

# **THE ARCUS VISIONES OF THE PLANETS ACCORDING TO DIFFERENT SOURCES**

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**ABSTRACT**

The heliacal phases of the planets and the stars are the pivotal phenomena of the Babylonian Astronomy and Astrology. In order to compute them since Ptolemy the scholars are using the method of the Arcus Visionis.

Different authors give different values for the arcus visiones.

Here are briefly examined the reasons for the disagreement.

The conclusion is that the different sets of the arcus visiones have different precision and reliability and are based on observations in different locations with different quality of the atmosphere.

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The notion 'arcus visionis'<sup>1</sup> (AV) was introduced by Ptolemy in his *Almagest*. Its function was to compute the time when a certain planet or star will become visible or vanish.... i.e. its heliacal phases. In the 'Handy Tables' ascribed again to Ptolemy, we find another, different set of AV's.

We have also the Hindu values and 'the ancient opinion' cited by the Arab astronomers, which is almost identical with the Hindu (*Kennedy 1960*).

From the 'modern' authors we have only the values of Carl Schoch in 2 main variations: one from 1924 (*Schoch 1924*) and another one from 1927 (*Schoch 1927*).

Only Schoch makes distinction between different heliacal phases and consequently computes different arcus visionis for each of them.

While Ptolemy, for example, gives only one value, 10°, for Mercury, Schoch gives different values of the AV for all 4 heliacal phases of the planet (see table 1). This approach makes much more sense.

It is unfathomable and very strange how Ptolemy could give only one value for the AV of a planet that can change drastically its brightness in its different phases with 3 whole magnitudes<sup>2</sup>!

Now comes a very logical question. Why the different sets of AV are different? To answer this we must examine the sources of the authors.

Ptolemy says in the *Almagest* that he draws on observations made in Phoenicia while Schoch computes his values using babylonian tablets published by Kugler and Epping. We do not know about the sources of the Hindu tradition, but it is logical to assume that they are observations made in India.

In his publication from 1924, Schoch writes about the number of the babylonian observations he used: 30 for Mercury, 15 for Venus, 12 for Jupiter, 9 for Saturn and 4 for Mars. Schoch also explicitly writes that these were real observations and not from prediction-tablets ('goal-year' texts).

Obviously the observations that were used to compute the AV of the planets were made in places with different atmospheric extinctions<sup>3</sup>. Most probably also some of the observers have done more and others less observations.

Without doubt, the most inexact AV's are those in the *Almagest* and there is no extinction for which they can be valid!

Mars and Saturn have almost the same AV although that Mars on the average shows up with 1 magnitude dimmer than Saturn.

Both Jupiter and Mercury according to Ptolemy have an AV of 10°.

In his Morning First apparition though, Jupiter is with 3 magnitudes brighter than the average Mercury (+1.0)!

The irony here is that the 'visibility tables' made by the Arabs for almost 1000 years were exclusively based on these values (*Kennedy 1960*).

At the other end, the most reliable values are those of Schoch.

However, we should not forget that they are based on babylonian historical observations only. Comparing with my own practical observations, I can tentatively deduce an atmospheric extinction of around 0.12 for Babylon in order for these arcus visiones to hold. This means extremely clear, dry and transparent atmosphere<sup>4</sup>.

So, the Schoch's AV's may be valid only for places with extinction around 0.12.

The Handy Tables are for computing the MF of the planets at places again with extinction of 0.12.

The Hindu values are good for tropical humid atmosphere with extinction of 0.40. The 9° for the AV of Venus though is too high for any atmosphere.

The Al-Khasini set is the same as the Sanskrit one. Only the AV of Mars is different which must be a scribal error since it cannot be possibly lower than that of Saturn. (Mars shows up usually with 1 mag. dimmer than Saturn)

From all AV sets the Schoch values are the most important for 3 reasons: first: all scholars, past and present have used and use these or similar<sup>5</sup> values; second, sorry to say, we do not have anything better so far<sup>6</sup>, and third: these values are in the basis of 2 computer programs for calculating the heliacal phases of the planets.

The programs are my own program 'Babylonia' ver. 1.3 from year 2000 and the program 'Planetary, Lunar and Stellar Visibility' ver. 3.01 from year 2005 developed by professor Noel Swerdlow from University of Chicago and Rainer Lange from the 'Alcyone' software company<sup>7</sup>.

Needless to say, these programs are as accurate as the Schoch's tables... i.e. not very much.

**TABLE 1: THE ARCUS VISIONES OF THE PLANETS** by different sources

	Almagest Handy T.		Al-Khasini	Hindu	Schoch 1924				Schoch 1927			
♃	11°	13°	15°	15°	<i>mf</i> 13°	<i>el</i> 10.5°	<i>mf</i> 13°	<i>el</i> 10.3°				
♄	10°	9°	11°	11°	9.3°	7.4°	9°	7.5°				
♅	11.5°	14.5°	13°	17°	15.5°	14.2°	14.5°	13.2°				
♆	5°	6° <i>mf, el</i>	7° <i>ef, ml</i>	9°	9°	5.7 5.8	5.8 5.2	5.8 5.5	5.8 5.2			
♇	10°	12°	13°	13°	13.2	9.5 10.5 11.1	13.0 9.5 10.2 11					
					<i>mf ml</i>	<i>ef el</i>	<i>mf ml</i>	<i>ef el</i>				

*mf*: Morning First; *ml*: Morning Last; *ef*: Evening First; *el*: Evening Last

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## NOTES

1: Translated from Latin, it means 'arc of vision'. The arcus visionis tells us what is the altitude of the Sun below the horizon when a certain celestial body is exactly on the horizon. This method is flawed in principle and leads to many errors. However this will be addressed in a separate article.

2: Mercury can be -1.5 mag. in its Morning Last and +1.5 in its Evening Last.

3: The atmospheric extinction shows how transparent is the atmosphere. Its values range, for the most locations, between 0.10 and 0.40, meaning how many star magnitudes are extinguished by one air-mass (thickness of the atmosphere at the zenith).

4: This is in contrast with the 0.27 evaluation of the atmospheric extinction at Babylon done on theoretical grounds by Teije de Jong (2002)

My preliminary evaluation of 0.12 is based on practical observations only.

5: Kugler in his analysis of Babylonian texts with heliacal rises of stars uses the AV's of Wislicenus which are very similar to those of Schoch.

6: There are some modern algorithms, like the one of B. Schaefer which claim to be better. This however is not true. I will review them in detail in future articles.

7: Read my review of prof. Swerdlow's program in the first issue of 'The Babylonian Sky-Observer', a journal edited by me, forthcoming in April 2006.

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