

THE SCIENTIFIC TAPESTRY: MUSLIM MATHEMATICIANS AND PHYSICISTS IN THE INTELLECTUAL LANDSCAPE IN THE MUSLIM HISTORY

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Abstract

The Banu Abbas regime, which spanned from the 8th to the 13th century, was a pivotal period in Islamic history marked by significant advancements in various fields, including mathematics and physics. Muslim scholars made remarkable contributions that not only preserved ancient knowledge but also laid the foundation for further developments in these disciplines. This abstract focuses on the contributions of Muslim scholars to mathematics and physics during the Banu Abbas era. In mathematics, scholars such as Muhammad al-Khwarizmi played a pivotal role in introducing the Hindu-Arabic numeral system to the Islamic world, a system that is now widely used globally. Al-Khwarizmi's seminal work "Al-Kitab al-Mukhtasar fi Hisab al-Jabr wal-Muqabala" laid the groundwork for algebra, a term derived from the Arabic word "al-jabr." This text, along with other mathematical treatises, explored solutions to quadratic and cubic equations, providing a systematic approach that significantly influenced the development of algebraic principles. Additionally, the translation movement in the Banu Abbas period facilitated the transfer of Greek and Roman mathematical knowledge to the Islamic world. Scholars like Thabit ibn Qurra translated and expanded upon works by ancient mathematicians like Euclid and Archimedes, contributing to the enrichment of mathematical understanding. In the realm of physics, Muslim scholars made groundbreaking contributions, particularly in the field of optics. The works of Ibn al-Haytham, known as Alhazen, were instrumental in shaping the understanding of light and vision. His "Book of Optics" explored the principles of reflection, refraction, and the anatomy of the eye, laying the foundation for the modern understanding of optics. Alhazen's experiments and observations on light and optics were foundational for subsequent European scientists, including the likes of Kepler and Galileo.

Key words: Islamic Golden Age, Mathematics, Physics, Scientific Legacy, Optics.

INTRODUCTION

The Holy Quran, the cornerstone of Islam, encompasses revealed knowledge and offers comprehensive guidance for humanity. Numerous verses in the Quran elaborate on natural phenomena across various disciplines such as astronomy, geology, and embryology. The term "Ilm" (knowledge), reiterated nearly 750 times in the Quran and Hadith, underscores the importance of education in Islam. The religion encourages the study of natural phenomena and highlights God's miracles, providing guidelines for all aspects of life. The Umayyad Caliphate saw a harmonious relationship between human nature and religious obligations. Islam, a religion promoting human development and societal prosperity, inspired scholars to delve into the natural world. The Quran and Hadith served as catalysts for scientific progress in Islamic civilization, fostering a dynamic force behind the advancements in science.

This qualitative study aims to explore the historical contributions of Islamic scholars in the fields of mathematics and physics during the Umayyad Caliphate, offering insights valuable for curriculum planners, designers, and developers in integrating content that inspires future generations. The Holy Quran, the textbook of Islam is comprised of revealed knowledge; it contains complete guidance for all human beings. There are many verses in the Holy Quran describing the natural phenomena in several disciplines such as astronomy, geology and human embryology etc. Most repeated word in Quran and Hadith is Ilm (knowledge) and this word has repeated in Holy Quran almost 750 times¹. Islam emphasizes the study of natural phenomena and God's miracles and provides guidelines for all the public and private aspects of life.

In Islam, there is a relationship between human nature and religious obligations. Islam, the religion of humanity, emphasizes the development and prosperity of society. The crux of the teachings of Islam is to explore the earth, mountains, stars, the change of the day and night, the creation of living things, the system of rain and other phenomena, as it is ordered by Allah Almighty. Muslim scholars motivated by Quran and the teachings of Prophet Muhammad (PBUH), studied the natural phenomena. The teachings of Islam were the dynamic force behind the progress of science in Islamic civilization. The holy Quran and Hadith proved important stimuli for Muslims to study the different aspects of nature².

In Banu Abbas regime, Muslim scientists were credited as torch bearer in several branches of science. The role of Muslim scholars in the development of all branches of science, particularly in mathematics and Physics cannot be ignored. The major objective of this qualitative study was to explore the historical role of Muslim scholars in the field of mathematics and physics. The study will be significant for curriculum planners, designers and developers to include the content that will induce young Muslims to follow their heroes.

METHODOLOGY

A qualitative approach with document analysis was used in this historical study. The researchers collected data from Library of Islamic Institute Lahore, Punjab University library, Library of Sheikh Zaid Islamic Center, University of the Punjab, Lahore, Library of I.E.R, university of the Punjab, Lahore. Qaid e Azam Library Lahore, Muhaddas library Lahore, library of history department, university of the Punjab, Lahore and some other accessible sources.

LITERATURE REVIEW

The development of science started from the period of AlMansoor, the second caliph and caliph Haroon ul Rasheed also showed his keen interest for the progress of science. Haroon ul Rasheed made decision for the construction of a scientific institute, known as Bait ul Hikmah, but Mamoon developed and made it bigger; it became the center of education for Muslims. In the administration of Mamoon (813-833), Muslim scholars made progress in all fields of life and therefore that era is known to be the golden period of Muslim civilization for the progress of science and arts³.

At that time, the popular field of study was Greek philosophy. On the request of Mamoon, a Roman emperor sent all the books of Greek philosophy and these books were translated into Arabic language. Muslim philosophers, mathematicians, physicists and scientists had discovered the educational works of other cultures and developed these works for the prosperity of mankind⁴⁻⁶. Their contributions to mathematics and physics are given below.

MATHEMATICS

Muslim mathematicians got insight from previous knowledge of other civilizations in the beginning. They got the Arabic translation of Greek and Indian works on several branches of mathematics. These translated versions proved to be an impetus for Muslim mathematicians. They changed the mathematical disciplines and shaped the new branches of mathematics. In number system, Muslims used three basic techniques for calculation. These three techniques were: A finger counting method with the demonstration of arithmetical computations in the form of specific angles of fingers and finally, their total was saved in words; other technique was adopted from Babylonia and numbers were represented through alphabets; third and advanced technique was to represent the number in the form of nine figures and a symbol of zero⁷⁻⁹.

Basically, this number system was Indian and numbers were written in a different style. These numbers after some changes were introduced to West and were known to be Arabic numbers. Muslim mathematicians provided the base for the application of mathematics in daily life⁹. They explained the principles of mathematics to make them easy for public. People showed their interest to get mastery in all types of mathematics due to these explanations. Muslim mathematicians presented natural numbers and irrational numbers with the combination of existing Greek work. They studied the work of Euclid about geometry and provided different proofs of non-Euclidian theorems¹⁰.

A great Muslim mathematician, Muhammad bin Musa AlKhwazimi laid the foundations of algebra. He mixed Indian and Babylonia numbers to form a simple and easy structure in algebra. That structure

of numbers was so easy to use. He also expounded the usage of zero to develop an advance decimal system. The word “algorithm” is related to his name, Al-Khwarzimi. He wrote a book “*Hisab al Jabr wal Muqablah*” that was used as the textbook of western universities. In this book, he gave many examples related to Islamic civilizations. Therefore, we can say that Khwarzimi was the founder of modern algebra. He also developed the trigonometric ratios and a globe in the regime of Mamoon ul Rasheed¹¹.

Khwarzimi is also the author of a famous book “*Kitab al- Jama wal Tafriq bil Hisab al Hindi*”. Khwarzimi presented the solutions of linear and quadratic equations in this book. The credit for the introduction of the terms algebra, zero, sifr/cipher and discovery of Trigonometry goes to Muslim mathematicians. The introduction of trigonometric ratios like Sine θ , Cosecant θ and Tangent θ significantly developed the measurement of lands and Greek system of measurement was replaced by trigonometric ratio system to solve the problems of measurement related to spherical triangles¹². Jafar Muhammad, Ahmad and Hassan known as banu Musa (sons of Musa bin Shakir) jointly worked and compiles these books on mathematics and physics in 9th century: “*Kitab ul Hiya*” (The book of ingenious devices); “*Kitab Marifat al Askal al Basitawal Koris*”, and “*Kitab Ghalak al Handasia*” . These books helped Muslims for application of their studies in surveying, designing and developing all types of wheels. Sabit bin Qurrah, a great translator studied mathematics from Ibn Shakir and became famous mathematician and astronomer. He developed some theories in non-Euclidian geometry, algebra, calculus and trigonometry and also recommended some changes in Euclid’s theorems. He developed calculations to find the volumes of several bodies¹³⁻¹⁵.

The daily life activities and the religion affairs of a Muslim mainly concern with the moon and the sun. Muslims determine the beginning and the end of month according to their lunar calendar. Moreover, Muslims calculate the time of the prayers and fasting according to the movement of sun. The advancement of mathematics helped Muslims to develop astronomy, as algebra and spherical trigonometry help to precise calculations of stars. Therefore, Muslims took their keen interests to contribute significantly in the field of astronomy. At that time astronomical knowledge was considered as the part of mathematics. Now, astronomy is considered as the applied branch of physics. The contribution of some famous Muslim astronomers is explained below.

Mashallah and Ibn Nawbakht were also well known astronomers; they assisted in drawing the plan of Baghdad city. Al- Fazari was the first person, who built a structure of hoops to see the motion of heavenly bodies was Al- Fazari. His son, Muhammad bin al- Fazari, was also a famous expert of astronomy. A famous Muslim scholar Yaqub Ibn Tariq studied astronomy from Indian scholar Manka Hindi and then introduced it to Muslims¹⁶⁻¹⁹.

Al-Khwarzimi used Sind-Hind method and Persian method in astronomy. Habash al Hasib was an outstanding astronomer; he helped to draw Mamoonic tables. He introduced a graphical way to determine the correct direction of Qiblah. He determine the diameter of moon, the perimeter of earth and the trigonometric values. Al-Farghani was also a famous astronomer, who determined the diameter of earth as 6500 miles.

He wrote a book “ *Kitab fi Harkat al Samawiyah wa Jawamillm*” on astronomy²⁰. Under his supervision, an instrument was built to measure the flow of Nile River. A great astronomer Jabir bin Sinan al Battan found the length of a year as 365 days, 5 hours, 46 minutes and 24 seconds. He studied the lunar and moon eclipse and gave a new method to see the new moon²¹⁻²².

PHYSICS

In Banu Abbas regime, the nature of the subject of physics was different than that of today. At that time, the discipline of physics was as a natural philosophy; covering life sciences and earth sciences and the physics itself. Instead of philosophy, speculations or simple theories, Muslims developed physics rely on experiments. They were the first to categorize sound; they explained that the sounds of animals are closely related to the structures of their necks, throats and larynx. The concepts of atom, energy, force, gravity, light, earthquake and space were of much interest for scientists or physicists of that time²³⁻²⁴. Muslim physicists made progress in physics and established it as a new discipline. The contribution of some famous Muslim physicists is discussed below.

IBN AL HAITHAM

Ibn al Haitham is a famous name in the world of physics, particularly in optics. He is also credited as the father of modern optics. He invented a pinhole camera to see the solar eclipse. He wrote a famous book “*Kitab al Manazir*” on optics. This book had been used as the most authentic work on optics for more than six centuries. In this book, Ibn al Haitham had written his findings of the experiments and mathematical investigations on the properties of light about vision²⁵.

AL BAIROONI

Al Bairooni was famous physicist, who gave the rule to determine the specific density of body. He found the specific density of about eighteen types of some stones. He worked on the theory of communicating vessels as well. His significant text is ‘Shadow’. The phenomena with shadows, tangent and secant functions, shadow observations with its application for several astronomical issues and management of time for prayers are discussed in this text. His area of interest was hydrostatics. He stated the ratios among densities of some metals like gold, mercury, lead, copper and iron etc.²⁶.

KHAZINI

Khazini was a famous physicist in the fields of hydro statistics and dynamics. He presented the theories of kinetics; the theory of obliquity and inclination and the theory of impulse. These theories played a vital role in the field of kinetics. He also made progress in the field of hydro statistics; he prepared an instrument to find the specific gravity of liquids. He found the correct specific gravity of some solid and liquid materials by using the same apparatus of his master Al Bairooni. He also worked on air and gave the useful suggestions, which proved basis for the inventions of instruments like barometer, air vacuums and air pumps²⁷.

CONCLUSION

It is concluded that Muslim scholars significantly contributed to the subjects of mathematics and physics. They replaced the theoretical science of Greek with experimental science and gave the new horizons to all branches of science. Muslim scholars acquired the Greek knowledge of mathematics and natural philosophy (physics) and the works of Indian scholars. They criticized their works and transformed in the new branches. Development of algebra, the use of zero, advancement in spherical trigonometry and the awesome inventions in the field of physics are the remarkable achievements of Muslim mathematicians and physicists. Being a Muslim, it is obligatory to study the different aspects of nature, as it is demanded in Quran. Learning from the history of Muslim scholars, Muslim youth should carry on the practices of learning and applying the knowledge for the prosperity of individual, society and the nation.

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