Old Cosmologies, New Cosmologies

The rigid peripatetic division of the universe into two different parts—one immutable and made of crystalline spheres, situated between the fixed stars and the moon, the other mutable, under the moon—was also related in the Aristotelian paradigm to the concept of the natural sublunar world formed by the four elements: fire, air, water, and earth. Every element behaves differently, according to its so-called "natural movement". Light elements, such as fire and air, always tend to go upward, while heavy elements, such as water and earth, move downward following a rectilinear movement. Every element aims, in fact, to reach its own natural place, unless an external force causes a movement opposite to its nature—a "violent movement" (e.g., a stone thrown into the air). In both cases, Aristotelian theory considers movement as a quality common to all natural things because of the elements which compose them. By contrast, the heavens, since perfect and composed by a single element (aether), are immutable and travel in constant circular motion around an immovable center represented by Earth. An important corollary to the theory of natural places was the finite character of the world, because it implied the existence of a unique center of the world (the Earth), while evidently it would not be possible for an infinite universe to have a center.

These longstanding paradigms were destined to be challenged from the sixteenth century onward, both from a speculative and an empirical perspective. Observation of stellae novae and comets condemned the crystalline spheres and raised doubts regarding the doctrine of the immutability of heavens. According to the traditional Aristotelian account, comets were phenomena in the sublunar atmosphere. The great astronomer Johannes Regiomontanus (1436–1476) did not challenge this vision of the cosmos when he calculated the distance of the 1472 comet by considering the angle of parallax, but about a century later, the Jesuit Christopher Clavius (1538–1612), observing a nova (1572), and Tycho Brahe (1546–1601), observing a comet (1577), both demonstrated that the suddenly bright star and the comet must lie beyond the moon, and that therefore the doctrine of the spheres was false. The demonstrated fluidity of heavens also compromised, more crucially, the doctrine of their immutability. Two factors made possible such an achievement: the availability of better measuring instruments, and a stronger emphasis on mathematics. This emphasis on mathematics was probably the most important contribution of Platonism to the development of natural philosophy, and in particular astronomy, during the Renaissance. Though it is true that Neoplatonic philosophers had proposed alternatives to the Peripatetic theories on the heavens (e.g., Marsilio Ficino argued that the heavens were made of spiritus and rejected the division of the universe into spheres), it was their insistence on the importance of geometry and mathematics that opened the way to the quantitative vision of the world which gradually replaced the qualitative paradigm connected to the Aristotelian tradition.

The decision of Nicolaus Copernicus (1473–1543) to propose a heliocentric system, remove the Earth from the center of the universe, and establish a relationship between the distances of the different planets from the sun and the amplitude of their orbits was based on mathematical reasoning and the weaknesses of Aristotelian-Ptolemaic system in this regard. Johannes Kepler (1571–1630) defended the Copernican theory by re-utilizing geometrical arguments from Plato's Timaeus, and he also developed other theories (such as the elliptical form of the planetary orbits) founded on the geometrical structure that he attributed to the universe. Despite the fact that aspects of his method, and in particular the regressus, were essentially Aristotelian, Galileo Galilei (1564–1642) has been often described as a Platonist, insofar as Platonism endorsed a mathematical approach. Galileo denied the reality of the physical elements of the Aristotelian world and the theory of their natural movements, and replaced them with corporeal matter, whose properties and motions could be described in mathematical terms. Furthermore, by relying on new instruments such as the telescope, Galileo was also able to make new observations which revealed the imperfections of the supralunar world. Galileo and the Copernican theory met with the resistance of the Church, but also of the universities, whose professoriate was not eager to renounce one of the central pillars of its teaching. On the other hand, the Tychonic system elaborated by Brahe, which attempted to conciliate the traditional Aristotelian-Ptolemaic cosmology with Copernicus, encountered support even among Jesuit scientists.

However, neither mathematics nor fresh observations were capable of resolving the problem of the nature of the universe: was it finite or infinite? Is there only one world or do multiple worlds exist? According to the Aristotelians the universe must be finite, because it is impossible to have an infinite body in act, and Copernicus and his followers also endorsed the finitude of the heavens. Theology, however, offered arguments against the finitude of the universe: Nicholas of Cusa (1401–1464) connected the infinity of God to the infinity of heavens, and Palingenio

Stellato (or Pierangelo Manzolli, 1500/3–1543 ca.), in his Zodiacus Vitae, compiled themes from different traditions (e.g., the Aristotelian spheres and the Platonic ideas), describing a universe made of infinite light in order to celebrate the glory of God. Francisco Suarez (1548–1617), and a few years later the Conimbricenses, also defended the existence of an infinite space, even if it was only an imaginary one, combining Peripatetic doctrines with theological ones (above all the omnipresence of God, which cannot be limited by a finite space). Giordano Bruno used the relationship between God and His creation to argue for the infinity of the world. Bruno's position was in complete opposition to the Aristotelian cosmology: the spheres are broken, there is no hierarchy between the different parts of the world and no center, and therefore the natural movements are rejected. Bruno developed his theory of infinity not only by relying on metaphysical arguments but also on a radical revision of the Aristotelian definition of space, which he understood as a continuous quantity. Bruno's proposal provoked reactions all over Europe: Kepler rejected it several times in different ways. Nevertheless, Kepler agreed with Bruno's belief in the plurality of worlds—a problem which raised theological issues because of the question of salvation. Tommaso Campanella—an author who denied the infinity of the universe—resolved it by arguing that the inhabitants of the other worlds were not men, and therefore did not need to be saved by God.

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