Moorish stimulus to European Renaissance

Dr. Linda Belabdelouahab-Fernini
University of M'Sila

Abstract

The middle Ages, as the precursor of Modern Times, were not totally dark and witnessed some great achievements essential to Renaissance philosophical thought. The Classical and Scientific Renaissance in Europe did not occur overnight but were the fruit of manifold contributions. Making the link between the two ages will help revisit the Moorish stimulus to European Renaissance and highlight its impact on subsequent European enterprises.

This article examines how the Moors stimulated European Renaissance. It attempts to show the impact they had on European literature, and most importantly the scientific inheritance they left, which was so significant that it even triggered European expansion. It is in this scientific context that Columbus's idea to sail west to reach the East took shape .

This article also endeavors to rehabilitate the role of the Moors in the making of European Renaissance. The Moors were not mere transmitters of the Greek heritage, but rather refiners and creators, who considerably contributed to the foundations of Western Science. Moorish scholarship was disseminated to the West through the Iberian Peninsula. The crusades and the schools of translation are portrayed as outstanding means through which Europeans became aware of the Moorish scientific genius that was an impetus to the subsequent European Renaissance .

Keywords: The Moors- European Renaissance- Iberian Peninsula- Foundations of Western science-

ملخص

اعتبرت العصور الوسطى كتمهيد للعصر الحديث، ولم تكن مظلمة تماما بل شهدت بعض الإنجازات الكبيرة التي كانت أساسية لنهضة الفكر الفلسفي.لم يحدث عصر النهضة الكلاسيكية والعلمية في أوروبا بين عشية وضحاها،بل كان ثمرة مساهمات متعددة الجوانب. محاولة الربط بين العصرين سيساعدنا على إعادة النظر في الحافز المغاربي للنهضة الأوروبية وإبراز أثره على المشاريع الأوروبية اللاحقة.

يسلط هذا المقال الضوء على تحفيز المغاربة للنهضة الأوروبية. و يهدف أيضا إلى إظهار مدى تأثير هم في الأدب الأوروبي، إضافة إلى تراثهم العلمي الذي كان ذات أهمية بالغة وآثار جد معتبرة ساهمت حتى في الهام التوسع الأوروبي. حيث في نفس هدا السياق، تبلورت فكرة كولومبوس بالإبحار غربا للوصول إلى منطقة الشرق.

كما يسعى هذا المقال إلى إعادة الاعتبار للدور المغاربي في صنع النهضة الأوروبية. لم يكن المغاربة مجرد ناقلي للتراث اليوناني، بل مبدعون ساهموا بقدر كبير في تأسيس العلوم الغربية. و قد تم انتشار معرفتهم عبر شبه الجزيرة الإيبيرية. حيث ساهمت الحروب الصليبية ومدارس الترجمة في تمكين الأوروبيين من الاطلاع على العبقرية العلمية المغاربية التي كانت دافعة للنهضة الأوروبية فيما بعد.

Introduction

As some writers describe it, America is the child of the Middle Ages and the mother of Modern Times. Re-thinking the Moorish stimulus to European Renaissance is basically reinterpreting the link between the two ages and investigating its impact on subsequent European enterprises namely: Columbus's voyage to the New World. It is fair to say that the Middle Ages were the precursor of Modern Times. However, it is fallacious to consider that the Middle Ages were dark and latent. The thousand years preceding the Renaissance were loaded with great accomplishments. Medieval Platonism and Aristotelianism were crucial to Renaissance philosophical thought. The progresses in mathematical discipline including Astronomy were indebted to medieval precedents. This article examines how the Moors stimulated European Renaissance. It attempts to show the impact they had on

European literature, and most importantly the scientific impetus and heritage they left, which were so considerable that they even triggered European expansion. It is also in this Moorish context that Columbus's 1492 enterprise was undertaken.

The Classical and Scientific Renaissance

There is a difference between the Classical Renaissance of Europe which relates to literature and art and the Scientific Renaissance of the 12^{th} and 13^{th} centuries. The Moors stimulated both. Actually, the transmissions, refinements and discoveries of the Arabs and the Moors constituted the foundations of Western Science. It is through the Iberian Peninsula [1] that Moorish scholarship was diffused to the West. The crusades and the schools of translation were very important means by which Europeans became aware of the Moorish science that was an impetus to the subsequent European Renaissance.

The Moors and Moorish Civilization

The definitions of the term "Moor" and its cognates have changed significantly throughout different ages, places, cultures, and languages.The Moors were the Muslim inhabitants of Islamic Spain, or Al-Andalus. The word Moor was used in antiquity and medieval Western Europe to refer to dark-skinned North Africans of Arab and/or Berber origin who invaded Spain in 711 C.E. and established an Islamic culture that lasted for more than seven centuries.

After the destruction of Carthage in 146 B.C.E., the word Mauri referred to the tribes inhabiting the Roman provinces of Mauretania, today's western Algeria and northeastern Morocco. In the Latin Middle Ages, Mauri indicated a mixture of Berbers and Arabs of the coastal regions of Northwest Africa. In Spain, Portugal, and Italy, Mauri changed into Moros. In the fourteenth century, the English utilized the term with a racial connotation for black peoples. From the early modern times up to the mid twentieth century, the word was a reference to persons and events of Islamic North African and Spanish

history and culture. Since the mid-twentieth century, the term bears racial connotations.

The Muslims who once lived in Spain have been given different names. The most popular synonym for the Muslims is 'the Moors.' Most historians use it to label Muslims either before, during or after their presence in Spain. In addition, Muslims are often referred to as 'the Mudejares and 'the Moriscos. The latter originates from the Arab 'mudajjal. It first indicated the Muslims who fought their Muslim brothers with the Christians. Besides, it depicted all Muslims who stayed in Spain after their persecution and worked for the Christian nobles.

When the Mudejares were compulsorily baptized, they became known as Moriscos, the Christian Moors. This word was similarly utilized to describe the Muslims in the South who, following the fall of Granada in 1492, were also forcibly baptized[2].

The Muslims who originally arrived in Spain in 711 C.E were mainly Arabs and Berbers of North Africa. By 770 C.E. people of all races from North Africa and Arabia migrated to Andalusia corresponding to Spain and Portugal at that time. Intermarriages occurred with various nationalities including the native Spanish-Muslim population. During the reign of Abdur-Rahman, (755-788), these people began the work of building an Islamic civilization equivalent to the one already existing in Damascus and Baghdad. Within the span of a century, they succeeded to develop a unique civilization far in advance of any in Europe. Their great contribution is commonly known as the Moorish Civilization.[3] Since then, the Moorish legacy became an inextricable episode of the Spanish history.

Moorish impact on European literature

The first European tale of the Moorish invasion of Spain, The Chronicle of 754, which covers the years 610 to 754, refers to the

Visigothic capitulation, the “loss of Spain” (perdida de España) at the hands of the Arabs and Moors sent by Moussa Ibn Nusayr, the Muslim ruler of North Africa. It is considered as one of the best accounts for the story of the Moorish conquest of Spain and southern France; it provided the basis for Roger Collins, The Arab Conquest of Spain, 711-797, the first modern historian to use it so completely. The European historiography on the Crusades depicts disparaging Moorish portrayals. French, Italian, and English accounts of the medieval Moors repeat these stereotypes and strengthen this negative image.

Modern European historiography started to consider the Moor as subject rather than enemy and kept the romantic and epic mode in evaluating Moorish history. Such depictions can be found for instance in the works of Ernest Renan, Richard Burton Personal Narrative, Washington Irving The Alhambra, and William Montgomery Watt A History of Islamic Spain.

In the late medieval through the modern periods, the Moor becomes a literary figure. Among the first, and most remarkable depictions of Moorish characters is Avengalvon, who, in the Poem of the Cid, went with this hero of the “reconquest” on his expedition to Almoravid Valencia. The Moorish foe of Roland in the Chanson de Roland is Baligant. During this period, we observe a “humanization” of the Moors in literary works. In Spain, literary works, dramatizing the Spanish hegemony over the Moriscos, such as those of Abencerraje and Ginés Pérez de Hita's Guerrasciviles de Granada (Civil Wars of Granada), marked the beginning of the Moorish novel.

The early modern period also witnessed the circulation of captivity narratives. The Moors had a substantial influence on European literature and on the works of majestic writers like Cervantes and Shakespeare.The frequent clashes between Spain and North Africa in the sixteenth-century impacted Cervantes, Spain’s greatest literary

figure, who was himself taken prisoner to Algiers. His five year captivity there led to the plays, "The Bagnios of Algiers" and "The Great Sultana."[4] These latter also mention important episodes in Don Quixote.[5] Set in a clashed Spanish-Muslim context, the plays inform us of Spain's vision of the Mediterranean Islam. Jan Carew relates that the tales of the knight's errantry and courtly love, which obsess Cervantes' hero, Don Quixote, were filtered through centuries of the Moorish-Islamic experience[6]. As far as Shakespeare is concerned, although he never travelled, the information he gathered about the Moors and Morocco came from different friends[7]. He wrote an ode to his Moorish mistress, Lucy Morgan, of Clerkenwell[8], and he was very interested in the black figure. He dealt with the noble Moor, Othello, [9] and the caricature of the black slave, Calliban.

Luís deCamões' Lusiads, depicted African Kings in an ambivalent way, as wise and infidel mouros. The portrayal of the laviscious Moor is found in European translations of the One Thousand and One Nights. The term Moor also instructs modern conceptions of the Muslim inhabitants of medieval Iberia and Western Europe. The image of the Moor has played an outstanding role in more recent European and even American writing, in texts such as Heinrich Heine's verse play Almansor (1821), and more recently in Amin Maalouf's Leo Africanus (1988) to cite just a few.

The influence of Moorish Science on Europe

*** The Cairo House of Wisdom**

In the Middle Ages, Egypt and North Africa had the leadership in Science and Mathematics. A Science academy, similar to that of Baghdad, was established in Cairo.[10] At that time Europe was less developed, and it was introduced to Mathematics, Sciences, Medicine and Literature through North Africa that had a significant impact on European Renaissance. However, this intellectual debt has never been

explicitly acknowledged by western historians. Unfortunately, in most cases, Muslim scholars' innovations were often denied and attributed to customary preservations of Greek learning. The impact of Moorish innovations on Columbus's enterprise has never been mentioned in an unequivocal way. It is in this scientific atmosphere that the idea to sail west to reach the East took shape. Moreover, it is thanks to the available scientific information and tools that Columbus's voyage to the New World was made possible.

Most contributions to world knowledge came from the Cairo Academy of Science called "Dar-el-Hikma" or "House of Wisdom[11]". It was there that Ibn Yunus, one of the greatest Muslim astronomers, completed "Hakimi Tables,"[12]and where Ibn al Haytham (known as Alhazen) enriched Physics, Mathematics, Astronomy and Medicine. [13]

The works of Ibn Yunus and Ibn al Haytham had an important impact on the development of Science in medieval Europe. As Ibn Yunus improved the tables of Ptolemy, a much earlier Egyptian astronomer, the book of Ibn al Haytham on Optics, Kitab al Manazir, which contains important discoveries in the physiology of vision and the theory of reflection of light, had a tremendous influence on the development of Optics in Europe at that time. [14]

Ibn al Haytham posed and solved the problem that was going to bear his name in Europe: The Alhazen's problem. It is only in the seventeenth century that Christian Isaac Barrow and other scientists became interested in Alhazen's problem. [15] In addition, Ibn al Haytham tried to prove the interdependence of Euclid's fifth postulate.[16]He stated a proposition about perpendicular and oblique lines, a method which was not utilized until the eighteenth century by J. H. Lambert. In 1882, this proposition was confirmed as an important axiom by Maritz Pash, an "order" axiom as Hilbert put it. [17]

The influence of the Cairo Academy of Science was most important in Mathematics, Physics and Astronomy. For example, the word 'algebra'[18] is an Arabic word used to describe some of the new mathematics brought to Europe by the Moors. Also, the word "algorithm," a mathematical procedure, is a corruption of the of the name Al Khawarizmi, the Berber author of the algebra textbook that Abu Kamil[19] developed to a highest level in Egypt. His algebra was the most popular and advanced of its time.

The characteristics of Abu Kamil's algebra lie in the high theoretical level. Abu Kamil was one of the Muslim mathematicians who used irrational numbers [20] in a theoretical way. This very achievement did not reach Europe until the end of the sixteenth century.
The influence of Abu Kamil on medieval mathematicians was great. But it is in Medicine that the Moors had the greatest impact on the other parts of the World. They were very known, especially throughout Europe, for their outstanding skill in medicine. The surgeon Abu al Qasim, for example, influenced European medicine in a remarkable way. The medieval Encyclopedia he wrote, which includes views on surgical instruments, was the most advanced of that time[21]. For almost seven centuries, medical schools in Europe owed everything to Moorish research. [22]

In the Middle Ages, Africa was at the origin of subsequent flowering of mathematics and science in Europe. But in the case of Iberia, the infusion of African learning was immediate, following the Moorish conquest in the $8^{th}C^{23}$. Muslim rule in Spain lasted from 711, when the Arabs and Berbers invaded and expelled the Vizigoths, until 1492, when the Catholic Monarchs expelled the Muslims after the fall of Granada. Throughout this period, the Islamic culture and the Arabic language spread across Andalusia- the Moorish name for Spain- and gained an ultimate development and significance. His pano-Arabic forms of poetry developed and were of great importance for the West.

It was in Andalusia that "Arabic and European literatures merged with a resulting influence on western styles and modes of feelings." [24]

*** Translation**

One of the first European mathematicians who tried to end the European isolation with regard to Mathematics was Fibonacci, also known as Leonardo of Pisa who made extensive travels to Algeria and to the Middle East. He wandered as a merchant and investigated on what was studied in Egypt, Syria, Greece, Sicily- and all the other places that were under Muslim influence. These places were foremost vehicles of Muslim scholarship into Europe.Fibonacci fulfilled that "-so that the science might be easily understood, and the Latin people should no longer be deprived of it as he explained." [25]

It is important to mention that the Arabic language facilitated communication between African scientists and those in places under Muslim sway, from Spain to Italy, in the West across Africa and Asia, to China in the East. During this period of extensive trade, Muslims went to every place they could to increase their wealth and diffuse their knowledge and religion. For example, the Arabic numerals we use today were adopted from India and brought into Europe by the Moors of North Africa. To make the Muslim lore more accessible to those who knew only Hebrew, Arabic-Hebrew dictionaries were compiled[26.]

Translation played an excellent role in the Arabic impact on European Renaissance. Its role extended to the circulation of sciences. The Muslim courts of Spain included centers for translation of Arabic works into Latin. Likewise, as early as the twelfth century "scholars from France, England, Italy and Germany came to Spain in pursuit of knowledge and became conversant with the Arabic culture through those translation centers." [27]

Moreover, the schools of translation were like bridges between the Muslim and Christian scholars. The school of Toledo, founded by Alphonso X in the thirteenth century, was the most important one. Furthermore, Moorish scientific treaties were extensively used in Paris, Salerno and Bologna. "The translation from Arabic provided links between Spain, Portugal, France, Italy and England." [28]The first university of Christian Spain was founded at Valencia by Alphonso VII in the 13thC, and the teachers were Muslims and Jews.

The Moorish presence in Europe had also a linguistic impact. There are numerous examples of words with Arabic origin[29]. These words, coffee, sugar, rice, cotton, lemon, alcohol, algebra, admiral, astrolabe constitute just a sample of the list that was enriched by Sertima while discussing the same question. [30]

Manifold works in Medicine, Mathematics and Astronomy became standard texts in European universities. For instance, the Jadwal[31] became a standard text in Oxford. In addition, Ferdinand II founded a university at Naples, in 1224, and the curriculum he established emphasized Moorish scholarship. He even replaced theological studies by Moorish medicine and law[32].

However, it is often believed that the Moors were merely transmitting the Greek heritage, lost to Europeans in the Dark Ages. Europeans attribute to the Moors the role of preservation and deny their role of creation. Even when the Moorish achievements are acknowledged, Moorish scholars are claimed to be Latin instead of African. And whenever their role in the enhancement of the arts and sciences is conceded, it seems that their role of preservation of Greek science becomes predominant and often replaces that of their intensive contributions. This very question was the main concern of many African writers. Ivan Van Sertima is one of the pioneer African writers to raise this issue. In his article "Mathematics in the Age of

Imperialism," he shows the role of African scholars in the development of Mathematics. Objective appreciations about Moorish achievements are also expressed by scholars as Carl Boyer:

> …it is sometimes held that the Arabs had done little more than put Greek science into cold storage until Europe was ready to accept it, at least in the case of Mathematics the tradition handed over to the Latin world in the 12th and 13th centuries was richer than that with which the Arabic conquerors had come into contact in the 7th century.[33]

*** The Crusades**

The Crusades were another means by which Europeans became aware of Muslim learning. Despite the massacres committed against Muslims, the crusaders recognized that they were in contact with a civilization far superior to their own, and then even tried to become acquainted with Arabic literature. Seven centuries after they were defeated, the Moors surpassed the Christian Europeans in their learning. Jan Carew draws a comparison between their two degrees of literacy and demonstrated that "(…) at the time when the insignificant provinces of Moorish Spain contained libraries running into thousand of volumes, the cathedrals, monasteries and Palaces of Leon, under Christian rule, numbered books by the dozen." [34]

Unfortunately, under the order of Cardinal Ximens de Ciserneros, African and Arabic books were burnt. The church at that time saw foreign learning as evil. But key Moorish works had already been translated and circulated before the intellectual holocaust. In Cordoba, for example, the Caliph al Hakim II gathered money to collect a library of 400,000 volumes in the Islamic World.That was made possible since the Muslim world acquired from China the ability of making paper more than 400 years before the rest of non-Muslim Europe. Although Cordoba fell into Christian hands in 1236, all these

works remain permanent African contributions to Iberia and the rest of Europe. In addition, the foundations of the mathematical logic that developed in the 19th C and 20th C were laid by Muslim scholars. Ibn Rushd (1126-98) for example, Averroes as known in Europe, [35] was one of the numerous prominent Muslim scholars at that time. Albert the great of Swabia was very influenced by Ibn Rushd. Likewise, he based his theory of abstractions on the work of Ibn Sina, Avicenna as named by Europeans[36]. Styazhkin, a historian of logic, testifies that "the scholastics were able to draw the idea of formal implication from Aristotle; from the elements of the Arabian Logicians: Avicenna, Al Farabi, Al Ghazali (Alqazal) and Averroes" [37] to name just a few of them.

Al Farabi[38] was one of the earliest Islamic thinkers to transmit to the Arab world the doctrines of Plato and Aristotle, thereby greatly influencing such later Islamic philosophers as IbnSina and Ibn Rushd[39]. Many of Al Farabi's works have been preserved in medieval Latin translations. In addition to his philosophical writings, Al Farabi compiled a Catalogue of Sciences, the first Muslim work to attempt a systematization of human knowledge[40].

On the other hand, the crusades increased the interest of Europeans in the rest of the world. They valued the spices and the riches of the Middle East and Asia. During the Middle Ages, Europeans knew little about Asia, Africa and the Middle East. The Renaissance helped increase people's curiosity about the world around them. The accounts of travellers also played an important role in making Europeans more curious about other lands. It is good to mention that the technological advances in sailing technique, in the fifteenth century, made this theoretical curiosity become practical exploration.

The Moors and Columbus's enterprise

The revisionist literary production that characterized the Quincentenary of Columbus's arrival to the New World dealt with the Genoese' voyage from several angles. Little mention was made to the Moorish contributions to his enterprise. We sustain that Columbus's voyage has to be placed in its Moorish historical context. It is the available scholarship of the Moors and their mastery of navigational knowledge that helped fulfil his trip.

Columbus could not have ignored all the Moorish scientific knowledge and scholarship available in the fifteenth century. The Arab shipbuilding had a far-reaching impact on European explorations in general and on his enterprise in particular. Two of the three ships that constituted the expedition of Columbus's first voyage to the New World were caravels. What is worth mentioning is that both caravels were successful in making the return trip. The first voyage of Columbus in 1492 places him at midpoint in this technological development. He had with him a number of instrumental aids like the compass and the astrolabe. Columbus's enterprise to the New World is considered as a European achievement while, in fact, a number of factors helped in the fulfilment of his project. At the time of his sailing from Palos, until the late fifteenth century, Europe was not the best equipped for far ventures; it after all, might well have been an object of discovery.

On January 2nd, 1492, the dual monarchy of Castile and Aragon of Ferdinand and Isabella completed the conquest of Granada. This conquest put an end to the Muslim power in the Iberian Peninsula- a great empire where people from different cultures and religions used to live together in a cultural and religious symbiosis. The Catholic Kings were now about to achieve the final stage of the Reconquista. In the royal headquarters at Santa Fe, just near Granada, only a few days before the official capitulation of the city, Christopher Columbus

received permission from the Queen to proceed with his project of the western route to the Orient. Since both events occurred the same year, it is interesting to find out which one preceded the other. And more specifically which one gave birth to the other.

Actually, in their Age of Glory and discoveries, the Moors paved the way to Columbus's scheme through the lore and knowledge they made available. After their defeat, Columbus finally benefited from the attention of the Monarchs who were too busy fighting to gamble on a risky voyage westward. The yet impossible recapture of the last part of the Iberian Peninsula was over. After the fall of Granada, the Catholic Kings were able to undertake a scheme that was going to allow them to pursue their aims: the purification of the new-born Spain and the advocating of the Christian religion overseas. Only Columbus's project included the two goals.

The fall of Granada was not only characterized by the Moorish defeat, but also by the Moorish and Jewish expulsions. On March 31st, 1492, the Catholic Kings signed the decree of expulsion, which had to remain secret for one month. Then, the Jews and the Moors had only three months to decide whether to leave or to stay and convert. On July 31st, according to this very decree, under threat of death, those who did not convert at least nominally to Catholicism began their diaspora. The departure of Columbus's fleet from the port of Palos was not accidental or fortuitous. One of the reasons is that the shipping lands of Cadiz and Sevilla were clogged with fleeing Moors and Jews.

The early history of America can be linked with the history of its early settlers. It is also important to identify the people who set sail to the New World with Columbus's first voyage.Among the crew focus is to be laid on the Pinzons Brothers: Francisco Martin Pinzon, chief mate

of the Pinta, Martin Alonso Pinzon, captain of the Pinta, and Vicente Yanez Pinzon, captain of the Nina.
The Pinzons brothers were expert ship outfitters, and they had a key role in gathering the crew of Columbus's voyage. No one wanted to enrol in Columbus's Crew until the Pinzons announced their departure. They also repaired the Santa Maria during the voyage. Martin Alonzo Pinzon calmed the crew, when it grew impatient during the voyage since no land was at the horizon, avoiding a rebellion to Columbus. Rodrigo de Triana who first saw land was under the command of Martin Alonso Pinson.

Our view is that without the help of the Pinzons, Columbus would not have been able to proceed with his voyage. The Pinzons were of Muslim origin. The Pinzon family was related to Abuzayan Mohamed II; the Moroccan Sultan of the Mrinid dynasty (1196-1465).With the Muslimorigin of the Pinzons[41], the Moorish presence in Columbus's first voyage is confirmed.
Such historical evidence highlights the Moorish Columbus connection. Without the available Moorish scholarship and Moorish assistance before and during the voyage, Columbus's enterprise might have never taken place.

Conclusion

The brief account on the achievements of the African Mathematicians and Scientists in the Middle Ages provided evidence that they were essential to the later European Renaissance. Moorish accomplishments in science, astronomy, mathematics, law, history, medicine, pharmacology, optics, agriculture, architecture, and theology were substantial. The Moors also contributed in their glory as well as in their defeat to fuel the curiosity of Europeans to seek new routes across the Ocean Sea and undertake enterprise that would revolutionize the world.

Restoring the Moorish legacy in the making of European Renaissance will definitely help unveil an outstanding springboard historical episode. Even though the latter was often subject to oblivion, its place in the compilation of the history of the European Renaissance can no longer be denied.

[1]- It was named Al-Andalus by the Moors.

[2]- *« The Moriscos and the Mudejares »*, in <http://www.cyberistan.org/islamic/moriscos.html#moris>[May, 2015].

[3]- A.Zahoor, *« Quotations on MoorishIslamicCivilization »*, in <http://www.cyberistan.org/islamic/quote3.html> [June, 2015].

[4]- Miguel de Cervantes, "*The Bagnios of Algiers" and "The Great Sultana"* Edand trans by Barbara Fuchs, Aaron J. Ilika (University of Pennsylvania Press, May 2012) in <http://www.jstor.org/stable/j.ctt3fhhwc> [October, 2014] The two plays were first translated in English in 2012.

[5]- Miguel de Cervantes, *Don Quixote*Trans by John Ormsby (The Pennsylvania State University, 2012). A PDF version can be downloaded in<http://www2.hn.psu.edu/faculty/jmanis/cervante/quixote.pdf> [October, 2014].

[6]- Jan Carew, "*Moorish Culture bringers : bearers of enlightenment*" in *The Golden Age of the Moor* Ivan Van Sertima (New Brunswick: Transaction Publishers, 1992), p. 253.

[7]- He also knew Queen Elizabeth's ambassador to Morocco and the Moroccan ambassador to London. In addition, he read Leo Africanus's geographical history of Africa; and in his play *Othello*, he quotes several sentences from Leo's work. Refer to Rosalind Johnson, "*African presence in Shakespearean drama"* in *African Presence in Early Europe*by Iva Van Sertima (New Brunswick: Transaction Publishers, 1985), pp. 276-287.

[8]- Edward Scobie, "*African Women in Early Europe" Journal of African Civilizations*Vol 6. No 2 (December 1986): 207.

[9]- Emily C. Bartels, *"Making more of the Moor :Aoroon, Othello, and Renaissance refashionings of race," Shakespeare Quarterly*41: 433-54 Winter 90. This article discusses the Moors in literature especially in William Shakespeare's plays. For further information on African influence in Medieval Civilization and European Civilization refer to: Ivan Van Sertima, *The Golden Age of the Moor*, (New Brunswick: Transaction Publishers, 1992).

[10]- Refer to: Jonathan Lyons, *The House of Wisdom: How the Arabs transformed Western Civilisation*(New York; 2010).

[11]- It was built in Cairo in 1005 with a grant from the Fatimid Caliphs who ruled North Africa where the high level mathematicians worked together.

[12]- *El Hakimi Tables* contained observations on eclipses and conjunctions of the planets. The problems of spherical astronomy were solved with the aid of orthogonal projections of the celestial sphere on the horizon and the planet on the Meridian. Refer to the *Encyclopedia of Islam*, V 2, 1926, p. 49. An article entitled "Sixteenth Century Astronomers had Prosthoaphaeresis" in *The Mathematics Teacher*, referred to the trigonometric formula which had been discovered by IbnYunus, over 500 years earlier in Africa.

[13]- George Sarton, *Introduction to the History of Science*, (Baltimore: Cambridge Institution, 1927), p. 716. Quoted in Sertima's*The Golden Age of the Moor*.

[14]- His work was so important that it was translated into Latin and published in Europe. Five hundred years after his death, it was still of great influence. Refer to Sorton's *introduction to the History of Science*.

[15]- Adolf P. Youschevitch, *Les MathematiquesArabes* (Paris, 1976), pp. 91-92 (Translated from French to English by B. Lampkin). The result of the formula of Ibn al Haytham was not known in the earlier Greek period and was not discovered in Europe until the 17th C. Very few are aware that one of the fonders of this important branch of mathematics was Ibn al Haytham about 1000 years ago. Euclid's *Elements* was used as a text for 2000 years, and even today a modified version of his first few books from the basis of high school instruction in plane geometry. The first printed

edition of Euclid's works was a translation from Arabic to Latin that appeared in Venice in 1462.

[16]- Postulate: This termis used to refer to the first principles peculiar to a particular system, such as Euclidean geometry. It is used to refer to the first principles in mathematics.

[17]- Youschevitch, Ibid, p. 116.

[18]- Algebra, which is an Arabic word '*al Jabru*' is the root of the word algebra. Algebra as a science is a contribution to the ancient knowledge in the Islamic world where it was known as the "science of restoration and balancing." In the 9th C, Al Khawarizmi wrote one of the first Arabic algebras, a systematic expose of the basic theory of equations, with both examples and proofs. A Latin translation of Al Khawarizmi's*Algebra* appeared In the 12th C, and in the 13th C appeared the writings of the Italian mathematician, Leonardo Fibonnaci (1170-1239) because this latter had traveled in Islamic lands, and had used an Arabic method of successive approximations.

[19]- Abu Kamil (850-950. His full name was Abu KamilIbn Islam Mohammed IbnShuja al Hassib al Masri. His work was known to Leonardo Fibonacci of Piza(1170-1230) who based his research on Abu Kamil's Algebra. He even copied 17 problems of the 21 problems of Abu Kamil's on the Pentagon and Decagon.

[20]- Irrational numbers : are numbers the decimal expressions of which are non terminating and non periodic.

$\sqrt{2}$=1,414 213 562.. π=3,141592653… Actually, the development of geometry irradicated the need for more numbers.

[21]- For example, the vivisection and dissection of dead bodies were practiced in Moorish anatomical schools. Both men and women were trained to perform delicate surgical operations. The Moors were the first to trace the curvilinear path of rays of light through the air. This was in 1100 AD and it was a prerequisite to the design of corrective eyeglasses. For further information refer to Sertima's *The Golden Age of the Moor*.

[22]- Sorton, op.cit., 616.

[23]- Teaching Resource Center, "*The Flowering of Islamic Spain," Middle East Resources* (March, 1992), p. 2.

[24]- Aldo Mieli, *LaScienceArabe* (Leiden: E J Bill, 1938), p. 213.

[25]- Ettore Carruccio, *Mathematics and Logic in History and Contemporary Thought*(Chicago: 1964), p. 159.

[26]- David Ben Abraham (Abu Sulaiman Daoud al-Fas) and John Ben David (Abu ZakariyaIbnDaoud), two African Jews from Fes, Morocco, compiled Arabic-Hebrew dictionaries.

[27]- For further information consult: Aldo Mieli, *The Genius of Arabic Civilization* (MIT Press, 1983)

[28]- Ivan Van Sertima, *The Golden Age of the Moor* (New Brunswick: Transaction Publishers, 1992), p. 10.

[29]- Jose V. PrimientaBey, "*Moorish Spain Academic Source and Foundation for the Rise and Success of Western European Universities in the Middle Ages"* in *The Golden Age of the Moor*by Ivan Van Sertima, p. 182.

[30]- For further information on the Moorish lore in the Middle Ages, consult the following references: Bartel L. Vander Waeden, *A History of Algebra: From Al Khawarizmi to Emmy Noether* (New York: Springer, 1985). And, Lewis Bernard, *The Arabs in History* (New York: Harper & Row, 1960).

[31]- A Moorish work on Astronomy.

[32]- Sertima, *The Golden Age of the Moor*, p. 172.

[33]- Carl Boyer, *A History of Mathematics*(New York, Willey, 1968), p. 193. More awareness about the Moorish heritage has been lately portrayed by the 1001 inventions exhibition like one that took place on 30th August, 2013. Prince Carl Philip of Sweden officially launched the award-winning 1001 Inventions exhibition, at the renowned Värmlands Museum in Karlstad. For further information on the exhibition throughout the world consult the following like where press and media releases are provided:

<http://www.1001inventions.com/sweden#video> [October, 2014]. Also refer to Salim T. S. Al-Hassani, *1001 Inventions: The Enduring Legacy of Muslim Civilization*(Washington D. C., 2012) and Washington Irving, *Tales of the Alhambra* (Nevada, USA, 2010).

[34]- Jan Carew, *"Moorish Culture bringers: bearers of enlightenment"* in Sertima's*The Golden Age of the Moor*, (Transaction Publishers, 1992), p. 252.

[35]- Averroes, IbnRushd (1126-98) was one of the major Islamic scholars of the Middle Ages. His works contributed significantly to the development of both Jewish and Christian thought in subsequent centuries. Born in Cordoba, he was thoroughly educated in Muslim science, medicine, philosophy and law. He died in Marrakech in North Africa in 1198.

[36]- Avicenna (980-1037). During the Middle Ages, few scholars contributed more to science and philosophy than the Muslim scholar Avicenna. He is well known for two major works: the first work was *The Book of Healing*, a large Encyclopedia concerning the natural sciences, logic, mathematics, psychology, astronomy, music and philosophy. It is considered as the largest work ever written by a single person. *The Canon of Medicine*was a systematic exposition of the achievements of Greek and Roman physicians.

[37]- N. I. Styazahkin, *History of Mathematical Logic from Leibniz to Peono* (Cambridge: MIT, 1969), p.8.

[38]- Al Farabi (873-950) was the first Islamic philosopher to uphold that the philosophical truth is the same throughout the world. He is known to the Latin World under the name of Alfarabius.

[39]- He also believed that the rational faculty is the sole part of the human being that is immortal.

[40]- Emerita Litchteenstadler, *Introduction to Classical Arabic Literature with Selactions of Representative Works in English Translation (*Schoken, Library of Classical Arabic Literature, 1976). For further information consult: Al Ghazali, *On the Duties of Brotherhood,* Overlook, 1976.

[41]- Youssef Mrouah, « Muslims in the Americas Before Columbus » web version by A. Zahoor. In
<http://www.cyberistan.org/islamic/mamerica.html> (January, 2015.