The Copernican Revolution in Transylvania

MIHOLCSA Gyula

Romanian Television

Abstract

The evolution of our thinking is a very interesting and instructive story. The standard bearers are founders of religions, philosophers, sometimes scientists too. The pioneering work of the latter was little understood by most of people. Our aim in this paper is to present a concrete situation, in which we could fallow the previous ideas: the acceptance of the heliocentric theory of Copernicus in Transylvania. We will do it through two paintings on wood of the Solar system, in two Transylvanian churches: one in a Greek-Catholic church in Șurdești (Maramureș county), and the other in a Unitarian church in Ocland (Harghita county). Although they were made in the same period, these two paintings represent two opposite systems: the geocentric one and the heliocentric one. How was that possible?

Keywords: solar system, Copernicus, geocentric, heliocentric, Transylvania.

1 Introduction

The aim of this paper is to find out how the heliocentric theory of the solar system penetrated Transylvania, according to which the Earth is not in the center of the solar system, but the Sun, and the planets revolve not around the Earth, but around the Sun, together with the Earth. We will approach this problem not through the prism of the scientific works of the time, works that were not accessible to ordinary people, but through the prism of those possibilities, to which the broad masses of people had access.

Although very few could see, today everyone knows that the Earth is round, rotates around its axis, and moves around the Sun. Some have supported this idea for over 2000 years, however, most people have only been familiar with this idea for about 200 years.

In the north of Transylvania, in Șurdești (Maramureș County), there is an old wooden Uniate (Greek-Catholic) church. Inside the church there is an interesting mural painting, made in 1783. (Figure 1).

Fig. 1: The interior of the Uniate (Greek-Catholic) church in Șurdești (Maramureș County)

It depicts the solar system. It is one of the variants of the geocentric model, in which the Earth is at the center of the planetary system (Figure 2).

Fig. 2: The ceiling of the Uniate church in Șurdești (Maramureș County, photo 2016)

There are several wooden churches in Transylvania, from the same period, where we can see painted on the ceiling the whole geocentric representation of the solar system, such as Ulciug (Sălaj County),

the painting dating from 1781 (Figure 3).

Fig. 3: The ceiling of the Uniate church in Șurdești (Maramureș County, photo 2016)

In the southern part of Transylvania, in the village of Ocland on the Homorod Valley (Harghita County) there is an old stone church. It had once been Roman Catholic, becoming Unitarian after the 16th-century Religious Reformation. Inside, above the pew with painted benches, there is a coffered ceiling, made in 1771, on the occasion of the renovation of the church (Figure 4).

Fig. 4: The interior of the Unitarian church in Ocland (Harghita County), with a coffered ceiling.

One of the tapes depicts the solar system. This time, it is Copernicus' heliocentric solar system, *Systema Copernicanum*, with the "S" Sun at its center (Figure 5).

Fig. 5: Painted box from the Unitarian church in Ocland (Harghita County, photo 2017).

What is interesting about the two paintings (Figures 2 and 5) is that both are in places of worship, only 300 km apart, and both were made in the late eighteenth century. How is it possible then that the solar system is portrayed in such contradictory conceptions?

2 Solar Systems

To understand this difference, we must go back in time to where the two conceptions of the universe were born. The Greeks, like the Babylonians, the Chinese, or the ancient Egyptians, studied the vault of heaven and the motion of the Sun, the Moon, and the stars. People believed that some of the celestial bodies were gods who decided the fate of the world, as well as that of humans, so if they could foresee their movements, they would guess their own future. That's why they followed their movements very closely.

2.1 Anaximander's geogentric system

Viewed from Earth, all celestial bodies, including the Sun, appear to revolve around the Earth. And so the first cosmological model was born: The universe is a huge empty globe, in the middle of which is the Earth and around which orbit all the celestial bodies: the Sun, the Moon, the planets and the stars. This was formulated by ANAXIMANDER of Miletus (A.C. 610-546), who thus created the world's first mechanical model: The earth is - floating freely - in the center of the spherical world, without leaning on anything. Around it, at different distances, the stars rotate, then the Moon, and the farthest, the Sun. Their movement is explained by the wind created by the Sun, by the evaporation of water from the hydrosphere that surrounds the Earth.

Over time, this system has been improved. Ancient astronomers quickly realized that most stars were motionless, but there were a few that moved relative to them. These were the "wandering stars," the "errant stars," or, in their current name, the planets. In total, they discovered seven[1] such celestial bodies, which had a visible motion with the naked eye (at that time there were no telescopes) to the "fixed" stars: the Moon, Mercury, Venus, the Sun, Mars, Jupiter and Saturn. HERACLITUS of Ephesus (A.C. 535-475) proposed this order of the planets, concerning which can cover which, so it can pass in front of it.

The question was: why do the stars move, why do the planets move, who and how are they set in motion? Since the universal gravitational attraction was unknown at the time, the Greek astronomer, mathematician, and geographer EUDOXUS of Knidos (A.C. 397-345) assumed that these planets were trapped on huge concentric spheres, all centered in the middle of the Earth, spheres that rotate evenly[2]. which causes the celestial bodies trapped on them to revolve around the Earth. These spheres had to be transparent (because all the planets and stars could be seen through them), so they were supposed to be made of crystal. Each planet had its own crystal sphere, and on the eighth sphere, the largest, the "fixed" stars were supposed to be trapped.

Along the way, it was discovered that the motion of the planets relative to the fixed stars is extremely complex: they move sometimes faster, sometimes slower, and sometimes even backwards. Explaining this retrograde motion has presented astronomers with a lot of trouble for 2,000 years.

These complicated movements made it necessary to introduce new crystal spheres, so that by combining their uniform movements, the complex motion of the planets could be explained. By A.C. 325, the Greek astronomer and mathematician KALLIPOS of Kyzicos (A.C. 370-300) has already reached 34 crystal spheres for the 7 planets.

2.2 Aristotle's geocentric system

Based on these models, as well as the observations and measurements made, ARISTOTLE (AC 384-322) described the final structure of the universe: in the middle of the universe is the Earth, and around it revolves all the others, each planet in its own perfect orbit. circular composed of several concentric "spherical celestial" layers, made up of "ether" (Figure 6). The celestial spheres of the planets are surrounded by the largest sphere, that of the stars, so the universe is not infinite, because beyond the sphere of the stars there is nothing left (Figure 2, Figure. 5)

2.3 Aristarchus' heliocentric system

But ARISTARCHUS of Samos (A.C. 320-250), the greatest astronomer of antiquity, had a completely different view of the universe. He stated (A.C. 270) that it is not the Earth, but the Sun, that is at the center of the Universe, and the Earth, the other planets, and the stars revolve around the Sun (Figure 7). In addition, he claimed, the Earth revolves around its own axis.

This model was rejected by the society in which he lived, and for all these statements, ARISTARH was accused of blasphemy and exiled not only from his city, but also from Greece, thus preserving the unitary, geocentric conception of the world.

[1] Also 7 celestial bodies are represented on the paintins on figures 2, 3, 5 and 6

[2] Since the planets were considered gods, they could only move "perfectly": circular and uniform motion.

Fig. 6: The geocentric solar system of ARISTOTLE, from the book by Andreas CELLARIUS (1661)

2.4 The Egyptian hybrid system

But there were other concepts in antiquity. The Egyptians, worshipers of the Sun God, claimed that two of the planets move differently: Venus and Mercury do not revolve around the central Earth, but around the Sun, which revolves around the Earth (Figure 8). The Greek philosopher and astronomer HERACLIDES Ponticus (A.C. 390-322) took this model (through A.C. 350) and popularized it in Greece. Moreover, he considered that the Earth is not fixed, but rotates around its axis, from west to east, making a complete rotation in 24 hours.

This model of HERACLIDES was taken over in the 5th century (around A.D. 410) by the Latin encyclopedist Martianus CAPELLA (A.D. 360-428) from the Roman province of Africa (now Algeria). He describes it in his book on the seven liberal arts[3], *De nuptiis Philologiae et Mercurii*, the liberal

[3] Martiani CAPELLAE: *De nuptiis philologiae et mercurii artibus liberalibus*, Francofurti, 1836.

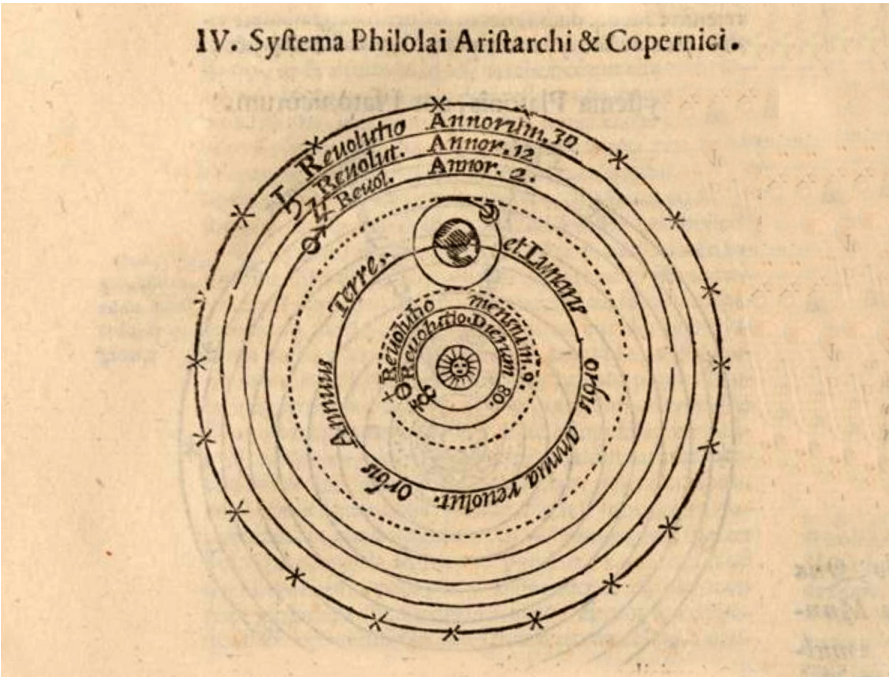

Fig. 7: The heliocentric planetary system of ARISTARCHUS, from RICCIOLI's book (1651: p.102)

arts suggested by the seven planets then known: grammar, dialectics, rhetoric, geometry, arithmetic, music, and astronomy.

This model is presented in NABOTH's book, *Primarum de Coelo et Terra*[4], published in Venice in 1573, 30 years after the publication of COPERNICUS book, which was not yet banned by the Church. This book also presents COPERNICUS' model.

2.5 Ptolemy's geocentric system

Aristotle's conception was carried forward around 150 by the Roman mathematician and astronomer Claudius PTOLEMY of Alexandria (87-165), who also considered in his work *Megiste Syntaxis*[5] that at the center of the universe is the motionless Earth, and around it all other celestial bodies rotate (Figure 9).

PTOLEMY, however, had another explanation for the retrograde motion of the planets, namely that the planets are not fixed on their spheres, but describe circular motions, that is, epicycles around their place on the sphere. With the help of these complex movements, PTOLEMY was able to

[4] Valentino NAIBODA: *Primarum de Coelo et terra institutionum*, Venetiis, 1573.
[5] *The Great Treaty*, transmitted to posterity through the Arab chain, under the title *Almagest*

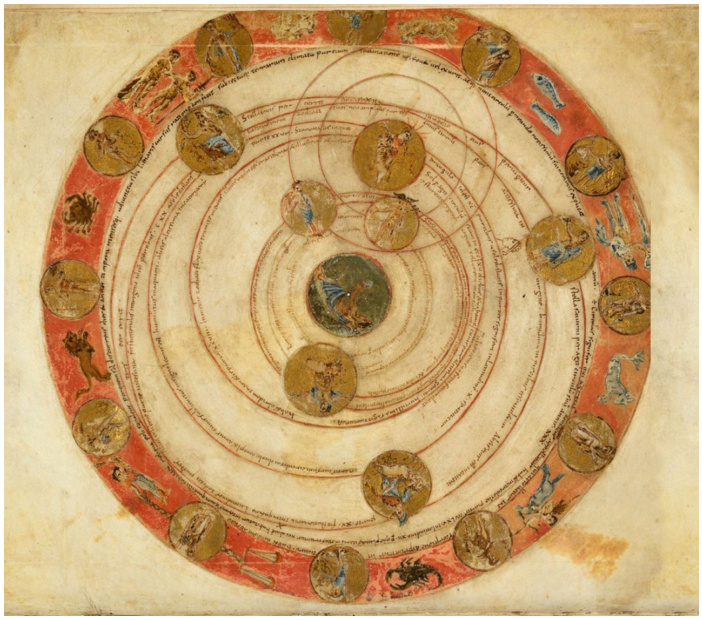

Fig. 8: Martianus CAPELLA's geocentric planetary system. The image is the representation of the position of the seven planets, on March 18, the year A.D. 816. [source: Wikimedia Commons]

explain the motion of the planets with satisfactory accuracy and thus predict or reconstruct their position at the time of a person's birth. This model has been considered the basic model of the universe in astronomy for 1500 years, and has met the requirements of astronomers, astrologers, and calendar writers.

2.6 The Christian geocentric system

A new religion was born in medieval Europe: Christianity. In a few centuries it spread throughout Europe, becoming the only religion. The basis of religion was the Bible. The geocentric system - Aristotelian or Ptolemaic - corresponded entirely to the ideology of the growing Christian church, because it was in line with the basic idea that man, as a creature created by God, must be in the center of the universe, in the middle of a perfect planetary system:

> *5. He set the earth on its foundations, so that it should never be moved* [Psalm 104:5].

Joshua speaks of stopping, therefore, of motion, only in the case of the Sun and the Moon [Joshua 10:12 and 13]:

> *12. At that time Joshua spoke to the Lord in the day when the Lord gave the Amorites over to the sons of Israel, and he said in the sight of Israel, "Sun, stand still at Gibeon, and moon, in the Valley of Aijalon."*

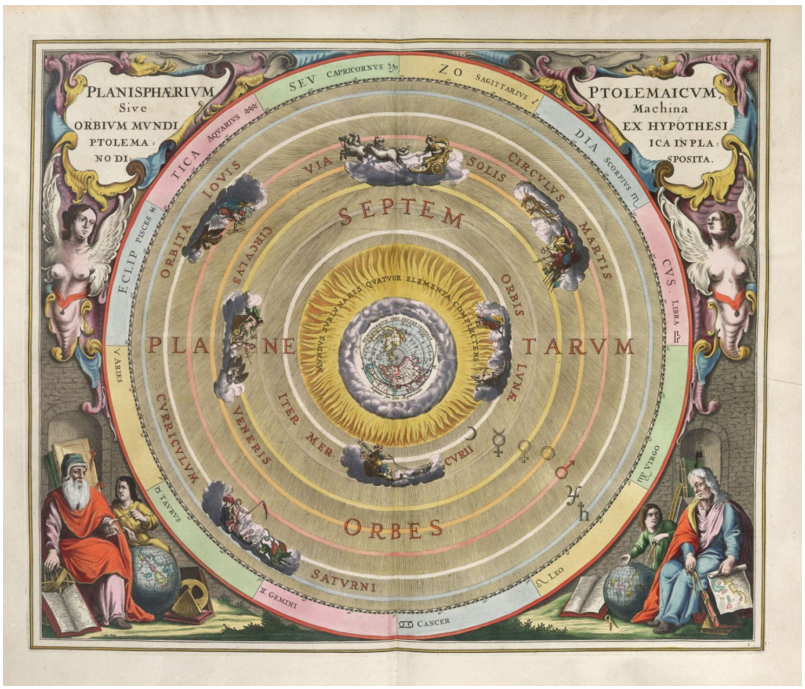

Fig. 9: PTOLEMY's geocentric planetary system [CELLARIUS, 1661]

> *13. And the sun stood still, and the moon stopped, until the nation took vengeance on their enemies.*
>
> *Is this not written in the Book of Jashar? The sun stopped in the midst of heaven and did not hurry to set for about a whole day.*

This verse from the Book of Joshua was most often quoted as proof of the stillness of the earth. Thus the Aristotlian geocentric conception of the world became the longest-lived theory of all time, remaining valid for 2000 years (Figure 10). In the Middle Ages, ARISTOTLE'S physics was taught in schools and universities, as well as this conception of the universe.

2.7 Copernicus' heliocentric system

But the age of the Renaissance, of the Religious Reformation, of the first technical revolution, of the great geographical discoveries, of the discovery of the pattern and of the founding of the universities, meant a decisive turning point in the evolution of the conception of the universe. It all started with navigation. Ships moving away from land and wandering the seas, as well as caravans crossing the desert, were guided only by the Sun and the stars. This is how the creation of more and more accurate astronomical maps began, for which the positions of the stars and planets had to be measured precisely.

With the improvement of measuring instruments and the more and more precise determination of

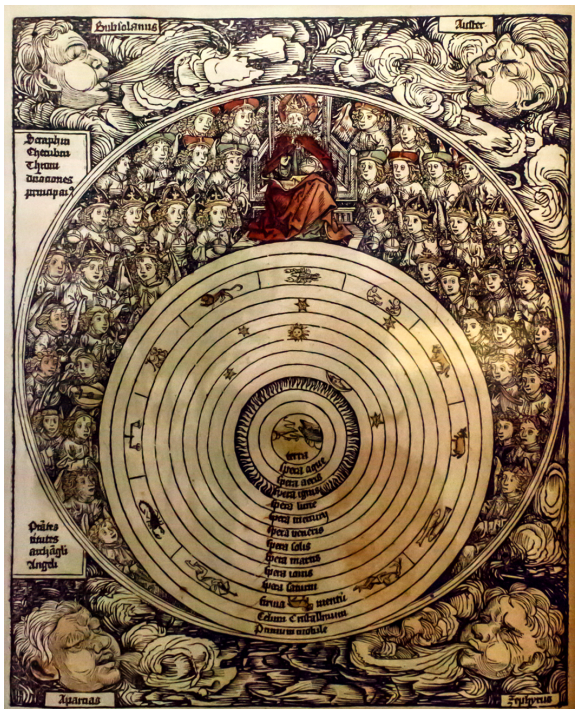

Fig. 10: The geocentric system in Hartmann SCHEDEL's Liber chronicarum mundi (1493).

the position of stars and planets, some errors of geocentric theory came to light, and new questions arose which could not be explained by the complicated models of Aristotle or Ptolemy.

To solve these problems, in the book *De revolutionibus orbium coelestium* of 1543, Nicolaus COPERNICUS (1473-1543), the canon of Polish-German origin in Frauenburg, returned to the old, abandoned and long-forgotten conception of ARISTARCHUS of Samos. After listing the planets, including Earth, COPERNICUS concludes:

> *But at the center of all these planets is the Sun. For who could place the light of this wonderful church in a more suitable place than that from which it can illuminate them all at once? ... Thus, in this composition, we find the sublime harmony of the Universe.*
>
> [BARTA, 1972: 359]

So COPERNICUS removed the Earth from its privileged position, placing it among the ordinary planets, and moved the center of the Universe from Earth to the Sun. This was the "Copernican revolution" because it produced a radical change in the *ideology* of the universe. (Figure 11)

With this assumption he explained how simple and elegant the retrograde motion of the planets is, without the need for the celestial spheres of ARISTOTLE, or the epicycles of PTOLEMY.

But his theory, the heliocentric model, was diametrically opposed to the geocentric one accepted by the Catholic Church. That is why neither the Catholics nor the Protestants newly detached from

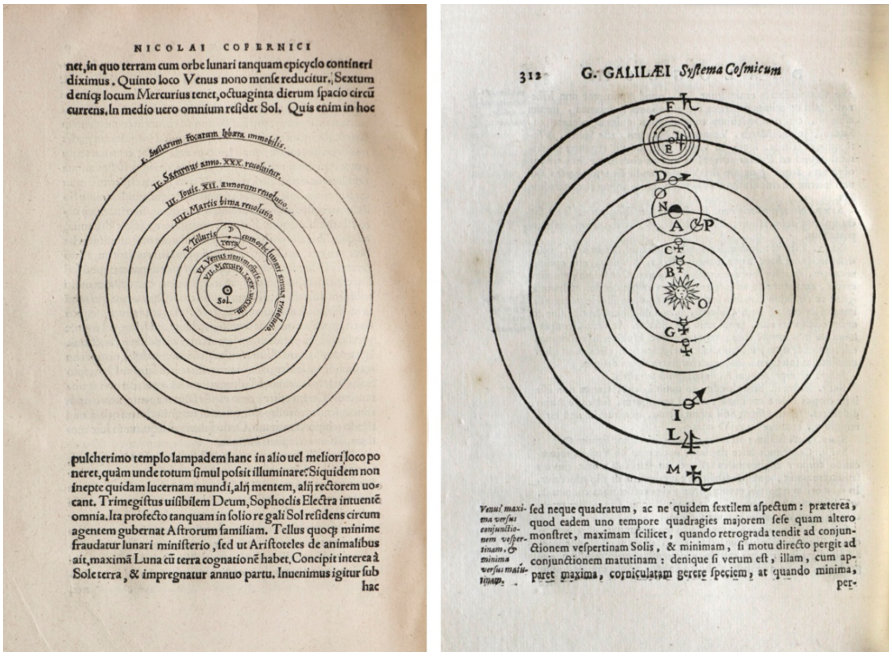

Fig. 11: COPERNICUS' heliocentric planetary system, from his book (1543), respectively from GALIEI's book. The image in the book of GALILEO is richer with four satellites of Jupiter, which GALILEO discovered. (1632)

them accepted the new conception, since the basis of both denominations was the Bible, according to which the Earth stands motionless at the center of the Universe. Curiously, those who launched the most vehement attacks primarily against CORPERNICUS were the Protestants, who were calling for the renewal of the church.

> *Who dares to put Copernicus' authority over the Holy Spirit? Some mentioned a Venetian astrologer who wanted to prove that the Earth is the one that rotates and not the sky, the Sun and the Moon. This madman wants to overthrow all astronomy! The Holy Scriptures say that Joshua had commanded the Sun to stop, not the Earth!*
>
> [LUTHER, 2017: 257-258]

COPERNICUS expected such attacks because he knew the position of the Church on this issue. Therefore, in the preface of his book he presents the heliocentric idea only as a mathematical possibility. This is how the Church did not attach too much importance to the book, which, in fact, was known only to a few astronomers.

2.8 Tycho Brahe's hybrid system

Meanwhile, another Danish astronomer, Tycho BRAHE (1546–1601), also studied the motion of the planets, making very accurate measurements of their positions for 20 years in the first astronomical observatory in Europe built by him (Uraniborg, on Hven Island, now under Swedish tutelage), at a time when the telescope did not yet exist. Following these measurements, he found that the planets did not revolve around the Earth, but around the Sun, and in 1577 he accepted this idea of COPERNICUS. His only differing opinion was about the Earth (Figure 12):

> *I believe without a doubt that the still earth must be placed at the center of the universe, as ancient astronomers and physicists and the Scriptures testify. But I do not share at all the assumptions of Ptolemy and those of antiquity that place the Earth at the center of the orbits of the planets; I am convinced that the celestial movements are arranged in such a way that the Earth is only the center of the motion of the Moon, the Sun, and the eighth sphere — which is farthest away. The other 5 planets revolve around the Sun, as around their ruler and king.*[6]
>
> [SIMONYI 1978: 159]

We cannot know if this was his scientific conviction, or if he did so in order not to be in conflict with the basic principles of theology, that is, with the Church. The truth is that at that time it was not even possible to establish directly by measurements whether the Earth is standing and the Sun is moving around it, or vice versa. There was evidence of the Earth's motion around the Sun, but all was indirect.

Tycho BRAHE's model seemed to resolve the contradiction between astronomers' measurements and the Church's accepted system, bringing peace to the world of astronomy. Astronomers breathed a sigh of relief because they could give up the complicated epicycles of Ptolemy, without contradicting the *Holy Scriptures*. And, in fact, regarding the solar system on Earth, we see it exactly as Tycho BRAHE described it. This is why this model has enjoyed so much success, while also corresponding to all measurements since then.

2.9 Johannes Kepler's heliocentric system

After Tycho BRAHE's patron died in 1588, the new king of Denmark, CHRISTIAN IV, in 1597 dispossessed him of the island where he had his famous observer. Tycho BRAHE went to Hamburg, then to Prague and looked for an assistant to continue his research. He chose Johannes KEPLER (1571–1630), a brilliant young astronomer in mathematics. KEPLER asked him for the measurement data of the planet Mars, and analyzing this data mathematically, he noticed that the planet does not move at a constant speed. After six years of searching and trying out various hypotheses, he found that the planet could not move in a circular trajectory, but rather elliptical, with the Sun in one of its foci.

> *We, to whom the divine goodness has bestowed upon us, by the creature of Tycho Brahe, a more rigorous scrutineer than anyone else, and by whose research has shed light on a deviation of the order of magnitude of 8 'from Ptolemy's calculations, it is fitting to receive and use this divine goodness with a feeling of gratitude. Relying on the evidence for the incorrectness of the assumptions that served as the basis for the calculation, we*

[6] Tycho BRAHE: *Astronomiae instauratae progymnasmata*, 1852.

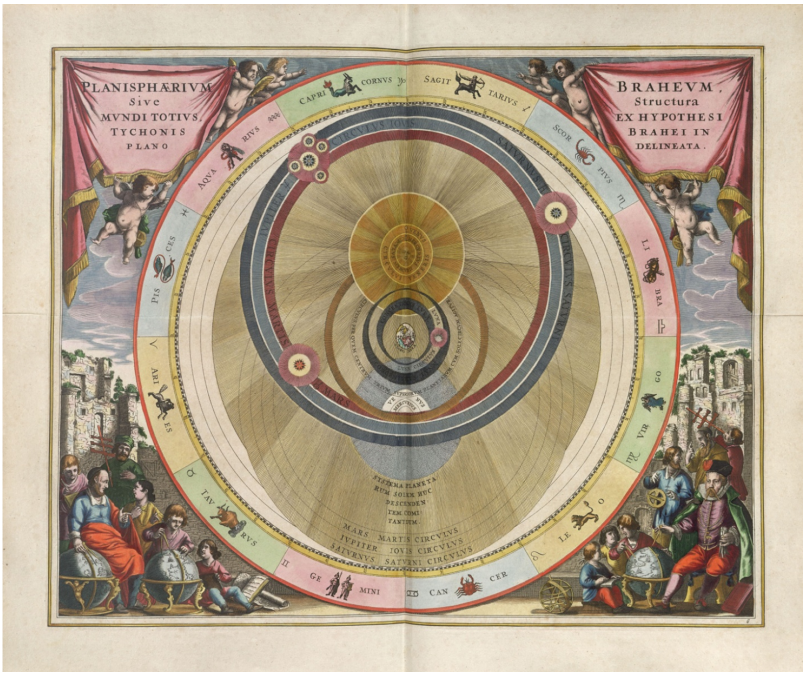

Fig. 12: Tycho BRAHE's geocentric planetary system [CELLARIUS, 1661]

> *will direct our efforts to finally lay the groundwork for the correct form of the celestial movements. These 8 minutes, exclusively, paved the way for the modernization of the entire astronomy.*
>
> [SIMONYI 1978: 160]

It was the first work to abandon circular trajectories, based on the Platonic conceptions of mystical perfection, initially agreed upon by KEPLER himself, in his first book in 1596, *Misterium Cosmographicum*.

KEPLER then applied this idea to the entire Copernican solar system (he was a follower of the heliocentric system), resulting in a heliocentric system that accurately described the motions of all the planets. He published the results in the book *Astronomia Nova*, in 1609. In the book KEPLER did not explain why the planets move according to the three discovered laws of motion, but only described their motion. The explanation came in 1687 from an English physicist, Isaac NEWTON.

3 Dispute of Solar Systems

3.1 Galileo Galilei

The peace brought to astronomy by Tycho BRAHE's model lasted only 50 years. Until the Italian physicist Galileo GALILEI (1564–1642) constructed a telescope[7]. With the help of his telescope he made several crucial discoveries. He discovered that there are mountains on the moon, so the moon is not a "perfect" celestial body. By this, GALILEI proved that there are no two separate worlds (sublunary - life-changing, supralunar - the immutable universe), but there is only one world. Then he discovered the satellites of Jupiter, so it is not true that all celestial bodies revolve around the Earth; that Venus has phases similar to those of the Moon. These discoveries led him to conclude that Nicolaus COPERNICUS was right: the Earth revolves around the Sun! In 1632 he published the book Dialogo, in which he described all these phenomena, concluding that COPERNICUS' theory was not a simple mathematical model, but reality itself.

> *Now let us resume the two movements attributed to the Earth, that is, the annual and the daily, the first being to be understood as being performed by the center of the Earth in large orbit, that is, of a maximum circle described in the ecliptic plane, fixed and immutable, and the second. , being executed by the globe around its own center or its own axis.*
>
> [GALILEI, 1962: 253]

3.2 Prohibition and index

This time, the Church reacted harshly. On June 22, 1633, the Inquisition sentenced GALILEI to life imprisonment (which later became a forced residence for life) and banned all books that taught COPERNICUS 'ideas, indexing them.

The effects of the ban were not long in coming: everywhere, only geocentric theory could be taught in schools. A telling example in this sense is the book by Johannes HONTERUS from Brasov (1498-1549), *Rudimenta Cosmographica*[8]. HONTERUS, humanist encyclopedic spirit, church reformer, cartographer, pedagogue and prominent spiritual leader of the Saxons from Transylvania, was born in Braşov. He studied abroad, and after returning home, reorganized the Saxon church in Transylvania based on the Lutheran principles of the Reformation. He set up a printing house, taught and was the first Protestant pastor of Brasov. In 1541, the German school in Braşov received a new building and new operating regulations, thus becoming the first gymnasium in Transylvania. In 1530, Johannes HONTERUS published *Rudimenta*, a book to popularize knowledge, which contains basic information from the natural sciences, maps, and knowledge of geography and astronomy. Since it was published 14 years before the publication of Copernicus' book, it obviously refers exclusively to the geocentric system (Figure 13).

> *Years, the bend of his six, even Jupiter passes between the stars. Mars, on the other hand, in two years, slowly crosses the zodiac signs. The sun fills it, orbiting it all year round.*
>
> [HONTERUS, 1984: 41]

[7] Its lens is now in the Galilee Museum in Florence.
[8] *Elemente de cosmografie*, Cracovia, 1530. The first edition in Braşov was is 1541.

The book has become a huge success, reaching over 40 editions, especially in Western European countries. In some of the great western cities it was republished almost every year, until 1692, the year of its last appearance. Interestingly, in this multitude of reprints is the fact that even the last ones - published 150 years after COPERNICUS 'book - continued to proclaim the geogentric system, not even alluding to the Copernican heliocentric system.

Fig. 13: The geocentric planetary system in HONTERUS 'book, 1566 edition.

The situation is similar in the case of the great Czech philosopher and pedagogue, Jan Amos KOMESKY (COMENIUS, 1592-1670), who in his book for students *Orbis Sensualium Pictus*[9] from 1658, in the third lesson entitled *Coelum*, depicts the geocentric system (Figure 18a.)

This was possible for two reasons. The first is that COPERNICUS' work was not well known; the second is the prohibition of the church. The indexing of COPERNICUS 'works and the news of Galileo's condemnation prevented the Copernican model from spreading throughout Europe.

Moreover, circles close to the church began to look for scientific evidence that GALILEI and COPERNICUS were wrong and that the Sun revolved around the Earth. At the forefront of these trials were the Jesuits. Jesuit intellectuals, representatives of church science, tried to improve the Ptolemaic geocentric concept so that they could explain the increasingly accurate astronomical measurements, without urging the Earth from the center of the solar system. Thus were born the so-called geo-heliocentric or "hybrid" concepts, in which certain planets no longer revolve around the Earth, but around the Sun, or in some more complicated systems, rotate in elliptical orbits around both[10]. But

[9] The *Visible World*, illustrated textbook, written in 150 lessons for students.

[10] The German physician, mathematician and astrologer Israel HUBNER (established in Sibiu in 1660) imagined such a solar system in 1667, in which Mercury and Venus revolve around the Sun, the Moon around the Earth, and the others - Mars, Jupiter and Saturn - around the Sun and Earth, in ellipsoidal orbits.

at the center of the solar system, and obviously of the Universe, remained the Earth.

However, the most successful model remained the one developed by Tycho BRAHE, who was eventually taken over by most Jesuits because he correctly described the motion of the planets. His vision seemed to correspond entirely to reality, given that at that time there was no way to decide whether the Earth revolved around the Sun, or vice versa.

3.3 Șurdești

Under these conditions, it is not surprising that, at the end of the 18th century, the geocentric system was preached in the village churches. What happened in Șurdești as well. Șurdești village is located on the Cavnic brook valley, surrounded by mountains and forests, located at a distance of 20 km from Baia Mare. The village was first documented in 1411, under the name Swrgyanfalwa. After the settlement was almost completely destroyed by the invasion of the Tartars in 1717, it was rebuilt with the support of the Austro-Hungarian Monarchy, in 1766 a Uniate wooden church was built here (Figure 14).

Fig. 14: Uniate Church in Șurdești (Maramureș County, 2017).

The 54-meter-high tower, built in the 19th century, was until 1966 the tallest wooden tower in Europe. At the same time, a multi-storey porch with arches was added. In 1999, along with seven other wooden churches in Maramureș, it was included on the UNESCO World Heritage List. The interior painting of the church was completed in 1783, which suggests that the appearance of the geocentric solar system also dates from 1783. The painting (fig. 2) shows that around the Earth,

located in the middle orbit the Moon, then the Sun. Further on, Jupiter is seen with the four satellites discovered by Galileo, above, Saturn with its rings, and at the end, the star of the stars. On closer inspection, we notice a planet orbiting the Sun, probably a hybrid planetary model. It's the planet Mars. At an even closer look, we notice two other orbits, very close to the Sun. It seems to represent Mercury and Venus, which also orbit the Sun. In the ancient Egyptian model or that of Martianus CAPELLA, only two planets revolved around the Sun, while three planets orbit here: Mercury, Venus and Mars.

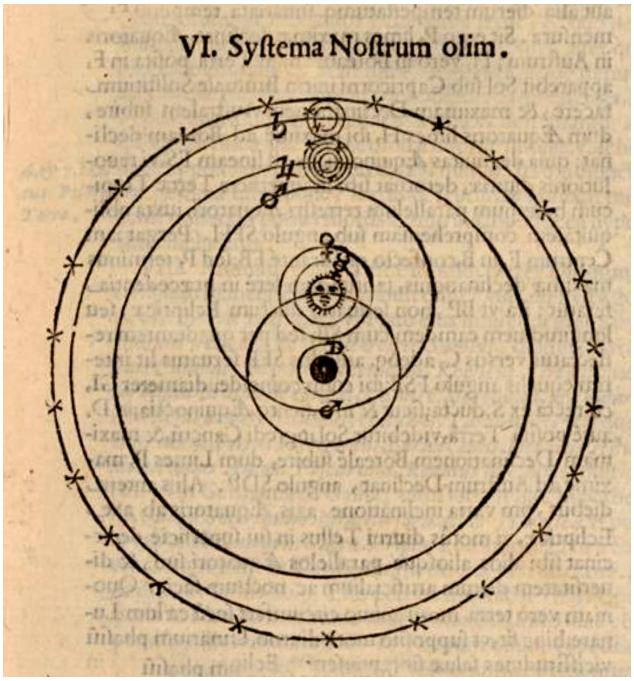

Fig. 15: Riccioli's planetary model, from his own book [RICCIOLI, 1651: 103]

Where did this model come from, who created it? Valentin NAIBOD's book[11] lists the models of solar systems known until then: that of PTOLEMY, that of Tycho BRAHE and that of COPERNICUS. The model from Șurdești is not among them. We also find another book, much later, from 1647, *Selenography*, in which the Danish astronomer Johannes HEVELIUS, in addition to a very detailed description of the Moon, also publishes three drawings with the three great models of the universe, but the one from Șurdești is also lacking here. Looking further, we find another book from 1651, *Almagestum novum*[12], written by the Jesuit priest and astronomer Giovanni Battista RICCIOLI (1598-1671). Here are all the models known to date. In drawing VI on page 103, we can also see the model from Șurdești, according to which three planets revolve around the Sun! This drawing is presented as "our own model", so that of RICCIOLI (Figure 15).

[11] Valentino NAIBODA: *Primarum de coelo et terra institutionum*, Venetiis, 1573.
[12] The title of the book alludes to PTOLEMEU's *Almagesta*.

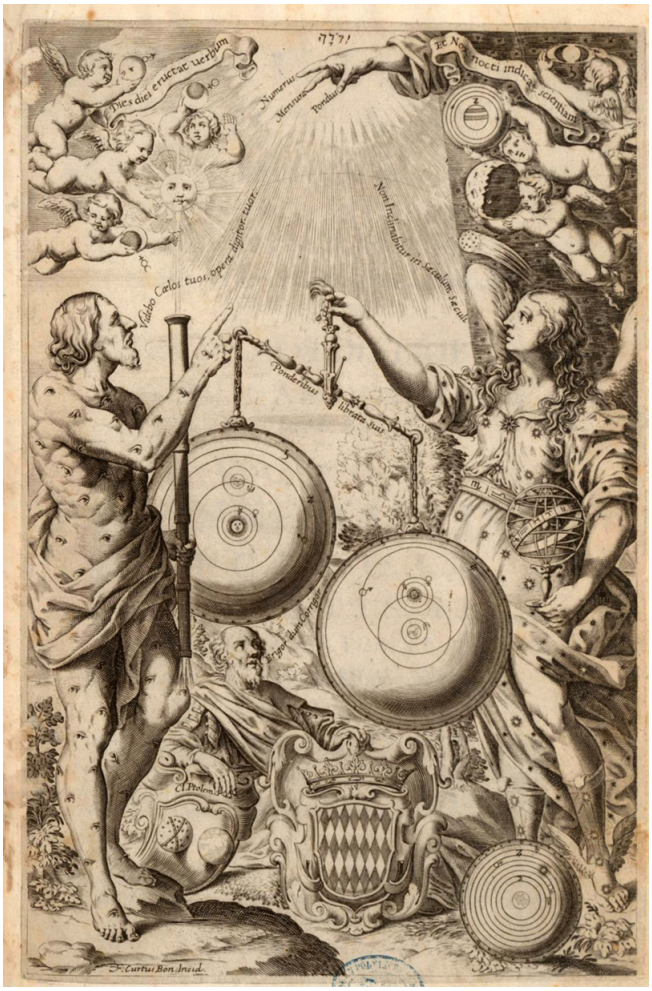

Fig. 16: The first page of RICCIOLI's book, from 1651 [RICCIOLI, 1651]

RICCIOLI actually discovered with the telescope that not only the two planets, Venus and Mercury (claimed by the Egyptians, and Martianus CAPELLA) revolve around the Sun, but also Mars. It was the Jesuit priest and astronomer RICCIOLI, who was commissioned by the Catholic Church to prove that, despite Galileo GALILEI's arguments, the Earth does not move. He found 77 counter-arguments, among which, along with some such as: the inappropriate placement of Hell or aesthetic objections related to harmony and proportionality, we also find some scientific approaches (eg, the discovery of the Coriolis force). The same model of RICCIOLI appears on the title page of the respective book, where the muse of astronomy, Urania, compares the two models: the heliocentric one of COPERNICUS with the geocentric one of RICCIOLI. PTOLEMEU, whose model lies thrown in the right corner, looks resignedly at the result of the comparison (Figure 16).

This model appears in only a few later astronomical books of synthesis, such as *Iter extaticum* (1660) by Atanasi KIRCHER, under the name of the semitychonic system, and in the *Atlas Novus Coelestis* (1742) by Johann Gabriel DOPPELMAIR, and here only as a phase. intermediate for the tychonic system. It does not appear, for example, in Johannes ZACH's *Specula* (1696), where, as in most books, only the three basic models are presented: Ptolemaic, Tychonic, and Copernican (Figure 19).

After all this, all we have to do is ask ourselves: how does the planetary model of an Italian Jesuit end up on the ceiling of the church in Șurdești?

The Jesuits were brought to Transylvania in 1579, immediately after the Religious Reformation, by the Catholic prince BÁTHORI István, to counteract the momentum of the reform. After repeated expulsions and recalls - depending on the religion of the prince of Transylvania - the Jesuits eventually settled in Transylvania. In charge of the Religious Counter-Reformation, the Jesuits quickly realized that the use of force was not enough to convert Protestant believers, but they would have to put both science and education at the service of the church. Thus, they created a very efficient school network in Transylvania: in Cluj, Alba Iulia, Odorheiu Secuiesc, Sibiu, Timișoara, Oradea, Târgu Mureș, Satu Mare and Baia Mare. The Jesuits came to Baia Mare from Cluj, in 1674, founding a Jesuit mission there, which included a monastery and a school, in which they integrated in 1755 the famous Schola Rivulina. The Habsburg Catholic power tried to recover, sometimes even by force, its buildings from the Protestant believers, and at the same time targeted the Orthodox Church. In the time of Archbishop Athanasius ANGHEL, the Transylvanian Orthodox Archdiocese was united with the Catholic Church, the religion of power in Vienna. Thus was born in 1698 the Uniate Church in Transylvania.

The faithful from Baia Mare started the construction of the Greek-Catholic church in 1771. Today, a new, more imposing church is being built in its place. Next to the church, there was a popular Uniate school with four classes, but, starting in 1793, that is 10 years after the painting of the church in Șurdești. Because in the years when the solar system was painted, Uniate s did not yet have a school of their own, it is likely that the Jesuits taught Uniates in their own schools. Under these conditions, it is very likely that the geocentric planetary system in the wooden Uniate church in Șurdești, located only 20 km from Baia Mare, was built under the influence of the Jesuits. It is possible that the work of Giovanni RICCIOLI, known as a great astronomer of the time, was found in the library of the Jesuit school in Baia Mare, and the planetary system was copied from there on the ceiling of the church in Șurdești[13]. We can therefore see how strong the influence of the Catholic Church was in Transylvania, even in the field of astronomy: in 1783, so at the end of the 18th century, geocentric planetary models were still painted on the church ceilings. The situation was similar in Europe.

3.4 Ocland

In view of all this, how was it possible that in Ocland a heliocentric planetary system was painted on the ceiling of the church - even earlier than in Șurdești, in 1771? How could the Copernican model penetrate the Unitarian church in Ocland? Most likely, the painting was commissioned by the then priest of the church, MEHE Mihály, during the renovation of the entire church between 1769-1771. Thus we will reformulate the question: how could the priest of MEZE Mihály find out about the Copernican heliocentric system, and how he became a follower of this theory, so that he ordered the Copernican system to be painted on the most important box on the ceiling, the middle one?

[13] [UZA, 2014]

4 The Penetration of the Copernican System iin Transilvania

Because of the prohibitions and the index on the heliocentric books, we must look for those ways that bypass the Catholic Church.

4.1 Calendars

One of the important contributions of the Renaissance was the invention of printing. Thanks to the typographic multiplication, a new genre of publication appears: the calendar. It was a popular book that has been one of the most widely read and reprinted works in the last 400 years. His audience was comparable only to that of the Bible. Calendars, in addition to calendar data, also contain basic knowledge, including astrology data. Thus a new possibility arose that, by evading church censorship, calendars could propagate new astronomical knowledge. The famous German astronomer Johannes Müller von KÖNIGSBERG (REGIOMONTANUS, 1436-1476), was also the author of calendars. In 1471, he published the first calendar, which obviously contained the geocentric model, given that it had appeared half a century before the book of COPERNICUS. A century later, in 1575, the Cluj writer and typographer HELTAI Gáspár (1520-1574) translated it into Cluj in Hungarian, under the title *Csízió*. Although this calendar is published 45 years after the publication of COPERNICUS' book, it includes the Sun in the planet's range, so it contains the geocentric model, without making any reference to the heliocentric one.

It is almost unbelievable that even in the 1909 edition of the Csízió calendar, the Earth is at the center of the solar system, and the Sun appears as a planet.

> *The sun is the fourth planet under Mars in the fourth sky, 166 times larger than Earth. Its height is three thousand times a thousand, nine hundred times a thousand and sixty-five miles.*
>
> [Csízió, 1986: 32]

At the Szekler National Museum in Sfântu Gheorghe there is a rich collection of calendars, consisting of several hundred copies. From their multitude, it appears that even in those that appeared at the beginning of the 19th century, the Sun is mentioned as the fourth planet. Therefore, the popular calendars did not propagate the heliocentric planetary system in any way, but on the contrary, they delayed its knowledge. The oldest calendar in Transylvania in which the Sun appears positioned in the center of the planetary system, appeared in Cluj, in 1792, under the title *Calendar after the new and old style*[14] by HANCKENS Bálint. He no longer lists the Sun among the planets, but speaks of the Sun and planets, and places it in the center (Figure 17). But this happens 20 years after the tape was made in Ocland. Therefore, the calendars give no explanation for the tape in question, which appeared in Ocland in 1771.

4.2 Schools and universities

Another possible way in which the heliocentric conception could penetrate the consciousness of ordinary people is the educational network. Of course, we should not think of denominational schools, but of public schools, where church bans are not so strict. But at that time, the schools in Transylvania were almost exclusively in the hands of the churches. The situation changed only from

[14] The "new" and "old" styles refer to the Gregorian and Julian calendars, respectively.

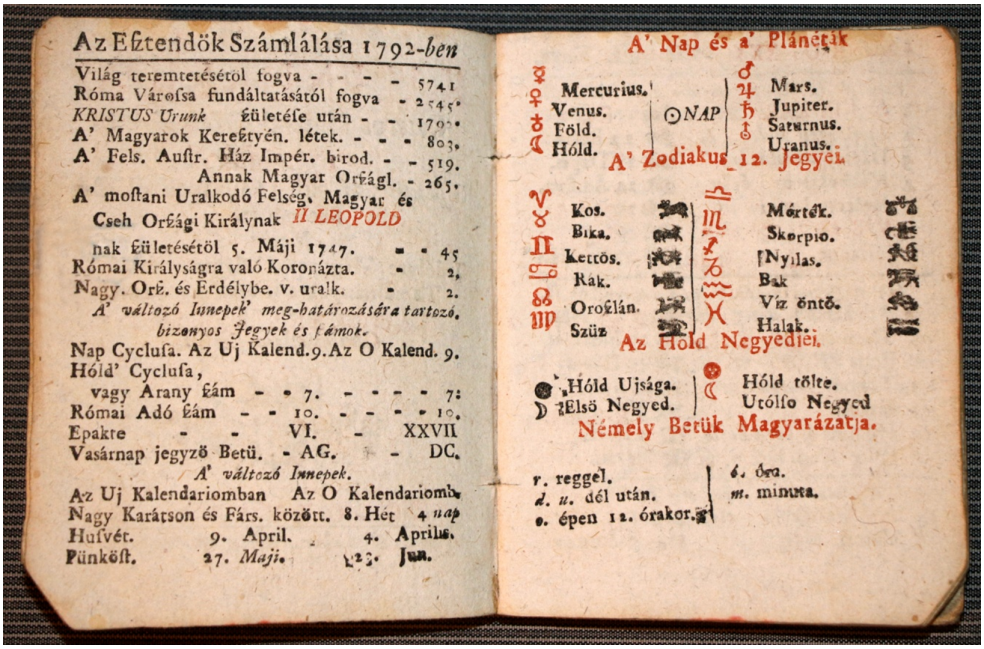

Fig. 17: Bálint HANCKENS's calendar, with the Sun in the middle of the planets (1792).

1777, when Maria Theresa issued the decree *Ratio Educationis*, aimed at organizing a unitary public education system, under state control. But *Ratio Educationis* does not explain the phenomenon in Ocland for two reasons: once, because the decree appeared in 1777, while the painted box from Ocland dates from 1771. Secondly, because of the content of the textbooks. The printing house in Buda enjoys the exclusive right to print textbooks ordered for the benefit of schools in Hungary and associated countries. But this printing house was none other than the printing house of the Jesuit University of Nagyszombat (Trnava, Slovakia), moved to Buda. So the confessional schools remained.

Catholic schools were run by Jesuits, who obviously taught the geocentric conception of the universe. In Protestant schools, the situation was somewhat different. At the end of the seventeenth century, in the Protestant countries, the visceral resistance to the heliocentric conception was somewhat abandoned. Thus, Protestant universities in the West were already spoken of, and sometimes written about, COPERNICUS' heliocentric system. Many Protestant students from Transylvania went to study in the West: the Reformed, more conservative universities in Germany, and the Unitarians, especially the more liberal Dutch universities. After graduating from university, they generally returned home to Transylvania to teach in schools.

APÁCZAI Csere János (1625-1659) was born in Apața (Brașov County). He completed his secondary education in Cluj, then attended the upper gymnasium in Alba Iulia. After that he went to the Netherlands, where he attended several universities. His major work, *Magyar Encyclopaedia*[15], was

[15] *Hungarian Encyclopedia*, Ultrajecti (today Utrecht, Netherlands.), 1653

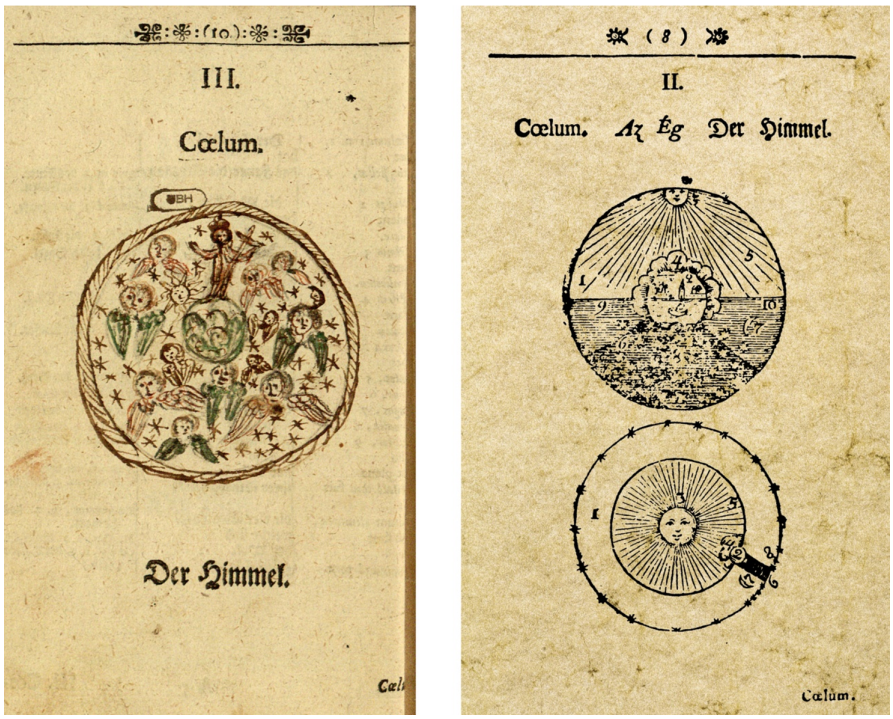

Fig. 18: The solar system in two editions (1698 and 1793) of the book Orbis Sensualium Pictus.

written and published in 1653 in Utrecht. In it, in addition to various other encyclopedic knowledge, he also deals with astronomy, describing the solar system.

> *Just in the middle of it is the Sun, which, spinning fast around its own axis, spins our sky around it, along with all the beasts.*
>
> [APÁCZAI, 1653: 101, XXI, 2]

APÁCZAI was the first to promote the heliocentric conception in Transylvania, and implicitly in Hungary. Moreover, he did it not in the language of science, Latin, unknown to the common people, but in his mother tongue, Hungarian. It is true that more than a century has passed since the publication of COPERNICUS' book, but we must not forget that these were the years of the harshest prohibitions, and the trial of the Inquisition of Galileo, who had died only 10 years before, was still alive in people's memory. Unfortunately, APÁCZAI's too modern vision, but perhaps the envy of the other teachers, limited his teaching. Moreover, he was threatened for his opinions and modern teaching even by the prince of Transylvania, RÁKOCZI György II, a theme elaborated by the writer Géza PÁSKÁNDI:

> *Mr. Apáczai, don't teach anything else! God help me, if you teach me anything else, I will order you to be thrown into Mureș or thrown out of the Tower!*

This revolutionary spirit died of tuberculosis at the age of 34. Even in those decades began the long debate on the two conceptions of the universe, a debate that would last until the end of the eighteenth century.

In this context, we must mention the book of the Czech philosopher and pedagogue Jan Amos KOMENSKÝ (COMENIUS, 1592-1670) who, however, kept pace with scientific development. In the trilingual edition (Latin / Hungarian / German) in Bratislava of the textbook *Orbis Sensualium Pictus* (1793), the illustration was changed to the lesson Coelum (Heaven) (fig. 18 b), and it is already written that:

> *Heaven 1. seems to revolve around the center Earth. 2. but, indeed, the Earth revolves around the Sun.*
>
> [COMENIUS, 1793: 8]

But that's after the Ocland cassette, too.

4.3 Libraries

A third possibility for the propagation of the heliocentric conception - outside the clerical censorship - could be the private initiative, ie the private libraries. It was the idea of the American professor of astronomy Owen GINGERICH to inventory the copies of COPERNICUS' book for the analysis of the propagation of Copernican principles, since, due to church censorship, the Copernican conception could be known almost exclusively from this book. The few books of COPERNICUS that arrived in Transylvania must be sought first of all in the private collections. In the Carpathian Basin, 8 such specimens have been preserved for posterity, 3 of which are in Transylvania.

4.3.1 Evangelical Gymnasium from Brașov

One of them is in Brasov. Michael WEISS (1569-1612) was born in Mediaș, and after elementary school, he learned Hungarian at the Jesuit college in Cluj. He was then a clerk at the court chancellery and a diplomat of several Transylvanian princes. In 1612, he fell victim to the adventurous campaigns of the Transylvanian prince BÁTHORY Gábor. Michael WEISS had a rich library containing many astronomy books, including COPERNICUS' book. In 1608, he donated his books to the library of the evangelical gymnasium in the city of Brașov (the library founded with the gymnasium by Johannes HONTERUS in 1544). COPERNICUS' book can be found in the library's catalog - which begins in 1572 - in its 1608 inventory. After a while, the book no longer appears in the registers. Most likely lost in the fire of 1689, when the entire library burned down. The Ocland priest who commissioned the painted tape in 1771 would never have had the opportunity to see this book, as the book was no longer 82 years old at the time of the painting. And he would not have learned much about planetary systems either, because in the 18th century, in the Saxon schools of Transylvania, despite the effervescent cultural life here, physics was still not taught. The school purchased another copy of COPERNICUS' book, which still exists today. It is recorded that it was bought in 1796, a quarter of a century after the installation of the box in Ocland.

4.3.2 Reformed college from Orăștie, Mihail Halici

In this order of ideas, it is worth mentioning the humanist scholar Mihail HALICI (1643-1712), born in Caransebeș, exactly 100 years after the publication of COPERNICUS' book. He studied at the

reformed academic gymnasium in Aiud, where he had a very good friend, PÁPAI Páriz Ferenc, to whom - on the occasion of obtaining his doctorate in medicine - he dedicated an ode in 10 lines (1674), which is practically the first poem in Romanian literature. written in metrical verses[16].

HALICI had a very rich personal library with many astronomy books[17]. Although the book of COPERNIC was not among them, it had a book by Johannes KEPLER - inherited from ENYEDI Sámuel -, *Epitome astronomiae Copernicanae* (Linz, 1618), which was also a source for heliocentric theory, a book also indexed. by the Catholic Church. Unfortunately, there is no study that follows the trajectory of HALICI's ideas and astronomical beliefs, starting from the Reformed College in Orăștie, where HALICI was also rector for two years, and to which he bequeathed his entire library[18].

4.3.3 Reformed college from Cluj

The other two copies of COPERNICUS' book are in the Library of the Academy of Cluj. They arrived here on the occasion of the nationalization in 1948, when the Romanian state confiscated all the older libraries belonging to some schools or churches. One of the copies shows the stamp of the Reformed College from Cluj from 1871, exactly 100 years after the appearance of the tape from Ocland. But didn't the book get here faster? If we browse the catalogs of the library of the reformed college, the book still appears in the catalog from 1825, so at that time it was already owned by the college. The previous catalog dates from 1767, but the book does not appear in this catalog. So COPERNICUS' book arrived there at a later date in 1767. It was during this period (1769-1771) that the Unitarian church in Ocland was renovated. Therefore, even if the pastor of Ocland had passed through here until the preparation and renovation work had begun, he would not have found COPERNICUS' book.

4.3.4 The Unitarian College from Cluj

Among the notes on the owners of the third copy is the Unitarian church, so the book belonged to the Unitarian college. The Reformation - not long after its appearance - underwent a new reform in Transylvania, and with the help of refugees from Europe (Faustus SOCINUS, Giorgio BIANDRATA, etc.), due to the religious tolerance of Transylvania. Thus was born the Unitarian confession in Transylvania. Interpretations of the Bible became even more liberal, so the Unitarians accepted the new visions more easily. In Cluj, the spiritual capital of Transylvania, in 1557 the Unitarian College was established. The first Unitarian school operated in the former Franciscan monastery. The old building no longer exists, it was demolished a few decades ago, and another building was built in its place. In the 1743 catalog of the college library, COPERNICUS' book is identified by the number "C86." He was there a long time ago: in the 1661 catalog he was in position 18. So long before he painted the box in Ocland. All this leads to the conclusion that, theoretically, the Unitarian pastor of Ocland could be inspired from here, from the library of the Unitarian college, to make the box painted with the Copernican model, from 1771.

But was this book really studied in college or was it just lined up on the shelf, among other bibliophile rarities? An inventory note clarifies this issue somewhat. In the Cluj archives of the Hungarian Unitarian Church, there is a document, *Fasciculus Rerum Scolasticarum*, in which there is a note, according to which, on September 24, 1717[19], the advisor to the governor general, BIRÓ Sámuel

[16] Hexameters and pentameters
[17] HAJÓS József. *Korai Kopernikusz-vonatkozásainkról*, Korunk Nr.7, Cluj, 1973.
[18] The book is now in the University Library of Cluj.
[19] Geography began to be taught in college in 1716.

(1665-1721) donated to the Unitarian College of Cluj a map, on which the universe is depicted according to the Ptolemaic, Tycho BRAHE, and Copernican conceptions. Subsequently, the senior of the school made a new note, dated September 25, 1717, according to which, "Mapa ab ilustrissimo Samuele BIRO, colata coro auditori", ie the map that BIRÓ Sámuel donated to the college was displayed in the auditorium, seen all the time by students. This means that he also teaches classes on this map. The map no longer exists today, but it contained the three important visions of the universe (Figure 19).

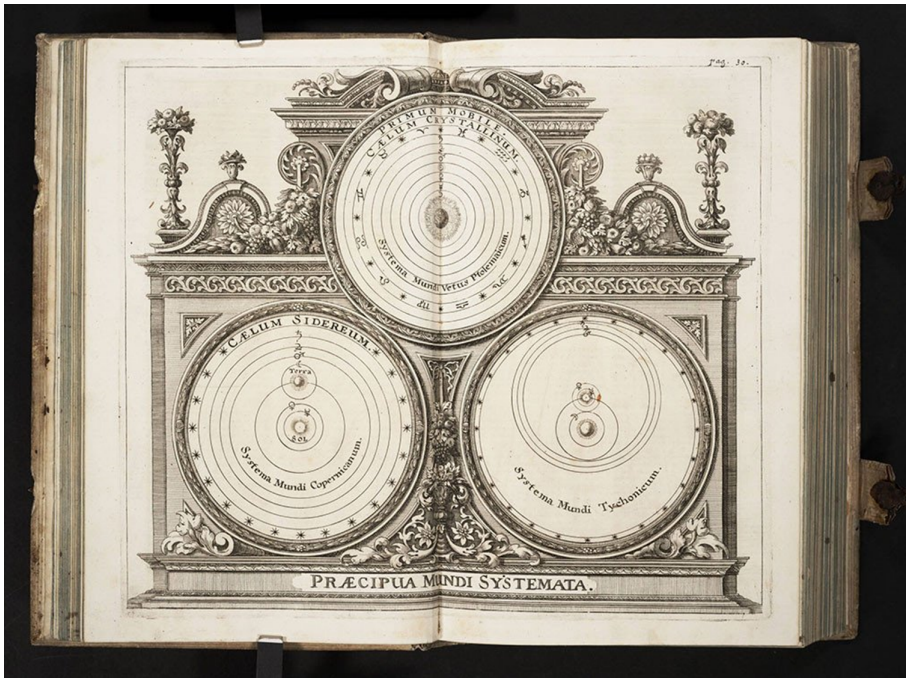

Fig. 19: Johann ZAHN: Praecipua Mundi Systemata [ZAHN, 1696: pag. 30]

We also find out from the archive that MEZEI Mihály was among the students of the college. MEZEI Mihály, the future Unitarian pastor from Ocland, attended the Unitarian College in Cluj in 1735, as evidenced by the fact that he passed alone, "manus propria", in *Seniori Matricula*, on July 16, 1735. MEZEI Mihály not only graduated from college, but became a Unitarian pastor. MEZEI Mihály was ordained on June 16, 1759, at the synod of Aita Mare, as evidenced by the inscription of his name in the minutes of the synod and consistory: "Michael MEZEI pastor Ecclesiae Homorod Karátsonfalviensis Unitariorum, manus propria." Homorodkarácsonyfalva (Christmas) is a quiet village in the Homorod Valley, just outside the village of Ocland. The Unitarian pastor of MEZEI Mihály moved to Ocland in 1769. The village has only one church, dating back to the end of the 13th century. But the oldest written attestation of this church dates back only to 1715, consisting of a visitation note of the Odorheiu Secuiesc Conscription: "The church is made of stone, covered with shingles, the tower, made of stone, covered with shingles." Over time, the condition of the building deteriorated. The newly appointed Unitarian pastor, MEZEI Mihály, began the renovation of the entire church in 1769. This was done within two years. The work was completed in 1771. Then

the floral boxes were mounted on the ceiling of the ship. The work was executed by the carpenter ELEKES András from Ocland, a fact recorded on one of the tapes. Among the numerous boxes with floral motifs we find some with representations of animals, as well as two famous boxes: an eternal calendar for calculating the date of Easter[20], and another with the heliocentric planetary system, "Copernicarum System" (fig. 5). It is very likely that they were commissioned by the pastor of MEZEI Mihály, the one who led the renovation works and, how else, if not based on the knowledge and vision about the world acquired at the Unitarian College in Cluj?

5 Conclusions

The two-century scientific dispute between geocentric and heliocentric models was settled in 1728, when the English astronomer James Bradley[21] (1692-1762) was able to find direct evidence of the Earth's motion. BRADLEY demonstrated by the phenomenon of light aberration that the Earth is the one that is in motion, that is, that this motion occurs around the Sun. Therefore, Aristarchus, Copernicus, and Galileo were right. However, the heliocentric works were finally removed from the index only after 100 years, in 1835.

It is possible that this painted box from Ocland was the first imagistic representation in Transylvania of the heliocentric system (apart from those in the specialized books). It was not an ordinary representation of the time, but a bold, relatively early appearance of the Copernican model of the universe. An indisputable proof in this sense is the image from Șurdești (fig.2), which, although made around the same time, still represents the geocentric model.

But there is other evidence to that effect.

The first book of philosophy in Hungarian appeared a year later, in 1772: Magyar nyelven Filosofia. In it, the Franciscan monk SARTORI Bernát, a native of Oradea, fought as valiantly against the Copernican idea as Martin LUTHER, 250 years ago. . In his book on philosophy, in the part about physics, the third question is whether the Sun or the Earth move?

> *Closing. The movement of the earth, as Copernicus teaches us, seems to oppose on the whole the clear words of Scripture.*
>
> [SARTORI, 1772: 186]

The first book on physics in Hungarian appeared in 1777, *A Természetiekről, Nevvton tanítványainak nyomdoka szerént hat könyv*, in which János MOLNÁR, among others, laid the foundations of the then-specialized Hungarian language in physics. In the book, the author describes the heliocentric system, but does so not because he considers it true, but:

> *To make things easier, we will follow the path of Copernicus and Newton, after which the Earth is also a wandering star.*
>
> [MOLNÁR, 1777: 156]

Most scientists no longer doubted the theories of COPERNICUS, KEPLER or NEWTON. But this scientific position had not yet penetrated the public consciousness, so until the end of the eighteenth century, the Copernican debate had not been decided unanimously. It was not until the beginning

[20] Published also in national geographic
[21] The same astronomer who also discovered the notational motion of the Earth's axis.

of the 19th century that the custom of COPERNICUS' theory being accompanied by the phrase "mathematical hypothesis" disappeared.

Considering all this, the image of the Copernican solar system, painted in 1771 on the ceiling of the Unitarian church in Ocland, seems to be a small "miracle": it is not just a curiosity of the time, but an open assumption, the first Transylvanian attempt to brings the Copernican revolution into the public consciousness. This is the image of the universe that the simple man from Ocland could see painted over his head, every Sunday, when he went to the church in the village.

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