OVERCOMING ARISTOTLE: THE COPERNICAN REVOLUTION

CLAUDIU BACIU

Abstract. The Copernican revolution's success was based not only on the accuracy of the newly established astronomical computation of the celestial trajectories but especially on a new understanding of the heavenly bodies. The paper first sketches the Aristotelian cosmology and its mainly qualitative approach. Thereafter, it shows that this qualitative approach was slowly changed in the Renaissance by a quantitative approach that abandoned the principle of the existence of different ontic regions.

Key words: Aristotle, Copernicus, logical generalization, substance, modern atomism.

In his book, about the Copernican Revolution, Thomas S. Kuhn maintains that this revolution - initiated by Copernicus and accomplished by his successors – cannot be explained using exclusively scientific concepts (Kuhn, 1995, p. VII). Although Copernicus was a scientist, his approach was influenced by the general intellectual atmosphere of his age. In the following, we will discuss some of the aspects involved in the framework of the Copernican revolution.

For this scientific change to be possible, it was needed first that astronomers give up the Aristotelian interpretation of the Earth as the center of the Universe (Kuhn, 1995, pp. 78-87). However, this abandonment was much more difficult than it seems today, because of the way the Earth was conceived. In retrospect, we could think that until Copernicus, there was no difference in the way in which Earth and the heavenly planets were understood: as if ancient people were only deceived in their understanding by the perception of some similar objects. But such a difference existed: in Aristotelian physics, the world consisted of five elements: earth, water, air, fire, and the aether. As we can imagine, the element earth, which was the heaviest of all, was specific to the Earth, whereas fire and aether were specific to the stars. Only when theologians, philosophers, and astronomers started to think about the planets and stars in heavens as consisting of the same matter as the Earth, was it possible to overcome the traditional Aristotelian ontology. Only when Earth was no longer considered unique among the cosmic bodies, could it lose its central position in the universe. To be accepted, this idea required a profound metaphysical change that took place at the end of the Middle Ages and the beginning of the Renaissance within Christian theology. This change was initiated by Cardinal Nicolaus Cusanus and his speculations regarding the Infinite.

Cercetări filosofico-psihologice, anul XII, nr. 1, București, 2020, p. 15-19.

On the other hand, the overcoming of the Aristotelian cosmology had, paradoxically, already been prepared in late antiquity, with the bifurcation between cosmology and astronomy (Kuhn, 1995, p. 105). Whereas antique cosmology was centered on a qualitative view of the world that found its most developed expression in the philosophy of Aristotle, the Hellenistic astronomy was interested mainly in the mathematical description of the motions of stars, i.e., in a quantitative approach. Hellenistic astronomers like Ptolemy tried to elaborate models of such motions that could predict as accurately as possible the changes of the positions of stars. These models were based on observations and not on speculations as with many of the Aristotelian ideas. Due to many circumstances, astronomy stopped its development during the Middle Ages. It recovered its progress again only at the end of this period. At the beginning of the Renaissance - when the traditional way of calculating the trajectories of stars became more and more complex and difficult because of an increasing amount of data and observations that had to be made congruent with Ptolemy's model - Copernicus introduced the new heliocentric hypothesis as a means of simplifying these calculations. (Astronomy was and continues to be a science involving observations made during a long time, information that had to be incorporated into a harmonious and unitary model that could predict the planetary motions accurately. However, during the Middle Ages, it was very difficult to collect and adequately keep such data.)

The bifurcation between cosmology and astronomy is an early example that predictive knowledge can develop without being grounded in an intuitive understanding. Today, in the field of quantum physics, scientists have the same approach: they are comfortable with the possibility of accurately predicting quantum processes, without explaining them through concepts borrowed from our common experience. Modern science took the path of abandoning qualitative inquiry.

This abandonment is the main reason why modern science is no longer a science of what there is, a science that aims at knowing the "truth" about reality, as the ancient science was, but it is a mathematical knowledge of the relationships between different elements of reality. And this mathematical knowledge or mathematical model can change easily whenever significant observations are added to the existent observations on which the previous model was based, contradicting it. Therefore, the "truth" of modern science is not the "truth" of ancient science: in that time, "scientists" wanted to know the true nature of being, a nature that they considered to be immutable and eternal.

Such a nature was not accessible through measurements but through speculative thinking. For example, when Aristotle defined man as being a rational animal, he isolated the most important features of the human being, those features without which no human person could be considered human. But it is obvious that neither rationality nor animality can be measured mathematically. Thus, when we speak about the qualitative character of ancient science, at least in the way Aristotle developed it, we must take into account that its endeavor was oriented toward grasping those essential features of reality that made reality what it was.

On the other hand, modern science abandoned the quest for such features, which eventually were seen as something hilarious, as we learn from the famous "vis dormitiva" of Molière. And they were considered hilarious because, in the eyes of the moderns, they pretended to explain something that was obvious, while actually explaining nothing: why does someone sleep or feel sleepy? Because they are driven by a *vis dormitiva* or a sleeping drive.

However, the Aristotelian approach, which continued the tradition of ancient Greek philosophy, was different: it tried to identify the core features of an existing thing. In this context, we may recall that, in his Academy, Plato is supposed to have defined the human being as a featherless animal, endowed with flat nails (Laërtius, 1905, p. 231). Although such a description could have some relevance, certainly nobody would agree that featherlessness and flat nails are the features that define the human being, i.e., its fundamental qualities. Therefore, the endeavor of ancient philosophers to identify the fundamental qualities of an existing thing and distinguish them from the accidental ones (like the color of his hair) was one of the most important achievements of the human mind. They discovered the process of generalization in which the human mind abstracts necessary features from unnecessary ones. While making such generalizations, features considered necessary were thought of as substances, as elements that sustained the existing thing. And they assumed that such elements were immutable and eternal because they could be found in every real thing, in the same way in which we find rationality and animality in every human being, even though some people are more prone to rational thinking and others to animal behavior.

Aristotle distinguished between four types of causes: the material cause, the formal cause, the final cause, and the efficient cause. Those necessary features were considered as being formal causes, i.e., what builds up the identity of an existing thing (in this context "Form" must be thought of, not as shape, but as the Platonic "Idea," i.e., as that ideal model after which concrete things have been made.) Later, from those four types of causes that explained the existence of a thing, only the efficient cause was maintained. Modern science sought efficient causes in explaining things, and not formal causes. As a result, formal causes - which once were thought of as existing objectively, beyond the human mind, within real things - transformed into concepts through which the human mind could control reality. We may say thus that with respect to the *vis dormitiva* of Molière, the comedy is due to the fact that something which previously was thought of as a formal cause was now interpreted as an efficient cause, the explanation becoming hence pure tautology.

Kuhn considers that Copernicus' astronomical system was not more efficient in predicting the motions of the stars and the planets than that of Ptolemy (Kuhn, 1995, p. 171). Also, it was not more simple than the Ptolemaic system, Copernicus still using epicycles like his predecessors. However, it involves a new understanding of the relationship between planets. The motions of planets and stars now depend upon each other, and, as Copernicus emphasizes, any small change

made in the case of one of the planets' orbits would entail a collapse of his whole system (Kuhn, 1995, p. 176). In the Ptolemaic system, one could adjust the orbits of the planets (by introducing, for example, expedients like the epicycles) easily in order to make them match observations. But this was no longer possible in the system of Copernicus because now the positions of the planets on their orbits were not calculated only in relation to the Earth, but also in relation to each other and to the sun, the center of their orbits.

In the debates around Copernicanism following the publication of the book of Copernicus, the conflict between the new positivist mentality that seems to emerge in Renaissance - a mentality that preferred to support facts and well documented information against speculations - and the old mentality that favored symbolism and a more metaphorical interpretation of reality, (the latter rooted, of course, in religion), becomes increasingly visible. We see this in the attempts of theologians like Luther to reject Copernicus' astronomical and mathematical arguments with quotations from the Bible, like the one in which Joshua (*Joshua* 10:13) is supposed to have commanded the sun to stop its motion in the sky. Such passages were based on common perception, but they were endowed with religious authority. The symbolic interpretation of reality does not put as much weight on what is immediately seen as on its meaning, on the transcendent content that lies behind the concrete fact. And this content can only be thought of. It allows a very lax connection with the fact through which it seems to be perceived. This is very evident in the religious inclination to interpret tribulations and sufferings as being grounded in God's will, and thus as having a positive meaning. Such an approach grounds modern theodicy, in which evil is only the incomplete image of what really the divine Good is.

Symbolic understanding was compatible with the traditional qualitative view of reality, which, as we saw previously, searched initially for constant traits that existed within phenomena but were not obvious. It was a more abstract perspective but grounded in the same approach. Like human rationality, which can be exhaustively grasped neither by mind nor senses, religious or metaphysical symbols were not something that could be verified immediately, or experimentally, i.e., in a way that everyone could repeat to prove the truth of such assertions. These symbols were and still continue to be vague concepts, i.e., they have an indeterminate logical intension, and of course, as a consequence also an unclear logical extension. This is why people use them in divergent or even contradictory senses and contexts. Modern people became increasingly trained in the spirit of exactitude; they became accustomed to expect that every claim needs to be proved not only with logical instruments like syllogisms but also through supporting facts. Also, because many concepts and ideas lack corresponding facts, modern people started either to abandon them or to ascribe them less importance. This trend led to a devaluation of humanities and of course, to immanent, materialist and welfare-seeking views. Today, concepts like 'consciousness' or 'reason' are avoided in psychology because of their vague content, especially because one cannot ascribe them a complete set of functions.

Although Copernicanism emerged from the Hellenistic astronomy which was related to the Aristotelian conception of spheres, in Renaissance a new view of the universe started spreading: the view that the universe was not finite as Aristotle thought of , but infinite. The first who expressed this idea was the aforementioned Cardinal Nicolaus Cusanus. However, his speculations had a theological goal, aiming at showing the unlimited power of God, who, being Himself infinite, had to be able to create an infinite world. Cusanus did not speculate about the nature of the bodies that populated the infinite space of the world. Only later, did this question arise. It was developed by Giordano Bruno, who associated the speculations of Cusanus with the ancient philosophical speculations of the Greek atomists Leucippus and Democritus, speculations that were taken over by the Roman philosopher Lucretius. These thinkers assumed that matter consisted of indivisible small bodies, called atoms. These atoms moved in an empty space, the void, building the larger bodies that we see now. Because space was thought of as infinite, the position of Earth to the other planets was accidental. In fact, many other Earths and Suns existed in the infinite space, being made up from the same atoms. Bruno took over this conception spreading it to his contemporaries.

Although Copernicus did not yet imagine that the universe was infinite, he concluded that the distance from Earth to the sphere of the stars was much greater than had traditionally been assumed. This idea could have contributed to creating a representation of the infinity of space. With the idea of infinite space, the conception of the old atomism found more and more followers, eventually becoming the main paradigm of modern materialist science.

Kuhn, T.S. (1995). *The Copernican Revolution: Planetary Astronomy in the Development of Western Thought*, Cambridge, Massachusetts, and London, Harvard University Press.

Laërtius, Diogenes (1905). *The Lives and Opinions of Eminent Philosophers*, literally translated by C. D. Yonge, London, George Bell and Sons.