Persian Poet, Mathematician and Astronomer Omar Khayyam

Contributed by Akbar Nemati

Ghiyath al-Din Abul Fateh Omar Ibn Ibrahim al-Khayyam was born at Nishapur, the provincial capital of Khurasan around 1044 A.D. (c. 1038 to 1048). Persian mathematician, astronomer, philosopher, physician and poet, he is commonly known as Omar Khayyam. Khayyam wrote a large number of books and monographs in the above areas. Out of these, 10 books and thirty monographs have been identified. Of these, four concern mathematics, three physics, three metaphysics, one algebra and one geometry. Khayyam was also a well-known poet. In this capacity, he has become more popularly known in the Western world since 1839, when Edward Fitzgerald published an English translation of his Rubaiyat (quatrains).

Birth:
Date: 1048 CE
Place: Nishapur, Persia (Iran)
Death:
Date: 1123 CE
Place: Nishapur, Persia (Iran)
Name:
Abu ol-Fath ebn-Ebrahim 'Omar ol-Khayyami of Nishapur (Khayyam means "tent maker")
Major Contributions:

- Jalali Calendar (more accurate than the Julian, and almost as accurate as the Gregorian intercalation system)
- Contributions to Algebra (geometric solution of cubic equations)
- Astronomical tables
- And the Rubaiyat

Work:

- Mathematician
- Scientist
- Astronomer
- Philosopher
- Poet

Persian mathematician, astronomer, philosopher, physician and poet, he is commonly known as Omar Khayyam.
Omar Khayyam's full name was Ghiyath al-Din Abu'l-Fath Umar ibn Ibrahim Al-Nisaburi al-Khayyami, A literal translation of the name al-Khayyami (or al-Khayyam) means 'tent maker' and this may have been the trade of Ibrahim his father and although generally considered as Persian, it has also been suggested that he could have belonged to the Khayyami tribe of Arab origin who might have settled in Persia.
Despite being out of favor on all sides, Khayyam remained at the Court and tried to regain favour. He wrote a work in which he described former rulers in Iran as men of great honour who had supported public works, science and scholarship.
His influence on the development of mathematics in general and analytical geometry, in particular, has been immense. His work remained ahead of others for centuries till the times of Descartes, who applied the same geometrical approach in solving cubics. His fame as a mathematician has been partially eclipsed by his popularity as a poet; nonetheless his contribution as a philosopher and scientist has been of significant value in furthering the frontiers of human knowledge.
The political events of the 11th Century played a major role in the course of Khayyam's life. The Seljuq Turks were tribes that invaded southwestern Asia in the 11th Century and eventually founded an empire that included Mesopotamia, Syria, Palestine, and most of Iran.
Toghril Beg, the founder of the Seljuq dynasty, had made Esfahan the capital of his domains and his grandson Malik-Shah was the ruler of that city from 1073.
An invitation was sent to Khayyam from Malik-Shah and from his vizier Nizam al-Mulk asking Khayyam to go to Esfahan to set up an Observatory there. Other leading astronomers were also brought to the Observatory in Esfahan and for 18 years Khayyam led the scientists and produced work of outstanding quality. It was a period of peace during which the political situation allowed Khayyam the opportunity to devote himself entirely to his scholarly work.
Khayyam introduced a calendar that was remarkably accurate, and was named as Al-Tarikh-al-Jalali. It had an error of one day in 3770 years and was thus even superior to the Georgian calendar (error of 1 day in 3330 years).
Khayyam measured the length of the year as 365.24219858156 days. Two comments on this result. Firstly it shows an incredible confidence to attempt to give the result to this degree of accuracy. We know now that the length of the year is changing in the sixth decimal place over a person's lifetime. Secondly it is outstandingly accurate. For comparison the length of the year at the end of the 19th century was 365.242196 days, while today it is 365.242190 days.
His contributions to other fields of science include a study of generalities of Euclid, development of methods for the accurate determination of specific gravity, etc. In metaphysics, he wrote three books Risala Dar Wujud and the recently discovered Nauruz- namah. He was also a renowned astronomer and a physician.
Apart from being a scientist, Khayyam was also a well-known poet. In this capacity, he has become more popularly known in the Western world since 1839, when Edward Fitzgerald published an English translation of his Rubaiyat (quatrains). This has since become one of the most popular classics of world literature.
Indeed Khayyam did produce such a work, the Treatise on Demonstration of Problems of Algebra which contained a

complete classification of cubic equations with geometric solutions found by means of intersecting conic sections.
He demonstrated the existence of equations having two solutions, but unfortunately he does not appear to have found that a cubic can have three solutions
Algebra would seem to rank first among the fields to which he contributed. He made an attempt to classify most algebraic equations, including the third degree equations and, in fact, offered solutions for a number of them. 'This includes geometric' solutions of cubic equations and partial geometric solutions of most other equations. His book Maqalat fi al-Jabr wa al-Muqabila is a master- piece on algebra and has great importance in the development of algebra. His remarkable classification of equations is based on the complexity of the equations, as the higher the degree of an equation, the more terms, or combinations of terms, it will contain.
Khayyam recognizes 13 different forms of cubic equation. His method of solving equations is largely geometrical and depends upon an ingenious selection of proper conics.
In fact Khayyam gives an interesting historical account in which he claims that the Greeks had left nothing on the theory of cubic equations. Indeed, as Khayyam writes, the contributions by earlier writers such as al-Mahani and al-Khazin were to translate geometric problems into algebraic equations (something which was essentially impossible before the work of al-Khwarizmi). However, Khayyam himself seems to have been the first to conceive a general theory of cubic equations. He also developed the binomial expansion when the exponent is a positive integer. In fact, he has been considered to be the first to find the binomial theorem and determine binomial coefficients. In geometry, he studied generalities of Euclid and contributed to the theory of parallel lines.
Khayyam studied philosophy at Naishapur and one of his fellow students wrote that he was:-
... endowed with sharpness of wit and the highest natural powers ...

Khayyam wrote a large number of books and monographs in the above areas. Out of these, 10 books and thirty monographs have been identified. Of these, four concern mathematics, three physics, three metaphysics, one algebra and one geometry
Malik-Shah's third son Sanjar, who was governor of Khorasan, became the overall ruler of the Seljuq empire in 1118. Sometime after this Khayyam left Esfahan and traveled to Merv (now Mary, Turkmenistan) which Sanjar had made the capital of the Seljuq empire. Sanjar created a great centre of Islamic learning in Merv where Khayyam wrote further works on mathematics. He died at Nishapur in 1123-24.