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## Contribution of Muslim Scientists to the World: An Overview of Some Selected Fields

Muhammad Adil Afridi  
 Department of General Studies, KIRKHS  
 International Islamic University Malaysia

### Abstract

The Qur'Ēn which is the foundation of Islamic teachings gives the utmost emphasize on pursuing knowledge. Muslim scholars from the past were very much aware of this instruction given by Allah (*s. w. t.*) and they were very captivated by it. They developed many ideas and theories in the field of knowledge. This paper will try to shed some light on a few works that have been carried out by Muslim scholars. However, it focuses on the contributions of Muslim scholars in Mathematics, Physics and Medicine only. It is hoped that, by remembering all those Muslim heroes and their contributions; contemporary Muslim societies, particularly muslim scholars will be inspired.

**Keywords:** *Muslim scientists, natural science, contributions of Muslims to science.*

### Abstrak

Al-Qur'an sebagai pegangan asas bagi pengajaran Islam menekankan peri pentingnya mengejar ilmu pengetahuan. Sarjana Muslim masa lampau amat sedar tentang arahan ini yang disampaikan oleh Allah (*s. w. t.*) dan mereka sangat tertarik dengannya. Mereka telah berjaya mencetuskan banyak idea dan teori dalam pelbagai bidang ilmu pengetahuan. Kertas ini akan cuba memaparkan usaha dan kemajuan dalam beberapa bidang yang diterokai oleh sarjana Muslim. Namun, tumpuan akan diberi pada sumbangan sarjana Muslim dalam bidang Matematik, Fizik dan Perubatan sahaja. Dengan mengingati ketokohan dan sumbangan para sarjana Muslim ini, mudah-mudahan sarjana dalam masyarakat Muslim kini akan terdorong untuk berjaya.

**Kata kunci:** *saintis Muslim, sains tabii, sumbangan Muslim kepada sains*

### Introduction

To the Muslims, history is a chain of incidents that inform the time values of Islam; it concentrates on knowing and "realizing" these ideologies than in nurturing uniqueness and change as essential virtues. The symbol of Islamic civilization is not a rolling river, but the dice of the Ka'bah; the firmness of which represents the everlasting and incontrovertible character of Islam.<sup>i</sup>

The arts and sciences in Islam are based on the idea of

unity, which is the heart of the Muslim revelation. All unpretentious Islamic art, whether it be the Alhambra or the Paris Mosque, carries the plastic methods through which one can anticipate the Divine Unity manifesting itself in multiplicity, so are all the sciences that can properly be called Islamic reveal of the unity of Nature. One might say that the aim of all the Islamic sciences; all the medieval and ancient cosmological sciences, is to show the unity and interrelatedness of all that exists. Thus, in planning the unity of the cosmos, human being may be led to the unity of the Divine Principle, of which the unity of Nature is the image.<sup>ii</sup>

The history of Islamic involvement in science, technology, and entrepreneurship is a remarkable saga of new sightings in pure and applied science; in which technological advancement and entrepreneurship that establish the spirited and essential base of modern

*\*Corresponding author:*

*Dr. Muhammad Adil Afridi*

*Department of General Studies, KIRKHS*

*International Islamic University Malaysia (IIUM)*

*Email: [dradil@iium.edu.my](mailto:dradil@iium.edu.my)*

science, technology and business arrangements. The story of the Muslim sciences takes the form of captivation of knowledge from different civilizations, accumulating their original and significant contributions, and increasing knowledge across countries and regions through trade, cultural interactions, and education. This story is also of the saga of decline and evisceration of the Islamic population at the beginning in the early 17<sup>th</sup> century.<sup>iii</sup>

The key time periods in which can be captured the growth and descent of the Islamic sciences are: the age of transformation of ancient texts, namely Greek, Chinese, Indian etc. Between the 8<sup>th</sup> and 9<sup>th</sup> centuries then came the era of original thinking and influences of the 9<sup>th</sup> and 11<sup>th</sup> century. This was shadowed by the weakening in intellectual and systematic thoughts until the 17<sup>th</sup> century. In contemporary world, Islam is understood as many things, but seldom viewed as a cradle of motivation and instruction. Nevertheless, it is a force of education and it is not only verses of the Quran that affirm to that fact, but also the boundless body of scholarships produced during the Middle Ages. While Europe was in the throes of darkness, it was the Muslims, prompted on by the elegance of their teachings, that picked up the torch of scholarship and science. It was the Muslims who nurtured the knowledge of ancient times, expanded upon it, and finally, passed it on to Europe. It is important for contemporary Muslims to know about and appreciate the contributions of the Islamic civilization by the early Muslims. Colonialism; the organization of the Western educational model, along with Euro centrism often reveal Islam as backward, incongruent with science and technology and anti-educational. Muslim school children never acquired of their prominent past and the only thing often passed on to them is the inferiority complex. Mistakes can be learnt from the past and we can enrich our future by analyzing them critically.<sup>iv</sup>

Finally, this paper will try to accomplish the goal of describing contributions of Muslim scholars in Islamic civilization but most importantly in science with a brief explanation of their work in Mathematics, Physics and Medicine. Furthermore, this study will also try to promote the methodology to gain the same influential position in the field of knowledge, science and other fields as was acquired by previous Muslim scholars by discussing the definition and necessity of Islamization of Knowledge.

### **Contributions of Muslim Scholars**

In the seventh century CE, prophet Muhammad (p.b.u.h) was sent to the people of Arabia. Within a decade of his death, the Muslims had conquered all of the Arabian Peninsula. Within a century, Islam had spread from Al-Hamrah in Spain to the borders of China. Islam unified science, theology, and philosophy. Muslims were commanded by Allah SWT to study, seek knowledge, learn and benefit from others; in the holy Quran and by the prophet Muhammad (p.b.u.h) in the Sunnah. It was this that inspired the Muslims to great heights in sciences, medicine, mathematics, astronomy, chemistry, philosophy, art and architecture.<sup>v</sup>

Muslim scholars commenced in acquiring Greek expositions and established their study and conversion into Arabic a few centuries after the Hijrah. They significantly examined, assembled, approved and incremented the science and philosophy of the Greeks. After this phase began what is acknowledged as the Golden Age of Islam, which remained for over two centuries. It is that we discovered many Islamic scientist who left behind hundreds and thousands of books on several branches of science.<sup>vi</sup>

It may be notable that the Islamic enlightened route started with “Read”, followed by five Qur’anic verses consults about science. A statistic for the number of alphabet in the word of “science” and its derivations in the noble Quran, it was repetitive 779 times, that is averaging 7 times a chapter. It positions the second after the word “Allah”. This in fact replicates the importance of knowledge in the Islamic civilization. Prophet Muhammad (p.b.u.h) also informed that, “The Prophet Muhammad (p.b.u.h) said: Allah, His angels and all those in Heavens and on Earth, even ants in their hills and fish in the water, call down blessings on those who instruct others in beneficial knowledge (Al-Tirmidhi, Hadith 422) Consequently, Muslim scholars received this fact clearly and then contributed uniquely to human history in terms of science in countless volumes that can never be presented in a single study.<sup>vii</sup>

The contribution of Muslim scholars in science is also a vast area to be discussed but this paper attempts to shed light on a few sectors where Muslim scholars are still treated as pioneers that are as follows:

**In Mathematics:** it is surprising to take note that Islam so intensely desires mankind to study and explore the universe. For example in the Holy Qur’an, it is stated that:

*“We (Allah) will show you (mankind) our signs/patterns in the horizons/universe and in yourselves until you are convinced that the revelation is the truth.”*

[The Qur'an, 14:53]

This brought about Muslim scholars fascination in Mathematics, Physics, Medicine and other sciences. The Muslims developed the symbol for zero and they systematized the numbers into the decimal system - base 10. Additionally, they designed the symbol to represent an unknown quantity, i.e. variables like  $x$ . Here we will give a short biography of these wonderful Muslim scholars who contributed in the field of Mathematics:

*Muhammad bin Musa al-Khwarizmi* who contributed the foundation of the subject of algebra, which was later advanced by others, most notably by Umar Khayyam. Al-Khwarizmi's work, in Latin translation, carried the Arabic numerals along with the mathematics to Europe, through Spain. The word “algorithm” is derived from his name.. Al-Khwarizmi, born in 780 CE., was the forefather of modern Algebra. He developed sine, cosine and trigonometry tables, which were later translated to the West. His book on algebra “*Hisab al-Jabr waal-Muqabalah*” (*The Calculation of Integration and Equation*) was used until the 16th century as the principal textbook of European universities. In it he composes that given an equation, collecting the unknowns into one side of the equation is called *al-Jabr* and collecting the known on the other side of the equation is called *al- Mukabalah*. He also described six basic types of equations:

$$nx = m,$$

$$x^2 = nx,$$

$$x^2 = m, m + x^2 = nx, m + nx + x^2 \text{ and } x^2 = m + nx$$

He also explained the particular equation  $x^2+21=10x$  using geometrical arguments.<sup>viii</sup>. Al-Khwarizmi also aided in announcing Arabic numerals, which are decimal position system, and the concept of zero. Algebra and Algorithm are in fact combination of his work and name. Interestingly, this book on algebra comprised many examples from the Islamic inheritance laws and how they could be answered using algebra. Under al-Mamun, the caliph of that time, with some others were the first to map the globe..

*Ghiyath al-Din al- Kashani* was Ghiyath al-Din al-Kashani of the late fourteenth century. He functioned on the theory of numbers and techniques of computations. In 1424, he figured a value of 2pi to sixteen decimal digits of accuracy using an approximation of the circle by 805306368 side polygon. One of his most important works was “*Miftah-ul-Hissab*” or “*The Calculators' Key*”; in it he defined an algorithm for finding the fifth root of any number. The book was taught in Persian schools until the seventeenth century. Later in his life he relocated to Samarkand on the invitation of the ruler to support directly a new scientific school and observatory and conduct research with other scholars of the time. Kashani also wrote on how to approximate sine by solving a cubic equation accurately.<sup>ix</sup>

*Abu Wafa Muhammad al-Buzanji* was born in Buzjan, Nishapur in 940 CE. He became a great mathematician and astronomer in Baghdad and died in 997 CE. Al-Buzanji's main contribution lies in several divisions of mathematics, specifically geometry and trigonometry. In geometry he added to a solution of geometrical problems with opening of the compass, construction of a square equivalent to other squares, regular polyhedral, construction of regular hexagon taking for its side of the equilateral triangle inscribed in the same circle, constructions of parabola by points and geometrical solution of the equations  $x^4 = a$  and  $x^4+ax^3 = b$ . Al-Buzanji's involvement in the progress of trigonometry was also widespread. He was the first person to show the generality of the sine theorem relative to spherical triangles. He established a new scheme of assembling sine tables, the value of  $\sin 30$  being correct to the eight decimal place. In addition, he deliberated tangent and planned tables for them. He announced the secant and cosecant for the first time. He composed a large number of books on mathematics and other subjects, most of which have been lost or exist in modified forms. He also penned rich commentaries on Euclid and al-Khwarizmi. A substantial part of today's trigonometry can be traced back to him.<sup>x</sup>

*Abu Abdullah al- Battani* (862-929 CE) was the son of a scientist and also a famous astronomer, mathematician and astrologer. He is often considered as one of the greatest astronomers of Islam. In mathematics, al-Battani was the first to substitute the practice of Greek chords and the first to cultivate the concept of cotangent and provided their table in degrees. He composed a number of books on

astronomy and trigonometry.<sup>xi</sup> In the tenth century, *Mohammad b. Ahmed* invented the concept of zero or *sifr*. Thus, swapping the cumbersome, Roman numerals and creating a revolution in mathematics. This directed to improvements in the calculation of the program of the worlds and progresses in the fields of astronomy and geography. Muslim mathematicians had invented both the Babylonian hexadecimal system and the Indian (Hindu) decimal system, and this provided the basis for numerical techniques in mathematics. Muslims constructed mathematical models using the decimal system, conveying all numbers by means of ten symbols, and each symbol permitted the value of position as well as absolute value. Many inventive methods of doing multiplications were established by Muslims; methods of checking by casting out nines, and decimal fractions. Thus Muslim scholars added and positioned the foundations of modern mathematics and the use of mathematics in the fields of science and engineering.<sup>xii</sup> In the seventeenth century, *Al-Hassan ibn al-Haytham*, Europe cracked the problems framed by Al- Hassan Ibn al-Haytham (965-1041) known as "Alhazen's problem". Again his work that was interpreted into Latin made Europeans aware of al-Haytham's amazing successes in the field of *Optics "Kitab al-Manazir"*. A theory of vision and a theory of light, and was called by his successor of the twelfth century "Ptolemy the Second". Furthermore, by encouraging the use of experiments in scientific research, al-Haytham played an important role in setting the scene for modern science.<sup>xiii</sup>

Al-Haytham's advancement to geometry and number theory went well beyond the Archimedean tradition. Al-Haytham also operated on analytical geometry and the early stages of the link between algebra and geometry. Subsequently, this work headed to pure mathematics with the harmonious fusion of algebra and geometry that was exemplified by Descartes in geometric analysis and by Newton in calculus. Al-Haytham was a scientist who made major contributions to the fields of mathematics, physics and astronomy during the latter half of the tenth century. John Peckham's use of al-Haytham's *kitab Al-Manazir* and Witelo's *optics* in the late thirteenth century, has echoes of *Kitab al-Manazir*.<sup>xiv</sup>

Muslim scholars added not only to the use of logic in the development of mathematical ideas and relationships, but also to an effective system of numeration that involved zero and headed to the solution of equations. Muslims had thus begun the work that directed on to mathematical modeling and its application for the purpose of testing their theories. This

knowledge and approach was slowly transferred to Europe through Spain and Sisley.<sup>xv</sup>

**In Physics:** in comparison to all sciences that developed and developed across the passage of nations and civilizations, the natural sciences of Muslims commenced by relying on the publications of the Greeks who drew on mere philosophies in their attempts to understand nature without resorting to experimentation. However, Muslim scientists spared no efforts to develop this basis; they excelled in physics in an unprecedentedly subtle and intelligent fashion to the extent that they seemed to establish a new science. For example, they made physics rely on experimentation and induction rather than on philosophy, speculations, or mere thoughts.<sup>xvi</sup>

Muslim scientists studied acoustics; its origin and its transfer. They were the first to understand that sounds are affected by the bodies that cause them and that these sounds transfer in the air in the form of circular waves. Muslim scientists were also the first to categorize sounds into different types; they expounded that the sounds of animals differ according to the length of their necks, the width of their throats and the structure of their larynx.<sup>xvii</sup>

Muslim scientists were also the first to interpret the occurrence of echo as a reflection of the sound wave which hits a high mountain or wall. The reflection of the echo cannot be realized due to spatial closeness.

*Abual-Rihan Al-Beruni* is a renowned physicist, who determined the specific density of 18 types of precious stones. He established the rule which stated that the specific density of body is equivalent to the volume of the water which makes it moves. He also interpreted the exit of water from geysers and artesian wells in light of the theory of communicating vessels. One of the most important of al-Biruni's many texts is *Shadows* which is thought to have been written around 1021. The contents of the work include the Arabic nomenclature of shade and shadows, strange phenomena involving shadows, gnomonic, the history of the tangent and secant functions, applications of the shadow functions to the astrolabe and to other instruments, shadow observations for the solution of various astronomical problems, and the shadow-determined times of Muslim prayers. *Shadows* is an extremely important source for our knowledge of the history of mathematics, astronomy, and physics. It also contains important ideas such as the idea that acceleration is connected with non-uniform motion, using three rectangular coordinates to

define a point in 3-space, and ideas that some see as expecting the summary of polar coordinates. Topics in physics, which were studied by al-Biruni comprised hydrostatics and made very accurate measurements of specific weights. He defined the ratios between the densities of gold, mercury, lead, silver, bronze, copper, brass, iron, and tin. Al-Biruni displayed the results as combinations of integers and numbers in the form of  $1/n$ ,  $n = 2, 3, 4... 10$ .<sup>xviii</sup>

*Abu al-Fath Abd al-Rahman Mansour al-Khāzini* was an incomparable physicist, particularly in relation to dynamics and hydrostatics to the extent that even succeeding researchers were startled. His theories have been calculated in the field on kinetics in schools and universities up till now. Among these theories are the Theory of Obliquity and Inclination and the Theory of Impulse. These two theories played an important role in kinetics. A lot of historians in the field of science regard Al-Khazani the physicist of all physicists. He dedicated most of his time to study hydrostatics; he developed a device to determine the specific gravity of liquids. He further studied the issue of resistance the body faced when it got into water. Al-Khazani as operated the same apparatus used by his great master Al-Beruni to determine the specific gravity of some solid and liquid materials. The measurements of Al-Khazani were so accurate that they amazed his contemporaries and successors.<sup>xix</sup>

Al-Khazini pointed out that air had weight and power to boost things like air, adding that the weight of the object in the air weighs less than its actual weight and its condensed weight depends on the density of air. It is worth of to that these studies paved the way for the inventions of the barometer (pressure measurement), air vacuums and pumps among others.

### Discovering the Laws of Motion

When considering the laws of motion in physics, Muslim scientists were the first to discover the following:

*Laws of Motion:* the importance of the laws of motion lies in the fact that they are viewed as the backbone of contemporary civilization. For example, the sciences of mobile machinery nowadays from the cars, trains, aeroplanes, space rockets, and transatlantic rockets, among others rely on these laws. They have aided man to invade outer space and to land on the moon. Moreover, they are deemed the basis for all physical sciences which depend on motion. Optics is the motion of light, sound is the motion of light waves, and

electricity is the motion of electron. It is well known worldwide that these laws had been revealed by the English scientist *Isaac Newton* since he published his book *Principia*. This fact, is acknowledged by the whole world and in all scientific circles, including the Muslim schools of course and remained so till the beginning of the twentieth century when a group of contemporary physicists, most prominently Professors of Mathematics examined these laws. They checked the accessible body of Islamic manuscripts in this field and came up with the fact that Muslim scientists were the first to discover these laws. All what Newton did was to collect what had been written on these laws and formulated them in a mathematical form. Setting bias and mere theoretical speech aside, the efforts of Muslim scientists are undisputable. They are recognized in their manuscripts which had been written seven centuries before the birth of Newton.<sup>xx</sup>

*The First Law of Motion:* the first law of motion in physics stipulates that if the total powers that distress an object are zero, this object will stay unmoving. Likewise, a mobile object leftovers with its constant speed state unless it finds any power that shakes it, such as friction. This was stated in Newton's mathematical statement when he said "In the absence of force, a body either is at rest or moves in a straight line with constant speed". When it comes to Muslim scientists and their role in this field, Avicenna in his book "*Insinuations and Notices*" (*Isharat wa Tanbihat*) identified the same law in his own words "You know if the object is left unaffected by external influence, it remains as it is". It is clear that the previous statement of Avicenna regarding the first law of motion precedes that of Isaac Newton who appeared six centuries later. In this statement Avicenna asserted that the object remains at rest or moves at constant speed in a straight line unless external power influences it. That is to say that Avicenna was the first to discover the first law of motion.

*Second Law of Motion:* the second law of motion associates the total powers distressing an object and the increase of its speed, which is known as speed and this speed is in proportion with the volume of the power and has its same direction. According to Newton's mathematical formulation, "A body experiencing a force  $F$  experiences an acceleration  $a$  related to  $F$  by  $F = ma$ , where  $m$  is the mass of the body. Alternatively, force is proportional to the time derivative of momentum". When it comes to Muslims, Hebatullah bin Malaka Al-Baghdadi (480-560 A.H./ 1087-1164CE) indicated in his book "*The Considered in Wisdom*" (*Al-*

*Moatabar fil Hikma*). The most solid power transfers fast and takes a short time. Stronger power leads to faster power and shorter the time. If the power does not decrease, the speed does not decrease, either". In chapter fourteen entitled the Vacuum, he pointed out that "The faster the speed, the stronger the power. The stronger the power that pushes the object, the faster the speed of the object at move, and the shorter the time spent for covering the distance". This is exactly what Newton mathematically formulated and named the second law of motion.<sup>xxi</sup>

**Third Law of Motion:** the third law of motion states that if two objects interact, the force of the first object on the second object is called the power of the action, which is equal to the force of the second object practices on the first object, but it holds the opposite direction. This power is called the force of the reaction". Newton mathematically formulated this law as follows: "Every action has a reaction which is equal in magnitude and opposite in direction".

Prior to Newton, Abul Barakat Hebatullah bin Malaka stated in his book, *The Considered in Wisdom* that "In the wrestling arena, everyone has a force practiced against the other. If one of them retreated, this does not mean that his power disappears, but this retreated power still exists, because without it the second one would not need it to influence the first one". The same meaning has been reiterated in the writings of Imam Fakhr El-Din Al-Razi in his book *The Eastern Disciplines in Theology and Natural Sciences*. He pointed out that "the circle is pulled by two equal forces until it stops in the middle, it is taken for granted that each force has practiced an action that obstructs the other". The same concept had been asserted by Ibn Al-Hayyatham in his book, *The Scenes*. He pointed out that "The moving object is encountered by an obstruction, and if this force remains, this moving object retreats in the opposite direction in the same speed practiced by the first object and according to the power of obstruction". It is obvious that all that had been mentioned by Muslim scientists in these texts is the origin of the third law of motion; which was formulated by Newton after he had taken its content.<sup>xxii</sup>

At the beginning, Muslims relied on the publications of their predecessors, such as the book entitled *Nature* by Aristoteles in which he dealt with kinetics and the books of Archimedes which contained information on the floating bodies in water and the specific gravity of some materials. Besides, Muslims depended on the publications of Actaspus, which entailed scientific results of the uplifting of pump and water clocks, and

Heron of Alexandria who tackled the pulley, the wheel and the law of work. Muslim scientists spared no efforts to develop the physics- related theories and thoughts of their predecessors; they managed to introduce experimentation, which is seen as the main pillar of physics.<sup>xxiii</sup>

**In Medicine:** in Islam, the human body is a home of indebtedness; in what way it functions, by what method to keep it fresh and safe, in what manner to prevent diseases from attacking it or what remedies to seek for those diseases, have been important issues for Muslims. Prophet Muhammad (p.b.u.h) himself insisted that people to "take medicines for your diseases", as people at that time were reluctant to do so. He also said:

"Allah created no illness, but established for it a cure, except for old age. When the antidote is applied, the patient will recover with the permission of Allah."

This was solid inspiration to boost Muslim scientists to discover, progress, and spread over empirical laws. Ample considerations were given to medicine and public health precaution. The very first hospital was constructed in Baghdad in 706 CE. The Muslims also used camel convoys as transportable hospitals, which stimulated from place to place. Since the religion did not prohibit it, Muslim scholars used human bodies to study anatomy and physiology and to support their students' realization on how the body works. This pragmatic study allowed surgery to mature very quickly.

*Abu Ali Ibn Sina (980-1037)*, better recognized to the West as Avicenna, was conceivably the ultimate physician until the contemporary epoch. His renowned book, *Al-Qanun fi al-Tibb*, stayed as a typical textbook even in Europe, for over 700 years. Ibn Sina's effort is still considered and assembled upon in the East.

Other substantial offerings were made in pharmacology, such as Ibn Sina's *Kitab al-Shifa'* (Book of Healing), and in public health. The Ottomans were particularly noted for their building of hospitals and for the high level of hygiene practiced in them. Every single city in the Islamic world had a number of outstanding hospitals and many of them were specialized for particular diseases, including mental and emotional disease. Abu Ali Ibn Sina, alone wrote 246 books, together with *Kitab-al Shifa' (The Book of Healing)* containing 20 volumes and *Al-Qanun fit Tibb (The Canons of Medicine)*. The Qanun was the principal guide for medical science in the West from the twelfth

to the seventeenth century. Dr. William Osler, who wrote *The Evolution of Modern Science*, remarked “The Qanun has remained a medical Bible for a longer period than any other work”. Comprising over a million words, it graphed the entire medical facts available from ancient and Muslim sources together with innovative assistances. Ibn Sina’s creative influences involved such developments such as acknowledgment of the communicable nature of phthisis and tuberculosis; spreading of diseases through water and soil and the collaboration between psychology and health. Also, the book defined over 760 medicines and became the most authentic of its era. Ibn Sina was also the first to describe meningitis and prepared iconic contributions to anatomy, gynecology and child health.<sup>xxiv</sup> This interest in medicine went back to the time of the Prophet Mohammad (p.b.u.h), who once said that “*there is always a cure that exists for every disease*”. With this essence there were hospitals and clinics built all over the Muslim world; the earliest built in 707 by Caliph Walid ibn Abd a-Malik in Damascus. Muslims were equipped with many developments such as the awareness of flow and separation of blood and the establishment of the first apothecary shops and the earliest school of pharmacy.<sup>xxv</sup>

*Abu Bakr Muhammad ibn Zakariya al-Razi (865-925 AD)*, identified as Rhazes, was one of the greatest inexhaustible Muslim doctors and perhaps second only to Ibn Sina in his endeavors. He was born at Ray, Iran and became a student of Hunayn ibn Ishaq and later a student of Ali ibn Rabban. He penned over 200 books, including *Kitab al-Mansuri*, ten volumes on Greek medicine, and *al-Hawi*, a compendium of medicine in 20 volumes. In *al-Hawi*, he encompassed every single medical subject’s statistics offered from Greek and Arab sources and then added his clarifications based on his understanding and assessments. He categorized substances such as vegetable, animal or mineral while other alchemists divided them into “bodies”, “souls” and “spirits”.<sup>xxvi</sup>

Al-Razi was first positioned to head the first Royal Hospital at Ray, from where he quickly moved to a similar position in Baghdad where he remained the head of its famous hospital for a long time. He created a treatment for kidney and bladder stones, and clarified the nature of various infectious diseases. He also conducted research on smallpox and measles and was the first to announce the usage of alcohol for medical purposes. An exclusive piece of his medical system was that he significantly preferred cure through

accurate and controlled nourishment intake. This was pooled with him emphasizing on the impact of psychological aspects on health. He also anticipated therapies first on animals in order to assess their effects and side effects. He was also an expert surgeon and the first to use opium for anesthesia.<sup>xxvii</sup>

*Abul Qasim al-Zahrawi (963-1013 CE)* who is recognized as Albucasis to the West, was a renowned surgeon in his time, at the court of Caliph al-Hakam II, whom students and patients from the muslim world and Europe flocked to him. He wrote the medical encyclopedia *al-Tasrif li man ajaz an-il-talif*, which enclosed 30 segments of surgical facts and drawings of 200 surgical tools, majority of which he designed himself. The Encyclopedia was not only a typical one for physicians, but it was being used for five era later as the standard textbook on surgery in universities in Europe. He also accomplished many elusive operations such as Caesarean and was also the first to use silk thread for sewing wounds.<sup>xxviii</sup>

*Al – Idrisi* was born in Cordoba, Spain in 1099. His major involvement was in medicinal plants which he labelled in many books, such as *Kitab al-Jami-li-Sifat Ashtat al-Nabatat*. He collected plants and compile data not described previously. A large number of new medicines from plants with their assessments suited to medical doctors were obtained through him. Al-Idrisi also prepared unique assistances to topography, as connected to economics, physical factors and cultural aspects. He penned geographical encyclopedias, the largest called *Rawd-Unnas wa Nuzhalat Nafs* (Pleasure of Men and Delight of Souls). Al-Idrisi also inscribed on the themes of fauna, zoology and therapeutically features. His work was soon translated into Latin and his books on geography especially stayed famous in the East and West for more than a few decades.<sup>xxix</sup>

*Abu Muhammad Ibn al-Baitar* was one of the paramount Muslim scientists from Spain and one of the chief botanists and pharmacists of the Middle Ages. He travelled on many wandering voyages to gather plants as far as Africa and Asia. He wrote *Kitab al-Jami al-Adiwaya al-Mufrada*, one of the supreme botanical accumulations of medicinal plant written in Arabic. The encyclopedia was completed of over 1,400 items, many of which were not known before. The book discussed the works of 150 authors, mostly Arabic and cited about 20 early Greek scientists. It was translated into Latin and printed as late as 1758.<sup>xxx</sup> Ibn al-Baitar’s works were categorized by thoughts, investigation and

classification and exercised a profound influence on Eastern as well as Western botany and medicine. Many of his works were translated into and published late in the western languages. Many earlier scientists had deliberated numerous portions of his books and quoted a number of references to it. Medicine is regarded as one of the extensive fields of life sciences to which Muslims had noticeable influence. These contributions were unprecedentedly comprehensive, divergent, and educative to the level that the recipient spectator of these everlasting influences may have faith in that medicine which may not be present earlier to the advancement of Muslims.<sup>xxxii</sup> When Islam emerged, Arabs, during the pre-Islamic era, were familiar with this primitive medicine. Prophet Muhammad, (Peace be upon him (p.b.u.h) called for medication. Osama bin Sharik (May Allah be pleased with him) quoted the Prophet as saying:

*“Seek medication because Allah has created a medication for each disease except senility”*

Prophet Muhammad (s.a.w.) was known to strive for medication with honey, dates and natural herbs, among other materials which were known as *“Prophetic Medicine”*. However, Muslim scientists did not confine themselves to *“Prophetic Medicine”*; they understood that life sciences, including medicine, necessitate constant investigation and surveillance. Muslim medical scientists were described by their understanding of specialization. They were, for example, categorized into ophthalmologists identified as (Al-Kahalyin), surgeons, practitioners of the so-called hijama, known as hajjamoun, and gynecologists, among others.<sup>xxxiii</sup>

During the Abbasid era, Muslims outshone in all branches of medicine. They amended the mistakes made by their former counterparts in various concepts. Moreover, they did not constrained themselves to sheer copying and translation; rather, they continued doing research and rectified the errors of their predecessors.<sup>xxxiii</sup>

### **Conclusion**

Contributions of Muslims in science, technology and entrepreneurship from the 8<sup>th</sup> to 16<sup>th</sup> century is a noteworthy expansion in human antiquity. The Muslim scholars not only conserved the ancient knowledge, but also transformed it into major new contributions to basic science and technology. The basic contributions were in fields such as astronomy, chemistry,

mathematics, philosophy, geography, and physics, which constitute the basis of modern science and technology. They also provided connectivity between Arab and the other parts of the world like the Far East, Middle East, and European regions by distributing knowledge. Islamization of Knowledge (IOK) is the correct solution for our problems. It seems that Islamization of Knowledge is essential to be established because it will cleanse the contemporary corrupted knowledge which is believed to be the main downfall of Muslims. Muslim societies can embrace the spirit of scientific progress and accomplishment of early Islamic scholars. They could adopt and adapt the technological advancements of the West to address their own conditions and contribute their own discoveries through promoting Islamization of Knowledge in their education sector because it integrates the beautiful heritage of Islam with modern science by undertaking a certain methodology. But certainly integration of two types of knowledge needs a qualified Islamized expert or institution which undertake the Islamic worldview comprehensively and the Sciences of the time.

Science and technology can prosper among Muslims again, and others, if the conditions for free inquiry, proper incentives, institutional support, and the benefits of science are encouraged.

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