



From *Nadyantaka* to *Pausṇa*: compilation of stars catalogued in *Sarvasiddhāntarāja*

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Abstract. *Sarvasiddhāntarāja* (1639 CE) is an astronomical treatise composed by Nityānanda. Almost all texts on Indian astronomy provide the coordinates of 27 stars, which are known as junction stars. However, *Sarvasiddhāntarāja* is one of the rare texts which gives coordinates of 84 stars along with other parameters associated with them. Nityānanda describes this topic in great detail systematically in over 52 verses. In this paper, we provide a critical edition of these verses along with their translation. We have also compiled a list of all star names found in the text along with the parameters associated with them, and presented them in a tabular form.

Keywords. *Sarvasiddhāntarāja*—compilation of stars—Nityānanda.

1. Introduction

The transmission of knowledge from the Orient to the European nations traces its roots to the Arab invasions. Many Europeans, mainly the British, developed an interest in learning Indian astronomy and reported their findings to the Royal Society, where it was received with curiosity and perhaps, astonishment.

By the end of the 18th century, many reports on Indian astronomy had reached and a comparative study had begun. We see one such attempt in identifying the stars as known to Indians. Jones (1799) mentions about the “extremely contemptuous” of M. Montucla¹ and provides a detailed study of the stars in the Hindu zodiacal system. After giving a complete picture of the individual stars and the shapes of the asterisms, he writes

“I have not the boldness to exhibit the individual stars in each mansion, distinguished in Bayer’s, method, by

Greek letters, because, though I have little doubt that the five stars of *Aslesha*, in the form of a wheel, are η , γ , μ , ζ , ϵ of the Lion, and those of *Mula* γ , ϵ , δ , ζ , ϕ , τ , σ , ν , θ , ξ , π of the Sagittary: and though I think many of the others equally clear, yet, where the number of stars in a mansion is less than three, or even than four, it is not easy to fix on them with confidence; and I must wait, until some young Hindu astronomer, with a good memory and good eyes, can attend my leisure on serene nights at the proper seasons, to point out in the firmament it-self the several stars of all the constellations for which he can find names in the *Sanskrit* language. The only stars, except those in the *Zodiac*, that have yet been distinctly named to me, are the *Septarshi*, *Dhruba*, *Arundhati*, *Vishnupad*, *Matrimandel*; and, in the southern hemisphere, Agastya, or Canopus (Jones 1799, p. 301).”

It is interesting that Jones was able to discuss the details of these 27 stars with the Sanskrit scholars and the analogy provided was very apt. The zodiacal belt was understood as the circular base of a cone with the apex at the pole of the ecliptic. Subsequent studies by Burgess (1866), Colebrooke (1807) and others basically reiterated this idea – thus the total number of stars known to Hindus were 27 + 5 or 6.

These ideas were carried down to the 20th century when Pingree also supported the idea of Montucla that

¹The paper by Montucla was published in *Histoire* (its *Mathématiques* (1758), tome i, p. 402). There is another reference: as stated by Burgess (1983), Sir William Jones had treated Montucla’s theory (that Hindu astronomy was chiefly based on Ptolemaic) with contempt.

the names of stars were borrowed from the west (Pingree & Morissey 1989).

We began the search for the detailed description of the stars in various texts and found two distinct sources. The first were the *Karaṇas* and *Sārinīs* or tables; the second were the astrolabes. Since the main objective of the *Karaṇas* is the determination of the planetary positions, the citations would be limited to the 27 stars only.

Astrolabes attracted the attention of Hindu astronomers by about 14th century. The Arab instrument was introduced along with a manual. The very first one was by Mahendra Sūri (Ohashi 1994), which listed all the stars from the original version.

Two centuries later many more texts were made available with longer lists of stars (Sarma 2018). Many of these are not well studied. Of particular interest is the work *Sarvasiddhāntarāja* of Nityānanda, which lists about 84 stars. The present paper aims at decoding the coordinates along with critical edition and translation of the details provided in the text.

1.1 The text: *Sarvasiddhāntarāja* of Nityānanda

Sarvasiddhāntarāja is a comprehensive astronomical text composed by Nityānanda. The year of composition of the text is 1639 CE. One special feature of the text *Sarvasiddhāntarāja* with respect to other *siddhāntik* texts is that it devotes two chapters pertaining to the stars. The chapter named *bhānāñjñānam* is one of them. The other chapter named *sankrāntyādi* forms the basis for the present analysis. It contains 58 verses. After the first four verses Nityānanda starts listing the coordinates of the stars in 51 verses (from 5 to 56). Since the first four verses and the last two verses of the chapter do not contribute to the star coordinates directly, we have translated only verses 5–56. In between verses four and five, there is a sentence

अथात्र चतुरशीतिताराणां ध्रुवकमानानि शराश्व
प्रोच्यन्ते ।

athātra caturasātitārāñām dhruvakamānāni
procyante ।

Now here, measurements [pertaining] to the longitudes (*Dhruvakas*) and latitudes (*sāras*) of the 84 stars are being told.

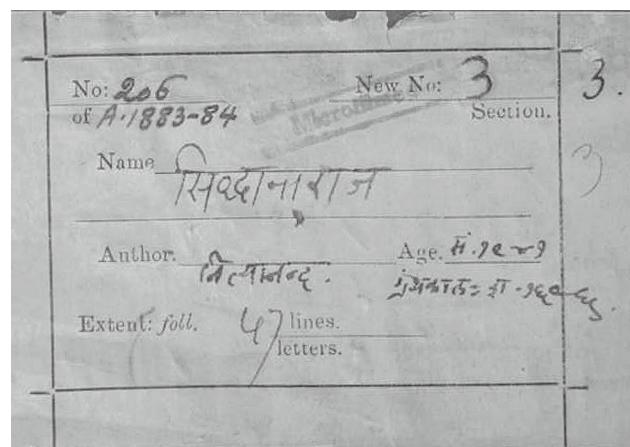


Figure 1. The title page of the manuscript obtained from BORI, which is identified as BORI 206 of A 1883–84.

It is worth mentioning here that, as per the above sentence, the total number of stars listed in the text is 84. However, in actual, the text contains the list of 89 star names along with their coordinates. We have tried to solve this discrepancy.

We have used the manuscript available in Bhandarkar Oriental Research Institute (BORI). The manuscript is identified as BORI 206 of A 1883–84 with a new section number 3, with the author identified as “Nityānanda” and the title of the text is labelled as *Siddhāntarāja*.

The title page (Figure 1) of the manuscript identifies the text as *Siddhāntarāja*. Hence, initially we thought that there are two different texts composed by Nityānanda with similar names; *Siddhāntarāja*² and *Sarvasiddhāntarāja*. However, the name of the text is *Sarvasiddhāntarāja* though it is labelled in the title page as *Siddhāntarāja*. At the end of each chapter there is a concluding sentence which describes the place, name of the author, the name of the text, the chapter and so on. Here, we provide the sentence, which comes at the end of the chapter *saṃkrāntyādi* in Figure 2. We also provide the transcription of the same both in *Devanāgarī* and in Roman transliteration.

इत्येतस्यामिन्द्रपुर्या वसन्सन्नित्यानन्दो देवदत्तस्यपुत्रः
सारोद्धरे सर्वसिद्धान्तराजे संक्रान्त्याद्यं |

ityetasyāmindrapuryām vasansannityānando
devadattasyaputraḥ sāroddhāre sarvasiddhāntarāje
saṃkrāntyādyam|

²The second page of the manuscript too is labelled as *Siddhāntarāja*.

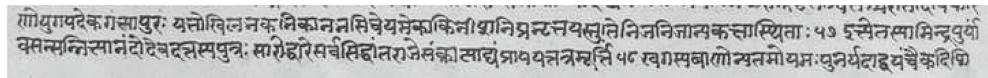


Figure 2. Last sentence of the chapter named *samkrāntyādi*.

Apart from the coordinates (*Dhruvakas* and *Viksepas* or *saras*), it also gives magnitude of brightness and latitudinal direction (North/South). In the next section, we would be describing each of these parameters.

2. Parameters

2.1 The coordinates: *Dhruvaka* and *Sara*

The *Dhruvaka* and *Sara/Vikṣepa* are the two coordinates, pertaining to the stars, defined in all Indian astronomical texts. Equivalent terms corresponding to these are not found in modern texts on spherical astronomy. Hence, we define these with the help of a figure. In Figure 3, *P* and *K* are the poles of the equator and ecliptic, respectively. The *Dhruvaka* is the angle measured from the first point of Aries (γ) along the ecliptic to this point *C*. Here, *C* is the point of intersection of the ecliptic and the great circle passes through the pole (*P*) and the star *X*. Similarly, the *Vikṣepa* or the *Sara* is the angle measured along the great circle passing through the pole of the equator from *C* to *X*. Therefore

$$\text{Dhruvaka} = \gamma C \text{ and } \text{Sara} = CX.$$

Nityānanda gives the magnitude of the *Dhruvaka* and the *Sara* of the stars in the *bhūta-saṅkhyā* system. The value corresponding to *Dhruvaka* given in the text ranges from 0° to 30° . That means, in the case of the actual coordinate to be determined by adding $30 \times i$ to the coordinate given in the text, where ' $i = 0, 1, \dots, 11$ ' depending upon the *rāśī* (zodiac sign) into which the star is grouped into. For example, suppose a star is situated in '*Śiṁha-rāśī*' (Cancer) and the coordinate given in the text is ' x ' degrees, then the value of ' i ' is 4 and the actual coordinate of the star is $(30 \times 4) + x = 120 + x$. However, the second coordinate *Sara* is to be used without any modification.

As far as the *Sara* is concerned, the latitudinal direction (North/South) is also specified in the text along with the magnitude of the *Sara*.

2.2 Brightness scale

This is an important parameter which is given by Nityānanda in *Sarvasiddhāntarāja*. He also gives the

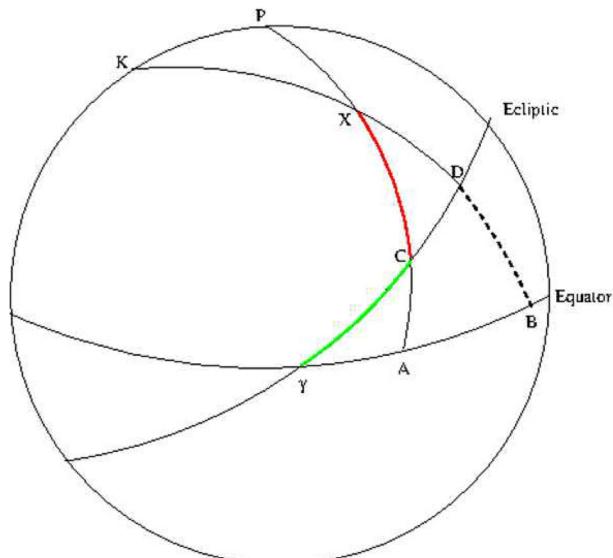


Figure 3. Coordinates *Dhruvaka* – *Vikṣepa* and right ascension – declination.

magnitude of the brightness of the stars apart from their coordinates, providing the brightness as a scale called *pramaṇa*, which is equivalent to the magnitude scale used today. The first (termed *prathamapramāṇa* or *ādyamāṇa*) is the brightest; the second brightest is termed *dvimīti*, the third as *trimīti*; it mentions even a fourth one as *caturtha-pramāṇa*. These scales are specifically described in the middle of the text after the description of the stars of Leo. It states that there are thousands of stars fainter than magnitude 6. This value of the magnitude helps us in the identification. For example, if there are two stars very close to each other, based on the brightness scale, the correct one can be identified (Shylaja & Pai 2018a,b).

The verse (numbered 30) which describes this is as follows:

...
यदाद्यमानं महादेव तत्स्यात् ।
मध्यं त्रिमानं किल षष्ठमानम्
भं सूक्ष्मभास्मनेकतारम् ॥

...
yadādyamānam mahadeva tatsyāt ।
madhyam trimānam kila saṣṭamānam
bham sūkṣmabhāsmanekatāram ॥

The [term] *ādyamāṇa* is [referring to the] stars of biggest/brightest (*mahat*) [magnitude]. The [word] *trimāṇa* refers [to the stars] of medium (*madhya*)

[magnitude]. [Similarly,] there are many stars that are tiny/fainter [magnitudes] which are referred to as *sasthamāna*/sixth magnitude, are shining in the sky.

Now, we provide a critical edition and translation of the verses in the next section.

3. Critical edition and translation

This section is divided into 12 subsections based on 12 *rāśis* or zodiacal signs, which mark the intervals of 30° . All the declinations are covered within this range of ecliptic longitude. In each subsection, we have provided the critical edition of the verses in both *Devanāgari* and Roman transliteration along with the translation.

3.1 Stars in Aries (*Mesarāśī*)

अथात्र चतुरशीतिताराणां ध्रुवकमानानि शराश्व
प्रोच्यन्ते ।

*athātra caturasāttitārāṇāṁ dhruvakamānāni
procyanте ।*

Here again, measurements [pertaining] to the longitudes (*Dhruvakas*) and latitudes (*sāras*) of the 84 stars are being told.

बाणैर्नृपालैः ५ | १६ प्रथमप्रमाणो
नद्यन्तकोऽवाग्निपदाद्विष्वाणैः ५३ | ४५ |
व्यांगांशं^३ दिग्भि ९ | ५० द्विमितिस्तु सौम्यो
मत्स्योदरस्तत्वलवैः दलाद्यैः २५ | ३० ||५||

*bāṇairnrpālaiḥ prathamapramāṇo
nadyantako'vāgnipadādbhibāñaiḥ |
vyamgāṁśadigbhidvimitistu saumyo
matsyodarastatvalavaiḥ dalādyaīḥ ||५||*

The Magnitude of the [star] '*Nadyantaka*' is five degrees sixteen minutes (5|16) and is of the first [order brightness] [and the other coordinate is] quarter of a degree subtracted from 54 degrees (53|45). This star is situated along the southern direction (*avaś*). For [the star] '*Matsyodara*', [the coordinates are] $(\frac{1}{6})^{\text{th}}$ of a degree subtracted from 10 [degrees] (9|50) with second [order] magnitude [in brightness scale] and 25 and a half degrees (25|30), and is along the northern direction.

शक्रैरसै १४ | ६ स्त्रिप्रमितोत्तरस्यां
विषष्टनागै ७ | ५० रिह चाधिनी स्यात् |
शक्रैः सुरै १४ | ३३ स्त्रिप्रमितः सदोदक
विषष्टभूपञ्च ५० | ५० भिराप्तपाणिः ||६||

³The manuscript reading is व्यः गां.

*sākrairarasai stripramitottarasyāṁ
viṣṭaśānāgai riha cāsvinī syāt |
sākraiḥ surai stripramitāḥ sadodak
viṣṭaśābhūparāca bhirāptapāñih ||६||*

The coordinates of '*Asvinī*', with third magnitude, are 14 degrees and 6 minutes (14|6) and $(\frac{1}{6})^{\text{th}}$ of a degree subtracted from 8 [degrees] (7|50) in northern direction. The star which has the coordinates 14 [degrees], 33 [minutes] (14|33) and $(\frac{1}{6})^{\text{th}}$ of a degree subtracted from 51 [degrees] (50|50). This [star] which shines with third order brightness in northern direction is [known as] '*Āptapāñi*'.

नृपै १६ | ० रुदकित्रप्रमितं विपादै
रसाध्विभिः ४५ | ४५ स्यादिह पीठमूलं |
त्रिबाहुभिर्भूमिगुणै २३ | ३१ रुदीच्यां
पादोनषड्भिं ५ | ४५^४ भरणी सुसूक्ष्मा ||७||

*nṛpai rudaktripramitam vipādai
rasābdhibhiḥ syādiha pīṭhamūlam |
tribāhubhīrbhūmiguṇai rudīcyāṁ
pādonasaḍbhi rbharaṇīsusūkṣmā ||७||*

[The star] '*Pīṭhamūla*', whose magnitude [of brightness] is three degrees, is situated in the northern direction with the coordinates 16 degrees (16|0) and quarter of a degree subtracted from 46 degrees (45|45). The minute (*susūkṣma*)⁵ '*Bharani*' is situated in the northern direction with the coordinates 23 degrees 31 minutes (23|31) and quarter of a degree subtracted from 6 degrees (5|45).

व्यर्कांशभै २६ | ५५ | स्त्रिप्रमितिः सदोदग्
व्यंगांशचन्द्राक्षलवै ५० | ५० सुषीठः |
सृष्टयादिकाले निहितं विधात्रा
भसप्तकं व्योमनि मेषराशौ ||८||

*vyarkāṁśabhai stripramitiḥ sadodag
vyamgāṁśacandrākṣalavai rsupīṭhāḥ |
srstyādikāle nihitam̄ vidhātrā
bhasaptakam̄ vyomani meṣarāśau ||८||*

The [star] '*Supīṭha*' which is directed always towards the north with third degree brightness and with [the coordinates] 27 degrees diminished by $(\frac{1}{12})^{\text{th}}$ of a degree⁶ (26|55) and $(\frac{1}{6})^{\text{th}}$ of a degree (10') subtracted from 51 degrees (*candraṅka*) (50|50). At the time of creation of the universe, these seven stars had been thrown by the creator in the *Mesarāśī* [which is situated] in the sky.

इति मेषनक्षत्राणि |

iti meṣanaksatrāṇi|

⁴The string “पादोनषड्भिः” represents the number ५|४५. However, the numerals are not found in the manuscript.

⁵The term *Susukṣma* refers to the sixth-order brightness.

⁶ $27^\circ - 5' = 26^\circ 55'$.

These are the stars [situated] in *Mesa[rāśī]*.

3.2 Stars in Taurus (*Vṛṣabha-rāśī*)

सार्द्धः शरै ५ | ३० रुत्तरदिग्द्विमानं
जात्यंशकै २२ | ० मनुषशीर्षधिष्यम् ^७
गजैर्जनै ८ | २४ रुत्तरदिविष्पादैः
युगैः ३ | ४५ | शरोन्मानमिहानिधिष्यम् ||१||^८

*sārdhāḥ śaraiḥ ruttaradigdvimānam
jātyaṁśakai rmānuṣasāśadhiṣṇyam
gajairjinai ruttaradigvipādaiḥ
yugaiḥ śaronmānamihāgnidhiṣṇyam ||१||*

The star ***Mānuṣasīrṣa*** [is situated] with second order brightness along the north [with the coordinates] five and a half degrees (5|30) and twenty-two degrees (22|0) respectively. Here, the magnitude of brightness of the star ***Agni*** is five (*sara*) which is situated along the northern direction with the coordinates 8 degrees, 24 minutes (8|24) and quarter a degree less to 4 degrees (3|45) respectively.

विपादसूर्ये ११ | ४५^९द्विमितिस्तुसौम्यः
सत्र्यंशकैर्गोनयनै २१ | २० नृपाशः।
सपष्टगोभूमि ११ | १० रिहायमानाऽ
[अ]वाग् रोहिणी साडिग्रशरै ५ | १५ विभागैः ||१०||

*vipādasūryairdvimitistusaumyah
satryaṁśakairgonayanai rnypārśvah |
saśaṣṭagobhūmi riḥādyamānā-
[a]vāg rohiṇī sāñghrisarai rvibhāgaiḥ ||१०||*

Quarter of a degree subtracted from 12 degrees (11|45) is the [*dhruvaka*] of a star which is situated in the north with second order brightness. The second coordinate of the star ***Nṛpārśva*** is the $(\frac{1}{3})^{\text{rd}}$ of a degree added to 29 degrees (29|20). 19 degrees along with $(\frac{1}{6})^{\text{th}}$ of a degree (19|10) is the one coordinate of the star ***Rohini*** which shines with first order brightness along the sothern direction with the second coordinate being five and a quarter degrees (5|15).

षडक्षिभि २६ | ० दक्षिणदिक्कुरामैः
धृत्या^{१०}३१ | १८^{११}द्यमानो मिथुनस्य पादः |
एतानि भानि स्फुरदंशुकानि
वृषे स्थितानि प्रभवन्ति पञ्च ||११||

⁷धिहं.

⁸धिसंय.

⁹Manuscript reads it as १२ | ४५ (12|45). But the actual one is ११ | ४५.

¹⁰धृत्यात्र.

¹¹Manuscript reads it as १|18, instead of 31|18.

*sadakṣibhi rdakṣinādikkurāmaiḥ
dhṛtyādyamāno mithunasya pādah |
etāni bhāni sphuradāṁśukāni
vṛṣe sthitāni prabhavanti parīca ||११||*

The star '***Mithunasya-pāda***', which shines along the southern direction with first order brightness, has the coordinates 26 (*sadakṣi*) degrees (26|0) and 31 (*kuraṁma*) degrees, 18 (*dhṛti*) minutes (31|18). These stars situated in the *Vṛṣarāśī* with [the shape of] a trembling upper garment (*sphuradāṁśuka*) form [a group of] five [stars].

इति वृषेनक्षत्राणि |

These are the stars situated in the *Vṛṣarāśī*.

3.3 Stars in Gemini (*Mithuna-rāśī*)

लवांगभागेन ० | १०^{१२}भवेद्विमानो-
वाक्साडिग्रमेघैः^{१३}१७ | १५ नृयुगांसकाख्यः |
सत्र्यंशरूपेण १ | २० | तथाद्यमानः
स्कन्दो विपादत्रियमै २२ | ४५ रुदव्यः ||१२||

*lavāṅgabhāgena bhaveddvimāno
vāksāñighrimēghaiḥ nryugāṁsakākhyah |
satryaṁśarūpeṇa tathādyamānah
skando vipādatriyamairudavyah ||१२||*

The [star] '***Nṛyugāṁsaka***' shines in the northern direction with two degree brightness has the coordinates $(\frac{1}{6})^{\text{th}}$ of a degree (0|10) and quarter of a degree added to 17 degrees (17|15). With the coordinate equal to $(\frac{1}{3})^{\text{th}}$ of a degree added to one degree (1|20), the '***Skanda***' shines with the first order brightness. The [magnitude of the *vikṣepa*] is quarter of a degree subtracted from 23 degrees (22|45) and [the direction is towards] north.

षट्ठांशहीनद्वितयेन १ | ५० ^{१४}सौम्यः
साडग्रीषुभि ५ | १५^{१५}द्विप्रमितोऽम्बुवत्सः |
व्यङ्गिद्वयेण २ | ४५ | द्विमितं यमाशं
जिनैः सुरैः २४ | ३३ स्यान्मिथुनस्यमध्यम् ||१३||

¹²The term '*anāṅgabhāga*' refers to $(\frac{1}{6})^{\text{th}}$. Hence, '*lavāṅgabhāga*' is $(\frac{1}{6})^{\text{th}}$ of a degree, which is nothing but 10 min or 0°|10'.

¹³The reading is नेवैः instead of मेघैः which represents the number 17.

¹⁴Numeral १ is not so clear in the manuscript.

¹⁵The co-ordinate should be 5|15. But, the manuscript reading is 5|25 which is wrong.

*sastāṁśahāñadvitayena saumyah
sāṅghrāśubhir dvipramito'mbuvatsah |
vyānighritrayenā dvimitam̄ yamāśam̄
jinaiḥ suraiḥ syāñmīthunasyamaddhyam ||13||*

Two degrees diminished by $(\frac{1}{6})^{\text{th}}$ of a degree (1|50) and quarter of a degree added to 5 degrees (5|15) are the coordinates of the [star] ‘*Ambuvatsa*’ which shines with second order brightness in the northern direction. In the southern direction, the [star named] ‘*Mīthunasyamadhyā*’ shines with second order brightness with the coordinates (2|45) (quarter of a degree subtracted from 3 degrees) and 24 degrees 33 minutes (24|33).

*sāṣṭāṁśarāmē: ३ | ७ | ३० | घनर्म यमाशं
दलाद्यविष्टैः: १३ | ३० मृगशीष्मृक्षं |
व्यर्कांशशैलैः: ६ | ५५ | धृतारकोदक्
सार्द्धाङ्गषड्भिः: ६६ | ३० त्रिमितिर्विभाति ||१४||*
*sāṣṭāṁśarāmē: ३ | ७ | ३० | ghanabham̄ yamāśam̄
dalāddyavisiṣṭaiḥ mrgasāīśamrkṣam̄ |
vyarkāṁśasailaiḥ dhruvatārakodak
sārdhaṅgaśadbhīḥ trimitirvibhāti ||14||*

The star (*rksam*) ‘*Mrgasīrṣa*’ having the coordinates equal to 3 degrees along with $(\frac{1}{8})^{\text{th}}$ of a degree (3|7|30) and half along with thirteen (13|30) shines with three degrees¹⁶ of magnitude along the southern [direction]. The star ‘*Dhruva*’ (*Dhruvatāraka*) which shines along the north with the third degree brightness has the coordinates seven degrees diminished by $(\frac{1}{12})^{\text{th}}$ of a degree (6|55) and sixty-six degrees along with half of a degree (66|30).

*व्यंगांशनागैः: ७ | ५० प्रथमप्रमाणो-
[अ]वाक्पादहीनाब्लवैः¹⁷ १६ | ४५ नृहस्तः: |
सार्द्धाप्रचन्द्रैः: १० | ३० द्युमितिर्लाद्यैः:
कुलोचनैरुत्तर २१ | ३० दिग् नरांसः¹⁸ ||१५||*

*vyamgāṁśanāgaiḥ prathamapramāṇo-
[a]vākpādahāñābdalavaiḥ nrhastah |
sārdhābhracanddraiḥ dyumitirdaldādyaiḥ
kulocanairuttara dig narāmsah ||15||*

¹⁶The term *ghana* is used to find the cube of a number. Hence, as per *bhūtasankhyā* system, it is used to represent the number 3.

¹⁷The manuscripts reads as अवाक्पादहीन्ब्लवैः. Here, the number corresponds to the string अब्द is 17.

¹⁸The reading in the manuscript is नुरंसः which is erroneous. The actual reading should be त्रंसः which means shoulder (*amsa*अंसः) of a man (*nṛ*नृ). Hence, नृ + अंसः becomes त्रंसः (*nramsa*). However, the word त्रंसः will not fit into the metre of the verse. Therefore, we have modified it as *Narāmsa* (*Nara* + *amsa*) or नरांसः as an editorial modification so that it fits into the metre. The meaning of this is same as that of *nramsa* (shoulder of a man).

The star ‘*Nṛhasta*’ has the first order brightness and is along the southern direction. The coordinates of the star are eight degrees diminished by $(\frac{1}{6})^{\text{th}}$ of a degree (7|50) and quarter of a degree subtracted from seventeen degrees (16|45). Half a degree along with ten degrees (10|30) and half a degree along with twenty-one degrees (21|30) are the coordinates of the star ‘*Narāmsa*’ which shines with two degree of brightness along the northern direction.

*धृत्यानगै १८ | ७ स्त्रिप्रमितैर्नगैश्च
सपञ्चमांशै ७ | १२ यमदिक्तथास्त्रद्रौ |
रामाक्षिभि २३ | ० दक्षिणः आद्यमानः
स्याल्लुधकः¹⁹ सार्द्धनवान्नि²⁰ भागैः ३९ | ३० ||१६||*

*dhṛtyānagai stripramitairnagaśca
sapañcamāṁśai ryamaddiktathā“rdrā |
rāmāksibhirdaksināḥ ādyamānāḥ
syallubdhakāḥ sārddhanavāgnibhāgaiḥ ||16||*

The star ‘*Ārdrā*’ which is situated in the south, shines with third degree brightness, has the coordinates eighteen degrees, seven minutes (18|7) and seven degrees along with $(\frac{1}{5})^{\text{th}}$ of a degree (7|12). Along the south with first order brightness, the star ‘*Lubdhaka*’ shines with the coordinates twenty-three degrees (23|0) and half a degree added to thirty-nine degrees (39|30).

*भल्लुकपृष्ठं सदलाङ्गनेत्रैः: २६ | ३० |
तानैर्जिनै २९ | २४ रुत्तरदिक्त्रिमानं |
गोलोचनै २९|० रायमितिरगस्त्यो
बाणाद्रिभि ७५ दक्षिणदिक्प्रसिद्धौ: ||१७||*

*bhallūkapr̄ṣṭham sadalāṅganetraḥ
tānairjinai ruttaradiktrimānam |
golocanai rāyamitiragastyo
bānādribhi rdakṣinādikprasiddhaḥ ||17||*

The star ‘*Bhallūkapr̄ṣṭha*’ shines with third degree brightness along the northern direction with the coordinates twenty-six degrees along with half of a degree (26|30) and forty-nine degrees, twenty-four minutes (49|24). The famous ‘*Agastya*’ shines with first order brightness along the southern direction with the coordinates twenty-nine degrees (29|0) and seventy-five degrees (75|0).

*केचिन्मृगव्याधमपिब्रूवन्ति
षड्ग्रीवंशभागो २६|० यमदिक् खवेदैः ४० |
एतानि भानि प्रथितानि युग्मे²¹
भवन्ति च द्वादशसंख्यकानि ||१८||*

¹⁹स्या: ल्लुधकः.

²⁰नरवान्नि.

²¹Here, ‘युग्म’ refers to the zodiacal sign ‘मिथुन’.

kecinmgavyādhamapibruvanti
śadyimśabhaṁ yamadik khaveddaiḥ |
etāni bhāni prathitāni yugme
bhavanti ca dvādaśasamkhyakāni ||18||

Some say about the star '**Mrgavyādha**' which is situated along the southern direction with the coordinates twenty-six degrees (26|0) and forty degrees (40|0). These stars are spread along the *Mithunarāśī* (also known as *yugmarāśī*) and are totally twelve in number.

इति मिथुनक्षत्राणि ।
iti mithunanakṣatrāṇi |
Thus, the stars in the *Mithunarāśī*.

3.4 Stars in Cancer (*Karkarāśī*)

सार्द्धद्वयेनो २ | ३० त्तरदिविद्वमानः
पुनर्वसुः सार्द्धरसैः ६ | ३० विभाति ।
पञ्चांशकैः ५० आद्यमितिर्नृपालैः १६ | ०
अवाक् स्थितो लुधकबन्धु संज्ञः ||१९||

sārddhadvayeno ttaradikdvimānah
punarvasuḥ sardhharasaiḥ vibhāti |
pañcāmśakaiḥ ādyamitirnrpālaiḥ
avāksthito lubdhakabandhusamjñāḥ ||19||

The star **Punarvasu** shines, along northern direction, with the coordinates two and a half degrees (2|30) and six and a half degrees (6|30) respectively with second order brightness. The star named **Lubdhakabandhu** which is situated along southern direction has the coordinates five degrees (5|0) and sixteen degrees respectively. [The star also has] first order [brightness] in the [brightness scale].

सत्र्यांशसूर्यैः १२ | २० त्रिमितं सदोदग
गोलोचनैः २९ युग्मकमस्य ²²संज्ञं ²³
पुष्यो नृपैः त्र्यंशयुतैः १६ | २० सदोदग
रुपेण १ | ० मेघप्रतिमो विभाति ||२०||

satryamśasūryaiḥ trimitam sadodag
golocanaiḥ yugmakamasya samjñām |
pusyo nrpaṭaiḥ tryamśayutaiḥ sadodag
rupeṇa meghapratimo vibhāti ||20||

One-third of a degree added to (*satryamśa*) 12 (*sūrya*) degrees (12|20) [is the one of the coordinates of the star which] shines with the third order brightness (*trimitam*) and directed towards the north always (*sadodag*). [The second coordinate] is 29 degrees (*go* (9), *locana* (2); 29|0) and this [star] is known by the name '**Yugmaka**'. The [star] **Pusya** has the

²²युग्मकमस्य.

²³Manuscript reads the numeral as 16|30.

coordinates one-third of a degree added to sixteen degrees (16|20) and one degree (1|0). [This star is situated] always along the north and shines like cloud-cluster.²⁴

दलाढप²⁵ जात्या २२ | ३० त्रिमितिर्यमाशास-
श्लेषा विसूर्याश नगैः ६ | ५५ विभागैः ।
जात्या २२ | ध्रुवाक्षो द्विमितिः सदोदक
त्रिपर्वतैः ७३ पश्चिमभागसंस्थः ||२१||

dalaḍhya jātyā trimitiryamāśā'-
ślesā visūryāṁśa nagaiḥ vibhāgaiḥ |
jātyā dhruvākṣo dvimitiḥ sadodak
triparvataih pasćimabhāgasamsthah ||21||

Half a degree added to twenty-two degrees (22|30) becomes the first coordinate of the [star] **Āślesā** which shines with third order brightness along the southern direction. The second coordinate is $(\frac{1}{12})^{\text{th}}$ of a degree subtracted from seven degrees (6|55). Twenty-two degrees (22|0) is the coordinate of the **Dhruvākṣa** which shines with second order brightness along the northern direction always, and situated on the western part, has the other coordinate whose value is given as seventy-three degrees (73|0).

पश्चान्मुनीन्द्रो द्विमितिस्तुसिद्धैः ²⁶२४
उदग्नवाण्डिप्रमितैर्जिनैश्च ४९ | २४ |
विपादभै २६ | ४५ दर्क्षिणगाद्विमानः
गजेषुभिः षड्ज्वलनैश्च ²⁷५८ | ३६ नौका ||२२||

pasćānmunīndro dvimitistusiddhaiḥ
udagnavābdhipramitairjinaśca |
vipādabhairdaksināgādvimānah
gajesubhiḥ ṣadjavalanaiscā naukā ||22||

After that, [the star named] **Munīndra** which has scale of brightness as 2 (*dvimiti*), along the northern (*udag*) direction [having the coordinate] twenty-four (*siddha*) degrees (24|0). [The second coordinate is] 49 (*nava* (9), *abdhi* (4)) [degrees] and 24 (*jina*) minutes (49|24). Quarter of a degree subtracted from twenty-seven (26|45) is one of the coordinates of the star **Nauka** which is directed towards the south and has second order brightness. The second coordinate of [*Nauka*] is fifty-eight degrees, thirty-six minutes (58|36).

²⁴Here, it is to be noted that the magnitude of the brightness of the star *Pusya* is not mentioned. However, it is mentioned that it is identified as a cloud-cluster. Here, we have interpreted the term '*meghapratima*' as the cloud-cluster.

²⁵दलाढ.

²⁶The term '*siddha*' is also used to refer '*jina*', which represents the number 24 as per *bhūta-sankhyā* system.

²⁷षड्जनैश्च.

सपादपिण्डैः २८ | १५²⁸ त्रिमितिस्ततः प्राग्
अन्योमुनिः पञ्चयुगौ ४५ रुदक्यः |
त्रिमानमन्त्यांशचतुर्थपादे²⁹ २९ | ४५
सौम्यं नवाशि २९ | ० प्रमितैस्तु युग्मम् ||२३||

*sapādapiṇḍaiḥ trimitistataḥ prāg
anyomuniḥ pañcayugairudakyah |
trimānamantyāṁśacaturthapāde
saumyam navāśvi pramitaistu yugmam ||23||*

The coordinates of the star ‘*Anyomuni*’ (meaning of which is ‘the other sage’) are 28 (*piṇḍa*) degrees added to quarter of (*sapāda*) of a degree (28|15) and 45 (*pañca* (5) *yuga* (4)) degrees (45|0). [The star] whose scale of brightness is 3 (*trimiti*) is situated in the northern direction. [The star] ‘*Yugma*’ shines with the brightness scale three (*trimāna*) with the first coordinate being in the fourth quarter of the last degree³⁰ (*antyāṁśācaturthapāda*; 29|45) and the second coordinate is 29 degrees (*nava* (9), *asvi* (2); 29|0). [The direction] is towards north (*saumya*).

इति दशनक्षत्राणि कर्किस्थितानि ।
iti dasā nakṣatrāṇi karkisthitāni |

Thus, the ten stars situated in *Karkarāśi* [have been told].

3.5 Stars in Leo (*Simharāśi*)

अर्द्धांशकेनो ० | ३० त्तरदिक्त्रिमानः
पूर्वधृवाक्षः शरपर्वतांशैः ७५ | ० |
व्यांगांशषड्भिः ५ | ५० द्विमितिः भुजङ्गो
याम्यः सपादाध्यिरसैः ६४ | १५ विभागैः ||२४||

*arddhāṁśakenottaradidaktrimānah
pūrvadhruvākṣah śaraparvatāṁśaiḥ |
vyamgāṁśaḍdbhiḥ dvimitiḥ bhujango
yāmyah sapādādhiraśaiḥ vibhāgaiḥ ||24||*

The star named *Pūrvadhruvākṣa* is situated along the northern direction with three degree of brightness has the coordinates half a degree (0|30) and seventy-five degrees (75|0). ($\frac{1}{6}$)th of a degree subtracted from six degrees (5|50) becomes one of the coordinates and the other coordinate of the star *Bhujaniga*, which is along the south with second order brightness, is sixty-four degrees along with quarter of a degree (64|15).

²⁸The string सपादपिण्डैः represents the number २८ | १५.. But, the manuscript reading is २५ | १५ which is incorrect.

²⁹त्रिमानमन्त्यांशचतुर्थपादे.

³⁰This means the last quarter of the last degree part of the *rāśi*. Here, the last part means 30°. Hence, the fourth quarter of the last degree refers to 29°45 min.

गजैस्त्रिरामै ८|३३ द्विमितिनवांशैः:³¹
९ सिंहांसकस्तिष्ठति वोत्तरस्यां |
व्यांगांशखेटैः ८|५० प्रथमप्रमाणा
लवांगभागेन ० | १० मधोत्तरस्था ||२५||

*gajaistrirāmaidvimitirnavāṁśaiḥ
simhāśakastiṣṭativottarasyaṁ |
vyamgāṁśakhetaiḥ prathamapramāṇā
lavāṅgabhāgena maghottarasthā ||25||*

The star *Simhāsaka* is situated along the northern direction, with second magnitude [in brightness scale], with the coordinates eight degrees and thirty-three minutes (8|33) and nine degrees (9|0) respectively. [The *dhruvaka*] of the star *Magha* is ($\frac{1}{6}$)th of a degree less to nine degrees (8|50) and [the *sāra*] is ($\frac{1}{6}$)th of a degree (0|10). [The star *Magha*] has first order brightness and is situated in the north.

खेटैनगौ ९ | ७ रुत्तरदिक्त्रिमानः
सप्तांशिः³² भागैः ४७ पुरतोमुनीन्द्रः |
दिङ्गिभः १०³³ त्रिमानः सदलैकबाणैः ५१ | ३०
उदक्यतः तत्पुरतोमुनीन्द्रः ||२६||

*khetainagairuttaradidaktryamānah
saptābdhibhāgaiḥ puratomunīndraḥ |
dinbihiḥ trimānah sadalaikabāñaiḥ
udakyataḥ tatpuratomunīndraḥ ||26||*

The star of brightness scale 3 having the [first coordinate] 9 (*khetā*) degrees, 7 (*naga*) minutes (9|7) is directed towards the north (*uttaradik*). This [star] is called as ‘*Puratatomunīndra*’ (the one which is next to the *Munāndra*) [whose second] coordinate is 47 (*sapta-abdhi*) degrees (47|0). [The coordinates of the star named] ‘*Tatpuratomunīndra*’ (second next to the star *Munāndra*) are 10 (*dik*) degrees (10|0) and (51) (*eka-bāñā*) degrees along with half (sadala) half of a degree (51|30). [The magnitude of the brightness] is three (*trimāna*) and the direction is towards the north.

मेघै १७ | ० लवै³⁴ स्त्रिप्रमितं सदोदग्
तत्त्वांशकैः २५ | ० युग्मकमन्यदेव |
इतीह युग्मत्रयमवलोक्य
त्रिविक्रमस्य प्रवदन्ति पादान् ||२७||

*meghai lavaistrimitam sadodag
tatvāṁśakaiḥ yugmakamanyadeva |*

³¹ववांशैः.

³²सभांशिः.

³³Manuscript reads the number as १७, which is wrong since the string दिङ्गिभः corresponds to the number १०.

³⁴लवैः.

itāḥa yugmatrayamavalokya
trivikramasya pravadanti pādān ||27||

Another [star named] ‘*Yugmaka*’³⁵, which is entirely different (*anyadeva*) [from the star named ‘*yugmaka*’ which was mentioned earlier], has the coordinates 17 (*meha*) degrees (*lava*) (17|0) and 25 (*tatva*) degrees (25|0). It has third order brightness and is directed towards the north. Here, it is being told that the three (*traya*) such twin pairs (*yugmaka*) as the legs (*pādān*) of the *Trivikrama*, are imagined.³⁶

षष्ठांशयुक्ताब्द १७ | १० लवैर्द्विमानो
मुनिर्विसिष्ठोद्धिशरै³⁷५४ | ० रुदक्यः |
नखै २० द्विमानं शशिदिक् सुरेन्द्रैः १४
सिंहस्यपृष्ठं³⁸ प्रवदन्ति तज्ञाः ||२८||

ṣaṣṭāṁśayuktābdddalavairdvimāno
munirvasisiṣṭhobdhisāraī rudakyah
nakhairdvimānam sāśidik surendraī
simhasyaprsthām pravadanti tajñāḥ ||28||

The coordinate of the star *Vasishta*, who is a sage (*muni*), is one-sixth (*ṣaṣṭāṁśa*) of a degree added to 17 (*abda*) degrees (*lava*) (17|10). The brightness scale is 2, the second coordinate is 54 (*abdhī-sāra*) degrees (54|0) and the direction is towards the north. The coordinates of the star *Simhasyaprsthā* are twenty (*nakha*) degrees (20|0) and forteen (*surendra*) degrees (14|0) respectively. The brightness of the star is second degree and the direction is towards the south.

सपादजात्या २२ | १५ त्रिमितिः सदोदक्
सार्द्धग्रहैः ९ | ३० तिष्टति³⁹ फाल्युनीह |
वित्र्यंशतत्वै २४ | ४० द्विमितिः सदोदग्
मुनिः पुरस्थः सपदाङ्गबाणैः ५६ | १५⁴⁰ ||२९||

³⁵The author is using the word ‘*yugmaka*’ for the second time to represent the twin star. He explicitly tells that, this star (*yugmaka*) is entirely different [from the ‘*yugmaka*’ which has been described earlier].

³⁶We see the word for a new constellation here. ‘It is said that these are the three footprints of ‘*Trivikrama*’. Thus, a constellation *Trivikrama* can be imagined here. The three pairs correspond to the three foot prints of *Trivikrama*. This is a new name hitherto unknown in the context of the names of stars. The resemblance to the foot prints is striking.

³⁷मुनिर्विसिष्ठोद्धिशरै.

³⁸सिंहस्यपृष्ठं.

³⁹तिष्ट.

⁴⁰Manuscript reads the number as ५१ | १५.

sapādajātyā trimitih sadodak
sārdhagrahaih tiṣṭati phālgunāḥ |
vitryamṣātavairdvimitiḥ sadodag
munih purasthaḥ sapadārigabāñaiḥ ||29||

Here, the star *Phālguni* which is situated with the third order brightness along the north always has the coordinates quarter a degree added to twenty-two degrees (22|15) and half a degree added to nine degrees (9|30) respectively. The [coordinate of the star] ‘*Muni*’ which is situated at the front (*purastha*) is one-third of a degree subtracted (*vitryamṣā*) from 25 (*tatva*) degrees (24|40). It shines with the second order brightness in the northern direction. The other coordinate is fifty-six (*arigabāñā*) degrees along with a quarter (*sapāda*) of a degree (56|15).

एकादशाक्षणि भवन्ति सिंहे
यदाद्यमानं महदेवतस्यात् |
मध्यं त्रिमानं किल षष्ठमानं
भं सूक्ष्ममध्यमनेकतारम् ||३०||

ekaśadasārkṣaṇī bhavanti simhe
yadādyamānam mahadevatasyāt |
madhyam trimānam kila ṣaṣṭamamānam
bham suksmamabhamanekataaram ||30||

There are eleven stars in the *Simha-[rāśī]* (Leo). The stars which have the first order brightness (*ādyamāna*) are the ones with bigger (*mahat*) magnitudes. Third order ones are indeed have the moderate magnitudes (*madhya*). The stars who have sixth order brightness are the smallest (*suksmam*) ones; there are so many stars (*bham*) with this magnitude shine [in the sky].

पूर्वधृवांशाः निजराशिसंस्थाः:
पश्चादिषोरुत्तररायाम्यभागाः |
ज्येयाबुधेरितिरियं प्रवीणैः
ज्योतिर्विचारेगणितागमज्ञैः ||३१||

pūrvam dhruvāṁśāḥ nijarāśisamsthāḥ
paścādiṣoruttarayāmyabhāgāḥ |
jneyabudhairitiriyam pravīnaiḥ
jyotirvicāre gaṇitāgamajñaiḥ ||31||

The *dhruvakas* in degrees [of the stars] stated at first (*pūrvam*) are situated in the corresponding *rāśīs* (*nijarāśī*). The [quantity stated] later is *sāra/iṣu* which is either along the north or the south. This has to be understood like this by the intelligent people who are expert in astronomical theories and are well versed in traditional mathematical doctrine (*gaṇitāgama*).

इति सिंहनक्षत्राणि |

iti simhanakṣatrāṇi |

Thus the stars in the *Simharāśī*.

3.6 Stars in Virgo (*Kanyārāśī*)

तत्वैः ० | २४ कलाभिः प्रथमप्रमाण
 सूर्याशकै १२^{४१} रुत्तरा च सदोदग्^{४२}
 सार्द्धत्रिभागे ३ | ३० रुदगग्निमानं
 खसागरांशैः ४० | ० | खलु सिंहगुह्यम् || ३२ ||

tatvaiḥ kalābhīḥ prathamapramāṇā
 sūryāṁśakai ruttarā ca sadodag |
 sārddhatribhāgai rudagagnimānam
 khasāgarāṁśaiḥ khalu simhaguhyam ||32||

Twenty-four minutes (0|24) is the first coordinate of the star *Uttarā* which has first order brightness and directed towards the north always. The second coordinate is twelve degrees (12|0). The star *Simhaguhya* shines along the north with third order brightness has the coordinates half a degree along with three degrees (3|30) and forty degrees (40|0) respectively.

पादोनषड्भिः ५ | ४५ द्विमितिः सदोदक
 वेदेषु ५४ | ० भागैः भगवान् मरीचिः |
 जात्या २२ | ० त्रिमानो यमदिक् तदैव
 हस्तो विभाति प्रथितः स भेषु ||३३||

pādonasadbhiḥ dvimitih sadodak
 vedesu bhāgaiḥ bhagavān marīciḥ |
 jātyā trimāno yamadik tadaiva
 hasto vibhāti prathitah sa bheṣu ||33||

The star *Marīci* has the coordinates quarter of a degree subtracted (*pādona*) from six degrees (5|45) and fifty-four (*veda-isu*)⁴³ degrees (54|0). The brightness scale is 2 and the star is towards the north always (*sadā-udak*). The star *Hasta* shines with three degree brightness along the southern direction has the coordinate twenty-two degrees (22|0). This (*sa*

⁴¹Numeral 12 is missing in the manuscript.

⁴²Actual reading in the manuscript is सूर्याशकैरुत्तरा च, where three syllables are missing. Also, the direction of the star *Uttarā* is not given. The word corresponds to missing syllables should be the one which represents the direction of the star. Since, *Uttarā* is a junction star (one of the 27 stars), which is mentioned in almost all astronomical texts, it is easy to fix the direction which is the north. Hence, the word which is missing the manuscript should be the one which is used to represent the northern direction. Since, the author has used different synonyms for the same, we thought it would be appropriate to use the string सदोदग् which fits into the metre. Also, the author has used the same word several times to represent the northern direction.

⁴³The term ‘*vedesu*’ is two words, *veda* and *isu* (*bāna*), which represents number 4 and 5, respectively, and not the seventh case (*saptamāī vibhakti*) of the *prātipadika*, *veda*.

[*Hasta*] is extended/spread over (*prathita*) along the the [group of] stars (*bhesu*).

Note: Here, it is to be noted that the magnitude of the latitude of the *Hasta* is not mentioned explicitly. However, it is mentioned that the direction is towards the south.

वित्त्र्यंशरूपाधिभि २० | ४० | रुत्तराशः
 श्वाव्यंडिघ्रखेटैः ८ | ४५ | त्रिमितिः प्रसिद्धः |
 सत्त्र्यंशपिण्डैः २८ | २० स्त्रिमितं च पिण्डैः २८
 सदोदरं शक्तिभमामनन्ति ||३४||

vitryamśarūpāśvibhi ruttarāśah
 śvāvyanighrikhetaiḥ trimitiḥ prasiddhaḥ |
 satryamśapiṇḍaistrimitam ca piṇḍaiḥ
 sadottaram śaktibhamāmananti ||34||

The [star] *Svā* which is well known is situated along the northern direction and has the third order brightness; the coordinates are one-third of a degree subtracted from twenty-one degrees (20|40) and one-fourth of a degree subtracted from nine (*khetā*) degrees (8|45). The star which is situated always in the north, with third order brightness, is known as *Sakti*. The coordinates [of this star] are one-third of a degree added to twenty-eight degrees (28|20) and twenty-eight degrees (28|0).

एतानि षड्भानि सदायुवत्यां⁴⁴
 अथोकदम्बाभिमुखस्थितानि |
 सर्वाणि भानि प्रथितानि नूनं
 धृवोन्मुखान्यायनकर्मणैव ||३५||

etāni ṣadbhāni sadāyuvatyām
 athokadambābhimukhasthitāni |
 sarvāṇi bhāni prathitāni nūnam
 dhruvonmukhānyāyanakarmaṇaiva ||35||

These six stars are situated face to the pole of the ecliptic (*kadamba*). The *āyanakarma* has to be performed to all stars, [in order to get the equitorial coordinates such as declination so that the stars] are faced to the equator.

इति कन्यानक्षत्राणि |
 iti kanyānakṣatrāṇi |

Thus the stars in *Kanyārāśī*.

⁴⁴Here, in this context, the meaning of the phrase *sadāyuvatyām* is not clear. We have translated the verse by omitting this phrase as it is not of much relevance.

3.7 Stars in Libra (*Tula rāśī*)

व्यङ्गिद्वयेण २ | ४५⁴⁵ प्रथमप्रमाणा
द्वाभ्यां ग्रहे २ | ९ दक्षिणगा च चित्रा |
साष्टांशरामैः ३ | ७ | ३० | प्रथमप्रमाणा⁴⁶
स्वाती कुरामैर्धृतिभिश्च ३१ | १८ सौम्या ||३६||

vyanighritrayena prathamapramāñā
dvabhyaṁ grahai rdakṣināgā ca citrā |
sāṣṭāṁśarāmāih prathamapramāñā
svātī kurāmairdhṛtibhiśca saumyā ||36||

The coordinates of the star *Citrā*, which shines with first order brightness along the southern direction, are one-fourth of a degree subtracted from three degrees (2|45) and two degrees, nine minutes (2|9). The star *Svātī* has the coordinates one-eighth of a degree added to three degrees (3|7|30) and thirty-one degrees and eighteen minutes (31|18). [This star] has first order brightness and is along the northern direction.

सपादभूपै १६ | १५ द्विमितिश्च याम्यो
द्वृजेश्वरो भूविश्चिवैः खबाणैः ५१ | ५० |
सार्द्धाद्वद्भागै १७ | ३० द्विमितं सदावाग्
नक्षत्रमेकं सपदाक्षबाणैः ५५ | १५ ||३७||

sapādabhūpai rdvimitisica yāmyo
dvijesvāro bhūviśikhaiḥ khabāṇaiḥ |
sārddhābdabhaṅgai rdvimitam sadāvāg
nakṣatramekam sapadākṣabāṇaiḥ ||37||

The one-fourth of a degree added to sixteen (*bhuūpa*) degrees (16|15) is one of the coordinates of the star named *Dvijesvāra* shines with second order along the south. The other coordinate is fifty-one degrees, fifty minutes (51|50). There is ‘one star’ (*Nakṣatramekam*) which is situated along the north (*vyā g*) always with second order brightness has the coordinates half a degree along with seventeen degrees (17|30) and one-fourth of a degree added to fifty-five degrees (55|15).

स्यान्मातृचक्रं कुयमैः सषष्ठैः २१ | १०
उदग्विमानं सदलाक्षवेदैः ४५ | ३० |
ऋक्षं कुदर्सैर्नगवल्लिभिश्च २१ | ३७⁴⁷
याम्यं द्विमानं कुशरैः खवेदैः ५१ | ४० ||३८||

syānmatrcakram kyamaiḥ sasaṣtamaiḥ
udagdyimānam sadalākṣavedaiḥ |
rkṣam kudasrairnagavahnbhiśca
yāmyam dvimānam kuśaraiḥ khavedaiḥ ||38||

⁴⁵The string व्यङ्गिद्वयेण represents the number २ | ४५. However, the number is missing in the manuscript.

⁴⁶प्रथमप्रमाणा.

⁴⁷The string नगवल्लि represents the number ३७. Whereas, the manuscript reads it as ३०.

The star which has the coordinate one-sixth of a degree added to twenty-one degrees (21|10) is the *Maṭrcakra*. This has second order brightness and is along the north with the coordinate half a degree along with forty-five degrees (45|30). ‘[One] star’ (*Rkṣam*) has coordinates twenty-one degrees, thirty-seven minutes (21|37) and fifty-one degrees, forty minutes (51|40) towards south and has second order brightness.

सिद्धैश्च पिण्डै २४ | २८ स्त्रिमिता यमाशा
विपादभागेन ० | ४५ तुलैकसिक्का |
पिण्डैस्त्रिरामै २८ | ३३ स्त्रिमिता च सौम्या
विपादखेतैश्च ८ | ४५ तुलान्यसिक्का ||३९||

siddhaiśca piṇḍaistrimitā yamāśā
vipādabhāgena tulaikasikkā |
piṇḍaistrirā maistrimitā ca saumyā
vipādakhetāśca tulānyasikkā ||39||

Twenty-four (*siddha*) degrees, twenty-eight (*pinda*) minutes (24|28) is the coordinate of the star *Tulaikasikkā* which is directed towards the south with third order brightness. The other coordinate is one-fourth of a degree subtracted from one degree (0|45). The star *Tulānyasikkā* has the coordinates twenty-eight (*piṇḍa*) degrees, thirty-three (*trirāma*) minutes (28|33) and one-fourth of a degree (*vipāda*) subtracted from nine (*kheta*) degrees (8|45). It shines along the north with third order brightness.

तुलावशे २९ | ५२ षेष्टकले विशाखा
वाग्व्यङ्गिद्वयुग्मेन १ | ४५ | चतुःप्रमाणा |
नवैव धिष्यानि तुलास्थितानि
ज्योतिर्विदां व्योमनि सम्मतानि ||४०||

tulāvasēśe'sṭakale visākhā
vāgvyanighriyugmena catuhpramāñā |
navaiva dhiṣyāni tulāsthitāni
jyotirvidāṁ vyomani sammatāni ||40||

The star *Visākhā* is situated along the north, at the position from where eight minutes are remaining in the *Tulā [rāśī]*, with the brightness of fourth order. [That is, the longitude is twenty-nine degrees, fifty-two minutes (29|52)]. The second coordinate is one-fourth of a degree (*vyanighri*) subtracted from two (*yugma*) degrees (1|45). These are the only nine stars (*dhiṣyā*) which are situated in *Tulā [rāśī]* in the sky which have been accepted by the knowers of astronomy.

इति तुलानक्षत्राणि |

iti tulānakṣatrāṇi |

Thus the stars in the *Tulā rāśī*.

3.8 Stars in Scorpio (*Vṛścikarāśī*)

रुद्रैस्त्रिरामै ११ | ३३ स्त्रिमितिर्यमाशा
द्वाभ्यां त्रिभि २ | ३ र्भाति सदानुराधा |
विक्र्यंशतिथ्या १४ | ४० द्यामितिर्यमाशः
सषष्टभागैकयुगै ४१ | १० नृपादः ||४१||

*rudraistrirāmai strimitiryamāśā
dvābhyaṁ tribhirbhāti sadānuradhaḥ |
vitryamṣatithyā dyamitiryamāśāḥ
saṣatābhāgaikayugair nrpādaḥ ||41||*

The star **Anurādhā** shines with third order brightness along the southern direction with the coordinates eleven degrees, thirty-three minutes (11|33) and two degrees, three minutes (2|3) respectively. One-third of a degree subtracted from fifteen (*tithi*) degrees (14|40) is the one of the coordinates of the star **Nrpāda** which shines with first order brightness along the southern direction with the latitude forty-one degrees along with one-sixth of a degree (41|10).

व्यष्टांशकैर्गोविधुभि १६ | ५२ | ३० द्विमाना
ज्येष्ठास्ति विक्र्यंश ४ | ४० शरैर्यमाशा
नखांशकै २० | ० वेदमितं च सौम्यं
युग्माभिधं सार्दुशराद्रि ७५ | ३० | भागैः ||४२||

*vyastāṁśakairgovidhubhirdvimānā
jyesthā sti vitryamṣasārairyamāśā |
nakhamṣakairvedamitam ca saumyam
yugmā bhiddham sā rddhasārādribhā gaiḥ ||42||*

One-eighth of a degree subtracted from nineteen degrees (*govidhu*) (18|52|30) is the *dhruvaka* of the star **Jyesthā** whose order of brightness is two and the *sāra* is one-third of a degree subtracted from five degrees (4|40) along the southern direction. Along the north, with the *dhruvaka* of twenty degrees (20|0), with fourth order (*vedamitam*) brightness, there is a star known as **Yugma** is situated whose *sāra* is seventy-five (*sārādri*) and a half degrees (75|30).

सार्द्धजिनै २४ | ३० स्त्रिप्रमितं सदोदग्
सप्तान्निभिः ३७तिष्ठति सर्पशीर्षम्⁴⁸|
एतानि पञ्चैव⁴⁹ परिस्फुटानि⁵⁰
ज्ञेयानि धिष्यानि च वृश्चिकाख्ये ||४३||

*sārddhairjinai stripramitam sadodak
saptāgnibhiḥ tiṣṭhati sarpaśīrṣam |
etāni pañcaiva parisphutāni
jneyāni dhiṣṇyāni ca vṛścikākhye ||43||*

The star **Sarpaśīrṣa** which is situated always along the north with three degree of brightness has the coordinates twenty-four and a half degrees (24|30), and thirty-seven degrees (37|0) respectively. These are the only five stars known to be present in the *rāśī* known by the name *Vṛścika*.

इति वृश्चिकनक्षत्राणि |

iti vṛścikanakṣatrāṇi|

Thus the stars in the *Vṛścikarāśī*.

3.9 Stars in Sagittarius (*Dhanurāśī*)

द्वाभ्यां ग्रहै २ | ९⁵¹ रुत्तरमग्निमानं⁵²
षड्वर्ग ३६ | ० भागैर्भुजगस्यशीर्षम् |
रामैर्नगै ३ | ७ रग्निमितं च याम्यं
विश्वैः सुरै १३ | ३३ स्तिष्ठति मूलमृक्षम्⁵³ ||४४||

*dvābhyaṁ grahai ruttaramagnimānam
ṣadvarga bhāgairbhujagasyaśīrṣam |
rāmairnagai ragnimitam ca yāmyam
viśvaiḥ surai stiṣṭhati mūlamṛkṣam ||44||*

With third order (*agnimānam*) brightness and with the coordinate two degrees, nine minutes (2|9), the star **Bhujagasyaśīrṣa** is situated along the north; the second coordinate is square of six (*ṣadvarga*) degrees (36|0). Three degrees, seven minutes (3|7) is the *dhruvaka* of the star **Mūla** which is situated along the south with third (*agnimitam*) order brightness and with the *sāra* equal to thirteen degrees, thirty-three minutes (13|33).

सार्द्धेषुभिः ५ | ३० | सर्पशिरस्त्रिमानं
सौम्ये खनागै ८० युगलाक्षमृक्षम्⁵⁴|
रुद्रैः सुरैः ११ | ३३ | त्रिप्रमितं यमशं
विपादशैलै ६ | ४५ जलदैवतर्क्षम् ||४५||

*sārddhesubhiḥ sarpaśīrastrīmānam
saumye khanā gairyugalākṣamṛkṣam |
rudraiḥ suraiḥ tripramitam yamāśam
vipādaśailai rjaladaivatarkṣam ||45||*

⁵¹The string द्वाभ्यां ग्रहै: represents the number २ | ९. However, this is missing in the manuscript.

⁵²रुत्तरमग्निमानं.

⁵³मूलवृक्षं.

⁵⁴युगलाक्षवृक्षं.

⁴⁸सत्त्वशीर्षम्.

⁴⁹पञ्चैव.

⁵⁰परिस्फुटानि.

The star ***Yugalakṣa*** (pair of snakes) which is situated along the north with the head of the snake (*sarpaśira*) has the coordinates five and a half degrees (5|30) and eighty degrees (80|0) has the third order brightness. With the coordinate eleven degrees, thirty-three minutes (11|33) and with third order brightness, the star ***Jaladaivata*** is situated along the southern direction with [the *sara* of] one-fourth of a degree subtracted from seven degrees (6|45).

धृत्येषुबाणै १८ | ५५ स्तु चतुःप्रमाणं
याम्यं कृतांशैः ४ | खतु वैशदेवम् |
व्यर्कांशतत्वैः २४ | ५५ प्रथममाणं
सौम्यं द्विषष्ट्या ६२ | ० भिजिदाख्यमृक्षम् ||४६||

*dhrtyeṣubāṇaiṣu catuhpramāṇam
yāmyam kṛtāṁśaiḥ khalu vaisvadevam |
vyarkāṁśatatavatvaiḥ prathamapramāṇam
saumyam dvīṣṭamyaḥ bhijidākhyamṛksam ||46||*

Eighteen (*dhr̥ti*) degrees, fifty-five (*iṣubāṇa*) minutes (18|55) is the one of the coordinates of the star ***Vaisvadeva*** which is directed towards along the south and has the fourth order magnitude in brightness scale. The second coordinate is four (*kṛta*) degrees (4|0). One-twelfth of a degree subtracted from twenty-five (*tatva*) degrees (24|5) is the *dhruvaka* of the star known by the name ***Abhijit*** which has first order brightness. This is situated along the north with the *sara* of sixty-two degrees (62|0).

गोलोचनैः २९|० राममितं च सौम्यं
सपादभूपैः १६ | १५ किल सर्पपुच्छम्⁵⁵
एतानि षड्भानि धनुः स्थितानि
ज्ञेयानि गोलादिविचारदक्षैः ||४७||

*golocanaiḥ rāmamitam ca saumyam
sapādabhuṭpaiḥ kila sarpapuccham |
etāni sadbhāni dhanuh sthitāni
jñeyāni golādivicāradakṣaiḥ ||47||*

The star ***Sarpapuccha*** is situated along the north has third order brightness (*rāmamitam*). Twenty-nine (*golocana*) degrees (29|0) and quarter of a degree added to sixteen degrees (16|15) are the two coordinates of the star. It is to be understood by the scholars who contemplate on spherical [astronomy] etc. that these six stars [stated above] are situated in *Dhanu[-rāśi]*.

इति धनुर्क्षत्राणि |

iti dhanurnakṣatrāṇi

Thus the stars in *Dhanurāśi*.

⁵⁵सत्त्वयुक्तं.

3.10 Stars in Capricorn (*Makararāśi*)

पादोनरुद्रै १० | ४५ द्विमितिः सदोदक⁵⁶
नवाक्षितिः २९ स्याच्छ्रवणः सपादैः |
रुद्रै ११ | १५ स्त्रिमानं सशरांशतानैः ४९ | १२
सौम्यं भवेद्वायसनामधिष्यम् ||४८||

*pādonorudrair dvimitih sadodak
navākṣitiḥ syācchravaṇaḥ sapādaiḥ
rudrai strimānam saśarāṁśatānaiḥ
saumyam bhavedvāyasānāmadhiṣyam ||48||*

With the coordinate quarter of a degree (*pādona*) subtracted from eleven degrees (10|45) and with second order birghtness, the star ***Sravana*** is situated always along the north with the *Vikṣepa* of twenty-nine (*navākṣiti*) degrees (29|0). The coordinates of the star named ***Vāyasa*** are eleven degrees along with quarter of a degree (11|15) and forty-nine degrees along with one-fifth (*sārāṁśa*) of a degree (49|12). This star [*Vāyasa*] shines along the north with third order brightness.

नखांशकै २० रायनकर्मयुक्ताः
याम्याङ्गरामै ३६ स्त्रिमिता धनिष्ठा |
भांशै २७⁵⁷ स्त्रिमानं यमदिक्त्रिनेत्रैः २३
मत्स्यस्यपुच्छं प्रवदन्ति विज्ञाः ||४९||

*nakhāṁśakai rāyanakarmayuktāḥ
yāmyāṅgarāmai strimitā dhaniṣṭhā |
bhāṁśai strimānam yamadiktrinetraih
matsyasyapuccham pravadanti vijñāḥ||49||*

The *dhruvaka*, which has been obtained by performing *āyanakarma*, is twenty (*nakha*) degrees (20|0) for the star ***Dhaniṣṭhā*** which shines along the south with third order brightness; the *Vikṣepa* is thirty-six (*āṅgarāma*) degrees (36|0). The star with twenty-seven (*bham*) degrees (27|0) and twenty-three (*trinetra*) degrees (23|0) as the coordinates, and is situated along the southern direction with third order brightness is called as ***Matsyasyapuccha*** by the scholars.

इति चत्वारि मकरनक्षत्राणि |
iti catvāri makaranakṣatrāṇi|

Thus the stars in *Makararāśi* are four [in number].

⁵⁶The string सपादैः रुद्रैः represents the number ११ | १५. However, this is missing in the manuscript.

⁵⁷The string भांशैः represents the number २७. However, this is missing in the manuscript.

3.11 Stars in Aquarius (*Kumbharāśī*)

एकेन षड्वह्निभि १ | ३६ रग्निमानं
 याम्यं द्वये २ | ० नात्र तु नक्रपुच्छम् |
 व्यर्काशविश्वैः १२ | ५५ प्रथमप्रमाणं
 याम्यं कुदस्त्रैश्च २१ | २४^{५८}जिनैकपालः^{५९} ||५०||

*ekena ṣadvahnibhi ragnimānam
 yāmyam dvayenātra tu nakrapuccham |
 vyarkāṁśavisvaiḥ prathamapramāṇam
 yāmyam kudasraiśca jinairkapālaḥ ||50||*

Here is the star *Nakrapuccha* whose coordinates are one degree, thirty-six (*ṣadvahni*) minutes (1|36) and two degrees (2|0) and is along the south with third order brightness (*agnimāna*). The coordinates of the star *Kapāla* are one-twelfth of a degree subtracted from thirteen (*visvā*) degrees (12|55) and twenty-one (*kudasa*) degrees, twenty-four (*jina*) minutes (21|24) respectively. The star has first order brightness and is situated along the south.

सत्र्यंशतिथ्या १५ | २०^{६०}द्विमितं सदोदग
 वित्र्यंशषट्या ५९ | ४० किल काकपुच्छम् |
 नखै २०^{६१}स्त्रिमानं यमदिग्दलेन ० | ३०
 शतर्क्षमेवायनकर्मयुक्तम् ||५१||

*satryamśatithyādvimitam sadodag
 vitryamśaṣṭyā kila kākapuccham |
 nakhai strīmānam yamadigdalena
 satarkṣamevāyanakarmayuktam ||51||*

One-third of a degree along with fifteen (*tithi*) degrees (15|20) is the coordinate of the star which shines always along the north with second order brightness; the star is indeed *Kākapuccha*, with one-third of a degree subtracted from sixty degrees (59|40) as the second coordinate. The star *Sata[-bhīṣak]* shines with third order brightness along the southern direction with the coordinates twenty (*nakha*) degrees (20|0) and half of a degree (0|30) respectively, which have been obtained by performing *āyanakarma*.

रसाक्षिभि २६ स्त्यायनकर्मयुक्तं
 सौम्यं जिनैः २४ स्यादजपादित्रमानं |
 एतानि पञ्चैव हि यन्त्रवृष्ट्या
 धिष्यानि कुम्भे गदितानि तज्जैः ||५२||

*rasākṣibhi stvāyanakarmayuktam
 saumyam jinaiḥ syādajapādtrimānam |*

^{५८}The string कुदस्त्रैश्च represents the number २१. But, the manuscript reads it as २०.

^{५९}जिनैकपालः:

^{६०}सत्र्यंशतिथ्या represents the number १५ | २०. However, it is written as १५ | ३ in the manuscript.

^{६१}The string नखैः represents the number २०. However, this is missing in the manuscript.

*etāni pañcaiva hi yantradṛṣṭyā
 dhisnyāni kumbhe gaditāni tajñaiḥ ||52||*

Twenty-six (*rasākṣi*) degrees (26|0), which has been obtained by performing *āyanakarma*, and twenty-four (*jina*) degrees (24|0) are the *dhruvaka* and *sāra* respectively of the star *Ajapād* which is situated along the north with third order brightness. These are the only five stars, whose coordinates have been obtained by the instrumental observation (*yantradṛṣṭyā*), which are situated in the *Kumbharāśī* as said by the scholars.^{६२}

इति कुम्भनक्षत्राणि |

iti kumbhanakṣatrāṇi|

Thus the stars in the *Kumbharāśī*.

3.12 Stars in Pisces (*Mātarāśī*)

सार्द्धद्वयेन २ | ३० द्विमितं सदोदग्
 गोभूमि^{६३}१९ रंशेस्तुरगाङ्ग^{६४}भं स्यात् |
 नौ ७ स्त्रिमानं शशिदिक षडक्षि- २६
 भागैरहिर्बुध्यभमायनाद्यम् ||५३||

*sārddhadvayena dvimitam sadodag
 gobhūmi raṁśesturagāṅga bham syat |
 nagastrīmānam śasidik ṣaḍakṣi-
 bhāgairahirbudhnyabhamāyanādyam ||53||*

Half of a degree added to two degrees (2|30) is one of the coordinates of the star *Turagāṅga* which shines with second order brightness along the north with the latitude equal to nineteen (*gobhūmi*) degrees (19|0). With the coordinate equal to seven (*naga*) degrees (7|0), with third order brightness, the star *Ahirbudhnya* shines along the southern direction; the second coordinate is twenty-six (*ṣaḍakṣi*) degrees (26|0).

नागैः सपादै ८ | १५ स्तुरगास्य^{६५}
 धिष्यंद्विमानमेकत्रिभि ३१ रुत्तराशम् |
 दिग्भिः कुरामै १० | ३१ यमदिग्द्विमानं
 सार्द्धैः खचन्द्रैः १० | ३० किल जन्तुपुच्छम् ||५४||

*nāgaiḥ sapādaisturagā syadhiṣṇyam
 dvimānamekatribhiruttarāśam |
 digbhiḥ kurāmairyamadigdvimānam
 sārddhaiḥ khacandriḥ kila jantupuccham ||54||*

^{६२}This is a clear indication that measurements were made with instruments and recorded. This is important particularly in this *rāśī* since all the stars are quite faint.

^{६३}मोभूमि.

^{६४}तुरुगांग.

^{६५}तुरुगांस.

The star **Turagāsyā** has the coordinates quarter of a degree added to eight degrees (8|15) and thirty-one degrees respectively. It shines with second order brightness along the northern direction. Along the southern direction with second order brightness, the star **Jantupuccha** is situated with the coordinates ten degrees, thirty-one (*kurāma*) minutes (10|31) and half of a degree added to ten (*khacandra*) degrees (10|30).

धृत्याभुवा १८ | १ द्वादशभिश्च सिद्धैः १२ | २४
 सदोत्तरे तिष्ठति वाजिबाहुः |
 त्रिबाहुभिः शैलमितै २३ | ७ द्विमानं
 तत्वैः कुदस्त्रैः २५ | २१ शशिदिक्तुरङ्गः ||५५||

*dhṛtyābhuvā dvādaśabhiśca siddhaiḥ
 sadottare tiṣṭhati vājibāhuḥ |
 tribā hubhiḥ śailamitairdvimānam
 tatvaiḥ kudasraiḥ śasidikturanigah* ||५५||

The star **Vājibāhu** is situated in the north always with the coordinates eighteen degrees, one minute (18|1) and twelve degrees, twenty-four minutes (12|24). Twenty-three (*tribāhu*) degrees, seven minutes (23|7) is the *dhruvaka* and twenty-five degrees, twenty-one minutes (25|21) is the *sāra* of the star **Turanga** which is situated along the southern direction with second order brightness.

Note: Here, the magnitude of the star ‘*Vājibāhu*’ is not mentioned.

गोलोचनैः २९ सूक्ष्मतरं यमाशं
 वित्र्यंशयुग्मेन १ | ४०^{६६}तु पौष्ण^{६७}धिष्यम् |
 एतानि पञ्चैव भवन्ति मीने
 युगाष्ट ८४ सर्वाणि च भानि चक्रे ||५६||

*golocanaiḥ sūkṣmaram yamaśam
 vitryamśayugmena tu Pausṇa⁶⁸ dhiṣyam |
 etāni pañcaiva bhavanti māne
 yugāṣṭasarvāṇi ca bhāni cakre* ||५६||

The star **Pausṇa** (popularly known as **Revati**) has the *dhruvaka* and *sāra* which are equal to twenty-nine (*golocana*) degrees (29|0) and one-third of a degree subtracted from two degrees (1|40) respectively. The star is situated along the southern direction with sixth order brightness (*sūkṣmatara*). These are the only five [stars] which are situated in the *Māna*-[-*rāśī*]. There are a total of 84 (*yugāṣṭa*) stars are situated in the entire *rāśicakra* (or ecliptic).

⁶⁶The string वित्र्यंशयुग्मेन represents the number १ | ४०. However, this is missing in the manuscript.

⁶⁷पौष्ण.

⁶⁸*Pausṇa*.

इति मीननक्षत्राणि |

iti mānanakṣatrāṇi|

Thus are the stars in *Mānarāśī*.

इति नक्षत्रध्रुवाः सशराः समाप्ताः |

iti nakṣatradgruvaḥ saśarāḥ samāptāḥ|

Thus [the description of] *dhruvakas* of the stars along with the *sāras* is completed.

4. Table of 89 stars given by Nityānanda in *Sarvasiddhāntarāja*

Here, we provide the table of 89 stars as given by Nityānanda in his work *Sarvasiddhāntarāja*. Table 1 contains six columns. The first column gives the number and the second gives the name of the star. The third column is for the *Dhruvaka*. The value of *Dhruvaka* ranges from 0° to 360° ; the degrees correspond to elapsed *rāśīs* have been added to the textual value. Hence, the table contains the actual magnitude of the *Dhruvaka* of the star. The fourth column is for the *Sāra* and the latitudinal directions are given in the fifth column. Letter *S* is used for the Southern direction and *N* for the Northern direction. For ease of comparison of the stars names and their magnitudes, as is known today, are also included in the table. The identifications have been discussed in detail in our earlier papers (Pai & Shylaja 2016, 2019, 2020; Shylaja & Pai 2018a,b, 2019a,b,c). The sixth column gives the magnitude of the brightness of the star. First-order brightness is represented using the numeral 1, the second-order brightness by 2, the third-order brightness by 3 and so on. The magnitudes estimate appear to be very approximate.

5. Discussion

We thus find that this is a very exhaustive list of stars provided by any Indian text. The star list has been prepared for the manual for the use of the astrolabe; this is deemed to be a commentary on the manual first prepared by Mahendra Sūri (which is a translation of the original Persian manual) and subsequently by Malayendu (Ohashi 1994). However, it appears that Nityānanda has taken pains to observe the stars and mark the positions as specifically stated in verse 52.

Table 1. Star list with coordinates, magnitudes and identification.

Number	Star	Dhruvaka (deg. min.) (° ')	Sara (deg. min.) (° ')	Dir.	Mag.	Identification (magnitude from SIMBAD)
1	<i>Nadyantaka/</i> <i>नद्यन्तकः</i>	5 16	53 45	S	1	γ Phe (3.41) or α Phe (2.4)?
2	<i>Matsyodara/</i> <i>मत्स्योदरः</i>	9 50	25 30	N	2	β And (2.07)
3	<i>Asvinī/</i> <i>अश्विनी</i>	14 6	7 50	N	3	β Ari (2.64)
4	<i>Āptapāñi/</i> <i>आप्तपाणि:</i>	14 33	50 50	N	3	α Cas (2.24)
5	<i>Piṭhamūla/</i> <i>पीठमूलम्</i>	16 0	45 45	N	3	γ Cas (2.15)
6	<i>Bharanī/</i> <i>भरणी</i>	23 31	5 45	N	6	ϵ Ari (5)
7	<i>Supiṭha/</i> <i>सुपीठः</i>	26 55	50 50	N	3	δ Cas (2.68)
8	<i>Mānuṣaśīrṣa/</i> <i>मानुषशीर्षम्</i>	35 30	22 0	N	2	β Per (2.09)
9	<i>Agni/</i> <i>अग्निः</i> (<i>Kṛttikā</i>)	38 24	3 45	N	5	η Tau (2.87)
10	<i>Nṛpārśva/</i> <i>नृपार्श्वः</i>	41 45	29 20	N	2	α Per (1.79)
11	<i>Rohiṇī/</i> <i>रोहिणी</i>	49 10	5 15	S	1	α Tau (0.87)
12	<i>Mithunasya-pāda/</i> <i>मिथुनस्य-पादः</i>	56 0	31 18	S	1	β Ori (0.18)
13	<i>Nṛyugāmsaka/</i> <i>नृयुगांसकः</i>	60 10	17 15	N	2	γ Ori (1.64)
14	<i>Skanda/</i> <i>स्कन्दः</i>	61 20	22 45	N	1	α Aur (0.08)

Table 1. Continued.

15	<i>Ambuvatsa/</i> अम्बुवत्सः	61 50	5 15	N	2	β Tau (1.65)
16	<i>Mithunasya-madhya/</i> मिथुनस्यमध्यम्	62 45	24 33	S	2	ϵ Ori (1.69)
17	<i>Mrgaśīrṣa/</i> मृगशीर्षम्	63 7.5	13 30	S	3	λ Ori (5.61)
18	<i>Dhruvatārakā/</i> <i>Dhruva/</i> ध्रुवः	66 55	66 30	N	3	Polaris (1.97)
19	<i>Nṛhasta/</i> नृहस्तः	67 50	16 45	S	1	β Aur (1.90)
20	<i>Narāṃsa/</i> नरांसः	70 30	21 30	N	2	θ Aur (2.62)
21	<i>Ārdrā/</i> आर्द्रा	78 7	7 12	S	3	γ Gem (1.93)
22	<i>Lubdhaka/</i> लुध्यकः	83 0	39 30	S	1	α CMa (-1.47)
23	<i>Bhallūkaprṣṭha/</i> भल्लुकपृष्ठः	86 30	49 24	N	3	Unable to identify it may be α UMa or β UMi
24	<i>Agastya/</i> अगस्त्यः	89 0	75 0	S	1	α Car (-0.76)
25	<i>Mrgavyādha/</i> मृगव्याधः	26 0	40 0	S	-	Another name for <i>Lubdhaka</i>
26	<i>Punarvasu/</i> पुनर्वसुः	92 30	6 30	N	2	β Gem (1.16)
27	<i>Lubdhakabandhu/</i> लुध्यकबन्धुः	95 0	16 0	S	1	α CMi (0.34)
28	<i>Yugmaka/</i> युग्मकम्	102 20	29 0	N	3	ι UMa (3.12) κ UMa (3.57)

Table 1. Continued.

29	<i>Puṣya/</i> पुष्यः	106 30	1 0	N	-	M44 Praesepe (3.7) (shines like a cloud)
30	<i>Āśleṣā/</i> आश्लेषा	112 30	6 55	S	3	α Cnc (4.26)
31	<i>Dhruvākṣa/</i> द्रुवाक्षः	112 0	73 0	N	2	χ Dra (3.55)
32	<i>Muṇīndra/</i> मुनीन्द्रः	114 0	49 24	N	2	α UMa (1.81)
33	<i>Naukā/</i> नौका	116 45	58 36	S	2	ζ Pup (2.2)
34	<i>Anyomuni/</i> अन्योमुनि:	118 15	45 0	N	3	β UMa (2.34)
35	<i>Yugma/</i> युग्मम्	119 45	29 0	N	3	λ UMa (3.45) μ UMa (3.06)
36	<i>Pūrvadhruvākṣa/</i> पूर्वध्रुवाक्षः	120 30	75 0	N	3	δ Dra (3.07)
37	<i>Bhujanga/</i> भुजङ्गः	125 50	64 15	S	2	γ Vel (1.7)
38	<i>Simhāsaka/</i> सिंहासकः	128 33	9 0	N	2	γ Leo
39	<i>Maghā/</i> मघा	128 50	0 10	N	1	α Leo (1.36)
40	<i>Purato-muṇīndra/</i> पुरतोमुनीन्द्रः	129 7	47 0	N	3	γ UMa (2.41)
41	<i>Tatpuratomuṇīndra/</i> तत्पुरतोमुनीन्द्रः	130 0	51 30	N	3	δ UMa (3.32)
42	[Another-] <i>Yugmaka/</i> युग्मकम्-[अन्यत] (or <i>Yugmaka II</i>)	137 0	25 0	N	3	ν UMa (3.49) ξ UMa (3.79)
43	<i>Vasiṣṭha/</i> वसिष्ठः	137 10	54 0	N	2	ε UMa (1.76)

Table 1. Continued.

44	<i>Simhasyaprsthā/</i> सिंहस्यपृष्ठम्	140 0	14 0	S	2	δ Leo (2.56)
45	<i>Phālgunī/</i> फाल्गुनी (<i>Pūrvaphālgunī</i>)	142 15	9 30	N	3	θ Leo (3.33)
46	<i>Muni/</i> मुनिः (<i>purasthah munih</i> / Sage at the front)	144 40	56 15	N	2	ζ UMa (2.23)
47	<i>Uttarā/</i> उत्तरा (<i>Uttarā-Phālgunī</i>)	150 24	12 0	N	1	β Leo (2.14)
48	<i>Simhaguhya/</i> सिंहगुह्यम्	153 30	40 0	N	3	ι Leo (4.0)
49	<i>Marīci/</i> मरीचिः	155 45	54 0	N	2	η UMa (1.85)
50	<i>Hasta/</i> हस्तः	172 0	—	S	3	δ Crv (clearly stated as a group of stars)
51	<i>Śvā/</i> श्वा	170 40	8 45	N	3	ϵ Vir (2.85)
52	<i>Śakti/</i> शक्तिः	178 20	28 0	N	3	η Boo (2.68)
53	<i>Citrā/</i> चित्रा	182 45	2 9	S	1	α Vir (0.98)
54	<i>Svātī/</i> स्वाती	183 7.5	31 18	N	1	α Boo (0.05)
55	<i>Dvijeśvara/</i> द्विजेश्वरः	196 15	51 50	S	2	γ Cru (1.63)
56	<i>Nakṣatrameka/</i> नक्षत्रमेकम् (One star)	197 30	55 15	N	2	β Boo (3.49)

Table 1. Continued.

57	<i>Mātrcakra/</i> मातृचक्रम्	201 10	45 30	N	2	δ Boo (3.46)
58	<i>Rksa/</i> ऋक्षम् (One star)	201 37	51 40	S	2	β Cen (0.61)
59	<i>Tulaikasikkā/</i> तुलैकसिक्का	204 28	0 45	S	3	α Lib (2.75)
60	<i>Tulānyasikkā/</i> तुलान्यासिक्का	208 33	8 45	N	3	β Lib (2.61)
61	<i>Viśakha/</i> विशाखा	209 52	1 45	N	4	α Lib / μ Lib (5.32)??
62	<i>Anurādhā/</i> अनुराधा	221 33	2 3	S	3	δ Sco (2.29)
63	<i>Nṛpāda/</i> नृपादः	224 40	41 10	S	1	α Cen (0.01)
64	<i>Jyeṣṭhā/</i> ज्येष्ठा	228 52.5	4 40	S	2	α Sco (0.91)
65	<i>Yugma/</i> युग्मम्	230 0	75 30	N	4	γ Draco (2.24) and β Draco (2.79)
66	<i>Sarpaśīrṣa/</i> सर्पशीर्षम्	234 30	37 0	N	3	α Ser (2.62)
67	<i>Bhujagasyaśīrṣa/</i> भुजगस्यशीर्षम्	242 9	36 0	N	3	α Ser (2.62) (Same as <i>Sarpaśīrṣa</i>)
68	<i>Mūla/</i> मूलम्	243 7	13 33	S	3	λ Sco (1.62)
69	<i>Yugalākṣa/</i> युगलाक्षम्	245 30	80 0	N	3	β & γ Dra probable
70	<i>Jaladaivata/</i> जलदैवतः	251 33	6 45	S	3	δ Sgr (2.72) possible ν Sgr (2.92) also agreeable
71	<i>Vaiśvadeva/</i> वैश्वदेवम् (<i>Uttarāśādha</i>)	258 55	4 0	S	4	σ Sgr (2.05)

Table 1. Continued.

72	<i>Abhijit/</i> अभिजित्	264 55	62 0	N	1	α Lyr (0.03)
73	<i>Sarpapuccha/</i> सर्पपुच्छम्	269 0	16 15	N	3	η Oph (2.43)
74	<i>Śravaṇa/</i> श्रवणः	280 45	29 0	N	2	α Aql (0.76)
75	<i>Vāyasa/</i> वायसः	281 15	49 12	N	3	β Cyg (3.05)
76	<i>Dhanīsthā/</i> धनीष्ठा	290 0	36 0	S	3	β Del (3.64)
77	<i>Matsyasyapuccha/</i> मत्स्यस्यपुच्छम्	297 0	23 0	S	3	α Gru (1.74)
78	<i>Nakrapuccha/</i> नक्रपुच्छम्	301 36	2 0	S	3	σ Aqr (4.82)
79	<i>Kapāla/</i> कपालः	312 55	21 24	S	1	α PsA (1.16)
80	<i>Kākapuccha/</i> काकपुच्छम्	315 20	59 40	N	2	α Cyg (1.25)
81	<i>Śata/bhiṣak]/</i> शत-[भिषक्]	320 0	0 30	S	3	λ Aqr (3.73)
82	<i>Ajapād/</i> अजपाद् (<i>Pūrvabhbhādrapada</i>)	326 0	24 0	N	3	α Peg (2.48)
83	<i>Turagāṅga/</i> तुरगाङ्गः	332 30	19 0	N	2	θ Psc (4.27)
84	<i>Ahirbudhnya/</i> अहिर्बुद्ध्यम् (<i>Uttarābhādrapada</i>)	337 0	26 0	S	3	γ Peg (2.84) (taking north)
85	<i>Turagāśya/</i> तुरगाश्यः	338 15	31 0	N	2	β Peg ?? (2.07)
86	<i>Jantupuccha/</i> जन्तुपुच्छम्	340 31	10 30	S	2	β Cet (2.04)

Table 1. Continued.

87	<i>Vājibāhu/</i> वाजिबाहुः:	348 1	12 24	N –	ω Psc (3.62) ??
88	<i>Turaṅga/</i> तुरङ्गः:	353 7	25 21	S 2	α And?? (2.07)
89	<i>Pauṣṇa/</i> पौष्णा॒ (<i>Revati</i>)	359 0	1 40	S 6	ζ Psc (4.96) ϵ Psc (4.27) also agrees

Note: *Kṛttikā* (*Agni*) is described as an arrow of fire stars in Taurus described as the fluttering upper garment.

Pusya has cloud-like appearance. *Vasiṣṭha* is usually the sixth star among the seven in Ursa Major and is well known because it has a companion called *Arundhati*.

In this compilation, it is given the fifth place. The other five stars are referred to by stating *Muni*, next *Muni*, next *Muni* and so on.

Only *Vasiṣṭha* and *Marīci* have been given the names.

The name *Vasiṣṭha* seems to be placed wrongly

The 27 stars of the zodiac are very well known. The identification of the fainter ones among them had been a problem and with this catalogue the problem appears resolved (Pai & Shylaja 2016). The names of the other stars can be arranged broadly under two groups. Some of them are translations of the original Persian names. The names *Nadyantaka*, *Bhallūkapr̄ṣṭha*, *Naukā*, *Simhasyapr̄ṣṭha*, *Simhaguhyā*, *Sarpasīrṣa*, *Bhujagasyasīrṣa*, *Sarpapuccha*, *Vāyasa*, *Kākapuccha*, *Turagāṅga*, *Turaṅga* and *Jantupuccha* belong to the first category. They refer (given in the same order) to the end of river called Eridanus, the bear of the Ursa Major, the body parts of the lion in Leo, the head of the serpent, the crow, the body parts of the horse called Pegasus and so on. There are other names such as *Mānuśasīrṣa*, *Nṛpārśvā*, *Nṛhasta*, *Nṛpāda* and *Narāṁsa* which mean the head, hand or leg of a human figure. The corresponding original names such as Perseus, Ophiucus and Centaurus are not indicated. The second category has names to be originally named here in India. It is interesting to see that the constellation Cassiopeia is identified as a *Pāñha*, a throne; its stars are called *Pīthamūla* and *Supīthā*. Some names such as *āptapāñi*, *Nṛyugāṁsaka*, *Skanda*, *Ambuvatsa*, *Lubdhakabandhu*, *Svā*, *Sakti*, *Dvijesvara*, *Yugalākṣa* and *Kapāla* were not known hitherto. There is a third category wherein there are no names at all. They are simply written down as *Rkṣa* and *Nakṣatrameka*. Stars

of Ursa Major (*Saptarsi*) are written as the first *Muni*, second *Muni*, the next *Muni*, the *Muni* after that, and so on.

For the stars of Libra, it is written *Tulaikasikkā* and *Tulānyasikkā*, which translates as the first star and the other star (of *Tula*, Libra). Many pairs of stars have been listed as *yugma/yugmaka*. As mentioned earlier the coordinates have been helpful in identifying the pair. Three such pairs have been identified with *Trivikrama* (Shylaja & Pai 2019a) as the three footprints of the Lord Viṣṇu (mythological story depicts him coming in the disguise of a small boy and asking for a place to put three steps; one step covered the entire earth, the second covered the sky and so, the story goes, he put the third step on the head of the King who offered him this boon).

Further, we need to provide justification for the statement made by the Nityānanda at the beginning that, he is going to present a list of the *dhruvakas* and *saras* of 84 stars; though the names of 89 stars with their coordinates are provided. The star *Mrgavyādha* listed is cited from the previous sources. Nityānanda explicitly says that

kecinmrgavyādhamapibruvanti
some say about the *Mrgavyādha* too.

This appears in the *Mithuna-rāśi* and text says
bhavanti ca dvādaśasamkhyakāni,

which means that the number [of stars in the *Mithuna-rāśī*] are 12. Hence, he does not consider the *Mrgavyādha* in the list.

We further notice that stars grouped under *Dhanu* are seven, but the concluding statement says six. Likewise *Mīna* also has seven stars but it is stated as five. Under the group of *Vṛścika*, the last star is *Sarpasīrṣa* with coordinates $24^{\circ}30'$ and $37^{\circ}0'$ N. The *Dhruvaka* transforms to $264^{\circ}30'$ from the first point of Aries. The first star in the next group *Dhanu* is called *Bhujagasyasīrṣa* with coordinates $2^{\circ}9'$ and $36^{\circ}0'$ N. The *Dhruvaka* of this will be $272^{\circ}9'$. The names of the two stars imply the same meaning – the serpent's head. After applying the precession correction of 15 for 1428 CE we can get the declinations for the two stars. This takes us to the region of the head of the serpent in the constellation of Serpens, which is a small group of four–five stars (γ , κ , ι , τ and β) within about 3° . Thus, it is possible that both these entries correspond to the same star, most probably β Ser.

That reduces the total of 89 to 85, which leaves us with one more case to be dealt with. Let us take a look at stars identified as *Dhruvākṣa* and *Pūrvadhruvākṣa*. Since the magnitudes are specified they correspond to two different stars. However, whether they correspond to the same star or not cannot be verified immediately. This doubt arises because they are very close to each other and measurements made at different epochs could have lead to two different entries as in the case of *Sarpasīrṣa* and *Bhujagasyasīrṣa*.

The identification of a magnitude scale for stars is a new idea that has emerged from this study. The exhaustive list of astrolabes (Sarma 2018) does not contain the magnitude information for stars. The coordinates can be read out from the star dial with difficulty; this led to the marking of the supernova of 1604 (Shylaja 2019).

We have continued the search with other catalogues for example those of Malayendu and Padmanābha which will be presented separately in a forthcoming paper.

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