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Numbers and Symbolism in the Sanskrit works of Jainas

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Introduction: *Jaina philosophy stands as a vital and distinct system within the Indian intellectual tradition. While often contrasted with the six orthodox schools (Ṣaḍ-darśana)—Sāṅkhya, Yoga, Nyāya, Vaiśeṣika, Pūrvamīmāṃsā, and Vedānta—the Jaina system offers a unique framework defined by its own specialized concepts and methodologies. A hallmark of Jaina thought is its deep integration of metaphysical inquiry with empirical sciences, specifically* ***Cosmology*** *and* ***Mathematics****. In this tradition, numerical precision is not merely a secular tool but a philosophical necessity used to map the complexities of the universe. This paper seeks to introduce the significant mathematical contributions found within Jaina literature, exploring how these ancient texts serve as both spiritual guides and scientific manuals.*

Keywords: Samkhyāta (countable) , Asamkhyāta (uncountable), Ananta (infinite) Ojarāśi (odd numbers), Yugmarāśi (even numbers), residual class of n (the sets of integers which give the remainder 0,1,2,…n-1 on division by n so that exactly one number having each remainder)

Gaṇita literally means 'the science of calculations' and is often taken as the Indian name for Mathematics. The word Samkhyāna is found used for Gaṇita in various old treatises. In Buddhist literature there are three classes of Gaṇita as Mudra (finger arithmetic), Gaṇana (mental arithmetic), Samkhyāna (higher arithmetic-in general).The earliest enumeration to these three classes can be observed in the Di¯gha Nikāya, Vinaya Piṭaka, Divyāvadāna and Milindapanho.[1] Later Gaṇita came to mean Mathematics in general, while finger and mental arithmetic were excluded from the scope of its meaning. For the calculation in Gaṇita, writing and writing material became essential. Pāti¯ (board) or dhūli¯ (sand) spread on pati¯ or ground was used for writing with a piece of chalk (or hand). Thus pati¯gaṇita (board calculations) or dhūli¯gaṇita (dust work) terms came into effect. Numerical figures are seen in the inscriptions of early days. Later Bhūtasankya system (words to represent numbers) was used. Different terms were used for representing place value of numbers. Mahāvi¯rācārya, the Jaina mathematician is unique among the Indian mathematicians for having authored Gaṇitasārasangraha the everfirst book on pure Mathematics(without astronomical aspects) in Sanskrit. Mahāvi¯ra also used the words Eka, Daśa, Śata, Shasra, Daśasahasra Lakṣa, Daśalakṣa ….. to represent $10^0,10^1,10^2 10^3,10^4,10^5,10^6$ …….respectively[2].

The jainas have classified numbers mainly as Samkhyāta (countable), Asamkhyāta (uncountable) and Ananta (infinite). They did show some speciality while speaking of counting numbers. To them the least countable number is 2 and not 1. But again 2 is not equal to one in representation. The rule for this is ‘ Eko gaṇanasamkhya na upeti ‘[3], which means that one is not considered as a ‘gaṇanasamkhya’ or counting number.

The author of Dhavalā books, Vi¯rasena (9th century AD) has used some special methods of expressing big numbers. E.g., The biggest number that is definitely stated is the number of developable human souls. To be precise between koti-koti-koti and koti-koti-koti-koti. i.e.,$1,00,00,000^3$ and $1,00,00,000^4$

In the Jain canonical work Anuyogadvārasūtra (100 BC) numbers like Koṭi-Koṭi are seen. Another number representing a period of time is known as Śi¯rṣaprahelika[4]. It is stated to be as big as $(8,400,000)^{28}$. But Tiloyapannatti vv 4.277-283 gives up to the number 84^{31}, 10^{90}, known as 'acalātma'.[5]

Some special products of numbers are given by Mahāvi¯ra[6].Such numbers are said to be in the form of a necklace. Eg

$$139 \times 109 = 15151$$

$$152207 \times 73 = 11111111$$

$$12345679 \times 9 = 111111111$$

$$333333666667 \times 33 = 11000011000011$$

Nemicandra used Kaṭapayādi system to constitute 17 alpha numbers (akṣarasamkhya)[7]. The smallest number 32 used is represented by 'rāga'. Nemicandra also used metric scale in Prakrit which is often largely found in Sanskrit literature.

Eg:- Adavannā sattsayā sakttsahasā- Eight fifty seven hundred seven thousand- 7578

Nemicandra has cited numbers in non metric scale notation. Dipak Jadav has pointed out that 19, 29, 39, 49, etc. offer as Indian instances of vinculum numbers. Vinculum is also seen in Gommaṭasāra-Ji¯vakānda of Nemicandra

Birahiyasaya- Two less Onehundred – 98 Uṇathi¯s- One less Thirty - 29

avayavi¯s - Nine Plus Twenty - 29

To express number under mathematical operations is an interesting phenomenon in Indian Mathematics. Tiloyapannatti and Nemicandra works are seen to have such examples,

cchakkadi= six kriti = $6^2 = 36$.

Duguṇasol 2x16=32

In certain other cases each of the digits of the number is expressed without its denomination

Dugacaurattadasagegi= Two four eight eight seven one. = 178842 (in reverse order)

In Dhavalā -3 p. 249 the countable numbers are divided into 2 namely, 'Ojarāśi' (odd numbers) and 'Yugmarāśi' (even numbers)[8] Odd numbers are again divided into 2 namely, 'Tejoj'and 'kalioj'. Here Thejoj are those numbers when divided by 4 gives remainder 3 and Kalioj are those when divided by 4 gives remainder 1.

Clearly if a ≡ 3 mod 4, a is 'Thejoj' and

a ≡ 1 mod 4, a is 'Kalioj'

Eg: $\frac{15}{4} \rightarrow$ remainder 3 so 15 is 'Thejoj'

$\frac{25}{4} \rightarrow$ remainder 1 so 25 is 'Kalioj'

Even numbers are again divided into 2. Namely 'Kṛtayugm' and 'Badarayugm'

'Kṛtayugm'is a number which gives remainder 0 on division by 4. 'Badarayugm' is a number which gives remainder 2 on division by 4.

Clearly if a ≡ 0 mod 4, a is Kṛtayugm and

if a ≡ 2 mod 4, a is Badarayugm

Eg:- $\frac{48}{4} \rightarrow$ remainder 0, so 48 is Kṛtayugm

$\frac{34}{4} \rightarrow$ remainder 2. So 34 is Badarayugm

Now it is very interesting to see that these numbers Kṛtayugm, Kalioj, Badarayugm, Thejoj can be called the residual class of 4.

Yativṛṣabha in his work Tiloyapannatti has also projected the ideas of number system as well as of symbolism. It is to be noted that the Jaina school needed a quantitative analysis of Karmic events for which the new mathematical infinity was to play an important role. Through a long process, 21 types of ranges (or numbers) were produced (by Yativṛṣabha) by carrying out certain types of multiplication, squaring as well as by adding or projecting various types of sets.[9]

The ideas of 21 types of numbers are developed in different ways. 4 pits in cylindrical form with diameter 1 lac yojana and depth one thousand yojanas are dug. Out of these the 3 stable pits are śalākā, pratiśalākā and mahāśalākā and the fourth pit is unstable.

2 mustard seeds are dropped into the fourth pit which is the jaghanya samkhyāta S_1 least or minimal finite. On dropping one more mustard seed it become non-minimal and non maximal. Or it becomes madhyama samkhyāta. Similarly mustard seeds are dropped till the pit is filled up.

These mustard seeds are dropped one by one into islands and seas which are situated concentrically around the Jambu island successively. As soon as the pit has been exhausted a seed is dropped into śalākā pit and the diameter of the unstable pit is increased to that of the island or ocean where the last seed is dropped. Again this new unstable pit is filled up and exhausted in a similar way and a second seed is dropped in the śalākā pit. As before the diameter of the unstable pit is increased, filled up, exhausted and a seed is dropped into śalākā pit. This process is continued till the śalākā pit is completely filled up and then one seed is dropped into the pratiśalākā pit. When the pratiśalākā pit is filled up in this way one seed is dropped into mahaśalākā pit. The process is stopped when the mahaśalākā pit is filled up and the new unstable pit with diameter as that of the sea or island where the last seed is dropped for exhaustion is dug. This pit is completely filled up with seeds and that number of seeds will denote 'jaghanya pari¯ta asamkhāyta'. If one is subtracted from this 'utkṛṣta samkhāyta' is obtained. i.e., $S_u = A_{pj} - 1$

Then the vargita- samvargita of A_{pj} is jaghanya yukta asamkhyāta

i.e., $A_{yj} = A_{pj}^{\,A_{pj}}$ and 'pari¯ta utkṛṣta samkhāyta' $A_{pu} = A_{yj} - 1$

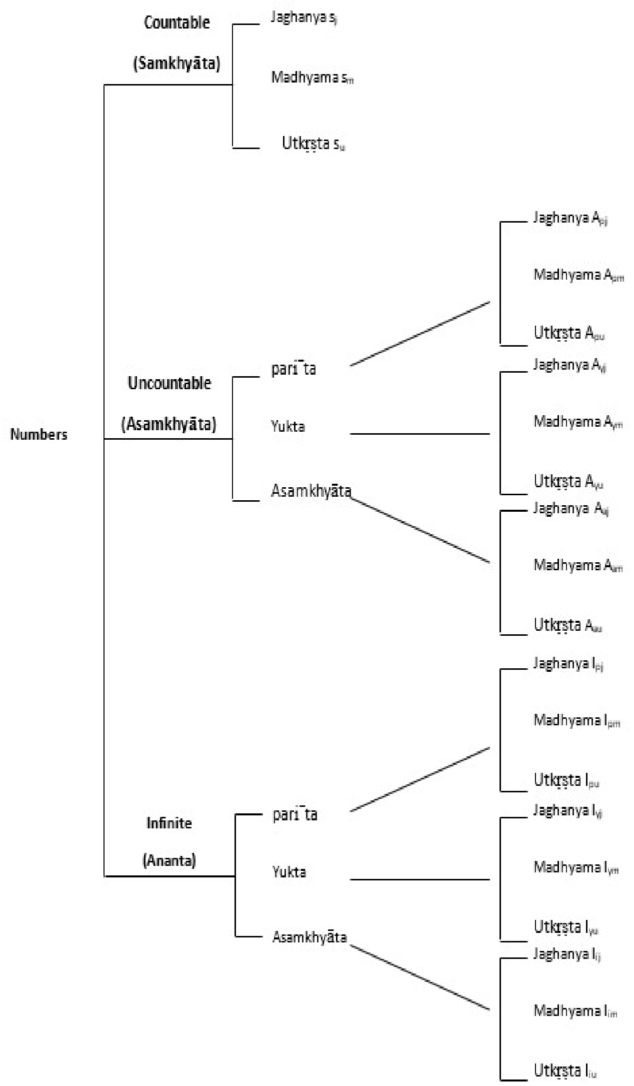
Again jaghanya asamkhyāta asamkhyāta $A_{aj} = A_{yj}^{\,2}$ and the maximal yukta asamkhyāta $A_{yu} = A_{aj} - 1$

Again six innumerate sets, as per the karma theory of the jainas, are added to three times vargita samvargita of A_{aj} and the operation of three times vargita samvargita is done. To this 6 more innumerate sets are added and three times vargita samvargita is done and jaghanya parita ananta or I_{pj} is obtained.

It is worth admiration that Yativṛṣabha has highlighted in addition to gaṇanānanta (computation infinity) 10 other types of ananta which can be enlisted as follows: nāmananta, sthāpanānanta, dravyānanta, śāsvatānanta, apradesikānanta, ekānanta, ubhayānanta. vistārananta, sarvānanta, bhāvānanta.[10]

In general any literature in Sanskrit is read upon with a view that it contains only philosophical or spiritual ideas. Most of the literary outpourings in Sanskrit are treasure houses containing multidisciplinary and interdisciplinary concepts. Jaina literature in Sanskrit too is to be viewed in this perspective.

21 types of numbers



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