Role of Muslims in Growth of Science and Technology (800-1500 AD)

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ABSTRACT

The current paper highlights the role of Muslims in growth of science and technology. There are hundreds and thousands of Islamic manuscripts in the world library, dealing with scientific works of Muslim scientist of the eight hundred to fifteen hundred A.D. I have mentioned a few great Muslim scientists and their scientific works may help in focusing the Muslim achievement from eight to fifteenth century. Algebra (Al-Jabra) is the creation of Al-Khawarazmi (210AH/875AD) a genius who came from Khawarizm in Central Asia. He has coined the word algorithm used today in numerical analysis and his reputation has been compared by western scholars i. e.Euclid . Ibn al Haytham(d.430AH/1039AD) invented analytical geometry by establishing the close relationship between algebra and geometry using the new technique in his study of optics. Muslim mathematician made great contribution problems and make calculation

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There are hundreds and thousands of Islamic manuscripts in the world libraries, dealing with scientific works of Muslim scientists of the eight hundred to fifteen hundred AD (8th – 15th century AD). I have mentioned a few great Muslim scientists and their scientific works may help in focusing the Muslim achievement from 8th to 15th century.

Generally field of work of Muslim scientist were broad enough to include most of the sciences in those days. But in later parts of life, each of them became specialist in one or more of the sciences. Muslim contribution in science and technology are discussed below –

Practically all sectors of modern mathematics are attributable to the efforts of Muslim scientists.[1]This includes its bases and terminology, either taken directly from the Arabic or translated literally from words coined by Muslim specialists. Early Muslims used the letters of the Arabic alphabet as numerals but by ninth century, the Western Muslims had invented al-arqam al-gharibiyah 1,2,3,4,5,6,7,8 and 9 based on a number of angles equal to the weight of each symbol, while the Eastern had devised al-arqam al-hindiyah١٢٣٤٥٩ from ancient Sanskrit characters. One of the greatest invention of Muslim scientists is the zero (sifr), written 0 for the west and. for the East.

Muslims continued building their new mathematical model by introducing the decimal system, the ingenious idea of expressing all numbers by means of ten symbol. Each symbol accorded the value of position as well absolute value.[2]For multiplication,

they used the lattice method, for division, they used first a trial-and-error method which they quickly replaced by the so called scratch method and then by long division. To denote a fraction, the Muslims introduced the separation line and expression by decimals (e.g. ½ and 0.5).

Algebra (al-jabr) is the creation of Al-Khawarazmi (210 AH/875 AD) a genius who came from Khawarizm in Central Asia. He has coined the word 'algorithm', used today in numerical analysis and his reputation has been compared by western scholars with that of Euclid, one of the greatest mathematicians of all time.[3] He translated several Greek works and in his own famous book *Hisab Al-Jabrwa Al-Mu-qabalah*, he defined jabr as the transposition of a quantity from one side of an equation to the other and muqabalah as the simplification of the resulting expressions. In his algebra, Al-Khawarazmi changed number from its arithmetic character of finite magnitude to an element of relation and infinite possibilities.

Al-Khawarazmi introduced a method, similar to long division, to extract the square root of a number. He then established the algebraic system for solving first and second degree equations with one unknown. He discussed algebraic multiplication and division, offering an algebraic method for finding a triangle's altitude and the two segments of its base when the lengths of its three sides are known.

Al-Khawarazmi was among the first Muslim mathematicians to develop trigonometry by introducing the theories of jib (sine), tajib (cosine), dhill (co-tanget) and tadhill (tangent). His works includes 100 tables of sine and co-tangent and other trigonometrical values. In his work on algebra, Al-Khawarazmi calculated the areas of the triangle, parallelogram and circle, using $3 + 1/7$ as the approximate for π.

Ibn al-Haytham (d. 430 AH/1039 AD) invented analytical geometry by establishing the close relationship between algebra and geometry using the new technique in his study of optics. He solved the problem of drawing from two given points in the plane of a circle. He also tried to solve the cubic equation by conics and postulated original geometrical theorems such as that of the radical axis. Ibn al-Haytham elaborated upon Euclid's fifth postulate, using a trirectangular quadrilateral. He proved that the fourth angle is always a right angle. He assumed that the locus of a point that remains equidistant to a given line is necessarily parallel to that line – an assumption equivalent to Euclid's postulate.[4]

The Algebra of Umar Khayyam (d. 526 AH/1131 AD) is one of the most outstanding mathematical texts of medieval period. It deals with equations through the cubic order, classifying and solving them (usually geometrically) and always preserving the relation between the unknowns numbers and geometrical forms.[5]

Muslim mathematicians made great contributions towards geometry. They applied geometry in surveying, construction of machines and used to solve problems and make calculations. Muslims were the inventors of plane and spherical trigonometry introducing functions of sine, cosine and tangent. Al-Battami (d. 317 AH/929 Ad) presented a formula involving three sides and one angle of a spherical triangle which has no equivalent in Ptolemy. Abul-Waffa (d. 388 AH/929 AD) was one of the greatest Muslim mathematician who invented secont and cosecount,

demonstrated the sine theorem for the general spherical triangle and proposed a new technique for the construction of sine tables.

In Physics Islamic contribution can be appreciated by a thorough study of Muslim Physics.

Ibn al-Haytham (d. 430 AH/1039 AD) was a great mathematician as well as greatest Physicist. He had significant contribution to optics to formulate a new comprehensive theory which overcame difficulties in previous work on the subject. Earlier theories had postulated that vision occurred when some sort of image given off from seen objects entered or affected the eye. However, they failed to explain how the eye could see many different people in different locations could see the same object.[6]Ibn al-Haytham in his "*Kitab al Manazir*" (book on optics) suggested that the eye registered only the single rays which enter the eye perpendicular to the points of the convex surface of the eyes.[7] This means that images from the visual field of the eye not only kept a fixed arrangement as they entered the eye but that vision could be analyzed mathematically in terms of a 'visual cone' with its points on the point at which the image enters the eye and its base on the object. He also discovered the idea of light as a physical ray and discussed the relationship of cognition and visual perception. In other works, he discuss the rainbow, burning mirrors, shadows and a theory of the shape of the eclipse.

Ibn al-Haytham's work in optics had a major influence on Roger Bacon and other Latin writers on optics.

Al-Biruni (973-1048 AD) of Afghanistan was a great scientist well versed in mathematics, astronomy, physical science and other subjects. He was also a great experimentalist. He was an instrument maker and constructed astrolabes and a geared mechanical calender.[8]

Another scientist Al-Khazim wrote a book '*KitabMizan al Hikma*' based on his work on specific gravity and discussed it a theory of gravity and many instruments. His book is a fine work on mechanics and physics.

In the field of Chemistry, Muslim scientists also made significant contributions. The works of Jabir (8th century AD), Al-Kindi (9th century AD), Abu Bakar al Razi (d. 925 Ad) and others were very important. Modern chemical industries of today owe much to their works.[9] Al-Razi contributed valuable knowledge and know how to modern chemist regarding distillation, calcination, evaporation, sublimation, creation etc. and the various chemical processes involved in them. His book '*Kitab al-Asrar*' gave full account of different chemical equipment. Al-Kindi was also a great chemist. His treatise '*Kitabkimiya'al-itrwaalTasidat*' (book of perfume, chemistry and distillation) was very useful for Islamic chemical industry.

In the field of geography the Muslims explored China, Japan, India, South-East Asia and the Indian Ocean, Scandinavia, Ireland, Germany, France and Russia and Mediterranean as well as Africa. They reached the polar regions and knew of the existence of a land beyond the Atlantic ocean.

Al-Khawarazmi had contributed to the measurement of the earth's circumference. By order of Caliph Al-Mamun he also helped draft the first Muslim

geographical map of the known world and his book surah Al-Ard expanded on the geography of Ptolemy.[10]

The greatest of the Muslim geographers was surely the Moroccan from sabtah, Al-Idrisi (1100-80). He founded the discipline of mathematical geography. He created the system of cylindrical projection of the earths surface. Dividing the earth into seven aqalim. Al-Idrisi called the area lying between any two meridians of longitude iqlim. He divided each iqlim into ten regions. Thus his map of the world consisted of seventy sheets.[11]

Ibn Battutah (1303-77 AD) proved to be the greatest Muslim traveller in 14th century. Leaving his base al-Tangiers, he spent thirty years voyaging as far eastward as the Maldives, Indochina and China.[12]The prime Muslim authority on the Indian ocean was Shihabuddin Ahmad IbnMajid of Oman, known by the Muslims of the time as the lion of the sea. IbnMajid led Vasco da Gama across Indian ocean as captain of da Gama's ship.

Muslim scientists were active in studying nature and serious in applying their knowledge for the benefit of the people. Engineers and architects were called in those days as 'almuhandisun' which came from the word 'handasa' meaning 'engineering and architecture'. However in many cases there was no much differences between an engineer and a scientist. Thus Jabir was a chemist and engineer, Al-Kindi a physicist as well as metallurgist and engineer, Al-Razi a chemist engineer and physician, Al-Biruni an astronomer, physicist and engineer.

During the glorious period of Islamic civilization (700-1500 AD) Islamic science and technology flourished throughout the Islamic world. Many great Muslim scientist were born in this period. Islamic science and technology played a vital role in the foundation of European science and technology to be flourished later on.

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