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IT'S ABOUT TIME!

Ken Tapping, 8th July, 2014

We have been measuring and expressing time in some way for centuries. However, over that period our idea of time and how to determine it has changed a lot. For much of our history, having some way to "know the time" has been to do with managing our hours of daylight and in some cases scheduling religious observances. The day was set to be 24 hours long, with noon being when the Sun was at its highest angle above the horizon, which happens when it lies due south. Midnight was then when the Sun lay due north, somewhere below the horizon. Even today, in our industrialized society, hours of work are mostly set up to make best use of hours of daylight. Measuring what we can call Local Solar Time, which is more or less Local Standard Time, is easy; we can do it using a sundial. The earliest examples were just sticks or rocks stuck in the ground. However, over the centuries sundials became more sophisticated and more accurate, and could even tell time of year.

Unfortunately, sundials are not portable; they have to be carefully set up, and are useless in cloudy weather or at night. In Northern Europe there are many cloudy days and in winter at latitudes above 45 degrees or so the Sun does not spend much time above the horizon. So some other means of monitoring the passage of time were invented. Initially these were calibrated candles, water leaking at a steady rate through a small hole, hourglasses or many other ingenious inventions. This culminated in the pendulum clock. Mechanical clocks improved dramatically over the years. Then electronic clocks came along, using crystals and then resonances inside atoms. These are so accurate they led us to a problem that we are facing today. They are so accurate they can be used to detect the slowing of the rotation of the Earth due to tidal effects by the Moon and Sun, and changes in the rotation rate due to Earthquakes. Since solar time is linked to the rotation of the Earth, they can detect changes in it.

This led to the need to periodically adjust our electronic clocks to keep pace with solar time. We do this by establishing the solar time by precise astronomical measurements and tweaking our electronic clocks by adding an occasional "Leap Second" whenever the error gets too large.

Although on one side we want our clocks to stay in step with solar time, so we can continue to work with the Sun, there are some applications for which these tweaks are a problem. For example navigation satellites like to use clocks that don't need to be adjusted. Adding an occasional Leap Second reliably can be difficult. This has led to a choice we need to make; whether to keep our clocks as they are, synchronized with the rotation of the Earth and the rhythm of day and night, or to let our clocks run at a steady rate. Initially most of us would not notice the difference, but eventually this would lead to big differences between Local Solar Time and official clock time. Then we would have to decide whether to make a big correction to get Local Solar Time and clock time back in step, or to allow the discrepancy to get larger and larger. Maybe we will need to maintain two time systems and monitor the difference between them. In an age where we worry about the basic nature of space and time, it is interesting to see that our biggest problem with time is totally practical. That's something to think about next time you set your watch to "The beginning of the long dash", from NRC's time transmissions on the radio.

Jupiter is now lost in the sunset glow. However, we still have Mars and Saturn. Mars, the bright red starlike object in the south-west needs a big telescope to enjoy it, but Saturn, a moderately bright object in the south, is magnificent, even through small telescopes. Venus rises about 4 am. The Moon will be Full on the 12th.

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