PHILOSOPHICAL SIGNIFICANCE OF ABU RAYHAN BERUNI'S VIEWS ON ENGINEERING KNOWLEDGE

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Annotation: *This article examines the renaissance of engineering and exact sciences in the medieval Eastern world during the Arab Caliphate period. In particular, Abu Rayhan Beruni, along with his engineering views, stated that he made an important contribution to the development of such sciences as chronology, astronomy, geography, geology, geodesy, astronomy, physics, botany, mineralogy, ethnography, and history.*

Keywords: *optics, "Houses of Wisdom",earth meridian, cylinder, "impetus" "conical structure" Euclid's "Elements," Ptolemy's "Almagest," "Mineralogy," "India"*

ФИЛОСОФСКОЕ ЗНАЧЕНИЕ ВЗГЛЯДОВ АБУ РАЙХАНА БЕРУНИ НА ИНЖЕНЕРНОЕ ЗНАНИЕ

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Аннотация: *В статье рассматривается возрождение инженерных и точных наук в средние века на Востоке в период Арабского халифата. В частности, утверждается, что взгляды Абу Райхана Беруни на инженерное дело способствовали развитию таких наук, как хронология, астрономия, география, геология, геодезия, физика, ботаника, минералогия, этнография, история.*

Ключевые слова: *оптика, «Дома мудрецов», земной меридиан, цилиндр, «импетус», «конический прибор», «Начала» Евклида, «Альмагест» Птолемея, «Минерология», «Индия».*

ABU RAYXON BERUNIYNING MUHANDISLIK BILIMLARIGA OID QARASHLARINING FALSAFIY AHAMIYATI

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Annotatsiya: *Mazkur maqolada Sharq olamida o‘rta asrlardagi muhandislik va aniq fanlarning Arab xalifaligi davridagi ilm fandagi uyg’onishlar ko‘rib chiqilgan. Xususan Abu Rayxon Beruniy muhandislik sohasidagi qarahlari bilan brga uning xronologiya, astronomiya geografiya, geologiya, geodeziya, astronomiya, fizika, botanika, mineralogiya, etnografiya, tarix kabi fanlarning rivojlanishiga muhim rol qo’shganligi bayon qiligan.*

Kalit so‘zlar: *optika, “Donishmandlar uylari”,yer meridian, silindir, “impetus” “konussimon qurilma” Evklidning “Elementlar” , Ptolemeyning “Almagest”, “Minerologiya”, “Hindiston”*

ENTRANCE

The peculiar culture of the caliphate period, which rapidly strengthened in the countries of the Muslim East from the 7th century onwards, continued on the basis of the traditions of scientific thought of the Middle East and the Hellenistic period. The achievements of scientists and engineers of the Hellenistic period contributed to the further development of medicine, astronomy, and mathematics. Manuscripts of Aristotle, Euclid, Archimedes, and others, translated from ancient Greek into Persian and Arabic, later served as a source for translating into Latin. Also, Eastern scholars translated the works of Greek philosophers and wrote commentaries on them. For example, Abu Nasr Farabi's works on the works of Aristotle were well-known and famous. Many works of ancient mechanics have survived to this day only in Arabic. According to V. Gorokhov, in the Middle Ages, the works of scholars and translations of ancient authors from the countries of the Muslim East reached Europe through the Caliphate of Spain (Cordoba), Sicily, and Byzantium.[23]

The reign of Caliph Harun al-Rashid (763 or 766 - 809) marked the beginning of the first comprehensive renaissance in the Muslim Eastern world. The emergence of this renaissance was influenced by other cultures. Important relations have been established with India and China. By the end of the 9th century, Baghdad, the capital of the Caliphate, became a center of science and enlightenment in the world. Here, under the special patronage of the Caliph, the "House of Wisdom" was opened. A large group of scholars, translators, and calligraphers were engaged in translating scientific treatises from Greek and Syriac into Arabic. In the initial stages, most of the translations were carried out by foreign scholars. Caliph Harun al-Rashid actively supported scholars who not only studied Greek but also translated Greek philosophical and scientific works. He sent people to the West to buy Greek manuscripts. It is known that since most scientific works of this period were written in Arabic, Eastern science is usually called Arabic science. In particular, the 9th-11th centuries marked the flourishing period of science in the Muslim East. By this time, public libraries, particularly "Houses of Wisdom" and educational institutions, had opened in Baghdad, Cairo, Damascus, Ray, Gurganj (Urgench), Bukhara, Ghazni, Samarkand, and other cities.

[23] Горохов В. Г. Знать, чтобы делать: История инженерной профессии и ее роль в современной культуре. – М.: Знание, 1987. –С.30.

MAIN PART (RESULT AND DISCUSSION)

Naturally, the development of mathematics and geometry in the countries of the East served as the basis for the development of engineering knowledge. After all, it is impossible to imagine engineering activity without calculations and measurements. During this period, the development of engineering mechanics began with the creation of the theory of "impetus" (Greek: *impetus*, impulse) - the "driving force." The foundations of this theory were laid by the Alexandrian scholar John Philoponus (c. 490-570). At first glance, the impulse seems to be an analogue of the body's momentum. But in reality, this is not a vector quantity, but a scalar quantity, and the theory of momentum is an attempt to reconcile Aristotle's explanation of the causes of mechanical motion with practice. The study of mechanics in Islamic countries began with the translations and commentaries of ancient authors - Aristotle, Archimedes, and Heron, and later followed the same directions. In the works of Ibn Sina and Beruni, the theory of "impetus" is further developed.[24]

According to Ibn Sina and Beruni, "natural" and "forced desire" cannot coexist simultaneously. The body moves under the influence of the "forced desire" until it is tired of the influence of the external environment. After this, it immediately stops for a moment and, under the influence of "natural desire," begins to move, i.e., descends vertically. Thus, according to Ibn Sina's theory, at one point in the trajectory of a thrown object, the force of gravity does not act on it. It can be said that this theory played an important role in the engineering activities of that and subsequent periods.

Of course, the scale of scientific and educational development in the Muslim East was much broader. During this period, scientists began to develop experimental, i.e., experiential science, which had a priority significance in the formation of engineering activity. In particular, our compatriot scholar Abu Rayhan Beruni determined the density of metals and other substances using his "conical device." Beruni's "conical structure" was like a vessel that narrowed upward and ended with a cylindrical "neck." A small round hole is made in the middle of the neck, to which a curved tube of the corresponding size is glued. Water is poured into the vessel. Pieces of metal, the density of which is being determined, were lowered into a container with water through a curved pipe equal to the volume of the metal being studied. The "neck" was quite narrow (as wide as a little finger). The rise of water was noticeable even when changing the weight equal to the volume of a millet grain. After a series of experiments, the pipe itself was replaced with a new one. Then water flows through it, and the density of the metal or substance is determined. According to Beruni's measurements, the density of gold converted into modern units of measurement was 19.5 and mercury was 13.56.[25]

Al-Biruni observed and described the change in the Moon's color during a lunar eclipse and the phenomenon of the solar corona during a total solar eclipse. He put forward the idea of the Earth's rotation around the Sun and considered the geocentric theory very weak. He wrote a comprehensive work about India and translated Euclid's "Elements" and Ptolemy's "Almagest" into Sanskrit.

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[24] Sagdullayev A.S. O‘zbekiston tarixi. I kitob. - Toshkent: «Donishmand ziyosi». 2021. –B.43

[25] Abu-Rayhon Beruniy. Minerologiya. Toshkent - 2017 yil. –B.196.

Beruni's circle of interests was very wide. Mathematics, chronology, astronomy, geography, geology, geodesy, astronomy, physics, botany, mineralogy, ethnography, history. In astronomy, along with the geocentric system, Beruni also recognized the heliocentric system. To solve cubic equations, Beruni used the test method. His thirst for knowledge appeared very early, and even in his youth, he was closely connected with the scientific circles of ancient Khorezm. According to his testimony, at the age of 21-22, he "made astronomical measurements using a circle with a diameter of 15 cubits and other tools necessary for this."[26] At this time, a coup d'état took place in Khorezm, and after living in a foreign land for about ten years, he was forced to leave Khorezm. This negatively affected Beruni's fate. Upon his return, Beruni became one of the statesmen of Khorezm. During these years, he conducted measurements of the density of metals and precious stones. At the same time, he began extensive correspondence with another famous scientist who worked in Khwarazm, Ibn Sina (Avicenna, 980-1037), with whom he discussed a number of issues of natural science and Aristotelian physics. While Beruni sharply criticized many of Aristotle's ideas, Ibn Sina played the role of Aristotle's defender.

In 1017, Mahmud of Ghazni, the ruler of Khorasan and Afghanistan, conquered Khwarazm, and Beruni was sent to Ghazni along with other prisoners. Despite the difficult conditions, Beruni continued his scientific activity, completing a number of works on geography and astronomy, including the famous work "India." When Mahmud's son Mas'ud ascended to the throne, he paid attention to Beruni and patronized him. The scholar dedicated his major work on astronomy and spherical trigonometry to Mas'ud and named it "Qanun al-Mas'udi." He also wrote "Mineralogy" and "Book of Medicines." Beruni died on December 13, 1048[27]. The renowned Russian orientalist scholar I.Yu. Krachkovsky emphasized that Beruni was an encyclopedic scholar who equally covered all fields of modern sciences, especially the natural history of mathematics and physics[28].

RESULT

In conclusion, we can study how Beruni developed engineering knowledge based on experimental natural science in the East. The inventions and engineering achievements brought to Europe by the East, such as the mechanical clock, compass, gunpowder, and paper, played a huge role in the development of European civilization. The development of engineering knowledge in the Middle Ages also took place in other regions of the East.

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[26] Abu-Rayhon Beruniy. Geodeziya. Toshkent - 1966. –B.45.
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