

## BOOK REVIEW

Jain L.C. and Jain Prabha, *Exact Sciences in Karma Antiquity* (Vols. I-IV), Sri Brāhmi Sundari Prasthāśram, Jabalpur, India

**Reviewed by: Madhvendra Narayan**, Indian National Science Academy, New Delhi.

In the introductory part of the volume I the author gives a brief background of the development of mathematical knowledge of cosmos, three universe (*triloka*). The *Karma* theory (knowledge) upto the period of Maurya emperor Chandragupta was *śruta jñāna* for want of script in India. Ācārya Bhadrabāhu (c.4<sup>th</sup> century BC) was perhaps the first to attempt to put the *karma* theory into a written document for posterity. Later on the theory of *karma* creation and its mathematical symbols were delivered in the form of sermons in the folk prevalent language called Prakrit. The sermons of Lord Mahāvīra leading to revelation were divided into two parts, inclusive (*aṅga praviṣṭa*) and exclusive (*aṅga bāhya*). The last of the twelve *aṅgas* is Dṛṣṭivāda which was classified into five parts of which *parikarma* included scriptology and mathematics. *Karaṇānuyoga* which is part of Digambara Jaina literature deals with astronomy, mathematics, cosmology & cosmography. The author has compiled three such texts alongwith their english translation in first three volumes and the fourth one is appendices to *karaṇānuyoga* texts. The volumes under review are

- I. The *Tiloyapaṇṇatti* of Ācārya Yativṛṣabha
- II. *Triloksāra* of Nemichandra Siddhāntacakravartī
- III. The *Jambūdīva-Paṇṇatti-Saṃgaho* of Paūmaṇaṃḍi and the *Lokavibhāga* of Siṃhasūrarṣi
- IV. Appendices on *Karaṇānuyoga* texts

The four volumes compendium give knowledge about mathematical significance of the cosmos, the three universe (*triloka*). This is somewhat beyond the knowledge of astronomy to appreciate the cosmology and *karma* theory. The fundamental principle of *karma* theory as described in ancient Prakrit texts of mathematical Jainalogy according to the author is “as you sow so you reap” at

every point and at every instance in cosmos. This principle of independence from all others has appealed even to the posterity and it has enabled to create a chain reaction in annihilation of vision charm disposition resulting in knowledge, bliss and power.

*Tiloyapaṇṇatti* of Ācārya Yativṛṣabha (volume I in nine chapters) deals with Jain cosmography and also with many topics of religious and cultural interest. The first chapter describes the volume and contents of whole universe. The distance in space is defined in terms of *aṅgula* for foot, *kosa* and *yojana* which is fundamental in geographical, astronomical and cosmological measure. The concept of time and space as *pradeśa* and *samaya* may be compared with those of Greek philosophers, Zeno of Elia. The chapters also describe eight types of universes in different geometrical shapes like cube, cuboid, trapazoid etc. The second and third chapters focus on summation of various types of progressions proceeding from a center of disc. The fourth chapter describes the human universe in details where the value of  $\pi$  is given as  $\sqrt{10}$ . The chapter five describes the oblique universe which is a structure horizontal consisting of rings with width which form a geometrical progression with 2 as common ratio. The formula for finding circumferences of sea and island are also given. The height of sun, moon and other celestial bodies are described in chapter seven.

*Triloksāra* (Volume II) is a work by famous author Nemichandra Siddhāntacakravartī who belonged to *deśīya gaṇa*. The *Triloksāra* has 1018 *prākṛit* verses and there are three commentaries available by Mādhavachandra Traividya, Pt. Todarmala of Jaipur and Aryika Visuddhamati Sri Mahavirji, Rajasthan. So far the mathematical contents of *Triloksāra* are concerned it is divided into six chapters. In the first chapters, *Loka Sāmānyādhikāra* the general universe is described where the whole space is composed of infinite space points. The cosmological measure of space is *jagaśreṇī*, the seventh part of which is *rāju*. The volume of universe can be measured in terms of *rāju*; the author also discusses two types of states in universal and nonuniversal. Second chapter describes the residential deities, which are equivalent to Jina temples. The various types of deities have armies or classes whose contents go on increasing class to class in geometric progression. The formula for this geometric progression has also been provided. *Vyantara* universe is described in chapter three and the Jina temples contained in this universe are given by  $L^2/(300 \text{ yojanas})^2$  where L is world line and  $L^2$  is world area. The astral universe has been described in chapter

four where total no. of astral bodies is given to be  $L^2 / (256 \text{ aṅgulas})^2$ . Two types of widths *valaya* and *sūcī vyāsa* have been identified for the island or sea and formulae for calculating them have also been provided. The formulae for calculating circumference of arbitrary island and sea have also been provided. The motion of astral bodies in various islands and seas has been depicted. The no. of planets constellations and stars in the family of moon have been calculated after a lengthy calculations. The names of constellations of Zodiac are also given along with their ruling planet. Chapter five describes the universe of celestial planes. They are classified as *kalpa* and *kalpātīta*. The planes are organized in a sequential no. system where the lower heavens have greater no. and upper having a less no. of celestial planes. The structural limits of these planes are also provided. The dimensional structures of cities and forts surrounding walls are also given. The chapter six describes human and subhuman universe. Various *merus* in various regions are described as *sumeru* mountains. Big lakes and rivers alongwith their dimensions have been described. The under regions (*pātālas*) consisting of three parts filled with air, air water, and water have also been described which causes tides and ebbs in the oceans as the moon waxes and wanes. *Trilokasāra* contains maximum number of formulas and commentaries. It also contains maximum information regarding the Jaina calender along with formulas needed for calculations of astronomical events.

Volume III in the series focus on the English and Hindi translation of mathematical verses of *Lokavibhāga* and *Jambūdīva Paṇṇatti Saṃgaho*. The *Lokavibhāga* has eleven divisions. The *prathmovibhāgaḥ* or first chapter describes five types of *purāṇas* and universe location and its divisions. The different verses describe the seven regions, Bharata being one and six rain carrying mountains. The location of the Bhārata region has also been specified and also the dimension of Bhāratavarṣa which is 1/190 part of Jambū island. The second division describes the *Lavaṇa* seas. Every fortnight the width, shape and height of water increases. The third division describes the second island called *Dhātakikhaṇḍa* where there are two *sumeru* mountains in the east as well as west. While the fourth division describes the widths of successive island and sea the fifth division gives description of periodic cycle of *yuga* having six types of subperiods. The sixth division describes the astral universe (*Jyotirloka*), with intervals between stars, various planets and their dimensions, motion of planets and stars. The seventh division describes the lower universe in which 16 types of earths have been described one below another. Their location and thickness has

also been mentioned. The various types of deities with their residences, longevity and heights have been detailed. In the seventh division the lower universe (*adholoka*) has been described in which sixteen types of earth one below another along with their location and thickness. Different classes of deities have been described and their number vary in geometrical progression. The tenth division details the upper universe which includes celestial planes, discs therein their no., measurements and also the sequential order. In the second part of volume III, the mathematical verses of *Jambūdīvapaṇṇatī Saṁgaho* have been described. The first four chapters describe the measure of the Jambū island, seven regions and their boundaries, height of mountains, dimension of lakes and rivers and also the dimension of *meru* mountain. The chapter six provides formula for measuring chord, arc length, diameter etc. of various geometrical objects. The various countries like, Ariṣṭapuri, Kṣemapuri, Manjuṣa with their capital names has been discussed. Lower Videha with its cities, mountain, gardens, rivers and buildings has been described in chapter nine. The chapter ten and eleven describes the Lavaṇa sea and Dhātaki island. The celestial planes of moon and sun and rules for finding total no. of moon has been described in chapter twelve.

Volume IV focuses on the importance of mathematical research in which the chronological development of mathematics from ancient to modern time has been described. Mahāvīra (6<sup>th</sup> BC) provides the mathematical details through the theory of *karma* where emphasis has been laid on mathematical symbolism. The origin of mathematical probability, the concept and importance of a group, meanings of mathematical invariance, non-Euclidian geometry, origin of mathematics of general relativity have been subject matter of study of Jaina school of mathematics for a long period of time. The application of mathematics in various other disciplines like cybernetics, economics etc. has also been described. In another chapter the origin of Zero and importance of decimal place value system has been discussed. Various Jaina texts such as *Tiloyapaṇṇatti*, *Triloksāra* and *Labdhisāra* give an elaborate exposition of a systematic development of mathematical models. The volume IV contains four appendixes. The first appendix contains unit of length and describes three types of *aṅgula* in *Tiloyapaṇṇatti* whereas number explicit unit of length has been defined in *Trilokasāra*. The *samaya* concept of instant has been defined as a unit or irreducible unit of time in physical nature of things. The definition introduces an ultimate time particle or time period called instant. The third appendix discusses the geographical knowledge in Jaina texts. *Prathamānuyoga* and *Karaṇānuyoga*, both group of Jaina texts describes the

geology, geography, geomorphology, dimatology of Jambū island. The concept of sun & moon, length of day and night has been discussed. A chapter on Jina initiation by Maurya emperor Chandragupta (c. 320 BC) and origin of *Brāhmi* and *Sūndari (kharoṣṭhi)* scripts in India has also been included. The author has presented a critical analysis about Vikram era based on various sources such as the folklores and traditions. The author also tries to establish the point that the Vikram era was mark of defeat and expulsion of foreign rulers from the land.

The mathematical content of the four texts under review are similar in description, formulas and other treatment. The Sanskrit verses have been compiled at one place in similar fashion in all the four volumes and thereafter their translations have been provided. This is commendable work, however, the author's claim that the mathematical manoeuvre of Jaina geography, astronomy and cosmography contained in these four texts provides a base for theory of *karma* has not been elaborated. The *karma* concept and its relationship with Jaina philosophy and literature specially mathematics have not been explained in detail.

