Talk at Bhaskaracharya Pratishthana on 2/2/2026

Time: 5.30 pm to 6 pm

Speaker: S. A. Katre

Some original Sanskrit verses related to Ancient Indian Mathematics

ब्रह्म-कु-शशि-बुध-भृगु-रवि-

कुज-गुरु-कोण-भगणान् नमस्कृत्य |

आर्यभटस्त्विह निगदति

कुसुमपुरेऽभ्यर्चितं ज्ञानम् ॥१॥ Ganitapada (Aryabhata, 499 AD)

This is the first verse of Ganitapada which is a small book on Mathematics by Aryabhata and this book has just 33 verses, but a lot of content. The last two verses tell about the Kuttaka method which deals with solving 2 linear congruences equations (Chinese remainder theorem).

In the verse, Aryabhata first salutes brahma. It is probably because he is a follower of Brahma-Siddhanta or Pitamaha-Siddhanta on Astronomy.

Then he salutes the Earth.

Then he salutes the grahas in the decreasing order of their speed with respect to the distant stars. Graha→ 7 grahas seen moving in the sky by naked eye in the time of Aryabhata. These include the Sun, the moon and the 5 planets Mars, Mercury, Jupiter, Venus, Saturn.

Bowing to Brahma, Prithvi, Moon, Mercury, Venus, Sun, Mars, Jupiter, Saturn and Nakshatras, Aryabhata is imparting the honoured knowledge at Kusumpura (Pataliputra).

ब्रह्मा, पृथ्वी, चंद्र, बुध, शुक्र, सूर्य, मंगळ, गुरू, शनि आणि नक्षत्रांना नमन करून, आर्यभट येथे कुसुमपुरांत (पाटलिपुत्रात) सन्मानित ज्ञान सांगत आहे.

एकं च दश च शतं च

सहस्रं त्वयुतनियुते तथा प्रयुतम् |

कोट्यर्बुदं च वृन्दं

स्थानात् स्थानं दशगुणं स्यात् ॥2॥ Ganitapada (Aryabhata, 499 AD)

Here Aryabhata tells the names of place values starting from 1 and ending with 1 Abja =1 billion (10^9). We do not see the word laksh (लक्ष) used here. Laksh was seen being used from the time of Shreedharacharya (c 750).

Here we see that each place value is given a name. We do not use all these names now for convenience. Instead we use 2-digit numbers when we talk about large numbers.

e.g. 23 thousand 4 hundred and 43.

Eka, dasha, shata, sahasra, ayuta = tens of thousands, niyut = laksha, prayut = ten lakhs, koti, arbud = ten crores, vrinda = abja (hundred crores). Next place is ten times the current place.

एकं, दहं, शतं, सहस्र, अयुत = दशसहस्र, नियुत=लक्ष, प्रयुत =दशलक्ष, कोटि, अर्बुद = दशकोटि, वृन्द =अब्ज (शतकोटि) या प्रत्येक स्थानापेक्षा पुढील स्थान दसपट आहे.

[येथे दहा स्थानांचा उल्लेख आहे. श्रीधराचार्य,..., भास्कराचार्य यांनी अठरा स्थानांची नावे दिली आहेत. त्याप्रमाणे एकं, दहं=दश= दहा, शतं, सहस्र, अयुत = दशसहस्र, लक्ष, प्रयुत = दशलक्ष, कोटि, अर्बुद = दशकोटि, अब्ज=पद्म= शतकोटि, खर्व, निखर्व, महापद्म, शंकु, जलधि, अंत्य, मध्य, परार्ध= 10^{17} अशा संज्ञा प्रचलित आहेत.]

एकदशशतसहस्रायुतलक्षप्रयुतकोटय: क्रमश: |

अर्बुदमब्जं खर्वनिखर्वमहापद्मशङ्कवस्तस्मात् ||11||

जलधिं चान्त्यं मध्यं परार्धमिति दशगुणोत्तरं संज्ञा: |

संख्याया: स्थानानां व्यवहारार्थं कृता: पूर्वै: ||12|| Lilavati (Bhaskaracharya, 12th Century)

Trillion = महापद्म = 10^{12} = 1 Lakh Crore = 1 लक्ष कोटि

In Rigveda first 5 names are used: एक दश शत सहस्र अयुत. Many of the names here are seen derived from the names given in Yajurveda. For convenience some of the previous names were given to larger numbers and some names were changed in due course, but we see that from the times of Shreedhara (8th Century) to Bhaskaracharya (12th century) the same names were used by various mathematicians and the names of Bhaskaracharya are used and remembered now.

[[4-4-11-3]] Yajurveda

इमा मे अग्न इष्टका धेनव: सन्त्वेका च शतं च सहस्रं चायुतं च || नियुतं च प्रयुतं चार्बुदं च न्यर्बुदं च समुद्रश्च मध्यं चान्तश्च परार्धश्चेमा मे अग्न इष्टका धेनव: सन्तु....

एक 1 (दश) 10 शत 100 सहस्र 1000 अयुत 10000 नियुत= लक्ष =10^5
प्रयुत= 10^6 = 1 million, अर्बुद, न्यर्बुद, समुद्र=10^9 मध्य, अन्त, परार्ध=10^{12} (Names in Yajurveda)

Parardha refers to the end of our material world which is considered as half of the whole as made by Prajapati. This word was used for the last word in the sequence of place value names by Yajurveda and also by Shridhara-Bhaskaracharya, but these last words refer to 10^{12} *and* 10^{17} respectively.

Siddhartha (Gautam Buddha) quoted the name for 10^{53}*as* तल्लक्षण in a swayamvara.

In 9th Century, Mahaveeracharya gave 24 names by repeated use of dasha and shata. These names are not consistent with the names given by other contemporary mathematicians, but his method of using dasha, shata for larger place value names is used nowadays, so that we do not have to remember each and every place value name.

वर्ग बेरीज व घन बेरीज

Sum of squares and sum of cubes of first n natural numbers

सैकसगच्छपदानां

क्रमात् त्रिसंवर्गितस्य षष्ठोंऽश: |

वर्गचितिघन: स भवेत्

चितिवर्गो घनचितिघनश्च ||२२|| Ganitapada (Aryabhata)

पद, सैकपद, सैकसगच्छपद (पद= number of terms=गच्छ)

n, n+1, n+n+1

क्रमात् =one by one

त्रिसंवर्गित= multiply the 3 numbers षष्ठोंऽश=1/6 th part.

चिति= sum of first n natural numbers = n(n+1)/2, चितिवर्ग = square of चिति

वर्गचिति=sequence of squares, घनचिति= sequence of cubes

वर्गचितिघन= sum of squares of first n natural numbers

घनचितिघन= sum of cubes of first n natural number

$$\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6}$$

$$\sum_{i=1}^{n} i^3 = \left(\frac{n(n+1)}{2}\right)^2.$$

गच्छ (पदांची संख्या), गच्छांत एक मिळवून आलेली संख्या आणि या दोन्ही संख्यांची बेरीज या तिहींच्या गुणाकाराचा षष्ठांश इतके मान वर्गचितिघनाचे ($\sum_{i=0}^{n} i^2$ चे) असते.

$\sum_{i=0}^{n} i$ (चिति) याच्या वर्गाबरोबर घनचितिघनाचे

($\sum_{i=0}^{n} i^3$ चे) मान असते.
