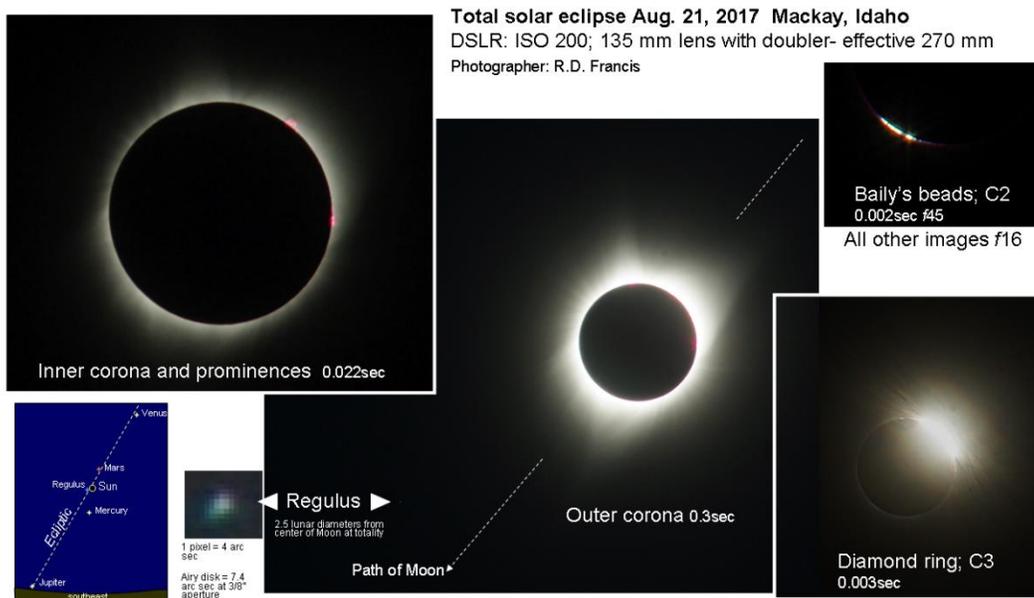# Eclipses, Keeping Track of Ancient History, and the Winding Down Celestial Clock
- Robert D. Francis

The total solar eclipse of August 21 had been predicted, to within a second, at each location along its path across the U.S.   The same is true of every solar and lunar eclipse for thousands of years in the past, as well as into the future. This allows us to date events in ancient history, like wars or reigns of kings, and it also provides evidence that the Earth is gradually spinning slower and slower. If you think the spinning of the celestial spheres is an immutable celestial clock, think again.

Total solar eclipse Aug. 21, 2017 Mackay, Idaho
DSLR: ISO 200; 135 mm lens with doubler- effective 270 mm
Photographer: R.D. Francis

Inner corona and prominences 0.022sec

Baily's beads; C2
0.002sec f45
All other images f16

Regulus
2.5 lunar diameters from center of Moon at totality
1 pixel = 4 arc sec
Airy disk = 7.4 arc sec at 3/8" aperture

Outer corona 0.3sec

Path of Moon

Diamond ring; C3
0.003sec

Dozens of eclipses were observed and meticulously recorded by the Chinese, Babylonians and others going back nearly 3,000 years. Some are linked to particular historical events. A famous one occurred in 585 BC during a battle between the Lydians and the Medes. According to Herodotus, both armies laid down their weapons, and a truce was concluded.

The ancients did not have a universal way of counting the years, as we have now, but often reckoned the years of their lives after the reigns of kings. This includes kings of Babylon, Persia, Israel, and the emperors of Rome going from 747 BC to after 30 AD. By correlating ancient eclipse records, such as a series of 36 eclipses in ancient China, to modern eclipse calculations, it is possible to assign reliable dates to historical events.

There are a few small inaccuracies, however. For example, a total solar eclipse on April 15, 136 BC, recorded on a Babylonian cuneiform tablet, said that totality began at 8:22 AM, but modern calculations put the time 3.4 hours later. Similar errors occur for other eclipses. The problem is that the modern calculations assume that the length of Earth's days has been constant. If, however, it is assumed that day has lengthened by about 1/30 of a second in the 2,153 years since the Babylonian eclipse, the 3.4 hour discrepancy more or less disappears. 1/30 of a second seems insignificant, but in over 2,000 years it adds up. 1/30 x 365 days is 12.2 seconds in a year. In 2,153 years an

error of 13,133 seconds, or 3.64 hours, accumulates (you have to divide by 2 because the difference is 1/30 today, but zero in 132 BC).

Now we know that the tidal force of the Moon is slowing the Earth's rotation. Eventually the Earth will show the same side to the Moon permanently, just as the Moon presently shows one side to the Earth. Thus the Earth and Moon will be locked in a tidal embrace, but this will not happen for billions of years, probably after the Sun has become a red giant and swallowed the Earth.

However the historical eclipse records don't quite square with this tidal breaking explanation; note that the solution above slightly misses the 3.4 hour discrepancy. Other ancient eclipses are off by varying amounts, suggesting that the day is not lengthening at a steady rate. Possibly there is some gravitational interaction between the liquid core and the solid mantle. It's like walking around with a jug half full of sloshing water. The Earth is quite a complicated clock, and not as reliable as some have believed!