

The Earth and the Sun : Notes/W.S.-140

The Calendar

The importance of our calendar cannot be underestimated. It was especially important to earlier cultures, when the timing of planting and harvesting of crops was critical.

The moon's orbital period, the time from new moon to new moon, is about 29.5 days. In twelve lunar months, the year is only 354 days long. This "year" didn't work out because the true year is about 365 days long. Extra months were inserted. Some years had thirteen months. There was great confusion about the calendar in ancient times.

In 46 BC, Julius Caesar demanded a reform of the calendar. The new calendar became known as the Julian Calendar. This calendar had 365 days and twelve months. Some months had extra days inserted. The new months were not based on the period of the moon. Every fourth year (a leap year) had 366 days. This gave the year, an average length of 365.25 days. Years divisible by four, like 2008, are usually leap years.

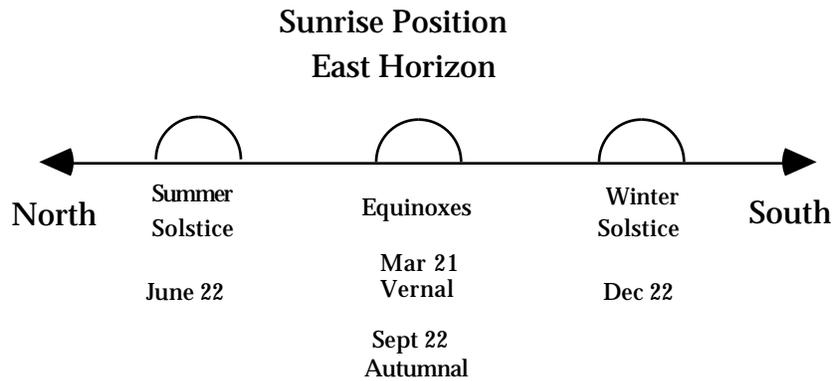
The year of 365.25 days was a little too long. In 1582, Pope Gregory XIII decided that there should be an adjustment. This new calendar, which is still in use today, is called the Gregorian Calendar.

The year is closer to 365.24 days. So, for every hundred years, a day is subtracted, so century years (1700, 1800, 1900 ...) were not leap years. But the year is really closer to 365.2425 days. This means that every four hundred years, a day needs to be added. So every century year, that is divisible by 400, is a leap year. So 1600 and 2000, were leap years. This "year" still needs to be adjusted periodically. But, it is accurate to within a few seconds per year.

The true year is about 365.2422 days (vernal equinox to vernal equinox). This is the time that it takes for the seasons to repeat.

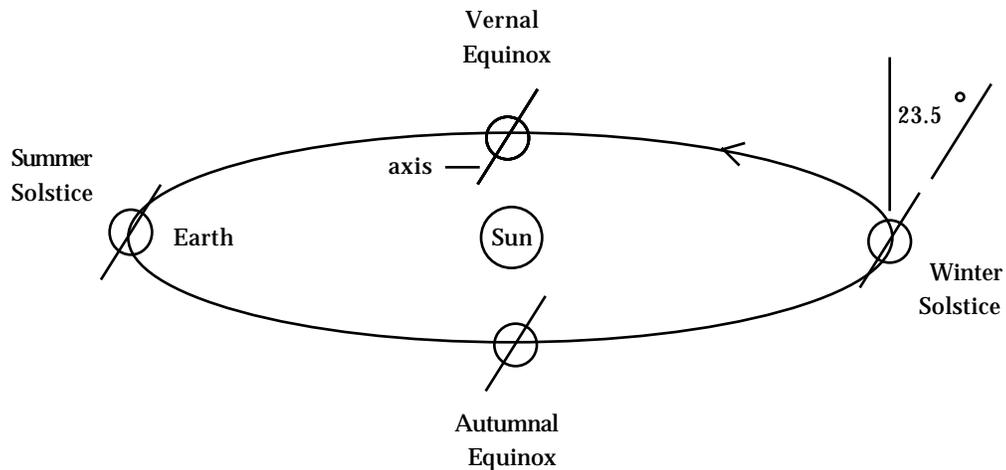
The Seasons

It was noticed many centuries ago, that the sunrise position depended on the time of the year. This can be seen in the diagram below.



The sun rises furthest north at the summer solstice. This is the time of the year when the days are longest. It rises furthest south at the winter solstice. This is when the days are shortest. At both equinoxes, the days and nights are of equal length.

This phenomenon is explained by the diagram below. The Earth's rotation axis is inclined at 23.5° to the perpendicular of the orbit plane. If this angle was zero there could be no seasons.



During the summer, in the northern hemisphere, the sun's light is more intense because the sun is higher in the sky which leads to warmer weather. During the winter, it is cooler because the sun is lower in the sky.

In the southern hemisphere, the seasons occur in the opposite sense.

Questions:

- 1) Why was the calendar so important to early cultures?
- 2) How much time does it take for the moon to orbit the earth?
- 3) What is the true length of the year to four decimal places?
- 4) What is the purpose of having a leap year?
- 5) Will the year 2200 be a leap year?
- 6) What is the cause of the seasons?
- 7) When is the summer solstice?
- 8) When are the days and nights of equal length?
- 9) In Australia, when are the days longest?
- 10) Explain why it is warmer in the summer than the winter in the northern hemisphere.

Answers:

1) The calendar was important to early cultures because it told them when to plant and harvest crops., 2) 29.5 days (full moon to full moon), 3) 365.2422 days, 4) The year, which is the time that it takes for the earth to go around the sun, is not exactly 365 days. It is closer to 365.25 days. So a day must be added every four years., 5) No. It is not divisible by 400., 6) The seasons are caused by the fact that the earth's axis is oriented at an angle of 23.5° to the perpendicular of the earth's orbit plane., 7) June 22, 8) Mar 21 and Sept 22, 9) Dec 22, 10) In the northern hemisphere, during the summer months, the sun is higher in the sky, so the sun's light is more intense.