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## Tones and Intervals of Hindu Classical Music

Donald A. Lentz

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DONALD A. LENTZ

**Tones and Intervals  
of Hindu Classical  
Music**

new series no. 24

*University of Nebraska Studies*

january 1961

# **TONES AND INTERVALS OF HINDU CLASSICAL MUSIC**

DONALD A. LENTZ

# TONES AND INTERVALS OF HINDU CLASSICAL MUSIC

*A Discussion and Comparison for the Western Musician  
of the Basic Tones and Intervals of the Hindu  
Classical Music with Those of Western Music*

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ART IS ALL ENDURING and limitless, and defies positive, unvariable classification. No attempt is being made in this book to compare artistic, subjective or emotional factors. Only the objective elements, techniques and procedures of music that are tangible and definite are being compared and classified.

Western music, having reached a plateau under the present harmonic system, is projecting into new channels for textural inspiration. Composers have exploited the present system, using existing intervals in every conceivable manner under existing tonal and atonal theories. Devices such as smaller intervals (example: tempered quarter tones), electronic combinations, aleatonic principles, etc. are being dealt with experimentally. It is conjectural if there will be universal acceptance of any of the present experimental devices.

The Western world, until recent communications and transportation advances expanded the geographic scope, gave little attention to the cultures of remote places. Leading musicologists have differed in their explanations of the musical systems of these areas. India and China have cultures far older than any of the Western world. Their theoretical musical systems are the most significant of Asia and Africa and have influenced the theoretical systems of most of the rest of Asia.

Many facets of India as a country are very heterogeneous and disunited. There is great variety. Art and culture along with religion have been the greatest unifying forces in India through the centuries. Their culture with its great maturity has much to offer the adolescent Western world. India through history has absorbed most of its invaders, assimilating and using many of their ideas. The Persian-Mongol influence of the Mogul reign (1526-1857) had a definite impact on the Northern areas; the Dravidian culture



of the South shows little of this effect. The language differences throughout the country are pronounced, making each locality seem almost an independent entity. There are fifteen major languages and over seven hundred dialects in India. The Tamil of the South cannot understand the Hindi of Delhi or the Bengali of the north-east section. English is the main language of communication, especially for official purposes, because of British influence. The move in New Delhi to establish Hindi as the official tongue is meeting strong opposition from other major language groups.

In the study of the Hindu Classical music system the confusion due to apparent discrepancies of explanations among Western writers on the Hindu system was at first doubly augmented by the differences in terminology between the many regions in India; in general, between the North (Hindustani) and South (Karnatic). The confusion resulting from the varying terminology and modes of explanation was brought into focus when the language problem between localities was clarified. The differences in explanation by top Hindu authorities ultimately proved only to be of degree and not of kind; and when the terminology was categorized, the over-all greatness and basic uniformity of the physical aspect of the musical system was apparent and understandable. The basic elements as described by ancient Sanskrit writers prevail, but the names and treatment in different regions vary.

To Western composers thinking in terms of smaller intervals, the microtonic elements of Hindu Classical music, known as *svara* and *sruti*, are an existing example which might shed some clues. Any attempt at transfer of some of the ideas of irregular sized and smaller intervals to Western music to enhance the beauty and potential texture must be approached with a complete knowledge of the factors and problems inherent in the contrasting systems of just and tempered intonations.

Contemporary Hindu scholars contend that the basic theoretical principles of Hindu Classical music are found in Bharata's *Natya Sastra* (c. 200 B. C.). Several Hindu musicians commented that the concepts as explained by Bharata (in chapters 28-33) were divinely inspired. Some also stated that the folk music was a derivation of the Classical music. The music has been mainly taught by rote and traditionally carried down in memory. Script notation is more practical under this system than staff notation because of the close correlation and interdependence between music, religion and dance. There have been some attempts to develop a notation along Western lines in recent times but with doubtful success. Definite classifica-

tion of the *ragas* (modes or scales) goes back only to the 17th century.

The cosmological aspect in music is of great importance to the Indian. Western cultures do not give stress to cosmological factors, and consequently it would be difficult to apply these Indian concepts to Western music. In India certain sounds produce *ragas* which are acceptable only at certain times, such as only in the morning, or evening, or spring, or fall, etc. It was commented that back in the vague origins of ancient Indian music the names given to basic tones (*svara*) may have been derived from the sound of animals in nature; such as *Sa* being like the sound of a peacock, *Ga* being like the sound of a goat, and *Ni* like the sound of an elephant, etc. Some Indians go so far as to allege that there is a music of the spheres, *Anabata*, which is audible only to the Yogi.

The technical concept of the Hindu Classical music system must be approached in an entirely different manner from that of the Western music with its arbitrary, tempered intervals capable of producing massive harmonic sounds. Their intervals are a product of "just" intonation and the minute subdivisions which produce such exquisite melodies cannot effectively be accompanied vertically. The subtle, developing, accompanying *tala*, or rhythmic element, offers a fine contrapuntal adjunct and ample support and completeness which in the Western world is derived from a harmonic background. Indian music is modal, closer to the Greek modes than the Ecclesiastical; and because of the varying and minute sizes of the intervals, it does not lend itself to harmonic or pitched contrapuntal treatment. Like all modal music the relationship of each tone to its tonic and drone is important. The accompanying pitched drone with its implied overtones suggests the tones which are selected for each particular *raga* to give it its peculiar, characteristic flavor. The usage of numbers in philosophical discussions in ancient Sanskrit treatises formed the basis for the number of tones used in the ascending and descending scales, along with the scale degree to be stressed or de-emphasized.

The Indian musician is performer, composer and interpreter all at the same time. He is trained in the complete knowledge of artistic exploitation of the *ragas*. This includes elaborate improvisations necessary to develop the musical idea inherent in the *raga*. The Indian claims his system is never stagnant but always expanding.

To analyze and stress physical characteristics of an art form is not an Indian trait. This posed a real problem when conferring with

the Indian musicians. As with the Western musician, a majority knew very little of the actual physical explanation of their system. Long, rapturous discourse based on a subjective attitude or a cosmic phenomenon satisfied. The scholars who understood the physical basis for the art were men of stature and their explanations were positive although these would vary greatly in terminology and stress between different parts of the country—just as many of the books do.

The physical facts, however, can be compared with Western music and general deductions drawn from this comparison. Since the concern in this book is only the physical explanation of the intervals which are used in the Hindu Classical system, many equally important and fascinating facets of the music are not included. The raga system with its interesting method of subtle divergences, cosmic significances and exact classifications as well as the potent and vital tala (rhythmic) system with its intriguing multiple subdivisions are each a subject in themselves.

## 2 / Tones and Intervals

### THE *Sruti*

THERE ARE SEVERAL possible ways to measure and compare the size of an interval. The cent method is used primarily in this book. The cent is an accepted, arbitrary unit of measurement of tones. There are 1200 cents to the octave. Each tempered half-step of the Western octave is 100 cents, as seen in column VI of the Comparative Chart, pages 10 and 11. This is regardless of key. The relative values could be given in savarts, but unless the reader has a working knowledge of logarithms the cent method will be more intelligible. Definite vibration frequencies have been avoided as the Indian system does not have a fixed "do" (or *Sa*).

Three different small intervals called *sruti* are the basis for the Indian tonal system. The names used in this book for these small intervals are those of the southern area of India, although the names used in other areas could be substituted. The size of the interval is the important factor. The intervals, listed according to ratio, are:

1.  $81/80$ . *Pramana sruti* (or comma diesis): equal to 22 cents or 5.4 savarts. This is the difference between a major and minor tone. ( $9/8 \div 10/9 = 81/80$ .)
2.  $25/24$ . *Nyuna sruti*: equal to 70 cents or 17.73 savarts. This is the difference between a minor tone and a semitone. ( $10/9 \div 16/15 = 25/24$ .)
3.  $256/243$ . *Purana sruti* (or limma): equal to 90 cents or 22.65 savarts. This is the difference between a perfect fourth and two major tones. Other rare *sruti*, such as 27 cents, have been considered but do not seem to be commonly used in India.

These *sruti* are derived from a cycle of eleven ascending fifths and eleven ascending fourths, as shown in the Comparative Chart, pages 10 and 11. This produces 22 intervals (or tones) within the

ambit of an octave. Some Sanskrit treatises as well as some contemporary scholars increase this number greatly by going up more fifths and fourths, while others do not recognize all 22.

All ratios used in computing intervals are arrived at from the chord of nature (which is the fundamental of any pitch and its overtone series). The fundamental of the chord of nature is considered to be 1. The ratio from the fundamental to the second partial or first overtone, which is an octave above the fundamental, is  $2/1$ . The second overtone or third partial, which is a twelfth above the fundamental, has the ratio  $3/1$ . The third overtone or fourth partial, which is a double octave above the fundamental, has the ratio of  $4/1$ ; etc. A tone can be reduced an octave by doubling the denominator. Example: if the denominator of the octave ( $2/1$ ) is doubled ( $2/2$ ), the tone is reduced one octave (1) and is the same as the fundamental. If in the ratio  $3/1$  the denominator is doubled ( $3/2$ ), the interval of a twelfth is reduced one octave and becomes a fifth above the fundamental and is a tone within the same octave as the fundamental.

Starting with any fundamental as 1, one may multiply this by  $3/2$ , which is the ratio of a perfect fifth. This produces *Pa* or sruti no. 14, column I in the Comparative Chart, and is the second tone in column VIII. This ratio ( $3/2$ ) is then multiplied by another fifth ( $3/2$ ) which equals  $9/4$ . ( $3/2 \times 3/2 = 9/4$ .) This when reduced within the ambit of an octave becomes  $9/8$  and no. 5 of column I. It is also the third tone in the cycle of fifths as listed in column VIII. The ratio  $9/8$  multiplied by another perfect fifth ( $3/2$ ) equals  $27/16$ . ( $9/8 \times 3/2 = 27/16$ .) This is sruti no. 18 of column I and is the fourth tone in the cycle of fifths as indicated in column VIII.  $27/16 \times 3/2$ , the next perfect fifth, equals  $81/32$ , or  $81/64$  when the register is corrected. This is no. 9 in column I. This procedure is continued through eleven fifths.

The same process is used in arriving at the tones derived from the cycle of perfect fourths. The ratio  $1/1$  is again considered the first tone of the cycle, the same initial tone as used in the cycle of fifths. Starting with the fundamental as 1, one may multiply this 1 by  $4/3$  which is the ratio of the perfect fourth. This produces *Ma* or sruti no. 10 in column I, or the second tone in the cycle of fourths as listed in column IX. The ratio  $4/3$  multiplied by another perfect fourth ( $4/3$ ) equals  $16/9$ , or no. 19 in column I. This is the third tone in the cycle of fourths listed in column IX.  $16/9 \times 4/3$  equals  $32/27$ , or no. 6 in column I when reduced within the ambit of an octave. This is continued through eleven ascending fourths,

the same as was done in the cycle of fifths. The order of tones is listed in column IX.

Combining these eleven tones of the cycle of fourths with the eleven tones of the cycle of fifths results in 22 sruti tones within the Indian octave. When all the tones have been reduced to within the ambit of an octave it will be seen that each tone derived from the cycle of fifths is an  $81/80$  (Pramana sruti) higher than the contiguous tone in the cycle of fourths.

### THE Svara

Svara is the name given to the basic tones of a raga selected out of the 22 sruti. Any of the 22 sruti may become a svara in some particular raga. There are usually seven svara. The seven basic svara or tones of the octave, given in ascending order with the abbreviation of each, are: *Shadaja* (Sa), *Rishabha* (Ri), *Gandhara* (Ga), *Madhyama* (Ma), *Panchama* (Pa), *Dhaivata* (Dha), *Nishada* (Ni). These names are more or less common in all sections of India, both North and South.

Definite controls governed by pattern determine which sruti become svara. These vary according to the musical requirements of each raga. Each svara is formed by an uninterrupted series of sruti. This means that any one from a pattern of two, three or four sruti may become a svara. From sruti nos. 2, 3, 4, 5 or 6 from column I of the Comparative Chart may be selected the Rishabha (or Ri) svara. The Gandhara (or Ga) svara may be selected from sruti nos. 6, 7, 8 or 9 of column I. The Madhyama (Ma) svara may be chosen from sruti nos. 9, 10, 11 or 12 of column I. The Dhaivata (Dha) svara may be selected from sruti nos. 15, 16, 17 or 18 of column I. The Nishada (Ni) svara is chosen from sruti nos. 19, 20, 21 or 22 of column I. The exceptions are nos. 1 and 14 (Sa and Pa) in column I of the Comparative Chart which are always considered unvariable. Sa and Pa correspond to the Western tonic (keynote) and dominant respectively. When a sruti is used as one of the svara in a particular raga, the other tones not used as svara remain sruti which may or may not be used in the particular raga. Those which are used are employed only as embellishments for the svara.

To the Hindu musician svara not only means a definite pitch but also includes within the tone an expressive or emotional element ranking in importance with the pitch. A similar significance

is attached to the expressive or emotional factor inherent in each raga.

The two basic scales of *svara* are called *Gramas*. The *Sa Grama* scale starts on *Sa* of the middle register and has the following *sruti* distribution:

*Sa*—4 *sruti* between *Sa* and *Ri*  
*Ri*—3 *sruti* between *Ri* and *Ga*  
*Ga*—2 *sruti* between *Ga* and *Ma*  
*Ma*—4 *sruti* between *Ma* and *Pa*  
*Pa*—4 *sruti* between *Pa* and *Dha*  
*Dha*—3 *sruti* between *Dha* and *Ni*  
*Ni*—2 *sruti* between *Ni* and *Sa*

The *Ma Grama* scale starts on *Ma* of the middle register and has the following *sruti* distribution:

*Ma*—4 *sruti* between *Ma* and *Pa*  
*Pa*—3 *sruti* between *Pa* and *Dha*  
*Dha*—4 *sruti* between *Dha* and *Ni*  
*Ni*—2 *sruti* between *Ni* and *Sa*  
*Sa*—4 *sruti* between *Sa* and *Ri*  
*Ri*—3 *sruti* between *Ri* and *Ga*  
*Ga*—2 *sruti* between *Ga* and *Ma*

The raga is the end product of these intervals and tone arrangements. In its complete sense it is a melodic pattern which conveys emotion, mood or flavor, often with a psychological or cosmic basis. It uses varied arrangements of the 22 *sruti* following the *svara* idea of *Sa grama* or *Ma grama*. Great variety is obtained by altering (or changing) the *sruti* within the *svara*. For example, referring to column I of the Comparative Chart, instead of using no. 3, *Suddha Rishabha* (a *pramana* or 112 cents) above *Sa* for *Ri*, the sound can be varied by using no. 2, *Gauli Ri* (22 cents above *Sa*) for the *Ri*; or No. 4, *Trisruti Ri* (182 cents above *Sa*); or no. 5, *Chatussruti Ri* (204 cents). One of the characteristics of the raga is determined by the particular *sruti* variants selected which are unique to each particular raga.

Certain tones of the raga are stressed or de-emphasized; and as in the early Greek modes, the pillar tone (*ansa*), the final (*Nyasa*), the melodic center, the incipient and the beginning tone (*Graha*) are important. Frequently the tonic or pillar tone is changed but the same *sruti* interval arrangements are used as in the original. This is called *sruti bhedan* (or modal shift of the tonic). This

change of established tones to be stressed or slighted offers hosts of possibilities for variety.

Today ragas are classified either as *Janaka* (primary) or *Janya* (secondary). Ragas were classified as *Murchanas* in the period prior to A. D. 500. The Janaka types use seven basic svaras both ascending and descending. These may be embellished with *Gamalkas* (or "graces") which are selected adjacent sruti not employed as svaras for a particular raga. The Janya types are much freer; and while derived from the Janaka, they usually use one or more variable sruti. Frequently the number of ascending tones will vary from the number of descending tones. For example: the ascending line may have 5 (minimum), 6 or 7 tones while the descending line may also be irregular and have either 5, 6 or 7 tones. A scale of 6 descending svara and 7 ascending is a good example of the irregularity (*Vakra*).

While there are only 72 basic ragas or melodic patterns, (36 Janaka or fundamental and 36 Janya or secondary), nearly 35,000 transilient or derived scales can be classified and around 92,000 are possible.



IV Number of cents above funda- mental (Indian)	V Interval size and number of cents in just in- tonation	VI Note and number of cents in tempered intona- tion	VII Type of sruti interval from preceding tone	VIII Appear- ance from funda- mental in cycle of fifths	IX Appear- ance from funda- mental in cycle of fourths	X Comple- mentary pairs.	XI West- ern name	XII Some Southern names	Some No
		C		1	1		C	Shadaja	Shadaja
90	Chromatic semitone		Purana		6	22 cents		Guali Rishabha or Ekasruti Rishabha	Komal 1
112	Diatonic semitone 112	D <sup>b</sup> 100	Pramana	8			D <sup>b</sup>	Suddha Rishabha or Dvisruti Rishabha	Madhya
182	Minor 2nd		Nyuna		11	<70) 22 cents		Trisruti Rishabha	Suddha
204	Major 2nd 204	D 200	Pramana	3			D	Chatussruti Rishabha	Tivra P
294	Pythagorean 3rd		Purana		4	<70) 22 cents		Suddha Gandhara or Bhairavi Gandhara	Ati-kom
316	Minor 3rd 316	E <sup>b</sup> 300	Pramana	10			E <sup>b</sup>	Shatsruti Rishabha or Sadharana Gandhara	Komal
386	Major 3rd 386	E 400	Nyuna		9	<70) 22 cents	E	Antara Gandhara	Suddha
408	Ditone		Pramana	5				Chyuta Madhyam Ga or Tivra Antara Ga	Tivra C
498	Fourth 498	F 500	Purana		2	<90) 22 cents	F	Suddha Madhyama	Suddha
520	Sharp 4th		Pramana	12				Begada Madhyama or Tivra Suddha Ma	Ekasruti
590	Aug. 4th 590+	F# 600	Nyuna		7	<70) 22 cents	F#	Prati Madhyama	Tivra M
612	Dim. 5th 610		Pramana	7				Chyuta Fanchama	Tivra
702	5th 702	G 700	Purana	2		680 } 702 } 22 cents	G	Panchama	Pancha
792	Aug. 5th		Purana		5	<90) 22 cents		Ekasruti Dhaivata	Ati-kom
814	Minor 6th 814	A <sup>b</sup> 800	Pramana	9			A <sup>b</sup>	Suddha Dhaivata or Dvisruti Dhaivata	Komal
884	Major 6th 884	A 900	Nyuna		10	<70) 22 cents	A	Trisruti Dhaivata	Suddha
906	Sharp 6th 906		Pramana	4				Chatussruti Dhaivata	Tivra D
996			Purana		3	<90) 22 cents		Suddha Nishada or Komal Kaisiki Ni	Ati-kom
1018	Minor 7th 1018	B <sup>b</sup> 1000	Pramana	11			B <sup>b</sup>	Shatsruti Dhaivata or Kaisiki Nishada	Komal
1088	Major 7th 1088	B 1100	Nyuna		8	<70) 22 cents	B	Kakali Nishada	Suddha
1110	Dim. 8ve 1130		Pramana	6				Chyuta Shadia Nishada	Tivra N

## 4 / *A Physical Analysis of Basic Tones and Intervals from the Comparative Chart*

A COMPARISON of the various factors on the Comparative Chart on pages 10 and 11 should give an understanding of the nature of the tones and intervals used in the Hindu Classical music system and a basis for comparison with Western tempered and just intonation concepts. The idea of 22 sruti seems to be standard in India and the minor variants which one finds occasionally can usually be explained by the expansion or reduction of the number of tones derived from the cycles of fourths or fifths.

Column I of the Comparative Chart lists the common 22 sruti of intervals above any set fundamental by an arbitrary assignment of numbers from 1 for the fundamental to 22 for the largest interval above the fundamental. There is a disagreement between North and South Indian sources as to this numbering. Some explain Sa as being the fourth sruti. For convenience the Southern system using Sa as number 1 is being used in this book. Also the C scale will be used arbitrarily in this book as the Western equivalent when making comparisons with the Hindu scale system. Any other scale could have been chosen as the Hindu system does not have a fixed pitch for Sa. Sa, not being a fixed tone, is a relative final, or movable tonic, to which all of the tones of any particular raga (melodic scale) bear a definite relationship.

The ratios of each of the sruti to the Sa (fundamental, or 1) are shown in column II. The derivation of these ratios from either the cycle of fourths or the cycle of fifths was explained in chapter 2. Note that no. 2 is a 90 cent interval (Purana) above the fundamental and not the 70 cents of a chromatic semitone (Nyuna). This fits into the pattern perfectly. There is an irregular Pramana sruti below 1 (or Sa) which is rarely used so it is not listed. It is derived as no. 13 in the cycle of fourths and has a cent value of 1178

and a ratio of 160/81. This makes it 22 cents or a Pramana sruti below Sa (1) or 68 cents above sruti no. 22, which thus makes it irregular. Likewise a Pramana sruti of 22 cents exists below sruti no. 14 (Pa). It is no. 12 in the cycle of fourths, measures 680 cents and has a ratio of 40/27. It is also rarely used. A Pramana sruti of 22 cents and a ratio of 81/80 is possible above 1 (or Sa). It is no. 13 in the cycle of fifths. This is seldom used. Again, it would create an irregular sruti of 68 cents with sruti no. 2—the same as with the sruti above no. 22. Irregular sized sruti occur when the cycle of fourths or fifths is expanded beyond eleven. Only intervals of 22, 70 or 90 cents are found in column IV. These are the commonly recognized sruti. Along this line note that no. 13 in the Comparative Chart is given as 612 cents to conform to this pattern. The actual cent value is closer to 610 as shown in column V. Though the irregular sruti are omitted in the Comparative Chart, they do form the basis for rare instances when the musician expands the number of sruti beyond the conventional 22 sruti tones.

Large ratios have been reduced, such as 1024/729 to 45/32, or 729/512 to 64/45 (which differs slightly from the 11/8 of the F sharp in column III). The discrepancies are so slight as to be negligible and do not affect the understanding of the system. The exact derivation of any particular tone can be checked from column VIII or column IX. The numbers used in these columns indicate the number of fifths or fourths from the fundamental (1).

A comparison of the ratios with Western just intonation ratios can be made by referring to column III. In the comparison the Southern names of column XII are being used. Basically the Hindu intervals are derived from just ratios. Corresponding ratios between the Hindu system (column II) and the Western just intonation (column III) are apparent when they both use the same starting pitch. Using Sa and C as identical starting pitches, the D flat (16/15) equals Suddha Rishabha (16/15); D equals Chatussruti Rishabha, etc. The ratios for just intonation as given in column III apply to any set tonic and as the tonic changes the size of the intervals changes. Ascending from any given pitch in just intonation, the relationship of each of the eight ascending tones of a scale to its preceding tone is: 9/8 (called a major whole step), 10/9 (a minor whole step), 16/15 (half step), 9/8, 10/9, 9/8, 16/15. One sees in just intonation that the interval from C to D in C major is 9/8 or a major whole step, while the same tones (C to D) in F major are a minor whole step or 10/9. Just intonation with its major whole tones and minor whole tones offers a problem for modulation.

Columns IV and V show the tones with exact cent values. This of course results when two tones have the same ratio. It should be remembered that just intonation is very restricted; if there is a modulation (or change of tonic), few just tones of the new keys will then correspond in cent value to the tones of the Hindu sruti system.

If Western music had developed along the lines of just intonation, it would have been easy to incorporate new microtonic intervals, as in the Hindu system. However, with the departure from just to tempered intonation with its modulatory and harmonic stress it becomes apparent when comparing column IV to column VI (which represents the tempered tones) that few parallels exist. To point out this factor, a comparison of the cent values of each system is made. Apart from the keynotes, no other tone within the octave of the Hindu system parallels a tone within our tempered octave. The variance may be slight as between G (700 cents) and Pa (702 cents). One-fiftieth of a tempered semitone is extremely small, but all the other intervals vary more. For example: D flat (100 cents) finds its closest counterparts in Suddha Rishabha at 112 cents and Gauli Ri at 90 cents. A factor to be considered when comparing tempered intonation with intonation of the Hindu system is that the tone of the Hindu system whose ratio comes closest to a tone of the Western tempered scale is frequently not the main tone of a raga. The raga system often shifts the stress from a tone which may be closer to a tempered tone to another adjacent sruti. In so doing the tone which happens to correspond more closely to our scale might even be omitted. Such a modified tone is called *Vikrit*.

The tones selected for any raga from the 22 available tones are variable, and as a result a multitude of combinations is possible. The only constant or invariable tones are Sa and Pa. These two tones do not have the stature of our tonic and dominant because of the modal nature and the changing of stress of the tones of the Hindu raga system. Since 22 sruti are involved, any one of which may be a main tone, the Hindu system has far more latitude than the Western tempered tonal system which deals with only eleven tones.

In analyzing column VII, only the intervals of 22, 70 and 90 cents or combinations of these are presented. These each represent the three basic sruti intervals as previously described. Briefly stated: Pramana (comma diesis) equals 22 cents, Nyuna 70 cents and Purana (Pythagorean limma) 90 cents. The interval between sruti no. 22 and the octave of Sa (1) equals a Purana or 90 cents. On the

Comparative Chart the Indian name of the intervals is being used.

An especially interesting feature is found when analyzing this sruti arrangement. In column X a list of sruti pairings is made which gives nice uniformity to the system. Sa and the Pramana sruti immediately above and below are not paired as these Pramanas are not used. Starting with no. 2 of column I, pairs of sruti occur in which in each case the two tones are the interval of one Pramana sruti (22 cents) apart. The lower tone is derived from the cycle of fourths and the upper tone from the cycle of fifths. Sruti nos. 2 and 3 are a pair in which the tones are one Pramana sruti apart; nos. 4 and 5 are also a pair in which the tones are a Pramana sruti apart, as are nos. 6 and 7, nos. 8 and 9, 10 and 11, 12 and 13, 15 and 16, 17 and 18, 19 and 20, and 21 and 22. Note that sruti no. 14 is omitted. The Pramana sruti below no. 14 which has a value of 680 cents is not listed in the Comparative Chart as it is derived as the twelfth tone in the cycle of fourths. This was explained on page 13.

The type of interval separating each of the pairs varies. For example, between pair nos. 2 and 3 and pair nos. 3 and 4 there is a Nyuna sruti. On the Comparative Chart it is indicated as "< 70" cents. The Nyuna sruti likewise separates pair nos. 4 and 5 from pair nos. 6 and 7, and pair 6 and 7 from pair 8 and 9; also pair 10 and 11 from pair 12 and 13, and pair 12 and 13 from no. 14 and its lower Pramana (explained in preceding paragraph); pairs 15 and 16 from 17 and 18, and 19 and 20 from 21 and 22. All of the other pairs are separated by a Purana sruti (90 cents). This has significance in the scheme of tone selection for the ragas. Two tones from the same pair are not usually used as basic tones or svara of any raga. The remaining tone may be used as an embellishment (Gamalka) to the tone of the pair which was selected as the basic svara.

Many explanations based on cosmological, artistic or subjective reasoning were offered by Hindu musicians as to the derivation of these sruti. However, by analyzing columns VIII and IX it is seen that by reducing all of the perfect fourths and fifths into the ambit of an octave and separating them by the basic three sruti intervals a physical explanation is arrived at which the Westerner can understand. This also fits the more or less common and standard theories of most regions of India.

The Southern names of column XII seemed to be quite generally accepted in South India. A greater variety of names was found in the Northern areas. Frequent Northern terminology considered

the normal form of the *svara* as *Suddha*; a tone raised one *sruti* as *Tivra*; a tone raised two *sruti* as *Tivratara*; a tone raised three *sruti* as *Tamativra*. A tone lowered one *sruti* was called *Komal*; lowered two *sruti* was called *Ati-komal*; a tone lowered three *sruti* was called *Shikara*. There was not always uniformity in the North as to which *sruti* was to be used as the normal form. In some areas the normal form was the *sruti* that was considered the raised or lowered form of another area. The names given in column XIII were encountered frequently. The varying names of most of the regions of India can be readily applied to the *sruti* form given in column I which numbers the *sruti* according to its size from the *Sa* (keynote). There seemed to be a variety and interchange of the names given to *sruti* nos. 16, 18, 19 and 20.

The Western harmonic system employs the tempered half-step. These half-steps being equal are easily recognizable and combined. Some intervals such as an augmented fourth or major seventh are more difficult to produce accurately in certain keys than others. The problems of the small Indian *sruti* are entirely different. The *sruti* system makes only melodic, not vertical, use of the small intervals. Hence there is no need to hear both vertically and horizontally as in the Western music. However, there is usually a relationship of a fixed drone to the tones within any *raga*. Since the *sruti* and point of emphasis of tones vary in each *raga*, the drone, which must be consonant (*Samvadita*) with the main tones, likewise varies according to the *raga* used. Since the *sruti* are so small, it would be very difficult to sing several successive ones with correct pitch. (Check the analysis of column X in the Comparative Chart.) However, in the melodic patterned order in which they occur in the various *ragas* (modes or melodic scales) they can be sung and heard with good accuracy.

## 5 / Enlargement of the Basic Sruti into Common Compound Intervals

ONLY SELECTED sruti from the total 22 sruti are used in any raga (mode, or melodic scale). The system is beautifully developed so that the basic sruti chosen completely complement each other, physically and cosmologically. Throughout, the major tone ( $9/8$ ) will always be made up of four sruti. Example: between nos. 1 and 5 of column I in the Comparative Chart. All minor tones ( $10/9$ ) are made up of three sruti as is found between nos. 1 and 4 of column I. The semitone ( $16/15$ ) is composed of two sruti. The difference between a major tone and a minor tone is equal to a comma diesus (Pramana sruti) or 22 cents. There seems to be no actual use of two adjacent tones a comma diesus apart in any standard raga.

The comma diesus (or Pramana sruti),  $81/80$  or 22 cents, plus the limma (or Nyuna sruti),  $25/24$  or 90 cents, is equal to a semitone,  $16/15$  ( $135/128$ ) or 112 cents. 22 plus 90 equals 112. This is, however, not the tempered semitone which equals 100 cents.

Throughout there are complementary intervals, i.e., an interval and its inversion which equals an octave. If one of the intervals is consonant, the other is also consonant; if dissonant, the other is dissonant. Example:

$3/2$  (ratio of a just fifth)  $\times 4/3$  (ratio of a just fourth) equals 2 (an octave above any fundamental).

$5/4$  (major third)  $\times 8/5$  (minor sixth) equals 2.

$16/15 \times 15/8$  equals 2.

$9/8 \times 16/9$  equals 2.

$10/9 \times 9/5$  equals 2.

$256/243 \times 243/128$  equals 2.

All the sruti selected as svara for any particular raga must be

complementary to each other. Whatever form of a tone (example: Ri no. 2, 3, 4 or 5 on the Comparative Chart) is used as *svara*, a complementary *sruti* is chosen as *svara* for Ga, Ma, Dha and Ni. This restricts the choice of *sruti* for each raga.

The three *sruti* intervals, *Pramana*, *Nyuna* and *Purana*, may be combined to produce larger intervals which figure in the scheme of things. These common intervals are:

1. *Dvisruti*. This interval can have either of two constant values:
  - (a).  $16/15$ , or a semitone of 112 cents. It is made up of a *Purana* (90 cents) plus a *Pramana* (22 cents). An example of this is between nos. 1 and 3 in column I of the Comparative Chart. Other examples occur between nos. 4 and 6, 5 and 7, 8 and 10, 9 and 11, 12 and 14, 14 and 16, 17 and 19 and 18 and 20.
  - (b).  $135/128$ , which makes a tone slightly less than a tempered semitone, or 92 cents. This is formed by a *Nyuna* (70 cents) plus a *Pramana* (22 cents). An example of this interval is found between nos. 3 and 5 of column I in the Comparative Chart. Other examples occur between nos. 7 and 9, 11 and 13, 16 and 18 and 20 and 22.
2. *Trisruti*. This equals a minor tone ( $10/9$ ) or 182 cents. It is made up of a *Pramana* (22 cents), a *Nyuna* (70 cents) and a *Purana* (90 cents). An example of this interval is found between nos. 3 and 6 of column I in the Comparative Chart. Other examples are found between nos. 1 and 4, 5 and 8, 7 and 10, 9 and 12, 11 and 14, 14 and 17, 16 and 19 and 18 and 21.
3. *Chatussruti*. This interval equals a major tone ( $9/8$ ) or 204 cents. It is composed of a *Purana* (90 cents), a *Nyuna* (70 cents) and two *Pramana* (each 22 cents).  $256/243 \times 25/24 \times 81/80 \times 81/80$  equals  $9/8$ . A *Chatussruti* interval can also be expressed as a combination of the two types of *Dvisruti*.  $16/15 \times 135/128$  equals  $9/8$ . An example of this is found between nos. 1 and 5 in column I of the Comparative Chart. Other examples are found between nos. 2 and 6, 3 and 7, 4 and 8, 5 and 9, 6 and 10, 7 and 11, 8 and 12, 9 and 13, 10 and 14, 14 and 18, 15 and 19, 16 and 20, 17 and 21 and 18 and 22.

Less common intervals are:

*Panchasruti*. This equals  $32/27$  or 294 cents, as found between nos. 5 and 10 on the Comparative Chart. This interval is slightly



smaller than a minor third. When combined with a major whole step ( $9/8$ ) it equals a perfect fourth.  $9/8 \times 32/27$  equals  $4/3$ .

*Shatsruti*. This equals  $6/5$  or 316 cents, as found between nos. 8 and 14 on the Comparative Chart. This interval is slightly larger than a minor third. When combined with a just major third ( $5/4$  or 386 cents) it equals a perfect fifth.  $5/4 \times 6/5$  equals  $3/2$ .

These examples give an idea of the diversity of the intervals and the potential as far as subdivision and combination are concerned. These interval arrangements figure prominently in the selection of the sruti for each of the ragas. It can now be seen how just intonation with its major tone ( $9/8$ ) and minor tone ( $10/9$ ) can be further refined by division of the intervals according to the ideas used by the Hindus. It is also equally evident that if the intervals of our tempered system were to be divided into more minute subdivisions it would require further arbitrary units to parallel the present arbitrary subdivision of the octave into tempered half steps of 100 cents or whole steps of 200 cents.

## 6 / *General Observations and Deductions*

THE USE OF microtonic tones, the diversification of the un-metered tala and the employment of subtle, highly refined and minutely graded inflections as one finds in the Hindu Classical music presupposes that a person in order to have a complete comprehension must have high natural musical ability and thorough training. The Western music with its tempered basis, its larger intervals and its metered rhythm is more easily heard and understood by a large majority of people than the more complex Hindu music. As any system gets more intricate, fewer people can react to it. Devices used by some of our Western contemporaries tax the hearing ability of many, but the intervals are still the same and are recognizable. It is their combination and progression which gives the effect of unfamiliarity.

The complexity found in the higher forms of Western music is a product of interval arrangement and/or progression. Departure from conventional patterns produces unfamiliar progressions or sounds which require understanding to appreciate. To date, no interval smaller than the half-step is used. Most people have the capacity to hear this smallest of Western intervals, and training clarifies and brings understanding of the more complex arrangements.

The small intervals of the Hindu system go past the range where the average ear can differentiate between them. Not only training but also a high degree of keenness of hearing is necessary to distinguish these small intervals regardless of their arrangement. This is a limiting factor, but the Oriental seems to attach slight importance to this limitation. This difference of approach, attitude and training was apparent when talking to Hindu musicians who took for granted that the small microtonic sruti intervals are perceivable to the average musician's ear. To them this would entail hearing

such minute differences as 1.731 cents which exists between the major sevenths of the tempered and just intonation scales; the 1.955 cents between the perfect fourths and perfect fifths of the tempered and just intonation scales; or the 3.686 difference between the major thirds and the 3.910 difference between the major tones of the two intonation systems. They speak of these differences as quite noticeable. A well-trained Western musician with a keen ear would hear these differences, but few of the average listeners who make up much of our audiences and whose musical training is limited would be able to perceive these minute gradations. These small microtones of the Hindu system, which are so demanding of the ear in melodic usage alone, would compound the demands on the ear many times if they were also combined harmonically in the Western manner.

The *Deshi*, or folk type, of Indian music in truth bears slight similarity to the Hindu Classical music. It seems unfitted by strict rules and instead follows the style of most folk music. It is possible to explain the *Deshi* technical structure as being built on the simpler ragas. Several Indian musicians explained it thus; just as they also explained the Western scales in the terms of the all-inclusive and flexible raga system. Our harmonic minor scale finds a counterpart in the *Kirovani* raga; the melodic minor scale in the *Gaurinatha*. The arbitrary scale used in Scriabin's *Prometheus* has a parallel in *Vaschaspati*. The melodic magnitude of the raga system extends far beyond our Western melodic system and embraces practically all types of accepted Western scale patterns.

A strongly developed harmonic system such as found in the Western world is diametric in conception and pattern to the melodic system of the Hindus. Lush harmonies would obliterate the subtle nuance and gradation of their small intervals. The highly personal style of their improvisation of melodic forms without harmonic fetters is very different from the type of set improvisation on set chords as one finds in better jazz. The Indian musician is both creator and performer. Improvisation according to the characteristic nuance of each raga is combined with a more or less formalized exposition in each musical work to give a refreshing yet controlled musical impression. The improvisation usually continues after the exposition, not in a haphazard fashion, but with use of a variety of structural forms.

The attractiveness of tasteful modulation with its attendant color, light and shade is not possible in the Indian system which does not modulate, but weaves around a set drone and its implied overtones. This drone varies for different ragas. The color element is

supplied by the use of many extra melodic tones within the octave and by the use of characteristic, highly refined Gamalkas (graces or embellishments).

Rhythm of a vertical or possibly harmonic implication is not part of the Westerner's technique. The highly developed tala or rhythmic system with its avoidance of strict meter and its constant development by the use of accumulating combination of beat subdivisions finds no counterpart in Western music. Its great interest and capacity for development and progression is used in place of and for a purpose similar to our chordal, harmonic factor. Some of these rhythmical ideas should be thoroughly investigated, as they would most certainly be a vital, usable and artistic addition to Western art. Stravinsky is one of the few Western composers who has developed rhythms which parallel in some respects those of the Hindu tala.

As was stated in an earlier chapter, except for the keynote, no tone of the tempered system has an exact counterpart in the Hindu system. Just and tempered intonations are differently conceived. This factor eliminates the possibility of combining the melodic interval theory of the sruti system with our modulating, harmonic, arbitrary tempered interval theory.

Several approaches have been suggested as a means of arriving at a method of notation and combination which would include all the tones of the two systems. Attempts might be made to achieve this along the following lines: through a system of measurement such as cents; or through the Universal Scale of Sounds made up of 65 tones—53 harmonic and cyclic intervals and 12 quarter tones; or through the natural division of the octave into 52 commas, or 53 as expounded by the ancient theorists.

However, the main problem is not one of notation. The basic elements of relationship, quality, stress and purpose within each of the two systems have evolved diametrically, and if attempts are made to combine these elements as they are today, both musical systems could lose their effectiveness and individualities. Some of the younger Hindu musicians are attempting to incorporate Western ideas. Certain of the simple ragas which approximate scales in our tonal system lend themselves to this treatment without too much difficulty. The simplification and introduction of many of the Western devices is certainly a deterioration of the subtle classical form. The expansion of the radio and the motion picture industries of India is tending to popularize a hybrid type of music at the expense of the established classical form that is a part of the highest

Indian culture. This is resulting in a nondescript kind of music with little of the beauty of the age-old classical form or the charm of the Deshi.

A knowledge of the Hindu system of music by the Western musician certainly has value and might provide enriching ideas. However, there must remain an awareness that a highly developed and refined melodic system built on small intervals cannot readily combine with any harmonic system built on tempered intonation. Some ideas along procedural or usage lines may be possible in linear or contrapuntal writing.

The Hindu Classical music and the Western music systems are each unique and each has a place in its culture. Artistic, subjective and emotional factors are paramount. The objective techniques and procedures are intriguing but secondary.

## Glossary

Proper names from columns XII and XIII of the Comparative Chart and raga names as found on page 21 have not been listed.

Anabata: music of the spheres audible only to the Yogi.

Ansa: pillar tone of the raga.

Ati-komal: a tone lowered two sruti.

Chatussruti: an interval equal to a major tone and made up of four of the small basic sruti. See page 18.

Chatussruti Rishabha: a raised form of Rishabha.

Cent: a term used in assigning a numerical size to an interval. The octave is arbitrarily divided into 1200 cents. This gives each tempered semitone a value of 100 cents. The cent value of any ratio can be arrived at by logarithms.

Comma: an interval with a ratio of  $81/80$ . This can be arrived at in several different ways. The true Pythagorean comma is the interval found by building up twelve perfect fifths and comparing the resulting tone with the corresponding tone built by octaves from the same fundamental. The comma diesis which is the difference between a major tone ( $9/8$ ) and a minor tone ( $10/9$ ) is called a *Pramana sruti* in Hindu music. It occurs between each pair of tones as derived from the cycle of fourths and the cycle of fifths as explained on page 5.

Deshi: folk type.

Dhaivata, or Dha: the sixth basic tone or svara of the scale.

Dvisruti: an interval made up of *two* small basic intervals. See page 18.

Gamaka: an embellishment or grace note.

Gandhara, or Ga: the third basic tone or svara of the scale.

Gauli Ri: a lowered form of Rishabha.

Graha: beginning tone of the raga.

Gramas: a basic scale. There are two: Sa Grama in which the scale starts on Sa and follows a definite interval pattern; and Ma Grama in which the scale begins on Ma and follows a definite interval pattern.

Janaka: name given to primary or regular raga in recent classification. A Southern term. See page 9.

**Janya:** name given to secondary ragas which are derived from Janaka. A Southern term.

**Karnatic:** South Indian.

**Komal:** a tone lowered one sruti.

**Limma:** an interval with a ratio of  $256/243$ . It is the difference between a perfect fourth and two major tones.

**Madhyama:** the fourth basic tone or svara of the scale.

**Mudras:** gestures.

**Murchana:** an early mode of raga classification.

**Nishadha, or Ni:** the seventh basic tone or svara of the scale.

**Nyasa:** final tone of the raga.

**Nyuna:** one of three fundamental microtonic intervals with a ratio of  $25/24$  or 70 cents.

**Panchama, or Pa:** the fifth basic tone or svara of the scale.

**Panchasruti:** an uncommon, irregular interval with a ratio of  $32/27$ .  
See page 18.

**Pramana:** a comma diesus; one of three fundamental microtonic intervals with a ratio of  $81/80$  or 22 cents.

**Purana:** one of three fundamental microtonic intervals with a ratio of  $256/243$  or 90 cents.

**Raga:** a characteristic combination of a melodic pattern or mould with an emotion, passion or mood.

**Rishabha, or Ri:** the second basic tone or svara of the scale.

**Savart:** a system giving relative numerical values to tones. It was originally based on a rotating Savart wheel.

**Shadaja, or Sa:** the first basic tone or svara of the scale.

**Shatsruti:** an uncommon, irregular interval with a ratio of  $6/5$ .  
See page 19.

**Shikara:** a tone lowered three sruti.

**Sruti:** a definitely defined microtonic interval.

**Suddha:** considered the normal form of sruti by some North Indian musicians. The South Indian frequently uses this term to indicate a varied form of sruti.

**Svara:** one of the seven basic tones of the raga selected from the 22 sruti. See page 7.

**Tala:** musical time or rhythm.

**Tamativra:** a tone raised three sruti.

**Tivra:** a tone raised one sruti; or, a raised form of the svara.

**Tivrata:** a tone raised two sruti.

**Trisruti:** an interval equaling a minor tone and made up of *three* small basic intervals. See page 18.

**Vakra:** irregularity in svara arrangement in a raga.