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Research Paper

Modeling in Vedic Mathematics

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Abstract:
According to Aryabhata (6.476 AD), Mathematics and Astronomy presented in his Aryabhaliyam (C.499 AD) (See Sharma [6]) follow. vedas, the oldest embodiment of scientific knowledge, Indeed, Indian Mathematics till 1700 AD. is largely the development of Mathematics available in India till 500 AD. for an account of Indian savants in Astronomy and Mathematics, one may refer to a recent work by Mohan and chander [1] and Rao[5] and the purpose of this paper is to present some interesting problems of mathematical modeling found in the composition of Bhaskara (6,1114 AD) and his predecessors, some classical examples are cited.
Keywords: *Mathematics, vaidik, algebra and Astronomy*

I. Introduction:-

Recent researches reveal that ancient India's excellence in mundane sciences, especially in Mathematics (inclusive of Astronomy) is evidenced by Vedic and Puranic literature. It is said that ancient "Indian Mathematical genius was predominantly algebraic and computational and that {it eschewed (Keep off) proofs and rationales } it kept off proofs and appropriateness. But there are several instances in Mathematical literature, especially in Commentaries, which show that ancient Indian Savants favored generally implicit and rarely explicit arguments in support of their propositions. Of course, these arguments were in tune to the contemporary tradition and educational techniques, and the same cannot be and must not be compared with modern taste of Mathematical analysis.

I am templed to quote Acrărya Badarinatha Sukla regarding the composition of Pursānas. He writes (cf Preface to Markandeya Purana published by the chowkhamba Vidya Bhawan, Varanasi, 1961**).**

"पुराण-विद्या वेद-विद्या, समान अनादि है और पौराणिक वाङ्गमय वैदिक -वाङ्गमय के समान सर्व-प्रथम ब्रम्हा से ही प्रादुर्भूत हुआ है। अन्तर केवल यह है कि वैदिक वाङ्गमय के की प्रथम उपलब्धि जिस रूप में हुई बाद में भी उस रूप की ज्यों की त्यों रक्षा की गयी। उसकी पदावली में किसी प्रकार के परिवर्तन को अग्राह्य माना गया, वो जिस रूप में पहली बार सुना गया उसी रूप में बाद में भी बराबर कहा- सुना जाता रहा। इसीलिये उसका दूसरा नाम अनुभव अथवा श्रुति पड़ा, पर पौराणिक वाङ्गमय के सम्बन्ध में यह बात नहीं है, पुराणों की रक्षा शब्दों में नहीं, अपितु अर्थो में की गयी, उसकी भाषा बदलती रही पर अर्थ वही रहा। ब्रम्हा के मुख से निकली पुराणवाणी का जो अर्थ था वही आज की पुराण-भाषा में निहित है। इस प्रकार, वेद में जो कुछ उपलब्ध है, अपने आदिम शब्द और अर्थ दोनों रूपों में ज्यो के त्यो आज भी सुरक्षित है, पर पुराण केवल अपने मौलिक अर्थो में ही सुरक्षित है। पुराणों के विषय में इस सम्भावना के लिए पर्याप्त स्थान है कि उनमे नूतन भाषा के साथ नूतन अर्थ का भी समावेश हुआ है।

Purans are placed at the top amongst Non-Vedic Sanskrit literature. For example
पुराणां सर्वशास्त्रणां प्रथम ब्रह्मणा स्मृतम्।
उत्तम सर्वलोकानां सर्वज्ञानोपपादकम्। (पदम् पुराण)

According to the following verse from Matsya Purānas, the culture of Purānas preceeds Vedas:
पुराणं सर्वशास्त्राणां प्रथमं ब्रह्मणा स्मृतम्।
अनन्तरं च वक्त्रेभ्यो वेदास्तस्य विनिर्गता: ॥

Therefore, one may conclude that the knowledge available in Vedic literature is in its purest form, line Vedic savants did not favour changes in contents, presentation and language (Vedic Sanskrit) of Vedas. This means that with increasing popularity of ordinary Sanskrit language, Sanskrit was accepted as the language of scholars and medium of scientific education. Aryabhata's explanation for presenting. Astronomy and

Mathematics from Vedas or Vedic literature in Aryabhatiyam for day to day use in remarkable. He writes at the end of the Aryabhatiyam, which is composed in Sanskrit.

आर्य्यभटीयं नाम्ना पूर्व स्वायम्-भुव सदा सद्यत्।

सुकृतयुषो: प्रणाशं कुरुते प्रतिकन्चुकं योऽस्य ॥

It reveals conveys: In the ancient period, Astronomy was brought out from Vedas and popularized in the public. Brahmagupta's Brahma-sputa-siddhanta ("reviked system of Bratma"), (C.628AD) and Bhaskara's sidhanta Siromani (" diadem of an astronomical System") (C.1150. AD) contain modeling problems from agriculture, geometry and social life. - Bhaskara ar Bhaskarăcăriya born in 1114AD is generally called Bhaskara II in History of Mathematics). I wish to cite a few example prfarebly from Bhaskara's Lilavati.'

Volume of a heap of grains

अनुणुषु दशमांशो अनुष्वये कादशांशः

परिधि नवम भागः शूकधान्येषु वेधः

भवति परिधि षष्ठे वर्गिते वेधनिघ्ने

धन गणितकरा: स्यु भार्गधा तश्चा खार्यः

Meaning: If the grain are big and spherical their heap (right circular cone) has height, which is $\frac{1}{10}$ th of the circumference. If they are small and spherical, the proposition is $\frac{1}{11}$ th and if they are pointed, it is $\frac{1}{9}$ th, the volume can be computed by.

(height) x $(\frac{circumference}{6})^2$

This gives the answer in C^3; it also represents the number of Magadha Kharikas (Here C stands for "cubit or hasta and 1 cubit = 24 Angulas).

Explaination

A heap of grains is in the form of a right circular cone. Its circumference can be measured but not its height without disturbing the heap. So Bhaskara cărya gives method to compute the height for 3 different types of grains:

Formula: V = Volume = $\pi r^2 \frac{h}{3}$ the [(r the radius)]

In Magadha state. (Now part of present Bihar), a certain quantity of grains of unit volume as called Khari. Indeed Bhaskara's formula gives

V = $(\frac{2\pi r}{6})^2 h = \frac{\pi^2 r^2 h}{9} \cong \frac{\pi r^2 h}{3}$, it are take $\pi \approx 3$

This is a good model for rough evaluation.

A formula for the length of a chord of a Circle:

चयोननिघ्नंपरिधि : प्रथमाहय: स्यात्

पंचाहत: परिधि वर्ग चतुर्थभाग: ।

आद्योनितेन खलु तेन भजेच्चतुघर्ण

व्यासाहतं प्रथम प्राप्तमिह ज्यका स्यात् ॥

Its literal meaning is: Subtract the (given) arc (cut off by the church) from the circumferences of the circle). Multiply the remainder by the dreamference call (this) product "first". (Now) multiply the square of the circumference by $\frac{5}{4}$ 1 Subtract from et the first, and divide the first by this remainder. The result multiplied by four times the diameter is the (length of the) chard.

Accordingly, if d= the diameter, p= circumference c= are length

Then the length of the chard = $\frac{4dc(p-c)}{q}$

Where q = $\frac{5p2}{4-c\,(p-c)}$

This formula gives an approximate value and it is difficult to trace its derivation. No one Knows how Bhaskara arrives at this formula. How even, using an idea of proportion, a proof of this formula has only recently been suggested on Naimpally [2]. The formula is a good model any way.

There are several instances of proportional modeling in Hindu Arithmetic, Algebra and Geometry. The above instances have been presented in their Original version so that one may have the real and undiluted flavour of pellucidity, clarity (clearness) and beauty of mathematical compositions. The 9th century Join mathematician Mahavirácarya discusses several geometrical model concerning approximate areas of closed carver on a plane in his magnum opus Ganita Săra sarigraha (compilations of Essence of Mathematics) for details, one may refer to [4, Chappell - Vlll]

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