

Iranian mathematics and astronomy in 17th century Holland

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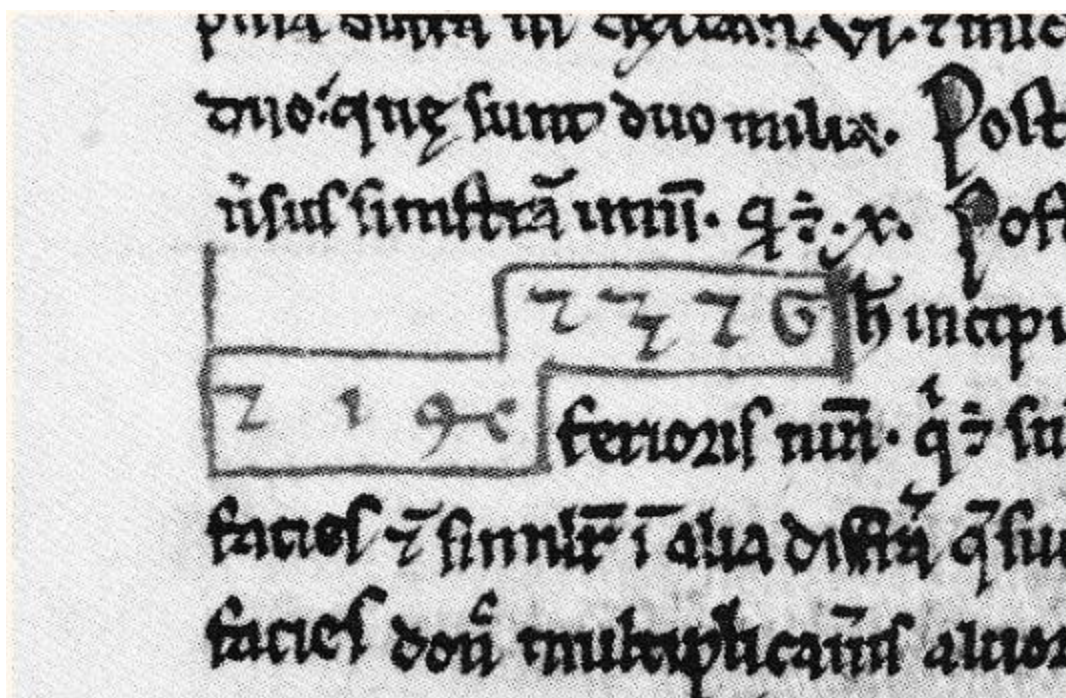
Iranian mathematics in the West

Between the 10th and 13th century, Europe learnt about the work of **early** mathematics in the Islamic tradition:

- Khwarizmi, arithmetic and algebra
- Farghani, astronomy

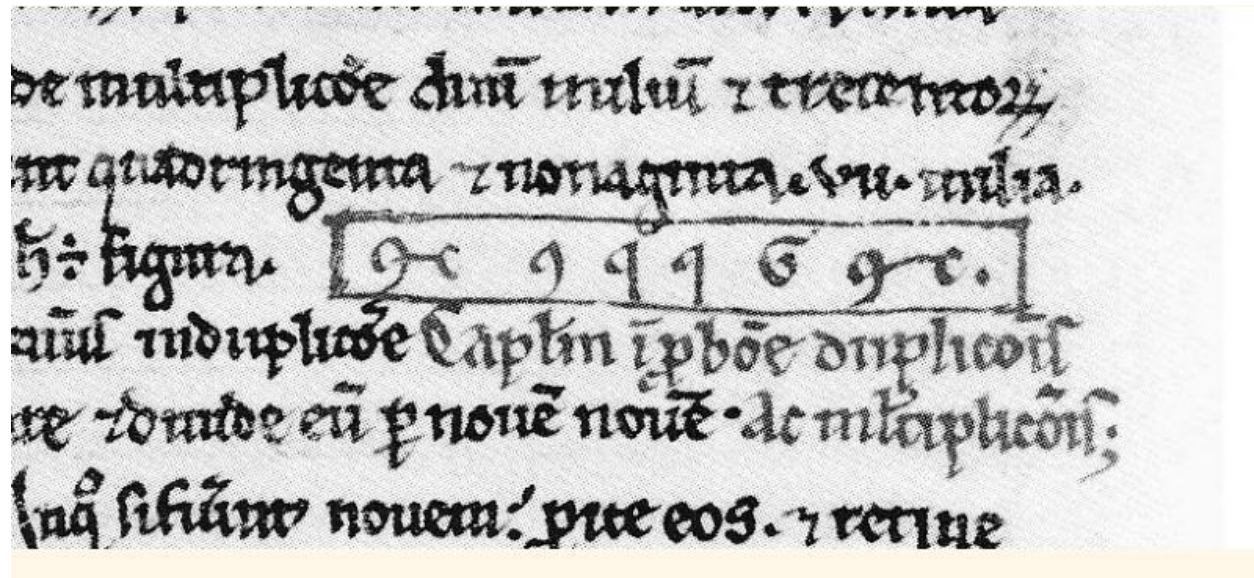
Iranian mathematics in the West

Example: Latin translation of the work of Khwarizmi on computation: multiplication



Iranian mathematics in the West

Example: Latin translation of the work of Khwarizmi on computation: the product



Iranian mathematics in the West

Between the 10th and 13th century, Europe did not learn about the work of later Iranian Mathematicians in the Islamic tradition:

- Kushyar ibn Labban (ca. 400 H/ 1010 CE)
- Abu Rayhan Biruni
- Nasir al-Din Tusi

Reason: Knowledge travelled slowly, the distance between Iran and Spain/Sicily is long.

Jacobus Golius (1596-1667)



Professor of Arabic and Mathematics at Leiden

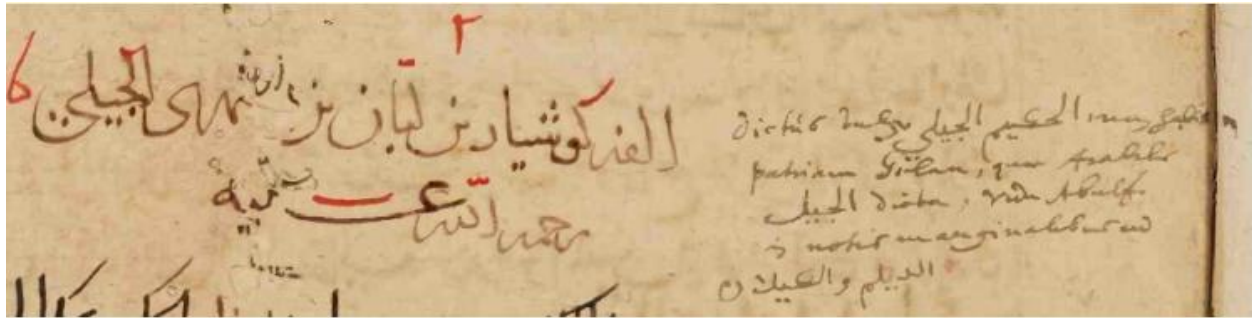
University, Holland

Collected more than 400 Arabic manuscripts in Aleppo and Istanbul between 1625-1629, and brought them to Leiden in Holland

Arabic manuscripts collected by Golius, unknown in the West

- Books 5-7 of the Conics of Apollonius of Perga (200 BCE), several versions (Shirazi, Isfahani, Nasir al-Din Tusi), also astronomy by Tusi
- Zij-e Jamīc by Kushyar
- Algebra by c Umar Khayyam
- Miftah al-Hisab by Jamshid Kashani, also a text by him on sizes and distances of the planets,
- Abu Rayhan Biruni, list of his own works; Exhaustive discussion (isti c ab) of astrolabes; Introduction to Astrology
- Kamal al-Din Farisi, Tanqih al-Manazir, Optics
- Etc. etc. etc; also many mss. on literature, Islam, history

Golius' manuscript of the Zij-e Jami c



Part of first page of the ms. with a note by Golius in Latin.

There was enormous enthusiasm in Holland about this treasure of 400 manuscripts.

It was considered more important than the Spanish "silver eet" which had been captured in 1628 (in Cuba) by Piet Hein.



Latin poem by Constantijn Huygens 1629.

Quaeritur, et vario nuper sub iudice lis est,

Utra Batauorum gloria cedat utri.

Heinius occiduo detraxit vellus Ibero,

Eoi spoliū Golius orbis habet.

Heinius interitum, turbata sorte, minantes,

Golius aeternas per freta vexit opes.

Heinius in paucos ducit sua munera riuos,

Participes omnes Golius ore facit.

Felicem patriam, quae se praediues utrimque

Nescit utra potius prosperitate beet!

Letter by Golius to Pierre Gassendi, with list of manuscripts, printed in 1630

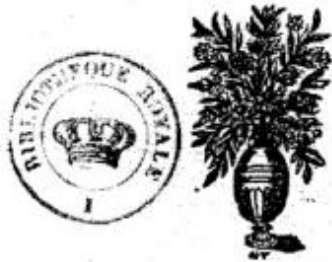
CATALOGVS
RARORVM LIBRORVM,

Quos ex Oriente nuper aduexit, &
in publica Bibliotheca inclytæ
Leydenfis Academiæ deposuit

Clariff. & de bonis Artibus meritiff.

IACOBVS GOLIVS,

*In illa eadem Academia, & Linguarum
Orientalium, & Matheseos
Professor assignit.*



PARISIIS,
Excudebat ANTONIVS VITRAY.
M. DC. XXX.

The first reference to Kashani in the West!

Clavis Arithmeticæ, & Algebrae, autore Giemschid
Gaiat Persæ.

Key to Arithmetic and algebra by Giemschid
Gaiat Persae

More treasures, brought by Golius to Leiden in 1629 for his private collection (and sold in 1696 by his heirs!)

كتاب صور النجوم المنسوب الى عبد الرحمن الصوفي صورة وكتبه بن
المصنف في سنة اربعماية من الهجرة
21 Astronomia Abd' Arrahmân Assoufi; cujus filius ipsemet signa cœ-
lestia delineavit, totumque volumen descripsit ante annos 688.
Arab.

كتاب جوامع الحساب ورسالة الحلالية في الاسطرلاب وكتاب محمد
ابن احمد البروني في الاسطرلاب
20 Explicatio usus Astrolabii, auth. Gjalâli: item Muhammed Ibn
Ahmed Albirouni de Astrolabio. Perf.
كتاب كهان سناخت مبهان فيه صور عالم العلوي والسفلي
كشفا عن اسرار الهمة لاني حسن ابراهيم الهطان
21 Astronomia Ali Alhasen, Ibn Ali, Ibn Muhammed, Ibn Ibrahim
Almerwazi.
كتاب مفتاح عشرين باب في معرفة الاسطرلاب
22 Tractatus de Astrolabio, xx. capitibus distinctus, authore Chozia
Nasîr. Perf. LIBRI

How did Golius study Iranian mathematics and astronomy?

1. In university lectures only to a little extent or not at all
2. In private studies
3. With students, in private lectures

1 University lecture

Golius lectured in the University at 9 hours in the morning on mathematics, and at 12 or 13 hours on Arabic or Persian.

In the spring of 1661, his mathematics lecture was on Menelaus (ca. 50 CE), Spherical Triangles, a treatise lost in Greek, which has been translated from an Arabic version into Latin.

Hora Nona: D. Iacobus Golius Menelaum de Triangulis sphaericis, auctorem Graecum, Graece deperditum, ex Arabica versione Latine redditum exponit.

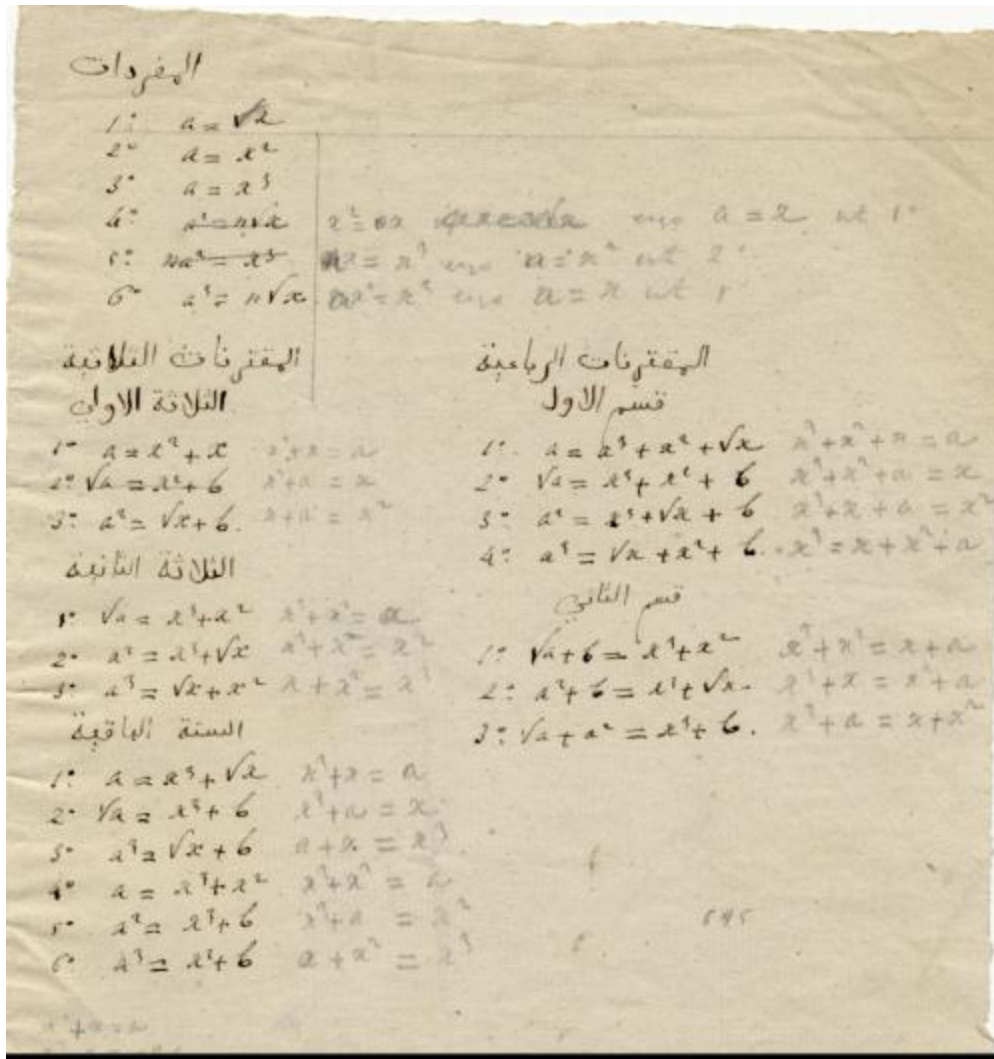
Which version? Harawi? Abu Nasr ibn Iraq? Tusi? or Maurolico (printed 1554 in Latin) [in which case there was little or no relationship with Iranian mathematicians]?

2. Example of private study: Golius prepared an Arabic edition with Latin translation and commentary on the astronomy of Farghani (printed after his death, Amsterdam

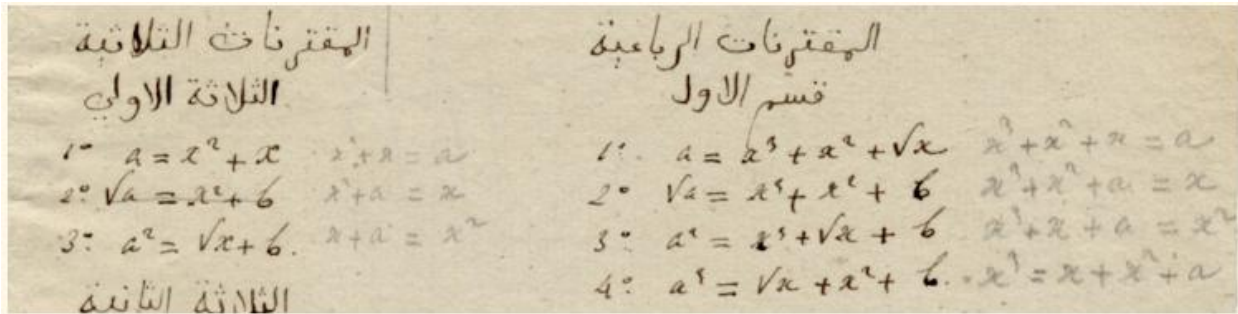
1669)



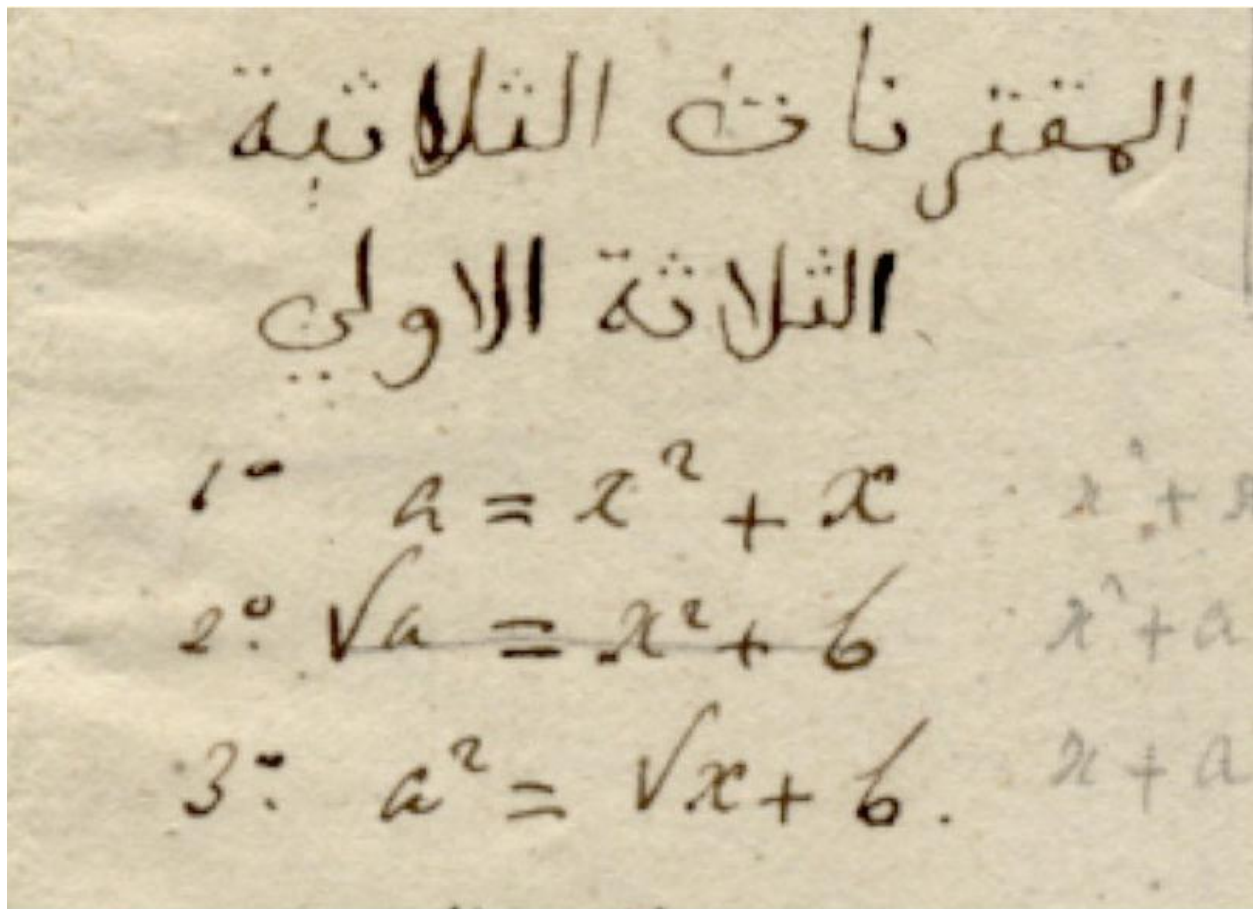
2. Another example of private study: Khayyam, Algebra, leaf with notes in Ms. Or. 14, brought by Golius to Leiden



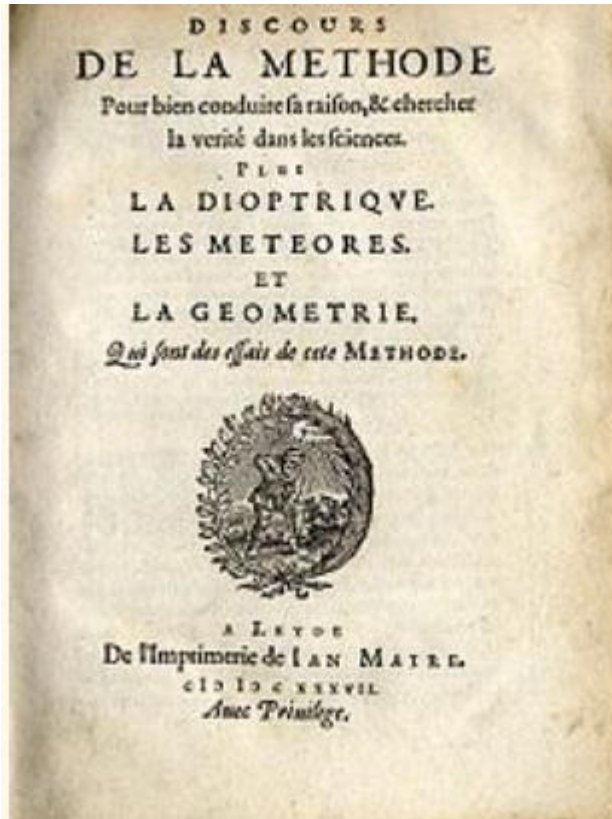
Example of private study: part of the leaf



Example of private study: part of the leaf (with mistakes!)



What did Golius do?



He tried to convert the equations studied by Khayyamin the modern algebraic notation that was introduced by Rene Descartes in La Geometrie (printed in Leiden in 1637)

3. Golius also studied this material with his student Frans van Schooten jr.

Golius (1596-1667)



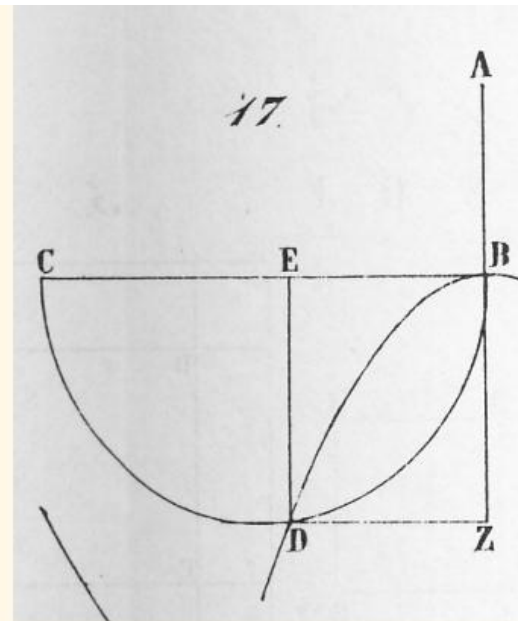
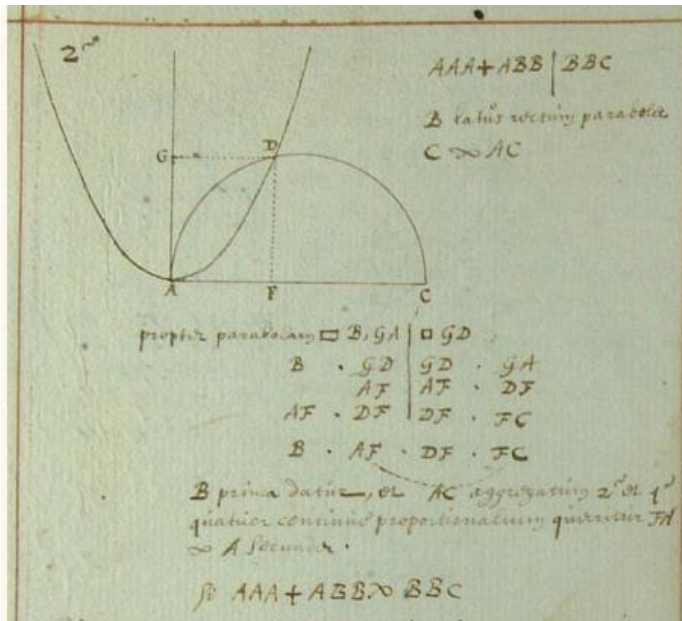
Professor of mathematics (in the Latin language) at Leiden University

Frans van Schooten (1615-1660)

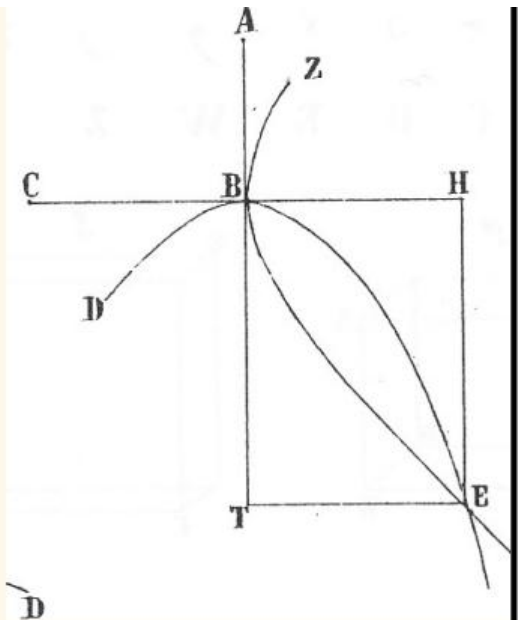
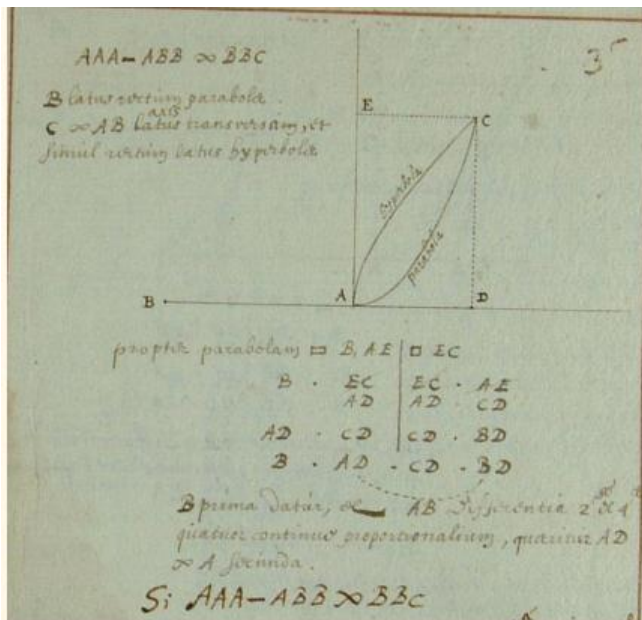


Professor of mathematics (in the Dutch language) at Leiden University

Manuscript by Van Schooten contains solution of cubic equation $x^3 + ax = b$ similar to Khayyam



Manuscript by Van Schooten contains solution of cubic equation $x^3 = ax + b$ similar to Khayyam



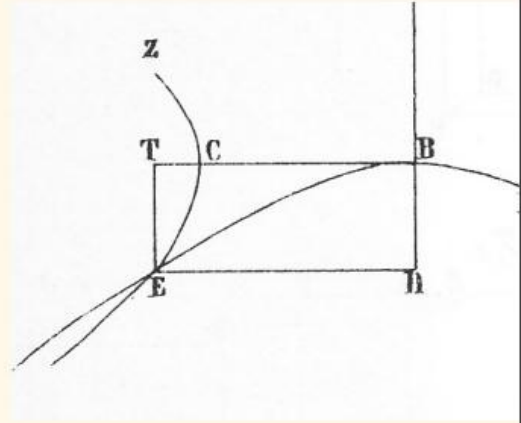
Manuscript by Van Schooten contains solution of cubic equation $x^3 + b = ax$ similar to Khayyam

$ABB-AAA \mid BBC \quad 4^{\text{a}}$
B latus rectum Parabolae
C \propto AB . axis transversa & similitudinem hyperbolae .

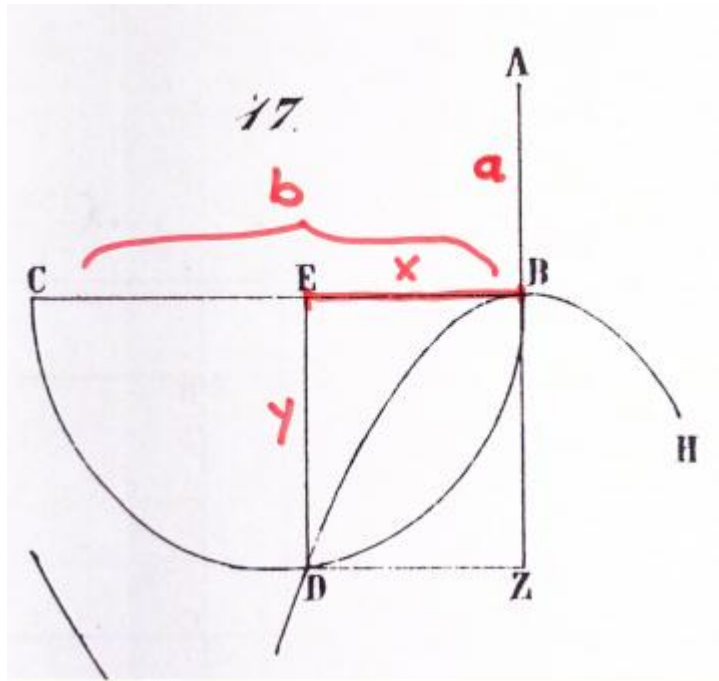
propter parabolam $\square B, BD \mid \square DC$	
$B \cdot DC$	$DC \cdot BD$
$BE \cdot EC$	$BE \cdot EC$
$BE \cdot EC$	$EC \cdot EA$
$B \cdot BE \cdot EC \cdot EA$	

D prima datur, & AB Differentia 2^a & 4^a
quatuor continuè proportionalium, quarum
BE vel Be \propto A secunda .

Equatio Amphibala
si $ABB-AAA \propto BBC$



Khayyam's idea of the solutions of these cubic equations (in modern notation)



We want to solve $x^3 + a^2x = a^2b$, x ;
 a ; b are line segments.

Let y be such that $a/x = x/y = y/b - x$.

Then $x^2 = ay$ [equation of a parabola].

Also $y^2 = x(b-x)$ [equation of a circle]

Also $(a/x)^2 = (a/x) \cdot (a/x) = (x/y) \cdot (y/b - x) = x/(b-x)$

so

$x^3 = a^2 \cdot (b-x)$: this is what we want.

Relevance of these cubic equations $x^3 + ax = b, x^3 = ax + b, x^3 + b = ax$.

Rene Descartes had published (in 1637) his general method for solving geometrical problems.

In this method, a geometrical problem was always reduced to an algebraic equation.

This algebraic equation then had to be solved geometrically (as Khayyam had shown for his cubic equations) so this is why Khayyam was important.

Descartes said that these solutions were necessary for equations of higher degree also [but he had not always shown how]

Francois Viète had also studied these equations algebraically; his work was published by Van Schooten.

How did Golius select the Arabic manuscripts which he wanted to study?

1. Relevance for contemporary mathematics (Menelaus on spherical triangles, Descartes)
2. Interest in medieval Islamic mathematical and astronomical tradition.
3. He spent only a small part of his time to mathematics and astronomy; much more time to putting together an Arabic dictionary! also History of Timur Leng, Persian poetry by Saadi.

Thank you for your attention!

The presentation can be downloaded at

<http://www.jphogendijk.nl/talks/isfahan-saturday.pdf>