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A SHORT MODERN HISTORY OF STUDYING SACROBOSCO'S *DE SPHAERA*

CORFU ALIN CONSTANTIN*

ABSTRACT. A Short Modern History of Studying Sacrobosco's *De sphaera*. The treatise generally known as *De sphaera* offered at the beginning of the 13th century a general image of the structure of the cosmos. In this paper I'm first trying to present a triple stake with which this treaty of Johannes de Sacrobosco (c. 1195 - c. 1256). This effort is intended to draw a context upon the treaty on which I will present in the second part of this paper namely, a short modern history of studying this treaty starting from the beginning of the 20th century up to this day. The first stake consists in the well-known episode of translation of the XI-XII centuries in the Latin *milieu* of the Greek and Arabic treaties. The treatise *De sphaera* taking over, assimilating and comparing some of the new translations of the texts dedicated to astronomy. The second Consists in the fact that Sacrobosco`s work can be considered a response to a need of renewal of the curriculum dedicated to astronomy at the University of Paris. And the third consists in the novelty and the need to use the *De sphaera* treatise in the Parisian University's curriculum of the 13th century.

***Keywords**: astronomy, translation, university, 13th Century, Sacrobosco, Paris, curriculum*

The context. The *De sphaera* treaty of Master Johannes de Sacrobosco in the Curriculum of the University of Paris of the 13th Century

In this first part of the research I aim to present the place of the treatise *De sphaera*, written by Johannes de Sacrobosco, at the beginning of the 13th century at the Parisian University in the curriculum of the liberal arts and the content of the treatise. The treatise *De sphaera* is one of the four treatises that form the corpus of the works of the master Johannes de Sacrobosco, the other three being the treaty on algorithms (*Algorismus)*, the treaty dedicated to calculating the calendar

* PhD candidate, Doctoral School in Philosophy, Faculty of History and Philosophy, Babeş-Bolyai University, Cluj-Napoca, Romania. E-mail: corfu.alinconstantin@yahoo.ro.

date of Easter (*Computus*), and the *Tractatus quadrant*. For a better picture of the context in which the treaty was written it is necessary to present first the efforts of previous centuries that led to the need to write the treatise *On the Sphere*.

The first stake, which consists in the well know translation episode of the XIth -XIIth centuries in the Latin environment of the Greek and Arabic treaties has as main promoter Gerard of Cremona and his efforts to translate the *Almagest* to Ptolemy. Gerard's translation of the *Almagest* led to its use as a central treatise on astronomy at the University of Paris. It can be considered that, due to Gerard's effort of translation, some Greek and Arabic terms occurred in Latin: *zona*, *orizon*, *zenith*, *nadir*, etc. Gerard of Cremona translates not only Ptolemy's *Almagest* but also 75 other works from Arabic, many of which Dedicated to the subject of natural philosophy. Sacrobosco uses in his treatise *De sphaera* some of these translations, namely, *The Elements*[1] of Euclid, *On the Sphere* by Theodosius and the treatise *On Heaven,*[2] by Aristotle.

Through the efforts of Gerard of Cremona and the large number of treatises translated by him, one can assume one of the first major steps that led to the satisfaction of the desire to recover the practical part of astronomy and the entry of treatises dedicated to Aristotle's natural philosophy in Paris. Another reason for this approach may be one that consists in a need to renew the subjects that were present in the curriculum of the seven liberal arts. This theory is supported by Lemay, R. in his work *Abu Ma'shar and Latin Aristotelianism in the Twelfth Century*[3] which, drawing a parallel between the texts translated by Gerard of Cremona and the four subjects of the quadrivium, relies on the need to receive Greek and Arabic texts as aiming to change the entire university curriculum. According to this theory, the assumption of the position of the translator aiming at such an approach is clearer as they already announce an assumed role.

With the presence of these treatises on astronomy and mathematics translated from ancient Greek and Arabic, the university environment of the thirteenth century was able to begin a rethinking of the curriculum and texts that were considered capital for the training of both teachers and future students. This approach to the renewal of astronomy in the university curriculum can be considered as one of the first steps by which the liberal arts changed their status, becoming more of a first preparatory stage for future university training. According to McCluskey, the student was required to sustain a *pro forma* (summary) reading of a *De sphaera*

[1] T. L. Heath, *The Thirteen books of Euclid's elements*, University Press, Cambridge, 1968.

[2] Aristotel, *Despre cer*, trad. Nicolau Şerban, ed. Paideia, București, 2005.

[3] Lemay, Richard, *Abu Ma'shar and Latin Aristotelianism in the Twelfth Century*, American University of Beirut, Beirut, 1962.

treatise in order to obtain a degree in arts. In the 13th century, this reading was mandatory in Paris, while at Oxford in the fourteenth century on *Computus*. To this effort were gradually added treatises on arithmetic and geometry, but also treatises dedicated to the way in which astronomy instruments were used (astrolabe, quadrant, etc.) to demonstrate and put into practice the theories of this science.

One of the first moments of the entry of these new translations in the Parisian and English university curriculum of the twelfth century can be characterized by two main figures of the Latin environment. One of the first appeals was instituted by Bernard of Chartres (c. 1124) who proposed the renewal of the Parisian university curriculum by studying and assimilating new translations. The treatises he proposed, according to Montgomery,[4] were devoted to the study of natural philosophy, treatises that were very little remembered or studied in the liberal arts curriculum; in the curriculum dedicated to astronomy, the works of authors such as Martianus Capella (360-428), Macrobius (370-430) or Isidore of Seville (560-636) were studied until then.

Another call of the need to revise the English university curriculum but also of the Parisian one in the 12th century is made by Daniel of Morley (c.1140 - c. 1210). He repeatedly criticized the way in which the professors of the University of Paris were rigid or disinterested in this great flow of treatises that could change the way they understood or thought what was known to be part of the sphere of natural philosophy.[5]

These first two examples are not isolated, the way in which figures such as John of Seville, Plato of Tivoli, Gerard of Cremona and many other translators, professors or students criticized and advocated for the introduction, importance and necessity of Greek-Arabic texts in the university curriculum it is also one well-known. Thus, these criticisms can easily denote the fact that translators assumed the stakes that these texts came with.

The translator put in front of this image, between what was written on natural philosophy in the Greek and Arabic traditions and those with which the Latin environment was familiar until the 11th century, undertook the creation of a link that was intended to pass through the Latin environment with the main purpose of assimilating, thinking and militating a possibility of innovation through these new translations. The central stake of the translator lied in the creation of a wide and concentrated transmission of these writings in and for the Latin cultural environment.

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[4] Scott L. Montgomery. *Science in Translation, Movements of Knowledge through Cultures and Time*. University of Chicago Press, 2000, pp. 145.

[5] *Idem*.

As for the novelty and need to use the *De sphaera* treatise, it is necessary to mention from the beginning the character of this treatise. Sacrobosco`s work is a textbook of astronomy in the liberal arts. Being an introductory to the study of astronomy, it was conceived as a tool for understanding Aristotle`s *De caelo* and Prolemy`s *Almagesta*. Its need and novelty reside, as mentioned above, on the one hand in the need of students to obtain a degree in arts, who were required to sustain a *pro forma* reading on this treaty, and on the other hand from the desire of the Latin environment to a own tradition, the treatise *De sphaera* was wishing to be a Latin cultural product.

Studying Sacrobosco at the beginning of the 20th century: Before Lynn Thorndike's critical edition

The short modern history presented in this paper starts with Pierre Duhem's *Le système du monde: histoire des doctrines cosmologiques de Platon à Copernic*, Tome 3[6] which offers from page 238 to 240 a short chapter on Sacrobosco. In his two pages and a quarter Duhem stars by naming 3 of Sacrobosco's works (*Algorismus*, *Sphaera* or *Sphaericum opusculum* and the *Calendrier ecclésiastique*) criticizing Sacrobosco's treaty *On the sphere: „Cependant, les quatre chapitres qui devaient assurer à leur auteur cette réputation étendue et durable ne formaient qu'un petit traité bien humble, bien pauvre d'idées comme de faits et, pour tout dire, bien mediocre."*[7] This criticism may have been due to the lack of a critical edition at that present time, must probably Duhem consulted a vernacular or incunable writing, and of the opportunities with which the end of the 19th century and the beginning of the 20th had come. The third part of Duhem's work appears in 1915, a year before his death in 1916 and his enormous work remains one of the first pillars in any effort of studying ancient and medieval astronomy.

If Duhem introduced the name of Sacrobosco in his 10 volume work in 1915, Thorndike Lynn publishes in 1949 at the The University of Chicago Press, *The Sphere of Sacrobosco and Its Commentators,*[8] the first critical edition known up to this day. Lynn's effort did not concern only the treaty *On the sphere.* In his book he offers a critical edition on the commentary of Robertus Anglicus (XIIIth century), better

[6] Pierre Duhem, *Le système du monde : histoire des doctrines cosmologiques de Platon à Copernic*, Hermann et fils, Paris, Tome 3, 1915.

[7] Trans.: However, the four chapters which were to assure their author of this extensive and enduring reputation formed only a small, very humble treatise, very poor in ideas as in facts and, in short, very mediocre. *Le system du monde*, Tome 3. pp. 239.

[8] Thorndike, Lynn, *The Sphere of Sacrobosco and Its Commentators*, The University of Chicago Press, 1949.

known for his commentary in 1271 upon *De sphaera,* as well as a Latin transcription ascribed to Michael Scot, the commentary of Cecco d'Ascoli, an Anonymous commentary and 5 Appendix that name Sacrobosco's works.

Lynn's critical edition of *De sphaera* uses 12 manuscripts. Those textual witnesses will be presented in the table below. The need of this table is for showing Lynn's effort in 1949 and the progress that was made up to this day.

A	Oxford, Bodleian, Canon. Misc. 105, fols. 23-11r, text of the *Sphere;* 11r-61r, anonymous questions and commentaries
B	Oxford, Bodleian, Canon. Misc. 161, fols. 9r-19r, *Shere*; 8v-19r mgs, Glosses
C	Oxford, Bodleian, Digby 166, fols. 1r-6r, anon. commentary; 21ra-26vb, *Sphere*
D	Oxford, Bodleian, Digby 228, fols. 61va-65vb, *Sphere*; 66ra-73va, commentary of Robertus Anglicus
E	Oxford, Bodleian, Digby 48, fols. 48r-88r, *Sphere* with commentary of Robertus Anglicus
I	Cambridge, University Library Ii. III. 3, fols 25r-35v, *Sphere*
J	Cambridge, University Library Ff. VI. 13, fols. 17v-20r, 26v-34v, *Sphere*
K	Boston, Mass., Medical Library 20, fols. 88r-97v, *Sphere*
M	Cambridge, McClean Collection, Fitzwilliam Museum, 166, fols. 20r-38v, *Sphere*
N	New York, Public Library 69, fols. 80r-113v, *Sphere*
O	Princeton University, Robert Garrett 99, fols. 124ra-136vb, *Sphere* with glosses
Q	Paris, Bibliothèque Nationale, Latin MS 7392, fols. 2ra-43rb, *Sphere* with commentary of Robertus Anglicus[9]

As can be easily seen, Lynn uses 5 manuscripts from Oxford (England), 3 from Cambridge (England), 3 from the United States, and one from Paris (France). Although he covers the influence that Sacrobosco had in England after writing *On the sphere*, surprisingly he uses a single treatise from the Parisian environment in which and for which the treaty was initially written. To this list, as we shall see, it will be added a new treaty which Olaf Pedersen[10] considers to be the earliest.

[9] Lynn's edition (1949) on page IX does not offer the treatises ordered in this form, the need for a table was made for an editorial reason.

[10] Pedersen, O. (1985). "In Quest of Sacrobosco", *Journal for The History of Astronomy* – J HIST ASTRON. 16. 10.1177/002182868501600302.

According to Thorndike[11] Johannes de Sacrobosco was known as the author of the treatise *On the Sphere* (*De sphaera*) which was written in the early thirteenth century (possibly in 1220). In the same passage, Thorndike also informs us about the lack of biographical data about the author, although starting from his name, Sacrobosco, his origin can be assumed to be English, namely from Hollywood or Halifax. During his lifetime, he taught at the University of Paris, where he died. Thorndike[12] informs us that he was buried at the church of St. Maturin, and on his tomb is an inscription dedicated to his memory that mentions his name.

Sacrobosco's treatise *De sphaera* consists of an introduction and four chapters. After an analysis of the text established by Thorndike[13] the topic identified in this treatise is in the order as follows: the definition of the sphere, the division of the sphere, about the four elements, a definition of the sky, the sky and its motion, about the shape of the Earth, the Earth, its motion and position, about the shape of the water, about the celestial circles, about the equinox, the North and South Pole, the Zodiac and its signs, the Ecliptic, what does "a sign" mean, the color, the Meridian, the Horizon, the Tropic of Cancer and Capricorn, the arctic and antarctic circle, the five tropics, sunrise and sunset signs, cosmic location, sunrise and sunset time, sunrise and sunset, right ascent, oblique ascent, day inequality, sun movement, day and night , the straight and oblique ascent, the inhabitants of the equator, between the equator and the tropic of cancer, about the seven climates, the movement of the sun (again), about the other planets, the causes of the lunar eclipse and the causes of the solar eclipse. Thus, the treatise comprises around 30 different topics, each being discussed in at least one specific paragraph.

Besides Lynn's 12 manuscripts, I have identified another 26: 24 from the Oxford Libraries, from point 2 up to point 26 as can be seen in the table below. Even if not all the manuscripts are needed to make a critical edition, Sacrobosco's text being an astronomy textbook that had a great widespread in the European university's environment, I only wanted to point out that a *census* of all the manuscripts of *De sphaera* still remains a *desideratum.*

1	USA, New Haven, Beinecke Rare Book & Manuscript Library, Beinecke MS 797 [cc. 1450 and 1500]
2	USA, University of Pennsylvania, Collection The Scholarly Tradition, UPenn LJS 26 [c.c. 1225-1275]

[11] Thorndike, Lynn, *The Sphere of Sacrobosco and Its Commentators*, The University of Chicago Press, 1949, pp. 1-2.

[12] Thorndike, Lynn, *The Sphere of Sacrobosco and Its Commentators*, The University of Chicago Press, 1949, pp. 2.

[13] Thorndike, Lynn, *The Sphere of Sacrobosco and Its Commentators*, The University of Chicago Press, 1949.

3	MS. Add. A. 2 — 15th century, middle; Italian North
4	MS. Ashmole 1285 — Composite manuscript
5	MS. Ashmole 360 — Composite manuscript
6	MS. Auct. F. 5. 23 — Composite manuscript
7	MS. Auct. F. 5. 25 — Composite manuscript
8	MS. Auct. F. 5. 29 — Composite manuscript
9	MS. Bodl. 472 — c. 1437; French, Louvain
10	MS. Bodl. 491 — 14th century, late; English
11	MS. Bodl. 607 — Composite manuscript
12	MS. Bodl. 679 — 13th century, late; English
13	MS. Canon. Ital. 157 — Composite manuscript
14	MS. Canon. Misc. 436 — 15th century
15	MS. Canon. Misc. 561 — 15th century, middle; Italian, North
16	MS. Digby 15 — 15th century, middle; English (?)
17	MS. Digby 193 — 14th century
18	MS. Digby 215 — 15th century, middle; Italian, North
19	MS. Digby 81 — Composite manuscript
20	MS. Digby 93 — Composite manuscript
21	MS. Digby 98 — Composite manuscript
22	MS. Fairfax 27 — Composite manuscript
23	MS. Lyell 36 — 15th century, second half; English
24	MS. Rawl. C. 677 — 14th century
25	Merton College MS. 261 — Composite manuscript
26	Merton College MS. 35 — Composite manuscript

The purpose of the aforementioned considerations is that Edward Grant in his book *Planets, Stars, and Orbs, The Medieval Cosmos*[14] selected a number of over 300 *questiones* (questions) each dedicated to a topic related to the sphere of astronomy between the 12th and 17th centuries for showing the continuity of these questions. The subjects present in Sacrobosco's treaty do not make an exception to such an incorporation of them into a much broader framework of thought of astronomy and its continuity. Although this treatise deserves a study in itself for its placement in a historical-scientific paradigm, in addition to the fact that in Grant's work it is not used *per se* but only recalls some issues that the treaty raised.

Olaf Pedersen in 1985 (36 years after Lynn's edition) writes an article named *In Quest of Sacrobosco.*[15] Here he recalls 2 hypotheses regarding the possible place where Sacrobosco could have been born (the English and the Irish one), recalls 4 of his works (*Algorismus, Computus, Tractatus de quadrante, Tractatus de sphaera)* presenting their size, a good number of manuscript of each one and some spurious works that were considered to be written by Sacrobosco. One of the great merits of Pedersen`s paper is the identification of MS Copenhagen GKS 277,2[16] which Lynn omitted in his critical apparatus (we don't know if deliberately) when he drafted his critical edition. The Copenhagen MS it is believed to be the oldest manuscript of Sacrobosco's *De sphaera.*

It is interesting to see how the number of vernacular treatises in Pedersen's research increases significantly when Matteo Valleriani in 2020 publishes *De sphaera of Johannes de Sacrobosco in the Early Modern Period*[17] together with a group of researchers. In the project "The Sphere: Knowledge System Evolution and the Shared Scientific Identity in Europe" which aims to reconstruct the transmission that the treatise of John of Sacrobosco (*De Sphaera*) had at the second half of the 15th century until 1650. This study focuses mainly on introductory treatises on the liberal arts in European universities. The authority of *De sphaera* was already established in the 13th century in the Parisian university environment, the study of the researchers in this book is to see how it was used in early modernity (its university character persisting until then). In order to sketch the effect of Sacroboso's work between 1550 and 1650, the authors had to study one author at

[14] Edward Grant, *Planets, Stars, and Orbs, The Medieval Cosmos, 1200–1687*. Cambridge University Press, 1994.

[15] Pedersen, O. (1985). "In Quest of Sacrobosco". *Journal for The History of Astronomy* – J HIST ASTRON. 16. 10.1177/002182868501600302.

[16] Pedersen, O. (1985). "In Quest of Sacrobosco". *Journal for The History of Astronomy* – J HIST ASTRON. 16. 10.1177/002182868501600302. pp. 185.

[17] Valleriani, Matteo (Ed.) - *De sphaera of Johannes de Sacrobosco in the Early Modern Period*, Springer International Publishing, 2020, pp. 197.

a time who either commented on Sacrobosco's treatise or was influenced by it. Not all the authors presented in the catalog of their research are present in this study but their files can be consulted in the site made by this group https://sphaera.mpiwg-berlin.mpg.

The following table shows the data offered by Pedersen in comparison with Valleriani's research. All the data comes from Pedersen's article.[18] Valleriani's research is being marked by his name and the year 2020. As can be seen Valleriani adds 309 new incunable texts and presents 30 vernacular ones, but up to this day, as I have already presented, no complete census of the manuscripts of Sacrobosco's works has ever been made.

Treaty	Nr. of words	Incipits	Nr. of MS.	Incunable 1400-1673	Vernacular Texts	Modern editions
Algorismus	5600	"Omnia quae a primaeva origine rerum"	+50	+5 1488-1582	?	F. Saaby Pedersen (1983)
Computus	19000	"Compotus est scientia considerans tempora"	+26	+35 1531-1673	0	0
Tractatus de quadrante	2000	"Omnis scientia per instrumentum operativa"	5	0	0	0
Tractatus de Sphaera	9000	"Tractatum de spera quattuor capitulis distinguimus"	+200	1472-1673 Pedersen(1985) + 50 Valleriani(2020) 359	Valleriani (2020) +30	Lynn - 1949
Others	*Theorica planetarum*	Catalog Vatican= MSS Ottob. 3024 și3290	*Com. De caelo*	*Com. De generatione et corruptione*		

[18] Pedersen, O. (1985). "In Quest of Sacrobosco". Journal for The History of Astronomy – J HIST ASTRON. 16. 10.1177/002182868501600302.

Conclusions

In this article, I have tried to present the place of the treatise *On the Sphere* in the context of the 13th century focusing on 3 stakes with which the treaty came. The first stake consisting in the episode of translation of the XIth -XIIth centuries in the Latin environment of the Greek and Arabic treaties, the second stake in the need to renew the curriculum dedicated to astronomy at the University of Paris and the third consisted in the novelty and the need to use the *De sphaera* treatise in the Parisian University's curriculum of the 13th century. With this purpose, in the second part of this paper I have presented a short history filtered through the works of Pierre Duhem, Thorndike Lynn, Olaf Pedersen and Matteo Valleriani that gave, starting with the year 1915, an image of Sacrobosco's works and influence. Thanks to Valleriani's *De sphaera of Johannes de Sacrobosco in the Early Modern Period* we now have a better image of Sacrobosco's treaty *On the sphere,* an image that has it's beginning with the printed press up to the second half of the 17th century. Although the modern scholarship recorded some serious progress regarding the study of the aforementioned treatise, the period starting from the beginning of the 13th century up to the printing episode covered by Valleriani still remains a topic to be explored.

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