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NO MORE ECLIPSES

Ken Tapping, 24th February, 2015

Our earliest clocks were devices like sundials. We used solar time when the Sun was up and we slept when the Sun went down. Since we lived our lives according to daylight, “solar time” made sense. Actually, “Earth Time” is a better term, because the rising and setting of the Sun are due to the rotation of the Earth. Of course sundials do not work well on cloudy days, or after the invention of candles enabled us to work at night.

This led to our inventing clocks that do not depend on sunlight, such as water clocks, graduated candles and increasingly sophisticated mechanical devices. Over time navigation and other applications led to a continuing need for more accurate clocks. Eventually resonances in atoms themselves replaced balance wheels and pendulums. We reached a point where our clocks became better timekeepers than the Earth. We found that our planet’s rotation is gradually slowing, and the main culprit is the Moon.

The Moon pulls the sea and atmosphere on the side of the Earth facing it into a bulge. It also pulls the Earth away from the ocean and atmosphere on the other side, leaving another bulge. Each day the rotation of the Earth takes all parts of the Earth through a bulge twice. This is what causes the tides we see every day: two high tides roughly 12 hours apart. The two bulges try to stay in line with the centres of mass of the Earth and Moon. However, friction against the bottom of the sea and collisions with the shores of the continents make the Earth try to drag the bulges along with its rotation, so the bulge on the side of Earth facing the Moon leads and the bulge on the other side lags the in-line positions we would expect.

These tidal bulges are big, and their gravitational attraction is significant. The gravity of the bulge dragged ahead is offset from the line joining the Earth and Moon, which means part of that attraction is accelerating the Moon slightly, and pulling back against the Earth’s rotation. Paradoxically, giving something in orbit a push from behind or a pull from in front does not produce the result one might expect. The object does not go faster; it moves into a higher orbit. So this tidal pulling at the Moon is slowly moving it further away from us. The effects are tiny: in 100 years the Moon moves 38 mm further away and our day lengthens by about 2 milliseconds.

It is believed that our ancestors came out of Africa some 60 thousand years ago. So their day would have been 1.2 seconds or so shorter than it is now, and if we have not rendered ourselves extinct by then, it will be around 1.2 seconds longer in 60,000 years. Actually, it could be a little less than that because as the Moon moves away, its tidal influence on us will decrease. Although the gradual slowing of the Earth’s rotation by tidal forces is unlikely to be a problem for us any time soon. Another consequence is that eventually there will be no more total eclipses of the Sun.

At the moment we enjoy an astronomical coincidence that might not occur anywhere else in our galaxy, possibly in the universe. From the Earth the Moon looks almost exactly the same size as the bright disc of the Sun, and occasionally it moves precisely between us and that disc. The result, which we call a total eclipse, is that the bright disc of the Sun is precisely covered and we see the dimmer structures in the solar atmosphere, such as the million-degree solar corona.

As the Moon moves away, total eclipses will get rarer, and replaced with events where part of the bright disc remains uncovered. Then, one day in the remote future, astronomers, assuming there are any, will gather at some place on Earth, to see the Moon cover the solar disc one last time. Of course that also will not be for quite a while.

Venus lies in the southwest after sunset, with Mars close by and much fainter. Jupiter dominates the southern sky and Saturn rises around 3am. The Moon will reach First Quarter on the 25th.

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