GPS is Out! Radio is Out! And I'm WAY Out! Home is..??? (4 of 4)

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Since time immemorial, sailors have "sailed down the latitudes" and this column finishes answering what you might do when you are far at sea – celestial navigation with "string and bailing wire" with our home-made Quadrant.

The Equation of Time – Or The Little Poem

OK, back to the top. I said another requirement was remembering a little poem – and it has to do with the scientific fact that the Earth wobbles a little around its axis. This means that Sun passes over Greenwich, England at noon – but not exactly. It passes overhead at sometime between 11:44 GMT and 12:14 GMT, depending on the time of year. So, what is the adjustment? It is in the poem…

14 minutes late around Valentine's Day
4 minutes early in the middle of May
6 minutes late near the end of July
16 minutes early when Halloween's nigh

These variations last two weeks either side of those four peaks.

Again, with a calendar and some simple arithmetic, the Equation of Time can be calculated for specific days to within a minute of the correct figure. Let's go back to the April 24th example above. We have to calculate the number of days from two weeks after Valentine's Day to two weeks before the middle of May, i.e., about 61 days. April 21 is 55 days into this period, i.e., about 90% of 61 days. The (absolute) range between Valentine's Day (+14 minutes) to mid-May (-4 minutes) is 18 minutes. 90% of the 18 minutes range is about 16 minutes. So the Equation of Time is 14 - 16 minutes = -2 minutes. So, on April 24th, the Sun crosses the Greenwich Meridian at approximately 11.58am (noon less 2 minutes!)

OK, Now Let's Find Our Latitude

We've assembled all the pieces. The rest is math. First, measure the Sun's altitude when the Sun is bearing due south (or north, if you are in the Southern Hemisphere) with your Quadrant and deduct it from 90°. The result is the angle between your zenith and the Sun. In navigation, this angle is known as the Zenith Distance. To calculate your latitude, think about where the Sun lies in relation to you and the equator. If the Sun is between you and the equator (as it would be in our climes), add the Sun's declination (12.9o in our example above) to the Zenith Distance. (If the equator is between you and the Sun, deduct the Sun's declination from the Zenith Distance.) So, let's say that at noon on our April 24th example, the Sun has a declination of 12.9° North. In our example, the Sun's altitude is found to be, e.g., 61° via our Quadrant so its Zenith Distance is 29° (90-61.) The Sun lies between the observer and the equator, so the declination is added to the Zenith Distance. The latitude, therefore, is 29° + 12.9° = 43.9° North.

Next, Finding Longitude – Where is it Noon?

The Earth rotates 15° each hour or about 1° every 4 minutes. Knowing this, the rest is, again, math. If it is noon where you are, the difference in time between the Sun's transit over the Greenwich Meridian (noon, Equation of Time above) and the time it took to your position can be converted directly to a longitude. Remember we noted that GMT is 5 hours ahead of Eastern Standard Time at the top of the column? So, how many degrees is 5 hours of time when 1° every 4 minutes? Five hours is 300 minutes, which 5 goes into 75 times, or 75o – but few people sit exactly on the meridians so you need to make measurements. Timing the Sun's exact transit over your meridian, however, is not easy. Using the simple equipment described here, the best method is to measure the Sun's height a half-hour or so before noon and note the time of the observation and continue to do so periodically until the Sun has descended to an equivalent height a half-hour after noon. Average the results and this will be very close to the actual measurement at noon. (It also assumes that your position has remained pretty much unchanged in the intervening period.)

So, again using our April 24th example, if we averaged times of 1630 UCT over our meridian and we know from above that noon at Greenwich was 1158 UCT, we have 4 hours, 32 minutes (272 minutes) of Longitude to account for. 272 minutes divided by 4 (1° every 4 minutes) means we have 68° of west (after) Longitude. So, pulling all the examples together, we would have found ourselves on April 24th at 43.9° North by 068° West, or just south of the Sea Buoy "TBI" at the entrance to Penobscot Bay up in Maine!

Admittedly, this wasn't easy. But it wasn't hard either – it was simply detail intensive but if that results in knowing where you are, the tedium turns into satisfaction and some degree of excitement to be "at one" with the world's great navigators and explorers! And hopefully it gives you an answer to the "all systems failed – now what?" question! It is also an appreciation of how wondrous the GPS system is (see "Gee, How Does GPS Do It?", SSP, 1/2/08) since all this and much more is done instantly. And we've passed along important celestial navigations techniques and concepts, which we can't forget…!

I would like to thank Tony Crowley, who lives in Herts, England, for inspiring this article. Tony is a published author. He wrote a book called The Lo-Tech Navigator which was published by Sheridan House, and is a contributor to Ocean Navigator magazine, http://www.oceannavigator.com.

BTW, if you are interested in being part of USCG Forces, email me at JoinUSCGAux2010@aol.com or go direct to John Blevins, who is in charge of new members matters, at FSO-PS@emcg.us and we will help you "get in this thing…"