III. BÖLÜM / CHAPTER III

ASTRONOMİ

ASTRONOMY

PROCEEDINGS PAPER / SEMPOZYUM BİLDİRİSİ

1. Uluslararası Prof. Dr. Fuat Sezgin İslâm Bilim Tarihi Sempozyumu Bildiriler Kitabı

The 1st International Prof. Dr. Fuat Sezgin Symposium on History of Science in Islam Proceedings Book

İSTANBUL UNIVERSITY PRESS

DOI: 10.26650/PB/AA08.2020.001.012

What Was It That Didn't Turn the World? The Idea of the Stationary Earth, Ibn Sīnā, and the Proofs That Followed

Dünyayı Döndürmeyen Neydi? Durağan Dünya Düşüncesinin İbn Sīnā ve Sonrasındaki Delilleri

Mehmet Sami BAGA*

ABSTRACT

The Earth is positioned at the center of the universe in the Ptolemaic model of the universe. The center of the Earth is at the same time the center of the universe in this model. This system, which was constructed according to Aristotelian physics, was accepted as the prevailing theory up to the adoption of the heliocentric universal model in the 16th century. The Earth was at the same time assumed to be completely stationary in the geocentric theory. Movement around its own axis or around another celestial body was out of the question for it. In Antiquity and the Middle Ages when observational instruments like the telescope were not yet in use, this theory was seen to be rationally based on data obtained directly from the senses. In this context, various justifications had been provided about the world being stationary and existing at the center. Representatives from the Peripatetic philosophy in the Muslim world also were seen to accept the geocentric model. In The Book of Healing, Ibn Sīnā (d. 1038 CE) subjected the proofs that had come to him about the Earth being stationary by distinguishing an independent chapter. The 14th century follower of Ibn Sīnā's philosophy, Najm al-Dīn al-Kātibī addressed this topic in *Ḥikmat al-'ain*, and the work's principle commentators also commented on his assessments. This study will address Ibn Sīnā's assessments on the Earth being stationary in the geocentric model of the universe and will discuss the reflections of these assessments in *Ḥikmat al-'ain* as an Avicennan text.

Keywords: Geocentric understanding of the universe, Ptolemaic astronomy, Ibn Sīnā, Najm al-Dīn al-Kātibī, Ḥikmat al-'ain

ÖZ

Batlamyusçu evren modelinde yerküre âlemin merkezinde konumlandırılır. Bu modelde yerin merkezi aynı zamanda âlemin de merkezidir. Aristoteles fiziğine göre kurgulanan bu sistem, 16. yüzyılda güneş merkezli evren modeli benimseninceye değin hakim teori olarak kabul görmüştür. Yer merkezli bu teoride yerkürenin aynı zamanda tamamen hareketsiz olduğu kabul edilir. Onun için kendi ekseni etrafında ya da başka bir gök cisminin etrafında hareket söz konusu değildir. Teleskop gibi ileri düzey rasat aletlerinin henüz kullanılmadığı antik dönemde ve orta çağda bu teorinin doğrudan duyu ile elde edilen verilerle rasyonel olarak temellendirildiği görülür. Bu çerçevede dünyanın merkezde oluşu ve hareketsizliğine dair çeşitli gerekçeler sunulmuştur. Meşşâî felsefenin Müslüman dünyadaki temsilcilerinin de yer merkezli sistemi kabul ettikleri görülür. *Kitâbu'ş-Şifâ*, *es-Semâu ve'l-â'lem*'de İbn Sînâ (ö. 1038) müstakil bir fasıl ayırarak yerin hareketsizliğine dair kendisine kadar gelen delilleri bir kritiğe tabi tutmuştur. İbn Sînâcı felsefenin 14. yüzyıldaki takipçisi Necmeddin el-Kâtibî de *Hikmetü'l-'ayn*'da bu konuyu ele almış, eserin şârihleri ise onun değerlendirmelerini yorumlamışlardır. Bu çalışmada yer merkezli evren modelinde yerin hareketsizliğine dair İbn Sînâ'nın değerlendirmeleri ele alınacak ve bu değerlendirmelerin İbn Sînâcı bir metin olan *Hikmetü'l-'ayn*'daki yansımaları irdelenecektir.

Anahtar Kelimeler: Yer merkezli âlem anlayışı, Batlamyus astronomisi, İbn Sînâ, Necmeddin el-Kâtibî, Hikmetü'l-'ayn

Submitted/Başvuru: 17.04.2019 **Accepted/Kabul:** 14.05.2019

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Citation/Atıf: Baga, S. M. (2020). What was it that didn't turn the world? The idea of the stationary earth, Ibn Sīnā, and the proofs that followed. In M. Kaçar, C. Kaya, A. Z. Furat (Eds.), *The 1st International Prof. Dr. Fuat Sezgin Symposium on History of Science in Islam Proceedings Book* (pp. 131-138). https://doi.org/10.26650/PB/AA08.2020.001.012

Introduction

Throughout history, a remarkable portion of mankind's effort to understand composes that which regards the universe's order of existence. The basic nature of this effort, which with a modern nomenclature and most general description can be called cosmology, may also be summarized in the way that it identifies how the heavens, which humans consider themselves to be utterly surrounded by when directing one's view up from the Earth that is one's abode, have occurred and how they process, as well as explain the motion that is clearly experienced around it. This understanding and effort at having understanding was conducted during Antiquity and the Middle Ages within astronomy, which is classified partly as a sub-branch of mathematics partially within the philosophy of nature.

Various theories that elucidate upon the structure and movement of the universe as a whole in this context are seen to have emerged. The geocentric understanding, which sees the universe as a finite, limited sphere and places the Earth at its center, has seen acceptance as the dominant understanding up to modern times no doubt. In the known history of this approach, Eudoxos (b. *c.* 395-390 BCE d. *c.* 342-337 BCE) comes across as having a pioneering role in undertaking the mathematical description of astronomical occurrences using the Homocentric Spheres System (Linton, 2004, p. 25; Waerden, 1975, pp. 180–181). His attempt to explain his views on the heavens with a mathematical model was strengthened by the physical base that Aristotle (b. 384 BCE, d. 322 BCE) would provide to this model. In order to explain certain planetary motions that this system has difficulty explaining, Ptolemy (140 CE) called for the system to be itemized mathematically. Thus, this explanation of the order of the universe established itself as the dominant understanding for centuries together with its Aristotelian physical base. In the Middle Ages, the acceptance of Aristotelian influence and Ptolemy's mathematical explanations continued in the Islamic world, while in the Christian world, the understanding of Thomas Aquinas (b. 1225 CE, d. 1274 CE) in particular maintained the nature of this understanding as the dominant theory through the church's reconciling with understanding the universe.

Again, from ancient scholars, another system was put forth by Aristarchus of Samos (b. *c.* 310 BCE, d. *c.* 230 BCE) who is often referred to as the Copernicus of antiquity (Linton, 2004, p. 39) that in fact acknowledged that it was not the Earth at the center but the Sun. This system, unlike the Homocentric Spheres System, predicted that all the planets including the Earth filled circular orbits around the Sun. However, because a physics system that would support this theory could not be established behind it, this system could not stand up against the geocentric theory. This is because Aristotle had undertaken placing the motion of a system that aims to explain the structure and motion of the universe on physical foundations for the geocentric theory;[12] in other words, the motion must provide its physical laws. In contrast, predetermining the positions where planets would be found or being able to make calculations about their masses with a mathematical model based solely on observation and calculation would not be enough on its own. Because the geocentric understanding had become the dominant theory, falling back on common sense can also be mentioned as more convenient for humans who had turned their gaze and attention to the heavens and considered the Earth to be at the center of everything, which they had found for themselves and was above them; that the heavens simply surround the Earth was extremely commonplace. This judgment, which had been reached by staying within the limits of common sense, is so inclined to establish itself that even today it leads us to a usage in the form of "The sun rises and sets." In that case, because the idea that the globe is at the center and motionless had been strongly supported both by being nearer to common sense and making a physical explanation of motion in this system, its nature of being the dominant theory had continued for centuries until Heliocentrism, which Copernicus proposed in the 16th century.

Aside from the Earth being located at the center of the universe, perhaps the most important principle that was considered is that the Earth is at the same time motionless. Namely, the Earth, which is found at the center, also does not change its position, just as it doesn't move in an orbit simply as a result of being at the center. This is because the assumption that the

1 For the relationship between Aristotelian cosmology and Ptolemic astronomy that the Islamic world had adopted, see George Saliba, 2004, pp. 251–268.

Earth is in motion appears contrary to "the order," which had deteriorated for various reasons such as earthquakes, which are present on Earth. Just as the Earth exists at the center, its being motionless also appears in harmony with common sense. Together with this, a variety of proofs in support of this idea had also been put forth. From Aristotle, new evidence was added until it reached Ibn Sīnā and later thinkers who adopted this understanding; sometimes the evidence was even critiqued by those who had adopted the theory itself. This study will include an analysis in the context of Ibn Sīnā's critique of the evidence in *The Book of Healing*, his evaluations, and Najm al-Dīn al-Kātibī's (d. 1276 CE) reflections in *Ḥikmat al-'ain*.

1. The Various Philosophical Principles Underlying the Idea of the Stationary Earth

The argument that the Earth does not revolve was a subject jointly investigated in astronomy and natural philosophy during the pre-modern period. This argument considered existence in the center through its principles that the Earth is sphere-shaped and its center is at the same time the center of the universe. With Aristotle dividing the universe into two sections physically (i.e., the area above and the area below the Moon), different physical rules were assumed to be valid in these two areas of existence. Thus a physical understanding where the linear motion on earth, which forms the sub-lunar and at the same time is the center of the universe, is valid; thus formation and deterioration are valid too, as well as a physical understanding that functions according to uniform cyclical motion that has no formation-deterioration in the celestial spheres up to the last firmament, which is called the firmament of fixed stars and surrounds it.

One principle that is valid on both sides of the universe that has been physically split in two is this: simple things have a spherical shape. In this way, alongside the Earth, the spheres surrounding it are also based on the shape of the sphere. According to Ibn Sīnā, the thing that determines the arrangement of these spheres is the precedence in existence for the supra-lunar area. Namely, the sphere, which is the defect of the cosmic mind and comes first in the sequence of emergence within the master-servant relationship, precedes the defect of the cosmic mind, which comes later in ranking. The thing that determines the sub-lunar sequence is heaviness-lightness and a natural understanding of space as a result of this. Because supra-lunar existences are formed of the substance of ether, they do not have qualities like heaviness-lightness. If considering Ibn Sīnā's perspective, even though they don't exist in terms of time, their arrangements precede people and therefore have a master-servant relationship between them. Conversely, heaviness-lightness determines the natural position of the sub-lunar bodies. According to what is known about the Earth consisting of four elements that occur by taking different representations of the original state of the universe, earth being the absolute heaviest of these elements takes place in ranking closest to the center, or at the lowest place, and fire takes place farthest from the center, at the highest place. Water and air are ranked according to their relative status such that water, being lighter than earth but heavier than air, takes place above earth, while air, being lighter than water but heavier than fire, takes place below fire. This is one arrangement that also reveals their natural placements at the same time. The elements, being in accordance with this arrangement, move linearly towards the center (down) and away from the center (up).

Cyclical motion, being the basic characteristic of supra-lunar physics, is determined as willful motions, particularly from Ibn Sīnā's perspective, and is put forth with a presentation that the motions occur through the influence of souls whose aim is to resemble the cosmic mind. Again, one of the principally-adopted points is that the linear and cyclical-motion principles cannot come together in the same thing. In other words, the principle of cyclical motion cannot be found simultaneously in a thing that possesses the principle of linear motion; things possessing the principle of cyclical motion will not be able to have the principle of linear motion (Ibn Sīnā, 2014, p. 86). This is because weight and lightness are naturally the reason for motion to and from the center (Aristotle, 1991, 5: 269b).

We encounter three kinds of motion when we consider a center and classify motion according to Aristotelian physics: motion toward the center, from the center, and in the center. While the first two of these, motion toward the center and motion away from the center, have a linear quality, motion that happens in the center occurs circularly or cyclically around the center. Therefore of these, while linear motions are presented as the basic style of motion for sub-lunar objects, cyclical

motion has been equated with orbital objects. A stationary center where cyclical motion will occur is considered so needed in the diagram that Aristotle also offered this logical justification in relation to the necessary occurrence of the existence of the Earth and its motionlessness (Aristotle, 1991, 33: 286a).

The basic framework summarized here is also seen protected in the period after Ibn Sīnā. *Ḥikmat al-'ain*, penned as a concise classic of philosophy by Najm al-Dīn al-Kātibī, provides content that adopts the same framework. The thing that changes here is the development of sub-explanations that would increase the explanatory power of the system, and changing evidence from place to place. Studies performed in Maragheh under the presidency of Nasīr al-Dīn al-Tūsī (d. 1274 CE) whom Najm al-Dīn al-Kātibī personally included in this, can be said to have had an important role.[26] However, one critique from Ibn Sīnā's perspective on the general framework that first emerged here must be given room.

2. Ibn Sīnā's Critique on the Evidence of the Non-Rotating Earth

First of all, it must be underlined that the main issue Ibn Sīnā discussed is not, in fact, of the earth existing at the center of the universe. The imagined universe having a finite-limited sphere in the center, which is accepted as a part of Aristotelian philosophy, is like an issue that is accepted without question.[37] The thing that will instead be discussed is the issue where we consider whether the *motions* seen in the sky are really happening in the sky or, if not, is the firmament fixed and do the heavens move through the illusion created by the positional change that results from the movement of the Earth. Ibn Sīnā's preference of course is toward the Earth being fixed. However, his various critiques are the issue in partly explaining the reason for this fixedness.

In *The Book of Healing (Kitāb al-shifāʾ),* Ibn Sīnā first evaluates the claim that the heavens are stationary and the Earth is in motion and rejects the evidence in this direction. According to this claim, the sun and stars rise and set due to motion of the moving Earth and its change in the alignment it has to them. In other words, the motion that is in fact assumed to be in the sky is not in the heavens; it emerges due to the movement of the Earth itself. In this case, the sensation that is in the form of the heavens moving actually consists of an illusion.

Ibn Sīnā mentions two proofs to refute this claim. In the first proof, an object dropped from above will in the case of a moving Earth reach the ground with a deviation according to its symmetry when considering the Earth's rotational speed. Namely, this object will not fall on the point parallel to where it was before it was released; it will fall beyond this point or near it according to the direction of the Earth's rotation. In the second proof, he mentions that the falling distance of two arrows that are shot to the east and west will be different. Namely, the arrow show straight in the direction that the world turns will be slower and the arrow shot in the opposite direction will travel further. In other words, because nothing assumed in the two proofs happened according to Ibn Sīnā, the assumption that the world moves as first mentioned is invalid because the object dropped from above falls to the point it had been aligned with before being dropped, and the distance that arrows shot to the east and west fall is the same (Ibn Sīnā, 2010, 61, #108).

In the second part of his critique, Ibn Sīnā critiques the proofs of those who defend the idea that Earth is at the center and doesn't turn and who justify this in various ways. Ibn Sīnā here didn't give names; he just tried to reveal that those who advocated this world in the period up to his own had put forth false justifications. One of the common directions of the justifications that he criticized is explaining the existence of the Earth in the center in a style that can be described as deviating from the physics of Aristotle and its being stationary in a way that contradicts the natural understanding of

2 For the importance of the Maragha Observatory in Islamic History and the new approaches it brought to the Ptolemaic system using the mathematical model named the Tusi Couple after Nasīr al-Dīn al-Tūsī, see Sayılı, 1998, pp. 187–223; Saliba, 1991, pp. 67–99); Ragep, 2017, pp. 161–179. Saliba established concrete connections between scientific studies in the Islamic world and the Renaissance in Europe, particularly in astronomy. See Saliba, 2007, pp. 193–232.

3 Unlike Aristotle, however, Ibn Sīnā must be emphasized as not accepting the universe as one that exists by itself but as one created uniquely as an eternal act (fiʿl) of God, and he accepted this as infinite only in terms of time. For his explications about priority-posteriority (taqaddum, taahhur) and immediate creation (al-ibdāʿ), see Ibn Sīnā's *Remarks and Admonitions* (2014, p. 137, 139.

space. Said another way, Ibn Sīnā already explains the Earth's existence in the center as its natural existence in space and the occurrence of motionlessness as a natural requirement of being in space; only in the explanations he critiqued, albeit for different reasons, is the Earth found ultimately to be deliberately (or "forced") in the center and motionless. The compelling element in these justifications that Ibn Sīnā quoted and found weak is that sometimes the heavens pulled the Earth in all directions evenly, sometimes it pushes it evenly, and sometimes the tendency of the Earth is equal in all directions. Yet again, the basic assumption of all these is that the Earth is forced to rest in the center, and this assumption is the main reason for its weakness and inaccuracy according to Ibn Sīnā (2010, 62-63, #111).[48] Moreover, some of our observations also show the invalidity of assuming such a forcing according to him. For example, let's assume the Earth to be in the center and the heavens to pull it equally from all directions and therefore force it to be stationary. A small thing should be more affected by this attraction than a big thing, and something close should be more affected than something far away. In this case, why does dried clay (plaster) thrown in the air experience much more of the earth's gravity than its own and not fly straight to the heavens? Again, when assuming that this pull disappears, either (1) that the Earth lifting and moving straight to the firmament means this is impossible, or (2) that the Earth will stay in place means the globe will stand still before being pulled, which is assumed in this case. Therefore, no situation emerges in either assumption where the Earth is being deliberately pulled (Ibn Sīnā, 2010, 65, #115).

Alongside this, Ibn Sīnā also critiqued explanations that, along with accepting the Earth being at the center, tried to describe the Earth's stationary existence through it possessing a shape other than a sphere or through the existence of a limitless universe. By stating the stability of water to be more doubtful than that of soil, Ibn Sīnā, who stated that according to this a boundless object was impossible or namely that the universe is finite, also opposed the view that saw soil above water and that defended soil being fixed over water with the middle of water being dented (Ibn Sīnā, 2010, 64, # 112).

3. Reflections on the Idea of Motionlessness in the 14th Century: Najm al-Dīn al-Kātibī's Ḥikmat al-'ain and Commentaries

The idea of the Earth being motionless and at the center was also advocated in Najm al-Dīn al-Kātibī's *Ḥikmat al-'ain*, which was penned from the perspective of Ibn Sīnā. The two proofs that had previously been proposed by Ibn Sīnā as the malady of motionlessness are no longer accepted as credible here. al-Kātibī included the following in the passage addressing this topic:

> *Some claim the Earth to move directly eastward and planets to emerge in the east and disappear in the west not because of the movement of the heavens but because of the Earth's motion, because the firmament is still. However, this claim is false. The reason for this superstition is not just the following: "When such a thing is the topic, the bird moving in the direction of the Earth cannot catch it. This is because the Earth, in one day and night, moves faster than the bird in returning to its original position." This is due to the mandatory requirement (inseparable) predicted here being impossible between the two things. For just as the ether is subject to disaster, so too is the air adjoining the Earth permitted to follow its motion. The main reason contrary to this is the impossibility of the Earth, which possesses a linear tendency, to move cyclically.* (al-Kātibī, 2005, p. 130)

Najm al-Dīn al-Kātibī finds the justification Ibn Sīnā mentioned about the stableness of the Earth invalid and ties this case to another reason. Although Ibn Sīnā gave two examples, both cases are based upon the same assumption. Thus, the impossibility or conflicting situation stated in the proofs mentioned from al-Kātibī's point of view is understood to be based on the prediction that the air surrounding the Earth will not move when assuming the Earth is in motion. In fact, in

4 Ibn Sīnā also dealt with a separate treatise upon a question that was asked that Earth's existence in the center its natural existence in space. See. Ibn Sīnā, *Risāle fī sababi kıyām al-'ard fī vasat as-semā,* Süleymaniye Kütüphanesi, Hamidiye nr. 1448, vr. 627a-631a, especially vr. 630a-b. Aristotle, after noting the Earth to be in the middle and motionless, also stated that qualifying these types of motions of bodies toward or away from the center as motions required by nature that occur due to heaviness-lightness would be appropriate by objecting to explanations of this motion being in any way a coercion. See Aristotle's "On the Heavens," pp. 50–51, 296a–297a.

the example given, because the bird's speed of flight and the Earth's rotational speed are so different, a bird flying in the direction of the Earth's rotation is stated to be unable to catch up to the earth or return home. However, al-Kātibī states that in the case of the Earth being in motion, the air surrounding it does not need to be stationary; air that surrounds the Earth can quite possibly move subjectively with it, just as the thrall is subject to disaster in celestial spheres. Thus the impossibility cited in the example does not need to occur. al-Kātibī presents a basic principle of the Earth here that Ibn Sīnā in fact also accepted but didn't use as evidence in this matter: The Earth possesses a linear tendency and it having cyclical movement is impossible.

In fact, the source of al-Kātibī's statements is Nasīr al-Dīn al-Tūsī, as the text's commentator, Ibn al-Muṭahhar al-Ḥillī (d. 1325 CE), also stated (al-Ḥillī, 1959, p. 343). al-Tūsī's work, *al-Tadhkira fī 'ilm al-hay'a*, which in this aspect has been shown in some modern studies as the precursor to Copernicus and contained several critical assessments on the Ptolemaic system, has statements that al-Kātibī would quote directly and revealed that the air enveloping the earth can move with it. Contrary to Ibn Sīnā's proofs, Nasīr al-Dīn al-Tūsī based the earth being stationary on it having a linear tendency and not being able to move cyclically.[510]

Well, is evaluating the approach put forth by Nasīr al-Dīn al-Tūsī and adopted by al-Kātibī as a step forward possible? Giving a positive answer to this question is possible in one respect, because an explanation has been brought to cases where certain observations on daily life have emerged and require extra explaining. Questions such as the relationship between a bird flying in the air and the world's rotation, how an object dropped overhead falls with symmetry, or as a simpler and more understandable example how a person who jumps in the air lands in the same place now have an answer. When looked at from this perspective, the idea of the Earth being motionless can appear to be supported by more advanced explanations. From another perspective, however, this approach also means that its current position is strictly maintained and, in this respect, has a value that makes its position more steadfast. Thus although observation-based examples that would support the idea of motionlessness have been abandoned here, linear motion still maintains the quality of having the basic characteristic of sub-lunar physics and is also supported by a principle taken from natural philosophy: The principles of both linear and cyclical motion cannot be found in the same thing. This metaphysical principle has positioned what is natural opposite the restricted being and contains a sub-principle where the restricted being cannot be in the place where the natural thing is not.

The commentaries of *Ḥikmat al-'ain* also made explanations on this issue. By objecting to this metaphysical principle, Ibn al-Muṭahhar al-Ḥillī, the text's first commentator, suggested that although the nature of things requires linear movement, under the influence of a compelling causality, that thing can move circularly. Therefore, he did not accept the natural-constricted contrast (al-Ḥillī, 1959, p. 343). Yet al-Ḥillī's objections must be stated as not appearing to be about providing proofs theoretically nor intending to question the assumption about the Earth being stationary and at the center.

Another principal commentator, Shams al-Dīn Muhammad bin Mubārak Shāh al-Bukhārī (d. after 1382 CE) first examined an idea that emerged on why the heavens are fixed and the earth is in motion. According to his explanation, the reason for this mistaken idea is that some thinkers try to explain the movements of the stars as slow to the west but fast to the east. According to them, whether peculiar or common, because the same object cannot possibly move in two separate directions and slow motion cannot be attributed to the Earth, these people claimed the earth is moving by attributing the day's fast movement to the Earth. This is because they think the outermost heavens are stationary (al-Bukhārī, 1974, pp. 551–552). al-Bukhārī did not agree with those who proposed this idea; he only found the approach of "It's possible that air turns with the earth" which al-Kātibī used while evaluating arguments that were brought against this view, incorrect. In other words, he rejected that the air surrounding the Earth could move with the Earth. According to him, this idea is a result reached through the motion of comets. Yet as claimed, the material of the ether is in fact not subject to the heavens. If

5 See *Nasīr al-Dīn al-Tūsī's Memory on Astronomy (al-Tadhkira fī 'ilm al-hay'a)* in Rageb, 1993, 1, p. 107. For details on al-Tūsī's reservations (shukūk) about the Ptolemy model see *Ibid,* Jamil Rageb's introduction, pp. 48–51.

that were the case, the motion of comets wouldn't match the speed of the equator but would continue from north to south. In that case, this motion is due to a heavy body adjacent to the comet. Moreover, if the ether is accepted as being subject to the heavens by way of what is claimed, such an association would be out of the question for the Earth. Otherwise, two stones of different sizes wouldn't fall to the same place when thrown in the air; because the air would move the one that is big less, the big one would fall further west than the small one. However, this is not the case in reality. If al-Bukhārī had adverted to the various proofs (such as air rotating at this speed would have to be felt, seeing westward-moving clouds and breezes would be impossible, we would not be able to move counter to the rotation of the Earth) that had been brought against the possibility of air also rotating with the Earth, these proofs would not have been found credible. Instead of this, he objected to establishing a similar relationship between the earth and the air that surrounds it over the relationship established between the ether and the heavens (al-Bukhārī, 1974, pp. 553–554).

Muhammad bin Mubārak Shāh al-Bukhārī, by refuting the claim of previous thinkers that the Earth moves due east, particularly highlighted as al-Kātibī did what they hadn't applied to the Earth naturally not possessing the principle of circular motion, and al-Bukhārī conveyed these proofs they used by citing the proofs that al-Kātibī had critiqued. According to him, the reason those thinkers hadn't made a choice like that was: (1) When defending the claim that the Earth moves in this way, even if its circular motion is not possible, the Earth could be claimed to move circularly by being forced (al-qasr), and (2) The style of explanation that al-Kātibī applied was physical, not mathematical. Moreover, the thinkers of old were unable to apply a proof apart from these (mathematical ones) for supporting their own ideas (al-Bukhārī, 1974, pp. 554–555).[614] Thus, like Ibn al-Muṭahhar al-Ḥillī, al-Bukhārī also revealed that he did not share the same views as al-Kātibī on the point of proving the matter.

Another commentator from *Ḥikmat al-'ain*, Quṭb al-Dīn al-Shirāzī (d. 1311 CE) put the claim on the agenda that, like the other two scholars, that even though the Earth naturally doesn't have the principle of circular motion, the Earth would be able to move circularly in a forced way. According to him, the answer to the objection is, in such an assumption, (1) The motion of the Earth is an endless circular motion that protects the existence of time such that such a motion is voluntary and therefore could not be forced, and (2) The Earth possesses a universal will. al-Shirāzī's style of presentation implies that these two results are also unacceptable and shows that he did not accept the circular motion of the Earth being forced.[715]

Thus the proofs included in *Ḥikmat al-'ain* were shaped through Nasīr al-Dīn al-Tūsī's contribution, but the commentators approach, especially al-Bukhārī's, appears to be critical of this "new" argument. However, the ultimate purpose of all these evaluations was to not to question the basic assumption that the system was based on, in other words, not to question the theory that the Earth is in the center and motionless; on the contrary, it was to seat it on more solid foundations as much as possible by taking into account the criticisms that had come.

Evaluation and Result

In addition to the geocentric model of the universe, accepted as the dominant theory up to the 16th century, maintaining the feature of being a common-sense explanation that would hold humankind's view when turned to the sky, it also maintained this feature through the power of physical explanation that backs it up. One of the most important elements that this theory contains, aside from the Earth being in the center, is it being motionless as well. This is also a result of the need for a fixed center in order to explain the movement of the heavens. The classical proofs in question are what the philosophers who defended the Earth being in the center and motionless, including Aristotle and Ibn Sīnā, brought against those who claimed in contrast that the Earth was in the center but moved due east. Thus, doubt appears to have begun to be felt about the power of these proofs' explanations, and defending the Earth's motionlessness had begun through a principle that, unlike the proofs of old, had come from the metaphysical and natural philosophies. This transformation, which we

6 Of the principal commentators in the later period on *Ḥikmat al-'ain*, Mohy al-Dīn Mohammad b. Mūsā al-Tālishī (d. 1479 CE) generally repeated the emphases of al-Bukhārī. See al-Tālishī, *Sharh Ḥikmat al-'ain,* Millet Kütüphanesi, Fazıl Ahmed Paşa nr. 822, vr. 215a–216a.

7 See Quṭb al-Dīn al-Shirāzī, *Kitāb al-Favāid fī Sharh Ḥikmat al-'ain al-kavāid,* Süleymaniye Kütüphanesi, Ayasofya nr. 2429, vr. 111b.

encounter in *Ḥikmat al-'ain*, an Avicennan philosophical classic, is based on explanations about the air surrounding the earth also turning with it, which Nasīr al-Dīn al-Tūsī had put forth and as Ibn al-Muṭahhar al-Ḥillī points out in the text's commentary. This new explanation from al-Tūsī, who was known through the studies he did on the motion of the planets, which have various difficulties in describing the Ptolemaic system, and who was apparently known by Copernicus himself, appears seems to have had importance as the topic of an independent study that would be a significant step towards the heliocentric system.

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