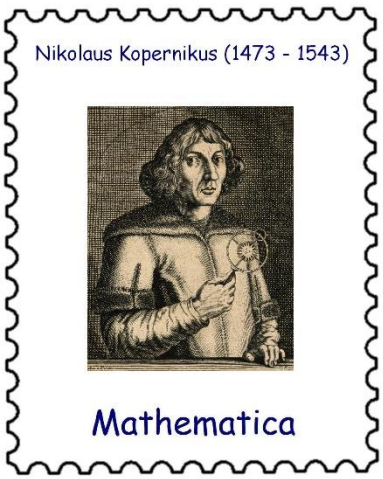
NICOLAUS COPERNICUS (February 19, 1473 – May 24, 1543)

by HEINZ KLAUS STRICK, Germany



NICOLAUS COPERNICUS (in Polish: MIKOŁAJ KOPERNIK) was born in Thorn (now Toruń in Poland). This oldest city in East Prussia had submitted itself to the Polish king as a patron in 1466 after armed conflicts with the Teutonic Order.

His father NIKLAS KOPPERNIGK was a wealthy copper merchant whose ancestors came from Kraków. The influential family of his mother BARBARA WATZENRODE had emigrated from Silesia to the Hanseatic city of Thorn in the 14th century.

When NICOLAUS's father died in 1483, LUCAS WATZENRODE, his mother's brother, who was Prince-Bishop of Warmia from 1489, looked after the four children. A daughter BARBARA entered a Cistercian monastery where she soon rose to become abbess; for KATHARINA he negotiated a marriage contract with a Kraków merchant and ANDREAS and NICOLAUS studied at the University of Kraków after attending secondary school in Thorn.

Of the subjects of the *Seven Liberal Arts* (*trivium*: grammar, rhetoric, dialectic; *quadrivium*: arithmetic, geometry, music, astronomy) NICOLAUS was particularly interested in geometry and astronomy. He bought a Latin edition of the *Elements* of EUCLID, a copy of the ALPHONSIN tables for calculating the positions of the planets and a treatise by REGIOMONTANUS on spherical trigonometry.

When the post of canon (member of the cathedral's chapter) became vacant in Frauenburg (Frombork), his uncle saw to it that NICOLAUS was given this well-paid, lifelong position.

At the same time, he urged him to study both canon and secular law in Bologna. In Bologna, COPERNICUS lived in the house of the astronomy professor DOMENICO MARIA DA NOVARA, whom he assisted in his nightly observations. Here he became acquainted with the work of REGIOMONTANUS on the *Almagest* of PTOLEMY, published posthumously in 1496, as well as the sharp-tongued criticism of the scholar GIOVANNI PICO DELLA MIRANDOLA on the dubious astrological methods of his contemporaries. Nevertheless, NOVARA annually fulfilled a well-paid commission from the city of Bologna, namely to compile an astrological calendar – with predictions about favourable and unfavourable constellations of the planets.

There were hardly any objections to astrology on the part of the Church, as it says in *Genesis 1.4*:

> *"And God said, let there be lights in the firmament of the heaven to divide the day from the night; and let them be for* signs*, and for seasons, and for days, and years."*

COPERNICUS also learnt about the doctrine of *Neoplatonism* from NOVARA, in which the sun played a special role as the image of God.

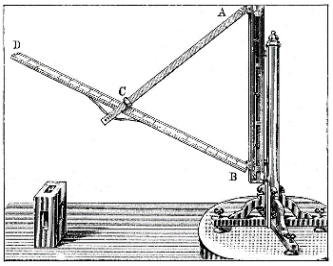
After spending part of the Holy Year 1500 in Rome, where he also lectured on mathematics, he returned to Frauenburg for a short time and took another leave of absence to study medicine at the University of Padua. After two years, he discontinued his studies and received his doctorate in canon law from the University of Ferrara in 1503.

After returning to Frauenburg, COPERNICUS worked as his uncle's personal secretary and episcopal personal physician. His medical advice was also sought by other princes and church representatives for decades afterwards. LUCAS WATZENRODE also ensured that NICOLAUS's brother ANDREAS was given a position as canon in Thorn. However, when ANDREAS fell ill with leprosy in 1512, he was excluded from every community and he died alone somewhere in Italy.

As canon, NICOLAUS COPERNICUS took over the office of administrator, temporarily from Allenstein (now Olsztyn), on a rotational basis.

He was responsible, among other things, for collecting tenure from the peasants who cultivated the church-owned lands, for the allocation of farms and fields that had become vacant, for the construction of military facilities for the defence of the country, and for the finances of the cathedral chapter. He also administered the mill belonging to the bishop's mill, a bakery and a brewery. Within this framework he determined how the price of bread was to be calculated depending on the harvest yields.

This left him little time for his own celestial observations, for which he had a small tower built. For his measurements, especially of star occultations and lunar eclipses, he had a *quadrant*, a *triquetrum* (cf. Wikipedia illustration on the right) and an *astrolabe* at his disposal.



Over the course of time, he became more and more convinced that the previous astronomical world view needed to be radically changed.

According to the teachings of ARISTOTLE, the planets revolved around the Earth, which was at the centre of the universe, on unchanging, material but invisible, nested concentric spheres.

If the distances to the earth were always the same, there should be no fluctuations in the apparent brightness of the planets, but, except for the moon, this was not the case. CLAUDIUS PTOLEMY had apparently solved this problem in the 2nd century by his *epicycle theory*, a system of circles moving on a circle: Each planet travelled on a small circular orbit (*epicycle*), which in turn travelled on a large circular orbit (*deferent*) around a fixed centre.

Around 1510, COPERNICUS wrote a manuscript of only a few pages, *De hypothesibus motuum coelestium a se constitutis commentariolus* (A commentary on the hypotheses of the heavenly movements) which he sent confidentially to some of his acquaintances, who in turn forwarded it to others. Working out the details to this theory, including the determination of radii and orbital periods, would keep him busy during the next decades.

Here are his most important insights:

- The planets orbit the sun – as if it were in the centre; therefore, the centre of the universe is *near* the sun. The centre of the earth is therefore not the centre of the universe.
- The earth makes three circular movements: Every year it moves once around the Sun, every day it rotates once around its own axis (*thus creating the celestial fireworks of sunrise and sunset and the whole round of stars*) and, in addition, the Earth's axis rotates during a year in such a way that the position of the axis remains almost unchanged (*precession*).
- The order of the planets is: Mercury, Venus, Earth with the Moon, Mars, Jupiter, Saturn. The apparent alternation of forward and backward movements of the planets is a geometrical effect resulting from the position of the earth during its orbit.
- The distance of the earth from the sun is insignificant compared to the distance to the immovable sphere of the fixed stars; therefore, during the course of the year, no differences (*parallax*) will be observed with regard to the position of the stars.
- God and His angels hover beyond the sphere of the fixed stars.

Even though the title page of the *Commentariolus* did not indicate who wrote the paper, it eventually became known even in Rome that an astronomer of distinction lived in far-off Warmia. Thus, in 1514, an invitation reached him to attend the Fifth Lateran Council of the Church, at which the problem of *calendar reform* was finally to be tackled. COPERNICUS did not attend the Council, but submitted a written statement, although his letter, however, seems to have never arrived in Rome.

The successors of his uncle LUCAS WATZENRODE, who died in 1512, also relied on COPERNICUS's administrative skills. When the 21-year-old ALBRECHT VON HOHENZOLLERN was elected the new Grand Master of the Teutonic Knights in 1511, a particularly turbulent time began for Warmia. There were repeated raids by mercenaries of the Order and in 1520 Frauenburg was even completely destroyed. After constant warfare, peace finally came in 1525, when ALBRECHT dissolved the Order and swore an oath of loyalty to the Catholic Polish King SIGISMUND. But no sooner was ALBRECHT installed as *Duke of Prussia* by SIGISMUND than he converted to Protestantism.

Part of the peace treaty was also a reorganisation of the coinage. COPERNICUS had already pointed out the danger of inflation in 1517, and for years he had been observing how the state and individual cities had taken to issuing new coins with the same nominal but constantly decreasing material value, which tempted goldsmiths to melt down old coins and use the silver they contained elsewhere. He demanded that in future, there should only be one issuing authority for coins with a fixed silver-copper alloy.

After peace was established, COPERNICUS could finally devote himself to the elaboration of the theses of his *Commentariolus*. Although he had been asked from various sides to finally do so, including by the Roman Curia Cardinal NICOLAUS VON SCHÖNBERG, who even offered to pay the printing costs, COPERNICUS had hesitated – possibly because he feared making a fool of himself with his revolutionary theory.

This only changed when GEORG JOACHIM RHETICUS, a 25-year-old mathematician and astronomer at the University of Wittenberg, and a confidant of PHILIPP MELANCHTHON, came to Frauenburg in May 1539 and transmitted the request of the Nuremberg editor JOHANN SCHÖNER and the printer JOHANNES PETREIUS to him to publish the work.

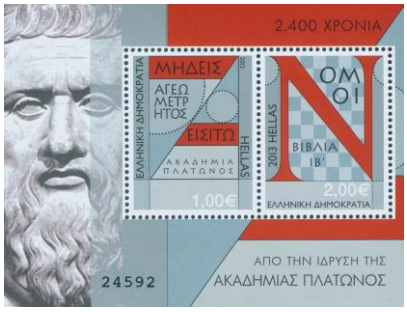
In the following two and a half years, the final version of the six-volume work was written – with the support of RHETICUS, who critically reviewed all the formulations of the text and all the calculations, and made suggestions for improvements. In his measurements COPERNICUS mainly used data that came from PTOLEMY, using comparatively few that he determined himself. For example, he never succeeded in determining the position of Mercury because the limited visibility near the Vistula River did not permit this. As a kind of rehearsal for the main work, RHETICUS published the *Narratio prima* in August 1540, a first summary that met with great interest and even had to be reprinted.

In the fight against Protestantism, the Catholic Church established strict rules. The Bishop of Warmia, JOHN DANTISCUS, among other things, increased the pressure on the secular canons, who had committed themselves to celibacy, to separate from their "housekeepers", and even demanded that the canons received higher ordinations, which COPERNICUS refused.

The presence of Protestants in Warmia was actually not tolerated. Although the bishop could hardly have been unaware of COPERNICUS's collaboration with the professing Lutheran RHETICUS, the two were able to complete their work on the manuscript.

COPERNICUS wrote a preamble in which he dedicated his work to the Pope. This was also done in the hope that he would save the work from becoming the victim of *fools* who ... *without mathematical knowledge ... presume to judge ... and on the basis of some passage in the SCRIPT, which they have maliciously twisted to their purpose, ... censure and denigrate my project.*

COPERNICUS suspected that JOSHUA's command "*Sun, stand still over Gibeon*" from the Book of *Exodus*, in particular, could be cause for the rejection of his theory, and this would later be the case. In 1559, his work was placed on the *Index librorum prohibitorum* (Index of Forbidden Books) of the Catholic Church. MARTIN LUTHER and MELANCHTHON would also reject the COPERNICAN world view for this reason.



At the end of the preamble was the remarkable sentence:

Mathematics is written for mathematicians

referring to the saying at the entrance of PLATO's Academy:

Let no one ignorant of geometry enter here.

The work itself was divided into six books. In the first volume, the structure of the heliocentric system was explained, including the orbital periods of the individual planets; even COPERNICUS could not do without epicycles for the inner planets Mercury and Venus. In addition, he addressed the question of why we do not notice the Earth's rotation (because the Earth, the water and the air surrounding it form a unit). The volume concluded with results on the geometry of chords and related tables.

The second volume dealt with the basics of spherical astronomy and contained a comprehensive catalogue of the fixed stars. In the third volume, COPERNICUS addressed the precession of the equinoxes and the apparent movements of the Sun. The fourth volume was devoted to the moon and its movements. The fifth volume explained how to determine the positions of the five planets; the sixth volume examined the deviation of the planetary orbits from the ecliptic.

In autumn of 1541 the manuscript was completed. RHETICUS, who had to resume his teaching activities in Wittenberg, took the manuscript with him, but could not travel to Nuremberg until May 1542 to hand the work over to PETREIUS. During the next few months he supervised the printing of the first pages, but then changed to a higher-paid position at the University of Leipzig. From then on, the Wittenberg theologian ANDREAS OSIANDER took over the proof corrections.

Without the consent of RHETICUS or COPERNICUS, OSIANDER made serious changes to the work: He expanded the title from *De revolutionibus* to *De revolutionibus orbium coelestium* (On the Orbits of the Celestial Spheres) – COPERNICUS had deliberately omitted the reference to spheres. In addition, OSIANDER added a preface to the reader, without giving his name, in which he described the theses contained in the work as hypotheses without any claim to truth and thus essentially reduced them to the aspect of a simpler astronomical calculation method.

The theologian OSIANDER thus expressed his conviction that a human being was fundamentally incapable of recognising the actual facts – only a divine revelation could reveal the true situation.

RHETICUS only learnt of OSIANDER's intervention when the printing of the work was completed in April 1543 and PETREIUS was not willing to reprint the first pages. This would have been quite possible, as the printed pages were initially stored individually and only gathered together and bound when a book was sold.

For many years, the preface was attributed to COPERNICUS himself – as if he had not been convinced of his own model. It was not until 1609 that JOHANNES KEPLER drew attention in his *Astronomia Nova* to the changes made by OSIANDER.

COPERNICUS suffered a stroke in December 1542, and was without memory, deprived of speech and paralysed on the right side, and so he would have been unaware of all this. It is not until the day of his death that the last pages arrived from Nuremberg.

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https://www.spektrum.de/wissen/nikolaus-kopernikus-ein-heliozentrisches-weltbild/2041501

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More stamps about COPERNICUS can be found at

https://mathshistory.st-andrews.ac.uk/Miller/Store/copernicus.html