

MATHEMATICS IN CONTEXT: THE ARABIC-ISLAMIC GOLDEN AGE

THE ARABIC WORLD BEFORE MOHAMMED

Arabia, on the eve of Mohammed's birth and the growth and spread of Islam, was a collection of regional cultures separated by language, religion, and politics. Neither Christianity nor Zoroastrianism nor the regional Arabian and African religions were capable of breaking down the regional cultural barriers and forging a civilizational area. The unifying mission of Mani in the third century had only limited success. Significantly, there were various political, economic, and intellectual resources spread throughout these regions. These resources were consolidated during the Mohammedan expansion and formed the basis of the cultural growth of the Arabic-Islamic world from the 700s on.

When Justinian closed the School of Athens in 529, the School's philosophers migrated to Baghdad. In Persia, Khosro the Holy, a contemporary of Justinian and a patron of science, invited Greek scholars to his court. Christian monasteries, centers of learning, were scattered throughout the Near East. As it spread, Islam linked Greek, Christian, Persian, and Babylonian traditions, as well as Indian and Chinese traditions.

The Arabs possessed no numerals before the time of Mohammed (sixth century); numbers were written in words. Before the end of the eighth century, they possessed a good numerical notation and Brahmagupta's work on arithmetic and algebra. Before the end of the ninth century, they were in possession of the major Greek mathematical works.

Agriculture and commerce arose in central Arabia at the beginning of the Christian era. Jews escaping Babylonian persecution and, later, the destruction of Jerusalem by Titus and Hadrian, entered Arabia as craftsmen, goldsmiths, swordsmiths, and traders. Heretical Nestorians, Coptic Monophysites and other Christians also entered Arabia in the centuries before the Islamic expansion. Jews and Christians struggled to gain control of the Yemen spice trade. This struggle culminated in a raid on Mecca by Abyssinians around the time Mohammed was born.

Mohammed helped to stabilize Arabia. Blood-feuds were pacified. The power focused on petty strifes that divided the population of the peninsula became concentrated in "one hand" ready and eager to attack the powerful neighbors who had despised the weak and barbaric desert people for two millennia (Darlington, 1969: 339)

ISLAMIC EXPANSION

Trade revived, and the status and power of the merchants improved as the Islamic conquests restored, extended, and decentralized the trade network lost by the troubled Roman Empire. Old cities such as Damascus, Alexandria, and Antioch were revived and served as models for new cities, especially the new capitols of Cairo, Baghdad, and Cordoba. These events parallel the flowering of "mother-cities" such as Miletus and more or less autonomous satellite cities during the Ionian commercial revolution of the seventh century BCE.

The early merchants were mostly Christians, Jews, and Zoroastrians; later Moslems and Arabs became the dominant traders (they disdained agriculture but not trade). Port cities such as Baghdad, al-Barash, Siraf, Cairo, and Alexandria became active commercial centers (Hitti, 1956: 343–347).

The Caspian Sea, close to the Persian cultural centers and the wealthy cities of Samarkand and Bukhara, was the major scene of maritime commerce in Arabia. Mediterranean trade was never very prominent; neither was trade across the Black Sea (though there was some land trade in the tenth century with the northern Volga regions). Moslem traders, according to Arab tradition, reached China from al-Varash during the reign of al-Mansur. In any case, several embassies had been exchanged between China and the Arabs by the middle of the eighth century.

In 751, the Arab governors of Samarkand captured some visiting Chinese paper experts. The Arabs learned about paper-making and eventually made a linen paper from Khorasan flax that was tougher than the paper the Chinese made from bamboo fibers. Linen paper replaced costly papyrus and parchment, and palm leaves. This greatly facilitated the transcription and reproduction of the Arabic translations of the Greek manuscripts. By the end of the eighth century, Baghdad had its first paper mill.

Darlington (1969: 351) argues that while war accounts for the

expansion of Islam, it does not account for Islam's stimulation of cultural growth. He draws attention to the fact that stimulation only occurred where there was "something valuable before the coming of Islam". In each case, the "flowering of culture" lasts about six generations. This may reflect a "recombination effect"; that is, each conquest linked mutually stimulating cultural traditions, and an immediate "recombination effect" gave rise to cultural innovation". However, neither Islam nor the original cultures were organized to sustain cultural growth:

So it was that successively in Damascus and Baghdad, in Cordoba and Marrakesh, in Isfahan and Delhi, we see the characteristic flaw of the new hybrid Islamic civilizations always based on a precarious balance between conversion and non-conversion, hybridization and non-hybridization, a balance which Muslim violence was not fitted to sustain. When the conquest ceased, with the expulsion of the Almoravids from Granada, with the retreat of the Turks from Vienna, with the collapse of the Moguls in Delhi, the intellectual and artistic as well as the political life of Islam came to a standstill.

THE CALIPHS

The Omayyads ruled Arabia from 661 to 750. An Arabic currency was introduced between 685 and 705. Between 705 and 715, the Omayyads reached the height of their power. In 750, the Abbasid family overthrew the Omayyads. The Omayyad Abd-al-Hathman escaped, and established the Omayyads in Spain, at Cordoba. The Abbasids ruled Arabia from 750 until the Mongol invasion of Persia in 1256 and the sacking of Baghdad in 1258.

Abu'l-Abbas was the first Abbasid Caliph. He died in 754. Al-Mansur (who reigned from 754–775) is considered the actual founder of the Abbasid dynasty. He established his capitol at Baghdad in 762. Al-Mansur intended to make Baghdad a military post for himself and his family, and for his Khorasanian bodyguard. The post was built under the auspicious horoscope of the court astrologer. It was under the rule of Harun al-Rashid (786–809) that Arabic-Islamic mathematics began to develop, under Indo-Persian, Syrian, and especially Hellenic influences.

The location of Baghdad made it a center for the transmission of Persian culture into the Arab world. The Caliphate was modelled after the Sasanid Chosroism. Slowly, Persian ideas and ways of life penetrated the

Caliphate until it became, in Hitti's (1956: 294) words, "more of a revival of Iranian despotism and less of an Arabian Sheikdom". Within three generations after al-Mansur set the foundation stone for his military post at Baghdad, the major works of Aristotle (many of them spurious), the leading neo-Platonist treatises, most of Galen's writings, and many Persian and Indian scientific works were available in Arabic translations from the Persian, Sanskrit, Syriac, and Greek. Merchants were central figures in the Baghdad community. So were scholars, if we can judge from a contemporary account of the daily routine of Ishaq ibn Hsuein, one of the great translators, by Ibn-Kallikan (Hitti, 1956: 306).

HELLENISM, THE GREAT TRANSLATORS, AND INTELLECTUAL LIFE

The diffusion of Hellenism into Arabic-Islamic culture occurred through Arabic-Islamic contacts with Christian Syrians at Edessa, heathen Syrians (self-proclaimed Sabians after the ninth century) in Harran, the cities of Antioch and Alexandria, and the numerous cloisters of Syria and Mesopotamia. Raids into "the land of Romans", especially during the reign of Harun al-Rashid, netted Greek manuscripts (primarily in Amorium and Ancyra) among the booty.

The search for Greek manuscripts led al-Ma'mun's emissaries to distant lands such as Constantinople and to the court of the Armenian emperor, Leo. The Byzantine emperor responded to al-Mansur's requests by sending manuscripts of Euclid as well as other works (Hitti, 1956: 309–315). Greek was unknown in Arabia. Translations were made by Jewish, heathen, and in particular Syrian Nestorian Christian subjects. The Syrians translated the Greek works into Syrian and then Arabic. The Greek influence reached its height under al-Ma'mun.

ARABIC-ISLAMIC MATHEMATICS I: INTELLECTUAL CONTEXT

The Abbasid Caliphs were patrons of medicine, astronomy, and mathematics. They brought or invited foreign physicians and other scholars to Baghdad. In 772, a Hindu astronomer named Kankah (or Mankah) arrived at the court of al-Rashid with a text generally thought to be the *Sindhind*, the Hindu revision of Brahmagupta's *Siddhantas*. (There is some controversy about just when the Hindu astronomer arrived and when the

text was translated). The astronomer Ibrahim al-Fazari, a personal friend of al-Mansur, is said to have translated the *Sindhind*; sometimes the translation is credited to his son. There is some doubt about whether the *Sindhind* was translated this early (O'Leary, 1949: 152–153). The Arabs found it necessary to translate Euclid and Ptolemy before they could understand and use the *Sindhind*. The *Elements* and the *Almagest* were thus among the earliest, if not the earliest manuscripts translated.

The Golden Age of Arabic-Islamic mathematics and science begins with the translations of the Greek works under al-Rashid and his son and successor, Caliph al-Ma'mun (809–833). Al-Hayyan (fl. 786–833) translated Euclid about 820; Apollonius was translated by al-Himshi and the Banu Musa (three brothers) around 875. Ishaq ibn Hunein and Tabit ibn Qurra translated Archimedes, Menelaus, Aristotle, and Ptolemy about 890. And Diophantes, Heron, Autoclycus, Theodosius, and Hypsicles were translated by Qusta ibn Luqa toward the end of the ninth century.

Ishaq ibn Hunein (809–873) was a Nestorian Christian, and is known as “the sheikh of the translators”. Tabit ibn Qurra (836–901) led another group of translators from Harran, the center of the heathen Sabians. These Syrians had a long tradition of interest in astronomy and mathematics, rooted in star-worship. Under al-Mutawakkil, a school of philosophy and medicine, previously at Antioch and before that located in Alexandria, was established in Harran. Al-Hayyay is a forerunner of the Harran translators.

The Sabian Tabit was the first translator in a family line of translators. He was succeeded by his son (Sinan), two grandsons (Tabit, and Ibrahim), and one great grandson (al-Faraji). The most important Sabian intellectual after Tabit ibn Qurra was al-Battani, a convert to Islam.

The latter part of the tenth century saw the rise of Jacobite or Monophysite translators who concentrated on revising existing translations and preparing new translations of Aristotle. The introduction of neo-Platonic thought and mysticism into Arabia was due chiefly to these Monophysites.

Around 970, a school of popular philosophy influenced by Pythagoreanism flourished at al-Bashrah under “the brethren of sincerity” (Ikhwan al-Safa). There was also a branch in Baghdad. Like the original Pythagoreans, the brethren was a religious and political secret society. The group was opposed to the established government, and was linked to ultra-Shi'ites probably espousing Isma'ilite views. Al-Ghazzali was influenced by this school.



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