ISLAMIC TECHNOLOGY: AN APPRISIAL ON THE RECIPROCAL EXCHANGE BETWEEN THE EAST AND THE WEST

Khawaja Muhammad Saeed (Ph.D)
Department of Philosophy
University of the Punjab
Lahore, Pakistan

Abstract

I submit that I fully know and accept the scientific contributions and innovations made by non-Muslims through the various phases of human civilizational development. But since my focus in the article is to highlight scientific contributions and Philosophical ideas introduced within the Islamic world, I only projected them in detail. As a Philosopher I am fully cognizant that knowledge, science and academic scholarship in human venture in which people of all religions orientations have played their parts.

Introduction

Scientific and technological developments are the main criteria of a developed nation. It is believed that only the West is capable of making such credit and achievement. Indeed, progress /development are not exclusive to a particular nation and region which may inherit it to succeeding generations. Progress depends largely on acquisition and one who wills so and makes endeavor in this direction is bound to be rewarded with progress. Hence, it will not be considered as the legacy of a particular group or region. Moreover, the structure of modern science and technology, however impressive it might appear today, is based largely on the achievements made by Muslim masters in the past. In the Qur'an There are 756 verses emphasize on empirical observation on natural phenomenon for example.

وهو الذی انزل من السمائماءٍ فاخرجنا به نبات کل شیءٍ فاخرجنامنه خضرًا نخرج منه

حبًّامترا کبًا و من النخل من طلعها قنوان دانیة و جنتٍ من اعنابٍ و الزیتون والرمان مشتبهًا و

غیر متشابه انظرو الیٰ ثمره اذا اثمر وینعه ان فی ذلکم لایت لقوم یومنون

"It is He Who sends down water from the sky from which We bring forth growth of every kind, and from that We bring forth the green shoots and from them We bring forth close-packed seeds, and from the spathes of the date palm date clusters hanging down, and gardens of grapes and olives and pomegranates, both similar and dissimilar. Look at their fruits as they bear fruit and ripen. There are Signs in that for people who have iman(Faith)."[1]
Similarly:

افلم ینظروا الی السماء فوقهم کیف بنینها و زینها وما لها من فروج۔ والارض مددنها و القینا

فیها رواسی و انبتنا فیها من کل زوج بهیج۔ تبصرۃ وذکریٰ لکل عبد منیبٍ۔

"Have they not looked at the sky above them: how We structured it and made it beautiful and how there are no fissures in it? And the earth: how We stretched it out and cast firmly embedded mountains onto it and caused luxuriant plants of every kind to grow in it, an instruction and a reminder for every penitent human being."[2]

Holy Qur'an emphasized on empirical knowledge. For example:

واذ قال ابراهم رب ارنی کیف تحی الموتی قال اولم تومن قال بلی ولکن لیطمن قلبی قال

فخذ اربعه من الطیر فصر هن الیك ثم اجعل علی کل جبل منهن جزءًاثم ادعهن یاتینك سعیاً

واعلم ان الله عزیز حکیم۔

"When Ibrahim said, 'My Lord, show me how You bring the dead to life.' He asked, 'Do you not then have iman?' He replied, 'Indeed I do! But so that my heart may be at peace.' He said, 'Take four birds and train them to yourself. Then put a part of them on each mountain and call to them; they will come rushing to you. Know that Allah is Almighty, All-Wise."[3]

الم تران الله انزل السماء ماءٍ فسلكه ينابيع فی الارض ثم یخرج به زرعًا مختلفًا الونه ثم یهیج
فتره مصفرًا ثم یجعله حطامًا ان فی ذلك لذكری لاولی الالباب۔

"Do you not see that Allah sends down water from the skyand threads it through the earth to emerge as springs and then by it brings forth crops of varying colours, which then wither and you see them turning yellow and then He makes them into broken stubble? There is a reminder in that for people of intelligence."[4]

According to Hadith Prophet Muhammad (P.B.U.H)
" There is no disease that Allah (God) has created, except that He also created its treatment." [5]

"Make use of medical treatment, for Allah (God) has not made a disease without appointing a remedy for it, with the exception of one disease, namely old age." [6]

" Allah (God) has sent down both the disease and the cure, and He has appointed a cure for every disease, so treat yourself medically."[7]

" The one Who sent down the disease sent down remedy." [8]

Prophet Muhammad (P.B.U.H) developed Islamic Calendar in 622 A.D

Therefore, the achievement of the Muslim scientists in modern science holds the same place as the foundation does in the building. If the foundation is weak, the building cannot be able to erect for long time. It is very clear that modern science is closely related to Muslim science and that some times was accompanied by technology. At that time there was no such sharp distinction between these two. They relied on sense power as well as reason for ascertaining reality. To awake from the domination of Greek philosophy Muslim science and technology abandoned deductive and analogical methods and opted the experimental method. Greek masters never realized the need for establishing laboratory. Aristotle, Pythagoras, Galen, Aristocrat had no laboratories. But Muslim scientists not only employed this but also insisted on using the experimental method in studies related to material realities. And today, the modern science also stands for experimental method. Experiment and science are so inextricably interwoven with each other it is very difficult to designate them separately. Muslims scientific and technological accomplishments are not related to the establishment of laboratories and observatories but also they have invented various instruments for its progress. Western historians of science have also borne testimony to the abovementioned facts.

The West though acquainted with the scientific achievements of the Greeks, was amazed to note the scientific development of the Islamic world, and that are basically the fruits of the Islamic scientists. Ray, Merv, Baghdad, Damascus, Cairo, Cordova and Grenada were famous for the centers of Muslim scientific reflections and progress. In this regard the role of Spain was very significant, it was accessed students from France, England, Portugal, Italy and Germany to study astrology, astronomy, medicine, alchemy, physics and mathematics in the universities of Grenada, Cordova, and Madrid. These students were translated and contributed extensive works on science, the name of John of Lorraine and Gerbart Aurillac who was latter known as the Pope Sylvester-ii. [9] He was educated in Barcelona. Dr. Irving "opines that he was first to learn and introduce the Arabic numerals in Europe."[10] Pedro Alfonso contributed a monograph on astronomy along with a world map and drowned heavily from the Muslim scientists. Some students, such as Hugo Sancta lenis, Plato of Tivoli, Abraham bar Hiyya, Robert of Chester, Herman of Carinthia and Rudlof of Bruges were studied in Spain and translated numerous Arabic writings on astronomy, alchemy, astrology in their own languages.

The Europeans interest in Muslim science developed gradually and as a result many of sciences came into being for Arabic works apart from the Spain. "The centers of translation of Toledo, Seville and Salerno are noteworthy and approximately 150 years these centers functioned smoothly."[11]"Among those associated with the centers the following are worthwhile, like, Adelard of bath, John of Seville, Domingo Gundisalvo, Alfred of Sereshal, Daniel of Morley, Gerad of Cremona and Michael Scot. Gerad of Cremona is the most reputed among them and he translated 92 works of the Muslim scientists."[12] "

This translation activities sometimes were not preserved rightly, like the Ptolemy's famous work "*Megale Syntaxes*" had become extinct, though it was preserved by the Muslims under the title " *al- majasti*", whose Latin translation made from the Arabic was entitled " Almages."[13] Not only in science but also in technology Muslims have made some distinctive impact for its improvement. "Roger Bacon, the father of modern science, learnt from Muslims the experimental method because he was a student of Muslim institutions of Spain. Roger Bacon's method immediately reached to the various parts of Europe and popularized as the Baconian method and the Copernicus, a leading astronomer of Europe borrowed much from Muslims works."[14]As a result the introduction of experimental method mainly various branches of science and technology, such as medicine, chemistry, astronomy and physics registered great advance in Europe, of which the universities of Salerno, Bologna, Paris, Padua and Oxford, patterned after Muslim institutions were the center. In 8th Century Jabir ibn Hayyan, was father of chemistry He first time introduced the experimental methods in chemistry. He also introduced theories about the transmutation of metals. He was first chemist who produced numerous acids for instance Nitric acid, Sulfuric acid and hydrochloric acid etc. Arabic chemists introduce destructive distillation.

The first pharmacy and drugstores were opened in Baghdad. Haroon-ar- Rashid opened first public hospital in Baghdad. The disease transmission in direct or indirect contact can be traced back to several hadiths attributed to Hazart Muhammad (P.B.U.H). He (P.B.U.H) was fully aware about infectious nature of some disease like leprosy and sexual transmigration of infections. "Basically, this revival and reciprocal exchange is an end of dark ages and the beginning of the Industrial Revolution in Europe."[15] Thus Alessandro Bausani opined rightly as "It is also true that during our middle ages the Muslim world was considered more or less like America now i.e. the world to which one had to go perfect oneself in science and technology"[16] Science & Technology is an instrument through which the civilization of a society can be measured. In the medieval period scientific & technological and the philosophical achievements were the basic parameters to judge Islamic civilization. Hence, that civilization was synthetic in character. It will not be impertinent to remark in this context that the translation activity of many Greek works reached Europe only through Muslims. And in this regard we may say that one hand pre-Islamic science and technology have played a pivotal role to enrich this Islamic civilization, where the activities of Byzantium scientist, like, Philon, Heron of Alexandria provided main impetus for the growth of Muslim technology. "On the other, Islamic scientists developed extensive thoughts of the classical Greeks and opened a new avenue for reciprocal exchange.

On the course of time, the activities of Philon and Heron have provided very good source materials to the Muslim scientists and that have been translated into Arabic because, they have described ingenious devices that embodied the principle of mechanics, aerostatics and hydrostatics. Prior to this in the 1st century B.C. Vitruvius described a number of mechanics that includes water –mill with a vertical undershot wheel, various water-lifting mechanism and several heavy weight raising mechanism etc."[17] We know that the vertical undershot, overshot and horizontal water wheels were the common practice in the Middle East. Civil engineering mechanical systems of Egypt and Iraq were used for intensive irrigation that was incorporated wax dams, shrices and wires.

"Muslim scientists developed cavalry and new weaving techniques that were transmitted in the various parts of the Europe. Harun al – Rashid's *Khizanat al- Hikma* had played a significant role to develop science and technological knowledge in the Islamic society. Thereafter, Bayt-*al-Hikma* of al Mamun had rendered a great service to develop the thought of science and technology among the Islamic people of the globe of that period."[18]

Muslim scientists and technologists received the heritage of their predecessors and later on they developed it in their own endeavors and grew into their own science and technology through a continuous process of invention, research and development. Al- Jazari and Banu Musa brothers have not accepted the predecessor's thoughts; rather they have boldly criticized the predecessor's activities and established their own methods. Therefore, it is generally believed that the works of Homer, Thucydides and the Greek dramatists were the part of the cultural background of every educated European, but in science and technology the scenes were something different." In the medieval period particularly in the 6th century A.H. Corresponding 12th century A.D. the writings of al-Farabi, al Ghazali, al- Farghani, Ibn Sina and Ibn Rushd were translated into Latin and became known and popularized with high esteem in the West."[19]At the same time the writings of Aristotle got a predominating influence on Islamic society and his works were translated into Arabic.

Among the various luminaries in the Islamic firmament the role of Ibn Sina and Ibn Rushd were very prominent philosophers.

"Their critical approaches and logical acumens on Aristotle's writings became the foundation of European scientists and philosophical thoughts. Beside these, numerous other scientific works had originally been translated from Greek into Arabic. Charles Singer, in the Epilogue of the 2nd volume of A *History of Technology* maintained that in the medieval period in skill ness and inventiveness "East was superior in science and technology."[20] "A few examples we may indicate here as – in textiles- *Muslin, sassanet, damask, taffetah* etc.; in chemical technology-*alembic, alkali, alfalfa* etc."[21] "Some scholars says, Spanish is particularly rich in words of Arabic origin and that has deep link with Islamic Irrigation and agriculture, such as *tahona* for a mill, acena for water wheel, *acequia* for an irrigation canal and so on."[22] In the medieval period numerous Arabic works on science subjects were translated into Latin by the generous activity of the translation bureau of Toledo, which can be considered as a notable example of this exercise. "Comparatively in technology, the Arabic translations were not so available like science but around 1277 A.D. in the court of Alfonso x of Castile, a work in Spanish entitled *Libros del Saber de astronomia* was compiled under the direction of the king." [23]

Relations between Christian Europe and the Islamic world were not always hostile. Muslim rulers were often enlightened men and well tolerant towards their Christian. Furthermore, commercial intercourse helped a lot to the establishment of communities of European merchants in the Muslim cities, while group of Muslim merchants settled in Byzantium where they made contact with Swedish traders. "More specially we can mention here that there was a deep commercial contact between Fatimid Egypt and the Italian town of Amalfi in the 4th and 5th century A.H., corresponding 10th and 11th century A.D.**"**[24] The most remarkable exchanges took place in the Iberian peninsula where tolerant ruler of the Umayyad caliphs and their successors established friendly relationship between Muslims and Christians.

"Muslim technologies passed from Spain into Italy and also in the various parts of the Northern Europe. Indeed, Europeans accelerated Muslim technological and scientific inventions that influenced various parts of the West for the many centuries." [25]

It is worthy to mention that "Muslim irrigation system with their associated hydraulic works and water-lifting machines remained as the basic foundation of Spanish agriculture, which in due course passed to the European world."[26] Some other installations passed into Christian hands, like industrial plant at Jativa near Valencia two large water clocks on the bank of Tagus at Toledo were found by the Christians when they penetrated in the city in 1085 A.D. These few indications prove that the Muslim ideas were assimilated in European science and technology. "Various other examples of technology transfer are also found which can be expressed as an integrated outlook of Muslim technology to the West such as Foundry technology; Wrought products technology Powder technology etc. and these are the Muslims adopted techniques as a major tool of technological processing."[27]

It is well known that Muslim scientists studied deeply on the fundamental questions of science and technology, especially Ibn Sina made intensive study on force, motion, light, heat, vacuum etc. that paved the way for theoretical and applied mechanics. Useful works were done in the field of mechanics on the wheel, axle, lever, pulley, inclined plane, windmill, water wheel, toothed wheel etc. The name of Al Khazini is very significant who made study on mechanics, hydrostatics and physics. "His book *Mizan al Hikmah* (Book of the Balance of Wisdom) is very remarkable in this regard. Beside these, Ali Ibn Rustam al- Khurasani was a notable constructor of clocks and therefore, he was called as al- Sa'ati (the clock maker). Another Muslim Mechanician of the 13th century A.d. was Ab'ul Isa Isma'il Ibn Razzaz (the son of rice merchant) Badi al Zaman al Jazari. He wrote many treatises on Geometrical mechanism. One of the famous treatises is *Kitab al- Marifat al Hiyal al Hndsiyyah* that was mainly discussed on hydraulic apparatus that was considerd as a best material in Arabic mechanics."[28] So the Mutual and reciprocal transfer of technology is perceived in the Muslim world.

***WATER LIFTING TECHNOLOGY**:*

The supply of water for irrigation, drinking, domestic and industrial purposes has always been consideration in the Muslim countries. The climate and topographical conditions of the Muslim countries are something different from the European lands. In Muslim countries particularly in the Middle East the heavy rainfall, abundant rivers and streams do not occur and found. In medieval Islam, some parts of Iran and Mesopotamia and also the Mediterranean coastland have sufficient rainfalls that enable the people of those regions to practice agriculture without irrigation. However, the overall scenario of the Muslim countries is that they mostly facing problem to irrigate their corps and cultivation.

These problems motivate the Muslim farmers of those regions for finding alternative measure in lifting water from various sources for their everyday needs. Generally, in the steppe lands or in the desert, water is coming out from the wells and that are to be supplied for cultivation, irrigation, drinking and cooking purposes. The easiest means to uplift water from the well is to tie a rope to a bucket and then drown the bucket into the well to pour water into it and then it is taking back. Some times, more advanced is the well –headgear consisting of a drum upon which the rope is wound and a windlass to turn the drum. In the settled population where the requirements are high there these methods were not very sufficient.

Beside this," the first machine is the *shaduf* that was known in ancient period in Egypt and Assyria. It consists of two posts made from wood, masonry or other materials. Between them a horizontal wooden bar was attached which provided a fulcrum for the routable beam of the machine, dividing it approximately in a 2:1 ratio. At the end of its short arm is a counter weight made of stone or clay that lifts the full bucket. The bucket is suspended by the rope or pole fixed to the end to the long arm of the beam. The operator bears down on the beam or the rope and lowers the bucket into the water and the counter weight brings the bucket up and its contents are tipped into the tank and sometimes the water reached to the field for cultivation or irrigation."[29]

Two other technologies were used for water lifting by the Muslim scientists were the *saqiya* and the *noria/ na'ura*. The one driven by animal power and the other by water. "In Arabia this techniques were used prior to the advent of Islam and during the period of the Prophet Hadrat Muhammad a special term *nadih* was used for the camel driven water-lifting system from the wells. Most probably this technique was transmitted to Spain from Syria, when the Muslims introduced their irrigation method to Spain."[30] From Ibn Bassal's account it is understood that *saqiya* was a standard technological method of water- lifting device by the luxurious people of the Islamic world. Another type of water- lifting technology was most suitable in the areas where the fast flowing streams were available and whose courses was not far distance below the surrounding areas of the fields. "Al Muqaddasi informed that there were many *norias* on the rivers at Ahwaz in Iran. They raised water and flowed through aqueducts into cisterns in the town and also through irrigation channels to the orchards. Al- Idrisi (584 A.H./ 1154 A.D.) described that it was used to supply water of Talvera. The wheel was 90 cubits (135 feet) in diameter and it raised water from the river Tagus and delivered into an aqueduct that led into the city. His installation was therefore very equivalent to the *norias* of Hama**."**[31] In India the utilization of Saqiya and Naura was prevalent for a long time and Indian Muslims were very much depended on this water –lifting technology for a long time. The notable historian Irfan habib has discussed on the history of this technology in his book in detail and took the decision that this system proved that there was a very good link between India and the Muslim countries.

"Spain was famous for remarkable Muslim scholars on Agriculture, and the lst reputed writer was abu Zakariyya Yahya Ibn Muhammad Ibn Ahmad Ibn Awwam al- Asbili. His valuable book was entitled as *Kitab al Falaha*. This book was based on the Greek, Roman, Nabatean and Muslim Predecessors where he was not confined to their thoughts only rather he included many points that are considered as his own observations."[32]

Shaikh Radi al Din al Qarshi wrote an important book on Agriculture Science and that was entitled as "*Jami Far'id al- Malaha fi Jawami Fawa'id al Falahah* where the concept and technology of Watering, digging of canals, wells and water-lifting devices were discussed." [33]

Modern Islamic technology is facing some problems that are basically related to religion. All religious sections are against the dreaded nuclear arms, against utilizing poisonous gasses as weapons, against spoiling the environment and nature etc. However, Muslims are not pessimistic in this aspect. There are two main ways to approach the problem, one is to explain all the controversial points in the light of reason and the second is to design a future policy for scientific and technological development apart from the religious manipulations. Because, the epistemology of Islam emphasizes upon the development of knowledge, the Islamic term *'ilm* actually incorporates almost every branches of knowledge from pure observation to the highest metaphysics. No science and technology is indifferent from metaphysics. Thus *'ilm* can be acquired from revelation as well as from the reason/ intellect, from observation as well as intuition, from tradition as well as theoretical speculation. Therefore, the various diverse ways of studying nature and reality are equally efficacious in Islam. Muslim scholars were able to access with other civilizations. Hence, its attempt is to synthesize the existing sciences of various civilizations that they inherited from their predecessors.

"In Ibn Hazam,s treatise the Categories of Sciences (*Maratib al Ulum*) we find perfect fusion of knowledge and values. While establishing a hierarchy of sciences, "Ibn Hazm also insists on their interdependence."[34] Now the dimensions have changed and there are much scientific as well as technological advancement are perceived in the world but the classical exchanged of science and technological thoughts are still considered as the remarkable incidents of the annals of mankind.

Medical science

Arab physicians first use alcohol for medical treatment. Ammar ibn Ali of Mosul wrote a book about Eye diseases. It was master piece on ophthalmology in medieval Islam. He invented a hollow metallic syringe hypodermic needle, which applied through the sclerotic and successfully extract the cataracts through suction. The father of modern surgery Abu al- Qasim al- Zahrawi, , Wrote a book " the *Kitab al Tasrif* ," this book was taught until the 16th century in European Universities. "Ibn al Haytham was father of Optics. "He was founder of psychophysics and practical psychology". This book is very helpful in understanding of light and vision and laws of light such as reflection, rarefaction and function of prism in the study of light. This book introduced numerous methods of eye surgery and pathology medicine. Ibn Sina (Avicinna) is called father of modern medicine. He wrote medical encyclopedia which consist of 14 volumes "*The Canon of Medicine*." This encyclopedia was taught as a text book in European Universities until 17th century. This book describes about the discovery of contagious diseases, sexually transmitted diseases, the use of ice for treatment of fever, the separation of medicine from pharmacology. It was first book in the history of medicine to carry out cancer therapy. "In this book he discovered the methods for treatment of cancer with *"Hindiba*" herbal compound drug which was later identified as anticancer by Ibn al- Baitar."[35]

During the early Muslim period the science of medicine was categorized into various sections e.g. *Ilm al- Adawiya* (The Science of Medicine), *Ilm-e- Kimiya* (The Science of chemistry), *Ilm-e- Qarabadin* (The Science of pharmacology), *Ilm al- Jarahat* (The Science of Surgery), *Marahim* (Ointments), *Ilm al- Tashri wa Munafe* (The Science of Physiology an Anatomy), and *Tibb-e- Jamaliyat* (The science of beauty). These were important branches of Medicine. *Kulliyat* was also important branch of *Tibb.* It includes Pathology, Hygiene, Symetology and Diagnosis.The field of treatment and care was also divided in various branches. They included *Amrad al- Rijal* (The diseases of men), *Qanun-e-Izdwaj* (The law of married life), *Amrad al- Nisa* (The diseases of women), and *Amrad-e- Chashm* (The diseases of eye).

"Prophet Muhammad (P.B.U.H) had mentioned various things to cure different diseases directly. He said do not leave or go the area where people suffer with some epidemic. The Sunnah of Prophet mainly concerned with hygiene. The washing of hands before meal, way of sitting while eating meal and drinking of water are best examples of hygiene of Prophet Muhammad (P.B.U.H). These hygienic benefits were latter proved by science."[36]

At the end I would like to quote some Ahadith containing references to Knowledge, Science and Technology

عن انس قال قال رسول ﷺ طلب العلم فريضة على كل مسلم۔

Anas said, The Messenger of Allah (peace be upon him) said: "The seeking of Knowledge is obligatory upon every Muslim"

عن ابی هریرۃ قال قال رسول ﷺ الکلمة الحکمة ضالة المومن فحیث و جدها فهو احق بها۔

Abu- Hurairah said, The Messenger of Allah (peace be upon him) said: " The word of wisdom is the lost property of the believer, so wherever he find it, he has a better right to it".

عن انس قال قال رسول ﷺ من خرج فی طلب العم فهو فی سبیل الله حتی یرجع

Anas said, The Messenger of Allah (peace be upon him) said: " He who goes forth in search of knowledge is in the way of Allah till he return."

ان العلماء هم ورثة الانبیاء ورثو العلم من اخذه اخذ بحظ و افر۔

"The learned (researchers) ones are heirs of the Prophets---- they leave knowledge as their inheritance; he who inherits a great fortune".

Conclusion

From very beginning Muslims were interested in different Sciences such as medicine, mathematics, botany, astronomy, geography, alchemy, and others. They Studied and developed them along with other subjects of religious sciences such as history, *Qur'an, hadith, fiqa, tafsir* etc.

REFERNCES

1. Al-Qur'an 6:99
2. Al-Qur'an 50:6-8
3. Al-Qur'an 2:260
4. Al-Qur'an 39:21
5. Sahih al-Bukahri, 7:71:582
6. Sunan Abi Dawood, 28:28:3864
7. Ibid 28:28:3865
8. Al Muwatta 50.5.12
9. Hafizur Rahman Siddiqui, " Science for the Muslim World into Europe", Quest for New Science, Edited by Rais Ahmad and S. Naseem Ahmad, Centre for Studies on Science, Aligarh, 1984, p.128.
10. Ibid., p.128.
11. Ibid., p.128.
12. Ibid., p. 128.
13. Ibid., p. 128.
14. Ibid., p.131.
15. Ibid., p. 134.
16. Alessandro Bausani, " Islamic Science and the West". Paper presented in conference on Science in Islamic Polity, Islamic Scientific Thought and Muslim Achievements in Science, vol-1, p.27. 1983. Islamabad, Pakistan).
17. Ahmad Y. al Hassan and Donald R. Hill, *Islamic Technology- an Illustrated History*, Cambridge University Press, Cambrdige & Unesco, 1986, p.32.
18. Ibid., p.32. see also De Lacy O 'Leary, *How Greek Science Passed to the Arabs*, Routledge & Kegan Paul Ltd., London, 1957, pp. 91-93
19. Ibid., p. 32.
20. Ibid., p.32.
21. Ibid., p.32.
22. Ibid., p. 33.
23. Ibid., p.
24. Ibid., p. 34. See for detail- F. Sherwood Taylor, *Science Past and Present*, William Heinemann Ltd., London, 1945, pp. 6-9.
25. Ibid., p. 34.
26. Ibid., p.34
27. Md. Hamiduddin, " The Technology of Future- The Technology for the Muslim World", Quest for New Science, op. cit., p. 240.
28. Muhammad Saud, Islam *and Evolution of Science*, Islamic Research Institute, Islamabad, Pakistan, 1986.
29. Hassan and Hill, op. cit., p.40.
30. Ibid., p. 40.
31. Ibid., p. 42.
32. Muhammad Saud op. cit.,, p. 124.
33. Ibid., p.124.
34. Ziauddin Sardar, " Arguments for Islamic Science", Quest for New Science, op. cit., pp.43-45.
35. http://en.Wikipedia.org/wiki/Timeline_of_science_and_technology_in_the_Islamic_world
36. Adnan Malik khan, Development of sciences in Muslim Spain, Institute of Islamic Studies, Aligarh Muslim university, India,2003. pp. 11,17