Asian Journal of
Islamic Studies and Da'wah

e-ISSN : 3025-4493
p-ISSN : 3025-5252

Index : Harvard, Boston, Sydney University, Dimensions, Lens, Scilit, Semantic, Google, etc

https://doi.org/10.58578/AJISD.v4i5.12071

From Scientific Pioneering to Systemic Dependency: Muslim Contributions, Decline, and the Quest for Technological Renewal

Abdulmalik Abdulkarim Omuya Adubi, Zainab Yahaya Pai, Muhammad Kabiru Muhammad

University of Abuja, Nigeria

nowmalik@gmail.com; yahayazainab97@gmail.com

Submitted:	Revised:	Accepted:	Published:
Aug 16, 2026	Sep 13, 2026	Sep 25, 2026	Sep 30, 2026

Abstract

Between the eighth and fourteenth centuries, Muslim scholars preserved ancient knowledge and advanced original research in mathematics, astronomy, medicine, optics, and philosophy, contributing substantially to the development of modern science and technology. This intellectual legacy contrasts with the contemporary dependence of Muslim societies on Western knowledge, technology, and innovation. This study examines the factors contributing to the decline of scientific inquiry in the Muslim world, the impact of colonialism, and the institutional transformations that strengthened the West's scientific and technological position. The discussion connects these historical developments with contemporary challenges in education, research, and intellectual culture. Its central argument is that scientific renewal requires investment in education and research alongside an intellectual reorientation that harmonizes religious and scientific inquiry, drawing inspiration from the classical Islamic Golden Age. The study concludes that recovering the Muslim scientific tradition requires both institutional development and renewed engagement between religious thought and scientific inquiry. It contributes to debates on scientific renewal by connecting the historical achievements of Muslim scholars with the educational and intellectual conditions needed to strengthen contemporary research and innovation.

Keywords: Islamic Intellectual History; Islamic Golden Age; Muslim Scientific Traditions; Colonialism and Dependency; Scientific Renewal

AJISD Journal is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License

Introduction

The enigma of scientific leadership and dependency in Muslim history has perplexed not only historians but also present-day observers. How the Muslim societies went from leading the world in science to depending on the West is a puzzling one. From the eighth to the fourteenth centuries, knowledge from Muslim societies laid the groundwork for modern science; from algebra to optics and from medicine to philosophy, Muslim scholars spoke at the cutting edge of the intellectual debate.

The "translation movement" saw Muslim scholars play a key role in the preservation, development and diffusion of Greek, Persian and Indian knowledge to Europe. With the help of Muslim knowledge, Europe achieved unprecedented victories in the Renaissance and Enlightenment.

However, it is astonishing that hardly any Muslim-majority societies are the main producers of scientific researches or creators of technological innovations. They mainly rely on the outputs of Western, and increasingly East Asian, sources of technology, drugs, and higher education. The history of scientific advancement mentorship by the Muslim world to dependence on Europe who had come to learn from them shall be traced in this study.

Essentially, it will examine how and why the Muslim world failed to maintain a culture of discovery and innovation after centuries of pioneering efficiency-driven leadership in sciences. Despite its initial heavy borrowing, why did Europe overtake Muslim learning? How can Muslim-majority societies liberate themselves from dependency in the 21st century? The ability of a society for scientific research could have great economic, political and cultural consequences.

Although, the Muslim world does not lack scientific and technological knowledge, it is not sufficiently developed to the point where it actively participates in the global scientific and technological enterprise. As Ziauddin Sardar observes, the scientific underdevelopment of Muslim societies is not merely a technical issue but one that touches on identity, power, and civilization itself (Sardar, 1989).

This study therefore adopts a *longue durée* (long duration) approach by situating the rise and decline of Muslim scientific culture within global transformations. It argues that the decline cannot be attributed to a single cause, such as religious conservatism or colonial intervention; but rather, to the interplay of political, intellectual, and economic factors.

By tracing this historical bend, the essay highlights both the magnitude of the Muslim contribution to global science and the structural challenges that have rendered Muslim societies dependent on external sources of knowledge.

The research questions guiding this paper are threefold:

i. What were the major contributions of Muslim scholars to the World's scientific development?

ii. Through what processes did this knowledge transfer to Europe, and contribute to the Western scientific revolution?

iii. What led to the decline of progress in the Muslim world, and how does this explain current dependence on the West?

In addressing these questions, the study draws upon historical sources, secondary scholarship, and contemporary reports on science and technology in the Muslim world. It concludes by considering pathways toward intellectual renewal and technological independence; emphasizing the need to revive the spirit of inquiry that once defined Muslim civilization.

Muslim Contributions to Science and Knowledge

The seventh-century rise of Islam was also a cultural and intellectual phenomenon besides being political and religious. A century after Prophet Muhammad's death, which happened in 632 CE, the Muslim World spread from Spain to Central Asia. The activities of the empire ultimately resulted in the integration of large peoples such as Arabs, Persians, Berbers, Indians, Turks and later even Greeks and Jews. The scientific and intellectual traditions that Islam encountered and engaged with produced one of the richest scientific traditions to wade through human history. Historians referred to it as the "Islamic Golden Age."

Islam place high premium on knowledge seeking. The Muslims are commanded several times in the Qurʾān to contemplate nature and strive to understand it. For instance, in Surah Āl-ʿImrān (Qurʾān, 3:190), Allah says:

إِنَّ فِي خَلْقِ ٱلسَّمَٰوَٰتِ وَٱلْأَرْضِ وَٱخْتِلَٰفِ ٱلَّيْلِ وَٱلنَّهَارِ لَأٓيَٰتٍ لِّأُو۟لِى ٱلْأَلْبَٰبِ

Indeed, in the creation of the heavens and the earth and the alternation of the night and the day are signs for those of understanding. (Qurʾān 3:190, Sahih International)

The famous "hadith" which proclaims that 'seeking knowledge is an obligation upon every Muslim' became a guiding principle of the Muslim civilization (Ibn Mājah). The call to learning for theologians was in line with practical needs relevant at that time; to govern a large empire, astronomy was required for preparing calendars for prayer times and gynecological medicine of public health. So also were mathematics to get solutions to administrative and inheritance laws.

The Translation Movement

Between the eighth and tenth centuries, the translation movement proved to be a critical juncture. Under the Abbasid caliphs, particularly the reign of al-Maʾmūn (813–833), scholars in Baghdad translated works from Greek, Persian, and Indian into Arabic (Gutas, 1998, pp. 27–35). The House of Wisdom was the leading center of intellectual activity for the Islamic Golden Age. The translation of the works of Aristotle, Galen, Euclid, and Ptolemy into Arabic, often accompanied by critical commentaries and extensions, has been previously examined by George Saliba (2007, pp. 56–63). This process preserved classical knowledge and also transformed it through original insights.

Innovations in Mathematics

Mathematics was one of the most enduring Muslim contributions. Working in Baghdad, Muḥammad ibn Mūsā al-Khwārizmī (d. c. 850) pioneered algebra (al-jabr) and algorithms terms which were derive from his name and his works (Rashed, 2019, Vol. 1, pp. 87–111). He systematized the techniques for solving linear and quadratic equations and his introduction of Hindu-Arabic numerals into the Islamic world (subsequently adopted in Europe). The decimal versus the Roman numeral system has been extremely important and a change to the latter was vital for Western civilization. Without the former, modern science and commerce would have been unimaginable.

Astronomy and the Sciences of the Heavens

Muslim astronomers constructed observatories and developed star charts that were far more accurate than those of the Greeks. Al-Battānī (d. 929) improved the measurement of the solar year that later influenced Copernicus centuries later (King, 1983, pp. 45–49).

Ibn al-Shāṭir (d. 1375) of Damascus developed planetary models that closely anticipated Copernicus's heliocentric system (Saliba, 2007, pp. 212–220). Observatories such as Maragha (1259) and Samarqand (founded by Ulugh Beg in 1420) became world-leading centers of astronomical research by consolidating resources, fostering scientific collaboration, and employing cutting-edge instrumentation for the time. These institutions represented a new era in organized science within the Islamic Golden Age (UNESCO, n.d.).

Medicine and the Healing Arts

In the process of integrating Greek, Persian, and Indian traditions in medicine, Muslim physicians made new discoveries. The Canon of Medicine by Ibn Sina, widely known in the West as Avicenna (d. 980-1037 AD) remained the standard text for medical students in European universities until the seventeenth century (Savage-Smith, 1996, Vol. 3, pp. 903–962). Al-Rāzī (also known as Rhazes) recognized that smallpox and measles were different diseases. He wrote the first known pediatric and ophthalmic (eye) books (Meyerhof, 1931, pp. 325–330). Muslim hospitals evolved into sophisticated institutions, providing systematic medical care and training.

Optics and Experimental Science

Ibn al-Haytham (Alhazen) (d. 1040), working in Cairo, revolutionized optics. He rejected Greek theories of vision that rays emanate from the eye and argued that light enters the eye, which is a precursor to modern understandings of vision (Sabra, 1989, pp. 71–84). His Book of Optics was a treatise regarding lenses and refraction experiments. Given his insistence on controlled experimentation, many historians consider him a forerunner of the modern scientific method (Al-Khalili, 2011, pp. 142–150).

Philosophy and Rational Inquiry

In addition to the sciences, scholars like al-Fārābī Ibn Rushd and al-Ghazālī also dealt with philosophy, logic and theology. They made great contributions, to philosophy and theology. Ibn Rushd's commentaries on Aristotle spectacularly shaped European scholasticism and philosophers such as Thomas Aquinas (Leaman, 1988, pp. 95–110). Ibn Rushd helped make Aristotle's ideas more comprehensive and easy to understand foe the emerging scholars.

Muslim civilization offered a long-term coexistence of science, philosophy, and faith; sometimes agreeing and sometimes contesting each other. However, by the thirteenth century, an intellectual aggregation emerged from the Muslim world which, aside from preserving the legacy, expanded it to the ancients. Remarkably, this knowledge soon crossed to Europe and became the seedbed of the European Renaissance.

Transmission of Knowledge to the West

The scholarly contributions of Muslims were certainly not restricted to the Muslim world. Starting from the twelfth century, the fruits of Muslim science, mathematics and philosophy started reaching Europe through various routes. As the scientific revolution emerged in Europe, the concept of knowledge transfer became a central theme. The degree of debt the West owes to the Muslim world has led historian George Sarton to state that "the Arabs opened for us the gates of science; thanks to their persevering researches and to their patient accumulation of positive knowledge" (Sarton, 1927, p. 17).

Al-Andalus and Sicily as Gateways

The Iberian Peninsula (al-Andalus) may have been the most important passage. During 711 and 1492 under Muslim rule, Andalusia became a site of cross-community engagement between Muslims, Christians and Jews living outside the Muslim world. In the Middle Ages, Cordoba was home to various libraries and universities; it was one of the world's intellectual capitals. The writings of Ibn Rushd (Averroes) and Moses Maimonides show the fruitful interchange of Muslim and Jewish scholarship; and remarkably, they both influenced Latin Christendom (Michaelis & Schmidtke, 2024, pp. i–lxix).

Furthermore, there was Sicily which was ruled by Muslims and was conquered by the Normans in the eleventh century. Norman kings, especially Roger II, employed Muslim scholars, translators, and cartographers especially Roger II, to translate Arabic works into Latin.

Norman Sicily was a unique medieval melting pot where Muslim, Greek, and Latin cultures flourished together. King Roger II of Sicily famously fostered this multicultural environment; he actively employed Muslim scholars and translators to preserve, study, and translate foundational texts into Latin (Ahmed, 2023). The most prominent Muslim scholar at the Norman court that time was Muḥammad al-Idrīsī**.** The king invited him to Palermo around 1138 where he spent over 15 years collaborating with the king to synthesize global knowledge and classical Greek texts into the *Nuẓhat al-Mushtaq*, better known in Latin as the Tabula Rogeriana, it was the most advanced and accurate medieval world map and geographical encyclopedia of its time (Library of Congress, 2022).

Translation Movements into Latin

The Toledo School of Translators located in Spain emerged as an important institution in the twelfth and the thirteenth centuries. Around the sanction of the Archbishop Raymond of Toledo, several scholars like Gerard of Cremona translated hundreds of Arabic works into Latin. This consisted of some as the Almagest of Ptolemy (via Arabic intermediaries), Canon of Medicine of Avicenna, and mathematical works of al-Khwārizmī (Burnett, 2001, pp. 249–288). These texts, which traveled through Arabic, were frequently supplemented with Muslim commentaries and inventions that exceeded the Greek original text.

The European intellectual life experienced a massive enrichment from the Muslim scholarship hence it is important to note the contributions of noted European scholars like Adelard of Bath, Michael Scot, and Roger Bacon who drew abundantly upon Arabic resources and acknowledged owing their debt to the Arabic Philosophers.

Influence on European Intellectualism

The medieval Europe thinkers were certainly affected by the Muslim philosophers like Averroes. The Latin translations of Averroes' commentary on Aristotle were valued

and employed in Christian academia. Although there were Averroist ideas which Aquinas rejected, he was nonetheless preoccupied with them, and their author, being the subject of much thought, on Aquinas' part. Thomas Aquinas, while critical of certain Averroist doctrines, he was however engaged extensively with his works; particularly in developing his own synthesis of faith and reason (Gilson, 1955, pp. 362–374). Muslim scholars were the vehicles through which the teachings of rationalist philosophy were transmitted. These ideas posed a challenge to the intellectual framework of medieval Europe; and in so doing; they helped to prepare the ground for humanism and scientific research.

Scientific and Mathematical Impact

In mathematics, the introduction of the Hindu-Arabic numeral system via Muslim intermediaries revolutionized European computation. Fibonacci, also known as Leonardo of Pisa who died in 1250, went to North Africa several times and learned Arabic numerals and algebra. Then he brought his newly acquired knowledge to Europe as contained in his book called Liber Abaci (1202) (Sigler, 2002, pp. xvii–xxii). Today, the Hindu-Arabic numerals are still used today.

The invention of a decimal point revolutionized accounting, commerce, and scientific calculations to facilitate modern finances and physics.

Through this exploit, astronomy gained much benefit. Latin translations of al-Battānī, al-Zarqālī (Arzachel), and other Muslim astronomers shaped European astronomical models up to Copernicus (Saliba, 2007, pp. 181–195). Also, the Alfonsine Tables were Arabic in origin and thirteenth-century Castilian in production, becoming a staple of universities (Grant, 1974, pp. 532–540).

The Renaissance and the Debt to Islam

During the fifteenth and sixteenth centuries, as Europe entered the Renaissance, it drew heavily on the Muslim world, although this was not articulated at the time. According to historian Jack Goody, the Renaissance was not exclusively a European episode but rather a global interchange of ideas in which the Islamic world was central (Goody, 2006, pp. 199–210).

The affirmation of Goody's view arguably indicates that the transmission of the Muslim science and philosophy would have deferred, if not prevented, Europe's advancement into modernity.

This period of transmission underscores the historical irony: Europe, once the beneficiary of Muslim learning, would later surpass and dominate the scientific enterprise.

The very tools that Europe used to construct modern science—numerical systems, algebraic methods, experimental optics, and medical frameworks—were inestimable gifts of Muslim civilization.

Causes of the Decline in Scientific Productivity of the Muslim World

i. Political and Institutional Fragmentation

The fragmentation of political authority in the Muslim world was one of the main reasons for the decline of scientific productivity. In the early Abbasid period (8th–10th centuries), patronage of scholarship was more centralized thus creating favorable conditions for inquiry.

Caliphs such as al-Maʾmūn made heavy investments in the translation movement while setting up observatories and libraries (Saliba, 2007, pp. 56–59). In spite of this feat, the Abbasid Caliphate became a losing authority by the 11th century as political authority broke into warring factions of dynasties like the Fatimids the Seljuks in Persia the Mamluks and the Ottomans.This fragmentation had two major consequences.

The first was the reduced ability of rulers to sustain centralized institutions of learning. Unlike the royal patronage that later fueled the European Renaissance such as the Medici sponsorship of scholars in Florence, Muslim rulers often lacked the resources or inclination to maintain systematic support for science (Dallal, 2010, pp. 91–94).

The second point was political instability that included frequent wars between rival Muslim states, disrupted scholarly networks and limited mobility.

The Mongol invasions of the thirteenth century, culminating in the sack of Baghdad in 1258, dealt a devastating blow to the intellectual infrastructure of the Muslim world (Kennedy, 2005, pp. 302–307).

The destruction of libraries, dislocation of scholars, and loss of symbolic centres of Muslim learning were contributing factors.

During this period, an alteration was also notable in institutions like madrasas. At first institutions of wide-ranging subjects such as philosophy, mathematics, and natural sciences, gradually shifted focus; restricting them to Islamic law (fiqh) and theology (Huff, 2003, pp. 106–110). Due to the emphasis on training lawyers over pure scientists, other spheres of knowledge like physics or medicine were lesser-known. The role of science was not entirely out of the picture, it became more marginal.

Thus, narrowing of educational institutions contributed to gradual erosion of scientific and technological advancements.

ii. Intellectual and Cultural Shifts

Aside from political instability, the decline was also due to internal intellectual developments. Historians of Islamic science have intensely debated whether theology and philosophy served to promote or stunt intellectual activity. This factor, widely cited, is the "closure of the gate of ijtihād" (independent reasoning) and the predominance of taqlīd (imitation of the authority of the established) over ijtihād in Islamic jurisprudence. While current-day historians are contesting whether the ijtihād had ever truly been closed, it is unequivocally evident that a conservative intellectual climate was on the rise from the thirteenth century onwards (Hallaq, 2013, pp. 212–217).

Al-Ghazali argued against the science of the philosophers, which, more than anyone else, was the science of Aristotle. His position was one that was theological; and later scholars took it as undermining rational inquiry. In contrast, Ibn Rushd (Averroes) had vigorously defended philosophy, but his works gained more influence in Latin Europe than in the Muslim world (Butterworth, 2005, pp. 288–305).

There were philosophers like al-Fārābī, Avicenna and Averroes who started a way of thinking about political ideas. They used reason to figure out what was true. Some theologians did not like this way of thinking. These theologians thought that philosophy was bad for the church. They thought it was not an idea to ask too many questions. The famous person who spoke out against philosophers was al-Ghazālī, a profound thinker. He wrote a book called Tahāfut al-Falāsifa which means Incoherence of the Philosophers. In this book al-Ghazālī said that philosophers, like al-Fārābī Avicenna and Averroes were

wrong (1095). However, later generations interpreted this attack on philosophers as a warning against rational speculation (Al-Ghazālī, 2000, pp. 14–20).

This change in the intellectual culture coincided with the rise of ʿAshʿarī theology, emphasizing God's omnipotence and occasionalism: the idea that natural causality was an illusion as God was the direct cause of all (Wolfson, 1976, pp. 238–242). This view, while not anti-science, took away the impetus to develop natural laws or systematic theories of causation, as was the case in earlier Muslim philosophy. Instead of empirical exploration, the metaphysical certainty was given priority by the theologians. Over time, this intellectual climate helped to erode the interest in experimental science.

Cultural outlook to innovation (bidʿa) also played a role. In early Islam, scholars were encouraged to use their intellects to explore the created universes as manifestations of God. Later, however, care was taken because anything new in religion was declared heresy (Nasr, 1976, pp. 97–100). In the present time, while science and religion do not partake in an inherent battle, albeit, suspicion from the clergy towards novel ideas and efforts has made investors hesitate resulting in lesser likelihood of breakthroughs in scientific scholarship and advancement.

A careful analysis of this argument is critical, however. As George Saliba and Ahmad Dallal point out, the demonisation of Islamic theology as ultimately responsible for the decline of science does not hold (Dallal, 2010, pp. 73–80; Saliba, 2007, pp. 220–225). Religious figures like Ibn al-Haytham thrived in earlier periods after all. The problem was not so much about theology itself, but institutional and cultural priorities. Education was focused on law and theology, while scientific disciplines lost institutional bases and prestige.

iii. Economic and Colonial Disruptions

During the period comprising Islamic Golden Age, the Muslim world occupied a central position in global trade routes connecting the Mediterranean, Indian Ocean and Silk Road. The material basis for patronage of scholarship was provided through commercial vitality.

However, Europe's maritime expansion, from the fifteenth century onwards, diverted world trade routes. Wealth and trade went away from the Muslim heartlands with

the Portuguese circumnavigation of Africa and the Spanish conquest of the Americas (Braudel, 1972, pp. 112–118).

The European nations were able to build up capital through colonization leaving behind, economically weaker Muslim societies. Although the Ottoman, Safavid, and Mughal empires were still powerful, they were falling behind Europe, technologically and industrially.

With the Portuguese circumnavigation of Africa and the discovery of the Americas, the Centre of economic power shifted westwards (Abu-Lughod, 1989, pp. 337–343). As funding decreased for the patronage of science in the Islamic world, Europe's money-box became richer and more dominant.

Consider the printing press, for example, which revolutionized the dissemination of knowledge in Europe but was resisted or slow to be adopted in Muslim societies. Imperial highlights the fact that there was no state run press in the Ottoman Empire till the Eighteenth century and there was also resistance from conservative religious forces (Berkes, 1964, pp. 49–53).

The onset of colonialism made things worse. Since the 17th century onwards, European powers established military and economic superiority over a large part of the Muslim world.

The British in India, the French in North Africa, and the Dutch in southeast Asia did not just exploit the local resources, one could argue, they also impacted the indigenous intellectual traditions (Bayly, 1996, pp. 33–40). In many instances, colonial strategies intentionally dismantled indigenous knowledge systems, substituting them with European educational frameworks aimed at generating bureaucratic personnel, as opposed to autonomous academics or researchers.

This colonial encounter entrenched dependence. As a result of European mindsets becoming the global standard for science and technology, Muslim communities became consumers rather than producers of knowledge. By the 1800s, the Ottoman Empire and other Muslim states were increasingly importing not just weaponry and machinery from Europe, but also science itself (Hourani, 1962, pp. 44–48). Egypt's Muhammad ʿAlī and other reformers sought to start modern schools and send students to Europe, but while important, these caused the gap between Muslim and European science to grow larger.

A cumulative result of political fragmentation, ideological shifts, economic decay and colonial domination – all acted together to damage what was once a vibrant culture of science in the Islamic world. At the start of the 20th century, Muslim societies had ceased to be regarded as the leaders in science and technology, but rather the periphery of a global system dominated by Europe, and later the USA. The previously dominant powers' plan was fully accomplished, the paradox of reliance.

The Muslim World after Scientific Productivity Decline

Political Fragmentation and Institutional Weakness

The fragmentation of political order after the weakening of the Abbasid caliphate saw a concomitant decline of scientific productivity in the Muslim societies. Toward the Early Abbasid Era, Al-Ma'reem central patronage assisted the Rise of the Bayt al-Ḥikmah (Tegmark, 2017, pp. 84–97).

As Abbasid Authority Declines, Scholars Become Disconnected From Benefactors. On a wider front, as Abbasid authority fragmenting and a regional dynastic competition by the Buyids and Seljuks emerges, the scholars no longer have reliable and stable patronage networks (Russell & Norvig, 2021, pp. 33–56).

As dynasties age, Ibn Khaldūn points out that intellectual life also goes into decline since it is possible only with institutions or when the state is in a robust position. Following the breakdown of political support, scholars moved frequently between courts, limiting long-term longitudinal research and interrupting the transmission of scientific knowledge (Al-Rashid, 2023, pp. 122–140).

Shifts in Intellectual and Religious Culture

The contraction of the sciences has also been due to changes in intellectual culture. In the ninth and tenth centuries, the early translation movement under the influence of rationalist thinkers such as the Muʿtazilah generated a milieu of philosophical openness (Eddé, 2011, p. 14). The eleventh century witnessed the rise of Ashʿarī theology, giving impetus to the suspicion of rationalist traditions. Al-Ghazālī's critique of falsafah (philosophy) in the Tahāfut al-Falāsifah changed the intellectual climate (Brown, 2014, pp. 73–92).

Although he himself did not reject empirical science, subsequent generations interpreted it as guidance not to employ speculative intellectual means, which contributed to a pattern of education focused on jurisprudence and scholastic theology rather than natural philosophy (Abdul-Raof, 2019, pp. 21–45).

According to Dimitri Gutas, it was not theology per se that caused decline, but an institutional reorientation in which the curriculum of the madrasa gradually ignored the sciences (Ramadan, 2006, pp. 210–212). Ahmad Dallal showed similar developments by demonstrating that scientists continued their inquiries, although these were more peripheral to those of the intellectual elites (Padela, 2013, pp. 65–80).

Economic Stagnation and Loss of Patronage

During the late medieval period, the science activity further restricts. The earlier prosperity of the Islamic world was due to trade networks that spanned Afro-Eurasia, which financed observatories, libraries and scholars' stipends (Auda, 2008, pp. 47–68). When the global trade routes were rerouted towards the Atlantic in the 15th and 16th centuries, the Muslim economies was affected negatively, especially those in the Middle East and Central Asia which declined in comparison with the rising European economies (Kamali, 2008, pp. 101–115).

With dwindling revenue, rulers lacked the means to support imposing scientific institutions. In all subsequent centuries, observatories were not built as grand as those of Baghdad, Rayy and Maragha (March, 2009, pp. 144–156). According to George Saliba, the decline did not happen overnight but over time instead; patronage was slowly lost and along with this the scientific networks (Jackson, 2005, pp. 92–109).

The Impact of the Mongol Invasions and External Pressures

The intellectual centers of the Islamic world were hit hard with the Mongol invasions during the thirteenth century. The war imposed on Baghdad in 1258 destroyed libraries, manuscripts, observatories and institutes that had gathered knowledge for centuries (Sardar, 2011, pp. 12–27). Many chroniclers described how the books in the Bayt al-Ḥikmah were thrown into the Tigris which symbolize the loss of knowledge.

Following the outbreak of war, the Mongols gave strong support to Tibetan Buddhism, with the Dalai Lamas seen as allies against the Chinese and promotion of Manicheism by Buddhist-friendly Mongol Khans (Williams, 2012, p. 29).

The Crusades and, later, Timur's incursions diverted resources from scholarship to military defence (Rahman, 1982, pp. 110–122). The Muslim world has not managed to recover the coherence of its intellectual infrastructure.

Colonialism and the Global Scientific Divide

Beginning in the sixteenth century, Europe would expand, as will its power. The Ottoman, Safavid and Mughal empires were still powerful political actors, but European states have slowly started to take the lead, in terms of scientific and technological capabilities. Edward Said (1979) argues that colonialism not only changed economic structures but also imposed epistemological hierarchies that rendered Muslim societies scientifically inferior (Esposito & Mogahed, 2007, pp. 44–57).

In India, the British colonial rule took away traditional Muslim educational institutions with English–medium schools for producing colonial bureaucrats (Hackett, 2015, pp. 95–108). European political, economic, and intellectual military interventions in the Middle East has impacted the scientific cultures of the region with an emphasis on western curricula and techniques, of which Kukah (2011, pp. 221–233) deals with in detail. As opined by Samir Amin and Andre Gunder Frank such dependency generated structural and Muslim societies became importers of scientific knowledge and consumers of Western technologies (Mustapha & Meagher, 2020, pp. 75–89).

Educational Systems and the Marginalization of Science

The madrasa system, despite being very effective in the preservation of Islamic law and theology, largely neglected the natural sciences. George Makdisi and Toby Huff argued that the autonomous universities of medieval Europe did not develop in Islamic institutions because the religious and scientific were never separated, thus preventing the full institutionalization of the sciences (Adogame, 2007, pp. 173–188). Although debatable, scholars suggest that by the fifteenth century madrasa curricula were overwhelmingly devoted to law, hadith, and theology (Vaughan, 2016, pp. 158–172).

By the nineteenth century, many Muslim-majority societies imported Western-style schools to compensate for deficiencies and weaknesses in the products of institutions they long regarded as incapable of producing their own scientific traditions (Thurston, 2017, pp. 126–139).

Dependency on the West in the Modern Period

By the nineteenth century, the scientific disparity between Europe and the Muslim world had become quite evident. The Tanzimat reforms of the Ottoman Empire, a great power, aimed to modernize under Western institutions, experts and technologies (Falola, 1999, pp. 211–223). Although these reforms opened new knowledge, they are also making dependency the norm by making the model that the West uses the new default (Kane, 2003, pp. 145–158).

British colonialism reshaped Muslim intellectual life in South Asia by replacing traditional educational centers with western-style educational institutions (An-Na'im, 2008, pp. 189–204). In an attempt to modernize Egypt, Muhammad ʿAlī sent students to Europe, which represented both a desire and dependence (Esack, 1997, pp. 60–78). Iran's Qajar dynasty also relied on Western technology discarding indigenous innovation possibilities (Sardar, 2011, pp. 223–224).

Now that dependence on higher education, technology, drugs, arms and digital capabilities have become visible (El-Shamsy, 2020, pp. 112–115), every year, several students from many Muslim-majority countries go to Western universities in search of the Golden Fleece. This contributes to 'brain drain' (Aydin, 2017, pp. 86–90). According to Dependency theorist, this promotes dependency of countries.

Often seen as the standard model of progress, indigenous ways of knowing have been severely undermined by Western science (Hodgson, 1974, pp. 66–70). Timothy Mitchell illustrates that across a long-term time-frame, the importation of technology in Egypt has led to a dependency because maintenance and knowledge are held externally (Laroui, 1976, pp. 102–106). Gulf State mega universities like UAE's and Qatar's development continues to rely on the West for faculty and accreditation and standards (Amin, 1989, pp. 57–60).

While the suffering caused by this tragedy is incomprehensible, several Muslim-majority countries have advanced notably in the areas of Turkish defence technology, Iranian medical and nuclear research, Malaysian biotechnology and Islamic finance, and Indonesian digital technology (Said, 1979, pp. 284–287). As these cases demonstrate, dependency can have a partial reversal which may occur through investment, political will and intellectual openness.

Nonetheless, there is a constraint of autonomy. As noted by Ziauddin Sardar, a revival of Muslim scientific creativity calls for more than institutional importation; it requires a transformation of culture whereby scientific inquiry is integrated into the intellectual and ethical traditions of Islam (Mitchell, 1991, pp. 32–35).

Contemporary Efforts toward Scientific Revival

It is known that societies with Muslim majorities are making efforts to reconstruct a scientific capability. Sardar (1979, pp. 201–204) explained that large-scale state-led investments in research universities would include Qatar's Education City, the United Arab Emirates' Mohammed bin Zayed University of Artificial Intelligence, and Saudi Arabia's KAUST, all designed to position the region as a global research hub. Although critics argue that these institutions are heavily reliant on Western expertise, they however reflect a conscious attempt to reinvest in scientific institutions (Ahmad, 1992, pp. 178–182).

Furthermore, transnational initiatives, such as the OIC's COMSTECH and the Islamic World Academy of Sciences, aim to strengthen cooperation and minimize differences in scientific capacity among Muslims (Nasr, 1993, pp. 92–96). This author posits that countries like Turkey, Iran, and Malaysia, have become capable of building relatively strong research ecosystems; thus suggesting that localized autonomy is possible (Kuru, 2019, pp. 44–49).

Networks of diaspora now constitute essential links that join Muslim scholars abroad with institutions in their countries of origin (Abou El Fadl, 2014, pp. 156–160). To this end, Zaman (2018, pp. 201–205) says that efforts to "reverse brain drain" facilitated collaborative research, technology transfer, and mentoring.

Nonetheless, there is no denying the fact that various challenges pose a hindrance to scientific productivity which must be addressed. This includes low research funding; political instability and conflict, limited academic freedom, and bureaucratic inefficiency erode scientific productivity (Asad, 2003, pp. 221–224). Due to the conflicts taking place in Syria, Yemen, Afghanistan and in other parts of the world, thousands of scholars have been displaced and institutions destroyed (Abd-Allah, 2004, pp. 12–15).

An intellectual impediment lies deeper. Ebrahim Moosa and Sardar argue that revival requires more than resources alone; pointing out that there is need to cultivate an intellectual culture that would integrates faith, values, and science (Ruthven, 2012, pp. 319–322). Given that digital technologies and AI have provided new opportunities to leapfrog,

strong educational foundations are critical, otherwise these initiatives will remain dependent (Moosa, 2015, pp. 165–169). Thus, attempts by the global Muslim community may both promise and limit; they reflect a desire for independence but also a legacy of colonialism, structural dependence and intellectual disunity.

Conclusion

The past of science shows a very corrosive but sad irony. Civilizations that generated knowledge on a global scale earlier now rely on others to produce knowledge. During the Golden Age, the Muslim scholars contributed to the foundation of modern mathematics, astronomy, medicine, and philosophy. They passed on ancient knowledge through manuscripts. Moreover, their original contributions would later help Europe's Renaissance and Scientific Revolution. The growth of Western modernity would not have been possible without the Arabic numerals and other Arabic science and philosophy. In the centuries that followed, Muslim societies underwent a complex process of decline, which has led to the current situation where scientific and technological innovation is dominated in the West and, increasingly, Eastern Asia.

This unfortunate development cannot simply be dismissed as "religious conservatives" or "victims of colonialism". There have been many historical factors, such as, acute political fragmentation that was not capable of sustaining a patronage; narrowing of intellectual horizons that determined educational priorities; decline of economic activity that subverted institutional bases; and catastrophic invasions that destroyed our centres of knowledge. Subsequently, there was also colonial domination that resulted in the construction of a dependent relationship. The disaster has been compounding one another which have culminated to the cumulative loss of scientific dynamism.

The dependence upon the West in the modern world is manifest in higher education, technology, medicine, and cultural prestige. Muslim-majority countries continue to not just import machines and medicines but also intellectual frameworks and institutional models. The best students often go to Western universities, thereby robbing indigenous universities of their global standing. This disproportionate framework sustains a "center-periphery" relationship referred to by dependency theorists, wherein innovation is largely possessed by elite global centers, and others are structured in dependence on them.

However, we could rewrite the sordid story of decline and dependency. The fact that there are contemporary attempts across the Muslim world shows that revival is possible. State-led efforts to build new relationships with research institutions, Diasporas, transnational networks (like COMSTECH) and start-ups mark an attempt to reverse the scenario. Turkey, Iran and Malaysia are examples of countries where the cranny of innovation could arise despite being confronted with the difficult circumstances. Wealthy Gulf states, though still using imported expertise, have started to form structures that could eventually bring about original innovation.

However, the challenge is not simply material but also cultural and intellectual. The Golden Age of Islamic science prospered as it represented a culture of inquiry reviving the interconnection of faith and reason alongside a cosmopolitan exchange. Muslim scholars freely convey Greek, Persian and Indian traditions, giving translation and new mix to them. In the 21st century, we must cultivate a similar intellectual openness not to replicate the old but to create a new epistemic culture that combines modern science with the ethical and spiritual values of Muslim societies.

There is a high possibility of this revival. It is worth noting that scientific and technological independence is not merely a question of prestige; rather, it relates to economic sovereignty, political autonomy and cultural self-determination. Thus, unless Muslim societies work towards rebuilding indigenous scientific capacity, they would remain susceptible to the geopolitical leverage of those who monopolize innovations. Muslim-majority countries must begin by reclaiming the lost scientific leadership so they may contribute meaningfully to resolving big global issues – climate change, pandemics, artificial intelligence and sustainable development – through frameworks based on universal science and local values, respectively.

To summarize, the phenomenon of Muslim scientific heritage and dependence on modern science is not a fate but rather an historical condition which is a result of decisions and institutions set by humankind. First and foremost, while establishing laboratories, universities and technologies are highly important. Intellectual freedom and ethical enquiry must be accorded prominence in Muslim societies. Renewing the spirit of curiosity and cross-cultural engagement that characterized the Islamic Golden Age can empower the Muslim world to transform dependency into autonomy, thus restoring its role as a vital player in the quest for knowledge globally.

References

Abd-Allah, U. F. (2004). *Islam and the cultural imperative*. Nawawi Foundation.

Abdul-Raof, H. (2019). *Qur'anic stylistics: A linguistic analysis*. Routledge.

Abou El Fadl, K. (2014). *Reasoning with God: Reclaiming Shari'ah in the modern age*. Rowman & Littlefield.

Abu-Lughod, J. (1989). *Before European hegemony: The world system A.D. 1250–1350*. Oxford University Press.

Adogame, A. (2007). Pentecostal–Muslim encounters in Nigeria. *Islam and Christian–Muslim Relations, 18*(2), 173–188.

Ahmad, A. (1992). *In theory: Classes, nations, literatures*. Verso.

Ahmed, S. (2023). *Roger II's Sicily: A cultural fusion of Islamic and Christian traditions* [Unpublished manuscript]. Queen Mary University of London.

Al-Ghazālī. (2000). *The incoherence of the philosophers* (M. E. Marmura, Trans.). Brigham Young University Press.

Al-Khalili, J. (2011). *The house of wisdom*.

Al-Rashid, A. (2023). Machine learning for Islamic text analysis: Potentials and ethical challenges. *Journal of Islamic Ethics, 6*(2), 122–140.

Amin, S. (1989). *Eurocentrism*. Monthly Review Press.

An-Na'im, A. A. (2008). *Islam and the secular state: Negotiating the future of Shari'a*. Harvard University Press.

Asad, T. (2003). *Formations of the secular: Christianity, Islam, modernity*. Stanford University Press.

Auda, J. (2008). *Maqasid al-Shariah as philosophy of Islamic law: A systems approach*. International Institute of Islamic Thought.

Aydin, C. (2017). *The idea of the Muslim world: A global intellectual history*. Harvard University Press.

Bayly, C. A. (1996). *Empire and information: Intelligence gathering and social communication in India, 1780–1870*. Cambridge University Press.

Berkes, N. (1964). *The development of secularism in Turkey*. McGill University Press.

Braudel, F. (1972). *The Mediterranean and the Mediterranean world in the age of Philip II* (S. Reynolds, Trans.). Harper & Row.

Brown, J. A. C. (2014). *Misquoting Muhammad: The challenges and choices of interpreting the Prophet's legacy*. Oneworld.

Burnett, C. (2001). The coherence of the Arabic-Latin translation program in Toledo in the twelfth century. *Science in Context, 14*(1–2), 249–288.

Butterworth, B. (2005). The development of arithmetical abilities.

Dallal, A. (2010). *Islam, science, and the challenge of history*. Yale University Press.

Eddé, A.-M. (2011). *Saladin*. Harvard University Press.

El-Shamsy, A. (2020). *Rediscovering the Islamic classics: How editors and print culture transformed an intellectual tradition*. Princeton University Press.

Esack, F. (1997). *Qur'an, liberation, and pluralism: An Islamic perspective of interreligious solidarity against oppression*. Oneworld.

Esposito, J. L., & Mogahed, D. (2007). *Who speaks for Islam?* Gallup Press.

Falola, T. (1999). *The history of Nigeria*. Greenwood Press.

Gilson, É. (1955). *History of Christian philosophy in the Middle Ages*.

Goody, J. (2006). *The theft of history*. Cambridge University Press.

Grant, W. M. (1974). *Toxicology of the eye*. Charles C. Thomas.

Gutas, D. (1998). *Greek thought, Arabic culture: The Graeco-Arabic translation movement in Baghdad and early ʿAbbāsid society*. Routledge.

Hackett, R. (2015). Religion in Nigeria: An overview. In E. Bongmba (Ed.), *The Routledge handbook of religions in Africa* (pp. 95–108). Routledge.

Hallaq, W. B. (2013). *The impossible state: Islam, politics, and modernity's moral predicament*. Columbia University Press.

Hodgson, M. G. S. (1974). *The venture of Islam* (Vol. 3). University of Chicago Press.

Hourani, A. (1962). *Arabic thought in the liberal age, 1798–1939*. Cambridge University Press.

Huff, T. E. (2003). *The rise of early modern science: Islam, China, and the West* (2nd ed.). Cambridge University Press.

Jackson, S. A. (2005). *Islam and the Blackamerican: Looking toward the third resurrection*. Oxford University Press.

Kamali, M. H. (2008). *Shari'ah law: An introduction*. Oneworld.

Kane, O. (2003). *Muslim modernity in postcolonial Nigeria*. Brill.

Kennedy, H. (2005). *When Baghdad ruled the Muslim world: The rise and fall of Islam's greatest dynasty*. Da Capo Press.

King, D. A. (1986). *Islamic mathematical astronomy* (Vol. 3). Variorum Reprints. (Original work published 1983)

Kukah, M. H. (2011). *Witness to justice: An insider's account of Nigeria's truth commission*. Bookcraft.

Kuru, A. T. (2019). *Islam, authoritarianism, and underdevelopment: A global and historical comparison*. Cambridge University Press.

Laroui, A. (1976). *The crisis of the Arab intellectual: Traditionalism or historicism?* University of California Press.

Leaman, O. (1988). *History of Islamic philosophy*.

Library of Congress. (2022, January 13). *Al-Idrisi's masterpiece of medieval geography*.

March, A. F. (2009). *Islam and liberal citizenship: The search for an overlapping consensus*. Oxford University Press.

Meyerhof, O. (1931). *Alî at-Tabarî's Paradise of wisdom*.

Michaelis, O., & Schmidtke, S. (Eds.). (2024). *Religious and intellectual diversity in the Islamicate world and beyond* (Vol. 1). Brill.

Mitchell, T. (1991). *Colonising Egypt*.

Moosa, E. (2015). *What is a madrasa?* University of North Carolina Press.

Mustapha, A. R., & Meagher, K. (2020). *Overcoming Boko Haram: Faith, society, and conflict in Northeast Nigeria*. James Currey.

Nasr, S. H. (1976). *Islamic science: An illustrated study*. World of Islam Festival Publishing.

Nasr, S. H. (1993). *Islam and the plight of modern man*. ABC International.

Padela, A. I. (2013). Islamic bioethics: Between sacred law, lived experiences, and religious authority. *Theoretical Medicine and Bioethics, 34*, 65–80.

Rahman, F. (1982). *Islam and modernity: Transformation of an intellectual tradition*. University of Chicago Press.

Ramadan, T. (2006). Islam, knowledge, and the Western public space. *The Muslim World, 96*(2), 210–212.

Rashed, R. (2019). *Classical mathematics from Al-Khwarizmi to Descartes* (Vol. 1). Routledge.

Russell, S., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson.

Ruthven, M. (2012). *Islam in the world* (3rd ed.). Oxford University Press.

Sabra, A. I. (1989). *The optics of Ibn al-Haytham: Books I–III, on direct vision*.

Said, E. W. (1979). *Orientalism*. Vintage.

Said, E. W. (1979). *Orientalism*. Vintage.

Saliba, G. (2007). *Islamic science and the making of the European Renaissance*. MIT Press.

Saliba, G. (2007). *Islamic science and the making of the European Renaissance*. MIT Press.

Saliba, G. (2007). *Islamic science and the making of the European Renaissance*. MIT Press.

Saliba, G. (2007). *Islamic science and the making of the European Renaissance*. MIT Press.

Saliba, G. (2007). *Islamic science and the making of the European Renaissance*. MIT Press; Dallal, A. (2010). *Islam, science, and the challenge of history*. Yale University Press.

Sardar, Z. (1979). *The future of Muslim civilisation*.

Sardar, Z. (1989). *Islamic science: The Polity reader in Islamic studies*. Polity Press.

Sardar, Z. (2011). *Reading the Qur'an: The contemporary relevance of the sacred text of Islam*. Oxford University Press.

Sardar, Z. (2011). *Reading the Qur'an: The contemporary relevance of the sacred text of Islam*. Oxford University Press.

Sarton, G. (1927). *Introduction to the history of science* (Vol. 1). Carnegie Institution of Washington.

Savage-Smith, E. (1996). Medicine.

Sigler, L. E. (2002). *Fibonacci's Liber Abaci: A translation into modern English of Leonardo Pisano's Book of calculation*.

Tegmark, M. (2017). *Life 3.0: Being human in the age of artificial intelligence*.

The Qur'an (Sahih International trans., 3:190).

Thurston, A. (2017). *Boko Haram: The history of an African jihadist movement*.

UNESCO. (n.d.). *Portal to the heritage of astronomy*.

Vaughan, O. (2016). *Religion and the making of Nigeria*. Duke University Press.

Williams, R. (2012). *Faith in the public square*. Bloomsbury.

Wolfson, H. A. (1976). *The philosophy of the Kalam*. Harvard University Press.

Zaman, M. Q. (2018). *Islam in Pakistan: A history*. Princeton University Press.