



**UP THE CREEK**  
**September 1, 2014**

*How nothing is as simple as it should be*

As shown on the accompanying “Just the Facts,” the official start of the fall season, AKA the Autumnal Equinox, is to occur September 22. This newsletter began as a harmless, fluffy piece about the significance of the equinox, based on a lifetime of accumulated beliefs, which would have amused most of you who know more than I do about the subject. Then I made the mistake of doing a little research, proving again the rightness of Michel de Montaigne who said, “Nothing is so firmly believed as what we least know.”

The word “equinox” is claimed to be from Latin meaning “equal night,” which I would assume implies equal night and day. So the sun should spend equal time above and below the horizon on equinox day. To prove it, I visited the online US Navy Observatory website. There you can order up a table of sunrise and sunset times customized for any location. A table calculated for Cedaredge reports that the sunrise on September 22 will be 5:59 Mountain Standard Time, and sunset is – er – 6:09. So how come there's ten minutes of non-equinox?

Well, it turns out that the equinox would be the day when the *center* of the sun (don't try to find that without a welding helmet on) would cross the western horizon 12 hours after crossing the eastern horizon, whereas sunrise and sunset are computed to be when the *upper rim* of the sun crosses each horizon. Actually, we should say when the upper rim of the sun *appears* to cross the horizon. There is this thing called atmospheric refraction that, by bending light, makes the sun appear to be fully risen each morning while in reality it's still below the horizon. The same illusion happens in the evening. The sun is long gone as we watch it begin to set. So every beautiful sunset is a mirage, the real thing having happened some minutes ago. “Man, that sunset was unreal!” You just said a mouthful, friend.

The US Navy Observatory takes atmospheric refraction into account when calculating sunrise-sunset times, to match the image that we deluded humans see, rather than what celestial mechanics says is actually happening. Now there is another website [www.timeanddate.com](http://www.timeanddate.com), which quibbles that the atmosphere must have a pressure of 101.325 kilopascals (kPa) and temperature of 15°C in order for the calculation of refraction to be correct. That means that if you are going to stand outside and check the table of sun rise and set times, you need an accurate timepiece, a barometer, a thermometer, and some idea of what a kPa is. I have heard you can put kPa in car tires, as a substitute for psi, but it takes about seven times as many, and it may make the vehicle ride rougher.

Okay, if not on the official equinox, is there is a date with equal day and night? Yes, and it depends on latitude. It occurs earliest on August 29 at latitude 5 degrees south and latest on October 17 at 5 degrees north. Here at latitude 39 north, it happens on September 26. Nowhere does it actually happen at the official equinox. It must be that we are working with a poor definition. Here's the scientifically correct one, from timeanddate.com: “The equinoxes occur at the moment the sun crosses the celestial equator – the imaginary line in the sky above the Earth's equator.”

Right. It helps if you are smoking kPa.