Is Nature independent from God's Will? Some Views from Classical Islamic Philosophy*

by Luis Xavier López-Farjeat

The Islamic classical period (750–1258) is the most representative of the history of Islamic philosophy. With the rise of the Abbāsids in 750, a new translation movement of antique texts drove the subsequent spread of scientific and systematic philosophical ideas throughout the caliphate, which had a great impact on the development of Islamic thought. Islam's first substantial contact with Greek philosophy occurred at the beginning of this period. By the 9th century, Islamic thinkers assimilated, adapted, and transformed philosophical Greek ideas, recontextualizing concepts and arguments according to their own tradition, cultural environment, and intellectual interests, giving rise to what we now commonly call 'Islamic philosophy' or, sometimes, 'philosophy in Islamic lands'.

What is usually understood by 'Islamic philosophy' is a series of theoretical concerns and the configuration of a worldview that arose within Islamic lands and an Islamic cultural environment. This does not mean that Islamic philosophers raised problems that were of interest exclusively to Muslims. They were engaged with philosophical problems *per se*. The cultural and religious environment in which they produced their ideas, however, was a major factor that shaped their philosophical views. In their thought, there is a close connection between philosophy and religion. Yet they did not form a single, monolithic school of thought. Moreover, the philosophers were not necessarily committed to defending the various versions of Islam held by the juridical and theo-

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logical schools. Unlike the medieval Christian tradition, in which theologians were also philosophers, in the classical Islamic tradition most philosophers thought of themselves as philosophers, not as theologians. Some theologians, in turn, were suspicious of philosophy, although in many cases they assimilated philosophical ideas, giving rise to what we might consider a philosophical theology (*kalām*).

Among the different sciences and disciplines developed by Islamic philosophers from the classical period, natural science was of particular interest. Amidst Islamic scholars, different—and sometimes competing—theories aimed to explain the origin of the physical world and natural processes. Two paradigms were dominant during this classical period. On the one hand, Islamic theologians (*mutakallimūn*) committed themselves to the study of nature (ṭabīʿa) to further their understanding of the physical world as an effect of God's will and His act of creation out of nothing. On the other hand, Peripatetic philosophers, that is, those who followed Greek authors who had written on physics and natural science, argued for the eternity of the world. The definition of nature closely relates to this debate on the origin of the world. While for the theologians the world was created by God and everything that happens in it depends absolutely on the divine will, the philosophers, while conceiving the world as generated by God as the First Cause, argued at the same time in favor of natural causality and, therefore, of the autonomy of natural causal processes.

The Notion of 'Nature' and its Aristotelian Background

Islamic philosophers adopted Aristotle's notion of 'nature' as the principal cause of motion. These philosophers explained the origins and behavior of natural bodies in connection with the processes occurring in what in philosophical jargon was called the "supralunary realm," that is,

the heavens. Most philosophers argued that although natural processes depend on the First Cause acting through secondary or intermediate causes, that is, the celestial spheres, natural causality was still efficacious. They understood that celestial spheres were responsible for the natural processes that take place in the sublunary world, that is, the Earth. According to their cosmological models, the circular motion of the heavens affects the natural processes that take place below them in the sublunary realm. The sublunary realm consists of the four elements: earth, water, air, and fire. In contrast with the perfectly uniform circular motion of the heavens, the motion of the four elements is rectilinear. Earth and water move downward, while air and fire move upward. Most Islamic philosophers considered the rectilinear motion of the four elements to be erratic.

Like Aristotle and other Greek philosophers, Islamic Peripatetic philosophers thought the four elements constantly mixed with each other, giving rise to composite bodies. The mixing of the elements is due to the circular motion of the heavens affecting the rectilinear trajectory of the elements. When mixed, these elements give rise to the elementary natural materials that make up bodies, for example, the seeds of plants or the flesh, bones, and blood of animals. Besides the influence of the heavens on natural processes, philosophers were also interested in natural processes *per se* and, thus, in the study of natural bodies. For them, natural science included disciplines that investigated the behavior of the heavens and the celestial spheres (cosmology, astronomy, meteorology, etc.) as well as disciplines that study natural bodies in the sublunary realm (physics, biology, psychology, etc.).

'Nature' and 'Causality' in Greco-Arabic

The Arabic term Islamic Peripatetic philosophers used for 'nature' is ṭabīʿa. As mentioned, most of these philoso-

phers inherited the Aristotelian notion of 'nature', sometimes with slight modifications. In his *Physics* Aristotle discussed the meaning of 'nature' and distinguished between those things that exist by nature and those things that exist through other causes. Within the first category, he mentions animals and their parts, plants, and the four elements. Their main characteristic is that 'they exist by nature', that is, they possess an intrinsic principle or innate impulse for change and motion. The second category includes the products of art (i.e., artificial products). This means that to exist, these things need the intervention of other causes because they do not contain the principle of their own production within themselves.

The difference between products of art and natural things functions as a preamble to the definition of 'nature', which Aristotle understands as a "principle or cause of being moved and of being at rest in that to which it belongs primarily, in virtue of itself and not accidentally" (*Physics* 2.1, 192b20–23). Aristotle's ancient and medieval commentators debated this definition, and contemporary interpreters still debate it today. It is not clear whether the 'intrinsic principle' should be understood as an active principle (as the 'formal' structure of natural bodies) or as a passive principle (as the disposition of 'matter' toward motion or change). While Aristotle seems to understand 'nature' as an intrinsic principle through which bodies can move or be at rest, he also affirms that the role of this principle does not consist in "moving something or causing motion, but suffering it" (*Physics* 8.4, 255b29). The tension between these two ways of understanding 'nature'—as an intrinsic principle from which the power to move emerges and as a disposition to be moved or to suffer motion—can lead to different interpretations of Aristotle's *Physics*.

For instance, late ancient philosophers such as Alexander of Aphrodisias (3rd century) and John Philoponus (d. 570), interpreted 'nature' as a power or force that permeated all nat-

ural bodies. Both argued that the power that animates living beings and lets them move themselves is a soul. It may be that this view influenced 9th and 10th-century Baghdadi thinkers. Early philosophers in Islamic lands such as al-Kindī (d. 873) and al-Fārābī (d. 950) understood nature as an intrinsic and active principle through which bodies move themselves, instead of having a passive disposition to undergo motion. However, several Islamic theologians, especially those who were part of the 9th-century theological school known as the Ashʿarites, disagreed. Ashʿarite thinkers like al-Bāqillānī (d. 1013) and al-Ghazālī (d. 1111) argued that nature alone was not sufficient to explain motion and change. According to these theologians, there is no reason to assume that nature has an intrinsic principle of motion. Nature undergoes motion or change through external causes, some of which are natural. But given that, for these theologians, the only cause and agent is God, it is unnecessary to introduce natural or intermediary causes. In other words, God is the real cause of motion and change and not nature itself. For instance, for many Ashʿarites, fire was not the cause of combustion: fire does not have an intrinsic active principle to burn a piece of cotton. Al-Bāqillānī and al-Ghazālī argue that God is the real cause and principle of combustion. Combustion is a natural phenomenon that takes place through God's causality; fire is merely an occasion for combustion but not itself the cause of combustion.

This position challenges two ideas: firstly, that nature has an intrinsic active principle that makes motion and change possible, and, secondly, the notion of natural causality. It ultimately leads to occasionalism, that is, the view that God causally determines every process that takes place in the world at every instant. In the seventeenth discussion of al-Ghazālī's *Incoherence of the Philosophers*, there is a good example of Islamic occasionalism. There, he holds that God can interfere in any natural process. He uses combustion as an example and

argues that the efficient cause of fire burning a piece of cotton is not the fire itself but God. Occasionalism downplays the notion of natural causality to give priority to divine causality. Theologians such as al-Ghazālī defended occasionalism to make room for God's direct intervention in natural processes. The philosophers, however, held that God, or the First Cause, acts only through intermediary causes. Thus, philosophers like al-Fārābī and Ibn Sīnā (d. 1037) defended an emanative cosmological model in which multiple secondary causes are involved in natural processes.

Despite there are some differences if one reads carefully the different Islamic philosophical conceptions of nature, in general terms the philosophers agreed that the natural or sublunary world is the effect of secondary causes (be it what they called the agent intellect, or the circular motion of the celestial spheres). These causes generate 'prime matter', that is, the primary component of all bodies in the sublunary world. The four elements proceed from prime matter and, when these elements combine and mix in different ways, influenced by the celestial spheres, they generate numerous kinds of bodies: minerals, plants, animals, and human beings. In this short space, I will briefly compare two of the most important conceptions of nature within classical Islamic philosophy, namely, that of Ibn Sīnā (Latinized as Avicenna) and Ibn Rushd (d. 1198, Latinized as Averroes).

'Nature' According to Ibn Sīnā

Ibn Sīnā's understanding of 'nature' is found in the part devoted to *Physics* of his monumental work known as *The Healing*. There, he adopts Aristotle's definition: nature is the first principle of motion. Unlike Aristotle, however, Ibn Sīnā does not think the existence of nature is something self-evident; it needs to be demonstrated. Physics cannot demonstrate it because, in his interpretation of Aristotle's theory of

science, a science cannot demonstrate its own subject matter. Thus, Ibn Sīnā holds that the metaphysician must prove the existence of nature.

Ibn Sīnā understands that, according to the science of metaphysics, God, or the First Cause, is the originator of the world as a provider of forms or essences to the material world. God provides forms or essences to an eternal prime matter, thus producing natural bodies that are composites of form and matter. However, he describes form and matter as intrinsic principles of natural bodies. In addition to these two principles, Ibn Sīnā mentions two extrinsic principles. The first is the agent, which impresses the form of bodies into their matter, making the matter subsist through the form. The second of these principles is the end; that for the sake of which these forms are impressed into the matter. Ibn Sīnā is referring to what Aristotle calls the efficient and final causes and explains these extrinsic principles in the *Metaphysics* of *The Healing*. In the *Physics*, the starting point is Aristotle's hylomorphism, that is, the idea that all bodies are a compound of form and matter. As Aristotle, Ibn Sīnā thinks that form and matter are inseparable principles of bodies. Moreover, privation is the principle of 'corruption', that is, the passing away or destruction of bodies: when a body's substantial form changes, the body is transformed substantially.

After explaining the intrinsic and extrinsic principles of bodies, Ibn Sīnā deals in the first book of his *Physics* with the definition of nature. He makes a distinction between motion caused by external causes (e.g., water being heated or a stone's rising) and motion proceeding from bodies themselves (e.g., water cooling itself after being heated or the falling of a stone when it is left alone). Within the latter category, he distinguishes four types of motion. (1) Some motions and changes are non-volitional and proceed uniformly, that is, according to a single course (e.g., a stone falls). (2) Other motions are

volitional and proceed non-uniformly (e.g., the actions of animals caused by the animal soul). (3) Other motions are non-volitional and proceed non-uniformly (e.g., plant growth caused by the vegetative soul). (4) Finally, there are volitional motions that proceed uniformly (e.g., the motion of celestial spheres caused by celestial souls).

The cause of these motions is nature itself. Ibn Sīnā does not treat them as motions or changes that affect bodies but as motions produced by bodies themselves. Thus, Ibn Sīnā views nature as an active principle that produces motion. Moreover, he explains that there are four kinds of motion: (1) according to quantity (e.g., increase or decrease in volume); (2) according to quality (e.g., alterations in temperature, color, or other properties); (3) according to place (e.g., locomotion and return to 'natural place', that is, a stone moving downward and fire moving upward); and (4) according to position (e.g., the circular motion or rotation of the celestial spheres). Unlike Aristotle, Ibn Sīnā thinks the celestial spheres move with respect to position and not with respect to place: circular motion does not imply changing spatially from one place to another, as rectilinear motion does. Therefore, unlike Aristotle, Ibn Sīnā does not understand circular motion as a kind of local motion.

Finally, according to Ibn Sīnā, there is a principle of motion with respect to the substance (that is, when the form is acquired). In *Metaphysics* 9.5, Ibn Sīnā himself considers that this motion must take into consideration his emanative model. According to Ibn Sīnā's emanative scheme ('emanative' insofar as it is brought about through an 'overflow' of God's generosity), through its self-contemplation, the necessary being (God) causes the existence of a series of intellects. These intellects, through thinking themselves, the intellect above them, and God, cause the existence of subsequent intellects (as well as the respective souls and bodies of the heavens). The lowest of these immaterial intellects, the tenth intellect, is the

active or agent intellect, from which the forms of the sublunary world emanate. This complex— and even exotic to our eyes—model is necessary for understanding the motion with respect to the substance, that is, the process through which material bodies receive their forms. This means, as Ibn Sīnā holds in *Physics* 1.5, that nature has the disposition to acquire its form from elsewhere. In this sense, nature is passive. So, to the question raised earlier of whether Aristotle's principle of motion refers to an intrinsic active principle or a passive disposition toward motion, Ibn Sīnā assumes both: nature is active as long as it is itself the immediate efficient cause of motion; however, nature is passive as long as it has the disposition to become subject to motion.

Physics also deals with the necessary conditions for motion, not just the principles of motion and the kinds of motion. These conditions are place, time, and continuity. Briefly, the place is defined as that in which a body exists, and no other body can exist together with it; thus, the place shall be understood as coextensive with the body. According to this definition, place is the unmovable limit where a body is contained. Like Aristotle, Ibn Sīnā explains that place should not be confused with the void. The void is commonly understood as something that exists between two bodies. Following Aristotle, Ibn Sīnā holds that place does not exist separately from bodies. Therefore, the void—that is, a place where there are no bodies—is something that cannot have a real existence. The place is defined in relation to a body. Therefore, the place cannot be thought of as different from the bodies themselves.

Some theologians, however, argued that the void was necessary for motion to take place. By contrast, Ibn Sīnā argues that there could not be a void between the two extremes of motion. According to Ibn Sīnā, motion must be continuous, contiguous, and successive in time. Thus, he rejects the possibility of the void and discontinuous motion: if the void

existed, bodies would necessarily move to infinity, as in the case of Zeno's paradox: if Achilles wants to catch up with the tortoise, he will need to travel infinite distances; thus, he will never reach the tortoise. In this refutation of the void, Ibn Sīnā uses the notions of time and continuity.

Concerning the notion of 'time', Ibn Sīnā defines it as the measure of motion when it is divided into the prior or the posterior, not with respect to time but with respect to distance. He adds that time cannot be self-subsistent but, rather, exists in matter through the intermediary of motion. Thus, if there is neither motion nor change, there is no time. Every motion or change happens according to before and after. Before and after cannot exist simultaneously. If there were no change or difference involved in a thing's generation or corruption, that is, if there were no difference between the way something was before and how it is after changing, then there would be no time. In other words, time exists only with the renewal of states (from before and after), and this renewal must be continuous. Otherwise, again, there would be no time.

'Nature' According to Ibn Rushd

Ibn Rushd also preserved the Aristotelian definition of nature as the principle of motion and change. However, unlike Ibn Sīnā, Ibn Rushd adhered to Aristotle's view of nature as something self-evident, which did not need to be demonstrated. According to Ibn Rushd, physics aims to investigate the general causes of everything that exists in nature, its general properties, and its causes. With that purpose in mind, he affirms that he will follow Aristotle, who began by defining nature and then explained its first causes, namely, prime matter and the prime mover. Ibn Rushd addresses the idea of prime matter in the first two books of his commentaries on the *Physics*. After discussing the prime matter and the different kinds of motion, in book eight of his *Long Commentary*

on Physics, he provides proofs for the existence of what, following Aristotle, he calls the 'prime mover', showing that efficient and final causes can be considered part of physics and not only as part of metaphysics, as Ibn Sīnā thought.

Ibn Rushd understands 'prime matter' as a physical principle that is neither generable nor corruptible but is the precondition for change (of generation and corruption). As explained earlier, prime matter is pure potentiality and, therefore, can assume any form, given its lack of essential properties. Prime matter needs to be actualized. This actualization takes place because the first mover causes the transformations of matter into simple bodies (the four elements) and the rest of the natural bodies, constituted by the mixture of the four elements. In sum, the complex process of actualizing prime matter leads to the formation of bodies that are matter–form composites. Prime matter remains unchanged as long as it is not subject to generation and corruption.

Those changes are due to the influence of the celestial spheres on the processes that take place in the sublunary realm. The union of matter and form takes place through the eternal and continuous motion of the celestial spheres. That process explains the emergence of corporeal forms, which is matter's most basic determination, its dimensionality (length, breadth, and depth). Through the first transformation of prime matter, simple bodies emerge. These simple bodies are the four elements with their specific properties: fire (hot and dry), air (hot and moist), water (cold and moist), and earth (cold and dry). In the sublunary world, these elements are mixed with each other. These elements cannot reach a state of purity; depending on the proportion of their mixture, the four elements give rise to what Aristotle and Ibn Rushd call 'homoeomerous bodies' (that is, bodies composed of homogeneous parts) that constitute the tissues and organs of the organic bodies of plants and animals.

The four elements are subject to three different kinds of change: locomotion, alteration, and generation and corruption. In addition to these, all other bodies are also subject to growth and diminution. In his three commentaries on the *Physics*, Ibn Rushd examines the Aristotelian distinction between natural beings (characterized by their capacity to move by themselves) and artificial beings (characterized by their need for an external mover). Like Ibn Sīnā, he holds that natural beings have the principle of change in themselves, so nature is an active principle. There is, however, an important distinction between Ibn Sīnā and Ibn Rushd. Ibn Sīnā holds that nature is both active and passive in some respects because it is the recipient of forms provided by the agent intellect. Therefore, metaphysics studies the causal process whereby natural bodies receive their forms. In other words, the study of the efficient and final causes is the domain of the metaphysician. By contrast, Ibn Rushd does not hold that forms are given; rather, they emerge from prime matter itself through the change or motion triggered by the eternal circular motion of the celestial spheres. These spheres, in turn, are moved by their desire for the unmoved mover. Ibn Rushd views the unmoved mover as the final or ultimate cause of the universe.

In the long commentaries on *Physics* and *Metaphysics*, where Ibn Rushd's final and more Aristotelian position can be found, unlike Ibn Sīnā, he does not credit the active intellect with the production of sublunary forms. Rather, natural forms exist potentially in prime matter. Thus, the forms of simple bodies (the four elements) and the forms of compound bodies or homoeomeric compounds are obtained from matter itself through the eternal and continuous motion that triggers natural processes, that is, the transformation of matter. Following Aristotle closely, Ibn Rushd understands motion as the actualization of beings that can move. In other words, bodies have the potentiality for motion. As long as this potentiality

is actualized, motion is understood as the perfection of what is movable. As in the case of Ibn Sīnā, for Ibn Rushd, motion can be divided according to different categories: there is motion according to substance, quantity, quality, and position. Motion itself cannot be placed within any of the categories. Each category constitutes different kinds of motion: increase or decrease in volume, alteration, generation and corruption, and moving from one position to another. According to Ibn Rushd, in its broadest sense, motion is continuous; otherwise, nature would cease to exist. The mature Ibn Rushd of the *Long Commentary on Physics* affirms the eternity of motion. Time is not identical to motion, but it is closely connected with it. Without motion, time would be imperceptible.

Another condition or characteristic of physical bodies is place: bodies occupy a place, and place does not exist separately from bodies. Like Aristotle and Ibn Sīnā, Ibn Rushd understands place as the outer surface of a body. The place should not be confused with empty space or the void. Also, Ibn Rushd denies the possibility of the void.

The Constitution of the Natural World: Atomism among the Mutakallimūn

There were different theories among Islamic theologians regarding the constitution of the material world. In early *kalām*, that is, around the late 8th and early 9th centuries, some theologians thought material bodies were made up of either a bundle of accidents, out of a bundle of interpenetrating material bodies, or out of atoms with their incorporeal accidents. Out of these three positions, among Islamic theologians, the last became the predominant view. Islamic theologians held that God created the world in time and understood 'creation' as a permanent process through which God constantly creates and recreates atoms and accidents. The created world is nothing but the interaction of atoms that depend on God. This

interaction explains the constitution of bodies but also the events and occurrences that take place in space and time.

The theological literature that is most characteristic of Islamic atomism dates from the 10th and 11th centuries. It was produced mainly by the early theological school known as the Muʿtazilites from Basra and Baghdad and by a later school already mentioned, the Ashʿarites. According to these *mutakallimūn* or theologians, a finite number of atoms make up the material bodies in the natural world. Among early theologians, the difference between atoms and bodies was that whereas atoms lacked dimensions, bodies had length, breadth, and depth. The combination of atoms produces the dimensions of bodies. However, there was an intense debate among the Muʿtazilites regarding the number of atoms that were necessary to constitute a body. For most Muʿtazilites, bodies were composed of a finite number of atoms (four, six, eight, etc.). Discreteness was a characteristic applied to atoms, material bodies, space, time, and motion. The number of atoms constituting a body needed to be finite; otherwise, an infinite number of atoms would imply an infinite number of divisions. Most Islamic theologians, except for al-Naẓẓām, completely rejected the existence of an actual infinite number. If there were an actual infinity, something similar to Zeno's paradox would result.

In fact, Abū al-Hudhayl formulated an argument similar to Zeno's dichotomy paradox. If an ant moves along a sandal, to cross the entire sandal the ant would need to first traverse half the sandal. But to traverse half the sandal it would first need to traverse half of the half, and so on. Therefore, the ant would never be able to cross the entire sandal. According to Abū al-Hudhayl, this argument proves that bodies cannot be continuous and composed of infinite parts. Conversely, bodies are discrete rather than continuous and are composed of a finite number of atomic parts. This argument was rejected

by the theological tradition. For instance, al-Naẓẓām (d. 845) rejected it and instead formulated a theory of leaps, according to which the ant does not need to traverse each point of the sandal. Rather, in its path, the ant traverses some points but leaps over others. Al-Naẓẓām, among several theologians, suggested that the division of material bodies into infinite parts was coherent. However, his position was not well received by many other theologians.

In the 10th century, the Persian Muʿtazilite Abū Hāshim al-Jubbāī added spatiality to the notion of the atom. Given their materiality, atoms occupy a place in space. However, atoms have a minimal magnitude. An atom is comparable with the geometrical notion of a point. Points have no parts and, in this sense, are equivalent to indivisible magnitudes or atoms. Since points are indivisible, when a line is defined as the shortest distance between two points, two indivisibles constitute the notion of length. Similarly, bodies are the result of the aggregation of indivisibles, that is, discrete atoms with a minimal magnitude and spatially separated from each other.

It is worth noting how the aggregation of several atoms results in a body. For most Islamic theologians of the 8th and 9th centuries, space itself was also composed of minimal, indivisible parts. However, this was one of the most criticized views of atomist theologians. Many 10th-century theologians, including al-Jubbāī himself, rejected this position. One of the difficulties implied in the notion of space as composed of minimal parts was the existence of the void.

There were different conceptions of space among Islamic theologians. For most Basrian Muʿtazilites, space consisted of the place occupied by a body. The existence of place thus depended on the specific area where a body is situated. However, if a body changed its position or was removed from an area, the space left behind should be considered an empty space or a void. This distinction is relevant: according to some

Islamic theologians, there were two kinds of space necessary for motion to take place. On the one hand, there was 'space', understood as the place that a body occupies. On the other hand, there was 'space', understood as an empty place that could be occupied by a body. These two kinds of space were viewed as contiguous regions that explain motion: bodies occupy a place, but at the same time, they are surrounded by unoccupied space, that is, empty space.

This last distinction was controversial among theological schools. It was defended primarily by the Basrian Muʿtazilites and by the Ashʿarites, whereas most Baghdadi Muʿtazilites rejected the idea of an empty or unoccupied space. The Baghdadi Muʿtazilites argued that there is no void, and space is filled with atoms. Now, if there is no empty space, then space cannot be the empty place that a body could occupy but is, rather, the surface that encloses bodies. These Muʿtazilites were, therefore, closer to the Peripatetic position than other theologians. Aristotle not only criticized atomism but also rejected the existence of the void and the idea of space as something unoccupied by matter. He also held that there is no space without bodies and that, therefore, space is the surrounding surface of bodies. It is evident, then, that among Islamic theologians, there was a discussion regarding the existence or non-existence of the void and the way space should be defined.

The conception of space relates to motion and change. One of the reasons why the Muʿtazilites from Basra argued for the existence of the void was that if there were no empty space between atoms and bodies, motion would be impossible. Given that locomotion is empirically confirmable, that is, that a body can move from one place to another, the void must exist. By contrast, the Baghdadi Muʿtazilites opposed this position, arguing that instead of empty space, there must be air. Therefore, when a body moves from one place to another, this body must occupy the same place as the air. They

considered this possible because they believed air to be a body capable of expansion and compression.

Space and time were both described as relative measures. Moreover, given the discreteness of atoms, both space and time were considered discrete. The notion of space is closely related to the notion of a body. The existence of space is empirically verifiable through observing the behavior of bodies. An essential characteristic of material bodies is that they can move from one place to another; that is, they are subject to motion. Understood as the duration between two events or actions, time is dependent on motion. Among Islamic theologians, time was usually conceived of as 'timing'. To measure time, bodies need to be in motion, and motion can only take place if there is space. Time and space coexist as properties of the physical world; they would not exist if there were no bodies. However, according to most Islamic theologians, time and motion are discrete or discontinuous. In their view, if there were continuity in time and motion, there would be an infinite number of past days and the motions of bodies would be infinite. If time and motion were infinite, this would imply the material world has always existed: given that time is the measure of motion, infinite time implies infinite motion, and infinite motion implies that material bodies have always existed.

Thus, if there were continuity in space, time, and motion, then the conclusion that the world perpetually exists and has perpetually existed would be correct, as Aristotle and the Peripatetic philosophers argued. However, most Islamic theologians argued that the world was created in time. Thus, through their atomistic conception of the material world, they tried to prove that the world and its constituents were not infinite in themselves but depended on divine agency, that is, on God's creative act. As shown, this position led these theologians, especially some Ashʿarites, to defend hard determinism and sometimes occasionalist positions, which down-

played—and, in some cases, altogether denied—the idea of natural causality.

Islamic Philosophers Against Atomism

Islamic philosophers disagreed with the atomistic views of the theologians. Ibn Sīnā formulated one of the most devastating criticisms of atomism. Again, his approach was heavily dependent on Aristotle's philosophy of nature. Ibn Sīnā defined natural bodies as substances with length, breadth, and depth. Instead of proposing an atomistic structure for material bodies, he argued, following Aristotle's hylomorphism, that each body is fundamentally constituted by two internal principles, namely, form and matter. Ibn Sīnā's arguments against atomism attacked the idea that the aggregation of parts cannot constitute a natural body. Some of these arguments were mathematical and others were physical, and they are extremely complex. At the risk of simplifying too much, the core of his arguments is that the coherence of understanding how the aggregation of atoms gives rise to composite bodies is problematic. Atomist theologians held that atoms were the smallest parts (or minimal parts) that existed next to one another without touching one another. Ibn Sīnā held that, according to Islamic theologians, there is always empty space, or void, left between these particles when they come together. Therefore, it would be impossible to explain how the aggregation of these particles, which are separated by a void, results in solid, composite bodies.

If atoms are separated by void, this means that bodies are divisible, and it is not entirely clear how separated atoms A, B, and C come together. Thus, proposing that A, B, and C are contiguous or continuous does not solve the problem of their separation. If one assumes that there is a thing, x, by virtue of which A and B are in contact, and another thing, y, by virtue of which B and C are in contact, then there would

remain a separation between the middle parts, x and y, and A, B, and C. Thus, the existence of composite bodies, as perceived empirically, would remain unexplained. The only alternative is to hold that atoms interpenetrate one another. If this were the case, then composite bodies would never be larger than a single atom. Even explaining this hypothesis about how the parts of composite bodies come together runs into problems. If two or more parts (or particles) come together, each particle has the power to move and exert motion on the others, and this would generate friction between them. This friction between two particles, even if mediated by a third particle, would prevent the particles from uniting with each other. This shows that, in fact, the composite body would be ultimately reducible to each of these particles. There would be no way to account for the existence of composite bodies.

Even after Ibn Sīnā's critics, several Ashʿarites emphasized the discontinuity and atomistic structure of nature to justify God's continuous action in the natural world. God creates atoms and maintains their union; thus, humans perceive nature as solid and continuous, even though composite bodies are inherently discontinuous. Whereas Ibn Sīnā thought the Islamic theologians had failed in their attempt to explain how the aggregation of atoms gives rise to composite bodies, the Ashʿarites did not see this process as impossible. They held that God creates and renews the world constantly without Himself being subject to any kind of physical or metaphysical law: in other words, God is omnipotent.

In his work *Uncovering Methods of Proofs with Respect to the Beliefs of the Religious Community*, as well as in *The Incoherence of the Incoherence*, Ibn Rushd criticizes the Ashʿarite positions about creation and their understanding of natural bodies as composed of indivisible particles or atoms. Ibn Rushd defends Aristotelian hylomorphism and the

continuity of nature. He holds that God is the cause of the motion of the first heaven or sphere of the fixed stars and the celestial spheres. God moves the first heaven, that is, the first moved and first mover, by way of desire. In this sense, Ibn Rushd admits that God does act in nature, but not in the same way the Ashʿarites thought. Although nature is a product of God, it is something apart from Him and is ruled by natural laws. Ibn Rushd believes the Ashʿarites reduce nature to practically nothing by holding that it is intrinsically discontinuous and that it depends absolutely on God.

Islamic Philosophers and the 'Minima Naturalia'

The main tension between Islamic atomism and the philosophical positions of Ibn Sīnā and Ibn Rushd comes down to this: while atomism assumes a discontinuous conception of nature, the philosophers argue for the continuous structure of nature. Viewing nature as a continuum implies that it can be infinitely divided. Now, as Aristotle himself argued in his *Physics*, an actual infinity is impossible. Unlike mathematicians, both Islamic philosophers and theologians agreed with Aristotle on this last point, but they formulated different responses. On the one hand, as explained, the theologians conceived of atoms as indivisible and, thus, as having no parts. According to Islamic atomists, composite bodies are made up of discrete or discontinuous atoms. On the other hand, the philosophers formulated a different response to the problem of the impossibility of actual infinity. Ibn Sīnā and Ibn Rushd adopted a position not very far from atomism, namely, the Aristotelian doctrine known as *minima naturalia* (literally, 'the smallest natural things'). According to this doctrine, bodies are conceptually divisible to infinity, but physically, there are limits beyond which they cannot be divided. In this sense, although Ibn Sīnā and Ibn Rushd disagree with the Islamic atomists, they agree that

physical bodies cannot be divided to infinity. While atomist theologians postulated the existence of an indivisible particle (atom), the philosophers postulated the existence of the smallest or minimal particle.

The doctrine of *minima naturalia* appears in Aristotle and his commentator John Philoponus. It is usually assumed that this doctrine was developed primarily by the Latin scholastics. However, a few scholars working in Islamic philosophical texts have noticed that Ibn Sīnā and Ibn Rushd made important contributions to a theory that is still a matter of debate within contemporary scientific and philosophical literature. According to this doctrine of *minima naturalia*, bodies are compounds of minimal parts that are not infinitely divisible. These minimal parts can be divided, but at a certain limit, they become parts or components of a different body. In *Physics* 1.4, Aristotle introduced the notion of *elachista* (the smallest, or *minima*, in Latin) to explain that natural bodies, like flesh, blood, bones, etc. have a definite limit regarding their size. This means that a body, for instance, an animal, will grow or decrease in the way it is determined by both its matter and its form.

The doctrine of *minima naturalia* assumes that bodies are matter–form composites. Matter has a qualitative disposition that is suitable to the given form. If a body is destroyed and thus loses this qualitative disposition, then the form can no longer be preserved in that body. For example, if a bone is destroyed, it will lose its qualitative disposition and, thus, it will not remain a bone. The smallest physical quantity that was part of the bone will acquire a different form. In other words, the minimal part of the bone will still remain a part of the bone until it becomes something else: dust, for example, which mingles with the dirt in the ground. The smaller the part of a body is, the more vulnerable it becomes to the influence of the surrounding bodies.

In fact, minimal parts can become so small that they become incapable of counteracting the effect that surrounding bodies exert on them. Therefore, there comes a point where minimal parts become identical to the surrounding bodies, and thus they lose their previous form. This is precisely what would happen in the case of a bone that is destroyed or disintegrated until it mingles with the dirt in the ground.

Although Ibn Sīnā and Ibn Rushd rejected theological atomism, they ended up developing a similar physical theory. Whereas the theologians posited atoms, the philosophers posited indivisible minimal parts. There is a difference, however. Theologians thought atoms were conceptually and physically indivisible. Yet the philosophers held that minimal parts were conceptually divisible to infinity, but not physically. They said there were physical limits beyond which the smallest parts could not be divided; beyond that point, they became integrated into other bodies.

As can be seen from the different sophisticated approaches to the study of nature I have explained here, Islamic intellectuals were deeply interested in understanding nature, its structure, and processes. The theologians conceived nature as an effect of the divine will, and therefore as absolutely dependent on it, thereby diminishing natural causality. By contrast, the philosophers, strongly influenced by the science of their time, i.e., Greek science and especially Aristotle, sought, without discarding the idea of God as the author of nature, a systematic explanation of nature in which the philosophical notion of causality was preserved. While each of these approaches is in contention with the other, both formulate powerful arguments that continue to arouse debate. The questions they asked were the right ones and are still valid today: does nature possess an intrinsic principle of motion, or does it require an external agent? Are causal models still effective in explaining physical and natural processes?

What is matter? What is a living being? Although the scientific-philosophical model on which they built their answers has been left behind, the way they posed their questions and the answers they formulated are still exemplary.