Samskrit and Music

Ramamurthy N August 2011

Every subject of the globe has been dealt with in details in our Samksrit language. On account of the complexity of the language it is not so popular. Also it needs in depth knowledge of Samskrit and the related subject as well to unearth the hidden treasure.

Piṇgalā (3rd Century C.E.), author of *Chandas-sāstra* explored the relationship between combinatory and Musical theory anticipating Mersenne (1588-1648) author of a classic on musical theory. *Chandas-sāstra* has been dealt with in a separate article in detail.

Representation of Numerals in Samskrit

In ancient times, throughout India, almost all the scientific books were written using three types of number systems viz., *Kaṭapayādi Saṅkhyā*, *Bhūta Saṅkhyā* and *Āryabhaṭīya Saṅkhyā.*

> "We owe a lot to Indians, who taught us how to count, without which no worth-while scientific discovery could have been made" - Albert Einstein

Dr. David Gray in his book Indic Mathematics writes: the study of Mathematics in the West has long been characterized by a certain ethnocentric bias, a bias which most often manifests not in explicit racism, but in a tendency toward undermining or eliding the real contributions made by non-Western civilisations. The debt owed by the West to other civilisations and to India in particular, goes back to the earliest epoch of the "Western" scientific tradition, the age of the classical Greeks and continued up until the dawn of the modern era, the renaissance, when Europe was awakening from its dark ages.

यथा शिखा मयूराणां, नागानां मणयो यथा ।
तद्वद् वेदाङ्गशास्त्राणाम् गणितं मूर्धनि स्थितम् ॥

वेदाङ्ग ज्योथिषम्

> "Like the crest of the peacock, like the gem on the head of a snake,
> So is Mathematics at the head of all knowledge."
> *Vedāṅga Jyothiṣa – Lagadha,* Verse 35

Mathematics is universally regarded as the science of all sciences and "the priestess of definiteness and clarity". "Everything that the greatest minds of all times have accomplished towards the comprehension of forms by means of concepts is gathered into one great science, Mathematics". J.F. Herbert.

Indian Mathematics belongs not only to a hoary antiquity but is a living discipline with a potential for manifold modern applications. Indian Mathematicians gave the world the numerals, which are now in use universally. The crowning glory of Indian Mathematics was the invention of zero and the introduction of decimal notation without which Mathematics as a scientific discipline could not have made this much headway.

Kaṭapayādi Method:

Kaṭapayādi – कटपयादि, (beginning with *Ka*, *Ṭa*, *Pa* and *Ya*), is one of the general methods of representing numerals in Samskrit. This method was described by the sage *Vararuchi*. The nine numbers and the nought were represented by the letters in the Samskrit consonants (as described in the table below). This enabled the ancient writers of Samskrit poetry to write long numbers as words and verses made up of letters. This was done to help with the learning of long lists of numbers, to convey secret messages and to narrate the numbers poetically.

Vedic knowledge is in the form of *ślokas* or poems in Samskrit verses. A number was encoded using consonant groups of the Samskrit alphabet and vowels were provided as additional latitude to the author in poetic composition. The coding key is given as ***kādi nava, tādi nava, pādi pañchaka, yādyaṣṭakaśca kṣa śūnyam*** - translated as below:

- The nine letters starting with '*ka*'
- The nine letters starting with '*ṭa*'
- The five letters starting with '*pa*'
- The eight letters starting with '*ya*'
- And the letter '*kṣa*' meaning zero.

Note: The letters *ka* to *jha* have the values from 1 to 9. The tenth letter *ṅa* has value zero. Similar is the case with *na.* That these letters have the value zero has not been explicitely stated in this verse and left to be understood. However, the conjunct consonant *kṣa* also has the value zero, which unless stated could not be inferred, due to which it has been mentioned.

Table 1: *Kaṭapayādi* numerals

क	ख	ग	घ	ङ
ka	*kha*	*ga*	*gha*	*ṅa*
1	2	3	4	5
च	छ	ज	झ	ञ
ca	*cha*	*ja*	*jha*	*ña*
6	7	8	9	0
ट	ठ	ड	ढ	ण
ṭa	*ṭha*	*ḍa*	*ḍha*	*ṇa*
1	2	3	4	5
त	थ	द	ध	न
ta	*tha*	*da*	*dha*	*na*
6	7	8	9	0
प	फ	ब	भ	म
pa	*pha*	*ba*	*bha*	*ma*
1	2	3	4	5
य	र	ल	व	
ya	*ra*	*la*	*va*	
1	2	3	4	

श *śa*	ष *ṣa*	स *sa*	ह *ha*	क्ष *kṣa*
5	6	7	8	0

This method operates as given below:

- Numbers corresponding to each letter of any word is taken from the table
- They are written from left to right serially
- They are transposed from right to left
- Consonants have numerals assigned as per the above table. Every letter has unique number value, but the numbers can be represented by different letters. For example, *ba* (ब) is always three (3) whereas 5 can be represented by either *ṅa* (ङ) or *ṇa* (ण) or *ma* (म) or *śa* (श).
- All vowels like *a* (अ) and *ṛ* (ऋ) are assigned value zero (0).
- In case of a conjuct, consonants attached to a non-vowel will be valueless. For example, *kyā* (क्या) is formed by *k* (क्) + *ya* (य) + *a* (अ). The only consonant standing with a vowel is *ya* (य). Hence the corresponding numeral for *kyā* (क्या) will be 1.
- There is no way of representing decimal separator in this system.
- Indians used the Hindu-Arabic numeral system for numbering, traditionally written in increasing place values from left to right. This is as per the rule *aṅkānām vāmato gatiḥ* (अङ्कानाम् वामतो गतिः) which means numbers go from left to right.

An exactly similar code has been in vogue from the letters of English alphabet also.

Table 2: English alphabets representing numbers

Numbers	**English Alphabets**
1	b or p or ph
2	c or q or ch
3	d or r or sk
4	f or s or sh
5	g or t or th
6	h or v or gh
7	j or w or wh
8	k or x or kn
9	l or z
0	m or n or ng

The way the code works is:

1. There is a choice of letters for each number as shown in the table above.
2. The vowels a, e, i, o, u and the letter ‘y’ do not stand for any number.

Example:

fat = 45 (f = 4 and t = 5, a ignored)
father = 453
long = 90

Similar code is being used in telephones (both in desk phones and mobiles as well) nowadays as below:

Numbers	English Alphabets
2	a or b or c
3	d or e or f
4	g or h or i
5	j or k or l
6	m or n or o
7	p or q or r or s
8	t or u or v
9	w or x or y or z

Code words are used to remember the number to dial.

Melakarta or *Sampoorna Rāgas*:

An interesting feature of the *Melakarta Rāgas* of *Carnatic* (classical) music is described to explain the above method of numerals in Samskrit.

The numbers corresponding to first two letters of the *Rāga* are to be read from the above table and transposed. The number of the *Rāga* is obtained.

For example:

a. 15th *Melakarta Rāga* **मायामालवगौल** *Māyāmalavagoula* – The first two letters are **मा** (*Mā*) and **या** (*Yā*). The numbers corresponding to these letters in the above table are 5 and 1 = 51. By transposing 51 we get 15, which is the number for the *Rāga*.
b. 30th *Melakarta Rāga* **नागनन्धिनि** *Nāganandhini* – The first two letters are **ना** *Nā* and **ग** *Ga*. The numbers corresponding to these letters in the above table are 0 and 3 = 03. By transposing 03 we get 30, which is the number for the *Rāga*.

Note: In Samskrit the half letters are not taken into consideration for counting/ calculations.

The below table lists down all the 72 *Melakarta Rāgas*, in that order.

#	Name of the *Rāga* – English	Name of the *Rāga* – Samskrit
1	*Kanakāngi*	कनकांगि
2	*Ratnāngi*	रत्नांगि
3	*Gānamūrti*	गानमूर्ति
4	*Vanaspathi*	वनस्पथि
5	*Mānavathi*	मानवथि
6	*Thānarūpi*	थानरूपि
7	*Senāvathi*	सेनावथि

#	Name of the *Rāga* – English	Name of the *Rāga* – Samskrit
8	*Hanumathoḍhi*	हनुमथोढि
9	*Dhenukā*	धेनुका
10	*Nāṭakapriyā*	नाटकप्रिया
11	*Kokilapriyā*	कोकिलप्रिया
12	*Rūpavathi*	रूपवथि
13	*Gāyakapriyā*	गायकप्रिया
14	*Vakulābharaṇam*	वकुलाभरणम्
15	*Māyāmālavagoula*	मायामालवगौल
16	*Cakravākam* **	चक्रवाकम्
17	*Sūryakāntam*	सूर्यकान्तम्
18	*Haṭakāmbari*	हटकाम्बरि
19	*Jhankāradhvani*	झन्कारध्वनि
20	*Naṭabhairavi*	नटभैरवि
21	*Kīravāṇi*	कीरवाणि
22	*Kharaharapriyā*	खरहरप्रिया
23	*Gourimanohari*	गौरिमनोहरि
24	*Varuṇapriyā*	वरुणप्रिया
25	*Māraranjani*	माररन्जनि
26	*Cārukeśi*	चारुकेशि
27	*Sarasāngi*	सरसान्गि
28	*Harikāmbhoji*	हरिकाम्भोजि
29	*Dhīraśankarābharaṇam*	धीरशन्कराभरणम्
30	*Nāganandhini*	नागनन्धिनि
31	*Yāgapriyā*	यागप्रिया
32	*Rāgavardhani*	रागवर्धनि
33	*Gāngeyabhūśani*	गान्गेयभूशनि
34	*Vāgadhīsvari*	वागधीस्वरि
35	*Śūlini*	शूलिनि
36	*Calanāta*	चलनात
37	*Sālagam*	सालगम्
38	*Jalārnavam*	जलार्नवम्

#	Name of the *Rāga* – English	Name of the *Rāga* – Samskrit
39	*Jhālavarāḷi*	झालवराळि
40	*Navanītham*	नवनीथम्
41	*Pāvani*	पावनि
42	*Raghupriyā*	रघुप्रिया
43	*Gavāmbodhi*	गवाम्बोधि
44	*Bhavapriyā*	भवप्रिया
45	*Śubhapanthuvarāḷi*	शुभपन्थुवराळि
46	*Śadhvidha Mārgiṇi*	शध्विध मार्गिणि
47	*Suvarṇāngi*	सुवर्णांगि
48	*Dhivyāmaṇi*	धिव्यामणि
49	*Dhavaḷāmbari*	धवळाम्बरि
50	*Nāmanārāyaṇi*	नामनारायणि
51	*Kāmavardhini*	कामवर्धिनि
52	*Rāmapriyā*	रामप्रिया
53	*Gamanaśrama*	गमनश्रम
54	*Viśvāmbhari* **	विश्वाम्भरि
55	*Śyāmaḷāngi* **	श्यामळान्गि
56	*Ṣanmukhapriyā*	षन्मुखप्रिया
57	*Simmendra Madhyamam***	सिम्मेन्द्र मध्यमम्
58	*Hemāvathi*	हेमावथि
59	*Dharmāvathi*	धर्मावथि
60	*Nīthimathi*	नीथिमथि
61	*Kāntāmaṇi*	कान्तामणि
62	*Riśabhapriyā*	रिशभप्रिया
63	*Lathāngi*	लथान्गि
64	*Vācaspathi*	वाचस्पथि
65	*Mecakalyāṇi*	मेचकल्याणि
66	*Citrāmbari* **	चित्राम्बरि
67	*Sucarithā*	सुचरित्रा
68	*Jyotisvarūpiṇi* **	ज्योतिस्वरूपिणि
69	*Dātuvardhani*	दातुवर्धनि

#	Name of the *Rāga* – English	Name of the *Rāga* – Samskrit
70	*Nāsikā Bhūśaṇi*	नासिका भूशणि
71	*Kosalam*	कोसलम्
72	*Rasikapriyā*	रसिकप्रिया

** Earlier it was stated that the half letters are not accounted for in all Mathematical calculations. The ragas marked ** above are some exceptions to this rule. The half letters are also considered in these cases.