Appendices

Appendix A
Archaeoastronomy Tools

A.1. Introduction

There are a number of useful sources of information as well as devices and software packages that are very useful for work in archaeoastronomy. We merely list a few of them here.

The first five chapters and appendices A–D of the laboratory manual by Schlosser et al. (1991/1994), *Challenges of Astronomy: Hands-On Experiments for the Sky and Laboratory* (New York: Springer), are especially suitable for archaeoastronomy students.

A.2. Spherical Astronomy Aids

(1) Green, R.M. 1985. *Spherical Astronomy* (Cambridge: University Press), includes discussions of relativistic effects.
(2) Smart, W.M., *Spherical Astronomy*, revised by Green, R.M. (1977), and still the best general discussions of spherical astronomy.
(3) Woolard and Clemence (1966) *Spherical Astronomy* (New York: Academic Press), contains useful formulas and discussions beyond those discussed here.
(4) *Astronomical Almanac* (annual) (Washington: Superintendent of Documents); (London: Her Majesty's Stationery Office), contains numerous tables and information.

A.3. Computational and Sky Simulation Software

We include a selected number of software packages with which we are familiar and have used to varying degrees in this work. For up-to-date and more complete lists, we recommend the software review pages linked to the Sky & Telescope website as well as recent reviews in that magazine before any purchase is made.

Sources of useful programs include:

(1) Standish, E.M. JPL Planetary and Lunar Ephemerides on CD-ROM. Available on-line and from Willmann-Bell, Richmond, VA.
(2) Bretagnon, P., and Simon, J.-L. 1986. *Planetary Programs and Tables from –4000 to +2800*. (Richmond: Willmann-Bell).
(3) Duffett-Smith, P. 1985/1990. *Astronomy with your Personal Computer*. (Cambridge: Cambridge Univ. Press); and 1996. *Easy PC Astronomy* (Cambridge: the Press Syndicate of the University of Cambridge).

The first work contains algorithms and FORTRAN subroutines to provide rectangular coordinates of the Sun, Moon, and nine planets. Three sets of ephemerides are provided: *DE 200* (includes nutation but not librations, and covers the interval 1599 Dec. 9 to 2169 Mar. 31); *DE 405* (includes both nutation and librations, for the interval 1599 Dec. 9 to 2201 Feb. 20); and *DE 406*, the "New JPL Long Ephemeris" (includes neither nutation nor librations, but covers the interval –3000 Feb. 23 to +3000 May 6).

The second work contains programs containing algorithms and formulae for computing azimuths, altitudes, and other practical quantities. Corrections for refraction and extinction are included. "Easy PC Astronomy" offers a script language for calculations.

(4) Montenbruck, O. 1989. *Practical Ephemeris Calculations*. (New York: Springer).
(5) Montenbruck, O., and Pfleger, T. 1991. *Astronomy on the Personal Computer*. (New York: Springer).

Some of the self-contained computer software programs available at present include:

(1) *Distant Suns* (PC) (RomTech, Inc., 2945 McMillan Avenue, Sanhui, Obispo, California, 93401-6767 U.S.). This software package produces all sky and horizon

views, but our printed charts sometimes bear a spurious anti-ecliptic that does not appear on screen or even in the preview screen, possibly an unmasked view of the far side of the sphere. The program is best used for contemporary sky simulations; avoid negative Gregorian dates.

(2) Guide 8.0 (PC) (Project Pluto, 168 Ridge Road, Bowdoinham, Maine, 04008).

This software makes excellent deep sky prints for astronomical observations. We have not used it much for archaeoastronomy, but others have. The star positions incorporate corrections for proper motions as well as for precession. We have been successful in receiving timely responses to our emails from "Project Pluto" (Bill Gray), in sharp contrast to the lack of responses from most star chart or planetarium software vendors.

(3) *Redshift: Multimedia Astronomy* (PC) (Maris Multimedia Ltd., 99 Mansell St., London E1 8AX, England).

This package is one of the most versatile we have found. We tested it on the lunar eclipse of Aug. 9, 2403 B.C. (Julian Calendar), calculated by Schoch (1927) for Babylon, and found it to show the total umbral eclipse on this date. There are conjunction and eclipse finders for specified years or ranges of years. Movies of such events can be played, and many modes of viewing the sky are available.

(4) *Starry Night* (PC) (Sienna Software, 411 Richmond St. East, Suite 303, Toronto, Ontario, M5A, 3S5, Canada).

Starry Night is said to produce some of the most visually stunning results. Many prefer this software package, but we have not had opportunity to use it.

(5) *Superstar* (PC).

This software package contains solar system objects, stars from the Smithsonian Astrophysical Observatory, Variable stars from the General Catalogue of Variable Stars, clusters, nebulae, and galaxies, all to relatively faint limits (specifiable). This package is good for calling up star charts, but we did not find it particularly friendly, and obtaining hard copy charts from its screens can be a nightmare.

(6) *TheSky* (PC) (The Sky Astronomy Software for Windows, available through the Astronomical Soc. of the Pacific, San Francisco, CA).

This software package provides nice views of the sky at various time in the past and for everywhere on Earth, and, by a selection of "filters," various planets, Sun, Moon, stars, clusters, galaxies, and nebulae can be included. There is a slight bias toward equatorial charts; fields have to be rotated to present horizon views (although both sets of grids are available). There is no ecliptic system of coordinates either in text information or charting available, other than the ecliptic depiction itself (this shortcoming is shared by many of the packages). All charts can be printed as needed. This program is best run on contemporary sky simulations.

(7) *Visible Universe* (PC) (Parsec Software, 1949 Blair Loop Road, Danville, VA. 24541).

This software package provides views of sky from any geographical location from any date in the distant past to the future. Solar system objects, stars from the Bright Star Catalogue, brighter clusters, nebulae, and galaxies are included. Time lapse images can produce a dynamic recreation of events. For example, the simulation of the blood-red eclipsed Moon rising above the Heelstone at Stonehenge on Dec. 22, 1471 B.C. is breathtaking. We are unsure if the current package is being maintained.

(8) *Voyager* (MacIntosh) [Carina Software, San Leandro, CA]

This package can provide all sky views and display horizon views from any epoch; it contains the brighter stars, the planets, Sun, and Moon. The graphic screens as well as text can be output to printers. Voyager has consistently been hailed as one of the best packages available. As far as we have been able to tell, however, the company does not respond to email. The PC version of this software package is available in Voyager III. This program appears to be reliable for ancient sky simulations, but one should be cautious when using any program for historical work if the corrections for ΔT, due to Earth's variable rotation, treatment of precession, or calendar implementation are not explicitly described.

A.4. Planetary Positions

(1) The Tuckerman Tables.
Tuckerman, Bryant. 1962. *Planetary, Lunar, and Solar Positions 601 B.C. to A.D. 1 at Five-Day and Ten-Day Intervals* (Philadelphia: The American Philosphical Society). The Amer. Phil. Soc. Memoirs, No. 56.
Tuckerman, Bryant. 1964. *Planetary, Lunar, and Solar Positions A.D. 2 to A.D. 1649 at Five-Day and Ten-Day Intervals* (Philadelphia: The American Philosphical Society). The Amer. Phil. Soc. Memoirs, No. 59.

In these two volumes, Tuckerman uses improved theories and ephemerides and attention to roundoff error to present the geocentric ecliptic longitude and latitude positions of the naked-eye planets for an important segment of history; as a check, he compares them to the earlier work of P.V. Neugebauer (1914, 1929) and investigates the differences between them. See the Introduction to the 1962 volume for a discussion of error. He gives estimated uncertainties in celestial longitude (p. 12) of 0.011°, 0.016°, 0.006°, 0.016°, 0.025°, 0.155°, 0.22° for Mercury, Venus, the Sun, Mars, Jupiter, Saturn, and the Moon, respectively; but also see Stephenson and Houlden (1981) for a discussion of the precision and Houlden and Stephenson (1986) for a discussion of the accuracy and for corrections, which can amount to as much as 0.7° (for longitudes of Mars), when Stephenson's positions are compared with those provided by numerical integration techniques. The positions of the Moon, Mercury, and Venus are given at 5-day intervals, and those of the Sun and outer planets at 10-day intervals.

(2) Supplement to the Tuckerman Tables.
Houlden, M.A., and Stephenson, F.R. 1986. A *Supplement to the Tuckerman Tables.* (Philadelphia: The American Philosphical Society). The Amer. Phil. Soc. Memoirs, No. 170.

This is an important update to the Tuckerman tables for the longitude positions of the outer planets for the full interval 601 B.C. to 1649 A.D. Tables are explicitly given for Mars, and graphs of the corrections are given for Jupiter and Saturn. The predicted brightnesses of all naked-eye planets in magnitude measure are also tabulated.

(3) Stahlman, W., and Gingerich, O. 1963. *Solar and Planetary Longitudes for Years –2500 to +2000 by Ten-Day Intervals*. (Madison: Univ. of Wisconsin Press).
(4) United States Naval Observatory almanacs (and corresponding sources in other countries).

The positions of planets can be calculated for modern epochs to good precision by software packages such as the "Floppy Almanac" and the annual Astronomical Almanac, available from the U.S. Government Printing Office, Superintendent of Documents, Mail Stop: SSOP, Washington, D.C. 20402-9328. Certain astronomy supply houses also carry them.

(5) Orbital calculations can be carried out given observations, or given the elements of an orbit, predicted positions can be computed. Several resources are available:
(a) Schlosser et al. (1991/1994) have a section on celestial mechanics in which planetary positions can be calculated; tables are provided as shortcuts. Ch. 14 and App. E are suitable for finding approximate positions of planets.
(b) Danby, J.M.A. 1988. *Fundamentals of Celestial Mechanics*, 2nd ed. (Richmond: Willmann-Bell, Inc.) available with floppy disks containing celestial mechanics programs.
(c) Boulet, D. 1992. *Methods of Orbit Determination for the Micro Computer*. (Richmond: Willmann-Bell, Inc.) with optional program listings in BASIC.

A.5. Miscellaneous Tables

(1) Meeus, J. 1983a. *Astronomical Tables of the Sun, Moon, and Planets* (Richmond: Willmann-Bell, Inc.), is a collection of interesting and sometimes useful tables. It also contains programs for scientific calculators (HP-67, HP-41C, TI-59). Especially relevant to archaeoastronomy are the tables for the Oppositions of Mars, Jupiter, and Saturn from year 0, the conjunctions of Venus from 0 to 2500; the transits of Venus from 1 to 300 and of Mercury from 1 to 600; the dates of the onsets of the seasons from 1 to 3000.
(2) Goldstine, H.H. 1973. *New and Full Moons 1001 B.C. to A.D. 1651*. (Philadelphia: The American Philosophical Society). The Amer. Phil. Soc. Memoirs, No. 94. This work is another of those inspired by Otto Neugebauer to modernize and make more convenient the study of early science. It provides the times of full and new moons as observed at Baghdad, regarded as approximately equivalent to ancient Babylon. The tables employ a terrestrial longitude correction of $+3^{h}00^{m}$ to Greenwich (therefore, for Greenwich time, –3:00 should be applied), and provide the geocentric (not topocentric) lunar longitude at each instant.

Appendix B
Modern Star Charts

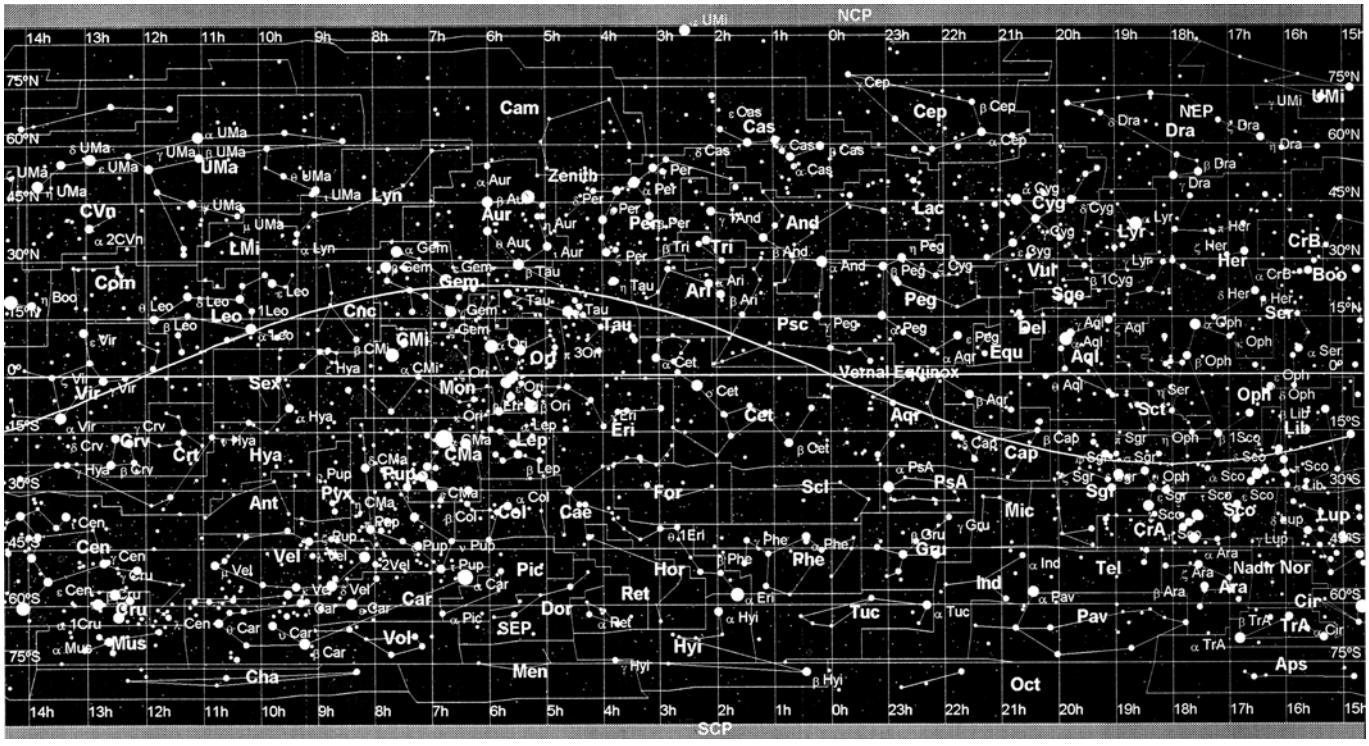
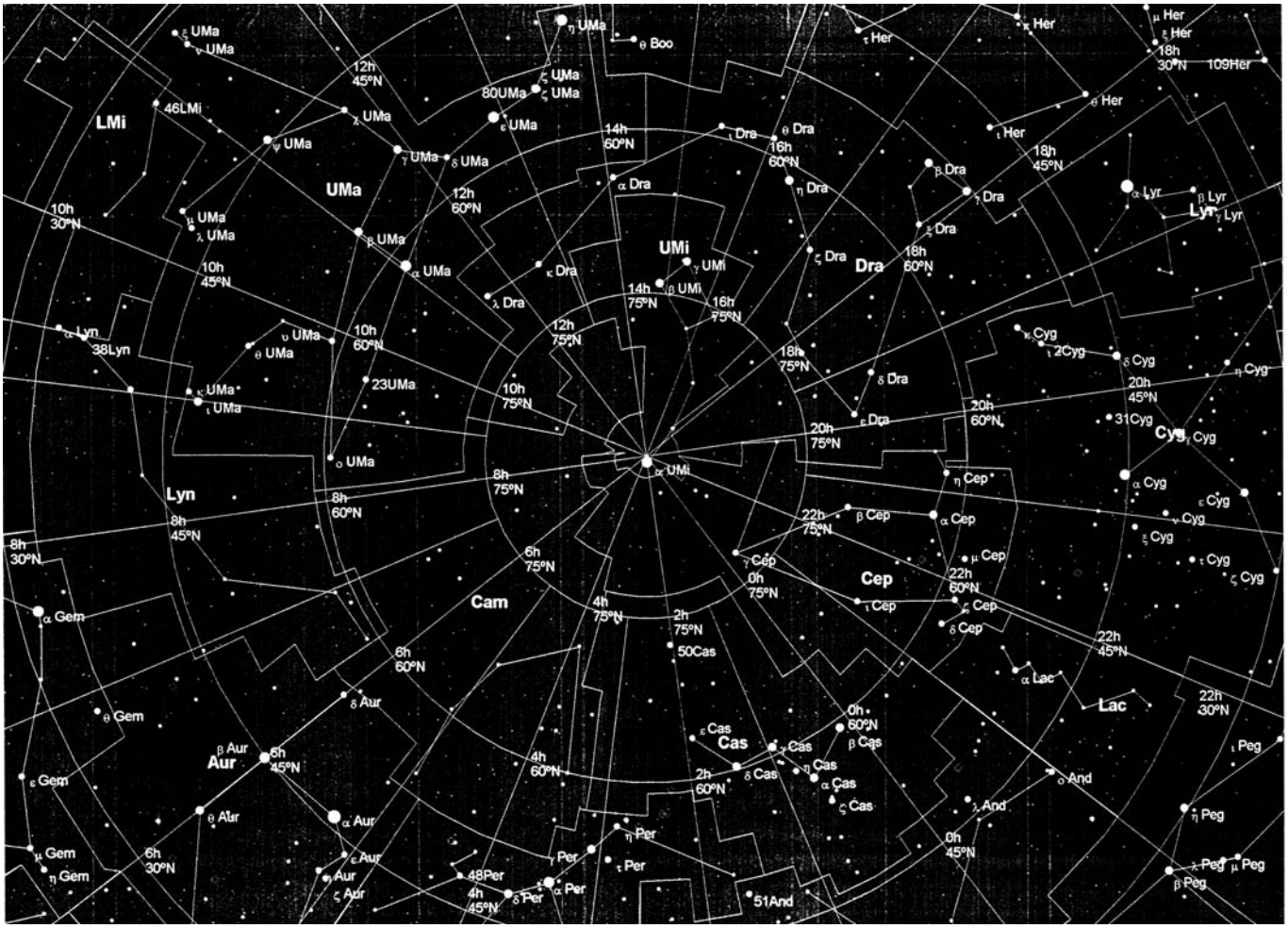
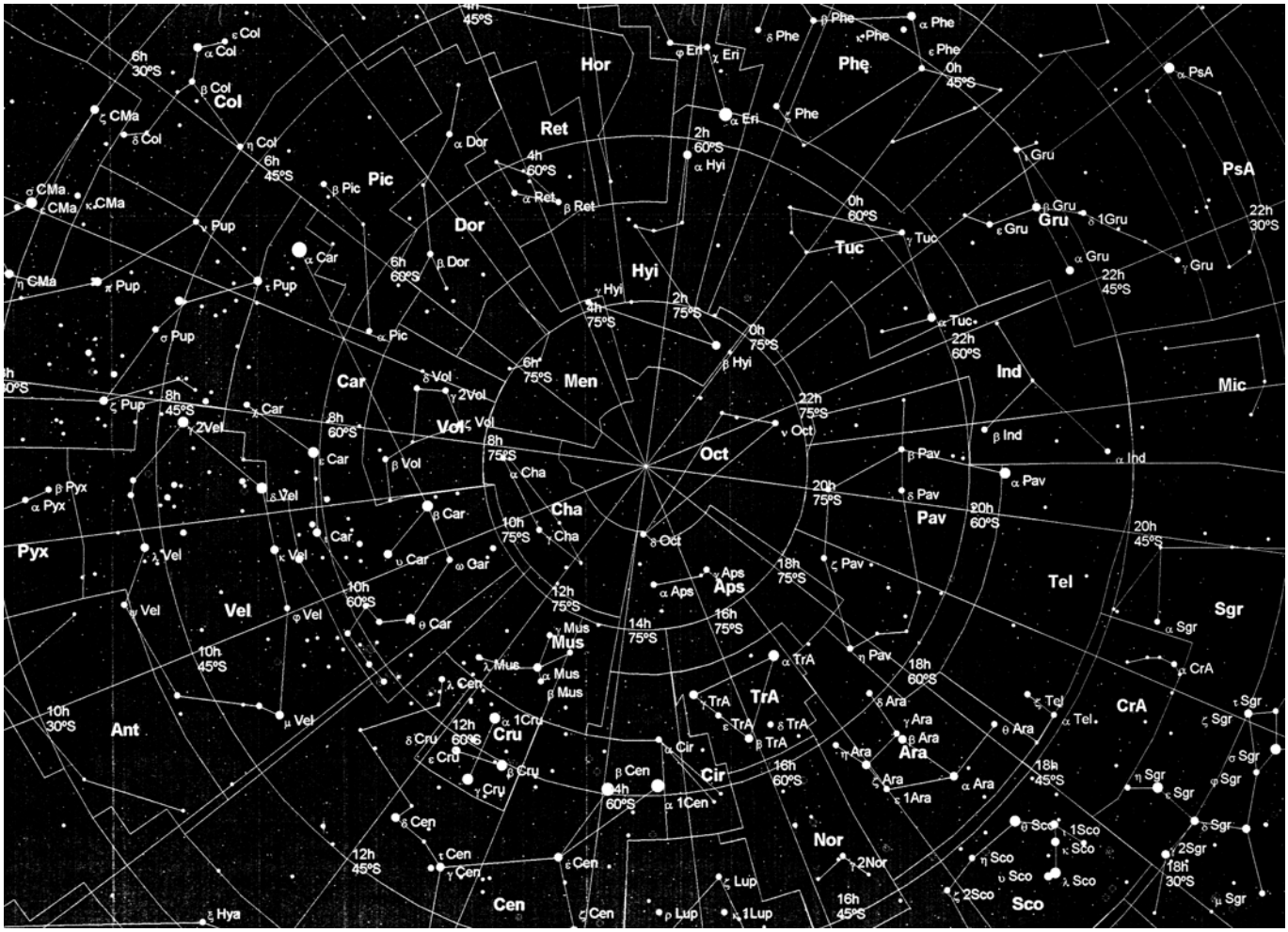


FIGURE B.1. The sky in the equatorial system of coordinates: Note the ecliptic, a sinusoid crossing the celestial equator at 0^h, going north, and at 12^h, going south. The equinox of 2000.0 is shown, along with the (α, δ) grid. The labels are Bayer designations for naked-eye stars and shortened Latin names for the constellations. The north and south ecliptic poles (*NEP*, *SEP*) are also indicated. Produced by E.F. Milone with RedShift software.



(a)

FIGURE B.2. The northern (a) and southern (b) polar regions of the equatorial system, equinox 2000.0: The poles mark 90° north and south declination, respectively. The labels are Bayer designations for naked-eye stars and shortened Latin names for the constellations. Produced by E.F. Milone with RedShift software.



(b)

FIGURE B.2. *Continued.*

Appendix C
Sample Exercises and Problems

§2

(1) Compute the maximum altitude achieved by the Sun during the year at sites with latitude = 90°, 66.7°, and 23½°.
(2) Calculate the maximum azimuth of the setting summer solstice Sun at sites with latitude = 51° and 32°.
(3) Calculate the maximum elongation of (a) Mercury and (b) Venus as seen from the Earth; use mean distances from the Sun for all planets.
(4) Calculate the hour angle and declination for an object at azimuth 120° and altitude 50° at a site with latitude = 45°.
(5) Do the calculation in Question 4 for a site with latitude –45°, and comment on the required convention for treating Southern Hemisphere site calculations.
(6) Compute the right ascension and declination for an object with celestial longitude 75° and celestial latitude 5°.
(7) Calculate the arc distance between two objects on the sky separated by 45° of right ascension and 20° of declination.
(8) At a certain observatory, Orion's Belt is observed to rise parallel to the horizon. From star charts and spherical astronomy, determine the latitude of the site.
(9) Calculate the difference (a) in azimuth and (b) the difference in hour angle for two objects on the ecliptic, one at 0° and the other at +10°.
(10) At a certain site a 1- or 2-day-old crescent Moon is observed to have its horns pointing up, directly away from the horizon. If the date is Sept. 21, what is the latitude of the site?

§3

(1) Calculate the hour angles of the onset of civil and astronomical evening twilight at a) the equator and b) a latitude of 51°N. [See §3.1.2.5 and (2.5).]
(2) Compute the refraction and the observed altitude under standard atmospheric pressure and temperature conditions for objects at the following altitudes [see §3.1.3 and (3.16)]: $h = 30°$, $h = 45°$, $h = 60°$, and $h = 90°$.
(3) Calculate the expected (algebraically) maximum altitude of the Sun at midwinter from Novaya Zemlya [see §3.1.3 and (3.16)].
(4) Calculate the effective magnitude of a cluster of 50,000 stars of average magnitude 16 [see §3.1.2.4.5 and reasoning behind (3.13)].
(5) Calculate the apparent azimuth of sunrise at midsummer at a site with latitude = 51°. Assume $dz = ½°$ [see §3.1.3 and (2.1)].
(6) Taking refraction into account, what is the algebraically smallest latitude at which the phenomenon of the "midnight Sun" can be observed?
(7) From the precessional pole charts (Figures 3.9 and 3.10), which of the first magnitude stars were circumpolar (a) at Giza (Cairo will do!) at 2500 B.C. and (b) at Callanish, 1500 B.C.?

§4

(1) Calculate the angle between the shadows' edges of a vertical gnomon cast by the Sun at 12 and 1 P.M. local solar time for a flat sundial.
(2) Calculate the length of the solar shadow at noon at a site with latitude 45° for such a sundial at (a) summer solstice and at (b) winter solstice.
(3) Calculate the length of daylight for Alexandria in winter and sunlight, correcting for expected mean refraction and the semidiameter of the Sun.
(4) Determine the length of astronomical twilight for Alexandria (as per Question 3).
(5) Compute the altitude of Thuban (alpha Draconis) at 2500 B.C. at Giza (Cairo will do!) at upper culmination.

(6) Derive the mean length of the synodic month from that of the mean sidereal month length and the sidereal year length.
(7) Derive the length of the tropical year from the sidereal year and the precession rate.
(8) Calculate the length of a "seasonal hour" at winter solstice at (a) Rome and at (b) Karnak.
(9) Calculate the length of a "seasonal hour" at summer solstice at (a) Rome and at (b) Karnak.

§5

(1) Determine the maximum altitude of a sundog for a setting/rising Sun.
(2) Compute the maximum altitude of the primary and secondary rainbows of the rising/setting Sun.
(3) Compare the azimuths of the rainbows of Question 2 for a setting summer solstice Sun at latitudes = 20° and 60°.
(4) Calculate the brightness required for the Crab Nebula supernova to be visible in the daytime.
(5) Estimate the energy produced by the impact of a 50-km-diameter comet on the forward (Eastern) limb of the Moon. Assume maximum possible velocity of impact.
(6) Estimate the brightness of the impact described in Question 5 for an observer on Earth. Explicitly list and discuss all assumptions.
(7) Discuss the *arcus visionis* needed to see a first magnitude star when it is (a) 1° and (b) 10° above the astronomical horizon above the Sun.

§§6–15

(1) Demonstrate the correctness of the statement in fn. 4 of §6 concerning the identical equations derived for the Southern Hemipshere.
(2) Calculate the amplitudes of the rising/setting Sun at (a) Stonehenge and at (b) Tenochtitlan for appropriate epochs.
(3) Calculate the extreme amplitudes of the rising/setting Moon at (a) Stonehenge and at (b) Callanish.
(4) Compute (a) the Julian day number and (b) the back-calculated Gregorian date of October 31, 1517.
(5) Determine the date of Easter for the current year (stating the criteria and whose criteria they are).
(6) Discuss the importance and limitations of the probability approach to deciding the "reality" of astronomical alignments.
(7) A commonly discussed problem is how the pyramids could have been aligned as accurately as they apparently are. List and discuss several astronomically based schemes for doing so.
(8) Compute by interpolation (from the data given in Table 2.3) the expected lengths of the seasons for the epoch of the construction of Angkor Wat (§§9.3 and 15.3.2). Can you think of an alternative interpretation for the numbers of *asuras* and *devas*?
(9) Suppose you have an eroded Maya monument of which you can read:

#.17.5.3.# #Ix #Zip

Give the correct reading of the Long Count and the Calendar Round.
(10) Suppose you infer from a myth that Jupiter, Saturn, and Venus were "close together" in the sky in the constellation Gemini. Define "close together," and calculate the approximate dates when this would have been true in the past 3000 years.
(11) Suppose a painting in a cave depicts a deity whom you have identified as Saturn and is illuminated at the winter solstice. What inferences would you consider legitimate as to the astronomical conditions when the painting was created? About how often would those conditions repeat?
(12) On what days of the retrodicted Gregorian year would zenith passage of the Sun occur at latitude 21°15′N?

Appendix D
Mayan Calendar Progression: A Sample

To see progression by days (kins), read across all columns (dates 1–20). To see progression by months (Uinals), read down.

1				2				3				4				5			
1	Imix	19	Uo	2	Ik	end of	Uo	3	Akbal	1	Zip	4	Kan	2	Zip	5	Chicchan	3	Zip
8	Imix	19	Zip	9	Ik	end of	Zip	10	Akbal	1	Zotz	11	Kan	2	Zotz	12	Chicchan	3	Zotz
2	Imix	19	Zotz	3	Ik	end of	Zotz	4	Akbal	1	Tzec	5	Kan	2	Tzec	6	Chicchan	3	Tzec
9	Imix	19	Tzec	10	Ik	end of	Tzec	11	Akbal	1	Xul	12	Kan	2	Xul	13	Chicchan	3	Xul
3	Imix	19	Xul	4	Ik	end of	Xul	5	Akbal	1	Yaxkin	6	Kan	2	Yaxkin	7	Chicchan	3	Yaxkin
10	Imix	19	Yaxkin	11	Ik	end of	Yaxkin	12	Akbal	1	Mol	13	Kan	2	Mol	1	Chicchan	3	Mol
4	Imix	19	Mol	5	Ik	end of	Mol	6	Akbal	1	Chen	7	Kan	2	Chen	8	Chicchan	3	Chen
11	Imix	19	Chen	12	Ik	end of	Chen	13	Akbal	1	Yax	1	Kan	2	Yax	2	Chicchan	3	Yax
5	Imix	19	Yax	6	Ik	end of	Yax	7	Akbal	1	Zac	8	Kan	2	Zac	9	Chicchan	3	Zac
12	Imix	19	Zac	13	Ik	end of	Zac	1	Akbal	1	Ceh	2	Kan	2	Ceh	3	Chicchan	3	Ceh
6	Imix	19	Ceh	7	Ik	end of	Ceh	8	Akbal	1	Mac	9	Kan	2	Mac	10	Chicchan	3	Mac
13	Imix	19	Mac	1	Ik	end of	Mac	2	Akbal	1	Kankin	3	Kan	2	Kankin	4	Chicchan	3	Kankin
7	Imix	19	Kankin	8	Ik	end of	Kankin	9	Akbal	1	Muan	10	Kan	2	Muan	11	Chicchan	3	Muan
1	Imix	19	Muan	2	Ik	end of	Muan	3	Akbal	1	Pax	4	Kan	2	Pax	5	Chicchan	3	Pax
8	Imix	19	Pax	9	Ik	end of	Pax	10	Akbal	1	Kayab	11	Kan	2	Kayab	12	Chicchan	3	Kayab
2	Imix	19	Kayab	3	Ik	end of	Kayab	4	Akbal	1	Cumku	5	Kan	2	Cumku	6	Chicchan	3	Cumku
9	Imix	19	Cumku	10	Ik	end of	Cumku	11	Akbal	1	uayeb	12	Kan	2	uayeb	13	Chicchan	3	uayeb
3	Imix	14	Pop	4	Ik	15	Pop	5	Akbal	16	Pop	6	Kan	17	Pop	7	Chicchan	18	Pop
10	Imix	14	Uo	11	Ik	15	Uo	12	Akbal	16	Uo	13	Kan	17	Uo	1	Chicchan	18	Uo
4	Imix	14	Zip	5	Ik	15	Zip	6	Akbal	16	Zip	7	Kan	17	Zip	8	Chicchan	18	Zip
11	Imix	14	Zotz	12	Ik	15	Zotz	13	Akbal	16	Zotz	1	Kan	17	Zotz	2	Chicchan	18	Zotz
5	Imix	14	Tzec	6	Ik	15	Tzec	7	Akbal	16	Tzec	8	Kan	17	Tzec	9	Chicchan	18	Tzec
12	Imix	14	Xul	13	Ik	15	Xul	1	Akbal	16	Xul	2	Kan	17	Xul	3	Chicchan	18	Xul
6	Imix	14	Yaxkin	7	Ik	15	Yaxkin	8	Akbal	16	Yaxkin	9	Kan	17	Yaxkin	10	Chicchan	18	Yaxkin
13	Imix	14	Mol	1	Ik	15	Mol	2	Akbal	16	Mol	3	Kan	17	Mol	4	Chicchan	18	Mol
7	Imix	14	Chen	8	Ik	15	Chen	9	Akbal	16	Chen	10	Kan	17	Chen	11	Chicchan	18	Chen
1	Imix	14	Yax	2	Ik	15	Yax	3	Akbal	16	Yax	4	Kan	17	Yax	5	Chicchan	18	Yax
8	Imix	14	Zac	9	Ik	15	Zac	10	Akbal	16	Zac	11	Kan	17	Zac	12	Chicchan	18	Zac
2	Imix	14	Ceh	3	Ik	15	Ceh	4	Akbal	16	Ceh	5	Kan	17	Ceh	6	Chicchan	18	Ceh
9	Imix	14	Mac	10	Ik	15	Mac	11	Akbal	16	Mac	12	Kan	17	Mac	13	Chicchan	18	Mac
3	Imix	14	Kankin	4	Ik	15	Kankin	5	Akbal	16	Kankin	6	Kan	17	Kankin	7	Chicchan	18	Kankin
10	Imix	14	Muan	11	Ik	15	Muan	12	Akbal	16	Muan	13	Kan	17	Muan	1	Chicchan	18	Muan
4	Imix	14	Pax	5	Ik	15	Pax	6	Akbal	16	Pax	7	Kan	17	Pax	8	Chicchan	18	Pax
11	Imix	14	Kayab	12	Ik	15	Kayab	13	Akbal	16	Kayab	1	Kan	17	Kayab	2	Chicchan	18	Kayab
5	Imix	14	Cumku	6	Ik	15	Cumku	7	Akbal	16	Cumku	8	Kan	17	Cumku	9	Chicchan	18	Cumku
12	Imix	9	Pop	13	Ik	10	Pop	1	Akbal	11	Pop	2	Kan	12	Pop	3	Chicchan	13	Pop
6	Imix	9	Uo	7	Ik	10	Uo	8	Akbal	11	Uo	9	Kan	12	Uo	10	Chicchan	13	Uo
13	Imix	9	Zip	1	Ik	10	Zip	2	Akbal	11	Zip	3	Kan	12	Zip	4	Chicchan	13	Zip
7	Imix	9	Zotz	8	Ik	10	Zotz	9	Akbal	11	Zotz	10	Kan	12	Zotz	11	Chicchan	13	Zotz
1	Imix	9	Tzec	2	Ik	10	Tzec	3	Akbal	11	Tzec	4	Kan	12	Tzec	5	Chicchan	13	Tzec
8	Imix	9	Xul	9	Ik	10	Xul	10	Akbal	11	Xul	11	Kan	12	Xul	12	Chicchan	13	Xul
2	Imix	9	Yaxkin	3	Ik	10	Yaxkin	4	Akbal	11	Yaxkin	5	Kan	12	Yaxkin	6	Chicchan	13	Yaxkin
9	Imix	9	Mol	10	Ik	10	Mol	11	Akbal	11	Mol	12	Kan	12	Mol	13	Chicchan	13	Mol
3	Imix	9	Chen	4	Ik	10	Chen	5	Akbal	11	Chen	6	Kan	12	Chen	7	Chicchan	13	Chen
10	Imix	9	Yax	11	Ik	10	Yax	12	Akbal	11	Yax	13	Kan	12	Yax	1	Chicchan	13	Yax
4	Imix	9	Zac	5	Ik	10	Zac	6	Akbal	11	Zac	7	Kan	12	Zac	8	Chicchan	13	Zac
11	Imix	9	Ceh	12	Ik	10	Ceh	13	Akbal	11	Ceh	1	Kan	12	Ceh	2	Chicchan	13	Ceh
5	Imix	9	Mac	6	Ik	10	Mac	7	Akbal	11	Mac	8	Kan	12	Mac	9	Chicchan	13	Mac
12	Imix	9	Kankin	13	Ik	10	Kankin	1	Akbal	11	Kankin	2	Kan	12	Kankin	3	Chicchan	13	Kankin
6	Imix	9	Muan	7	Ik	10	Muan	8	Akbal	11	Muan	9	Kan	12	Muan	10	Chicchan	13	Muan
13	Imix	9	Pax	1	Ik	10	Pax	2	Akbal	11	Pax	3	Kan	12	Pax	4	Chicchan	13	Pax
7	Imix	9	Kayab	8	Ik	10	Kayab	9	Akbal	11	Kayab	10	Kan	12	Kayab	11	Chicchan	13	Kayab
1	Imix	9	Cumku	2	Ik	10	Cumku	3	Akbal	11	Cumku	4	Kan	12	Cumku	5	Chicchan	13	Cumku
8	Imix	4	Pop	9	Ik	5	Pop	10	Akbal	6	Pop	11	Kan	7	Pop	12	Chicchan	8	Pop
2	Imix	4	Uo	3	Ik	5	Uo	4	Akbal	6	Uo	5	Kan	7	Uo	6	Chicchan	8	Uo
9	Imix	4	Zip	10	Ik	5	Zip	11	Akbal	6	Zip	12	Kan	7	Zip	13	Chicchan	8	Zip
3	Imix	4	Zotz	4	Ik	5	Zotz	5	Akbal	6	Zotz	6	Kan	7	Zotz	7	Chicchan	8	Zotz
10	Imix	4	Tzec	11	Ik	5	Tzec	12	Akbal	6	Tzec	13	Kan	7	Tzec	1	Chicchan	8	Tzec
4	Imix	4	Xul	5	Ik	5	Xul	6	Akbal	6	Xul	7	Kan	7	Xul	8	Chicchan	8	Xul
11	Imix	4	Yaxkin	12	Ik	5	Yaxkin	13	Akbal	6	Yaxkin	1	Kan	7	Yaxkin	2	Chicchan	8	Yaxkin
5	Imix	4	Mol	6	Ik	5	Mol	7	Akbal	6	Mol	8	Kan	7	Mol	9	Chicchan	8	Mol
12	Imix	4	Chen	13	Ik	5	Chen	1	Akbal	6	Chen	2	Kan	7	Chen	3	Chicchan	8	Chen
6	Imix	4	Yax	7	Ik	5	Yax	8	Akbal	6	Yax	9	Kan	7	Yax	10	Chicchan	8	Yax
13	Imix	4	Zac	1	Ik	5	Zac	2	Akbal	6	Zac	3	Kan	7	Zac	4	Chicchan	8	Zac

6				7				8				9				10			
6	Cimi	4	Zip	7	Manik		5 Zip	8	Lamat	6	Zip	9	Muluc	7	Zip	10	Oc	8	Zip
13	Cimi	4	Zotz	1	Manik		5 Zotz	2	Lamat	6	Zotz	3	Muluc	7	Zotz	4	Oc	8	Zotz
7	Cimi	4	Tzec	8	Manik		5 Tzec	9	Lamat	6	Tzec	10	Muluc	7	Tzec	11	Oc	8	Tzec
1	Cimi	4	Xul	2	Manik		5 Xul	3	Lamat	6	Xul	4	Muluc	7	Xul	5	Oc	8	Xul
8	Cimi	4	Yaxkin	9	Manik		5 Yaxkin	10	Lamat	6	Yaxkin	11	Muluc	7	Yaxkin	12	Oc	8	Yaxkin
2	Cimi	4	Mol	3	Manik		5 Mol	4	Lamat	6	Mol	5	Muluc	7	Mol	6	Oc	8	Mol
9	Cimi	4	Chen	10	Manik		5 Chen	11	Lamat	6	Chen	12	Muluc	7	Chen	13	Oc	8	Chen
3	Cimi	4	Yax	4	Manik		5 Yax	5	Lamat	6	Yax	6	Muluc	7	Yax	7	Oc	8	Yax
10	Cimi	4	Zac	11	Manik		5 Zac	12	Lamat	6	Zac	13	Muluc	7	Zac	1	Oc	8	Zac
4	Cimi	4	Ceh	5	Manik		5 Ceh	6	Lamat	6	Ceh	7	Muluc	7	Ceh	8	Oc	8	Ceh
11	Cimi	4	Mac	12	Manik		5 Mac	13	Lamat	6	Mac	1	Muluc	7	Mac	2	Oc	8	Mac
5	Cimi	4	Kankin	6	Manik		5 Kankin	7	Lamat	6	Kankin	8	Muluc	7	Kankin	9	Oc	8	Kankin
12	Cimi	4	Muan	13	Manik		5 Muan	1	Lamat	6	Muan	2	Muluc	7	Muan	3	Oc	8	Muan
6	Cimi	4	Pax	7	Manik		5 Pax	8	Lamat	6	Pax	9	Muluc	7	Pax	10	Oc	8	Pax
13	Cimi	4	Kayab	1	Manik		5 Kayab	2	Lamat	6	Kayab	3	Muluc	7	Kayab	4	Oc	8	Kayab
7	Cimi	4	Cumku	8	Manik		5 Cumku	9	Lamat	6	Cumku	10	Muluc	7	Cumku	11	Oc	8	Cumku
1	Cimi	4	uayeb	2	Manik		5 uayeb	3	Lamat	1	Pop	4	Muluc	2	Pop	5	Oc	3	Pop
8	Cimi	19	Pop	9	Manik	end of	Pop	10	Lamat	1	Uo	11	Muluc	2	Uo	12	Oc	3	Uo
2	Cimi	19	Uo	3	Manik	end of	Uo	4	Lamat	1	Zip	5	Muluc	2	Zip	6	Oc	3	Zip
9	Cimi	19	Zip	10	Manik	end of	Zip	11	Lamat	1	Zotz	12	Muluc	2	Zotz	13	Oc	3	Zotz
3	Cimi	19	Zotz	4	Manik	end of	Zotz	5	Lamat	1	Tzec	6	Muluc	2	Tzec	7	Oc	3	Tzec
10	Cimi	19	Tzec	11	Manik	end of	Tzec	12	Lamat	1	Xul	13	Muluc	2	Xul	1	Oc	3	Xul
4	Cimi	19	Xul	5	Manik	end of	Xul	6	Lamat	1	Yaxkin	7	Muluc	2	Yaxkin	8	Oc	3	Yaxkin
11	Cimi	19	Yaxkin	12	Manik	end of	Yaxkin	13	Lamat	1	Mol	1	Muluc	2	Mol	2	Oc	3	Mol
5	Cimi	19	Mol	6	Manik	end of	Mol	7	Lamat	1	Chen	8	Muluc	2	Chen	9	Oc	3	Chen
12	Cimi	19	Chen	13	Manik	end of	Chen	1	Lamat	1	Yax	2	Muluc	2	Yax	3	Oc	3	Yax
6	Cimi	19	Yax	7	Manik	end of	Yax	8	Lamat	1	Zac	9	Muluc	2	Zac	10	Oc	3	Zac
13	Cimi	19	Zac	1	Manik	end of	Zac	2	Lamat	1	Ceh	3	Muluc	2	Ceh	4	Oc	3	Ceh
7	Cimi	19	Ceh	8	Manik	end of	Ceh	9	Lamat	1	Mac	10	Muluc	2	Mac	11	Oc	3	Mac
1	Cimi	19	Mac	2	Manik	end of	Mac	3	Lamat	1	Kankin	4	Muluc	2	Kankin	5	Oc	3	Kankin
8	Cimi	19	Kankin	9	Manik	end of	Kankin	10	Lamat	1	Muan	11	Muluc	2	Muan	12	Oc	3	Muan
2	Cimi	19	Muan	3	Manik	end of	Muan	4	Lamat	1	Pax	5	Muluc	2	Pax	6	Oc	3	Pax
9	Cimi	19	Pax	10	Manik	end of	Pax	11	Lamat	1	Kayab	12	Muluc	2	Kayab	13	Oc	3	Kayab
3	Cimi	19	Kayab	4	Manik	end of	Kayab	5	Lamat	1	Cumku	6	Muluc	2	Cumku	7	Oc	3	Cumku
10	Cimi	19	Cumku	11	Manik	end of	Cumku	12	Lamat	1	uayeb	13	Muluc	2	uayeb	1	Oc	3	uayeb
12	Cimi	14	Pop	5	Manik		15 Pop	6	Lamat	16	Pop	7	Muluc	17	Pop	8	Oc	18	Pop
4	Cimi	14	Uo	12	Manik		15 Uo	13	Lamat	16	Uo	1	Muluc	17	Uo	2	Oc	18	Uo
11	Cimi	14	Zip	6	Manik		15 Zip	7	Lamat	16	Zip	8	Muluc	17	Zip	9	Oc	18	Zip
5	Cimi	14	Zotz	13	Manik		15 Zotz	1	Lamat	16	Zotz	2	Muluc	17	Zotz	3	Oc	18	Zotz
6	Cimi	14	Tzec	7	Manik		15 Tzec	8	Lamat	16	Tzec	9	Muluc	17	Tzec	10	Oc	18	Tzec
13	Cimi	14	Xul	1	Manik		15 Xul	2	Lamat	16	Xul	3	Muluc	17	Xul	4	Oc	18	Xul
7	Cimi	14	Yaxkin	8	Manik		15 Yaxkin	9	Lamat	16	Yaxkin	10	Muluc	17	Yaxkin	11	Oc	18	Yaxkin
1	Cimi	14	Mol	2	Manik		15 Mol	3	Lamat	16	Mol	4	Muluc	17	Mol	5	Oc	18	Mol
8	Cimi	14	Chen	9	Manik		15 Chen	10	Lamat	16	Chen	11	Muluc	17	Chen	12	Oc	18	Chen
2	Cimi	14	Yax	3	Manik		15 Yax	4	Lamat	16	Yax	5	Muluc	17	Yax	6	Oc	18	Yax
9	Cimi	14	Zac	10	Manik		15 Zac	11	Lamat	16	Zac	12	Muluc	17	Zac	13	Oc	18	Zac
3	Cimi	14	Ceh	4	Manik		15 Ceh	5	Lamat	16	Ceh	6	Muluc	17	Ceh	7	Oc	18	Ceh
10	Cimi	14	Mac	11	Manik		15 Mac	12	Lamat	16	Mac	13	Muluc	17	Mac	1	Oc	18	Mac
4	Cimi	14	Kankin	5	Manik		15 Kankin	6	Lamat	16	Kankin	7	Muluc	17	Kankin	8	Oc	18	Kankin
11	Cimi	14	Muan	12	Manik		15 Muan	13	Lamat	16	Muan	1	Muluc	17	Muan	2	Oc	18	Muan
5	Cimi	14	Pax	6	Manik		15 Pax	7	Lamat	16	Pax	8	Muluc	17	Pax	9	Oc	18	Pax
12	Cimi	14	Kayab	13	Manik		15 Kayab	1	Lamat	16	Kayab	2	Muluc	17	Kayab	3	Oc	18	Kayab
6	Cimi	14	Cumku	7	Manik		15 Cumku	8	Lamat	16	Cumku	9	Muluc	17	Cumku	10	Oc	18	Cumku
13	Cimi	9	Pop	1	Manik		10 Pop	2	Lamat	11	Pop	3	Muluc	12	Pop	4	Oc	13	Pop
7	Cimi	9	Uo	8	Manik		10 Uo	9	Lamat	11	Uo	10	Muluc	12	Uo	11	Oc	13	Uo
1	Cimi	9	Zip	2	Manik		10 Zip	3	Lamat	11	Zip	4	Muluc	12	Zip	5	Oc	13	Zip
8	Cimi	9	Zotz	9	Manik		10 Zotz	10	Lamat	11	Zotz	11	Muluc	12	Zotz	12	Oc	13	Zotz
2	Cimi	9	Tzec	3	Manik		10 Tzec	4	Lamat	11	Tzec	5	Muluc	12	Tzec	6	Oc	13	Tzec
9	Cimi	9	Xul	10	Manik		10 Xul	11	Lamat	11	Xul	12	Muluc	12	Xul	13	Oc	13	Xul
3	Cimi	9	Yaxkin	4	Manik		10 Yaxkin	5	Lamat	11	Yaxkin	6	Muluc	12	Yaxkin	7	Oc	13	Yaxkin
10	Cimi	9	Mol	11	Manik		10 Mol	12	Lamat	11	Mol	13	Muluc	12	Mol	1	Oc	13	Mol
4	Cimi	9	Chen	5	Manik		10 Chen	6	Lamat	11	Chen	7	Muluc	12	Chen	8	Oc	13	Chen
11	Cimi	9	Yax	12	Manik		10 Yax	13	Lamat	11	Yax	1	Muluc	12	Yax	2	Oc	13	Yax
5	Cimi	9	Zac	6	Manik		10 Zac	7	Lamat	11	Zac	8	Muluc	12	Zac	9	Oc	13	Zac

11				12				13				14				15			
11	Chuen	9	Zip	12	Eb		10	Zip	13	Ben	11	Zip	1	Ix	12	Zip	2	Men	13	Zip
5	Chuen	9	Zotz	6	Eb		10	Zotz	7	Ben	11	Zotz	8	Ix	12	Zotz	9	Men	13	Zotz
12	Chuen	9	Tzec	13	Eb		10	Tzec	1	Ben	11	Tzec	2	Ix	12	Tzec	3	Men	13	Tzec
6	Chuen	9	Xul	7	Eb		10	Xul	8	Ben	11	Xul	9	Ix	12	Xul	10	Men	13	Xul
13	Chuen	9	Yaxkin	1	Eb		10	Yaxkin	2	Ben	11	Yaxkin	3	Ix	12	Yaxkin	4	Men	13	Yaxkin
7	Chuen	9	Mol	8	Eb		10	Mol	9	Ben	11	Mol	10	Ix	12	Mol	11	Men	13	Mol
1	Chuen	9	Chen	2	Eb		10	Chen	3	Ben	11	Chen	4	Ix	12	Chen	5	Men	13	Chen
8	Chuen	9	Yax	9	Eb		10	Yax	10	Ben	11	Yax	11	Ix	12	Yax	12	Men	13	Yax
2	Chuen	9	Zac	3	Eb		10	Zac	4	Ben	11	Zac	5	Ix	12	Zac	6	Men	13	Zac
9	Chuen	9	Ceh	10	Eb		10	Ceh	11	Ben	11	Ceh	12	Ix	12	Ceh	13	Men	13	Ceh
3	Chuen	9	Mac	4	Eb		10	Mac	5	Ben	11	Mac	6	Ix	12	Mac	7	Men	13	Mac
10	Chuen	9	Kankin	11	Eb		10	Kankin	12	Ben	11	Kankin	13	Ix	12	Kankin	1	Men	13	Kankin
4	Chuen	9	Muan	5	Eb		10	Muan	6	Ben	11	Muan	7	Ix	12	Muan	8	Men	13	Muan
11	Chuen	9	Pax	12	Eb		10	Pax	13	Ben	11	Pax	1	Ix	12	Pax	2	Men	13	Pax
5	Chuen	9	Kayab	6	Eb		10	Kayab	7	Ben	11	Kayab	8	Ix	12	Kayab	9	Men	13	Kayab
12	Chuen	9	Cumku	13	Eb		10	Cumku	1	Ben	11	Cumku	2	Ix	12	Cumku	3	Men	13	Cumku
6	Chuen	4	Pop	7	Eb		5	Pop	8	Ben	6	Pop	9	Ix	7	Pop	10	Men	8	Pop
13	Chuen	4	Uo	1	Eb		5	Uo	2	Ben	6	Uo	3	Ix	7	Uo	4	Men	8	Uo
7	Chuen	4	Zip	8	Eb		5	Zip	9	Ben	6	Zip	10	Ix	7	Zip	11	Men	8	Zip
1	Chuen	4	Zotz	2	Eb		5	Zotz	3	Ben	6	Zotz	4	Ix	7	Zotz	5	Men	8	Zotz
8	Chuen	4	Tzec	9	Eb		5	Tzec	10	Ben	6	Tzec	11	Ix	7	Tzec	12	Men	8	Tzec
2	Chuen	4	Xul	3	Eb		5	Xul	4	Ben	6	Xul	5	Ix	7	Xul	6	Men	8	Xul
9	Chuen	4	Yaxkin	10	Eb		5	Yaxkin	11	Ben	6	Yaxkin	12	Ix	7	Yaxkin	13	Men	8	Yaxkin
3	Chuen	4	Mol	4	Eb		5	Mol	5	Ben	6	Mol	6	Ix	7	Mol	7	Men	8	Mol
10	Chuen	4	Chen	11	Eb		5	Chen	12	Ben	6	Chen	13	Ix	7	Chen	1	Men	8	Chen
4	Chuen	4	Yax	5	Eb		5	Yax	6	Ben	6	Yax	7	Ix	7	Yax	8	Men	8	Yax
11	Chuen	4	Zac	12	Eb		5	Zac	13	Ben	6	Zac	1	Ix	7	Zac	2	Men	8	Zac
5	Chuen	4	Ceh	6	Eb		5	Ceh	7	Ben	6	Ceh	8	Ix	7	Ceh	9	Men	8	Ceh
12	Chuen	4	Mac	13	Eb		5	Mac	1	Ben	6	Mac	2	Ix	7	Mac	3	Men	8	Mac
6	Chuen	4	Kankin	7	Eb		5	Kankin	8	Ben	6	Kankin	9	Ix	7	Kankin	10	Men	8	Kankin
13	Chuen	4	Muan	1	Eb		5	Muan	2	Ben	6	Muan	3	Ix	7	Muan	4	Men	8	Muan
7	Chuen	4	Pax	8	Eb		5	Pax	9	Ben	6	Pax	10	Ix	7	Pax	11	Men	8	Pax
1	Chuen	4	Kayab	2	Eb		5	Kayab	3	Ben	6	Kayab	4	Ix	7	Kayab	5	Men	8	Kayab
8	Chuen	4	Cumku	9	Eb		5	Cumku	10	Ben	6	Cumku	11	Ix	7	Cumku	12	Men	8	Cumku
2	Chuen	4	uayeb	3	Eb		5	uayeb	4	Ben	1	Pop	5	Ix	2	Pop	6	Men	3	Pop
9	Chuen	19	Pop	10	Eb	end of		Pop	11	Ben	1	Uo	12	Ix	2	Uo	13	Men	3	Uo
3	Chuen	19	Uo	4	Eb	end of		Uo	5	Ben	1	Zip	6	Ix	2	Zip	7	Men	3	Zip
10	Chuen	19	Zip	11	Eb	end of		Zip	12	Ben	1	Zotz	13	Ix	2	Zotz	1	Men	3	Zotz
4	Chuen	19	Zotz	5	Eb	end of		Zotz	6	Ben	1	Tzec	7	Ix	2	Tzec	8	Men	3	Tzec
11	Chuen	19	Tzec	12	Eb	end of		Tzec	13	Ben	1	Xul	1	Ix	2	Xul	2	Men	3	Xul
5	Chuen	19	Xul	6	Eb	end of		Xul	7	Ben	1	Yaxkin	8	Ix	2	Yaxkin	9	Men	3	Yaxkin
12	Chuen	19	Yaxkin	13	Eb	end of		Yaxkin	1	Ben	1	Mol	2	Ix	2	Mol	3	Men	3	Mol
6	Chuen	19	Mol	7	Eb	end of		Mol	8	Ben	1	Chen	9	Ix	2	Chen	10	Men	3	Chen
13	Chuen	19	Chen	1	Eb	end of		Chen	2	Ben	1	Yax	3	Ix	2	Yax	4	Men	3	Yax
7	Chuen	19	Yax	8	Eb	end of		Yax	9	Ben	1	Zac	10	Ix	2	Zac	11	Men	3	Zac
1	Chuen	19	Zac	2	Eb	end of		Zac	3	Ben	1	Ceh	4	Ix	2	Ceh	5	Men	3	Ceh
8	Chuen	19	Ceh	9	Eb	end of		Ceh	10	Ben	1	Mac	11	Ix	2	Mac	12	Men	3	Mac
2	Chuen	19	Mac	3	Eb	end of		Mac	4	Ben	1	Kankin	5	Ix	2	Kankin	6	Men	3	Kankin
9	Chuen	19	Kankin	10	Eb	end of		Kankin	11	Ben	1	Muan	12	Ix	2	Muan	13	Men	3	Muan
3	Chuen	19	Muan	4	Eb	end of		Muan	5	Ben	1	Pax	6	Ix	2	Pax	7	Men	3	Pax
10	Chuen	19	Pax	11	Eb	end of		Pax	12	Ben	1	Kayab	13	Ix	2	Kayab	1	Men	3	Kayab
4	Chuen	19	Kayab	5	Eb	end of		Kayab	6	Ben	1	Cumku	7	Ix	2	Cumku	8	Men	3	Cumku
11	Chuen	19	Cumku	12	Eb	end of		Cumku	13	Ben	1	uayeb	1	Ix	2	uayeb	2	Men	3	uayeb
5	Chuen	14	Pop	6	Eb		15	Pop	7	Ben	16	Pop	8	Ix	17	Pop	9	Men	18	Pop
12	Chuen	14	Uo	13	Eb		15	Uo	1	Ben	16	Uo	2	Ix	17	Uo	3	Men	18	Uo
6	Chuen	14	Zip	7	Eb		15	Zip	8	Ben	16	Zip	9	Ix	17	Zip	10	Men	18	Zip
13	Chuen	14	Zotz	1	Eb		15	Zotz	2	Ben	16	Zotz	3	Ix	17	Zotz	4	Men	18	Zotz
7	Chuen	14	Tzec	8	Eb		15	Tzec	9	Ben	16	Tzec	10	Ix	17	Tzec	11	Men	18	Tzec
1	Chuen	14	Xul	2	Eb		15	Xul	3	Ben	16	Xul	4	Ix	17	Xul	5	Men	18	Xul
8	Chuen	14	Yaxkin	9	Eb		15	Yaxkin	10	Ben	16	Yaxkin	11	Ix	17	Yaxkin	12	Men	18	Yaxkin
2	Chuen	14	Mol	3	Eb		15	Mol	4	Ben	16	Mol	5	Ix	17	Mol	6	Men	18	Mol
9	Chuen	14	Chen	10	Eb		15	Chen	11	Ben	16	Chen	12	Ix	17	Chen	13	Men	18	Chen
3	Chuen	14	Yax	4	Eb		15	Yax	5	Ben	16	Yax	6	Ix	17	Yax	7	Men	18	Yax
10	Chuen	14	Zac	11	Eb		15	Zac	12	Ben	16	Zac	13	Ix	17	Zac	1	Men	18	Zac

16				17				18				19				20			
3	Cib	14	Zip	4	Caban	15	Zip	5	Etz'nab	16	Zip	6	Cauac	17	Zip	7	Ahau	18	Zip
10	Cib	14	Zotz	11	Caban	15	Zotz	12	Etz'nab	16	Zotz	13	Cauac	17	Zotz	1	Ahau	18	Zotz
4	Cib	14	Tzec	5	Caban	15	Tzec	6	Etz'nab	16	Tzec	7	Cauac	17	Tzec	8	Ahau	18	Tzec
11	Cib	14	Xul	12	Caban	15	Xul	13	Etz'nab	16	Xul	1	Cauac	17	Xul	2	Ahau	18	Xul
5	Cib	14	Yaxkin	6	Caban	15	Yaxkin	7	Etz'nab	16	Yaxkin	8	Cauac	17	Yaxkin	9	Ahau	18	Yaxkin
12	Cib	14	Mol	13	Caban	15	Mol	1	Etz'nab	16	Mol	2	Cauac	17	Mol	3	Ahau	18	Mol
6	Cib	14	Chen	7	Caban	15	Chen	8	Etz'nab	16	Chen	9	Cauac	17	Chen	10	Ahau	18	Chen
13	Cib	14	Yax	1	Caban	15	Yax	2	Etz'nab	16	Yax	3	Cauac	17	Yax	4	Ahau	18	Yax
7	Cib	14	Zac	8	Caban	15	Zac	9	Etz'nab	16	Zac	10	Cauac	17	Zac	11	Ahau	18	Zac
1	Cib	14	Ceh	2	Caban	15	Ceh	3	Etz'nab	16	Ceh	4	Cauac	17	Ceh	5	Ahau	18	Ceh
8	Cib	14	Mac	9	Caban	15	Mac	10	Etz'nab	16	Mac	11	Cauac	17	Mac	12	Ahau	18	Mac
2	Cib	14	Kankin	3	Caban	15	Kankin	4	Etz'nab	16	Kankin	5	Cauac	17	Kankin	6	Ahau	18	Kankin
9	Cib	14	Muan	10	Caban	15	Muan	11	Etz'nab	16	Muan	12	Cauac	17	Muan	13	Ahau	18	Muan
3	Cib	14	Pax	4	Caban	15	Pax	5	Etz'nab	16	Pax	6	Cauac	17	Pax	7	Ahau	18	Pax
10	Cib	14	Kayab	11	Caban	15	Kayab	12	Etz'nab	16	Kayab	13	Cauac	17	Kayab	1	Ahau	18	Kayab
4	Cib	14	Cumku	5	Caban	15	Cumku	6	Etz'nab	16	Cumku	7	Cauac	17	Cumku	8	Ahau	18	Cumku
11	Cib	9	Pop	12	Caban	10	Pop	13	Etz'nab	11	Pop	1	Cauac	12	Pop	2	Ahau	13	Pop
5	Cib	9	Uo	6	Caban	10	Uo	7	Etz'nab	11	Uo	8	Cauac	12	Uo	9	Ahau	13	Uo
12	Cib	9	Zip	13	Caban	10	Zip	1	Etz'nab	11	Zip	2	Cauac	12	Zip	3	Ahau	13	Zip
6	Cib	9	Zotz	7	Caban	10	Zotz	8	Etz'nab	11	Zotz	9	Cauac	12	Zotz	10	Ahau	13	Zotz
13	Cib	9	Tzec	1	Caban	10	Tzec	2	Etz'nab	11	Tzec	3	Cauac	12	Tzec	4	Ahau	13	Tzec
7	Cib	9	Xul	8	Caban	10	Xul	9	Etz'nab	11	Xul	10	Cauac	12	Xul	11	Ahau	13	Xul
1	Cib	9	Yaxkin	2	Caban	10	Yaxkin	3	Etz'nab	11	Yaxkin	4	Cauac	12	Yaxkin	5	Ahau	13	Yaxkin
8	Cib	9	Mol	9	Caban	10	Mol	10	Etz'nab	11	Mol	11	Cauac	12	Mol	12	Ahau	13	Mol
2	Cib	9	Chen	3	Caban	10	Chen	4	Etz'nab	11	Chen	5	Cauac	12	Chen	6	Ahau	13	Chen
9	Cib	9	Yax	10	Caban	10	Yax	11	Etz'nab	11	Yax	12	Cauac	12	Yax	13	Ahau	13	Yax
3	Cib	9	Zac	4	Caban	10	Zac	5	Etz'nab	11	Zac	6	Cauac	12	Zac	7	Ahau	13	Zac
10	Cib	9	Ceh	11	Caban	10	Ceh	12	Etz'nab	11	Ceh	13	Cauac	12	Ceh	1	Ahau	13	Ceh
4	Cib	9	Mac	5	Caban	10	Mac	6	Etz'nab	11	Mac	7	Cauac	12	Mac	8	Ahau	13	Mac
11	Cib	9	Kankin	12	Caban	10	Kankin	13	Etz'nab	11	Kankin	1	Cauac	12	Kankin	2	Ahau	13	Kankin
5	Cib	9	Muan	6	Caban	10	Muan	7	Etz'nab	11	Muan	8	Cauac	12	Muan	9	Ahau	13	Muan
12	Cib	9	Pax	13	Caban	10	Pax	1	Etz'nab	11	Pax	2	Cauac	12	Pax	3	Ahau	13	Pax
6	Cib	9	Kayab	7	Caban	10	Kayab	8	Etz'nab	11	Kayab	9	Cauac	12	Kayab	10	Ahau	13	Kayab
13	Cib	9	Cumku	1	Caban	10	Cumku	2	Etz'nab	11	Cumku	3	Cauac	12	Cumku	4	Ahau	13	Cumku
7	Cib	4	Pop	8	Caban	5	Pop	9	Etz'nab	6	Pop	10	Cauac	7	Pop	11	Ahau	8	Pop
1	Cib	4	Uo	2	Caban	5	Uo	3	Etz'nab	6	Uo	4	Cauac	7	Uo	5	Ahau	8	Uo
8	Cib	4	Zip	9	Caban	5	Zip	10	Etz'nab	6	Zip	11	Cauac	7	Zip	12	Ahau	8	Zip
2	Cib	4	Zotz	3	Caban	5	Zotz	4	Etz'nab	6	Zotz	5	Cauac	7	Zotz	6	Ahau	8	Zotz
9	Cib	4	Tzec	10	Caban	5	Tzec	11	Etz'nab	6	Tzec	12	Cauac	7	Tzec	13	Ahau	8	Tzec
3	Cib	4	Xul	4	Caban	5	Xul	5	Etz'nab	6	Xul	6	Cauac	7	Xul	7	Ahau	8	Xul
10	Cib	4	Yaxkin	11	Caban	5	Yaxkin	12	Etz'nab	6	Yaxkin	13	Cauac	7	Yaxkin	1	Ahau	8	Yaxkin
4	Cib	4	Mol	5	Caban	5	Mol	6	Etz'nab	6	Mol	7	Cauac	7	Mol	8	Ahau	8	Mol
11	Cib	4	Chen	12	Caban	5	Chen	13	Etz'nab	6	Chen	1	Cauac	7	Chen	2	Ahau	8	Chen
5	Cib	4	Yax	6	Caban	5	Yax	7	Etz'nab	6	Yax	8	Cauac	7	Yax	9	Ahau	8	Yax
12	Cib	4	Zac	13	Caban	5	Zac	1	Etz'nab	6	Zac	2	Cauac	7	Zac	3	Ahau	8	Zac
6	Cib	4	Ceh	7	Caban	5	Ceh	8	Etz'nab	6	Ceh	9	Cauac	7	Ceh	10	Ahau	8	Ceh
13	Cib	4	Mac	1	Caban	5	Mac	2	Etz'nab	6	Mac	3	Cauac	7	Mac	4	Ahau	8	Mac
7	Cib	4	Kankin	8	Caban	5	Kankin	9	Etz'nab	6	Kankin	10	Cauac	7	Kankin	11	Ahau	8	Kankin
1	Cib	4	Muan	2	Caban	5	Muan	3	Etz'nab	6	Muan	4	Cauac	7	Muan	5	Ahau	8	Muan
8	Cib	4	Pax	9	Caban	5	Pax	10	Etz'nab	6	Pax	11	Cauac	7	Pax	12	Ahau	8	Pax
2	Cib	4	Kayab	3	Caban	5	Kayab	4	Etz'nab	6	Kayab	5	Cauac	7	Kayab	6	Ahau	8	Kayab
9	Cib	4	Cumku	10	Caban	5	Cumku	11	Etz'nab	6	Cumku	12	Cauac	7	Cumku	13	Ahau	8	Cumku
3	Cib	4	uayeb	4	Caban	5	uayeb	5	Etz'nab	1	Pop	6	Cauac	2	Pop	7	Ahau	3	Pop
10	Cib	19	Pop	11	Caban	end of	Pop	12	Etz'nab	1	Uo	13	Cauac	2	Uo	1	Ahau	3	Uo
4	Cib	19	Uo	5	Caban	end of	Uo	6	Etz'nab	1	Zip	7	Cauac	2	Zip	8	Ahau	3	Zip
11	Cib	19	Zip	12	Caban	end of	Zip	13	Etz'nab	1	Zotz	1	Cauac	2	Zotz	2	Ahau	3	Zotz
5	Cib	19	Zotz	6	Caban	end of	Zotz	7	Etz'nab	1	Tzec	8	Cauac	2	Tzec	9	Ahau	3	Tzec
12	Cib	19	Tzec	13	Caban	end of	Tzec	1	Etz'nab	1	Xul	2	Cauac	2	Xul	3	Ahau	3	Xul
6	Cib	19	Xul	7	Caban	end of	Xul	8	Etz'nab	1	Yaxkin	9	Cauac	2	Yaxkin	10	Ahau	3	Yaxkin
13	Cib	19	Yaxkin	1	Caban	end of	Yaxkin	2	Etz'nab	1	Mol	3	Cauac	2	Mol	4	Ahau	3	Mol
7	Cib	19	Mol	8	Caban	end of	Mol	9	Etz'nab	1	Chen	10	Cauac	2	Chen	11	Ahau	3	Chen
1	Cib	19	Chen	2	Caban	end of	Chen	3	Etz'nab	1	Yax	4	Cauac	2	Yax	5	Ahau	3	Yax
8	Cib	19	Yax	9	Caban	end of	Yax	10	Etz'nab	1	Zac	11	Cauac	2	Zac	12	Ahau	3	Zac
2	Cib	19	Zac	3	Caban	end of	Zac	4	Etz'nab	1	Ceh	5	Cauac	2	Ceh	6	Ahau	3	Ceh

1				2				3				4				5			
7	Imix	4	Ceh	8	Ik		5 Ceh	9	Akbal	6	Ceh	10	Kan	7	Ceh	11	Chicchan	8	Ceh
1	Imix	4	Mac	2	Ik		5 Mac	3	Akbal	6	Mac	4	Kan	7	Mac	5	Chicchan	8	Mac
8	Imix	4	Kankin	9	Ik		5 Kankin	10	Akbal	6	Kankin	11	Kan	7	Kankin	12	Chicchan	8	Kankin
2	Imix	4	Muan	3	Ik		5 Muan	4	Akbal	6	Muan	5	Kan	7	Muan	6	Chicchan	8	Muan
9	Imix	4	Pax	10	Ik		5 Pax	11	Akbal	6	Pax	12	Kan	7	Pax	13	Chicchan	8	Pax
3	Imix	4	Kayab	4	Ik		5 Kayab	5	Akbal	6	Kayab	6	Kan	7	Kayab	7	Chicchan	8	Kayab
10	Imix	4	Cumku	11	Ik		5 Cumku	12	Akbal	6	Cumku	13	Kan	7	Cumku	1	Chicchan	8	Cumku
4	Imix	4	uayeb	5	Ik		5 uayeb	6	Akbal	1	Pop	7	Kan	2	Pop	8	Chicchan	3	Pop
11	Imix	19	Pop	12	Ik	end of	Pop	13	Akbal	1	Uo	1	Kan	2	Uo	2	Chicchan	3	Uo
5	Imix	19	Uo	6	Ik	end of	Uo	7	Akbal	1	Zip	8	Kan	2	Zip	9	Chicchan	3	Zip
12	Imix	19	Zip	13	Ik	end of	Zip	1	Akbal	1	Zotz	2	Kan	2	Zotz	3	Chicchan	3	Zotz
6	Imix	19	Zotz	7	Ik	end of	Zotz	8	Akbal	1	Tzec	9	Kan	2	Tzec	10	Chicchan	3	Tzec
13	Imix	19	Tzec	1	Ik	end of	Tzec	2	Akbal	1	Xul	3	Kan	2	Xul	4	Chicchan	3	Xul
7	Imix	19	Xul	8	Ik	end of	Xul	9	Akbal	1	Yaxkin	10	Kan	2	Yaxkin	11	Chicchan	3	Yaxkin
1	Imix	19	Yaxkin	2	Ik	end of	Yaxkin	3	Akbal	1	Mol	4	Kan	2	Mol	5	Chicchan	3	Mol
8	Imix	19	Mol	9	Ik	end of	Mol	10	Akbal	1	Chen	11	Kan	2	Chen	12	Chicchan	3	Chen
2	Imix	19	Chen	3	Ik	end of	Chen	4	Akbal	1	Yax	5	Kan	2	Yax	6	Chicchan	3	Yax
9	Imix	19	Yax	10	Ik	end of	Yax	11	Akbal	1	Zac	12	Kan	2	Zac	13	Chicchan	3	Zac
3	Imix	19	Zac	4	Ik	end of	Zac	5	Akbal	1	Ceh	6	Kan	2	Ceh	7	Chicchan	3	Ceh
10	Imix	19	Ceh	11	Ik	end of	Ceh	12	Akbal	1	Mac	13	Kan	2	Mac	1	Chicchan	3	Mac
4	Imix	19	Mac	5	Ik	end of	Mac	6	Akbal	1	Kankin	7	Kan	2	Kankin	8	Chicchan	3	Kankin
11	Imix	19	Kankin	12	Ik	end of	Kankin	13	Akbal	1	Muan	1	Kan	2	Muan	2	Chicchan	3	Muan
5	Imix	19	Muan	6	Ik	end of	Muan	7	Akbal	1	Pax	8	Kan	2	Pax	9	Chicchan	3	Pax
12	Imix	19	Pax	13	Ik	end of	Pax	1	Akbal	1	Kayab	2	Kan	2	Kayab	3	Chicchan	3	Kayab
6	Imix	19	Kayab	7	Ik	end of	Kayab	8	Akbal	1	Cumku	9	Kan	2	Cumku	10	Chicchan	3	Cumku
13	Imix	19	Cumku	1	Ik	end of	Cumku	2	Akbal	1	uayeb	3	Kan	2	uayeb	4	Chicchan	3	uayeb
7	Imix	14	Pop	8	Ik		15 Pop	9	Akbal	16	Pop	10	Kan	17	Pop	11	Chicchan	18	Pop
1	Imix	14	Uo																

6				7				8				9				10			
12	Cimi	9	Ceh	13	Manik	10	Ceh	1	Lamat	11	Ceh	2	Muluc	12	Ceh	3	Oc	13	Ceh
6	Cimi	9	Mac	7	Manik	10	Mac	8	Lamat	11	Mac	9	Muluc	12	Mac	10	Oc	13	Mac
13	Cimi	9	Kankin	1	Manik	10	Kankin	2	Lamat	11	Kankin	3	Muluc	12	Kankin	4	Oc	13	Kankin
7	Cimi	9	Muan	8	Manik	10	Muan	9	Lamat	11	Muan	10	Muluc	12	Muan	11	Oc	13	Muan
1	Cimi	9	Pax	2	Manik	10	Pax	3	Lamat	11	Pax	4	Muluc	12	Pax	5	Oc	13	Pax
8	Cimi	9	Kayab	9	Manik	10	Kayab	10	Lamat	11	Kayab	11	Muluc	12	Kayab	12	Oc	13	Kayab
2	Cimi	9	Cumku	3	Manik	10	Cumku	4	Lamat	11	Cumku	5	Muluc	12	Cumku	6	Oc	13	Cumku
9	Cimi	4	Pop	10	Manik	5	Pop	11	Lamat	6	Pop	12	Muluc	7	Pop	13	Oc	8	Pop
3	Cimi	4	Uo	4	Manik	5	Uo	5	Lamat	6	Uo	6	Muluc	7	Uo	7	Oc	8	Uo
10	Cimi	4	Zip	11	Manik	5	Zip	12	Lamat	6	Zip	13	Muluc	7	Zip	1	Oc	8	Zip
4	Cimi	4	Zotz	5	Manik	5	Zotz	6	Lamat	6	Zotz	7	Muluc	7	Zotz	8	Oc	8	Zotz
11	Cimi	4	Tzec	12	Manik	5	Tzec	13	Lamat	6	Tzec	1	Muluc	7	Tzec	2	Oc	8	Tzec
5	Cimi	4	Xul	6	Manik	5	Xul	7	Lamat	6	Xul	8	Muluc	7	Xul	9	Oc	8	Xul
8	Cimi	4	Yaxkin	13	Manik	5	Yaxkin	1	Lamat	6	Yaxkin	2	Muluc	7	Yaxkin	3	Oc	8	Yaxkin
6	Cimi	4	Mol	7	Manik	5	Mol	8	Lamat	6	Mol	9	Muluc	7	Mol	10	Oc	8	Mol
13	Cimi	4	Chen	1	Manik	5	Chen	2	Lamat	6	Chen	3	Muluc	7	Chen	4	Oc	8	Chen
7	Cimi	4	Yax	8	Manik	5	Yax	9	Lamat	6	Yax	10	Muluc	7	Yax	11	Oc	8	Yax
1	Cimi	4	Zac	2	Manik	5	Zac	3	Lamat	6	Zac	4	Muluc	7	Zac	5	Oc	8	Zac
8	Cimi	4	Ceh	9	Manik	5	Ceh	10	Lamat	6	Ceh	11	Muluc	7	Ceh	12	Oc	8	Ceh
2	Cimi	4	Mac	3	Manik	5	Mac	4	Lamat	6	Mac	5	Muluc	7	Mac	6	Oc	8	Mac
9	Cimi	4	Kankin	10	Manik	5	Kankin	11	Lamat	6	Kankin	12	Muluc	7	Kankin	13	Oc	8	Kankin
3	Cimi	4	Muan	4	Manik	5	Muan	5	Lamat	6	Muan	6	Muluc	7	Muan	7	Oc	8	Muan
10	Cimi	4	Pax	11	Manik	5	Pax	12	Lamat	6	Pax	13	Muluc	7	Pax	1	Oc	8	Pax
4	Cimi	4	Kayab	5	Manik	5	Kayab	6	Lamat	6	Kayab	7	Muluc	7	Kayab	8	Oc	8	Kayab
11	Cimi	4	Cumku	12	Manik	5	Cumku	13	Lamat	6	Cumku	1	Muluc	7	Cumku	2	Oc	8	Cumku
5	Cimi	4	uayeb	6	Manik	5	uayeb	7	Lamat	1	Pop	8	Muluc	2	Pop	9	Oc	3	Pop
12	Cimi	19	Pop	13	Manik	end of		1	Lamat	1	Uo	2	Muluc	2	Uo	3	Oc	3	Uo

11				12				13				14				15			
4	Chuen	14	Ceh	5	Eb	15	Ceh	6	Ben	16	Ceh	7	Ix	17	Ceh	8	Men	18	Ceh
11	Chuen	14	Mac	12	Eb	15	Mac	13	Ben	16	Mac	1	Ix	17	Mac	2	Men	18	Mac
5	Chuen	14	Kankin	6	Eb	15	Kankin	7	Ben	16	Kankin	8	Ix	17	Kankin	9	Men	18	Kankin
12	Chuen	14	Muan	13	Eb	15	Muan	1	Ben	16	Muan	2	Ix	17	Muan	3	Men	18	Muan
6	Chuen	14	Pax	7	Eb	15	Pax	8	Ben	16	Pax	9	Ix	17	Pax	10	Men	18	Pax
13	Chuen	14	Kayab	1	Eb	15	Kayab	2	Ben	16	Kayab	3	Ix	17	Kayab	4	Men	18	Kayab
7	Chuen	14	Cumku	8	Eb	15	Cumku	9	Ben	16	Cumku	10	Ix	17	Cumku	11	Men	18	Cumku
1	Chuen	9	Pop	2	Eb	10	Pop	3	Ben	11	Pop	4	Ix	12	Pop	5	Men	13	Pop
8	Chuen	9	Uo	9	Eb	10	Uo	10	Ben	11	Uo	11	Ix	12	Uo	12	Men	13	Uo
2	Chuen	9	Zip	3	Eb	10	Zip	4	Ben	11	Zip	5	Ix	12	Zip	6	Men	13	Zip
9	Chuen	9	Zotz	10	Eb	10	Zotz	11	Ben	11	Zotz	12	Ix	12	Zotz	13	Men	13	Zotz
3	Chuen	9	Tzec	4	Eb	10	Tzec	5	Ben	11	Tzec	6	Ix	12	Tzec	7	Men	13	Tzec
10	Chuen	9	Xul	11	Eb	10	Xul	12	Ben	11	Xul	13	Ix	12	Xul	1	Men	13	Xul
4	Chuen	9	Yaxkin	5	Eb	10	Yaxkin	6	Ben	11	Yaxkin	7	Ix	12	Yaxkin	8	Men	13	Yaxkin
11	Chuen	9	Mol	12	Eb	10	Mol	13	Ben	11	Mol	1	Ix	12	Mol	2	Men	13	Mol
5	Chuen	9	Chen	6	Eb	10	Chen	7	Ben	11	Chen	8	Ix	12	Chen	9	Men	13	Chen
12	Chuen	9	Yax	13	Eb	10	Yax	1	Ben	11	Yax	2	Ix	12	Yax	3	Men	13	Yax
6	Chuen	9	Zac	7	Eb	10	Zac	8	Ben	11	Zac	9	Ix	12	Zac	10	Men	13	Zac
13	Chuen	9	Ceh	1	Eb	10	Ceh	2	Ben	11	Ceh	3	Ix	12	Ceh	4	Men	13	Ceh
7	Chuen	9	Mac	8	Eb	10	Mac	9	Ben	11	Mac	10	Ix	12	Mac	11	Men	13	Mac
1	Chuen	9	Kankin	2	Eb	10	Kankin	3	Ben	11	Kankin	4	Ix	12	Kankin	5	Men	13	Kankin
8	Chuen	9	Muan	9	Eb	10	Muan	10	Ben	11	Muan	11	Ix	12	Muan	12	Men	13	Muan
2	Chuen	9	Pax	3	Eb	10	Pax	4	Ben	11	Pax	5	Ix	12	Pax	6	Men	13	Pax
9	Chuen	9	Kayab	10	Eb	10	Kayab	11	Ben	11	Kayab	12	Ix	12	Kayab	13	Men	13	Kayab
3	Chuen	9	Cumku	4	Eb	10	Cumku	5	Ben	11	Cumku	6	Ix	12	Cumku	7	Men	13	Cumku
10	Chuen	4	Pop	11	Eb	5	Pop	12	Ben	6	Pop	13	Ix	7	Pop	1	Men	8	Pop
4	Chuen	4	Uo	5	Eb	5	Uo	6	Ben	6	Uo	7	Ix	7	Uo	8	Men	8	Uo

16				17					18				19				20			
9	Cib	19	Ceh	10	Caban	end of		Ceh	11	Etz'nab	1	Mac	12	Cauac	2	Mac	13	Ahau	3	Mac
3	Cib	19	Mac	4	Caban	end of		Mac	5	Etz'nab	1	Kankin	6	Cauac	2	Kankin	7	Ahau	3	Kankin
10	Cib	19	Kankin	11	Caban	end of		Kankin	12	Etz'nab	1	Muan	13	Cauac	2	Muan	1	Ahau	3	Muan
4	Cib	19	Muan	5	Caban	end of		Muan	6	Etz'nab	1	Pax	7	Cauac	2	Pax	8	Ahau	3	Pax
11	Cib	19	Pax	12	Caban	end of		Pax	13	Etz'nab	1	Kayab	1	Cauac	2	Kayab	2	Ahau	3	Kayab
5	Cib	19	Kayab	6	Caban	end of		Kayab	7	Etz'nab	1	Cumku	8	Cauac	2	Cumku	9	Ahau	3	Cumku
12	Cib	19	Cumku	13	Caban	end of		Cumku	1	Etz'nab	1	uayeb	2	Cauac	2	uayeb	3	Ahau	3	uayeb
6	Cib	14	Pop	7	Caban		15	Pop	8	Etz'nab	16	Pop	9	Cauac	17	Pop	10	Ahau	18	Pop
13	Cib	14	Uo	1	Caban		15	Uo	2	Etz'nab	16	Uo	3	Cauac	17	Uo	4	Ahau	18	Uo
7	Cib	14	Zip	8	Caban		15	Zip	9	Etz'nab	16	Zip	10	Cauac	17	Zip	11	Ahau	18	Zip
1	Cib	14	Zotz	2	Caban		15	Zotz	3	Etz'nab	16	Zotz	4	Cauac	17	Zotz	5	Ahau	18	Zotz
8	Cib	14	Tzec	9	Caban		15	Tzec	10	Etz'nab	16	Tzec	11	Cauac	17	Tzec	12	Ahau	18	Tzec
2	Cib	14	Xul	3	Caban		15	Xul	4	Etz'nab	16	Xul	5	Cauac	17	Xul	6	Ahau	18	Xul
9	Cib	14	Yaxkin	10	Caban		15	Yaxkin	11	Etz'nab	16	Yaxkin	12	Cauac	17	Yaxkin	13	Ahau	18	Yaxkin
3	Cib	14	Mol	4	Caban		15	Mol	5	Etz'nab	16	Mol	6	Cauac	17	Mol	7	Ahau	18	Mol
10	Cib	14	Chen	11	Caban		15	Chen	12	Etz'nab	16	Chen	13	Cauac	17	Chen	1	Ahau	18	Chen
4	Cib	14	Yax	5	Caban		15	Yax	6	Etz'nab	16	Yax	7	Cauac	17	Yax	8	Ahau	18	Yax
11	Cib	14	Zac	12	Caban		15	Zac	13	Etz'nab	16	Zac	1	Cauac	17	Zac	2	Ahau	18	Zac
5	Cib	14	Ceh	6	Caban		15	Ceh	7	Etz'nab	16	Ceh	8	Cauac	17	Ceh	9	Ahau	18	Ceh
12	Cib	14	Mac	13	Caban		15	Mac	1	Etz'nab	16	Mac	2	Cauac	17	Mac	3	Ahau	18	Mac
6	Cib	14	Kankin	7	Caban		15	Kankin	8	Etz'nab	16	Kankin	9	Cauac	17	Kankin	10	Ahau	18	Kankin
13	Cib	14	Muan	1	Caban		15	Muan	2	Etz'nab	16	Muan	3	Cauac	17	Muan	4	Ahau	18	Muan
7	Cib	14	Pax	8	Caban		15	Pax	9	Etz'nab	16	Pax	10	Cauac	17	Pax	11	Ahau	18	Pax
1	Cib	14	Kayab	2	Caban		15	Kayab	3	Etz'nab	16	Kayab	4	Cauac	17	Kayab	5	Ahau	18	Kayab
8	Cib	14	Cumku	9	Caban		15	Cumku	10	Etz'nab	16	Cumku	11	Cauac	17	Cumku	12	Ahau	18	Cumku
2	Cib	9	Pop	3	Caban		10	Pop	4	Etz'nab	11	Pop	5	Cauac	12	Pop	6	Ahau	13	Pop
9	Cib	9	Uo	10	Caban		10	Uo	11	Etz'nab	11	Uo	12	Cauac	12	Uo	13	Ahau	13	Uo

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PLATE 1. (Ch. 8) A view to the east along the approach to the entrance of the temple of Amun-Re at Meroe far to the south: The picture, taken the day before the winter solstice, clearly shows that Amun-Re's temple was oriented to the winter solstice sunrise, interesting support for the view that the similar alignments at Karnak were intentional. Photo by J. Robertson.

PLATE 2. (Ch. 9) Persepolis, the capitol of Darius I: The columns of the royal palace are aligned so that the shadows of each row of columns strikes the next row at the summer solstice. Photo by W. Dutz for D.H. Kelley.

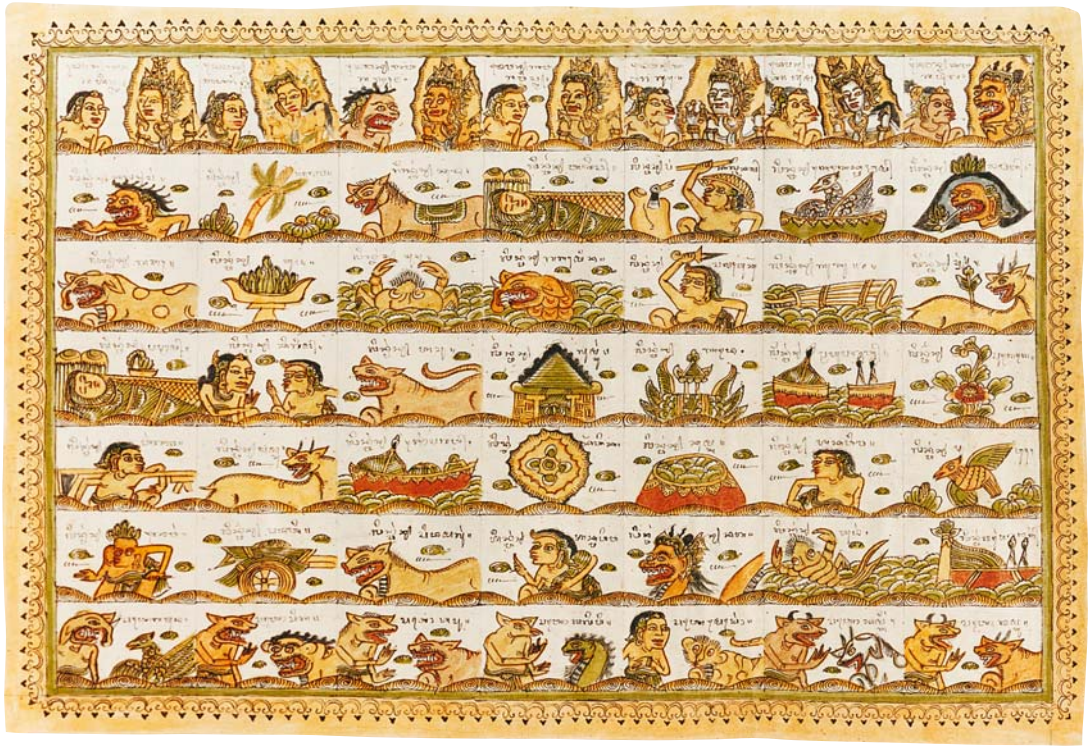

PLATE 3. (Ch. 9) A *pelelintangan*, a diagram to show the fortune associated with a 35-day sequence created by the combination of the 7-day week and the 5-day week: The diagram has 49 divisions, the seven across the top associated with the seven days of the week, each showing, ideally, a god, a tree, a bird, a shadow puppet character, and an animal, each associated with a particular day and a particular planet. Across the bottom are seven animals, identified as heads of a seven-headed demon and associated with the days of the 7-day week. Courtesy, Norman Totten.

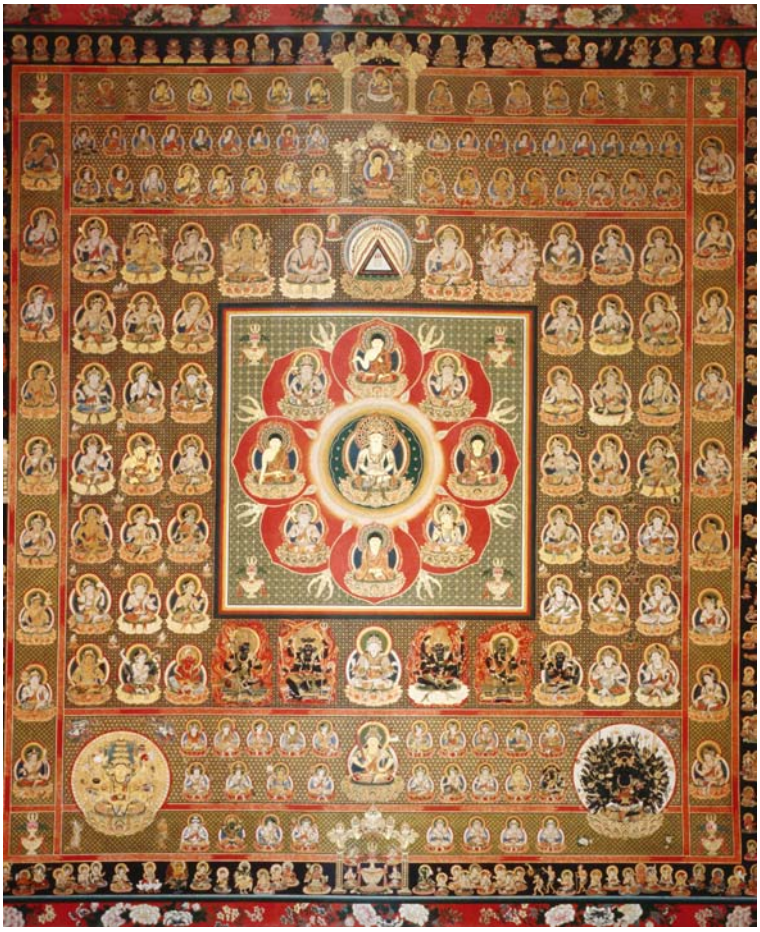

PLATE 4. (Ch. 10) The most complex mandala we have seen is that of Garbhadata or Taizoukai mandala published with a preliminary commentary by Nishiyama (1999). This Chinese Buddhist mandala is said to have been brought to Japan from China in 806 A.D. Over 300 deities seem to be represented. The ruling deities of the 28 lunar mansions appear, as do the nine planetary lords and the 12 signs of the zodiac. A comet (*ketu*) and meteor (*Nirghataketu*) are also represented, generically (recall that in India *Ketu* is a deity, one of the nine planets). Original in Toji Temple, Kyoto, Japan. Photograph by Dr. G. Newlands of a silk cloth version produced by Fukagawa Fudou, courtesy, M. Nishiyama.

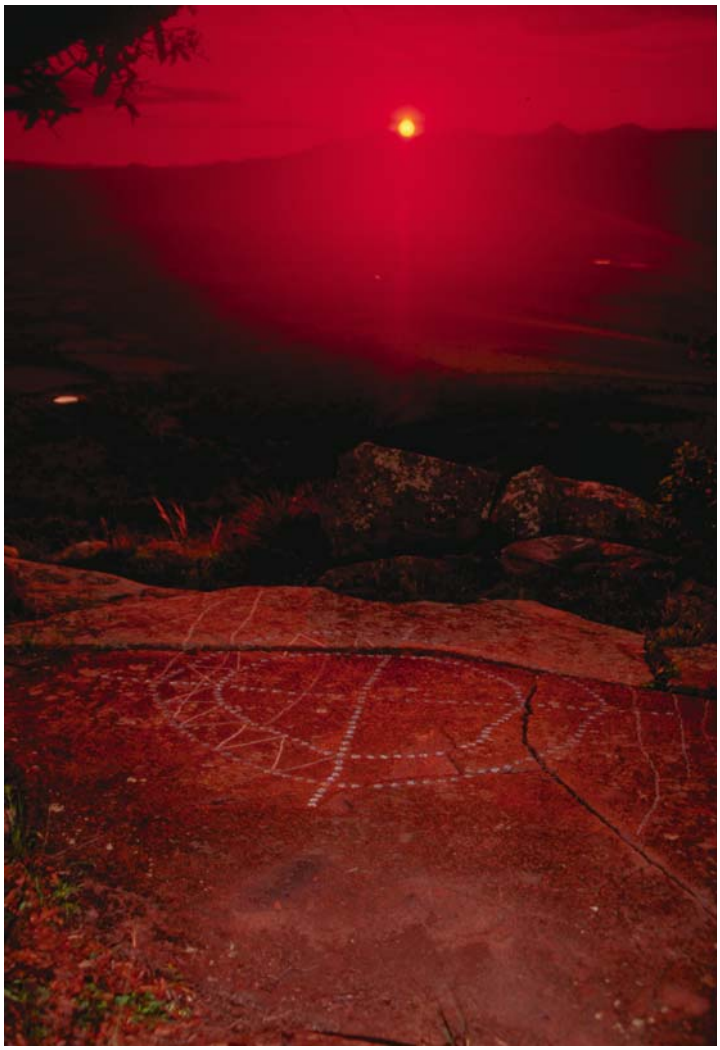

PLATE 5. (Ch. 12) The roadway from the Sun Temple, Alta Vista, struck by the rising Sun, taken at the pecked cross overlooking the site within one day of summer solstice, 2000. Photo by Daniel Zborover for D.H. Kelley.

PLATE 6. (Ch. 13) Shadow-play spiral painting at Burro Flats, California, approximately two weeks after winter solstice. Photo by E.F. Milone.

PLATE 7. (Ch. 14) Ollantaytambo view at June solstice. Photo courtesy of William Sullivan.

PLATE 8. (Ch. 15) "This is dawn": A copy of the original artwork with a modern cosmic turtle, by Christine Sioui Wawanaloath. This is an artistic rendering of various symbols of American Indian groups, based partly on sacred traditional Algonquin drawings to which she has access and partly on her perceptions and intuitions. Courtesy of the artist, Christine Sioui Wawanoloath.