Astronomy 4 Term Project

Constructing and Using an Astrolabe

Introduction: The astrolabe was the most widely used astronomical instrument before the invention of the telescope. It was also perhaps the astronomical instrument that remained in use over the longest period of time. Invented in antiquity, the device was still in use in the seventeenth century. Astrolabes served at least three purposes: i) as observing devices, they could be employed to measure altitudes of celestial objects above the horizon, to determine the heights of towers or mountains, or for surveying in general; ii) as computing devices (the world's first pocket calculators), they could be used to find the direction to Mecca or one's geographical latitude, to cast horoscopes or to solve trigonometric functions; iii) as time-keeping devices, they could be used to tell time by day or night.

Task: Your goal here is to construct one part of an astrolabe, the climate (also called a latitude plate or tympan), following detailed instructions provided in James Evans, *The History & Practice of Ancient Astronomy* (Oxford, 1998), pp. 141-61, esp. 158-61 [on reserve in Kresge Library]. We will provide you with the other essential part, the rete, which fits over the climate and rotates to create a working instrument. You should also write a detailed set of instructions for telling time with your astrolabe. The instructions and your working astrolabe should be submitted together as your work for this project.

Procedures: Before starting, you should read Evans' full discussion of the astrolabe, pp. 141-61, and the essay on astrolabes by Sara Schechner Genuth in *Western astrolabes* (Chicago, 1998) [also on reserve in Kresge]. These authors explain the theory of the astrolabe and provide illustrations of various historical astrolabes.

To construct the climate, you will need a straightedge, compass, protractor and a sheet of sturdy paper at least 20 x 40 inches in dimensions. For some of the circles, you will need to draw a rather large radius; try using a string tied to a pencil or a pencil taped to a meter stick if your compass does not open wide enough. We also suggest that you mark all the lines initially in light pencil, making it easier to correct mistakes by erasures. So that your climate will match the rete we provide, make your climate to the following dimensions: radius of the outermost circle (the Tropic of Capricorn – Evans, p. 159) is 16 cm; radius of the equator (and the celestial sphere) is 10.8 cm. To be able to use your astrolabe in Hanover, make your climate for geographical latitude of 44 degrees. Be sure to write the latitude on your climate.

On the climate, mark the almucantars (circles of equal altitude), azimuths, and seasonal hours. See Evans, pp. 446-47, for illustrations of what your finished climate should look like. You need not try to draw almucantars or equal azimuth lines at distances closer than ten-degree intervals; you may want to mark only fifteen-degree intervals. To draw these circles, you will be using stereographic projection. Evans provides a useful discussion of how this procedure works; if you get stuck, please talk to one of the TAs for the course. It will also help if you remember how to bisect a line with a compass and straightedge, a procedure much easier than measuring the line with a ruler and dividing its length in half.

For ease in using your astrolabe, you may want to glue the paper climate, when completed, to a stiffer piece of cardboard. Attach the transparent rete so that it can spin around the center of your climate (a thumbtack works nicely). You now have a working astrolabe with the rete mapping celestial objects (stars and the Sun, which moves over the course of a year around the ecliptic marked with the twelve zodiacal signs) and the

climate providing a grid of coordinates (almucantars and azimuths) for the sky visible to an observer at a the geographical latitude of Hanover.

Results: After completing your astrolabe, write a short "owner's manual" to describe how to tell time with the instrument. Write the manual for "equal hours" (the method we currently use for telling time, according to which the clock moves uniformly and hours always have the same length) and "seasonal hours" (the method in which the day and night are each divided into twelve hours, the length of which change during the course of the year). See Evans for a discussion of these two methods of telling time. Both were widely used during early modern times. Remember that when the Sun is on the meridian to the south, it is noon locally. And when the Sun is on the meridinal great circle but below the horizon, it is midnight locally.