IBN SĪNĀ—AL-BĪRŪNĪ CORRESPONDENCE—III

Translated by ***Rafik Berjak and Muzaffar Iqbal***

In this third installment of the correspondence between Ibn Sīnā and al-Bīrūnī, five more questions are asked and answered. Al-Bīrūnī rejects Aristotle's reasoning for his assertion that if the heavens were to be elliptical rather than spherical, a vacuum would be created. Al-Bīrūnī also objects to Aristotle's assertion that the motion of the heavens begins from the right side and from the east. In his eighth question, al-Bīrūnī asks how is it that Aristotle considered the element fire to be spherical. The ninth question deals with the movement of heat and the tenth with the transformation of elements into each other. Ibn Sīnā responds to all questions.

***Keywords*:** Ibn Sīnā–al-Bīrūnī correspondence; shape of the heavens; criticism of Aristotle's reasoning for the spherical motion of the heavens; sublunar physics; theory of transformation of elements.

---

(33) The Sixth Question: [Aristotle] has mentioned in Book II that [the shape of the heaven is of necessity spherical because] the oval and the lenticular shapes would require space and void whereas the sphere does not, but the matter is not so. In fact, the oval [shape] is generated by the rotation of ellipse around its major axis and the lenticular by its rotation around its minor axis. As there is no difference concerning the rotation around the axes by which they are generated, therefore none of what Aristotle mentions would occur and only the essential attributes of the spheres would follow necessarily. If the axis of rotation of

---

Rafik Berjak is a scholar of Arabic language and literature; 9120-152A Ave, Edmonton, AB T5E 5W1, Canada; Email: rberjak@shaw.ca. Muzaffar Iqbal is President, Center for Islam and Science, 349-52252 Range Road 215, Sherwood Park, AB T8E 1B7 Canada; Email: Muzaffar@cis-ca.org.

Islam & Science, Vol. 2 (Summer 2004) No. 1
 ISSN 1703-7603

the oval is its major axis and if the axis of rotation of the lenticular is its minor axis, they would revolve like the sphere, without needing an empty space (*makān khāl*). This could happen, however, if the axis of [rotation of] the oval is its minor axis and the axis of [rotation of] the lenticular is its major axis. In spite of this, it is possible that the oval can rotate around its minor axis and the lenticular around its major axis, both moving consecutively without needing an empty space, like the movement of bodies inside the celestial sphere, according to the opinion of most people. And I am not saying this with the belief that the celestial sphere is not spherical, but oval or lenticular; I have tried hard to refute this theory but I am amazed at the reasons offered by the man of logic.

(34) The Answer: Yes—may Allah lengthen your life—your objection to Aristotle is sound and I have clarified this matter in some of my writings. Every commentator [of Aristotle] has offered apologies for his views. What comes to my mind now is what Themistius has said in his commentary on *Kitāb al-Samā'*, [that is], that the Philosopher's views should be interpreted in the best possible way. So we say that no void whatsoever would result from the circular movement of the sphere, whereas this is possible in the case of the oval and lenticular shapes. Despite this apology, he still denounces Aristotle's view, for it is possible to prove that the shape of the heavens is not oval or lenticular with arguments—some of which are natural proofs and others are mathematical. And since you have a mastery of mathematics and live in a region where [numerous] experts in geometry reside, there is no need for me to go into further details.

(35) Nonetheless, your assertion that no void would occur from the movement of the oval and lenticular shapes, as you have observed from the moving bodies within the celestial sphere, is not the same as [the other saying], because in the celestial sphere there are, vis à vis the moving bodies, other moving bodies touching them consecutively. As for the heavens, if it were lenticular and moved, but not around the minor axis, or if it were oval and moved, but not around the major axis, then a void would necessarily occur because there is no body beyond the heavens that would be touched by the body of the heavens

during the movement, as is the case for the bodies within the heavens.

(36) The Seventh Question: When [Aristotle] mentioned directions, he established that the right is the starting point for the motion of every planet; he then reversed the matter, for he said that the motion in the sky is from the east because that is the right side; and the reverse is not permissible, thus leading to a circular argument.

(37) The Answer: The Philosopher did not assert that the motion of the heavens is from the east because the east is right. What he asserted was that the east is the right side because motion appears from the east. The movement of animals appear from the right and, for him, the moving heavens is [like] an animal; thus it necessitated that the east is the right of the heavens. It is impossible for a rational person to embark upon the task to prove that the heavens move from the east because there is no doubt about that; it has been always the case that the heavens move from the east. However, the Philosopher wanted to clarify the nature of [what is meant by] the right of the heavens after he had asserted what is the right direction for the heavens with reasoning.

(38) The Eighth Question: [Aristotle] claimed that when planets move, the air that touches the planets is heated because heat comes as a result of motion and coldness is a result of rest. So when the heavens move quickly, the air being touched becomes hot, eventually becoming fire, known as Ether. The faster the motion, the stronger and more intense the heating. It is very clear that the fastest motion of the heavens occurs at the equator and when it approaches the two poles, the motion slows down. Let us assume that the heaven is A, B, C, D and the two poles are AB and the equator CD; the hottest points would be EF and these are the farthest points because here the motion is the fastest. Then, the motion slows down toward the two poles. The heat will gradually decrease until it disappears at the two poles. The fire image is presented here by the outer shape and the air image by the inner shape. This is what should occur according to the agreement of the ancients who agreed that the shape of the

fire is spherical and so is that of air, and nothing can illustrate this better than this figure [see Fig. 1].

(39) The Answer: According to most philosophers, the fire is not brought into being by the motion of the heavens but it is an independent element; it has its own sphere and a natural position of its own, like any other element. What you have said is nothing but the beliefs of those who considered the four elements to be [only] one, two or three. Like Thales, who considered them to be water; or Heraclitus, who considered them to be fire; or Diogenes, who considered them to be a substance between water and air; and Anaximander, who considered them to be air. Each one of them considers other bodies—as well as the generated accidents—as the accidents that appear in those bodies according to how they are shaped and do not consider that they are derived from another body. And Anaximander says—what you have mentioned—namely that the first element is air; when it is affected by cold, it becomes water and when it is heated by the motion of the heavens, it becomes fire or ether. However, Aristotle did not consider any of the four elements to be coming into existence from another element and the same is true for their parts. This objection [your raise], then, does not apply to Aristotle or to whoever said the same thing, which is the right and wise saying. As for the shape you drew, it is not supposed to be like that. The two nooks, E and F, that you drew, only apply to the condition you described. But the figure to prove your point has a problem, and it is that the curve AE should meet the curve EB roundly, without nooks between the points. And so should be the case with the two curves AF and FB according to this illustration 2 [Fig. 2].

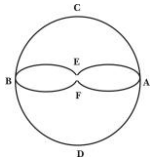

Fig. 1

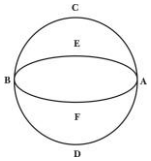

Fig. 2

(40) The Ninth Question: If [it is in the nature of] heat [to] rise from its centre, how is it that the heat of the sun reaches us? Are rays bodies, accidents, or something else?

(41) The Answer: You must know that heat does not leave its centre because heat is motionless, except in the case of accidental motion, when it is inside a moving body, like a motionless person inside a moving ship. And you must also know that the heat of the sun does not come to us by descending down from the sun for the following reasons: firstly, heat does not move by itself; secondly, there is no hot body that descends from above and heats what is down below, neither does heat come down from the sun by accidents; third, the sun is not even hot because heat that is being created here is not descending from above for the three reasons already mentioned. [Rather], heat occurs here from the reflection of light and air is heated by this process as can be observed in the [experiment of] burning mirrors. And you must know that the rays are not bodies—for if they were bodies there would be two bodies in one place, [and by that] I mean the air and the rays—but attributes of a transparent body. Aristotle has defined it in Book II of *Kitāb al-Nafs* (*On the Soul*) and in Book I of *Kitāb al-Ḥiss* (*Sense and Sensiblia*). According to him, light is the perfection of transparency and is in itself transparent.

(42) The Tenth Question: What causes transformation of elements into each other? Is it the result of their proximity or intermingling or some other process? Let us take the example of air and water: when water transforms into air, does it become air in reality, or is it because its particles spread out until they become invisible to the sight so that one cannot see these separate particles?

(43) The Answer: The transformation of elements into one another does not occur the way you mentioned. Water does not transform into air by the separation and the spread of its particles in the air until they disappear from the sight; rather, the water particles take off their watery image and put on an airy image. For more details, one can see the commentaries on *Kitāb al-Kawn wa'l-Fasād* and *Kitāb al-Athār al-χulwīyah* and the Book III of *Kitāb al-Samā'*. But here I clarify this case according to their methods and

the following logical example that they used to prove their sayings.

(44) Increase in the mass of bodies [can be explained by means of an example: [Suppose], we took a flask filled with water, sealed it tightly and exposed it to intense heat. The water particles in the flask would expand and crack the flask because their volume increased when they transformed into air. This happened either because of the spread of the space between the water particles, or not because of the spread of particles. But the void is impossible; therefore it is necessary that the latter is true. [Thus] the reason for transformation [of water into air] is not the spread of its particles, but the acceptance of another image by its atoms.

(45) If it would be said that air or something else entered the flask and increased its volume, we would say: that is impossible because a full container cannot accept another body inside it until it is emptied of the first occupant, and the water cannot leave the flask because it is tightly sealed and there is no way out. I observed a little flask. We tightly sealed it and put it in a kiln. It did not take long before it cracked and everything that was in it exploded into the fire. And it is known that nothing mixed with the particles of the water that were inside the flask that could cause a change, because, firstly, the fire was not inside the flask and, secondly, it did not enter it because there was no way into the flask. It is, therefore, obvious that this transformation occurred through a change in the air and fire natures of [air and fire] and not through the spread of parts. I have provided an example which supports Aristotle's views on the generation and change as parts of nature; and this suffices, for further elaboration would demand tenuous efforts. Many objections could arise in this matter and if you encounter any, please convey your questions and I would explain to you, God willing.

(46) These are the answers to the ten questions arising from the *Kitāb al-Samā'* of Aristotle; now we will answer the other questions by the permission of Allah the Exalted.