Salient Features of Kerala School of Mathematics

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Abstract

As in many other knowledge systems, India has also made commendable contribution to the realm of mathematics. The historians of mathematics strongly believed that after the period of Bhāskara II could not establish any progress in the mathematical activity in India.But in Kerala, many mathematical works and commentaries were written.Most of them were in the form of manuscripts.The eminent scholars like T.S. Kuppanna Sastri,T.A.Saraswati Amma, R.C.Gupta, K.V.Sarma etc.started working with special focus for disseminating Keralite's contribution to mathematics. This paper aims to bring out the salient features of Kerala school of Mathematics and its significance in Indian mathematics.

Keywords:- Kriyākramakarī commentary, Āryabhaṭīyabhāṣya, Līlāvatī Mahābhāskarīya, Āryabhaṭīya, Sūryasiddhānta, Dṛggaṇita, Yuktibhāṣa, Brāhmasphuṭasiddhānta.

Introduction

Indian mathematics has always got special attention among scholars all over the world. The classical works like *Āryabhaṭīya*, *Brāhmasphuṭasiddhānta, Gaṇitasārasaṅgraha*, *Siddhāntaśiromaṇi* etc. have written during the ancient period of Indian mathematics. The eminent scholars like G.R. Kaye, A.B. Keith, A. A. MacDonnell and D.A. Somayaji hold the view that Bhāskara II was the last Indian mathematician or after Bhāskara II no progress can be seen in the field of Indian mathematics[1]. But in 1832 C.M. Whish, the western historian of mathematics, substantiated the role of Indian mathematical works especially Kerala mathematical texts like *Tantrasaṅgraha, Yuktibhāṣa*, *Karaṇapaddhati* and *Satratnamāla.* This finding became a turning point in the realm of Kerala mathematics asitmade strong interests in the minds of veteran scholars like K.V. Sarma, T. Kuppunna Sastri, T.A. Saraswati Amma and R.C. Gupta. In the twentieth century also several researches have been carried out in the field of mathematics. Here in this an attempt is made to point out the salient features of Kerala School

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1. *A History of the Kerala School of Hindu Astronomy*, pp. 11-12.

of mathematics. The continuous mathematical tradition is said to have developed from 13th century. Even though social circumstances and the foreign assaults caused inversely the growth and development of intellectual activities all over India, Keralites were interested in various scientific disciplines especially in astronomy and mathematics. Thus a number of excellent original texts and commentaries have been produced during that period. Mādhava of Saṅgamagrāma (1340-1425 A.D), who is known as *Goḷavid*, enunciated a formula for finding the circumference of a circle to an advanced degree of accuracy. The *Kriyākramakarī* commentary of *Līlāvatī* written by Śaṅkara and Nārāyaṇa discusses this result in detail[1]**.** *Yuktibhāṣa,* the very famous old Malayalam work has given a geometrical proof for this infinite series. Vaṭaśśeri Parameśvara (1360-1455 A.D), the disciple of Mādhava, was the author of several astronomical works include *Dṛggaṇita, Grahaṇamaṅdana*, *Grahaṇanyāyadīpikā* and *Grahaṇāṣṭaka* and commentaries on *Āryabhaṭīya, Mahābhāskarīya, Sūryasiddhānta, Līlāvatī etc.* The other prominent figure Keḷallūr Nīlakaṅṭha Somayājin was the author of the famous work *Tantrasaṅgraha* and *Āryabhaṭīyabhāṣya*. He elaborately explains the formula for the sum of infinite convergent geometrical progression, while discussing about the derivation of an arc of a circle in terms of chord. The Kerala School had also produced great savants like Putumana Somayājin, Saṅkara Vāriyar and Saṅkara Varman. Before discussing the features of the Kerala School of mathematics it is better to examine the mathematical tradition in Kerala. There were a plenty of manuscript collections in the Naṁpūtiri families and Vāriyar families in Kerala. Some portions of this became destroyed due to the adverse climatic conditions and carelessness on the part of the custodians. Fortunately some unearthed manuscripts traced out the contribution made by the Kerala mathematicians to Indian mathematics. Thus the new phase of Indian mathematical tradition was born.

Salient Features of Kerala Mathematics

1. Kaṭapayādi System

It is an easy method in which Sanskrit alphabets are used for numeral notations.[2] For the ease verification and remembrance, this method is suitable. Āryabhaṭan system was also in Kerala for reducing the size of the text. As

1. *Līlāvatī of Bhāskarācārya with Kriyākramakarī of Śaṅkara and Nārāyaṇa*, p.379.

2. Ācāryavāgabhedyā is represented in *Kaṭapayādi* system as 1434160.

compared to *Kaṭapayādi*, this system may cause confusion in the users. So *Kaṭapayādi* system is more prevalent in Kerala during medieval times.

2. Profusion of quotations

As the Kerala school was enrich with commentarial literature, one can find out both traced and untraced quotations in those commentaries. For example, in the *Kriyākramakarī* commentary of *Līlāvatī,* the editor Prof. K. V. Sarma list out untraced quotations in alphabetical order. These quotations include the mathematical thoughts of Mādhava, Parameśvara, Jayadeva, Udayadivākara, Śrīdhara, Śrīpati, Bhāskara, Sūryadeva, Govindasvāmin and an Ācārya[1] (not specified). Nīlakaṅṭha Somayājin in his *Āryabhaṭīyabhāṣya*, also quotes the works like *Mahābhāskarīya*, *Sūryasiddhanta, Brāhmasphuṭasiddhānta, Laghumānasa, Gārgasaṁhita etc*.[2]

3. Continuity of tradition

The continuity of tradition is an important aspect related to Kerala mathematics. In order to preserve the tradition, the knowledge was transmitted from father to son or from teacher to disciple[3]**.** The findings of Mādhava are thus safely handled by Nīlakaṅṭha Somayājin, Śaṅkara Variyar and Jyeṣṭhadeva. Thus the oral tradition was recorded through the father-son or teacher-disciple relationship.

4. Analytical approach and giving rationales

Medieval mathematical texts are generally analytic in nature i.e. they explain the matters from fundamentals and provide rationales after each results. Especially Keralite works like *Yuktibhāṣa* and *Kriyākramakarī* contain rationales after each chapter. In *Kriyākramakarī* commentary these rationales are written in the form of *saṅgraha ślokas* and they are expressed in terms of geometry.

5. Strong observation and experimentation for computations

The medieval Kerala mathematicians usually possess the nature of keen observation, experimentation and thus by making correction in values obtained. Parameśvara carried out 55 years of observations and experimentations in the banks of *Niḷa*. So he suggested that verifications and corrections are important to make postulates.

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1. Vide *Līlāvatī of Bhāskarācārya with Kriyākramakarī of Śaṅkara and Nārāyaṇa*, p. 89 & 144.
2. *Contribution of Keḷallūr Nīlakaṇṭha Somayājin to Astronomy*, p. 39.
3. *A History of the Kerala School of Hindu Astronomy,* op. cit, p. 5.

6. Anticipation of modern mathematical findings

As Kerala mathematicians were aware of the basic principles of algebra, geometry and trigonometry, the achievements made in the Kerala school include Taylor series expansion for sine and cosine, Newton-Gauss interpolation formula, Infinite G.P convergent series, Gregory - Leibnitz's series for the Inverse tangent and approximation for the value of π. These results caught the attention of western as well as other Indian mathematicians. In brief, Kerala School of mathematics, is now become a field of interest of both the historians and scholars of mathematics. The study of the history of Kerala School of mathematics and its contributions are the thrust are as which require special mention. It may sometimes reveal vibrant thoughts to the mathematical world.

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