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Al-Khwarizmi and Thābit ibn Qurra and Their Impact on the Rational Sciences (A Historical Study)

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ABSTRACT

This research aims to highlight the contributions of Muslim scholars to the fields of transmitted and rational sciences by examining two prominent figures: Muḥammad ibn Mūsā al-Khwārizmī and Thābit ibn Qurra. These two scholars played a fundamental role in developing the foundations of human knowledge by integrating transmitted knowledge with rational inquiry and by linking earlier scientific heritage to the Islamic intellectual renaissance. The study addresses various aspects of their works. Al-Khwārizmī focused on mathematics, astronomy, and geography, and contributed to establishing the foundations of algebra, which represented a major intellectual revolution in the history of science. Thābit ibn Qurra, on the other hand, excelled in translation and the scientific interpretation of texts, in addition to his contributions to philosophy, medicine, and astronomy, reflecting his role in transmitting earlier sciences into the Islamic milieu and further developing them. The research concludes that the contributions of these scholars were not merely acts of transmission, but involved reformulation and development that produced an original scientific methodology, which later became a foundation for modern sciences. It also emphasizes that studying their efforts helps in understanding the position of Islamic civilization in the scientific and intellectual history of humanity.

Keywords: *Al-Khwarizmi; Thābit ibn Qurra; Islamic Civilization; Rational Sciences; Transmitted Sciences; Algebra; Islamic Intellectual Heritage.*

1. Introduction

Islamic Arab civilization placed great importance on knowledge and scholars, as the noble Islamic Sharia encouraged the pursuit of learning. Moreover, the Arabic language, the language of the Holy Qur'an, played a prominent role in this regard. It received special care from Arabs and Muslims due to its importance in preserving the identity and unity of the ummah. As a result, many scholars emerged who excelled in various fields of knowledge, particularly the rational sciences, such as mathematics, astronomy, medicine, physics, and others. The translation movement played an effective role in the development of these sciences.

Regarding the importance of these sciences in Islamic Arab civilization, Dr. Ṣāliḥ Aḥmad al-ʿAlī stated: "The interest in the sciences of mathematics, physics, and others among the Arabs extended to modern Arab scholars of the Mashriq. A number of them undertook the publication and republication of some of their books, while others translated certain

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works and provided commentaries on them. Among the most notable examples, without limitation, is Al-Jabr wa al-Muqābala by al-Khwārizmī, which Dr. ʿAlī Muṣṭafā Musharrafah and Dr. Aḥmad Mursī Aḥmad republished…"

He further adds: In reality, there is hardly a year in recent times in which a manuscript in the mathematical sciences is not published, especially among Arab scholars. Arab researchers have also published valuable studies in various mathematical and physical sciences, among the most notable being the works of Dr. Muṣṭafā Naẓīf on al-Ḥasan ibn al-Haytham and the science of optics, as well as the studies of Dr. Aḥmad Saʿīdāt on Arab science" (1).

Accordingly, the topic "Al-Khwarizmi and Thābit ibn Qurra and Their Impact on the Rational Sciences" is the focus of this study. The research is divided into two sections. The first addresses al-Khwārizmī's contributions to the rational sciences, while the second examines the contributions of Thābit ibn Qurra to the rational sciences.

2. Al-Khwārizmī's Contributions to the Rational Sciences

Islam called for education and emphasized the virtue of knowledge. Among the first Qur'anic verses that referred to learning is the Almighty's saying: "Read in the name of your Lord who created"(2), as well as His saying, Exalted is He: "Allah will raise those who have believed among you and those who were given knowledge by degrees; and Allah is All-Aware of what you do"(3), and His saying, Exalted is He: "And say: 'My Lord, increase me in knowledge"(4), and His saying, the Most High: "He it is who sent among the unlettered a Messenger from among themselves, reciting to them His verses, purifying them, and teaching them the Book and wisdom, although before that they were in clear error"(5). These and many other blessed verses are accompanied by noble Prophetic traditions, among them the saying of the Prophet (ﷺ): "Seek knowledge even unto China" (6), and the saying of Imam ʿAlī (peace be upon him):

Glory belongs only to the people of knowledge, for they

are guides to the right path for those who seek guidance.

The worth of every person is measured by what he knows,

and the ignorant are enemies of the people of knowledge.

So attain knowledge, and you will live forever through it;

people are dead, while the people of knowledge are alive(7).

The establishment of the House of Wisdom in Baghdad is considered one of the great civilizational achievements that fulfilled scientific, educational, and reformative objectives, providing noble services to all humanity. Therefore, the early scholars placed most of the fundamental sources and original works in that scientific house. Baghdad, with its House of Wisdom, attracted scholars, and people flocked to it from everywhere, drawn by its intellectual and scientific life(8). They brought various forms of thought and culture to it, and Baghdad witnessed social and ethnic groups that merged within study circles(9).

The Abbasid caliphs would correspond with scholars to acquire rare and exceptional works across various disciplines, and entrust them to translators for translation (10). Consequently, Baghdad became a hub not only for scholars, merchants, and leaders of political and religious movements, but also a convergence point beyond merely being the political capital and center of the Caliphate (11).

Amidst these conditions, numerous luminaries in diverse fields of knowledge emerged, providing services of immense importance not only to Muslims but to the entire world. Among them were Al-Hasan Al-Basri (d. 110 AH/728 CE), Muhammad ibn Sirin (d. 110 AH/728 CE), Al-Bukhari (d. 251 AH/870 CE), Al-Layth ibn Sa'd (d. 175 AH/791 CE),

Al-Khwarizmi (d. 232 AH/846 CE), Thabit ibn Qurra (d. 288 AH/901 CE), and many others whose scholarly contributions were significant and benefited people near and far.

Al-Khwarizmi is Abu Abdullah Muhammad ibn Musa al-Khwarizmi. He was born in 164 AH/781 CE in the town of Khiva, in the southern region of Khwarazm [(12)], which is present-day Uzbekistan. He was born into a Persian family, and after his birth, his family moved to live in the city of Baghdad. He studied mathematics at the House of Wisdom under a group of scholars, receiving an award in mathematics after two years of study. When Caliph Harun al-Rashid (d. 193 AH/809 CE) heard of his intelligence and acumen, he summoned him to be one of the Muslim scholars in the House of Wisdom. He was later appointed by Caliph al-Ma'mun (d. 218 AH/833 CE) as the head of this institution [(13)]. He accomplished many of his achievements and studies over a period of two decades (197–218 AH/813–833 CE), during which he was able to author and translate numerous works in the fields of algebra and astronomy. He translated many manuscripts from Greek into Arabic and also published many of his own works in Arabic. Al-Khwarizmi passed away after 232 AH/846 CE [(14)].

Al-Khwarizmi is regarded as one of the greatest Muslim scientists of global stature who left significant contributions to the fields of mathematics and astronomy. He was a shining star in the firmament of mathematics, and many Arab and European scholars owe a great debt to him, having been guided by the light of the new treasures he added to the precious wealth of knowledge. He stood at the head of a large group of translators, astronomers, and mathematicians at the House of Wisdom in Baghdad during the reign of Al-Ma'mun.

At the House of Wisdom, Al-Khwarizmi advanced mathematical thought by developing a system for solving all first- and second-degree equations with one unknown using algebraic and geometric methods. Thus, his work “Al-Kitāb al-Mukhtaṣar fī Ḥisāb al-Jabr wal-Muqābalah” (The Compendious Book on Calculation by Completion and Balancing) is considered the first systematic attempt to develop the science of algebra based on logical, scientific foundations. For this reason, Professor George Sarton designated the first half of the ninth century as the "Age of Al-Khwarizmi" in his work “Introduction to the History of Science”, stating that Al-Khwarizmi was the greatest mathematician of that era [(15)]. Commenting on his legacy, the author Muhammad Khan noted in his book “A Glimpse at Muslim Achievements in Cultural Sciences”: "Al-Khwarizmi stands in the foremost rank of mathematicians across all ages, and his works served as the principal source of mathematical knowledge for several centuries in both the East and the West"[(16)].

The science of algebra truly began with the rise of Al-Khwarizmi's star upon the publication of his famous work, Al-Kitāb al-Mukhtaṣar fī Ḥisāb al-Jabr wal-Muqābalah (The Compendious Book on Calculation by Completion and Balancing) [(17)]. In it, Al-Khwarizmi described how he provided solutions and various formulas for quadratic equations, along with proofs for the methods he employed. Not content with this alone, he proceeded to establish equations that represented simplifications for solving algebraic problems. Louis Charles Karpinski, in his book on Al-Khwarizmi, stated: "Al-Khwarizmi was the great master of Baghdad's Golden Age. He was among the first Muslim scholars to compile classical mathematics from both the East and the West, preserving it until it benefited a reawakening Europe. This man possessed vast knowledge, and science owes to him our present understanding of the disciplines of algebra and arithmetic"[(18)].

In all his endeavors, Al-Khwarizmi was able to address the operations of multiplication and division within mathematical formulations involving unknowns, in order to determine their values through a method he termed al-jabr wal-muqābalah (restoration and balancing). Europeans undoubtedly learned algebra from the works of Al-Khwarizmi. The French mathematician Viète remarked: "Until now, algebra and al-muqābalah that great art has been like a piece of gold whose brilliance cannot be concealed; mathematicians have known it through their use of this discipline"[(19)]. Similarly, the Italian mathematician Cardano noted that this art originated with Muḥammad ibn Mūsā al-Khwārizmī[(20)].

History records that the foundations of algebra were established with the work **Al-Kitāb al-Mukhtaṣar fī Ḥisāb al-Jabr wal-Muqābalah** (The Compendious Book on Calculation by Completion and Balancing) by Muḥammad ibn Mūsā al-Khwārizmī. This discipline had a long incubation period, originating from Babylonian mathematics and passing through the golden age of constructive geometry in the time of Euclid(21). Al-Khwārizmī authored numerous works, including:

1. A book on arithmetic.
2. A book on geography, in which he explained the views of Ptolemy.
3. A book combining arithmetic, geometry, music, and astronomy.
4. A book in two volumes on the tables and motions of stars.
5. A book explaining how to tell time using the sun.
6. A book on the use of the astrolabe.
7. A book clarifying methods of addition and subtraction.
8. Al-Kitāb al-Mukhtaṣar fī Ḥisāb al-Jabr wal-Muqābalah (The Compendious Book on Calculation by Completion and Balancing).
9. Kitāb Ṣūrat al-Arḍ (The Image of the Earth), on its geography.
10. A book on history.
11. A book on the image of the Earth concerning cities, mountains, islands, and rivers.
12. Kitāb al-Maʿrifah (The Book of Knowledge), dealing with astronomy.
13. A book of testaments (or legal opinions).
14. A translation and commentary on Ptolemy's “Almagest” into Arabic.
15. The First “Zīj” of al-Khwārizmī (astronomical tables).
16. The Second “Zīj” of al-Khwārizmī.
17. A treatise on the approximate ratio (π) and its mathematical value.
18. A treatise explaining the units used in measuring areas and volumes.
19. A treatise presenting another proof of the Pythagorean theorem using an isosceles right triangle.
20. A comprehensive treatise detailing the laws for adding, subtracting, multiplying, and dividing algebraic quantities.
21. A treatise explaining how to perform the four basic arithmetic operations on irrational quantities (surds).
22. Kitāb al-Rukhāmah (The Book of the Marble [Sundial]) a marble slab inscribed with lines to determine time by the sun.
23. A book on the depiction of the inhabited quarter (of the Earth).
24. A book on addition and subtraction (al-Jamʿ wa al-Tafrīq).
25. A book on the configuration of the Earth.

26. A book on commercial transactions (al-Muʿāmalāt).

27. A book on geometric calculation (al-Muqniʿ fī al-Ḥisāb al-Handasi).

28. The Great Book on Music.

29. Kitāb al-Shifāʾ (The Book of Healing).

30. A treatise on cubic and quartic equations.

31. Al-Risālah (The Epistle).

32. Five epistles on philosophy.

33. An epistle on the cosmos and divine obligation (al-Kawn wa al-Taklīf).

34. Zīj Malikshāh (The Astronomical Tables of Malikshah)[22].

From the foregoing, it is evident that the Islamic scholar Al-Khwarizmi laid the foundations of algebra through his two works, *Al-Mukhtaṣar fī Ḥisāb al-Jabr wal-Muqābalah* (The Compendious Book on Calculation by Completion and Balancing), which later became an essential reference for teaching in Europe for many centuries. Furthermore, Al-Khwarizmi contributed to the introduction of the decimal numeral system by introducing Indian numerals to the Islamic world, which were subsequently transmitted to Europe, leading to the advancement of arithmetic and modern mathematics.

In the fields of astronomy and geography, Al-Khwarizmi produced accurate astronomical tables and contributed to correcting the measurements of the longitude and latitude of cities. His influence on Europe and its Renaissance was clear through the translation of his works into Latin. The term "algorithm," which is fundamental to computer science today, is derived from his name and theories. Al-Khwarizmi also gained widespread fame in astronomy; by order of Caliph Al-Ma'mun, he abridged Ptolemy's "Almagest", naming it "Al-Sindhind". Al-Ziriklī mistakenly translated this title as "Al-Dahr Dāhir". As the Italian scholar Nello noted in his book "Astronomy in the Middle Ages", this is the translation cited by Ibn al-Qifti. "Al-Sindhind", as the aforementioned scholar explained, is derived from "Siddhānta", meaning "that which is straight, without deviation or change," a term applied by the Indians to the highest ranks of knowledge, including arithmetic and astronomy.

Al-Khwarizmi left numerous works across various disciplines. Among the most important are:

- Kitāb al-Jabr wal-Muqābalah (The Book of Algebra), his most significant work;
- Kitāb al-Jamʿ wal-Tafrīq fī al-Ḥisāb al-Hindī (The Book of Addition and Subtraction in Indian Arithmetic);
- Kitāb Rasm al-Murabbaʿ al-Maʿmūr (The Book on Drawing the Inhabited Square);
- Kitāb Taqwīm al-Buldān (The Book of the Demarcation of Countries);
- Kitāb al-ʿAmal bil-Asṭurlāb (The Book on the Use of the Astrolabe);
- Kitāb al-Tārīkh (The Book of History).

3. Contributions of Thābit ibn Qurrah to the Sciences and Knowledge

Thābit ibn Qurrah is Abū al-Ḥasan Thābit ibn Qurrah ibn Marwān ibn Thābit ibn Karāyā ibn Ibrāhīm ibn Karāyā ibn Mārīnūs ibn Salāqūriyūs al-Ḥarrānī. He was born in the city of Ḥarrān[23] in 221 AH/836 CE and died on Thursday, the 26th of Ṣafar, 288 AH/901 CE, in the city of Baghdad[24]. He was from the Ṣābi'ah Ḥarrānīyīn [25]. The city of Ḥarrān served as a geographic, commercial, and civilizational link between the Abbasid Caliphate and the Byzantine Empire, and thus the city benefited from both Abbasid and Byzantine cultures. Its strategic location encouraged Thābit ibn Qurrah to practice the profession of money-changing (al-ṣayrafah) from a young age [26].

At a young age estimated by some historians to be around fifteen Thābit devoted himself to learning languages (Greek, Hebrew, Syriac) and immersed himself in the study of philosophy, mathematics, logic, and medicine. He thus focused on studying the works of Euclid, Galen, Aristotle, and Plato. The languages he had learned aided him in this pursuit, and he became a translator of books written in these languages, particularly as he was described as possessing a strong memory and a penetrating intellect [(27)].

Due to certain of Thābit's religious interpretations, he faced censure from members of his own Ṣābian Ḥarrānian community. He was forbidden from entering the temple, repented for a period, then returned to his original views and was again barred from the temple. He consequently migrated to a large village in the Jazīrah region called Kafr Tūthā, where he resided for some time [(28)]. He later moved to the city of al-Raqqah in 234 AH/848 CE, where he established a private school for teaching the sciences of philosophy, astronomy, mathematics, and medicine. Many students graduated from this school, which contributed significantly to Thābit ibn Qurrah gaining widespread fame [(29)].

The most significant turning point in Thābit ibn Qurrah's scholarly life was his meeting with the Banū Mūsā (the sons of Mūsā ibn Shākir: Aḥmad, Muḥammad, and al-Ḥasan), who were patrons of the scientific movement at the House of Wisdom in Baghdad. These brothers would purchase Greek manuscripts from the Byzantine lands at high costs and then entrust them to distinguished linguists for translation [(30)].

This acquaintance proved immensely beneficial for Thābit's intellectual career. He moved with them to Baghdad, settled there, and worked alongside them as an active member of the scientific committee headed and supervised by the Banū Mūsā. Among them, Muḥammad ibn Mūsā al-Khwārizmī, renowned for his extensive contributions to mathematics and astronomy, often took Thābit ibn Qurrah with him on his journeys to Byzantine territories to acquire and purchase Greek books, which significantly contributed to developing Thābit's capabilities. The second son, Aḥmad, was a prominent scholar in mechanics (ʿilm al-ḥiyal) and astronomy, while their third brother, al-Ḥasan, specialized in geometry. Working alongside these eminent scholars endowed Thābit with invaluable experience and knowledge [(31)].

On this point, the German Orientalist Sigrid Hunke states: "Thābit was one of the geniuses whose talents blossomed in the house of the Banū Mūsā and was one of their significant discoveries"[(32)].

Thābit ibn Qurrah's brilliance and excellence in the sciences helped him gain proximity to the Caliph al-Muʿtaḍid billāh, who assumed the Abbasid caliphate in 279 AH/892 CE and was known for his love of knowledge and scholars. The Caliph appointed him to the position of court astronomer, and he soon became his foremost advisor and one of his closest confidants. As an indication of Thābit's intelligence, some historians note that in 283 AH/896 CE, Caliph al-Muʿtaḍid asked his astrologers about the conditions of that year. They replied that it would be a year of heavy rain and that Baghdad would be flooded. Thābit disagreed with them based on his scientific and astronomical calculations, predicting instead a year of drought. The outcome matched what Thābit had foretold, further strengthening his closeness to the Caliph, who bestowed upon him ample wealth and estates, in addition to the income he earned from practicing medicine and preparing pharmaceuticals [(33)].

Thābit ibn Qurrah combined mastery of a vast array of sciences, excelling in all of them. He excelled in mathematics, distinguished himself in astronomy, and mastered numerous languages from which he translated and transmitted knowledge. Consequently, he demonstrated brilliance in geometry, arithmetic, medicine, and pharmacology.

Thābit ibn Qurrah is among those Arab and Muslim scholars who regarded knowledge as an intellectual pursuit and an end in itself. They found in scientific research and the uncovering of truth an unparalleled mental delight, which led him to produce many significant contributions across various branches of science, including mathematics, astronomy, medicine, logic, and philosophy. Al-Qifṭī notes that he authored approximately one hundred and eighty books [(34)].

However, most of these books have been lost. Thābit ibn Qurrah was an exemplary mathematician, as evidenced by the importance of his works dedicated to mathematics. Among his writings in this field are: Al-Aʿdād al-Mutaḥābbah (Amicable Numbers), Ashkāl al-Qaṭṭāʿ (Figures of the Sector), Istikhrāj Masāʾil al-Handasa (Extraction of Geometrical Problems), Al-Nisba al-Muʾallafah (The Composite Ratio), Al-Mafrūḍāt (The Premises), Ālat al-Zumur (The Instrument of Clusters), Ashkāl al-Khuṭūṭ allatī Yamurr ʿalayhā Ẓill al-Qiyās (Figures of the Lines on which the Shadow of the Gnomon Passes), Ashkāl al-Qaṭṭāʿ (Figures of the Sector), and a Risālah fī al-Aʿdād (Treatise on Numbers)[35]. Both Ibn Khallikān and al-Dhahabī accorded him the epithet "al-Ḥāsib" (The Calculator) [36], which indicates his strength in the science of arithmetic. The Italian Orientalist Carmela Rometti noted that Thābit investigated conic sections and was unique in his inquiries [37].

He also excelled in geometry. Both Ibn al-Nadīm and al-Qiftī listed numerous works on this subject, including: Risālatuhu fī Istikhrāj al-Masāʾil al-Handasiyyah (His Treatise on Extracting Geometrical Problems), Kitāb fī Qaṭʿ al-Makhruṭ al-Mukāfiʾ (Book on the Parabolic Section), Maqālatuhu fī al-Handasa (His Treatise on Geometry), composed for Ismāʿīl ibn Bulbul, Kitābuhu fī anna al-Khaṭṭayn al-Mustaqīmayn idhā Kharajā ʿalā Aqall min Zāwiyatayn Qāʾimatayn Iltaqayā fī Jihhat Khurūjihā (His Book on [the proposition] that if two straight lines make angles with a transversal less than two right angles, they meet on that side), Kitābuhu fī al-Murabbaʿ wa Qiṭʿatih (His Book on the Square and its Segment), Kitābuhu fī Masāḥat al-Ashkāl al-Musṭaḥa wa Sāʾir al-Busṭ wa al-Ashkāl al-Mujassamah (His Book on the Area of Plane and Other Surface and Solid Figures)[38], Maqālatuhu fī Taṣḥīḥ Masāʾil al-Jabr bil-Barāhīn al-Handasiyyah (His Treatise on Correcting Algebraic Problems with Geometric Proofs)[39], and Kitābuhu fī Ālāt al-Sāʿāt allatī Tusammā Zakhāmāt (His Book on Timekeeping Instruments Called Clepsydras)[40].

From the foregoing, it is evident that Thābit ibn Qurrah laid important foundations in geometry, arithmetic, and number theory, and he made additions to the works of Euclid and Archimedes.

Al-Qiftī remarked on Thābit's efforts in translation: "As for what he translated from one language to another, it is considerable"[41]. Thābit ibn Qurrah's efforts were not limited to translation alone; he also corrected errors within the texts, abridged them, added to them, and wrote his own commentaries. George Sarton, author of A History of Science, said of him: "Thābit's work in translating Euclid's treatise on the regular heptagon constitutes the oldest systematic treatise on this subject"[42]. A prime example of his correction and addition of notes is his work on a botanical book by Aristotle, which had previously been translated into Arabic by Isḥāq ibn Ḥunayn [43].

Similarly, he abridged the Almagest (known in Greek as the Mathēmatikē Syntaxis, meaning "Mathematical Treatise"), considered one of the greatest one hundred books in history [44]. Thābit corrected the errors made by Ḥunayn ibn Isḥāq and refined the text [45]. In reality, Thābit ibn Qurrah functioned as the head of a translation school, overseeing the translations of others. He translated into Arabic works by Apollonius, including a treatise on conics, a treatise on touching circles, and a treatise on cutting lines. He also translated other works by Euclid, Archimedes, Autolycus, Theodosius, and others. Notably, some of these books have reached us only through their Arabic translations, as the original Greek versions have been lost to time. An example is the lost treatise by Euclid on the construction of the regular heptagon, which reached us through Thābit's translation. Regarding this, the historian George Sarton believed it to be the oldest systematic treatise on this subject [46].

Thābit was also highly proficient in astronomy. He belonged to the Ṣābian community of Ḥarrān, whose members had a long-standing engagement in this field. Brockelmann noted: "The people of Ḥarrān had a strong inclination towards mathematics and astronomy, as these were closely linked to their religious doctrine"[47]. Among his works in this science are: Kitāb Ḥisāb al-Ahilla (Book on the Calculation of Luminaries), Risālatuhu fī Sanat al-Shams (His Treatise on the Solar Year)[48], a book on observations(al-arṣād)[49], Kitāb fī ʿIllat Kusūf al-Shams wal-Qamar (Book on the Cause of Solar and Lunar Eclipses), Kitābuhu fī Ibtāʾ al-Ḥarakah fī Falak al-Burūj wa Surʿatihā wa Tawassuṭihā (His Book on the Slowing, Acceleration, and Mean Motion in the Zodiacal Sphere), and Kitābuhu fīmā Yaẓhar fī al-Qamar min Āthār al-Kusūf wa ʿAlāmātih (His Book on the Apparent Effects and Signs of Eclipses on the Moon)[50].

However, Thābit's significant role in astronomy lies in his advocacy of the "Theory of the Trepidation of the Equinoxes" (Nazariyyat Nawṣān al-Iʿtidālayn), which contradicted the earlier theory of the precession of the equinoxes (Mabādirat al-Iʿtidālayn). This theory of trepidation posits that there are oscillatory (cyclic) variations in the retrograde motion of the equinoctial points [the vernal and autumnal equinoxes are the points of intersection between the ecliptic and the celestial equator; the sun passes the first point at the beginning of spring and the second at the beginning of autumn, resulting in equal day and night worldwide]. In contrast, the theory of the precession of the equinoxes indicates that the timing of the equinoxes advances by twenty minutes per year due to the shift of the equinoctial points by fifty arcseconds along the ecliptic. This implies, as recounted by Ptolemy (d. 167 BCE near Alexandria), that Hipparchus (born in Nicaea, Anatolia, in the 2nd century BCE), when comparing his own observations with those made a century earlier in Alexandria by Aristyllus and Timocharis (3rd century BCE), determined that the stars had shifted slightly eastward, thus discovering the precession of the equinoxes"(51).

The theory of the trepidation of the equinoxes was originally formulated by "Theon of Alexandria" (late 4th century CE). Although it is an erroneous theory, it was accepted by many. Despite contradicting the theory of the precession of the equinoxes proposed by Hipparchus and explained by Ptolemy, some astronomers attempted to reconcile the two theories. The theory of trepidation was accepted by the Indian astronomer "Āryabhaṭa" (late 5th century CE), who can be considered a link between Theon and Proclus on one side, and "Thābit ibn Qurrah" (late 9th century CE) the first writer in the Islamic era to address this inquiry on the other(52).

It is clear from the foregoing that Thābit ibn Qurrah corrected certain theoretical concepts of Ptolemy and established precise calculations for planetary motion.

In the field of medicine and pharmacology, Thābit was a skilled physician who excelled in medicine and gained widespread fame in this discipline. He left numerous anecdotes, recounted by compilers such as al-Qifṭī and others. Thābit also authored several works in this field, some of whose titles are recorded by Ibn al-Nadīm and al-Qifṭī, demonstrating the diverse subjects tackled by this exceptional scholar:

- -His treatise on stones formed in the bladder, which al-Qifṭī titled *Kitābuhu fī Awjāʿ al-Kulā wal-Mathāna wa Awjāʿ al-Ḥaṣā* (His Book on Pains of the Kidneys, Bladder, and Stone Pains) (53).
- His book on joint pain and gout, a treatise (54).
- His treatise on white patches that appear on the body (55).
- His compendium of Galen's book on simple drugs (56).
- His treatise on smallpox and measles (57).
- His book on the interval between the two arterial pulsations (58), in two treatises. He composed this book in Syriac because he alluded in it to a refutation of al-Kindī. It was translated into Arabic by one of his students known as ʿĪsā ibn Asīr al-Naṣrānī.
- His book on the description of fetal formation.
- His book on infants born at seven months.
- A book on the dissection of certain birds, believed to be herons.
- His book on jaundice, its types, and its treatment.
- His book on the categories into which drugs are classified.
- His book on the categories by which drugs are weighed (59).
- Kitāb al-Khibrah fī ʿIlm al-Ṭibb (The Book of Experience in the Science of Medicine), mostly concerning therapeutics. This book, which he authored for his son Sinān, was published in Cairo by J. Ṣubḥī in 1928 CE. An analysis of it was written by Max Meyerhof in the journal Isis in 1930 CE. A manuscript copy dated to the 10th century AH exists in the Malik Library in Tehran under number (4543). This book is of the type known as kunnāsh or kunnāsh (a Syriac term, its Arabic equivalent being al-Ḥāwī [The Comprehensive]).

Regarding Thābit's skill in the art of diagnosis and treatment, the following account transmitted by al-Qifṭī in his book serves as a testament. Al-Qifṭī narrated: Abū al-Ḥasan ibn Sinān related: "One of my ancestors recounted about our grandfather Thābit ibn Qurrah that one day, as he was passing by on his way to the Caliph's palace, he heard wailing and lamentation. He asked, 'Has the butcher from this shop died?' They replied, 'Yes, by ALLAH, our master, suddenly last night.' He said, 'He is not dead. Take me to him.' The people turned aside with him and carried him to the butcher's house. He instructed the women to stop wailing and crying and ordered them to prepare some broth. He signaled to one of his attendants to strike the butcher's heel with a stick, while he felt his pulse. The attendant kept striking his heel until Thābit said, 'That is enough.' He then called for a cup, took out a small container from his sleeve containing a medicine, dissolved it in the cup with a little water, opened the butcher's mouth, and administered it to him. He swallowed it, and a cry and shout arose in the house and the street that the physician had revived the dead. Thābit then went forward to close the door. The butcher opened his eyes, they fed him the broth, sat him up, and Thābit stayed with him for a while. Soon, the Caliph's attendants arrived to summon him. He went out with them while the whole world was in an uproar, with common people crowding around him until he entered the Caliph's palace. When he stood before the Caliph, the Caliph said to him, 'O Thābit, what is this wonder that has reached us about you?' He replied, 'O my master, I used to pass by this butcher and see him cutting open a liver, sprinkling salt on it, and eating it. I found this act repulsive at first, then I reckoned that an apoplexy would befall him. Also, I kept watch over his condition. When I learned of his fate, I left and prepared a medicine for apoplexy which I carried with me every day. Today, when I passed by and heard the wailing, I said, "The butcher has died." They said, "Yes, he died suddenly last night." I knew then that the apoplexy had struck him. I entered his house and found no pulse. I struck his heel until his pulse movement returned, then gave him the medicine. He opened his eyes, and we fed him broth. Tonight he will eat a loaf of bread soaked in broth, and tomorrow he will leave his house"[(60)].

All compilers who mentioned his name attested to Thābit's proficiency in the art of medicine. Among the testimonies is what is recorded in Tārīkh al-Islām (History of Islam) by al-Dhahabī, who stated: "In the time of Thābit ibn Qurrah, the sage, there was no one who could match him in medicine, nor in any branch of philosophy"[(61)].

Thābit ibn Qurrah distinguished himself by translating and commenting on Greek works, thereby playing a pivotal role in transferring the scientific heritage into Arabic. He served as a crucial link between Greek and Islamic civilization. Consequently, Thābit ibn Qurrah had a clear and significant influence on the ideas of many later scholars, such as Ibn al-Haytham and al-Bīrūnī.

4. Conclusion

From the foregoing discussion, the following points become evident:

1. The profound emphasis placed by the Islamic faith on knowledge and its acquisition is clear. Numerous noble Quranic verses encourage Muslims to pursue knowledge and affirm the elevated status of scholars within the benevolent Islamic Sharia.

2. Many eminent Arab and Muslim scholars emerged who dedicated themselves to the pursuit of knowledge. A multitude of them excelled in various scientific fields, and through their genius, they left a distinct intellectual legacy and rendered significant benefits, not only to Muslims but to the entire world.

3. Al-Khwarizmi stands out as one of the most prominent scientists of global stature who left a substantial and noble legacy in the fields of mathematics and astronomy. He was a brilliant star in the firmament of mathematics, to whom many scholars worldwide are indebted, having been guided by the light of the new treasures he added to the precious wealth of knowledge.

4. Thābit ibn Qurrah combined mastery of numerous sciences, in which he excelled. He distinguished himself in mathematics, surpassed in astronomy, and mastered many languages from which he translated and transmitted knowledge. He also demonstrated brilliance in geometry, arithmetic, medicine, and pharmacology. His extensive body of work attests to this, as he contributed sciences and knowledge that benefited Muslims and others alike.

FOOTNOTE

1. *Mathematical Sciences and Their Status in Islamic Civilization*, vol. 3, p. 38.
2. Sūrat al-ʿAlaq, verse 1.
3. Sūrat al-Mujādilah, verse 11.
4. Sūrat Ṭā Hā, verse 114.
5. Sūrat al-Jumuʿah, verse 2.
6. Al-Ghazālī, *Iḥyāʾ ʿUlūm al-Dīn*, vol. 1, p. 18.
7. Al-Ghazālī, *Iḥyāʾ ʿUlūm al-Dīn*, vol. 1, p. 18.
8. Ibn Qutaybah, *Al-Maʿārif*, pp. 29–30.
9. Al-Maqdisī, *Aḥsan al-Taqāsīm*, p. 136; Al-Kubaysī, *Aswāq Baghdād*, p. 275.
10. ʿAbd al-Raʾūf, *Al-Ḥawāḍir al-Islāmiyyah*, p. 182.
11. Mez, *Islamic Civilization*, vol. 1, p. 87.
12. Musharrafah and Aḥmad, *The Book of Algebra and Al-Muqābala by Al-Khwārizmī*, p. 12.
13. Al-Masʿūdī, *Murūj al-Dhahab wa Maʿādin al-Jawhar*, vol. 4, pp. 4–5.
14. Badawī, *Orientalist Research on the History of Science among the Arabs*, issue 1, vol. 9, p. 31; Al-Ziriklī, *Al-Aʿlām*, vol. 7, p. 116.
15. Al-Difāʿ, *An Introduction to the History of Mathematics among Arabs and Muslims*, p. 66.
16. Al-Difāʿ, *An Introduction to the History of Mathematics*, p. 67.
17. Karpinski, L. C., *Latin Translation*, p. 70.
18. Karpinski, L. C., *Latin Translation*, p. 70.
19. Fauvel, *The History*, p. 33.
20. Fauvel, *The History*, p. 33.
21. King, *Amadeal Arabic*, p. 101.
22. Ibn al-Nadīm, *Al-Fihrist*, p. 384.
23. **Ḥarrān**: Yāqūt al-Ḥamawī said of it: “It is a great and famous city in the Jazīrah of Aqūr, and the capital of Diyār Muḍar. It lies one day’s journey from al-Ruhāʾ and two days from al-Raqqah, and it is on the road between Mosul, al-Shām, and the lands of the Byzantines. It is said that it was named after Hārān, the brother of Abraham (peace be upon him), because he was the first to build it; the name was then Arabized and became Ḥarrān.” For more details, see: *Muʿjam al-Buldān*, vol. 2, p. 235.

24. Ibn al-Nadīm, *Al-Fihrist*, p. 394; Al-Qifṭī, *Akhbār al-ʿUlamāʾ*, pp. 81–85; Ibn Khallikān, *Wafayāt al-Aʿyān*, vol. 1, p. 287.

25. **The Ḥarrānian Sabians**: They were not Sabians in the true sense, but adopted this name during the reign of al-Maʾmūn when he passed through their region on his way to fight the Byzantines, so that they would be counted among those from whom the jizyah was taken and who were granted protection. Al-Maʾmūn associated with them because of the strangeness of their appearance and granted them respite until his return from the Byzantine campaign. Previously, they had been called the Ḥunafāʾ and the Ḥarrānians. Exegetes elaborated extensively on the beliefs of this sect, the most prominent view being that they believed God to be the creator of the celestial bodies, which they worshipped, claiming that these bodies governed the world and were the source of good and evil. For more details, see: Al-Nīsābūrī, *Gharāʾib al-Qurʾān wa Raghāʾib al-Furqān*, vol. 1, pp. 312–343.

26. Ibn Khurdādhbah, *Al-Masālik wa al-Mamālik*, p. 125.

27. Al-Qifṭī, *Akhbār al-ʿUlamāʾ*, p. 81.

28. Al-Qifṭī, *Akhbār al-ʿUlamāʾ*, p. 81.

29. Al-Qifṭī, *Akhbār al-ʿUlamāʾ*, p. 81.

30. Ibn al-Nadīm, *Al-Fihrist*, pp. 330–394;

31. Al-Qifṭī, *Akhbār al-ʿUlamāʾ*, p. 115; Ibn Abī Uṣaybiʿah, *ʿUyūn*, p. 295.

32. Ibn al-Nadīm, *Al-Fihrist*, p. 330; Ibn Abī Uṣaybiʿah, *ʿUyūn*, p. 257.

33. Hunke, *Allah's Sun Shines over the West*, p. 113.

34. Ibn al-Nadīm, *Al-Fihrist*, p. 394; Al-Qifṭī, *Akhbār al-ʿUlamāʾ*, p. 81; Ibn Khallikān, *Wafayāt al-Aʿyān*, vol. 1, p. 278.

35. *Akhbār al-ʿUlamāʾ*, p. 81.

36. Ibn al-Nadīm, *Al-Fihrist*, p. 394.

37. *Wafayāt al-Aʿyān*, vol. 1, p. 278; Al-Dhahabī, *Tārīkh al-Islām*, vol. 15, p. 232. (36) *Science among the Arabs*, p. 86.

38. *Al-Fihrist*, p. 394; *Akhbār al-ʿUlamāʾ*, p. 81.

39. *Akhbār al-ʿUlamāʾ*, pp. 81–83.

40. *Akhbār al-ʿUlamāʾ*, p. 83.

41. *Akhbār al-ʿUlamāʾ*, p. 84.

42. Vol. 1, p. 119.

43. **Isḥāq ibn Ḥunayn**: Abū Yaʿqūb Isḥāq ibn Ḥunayn ibn Isḥāq al-Ṣābiʾī, born in Baghdad in 215 AH / 830 CE and died there in 298 AH / 910 CE. He was a physician and translator who enriched Arabic through what he translated from the books of the House of Wisdom and their commentaries. Al-Qifṭī, *Akhbār al-ʿUlamāʾ*, p. 80.

44. ʿAbd al-Amīr, *Dictionary of Astronomical Science*, p. 189.

45. Al-Qifṭī, *Akhbār al-ʿUlamāʾ*, p. 83.
46. *History of Science*, vol. 1, p. 119.
47. *History of Arabic Literature*, vol. 1, p. 201.
48. *Al-Fihrist*, p. 394; *Akhbār al-ʿUlamāʾ*, p. 82.
49. *Akhbār al-ʿUlamāʾ*, p. 83.
50. *Akhbār al-ʿUlamāʾ*, p. 82.
51. Sarton, *History of Science*, vol. 1, pp. 476–477.
52. *History of Science*, vol. 1, p. 478.
53. *Al-Fihrist*, p. 394; *Akhbār al-ʿUlamāʾ*, p. 83.
54. *Al-Fihrist*, p. 394.
55. *Akhbār al-ʿUlamāʾ*, p. 81.
56. *Akhbār al-ʿUlamāʾ*, p. 83.
57. *Akhbār al-ʿUlamāʾ*, p. 84.
58. *Akhbār al-ʿUlamāʾ*, p. 84.
59. *Akhbār al-ʿUlamāʾ*, p. 84.
60. *Akhbār al-ʿUlamāʾ*, pp. 184–185.
61. Vol. 15, p. 232.

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