Famous Muslims

Nasir al-Din al-Tusi

Born: 18 February 1201 in Tus, Khorasan (now Iran)
Died: 26 June 1274 in Kadhimain (near Baghdad now in Iraq)

Although usually known as **Nasir al-Din al-Tusi**, his proper name was Muhammad ibn Muhammad ibn al-Hasan al-Tusi. In fact al-Tusi was known by a number of different names during his lifetime such as Muhaqqiq-i Tusi, Khwaja-yi Tusi and Khwaja Nasir.

Al-Tusi was born in Tus, which lies close to Meshed in northeastern Iran high up in the valley of the Kashaf River. He was born at the beginning of a century which would see conquests across the whole of the Islamic world from close to China in the east to Europe in the west. It was the era when the vast military power of the Mongols would sweep across the vast areas of the Islamic world displaying a bitter animosity towards Islam and cruelly massacring people. This was a period in which there would be little peace and tranquility for great scholars to pursue their works, and al-Tusi was inevitably drawn into the conflict engulfing his country.

In Tus, al-Tusi's father was a jurist in the Twelfth Imam School. The Twelfth Imam was the main sect of Shi'ite Muslims and the school where al-Tusi was educated was mainly a religious establishment. However, while studying in Tus, al-Tusi was taught other topics by his uncle which would have an important influence on his intellectual development. These topics included logic, physics and metaphysics while he also studied with other teachers learning mathematics, in particular algebra and geometry.

In 1214, when al-Tusi was 13 years old, Genghis Khan, who was the leader of the Mongols, turned away from his conquests in China and began his rapid advance towards the west. It would not be too long before al-Tusi would see the effects of these conquests on his own regions, but before that happened he was able to study more advanced topics. From Tus, al-Tusi went to Nishapur which is 75 km west of Tus. Nishapur was a good choice for al-Tusi to complete his education since it was an important center of learning. There al-Tusi studied philosophy, medicine and mathematics. In particular he was taught mathematics by Kamal al-Din ibn Yunus, who himself had been a pupil of Sharaf al-Din al-Tusi. While in Nishapur al-Tusi began to acquire a reputation as an outstanding scholar and became well known throughout the area.

The Mongol invasion reached the area of Tus around 1220 and there was much destruction. Genghis Khan turned his attention again towards the east leaving his generals and sons in the west to continue his conquests. There was, amid the frequent fighting in the region, peaceful havens which attracted al-Tusi. The Assassins, who practiced an intellectual form of extremist Shi'ism, controlled the castle of Alamut in the Elburz Mountains, and other similar impregnable forts in the mountains. When invited by

the Isma'ili ruler Nasir ad-Din 'Abdi ar-Rahim to join the service of the Assassins, al-Tusi accepted and became a highly regarded member of the Isma'ili Court. Whether he would have been able to leave, had he wished to, is not entirely clear. However, al-Tusi did some of his best work while moving round the different strongholds, and during this period he wrote important works on logic, philosophy, mathematics and astronomy. The first of these works, *Akhlaq-i nasiri*, was written in 1232. It was a work on ethics which al-Tusi dedicated to the Isma'ili ruler Nasir ad-Din 'Abd ar-Rahim.

In 1256 al-Tusi was in the castle of Alamut when it was attacked by the forces of the Mongol leader Hulegu, a grandson of Genghis Khan, who was at that time set on extending Mongol power in Islamic areas. Some claim that al-Tusi betrayed the defenses of Alamut to the invading Mongols. Certainly Hulegu's forces destroyed Alamut and, Hulegu himself being himself interested in science, he treated al-Tusi with great respect. It may be that indeed al-Tusi felt that he was being held in Alamut against his will, for certainly he seemed enthusiastic in joining the victorious Mongols who appointed him as their scientific advisor. He was also put in charge of religious affairs and was with the Mongol forces under Hulegu when they attacked Baghdad in 1258.

Al-Musta'sim, the last Abbasid caliph in Baghdad, was a weak leader and he proved no match for Hulegu's Mongol forces when they attacked Baghdad. After having laid siege to the city, the Mongols entered it in February 1258 and al-Musta'sim together with 300 of his officials were murdered. Hulegu had little sympathy with a city after his armies had won a battle, so he burned and plundered the city and killed many of its inhabitants. Certainly al-Tusi had made the right move as far as his own safety was concerned, and he would also profit scientifically by his change of allegiance.

Hulegu was very pleased with his conquest of Baghdad and also pleased that such an eminent scholar as al-Tusi had joined him. So, when al-Tusi presented Hulegu with plans for the construction of a fine Observatory, Hulegu was happy to agree. Hulegu had made Maragheh his capital. Maragheh was in the Azerbaijan region of northwestern Iran, and it was at Maragheh that the Observatory was to be built. Construction of the Observatory began in 1259 west of Maragheh, and traces of it can still be seen there today.

The observatory at Maragheh became operational in 1262. Interestingly the Persians were assisted by Chinese astronomers in the construction and operation of the observatory. It had various instruments such as a 4 meter wall quadrant made from copper and an azimuth quadrant which was the invention of Al-Tusi himself. Al-Tusi also designed other instruments for the Observatory which was far more than a center for astronomy. It possessed a fine library with books on a wide range of scientific topics, while work on science, mathematics and philosophy were vigorously pursued there.

Al-Tusi put his Observatory to good use, making very accurate tables of planetary movements. He published *Zij-i ilkhani* (the Ilkhanic Tables), written first in Persian and later translated into Arabic, after making observations for 12 years. This work contains tables for computing the positions of the planets, and it also contains a star catalogue. This was not the only important work which al-Tusi produced in astronomy. It is fair to say that al-Tusi made the most significant development of Ptolemy's model of the planetary system up to the development of the heliocentric model in the time of Copernicus. In al-Tusi's major astronomical treatise, *al-Tadhkira fi'ilm al-hay'a* (Memoir on astronomy) he:-

... devised a new model of lunar motion, essentially different from Ptolemy's. Abolishing the eccentric and the center of prosneusis, he founded it exclusively on the principle of eight uniformly rotating spheres and thereby succeeded in representing the irregularities of lunar motion with the same exactness as the "Almagest". His claim that the maximum difference in longitude between the two

theories amounts to 10 proves perfectly true. In his model Nasir, for the first time in the history of astronomy, employed a theorem invented by himself which, 250 years later, occurred again in Copernicus, "De Revolutionibus", III 4.

The theorem referred to in this quotation concerns the famous "Tusi-couple" which resolves linear motion into the sum of two circular motions. The aim of al-Tusi with this result was to remove all parts of Ptolemy's system that were not based on the principle of uniform circular motion. Many historians claim that the Tusi-couple result was used by Copernicus after he discovered it in Al-Tusi's work, but not all agree.

Among numerous other contributions to astronomy, al-Tusi calculated the value of 51' for the precession of the equinoxes. He also wrote works on astronomical instruments, for example on constructing and using an astrolabe.

In logic al-Tusi followed the teachings of ibn Sina. He wrote five works on the subject, the most important of which is one on inference.

Tusi, a thirteenth century logician writing in Arabic, uses two logical connectives to build up molecular propositions: 'if-then', and 'either-or'. By referring to a dichotomous tree, Tusi shows how to choose the proper disjunction relative to the terms in the disjuncts. He also discusses the disjunctive propositions which follow from a conditional proposition.

Al-Tusi wrote many commentaries on Greek texts. These included revised Arabic versions of works by Autolycus, Aristarchus, Euclid, Apollonius, Archimedes, Hypsicles, Theodosius, Menelaus and Ptolemy In particular he wrote a commentary on Menelaus's *Spherics*, and Archimedes' *On the sphere and cylinder* (see [21] for details). In the latter work al-Tusi discussed objections raised by earlier mathematicians to comparing lengths of straight lines and of curved lines. Al-Tusi argues that comparisons are legitimate, despite the objections that, being different entities, they are incomparable.

Ptolemy's *Almagest* was one of the works which Arabic scientists studied intently. In 1247 al-Tusi wrote *Tahrir al-Majisti* (Commentary on the Almagest) in which he introduced various trigonometrical techniques to calculate tables of sines. As in the *Zij-i Ilkhahi* al-Tusi gave tables of sines with entries calculated to three sexagesimal places for each half degree of the argument.

One of al-Tusi's most important mathematical contributions was the creation of trigonometry as a mathematical discipline in its own right rather than as just a tool for astronomical applications. In *Treatise on the quadrilateral* al-Tusi gave the first extant exposition of the whole system of plane and spherical trigonometry.

This work is really the first in history on trigonometry as an independent branch of pure mathematics and the first in which all six cases for a right-angled spherical triangle are set forth.

This work also contains the famous sine formula for plane triangles:

$$\mathbf{a/\sin A = b/\sin B = c/\sin C}.$$

Another mathematical contribution was al-Tusi's manuscript, dated 1265, concerning the calculation of n-th roots of an integer in 1413. This work by al-Tusi is almost certainly not original but rather it is his version of methods developed by al-Karaji's school. In the manuscript al-Tusi determined the

coefficients of the expansion of a binomial to any power giving the binomial formula and the Pascal triangle relations between binomial coefficients.

We should mention briefly other fields in which al-Tusi contributed. He wrote a famous work on minerals which contains an interesting theory of color based on mixtures of black and white, and included chapters on jewels and perfumes. He also wrote on medicine, but his medical works are among his least important. Much more important were al-Tusi's contributions to philosophy and ethics. In particular in philosophy he asked important questions on the nature of space.

Al-Tusi had a number of pupils, one of the better known being Nizam al-a'Raj who also wrote a commentary on the *Almagest* . Another of his pupils Qutb ad-Din ash-Shirazi gave the first satisfactory mathematical explanation of the rainbow. al-Tusi's influence, which continued through these pupils:

Al-Tusi's influence, especially in eastern Islam, was immense. Probably, if we take all fields into account, he was more responsible for the revival of the Islamic sciences than any other individual. His bringing together so many competent scholars and scientists at Maragheh resulted not only in the revival of mathematics and astronomy but also in the renewal of Islamic philosophy and even theology.

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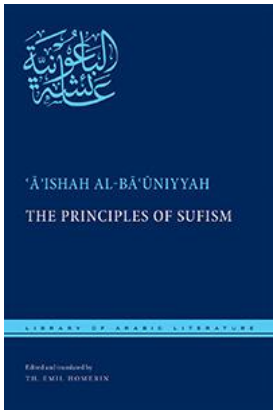
http://www-history.mcs.st-andrews.ac.uk/Biographies/Al-Tusi_Nasir.html

'Ā'ishah al-Ba'uniyya

ʿ**Ā'ishah bint Yūsuf al-Bāʿūniyyah** was born and died (1517) in Damascus, She was a Sufi master and a poet is almost the only medieval female Islamic mystic to have recorded her own views in writing, and she "probably composed more works in Arabic than any other woman prior to the twentieth century.



Her father Yūsuf was a Qadi (Islamic judge) in Safed, Tripoli, Aleppo, and Damascus, and a member of the prominent Ba'uni family, noted through the fifteenth century for its scholars, poets and jurists. Like her brothers ʻĀ'ishah was taught primarily by her father, along with other family members, studying the Quran, Hadith, jurisprudence, and poetry, and by her own claim, by the age of eight, ʻĀ'ishah had already learned the Quran by heart.

In 1475, ʻĀ'ishah undertook the pilgrimage to Mecca. She was married to Aḥmad ibn Muḥammad Ibn Naqīb al-Ashrāf (in 1503), from the prominent ʻAlid family of Damascus, also noted for their scholarship; by ʻĀ'ishah's reckoning, Aḥmad was descended from Muḥammad's daughter Faṭimah and her husband ʻAlī, via their son al-Ḥusayn

In 1513, ʻĀ'ishah and her son moved from Damascus to Cairo, returning to Damascus in 1517. ʻĀ'ishah's goal may have been to secure the career of her son. On the way, their caravan was raided by bandits near Bilbeis, who stole their possessions, including ʻĀ'ishah's writings. It appears that in Cairo the mother and son were hosted by Maḥmūd ibn Muḥammad Ibn Ajā, who was personal secretary and foreign minister to the Mamluk sultan Al-Ashraf Qansuh al-Ghawri. Ibn Ajā helped ʻAbd al-Wahhāb find work in the chancery and helped ʻĀ'ishah enter into Cairo's intellectual circles. ʻĀ'ishah went on to write him 'several glowing panegyrics'. In Cairo, ʻĀ'ishah studied law and was granted license to lecture in law and to issue legal opinions (fatwas); 'she gained wide recognition as a jurist'.

She left Cairo in 1516, with her son and Ibn Ajā, and several other noted scholars. She was granted an audience with Sultan Al-Ashraf Qansuh al-Ghawri in Aleppo shortly before his defeat at the Battle of Marj Dabiq: 'an extraordinary event befitting her exceptional life'. ʻĀ'ishah then returned to Damascus, where she died in 1517.

ʻĀ'ishah 'inherited an independence of mind and outlook which is seen in her companionship with her men contemporaries on equal terms'. Thus she was a close friend of Abu 'l-Thanā' Maḥmūd b. Ādjā (who was the final *ṣāḥib dawāwīn al-inshā'* of the Mamluk period) and corresponded, in verse, with the Egyptian scholar ʻAbd al-Raḥmān al-ʻAbbāsī. It is quite apparent from biographies of ʻĀ'ishah and from her own comments in her writings that she was highly regarded as a pious woman and Sufi master.

ʿĀ’ishah's known original works are-

- *Dīwān al-Bāʿūniyyah* (collection of poems)
- *Durar al-ghā’iṣ fī baḥr al-Muʿjizāt wa ’l-kha-ṣā’iṣ* (The Diver's Pearls, on the Sea of "The Miracles and Virtues")
- *al-Fatḥ al-ḥaqqī min fayḥ al-talaqqī* (True Inspiration, from the Diffused Perfume of Mystical Learning') (lost)
- *al-Fatḥ al-mubīn fī madḥ al-amīn* (Clear Inspiration, on Praise of the Trusted One)
- *al-Fatḥ al-qarīb fī miʿrāq al-ḥabīb* (Immediate Inspiration, on the Ascension of the Beloved) (lost)
- *Fayḍ al-faḍl wa-jamʿ al-shaml* (The Emanation of Grace and the Gathering of the Union)
- *Fayḍ al-wafā fī asmā’ al-muṣṭafā* (The Emanation of Loyalty, on the Names of the Chosen One) (lost)
- *al-Ishārāt al-khafiyyah fī ’l-Manāzi al-ʿaliyyah* (The Hidden Signs, on the "Exalted Stations") (lost)
- *Madad al-wadūd fī mawlid al-maḥmūd* (The Aid of the Affectionate God, on the Birth of the Praiseworthy Prophet) (lost)
- *al-Malāmiḥ al-sharīfah min al-āthār al-laṭīfah* (Noble Features, on Elegant Reports) (lost)
- *al-Mawrid al-ahnā fī ’l-mawlid al-asnā* (The Most Wholesome Source, on the Most Exalted Birthday)
- *al-Munktakhab fī uṣūl al-rutab* (Selections on the Fundamentals of Stations)
- *al-Qawl al-ṣaḥīḥ fī takhmīs Burdat al-madīḥ* (Reliable Words, on the Quintains of the "Mantle of Eulogy")
- *Ṣilāt al-salām fī faḍl al-ṣalāh wa ’l-salām* (Gifts of Peace, on the Merit of Blessing and Salutation) (lost)
- *Tashrīf al-fikr fī naẓm fawā’id al-dhikr* (Noble Thought, on the Benefits of Recollection in Verse)
- *al-Zubdah fī takhmīs al-Burdah* (The Fresh Cream Quintain of "The Mantle") (lost)
- Th. Emil Homerin, 'Living Love: The Mystical Writings of ʿĀ’ishah al-Bāʿūniyyah
  Homerin has also published some of the only translations of ʿĀ’ishah's work into English.

Source: https://en.wikipedia.org/wiki/%27A%27isha_al-Ba%27uniyya (edited).