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The Age of Reason and Emergence of Scientific Wisdom in the Medieval Civilizations of the ECO Region

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The Economic Cooperation Organization (ECO) Region was home to great empires and a cauldron of scientific wisdom, culture, and economic prosperity. The region has been ideally situated at the crossroads of major trade routes that spread ideas and gave rise to many scholars and philosophers who had a profound influence on the development of various fields of arts and sciences. The region had a great mix of religions; including Islam, Christianity, Hinduism, Judaism, and Buddhism. These religions co-existed and developed a tradition of knowledge sharing, which provided ideal conditions to establish this region as an intellectual hub of the world. The scholars and philosophers from Persia, Ottoman Empire, and Central Asia made phenomenal contributions to the scientific work while greatly influencing the Golden Age of Islam from the eighth to the fourteenth century and beyond. The ECO region has contributed many scientific discoveries and has brought remarkable innovations in the fields of medicine, astronomy, mathematics, cartography, and archeology, etc. This paper provides some historical background and reviews the major contributions to the development of science and technology by medieval empires of the ECO region. This research is also an attempt to identify common linkages amongst various scholarly and scientific works in addition to the cultural and historical legacies of the ECO region.

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1. Introduction

Science and technology advanced rapidly during the golden age of Islam from the eighth to the fifteenth century, and beyond. Islam was at the forefront of learning through so many centuries which established the foundation for Europe's renaissance and enlightenment.[1] Muslim scientists made great innovations and significant contributions to the development of algebra; astronomy, medicine, tools of navigation, architecture, engineering, and printing. The majority of the scientific discoveries and innovations that took place during the Golden Age of Islam were put forward by scientists and scholars from the present-day Economic Cooperation Organization (ECO) region.[2] These learned scholars were originally from a few of the present-day ECO Member States.

The region was ideally situated at the crossroads of major trade routes. The ECO region was home to great empires and a cauldron of scientific wisdom, culture, and economic prosperity. It was the intellectual and cultural hub of the world, which gave rise to many scholars and philosophers who had a profound influence on the development of various fields of arts and science. The uniqueness of this region was its diversity of many religions, which included Islam, Christianity, Hinduism, Judaism, and Buddhism, etc.[3] These religions co-existed and developed a tradition of knowledge sharing, which provided ideal conditions to establish this region as an intellectual hub of the world.

The scientific culture and centers emerged during medieval civilizations and contributed to the development of novel scientific work and philosophy. The ECO region has made original contributions to scientific work and had brought remarkable innovations in the fields of astronomy, medicine, mathematics, cartography, and archeology. Their contribution to science and technology serves as the foundation for a number of modern

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1 Víctor Pallejà De Bustinza, "How Early Islamic Science Advanced Medicine". December 2016. https://www.nationalgeographic.com/archaeology-and-history/magazine/2016/11-12/muslim-medicine-scientific-discovery-islam/.

2 Behrooz Broumand, "The contribution of Iranian scientists to world civilization." *Archives of Iranian medicine*, 9, no.3 (2006): 288-90.

3 S. Frederick Starr, *Lost Enlightenment: Central Asia's Golden Age from the Arab Conquest to Tamerlane.* (Princeton, N.J: Princeton University Press, 2013).

engineering and technological applications.[4] The scientific culture that developed during medieval civilizations in the ECO region established the scientific and cultural heritage of present-day Turkey, Iran, Uzbekistan, and Kazakhstan.

2. The Golden Age of Islam: Emergence of Science and Reason

The growth of Islam during the seventh century ushered the boom of scientific discoveries, which led to the emergence of the golden age of Islam. During this period, the scholarly work produced was unprecedented and unique for its time. By the year 750, the Arabs had conquered the Middle East, Central Asia, Spain, and parts of North Africa and the edges of China and India.[5] Building on the wisdom of ancient Latin and Greek civilizations, Muslim scientists stretched the boundaries of science and technological spheres. Islamic emperors put a great emphasis on learning, acquiring, and spreading the knowledge, which became the basis of Europe's renaissance and enlightenment.[6] Many Muslim scientists made original contributions to the development of science and played a central role in the preservation and transmission of scientific and philosophical work from ancient civilizations to the West.

Islamic empires under the Umayyad Caliphate, which ruled in Damascus from 661 to 750 and then under the Abbasid Caliphate that ruled in Baghdad from 751 to 1258, achieved a great political and economic fusion which led to the growth of intellectual and productive age in the Islamic history.[7] Baghdad was once the richest city and thriving capital of the world which attracted the cream of intellectuals and gained a fine reputation for knowledge sharing during the reign of some of its famous Caliphs. During this period, scholars from different ethnic and religious backgrounds traveled to Baghdad where they engaged in an intellectual discourse at the House of Wisdom. This fusion and diversity of various ethnic and religious tolerance transformed this region from a primarily tribal

4 Hillel Ofek, "Why the Arabic World Turned Away from Science," November 2011. Accessed August 2019. https://www.thenewatlantis.com/publications/why-the-arabic-world-turned-away-from-science.
5 Ofek, "Why the Arabic World Turned Away from Science,"
6 Bustinza, "How Early Islamic Science Advanced Medicine,"
7 Tijani Ahmad Ashimi, "Islamic Civilization: Factors Behind its Glory and Decline." *International Journal of Business, Economics and Law* 9, no. 5, (2016): 180-184.

culture to a more dynamic and tolerant society.[8] By the tenth century, Baghdad was the largest city in the world and it had a number of schools, libraries, mosques, banks, and hospitals.

Islam's Golden Age was not the sole consequence of Islamic achievements. Rather, the Islamic dynasties of the period included large numbers of Jews, Christians, Hindus, and even Chinese who made significant and lasting contributions to Islamic socio-cultural-scientific achievements.[9] Scholars from different backgrounds and faiths worked together in harmony to achieve the enormous intellectual, scientific and technological breakthroughs and milestones. Their collective contributions made it possible to achieve the Islamic Golden Age.

The absorption and assimilation of the Greek scholarly works can be attributed as one of the fundamental factors that contributed to the Golden Age of Islam. The assimilation phase was stimulated by the translation movement. Religious pluralism and ethnic diversity also promoted the tradition of learning among scholars. Some of the major scientific work and breakthroughs included the order of algebra; the magnetic compass, navigation tools, and advanced knowledge of medicine. Some historians liken the translation movements with to the scientific revolution of the sixteenth and seventeenth centuries in Europe.[10] During the translation movement, a tremendous amount of scholarly work by the Greeks in the fields of astronomy, medicine, mathematics, and natural philosophy was translated into Arabic. This translation movement provided the foundation for promoting the logic, reason, and inquiry in the sciences. For this reason, this will not be an exaggeration to state that other cultural centers of Islam, such as Istanbul, Samarkand, Bukhara, Shiraz, or Isfahan, probably would not have thrived without Baghdad's translation movement.

It is also important to note that the most renowned scientists or scholars of the era were not all ethnically Arabs but they originally

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8 Adel Abdul-Aziz Algeriani and Mohadi Mawloud, "The House of Wisdom (Bayt al-Hikmah) and Its Civilizational Impact on Islamic libraries: A Historical Perspective." *Mediterranean Journal of Social Sciences*, 8, no. 5, (2017) : 179-187.

9 Renima Ahmed, Tiliouine Habib, and J. Estes Richard, "The Islamic Golden Age: A Story of the Triumph of the Islamic Civilization." In *The State of Social Progress of Islamic Societies. International Handbooks of Quality-of-Life.* edited by Tiliouine Habib and J. Estes Richard. (Cham: Springer, 2016).

10 Bustinza, "How Early Islamic Science Advanced Medicine".

came from Central Asia, Persia, and Turkey. For example, Muhammad ibn Musa al-Khwarizmi was a Persian mathematician and astronomer who is known as the founder of Algebra, was born near the Aral Sea in present-day Uzbekistan. The computing term algorithm stems from his Latinized name 'Algoritmi'. Omar Khayyam was a Persian mathematician, astronomer, and poet, who contributed to the cubic equations. Abu Nasr al-Farabi is considered one of the "greatest Muslim philosophers" of the Islamic world who contributed to science, philosophy, ethics, and logic. Al-Farabi, also considered as "the second master" (the first one being the Aristotle), was born in Farab located somewhere in modern-day Kazakhstan.

3. The Emergence of the Scientific Wisdom in the Medieval Era in ECO Region

During the golden age of Islam, there was a great attraction for scholars and intellectuals of present-day Turkey, Iran, and Central Asia to visit Baghdad and quench their thirst for knowledge. The emergence of scientific wisdom in the ECO region was greatly influenced by the Baghdad's "House of Wisdom." During the period, new routes were discovered that connected a vast geographic region and opened up the avenues for wealth creation and property through trade and an agricultural revolution.[11] With these newly connected routes, many parts of Central Asia, Turkey, and Persia were urbanized and emerged the new hubs of commerce, trade, and wealth at an unprecedented scale; that helped boost the intellectual collaboration among different parts of the region. During this medieval period, cities such as Baghdad, Damascus, Cairo, Konya, Mosul, Mashad, Tabriz, Isfahan & Marv became great centers of learning.[12]

Every major city had at least a few madrasahs and associated public libraries. One of the largest libraries of the 10th century was located in Shiraz, Iran; it is reported to have had 360 rooms with specially built cabinets for the books.[13] Marv in eastern Persia is reported to

11 Ofek, "Why the Arabic World Turned Away from Science."

12 Zakaria Virk, "Science and Technology in Ottoman Sultanate". 2010. Accessed 2019. https://www.alislam.org/articles/science-and-technology-in-ottoman-sultanate/

13 A. Shapur Shahbazi, "Shiraz: History to 1940," *Encyclopædia Iranica* online edition. 2016. Accessed August 2019. http://www.iranicaonline.org/articles/shiraz-i-history-to-1940.

have ten well-stocked libraries during the 13th century, Baghdad had 30; Damascus in the 14th century had 150 madrasahs with libraries.[14]

Schools and scholarly centers (madrassas) played a central role in assimilation and transmission of intellectual and scholarly work in parts of Uzbekistan, Persia, and Turkey.[15] These schools attracted a large number of students and scholars from different parts of the surrounding region to carry out research. The Madrassas were the means of exchange of scientific work and communication of knowledge and ideas from other advanced scientific centers during that period, such as Egypt and Iraq. The wealth of knowledge and scientific achievement was reflected in the lifestyles of people of Persia, Central Asia, and Turkey in the form of education, military technology, and architecture.

3.1. The legacy of Samarkand and Bukhara

Medieval scientists of Central Asia made a substantial contribution to the development of science, arts, and philosophy.[16] Many cities in Central Asia were famous for their collection of manuscript books in their libraries during the medieval times. One of the earliest astronomical observatories and libraries emerged in the historical cities of Bukhara, Samarkand, and Urgench.[17] Scientists and scholars used to work for these institutions and debated on various steams of philosophy, mathematics, and medicine. Bukhara and Samarkand were the two major centers of education, culture, and science in Central Asia after Damascus and Baghdad.[18]

The Mongol emperor Timur invaded Damascus in 1401 and ordered the artists and scholars to settle at Timur's capital in Samarkand. A number of scientists were eventually taken to Samarkand. As a result, Damascus lost its intellectual prestige and Samarkand became the intellectual center of the time. However, by that time the Islamic dynasties had turned into true feudal regimes and lost

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14 Matthias Tomczak, "The rise of Islam. Arabic science. Lecture on Science, Civilization and Society" 2004. Accessed 2019. https://incois.gov.in/Tutor/science+society/lecture16.html.

15 Ekmeleddin Ihsanoglu, "Science in the Ottoman Empire." In *Encyclopaedia of the History of Science, Technology, and Medicine in Non-Western Cultures*, edited by Helaine Selin. (Dordrecht: Springer, 2016).

16 Starr, *Lost Enlightenment.*

17 Wikipedia. "Bukhara". 2004. Accessed 2019. https://en.wikipedia.org/wiki/Bukhara.

18 G.P. Matvievskaya. "History of medieval Islamic mathematics: Research in Uzbekistan." *Historia Mathematica*, 20, no. 3 (1993): 239-246.

their progressive role. The flourishing of science was limited to the individual interest of rulers. If any emperor had an interest in philosophy and science, it flourished, or otherwise, it declined if interests of a ruler were elsewhere.

Timur's grandson Ulugh Beg who was also an emperor and had an interest in the arts and sciences, particularly in the astronomical sciences.[19] Ulugh Beg was born on 22 March 1394, in the town of Sultania in present-day Azerbaijan. He had a great affection for learning arts and sciences. Ulugh Beg also founded the madrassa in Samarkand, which stands on one side of the Registan, the central square in Samarkand. To pursue his interest and follow his passion to study astronomy, Ulugh Beg built an excellent astronomical observatory in the 1420s and made Samarkand a great center of science for a few decades. This observatory is considered to be one of the finest observatories in the Islamic World.

Ulugh Beg and his colleagues developed and compiled the star catalogs and tables. Astronomical tables included the coordinates of over 1000 stars.[20] In his star catalog, Ulugh Beg explained how to determine the length of years and months including those of the Chinese calendars. The work also underlined how to measure the positions of the stars and it also included the chapters on determining the distance of the Sun and the Moon from the Earth. The observations undertaken at the Observatory were highly accurate. It is astonishing considering the fact that they were made without any help of optical instruments, only with the naked eye. Ulugh Beg was able to measure the length of the year with remarkable accuracy. The length calculation comes around to 365 days 6 hours 10 minutes 8 seconds. The actual length of star year by modern data is 365 days 6 hours 9 minutes, 6 seconds.[21] Thus, the error is just only less than a minute. It has been reported that Ulugh beg had copied the basic design of his observatory from the observatory of Maraghah.

Sadly, in 1449 his observatory was destroyed. It was rediscovered in 1908 by an Uzbek-Russian archaeologist from Samarkand. Unfortunately, Ulugh Beg's work could not inspire the modern

19 AdvanTour, "The astronomical miracle of medieval Uzbekistan," 2015. Accessed 2019. https://www.advantour.com/uzbekistan/samarkand/observatory.htm.

20 Heather Hobden, *Ulughbek and his Observatory in Samarkand.* (Lincoln : The Cosmic Elk, 1999).

21 AdvanTour, "The astronomical miracle of medieval Uzbekistan."

astronomy because, by the time his work was rediscovered, similar work had already been conducted in Europe. However, his style of work and techniques were used by the observatory at the other end of the Silk Road in Beijing established by Kublai Khan.

3.2. Emergence of the Culture of Science and Technology

Many cultures and societies contributed to the emergence of Islam's Golden Age. Persians – the predecessor people of modern Iran played a central role. Persians were one of the most culturally sophisticated societies and were the main force behind the creation of the Abbasid Dynasty.[22] Persian and Turkic scientists have made lasting contributions and broadened the understanding of medicine, mathematics, and philosophy. Scholars, such as Avicenna, Rhazes, Ferdowsi, al-Biruni, and al-Khwarizmi are unparalleled and attest to the fact that science and knowledge made great peak at the time of Abbasids.[23] Many scientific concepts including the Helio-Centric model of the solar system, finite speed of light, and gravity were first proposed by scientists of the time.[24]

Persians developed one of the oldest forms of water management system known as 'Qanats' for agricultural irrigation. The oldest known qanat 2,700 years ago, is still in use for the provision of drinking and agricultural water in the city of Gonabad. Persian engineers are also credited for improving the design of windmills originally developed by Babylonians. Another major contribution came from 12th -century Persian mathematician Mohammad ibn Musa al-Khwarizmi, who played a significant role in the development of algebra, algorithms, and Hindu-Arabic numerals. Al-Khwarizmi was born in a small town located in Khawrazm, a town in the Khorasan Province of Iran at that time. His contributions to mathematics, geography, astronomy, and cartography established the basis for innovation in algebra and trigonometry. Another Persian mathematician from the 11th century, Omar Khayyam, wrote the book "Treatise on Demonstration of Problems of Algebra

22 Ahmed et al. "The Islamic Golden Age."

23 Tabesh Yahya and Salehi Shima, "Mathematics Education in Iran From Ancient to Modern. Times," in *Mathematics And Its Teaching In The Muslim World*, edited by Bruce R Vogeli, Mohamed El Amin A. El Tom, (Singapore: World Scientific Publishing, 2020), 97-114.

24 Iran Review. "Persia Cradle of Science and Technology." 2011. Accessed 2019. https://web.archive.org/web/20150325161626/http://www.iranreview.org/content/Documents/Persia_Cradle_of_Science_Technology.htm

in 1070, which established principles of algebra and developed methods for solving cubic equations.

Abu Ali al-Hassan ibn al-Haytham is known as the father of optics for his impressive work on lenses, refraction, and reflection. Al-Haytham is known in the West as Alhazen and he was born in 965 in Persia.[25] He demonstrated that the vision is developed by the light that is reflected into the eye by an object, not emitted by an eye itself and reflected back supporting the earlier claims by Aristotle. Through his work on refraction, he determined that the atmosphere has a certain height and that twilight is caused by the refraction of radiation from the sun under the horizon. The majority of physicians during Islam's golden age were Christian, Persian, or Jewish. Ibn Sina, the great physician from the 10th to the 11th century better known to the west under his Latinized name Avicenna, was also a Persian.[26]

Marageh Observatory has a unique place in the history of medieval astronomy, especially in present-day Iran. Nasir-al-Din-Tusi was an eminent Persian mathematician, astronomer, and philosopher who was widely known as far as in China[27]. The observatory is believed to be one of the finest scientific institutes of that time; the main building housed the observational equipment, while other buildings were used for library, teaching, and accommodation of scholars.

Marageh observatory attracted astronomers and physicists from different parts of the Islamic world to carry out astronomical observations and perform calculations. These astronomers made significant contributions towards the design and construction of the astronomical instruments. In 1272, Tusi along with his fellow astronomers, mathematicians, and instrument makers made a compilation of one of the most vital Islamic astronomical tables, known as the Ilkhan Tables.[28] In Persia, Hulagu Khan was locally known as the Ilkhan. Therefore, the star tables produced at Marageh were termed as the Ilkhan tables.

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25 Iran Review, "Persia Cradle of Science and Technology." 2011.

26 Broumand, "The contribution of Iranian scientists."

27 UNESCO, "Category of Astronomical Heritage: Tangible Immovable Maragheh observatory, Iran." *Portal to the Heritage of Astronomy.* 2010. Accessed 2019. https://www3.astronomicalheritage.net/index.php/show-entity?identity=29&idsubentity=1.

28 UNESCO, "Maragheh observatory, Iran." 2010.

During the 1500s, the Safavid Empire emerged and reunited Iran. However, theological education dominated science education, which caused the math and science education to decline further. For the next three centuries, science in Iran could not flourish to a point of pre-Mongol invasion. In 1828, Russia conquered almost all the Caucasian territories from Iran. Iranian emperors and government officials then realized that military losses were due to a lack of modern science and technology. It was in this context that the Iranian emperors sent a group of students to Europe for training in modern sciences. Later in the 19th century Amir Kabir, the prime minister brought significant reforms to uplift the science and technology in Iran. He established Dar ul-Funun in 1851 as the first modern higher education institute which laid special emphasis on medicine, mathematics, natural science, and military training.

3.3. Science and Technology during the Ottoman Empire

Ottoman Empire was centered in present-day Turkey and its influence extended over to Southeast Europe, Western Asia, and North Africa from the 14th till the early 20th century. Throughout its rule spread over six centuries, the Ottoman Empire displayed a unique course of development of science and technology. Initially, science and technology in the Ottoman Empire developed under the impetus of the earlier Islamic centers of science and culture in Baghdad and Damascus.[29] However, in a short span of time, Ottoman science flourished to a point where it could inspire the old Islamic centers of science and culture.

Ottomans inherited their scientific heritage from the previous Seljuk State and on the foundation of the educational and scientific institutions that were established in the Anatolian cities in that period. However, the advanced cultural and scientific centers during the period such as in Egypt, Syria, Iraq, Persia, and Central Asia also contributed to the development of Ottoman science. Students from the Ottoman Empire went to Samarkand to study, while scholars from Central Asia immigrated to Ottoman centers of learning. Besides, Ottomans also benefited greatly from their non-Muslim scientists and European neighbors. Ottomans had employed experts and technicians from Europe to help manufacture weapons Ottomans engaged the services of scientists from the West

[29] Ihsanoglu, "Science in the Ottoman Empire."

and the East, without regard to religion or nationality, and this was an established practice in the Ottoman Empire.

The most important institution of learning was the Madrassa/ Madrasah (College) and it was the major source of education and science in the Ottoman Empire. With the founding of this Madrasah, the Ottomans experienced a wave of scientific progress. These madrassas provided religious, scientific, and educational services; they also trained the personnel for judicial, administrative, and bureaucratic positions. Mehmed II established the Fatih Külliye (complex) in 1453 in Istanbul, which comprised a mosque at the center and surrounded by several colleges, hospitals, schools, and a public kitchen. Besides the conventional madrassas, Suleman the Magnificent established an independent Medical College in the 16th century.

The invention of Sextant (an instrument used to measure the distance between stars), Dhat al-awtar (an instrument that designates the spring and autumn equinoxes), and the astronomical clocks are considered among the great achievements of the 16th century during the Ottoman period.[30] In mechanical technology, for example, Ottomans were the first in the world to use suction pipes for water pumping using double-action pumps and they also invented a crank-connecting rod system, which is now the basis of almost every modern automotive vehicle. They also invented a number of astronomical instruments, including the Rubi Afaki (Horizontal Quadrant) for astronomical observations.[31] In geography, the Piri Reis map was one of the earliest maps to include the Americas.

In astronomy, Taqi al-Din Muhammad ibn Ma'ruf al-Shami al-Asadi (1526–1585) was a renowned Turkish polymath: a scientist, astronomer, engineer, and inventor. He was one of the greatest scientists of the Ottoman Empire, made many great contributions to this field. He developed a new method for the calculation of the solar parameters with his experiments at the Istanbul Observatory. He determined the ecliptic degree as 23° 28′ 40″, which is very close to the current value of 23″ 27′. The Western world used chords for the measurement of angles beginning with Ptolemy from the second century AD up until Copernicus in the sixteenth century. Taqi al-

30 Virk, "Science and Technology in Ottoman Sultanate"
31 Ihsanoglu, "Science in the Ottoman Empire."

Din used trigonometric functions such as sine, cosine, tangent, and cotangent in conformity with the tradition of Islamic astronomy. The Istanbul Observatory was demolished as a result of the stiff differences among the Ottoman emperors under religious issues. This point in history is considered to be the beginning of the halting of the tradition of Ottoman science.

During the Ottoman period, the cultural and scientific heritage flourished and established the intellectual foundations of many Balkans and the Middle Eastern states, especially the Republic of Turkey in the lead, and formed the basis of the subsequent activities.

4. The Decline of Scientific Activity in the ECO Region

Many external invasions destroyed major learning centers and institutions of Islam which led to the slow decline of a multi-cultural and multi-ethnic civilization. One of the major threats against Islam's golden age emerged from the East during the 13th century. In 1206 CE, Chengez Khan established a powerful dynasty in Central Asia. The Mongol Empire conquered most of the Eurasian region, extending its influence to China in the east and much of the old Islamic caliphate in the west. The Mongol Leader - Hulagu Khan destroyed the House of Wisdom in Baghdad in 1258. Many historians look at this devastating point in history as the beginning of the end of the Islamic Golden Age.[32]

The religious pluralism also underwent a slow decline. By 1100 A.D, the environment had changed from a culture influenced by many religions to one increasingly dominated by Islam. In addition to invasions by the Mongols and the destruction of libraries and madrassas, the political mismanagement and discouragement of independent or logical reasoning in the 12th century in favor of institutionalized imitation is also considered as one of the factors that led to the decline.

Later, other Mongolian leaders, such as Timur or Tamerlane, continued their destructive missions in major cities and learning centers of Islam, while killing hundreds of thousands of people, and caused irreversible damage to the ancient irrigation systems of Mesopotamia and major economic infrastructure. These disconsolate events had an extremely negative impact on the life

32 Ahmed et al. "The Islamic Golden Age."

of the people of the entire region, which resulted in the erosion of the major civilizations and doomed the gains of past periods. Some historians attribute the lack of creative thinking as the main cause of the decline of the Golden Age of Islam. Finally, serious fractures within Islam itself began to assume greater importance. More and more emphasis was placed on the orthodox belief which had a muffling effect on cultural and intellectual work.[33]

5. Conclusion

Muslim scholars made ground-breaking discoveries in the Golden Age of Islam that encompassed outstanding scientific discoveries from the scholars of Samarkand, Bukhara, Persia, and Turkey. Indeed, the ECO Region was home to great empires and a cauldron of scientific wisdom, culture, and economic prosperity. The region sits at the crossroads of major trade routes that spread ideas and gave rise to many scholars and philosophers who had a profound influence on the development of various fields of arts and science. The region had a great mix of religions, including Islam, Christianity, Hinduism, Judaism, and Buddhism. These religions co-existed and developed a tradition of knowledge sharing, which provided ideal conditions to establish this region as an intellectual hub of the world.

The scholars and philosophers from Persia, Ottoman Empire, and Central Asia made phenomenal contributions to the scientific work while greatly influencing the Golden Age of Islam from the eighth to the fourteenth century and beyond. However, it is extremely unfortunate that Islamic civilization could not maintain the intellectual and scholarly discourse in the later centuries. Invasions by Mongol empires destroyed major learning centers and institutions of Islam which led to the slow decline of medieval Islamic civilizations. This was the devastating point in history, as the beginning of the end of the Islamic Golden Age. These unfortunate events had an extremely negative impact on the life of the people of the entire region, which resulted in the erosion of the major civilizations and doomed the gains of past civilizations. The possible reasons for this gradual loss of the Golden Age of Islam or the decline of inquiry in Islam can be attributed to the deterioration of religious pluralism during the medieval period. During the

33 Starr, *Lost Enlightenment.*

period, greater emphasis was placed on the orthodox belief which had a muffling effect on cultural and intellectual work.

Muslims today are incredibly underrepresented in science, accounting for less than one percent of the world's scientists. There are roughly 1.6 billion Muslims in the world, but only three scientists from Muslim countries have won Nobel Prize in science (one for physics, the two for chemistry). OIC countries account for only 2.4 percent of global research expenditure, 1.6 percent of patents, and 6 percent of scientific publications.[34] The social, economic, and security conditions in Islamic countries are staggering. It means that the Muslim world is not investing enough in scientific and technological research to address newly emerging challenges and threats from climate change, water scarcity, and food insecurity. In addition to adequate investment in science and technology, it also requires a deeper, rational, and cultural approach that promotes the value of critical inquiry and logical debate- essential to building the scientific spirit of learning and innovation to build the knowledge-based economies of the future.

Today, major parts of the Islamic world, including the medieval intellectual hubs and centers of learning, are in turmoil and chaos due to war on terrorism, religious extremism, violence, and massive population dislocation. Advancement in science and technology alone cannot bring peace and harmony in the Muslim world; unless moral, social, and ethical values are incorporated in the educational systems for the youth. Thus, there is a need for creating opportunities for young students to learn morality and social code of conduct, and promote religious tolerance or acceptability in their early age by learning the cultural heritage and rich history of the Islamic World in order to build a profound understanding that "all human beings are the same under the skin".

ECO region holds great significance to scientific and cultural heritage. Thus, there is a need for effective regional integration among the ECO member states to promote common scientific and cultural heritage and achieve peace and harmony in the region. Given the scale of past contribution to science and technology

34 Royal Society of United Kindom, "The Atlas of Islamic World Science and Innovation," 2017. Accessed 2019. https://royalsociety.org/~/media/policy/projects/atlas-islamic-world/atlas-final-report.PDF.

by Islamic Scholars, we must explore further and understand the details as to what went wrong that led to discontinuity or slowdown of scientific activity in the Muslim world, so that we do not repeat the same mistakes and rather we continue to make serious efforts to regain our lost prestige and legacy of the intellectual arena.

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