Classical Muslim scholars' Development of the Experimental Scientific Method: 'Iml al-IstiqrÉ'/induction approach and methodology

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Abstract: Sciences is referred to as the scientific truth or to prove it by the name of methodology of research in cosmic sciences, which examines the partial phenomena of the universe and life, the name (empirical experimental method), which means the method of extracting the general rule (scientific theory) or scientific law from the vocabulary of facts based on observation and experiment. The attempt of this article is to shed light on the Muslim polymath scholars' contribution to human civilization in their scientific methodology/inductive al-istiqrÉ' prior to the Europeans renaissance. It is unordinary view of Islam, the other side of Islam as penetrated by the western media; Islam is a religion of knowledge too.

Introduction:

The Islamic State in the era of the Rightly Guided Caliphate, the Umayyad and the ‘Abbasid, was interested in science and civilization. It also dealt with the religious aspects. The Islamic civilization was a civilization that mixes the mind and the spirit, as distinguished from many previous civilizations. Islam is a universal religion that encourages the demand for knowledge and the development of the cultural progress for the advancement of its nations and peoples. The fields of arts, science and architecture have varied as long as they do not fall outside the scope of Islamic rules. Because intellectual freedom was accepted under the shadow of Islam and this civilization spread after it became its vents and tributaries, shine on the West world, and this venue highlights the contributions of Muslim scholar in the fields of human life, social and environmental, during their long history, and their successive generations.

Scientific research is one of the complex aspects of scientific activity by scientists in order to increase the total of scientific knowledge and techniques. The science concerned with the methods and methods of research in cosmic sciences is referred to as the scientific truth or to prove it by the name of methodology of research in cosmic sciences, which examines the partial phenomena of the universe and life, the name (empirical experimental method), which means the method of extracting the general rule (scientific theory) or scientific law from the vocabulary of facts based on observation and experiment.

AÍmad al-RifÉ‘Ê defines *‘Iml al-IstiqrÉ’*/induction as the process of observing phenomena and compiling data about specific filed to reach general principles and relationships.[1] The term *istiqrÉ’*/induction is the translation of the Greek word “Enay Wyn” and its meaning leads, and is intended to lead the mind to do work leading to the attainment of a principle or law that controls

[1]AÍmad al-RifÉ‘Ê (1999). *ManÉhij al-BaÍth al-‘IlmÊ: TaÏbÊqÉt ’IdÉriyya wa IqtiÎÉdiyya* Amman: DÉr Wa’il lil-Nashr, p. 83.

the particles that are subject to our sensory perception.[2]Modern European scientists of the renaissance used the inductive method in achieving their cultural progress. Muslimscholars used *istiqrÉ'*/induction in the classical times, such Ibn al-Haytham (d. 431/1040), and a group of Muslim scholars in their writings.

In the inductive method, the scholar moves from the part to the whole or from the private to the general, where scholars begin to identify the particles, and then circulates the results accordingly. The inductive guide includes a scientific conclusion based on observation and scientific conclusion, whichis based on experience in the modern concept of observation and experimentation.

Many historians and theologians attribute the discovery of this approach to Francis Bacon (d. 1626), which developed during the modern European Renaissance his famous book entitled in Latin *Novum Organum Scientiarum*/New Instrument of Science (*The New Organon*or: True Directions Concerning the Interpretation of Nature)and means the method of experimental research,[3] to oppose Aristotle in his book *Old Organon*.[4]The extrapolation of the history of human thought attests to the fact that the scholars of Islamic civilization were earlier than Westerners to refute Aristotle's theoretical logic and to follow the experimental method before

[2]'AmÉr BËÍËsh and MuÍammad MaÍmËd al-DhunÊbÉt (2001). *ManÉhij al-NaÍth al-'IlmÊ wa Ùuruq 'I'dÉd al-BuÍËth* Algeria: DÊwÉn al-MaÏbË'Ét al-JÉmi'iyya.

[3] Francis Bacon (d. 1626) *The New Organon* or: True Directions Concerning the Interpretation of Nature, http://www.earlymoderntexts.com/assets/pdfs/bacon1620.pdf, pp. 14-15;MuÎÏafÉ NaÌÊf (1942). *Al-×asab ibn al-Haytham: BuÍËthuh waKushËfuhu al-BaÎariyya*, 123-128; YumnÉ ÙarÊf al-KhËlÊ (2000). *Falsafat al-'Ilm fÊ al-Qirn al-'AshrÊn: al-×aÎÉd, al-AfÉq al-Mustaqbaliyya* Kuwait: 'Ólam al-Ma'rifah, p. 264; Will Durant (1957). *The Story of Civilization: The Reformation*, p. 869, p. 915, and p. 939; ×abÊb al-ShÉrËnÊ (1981). *Francis Bacon* Casablanca: DÉr al-ThaqÉfah, pp. 34-37; KÉmil MuÍammad 'UwÊÌah (1993). *Francis Bacon: FaylasËf al-Manhaj al-TajrÊbÊ al-×adÊth* Beirut: DÉr al-Kutub al-'Ilmiyyah, pp. 12-17.

[4]KÉmil MuÍammad 'UwÊÌah (1993). *Francis Bacon: FaylasËf al-Manhaj al-TajrÊbÊ al-×adÊth* Beirut: DÉr al-Kutub al-'Ilmiyyah, pp. 12-17; Will Durant (1957). *The Story of Civilization: The Reformation*, p. 869, p. 915, and p. 939; ×abÊb al-ShÉrËnÊ (1981). *Francis Bacon* Casablanca: DÉr al-ThaqÉfah, pp. 34-37.

Bacon for several centuries.[5]They were able to distinguish between the nature of pure mental phenomena on the one hand, and physical phenomena on the other hand, and realized that the means or tool used in these phenomena must fit the nature of each of them, and Ibn Taymiyyah (d. 728/1328), was one of the first Muslim scholars who criticized Aristotle's logic, which he attacked vehementlyin his book *NaqÌ al-ManÏiq*/Criticism of Logic.[6] He called for sensory induction, which is suitable for research in cosmic phenomena,and leads to new knowledge.

The scholars of Islamic civilization have resorted to the experimental method inductive from experience and knowledge of its origins and rules, and they have made significant progress on the basis of the scientific and technical development movement. This is ×assan ibn al-Haytham (d. 431/1040), to name a few, describes the features of the experimental method of induction in the research of the phenomenon of vision.[7]

This text clearly shows that Ibn al-Haytham's general rules for the induction method are distinct from the rules of the Bacon'sApproach, as they are not a set of instructions that adhere to a specific arrangement that should not be exceeded. This gives them sufficient flexibility to prevent them from standing in front of the movement and development of science. Ibn al-Haytham's expressions also reflect many of the characteristics of empirical science and the elements of success of scientific research, which are lacking of bothAristotelian'sLogic and

[5]Francis Bacon has been called the father of empiricism. His works argued for the possibility of scientific knowledge based only upon inductive and careful observation of events in nature. Most importantly, he argued this could be achieved by use of a skeptical and methodical approach whereby scientists aim to avoid misleading themselves. While his own practical ideas about such a method, the Baconian method, did not have a long lasting influence, the general idea of the importance and possibility of a skeptical methodology makes Bacon the father of scientific method. This marked a new turn in the rhetorical and theoretical framework for science, the practical details of which are still central in debates about science and methodology today; KÉmil MuÍammad 'UwÊÌah (1993). *Francis Bacon: FaylasËf al-Manhaj al-TajrÊbÊ al-×adÊth* Beirut: DÉr al-Kutub al-'Ilmiyyah, pp. 12-17.

[6]Ibn Taymiyya, AÍmad ibn 'Abd al-×alÊm (d. 728/1328). *NaqÌ al-ManÏiq* ed. MuÍammad 'Abd al-GhazÉl ×amza, SulaimÉn ibn 'Abd al-RaÍmÉn al-ØunÊ', and MuÍammad ×Émid al-FiqÊ, Beirut: al-Maktabah al-'Ilmiyya, 1951.

[7]al-×assan ibn al-Haytham (d. 431/1040). *KitÉb al-ManÉÐir* ed. 'Abd al-×amÊd ØabrÉ Kuwait: al-Majlis al-WaÏanÊ lil-ThaqÉfa wal-FunËn wal-ÓdÉb, 1983, vol. 1: 59-62.

Bacon'sApproach. The comparison shows that the experimental step is limited in the method of scientific research among Muslim scholars.[8]

On the other hand, it is clear from a careful reading of scientific texts in the Islamic heritage that the credit for the discovery of the scientific method/experimental inductive is not attributable to a particular Islamic scholar similar to what is usually said about the approach of Aristotle, Bacon or RenéDescartes, but it is attributed to many Muslim classical scholars who paved in various branches of science for the scientific method/experimental inductive.[9]For example JÉbir ibn ×ayÉn (d. 199/815), sheds more light on the characteristics of the experimental approach he has followed, assuring that "every profession has its own artistic methods,"and warns of excessive confidence in the results of his experiments, despite his objectivity in scientific research. He says:

> In these books, we mention the characteristics of what we have seen only - not what we have heard or told or read - after we have tested it and tried it, and what we have extracted, we have measured it in the words of these.[10]

He also says:

> No one can claim the truth that he is not in the absence however, such as witness the past and in the future or in only like what in now.[11]

We find in the works of al-RÉzÊ (d. 376/986),[12] and al-BÊrËnÊ(d. 440/1048),[13]and al-BattÉnÊ, MuÍammad ibn JÉbir ibn SinÉn (d. 371/982),[14] and al-BuzjÉnÊ, AbË al-WafÉ'

[8]See the work of Ibn al-Haytham reflection and work on the inductive experimental/*al-manhaj al-istiqrÉ'Ê al-tajrÊbÊ* which his reflection that came in (354-430/965-1045), verses Francis Bacon (d. 1626), reflections. It appears nearly six centuries before the work of F. Bacon. MaÍmËd FahmÊ ZÊdÉn (1980). *al-IstiqrÉ' w al-Manhaj al-'IlmÊ*, Alexandria: DÉr al-JÉmi'Ét al-MaÎriyya, pp. 74-78; MuÎÏafÉ NaÌÊf (1942). *Al-×asab ibn al-Haytham: BuÍËthuh waKushËfuhu al-BaÎariyya*, pp. 123-139.

[9]See the work of Ibn al-Haytham reflection and work on the inductive experimental/*al-manhaj al-istiqrÉ'Ê al-tajrÊbÊ* which his reflection that came in (354-430/965-1045), verses Francis Bacon (d. 1626) reflections. It appears nearly six centuries before the work of F. Bacon. MaÍmËd FahmÊ ZÊdÉn (1980). *al-IstiqrÉ' w al-Manhaj al-'IlmÊ*, Alexandria: DÉr al-JÉmi'Ét al-MaÎriyya, pp. 74-78; MuÎÏafÉ NaÌÊf (1942). *Al-×asab ibn al-Haytham: BuÍËthuh waKushËfuhu al-BaÎariyya*, pp. 123-139.

[10]JalÉl MuÍammad 'Abd al-×amid (1972). *Manhaj al-BaÍth 'and al-'Arab fÊ MajÉl al-'UlËm al-ÙabÊ'iyya wal-Kawniyya* Beirut: DÉr al-KitÉb al-LibnÉnÊ, p. 125.

[11] QanawÉtÊ, George "al-KhÊmyÉ' al-'Arabiyya", in RushdÊ RÉshid (2005). *MawsË'at TÉrÊkh al-'UlËm al-'Arabiyya* Beirut: Markaz DirÉsÉt al-WiÍda al-'Arabiyya, vol. III.: 1121.

MuÍammad ibn MuÍammad ibn YaÍyÉ(d. 388/998),[15]and al-TÊfÉshÊ and al-KhÉzinÊ,'Abd al-RaÍmÉn (d. 530/1136),[16]al-SharÊf al-IdrÊsÊ, AbË 'Abdullah AÍmad ibn MuÍammad (d.

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[12] Seyyed Hossein Nasr (1987). *Sciences and Civilization in Islam*, p. 170; George QanawÉtÊ, "al-KhÊmyÉ' al-'Arabiyya", in RushdÊ RÉshid (2005). *MawsË'at TÉrÊkh al-'UlËm al-'Arabiyya*, vol. III., p. 1109; MuÍammad FÉris, *MawsË'at 'UlmÉ' al-'Arab wal-MuslimÊn*, p. 191; MÉjid 'UdwÉn *MawsË'at 'UlmÉ' al-KÊmiyÉ'*, p. 29; AÍmad Fu'Éd BÉshÉ (2002). *al-TurÉth al-'ImÊ al-IslÉmÊ: Sha'un min al-MÉÌÊ amm ZÉda lil-ÓtÊ*, p. 91; AÍmad 'Abd al-BÉqÊ (1991). *Ma'Élim al-×aÌÉrah al-'Arabiyya*, p. 418; Ibn Khalikān, AbË al-'AbbÉs Shams al-DÊin (d. 680/1282). *Wafiyyāt al-A'yān wa AnbÉ' AbnÉ' al-ZamÉn* vol. 4: 248-252

[13] 'Umar FarËkh (1984). *TÉrÊkh al-'UlËm 'and al-'Arab*, p. 164; RushdÊ RÉshid (2005). *MawsË'at TÉrÊkh al-'UlËm al-'Arabiyya*, vol. 1: 89; Edward Stuart Kennedy (1971). "al-Bīrūnī's Masudic Canon", *inal-AbÍÉth*, 24, pp. 59-81; Edward Stuart Kennedy et al.(1983).*Studies in the Islamic Exact Sciences*, Beirut: American University of Beirut, pp. 573–595; Mayer, Leo Ary (1956). *Islamic Astrolabists and Their Works*, Geneva: Albert Kundig, p. 46; ShÉkir KhaÎbÉk (1986). *al-GughrÉfyÉ 'and al-'Arab*, p. 21; MuÍammad 'AÏiyah al-AbrÉshÊ, AbË al-FutËÍ MuÍammad al-TawÉnsÊ (1956). *Silsalat TarÉjim A'lÉm al-ThaqÉfah al-'Arabiyya* Cairo: Maktabat al-NahÌa, pp. 116-119 and pp. 143-144; ; MÉjid 'UdwÉn *MawsË'at 'UlmÉ' al-KÊmiyÉ'*, p. 17; Rosenfeld, B. A. and Ekmeleddin Ihsanoğlu (2003). *Mathematicians, Astronomers, and Other Scholars of Islamic Civilization and Their Works (7th –19thc.)*. Istanbul: IRCICA, pp. 28–29; Jim Al-Khalili (2011). *The House of Wisdom: How Arabic Science Saved Ancient Knowledge and Gave Us the Renaissance* New York: The Penguin Press; 'Umar FarËkh (1984). *TÉrÊkh al-'UlËm 'and al-*'Arab, p. 223; YaqËt al-×amawÊ (1980). *Mu'jam al-AdabÉ'* Bieurt: DÉr al-Fikir; 'AlÊ AÍmad al-ShaÍÉt (1968). *AbË al-RiÍÉn al-BÊrËnÊ* Cairo: DÉr al-Ma'Érif; S. M. Razaullah Ansari, "On the Physical Researches of Al-Biruni", vol. 10, 2, pp. 198-199; 'Umar FarËkh (1984). *TÉrÊkh al-'UlËm 'and al-'*Arab, p. 223; Will Durant (d. 1885). *QiÎat al-×aÌarah*, tr. MuÍammad BadrÉn,vol. 13: 186; 'AfÊfÊ MuÍammad ØÉdiq (1977). *TaÏawur al-Fikr al-'AlmÊ 'anda al-MuslimÊn*, p. 133; M. Zaki Kirmani, N. K. Singh (2005). " al-BÊrËÊ, AbË Rayhan MuÍammad Ibn AÍmad (d. 973-?)," *Encyclopedia of Islamic Sciecne and Scientists* New Delhi" Global Vision, vol. 1: 149-161; Donald Hill. "al-Handasah al-Madaniyya al-MÊkÉnÊkÊyah", in RushdÊ RÉshid (2005). *MawsË'at TÉrÊkh al-'UlËm al-'Arabiyya*, vol. III, p. 964; 'AlÊ AÍmad al-ShaÍÉt (1968). *AbË al-RiÍÉn al-BÊrËnÊ* Cairo : DÉr al-Ma'Érif; S. M. Razaullah Ansari, "On the Physical Researches of Al-Biruni", vol. 10, 2, pp. 198-199.

[14] Gustave Le Bon, 1884. *La Civilisation des Arabes* Paris: Firmin-Didot); translated into Arabic by 'Ódil Zu'Êter, 1969. ×aÌÉrat al-'Arab, p. 457; RushdÊ RÉshid (2005). *MawsË'at TÉrÊkh al-'UlËm al-'Arabiyya*, vol. 1: 368-369, and vol. 1: 379-380; ÙËqÉn QadrÊ ×ÉfiÐ (1980). *TurÉth al-'Arab al-'IlmÊ fÊ al-RiyÉÌiyÉt w al-Falak*, pp. 132-133; Ibn al-NadÊm, AbË al-Faraj MuÍammed ibn IsÍÉq (d. 380). *al-Fihrist*, p. 444; RushdÊ RÉshid (2005). *MawsË'at TÉrÊkh al-'UlËm al-'Arabiyya*, vol. 1: 53-54, and vol. 1: 253-254; Seyyed Hossein Nasr (1987). *Sciences and Civilization in Islam*, pp. 182-183; ØÉ'id al-AndalusÊ, AbË al-QÉssim ibn AÍmad ibn 'Abd al-RaÍmÉn (d. 462.1070). *ÙabaqÉt al-Umam*, pp. 54-55; Ibn al-QafÏÊ JamÉl al-DÊn AbË al-×asan 'AlÊ ibn YËsuf (d. 646/1248). *AkhbÉr al-'UlamÉ' bi AkhbÉr al-×ukamÉ'*, p. 78; ShÉkir KhaÎbÉk (1986). *al-GughrÉfyÉ 'and al-'Arab*, p. 21.

[15]'Ali MËsÉ (2010). *Majisti Abi al-Wafa' al-Buzgani*, ed. RushdÊ RÉshid Beirut: Markaz DirÉsÉt al-WiÍda al-'Arabiyya; Hashemipour, Behnaz (2007). "BËzjÉnÊ: AbË al-WafÉ' MuÍammad ibn MuÍammad ibn YaÍyÉ al-BËzjÉnÊ". In Thomas Hockey; et al. *The Biographical Encyclopedia of Astronomers*. New York: Springer. pp. 188–9; Raynaud, D. (2012), "Abū al-Wafāʾ Latinus? A Study of Method", *Historia Mathematica*, 39 (1): 34–83; Youschkevitch, A.P. (1970). "AbË al-WafÉ' MuÍammad ibn MuÍammad ibn YaÍyÉ al-Ibn IsmÉ'Êl Ibn al-'AbbÉs". *Dictionary of Scientific Biography*, 1. New York: Charles Scribner's Sons. pp. 39–43; Kennedy, E. S. and Mustafa Mawaldi (1979). "Abū al- Wafāʾ and the Heron Theorems."*Journal of the History of Arabic Science* 3: 19–30; Saidan, Ahmad S. (1974). "The Arithmetic of Abūʾl- Wafāʾ."*Isis*, vol. 65: pp. 367–375; Suter, H. (1960). "Abu ʾl- Wafāʾ al- Būzadjānī." In *Encyclopaedia of Islam*. 2nd ed. Vol. 1, p. 159. Leiden: E. J. Brill.

[16] MuÎÏafÉ al-JayËsÊ (2005). *MawsË'at 'IlamÉ' al-'Arab wal-MuslimÊn wa A'lÉmuhum* Amman: DÉr UsÉmah, pp. 189-190; QadrÊ ×ÉfiÐ ÙËqÉn (1980). 'UlamÉ' al-'Arab wamÉ A'ÏËhu lil-×aÌÉrah, Riyyad: ManshËrÉt al-FÉkhiriyya; AÍmad 'Abd al-BÉqÊ (1991). *Ma'Élim al-×aÌÉrah al-'Arabiyya*, p. 99; M. Zaki Kirmani, N. K. Singh (2005). "al-Khazini, AbË'l-Fath 'Abd al-RaÍÉn (1115-1130)," *Encyclopedia of Islamic Science and Scientists* New Delhi" Global Vision, vol. 2: 559-566.

560/1165),[17] and Ibn al-NafÊs, ‘AlÉ’ al-DÊn ‘AlÊ ibn AbÊ al-×azm al-QurashÊ (d. 687/1288),[18]Ibn YËnusal-MaÎrÊ (d. 399/1009),[19] and others. They confirm their faith in the new approach in the collection of scientific truth and the exercise of this approach to recognize and accurate understanding of each postulate, its tools, characteristics and objectives.In this important fact lies the secret - the motive - behind the success of this approach and the pace of the movement of scientific progress urged by the teachings of Islam and its lofty principles represented in the verses of the Qur’Én and the Prophet’s ×adÊth/tradition, which honors science and scientists.

The Qur’Én as starting point:

The reading of the Islamic heritage indicates that the path taken by the scholars of the fundamentals and the modern scholars to arrive at the correct facts, news and sayings has

[17] Edward Kennedy Stewart. “al-GughrÉfyÉ al-RiyÉÌiyya”, in RushdÊ RÉshid (2005). *MawsË‘at TÉrÊkh al-‘UlËm al-‘Arabiyya* Beirut: Markaz DirÉsÉt al-WiÍda al-‘Arabiyya, vol. 1: 286-289 ;‘Umar FarËkh (1984). *TÉrÊkh al-‘UlËm ‘and al-*‘Arab, p. 208; al-SharÊf al-IdrÊsÊ, AbË ‘Abdullah AÍmad ibn MuÍammad (d. 560/1165). *Nuzhat al-MushtÉq fÊ IkhtirÉq al-’ÓfÉq*, vol 1: 7-8.

[18]Ibn ‘ImÉd, ‘abd al-×ay ibn AÍmad (d. 1679). *ShaÌarÉt al-Dhahab fÊ AkhbÉr min Dhahab* Beiurt: DÉr al-AfÉq al-JadÊdah, 1970, vol. 5: 400-401; ‘AlÉ’ al-DÊn AbË al-×asan ‘AlÊ ibn AbÊ al-×azm al-QarshÊ al- DimashqÊ (known as Ibn al-Nafis) was born in 1213 in Damascus and educated at the Medical College Hospital (Bimaristan al-NËrÊ) founded by NËr al- DÊn al-ZankÊ. Apart from medicine, he learned jurisprudence, literature, and theology and became a renowned expert on ShÉfi‘Ê jurisprudence as well as a reputed physician. His major significant contribution was his discovery of the blood's circulatory system, which William Harvey re-discovered in 1628. His 300-volume medical encyclopedia *al-Shamil fi al-Tibb*, which was incomplete at the time of his death, remained a milestone of science and medicine in medieval Europe. See RiÍÉb ‘AkkÉwÊ, 1996. *Ibn al-NafÊs ‘AlÊ ibn al-×azm al-QarashÊ, Galenus al-‘Arab*, Beirut: DÉr al-Fikr al-‘ArabÊ.; ZÊdÉn YËsuf, 2008. *‘I‘Édat IktishÉf Ibn al-NafÊs*, Cairo: NahÌat MaÎr lil-ÏibÉ‘ah; BarakÉt MuÍamad MurÉd, 1990. *Ibn al-NafÊs: wa-ItijÉhÉt al-Ïibb al-ÍadÊth*, Cairo: al-Øadr lil-ÏibÉ‘ah; SalmÉn QaÏÉyyah, 1984. *.al-ÏabÊb al-‘ArabÊ Ibn al-NafÊs 1211-1288*, Beirut: al-Mu’asasah al-‘Arabiyyah lil-DirÉsÉt; Iskandar, Albert Z. (1974). ”Ibn al-NafÊs”, *Dictionary of Scientific Biography*,edited by Charles C. Gillespie, New York: 1970-1980, vol. 9: 602-606; YËsuf ZaydÉn (2008). *Ibn al-NafÊs: SharÍ FuÎËl Hippocrates* Cairo: NahÐat MaÎr; YËsuf ZaydÉn (1999). *Ibn al-NafÊs: RisÉlat al-A‘ÌÉ’* Cairo: al-DÉr al-MaÎriyyah al-LibnÉniyya; YËsuf ZaydÉn (2000). *Ibn al-NafÊs: al-ShÉmil fÊ al-ØinÉ‘at al-Ùibiyya: al-Adwiyyah wal-*Aghdhiyyah, three vols. Abu Dhabi: al-Mujam‘ al-ThaqÉfÊ..

[19] al-MuqrÊ, AÍmad ibn MuÍammad (1968). *NafÍ al-ÙÊbmin GuÎun al-Andalus al-RaÏÊb*, ed. IÍsÉn ‘AbÉs Beirut: DÉr ØÉdir, vol. 1: 25; ‘AlÊ ‘Abdullah al-DafÉ‘ (1981). *al-UlËm al-BaÍtah fÊ al-×aÌarah al-‘Arabiyya w al-IslÉmiyya*, p. 302; Seyyed Hossein Nasr (1987). *Sciences and Civilization in Islam*, p. 170; Donald Hill (2004). *Islamic Science and Engineering* Edinburgh: Edinburgh University Press, p. 83; George Sarton (1950). *Introduction to the History of Science* Baltimore: Williams and Wilkins, vol. 1: 53; QadrÊ ×ÉfiÐ ÙËqÉn (1980). *TurÉth al-‘Arab al-‘IlmÊ fÊ al-RiyÉÌiyÉt w al-Falak* Beirut: DÉr al-ShurËq, pp. 55-66, and pp. 149-150; BÉqir AmÊn al-Ward (1986). *Mu‘jam al-‘UlamÉ’ al-‘Arab* ed. Kurkis Awad Beirut: ‘Ólam al-Kutub; RushdÊ RÉshid (2005). *MawsË‘at TÉrÊkh al-‘UlËm al-‘Arabiyya*, vol. 1: 233-235.

withdrawn from the method of thinking and experimentation in scientific research.For example, al-×assan ibn al-Haytham uses the term *al-i'tibÉr*/consideration, which is a Qur'Énic utterance to indicate empirical extrapolation/induction or mental development; also he used analogy to measure and explain the process of vision and the perception of visualizations.[20]

AbË Baker al-RÉzÊ also uses the three principles of: consensus, induction, and analogy in dealing with the unknown.He says:

> When we have seen these wonderful strange creatures, that our minds are not aware of their full cause, that we have not observed therefore, we ask everything that our minds do not realize, because in that the fall of most benefits from us, but we add to that what we realized by the experiments and observation and by people testify, we did not solve any of that trust only after the examination and experiments of it, along with the consensus of physicians, attested by analogy, and the test of strength and be in front of you.[21]

Muslim scholars,through the classical eras, of the Islamic societies (i.e. prior to the European Renaissance) of different disciplines based their works/discovery or innovation in the implementations and adaptation of the scientific method,on the basic principles derived from the teachings of their religion, and that can be summarized below. The doctrine of Islamic monotheism is the starting point in seeing the right human to the facts of existence, Almighty said:

> 1. Read! In the Name of your Lord, Who has created (all that exists), 2. Has created man from a clot (a piece of thick coagulated blood). 3. Read! And your Lord is the Most Generous,4. Who has taught (the writing) by the pen [the first person to write was Prophet Idrees (Enoch)], 5. Has taught man that which he knew not. 6. Nay! Verily, man does transgress all bounds (in disbelief and evil deed, etc.). 7.

[20]al-×assan ibn al-Haytham (d. 431/1040). *KitÉb al-ManÉÐir*, ed. 'Abd al-×amÊd ØabrÉ Kuwait: al-Majlis al-WaÍanÊ lil-ThaqÉfa wal-FunËn wal-ÓdÉb, 1983, vol. 1: 62; YËsuf ZÊdÉn (1999). *A'Édat IktishÉf Ibn al-NafÊs*, Abu Dhabi: al-Majma' al-ThaqÉfÊ, p. 94.

[21]MuÍammad JamÉl al-DÊn al-FandÊ (1985). *DirÉsÉt fÊ al-×aÌarah al-IslÉmiyya: bi-Munasaba al-Qirn al-KhÉmis 'Ashar al-HijrÊ: TurÉth al-MuslimÊn fÊ MajÉl al-'UlËm*, p. 256.

> Because he considers himself self-sufficient. 8. Surely! Unto your Lord is the return. Q. 96: 1-8.

It is the absolute truth, the source of all the partial knowledge facts that we were ordered to search for and its reliance on the world of facts as a source of trust and certainty, not as shadows or ghosts as considered and seen by the Greek culture.

> We will show them Our Signs in the universe, and in their own selves, until it becomes manifest to them that this (the Qur'an) is the truth. Is it not sufficient in regard to your Lord that He is a Witness over all things? Q. 41: 53.

Faith in the oneness of God Almighty necessarily requires mental human given everything in this presence to the wise Creator who created this world with his absolute direct will to the absolute highest degree of order, order and beauty, and plunged fixed laws and keep them consistent and intertwined in a tight balance between worlds objects,and we will benefit from it in real life after we stand on the truth of its behavior and we will point out the ability of the Creator and His will Almighty wants to show us through the system of the universe, unity, sustained accidents and phenomenology causal relations, monitor and realize it, and make use of them in real life after we stand on the fact that their behavior and we infer by the ability of the Creator and Oneness, and embark on scientific thinking within the framework of the concept of faith makes the road is always open before the renewal of the scientific method and its development to suit with the stages of development of various sciences, as it imparts self-assurance and confidence necessary to continue research and meditation, scientists saved from getting lost in the wilderness without a guide.Such as the reference to nature or reason or coincidence, or other concepts of the philosophies positivist conflict of old and modern and damaged by impotence and damage. As the Qur'Énic verses reads:

> Who has created the seven heavens one above another, you can see no fault in the creations of the Most Beneficent. Then look again: "Can you see any rifts?" Then look again and yet again, your sight will return to you in a state of humiliation and worn out. Q. 67: 3-4.

The method of research and reasoning is based on the Islamic concept of the author between the mind and the reality, and relies on the acquisition of knowledge on the mind and senses and the rest of the intellectual abilities that God gave to man. God has assumed the responsibility of the use of the means of science and tools in many places of the Qur'Én.Such as the verse reads:

> And Allah has brought you out from the wombs of your mothers while you know nothing. And He gave you hearing, sight, and hearts that you might give thanks (to Allah). Do they not see the birds held (flying) in the midst of the sky? None holds them but Allah [none gave them the ability to fly but Allah]. Verily, in this are clear proofs and signs for people who believe (in the Oneness of Allah). And Allah has made for you in your homes an abode, and made for you out of the hides of the cattle (tents for) dwelling, which you find so light (and handy) when you travel and when you stay (in your travels), and of their wool, fur, and hair (sheep wool, camel fur, and goat hair), a furnishing and articles of convenience (e.g. carpets, blankets, etc.), a comfort for a while. Q. 16: 78-80.

And in another Qur'Énic verse reads:

> Have We not made for him a pair of eyes? And a tongue and a pair of lips? And shown him the two ways (good and evil)? Q. 90: 8-10.

And in another Qur'Énic verse reads:

> And give full measure when you measure, and weigh with a balance that is straight. That is good (advantageous) and better in the end. And follow not (O man i.e., say not, or do not or witness not, etc.) that of which you have no knowledge (e.g. one's saying: "I have seen," while in fact he has not seen, or "I have heard," while he has not heard). Verily! The hearing, and the sight, and the heart, of each of those you will be questioned (by Allah). And walk not on the earth with conceit and arrogance. Verily, you can neither rend nor penetrate the earth, nor can you attain a stature like the mountains in height. Q. 17: 35-37.

Thus, we find that the scholars of Islamic civilization have imbued the teachings of their true religion and devised for themselves an Islamic scientific approach that transcended the limits of the philosophical views that characterized the Greek sciences. They moved on to experimenting and drawing conclusions with all the elements of the investigating researcher, realizing that their new curriculum has conditions and theoretical, practical and

believableelements to be familiar with. And a careful reading of the Islamic heritage literature reveals that Muslim scholars have previously identified the elements of the scientific approach in accordance with many new terms that are being discussed today by scientific methodologists such as observation and experimentation types And the use of science fiction in the similarity between different phenomena and the discovery of the unity that connects scattered facts.

The elements of the scientific experimental method in the Qur'Én:

Among the elements of the scientific experimental method in the Qur'Én is extrapolation. In the Qur'Én there are threads pointing to contemplation and drawing attention to the vast universe and space around us, as these Qur'Énic verses read:

> Who has created the seven heavens one above another, you can see no fault in the creations of the Most Beneficent. Then look again: "Can you see any rifts?" Q. 67:3
> Then look again and yet again, your sight will return to you in a state of humiliation and worn out. Q. 67:4

This text is an invitation to consider and reflect on the universe, coupled with the challenge of the Creator for his creation in a losing battle with humiliation and being worn out. The call for a fair fight is a foregone conclusion in favor of the Great Creator; however, the Almighty asks the creature (the worn out) to consider a second and third time because He wants to teach humans how to stir up their minds to strengthen their faith and talents, then to realize the creature's weakness before the Greatness of the Precision-Made universe, indicating authentic worship of the Greatest Maker.[22]

Because correct examination and exploration lead to correct results, the senses must be exploited optimally in order to realize these sound results. All of the senses do not appear unless

[22] al-QurÏubÊ, AbË 'Abdullah MuÍammad ibn AÍmad (d. 671/1273). *al-JÉmi' li-AÍkÉm al-Qur'Én*, Vol. 18: 180-194.

belief has settled in the heart, preparing the mind to benefit and be influenced. Those without faith possess senses that are impenetrable, as this Qur'Énic verse reads:

> Verily! The worst of (moving) living creatures with Allah are the deaf and the dumb, those who understand not (i.e. the disbelievers). Q. 8: 22.

The process of *istiqrÉ'*/examination and exploration needs to have a turn of the mind and to activate the senses, since human beings who possess senses such as sight and hearing but do not use them in the right direction, are absolutely irrational and perhaps even equated with the worst of beasts.[23] The Qur'Én further describes and refers to them as follows:

> And surely, We have created many of the *jinns* and mankind for Hell. They have hearts wherewith they understand not, they have eyes wherewith they see not, and they have ears wherewith they hear not (the truth). They are like cattle, nay even more astray; those! They are the heedless ones. Q. 7: 197.

Man is urged to search for particles of this universe and to discover the creations of the Creator in it, for He is urging the weak man after the other (the challenge) to search for a lack or defect or incisions in the universe. God Almighty knows that man will not and cannot find these possibilities with his limited senses, but the Almighty instructs and educates the Muslim community to search, try, observe, and then make a conclusion. As the Qur'Énic verse explicitly reads:

> And among His Signs is the creation of the heavens and the earth, and the **difference of your languages and colours**. Verily, in that are indeed signs for men of sound knowledge. And among His Signs is the sleep that you take by night and by day, and your seeking of His Bounty. Verily, in that are indeed signs for a people who listen.**And among His Signs is that He shows you the lightning, by way of fear and hope, and He sends down water (rain) from the sky**, and therewith revives the earth after its death. Verily, in that are indeed signs for a people who understand. Q. 30: 22-24.

[23] Ibid, vol. 7: 321-323.

The different tongues, colors, sleep, lightning, and rain are all cosmic particles striking the Qur'Én in order to give humans images and signs to look for their creator the Almighty and to ponder the obedience deserved by Him. Moreover, another Qur'Énic verse reads:

> And in the earth are neighbouring tracts, and gardens of vines, and green crops (fields etc.), and date-palms, growing out two or three from a single stem root, or otherwise (one stem root for every palm), watered with the same water, yet some of them We make more excellent than others to eat. Verily, in these things, there are *AyÉt* (proofs, evidences, lessons, signs) for the people who understand. Q. 13: 4.

An invitation to see the evidence and lessons of these molecules to see into the heart and mind. The text here calls upon the mind and the senses associated with it to see and hear, and moves the heart to connect to all of this manufacturer and greatness of the Almighty.

Human reasoning/*al-qiyÉs*

The Qur'Én draws people's attention to the necessity to persist in the universe and is a call to the believers (in particular) to monitor changes needed to strengthen their faith and bring it metaphysical understanding.

> Look then at the effects (results) of Allah's Mercy, how He revives the earth after its death. Verily! That (Allah) Who revived the earth after its death shall indeed raise the dead (on the Day of Resurrection), and He is Able to do all things. Q. 30: 50.

This is an invitation to watch the life after death and to draw the significant conclusion through the senses of the inevitability of future life after the death of man in this life, just as there is life after the rain in a dead land. One of these examples is originally a purely ideological issue, but it refers to the importance of *al-qiyÉs*/human reasoning to reach the correct scientific results, as the Qur'Én indicates in the following verse:

> The Messiah ['Iesa (Jesus)], son of Maryam (Mary), was no more than a Messenger; many were the Messengers that passed away before him. His mother [Maryam (Mary)] was a Siddiqah [i.e. she believed in the words of Allah and His Books (see Verse 66:12)]. They both used to eat food (as any other human being, while Allah does not eat). Look how We make the *AyÉt* (proofs, evidences, verses, lessons, signs,

> revelations, etc.) clear to them, yet look how they are deluded away (from the truth). Q. 5: 75.

This is an invitation to think in the form of *al-qiyÉs*/human reasoning to prove that the Prophet Jesus was a human being and not god, through the realization of reason and logic. He and his mother used to eat food, and this inevitably means he needed to take out waste (the Qur'Énic text that does not mention the output as a manner of politeness because it comes as a corollary to eating). Therefore, it is not fit to eat food to be a god. From this we see that the Quranic context gave evidence in many faith issues of metaphysical and paramount importance, and focused on compelling arguments to answer the proponents of the resurrection, using optimization mentality and witness visible that every sane person can use to measure his mind and physical senses, reaching out to the eternal truth.

In the Qur'Én there is an explicit call to observe and activate the role of the senses; it is a wonder in the Qur'Énic text that there are those senses to which exploitation rights extend. Optimum exploitation of Organic Existence of the senses of hearing and vision (for example) does not imply that a person can hear and see, if it is not used in consultation with data from around the universe and the life ground surrounding it. There is no value to all of this if you were not using these senses and what you see and hear to serve the great cause of human existence already, which is to worship the Almighty Creator and the application of His approach on the ground. God says:

> Have they not travelled through the land, and have they hearts wherewith to understand and ears wherewith to hear? Verily, it is not the eyes that grow blind, but it is the hearts which are in the breasts that grow blind. Q. 22: 46.

The invitation of the Qur'Én to present these findings is still visible in nations and peoples. Several questions should be raised in the human psyche: Where are those who do not see or hear? How was their end? The more important question is why they are extinct. God says:

> Is it not a guidance for them (to know) how many generations We have destroyed before them, in whose dwellings they walk? Verily, in this are signs indeed for men of understanding. Q. 20: 128

If the invitation is to observe and think, and then cogitate and wonder, then conclude to get to the truth, which is situated in the sense of the believer, then that end (truth) is replicable if the same instructions are repeated. Another call is to observe the persistence of difference and change of repetitive cosmic phenomena. God says:

> Verily! In the creation of the heavens and the earth, and in the alternation of night and day, there are indeed signs for men of understanding. Q. 3: 190.

The Qur'Énic expression here paints a vivid picture of the proper reception of cosmic influences in common sense, a lively picture of the effects of these items for the eyes and ideas as the right response at the center of the universe by night and by day. The Qur'Énic text describes induction of watching and careful consideration, to draw attention to the beauty of the universe with its scientific miracles. God says:

> And indeed We have adorned the nearest heaven with lamps, and We have made such lamps (as) missiles to drive away the *ShayÉÏÊn*/devils, and have prepared for them the torment of the blazing Fire. Q. 67: 5.

This text emphasizes the aesthetic function of the scientific and practical side of beauty, which comes as a result of making every elaborately masterly work one of beauty and splendor and glory, and it also says:

> Verily! We have adorned the near heaven with the stars (for beauty). Q. 37: 6.

This aesthetic gesture in the induction of the universe urges man (the believer) to look at the two components and get to know his Creator Almighty by questioning scientific givens through the temptation of beauty.

It is no exaggeration to say that Muslim scientists were the first inventors of the experimental method for handling scientific data and the universe around them. This experimental technique

has led to the establishment of the rules of the experimental scientific method, which is still used by contemporary science, known in the classical Arabic language of the Muslim scholars as *istiqrÉ'*.[24]

We turn to the Qur'Énic features of the scientific method and to the style of discipline that produced the scientific method, the features and steps of *'ilm al-jarÍ wal-ta'dÊl* (the systematic approach to critiquing a narrator's position as a narrator) that was developed by eminent Sunni scholars in order to protect the Sunna of the Prophet from intruders and corruption.[25] They used these expressions as tools for evaluating the chain of transmission for various *ÍadÊth*s. This discipline attracted a method of critique of two factors. The first factor was the Islamic sciences, all of which were interconnected in either theoretical or applied/practical ways. The second factor was the impressive precision on which the sciences were born according to a scientific scale of high sensitivity.[26]

The discipline of *'ilm al-jarÍ wal-ta'dÊl* emerged from four main factors: first, honesty and integrity of the subject[s], i.e. *ÍadÊth* literature to criticism; second, accuracy and the search for judgment; third, commitment of good manners to the subject under examinations, i.e., *al-jarÍ* which refers to a series of expressions that are used to express some deficiency in the narrations of a narrator. Sometimes the narrator may be criticized for being a liar, a fabricator of *ÍadÊth*,

[24] MuÎÏafÉ NaÌÊf (2008). *al-×asan Ibn al-Haytham BuÍËthih wa KushËfih al-BaÎariyyah*, Beirut: Markas DirÉsÉ al-WiÍdah al-'Arabiyyah, pp. 14-16.

[25] See Ibn AbÊ ×Étim, MuÍammad ibn IdrÊs b. MunÌir (d. 326/938). *KitÉb al-JarÍ wal-Ta'dÊl* Beirut: DÉr IÍyÉ' al-TurÉth al-'ArabÊ, 1970; Ibn ×abÉn, MuÍammad ibn AÍmad (d. 354/965). *KitÉb al-MajrËÍÊn min al-MuÍadithÊn wal-Öu'afÉ' wal-MatrËkÊn* ed. MaÍmËd IbrÉhÊm ZÉyid, Aleppo: DÉr al-Wa'Ê, 1982; Ibn 'AdÊ 'Abdullah al-JurjÉnÊ (d. 976). *al-KÉmil fÊ Öu'afÉ' al-RijÉl* ed. SuhÊl ZakÉr, YaÍyÉ MukhÏÉr GazÉwÊ Beirut: DÉr al-Fikir, 1988.

[26] In the work of al-ShÉÏÊbÊ (d. 790/1388). *al-MuwafaqÉt fi UÎËl al-SharÊ'a*, he reflected upon *al-istiqrÉ'* in Islamic jurisprudence/*al-fiqh* that *al-fiqh* is free of speculative content/*qaÏ'Ê lÉ ÐanÊ*; this is an indication of inductive/ *al-istiqrÉ'*, The origin of *al-fiqh* is categorically not presumptive; and the proof is that it arose from the faculties of law, and it is definitive. The first statement *al-ÐÉhir* extrapolation is useful to cut. al-ShÉÏibÊ, AbË IsÍÉq IbrÉhÊm. *al-MuwafaqÉt fi UÎËl al-SharÊ'a* Beirut: DÉr al-Kutub al-'Almiyya, 2009 :18-23.

having a poor memory, or being unknown. Lastly, overall, the amendment and the detail in the defamation in terms of a description of the narrator as being acceptable. It includes descriptions such as skilled and trustworthy, emphatically trustworthy, trustworthy, just, truthful, and acceptable.

Then, clearly, we see that these recent rules may be repeated in the approach and methods of Muslim Scholars of Applied Science. They establish an approach based on scientific integrity, honesty, accuracy, and good manners in any dispute, and equity with opponents and the overall theory and scientific detail. This was the epistemological approach of the *ÍadÊth* scholars in determining the authenticity of the *ÍadÊth*. Now it is essential to discuss the process and steps of the scientific approach, followed by practical selected samples of the Muslim scholars' epistemological method in the human experimental sciences.

Noticeable in the introductory works of Muslim scholars is the ongoing call to examin, to request evidence, and to ensure fairness. This approach has emerged clearly with dignified Muslim scholars such as al-×asan ibn al-Haytham (d. 450/1040), the polymath scholar in the fields of physics, mathematics and optics, Ibn SÊnÉ (d. 428/1037), AbË Bakr MuÍammad ibn-ZakariyÉ al-RÉzÊ (d. 321/925), Ibn al-NafÊs (d. 687/1288), in medicine, and JÉbir ibn ×ayÉn (d. 199/815), in chemistry, and Ibn KhaldËn (d. 809/1406),[27] in sociology, and many others. The rules of this experimental scientific method/*istiqrÉ'* are based on several principles that take the form of interconnected steps, relying on the preceding steps. Such steps are examination, observation then reasoning, then the imposition of hypotheses, then the experiment and extracted results. This was the general guidance of the scientific approach that was formed by Muslim

[27]Ibn KhaldËn, (d. 809/1406). *Muqadimmat Ibn KhaldËn* Beirut: DÉr al-Qalam, 1981.

scholars in practice and introduced into their theories and the scholarship of their findings, in a scientific atmosphere of impartiality full of passion and truth.

In addition, Muslim scholars committed to ethics of scientific research and etiquette/*Ódabih* distanced themselves from indulging in more than the realization of the human mind, or searching for forbidden or useless science, as indicated by JÉbir ibn ×ayÉn. They also credited original authors and retained the differences and rights of observation, polite commenting, correction, and multitudes of knowledge.

What distinguishes the experimental method of Muslim scholars is that it is a movement with a wide range of scientific freedom, one of making hypotheses and then seeking an open mind and vigilant senses to validate *istiqrÉ'*/induction or extrapolation based on observation then experiment, and then collecting the results. Thus, they relieve past human knowledge from illusions, myths, surmise, interpretations, and the connection of natural phenomena to powerful mythological legend. In addition, we shall stand with the experimental scientific method in the course of scientific scholars, which they incorporated into their research and theories, in order to acknowledge and benefit from their legendary efforts in theory and practice, and to learn from the virtue of their predecessors and their successors.

Jim al-Khalili, in his work titled *Pathfinders: The Golden Age of Arabic Science*, cited the following, which summarize the essence of Ibn al-Haytham's scientific methodology:

> The seeker after truth is not one who studies the writings of the ancient and, following his nature disposition, puts his trust in them, but rather the one who suspect his faith in them and questions what gathers from them, the one who submits to arguments and demonstration and not the saying of human beings whose nature is fraught with all kinds of imperfection and deficiency. Thus the duty of the man, who investigates the writings of scientists, if learning the truth is his goal, is to make himself an enemy of all that he reads, and, applying his mind to the core and margins of its content, attack it from every side. He should also suspect himself as he performs his

> critical examination of it, so that he may avoid falling into either prejudice or leniency.[28]

We begin with the encyclopedic scholar al-×asan ibn al-Haytham or Alhazen scientific methodology. A scientist, mathematician, astronomer, and philosopher, Ibn al-Haytham made significant contributions to the principles of optics, astronomy, mathematics, visual perception, and the scientific method/*al-istiqrÉ'*. He was the first to explain that vision occurs when light bounces on an object and then is directed to one's eyes. He spent most of his life close to the court of the Fatimid Caliphate in Cairo and earned his living authoring various treatises and tutoring members of the nobilities. Ibn al-Haytham is widely considered to be one of the first theoretical physicists and an early proponent of the concept that a hypothesis must be proved by experiments based on confirmable procedures or mathematical evidence—hence understanding the scientific method 200 years before Renaissance scientists. In medieval Europe, Ibn al-Haytham was honored as Ptolemaeus Secundus/the Second Ptolemy or simply called "The Physicist". He is also sometimes called al-Baṣrī after his birthplace Basra in Iraq, or al-Miṣrī/of Egypt.[29]

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[28] Jim al-Khalili, in his work title *pathfinders: The Golden Age of Arabic Science* London: Penguin Books, 2010: 152; see also, Ibn al-QafÏÊ, AbË al-×asan 'AlÊ (d. 1248). *AkhbÉr al-'UlamÉ' bi AkhbÉr al-×ukamÉ'* Cairo: Maktabat al-ÓdÉb, 2008: 114-115; Ibn al-'AbrÊ, Gregorias al-MalÏÊ (d. 685/1286). *TÉrÊkh MukhtaÎr al-Duwal* Cairo: DÉr al-ÓfÉq, 2001: 182; Ibn AbÊ UÎaybi'a AÍmad ibn QÉssim (d. 1270/668). *'UyËn al-AnbÉ' fÊ ÙabaÉt al-AÏibÉ'* ed. MuÍammad BÉsil and 'AbbÉs AÍmad al-BÉzz, Beirut: DÉr al-Kutub al-'Ilmiyya, n.d.: 506; MuÎafÉ NaÐÊf (1942). *Al-×asab ibn al-Haytham: BuÍËthuh waKushËfuhu al-BaÎariyya* Cairo: MaÏba'at NËrÊ, p. 12; 'Abd al-×alÊm MuntaÎir (1981). *TÉrÊkhal-'Ilm wa dawr al-'UlamÉ' al-'Arab fÊ Taqadumuh*, Cairo: DÉr al-Ma'Érif, p.149;

[29] al-AndalusÊ, Øa'id ibn MuÍammad (d. 462/1070). *ÙabaqÉt al-Ummam*, Beirut: BË 'UlwÉn, 1985: 150; Al-AndalusÊ, Øa'id ibn MuÍammad (1991). *Sciencein the medieval world: book of the Categories of Nations*; translated and edited by Sam'Én I. SÉlem and Alok Kumar, Austin: University of Texas Press; Ibn AbÊ UÎaybi'a AÍmad ibn QÉssim (d. 1270/668). *'UyËn al-AnbÉ' fÊ ÙabaÉt al-AÏibÉ'*, pp. 505-515; al-QifÏÊ, JamÉl al-DÊn 'AlÊ ibn YËsuf (d. 1248). *Ta'rÊkh al-×ukamÉ'* ed. MuÍammad 'AwnÊ 'Abd al-RaËf Cairo: Maktabat al-ÓdÉb, 2008: 160-167; al-BayhaqÊ, 'AlÊ ibn YazÊd (d. 1170). *Ta'rÊkh ×ukamÉ' al-IslÉm* ed. MuÍammad Kurd 'AlÊ, Damascus: al-Mujama' al-'IlmÊ al-'ArabÊ, 1976 Rushdi Rashid, dedicated a volume on Ibn al-Haytham under the series of *tÉrikh al-'UlËm 'ind al-'Arab* title *al-RiyÉÌiyÉt al-TaÍlÊliyya bayn al-qirn al-thÉlilwal-qirn al-khÉmis lil-hijra*, vol. 2: al-×asan ibn al-Haytham, tran. MuÍammad YËsuf al-×ujayrÊ, Beirut: Markaz DirÉsÉt al-WiÍdah al-'Arabiyya, 2011: 23-74.

It is essential to mention that Ibn al-Haytham grew up in the active era (toward the end of the 4th/10thcentury) of science, philosophy, and the translation movement for Greek, Indian, and Persian works.[30] His contemporary times saw volatile and diverse scientific and philosophical trends in addition to the various movements of thought and literature; thus, he was influenced by what went on around him, including conflicts of ideas, and he occupied himself with seeking knowledge and achievement. He spent his early life showing patience and perseverance over a long period, desiring to acquaint himself with a full range of knowledge from his surrounding intellectual environment. He searched for knowledge, reading what was available to him of the ancient books and of works of Muslim scholars before him. He was not satisfied with only familiarizing himself with literature and remarks, but he also scrutinized and reflected upon the topics and subjects of these books. Moreover, he summarized and wrote his own comments on these books, in order to understand the specifics of their meanings and to settle his mind.[31]

In terms of the transmitted knowledge from the surrounding civilizations during the advent of Islam up to the Ibn al-Haytham era, it is essential to discuss the motivation behind this transmitted knowledge to the abode of Islam: first, the Arab connection with other nations and knowledge from these nations that was useful and suitable; second, needs for such knowledge that was not available to them; third, as was mentioned earlier, the Qur'Én encourages Muslims to engage in intellectual activity/*al-tafkÊr*, such as the created heavens and the earth, and the human body.[32] Whenever the state desired to expand its cultural activity in political, economic,

[30] Ibn AbÊ UÎaybi'a AÍmad ibn QÉssim (d. 1270/668). *'UyËn al-AnbÉ' fÊ ÙabaÉt al-AÏibÉ'*, pp. 507.
[31] Ibn al-'AbrÊ, Gregorias al-MalÏÊ (d. 685/1286). *TÉrÊkh MukhtaÎr al-Duwal*, p. 11.
[32] See Q. 3: 191.

and otheraspects such as to contribute to its development, progress, growth, and urbanization, this expands knowledge and cultural activities, to which the Arabs were subject.[33]

The motive of Ibn al-Haytham in the transmitted commentary and writings was to benefit general science students. According to a modern scholars who dedicated an excellent work to Ibn al-Haytham said about this regards that:

> I have not extended my life and scarify my best and my strength in such envisaged three things: One: benefit from the requested truth and to be influences it in my life and after my death; And the other: I made that an exercise for me of these things to prove what my vision and intellectual ability to perfect in that domain of science; And third: I proceed with it as an ammunition and tool for several decades to come of aging time.[34]

In short, Ibn al-Haytham was a man of moral excellence, high caliber, and intelligence, an artist in the sciences, exceeding all of the scholars of his time in mathematical science, alone in his expertise, and he was always busy with many writings/classification, asceticism galore, and generous good deeds.[35]

It is important to state that Ibn al-Haytham was not a materialistic person, although he was among the associates to the sixth FÉÏimÊ ruler AbË ‘AlÊ ManÎËr, who was known by his regnal title al-×Ékim bi-Amr AllÉh (r. 996-1021), according to the works of Ibn AbÊ UÎaybi’a and many others mentioned by Ibn AbÊ UÎaybi’a who dedicated space in their works to Ibn al-Haytham’s nobility and character. Ibn AbÊ UÎaybi’a indicated that at one point the ruler wanted to reward Ibn al-Haytham with a sum of money/*dinars*; he then returned the money to the ruler, telling him that you need this money more than I do upon your return to your realm, and you should know that there is no price or bribe nor gift to spread knowledge and peace.[36] I can truly

[33] ‘Umar FarËkh (1983). *TÉrÊkh al-Fikir al-‘ArabÊ ilÉ AyÉm Ibn KhaldËn* Beirut: DÉr al-‘Ilm lil-MalÉyÊn, p. 270.
[34] MuÎÏafÉ NaÌÊf (2008). *al-×asan Ibn al-Haytham BuÍËthih wa KushËfih al-BaÎariyyah*, p. 12.
[35] Ibn AbÊ UÎaybi’a AÍmad ibn QÉssim (d. 1270/668). *‘UyËn al-AnbÉ’ fÊ ÙabaÉt al-AÏibÉ’*, p. 505
[36] BayhaqÊ, ‘AlÊ ibn Zayd (d. 565/1170). *TÉrÊkh ×ukamÉ’ al-IslÉm*, p. 86.

satisfy my daily needs with what I earn, and if I accept your money, I am going to be your slave, and if I spend it, I will become greedy, therefore, I will not occupy my life with that and would rather be pleased with work and duties.[37] He is known to have said, "If I would be given the chance, I would implement a solution to regulate the Nile flooding". This claim reached -×Ékim bi-Amr AllÉh, the Fatimid caliph in Egypt, who invited him to Cairo. Confident of his own abilities, Ibn al-Haytham boasted that he would take the great Nile River by building a dam and reservoir. Nevertheless, when he saw the extent of the challenge and the marvelous remains of ancient Egypt on the river banks, he reconsidered his own boast thinking. If such a huge project could be done, he reasoned, it would have been done by the brilliant builders of the past who had left us such fantastic architectural relics. He returned to Cairo to inform the caliph that his solution was not possible.[38] Knowing that that particular caliph did not entertain failure and that his life would be at risk if he were to disappoint him, Ibn al-Haytham feigned madness to avoid the caliph's wrath. He knew that Islamic law would protect a mad person from bearing responsibility for his failure. Despite the caliph's wild swings of mood, he nevertheless abided by Islamic law. Rather than executing or expelling Ibn al-Haytham from Cairo, the caliph decided to put the scholar under permanent protective custody. That was required by law in order to ensure his safety and that of others. Ibn al-Haytham was placed under what amounted to house arrest, far from the lively discourses and debates to which he was accustomed.[39]

Among the noble maxims of Ibn al-Haytham which directly contribute to the core of the scientific method of Muslim scholars is this: If you find good works of others do not attribute it to yourself, and you should reveal what you have benefited from, the child follows his father,

[37] Ibn AbÊ UÎaybi'a AÍmad ibn QÉssim (d. 1270/668). *'UyËn al-AnbÉ' fÊ ÙabaÉt al-AÏibÉ'*, p. 506
[38] Ibid, pp. 505-506
[39] al-QifÏÊ, JamÉl al-DÊn 'AlÊ ibn YËsuf (d. 646/1248). *Ta'rÊkh al-×ukamÉ'* ed. MuÍammad 'AwnÊ 'Abd al-RaËf, p. 115.

and the speech to the author.[40] I always soughtknowledge and truth, and believe that in order for me to get closer to God, there is no better way than the search for knowledge and truth.[41] Further, he said if a scholar invented a new idea or conducted fresh research that had not come from anyone before him, that scholar should emphasize that by saying "We do not know of any ancients who demonstrated this [new] meaning nor did we find it in books."[42] As human beings, we are not perfect, but we strive as much as our human ability and force allow, and it is overall from God we draw our assistance.[43]

The more we look, the more clearly we see the practical, methodological steps applied by Ibn al-Haytham, whose experience passed through several stages, until it reached the truth.[44] He began his experiments with *al-qiyÉs* (Syllogism) and he called it *al-sabr* and *istiqrÉ'* (Induction), followed by the experiment (*al-i'tibÉr*)and then partition (*al-IbÏÉl*) and then *al-ÍaÎr* he intended to assign all of the principles or set rules. He adopted this approach not only to validate the assumptions *al-manhaj al-raraÌÊ* (hypothetical approach) that he made, but also he intended to search for *iktishÉf al-'ilah* causes in order to prove the error /wrong hypothesis.[45]

Among leading Muslim scholars who were influenced by Ibn al-Haytham's works was KamÉl al-DÊn ibn ×asan ibn 'AlÊ al-FÉrisÊ (d. 719/1319). He benefited greatly from the works of his predecessors in general and Ibn al-Haytham's works in particular, because he found there a great certainty, and benefits and fine points based on true experiences and considerations. That was proved through engineering machine devices and observational measurements

[40] Sa'd ibn 'Abd al-'AzÊz (1977). *FalÉsifat al-IslÉm* Cairo: MaÏba'at al-Sha'b, p. 102; BayhaqÊ, 'AlÊ ibn Zayd (d. 1170). *TÉrÊkh ×ukamÉ' al-IslÉm*, p. 88.
[41] 'Abd al-×alÊm MuntaÎir (1981). *TÉrÊkh al-'Ilm wa Dawr al-'UlamÉ' al-'Arab fÊ Taqadumuhu* Cairo: DÉr al-Ma'Érif, p. 152; SulaymÉn FayÊÌ (1985). *Ibn al-Haytham 'Óalim al-BaÎariyÉt* Cairo: DÉr al-AhrÉm, p. 42.
[42] 'Abd al-×alÊm MuntaÎir (1981). *TÉrÊkh al-'Ilm wa Dawr al-'UlamÉ' al-'Arab fÊ Taqadumuhu*, p. 149.
[43] ×asan al-SharqÉwÊ (1987). *al-MuslimÏn 'UlmÉ' wa-×ukamÉ'* Cairo: Mu'asassat MukhÏÉr, p. 202.
[44] Ibn AbÊ UÎaybi'a AÍmad ibn QÉssim (d. 1270/668). *'UyÏn al-AnbÉ' fÊ ÙabaÉt al-AÏibÉ'*, p. 506.
[45] MÉhir 'Abd al-QÉdir MuÍammad (1997). *al-×asan Ibn al-Haytham wa Ta'sÊs falsafat al-'Ilm* Alexandria: DÉr al-Ma'rifah al-JÉmi'iyya, pp. 36-42

composed of valid assumptions, which led to the truth.[46] Of course, right assumptions lead to valid results and outcomes.

In the field of medicine, Muslims had a great role in the translation of works from previous civilizations and nations. The translation process was done with a faithfulness of integrity and confidence in terms of correction, rectification, and commentaries; the process then moved to a later stage, characterized by creativity as well as what could be considered a purely Islamic and independent knowledge/*'ilm*. One example of the first stage, which is the transmitters and translation movement, is ThÉbit ibn Qurah (d. 288/901), who excelled in several of the sciences, such as medicine, astronomy, and mathematics. The second stage is represented by many scholars or successors to the first stage, such as MuÍammad AbË ZakariyÉ al-RÉzÊ (d. 312/925), Ibn SÊnÉ or Avicenna (d. 427/1037), and so on.

The second stage is the stage of creativity, and the Islamic excellence in medicine among other fields of knowledge was ordained clearly as the experimental scientific method/*al-istigrÉ'*. Muslim physicians described the symptoms and diagnosed the illnesses, then connected and

[46]Nader all-Bizri, "Al-FÉrisÊ, KamÉl al-DÊn," in*The Biographical Encyclopaedia of Islamic Philosophy* ,ed. Oliver Leaman, London, New York: Thoemmes Continuum, 2006, vol. I, pp. 131–135; KamÉl al-DÊn ibn ×asan ibn 'AlÊ, *KitÉb TanqÊÍ al-ManÉÐir li-dhiwÊ al-AbÎÉr w-al-BaÎÉ'ir* ed. MuÎÏafÉ ×ijÉzÊ and Fu'Éd BÉshÉ Beirut: DÉr al-Kutub w-al-WathÉ'iq al-Qawmiyya, two volumes, vol. I, 1987, and vol. II., 2007; al-×asan Ibn al-Haytham, *KitÉb al-ManÉÐir fÊ al-AbÎÉr 'lÉ al-IstiqÉmah*, ed. 'Abd al-×amÊd Øabrah Kuwait: al-Majlis al-WaÏanÊ lil-ThaqÉfah wa al-FunËn wa al-ÓdÉb, 1983. The light is a natural phenomenon that captured the interest of philosophers and scientists throughout the ages; the field of optics was the study of the nature of light and its characteristics and related phenomena and applications. The importance of this discipline is that any progress made by specialists reflected on the rest of the branches of science and technical fields. Among the polymath scholars/scientists or philosophers of the Arab Islamic civilization who dedicated special interest to light and its various phenomena in some of their works were Ya'qËb ibn IsÍÉq al-KindÊ (d. 873), ×unayn ibn IsÍÉq (d. 873), ThÉbit ibn Qurah (d. 901), AbË baker MuÍammad ibn ZakariyÉ al-RÉzÊ (d. 923), Ibn SÊnÉ (d. 1037), Ibn Rushd (d. 1198), NaÎÊr al-DÊn al-ÙËsÊ (d. 1274), Ibn al-NafÊs al-QurashÊ al-NaÎrÊ 9d. 1288), and so on. However, Ibn al-Haytham had the most extraordinary work in this important field with his masterpiece work titled *KitÉb al-ManÉÐir*, which was considered by specialists as the basis for the field of modern optics. Modern scientists still refer to Ibn al-Haytham's work in optics and maintain his significance that whenever they discuss works in this field or compose treatises, books, and references. Hence the importance of *KitÉb TanqÊÍ al-ManÉÐir li-dhiwÊ al-AbÎÉr w-al-BaÎÉ'ir* of KamÉl al-DÊn ibn ×asan ibn 'AlÊ al-FÉrisÊ, which is considered as a commentary, explaining and critiquing Ibn al-Haytham work's *KitÉb al-ManÉÐir*, as Fu'Éd BÉshÉ indicated in his introduction to this work.

compared data, followed by the process of analyzing and interpreting the outputs after activating the careful methodological process of *al-istigrÉ'* and accurate observation. This was followed by the imposition of the assumptions and attempts to prove or disprove those assumptions through experience; then came the study of particles, in order to reach the end, via the development of medical theories and general laws.

The second selected Muslim scholar to incorporate the scientific experimental method *istiqrÉ'* in his medical work is Ibn al-NafÊs, 'AlÉ' al-DÊn AbË al-×asan 'AlÊ ibn AbË ×azm al-QarashÊ al-DimashqÊ (d. 687/1288), a polymath scholar in jurisprudence, traditions, philosophy, logic, literature, and theology. He was most famous for his work in medicine and the discovery of the lesser blood circulation as well as representing the scientific medical approach for Muslims, in which he ratified theories if they were approved rationally and measured by the senses; otherwise, he did not believe or accept them.[47] Through his scientific experimental method *istiqrÉ'*, however, his approach and that of Galen and Ibn SÊnÉ were redressed. The polite manner of disagreement with which he attributed some of their scribes' flaws signaled that he was well-read and intelligent, that he read critically, observed, and then compared to find the error and determine its origin.[48]

Although scientists previous to Ibn al-NafÊs have been noted for their innovation and the establishment of the experimental scientific method, Ibn al- NafÊs sent a new spirit, and his effort arrived in a peak time to serve this vital field in the history of human knowledge. As stated by one modern scholar on Ibn al-NafÊs's experimental scientific method, YËsuf ZÊdÉn:

> In the writings of Ibn al-NafÊs a countless other of facts related to the field of everyday experience and regular views forum to the field of scientific vision and systematic monitoring, it is noticeable Ibn al-NafÊs rise to direct experimentation albeit in connection with the decision of the well know physician before him, and often associated with the

[47] M. Zaki Kiramani, N. K. Singh (2005). "Ibn al-NafÊs", *Encylopaedia of Islamic Science and Scientists*, vol. 2: 404-407; YËsuf ZÊdÉn (1999). *A'Édat IktishÉf Ibn al-NafÊs*, Abu Dhabi: al-Majma' al-ThaqÉfÊ, pp. 24-31.

[48] Nahyan Fancy (2013). *Science and Religion in Mamluk Egypt: Ibn al-NafÊs, Pulmonary Transit and Bodily Resurrection* Routledge: London and New York, pp. 25-26.

> term (*al-qiÉs*/human analogical reasoning) and (*al-tajribah*/trial), in his discussion about means of proof). Furthermore, he said about al-NafÊs's approach he followed the principles according to gleaned set by [scholars] before him; adjust the analogy to display and when he wants to prove it goes to trial.[49]

Perhaps investigation can reverse who is famous and recognized, it is heard percussion unlike his reign there initiates denials, that indiscretion! perhaps disgraceful right, and familiar praised untrue; right is right in itself, not individuals saying it, but always remember the saying: If mind and motivation are equal, then the advanced profession is better than what came previously.[50] In the domain of mathematics, two examples of experimental scientific methodology are going to be addressed.

The first example of experimental scientific methodology is from MuÍammad ibn MËsÉ al-KhawÉrizmÊ (d. 232/850). He was of the era of Caliph Ma'mËn, who embraced him, and his methodology was reflected in his famous book *al-Jabir w-al MuqÉbalah /The Compendious Book on Calculation by Completion and Balancing*, where he stated in his introduction the goal of scientists writing books and pointed to their morals and their rank in science.[51] He established a mathematical method to employ this knowledge in everyday life; recalled in his book

[49]YËsuf ZÊdÉn (1999). *A'adat IktishÉf Ibn al-NafÊs*, p. 77; Dhahabī, Shams al-Dīn Abūʿ Abd Allāh Muḥammad ibn ʿUthmān (d. 748/1348). *Siyar Aʿlām al-Nubalāʾ*, ed. Shuʿayb al-Arnāʾūṭ and Ḥusayn al-Asad. Beirut: Muʾassasat al-Risālah, 1985, vol. 51: 312; Nahyan Fancy (2013). *Science and Religion in Mamluk Egypt: Ibn al-NafÊs, Pulmonary Transit and Bodily Resurrection*, pp. 23-25.

[50]Ibn QÉÌÊ Shuhba, AbË Baker ibn AÍmad (d. 896/1488). *ÙabaqÉt al-ShÉfi'Êyya*, ed. al-×ÉfiÐ 'Abd al-'AlÊm KhÉn Hyderabad: MaÏba'at Majlis DÉ'irat al-Ma'Érif al-'UthmÉniyya, 1978, vol. 1: 107; JalÉl MaÐhar (1974). *×aÌÉrat al-IslÉm wa AtharahÉ fÊ al-TaraqÊ al-'ÓlamÊ*, Cairo: Maktabat al-KhÉnjÊ, pp. 346-347; MuÍammad ØÉdiq al-'AfÊfÊ (1976). *TaÏawur al-Fikir al-'IlmÊ 'and al-MuslimÊn*, Cairo: Maktabat al-KhÉnjÊ,pp. 205-207; MuÍammad 'AlÊ 'UthmÉn (1998). *MuslimËn 'AlamË al-'Ólam*Alexandria: Maktabat Ma'rËf, pp. 51-52; al-ZarkalÊ, Khayr al-DÊn (2002). *al-A'lÉm*, Beirut: DÉr al-'Ilm lil-MalÉyÊn, vol. 4: 271;DafÉ', 'AlÊ 'AbdullÉh (1998). *RuwÉd 'Ilm al-Ùibb fÊ al-×aÌÉrah al-IslÉmiyyah*, Beirut: Mu'asassat al-RisÉlah lil-ÙibÉ'ah wa-l Nashr, pp. 451-453.

[51]Ibn al-NadÊm, AbË al-Faraj MuÍammed ibn IsÍÉq (d. 380/990). *al-Fihrist*, pp. 438-439; Rashed, Roshdi. (2013). *The development of Arabic mathematics: between arithmetic and Algebra*. Netherlands: Springer.; Gutas, Dimitri (1998). *Greek Thought, Arabic Culture: The Greco-Arabic Translation Movement in Baghdad and Early Abbasid Society (2nd-4th/8th-10th centuries)*, pp.133-134.

mentioned above were such everyday applications as selling and buying, and ritual applications such as the inheritance and wills.[52] He simplified in his book findings that included divisions and degree equations. Thus, he put forth a unique independent knowledge known as *al-jabir /al-gabra* resulting from his method and the true and proper logic. In recognition and gratitude of KhwÉrizmÊ, many mathematical concepts and terminologies are still used today from his efforts such as the science of Algebra and algorithm, one of the mathematical branches.[53]

A second mathematical example of applying the scientific methodology is Muḥammad ibn Muḥammad ibn Yaḥyā ibn Ismā'īl ibn al-'Abbās al-Būzjānī or AbË al-WafÉ al-BuzjÉnÊ (d. 338/998),[54] who excelled in all domain of mathematics. His method is based on a combination of mathematical theory and its applications, and he described the difference between the tasks of engineers and craftsmen. He was among the first early scholars to emphasize the importance of trained engineers to avoid errors, and he stressed the importance of informing manufacturers of mathematical proofs. His approach was to simplify mathematics for the public, by introducing simple mathematical problems that non-specialists could be used and applied.[55]

The accuracy and creativity of this scholar are found in his book titled *al-ManÉzil al-Sab'*, a systematic method to display information. Moreover, he included in his book an index and features to facilitate the task of the knowledge seeker.[56]

As for the field of chemistry, a profound Muslim chemist AbË 'Abdullah JÉbir ibn ×ayÉn(d. 199 /815) is considered the father and chief of chemistry.[57] It is the duty of a chemist to

[52]Gandz, Solomon. "The Algebra of Inheritance: A Rehabilitation of Al-Khuwārizmī" *Osiris* 5 (1938): 319–391; Seyyed Hossein Nasr (1987). *Sciences and Civilization in Islam*, pp. 148-152.

[53]See Rashed, Roshdi (1988). "al-KhawÉrizmÊ Concept of Algebra". In Zurayq, Qusṭanṭīn; Atiyeh, George Nicholas; Oweiss, Ibrahim M. *Arab Civilization: Challenge and Responses: Studies in Honor of Constantine K. Zurayk* New York: Sunny Press. p. 108; Gandz, Solomon. "The Origin of the Term 'Algebra'" *The American Mathematical Monthly* 33(9) (1926, November): 437–440; KhÉlid AÍmad ×arbÊ (2006). *NamÉdhij li-'UlËm al-×aÌÉrah al-IslÉmiyyah wa AtharuhÉ 'alÉ al-Ókhar* Alexandria: DÉr al-WafÉ'.

[54] Ibn al-NadÊm, AbË al-Faraj MuÍammed ibn IsÍÉq (d. 380). *al-Fihrist*, pp. 449-450.

[55]Saliba, Georgre (2007). *Islamic Science and the Making of the European Renaissance*, MIT, p. 56.

[56] Seyyed Hossein Nasr (1987). *Sciences and Civilization in Islam*, p. 149, pp. 170-171.

work and conduct experiments, and knowledge cannot be known without conducting experiments.[58] Further, he warned against going into the non-beneficial parts of science because they are a waste of time, and in accordance with moral logic, one should not waste time in the forbidden science, with the consequences of guilt and sin.[59] Moreover, one should avoid all of those scientists in various sciences that address science over the human mind and outside the scope of their senses,[60] because they have learned from revelations that prevent them from it. As the verse reads:

> And follow not (O man i.e., say not, or do not or witness not, etc.) that of which you have no knowledge (e.g. one's saying: "I have seen," while in fact he has not seen, or "I have heard," while he has not heard). Verily! The hearing, and the sight, and the heart, of each of those you will be questioned (by Allah). Q. 17: 36.

What they realized was according to the limited human mind and the narrow-mindedness of science no matter how great of performance they desired. Again, an explicit verse of the Qur'Én addresses that notion in the following verse:

> And they ask you (O MuÍammad) concerning the RËÍ (the Spirit); Say: "The RËÍ (the Spirit): it is one of the things, the knowledge of which is only with my Lord. And of knowledge, you (mankind) have been given only a little". Q. 17: 85.

In terms of applying the scientific methodology in the field of social sciences theory, *al-istighrÉb*, as was mentioned earlier regarding the field of transmitters and authenticity known as *'lm al-jarÍÍ wal-ta'dÊl* or *'lm al-rijÉl*/criticism of narrators, with respect to the experimental inductive/*al-istiqrÉ'* method that was used by Muslims since the beginning of its inception. It is no wonder that the pioneers in the domain of the humanities took advantage of the scientific

[57] Ibn al-NadÊm, AbË al-Faraj MuÍammed ibn IsÍÉq (d. 380). *al-Fihrist*, pp. 546-550.
[58] Ibid, p. 546.
[59] JÉbir ibn ×ayÉn (1954). *MukhtÉr JÉbir ibn ×ayÉn* Cairo: Pual Kraws, p. 4 and p. 234; ZakÊ NajÊb MaÍmËd (1961). *JÉbir ibn ×ayÉn* Cairo: Maktabat MaÎr, pp. 76-77.
[60] MuÍammad 'AlÊ al-JundÊ (1990). *TaÏbÊq al-Manhaj 'and 'UlamÉ' al-MuslimÊn* al-ManÎurah: DÉr al-WafÉ', pp. 15-137, and p. 147.

method in their studies in order to prove their theories. AbË Zayd ‘Abd al-RaÍmÉn ibn MuÍammed Ibn KhaldËn (d. 808/1406) is an excellent example.

In Ibn KhaldËn’s approach, the best example is his famous submitted magnum opus *al-Muqadimmah*, which historians have praised for its deeply introspective conclusion and proclaimed *al-Muqadimmah*as a knowledgeable and prolific scholar in *al-istigrÉ‘*. He was strong in his intuition of the analysis and comparison, and successful in controlling the reasons and factors as well as the delivery of a confirmation of the origins, rulings/provisions, and rules and principles.[61]

Ibn KhaldËn reflects on the methodological approach of his famous work *al-Muqadimmah* by saying that “I have invented [methodological approach] among the bizarre aspects as strange doctrine and an originality of methodology and style.”[62] The truth is that the methodological approach of Ibn KhaldËn dealt with history in a way that was theoretically exceptional from his predecessors. Whereas earlier historians saw history as diaries and accidental records only, Ibn KhaldËn was able to transform this to a different outlook, one that was deeper and more systematic, and based on the interpretation of history (emerging and calamity) in accordance with the principle of divine universal Sunna with an emphasis on two factors: religion and morality.[63]

[61] Abderrahmane Lakhassi, “Ibn Khaldun” in *History of Islamic Philosophy*, edited by S. H. Nasr and O. Leaman London: Routledge, p. 353; .Franz Rosenthal (1958). trans., *The Muqaddimah, An Introduction to History* Princeton: Princeton University Press, 11-12; DarwÊsh al-Jawydi (1995). *Mokaddimat Ibn KhaldËn*, by Abdurahman M. Ibn Khaldun Beirut: al-Maktaba al-Asriyah, p. 416; Mohammad A. Enan (1979). *Ibn Khaldun: His life and Work* New Delhi: Kitab Bhavan, pp. 2-8; Walter J. Fischel, (1967). *Ibn Khaldun in Egypt*, Berkeley: University of California Press, pp. 20-29; Aziz al-Azmeh, (1981). *Ibn Khaldun in Modern Scholarship: A Study in Orientalism*. London: Third World Centre, 1981; Myers, Eugene. A., “Ibn Khaldun, fore-runner of ‘new science’,” in *The Arab World*. New York, (March 1966), pp. 19-21;Syed Farid Alatas (2014). *Applying Ibn Khaldūn: The Recovery of a Lost Tradition in Sociology* Routledge: London and New York, pp. 158-160.

[62] Charles Issawi and Oliver Leaman, “Ibn Khaldun, ‘Abd al-Rahman (1332-1406),” in Routledge’s *Encyclopedia of Philosophy*. vol. 4., London: Routledge, pp. 623-627.

[63] Ibid.

Ibn KhaldËn saw history from perspectives both outwardly and inwardly; the outward represents the accidents and events, since days are full of actions, and the inward is a thorough consideration and examination of the explanation for the objects, the origin of which is in the ancient wisdom, and worthy to be constrained in the sciences and the creation of the universe.[64] Thus, while Ibn KhaldËn separated himself from the vulnerable philosophers, he was right, because his approach and interpretation were closer to the core of the experimental inductive methods than the methodology of the philosophers and theologians.[65]Therefore, Ibn KhaldËn undisputedly is the founder of sociology[66] and the producer of a new social philosophy and the founder of historical methodology.

> Society is an organism that obeys its own inner laws. These laws can be discovered by applying human reason to data either culled from historical records or obtained by direct observation. These data are fitted into an implicit framework derived from his views on human and social nature, his religious beliefs and the legal precepts and philosophical principles to which he adheres. He argues that more or less the same set of laws operates across societies with the same kind of structure; so that his remarks about nomads apply equally well to Arab Bedouins, both contemporary and pre-Islamic, and to Berbers, Turkmen and Kurds. These laws are explicable sociologically, and are not a mere reflection of biological impulses or physical factors. To be sure, facts such as climate and food are important, but he attributes greater influence to such purely social factors as cohesion, occupation and wealth.[67]

In my view, the attempt of humanities scholars to benefit from the experimental method and its application, despite its success, faced a challenge greater than what the natural science and mathematicians faced. Human sciences rely on humans as a key element in human nature, and innermost factors and influences overlap, as shown in the following Qur'Énic verse: "And

[64] Ibid.
[65] L.E. Goodman, "Ibn Khaldun and Thucydides," *Journal of the American Oriental Society.* Vol. 92, Issue 2 (April - June 1972): 250-270.
[66] Will Durant (1957). *The Story of Civilization: The Reformation* New York: MJF Books, p. 251.
[67] Charles Issawi and Oliver Leaman, "Ibn Khaldun, 'Abd al-Rahman (1332-1406), in Routledge's *Encyclopedia of Philosophy*. vol. 4., pp. 623-627.

shown him the two ways (good and evil)?" Q. 90: 10. This means that human beings are free to choose, to select between good and evil. Nevertheless, the Islamic law/*sharÊ'a* and revelation were able to give Muslims a broad understanding of the universe, life, humanity, and human beings' relationships among each another. As for the science that deals with the secrets of nature bestowed by God to His creatures, these deal with fixed data and are directed by divine instincts.[68]

Given all of the above, we can say that the civilization of today has not disengaged from the approach developed by Muslims, and they have excelled in the renewed creativity found in Islamic culture. Moreover, Muslims should be proud of something they introduced not only to Europe but to human history. The reason behind this pride is their scientific method, which was credited with preserving the legacy and heritage of previous civilizations in the sciences and arts.[69]

However, some Europeans were spiteful (pirates of knowledge and Islamic methodology) and deliberately denied Muslims the merit of their renaissance and thus denied Islamic influence on scientific fields at the present time. When Europeans claim these achievements were limited to them alone, they should take into consideration the scientific bridge of Muslim methodology and approach that brought knowledge to their continent that was submerged in darkness and ignorance.

The approach of ancient civilizations (Greek and Roman) was dependent on the human mind without optimizing the senses associated with it of hearing sound, sight, and intuition, but instead used a mental approach that spun mythology superstition and belief in a supernatural

[68] MuÎÏafÉ ×ilmÊ (1984). *ManÉhij al-BaÍth fÊ al-'UlËm al-IslÉmiyya* Cairo: Maktabat al-ZahrÉ', p. 7.
[69] MuÎÏafÉ NaÌÊf (1942). *al-×asab ibn al-Haytham: BuÍËthuh waKushËfuhu al-BaÎariyya*, pp. 123-139.

phantom force. Therefore, the ancient approach did not seek the truth with an open mind and active senses apart from fancy legends.[70]

Moreover, in the age of European Renaissance, Francis Bacon (d. 1626) was not the one who introduced inductive experiments/*al-manhaj al-istiqrÉ'Ê al-tajrÊbÊ* as is claimed.[71] He defined induction that exists between two or more cases, but heuristics are two types: measurement and extrapolation, and the older inductive reasoning conceived by Aristotle. The traditional induction was used by Francis Bacon and his followers.[72]

Francis Bacon's reflection on the inductive experimental method/*al-manhaj al-istiqrÉ'Ê al-tajrÊbÊ* consisted of axioms leading to a result, and the greater the number of axioms, the more results; induction is expressive of external reality so that we can get out of the formal logic of Aristotle, and the induction must be consistent with the rules and laws of the basic thought and be totally free of contradictions. The terms and rules of induction are also available through sound observation and experience, as are how to move from axioms to the rules of the results.[73]

Nevertheless, no doubt Bacon was influenced and motivated by classical Muslim scholarship such as Islamic manuscripts, books, and research; however, the credit was given to

[70] Abu al-×asan 'AlÊ al-NadawÊ (1987). *Al-Islam: Atharuhu fÊ al-×aÌarah wa FaÌlihi 'alÉ al-InsÉniyyah* Jada: DÉar al-ManÉr, pp. 85-89; ZakÊ NajÊb MaÍmËd (2009). *TajdÊd al-Fikir al-'ArabÊ* Amman: WizÉrat al-ThaqÉfah, pp. 312-316.

[71] Francis Bacon has been called the father of empiricism. His works argued for the possibility of scientific knowledge based only upon inductive and careful observation of events in nature. Most importantly, he argued this could be achieved by use of a skeptical and methodical approach whereby scientists aim to avoid misleading themselves. While his own practical ideas about such a method, the Baconian method, did not have a long lasting influence, the general idea of the importance and possibility of a skeptical methodology makes Bacon the father of scientific method. This marked a new turn in the rhetorical and theoretical framework for science, the practical details of which are still central in debates about science and methodology today; KÉmil MuÍammad 'UwÊÌah (1993). *Francis Bacon: FaylasËf al-Manhaj al-TajrÊbÊ al-×adÊth* Beirut: DÉr al-Kutub al-'Ilmiyyah, pp. 12-17.

[72] MuÎÏafÉ NaÌÊf (1942). *Al-×asab ibn al-Haytham: BuÍËthuh waKushËfuhu al-BaÎariyya*, 123-128; YumnÉ ÙarÊf al-KhËlÊ (2000). *Falsafat al-'Ilm fÊ al-Qirn al-'AshrÊn: al-×aÎÉd, al-AfÉq al-Mustaqbaliyya* Kuwait: 'Ólam al-Ma'rifah, p. 264.

[73] See the work of Ibn al-Haytham reflection and work on the inductive experimental/*al-manhaj al-istiqrÉ'Ê al-tajrÊbÊ* which his reflection that came in (354-430/965-1045), verses Francis Bacon (d. 1626) reflections. It appears nearly six centuries before the work of F. Bacon. MaÍmËd FahmÊ ZÊdÉn (1980). *al-IstiqrÉ' w al-Manhaj al-'IlmÊ*, Alexandria: DÉr al-JÉmi'Ét al-MaÎriyya, pp. 74-78; MuÎÏafÉ NaÌÊf (1942). *Al-×asab ibn al-Haytham: BuÍËthuh waKushËfuhu al-BaÎariyya*, pp. 123-139.

Europe. Moreover, Francis Bacon was credited with knowing how to think and learning to catch up with the human civilization, which came from Islamic science and platforms.[74]

Through these stages, the modern scientific method (theoretical and applied research) is discerned in the authenticity of Muslims curricula and promoted their civilization. Enormous scientific progress and the communications revolution come from overlapping cultures. Contemporary scholars have been influenced by the Islamic scientific approach and civilization, and contemporary science owes much to and is held spellbound by Muslim approaches and cultures that at one time dominated and prevailed in the world.

There is no doubt that the Islamic civilization in the Middle Ages is considered an important link in the history of science and civilization by the scientists of the establishment of a sound scientific methodology that helped develop new knowledge. But in the modern Islamic world, still need to re-read its heritage in modern times and terminology, not only to modernize the Islamic scientific culture, but also to Islamize scientific thinking according to the characteristics of Islamic perception and its components. The Islam of knowledge in general and scientific knowledge in particular must be from the main tributaries of Islamic awakening.

[74] Will Durant (1957). *The Story of Civilization: The Reformation*, p. 869, p. 915, and p. 939; ×abÊb al-ShÉrËnÊ (1981). *Francis Bacon* Casablanca: DÉr al-ThaqÉfah, pp. 34-37; KÉmil MuÍammad ‘UwÊÌah (1993). *Francis Bacon: FaylasËf al-Manhaj al-TajrÊbÊ al-×adÊth* Beirut: DÉr al-Kutub al-‘Ilmiyyah, pp. 12-17.