Using the astrolabe

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The following numbered paragraphs each illustrate a demonstration, or problem, involving an aspect of the astrolabe's many applications. It is up to you to discover for yourself variations on these and the many other related applications that can arise.

1. Hold the tablet in front of you, with north pointing away from you (and towards your local northern point) and slowly rotate the rete clockwise. You are emulating the apparent movement of the sky each day which turns once every 24 hours. Watch stars rising in the east (to your right) and setting in the west.

2. What time does the most southerly star in the 'W' pattern of Cassiopeia rise on June 1? Find the star (alpha Cassiopeiae) not far from the centre at right ascension (hour line) 0hr 45min, declination +55° using the pointer set on the outer rete scale. As you move the rete round clockwise you will find that the W is so close to the pole, that even star alpha never sets. Indeed, when this star is highest, it is still just north of the zenith.

3. You set up the sky for any time and date by turning the rete till the time in GMT (so remember to subtract an hour from BST) is set against the date on the tablet. Try setting 21hr 30min against April 23, and you will find the stars of Orion's Belt lined up on the horizon due west. What time does Orion's Belt rise on December 3? What do you notice about the angles made by the line of Orion's Belt (three stars) to the horizon in these two examples?

4. What time is sunrise on March 12 in Penzance (5° W longitude)? The Sun should be due south at noon. But the Sun is not always due south at 12:00 noon GMT, even at Greenwich, due to effects on sundial time arising from the inclination of the ecliptic to the equator (Earth's axial tilt) and an annual variation in the speed of the Earth around its orbit. The variation in the position of the 'mean Sun' can be worked out from the *equation of time*, which allows you to correct your positioning on the astrolabe. You could copy or stick this graph onto the back of your astrolabe tablet.

At Greenwich on March 12 the real Sun is lagging behind the Mean Sun by about 9 minutes, according to the graph, so it will not be south at Greenwich till 12:09. In Penzance, the Sun is not due south till 5 x 4 minutes later than Greenwich, which will make it 12:29 GMT. Set 12:29 against March 12 so the Sun is now due south: move the pointer south and where its centreline crosses the ecliptic is the position of the Sun. Holding the pointer in position to maintain the Sun's position, turn the rete so that the Sun is on the eastern horizon and read the time against March 12.

5. You can see on the rete that the ecliptic crosses the equator in two places (marking the equinoxes) at an angle due to the tilt of the Earth's axis, of about 23°. So the planets as they appear to circle our sky close to the ecliptic, can appear up to over 23° north or south of the celestial equator. Jupiter at the end of 2007, for example, was right down south in Sagittarius and could rise to a maximum altitude of some 15° above the southern horizon. In 2010 Jupiter in Pisces will be reaching an altitude of about 33° due south and in 2013 we shall be seeing the planet in Taurus some 62° high. The same tilt causes the Sun to rise and set at very different times and positions through the year. In addition, the *change* in sun rise/set times slows right down near the solstices, but in the Spring and Autumn the 'days draw out or in' very quickly indeed. Why is this? Positioning the Sun on your astrolabe and advancing the dates around these times will show you.

6. Civil twilight, evening or morning, lasts while the Sun's depression is between zero and minus 6°. Nautical twilight lasts while the Sun is below the horizon by less than 12°. At sea this is reckoned to be the time when the horizon becomes invisible. Astronomical twilight, however, demands a much deeper darkness, and the Sun must be below 18° degrees before this twilight ends. Your astrolabe will show you that at British latitudes during the weeks around the middle of the year, astronomical twilight lasts all night! To help in spotting objects like Mercury or the very young (or old) Moon you can set up their positions on the rete from the intersection of the *horizon* with the ecliptic at the setting time given for the planet on the almanac page. The Sun, Moon or planets will line up, approximately, along the ecliptic and you can see as the rete turns whether the ecliptic cuts the horizon at an oblique or steep angle. The best time to find faint objects in a bright sky is when this intersection is steepest. In 2010 on our monthly charts if you look at April 15, you will see that Mercury is visible around that date in the evening twilight. It is at an angle of 17° east of the Sun and sets 1hr 48 minutes after the Sun. On August 15, however, it is at the larger angle of 25° from the Sun, yet it will be extremely difficult to find, setting only 23 minutes after the Sun.