Sky maps as world maps

On the history of world view concepts

Voigt, Vilmos

Both in Hungarian and international folklore research the topic of world view was very often mentioned. However, some simple questions (e.g. what kind of "maps" on earth and sky etc. we know from the tradition), have been neglected. In my short paper I try to show, how interesting is the problem of "World view maps", as soon, as we come closer to the historical data. I can here but deal with one sub-chapter of the wide topic: in which way the astronomical maps refer to our earthly world view. We can easily realize that the same problem should be investigated in various cultures, from Stone Age to Australian or Polynesian aborigines, from Babylon to the Maya calendars etc. Folklorists have collected long lists of "star names" and data on "heavenly lore" among various peoples, including Hungarians too. But, because of the limits of my paper's length, here I will concentrate on one more precise and smaller subject: historical sky maps in the early modern European Tradition. And, just at the introduction to my paper I have to confess, because of printing difficulties I was not able to reproduce here a rich choice of illustrations. Maps and globes on the sky are superb production of printing, painting mechanical-engineering and constructing. It would be very difficult to reproduce here the fabulous multicolour maps, usually of considerable size, and quite naturally in three dimensions: making thus very difficult a good reproduction in our recent journals. I have tried still, to refer to some other publications, where interested reader would find more illustrative material.[1]

Astronomical (more precisely cosmographical) maps (and other forms or charts, globes etc.) are superb indicators of world view and its development. Notions like "above" and "below", "center", versus "periphery" or even "sphere", "hemisphere" can be derived from those charts. As for the traditional European World view, from Ancient Greece to the Renaissance the so called Ptolemaic

[1] Because I am referring to well known books and facts. I will give detailed source references only when necessary. Klinghammer (1998) was available to me after completing my present paper. It gives a concise bibliography, focused on the history of mapping.

system was dominant: the Earth was the center or fixed point of the Universe, around which the heavenly bodies (stars, planets and of course both Sun and Moon) moved. A new system, the so called Heliocentric system was first time fully presented by Nicolaus Copernicus (his major work *De revolutionibus orbium coelestium* was printed in Nuremberg 1543). According to his theory the planets revolve around the Sun, and the turning of the Earth on its axis accounts for the apparent rising and setting of the stars in the sky. The same idea was expressed by Johannes Kepler in his most important book *Harmonices Mundi* (1619), which was criticized but admired and silently accepted as a theorem by Galileo Galilei in his *Dialogi sopra i due massimi sistemi del mondo (1632).* The century between Copernicus and Galileo was often characterized as one of the decisive changes in world model paradigms in Europe. Not only the titles of some major publications, but the tone and style of these show clearly the aim to give not only a strictly astronomic or mathematic study, but to find a universal (sometimes metaphoric) key for understanding the whole world system.[2]

Astronomical and cosmographical maps of the 16th and 17th centuries reflect the changing world models. Epistemological studies in astronomy, physics, philosophy or cartography often deal with those maps, stressing the importance of these in shaping old or new models.[3] However, according to my best knowledge, no serious attempt was made to interpret the maps within the framework of semiotics. Since "actual" maps of the countries and stars may be more or less accurate, I think the semiotical aspects in the investigation of those are more obvious, if we deal with them as clearly arbitrary sign systems. That is the reason I choose constellation maps for my present analysis.

Stars (and constellations) can be represented in a form of a globe. The Greek philosopher, Anaximander (6th century B.C.), who was perhaps the first scholar known to us who spoke about the theoretical framework of such representation. Eudoxus of Cnidos (408-355 B.C.), a pupil of Plato, one of the most famous astronomers in 5th century B.C. argued for a global spheric world model, with the

[2] A few of the latest Hungarian books on the topic: Gazda – Marik (1982), Herrmann (1981), Simonyi (1986), Stegena (1981) etc. The best known books, usually referred to by Hungarian cartographers: Becker 1986, Brandt 1993, Egger 1970, Fauser 1973, Harley – Woodward 1987, Harms 1962, Harvey 1980, Meine 1982, Muris – Saarmann 1961.

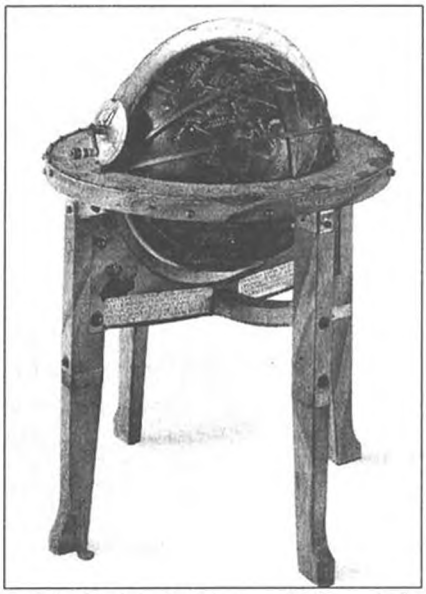
[3] See the data in any of the handbooks of the history of mapping. E.g. Kretschmer et al. 1986. Vol. I. 293-301, etc. For further details see: Dreyer 1953, Dijksterhuis 1961. etc., with further references. On the different aspects of the topics see, e.g. Bagrow 1964, Brown 1932, Leithauser 1958, Stevenson 1921, Taton – Wilson 1989, Warner 1971. etc.

1. Atlas Farnese (Naples)

sun, moon, the five known planets are "fixed" and at the same time are "moving" within that sphere. The great astronomer, Hipparchus (worked 146–127 B. C.) studied already the correspondences of planetary signs with the human and geographic features of the earth. The famous marble sculpture "*Atlas Farnese*" (the only copy existing today is in *Museo Nazionale* in Naples from the 1st-2nd centuries B.C., follows an earlier version from the 3rd century B. C.) shows a figure of a giant holding a 68 cm wide sky-globe. (fig. 1.)

From ancient Rome we have less evidences of global representations of the sky, but from Byzantium, and from the Middle Ages in West Europe there are numerous references to such globes. There are a dozen medieval Arabic sky-globes known to us. The oldest one among the is kept at the *Bibliothèque Nationale* in Paris (a small one, 18 cm diameter, made by an unknown master about 1080 A.D.). The end of the 15th century marked a new start to the golden age of such celestial globes. Nicolaus Cusanus (Nicholaus of Cues) made a small globe (17 cm diameter) 1440 in Nuremberg (today it can be seen at the *Kusanus-Museum* in Kues) with 44 stars on it. The diameter of the globes from the 1480s is usually 40-50 cm. The famous sky-globe by Gerard Mercator (1551) was a parallel to his earth-globe. All the globes presented the constellations by their recognized forms and names. (figs. 2-3.)

An early attempt was made by the Dutch theologian, P. Plancius 1598 to introduce new constellation figures: partly drawn from the Bible, partly of exotic animals, as e.g. giraffe, unicorn etc. The illustrations were cut by Jodocus Hondius, who soon took over all the properties of the world famous Mercator map drawings. Dutch explorers just before that time had made the first good map of the constellations of the southern hemisphere, thus Plancius could aim at a general figural reshaping of the constellations. The most famous globe of this type was made by Wilhelmus Janssonius Blaeu (1571-1638), founder of the most famous



2. Celestial globe by Johannes Stöffler – 1495. (Nürnberg, Germanisches Nationalmuseum)

3. Celestial globe by Jost Bürgi – 1592. (Astronomisch-Physikalisches Kabinett der Staatlichen Kunstsammlungen, Kassel

institution in old cartography, *Officina Blaviana*, 1603 (diameter cm 34), with stars of the southern hemisphere as well. Blaeu (who was a student of the world famous astronomer Tycho de Brahe) in his larger globe (1616, diameter 68 cm) made a perfect world model, directly influenced, according to many historians, by the then rediscovered *Atlas Farnese* sculpture. Later, in a Baroque style, new attempts were made to reshape the constellations with figures of the coats of arms of the European ruling dynasties, or with scenes from the Bible.

Another method for charting the sky was by flat maps, first drawn and later printed. Maps were better known and accepted than globes, because it was easier to produce a two-dimensional chart than a spherical globe. For maps (and globes) a common list of stars in always needed. The first major list, with names and constellation figures used in our days is usually attributed to the Alexandrian astronomer, Ptolemy (2nd century A.D.), known by the title of its Arabic and Latin translations, *Almagest,* which contains data for about 48 constellations. European scholars continued to enlarge, correct and publish it until the end of 16th century, when Tycho de Brahe's new, updated list of northern hemisphere constellations appeared (1600). For the southern hemisphere two Dutch astronomers, P.D. Keyser and F. De Houtman compiled the first general list of stars (1595-1597). For

centuries these lists served for the astronomical maps, until new, completed data were collected only then and by then modern astronomical instruments.

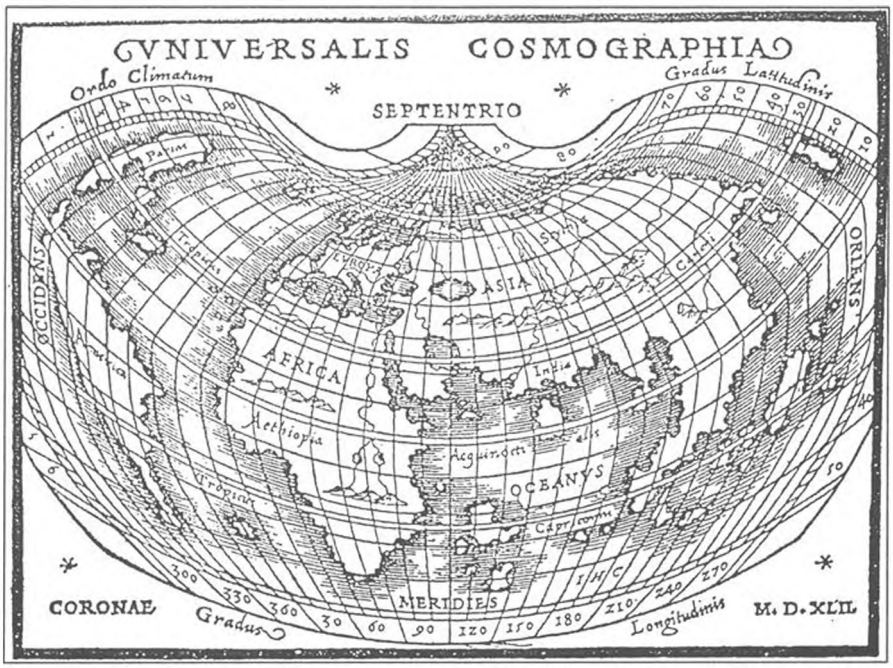
Names and figures for the stars are well known from all cultures of the world: for example 36 stars for Enlil, Anu and Ea from Mesopotamia, or the constellation pictures at the Hathor-Temple in Old Egypt. Greek and Roman authors refer to various stars and naming of the constellations. The highly developed Arabic (and in general Moslim) astronomy gave names to many bright stars. There is no doubt that medieval Europe had names for most of the visible stars. Astrology contributed much to the complicated naming system and tried to "decipher" the influence of most of the heavenly bodies upon the earthly beings.[4]

It is surprising how late the current constellation scheme was accepted in Europe - most probably in the first half of the 15th century. A century later, the first printed star maps (first of all the so called ecliptic planiglobes by Johannes Stabius and Conrad Heinfogel 1515 Nuremberg) with the woodcut constellation figures drawn by Albrecht Dürer served to fix our visual image of the heaven. (fig. 4.)

4. The Northern Hemisphere Constellations from the Planiglobe by Stabius and Heinfogel, woodcut by Albrecht Dürer (1515)

[4] On astrology a separate study is needed. The major work on the ideological and philosophical problems of world models is still the ten bulky volumes of Duhem (1913 – 1959). A very interesting, somehow differently oriented book, with rich bibliography of otherwise unaccessible publications: Szőnyi 1998.

Following these developments comes the work of others: Johannes Honterus, a Saxonian scholar from Transylvania, who first published his Rudimenta Cosmographica in 1541 (1542 published in Basle) (fig. 5.), the German cartographer Petrus Apianus and his *Images Syderum Coelestium* (Ingolstadt, 1536), followed by his chief work *Astronomicum Caesareum* (Ingolstadt, 1540), the Italian, Alessandro Piccolomini with his *De la Sfero del Mondo e Delle Stelle Fisse* (first published in 1540 with many subsequent reprints and French editions).



5. World map by Johannes Honterus (1542)

The most complete description was published by Johannes Bayer (Augsburg 1603, *Uranometria omnium asterismorvum...* and various later editions), with 51 constellation figures, including also a fairly accurate description of the southern hemisphere. German, and French and English astronomers of the second half of the 17th century added much to the picture of the sky.

One of the most important and perhaps the most beautiful star map was made by the Dutch mathematician and geographer, Andreas Cellarius (working between 1656 and 1702). His publication *Harmonia macrocosmica seu Atlas universalis et novus* (first published in Amsterdam 1660, then in various reprints until 1708) is an individual variant of cosmographic descriptions. He followed the German

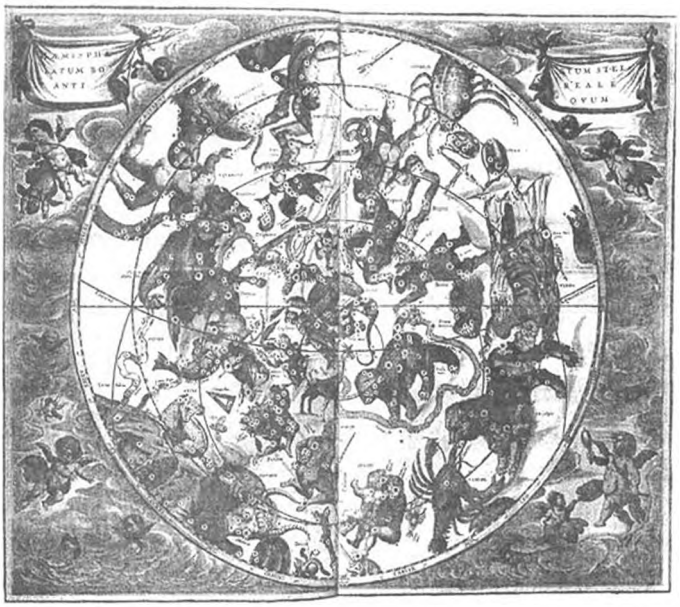
scholar, Julius Schiller (died 1627) in attributing Biblical motifs to the stars and constellations.

Johannes Hevelius, John Seller and the famous English astrograph, John Flamsteed followed the same way. A curiosity is the *Coelum Heraldicum* by the German Erhard Weigel (published in Jena 1688), associating the constellations with actual European rulers' coats of arms. By the time of the Enlightenment and French revolution, suggestion for new nomenclatures of the stars came into light. However, this time period is sadly out of the confines of the present survey.[5]

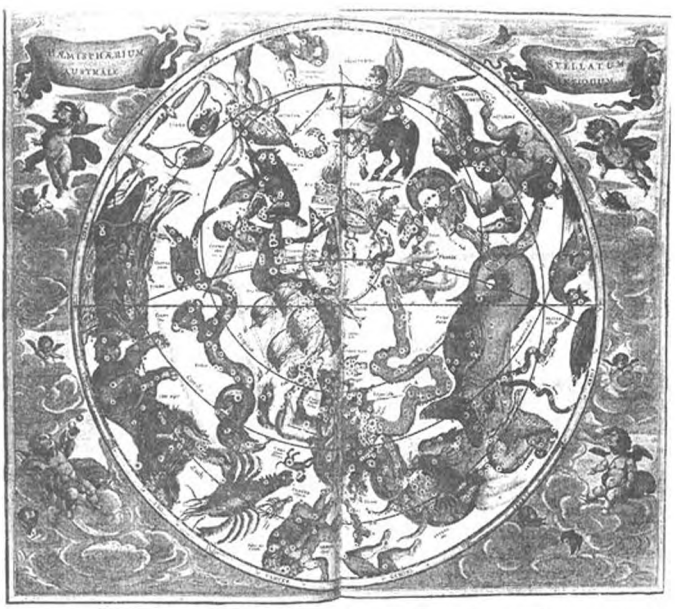
The splendid illustrations in Cellarius work serve different purposes.[6] He gives very elaborate illustrations both for the Ptolemaic and the Copernican system, and explains in other illustrations the Zodiac and the phases of the moon. For constellations he offers three different ideological transcriptions. In two maps *(Hemisphaerium stellatum boreale antiquum and Hemisphaerium stellatum australe antiquum)* (figs. 6-7.) he draws the well known constellations, mostly from "Greco-Roman mythologizing" tradition; however, these are arranged from east to west - the opposite direction, to which we are accustomed today - and with some old names for some constellations. More important for him was to present a Christian map of the constellations (again in two maps: *Coeli stellati Christiani Haemisphaerium posterius* and *Coeli stellati Christiani haemisphaerium prius* (figs. 8-9.), which depict Old Testament and New Testament scenes, and figures from the history of the church). Noah`s Ark, cithar-playing King David, the Magi, apostles and archangels, St. Helena with the Holy Cross, Pope Sylvester and St. Benedictus occur among other ecclesiastical motifs. A third interpretation is by projecting the stars` sphere onto the earthly globe. *Hemisphaerii borealis coeli et terrae sphaerica scenographia* unites the constellations of the northern hemisphere with the outlines of the continents. *Haemisphaerium scenographicum australe coeli stellati et terrae* (figs 10-11.) unites the Constellations of the southern hemisphere with the continents of America and a very large space for "Terra Australis Incognita". Two very accurate "political" maps, with boundaries of states and territories follow that: *Haemisphaerium stellatum boreale cum subiecto haemisphaerio terrestri* (for northern continents and constellations) and *Haemisphaerium*

[5] There is a long list of publications devoted to the history of sciences before and during French revolution. A summarizing collective volume, with summaries of previous researches is Rashed (ed.) 1988. A historical overview of changes in world view from Copernicus to the French Revolution: Saine 1987.

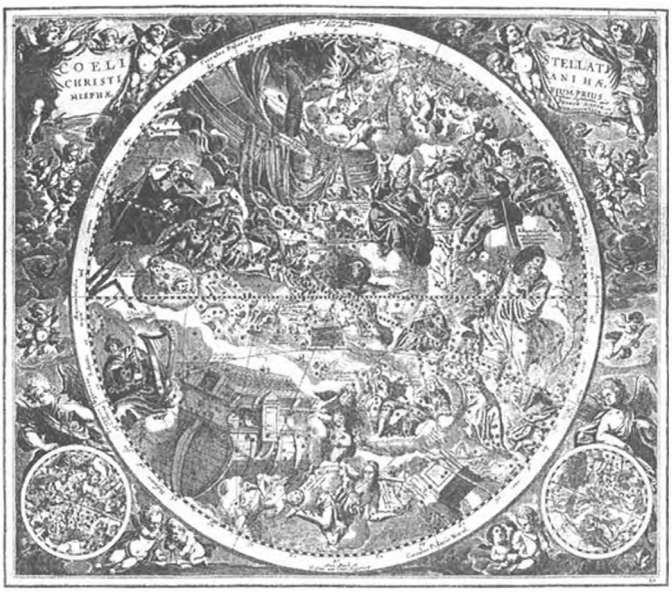
[6] For illustrations here I used the 1990 edition of the illustrations of Cellarius from a copy kept at the Hungarian National Library (Széchényi Library): Patay 1990. See also Skelton 1952., Barron 1989.



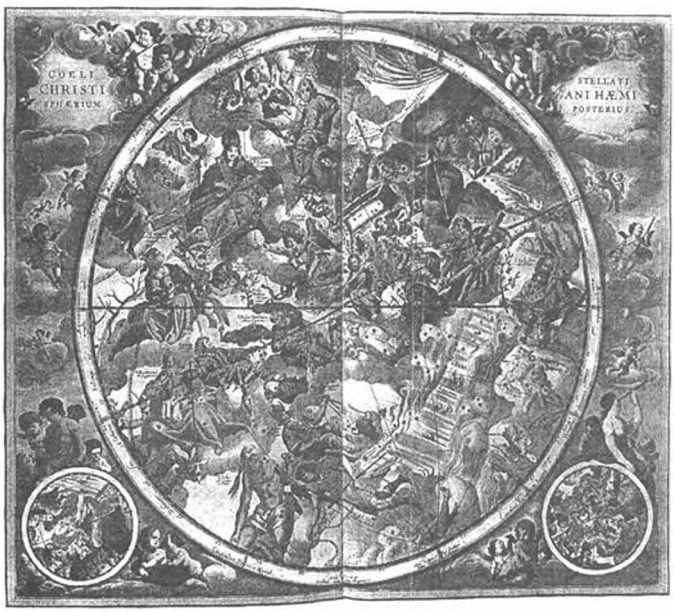
6. Cellarius (1660): the northern celestial hemisphere with the constellations known from the "old" tradition



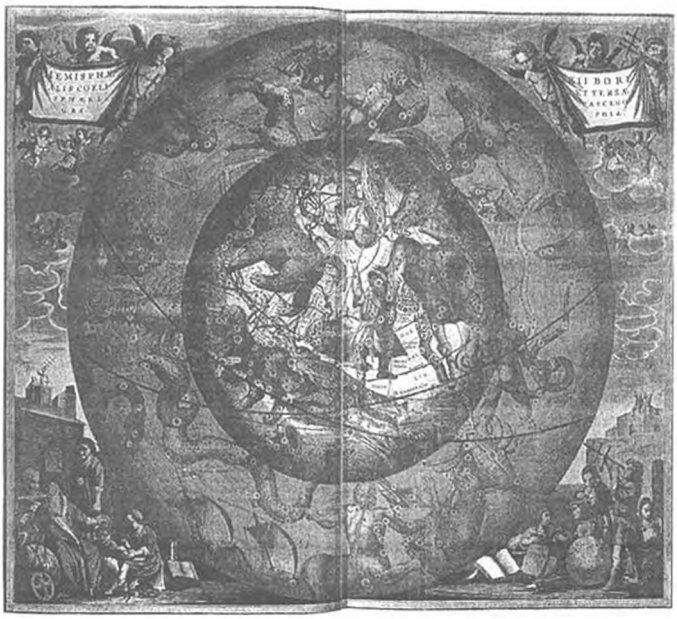
7. Cellarius (1660): the southern celestial hemisphere with the constellations known from the "old" tradition



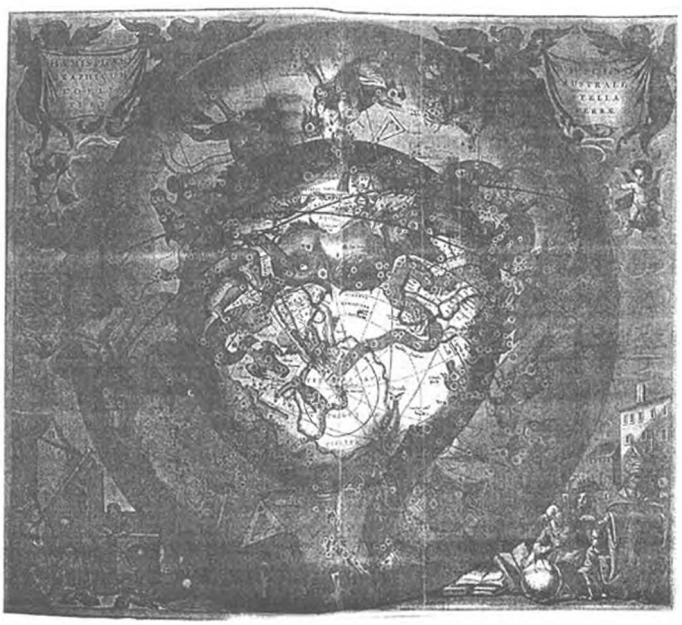
8. Cellarius (after Julius Schiller): Biblical representation of the constellations. (Collection Jonathan Potter, Ltd.)



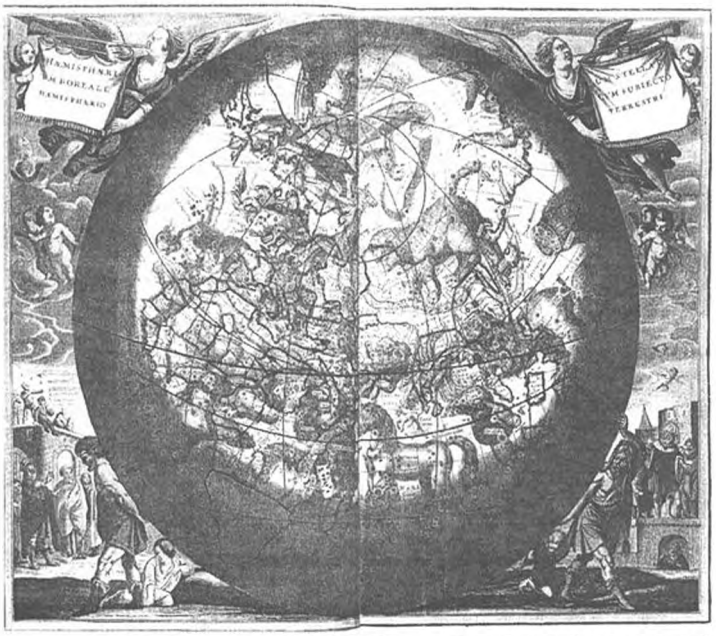
9. Cellarius (1660): The "other" (southern) hemisphere with Christian representations



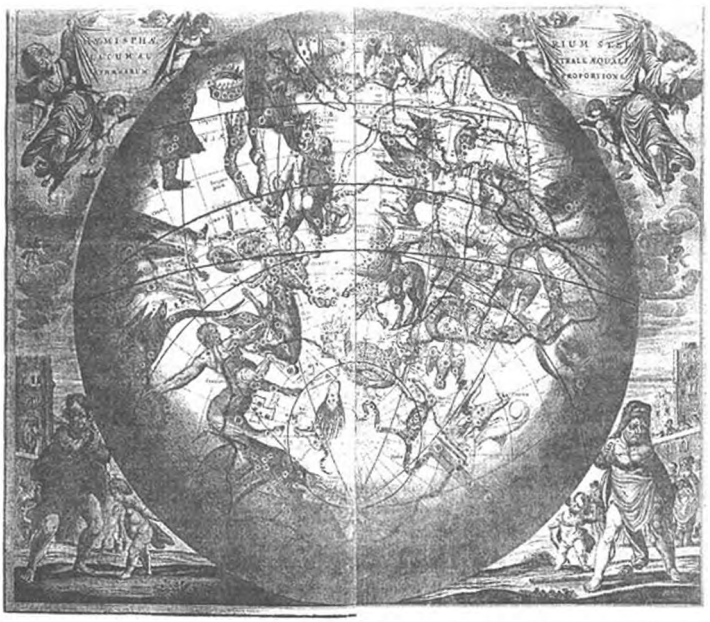
10. Cellarius: northern hemisphere with the outlines of the continents



11. Cellarius: southern hemisphere with the outlines of the continents



12. Cellarius: northern hemisphere projected onto the actual boundaries of states



13. Cellarius: southern hemisphere projected onto the Earth

stellatum australe aequali sphaerarum proportione (attempting the same for the southern hemisphere and continents) (figs. 12-13.).

The ideology of Cellarius' attempt is clear and direct. The sky is a map of the earth, and terrestrial geography is represented by the constellations. and if we propose Greek and Roman myths for explaining the curious shapes of the constellations, we should also christianize the figures of the sky-map. It is very important for us that in the same work we meet three "interpretations" of the same star distributions: an Ancient (pagan, Greco-Roman), a modern (Christian) and a secular (geographic) vocabulary. It is like a translation of the same message in three different languages. It might be difficult to imagine a better sample for the famous definition of signs : aliquid stat pro aliquo. In the case of geographical maps the items exist in fact and are explorable, visible for the actual visitors. If in old maps Paris (or Rome) has a singular shape, seas and islands are spread by a special proportion, then visitors or cartographers can check the maps. The stars are far, and in fact nobody can imagine that they represent small or big she-bears (Ursa minor, Ursa major), the poetic horse (Pegasus) or the dragon-killing hero (Perseus and Andromeda) . All those figures and names are but signs.

The pragmatic aspect of constellation signs is a well known phenomenon: they are maps for identifying stars and groups of stars, important for travelling, especially for navigation. It is not by chance that the same theories were made for terrestrial and celestial cartography, and that the famous cartographers of both domains were the same too.

It is easy to characterize the syntactic aspect of constellation signs. Single persons, with simple acts (pouring water, stretching a bow with an arrow etc.) are dominant among the visual representations. The very different brightness of the stars seems to be of secondary importance. Bright stars are placed on unimportant spots of the pictures, and uneven representation between symmetrical picture parts (e.g. in *Cancer*, *Scorpius*, *Libra* etc.) are very common. The syntax of the stars is not similar to that of human constructions, like houses or machines, where all the details must serve the practical purpose. It is more akin to fantasy pictures or poems, where any given next moment has a firm tie with the previous one, but still it remains unpredictable, how and what comes next.

For the semantic aspects the threefold mapping (Ancient, Christian, geographical) is of great importance. It becomes self evident that there is no single decipherment, no unique meaning of the stars: we always face alternatives in attributing semantics to any utterance. The three semantic interpretations conflict and coincide with one another. And because the stars are finally useless, far away and silent, there is no way to demonstrate which interpretation is more valid or

more fallible. This is again a difference from geographic maps, where in principle there could be achieved by actual improvement a "better" semantics.

Behind of this kind of "primary" interpretation of the astronomical maps, there lies in them another dimension of semiosis.

The double title of Cellarius' work (*Harmonia macrocosmica seu Atlas universalis et novus*) refers to both dimensions. The map is at the same time a "primary" picture (named here by symbolic denomination as *Atlas*, from the giant in Classical mythology compelled to support the heavens on his shoulders, and known at least since the famous *Atlas Farnese* in European astronomic tradition, and on a "secondary" level it depicts the "Harmony of the Macrocosm". The harmony of the universe is another a very old and widespread notion, known already as the Ptolemaic system, often labelled as the " Harmony of the Spheres". Pythagoreanism (with its ideas on the transmigration of the belief in numbers as the ultimate elements of the universe), the theological symbolism of the heaven throughout the Middle Ages and even musicology have frequently used the "harmonical" code of the universe. (fig. 14.) There are various ways for shaping a "harmonical system of the world". A founder of modern solmization (*solfeggio*), Bartolomeus Ramus (Bartolomé Ramos de Pareja), Professor at the universities in Salamanca and Bologna, in his work *De musica practica* (written 1472, published 1482) combines "mundus et musica" in a world map.[7] (fig. 15.) The famous German humanist Agrippa von Nettesheim in his summarizing work *De occulta philosohia sive de magia* (1531-1533) refers to music in a constant and elaborated symbolic language. Kepler's *Harmonices Mundi* (1619) is a summary of centuries' old trends in physics, astronomy, mathematics, musicology and theology,[8] in the book he gives the musical notes of Jupiter, Mars and Mercury and that of the music of the spheres[9] (fig. 16.) and we must not forget that he never revoked his early, astrological work *Mysterium Cosmographicum* (1596) either.

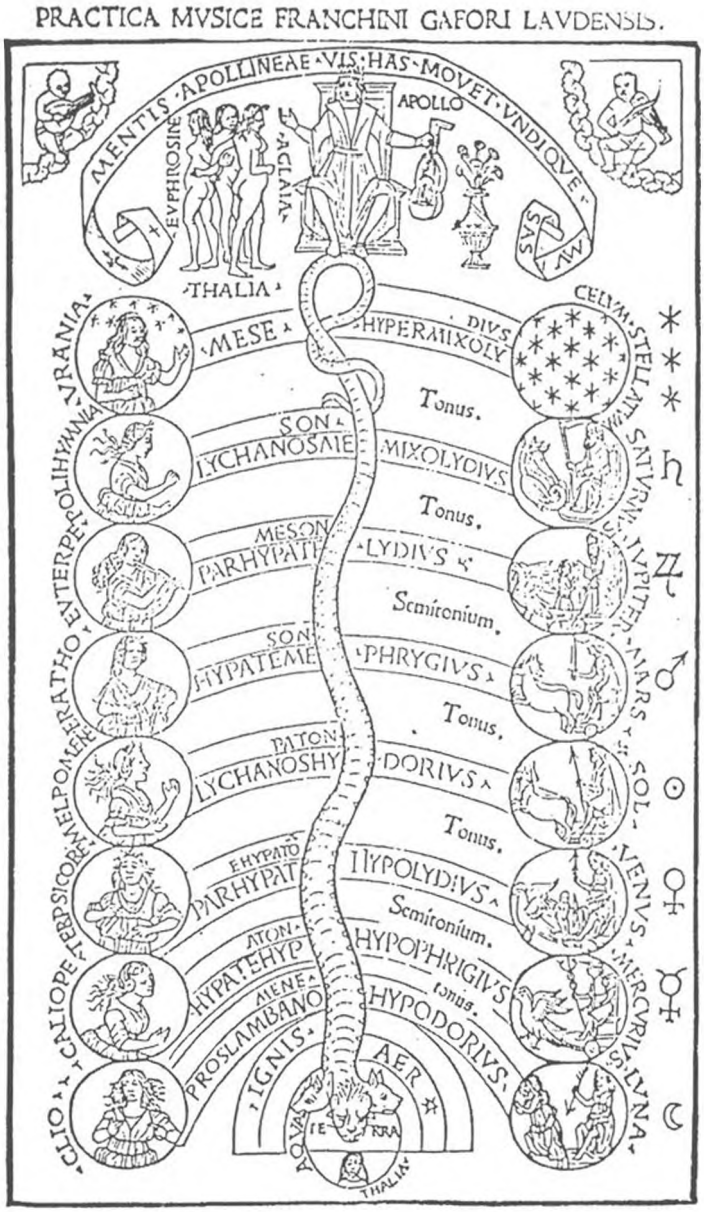
Thus we can easily demonstrate that astronomical maps present a "secondary modelling system" too.[10] Even modern works of art show the same method of thinking. (fig. 17.)

[7] See Besseler – Gülke 1973. 124 – 125.. Abb. 63.

[8] See from a musicological point of view: Harburger 1925, Dickreiter 1973 etc.

[9] On the music of the spheres properly, there are various interesting publications. See, among the latest ones: Schavernoch 1981, Proust 1990 and James 1993.

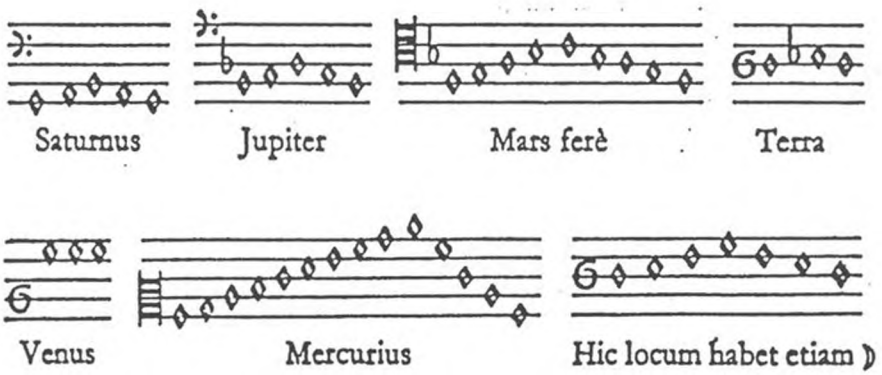
[10] Some general questions of time, harmony and stars were raised in a fantastic book by de Santillana and Von Dechend. For the details of art history of the astronomy see several books, first of all, Mazal 1993. – A beautiful book, with some illustrations, of course from Cellarius: Cornelius 1997. Because of the limits of my paper, I was unable to deal here with some of the interesting problems along the above mentioned lines. My paper is in fact a shortened and selected version of a longer study.



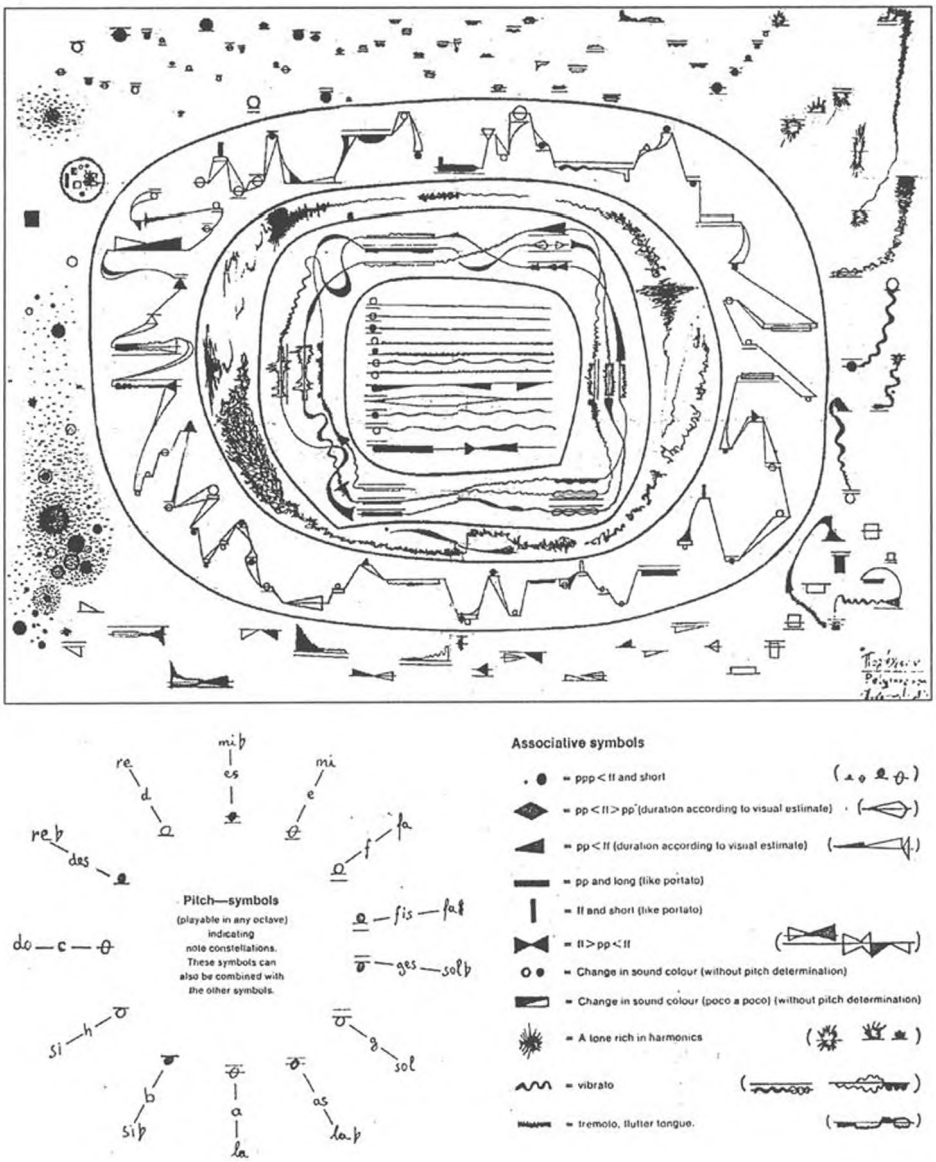
14. The harmonious union of the Muses, strings, modes and planets. (Vienna, Österreichische Nationalbibliothek, MS Ser. nov. 12745, fol. 64v.)

15. Bartolomé Ramos de Pareja: musical notes of a canon for four voices, with figures of winds, representing the four cardinal points. (Florence, Biblioteca Nazionale Centrale, Ms. Banco Rari 229: fol. CIII.b.)

Perihelii ☿ septimum subdupla, seu 128va	3.	0
Aphelii ☿ sextum subdupla, seu 64ta	2.	34–
Periphelii ♀ quintum subdupla, seu 32da	3.	3.+
Aphelii Veneris quintum subdupla, seu 32da	2.	58–
Periphelii Terrae quintum subdupla, seu 32da	1.	55–
Aphelii Terrae quintum subdupla, seu 32da	1.	47–
Periphelii Martis quartum subdupla, seu 16ma	2.	23–
Aphelii Martis tertium subdupla, seu 8va	3.	17–
Perihelius Jovis subdupla	2.	45
Aphelius Jovis subdupla	2.	15
Periphelius Saturni	2.	15
Aphelius Saturni	1.	46



16. Kepler's system of the movements by the planets and notes of the "music of spheres". (The last one is that of the Moon.)



17. Anestis Logothetis: Polychromia. Sky map like musical notes, using the composr's own musical graphic system

Three final remarks should be made, as pointers for further, thorough research.

1. We have said at several times that "a sign" does not exist – only "systems of signs" are conceivable. For astronomical charts a very elaborate and special grammar was needed, more complicated than that of the geographical maps. For constellations, groups of stars were bound together, and in attempts to describe the movement of the heavenly bodies, it was necessary to develop a very sophisticated mathematical-geometrical system. One of the most industrious "sign systems" was made for the stars.

2. If we understand properly the notion of "sign system" it must be of the same level of logical complexity when we create a *significans* for the *significatum*. In maps of the heaven we must introduce the same complexity as it is found in geographical maps. Only a whole world could serve as a sign for another world. When Cellarius uses in a series of his maps the term scenographia, or the expression *"aequali proportione"* he refers to that world model quality of the maps. In a provocative short sentence we could say that the only perfect sign system for the world is a celestial global map projected upon the geographical global map. The "harmony of the macrocosm" is due to the logical equivalance between world model *A* and world model *B*. It is not so often that we can see a perfect world model, a perfect sign system of the world. Some astronomical maps fulfil that criterion.

3. Mapping and systems of the universe are common topics in any general study of the signs. It would be most important to outline e. g. a Peircian astronomical semiotics. Everybody, who is familiar with such seminal papers of Peirce, as, for example, The Fixation of Belief (1877), mentioning as the most for the semiotics important "early scientists": Copernicus, Tycho de Brahe, Kepler, Galileo, would agree with this. However, in my present paper I could not deal properly with that question. But I wanted to mention its importance still!

Literature

BAGROW, Leo 1964. *History of Cartography.* (Edited by R. A. SKELTON.) Cambridge: Harvard University Press – London: C. A. Watts

BARRON, Roderick 1989 *Decorative Maps.* London: Bracken

BECKER, Werner 1968 *Vom alten Bild der Welt.* Leipzig. Koehler and Amelang.

BESSELER, Heinrich – GÜLKE, Peter 1973 *Schriftbild der mehrstimmigen Musik.* Leipzig: VEB Deutscher Verlag für Musik (Musikgeschichte in Bildern – Band III. Musik des Mittelalters und der Renaissance – Lieferung 5.)

BRANDT, Alexander 1993 *Globen auf ausgewählten Gemälden des 16. bis 18. Jahrhunderts.* Berlin: (Freundeskreis für Cartographica, 7. Heft.)

BROWN, B. J. W. 1932 *Astronomical Atlases, Maps and Charts. An Historical and General Guide.* London: Search Publishing Company (Reprinted: 1968)

CORNELIUS, Geoffrey 1997 *The Starlore Handbook.* New York: Duncan Baird. (Hungarian translation: *Csillagképek kézikönyve.* 1999: Budapest: Magyar Könyvklub)

DICKREITER, M. 1973 *Der Musiktheoretiker Johannes Kepler.* Bern: Francke

DIJKSTERHUIS, Eduard J. 1961 *The Mechanization of the World Picture.* Oxford: Clarendon (In German, Italian editions too.)

DREYER, J. L. E. 1953 *A History of Astronomy from Thales to Kepler.* Revised with a Foreword by W. H. STAHL. New York: Dover (Original edition: 1906)

DUHEM, Pierrre 1913-1931 *Le système du monde. Histoire des doctrines cosmologiques de Platon à Copernic.* Paris : Hermann

EGGER, Gerhart (hrsg.) 1969 *Theatrum Orbis Terrarum.* Wien: Österreichisches Museum für Angewandte Kunst

FAUSER, Alois 1973 *Kulturgeschichte des Globus.* München: Schuler

Ifj. GAZDA István – MARIK József 1982 *Csillagászattörténeti ABC* (Introduction to History of Astronomy). Budapest: Tankönyvkiadó

HARBURGER, Walter 1925 *Johannes Keplers kosmische Harmonie.* Leipzig: Insel (Reprint – Frankfurt am Main: Insel)

HARLEY, J. B. – WOODWARD, D. dir. 1987 *The History of Cartography. Vol. I. Cartography in Prehistoric, Ancient and Medievel Europe and the Mediterranean.* Chicago – London: University of Chicago Press.

HARMS, Hans 1962 *Künstler des Kartenbildes.* Oldenburg: E. Völker

HARVEY, P. D. A. 1980 *The History of Topographical Maps. Symbols, Pictures and Surveys.* London: Thames and Hudson

HERRMANN, Dieter B. 1981 *Az égbolt felfedezői.* Budapest: Gondolat (Hungarian translation of his German book: *Entdecker des Himmels.* (1978) Leipzig – Jena – Berlin : Urania)

JAMES, Jamie 1993 *The Music of the Spheres. Music, Science, and the Natural Order of the Universe.* New York: Grove

KLINGHAMMER, István 1998 *A föld- és éggömbök története* (History of Terrestrial and Celestial Globes). Budapest: ELTE Eötvös Kiadó

KRETSCHMER, Ingrid – DÖRFLINGER, Johannes – WAWRIK, Franz (bearbeitet von) 1986 *Lexikon zur Geschichte der Kartographie.* Band 1. A (= *Die*

Kartographie and ihre Randgebiete. Enzyklopädie. Redigiert und herausgegeben von Erik ARNBERGER. Band C/1). Wien: Franz Deuticke

LEITHÄUSER, Joachim G. 1958 *Mappae Mundi. Die geistige Eroberung der Welt.* Berlin: Safari

MAZAL, Otto 1993 *Die Sternenwelt des Mittellalters.* Graz: Akademische Druck und Verlagsanstalt

MEINE, Karl-Heinz 1982 *Mond- und Marsgloben.* Wien: Internationale Coronelli Gesellschaft

MURIS, Oswald – SAARMANN, Gert 1961 *Der Globus im Wandel der Zeiten.* Berlin: Columbus

PATAY Klára 1990 *Csillagtérképek 1990* (Star Maps 1990). Budapest: Képzőművészeti Kiadó

PROUST, Dominique 1990 *L'harmonie des sphères.* Croissy – Baubourg: Devry

RASHED, Roshi (ed.) 1988 *Sciences à l'époque de la Révolution française.* Paris: A. Blanchard

SAINE, Thomas P. 1987 *Von der Kopernikanischen bis zur französischen Revolution.* Berlin: Erich Schmidt

de SANTILLANA, Giorgio – von DECHEND, Hertha 1995 *Hamlet malma. Értekezés a mítoszokról és az idő szerkezetéről.* Budapest: Pontifex (=*Hamlet's Mill. An essay on myth and the frame of time.* Originally – 1959. Boston: Gambit. [In new, updated and enlarged versions, too.])

SCHAVERNOCH, Hans 1981 *Die Harmonie der Sphären. Die Geschichte der Idee des Welteinklangs und der Seeleneinstimmung.* Freiburg – München: Karl Albert

SIMONYI, Károly 1986 *A fizika kultúrtörténete* (Culture History of Physics). Budapest: Gondolat (3rd, enlarged edition, also in other languages)

SKELTON, Raleigh Ashlin 1952 *Decorative Printed Maps of the 15th to 18th Centuries.* London: Staples (reprinted: 1965)

STEGENA Lajos 1981 *Térképtörténet* (History of Maps). Budapest: Tankönyvkiadó

STEVENSON, Edward Cuther 1921 *Terrestrial and Celestial Globes. Their History and Construction.* Vol. I-II. New Haven: Yale University Press. (Reprint: New York – London, 1971)

SZŐNYI György Endre 1988 *"Exaltatio" és Hatalom. Keresztény mágia és okkult szimbolizmus egy angol mágus műveiben* ("Exaltation" and Power. Christian Magic and Occult Symbolism in the Works of John Dee). Szeged: JATE Press

TATON, René – WILSON, Curtis (ed.) 1989 *Planetary Astronomy from the Renaissance to the Rise of Astrophysics.* Part A. : *Tycho Brahe to Newton.* (The General History *of Astronomy* – General Editor: Michael HOSKIN – Volume 2.) Cambridge: Cambridge University Press

WARNER, Deborah Jean 1971 *The Sky Explored. Celestial cartography 1500-1971.* New York – Amsterdam: A. R. Liss (Reprint – Amsterdam: 1979. A. R. Liss)