The Impact of Islam on European Civilization

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(published in Horizons of Thought Vol.1, 2014)

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[Preface]

The impact of Islamic civilization on the European civilization is undeniable. Muslims' philosophical, theological and scientific thoughts that were introduced to the Medieval West had a remarkable impact on different aspects of European life. Ibn Sina, Ibn Rushd and Ghazali's works left a tremendous influence on Western Medieval philosophy and theology. Mathematics, physics, chemistry, astronomy and medicine are other areas of influence. Some Western scholars in the Middle Age studied Arabic, and translated Islamic sciences into Latin. Through trade and crusade wars too some aspects of Islamic culture were transmitted to the West.

Science and Civilization in Islam

To assess the influence of Islam on Europe first one has to see what the status of Muslims was in science and civilization and what were their achievements that made them able to influence other nations.

Islam emerged in early seventh century. The prophet Mohammad (PUH) was born in 571, his mission started from 610 and his demise was at 632. In less than a century Islam expanded to include the area from Turkestan to Spain. By the junction of Islamic culture with other cultures such as that of Persia, Syria, Egypt, and Mesopotamia a new civilization emerged that was for a long time unrivaled. Since its emergence in the first Islamic century the Islamic civilization opened its way toward progress and development and till the eighth Islamic century it continued its growth and blossoming.

By emphasizing on thinking and reflection and encouraging its followers to seek knowledge at any cost, Islam paved the way to making a civilization based on knowledge and spirituality.

Many verses in the Quran encourage believers to use reason and strongly blame those who do not use their intellects. In some verses the Quran invites people to study natural phenomena such as the heavens, earth, animals, history and their own inner reality, i.e. soul. In the Prophet's word, seeking knowledge is an obligation for all Muslim men and women and scholars enjoys a higher position in the society. These teachings led Muslims to learn various sciences and save them from falling into oblivion.

The cornerstones of Islamic sciences and culture are the Quran (God's words) and Tradition (sunnah/words and deeds of the Prophet). These are reference sources for many Islamic sciences and the foundation for the Islamic way of life.

Since in Islam there is no limitation in seeking knowledge and knowledge is the missing of the believers, Muslims attempted to benefit from the sciences, arts and skills of other peoples and thereby enrich their own culture. To this purpose they started translating many works from various languages such as Persian, Indian, Syriac and Greek through which they saved many of these works from loss and disappearance. They developed different sciences and established many new sciences both in the domain of religion and other sciences and thereby they created an unprecedented civilization that for a long time was unsurpassed.

Religious sciences that Muslims established include the exegeses of the Quran, hadith tradition, theology (al-kalam), jurisprudence (al-fiqh), Islamic ethics (al-akhlaq) and so on. Muslims developed other disciplines and sciences such as philosophy, logic, mathematics, physics, chemistry, biology and astronomy and established new sciences such as optics, algebra, laboratory chemistry, trigonometry, geology, and sociology.

Ways of Influence

The impact of Muslims on Medieval Europe is so undeniable that any assessment of the history of this era without analysis of the role that Muslims played is incomplete. From around the eleventh century Medieval Europe gradually became familiar with some aspects of Islamic civilization and through Muslims with some of Greek heritages.

In general, one can say that the Islamic culture and sciences found their ways to Medieval Europe in four ways: 1) European intermingle with Muslims, 2) Scholarly works such as studying and translation, 3) Crusade wars, and finally 4) commerce.

1. European Intermingle with Muslims

From its very first centuries Islam expanded to some parts of the Europe. Up to 715 some Greek Islands, north Italy (Sicily), and many cities of Spain were under the domain of Islamic rule. Narbonne in the north of France was for a while under Muslim control. Spain and Sicily were among regions in which the Islamic culture and civilization flourished. Establishment of schools, scientific centers, houses of translations and emergence of prominent scholars in various fields were some of the results of this civilization. The City of Toledo was the center of cultural and scientific activities and had a rich library. Sicily was a center from which books were sent to different important European universities and effected the development of knowledge in Europe.

Muslims, Christians and Jews used to live together peacefully and exchange their knowledge and experiences. Muslims carried a reach culture and civilization and Europeans were eager to obtain it. Muslims in Europe had more cultural and scientific presence than political and military ruling, so that long after their political and military presences were over these cultural and scientific influences continued to be present. This mingling brought a dramatic change in all areas of life in regions Muslims dominated. Following this, agriculture, technology, for example paper industry, exploring minerals, art such as music and architecture, life style, urban development, philosophy, sciences and literature were unprecedentedly developed. As an example, Muslims brought irrigation systems to Spain after which various kinds of agricultural products such as different types of grains, fruits and vegetables flourished in Spain.

In addition to this, political relationships between some European and Islamic governments helped the transmission of the Islamic culture and civilization. Montgomery Watt says: “Charlemagne was in diplomatic relations with the caliph of Baghdad, Harun ar-Rashid, as well as with the latter’s enemy, the Umayyad emir of Spain; and by this channel some knowledge of the vastness and power of the Islamic world might have reached Europe.”

[2. Crusades]

2. One of the tragic events in the relation between Muslims and Europeans were the Crusades. The Crusade wars started around 1095 and continued up to 1291. Despite the fact that this long war had devastating losses and many casualties, by entering Europeans in the Islamic world and their close connection with Muslims they became acquainted with various aspects of Islamic culture and civilization and tried to adopt it and import it to Europe.

As an example, when Fredrick II conquered Jerusalem, he was astonished by Islamic architecture. In his court there were many Muslim mathematicians and philosophers. He learned Arabic and employed translators to translate Islamic works. He himself was interested in Islamic sciences. It is well known that he sent some philosophical questions to Ibn Sabin de Murci, a Muslim philosopher of Spain, and received the answers, which is known as Sicilian Questions.

3. Trade

Another way of Islamic cultural impact on Europe was through trade. Both Muslim and European merchants who imported goods to Europe from the Islamic world were effective in this issue. Muslim merchants in different parts of the world especially in East Asia played an important role in the expansion of Islam. As Watt says, Islamic culture did not developed in Europe only through Muslim presence, but the export of goods which were produced in Muslim lands was also effective in this regard. It is notable that Jewish merchants were also active in this area. They were familiar with different languages and played the role of medium between Islamic and Christian cultures.

Among the skills related to trade that developed in Europe were shipbuilding and seafaring. Seafaring was advanced among Muslims. From Kilwa in east Africa through Malaka Strait in Malaysia was covered by Muslim seafarers. In the second half of twelve century, Spanish and Portuguese shipbuilders more than others learned from Muslim experiences in this area. One of the Muslim contributions in this regard was the mariner's compass. Watt says:"The main steps in the development of the mariner's compass seem to have been shared between the Arabs and Europeans."

Another significant contribution of Muslims in advancing seafaring skills was providing nautical charts. One of the evidences in this regard is the presence of many Arabic words in European languages in this field. According to many historians, Europeans barrowed the science of Geography from Muslims. One of the influential scientists in this regard is Idrisi (1100).

4. Translation

A great number of European scholars traveled to the Islamic world and studied Arabic and Islamic sciences. They translated many books from Arabic and wrote some books in which they elaborated what they learned from Muslims. They also spread these sciences by teaching them in Europe. According to some sources in Medieval Europe, more than 1400 Arabic books in various fields of sciences were translated.

Translated works are in three categories:

First are Greek works which were translated from Arabic into Latin. Although some Greek works had already been translated into Latin, however there is no doubt that many important Greek works including some of Aristotle's works were translated from Arabic. In the middle of the twelve century, a translation center was established in Toledo in which, according to the advice of the Archbishop Raymond, many Greek books were translated from Arabic into Latin. Among these works were some books of Aristotle, the translation of the Book of Causes, which was a selection of Proclus' Elements of Theology and the famous Theologia which was mainly taken from a book of Plotinus.

The second group of books that were translated from Arabic into Latin was Muslim's interpretations of Greek philosophy and sciences, and the third group belonged to independent Muslim works. In this regard Russell writes:

"Their learned men read Greek, and wrote commentaries. Aristotle's reputation is mainly due to them…Their importance, for us, is that they, and not the Christians, were the immediate inheritors of those parts of the Greek tradition which only the Eastern Empire had kept alive. Contact with the Mohammedans [he means Muslims], in Spain, and to the lesser extent in Sicily, made the West aware of Aristotle; also of Arabic numerals, algebra, and chemistry. It was this contact that began the revival of learning in the eleventh century, leading to Scholastic philosophy…if the Arabs had not preserved the tradition, the men of Renaissance might not have suspected how much was to gained by the revival of classical learning."

From among the long list of scholars who contributed in the transmission of Islamic sciences to Europe here I mention only few names.

Gerber (938-1002), who later became pope, after three years studying Islam in Spain translated some Arabic books and also wrote some books such as Geometria and Liber de Astrolbia in which he elaborated some aspects of Islamic sciences.

Constantine the African (1015-1087) traveled to some Islamic lands and studied some Islamic sciences such as medicine and became familiar with some Greek works in Arabic such as those of Galen and Hippocrates. When later he became the assistant of Giscard he took the advantage of his position in spreading Islamic sciences.

Adelhard of England also traveled to some Islamic lands and became an influential figure in introducing Europe to some Islamic sciences.

Gundisalvi (1151) translated some works of Aristotle including his Metaphysics from Arabic. He, along with some others, translated some parts

of ash –Shifa of Ibn Sina (Avicenna), Maghasid al-falasifa of Ghazali (Algazel) and De Scientias of Farabi. He is also the author of some books such as The Division of Philosophy and The Immortality of Soul.

Jean of the Spain also translated some works of Ibn Sina and Ghazali.

Gherado de Ceremona (1114-1187) from Italy after learning Arabic and some Islamic sciences translated many books such as Megale Syntaxes of Ptolemy (Almagest) and works of Ibn Hazm.

Avenduth (Ibn Davoud), Alfred Anglicus, Daniel de Morley, Michel Scot, Adam de Bocfeld, Herman of the German are some other names in this list.

Some Areas of Impact

Philosophy

Since seventh century Muslims started translating Greek Philosophy and sciences from Greek and Syriac into Arabic. The movement for translation was accelerated since the middle of the eighth century in Baghdad. The first works that were translated were on medicine and then other sciences and philosophy. Later some neo-Platonic works were translated. In addition to this, some works from other languages such as Persian were also translated into Arabic.

Muslims welcomed Greek philosophy because they thought that it was in harmony with Islamic teachings that encourage thinking and reflection on the world and its phenomena. Therefore, first they translated Greek philosophy, then interpreted and completed it, and finally they created their own philosophical system on the basis of Greek philosophy, Islamic teachings and what they have learned from other cultures especially Persian.

The first famous Muslim philosopher was Yaqub al-Kindi (801-873). More than 265 works are attributed to him in different sciences.

The second prominent Muslim philosopher was Abu Nasr Farabi (870-950). He is considered as the founder (muassis) of Islamic philosophy especially political philosophy.

An influential group of scholars called themselves Ikhwan as-Safa (Brothers of Purity). They established their secret group in 983 in Basra. Their treatises include 51 parts which covers various sciences.

Ibn Sina

One of the greatest Muslim philosophers is Ibn Sina/Avicenna (980-1037). His book as-Sifa is an encyclopedia of all sciences of his time.. It contains logic, metaphysics, mathematics and physics. Mathematics includes arithmetic, geometry, astronomy and music. Physics includes different branches of natural sciences, biology and psychology. This book was translated into Latin and was known as Sufficientiae.

Ibn Sina's thought was well known and respected both in Islamic world and in medieval Europe. Copleston says: "When portions of writings of Avicenna were translated into Latin in the twelfth century, the Christian world found itself faced for the first time with a closely knit system which was bound to exercise a strong attraction on certain minds." For example, Gondysalvi both in psychology and cosmogony refers to Ibn Sina and tries to harmonize the latters' ideas with Christianity. Ibn Sina was not only a commentator of Aristotle, but, in addition to this, he had his own independent philosophical system in which he refers both to Greek philosophy and Islamic belief system. As Copleston says, "…however much he borrowed from former philosophers, Avicenna had thought out his system carefully and independently and had welded it into a system of a peculiar stamp."

Islamic view of human knowledge and illumination, distinction between essence and existence, and argument for necessary being from contingent being were among the ideas that via Ibn Sina came into medieval philosophy. One of the contributions of Muslim philosophers was to show how and to what extent one can combine between Greek philosophy and religious beliefs. The connection of physics and metaphysics which was developed in the thought of Thomas Aquinas was largely inspired by Islamic philosophy particularly that of Ibn Sina.

Another hotly debated idea in medieval philosophy that has its origin in Ibn Sina, is the idea of intentions. Ibn Sina distinguished between first and second intentions. First intentions are universal concepts that are applicable on objective realities, such as the concept of human and horse. Second intentions are abstract universals which are only in the mind. These are logical concepts, such as subject, predicate, and proposition. The medieval philosophers such as Aquinas and William of Ockham paid serious attention to this discussion. However, a third type of universal concepts was recognized in Islamic philosophy which did not attract serious attention in the West was philosophical concepts, i.e., abstract concepts which have no referent in reality, but at the same time related to reality and describe it, such as concepts of causality, unity and contingency.

Ibn Sina's influence was not limited to one group or trend; rather it was so comprehensive that hardly one can see a philosopher who is not in a way influenced by him. Gundisalvi who studied Ibn Sina and Ghazali was the originator of a movement that Etienne Gilson calls it Augustinian-Avicennian Movement? His discussion on knowledge and wisdom is particularly inspired by Islamic philosophy.

It must be noted that some ideas of Ibn Sina are misinterpreted in the West. For instance, it is said that since according to Ibn Sina the creation is

necessary, therefore God has no free will, or God has no knowledge of particulars, or His power is limited. These misunderstandings can be seen even in the works of some contemporary philosophers such as Capleston. It seems that Ghazali is responsible for some of these misunderstandings. On the basis of these misunderstandings and under the influence of Ghazali some theologians like William of Auvergne (1249) claimed that Ibn Sina's philosophy is against religious beliefs.

Some Europeans accepted some ideas of Idn Sina and rejected some others, such as Alexander of Hales, John of Rochelle and Albert the Great (1260-1280). They accepted Ibn Sina's theories of abstraction and the necessity of illumination but did not accept his theory of active intellect. His critics, such as Aquinas, are also influenced by him. It is interesting that both Augustinian Bonaventura and Aristotelian Aquinas, both Italian and critics of each other, were influenced by Ibn Sina.

About the relation between Albert the Great and Aquinas, Brehier says that they both studied in Italy in an environment where studying the Islamic sciences were encouraged by Fredrick II. Albert was a student in Padua around 1223 and Thomas studied in Naples under an Averroesian professor before 1243.

After Ibn Sina many great philosophers appeared in Islamic world such as Tusi, Suhravardi, and Mulla Sadra Shirazi each of whom had his own system of philosophy and this tradition continued up to our time. However, this latter development of Islamic philosophy was not known by western scholars and thus did not have much impact on Europe.

Ghazali

Mohammad Ghazali/Algazel (1058-1111) is a Muslim theologian and Sufi who has been an influential figure in both Islamic world as well as in Medieval Europe. In his famous book The Incoherence of Philosophers, he rejected and condemned philosophers especially Farabi and Ibn Sina. In his view, many elements in philosophy are against religious beliefs. The impact of this book was beyond measure so that since then philosophy in Sunni world has never survived. Ghazali's works were also translated in Latin and grasped some European attentions. Ghazali anticipated David Hume in rejecting the causal relations in material world, but he interprets the succession of two phenomena to be according to God's will.

Ibn Rushd

Islamic Spain had also some famous philosophers among whom are Ibn Masarra (931), Ibn Baja (1138), Ibn Tufayl (1100-1185), and finally, the most influential of them, Ibn Rushd/ Averroes (1126-1198). Ibn Rushd is best known as the commentator par excellence of Aristotle philosophy. Aristotelianism in medieval Europe is due more than anyone else to the works of Ibn Rushd. He interprets and defends Aristotle philosophy against critics such as Ghazali. Ibn Rushd wrote Tahafut al-Tahafut/The incoherence of the Incoherence in response to Ghazali's The Incoherence of Philosophers.

The most famous translators of Ibn Rushd were Michel Scot and Hermann of German. One of the famous Averroisian theologians and the founder of Latin Averroists is Siger Brabant. From 1266 to 1277 he taught Aristotelian philosophy and the thought of Ibn Rushd in Paris University. Among the fourteenth century Averroesians is Jean de Baconthrop. Ibn Rushd was so influential that his impact led to a movement around the beginning of the Renaissance in Padua in the north of Italy.

Ibn Rushd was also sometimes misinterpreted in the West. For example, one of the ideas that are attributed to him is the idea of "double truth," which means that it is possible that a statement be true in philosophy and false in religion or vice versa. Whereas according to Ibn Rushd, philosophy and religion or reason and the scripture (i.e., the Quran) never contradict each other. Whenever such incoherence is seen one should know that this incoherency is only at the surface; therefore, the scripture must be interpreted symbolically and metaphorically so that does not contradict the reason.

The church condemned Averroesians in 1270. The famous Averroesian Siger of Brabant was condemned in 219 statements and put into prison.

The influence of Muslim philosophers on the West is an undeniable fact. Copleston writes: "the influence, positive or negative, of Islamic philosophy on that of Christendom is now a matter of common knowledge among historians." Elsewhere he states:

"The translation of works of Aristotle and his commentators, as well as the Arabian thinkers, provided the Latin Scholastics with a great wealth of intellectual material. In particular they were provided with the knowledge of philosophical systems which were methodologically independent of theology and which were presented as the human reflection on the universe. The systems of Aristotle, of Avicenna, of Averroes, opened up a wide vista of the scope of the human reason and it was clear to the medieval that the truth attained in them must have been independent of Christian revelation…In this way the new translations helped to clarify in the minds of the medieval the relation between philosophy and theology…"

According to Copleston, the philosophy of Muslim philosophers had superiority over the philosophy of Christian philosophers in medieval Europe, therefore they studied Muslim philosophy and respect it.

It is noteworthy that one of the ways that Islamic philosophy was introduced to medieval Europe was through Jewish philosophers. They knew Arabic and Islamic philosophy. One of these philosophers was Ibn

Gabirol (1021-1069) who lived in Spain. He was the author of Yanbu' al-Hayat (the Spring of Life), that was translated into Latin. Saint Bonaventura was influenced by his thought.

The most famous Jewish philosopher is Ibn Maymun/Maimonides. He was borne in Cordova in 1135 and died in Cairo in 1204. in His book, Delalat al-Haeirin (Guidance for Perplexed) explains Aristotelian rational philosophy. He interprets Holy Scriptures by reason. In his view, where religious text is not in harmony with rational thinking it must be interpreted allegorically. He disagrees with Aristotle in the idea of the eternity of the world. Maimonides is influenced by Farabi and Ibn Sina in arguing for the existence of God and had impact on Christian theologians.

The development of mystical thought in the Spain was not irrelevant to the Islamic influence either. In addition to some works of Ibn Sina and Ghazali, we should mention Sirr al-Asrar/ Secretes secretornum from an unknown Muslim author. This book that combines Aristotelian philosophy with neo-Platonic thoughts was translated into Latin and known to the scholars.

Finally, I should mention Dante's Divine Comedy. According to scholars like Bruno Nardi and Asin Palacios, Dante in his major philosophical concepts is in debt to Muslim philosophers. These concepts include: Divine light, intellects, the effects of spheres on human destiny, the idea of illumination and that only the intellectual dimension of the human is created.

The impact of Islamic thought on Europe was so vast that Watt writes: "All strands of European thought had to take cognizance of the translations from Arabic, nor merely the Averroes's and their opponents, the party of St Thomas Aquinas, but also conservative Platonists like Bonaventura and Roger Bacon. The whole range of subsequent European philosophy was deeply indebted to the Arabic writers."

In another passage he writes: "When one becomes aware of the full extent of Arab experimenting, Arab thinking and Arab writing, one sees that without the Arabs European science and philosophy would not have developed when they did. The Arabs were no mere transmitters of Greek thought, but genuine bearers, who both kept alive the disciplines they had been taught and extended their range." "

Here I will mention in brief the impact of Muslims in Medieval Europe in some scientific fields.

Mathematics

Since seventh century, Muslims paid serious attention to mathematics. They found out that the growth of philosophy and sciences depends on mathematics. Therefore, they translated mathematical books from different languages such as Indian, Syriac, and Greek into Arabic. They learned Indian numerals and eagerly developed mathematics.

Mohammad Ibn Musa Khwarizmi (847) known as Algorisms, put together Indian and Greek mathematical thought and got new valuable achievements. By bringing sifr (zero) into numerals he brought remarkable changes in mathematics. He also founded the science of algebra.

Al-Kindy, Ibn Sina, Banu Musa, Thabit Ibn Ghurra, Jamshid Kashani, Abulwafa Buzajani, Abu Rayhan Biruni, Khayyam Nishaburi and Nasir al-Din Tusi are among the great Muslim mathematicians each of whom had a remarkable contribution in the advancement of mathematics. Among the Muslim mathematicians of Spain we can name Maslama al-Majriti (1007) and his pupil Amr Kirmani (1066).

Jabir Ibn Sanan al-Battani/Albategnius (929) established trigonometry, and Buzjani and Tusi developed it. Establishment of observatories and attempts in precision in astronomical calculation helped the development of mathematics.

The Europeans in Spain and then in Sicily got familiar with the works and ideas of Muslim Mathematicians. The French Gerber, who later became the pope, was the first European scholar who studied mathematics in Islamic Spain and later spread mathematical sciences especially the Arabic numerals in Europe.

The translation of the Islamic mathematical works into Latin caused a significant impact on the development of mathematics in Europe. Through the works of Algorisms algebra became known in Europe and was considered as the basic for mathematical studies till the time of F. Viete (1540-1603), the French mathematician. Through these works Indian numerals, algorism as the method of calculation, and zero were adopted and the Gerber calculating table gave its place to Algorisms' numeral system. Since the tenth century, Arab numerical system was employed in Italy and then in other parts of Europe. This impact continued by translation of other mathematical works.

Some important Greek sources such as The Euclidean Principles and Almagest of Ptolemy (Megale Syntaxes) became known to Europeans by Muslims and through Arabic translations.

The Great Italian mathematician Leonardo Fibonacci in his childhood traveled with his father, who was a merchant, to the different Islamic countries and studied mathematics and taught and spread it when he returned to Italy. His works had an enormous impact on mathematical thought in Europe.

Astronomy

Muslims paid especial attention to astronomy particularly for religious reasons. Determining the direction of Mecca (qibla), the times of sunrise and sunset for times of prayer, eclipse for its prayer, and new moon for fast and the time of pilgrimage (hajj) and other rituals are some reasons that make necessary for Muslims to study astronomy. In addition, the Quran in many verses invites people to reflect on the heaven and earth, day and night in order to know the glory and majesty of the Creator. Moreover, finding the ways in traveling in the deserts was another reason for Muslims' interest in astronomy. One can also mention that the interest of some rulers in astrology was also a motivation for some in studying the status of stars.

Therefore, Muslims from the very beginning had seriously welcomed this science so that hundreds of great scholars emerged in this filed. They translated books such as Send Hind from Indian and The Prince's Astronomical Table (Zij-e Shahryari) from Pahlavi and Almagest from Greek.

Al-Battani presented the most precise observations in his book so that Medieval Latin thinkers used to praise him more than anyone else.

Muslims studied Ptolemy's ideas, reflect on it for centuries, purified and improved it and then questioned it and made serious criticism of it. For example, the criticisms of al-Bitruji (1204) in Spain on Ptolemy's ideas had a significant influence on the Astronomers of Renaissance such as Roger Bacon, and Robert Grosseteste. Tusi and Qutb Shirazi also seriously criticized Ptolemy's system and took new steps in astronomy.

One of the great steps in Islamic astronomy was the establishment of the observatory which was initiated in seventh century A. H. Observatories were made in Damascus, Bagdad, Cairo, Maraghe, Samarqand, Istanbul and other cities. Astronomical instruments such as astrolabe were innovated. In the western part of the Islamic world, such as Seville, Toledo, and Cordova also observatories were established and astronomical advances took place which were transmitted to Europe. Alfonso the tenth the king of Castile in establishing the most important observatory of Medieval Europe got help from Muslim scholars. Later European observatories also followed the example of Muslim's observatories and were similar to them. One of the consequences of using observatories which had impact on the development of astronomy was the arrangement of astronomical tables (zij). All Islamic astronomical instruments were transmitted to Europe via Spain or Crusades which was instrumental in the development of astronomy, whereas before contact with Muslims they were not familiar with these instruments.

In shifting from Ptolemy's system to Copernican and Galilean ideas one cannot neglect the role that Muslim astronomers such as Tusi played. The works of Muslim scholars were translated and were well known in Medieval Europe. Battani's (Albategnius) mathematical method in astronomical calculations was adopted by European Astronomers such as Copernicus, Kepler, Tycho Brahe and Galileo Galilei. The Astronomical table (zij) of Zarqali in twelfth century was translated and for centuries was used by European astronomers. As Philip Hitti says, even the works of Raymond of Marcel (1140) to a large extent was based on astronomical principles of

Zarqali, as Copernicus in his The Movements of Heavenly Sphere, benefited from Zarqali and Battani.

One of the traces of Islamic astronomy in Europe is the presence of many Arabic astronomical terms in European languages which are mentioned in the relevant sources.

Medicine

Medicine was also one of the sciences that Muslims had especial attention to it and physicians have always been respected in Muslim society. Thus medicine was developed and some encyclopedias about physicians were written, such as Tabaqat al-atibba of Ibn Usaybiah.

Muslims learned from Persian medicine which was developed in Gondishapur University and translated works from Indian and Greek sources. From these sources and Islamic teachings on health, they created a new Islamic medicine.

From among Muslim physicians zakariyya Razi (Razes) and Ibn Sina gained more fame in medieval Europe. Razi wrote about 220 books most of which related to medicine. His most famous medical book is Al-Hawi/the Comprehensive. This book which was translated into Latin was one of the main text books in Europe up to seventeen century. Razi was the first who described blister and typhoid.

Ibn Sina who was a philosopher and scientist was also a genius in medicine. He practiced medicine since he was sixteen years old. He has many discoveries and inventions in this science. His book Qanun (The Canon), which as Meirhof says is a master peace in the world of medicine, was translated into Latin and for centuries was the main reference in medicine.

In Spain also medicine improved and great physicians such as Abulqasim Zahravi, Ibn Zuhar Andolusi, and Ibn Rushd (Averroes) had important contributions. Gerard Cremona translated some medical books including Qanun of Ibn Sina. In fifteenth century Qanun was reprinted sixteen times and in sixteenth century more than twenty times. According to Meirhof, no book ever has been read like this. Up to more than six centuries this book was a reliable reference in Europe.

In 1279 Faraj Ibn Salim translated Razi's al-Hawi. This book too, was a textbook and a reference source in Europe and only in 1542 was reprinted five times.

According to some historians Salerno School in Italy, which had significant impact on the advancement of medicine in Europe, was established by Muslims. Philip Hitti also thinks that Muslims participated in establishing this school. Its most famous physician, Constantine the African studied Arabic and medicine in Islamic lands and transmitted it into this school. He taught Islamic medicine in this school and translated some works from Islamic medicine.

One of the traces of Muslims impact in medicine is the presence of many Arabic words in different branches of medical sciences and pharmacology. As Watt writes:

"In the works of Ferrari da Grado, for example, Avicenna is cited more than three thousand times, Rhazes and Galen thousand times each, and Hippocrates only a hundred times… European medicine in the fifteenth and sixteenth centuries was still little more than an extension of Arab medicine."

Chemistry

The first famous Muslim chemist is Jabir Ibn Hayyan (Geber) who was a student of Imam Sadiq. More than seventeen books in chemistry are known from him. In medieval Europe he was known as the father of chemistry. Meirhof says that Geber had a long shadow on the sciences in the Middle Ages. Acid sulfuric, acid nitric and some more are of his discoveries.

Zakariyya Razi founded the new chemistry. Before him chemistry had more metaphysical and spiritual character. More than twelve books in chemistry are related to him. He was the first who suggested chemical treatment. And he discovered alcohol. Other figures in chemistry are Ibn Wahshiyya, Abu Rayhan Biruni, and Ibn Sina. Muslim chemists had many laboratories and innovations that are mentioned in sources on the history of sciences. Many of these books were translated into Latin. Kalin Ronan says that chemistry was a gift of Arabs for the west. According to Gustavus Le Bon, without Muslims laboratories, Lavoisier was not able to take a step.

Physics

In the science of physics too many great scientists emerged in the Islamic world. Al-Kindi wrote a book on the light which was several times translated into Latin. But the most brilliant Muslim physicist was Ibn al-Haytham (Alhazen). His al-Manadir (optics) was repeatedly translated into Latin and since its translation many scientists even Johannes Kepler and Roger Bacon were influenced by it. Will Durant says that without Alhazen, Bacon could not do anything. According to Brehier, Alhazen's studying of light and the science of optics had enormous impact on the Latina scholars of the twelve century. One of his contribution is the analysis of visual perception which is classic and still is respected so that Witelo adopted it.

Universities and Research Centers

Scientific centers have a long history in the Islamic world. The city of Medina in the time of the Imam Sadiq in the seventh century was a scientific center. He had about four thousand students. The House of Wisdom (bayt al-hikma), in the eight century, was an important center for translation and research. In this period many schools were established in various regions. Teaching and learning became predominant and scholars were highly respected regardless of their religion and ethnicity. Libraries were built and jobs and skills related to education such as transcription and paper technology, translation and writing became prevalent.

The first university in its modern sense was al-Azhar which was established in 359 A.H. and gradually developed. This university has all facilities that students and professors needed for living and studying such as rooms, kitchen, classes and library. Its curriculum included all sciences of that time such as philosophy, mathematics, natural sciences, medicine, and Islamic studies.

A similar university was Nedamiyya in Baghdad which was made in 458 A.H. Following these examples, many schools and research centers were built in different cities such as Damascus, Nishabur, Isfahan, Samarqand and Balkh. One of the famous schools was al-Mustansiriyah of Bagdad which was opened in 640 A.H. Similar centers were established in Spain especially in Cordova, and Granada.

According to Philip Hitti, these universities became examples for Europeans in building universities, such as University of Paris, Oxford, and Naples all of which were established in the twelfth and thirteenth centuries. Their curricula, texts, and regulations and even their architectures were influenced by Islamic universities. For instance, the style of architecture of building of Cambridge University College is the same as Al-Azhar University.

Concluding Remark

I conclude with the remark of Montgomery Watt who says:

"…it is clear that the influence of Islam on western Christendom is greater than is usually realized. Not merely did Islam share with Western Europe many material products and technological discoveries; not merely did it stimulate Europe intellectually in the fields of science and philosophy; but it provoked Europe into forming a new image of itself. Because Europe was reacting against Islam it belittled the influence of Saracens and exaggerated its dependence on its Greek and Roman heritage. So, today an important task for us western Europeans, as we move into the era of the one world, is to correct this false emphasis and to acknowledge fully our debt to the Arab and Islamic world."

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