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CONTRIBUTIONS OF ARAB SCIENTISTS OF MEDIEVAL PERIOD IN SCIENCE AND TECHNOLOGY

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Abstract:-

Just as the Arab Muslims contributed in the field of Islamic knowledge in the medieval period, similarly they also contributed in the field of science and technology in a large number. So, it is observed that on one hand the Islamic scholars like Imam Abu Hanifa, Imam Shafi, Imam Ahmad bin Hambal, Imam Bukhari and others contributed in the field of Islamic knowledge, on the other hand the Arab Muslim scientists contributed in the field of Historiography, Geography, Mineralogy, Botany, Zoology, Geology, Physics, Chemistry, Mathematics, Astronomy, Medicine and Philosophy in a large number in that period. So, the Historians like Ibn Jarir, Ibn Ishaque, Ibn Hisham, Masudi, Ibn Khaldun, Zahavi and others, the Geographers like Qudama bin Jafar, Ibn Haukal, Abu Raihan al Biruni, Ibn Batuta, Al Istakhri, Abu Bakar Razi, Ibn-e-Majid and others, zoologists like Jahiz, Kindi, Farabi and others, the chemists like Khalid bin Yazid, Jafar Sadique, Jabir bin Hayyan, Tugrai and others, the Physicists like Al-Farabi, Al-Kindi, Razi, Ibn-e-Haisham, Shirazi and others, the astronomers like Yaqub bin Tarif, Hajjaj bin Yusuf, Ibn-e-Ishaque, Ibn-e-Ali, Mohammad bin Musa-al-Khawarizmi, Abul Wafa Buz-zani, and others, the Mathematicians like Maslama bin Muhammad al-Majriti, Muhammad bin Musa al-Khawarizmi, Abu kamil and others, the physicians like Haris bin Kildah, Ali bin Sahal, Abu Bakar Razi, Ibn-e-Sina, Al-Zahravi, Ibn-e-Nafis and others, the philosophers like Ibn-e-Nafis, Ibn-e-Tofail, Ibn-e-Rushd, Kindi, Farabi, Ibn-e-Sina, Gazzali, Ibn-e-Baja, Idrisi, Nasiruddin Tusi and others wrote a large number of valuable books by which the world is benefitted. The present paper is attempted to highlight some of the glorious contributions of Arab Muslim scientists of the Middle Ages to various fields of science and technology.

Keywords: Arab Scientists, Medieval Period, Mathematics, Physics, Chemistry, Botany, Zoology, Medicine

Introduction

Immediately after the establishment of Muhammad's government the education system was oral. But the practice of the writing of books started from the end of the Umayyad period, and it flourished during the Abbasid period (750-1258 CE): During this period, the Arabs did a lot of contributions in the field of Islamic Science and they wrote a lot of Islamic books. On the other hand, the scientists of that period also had contributed to the development of Science and Technology in a large number. They invented many things, and wrote many valuable books in Historiography, Mineralogy, Botany, Zoology, Physics, Chemistry, Mathematics, Geography, Astronomy, Philosophy and Medicines etc. At first the Arabs translated from Sanskrit and Greek books into Arabic, but gradually they achieved such great success in the field of Science and Technology that they became able to write valuable books on the above subjects. In those days

the Europeans were backward. But the wheel of Nature turned and after a long time Arab Muslims faced the downfall in this field. On the other hand, there was an awakening among the Europeans. So the current sciences is the result of European's awakening, but it is based on the credits of Arab scientists, because the European have reached this point with the help of the scientific books of Arab Scientists of Middle age.

Significance of the Study :

It has been thought for a long time, that despite the Arab ruling the earth for a long time, they have not contributed anything in the field of Science and Technology. This study will help new generation of Arabs to remind their forefather's contribution in the field of science and technology, so that, they can use money gathered from trading their natural recourses of oil and petroleum to promote the science and technology, that would be beneficial for themselves as well as for the world.

Objectives:-

1. The Paper aims to highlight the contributions of Arab scientists of the Middle age in propagation of science and technology.
2. It has been attempted to deal with the contribution to Physics, Chemistry, Mathematics, Botany, Zoology, etc.
3. It has been attempted to remind the Arab new generation regarding the contribution of their forefathers.
4. It aims to highlight that wheel of nature is always turning; it is its job to give and take from someone.

Data Collection:-

The study based on secondary data. The data has been collected from secondary sources like books, journals and websites for conducting the study.

Scope of the study:-

This study is restricted to Arab world of Middle age only.

INTERPRETATION:-

Physics

The scholars of Arab Muslims of Middle age exerted a influences to the intellectual community of the world in the field of Physics. A few examples of their success are cited below:-

Abu Yusuf Yaqub Kindi had achieved the great contribution in this field. He was the inventor of optics. He wrote a book in this regard named "Kitab-u-Ilm-il-Basar" Abu Bakar Razi wrote about 250 or more books in this regard. Abu Nasar Farabi proved the eight branches of the Physics. Ibn-e-Sina researched into all topics of the Physics of his period. *Will Durant* said, "He made original studies of motion, force, vacuum, light, heat and specific gravity"⁽¹⁾. Al-Biruni had the great contribution in the Physics. Hibatullah bin ali al Maruf Abu Bakar Bagdadi (1077-1152 CE) wrote a important book in Physics named "Kitab-ul-Mutabar" S. pines said "The text of Mu'tabar treating of this doctrine is the first one, As far as is known at present, where one finds implied this fundamental law of modern dynamics; a constant force gives rise to an accelerated movement"⁽²⁾.

Chemistry

Some achievements of Arab Muslims of middle age in the field of Chemistry are follows

Khalid bin yazid (died 407 CE) spent his valuable life in the field of Chemistry as he wrote four books in this regard. Imam Jafar Sadique (died 765 CE) was a famous Chemist of this period. Jabir bin Hayyan wrote a important book in Chemistry named "Kitab-us-Sabyeen" (it was translated into Latin). He wrote hundred books in this regard. Abu Yusuf Yaqub Kindi wrote a book in this regard named "Ibtal-u-da'wal Muddayeen Sifataz Zahab Wal Fizza min gair-e-Ma'adiniha". Abu Bakar Razi wrote 21 books in this regard but his most famous book is "Sirrul Asrar". Ibn-Ameel at-Tamimi wrote a book named "Miftahul Hikmah-al-Uzmah". Al-Hamdani

wrote a book in this regard named "Jawaharataine-Atiqataine" (third part of this book contains the description of different aspects of the metal). Farabi who wrote a book in Chemistry named "Fi-Maqalati Wajubis Sana, atil Kimya". Al-Majriti wrote two books in Chemistry named "i) Rutbatul Hakeem ii) Gayatul Hakeem". Tugrai was the famous Chemist of this period, he wrote some valuable books in this regard named "i) Haqayiqul Istish-had, ii) Kitabul Anwar wal Mafateeh, iii) Mafateehur Rahma, iv) Anwarul Hikmah". M. Ullmann said : *"it was not the Greek writings but these Arabic ones which prepared the way for western alchemy. Thus they introduced the process which leads via Arnald of Villanova, the Latin "Geber" and Paracelsus to Robert Boyle (1627-91), Joseph Black (1728-99), Joseph Priestly (1733-1804), Antoine Laurent Lavoisier (1743-1794) and finally to the miracle of modern Chemistry. But they also gave important impulses to European Cultural history; it may suffice to mention Jakob Bohme, the Rusicrucians (Novalis and Goethe) (see R.D.Gray, Goethe the Alchemist. A study of alchemical symbolism in Goethe's literary and scientific works, Cambridge 1952)*⁽³⁾.

Mathematics

The world community will ever remain grateful for the contribution of Arab Muslims of middle age in the field of Mathematics some of them are noted below:

Mohammad Ibn Musa al-Khawarizmi, was the founder of Mathematics and Al-Jebra in Muslim world. He wrote two books in this regard named i) Ilmul Hisab (it contains the principles of Mathematics and its formulas) ii) Kitabul Mukhtasar min Hisabil-Jabar Wal Muqabala (it is a very famous book in the history of Mathematics) Sartan said: *"His al-jebra hisab-al-jabr Wal muqabala is qually important. It contains analytical solutions of linear and quadratic equation and its author may be called one of the founders of analysis or algebra as distinct from geometry, he also gives geometrical solutions (with figures) of quadratic equations for ex. $X^2+10x=39$, an equation often repeated by Later writer*⁽⁴⁾. Will Durant said: *"This work, now lost in its Arabic form, was translated by Gerard of Cremona in the twelfth century, was used as a principal text in European Universities untill the sixteenth century, and introduced to the West the word algebra (al-jabr-"restitution" "completion"*⁽⁵⁾. Ahmad bin Yusuf bin al Dayah al Misri (died in 1912 CE) wrote an important book in this regard named "Risalatun fin Nisbah wat Tanasub" (it translated in Latin by Gerard of Cremona). Abu Kamil Shuja' bin Aslam (850-956AD) was the greatest Mathematician of Islam; he was alled "Al-Hasibul Misri" (Mathematician of Egypt). He wrote 14 books in this regard.

W. Hartner said: *"They entitle us to place him among the greatest Mathematicians of the Islamic middle age (for the development of Islamic Algebra)--. Through Leonard pisa and his followers, he exorcized considerable influence on the development of algebra in Europe and no less great was the impact of his geometrical writings (algebraic treatment of geometrical problems) on Western geometry"*⁽⁶⁾.

Abu Muhammad Hamid bin al Khazar al Khujandi (died in 1000 CE) was a great Mathematician of Muslim middle age. Sartan said: *"Al Khujandi better known as an astronomer, proved that the sum of two cubic numbers cannot be a Cubic number"*⁽⁷⁾.

Botany

The following Arab scholars ushered immense contribution in the field of Botany.

Jabir Hayyan wrote a book named "Kitab-ul-Hudud (it contains the discussion of plants and agriculture). Abdul Malik Asmai (740-828 CE) wrote a book named "Kitab-un-Nabat Wal Ashjar" (It contains the detailed discussion of plants and tress). Jahiz Basri wrote a famous book named "Kitab-uz-zar'Wan Nakhil" **Abu Hanif-al-Dinawari** (died in 895 CE) wrote a book named "Kitab-un-Nabat" (it was the important source of the Western experts of Botany and specially for Muslim experts of agriculture). **Abu Mansur Muaffaque bin Ali Haravi** was the expert of Botany in Eastern Islam, he wrote a book in this regard named "Al-Abniyah-an-Haqayiq-il-Adviah" (it contains the description of herbs and 584 medicines). **Ali bin Isa** (died in 1031 CE) wrote a book named "Tazkirat-ul-Kuhhalin" (it contains 143 uncompounded medicines and medicinal herbs which are used in eye treatment). **Abu Ali Sina** wrote a book named "Al-Qanun-fit-Tibb" (it contains the description of 800 medicines, and it is also the important addition in the field of Botany). **Al-Idrisi** was the expert person in the field of Geography and

Botany he wrote a famous book named "Al-Jami-li-Sifat-i-Ashtat-in-Nabat" (it contains the details of 360 herbs). **Abu Jafar-Mohammad-al-Gafiqi** wrote a book in this regard named "Al-Adviat-ul-Mufradah" (it contains the description of a large number of African and Asian herbs) beside them there are many others scientists, like Qurtubi, Ibn-e-Juljul, Ibn-e-Bajah, Ibn-ul-Baitar.

Will Durant said: "Abu Muhammad ibn Baitar of Malaga (1190-1248) gathered all Islamic Botany into a vast work of extraordinary erudition remained the standard Botanical authority till the sixteenth century, and marked him as the greatest Botanist and Pharmacist of the middle age"⁽⁸⁾.

B. Lewin said: "Ibn al Baytar (died 646/1248) put together all information available to him, quoting about 150 previous authors from discorides to his own teacher, Abu'l Abbas al-Nabati whose Rihla or "Botanical Journey" he often quotes. Most of these works Ibn al-Baytar certainly knew from secondary sources, al Ghafiki above all. In 2324 articles the Djami treats of about 1400 different drugs and plants, 400 of which were not known to the Greeks"⁽⁹⁾.

Agronomy

The Arab intellectual showed the ways of Agronomy the works of some of them are discussed here:-

Ibn-e-Mamati (died in 1209 CE) was very famous person in the field of Agronomy. He wrote a book in this regard named "Qawaneen-ud-Dawaveen". **Jamaluddin Watwat** (died in 1318 CE) was very great person in Agronomy, he wrote a book in this regard. **Mabahij-ul-Fikr wa Manahij-ul-Ibar**. **Abdul Gani Nablesi** (died 1592 CE) wrote a valuable book in this regard named "Ilm-ul-Mallaha-fi-Ilm-il-Fallaha" (it was a great book in Agricultural literature). **Abu-Zakaria Yahya bin Yahya bin Mohammad Ibn-ul-Awam Al-Ashbeli** (died in 1190 CE) wrote a valuable book in this regard named "Kitab-ul-Fallaha" **Will Durant** said: "Muslim Spain brought from Asia and taught to Christian Europe, the culture of rice, buckwheat, sugar cane, oranges, pomegranates, cotton, spinach, asparagus, silk, bananas, cherries, oranges, lemons, quinces, grape fruit, peaches, dates, figs, strawberries, ginger, myrrh. The cultivation of the vine was a major Industry among the moors, whose religion forbade wine. Masket garden, olives groves and fruit orchards some areas of spin notably around cardova, Granada and Valencia- "The garden spots of the world". The island of Majorca, won by the Moors in the eight century, became under their husbandry a pradis of fruits and flowers, dominated by the datipalm that later gave its name to the capital."⁽¹⁰⁾

P.K.Hitti said: "This Agricultural development was one of the glories of Muslim Spain and one of the Arabs lasting gifts to the land, for Spanish gradens Jave preserved to this day a "Morish" Imprint."⁽¹¹⁾

Geology

The Arab Muslim scholars of Medieval period had the considerable achievements in the field of Geology, some of them are discussed here

Kindi wrote a book named "Marifat-ul-Aad Qilalal Jibal" (it consist of the distance of the top peaks of mountains). **Abu Bakar Razi** wrote about the structure of the earth. **Masudi** wrote about the earth quakes, waves of the seas and pearls. **Ikhwanns-Safa** wrote about the structure of the seas and mountains. **Ibn-e-Sina** wrote a famous book in this regard named "Kitab-ul-Ahjar" (it contains the structure of mountains and other discussions of Geology. **Al-Biruni** presented an interesting idea that the Sindh Vally was a basin of the sea in a time which filled up by the soild. So **Will Durant** agreed with the idea of Al-Biruni and wrote "He speculated on the possibility that the Indus Valley had been once the bottom of a sea".⁽¹²⁾

Zoology

The Arab Muslim had the interesting achievements in this regard. Such as **Abu obaidah bin Musanna** (728-824 CE) was the first Arab Muslim who adopted the Zoology subject, he wrote about 100 (hundred) books in this regard among them 50 books are about horses and other 50 books are about camels, scorpions and snakes. Out of them four books are very famous as i) Tabaqat-ul-Fursan ii) Kitab-ul-Hayyat iii) Kitab-ul-Aqarib iv) Kitab-ul-Faras. **Abdul Malik Asmai** wrote five books in this regard as i) Kitab-ul-Khail ii) Kitab-ul-Ibil iii) Kitabut Wahoosh iv) Kitab-ush-shat v) Kitabut-Khalq-il-Insan. Jahiz **Basri** wrote a book named Kitab-ul Haywan (it consists of the details of 350 animals). **Al-Kindi** wrote the following books as i) Risalah fit-Tarif-il-Uns ii) Risalah-fi-Tamrikh-il-Haiwan iii) Risalah-fin-Nahal iv) Risalah-fil-Hasharat v) Kitab-un-fil-khail-i-wal Baitara. **Zakaria bin Mohammad al Qazveni** wrote a book named "Ajaib-ul-Makhluqal-wa Garayib-ul-Maujudat (it contains 130 animals). **Nuruddin Mohammad Ufi** wrote a book named Jami-ul Hikayat (it consists of four topics, each of them related to the animals). **Hamdullah Mustafa al Qazveni** wrote a book named "Nuzhat-ul-Qulub" (it consist the descriptions of 228 animals). Mohammad bin Musa bin Isa Ali al Damiri (1341-1405 AD) wrote a book named "Hayat-ul-Haiwan" (it consists 931 animals and their habits, nutritional value, Lawfulness and unlawfulness and medical utilitarianism etc.) **P.K.Hitti** said "*Al Damiri is the greatest Arab Zoologist*".⁽¹³⁾

Mechanics

The Arab scholars of middle age showed the way of mechanism to the world some of them are here

Ahmad bin Musa wrote a book named "Kitab-ul-Khail" (it contains 100 tools and machines) out of which 75 tools and machines were discovered by him. The book also consists of different sciences games such as the drinking pot producing musical sound at the time of drinking water. **Badiuzzaman Ismail Ibn al Razaz al Maruf bih al Jazri** wrote a book in this regard named "Kitab-un-fi Marifat-il-hiyal al Hindasih" (This book is pregnant with exposition of water clock, sun dial, different kind of pots, peaches, flashing of water and its various forms and water lifting machines)

Abu Ishaque Ibrahim al Zarqali made two water clocks in Talitala (Tolendo) on the bank of Taqus river. Fathullah Shirazi invented such a gun which used to fire twelve rounds at a time. **Abbas bin Firnas** was the man in Arabian history who thought of a nice plan to fly in the open sky by flight. **P.K.Hitti** said "*Ibn-Firnas was the first man in Arab history to make a scientific attempt at flight. His flying equipment consisted of a suit, a feather with wings which we are told carried him a long distance in the air when he alighted however, he hurt himself because his suit was not provided with a tail*".⁽¹⁴⁾

Medicine :

Imam Ibnul Qayyim wrote a book named "Zadul ma'ad" (it contains the description of 80 medicines). Ali bin Sahal wrote a book named "Firdaus-ul-Hikmah" it is a valuable book of this period. Abu Mohammad bin Zakaria Razi wrote about 200 books in different subject but his three books in medicine were very famous as i) Al-Hawi (in 24 volumes) ii) Kitabut Tibb-al-Mansuri (in ten volumes) iii) Kitabut Judri wal Hisbah. He was the first scientist who discovered the anti-biotic medicine for epidemic like measles and small pox.⁽¹⁵⁾ **P.K. Hitti** said "*of his monographs, one of the best known is a treatise on small pox and measles (al-judri-wal-hisbah) the earliest of its kind and rightly considered an ornament to the medical literature of Arabs. In it we find the first clinical account of small pox*".⁽¹⁶⁾

Ibn-e-Sina wrote a valuable book in this regards named "Al-Qanun" (it contains 14 volumes which has five parts i) In principles of medical science ii) Simple medicines iii) Disease of particular parts of the body iv) General disease v) Compound medicines, there are 10 Lakhs words in this book. It was said in Encyclopedia of Britannica that "*The canon of medicine (al Qanun fi-at-tibb) the most famous single book in the history of medicine in both east and west*".⁽¹⁷⁾ Abul Qasim bin khalifa bin Abbas Al-Zahravi was the famous Surgeon of Spain wrote a book named "At-Tasreef" (it contains 30 articles in it and most famous articale is in the surgical operation" He was the first surgeon who practiced the surgical operation. Sartan said: "*Abul Qasim (Abul casis) was the greatest Muslim Surgeon, he exerted a very deep influence upon the development of European Surgery down to the Renaissance*".⁽¹⁸⁾

Conclusion:-

The wheel of nature is always turning, it does not keep any nation in one state, it gives a nation a chance to develop for a certain period of time, and then it sets it on the path of decline, and provides an opportunity for other nation to develop. So, all ancient civilizations of Mesopotamia, Greece, China, Roman and India etc, were destroyed and no stability had been assigned forever. The same thing happened with Arabs and the Europeans. So, it shows that medieval Arab Muslims made great strides in science and technology, but on the other hand, due to the obedience of the European clergy, they were unable to learn anything other than theology, due to which they were very backward. But the wheel of nature turned and scientific progress of Arab Muslims stopped after a certain period of time. On the other hand, the Europeans began to move away from the clergy to science and they translated the Arabic books of Arab scientists into their own language and started teaching in their educational institution, and keep adding new ideas and new research areas, due to which they became enlightened in the world, and Arab Muslims occupied the old place of degradation of the Europeans. In this way, Arab Muslims openly opposed the Islam and Islamic teaching, and not keeping up with the demand of the time they axed on their own feet. Mentioning the Arab Scientists of the Middle age and their scientific achievements will not benefit unless the Muslims pay attention to Science. However, the Europeans translated hundreds of Arabic books of Arab Scientists into their own languages, which helped them in their scientific works on the one hand, and the development of their languages and literatures on the other hand. Teachers regardless of their dharma and religion should acknowledge their merit as the some European scholars acknowledged, because it was with the help of Arab scientists the European reached this point. Jawaharlal Nehru also acknowledged in his book "Discovery of India" that current science is based on the credit of Arab Scientists.

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