



Astronomy in Slovak-written texts 150 years ago

150 years of Hurbanovo observatory

Hurbanovo

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- If we came back to the moment of founding of Hurbanovo observatory in the year of 1871, what kind of information could we obtain about the universe at that time as readers reading Slovak books?

- In the era of ~1850 to ~1870, 6 books appeared:
- **1. Štěpňica Nauk a Umění = Nursery of Sciences and Arts**
Skalica 1852 Ondrej Šoltýs
- **2. Prostonárodní bibliotéka = National bibliotheca**
Buda 1863 (4th ed.) Maximilián Jalovecký
- **3. Slovenská čítanka pre nižšie gymnasia =**
Slovak reading book for lower gymnasia
Banská Bystrica 1865 Emil Černý (comp.)
(with texts of Daniel Lichard)
- **4. Physika čili Silozpyt = Physics**
Skalica 1869 Ivan Branislav Zoch
- **5. Školník = Teacher**
Vienna 1871 Ondrej Radlinský (comp.)
(parts on universe written by František Víťazoslav Sasinek)
- **6. Weliký žiwot Pána a Spasytele nasseho Krysta Gežjsse...**
The Great Life of our Lord and Savior Jesus Christ...
Skalica 1869 (3rd ed.) Martin of Kochem

- short books (100 to 200 pages), exceptionally longer
- All are popular books or schoolbooks
- The character of the text is determined by book-length and its difficulty.
- They treat many parts of human life and environment.
- Astronomy contains only a small part of the corpus
 - some knowledge (e. g. on Earth, or telescope) can be found in chapters outside of astronomy chapter
- All authors are priests (except for Zoch), Martin of Kochem was a theologian, preacher, and a Capuchin monk.
- Zoch, Jalovecký, Lichard were pedagogues.
- Jalovecký a Lichard were cultural workers.
- Sasinek was primarily a historian.
- Zoch, Sasinek, Šoltýs wrote schoolbooks.

- Hagiography of Martin of Kochem is the most different book of all six presented.
- It was one of the most popular books in Central Europe
- voluminous... 1,000 pages, only ~30 pgs contain astronomy
- First published in GER in 1677, (in CZE 1698, in SVK 1857)
- Planetary theory is geoheliocentric (that of Tycho Brahe)
- Kochem draws from A. Kircher and J. Hevelius
- overall 9 editions (the last issued at the start of 20th century)
- **It was read in rural areas during the WWII yet, while its content was unmodified since 1677!!!**
- It was not focused to popularize astronomy but to be moral-instructive handbook combined with the history of New Testament.
- Maybe the publisher (Škarnicele) had not any means nor educated people around to update the text on universe.
- It was ingenious business shot – the book was written in Czech language well understood in Czech and Slovak lands.

Astronomy, Cosmogony

- Jalovecký & Sasinek: Astronomy is a science dealing with heavenly objects, that is, stars.
- Zoch: Astronomy explains and defines phenomena of the universe.
- Only Martin of Kochem deals with creation of the world but his thoughts do not differ from what is written in the Bible.
- Division of the world (only Martin of Kochem): earth, space, supracelestial waters, and theological heaven (=Empyreum)
- Daniel Lichard in his “Astronomical fragments on the Sun” says that the world lasts for 5,840 years.
- Years remaining to the end of the world and the end of the world itself is not pertracted by any of the authors.

Sun

- Šoltýs: Sun is a dark object which was endowed by the matter of light by God. It has two types of rays, one type for shining, the other for heating. Its volume is 1.3 million times larger than that of the Earth. Distance to Earth is 20 million of German miles (GM) = $20 \times 7.5 \text{ km} = 150 \text{ mil. km}$.
- Jalovecký: The Sun never moves, only rotates, it itself shines, and is the head of Solar system; keeps planets together, shines upon them and heats them. Author mentions frequent optical phenomena: the red sun, halo, and sundogs.
- Lichard writes a lot of information. e. g. influence of the Sun on terrestrial life, heliocentrism, old mythological conceptions (incl. Slavic), distance, real and apparent diameter, parallax, density, surface gravity, and orbiting around central star (Alcyone of Pleiades).

- Zoch writes not much on the Sun... He treats its apparent moving on the sky (daily and nightly) and as the only one writes about the composition of the object derived from the spectral analysis. The sun is fiery object containing these chemical elements: K, Na, Ca, Fe, Mg, Cr, Ba, Ni, Cu, and Zn. There is no Au, nor Ag.
- Sasinek: The same as Šoltýs, but he adds solar rotational period: 25 days, 8 hrs, and 14 min., derived from the moving of sunspots. These are holes in the photosphere and thanks to them we can see non-shining surface of the Sun. Faculae are also mentioned. The Sun is 300,000× brighter than the Moon.
- Kochem: The Sun consists of 4 elements, but mainly from fire. It has mountains, valleys, rivers, seas with islands on its surface. Waters are made from molten metal. The Sun is thousand times hotter than the hottest terrestrial furnaces. It is also 140× bigger than the Earth. It revolves around the Earth in a distance of 9,602,080 GM with velocity of 260,000 GM/h.

Mercury, Venus

- When speaking about planets, Šoltýs and Sasinek mention their distance, orbital period and volume which are similar to current values. (2021).

Kochem: Mercury is the smallest planet, resides near the Sun and it is hardly discernable; made from 4 elements. On its surface there are high mountains, valleys, seas and rivers. No numeric values are provided by Kochem.

- Other 2 authors mention no surface details.

- Šoltýs & Sasinek: Venus – apparently the brightest planet, appears mainly during dusk.

Kochem: 6× smaller than the Earth, does not shine itself; with mountains, valleys, seas, rivers on its surface. The water is rosy and land is made from shiny matter similar to crystal. That's the reason why the planet is so bright.

Earth

- Šoltýs: Earth is spherical (+proofs), it rotates and orbits the Sun within 365 d, 5 h, 48 m.
- Jalovecký: Earth is spherical and dark, lit by the Sun and stars, reflected light comes from the Moon. It rotates around the axis and orbit the Sun. It keeps everything on surface when rotating thanks to its gravitational force. The planet hangs freely in space.
- Zoch: Earth is flattened (5.6 mile). Polar diameter is 1,713 GM. Author gives proofs of their sphericity and rotation. Earth moves along an ellipse around the Sun. The planet is inclined 23.5° to the ecliptic which is the cause of seasonal changes.
- Sasinek: Earth spins on its axis and goes around the Sun, spherical and dark (+proofs of sphericity), lit by the sun. Sasinek also gives the dates of solstices and equinoxes.
- Kochem: The Earth is the lowest planet of all. Circumference is 5,400 GM. The planet hangs freely in space. There are caverns inside the body.

Moon

- Šoltýs: Dark object that reflects the light from the Sun. 64× lesser Earth (volume), distant 50,000 GM. Its surface covered with seas, lakes, rivers, mountains and something resembling roads. Moon has 4 main phases. Jalovecký adds that the Moon hangs freely in a space and orbits the Earth in 28 days. He also adds the moments of occurrence of phases. He writes of optical phenomena connected with the Moon. Sasinek also mentions all these facts and amends that Moon is the main cause of the tides (6-hour frequency).
- Lichard writes a lot about the Moon. He mentions the role of the Moon in culture and mythology, its distance from the Earth (incl. story of its computation), spherical form, optical illusion of bigger Moon when near horizon, other physical characteristics like surface area, volume, mass, density, surface gravity etc.

- Zoch: Moon is distant 51 000 GM from us. Siderical orbital period is 27 d, 7 h, 43 m, 11+1/2 s. Zoch gives figures of apparent and real diameter. Moon travels in ellipse around the Earth and in cycloid around the Sun. Also orbital nodes are mentioned. Zoch informs that the one side of the Moon still faces the Earth and explains the cause of moon phases and tides. The Moon influences the Earth's atmosphere in the same way.
- Kochem: The Moon is spherical and dark object. The nearest object to the Earth distant 51 600 GM. Circumference is 1,555 GM. Consisted of 4 elements, similar to the Earth with its mountains, valleys, rivers and seas, but free of vegetation. Lunar surface is very hard and solid like metal, waters are crystal-clear but impotable. There is no rain. Brighter parts of the surface are rocky and harsh, darker ones are valleys covered with (eternal) shadows.

Mars

- Šoltýs: Mars also has phases and surface spots = mountains assumed by the author.
- Kochem: Martian surface is dry and hot; rocks are yellow like sulphur and produce dense and poisonous substance. Waters are similar to dense pitch mixed with sulphur. Dark flame and unhealthy smoke come out of them. Evil-smelling flames jet from the inside of the planet. There is a hundred-miles-wide abyss and kind of sulphuric substance is coming out of it. Mars is lit partly by the Sun, partly shines itself. It helps the Sun to heat other planets. No numerical values given by Kochem.

Jupiter, Saturn

- Sasinek: Light of Jupiter is white.
- Kochem: Jupiter has 20 times bigger volume than the Earth. The colour of light is similar to gold mixed with silver; also mountains are made from the same material. Waters abound in magnificent fragrance and many little objects move around the planet.
- Kochem: Saturnian surface is bumpy, covered with mounds, rocks, caves, and almost no plains. There are also seas, rivers and one abyss. Rocks are similar to lead, and waters to quicksilver. Waters produce irrespirable smoke and stink. Saturn has no proper light, lit by the Sun and two companions.

Uranus, other planets

- Šoltýs a Sasinek: Volume of Uranus is 88 times that of Earth. Orbital period is 82 years. Rotational period is unknown to both authors. Šoltýs remarks on discovery of the planet by William Herschel on 13th March 1781 from Bath.
- Sasinek: There are 84 asteroids moving between Mars and Jupiter; all are fragments of one former solid body. Ceres and Vesta are the largest ones, Atalante is the smallest. Its surface area is only 50 square German miles which is equal to area of County of Zvolen.

comets

- Šoltýs: Comet is a planet with burning head and long tail, moving orderly in its track. Then he deconstructs myths about comets.
- Jalovecký: Comets are stars with glare and beard or broom; some belong to our Solar system others do not; some are long lost; they have different sizes (the smallest are unable to be seen). The author argues against the superstitions on comets (famine, diseases, wars, etc.)
- Sasinek: Comets are stars with glare and tail. 11 of them belong to our Solar system, the rest does not. Comets cannot hit the Earth, maybe on Doomsday...
- Zoch: Misty objects with conspicuous nucleus moving on long ellipses. Tail rises as a consequence of their fast movement and resistance of ether. There are about 500 comets in space.

fixed stars

- Šoltýs: Fixed stars do not change their places, have proper light (like the Sun); also have similar properties like the Sun. They are as large as the Earth; some are even larger. Their total number is unknown.
- Jalovecký: Stars are shiny spheres and worlds themselves. They were created by God and hang freely in space; 1000s times larger than the Earth. There are uncountable numbers of stars; each one endowed with planets.
- Sasinek: Stars are freely hanging spheres with proper light. Centripetal and centrifugal forces keep them in their places. Immense number of stars. Sun outshines them during the day and cannot be seen in the sky. Divided in 6 basic classes. Dimmer stars can be seen only through the telescope. Some stars do not shine constantly but are dimmed by dark objects orbiting them.

- Kochem: Fixed stars consist of 4 elements. Immense number of stars. Divided in 6 classes (the smallest have $18\times$ Earth's volume, the largest have $107\times$ Earth's volume). They are not spiky (as they are often painted), spikes are only their rays. All stars are spherical and orbit around the Earth. Some fixed stars do not shine but reflect the light of other stars; some shine dimly and also reflects the light; others shine very clearly. They are placed in various distances. The nearest fixed star lies in the distance of 80 million GM. If one wants to come to the nearest star in speed of 100 GM per day, it would take him 2,000 years to reach it. Another 4,000 years would be needed to come to heaven.

Constellations / (super)novae

- Šoltýs: Constellation is a group of stars evoking a figure. Author mentions only 12 of them (zodiacal).
- Sasinek says the same as Šoltýs but he adds information on width of zodiac band (20°).
- Sasinek calls novae wondrous (literally thaumaturgical) stars; these are sudden brightened stars which shortly disappear from sight. They are either dying worlds or stars covered by dark companions. 22 were recorded in history, 19 of them of 1st magnitude. Appeared in Milky Way or nearby.

Milky Way

- Šoltýs: MW can be seen when the Moon is down. It is compiled from myriads of little stars.
- Jalovecký: Pile of thousands of millions distant stars that shines only like a faint glow.
- Zoch cites John Herschel who says that we are in the middle of all solar systems. Stars are scarce outside of Milky Way but of immense count inside of it. He mentions distant nebulae (25,000 ly) also full of stars.
- Sasinek: MW has immense number of stars seen when weather is clear.

shooting stars / fireballs

- Šoltýs: Fireball – falls down to Earth at night and falls apart in atmosphere; shooting star – sometime snuffs out in the air, sometimes falls down to Earth. Author recognizes 3 types of meteorites: irony, stony, dusty.
- Jalovecký: We don't know what shooting stars are. Maybe, stars which only travel through our atmosphere. Fireballs are also unknown. Their volume is about 60 litres.
- Zoch: Shooting stars are certain planetary objects which burn up in the air and distinguish shortly after.
- Sasinek writes eloquently about meteors and fireballs; what they are, superstitions about them; most famous falls; their mass; time of occurrence; where they come from; where in the space can be found.
- Kochem: Made from dust on the ground which is elevated to clouds by sunlight. There they get wet and sunlight gets them dry. They become firm and fiery steam knocks them down in high velocity.

spherical astronomy

- This part of astronomy is without changes for centuries and authors could not explain it today in another way.
- Šoltýs speaks about points on the heavens which are important for basic orientation (poles, points of east and west, nadir, zenith, zodiacal points), 9 main circles (equator, horizon, zodiac, meridian, 2 colures, 2 tropics, 2 polar circles). Zodiac is called as the ecliptic.
- Jalovecký mentions and explains terms such as these: horizon, 4 cardinal points, equator, tropics, polar circles, and poles.
- Zoch writes about terms like: zenith, nadir, almucantars, meridians, azimuth, poles, equator, declination circle, hour angle, right ascension, equinoxes, solstices, tropics, conjunction, quadrature, opposition, culmination, ecliptic and precession.

- Authors treats other topics such as: moons, eclipses, movements, orbits, telescope, history of astronomy, celestial ether, supracelestial waters, empyreum, light, aurorae, time, even astrology and superstitions connected with various celestial phenomena.
- This is kind of information that was available to the literate people of the time. Even Nicolaus de Konkoly himself met with many of these facts.