

Armenian Alphanumerical Notation on a 14th Century Iranian Astrolabe Found in Fez

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I. Introduction

I am indebted to Professor D. A. King for having brought to my attention the pictures of an astrolabe (#2710)², probably of Iranian origin, that was made by Muḥammad ibn, Ja'far al-Kirmānī, known as Jalāl, in 796 H (1393/94 AD)³. The instrument shows two different alphanumerical notations. That is to say that, besides the original Eastern Arabic alphanumerical notation, this astrolabe has an additional alphanumerical notation that accompanies and occasionally overlaps the Eastern Arabic one as well as the Arabic zodiacal names, on the outer scale and the ecliptic⁴.

Since the astrolabe was found in Fez, the first assumption was, of course, that the figures represented Rūmī or Fāsī notation⁵. However, close

¹ I would like to express my gratitude to J. Samsó, P. Kunitzsch, D. A. King, E. Calvo and M. Comes for their useful information on technical aspects of the astrolabe, as well as for making a number of helpful suggestions.

² IIC (International Instrument Checklist) number, preceded by the symbol #, according to the procedure followed by King [2005: 360].

³ The instrument is now kept in Dār al-Baṭḥā', Fez (inv. no. 764).

⁴ We know of a number of astrolabes handcrafted by at least three generations of the al-Kirmānī family, the well-known instrument makers in 13th and 14th century Isfahan, as we can see in King [2005: XVIII, 1008]. For what refers to the instruments made by Muḥammad ibn Ja'far al-Kirmānī, known as Jalāl, cf. King [2005: XIVd 753-774].

⁵ *Rūmī*, *Zimāmī* and *Fāsī* ciphers are conventionally called *Rūmī* although this range of names covers a decimal non-positional system of 27 symbols, used in the Maghrib for Suhayl 5 (2005)

examination shows that the ciphers in fact correspond to minuscule Armenian alphanumerical notation (Figs. 1, 2 & 3)⁶.

There are other astrolabes with Armenian alphanumerical notation⁷, be them originally Armenian or Arabic with latter Armenian additions⁸.

II. Armenian alphabet and alphanumerical notation⁹.

The Armenian alphabet was created ex novo around the year 400 A.D. due to the efforts of Mashtots (361-440 AD), also called Mesrop by later writers. This script, based on a Greek model and showing also Syriac influence, has remained in use down to the present day. Up to the moment the script had been fashioned, the language used for official inscriptions was Aramaic, although Greek was used in cultural milieus and Syriac in church circles¹⁰.

The Armenian alphabet consists of thirty-eight letters, although only the first thirty-six have assigned a numerical value¹¹, since the final two letters *o* and *ϕ* were added only after Arabic numerals were already in use.

administrative, commercial and notarial purposes, over a long period of time (from at least the 12th to the 19th century) and sharing a single ultimate Greek origin. Cf. for *Rūmī* ciphers Sánchez Pérez [1935]; Labarta – Barceló [1988]; Guergour [2000] and Comes, R. [2002-2003: 150 n. 3 & 170-171].

⁶ I had the opportunity to discuss “*Rūmī* and Armenian Alphanumerical Notation in Arabic Astronomical Instruments” in my contribution to the Workshop held in Barcelona in November 2004. *Programa de doctorat d’Història de la Ciència Àrab, Universitat de Frankfurt – Universitat de Barcelona* (Facultat de Filologia, 7-12 novembre 2004).

⁷ Astrolabes were not unknown in Armenia in the Middle Ages. Descriptions of astrolabes and other astrological instruments, as well as instructions for their use, are recorded in numerous manuscripts kept at the Mashtots Matenadaran Museum in Yerevan. According to Eynatyan, *Theory of the Calendar*, web.matenadaran.ar/en/heritage/mathematics, 2005, 2, there is also a fragment of a 10th century astrolabe kept at the Echmiadzin Museum, although D. A. King believes that its Armenian origin is very unlikely if the instrument was built in the 10th century.

⁸ For detailed information, see King, *A Catalogue of Medieval Astronomical Instruments* (provisional table of contents, May 2002), web.uni-frankfurt.de/fb13/ign/instrument-catalogue.html, Part II, 8 and [2005: 396-400, n. 106].

⁹ For a brief overview of ancient alphanumerical notations in general, cf. Kunitzsch [2005: 3-5] and Comes, R. (in press).

¹⁰ Thomson [1997, I, 200-202] in Hovannisian [1997].

¹¹ As in the rest of the Phoenician-based alphabets, each letter stands for a number based on its order in the alphabet (Fig. 1).

III. The Armenian alphanumerical notation on Jalāl's astrolabe

III. 1. The Armenian alphanumerical notation on the outer scale of the astrolabe (Fig. 2)

The Armenian alphanumerical notation was added on the instrument on top of the Eastern Arabic alphanumerical notation, sometimes even overlapping with the Arabic figures.

Although the Arabic notation follows the standard fashion with graduation 0° towards the middle of the *kūrsī*, the Armenian ciphers begin at a distance of 60° anticlockwise from the Arabic ones (see Fig. 2).

While the Eastern Arabic numbering shows four series, going from 5° to 90° and divided to indicate each 5°, the Armenian notation indicates the 360° of the outer scale of the astrolabe, with markings for each 5°, although not all the figures are written.

Armenian ciphers, thus, start with 5°, duplicating the Arabic cipher¹², and continue with 10°, 20°, 30°, 40°, 50°, 60°, 70°, 80°, 90°, 100°, (1)10°¹³, (1)20°, (1)30°, (1)40°. From this point on, only the following ciphers are indicated: (1)90°, 200°, (2)90°, 300° and (3)60°.

III. 2. The Armenian alphanumerical notation on the ecliptic of the astrolabe (Fig. 3)

The Armenian ciphers were added over the Arabic zodiacal names on the ecliptic, sometimes overlapping with the text, as occurs on the outer scale.

Although the original instrument indicates only the names of the zodiacal signs, the Armenian hand inserted the degrees, corresponding to each division, starting with Capricorn, maybe for the computation of right ascensions¹⁴, and ranging from 30° to 360°. The Armenian alphanumerical notation marks, therefore, 30° in the division corresponding to Capricorn, 60° in the following division and so on, until 360° in the last division.

¹² The Arabic notation marks every five degrees of the Arabic sequences, while the Armenian notation only duplicates the Arabic ciphers in the first 5° of the Armenian sequence (see Fig. 2).

¹³ The parenthesis mark the elided letters meaning one hundred, two hundred and three hundred.

¹⁴ Ascensions were often measured from Capricorn 0°. See King [1989:782-784] and [2004: 37-38 (α')].

IV. Concluding remarks:

In spite of the difficulty of determining when and why this astrolabe was overwritten with Armenian alphanumerical notation, we can assume that the notation was added to the Eastern Arabic alphanumerical notation either because the user or the person for whom these ciphers were added (probably an Armenian), was not sufficiently familiar with the Arabic language and ciphers, or at least did not feel comfortable with them, or because the scales were to be used for different purposes.

The Armenian alphanumerical notation could have been added to the astrolabe in New Julfa between 1603 and 1667, the most brilliant period of Safavid rule in Iran. From the end of the 14th century until the government of Shāh ʿAbbās I the Great (1587-1629), there was a succession of wars that caused devastation and decimated the population in historic Armenia. During the wars between the Ottoman Empire and Iran, around 1605 Shāh ʿAbbās I the Great, deported the wealthy Armenian merchants and craftsmen of Julfa to Isfahan, the Safavid capital, where a large colony named New Julfa was founded. New Julfa would very soon become one of the centres of Armenian intellectual life, where Armenian artisans and craftsmen, as well as merchants, were very active, especially after Shāh ʿAbbās I the Great gave them a virtual monopoly over the trade¹⁵. In 1667 Shāh ʿAbbās II died and decline set in again.

Curiously, however, the back of the astrolabe shows a Maghribī style zodiacal calendar with Western Arabic month-names that undoubtedly was added later by a Maghribī hand.

So it seems that this astrolabe, made in Kirman or Samarqand, reached Armenian hands, perhaps in Isfahan, before being taken to the Maghrib.

V. Bibliography

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¹⁵ Kouymjian [1997, II, 1-50] in Hovannisian [1997].

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Table comparing Armenian alphanumerical notation appearing on the astrolabe to Greek (Attic) as well as Western and Eastern Arabic alphanumerical notations.

Greek (Attic) characters ¹⁶	Transcr.	Arabic (W ; E) characters ¹⁷	Transcr.	Armenian characters	Transcr.	No.
E / e	E	ه	h	Ե / Ե	e	5
I / ι	I	ي	y	Ի / Ի	j	10
K / κ	K	ك	k	Ի / Ի	i	20
Λ / λ	L	ل	l	Լ / Լ	l	30
M / μ	M	م	m	Խ / Խ	x	40
N / ν	N	ن	n	Ն / Ն	c	50
Ξ / ξ	X	س; ص	ş; s	Կ / Կ	k	60
O / ο	O	ع	e	Հ / Հ	h	70
Π / π	P	ف	f	Ձ / Ձ	j	80
Ϟ	S	ص; ض	đ; ş	Ղ / Ղ	†	90
Ϙ	K	ق	q	Ճ / Ճ	č	100
P / ρ	R	ر	r	Մ / Մ	m	200
Σ / σ	S	ش; س	s; sh	Յ / Յ	y	300

Fig.1

¹⁶ Capital and minuscule Greek (Attic) and Armenian alphanumerical characters are separated by the sign (/).

¹⁷ Western and Eastern Arabic alphanumerical characters and corresponding transcriptions are separated by the sign (;).



1. Beginning of the Eastern Arabic alphanumerical notation.
2. Beginning of the Armenian alphanumerical notation.

Fig. 2



Fig. 3