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English Medieval Monks Could Have Calculated Longitude By Eclipse. Why Didn't They?

By Charles Kos

This article offers some ideas relating to several eclectic topics, which nonetheless have a common thread: Eclipses, longitude, and then Columbus. When looking through medieval English chronicles, (in this case translated into English, from Latin, accessible online for download in the public domain, such as *Matthew Paris's English History*) a few things become apparent. One is that monasteries, storehouses of knowledge, in days when universities were rare, had some knowledge that any singular lunar phenomenon might be visible at different locations on the Earth's surface, at different times. Monks could have applied this towards geographical calculation, as one of several possible methods for calculating longitude. They generally did not. Why?

I have a medieval history background. During my own historical research I noticed a few notes of interest for astronomers in the *Chronica Majora* of Matthew Paris, c.1200-1259. (That surname ironically appears to be an English name of the period, though he may have studied at Paris University.) Milton called him 'the greatest of our historians.' Paris was a monk of St Albans abbey, a one-day ride north of London. He was one of England's most prolific chroniclers. His output was such that his unique handwriting style was formerly referred to as the 'St Albans' hand', and was thought to have belonged to a collection of many scribes, all imitating the same technique. Where monastic annalists would write a paragraph or two summarising the year's events, Paris would write dozens of pages, many illustrated. His personal motto, always kept in mind was: 'Laziness is the enemy of the soul.'

We know comparatively little about the extent of medieval astronomy (even after the Middle Ages, John Dee's astronomy textbooks, which offered him an entry into professorship in Maths at Oxford, which he turned down, have been lost. His books on magic survive, perhaps skewing his modern evaluation as largely a magician). Many works have been lost, for instance in the wars of church reformation across Europe. An interesting entry jumps out of the page. It seems there was a lunar astronomer active in St Albans in the twelfth century, for the following is written and perhaps formulated by Roger of Wendover, or his predecessor under the year 1191:

A remarkable eclipse of the sun. In the month of June in the same year, on Sunday, the eve of St. John the Baptist, there appeared about the sixth hour of the day, an eclipse of the sun, which lasted till the eighth hour, the moon being twenty seven days old and the sun being in the sign of Cancer.

At once we see the mark of an astronomer conducting measurement, but also an astrologer. For instance noting the constellation of the eclipse would indicate the 'influence' of both; they were intertwined subjects until perhaps the 1600s. The constellation and age of the Moon also references a coordinate in space and time. The successor, Matthew Paris does not seem to have bothered with the constellations. Under the year 1248 we have:

On the feast of June in this year, just after sunset, the moon underwent an almost total eclipse.

This does not tell us the hour. No constellation is recorded. This is typical of Paris. Initially reading Paris' eclipse entries, I assumed astronomy skill at St Albans had in fact declined. Then I saw the following stunning statement, under the year 1256.

Whilst the festivities of Christmas were still being kept up, on the sixth day after Christmas-day, and the third before New Year's Day, which was the eve of St. Sylvester, the Sun underwent a partial eclipse. At Toledo the eclipse was total; and on the third day following, which was the Circumcision, the moon, according to the calendar, was one day old.

This is a remarkable passage. Toledo was the capital of astronomy in the west, in central Spain. They issued what are now known as the 'Tables of Toledo' (as well as strange astrological forecasts for coming earthquakes, wars and other disasters). These were based upon earlier Arab tables, of which there were a great many, and used for navi

Fig 1: *A conceptual schematic of the way the world should be plotted, according to Isidore of Seville, c. 560-636. The vertical line is the Mediterranean. The horizontal line is the Bosporus, Black and Azov Seas to the left, and Red Sea to the right. The implication of the Earth having only one face, and of majority landmass, perhaps reduced their need for developing a system of longitude.*

gation. These received an update in the 1270s, thereafter known as the 'Alfonsine Tables.' Perhaps the furthest and holiest journey an Englishman could make was a journey to Jerusalem, at the world's 'centre,' for which longitude calculation was not required.

The chronicler seems rather sure of himself. If a table was used, it evidently merely contained solar references, but otherwise, knowing the position of lunar phenomena at two different places on the globe, at the same time (read off from tables) would theoretically allow the calculation of a crude form of longitude. It could help in formulating attempts at dimensions of the known world. This was never taken advantage of, perhaps because monastic maps plotted Jerusalem at the centre of a disc, the Earth lacking any grid. Fig. 1 shows an idealised medieval vision of the Earth's surface.

On the other hand, St Albans is but a day's ride north of London, one of the richest monasteries, with many dignitaries staying to rest, from England and overseas. Writing the events down, by now, a year or two after they occurred, Paris has either developed a sudden interest in astronomy, late in life, or he has heard about this from a traveller. Paris cared about the difference between Toledo and St Albans enough to write about it in his chronicle. Did he develop the implications of this? No. Did his contemporary Roger Bacon make use of this information? That requires further research. Bacon copied and certainly possibly developed a longitude system used by the Arabs, (A notable exception to the title of this article, so there was at least one monk engaged in the field!) but the details are obscure, and require further research. In the absence of printing presses, the same book, rewritten, was sometimes ascribed to the person who copied (and inevitably modified) it. Citations were not made very often.

I am not aware of specifics as to method, but if the information was read off a table of measurements taken at Toledo, an eclipse in England could be compared to Toledo. (Modern system: London: 0.07° W, Toledo 4.02° W) Did astronomers at St Albans in the 1100s have access to such a table? Knowing the local time in Toledo as well as in St Albans at the time of the eclipse would have allowed a theoretical attempt at longitude, using the time difference as a certain number of hours and minutes of longitude. There is no evidence of the calculation of any longitude at St Albans: monastic maps also differed to navigational maps. All the known islands of the Earth were plotted on one side of a flat disc (or representation of a sphere). Paris even once complained that it was difficult to squeeze the British Isles onto the edge of such a map (Known as a Mappi Mundi, or Cloth of the World). One is reproduced in Fig 2. English chroniclers and others in the west had the misfortune to have Toledo located on a similar longitude. If only other Arab tables of the east were circulated in the monasteries, the time difference of eclipses may have been more obvious than with reference to Toledo.

Fig 2: *An English (the Psalter) Mappa Mundi. With Jerusalem as a sort of central 'pole', a world filled with land and cities perhaps makes it hard to think about longitude. Possibly aware of the spherical nature of the Earth, continents and islands are nevertheless all plotted on one side by monastic mapmakers. (A confusion with the Moon always showing one side?) Perception was hamstrung by the desire to view Earth as if it were a divine vision, like Enoch perceiving all the lands from above. (Maps of Matthew Paris, p. 209). A vast ocean surrounds the landmasses with its islands squeezed into the edges, however large they may really be.*

Columbus, knowing of the round world for certain, was less hamstrung. Using the ephemeris of Regiomontanus, he is known to have awed the locals in Jamaica in 1504 with a lunar eclipse. The 2.5 hour deviation in longitude west of Cadiz that he reported, relative to his tables, has been accounted for as reading the table as if it were the beginning of the eclipse, not midpoint, as Regiomontanus intended. (D.W. Olson, Sky and Telescope, 1992) Then again it also fit into his political/geographical conceptions of a smaller earth, claiming he was 7.5 hours west of Cadiz instead of 4.5 hours.

Columbus' longitudes and other calculations, (he gave longitude as a certain amount of hours west of Cadiz) were well off, perhaps indicating they were not determined based upon any eclipse, but upon how far he thought he had travelled in relation to the globe of his dimension.

The problem with the medieval conception was that monks thought in terms of a spiritual existence of city-to-city itineraries and pilgrimages rather than from the perspective of efficient trade-based travel, as practiced by

the Venetians. It is thought that the monks developed or retained an alternate world-map system in parallel with the traders of their day, who may have had greater access to the Arab maps and tables, and who possibly recognised that much of the Earth was water.

With Toledo at a similar longitude to anywhere in England, another point is raised. Monks were known for keeping to an hourly schedule, of a day divided into segments (Kells, *Book of Hours* for instance. A man rung a bell in a tower before clocks took over by the end of the middle ages). Yet with a sundial, sometimes difficult to read with the changing seasons, minutes are not bothered with, but could have been estimated by hourglass. If the difference between observation points is less than an hour, it would be perceived to occur perhaps at the same time.

Conclusions:
Progress in calculating distance by longitude was held back by, among other things, a desire to represent the Earth in a partly spiritual, unipolar format. In addition the lack of significant or obvious longitude difference between the centre of medieval astronomy, Toledo, and other European centres may have played a part. This coincided with a lack of precision and accuracy in measuring time, generally limited to an estimate of hours of the day, based upon the Sun. When ocean travel became more ubiquitous, the implication of the time difference regarding eclipses became more obvious, possibly leading to new maps and a firmer necessity to know real longitude.
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COMING EVENTS

Galactic Centre Star Party

Noon Saturday 24
September 2016
at LMDSS
See www.asv.org.au for details

VicSouth Desert Spring Star Party 2016

Hosted jointly by Astronomical Society of Victoria Inc. and Astronomical Society of South Australia
Friday 28 October – Tuesday 1 November (Melbourne Cup Day) 2016
At the Little Desert Nature Lodge, near Nhill, Victoria
See vicsouth.info for details

A Look Back at Murchison — *By Con Stoitsis*

Perry Vlahos wrote a great article on the LMDSS for the last edition of Crux. In the article Perry mentioned the old Murchison dark sky location, used by ASV members before we had the LMDSS. I was lucky enough to observe Halley's Comet from Murchison in March 1986, and also made it up there a few times in 1987. I recall vividly the skies were very dark, but it was a long drive, and the dirt roads were a handful, especially after rain. The location was actually two blocks of land, owned by two friendly farmers.

I've always had a special interest in the Murchison spot, and a few years ago whilst working in the Shepparton area, I was lucky enough to visit the exact location. It hadn't changed much at all, but the sky weren't as dark as back in the mid-80s. A little outside of Murchison there is a lot of residential development under way, and unfortunately this has resulted in an increased amount of artificial lighting.

In early 2004, I contacted both Ken Harrison and Steve Pattie, who were kind enough to shed some light on how it was we came to use this location. The story goes ASV member Ian Downes knew the owner of the first block of land, and when this was sold, the farmer who agisted the property offered the ASV the block of land across the road. This served the farmer well as our presence at night would keep out unwanted visitors. Apparently cattle stealing was still common in those days.

For the record, the first location was used from February 1983 until early- to mid-1986. The site over the road was used from mid-1986 until early to mid-1988. Both locations were just outside Murchison, on Woolshed and Bayles roads. As a teenager, Murchison was the first time I observed from a true dark sky, and it left a life-long impression with me. «