On Mathematical Contents of Jaina Prakrit Texts

A Brief Survey

Prof Padmavathamma,
H.O.D. Mathematics,
Mysore University

Prof. L.C. Jain
Hon. Director A.V.R.I.above Diksha Jewelers,
554, Sarafa, jabalpur (M.P.) INDIA (NORTH)

ABSTRACT

Certain mathematical contents of the Prakrit texts are simply described here in view of the symbolic mathematic used in Karnataka Vritti of the Gommatasara and the Labdhisara as elaborated by Pt. Todaramala. This consolidates the Karma theory in the Jaina School. The cosmological theory contains the astronomical and geographical mathematics which is quite simple for study yet deeper in approach to setting of mathematical background of a model.

1. INTRODUCTION

Let us start with a quotaton of the philosopher-scientist Albert Einstein[1], regarding mathematical achievements of the Greeks round about the Christain era, ``We reverence Greece as the cradle of western science. Here for the first time the world witnessed the miracle of logical system which proceeded from step to step with such precision that every single one of its propositions was absolutely indubitable - I refer to Euclid's geometry. This admirable truimph of reasoning gave the human intellect the necessary confidence in itself for its subsequent achievements. If Eculid failed to kindle your youthful enthusiasm, then you were not born to be a scientific thinker."

If we go through the Jaina technical terms in the Prakrit texts of the Karananuyoga or the Dravyanuyoga, we find that most of the terms are importing mathematical significance. Philosophy here is tinged with mathematics as Bertrand Russell puts it, it is a beginning of a mathematical philosophy. His work, Introduction to Mathematical Philosophy' is worth reading. If one reads the Karnataka Vritti of the Gommatasara, one can carry the same impression, for it carries the mathematical details of the Jaina Karma philosophy in the symbolic forms, arithmetical, algebraical and geometrical.[2]

Mahaviracharya[3], the author of the Ganitasara samgraha, did collect the mathematical material from the Jaina source material and he goes beyond in stating that whatever is more to be said may be seen in the Agama.[4] Sridharacharya is still controversial, however, in the history of mathematics.

Still now we do not have the Jyotisapatala of Mahaviracharya[5], nor the Parikarma text or commentary work of Kundkundacarya. Similarly the commentaries of Tumbucluracarya and Samantabhadracarya are not available which could have told and traced the algebraic symbolism of the Karnataka Vrltti of Kesava Varni.[6]

There are several problems in the history of mathematics and science which could be solved regarding the source in India if we could channelize the talents of brilliant scholars of Jainism and Prakrit towards this end in our universities. Bhopal university has opened such a course in the department of religion and culture recently. The problems are regarding the origination of and motivation of a paradigm shift in the terminology and usage of symbols. In the Prakrit texts, we find the logical and philosophical co-mathematical terms, no doubt as in other philosophies, but the mathematical manipulation through symbols is a peculiarity of the Digambara Jaina School. There is also no doubt that this was the achievement in the south perhaps round about the period of Kundkundacarya, when writing of the scripture might have been in full swing, after the compilation of the Satkhandgama[7] and the Kasayaphuda texts. Round about this period we find certain revolutionary events which speak of the mathematical talents of some genius.

2. Mathematical Terms, Symbols, And Events Round About the Christian Era

We shall relate the events and not go into their controversial details. Then it is upto the scholars to solve the problem of their source on the basis of an indispensable necessity. Zero in the place value system was needed by the Jaina School. We also find the place value system used in addition of the factor as well as in their subtraction, in the Karnataka Vritti. Zero was used in the writing of the Mahabandha to fill up the gaps and so on.

The Jain calender records a precession in the Vedamga Jyotisa calender during this period, and the Vikrama Samvat is established in India. Perhaps this was the era when various texts quoted by Virsenacarya were compilled for mathematical imports of the Karma philosophy. For example, the Varganasutra Vedanaksetravidhana, the Khottaniogaddara, Pariyamma, Kalavihano, and so on were some of the mathematical texts which could survive against the time.[8]

The cosmological texts including astronomy and geography, e.g., the Tiloyapannatti, the Suryaprajnapti, the Candapannatti, and so on, did not only depict calendrical details as the Vedamga Jyotisa but there was also a unified astronomical theory, set in a mathematical universe.[9] When several processes are depicted through a single manipulation it becomes a unified theory which is regarded as simple. The Greeks splitted it through the epicycles for finer calculations. Einstein gave a unified theory. Now there is an attempt for a theory of every thing (TOE) in physics. The Jaina School tried to give such a theory of every thing for the biological phenomena through the mathematical theory of karma.[10] The question is whether we could computerize such a theory and prepare files in the software to execute programmes as is happening even in astrology. What could be the resluts in the benefit of a society or a nation? Astronomical programmes will be found to be simpler. Rogers Billard has already computerized the Yuga system of Indian astronomy leaving the Prakrit version of calendar. Success in building up various programmes in the Karma theory will depend on how we are able to form states, input and outputs from the mathematical data furnished in the commentaries of the Gommatasara and the Labdhisara, through C^{++} language.

Let us have a look at the mathematical material in these texts which could be helpful in computerization. The simile and the number measures (upama and samkhya pramana) are finite and transfinite cardinals and ordinals of various types of sets (rasis). There are fourteen types of sequences (dharas) in the Trilokasara[11] which locate several types of sets and their measures. Every topic in the Karma theory deals with the minimum (jaghanya) and the maximum (utkrishta) fixing the domains and ranges between which the computer is to work. The eight operations called the parikarmasataka not only deal with the finite quntities but also transfinite quantities as well as the fixed and variable sets. The trikona-yantra (triangular matrix) can be given several programmes for the variability of the measures of the mass number (pradesas), configurations (prakrtis), energy levels (anubhagas) and the life-times (sthitis) of the Karma ultimate particles (paramanus). The Labdhisara depicts these variations in a symbolic way of mathematics.[12] The equations and inequality relations given in this way may pave the way to more complex manipulation of the problems posed in the modern set up of the Karmic data.

Before we give the measureable terms it will not be out of place to suggest that the vast mathematical data could be arranged in a computer file in a graded manner. From the lowest value we go to the largest value in a certain programme and these could be coded in one of the computer's high level languages such as Fortran Mathematica or C++. The contiollable and observable situations are defined in terms of the control (guna) and reachable (margana) stations (sthanas). Thus the computer could be helpful in showing the time dependent and time-independent phenomenology of the Karma theory of the Prakit texts referred above.

We now relate only the terms of the Prakrit texts which denote a measure which could be calculated to give a rough or fine gradation or topology. One should note that a variable measure is given in an algebraic way, set theoretic in approach. Its measure is therefore given between its minimum suitable value. This could be approximate also as is found in several places of the Labdhisara or the Suryaprajnapti, Tiloyapannatti or the texts on the Ganitanuyoga. Surely, this is based on probability.

Datta had collected some terms and tried to give their interpretation admitting that his attempt was premature. The Dhavala texts and the Karnataka Vrtti were not before him. However, his point of view was only historical. yet one has to dewlve deep into the theory also for showing the definitions and their historical importance. Dr. A.N. Singh also atempted the same way while he contributed articles on the mathematics of the Dhavala and other texts.[14] However a study of the hierarchy of various topics is needed for fruitful results and recognition.

In this brief article we give certain mathematical terms out of which the *asterisk* marked will be those whose measure could be rather ascertained (translated into Hindi from their Prakrit version): Parikkarma (eight operations-pratyutpanna, bhagahara, varga, vargamula, ghana, ghanmula, sankalita and vyutkalita); jiva rasi*; Ajiva rasi*; salaka (counting rod); samkhyata*; asamkhyata*, Muhurta*; Antarmuthurta*; Samaya*; Pradesa*; Varga*; Vargana*; Spardhaka*; Gunahani*; Nana Gunahani*; Anyanyabhyasta rasi*; Samayaprabaddha*; pudgala paramanu rasi*; Akasa pradesa rasi*; kala samaya rasi*; Kevalajnana rasi*; Kalpa*; Avali*; Rajju*; Yojana*; Kalasavarna; Yavat-tavat; Addha; Uddhara; Vyavahara; Ardhaccheda; Trikaccheda; Vargasalaka; Vargita-samvargita; Vikalpa; Bhanga; Samdrsti; Ganana Sthana; Oja and Yugma rasis; Gunasreni; Sarvadhana; Gaccha; Mukha; Madhyadhana; Adidhana; Uttaradhana; Dharas; Alpabahutva; Utsedha; Dhanusa; Bana; Viskambha; Ksetraphala; and so on.

Various terms of the Labdhisara have been defined by Todaramala in the Arthasamdrsti Adhikara of his samyakjnana Candrika commentary. These terms like the Apakarsana, Utkarsana, etc. give operational details in the theory of Karma.

The relations between various entities have been given through several formulae, both in the Karma theory and the Cosmological theory. These formulae can be seen in a collected form in the project work on the Labdhisara assigned by the Indian National Science Academy, New-Delhi.8 For Astronomy, published Doctoral thesis of Lishk.9 For Cosmological formulae, one can see the ``Mathematics of the Tiloyapannatti."[10]

3. Concluding Remarks

The appearance of the Ganitasara samgraha of Mahaviracarya in 1912, gave the first indication of the existance of the Jaina School of Mathematcs in the South India. It was a full book on practical mathematics. He was the first mathematician in the world to recognize the imaginary quantities. Most of his formulae may be seen in other forms in the Digambara Jaina texts on the Karma theory. Formulae given in the commentary of the Suryaprajnapti deserve special attention. The mathematics of the medieval period may also be seen in the works on astronomy and astrology which still await Hindi and English translation. These may be found in the Digambara and Svetambara Grantha Bhandaras. The Bhandara-keepers have to realize in right earnest that it is their prime duty to engage Panditas to translate the still unpublished scientific works into Hindi, rather than repeating publication of the published works. In this respect we must acknowledge our indebtendness to the foreign scholars who took interest in such affairs. Now the circumstances have changed and now we have to depend on our own attempts, attitude and choice, in the larger interest of the culture.

References And Notes

1. Albert Einstein, Ideas and opinions, Calcutta, 1979. p. 271.

2. Commatasara of Namicandra Siddhantacakravarti, vols. 1-4, Bhartiya Jnana Pitha, New Delhi, 1978-81.

3. The Ganitasara samgraha of Mahaviracarya, ed. and trans. by L.C. Jain, Sholapur, 1963.

4. A hecent article short in the Ganita Bharati, vol. 9 (1987), numbers 1-4 P. 54-56, by Ganitanand, Ranchi, has appeared on the date of sridhara. His remarks are worth mentioning here, S.B. Dixit (1896) had found a reference to sridhara by name in an old manuscript of Mahavira's Ganitasara samgraha (ca. 85), and so put the former before the later. .... Royal Asiatic Society, Bombay Rs. 230 of GSS also ends with the words (ABORI? Vo. 31, p. 268)

The similarity of several rules and of many other features between the works of sridhara and mahavira is accepted by scholars. Both may have drawn from a third and common source which is not known nor likely to be known. But most of the scholars considered Mahavira as borrower (he himself named his work as a ``collection'').

The date circa 799 A.D. was assigned to Sridhara by N.C. Jain, by equating him to the Jaina author of Jyotirhnanavidhi (799). And to reconcile salutations `Sivam' and `Jinam' of the different manuscripts it has been suggested that the same Sridhara, after writing mathematical works, may have turned a Jaina toward the end of his life.

The above note also gives the opinion of B. Dutta and A.N. Singh as 750 A.D. as the probable date of Sridhara. It appears that the common source material for both of the above mathematicians have been the Kasayapahuda and the Satkhandagama and their commentaries which might have been before them. As the modieval Jaina writers have been writing Jina and Siva for the same daity, some scribe might have got it changed under certain unknown circumstances. It does not seem possible that Sridhara could have availed the opportunity of the Jaina source material as a non-Jaina, and he must have compiled the work as a Jaina. It also seems possible that under certain circumstances he might have adopted Saivism but whether he wrote two such manuscripts after his conversion is doubtful. Thus looking into the needs of the Digambara Jaina School of Mathematics in the South, and both were Jainas in the Digambara Jaina Schools of Mathematics For this purpose of convincing argument one may see the project work on the Labdhisara of Namicandra Siddhantackaravarti, Indian National Science Academy, 1984-87, by L.C. jain.

5. Mention has been made by N.C. Jain while he was at Arrah Jaina Siddhanta Bhavana, and this manuscript is not available now.

6. Vide The Section of Mathematics in the Science and Civilization in China vol.3., by J. Needham and W. Ling, Cambridge, 1959.

7. These texts are in several volumes and have gone out of print. New editions of the former are now coming out of the press. Sathaandgama of Acarya Puspadanta and Bhutabali, Books 1-16, Amaroti, Vidisha, 1939-1959. Cf. Also, Kasaya Pahuda of Gunabhadracharya, alongwith the Jayadhavala commentary of Virsenacarya and Jinasenacarya, vol. 1-13, and the following Mathura, 1944..

8. For the texts of the Svetambara Jaina School, cf. the exhaustive article, The Jaina School of Mathematics, by B.B. Dutta, Bul. Cal. Math. Soc., vol. xxi, no. 2, 1929, pp. 115-145.

9. For details, see the `Jaina Astronomy' by Dr. S.S. Lishk, (1978), Doctoral Thesis approved by the (Patiala) Punjabi University, 1987, Vidyasagara Publications, Delhi. Cf. also Jain, L.C., * (1976). On the Spira-elliptic Motion of the Sun implicit in the Tiloyapannatti, IJHS, vol.13, no. 1, 1978, pp. 42-49.

10. Jain, L.C. System Theory in Jaina School of Mathematics, IJHS, Vol. 14, no.1, 1979, pp. 29-63.

11. Trilokasara of Nemicandra Siddhantackravarti, Sri. Mahavirji, 1976. Cf. also Jain, L.C. Divergent squences locating Transfinite sets in trilokasara, IJHS, vol. 12, no. 1, 1977, pp. 57-75.
12. Cf. the project referred in 4.
13. Cf. the ref. 8.
14. Singh, A.N. Mathematics of Dhavala, Sathkandagama, book 4 loc., citl., Amaroti, 1942, pp. i-xxiv. Datta, B.B., and Singh, A.N., History of Hindu Mathematics, Bombay, 1962.
15. Cf. ref. 4 for details.
16. Cf. Jain, G.R. Cosmology, old and new, Gwalior, 1942.
17. Cf. re. 4 for the project on the Labdhisara.
18. Cf. ref. 9.
19. Cf. Jain, L.C., Tiloyapannatti ka Ganita, in introduction to the Jambudiva pannatti Samgaho, Sholapur, 1958, pp. 1-109.