Arab Islamic Scholars: Contributions Lost

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علماء الحضارة العربية الإسلامية وإسهاماتهم المنسية

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Abstract

Arab Islamic scholars have played a major role in the development of science and knowledge and have produced work that has been regarded by many as the catalyst for the enlightenment of the world. They have set foundations and were responsible for many scientific breakthroughs. Yet contemporary history books and academic curriculums neglected these contributions and the role they played. This paper presents research evidence that documents some of these contributions and initiates the argument that there is a need to present such work, connect the past to the present by presenting what seems to have been lost along the way.

Keywords:

Arab Islamic scholars; development of science and knowledge; documentation of the Arab contributions

مستخلص البحث

لعب العلماء العرب المسلمون دوراً أساسياً في تطور العلم والمعرفة وأنتجوا أعمالاً عدت من عيون المراجع التي أسهمت بصورة واضحة في تنوير العالم، كما أرسوا القواعد الأساسية لكثير من العلوم التي نعرفها اليوم، وحازوا قصب السبق في الريادة في كثير من جوانب المعرفة، غير أن كتب التاريخ والمناهج التعليمية المعاصرة تجاهلت هذه الإسهامات وأغفلت الدور الحيوي لهؤلاء العلماء. تعرض هذه الورقة الأدلة العلمية التي توثق بعض تلك الإسهامات وبذا تحاجج أن ثمة حاجة لبيان مثل هذه الأعمال من أجل الربط بين الماضي والحاضر عن طريق بيان ما يبدو أنه قد ضاع في عالم النسيان.

كلمات مفتاحية:

العلماء العرب المسلمون، تطوير العلم والمعرفة، كتب التاريخ والمناهج التعليمية المعاصرة، توثيق إسهامات العلماء العرب.

Scholars of the Islamic Empire produced knowledge which acted as a catalyst for the enlightenment of the world. The West benefitted from this knowledge in that, as Barker (2001) explains, it caused their philosophy to develop some of its greatest thinkers, mysticism to assume a scientific character, the study of ancient languages to grow in extent and fertility, Historiography and geography to acquire a new vigor, poetry to arise, and architecture and finer tastes to appear. The Arab Islamic culture set the stage for the Age of Renaissance, the Age of Discovery, and the Age of the Reformation (Barker, 2001). From philosophy to the sciences, their knowledge radiated from their Arab Islamic center in Spain, spreading a light through Christian Europe (Nicholson, 2001). Their academies set the patterns for European universities (Guillaume, 2001). Their achievements and contributions are described as a 'miracle' because of the inability to explain these achievements which were incredible and unparalleled in the history of the world (Sarton as cited in FSTC, 2002).

But in modern times, hardly anyone in the West knows what these contributions are, or the impact they have had on modern science. When we come to look for these contributions in the curriculums and history books today, where the sciences and literatures of great scholars are written about, and which students study around the world, little, if any, information about the contributions of such scholars, or anything about their culture or civilization is found. Recent research on curriculums and history books taught around the world, shows that this culture is quite invisible except for minor geographical information (Al-Adrees, 2003). We are given information about the inventions and discoveries of Western scholars, yet the role of the Arab Islamic scholars in the development of knowledge, and their contributions, are not mentioned and seem to have been forgotten by modern history (Zaimeche, 2001). They do not seem to exist, and their work seems to have been dismissed (Moustafa, 2001), or accredited to Western scholars (FSTC, 2002). A person researching this topic even finds it hard to actually gain any information or an overall picture of these contributions in one place, such as a comprehensive bibliography (FSTC, 2001). We are told that they contributed greatly, yet we do not see recognition of such work in modern literature. There is about one thousand years of work, contributions missing (Zaimech, 2001) that are not accounted for. There is a gap in history, a missing link that needs to be connected.

What the system of numbers has to do with the term 'Arabic' next to it is quite an enigma to many, and hardly anyone knows where 'algebra' came from. And like the culture in which this information belongs to, it is shrouded in mystery, which not many understand nor care to research. The purpose of this paper is to present information to revive the work of such eminent scholars, initiating a beginning which will encourage others to fill in the missing link in history books and curriculums being taught around the world. The work of scholars who represent the genuine Islamic outlook towards education and towards their fellow human beings, and who were, according to Al-Habshi (as cited in FSTC, 2001) driven by an intense interest not for greed or fame but to gain knowledge and serve others, deserve to be recognized by curriculums all over the world. They have contributed greatly and it is to them that we owe a great debt.

There is a need in today's world to present a positive outlook towards the culture and religion that inspired, encouraged, and fostered such love for knowledge, producing men who began an educational revolution that paved the way for the modern world. There is a need to argue that these contributions should be presented not only as a form of recognition or to give credit where credit is due, but to show that this culture and religion are not producers of irrational individuals who have nothing but terror on their agendas.

Introduction

The Arab Islamic scholars documented their achievements and breakthroughs in the sciences

about four centuries before those that were recorded in Europe by the Western scholars. Research shows that it was only after the transfer of Arab Islamic knowledge, funded by European heads of states and powerful clergy, did Europe begin to take interest in the sciences and other fields of knowledge. It is only after the hundreds of Arabic literature translations descended on the 'barren soil of Europe' (Mayerhoff, 2001) did this soil become fertilized. They acquired knowledge that dealt with science and medicine (Mayerhoff, 2001; Brown, 2001), astronomy and mathematics (De Vaux, 2001), geography and commerce (Kramer, 2001) literature (Gibb, 2001; Kritzack, 1964), arts (Arnold, 1924) architecture (Christie, 2001; Briggs, 2001) and music (Farmer, 2001). Translators came from all over Europe to take back this valuable knowledge (Ahmed, 2006) and worked feverishly to bring back home the Arab Islamic treasures they had discovered. To show the zeal and enthusiasm with which these translators worked, it suffices to show the contributions of two of these translators. The first is Gerard of Cremona who spent about 40 years of his life (1147-1187) translating the works of Arab Islamic scholars and was accredited with translating 87 works from the Arabic language to Latin (FSTC, 2003). The second is Constantine the 'African' (d. 1087), a Tunisian Muslim said to have converted to Christianity and studied medicine in the Muslim schools of Africa and Baghdad (FSTC, 2001). He is considered the first mediator of Islamic sciences to the West whose work of translations and teaching led to the formation of the first faculty/university of Western Christendom, that stood at the head of medical knowledge in the Christian West (Durant, 1950), bringing about a generation of medical doctors and causing a revolution in Western medicine (FSTC, 2001).

Arab Islamic Sciences: New Horizons

Arab Islamic scholars presented scientific treasures to the world, which until the beginning of the 20th century, were considered important references for sciences as a whole. And contrary to what many Western historians like to believe, the Arab Islamic scholars produced original works, had academic professionalism which prevented them from plagiarizing, and were not mere copiers, imitators or simply mail carriers (Browne, 2001). They were scholars who were extremely intelligent, with a spirit of inquiry that led each to excel in at least two or three scientific fields. In the field of ophthalmology alone, as Sheikh (2001) explains, *The Textbook of Kalifah* (written around 1260) shows that Muslims in just 250 years produced 18 written works on ophthalmology, while the Greek work from Hippocrates to Paulus, spanning 1000 years, produced only 5 books on this subject. There are some 30 ophthalmology textbooks produced by Muslims, some of which still exist today (Sheikh, 2001). They deduced knowledge based on their own research and observation and oftentimes modified and corrected that of their predecessor (Sheikh, 2001; FSTC, 2003).

Medicine

In no other field have the contributions of Arab Islamic scholars benefitted humanity like they have on medicine. The list and variety of medical works translated at Toledo and used for inspiration is endless. Of all the sciences, medical science was the most renowned.

One of the best scholars who contributed a wealth of knowledge to medical education, not equaled by any, is Al-Zahrawi. Sheikh (2001) presents information on his work which is summarized here. Al-Zahrawi, Abul-Qasim Khalaf ibn Abbas (936-1013), also known as Abuicasis and Albucasis, was born near Cordoba and descended from the Ansar tribe of Arabia. His outstanding contribution to medicine is his encyclopedic work *'At-Tasrif li-man ajiza al-talif*',' comprised in 30 treatises. Completed about 1000 AD, it was the result of almost 50 years of medical education and experience. It was a miniature encyclopedia of 1500 pages, whose surgical parts were translated by Gerard of Cremona (1114-1187) into Latin and various editions were published in Venice in 1497, in Basel in 1541, and in Oxford in 1778. His work

had great influence on Europe, and for centuries, *Al-Tasrif* remained the manual of surgery in all early medical universities such as Salerno, and Montpellier. This book, as Sheikh further explains, reached eminence as the foremost textbook in Western Christendom, was referred to by the British Medical Journal as the oldest medical manuscript written in England around 1250, of which the first and most important treatise in it is Albucasis' De *Chirurgia of Albu-masim*. This manual remained as a reference and used by scientists like William Hunter (1717-1783).

Al-Tasrif, according to Sheikh, contains the earliest picture of surgical instruments and surgical procedures in history, about 200 are described and illustrated, including dentistry and surgical dermatology. Al-Zahrawi devised his own instruments whose introduction was a major breakthrough at the time and his surgical techniques were also revolutionary. One of these instruments that Sheikh writes about is for tonsillectomies. He also described how to connect sound teeth to those that were loose by gold or silver wire. In gynecology, Al-Zahrawi's work, mentioned by Sheikh, included instructions on training midwives to perform unusual deliveries, extracting dead fetuses, the designing and introduction of vaginal dilators, the description of forceps, and the use of caesarean methods. Sheikh also says that Al-Zahrawi classified 325 diseases, along with their symptoms and treatment, and described, for the first time in medical history, a hemorrhagic disease transmitted by unaffected women to their male children, referred to today as hemophilia.

Even in the field of urinary stone disease, Arabian medicine was in the forefront and was discussed in great detail (Dajani, 2002). Dajani's article documents the explanations and groundwork established by Arab Islamic scholars such as Ibn Qurrah, Al-Razi, Ibn Sina and also Al-Zahrawi. These explanations include the formation and growth of urinary stones. Their findings on uroscopy, as Dajani explains, were carefully discussed and explained. He says that differential diagnosis between colitis and kidney stones, and between kidney and bladder stones was very clearly made. Some operations on bladder stones were described and the first lithotripter to break an obstructing urethral stone was invented and used by the great Muslim surgeon Al-Zahrawi. And to prevent recurrence of stones, Dajani explains that they advised diuretics and plenty of fluids, avoiding heavy foods and in particular dairy products. He concludes that Arabian medicine, pharmacology and pharmacopeia, are rich in drugs and compounds prescribed for the treatment and breaking of urinary stones.

Another Muslim pioneer in medicine was, according to Meyerhoff (2001), Al- Razi, (c. 865-925), known in the West as Rhazes, a Persian Muslim with remarkable scientific output. Mayerhoff explains the work of this great scholar and begins by saying that Al-Razi produced more than 200 works, half of which are on medicine. He is the first to give a clear account of small pox and measles. His work was translated and reprinted 40 times between 1498 and 1866. His *Al-Hawi (The Comprehensive Book)* includes Greek, Syrian and Arabic medical knowledge. Of the more than 20 volumes of this work, 10 still exist today scattered in 8 to 10 different libraries around the world. This work was translated under the auspices of Charles I of Anjou. Mayerhoff explains that the direct contribution of Al-Razi, was setting up an exclusive ward for the mentally ill in Baghdad.

Muslim scholars' humane perspective towards their fellow humans was also revolutionary and clearly portrayed in medicine. As Smith (cited in FSTC, 2001) observes, the Muslim surgeons were reluctant to undertake the riskiest and most painful operations because of the discomfort it could inflict on patients. This was seen as a decisive breakthrough in the relationship between doctor and patient. Sayed (as cited in FSTC, 2001) also explains that they were dispassionate in their psychiatric evaluations, not associating them with the 'demonological theories' found in the West at that time. This resulted in making clear cut clinical observations about diseases.

The field of pharmacy is also a rich and fertile

ground in which one can mention innumerable contributions. Suffice it to present here Levey's account of the Arab Islamic scholars' influence on pharmacy presented in FSTC (2001). Levey explains that much of the work done in the Renaissance is just a compilation and slightly altered work of previous Muslim treatises. Pharmacopoeias in German, French, English and Spanish show Muslim influence. The London Dispensatory, in the late 17th century showed the extent of Muslim influence. Most work was in fact used up to the 19th century. And as Levy concludes, there is yet much to be learned from their early drug treatises.

In the field of Chemistry, Jabir (Gerber) and Al-Razi set foundations for modern science. Gerber, who according to Mayerhoff (2001), is known as the 'Arabian Prince and Philosopher' has about 100 works ascribed to him. His influence can be traced through the whole course of European alchemy and chemistry. Some of his work is discussed in FSTC (2001) which gives a good description of the amount of work and its influence on the West. Suffice it to mention here that Jabir described the preparation of many chemical substances: sulphide of mercury, oxides, arsenics etc., work which led to major industrial transformations including refining of metals, dyeing of clothes, use of manganese in glass, making use of pyrites, and giving exact descriptions of processes such as calcination, crystallization, sublimation and reduction. Jabir divided substances into animal, vegetable, and mineral substances. He was a practical chemist who gave precedence to laboratory work over theoretical observations. His *Book of Secrets* foreshadowed a laboratory manual. His laboratory included items still in use today such as the crucible, and the furnace or stove. Some of his revolutionary experiments, mentioned in the source, are the melting of metals, the sublimation of mercury, the preparation of caustic soda, the use of mercury ammonium chloride solution as dissolving reagent and the preparation of glycerin from olive oil. Hill (as cited in FSTC, 2001) notes that the discovery of inorganic acids was of crucial importance for the history of chemistry and became valuable agents for industrial applications.

Even the chemistry of soil erosion was a topic that was busily studied by the inquisitive minds of the Arab Islamic scholars. According to FSTC Limited (2002) the Spanish Arabs started a systematic study of soil chemistry and soil erosion hundreds of years ago. And it was some centuries later that Christian Europe began to accumulate the type of botanical knowledge which the Arabs of Spain and Africa developed. According to this source, during the 12th century, Ibn Al-Awwam from Seville (Spain), wrote an excellent book titled *The Book of Agriculture*, an outstanding piece of work which was an invaluable contribution to the field of scientific agriculture. He refers to many different works including that of Greek, Egyptian, Persian and Arabic origins. The book details 585 plants and discusses and gives practical hints on soil preparation, irrigation and improvement by grafting and preservation of fruits and other shrubs. It also includes garden plants, grain cultivation and the growing of vegetables. Ibn Al-Awwam talked about methods of fertilization and the enhancement of the richness of soil.

But the discussion of the above sciences and the impact they had on the West is not complete without discussing optics. Lindberg's (as cited in FSTC, 2003) study of Islamic impact on Latin optics recorded in Rashed's Encyclopedia is summarized very briefly in the next few paragraphs. The source begins by stating that the Arab Islamic scholars demolished the previous Geek assumptions of optical theory and the great scholar, Ibn al-Haytham, revolutionized the science. According to Lindberg, Ibn al-Haytham did not just explain the principal facts of visual perception, but he also established the 'intromission theory of vision,' and integrated 'anatomical and physiological claims' into the medical theory. Lindberg states that Ibn al-Haytham was able to draw together the mathematical, physical and medical traditions into a single comprehensive theory. He created a new optical tradition and established the aims

and criteria of optics which prevailed, until Kepler and beyond. He developed precision instruments and wrote treatises on the halo and the rainbow. Lindberg concludes that Ibn al-Haytham's theories and methodology had a profound impact on others, particularly Roger Bacon and Witelo.

Sheikh, (2001) presents the research work of Professor Hirschberg on optics which emphasizes even more the contributions of Arab Islamic Scholars and the role they played in the world arena in the field of medicine. Hirschberg explains that one of the most outstanding classical works titled '*Memorial of Ophthalmology*' was written by Ali Ibn Isa (1000 AD) whose work was compiled from the Greek material, 'The Ten Treatises of the Eye' by Galen. Ali Ibn Isa revised this work and added new knowledge. Hirschberg considered this work to be as important as the contributions of the Muslims to the Mosque of Cordoba (Spain).

Professor Hirschberg (as cited in Sheikh, 2001) presented the contributions of a number of eminent Arab Islamic scholars in the field of optics, whose work, according to the time he wrote his article, was still being benefitted from. One of the first mentioned is Ali Ibn Isa who was born in Baghdad (Iraq) and is described as the most famous of all the oculists of the Arab Islamic culture. To Hirschberg, Ibn Isa's work *Notebook of the Occulist*, is considered as the best and most complete textbook on eye diseases. It was translated with commentary into German by Hirschberg and Lippert (1904) and into English by Casey Wood (1936). He says that Ali Ibn Isa's book was the most widely referred to textbook by later ophthalmologists, first translated into Persian and then into Latin and printed in Venice in 1497.

The second of these great scholars mentioned by Hirschberg is a famous contemporary of Ali Ibn Isa, Ahmed Ibn Muhammad Al-Tabari. In his *Book of Hippocratic Treatment* he wrote a long treatise on diseases of the eye, but his work is unfortunately no longer available. The third scholar mentioned is Ammar Ibn Ali Al-Mosuli from Mosul (Iraq) who flourished around 1010 and the *Book of Choices in the Treatment of Eye Diseases* which, according to Hirschberg, deals with anatomy, pathology and describes 6 histories for cataract operation and case of optic neuritis. Hirschberg explains that this scholar alone discussed 48 eye diseases in a short work of about 1500 words, the manuscript of which can still be found in the Escorial Library in Madrid, Spain. Hirschberg states that until the 20th century this scholar's work was only available in Arabic and in Hebrew translation made by Nathan the Jew in the 13th century. It too was translated into German by professor Hirschberg in 1905. To Hirschberg, Ammar Ibn Ali Al-Mosuli is considered as the inventor of the cataract operation by suction, using a fine hollow needle inserted through the limbus. Amazingly enough, this type of cataract operation is still carried out today.

Other great Arab Islamic scholars that Hirschberg writes about, and briefly mentioned here, are Zarrindast 'Gold Hand' (Abu Muhammad Ibn Mansur Bin Abdullah) known as Al-Jurjani, an excellent surgeon from Persia who flourished around 1088 and who wrote *The light of the Eyes.* The scholar Al-Ghafiqi, Muhammad Ibn Qassoum Ibn Aslam Al-Ghafiqi, (died 1165) from Spain, wrote a book in the 12th century called *The Right Guide in Ophthalmology*. In 1965 Al-Ghafiqi had a bust made for him as a tribute of Cordoba 'to a most outstanding Muslim eye specialist.' Kalifah Ibn Al-Mahasin of Alleppo or Haleb (Syria) flourished around 1260 and wrote a book of 564 pages which included the discussion of 36 instruments. Salahuddin Ibn Yusuf from Hammah, Syria, born in 1290, wrote the *Light of the Eyes*. And Ibn Haitham, who was born in 965, was the first to explain that all vision was made possible because of refraction of light rays. Hirschberg said that from 800-1300 the World of Islam produced no less than 60 renowned eye specialists or oculists, authors of textbooks and producers of monographs in ophthalmology, while in Europe an oculist was unheard of before the 12th century.

What is interesting to note is that it was not until the 18th century that the method of removal of

cataract with a hollow needle was employed in Europe (Sheikh 2001). Other contributions by Arabs, in this field, include the introduction of terms such as eyeball, conjunctiva, cornea, uvula and retina. But the single most important contribution in ophthalmology by the Arabs, as Sheikh concludes, remains in the matter of cataracts.

Mathematics

The golden age of Muslim learning extended from the 7th to the 13th century. During this period, in the field of mathematics, Muslims contributed by inventing the present arithmetical decimal system and the fundamental operations connected with it: addition subtraction, multiplication, division, exponentiation, extracting the root, and introduced the concept of the 'zero' to the world (FSTC, 2002). In this article, six scholars are mentioned with information to document each scholar's contribution in this field. One of the most famous Mathematicians, that the article discusses, is Al-Khawarizmi, Muhammad Ibn Musa (780-850). The article explains that Al-Khowarizmi, known as the father of algebra, was born around 780 in the town of Kath (now buried in the sand) in the oasis of Khorezem and was appointed by Baghdad's ruler Al- Ma'mun as his court astronomer. He was also a mathematician and it is from his work, *Book of Calculations, Restoration and Reduction*, that Algebra (*Al-gabr*) derived its name. The source continues by explaining that in the year 1857, a Latin translation of a Muslim arithmetic text was discovered in the University of Cambridge library entitled '*Algoritimi de Numero Indorum*' which began with the words "Spoken has Algoritimi. Let us give deserved praise to God, our Leader and Defender." It is believed that this is a copy of Al-Khowarizmi's arithmetic text which was translated into Latin in the 12th century by an English scholar. Al-Khowarizmi left his name to the history of mathematics in the form of Algorism (the old name for arithmetic). The article further explains that Gerard of Cremona and Roberts of Chester translated the algebra of Al-Khowarizmi into Latin in the 12th century and it was this mathematician's work that was used all over the world until the 16th century. Another eminent scholar mentioned here is Al-Kindi, Abu Yusuf Yaqub Ibn Ishaq Al-Kindi, (801-873) who was born in Kufa. The information given about him begins with his surname which indicates ancestry in the royal tribe of Kindah, of Yemenite origin. It states that he is the first in Islam to be known as the philosopher of Arabs and wrote 11 texts on numbers and numerical systems. Al-Battani, Muhammad Ibn Jabir Ibn Sinan Abu Abdullah (850-929) was also a very important scholar mentioned who left his mark on this science. He was born in Battan, Mesopotamia and died in Damascus. The article describes Al-Battani as the father of trigonometry, as well as being an Arab prince and the governor of Syria. He is also considered to be the greatest Muslim astronomer and mathematician who raised trigonometry to higher levels and computed the first table of cotangents. Al-Biruni (973- 1050) is also accredited by this source as having laid the foundation for modern trigonometry. He was a philosopher, geographer, astronomer, physicist and mathematician.

The source ends by explaining that in the domain of trigonometry, the theory of the functions: sine, cosine, and tangent was developed by the Muslim scholars of the 10th century. It explained that Muslim scholars worked diligently in the development of plane and spherical trigonometry. It also explained how the trigonometry of Muslims is based on Ptolemy's theorem but is superior to it in that it employs the sine where Ptolemy used the chord, and is in algebraic instead of geometric form.

Astronomy

The contributions of the Muslim astronomers who lived between 9th and 12th centuries were both innovative and accurate and their influence continued for generations to come. Many of the most basic concepts of modern astronomy were either developed directly by Arab Islamic scholars, or came about as a result of their influence on

later astronomers (FSTC, 2001). For example, one of the first scholars to advocate and build permanently mounted astronomical instruments is Ulugh Beg (Krisciunas, 2001). According to Krisciunas, as a patron of astronomy, and an astronomer, it seems logical that Beg would be one of the first to come up with the idea of building an observatory. If one did not know the age which Beg lived and worked, one would think that the scholar under discussion was a recent scholar who was highly informed with modern research techniques. According to Krisciunas, in the Samarkand observatory there were between 60 to70 astronomers who were doing research in observation as well as giving seminars. He sums up by saying that their work relied on observations conducted in a systematic way, taking into consideration time for the establishment of reliable data, and for other reasons that are still followed in recent research methods.

FSTC (2001) presents material from The *Dictionary of Scientific Biography* which gives information on some of the scholars who worked in the field of astronomy. A brief summary of each of their contributions mentioned in the source is presented here. Two of these scholars, Al-Battani and Al-Biruni, were discussed above for their contributions in mathematics. The first scholar to be mentioned is Al-Battani who used the widest variety of instruments: astrolabes, tubes, a gnomon divided into twelve parts, a celestial globe with five armillaries, parallax rules, amural quadrant, sundials, vertical as well as horizontal. Al-Battani, who discovered the notions of trigonometrical ratios used today, also wrote the Sabian tables (*al-Zij al-Sabi*), a very influential work used for centuries after him. His work includes timing of the new moons, calculation of the length of the solar and sidereal year, the prediction of eclipses and the phenomenon of parallax. According to Kramer (2001), it was the information presented in Al-Battani's doctrine of the 'cupola of the earth' or 'world summit', or center (which was described by Ibn Rusta as the 'cupola of Arin,') was found in the *Imago Mundi* of Cardinal Peter of Ailly which was published in 1410. Kramer says that Christopher Columbus used this information to get to the New World, and therefore believes that this Islamic geographical theory may claim a share in the discovery of the New World. The second scholar mentioned is Al-Sufi (903-986) who made several observations on the motion of the sun, the length of the solar year. He made observations and descriptions of stars, setting out his results constellation by constellation, discussing the stars positions, their magnitudes, their color, and for each constellation providing two drawings from the outside and the inside of a celestial globe. He wrote on the astrolabe and its thousand or so uses. The third scholar is also Al-Biruni (973-1050) who claimed that the earth rotated around its own axis, calculated the earth circumference, and fixed scientifically the direction of Makkah from any point of the globe. He wrote 150 works, including 35 treatises on pure astronomy, of which only six have survived. The fourth scholar is Ibn Yunus (d. 1009) who is described as having made observations for nearly 30 years (977-1003) using, amongst others, a large astrolabe of nearly 1.4m in diameter, determined more than 10,000 entries of the sun's position throughout the years, recording the position of the sun, moon, and the stars. The fifth scholar is Al-Farghani who was one of Caliph Al-Ma'mun's astronomers. His contributions, according to the source, relate to the astrolabe, explaining the mathematical theory behind the instrument and correcting faulty geometrical constructions of the central disc, which was current then. His most famous book *Kitab fi alharakat al-samawiyah wa jaamai ilm al-nujum* on cosmography contains 30 chapters including a description of the inhabited part of the earth, its size, the distances of the heavenly bodies from the earth and their sizes, as well as other phenomena. The sixth scholar mentioned is Al-Zarqali (Arzachel) (1029-1087) who was said to have prepared the Toledan Tables and was also a renowned instrument maker who constructed a more sophisticated astrolabe. Finally we have Jaabir ibn Aflah (d.1145) who, according to the

source, was the first to design a portable celestial sphere to measure and explain the movements of celestial objects. In summary, it is explained that he is especially noted for his work on spherical trigonometry and that his book Kitab-al-Hay'ah which was translated by the Sicilian based Michael Scot, bore considerable influence in the West. More information about these sciences and the contributions of Arab Islamic scholars is presented by Carra de Vaux (2001), showing the extent and magnitude of their work.

How the works of various Muslim astronomers have been used, or relied upon by scholars who followed them has received attention by many sources, according to FSTC (2001) of which many "matters of contention," as the source says, remain. Greek origin in many Islamic works is usually very clearly specified since the Arab Islamic scholars have always been keen to document the information they gained from ancient scholars, no matter how slight the evidence may be. Yet when it comes to recognizing the Muslim origin of any breakthrough of significance amongst the likes of Copernicus, Galileo, such information is denied, "even if the evidence is beyond the glaring".

Geography

Because of the extent of the influence of the translations of Muslim scientific works in the 12th century which opened up a vast knowledge of the world to the West that was still in darkness, Kramer (2001) believes that the Arab Islamic culture should be viewed as the cultural ancestor of the West, especially in the field of geography. He presents an extensive amount of information on geography and begins by saying that from the 9th to the 14th century, a considerable and important geographical literature was produced in Arabic. He says that when Jaubert edited a French translation of Idrisi in 1870, it wasn't thought unlikely that this edition might increase geographical knowledge of the world, especially Africa. In the field of geography, Arab Islamic scholars gave credit for their beginnings to Ptolemy. And even though no early Arabic translation of the text of Ptolemy exists, as Kramer (2001) explains, an adaptation of this work, made about 830 by the astronomer Al-Khawarismi, does exist which shows that Al-Khawarizmi's longitudes and latitudes go back for the greater part to Ptolemy. But, as Kramer continues to explain, there is a great deal, such as the division of the inhabited world into seven zones or climates, that does not appear in Ptolemy. Al-Khawarizmi was one of the 70 geographers, according to Kramer, whom Caliph Al-Ma'mun (813-833) ordered to make maps of the Islamic world, and the result was an 'image of the earth', the description which existed in many of the works that came afterwards.

The Arab Islamic scholars may have begun with the works of the Greeks, but as Kramer continues, Islamic geography and Islamic astronomy soon went their own ways, and because they did not object to the spherical form of the earth, which was denied by Christian theologians, astronomers such as Al-Farghani (c.860), Al-Battani (c.900), Ibn Yunus (1000), and Al-Biruni (c. 1030), continued in their advancement in the field of geography. Kramer says that in the course of the 9th century, several descriptions of countries came into existence under such titles as '*The Book of Countries*' or '*The Book of Roads and Kingdoms*' whose chief writers are Ibn Khurradedhbeh (c.870), Al-Ya'qubi (c. 890), Ibn Al-Faqih (c. 903), and Ibn Rusta (c.910) who gave administrative and topographical description of the different countries under Islamic rule. FSTC (2001) also describes the contributions of Ibn Khurdadhbih's (d.912) and says that his book, *Book of Roads and Provinces*, described the main trade routes of the Islamic Empire, mentioning China, Korea, and Japan and extending to Java. This article also mentions the contributions of Al-Ya'qubi and The Book of Countries completed by 891, which gives a complete account of the countries he visited.

Kramer (2001) explains that by the 9th century came the development of the literary geographical school where the first map of the world came out. According to Kramer, the first

author to compose a geographical treatise of this kind is Abu Zaid al-Balkhi (d. 934). He states that Al- Jaihani also wrote a voluminous geographical treatise, and many books were soon produced by students of this school such as Istakhri (c.950), Ibn Hauqal (c.975), and Maqdisi (c.985). According to FSTC (2001) Al-Muqaddasi (another spelling for Maqdisi's name, originally from Al-Quds, Jerusalem) had the distinction of being the first geographer to produce maps in natural colors. He visited nearly every part of the Muslim world and wrote about them. This geographer, according to Kramer (2001), has left no subject of interest to modern geography that he had not worked on. He, according to Miquel (as cited in Kramer, 2001) is the creator of "total geographical science." Others mentioned by Kramer are: Al-Hamadani who described the Arabian peninsula; Al-Biruni who described India; Ibn Fadlan who was sent to the Volga Bulgarians; Al-Masudi, the globe-trotter of the Islamic world who visited China and collected large amounts of geographical and ethnographical knowledge of all the lands he visited; Al-Bakri who wrote a voluminous work on the countries he visited; and finally Nasir-i-Khusarau, from Khurasan who visited Egypt and Mecca.

Even after Europe gained back the lands under Arab Islamic rule, the Arab Islamic scholars were the ones who still produced the knowledge for the West (FSTC, 2001). The source explains that in the field of geography, the Norman King Roger II of Sicily (1101-54), entrusted Al-Idrisi with the composition of the known world, producing 70 maps, indicating the superiority of Islamic scholars at that time. We had many other works documented in this source that are briefly mentioned. Of these is Spaniard Ibn Jubair who went to Mecca and Mesopotamia; Ibn Battuta who journeyed as far as Ceylon, the Maldives, Constantinople, and the interior of Africa; Ibn Fatima who described the world; Abu'l-Fida's whose 'Table of Countries' (1327), until100 years ago, was the best known geographical work in Arabic next to Al-Idrisi; Yaqut (1228) and his compilation of geographical names in alphabetical order; Al-Qazwini (c.1275) who wrote about cosmography and geography, including the German countries; and finally Al-Dimashqi (c.1325).

The subject of Muslim Geography is vast, as Kratchokovsky's (as cited in FSTC, 2001) bibliography shows, and requires volumes to do it justice. The article maintains that Kratchokovsky's work is 919 pages long, covering the works of 260 Muslim geographers, including a bibliography of 54 pages, a piece of work that has taken forty years of his life to complete. It is described as one of the best works on this subject, but as the article explains, it has had extracts only translated into French, but nothing from it exists in either Arabic or English.

With the lack of information being presented in modern times about such great work and scholars it is no wonder that when speaking of the world's first navigators, only the names Christopher Columbus or Vasco de Gama flash through our minds. Little is known about the remarkable accomplishments of those that came before them. Little is known that long before these two Western adventurers came onto the scene, others had set the stage for them. In addition to the above, two other predecessors, worth mentioning here, are Zheng He and Piri Reis (FSTC 2002). According to this source, Piri Reis mapped the world, and Zheng He (1371-1433), the 15th century Chinese Muslim admiral born in Yunnan Province, Southwest China, navigated it. It gives credit to Zeng He as helping transform China into a superpower of its time, explaining that in 1420 the Ming navy "dwarfed the combined navies of Europe,"—to give an example, his "treasure ship" was 400 feet long, whereas that of Christopher Columbus's ship, the Santa Maria, was only 85 feet long. The source describes Piri Reis as a naval commander, born in 1465 in Gallipoli, whose famous map of America was shown to be a genuine document. It explains that he devised the first world map in 1513, of which only one fragment of it is left, which shows the Atlantic with the adjacent coasts of Europe, Africa and the New World. His second

world map was discovered in Topkapi Museum palace in the year 1929, signed by and dated by him in Muharram 919H (1513). Professor P. Kahle (cited in FSTC, 2002), a German scholar, made a through analysis and description of this map, observing that Piri Reis was an excellent and reliable cartographer. Kahle also pointed out that much of what was presented on Columbus had been distorted, as nearly all the important documents related to him, and in particular his ship's journal, have been preserved not in their original but in abstracts and edited works, mostly done by Bishop Las Casas.

An example of the way Arab Islamic contributions are dismissed in this field of study is shown when, according to FSTC (2002), in the mid 1960's Hapgood returned to the subject of the Topkapi map. The source explains that because Hapgood was so amazed by the richness of the map, and convinced that Muslim cartography is poor, he decided to attribute it to an advanced civilization dating from the ice age. This position has been described by the source as absurd and ridiculous in view of the work now done on the history of mapping. And ironically, with all this work and the many Arab Islamic contributions to geography, Kramer (2001) says that literary Islamic geography does not seem to have left much direct impression on European thought in the Middle Ages. He presents only one example of the acceptance of their geographical views on the Western writers, the *Opus Terrae Sanctae*, completed by Marino Sanuto in 1321 and dedicated to the Pope, which showed Jerusalem being the center of the world. After dismissing all the efforts exerted by the Arab Islamic scholars, Kramer (2001) seems to contradict himself when he says that the work of Arab Islamic scholars paved the way for the nations (such as Portugal, Turkey, Britain, Dutch, and the Netherlands) that afterwards sailed and ruled those waters. He also says that Vasco de Gama was aided by an Arab pilot who showed him the way to India and who possessed a very good sea map and other maritime instruments. Arabic sources name this pilot as Ahmad ibn Majid who, according to Sir R. F. Burton (as cited in Kramer, 2001), it even seems that Ibn Majid was venerated as the inventor of the compass.

Music and Poetry

The contributions of the Arab Islamic culture are so prominent that, according to Trend (2001), it can not be denied that while Europe was in misery and decay, both materially and spiritually, the Spanish Muslims were creating a civilization and an organized economic life. Muslim Spain, in Trend's opinion, played a decisive part in the development of not only science, but philosophy, art, and poetry, their influence reaching the highest peaks of the Christian thought of the thirteenth century, to Thomas Aquinas and Dante. To Trend, Muslim Spain was 'the torch of Europe'. Between the 8th and 11th centuries Greek treatises on music were translated into Arabic. New and original work was also written in Arabic by scholars like Al-Kindi. Farmer (2001) presents a wealth of information on the influences of music that the Arab Islamic culture had on the West. He believes that the cultivations of this art by the Arabs 'reduces to insignificance' its recognition in any other country. As far as the Arab Islamic contributions to poetry and literature are concerned, a great deal of their influence on the West can still be traced (Gibbs (2001). It is generally believed that the first Provençal poets were influenced by Arabic models (Barbieri as cited in Gibbs, 2001) and early troubadours followed an established tradition in Andalusia (Gibbs, 2001). Dante recorded in the *De Vulari Eloquto* that Italian poetry began under the rein of King Fredrick II (Barker, 2001) who was one of the powerful heads of states that took interest in transferring Arab Islamic knowledge to the West.

Conclusion

Armstrong will always remain for many as the first man to ever set foot on the moon, and history owes him that honor. The Arab Islamic scholars who played such a role in history should also have that honor of at least being accredited for it. They

played a role that can not be dismissed or forgotten. They should be included in curriculums that teach these sciences and should be considered the cornerstones of the knowledge they so diligently worked and slaved on. If Christopher Columbus and Vasco de Gama are always mentioned in the discussion of the discovery of the New World, then those who helped them realize these accomplishments should be recognized. And if the term 'Arabic' is used before the numbers the world now uses, and the term 'Algebra' is applied in the field of mathematics, then at least an explanation is owed. Efforts should be exerted for the inclusion and presentation of such material in today's curriculums of the world to show the rich history and the magnificent contributions of the culture now demonized. It is the same culture that has brought about the scholars who led the world in the development of new sciences and knowledge, information that has helped and continue to help mankind.

In the end one is bound to ask: Doesn't this information deserve to be acknowledged? And most importantly, how much of this information is being presented to the young impressionable minds of the heirs of this once great culture and civilization, the young minds that are now seeing nothing but a distorted, dark image on their cultural screens?

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