10. Existence of Inverse Raaga Scales and their Aesthetic appeal.

Music is as much a Science as it is an Art. But, by and large the Scientists, the Musicologists and the Musicians are still unacquainted with their common roots. In March 1970, Sangeet Natak Academy, New Delhi convened a seminar on Science and Music. Scientists, Historians and Musicians sat at a common table and exchanged ideas and everyone learnt that he was not isolated but had many things in common with everyone else. As a result of this Seminar, many eyes have been opened and many slumbering minds awakened.

Many problems were raised and discussed. It was felt that the attempts at deep studies of smaller areas of musicology could follow this generalized preliminary meetings of minds. The Academy therefore arranged a small symposium of Musical Scales and also a workshop on Psychological responses to Raagas in February 1973.

The symposium concentrated on the problems of musical scales. Shri K K Sharma of Calcutta has been studying the Mathematical and Philosophical implications of Moorchanas. **The subject matter of the present work has been taken from that study.**

To appreciate the reverse/inverse relationship in various Raagas it will of great help to understand the Science and Art of Indian Music, Moorchana Chakras, Swara Gramas, etc. a Musicometrical view of Indian music as explained by Sri K.K.Sharma. (Musical scales, report of Symposium, Feb 1973, Sangeet Natak Academy, New Delhi). The detail explainations have been given in the Appendix.

Here it would be suffice only to **appreciate** t**he nature of a tonal structure, possessing melodic validly, musicometrically in the light of basic tendency of Indian music to blend the dissonance and the consonance and the array & the disarray, together in a melodic whole creating waves after ways of melodic tension and relaxation and making the later prevail upon the former at the end of the musical experience.**

The objective criteria of the melodic validity of the tonal structure as enumerated by Narada, Bharata, Sangdeva etc. in terms of ten qualities i.e Dasagunayuktam throw particularly no light in the nature of the structure itself. The later designation, since the time of Matanga, of any such structure as a Raaaga,

meaning, that which pleases-ranjayati-iti-ragah, has hardly been able to improve the situation.

Indian Melody:

The primeval Indian System of melody had an elaborate logical structure based on certain principles, can be conclusively proved from the great importance given to tonal purity and precision in chanting of Vedic hymns.

It is also an indisputable fact that Vedic hymns have always been held in highest esteem for their deep spiritual meanings, and that they have inspired Indian philosophy, literature and art as nothing else has done.

This system of melody, as is evident from all that remains of it today, was structurally a balanced combination of rigidity of artistic norms and flexibility of artistic freedom, having its base in an artistic balancing of various pairs of opposites like consonance and dissonance, symmetry and asymmetry, definiteness and infiniteness. It was this balancing from top to bottom which cumulatively infused meaningfulness in to melody.

In modern times the melody has been defined by Helmholtz as "Horizontal resolution of harmony". He has further described it as " succession of single tones of varying pitches", making a design in pitch and rhythm to produce a satisfying musical effect in which motive, phrase and period are formed by combination in proper relationship of movements and sound**.** In some other analysis the melody has been defined as, "sequence of tones, when it is apprehended in terms of unified and single response which arises from the tones themselves, but is contributed by the act of the listener. The expressive intent of melody differs from that of words in the way that the function of words is to express the concept of actuality, "while the function of melody is to express the structural scheme of actuality. **Words generate concepts which may or may not stimulate feelings. Melody on the other hand generates feeling which may or may not generate concepts. The expressive character of melody makes a tune, "a sentence" that makes a sense. It also gives it the semblance of an idea by virtue of which a unique response of thought and mood is awakened in the listener**

This balance in melody is achieved through tonal order because **order is the heaven's first law in art as in nature and tonal order is the first and last mathematical order, because tone is the only mediating factor between music and mathematics. A melody is therefore a tonal structure in which aesthetic**

unity in complexity is achieved by sub-ordination of all its tonal elements to the basic and dominating ground ratio of the tonic. This is why the tonic has been called as Shadja in Indian musical terminology which means that it is both the progeny and the progenitor of the other six notes of the diatonic scale, the initial cause as well as the ultimate effect of its musical meaning.

The problem of balance between symmetry and asymmetry like that of balance between consonance and dissonance has led in the west as well in India the question of numerical constituents of tonal material because a tone is only a psychological phenomenon of the physical reality of a pitch which is caused by certain frequency of vibration in the air which is a purely mathematical term**. According to Theodore Lipps, "each interval resolves towards that tone which has a vibration rate of some power of 2, 3 & 5." Only tones having frequencies of some power of 2, 3 & 5 have been supported by James Jeans who says that two tones sound well together when the ratio of their frequencies can be expressed by the use of the small numbers and the smaller the number the better is the consonance and the farther we go from the small numbers the farther we go into the realm of dissonance or discord.** This fact was known to Pythagoras, some 2500 years ago, he was the first to ask the questions as to why consonance is associated with the ratio of small numbers. So far no satisfactory answer to this question has been found though a lot of attempts have been made to answer it. But this question takes us into deep thoughts of why and how of the relations between music and mathematics in to which perhaps no one is competent to go. In this connection the famous statement of Plato can be quoted which says, "God forever geometrizes" and also that of Galileo which says,"Nature's great book is written in mathematical language".

Mode:

A melodic Mode being constituted not by any of its Swaras (notes) individually but by the composite pattern of all its note-intervals in their totality. It is born wherever, that is at the beginning of whichever interval its tonic may happen to be located, with the added fact that each one of such locations produces a different mode with a different ethos and **what is true of a pattern is true of the reverse of it.** (it is this philosophy which has been the basic inspiration of the present study)

Note (a) Since the central term of reference for all the notes of a mode is its tonic , the later unfailingly creates the mode inherent in the pattern, where so ever it may be

located in the octave spiral. This also means that the location of the tonic is not an absolute but a relative concept in Indian music and that the ensuring **modes are algebraic rather than arithmetic phenomena**.

b) The fact that shifting of one tonic from one note interval to another produces altogether different mode is one of the central facts of the melodic system, called Moorchana in Indian Musicology, which mean brightening up by turn of each one of many aspects of melodic content contained in any note pattern. Since multiplicity of aspects in a note pattern is possible mathematically only when the note intervals are of unequal lengths, the chromatic scale of all twelve notes, which has an unchanging character with uniform note intervals, is totally unsuited for Indian Music. Only the presence of asymmetry in symmetry can bring out individuality in a community. Indian music believes in creating only such tonal communities as are composed of individualities distinguishable from one another and it permits the community to speak only through one individual at a time.

c) The reverse of a Swara pattern is also a Swara pattern, because the same laws of consonance-dissonance and symmetry–asymmetry relations enter in to the composition of both. This gives birth to tonal individualities in a tonal community, which are not only different from one another but also the reverses of one –another. This balance between freedom & law of tonal co-existence is the soul of Indian Music, which must express itself in elaboration of all its norms and their deviants.

Also, the tonic has one fixed character but the other six Swaras have many changing ones. Each mode should, therefore be formulated and known in terms of characters of all its Swaras taken as a whole.

The above theorems may be followed by several others for a more precise and coherent understanding of Indian System of melody. Though tonal language is too precise to be translated in to words and music is least tangible of all arts, still the facts stands that **music is ordered motion and the disciplined dynamism of music, generates a complex emotion through tonal motions and goes to the roots of our being and takes shapes in the inner gestures which embody our deepest and most ultimate response.** However, the knowledge of co-relation between musical form and emotional experience has yet to pass through lots of objective experimentation in order to attain the dignity of science.

Raaga: It has already been explained earlier that, **in simple words, 'Raaga' is a melodic law or order. Technically, it is a Swara pattern obeying the laws of consonances & dissonances. Also a Raaga is an artistic idea or an aesthetic scheme of which a Scale, a Mode and a melody or melodies form the raw material."**

In modern times certain requirements regarding the use of number of Swara of a scale and how they can be used to form a Raaga have also been laid down by the exponents/musicologists for Hindustani Music, which had already been explained in Chapter-7. They are reproduced below again for ready reference.

The chosen scale does not attain status of a Raaga unless it further obeys the following conditions:

1. It must necessarily possess aesthetic potentialities.
2. It must always take Sa as the fundamental swara.
3. It must employ the full range of an octave and so must cover both the tetra chords.(Tetrachord- a group of 4 swaras,explained already in detail in Chaper 7).
4. It must not omit both Ma & Pa simultaneously which means that it must always include at least one of them.
5. It must not take both flats and sharps of the same note consecutively.

   It had also been explained in detail in Chapter-7 that the above conditions have a truly scientific origin in the principle of tonality itself and have nothing that may be called capricious (sudden/unpredictable) about them.

   Similar requirements have also been laid down for Carnatic system of music too.

Now, if we analyse the inverse of a Raaga , which is formed by using the inverses of the swaras used in the original Raaga as explained in Chapter-9,we will see that the Inverse Raaga also obeys all the above mentioned requirement of a Raaga and , therefore ,will qualify to be a Raaga itself. It also will be a melodic law or order & a swara pattern obeying the laws of consonances & dissonances .The only difference will be that all the consonances will be replaced by all the dissonances & vice versa. Also this new wara pattern will be having its own aesthetic appeal, which may be totally different from the original Raaga.

In Chapter-12 the inverses of many established Raagas Scales have been formed both for Hindustani Raagas & Carnatic system of Raagas, using the above discussed principle of inverses. It is now for anybody proficient in those systems of music to convert those Swaras in to sound and see for himself wheather they have any

aesthetic appeal or otherwise. This has been done for few Raagas by the writer and it has been seen that the Inverse Raaga Scales so formed also do have a unique aesthetic appeal which is quite different from the original Raaga. Similar exercise can be done for Carnatic System of music and result can be seen to confirm the existence of Inverse Raagas in that system too.

And, what is true for Raagas the same is true for Scales/Thaats, Modes, Melodies (Indian/Foreign), Harmonies etc.

Table for Inversion of Swaras in Hindustani Raagas:

Swara	S	r	R	g	G	m	M	P	d	D	n	N	S'
Inverse Swara	S'	N	n	D	d	P	M	m	G	g	R	r	S

Swara	l k	j	j	x	x	e	e	i	/k	/k	fu	fu	l k
Inverse Swara	l k	fu	fu	/k	/k	i	e	e	x	x	j	j	l k

Swara	R1	R2	R3	G1	G2	G3	M1	M2	P	D1	D2	D3	N1	N2	N3
Inverse Swara	N3	N2	N1	D3	D2	D1	P	M2	M1	G3	G2	G1	R3	R2	R1