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WINTER SOLSTICE, 2016

Ken Tapping, 20th December, 2016

At 10:44 Universal Time on the 21st, which is 05:44 EST, or 02:44 PST, the Sun will reach the southernmost point in its yearly travels. This is the day with the least number of hours of daylight. The Sun will rise and set at its southernmost points on the horizon. After that it will reverse its course, very slowly at first, heading back northward. We will get more hours of daylight and we will be heading again for that special time when we leave work or school and the sky is still a bit light. Of course these evenings we have Venus, shining brightly in the southwest after sunset, providing some consolation for the icy darkness.

The winter solstice is just one event in the recurring passage of the seasons. Around March 21st the Sun will cross the celestial equator heading northward, marking the spring equinox. It will get as far north as it gets on June 21st, marking the summer solstice. Then it heads south again, crossing the equator around September 21st – the autumn equinox, on its way to the next winter solstice. Throughout our history these have been regarded as important events, not just as markers for transitions between the seasons, but also occasions for important religious ceremonies.

The seasons, solstices and equinoxes are all a consequence of the orientation of the Earth's axis. Imagine the Earth moving around the Sun, spinning as it goes, like a spinning top on a plate. One thing we notice with spinning tops is that if they are not vertical, they do a circular wobble. The Earth's axis is not vertical compared with the plane in which it orbits the Sun; it is about 23 degrees off "vertical". It wobbles too, just like a top, but each complete circular wobble takes a long time – about 26,000 years. Over a human lifetime or even many lifetimes we can treat the Earth's axis as pointing in a fixed direction, fortuitously towards a moderately bright star, Polaris, the Pole or North Star. That means that when the Earth is on one side of the Sun, the Northern Hemisphere is leaning sunward (the

summer solstice), and on the other side, it is leaning away (the winter solstice). Then of course there are two intermediate directions (the equinoxes) where the Earth is leaning sideways, neither toward nor away from the direction of the Sun. If we are leaning towards the Sun, we see it higher in the sky and in the sky longer. If we are leaning away the reverse happens.

We still hear people suggesting that summers are warmer because we are closer to the Sun. Actually, the Earth is at its closest to the Sun in early January and at its most distant in early July. Obviously slight changes in the Earth's distance from the Sun cannot be causing the seasons.

That long slow wobble, a process called "precession", causes the Earth's axis to describe a circle in the sky. It is pointing at Polaris at the moment, but 5000 years ago, when the pyramids were being built in Egypt, the Pole Star was not Polaris; it was Thuban, the brightest star in the constellation of Draco, "The Dragon". Precession has caused the Zodiac to slip. The first sign was once Aries. It has slipped back one sign and it now starts with Pisces.

In astronomy, we describe the positions of stars using analogues of the Earth's latitude and longitude system, referred to the Earth because in space there are no usable references. The result is that even over a year or so, precession slightly changes the coordinates of stars and other objects in the sky, and so corrections for precession are a standard part of making observations.

In this last article before Christmas, I want to take this opportunity to wish you all a Happy Christmas. Season's Greetings to All. Keep Looking Up!

Venus is low in the southwest after sunset. Mars lies to the left of Venus. Jupiter rises in the early hours. The Moon will be New on the 29th.

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