Dhruvarāśi Takanīka in Jaina Canons

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1. Introduction

At present the commentaries on the Sūryaprajñapti are those due to Malayagiri¹, Amolaka Rṣi² and Ghāsilāla³. Kohl⁴ had contributed a text which was revised by A. Olz. Similarly, the commentaries of the Candraprajñapti are available⁵. These texts are from the fifth sub-composition (upāṅga) of the Śvetāmbara Jaina School, in Ardhamāgadhī Prākṛt. According to Jacobi and Schubring they might have taken shape during the third and fourth century B.C. According to Needham and Ling⁶, they may go back to the latter part of the 1st millennium B.C. Certain descriptions are available in the contents rendered by Weber, Ind. Stud., 10, 254ff. (1868) and Thibaut⁷, JASB 40, comp. and also in his ‘Astronomie’ in the Grundias, p. 20ff., 29.

The ‘Tiloyapaṇṇatti’ was compiled by Yati Vṛṣabha (c. 5th century A.D. or earlier)⁸. This is in Śaurasenī Prākṛt and belongs to the Digambara Jaina School. Similarly in the same school the Dhavalā commentary texts were composed by Vīrasena (c. 9th century A.D.) on the Śaṭkhaṇḍāgama texts which were composed by Puṣpadanta and Bhuṭabali (c. 2nd century A.D. or earlier)⁹. The Gommaṭasāra¹⁰ texts of this school form the summary texts of the Śaṭkhaṇḍāgama texts, composed by Nemicandra Siddhāntacakravarti (c. 10-11th century A.D.).

The term Dhruvarāśi appears in the above texts except the Gommaṭasāra in which the term Dhruvahāra has been used. This appears to be an invariant or constant of the equation of motion and has been sometimes used as a parameter for generating a group of events which were periodic in character. The noted periodicity in the five-year yuga system of India was thus tackled through the Dhruvarāśi technique.

2. The Dhruvarāśi Technique in theTiloyapaṇṇatti

In the Tiloyapaṇṇatti, the technique of Dhruvarāśi has been applied for finding out the distance between the orbits of the moon and those of the sun from the Meru¹¹.

Description of the three relevant verses is as follows:
ekasaṭṭhi guṇidā pañcasayojaṇāṇi dasajuttā / 
te aḍḍāla vimissā dhuvarāsi ṇāma cāramahi // 122 // 
ekatthisahassā aṭṭhavaṇṇutaram sadarā taha ya / 
igisaṭṭhīe bhajide dhuvarāsi pamāṇamuddiṭṭham // 123 // 
31158
61

pañnarasehirām guṇidām himakarabimbappamāṇamavaṇṇijjam / 
dhuvarāśido sesarám viccālam sayalaviṇṇām // 124 // 
30318
61

Translation of the above verses is as follows:

Verse 122: On multiplication of five hundred and ten yojanas by sixty-one, and adding forty-eight to the product, the result (as divided by the denominator sixty-one) becomes the extension of the orbital ground called the Dhruvarāśi.

Note: \( \frac{510 \times 48}{61} \) is equal to 31158/61. This has been called the Dhruvarāśi or the orbital field of the sun or the moon.

Verse 123: The quotient obtained on dividing thirty-one thousand and one hundred fifty-eight by sixty-one has been shown as the pole-set or Dhruvarāśi.

Note: The above verse has been elaborated in this verse.

Verse 124: On multiplying the diameter of the moon by fifteen, the product is subtracted from the dhruvarāśi, the result is the measure of the interval of all the remaining orbits.

Note: Diameter of the moon is 56/61. Hence \((56/61) \times 15 = 840/61\). Now one can find the interval between the remaining orbits as equal to \((31158/61) - (840/61)\) or equal to \((30318/61)\).

Further Procedure

In the verse ahead, the following has been worked out. When \((30318/61)\) is divided by 14, one gets the interval between every one of the orbits as

\[ \frac{35214}{427} \text{ yojanas}. \]

Now to this amount is added the moon's diameter 56/61 yojanas, getting the common difference
\[
\frac{36^{179}}{427} \text{ yojanas}.
\]
Thus, the first orbit is at a distance of \(44820\) yojanas from the Meru.
The second orbit is at a distance of
\[
44820 + \frac{36^{179}}{427} \text{ yojanas from the Meru}.
\]
The third orbit is at a distance of
\[
44820 + 2 \left( \frac{36^{179}}{427} \right) \text{ yojanas from the Meru}.
\]
This is carried on till the last orbit.

Similarly the method of the Dhruvarāṣi in the Dhavalā has been used for confirming the measure of the set of the illusive visioned bias (mithyādrṣṭi jīva rāṣi) through four analytical methods\(^{12}\). However, this is altogether a different procedure for the use of the technique of a Dhruvarāṣi away from a convention of periodicity. Further, the Dhruvahāra (pole divisor) concept in the Gommaṭasāra, is given in details\(^{13}\), where a geometric regression or guṇahāni is produced with the Dhruvahāra as common-ratio.

3. The Dhruvarāṣi Treatment in the Sūryaprajñāpti and the Candraprajñāpti Commentaries

In various commentaries of the Sūryaprajñāpti and the Candraprajñāpti, the Dhruvarāṣi technique has been applied to calculate requisite sets which usually form an arithmetical or a geometrical sequence.

First of all the method is given to find out the measure of a Dhruvarāṣi for solving a particular problem of astronomy. Then the process of obtaining the subsequent progression of desired results is given.

There are as many as twelve examples in which the use of different types of the Dhruvarāṣis is given in the commentaries of the above texts. The muhūrta is divided into 62 parts and further subdivided into 67 parts. Similarly other units are divided and subdivided. The Vedāṅga system of time, however, is different for divisions and sub-divisions.

One of the examples may be illustrated as follows:

Suppose it is required to find out the position of the sun when it is in yoga with a constellation at the instant of the end of a requisite parva (half-lunation). For this, the following verses appear in the commentaries\(^{14}\)
Transcription: Verse 1

"tettisam ca muhuttā visaṭṭhibhāgā ya do muhuttassa /
cuttī cuṇṇiyabhāgā pavvīkaya rīkkhā dhuvarāsi // 1 //

Translation

Thirty three *muhūrtas* (plus) two parts out of sixty-two parts (plus) thirty-four parts out of sixty-two into sixty-seven parts, is to be known as the half-lunation (*parva*) from of the *Dhruvarāsi* corresponding to the (*sun*)-constellation (*yoga*).

Transcription: Verse 2

"icchā parva guṇāo dhuvarāsio ya sohaṇaṃ kuṇasu /
pūsāinām kamaso jahā diṭṭhamanantaṇāṇihiṃ // 2 //

Translation

The *Dhruvarāsi* is multiplied by whatever is the requisite (sequential number of) the *parva* (half-lunation); and then from the product are subtracted (the measure of) the constellations as *puṣya*, etc., in sequence, according to the omniscient vision.

Explanation

Let the problem be as to in which sun-constellation does the first *parva* ends. For this the *Dhruvarāsi* is

\[ 33 + \{2/62\} + \{34/(62 \times 67)\} \text{ muhūrtas}. \]

Here the *Dhruvarāsi* is calculated as follows:

In all there are 124 *parvas*, out of which 62 are bright halves and 62 dark halves in course of five-year *yuga* or five sun-constellation *yogas*. Hence, for one *parva* (half-lunation) we get 5/124 sun-constellation part of a *yoga*. Now this is multiplied by 1830 to convert it into the type of 67 parts getting (5 \times 1830) / 124 or 4575/62. Noting that the sun moves 1830 celestial parts in a *muhūta* or moves through 1830 half-*maṇḍalas* or *ahorātras* in a five-year *yuga*, we convert 4575/62 into *muhūrtas* by multiplying it by thirty. Thus, we get (4575 \times 30)/62 *muhūrtas* or 33+(2/62) + 34/(62 \times 67) *muhūrutas*. This is the *Dhruvarāsi* required for the purpose.

Now we pose the problem for the first *parva*, hence the *Dhruvarāsi* is multiplied by one. This product is to be subtracted by the period covered by the *puṣya* constellation. Hence we get \[ 33 + \{2/62\} + \{34/(62 \times 67)\} - 19 + (45/62) + \{33/(62 \times 67)\} = 13 + (19/62) + \{1/(62 \times 67)\}. \]

This period remains to be covered after the sun has passed over the *puṣya* constellation. Hence the sun remains in the *āśleṣā* for this much period. Just after
this, the first *parva* in form of the coming dark 15th of the *śravaṇa* month comes to an end.

Similarly the succeeding *parvas* are to be treated. For them the multiples of the *Dhruvarāśī* are 2, 3, 4, 5,............, 61, 62 respectively. The products form a geometric progression with the *Dhruvarāśī* as the common ratio.

In the above system, it may be noted that a *muhūrta* or 48 minutes set was sub-divided into 62 parts and each such part was further sub-divided into 67 parts. This system was slightly finer than the sexagesimal system of dividing an hour into, 60 minutes and each minute into sixty seconds.

**Concluding Remarks**

The above probe into the technique of the *Dhruvarāśī* (pole-set) appears to have been in use round about the fourth century B.C. when the *Sūryaprajñāpatti* types of works in the Jaina School were possibly being compiled for the *Karaṇā-nuyoga* group of study. The periodicity of natural phenomena and its calculations needed a group theoretic study and the *Dhruvarāśī* technique was an attempt towards it. From the several remaining examples it appears that progressions and regressions were the powerful tools for dealing with such periodic phenomena. It also appears that this technique might have played a decisive role in developing the later larger *yuga* system for the planetary motions whose account has been mentioned to have become extinct by Yativṛṣabhaścārya in his *Tiloyapaṇṇatti*\(^{15}\). This group theoretic *yuga* system seems to have been converted into the theory of epicycles in Greek later on. Mention may be made also of the work of Roger Billard on the *yuga* system of India through the computer\(^{16}\).

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**References**

1. *Ṭīka* by Malayagiri, (Pr. *Sūrapaṇṇatti*), Agamodaya Samiti, Bombay, 1919. This appears to have been compiled in c. 12th century A. D.


15. Tiloyapanaṇṇatti, op. cit., Ch. 7, V. 458 et seq.


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