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Stellarium software and the occultation of Aldebaran observed by Copernicus

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Abstract

Here we propose an example of the use of Stellarium software for simulating a phenomenon of 1497, the lunar occultation of Aldebaran observed by Nicolaus Copernicus. We will also use CalSKY for the phase of the moon.

Stellarium software and the occultation of Aldebaran observed by Copernicus

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Here we propose an example of the use of Stellarium software for simulating a phenomenon of 1497, the lunar occultation of Aldebaran observed by Nicolaus Copernicus. We will also use CalSKY for the phase of the moon.

Stellarium is a free open source planetarium which possesses a remarkable visual rendering of the sky and of the horizon. It is easy to use, in particular in choosing time and location of observations. We used it in some previous papers to simulate the sky seen by ancient stargazers [1-4]: simulations were quite useful in understanding the links of the ancient anthropized environment with the night sky and stars.

The examples proposed in [1-4] are concerning prehistoric times. However, there are many phenomena that we can find in historical records. Here we propose one of them, simulated by means of Stellarium: the lunar occultation of Aldebaran observed by Copernicus and mentioned in his book De Revolutionibus Orbium Coelestium. It is an example which uses another remarkable feature of the software, related to the calendar.

In [5], we read the following sentences about Stellarium: “Go to the date October 4, 1582 using the ‘Date/time window’. Fast forward the time using the bottom menu and keep your eye on the date you see. Did you find anything interesting? Try entering any date between October 5th and October 14th of 1582. Stellarium doesn’t allow you to enter these dates, because they don’t exist!! This is because of the calendar reforms by Pope Gregory

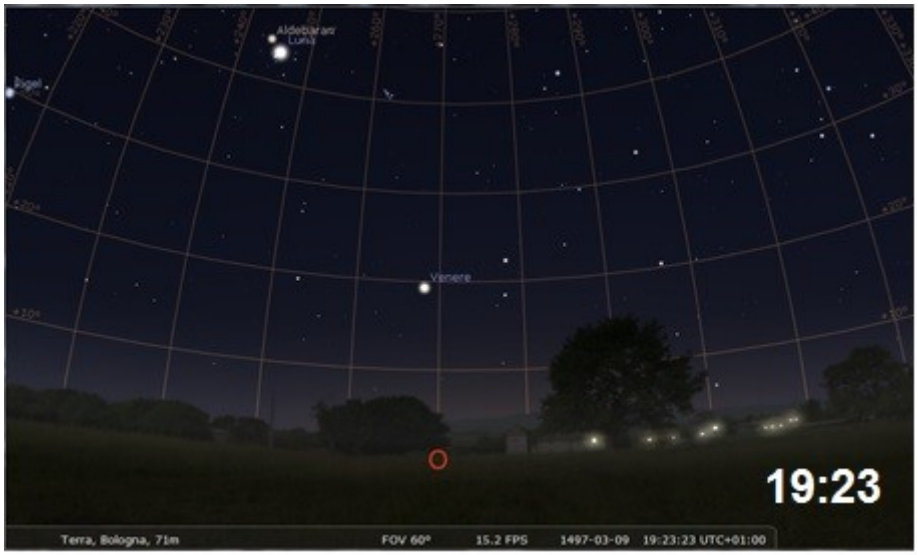
in 1582". The Pope introduced the Gregorian calendar as a refinement to the Julian calendar that was in use at that time. Moreover, it was necessary to have an agreement between the calendar and the dates of equinoxes; to have this agreement it was decided to remove ten days from the calendar, so that October 5th became October 15th 1582.

Therefore, if we are using Stellarium and we have a phenomenon recorded with a Julian date, we simply need to put this date in the software to see the sky of that day. Let us consider then the observation made by Copernicus of the lunar occultation of Aldebaran. It was on March 9, 1497 (Julian calendar). For the simulation we need also to know the location.

Nicolaus Copernicus was born in Thorn, Poland in 1473. He studied mathematics and astronomy at the University of Krakow. Thanks to his uncle's influence, Copernicus became a canon of the Church. In this manner, using the income gained from his position, he had the possibility to travel in Italy for further studies. So he spent some years in Bologna, Padua, and Ferrara. While he was in Bologna, he lived at home of his professor, the astronomer Domenico Maria Novara [6]. It was in Bologna that Copernicus made his first astronomical observations, that he made with the naked eye. In fact, Copernicus died in 1543, more than fifty years before Galileo used, for the first time, a telescope to observe the sky (Galileo discovered the satellites of Jupiter in 1610). However, it is possible that Copernicus used a sighting tube. This instrument was a tube without lenses that an observer could use to look through. The sighting tube was effective in blocking out the light around and allowing the observer to better concentrate on a single object. From his observations and studies, Copernicus concluded that the Earth rotates daily about its axis and that every planet, including Earth, are revolving around the Sun.

In the De Revolutionibus Orbium Coelestium, Book IV, Chapter XXVII (we use the edition of 1617, Nicolai Copernici Astronomia instaurata, libris sex comprehensa, qui de Reuolutionibus orbium caelestium inscribitur, excudebat Wilhemus Iansonius, Google e-book), Copernicus discusses the problem of the parallax of the moon. He reports the observations he made in Bologna, with his professor Novara of the abovementioned occultation on 9 March 1497 (he also observed a conjunction of Saturn and the moon on 4 March 1500 [7]). Let us read the words written by Copernicus on the occultation in the Chapter entitled "Confirmatio eorum, quae circa Lunae parallaxes sunt exposita". He tells: "Quod igitur parallaxes Lunae sic expositae conformes sint apparentijs, pluribus alijs experimentis possumus affirmare, quale est hoc quod habuimus Bononiae septimo Idus Martij post occasum Solis, anno Christi 1497. Consideravimus enim, quod Luna occultatura stellam fulgentem Hyadum, quam Palilicium vocant Romani, quo expectato, vidimus stellam applicatam parti corporis Lunaris tenebrosi; jamque delitescentem inter cornua Lunae in horae quintae noctis, propinquiorem vero Austrino cornu per trientem, quasi latitudinis sive diametri Lunae." Copernicus is using the Julian Calendar and tells that the observation was made in the evening, seven days before the Ides of March. For the star Aldebaran, he is using the Latin name Palicium. He continues to discuss the phenomenon, telling also that "manifestum erat, quod centrum Lunae secundum visum praecedebat stellam dimidia diametri, & idcirco locus ejus visus in longitudine partium 2 scrup. 36. In latitudine part. 5 scrup. 2 fere. Fuerunt igitur à principio annorum Christi anni AEgyptij. 1497 dies 76, horae 23 Bononiae, …". Here we can also appreciate the difference between the Julian Calendar and the Gregorian Calendar we use today. Copernicus explains that the observation was on the evening of 76th day of year 1497. Today, March 9 is the 68th day of year 2017.

Let us use Stellarium to simulate. The result is given in the following Figure 1. The occultation was due West. In the evening, Aldebaran was approaching the moon, as shown by the snapshots.



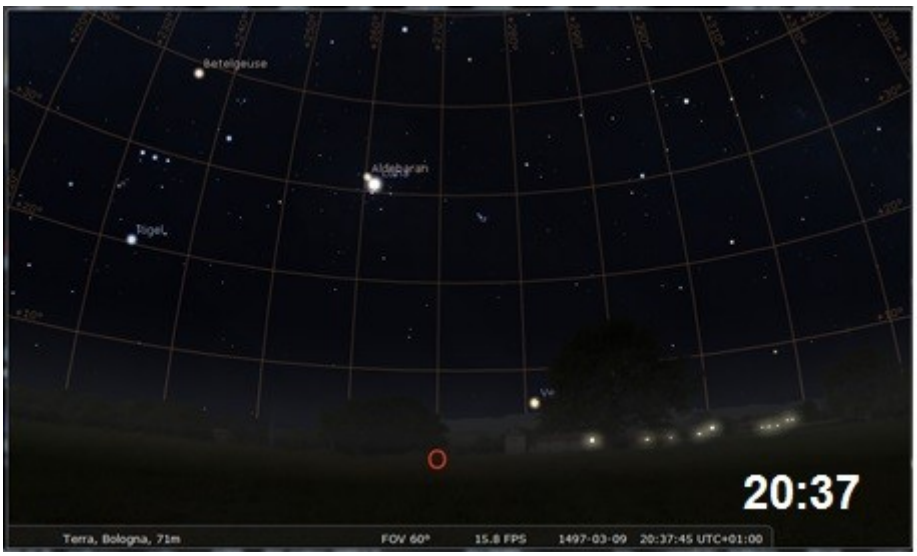


Figure 1: Observation due West (O, Ovest), from Bologna, March 9, 1497. Using Stellarium, we can see Aldebaran approaching the moon, as shown by the two snapshots.

In Stellarium, about 22:20, we have visible only the moon. Then, also the hour is in agreement with the words written by Copernicus, who told that the occultation was at the 23th hour of the day.

Copernicus is also describing the lunar phase. For what concerns the moon then, let us use another software. It is CalSKY, available at www.calsky.com/cs.cgi (we used it in [8]). We obtain that Saturday 4 March 1497, it was New Moon. Saturday 11 March 1497. Moon: First Quarter. This is the northernmost first quarter moon of the year. Former more northern first quarter moon was at 18.3.1491. Next more northern first quarter moon is at 1.3.1498. Saturday 18 March 1497. Moon: Full Moon. Saturday 25 March 1497. Moon: Last Quarter. This is the southernmost last quarter moon of the year. Former more southern last quarter moon was at 3.3.1491. Next more southern last quarter moon is at 14.3.1498.

In fact, Copernicus tells that he and Novara saw "stellam applicatam parti corporis Lunaris tenebrosi". The star was approaching the dark part of the moon (they were observing due West, the illuminated part of the moon was

towards the sun), closer to the lower horn, “propinquiorem vero Austrino cornu”.

Besides the lunar occultation of Aldebaran, described in De Revolutionibus, we can also use Stellarium to see the conjunction of Saturn and the moon on 4 March 1500 (Figure 2). This phenomenon is not described in the abovementioned book [9]. Using CalSKY, we have that Sunday 8 March 1500 was the first quarter moon and therefore Copernicus was observing the sky in the same condition of the lunar occultation of Aldebaran.

The two examples shown in the Figures 1 and 2 demonstrate the use of Stellarium for the simulation of astronomical events of which we have location and date, of Julian or Gregorian calendar (in the case the moon is involved, the software CalSKY is useful too). In fact, the simulation can help us in understanding the text written by Copernicus, such as in all the other cases of which we have a detailed description in historical records.

Figure 2: Observation due West (O, Ovest), from Bologna, March 4, 1500. Using Stellarium, we can the motion of Saturn with respect to the moon. Here in the image, the two bodies are almost coincident.

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