Roemer and the Speed of Light PhL 2.2.03

The moon Io is regarded as a perfect clock which ticks once every 1.76 earth days. If you look at it all the time through a telescope, you could write down the exact time it vanishes behind Jupiter for each of its orbits.

Suppose for the sake of argument the period of Io were exactly 24.00000 hours. Suppose when earth is at closest approach to Jupiter (opposition), the "ticks" made by the start of the Io eclipse occur at exactly 2:00 AM in the morning. Each night you go out in your back yard and you measure the absolute time the eclipse starts (not the duration of the eclipse). It is always 2:00 AM. Now without altering your perfect earth clock, you wait until about 6.5 months and then do some more readings. At this time, earth is at its farthest approach from Jupiter. Yes, you have a little trouble doing the readings because Jupiter only appears close to the sun, so maybe we shift our time to 5AM or something? Well, that is too hard. Instead, let's wait 3.25 months and then do some readings. We find perhaps that the eclipse starts are now around 2:08 AM instead of 2:00 AM as measured by our perfect earth clock. We explain this by saying simply that the light from Jupiter took an extra 8 minutes to reach us at this time of year, because it has to go about an extra sun-earth orbit radius, and we know from Kellog's ads that this time is about 8 minutes for light.

So Ole Roemer (Danish) used this idea to measure the speed of light. He had to know something about the radius of the earth's orbit and the nature of the two orbits. With the data at the time, he calculated about 2/3 of the correct value, not bad for 1676.

This was the <u>first</u> measurement of c ever done by our civilization. Before that, Galileo estimated at least 10X faster than the speed of sound.