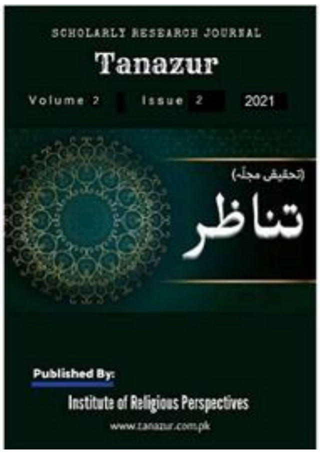

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Article: **Scholarly Extent of Early Muslims to Contribution in Modern Sciences**

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Scholarly Extent of Early Muslims to Contribution in Modern Sciences

Abstract:

The current knowledge of original sources does not permit us to draw a clear picture of the initial phases of scientific enterprise in Islamic civilization. What can be said with a certain degree of confidence pertains to the period beginning with the second half of the second century of Islam. By then, however, the enterprise of science in Islam was already well established, with definable branches in Islam was already well established, with definable branches and scientists of high caliber working in disciplines such as cosmology, geography, astronomy, and alchemy. This article presents a brief historical sketch of early Muslims' scholastic contribution into the modern-day sciences.

Keywords: Islam, Muslims' Contribution, History of Muslim Sciences, Translation Movement

Despite the paucity of early sources, we can confidently trace two branches of science-medicine and astronomy to the days of the prophet himself, because we do have verifiable sources allowing, because we do have verifiable sources allowing us to recount the story of their emergence in Madinah. Sayings of the Prophet (PBUH) dealing with health, sickness, hygiene, and specific diseases and their cures were complied and systematized by later generations of Muslims, and this body of literature provided the foundation for a specific branch of medical science in Islam: *al-tibb al-Nabawi*, Prophetic Medicine. Numerous Books on Prophetic medicine have preserved for us not only early accounts of how this branch of medicine emerged but also sophisticated theoretical discussions on the entire range of subjects dealing with health and medicine in Islam. Likewise, pre-Islamic Arabic astronomy was radically transformed under the influence of Qur'anic cosmological doctrines to give birth to characteristically Islamic astronomical literature generally referred to as radiant cosmology.

These early sciences had practical use for the first community of Muslims living in Madinah in the new Islamic state, but it is not merely their utilitarian aspect that is of interest to us here; what concerns us at the outset are the intrinsic links of these sciences with Islam. The very foundations of these two branches of science can be shown to have direct connection with the Qur'an and Sunnah, the two source that define all things Islamic. George Saliba notes:

> "It is not a coincidence, that the mathematical astronomical tradition which dealt with the theoretical foundations of astronomy also defined itself as a *hay'a* [cosmological] tradition, even though it rarely touched upon the Qur'anic reference to the cosmological *doctrines*"[1].

Likewise, other science that emerged in Islamic civilization can be shown to have intrinsic links with the Islamic worldview, even though they received a large amount of material from other civilizations. These links and connections will remain our continuous focus as we construct our narrative about the emergence of science in Islamic civilization.

Geographical expansion of Islam within its first century was, as noted earlier, accompanied by a social revolution that reconfigured the social, cultural, and intellectual climate of the old world. The same social revolution provided an opportunity for Islamic civilization to receive a very large amount of scientific material from Greek, Persian, and Indian sources. This infusion was not a random process; rather, it was an organized and sustained and sustained effort spread over three centuries, involving thousand, and rare manuscripts. But it must be pointed out as we approach this fascinating tale that this process could not have occurred without the ability of the recipient civilization to absorb. In other words, prior to the arrival of Greek, Indian, and Persian scientific material, there must brave been an indigenous scientific tradition ready and able to comprehend and revive this material. We know, for instance, that as early as the second quarter of the eighth century, astronomical treatises were being written in Sind (modern

[1] George Saliba, *Islamic Science and the Making of European Renaissance,* Library of Congress, U.S.A. 2007. pp. 17.

Pakistan) in Arabic. These early treatises were often based on Indian and Persian sources, but they employed technical Arabic terminology that could not have come into existence without the presence of an already-established astronomical tradition in Islamic civilization that could then absorb new material from Indian and Persian sources.As we proceed with the account of the emergence of science in Islamic civilization, we should note that the Islamic scientific tradition was emerging in a cosmopolitan intellectual milieu and that those who were making this tradition were not only Muslims but also Jews, Christians, Hindus, Zoroastrians, and members of other faith communities. An Indian astronomer who arrived in the court of the Abbasid Caliph al-Mansur (r. 754-755) as part of a delegation from Sind, for instance, was probably a Hindu. He knew Sanskrit and helped al-Fazari (*fl.* Second half of the eighth century) translate a Sanskrit astronomical text into Arabic; this text contained elements from even older astronomical traditions. The resultant translation, *Zij al-Sindhind*, became one of the sources of a long tradition of such texts in Islamic astronomy[2].

The emergence of the science tradition in this multireligious, multiethnic atmosphere was a dynamic process involving interaction between patrons of learning, scholars, scientists, rules, guilds, and wealthy merchants. To be sure, the scientific activity at this early time was not yet an institutionalized effort, but we do know that group of scientists were already working together in the second half of the eight century in Baghdad and other cities of Abbasid caliphate. We should also keep in mind that this scientific tradition was evolving at a time when the religious sciences had already been established on a firm foundation, with advanced texts in Qur'anic studies, philology, grammar, jurisprudence, and other branches of religious studies circulating among scholars. This fact is particularly important for our study because the prior establishment of religious sciences meanest that the new scientific tradition emerged into an intellectual milieu already shaped by religious thought.In the atmosphere of intense creativity that permeated Islamic civilization during this early period there was considerable strife and polarization at all levels of society. By the time science emerged as a differentiated field of study, Islamic polity had al-ready gone through two major internal fissures: the first (656-661) was sparked by the assassination of Uthman, the third Caliph, and led to a civil war in which close Companions of the Prophet found themselves pitched against each other under circumstances which threatened the very existence of the Muslim community. During the second rift (680-692), which sprang from two rival claim to the Caliphate, Husayn bin Ali[3], the Grandson of the Prophet, and all but one of his companions were killed at Karbala in October 680; Makkah was besieged by armed men; a radical splinter group, the Khawarij[4], took control of much of Arabia; and Ibn al-Zubaur, one of the close Companions of the Prophet,

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[2] Pingree, quoted in Muzaffar Iqbal, *Perspectives in Islam and Science.* Dost Publications: 1970. pp. 103-23.

[3] Al-Hussein ibn Ali ibn Abi Talib (11 or 13 January 626 CE – 13 October 680 CE) (3rd / 5thSha'aban 4 AH – 10th Muharram 61 AH) was the son of Ali ibn Abi Ṭalib (final *Rashidun Caliph* and first Shia Imam) and Fatimah Zahra (daughter of the Islamic prophet Muhammad) and the younger brother of Hasan ibn Ali. Hussein is an important figure in Islam as he is a member of the *Ahl al-Bayt* (the household of Muhammad) and *Ahl al-Kisa*, as well as being an Imam. He refused to pledge allegiance to what he considered the unjust rule of the Umayyads. As a consequence, he left Madina, his home town, from where he travelled to Mecca and then after the people of Kufa sent letters to him, pledging him allegence he set of for Kufa. The people of Kufa then broke their pledge and on the way his caravan was intercepted and he was killed and beheaded in the Battle of Karbala in 680 (61 AH) by Shimr Ibn Thil-Jawshan. The annual memorial for him, his family, his children and his As'haab (companions) is called *Ashura* (tenth day of Muharram) and is a day of mourning for Shia Muslims.

[4] Kharijites, literally "those who went out" is a general term embracing various Muslims who, while initially supporting the authority of the final Rashidun Caliph Ali ibn Abi Talib, then later rejected his leadership. They first emerged in the late 7th century, concentrated in today's southern Iraq, and are distinct from Sunni Muslims and Shiʿa Muslims. With the passing of time the Kharijite groups fell greatly in their numbers and their beliefs did not continue to gain any traction in future generations. From their essentially political position, the Kharijites developed extreme doctrines that further set them apart from both mainstream Sunni and Shiʿa Muslims. The Kharijites were particularly noted for adopting a radical approach to Takfir, whereby they declared other Muslims to be unbelievers and therefore deemed them worthy of death. The Kharijites were also known historically as the *Shurāh* (الشُراة), literally meaning "the buyers" and understood within the context of Islamic scripture and philosophy to mean "those who have traded the mortal life (al-Dunya) for the other life [with God] (al-Aakhirah)", which, unlike the term Kharijite, was one that many Kharijites used to describe themselves.

was killed in the sanctified city of Makkah, were fighting had been declared unlawful by the Qur'an.[5]These events initiated an intense debate among scholars, not only about what was happening and why but also certain other fundamental issues that arose in this context: is this a crisis of lead reship ?Who is qualified to lead the community? Are human act preordained? What are the boundaries of human freedom? What is the role of human intellect in matters of religion? What is the exact nature of Divine justice, of Hell and Heaven, and that of Divine attributes? These and related theological debates eventually gave birth to different schools of thought; some of these schools also developed their own positions in a later chapter. The period during which the earliest scientific works were written witnessed a revolt against the Umayyad[6], who had taken control of the Caliphate and shifted the capital of the Islamic state from Madinah to Damascus. Origination in newly conquered Iranian cities, especially in Mery, this revolt in favor of the Abbasid claim to the Caliphate moved westward under the leadership of Abu Muslim, who had captured the city of kufa by the middle of 749. Early in 750, abu'l abbas (posthumously Called al-Saffah) was proclaimed the first Abbasid Caliph at kufa. Two months later, the Umayyad were decisively defeated at eh battle of Greater Zab, and by June 750 most of them had been massacred, Abd al-Rahman I was the sole survivor from the ruling family; he escaped to Spain, where he established Umayyad rule (755-1031).[7]

Abu'l Abbas remained at war for the entire period of his caliphate and on his death in 753, his brother, Abu Ja'far, was proclaimed Caliph as al-Mansur (the victorious). In 762, al-Mansur decided to move his capital to a safer place. He himself supervised the process of the selection of its location; the choice fell for a small and ancient town, which was to become the fabled capital of Abbasid rule for the next five hundred years: Baghdad. Spanning both banks of the river Tigris, the new capital was designed as a circular city with sixteen gates. Its construction began on July 30, 762, a date determined by astrologers and engineers, among who was the aforementioned al-Fazari. The city was officially called *Madinat al-Salam,* the city of peace.

Beginning with the construction of Baghdad we can trace the developments in the scientific tradition in Islamic civilization with more confidence; our source material becomes more reliable and there is an exponential increase in available texts.In order to understand the nature of science in Islamic civilization at this stage of its development, we proceed with an outline of the various sciences as they emerged during the second half of the eight century.

The Initial Blossoming

By the time of the famous alchemist Jabir bin Hayyan, science in Islamic civilization had become considerably well established. Jabirian[8] corpus is so extensive and varied that some scholars have expressed doubts about its authorship by a single person. These highly sophisticated works, dealing with a vast range of subjects, were to leave a legacy that continued to influence science and discourse on science well into the fifteenth century. Jabir's writings

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[5] See for detail: Muzaffar Iqbal, *The Making of Islamic Science,* Greenwood Press, London, 2007, pp. 99-116

[6] The Umayyad Caliphate was the second of the four major Islamic caliphates established after the death of Muhammad. The caliphate was centered on the Umayyad dynasty, hailing from Mecca. The Umayyad family had first come to power under the third Caliph, Uthman ibn Affan (r. 644–656), but the Umayyad regime was founded by Muawiya ibn Abi Sufyan, long-time governor of Syria, after the end of the First Muslim Civil War in 661 CE/41 AH. Syria remained the Umayyads' main power base thereafter, and Damascus was their capital. The Umayyads continued theMuslim conquests, incorporating the Caucasus, Transoxiana, Sind, the Maghreb and the Iberian Peninsula (Al-Andalus) into the Muslim world. At its greatest extent, the Umayyad Caliphate covered 5.79 million square miles (15,000,000 km^2), making it the largest empire the world had yet seen, and the fifth largest ever to exist. See for more details:
Blankinship, Khalid Yahya (1994), *The End of the Jihad State, the Reign of Hisham Ibn 'Abd-al Malik and the collapse of the Umayyads,* State University of New York Press, p. 37

[7] Muzaffar Iqbal, *The Making of Islamic Science,* Greenwood Press, London, 2007, pp. 99-116

[8] In total, nearly 3,000 treatises and articles are credited to Jabir ibn Hayyan. Following the pioneering work of Paul Kraus, who demonstrated that a corpus of some several hundred works ascribed to Jābir were probably a medley from different hands, mostly dating to the late 9th and early 10th centuries, many scholars believe that many of these works consist of commentaries and additions by his followers, particularly of an Ismailipersuasion. (Josef W. Meri, Jere L. Bacharach (2006). *Medieval Islamic Civilization*. Taylor and Francis. p. 25.; Jabir Ibn Hayyan. Vol. 1. Le corpus des ecrits jabiriens. George Olms Verlag, 1989; Paul Kraus, *Jabir ibn Hayyan: Contribution à l'histoire des idées scientifiques dans l'Islam*, cited Robert Irwin, 'The long siesta' in Times Literary Supllement, 25/1/2008 p.8)

deal with the theory and proactive of chemical processes and procedures, classification of substances, astrology, cosmology, theory, medicine, alchemy, music magic, pharmacology, and several other disciplines[9]. What provides an internal cohesion to this corpus is the overall framework of inquiry and, more specifically his "Theory of Balance[10]." According to Jabir, all that exist in the cosmos has a cosmic balance. This balance is present at various levels and reflects the overall harmony of all that exists. In addition to Jabir, many lesser-known scientists of this period demonstrated keen interest in astronomy, mathematics, cosmology, and medicine. Only a small number of fragments works from this period have so far been studied, and this does not allow us to traverse the early history of Islamic scientific traditions. Texts available to historians of science take us directly into the first half of the ninth century, when Baghdad had already become the intellectually and scientific capital of the Abbasid empire, providing scientists patronage and opportunities to experiment, discuss, and discover. Most of these scientists were interested in more than one branch of science, as was usual at that time. The highest concentration of scientific activity at this early stage is, however, in mathematics, as tronomy, alchemy, natural history, and medicine.It is important to pay attention to this early period of Islamic scientific tradition, because the massive amount of Greek works subsequently translated into Arabic have created the erroneous impression that Islamic scientific tradition came into existence through the Translation Movement, and that all it did was to preserve Greek science for later transmission to Europe.

GREEK LINKING

That the Islamic scientific tradition preceded the translation movement, which brought a large number of foreign scientific texts into this emerging tradition, is beyond doubt; even our meager resources amply prove this. Astronomy, alchemy, medicine, and mathematics were already established fields of study before any major translations were made from Greek, Persian, or Indian sources. Translations were done to enrich the tradition, not to create it, as some Orient list has claimed.

In the field of astronomy, for instance, a very accomplished generation of astronomers, which included Yaqub b. Tariq[11] (*8th* Century) and several others, was already at work before the

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[9] Ibid.

[10] Balance Theory is a motivational theory of attitude change, proposed by Fritz Heider. It conceptualizes the cognitive consistency motive as a drive toward psychological balance. The consistency motive is the urge to maintain one's values and beliefs over time. Heider proposed that "sentiment" or liking relationships are balanced if the affect valence in a system multiplies out to a positive result. (Fritz Heider, *The Psychology of Interpersonal Relation*, New Jersey, 1958)

[11] Yaʿqūb ibn Ṭāriq (died c. 796 AD) was an 8th-century Persian astronomer and mathematician who lived in Baghdad. Works ascribed to Yaʿqūb ibn Ṭāriq include:

- *Zīj maḥlūl fī al-Sindhind li-daraja daraja* ("Astronomical tables in the *Sindhind* resolved for each degree"),
- *Tarkīb al-aflāk* ("Arrangement of the orbs"),
- *Kitāb al-ʿilal* ("Rationales"),
- *Taqṭīʿkardajāt al-jayb* ("Distribution of the *kardajas* of the sine"), and
- *Mā irtafaʿa min qaws niṣf al-nahār* ("Elevation along the arc of the meridian").
- An astrological work called *Al-maqālāt* (Chapters) is also ascribed to him by an unreliable source.
- The *Zīj*, written around 770, was based on a Sanskrit work, thought to be similar to the *Brāhmasphuṭasiddhānta*. This work was brought to the court of al-Mansūr from Sindh, reportedly by an Sindhi astronomer named Kankah.
- The *Tarkīb al-aflāk* dealt with cosmography, that is, the placement and sizes of the heavenly bodies. Its estimates of the sizes and distances of the heavenly bodies were tabulated in al-Bīrūnī's work on India; according to him, Yaʿqūb ibn Ṭāriq gave the radius of the Earth as 1,050 *farsakhs*, the diameter of the Moon and Mercury as 5,000 farsakhs (4.8 Earth radii), and the diameter of the other heavenly bodies (Venus, the Sun, Mars, Jupiter, and Saturn) as 20,000 *farsakhs* (19.0 Earth radii.)

For details: Hogendijk, Jan P. (1988). "New Light on the Lunar Crescent Visibility Table of Yaʿqūb ibn Ṭāriq". *Journal of Near Eastern Studies* 47 (2): 95. doi:10.1086/373260. JSTOR 544381. And Kennedy, E. S. (1968). "The Lunar Visibility Theory of Yaʿqūb Ibn Ṭāriq". *Journal of Near Eastern Studies* 27 (2): 126. doi:10.1086/371945. JSTOR 543759.

eighth translation movement[12]. Saliba also shows how this early astronomical tradition was related to Qur'anic cosmology. Pre-Islamic astronomy (known as *anwa*), which predicated and explained seasonal changes based on the rising and setting of fixed stars, was a subject of interest for Qur'anic scholars as well as for the early lexicographers, who produced extensive literature on the *anwa'* and *manazil* (lunar mansions) concepts[13].

The large amount of scientific data and theories that came into the Islamic scientific tradition from Greek, Persian, and Indian sources were not simply passively translated for later transmission to Europe. In fact, translated material went through constant and detailed examination and verification, and was accepted or rejected on the basis of experimental tests and observations. This process of scrutiny started as early as the ninth century that to say, almost contemporaneously with the translation movement. Tradition of the production of astronomical tables, for instance, may have been inspired by the Ptolemaic tables; they were the result of astronomical observations that began as early as the first half of the ninth century with the expressed purpose of "updating the *Zijes*, inspired by the *Handy Tables*"[14]. Furthermore, as Saliba points out,

> No astronomer working in the early part of the ninth century could still accept the Ptolemaic value for precession, solar apogee, solar equation, or the inclination of the ecliptic. The variations were so obvious that they must have become intolerable and could no longer be explained without full recourse to a long process of questioning the very foundation of the validity of all the precepts of Greek astronomy[15].

This critical attitude toward received material was not accidental or a passing phenomenon; among other things, it gave rise to a novel tradition of *Shukuk* literature, which cast doubts on various theoretical assumptions of Greek science, called for reexamination of observational data, produced texts that dealt with internal contradictions in each branch of Greek science, and produced a critical attitude toward the translated texts, which spurred a movement for their revision, both at the level of experiment and theory. Abu Bakr Zakaria al-Razi's yet-to-be-published *Kitabl al-Shukuk Ala Jalimus (Doubts concerning Galen)*, and Ibn al-Haytham's *al-Shukuk Ala Batlamyus, Dubitationes in Ptolemaeum* are excellent examples of this kind of literature (Sabra and Shehaby 1971). The translation movement is examined in more detail in a subsequent section of this chapter:

ISLAM AND ITS SCIENTIFIC TRADITION

Was there any connection between Islam and the scientific tradition that was emerging in Islamic civilization in the eighth century? Can this science be called "Islamic science"? These two questions are central to this book and will be examined throughout, but it may be beneficial to briefly mention the current prevalent position in this regard, which holds that Islam had nothing to do with the scientific tradition that emerged in the Islamic civilization. In fact, this approach is not specific to Islam; such accounts of science conceive all sciences, at all times and in all civilizations, to be enterprises totally independent of religion and if any interaction between religion and science becomes unavoidable, it is normally perceived as negative. For numerous reasons, this opinion regards any relationship between Islam and science with extra suspicion. Some even go as far as to say there is, in fact, no such thing as a normative Islam, and that all we can say with certainty is that there are numerous kinds of Islam-an Islam of the Makkan period, an Islam of the time when the Prophet was establishing a state in Madinah, an Umayyad Islam, an Abbasid Islam and so on . This approach to the question of Islam's relationship with science not only rejects the notion of anything that can be called "normative" or "essential" Islam, it also claims that

> Islam, as a religion, and at whatever historical moment is taken, is a specific ideology of a particular, historically determined society. As such, like all other social ideologies that command adherence and respect by the majority of the population because of their

[12] George Saliba, *Islamic Science and the Making of European Renaissance,* Library of Congress, U.S.A. 2007. pp. 16.
[13] *Ibid.* p. 17.
[14] Ibid. pp. 18.
[15] Ibid. p. 18.

> emotive content, it is inert in itself and has no historical agency but depends completely on who is using it and to what ends[16].

Gutas[17] in not alone; battalions of latter-day postmodernists secular historians of science neo-orient lists and even sociologists who have an aversion to religion hold the same view, under the influence of contemporary postmodernism. This comes in stark contrast to the nineteenth and early twentieth century orient lists that spent all their energies in constructing a homogeneous Islam in which "orthodoxy" could be identified and posited against an opposing tradition of "free thinking." Since the last decade of the twentieth century, and more so since the beginning of the twenty first century, the various effects of postmodernism have been busy at deconstruction and the creation instead of a fluid Islam that has nothing stable at any level. Thus, instead of the monolithic, homogenized, rarified, and static Islam of the Orient a lists, we now have an Islam that can be fundamentally different across-and within-regions and eras. Needless to say, both extremes have added little clarity to the conceptual categories so essential for real communication.

Dr. Muzaffar Iqbal states:

> "…an interesting contradiction in much of this thought: even though it is claimed there is no "essential Islam," one can still safely speak of some "Islamic" phenomena-for example, Islamic calligraphy and Islamic poetry. While the possibility of an "Islamic science" is immediately denied, the "Islamic garden" and "Islamic architecture" do not undergo the same vehement reductionism. Furthermore, and even more interesting is that while denying Islam any essential nature, proponents of this thought create an essential science separate from any wider context or framework."[18]

Such accounts of the scientific activity in Islamic civilization ignore the Qur'anic conception of nature outlined through verses, giving us a systematic and coherent view of the subject of scientific investigation-nature. Because of the antagonism toward the foundational relationship between Islam and the scientific tradition that was cultivated in Islamic civilization for eight hundred years, such accounts also fail to adequately explain the development of those branches of science that were directly related to Islamic practices: astronomy used to determine the distance and direction toward Makkah (the direction Muslims face for their obligatory prayers five times a day);geography; geodesy; cartography; *mawaqeet* (the science of timekeeping); and other such branches of science that have a direct relationship with Islamic practices. These are not simply the cases of "science in the service of religion," as is sometimes claimed; rather, these sciences emerged from a specific view of nature anchored in Islam.

The contemporary quasi-postmodern approach to Islam has also created an academic atmosphere, which inhibits empirical studies of the connections between Islam and the scientific tradition that existed in Islamic civilization prior to the modern era. When seen in its proper perspective, Islam is not a fluid conceptual framework that keeps changing with time; rather, an Islamic way of being can be verifiably traced back to the life of the Prophet of Islam - a life lived in the full light of history and preserved with great care for posterity. This concrete and real life of Muhammad is at the heart of the Islamic way of life. This life, which is considered to be a living model of the Qur'an, is not an abstract idea needing theological interpretation. Thus, while it is true that within the broad contours of the Islamic civilization all kinds of rulers, patrons of learning, scholars and scientists have existed and continue to exist, and that what any individual ruler believed or believes may influence the course of Islamic civilization to some extent no individual *defines* it. Islamic civilization is as any other civilization defined by its belief system a priori presuppositions and a legal and moral framework. It is this framework arising out of Islamic beliefs and practices that created the matrix from which intrinsic links between religion and the sciences grew and flourished in the Muslim lands.[19]

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[16] Gutas, Dimtri. *Greek Thought, Arabic Culture: Graeco-Arabic Translation Movement in Baghdad and Early Abbasid Society*. London: Routledge: 1998. pp. 218.

[17] Dimitri Gutas is an American Arabist and Hellenist and professor of Arabic and Islamic Studies in the Department of Near Eastern Languages and Civilizations at Yale University

[18] Muzaffar Iqbal, *The Making of Islamic Science,* Greenwood Press, London, 2007, p. 220

[19] Ibid, p. 21

Another dimension of these studies has to do with hasty judgments passed regarding the overall achievements of Islamic scientific tradition and with setting its demise in the twelfth century. Both of these judgments were passed early in the nineteenth century, when only a fraction of the source material available today had been discovered and studied, but they continue to remain the mainstream version. David kink on the view that:

> What happened in fact was something rather different. The Muslims did indeed inherit the sciences of Greek, Indian and Persian Antiquity. But within a few decades they had created out of this potpourri a new scenic, now written in Arabic and replete with new Muslim contributions, which flourished with innovations until the 15th century and continued thereafter without any further innovations of consequence until the 19th.[20]

Despite the large amount of new material discovered, published, and studied since those early notions were formed, not many contemporary writers are willing to reexamine the erroneous paradigm postulated by Goldziher (1915) and his generation, which pit Islam against "foreign science". These early judgments were also based in part. The works of medieval European scholars who themselves were aware of only a minuscule body of literature on Islamic on Islamic scientific tradition, mostly retrieved from Islamic Spain (*al-Andalus*), a region that lay outside the main centers of Islamic Scientific activity. It was not until the nineteenth and twentieth centuries.

> When historians of science from a multiplicity of national background investigated Islamic Scientific manuscripts in libraries all over Europe and then in the Near East. Their investigations revealed an intellectual tradition of proportion that no medieval or Renaissance European could ever have imagined: anyone who might doubt this should look at the monumental bio-bibliographical writings of Heinrich Souter, Carl Brakeman, and Fuat Sezgin[21].

Even though King's book is concerned with only one aspect of Islamic science (astronomical timekeeping and instrumentation), it has brought to the fields of history of Islamic science a large amount of new material

> Which has become known only in the past 30 years? Inevitably [it] modifies the overall picture we have Islamic science. And it so happens that the particular intellectual activity that inspired these materials is related to the religious obligation to pray at specific times. The material presented here makes nonsense of the popular modern notion that religion inevitably impedes scientific progress, for in this case, the requirements of the former actually inspired the progress of the latter for centuries[22].

Since this book is not on the history of Islamic scientific tradition but on the relationship between Islam and science, it cannot go into further details, but it is clear that what remains to be recovered and studied from the original sources in various branches of science is far greater than what has been studied from the original sources in various branches of science is far greater than what has been studied so far, and that a final assessment of the Islamic scientific tradition can only be made after further sources material has been carefully examined by competent historians and scholars.

Before exposing various aspects of the Islam and science relationship, it must be pointed out that sciences cultivated in Islamic civilization were not always the work of Muslims: in fact, a considerable number of non-Muslims were part of this scientific tradition what made this science Islamic were its integral connections with the Islamic worldview, the specific concept of nature provided by the Qur'an, and the numerous abiding concerns of Islamic tradition that played a significant role in the making of the Islamic scientific enterprise. There were, of course, at times bitter disputes between proponents of various views on the nature of the cosmos, its origin, and its composition, but all of these tensions were within the broader doctrines of Islam, which conceived the universe in its own specific manner-a definable, specific, and distinct conception that placed a unique, personal, and singular Creator at the

[20] King, David. *In Synchrony with the heavens: Studies in Astronomical Timekeeping and Instrumentatio in Medieval Islamic Civilization*. 2 Vols. Leiden. 2004. pp. 16.

[21] King, David.. *In Synchrony with the heavens: Studies in Astronomical Timekeeping and Instrumentatio in Medieval Islamic Civilization.* 2 Vols. Leiden. 2004. pp. 17.

[22] Ibid. p. 17.

center of all phenomena. Viewed from this perspective, the Islam and science nexus can be explored as a much more fruitful encounter within the greater matrix of Islamic civilization.

ISLAMIC SCIENCE OR NATURAL PHILOSOPHY?

As already mentioned, our current knowledge of primary sources about the first half of the eight century does not permit us to trace the beginning of the natural sciences in Islamic civilization in detail. By the end of that formative century, however, there was already a small and vibrant scientific community whose members were exploring the world of nature in a milieu filled with intellectual curiosity and creative energy. As was usual at that times, this community consisted of individuals who were interested in a wide range of subjects dealing with nature, history, and philosophy, and not with just one particular branch of science, their work is sometimes called *natural philosophy* rather than science. This term is also used for the enterprise of science that existed in the Greek and Roman civilizations. Their linkage adds weight to the view that science in Islamic civilization was somehow merely an extension of the earlier Greek and Roman science. There was, however, no one term in Greek or Latin equivalent to our contemporary term *science*, and what we understand as science was often called *philosophy* or *inquiry concerning nature* by the Greek and Romans themselves[23]. Unlike Greek and Latin, Arabic does have a specific word for science: *al-'ilm.* This word as well as its derivatives frequently occurs in the Qur'an. It is used to denote all kinds of knowledge, not just the knowledge pertaining to the study of nature, but this semantic linkage of all branches of knowledge does not mean that knowledge was not differentiated or classified into various hierarchical branches. Rather, it indicates that within a given classification of knowledge, all branches of knowledge were intimately linked through a vertical axis running through the entire epistemological scheme – grounding in the Qur'anic concept of knowledge.[24]

It is therefore, conceptually problematic to use the Aristotelian term *natural philosophy* as an equivalent for those branches of knowledge that dealt with the study of nature in Islamic civilization. This term may be a correct way of describing Greek and Roman scientific traditions, but its use here is applied to a very different conceptual scheme. Although a large amount of scientific not accompanied by an incorporation of the Greek epistemology from which the term *natural philosophy* originally emerged.The term *natural philosophy*, often used interchangeably with physics, emerged from within the Aristotelian classification of knowledge into three broad categories: metaphysics, mathematics, and physics. Metaphysics deals with unchanging things such as God and spiritual substances: mathematics studies unchanging abstractions not God or spiritual substances; and physics studies changeable thing in the natural world, including both animate and inanimate bodies. With regard to physics, although he accorded a high degree of importance to sense perception, he maintained that knowledge about nature cannot be derived by means of sense perception alone; to attain scientific knowledge about the physical world, universal propositions- obtained from sense perception by means of induction- are essential[25].

Aristotle's concept of God as well as his belief in the eternity of the world was in direct opposition to the Qur'anic concept of God and the world. Thus, even though a large amount of Aristotelian philosophy was incorporated into the Islamic philosophical tradition, his deity was unacceptable. The translation of his works thus created a tension within the emerging Islamic scientific tradition. The subsequent story of the interaction of Islam scientific is, to a large extent, a story of how Muslim philosophers and scientists a large extent, a story of how Muslim philosophers and scientist dealt with this tension. We will explore various facets of this tension in the next section.[26]

When the study of nature emerged in Islamic tradition as a fully differentiated field, it found its place within a preexisting frame work of classification of knowledge. This classification scheme follows a certain pattern based on the Qur'anic concepts both of knowledge and the faculties granted to human beings. Within this study of nature, innumerable specific disciplines

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[23] G.E.R. Lloyd. *Early Greek Science,* Random House 1973. pp. xi-xiii.

[24] Sabra, A. I. *The Appropriation and subsequent Naturalization of Greek Science in Medieval Islam: A Preliminary Statement* in Optics, Astronomy and Logic: Studies in Arabic Science and Philosophy, 1994, p. 223-243

[25] Aristotle. *The Complete Works of Aristotle. The Revised Oxford tr. Jonathan Barnes*. ed. 2 vols. Princeton, NJ: Princeton University Press. 1984. pp. 132.

[26] G.E.R. Lloyd. *Early Greek Science,* Random House 1973. pp. xi-xiii

emerged, which were in turn refined and further distinguished. Thus, for example, we have titles like the celebrated *Kitab al-Manazir* (*Optics*) of Ibn al-Haythan[27] and even more specific titles like *kitab tahid nihayat al-amakin li'tashih musafat al-masakin (The Book for the Determination of the Coordinates of positions for the correction of Distances between Cities)* of al-Biruni[28]. It was also common to use titles such as *Kitab al-Nujum (Book on Stars)* for works on astronomy and *kitab ilm al-hindasah (Book on the Science of Geometry)* for works on geometry. Certain Muslim philosopher more heavily influenced by Aristotle (e.g. al-Kindi, d. 1198 *ca*. 873; al Farabi, d 950; Ibn Sina, d. 1037; and Ibn Rushd, d. 1198) did in fact utilize the Aristotelian model for classification of knowledge, but even they had to modify his essential elements in order to incorporate the basic belief system of Islam. Thus even those even those schemes of classification of knowledge that were heavily influenced by Aristotle retained essential Islamic concepts regarding God, human beings, and the nature of this world. Other classification scheme, especially those of al-Ghazali (d.1111) and Ibn khaldun (d.1406), attempted to remove Aristotelian influences all together.

THE TRANSLATION MOVEMENT AND ITS IMPACT ON THE DEVELOPMENT OF SCIENCE IN ISLAMIC CIVILIZATION

From about the middle of the eighth to the middle of the eleventh century, a systematic, elaborate, sustained, and well-organized translation movement brought almost all philosophical and scientific books available in the Near East and the Byzantine Empire[29] into Arabic. This translation movement has now been the focus of scholarly studies for over a century and a half, and this scholarship had document a great deal of historical data and information. Thanks to the discovery and study of numerous manuscripts, we can identify numerous Greek, Pahlavi and Indian works and their translators, as well as subsequent translators. The scope of this translation movement can be judgment from the range of subjects covered, which included the entire Aristotelian philosophy, alchemy, mathematics, astronomy, astrology, geometry zoology, physics, botany, health sciences, pharmacology, and veterinary science. The extent of social, political, and financial patronage this movement received can be gleaned from the social classes that supported it, and included caliphs, princes, merchants, scholars, scientists, civil servants, and military leaders.

Over the past 150 years, the study of this translation movement has yielded much valuable text that have enhanced our understanding of the role of Greed science and philosophy in the making of the Islamic scientific tradition. At the same time, inaccuracies and stereotypes have crept into some of these accounts, and this is especially true for those works that attempt to identify the translation movement as the main cause of the origination of Islamic scientific tradition. Thus, it has been claimed that

> …the translation movement was the result of the scholarly zeal of a few Syria-speaking Christians who … decided to translate certain works out of altruistic motives for the improvement of society. The second theory, rampant in much mainstream historiography, attributes it to the wisdom and open- mindedness of a few "enlightened

[27] The *Book of Optics* (Arabic: *Kitāb al-Manāẓir* (كتاب المناظر) is a seven-volume treatise on optics and other fields of study composed by the medieval Muslim scholar Ibn al-Haytham, known in the West as Alhazen (965– c. 1040 AD).

The *Book of Optics* presented experimentally founded arguments against the widely held extramission theory of vision and in favor of intromission theory, as supported by thinkers such as Aristotle, the now accepted model that vision takes place by light entering the eye. Alhazen's work transformed the way in which light and vision was understood, earning him the title the "father of modern optics".

See for details: D. C. Lindberg (1976), *Theories of Vision from al-Kindi to Kepler*, Chicago, Univ. of Chicago Press, pp. 60-7.

[28] The determination of the coordinates of positions for the correction of distances between cities: a translation from the Arabic of *Kitāb taḥdīd nihāyāt al-amākin litaṣḥīh masāfāt al-masākin*. American University of Beirut, 1967

[29] The Byzantine Empire was the predominantly Greek-speaking continuation of the Roman Empire during Late Antiquity and the Middle Ages. Its capital city was Constantinople, originally known as Byzantium.

> rulers" who conceived in a backward projection of European enlightenment ideology, promoted learning for its own sake[30].

Gutas claims both of these theories fall apart under close scrutiny. He states that:

> "The translation movement was too complex and deep-rooted and too influential in a historical sense for its causes to fall under these categories- even assuming that these categories are at all valid for historical hermeneutics"[31].

This movement was unprecedented in the transmission of knowledge. It was a movement that enriched the Arabic language by forcing its epilogists to coin new technical terms, forced the best minds of the time to find way to accommodate, discard, or transform theories and ideas that conflicted with their religious beliefs, thought a very large amount of scientific and philosophical data into Islamic intellectual tradition that were, in the final analysis, greatly beneficial to the development of Islamic scientific tradition.

Although translation activity had already begun during the pre-Abbasid period, it was the Abbasids who provided resources for a sustained and systematic process of translation of scientific texts into Arabic. The translation movement became more organization and received financial and administrative impetus after the founding of Baghdad by al-Mansur (r. 754-775). Three distinct phases can be identified in this movement. The first began before the middle of the second century of Islam, during the reign of al-Mansur. Major translators of this first phase were Ibn al-Muqaffa (d. 139/756); his son, Ibn Na'ima (*fl*. eighth century); Theodore Abu Qurra (d.*ca*.826), a disciple of John of Damascus (d.749) who held a secretarial post under the Umayyad Caliphs; Thabit ibn Qurrah (d.901), a Sabian mathematician; Eustathius (fl. Ninth century), who along with Theodore Abu Qurra translated for al-Kindi; and Ibn al-Bitriq (877-944) , who was a member of the circle of the Caliph al –Ma'mun. Al-Ma'mun's accession marks the beginning of the second phase of the translation movement.[32]

Many new translators were involved during the second phase of the translation movement, which was led by Hunayn ibn Ishaq. These translators refined many translations of the first phase and extended the range of material being translated. For the first phase and extended the range of material being translated. For instance, Ar-istotle's *Topics* was first translated into Arabic from Syriac translation around 782, during the reign of the third Abbasid Caliph al Mahdi (d.785). This was done by the Nestorian patriarch Timothy I with the help of Abu Nuh, the Christian secretary of the governor of Mosul. The same work was retranslated about a century later, this time from the original Greek, by Abu Uthman al-Dimashqi, and approximately fifty years later, it was translated a third time by Yahya ibn Adi (d. 974) from a Syria version[33].

During the third phase of the translation movement, further refinement of the translated material took place and commentaries started to appear. This phase, beginning with the dawn of the tenth century and ending around 1020, also produced textual criticism that scrutinized translated material from scientific as well as philosophical points of view.

By the middle of the eleventh century the three-hundred year-old translation movement had reached its end. The tension between Islamic beliefs and ideas, concepts, theories, and data contained in these texts however was the main kinetic force for initiating in these texts however was the main kinetic force for initiating process of appropriation and transformation of the received material. This was slow and deliberate process over the course of which translated works were examined, classified, and sorted into categories. It was not official scrutiny by some office of the state or religious authority, but an organic process of ordering new ideas in the light of revelation undertaken by Muslim intellectuals, who debated, disagreed, passed judgments on each other, fought bitter battles over ideas, and lost or gained support from their peers. This inner struggle of a tradition in the making against foreign currents that were coming into its fold involved a wide range of philosophers and scientists. Some of them firmly aligned themselves with the Greek philosophical tradition, while others wrote against it. Those in between these two extremes attempted to harmonize new ideas with Islam's worldview based

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30 Gutas, Dimtri. 1998. *Greek Thought, Arabic Culture: Graeco-Arabic Translation Movement in Baghdad and Early Abbasid Society*. London: Routledge. p. 3.

31 Ibid. p. 4.

32 Muzaffar Iqbal, *The Making of Islamic Science,* Greenwood Press, London, 2007, p. 175

33 Gutas, Dimtri. 1998. *Greek Thought, Arabic Culture: Graeco-Arabic Translation Movement in Baghdad and Early Abbasid Society*. London: Routledge. p. 61.

on revelation. The end result of this long process was the appearance of a tradition of learning that examined, explored, and synthesized its own unique perspectives on nature and the human condition- perspectives that were distinctly Islamic, though not monolithic.[34]

Some Recent Perspective on the Translation Movement

This brief description of the translation movement provides some insights into the intellectual currents flowing into the Islamic tradition during that time. During these three centuries, the material infused into the Islamic tradition included philosophy as well as works on various branches of science drawn from the Greek, Persian, and Indian sources. This process of incorporation of foreign scientific and philosophical though into the Islamic tradition and its consequences has been thoroughly studied by historians of science and philosophy, and their studies have yielded opinions ranging from *reductionism* to *precursorism* two explanatory terms first used by Sabra in an important paper. Reductionism, in this context, refers to the view that:

> "…the achievements of Islamic scientists were merely a reflection- sometimes faded, sometimes bright, or more or less altered- of earlier (mostly Greek) examples. Precursorism (which has a notorious) is equally familiar it reads the future into the past, with a sense of elation"[35].

Despite the work of Sabra and a handful of other historians of science, the large-scale infusion of ideas, theories, and scientific data from the Greek scientific tradition into Islamic science through the translation movement has become a defining feature of the Islamic scientific tradition itself many histories of science tend to regard the eight hundred years of scientific activity in the Muslim world as being no more than some kind of depot where Greek science was parked and from where it was retrieved by Europe in later centuries. As Sabra has noted, the trans civilization transmission of science was an important event in history, but Apparently because of the importance of that role in world intellectual history many scholars have been led to look at the medieval Islamic period as a period of reception, preservation, and transmission, and this in turn has affected the way in which they have viewed not only individual achievements of that period but the whole of its profile[36].

The consequences of this approach toward the Islamic scientific tradition are visible in many science textbooks, where students are led to believe that nothing important happened in science between the Greek scientific activity and the Renaissance, Islamic scientific tradition is either not mentioned at all or is mentioned in a paragraph defining it as a repository of Greek science. That this distortion of historical facts still predominates in unfortunate, as what came into the body of Islamic though from outside was neither accidental nor marginal. It would be far more meaningful to understand.

> The transmission of ancient science to Islam … as an act of appropriation performed by the so-called receiver. Greek science was not thrust upon Muslim society any more than it was later upon Renaissance Europe. What the Muslims of the eighth and ninth centuries did was to seek out, take hold of and finally make their own a legacy which appeared to them laden with a variety of practical and spiritual benefits. And in so doing they succeeded in initiating a new scientific tradition in a new language which was to dominate the intellectual culture of the large part of the world for a long period of time. Reception is at best a pale description of that enormously creative act[37].

The translation movement was highly complex phenomenon of cross-cultural transmission that involved a very large number of people of diverse interests. It had political, intellectual, and religious motivations. It came into existence owing to certain internal needs of the Islamic polity of the time and once in existence, it produced enormous creative energy in an intellectual climate already filled with curiosity, ready to use whatever it could for its new ventures. Some of the new material was regarded as dangerous, extraneous, and foreign by certain quarters. This "foreignness" has been used by some scholars to draw the reductionist conclusion that the scientific tradition in Islam was nothing but a "foreign" entity that somehow survived despite

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[34] Ibid, pp. 72-97

[35] A.I. Sabra, Optics, *Astronomy and Logic: studies in Arabic Science and Philosophy,* University of Michigan, 1994. pp. 223-24.

[36] Ibid. p. 225.

[37] A.I. Sabra, Optics, *Astronomy and Logic: studies in Arabic Science and Philosophy,* University of Michigan, 1994. p. 226.

the opposition it faced from religious circles. This view has been succinctly called "the marginality thesis" and its validity has been challenged on sound historical grounds[38]. Sabra and other historians of science have also convincingly made a case for the originality of Islamic scientific tradition.

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[38] Ibid, pp. 229-30.