

Avicenna on heat and electricity

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Annotation. The article briefly reveals some of the views of the famous medieval scientist-encyclopedist Abu Ali ibn Sina (Avicenna, 980-1037) about acoustics in Physics. Based on the study of natural sciences from the physical part of the treatise "Sawdust of Nature" ("Kurozai Tabiyet"), specially dedicated to acoustics. It is characteristic that it is in this treatise that Avicenna treats some problems of acoustics from the point of view of the "science of nature" Physics" of that time.

One of them, a long one, which played an important role in the development of the theory of motion of a falling body and a body thrown at an angle to the horizon. This discussion took place between Ibn Rushd (Averroes) and Ibn Bajji (Avempas). In this discussion, the problem of the possibility and nature of the movement of the body in the void was also discussed.

The article has an interdisciplinary character, written at the junction of the subject of physics and history, taking into account historical and scientific analysis.

Keywords: physics on heat and electricity , natural sciences, analogy with pyrrhine mechanical motion, history, civilization, Sawdust of Nature , statistical electricity, Reasoning about the causes of thunder, small discharges, violent movement, Averroes (Ibn Rushd), and Ibn Bajji (Avempas), Abu Ali ibn al-Haysam, Aburayhan Beruni , Ibn Sina (Avicenna)

Abu Ali Husayn ibn Abdallah ibn Hassan ibn Ali ibn Sina (Avicenna) was born on August 16, 980 in the village of Afshana near Bukhara. His father Abdallah was from Balkh (now in Afghanistan). He was an educated man, interested in philosophy, science and theology. During the reign of Nuh ibn Mansur, Sama ni Abdallah moved from Balkh to Bukhara, where he served as an official in the finance department. Being on official business in the village of Afshana, Abdallah married a girl named Sitora. Ibn Sina (Avicenna) and his brother Mahmud were born here. In 986, the family moved from Afshana to Bukhara.

Great scientists with world-famous names - representatives of science and culture - like bright stars illuminate the path of all mankind. They are the founders of world civilization, and that is why they belong to all peoples and nations.

Avicenna's idea of the nature of heat and electricity is reflected mainly in his scientific correspondence with Aburaykhon Beruni [33], the treatise "Sawdust of Nature" [34], as well as in the treatise "Reasoning about the causes of thunder" [36].

Scientific correspondence as a form of scientific discussion has always played an important role in the history of science, continuing in fact to the present day from the correspondence of Archimedes to the correspondence of Bohr and Rutherford and other famous scientists of modern times. In the history of medieval science, scientific correspondence played a very important role, actually replacing direct contacts between scientists. There are two major debates in the history of physical and mathematical sciences in the Middle Ages. One of them, a long one, which played an important role in the development of the theory of motion of a falling body and a body thrown at an angle to the horizon. This discussion took place between Ibn Rushd (Averroes) and Ibn Bajji (Avempas). In this discussion, the problem of the possibility and nature of body movement in the void was also discussed [65, pp.159-169].

The second discussion of no less importance in the history of science is the scientific correspondence between Avicenna and Aburayhan Beruni about the writings of Aristotle in the form of questions and answers. Their correspondence discusses fundamental natural philosophical and physical problems of that time. We know Aburayhan Beruni's eighteen questions about Aristotle's "Physics" and "The Book of Heaven" and Avicenna's answer to them [33, pp.363-388].

Let's consider one of these questions concerning the idea of heat, although this correspondence also deals with other problems: the essence of motion, geometric optics, mechanics, mathematics, etc.

In his seventh question regarding Aristotle's "Physics", Aburayhan Beruni asks: "If bodies expand from heat and contract from cold and, due to the first reason, perfume bottles and other things burst, then why do the vessels in which the water froze burst and break?".

Avicenna's answer: "The essence of your question is the answer to it. If the body expands under the influence of heating and requires more space, which causes the bottle to burst, then also the body, which will shrink under the influence of cold, will take up less space, almost carrying out emptiness in the vessel. This change causes the vessel to rupture and causes it to burst. There are other causes of this phenomenon in nature, but the fact I have cited is most common. Thus, our words contain a sufficient answer" [33, p.387].

We see that both of them, in fact, correctly understood the problem of thermal expansion of bodies. The problem of heat and its nature is also considered in the philosophical part of their correspondence [33, pp.365-381].

It is this question – splitting the jug in winter, when the water freezes in it, is also considered in the fourth part of the treatise "Sawdust of Nature" [41]. But in Avicenna's "Sawdust of Nature" this question is answered in more detail and a little differently. Consider this question from the fourth chapter of the fourth section "Sawdust of nature". Because cold is the cause of the separation of parts of a thing that consists of a single substance, and the connection of parts of a thing that consists of different substances. Consequently, cold separates parts of the water when it freezes. For this reason, the body of water becomes porous, and its volume increases. It [will] not fit in the jug, and for this reason it will split it. The proof that cold separates parts of water is that when water freezes, it becomes lighter than in its original state. The proof that [water] becomes porous is that when ice is lowered into the water, [it] floats in the water, since [water when frozen] becomes lighter. Therefore, the reason for splitting the jug when the water freezes in it is clear.

It should be noted that we are talking here, apparently, about a clay jug, since it is the pottery that bursts due to this effect. Although metal jugs also existed in the Middle Ages, clay was the main material for making dishes. Avicenna agrees with the explanation of the expansion of the object during heating and its compression during cooling. This is evidenced by his scientific correspondence with Aburaykhon Beruni in relation to Aristotle's "Physics".

And he explains the essence of this issue in such a way that because of the cold, water particles, since they are homogeneous, move away from each other, and its volume becomes larger. This is the reason for the cracking of the jug.

The treatise "Sawdust of Nature" also contains such an interesting question concerning the theory of heat and electricity. For example, in the first chapter of the fourth section, Avicenna examines the cause of a spark popping out by rubbing against a clean washed robe. Speaking of a clean, washed robe, one should, of course, keep in mind a silk robe, since it is the friction of silk that leads to the appearance of sparks. It should be noted that in the Middle Ages in the era of Avicenna, the essence of electricity was not known. Therefore, he could not give a modern explanation of the phenomenon in question. But, nevertheless, he correctly saw the reason for the appearance of sparks in the friction process.

It is known that a spark appears as a result of contact and subsequent friction of dissimilar bodies. One contact does not yet lead to the appearance of sparks. When rubbing [repeated contact] on a clean silk robe, its matter is electrified, a process of accumulation of a statistical electric charge occurs, as a result of which "small discharges" - sparks appear.

Thus, Avicenna to some extent correctly explained the reason for the appearance of sparks, i.e. "statistical electricity".

In the fourteenth chapter of the fourth section of "Sawdust of Nature" Avicenna tried to explain the cause of thunder and lightning, rain and hail, the difference between spring and winter clouds [41]. He devoted a special treatise on these problems, i.e. on the causes of thunder, entitled "Reasoning about the causes of thunder" [36, pp.212-215]. This treatise, along with the treatise "Sawdust of Nature" with some brief explanations, was first translated into Russian in full by the author us [41; 40; 42], which we will place as an appendix in this work (see appendices).

From the treatise "Reasoning about the causes of thunder" and "Sawdust of Nature" it is clear that Avicenna correctly understood and explained the problems and issues of electrification of heterogeneous bodies and the representation of heat. Of course, there are some moments that say that these problems are explained more

than a thousand years ago. Despite this, some of his explanations of natural phenomena have not lost their valuable significance so far.

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