

## Islamic World and Scientific Activity in Historical Perspective

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**Abstract:** Science is not a native of any society. Rather every society of the world has contributed in one way or the other to the development of science in the history of human civilization. At the rise of the Islamic Empire, the Muslims were at the forefront in all sciences and technology. This period produced more than 100 men of genius recognized as having significantly changed the course of scientific thought. Great advances were made by these early Muslim scientists in the fields of botany, astronomy, mathematics, physiology, chemistry, medicine, geography, physics and other branches of science. Within this understanding, is the study basically concerned with the literature on the history of science in the Islamic world during the medieval period. It rightly highlights the outstanding contributions of Muslim scientists. Among the best in the Islamic-Western tradition are Ibn-Rushd, Al-Khawarizmi, al-Razi, Ibn-Sina, Ibn Baytar, Jabir Ibn al-Hayyan, al-Masudi, al-Haytham, Umar Khayam, Abu al-Qasim al-Zahrawi and Ibn Nafis etc. It then concludes with the submission that the contemporary Muslim world should promote science education and research for the progress of their societies in the modern era.

**Key words:** Islam, science, technology, education, world, civilisation

### INTRODUCTION

Science, which is a term traceable to the Greek word, 'scientia' refers to the state or fact of knowing, knowledge or cognizance of something specified or implied (Akanji and Yakubu, 2002). According to Isehunwa (2004), science is the acquisition of knowledge about the basic principle at work in nature and in the environment. Science probes into unknown and investigates established facts. The information that are thus obtained can be synthesized, classified as generalized and stated as norms, concepts, principles, theories and laws.

In the context of the brief definition stated above, it must be clear that science is not a native of any society and civilization. Rather every society of the world has contributed in one way or the other to the development of science in the history of human civilization. This is because people live in diverse environments whose challenges are tackled by established facts, by implication science. In this regard, science has both universal and environmental concepts.

The development of science can be broadly divided into 3 phases, namely the Golden Scientific Age of the Greeks, the Middle Age and the Renaissance. In the Golden Age, Greeks were the scientists to first undertook

true scientific enquiry. This period of 4th to 6th century BC, witnessed great mathematicians such as Archimedes and Apollonius, physicians and father of medicine such as Hippocrates. The period of Middle Age marked the era of Islamic initiatives in science. It was also referred to as the brilliant period of Islamic civilization (Ozigi and Canham, 1979). The period was also characterized by the translation of Greek to Arabic and others to Latin and Hebrew to smaller extent (Akanji and Yakubu, 2002). This period produced more than one hundred men of genius recognized as having significantly changed the course of scientific thought. Among the best in the Islamic-Western tradition are Ibn-Rushd, Al-Khawarizmi, al-Razi, Ibn-Sina, Ibn Baytar, Jabir Ibn al-Hayyan, al-Masudi among others. The renaissance period was the era of new initiatives in science. The new initiatives emerged in Europe when the monopoly of the church was broken and man began to ask questions, think for himself and were eager to discover new things (Olaoye, 2003).

Against this background, this study is basically concerned with the literature on the history of science in the Islamic world during the medieval period. It rightly highlights the outstanding contributions made by the Muslim scientists in all fields of science. In order to achieve this objective, this study will cover the following

issues: Interaction between Islam and science, Islamic world and scientific activity in history, as well as concluding remarks.

### **INTERACTION BETWEEN ISLAM AND SCIENCE**

Whatever kinds of relationships between Islam and science are to emerge prominently in our discussion will depend on the meanings given to the term 'Islam'. Indeed, the term Islam may be understood in several senses. It has been used by certain scholars to refer to the normative teachings of the religion as contained in the Qur'an and prophetic tradition (Bakar, 2003). The scholars understand Islam, including its perspectives on science, by going directly to the first source, the Qur'an and not through the intermediary of the historical manifestations of the religion in the form of its spiritual traditions, intellectual culture and civilization.

Oloyede (2006) sees Islam as a way of life, which encapsulates all activities of a Muslim. According to Abe (1993), Islam is a practical religion whose tenets are based on the provisions of the Qur'an. Qur'an is an encyclopedia of subjects on legal, social, military, legendary and religious matters. There are also scholars who use the word Islam not only to refer to its normative teachings that allow for fresh interpretations, but also to its culture and civilization as these dimensions have been manifested throughout Muslim history. If Islam is understood in this sense, then it has to be inclusive of its past intellectual culture, of which science used to be an integral part. A discussion of Islam and science based on this broader meaning of Islam would necessarily differ in scope, content and depth from the one that ignores the traditional theories and practices of science in Islamic civilization and their conceptual relationships with religion. It is a position that is informed by a solid knowledge of the history of Islam the religion and Islam the civilization. This civilizational approach to the Islam and science discourse which is sensitive to tradition is based on the conviction that past formulations of the relationship between Islam and science have an intrinsic value that make them relevant to contemporary attempts to arrive at the same conceptual goal (Nasr, 1964, 1968, 1976, 1993; Bakar, 2003). Some have disputed the value of this approach to our contemporary needs. But whichever decision we make on the relevance of tradition to contemporary discourse should only be based on a careful and objective study of past formulations, at least those associated with important scholars of Islamic intellectual history.

In our view, the most significant formulations would be those of practicing scientists. Pertinent to our whole

discussion, we are rather fortunate to have a long list of Muslim scientists in the past who were very knowledgeable in religion and other fields of study like history and philosophy. Their works on religion and science strike us as intellectually more revealing and appealing in helping us today to articulate relationships between the two domains than those produced by theologians and other men of religion with a limited knowledge of science (Bakar, 1999).

There is truly no dissonance between Islam and science for Islam undoubtedly encourages scientific activity. This is evident in the innumerable Quranic and hadith references, which show the importance attached by Islam to science. Science in Islam places on one the exercise of not merely one's intellectual and physical faculties but also one's spiritual (Balogun, 2002). Elaborating on this fact, Buccaile (1979) noted that the majority of scientific facts, which are either suggested or very clearly recorded in the Qur'an, have only been confirmed in modern times.

Anybody who reads and meditates upon the Holy Quran will discover that it invites man to study nature (Q17: 12, 43:3-5). The Qur'an even challenges human intellect and experience to find any flaw in the universe and assures man that such will not happen (Q67: 3). Besides, it invites man to biology by its frequent mention of plants and animals (Q16: 5-11); its mention of trees like figs etc, directs man to study Botany (Q16: 10-11); it challenge to man to fly into outer space reminds us of astronomical sciences (Q55: 33). Its talking of the sun, the moon and the heavenly bodies invites man to Astronomy (Q16: 12, Q21: 33, Q25: 61).

On the medical sciences, the Qur'an also makes reference to today's known medical disciplines. Accordingly, it emphatically talks on the physiological development of man, thereby introducing us to embryology (Q22: 5, Q39: 6). The Qur'anic assertions that life originated from water are confirmed by biochemists today. Its disproving the signs and symptoms of madness attributed to the Prophet (Siddiq, 2003) provides man the time to study psychiatry (Q15: 6-7) etc. Surah 24:35 is undoubtedly enough to inspire the early Muslims to engage in the study of electricity while Surah 23: 12-14 gives an insight into biology when it declares:

And indeed We created man (Adam) out of an extract of clay (water and earth). Therefore, We made him (the offspring of Adam) as a Nutfah (mixed drops of the male and female sexual discharge and lodged it) in a safe lodging (womb of the woman).

Then we made the Nutfah into a clot (a piece of thick coagulated blood), then we made the clot into a little lump of flesh, bones) then We clothed the bones with flesh and then We brought it forth as another creation. So Blessed is Allah, the Best of Creators.

In the area of physical geography, Surah 36: 38-40 postulates on the movement of celestial bodies when it reads:

And the sun runs on its fixed course for a term (appointed). That is the Decree of the Almighty, the All knowing. And the moon, We have measured for it mansions (to traverse) till it returns like the old dried curved date stalk. It is not for the sun to overtake the moon, nor does the night outstrip the day. They all float, each in an orbit.

What the above points to, is the fact that Islam enjoins man to probe into unknown and investigates established facts-science. The early Muslims have also proved the compatibility of Islam and science through their various contributions. It is within this context that the following study will be devoted to some aspects of Muslim initiatives in scientific activity during the medieval period.

#### **ISLAMIC WORLD AND SCIENTIFIC ACTIVITY IN HISTORY**

Under the impetus of Islamic teachings, a civilization grew up in the first second centuries that produced a dramatic change of outlook, arising from integrated concept of knowledge ('ilm) combining material and the spiritual aspects in a balance whole. This movement for scientific knowledge and progress led by Muslims lasted for at least seven centuries (from 700-1400 C.E) and produced more than one hundred men of genius recognized as having significantly changed the course of scientific thought (Dictionary of Scientific Biography, 1970-1976 cited in Esposito, 1995). The contributions made by the Islamic world to science are vast. It is not possible within the limit of this study to explore all the ramifications of Islamic scientific activity; hence, this exploration shall be limited to areas in which most decisive contributions were made.

**Alchemy:** The Muslims originated the science of chemistry formerly known as alchemy (*al-Kaymiyyah*).

In this field, the Muslims were noted for their inquisitiveness. They propounded theories, which were implemented (Opeloye, 1988). They were reported to have discovered many new substances such as potash, nitrate silver, corrosive sublime, nitric and sulfuric acids. They were equally known to be pacesetters in manufacturing especially in variety and beauty of design and perfection of workmanship (Balogun, 2002).

Jabir b. Hayyan was popularly known as the father of alchemy. Alchemy was inspired by the desire to transmute base metals (like iron) into noble metal (like gold and silver) and this they thought possible by an agent called elixir (Wickens, 1979). Jabir became popular in Kufa about 776 C.E where he set-up a laboratory and discovered several chemical compounds like ammonias, gold wash, potassium and sulfuric acid. Gibb (1962) noted in particular that Hayyan's practical knowledge of chemical processes in the production of concentrated acetic acid by the distillation of vinegar, the use of manganese dioxide in glass manufacture and the preparation of arsenic and antimony from sulfides had been widely acclaimed among scholars.

Jabir was the author of many scientific books prominent among which were *Kitab al-rahma* (Book of Mercy), *Kitab al Tajmi* (Book of Concentration) and *Kitab al-shibaq al sharqi* (Book of Eastern mercury). Most of these books were translated into European languages especially Latin and French. They were used in the West until the end of the 17th century. Other Muslim alchemists were Abu Bakr Muhammead b. Zakariya al-Razi and Abu Ali Hussayn b. Sina. Al-Razis *Kitab al asrar* (The Book of Secrets) on alchemy translated into Latin and other European languages was the source of chemical knowledge in Europe till the 14th century (Opeloye, 1988).

**Medicine:** In the field of medicine, the Muslims surprised the world by their immense contributions. Olaoye (2003) observed that the great medical tradition of Islam came about as a result of the need to solve the health care problems of man. Abu bakr Muhammad b. Zakariya al-Razi (865-925 C.E) known to the West as Rhazes was noted to be an outstanding physician who possessed a competent knowledge of physical and chemical subjects, which he applied to medicine (Gibb, 1962).

Hitti (1977) describes him as the greatest and the most distinguished of all the Muslim physicians and one of the most prolific writers. He authored more than 200 treaties and books on various subjects. Among these were *Kitab-Al-Judari wal-Hasbah* (The Book of Small Pox and Measles), which was published in Latin and

European languages in 40 editions between 1479-1860 C.E. (Siddiq, 2003). A medical encyclopedia, *Al-Hawi* or the comprehensive work was another book written by al-Razi. The twenty volume Encyclopedia covers the whole range of medical knowledge contrasting what the ancients said with his own experiences and opinions. Five of these volumes were devoted to optics and was accepted as the most authoritative book on the eye, its ailments and treatment for many centuries. Much of his research was translated into Latin and later into other western languages and he was quoted and commented upon in Europe until the 19th century (Hitti, 1977). Al-Razi was the inventor of seton in surgery. His treatise on small pox and measles contains the first well-researched account of the disease. Al-Razi's fame in the West was immense and his authority remained unquestioned till the 17th century C.E (Martin, 1979).

Ibn Sina (980-1037), who was known to the west as Avicenna was also acclaimed in the field of medicine (Olaoye, 2003) particularly for his *Kitab al-Shia'* (The Book of Healing) and the great *Kitab al-Qanun fi Tibb* (Canon of Medicine) which deals with general medicine, drugs, diseases, pathology and pharmacopoeia (Hitti, 1977). This book was the final codification of the Greaco-Arabic medical thought. It was translated into Latin and remained a standard textbook for medical knowledge in Europe to the 17th century (Opeloye, 1988). In fact, Hitti remarked that the canon of medicine remained a medical Bible for a longer period than any work.

**Mathematics:** In the field of mathematics, history will not forget that it were Muslims who gave the world the Arabic numerals the type of which were not known in Europe before. Prior to the introduction of Arabic numerals, the Europeans relied on the Roman numerals for whatever mathematical calculation they would do which in turn slowed down the pace of progress.

Muhammad Ibn Musa (780-850 C.E) popularly known as Khawarizmi, was the first to use the decimal notion and gave the digit the value of position. Khawarizmi was one of the greatest scientific minds who influenced mathematical thought than any other medieval writer. He wrote many books, among them is, *Kitab Al-Muktasar Fi Hisba Al-Jabr wal-Muqabalah* or Summary in the Process of Calculation for Reduction and Equation (Wickens, 1979). This book was used until the 16th century as the principal mathematical textbook of European universities. Al-Khawarizmi introduced into Europe the science of Algebra as well as Arabic numerals including Chiper (Sifr) and zero.

It is a truism that a remarkable progress was made in the field of mathematics with the introduction of Algebra and Arabic numerals. Today, the European mathematical vocabulary is full of adaptations of Arabic terms like chipher or zero from Sifr, algebra and aljabr, surd from Jardhr asamm, Algorism from Al-Khawarizmi etc (Opeloye, 1988).

The contribution of Ghiyath al-addin Al-Kahani could not be easily forgotten too. He wrote on the introduction of the decimal faction and was the first to have ever invested a calculating machine and also the first to have solved binomial theorem (Siddiq, 2003). Other prominent Muslim mathematicians are Abu Yusuf Ya'qub ibn Ishaq al-Kindi al-Sa'igh generally known as Avempace or avenpace both in Latin and English, Abubakr Muhammad Ibn Muhammad Ibn Tufayl al-Quaysi known in Latin as Abubacer, etc (Sheikh, 1982).

**Physics:** In the field of physics, the Muslims were not push-overs; they made remarkable contributions to the development of this field of science. One of the greatest Muslim physicists was Hassan Ibn Al-Haytham, commonly referred to as Alhazen in the West. He was born in Spain but resided chiefly in Egypt. Al-Haytham flourished about the end of the eleventh century. He is known in Europe by his research in optics. According to Ali (1981), Ibn Al-Haytham, was famous for his discovery of atmospheric refraction.

**Astronomy and space science:** The achievements of Islamic world in astronomy are still in existence and are still use today. The Islamic astronomical studies according to Opeloye (1988) were based on the observation of the movement of the celestial bodies. The name of Al-Khawarizmi stands out as that of the culminating influence of Muslim Astronomy upon European thought. His astronomical table was revised by a Spanish astronomer Maslama al-Mujriti and was translated into Latin in 1126. The work according to Hitti (1977) became the basis for other works both in the East and the West.

Other Muslim intellectuals in the field of astronomy include scientists like Ibn Rushd (Averroes), Al-Bathani and Al-Zarqali (Arzachel). They were often quoted in their works by the Polish astronomer, Nicolas Copernicus, who propounded the heliocentric system that had the planets moving around the sun. The basic information in the research of outstanding men of astronomy, like the Danish astronomer, Tyco Brahe, the German astronomer, Johannes Kepler and the Italian astronomer and physicist, Galileo Galilee, had made reference to these works of Muslim astronomers (Bram *et al.*, 1975).

**Geography:** Like the other fields of science discussed above, the Muslims made an appreciable progress in geography. Opeloye (1988) noted that the factors, which motivated the early Muslims to the study of geography, are both religious and secular. These among others include the need to locate the direction of the Ka'bah both for prayers and pilgrimage; the need to describe the routes and locations of towns in the newly established empires, the need to study the movement of the heavenly bodies as described in the Qur'an.

It is significant to point out that Muslim geographers introduced the concept of roundness of the earth (Hitti, 1977). Hitherto, the thinking had been that the earth was flat. The protagonists of the concept of roundness of the earth were Ibn Kherdezba (d.888 CE) and Ibn Rusta (d.903 C.E). According to Ibn Kherdezba, earth is a round ball and lies inside the spheres in the same way as the yoke lies in the egg. Ibn Rusta equally shared this proposition when he said: God be He praised, made the spheres as round as the ball, hollow and rotating. The evidence of this fact lies in the fact that the sun, the moon and the other planets do not rise and set on all beings all other the earth at one time; they rise on the Eastern parts before they set on the Western parts (Opeloye, 1988).

One can go on and on enumerating the contributions of Islamic world to science. The above discussion points to the fact that science is not anti-tethical to Islam and that scientific activity is not alien to the Islamic world.

### CONCLUSION

This study has discussed the contributions of Islamic world to the fields of science in the medieval period. In the course of doing that, efforts have been made to establish the relationship between Islam and science, using some relevant Qur'anic verses. The early Muslims also proved the compatibility of Islam and science through their remarkable achievements in the fields of medicine, alchemy, physics, geography, astronomy, mathematics, astronomy etc. These contributions were later impressed upon the Europe, which now claims to be dominant in the field of science while the brilliant contributions of Islamic world are greatly neglected in the modern world. It is therefore, our submission that the contemporary Muslim world should regain this lost glory by promoting science education and research for the progress of their societies and the world at large in this modern era.

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