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HISTORY OF THE FORMATION OF OPTICS

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ABSTRACT

The article is devoted to the history of the formation of optics as a subject and its aspects of development as well as national research on the phenomena of the properties of light. Optics is the study of the propagation, absorption, scattering of light, its application in technology and practice, and the role of light in human vision. Historically, many scientists have worked on this. First of all, Plato (429-347 BC) put forward the idea that "a special" fluid "comes out of the body and meets the soft fluid that comes out of our eyes, and if the two fluids are similar, our eyes can see."

KEYWORDS: *Sun, light, optics, convex mirror, lenses, vision, dispersion, rainbow, catoptrics.*

INTRODUCTION

Optics is the study of the propagation, absorption, scattering of light, its application in technology and practice, and the role of light in human vision. Historically, many scientists have worked on this. First of all, Plato (429-347 BC) put forward the idea that "a special" fluid "comes out of the body and meets the soft fluid that comes out of our eyes, and if the two fluids are similar, our eyes can see." Otherwise, our eyes will not be able to feel things,"he said. These ideas of Plato come close to the conclusions of modern science. That is, the limit of human vision corresponds to the area where the wavelength of light is l = 4000-7000 angestrem. Rays with <4000 A0 are called ultraviolet rays, and rays with wavelengths greater than >7000 A0 are called infrared rays. Our eyes cannot feel these rays. They contain white light.

Euclid (330-275 BC) took a new approach to the science of optics. Euclid wrote works on the study of light phenomena called Optics and Catoptrica. He explains the phenomena of optics on the basis of geometric principles. His first postulate was: "The rays of light from the eye travel in a straight line." He determined that the direction of propagation of light could be tilted to a certain angle by showing it by the laws of geometry.

The second postulate: "The image produced by the rays from the eye is conical, the height of the cone is in the eye, and the base is in the body."

Euclid explains the formation of shadows by creating images of objects under the influence of light using more than 10 postulates. He showed that in Catoptropica the image is formed in flat and spherical mirrors. In Catoptropics, Euclid cites experiments on the refraction of light. If we put a smaller item on the bottom of a container and bend it until it is no longer visible and the container is filled with water, the item will appear again.

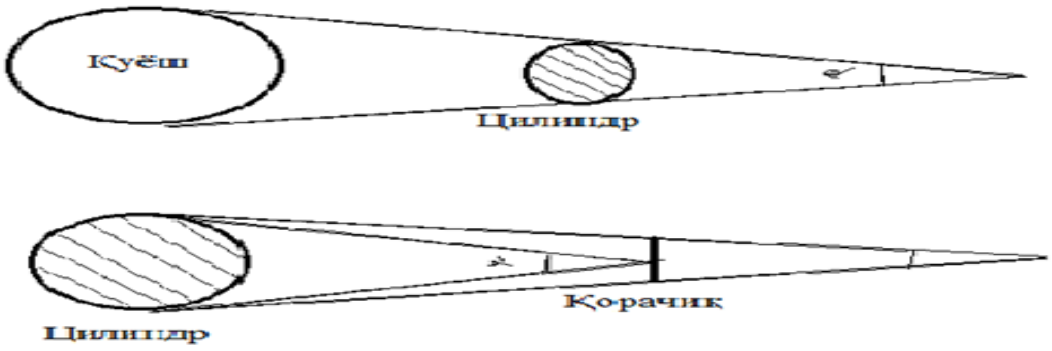
He says that "it is possible to create a flame with the help of sunlight with a sunken mirror." Thus, Euclid lays the foundation for modern geometric optics and demonstrates its practical application.

It was explained by Ptolemy (100 BC) and his disciples that a special substance, "fluid" light, falls out of the human eye into substances and is felt by our eyes. Others argue that light is emitted by objects or that it falls on our eyes and evokes sensations. Claudio Ptolemy learned through many experiments that light could pass through mirrors and water. In determining the results of the experiment developed a special device (divided into 360 parts) consisting of a metal disk. Using this device, he was able to show the direction of light propagation and the angle of deflection.

Observing the return of light from a mirror, Geron (I-II centuries) confirmed geometrically that the angle of incidence is equal to the angle of return relative to the normal held, and that light can intersect when it hits the mirror. Heron's experiments were confirmed by Fermat's theory, which developed the equations of the law of return after 1,500 years. GeronAlexandriusky, a geometric optician, also observed the reflection of light from a mirror according to the laws of catapult. According to the principle of Geron, the answer to the question: "Why does light fall on our eyes, return from the mirror, why does it move at an angle?" It is confirmed that our vision is directed in a straight line. The speed of our vision cannot be changed depending on the direction of vision.

As long as the light falls on our eyes, Geron continued, even if we open and close our eyes, the light will continue to direct itself.

In the later stages, Archimedes (287-212 BC) worked on the optics department. Archimedes can answer many questions in the field of optics. He observed experimentally that the sun's light moves at an angle [2]. Depending on the location of the sun, he observed and studied the fall of light and its effects on the eye. It is difficult to obtain an exact size when determining the size of the sun, either by eye or when using an instrument. Archimedes uses a ruler to determine length in his experiment. A metal disk is placed in the path of light coming from the sun. As we can see with the naked eye, the point where the light joins around the disk is at the end of the ruler. He conducted experiments to determine the diameter of the visible part of the Sun through the enlargement and contraction of the pupil of the eye.



1-расм. Архимед усули билан қорачиқни ўзгаришига қараб катталикни ўлчаш методининг схемаси

Aristotle (384-322 y.e.a.) in his theories considered that light is visible and that over time it propagates along a straight line.

Plutarch (46-126 yy) observes the direction of light, the return of the Moon, that is, the rays coming from the Sun fall on the Moon and return from it. He argues that this process is completely

contrary to the laws of reflected light.

Democritus hypothesized that light had a corpuscular nature according to the theory of Epicurus (341-270 BC). The nature of light explained its division into several parts.

S.I. Vavilov (1891-1951) studied the history of optical systems analytically. He found that the vision of the eye includes both central and decentralized objects. Astronomer Hipparchus was also involved in observing the direction of these rays.

S.I. Vavilov analyzed the interaction of internal and external rays in ancient research. He improved Plato's theory. According to Plato's theory, it describes the ability to see and process as a mental accent. SI Vavilov explains that in ancient studies he put forward 6 different ideas of light [1]:

1. Theory of visual rays;

2. Democritus and Epicurus' figurative return - the theory of the trace of light in the air;

3. The interaction of internal and external rays, the interaction of external and visual rays - Plato's theory;

4. Aristotle's theory of the transition of light from transparent media;

5. The theory of the propagation of light by air tension, that is, the theory that the rays generated by it in the air reach objects, not the rays emanating from the source;

6. Psychological light exposure from a distance (tempo);

Ibn al-Haytham (965-1040) wrote the "Treasure of Optics", which consists of 7 books ("Sokrovishcheoptiki") on the basis of the fundamental laws of optics. In doing so, he mainly advanced the law of light scattering and scattering along a straight line. Visibility is also determined by the size of the objects visible under the influence of light. His book "Optics" consists of the following parts:

- Eye and vision problems (eye anatomy, glare);

- Developed an optical instrument and was able to capture images of the Sun and the Moon;

- Studied the reflection of light from flat, spherical, cylindrical, conical mirrors;

- Determined the height-thickness of the atmosphere;

- Observing the direction of movement of the light, the first states that it moves parallel, the others perpendicular;

- Light transmission in a transparent environment;

- The problem of refraction of light;

- Checked the distribution of light from independent sources;

- Considers that light is composed of particles. Explained the law of return of light;

- Studied the laws of refraction and refraction of light in degrees and minutes in practice. He developed formulas for the law of refraction and showed that light can be in the same plane in the laws of rotation and refraction, relative to the normal transferred to a mirror;

- Magnification of a flat convex lens, determined that it depends on the distance to the object;

- showed the formation of a rainbow in his book "Treasure of Optics";

In the twelfth century, Ibn Al-Haytham's Latin textbook, Optics, was published in Europe. He is the author of the treatises "Light of the Moon", "Rainbow and the View" [1,2,3]. He was called Alhazen in Europe and was recognized as the founder of Optics after Ptolemy. S.I. Vavilov says

Alkhazen's books on optics were taught as a special course at European universities in the Middle Ages.

Beruni (973-1048) and Ibn Sina (980-1037) made scientific predictions as early as the tenth century, which puzzled world scholars until the twentieth century. Beruni, in his book Monuments of Ancient Peoples (Beruni was 25-26 years old at the time of writing), discusses this issue as follows. "There's been a lot of talk about sunlight," he said. Some say that this light is a fiery particle similar to the Sun itself, coming out of the Sun's body, while others say that the air is heated by the Sun as it is when it is exposed to fire. This means that the Sun is as hot as fire. There is also disagreement over the movement of sunlight. ”

Some say that light is timeless because it is not a body, while others say that its time is fast, that there is nothing faster than it, and therefore the speed of light propagation cannot be felt. For example, the motion of sound is heavier (slower) than the motion of light, and the process by which light is compared to it is propagated.

As for the cause of the temperature of sunlight, some say that it is light, while others have pointed out that the light is the cause of the sharpness of the opposite angles. In fact, the light itself has a temperature, says Beruni.

Beruni's statement about the nature of light is particularly noteworthy: "Particles of the solar body and the approach of a wave to its radiance are among the first causes of the Earth's temperature (heat)." These words of the great scholar, unlike Newton and Hugens, laid the groundwork for a new scientifically based conclusion in the twentieth century.

The following question addressed by Beruni to his contemporary Ibn Sina is noteworthy: "If heat (light radiates from the center, then why is it a light substance or a property of the Sun?)". Alloma raises two important issues through this question. First, Beruni, Aristotle, Ptolemy, and their followers contradicted the geocentric theory that the Earth is at the center of the universe, and the whole universe revolves around the Earth. He also wants to know his thoughts.

Ibn Sina confirms Aristotle's view of sunlight by refusing to dissipate heat from the center.

In the available literature, it is noted that the reasons for the refraction of light, the magnification of images using a lens, were first illuminated by the English scientist Bacon. It is also said that Bacon (1561-1626) was one of the first to notice and record the enlarged appearance of the letters when viewed through a round clear glass. However, the questions and answers of Beruni and Ibn Sina before Bacon on this subject have reached us.

In his letter, Beruni raises the following question: “When a white, round, clear bottle is filled with clear water, its burning is like the burning of a round stone. If the bottle is emptied of water and filled with air, it will not burn and will not collect sunlight. Why is that? That is, how does the power of burning and the power of collecting sunlight appear in a glass of water?”

Ibn Sina answered this question as follows: “Of course, water is a thick, relatively heavy, dense, clear body with a color in its essence. Light is reflected (refracted) from anything of this quality. This is why light is reflected in a round bottle filled with water. Burning power arises from the accumulation of light. But the light is not strongly reflected in the air. Because the air is relatively gentle and sparse. Therefore, if that round glass is filled with air, there will be no strong reflection in the glass. Indeed, light changes its direction when it passes from a low-density medium to a high-density medium (in clear parts) or, conversely, when it passes from a high-density medium to a low-density medium. In physics, this phenomenon is called the refraction of light.

When parallel rays pass through a convex lens, these rays are concentrated at one point and have the power to burn. This point is now called the focal point of the lens. If we compare the above-mentioned views of Beruni and Ibn Sina with the laws of modern physics, we will be convinced

that our ancestors were absolutely right in this matter as well.

Beruni asks Ibn Sina the following question in order to find out his opinion on seeing and the reasons for seeing: “What is perception through sight? Is the water smooth and shiny?”

Ibn Sina answered Beruni's question as follows: “According to Aristotle (384-322), vision is not a loss of clarity. It is the word of Plato to say that vision is a vision. There is no difference between the two opinions when the words of Plato and Aristotle come together. Of course, Plato made this point as absolute and general as it is considered a program for many. Master Abu Nasr al-Farabi explained and clarified in his book that there is no difference between the two words, his suggestion that the opinions of the two rulers (i.e. Aristotle and Plato) be united. But according to Aristotle, seeing with the light of the eye is the effect of the natural moisture inside the eye. It adheres to the delicate, clear level of moisture inside the eye, which is able to transform into all colors, the receiver of colors. It is appropriate to transfer the eyeball of the colors as the light that transmits the type of color is exposed to the object. Natural skin goes from the first round to the second, which is a delicate sheer with moisture and is affected by color. When this moisture passes from one type to another, it becomes a vehicle because the power of sight is not felt.”

It is clear from the answer that although Ibn Sina considered Plato's statement about the causes of vision, that is, "Sight is the perception of light," to be general, he mostly interpreted Aristotle's opinion and relied on his ideas.

In his major works, Physics and the Laws of Medicine, Ibn Sina clarified the matter: Can the light from our eyes illuminate the whole world? ” rejects Plato's view. This is a characteristic of even Galileo, who developed Plato's view: "When you look in the mirror, you see the reflection of the rays radiating from you in the mirror, and when the rays from the same eye fall on the objects, we see them."

Ibn Sina explains that the main causes of vision, on the contrary, occur as a result of the rays coming from objects falling on our eyes and refracting them through the cornea, and then appearing on the retina of the eye.

Ibn Sina devotes a chapter from the third part of the Laws of Medicine to the anatomy of the eye. In this section, he covers many issues such as the structure of the eye, the causes of vision, vision with two eyes, and the separation of colors.

In his book Physics, Ibn Sina considers that the reason for the shrinking of distant objects is due to the reduction of the angle of view, and even cites manual evidence. The play also explains the phenomenon of dispersion and the causes of radiation around the Moon on a scientific basis. According to him, the reason for the rainbow phenomenon is that the light rays coming from the Sun are separated into colored rays as they pass through the clouds in the atmosphere. The reason it is arc-shaped is because of the spherical nature of the Earth's atmosphere.

The formation of a beam around the Moon occurs in the field of view due to the fact that the rays coming from the Moon fall on the cloud particles in the Earth's atmosphere and return from it as if from a mirror and the illuminating source (Moon) is about the same distance from the Earth's atmosphere. Hence, Ibn Sina states both issues based on his own scientific observations and not on various myths.

Ibn Sina wrote a book called A Treatise on the Stars in response to Amir Sultan MuazzamGhiyasiddin's questions about whether the stars are visible at night and not during the day. The pamphlet consists of three parts, in which it is emphasized that the reason why the stars are visible at night and not during the day is due to the strong or weak illumination of the observer's position [7].

In conclusion, the history of the study of light phenomena is several thousand years old. The

research work of Asian scholars, in particular Al-Haytham, Beruniand Ibn Sina, in the study of the stages of development of light scattering, scattering, absorption and processes in it is of great importance in the formation and development of the science of optics.

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