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KARĪM KHĀN AND HIS PERCEPTIONS OF WESTERN SCIENCE DURING HIS VISIT TO BRITAIN IN 1840-41*

GULFISHAN KHAN**

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The present paper seeks to highlight Karīm Khān Mushtāq Jhajjari, an Indo-Muslim educated elite's perceptions of Western/British scientific and technical progress as embodied in his travelogue *Siyāhatnāmā* (Book of travels) and a Persian Universal history *Mir'āt-i-gītīnumā* (World Reflecting Mirror). Karīm Khān's representation of the modern European scientific thought and technical advancements could be appreciated against the vibrant socio-intellectual milieu of pre-colonial India, where there existed a dynamic tradition of rational enquiry and scientific research. Karīm Khān's discourses of the British scientific and industrial progress remains unique among writings of other South Asian Muslim during the same period. But compared to the eighteenth century Indo-Persian writers perceptions of the European sciences and technology, Karīm's eye-witness account is less expressive and his travelling gaze is also passive. The passiveness of Karīm Khān's gaze reveals increasingly asymmetrical relationship of power between the coloniser and the colonised. Nonetheless in any account of the reception/assimilation of the European scientific thought and technical ideas by the non-western societies these ideas should not be excluded.

Key words: Astronomy, Copernicus, Electric telegraph, Greenwhich Observatory, Jhajjar, John Herschel, Karīm Khān, Sir Mark Isambard Brunel, Steam-ship, Telescope, Tunnel, William Herschel.

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* The paper is dedicated to the memories of Professor M.A. Alavi and Dr. I. G. Khān, historians of Science.

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** Associate Professor in History, Centre of Advance Study, Department of History, Aligarh Muslim University, Aligarh, e-mail: gulfishankhan@gmail.com

I. Introduction

It was in September 1839 that Karīm Khān Mushtāq Jhajjari, a resident of Jhajjar — a small town located 37 miles south-west of Delhi in the district of Rohtak (Haryana), sailed for British Isles where he lived in the British metropolis for almost two years. Karīm Khān's visit to Britain is to be viewed against the background of the burgeoning colonialism during the mid-nineteenth century when Indian rulers were forced to depute their political and diplomatic representatives (*wakīl*) to Britain as a device to resist increasing colonial control of their political rights and economic resources.[1] Karīm Khān visited England to plead for the enhancement of monthly pay and other emoluments of Ḥasan 'Ali Khān (1861) a military general in the army of Jhajjar, against Faiz 'Ali Khān the ruler of the Jhajjar estate and his own nephew.[2] Karīm lived in the British metropolis for almost two years. The resplendence of the British capital fascinated the Indian observer no doubt, but only apparently, in reality he sought to unravel the sources of British power. Karīm Khān offered serious reflections on the socio-intellectual milieu of contemporary British society. He provided eye-witness detailed descriptions of cultural life, economy, gender-relations, political ideas, institutions, constitutionalism as well as sciences and industrial developments of the mid-Victorian Britain.[3] Karīm Khān is a participant, observer, author and narrator all rolled into one but he had little to say about himself by way of self-reflection in his travelogue which he maintained as a diary.[4] He was also something of a poet occasionally composed verses in Urdu, the newly emerging *lingua franca* of India, with "Mushtāq" as his *nom de plume* in which he also composed his travelogue. But for his topographical-cum-universal history *Mir'āt-i-gītīnumā* he chose Persian, the language of belles-letters, historiography and the dominant medium of expression of Muslim elite.[5] He had ability to absorb and remember details. Despite his inadequate skill of English language yet he was able to derive much information through personal observations and extensive social and intellectual interaction with the British aristocracy and gentry. He had inscribed verses of the classical Persian poets such as Shaikh Sādī Shīrāzī (1213-1292) and the great mystic poet Maulānā Jalāl al-Din Rūmī (1207-1273) and Maulānā Nūr al-Dīn Jāmī (d.1492) in the opening pages of his travelogue (*Siyāhatnāmā*). He had acquired some communicative skills in English language but he evinced no taste for English poetics and literature. A majority of his social acquaintances included prominent bureaucrats the civil servants of the Company and mostly those who had served in India such as Sir Charles Forbes (1774-1849), Charles Grant

(1778-1866), Charles Trevelyan (1807-86). Besides, Karīm was well-acquainted with majority of the British officers who had served in region known as the Delhi Territory such as Secretary Delhi Residency, Clark, H M. Elliot, and a former Resident at Delhi in the pre-Mutiny period.[6] During his sojourn in the British capital he enjoyed close contacts with British scholars, intellectuals, statesmen and the politicians. The British Orientalists Duncan Forbes (1798-1868), John Shakespeare (1774-1858) all were personally known to him. According to J. H. Garcin De Tassy (1794-1878) the French Orientalist, Forbes "described him as being a man of great intelligence and anxious to gain every possible information on European usages and modes of government."[7] With his British friends he also went to opera-houses and dined with them. He hosted dinners for Britons on board and during his residence in London and also presented costly gifts to many of them. Yet Karīm evinced little taste for the British cultural, literary and artistic life, and more for the modern European science and British industrial and technological progress.

Karīm Khān's account contains discourses on modern European sciences especially the new astronomy from the Copernicus's heliocentric world view to Herschel's findings in the sidereal astronomy as well as the industrial progress of the mid-Victorian Britain. His scientific and technical discourses were mainly based upon personal observations and first hand experiences.[8] Additionally, he was assisted by the Scottish Orientalist Duncan Forbes who was also his conversation partner and principle informant. To satisfy his quest for scientific knowledge during his sojourn in London he also availed the opportunity of holding scientific discussions with Sir John Frederick William Herschel (1792-1871) the British Royal Astronomer and geophysicist and the French-émigré engineer and inventor, Sir Mark Isambard Brunel (1769-1849) on the construction of the Thames tunnel, the first sub aqueous tunnel in history. Though he found the key not in the scientific progress and technological developments but the British system of government which ensured a stable and caring state, nonetheless he made extensive observations of the British techno-scientific progress. He visited British Parliament and saw the queen Victoria and several times met the Prime Minister Sir Robert Peel (1788-1850) who asked him 'What was the most wonderful feature of British life." For Karīm it was neither the railways nor the steamships and the weaving machines but the debates between the Tories and the Whigs.[9] He remained equally passionate about the modern science and its use of scientific knowledge for practical purposes, the technology.

Karīm had passion for learning and knowledge, the hall-marks of the educated elite and the Mughal bureaucrats. In the mid-nineteenth century educated upper classes of Delhi and other urban centres of north India were well-acquainted with the British culture and social life, which had come under the direct British occupation in 1803.[10] Jhajjar being located in the province (*ṣūba*) of Shāhjahanā bād Delhi under the Mughal imperial administration, due to geographical proximity, its educated gentry sought to imbibe cultural trends of the metropolitan city.[11]

II. Science and Technology the Medieval Legacy

India's scientific tradition was vigorous and outward looking in the centuries prior to establishment of colonial rule. Significant scientific developments and inventions occurred in the medieval period. During the Sultanate era scientific and technical influences from the Islamic East such as the spinning wheel, paper, the stirrup and the Persian wheel introduced by the Turks were readily assimilated and absorbed. New mechanical devices and scientific instruments such as the magnetic compass, astrolabes, sun-dials, astronomical and water clocks entered India.[12] From the early sixteenth century the Mughal court was a vital source of patronage for science and technology.[13] There was a continuous but selective absorption in technology such as in shipbuilding, armaments, metallurgy, cloth printing and architecture from Europe in various sectors of Indian economy and society during the pre-colonial period.[14] Far from existing in cultural and technological isolation and being averse to all innovation, India, over the centuries had borrowed extensively from, and contributed generously to, the scientific and technical knowledge of neighbouring regions, from the Middle East and Central Asia to China and Southeast Asia, and in fields as diverse as agriculture, architecture, astronomy, chemistry, medicine, metallurgy, textile production, shipbuilding and armaments.[15] Interest in sciences in general and astronomy in particular was a traditional Indo-Muslim preoccupation. Scientific subjects formed the core of the *ma'qulāt*, the rational discipline as distinct from *manqulāt* the traditional subjects. Scientific enquiry and research had become an integral part of the Mughal elite culture.

Astronomy in particular was assiduously cultivated in the circles of the traditional elite of the imperial city Delhi/Shāhjahanābād. Indeed by the eighteenth century science had become a fashionable content of polite Indo-Islamic urban culture being pursued as an intellectual enterprise prompted by curiosity as well

as a professional occupation. Astronomical researches and compilation of *zīj*, the astronomical tables remained a major preoccupation of the Indian ruling elite.[16] Scientific learning flourished in an intellectually vibrant culture under the Mughal court's patronage. Significantly, the scientists of the Mughal era and their achievements continued to be recorded by the successive generations of its conscious Indo-Persian and the Urdu speaking elite. A powerful tradition in the field of astronomical studies continued to flourish during the first half of the eighteenth century when financially strained Mughal court continued to sponsor large-scale scientific projects such as the compilation of the *Zīj-i Muḥammad Shāhī*.[17] The commentary of Khair Allāh Muhandis (d.1747), director of the Delhi Observatory under Muḥammad Shāh (r. 1719–1748), on *Zīj-i Muḥammad Shāhī* as excerpted in an encyclopaedia of mathematical sciences *Jam'-i Bahādur Khānī*, of the encyclopaedist Ghulām Ḥusain Jaunpūrī (1790–1832) confirms the selective acceptance of the principles of new astronomy, while still adhering to the Ptolemaic concepts of universe.[18] Besides, numerous scientific and technical treatises were composed which proliferated throughout India and today preserved in the libraries of South Asia and Europe.[19] Evidently, the traditional Indo-Islamic elite, the Indo-Persian as well as the Urdu speaking, were conscious of medieval India's scientific legacy. The establishment of the observatories under the court patronage of Emperor Muḥammad Shāh (r.1719-48) and various astronomical experiments conducted in these scientific institutions continued to be carefully recorded by the eighteenth and nineteenth century biographers and historians as an important scientific endeavour undertaken under the Mughal court patronage.[20] Significantly, the scientists of the Mughal era and their achievements continued to be recorded by the successive generations. Mīrzā Khair Allāh Muhandis continued to be lauded for his remarkable proficiency in the science of mathematics. In view of Abū Ṭālīb ibn Muḥammad Isfahānī (1752-1806), Mīrzā Khair Allah and Shaikh Muḥammad 'Abid were the matchless astronomers who collaborated in the compilation of the new astronomical tables of Muḥammad Shāh, known as *Zīj-i- Muḥammad Shāhī*.[21] The compilation of the *Zīj-i- Muḥammad Shāhī*, seems to be a grand project indeed in which scholars from Iran also collaborated. ʿAbd al-Latīf Shushtarī (1758-1806) a litterateur and diplomat, recalled that his uncle Sayyid Ni'mat Allāh (d. 1738) was employed as one of the co-scientist who collaborated in the royal scientific mission of the compilation of *Zīj-i- Muḥammad Shāhī* during the reign of Muḥammad Shāh. Sayyid Ni'mat Allāh had studied the exact sciences of mathematics and geometry in the cities of Iraq and Khurasan

and was also an elegant poet. "Sayyid Ni'mat Allāh bin Nūr al-Dīn popularly known as "Sayyid" was an exalted person. He achieved a high degree of proficienc in mathematics and geometry and had natural aptitude for poetics. He also possessed a *dīwān* (poetic collection) which contained more than three to four thousand verses. Sayyid was his *nom de plume*. He left Shushtar his home-town in his youth and lived in the cities of Iraq and Khurāsān where he studied exact sciences (*ulum-i- riyāzī*). After completing his education he arrived in India where the reigning sovereign Muhammad Shah bestowed honours upon him. He was associated with the subtleties knowing great astronomers/scientist in the great task of the compilation of *Zīj-i-jadīd Muḥammad Shāhī*. He died in Peshawar in 1738."[22] The well-known eighteenth century Mughal biographer Mīr 'Abdal-Razzāq Aurangabādī (1700–1758) had regrets for Rājā Jai Singh (1688–1743), the Astronomer Royal, that Raja's astronomical observations remained incomplete because, at least a span of thirty earth years was required for the planet Saturn to complete its one orbit around the Sun. Alas! In the meantime the Raja died.[23]

During the eighteenth century after the decline of the Mughal Empire new centres of learning sprang up, some, like Hyderabad under the Nizāms, Lucknow under the Nawābs of Awadh, specialising in Islamic science and Unani [*Yūnānī*] medicine. A case for Indigenous Renaissance in the post-Mughal succession state of Awadh based upon a combination of circumstances — successful absorption of centuries old Mughal scientific and technological tradition, presence of skilled French mercenaries and scientists, and above all literate agents with scientific outlook, trained in the rationalistic philosophy of Dars-i Nizāmī syllabus of Farangi Maḥal seminary — has been convincingly built up by the late I. G. Khān.[24] During the same period, there are instances of Mughal élites who sought a more direct recourse to the sources of European knowledge. They came into direct contact with British scholars and scientists, mostly members of the Asiatic Society of Bengal, in Kolkata, where they caught glimpses of progressive British culture of Newtonianism, religious non-conformism, and entrepreneurial spirit. Most impressive achievement was the translation of Newton's brainchild (excerpts from the translations are preserved in *Tuḥfat al-'ālam*) the *Principia* from original Latin into Arabic by Awadh-administrator-scholar Tafaẓẓul Ḥusain Khān (1727–1800).[25]

Despite the withering away of Mughal power, Delhi remained a significant locus for science, art and literature, and, until the cataclysmic events of 1857,

scientific subjects like astronomy (*hai'at*) geometry (*handasah*) and mathematics (*riyāzī*) were extensively cultivated by the 'Ulemā', the traditional scholars, as well as among the ṣūfī circles. Maulānā Muḥammad Ḥayāt, a sūfī and an accomplished teacher taught scientific subjects like astronomy (*hai'at*) and geometry (*handasāh*) and could draw geometrical figures, lines and circles, with unmatched accuracy inspite a big physical handicap, his blindness.[26] Similarly another eminent mystic of Delhi Khwājā Muḥammad Naṣīr (1775-1845) possessed special expertise in mathematics (*riyāzī*) the abstract science of number, quantity and space and the arithmetic (*ḥiqāb*), the science of numbers. He composed a number of treatises on music and mathematics.[27] Similarly, Maulawi Rashīd al-Dīn Aḥmad Khān (d.1826) had aptitude for rational sciences especially *'ilm-i-hai'at* and *'ilm-i handasāh* astronomy and geometry respectively.[28] Khwājā Farīd al-Dīn Aḥmad (1747-1828), the maternal grandfather of the well-known Indo-Muslim educationist and thinker Sayyid Aḥmad Khān (1817-1898), was a distinguished scholar of mathematics and astronomy. He was a pupil of the above mentioned Siyalkot-born scholar Tafaẓẓul Ḥusain Khān.[29] He sought close intellectual association with the British administrator scholars such as Gore Ouseley (1770-1844) and the famous French adventurer and polymath Claude Martin (1735-1800) to learn the latest in the field. He made a number of experiments with the use of proportional compass (*parkār-i mutanāsibah*) to solve geometrical and astronomical problems.[30] His grandson Sayyid Aḥmad Khān, also later on adapted two of the treatises, one on the art of mechanics called al-*Tashīl fī Jarr al-Thaqīl* published by the Orphan Press, for the Agra Book Society in 1844, and the other entitled, *Tarjumah Fawā'id al-Afkār fī A'māl al-Farjār* (Translation of the results of thought upon the use of compasses), which dealt with the science of geometry, for the curriculum of Agra and Delhi Colleges. His last writing entitled *Tuḥfah-'i Nu'māniyyah* written in 1815 deals with the manufacturing of astrolabes.[31] The interest in manufacturing of astronomical instruments was imbibed by his younger son — the maternal uncle of Sayyid Aḥmad Khān — Zain al-'Ābidīn (d. 1272/ 1856) who had no equal in his day in astronomy, knowledge of almanacs and science and as manufacturer of astronomical instruments. Sayyid Aḥmad Khān describes how "Day and night he would be exclusively engaged in making astronomical instruments and in observing the stars. Since he himself was very clever with his hands, he used to make all his apparatus himself. With his own hands he used to make brass globes of huge diameter and brass astrolabes, which are so fine to be accounted among the

marvels of age. Moreover, he used to make himself other instruments, such as *zāt al-ḥalqatain* and *zāt al-ḥalq, rub'-i mujayyib* (quadrants), *rub'-i muqantar, jarīb al-sā'ah, miqyās al-sā'ah ufuqīwa āfāqī*, dividers, proportional compasses, mechanical instruments of this kind and other instruments for the art of mechanics (*jarr-i-saqīl*) and other astronomical instruments including that of [ʿAbd al-'Alī] Bīrjandī, all of which were fashioned by his own hand."[32] Obviously the room where he kept these instruments looked like an observatory. C. F. Andrews (1871-1940) in his memoirs of Mawlawī Zakā Allāh vividly remembered Zain al-ʿĀbidīn thus: a Nawāb of Delhi whose house was looked upon as a strange place of mathematical and astronomical learning full of scientific instruments with pulleys hanging from the roof and astral globes and charts and astronomical tables scattered about."[33]

A significant feature of the medieval socio-intellectual life was an all-consuming passion with the inherited knowledge. A discussion of the Islamic philosophers/scientists and their contribution to learning continued to be invariably prefaced with an account of the Greek sages of antiquity such as Pythagoras, Socrates, Aristotle, Plato, Ptolemy and Euclid, as the past heritage of the learned world. Almost every universal historian provided brief life-sketches of Greek philosophers. Abū Tālib ibn Muḥammad Isfahānī, provided brief biographical sketches along with comments on theories of the major Greek philosophers from Luqmān to Euclid which the author wrote was derived from *Ta'rīkh-i-ḥukamā'* of Muḥammad Sarwarī.[34] Similarly Abd al-Rahmān Shahnawaz Khān Bānbāni Dehlawi (d.1807), the official historiographer of the Mughal emperor Shah Alam's reign (r.1759-1806), on the authority of the same *Ta'rīkh-i-ḥukamā'* observed that, "The majority of the philosophers are either the Greeks (*Yūnāni*) or else the Romans/Latin (*Rūmī*) as mentioned in the *Ta'rīkh-i-ḥukamā'*.[35] The adherence to the Graeco-Arab rationalism based on the works of Plato and Aristotle was excessive indeed. Islamic scholars' astronomical world-view was still dominated by the Greek scientist Claudius Ptolemy's earth centred geocentric conception of the universe.[36] Besides the Persian poetics and literature also remained a staple diet of traditional elite who cultivated scientific subjects. Not surprisingly, in the poetic imagination revival and promotion of science was considered essential for the rejuvenation of Indo-Islamic community. The nineteenth century Urdu poet Khwājā Altāf Ḥusain Ḥālī (1837–1914) saw science as the builder of civilisation, spearhead of progress and its flag bearer also.[37] The tradition of astronomical researches continued in the family of Mīrzā Khair Allāh Muhandis. Mīrzā Khair

Allāh wrote no less than eleven mathematical-astronomical writings as his son Mirzā Muḥammad ʿAli Riyāzī also compiled commentaries.[38] A chain of intellectual discipleship is also traceable to the same family of Lahore scientists and mathematicians. Tafaẓẓul Ḥusain Khān, studied the mathematical sciences (*riyāzī*), at Delhi with Mirzā Muhammad ʻAlī son of Khayr Allāh Muhandis before pursuing his favourite subjects under the teachers of famous Farangi Maḥal seminary. Further in the rational subjects (*ma`qulat*) Tafaẓẓul Ḥusain Khān was a pupil of Maulana Wajihuddin, a pupil of Mulla Niẓām al-Dīn, founder of Dars-i Niẓmī. Similarly Khwājā Farīd al-Dīn, was a student of Tafaẓẓul Ḥusain Khān, also had a number of pupils known for their taste for scientific subjects including his son Zain al-ʻĀbidīn. Besides Maulawī Karāmat ʻAli,[39] Rajab ʻAli, Hakīm Rustam ʻAli,[40] and the above mentioned Khwājā Muḥammad Naṣīr were the other distinguished pupils of Khwājā Farīd al-Dīn.[41]

III. Karīm Khān's account of Modern Astronomy

Karīm Khān's discourses on the modern astronomy included a lucid exposition of the major principles and ideas of the modern astronomy from Copernicus's revolutionary conception of earth as one of the smaller planets of the solar system to Isaac Newton's (1643–1727) great synthesis of the physical world. It also included Galileo's (1564–1642) telescopic discoveries of Moons of Jupiter and phases of Venus as well as Tycho Brahe (1546–1601) and Johannes Kepler's (1571–1630) laws of planetary motion but without mentioning the names of the scientists. He understood that modern European astronomy was a complete reversal of traditional Ptolemaic cosmology. It was also different from the ancient Indian theories as well as the models of the Islamic scholars. As in the preliminary remarks to his scientific discourses on the subject he explained: "It should be known that the modern philosophers, the Greek and European both, after careful deliberations discovered that this world (*dunyā*), the home of human beings and other creatures, also known as the planet earth (*kura'-i-arḍ*) the terrestrial globe is also a planet (*sayyāra*) which moves around its own axis. This proposition of the modern scholars is contrary to the views held by the ancient and Islamic philosophers/scientists."[42]. However, Karīm Khān sought to clarify that the Greek philosophers Aristarchus and Pythagoras (c. 570 BC–c. 495 BC) were the first to propose the notion of a spherical earth but their views could not receive acceptance. It was another celebrated ancient Greek astronomer called Claudius Ptolemy (c. 90–c. 168 AD), who put forth a conception of earth-centred (geo-centric)

universe that has influenced astronomical thought until now. He explicated thus:

> "The first person who wrote about the celestial mechanism and cosmology was Aristarchus [of Samos c. 310-230 BC]. He also discovered the phenomena of the lunar and solar eclipses. Fifty years later another scientist named Pythagoras was born, who also enjoy the distinction to be the first man who was convinced of the motion of the earth and sun being stationary. But his views could not be propagated. It was yet another philosopher called Ptolemy, born in the city of Alexandria in 130 AD and a well-known scientist among the Islamic as well as the European philosopher, whose ideas found acceptance among the scholarly circles. Thereafter, Ḥakim Copernicus who was born in 1530 AD in Poland, held similar opinion as that of Pythagoras. He propounded his ideas in a book and after the publication of this book his views were termed as Copernicanism." [43]

Thus Karīm Khān noted although not without an element of surprise, that the Copernican system had acquired the status of a philosophy under the epithet of "Copernicanism," and firmly established in scientific thought of European scholars. Karīm Khān transliterated this word into Persian script. Obviously he had no Perso-Arabic term for the system. Karīm reiterated that Islamic scholars did not subscribe to his views. The Muslims firmly adhered to the views of the Ptolemy. Thereafter, he sought to elaborate the heliocentric theory with accuracy. He described the relative position and distances of various planets in numerical terms and offered a spatial configuration of the solar system with exactitude. He noted, "The circumference of the Sun was ten crores and two lacs times larger in size than the planet earth." [44] According to Copernicus, Karīm elaborated, Mercury was situated nearest to the Sun while the planets of Venus, Earth, Mars, Jupiter, and Saturn followed in this sequence with respect to their increasing distance from the Sun. Mercury and Venus have no moons. Mars also had no moons. Jupiter had four satellites (*aqmār*, literally "the moons") while seven satellites orbited Saturn.[45] Karīm also knew that the European scientists had also speculated possibility of life on these planets like the planet Earth.

Thereafter he explained in earnestness Newton's classical theory of gravitational force without explicit mention of Newton. He alluded to the scientific fact that both, human beings and the living creatures on the earth as well as the movement of celestial bodies (*sayyārāt, thwābit*), such as the Earth, Sun, the Moon, the Stars, and the comets all remain in their own respective places/orbits

(*jāyi khud*) due to this universal force of attraction acting between all matters. Similarly, the same universal force of attraction determines the free fall of objects on earth. This phenomenon of Nature in English language is known as attraction and gravitation which means the power of attraction (*quwwat-i jāḍḥi bah*) and power of expulsion (*quwwat-i dāfi'ah*) and power of retention (*quwwat-i-mā sikah*). Karīm wrote that although scholars have written volumes on this subject, but as a commentator he frankly admitted his inability to elaborate this scientific and natural phenomenon. [46]

Moreover, Karīm Khān also emphasized the importance of telescope (*dūrbīn*) and realised that it had revolutionised the entire study of astronomy. It was an invention of the European scientists. He noted that with the aid of this unique instrument the European scientists had viewed a number of heavenly bodies and discovered a number of new facts. The scientists in Europe had made such detailed and accurate observations that not even a hundredth part of it could be comprehended easily. To see the use of the telescope and also to satisfy his intellectual curiosity, on June 9, 1841 Karīm visited Greenwich Royal Observatory with the permission of the Board of Admiralty Sydney Herbert in the company of Anthony Howe and Colonel Henry Robertson, younger brother of Archibald Robertson (1782–1847), Director of the Company, and formerly the Resident at Mysore. The very sight of the astronomical observations carried out in the Greenwich Observatory with the aid of telescope simply fascinated curious Indian observer. About the telescope he recorded in his travelogue in detailed manner:

The purpose of the telescope was to observe the stars and other heavenly bodies. The government bore its expenses, while some of the expenditure was also shared by merchants who also owned ships. It was located on the top of a hillock. More than a hundred thousand rupees (*lakh*) were spent in the preparation of the telescope. Additionally, the monthly expenditure was the responsibility of the royal government. The Astronomer Royal (*nujūmī bādshāhī*) showed the Observatory. One of the telescopes was more than three and half yard (*gaz*) in length. The diameter of the mirror of the telescope through which the stars and planets were viewed was seven *gaz*. It was reported that in the night one could view seas as well as the human beings (*ādmī*) on the moon. Therefore, the European astronomers conjectured that on every planet there existed life like the planet earth. The planet earth was seven thousand and nine hundred and sixteen miles in diameter. Its distance from the sun was ninety-five million miles (9 crore

and 50 lakh). Its annual revolution around the sun takes 365 days and five hours and fifty nine seconds (*daqīqa nujūmī*, literally the sixtieth part of an astronomical degree), which causes change of seasons. Its daily rotation around its axis in twenty four hours causes day and night.[47]

Later in his Persian universal history, Karīm fondly recollected his frequent visits to the Greenwich Observatory as a memorable event of his sojourn in the British metropolis. He noted that in the company of his British scientist friends (*Ḥukamā' farang*) he viewed the sky through the telescope. He noted that he viewed the Moon (*kura'-i-mah*) and ascertained that there were mountains and seas on its surface. In fact he felt the mountains resembled more like the volcanic formations (*jawalāmukhī*) of India. Thus Karīm came to know about Galileo's telescopic discoveries of presence of lunar mountains and craters on the surface of the moon but without mentioning the scientist by name. [48]

IV. Karīm Khān on Earthquakes and Volcanoes (*zalzala*)

It was not only the modern astronomy and the telescope which so fascinated Karīm Khān, he sincerely sought to widen his sphere of scientific horizons with a serious discourse on the causes of earthquake. According to him he had already made a diligent search in the works of the ancient philosophers but found nothing. The ancient philosophers hardly speculated on the causes of the natural calamity, the nature and causes of the volcanic eruptions, occurrence of the earthquakes which often strikes the planet earth. To his utter disappointment he came to know that unfortunately earlier no scientific study existed about that natural phenomenon. However, modern scholars have enquired about the causes of this natural catastrophe and though unlike the solar and lunar eclipses, the occurrence of an earthquake cannot be predicted in advance. As no method has yet been devised to predict the time, place or magnitude of earthquakes. [49]

The enquiry into the geological causes of earthquake led him to explore the structure and composition of the planet Earth. He came to know that in shape and structure the planet earth consisted of several layers like an onion with layers one inside the other. Moreover, like the human body, it contains liquids. The earth consisted of the water and also fire. He explained it with a simple diagram of the inner structure of the planet earth. The flow of the two elements, the water and fire, into each other could result in severe earthquake. Such an occurrence in an area of human habitation would ultimately damage life and property. If a conjunction

of the two, the fire and the water happens, it damages property. If the conjunction of the fire and water happens underwater, in that case after violent explosion, a mountain would be formed out of the erupted material. It could also cause a severe storm. But the latter naturally occurs only on the coastal regions. At this point Karīm felt relieved to know that India lay away from the epicentre. He thanked Allah, the Almighty, that his own country was comparatively safe from chances of such natural disasters. He noted that the major zones of seismicity remained Russia, China and Japan, although the vibrations of any major earthquake were felt in India too. Karīm's concern to know the causes of earthquake could be understood in the backdrop of the Great Lisbon Earthquake and waves of tsunami which struck Lisbon, the Portuguese capital, on Nov 1, 1755. As the shockwave of the largest ever-recorded disaster in Europe were felt throughout Europe and North Africa and it was a widely debated and discussed among the European scientists as well as the philosophers of Enlightenment. Karīm also came to know in India about this biggest ever disaster which struck the Portuguese capital or perhaps during his sojourn in London. He described: "Once in Lisbon, capital of Portugal, which is a European nation it so happened that there was a sudden storm in the sea. The people of the city gathered to find out the cause of sudden tumult. Soon they were bewildered to see that a beautiful volcanic mountain was formed from the erupted material in the midst of the sea and thereafter the storm and tumult subsided. It was a place with fresh air and clean atmosphere. Gradually people began to live on that mountain what was a beautiful place in the midst of the huge water body. However, after a period of twelve years, similar earthquake (*zalzala*) occured. The same mountain got submerged into water. Thousands of living beings, human beings as well as animals also got submerged in the water for ever along with the mountain."[50]

Further Karīm also related an occurrence of a kind of underwater volcanic eruption (modern term tsunami) in his home-town Jhajjar. In the year 1782, when Jhajjar was under Amar Singh an officer of Begum Samru /Sombre (1753-1836), ruler of Sardhana estate (Meerut U.P.), the water-level of a well in the locality called Brahmanwālā came up to the surface with sudden and violent tumult like that of a cannon. When the Hindu women who came to the same well to fetch water and saw this, they naturally got frightened and informed others about the strange scene. When people of the town went to the well they saw the water was gradually going to its original level. To seek an opinion he narrated this incident to Sir John Herschel, "whose dedicated scientific researchers had disproved the

theories of the ancients Socrates and Hippocrates."[51] Karīm recounted that after serious reflections the British scientist informed him that the incidence related by him about his home town was an earthquake of lower magnitude; consequently, the town remained safe from any natural calamity. Thus it was not the new astronomy but the seismic activity of the planet earth which he explored with the British astronomer Sir John Herschel. Nevertheless Karīm also pointed out specifically that John Herschel was the son of the famous British astronomer Sir William Herschel (1738–1822) who discovered a new planet called Herschel. Subsequently, the same was named as Uranus which is a Greek word. It is the eighth planet of the solar system."[52]

He narrated yet another incident to Herschel when vegetation (*nabāt*) also fell along with the rains. This happened in Sindh during the reign of the Mughal Emperor Farrukh Siyar. Karīm also added that the strange but beautiful natural event had also been verified by Mīr 'Abd al-Jalīl Bilgrāmī (1661–1725) the news- writer of the province in the form of a Rubā'īyi (quatrain).[53]

Although, there is no way to ascertain Karīm's high claims of holding direct discussion with the British scientist, yet Hershel's biography had allusion to India when he cited example of a volcanic eruption from the region of Kutch in Gujarat: "Herschel sets before us the phenomena of volcanic eruptions and their extraordinary effects. In the year 1819, in an earthquake in India, in the district of Cutch, bordering on the Indus, a track of country more than fifty miles long and sixteen miles broad was suddenly raised ten feet above its former level. The raised portion still stands up above the unraised, like a long perpendicular rampart, known by the name of Ullah Bund, or God's Wall." [54] Perhaps the unidentified informant was Karīm Khān.

V. Karīm Khān's Perceptions of the British technical and Industrial Progress

Karīm Khān concentrated on various aspects of the British Industrial Revolution without using the term Industrial Revolution as the term was coined later. The British technical advancements in the textile, ship-building, artillery and railways were evident to him like other visitors from the Continent. On board the ship Edinburgh he closely observed advancements in the art of ship-building industry and improvements in the navigational techniques. He also noted uses of compass and sextant in his travelogue. Tremendous improvement in the maritime

technology was something he had also experienced personally during his extensive travel in Britain, Ireland, France and Greece. Therefore, it was the railways "the great connector" which became main topic of Karīm's scientific and technical discourses. References to railways occur at numerous places in his travelogue, mainly in connection with his journeys within the city of London and outside such as between Blackwall to London and London and Tottenham. He also knew about the Great Western Railway Company's project between London to Bristol, and London and Liverpool. He reports that railway construction was an enormous project, usually undertaken by private companies. A sum of six million, a huge amount equivalent to one and half crore rupees, was spent in the construction of railway between London and Tottenham. He also observed that the area was mainly inhabited by professional classes mainly the tradesmen and merchants. After a visit to railway between Blackwall and London on 5, November 1841, he saw use of electric telegraph to transmit signals along a wire for railroad signalling. Karīm noted with immense curiosity the utterly bewildering arrays of mechanism and procedure involved in the invention known as the electric telegraph.[55]

In his description of the new technology and various inventions he simply transliterated the terms such as Railways, Great Western Railways, steam, tunnel and the electric telegraph into Persian and Urdu. But Karīm also provides Persian equivalents for all the inventions he described such as the for the railways '*arā ba-i dukhānī* and for gas *chirāgh-i-dukhānī* and steam ship was called *markab-i dukhānī* and *jahāz-i- dukhānī* while the electric telegraph was termed as *dak-khana barqī* or simply *tār* in Urdu. But for most of the time, he preferred to use the English terms. Karīm saw that the steam which means evaporation *bhāp* called *stīm* in English, obtained from the boiling water played a vital role in the industrialisation process of Britain. In fact, almost all the machines were operated with the power of steam.[56] During his sojourn in London, Karīm Khān visited the Royal Arsenal and the Dockyard of Royal Navy at Woolwich in the company of an English interpreter, with the official permission of Sir George Murray Master General of Ordnance (1772-1845) and Sydney Herbert Lord Admiralty. Perhaps, technologies with aristocratic flavour always attracted the ruling elite. Certainly, he was impressed with the technological advancement in the manufacturing of cannons and other weapons. The visitor observed the introduction of labour-saving and labour-facilitating devices in the shipbuilding and manufacturing of the cannons with curiosity and amazement. But he was not an uncritical admirer of British industrial progress. At the Arsenal he carefully examined various types of cannons

manufactured in various countries and found European cannons well-designed and well-made. But in the entire collection it was the lion-faced cannon (*top-sherdahān*) of Tipu Sultan, the ruler of Mysore state which was an object of Indian observer's admiration. He described the cannon a piece of superb skilled craftsmanship. It had elegant exterior decoration (*naqqāshi*) having details of its year of manufacturing, weight, and accurate measurements figures inscribed upon it in elegant Persian script. He contended that the Tipu's cannon which had been brought to Britain after the fall of Seringapatam, though in size slightly bigger, but in no way it was inferior to the European cannons.[57] Tipu's brass-barrelled gun with its belt, and buckle preserved in the historic Tower of London was the other major fascination for him. He carefully noted the Persian couplet beautifully engraved but without being sentimental.[58]

Tufang bī naẓīr kishwar-i-hind ki bāshad barq sozān sathnī ū, twānad sar nuwisht khasm bar dāsht ḥadaf gardad agar peshānī ū.

(Matchless gun of India is like a thunder

Can bring the fate of foe to an end, if aimed at the forehead.)

It seems the memories of Tipu's heroic struggle against the onslaughts of powerful British imperialism were fresh in the mind of the Indian visitor. Such recollection was only natural as Tipu's son Prince Jahāngir Zamān was also in London when Karīm lived in the imperial metropolis, and they met frequently.[59]

He also visited the Brunel-designed tunnel under the Thames River between Rotherhithe and Wapping. He met Mark Isambard Brunel and with him he held lengthy discussions about the construction of the enormous project and the cost involved in its undertaking. He noted that the contractors and the private companies on behalf of the government undertook these vast projects. He was informed that the proposed construction of the tunnel which began in 1826, was jointly financed by a group of one hundred and fifty investors. Such a group is known as Company. But the work had to be postponed for seven years due the financial difficulties which in turn was the result of wars with France. Apart from the above details, he also came to know that the tunnel measured one thousand, two hundred and fifty feet and a sum of more than ten million (*karor*) was spent in its construction He specifically noted that Brunel had been knighted in 1841 for his engineering feat.[60]

He also tried new technology such as the dive-bell which he recorded as a strange under water experience,[61] and also saw hot-air balloon ascents of the British balloonist Charles Green (1785-1870) at the Vauxhall Gardens. Hot-air balloons known in India but these were looked at more as a source of amusement, a plaything, rather than a serious invention in the field of transport technology. Yet he carefully noted the technique of its construction and the material used in it. He found that it was moved by coal-gas and the fabric used in its making was a type of silk.[62] He paid several visits to the Polytechnic Institution and explained that it was a Greek term which was also the language of the Holy Bible. Karīm Khān described it as a unique international centre of learning which housed the bewildering varieties of arts and crafts (*ṣan'at*) practiced anywhere in the world.[63]

VI Epilogue

Karīm Khān's techno-scientific discourses of the British scientific progress and improvements in industrial enterprises remain unmatched written by any other South Asian Muslim during the first half of the nineteenth century. Naturally, not every Indian traveller to Britain was interested in the varied manifestations of the modern sciences and technology. Two years prior to Karīm Khān, Yūsuf Khān "Kammalpōsh" (1803-61) a military officer (*subedār*) in the cavalry regiment of Awadh also lived in the imperial metropolis from August 1837-18 January 1838.[64] But his views of the British industrial progress are peripheral. He offers little comparison with India except when he visited the Woolwich Arsenal and observed: "People who were endowed with such skill and aptitude and remained preoccupied with such activities why would they not become rulers of the Seven Climes. To challenge them was like fighting against genii."[65] Similarly he evinced little interest in the questions of modern astronomy and celestial mechanics.[66] Two years later another Indian traveller Luṭfullāh Khān (b.1802), in the year 1844 spent summer and early autumn in London. He visited almost all those historical places, such as the St. Paul's Cathedral, British Museum, the Regent Park Zoological Gardens and other popular tourist sights. Huge bridges of the British metropolis with extensive use of iron fascinated him also. But unlike Karīm Khān, he did not care to enquire about the enormous expenditure spent in the construction of these massive projects. He also travelled by rail from Southampton to London and within the city also. Again unlike Karīm Khān, he showed no desire to know anything about the new technology which, no wonder, he found comfortable and easy to use. He also visited the Arsenal at Woolwich and termed it "the instruments

of British wealth,' but without any comment on the new manufacturing techniques of armament making. For the Greenwich Observatory something which fascinated Karīm Khān so deeply he noted briefly that it was a place from where "all the English seamen reckon their first meridian of longitude."[67]

Karīm Khān's continued engagement with the British Industrial inventions and scientific progress could be appreciated against the dynamic socio-intellectual milieu of Delhi and north Indian cities and *qaṣbāt* such as Jhajjar the home-town of the author.[68] Its conscious intelligentsia was eager to appropriate new knowledge and learning from all possible quarters. A relevant question arises that despite the existence of a well-informed intelligentsia no scientific change and technological breakthrough could occur. Indigenous agency and interlocutors could have played an important part in the diffusion of scientific ideas and knowledge. Understandably, technological changes are not selected by active and productive individuals, who need to represent all segments of society nor they need necessarily to concern with public welfare.[69] Moreover, unlike China in India there was no state monopoly on technology and scientific experiments such as the government monopoly of the examination system, secrecy and excessive state regulations in the study of astronomy and mathematics.[70] Regrettably the declining elites remained only passive recipients of knowledge. It has been rightly argued that the institutionalisation of Western science and technology involved a complex interplay of structure and agency [71] Men like Karīm Khān who were engaged in the task of dissemination of knowledge, and refashioning of scientific modernity and its discourse, had been increasingly marginalized. Evidently, there was no representation of the traditional intelligentsia from Delhi, and Awadh, the old seats of scientific learning whereas in the colonial Bengal the *bhadralok* the newly emergent middle-class were among the practitioners of scientific modernity.[72] Similar happy flowering of western sciences and indigenous tradition in Awadh also came to an abrupt end with an interventionist colonial state in which the "indigenous genius to innovate was suppressed by an over arching desire to dominate and replace the indigenous system of education." [73] Clearly Karīm Khān lacked a penetrating bourgeoisie gaze in Faucauldian sense where the viewer occupies a position of authority and control over the subject. Karîm's narrative displays spirit of observation but his travelling gaze is 'passive.'[74] The passiveness of his gaze reveals the fact of asymmetrical relationship of power between the coloniser and the colonised. Karīm's account of the European techno-scientific progress remained confined to mere descriptions rather than an act of 'appropriation.' For instance two of his

major obsessions the railways and telegraph 'tools of empire,' were soon introduced in India, railways in 1846 and telegraph in 1852, as an agent of modernisation and social change but in the process Karīm had no say.

There remains a hidden tension in Karīm Khān's admiration of British achievements in the domain of science and technology and the expressions of British power in India. On the one hand, he criticised Indian ruling elite for xenophobic passivity, ingrained conservatism racial aversion accusations which are found baseless by the modern scholars.[75] On the other hand, his narrative reverberates with his concern that Indians (*ahl i hind*) might not be able to appreciate his accounts of "the wonders" (*'aja'bat*) of Britain."[76] Our Indian observers' critique of Indian ruling elite and their ethos echoed contemporary official British views of Indian society. In the wake of the British industrial Revolution science and technology, especially steam heralded by steamship and railways critically informed British perspective. Technical achievements served to heighten a growing sense of difference between Britain and India. Most of Karīm Khān's informants were the middle class bourgeoisie British who were proud of their scientific achievements and industrial progress.

Karīm Khân 's discourses of the Western scientific and technical discourses are less elaborate and less expressive as compared to the perceptions of the eighteenth century Indo-Persian writers ʿItisām al-Dīn, Mirza Abu Tālib and Mir Muḥammad Ḥusain (d.1790), who had visited Europe (*Faragistān*) half a century earlier. British technical progress which was evident to the sensitive observer is mostly described as isolated events without noticing their interrelationships or the socio-economic impact of industrialization. Compared to Abu Tālib, Karim's understanding of the social transformation was less perceptive. For instance Abu Tâlib pointed out fifty years ago, "It was a well-known fact that Britain possessed well-built and strong ships. They were the major source of its strength and the main reason of British prosperity and wealth." [77]

Among the European scientists Karīm Khān was aware of Copernicus and knew only of course the Herschels, William and John. Karīm Khān also did not mention Sir Isaac Newton by name whose laws of universal attraction he so carefully corroborated. Perhaps he was not aware of the eighteenth century erudite Indo-Persian educated elites' discourses on the subject especially ʿAbd al-Latīf who represented Newton, the symbol of Enlightenment and a rallying cry for radical politics and social reform in his own country, as a doyen of European

scientists. Tafaẓẓul Ḥusain's great scientific achievement the translation of *Principia* remained confined in the pages of *Tuhfat al-'Alam* of ʿAbd al-Laṭīf Shushtarī. [78] However, three of the main European scientists Kepler, Tycho Brahe (1546-1601) and Galileo remained unknown to the eighteenth century Indo-Persian elite also who provided systematic discourses on the subject. [79] Nonetheless explicit mention of the Greek scientists Aristarchus, Pythagoras and Ptolemy shows that Karim knew that the modern science was an improvement the concepts and ideas of earlier scientists.

Nevertheless, it is to the credit of Karīm Khān that he explicitly rejected the geo-centric world-view and accepted the heliocentric theory. Furthermore, Karīm Khān addressed himself to the question as to why the Greek cosmological ideas were still entertained by the Muslims. What were the reasons of Muslims' attachment to Greek philosophy? He refers to the crucial period of transmission of Greek philosophy to the Islamic world under the Abbasids through translation of Greek scientific literature into Arabic under Caliph Mamun (753-775). Since that time Greek philosophical thought had dominated entire Muslim world view. He further wrote that it was precisely the period when the Traditions (*hadith*) of the Prophet were also compiled. Does Karīm Khān 's above statement imply that Muslim philosophers endeavoured to assimilate these ideas into religious discourses? We do not know, as Karīm Khān does not elaborate this aspect any further. Unlike other Islamic societies, European ideas were not integrated ideologically in the Islamic thought in India. In the context of South Asian Islam it was the task of the versatile genius Sayyid Aḥmad Khān, the "Renaissance man"[80], one of the architects of modern India. He not only recognised the regenerative role of education, science and technology but also formulated an active response to the scientific modernity as represented by the various facets of the British rule in India. He attempted a reconciliation of modern science with the revealed truths pointed out to similar parallels in early days of Islam when *'Ulemā'* reconciled the Greek learning with the scriptures of Islam. Thus he sought to prove that the western scientific thought was not antithetical to Islam rather Islam was compatible with modern science, if the Qur'ān was interpreted in the light of the reason. [81]

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References and Notes

1. Michael H. Fisher, *Counterflows to Colonialism, Indian Travellers and Settlers in Britain 1600-1857* Permanent Black, 2004, 275-281.

2. Karīm 's visit to England is also recorded in a local history: Munshi Ghulām Nabī Merathi, *Ta'rīkh-i-Jhajjar*, Faiz Ahmadi Press, 1866 pp. 222-3. The Jhajjar estate came under indirect British control in 1803 when Najābat ʿAli Khān an imperial bureaucrat of Emperor Shah Alam, after the British occupation of Delhi, was allowed to retain his *jāgīr* (land revenue assignment) comprising the area of Jhajjar, Dadri and Bahadurgarh, in lieu of military services rendered to British military general Gerard Lake (1744-1808). The fertile area of Jhajjar was held as a *jāgīr* of Mustafa Khān (d. 1745) and Murtaza Khān, the Mughal imperial bureaucrats also the grandfather and father of Najābat ʾAli Khān (d.1814), father of Hasan 'Khān. For the career of Najabat 'Ali Khān cf. Zahiruddin Malik, "*The Reign of Muḥammad Shāh 1719-48"* (Asia Publishing House, Bombay, 1977, reissued from Icon Pub. New Delhi, 2006), pp. 71, 93, 130, 131.

3. For Karīm Khān's perceptions of the British social, cultural life and political ideas and institutions, see, Gulfishan Khān, "Indian Muslim Perceptions of the West during the first half of the Nineteenth Century- Karīm Khān Mushtāq Jhajjari (1839-41), M. Haider, (ed.) *Sufis, Sultans and Feudal Orders, Nurul Hasan Commemoration Volume*, Manohar, Delhi 2004, pp.421-466.

4. Karīm Khān Mushtāq Jhajjari, *Siyāhatnāmā*, (Book of Travels), British Library, (London) OR. 2163, For details, see Garcin de Tassy, *Histoire de la litterature hindouie et hindoustanie*, 2nd edition, Vol. II, (Paris 1870), p.165. Nawab Karîm Khān, *Siyāhatnāmā* 'Ibādat Barçlawî (ed.) Idārah-i-adab-wa-tanqīd, (Lahore 1984) has edited the text. But present author's study is based on the Urdu manuscript lodged in the British Library.

5. Abd al-Karīm Khān Mushtāq Jhajjari, *Mir'āt-i-gītīnumā* (The World reflecting mirror) written in the format of topographical and geographical encyclopaedia is a universal history compiled upon his return to India There seems to have been three extant copies of *Mir'āt-i-gītīnumā* , all lodged in the British Library. Oriental Collections and Records, Delhi Persian 724, dated 1847, is an autograph copy, and it bears author's seal, which has been utilised for the present work. The other two manuscripts in the British Library collection are OR 1891 and OR 2038. All manuscripts are similar in contents and details.

6. For instance it was Theophilus Metcalf who is recorded to have donated the manuscript of his universal history *Mir'āt-i-gītīnumā* to the Delhi Archaeological Society in one of its meetings in the year 1847 recorded as Extracts of a Persian MS. Work, entitled the "Mirror of the World" compiled by "Kurreem Khan" of Jhajjar, and having reference

to the public buildings within the City of Delhi and its environs, by Sir Theophilus Metcalf, President. Cf. Proceedings of the Archaeological Society of Delhi in *Journal of the Delhi Archaeological Society*, Delhi Gazette Press, 1850 Appendix, pp. iii. The work was compiled on the suggestion of Governor General Hardinge when Karīm Khān met him in Delhi.

7. J. H. Garcin De Tassy "Livre de Voyage (Siyāht nāma) ou Itineraire de Dehli A Londres par Karīm Khān, de Jhajhar Traduit de l'Hindoustani par M. Garcin de Tassy, de l'Institut, etc., *Revue d'el Orient de l'algeri et des Colonies Bulletin de Societe Orientale de France, Quotrieme serie-tome premiere Anne*, 1865, pp. 105-7

8. *Siyāhatnāma* folio 195a. He utilised a Persian treatise of Jonathan Scott which contained an account of Europe. The same treatise is also included in *Ḥadiqat al-aqālīm*. Cf Murtaza Ḥusain Bilgrami, *Ḥadiqat al-aqālīm*, Nawal Kishore Press, (Lucknow, 1879, 1881), pp. 504-33.

9. See a self-reported dialogue with Robert Peel, *Mir'āt-i-gītīnuma* folio 116-17; *Siyā hatnāmā* folio 210-11. Also see, Gulfishan Khān, "Indian Muslim Perceptions of the West op. cit p.452.

10. For a classic portrayal of the Mughal capital in the period of transition, cf. Percival Spear, *Twilight of the Mughuls, Studies in late Mughul Delhi*, Cambridge, Cambridge University Press, 1951.

11. For another learned man of the town Najaf 'Ali Khān bin 'Azīm al-Dīn Jhajjarī, *Tafsīr-i-gharīb*, Sualimān Collection No. 47/4 *Tafsīr fārsī*, and *Masnawī Najaf ʿAli*, Habib Ganj Collection 50/72, 73 Maulana Azad Library Aligarh.

12. Iqtidar Husain Siddiqui, Science and scientific instruments in the Sultanate of Delhi, Presidential address Section II, *Indian History Congress*, Mysore, December. 1993.

13. M.A. Alavi and A. Rahmān, *Fathullah Shirazi, A Sixteen Century Indian Scientist*, N. Delhi INSA 1968

14. A. Jan Qaisar, *The Indian response to European technology and culture*, 1498-1707, Delhi, Oxford University Press, 1982; Irfan Habib, 'The Technology and Economy of Mughal India', *Indian Economic and Social History Review*, 17, (1) (1980), pp. 1-34.

15. S. N. Sen, 'Influence of Indian Science on Other Culture Areas', *IJHS*, 5.2 (1970) 332-46.

16. S. A. K. Ghori, "Development of Zīj Literature in India," *IJHS*, 20.1 (1985) 20-48; Rajesh Kochar, "Pre-telescopic Astronomy in India," in A. Rahmān, ed., *History of Indian Science, Technology and Culture AD 1000–1800*, Project of History of Indian Science, Philosophy and Culture (Delhi: Oxford University Press, 2000, Reprint 2007), pp. 171–197; S. A. H. Rizvi, "Glimpses of Astronomy in Medieval India" in A. Rahmān, ed., *History of Indian Science, Technology and Culture*, pp. 197–220.

17. *Zīj-i- Muḥammad Shāhī* as well as *Zīj-i-Ulughbegī* of Mirzā Ulugh Beg (1394–1449) belongs to Sayyid Aḥmad Khān's personal collection and are preserved in the Central Library of AMU. *Zīj-i- Muḥammad Shāhī* Maulāna Azad Library Aligarh Muslim University Collection MS. 30 Persian Science; Mirzā Ulugh Beg, *Zīj-i-Ulughbegī* Maulana Azad Library, Aligarh Muslim University Collection MS. 28 Persian Science.

18. Ghulām Ḥusain Jaunpuri, *Jam'-i Bahādur Khānī* (Calcutta: Lithographic Press, 1835), p. 579. For a full explanation what is referred as Jai Singh-Khairullāh-Ghulām Hussain model, see, S. A. H. Rizvi, "Glimpses of Astronomy in Medieval India," pp. 209–218

19. A. Rahmān, (ed.) *Science Technology in Medieval India*: *A Bibliography of Source Material in Sanskrit, Arabic and Persian* (New Delhi: National Science Academy, 1982).

20. For the reign of Muḥammad Shāh, cf. Z. Malik, *The Reign of Muḥammad Shah 1719–48* op.cit

21. Abū Tālib ibn Muḥammad Isfahānī, *Lubb al-Siyār wa Jahān Nūmā* 'Abd us salam collection, *Tārīkh-i Mughal* 382/152 Maulana Azad Library, AMU, Aligarh, folio 52. Abul-Khair Khair Allāh Khān Muhandis b. Lutf Allāh Muhandis (d. 1160/1747) belonged to the family of Indian mathematician; his grandfather Aḥmad al-Lāhaurī aqā Aḥmad Ma'mār was the architect of the famous Tāj Maḥal at Agra. He was appointed by the Mughal Emperor Muḥammad Shāh as the director of the royal observatory at Delhi in which capacity he also compiled the *zīj* the astronomical tables dedicated to the emperor. See, the seminal essay by Sayyid Sulayman Nadwi, "Lahaur ka ek muhandis khāndān jis ne Tāj aur Lāl Qal'ah banāyā," *Proceedings of the Idara-i-Maarif-i-Islamia*, First session, held at Lahore 15th and 16th April, 1933, Lahore 1935, pp.1-50. Also see, M. 'Abdullāh Chaghtai, "A family of the great Mughal Architects," *Islamic Culture*, 1937, vol. XI, no. 2 (April 1937), pp. 208–209.

22. Abd al-Latīf Shushtarī al-Mūsawī al-Shushtarī, *Tuḥfat al-'ālam* (Pers. MS. Elliott 382, Bodleian Library, Oxford, England), foilios 54–55

23. Cf. Nawāb bamcām al-Dawlah Shāh Nawāz Khān, *Ma'asir al-Umarā*', ed. Maulawī 'Abd al-Raḥīm and Ashraf 'Alī, 3 vols. (Calcutta: Bib. Indica, Asiatic Society of Bengal, 1888–1891), vol. II, pp. 81–83. However, in *Zīj-i- Muḥammad Shāhī* there are tables for Saturn all copied from LaHire.

24. See, I. G. Khān, "The Awadh Scientific Renaissance and the role of the French: C.1750–1820," *Indian Journal of History of Science*, vol. 38, no. 3 (2003), 273–301.

25. See, Gulfishan Khān, *Indian Muslim Perceptions of the West During the Eighteenth Century* (Karachi: Oxford University Press, 1998), 270-76.

    Chapter 7 "Perceptions of Scientific and Technological Developments," pp. 264–331.

26. Sayyid Ahmad Khān, *Athār al-Sanādīd* Delhi, 1263 A.H./ September 1846, Book 4, pp. 41-42. For details Cf. Gulfishan Khān, "Sayyid Ahmad Khān's Representations of the pre-Revolt life of Shahjahanabad/Delhi: *Asar al-Sanadid*," *Indian Historical Review*, vol. XXXVI, no. 1 (June 2009), pp. 89–90, 95.

27. *Athār al-Sanādīd* op. cit. pp. 34-6. For details Cf. Gulfishan Khān, "Sayyid Ahmad Khān's Representations of the pre-Revolt life of Shahjahanabad/Delhi: *Asar al-Sanadid*," pp. 89–90, 95.

28. *Athār al-Sanādīd* op. cit. pp. 89-91 Cf. Gulfishan Khān, "Ulama and the Delhi Madrasah: Some Early Colonial Experiences" in 'Abdul 'Ali and Zafarul Islam, eds., *Role of the Muslims in the Freedom Movement of India* (Aligarh: Institute of Islamic Studies, AMU, 2007), pp. 65-89.

29. Sayyid Aḥmad Khān, *Sīrat-i Farīdiyah* (Agra: Mufid-Am Press, 1896), pp. See, Gulfishan Khān, "Sayyid Ahmad Khān: Some Early Influences," in 'Abd ul 'Ali S. Ahsan, ed., *Contribution of Sir Syed Ahmad Khān to Islamic Studies*, Seminar Papers (Aligarh: Institute of Islamic Studies AMU, 2004), pp. 51–57.

30. See, Sayyid Aḥmad Khān, tr. and ed., *Tarjumah Fawā'id al-Afkār fī A'māl al-Farjār* (Translation of the results of thought upon the use of compasses) (Delhi: Sayyid al-Akhbar Press, 1849), See, the preface quoted in Gulfishan Khān, "Sayyid Ahmad Khān: Some Early Influences," pp. 52–56.

31. *Tuḥfah-'i Nu'māniyyah* was published as *Jauhar-i- Faridiya*. See, Khwājā Farīd al-Dīn Aḥmad, *Jauhar-i- Faridiya*, Maslih al-Matābi Press, Delhi, 1900. Gulfishan Khān, "Sayyid Ahmad Khān: Some Early Influences," pp. 43–61.

32. *Sīrat-i Farīdiyah*, pp. 42–3. See, C. Shackel, "English translation of Sir Sayyid Aḥmad Khān's Sirat-e-Faridiya," *Islamic Culture*, vol. 46, no. 4 (1972), p. 329. For Zain al-'Ābidīn's interest in astronomy and of astronomical instruments, see, Gulfishan Khān, "Sayyid Aḥmad Khān: Some Early Influences," pp. 57-59.

33. C.F. Andrews, *Zakaullāh* (Cambridge: 1929), p. 66.

34. Abū Tālib ibn Muḥammad Isfahānī, *Lubb al-Siyar wa Jahān Numā*, folios 33-38. also see, another eighteenth century history of Murtaza Ḥusain Bilgrami, *Hadiqat al-aqālim*, Nawal Kisore Press, (Lucknow, 1879, 1881), pp.. 228 ,232-369, followed with an account of the Islamic philosophers, 369-281

35. Abd al-Raḥmān Shāhnawāz Khān Banbanī Dehlawī, *Mir'at-i Āftab Numā*, Maulana Azad Library University Collection Farsiya Akhbar 11, folios 199-202. However, Ta'rīkh-i-ḥukamā' remains unidentified. A similar work called *Aqwāl-i- Ḥukamā'* of Maqsud 'Ali Tabrizi is extant. See. (HL3839, and 1777 Khuda Bakhsh Oriental Public Library, Patna).

36. See the first chapter on cosmology in the above cited 'Abd al-Raḥmān Shāhnawāz Khān Banbanī Dehlawī, *Mir'at-i Āftab Numā*,

37. See, Christopher Shackel and Javed Majeed, *Hali's Musaddas*: *The Flow and Ebb of Islam*, SOAS South Asian Texts (Delhi: Oxford University Press, 1997), pp. 134–136, 135–137.

38. One such commentary is preserved in the Maulana Azad Libray Ḥabib Ganj Collection Fārsiyā hi'at 44/9 entitled *Muqaddimah Taqwim* written in 1179/1765 A.D. copied by Zain al-Abidin son of Mirza Muḥammad 'Ali.

39. *Athār al-Sanādīd* op. cit. pp. 126-7
40. *Athār al-Sanādīd* op. cit. pp. 131-3
41. *Sīrat-i Farīdiyah* p.33
42. *Mir'āt-i-gītīnumā* folio 5
43. *Mir'āt-i-gītīnumā* folio 5
44. *Mir'āt-i-gītīnumā*, folios 5
45. *Mir'āt-i-gītīnumā*, folios 5–6.
46. *Mir'āt-i-gītīnumā*, folios 9
47. *Siyāhatnāmā*, folio 166
48. Mir'āt-i-gītīnumā folio 6
49. Mir'āt-i-gītīnumā folio 10
50. *Mir'āt-i-gītīnumā* , folio 11. Karim used Persian word *zalzala* to describe earthquakes, volcanic eruptions and also tsunami. Yūsuf Khān "Kammalpōsh" (1803–1861) who was in Lisbon in January 1838 was informed about the Great Lisbon Earthquake by the inhabitants of the Portuguese capital that eighty years ago the natural calamity struck the city in which more than sixty thousand people died and many buildings were destroyed. Yūsuf Khān "Kammalpōsh, *'Ajā'ibāt-i Farang*, known as, *Tārīkh-i Yûsufî* or *Travels of Yūsuf Khān* Kammalpōsh in England (Inglistān) (Lucknow: Nawal Kishore Press, 1873, 1898), p. 75 [Hereafter *'Ajā'ibāt-i Farang*], p. 75.
51. *Mir'āt-i-gītīnumā* folio 11
52. *Mir'āt-i-gītīnumā* folios 11. At that time Herschel was occupied with his book *Outlines of Astronomy* (London: 1849), a book for educated laymen.
53. *Mir'āt-i-gītīnumā*, folio 10a-11b.
54. Anonymous, *The Story of Herschels*: *A Family of Astronomers Sir William Herschel, Sir John Herschel, Caroline Herschel* (London: T. Nelson Publications, 1878), p. 83
55. *Siyāhatnāmā* folios.199b-200.
56. *Ibid*. folio 212a.
57. *Siyāhatnāmā* folios 193-4
58. *Siyāhatnāmā* folio 198
59. *Siyāhatnāmā* folio 94. Proceedings of the Anniversary Meetings of the Royal Asiatic Society held on 6th May 1837, Appendix, foot note 3 p. Xxxviii in Cf. *Journal of the Royal Asiatic Society of Great Britain and Ireland* Vol. 4, 1837.
60. *Siyāhatnāmā* folio 205; *Mir'āt-i-Gītīnuma* folios 110a-111a.
61. *Siyāhatnāmā, folio 93.*

62. *Siyāhatnāmā* folio 172

63. *Siyāhatnāmā, folio 93*

64. See, Rosie Llewellyn-Jones, Indian Travellers in Nineteenth Century England *Indo-British Review* Annual General Number, Vol XVIII-Number 1, 1990, pp. 137-142

65. *'Ajā'ibāt-i Farang* p.34.

66. *'Ajā'ibāt-i Farang*, p.43. He frankly refused to entertain any discussion on the subject with his British hosts and offered an apology that mathematical calculation and the questions of movement of heavenly bodies did not quite get into his head.

67. See E.B. Eastwick (ed.) *Autobiography of Lutfullah, A Mohamedan Gentleman; and his Transactions with His Fellow Creatures, intersperse with remarks on the habits, customs, and character of the people with whom he had to deal*. London: Smith Elder and Company 1857. For a new edition of the same see, Mushirul Hasan, edited, annotated, and with an introduction ed. *Seamless Boundaries Lutfullah's Narrative beyond East and West* (Delhi, Oxford University Press, 2007. p.223.

68. Gulfishan Khān, An Overview of the Scientific Thought and Technology in the Subcontinent during 18-19th Centuries *Insights* Vol. 1, no.4 (Islamabad 2009) pp.37-72

69. G. Basalla, *The Evolution of technology* , Cambridge 1988, p. 204

70. Toby E. Huff, The Rise of the Early Modern Science Islam China and the West, Cambridge University Press, 1993, 309-311.

71. Zaheer Baber, *The Science of Empire* pp.195-196, 225-6, 235-7.

72. Cf. Kapil Raj, 'Knowledge, Power and Modern Science: The Brahmins Strike Back', in Deepak Kumar (ed.), *Science and Empire: Essays in Indian Context (1700-1947)* (Delhi, 1991), pp. 115-25.

73. I. G. Khān, The Awadh Scientific Renaissance and the role of the French: C.1750-1820,.

74. The notion of the "clinical gaze" or "observation gaze" that is the penetrating and sage observation, having power to see the hidden truth, the idea as embedded in the seminal writings of Michel Faucault (1926-84) the French historian and critic, in his study entitled The Birth of the Clinic (1963), Discipline and Punish: The birth of Prison, first applied on human body and prisoners, and later in Order of Things for investigating the human sciences. Foucault speaks of the myth of the clinical gaze, that is, the myth that the physician can see into the heart of a problem in order to diagnose and treat it, and that this ability to know by gazing is a result of the vast array of observations that the clinician has made.The notion already applied as an analytical tool by the scientists for natural sciences, had recently been effectively appropriated by David Arnold for natural landscape of India increasingly studied by the colonial scientists, by substituting "improvement" for "reform." For the use of the concept of gaze see, David Arnold, *The Tropics and the Travelling Gaze India, landscape, and Science 1800-1856* Seattle: University of Washington Press, 2006, Travelling gaze, pp. 13-35

75. A J. Qaisar, *Indian Response*, p. 139. S. N. Sen, 'Influence of Indian Science on Other Culture Areas', *IJHS*, 5 (1970), pp. 332-46.

76. *Mir'at i gītīnumā*, folio 130-31 passim.

77. Cf. Abū Tālib ibn Muḥammad Isfahānī, *Māsir-i-tālibi fi bilād i Afranji*, Persian MS Ouseley, 108, (Bodleian Library, Oxford, U.K.) folios 113-4. Masir-e-talebi, *The Travels of Mirza Abu Taleb Khan A.H. 1213-1218 (A.D.1798-1803)* Edited and Introduced by Hosein Khadive-Jam, Published by Kitabhaye Jibi, Inc., Tehran, Iran 1974, p. 203.

78. *Tuḥfat al-'ālam* folios 156-167. Abdul Latif Khan Shushtari, Samad Muwaihhid ed. *Tuḥfat al-Alam, wa zayl al-tuhfah*, Tehran: Tahuri, (1984), pp. 299-325.

79. Cf. Chapter 7 "Perceptions of Scientific and Technological Developments," in Gulfishan Khan, *Indian Muslim Perceptions of the West During the Eighteenth Century*, *op. cit.* pp. 264–331.

80. F.C.R. Robinson, *Atlas of the Islamic World since 1500* (Oxford: OUP, 1982), p. 149

81. Cf. C.W Troll, *Sayyid Ahmad Khān; A Reinterpretation of Muslim Theology* (Delhi: Vikas Publishing house 1978), pp. 144-170. S. Irfan Habib and D. Raina, "Copernicus, Columbus, colonialism and role of science in nineteenth century India," *Social scientist* (1991), p. 59