

The distinctive features of Rik-Jyotisha

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Abstract. There are six appendices to the Veda, which include grammar, glossary of words (निरुक्त) etc. Jyotisha is one of those appendices. It mainly states the positions of the Sun and Moon and gives the method of making calendars required for performing sacrifices. There are two recensions of Jyotisha, Rik-Jyotisha and Yajus-Jyotisha. Rik-Jyotisha uses 19 years luni-solar cycle while Yajus-Jyotisha uses 5 years luni-solar cycle for its calendar making. Such cycles are called "Yuga" in these texts. The author of this paper has in January 1987 read a paper on the subject at Hyderabad and also published books on the said subject. The distinctive features of these two texts are not properly understood by the students of the subject. The object of this paper is to give the distinctive features of Rik-text as 19 year Yuga.

Key words : vedanga jyotish, metonic cycle

1. Introduction

There were three difficulties in interpreting Rik-text. The text is composed in the then Algebraic terms and language. It keeps some names of the units used in it as silent. We have to guess them and find them out, keeping consistency with the positions of the Sun and the Moon in the sky. Secondly there are two verses in the text the first and 32nd which are ambiguous. They mislead and give impression that the Yuga of Rik-Jyotisha is of 5 years. Thirdly the text does not mention anywhere that 19 year luni-solar cycle is used in the construction of its Yuga. Yet we cannot explain its meaning without using 19 year cycle.

Let us call Rik-Jyotisha as R V J and Yajus Jyotisha as Y.V.J. We are told that R V J was used by the Vedic sages for religious purpose as hand-book for performing 6 monthly sacrifices. It is treated as collection of "Mantras". Therefore, it is orally reproduced for thousands of years without any change whatsoever, and the true meaning of several terms is lost in this process. Here we have to use some legally settled rules of interpretation :

1. An interpreter of document knows a rule that "the author of the text, has placed comma and

full stop in the document with all his wisdom. It is only in a very rare case we should presume that some mistake has crept in it in the process of reproduction". 2. The portion of the text which gives clear meaning should be interpreted first keeping the object of the text in view. The ambiguous portion of the text should be interpreted thereafter using the rule of consistency.

There are in all 36 verses in RVJ and 43 verses in YVJ out of which 19 verses have the same meaning. We have 6 verses in RVJ which are not included in YVJ. They are RVJ-2,13,19,29,33 and 34. We find that the author of YVJ had dropped RVJ-13, 19 and 34 because their wordings could not be easily changed to suit the construction of 5 year cycle. We therefore, choose to explain RVJ-19 first. It has to be explained along with RVJ-14.

2. RVJ 14 and 19

Sage Lagadha divided the ecliptic path in 27 equal parts called Nakshatras. They are named according to the name of the prominent asterism in the divisions. The days were named in the calendar according to the Nakshatra covered by the Moon on the corresponding day. The Moon completes $365.25/27.3216 = 13.368546$ sidereal periods in a year. The fraction of the incomplete cycle is therefore 0.368546 i.e. $(0.368516 \times 27) = 9.95$ nakshatras. In Vedanga this fraction is called as "*Nakshatra's Ritu-Shesh*". In 19 years it totals to 189 nakshatras i.e. 7 sidereal months.

The year of the sacrifices was topical year each divided into 2 semesters (Ayanas) beginning at the winter and summer solstices. The Sun covered the asterism Dalphinus (Shravistha) on the day of summer solstice. There were thus 38 semesters in a Yuga. The total 189 nakshatra-Ritushesh $(190 - 1)$ was distributed in 38 semesters so that the Moon covered $(5 - 1/38)$ nakshatras per semester.

Symbols for Nakshatras : Sage Lagadha used a symbol for each nakshatra e.g. i.e. "Jau" for "Ashwayug", "Nya" for Bharanya etc. These symbols were derived either from the names of the nakshatras or from the names of the deity presiding over them. He rearranged the list by skipping over 5 nakshatras each time. The rearranged list is given in RVJ - 14.

जौद्राघ : खेध्वेहीरोषाचिन्मूषण्य : सोमाधान : ।
रेमृद्गाश्वा ओजस्तृष्वोहर्षेष्टा इत्यृक्षालिङ्गै ॥ १४ ॥

Tilak calls this list as Javadi list. Sage Lagadha treats it as an arithmetic series with difference of 5. It is used in RVJ -19 for finding out the names of the successive nakshatras covered by the moon on the 1st day of each semester in the Yuga. RVJ 19 reads as under :

श्रविष्ठाभ्यां गुणाभ्यस्तान् प्रग्विलग्रान्विनिर्दिशेत् ।
सूर्यान्मासान्षळभ्यस्तान् विद्याच्चान्द्रमसान् ऋतून् । १९ ॥

Meaning : "If we break the chain of nakshatras (a nakshatra before Shravistha and reproduce from it, Javadi multiplication series, (while crossing a group of 5 nakshatras) we get a Ritushesh in lunar nakshatras at the interval of 6 solar months.

Practical use : Take a rosary (माला) with 27 beads (मणी) with one bead having different colour (e.g. red) call it as Shravishthaa. Count the beads in a group of 5 each, beginning from Shravishthaa, we are required to make 7 rounds of the rosary before we reach the red bead, because we have to pass over it in earlier rounds. If RVJ 14 is reproduced while touching the links between each group of 5 nakshatras we get the name of the first day of each semester. When we begin counting for the next Yuga we have to move one bead backwards to reach the link before Shravishthaa. Table 1 explains the mathematical calculations. The name of the day of the summer solstice is found by adding 13 nakshatras each time because the Sun is at 180° away from the origin of its sidereal period on such days.

RVJ 19 as explained by other scholars : According to us, it is not possible to explain RVJ - 19 with the concept of 5 years cycle. Dixit (1981 p.79) has expressed his inability to explain the first line. For explaining the second line he introduced a theory of lunar seasons. There are 67 sidereal periods of the moon in 5 years. He asks us to multiply 67 by six to obtain total number of 402 lunar seasons in 5 years.

The concept of such lunar seasons is totally absent in contemporary or subsequent literature of 'Jyotisha'. It is totally absurd. When B. G. Tilak (1914, p. 101), Dwivedi (See Tilak 1914) and Kupanna Sastri (1985, p. 43) explained second line of RVJ-19, they followed Dixit. Their suggestions to change the first word in the second line from "सूर्यान्" to स्वर्क्षान् स्तर्यान् or स्तूर्यान् to suit the meaning is based on their concept of 5 year Yuga.

While interpreting first line, Tilak (1914, p. 101) and Kupanna Sastri (1985, p. 43) followed Dwivedi. They were confused over the meaning of the word "प्राग्विलम्नान्" and created its nexus with "orient sign" in astrology. Dwivedi found that, because there are 367 sidereal days in a year, in 5 years, $367 \times 5 \times 27 = 49545$ nakshatras cross the eastern horizon. They changed the word "गुणाभ्यस्तान्" to "गणाभ्यस्तान्" to suit the meaning as conceived by them. Tilak suggested that "लग्न" should be treated as a group of 3 nakshatras. He criticised Dwivedi for his interpretation which has no nexus with the object of the text. The confusion vanishes if we explain RVJ 19 with the help of 19 year yuga as narrated above.

3. RVJ 13

The next verse that calls our attention is RVJ - 13.

पक्षात्पञ्चदशाच्चचोर्ध्वं तद् भुक्तमिति निर्दिशेत् ।
नवभिस्तूद्गतोशः स्यादूनांशद्व्यधिकेन तु ॥ १३ ॥

Our explanation for it is as follows. The mathematical operations in RVJ follow step by step. The units of angle and those of time are derived from five year cycle. It presumes a year having a length of 366 days equal to 372 tithis. Moon covers 361.8 nakshatras in this period. The ritushesh in terms of tithis in such a hypothetical year is 12 tithis or 11 lunar nakshatras. The Sun covers 360.97° in such a year. RVJ - 10 gives the positions of the Sun at the end of each parvan in terms

TABLE No. 2

Sr. No. of the month	Sr. No. of last lunar nakshatra	Bhamshtaka	Kalaas of previous day	Constance Udweda	Dwisa-ptaiceehna Sammita
1	14	73 9/8	603+	171-73	98
2	29	22 2/8	603+	38-438	203
3	43	95 11/8	603+	209-511	301
4	58	44 5/8	603+	95-292	406
5	72	117 14/8	603+	266-365	504
6	87	66 8/8	603+	152-146	6
7	102	15 1/8	603+	19-511	111
8	116	88 11	603+	76-365	209
9	131	37 4/8	603+	247-438	314
10	145	110 13/8	603+	133-219	412
11	160	59 7/8	603+	19	517
12	175	8 1	603+	190-73	19
13	189	81 10/8	603+	57-438	117
14	204	30 3/8	603+	228-511	222
15	218	103 12/8	603+	114-292	320
16	223	52 6/8	603+	-73	425
17	248	1 1/8	603+	171-146	530
18	262	74 9/8	603+	38-511	25
19	277	23 2/8	603+	228	130
20	291	96 12	603+	95-365	228
21	306	45 5/8	603+	266-438	333
22	320	118 14/8	603+	152-219	431
23	335	67 8/8	603+	38	536
24	350	16 2	603+	38	38
12	361.8	99			
				565 Klis	
				11 N = 77 Klis }	
				→8 Nakshatra = 488Klis	603 Klis

TABLE No. 1

Sr.No. of the year.	Winter Solstice	As per RVJ 14	5th Nakshatra	Summer Solstice
1	2	3	4	5
1.	Shravishthaa (shravana + 38 div.)	वृ ष	Revatee (+13 Nakshatras)	-Hasta
2.	Mriga + 36 div.	श ष	Maghaa + 13N	-Shravishthaa
3.	Swaati + 34 div.	श ष	Poor. Aash ."	-Aardraa
4.	Poor. Bhaad + 32 div.	वृ ष	Krit + 13N	-Vishaakhaa
5.	Pushya + 30 div.	वृ ष	Hasta + 13N	-Utt. Bhaadra
6.	Jyeshthaa + 28 div.	वृ ष	Shravishthaa ."	-Aashleshaa
7.	Ashvini + 26 div.	वृ ष	Aardraa ."	-Moola
8.	Poor. Phal + 24 div.	वृ ष	Vishaakhaa ."	-Bharance
9.	Utt. Aashbd + 22 div.	वृ ष	Utt. Bhaadra ."	-Utt. Falg
10.	Robinee + 20 div.	वृ ष	Aashleshaa ."	-Shravana
11.	Chitraa + 18 div.	वृ ष	Moola + 13N	-Mriga
12.	Shata + 16 div.	वृ ष	Pharance ."	-Swaatee
13.	Punarvasu + 14 div.	वृ ष	Utt. Phal ."	-Poor. Bhaadra
14.	Anuraadhaa + 12 div.	वृ ष	Shravana ."	-Pushya
15.	Revatee + 10 div.	वृ ष	Mriga + 13N	-Jyeshthaa
16.	Maghaa + 8 div.	वृ ष	Swaatee + 13N	-Ashvinee
17.	Poor. Aashbd + 6 div.	वृ ष	Poor. Bhaadr. ."	-Poor. Phaal
18.	Krit + 4 div.	वृ ष	Pushya + 13N	-Utt. Aash
19.	Hasta + 2 div.	वृ ष	Jyeshthaa ."	-Robinee
20.	Shravishthaa	वृ ष	New Yuga Begins	

Table No. 4

Sr. No. of the year	Name of the year	New Year day at Sunrise	Winter Solstice	Mid Summer year Solstice	Year end	
1	2	3	4	5	6	7
1.	Samvatsara	Shu. 1	Shu. 1	Shu. 7		
2.	Anuvatsara	Shu. 11	Shu. 12	Vad. 3		+m
3.	Idvatsara	Vad. 7	Vad. 8	Vad. 14		
4.	Samvatsara	Shu. 3	Shu. 4	Shu. 10		
5.	Parivatsara	Shu. 14	Paurimasa	Vad. 6		
6.	Idavatsara	Vad. 10	Vad. 11	+m Shu. 2		
7.	Samvatsara	Shu. 6	Shu. 7	Shu. 13		
8.	Parivatsara	Vad. 2	Vad. 3	Vad. 9		
9.	Idavatsara	Vad. 13	Vad. 14	+m Shu. 5		
10.	Anuvatsara	Shu. 9	Shu. 10	Vad. 1		+m
11.	Idvatsara	Vad. 5	Vad. 6	Vad. 12		
12.	Samvatsara	Shu. 1	Shu. 2	Shu. 8		
13.	Anuvatsara	Shu. 12	Shu. 13	Vad. 4		+m
14.	Idvatsara	Vad. 8	Vad. 9	Amaavasya		+m
15.	Samvatsara	Shu. 4	Shu. 5	Shu. 11		
16.	Parivatsara	Pauri.	Vad. 1	Vad. 7		
17.	Idavatsara	Vad. 11	Vad. 12	+m Shu. 3		
18.	Anuvatsara	Shu. 7	Shu. 8	Shu. 14		
19.	Idvatsara	Vad. 3	Vad. 4	Vad. 10		+m
20.	New Yuga begins		Amaavasya			
	+ m Shows Adhikamasa					

TABLE No. 3

Month and tithi	Sr. No. Parvan	Sr. No. Last Lunar nakshatra	Col. 7 Table 8	As per RVJ 13 Table 8	Bhasdan Kalas
1	2	3	4	5	6
Bhadrapada sk. 15	15	218	320	+ 7	320
Bhadrapada Vd. 9	-	227	383	+ 7	390
Bhadrapada 30	16	232	425	+ 7	432
Ashvin Sk. 15	17	248	530	+ 7	537
Ashvin Vd. 30	18	262	25	+ 7	32
Kaartika Sk. 15	19	277	130	+ 7	137
Kaartika Vd. 30	20	291	228	+ 7	235
Maargashirsha Sk. 15	21	306	333	+ 7	340
Maargashirsha Vd. 30	22	320	431	+ 7	438
Push Sk. 15	23	335	536	+ 7	543
Push Vd. 30	24	350	38	+ 7	45
Rituabsha	11 tithis	361		(11N x 7)	+ 77
					122

Table No. 6

Sr. No.	Particulars	Originals	Amendments
1	2	3	4
1	RVJ. 4	अर्धं अर्धं	अप्यस्तौ
2		संज्ञिकं	संयुतं
3	RVJ. 8	द्विगुणं	प्रथमम्
4		पंचमभस्त्रु	पंचमभस्त्रु
5	RVJ. 12	चापिगते	चापिगते
6		उत्पेकं	उत्पेकं
7	RVJ. 19	अविष्टास्य	अविष्टास्य
8		गुणप्यस्तान्	गुणप्यस्तान्
9		प्राविष्टानान्	प्राविष्टानान्
10		सूर्यान्	सूर्यान्
11	RVJ. 24	भूयोप्यने	भूयोप्यने
12		राशिषु	राशिषु
13	RVJ. 31	तद्योर्ध्वं	तद्योर्ध्वं
14	RVJ. 13	treating 15 Pakshaas as 15 tithis in the explanation.	

Table No. 5

Sr.No. of the Year	Name of the Year	Lunar Nazara before Sunrise	Winter Solstice	Summer Solstice
1.	Samvatsara	0.00 N.	Shravishthaa	Hasta
2.	Anuvatsara	8.947 N.	Mriga	Shravishthaa
3.	Idvatsara	18.895 N.	Swaati	Aardraa
4.	Samvatsara	1.842 N.	Poor. Bhaa.	Vishaakhaa
5.	Parivatsara	11.789 N.	Pushya	Utt. Bhaad.
6.	Idavatsara	21.737 N.	Jyeshthaa	Aashleshaa
7.	Samvatsara	4.684 N.	Ashvinee	Moola
8.	Parivatsara	14.632 N.	Poor. Falg	Bharanee
9.	Idavatsara	24.579 N.	Utt. Aash.	Utt. Falg.
10.	Anuvatsara	7.526 N.	Robhee	Shravaga
11.	Idvatsara	17.474 N.	Chitraa	Mriga
12.	Samvatsara	0.421 N.	Shafa	Swaati
13.	Anuvatsara	10.368 N.	Punarvasu	Poor. Bhaad.
14.	Idvatsara	20.316 N.	Anuraadhaa	Pushya
15.	Samvatsara	3.263 N.	Revatee	Jyeshthaa
16.	Parivatsara	13.211 N.	Maghaa	Ashvinee
17.	Idavatsara	23.158 N.	Poor. Aashaa	Poor. Falg.
18.	Anuvatsara	6.105 N.	Kritika	Utt. Aashaa.
19.	Idvatsara	16.053 N.	Hasta	Robhee
20.	New Yuga	0.00 N.	Shravane + 38 Div	Hasta

of nakshatras and bhaamshaas. RVJ-11 is provided by the sage to record the positions of the Moon at the end of each parvan in terms of nakshatras and kalaas. These positions of Sun and the Moon are further corrected and made consistent with the Yuga of 19 years with the use of RVJ-12 and RVJ-13 respectively. The length of ecliptic circle is thus corrected as 360° . The relevant verses for our subject are therefore RVJ-11 and RVJ-13.

Now Kalaas is a fundamental unit for measuring the time cycle, covered by the moon at the rate of 603 kalaas per mean solar day. It is initially presumed that moon takes 610 kalaas to cover one nakshatra. Let us presume that moon starts its journey at mean time of sun-rise in the beginning of the Yuga at zero kalaas. When it reaches the end of 'n' nakshatras it does so after n (610 - 603) kalaas i.e. '7n' kalaas after Sun rise. Such number of kalaas are called Bhaadaan kalaas. RVJ - 11 provides a rule to calculate the time of entry of the moon on the day of change of various parvans in a year. Kupanna Sastri has correctly explained the rule. We provide Table 2 to make his explanation more clear. Column 7 gives the time of entry of the moon in the next nakshatra after the end of each parvan in a year.

Purpose for providing RVJ - 13 : In RVJ-11 it is presumed that in a year of 366 days, moon covers 361.8 nakshatras, however, the year consists of 365.25 days. Sage Lagadha makes further calculations for corrections in the following manner.

The average length of the year in a cycle of 19 years is 365.25 days, but the last year i.e. 19th year is presumed as basic year (or leap year) having a length of 366 days, consequently earlier 18 years have an average length of 365 days and 5 hours (i.e. 126 kalaas). The Moon covers 361 nakshatras in this period. It appears that there was a practice of making calculations of Bhaadaan kalaas at the end of various parvans in a group of 7 kalaas. The proper place for adjusting table No.2 with the natural positions of the moon, by adding 7 kalaas was found by the sage after 15th parvan and 9 days. Here he added 7 kalaas more in col. 7 of table 2. Table 3 gives the amended position. The author of the Yajus-text has dropped this verse because it was inconsistent with his theory of 5 years cycle.

RVJ 13 as explained by other scholars : Tilak (1914, p.73) uses three verses RVJ-11, 12 and 13 for calculating bhaadaan kalaas at the end of each Parvan according to his concept of 5 years Yuga. Kupanna Sastri (1985, p.58) uses only RVJ-11 and gives the same result in easier mathematical operation. (See table 2). Tilak's explanation for RVJ-13 therefore becomes, redundant Prof. Kupanna Sastri interprets the words "Pakshaat Panchadashaat Chordham" as "after the fifteen tithi" which is inconsistent with the wordings of the text (See Kuppanna Sastry 1988, p.55)

4. Other Verses

a) *RVJ - 13 :*

"चतुर्दशीमुपवसतस्तथा भवेद्यथोदितो दिनमुपैति चंद्रमा : ।
माघशुक्लाह्निको युंक्ते श्रविष्ठायां च वार्षिकीम् ॥ ३४ ॥

This verse is provided in RVJ for actual observations of the crescent moon in the eastern sky before the dawn of Amavasya day at the end of Pausha, Krishna Chaturdashi. On this day the Moon covers Shravistha nakshatra. Such a day coincides with winter solstices only once in 19 years. He has therefore, dropped the verse from his text.

b) *RVJ - 1 and 32* :

"पञ्चसंवत्सरमयं युगाध्यक्षं प्रजापतिम् ।
दिनत्वयनमासाङ्गं प्रणम्य शिरसा सुचिः ॥ १ ॥

The word " संवत्सर " used in Vedaanga has two meanings. When it is used as common noun it means a solar year. Vedaanga years are further classified in five types, Samvatsara, Parivatsara, Idaavatsara, Anuvatsara and Idvatsara. These are the proper nouns of its class. RVJ-8 and RVJ-9 are provided for classification of the years according to the limits of tithis and nakshatras, respectively, of the first day of each year. Table 4 gives the classifications of the year according to tithis while table 5 gives their classification according to the nakshatras. From Table 4 and 5 we find that in the cycle of 19 years we have five years which are classed as samvatsara. The word "मयं " occurring in the first line of RVJ-1 has second meaning that there are five years with their proper noun as Samvatsara in a Yuga of 19 years. This meaning is consistent with the other part of the text and therefore we have to accept it.

c) *RVJ - 32* : It reads as under :-

माघशुक्लप्रवृत्तस्य पौषकृष्णसमापिनः ।
युगस्य पंचमस्येह कालज्ञानं निबोधत ॥ ३२ ॥

These are the wordings in the verse as narrated by Dixit (1981, p.93) which he found from the copy of Bhatotpalas commentary on Brihatsamhita - Bhatotpalas dated his work as 966 A.D. Present text reads as under :

माघ शुक्ल प्रवृत्तस्तु पौष कृष्ण समापिना ।
युगस्य पंचवर्षाणि कालज्ञानं प्रचक्षते ॥ ३२ ॥

We treat the former citations as original as it is age old.

The second line in the original verse reads as "युगस्य पंचमस्येह " which means that there are five sub-yugas in 19 years cycle and the description about the beginning and end of the said yuga applies to last sub-yuga. This interpretation being consistent with other parts of the text deserve, to be accepted.

5. Emendations or transformations

The scholars who had a concept that Rik-Jyotisha describes 5 year yuga, suggested 14 emendations in the text by which they have actually transformed the nature of the Yuga from 19 years cycle to 5 years cycle. Table 6 gives their amendments. We have not suggested any amendments.

The last question about the use of 19 years luni solar cycle in Rik-Jyotisha is based on the

absence of such a statement in clear words in the text. When we have conclusively proved that the calculations in RVJ about the positions of the Sun and the Moon are based on 19 years luni-solar cycle this question does not subsist . We further add that RVJ is not an educational text, its main object is to provide rules for making a luni-solar calender consistent with the actual positions of the Sun and Moon in the sky, which could be achieved even without stating the theory behind such rules.

We hope this will help the readers in proper understanding of Rik-Jyotisha.

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