Astronomy and Cosmology in the 17th century. An Introduction

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Astronomy and cosmology concern at least three main features: the role of dominant authors like Kepler; the tension between new discoveries, new experiments on the one side and religious context and Aristotelian theories on the other side; the controversial clarification of notions like world, heaven, matter, space. Two examples illustrate this situation: Kepler's booklet on the New Star in the foot of the Ophiuchus (1606); Guericke's New (so-called) Magdeburgian experiments regarding the empty space (1672). As a consequence of Cusanus's ideas Guericke taught the identity of God, space, and nothing.

La astronomía y la cosmología se ocupan de al menos tres cuestiones principales: el papel de autores destacados como Kepler; la tensión entre nuevos descubrimientos y nuevos experimentos por un lado y el contexto religioso y la tradición aristotélica por otro; el debate y clarificación de nociones controvertidas como mundo, cielo, materia y espacio. Dos ejemplos ilustran esta situación: el libro de Kepler sobre la nueva estrella aparecida en los pies de Ophiuco (1606) y los llamados nuevos experimentos de Magdeburgo de Guericke sobre el espacio vacío. Basándose en las ideas de Nicolas de Cusa, Guericke enseñó la identidad de Dios, el espacio y la nada.

It seems to me that there are at least three main features whenever one is talking about astronomy and cosmology in the 17th century:

- The role of dominant authors like Galileo and Kepler and that of less well-known scholars like Athanasius Kircher, Robert Hooke, Vicente Mut or Eduard Weigel.
- The tension between new discoveries, new experiments on the one side and religious context and traditional, especially Aristotelian theories on the other side;
- The controversial clarification of key notions like world, heaven, matter, space, force, inertia.

I would like to illustrate this situation by using two examples:

Johannes Kepler's booklet On the new Star in the foot of the Ophiuchus published in 1606 (Kepler, 1606; Kepler, 2006) and Otto von Guericke's New (so-called) Magdeburgian experiments regarding the empty space published in 1672 (Guericke, 1672; Guericke, 1996).

1) Johannes Kepler’s booklet On the New Star in the foot of the Ophiuchus

The great scientific importance of this Keplerian publication becomes already evident from the long title. Therein Kepler speaks about a booklet being full of astronomical, physical, metaphysical, meteorological, and astrological disputations.

On October 11, 1604 (new style) the amateur astronomer Johannes Brunowsky informed Kepler in Prague that he had observed a new luminous star in the foot of the constellation of the Ophiuchus. Within a few days Brunowsky’s observation was confirmed by many European astronomers like Giovanni Antonio Magini in Bologna, David Fabricius in Friesland, Michael Mästlin in Tübingen. It could be observed up to February 1606. In modern terms it was a supernova. But in those days other explanations had to be looked for: an interpretation of this event for mankind seemed to be highly desirable.

Kepler’s argumentation is indeed based on mathematical astronomy, physics, metaphysics, meteorology and astrology in order to deal with five crucial questions: the star’s localization, possible motion, matter, coming into being, meaning. First of all, Kepler tried to demonstrate that the star had to be located in the region of the fixed stars. Such a localization contradicted Aristotle’s and the biblical history of creation as well. Yet, the new star did not show any parallax (chapter 15). Its twinkling reminded of the light of a fixed star. Thus Kepler used mathematical and physical arguments for his localization.

He amply discussed the physical question of light, colour, matter, coming into being. He rejected the assumption of possible motions out of the depth of space and back into it in order to guarantee the earlier existence of the star and to avoid conflicts with Aristotelism and biblical doctrines. The whole nineteenth chapter deals with the star’s matter.

The coincidence of its appearance and the great conjunction of Mars and Jupiter did not happen by chance but on ground of God’s will. He emphatically rejected the atomism of the Epicureans that was based on random events. Only reluctantly he eventually added the last astrological part of his treatise without binding himself to a certain opinion. He just said that the emperor Rudolph II had engaged him as an astronomer, not as a prophet.

2) Otto von Guericke’s New (so-called) Magdeburgian experiments regarding the empty space
Since the very beginning Guericke's hostility against Descartes is evident. He speaks about things that do not exist and that cannot exist according to the French philosopher: empty space. His work can be read as a refutation of the Cartesian world conception. His theory is embedded in a theology that in case provides the decisive argument. The mathematical theology of Nicholas of Cusa forces the uniqueness of infinity of God.

The example makes clear that in the 17th century a discussion about cosmology was not imaginable without theology (Knobloch, 2007).

Thus I would like to speak about the following aspects: 1. Nonquanta or Cusanian heritage. 2. Spatium, mundus, caelum (space, world, heaven).

1. Nonquanta or Cusanian heritage

Nicholas of Cusa's thinking played a crucial role for Guericke's cosmological ideas. In order to understand this situation we have to consider Cusanus's position. He relied on the Aristotelian theory of quantities and on the Euclidean theory of magnitudes when he developed his considerations about the infinite.

Posón, quantum is what can be divided into the parts contained in it. In such a way Aristotle defined the second of his six categories in his *Metaphysics* (Metaphysics V, 13, 1020a7). Divisibility is the defining attribute of a quantity, or the other way around: what cannot be divided cannot be a quantity.

Hence the absolute maximum or the infinite and the absolute minimum or the point are non-quantities for Cusanus (Nicolaus, 1964, p. 18). A non-quantity like the infinite has five characteristics:

- It is incomparable because there is no relation between the finite and the infinite (Nikolaus, 1967a, p.200).
- It is incomprehensible because according to Cusanus's epistemology every knowledge is based on a comparison.
- It is inaccessible because we cannot reach the absolute maximum by increasing a quantity.
- It is boundless (interminatum).
- It cannot be measured, it is immense (immensum) because all that which can be measured is situated between the maximum and the minimum.

This theory of quantities implies cosmological consequences. The world cannot be infinite because God is the absolute maximum, the infinite. There cannot be absolute maxima, two such receptacles of everything. If the experience or the understanding should deduce something being the receptacle of everything, it would have to coincide with God.
This is an inevitable conclusion considering the uniqueness of the absolute maximum. Guericke draws this conclusion: he deduces the existence of space, of the receptacle of everything and lets it coincide with God. Whatever characterizes God, characterizes this space and vice versa. We cannot imagine his notion of space without the Cusanian notion of God. By identifying space and God he is not forced to double the infinite.

"Solum enim Deus infinitus est, nec duo infinita esse possunt", "Because only God is infinite and there cannot be two infinites", we read in Guericke's last but one chapter (Guericke, 1672, p. 241). This is a literal citation taken from Nicholas of Cusa's *Idiota de sapientia*: "Duo enim infinita esse nequeunt" (Nikolaus, 1967b, p. 471).

2. Spatium, mundus, caelum (space, world, heaven)

Guericke diligently distinguished between the notions of space, world, and heaven. For that reason we should examine this analysis of notions in order to avoid misunderstandings.

2.1 Spatium (space)

Spatium, the space is the universal receptacle of all things. As such it is immaterial (immaterialum), pure (purum), void (vacuum), imaginary (imaginarius) (Guericke, 1672, p. 60, 63, 199).

At the same time it is the true space (spatium verum), space itself (spatium ipsum), uncreated (inreatum), infinite (infinitum) and thus according to Cusanus also immense (immensum), invisible by itself (per se invisibile). It is nothing, what is more: the true nothing (Nihil verum) (Guericke, 1672, p. 62, 70, 60).

When Guericke describes the infinite as indivisible, incomprehensible, without any possibility to bring it in relation and for that reason incomparable, he reports on the Cusanian theory of the infinite. In consequence of that theory, the space cannot be conceived of quantitatively, it is no quantity, according to Guericke because a quantity can be only applied to something created, according to Nicholas of Cusa because the infinite is no quantity. The Christian doctrine of creation and the Aristotelian doctrine of quantities lead to the same result.

2.2 Mundus (world)

"Mundus est astrorum synodus", the world is a synod — the notion has to be understood literally - a community of stars which have the same route
(Guericke, 1672, p. 199) or, in order to be more precise, of planets the sovereign of which, the sun, is placed in the middle so to speak on a royal throne.

In other words, Guericke's world is our solar system. Its extension is limited by the range of forces or virtues. The world exists in the infinite immense receptacle, in the space which does not have any orientation, any middle, any limit (Guericke, 1672, p. 199). Thus there cannot be any doubt that it is nowhere, "nullibi esse, dubium non est".

The impossibility of locating the Guerickian world implies the same result as the Guerickian identification of space with nothing which is necessarily everywhere. There is no infinite world, "mundus enim infinitus non datur".

2.3 Caelum (heaven)

Guericke's heaven is the intermediary space, "spatium intermedium", between the celestial bodies. For him, heaven is a notion of relation like place. The space around a celestial body, "spatium circunstans", is its heaven. Correspondingly, every celestial body has a heaven, something extensive, an exterior space, a sphere of activity that is limited by the sphere of activity of the neighbouring celestial body.

Yet, the heaven, the sphere of a celestial body differs from the space as receptacle of everything by the incorporeal and corporeal virtues as well of the concerned celestial body. For Guericke, the air is for example a corporeal virtue of the earth.

Let us reconsider the results hitherto deduced by Guericke: the increased infinite space is identical with God and with Nothing. Guericke draws the necessary conclusion Athanasius Kircher shrank back from: He identifies Nothing, the space, with God (Guericke, 1672, book II, chapter 8).

**Epilogue**

Isaac Newton does not cite Guericke in his masterpiece *Philosophiae naturalis principia mathematica*.

Obviously Guericke's theory of cosmic virtues had little attraction for the theorist of general gravitation. Newton explicitly refused the identification of God with space. He affirmed that God constitutes space by his eternal and omnipresent existence.
References


