Thursday. May 19. 1870. (1)

Saturnine Calculations

Dear George,

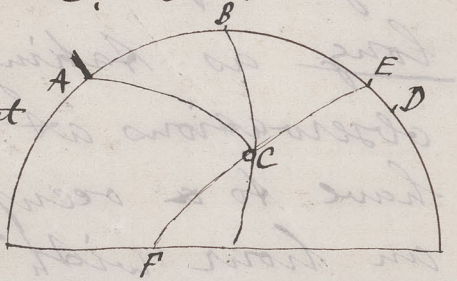
I suppose you will ~~not~~ object to my ~~take~~ making use of your cannons & gun-powder to celebrate the Queen's birthday.

I have at last succeeded to get satisfactory mirrors for my quadrant. I got a piece of ~~no~~ plate glass & varnished it with asphalt varnish, for the moveable mirror; & I got a piece of plate glass mirror for the fixed one. I found that any mirror, even a plate glass one, when it is put at high angles gives two reflections, or more, & is therefore ~~is~~ of little use for an instrument; whereas varnished plate gives only one at any angle. I made

them both of varnished plate, but I found that that gave so little light as to be almost useless; ~~so that~~ Therefore I changed the second one for a plate glass mirror. You look straight into the fixed mirror, so that the above ~~mentioned~~ mentioned defect does not interfere. I find that the mode of observation of the sun mentioned in last letter is highly preferable to old method for 2 important reasons, viz:- (1) A sextant only reads to 120° degrees so that if the sun's altitude at noon is more than 60° (as it is at present) an observation cannot be made ~~the~~ with an artificial horizon. (2) The sun's altitude changes very little at noon, ~~for~~ in a long period of time, whereas ~~if~~ if the observation is made at 7 or 8 A.M or 4 or 5 P.m, when the sun is going almost straight down the observation is much more accurate. For the sun goes at the rate of 15° in an hour, i.e. 1' in 4 seconds of time.

So that with a quadrant reading down to minutes you can ascertain your time within ~~2 or~~ 4 seconds or with an artificial horizon, within 2 seconds. I generally observe the altitude of the sun, & then as my quad. only reads down to degrees, I put it at the next degree, & wait for the sun to ~~come exact~~ come to that altitude. I then proceed thus:—

~~Given, in the spherical triangle ABC the line~~



(A is the pole,
D " " equator,
E the place of the sun at noon. EF is apparent path, B the zenith, & C is place when observed.)

Given in the spherical triangle ABC, AB (the colatitude of the place), BC (the co-altitude of the sun) & AC, (the N.P.D. of sun), to find the angle BAC. For there are the same number of degrees, min. &c, in the angle ABC as there are in the arc EC, ~~Suppose~~ for EC is a circle of Latitude.

Suppose then the angle BAC was 60° 15′ then, allowing 15° per hour, the time is 4h 1m P.M., or 4h 1m before noon, as the case may be.

~~Then Then subtracting or adding~~

Then if the equation of time is +3 minutes the time of observation was 4h 5m, so that by comparing the with the time by watch, your error may be found. This is not so long as taking equal altitude observations at noon; for you have to occupy at least half an hour with that; whereas I can calculate the time from this in 12 or 15 minutes. There is a simple rule given for the above calculation in the book on navigation which I got. You only need to have a table of Logarithmic sines, tangents, & secants. Hoping that you will excuse this very dry letter, I remain your affectionate brother, William.