

ASTR 130: INTRO TO ARCHAEOASTRONOMY

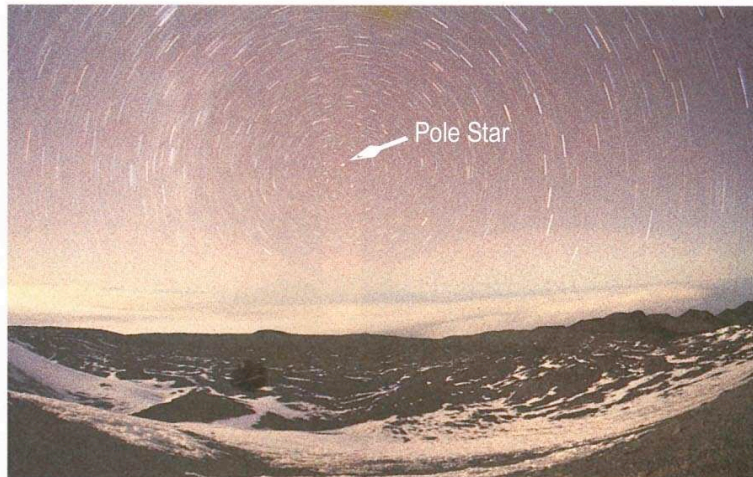
Homework #1

due Thursday, October 8, 2009

1. Motions of Stars in the Sky

Mauna Kea Star Trails

Looking North, time-lapse photos show the rotation of the night sky in star trails around Polaris. Polaris is 20 degrees above the horizon (= Hawaii's latitude north of the Equator).



Stars which are within 20 degrees of the NCP are called "circumpolar", and are visible all year.



Looking South, star trails circle a SCP which is 20 degrees below the horizon. Stars within 20 degrees of the SCP are never visible from Hawaii. The visible sky, angles of rising and setting stars on the horizon, and circumpolar stars all change with an observer's location north or south of the Equator.

- (a) The figure shows a time-elased exposure of the night sky viewed from Mauna Kea, looking north and looking south. Use the results of Tuesday's in-class sky-visualization exercise to draw arrows showing the direction that stars move in each panel. Label the direction (North, East, South, or West) at the center of the horizon for each of the two images.

(b) Draw a picture with an arrow that shows the direction of motion for a star just above the eastern horizon as viewed from Hawaii. Does the star rise or set along this horizon?

(c) Draw a similar diagram to show the direction of motion for stars near the Western Horizon as viewed from Hawaii. Again, does the star rise or set along this horizon?

Horizon Calendars (40 points) The calendar cycles that use the shift in the position of the Sun along the horizon provide one of the earliest and simplest ways of fixing a yearly cycle – one that is used by many cultures. The four unique yearly events: fall and spring equinoxes, summer and winter solstices are shown in the diagrams with the positions marked for the Sun. Using Stellarium, position yourself near the eastern horizon at sunrise for Hawaii. Record the date and time, then turn on the local horizon/zenith coordinates with the 'z' key. Roughly record the current angular position of the Sun on the horizon (north or south of east – you may want to turn on the ecliptic). Now advance the day with the + key and with the 'j'. How far does the Sun move at the time of the equinox? At the time of the solstices? Which event would be easier to pinpoint on the horizon. Explain your reasoning. Would it be easier to make more precise determinations of the date of your selected events from Hawaii or from a very northerly site like Stonehenge? Why?

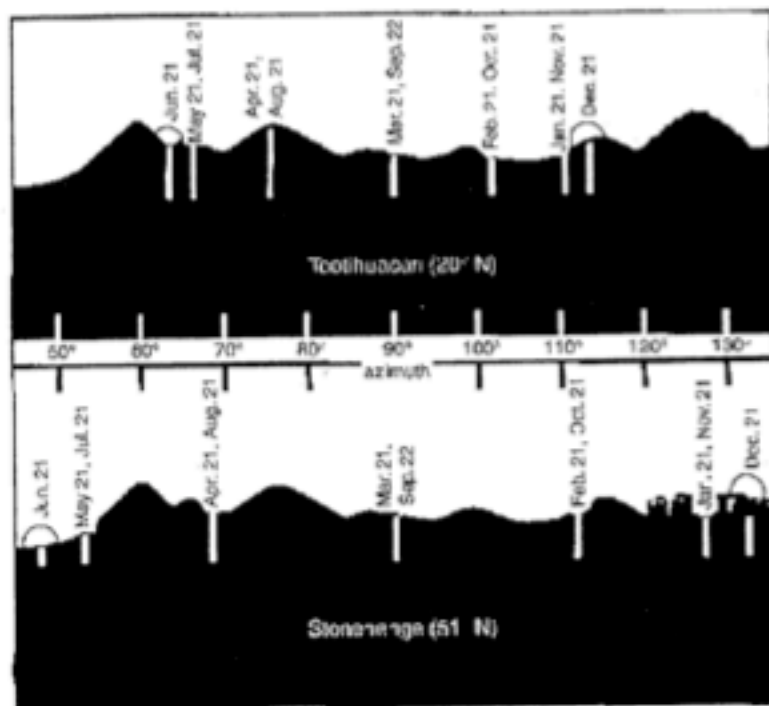


FIG. 27 Rising positions of the sun charted at monthly intervals throughout the year as viewed from Teotihuacan, Mexico (latitude: $19^{\circ}41' N$), and Stonehenge in the southern British Isles (latitude: $51^{\circ}11' N$). Diagram by P. Dunham

Examine Fig. 27 from Chapter 3 in *Skywatchers*. Draw in the direction of the Sun's rising motion on this diagram. (Orient yourself by determining in which direction you would

search to find the Pole star, if you were to pan along the horizon from the present view of the rising Sun. For each panel, think about whether Polaris will appear low or high in the sky when viewed against its (northern) horizon. Then think about where the celestial equator will fall in the present diagrams.) Draw in a 'straight' horizon across the bottom of the white vertical marker lines. Use the angular scale marked 'azimuth' in combination with your parallel rising-setting lines to roughly estimate how far (in degrees) the actual rising point of the Sun on the 'straight' horizon shifts from its rising point on the 'mountainous' horizon of the diagram for a few positions. We will use this kind of information to evaluate how difficult it is to make precise horizon alignments in our later work.