



Two Ninth-Century Indian Mathematicians and their works (A Brief Note)

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Abstract: Mahaviracharya and Govindaswami were two ninth-century Indian mathematicians, and they contributed to different fields of mathematics.

1.1 MAHAVIRACHARYA (800 – 870 CE)

Mahaviracharya in brief Mahavira was the most celebrated Indian mathematician of ninth century CE and by religion he was a Jain. He was born in 800 CE at Mysore in the Karnataka state of modern India. Later he enjoyed the patronage of a great Rashtrakuta king Amoghavarsa Nṛpatuṅga, who ruled from 815 CE to 877 CE at Mānyakheta, which is now a small village known as Malakheda, in Gulbarga District of Karnataka state of south India in modern time [1 p. 105] The reign of king Amoghavarsa Nṛpatuṅga was well-known for its political stability, prosperity and educational fertility in the history of south India and he was a religious minded and peace-loving king, patronized art and literature, and it is said that he, himself, wrote some literary works [2 p. 207]. It is believed that he became a Jaina monk latter [3 p. 94]

1.2 MATHEMATICAL WORK OF MAHAVIRACHARYA

It is apparent that under the patronage of Amoghavarsa Nṛpatuṅga, Mahaviracharya authored a marvellous text on mathematics in 850 CE entitled as *Gaṇit Sāra Sangraha* on elementary mathematics including arithmetic, algebra, geometry, mensuration etc. The distinguished feature of this work is that it is a purely mathematical, not astronomical unlike his predecessors. Probably this is the first available text which was devoted entirely to mathematics. This text was first edited and translated into English by M. Rangacharya of the Madras University, latter this valuable text was published by the Government of Madras in 1912 CE. This text is very important, as its title implies, it is an excellent compendium of the contemporary mathematics, and it forms a valuable source of mathematical achievements in ancient India. The *Gaṇit Sāra Sangraha* was the first arithmetical text in the form of a book of mathematics in the modern time. On account of this fact, *Gaṇit Sāra Sangraha* has been used as a text book of mathematics over several centuries in whole of the south Indian region [[4 p. 70][1 p. 105]].

It is said that Mahaviracharya composed two other texts, first one is known as *Jyotiṣ-patala* in he used the formulae of mathematics described, in his text *Gaṇit Sāra Sangraha*, for the calculations in astronomy and the second text *Sattrin-sikā*, which was a work on algebra [5 p. 17 and references therein].

Mahaviracharya described the formula for the sum of a geometric progression whose first is a and common ratio r in the following form:

“The first term when multiplied by the continued product of the common ratio, taken as many times as the number of terms, gives rise to the *gunadhana*. And it has to be understood that this *gunadhana*, when diminished by the first term and then divided by the common ratio lessened by one, becomes the sum of the series in geometric progression” [6 p. 612-613]. This implies, the sum of first n terms of geometric progression is given by:

$$S = a(r^n - 1)/(r - 1)$$

This is same as that of in modern time.

2.1 GOVINDASWAMI (800 – 860 CE)

Govindaswami was one of the great mathematical astronomers of the early India and it is believed that he was born about in the year 800 CE and died in the year 860 CE. He was also known by the other names as Bhatt Govinda as well as Govindaswamin. Śaṅkaranārāyaṇa was one the pupils of Govindaswami and he was an astronomer in the court of King Ravivarma, born in the year 844 CE, of Kerala state of modern India. This pupil mentioned in his work dates corresponding to 866 CE and 869 CE. On the basis of these dates it is inferred that Govindaswami worked and lived in Kerala during about the ninth century CE [7 p. 320]. He was contributed very much to mathematics and astronomy even then a very little is known about him. *Vyakhya*, a commentary on *Mahabhaskariya*, of Bhaskara-I is considered as the most important work of Govindaswami. *Mahabhaskariya*, was a work of Bhaskara-I which included the topics of mathematical astronomy like the longitudes of the planets, conjunctions of the planets with each other and with bright stars, eclipses of the sun and the moon, risings and settings and the lunar crescent etc. In this work Govindaswami introduced an important concept of proofs or *upapatti-s*, which was absent in almost all the earlier works on mathematics and astronomy in India, most probably he was the earliest Indian mathematician who expounded the method of proofs [8 p. 215 and references therein].

Govindaswami wrote the commentary, *Vyakhya*, in about 830 CE at his early age of about 30 years and it contains several examples of using a place-value Sanskrit system of numerals. One of the most interesting aspects of this commentary is Govindaswami’s construction of sine table which is based on hexadecimal fractional parts of the twenty four tabular sine intervals of $90^0/24=3^045'$ from the *Aryabhatiya* of Aryabhata-I which leads to more correct values in the sine table. Mathematicians and astronomers of early India constructed sine tables with a remarkable accuracy and precision and used this table for their astronomical calculations. In the commentary Govindaswami found certain other empirical rules to computation of sine differences in the argument range of 60^0 to 90^0 [9 p.50 and references therein].

2.2 GOVINDASWAMI USED THE THEORY OF PULVERISER OR KUTTAKA

He described two types of the indeterminate equations as the following:

(i). $(ax \pm c) \div b = y$

(ii). $N = ax + b = cx + d$

Thus, pulverisers are of two different kinds. Pulverisers like (i) are known as non-residual and those like (ii) are known as residual pulverisers [10 p. 102].

Conclusion - Mahaviracharya contributed in the field of arithmetic, geometry, mensuration etc. and Govindaswamy constructed a Sin table and also described the types of indeterminate equations.

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