A Summary of Muslim Mathematics

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Establishing in Baghdad, a recently founded capital of Abbasid caliphs, of دَارُ لحِكمَة *Dāru l-Ḥikmat* (*Abode of Wisdom*) by caliph Ma'mūn who ruled during 813-833, was destined to play a pivotal role in the development of Mathematics in the lands conquered by muslim armies. *Abode of Wisdom* was a sort of translation academy patronized by the caliph and wealthy families from his entourage. Works covering Mathematics, Astronomy, Engineering, and Medicine, were translated into Arabic, the language of the conquerors, from Greek, Syriac (Aramaic), Pahlavi (Classical Persian), and possibly from Sanskrit.[1]

Most of the mathematicians writing in Arabic between 9th and 13th Centuries were not Arabs, several were not muslims, others were first, or second-generation muslims. They translated, paraphrased, commented, and finally, appropriated for the islamic state, the work of Greek mathematicians. Some of the works of Greek scientists and philosphers survive only in Arabic.

In the course of their studies they made several in-depth investigations in Geometry, Diophantine Analysis, and Combinatorics. Their indebtednes to Greek predecessors involved both major classics as well as minor sources (like a lemma appearing as a *scholium* in some versions of Theodosius' *Spherics*[2]).

Their "algebra" was concerned with solving polynomial equations; it was entirely *verbal*: no symbols of any kind were employed (the unknown quantity was referred to as مَال *māl* ("property") which indicates connec-

[1] It is instructive to note that no works of Greek, Persian, or Indian literature were commisioned to be translated. This demonstrates purely utilitarian motives of the new Islamic rulers, and reflects the attitude of the total lack of interest towards other cultures, which later became characteristic of Islamic ideology. Compare this with the diametrally different attitude of Greek and Roman civilizations.

[2] *Theodosius Tripolites*, 2nd or 1st century BC; his work *Spherics* survived.

tions of this "algebra" with problems of inheritance rather than with geometry.

In Spain, scientific and philosophical texts in Arabic were the medium through which Latin West reacquainted itself with the achievements of Greek science in 12th century (later the Greek originals were brought to Europe by Italian scholars, and their Byzantine colleagues who were fleeing Turkish occupation of their homeland).

A list of some of the most important mathematicians follows.

مُحَمَّدُ بنُ مُوسَى الخوَارِزمِي *Muḥammadu bnu Mūsā 'l-Ḫwārizmī* (**Al-Khwārizmī**, *ca.* 780–*ca.* 850) as his name suggests he, or his family, came from Khorezm, a Persian town, today in northern Uzbekistan. Latin translations of his work الكِتَابُ لمُختَصَرُ فِي حِسَابِ لجَبرِوَلمُقَابَلَة *al-Kitābu l-muḫtaṣaru fī ḥisābi l-ğabri-wa-l-muqābalat*, (*A compendium of Calculus of* ***gebr*** *and* ***muqābala***) introduced into Mathematics the term *algebra*. His name has been immortalized in another term, *algorithm*, which attests to the influence of his lost work on the decimal representation of numbers and arithmetic operations. The title of this work was حِسَابُ لهِند *Ḥisābu l-Hind* (*Calculus of the Hindus*[3]).

ثَابِتُ بن قُرَّة *Ṯābitu bn Qurrat* (**Thābit ben Qurra**, 826–901) a native of Harran, a town in Northern Syria; an author of a treatise *On the Justification of the Algebraic Problems by Geometric Proofs*. He studied number theory (he proved a theorem providing a method for finding pairs of amicable numbers); corrected an earlier translation of the *Elements*.

[3]It is not at all clear to what extent the contents of that lost work is preserved in any of the 24 surviving Latin *alchorismus* treatises that appeared between 12th and 14th Centuries, since the latter contain both Arabic as well as late Roman material. It is certain, however, that Al-Kwarizmi's work facilitated spreading among the Arabs and in Latin Europe of the *Hindu calculus*, i.e., of the use of decimal representation of numbers and arithmetic operations involving such representations.

أَبُو كَامِل *Abū Kāmil* (**Abu Kāmil Shuja**, 9/10th Century) an Egyptian mathematician; we have no details about his life. His *Book of algebra* influenced Fibonacci.

اَلكَرَجِي *al-Karağī* (**Al-Karaji**, 953–1029) a commentator of Diophantus; formulated the rules of multiplication of polynomials, important for later Arabic "algebraists".

إِبنُ لهَيثَم *ʾibnu l-Hayṯam* (**Ibn Al-Haytham**, Latin *Alhazen*, 965–1040) author of numerous works on optics, spherical geometry, number theory (he is credited with discovering *Wilson's Theorem*:

$$\textit{for any prime } p,\ 1 + (p-1)! \textit{ is divisible by } p$$

long before Wilson), and several other contributions.

عُمَرُ لخَيَّامِي *ʿUmaru l-Ḫayyāmī* (**Omar Khayyām**, 1048–1131) a famous Persian poet from Nishāpūr (born and died there) whose *Rubʿāyāt*, i.e., *Quatrains*, immortalized his name in the English speaking world thanks to the translation by Edward Fitzgerald which first ppeared in 1859:

> *There was the Door to which I found no Key:*
> *There was the Veil through which I could not see:*
> *Some little talk awhile of* ME *and* THEE
> *There was–and then no more of* THEE *and* ME.

He was equally celebrated as a mathematician, particularly renowned for his study of cubic equation. During his stay in Samarkand (today in Uzbekistan), he composed his most famous mathematical work: *Treatise on Demonstration of Problems of Algebra*.

اَلسَّمَوأَل *as-Samawʾal* (**As-Samaw'al**, *ca.* 1130–*ca.* 1180) another noted "algebraist", a successor of Abu Kāmil and Al-Karaji; according to one view he was responsible for introduction of decimal fractions.

شَرَف الدِّين الطُّوصِي *Šaraf ad-Dīn aṭ-Ṭūsī* (**Sharaf ad-Dīn at-Tūsi,** *ca.* 1135–1213) a native of *Tūs*, a town in northeastern Persia. He left us a treatise on cubic equations which goes beyond what had been achieved by Khayyām; he used a method of finding approximate solutions which is essentially the *Ruffini-Horner* method.