ACHIEVEMENTS OF MUSLIMS IN THE FIELD OF SCIENCE AND TECHNOLOGY

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A history of Muslims' contribution to present-day science and technology is the exploration of the missing account of their glorious past. The Prophet Muhammad's (SAW) arrival opened a new epoch in the history of the Arabs. Soon after, Muslims successfully conveyed the message of Islam from the Arabian Peninsula to the Iberian Peninsula and from the frontiers of China to India. Muslims integrated science, theology, and philosophy as they were urged to study, acquire knowledge, and learn from others' expertise and civilization. They thus excelled in medicine, mathematics, astronomy, geometry, geology, mineralogy, chemistry, philosophy and architecture, and it was their greatest achievement to establish trigonometry as a distinct branch of mathematics. Muslim scholars began acquiring Greek treatises and initiated their study and rendering into Arabic. They examined critically, collated, corrected and enriched significantly major texts of Greek science and philosophy. The ensuing era started what is known as the Golden Age of Islam, which lasted for over two centuries. The present study is an attempt to examine the contribution of Muslim scientists, philosophers and theologians in the promotion of science and scientific research in various periods of history. Based mainly on Arabic, Persian, Urdu and English sources, the study focuses on the intellectual legacy of the Muslims, their interest in the progress of science and philosophy and its impact on the West.

Introduction

Within three years of the death of the Prophet Muhammad (SAW) in 632 CE, Muslims had fully united the Arabian Peninsula, and begun to spread their faith into the territories ruled by the Byzantine and Sassanid emperors, the great powers of the period. Islam swiftly spread to Persia, Iraq, Syria, Egypt and Jerusalem, and even moved into Central Asia and western North Africa. In less than half a century saints and scholars of Islam had successfully opened up the gates of the world to Islam.[1]

Due to their indomitable faith Muslims had brought under their influence not only the entire Arabian Peninsula, North Africa and the Iberian Peninsula, but also large parts of the Indian subcontinent as well. Within a single century Islam had spread almost six thousand miles between the Atlantic and the Indian Ocean.[2] On the other hand, Muslims had shown keen interest in reading, writing and learning. The very first revelation that came to the Prophet Muhammad (SAW) was a command to read and write, and in the praise of the pen, which is the only means or custodian of human knowledge.

The Qur'an bears ample witness to this emphasis on learning in Islam:

> Read with the name of thy Lord, Who createth,
> Createth man from a clot. Read, and thy Lord is the
> Most Bounteous,
> Who teacheth by the pen:
> Teacheth man that which he knew not.[3]

Due to Allah's command Muslims tried to seek knowledge and advancement for the betterment of mankind to know the creation and its purpose. Islam urges its adherents to be dynamic and energetic in the pursuit of knowledge. Allah has made the universe subservient to human knowledge as stated in the holy Qur'an:

> And He has subjected to you, as from Him, all that is in the heavens and on earth: behold, in that are signs indeed for those who reflect.[4]

In the sayings of the Prophet SAW, seeking the knowledge has been put down as a duty. For example:

To acquire knowledge is the duty of every Muslim man and woman.[5]

Emphasis on Science in the Early Islamic Period

Caliph Amir Muawiyah (602-680) was the first to appoint a Christian as chief secretary at his court; he also appointed Ibn Athal, a Christian physician, as the district magistrate of Hams. The latter translated several medical books into Arabic for the Caliph. This was the initiation of translation work for the Muslims. Prince Khalid bin Yazid (d.704), a grandson of Caliph Amir Muawiyah, was an expert in Islamic sciences who wanted to learn chemistry and medicine. Khalid consulted Jewish and Christian scholars because they were the only skilled persons in those days in the discipline. He studied chemistry with Miryanis, a Christian from Ruhban. Khalid authored three treatises in chemistry, and patronized much translation of different classical books into Arabic. This gave a fillip to the study of science among the early Muslims, which led to the Islamic resurgence.[6]

This surge in Arabic learning had already begun in Egypt just after the arrival of Islam; within a short time people started to learn Arabic. Soon Arabic replaced Coptic as the lingua franca of Egypt. Ibn Nadim reported that for the first time in the history of Islam books were translated from Coptic to Arabic by the translators appointed by Prince Khalid. Astafan was the famous translator of that period. Caliph Marwan ibn Hakam (684-685) directed Maserjawayis, a Jewish physician, to render Bishop Aaron's books on pharmacopoeia from Syriac to Arabic. This book was kept in the royal library at Damascus. By the order of Caliph Umar ibn Abdul Aziz (c. 682-720) many copies were made. Ibn Abjar, a physician professor from Alexandria, embraced Islam at the hands of Umar ibn Abdul Aziz who on becoming caliph appointed him as the chief physician at his court.[7]

Science under the Abbasids

The foremost initial contribution to science and learning in Abbasid period was that translation of Greek scholarship in science and philosophy into Arabic.[8] Particularly, the Muslim translators saved the rare works of Hippocrates (c.460-360 BCE) and Galen.[9] Within a short time Muslim philosophers, mathematicians, physicians, geographers, alchemists, botanists and their peers in different disciplines had worked throughout the caliphate and achieved the amazing feat of uncovering the vast intellectual heritage received from the earlier civilizations. Their contributions to various disciplines are discussed below:

Mathematics

In the initial days of Islamic reawakening a number of Greek and Indian works on geometry and arithmetic were translated into Arabic. Muslim mathematicians altered the nature of numbers, updated some mathematical disciplines, and developed an almost new branch of mathematics.[10]

In terms of calculation system Muslims generally used three techniques: finger counting digits imaging alphabets and numbers varying from 0 to 9. Muslim geometers and mathematicians studied very prudently the fifth postulate of Euclid regarding the fact that one and only one parallel line can be drawn to an existing line from a point outside of that line. Muslim mathematicians presented alternative proofs of non-Euclidian theorems.[11]

In algebra, Abu Abdullah Muhammad ibn Musa Al-Khwarizmi (c.780-850) combined Babylonian and Indian numerals into simple and feasible structures that everyone could use. He explained the use of zero and advanced the decimal system for practical reasons. Both the terms "algebra" and "algorithm" owe their currency to him.[12]

Banu Musa, who examined problems in constructing unified geometrical figures. Muslims carried out practical applications of their studies by applying advanced geometry to surveying, designing and improving all types of wheels, including waterwheels and more advanced methods of drawing water, refining the design of farming equipment, and developing engines, machines for load traction and lifting or weighing.[13]

One great Muslim scholar who made singular and matchless contribution to the fields of Mathematics and trigonometry was Khwaja Nasir al-Din al-Tusi (1201-1274). He was born in the evening shades of the Abbasid era. Born on 18 February 1201 at Tus, Khurasan and died on 26 June 1274, Baghdad, Iraq. He was one of the outstanding philosophers, scientists, mathematicians and astronomers of all times.[14] He received his early education in Tus under the tutelage of his father. In pursuit of higher learning Tusi went to Nishapur where he studied philosophy under Fariduddin Damad and mathematics under Muhammad al-Hasib. He also studied mathematics and astronomy with Kamaluddin Yunus (d.639/1242) and became famous astronomer. *Tahrir al-Majisti* (Redaction of al-Majist) Revision of Ptolemy's Almagest; the epistles of Theodosius, Hypsicles, Autolucus, Aristarchus, Archimedes, Menelaus, Thabit b. Qurra and Banu Musa *Kitāb al-Shakl al-qattā* (Book on the complete quadrilateral i.e. spherical trigonometry).[15]

Astronomy

Astronomy was believed to be one of the mathematical sciences by the early Muslim scholars because mathematics has close relationship with it. The interest in astronomical studies came down to the Muslims through the study of Ptolemy's *al-majist*. By the eighth century al-Mansur, the second Abbasid caliph, had brought together a group of Persian, Indian and other scholars to Baghdad, which led to the real breakthrough of Islamic science. *Al-majist* was rendered several times into Arabic. Hunayn ibn Ishaq (809-877) made his own Arabic version of *al-majist*.[16]

The Muslim mathematician Ibrahim al-Fazari (d. 161/777) was the first person who built an astrolab. He wrote on the use of the armillary sphere (a skeleton sphere made up of hoops to show the motions of the heavenly bodies), and made tables in accordance with the Islamic Calendar. His son Muhammad ibn Ibrahim al-Fazari (d.796 or 806) was also a mathematician, who excelled in the science of the stars. He was an authority on the planetary motion. Al-Mansur ordered that Brahmagupta's *Siddhanta* should be translated into Arabic so that Arabs might use it as a basis for calculating the orbits of planets. Muhammad ibn Ibrahim al-Fazari rendered it as *Sindhind al-Kabir*, and his translation became the main source of astronomical knowledge until the time of Caliph al-Ma'mun. He was the first among the Muslims in the early Abbasid era to get involved in this type of science.[17]

One the profound scholars of that period were Ahmad ibn 'Abdallah Habash al-Hasib al-Marwazi (d. 870), al-Khwarizmi and Abu Ma'shar. For astronomical calculations, al-Khwarizmi relied on the *Sind-hind* method but in adjustment he relied on the method followed by the Persians.[18] Among the astronomers the outstanding one was Habash al-Hasib under whose guidance "Ma'munic" tables were drawn up. He developed a method of calculating celestial distances exactly. He calculated the perimeter of earth, the diameter of moon and also calculated tables of trigonometric values and the sine values at one-degree intervals of three places. He was the first to make a table of tangent values. He developed a graphical method to find the *qibla*, a method of calculating the distance "by the straight arrow" or the great circle distance between Baghdad and Makkah to be 677 miles, while the accurate distance was to be 712 miles. Al-Hasib was the first to calculate the exact appearance of the new moon. His book *Kitab al-ajram w-al-a'bad* (The Book of Bodies and Distances) is of astronomical use.[19]

The 9th century witnessed rapid growth in astronomy under famous scholars like Abu'l-'Abbas al-Fadl ibn Hatim al-Nairizi, a Persian mathematician and astronomer who worked under Caliph al-Mu'tadid (892-902). Al-Nairizi compiled astronomical tables and wrote a book on

atmospheric phenomena. He wrote a treatise on the *spherical astrolabe* and commentaries on *Al-magest* and Euclid. His work on astrolabe is divided into four books: Historical and critical introduction; description of the spherical astrolabe; its superiority over plane astrolabes and all other astronomical instruments; the third and fourth are Applications.[20]

Thabit ibn Qurrah (836–901) was an astronomer, mathematician and physician also known as a great translator. He studied under the renowned mathematician of the Abbasid court, Muhammad ibn Musa ibn Shakir, at Baghdad. In astronomy he is reputed for justifying the theory of the oscillatory motion of the equinoxes. Thabit has mathematized astronomy to a great extent. He was one of the early reformers of Ptolemaic views, analyzed several problems related to the movements of sun and moon and wrote treatises on sundials. He was active in broadening the notion of traditional geometry to geometrical algebra and developed a number of theories in non-Euclidean geometry, spherical trigonometry, integral calculus and numbers. He rejected many of Euclid's theorems or suggested significant modifications.[21] He studied different aspects of conic sections by applying arithmetical terminology to geometrical quantities mainly on parabola and ellipse. His calculations are designed to find the surfaces and volumes of various kinds of bodies and structure. Estimates of his scientific works vary between thirty to forty, but only nine of them survived.[22] Abu Abdallah Muhammad ibn Jabir ibn Sinan al-Battani's (244-317/ 858-929) improved Ptolemy's measurement of the obliquity of the ecliptic 23°, 35' by testing data; the determination of the equinoxes and the length of the year as being 365 days, 5 hours, 46 minutes and 24 seconds.[23]

'Abd al-Rahman al-Sufi (903-986) also called Azophi, was a Persian scientist who wrote his magnum opus on stellar astronomy entitled *Suwar al-Kawakib al-Thabit al-Musawwar* in 964. Al-Sufi in his atlas of heavens (*book of constellations*) expresses the 'nebulosity' of the nebula in Andromeda.[24] After getting information from Arab sailors in the Malay Archipelago, al-Sufi identified the southern group of stars *al-Baqar al-Abyad* or the 'White Bull', presently this cluster of stars identified as Nubecula Major (the greater Magellanic Cloud).[25]

No account of Muslims contribution to astronomy will be complete without including al-Tusi's contribution to astronomy. As mentioned earlier he studied mathematics and astronomy with Kamal al-Din Yunus and became famous astronomer. During his stay at Nishpur he joined the lectures of Qutbuddin al-Misri and also met Fariduddin Attar, a great Sufi Shaikh. He also corresponded with al-Qunawi, the son-in-law of Ibn al-Arabi. During Mongol debacle of Persia, al-Tusi rendered his services as an astronomer to Hulagu Khan who made him in charge of religious endowments (*awqaf*), and al-Tusi successfully persuaded Hulagu to establish Maragha observatory.[26] For most part of his life he worked at Maragha and brought greater revival in mathematical and astronomical studies. He wrote commentaries on the Greek mathematical texts Euclid to Ptolemy. His *Zij-i Ilkhani* (1271) (Ilkhan Tables) is amazingly accurate table of planetary movements based on research at the Maragha observatory. This astronomical table at Maragha was named after Ilkhans. A lunar crater (60 Km diameter) located on the southern hemisphere of the moon is named after him as 'Nasireddin'. Soviet astronomer Nikolai Stepanovich Chernykh named after him a minor planet (10269 Tusi) discovered in 1979. He composed a treatise on the heavens based on Al-Hazen's resume of astronomy.[27]

Al-Tusi also devised his celebrated Tusi Couple and presented a hypothetical model of epicyclical motion that involved a combination of motion each of which was uniformed with respect to its own centre. This model was applied to the applied to the motions of all heavenly bodies in the fourteenth century by the astronomer Ibn al-Shatir. Similarly al-Tusi was the first to treat trigonometry as a separate discipline independent of spherical astronomy. It enabled astronomers to compute distances and directions of points on the celestial spheres more efficiently and precisely than ever before.[28]

Medicine

The medical science of the ancient Greeks revolutionized the initial idea of the study of medicine in the early Arab scholars of the east. The

Muslim conquest of Egypt and Persia paved the way for Muslims to gain control over both Alexandria and Jundishapur (modern Shahabad, Iran), the early centres of science and medicine. The translation work for the Muslims was launched during the Umayyad period. Caliph Amir Muawiyah was the first to appoint Ibn Athal, a Christian physician, as the district magistrate of Hams. There he translated several medical books into Arabic for the Caliph. Prince Khalid bin Yazid studied chemistry with Miryanis, a Christian from Ruhban. Astafan translated books from Coptic to Arabic for Prince Khalid. Maserjawayis, a Jewish physician, was directed by the Caliph Marwan ibn Hakam to render Bishop Aaron's books on pharmacopoeia from Syriac into Arabic. Caliph Umar ibn Abdul Aziz ordered multiple copies of the book. Ibn Abjar, a physician professor from Alexandria, embraced Islam at the hands of Umar ibn Abdul Aziz who on becoming caliph appointed him as the chief physician at his court.[29]

The Muslim contact with Jundishapur began by a coincidence due to the sickness of Caliph al-Mansur, who sought medical assistance for his ailment of dyspepsia in 148/765. After his successful treatment caliph al-Mansur became a zealous patron of the study of medicine and invited scholars to translate medical books into Arabic, which led to the Islamic reawakening. The vast translation movement that started at the end of the 8th century left an indelible mark on the history of mankind.[30] The Muslim scholars' interest in the study of medicine was based largely on the writings of Hippocrates (460-370 BCE), Aristotle (284-322 BCE), Dioscorides (c.40-90 CE), Galen (131-201CE), Oribasius (320-403) and Paul of Aegina (c.625- c.690). The great educational movement marked the Golden Epoch of Islamic civilization which reached its pinnacle during the 10th century.[31]

The Abbasid caliphs were profoundly involved in obtaining original Greek classical tomes by providing funds and using diplomacy. Muslim scholars directly translated Greek books into Arabic, and not from Syriac. By the end of the 9th century most important titles had been translated into Arabic. It clearly shows that all available early books

were transferred into Arabic. The Muslim scholars did not imitate blindly the texts of their Greek pioneers, but they examined critically, collated, corrected and enriched significantly the major texts of Greek medicine. With this goal, Muslim scholars paid serious attention and devoted their energy to serving humanity. They enriched their knowledge by absorbing the accomplishments of early Greece as well as enhanced their intellectual scope from Syriac, Persian and Indian sources.[32]

Yuhanna ibn Masawayh (777-857) was famous in Europe as Mesue Senior, one of the early distinguished physicians in Islam. He was born in Jundishapur where his father worked thirty years as a pharmacologist in the hospital's dispensary. Later on Yuhanna moved to Baghdad in search of a better life, and studied under Jibril ibn Bakhtishu. In this affluent city he became a renowned ophthalmologist and the private physician of Caliph Harun al-Rashid.[33] Ibn Masawayh wrote on barley water (*Ma'ash Sha'ir*), its nutritional and medicinal value; on food and drink and their making: *Fi al-Aghdhiyyah*, *Fi al-Ashribah* and *at-Tabikh*. He also wrote on monitoring one's health, *Tadbir al-Asihhah* on bathing, on averting unhealthy effects of certain foodstuff, on poisons and their cure, and on purgative medicines.[34]

Ibn Masawayh wrote mostly in Syriac and Arabic and composed earliest medical treatises on ophthalmology. He penned a treatise of 132 medical aphorisms, *Kitab al Nawadir al-Tibbiyah* (Latin *Aphorismi Iohannis Damasceni*). He authored *Kitab al-Mushajjar al-Kabir*, a guide to medicine with a brief account of diseases, symptoms, diagnosis, treatments and diet. His earliest treatise, *Daghal al-'ain* (Disorder of the Eye) is still extant. He is credited with one more work on ophthalmology, *Marifat mihnat al-kahhalin* (*Knowledge of the Oculist Examination*). Ibn Masawayh had three sons, among them Yuhanna gained recognition in his field. Caliph Harun Rashid established a specialist hospital in Baghdad and Yuhanna was appointed its superintendent and also directed by the caliph to supervise translations.[35]

Abu al-Hasan Ali ibn Sahl Rabban al-Tabari (c.810- c.861) was a renowned physician of his time who compiled an encyclopaedia of medicine with particular reference to paediatrics and child development. He pointed out the gravity of tuberculosis and explained its adverse affects.[36] His major books are *Firdaus al-Hikmah, Tuhfat al-Muluk* (The King's Present); *Kitab al-Din-w-Daulat* (Book of Religion and State); *Hafzh al-Sihhah* (The Book for Preservation of Health); *Kitab al-Ruqa* (Book of Magic or Amulets); *Kitab fi al-Hijamah* (Treatise on Cupping); and *Kitab fi Tartib al-'Ardhiyah* (Treatise on the Preparation of Food).[37]

Abu Yusuf Yaqub ibn Ishaq al-Kindi (c. 185/801- c. 260/873), was popular as al-Kindi, but also known as Alkindus in the West. He was renowned as 'the philosopher' of Islam who contributed to medicine and science.[38]

Abu Bakr Muhammad ibn Zakriya ar-Razi (841-924) known in the west as Rhazes and Albubator worked as a chemist and pursued his study of medicine to become a distinguished physician. He was an intellectual and the most innovative of all the Muslim physicians.[39] He was one of the most profound and prolific writers of his age, and left voluminous writings. Gerard of Cremona rendered this work into Latin with the title *Liber ad Almansorem* in which on the topics of anatomy and physiology Ar-Razi followed a similar approach to those of Hippocrates, Galen and Oribasius.[40] He put forward an exclusive study of the various organs of the body, and contributed a chapter on the theme of maintaining health and another on the diets and the drugs and their effect on the human body. He mentions the exceptional taste of certain foods, drinks and medicine whether sweet, sour, bitter or severe. He classifies the attributes of medicine into two---theory (*'ilm*) and practice (*'amal*). The last part he devotes to patients' care during the recuperating period. He wrote *al-Tibb ar-Ruhani*, spiritual cure, in which he examines the rational and visionary nature of mankind, and the issues akin to human sufferings, weaknesses, happiness, desire, annoyance, pain, greed, intoxication, virtues and death. Ar-Razi was so insightful in his practical knowledge that he dived deep into human psyche, its intricacies where

he validated the significance of psychotherapy and psychology as two essential areas of the healing art. His book on medicine became a textbook in the medical institutions of Europe for over a century.[41]

Chemistry

The Arabic word *Al-kimia'* and its Latin cognate *'Chem'*, the precursor of modern 'chemistry' are derived from the ancient Greek word '*Chemeia*'. Prior to the rise of Islamic civilization, the subject of alchemy and its basic characteristics was well established by the ancient Hellenistic sages. The development of Islamic alchemy was begun in the 7th century with the writings of Prince Khalid bin Yazid who translated Greek books on chemistry into Arabic. Ibn Nadim recorded four books of Khalid, namely *Kitab al-Hararat, Kitab al-Sahifat al-Kabir, Kitab al-Sahifat al-Saghir*, and *Kitab Wasiyya il'l Ibnuhu fi'l San'a.*[42]

Abu Musa Jabir ibn Hayyan (721- c. 815), with his name Latinized as Geber in the West was the father of Muslim alchemy at Baghdad. He was not only universally recognized in the Muslim world but in the West as well. Jabir's science of *al-kimiya,* from which both Arabic words 'alchemy' and 'chemistry' stem, was based upon the Hellenistic view that all metals are basically the identical matter, but with varying impurities. But his predominant work remains alchemy where he provides a rational basis for the expansion of chemistry and pharmacy. He was the founder of experimental chemistry, and was outstanding in his laboratory work by examining and analyzing a great many substances.[43] Jabir was the first to prepare sulphuric acid by distillation, and he prepared mercury oxide and nitric acid. He distilled hydrochloric acid, and was the first to discover caustic soda, as well as the first to regain silver nitrate. He prepared mercury chloride, and also invented aqua regia that could dissolve gold.[44]

Similarly, ar-Razi developed sutures made from animal skin known as "Al-Qissab" and was the first to make mercury ointment. He evolved wonderful methods of distillation and extraction, which have led to his

finding of sulphuric acid by dry distillation of vitriol (al-zajat) and alcohol.[45] In his book *Sirr al-Asrar* (the Latin *Liber Secretorum bubacaris*), ar-Razi divides his subject matter into three categories: (1) the identification of drugs from plant, animal, and mineral origins and its use in treatment; (2) the understanding of equipment and tools used; (3) the familiarity of the seven alchemical procedures and techniques like sublimation and condensation of mercury, precipitation of sulphur and arsenic etc.

Geography

The first Muslim geographer was Hisham al-Kalbi (747-819/821). He was expert in Arabic, had good knowledge of Aramaic, Pahlavi, and South Arabian dialects. He wrote many books in different fields and subjects.[46] Muhammad ibn Musa al-Khwarizmi, the noted mathematician and astronomer, worked on geography too. His *Kitab Surat-al-Ard* (*Book of the Shape of the Earth, with its cities, mountains, seas, all the islands and rivers*) triggered Muslims' keen interest in geography. The book is an improved version of Ptolemy's *Geographiae* together with maps. Al- Khwarizmi corrected the data for the length of the Mediterranean Sea and the location (degrees of longitude) of the cities in Asia and Africa.[47]

Abul Hasan Ali ibn Husain al-Masudi, author of *Muruj al-Dhahab wa-Ma'adin al-Jawhar* (d. 345/ 956), is known as Herodotus of the Arabs because he combined history with scientific geography. He prepared a world map, and travelled widely in Spain, Russia, Persia, Central Asia, India, Zanzibar, Near East and the Muslim world.[48]

Abu Ishaq Ibrahim al-Farsi al-Istakhri, author of *Kitab Masalik al-Mamalik* (d. 340/951) travelled widely in a number of countries, including India, where he met his contemporary Ibn Hauqal. In his book al-Istakhri drew a world map including Sindh because he visited the region in 951. Apart from the socio-political and cultural aspects of the region he left valuable information about its climate, vegetation and

agricultural products. Al-Istakhri left an example of map making and success in cartography.[49]

Conclusion

The Muslim contribution to science and medicine comprises, first, bringing to light (a) the work of ancient Greek scholars in the field of science, and (b) bringing to the knowledge of Europe the works of Indian men of science especially in mathematics, astronomy and medicine. Through their translation of classical texts in Latin and Sanskrit, the Muslim scholars gave impetus to further research and thinking related to the questions of science. It's a pity that their works were not known outside the circle of dedicated students of science.

Muslims acquired the diverse cultural heritage of Asia, Greece, Rome and Byzantium as well as India. They preserved and altered much of this cultural heritage according to Islamic norms and values. The most valuable contribution of Muslims was in the fields of medicine, astronomy, mathematics and natural sciences. The multi-ethnic and multilingual elite community that included Christians, Jews and Muslims were the pioneers of translation movement of the classical scientific books. The success of this amazing scientific association and broad-mindedness of rulers of the time paved the way for the Islamic reawakening. It is the Islamic civilization that paved the way for the West's revolutionary achievements in science.

We can gauge the importance of science and quest for knowledge under the Abbasids with the intellectual revolution that came in the wake of translation work promoted by al-Ma'mun. He encouraged people to bring books to him and exchanged them for their weight in gold. With this enthusiasm, within a short period, Muslims successfully transferred all kinds of extant knowledge at that time into Arabic. Soon Arabic became the language of Islam and science and many scientific terms current in today's science are borrowings from Arabic. Some of the ancient classical tomes owe their survival to Muslim scholars and rulers.

Furthermore, science and medicine thrived for two centuries in the Abbasid caliphate. However, the latter Abbasid period has shown a markedly slackened intellectual zeal for science. The causes of this slump might be cultural and difficult to isolate: the absence of stable government and court patronage, the fall of some kingdoms and the lack of suitable environment that resulted for it, sectarian intolerance, luxury loving courts and sycophancy they encouraged; the decline of Muslim power in different countries, and rise of nationalism leading to the narrowing of horizons.

Nevertheless, from the 8th to the middle of the 10th century the intellectual legacies of the Muslims and their contributions to various fields of science left an enormous impact upon the people. The legacy of Islam found its appearance in renaissance in Europe, in the 14th to 16th centuries. Prejudice in the West in later centuries not only tried to minimize the Muslims' contribution to different sciences, but also distorted the names of the original scientists beyond recognition. For example, Bertrand Russell remarks:

Arabic philosophy is not important as original thought. Men like Avicenna and Averroes are essentially commentators. Speaking generally, the views of more scientific philosophers come from Aristotle and the Neoplatonists in logic and metaphysics, from Galen in medicine, from Greek and Indian sources in mathematics and astronomy, and among mystics religious philosophy has also an admixture of old Persian beliefs. Writers in Arabic showed some originality in mathematics and in chemistry---in the latter case, as an intellectual result of alchemical researches. Mohammedan civilization in its great days was admirable in the arts and in many technical ways, but it showed no capacity for independent speculation in theoretical matters. Its importance, which must not be underrated, is as a transmitter. Between ancient and modern European civilization, the dark ages intervened. The Mohammedans and the Byzantines, while lacking the intellectual energy required for

innovation, preserved the apparatus of civilization----education, books, and learned leisure. Both stimulated the West when it emerged from barbarism---the Mohammedan chiefly in thirteenth century, the Byzantines chiefly in the fifteenth. In each case the stimulus produced new thought better than any produced by the transmitters------in the one case scholasticism, in the other the Renaissance (which however had other causes also).[50]

It is only in recent years that the work of Muslim scientists is being accorded its due place in the development of science. Indeed, the Muslims cannot ever forget their Prophet's emphasis on the pursuit of knowledge.

> Whoso meets with death while in search of knowledge to bring Islam back to life, there will be only one degree in Paradise between him and the Prophets?[51]

Notes and References

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[1] Isma'il, R. al-Faruqi and Lois Lamya al-Faruqi, *The Cultural Atlas of Islam*, New York: Macmillan Publishing Company, 1988, 212-215; Muzaffar, Iqbal, *Islam and Science*. England: Ashgate Publishing Limited, 2002, 6-8.

[2] *Ibid.*, 216-228; Howard R. Turner, *Science in Medieval Islam: An Illustrated Introduction*, Austin: University of Texas Press, 2002, 5-7.

[3] *Al-Qur'an*, Al-Alaq: 1-5.

[4] *Al-Qur'an*, Al-Jathiyah: 13.

[5] *Bukhari-Muslim*: 2.

[6] Ibn al-Nadim, Abu al-Farj Muhammad, *Al-Fihrist*. Cairo, n. d., 243; Ibn Khallikan, Shams al-Din Ahmad Muhammad ibn Abu Bakr.

Wafayat al-Ayan wa- Anba Abna al-zaman. Ed. Ihsan Abbas, Beirut: Dar Sader, 1377/1977, 2: 224-226; Shibli 1989, 4-5.

[7] Sulayman ibn Juljul, *Tabaqat al-Atibba wal Hukama*. ed. Fuad Sayyid, Cairo: Institut Franc d'Archeologie Orientale, 1955, 61; Ibn Nadim 1884, 419; Ibn Abi, Usaybah. *Uyun al-Anba fi Tabaqat al-Atibba*, Ed. M. Mukler. Cairo, 1884, 226; Shibli 1989, 5-6; D. M. Dunlop. *Arabic Science in the West*. Karachi: Pakistan Historical Society, 1988, 2-3; Muzaffar 2002, 14.

8. Ibn Juljul, 187; Ibn Nadim 1884, 357.

9. Donald Campbell, *Arabian Medicine and its Influence on the Middle Ages*, I, London: Routledge, 2002, 3-12; M. A. Saleem Khan, *Early Muslim Perception of India and Hinduism*, New Delhi: South Asian Publishers, 1997, 210.

[10] Turner 2002, 44.

[11] *Ibid.*, 45-46; Al-Faruqi 1988, 331.

[12] Al-Faruqi 1988, 331; Adel S. Bishtawi. *Origin of the Arabic Numerals*. London: Books Publishing, 2008, 206; Muzaffar Iqbal 2002, 37, 72; Turner 2002, 47; Mohammad R. Mirza, 2003, 7-8, 113; Seyyed Hossein Nasr, *Science and Civilization in Islam*, Shah Alam: Dewan Pustaka Fajar, 1984, 45.

[13] Turner 2002, 46-47; Baharudin Ahmad 2008, 352-353.

[14] Hossein Nasr 1984, 55-56, 81; Turner 2002, 204.

[15] *Ibid.*, 54; *Ibid.*, 68

[16] *Ibid.*,168; *Ibid.*, 61.

[17] Sa'id al-Andalusi. 1996, 46-47; al-Qifti, 177-178; Ibn Nadim 1884, 381; Abu al Hasan Ali ibn Husain al-Masudi. *Muruj adh-Dhahab wa Maadin al-Jawhar*. Bayrut: Dar al-Fikr, 2000, 1: 150; David Pingree, 1970, 103-106; Dunlop 1988, 6.

[18] Hossein Nasr 1984, 169.

[19] *Ibid.*; Helaine 1997, 392.

[20] *Ibid.*, 170.

[21] Al-Faruqi 1988, 331; Hossein Nasr 1984, 44; Helaine 1997, 376-376; Roshdi Rashed 2009, 601-605; Turner 2002, 30.

[22] Selin Helaine 1997, 377; Rashed 2009, 617; Hossein Nasr 1984, 45, 149; Mohammad R. Mirza 2003, 186; Al-Faruqi 1988, 332.

[23] Hossein Nasr 1984, 170; Turner 2002, 65; Muzaffar Iqbal 2002, 112, 176; al-Faruqi 1988, 332.

[24] Mohammad R. Mirza 2003, 177; Turner 2002, 71.

[25] *Ibid.*, 78; Turner 2002, 71; Muzaffar Iqbal 2002, 87-88; Mohammad R. Mirza 2003, 178.

[26] Hossein Nasr 1984, 55; Turner 2002, 68.

[27] *Ibid.*, 55; *Ibid.*, 68, 105-106.

[28] *Ibid.*, 55-56; *Ibid.*, 68-69, 105-106.

[29] Shibli 1989, 4-5; Muzaffar 2002, 14; Munawar A. Anis and Sami K. Hamarneh eds., *Health Sciences in Early Islam*, II, Texas: Noor Health Foundation/ Zahra Publications, 1984, 78.

[30] Hossein Nasr 1984, 193; Munawar 1984, 43.

[31] Shibli 1989, 9-12; al-Faruqi 1988, 324; Mohammad R. Mirza 2003, 122; Saleem Khan 1997, 184; Campbell 2002, 60; Munawar 1984, 243.

[32] Campbell 2002, 60-65; Saleem Khan 1997. 210.

[33] Hossein Nasr 1984, 193; Muzaffar Iqbal 2002, 41; Campbell 2002, 62; Al-Faruqi 1988, 324.

[34] Ibn Nadim, 425-426; Ibn Abi Usaybah 1882, I, 175-183; Munawar 1984, 70, 245.

[35] Ibn Abi, Usaybah 1882, 136, 173; Hossein Nasr 1984, 94-95; Shibli 1989, 17; Al-Faruqi 1988, 324.

[36] *Ibid.*, 196; Mohammad R. Mirza 2003, 186, 195; Khan 1990, 20-21; Al-Faruqi 1988, 324; Munawar 1984, 74.

[37] Hossein Nasr 1984, 196; Khan 1990, 23-25; Al-Faruqi 1988, 324.

[38] *Ibid.*, 43-44; Campbell 2002, 63.

[39] *Ibid.*, 128; Campbell 2002, 65; Saleem Khan 1997, 99.

[40] Hossein Nasr 1984, 46; Mohammad R. Mirza 2003, 114; Campbell 2002, 66.

[41] Munawar 1984, 84-85, 245.

[42] Ibn Nadim, 243; Shibli 1989, 5, 155; Hossein Nasr 1984, 245.

[43] Turner 2002, 190-191; Hossein Nasr 1984, 258-259; Muzaffar Iqbal

2002. 24-28; Al-Faruqi 1988, 326-327.

[44] Hossein Nasr 1984, 265-266; Turner 2002, 191; Al-Faruqi 1988, 328.

[45] *Ibid.*, 268-269.

[46] *Ibid.*, 99-100; Turner 2002, 118.

[47] *Ibid.*, 45; *Ibid.*, 119; Al-Faruqi 1988, 334.

[48] *Ibid.*, 36-37; *Ibid.*,208; *Ibid.*, 67; Al-Faruqi 1988, 333.

[49] *Ibid.*, 44-45; *Ibid.* 231., *Ibid.*, 68; Al-Faruqi 1988, 334.

[50] Bertrand Russell. *A History of Western Philosophy*. London: Unwin Hyman Limited, 1987, 420.

[51] *Daarimi, Mishkat*, I, 2563.