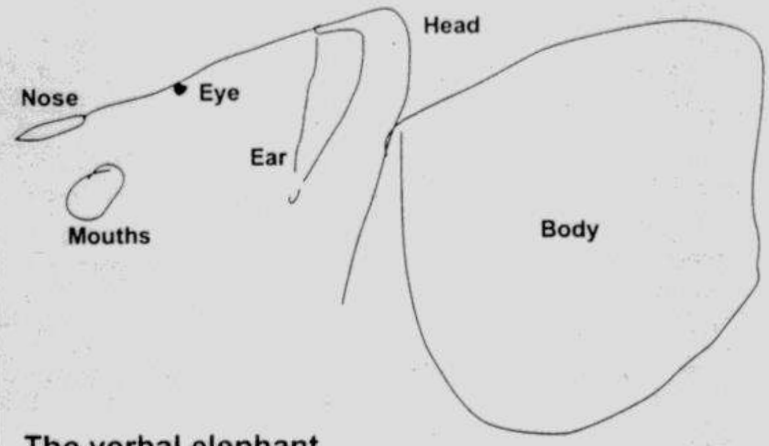
DISCOVERY

The Williams conundrum

People with Williams Syndrome seem to be proof that language skills function in separate areas of the brain from other skills. Though spacially and mathematically retarded, Williams sufferers verbalize well.

The illustrated elephant

Drawing of an elephant by an 18-year-old Williams patient:



The verbal elephant

Description of an elephant by the same patient:

"And what an elephant is, it is one of the animals. And what the elephant does, it lives in the jungle. It can also live in the zoo. And what it has, it has long gray ears, fan ears, ears that can blow in the wind. It has a long trunk that can pick up grass, or pick up hay... If they're in a bad mood it can be terrible... If the elephant gets mad it could stomp; it could charge. Sometimes elephants can charge, like a bull can charge. They have big long tusks. Thay can damage a car... It could be dangerous. When they're in a pinch, when they're in a bad mood it can be terrible. You don't want an elephant as a pet. You want a cat or a dog or a bird..."

Copley News Service/Dan Clifford

A Look At The Autumn Heavens

By GLENN LANGHORST
Knight-Ridder Newspapers

Although autumn officially comes on Sept. 22, signs of fall already are visible across the northern Minnesota landscape. A pair of maple trees in my yard, with their annual changing leaves, have become my personal autumnal barometer over the years.

This year my tree friends have begun their mysterious metamorphosis of color earlier than I have ever observed.

Along with earthly transitions in the natural world, the heavens also proclaim the advent of autumn. One celestial sign I watch for is the departure of the beautiful star Arcturus from the evening sky. This bright reddish star can be found above the western horizon about an hour after sunset by arcing a line outward through the Big Dipper's handle.

Arcturus appears at the bottom tip of the kite-shaped constellation of Bootes. Look just to the left of Bootes for the Northern Crown, a conspicuous arc of fainter stars.

Like the reddening leaves of my maples, ruddy Arcturus announces the coming of autumn with its fall to the western horizon. For observers under dark sky conditions, another seasonal sign can be seen later on in the night, the Milky Way. This band of diffuse starlight makes its highest standing of the year at the end of summer.

Skywatchers will notice that the ghostly path of distant suns arches high overhead through the bright star figure of the Summer Triangle, our final transitional sky sign. From its lofty perch, watch the Summer Triangle steadily descend westward followed by the fall and winter constellations.

(Glenn Langhorst is director of the Alworth Planetarium at the University of Minnesota-Duluth and an instructor at Fond du Lac Community College in Cloquet, Minn. Send your comments to the Alworth Planetarium, UMD, Duluth, Minn. 55812.)

Exhibit 15

THE SKYWATCHER'S HANDBOOK

NIGHT AND DAY, WHAT TO LOOK FOR IN THE HEAVENS ABOVE

COLIN A. RONAN AND STORM DUNLOP

Colin A. Ronan, MSc FRAS was president of the British Astronomical Association in 1990, its centenary year, and was accorded the honour of having asteroid 4024 named after him. He was also editor of the Association's Journal and a member of the International Astronomical Union. He trained as an astronomer and historian of science and was author of more than 25 books – one of which (a biography of Edmond Halley) has become a standard work. At the time of his death in 1995 he was working on a multi-volume abridgement of Joseph Needham's *Science and Civilisation in China*.

Storm Dunlop, FRAS FRMetS is also a member of the American Association of Variable Star Observers. He is a writer on astronomy and meteorology and has also completed a major translation from the German, *Variable Stars*. His other interests are planetary geology and meteorological photography.

Brian Jones is an amateur astronomer who has edited a variety of astronomical journals, including the *Handbook for Astronomical Societies* for the Federation of Astronomical Societies, and contributes articles on astronomy to popular-interest magazines. His recent work is aimed at fostering an interest in astronomy among a younger audience.

Published in the United States of America by Crown Publishers, Inc, 201 East 50th Street, New York, New York 10022.

Printed in Hong Kong

Editor: Jonathan Hilton
Managing Editor: Ruth Binney
Assistant Editors: Louise Tucker
Gwen Rigby
Art Director: Paul Wilkinson
Picture Editor: Zilda Tandy
Production: Barry Baker, Janice Storr

Conceived, edited and designed by Marshall Editions Limited
170 Piccadilly, London W1V 9DD

Library of Congress Cataloging in Publication Data
Main entry under title:

The Skywatcher's handbook

Includes index.
1. Astronomy—Observers' manuals. I. Ronan, Colin A. II. Dunlop, Storm.
QB64.S58 1985 520 85-3810

ISBN 0-517-573261

10 9 8 7 6 5 4 3

INTRODUCTION

The sky remains the most reliable source of the best things in life that are free. The Moon does, indeed, belong to everyone. So do rainbows, shooting stars, eerie eclipses and breathtaking sunsets. Although the sky's most dramatic phenomena do not occur every day, it is still true that, wherever you are, what takes place in any 24-hour period in the sky will provide substantial interest to the skywatcher who has learned to interpret it.

Observation of the sky was vital to ancient people – not only the learned, but shepherds, farmers, fishermen and sailors, who relied on the information it gave them day and night. Even today, these same groups of people have a vested interest in skywatching, and are enviable for the knowledge that seems just to come naturally. But we can all share in it if we want to. The sky is a recreational resource far too many people miss out on. Anyone who finds himself remarking on the weather (and that means everyone) is a potential skywatcher.

The two great sciences arising from the study of the skies are meteorology and astronomy. The original word for meteorology was coined by Aristotle to describe atmospheric conditions, and now relates particularly to weather forecasting. Astronomy derives from another ancient Greek word meaning star-arranging. It is generally associated with the sky at night – when heavenly bodies are most easily observed. Both studies can, of course, be a life's work; but equally, both can make rewarding leisure pursuits, open to all. A healthy curiosity and a little patience are enough to qualify you for skywatching.

Just as the Earth has its seasonal rhythms, so the sky has its own distinct pattern, with characteristics unique to dawn, full daylight, evening and dark. The first two sections of this handbook are devoted to exploring the day and night skies. The Daylight Sky will give you the basics of meteorology so that you can make sense of weather maps, identify the form and movement of the clouds and the direction of the

wind, and attempt some predictions of your own. Here you will find everything from building your own weather station to the significance of a full solar eclipse.

In The Night Sky, even the city dweller, plagued by artificial lighting, will find help in picking out the more spectacular astronomical sights, from the readily perceived phases of the Moon to the changing pageant of the constellations. Familiarity with the planets is enormously satisfying; Mercury and, especially, Venus (the Morning and Evening Stars) can be magnificent in twilight and early evening. Jupiter, too, is a wonderful sight in the night sky, considerably enhanced by viewing it through binoculars. Meteors – the shooting stars of earlier times – comets, galaxies and the multitude of stars that can be seen with a telescope or the naked eye are all dealt with in The Night Sky.

The third section of this handbook concerns itself with Observing and Recording the Sky. Your skywatching takes on greater meaning when you make your observations permanent; they could be of real scientific value (comets West, Bennett and Alcock are among those bearing the names of their amateur discoverers). Here we describe the best ways to photograph the day and night sky, as well as how to build and equip your own home observatory.

The more you skywatch, the more useful you will find the Appendices, which are full of key dates for celestial events, essential statistics and even details of societies of amateur meteorologists and astronomers you would be welcome to join. Their enthusiasm and assistance can enrich your skywatching considerably. The sky is, in every sense, an immense subject, but it is also a generous and constantly accessible one. It is hoped that with the help of this book you can meet it half-way.

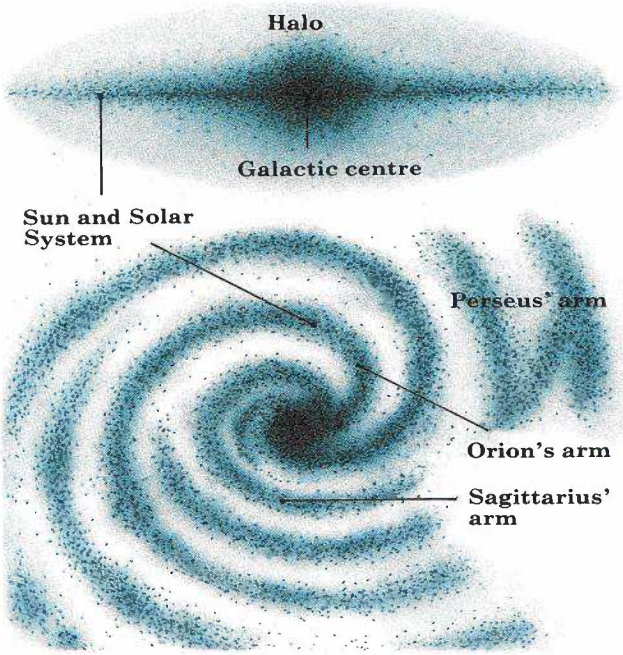
Colin A. Ronan, MSc FRAS

The Galaxy/1

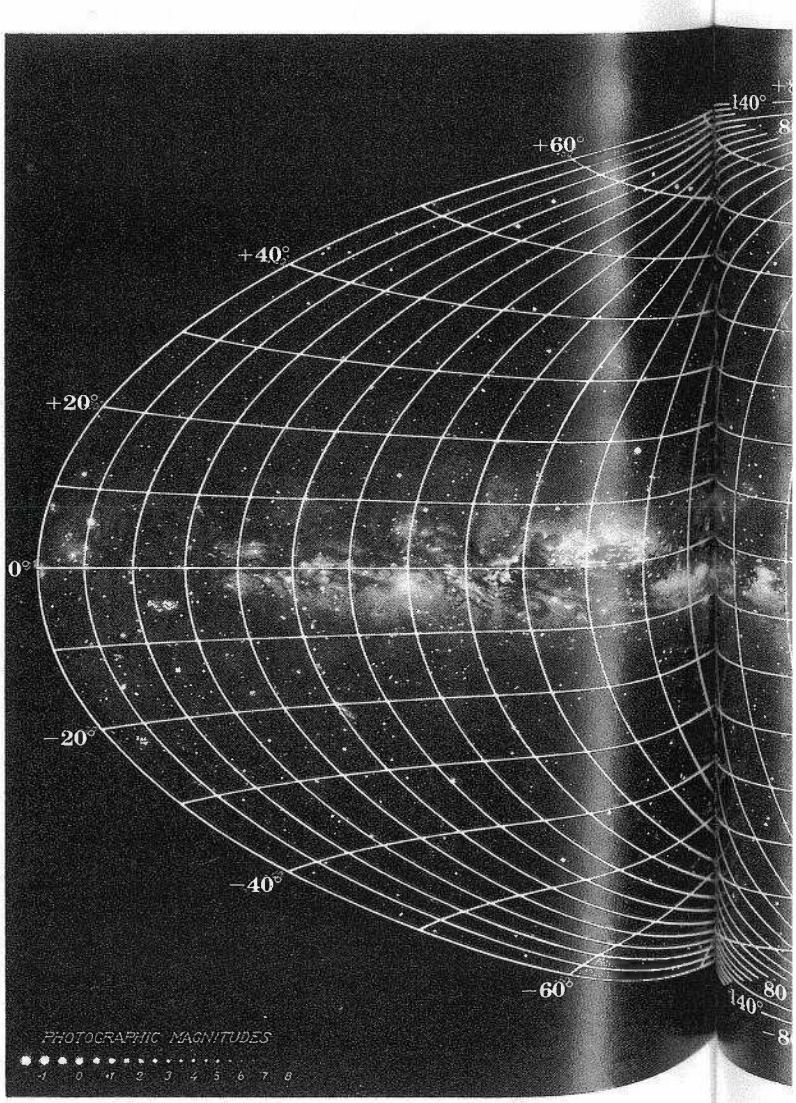
For a skywatcher appearances can be deceptive. The stars appear as if they are fixed to the inside of a dome or a sphere, and indeed this is how early astronomers believed them to be: fixed in the dome of space. Not until 1576 were ideas about an infinite universe of stars published by the Englishman Thomas Digges. Yet even when this idea came to be accepted, astronomers still thought the stars to be fixed in position.

Astronomers believed this because this is how they appear to be, unmoving, settled in their specific places in the many constellations. Every generation has observed them to be the same. Yet they are moving; it is only their great distance that makes it impossible to detect this movement with the unaided eye. It was Edmond Halley who first detected such motions in 1717, yet it was not until some 170 years later that they were studied in detail.

Each star has an individual motion. In addition, all are orbiting around the centre of a vast island of stars, dust and gas, known as a galaxy. It has been estimated that our Sun takes approximately 225 million years to complete one full galactic orbit. You



The edge-on view of the Galaxy, *top*, does not show the spiral arms. These can be seen only when looking down on the Galaxy, *above*. The missing part is on the far side of galactic centre, invisible from Earth.



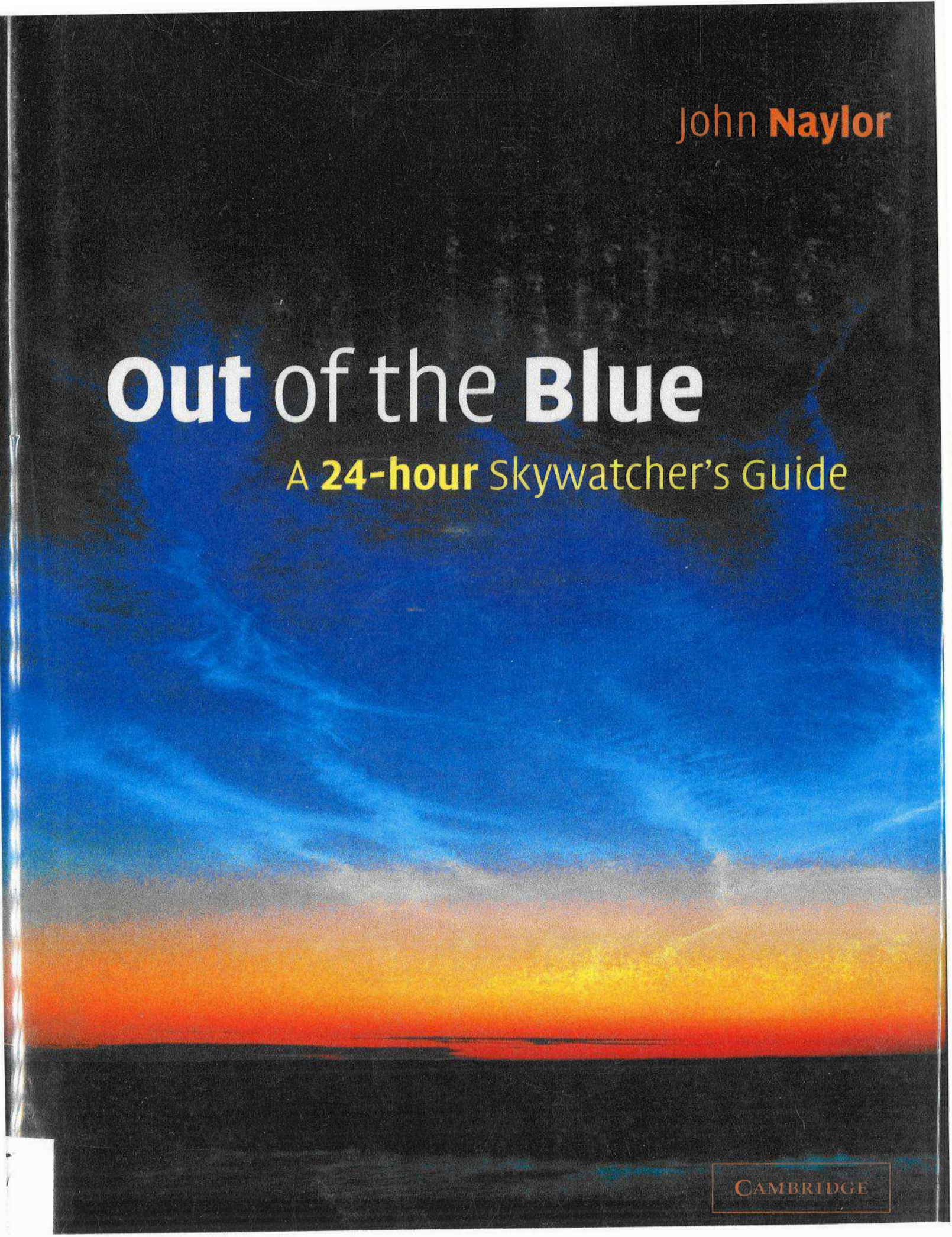
A composite of many photographs was used by the Lund Observatory in Sweden to create this view, similar to a map projection. It shows the concentration of stars and star fields in the plane of the Galaxy.

Exhibit 16

John **Naylor**

Out of the **Blue**

A **24-hour** Skywatcher's Guide



CAMBRIDGE

Out of the Blue

Why is the sky blue and why are sunsets red? When can I see a rainbow? Why is the Moon sometimes visible in daylight? In *Out of the Blue*, skywatcher John Naylor offers practical advice about where and when you can expect to see natural phenomena, what you will see and how to improve your chances of seeing it. He takes in both the night sky and the day sky, and deals only with what can be seen with the naked eye. Drawing on science, history, literature and mythology, and written in a popular style that assumes only basic scientific know-how, *Out of the Blue* is for everyone who enjoys being outdoors and who feels curious or puzzled about things optical and astronomical.

JOHN NAYLOR has been fascinated by the night sky since he was a child growing up in Peru, and by the daytime sky as an adult. He went to London University to study engineering and philosophy, and now teaches physics at a secondary school in London.

Out of the Blue

A 24-hour Skywatcher's Guide

JOHN NAYLOR

CAMBRIDGE
UNIVERSITY PRESS

PUBLISHED BY THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE
The Pitt Building, Trumpington Street, Cambridge, United Kingdom

CAMBRIDGE UNIVERSITY PRESS
The Edinburgh Building, Cambridge CB2 2RU, UK
40 West 20th Street, New York, NY 10011–4211, USA
477 Williamstown Road, Port Melbourne, VIC 3207, Australia
Ruiz de Alarcón 13, 28014 Madrid, Spain
Dock House, The Waterfront, Cape Town 8001, South Africa

http://www.cambridge.org

First published 2002

Printed in Italy at G. Canale & C. S.p.A.

Typeface Trump Medieval 9.5/13pt *System* QuarkXPress™ [SE]

A catalogue record for this book is available from the British Library

ISBN 0 521 80925 8 hardback

All diagrams drawn by the author, John Naylor

But the eye is a Jack-of-all-trades, a superbly flexible organ which can scan the entire sky in a matter of seconds, and take in with a single glance the spectacle of a clear dark sky, the majesty of the Milky Way, or the thrill of a meteor shower. These are not things that can be done with a telescope. And the more you use your eyes, the better you become at spotting things.

The other great advantage of relying on your eyes rather than on a telescope is that your eyes are always with you. Most astronomical telescopes are not very portable, and you won't always have one to hand when there's something worth seeing. If you rely on only your eyes, you'll never be caught short when there is something to see. This is not to say that a telescope isn't worth having. Far from it: the Moon's surface, or the disc of a planet, seen through a powerful telescope, are extraordinary sights. But a telescope does not, in itself, overcome the major disadvantage most people face when looking at the sky: not knowing what to look at, or how to look at it.

While on the subject of optical instruments, there is the important question: to photograph, or not to photograph? I have found that photography can get in the way of looking carefully, and enjoying a sight. In any case, you soon discover that many of the sights that you want to photograph are quite common. If, like me, you are not a particularly skilled photographer, and lack the patience necessary to improve your skills, leave photography to others. I now seldom carry a camera. I believe that the only point of lugging a camera around is for those once-in-a-blue-Moon events, and of which there are few, if any, good images. There are occasions when I could have kicked myself for not having a camera to hand, like the time I saw Manhattan looming above the horizon some 40 km across water from the shores of Connecticut. But I did have binoculars, and I spent the time exploring the sight, rather than fiddling around with the controls of a camera. In fact, I would say that, given a choice, binoculars are more useful to a skywatcher than a camera. The decision, of course, is yours. There are some grand sights to be photographed, as you can tell from the photographs in this book.

What of U.F.O.s, or unidentified flying objects? Leaving aside the issue of whether aliens have visited the Earth from another world, a subject too vast and contentious to be dealt with here, there will be occasions when you will see something in the sky that perplexes you. Don't jump to conclusions; there will almost certainly be a rational explanation. In defence of my scepticism, I offer my own U.F.O. experience. One night some years ago, in the city where I live, I saw four or five glowing ovals flying swiftly overhead. I had hardly glimpsed them out of the corner of my eye than they vanished behind some nearby buildings. They moved silently, one behind the other, weaving slightly from side to side. I realised that they were not aircraft or I

would have heard their engines. What were they? For years after, I remained perplexed by what I had seen. Then one night, by chance, I saw a similar formation. This time I had binoculars to hand. I quickly raised them to my eyes, focused, and saw geese. As soon as I did so I could see why they looked like fast-moving glowing ovals. In the first place they were flying directly over me just above roof height so they took only a few seconds to cross my entire field of view, which made their apparent speed very great indeed. Secondly, they made no noise, something that had added to my confusion the first time I saw them. Finally, the glowing ovals were their wings, which reflected the orange glow of the streetlights below. This has been my only U.F.O. sighting to date. I have no doubt I shall see other things that puzzle me, and which I may be unable to explain, though I don't expect ever to see a flying saucer.

Finally, a few words about the rewards of skywatching. Sadly, light pollution due to street lamps prevents us from seeing all but the brightest stars. Astronomers complain that today's skies, especially city skies, are barren wastelands, devoid of all but a handful of stars, and hardly worth a second glance. But although light pollution makes it all but impossible to see faint stars and galaxies, including our own Milky Way, it doesn't prevent us from seeing the Moon, planets and the brightest stars. In fact, where the Moon and planets are concerned, you can see almost as many of the Moon's many aspects from most cities as you can from the darkest countryside. And, at their brightest, planets can be seen without difficulty even from the centre of a large city.

Above all there is the pleasure of simply allowing your eyes to roam until they fasten on something interesting, and of recognising it for what it is. The chances of seeing something hitherto unknown, or extremely rare, are slim. If you are new to skywatching, you will make many discoveries, but they will be of things that are new to you. If you are unfamiliar with the sky, you soon find that nature is brimming with optical phenomena that you have never heard of, let alone seen. If you keep your eyes peeled, there is a chance that you will see something that is new to you almost daily, or see something familiar in a new light. When you first see such phenomena you experience a thrill of discovery – always a magical moment. But it won't take you long to realise that most of these sights are everyday events, and that it was merely ignorance that stopped you noticing them sooner.

Gradually your experience of nature acquires another dimension as you realise that what we see is the result of the passage of light through the atmosphere, of reflection and refraction in the world around us. Rainbows and halos are particularly striking examples of this, but they are not in a

Chapter 5 | RAINBOWS

> Shortly we came in sight of that spot whose history is so familiar to every school-boy in the wide world – Kealakekua Bay – the place where Captain Cook, the great circumnavigator, was killed by the natives, nearly a hundred years ago. The setting sun was flaming upon it, a Summer shower was falling, and it was spanned by two magnificent rainbows. Two men who were in advance of us rode through one of these and for a moment their garments shone with a more than regal splendor. Why did not Captain Cook have taste enough to call his great discovery the Rainbow Islands? These charming spectacles are present to you at every turn; they are common in all the islands; they are visible every day, and frequently at night also – not the silvery bow we see once in an age in the States, by moonlight, but barred with all bright and beautiful colors, like the children of the sun and rain. I saw one of them a few nights ago.
>
> Mark Twain, *Roughing It*

5.1 Unweaving the rainbow

How many rainbows have you seen recently, say in the last six months? Not many, I'll wager. The fact is that, unless you live somewhere where the conditions that favour their formation occur on an almost daily basis, such as an oceanic island like Hawaii, you probably don't often get the chance to see a rainbow. In Hawaii, if Mark Twain is to be believed, they are so common that you can't miss them. But, wherever you live, rainbows almost certainly occur more frequently than you think. It's mostly a matter of looking for them when conditions are right.

Almost everyone knows the old rule of thumb that Sun plus rain equals a rainbow. But, as you may have discovered, this rubric isn't foolproof. What's missing are important details like the Sun must be close to the horizon and the rain must be in the opposite quarter of the sky. In fact, if you are a novice skywatcher, by the time you've taken on board all the extra conditions necessary to guarantee a rainbow, your initial enthusiasm may be quite blunted! But don't give up. When you've gone out of your way to see a few rainbows, and learned more about the circumstances in which they

no sense of the Earth's motion. Instead, the Sun and Moon appear to chase one another endlessly around the sky, and planets to weave their way among the fixed stars from one day to the next, all apparently circling the Earth. The challenge is to make the link between your first hand, Earth-centred experience, and the heliocentric reality; and this requires considerable imaginative effort. What follows is intended, in part, to help you make the necessary connections between what you see, and the reality behind it.

It has to be said that if you want to become familiar with the night sky you must be prepared to be a constant, if informal, skywatcher. Through sustained and thoughtful naked-eye observation – yes, you must think about what you see – you will gradually become familiar with the motions of celestial bodies, so that sooner or later you come to understand them for yourself, without the need to have them explained by someone else, or to refer to sky maps or data concerning planetary positions. Of course, this demands a degree of commitment. And while you don't have to go outside on every clear night, you should get into the habit of looking at the sky from time to time to keep track of what's going on 'up there'.

Every time you look at the night sky keep in mind that one of the things you are trying to understand is how the apparent Earth-centred motions of celestial bodies are linked to their real Sun-centred motions. The test of whether you have succeeded in this is whether, from the comfort of an armchair, you can picture in your mind's eye, at any time of the year, the approximate relative positions of the planets, including the Earth, and the direction in which they are moving around the Sun.

8.3 The celestial sphere

The night sky is an illusion. This is not to say that what you see is not there but rather that your interpretation of it is incorrect. All stars are so far from the Earth that it isn't possible to detect any parallax between them with the naked eye. This makes it appear as if they are all equally distant from the Earth, which in turn helps to create the illusion that we are at the centre of a huge sphere of indeterminate size.

Astronomers long ago accepted that this illusion provides the basis for a very useful fiction. For the purposes of drawing maps of the sky, and of keeping track of the apparent motions of the Sun, the Moon and planets, astronomers assume that all stars lie on the surface of a huge sphere of indeterminate size which they call the celestial sphere. The Earth's lines of latitude and longitude are projected onto this sphere so that, for example, the

A group of stars that does not make up a constellation, but which is nevertheless distinctive enough to have been named, is known as an asterism. Among of the best-known asterisms are the Plough, or Big Dipper, the Square of Pegasus, the Summer Triangle (Vega, Deneb and Altair), the Pleiades, or Seven Sisters, and the Southern Cross (visible only from the southern hemisphere).

The most distinctive constellation in the sky is probably Orion. Furthermore, since Orion lies on the celestial equator everyone on Earth can see it. Most people, however, probably associate constellations with the zodiac. This is a collection of constellations that happen to lie on the ecliptic, i.e. on the Sun's apparent path through the sky during the year. They are known collectively as the zodiac because all but one of them has been named after a creature. The astrologers of ancient Mesopotamia divided the ecliptic into 12 constellations. Since that time, however, astronomers have made various adjustments to the original scheme and in modern maps of the sky the ecliptic passes through 13 constellations. The thirteenth constellation, which is not recognised in astrology, is Ophiuchus and lies between Scorpius and Sagittarius. Many of the zodiacal constellations are quite difficult to see in their entirety with the naked eye since they all contain several faint stars.

Although the constellations that make up the zodiac are of unequal size, the largest being Virgo and the smallest being Libra, astrologers divide the ecliptic into 12 equal sections. Astrologically speaking, therefore, the Sun takes approximately one month to pass through each of these sections and its position on the celestial sphere can thus be given approximately by stating the sign through which it is passing. This means that the zodiacal constellations that you see in the night sky are those through which the Sun passed six months earlier. For example, although Cancer and Leo are visible high in the midnight sky during February, the Sun actually passes through them in August. Although astronomers do not make use of the zodiac, informal skywatchers may find it convenient, if they wish to give the approximate position of a planet or the Moon, to refer to the zodiacal constellation in which the celestial body can be seen rather than using the system of celestial coordinates employed by astronomers.

The starting point of the zodiac was fixed by Hipparchus in the second century B.C. He established the convention that the spring equinox occurs as the Sun enters the constellation of Aries. However, because of the precession of the Earth's axis, the ecliptic also precesses and in the 2000 years since Hipparchus, it has moved on by some 30°. Thus the spring equinox no longer falls in Aries. It now coincides with the start of Pisces, but it is still

Exhibit 17

Canku Ota

(Many Paths)

An Online Newsletter Celebrating Native America

August 2015 - Volume 13 Number 8

Native Skywatchers Team Encourages Participants To "Look Up" To Find Star Knowledge

by Joseph V. Sowmick - Saginaw Chippewa Tribal Observer Photojournalist

Indigenous teachings encouraged 27 participants to "look up" as the Ziibiwing Center of Anishinabe Culture & Lifeways unveiled their latest two-day educational workshop June 18-19: Native Skywatchers – Ojibwe and Lakota/Dakota Star Knowledge.

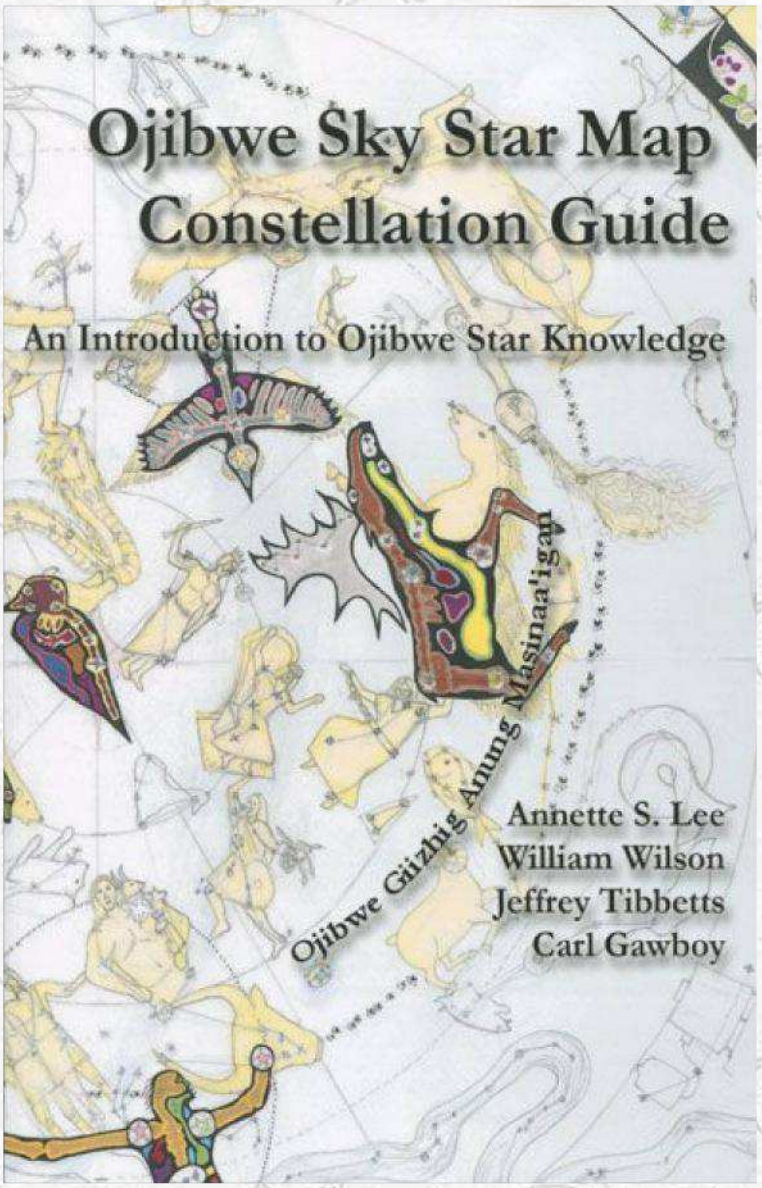
Ziibiwing Assistant Director and event coordinator Judy Pamp said Ziibiwing, Central Michigan University's College of Humanities and Social Behavioral Sciences and the Olga J. and G. Roland Denison Visiting Professorship of Native American Studies collaborated.

The presenters include St. Cloud State University Planetarium and Native Skywatchers Director Annette S. Lee, from the Dakota nation, with fellow team members Bois Forte Ojibwe author Carl Gawboy, Fond du Lac Tribal, and Community College Title III Project Director Jeffrey Tibbetts and William Wilson, Canadian Ojibwe tribal elder and artist.

"The workshop is designed for all educators and persons interested in increasing their knowledge of Ojibwe and Dakota/ Lakota star knowledge," Lee said. "Included in the workshop are multiple hands-on activities so participants will be able to experience the culture and the science in the most authentic and meaningful way possible…"

Wilson provided illumination of his work during his afternoon teaching of "Growing up Traditional: Ojibwe Culture, Language & Art."

"We learn from those teachings of the ancestors who have walked before us and we see creation as the spirits see us," Wilson said. "We as Anishinabe



"Ojibwe Sky Star Map - Constellation Guidebook: An Introduction to Ojibwe Star Knowledge" by Annette S. Lee, William Wilson, Jeffery Tibbetts, Carl Gawboy.

people look past the outer surface and see what is truly there and we connect to the spirit world. This is why we see the lines of communication connect in Ojibwe art because when it comes down to the teaching… we are all connected."

Each skywatcher has a background in art, although Tibbetts offered a unique perspective into stone sculpting and working with mixed media.

"I've had to learn most of what I know about art learning on my own and by watching my dad carve," Tibbetts said. "We learn about things best by observing the people around us. What we can't or don't learn by observing others allows us to be creative enough to seek out new teachers and opportunities. I had to do that with both art and cultural things…"

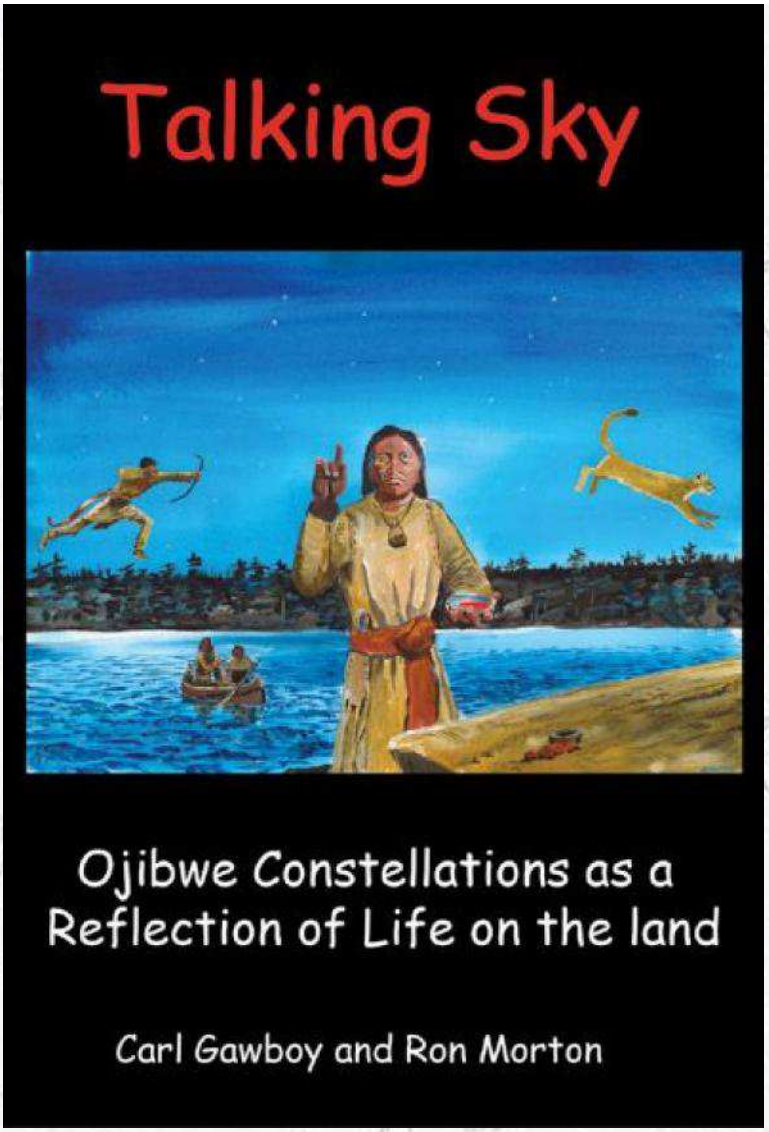
As an archaeo-astromer, Gawboy enlightens in his awardwinning research treatise "Talking Sky: Ojibwe Constellations as a Reflection of Life on the Land".

"It is interesting to see where western thought and academia are still trying to catch up where they finally realize that native natural knowledge, and what the elders shared in their stories, is now referred to as science," Gawboy said. "Many of the old paradigms held as fact over the years have changed as the science of Ojibwe star knowledge is shared. Take for example, the old idea of Indian time: Part of Ojibwe astronomy is how they marked time. Native people knew there was a time to harvest medicine and crops and looked to the sky for that knowledge."

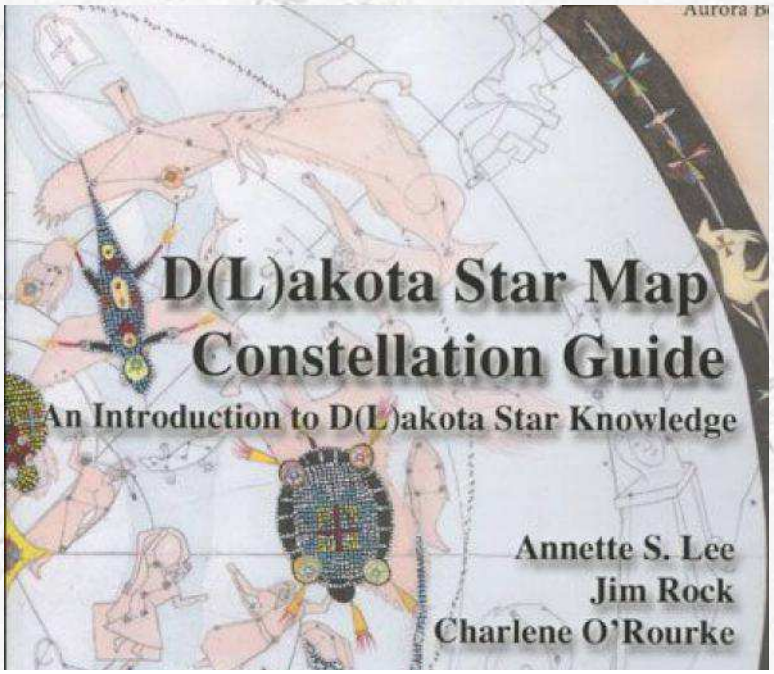
Jonathon Miller, adjunct science instructor of the Saginaw Chippewa Tribal College, attended the workshop and has offered astronomy and archaeoastronomy courses.

"It is important to integrate as much Native culture into the curriculum as possible," he said. "… I have read a few of the books that Carl Gawboy has authored and each one has had a profound impact my appreciation for Native culture. Both Mr. Gawboy and Annette S. Lee are people who are an inspiration to those of us who love astronomy and are very interested in learning about the Native application of it…"

The skywatchers concluded the seminar with participants forming a circle with the afternoon star high in the sky.

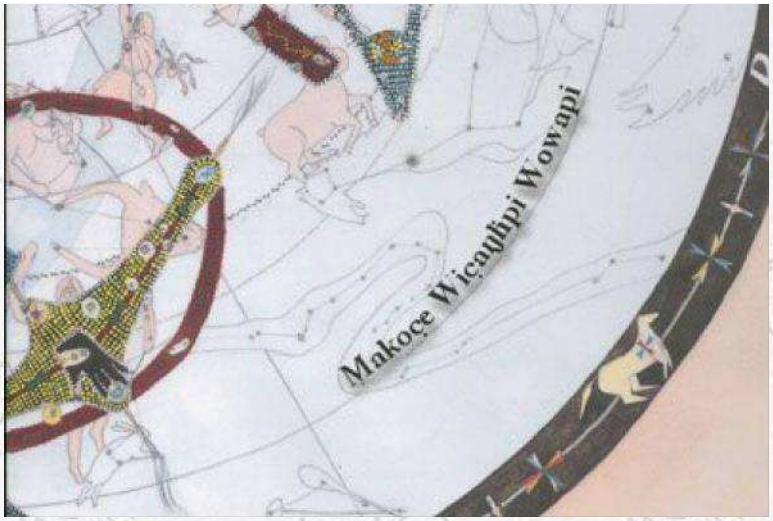


"Talking Sky - Ojibwe Constellations as a Reflection of Life on the Land"
by Carl Gawboy and Ron Morton



Lee offered a Dakota honor song on her shaker and shared a prayer of hope for all our relations.

"It is an honor to come together as we all our remembering, revitalizing and celebrating the history of Ojibwe and Lakota/Dakota Star Knowledge," Lee said. "This is the essence of cultural astronomy and many elders and Native people have bits and pieces of the knowledge so freely shared with them. We only know a little and we don't have to be experts but we can be humble and practice these teachings. The late White Earth Ojibwe Elder Paul Schultz had a vision that the young people will bring the star reading back… I believe that vision is happening today."



"D(L)Akota Star Map Constellation Guidebook: An Introduction to D(L)Akota Star Knowledge"
by Annette S Lee, Jim Rock, Charlene O'Rourke

Pamp encouraged everyone to "get outdoors and take a look at the beautiful universe created by Gitchi Manidoo (Creator)…"

All are welcome to join the Ziibiwing Center on July 29 for an outdoor movie and star stories event with storyteller Larry Plamondon.

Ojibwaystargazing

Curly Tail, the Great Panther

Pa showed me how stories of the ancients were illustrated in the constellations that hung so close to us on clear northern nights.

Hiegman Lake pictographs ... are these constellations?

Ojibway stargazing

There's more up there than a Greek guy in a tunic

by Carl Gawboy

After the world was created, Nanaboujou and the evil Curly Tail, the Great Panther, had a battle. Nanaboujou, a protector of the Ojibway people, shot a magic arrow into the side of Curly Tail.

Taking to his bed, Curly Tail offered the riches of the world to whoever could cure him. Nanaboujou donned a frog skin as disguise and went to the bedside of the evil one. Instead of curing him, Nanaboujou rammed the magic arrow deeper into Curly Tail's chest.

It was on that account that the great flood came and covered the earth.

Now each year, the Great Panther rises in the evenings in April, the dangerous time of snowmelt and flood.

Look into the dark sky above Lake Superior.

The Greeks weren't the only ones who saw their legends, heroes and villains illuminated in the heavens on starry nights.

The origins of my quest to learn Ojibway constellations and their connection to Rock Art – the pictographs painted long ago – lie in my childhood.

On an early spring night when I was very young, my father and I walked back to the house after chores. The sickle-shaped constellation called "Leo" by the Greeks was directly overhead.

"The Chippewas didn't see a lion in those stars," my father told me. "They saw the Panther's tail."

I was fascinated by the idea that there were different ways of seeing the same constellation.

Pa was talking about Curly Tail, the Great Panther, a presence respected and feared, capable of great harm, but who also possessed knowledge of healing. As we stood there, he told me that story of the constellation.

Pa's story of the Panther started me on my life's work, searching for the indigenous knowledge of my place ... the Arrowhead, the Laurentian Shield, the North. On that cold spring night, I began to see the stars differently.

Sweating stones (makte'aiming) are what many Ojibway people see when viewing the Pleiades, also called the Seven Sisters. It is part of Bugonegiizhig, a Hole in the Sky, or the opening into the star world or the roof poles for the "shaking tent" ceremony. The stones are for the nearby sweatlodge (madoodiswan). Here, too, in the heavens lies the exhausted "bother" from the sweatlodge, the outline of which is known as Corona Borealis. Several poles have been torn away; the bother, as the story goes, has thrown himself into the snow with a dislodged pole nearby and is outlined by what the Greeks knew as the constellation Hercules.

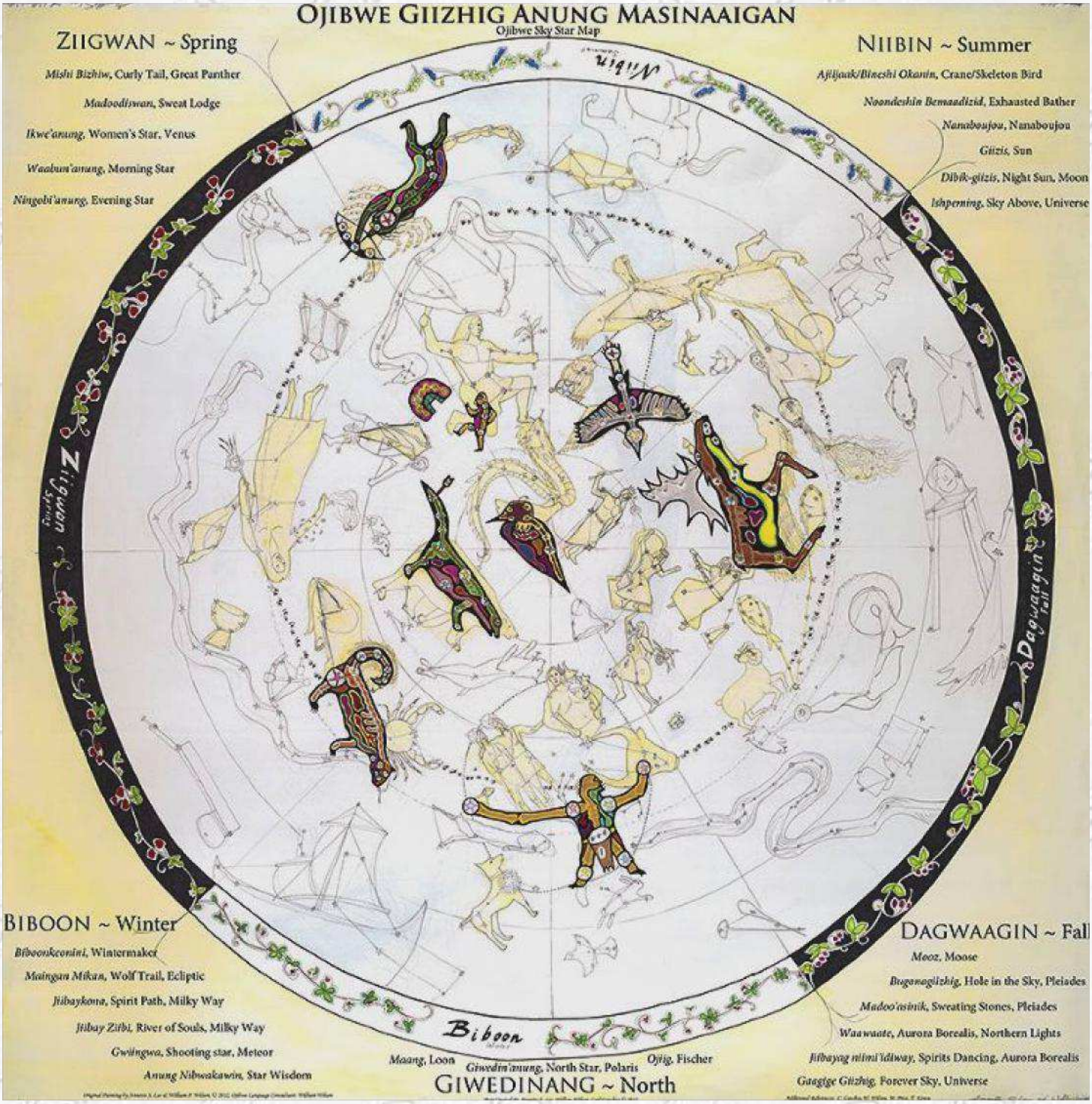
I grew up in a small log house on a homestead 10 miles south of Ely, Minnesota. We had chickens and cows. We made hay with horses.

Pa worked in the woods and made extra cash as a laborer at the Rabbits taconite plant. We harvested wild rice, gardened, fished, hunted and trapped.

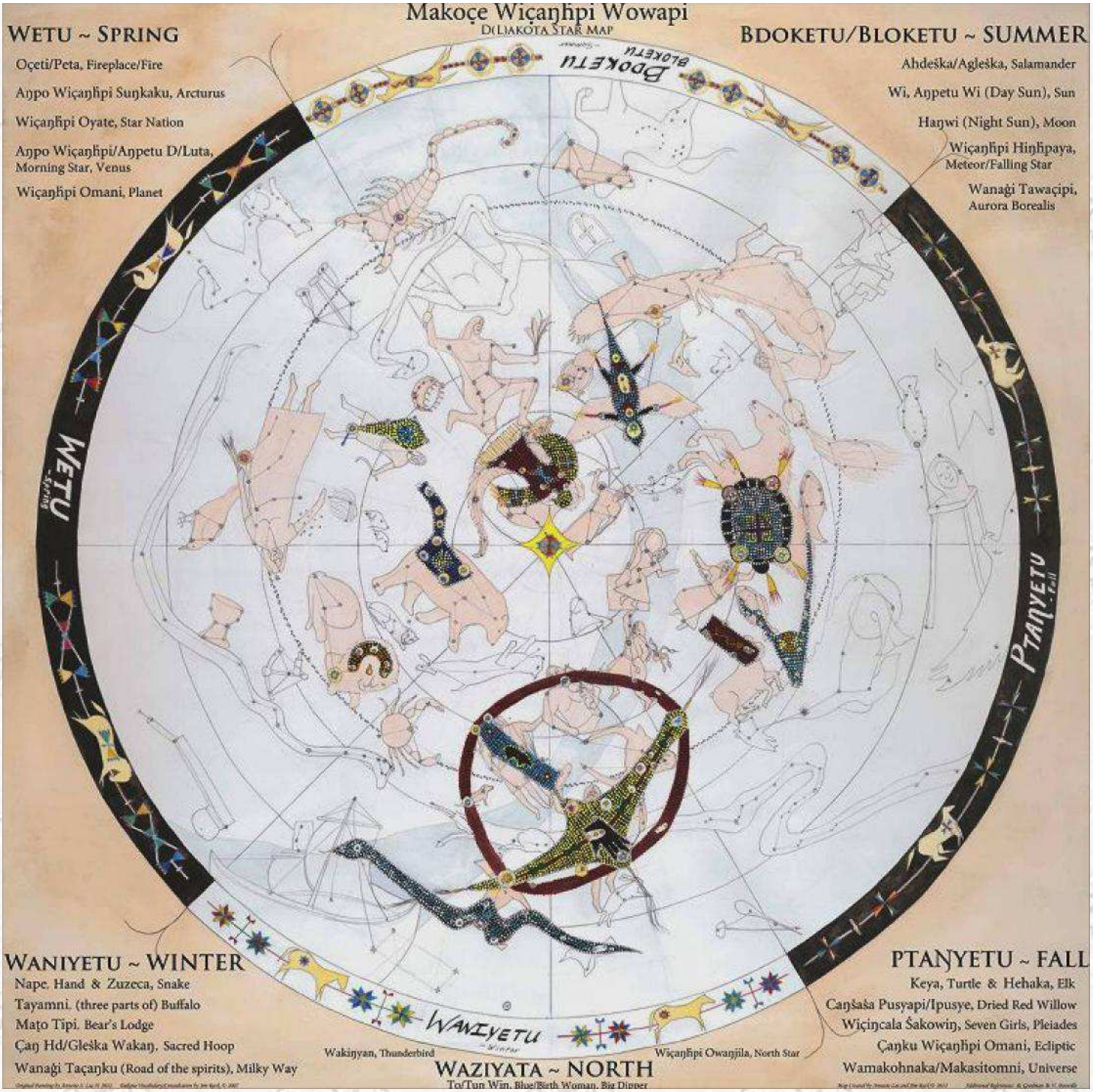
Since we were too poor to buy books, my schoolteacher mother craftily offered to keep a branch of the Ely Public Library in our house. (Our large family made up the chief

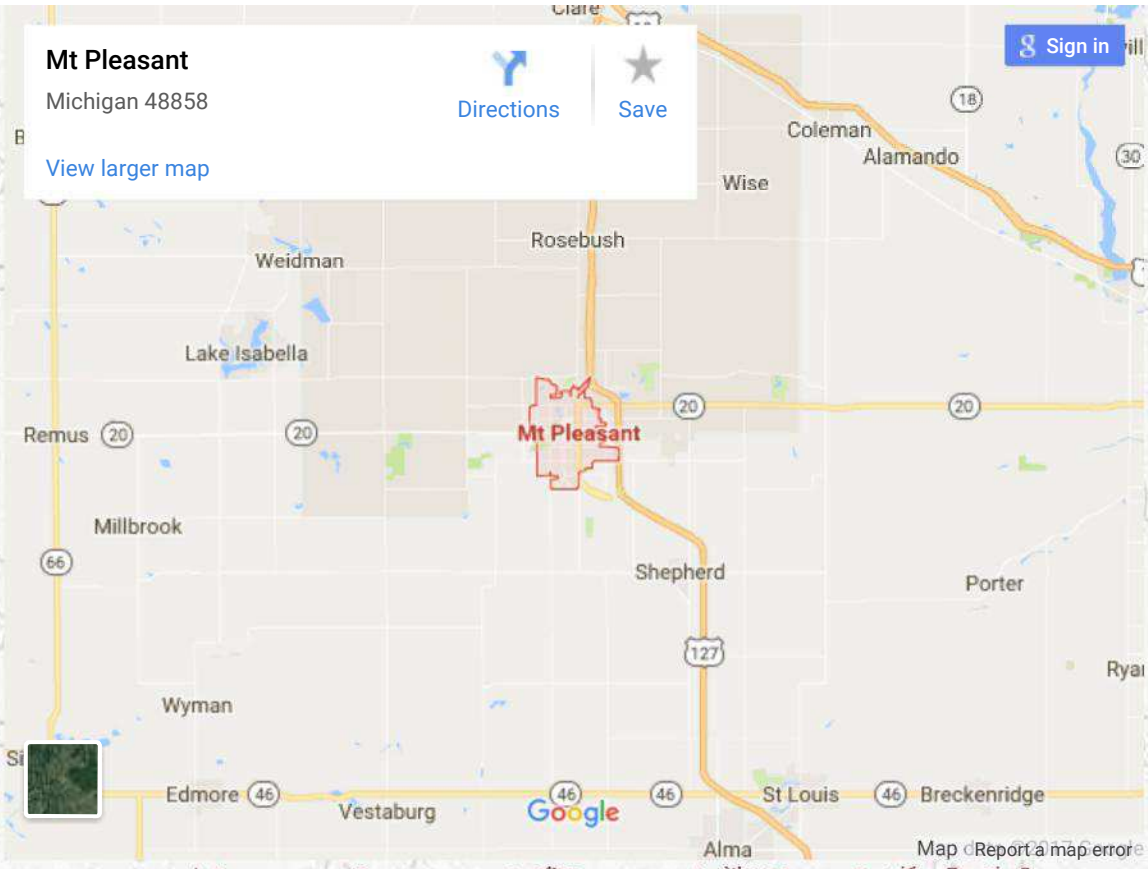
Ojibway Stargazing
Artist Carl Gawboy joined Annette S. Lee's Native Skywatchers project in part because of a 2005 story he did for Lake Superior Magazine.

Native Skywatchers:
Ojibwe Giizhig Anung Masinaaigan ~ Ojibwe Sky Star Map



Native Skywatchers:
Makoce Wicanhpi Wowapi ~ D(L)akota Star Map


Makoce Wiçaŋȟpi Wowapi
D(L)AKOTA STAR MAP
WETU ~ SPRING
Oçeti/Peta, Fireplace/Fire
Aŋpo Wiçaŋȟpi Suŋkaku, Arcturus
Wiçaŋȟpi Oyate, Star Nation
Aŋpo Wiçaŋȟpi/Aŋpetu D/Luta, Morning Star, Venus
Wiçaŋȟpi Omani, Planet
BDOKETU/BLOKETU ~ SUMMER
Ahdeška/Agleška, Salamander
Wi, Aŋpetu Wi (Day Sun), Sun
Haŋwi (Night Sun), Moon
Wiçaŋȟpi Hiŋȟpaya, Meteor/Falling Star
Wanaġi Tawaçipi, Aurora Borealis
WANIYETU ~ WINTER
Nape, Hand & Zuzeca, Snake
Tayamni, (three parts of) Buffalo
Maṭo Tipi, Bear's Lodge
Çaŋ Hd/Gleška Wakaŋ, Sacred Hoop
Wanaġi Taçaŋku (Road of the spirits), Milky Way
PTAŊYETU ~ FALL
Keya, Turtle & Hehaka, Elk
Caŋšaša Pusyapi/Ipusye, Dried Red Willow
Wiçiŋcala Šakowiŋ, Seven Girls, Pleiades
Çaŋku Wiçaŋȟpi Omani, Ecliptic
Wamakohnaka/Makasitomni, Universe
WAZIYATA ~ NORTH
To/Tun Win, Blue/Birth Woman, Big Dipper
Wakiŋyan, Thunderbird
Wiçaŋȟpi Owaŋjila, North Star
WETU
BDOKETU
PTAŊYETU
WANIYETU



Home Page | Front Page | Archives | Our Awards | About Us
Kid's Page | Coloring Book | Cool Links | Guest Book | Email Us

Exhibit 18

EVERYONE GETS IT.
AdVantageNEWS.com
NEWS. SPORTS. LOCAL.

Digging into ancient religion

by AdVantage News February 5, 2015

COLLINSVILLE — Archaeologists can look at the immense Cahokia Mounds. They can dig up bits of pottery and tools. They can even find human remains. But what do these physical traces reveal about the religion followed by the people who lived here 1,000 years ago?

Susan Alt will try to answer that question Sunday, Feb. 22, when she speaks at the Cahokia Mounds State Historic Site. The free event begins at 2 p.m.

Alt, a Ph.D. from Indiana University, has spent years researching the mounds. Most recently, she has excavated Emerald Mound, a site about 25 miles from the historic site, near the town of Lebanon. She has found evidence of structures there that may have served as shrines and living quarters for people making pilgrimages to and from Cahokia.

Photo from Cahokia Mounds Facebook page

Monks Mound, the largest mound at Cahokia Mounds State Historic Site.

She and her husband, Timothy Pauketat of the University of Illinois, believe Emerald Mounds was aligned with the moon's phases and attracted religious pilgrims from all across the Midwest. Their findings suggest it predates Cahokia Mounds and helped spur development of Cahokia into a city of 10,000 people or more.

"We're finding that religion wasn't an outcome of greater complexity," Alt has said. "Rather, greater complexity was a product of a religious movement."

The historic site's lecture series continues March 22 when William Romain presents "Ancient Skywatchers of the Eastern Woodlands," a look at the 5,000-year-old tradition of Native American skywatching. Romain documents celestial alignments of site, including the great city of Cahokia.

Cahokia Mounds State Historic Site, administered by the Illinois Historic Preservation Agency, is just eight miles from downtown St. Louis, in Collinsville, off Interstates 55/70 (Exit 6) and Interstate 255 (Exit 24), on Collinsville Road. The Interpretive Center is open 9 a.m. to 5 p.m. Wednesday through Sunday. There is no admission fee but we do suggest donations of $7 for adults, $5 for seniors, $2 for students and $15 for families.

For information, call (618) 346-5160 or go to www.cahokiamounds.org.

Tags

featured

by AdVantage News February 5, 2015

Comments

Type subject here...

Exhibit 19

FROM THE ARCHIVES

Harvest time in Amish country
April 10, 2005

Itinerary: Harvest Time
October 14, 1999

54 HOURS : Great Gourds: It's Harvest Time
October 12, 1995

At Harvest Times, All Roads Lead to Napa
September 7, 1995

It's Harvest Time Down on the Farm--in Norwalk
August 9, 1992

Time Is of the Essence to Scientists in Ohio Studying Ancient Astronomical Markers

January 11, 1987 | Associated Press

DAYTON, Ohio — An ancient tribal priest peered down from a high bluff along a stream that centuries later is called the Little Miami River.

As the summer sun rises, he watches for a shadow to fall across the length of a carefully positioned stone called "Sun Serpent." Then, as his vigil is rewarded, he turns and pronounces it is again time to begin the sacred ceremonies celebrating the approach of the harvest.

Dr. John White, a Youngstown State University anthropology professor, has that scene fixed in his mind because he has studied the serpent-shaped mound of stones, which he dug from the silt of the Little Miami's flood plain.

Scientific Memorials

White believes the 66-foot Kern Sun Serpent, located at Camp Kern, a YMCA camp in Warren County near the village of Morrow in southern Ohio, is one of two unique astronomical alignments that were used about 800 years ago to mark the summer and winter solstices.

It also is his and his colleagues' opinion that artifacts like the ancient Sun Serpent are memorials to the scientific sophistication of prehistoric Native American Indians.

The colleagues include J.M. Heilman, curator of anthropology at the Dayton Museum of Natural History; Dr. N'omi Greber, curator of archeology collections at the Cleveland Museum of Natural History, and Dr. Ray A. Williamson, an archeoastronomer and editor of Archeoastronomy in America.

Heilman discovered another unusual set of 800-year-old astronomical markers at the museum's Incinerator Site village, which he is excavating and slowly reconstructing at the south end of Dayton.

Skilled Sky Watchers

Greber is investigating whether a series of large, geometric earthworks near Chillicothe, Ohio, are actually a complex system of astronomical alignments.

The four scientists say prehistoric inhabitants of this country were skilled sky watchers who devised many ways of sighting and marking annual astronomical events such as the summer and winter solstices and spring and autumn equinoxes.

The summer solstice is the longest day of the year and marks the beginning of summer, while the winter solstice is the shortest day of the year and marks the beginning of winter. During the spring and autumn equinoxes, day and night are of equal length.

Williamson's 14 years of research have taught him that the sun and its relationship to planting and harvest times was the central interest of most of the ancient sky watchers.

Sacred Ceremonies

"To really get a more than slight inkling of it, you have to begin to think of their world," he said. "There was very little difference between the secular and the sacred. Keep in mind they set up a calendar because they began to notice regularity in the sky. Perhaps first they set it up to mark a planting cycle, then they got more interested in timing ceremonies. But the ceremonies, which were quite sacred, were related to agriculture."

"The important thing to be trying to get people to understand is that if we didn't have city lights and television and went out and looked at the sky regularly, the things we are talking about are very easy to see if you're studying the sky," said Greber.

"When people knew these things, when they were part of the culture which surrounded (the people), I think most people knew a lot of things about the sun, moon and stars--like we know a lot about automobiles. They knew."

MORE:

Seizure Led to FloJo's Death

His 104 scores make his case

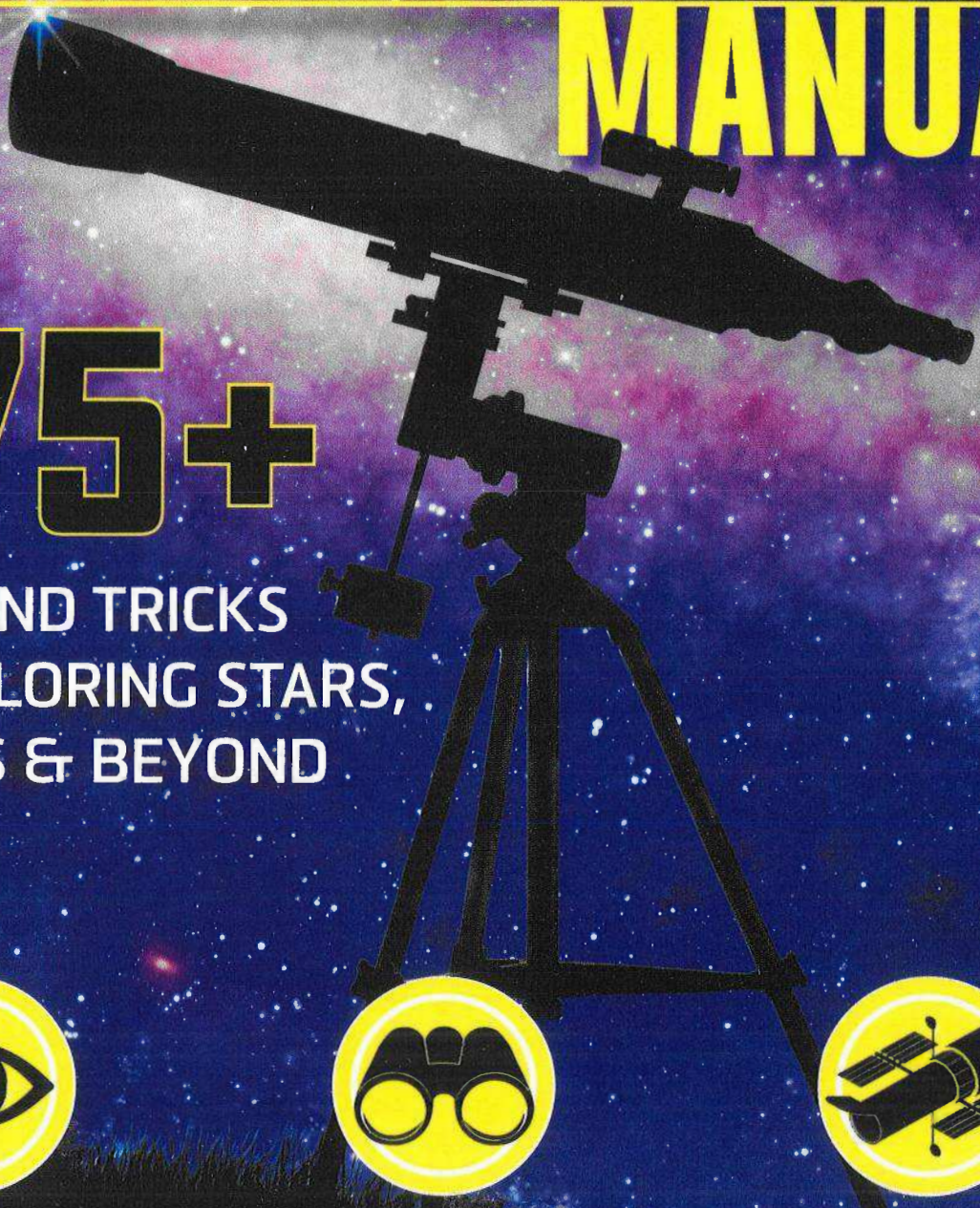
Restaurant review: South Beverly Grill

Brutal Murder by Teen-Age Girls Adds to Britons' Shock

Comaneci Confirms Suicide Attempt, Magazine Says

Exhibit 20

THE TOTAL SKYWATCHER'S MANUAL



275+

SKILLS AND TRICKS FOR EXPLORING STARS, PLANETS & BEYOND

NAKED-EYE ASTRONOMY TIPS

TELESCOPES & OTHER TOOLS

ADVANCED TECHNIQUES

THE TOTAL SKYWATCHER'S MANUAL

275+ SKILLS AND TRICKS FOR EXPLORING STARS, PLANETS & BEYOND

Linda Shore, David Prosper & Vivian White
of the Astronomical Society of the Pacific

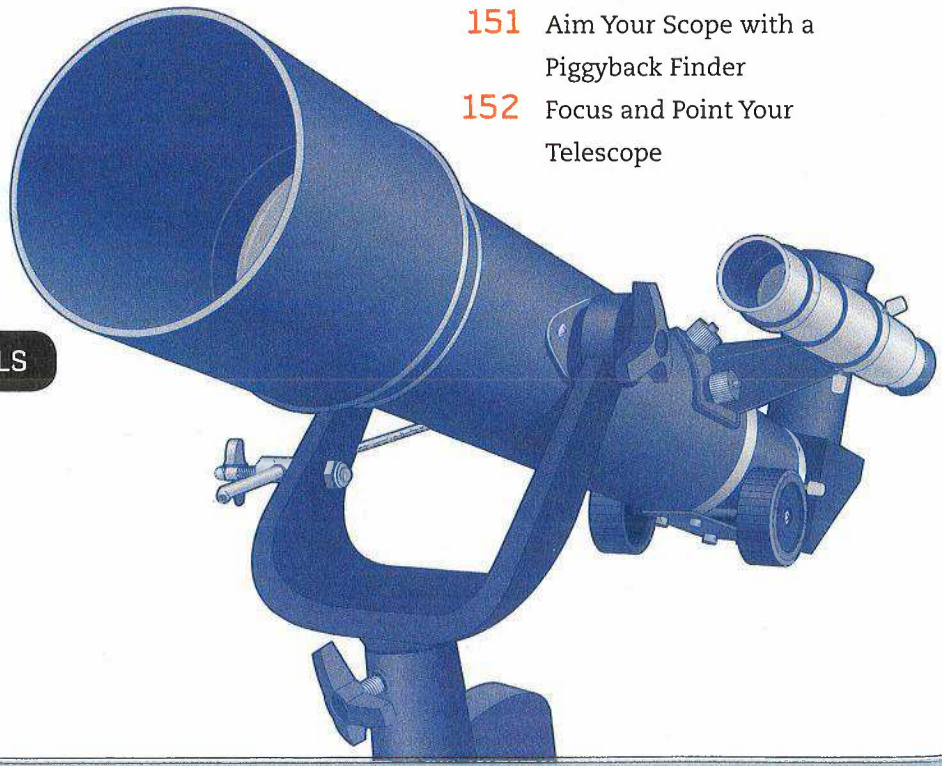
weldonowen

CONTENTS

NAKED-EYE ASTRONOMY TIPS

CONTENTS

TELESCOPES & OTHER TOOLS



06

TOP FIVE
RECOGNIZE IDEAL SKYWATCHING CONDITIONS

Discover the best viewing conditions for skywatching—you'll have more fun the more you can see!

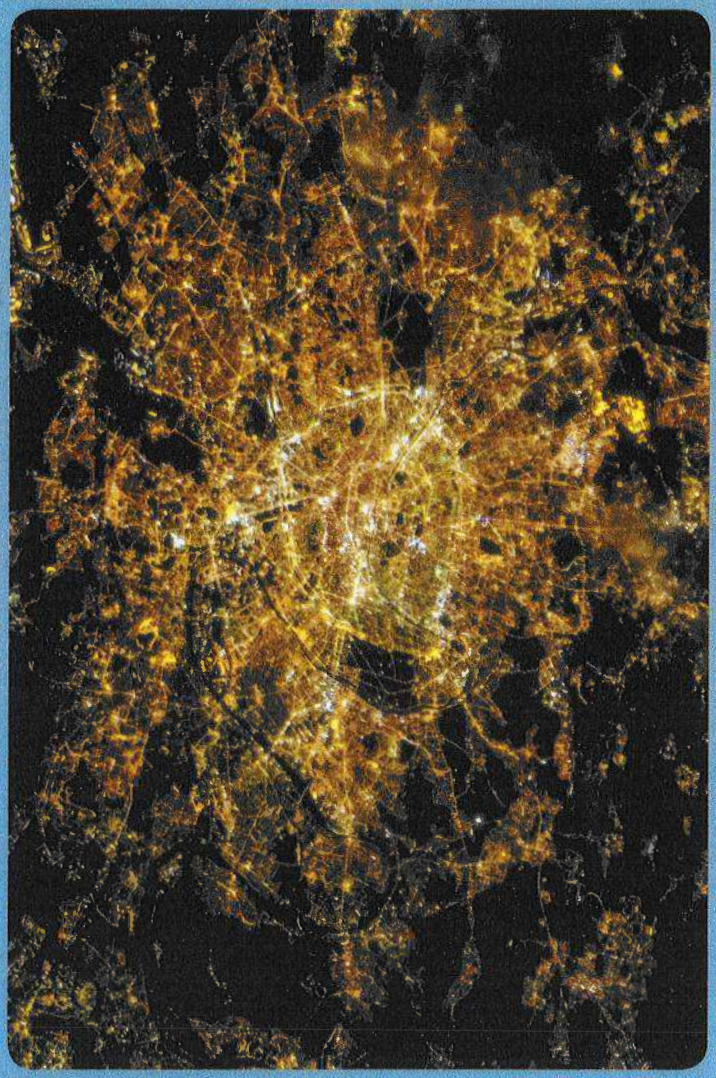
☐ **CHECK THE WEATHER** Cloud cover, haze, fog, dust, and smog all will obscure your view. Even if the night sky is clear, high humidity can affect your visibility and rapidly turn to fog and haze. If you live in a foggy or wet area, monitor the weather closely so you can take advantage of rare nights of good stargazing.

☐ **ENLIST TECHNOLOGY** Available on the web and as mobile apps, Clear Sky Chart is an essential astronomical forecast that alerts you to upcoming clear, dark, and ideal skies. Download it and never doubt! Also, given Earth's orbit around the Sun, you'll see different stars in different seasons. It helps to download a seasonal star chart app so you can plan excursions at optimum times.

☐ **MONITOR THE MOON** It's also a good idea to keep an eye on the lunar phases so you can avoid observing near a full Moon, which will wash out faint objects on an otherwise perfect star-seeking night.

☐ **AVOID LIGHT POLLUTION** Stay away from streetlights, car headlights, and other sources of bright light. Even looking at your phone can ruin your eyes' dark adaption.

☐ **GET UP HIGH** Our atmosphere is full of dust and turbulence, distorting light and limiting telescopes. The less atmospheric dust and turbulence you look though—the higher in altitude you are—the better your seeing will be.



07 GO URBAN OR RURAL

The dark skies of the countryside, jam packed full of stars, can be very confusing for beginners. An odd upside to city light pollution is that the brightest stars are very prominent. Light pollution blocks many stars, the Milky Way, and all but the brightest meteors from city viewers, and, since the brightest stars make up well-known constellations, light pollution makes those constellations easier to find and identify. The lack of background stars also makes it less difficult to find planets.

Meanwhile, viewing the stars in rural areas can be a life-changing experience. Depending on the season, the Milky Way may stretch across the sky, visible as a luminescent cloud. Stars may sprinkle the entire sky, while meteor showers can put on an incredible show. You might even spot distant galaxies and nebulae, such as the Andromeda Galaxy (M31/NGC 224) and the Orion Nebula (M42/NGC 1976).

08 PACK A BEGINNER SKYWATCHING KIT

While you can skywatch with just your eyes, it helps to stock basic supplies. Follow these suggestions and you will be perfectly prepared for observing the night sky.

☐ **BLANKET** As the night progresses and the temperature drops, you'll be glad you have a blanket. It also helps keep you dry when lying on the ground—great for watching meteor showers.

☐ **LAWN CHAIR** Stay comfortable. Adjustable lawn chairs—or even better, reclining ones!—are perfect for observing the sky and keep your neck safe from strain.

☐ **RED LIGHT** Normal flashlights will destroy your ability to see in the dark. As movie ushers learned, red lights are great for helping you see while preserving your night vision. Get one or make your own (see #10).

☐ **DRINKS AND SNACKS** Water will keep you hydrated, while coffee or tea in a thermos can help you stay awake. Also, everyone loves snacks.

☐ **STAR CHARTS** Print out a star chart or bring a planisphere that's specific to your area. (Also see #23–24 for our planisphere templates.) If you are observing in an area with a lot of light pollution, try using a stargazing app on your mobile device.

☐ **EXTRA CLOTHES** Even in warm climates, the night can get chilly, so bring a hat, a scarf, and gloves. Heat packs for your hands and feet are also not a bad idea.

122 SAY HELLO TO THE FIRST GREAT SKYWATCHERS

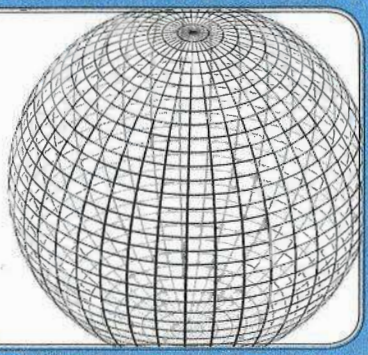
Long before space telescopes streamed feeds online for anyone who cares to look, many people took educated shots in the dark about what makes the universe tick. Here are just a few of the figures who helped shape our understanding of our own tiny place in the cosmos, many years before we had much of a clue.

THALES
(624 BCE–526 BCE)

A Greek philosopher, traveler, and mathematician, Thales was one of the first to postulate that the movements of heavenly bodies and forces of weather were not, as commonly believed, controlled by gods but could be explained with scientific principles. According to Herodotus, Thales accurately predicted the occurrence of an eclipse around 585 BCE.

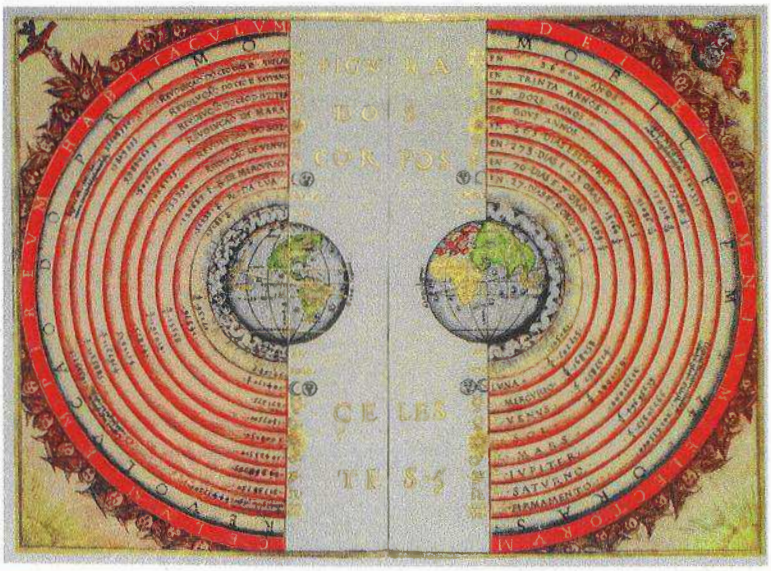
PYTHAGORAS
(570 BCE–485 BCE)

Possibly best known for the geometric theorem that bears his name, Pythagoras was also the first person to claim that Earth and the planets were spherical. While he got that right, he also got a lot wrong, like thinking that the enormous, planet-containing spheres rubbed against each other to create "music of the spheres."



ARISTOTLE
(384 BCE–322 BCE)

Doing one better than Pythagoras, Aristotle backed up his belief that Earth was round with observations, including the circular shadows that appear during eclipses, and the fact that stars shift position as a person moves north or south. Like Pythagoras, he got a lot wrong, too. He thought Earth was the stationary center around which everything else moved.



HIPPARCHUS
(190 BCE–120 BCE)

One of the greatest astronomers of ancient times, Hipparchus used relatively primitive astronomical tools—like the gnomon (see #38 to make your own)—to make his heavenly observations. Among his achievements are the creation of an enormous star catalog, as well as a scale comparing the brightness of stars.

ERATOSTHENES
(276 BCE–194 BCE)

Passionate for knowledge in general, Eratosthenes wore many hats. While this Greek thinker dabbled in everything from music theory to mathematics, poetry to astronomy, he essentially invented geometry and is best known for first calculating with great precision both the circumference of Earth and its tilt on its axis.

ARISTARCHUS
(310 BCE–230 BCE)

Ever in the shadow of Aristotle, Aristarchus was actually the first recorded person to propose a model of the universe with the Sun at its center and Earth and the other planets revolving around it. Far too radical an idea for the time, it would take almost 1,200 years for a heliocentric model to catch on in a serious way.

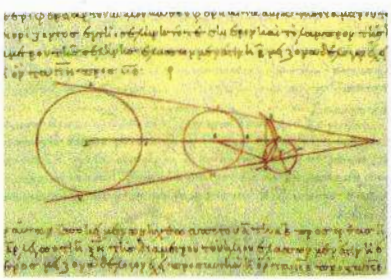


ILLUSTRATION CREDITS

Conor Buckley: 01–02, 18, 21, 25, 34–36, 38, 49, 61–64, 69–71, 73, 75–77, 87, 89, 91, 96, 98, 107, 125–126, 142–144, 150, 160, 163, 226, 230, 247, 289, 291, 298 Hayden Foell: 148–149, 172, 240, 249 Aaron John Gregory: 12–13, 29–32, 40–47, 52–59, 79–86, 112–121, 130–132, 137–140, 154–157, 186–189, 193–196, 203–206, 210–217, 225, 235–238, 261 Vic Kulihin: 179, 262, 294, 296 Liberum Donum: 17, 68, 78, 93, 103, 123, 185, 207, 229 Christine Meighan: 09–10, 22, 28, 101, 110, 151, 158–159, 169, 171, 174, 180, 221–222, 232, 248, 251, 263 Robert L. Prince: 127, 141, 147, 266, 271, 293 Bryon Thompson: 27 Lauren Towner: 08, 23–24, 128, 161, 165–166, 219, 223, 239, 265, 292

PHOTOGRAPHY CREDITS

All images courtesy of Shutterstock unless otherwise noted. Aeronet: 271 Miguel Araoz: 63 Aristarchus of Samos: 122 AstroZap: 181 Astronomical Society of the Pacific: 152 Rogelio Bernal Andreo: 200 Bob Atkins: 182 Jeff Barton: 199 Yuri Beletsky: p. 4, 14 Giuseppe Bertini: 122 Andrew Borde: 122 Bushnell: 146 Celestron: 146 Kevin Cho: 65 Corbis: 124 ESA/Hubble: 208 Explore Scientific USA: 144, 174 Getty Images: 100 Graham Green: 287 David Hayworth: 153 The Hubble Heritage Team (STScI/AURA): 109 Brocken Inaglory: p. 5, 67 Jim's Mobile, Inc. D/B/A JMI Telescopes: 178 Steven R. Majewski: 137 Shevill Mathers: 108 Meade: 183 Terry McKenna: 177 Scott D. McLeod: 88 Valetine Naboth: 122 Gautham Narayan: p. 7, 167 NASA: 04, 07, 11, 37, 95, 97, 133, 136, 264–265, 268 NASA, ESA and AURA/Caltech: 202 NASA/ESA, M. Robberto (Space Telescope Science Institute/ESA) and the Hubble Space Telescope Orion Treasury Project Team: 263 NASA Scientific Visualization Studio: 271 Barnaby Norris: 61–62, 64 Orion: 296 Wally Pacholka: 37 Matt Payne: 89 Planetary Society: 271 Lorraine Rath: 256 Gote Reber: 253 Joe Roberts: 162 Rolls Press: 274 Mike Salway: 39 SciencePhotoLibrary: 104, 105, 134, 275, p. 272 Science Source: pp. 2–3, pp. 8–9, 04, 15, 20, 33, 48, 102, 164, 184, 191–192, 197, 208–209, 227–228, 231, 241, 269–271, 277, 283, 295 Joshua Stevens: 271 Jimmy Thomas: 224 Mike Trenchard: 271 Chase Turner: 99 White Sand Missile Range/Applied Physics Laboratory: 274 Wikicommons: 122, 253, 274 Wikipedia: 208, 253 Hurst Wilson: 22 Bartolomeu Velho: 122 Frank Zulio: 21

weldonowen

PRESIDENT & PUBLISHER Roger Shaw
SVP, SALES & MARKETING Amy Kaneko
FINANCE MANAGER Phil Paulick

SENIOR EDITOR Lucie Parker
PROJECT EDITOR Nic Albert
EDITORIAL ASSISTANT Jaime Alfaro

CREATIVE DIRECTOR Kelly Booth
ART DIRECTOR Lorraine Rath
DESIGNER Allister Fein
ILLUSTRATION COORDINATOR Conor Buckley
SENIOR PRODUCTION DESIGNER
Rachel Lopez Metzger

PRODUCTION DIRECTOR Chris Hemesath
ASSOCIATE PRODUCTION DIRECTOR
Michelle Duggan
DIRECTOR OF ENTERPRISE SYSTEMS
Shawn Macey
IMAGING MANAGER Don Hill

1045 Sansome Street, Suite 100
San Francisco, CA 94111
www.weldonowen.com

Weldon Owen is a division of

BONNIER

Library of Congress Cataloging-in-Publication data is available.

ISBN 13: 978-1-61628-871-6
ISBN 10: 1-61628-871-X

10 9 8 7 6 5 4 3 2 1
2015 2016 2017 2018 2019

Printed in China by 1010 Printing.

Exhibit 21

The Total Skywatcher's Manual

The Total Skywatcher's Manual

We are pleased and proud to announce the recent release of the *The Total Skywatcher's Manual*, a fully illustrated, family friendly guide for astronomy enthusiasts of all ages and backgrounds.

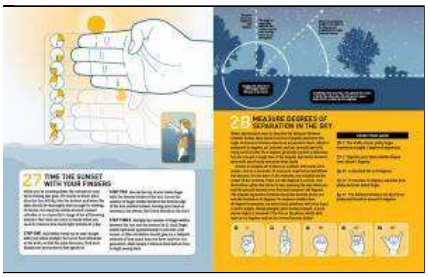
Written by ASP staff (Linda Shore, David Prosper, and Vivian White), this quintessential guide will help you choose the best telescope, identify constellations and objects in the night sky, search for extraterrestrial phenomena, plan star parties, capture beautiful space imagery and much more.

Order signed editions of the book through the ASP's AstroShop.

Order on Amazon.com.

Below are some sample pages from the book (click on images for larger versions).

Time the sunset with your fingers/Measure degrees of separation in the sky



Spot a llama in the Incan Milky Way/Learn how the aboriginals see the Milky Way

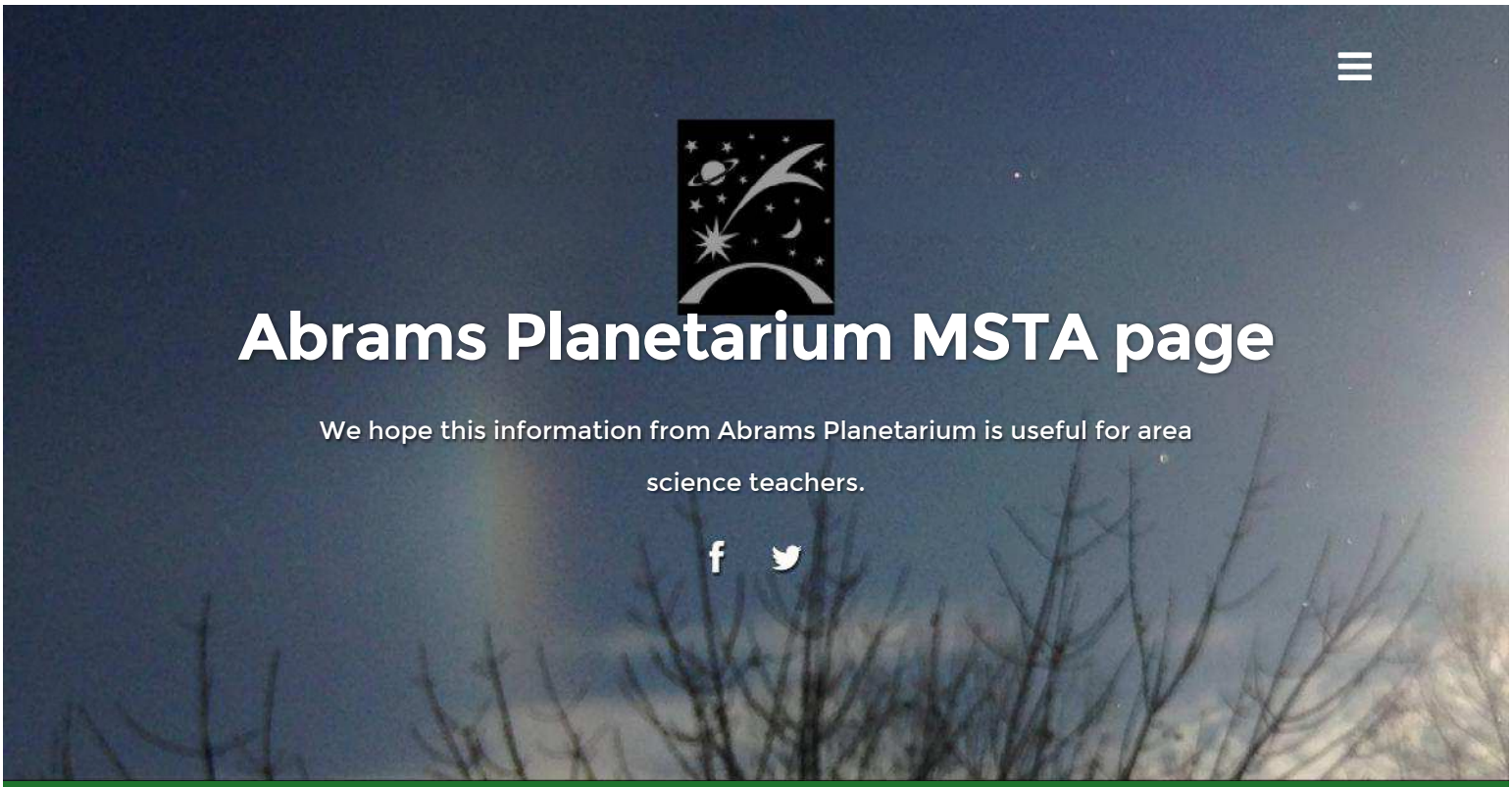
View the Moon with a scope

Pick a proper eyepiece

Sign Up for Email Updates

390 Ashton Avenue, San Francisco, CA 94112
T 415.337.1100 F 415.337.5205

Exhibit 22



Abrams Planetarium MSTA page

We hope this information from Abrams Planetarium is useful for area science teachers.

Celestial Highlights for October and early November 2015
by Robert C. Victor.
Twilight sky maps by Robert D. Miller.

During October and early November, there are exceptionally beautiful gatherings of planets in the morning sky. A waning crescent Moon graces the lineup of planets on Oct. 8-11 and Nov. 6-7. Except as noted, these spectacular sights covering Oct. 1-Nov. 10 will be well seen about an hour before sunrise. All the October events are illustrated on the accompanying Sky Calendar.

We hope you will be inspired to organize morning sky watching sessions for your students! With daylight saving time still in effect through October, a 45-minute skywatch from 1-1/2 hours to 45 minutes before sunrise might not be unreasonably early by the clock.

Abrams Planetarium will present a preview of planetary gatherings of 2015-2016 on Thursday, Sept. 24 at 7:30 p.m. and again in early October. On selected clear mornings in October, Abrams Planetarium at Michigan State University may offer predawn sky watches atop our parking ramp to observe the planet gatherings. Follow us on Twitter or Facebook for announcements.

FRI. OCT. 2:

one hour before sunrise: The waning gibbous Moon, about three-quarters full, is high in southwest. Just 1.5° (three moon-widths) to upper left of the Moon's bright limb is the star Aldebaran, marking the eye of Taurus, the Bull. The Moon is creeping slowly eastward toward the star, and will occult or cover it shortly before 10 a.m. EDT from Michigan. Shortly before 11 a.m., the star reappears near the midpoint of the Moon's dark limb. In clear skies, both daytime events are observable through a telescope.

Ranking next in brilliance after the Moon are two planets in the eastern sky: An hour before sunup on Oct. 2, find Venus with Jupiter 16° to its lower left. Next in brightness after Jupiter is Sirius, the "Dog Star" in SSE. Between Sirius and the Moon that morning, lies Orion the Hunter, halfway up the southern sky. Return to Venus and Jupiter in the east and look for two lesser objects of contrasting color between them: Blue-white Regulus 6° lower left of Venus, and reddish Mars about the same distance upper right of Jupiter. Keep your eyes on the eastern morning sky for the next 5 weeks for some spectacular changes.

THURS. OCT. 8:

one hour before sunrise: Venus gleams brilliantly within 4° lower left of the crescent Moon. Bright Jupiter shines 13° lower left of Venus. Faint reddish Mars glows 4° above Jupiter and 9° lower left of Venus. Mercury, just beginning a morning apparition, rises in east within 19° lower left of Jupiter. Mercury brightens rapidly and climbs higher in coming days, but not high enough to meet any of the other planets. This morning and tomorrow, note the blue-white star Regulus, heart of Leo, about 2.5° north (upper left) of Venus. This morning, students can follow the Moon and Venus until sunrise and well beyond to catch Venus in the daytime. A telescope and even a steadily held pair of binoculars will reveal Venus as a crescent. Look an hour before sunup each of the next three mornings and follow the Moon as it slides down the lineup of four planets.

FRI. OCT. 9:

The Moon appears lower and closer to the Sun this morning, so today's crescent is thinner than yesterday's. Brilliant Venus is now within 8° to the Moon's upper right. Bright Jupiter is about 5.5° lower left of the Moon. Faint Mars appears less than 4° upper right of Jupiter and about the same distance north (upper left) of the lunar crescent. Can you spot Mercury very low in east?

SAT. OCT. 10:

The old Moon, just 2.5 days before New, is a striking sight with the sunlit crescent cradling the earth-illuminated darker side within its horns. Look for Mercury 11° lower left of Moon, and Jupiter within 8° above the Moon. Higher yet, in order: dim red Mars, brilliant Venus, and Regulus to Venus' upper left.

SUN. OCT. 11:

Last chance to see the thin crescent Moon in the morning sky in this cycle of phases. Just 37 hours before New, it's a few degrees above the horizon and a few degrees south of due east. Mercury is just over 1° upper left of the Moon' northern cusp (upper point of the crescent), 29° lower left of brilliant Venus and 18° lower left of Jupiter. Faint Mars is 2.8° above Jupiter, while Regulus is 3.1° to the upper left of Venus. This week, watch Mars close in on Jupiter, while Venus widens its distance from Regulus. Mercury climbs to its highest in the morning sky for this year late this week, but gets no closer than 28° to the lower left of Venus.

THURS. OCT. 15:

one hour after sunset: Look low in SW to WSW to find the 3-day old waxing crescent Moon with Saturn 8° to its upper left. Look also for reddish twinkling Antares, heart of the Scorpion, 10° lower left of Saturn. By Friday evening, the Moon will appear 5° upper left of Saturn.

SAT. OCT. 17:

one hour before sunrise: Look closely for faint Mars just 0.4° (less than a Moon's width) to the north (upper left) of Jupiter.

OCT. 22-29:

Three planets, in order of brightness Venus, Jupiter, and Mars, form a trio, appearing within a 5-degree field of view. Binoculars magnifying up to about 10-power will fit the trio in on these eight mornings. Binoculars of lower magnification, such as 7X, will fit them in for a longer interval, Oct. 17-Nov. 2 if they provide a 7-degree field. Most trios of naked-eye planets involve Mercury (always low in twilight) or Venus (usually low), but on this occasion we catch Venus at its greatest apparent distance from the Sun and near peak altitude of a very favorable apparition high in the eastern morning sky. Not until November 2039 will we witness another compact trio of planets so high in a dark sky.

SUN. OCT. 25 AND MON. OCT. 26:

Venus and Jupiter will appear just over a degree apart, providing striking views, all within a single telescope field: Jupiter with its four bright moons discovered by Galileo, and Venus appearing as a "half moon". This sight is not to be missed! The next pairings of Venus-Jupiter, at dusk on August 27, 2016 and at dawn on November 13, 2017, will be tighter, but low in twilight and will catch Venus on the far side of its orbit, displaying a tiny, nearly full disk. We must wait until the year 2036 for a pairing of Jupiter with Venus in crescent phase.

BEGINNING TUES. OCT. 27,

in morning twilight: Follow the Moon daily for 15 mornings, as it wanes from Full low in the west on Oct. 27, to a thin, old crescent low in ESE only 30 hours before New on Tues. Nov. 10. Watch also for these events:

THURS. AND FRI., OCT. 29 AND 30,

one hour before sunrise: Watch the waning gibbous Moon leapfrog past Aldebaran, eye of Taurus, the Bull. (Moon will appear widely S (lower left) of Pollux Nov. 2, and 7° from Regulus Nov. 4 and 5.) On Oct. 29 and 30, 45 min. before sunrise, Mercury passes within 4° N of emerging Spica. Use binoculars to see this star to the lower right of Mercury. Each morning, Spica appears higher in the sky (resulting from Earth's revolution around the Sun), and Mercury lower (because the inner planet is faster).

TUES. NOV. 3:

Venus passes Mars in the last of three close predawn pairings of planets in October-November 2015. Look for the faint red planet just 0.7° N (upper left) of brilliant Venus. This morning the Moon is at Last Quarter phase, appearing half full and 90° or one-quarter circle west of the Sun. First activity of the morning in the schoolyard: In your right hand with arm fully extended, hold a ball up to the Moon and note how the lighting on the ball matches the lighting on the Moon! Use a telescope with a low-power eyepiece fitted with a polarizing filter to view the Moon Nov. 2-4. Rotate the eyepiece in its tube until the blue sky is darkest, and there'll be plenty of contrast for seeing details on the Moon, even in the daytime!

FRI. NOV. 6:

Jupiter within 3° N (upper left) of Moon. Venus 11° to Moon's lower left. Mars 1.6° upper right of Venus.

SAT. NOV. 7:

Venus 1.6°, Mars 2.8°, to upper left of Moon. Venus-Mars 2.0° apart.

MON. NOV. 9:

Spica within 4° S (lower right) of Moon.

AND FINALLY, ON TUES. NOV. 10,

about 45 minutes before sunrise: Look for a thin, old crescent Moon, about 30 hours before New, rising in E to ESE 11° lower left of Spica.

LOOKING AHEAD:

In mid-December 2015, Saturn will emerge into the morning sky. When Mercury returns from late January through most of February 2016, all five naked-eye planets will be fine display in a long arc from ESE to W across the southern morning sky. Stay tuned!

RESOURCES:

For illustrations of most of the events listed above, we are providing the October 2015 Sky Calendar. To subscribe, visit www.abramsplanetarium.org/skycalendar/

For a selection of Robert Miller's monthly charts depicting positions of bright planets and first-magnitude stars at mid-twilight, visit www.abramsplanetarium.org/msta/

An activity, Modeling seasonal visibility of stars and visibility of the planets, to help students investigate visibility of bright planets and first magnitude stars, is also available at that link. As stars and planets come and go in morning and evening skies and display beautiful pairings and groupings, students can model these changes and explain their observations with the aid of items provided: Two planet orbit charts, Mercury through Mars and Mercury through Saturn; a table of data for plotting planets on orbit charts; and a sheet with questions on star and planet visibility in 2015-2016.

Robert C. Victor was Staff Astronomer at Abrams Planetarium, Michigan State University. He is now retired and enjoys providing skywatching opportunities for school children in and around Palm Springs.

Robert D. Miller, who provided the twilight charts and the planet orbit charts, did graduate work in Planetarium Science and later astronomy and computer science at Michigan State University and remains active in research and public outreach in astronomy.

PRINTABLE PDF VERSION OF THE ABOVE CELESTIAL HIGHLIGHTS OCT-NOV 2015:

Celestial Highlights for October and early November 2015
by Robert C. Victor. Twilight sky maps by Robert D. Miller.

During October and early November, there are exceptionally beautiful gatherings of planets in the morning sky. A waning crescent Moon graces the lineup of planets on Oct. 8-11 and Nov. 6-7. Except as noted, these spectacular sights covering Oct. 1-Nov. 10 will be well seen about an hour before sunrise. All the October events are illustrated on the accompanying **Sky Calendar.**

We hope you will be inspired to organize morning sky watching sessions for your students! With daylight saving time still in effect through October, a 45-minute skywatch from 1 1/2 hours to 45 minutes before sunrise might not be unreasonably early by the clock.

Abrams Planetarium will present a preview of planetary gatherings of 2015-2016 on Thursday, Sept. 24 at 7:30 p.m. and again in early October. On selected clear mornings in October Abrams Planetarium at Michigan State University may offer predawn sky watches atop our parking ramp to observe the planet gatherings. Follow us on Twitter or Facebook for announcements.

Fri. Oct. 2, one hour before sunrise: The waning gibbous Moon, about three-quarters full, is high in southwest. Just 1.5° (three moon-widths) to upper left of the Moon's bright limb is the star **Aldebaran**, marking the eye of Taurus, the Bull. The Moon is creeping slowly eastward toward the star, and will occult or cover it shortly before 10 a.m. EDT from Michigan. Shortly before 11 a.m., the star reappears near the midpoint of the Moon's dark limb. In clear skies, both daytime events are observable through a telescope.

Ranking next in brilliance after the Moon are two planets in the eastern sky. An hour before sunup on Oct. 2, find **Venus** with **Jupiter** 16° to its lower left. Next in brightness after Jupiter is **Sirius**, the "Dog Star" in SSE. Between Sirius and the Moon that morning, lies **Orion the Hunter**, halfway up the southern sky. Return to Venus and Jupiter in the east and look for two lesser objects of contrasting color between them. Blue-white **Regulus** 6° lower left of Venus, and reddish **Mars** about the same distance upper right of Jupiter. Keep your eyes on the eastern morning sky for the next 5 weeks for some spectacular changes.

Thurs. Oct. 8, one hour before sunrise: Venus gleams brilliantly within 4° lower left of the **crescent Moon.** Bright **Jupiter** shines 13° lower left of Venus. Faint reddish **Mars** glows 4° above Jupiter and 9° lower left of Venus. **Mercury**, just beginning a morning apparition, rises in east within 19° lower left of Jupiter. Mercury brightens rapidly and climbs higher in coming days, but not high enough to meet any of the other planets. This morning and tomorrow, note the blue-white star **Regulus**, heart of Leo, about 2.5° north (upper left) of Venus. This morning, students can follow the Moon and Venus until sunrise and well beyond to catch Venus in the daytime. A telescope and even a steadily held pair of binoculars will

VIEWING TIPS FOR HALLEY'S COMET IN 2061

ADDRESS.

Abrams Planetarium

755 Science Road

Michigan State University

East Lansing, MI 48824

PHONE NUMBERS.

Planetarium Phone: (517) 355 4676

EMAIL.

Robert Victor

rvictormi@earthlink.net

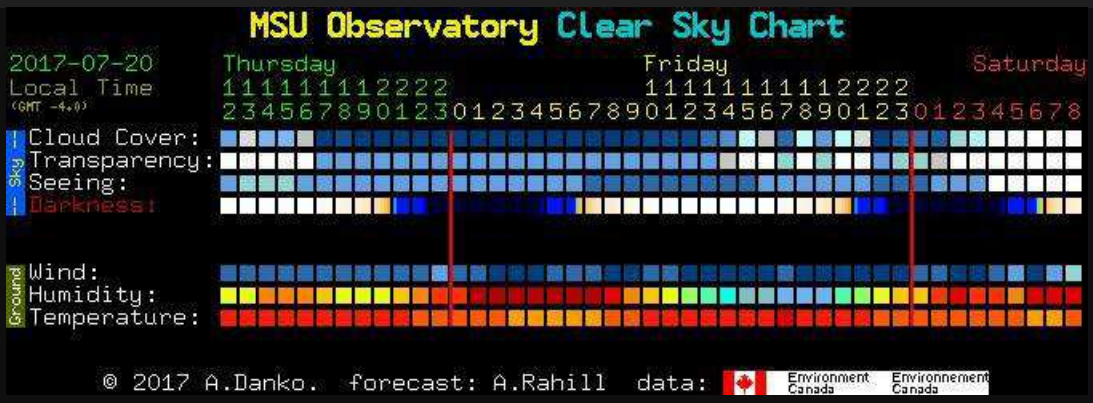


Exhibit 23

A Union of Cultures

Fond du Lac

Tribal & Community College

1995-97 CATALOG

Fond du Lac

Tribal & Community College

2101 Fourteenth Street

Cloquet, Minnesota 55720

TEL:(218)879-0800

TDD:(218)879-0821

FAX:(218)879-0814

1-800-657-3712

World Wide Web Address:

http://www.fdl.cc.mn.us

WELCOME

Fond du Lac Tribal and Community College (FDLTCC) has a unique mission in providing education to the public as the nation's only tribal and state funded community college.

FDLTCC is proud of its tradition of service to students and the community. You the students are the principal focus of our faculty and staff.

FDLTCC offers students an opportunity to pursue their liberal arts and sciences education in a multicultural climate. In today's world recognizing and understanding cultural diversity is essential. The job market today demands employees who are not only knowledgeable in their particular field but who understand the importance of unconditionally respecting the difference of others. FDLTCC provides the learning environment to meet the needs of tomorrow's leaders.

On behalf of the board of directors, the faculty & staff and the students of FDLTCC, I welcome you to a unique college with an environment for learning, educational challenges and opportunities, designed just for you.

Sincerely,

Lester Jack Briggs
President, FDLTCC

MISSION, ACCREDITATION, HISTORY

MISSION

The mission of Fond du Lac Tribal & Community College is to acknowledge the right of each individual to achieve a sense of self-actualization and to provide for the building of educational and civic relationships through the medium of education and lifelong learning.

Fond du Lac Tribal & Community College will enhance the academic, economic, and cultural growth of the community through programs of educational excellence and a commitment to celebrate the diverse cultures of our community.

To achieve the principles of its mission, Fond du Lac Tribal & Community College shall:

- Promote scholarship and academic excellence through transfer and career education
- Provide educational opportunities to community residents of all ages to foster a commitment to lifelong learning
- Provide access to higher education by offering developmental education
- Provide educational access to historically underserved populations, particularly Anishinaabe communities
- Promote the language, culture, and history of the Anishinaabe
- Promote teaching excellence
- Provide opportunities for applied research
- Provide programs which will celebrate the cultural diversity of our community and promote global understanding

ACCREDITATION

Fond du Lac Tribal and Community College is accredited by the Commission on Institutions of Higher Education of the North Central Association of Colleges and Schools through the Arrowhead Community College Region. Since it is an accredited member of the North Central Association, credits earned at Fond du Lac Tribal & Community College may be transferred for full credit to all member institutions.

HISTORY

Fond du Lac Tribal & Community College is a unique institution, created by the Minnesota Legislature in 1987 and chartered as a tribal college by the Fond du Lac Reservation that same year. Its commitment to meet the educational needs of a diverse population is reflected in its mission statement.

Fond du Lac Tribal and Community College has been part of the Arrowhead Community Colleges, established in October, 1981 with the merger of the five existing northeastern Minnesota Community Colleges: Itasca at Grand Rapids, Hibbing at Hibbing, Mesabi at Virginia, Rainy River at International Falls, and Vermillion at Ely. The new multicampus network became fully operational July 1, 1982.

Fond du Lac Tribal & Community College opened its doors in the Fall Quarter of 1987, eight years after the Fond du Lac Reservation Business Committee (RBC) first voiced the need for a community college as part of a comprehensive educational plan for the reservation.

The tribal community college idea gained momentum in the early 1980's as the Reservation Business Committee documented a need for higher educational opportunities among the residents of both Carlton and St. Louis counties.

In 1985, Mesabi Community College accepted the RBC's invitation to hold classes at the Ojibway School on the Fond du Lac Reservation. The collaboration was immediately successful and in 1986, the Minnesota Legislature funded a feasibility study for a community college operated as a joint venture of Fond du Lac tribal government and the Arrowhead Community College Region (ACCR).

In 1987 the Bureau of Indian Affairs determined that FDLTCC was eligible for funding under the Tribally Controlled Community College Act (Public Law 95-471), and the Minnesota Legislature appropriated money for the college's first two years of operation.

In 1989, the Minnesota Legislature authorized the beginning of design development for a college campus. A planning committee representing tribal and civic government, business, the Arrowhead Community College Region, and FDLTCC students, faculty, and staff worked with architect Thomas A. Hodne, Jr. to produce a concept reflecting both Indian and non-Indian cultural values. The Minnesota Legislature approved the plan later that year.

Architectural plans completed in 1990 called for a campus built in three phases. Construction of the first phase began in July 1991. The new campus, able to accommodate the equivalent of 500 full-time students, opened its doors Fall Quarter 1992.

In 1994 the Bureau of Indian Affairs reconfirmed Fond du Lac as a Tribal College under the Tribal Community College Act; Congress passed legislation giving Fond du Lac status as a Land Grant Institution, and the Legislature approved Fond du Lac as a full college by state standards with co-governance language between the state and the Fond du Lac Band of Lake Superior Chippewa. The Minnesota Higher Education Board confirmed Fond du Lac Tribal and Community College as a full community college by state standards.

In 1995 planning funds were appropriated by the legislature for the development of phase two in the building program. Plans include housing and additional classrooms and office space.

THE PURPOSE AND PHILOSOPHY OF TRIBAL COLLEGES

Tribally-controlled colleges were founded by Indian people to meet the needs of Indian people for an educational environment that respects both Indian people as individuals and the tribal culture. Their underlying philosophy is that Indian people must assume control of their own resources.

The first tribally-controlled College, Navajo Community College, opened its doors in 1968. There are now 29 tribally-controlled colleges in the United States, forming the American Indian Higher Education Consortium (AIHEC). The Consortium provides a united voice for tribally-controlled colleges and acts as a clearinghouse for sharing resources for member colleges. FDLTCC became a full voting member of AIHEC in 1989.

While most tribally-controlled colleges provide the first two years of education, some are four year institutions and others are moving in that direction.

THE AMERICAN INDIAN COLLEGE FUND

The American Indian College Fund (AICF), a fund-raising organization supporting tribal colleges, became fully operational in September 1989. Fond du Lac Tribal & Community College, like all tribal colleges, receives a yearly allocation from the AICF to be used for Indian student scholarships.

Modeled after the United Negro College Fund, the AICF's goal is to raise $10 million over the next few years. To do so, it has turned to major foundations, corporate supporters, and the American public at large.

The positive response through the AICF to the needs of tribal colleges increases every year as more and more people become aware of their existence and high rates of success in providing quality education to Indian students.

THE MINNESOTA STATE COLLEGES AND UNIVERSITIES

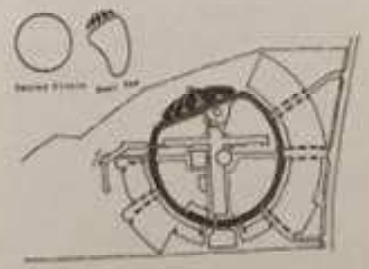
Fond du Lac Tribal and Community College is one of 62 college and university campuses that make up Minnesota State Colleges and Universities (MnSCU). This new statewide system of community colleges, state universities, and technical colleges is governed by a Board of Trustees. MnSCU is dedicated to providing students with a wide array of opportunities for lifelong education in both technical and academic fields, ranging from short course certificates to the master's degree. More than 162,000 students attend Minnesota State Colleges and Universities in communities throughout the state.

THE CAMPUS

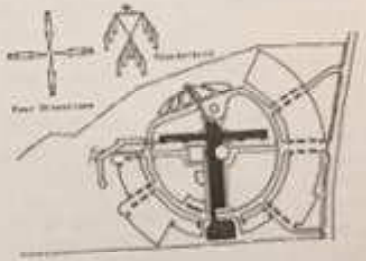
The Fond du Lac Tribal & Community College campus is the product of extensive consultation among tribal and civic leaders, its business people, educators, and students. This group defined their needs and, with the help of a skilled architect, created a campus reflecting the integrated cultures of the Northeastern Minnesota area.

The symbolic concepts integrated in the design include:

-The sacred circle and the wheel. This is the campus ring road, which has its northerly slopes planted to represent the bear paw. Together, the bear paw and the circle represent strength and protection.



-The four directions and the cross. The cross is formed by the 90-foot-wide clearing in the middle of the campus. The 70-foot-wide building is centered in the clearing. The four arms of the building represent the four directions - an American Indian symbol representing greater harmony in life.



-The Thunderbird dominates the shape of the building itself. Extensive use of windows provides earth and sky views of the outdoor environment. The campus is located among a magnificent stand of Norway Pines.

-The four colors of the Fond du Lac Reservation are red, black, white, and yellow. They are used on the four exterior metal walls of the building.

-The circular amphitheater topped with a blue dome is inside and outside with large windows separating the two halves. Floor tiles in the area are green to represent the earth.

4 cr
NAABE
ts to the
tional
Analysis
ed in

4 cr

the

language. (Prereq

ANSH 211 2 cr
EXAMINATION OF ANISHINAABE LANGUAGE
An overview of the Anishinaabe Language at an introductory level.

ANTHROPOLOGY

ANTH 101 3 cr
INTRODUCTION TO AMERICAN INDIAN STUDIES
This course will look at the various American Indian cultures of North America. North American prehistory, and the historic period from contact to the present will be addressed. Indian history, religion, and philosophy will be studied with an emphasis on the Anishinaabe people of Minnesota.

ANTH 108 4 cr
NATIVE SKYWATCHERS
A cross-disciplinary study of the practical and spiritual role of the sky in the indigenous cultures of the continental Americas. Astronomical and meteorological-inspired art, architecture, and mythologies will be examined, with special emphasis on the Great Lakes Region.

crafts of the Anishinaabe and the environment where indigenous materials were gathered for the making of crafts.

ART 110 3 cr
DRAWING I
This course presents the fundamentals of representative freehand drawing with emphasis on expression and organization. (Prerequisite: Art 101 or consent of instructor)

ART 111 3 cr
DRAWING II
This course provides continued practice in drawing fundamentals and development of skills, with increased emphasis on the model and greater experimentation with techniques. (Prerequisite: Art 110 or consent of instructor)

ART 125 3 cr
PAINTING
This course provides an orientation to painting in various media, including the study and exploration of tempera, acrylics, and oils. (Prerequisite: Art 101 or consent of instructor)

ART 126 3 cr
WATERCOLORS
This course consists of painting demonstrations, painting sessions, and the study of the newest ideas using design in watercolor.

of jewelry fabrication.

ART 140 3 cr
SCULPTURE
An introductory course in three-dimensional art.

ART 161 3 cr
ART HISTORY
A survey of ancient and medieval art, with emphasis on architecture, sculpture, and painting.

ART 162 3 cr
ART HISTORY II
A survey of Renaissance through 18th Century art, with emphasis on architecture, painting, and sculpture.

ART 163 3 cr
ART HISTORY III
A survey of 19th and 20th Century art with emphasis on architecture, painting, and sculpture.

ART 171 3 cr
BASIC PHOTOGRAPHY
Designed for the beginning photographer, this course concentrates on the fundamentals of black and white photography; explores camera operation, film processing, contact prints, the print process, cropping, and dry mounting. A strong emphasis is placed on artistic expression via photographic composition: effective cropping, rule of thirds, depth of field, and contrast. (The student must provide his own film and photographic paper.)

techniques of officiating hockey. Preparation for certification by the Minnesota State High School League as an official.

PE 199 1-3 cr
SPECIAL TOPICS
Study of special topics in PE. Special course topics will be announced in the *class schedule.*

PHYSICS

PHYS 101-102-103 4 cr ea
GENERAL PHYSICS
Selected topics from mechanics, kinetic theory, heat and thermodynamics, wave motion, sound, electricity and magnetism, light, and modern physics. (Prerequisite: high school Higher Algebra or consent of instructor.) (3 lec; 2 lab)

PHYS 111-112-113 5 cr ea
ENGINEERING PHYSICS
Selected topics in mechanics, heat and thermodynamics, wave motion, sound, light electricity and magnetism, modern physics. Required for pre-engineering, pre-physical science, and pre-med majors. (Concurrent enrollment in Math 111-112-113.) (4 lec; 2 lab)

PHYS 131 3 cr
ASTRONOMY: THE SOLAR SYSTEM
A nonmathematical study of the solar system: the sun, the planets, the asteroids, and the comets. A study of their present structure and origin.

PHYS 133 3 cr
ASTRONOMY: THE UNIVERSE
A nonmathematical study of the universe outside the solar system. Properties of different stars, galaxies, neutron stars, black holes, evolution of the universe.

POLITICAL SCIENCE

POLS 110 4 cr
AMERICAN GOVERNMENT
A study of the structure and function of the national government of the United States, comprising a survey of political theory, a comprehensive study of parties and elections, a consideration of civil rights, and an examination and analysis of the branches of the national government.

POLS 111 4 cr
STATE AND LOCAL GOVERNMENT
A study of the structure and function of state and local governments with emphasis on state and local problems and conditions in Minnesota.

POLS 112 4 cr
INTERNATIONAL POLITICS
A study of contemporary international relations, foreign policy, and international organization.

POLS 199 1-3 cr
SPECIAL TOPICS
Study of special topics in Political Science. Special course topics will be announced in the *class schedule.*

PSYCHOLOGY

PSYC 102 3 cr
TRANSITION TO COLLEGE *
A course utilizing a psychological/educational approach to assist students in transition to college life. Discussions will focus on attitudes which foster a fear of success and feelings of helplessness, low self-esteem, stress, and anxiety. Students will learn relaxation techniques as well as techniques to achieve self-directedness, set and carry out goals, and manage time. (*Offered only for participants in the Student Support Services program).

mental health, and social psychology.

PSYC 222 4 cr
INDUSTRIAL PSYCHOLOGY
A study of human behavior in the work environment. Topics for discussion will include the nature of work in the modern world, organizational theory, personnel selection, personnel training, work efficiency, human motivations, leadership and supervision, job satisfaction, and human engineering.

PSYC 223 3 cr
CHILD AND ADOLESCENT PSYCHOLOGY
A study of the psychological development of the individual from the prenatal period through adolescence. Analysis of the hereditary and environmental factors influencing physiological, cognitive, emotional, and social development as they are related to the child's and adolescent's growth and development (Prerequisite: PSYC 220).

PSYC 224 3 cr
GROUP DYNAMICS
Understanding the group process, the role of the leader in organizing and developing groups, group teaching, and group advising and acquisition of skill in developing an environment where new behavior may occur.

PSYC 226 3 cr
DEVELOPMENTAL PSYCHOLOGY
Course designed to offer scientific knowledge concerning the psychological development during separate phases in the span of human development. (Prerequisite: Psyc 220)

Fond du Lac Tribal & Community College Board of Directors

BONNIE WALLACE
Chairperson
Director, American Indian Support Program, Augsburg College

STEVE COUTURE
Principal, Minneapolis Public Schools, Mpls

PETER DEFOE
Secretary/Treasurer FDL Reservation

GEORGE HIMANGO
Director/Coordinator Homebound/Desegregation, Duluth Public Schools

ROBERT PEACOCK
Chairman FDL Reservation

SANDRA SHABIASH
Director Indian Education Carlton School District

CONNIE SAARISTO
Government Services Coordinator, First Plan of Minnesota, Duluth

Fond du Lac Tribal & Community College Administration

BRUGGS, LESTER JACK, President

BARNACK, CANDACE, Dean of the College

ANDERSON, LARRY, Director of Student Services

HAMMITT, STEPHANIE, Director of Fiscal Operations

Fond du Lac Tribal & Community College Faculty

AHLGREN, MARLA, English
B.S., University of Minnesota-Duluth
M.A., University of Minnesota-Duluth

AZEN, REBEKAH, Librarian
B.U.S., University of New Mexico
Master of Library and Information Science
Louisiana State University

BAKKA, NORMA JEAN, Counseling
B.A., Bemidji State University
M.S., University of Wisconsin-Superior

BARNACK, CANDACE, Speech Communication
B.S., University of Wisconsin-Superior
M.A., University of Wisconsin-Superior

CYR, WILF, Anishinaabe Language
A.A., Rainy River Community College
B.A., Bemidji State University
B.S., Bemidji State University
M.Ed Candidate, University of MN-Duluth

DWYER, CHARLIN F., English
B.A., University of Minnesota-Duluth
M.Ed., Harvard University

GELINEAU, VIRGINIA, Speech Communication
B.S., University of Wisconsin-Superior
M.A., University of Wisconsin-Superior

GILE-AUBID, CANDI, Human Services
B.S., St. Cloud State University
M.S.W., University of Minnesota - Duluth

GITTINGS, RONALD, Sociology
B.A., Marian College
M.S., Indiana State University

GUTTING, SR. THERESE, Business/Computer Science
B.S., Viterbo College
M.S., University of Minnesota-Duluth
Ph.D. Ed, Kennedy-Western University

HOLMES, CYNTHIA, Art
B.F.A., Minneapolis School of Art and Design
M.A.E., Rhode Island School of Design

HUDSPITH, JOSEPH, Biology
B.S., Michigan State University
M.S., South Dakota State University

JARVINEN, DONALD, Human Services
B.A., St. John's University
M.S., University of Wisconsin-Superior

KALLIS, WILHELM, Counselor/Psychology
B.A., Minot State University
M.A., University of North Dakota

KLEINKE, KRISTIN, Music/Philosophy
B.A., Gustavus Adolphus College
M.A., Northwestern Lutheran Theological Seminary
M.M., Candidate, University of Minnesota

LANGHORST, GLENN, Physics
B.A.S., University of Minnesota-Duluth
M.Ed., University of Minnesota-Duluth

MICKELSON, PAUL, Biology/Chemistry
B.S., University of Minnesota-Duluth
M.S., University of Minnesota-Duluth

PUCEL, MARY GAYLE, Business/Political Science
B.S., St. Cloud State University
M.S., St. Cloud State University
M.B. A., St. Cloud State University

SEITZ, DENNIS, Law Enforcement
B.A., Regis College
J.D., University of Denver

SHULTZ, JUDITH, Reading/Study Skills
A.A., Marshalltown Community College
B.A., University of Northern Iowa
M.A., University of Northern Iowa

STATZELL, DONNA, Physical Education
B.S., Valparaiso University
M.S., Indiana University

VAN CLEAVE, NANCY, Computer Science
B.S., Eastern Illinois University
M.A., Eastern Illinois University
M.S., University of Kentucky
Ph.D., University of Kentucky

WENDORFF, FRANCES, Mathematics/Reading
B.A., College of St. Benedict
M.A. Candidate, University of Wisconsin-Superior

WETHERBEE, TED, Mathematics
B.A., University of Minnesota-Duluth
M.S., Ohio University

WOLF, DALE, Law Enforcement
B.A., University of Minnesota-Duluth
J.D., William Mitchell College of Law

Fond du Lac Tribal & Community College Staff

AZEN, REBECCA, Librarian

BAKKA, JEAN, Counselor Student Support Services

BASSETT, TERRY, Maintenance

BERG, LINDA, Clerical Staff

BERNHARDSON, MARK, Maintenance Foreman

CLARK, BRIAN, Maintenance

DEFOE, SHIRLEY, Director of Development

DWYER, BOB, Director of Outreach Services/Continuing Education

GORDON, NANCY, Secretary Instructional Services

HAGENAH, PAULA, Business Office Clerk

HANSON, ANITA, Counselor/DSD

IWASKO, JUDY, Secretary/Student Support Services

KALLIS, WILHELM, Counselor

KLOOKE, DARLA, Student Services

LIBBON, SARAH, Student Support Services Tutor

OLBEKSON, ERNIE, Maintenance

PEACOCK, MIKE, Director Reservation Programs

POLLEY, LEAH, Clerical Staff

RHOELEN, JOHN, Financial Aid Assistant

MATURI, SANDI, Records Office Clerk

SHELTON, LINDA, Director Student Support Services

SULLIVAN, RAE, Accounting Technician

THOMAS, GALE, Administrative Secretary

URBANSKI, THOMAS, Director School To Work Program

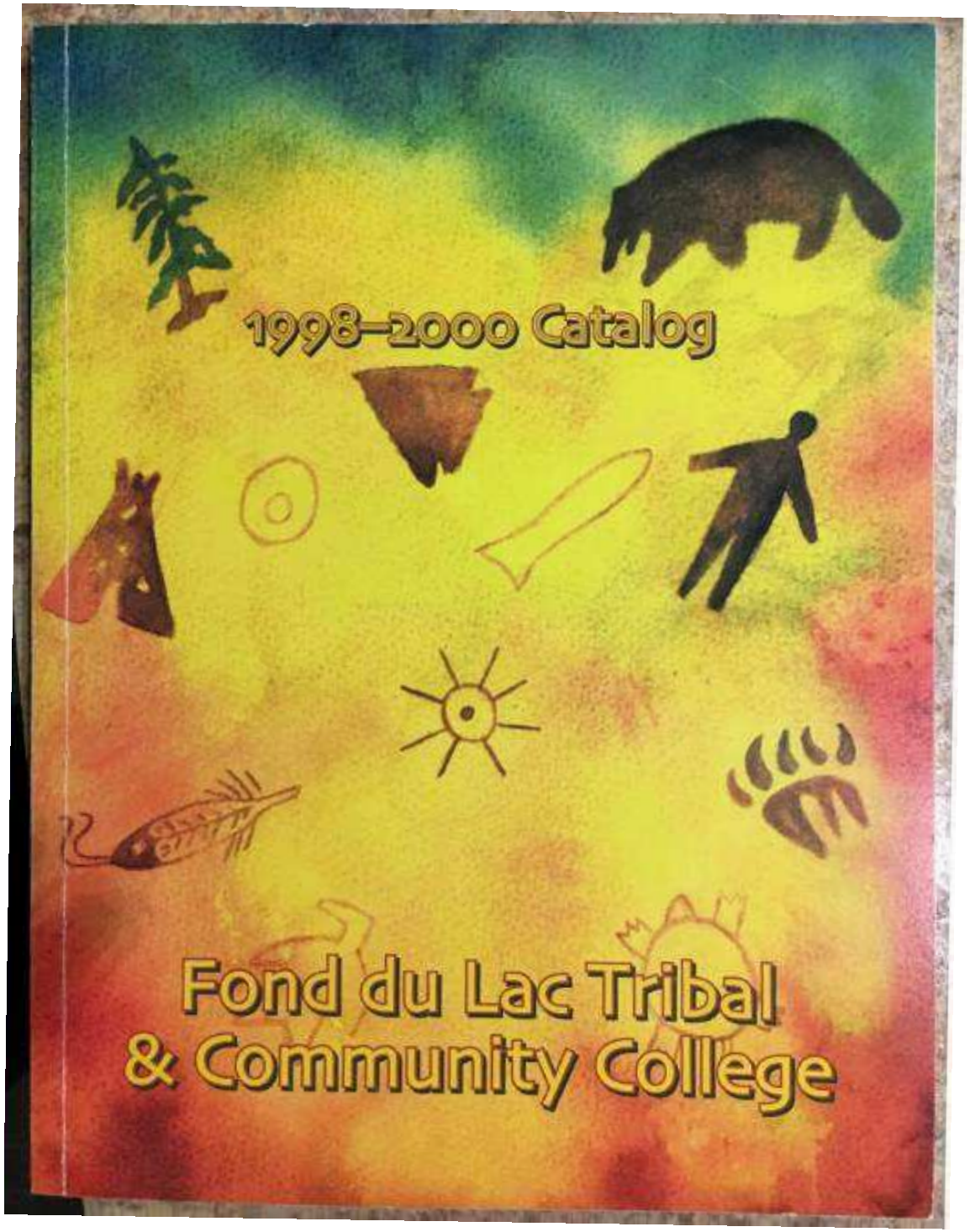
UTTER, ADAM, Director Public Information

WALTER, JANET, Financial Aid Director

WAPPES, CONNIE, Student Support Services Tutor

WAPPES, LORAN, Information Systems Engineer

Exhibit 24


1998–2000 Catalog
Fond du Lac Tribal
& Community College

versational and written form. Students will learn to converse in Ojibwe as well as attain an understanding of the complexity and beauty of the Anishinaabe language. Analysis of sentence structure will be introduced and expanded at the introductory and advanced levels to lead to the delivery of oral presentation.

ANSH 1001 **4 credits**
Introduction to Anishinaabe Language
This course will introduce students to the Anishinaabe Language. Conversational and writing skills will be learned leading to an oral presentation. Analysis of sentence structure will be utilized in attaining an understanding of the complexity and beauty of the Anishinaabe Language. Students will write and speak simple sentences.

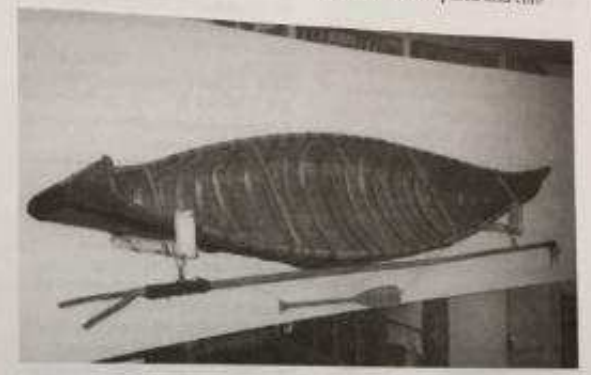
ANSH 1002 **4 credits**
Anishinaabe Language II
This course will continue to reinforce the conversational and writing skills which began in ANSH 1001. New vocabulary, grammatical concepts, and utilization of acquired skills will be emphasized. (Prerequisite: ANSH 1001)

ANSH 1010 **1 credit**
Examination of Anishinaabe Language
An overview of the Anishinaabe Language at an introductory level.

ANSH 1099 **1–3 credits**
Special Topics
Study of special topics in Anishinaabe Language. Special course topics will be announced in the class schedule.

ANSH 2001 **4 credits**
Anishinaabe Language III
This course is designed for advanced students of the Anishinaabe language who wish to increase their knowledge of complex sentence structure building and analysis skills. The goal of this course is to develop oral and written fluency. (Prerequisite: ANSH 1002)

ANSH 2002 **4 credits**
Anishinaabe Language IV
This course will continue to build on the advanced skills presented in ANSH 2001. The focus will be upon analysis of short stories and the delivery of oral presentations in the Anishinaabe Language. (Prerequisite: ANSH 2001)



ANTHROPOLOGY

The mission of the Anthropology Department is to provide for the study of human nature, society, and culture, focusing on the American Indian and world perspectives.

ANTH 1001 **3 credits**
Introduction to American Indian Studies
This course will look at the various American Indian cultures of North America. North American prehistory and the historic period from contact to the present will be addressed. Indian history, religion, and philosophy will be studied with an emphasis on the Anishinaabe people of Minnesota.

ANTH 1010 **4 credits**
Native Skywatchers
A cross-disciplinary study of the practical and spiritual role of the sky in the Indigenous cultures of the continental Americas. Astronomical and meteorological-inspired art, architecture, and mythologies will be examined, with special emphasis on the Great Lakes Region.

ANTH 1020 **3 credits**
Cultural Anthropology
A survey of man's cultural development from the beginning of human history to the present. Ancient, preliterate and modern societies are compared and contrasted, pointing out the differences and similarities that have been used in solving man's problems.

ART

The mission of the Art Department is to provide students with an awareness and understanding of how art functions in society emotionally, psychologically, and spiritually. The courses provide an environment that encourages risk taking and exploration as well as refining and redefining necessary skills and techniques. An emphasis on problem solving enables students to diversify and to make the tools applicable to other venues. These introductory courses are designed for students with little or no experience in creative art.

ART 1001 **3 credits**
Introduction to Art
An orientation to art-related problems, techniques, and materials as well as an introduction to the principle elements of two- and three-

Fond du Lac Tribal & Community College Board of Directors

Steve Couture
Peter Defoe
George Himango
Robert Peacock
Connie Saaristo
Sandra Shabiash
Bonnie Wallace, Chair, and liaison to MNSCU

Minnesota State Colleges and Universities Board of Trustees

Nancy Brataas
Kathleen Caffey
Archie D. Chelseth
Daniel G. Coborn
Dennis Dotson
David Erickson
Robert Erickson
Christine Fritsche, Vice Chair
Stephen L. Maxwell, Treasurer
Gary Mohrenweiser
Michael Nesdahl
Denise Stephens, Secretary
Michael Vekich, Chair
James Wafler
Charles W. Williams, liaison to FDLTCC

Fond du Lac Tribal & Community College Foundation Board of Directors

Ken Hallberg
Carol Hayward
David Laird
Peggy Lavick
Ron McKinley
John McKinney
Robert Peacock
Connie Saaristo, Vice-Chair
Rick Smith
Bonnie Wallace
Frederick T. Weyerhauser, Treasurer
Dale Wolf, Chair

Fond du Lac Tribal & Community College Administration

Briggs, Lester Jack
President
Ed.D. Candidate, University of Minnesota
B.S., Bemidji State University

Anderson, Larry
Dean of Student Services
M.S., University of Wisconsin-Superior
B.S., University of Wisconsin-Superior

Antell, Lee
Dean of Instruction
Ed.D., University of Minnesota
M.S., University of Minnesota
B.S., Moorhead State University

Leonidas, Terry
Director of Fiscal Operations
M.A., College of St. Scholastica
B.ACCT., University of Minnesota-Duluth

Fond du Lac Tribal & Community College Faculty

Ahlgren, Marla
English
M.A., University of Minnesota-Duluth
B.S., University of Minnesota-Duluth

Bakka, Norma Jean
Counseling
M.S., University of Wisconsin-Superior
B.A., Bemidji State University

Barnack, Candace
Speech Communication
M.A., University of Wisconsin-Superior
B.S., University of Wisconsin-Superior

Braxton-Brown, Jonah
History/Political Science
M.A., Candidate, Western Washington University
M.A., Eastern Washington University
B.A., University of Redlands

M.S., University of Wisconsin-Platteville
B.S., University of Wisconsin-Platteville

Diver, Charlin F.
English
M.Ed., Harvard University
B.A., University of Minnesota-Duluth

Gittings, Ronald
Sociology
M.S., Indiana State University
B.A., Marian College

Greeman, David
Law Enforcement
M.S., University of Wisconsin-Superior
B.A., College of St. Thomas
A.A., Normandale Community College

Gutting, Sr. Therese
Business/Computer Science
Ph.D, Ed., Kennedy Western University
M.S., University of Minnesota-Duluth
B.S., Viterbo College

Hanson, Anita
Counselor/Office for Students with Disabilities
M.A., University of Minnesota-Duluth
B.S., North Dakota State University

Holmes, Cynthia
Art
M.A.E., Rhode Island School of Design
B.F.A., Minneapolis School of Art and Design

Jarvinen, Donald
Human Services
M.S., University of Wisconsin-Superior
B.A., St. John's University

Jones, Dan
Anishinaabe Language
B.S., Bemidji State University
A.A., Rainy River Community College

Kleinke, Kristin
Music/Philosophy
M.M., University of Minnesota
M.A., Northwestern Lutheran Theological Seminary
B.A., Gustavus Adolphus College

Langhorst, Glenn
Physics
M.Ed., University of Minnesota-Duluth
B.A.S., University of Minnesota-Duluth

Mickelson, Paul
Biology/Chemistry
M.S., University of Minnesota-Duluth
B.S., University of Minnesota-Duluth

Monson, Mary
Nursing
B.A., College of St. Scholastica
A.A., Normandale Community College

Pucel, Mary Gayle
Business/Political Science
M.B.A., St. Cloud State University
M.S., St. Cloud State University
B.S., St. Cloud State University

Seitz, Dennis
Law Enforcement
J.D., University of Denver
B.A., Regis College

Shultz, Judith
Reading/Director of Center for Academic Achievement
M.A., University of Northern Iowa
B.A., University of Northern Iowa
A.A., Marshalltown Community College

Statzell, Donna
Physical Education
M.S., Indiana University
B.S., Valparaiso University

Wendorff, Frances
Mathematics/Reading
M.A. Candidate, University of Wisconsin-Superior
B.A., College of St. Benedict

Wetherbee, Ted
Mathematics
M.S., Ohio University
B.A., University of Minnesota-Duluth

Wolf, Dale
Law Enforcement
J.D., William Mitchell College of Law
B.A., University of Minnesota-Duluth

Fond du Lac Tribal & Community College Staff

Adamscheck, Dennis
Network Engineer/Webmaster
A.A., Fond du Lac Tribal & Community College

Anderson, Karene
Secretarial/Intermittent
Diploma, DAVTI

Berg, Linda
Admissions Representative/Student Services
A.A.S., Mesabi Community College

Bernhardson, Mark
Maintenance Foreman

Clark, Brian
Maintenance

DeFoe, Shirley
Director of Development

Denny, Janice
Director of Augsburg Outreach Site
A.A.S., Minneapolis Community College

Diver, Bob
Director of Continuing Education
B.A.S., College of St. Scholastica

Fall, Dennis
Maintenance/Intermittent
A.A., Fond du Lac Tribal & Community College

Gordon, Nancy
Bookstore Coordinator
A.A., Rainy River Community College

Gordon, Wade
Director of Kellogg Grant
PSY.D. Candidate, Minnesota School of Professional Psychology
B.S., University of Wisconsin-Superior

Gossett, Darla
Records Office Clerk
A.A., Fond du Lac Tribal & Community College

Hagenah, Paula
Business Office Clerk
A.A.S., Hibbing Community College

Iwasko, Judy
Secretary/Student Support Services

Libbon, Sarah
Tutor/Student Support Services
B.A., University of Minnesota-Morris

Maciewski, Patricia
Switchboard/Receptionist
A.A.S., Community College of the Air Force

Olbekson, Ernie
Maintenance

Peacock, Mike
Director of Reservation Programs
B.A., Bemidji State University

Tolles, Leah
Secretary/Instructional Services
A.A., Fond du Lac Tribal & Community College

Shelton, Linda
Director of Student Support Services
B.S., College of St. Scholastica
A.A., Fond du Lac Tribal & Community College

Skurich, Elliott
Director of Financial Aid
B.B.A., University of Minnesota-Duluth

Sullivan, Rae
Accounting Technician

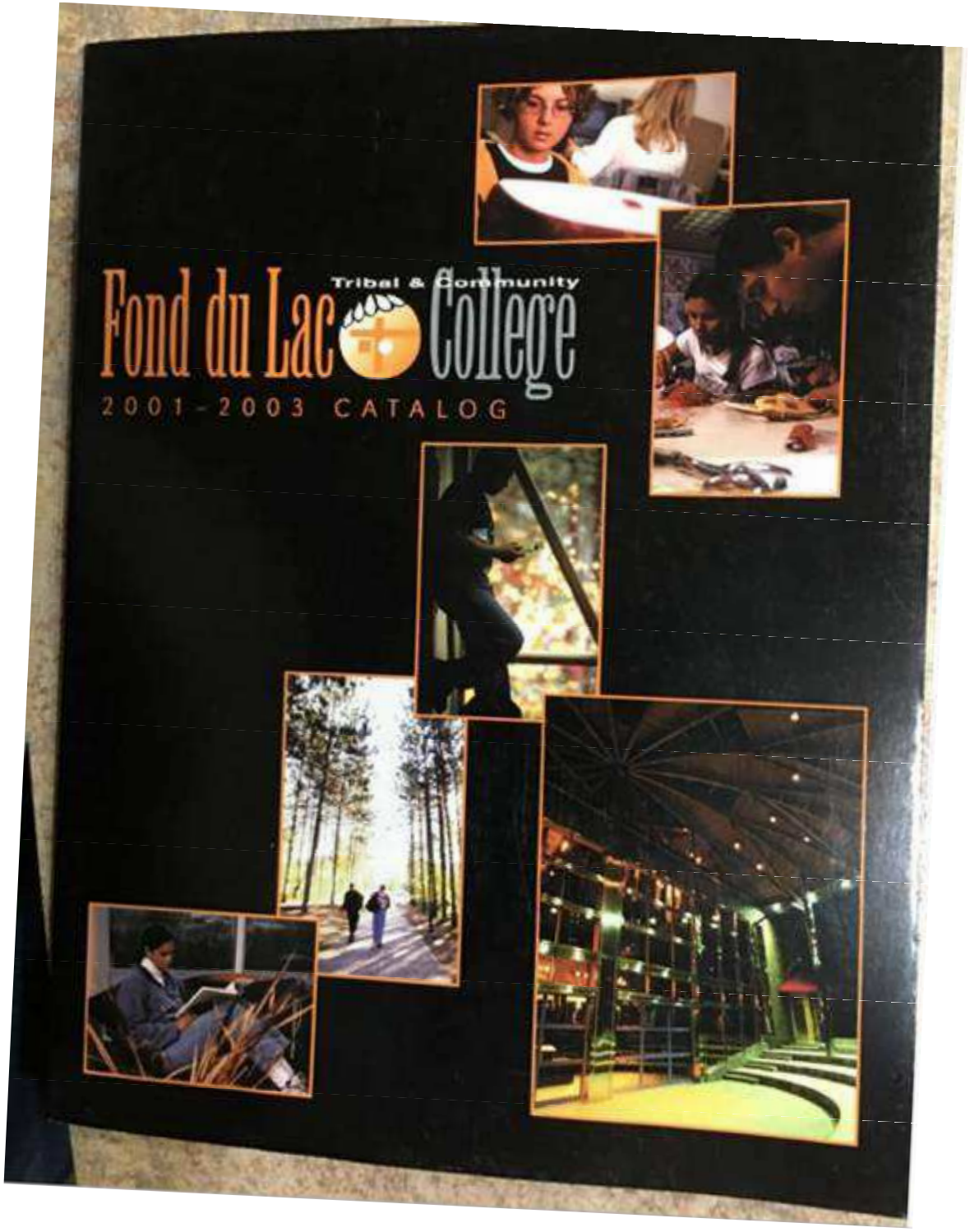
Thomas, Gale
Administrative Secretary

Urbanski, Thomas
Director of Public Information
Director of School-to-Work

Walter, Janet
Associate Director of Student Services

Wappes, Loran
Information System Engineer
B.E.E., University of Minnesota

Exhibit 25


Tribal & Community
Fond du Lac College
2001 - 2003 CATALOG

...SHINAABE
...UAGE

...of the Anishinaabe ... Department is to ... students to and ... knowledge of ... language in a con- ... and written form. ... will learn to con- ... as well ... under- ... of the ... and ... to lead ... of oral presen-

...1 4 credits
...tion to
...abe Language
...will introduce students ... Language. Con- ... and writing skills will ... leading to an oral pre- ... analysis of sentence ... will be utilized in attain- ... standing of the com- ... beauty of the Anishi- ... Students will ... simple sentences.

...2 4 credits
...abe Language II
...will continue to rein- ...versational and writ- ...which began in ANSH ... vocabulary, grammatical ... utilization of ... will be emphasized. ... ANSH 1001)

...0 1 credit
...tion of
...abe Language
...of the Anishinaabe

Special Topics ... credits
Study of special topics in Anishinaabe Language. Special course topics will be announced in the class schedule.

ANSH 2001 4 credits
Anishinaabe Language III
This course is designed for advanced students of the Anishinaabe language who wish to increase their knowledge of complex sentence structure building and analysis skills. The goal of this course is to develop oral and written fluency. (Prerequisite: ANSH 1002)

ANSH 2002 4 credits
Anishinaabe Language IV
This course will continue to build on the advanced skills presented in ANSH 2001. The focus will be upon analysis of short stories and the delivery of oral presentations in the Anishinaabe Language. (Prerequisite: ANSH 2001)

ANTHROPOLOGY

The mission of the Anthropology Department is to provide for the study of human nature, society, and culture, focusing on the American Indian and world perspectives.

ANTH 1001 3 credits
Introduction to American Indian Studies
This course will look at the various American Indian cultures of North America. North American prehistory and the historic period from contact to the present will be addressed. Indian history, religion, and philosophy will be studied

ANTH 1005 1 credit
Cultural Diversity
This course is designed to help students understand cultural differences that exist and multiculturalism as it relates to the world today. The course offers an overview of cultural structure and context as it relates to people of different cultures, and provides a hands-on experience to aid in the understanding of other cultures. Course topics include terms that relate to cultural diversity, multiculturalism in the workplace, differences that exist between cultures and the problems that arise as a result of these differences, and general principles for cultural sensitivity.

ANTH 1010 4 credits
Native Skywatchers
A cross-disciplinary study of the practical and spiritual role of the sky in the Indigenous cultures of the continental Americas. Astronomical and meteorological-inspired art, architecture, and mythologies will be examined, with special emphasis on the Great Lakes Region.

ANTH 1020 3 credits
Cultural Anthropology
A survey of man's cultural development from the beginning of human history to the present. Ancient, preliterate and modern societies are compared and contrasted, pointing out the differences and similarities that have been used in solving man's problems.

ART

The mission of the Art Department is to provide students with an awareness and understanding of how art functions in society emotionally, psychologically, and spiritually. The courses provide an environment that encourages risk taking and exploration as well as refining and redefining necessary skills and techniques. An emphasis on problem solving enables stu-

resent
ion. Addi-
ncerned
tion and

1 credit

oftball.
n by the
ool

1 credit

olleyball.
n by the
ol

1 credit

sketball.
by the
ol

1 credit

ckey.
by the
ol

credits

Spe-

dule.

Physics I and II

A non-calculus general physics course designed for pre-professional and non-science majors. Concepts in mechanics, electricity, magnetism, heat, light, sound, and modern physics will be explored through extensive laboratory activities. (Prerequisite: high school Higher Algebra or consent of instructor) (lecture and lab)

PHYS 1010–1011 **5 credits per course**

General Physics I and II

Calculus-level general physics course designed for science and engineering majors. Concepts in mechanics, electricity, magnetism, heat, light, sound, and modern physics will be examined. (Prerequisite: Concurrent enrollment in Calculus sequence) (lecture and lab)

PHYS 1020 **4 credits**

Astronomy

An introductory study of the nature and dynamics of the Solar System and universe beyond. Observations of the sun, moon, planets, and stars will give students a personal and real-world connection to the universe we live in.

PHYS 1030 **3 credits**

Meteorology

An introduction to the study of the nature and dynamics of the Earth's atmosphere with emphasis on weather processes and meteorological observation.

view of the national and a basic international political arenas so that students can better understand how government should work and how it actually does work in the real world.

POLS 1010 **3 credits**

American Government

A study of the structure and function of the national government of the United States. The course examines the Presidency, Congress, and federal courts as well as the impact of interest groups, political parties, and the media upon government.

POLS 1020 **3 credits**

State and Local Government

This course examines the structure and function of state and local governments with emphasis on state and local problems and conditions in Minnesota.

POLS 1030 **3 credits**

International Relations

This course examines contemporary international relations, foreign policy, and international organizations.

POLS 1099 **1–3 credits**

SPECIAL TOPICS

Study of special topics in Political Science. Special course topics will be announced in the class schedule.

Hanson, Anita
Counselor/Office for Students with Disabilities
M.A., University of Minnesota-Duluth
B.S., North Dakota State University

Harvey, Robert
Law Enforcement
M.Ed., University of Minnesota-Duluth
B.S., Bloomsburg State University

Hedberg, Kathleen
Early Childhood Development
M.Ed., University of Minnesota-Duluth
B.S., University of Minnesota-Duluth

Hixon, Bruce*
Speech
M.A., University of Minnesota
B.A., University of Minnesota
A.A., University of Minnesota

Holmes, Cynthia
Art
M.A.E., Rhode Island School of Design
B.F.A., Minneapolis School of Art and Design

Jaakola, Elizabeth
Music
B.M., University of Minnesota-Duluth

Jarvinen, Donald
Human Services
M.S., University of Wisconsin-Superior
B.A., St. John's University

Jones, Dan
Anishinaabe Language
B.S., Bemidji State University
A.A., Rainy River Community College

Kallis, Bill
Counselor/Psychology
M.A., University of North Dakota
B.A., Minot State University

Kehanna, Patricia*
American Indian Studies
J.D., University of Minnesota Law School
B.S., University of Maryland

Kleinke, Kristin
Music/Philosophy
M.M., University of Minnesota
M.A., Northwestern Lutheran Theological Seminary
B.A., Gustavus Adophus College

Kneeland, Todd
Speech
M.A., University of Wisconsin-Superior
B.A., Principia College

Laine, Debra
Physical Education
M.A.Ed., University of Minnesota
B.A., University of Wisconsin-Stout

Lamirande, Wade
Law Enforcement
B.A., University of Minnesota-Duluth

Langhorst, Glenn
Physics
M.Ed., University of Minnesota-Duluth
B.A.S., University of Minnesota-Duluth

Lyons, Kristine
Theatre
M.Ed., College of St. Scholastica
B.S., Bemidji State University

Maciewski, Bryan Jon
Business
M.B.A., Embry Riddle Aeronautical University
B.S., University of Maryland
A.A., St. Leo College
A.S., Community College of Air Force

Martineau, Roxanne
M.S. Candidate, University of Minnesota
B.S., University of Minnesota
A.A., Fond du Lac Tribal & Community College

Meyer, Patricia
M.S.W., University of Minnesota-Duluth
B.S.W., Mankato State

Exhibit 26

Tribal & Community

Fond du Lac College

2003–2005 Catalog

ıeory and laboratory
for men and women may
ward a major or minor in
education. Courses 1081
3 will not meet the PE
raduation requirements.

2 credits

ion to Recreation/Leisure
ıction and in-depth
f the growing field of
ecreation and leisure

2 credits

n to Physical

ıe history, philosophies
aders, and present
sical education. Addi-
sis will be concerned
ɔnal preparation and
eadership.

1 credit

ɔftball
officiating softball.
certification by the
e High School
fficial.

PHYSICS

It is the mission of the Physics department to provide introductory coursework in the fields of physics, astronomy, and meteorology to meet the need of students in liberal arts and pre-professional programs as well as of students who wish to pursue a career in these fields.

PHYS 1001/1002

4 credits per course (3 lecture, 1 lab)

Introduction to Physics I and II
A non-calculus general physics course designed for pre-professional and non-science majors. Concepts in mechanics, electricity, magnetism, heat, light, sound, and modern physics will be explored through extensive laboratory activities. (Prerequisite: high school Higher Algebra or consent of instructor)

PHYS 1020 — 4 credits

Introductory Astronomy
An introductory study of the nature and dynamics of the solar system and universe beyond. Observations of the sun, moon, planets, and stars

ANTH 1010 **4 credits**

Native Skywatchers

A cross-disciplinary study of the practical and spiritual role of the sky in the indigenous cultures of the continental Americas. Astronomical and meteorological-inspired art, architecture, and mythologies will be examined, with special emphasis on the Great Lakes Region.

ANTH 1020 **3 credits**

Cultural Anthropology

A survey of cultural development from the beginning of human history to the present. Ancient, preliterate and modern societies are compared and contrasted, pointing out the differences and similarities that have been used in solving human problems.

ART

The mission of the Art department is to provide students with an awareness and understanding of how art functions in society emotionally, psychologically, and spiritually. The courses provide an environment that encourages risk taking and exploration as well as refining and redefining necessary skills and techniques. An emphasis on problem solving enables students to diversify and to make the tools applicable to other venues. These introductory courses are designed for students with little or no experience in creative art.

ART 1001 **3 credits (1 lecture, 2 lab)**

Introduction to Art

An orientation to art-related problems, techniques, and materials as well as an introduction to the principle elements of two- and three-dimensional design. For students with little or no experience in creative art.

ART 1010 **3 credits (1 lecture, 2 lab)**

Drawing

This course presents the fundamentals of representative freehand drawing with emphasis on expression and organization.

ART 1020 **3 credits (1 lecture, 2 lab)**

Design

This course examines the fundamentals of two- and three-dimensional design with an emphasis on the elements of graphic design.

ART 1030 **3 credits (1 lecture, 2 lab)**

Painting

This course provides an orientation to painting in acrylics, including the study and exploration of principle elements of painting.

ART 1040 **3 credits (1 lecture, 2 lab)**

Watercolors

This course consists of painting demonstrations, painting sessions, and the study of the newest ideas using design in watercolor.

ART 1060 **3 credits (1 lecture, 2 lab)**

American Indian Art

This course is designed to increase awareness of American Indian culture through the study of the basic elements of creative art. The relationship between elements of design and traditional art from the Anishinaabe culture will be stressed.

Art 1070 **3 credits (1 lecture, 2 lab)**

Introduction to Jewelry

This course consists of an exploration of the design, materials, and technical processes of jewelry fabrication. The focus will be on use of natural materials as well as found objects. (This course does not address silver smithing techniques.)

ART 1080 **3 credits**

Art History I

A survey of ancient, medieval, and Gothic art with emphasis on architecture, sculpture, and painting from both a Western European and non-Western cultural and historical viewpoint.

ART 1081 **3 credits**

Art History II

A survey of Renaissance through 20th century art with emphasis on architecture, sculpture, and painting from both a Western European and non-Western cultural and historical viewpoint.

ART 1090 **3 credits (1 lecture, 2 lab)**

Photography I

Designed for the beginning photographer, this course concentrates on the fundamentals of black and white photography; explores camera operation, film processing, contact prints, the print process, cropping, and dry mounting. A strong emphasis is placed on artistic expression via photographic composition: effective cropping, rule of thirds, depth of field, and contrast. (The student must provide their own camera, film, and photographic paper.)

ART 1091 **3 credits (1 lecture, 2 lab)**

Photography II

Designed for students with a basic knowledge of black and white photography. There is a strong emphasis on photo journalism projects, photographic composition and artistic expression, and special emphasis on individual projects including photo documentation of news events, human interest/event documentary and mechanical processes of special application to news, public relations and multimedia production. (Prerequisite: Art 1090)

Bernhardson, Mark
Maintenance Foreman

Bergstrom, Amy
Director of American Indian Teacher Corps
Ed.M., Harvard University
B.A.A., University of Minnesota-Duluth

Broeffle, Candi
Customized Training Representative
B.A. Candidate, Concordia University
A.A., Fond du Lac Tribal & Community College

Camp, Mashugashon
Clerical
A.A. Candidate, Fond du Lac Tribal & Community College

Carlson, Bruce
Director of Housing
B.S., University of Wisconsin-Superior
A.A., Fond du Lac Tribal & Community College

Clark, Brian
Maintenance

Cresap, Robert
Director of Visions 2000 Program
M.S., University of South Dakota
B.S., Valley City State

Danz, Irene
Director of Farm Service Agency Tribal Outreach Program
B.A., University of Minnesota-Duluth
A.A., Fond du Lac Tribal & Community College

DeFoe, Shirley
Director of International Exchange Program

Denny, Janice
Director of Urban Outreach Site
B.S., Metropolitan State University
A.A.S., Minneapolis Community College

Eisfeld, Bonnie
College Receptionist
A.A., Fond du Lac Tribal & Community College

Fall, Dennis
Switchboard/Receptionist
A.A., Fond du Lac Tribal & Community College

Gassert, Deb
Recruiter, American Indian Teacher Corps
Certificate, Arrowhead Beauty College

Gordon, Nancy
Bookstore Coordinator
A.A., Rainy River Community College

Gordon, Wade
Director of Institute for Objective Human Understanding
Psy.D. Candidate, Minnesota School of Professional Psychology
B.S., University of Wisconsin-Superior
A.A., Fond du Lac Tribal & Community College

Gossett, Darla
Student Registration Coordinator
M.A., Concordia University
B.A., Concordia University
A.A., Fond du Lac Tribal & Community College

Hagenah, Paula
Business Office Clerk
A.A.S., Hibbing Community College

Isham, Donna
Clerical/Intermittent
A.A.S., Fond du Lac Tribal & Community College

Iwasko, Judy
Personnel Aide

Seminary
B.A., Gustavus Adophus College

Lamirande, Wade
Law Enforcement
B.A., University of Minnesota-Duluth

Langhorst, Glenn
Geology/Physics
M.Ed., University of Minnesota-Duluth
B.A.S., University of Minnesota-Duluth

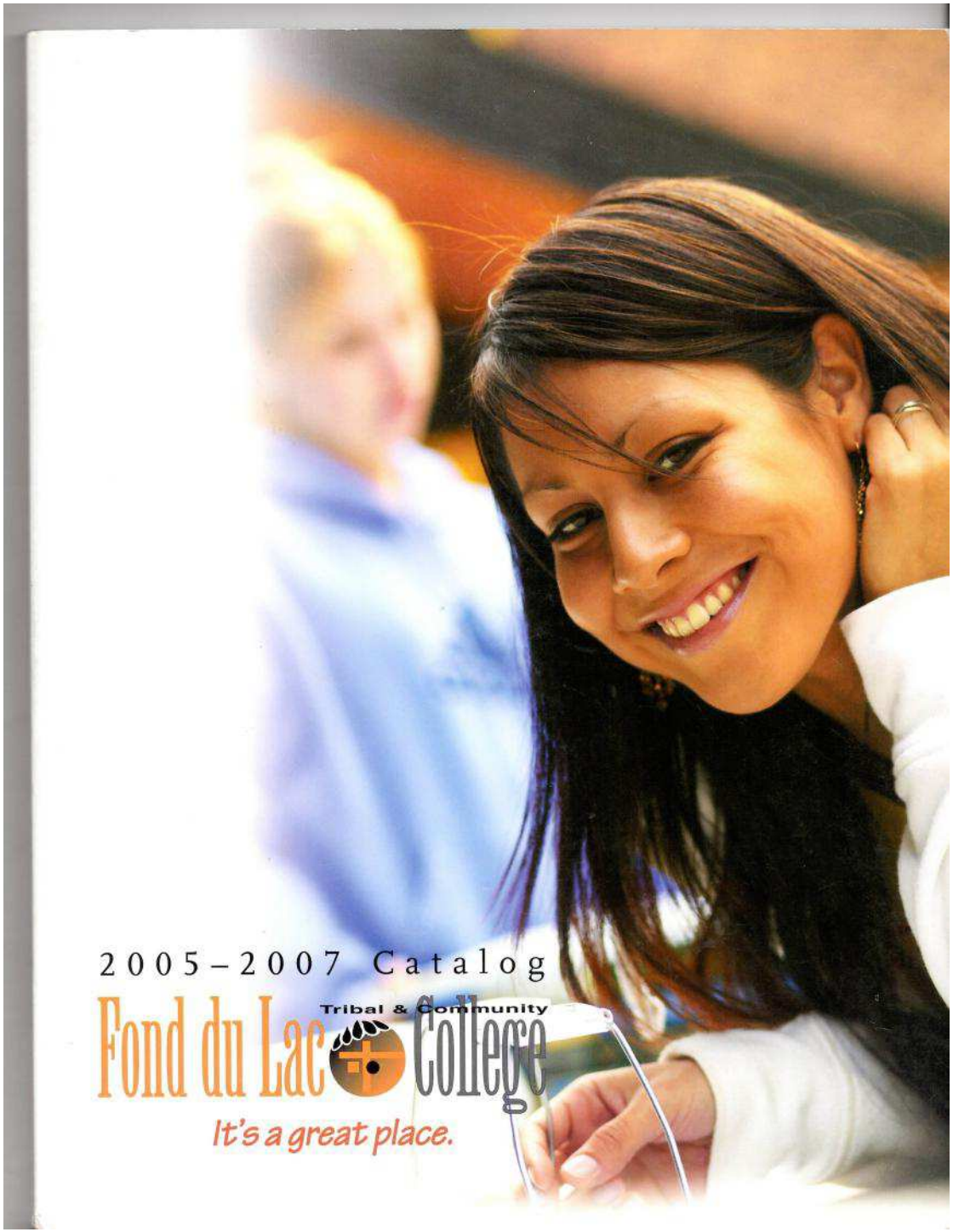
Lee, Annette
Math/Physics
M.F.A., Yale University
B.A., University of California-Berkeley
B.F.A., University of Illinois-Urbana Champaign

Nursing
B.A., College
A.A., Norma

Jean Ness*
Psychology
Ed.D, Unive
M.A. Univer
B.S., Univers

Nicholson, S
Physics
Post Doc., St
Ph.D., Unive
M.S., State U
B.S., State U

Exhibit 27


2005–2007 Catalog
Tribal & Community
Fond du Lac College
It's a great place.

2005–2007 CATALOG

Fond du Lac Tribal & Community College

2101 14th Street
Cloquet, Minnesota 55720
(218) 879-0800
1-800-657-3712
TTY (218) 879-0805
Fax (218) 879-0814
www.fdltcc.edu

AMIN 2010 **2 credits**
Survey of Bilingual American Indian Education
This course is a survey of American Indian Education, with emphasis on historical precedents leading to the present day American Indian Education programs.

AMIN 2030/SOC 2030 **3 credits**
Contemporary Indian Concerns
This course is an introductory overview of American Indian culture, history, and traditions. It includes philosophical, religious, and contemporary issues.

AMIN 2040 **5 credits**
Museum Practices
Museum practices will include basic instruction in a spectrum of museum related skills including conservation, documentation, and display of cultural objects as well as exploring the role of the curator in exhibit development, description, design, fabrication, museum management, and fundraising.

AMIN 2050 **1 credit**
Field Work
Students will gain practical experience in elementary and secondary schools by volunteering as tutors with American Indian students. A weekly seminar intended for reflection and learning is also required. (Prerequisite: consent of instructor.)

AMIN 2090 **1–3 credits**
Practicum
Students will serve as a paraprofessional in their major field. A weekly meeting will be scheduled to discuss the student's progress. (Prerequisite: consent of instructor.)

ANISHINAABE LANGUAGE

The mission of the Anishinaabe language department is to introduce students to and expand their knowledge of Anishinaabe language in a conversational and written form. Students will learn to converse in Anishinaabe as well as attain an understanding of the complexity and beauty of the Anishinaabe language. Analysis of sentence structure will be introduced and expanded at the introductory and advanced levels to lead to the delivery of oral presentation.

ANSH 1001 **4 credits**
Introduction to Anishinaabe Language
This course will introduce students to the Anishinaabe language. Conversational and writing skills will be learned, leading to an oral presentation. Analysis of sentence structure will be utilized in attaining an understanding of the complexity and beauty of the Anishinaabe language. Students will write and speak simple sentences.

ANSH 1002 **4 credits**
Anishinaabe Language II
This course will continue to reinforce the conversational and writing skills which began in ANSH 1001. New vocabulary, grammatical concepts, and utilization of acquired skills will be emphasized. (Prerequisite: ANSH 1001)

ANSH 1010 **1 credit**
Examination of Anishinaabe Language
An overview of the Anishinaabe language at an introductory level.

ANSH 1099 **1–3 credits**
Special Topics
Study of special topics in Anishinaabe language. Special course topics will be announced in the class schedule.

ANSH 2001 **4 credits**
Anishinaabe Language III
This course is designed for advanced students of the Anishinaabe language who wish to increase their knowledge of complex sentence structure building and analysis skills. The goal of this course is to develop oral and written fluency. (Prerequisite: ANSH 1002)

ANSH 2002 **4 credits**
Anishinaabe Language IV
This course will continue to build on the advanced skills presented in ANSH 2001. The focus will be upon analysis of short stories and the delivery of oral presentations in the Anishinaabe language. (Prerequisite: ANSH 2001)

ANTHROPOLOGY

The mission of the Anthropology department is to provide for the study of human nature, society, and culture, focusing on the American Indian and world perspectives.

ANTH 1001 **3 credits**
Introduction to American Indian Studies
This course will look at the various American Indian cultures of North America. North American prehistory and the historic period from contact to the present will be addressed. Indian history, religion, and philosophy will be studied with an emphasis on the Anishinaabe people of Minnesota.

ANTH 1005 **1 credit**
Cultural Diversity
This course is designed to help students understand cultural differences that exist and multiculturalism as it relates to the world today. The course offers an overview of cultural structure and context as it relates to people of different cultures, and provides a hands-on experience to aid in the understanding of other cultures. Course topics include terms that relate to cultural diversity, multiculturalism in the workplace, differences that exist between cultures and the problems that arise as a result of these differences, and general principles for cultural sensitivity.

ANTH 1010 **4 credits**
Native Skywatchers
A cross-disciplinary study of the practical and spiritual role of the sky in the indigenous cultures of the continental Americas. Astronomical and meteorological-inspired art, architecture, and mythologies will be examined, with special emphasis on the Great Lakes Region.

ANTH 1020 **3 credits**
Cultural Anthropology
A survey of cultural development from the beginning of human history to the present. Ancient, preliterate and modern societies are compared and contrasted, pointing out the differences and similarities that have been used in solving human problems.

ART

The mission of the Art department is to provide students with an awareness and understanding of how art functions in society emotionally, psychologically, and spiritually. The courses provide an environment that encourages risk taking and exploration as well as refining and redefining necessary skills and techniques. An emphasis on problem solving enables students to diversify and to make the tools applicable to other venues. These introductory courses are designed for students with little or no experience in creative art.

ART 1001 **3 credits (1 lecture, 2 lab)**
Introduction to Art
An orientation to art-related problems, techniques, and materials as well as an introduction to the principle elements of two- and three-dimensional design. For students with little or no experience in creative art.

ART 1010 **3 credits (1 lecture, 2 lab)**
Drawing
This course presents the fundamentals of representative freehand drawing with emphasis on expression and organization.

ART 1020 **3 credits (1 lecture, 2 lab)**
Design
This course examines the fundamentals of two- and three-dimensional design with an emphasis on the elements of graphic design.

ART 1030 **3 credits (1 lecture, 2 lab)**
Painting
This course provides an orientation to painting in acrylics, including the study and exploration of principle elements of painting.

ART 1040 **3 credits (1 lecture, 2 lab)**
Watercolors
This course consists of painting demonstrations, painting sessions, and the study of the newest ideas using design in watercolor.

ART 1060 **3 credits (1 lecture, 2 lab)**
American Indian Art
This course is designed to increase awareness of American Indian culture through the study of the basic elements of creative art. The relationship between elements of design and traditional art from the Anishinaabe culture will be stressed.

Art 1070 **3 credits (1 lecture, 2 lab)**
Introduction to Jewelry
This course consists of an exploration of the design, materials, and technical processes of jewelry fabrication. The focus will be on use of natural materials as well as found objects. (This course does not address silver smithing techniques.)

ART 1080 **3 credits**
Art History I
A survey of ancient, medieval, and Gothic art with emphasis on architecture, sculpture, and painting from both a Western European and non-Western cultural and historical viewpoint.

ART 1081 **3 credits**
Art History II
A survey of Renaissance through 20th century art with emphasis on architecture, sculpture, and painting from both a Western European and non-Western cultural and historical viewpoint.

ART 1090 **3 credits (1 lecture, 2 lab)**
Photography I
Designed for the beginning photographer, this course concentrates on the fundamentals of black and white photography; explores camera operation, film processing, contact prints, the print process, cropping, and dry mounting. A strong emphasis is placed on artistic expression via photographic composition: effective cropping, rule of thirds, depth of field, and contrast. (The student must provide their own camera, film, and photographic paper.)

ART 1091 **3 credits (1 lecture, 2 lab)**
Photography II
Designed for students with a basic knowledge of black and white photography. There is a strong emphasis on photo journalism projects, photographic composition and artistic expression, and special emphasis on individual projects including photo documentation of news events, human interest/event documentary and mechanical processes of special application to news, public relations and multimedia production. (Prerequisite: Art 1090)

PE 1083 **2 credits**
Introduction to Physical Education
A study of the history, philosophies of selected leaders, and present trends in physical education. Additional emphasis will be concerned with professional preparation and problems of leadership.

PE 1075 **1 credit**
Officiating Softball
Techniques of officiating softball. Preparation for certification by the Minnesota State High School League as an official.

PE 1076 **1 credit**
Officiating Volleyball
Techniques of officiating volleyball. Preparation for certification by the Minnesota State High School League as an official.

PE 1077 **1 credit**
Officiating Basketball
Techniques of officiating basketball. Preparation for certification by the Minnesota State High School League as an official.

PE 1078 **1 credit**
Officiating Hockey
Techniques of officiating hockey. Preparation for certification by the Minnesota State High School League as an official.

PE 1099 **1–3 credits**
Special Topics
Study of special topics in PE. Special course topics will be announced in the class schedule.

PE 2015 **4 credits (3 lecture,1 lab)**
Fitness Instructor Skills
This class is designed to provide a basis for safe and effective fitness instructor training. Students will be exposed to a variety of Native American traditional music, movement, and meditation techniques. The student will demonstrate knowledge in the following areas: step and slide aerobics, interval training, resistance training, high-low aerobics, circuit training, water aerobics, kickboxing basics, rhythmic stretching, yoga basics, relaxation exercises. This course prepares the student to take the National Fitness Certification Exam from the American Council on Exercise (CPR certification is required to take the exam.) (Prerequisite: Anatomy and Physiology in high school within the last five years, grade of C or better, or consent of instructor)

PHYSICS

It is the mission of the Physics department to provide introductory coursework in the fields of physics, astronomy, and meteorology to meet the need of students in liberal arts and pre-professional programs as well as of students who wish to pursue a career in these fields.

PHYS 1001/1002 **4 credits per course (3 lecture, 1 lab)**
Introduction to Physics I and II
A non-calculus general physics course designed for pre-professional and non-science majors. Concepts in mechanics, electricity, magnetism, heat, light, sound, and modern physics will be explored through extensive laboratory activities. (Prerequisite: high school Higher Algebra or consent of instructor)

PHYS 1020 **4 credits**
Introductory Astronomy
An introductory study of the nature and dynamics of the solar system and universe beyond. Observations of the sun, moon, planets, and stars will give students a personal and real-world connection to the universe we live in.

PHYS 1030 **3 credits**
Meteorology
An introduction to the study of the nature and dynamics of the Earth's atmosphere with emphasis on weather processes and meteorological observation.

PHYS 1099 **1–3 credits**
Special Topics
Study of special topics in Physics. Special course topics will be announced in the class schedule.

POLITICAL SCIENCE

The mission of the Political Science department is to provide students with a basic overview of the national and international political arenas so that students can better understand how government should work and how it actually does work in the real world.

POLS 1010 **3 credits**
American Government
A study of the structure and function of the national government of the United States. The course examines the Presidency, Congress, and federal courts as well as the impact of interest groups, political parties, and the media upon government.

POLS 1020 **3 credits**
State and Local Government
This course examines the structure and function of state and local governments with emphasis on state and local problems and conditions in Minnesota.

POLS 1030 **3 credits**
International Relations
This course examines contemporary international relations, foreign policy, and international organizations.

POLS 1099 **1–3 credits**
Special Topics
Study of special topics in Political Science. Special course topics will be announced in the class schedule.

Holmes, Cynthia
Art
M.A.E., Rhode Island School of Design
B.F.A., Minneapolis School of Art and Design

Jaakola, Elizabeth
Music/American Indian Studies
M.M., University of Minnesota-Duluth
B.M., University of Minnesota-Duluth

Jarvinen, Donald
Human Services
M.S. University of Wisconsin-Superior
B.A., St. John's University

Johnson, Douglas
Economics
M.A., University of Minnesota-Duluth
B.S., Minnesota State University-Mankato

Johnson, Michele
English
M.A., Chapman University
B.E., Eastern Washington University

Jones, Dan
Anishinaabe Language
B.S., Bemidji State University
A.A., Rainy River Community College

Kallis, Bill
Counselor/Psychology
M.A., University of North Dakota
B.A., Minot State University

Kamp, Adam
English
M.A., University of Iowa
B.A., Cornell College

Kennedy, Jason
Geography/Business
M.S., Minnesota State University-Mankato
B.A., California State University-Sacramento

Kleinke, Kristin
Music/Philosophy
M.M., University of Minnesota
M.A., Northwestern Lutheran Theological Seminary
B.A., Gustavus Adolphus College

Langhorst, Glenn
Geology/Physics
M.Ed., University of Minnesota-Duluth
B.A.S., University of Minnesota-Duluth

Lemon, Charles
Law Enforcement
A.A., Hibbing Community College

Lyons, Scott
Law Enforcement
B.A., University of Minnesota-Duluth

Maciewski, Bryan Jon
Business/Marketing
M.B.A., Embry Riddle Aeronautical University
B.S., University of Maryland
A.A., St. Leo College
A.S., Community College of Air Force

DeLille Martineau, Roxanne
Speech/Anthropology
M.S., University of Minnesota
B.S., University of Minnesota
A.A., Fond du Lac Tribal & Community College

McBride, Kenneth*
Biology/Math
B.A., Purdue University
M.P.A., Indiana University
M.S.C., Indiana University

Monson, Mary
Nursing
M.A., College of St. Scholastica
B.A., College of St. Scholastica
A.A., Normandale Community College

Ness, Jean*
Psychology
Ed.D., University of Minnesota
M.A., University of St. Thomas
B.S., University of Minnesota

Nicholson, Stuart*
Physics
Post Doc., State University of New York-Albany
Ph.D., University of Georgia
M.S., State University of New York-Albany
B.S., University of New York-Albany

Olsen, Mark*
Physical Education
B.S., North Dakota State University

Pertler, Thomas
Law Enforcement
J.D., Hamline University
B.A., University of Minnesota-Duluth

Peterson, Robin
Corrections
B.S., Wichita State University

Preston, Margaret*
English
M.A., New Mexico State University
B.A., University of Minnesota

Pucel, Mary Gayle
Business/Political Science
M.B.A., St. Cloud State University
M.S., St Cloud State University
B.S., St. Cloud State University

Reinhard, John
English
M.F.A., University of Michigan
M.A., Eastern Michigan University
B.S., University of Michigan

Ringhand, Mary*
Anishinaabe Language
J.S., University of Minnesota

Rynex, Carolyn
Music
B.A., Trinity College

Sandal, Jay
Biology
M.S., University of Minnesota-Duluth
B.S., University of Minnesota-Duluth

Schwartz, Barry
Music
B.A., Minnesota State University-Moorhead

Shene, Robert
Law Enforcement
B.S., United States Coast Guard Academy

Shultz, Judith
Reading/Coordinator of Center for Academic Achievement
M.A., University of Northern Iowa
B.A., University of Northern Iowa
A.A., Marshalltown Community College

Snustad, Andrew
Spanish
B.A., University of Montana
M.A., University of Montana

Sorenson, Sara Marie
Speech/English/Theater
B.S., Minnesota State University-Moorhead

Stead, Arnold*
English/Philosophy
Ph.D., University of Missouri-Columbia
M.A., Iowa State University
B.A., Bemidji State

Stocking, Lonnie*
Business
B.S., Bemidji State University

Straub, Wayne
Physical Education

Syrett, Cheryl
Physical Education
B.F.A., University of Minnesota-Duluth

Trebian, Mark
Computer Science
M.S., University of Wisconsin-Stout
B.S., University of Wisconsin-Platteville
B.S., Mount Senario College

Wagner, Phillip
Law Enforcement
B.S., Louisiana College

Walton, Melissa
Child Development
M.S., University of Wisconsin-Superior
B.A., College of St. Scholastica

Wappes, Connie
Mathematics
M.A., University of Phoenix
B.S., Ohio State University

Wendorff, Frances
Mathematics/Reading
M.A., Candidate, University of Wisconsin-Superior
B.A., College of St. Benedict

Weston, Dale*
English
B.S., Hamline University

Fond du Lac Tribal & Community College Board of Directors

Peter Defoe
Kevin Dupuis
Stephanie Hammitt, Chair
Vince Martineau
Mike Rabideaux
Gene Reynolds
Roger Smith
Patty Petite
Vern Zacher

Minnesota State Colleges and Universities Board of Trustees

Will Antell, Liaison to FDLTCC
Duane Benson
Michael Boulton
Tyler Despins
Cheryl Dickson, Treasurer
Ivan Dusek
Ruth Grendahl
Clarence Hightower
Robert H. Hoffman, Chair
Vincent Ijioma
Carol Ley
Lew Morgan
David Olson
David Paskach
Thomas Renier
Anne Curme Shaw, Vice Chair
Christopher Schultz

Fond du Lac Tribal & Community College Foundation Board of Directors

Debbie Briggs
Debra Demianiuk
Dixie Dorman
John Gassert
Ann Glumac
Connie Hyde
Thomas Jubie
Paul M. Munson
Joan Nurminen
Del Prevost
Kevin Stangl
Randy Wagner
Chuck Walt
Kirk Wimmer
Dale Wolf

Fond du Lac Tribal & Community College Administration

Day, Donald R.
President
Ed.D., University of North Dakota
M.Ed., University of Minnesota-Duluth
B.A., Bemidji State University

Anderson, Larry
Vice President of Administration and Student Affairs
M.S., University of Wisconsin-Superior
B.S., University of Wisconsin-Superior

Gutting, Sister Therese
Vice President of Academic Affairs
Ed.D., Kennedy Western University
M.S., University of Minnesota-Duluth
B.S., Viterbo College

Skurich, Elliot
Director of Fiscal Operations
B.B.A., University of Minnesota-Duluth

Fond du Lac Tribal & Community College Faculty

*Faculty at outreach sites

Ahlgren, Marla
English
M.A., University of Minnesota-Duluth
B.S., University of Minnesota-Duluth

Anderson, Michael
Law Enforcement
B.A., University of Minnesota-Duluth

Beckman, Brad
Physical Education
B.S., University of Wisconsin-Superior

Braxton-Brown, Jonah
History/Political Science
M.A., Candidate, Washington State University
M.A., Eastern Washington University
B.A., University of Redlands

Broughton, Nancy
Library/Archives Director
M.A., University of Wisconsin-Madison
M.S., University of Nevada-Reno
B.S., University of Wisconsin-Platteville

Bruning, Marcus
Health/Law Enforcement
B.A., Concordia College
Law Enforcement, Normandale Community College

Dillon, Edward*
Math
M.S., University of Iowa
B.S., University of Iowa

Diver, Charlin F.
English
M.Ed., Harvard University
B.A., University of Minnesota-Duluth

Downwind, Bradley*
Anishinaabe Language

Drewlo, G. Scott
Corrections
B.S., St. Cloud State University

Estey, Carrie
Art
M.A., University of Arizona
B.S., Bemidji State University

Fairbanks, Tawana*
Psychology
M.Ed., University of Central Oklahoma
B.S., University of Central Oklahoma

Fellegy, Anna
English
Ph.D., University of Minnesota
M.A., University of Minnesota
B.S., University of Wisconsin-Superior

Foster, Sherrie
Speech/Theatre
M.A., University of Minnesota
B.S., University of Minnesota
B.A., St. Mary's College

Gillespie, Michael
Biology
M.S., University of Minnesota-Duluth
B.A., University of Minnesota-Duluth

Gittings, Ronald
Sociology
M.S., Indiana State University
B.A., Marian College

Gould, Roxanne*
American Indian Studies
Ed.D, University of Minnesota
M.A., University of South Dakota
B.A., University of South Dakota

Grace, Patricia
Counselor
M.S., Drake University
B.S., Mankato State University

Greeman, David
Law Enforcement
M.S., University of Wisconsin-Superior
B.A., College of St. Thomas
A.A., Normandale Community College

Grunenwold, Steven*
English
M.A., Bemidji State University
B.S., Bemidji State University

Gustafson, John
Computer Science/Electric Utility Technology
Ph.D., University of Minnesota
M.S., University of Minnesota
Bachelor of Physics, University of Minnesota

Hamilton, Cherie
Art
M.A., University of Illinois-Urbana
B.A., Western Washington University

Hanson, Anita
Counselor/Office for Students with Disabilities
M.A., University of Minnesota-Duluth
B.S., North Dakota State University

Hanson, Donald
Chemistry
M.S., University of Wisconsin-Superior
B.S., University of Minnesota-Duluth

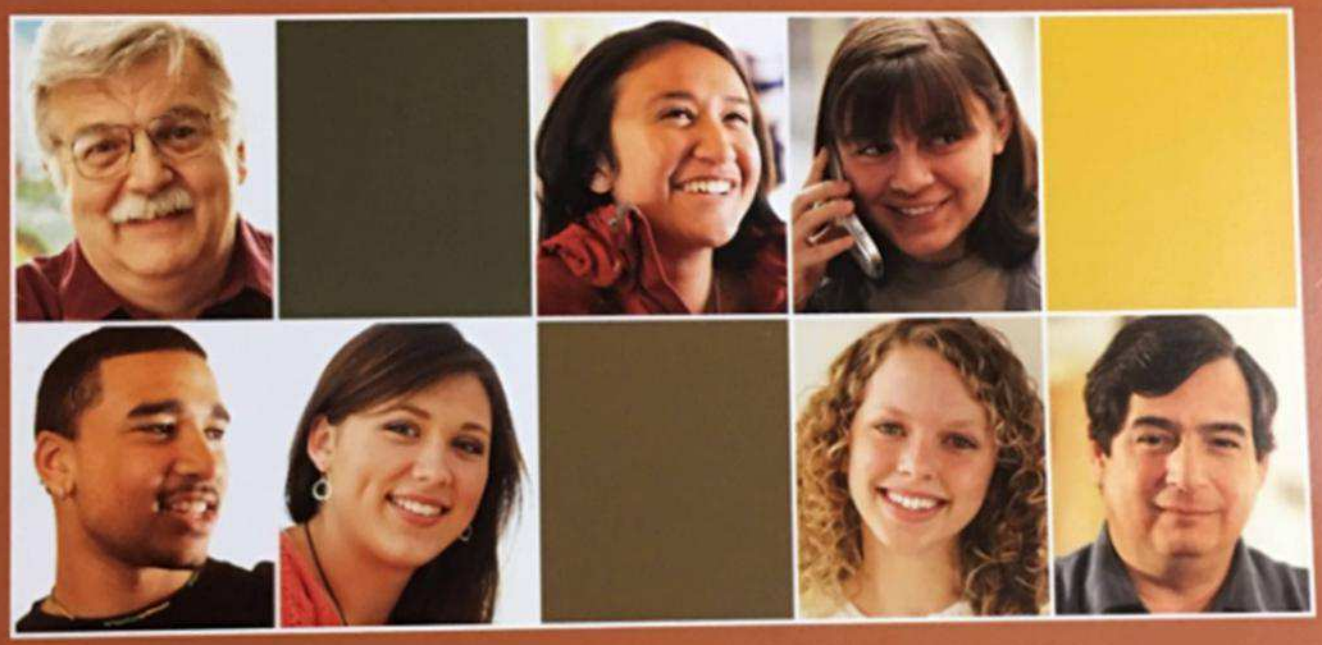
Hedberg, Kathleen
Child Development
M.Ed., University of Minnesota-Duluth
B.S., University of Minnesota-Duluth

Heath, Mitzi*
Psychology
M.A., St. Mary's University

Henry, Peter*
English/Speech
B.A., Carleton College

Exhibit 28

It's a great place.



2008–2010 CATALOG

Fond du Lac Tribal & Community College

Grace, Patricia
Counselor
M.S., Drake University
B.S., Mankato State University

Greeman, David
Law Enforcement
M.S., University of Wisconsin-Superior
B.A., College of St. Thomas
A.A., Normandale Community College

Grimmelbein, Mark*
Biology/Mathematics
M.S., University of Illinois
B.S., University of Illinois
B.S., Bemidji State University

Hamilton, Cherie
Art
M.A., University of Illinois-Urbana
B.A., Western Washington University

Hansen, Amy
Nursing
M.S., University of Phoenix
B.A., College of St. Scholastica

Hanson, Anita
Counselor/Office for Students with Disabilities
M.A., University of Minnesota-Duluth
B.S., North Dakota State University

Hanson, Donald
Chemistry
M.S., University of Wisconsin-Superior
B.S., University of Minnesota-Duluth

Hedberg, Kathleen
Child Development
M.Ed., University of Minnesota-Duluth
B.S., University of Minnesota-Duluth

Holmes, Cynthia
Art
M.A.E., Rhode Island School of Design
B.F.A., Minneapolis School of Art and Design

Jaakola, Elizabeth
Music/American Indian Studies
M.M., University of Minnesota-Duluth
B.M., University of Minnesota-Duluth

Jarvinen, Donald
Human Services
M.S., University of Wisconsin-Superior
B.A., St. John's University

Johnson, Douglas
Economics
M.A., University of Minnesota-Duluth
B.S., Minnesota State University-Mankato

Johnson, Duane
First Responder

Johnson, Michele
English
M.A., Chapman University
B.A., Eastern Washington University

Jones, Dan
Anishinaabe Language
B.S., Bemidji State University
A.A., Rainy River Community College

Kallis, Bill
Counselor/Psychology
M.A., University of North Dakota
B.A., Minot State University

Langhorst, Glenn
Geology/Physics
M.Ed., University of Minnesota-Duluth
B.A.S., University of Minnesota-Duluth

Lemon, Charles
Law Enforcement
A.A., Hibbing Community College

Lohman, Thomas
Electric Utility Technology
B.S.E.E., University of Minnesota-Duluth

Lyons, Scott
Law Enforcement
B.A., University of Minnesota-Duluth

Maciewski, Bryan Jon
Business/Marketing
M.B.A., Embry Riddle Aeronautical University
B.S., University of Maryland
A.A., St. Leo College
A.S., Community College of Air Force

MacKay, Jennifer
Head Coach, Women's Basketball
M.A., University of Nebraska-Kearney
B.S., University of Minnesota

structure building and analysis skills. The goal of this course is to develop oral and written fluency.
(Prerequisite: ANSH 1002)

ANSH 2002 **4 credits**
Anishinaabe Language IV
This course will continue to build on the advanced skills presented in ANSH 2001. The focus will be upon analysis of short stories and the delivery of oral presentations in the Anishinaabe language.
(Prerequisite: ANSH 2001)

ANTHROPOLOGY

The mission of the Anthropology department is to provide for the study of human nature, society, and culture, focusing on the American Indian and world perspectives.

ANTH 1001 **3 credits**
Introduction to American Indian Studies
This course will look at the various American Indian cultures of North America. North American prehistory and the historic period from contact to the present will be addressed. Indian history, religion, and philosophy will be studied with an emphasis on the Anishinaabe people of Minnesota.

ANTH 1005 **1 credit**
Cultural Diversity
This course is designed to help students understand cultural diversity and the need for cultural competence as it relates to our world today. Designed as a seminar, this course will provide an overview of culture and its many dimensions. It will provide hands-on experience to aid in the understanding of other cultures and offer tools for cultural competence in both our personal and public lives.

ANTH 1010 **4 credits**
Native Skywatchers
A cross-disciplinary study of the practical and spiritual role of the sky in the indigenous cultures of the continental Americas. Astronomical and meteorological-inspired art, architecture, and mythologies will be examined, with special emphasis on the Great Lakes Region.

ANTH 1020 **3 credits**
Cultural Anthropology
A survey of cultural development from the beginning of human history to the present. Ancient, preliterate and modern societies are compared and contrasted, pointing out the differences and similarities that have been used in solving human problems.

ART

The mission of the Art department is to provide students with an awareness and understanding of how art functions in society emotionally, psychologically, and spiritually. The courses provide an environment that encourages risk taking and exploration as well as refining and redefining necessary skills and techniques. An emphasis on problem solving enables students to diversify and to make the tools applicable to other venues. These introductory courses are designed for students with little or no experience in creative art.

ART 1001 **3 credits (1 lecture, 2 lab)**
Introduction to Art
An orientation to art-related problems, techniques, and materials as well as an introduction to the principle elements of two- and three-dimensional design. For students with little or no experience in creative art.

PHYSICAL EDUCATION FOR MAJORS AND MINORS

These theory and laboratory courses for men and women may apply toward a major or minor in physical education. Courses 1081 and 1083 will not meet the PE general graduation requirements.

PE 1075 **1 credit**
Officiating Softball
Techniques of officiating softball. Preparation for certification by the Minnesota State High School League as an official.

PE 1076 **1 credit**
Officiating Volleyball
Techniques of officiating volleyball. Preparation for certification by the Minnesota State High School League as an official.

PE 1077 **1 credit**
Officiating Basketball
Techniques of officiating basketball. Preparation for certification by the Minnesota State High School League as an official.

PE 1099 **1–3 credits**
Special Topics
Study of special topics in PE. Special course topics will be announced in the class schedule.

PE 2015 **4 credits (3 lecture,1 lab)**
Fitness Instructor Skills
This class is designed to provide a basis for safe and effective fitness instructor training. Students will be exposed to a variety of Native American traditional music, movement, and meditation techniques. The student will demonstrate knowledge in the following areas: step and slide aerobics, interval training, resistance training, high-low aerobics, circuit training, water aerobics, kickboxing basics, rhythmic stretching, yoga basics, relaxation exercises. This course prepares the student to take the National Fitness Certification Exam from the American Council on Exercise (CPR certification is required to take the exam.) (Prerequisite: Anatomy and Physiology in high school within the last five years, grade of C or better, or consent of instructor)

PHYSICS

It is the mission of the Physics department to provide introductory coursework in the fields of physics, astronomy, and meteorology to meet the need of students in liberal arts and pre-professional programs as well as of students who wish to pursue a career in these fields.

PHYS 1001/1002 **4 credits per course (3 lecture, 1 lab)**
Introduction to Physics I and II
An algebra-based general physics course designed for pre-professional and non-engineering majors. Concepts in mechanics, electricity, magnetism, heat, light, sound, and modern physics will be explored through extensive laboratory activities. (Prerequisite: high school Higher Algebra or consent of instructor)

PHYS 1020 **4 credits**
Introductory Astronomy
An introductory study of the nature and dynamics of the solar system and universe beyond. Observations of the sun, moon, planets, and stars will give students a personal and real-world connection to the universe we live in.

PHYS 1030 **3 credits**
Meteorology
An introduction to the study of the nature and dynamics of the Earth's atmosphere with emphasis on weather processes and meteorological observation.

PHYS 1099 **1–3 credits**
Special Topics
Study of special topics in Physics. Special course topics will be announced in the class schedule.

POLITICAL SCIENCE

The mission of the Political Science department is to provide students with a basic overview of the national and international political arenas so that students can better understand how government should work and how it actually does work in the real world.

POLS 1010 **3 credits**
American Government
A study of the structure and function of the national government of the United States. The course examines the Presidency, Congress, and federal courts as well as the impact of interest groups, political parties, and the media upon government.

POLS 1020 **3 credits**
State and Local Government
This course examines the structure and function of state and local governments with emphasis on state and local problems and conditions in Minnesota.

POLS 1030 **3 credits**
International Relations
This course examines contemporary international relations, foreign policy, and international organizations.

POLS 1099 **1–3 credits**
Special Topics
Study of special topics in Political Science. Special course topics will be announced in the class schedule.

Exhibit 29

Native Skywatchers

College / School Details

General Information (collegeProfile?tab=0&icode=27137)

Costs & Financial Aid (collegeProfile?tab=1&icode=27137)

Student Services (collegeProfile?tab=2&icode=27137)

Courses & Scheduling (collegeProfile?tab=3&icode=27137)

Student Population (collegeProfile?tab=4&icode=27137)

All Contact Information (collegeProfile?tab=5&icode=27137)

View All Details (collegeProfile?tab=6&icode=27137)

Request Information (askProvider?icode=27137&progr=)

Related Information

View All Programs Offered (educationProgram?icode=27137)

View WIOA Programs Offered (educationProgram?icode=27137&wia=Y) WIOA (/iseek/education/wia.html)

View All Courses Offered (educationCoursesList?icode=27137)

View WIOA Courses Offered (educationCoursesList?icode=27137&wia=W) WIOA (/iseek/education/wia.html)

View Non-Credit Courses Offered (educationCoursesList?icode=27137&credit=N)

Fond du Lac Tribal and Community College
2101 14th St.
Cloquet, MN 55720-2984
View map (/iut/map?address=2101 14th St., Cloquet, MN, 55720&p1=46.690234&p2=-92.448993&fullHeader=N&gkey=ABQIAAAAluInbwjqegpUX2OYntHR4RTpFwgumMHvOovl-eds0h055U9YmQ)

Phone: (218) 879-0808 or (800) 657-3712
Fax: (218) 879-0814
http://www.fdltcc.edu (http://www.fdltcc.edu)

SEND ME INFO

Course: Native Skywatchers

A cross-disciplinary study of the practical and spiritual role of the sky in the indigenous cultures of the continental Americas. Astronomical and meteorological-inspired art, architecture, and mythologies will be examined, with special emphasis on the Great Lakes Region.

Division:
None

Course Number:
ANTH 1010

Delivery Method(s):
CLASSROOM

Comments:
None

Estimated Tuition & Fees:
$635.60
This cost is an estimate only. There may be additional fees. Please contact Fond du Lac Tribal and Community College (http://www.fdltcc.edu) for more information.

Schedule Information for Native Skywatchers

Section Number	Delivery	Start Date	End Date	Details
01		08/21/2017	12/15/2017	View details (educationCoursesClass;jsess icode=27137&division=000&c

Start a new search (educationSearch)

Regions

Select a region below to learn about careers in that region.

Information For...

Adult Learners (/pathways)
Career Counselors (/guide/counselors/index.html)
Ex-Offenders (/exoffenders/index.html)
Immigrants and Refugees (/guide/immigrants/index.html)
Parents (/parents/index.html)
People with Disabilities (/guide/disabilities/index.html)
Recently Unemployed (/jobs/losejob.html)
Veterans (/guide/veterans/index.html)

Industries

Energy (/guide/energy/index.html)
Green (/guide/green/index.html)
Health Care (/guide/healthcare/index.html)
IT (/guide/it/index.html)
Manufacturing (/guide/manufacturing/index.html)

MyMnCareers

MyMnCareers (/mymncareers/index.html) is for Adult Basic Education students and others who want to explore careers, set goals, get training, or learn more to advance their careers.

Continuing Education

Continuing Education & Customized Training (https://mnscu.rschooltoday.com/public/home.cfm)

Career and Technical Education

LMIwise (/lmiwise/)
MN Career Pathways (http://www.mncareerpathways.org)
MN Programs of Study (http://www.mnprogramsofstudy.org)

GPS LifePlan

GPS LifePlan (/careers/gpslifeplan.html) helps students set goals and design plans for their future success. (/careers/gpslifeplan.html)

30 7th Street East, Suite 350, St. Paul, MN 55101-7804
Toll-free: 800-456-8519 | International: +1-651-5560596 | MN Relay: 800-627-3529

Minnesota State Colleges and Universities is an Equal Opportunity employer and educator.

(http://www.facebook.com/careerwiseMN) (https://twitter.com/careerwiseMN) (https://mnlearningthatworks.org/) (http://www.youtube.com/user/iseekvideouploads) (http://www.vimeo.com/iseek/videos/)

Native Skywatchers

College / School Details

General Information (collegeProfile?tab=0&icode=27137)

Costs & Financial Aid (collegeProfile?tab=1&icode=27137)

Student Services (collegeProfile?tab=2&icode=27137)

Courses & Scheduling (collegeProfile?tab=3&icode=27137)

Student Population (collegeProfile?tab=4&icode=27137)

All Contact Information (collegeProfile?tab=5&icode=27137)

View All Details (collegeProfile?tab=6&icode=27137)

Related Information

View All Programs Offered (educationProgram?icode=27137)

View WIOA Programs Offered (educationProgram?icode=27137&wia=Y) WIOA (/iseek/education/wia.html)

View All Courses Offered (educationCoursesList?icode=27137)

View WIOA Courses Offered (educationCoursesList?icode=27137&wia=W) WIOA (/iseek/education/wia.html)

View Non-Credit Courses Offered (educationCoursesList?icode=27137&credit=N)

Fond du Lac Tribal and Community College
2101 14th St.
Cloquet, MN 55720-2984
View map (/iut/map?address=2101 14th St., Cloquet, MN, 55720&p1=46.690234&p2=-92.448993&fullHeader=N&gkey=ABQIAAAAluInbwjqegpUX2OYntHR4RTpFwgumMHvOovl-eds0h055U9YmQ)

Phone: (218) 879-0808 or (800) 657-3712
Fax: (218) 879-0814
http://www.fdltcc.edu (http://www.fdltcc.edu)

Class Schedule for Native Skywatchers

Course Number: ANTH 1010	**Section No.** 01
Credits / CEU / Units: 04	**Class Format:** LECTURE
Delivery Method: CLASSROOM	**Days of week class is held:** Tuesday, Thursday.
Start / End Date: 08/21/2017 - 12/15/2017	**Start / End Time:** 09:00 AM - 10:40 AM
Maximum Enrollment: 40	**Comments:** **ID:** 000184/20183

Registration Information

Deadline:
08/25/2017

Back to course detail (/education/education/educationCoursesDetail?division=000&course=ANTH+1010&icode=27137)

Start a new search (educationSearch)

Regions

Select a region below to learn about careers in that region.

Information For...

- Adult Learners (/pathways)
- Career Counselors (/guide/counselors/index.html)
- Ex-Offenders (/exoffenders/index.html)
- Immigrants and Refugees (/guide/immigrants/index.html)
- Parents (/parents/index.html)
- People with Disabilities (/guide/disabilities/index.html)
- Recently Unemployed (/jobs/losejob.html)
- Veterans (/guide/veterans/index.html)

Industries

- Energy (/guide/energy/index.html)
- Green (/guide/green/index.html)
- Health Care (/guide/healthcare/index.html)
- IT (/guide/it/index.html)
- Manufacturing (/guide/manufacturing/index.html)

MyMnCareers

MyMnCareers (/mymncareers/index.html) is for Adult Basic Education students and others who want to explore careers, set goals, get training, or learn more to advance their careers.

Continuing Education

Continuing Education & Customized Training (https://mnscu.rschooltoday.com/public/home.cfm)

Career and Technical Education

- LMIwise (/lmiwise/)
- MN Career Pathways (http://www.mncareerpathways.org)
- MN Programs of Study (http://www.mnprogramsofstudy.org)

GPS LifePlan

GPS LifePlan (/careers/gpslifeplan.html) helps students set goals and design plans for their future success. (/careers/gpslifeplan.html)

MINNESOTA STATE
(http://www.mnscu.edu/)

30 7th Street East, Suite 350, St. Paul, MN 55101-7804
Toll-free: 800-456-8519 | International: +1-651-5560596 | MN Relay: 800-627-3529

Minnesota State Colleges and Universities is an Equal Opportunity employer and educator.

(http://www.facebook.com/careerwiseMN) (https://twitter.com/careerwiseMN) (https://mnlearningthatworks.org/) (http://www.youtube.com/user/iseekvideouploads) (http://www.vimeo.com/iseek/videos/)

Fond du Lac Tribal and Community College

My Plan for Fall 2017

Wish List: 0 **Wait List: 0** **Registered: 0**

< Search Results & Plan

Continue to Review My Plan >

ANTH 1010 - Native Skywatchers
Fall 2017, Section 01

Add	Equivalent	Waitlist	ID #	Subj	#	Sec	Title	Dates	Days	Time	Crds	Status	Instructor	Delivery Method	Loc
			000184	ANTH	1010	01	Native Skywatchers	08/21 - 12/15	T Th	9:00am - 10:40am	4.0	Open	Langhorst, Glenn		

Meeting Details

Dates	Days	Time	Building/Room	Instructor
8/21/2017 - 12/15/2017	T Th	9:00am - 10:40am	Fond du Lac Tribal and Community Collge 257	Langhorst, Glenn

Location Details

Offered through: Fond du Lac Tribal and Community College.
Campus: Fond du Lac Tribal & Community College. **Location:** Fond du Lac Tribal and Community College.

Seat Availability

Status: Open **Size:** 40 **Enrolled:** 5 **Seats Remaining:** 35

Add/Drop/Withdraw

Full refund is not available if course is dropped on or after August 28, 2017.
The last day to add this course is August 25, 2017. The last day to drop this course is August 25, 2017.
The last day to withdraw from this course is November 27, 2017.

Tuition and Fees (Approximate)

Tuition and Fees (approximate):

Tuition -resident:	$635.60
Tuition -nonresident:	$635.60
Approximate Course Fees:	$65.40

Course Level

Undergraduate

General/Liberal Education Category

- Global Perspective
- Global Perspective
- People and the Environment
- People and the Environment

Minnesota Transfer Curriculum Goal

- Goal 08 - Global Perspective
  - Describe and analyze political, economic, and cultural elements which influence relations of states and societies in their historical and contemporary dimensions.
  - Demonstrate knowledge of cultural, social, religious and linguistic differences.
  - Understand the role of a world citizen and the responsibility world citizens share for their common global future.
- Goal 10 - People/Environment
  - Explain the basic structure and function of various natural ecosystems and of human adaptive strategies within those systems.
  - Discern patterns and interrelationships of bio-physical and socio-cultural systems.
  - Evaluate critically environmental and natural resource issues in light of understandings about interrelationships, ecosystems, and institutions.

Description

A cross-disciplinary study of the practical and spiritual role of the sky in the indigenous cultures of the continental Americas. Astronomical and meteorological-inspired art, architecture, and mythologies will be examined, with special emphasis on the Great Lakes Region.

Exhibit 30

Augsburg College

American Indian Studies 495

Native Skywatchers: IEAA
Indigenous Ethno- & ArchaeoAstronomy

1 Semester Credit

Spring Semester 2015

Instructor: Jim Rock
Cell: (952) 994-0671
Email: rock@augsburg.edu

Office Hours: Available by appointment

Dates: Jan. 12, [not 19 MLK], 26; Feb. 2, 9, 16, 23; Mar. 2,9,23,30; Apr. 6,13,20,27 [14 Sessions]
Days/Times: Mondays 6-9:30 pm
Location: Lindell Library 16

Course Description:

As Indigenous people, our ancestors, relatives and Native Skywatchers of Turtle Island lived and still live here between Sky and Earth as we have for tens of millenia...or "always." So how did the Maya measure the synodic lunar period to within 20 seconds per month of NASA's ability over a thousand years earlier? What is the truth and symbolism behind the astronomy of the Maya 2012 December solstice date known as the 13th baktun? How did the designers of the rock spirals atop Fajada Butte in Chaco Canyon intend for their observations to be applied in the community? What constellations match the Chumash arborglyphs on the oak "scorpion tree?" Where is the Dakota Center of the Universe and from which star(s) and cave(s) do we originate?

"Once upon a SpaceTime," as the Universal Story begins..., the very stuff that would become our bodies today came from the stars and existed long before there was even a first day on Earth! Is this idea from modern western scientists or from ancient indigenous scientists? The answer is: "Yes! StarStuff-R-Us...This is nucleosynthesis." We have always been scientists and storytellers who carefully read and told the story as written in Nature.

Indigenous ethnoastronomy and archaeoastronomy (IEAA) looks at the ways in which the motion and cycles of celestial bodies as measured from architectural structures and natural features can provide an essential framework for daily and seasonal activities, social and political relationships, and for ethical, philosophical and spiritual beliefs. The highly interdisciplinary nature of ethnoastronomy combines and applies astronomy, cultural astronomy, cultural anthropology and history, architecture, archaeology and even linguistics, dance, music, art, games, biochemistry, ethnobotany, mathematics and technology to investigate and interpret many kinds of evidence as we appreciate, respect and honor the deep wisdom of our Elders and Relatives as it was preserved and still comes alive within us.

Competence Statement:

Instructor/Students are informed about and know the regional-historical, socio-cultural, philosophical and scientific-technical foundations of American Indian astronomy in several contextual settings well enough to critically understand, in a conscientized manner, how to approach and address contemporary issues such as sacred site and star knowledge preservation and transmission protocols, indigenous language preservation, light pollution, telescope construction ethics, and the implications for establishing and maintaining place-based,

indigenous ed standards in mainstream science at schools, universities, museums and parks.

Goal:

To become more aware/cognizant, motivated/curious and humbly competent as we learn about our indigenous star stories and knowledge as it is and was passed on in indigenous oral, written and symbolic traditions. We will challenge each other to value and research more about our ancestral sky knowledge and practices as well as the wisdom of our relatives throughout South, Central and North Turtle Island/America. We will also examine applied celestial navigational links and possible cultural diffusion to/from the Polynesian-Pacific Triangle by comparison and contrast, analysis, synthesis and evaluation. You will choose a personal & cultural research interest to develop and present individually or in pairs.

Learner Outcomes and Evaluation:

As a result of this course, students will be able to:

- Cite and describe specific locations, cultures and/or architecture being studied in the cross-disciplinary fields of archaeoastronomy and ethnoastronomy such as Chaco Canyon, Cahokia, Kituwah, Teotihuacan, Chichen Itza/Kukulkan, Cuzco/Macchu Pichu, Tiwanaku, Mauna Kea, the Dogon, Giza, Angkor Wat, Stonehenge, etc.
- Explain in what ways our global ancestors used architecture (periodic shadow/light alignments) to measure: the changing day-night cycle(the four special days in the calendar), sunrise-sunset positions, lunar-solar alignments, and/or planetary cycles and alignments... so they could enhance their agriculture and/or control randomness and/or their people among other reasons.
- Explain why the Maya calendar is a combination of cycles that combine to predict patterns within a mathematical framework that emphasizes 13 and 20 rather than the western 12 and 60. Distinguish how Maya and Western astronomies make use of 52. Why was the 13 baktun cycle very useful/significant?...or five of these 13 baktun cycles?
- Describe why the "Venus dance" has been so important to the Maya and other cultures.
- Critically analyze and evaluate the geographic, agricultural, academic, philosophical-spiritual and ceremonial role of astronomy, past and present, and its significance in the lives of diverse students, families and communities in our contemporary society.
- Demonstrate professional and ethical practices while researching cross-cultural astronomy and demonstrate an ability to work with culturally diverse populations.
- Discuss and write about the ways diverse global cultures across space and time have attached prime significance to the astronomical phenomenon known as precession of the equinoxes (the "wobble") and why has tracking this information by Saturn-Jupiter conjunctions been so highly valued and even secretly guarded by those in socially elite power positions? Also, how and why does such specific, interrelated, astrosymbolism occur across the planet...by cultural diffusion or psychology or some other reason(s)?
- Identify and trace related cross-cultural patterns in the astromythology (star stories) and astrosymbolism (with "math in the myth") associated with the awareness of the 26,000 year precession cycle(wobble) and the slowly changing zodiacal pattern.
- Explain the three points of the "technical language of myth" as applied to precession according to von Dechend and De Santillana in their "Hamlet's Mill" hypothesis.
- Summarize and critically evaluate Sullivan's theory of cultural diffusion using desktop planetarium software and the Andean astromythology he interprets according to the

Exhibit 31

Native Skywatchers - Earth Sky Connections

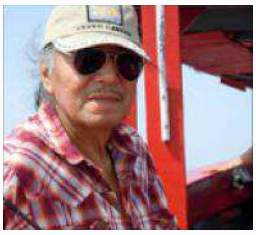
About

Native Skywatchers–Earth Sky Connections **weaves together art, science & culture in a way that will inspire learners to create art in relation to the stars & earth. Participatory art workshops offered in northern & central MN.**

Native Skywatchers **Facilitators**:

- Annette S. Lee
- William Wilson
- Jeff Tibbetts
- Anne Meyer

Annette Lee is mixed-race Dakota-Sioux who is an astrophysicist and artist who leads the *Native Skywatchers* research project, which seeks out and celebrates indigenous peoples' connection to the stars. Recently she painted/co-painted two native star maps: *Ojibwe Giizhig Anung Massingaagan* and *D(L)akota Wichanpi Wowapi Makoce*. Annette previously taught art at Fond du Lac Tribal & Community College, was a teaching artist for a Central MN Arts Board grant and holds a MFA from Yale. Currently Annette is an Associate Professor of Astronomy & Physics at St. Cloud State University in St. Cloud, Minnesota and Director of *Native Skywatchers* and the SCSU Planetarium.



William Wilson is an Ojibwe artist who paints brightly colored, traditionally inspired, Ojibwe style X-raypaintings. His artwork is motivated by his close connection to culture and dreams. William taught for several years at an Ojibwe Culture immersion school in Wisconsin. Currently William is a culture and language consultant for Fond du Lac Tribal & Community College and a teaching artist for a Central MN Arts Board grant.

Search

Upcoming Events

Native Skywatchers Art-Culture-Science 1-day Workshop

August 7 @ 9:00 am - 3:00 pm

View All Events

Contact

Telephone

320-308-2013

Jeff Tibbetts is an Ojibwe artist enrolled with the Fond du Lac Band of Lake Superior Chippewa. Jeff's work isinspired by his close connection to Ojibwe Culture. His sculptures often includes Ojibwe Animal Clans and their connection to the Ojibwe people. Holds a Master's degree in Education- Ojibwe Language and Culture and has been practicing art for the past 20 years. Jeff has been a teaching artist at the Ojibwe Tribal School and at a local Cloquet school.

Anne Meyer is a St. Joseph, MN native who became devoted to clay after apprenticing under Richard Bresnahan at the St John's Pottery. Since then her artwork has included much wood-fired figurative sculpture and intricately carved sgraffito pottery. She has also found numerous ways to explore her love of teaching in the last ten years. She has given many demonstrations and lectures at midwest colleges, taught many community-ed classes to youth and adults, and done residencies in schools for several years. Her tools as a teacher grew significantly by working with the Perpich Center for Arts residencies in schools for several years. Her tools as a teacher grew significantly by working with the Perpich Center for Arts Education in an ASAP project grant from 2010-2012.

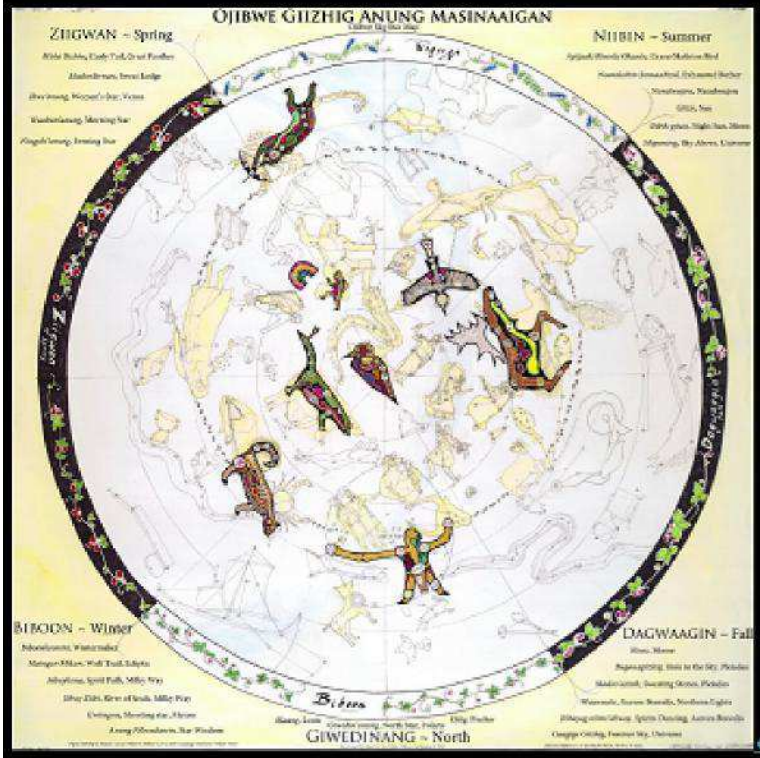
Exhibit 32

Back to SCSU Planetarium webpage Back to Annette Lee's webpage.

Native Skywatchers - Ojibwe Star Map:

OJIBWE GIIZHIG ANUNG MASINAAIGAN - OJIBWE SKY STAR MAP

Created by Annette S. Lee, William P. Wilson, Carl Gawboy, © 2012



Click here to download this map.

Original Painting by Annette S. Lee & William P. Wilson, © 2012

Native Skywatchers **is a non-profit, educational, native-led team of scientists, educators, artists, historians, language and cultural experts. We aim to revitalize, to remember and to create programming and resources related to the Ojibwe and D(L)akota star knowledge, primarily for native communities. We also seek to help all people to build a stronger relationship with the stars - our oldest relatives.**

Ojibwe Star Vocabulary

Audio Recordings: William Wilson

	Ojibwe	Spoken	Related Greek Constellations
ZHIGWAN - SPRING			
Curly Tail, Great Panther	*Mishi bizhiw*		Leo, Hydra
Sweat Lodge	*Madoodiswan*		Corona
BIBOON - WINTER			
Wintermaker	*Biboonkaanini*		Orion, Canis Minor, Taurus
Giwedinang - NORTH			
Loon	*Maang*		Little Dipper
Fischer	*Ojing*		Big Dipper
North Star	*Giwedin'anung*		Polaris
DAGWAAGIN - FALL			
Moose	*Mooz*		Pegasus
Hole in the Sky	*Bugonagiizhig*		Pleiades

Sweating Stones	*Madoo'aiinik*		Pleiades
NIIBIN - SUMMER			
Crane/Skeleton Bird	*Ayiyaak'Binesiki Okaan*		Cygnus
Exhausted Bather	*Noomdashin Bemaadizid*		Hercules
Nanaboujou	*Nanaboujou*		Scorpio
OTHER			
Star	*Anung*		
Star World	*Anung aki*		
Moon	*Dibik-giizis (Night Sun)*		
Sun	*Giizis*		
Sky	*Gizhig*		
Venus	*Ikwe'anung (Women's Star)*		
Venus -Evening Star	*Onaagoshi'anung*		
Venus - Morning Star	*Waabun'anung*		
Ecliptic	*Maingan Mikan (Wolf Trail)*		
Milky Way	*Jiibaykana (Spirit Path)*		
Milky Way	*Jiibay Zibi (River of Souls)*		
Meteor/Falling star	*Bangishin anung*		
Universe	*Gaagige Gizhig (Forever Sky)*		*Ishpeming* (the Sky Above)
Aurora Borealis (Northern Lights)	*Jiibayag niimi'idiwak (the Spirits are dancing)*		*Waawaate*
Star Knowledge (Wisdom)	*Anung Nibwakawin*		
(Sky) Star map	*Gizhig Anung Masinaaigan*		
East	*Waabanong (Waaban)*		
West	*Ningabianong (Ningabi'an)*		
North	*Giiwedinong (Giiwedinang/Giiwendin)*		
South	*Zhaawanong (Zhaawan)*		

Native Skywatchers, Annette S. Lee
314 Wick Science Building
720 Fourth Ave. South
St. Cloud State University
St. Cloud, MN 56301
320-308-2013
aslee@stcloudstate.edu

Other Curriculum Available:

Ojibwe Star Vocabulary Sheet

Ojibwe Star Wheel Holder - 1 of 2

Ojibwe Star Wheel Circle - 2 of 2

Ojibwe Moons

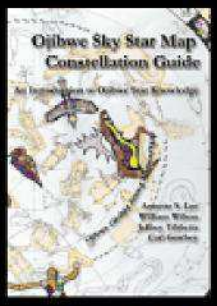
Solns. to the Ojibwe Star Wheel

Constellation Guide Handout

*** Ojibwe Constellation Guidebook (June 2014). ***

To order email Jim Knutson-Kolodzne

jkolodzne@stcloudstate.edu
320-308-544



...coming soon Audio CD with Star Vocabulary & Star songs (Spring 2016).

HOPE TO SEE YOU AT THE NATIVE SKYWATCHERS WORKSHOP JUNE 2016!

Click Here to Order a Star Map Poster....*Ojibwe Giizhis Anung Masinaagan*

Ojibwe Giizhis Anung Masinaagan (Ojibwe Sky Star Map)

Medium Size 21x 21" $30

Large Size 30 x 30" $61

or email Jim Knutson-Kolodzne

jkolodzne@stcloudstate.edu
320-308-544

updated 8-6-15

Native Skywatchers - Earth Sky Connections- Art Workshops & Classes

Educator & Comm. Workshops

Native Skywatchers Two-day Workshops

Mon. & Tues. June 20 & 21, 2016, Fond du Lac Tribal & Community College, Cloquet, MN.

Thurs. & Fri. July 14 & 15, 2016, Minnesota Department of Education, St. Paul, MN

Click here for more info. Cost is $95 for the two days, includes resources, handouts, meals and more....

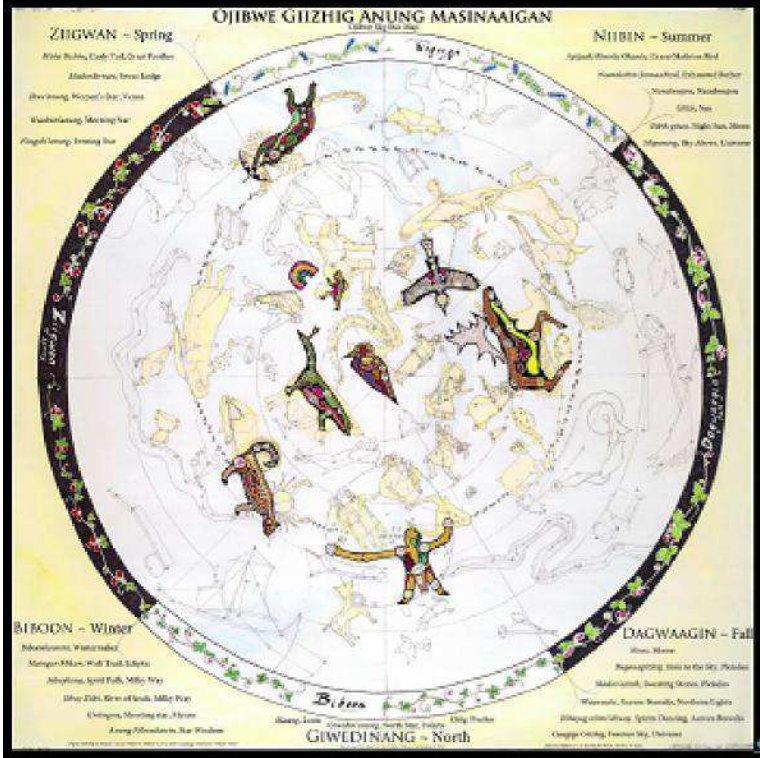
Click here to Register.

Back to SCSU Planetarium webpage Back to Annette Lee's webpage.

Native Skywatchers - Ojibwe Star Map:

OJIBWE GIIZHIG ANUNG MASINAAIGAN - OJIBWE SKY STAR MAP

Created by Annette S. Lee, William P. Wilson, Carl Gawboy, © 2012



Click here to download this map.

Original Painting by Annette S. Lee & William P. Wilson, © 2012

Native Skywatchers **is a non-profit, educational, native-led team of scientists, educators, artists, historians, language and cultural experts. We aim to revitalize, to remember and to create programming and resources related to the Ojibwe and D(L)akota star knowledge, primarily for native communities. We also seek to help all people to build a stronger relationship with the stars - our oldest relatives.**

Ojibwe Star Vocabulary

Audio Recordings: William Wilson

	Ojibwe	Spoken	Related Greek Constellations
ZHIGWAN - SPRING			
Curly Tail, Great Panther	*Mishi bizhiw*		Leo, Hydra
Sweat Lodge	*Madoodiswan*		Corona
BIBOON - WINTER			
Wintermaker	*Biboonkaanini*		Orion, Canis Minor, Taurus
Giwedinang - NORTH			
Loon	*Maang*		Little Dipper
Fischer	*Ojing*		Big Dipper
North Star	*Giwedin'anung*		Polaris
DAGWAAGIN - FALL			
Moose	*Mooz*		Pegasus
Hole in the Sky	*Bugonagiizhig*		Pleiades

Sweating Stones	*Madoo'aiinik*		Pleiades
NIIBIN - SUMMER			
Crane/Skeleton Bird	*Ayiyaak'Binesiki Okaan*		Cygnus
Exhausted Bather	*Noomdashin Bemaadizid*		Hercules
Nanaboujou	*Nanaboujou*		Scorpio
OTHER			
Star	*Anung*		
Star World	*Anung aki*		
Moon	*Dibik-giizis (Night Sun)*		
Sun	*Giizis*		
Sky	*Gizhig*		
Venus	*Ikwe'anung (Women's Star)*		
Venus -Evening Star	*Onaagoshi'anung*		
Venus - Morning Star	*Waabun'anung*		
Ecliptic	*Maingan Mikan (Wolf Trail)*		
Milky Way	*Jiibaykana (Spirit Path)*		
Milky Way	*Jiibay Zibi (River of Souls)*		
Meteor/Falling star	*Bangishin anung*		
Universe	*Gaagige Gizhig (Forever Sky)*		*Ishpeming* (the Sky Above)
Aurora Borealis (Northern Lights)	*Jiibayag niimi'idiwak (the Spirits are dancing)*		*Waawaate*
Star Knowledge (Wisdom)	*Anung Nibwakawin*		
(Sky) Star map	*Gizhig Anung Masinaaigan*		
East	*Waabanong (Waaban)*		
West	*Ningabianong (Ningabi'an)*		
North	*Giiwedinong (Giiwedinang/Giiwendin)*		
South	*Zhaawanong (Zhaawan)*		

Native Skywatchers, Annette S. Lee
314 Wick Science Building
720 Fourth Ave. South
St. Cloud State University
St. Cloud, MN 56301
320-308-2013
aslee@stcloudstate.edu

Other Curriculum Available:

Ojibwe Star Vocabulary Sheet

Ojibwe Star Wheel Holder - 1 of 2

Ojibwe Star Wheel Circle - 2 of 2

Ojibwe Moons

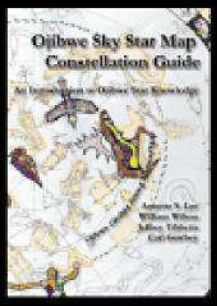
Solns. to the Ojibwe Star Wheel

Constellation Guide Handout

*** Ojibwe Constellation Guidebook (June 2014). ***

To order email Jim Knutson-Kolodzne

jkolodzne@stcloudstate.edu
320-308-544



...coming soon Audio CD with Star Vocabulary & Star songs (Spring 2016).

HOPE TO SEE YOU AT THE NATIVE SKYWATCHERS WORKSHOP JUNE 2016!

Click Here to Order a Star Map Poster....*Ojibwe Giizhis Anung Masinaagan*

Ojibwe Giizhis Anung Masinaagan (Ojibwe Sky Star Map)

Medium Size 21x 21" $30

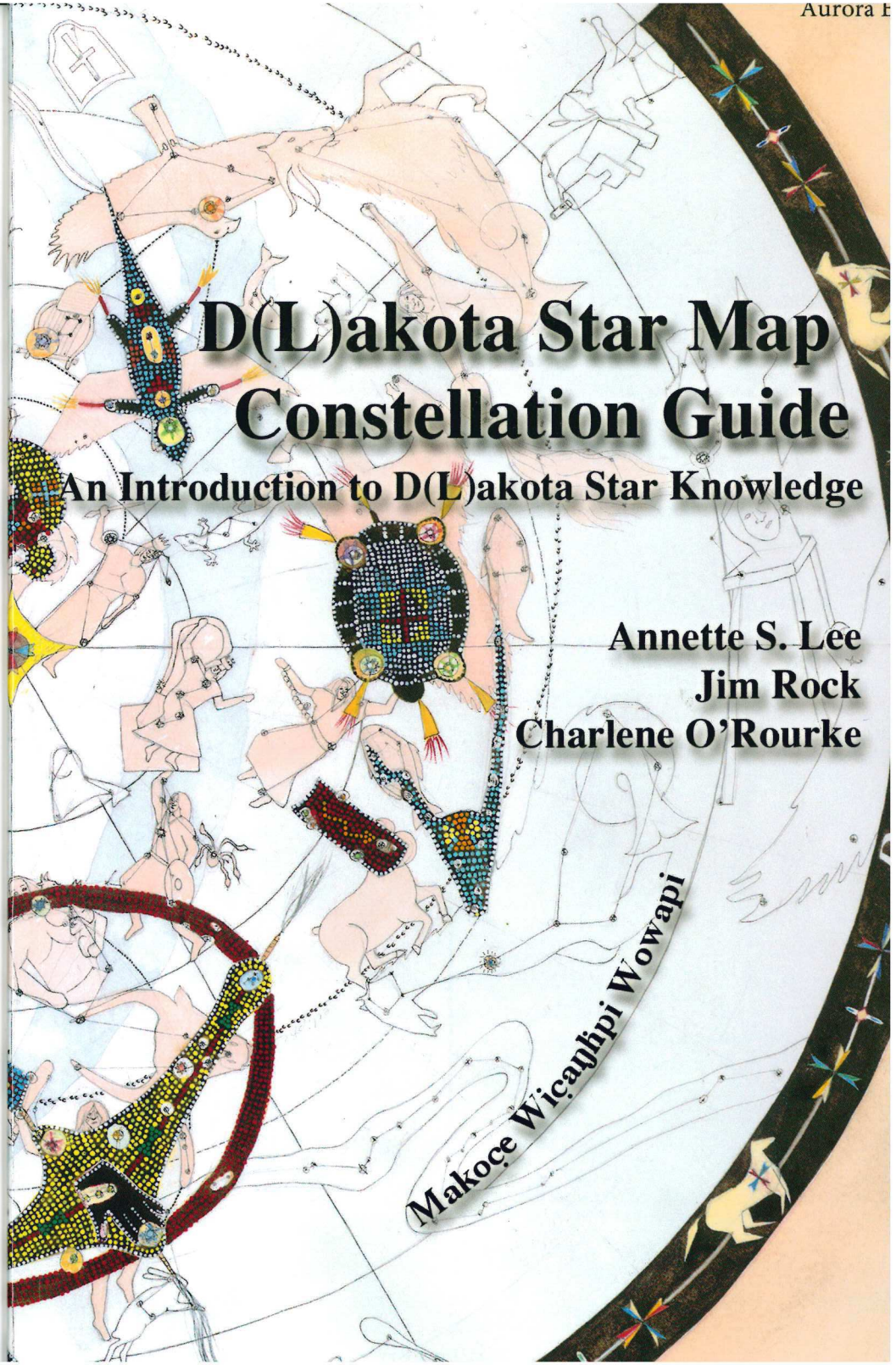
Large Size 30 x 30" $61

or email Jim Knutson-Kolodzne

jkolodzne@stcloudstate.edu
320-308-544

updated 8-6-15

Exhibit 33



D(L)akota Star Map Constellation Guide

An Introduction to D(L)akota Star Knowledge

Annette S. Lee
Jim Rock
Charlene O'Rourke

Makoce Wicaŋhpi Wowapi

Makoce Wiçaŋȟpi Wowapi – D(L)akota Star Map Constellation Guidebook

First published in June 2014
Layout and editing by A. M. Fellegy, Avenue F Productions, Cloquet MN 55720
The LakotaLSU font used to print this work is available from Linguist's Software, Inc., PO Box 580, Edmonds, WA 98020-0580 USA. Telephone (425) 775-1130, www.linguistsoftware.com.
Printed by Lightning Source-Ingram Spark, North Rocks, CA 99999

Cover art: *Makoce Wiçaŋȟpi Wowapi – D(L)akota Star Map* by Annette S. Lee and Jim Rock

ISBN 978-0-692-23254-5

http://web.stcloudstate.edu/planetarium/native_skywatchers.html

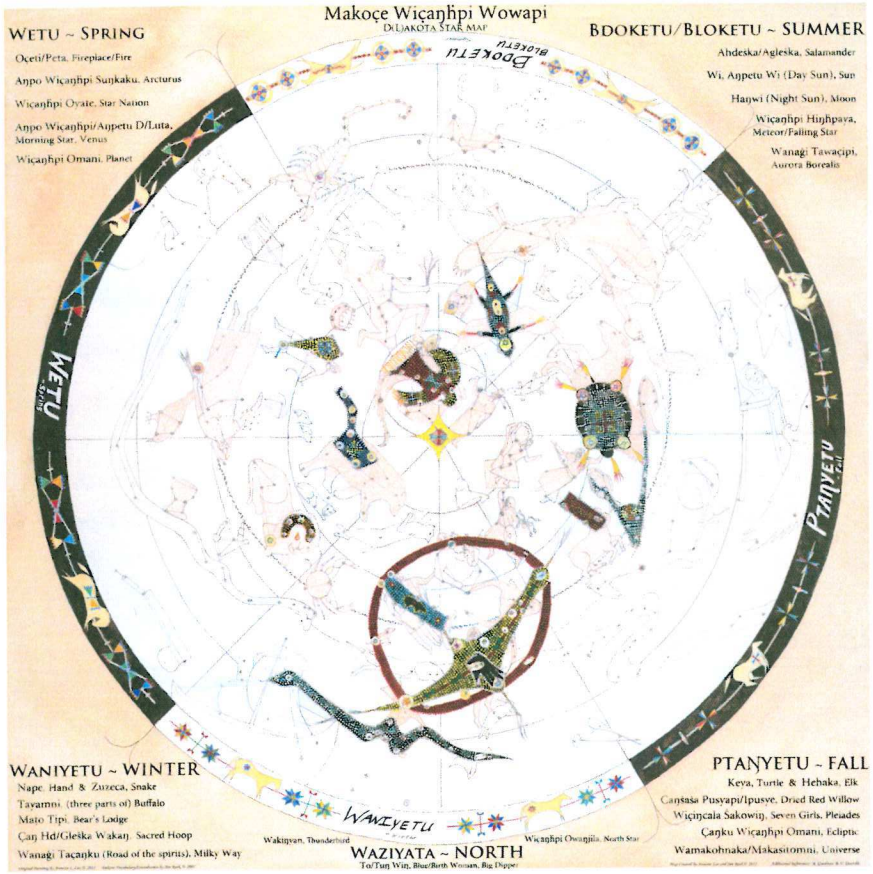


Fig. 1. Makoçe Wiçaŋȟpi Wowapi - D(L)akota Star Map

INTRODUCTION

Native Skywatchers

In the Ojibwe language, the Big Dipper is known as *Ojiig,* the Fisher [1], and in D(L)akota star knowledge, the same group of stars is seen as *To Wiŋ/Tuŋ Wiŋ,* Blue Woman/Birth Woman [2]. In each, there are stories and teachings that help guide, teach, and inspire native peoples. This book is an outgrowth of Native Skywatchers research and programming, which focuses on understanding the Ojibwe and D(L)akota importance of these and other celestial connections. We seek to address the crisis of the loss of the indigenous star knowledge, specifically the Dakota and Ojibwe who are the native peoples of Minnesota. Our purpose is to remember, rebuild, and revitalize the native star knowledge.

There is urgency to this project for two reasons: 1) Native star knowledge is disappearing as elders pass. One Ojibwe elder spoke of his vision of "the star medicine returning through the native youth." He specifically called them "star readers" [3]. In 2011, he passed away suddenly. 2) The Minnesota State Science Standards for K-12 education require an "understanding that men and women throughout the history of all cultures, including Minnesota American Indian tribes and communities, have been involved in engineering design and scientific inquiry. . . .for example, Ojibwe and Dakota knowledge and use of patterns in the stars to predict and plan" [4]; yet, there is a complete lack of materials.

As with many North American tribes, much cultural knowledge, especially cultural astronomy, has been lost. The goal of the Native Skywatchers programming is to build community around native star knowledge. Native Skywatchers research and programming seeks out and brings together elders, culture teachers, language experts, and community members to discuss Ojibwe and D(L)akota star knowledge. Together, we have created two astronomically accurate and culturally important star maps, *Ojibwe Giizhig Anung Masinaa'igan* – Ojibwe Sky Star Map and *Makoçe Wiçaŋȟpi Wowapi* – D(L)akota Star Map, which were first disseminated to regional educators at a Native Skywatchers Middle School Teacher workshop in June 2012. In addition, we have developed hands-on curriculum that combines astronomy, culture, language, and art.