



Abu Rayhan al-Biruni

History of Geology

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Born: 4 Oct. 973, near Khwarzim, Uzbekistan.
Died: 13 Dec. 1048, by some accounts after 1050.

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Abstract

Biruni was a native of what is now the Uzbekistan Republic of the former Soviet Union. He was associated after 1018 with the court of Sultan Mahmud and later Sultan Mawdud in the city of Ghazna, Afghanistan, where he spent the remainder of his life. During this period, he participated in Mahmud's military campaigns in northern India and gathered materials used in his geographical and historical account of India. This is one of his two major surviving works. The other is a treatise on gemstones and metals, which is the third known text on mineralogy. His measurements of mineral densities resulted in numerical values very close to modern determinations, and were not equalled in precision by European scientists until the 18th century. Biruni's original works, written in Persian and translated into Arabic, include discourses on mathematics, astronomy, physics, botany, geography, geology, mineralogy, history, and chronology.

The beginning of the second millennium was a time of ascending power for the loosely knit Muslim empire. Science and mathematics were cultivated at many courts, and Islamic scientists made significant contributions, particularly in astronomy and mathematics. Biruni's work must have had considerable influence on contemporary Muslim scientists, but none of his work was translated into a European language until the 20th century. Thus, his influence was only indirect and minimal on Renaissance science in Europe.

Introduction

Al-Biruni was a Muslim native of modern Uzbekistan, which borders the southern half of the Aral Sea and stretches to Afghanistan. He was a contemporary of **Avicenna** (Ibn Sina) of modern Tadjikistan in central Asia. Avicenna was a far-ranging genius who had considerable influence in Europe. Biruni's Muslim impact was great, however later influence on European science was minimal. The beginning of the second millennium was a time of ascending Muslim power. The **Abbasids** (AD 750-1258) established a long-lived dynasty in Baghdad, which was the center of the loosely knit Muslim empire that contained many local sultans. At its zenith, the Muslim empire stretched from Spain to India.

Many of the Muslim sultans cultivated science and mathematics at their courts. Greek and Roman works were translated; thus the ideas of **Aristotle** had influence. Muslim observers made many new discoveries, particularly in astronomy and mathematics. Geography--through military conquests--and geology also developed. From India, came the decimal number system, and paper was acquired from China. These very significant scientific developments came about while Europe endured its "Dark Age."

The **Ghaznavids** established a dynasty in what is today Afghanistan, centered in Ghazna (near Kabul). The dynasty survived more than two centuries. Biruni's ability was recognized early, and he studied many subjects as a youth. In 1018 (or 1017?), **Mahmud** (3rd sultan) brought him to Ghazna, where Biruni spent the rest of his life, except for military campaigns into northern India. Biruni probably held the role of "royal advisor" and possibly tutor.

Al-Biruni's Major Works

Al-Biruni's works were written in Persian and translated into Arabic. They include mathematics, astronomy, physics, botany, geography, geology, mineralogy, history, and chronology. The two major surviving works are a historical account of India and a treatise on gems and precious minerals.

- **India** -- Material was gathered during Mahmud's Indian military campaigns and represents an important source on Indian history and geography during early Medieval time. Biruni examined the Ganges River from the mountains to its delta. He noted that downstream decrease in sediment size is related to current strength. He also showed the sea had once covered the region of great Indian rivers; he observed fossil seashells in rocks high above the modern ocean. He noted that Hindus relate tides to phases of the moon, although the cause was unknown.
- **Gems** -- The work was written late in Biruni's life, during **Mawdud's** reign (6th sultan). It comprises two parts--precious stones and metals. He described about 100 known minerals, their varieties and rock occurrences, and characteristics--color, hardness, production, cost, etc. His density measurements are particularly important. He designed a method for

weighing water displaced by specimens to arrive at numerical values for 18 minerals. He described the mineral deposits from the entire world known to him--China, India, Ceylon, Byzantium, Egypt, Mozambique, and the Baltic region. This important reference on precious stones was quoted by many later scientists. It is the third authentic text known on mineralogy, and equal precision in density measurement was not achieved in Europe until the 18th century.

"India" and "Gems" were obviously significant works for their times and must have had considerable influence on contemporary Muslim scientists. But neither was translated into a European language until the 1900s. "Gems" was not translated (into Russian) until 1963, in fact. Thus, Biruni had only indirect influence on European Renaissance science.

Other Works by Al-Biruni

- *Chronology of ancient nations* -- Description of Arabic, Persian, Hebrew, Greek, and various other calendrical systems then in use.
- *Key to astronomy* -- Major lost treatise.
- *Introduction to elements of the art of astrology* -- Popular work on basic math and astronomy.
- *A book of location of chords in the circle* -- Original mathematical methods and proofs.
- *The Masudi canon* -- Lengthy work on math and geography, triangulation method for determining longitude, trisecting angles, doubling a cube, etc.

Biruni was the first in the mid-east to state that earth orbits around the sun, even though he repeats the *Koran* that earth is the center of the universe. He regarded the earth as a sphere and computed its circumference close to modern values. His extensive work on topography of middle Asia is particularly interesting for his study of the changing course of the Amu Darya River during the geological past. Thus, Biruni also could be considered as a fluvial geomorphologist.

Historical Assessment

Al-Biruni was one of many early scholars to be resurrected by Soviet science historians during the middle 20th century. This effort was an attempt to enhance the reputation of Soviet science or, in some cases, unjustly claim priority for significant discoveries. According to the *Great Soviet Encyclopedia* (1973, vol. 3, p. 345):

His [al-Biruni's] exceptional erudition was combined with views that were very progressive for his time. He had an ironic attitude toward religious superstitions and spoke out against enmity between peoples.

It is true that Biruni was opposed to alchemy, and he discounted the magical or mystical powers attributed to gemstones, but this hardly marked him as antireligious and pro-soviet, as this propaganda suggested. He was thoroughly Muslim, entirely in keeping with the culture of his time. This had nothing to do with the brand of communism practiced in the Soviet Union prior to its collapse in the 1990s. Faul and Faul (1983, p. 20) present a more realistic appraisal of al-Biruni's historical significance.

... it is worthwhile for Biruni to become better known to western science ... his accomplishments were not insignificant and he did have considerable influence with contemporary Muslim scientists.



Related Websites

- Brief biography of [al-Biruni](#).
- Al-Biruni [world map](#).
- Summary of [al-Biruni](#).
- Portrait of [al-Biruni](#).