Nicolaus Copernicus as a Surveyor and Cartographer

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Motivations

2023 marked the 550th anniversary of the birth of Nicolaus Copernicus

The World Copernican Congress was held in Poland, where his achievements, in geodesy and cartography, were presented.
https://www.copernicus2023.com/

This presentation is a summary of knowledge about the geodetic and cartographic activity of Nicolaus Copernicus

A few dates from the life of Nicolaus Copernicus

Nicolaus Copernicus was born on 19 February 1473 in Toruń, Poland

Studies in Cracow, Bologna and Padu

- Most of his life he spend in Lidzbark Warmińsk, Olsztyn and Frombork

Nicolaus Copernicus - surveyor

- Prof. Tadeusz Banachiewicz (1882-1954) should be quoted:

"…our great man was also the first modern surveyor, because he stated that the shape of the Earth depends on the force of gravity, that the Earth, like other celestial bodies, must have a round shape for the attraction of particles of matter (long before Newton)"

Nicolaus Copernicus - surveyor

He determined latitudes and longitudes. He used simple instruments such as a spherical astrolabe, an equatorial instrument (instrumentum parallacticum), and a quadrant.

Copernicus achieved relatively high precision measurement in determining time (about one minute) and determining position (about 2' to 5')

- Copernicus determined the difference in longitude between the meridians of Krakow and Frombork. In this way, he introduced the domestic meridian instead of the hitherto used meridian passing through Alexandria and Toledo.

Astronomical instruments in the time of Copernicus

The instruments used by Copernicus:

- Astrolabe, quadrants, triquetrum (equatorial triangle), and others

Quadrant

Astrolabium

Triquetrum

Nicolaus Copernicus - cartographer

Copernicus' first cartographic work was a map of Warmia and part of Prussia, made around 1510.

- This first map of Livonia, made with the participation of Copernicus, has not survived, however, that it fell into the hands of a Cracow canon and cartographer, Bernard Wapowski

Nicolaus Copernicus - cartographer

Copernicus provided the material for the preparation of B. Wapowski's map, published in 1526.

- It is also assumed that Copernicus, together with Wapowski, assisted the Italian cartographer Marcus Benevenano in his work on the first modern map of Central and Eastern Europe (Tabula moderna Poloniae, Ungariae, Boemiae, Germaniae, Russiae, Lithuaniae), attached to the Geography of Ptolemy published in 1507.

Map of Bernard Wapowski from 1526

Endesch's map of Warmia from 1755

Clocks in the time of Copernicus

- The history of timekeeping consists of three main epochs:
- the epoch of continuous flow, lasting until about 1360,
- then the era of non-resonant control (mechanical clocks) which ended in 1656 with the construction of the first pendulum clock,
- the era of resonance control, which continues to this day, and was marked in 1927 by the construction of the quartz clock and the commissioning of the atomic clock in 1955.
  - However, before that, long before the era of continuous flow, sundials were used
- How did Copernicus solve the problem of timekeeping? He must have determined the time from his observations by means of a quadrant and probably by means of some sundial.

Clocks in the time of Copernicus

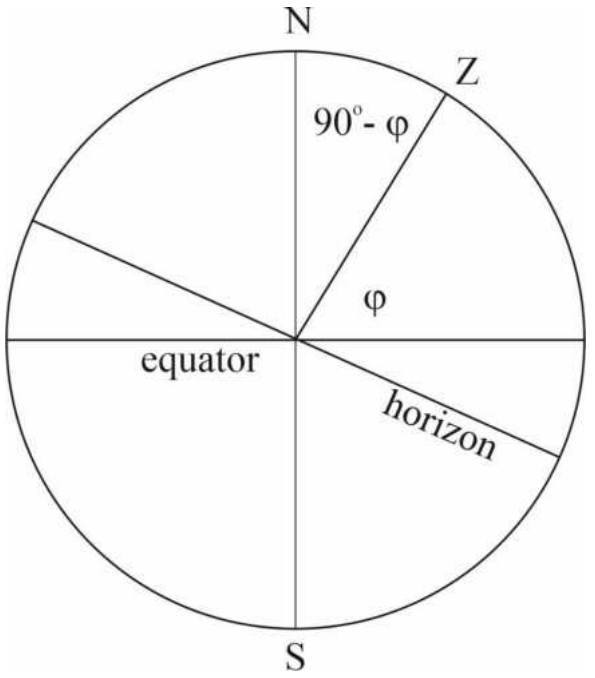
How did Copernicus solve the problem of timekeeping?

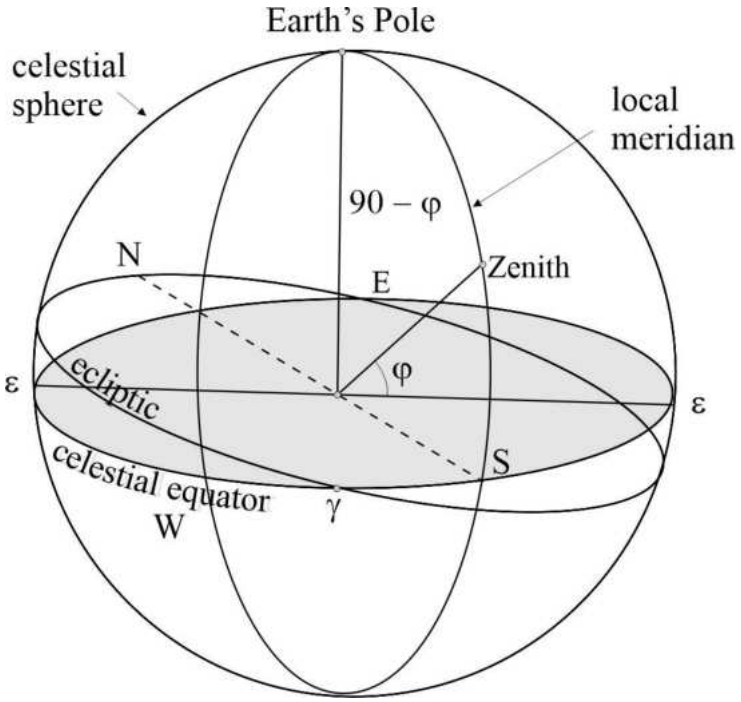
He must have determined the time from his observations by means of a quadrant and probably by means of some sundial. Perhaps it was a clock placed on one of the towers of the Frombork Cathedral, although no mention of it has survived.

- The eminent Copernican researcher Ludwik Antoni Birkenmajer writes that *"there is nothing to suggest that Copernicus had any mechanical clocks, despite the fact that they were no longer rare in the 16th century*".

Determination of latitude in the time of Copernicus

Copernicus to determine the latitude of Frombork from the observation of the zenith distance of the Sun on the days of the spring and autumn equinoxes and obtained a fairly accurate value





Determination of longitude in the time of Copernicus

Longitude has proved to be much more difficult to determine, as it is a function of time and involves the simultaneous comparison of two clocks, one of which is located at a given point of the Earth and the other on the "zero" meridian.

- Ptolemy noted that lunar eclipses are perfect for this purpose, because all phases of the eclipse are seen at any point on Earth simultaneously.
- Copernicus used lunar eclipses to determine the longitude of Frombork.

Methods of mapping in the time of Copernicus

- Ptolemy's geography formed the basis for the world map and twenty regional maps. Ptolemy introduced the concept of geographic coordinates and used astronomical methods to determine the location of points on Earth.

Methods of mapping in the time of Copernicus

- We can guess how maps were made in Copernicus' time by analyzing Bernard Wapowski's work from 1558:

"*A few dozen of the principal points must have been determined in width and length by astronomical means, and the rest of the landscape, of course, already outlined by itineraries*."

Assessment of the accuracy of the Map of Lithuania made in 1613

- The accuracy assessment of the Map of Lithuania from 1613, is: **mϕ ≈12.5'** and **mλ ≈ 39'** (Merczyng 1995)
- Calculations repeated in this paper show that: **mϕ ≈13.1'** and mλ ≈ **35.2'.**

Summary

On the 400th anniversary of the birth of Nicolaus Copernicus, the Municipality of Krakow established a foundation and entrusted the Academy of Arts and Sciences with awarding prizes from the foundation's funds in five-year period for outstanding work in the field of astronomy and related sciences, i.e. astrophysics, geodesy, physical geography, terrestrial magnetism and meteorology. One of the recipients of the Prize is Prof. **Adam ŁYSZKOWICZ**