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**MASTER OF ARTS (MUSIC) - SECOND SEMESTER**



**MAMUD2.02**

**MUSICOLOGY - II**



**THEORY SYLLABUS  
MAMUD2.02  
MUSICOLOGY - II**

<b>Unit No.</b>	<b>Name of the Unit</b>	<b>Name of the Course Writer</b>	<b>Name of the Editor</b>	<b>Page No's.</b>
Unit – I	Sruti Nomenclature, Bharata's experiment relating to Dhruva Veena and Chala Veena, Significance of the experiment. Various views regarding the number of srutis used in Indian Music	Mrs. K. Saraswathi Vasudev	Dr.R.N.S. Saileswari	1 – 23
Unit – II	Cycles of IV & V, Discussion of the validity of derivation of 22 srutis by the method of cycles of 4 <sup>th</sup> and 5 <sup>th</sup> Musical intervals expressed in fractions and also in Cyclic cents.			24 - 44
Unit – III	Science in Music: Use of the technology in the propagation and preservation of Music, Tape Recorder, Compact Disk, Radio, Television and Computer			45 – 81
Unit – IV	Accountstics of concert Halls – Echo – Requirements of Open – Air Theatre and Concert Hall			82 - 92
Unit - V	<u>RAGA LAKSHANAS:</u> Anandabhiravi, Kalyani, Bhairavi, Kharaharapriya, Saveri, Begada, Siranjani, Madhyamavathi.			93 - 105



## INDEX

	Syllabus	2
	INDEX	3 - 4
<b>UNIT-I</b>	<b><i>Sruti Nomenclature, Bharata's experiment relating to Dhruva Veena and Chala Veena, Significance of the experiment. Various views regarding the number of srutis used in Indian Music</i></b>	<b>5 – 23</b>
	1.0 Objectives	1
	1.1 Introduction	1 – 18
	1.2 Experimental Vinas	18 -19
	1.2.1 Dhruva Vina, Chala Vina Experiment	19 – 22
	1.3 Self Assessment Questions	22 – 23
	1.4 Reference Books	23
<b>UNIT-II</b>	<b><i>Cycles of IV &amp; V, Discussion of the validity of derivation of 22 srutis by the method of cycles of 4<sup>th</sup> and 5<sup>th</sup> Musical intervals expressed in fractions and also in Cyclic cents.</i></b>	<b>24 - 44</b>
	2.0 Objectives	24
	2.1 Introduction	24 – 39
	2.2 Cycle of Fifths	40 – 44
	2.3 Self Assessment Questions	44
	2.4 Reference Books	44
<b>UNIT-III</b>	<b><i>Science in Music: Use of the technology in the propagation and preservation of Music, Tape Recorder, Compact Disk, Radio, Television and Computer</i></b>	<b>45 - 81</b>
	3.0 Objectives	45
	3.1 Radio, Tape recorder computer – Disc	45
	3.1.1 Recording	45
	3.1.2 Radio	45 – 46
	3.1.3 Television	46
	3.2 The need for public Gramophone record Libraries	46 – 53
	3.2.1 The nature of provision	53 – 56
	3.2.2 The extent of provision and use	56 – 59
	3.2.3 The means of provision	59 – 64
	3.2.4 Programme for specific audiences	64
	3.2.5 Rural Programmes	64 -66
	3.2.6 Rural Forums	66 – 68
	3.2.7 Farm and Home Units	68 – 69
	3.2.8 Educational Programmes	69 – 71
	3.2.9 Teacher Training	71 – 72
	3.2.10 The Open University	72
	3.2.11 Non-Formal Education	72
	3.2.12 Programmes for Women and Children	72 – 74
	3.2.13 Women's Programmes	74 – 75
	3.3 Radio Engineering	75
	3.3.1 Sound Source	75 – 76
	3.3.2 Studio Acoustics	76
	3.3.3 Placement of Microphones	76
	3.3.4 Microphones	77

		3.3.5	Programme Links	77 - 78
		3.3.6	Transmitting Station	78
		3.3.7	Frequency Management	79
		3.3.8	Propagation	79 – 80
		3.3.9	Satellite Systems	80 – 81
	3.4	Self Assessment Questions		81
	3.5	Reference Books		81
<b>UNIT-IV</b>	<b><i>Acoustics of concert Halls – Echo – Requirements of Open – Air Theatre and Concert Hall</i></b>			<b>82 - 92</b>
	4.0	Objectives		82
	4.1	General Acoustics		82 – 84
		4.1.1	Production and transmission of sounds - Reflexions of sounds	84
		4.1.2	Lakshanas of concert halls, open air theatres	84 – 85
		4.1.3	Concert rooms	85
		4.1.4	Resonance	85
		4.1.5	Sound Proof Theatres	85 – 86
		4.1.6	Open – theatre	86 – 87
		4.1.7	Musical Observatories	87 – 88
		4.1.8	Sruti (Relative Frequency or Pich)	88 – 89
	4.2	Some Acoustic Marvels		89
		4.2.1	Nagara Mantapam	89 – 90
		4.2.2	The Hallow Gopuram	90
		4.2.3	Reflecting Board in Golkonda	90
		4.2.4	Open air Theatre	90
		4.2.5.	Sangeethamahal	90
		4.2.6	Tiger Cave	90 – 91
		4.2.7	Hormonic Series	91 – 92
		4.2.8	Inverse law and Direct law	92
<b>UNIT-V</b>	<b><i>Raga Lakshanas: Anandabhiravi, Kalyani, Bhairavi, Kharaharapriya, Saveri, Begada, Siranjani, Madhyamavathi.</i></b>			<b>93 - 105</b>
	5.1	Anandabharavi		93 – 94
	5.2	Kalyani		94 - 96
	5.3	Bhairavi		96 - 97
		5.3.1	History	97 - 98
	5.4	Kharaharapriya		98 – 100
	5.5	Saveri		100 – 101
	5.6	Begada		101 – 102
	5.7	Siranjani		102 – 103
	5.8	Madhyamavathi		103 – 104
	5.9	Self Assessment Questions		105
	5.10	Reference Books		105

## UNIT-I

### **SRUTI NOMENCLATURE, BHARATA'S EXPERIMENT RELATING TO DHRUVA VEENA AND CHALA VEENA. SIGNIFICANCE OF THE EXPERIMENT. VARIOUS VIEWS REGARDING THE NUMBER OF SRUTIS USED IN INDIAN MUSIC**

#### **1.0 OBJECTIVES**

By reading this unit it can be understood

1. 22 Sruti values
2. Sruti nomenclature
3. Druva veena and chala veena experiment

#### **1.1 INTRODUCTION**

Music is an integral part of Indian culture and life style. No occasion is complete without Music filling the air. Man has always drawn inspiration from Mother Nature. Whistling winds, running water, cooing birds roaring beasts, thundering sky-makes the submerged Musical instincts surface, on a receptive mind. Man has found it easy to give vent to his innermost feelings through Musical, successfully.

In one form or other, Music plays an important role in one's life. Right from the beginning of civilization Music has been the medium, through which , personal impressions, history, mythological incidents, social life and many such details are recorded, preserved and carried onward till today.

There are many forms, of Music each of which is distinctive of the place, customs of people, historical and social scenario etc. A keen study of Music of different times by various composers gives a clear picture of the set up behind it. In India, we see Music dominating our social, religious and cultural lives, since the Vedic age.

Through centuries, it has undergone considerable changes Exhaustive studies, authoritative treatises, research works and innovative contributions have given a refinement and perfection to our present classical Music forms. Indian Classical Music is now divided into two main streams – karnatak (Carnatic) and Hindusthani. Until 12<sup>th</sup> Cent. A.D, only one form of classical Music prevailed all over our Country.

During Allahuddin Khiji's regime at Delhi, a Persian Musician, Amir Khusro came to India, on invitation by the ruler of Delhi. He studied Indian Music, that was prevailing then

and changed several aspects to suit his method, composed several new pieces to establish his ideas and popularized a Musical form that was a mixture of Persian and Indian Music.

Later it came to be known as Hindustani (Uttaradi) Music. In southern India, the original Indian Music is preserved and nourished in its original form and is handed down to the present generation. It is now popularly known as Dakshinadi or Carnatic Music.

It is an established fact that, Classical Music now in its refined form finds its origin in folk Music. Even now we find many tunes resembling a few of the old folk tunes. That is altogether topic, which needs a special study. In these chapters we will learn about all the Musical terms used, different forms of compositions, contribution of composers and Musiciologists belonging to different times, Musical instruments, set Music, innovative (manodharma) Music, Ragalakshnas, Tala – Laya and other allied topics.

In the history of world Music, Indian Music is one of the earliest to use quarter-tones. It is the use of quartertones and micro tones that imparts a peculiar charm, colour and flavour to the Music of India. Twenty-two such notes i.e., ten notes in addition to the universal twelve notes of the gamut have been in use for centuries. Many ancient Sanskrit and Tamil works refer to the 22 srutis as the foundation of the Indian Musical scale, with the progress of the art a few more srutis have come into use.

From Bharata's natya sastra, we get the earliest authentic reference to the gramas. He mentions 2 gramas – Shadjagrama and Madhyama grama with its proper sruti values. The gramas are based on the 22 srutis. The sruti value of shadjagrama are 4324432, whereas for madhyama grama it is 4342432, samvadi is the keynote of Bharata's system. He devised the 22 srutis with the help of an experiment conducted on the Druva and Chalaveena. He took 2 veenas of identical size and shape and named them as Dhruva Chalaveena. Both were to the notes of Shadjagrama.

The Dhruva veena was kept constant while reduction of srutis were effected in the chalaveena by deflecting to the required measurements. In the first stage he deflected the Pa string of chalaveena by one sruti. By comparing he found that the difference between shadjagrama and Madhyamagrama is one sruti in the 'Pa' string. By reduction again by one sruti he found that Ga and Ni of chalaveena coincide with Ri and Dha of Dhruvaveena. With this he proved that there 3<sup>rd</sup> stage again after reducing one sruti he compared the 2 veenas he found that 'Dha and Ri' or chalaveena coincide with Pa and Sa of Dhruva veena. With this he was able to prove that there existed 3 srutis difference between 'Pa and Dha' and Sa and Ri'



Aain after reduction he found that 'Pa, ma and Sa' chalaveena coincide with the 'Ma, Ga and Ni of Dhruvaveena.

This proved that there is 4 sruti interval between Pa and Ma. Ga and ma and Sa and Ni. After this he repeated the same process. But the notes he obtained were repetitions. With this he proved that only 4 sruthi intervals are possible in an octave. They are Ekasruti, Dvisruti, Trisruti and Chatusruti. He further proved that Ekasruti itself is so of three varieties, pramana, Nyasa and Purna. It is very interesting to note that the reduction was effected with Pa string and the scale obtained was a downcard scale.

After describing the gramas Bharata defines moorchanas derived from these gramas. He explains 14 moorchanas, 7 each for the 2 grama. The M moorchanas of shadjagrama uttaramandra, Rajani, uttarayatha, Suddha shadja, matsarikritha and abhirudgata. The starting svaras for these moorchanas will be Sa, Ni, Dha, Pa, Ma, Ga, Ri respectively.

Likewise 7 moorchanas of Madhyama grama are uviri, Harinaswa, Kalopanatha, sudhamadhya, Margi, pauravi and Hrsyasaka. Then he describes how the moorchanas are divided into 4 classes, Purna, Shadavita, Andavita and Sadharita (7,6,5,4). They are 84 in numbers based on moorchanas.

Bharata defines jathi. He defines 18 Jathis based on its usage of svaras and its importance. In both grama there are 18 jathis, 7 in shadjagrama and 11 in madhyagrama. Of these the jathis of shadjagrama are considered as sidha while that of madhyama grama are grouped as viktharajathis. Jathi described by explains the 10 lakshanas of jathi such as Graha, amsa, tara, Mandra, Nyasa, Apanyasa, Alpatva, bahuda, shadava abd audava.

Theoretically; the number of srutis figuring in Indian Music has been estimated by various scholars as 22, 24, 27, 32, 48, 53 and 96. Palkurki Somanatha Kavi gives the number of srutis as 22. Though in modern Music, we use a few srutis in addition to the 22, the number 22 represents the barest minimum of srutis that has been actually used in Indian Music form ancient times. A few of these srutis figure in rare ragas and they live only through these ragas. A well-trained ear can perceive and identify at least 50 notes in an octave.

In Music, however, we are concerned only with those srutis which actually occur in ragas and which bear a concordant relationship with one another. The rest are discarded as unserviceable srutis. The use of these subtle tones is in fact the glory of Indian Music and testifies to the highly developed aural powers of the Indian Musician. Musicians are not,

generally speaking, conscious of the precise frequency values of these srutis, but keeping the nadatma rupa or the melodic picture of the raga in their minds, they are able to sing or play the srutis accurately. Just as a person can speak a language correctly without knowing in detail its, grammar, so also a person can sing a raga or a composition in it correctly, without knowing the frequencies of the notes figuring in the raga r m p N N n d- the n above is outside the 22 srutis.

The subject of 22 srutis is one of the most difficult branches of the science of Indian Music. It can be understood only by persons with many years of Musical training. In fact thosejanya ragas, which can possibly claim more than one janaka mela are put under particular melakartas on the basis of their sruti values only. The melodic individuality of a raga is revealed only when its characteristic srutis are sounded.

A sruti is a note of minute pitch which a refined and trained ear can distinguish. It is the smallest audible difference of pitch. It is a fraction of a semi-tone. There is no such thing as a unit sruti with a constant value. An eka sruti (single sruti) interval is of three sizes. When we say that there is an interval of one sruti between a pair of notes, the value of this sruti interval may be one of these according to the notes forming the pair. When we say that there is an interval of one sruti between a pair of notes.

The values of these srutis are, in the increasing order of pitch:  $\frac{81}{80}$  (Comma of Didymus: 22 cents),  $\frac{25}{24}$  (70 cents) and  $\frac{256}{243}$  (Pythagorean Limma: 90 cents).  $\frac{81}{80}$  is called the pramana sruti. The other two srutis are termed nyuna sruti and purna sruti respectively. The term purna sruti denotes the eka sruti interval of the highest pitch. The term nyuna sruti means the sruti that is slightly less than the purna sruti. The octave is divided into 22 intervals of unequal pitch. In other words, the sthayi is conceived of as the sum total 22 srutis of unequal size. Notes which are separated from one another by an interval of less than a pramana sruti are not reckoned.

A dvisruti interval has two values:  $16/15$  and  $135/128$ . The former is the diatonic semi-tone and is called the purna dvisruti interval (112 cents). The latter is slightly less than the semi-tone and is called the nyuna dvisruti interval (92 cents). Between the shadja and the suddha rishabha is a semi tone  $16/15$ . But between suddha rishabha and chatussruti rishabha is the slightly flattened semi-tone  $185/128$  or nyuna dvisruti interval –  $16/15 \times 185/128 = 9/8$ .

A trisruti interval has a constant value  $10/9$  (182 cents) and corresponds to the minor tone. A chatussruti interval has also a constant value  $2/8$  (204 cents) and corresponds to the major tone.

A chatussruti interval comprises two pramana srutis (commas), one nyuna sruti and one purna sruti (limma)

$81/80 \times 81/80 \times 25/24 \times 256/248 = 9/8$ . i.e.  $22+22+70+90 = 204$  cents.

A chatussruti interval comprises a purna dvisruti interval and a nyuna dvisruti interval  
 $16/15 \times 135/128 = 9/8$ .

A panchassruti interval is equal to  $82/27$  (294 cents) Between the chatussruti rishabha and the suddha madhyama is a panchasruti interval –  $9/8 \times 82/27 = 4/5$ .

A shatsruti interval is equal to  $6/5$  (316 cents). There is a shatusruti interval between antara gandhara and panchama:  $5/4 \times 6/5 = 8/2$ .

The difference between a shatsruti interval and a panchasruti interval (6-5) is a comma  $81/80$  or a pramana sruti.

The difference between a panchasruti interval and a chatussruti interval (5-4) is a limma  $256/243$  or a purna sruti.

The difference between a chatussruti interval and a trisruti interval (4-3) is a comma  $81/80$  or a pramana sruti.

The difference between a trisruti interval and dvisruti interval (3-2) is  $25/24$  or a nyuna sruti.

The difference between a dvisruti interval and an ekasruti interval of the purna type (2-1) is a comma  $81/80$  or a pramana sruti.

European Musicians, brought up in the tradition of equal temperament, while listening to India Music employing quarter-tones are likely to get the impression that impure notes are being played. This is an erroneous notion. It is of interest to note that in recent years attempts have been made in Europe to write quarter-tone Music and pianos containing 24 keys to the octave have been made. A whole opera employing quarter-tone Music was performed some decades ago in Germany.

Since equal temperament is resorted to in Western Music, a quarter-tone, there will mean an exact half of a semi-tone i.e. 50 cents which is not the case with Indian Music.

It is possible to have 22 frets on the vina finger-board to indicate the 22 sruti-sthanas and play Music, but this arrangement will become too unwieldy. The present arrangement by which we produce the srutis by deflecting the string from the lower svarasthanas is quite satisfactory. The distribution of 22 srutis over the 12 svarasthanas is an easy and workable arrangement. The 12 frets for an octave on the vina do not warrant the assumption that only 12 notes are used in an octave.

In ancient Music, the 22 srutis were distributed over all the sapta svaras. But later on, when sa and pa came to be regarded as avikruta svaras. (i.e., changeless and not admitting of varieties) sa and pa took one sruti each and the remaining 20 srutis were distributed amongst the 5 notes; ri g a ma dha and ni at the rate of 4 for each note. Thus  $4 \times 5 = 20 + 1 + 1 = 22$  srutis. Hence the significance of the statement: svaras are 7, svarasthanas are 12 and srutis are 22.

The 22 srutis of ancient Music were not mere theoretical postulates. They were solid Musical facts and were ascertained when Rig Vedic hymns and melodies were sung with sa, ma and pa as the tonic note or adhara shadja.

A Musical scale is a collection of all the notes used in the octave in a particular country. A Musical scale is a gradual evolution. It is the result of centuries of Musical thought and practice.

The 22 srutis are the foundation of the original scale and they were derived primarily for fixing the values of the suddha svaras i.e., the notes of the *Sama gana*. Excepting for the notes sa, ma and pa, the term *Suddha svara* in ancient Music and modern Music denotes notes of entirely different pitch. The frequencies of these notes have been given in the preceding chapter. The srutis are derived upon the principle of samvaditva or consonance. The 22 srutis were evolved through the Cycles of Fifths and Fourths i.e., by the sa-pa and sa-ma methods (*samvada dvaya*).

The 22 srutis are arrived at by the shadja panchama bhava. Ahobala has only stated what was already known.

(Note: panchama interval below the shadja gives the suddha madhyama.) Thus a cycle of under fifths will give the values obtained in the Cycle of Fourths.

The traditional mention of Panchama and Madhyama as the basis of derivation should be taken only as illustrative and not exhaustive. The Cycle of Thirds sa-ga series will furnish other srutis as well.

All the 22 srutis become svaras in some raga or other. Srutis actually used in a raga attain the status of svaras in that raga and the other notes remain merely as srutis.

It will be useful at this stage for the student to become familiar with the frequencies of the easier srutis and then to study the more difficult ones.

From the Harmonic Series, we see that the values of the successive intervals are :- a sthayi (octave,) a panchama (perfect 5<sup>th</sup>), suddha madhyama (perfect 4<sup>th</sup>), antara gandhara (major 3<sup>rd</sup>). *Sadharana gandhara* (minor 3<sup>rd</sup>) etc. From the 8<sup>th</sup> to the 9<sup>th</sup> is a chatussruti (major tone), from the 9<sup>th</sup> to the 10<sup>th</sup> is a trisruti (minor tone) and from the 5<sup>th</sup> to the 16<sup>th</sup> is a dvisruti (diatonic semi-tone). The other successive intervals are of interest only from the academic point of view and are not of Musical importance.

The Harmonic Series again gives us the values of Panchama as  $\frac{8}{2}$ ; Antara Gandhara as  $\frac{5}{4}$  and Chatussruti Rishabha as  $\frac{9}{8}$ .

There is an interesting point about these three notes:-

Panchama is the arithmetical mean of shadja and tara shadja, i.e.,  $\frac{1+1}{2} = \frac{8}{2}$

Antara Gandhara is the arithmetical mean of shadja and panchama  $\frac{1+\frac{8}{2}}{2} = \frac{5}{4}$

Chatussrui Rishabha is the arithmetical mean of shadja and antarra gandhara  $\frac{1+\frac{5}{4}}{2} = \frac{9}{8}$ .

The sa-pa series or the cycle of Fifths given us the following notes:-

Sa (the starting note of the cycle) = 1 ; Panchama = Panchama of this Panchama is the tara sthayi Chatussruti rishabha  $\frac{8}{2} \times \frac{3}{2} = \frac{9}{4}$  which is a \* compound interval. This note in the

Madhya sthayi will have the value  $(\frac{9}{4} \div \frac{2}{1}) \frac{9}{8}$ .

The Panchama of this Chatusruti Rishaba gives us the Chatussruuti Dhaivata  $\frac{9}{8} \times \frac{3}{2} = \frac{27}{16}$  which is the Pythagorean major 6<sup>th</sup>.

The Panchama of this Chatussruuti Dhaivata give us a note in the tara sthayi which is slightly above the Antara Gandhara  $\frac{27}{16} \times \frac{3}{2} = \frac{61}{32}$ . This note in the Madhya sthayi =  $\frac{81}{82}$  divided by 2 =  $\frac{81}{164}$ . This note is higher than the Antara gandhara by a comma interval  $\frac{5}{4} \times \frac{81}{80} = \frac{81}{64}$ . This note is called the Tivra Antara Gandhara or the Chyuta Madhyama Gandhara and is the Pythagorean major 3<sup>rd</sup>.

Its Panchama gives us the note: Tirva Kakali Nishada or the Chyuta Shadja Nishadha  $\frac{81}{64} \times \frac{3}{2} = \frac{243}{128}$ . This note is the Pythagorean major 7<sup>th</sup>.

The sa-ma series or the Cycle of Fourths gives us the following notes:-

Sa (the starting-note of the cycle )= 1

Its suddha madhyama =  $\frac{4}{3}$

The suddha madhyama of this madhyama is the flattened kaisiki nishada :  $\frac{4}{3} \times \frac{4}{3} = \frac{16}{9}$ .

The suddha madhyama of this nishada is the tara sthayi flattened sadharana gandhara:

$\frac{16}{9} \times \frac{4}{3} = \frac{64}{27}$ . This note in the Madhya sthayi will have the value  $\frac{64}{27}$  divided by 2 =  $\frac{32}{27}$ .

The suddha madhyama of this gandhara is the flattened form of suddha dhaivata:-

$\frac{32}{27} \times \frac{4}{3} = \frac{128}{81}$ .

The suddha madhyama of thi dhaivata is the eka sruti rishabha of tara sthayi:-

$\frac{198}{81} \times \frac{4}{3} = \frac{512}{243}$ . This note in the Madhya sthayi will have he value  $\frac{256}{243}$ .

If suddha madhyama is taken as shadja, it antara gandhra will be the note of frequency  
 $:\frac{4}{3} \times \frac{5}{4} = \frac{5}{4}$ . This note is the Trisruti Dhaivata and is at a trisruti interval from Panchama.

The same note a Fifth below gives us the Trisruti Rishabha  $\frac{10}{9}$  (minor tone).

Between the Antara gandhara and the suddha madhyama is a dvisruti interval,  $\frac{16}{15}$ ;  
 thus  $\frac{5}{4} \times \frac{16}{15} = \frac{4}{3}$ . Between the kakali nishada and tara shadja is also a dvisruti interval :

$\frac{15}{8} \times \frac{16}{15} = 2$ , The suddha rishabha is a dvisruti interval from shadja and its frequency is  $\frac{16}{15}$ .

The Prati madhyama is a dvisruti interval from suddha madhyama and its frequency is  
 $:\frac{9}{8} \times \frac{16}{15} = \frac{6}{5}$ .

The Prati madhyama is a dvisruti interval from suddha madhyama and its frequency is  
 $:\frac{4}{3} \times \frac{16}{15} = \frac{64}{45}$ .

The ratio of the frequency of a note to that of a lower note is termed the interval between them. In order to obtain the interval value between them. In order to obtain the interval value between any two notes, divide the frequency of the higher note by that of the lower note. Thus the interval between suddha madhyama and Panchama is a chatussruti interval :  $\frac{3}{2} \div \frac{4}{3}, i.e., \frac{3}{2} \times \frac{3}{4} = \frac{9}{8}$ .

It consequently follows that a lower note multiplied by the interval between it and the next higher note gives the pitch of that higher note. Thus  $\frac{5}{4} \times \frac{16}{15} = \frac{4}{3}$ .

And if n= the number of vibrations of sa, then the frequency of any other note say like chatussruti rishabha =  $\frac{9}{8}n$ ; that of antara gandhara =  $\frac{5}{4}n$  and so on. If the interval is inversed, we get the vibrating length or the speaking length of the string.

A careful and analytical study of the Sankarabharana scale reveals to us that almost all the important intervals used in Music figure therein.

There is a dvisruti interval between ga and ma:

$$\frac{5}{4} \times \frac{16}{15} = \frac{4}{3}$$

There is a trisruti interval between ri and ga:

$$\frac{9}{8} \times \frac{10}{9} = \frac{5}{4}$$

There is a chatusruti interval between ma and pa:

$$\frac{4}{3} \times \frac{9}{8} = \frac{3}{2}$$

There is a punchasruti interval between ri and ma:

$$\frac{9}{8} \times \frac{32}{27} = \frac{4}{3}$$

There is a shatsruti interval between ga and pa :

$$\frac{5}{4} \times \frac{6}{5} = \frac{3}{2}$$

In the sruti scheme, precedence is first given to sa-pa values, then to sa-ma values and then to sa-ga values.

It is not unusual for a raga to change some of its characteristics srutis in particular sancharas. Occasionally in some ragas, the frequencies of svaras differ in their arohana and avarohana. Rishabha and Gandhara of Todi are instances in point.

The following table gives the modern names for the 22 srutis, their frequency as also the ragas in which they are met with. The four sruti varieties of a note are for the sake of convenience, referred to in the increasing order of pitch as ra, ri, ru, re; ga, gi, gu, ge and so on.



**Table V- Dvavimsati (22) Sruti Chart**

Name of the sruti	How represented	Frequency	Value in vibrations per second with sa=240	Value in cyclic cent	Ragas in which the srutis are met with
Shadja	Sa	1	240	0	All ragas
Ekasruti Rishabha	ra r <sub>1</sub>	$\frac{256}{243}$	252.8	90	Gaula, Saurashtra
Dvisruti Rishabha	ri r <sub>2</sub>	$\frac{16}{15}$	256	112	Mayamalavagaula
Trisruti Rishabha	ru r <sub>3</sub>	$\frac{10}{9}$	266.6	182	Bhairavi, Sriraga
Chatussruti Rishabha	re r <sub>4</sub>	$\frac{9}{8}$	270	204	Sankarabharana and Kalyani
Suddha Gandhara or Komal Sadharana Gandhas	ga g <sub>1</sub>	$\frac{82}{27}$	284.4	294	Bhairavi, Sriraga
Sadharana Gandhara	gi g <sub>2</sub>	$\frac{6}{5}$	288	316	Kharaharapriya
Antara Gandhara	gu g <sub>3</sub>	$\frac{5}{4}$	300	386	Sankarabharana
Chyuta madhyama ga or the Pythagorean major 3 <sup>rd</sup>	ge g <sub>4</sub>	$\frac{81}{64}$	303.75	408	Devagandhari and Saurashtra
Sudha madhyama	ma m <sub>1</sub>	$\frac{4}{3}$	320	498	Kuntalavrali
Trivra suddha madhyama	mi m <sub>2</sub>	$\frac{27}{20}$	324	520	Begada and Gaulipantu
Prati madhyama	mu m <sub>3</sub>	$\frac{45}{32}$	337.5	590	Kalyani
Chyuta panchama madhyama	me m <sub>4</sub>	$\frac{729}{512}$ or $\frac{64}{45}$	341.7 or 341.3	610	Varali
Panchama	Pa	$\frac{3}{2}$	360	702	All ragas where p is not varja
Ekasruti dhaivata	dha d <sub>1</sub>	$\frac{128}{81}$	379	792	Saveri
Dvisruti dhaivata	dhi d <sub>2</sub>	$\frac{8}{5}$	384	814	Mayamalavagaula
Trisruti dhaivata	dhu d <sub>3</sub>	$\frac{5}{3}$	400	884	Kambhoji
Chatussruti dhaivata or the Pythagorean major 6 <sup>th</sup> nishada	dhe d <sub>4</sub>	$\frac{27}{16}$	405	906	Kalyani

Sudha nishada or the Komala kaisiki	na n <sub>1</sub>	$\frac{16}{9}$	426.6	996	Bhairavi
Kaisiki nishada	ni n <sub>2</sub>	$\frac{9}{5}$	432	1018	Kharaharapriya
Kakali nishada	nu n <sub>3</sub>	$\frac{15}{8}$	450	1088	Sankarabharana
Chyuta shadja nishada or the Tivra kakali nishada or the Pythagorean major 7 <sup>th</sup>	ne n <sub>4</sub>	$\frac{243}{128}$	455.6	1110	Kuranji-Devagandhari, Saurashtra, Nilambari
Tara shadja	sa	2	480	1200	All ragas except the Nishadantya Dhai vatantya and Panchamanya raga.

Note : The notes suddha gandhara and suddha nishada in the above table are the same as the old shadja grama gandhara and nishada, and not the same as the suddha gandhara and suddha nishada of the scheme of 72 melakartas. Likewise it should be noted that the mnemonics ra ri ru re: ga gigu ge etc., have not the same values as the ra ri ru and ga gigu of the 72 Melakarta scheme. In the above Table only those ragas in which the srutis are characteristically met with are given as example.

From the above table it will also be seen that.

1. There is a purna sruti interval  $\left(\frac{256}{243}\right)$  between sa and ekasruti rishabha; between chatussruti rishabha and komala sadharana gandhara; between pa and ekasruti dhaivata; between chatussruti dhaivata and komala kaisiki nishada;
2. There is a nyuna sruti interval  $\left(\frac{25}{24}\right)$  between dvisruti rishabha and trisruti rishabha; between sadharana gandhara and anara gandhara; between dvisruti dhaivata and trisruti dhaivata; between kaisiki nishada and kakali nishada,  $\left(\frac{25}{24}\right)$  is the deisis).
3. There is a pramana sruti interval  $\left(\frac{81}{80}\right)$  between ekasruti rishabha and dvisruti rishabha; between trisruti rishabha and chatussruti rishabha; between komal sadharana gandhara and sadharana gandhara; between antara gandhara and chyuta madhyama gandhara;

between ekasruti dhaivata and dvisruti dhaivata; between trisruti dhaivata and chatussruti dhaivata; between komal kaisiki nishada and kaisiki nishada; between kakali nishada and chyuta shadja nishada.

An octave consists of 10 pramana srutis (commas) 220 cents, 7 purna srutis (limmas) 630 cents and 5 nyuna srutis (350 cents); Total 1200 cents.

From Table V it will be seen that the difference between a purna sruti and a nyuna sruti is 20 cents. Likewise the difference between a purna dvisruti and a nyuna dvisruti is 20 cents. This interval which is less than a pramana sruti was too subtle and the ancient scholars therefore ignored it from the point of view of practical Music (sruti Sadharana Prakarana).

Although the frequencies of the srutis are not mentioned in terms of vibrations per second or even in fractions in ancient works, still from the methods outlined for their derivation we are able to fix their values, and with modern knowledge we are able to prove mathematically the accuracy of the scheme of 22 srutis. The aesthetic basis and logic behind the scheme of 22 srutis is also clear.

It is however clearly mentioned in ancient works that the octave bears a daviguna relationship i.e., the frequencies of a note and its octave bear the ratio 1:2. When a stretched string is stopped at  $1/3$  length and the segmented lengths of the string are plucked consecutively, it will be found that the shorter and the longer segments give the notes. Tara panchama and Madhya panchama respectively. This again is an example of daviguna relationship. The frequency of Panchama was thus fixed as  $3/2$  and the frequencies of all the other srutis were then calculated.

The four srutis of ga, ma and ni may also be referred to as ekasruti, dvisruti, trisruti and chatussruti gandhara, madhyama and nishada respectively after the manner of rishabha and dhaivata.

It is also worthy of note that the four srutis of each of the notes: rig a ma dha ni progress in a symmetrical order.

The frequencies given for the 22 srutis in Table V are those which have been arrived at after mature deliberations in the conferences held during recent decades. When a suitable apparatus which will indicate the frequencies of notes sung or played is devised, we can experimentally prove the values of these srutis. In the Pradarsana Vina, one can see visually the different sthanas of the 22 srutis and perceive their inter-relationships.

The srutis bearing septimal ratios possibly occur in a few ragas. The note of frequency  $7/6$  (280 vibrations per second = 240) occurs between chatussruti rishabha and komal sadharana gandhara. The note of frequency  $7/5$  (336 vibrations per second) occurs between tivra suddha madhyama and prati madhyama. Since this note is less than Purva kalyani Madhyama by a very small interval it will be difficult aurally to distinguish between the notes  $7/5$  and  $45/32$ . The note of frequency  $7/4$  (420 vibrations per second) occurs between chatussruti dhaivata and komala kaisiki nishada. The notes  $7/6$  and  $7/4$  are samavadi svaras.

The notes of frequencies  $25/24$  and  $25/16$  also are samvati svaras and are rarely used.

Just as there are twin svarasthanas for each of the 5 notes rig a ma dha ni, there are twin srutis for each of the ten svarasthanas, other than sa and pa. No two consecutive srutis can occur successively in a raga.

It is desirable and certainly will be more accurate to describe the svaras figuring in ragas in terms of their precise sruti values. But such a description will be of use only to a limited few and hence the traditional method of describing ragas in terms of their svarasthanas has been adopted in this book in the hope that the students will find the correct srutis with their teachers's help. The continuous curve and the constant portamento in Indian classical Music is due to the fact that it is more the interval that is sung or played, rather than the mere note.

The topic of 22 srutis as understood and applied in modern Music (adhunika sangita) has been dealt with in detail in this chapter. We shall now see its application in ancient Music.

As has already been stated, the 22 srutis were primarily derived for the purpose of fixing the suddha svaras of the ancient scale. Since the idea of sa and pa as avikruta svaras had not yet dawned, even sa and pa were regarded as admitting of varieties, and thus we have the 22 srutis distributed over the sapta svaras in the order 4 3 2 4 4 3 2. Names for the 22 srutis are found in Bharata's Natya sastra and these names are repeated in the Sangita ratnakara, Sangita parijata and Sangita darpana. But Narada's Sangita makaranda and Bhavabhata's Anupa Sangita vilasa give different sets of names for the 22 srutis. Ugra is a name figuring in the first two nomenclatures. Whereas in Narada's scheme, it is the highest rishabha sruti, in the scheme of others, it is the first nishada sruti.

**Table I**  
**Sruti nomenclature - (Bharata and Sarngadeva)**

<b>Name of the Srutis</b>	<b>Sapta svaras</b>
Tivra Kumudvati Manda Chhandovati	Shadja
Dayavati Ranjani Ratika	Rishabha
Randri Krodha	Gandhara
Vajrika Prasarini Priti Marjani	Madhyama
Kshiti Rakta Sandipini Alapini	Panchama
Madanti Rohini Ramya	Dhaivata
Ugra kshobini	Nishada

The italicised names in the above table are the *niyata srutis* of the *sapta svaras* of the ancient scale i.e., they were the *srutis* on which the *suddha svaras* of the ancient scale were produced. In other words: *sruti* Nos. 4, 7, 9, 13, 17, 20 and 22 were the *niyata sruti*. *Svaras* which took other *srutis* were collected *vikrta svaras*.

**Table II**  
**Sruti nomenclature - (Narada's Sangita makaranda)**

<b>Name of the Srutis</b>	<b>Sapta svaras</b>
Siddha Prabhavati Kanta Suprabha	Shadja
Sikha Diptimati Ugra	Rishabha
Hladi Nirvirz	Gandhara
Dira Sarpasaha Kshanti Vibhuti	Madhyama
Malini Chapala Bala Sarvartna	Panchama
Santa Vikalini Hridayonmalini	Dhaivata
Visarini Prasuna	Nishada

**Table III**  
**Sruti nomenclature**  
**(Bhavabhata's Anupa Sangita Vilasa)**

<b>Name of the Srutis</b>	<b>Sapta svaras</b>
Nandana Nishkala Guda Sakala	Shadja
Madhura Lalita Kakshara	Rishabha
Bhragajati Hrasvagiti	Gandhara
Ranjika Chapara Purna Alankarini	Madhyama
Vainika Valita Tristhana Susvara	Panchama
Saumya Bhashangika Vartika	Dhaivata
Vyapaka or Prasanna Subhaga	Nishada

Alaku is the name for *sruti* in ancient Tamil Music and the 22 *srutis* are referred to as 22 *alaks* in the *Silappadikaram*.

The fact that names for the 22 *Srutis* have been given is proof of the tonal recognition accorded to these notes. Some authors have mentioned 66 *srutis* i.e., 22 for each octave and have given names to them. This only strengthens the idea that the ancients were keenly alive to the use of 22 notes in the octave. Raja Sir Sourendra Mohan Tagore in his book "22

Musical srutis of the Hindus” published in 1886 in Calcutta, has given the following names for the 66 srutis which have been handed down:-

**Table : IV**

Mandra Sthayi	Madhya Sthayi	Tara Sthayi
Mandra	Nadanta	Isvari
Anti mandra	Nishkala	Kaumari
Ghora	Gurha	Savarali
Antighora	Sakala	Bhogavirya
Mandala	Madhura	Manorama
Saumya	Gali	Snsnigdha
Sumana	Ekakshara	Divyanga
Pushkara	Bhringajati	Sulalita
Sankhini	Raagiti	Vidruma
Nila	Suranjika	Maharka
Utpala	Purna	Sangini
Anunasika	Alankarini	Raka
Ghoshavati	Vamsika	Lajja
Nilanada	Vainika	Kali
Avartani	Tristhana	Sukshmati sukshma
Ranada	Susvara	Pushta
Ekagambhira	Saumya	Supushtika
Dirghatara	Bhashangini	Vispashta
Nadini	Vartika	Rokari
Mandraja	Sampurna	Karali
Suprasanna	Prasanna	Visphotanta
Ninada	Sarva vyapinika	Medina

**Srutis are also classified under two heads:-**

- (a) svaragata i.e. those which are inherent to the seven principal notes.
- (b) Antara i.e. those which are intermediate between those notes.

Srutis are in fact countless.

An interesting 18<sup>th</sup> cent. Manuscript in the Tanjore Saraswati Mahal Library by name *Metadhikara lakshna* (MS. No. 11604) gives the following new, intelligent and self-explanatory nomenclature for the 24 srutis:-

**Table V**

<b>Purvanga</b>		<b>Uttaranga</b>	
1	Shadja	15	Panchama
2	Prati Suddha Rishabha	16	Prati Suddha Dhaivata
3	Suddha Rishabha	17	Suddha Dhaivata
4	Prati Chatussruti Rishabha (Prati Suddha Gandhara)	18	Prati Chatussruti Dhaivata (Prati Suddha nishada)
5	Chatussruti Rishabha (Suddha Gandhara)	19	Chatussruti Dhaivata (Suddha Nishada)
6	Prati Sadharana Gandhara (Prati Shatsruti Rishabha)	20	Prati Kaisiki Nishada (Prati Shatsruti Dhaivata)
7	Sadharana Gandhara (Shatsruti Rishabha)	21	Kaisiki Nishada (Shatsruti Daivata)
8	Prati Antara Gandara (Prati Antara Rishabha)	22	Prati Kakali Nishada (Prati Kakali Dhaivata)
9	Antara Gandhara	23	Kakali Nishada
10	Chyuta Madhyama	24	Chyuta Shadja Nishada
11	Suddha Madhyama		
12	Aprati Madhyama		
13	Prati Madhyama		
14	Chyuta Panchama Madhyama		

From the Table on the previous page, it will be seen that the two extra srutis, are srutis, Nos. 8 and 22. These are the srutis between the Sadharana gandhara and Antara gandhara and between the Kaisiki nishada and Kakali nishada. The two srutis occur in the Saveri raga in the phrases s r g r s and p d n d p m g r s. These two srutis do not figure in the scheme of 22.

This Manuscript is incomplete and its author too is not known. With the 24 srutis as 24 svarasthanas, the author has propounded an ingenious scheme of 4624 melakartas. There are 136 chakras, each charka comprising 34 melakartas (136 x 34 = 4624). For each of the four madhyama varieties there are 34 chakras or 1156 melakartas. The scheme though of academic interest is interesting as showing the lofty heights to which the genius of man has flown in the realm of pure Musical theory.

Now that the student has become familiar with the topic of 22 srutis, the significance of Bharata's classification of svaras into: Vadi, Samvadi, Anuvadi and Vivadi will be appreciated. Vadi is the sounding note and samvadi is the note consonant with the vadi.

A samvadi svara is separated from the vadi svara by 9 or 13 srutis i.e., it is at a Panchama sthana or a Suddha Madhyama Sthana from the vadi svara. In other words, if the frequency of the vadi svara=1, the frequency of its samvadi svaras will be  $\frac{3}{2}$  and  $\frac{4}{3}$ . Thus

between vadi svara and the samvadi svara there are either 8 or 12 srutis. When a vadi svara and its samvadi svara (either its panchama or suddha madhyama) are sounded together, the effect is pleasant and this is a universal truth. Svaras which are related to the vadi svara as antara gandhara  $\frac{5}{4}$  or sadharana gandhara  $\frac{6}{5}$  are called Anuvadi svaras.

These svaras are separated from the vadi svara by 7 or 6 srutis. Svaras at an interval of 2 srutis from the vadi are vivadi to one another: these are mutually dissonant notes. The anuvadi svaras are neither so consonant nor so dissonant in relation to the vadi svara.

The vadi svara is the same as the jiva svara of a raga and is the most frequently sounded note in a raga. It contributes to the melodic entity of the raga. Therefore chromatic scales are unknown in Indian Music. Ragas where in two semi-tones occur in succession are subject to vivadi dosha and lack the requisite quality of rakti.

The 40 of the 72 melakartas which take one or two of the following notes – Suddha Gandhara, Suddha Nishada, Shatsruti rishabha, or Shatsruti Dhaivata- are thus \*vivadi melas. In those meals, the vivaditva is skilfully got over by playing one of the vivadi svaras with gamaka. But there is no vivaditva in the case of two semi-tones occurring around shadja or panchama, since the one is a basic note and the other is a highly concordant note. Thus n s r (kakali nishada, shadja and suddha rishabha) can occur in succession; likewise.

## 1.2 EXPERIMENTAL VINAS

The vina was not only used as a concert instrument from early times, but was also used for studying and verifying the various Musical laws and phenomena. Both the harp type and the lute type of vinas have been in existence from the vedic times. The emergence of the fretted vina with its immense possibilities for playing subtle gamakas, naturally forced the harp type of vina into oblivion.

A study of the note obtained in the cycles of fifths and fourths enabled the ancient scholars to perceive the different Musical intervals. They were already familiar with the chatusruti interval ( $\frac{9}{8}$  or 204 cents), trisruti interval ( $\frac{10}{9}$  or 182 cents) and the dvisruti interval ( $\frac{16}{15}$  or 112 cents) in the sa grama. The ma grama helped them to appreciate the interval of a pramana sruti, 22 cents. When the notes of cycles of fifths and fourths, worked up to the 12<sup>th</sup> cycle in each case, were reduced to one octave and studied, it was found that there were 13 twins of note, inclusive of the octave shadja, the notes constituting each twin being separated by the interval of pramana sruti (comma  $\frac{81}{80}$  or 22 cents). It was also



noticed that in each twin, the lower note belonged to the cycle of fourths and the higher note to the cycle of fifths. The same study helped them to realize that in addition to the pramana sruti, there were two other types of ekasruti intervals : 25/24 or 70 cents and 256/243 or 90 cents.

In his Natya Sastra (4<sup>th</sup> cent B.C.) Bharata has suggested an interesting experiment to get a clear grasp of these three types of ekasruti intervals. These three types of ekasruti intervals are in the increasing order of magnitude respectively termed the pramana, nyuna and purna sruti intervals or the sruti of minimum, medium and maximum values.

### 1.2.1 DHRUVA VINA: CHALA VINA EXPERIMENT

Two vinas which were exactly identical in all respects including the timbre of their notes were chosen and tuned to the scale of sa grama. That is the seven strings of each vina were turned to the notes of the following frequencies.

s	r	g	m	p	d	n
1	10/9	32/27	4/3	3/2	5/3	16/9

These two seven-stringed vinas were of the harp type and were played on open strings, the identical pitch to which the seven strings of the two vinas were tuned. Of the two vinas, the pitch of one was kept constant and this was called the Dhruva vina or Achala vina. This stationary vina (A) was used for reference. The other vinal called the chala vina, (B) was subjected to progressive reduction in pitch in four successive stages. At each state the reduction effected was by an interval of one sruti. Although the phrase ‘reduction effected in each case was equal, still the rider added by Bharata at the end of each stage, that such as such a note of the chala vina, will now be equal to such and such a note of the dhruva vina, conclusively proves that the reduction in pitch, effected at each stage, though within the limits of an ekasruti intervals was still not the same.

#### Now to the experiment described by Bharata:

**Stage 1:** ‘Let the pa string of the chala vina be reduced by one sruti. The scale of the chala vina will now be that of ma grama’.

Note: The frequency of this reduced panchama was only 40/27 or 680 cents and not any other pitch, since between this note and the dhaivata above there was a chatussruti interval. The panchama string was thus reduced by an interval of a coma or a pramana sruti.

Now convert the scale of this chala vina into one of sa grama, by lowering the pitches of the remaining six strings by the same interval of a pramana sruti.

The strings were reduced in pitch by slightly decreasing the tension i.e., by loosening the strings to the required extent. Both the vinas became now sa grama vinas, but the tonic note of the chala vina was a coma lower down, compared to the pitch of the achala vina, each string of the chala vina is a pramana sruti lower than that of the corresponding string of the dhruva vina.

**Stage-2:** reduce the panchama of the chala vina again by one sruti and afterwards reduce the other six strings also by the same interval. The gandhara and nishada of the Chala vina will now be found to coincide in pitch with the rishabha and dhaivata of the chala vina (II). This means that the extent of the reduction was such as to make this coincidence of notes possible. The sum total of the reduction made in the two stages was thus equal to an interval of a diatonic semitone,  $16/15$  or 112 cents. Since the first reduction was by an interval of a comma, it is evident that the reduction in stage 2 was by an interval of a purna sruti  $256/243$  or 90 cents. It is clearly seen that each string of the chala vina is a purna dvisruti interval below the corresponding string of the dhruva vina.

**Stage-3:** 'Reduce the panchama of the chala vina again by one sruti and follow this up by reducing the pitch of the other six strings similarly. The dhaivata and rishabha of the chala vina will now be found to coincide with the panchama and shadja of the dhruva vina' (III). This means that the extent of the reduction was such as to make this coincidence possible. The sum total of the reduction made in all three stages was equal to an interval of a minor tone,  $10/9$  or 182 cents. Since the total reduction made at the end of the second stage was a diatonic semitone it follows that the reduction made in the third stage was by an interval of a nyuna sruti,  $25/24$  or 70 cents. It is thus seen that the pitch of each string of the chala vina is now less than that of the corresponding string of the dhruva vina by the interval of a trisruti or  $10/9$ .

**Stage 4:** 'Reduce the panchama of the chala vina again by one sruti and carry out this process for the other six strings as well. It will now be found that the pa, ma and sa of the chala vina coincide with the ma, ga and ni of the achala vina (IV). It is clear that the reduction effected in this last case was by a pramana sruti, since the notes of the pairs; pa and ma; and ma and ga; and sa and ni have between them a chatussruti interval. We thus find that

the pitch of each string of the chala vina is less than that of the dhruva vina by a major tone, 9/8 or 204 cents.

Thus the effective reduction in pitch made in,

Stage 1	was a pramana sruti	81/80
Stage 2	was a purna sruti	256/243
Stage 3	was a nyuna sruti	25/24
Stage 4	was a pramana sruti	81/80

In other words, the reduction has been respectively by the intervals of a minimum sruti, maximum sruti, medium sruti and minimum sruti. In terms of the shadja of the dhruva vina, the frequencies of the panchama string of the chala vina at the four respective stages were: 40/27, 45/32, 27/20 (the frequency of Begada madhyama) and 4/3. It should be remembered that the scale of the chala vina at the conclusion of each change of pitch of the seven strings was one of sa grama, the value of the adhara shadja progressively decreasing in each case.

One interesting point in Bharata's experiment is, he asks us to start the reduction in each case with the panchama string. As a practical Musician, he knew and fully realized the value of initiating the change from the string which gave the strong consonant note.

**The object of Bharata in devising this experiment was:**

1. To demonstrate the three types of ekasruti intervals that occurred in the Indian Musical scale.
2. To familiarize Musicians with the idea of inversion of intervals. Thus the Begada madhyama is an inverted minor tone from the panchama.
3. To impress the distinction between absolute pitch and relative pitch.
4. To illustrate the 22 srutis.

It is useful to remember that in ancient times, all Musical instruments were tuned to absolute pitch as it the case with European Musical instruments even now and the middle octave shadja was a note of a precise frequency just like the international philharmonic pitch.

With the emergence of the concept of adhara shadja in the Post-Bharata period, all ragas came to be sung to a common tonic note. Again the emergence of the concept of shadja and panchama as avikrta svaras made the pramana sruti intervals around these two notes pale into insignificance. The note of frequency 40/27 so prominent in the ma grama fell into

desuetude along with the ma grama and gradually gave way to the note 64/45 which came to be called by various names as *Kaisiki panchama*, *mrdu panchama* and *varali madhyama*.

Bharata in his experiment missed the note 64/45 because he was proceeding downwards from panchama. If he had proceeded upwards from suddha ma, he would have hit upon the note 64/45. He adopted the downward course since he wanted in first instance to illustrate practically the ma grama and hence the note 40/27 had to be touched. The other notes got in successive reductions were only 45/32, 27/20 and 4/3. This is clear from the rider which he has given at each stage i.e., that such and such a note of the chala vina coincides with such and such a note of the dhruva vina.

Further, Musicians at that time were already familiar with the downward progression. The murchanas of *sa grama* were enumerated in the downward order. The progression of *sama gana* Music was in the downward order.

This experiment can even now be performed with the Pradarsana vina devised by the author of this book and Bharata's conclusions verified. Those who perform this experiment will incidentally get training in the reduction of pitch by such delicate intervals as pramana, nyuna and purna srutis.

In the experiment. Bharata has no mentioned the equivalents of the notes given by all the strings of chala vina in relation to the notes given by the strings of the dhruva vina. He has referred to the notes of only those strings of the chala vina whose pitches exactly coincide with those of the dhruva vina. He refrained from doing so, since the srutis of the particular strings of the chala vina after reduction, were either close to the other correct srutis or were useless.

The Dhruva vina-Chala vina experiment can be performed in the reverse order starting from the madhyama string and proceeding in the Arohaba karma by tightening the string to the desired pitch in each case and the results verified.

It is possible that the four stages of reduction mentioned by Bharata for each of the sapta svaras might have suggested to Mahendra Varman, the author of the Kudumiyamalai inscription of the four sruti varieties, ra, ri, ru, re, ga, gi, gu, ge, etc., for the sapta svaras.

### **1.3 SELF ASSESSMENT QUESTIONS**

1. Write an essay on the Dhruva veena and Chala Veena Experiment.
2. Write about the values of 22 sruthis and various views of 22 Sruthis used in Indian Music.

3. Describe the Sruti nomenclature and mention the various nomenclatures for the 22 sruthis.

#### **1.4 REFERENCE BOOKS**

1. South Indian Music by Prof.P.Sambamurthy.
2. Sangita Sastra Saramu by S.R Janakee Raman.

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## UNIT-II

### CYCLES OF IV & V, DISCUSSION OF THE VALIDITY OF DERIVATION OF 22 SRUTIS BY THE METHOD OF CYCLES OF 4<sup>th</sup> AND 5<sup>th</sup> MUSICAL INTERVALS EXPRESSED IN FRACTIONS AND ALSO IN CYCLIC CENTS.

#### 2.0 OBJECTIVES

After reading this unit you will be able to know

1. Derivation of 22 srutis
2. Method of cycles of 4<sup>th</sup> and 5<sup>th</sup>
3. Cents method

#### 2.1 INTRODUCTION

Music is the brightest gem adorning the crown of India's culture. It has a long and honorable past. Its beginnings go back to the dim pre-historic times. At a time when many nations had not emerged from the stage of folk song, India had developed a magnificent system of art Music.

The story of the evolution of Indian Music from its early primitive stages to its present highly evolved form is one of absorbing interest. A study of the Musical history of India is not only of cultural value, but enables one to understand something of the genius of the race that has given to the world the magnificent raga and tala systems, the idea of manodharma sangita and the concepts of rhythmical harmony and abhinaya.

In the history of world Music, India was the first country to evolve a sol-fa system. The Indian solfa letters sa, ri, ga, ma, dha, ni are mentioned in such an early work as the Narada Parivrajaka Upanishad. Indians were the earliest people to think in terms of absolute Music. This concept is enshrined in the very concept of the raga. They were familiar even in early times with the cycles of fifths and fourths (samaveda adyaya) derivation of scales by the process of modal shift of tonic.

From the Vedic literature we know that Vedic Music was more developed and systematic with its pentatonic scale and having three registers, high, low, and medium or circumflex. It is richer than Music of the prehistoric times. Different Pratishakhya or recessions of Vedas inform that though Music was mostly pentatonic like those of the Music

of other ancient nations of the world, yet six or seven tones were in use in the Kauthumiya and some other recessions. So Music in the Vedic time used to be practiced in various methods with different tones. Music in the Vedic time was systematized with some fixed principles and methods, and it was colored with different emotional units and different feelings which used to be transmitted in the mind of the priests and Yajamanas.

It has been said before that the notes of the Vedic time were of different kinds, and among them the registral and the Musical notes were very prominent. The register-notes were known as the *sthana-svaras*, and they were known as *udatta* or high, *anudatta* or low, and *svarita* or balancing circumflex.

The Vedic Musical notes were known as *krusta*, *prathama*, *dvitiya*, *tritiya*, *chaturtha*, *mandra* and *atisvarya*. These notes were in descending order (arohana-gati), quite opposite to the ascending order (avarohana gati) of the Music of the Christian era.

It is known that the primitive Music used to begin from the high note, and terminated in the low note, and this practice was followed even in the Vedic time. As there is no genuine proof or record of the definite practice of Music of the prehistoric time, so it is not possible to determine its correct method of embellishment of the remote time.

The matras or beating meters were kept by the finger signs, or by nodding of the head in different directions. The Vedic Music is known as the saman or samagana. The samanas were sung with the help of the Vedic notes, and when the mantrams were recited in monotonous tune, they were known as the stotrams or recitative hymns. It should be remembered that Music of the Vedic time was either the recitative, or the tuneful.

The stotras in praise of different Vedic gods or deities were the recitative one, and four kinds of ganas-aranyegeya, gramegeya, uha and uhya were practiced with different tones and tunes. Most of the ganas or songs were auspicious, though some of them were used in abhichara-kriya or in unholy and displeasing performances. Stobhas were in use in the words of the songs, so as to create emotional motive with the elaboration of the speeches.

The profession of Music was as old as the Yajurveda. The classification of Musical instruments into tata, sushira, avanddha and Ghana (chordophones, aerophones, membranophones and auto phones) mentioned in Bharata's Natya Sastra has been universally accepted as the most scientific system of classification. Knowledge of facts like these makes us feel proud of our great heritage. No study of Indian Music will be complete without a study of its history.

In sufficient knowledge of the historical evolution of Indian Music has made many scholars and critics commit mistakes. It is no use importing the highly evolved Musical concepts of later times to the earlier period. The yazh was a kind of harp and was played on open strings. It was not fretted instrument. The modern violin and the siriyaazh are entirely different instruments and not the same and not the same as is the view of some people. The nagasvaram came into vogue only about seven centuries ago.

This important instrument is not found in the temple sculptures of the earlier period. Nor is this instrument referred to in the early Agamas pertaining to temple rituals. The sankirna jati of the Kudumiyamalai inscription has nothing to do with the later sankirna jati laghu.

Excepting for the notes: sa, pa and the suddha madyama, the the frequencies of the ancient suddha svaras and the modern suddha svaras are entirely different. Lack of knowledge relating to practical Music has led some scholars to give incorrect interpretations to Musical passages in the Silappadikaram and other works.

The Yazh with thousand strings referred to in ancient Tamil literature could not have been a Musical possibility. The modern metallic strings of refined gauges were unknown in ancient times. It is too much to assume that there was a frame to sustain the tension of a thousand strings. If thousand strings were really used, the instrument must have been very unwieldy in size and incapable of being used by one person or even by small group of persons. Then there is the factor of the time involved in tuning one thousand strings.

Likewise to assume that the ancients used as many as 96 srutis in an octave is beyond human comprehension and contrary to the facts of Musical history.

Indian Music has had a continuous development from early times. Whenever a conflict arose between lakshana and lakshya, the former was altered or was interpreted in such a manner as to conform to the latter. Lakshya pradhanam khalu sastram! This liberal attitude of Music scholars, century after century, has been responsible for the steady growth and development of Indian Music. The history of Khamas raga is an instance in point. This process of progressive evolution of the art is sometimes referred to as the doctrine of lakshya.

Likewise when there was the impact of a foreign Musical system on South Indian Music, those traits in the exotic system which conduced to the development of the indigenous Music were tacitly borrowed and assimilated.



Only those traits which did not come into conflict with the basic features of the indigenous system were imbibed. The Musical conscience of the community gradually acquiesced in the adoption of such alien traits since it resulted in the enrichment of the art. This process of assimilation is referred to as the Doctrine of eclecticism.

It is generally believed that the classical period began in the 600-500 BC. At that time, there existed different materials and schools of Music. The main three schools were known as (1) The Natya-school of Bharata of the Natyasastra, (2) the Naradiya Gandharva School and (3) Nandikesvara school.

Till about the 13<sup>th</sup> century A.D. there was a single system of Music prevalent throughout the length and breadth of India, with some local variations. The bifurcation into the two systems came later. We come across terms, kharnatic Music and Hindustani Music for the first time in Haripala's work! Sangita Sudhakara written some time between 1309 and 1312 A.D. The term Hindusthani Music is not found in early medieval literature. This term came into vogue after the advent of the Muslims in Delhi. Due to contact with Persian and Arabian styles, the Music of the North began to develop along fresh channels.

Much of the knowledge that we owe at present regarding the nature of scales and srutis (quarter-ones) is due to the experiments in Music carried out by scholars in ancient and medieval times. These experiments performed with great care and accuracy led them to perceive the beauties of the scale of just intonation and the frequencies of subtle srutis.

The early perception of the highly concordant notes, panchama ( $3/2$  or 702 cents) and madhyama ( $4/3$  or 498 cents), led them to work out the cycles of fifths and fourths to their logical conclusions. Although the cycle of fourths is implied in the cycle of fifths, the fourth (suddh madhyama) being an inverted fifth (panchma) from the immediately higher sa, still it was found useful to work out the series of fourths as well.

The knowledge of the 22 srutis was obtained by working out these two cycles. The scale of equal temperament, which became a necessity in Europe on account of the exigencies of harmony, was unknown in India. From Bharata's natya sastra, we get the earliest authentic reference to the gramas. He mentions 2 gramas – Shadjagrama and Madhyama grama with its proper sruti values.

The gramas are based on the 22 srutis. The sruti value of shadja grama is 4324432, whereas for madhyama grama it is 4342432, samvadi is the keynote of Bharata's system. He devised the 22 srutis with the help of an experiment conducted on the Druva and

Chalaveena. He took 2 veenas of identical size and shape and named them as Dhruva Chalaveena. Both were to the notes of Shadjagrama. The Dhruva veena was kept constant while reduction of srutis were effected in the chalaveena by deflecting to the required measurements .In the first stage he deflected the Pa string of chalaveena by one sruti.

By comparing he found that the difference between shadjagrama and Madhyamagrama is one sruti in the 'Pa' string. By reduction again by one sruti he found that Ga and Ni of chalaveena coincide with Ri and Dha of Dhruvaveena. With this he proved that there 3<sup>rd</sup> stage again after reducing one sruti he compared the 2 veenas he found that 'Dha and Ri' or chalaveena coincide with Pa and Sa of Dhruva veena. With this he was able to prove that there existed 3 srutis difference between 'Pa and Dha' and Sa and Ri' Aain after reduction he found that 'Pa, ma and Sa' chalaveena coincide with the 'Ma, Ga and Ni of Dhruvaveena.

This proved that there is 4 sruti interval between Pa and Ma. Ga and ma and Sa and Ni. After this he repeated the same process. But the notes he obtained were repetitions. With this he proved that only 4 sruthi intervals are possible in an octave.They are Ekasruti, Dvisruti, Trisruti and Chatusruti. He further proved that Ekasruti itself is so of three varieties, pramana, Nyasa and Purna. It is very interesting to note that the reduction was effected with Pa string and the scale obtained was a downcard scale.

In the history of world Music, Indian Music is one of the earliest to use quarter-tones. It is the use of quartertones and micro tones that imparts a peculiar charm, colour and flavour to the Music of India. Twenty-two such notes i.e., ten notes in addition to the universal twelve notes of the gamut have been in use for centuries. Many ancient Sanskrit and Tamil works refer to the 22 srutis as the foundation of the Indian Musical scale, with the progress of the art a few more srutis have come into use.

Theoretically; the number of srutis figuring in Indian Music has been estimated by various scholars as 22, 24, 27, 32, 48, 53 and 96. Palkurki Somanatha Kavi gives the number of srutis as 22. Though in modern Music, we use a few srutis in addition to the 22, the number 22 represents the barest minimum of srutis that has been actually used in Indian Music form ancient times.

A few of these srutis figure in rare ragas and they live only through these ragas. A well-trained ear can perceive and identify at least 50 notes in an octave. In Music, however,

we are concerned only with those srutis which actually occur in ragas and which bear a concordant relationship with one another.

The rest are discarded as unserviceable srutis. The use of these subtle tones is in fact the glory of Indian Music and testifies to the highly developed aural powers of the Indian Musician. Musicians are not, generally speaking, conscious of the precise frequency values of these srutis, but keeping the nadatma rupa or the melodic picture of the raga in their minds, they are able to sing or play the srutis accurately.

Just as a person can speak a language correctly without knowing in detail its, grammar, so also a person can sing a raga or a composition in it correctly, without knowing the frequencies of the notes figuring in the raga r m p N N n d- the n above is outside the 22 srutis.

The subject of 22 srutis is one of the most difficult branches of the science of Indian Music. It can be understood only by persons with many years of Musical training. In fact those janya ragas, which can possibly claim more than one janaka mela are put under particular melakartas on the basis of their sruti values only. The melodic individuality of a raga is revealed only when its characteristic srutis are sounded.

A sruti is a note of minute pitch which a refined and trained ear can distinguish. It is the smallest audible difference of pitch. It is a fraction of a semi-tone. There is no such thing as a unit sruti with a constant value. An eka sruti (single sruti) interval is of three sizes. When we say that there is an interval of one sruti between a pair of notes, the value of this sruti interval may be one of these according to the notes forming the pair.

The values of these srutis are, in the increasing order of pitch:  $\frac{81}{80}$  (Comma of Didymus: 22 cents),  $\frac{25}{24}$  (70 cents) and  $\frac{256}{243}$  (Pythagorean Limma : 90 cents).  $\frac{81}{80}$  is called the pramana sruti. The other two srutis are termed nyuna sruti and purna sruti respectively. The term purna sruti denotes the eka sruti interval of the highest pitch. The term nyuna sruti means the sruti that is slightly less than the purna sruti. The octave is divided into 22 intervals of unequal pitch. In other words, the sthayi is conceived of as the sum total 22 srutis of unequal size. Notes which are separated from one another by an interval of less than a pramana sruti are not reckoned.

A dvisruti interval has two values:  $16/15$  and  $135/128$ . The former is the diatonic semi-tone and is called the purna dvisruti interval (112 cents). The later is slightly less than the semi-tone and is called the nyuna is slightly less than the semi-tone and is called the nyuna dvisruti interval (92 cents). Between the shadja and the suddha rishabha is a semi tone  $16/15$ . But between suddha rishabha and chatussruti rishabha is the slightly flattened semi-tone  $185/128$  or nyuna dvisruti interval –  $16/15 \times 185/128 = 9/8$ .

A trisruti interval has a constant value  $10/9$ (182 cents) and corresponds to the minor tone. A chatussruti interval has also a constant value  $2/8$  (204 cents) and corresponds to the major tone.

A chatussruti interval comprises two pramana srutis (commas), one nyuna sruti and one purna sruti (limma)

$81/80 \times 81/80 \times 25/24 \times 256/248 = 9/8$ . i.e.  $22+22+70+90 = 204$  cents.

A chatussruti interval comprises a purna dvisruti interval and a nyuna dvisruti interval  $16/15 \times 135/128 = 9/8$ .

A panchassruti interval is equal to  $82/27$  (294 cents) Between the chatussruti rishabha and the suddha madhyama is a panchasruti interval –  $9/8 \times 82/27 = 4/5$ .

A shatsruti interval is equal to  $6/5$  (316 cents). There is a shatusruti interval between antara gandhara and panchama:  $5/4 \times 6/5 = 8/2$ .

The difference between a shatsruti interval and a panchasruti interval (6-5) is a comma  $81/80$  or a pramana sruti.

The difference between a panchasruti interval and a chatussruti interval (5-4) is a limma  $256/243$  or a purna sruti.

The difference between a chatussruti interval and a trisruti interval (4-3) is a comma  $81/80$  or a pramana sruti.

The difference between a trisruti interval and dvisruti interval (3-2) is  $25/24$  or a nyuna sruti.

The difference between a dvisruti interval and an ekasruti interval of the purna type (2-1) is a comma  $81/80$  or a pramana sruti.

European Musicians, brought up in the tradition of equal temperament, while listening to India Music employing quarter-tones are likely to get the impression that impure notes are

being played. This is an erroneous notion. It is of interest to note that in recent years attempts have been made in Europe to write quarter-tone Music and pianos containing 24 keys to the octave have been made. A whole opera employing quarter-tone Music was performed some decades ago in Germany.

Since equal temperament is resorted to in Western Music, a quarter-tone, there will mean an exact half of a semi-tone i.e. 50 cents which is not the case with Indian Music.

It is possible to have 22 frets on the vina finger-board to indicate the 22 sruti-sthanas and play Music, but this arrangement will become too unwieldy. The present arrangement by which we produce the srutis by deflecting the string from the lower svarasthanas is quite satisfactory. The distribution of 22 srutis over the 12 svarasthanas is an easy and workable arrangement. The 12 frets for an octave on the vina do not warrant the assumption that only 12 notes are used in an octave.

In ancient Music, the 22 srutis were distributed over all the sapta svaras. But later on, when sa and pa came to be regarded as avikruta svaras. (i.e., changeless and not admitting of varieties) sa and pa took one sruti each and the remaining 20 srutis were distributed amongst the 5 notes; ri g a ma dha and ni at the rate of 4 for each note. Thus  $4 \times 5 = 20 + 1 + 1 = 22$  srutis. Hence the significance of the statement: svaras are 7, svarasthanas are 12 and srutis are 22.

The 22 srutis of ancient Music were not mere theoretical postulates. They were solid Musical facts and were ascertained when Rig Vedic hymns and melodies were sung with sa, ma and pa as the tonic note or adhara shadja.

A Musical scale is a collection of all the notes used in the octave in a particular country. A Musical scale is a gradual evolution. It is the result of centuries of Musical thought and practice.

The 22 srutis are the foundation of the original scale and they were derived primarily for fixing the values of the suddha svaras i.e., the notes of the *Sama gana*. Excepting for the notes sa, ma and pa, the term *Suddha svara* in ancient Music and modern Music denotes notes of entirely different pitch. The frequencies of these notes have been given in the preceding chapter. The srutis are derived upon the principle of samvaditva or consonance. The 22 srutis were evolved through the Cycles of Fifths and Fourths i.e., by the sa-pa and sa-ma methods (*samvada dvaya*).

The 22 srutis are arrived at by the shadja panchama bhava. Ahobala has only stated what was already known.

(Note: panchama interval below the shadja gives the suddha madhyama.) Thus a cycle of under fifths will give the values obtained in the Cycle of Fourths.

The traditional mention of Panchama and Madhyama as the basis of derivation should be taken only as illustrative and not exhaustive. The Cycle of Thirds sa-ga series will furnish other srutis as well.

All the 22 srutis become svaras in some raga or other. Srutis actually used in a raga attain the status of svaras in that raga and the other notes remain merely as srutis.

It will be useful at this stage for the student to become familiar with the frequencies of the easier srutis and then to study the more difficult ones.

From the Harmonic Series, we see that the values of the successive intervals are :- a sthayi (octave,) a panchama (perfect 5<sup>th</sup>), suddha madhyama (perfect 4<sup>th</sup>), antara gandhara (major 3<sup>rd</sup>). *Sadharana gandhara* (minor 3<sup>rd</sup>), etc. From the 8<sup>th</sup> to the 9<sup>th</sup> is a chatussruti (major tone), from the 9<sup>th</sup> to the 10<sup>th</sup> is a trisruti (minor tone) and from the 5<sup>th</sup> to the 16<sup>th</sup> is a dvisruti (diatonic semi-tone). The other successive intervals are of interest only from the academic point of view and are not of Musical importance.

The Harmonic Series again gives us the values of Panchama as  $\frac{8}{2}$ ; Antara Gandhara as  $\frac{5}{4}$  and Chatussruti Rishabha as  $\frac{9}{8}$ .

There is an interesting point about these three notes:-

Panchama is the arithmetical mean of shadja and tara shadja, i.e.,  $\frac{1+1}{2} = \frac{8}{2}$

Antara Gandhara is the arithmetical mean of shadja and panchama  $\frac{1+\frac{8}{2}}{2} = \frac{5}{4}$

Chatussrui Rishabha is the arithmetical mean of shadja and antarra gandhara  $\frac{1+\frac{5}{4}}{2} = \frac{9}{8}$ .

The sa-pa series or the cycle of Fifths given us the following notes:-

Sa (the starting note of the cycle) = 1 ; Panchama = Panchama of this Panchama is the tara sthayi Chatussruti rishabha  $\frac{8}{2} \times \frac{3}{2} = \frac{9}{4}$  which is a \* compound interval. This note in the Madhya sthayi will have the value  $(\frac{9}{4} \div \frac{2}{1}) \frac{9}{8}$ .

The Panchama of this Chatussruti Rishaba gives us the Chatussruti Dhaivata  $\frac{9}{8} \times \frac{3}{2} = \frac{27}{16}$  which is the Pythagorean major 6<sup>th</sup>.

The Panchama of this Chatussruti Dhaivata give us a note in the tara sthayi which is slightly above the Antara Gandhara  $\frac{27}{16} \times \frac{3}{2} = \frac{61}{32}$ . This note in the Madhya sthayi =  $\frac{81}{82}$  divided by 2 =  $\frac{81}{64}$ . This note is higher than the Antara gandhara by a comma interval  $\frac{5}{4} \times \frac{81}{80} = \frac{81}{64}$ . This note is called the Tivra Antara Gandhara or the Chyuta Madhyama Gandhara and is the Pythagorean major 3<sup>rd</sup>.

Its Panchama gives us the note: Tirva Kakali Nishada or the Chyuta Shadja Nishadha  $\frac{81}{64} \times \frac{3}{2} = \frac{243}{128}$ . This note is the Pythagorean major 7<sup>th</sup>.

The sa-ma series or the Cycle of Fourths gives us the following notes:-

Sa (the starting-note of the cycle )= 1

Its suddha madhyama =  $\frac{4}{3}$

The suddha madhyama of this madhyama is the flattened kaisiki nishada :  $\frac{4}{3} \times \frac{4}{3} = \frac{16}{9}$ .

The suddha madhyama of this nishada is the tara sthayi flattened sadharana gandhara:

$\frac{16}{9} \times \frac{4}{3} = \frac{64}{27}$ .

This note in the Madhya sthayi will have the value  $\frac{64}{27}$  divided by 2 =  $\frac{32}{27}$ .

The suddha madhyama of this gandhara is the flattened form of suddha dhaivata:-

$$\frac{32}{27} \times \frac{4}{3} = \frac{128}{81}.$$

The suddha madhyama of thi dhaivata is the eka sruti rishabha of tara sthayi:-

$$\frac{198}{81} \times \frac{4}{3} = \frac{512}{243}. \text{ This note in the Madhya sthayi will have the value } \frac{256}{243}.$$

If suddha madhyama is taken as shadja, it antara gandhra will be the note of frequency  
:  $\frac{4}{3} \times \frac{5}{4} = \frac{5}{4}$ . This note is the Trisruti Dhaivata and is at a trisruti interval from Panchama. The

same note a Fifth below gives us the Trisruti Rishabha  $\frac{10}{9}$  (minor tone).

Between the Antara gandhara and the suddha madhyama is a dvisruti interval,  $\frac{16}{15}$ ;

thus  $\frac{5}{4} \times \frac{16}{15} = \frac{4}{3}$ . Between the kakali nishada and tara shadja is also a dvisruti interval :

$$\frac{15}{8} \times \frac{16}{15} = 2, \text{ The suddha rishabha is a dvisruti interval from shadja and its frequency is } \frac{16}{15}.$$

The Prati madhyama is a dvisruti interval from suddha madhyama and its frequency is

$$: \frac{9}{8} \times \frac{16}{15} = \frac{6}{5}.$$

The Prati madhyama is a dvisruti interval from suddha madhyama and its frequency is

$$: \frac{4}{3} \times \frac{16}{15} = \frac{64}{45}.$$

The ratio of the frequency of a note to that of a lower note is termed the interval between them. In order to obtain the interval value between them. In order to obtain the interval value between any two notes, divide the frequency of the higher note by that of the lower note. Thus the interval between suddha madhyama and Panchama is a chatussruti

$$\text{interval} : \frac{3}{2} \div \frac{4}{3}, \text{ i.e., } \frac{3}{2} \times \frac{3}{4} = \frac{9}{8}.$$

It consequently follows that a lower note multiplied by the interval between it and the next higher note gives the pitch of that higher note. Thus  $\frac{5}{4} \times \frac{16}{15} = \frac{4}{3}$ .



And if  $n$  = the number of vibrations of sa, then the frequency of any other note say like chatussruti rishabha =  $\frac{9}{8}n$ ; that of antara gandhara =  $\frac{5}{4}n$  and so on. If the interval is inversed, we get the vibrating length or the speaking length of the string.

A careful and analytical study of the Sankarabharana scale reveals to us that almost all the important intervals used in Music figure therein.

There is a dvisruti interval between ga and ma:

$$\frac{5}{4} \times \frac{16}{15} = \frac{4}{3}$$

There is a trisruti interval between ri and ga:

$$\frac{9}{8} \times \frac{10}{9} = \frac{5}{4}$$

There is a chatusruti interval between ma and pa:

$$\frac{4}{3} \times \frac{9}{8} = \frac{3}{2}$$

There is a puchasruti interval between ri and ma:

$$\frac{9}{8} \times \frac{32}{27} = \frac{4}{3}$$

There is a shatsruti interval between ga and pa :

$$\frac{5}{4} \times \frac{6}{5} = \frac{3}{2}$$

In the sruti scheme, precedence is first given to sa-pa values, then to sa-ma values and then to sa-ga values.

It is not unusual for a raga to change some of its characteristics srutis in particular sancharas. Occasionally in some ragas, the frequencies of svaras differ in their arohana and avarohana. Rishabha and Gandhara of Todi are instances in point.

The following table gives the modern names for the 22 srutis, their frequency as also the ragas in which they are met with. The four sruti varieties of a note are for the sake of convenience, referred to in the increasing order of pitch as ra, ri, ru, re; ga, gi, gu, ge and so on.

**Table V- Dvavimsati (22) Sruti Chart**

Name of the sruti	How represented	Frequency	Value in vibrations per second with sa=240	Value in cyclic cent	Ragas in which the srutis are met with
Shadja	Sa	1	240	0	All ragas
Ekasruti Rishabha	ra r <sub>1</sub>	$\frac{256}{243}$	252.8	90	Gaula, Saurashtra
Dvisruti Rishabha	ri r <sub>2</sub>	$\frac{16}{15}$	256	112	Mayamalavagaula
Trisruti Rishabha	ru r <sub>3</sub>	$\frac{10}{9}$	266.6	182	Bhairavi, Sriraga
Chatussruti Rishabha	re r <sub>4</sub>	$\frac{9}{8}$	270	204	Sankarabharana and Kalyani
Suddha Gandhara or Komal Sadharana Gandhas	ga g <sub>1</sub>	$\frac{82}{27}$	284.4	294	Bhairavi, Sriraga
Sadharana Gandhara	gi g <sub>2</sub>	$\frac{6}{5}$	288	316	Kharaharapriya
Antara Gandhara	gu g <sub>3</sub>	$\frac{5}{4}$	300	386	Sankarabharana
Chyuta madhyama ga or the Pythagorean major 3 <sup>rd</sup>	ge g <sub>4</sub>	$\frac{81}{64}$	303.75	408	Devagandhari and Saurashtra
Sudha madhyama	ma m <sub>1</sub>	$\frac{4}{3}$	320	498	Kuntalavrali
Trivra suddha madhyama	mi m <sub>2</sub>	$\frac{27}{20}$	324	520	Begada and Gaulipantu
Prati madhyama	mu m <sub>3</sub>	$\frac{45}{32}$	337.5	590	Kalyani
Chyuta panchama madhyama	me m <sub>4</sub>	$\frac{729}{512}$ or $\frac{64}{45}$	341.7 or 341.3	610	Varali
Panchama	Pa	$\frac{3}{2}$	360	702	All ragas where p is not varja
Ekasruti dhaivata	dha d <sub>1</sub>	$\frac{128}{81}$	379	792	Saveri
Dvisruti dhaivata	dhi d <sub>2</sub>	$\frac{8}{5}$	384	814	Mayamalavagaula
Triruti dhaivata	dhu d <sub>3</sub>	$\frac{5}{3}$	400	884	Kambhoji
Chatussruti dhaivata or the Pythagorean major 6 <sup>th</sup> nishada	dhe d <sub>4</sub>	$\frac{27}{16}$	405	906	Kalyani

Sudha nishada or the Komala kaisiki	na n <sub>1</sub>	$\frac{16}{9}$	426.6	996	Bhairavi
Kaisiki nishada	ni n <sub>2</sub>	$\frac{9}{5}$	432	1018	Kharaharapriya
Kakali nishada	nu n <sub>3</sub>	$\frac{15}{8}$	450	1088	Sankarabharana
Chyuta shadja nishada or the Tivra kakali nishada or the Pythagorean major 7 <sup>th</sup>	ne n <sub>4</sub>	$\frac{243}{128}$	455.6	1110	Kuranji-Devagandhari, Saurashtra, Nilambari
Tara shadja	sa	2	480	1200	All ragas except the Nishadantya Dhai vatantya and Panchamanya raga.

Note : The notes suddha gandhara and suddha nishada in the above table are the same as the old shadja grama gandhara and nishada, and not the same as the suddha gandhara and suddha nishada of the scheme of 72 melakartas. Likewise it should be noted that the mnemonics ra ri ru re: ga gigu ge etc., have not the same values as the ra ri ru and ga gigu of the 72 Melakarta scheme. In the above Table only those ragas in which the srutis are characteristically met with are given as example.

From the above table it will also be seen that.

1. There is a purna sruti interval  $\left(\frac{256}{243}\right)$  between sa and ekasruti rishabha; between chatussruti rishabha and komala sadharana gandhara; between pa and ekasruti dhaivata; between chatussruti dhaivata and komala kaisiki nishada;
2. There is a nyuna sruti interval  $\left(\frac{25}{24}\right)$  between dvisruti rishabha and trisruti rishabha; between sadharana gandhara and anara gandhara; between dvisruti dhaivata and trisruti dhaivata; between kaisiki nishada and kakali nishada,  $\left(\frac{25}{24}\right)$  is the deisis).
3. There is a pramana sruti interval  $\left(\frac{81}{80}\right)$  between ekasruti rishabha and dvisruti rishabha; between trisruti rishabha and chatussruti rishabha; between komal sadharana

gandhara and sadharana gandhara; between antara gandhara and chyuta madhyama gandhara; between ekasruti dhaivata and dvisruti dhaivata; between trisruti dhaivata and chatussruti dhaivata; between komal kaisiki nishada and kaisiki nishada; between kakali nishada and chyuta shadja nishada.

An octave consists of 10 pramana srutis (commas) 220 cents, 7 purna srutis (limmas) 630 cents and 5 nyuna srutis (350 cents); Total 1200 cents.

From Table V it will be seen that the difference between a purna sruti and a nyuna sruti is 20 cents. Likewise the difference between a purna dvisruti and a nyuna dvisruti is 20 cents. This interval which is less than a pramana sruti was too subtle and the ancient scholars therefore ignored it from the point of view of practical Music (sruti Sadharana Prakarana).

Although the frequencies of the srutis are not mentioned in terms of vibrations per second or even in fractions in ancient works, still from the methods outlined for their derivation we are able to fix their values, and with modern knowledge we are able to prove mathematically the accuracy of the scheme of 22 srutis. The aesthetic basis and logic behind the scheme of 22 srutis is also clear.

It is however clearly mentioned in ancient works that the octave bears a dviguna relationship i.e., the frequencies of a note and its octave bear the ratio 1:2. When a stretched string is stopped at  $1/3$  length and the segmented lengths of the string are plucked consecutively, it will be found that the shorter and the longer segments give thenotes. Tara panchama and Madhya panchama respectively. This again is an example of dviguna relationship. The frequency of Panchama was thus fixed as  $3/2$  and the frequencies of all the other srutis wre then calculated.

The four srutis of ga, ma and ni may also be referred to as ekasruti, dvisruti, trisruti and chatussruti gandhara, madhyama and nishada respectively after the manner of rishabha and dhaivata.

It is also worthy of note that the four srutis of each of the notes: rig a ma dha ni progress in a symmetrical order.

The frequencies given for the 22 srutis in Table V are those which have been arrived at after mature deliberations in the conferences held during recent decades. When a suitable apparatus which will indicate the frequencies of notes sung or played is devised, we can experimentally prove the values of these srutis. In the Pradarsana Vina, one can see visually the different sthanas of the 22 srutis and perceive their inter-relationships.

The srutis bearing septimal ratios possibly occur in a few ragas. The note of frequency  $7/6$  (280 vibrations per second:sa = 240) occurs between chatussruti rishabha and komal sadharana gandhara. The note of frequency  $7/5$  (336 vibrations per second) occurs between tivra suddha madhyama and prati madhyama. Since this note is less than Purva kalyani Madhyama by a very small interval it will be difficult aurally to distinguish between the notes  $7/5$  and  $45/32$ . The note of frequency  $7/4$  (420 vibrations per second) occurs between chatussruti dhaivata and komala kaisiki nishada. The notes  $7/6$  and  $7/4$  are samavadi svaras.

The notes of frequencies  $25/24$  and  $25/16$  also are samvati svaras and are rarely used.

Just as there are twin svarasthanas for each of the 5 notes rig a ma dha ni, there are twin srutis for each of the ten svarasthanas, other than sa and pa. No two consecutive srutis can occur successively in a raga.

It is desirable and certainly will be more accurate to describe the svaras figuring in ragas in terms of their precise sruti values. But such a description will be of use only to a limited few and hence the traditional method of describing ragas in terms of their svarasthanas has been adopted in this book in the hope that the students will find the correct srutis with their teachers's help. The continuous curve and the constant portamento in Indian classical Music is due to the fact that it is more the interval that is sung or played, rather than the mere note.

The topic of 22 srutis as understood and applied in modern Music (adhunika sangita) has been dealt with in detail in this chapter. We shall now see its application in ancient Music.

As has already been stated, the 22 srutis were primarily derived for the purpose of fixing the suddha svaras of the ancient scale. Since the idea of sa and pa as avikruta svaras had not yet dawned, even sa and pa were regarded as admitting of varieties, and thus we have the 22 srutis distributed over the sapta svaras in the order 4 3 2 4 4 3 2. Names for the 22 srutis are found in Bharata's Natya sastra and these names are repeated in the Sangita ratnakara, Sangita parijata and Sangita darpana. But Narada's Sangita makaranda and Bhavabhata's Anupa Sangita vilasa give different sets of names for the 22 srutis. Ugra is a name figuring in the first two nomenclatures. Whereas in Narada's scheme, it is the highest rishabha sruti, in the scheme of others, it is the first nishada sruti.

## 2.2 CYCLE OF FIFTHS

Cycle of fifths or Spiral of fifths means a series of fifths or panchama svaras. (The panchama svara is the third harmonic note and next octave is the most consonantal interval) In this process, the fifth of each note of the cycle is taken as the tonic note and its panchama determined; the relation of the new panchama to the original tonic note, shadha is then determined.

For instance, with the middle octave shadja as the starting note we find its fifth is the panchama of the same octave, frequency  $3/2$ , Taking this panchama as shadja, its fifth is found to be  $3/2 \times 3/2 = 9/4$  or the Chatussruti rishabha of the taaara sthayi. The fifth or panchama of this note is found to be  $9/4 \times 3/2 = 27/8$  or Chatussruti dhaivbaata of the tara sthayi. The fifth or panchama of this note is found to be  $27/8 \times 3/2 = 81/16$  or the chyuta madhyama gandhara of the aati tara ssthayi and so on.

The process was continued till the 12<sup>th</sup> cycle in each case when it was found that the 12<sup>th</sup> note of the cycle in one case and the 11<sup>th</sup> and 12<sup>th</sup> notes of the cycle in the other are higher lower than shadja or panchama by the small interval of a comma or pramana sruti. These notes were ignored as not being of practical importance and the retained and these are the 22 srutis of the ancient Indian scale. The further notes obtained in the two cycles were only of academic interest, since all the notes, important from the point of view of practical Music, were already obtained.

The following Table all the notes shown on the right of the central line, belong to the cycle of fifths and those shown on the left, to the cycle of fourths. The Roman numerals indicate the order in which the several notes occur in the cycles of fifths or fourths. All compound intervals arrived at in the working out of this process are reduced to the middle octave for purpose of easy comparison, the precise octave of the note however, being indicated in notation against each note.

In the scale of equal temperament, the octave is divided into 1200 equal parts of cents and each semitone comprises 100 cents. This Table visually shows the points of difference in the frequencies of the note belonging to the scales of just intonation and equal temperament are used in Indian Music, the unsuitability of the harmonium and other fixed-toned instruments of the west (tuned to the scale of equal temperament) for playing correct Indian-Music is obvious.

The limitations of the uncultivated human ear being what they are, it is too much to expect the average person to perceive the refined ten sets of twin notes, the b notes of the lower pitch belongs to the cycle of fourths and the note of the higher pitch, to the cycle of fifths and this is naturally so, since ma is a note less in pitch compared to pa. At the sixth stage of each cycle, a small but negligible correction of 2 cents is introduced to facilitate easy calculation.

In the cycle of fifths, two cents are subtracted and in the cycle of fourths two cents are added. In the cycle of fourths, the correction is made in stage VI to get at the antara gandhaa  $5/4$  a harmonic note heard in the tambura. All these delicate srutis are the pride and glory of Indian Music and are carefully treasured up in the ragas and compositions of great composers in those ragas.

In the sa grama all the notes excepting Panchama are obtained in the cycle of fourths distinctions in the frequencies of the notes belonging to the two scales, but nevertheless these distinctions are solid and aesthetic facts.

The note  $4/3$  does not come in the cycle of fifths and the note  $3/2$  does not come in the cycle of fourths. The idea of seven octaves as possibly suggested by the cycle of fifths since at the 12<sup>th</sup> stage, the original sa was almost again got.

Most of the conclusions arrived at ancient scholars can be proved by modern methods. The beauty and symmetry underlying the scale of 22 srutis is clear from the illustration. There are the pairs of notes and these with the sa and pa give the 22 srutis of the Indian Musical scale.

The two notes constituting each pair are found to be uniformly separated by the interval of a comma or paramana sruti. The interval of a comma though small is still recognisable by the trained ear. Of. Even the note  $40/27$  is obtained in the cycle of fourths and the note of the higher pitch, to the cycle of fifths and this is naturally so, since ma is a note less in pitch compared pa.

At the sixth stage of each cycle, a small but negligible correction of 2 cents is introduced to facilitate easy calculation. In the cycle of fifths, two cents are subtracted and in the cycle of fourths two cents are added. In the cycle of fourths, the correction is made in stage VI to get at the antara gandhara  $5/4$  a harmonic note heard in the tambura. All these delicate srutis are the pride and glory of Indian Music and are carefully treasured up in the ragas and compositions of great composers in those ragas.

N Not used 160/81 1178 XII	
	-V 1100 Chyuta shaja ni
N 15/8 Kakali ni 1088 VII	-1100 243/128 N
	-X 1018 Kaikiki ni 9/5
N 16/9 Bhairavi ni 996 II-	-1000 cents N
N5/3 Trisruti dh 884 ix-	-III906 chatussrutidha 27/16
	-900 cents D
D 128/81 Ekasruti dha 792 IV	VIII 814 suddha dha 8/5
	-800 D
M Not used 40/27 680 XII	- 1702 Panchama 3/2 P
	700 cents
M 1024/729 or 45/32 prati Ma or	- VI 610 Chyuta pa --- 729/512 or 64/45-
	M
	- 600 cents
M 4/3 Suddha ma 498 I -	XI 520 Begada ma 27/20
	- 500 M
G 5/4 Antara ga 386 VIII-	-IV 408 Chyutta madhyamaa ga
	- 400 81/64 G
G 32/27 Bhaairavi ga 294 III -	- IX 316 Sadharana ga 6/5
	- 300 G
R 10/9 Trisruti ri 182 X-	II 204 Chattussruti ri 9/8 R
	-200
	VII 112 Suddha ri 16/15
	- 100 R
256/243 Gaula ri 90 V-	VII 22 81/80 (Not used)
	0 Sa

In the sa grama, all the notes excepting Panchama are obtained in the cycle of fourths. Even the note 40/27 is obtained in the cycle of fourths.

Two other methods of determining the notes occurring in the cycles of fifths and fourths are given below:-

So other methods of determining the cycle of fifths and fourths are given below:-

1. **Cents method:** Take Madhya shadha as equal to 0. Its Panchama will be equal to 702 cents. The Panchama of this Panchama is got by adding 702 to 702. The result is 1404 and this is a compound interval or a note in the tara sthayi. By subtracting from this 1200 which is the value of the note in the Madhya sthayi. This is the chatussruti rishaba. By adding 702 to it, we get 906 cents which is the frequency of the chatussruti dhaivata and so on.

**2.3 Cycle of Fourths;** For the cycle of fourths, add 498 in each case and proceed as mentioned above.



i. **Arithmetical method:** The octave consists of 22 srutis. The panchama has 13 srutis to it, we get the value 17 which is the sruti value of the ans suddha madhyama  $9(13+9)=22$ . Take Madhya shadha as equal to 0 its Panchama is the 13<sup>th</sup> sruti. The Panchama is got by adding 13 to it. The result is 26 and this is a compound interval or a note in the higher octave. By subtracting 22 from it (the total number of srutis in an octave) we get 4 which is the value of the note in the Madhya sthayi. This is the chatusruti rishabha. By adding 13 chatusruti dhaivata and so on.

For the cycle of fourths, add 9 srutis in each case and proceed as mentioned above.

The tables give the values or the notes of the cycles of fifths and fourths worked out in the above two method. Corresponding to a reduction of 2 cents in the sixth cycle in the cycle of fifths, a reduction of one sruti is made, in the arithmetical method; likewise an addition of 2 cents in the sixth cycle in the cycle of fourths. The reasons for this subtraction and addition have already been explained on.

**Table 5**  
**Cycle of Fifths**

No. of the cycle	Basic note	Resulting note	Value in cents	Value in sruti number
1	Sa	Pa	702	13
2	Pa	Chatussruti ri	$702+702=1404-1200=204$	$13+13=26-22=4$
3	Chatussruti ri	Chatussruti dha	$204+702=906$	$4+13=17$
4	Chatussruti dha	Chyuta madhyama ga	$906+702=1608-1200=408$	$17+13=30-22=8$
5	Chyuta madhyama ga	Chyuta shadja ni	$408+702=1110$	$21+13=34-22=12$ or 11
6	Chyuta shadja ni	Suddha ri	$610+702=1812-1200=612$ or 610	$21+13=34-22=12$ or 11
7	Chyuta pa	Suddha ri	$610+702=1312-1200=112$	$11+13=24-22=2$
8	Suddha ri	Suddha dha	$112+702=814$	$2+13=15$
9	Suddha dha	Sadharana ga	$814+702=1516-1200=316$	$15+13=28-22=6$
10	Sadharana ga	Kaisiki ni	$316+702=1018$	$6+13=19$
11	Kaisiki ni	Begada ma	$1018+702=1720-1200=520$	$19+13=32-22=10$
12	Begada ma	Pramana sruti above saand not used	$520+702=1222-1200=22$	$10+13=23-22=1$

**Table 6**  
**Cycle of Fourths**

No. of the cycle	Basic note	Resulting note	Value in cents	Value in sruti number
1	Sa	Sudha ma	498	9
2	Suddha ma	Bhairavi ni	$498+498=996$	$9+9=18$
3	Bhairavi ni	Bhairavi ga	$996+498=1494-1200=294$	$18+9=27-22=5$
4	Bhairavi ga	Ekasruti dha	$294+498=792$	$5+9=14$
5	Ekasruti dha	Ekasruti ri or Gaula ri	$792+498=1290-1200=90$	$14+9=23-22=1$
6	Gaula ri	Prati ma	$90+498=588$ or 590	$1+9=10$ or 11
7	Prati ma	Kakali ni	$590+498=1088$	$11+9=20$
8	Kakali ni	Antara ga	$1088+498=1586-1200=386$	$20+9=29-22=7$
9	Antara ga	Trisruti dha	$386+498=884$	$7+9=16$
10	Trisruti dha	Trishruti ri	$884+498=1382-1200=182$	$16+9=25-22=3$
11	Trisruti ri	Pramana sruti below pa and no used	$182+498=680$	$3+9=12$
12	Pramana sruti below pa	Pramana sruti below sa and not used	$680+498=1178$	$12+9=21$

### 2.3 SELF ASSESSMENT QUESTIONS

1. Explain about sruti and give values of 22 sruti in fractions and cents.
2. Enumerate the cycles of fifth and explain in detail.

### 2.4 REFERENCE BOOKS

1. South Indian Music by P. Sambamurthy.

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## UNIT - III

### SCIENCE OF MUSIC: USE OF TECHNOLOGY IN THE PROPAGATION AND PRESERVATION OF MUSIC, TAPE RECORDER, COMPACT DISK, RADIO, TELEVISION AND COMPUTER

#### 3.0 OBJECTIVES

This unit gives knowledge in

1. Usages of Radio, Tape recorder, Television and computer – Disc
2. Public gramophone record libraries
3. Awareness of Educational programs and womans programs
4. Radio Engineering and Studio Acoustics
5. Frequency management and Satellite management

#### 3.1 Radio, Tape recorder computer – Disc

Gramophone plays an important role in the filed of Music. It became so easy to learn classical and other songs like cenefield to the people by this media. It is a memory of the great Musicians and also vidwans and the gramophone records are the source of both listening and learning. Veena Dhanamma, Rachappa, Kittappa's Music were recorded and they are helping in developing the knowledge. But people are in a wrong step nowadays, by hearing the manodharma kalpanaswaras also which are mainly intended for originality and they are loosing the practical oriented subject. So the gramophone records are also to be used in proper sense grasping the important knowledgeable things in Music.

**3.1.1 Recording:** The singer will be having the sound proof arrangement avoiding the sound entering outside. Microphone will be infront of him. The singing sound of the singer will be vibrated as waves in the room it self. It will move the thin part of the microphone. That movement will be passed on through electricity to the another ending part of the arranged good having a needle like tool. The (material) needle will be arranged making to the plate of (candil) the movement of the needle will be acted by electricity. The negative part of the plate will be used to copy the recordings in thousands of number. The needle of the tool with balanced movement (not in high or low) helps as uniform sound.

**3.1.2 Radio:** Radio is an important media to get so many unknown things media we listen songs dramas social and environmental health matters advertisements what not every thing

from radio. New songs and demonstrations teaching in practical Music live or recorded are broadcast from transmission. There discussions in every subject research and analytical discussions in so many stations. Now a days radio has vast linked channels (Stations). The children will be taught school programmes and scientific knowledge through radios at their curriculum hours.

The singer song entering into the microphone through air and electricity moves the air as waves. Radio's motor receivers the waves sound from different centres and helping us in hearing the same to us all.

Radio is discovered by markony from Italy. India introduced Radio in 1924. Voice of America is communicating all the radio programmes and over 8 crores people in the world are listening radio. The British Broad costing corporation is communicating the news from 40 languages.

**3.1.3 Television:** John Lag Biard discovered Television in 1926. Along with hearing in this we can see the picture also the social political cultural and other programmes are being transmitted by television. Now a days colour televisions are in use the artificial satellite to communications will carch out from any TV set in the world. The mobile TVs are also formed by American Scientists in Japan there are made small TVs in the wrist watches also.

In communicative mass media the telephone, Telegraph, Radio, Television, Radars are made with Electronic goods were can communicate in a news by photo (Radio) by the electronic experiment.

Radar can catch the vibrations of Radio and can catch their existence.

### **3.2 THE NEED FOR PUBLIC GRAMOPHONE RECORD LIBRARIES**

It is generally assumed that one of the happier results of the last war was an improvement (particularly among younger people) in standards of Musical appreciation, evidenced in a greater willingness to listen to serious Music, albeit within a rather limited range. Be that as it may, there has not been any substantial increase in the facilities available in this country for attendance upon "live" Musical performances. In London, there is more opera than before the war and a greater number of orchestral concerts, but this latter is probably balanced by a decline in solo and chamber Music recitals. In the provinces, opera is probably sparser than ever before and certainly less in amount than in any other area of

comparable population in Europe, and though there are more orchestral concerts, and these are held in a greatly increased number of towns, as a result of programmes being planned for repetition in a number of widely differing places the range of Music performed outside the half-dozen great cities is small indeed. The Arts Council's policy of fostering (in a manner reminiscent in both method and liberality, of the nineteenth-century poor law) local chamber Music societies has led to an increase in this sort of Music, but the deplorable artistic immaturity of many Arts Council stipendiaries coupled with the virtual disappearance (again, except from half a dozen places) of the "touring celebrity", has ended for ever the palmy days of the 20s and 30s when an ordinary provincial middle-town might hear regularly artists of the quality of Menuhin, Tauber, and Heifetz.

\*The "guarantee" basis of the grants makes it virtually impossible for a society to build up reserves in good years to tide over the bad. The actual amount offered in 1960-61 averaged £41 per society, or under £10 per concert.<sup>2</sup>

It is, unfortunately, true that to lead a full Musical life is not possible in Great Britain, for even in London there is not that opportunity to keep abreast of developments on a world-wide scale which is the feature of the greatest continental cities. Particularly is this so in the case of dramatic Music. What do we, know of post-Straussian German opera? "Mathis der Maler", "Wozzeck", "Romeo und Julia" and "Elegie für junge Liebende" is about the lot. All we have heard from the rest of the world (apart from local products by Britten and his colleagues and the gallant efforts-on view in London only for one week each year-of the New Opera Company) is a few works by Janacek, Menotti, 'and Stravinsky, and one each by Poulenc, Honegger, and Bartok. It is salutary to compare this situation with that in continental cities of size similar to the larger English provincial centres. In one week chosen at random Stuttgart (population not much more than Leeds), apart from a performance of "Die Meistersinger" with soloists of European reputation, heard a modern German work of high quality, a revival of a work of the German romantic school, an Italian repertory work, and an evening of ballet consisting of a standard French work and a contemporary German one: a random week in Dusseldorf (population the same as Manchester) produced two works by Wagner, and one each by Krenek, Weill, and Richard Strauss. The only one of the German works performed in this country in recent years was "Die Meistersinger" (and that in London only), yet all of the others were of a quality to justify them being made available to Music-

lovers here. Musical comedy and the efforts of no less than four orchestras (one of them a chamber-ensemble known throughout the world) were also available in Stuttgart, and Music is subsidized from public funds to the extent of hundreds of thousands of pounds annually. Leeds can spare only £18,313 a year (5, p. 50) to help Music and the theatre along (and that is better than most English cities), and allowed its only local symphony orchestra to be disbanded because it was costing more than that figure.<sup>6</sup> Frankfurt's municipal theatre employs some 600 persons? (the majority Musicians, vocal and instrumental), which compares rather favourably with the City Organist at Birmingham and the tiny company at Manchester Library Theatre, yet the English cities are the larger. This state of affairs applies right down the population scale: Karlsruhe and Stoke-on-Trent are much of a size, but the former has an opera capable of taking "Tristan" into its stride whilst the latter now has no theatre at all, so cannot even, as heretofore, enjoy a Sadler's Wells "Merry Widow" once a year (5, pp. [2], 80); Heidelberg and Oxford are similar both in size and in other respects, but Heidelberg has an opera which can turn out a competent "Entfuhrung" as a matter of routine whilst Oxford has only the university amateurs; Mainz and Middlesbrough have similar numbers of inhabitants and both make chemicals, but whilst the municipal theatre and orchestra at Mainz employ 288 persons<sup>8</sup> professional opera in Middlesbrough (except of the Arts Council "Intimate" sort) was last heard some forty years ago.

Admission prices, too, for such Music as is available in Great Britain, are generally higher than abroad-even where, at first sight, this would appear to be untrue, the prevalence of reduced "subscription" (abonnement) rates in Germany, and the existence of "repetitions generales" and special prices for anyone with the remotest claim to "student" status in the Latin countries, makes listening to Music relatively cheap for the local residents, whatever it may be for tourists. In the British towns where admission prices have been kept low (for example Sheffield), the ration of soloists of international reputation is proportionately reduced-they may be foreign, but that does not necessarily mean the same thing

Unlike the situation in "live" Music, for broadcast Music Great Britain is relatively fortunate. No other country has anything quite like our "Third Programme", and the quiet tenacity the B.B.C. has shown in supporting this most valuable of its services against the irresponsible attacks levelled at it from time to time must be highly commended. Not only does it make available to the remotest corners of the country a steady stream of good Music, it also brings us representative broadcasts from the great European festivals, and occasionally does great work in drawing to our attention the excellences of a neglected composer, by

presenting a conspectus of his works such as cannot be obtained in public performances (the revival of interest in the great but neglected Janacek is primarily due to such a campaign, and somewhat earlier a series of programmes of the work of Schutz opened doors in Musical appreciation which had been closed for well over a century).

Nevertheless, even the brilliant results achieved by the B.B.C. do not fill the gap which exists in Musical provision. True, a great deal of good modern Music not otherwise available in this country is performed. In this way we have heard Schonberg's "Moses und Aron" and Liebermann's "Leonora 40/45" but what of Reutter's "Doktor Johannes Faust" and Krenek's "Karl V"? Some notable revivals of little-performed or forgotten works of earlier centuries have also been given (performances of Berlioz's "Requiem" and recordings or revivals by Italian houses of operas of the *bel canto* school, for example, long before Beecham and Callas respectively made them fashionable), though here again there are unpredictable gaps (we were for years promised "Les Huguenots", but it failed to appear—nothing substantial of the school of Meyerbeer can be recalled as ever having been broadcast). Even of the works which are performed, however, only one or two performances can be given. There is no opportunity to really get to know an important new work or a revived forgotten one. Furthermore, of course, as with all broadcast or live Music, there are two insuperable difficulties—the listener cannot plan his own listening, nor can he choose his own performers or compare side-by-side the work of alternative performers. To take the latter point first, it is true that, for popular works, over a long period, one may, by broadcast performances here and live performances here and abroad, get that special insight into a work which comes from comparing the approaches and results of different performers in it, but only over a very long period and only for very popular works. The gaps which exist in the range of public and broadcast Musical performances (French grand opera, mentioned above, is one of them; Handel's choral works, Bach's church cantatas, and the operas of Lortzing are more examples) are absolute cases in which a listener cannot plan his own listening, but the insuperable difficulty, even in the most Musically well-provided community, that it is only possible to cover the whole range of Music by performances over a great length of time, is quite as serious.

Fortunately, however, there is one means by which all the deficiencies so far enumerated (absence of live performances in Great Britain, gaps in the range of broadcast performances, lack of possibility of individual planning of listening, and impossibility of comparative listening) can be greatly minimised—by the use of gramophone records. Anyone

with access to a comprehensive collection of gramophone records, built up over a long period (this it must be, as the available recorded repertoire changes quickly in these days of transition from monaural to stereophonic discs), from works recorded in all the principal Musical countries (there are means of obtaining foreign records, particularly of works not extensively recorded in Great Britain), is able to plan his listening to suit any objective, be it recreational or instructional,\* and in the case of the established repertoire to do an endless amount of "comparative listening". to different performances of the same work.

So much for the usefulness of records-o-they are demonstrably a most valuable, and, indeed, indispensable element in the overall provision of Musical facilities for any community.

\*For example, of Richard Strauss's fifteen operas, of which only five have been performed in England of recent years, the following are available complete: "Arabella", "Ariadne", "Capriccio", "Die Frau ohne Schatten ", "Der Rosenkavalier", "Salome"; considerable excerpts are also available from "Daphne", "Elektra", and "Intermezzo". Seven of Mahler's ten symphonies are available, and seven of Bruckner's nine. Of Smetana's operas all we see here is "The Bartered Bride"-four more are available on record. Forty-six of Bach's church cantatas are recorded-how long would we have to wait to hear all these in public or broadcast performances? Two of the greatest works of the twentieth century are Schonberg's "Moses und Aron" and Berg's "Lulu" (A performance by the Hamburg State Opera was given at Sadler's Wells, October 1962-EDITOR.)-they have been broadcast here, but (except for one scene of "Moses" in concert version at Leeds) this has never been performed live: both are available complete on record.

For example, one can compare the Don Giovanni of Brownlee (pre-war). Now what are the means by which, in the twentieth-century world, community facilities are provided? Certain amenities each normally-privileged individual provides for himself-for example, by private contract with commercial firms, he provides his own furniture and clothing, and in general food and housing.

At this point, however, another factor appears. Of very recent years, the community as a corporate entity has taken upon itself certain aspects of food provision (subsidised foods and orange juice for infants, and provision of cheap restaurants where such are not available through private enterprise) and for many years the community has regarded it as a corporate duty to make available adequate housing for the underprivileged. Corporate provision of



libraries and educational facilities, like municipal housing, started as a service for the under-privileged, but more recently two new elements have intruded themselves into social theory. The first is corporate provision of services as a means of redistribution of income (for example, the National Health Service, financing, mainly out of taxation based on income, a service equally available to all). The second is the corporate provision of services as a means, of economic management of them. A situation whereby each individual household provided its own water, sanitation, and roads was found inefficient centuries ago, and one whereby each manufactured his own electric power, gas, and atomic energy is even more inconceivable on sheerly technical grounds.

Public libraries have, in the light of this new social theory (the first principle is that of the welfare state, the social of the technological revolution), evolved from being a service for the under-privileged to become an integral element of first the with that of Siepi (2 versions), Fischer-Dieskau, Waechter, and Taddei. Of Puccini's "Fanciulla del West" (about which there seems to exist a conspiracy among English opera promoters to deprive us of a live hearing) there are three recorded versions, and no less than six recorded "Butterflies" (Tebaldi and Angeles-2 versions each-Callas, and Monte). There are fifteen versions available of the Brahms Violin Concerto, twenty of Beethoven's "Eroica" symphony and sixteen of his "Choral". Of such relatively unfamiliar works as the Janacek Sinfonietta and Respighi's "Pines of Rome" there are four and ten versions respectively.

*The "conspiracy" regarding "La fancrulla del West" was finally broken in December 1962 by {he Sadler's Wells productiolls of (hat work- EDITOR.)*

welfare state (all classes now use the public library, indeed in many cases the under-privileged-such as now exists of it-is the hardest class to attract) and secondly of the technological society. The growth of specialisation has led to such a proliferation in the amount and a variety in the forms taken by recorded knowledge that a new specialisation-call it librarianship or documentation-has arisen to orientate this knowledge so that it may be used for further technological expansion. Gramophone records are one of the new forms taken by recorded knowledge, and like the other forms (microforms, punched cards, photographic reproductions and so on) the case for their provision by the community as a body rests on two propositions-firstly that they are an element of some amenity which will lead to a fuller life for the community, or a significant part of it, and secondly that it is impossible for each individual to make full provision personally for his own needs in the field involved.

That Music is such an amenity none can deny. That it has been regarded as worthy of community support from early times is indisputable: from the days when culture was an ecclesiastical monopoly to be used for the service of God, through the days when culture was only accessible to a minority with nobility and wealth, to today when, as a result of growth in social enlightenment, it is within the grasp of all who require it-by means of almsgiving, private patronage, and now financing from local or national taxation, Music has been at least partly supported from funds provided by others than its direct users. This patronage of Music has, it is true, as demonstrated above been less generous in Great Britain than in many other countries but the principle is firmly established, nationally by government financing of the Arts Council and locally by local authority assistance for concert provision in their areas (the Leeds example quoted above is far from unique-most large cities now make possible at least a few orchestral concerts annually in their areas). Furthermore, Musical education, in schools and universities by formal teaching and in adult education by the appointment of Music organisers, is now general.

On the evidence given here, it is submitted that gramophone records are an essential feature in Musical provision and appreciation, without which no full Musical life is possible. It is submitted that, though an individual may build up a library of records for himself (as he may of books), unless he is possessed of quite abnormal wealth (and house-room!) he will not be able to purchase for himself (even if they were available when he wished to purchase them, which-again as with books-is far from being the case) all he needs. Therefore, as with books, there is an irrefutable case for their provision by some public authority, which will both purchase and, by the ministrations of specialist technicians (in this case librarians), make them available for the public as a whole. The basis of finance of such publicly-formed collections should be such that the collection is made available to the public.

Social services are provided, in general, on one of two financial bases: either the providing body may bear from corporate funds the whole cost of the service, making it available free of charge (as is the case at present with public libraries), or the providing body may make what it considers reasonable charges for the service (such charges as will not deter the user, not "economic" charges, which often will deter the user), bearing from corporate funds any sum by which the cost of the service exceeds income from such charges (examples of this method are common in public Music-provision-it is the method used by the Arts Council, and also by continental cities financing opera houses I and British local authorities providing concerts). It would/seem to be only commonsense to use one of these two bases in

financing publicly-provided record collections, as these are the two methods used in the social services most nearly allied to public provision of gramophone records.

### 3.2.1 THE NATURE OF PROVISION

From what has been said above, it is obvious that gramophone record libraries are envisaged primarily as a force in Musical appreciation. It therefore follows that the foundation of the collection should be the standard Musical repertoire together with non-established works of serious intent, both old and new. It is, however, necessary to consider what else should be provided. So far as Music is concerned, there are two classes to consider-"Light" Music and "ephemeral" Music. By the former is connoted such work as that of Sullivan, Lehar, the Vienna Strausses, and even such modern Musical comedies as would seem to have some likelihood of extended life ("Oklahoma" and "West Side Story" are two such examples). The latter includes so-called "dance Music" in all its weird varieties (ranging from fox-trot to rock 'n' roll) and "jazz", together with the modern equivalent of the Victorian popular ballad. A feature of this latter type is that items rarely occupy more than one side of a 7-inch 45 Lp.m. disc-such larger (33 Lp.m.) discs of this sort of Music as have appeared are always of the "recital" type, including a number of short works on one side. The costs involved in private purchase of this type are therefore much lower than of multi-sided "serious" works (11, 12, pp. 19-20, 26).

Here, again, it is suggested that invaluable lessons can be learned from parallels in public financial support of "live" Music and from the practice of public libraries. Except in holiday resorts, in this country publicly-financed Music is usually of the "standard-repertoire" type, though the Sadler's Wells Opera now follows the old-established practice of continental cities, where a rather broader policy has long been pursued. On the two nights following the set of performances listed above as having been given at Stuttgart, the Opera there presented two operettas-"Das Opernball" and "Die lustige Witwe"-and at least one of the works of our national operettist, Sullivan ("The Gondoliers"), has been given in a German civic-financed house.<sup>13</sup> Sadler's Wells is now following suit with a liberal diet of Lehar and Offenbach-though, as yet, for reasons not explained, no Lortzing or Suppe-(and now that the Gilbert and Sullivan copyrights are expired, Sullivan will join the bill of fare) to provide a sorbet between the heavier but more nourishing courses of Bizet and Puccini. So far as is known, however, except as a "sprat to catch a mackerel" in holiday resorts, or on a profit-making basis to keep public halls employed, nowhere in Great Britain or elsewhere does the ephemeral type of Music receive public sponsorship.

Public libraries, with few exceptions, have pursued a less well defined "quality" policy in their book selection. Most of them aim, nowadays, at providing everything from technical documentation at the top of the scale to love stories and science fiction at the bottom. This dissipation of effort over a wide field, combined with a dualism of purpose between instruction and recreation, has not been to public libraries' advantage (in particular it has militated against "specialist-bibliographical" training of staff), and it is no exaggeration to say that the reason money is not available in most places for gramophone records is because it is spent on ephemeral novels. Public libraries with existing gramophone record collections have generally seen the danger of casting the net too wide, and if anything the existing tendency is perhaps to place the bar too high, with a resultant limitation in the number of potential users. This is probably justified in the inaugural stages, in which most existing collections still are. However, it is vital that, before there is any great increase in the number of record libraries, principles as to the nature of material bought should be firmly established.

It is not economical to provide ephemera from public funds. This applies as firmly to records as to books. There are overheads inherent in public enterprise (a hierarchical establishment, a costly building, the apparatus of democracy) which are not present in private enterprise of the type with which we are concerned (the "circulating library" and the record shop). In the case of records there is the additional factor that whereas ephemeral novels usually wear themselves out in use, the ephemeral record dies in popularity so quickly that there may well be a problem of obsolescence to add to that of the wastefulness of subjecting such records to all the necessary processes of a public record collection-accessioning, cataloguing, issuing, discharging, and so on. It is, therefore, submitted that, on economic grounds and also on the ground that they are of no value in the furthering of Musical appreciation, records of purely ephemeral Music should not be included, except in the unlikely event of a library authority deliberately making separate financial provision for them. In such a case, the processes of accessioning, etc., should be reviewed critically and cut to the irreducible minimum-as most public libraries do with their fiction stocks.

Not all records are of Music, and a definite policy regarding the types of non-Musical record is as important as for those of Music. Recordings of poetry and drama would seem to be subject to much the same considerations as Music-it is the quality of the item recorded which should be the criterion, and, whilst the line should be drawn against providing recitals by television personalities of verse of the type tucked away in odd corners of popular newspapers or recordings of "light programme" feature shows, the library should aim at

providing not only Shakespeare and Milton but also T. S. Eliot and Arthur Miller. A particularly valuable feature would seem to be recordings in the original language of important foreign plays (unfortunately, however, only French plays are at all easy to get in this country at the moment). Apart from the intrinsic usefulness of these non-Musical records (which are highly popular when available in reasonable numbers, their provision is important from a policy point of view in that they widen considerably the circle of intelligent people interested in the record collection, which otherwise is limited to the Musically conscious part of the population. The advantages of as many people as possible supporting the record library are (particularly when money is required) too obvious to need elaboration.

This consideration also applies to another class of nonMusical record, the language-teaching series, issued mainly by Linguaphone. At present more libraries provide these than any other non-Musical type. Nevertheless, despite their popularity when provided, objection to their provision has been made on the grounds that the wear and tear on them is excessive and that, consisting as they do of a series of records which may be required more rapidly by one user than another, one user may be held up by the slower progress of another (12, p.21). The answer to this latter point would seem to be a generous degree of duplication, which will be justified anyway by the use made of them. The provision of these courses would seem to be a natural corollary of providing language textbooks, which brings up another point-the use of records to supplement public libraries' reference collections. A collection of gramophone records (together, of course, with a player) can serve many purposes in a reference library. The most obvious of these is to illustrate the library's stock on Musical history<sup>16</sup> (the various Musical archive collections and histories of recorded sound are of especial use in this connection), but other purposes, perhaps less obvious, are a collection of bird songs and sounds of Musical instruments. The use of a record player in the reference library is, surely, no more unorthodox than the use of a microfilm reader. The use of a tape recorder to record voices of personalities and locally-important events for the local history collection is, perhaps, rather off the subject of gramophone record libraries, but it must never be forgotten that a good many commercially-produced recordings are of local history interest somewhere-for instance the two discs of Thurston Dart performing on the organ of Rotherham Parish Church find a natural home in the Rotherham Public Library's local history collection.

The only other class of records needing consideration is sound effects. So far as these record specific sounds (e.g., Big Ben, the bells of a specific church, the Bruges carillon, or an Amsterdam steam organ) they may, like bird songs, have their uses in a reference library. It is

far more doubtful, however, whether libraries should provide the general type of sound effects (train whistle, waves on rocky shore, aeroplane diving, and so on) used for theatrical performances. So small a proportion of the costs of even an amateur production do they account for, and so heavy is the wear and tear they receive, that it would seem desirable for dramatic societies to provide their own sound effects. When a play does require a "specific" sound there seems no reason (other than performing rights, which may perhaps safely be ignored in many cases) why it should not be re-recorded on tape from the reference collection.

### **3.2.2 THE EXTENT OF PROVISION AND USE**

We must now, having disposed of considerations of the nature of the records to be provided, proceed to the policy to be implemented regarding coverage of the field decided upon. Two factors are involved here: the physical form of records to be stocked and the number of records needed. There is, of course, now no case for the provision of S.P. (78 r.p.m.) discs: those existing libraries which possess stocks of them now find them a drug on the market, and some have disposed of them. L.P. (33 r.p.m.) discs will form the great bulk of any record library, and form the whole of many existing collections (18, pp. 218-9), but despite the objections to them expressed by some<sup>19</sup> there seems no valid reason for excluding 45 r.p.m. discs, and substantial advantages are to be gained from including a proportion of them, the most notable of which are the availability of certain material on 45 r.p.m. which is not available on L.P. (for example, one of the two discs by Thurston Dart mentioned above<sup>17</sup>) and the possibility of reducing casual wear on the popular sections of L.P. "recital" discs, which sections are often duplicated on 45 r.p.m. A far more difficult problem is the policy to be adopted regarding stereophonic discs: here again, professional opinion differs<sup>19</sup>, but it is difficult to believe that within a few years this form will not be universally adopted- and gramophone record libraries, if they are to avoid having dead stock left on their hands, need to have a wary eye for future trends. At present, for a new record library a policy of half-and-half monaural and stereophonic would seem sensible, with the popular (for example, Beethoven and Tchaikovsky), which will wear out quickly, on monaural, and the less popular (Schonberg and Hindemith for instance), which will be with us a long time, on stereo.

We must also decide what the irreducible unit of size amounts to, if the library is to be able to operate usefully and reasonably independently, except for non-standard items, of outside assistance. That a library should be able to operate efficiently on the basis of its own resources, rather than those available in other libraries, is perhaps more important for records

than for books, for whereas there exists for books an extensive (and highly costly) system of interlending between libraries, nothing of the sort yet exists for records, and in view of the easily damaged physical nature of records, the paucity (as compared with books) of items involved, and the lessons we have learned on such matters as the cost of maintaining union catalogues, it seems unlikely that there will ever be interlending between libraries of records comparable with that existing of books.

It must never be forgotten that Musical taste does not stand still, and the record library should aim at being always a little ahead of Musical fashion rather than behind it. It really needed little prescience by anyone familiar with Musical trends on the continent to forecast the breakthrough of Schonberg and Bruckner into popular esteem a couple of years ago – exactly the same thing happened with Stravinsky in the immediate post-war years. Yet how many record librarians, indoctrinated in their student days by the English Musical press, now find themselves, as a result of basing their selection only on demand over the previous few years, cluttered with unused Vaughan Williams and Delius and over-duplicated Sibelius? Nobody familiar with the decidedly lukewarm enthusiasm for these former favourites of the English Musical scene shown by the mainstream of Musical opinion abroad could have so grossly over-estimated both their status and the lasting-power of their popularity. The, next breakthrough will be the Richard Strauss post-Ariadne operas, and the present revival-mania for Italian *bel canto* will be succeeded by a similar resurrection of French grand opera-but how many record librarians are anticipating these trends in their present stock-selection? We must learn to distinguish between popular favourites (who come and go) and composers whose works are destined to become true basic stock.

It is suggested that much the same considerations apply to determining the nature of this basic stock in records as in books. No general library worthy of the name should be lacking in works such as the plays of Shakespeare, Aeschylus, and Shaw, the poems of Milton, the novels of Dostoevsky, or such modern classics as "The Seven Pillars of Wisdom" and "Ulysses". No matter how small the readership served, somewhere in every general library system should be copies of these books; there can be no excuse for relying on interlending to obtain them. Similarly, every record library should, from its own stock, be able to supply all Beethoven's symphonies, Mozart's six great operas, and (so far as it is recorded) the whole of Wagner from "Der fliegende Hollander" onwards. It is estimated (by reference to The Gramophone Long-Playing Classical Record Catalogue) that to provide in single copies the whole of the absolutely basic repertoire would mean purchasing about 500



discs: this, of course, does not take into account the question of duplication of titles in monaural and stereophonic forms, or the provision of non-Musical records of the types discussed above.

No library, however, can subsist only on classics-the basic stock must be leavened by a liberal element of the popular and the new. In order to give the collection variety, to ensure that it is not too academic for use by the general public, and to keep its users' interest, it is suggested that not more than 50 per cent of the stock should be of the "standard classical" type-the remainder will be the serious contemporary works and light Music of lasting interest mentioned above. It would appear, then, that the minimum size for a public record collection, if it is to satisfy its users' reasonable requests from its own resources, will be about 1,000 discs, which will involve an initial cost of at least £1,500 on stock alone, to which must be added a substantial figure for equipment. The cost of establishing a satisfactorily-sized record library would, then, appear to be comparable with that for a small branch of a public library. It seems unlikely that public library authorities of so small a size that the establishment of a new branch library is a serious matter financially will be able to contemplate the provision of a gramophone record service on worthwhile lines. It is, furthermore, most desirable that in charge of a gramophone record library should be a librarian who possesses not only professional qualifications but also a sound knowledge of Music and records-a subject specialist in fact. Now subject specialists are not employed in small general libraries-there are far too few of them even in the large city, county, and university libraries and they just do not occur elsewhere.

So much for the minimal sized collections. Larger general libraries do not limit their book stocks to important English books, but attempt to acquire at any rate some representation of the trends of literature and learning throughout the world. Larger record libraries will need to apply this internationalism to their record selection. This type of library should be a little ahead of public needs, and can, by providing a combination of carefully-selected stocks and the specialist staff needed to exploit them, play an important part in the formation of taste. As, by a combination of informed selection and skilled exploitation, a library can introduce its German-speaking readers to Berthold Brecht and Hermann Kasack, so it can introduce its Music lovers to Hermann Reutter and Gottfried von Einem.

A library service which interprets its function so seriously as this, however, is taking on a responsibility which can only be effectively discharged if ample resources are available-resources of stock and staff, and also of organization for the selection and acquisition of



foreign-published material, be it books or records, is largely a matter of organisation. Great city, county, and university library services will have on their staffs not only subject specialists in Music, but also in foreign bibliography, and will maintain a wide range of foreign contacts as well as relations with specialist agencies in this country. They will subscribe to the necessary foreign bibliographies, which will be used as a basis for their activities in the foreign language field. These are not without relevance to the selection of foreign records, as the technique and organisation established in such libraries for the acquisition of foreign books will be an invaluable parallel upon which to build an organisation to do the same job for records, substituting, of course, the national record catalogues for the national bibliographies. Similarly, the channels of purchase established for foreign books will serve as a model for similar channels of record supply.

A pattern begins to emerge of the structure of a national record library service. It will consist of a number of minimal, or near-minimal, sized collections, which, together with a small number of much more comprehensive collections, should cover the whole country.

### **3.2.3 THE MEANS OF PROVISION**

Having decided that gramophone record libraries should be made available to the public by some form of corporate action, we must consider the means by which the provision is to be made. The possible means are three--central government action, the creation of an ad hoc organisation, or local government action. The first two maybe rapidly dismissed. That an existing or future department of state should take upon itself the direct provision of gramophone records, or that a nation whose whole tradition of government is against the creation of ad hoc corporations\* (the departure from this tradition in \*The fate of Mc Colvin's proposals for ad hoc library units, generally agreed to be excellent for the purpose for which they were intended, but not conforming to general-purpose areas, is surely an indication of what would happen to any future proposal for ad hoc bodies. The lack of local enthusiasm' for "joint board" police and fire services covering several local authority areas, despite strong governmental pressure in favour of them in the post-war years, is another instance 1945-50, in the creation of such corporations for nationalised industries and the National Health Service, has not been entirely happy either, in results or public opinion) should be set up for the purpose is unthinkable, We are left, therefore, with action by local authorities. This being so, there would seem to be three channels through which a local authority could provide records -by the use of the formal education system, by the setting up of a new department, or by provision through the local authority administered public library service. The use of the

last has everything to commend it, and the other two nothing to commend them: formal education has no established channel through which the provision could be made, and the establishment of a new (and very small) department within the local government service, besides being contrary to current practice (which is all in favour of integration into a relatively few large departments) would be wasteful when, in public libraries, a machinery already exists for doing just what a record collection would need to do: this point is recognised by the Ministry of Education and by the Roberts Committee both of which (the first on legal grounds and the second on grounds of policy) place the responsibility for record service firmly on public libraries. The service points are there, and the staff trained in the appropriate techniques of registration, cataloguing, and distribution are there. There is at least a skeleton of staff with the relevant subject knowledge of Music and records, and the general establishment of record libraries would lead to an increase in their number. Most important of all, public libraries in Great Britain and elsewhere have already made a substantial start in providing record collections over 80 library authorities in Britain (about 15 per cent of the total number) provide at least some records, 25 though only a small minority of these have anything which can be called a reasonable-sized stock, and no British library as yet has succeeded in applying to its record collection the standards of comprehensiveness which large cities apply to their book collections.

Public libraries, then, are the obvious means by which record collections should be made available to potential users. This being said, we must not blind ourselves to the fact that British public library areas as at present constituted are far from ideal for the purpose, mainly because most of them are far too small to possess the reasonably large financial resources necessary for providing any public library service beyond the limits of a popular lending library. This, of course, is the most pressing problem of the public library in general, of which we have heard ad nauseam in recent years and will hear a good deal more before the future pattern finally emerges by legislation. Even a quite small area can provide a satisfactory fiction and light non-fiction book service if it is prepared to levy a high rate for the purpose (there are libraries of this type operating quite efficiently at about 20,000 population). For other types of provision, however (reference, technical, Music, and records), the fact that there are certain high and irreducible unit costs involved (certain books and other material, or our 500 basic records mentioned above, that must be provided, together with subject-trained staff, no matter how small the area, in order to do the job efficiently) makes provision by very small authorities virtually impossible. For this reason, those in favour of gramophone record

libraries should actively support the attempts being made to eliminate very small library areas, locally by stressing the advantages of voluntary negotiated mergers and nationally by influencing the trend of the proposed new legislation, to ensure that the future library areas shall not only be of reasonable size, but that they shall be suited to the special needs of gramophone record service.

In this connection it should not be overlooked that the most progressive areas to date in respect of gramophone record service have been the non-county boroughs of reasonably large size, with counties and county boroughs lagging badly behind. There are probably two reasons for this: firstly, that the bulk of the larger non-county boroughs are concentrated in the London area, where influences very easily spread across the completely arbitrary boundaries between library areas, with the result that a service initiated experimentally in one area soon tends to become established practice in many areas in the same vicinity, and where financial conditions are in general much easier than in the provinces; and secondly that in non county boroughs, with their more restricted range of functions, libraries tend to be relatively more important than in counties and county boroughs, and their needs for expansion into new types of services do not get submerged under more pressing considerations as happens all too frequently in counties and county boroughs. It will be interesting to see whether the local government set-up projected for the London area (broadly that advocated by the Royal Commission on Local Government in Greater London, giving as it does far greater powers than at present to (in general much larger) London boroughs, will react to the favour of library services in an area which is, financially at least, at present well-provided in this respect, or whether the provincial county and county borough situation of libraries being a minor service dwarfed by education and other major services will become general in London also.

It is most unlikely that any new library legislation will be framed specifically for convenience in gramophone record provision. The fact that (as with all "subject departmental" schemes) only large areas with great resources could provide really comprehensive stocks of records will not commend itself to legislators, who tend to regard the library service as a pawn which can be thrown to the small authorities to leave them something to justify their existence having lost all the "important" services: we must look forward to a number of the future library authorities being of 40,000 population or less) It is obvious that, whilst the public library service will form the channel for it, 'very many of the

future, as well as the existing, public libraries will be quite incapable of themselves efficiently operating a special service such as a record library.

Efficiency is, particularly when one is concerned with establishing a minimal-sized unit, very closely allied to economy, and it seems reasonable to suggest that the smallest authorities which should themselves attempt to provide record libraries should be those which feel that they could ensure the minimum amount of use of it necessary to make the minimal-sized record library outlined above (say 1,000 discs with a specialist librarian in charge) an economical proposition: to assess this is not easy.

Whilst, therefore, it will be economically justifiable on grounds of likely use to provide gramophone record libraries in (wholly residential) areas of populations getting down towards the likely minimum size for future library authorities (some of the best and best-used of existing collections are in wealthy residential areas in that population group), there may well be (industrial) areas several times that size where a collection would not get such an amount of use as would justify its provision at the minimal level of size and efficiency outlined above. It is obvious, therefore, that considerations of the extent of provision and the extent of use are closely interrelated, and the nature (particularly, alas, the social constitution) of an area is as important as its size in determining whether the likely use of a gramophone record library would justify its provision, and if so whether at the minimal or some higher level.

One must assume that all county libraries and libraries of county boroughs (which in future! will be, in general, over 100,000 population at least and most of them substantially more<sup>29</sup>) and London boroughs (which will be 200,000 upwards<sup>30</sup>) will provide their own record libraries-it would be absurd to "It is not without significance that the Hulton Readership Survey, 1955 (p. 7) reveals that only two of an extensive list of Sunday newspapers carried a certain amount of Musical news (The Observer and the Sunday Times), and that these two were read by about a quarter of the "professional" classes and by not much more than 1 per cent of the "working" classes. The new (1961) Sunday Telegraph, which also carries a little Musical matter, also, from the nature of its general content appears to be aimed at the "middle" classes. The connection between social class and Musical consciousness does not appear to be at all as rigid in the U.S.A. as in Great Britain, for in the U.S.A. there does

seem to be a definite population level (about 100,000) at which gramophone record libraries begin to be a practical proposition (only about one library in 25 there has a record collection, but three out of four of those serving over 100,000 have one.<sup>24</sup> From observation, I would say that in France and Germany at any rate Musical audiences tend to be of much the same social classes (e.g. clerical, professional and managerial) as in Great Britain suggest that authorities charged with operating school systems and technical colleges could not efficiently administer a record library. What of the provincial urban libraries below county borough size') As suggested above, it is likely that these will be of sizes down to, and even below, 40,000 population.<sup>27</sup> Many, if not most, of these 40,000-minus to 100,000-plus areas will be of the "industrial" rather than the "residential" type, in which potential use will not justify the economical provision of a minimally-efficient sized record library. Yet they will all have a number of residents who wish to make use of record library facilities, and should not be denied them.

In theory this should result in efficiency, as it-would ensure that records were only provided by reasonably large authorities, but in practice there are two objections to it: firstly it would mean a slight complication of the rating system (in that some independent library authorities would pay two library rates, one for their own service, another to the county for the gramophone record service); secondly, as mentioned above, it is a fact that so far non-county boroughs (and in particular Metropolitan Boroughs) have been in the forefront of gramophone record provision, whilst counties and county boroughs have, with few exceptions, shown little interest in the subject. Never the less, this possibility should not be too lightly dismissed, as it is likely to be the only means of obtaining sizeable areas for the purpose-the alternative could be a proliferation of tiny, incomplete, collections, lacking even the trained staff necessary for their proper care.

The trained subject specialist librarian who should always be in charge of a gramophone record library should be acknowledged as a responsible department head, and paid as such (that is, his special qualifications and responsibilities should ensure that his post is regarded of a "more responsible character" and that he always be graded above the basic scale for chartered librarians). It seems commonsense to amalgamate the record library with the Music library where a Music library already exists, and to use the record library as an

opportunity to establish a special department for records and Music where there is no existing special Music department: gramophone record provision, then, should always form part of a special Music library, with a responsible Music librarian in charge, directly responsible to whoever the other department heads (such as the reference librarian) are responsible to (usually chief and deputy librarians), and not to any other department head.

### **3.2.4 PROGRAMME FOR SPECIFIC AUDIENCES**

Unlike Music, plays, news, features, talks and discussions which are aimed at listeners in general, there are several programmes which are directed to specific audiences, like villagers, students, women, children, tribal people, industrial workers and members of the armed forces. In this and the next two chapters we shall deal briefly with these and also with subjects like Vividh Bharati, religious broadcasts and anniversaries, sports commentaries, election broadcasts, science programmes and publicity for social welfare projects.

### **3.2.5 Rural Programmes**

The first definite attempt to introduce village broadcasting was made by the Bombay Station which started regular programmes in Marathi, Gujarati and Kannada in 1933, the first community set being installed at Bhiwandi in the Thana District. Early in 1935 the government of North West Frontier Province accepted Marconi Company's offer to loan a transmitter to be set up at Peshawar, and some village sets ('strong enough to be heard at about a hundred yards distance'), for one year on the condition that if the trials were satisfactory the former would buy the whole equipment. There were difficulties about the charging of batteries and maintenance of sets, but the programmes proved popular, and the villagers found the information imparted useful.

In 1935, the Punjab government made a grant of Rs. 48,040 for a rural broadcasting scheme with programmes for Punjab villages from the Delhi station which was to open on January 1, 1936. The scheme was placed under the charge of Mr. F.L. Brayne L.C.S., Rural Reconstruction Commissioner who took keen personal interest in the project. These broadcasts started in June 1936 as a joint venture of AIR and the Punjab government, with the former responsible for the production of programmes with the help of staff recruited from among the applicants sent by the latter. These broadcasts continued till December, 1937 when the project was transferred to the newly opened Lahore station. Thereafter, a new scheme worked out for the Delhi station was sanctioned, and inaugurated on October 16, 1938. It provided for the installation of 120 Community receivers in such villages in the Delhi

province as had a population of 600 or above. AIR also assumed responsibility for the charging and periodical replacement of batteries, and also for the maintenance of the sets.

In Bengal, Mr. P.J. Griffiths, then the District Magistrate of Midnapore, drew up a tentative scheme for rural broadcasting which envisaged the erection of a transmitter with an effective range of 70 to 100 miles (110 to 160 kilometres) and to run a local service independent of AIR. Although the Bengal government was prepared to allot Rs. 82,000/- for the purpose, the scheme was abandoned on the advice of the Controller of Broadcasting, Mr. Fielden, who pointed out among other things that the money was insufficient. It was decided instead that the Calcutta station of the then Indian State Broadcasting Service would install and maintain 15 Community Sets on behalf of the Bengal government. Even so, the scheme was not much of a success because Midnapore was too far away from Calcutta for reliable reception.

In Madras the local government decided to appoint its own radio engineer and install community sets not only in some selected villages but also in urban areas and municipal parts, the programmes being radiated on the transmitter which the city Corporation had acquired from the erstwhile Madras Radio Club. This arrangement lasted till June 16, 1938 when the AIR station opened. Thereafter AIR Madras started its own rural programmes on November 1, 1938. In Bombay, the local government purchased 18 village sets in April 1937 and installed seven of these in villages in the Thana District and nine in the Colaba District. The programmes were produced and radiated by AIR Bombay.

AIR regarded rural programmes important enough to make these an integral part of the daily transmission at each new station opened. The duration was about 30 minutes and the programmes were usually presented by two characters', both men with a village background, who invariably became very popular with listeners because in their diction and style they identified themselves with the people in the villages. The programmes were given in the evening, generally a little after sunset so that villagers could listen to these at the Panchayat Ghar or wherever the Community set was located. Talks and discussions were on agricultural problems, health Cooperatives as also on subjects dealing with eradication of illiteracy and prevalent social evils. Market rates were an essential ingredient of the programmes which also had a fair proportion of folk Music. A prominent feature was replies to listeners' letters and the village people were encouraged to send queries on whatever problems they had. These were then replied to after consulting experts where necessary. Then, as now, the emphasis in communication was on the use of simple language and the main local dialects.



Considering the growing interest of farmers in improved agricultural practices, and the realization by them that radio had proved a very good source of information and education about new techniques, the duration of rural programme has been gradually increased at most stations and today it is an hour and above every day, of which about 30 minutes are devoted to hard core information and the rest to entertainment. Effort is also made wherever possible to place the rural programme in proximity with the regional news bulletins to help the villagers towards better awareness of what is happening in the state or elsewhere. Some stations broadcast short rural programmes of seasonal interest 5 to 10 minutes daily at an hour when the farmers preparing to go to their fields. Rural programmes form about 6% of the total programme output of Akashvani.

### **3.2.6 Rural Forums**

The setting up of Radio Rural Forums in 1956 was an interesting venture jointly sponsored by the Ministry of I & B and UNESCO, at Pune from February 19 to April 26. Each Forum comprised 15 to 20 people and had its own Chairman, and a convenor who acted as the secretary. The State government appointed an Organizer in each of the five Districts of Maharashtra (Ahmed Nagar, Kolhapur, Nasik, North Satara and Pune) in which the Forums functioned covering a total of 150 villages. Each programme was of 30 minutes, on two days of the week, and related to agriculture and Forum filled in the form regarding attendance as also the comments made and queries raised in the post broadcast discussion with the Chairman and forwarded these to the District Organiser. The replies to the queries given by the experts concerned were read out at a subsequent forum meeting. The evaluation of the experiment by Mr. Paul Neurath, a U.N. expert, showed that it had been a considerable success. Mr. N.L.Chowla, S.D. Pune had with him for this series of programmes two talented script writers, Mr. D.D. Jadhav was the Organizer of Forums. The number of Farm Forums was increased but the enthusiasm about these Forums on the part of the State government seemed to have declined thereafter, and the project was discontinued.

It was decided by AIR in 1959 to make Radio Rural Forums a part of every station's rural programme and the scheme was inaugurated on December 17, 1959 with 800 Forums which were estimated to have increased to 7500 in 1964. The target for the end of the Third Five Year plan was set somewhat unrealistically at 25,000 Forums.

It has been seen time and again that the success of any plan for community listening depends ultimately on how well the State Authorities maintain the receiving sets in working



order. All India Radio should rightly have the responsibility only for the planning, production and presentation of programmes and this it must do to the best of its ability. The Vidyalankar Committee appointed by the Government had some hard things to say in its Report (1963) about the rural programmes and the facilities for listening to these in the villages. About the Community Listening Scheme formulated in 1954 under which the Centre, the States and the local Communities shared in the cost in the proportion of 50%, 25% and 25% respectively, the report said that the maintenance cost of some of the receiving sets supplied by the Ministry of Community Development was so high that it was no longer possible for the Communities to maintain these. It estimated that at any time the number of "sick sets" was about 35%.

The Vidyalankar Committee strongly endorsed the demand for extending the duration of the rural programmes to about 21 hours in the evenings and one hour each in the morning and afternoon, and recommended that this aim be achieved in the next five years. The Committee also drew attention to the comparatively little Coverage given to rural news and felt that this led to the impression that nothing newsworthy ever happened in rural India. About the rural programmes, it said these tended to 'be too much studio based, and felt that it would be good programme policy if all frequent intervals the microphone was taken to villages and recordings of off-the-cuff reactions of villagers broadcast unedited.

In its report three years later, the Chanda Committee also gave some suggestions for making the rural programmes more effective. These included imparting training in rural programmes not only to Programme Executives in AIR, Block Development Officers and village level workers but also those who participated in the programmes. It also emphasized the point that backward sections of the rural community did not benefit from the radio programmes because of the traditional obstacles in the free mixing of castes and sexes. Thus women artisans, landless labourers, Harijans were hardly represented in the audience, and, this applied also to the membership of rural forums as well as the audiences for daily programmes. According to the Committee the programmes and the messages they carried did not reach those very sections which were most in need of instruction, information and the broadening of their horizon.

The Chanda Committee also drew attention to a report in which an audit on the working of the community listening scheme in the Punjab, Himachal Pradesh, Madhya Pradesh and Rajasthan had observed (i) delays ranging from six months to five years in the distribution of receivers (ii) 25 to 30 % set not being utilized for want of repairs and (iii) 64

% of the sets in one of the States being installed in such in accessible places that they were closed for the greater part of the time.

### **3.2.7 Farm and Home Units**

An interesting development later was that in 1965 the Ministry of I & B, in consultation with the Ministry of Agriculture and Education, decided to establish 'Farm and Home Units' at ten AIR Stations (Jullundur, Lucknow, Patna, Cuttack, Raipur, Pune, Hyderabad, Bangalore, Tiruchi and Delhi) in order to provide relevant, timely and problem-oriented technical information to farmers of small homogeneous areas with similar agro-economic conditions. Each such Unit is headed by a Farm Radio Officer who is a graduate in Agriculture and has practical experience of work in villages and has received training in extension methods. He is assisted by one or two Farm Radio Reporters and a script writer. Each Unit is provided with ultra-portable tape-recording machines for recording farmers and extension workers in the field. These recordings are then suitably used in the programmes broadcast.

At the Akashvani headquarters in Delhi, the work; of the Farm and Home Units is coordinated and supervised by the Director F & H, who has a Joint Director and Farm Radio Reporter to assist him. The emphasis in these Farm and Home programmes is on a direct method of presentation, dictated by the need to convey hardcore scientific and technical information and quick timely guidance. Due stress is also laid on soil and water management, social forestry, environmental protection and ecological balance in addition to family welfare, nutrition and eradication of social evils.

The setting up of 'Farm Schools of the Air' is a recent innovation which has yielded good results, and increased awareness and the desire for learning latest agricultural techniques among the farmers. The procedure adopted is to broadcast an intensive training course on some specific agricultural or allied subject. Listeners are registered for each course, examinations are conducted at the end of the course, and prizes and certificates are awarded to those who are successful. To cite a few typical examples, AIR Bangalore's course on paddy cultivation had 23 lessons and Tiruchi's on poultry farming 31 lessons. 950 farmers registered for Delhi's course on manures and fertilizers. The enthusiasm evinced by farmers may be gauged from the very large numbers attracted by some of the stations. Thus Cuttack had over 30,000 farmers registering for different courses, with 54,000 at Sambalpur (also in Orissa), 9529 at Rajkot, 7200 at Trichur and 6682 at Madras.

A notable aspect of the scheme is that some of the prizes given to successful farmers are by various public and private organisations, such as State Co-operative (dealing with agricultural inputs like seeds, insecticides, spraying machines and marketing of the produce), Fertilizer Corporations and Nationalised Banks .

The latest figure (March 85) for the number of stations having Farm and Home Units is 64. In the broadcast of rural programmes, AIR can derive great satisfaction at having gradually won the confidence of the traditionally conservative farmers and helping them, through the use of new and improved techniques, to diversify crops, achieve higher production with obvious economic advantage to their selves and the country.

The transistor has revolutionised the pattern of listening in villages as well as in towns and cities. It must be a very poor landowner indeed who cannot afford to have such a set to give him all the information he needs about farming and getting the best out of what land he has. Villagers no longer have to go every evening to the Community Centres for the Farm & Home or the general rural programmes, although it must be said that there is much to be gained by listening in the company of other farmers and discussing matters of common interest with them and resolving doubts if any by taking to those with wider knowledge and experience. It would thus appear that the Community sets, provided they are properly located and maintained, will have a useful role to play for many years yet.

### **3.2.8 Educational Programmes**

In AIR's priorities of utility programmes for specific audiences those for schools came next after rural programmes, although for various reasons they have not been much of a success. Educational broadcasts of an occasional and informal character were first started at Bombay in January, 1929. The Corporation of Madras put over Music lessons and stories on school days from 4 to 4.30 p.m. from April 1930, on the transmitter it had taken over from the Madras Radio Club.

With the creation of a regular broadcasting service, and the opening of a powerful station at Delhi it seems to have been considered advisable to concentrate at first on the more immediately remunerative and popular types of broadcast programmes in view of the limited funds available. It was however was growing and when in 1937 the University of Calcutta and the Education Department of Bengal showed an interest in the matter, the Station Director, Calcutta was authorized to accede to their desire, as far as funds permitted. Calcutta started half-hour programmes on two days in a week from November 1937.

Thereafter all other stations were asked to start school broadcasts from October 1938, without insisting on an extensive installation of receiving centres as a condition prior to such broadcasts, since it was felt that the radiation of school programmes would in itself be the best means of stimulating interest and persuading educational institutions to equip themselves with the means of benefiting from them. In the years to come this hope and optimism was belied wherever these programmes were introduced, and the lack of programme arrangements at the receiving end has continued to be the weakest point of the system.

While school broadcasts were started at Bombay, Delhi and Madras (and continued at Calcutta) from October 1938, similar action at Lahore, Peshawar and Lucknow was postponed indefinitely 'till the financial outlook was brighter'. As on March 31, 1939 the number of institutions in India which possessed receiving sets was 83 colleges and 314 schools, making a total of 478 (including another 81 sets whose location was not clearly specified).

At the moment, school broadcasts are being heard from 65 stations, but the programmes originate at 48 stations, and the other only relay them. The duration varies from 15 to 20 minutes and the frequency is generally five or six days in the week. The programmes are broadcast both for Primary and Secondary schools, and most stations also carry one programme a week (of about 15 minutes) directed to school teachers. Bulk of the programmes are in the regional languages but some are given in English also. Programme Planning is done state-wise, with the help of education experts. A consultative panel in each State meets twice a year and gives advice on the planning and presentation of programmes.

The staff at the originating station includes a Producer, an Assistant Editor and a Production Assistant. At the Directorate General there is a Chief Producer assisted by an Assistant Director of Programmes, who keeps in touch with the Ministry of Education, and the National Council for Educational Research and Training. Ideally, a school broadcast envisages that students will listen in the classroom under the guidance of a teacher who will have received printed material in advance from the radio station on the basis of which he will explain to the boys and girls beforehand what the programme will be about. At the end of the radio lesson he would follow up the subject, explaining and annotating it as may be necessary, and answer questions put to him. In practice, this happens but rarely.

Except in certain States where some pains have been taken, the general experience is that the broadcasts are not made a part of the school's daily time-table, there is no room set apart for listening, and the receiving set is either out of order, or perhaps installed in the headmaster's room. The Chanda Committee in its Report observed that hardly any schools in cities took advantage of these programmes. Among the reasons they listed for lack of interest in school broadcasts was their not being related to the prescribed syllabus, while the problem in villages was that the programmes were felt to be urban oriented. Despite impressive statistics of the number of receiving sets stated to be installed in schools, the plain 'sad fact is that the school broadcast scheme exists mainly on paper.

It is likely that better results may be obtained through the use of tape-recordings and video cassettes supplied to schools where these can be replayed to different batches of students at hours convenient to schools instead of depending on direct relays. If the material has been prepared attractively and combines enrichment judiciously with the needs of the prescribed syllabus, and the teacher guiding the group listening is good and conscientious about the assignment, it is imaginable that school broadcasts can be made to mean very much more than they do now.

### **3.2.9 Teacher Training**

In contrast with its experience in broadcasting to school students, Akiashvani has achieved a notable success in training teachers through the medium of radio. This is illustrated by what happened in Kerala where the problem was to train 1,20,000 primary teachers, in order to effect a qualitative improvement of teaching standards with the introduction of an enriched syllabus. It was seen that this task could be attempted effectively through a Radio-cum-Correspondence Teacher Training Course, which was inaugurated for Standard VI teachers in November 1975 in a series of weekly programmes. This multi-media training programme involved the use of notes printed and circulated in advance to registered teachers who, after listening to the lesson, sent in questions to the radio teacher, whose replies were given in subsequent broadcasts. To provide personal guidance, contact classes were held at selected centres for conducting laboratory experiments and discussions on radio lessons. Finally, the result of the teacher responses and contact courses were graded and certificates issued by the State government.

Similar teacher training courses have been held successfully in Assam, Maharashtra, Madras and Gujarat. In the last named the immediate problem was the need to train English teachers for classes 6 and 7 for about 11,000 schools in the State.

### **3.2.10 The Open University**

All India Radio Delhi started 'University of the Air broadcasts' on September 7, 1966, the idea being to reinforce the efforts of the Directorate of Correspondence Courses, Delhi University. These were helpful both in providing an opportunity for studying for a degree to those who were not able to get admission to any college, and those who were doing whole-day jobs and would not be able to attend college classes anyway. In the beginning the lessons were of 30 minutes each, three times a week on the Yuva Vani Channel (Delhi D) at 7.05 a.m. In 1968 the frequency was increased to 5 times a week and the lessons given in Hindi and English for 20 minutes each.

This University of the Air idea has since been extended to Tamil Nadu where the correspondence course of the Madurai University is given a radio support with lessons recorded at Tiruchi, and copies sent to other stations in the State for simultaneous broadcast at 10.30 p.m. Likewise, the correspondence courses of the Punjab University and the Punjabi University are supported with broadcasts from the Jullundur Station.

### **3.2.11 Non-Formal Education**

The rapid growth of our population and the difficulties of meeting the consequent educational needs not only at the school but also at higher levels, the extent of illiteracy and the problem of drop-outs in rural areas especially, all seem to point to radio as an important known as non-formal education. Experience elsewhere in the world also encourages this belief because radio is not only very pervasive but also the cheapest of the mass media.

Already, Akashvani is being used in several ways to impart education, as in rural and Farm and Home programmes. More specifically five of the AIR stations at Jaipur, Nagpur, Simla, Srinagar and Tiruchi are putting over non-formal education (N.F.E) programmes for young people between 15 and 25 years of age in the villages. Tiruchi also broadcasts such programmes for the lower age group of 6 to 14 years also.

### **3.2.12 Programmes for Women and Children**

For reasons which are not always clear, but can only be guessed at, these two programmes have always been talked about or organised at the stations, together. It could be

that mothers have (or should have) an encouraging hand at home, getting little boys and girls to listen to the generally varied and interesting fare put over for them. In the Report on Broadcasting (1940) there is no mention about either of these programmes, which indicates that these must have been introduced in a regular way only after March 1939. However, Awasthy is probably right when he says in his book that the programmes given by the Madras Corporation from its station from April 1, 1930, for primary class students in Tamil, could rightly be called the earlier children's programmes. Most old AIR hands recall that the children's programmes were the first to be started, and were given on Sunday mornings, and that there were almost always several kids present in the studio itself as an audience.

These proved quite popular, and there was a sizable fan mail with many requests for being allowed to sit in the studios to watch and listen while the programme was on. These broadcasts were usually compered by stock characters like 'bhaiyya' (elder brother), or 'didi' (sister) who became identified with the little listeners as part of their families. At North Indian stations like Delhi, Lahore, Lucknow and Peshawar these comperes were also called 'Khala' (auntie) and 'mamoon jan' (maternal uncle).

It was decided in the Station Directors' conference held in 1950 that the children's programmes should henceforth be for two age groups, the older ones of about 8 to 14 years, and the younger 'tiny tots' of around 4 to 8 years, but these limits were never clearly indicated. P.c. Chatterji has commented in 'Two Voices' on the need to carry out studies to examine how the content and the style of the presentation of programmes for the two age groups should differ, and to determine the best duration for each item (to avoid tiring the children whose minds are prone to wander off unless the programme is very interesting) and what element of repetition there should be in each broadcast so that clear impressions are left on the young mind.

In 1959 it was decided, wisely according to this writer, that such programmes need not be presented by children. The most important thing is that the programmes should be for children', and nothing much is to be gained by making these also 'by children.' Experience and personal observation seem to suggest that children like a 'father' or 'elder brother or sister' figure to be conducting the programme and holding it together. Also, if there is advice or guidance to give, the young ones will take it more readily and naturally from one who is senior to them, and whose voice carries a measure of authority.



The quality and effectiveness of the programmes for children has always depended upon the personality, imagination and the interest taken by the Programme Assistant (Executive) or the Producer, and how successfully he is able to enlist the co-operation of those writers and speakers who have a flair for communicating with children, and to encourage them to keep up a steady flow of fresh ideas and ways of presentation. It would seem appropriate to close this section with a quotation from the Verghese Group Report: would feel that the children's Programme merits the greatest attention and the very best production talent. This is where cultural tastes can be influenced and interests awakened in the world around."

### **3.2.13 Women's Programmes**

Although the need for special programmes for women was not felt as spontaneously as those for villages, school students and children when All India Radio first started operating, it became evident gradually that these could serve a useful purpose, especially in the Indian context. In most of our homes there is only a limited amount of time when, with men away to work and children away to school, women can be free for a while from cooking and other domestic chores. Apart from that, women do have certain areas of special interest which need catering to although it has been argued sometimes that forming, as they do, almost half of the population they should be able to listen to and benefit from the general programmes of entertainment and education, as men do.

At the moment all stations broadcast one or more such programmes every week, the usual duration being around 30 minutes. Multilingual stations like Bombay have separate programmes in Marathi and Gujarati. Delhi puts over five of these in a week from 12.30 to 1.05 p.m., of which two (Wednesdays and Fridays) are directed to women in neighborhood villages within the station's reception range, and such homes in the city where the families have lately migrated from villages and small towns, and not yet become quite urbanised in their ways.

In the programmes, usually compered by one or two women on the station's own staff, the emphasis has understandably shifted over the years from cooking, sewing, making of pickles, and beauty hints, to family welfare, including nutrition, health, child education, family planning, problems of working women, legal rights and oilier aspects of social equality between men and women. At present there are 22 full-fledged Family Planning Units each consisting of one Extension officer, one Field Reporter and one script writer, and 14



small units at other AIR stations consisting of one Field Reporter only. The annual reports of the Ministry of Information and Broadcasting did for several years take of women's listening clubs, as also similar clubs for group listening by children, but it is doubtful if these have made any headway. Listening to programmes-even in villages has increasingly become a personal and individual activity, especially with the advent of portable and low cost transistors, and it is best that it remains so. The time and effort of the Akashvani staff could be more usefully employed in improving the programmes rather than organising and sustaining listening clubs, against obvious odds.

Conditions in India are not quite the same as in England, but it is useful to recall that the Beveridge Committee report on the BRC described the Women's Hour as the most effective piece of mass education in the whole of BBC output. It has been noticed in U.K. that a very large proportion of women listen to school broadcasts because they want to keep up with their children at school, so as not to be treated by the latter as ignoramuses. In the field of adult education too, therefore, women listening at home have a very vital part to play in the society.

### **3.3 RADIO ENGINEERING**

One half of a total broadcasting system consists of a sound source and pick-up devices (microphones) placed in a controlled acoustical environment (studio), a Control Room self-up and the transmitting station with its associated radiator. The propagation medium to which the radiator of the transmitting station is coupled and the receiver constitute the other half of the system.

#### **3.3.1 Sound Source**

Sound sources give rise to audio frequency waves which consist of a series of compressions and rarefactions in the air, or simply stated, variations in air pressure. The rate at which these variations occur defines the wave frequency. The frequencies which can be perceived by the human ear are limited in range. At the lower end a sense of feeling preceding the sense of hearing takes place at approximately 16Hz (cycles/sec). The upper limit of hearing for young people is of the order of 16 KHz (Kilocycles/sec), decreasing to approximately 12 KHz for older people. The variations in air pressure generated by the sound source are intercepted by suitably generated by the sound source are intercepted by suitably placed pick-up devices (microphones). The devices basically convert acoustical energy into corresponding electrical variations. The quality of the electrical output derived from

microphones depends very largely on the characteristics of the environment in which these and the sound sources are located.

### **3.3.2 STUDIO ACOUSTICS**

A room is said to be 'dead' if there is little or no reflection of a sound wave from the walls and the ceiling. The location in a room is completely 'dead' if any sound originating from that location never returns to it in the shape of a reflected wave. A microphone placed in the 'dead' position picks up only the sound emanating directly from the source. The effect is usual the other hand, a live room is one in which a great deal of reflection takes place and sound returns to its source several times, with diminishing intensity, till it completely dies out. An clarity and poor articulation where spoken word is involved. The terms 'dead' and 'live' thus basically signify reverberation. It is effectively controlled by varying the absorption caused by the wall surfaces within the studio. This is achieved by affixing absorbing material on the walls as well as the ceiling and by judicious arrangement of furnishings so that the best effect is obtained. This process commonly called acoustic treatment, helps also to achieve sound proofing characteristics or in other words, the rejection of unwanted extraneous sounds. The ideal value of absorption depends upon a number of factors such as the dimension of the room the number of performers likely to be present and the instruments involved. The properties of the absorbing material tend to be frequency sensitive and particular skill is therefore, necessary to ensure that its action is efficient at all audio frequencies.

### **3.3.3 PLACEMENT OF MICROPHONES**

Even after the optimal adjustment of room acoustics, it is necessary to employ special techniques in the placement of microphones and in seating the artist, before the microphones so as to achieve the best balance. These techniques aim at building up a proper volume relationship and time-lag between the original and reflected sound. This objective is achieved principally by adjusting the distance between the sound source and the microphones and between the reflectors and the microphone assumes particular importance in the case of programmes originating from locations remote from the studio complex (as in the case of Outside Broadcasts) since in this case the acoustic conditions already prevailing at the location must necessarily be met.

### 3.3.4 MICROPHONES

A crucially important action in the process of producing a programme is the proper selection of microphones. It should be said at the outset that while multi-microphone pick up is not unusual in broadcasting it is most often preferred to use as few microphones as possible an improperly placed combination of microphones may tend to create impairments which, in effect, are akin to poor acoustics. A microphone produces high fidelity electrical output only when it exactly follows the impinging sound impulses. In order to do this the microphone must satisfy the following conditions.

- ❖ Respond equally well to all frequencies in the audio rang;
- ❖ Not add extra frequencies which do not exist in the original sound (harmonic distortion);
- ❖ Not by itself generate electrical noise.
- ❖ Capability to produce sufficient electrical output for the smallest perceivable value of sound pressure (sensitivity).
- ❖ The microphone should additionally be:
- ❖ Acoustically transparent so that it does not presence; distort the wave-front;
- ❖ Free from acoustical resonance.

A high-fidelity microphone is also often called an objective microphone. Contrary to what might be expected, completely objective reproduction is not always preferred by broadcasters; a good producer often desires a modification that heightens the effect intended to be created. Some microphones are designed dent sound. These directional microphones are extensively used, not merely to achieve the best balance but also to reject extraneous noise.

### 3.3.5 PROGRAMME LINKS

For maximal, coverage, broadcast transmitters are usually located away from .the' town. This helps to isolate the radiator (antenna) from tall buildings and other structures which would absorb radiated energy and otherwise distort, the radiation pattern. Contrarily the studio centres are situated within the towns for the convenience of the programme talent. The separate location of the studio centre and the transmitter necessitates in connection by telephone lines which by proper treatment, are; especially engineered for broadcast services.

These lines must provide uniform frequency transmission characteristics over the largest audio range. It is also common practice to provide back-up FM radio links which ensure the continuity, of transmission even in, the event of any failure of the inter connecting telephone lines.

### **3.3.6 TRANSMITTING STATION**

A transmitting station Consists of the transmitted proper, the radiating system, the radio frequency transmission line interconnecting the two, and ancillaries like the speech input equipment, power plant and the air-conditioning set-up. The transmitter by itself is the apparatus where a radio frequency wave is ,generated, amplified, modulated and then delivered to the radiator (modulation is the process by which the audio frequency signal is impressed upon the radio frequency wave, called the carrier). The transmitter may be Amplitude Modulated (AM) or Frequency Modulated (PM). In the former" the intensity of the radio frequency carrier is varied in accordance with the programme signal. In FM it is the frequency of the carrier which is varied. The band of frequencies occupied by the radiated electromagnetic wave depends on the type of modulation, typical values being 20. KHz is AM and 180 KHz in PM. The power level of the transmitter is determined by the coverage desired to' be achieved, having in mind the operating frequency. The limits of the coverage area are set by atmospheric liaise. (caused largely by thunderstorm activity), man-made interference (caused by automobile ignition systems, untended radiation from electrical appliances etc.) or, more likely, by interference from other transmitters operating on the same or adjacent frequencies. The speech input equipment at the transmitting station consists essentially of amplifiers which raise the incoming audio frequency signals (from the studio centre) to the level necessary for the transmitter, limiters which prevent excessive modulation and consequential distortion, and monitoring facilities which help to keep continuous check On the quality of the signal. The terminal point of the sending end of the broadcasting system is the radiator which consists of the antenna, together with the antenna-ground system where it is provided to minimise losses. An antenna functions in essence, as an open oscillatory circuit which has it inductance and capacity distributed over a large area so that most of the energy flowing in the system is radiated in the form of variations in the intensity of electrical and magnetic fields to be eventually intercepted by the antennas associated with receivers.

### **3.3.7 FREQUENCY MANAGEMENT**

To avoid overlapping of assigned frequencies and the resulting interference, it is necessary that each station must operate on a particular pre-determined frequency which must not drift by more than a very small permissible tolerance. There are limited number of channels available for assignment in the frequency bands allocated in the Radio Regulations for the broadcasting service. Since the number of transmitters in operation greatly exceeds the number of available frequency channels, multiple use of common frequencies is unavoidable. It is necessary however, that re-use of the same frequency must be made in perfectly compatible manner. This requires close coordination between various countries', especially those in the neighbourhood of each other. The essence of this coordination process is the spacing of transmitters operating on the same or adjacent frequencies at distances sufficiently far apart so that in any service area the unwanted, or the interfering, signal is lower than the wanted signal by a prescribed minimum value. The need for international discipline has been recognised in the establishment of the International Frequency Registration Board (IFRB) which is one of the Organs of the International Telecommunication Union (ITU). It is the responsibility of the IFRB to ensure that radio transmissions emanating from the territories of the member countries are compatible and do not cause mutual interference. In India and other countries of the Asia and Pacific region, the frequencies assigned to broadcast stations may be from one of the following hands:

Medium Frequency (Medium wave) band: 525-1605 KHz (Kilo Hertz).

High Frequency (Short wave) band: 3-30 MHz (Mega Hertz).

As a general principle, the first two bands support the Amplitude Modulated (AM) transmission systems. FM transmissions, because of band-width considerations are confined only to the VHF band.

### **3.3.8 PROPAGATION**

The basic distinction between the above three bands results from differences in the mode of propagation. Medium frequencies travel along the ground and tend to hug the earth surface. At night they are also reflected by the ionosphere enveloping the earth and reach longer distances. Services radiated in the MF band are generally stable and therefore preferred for domestic service. The high frequencies are propagated solely by reflection of the radiated beam by the ionospheric layers (60 to 400 Km above earth's surface). Since the existence of these layers is attributed to the action of solar radiation on atmosphere, the

characteristics of these layers are susceptible to diurnal and 'Seasonal variation. Significant, usually predictable, changes also occur with the cyclical variations in solar activity of which the susceptible to diurnal and seasonal variation. Significant, usually predictable, charges also occur with the cyclical variations in solar activity of which the sunspot number is a good index. Because of the resulting instability, high frequency transmission provides only a second quality service and require continual management for optimization. The advantage of course, is that they reach very long distances and provide the means to the broadcasters to establish international programme services. In the VHF band, the propagation is essentially limited to the line of sight which repropagation is essentially limited to the line of sight which requires that high antenna towers be used. The chief advantages of VHF transmission are high fidelity and less susceptibility to interference and noise. The disadvantage, apart from the necessity of high tower structures, is the relatively greater cost of receiving equipment.

### **3.3.9 SATELLITE SYSTEMS**

The recent advances in space technology have made it possible to use communication to support very long distance transmission of radio, signals, Especially favoured are the geostationary satellites which are placed directly above the Equator and at a height of approximately 36000 km. Since the satellite is made to move at the same speed and in the same sense as the earth itself, to any observer at any point on the earth's surface the satellite appears to be stationary. A geo-stationary satellite when used as a communication platform functions as a repeater in Space, and -enables the signal to be delivered at extremely large distances. A satellite may be used in the broadcasting service either, for direct broadcasting or simply for the long distance transportation of programme signals to be rebroadcast from terrestrial transmitters. In the latter case the satellite renders' more or less the same function as in the case of telecommunications where it is necessary to employ large earth stations, both at the transmitting as well as the receiving end. On the other hand, in the former case the signal delivered in the service area is designed to be sufficiently strong to be picked up by relatively inexpensive receivers. The type of application determines the size and the technical features of the space system. Recognising the potential of a satellite repeater, AIR has decided to participate in the INSAT mission for the country-wide distribution, of centrally or regionally originated programme services, such as the news bulletins. AIR has' also recognised the possibility that at a future point in time it might become desirable to establish direct satellite based services in the individual reception mode permitting direct-to-home broad,. Casting, The necessary provision was, therefore, sought and obtained in the frequency

assignment plan formulated at a Conference convened by the ITU in the year 1977 for the assignment of frequencies in the 12 GHz (Giga Hertz) band. The Radio Regulations allocate the following frequency bands to the broadcasting satellite service (BSS).

In addition the future possibility of allocating a frequency band in the vicinity of 1 GHz is being internationally explored. Initial assessment indicates that in this band, it may be possible to achieve satisfactory reception with inexpensive and portable receivers such as may be provided in the automobiles.

### **3.4 SELF ASSESSMENT QUESTIONS**

1. Explain about the General accoustics with suitable examples
2. Write short notes on:
  - a. Studio Accoustics
  - b. Radio Engineering
  - c. Frequency managemant
  - d. Satellite Systems

### **3.5 REFERENCE BOOKS**

1. South Indain Music (Book - II) by Prof.P.Sambamurthy.
2. [https://chandrakantha.com/articles/electronic\\_aids/el\\_aids\\_music\\_ed.html](https://chandrakantha.com/articles/electronic_aids/el_aids_music_ed.html) for Eloc tonic aids in music Education

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## UNIT - IV

### ACCOUNSTICS OF CONCERT HALLS – ECHO – REQUIREMENTS OF OPEN – AIR THEATRE AND CONCERT HALL

#### 4.0 OBJECTIVES

This unit gives knowledge in

1. Acoustics of concert halls
2. Sound Proof Theatres
3. Echo- Open – theatre
4. Acoustic marvels

#### 4.1 GENERAL ACOUSTICS

A Musical note is produced by a continued vibration of regular frequency. A complete vibration is a whole to and from movement. Musical notes are measured in terms of vibrations per second. The pitch of frequency of (a note in its number of complete a note in its number of complete) vibrations per second is called acoustics.

If the frequencies of two notes bear the ratio of 2:1 the former note will be found to be the active note of the latter. This relationship is called divigunathva. The octave notes bear the dviguna relationship.

In other words if the pitch of a note, say like the madhyasthayi Antara gundhara is equal to 300 vibrations per second the pitch of the Antaragandhara of the Tarasthayi will be equal to 600 vibrations per second.

A  $\frac{9}{8}$  interval is called major tone and is chatusruti interval.

A  $\frac{10}{9}$  interval is called major tone and it is Trisruti interval.

A  $\frac{16}{15}$  interval is called semi tone and it is called Dvisruti interval. The chatusruti rishabha is

a major tone above the shadja  $1 \times \frac{9}{8} = \frac{9}{8}$  the Antara gandhara is a mirror tone above the

chatusruti rishabha  $\frac{9}{8} \times \frac{10}{9} = \frac{5}{4}$  the Suddha madhyama is a semi tone above the

Antaragandhara  $\frac{5}{4} \times \frac{16}{15} = \frac{4}{3}$ .



The major tone and the minor tone differ by an interval called  $\left(\frac{81}{80}\right)$  pramanasruti.

### Table

Giving the relative frequencies of the swaras of the Sankarabharana and Mayamalavagoula scales, assuming Sa = 240 Vibrations per second.

Name of Raga	Relative frequencies of the Swaras							
	S	R	G	M	P	D	N	S
Sankarabharanam	1	$\frac{9}{8}$	$\frac{5}{4}$	$\frac{4}{3}$	$\frac{3}{2}$	$\frac{24}{16}$	$\frac{15}{8}$	480
	240	270	300	320	360	405	450	
Mayamalavagaula		$\frac{16}{15}$	$\frac{5}{4}$	$\frac{4}{3}$	$\frac{3}{2}$	$\frac{8}{5}$	$\frac{15}{8}$	480
	240	256	300	320	360	384	450	

The sthayi is produced in the ratio of 1,2,4,8 etc. This is geometrical progression. In consequence the vibrations numbers of the corresponding notes of the they is also produced in stance the vibrations numbers of the note of in the different sthayis

Are in the following ratio

$$\begin{array}{cccc} g & g & G & g \\ 1 & 2 & 4 & 8 \end{array}$$

### Some problems

Problem 1. The tarasthayi suddha madhyama is equal to 640 vibrations per second what is the frequency of mandra sthayi pancha ma ?

$$M = 640, S = 640 \times \frac{3}{4} = 480$$

$$\therefore S = 240 \times \frac{3}{2} = 180$$

Problem 2. Two notes have the frequency 320 and 480 vibrations per second respectively. Assuming the note of the lower pitch to be Antaragandhara determine the other note.

Antara gandhara = 320 vibrations per second

$$\therefore \text{Shadja} = 320 \div \frac{5}{4} \text{ i.e. } 320 \times \frac{4}{5} = 256, \text{ No. } \frac{480}{256} = \frac{15}{8} \text{ Kakalinishada}$$

#### 4.1.1 Production and transmission of sounds - Reflexions of sounds

There are Musical concert halls to perform concerts. These are all in the shape of rectangular (Deartha Chaturasram)

In our atmosphere the velocity of the sound is 1100 feet for a second. If our ear wants to listen 2 sounds separately there should be 1/8 second difference in between them.

$\therefore \frac{1100}{8} = 137\frac{1}{2}$  i.e., we will listen to a sound from a place where it is produced in 1/8 seconds (we will listen it separately in 1/8 seconds. It will take 1/8 seconds to reach our ear. It will travel in between 137½ feet. If we produce any sound, it will reach us separately when any solid substance attacks us in the distance of  $68\frac{3}{4}$  feet i.e. half of the distance in  $37\frac{1}{2}$  feet. That is the error of echo.

So any concert hall should have the limitation in the length of this estimation. So it will be in correct position if the length of the hall will be in 60 feet. If the width of the hall will be in 40 feet it will be in the position of correct measurements. When the sound will reach the hard walls of the room it will again reach back and now and there it will be accumulated. This error is called reverberation. To remove this error we have to arrange smooth pads to the walls smooth carpet on the floor, and the chairs, smooth and soft pillows on the hard walls and seats are some of the modifications to take care of avoiding revibrations we have to arrange triangular shaped flags or paper decorations to avoid this revibration.

If we arrange the portraits of vageyakaras on the walls of the walls and slogans of Music here and there it will be so pleasant in a concert hall and it will create spiritual atmosphere also

#### 4.1.2 Lakshanas of concert halls, open air theatres

1. The sound must be listened wherever the listener is in the concert hall.

2. The walls of the concert room should be in a position of preventing the sounds of outside.
3. The sound of Music should be heard in a balanced way rather than higher or low.
4. The timber of the sound (Nadaguna should be clear).
5. The sound should be conveyed all over the hall without accumulating the vibrations anywhere.
6. The sound produced in a particular time should be accurate and it should not disturb the sound which follows the first.

#### **4.1.3 Concert rooms**

The orchestras in coirs normally produce big sounds in auditoriums or speakers also face this there should be soft and smooth carpet in beneath the gayakas or vidwans in a way by which the timber or nadaguna will be increased.

When rehearsals are going on in the concert rooms there thick screens should be arranged. If there is group of audience in more in number then also the timber will be enhanced without any disturbance.

#### **4.1.4 Resonance**

There may be high and low stages in listening any sound. The reason of producing the sound will be in resonators in stringed instruments the wind will be vibrated and it will be produced in higher and it will be produced in higher dwigunathuam because of the resonator in the pot like shaped instruments (Veena Kunda – Dandi etc).

There is this arrangement in sushira and vayuvadyamulu. In these wind instruments, the sound will be vibrated so many times and it will be so clear with timbre or Nadagunam.

In stringed instruments like veen and gotuvaidyam there will be round shaped pot sorakaya Burra in violin. Bas Bar – Two sides of the Bridge. Like wise in wind instruments. There will be already the wind occupied and the sound will be in very good timber. This nada gunam depends upon the therum of law livers law. The perfect nutting or fitting of the strength also plays an important role.

#### **4.1.5 Sound Proof Theatres**

Sound proof theatres are those which prevent the outside sound entering into the theatre and which prevent the inner sound to the out and keeping the sound in the theatre it

self sound proof means the preventing arrangement of sound inner to outside and outer to inside when constructing the palaces, it is necessary to construct them in a manner of above so that the practice also may be perfect. There will be an inner box arrangement in sound proof theatres. The inner room and also outer room should be in a manner so that the connection should not be linkup. The inner box, screws, the iron pins washers, Bushes - like this we will plan the sound not spreading out. There must be absorbing materials in between the two cells. Then it may be called as sound proof one. If we want to lighten double of the sound in frequency we have to construct a special wall.

#### **4.1.6 Open – theatre**

There will be an open place with both sides of the walls. The over roof will be opened. There should be a stage arranged and in front of it so many people will sit. There will be a convenient place to the people who sit comfortably and listen to Music.

If there is gallery for the audience it will be so fine and the sound will be clear. Both sides of the walls in between open air this type of construction is positive for hearing the stage concert. The sound will touch the two sides of the walls and gives echo and the audience will be able to listen it clearly. The walls of the opening theatre should be closed with an old paper of ½" and a carpet on the floor to be kept so that the stage can convey the sound clearly to the people.

In western countries also Music plays an important role in the life cycle of humanity. There are so many Music halls and theatres to perform Music concerts and practice without difference in caste religion young and old in the people. These Music halls theatres sabha mantapas are helping in progressing the youth and inculcating Music aptitude in the contributors of arts and others.

They are giving so much of knowledge and progress of Music. The universities and laboratories of Music are very much helpful in giving knowledge of Musical aptitude. These are all beautifully decorated and each city / counties 2 or more palaces.

The grand open house in Paris is really a heaven. There will be 2000 people in a vast Mandapam or hall sitting in gallery and looking clearly through the glasses arranged in the opera. The time instruction also there and punctuality is maintained by the conductors.

There is status of Mondelson in Gevanduwonhz opera palace which is famous in the world useful. There are very attractive glasses and wooden in Square and one attractive thing

is the construction of specially made Cimmant squares and also wooden squares. In this type of construction the vibrations of sound will revibrative so beautifully and there.

#### 4.1.7 Musical Observatories

These Musical observatories are the sound proof walled constructions. In these buildings 600 to 800 pupil are practicing. There will be two rooms one bigger in size and another smaller. They will perform the concert conveniently.

Gevandwouhz building has two wonderful constructions of round wheel and the opera house is constructed with sound proof system. Mandalsen is the person who founded conservatories in lipzig. He is the great founder of 16000 feet tube in the world largest building, Gevandwouhz.

The atmosphere there will be in a pleasant sense that even the new person can be attracted by those arrangements. Even the quarter tones of the Musical notes can be performed there as the cover of the upper portion is arranged so. This also acts an educational system for the students.

Munich Germany, Holland, Nutrich – those countries have the clock towers of Music the military Music also can be listened now and then.

“Acoustics” is the science of sound as studied by physicist with reference to a single sound all that goes in its production by the human voice or stringed wind and in percussion instruments. It is Nadasastra.

A Musical Note (Swara) : it has three Qualities

1. Pitch : Sruti high or low
2. Loudness or Intensity
3. Timbre by which two human ear distinguishes what instrument generates the note say a Violin, Veena, Nada Swara, Gotuvadyam, Flute, Clarinet etc.

**Tone:** A simple tone is produced by the tuning fork. It has a single frequency.

A complex tone is produced by a fundamental pitch and a few harmonics (overtones) Anuranana or swayambhoo swaras as emitted by a violinstring.

The bamboo flute gives out practically a simple tone for each note except for a faint octave, though each note may be played in a higher or lower octave (Sthayi) by altering the pleasure of the blown air.

**Music :** It is not only a mere sound of pressure between the layers of the larynx but – a divine and melodic consonant sound will be produced in a human voice the same production of the sound on instrumental is that it should approximate to the graces of human voice.

#### **4.1.8 Sruti (Relative Frequency or Pitch)**

Long before any thing is known about pitch numbers or the means of counting them, Pythagoras has discovered that if a string is divided into two parts by a bridge, in such a way as to give two constant Musical tones when structure the length of these parts must be in the ratio of these whole numbers. If the bridge is so placed that  $\frac{2}{3}$  of the string lie to the right, and  $\frac{1}{3}$ <sup>rd</sup> of the left so that the two lengths are in ratio  $\frac{2}{1}$ . They produce an interval of an octave the greater length giving the deeper tone. Placing the bridge so that  $\frac{3}{5}$  of the string lie on the right, and  $\frac{2}{5}$  the on the left ratio of the two lengths is  $\frac{3}{2}$  and the interval is a fifth. These measurements have been executed with great precision by the Greek Musicians and has given rise to a system of tones contrived with considerable art for these measurements they used a peculiar instrument the monochord, consisting of a sounding board and box on which a single string was stretched with a scale below so as to set the bridge currently “Helmholtz” – scientist.

The Vibrational values of the notes were worked out however very late in the 17<sup>th</sup> century by means of what is called a Siren. It is just a thin disc of card board or thin plate which can be set in rapid rotation about its axis by means of a string which passes over a larger wheel. On the margin of the disc, there is punched a set of holes at equal intervals. These holes may number 16 at the top most circle, that is nearest the edge and in smaller concentric circles they may be reduced to 12, 10 and 8 respectively in each circle. If air is blown through a tube along each circle notes are produced and the relative pitches can be determined from the note arising from each set of holes by the ear.

Hence it follows firstly that the pitch of a tone depends only on the number of puffs or swings and note on their form intensity or method of production. Further it is very easily seen with this instrument that on increasing the velocity of rotation and consequently the number of puffs produced in a second the pitch becomes sharper or higher. The same result ensures if maintaining a uniform velocity of rotation we first blow into a series with a smaller and then into a higher number of holes.

The European Music gives major ( $\frac{1,5}{4}$  and  $\frac{3}{2}$ ) minor  $\frac{1,6}{5}$  and  $\frac{3}{2}$  and also semitone (Dvisruti) Equal temperament the octave of piano is divided into 12 equal intervals

i.e., each interval being mathematically the 12 root of 2 since the octave is frequency. Compared with fundamental the European generally works out the ratio is equal to 1200 cyclic cents each cyclic cent being 100.

As for every fundamental pitch of a singer, the listener is able to say that Music is true in every raga which the artist sings or plays it will be arising harmonic notes such as Sa and Pa of the drone.

The harmonica stepping is more noticeable on the violin and was actually noticed by Subbarama Deekshithar's book. The Orthodox tradition about the higher sruti of a selected swara as used in ascent and the lower sruti of the same swara (Avarohana) is maintained.

Thus the Music has the science of acoustics with aesthetic beauties.

## **4.2 SOME ACOUSTIC MARVELS**

India is a land of acoustic marvels. The requisites of concert halls and open air theatres as well as the laws pertaining to sound were known and understood centuries ago. Some of them have been put in practice. The facts relating to velocity of sound in air and sounds traveling in spherical waves, were known and utilized by Tirumal Naik, who ruled over Madurai in the early 17th Century.

### **4.2.1 Nagara Mantapam**

Tirumal Naik was a devotee of Sri Andal of Srivilliputtur. He would not take his mid day meal until he knows that the *uchchikalapuja* for Andal was over. In his days there were neither telegraphic nor telephonic facilities. He therefore installed a number of drum stations (Nagara mantapas) between Madurai and Srivilliputtur along the road side. When the mid day Puja for Sri Andal was over a particular rhythmic sequence (*jati* or *bol*) was played on the drum, at the Srivilliputtur temple. This *jati* is picked up by the person in the next drum station and he repeated the performance. This was picked up by the person in the third drum station and he played the same rhythmic sequence continued till the man in the drum station at Madurai temple heard it and played the *jati* sequence on his drum. Tirumal Naik thus got the message in five minutes and then he took his mid day meals.

Sound travels 1100 feet per second in air since sound travels in spherical waves the person at the earlier drum station also heard the *jati* sequence played by the man at the forward station and he got the confirmation that his message had been picked up and acted upon by the person at the next station. Some of these Nagara mantapas which are about 12 x

12 x 12, can still be seen though in a dilapidated condition on the Srivilliputtur – Madurai road.

#### **4.2.2 The Hallow Gopuram**

In the big temple in Thanjavur one can witness the phenomenon of intermittent reflections of sound. The tower of the big temple is hollow in side standing the near the peripheral part of the base, if one sings a phrase like of ga, ma, pa in Sankara bharana raga it can be heard at least six times the untensity of the reflection sound is followed by an alternate period of silence.

#### **4.2.3 Reflecting Board in Golkonda**

In Golkonda fortress (near Hyderabad) the palace of the ruler is situated at an elevation and at some distance from the entrance. This palace is near the cell where the great Bhaktha Bhadrachala Ramadasa entrance came near the fortress and was reflected by a flat wall situated about a furlongs away. This reflected sound reached the ruler immediately and he was put on the alert one can experience this phenomenon even today.

#### **4.2.4 Open air Theatre**

There are beautiful open air theatre in Nagarajumaknoda. These theatres have walls on all the four sides and there is no roof. There is lerraced accommodation opposite the stage for people to set upon.

#### **4.2.5. Sangeethamahahal**

The sangeethamahahal in Thanjavur built more than three hundred years ago is an ideal concert hall. This is rectangular in shape. This hall remains one of the concert hall of Gewandwhus in Leipzing - Germany.

In the Sangeethamahahal there seems to have been an aqueduct under with the floor and which facilitated the transmission of sound from the stage to the extreme end of the auditions but no trace of this exists now in this hall even the faint notes reduced on the veena could be heard clearly at the entrance at the other end.

#### **4.2.6 Tiger Cave**

The tiger cave situated about three miles to the north of Mahabalipuram is not known as well as it should be on a pieces of flat rock a small rectangular chamber are extremely 87 inches long at the back, 84 inches long at the front and four feet broad. The side walls slightly



coverage towards the front the height of the ceiling is 74 inches at the back and 70 inches at the front. Thus the roof of the chamber instead of being quite horizontal is slightly inclined towards the ground. The edge of the top part is gracefully carved down to Kodungai.

There are four steps scooped out in rock leading to this chamber. When one sings or plays on an instrument from the cell it is heard clearly all round from a distance of more than 500 feet the tone colour and the timbre of the voice and the instruments are heard all the purity. Within the oblong chamber sitting accommodation is provided for a party of four performances. The back wall of the chamber is slightly concave. The chamber faces east and the roaring sea is just about two furlongs off. There is a sandy room and listen to the Music performed clearly and in absolute peace. The ideal place for one to sit and perform is just above the steps and near the edge of the front of the chamber. The Music is strengthened by the reflections from the back the roof and the sides. There is Nadakkattu. Even the yazh with its delicate tones on the Swaramandala could be heard in obsolete at present there is a small square yard 60 feet by 60 feet and about 10 feet below the chamber and in front of it. The name Tiger cavers a misnomer the more appropriate name for this will be yalimantapam for there are among the sculptured pieces on the rock face heads of several yalis beautifully carved. This open air theatre was sculptured during the time of Narasimha Varma-II (8<sup>th</sup> centuries).

#### **4.2.7 Harmonic Series**

A harmonic series of notes is a series of notes whose vibration numbers progress in the following proportions 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 etc. This is arithmetical proportion.

If a structured string like that of veena tambura or veena is plucked or bowed, the string vibrates as a whole. The amplitude of vibration is greatest at the centre, and this part of the string is called antinode. The two ends on either side of the vibrations length of the string are at rest and they are called the nodes. A node is a place where there is no motion.

Every performer on a stringed instrument like the veena or the violin knows that:

1. When he plays on open strings the entire length of the string vibrates.
2. When he stops the string by pressing his finger against the finger board he makes only a portion of its length i.e. the length between the bridge and the finger to vibrate.
3. With the shortening of this vibrating length of the string the pitch increases.
4. With the increase in the tension of the string the pitch increases.

5. Also that thicker strings give notes of lesser pitch

These truths are summed up in the following laws relating to the transverse vibrations of strings.

1. The pitch of a string is inversely proportional to its thickness.

Thus when the vibrating column of air is lengthened by closing more finger holes from the mouth hole end the pitch is decreased and vice versa.

In the Mridangam, shorter the are of the drum head, higher the pitch. In the human voice, greater the length of the vocal cords less the pitch compared with womens voices, because of the greater length of vocal cords in mens voices. Direct law is a case where in of two factors if one is increased the other also increases.

Thus of the two factors pitch and tension is increased the pitch also increases and vice versa. The pitch of a string is directly proportional to the square root of its tension.

Thus in a stringed instrument the three factors that effect and determine the pitch of a note are the length, tension and thickness.

#### **4.2.8 Inverse law and Direct law**

Inverse law is a case where in of two factors, when one is increased the other decrease in consequence. Thus, of the two factors pitch and length of a stretched string is shortened the pitch is increased vice versa. In the flute the pitch is inversely proportionate to the length of the vibrating column of air.

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## UNIT – V

### RAGA LAKSHANAS

**Anandabhiravi, Kalyani, Bhairavi, Kharaharapriya, Saveri, Begada, Siranjani, Madhyamavathi.**

In this unit the above raga lakshanas are dealt in detail:

#### 5.1 ANANDABHAIRAVI

**Murchana:** Arohana: s g r g m p d p Ś

Avarohana: ś n d p m g r s

Anandabhairavi is the janya of the 22<sup>nd</sup> mela Kharaharapriya.

Bhashanga raga, Vakra-shadava, sampurna raga.

The swarasthanas used are Shadja, Chatusruti Rishabha, Sadharana Gandhara, Suddha Madhyama, Panchama, Chatusruti Dhaivata, Kaisiki Nishada and three anya swaras Antara Gandhara, Kakali Nishada and Suddha Dhaivata.

Tri-anyaswara bhashanga raga. Can be sung at all times.

Sri Syama Sastry composed very beautiful compositions in this raga. Anandabhairavi was considered to be his 'property'.

#### Sanchara

D, p, p, n n P m m g M P, d M, p G r Ğ̃ - g m P, n

M, p G r Ğ̃ - Ğ̃ p m g r r G r S ; - S, r r S n Ñ̃ - Ñ̃ S P M M n p p M g m p M,  
p G r Ğ̃ - g m P, m g m n n p m G, r r G r S ; - S r s Ñ̃ - ñ s g r g m P - P ã̃ m p Ś, Ś,  
- Ś, r r Ğ̃ r Ś Ñ̃ - n ś ġ̃ r - n ś r ś - n d P - d P \ Ğ̃, r Ś N D P - d p / Ś \ P - ś ś n d P - p m g m  
P, d M, P G R g m p ġ̃ - Ğ̃ / D P G, r - Ğ̃ p m g r r G r S S r s Ñ̃ - ñ s Ñ̃ Ñ̃ m g  
G, m p m M - m \ N ñ s g m p m g r - Ğ̃ p m g r r G r S s ñ N, s R s S ||

## Compositions

S. No.	Composition	Tala	Composer
1.	Rama Rama nivaramu	Adi	Tyagarajasamy
2.	Kshirsagaravihara	Khanda Chapu	Tyagarajaswamy
3.	Mari vere gati evvamma	Misrachapu	Syama Sastry
4.	O Jagadamba nannu	Adi	Syama Sastry
5.	Samini Rammanave (Varna)	Ata	Syama Sastry
6.	Pahi Sri Girirajasute	Adi	Syama Sastry
7.	Himachalatanaya brova	Adi	Syama Sastry
8.	Manasa Guruguharupam	Tisra	Muttuswamy Dikshitar
9.	Tyagaraja Yoga Vaibhavam	Rupaka	Muttuswamy Dikshitar
10.	Kamalamba Samrakshatumam	Chapu	Muttuswamy Dikshitar
11.	Abhayamba nayaka	Adi	Muttuwamy Dikshitar
12.	Nimadi Challenge	Adi	Matrubhutayya
13.	Madhuranagarilo	Adi	Tribhuvanam Swaminatha Iyer
14.	Sripatisutubari	Adi	Kshetrayya
15.	Manchidinamunede	Adi	Kshetraya
16.	Paluke bangaramayena	Adi	Ramadas
17.	Varanavadana	Adi	Swati Tirunal
18.	Kamala sulochana	Adi	Purandara Dasa
19.	Sadbhaktiyu kaluga	Rupaka	Ramnad Srinivasa Iyengar

## 5.2 KALYANI

### Murchana

Arohana : s r g m p d n ś

Avarohana : ś n d p m g r s

65<sup>th</sup> melakarta raga ; (to conform to the Katapayadi formula, the phrase ‘Mecha’ was prefixed to the name of this raga) ; 5<sup>th</sup> raga in the XI charka; Rudra-ma. The most popular and well-known prati-madhyama raga. A melakarta claiming a large number ofjanya raga. In the obsolete nomenclature for the 72 melas, the 65<sup>th</sup> mela is named Santakalyani. Ri gu mi dhi nu.

This is a murchchanakaraka mela, Its ri, ga, pa, dha and ni taken as shadja, respectively result in the ragas, Harikambhoji, Nathabharani, Sankarabharana, Kharaharapriya and Todi.

Besides Shadja and Panchama, this raga takes the Chatussruti Rishabha, Antara Gandhara, Prati Madhyama, Chatussruti Dhaivata and Kakali Nishada.

Sampurna raga. Sarva svara gamaka varika rakti raga. In both the arohana and avarohana, all the Swaras are ragachhaya Swaras. Ri, ga, dha and ni are nyasa svaras : ga and pa are resting notes. Janta svara prayogas like r r g g m m dd. g g m m d d n n, m m d d n n r r and datu svara prayogas like n ġ ř n, d n ř n d m, g n d m g r are prominent. Madhyama varja phrases like g g d d n n ř ř lend beauty to the raga. The phrase D n r g m d n ř n d m g r n where both shadja and panchama notes are deleted, adds beauty to the raga. Gamakas of the kampita, Sphuritam and Tripuchcham variety lend colour to this raga. A majestic raga. One of the major ragas and affords scope for elaborate alapana. Well distributed. Can be sung at all times; but the effect is decidedly better when sung in the evening.

On account of the presence of tivra svaras in this raga, it is very useful for being sung at the commencement of concerts. The requisite Musical atmosphere is soon created.

All great composers and minor composers of note have composed in this raga. All types of compositions are represented in this raga. Useful for singing slokas, padyas and viruttams. Figures in operas and dance dramas. Compositions in this raga begin on the notes, sa, ri, ga, pa, and ni. The scale of Kalyani ( Yaman that of Hindusthani Music) is met within Hungarian Music. This is the earliest prati madhyama raga known to Musical history and is the ga murchhana of sa grama.

Subtle srutis like tivra antara gandhara 81/64 and tivra kakali nishada 243/128 figure in some places.

### Sanchara :

g m p d n Ś – ś n d P m g r – g m p d n D p m – p d n Ś – ś n D – d n d g r s n D – d n s r s n d P m g r – g m g n D P m – d d p m G r – n r g m P m g r r S n d r S ||

### Some Prominent compositions:

Gita	Kamalajadala	Triputa	Ancient
Varna	Vanajakshiro	Adi	“
Varna	Vanajaksha	Ata	Pallavi Gopalayyar
Kriti	Nidhi chala	Chapu	Tyagaraja
Kriti	Etavunara	Adi	Tyagaraja
Kriti	Sive pahimam	Adi	Tyagaraja
Kriti	Nammi vachchina (Kovur Pancharatnam)	Adi	Tyagaraja
Kriti	Bhajana Sayave	Adi	Tyagaraja
Kriti	Evara madugudura	Adi	Tyagaraja
Kriti	Sundari ni divya (Tiruvottiyur Pancharatnam)	Adi	Tyagaraja

Kriti	Amma ravamma	Jhampa	Tyagaraja
Prahlada Bhakti Vijayam (Opera)	Vasudevayani	Adi	Pallavi Gopalayyar Tyagaraja
Kriti	Kamalambam	Adi	Muttuswamy Dikshitar
Kriti	Bhajarere	Chapu	Muttuswamy Dikshitar
Kriti	Talli ninnu nera	Misrachapu	Syama Sastri
Kriti	Birnavara lichchi	Rupaka	Syama Sastri
Kriti	Himadrisute	Rupaka	Syama Sastri
Kriti	Ninnu vina gati gana	Adi	Subbaraya Sastri
Kriti	Birana brova	Rupaka	Talangambadi Panchanadayya
Kriti	Nija dasa varada	Adi	Patnam Subrahmanya Ayyar
Kriti	Devi Minakshi		0
Kriti	Aviralamagu	Tripata	Cheyyur Chengalvaraya Sastri
Kriti	Saraswati	Rupaka	Tiruvottiyur Tyagayyar
Pada	Parengum	Adi	Ghanam Krishnayyar
Pada	Ettaikkandu	Rupaka	Subbaramayyar
Pada	Tailale unnai	Adi	Subbaramayyar
Javali	Entati Kuluke	Rupaka	Pattabhiramayya

### 5.3 BHAIRAVI

#### Murchana

Arohana : s r g m p d n ś

Avarohana : ś n d p m g r s

Janya raga; derived from the 20<sup>th</sup> melakarta Nathabhairavi Special Feature

The Dhauvata in the arohana is Chatussruti Dhaivata. This is the rare example of a janya raga with a kramasampurna arohana and avarohana. Bhairavi is also a raga wherein the accidental note is incorporated in the scale itself.

Some scholars give the arohana as: s g r m p d n ś. The phrase s g r g m occurs in this raga, but s r g m is used more frequently. If the arohana is maintained as s g r g m, s r g m cannot come. Hence the correct view is to take arohana as karma sampurna and to treat s g r g m as a visesha prayoga.

Besides Shadja and Panchama, the notes taken are Chatussruti Rishabha, Sadharana Gandhara, Suddha Madhyama, Suddha Dhaivata, Chatussruti Dhaivata and kaisiki Nishada.

Ekanya – svara bhashanga raga; the only accidental note Chatussruti Dhaivata, occurs in the phrases p d' n S, p d' n s R, p d' n d' n S and s n d' n S. Occasionally the phrase p d n s N rendered in madhyamakala, takes the suddha dhaivata. In the phrase p d n d p, both the dha notes are suddha. Usually in bhashanga ragas, anya svaras are not nyasa svaras : but Bhairavi

is an exception. Even here, it occurs only as a hrasva nyasa – P d N d – d n s r s N d – r N d and G r s N d. The ending note in each of these phrases is just touched and not stressed.

Many of the compositions begin on the nishada svara and a few on the rishabha and dhaivata ; ri, ga, ma, and ni are the raga chhaya svaras; ri, ma, pa, ni and chatussruti dha are nyasa svaras; ga, ma, and ni are kampita svaras ; (a) r m G r s (b) pdM (c) p d n d M and (d) m p G r s are visesha prayogas; pa and ri are amsa svaras or resting notes. Chatussruti dha is not a resting note.

Whereas in phrase d n S, the ni is sounded in the svasthana, in the phrases : n n d P and P d n d p, the ni is slightly flattened and rendered.

Janta svara prayogas like r r g g m m g g and datu svara proyogas like n g r g s r, n r s r n S, p r S n d P, m n d P, m p g r s are prominent. Sarva svara gamaka varika rakti raga; the best of the rakti ragas. An evening raga according to some scholars; but can be sung at all times. Well distributed., Slokas padyas and viruttams can be sung in this raga. All great composers and minor composers of not have composed in this raga. All types of Musical compositions are represented in this raga. A major raga admitting of elaborate scope for alapana. Used in operas and dance dramas. This raga corresponds to the Tamil pan, Kausikam.

### 5.3.1 History :

The origin of this raga can be traced to the Panchama murchhana of sa grama viz., Suddha shadja. The use of the “Chatussruti dhaivata in the arohana-krama combinations was gradually acquiesced in by scholars and it became a regular bhashanga raga more than 1500 years ago. This is one of the old ragas and it is the 7<sup>th</sup> of the nineteen prasidha (prominent) melas mentioned by old scholars. This raga is mentioned in the Sangita Ratnakara, Sangita Makaranda and Sangita Samaya Sara.

In fact we hear of compositions only in bhashanga Bhairavi raga from early times. The Nathabhairavi has remained as a scale for centuries.

### Sanchara :

R g m p \* d n S s n \*D - \*d n s r s r s N \* d – n s r s R – r g m G r S N \* d – n s n g r g s r – n s n r s r n S – p d p d p M – p R S r n d p – p m N d P – m n d P – m p G r s – r g m p d p G r S – r g m G r s N \*D – n s r s R – P \* d n s r s II

### Some prominent compositions:

Gita	Sri Ramachandra	Dhruva	Ancient
Svarajati	Kamakshi	Chapu	Syama Sastri
Varna	Viriboni	Ata	Pachchimiriya Adiyappayya
Kriti	Koluvaiyynade	Adi	Tyagaraja
Kriti	Chetulara	Adi	Tyagaraja
Kriti	Sri Raghuvara	Adi	Tyagaraja
Kriti	Upacharamulanu	Adi	Tyagaraja
Kriti	Raksha Bettare	Adi	Tyagaraja
Kriti	Tanayuni brova	Adi	Tyagaraja
Kriti	Upacharamu	Rupaka	Tyagaraja
Kriti	Tanayande (Nowka Charitram)	Chapu	Tyagaraja
Kriti	Chitayamam	Rupaka	Muthuswamy Dikshitar
Kriti	Balagopala	Adi	Muthuswamy Dikshitar
Kriti	Maha Tripura	Rupaka	Pallavi Gopalayyar
Kriti	Nipadamule	Adi	Patnam Subrahmanya Iyer
Kriti	Ika nannu brova	Adi	Pallvi Gopalayyar
Kriti	Sri Parthasarathe	Khanda Triputa	Mysore Sadasiva Rao
Kriti	Arukku	Chapu	Gopalakrishna Bharati
Kriti	Tudi Seydidu	Rupakam	Ramaswamy Sivam
Ashtapadi	Sritakamala	Triputa	Jayadeva
Tarangam	Jaya Jaya Gokulabala	Triputa	Narayana Tirtha
Padam	Mandati	Triputa	Kshetrayya
Padam	Velavare	Adi	Ghanam Krishnayyar

## 5.4 KHARAHARAPRIYA

### Murchana

Arohana : s r g m p d n ś

Avarohana : ś n d p m g r s

22<sup>nd</sup> Melakarta raga; 4<sup>th</sup> raga in Iv Chakra (Veda-bhu). This is a Murchanakaraka mela. Its ri, ga, ma, pa, and ni when taken as shadja, will respectively result in the melas, Hanumattodi, Mechakalyani, Harikambhoji, Nathabhairava and Dhaira sankarabharana.

Besides Shadja and Panchama, the notes taken are chartussruti Rishbha, Sadharana Gandhara, Suddha Madhyama, Chatussruti Dhavata and Kaisiki Nishada.

A mela raga with a pair of symmetrical tetrachords – the tetrachords being separated by the interval of a major tone. Sampurna raga; sarva svara gamaka varika rakti raga, ri, ga,



dha and ni are the raga chhaya svaras and nyasa; ri and pa are resting notes. The pratyahata gamaka lends colour and svarupa to this raga.

The slow rendering of the phrases : N d P m G R and N d p d n s N d P m G r will be found to be ranjaka pryoogas ; fairly distributed; can be sung at all times. A mela raga with a large number of janya raga. Compositions in this raga commence on almost all the notes Tristhayi raga. A gana rasa prodhana raga.

We owe this raga to Tyagaraja. He is the only composer to have composed many beautiful kritis in this raga. He brought the raga to prominence through his kritis. This raga corresponds to the kaphi that of Hindusthani Music. With the emergence of Kharaharapriya, the svarupa of Bhairavi became clearly defined.

Sriraga, a janya of this mela, figures as the 22<sup>nd</sup> mela in the asampurna mela paddhati.

Note : There is an appropriateness in the raga name, Harapriya (i.e., pleasing to, or liked by Hara or Siva) – Khara being the Katapayadi prefix. This raga approximates to the ancient sama gana scale, the primordial scale of Indian Music and the scale in which Siva delights in.

#### Sanchara :

r g m p d N d P P - m p d G<sup>~</sup> P G<sup>~</sup> R - g r N<sup>~</sup> D -  
 d n g g g r s n d N d p - D N<sup>~</sup> - G R S - r g m M \ D \ P -  
 m p d G<sup>~</sup> - r g m p d n s N D N<sup>~</sup> g r S<sup>~</sup> - d n s r g R<sup>~</sup> -  
 R<sup>~</sup> G<sup>~</sup> P<sup>~</sup> G<sup>~</sup> R<sup>~</sup> s s S<sup>~</sup> - d n s r G<sup>~</sup> R<sup>~</sup> - d G<sup>~</sup> R<sup>~</sup> s s N d p m -  
 P s S<sup>~</sup> s r r N d P m p d G<sup>~</sup> - r g m P d N d G<sup>~</sup> P - G R -  
 g r n s r m g r S R N D N<sup>~</sup> S ||

#### Some prominent compositions :

Kriti	Chakkani raja	Adi	Tyagaraja
Kriti	Nadachi Nadachi	Adi	Tyagaraja
Kriti	Kori sevimpa	Adi	Tyagaraja
Kriti	Videmu seyave	Adi	Tyagaraja
Kriti	Prakkala Nilabadi	Tripata	Tyagaraja
Kriti	Rama Ni samana	Rupaka	Tyagaraja
Kriti	Sankalpame	Adi	Patnam Subrahmanyam Ayyar
Kriti	Tyagaraja	Adi	Tiruvottiyur Tyagayyar.

According to some schools, the raga of the kriti 'Rama niyeda' (Tyagarajaswamy) is only Dilipakam and not Kharaharapriya.

## 5.5 SAVERI

### MURCHANA

Arohana : s r m p d ś

Avarohana : ś n d p m g r s

Janyam of 15<sup>th</sup> Mela Mayamalavagaula.

Audava – Sampurna raga; Upanga raga.

In the Arohana, ga and ni are Varja. This ragam takes Shadja, Suddha Rishaba, Antara Gandhara, Suddha Madhyama, Panchama, Suddha Dhaivata and Kakali Nishada.

The Jiva Svaras are : ri, ma, dha

The Nyasa svaras are : ma, pa, dha

The Graha svaras are : sa, pa, dha (ga rarely)

### Other Features

This is an ancient raga.

It expresses Karuna rasa; can be sung at all times; more suitable for singing between 9 and 12 in the morning. In the phrase s r m p D, Ekasruthi Dhaivatam occurs. In the phrase n n d m g r s , d m g r s , the absence of Panchamam adds beauty to this raga. The phrase s r g r g m g r s occurs rarely. Datu svara phrases like s r s M, r m r D, p d p R are quite often used. In the following phrases s r M g r – s r m G r – s r m p d p m g r , the svaram ri is used as Alpa Nyasa svaram. The similar Arohana Avarohana pattern in the 22<sup>nd</sup> Melam gives Salagabhairavi , in the 28<sup>th</sup> Melam gives Yadukulakambhoji, in the 29<sup>th</sup> Melam gives Arabhi. It is said that Pallavi Seshayyar sang this ragam for 8 hours.

### Sancharam :

S r m p D; p M – p d ś ś ś n D – P d ś r ġ r Ġ ġ r ś ś n D – p d s r ś ś n D – P m p d n d p m g r S – n n d m g r s – s n D p m p d s R – s r m – r m D – m d Ṙ – Ś n D – p m p d n d p m g r S – s n D – p d s r s ||

## Compositions:

Geetham	Janakasuta	Rupakam	Ancient
Varna	Sarasuda	Adi	Kothavasal Venkatramayyar
Kriti	Daridapuleka	Adi	Tyagaraja
Kriti	Tulasi	Rupakam	Muthuswami Dikshitar
Kriti	Srirajagopala	Adi	Syama Sastri
Kriti	Sankari Samkuru	Rupakam	Tyagaraja
Kriti	Nane uzhudhum	Rupakam	Muthu Tandavar
Kriti	Magatvamulla	Misrachapu	Arunchala Kavirayar
Kriti	Adithalum	Adi	Vedanayakam Pillai
Kriti	Evarura	Chapu	Tyagaraja
Kriti	Maruvakudaya	Adi	Karur Dakshinamurti Sastri
Kriti	Nenarunchara	Adi	Karigiri Rao
Kriti	Peddadevudani	Adi	Mysore Sadasiva Rao

## 5.6 BEGADA

### Murchana

Arohan : s g r g m p d p s

Avarohana : s N d p M g r s

Janaya raga; derived from the 29<sup>th</sup> melakarta; Dhira Sankarabharana.

Besides Shadja and Panchama, the notes taken are Chatussruti Rishabha, Antara Gandhara, Suddha Madhyama, Chatussruti Dhaivata and Kakali Nishad.

Vakra shadava – sampurna raga. Arohana alone is vakra. Dvisvara vakra arohana. Upanga raga. In the combination d p M, the madhyama svara is slightly shraped (27/20) and sung. Likewise in combinations like P, d N d p and r N d p the Nishada is slightly flattened and sung. These two notes which establish the melodic individuality of the raga have been aptly termed the Begada madhyama and Begada nishada respectively. The correct Suddha Madhyama (4/3) and the correct Kakali Nishada(15/8) are also used in many places. Gamaka varika rakti raga; ma, dha and ni are the raga chhaya svaras. Can be sung at all times; but afternoon is an appropriate time for singing this raga. The phrase s n d n S comes in as a rare ranjaka prayoga; ri and dha are not nyasa svaras; ma and pa are nyasas; pa is a resting note. In the phrase N d p, the nishada is sounded with a tinge of tara shadja. Compositions begin on the notes, ga ma, dha and ni. Tristhayi raga; m g r r P occurs as a visesha sanchara.

An impressive raga. Can be sung at the commencement of concerts. Used in operas. The gamaka pradhana and sruti pradhana aspects of Karnatic Music are well illustrated by

this raga. The rendering of nishada and madhyama with dirgha kampita in the avarohana deserves attention p d M is a visesha sanchara.

Patnam Subrahmanya Ayyar was an adept in singing this raga. For this reason he was called Begada Subrahmanya Ayyar.

This is not an ancient raga. This raga is also called Byagadai.

Some Tamil workers call this, Vegadai.

There is the saying : Begada migada, i.e., Begada raga is as relishing as migada (cream of the milk).

### Sanchara :

g m p d P – N d P – m d p m g g m r – g m d p m p R S – g m p d p S s – S n d p – s n r S – g r G m R s – N d p – m p d p S – p d p r N d p – g m g m p d P d N d p – m d p m g g m r – g m d p m p R S n n d p m p g r S – S n d p – s n g r GI g m p d p r N d p – m p R S II

### Some prominent compositions:

Varna	Inta chalamu	Adi	Vina Kuppaiyyar
Varna	Intapriyamuga	Ata	Aiyasami Nattuvanar
Kriti	Nadopasana	Adi	Tyagaraja
Kriti	Nipadapankaja.	Adi	Tyagaraja
Kriti	Lokavanachatura	Adi	Tyagaraja
Kriti	Tanavaritanam	Adi	Tyagaraja
Kriti	Sundari	Rupaka	Tyagaraja
Kriti	Bhaktuni Charitramu	Adi	Tyagaraja
Kriti	Gattiganu	Adi (tisragati)	Tyagaraja
Kriti	Tyagarajaya	Rupaka	Muthuswami Dikshitar
Kriti	Sankari nivani	Rupaka	Subraraya Sastri
Kriti	Intaparakela	Rupaka	Vina Kuppaiyyar
Kriti	Abhimana	Adi	Patnam Subramanya Ayyar
Kriti	Anudinamunu	Rupaka	Ramnad Srinivasa Iyengar
Kriti	Innum Paramukha	Rupaka	Doraisami Iyer
Kriti	Ganarasamudan	Rupaka	Papanasam Sivan
Javali	Idi niku	Chapu	Dharmapuri Subbarayar

## 5.7 SRIRANJANI

### Murchana

Arohana : s r g m d n ś

Avarohana : ś n d m g r s

Janya raga; derived from the 22<sup>nd</sup> melakarta Kharaharapriya.

The notes taken by this raga are Shadja, Chatusruti Rishabha, Sadharana Gandhara, Suddha Madhyama, Chatusruti Dhaivata and Kaisiki Nishada.

Though a shadava raga, being panchama varja it cannot repeat under any other mela. In other words, Sriranjani cannot be deemed as a janya of any other mela.

Shadava – Shadava raga. Panchama varja raga; symmetrical raga. Upanaga raga; ri, ga, dha and ni are the raga chhaya swaras; r g m r g s, m r g r s and m n d n s are visesha sancharas; gamaka varika rakti raga. A bright, catchy and impressive raga; ga is not nyasa; ma is a good nyasa svara; compositions being on the notes ma, ni, sa and ri. Pratyahata gamaka lends colour to this raga. Can be sung at all times.

Gana rasa pradhana raga. Tristhayi raga. Minor raga.

The name of the raga suggests that it is pleasing to Lakshmi, the Goddess of wealth. Some Musicians have obtained relief by singing this raga during moments of want.

#### Sanchara:

S, r g M, m – M m g r g M, m – g m d n d m g r – g m d n Ś, ś – n ś ġ r ś – n ś ġ r ġ m ġ r ś – ś ś n d m g r – g m d n Ś, n d m g r – g m n n d m g r – g d d m m g g r r S – n n d m d n S||

#### Some Prominent Compositions

Kriti	Marubalka	Adi	Tyagaraja
Kriti	Bhuvini Dasudane	Adi	Tyagaraja
Kriti	Brochevarevare	Adi	Tyagaraja
Kriti	Sariyevvare	Adi	Tyagaraja
Kriti	Sogasuga mridanga	Adi	Tyagaraja
Kriti	Sridundurge	Ekatala (Khanda jati)	Muthuswamy Dikshitar
Kriti	Brochutaku	Adi	Karur Dakshinamurti Sastri

## 5.8 MADHYAMAVATI

### MURCHANA

Arohanam : s r m p n ś

Avarohanam : ś n p m r s

Janyam of 22<sup>nd</sup> Melam Kharaharapriya

Audava ragam. Upanga ragam

In both Arohanam and Avarohanam, ga and dha are Varjam, Shadjam, Chatusruthi rishabham, Suddha Madhyamam, Panchamam and Kaisiki Nishadam are found in this ragam.

Jiva swaras : ri, ma, ni

Nyasa swaras : ri, ma, pa, ni

Graha swaras : sa, ri, ma, pa, ni

### Other Features

This is a full Murchanakaraka ragam: the ri, ma, pa and ni through Graha Bhedam, will yield Hindolam, Suuddhasaveri, Udayaravichandrika and Mohanam respectively. r m r p m n p s – n r s r n s p n m p are fine. Datu svara prayogas in this raga. This raga is considered a mangala (auspicious) raga. Hence it is often sung at the end of concerts and functions. Though suitable for singing at midday, it can be sung at all times. This is an ancient raga. In early days, this raga was also called ‘Madhyamadi’. It is equivalent to Pan Senthuruthi in ancient Tamil Music.

### Sanchara:

r m p N n – m p n ś ś – p n ś Ṙ Ṙ – r m p m R r ś – N, ś r ś – n ś r ś ś n P, m – p r ś ś n  
P, m – P ś n P m – m p N, p m R – r m r p m n p Ś – n’ r ś r n ś p n m P – r m P p m R  
S – n s r S s n P – m p n s R r p m R S ||

### Compositions :

Varna	Saraguna	Adi	Thiruvottiyur Tyagarayar
Kriti	Rama katha sutha	adi	Tyagarayar
Kriti	Vinayakuni	Adi	Tyagarayar
Kriti	Dharma Samvarthini	Rupakam	Muthuswami Dikshitar
Kriti	Palinchu Kamakshi	Adi	Syama Sastri
Kriti	Innum Priavamala	Adi	Muthu Thandavar
Kriti	Guruvai Panindu	Adi	Gopalakrishna Bharathiar.
Thiruppugazh	Koor Vel	Chaturasra Triputai	Arunagirinathar
Thiruppugazh	Palo theno	Chaturasra Triputai	Arunagirinathar

## 5.9 SELF ASSESSMENT QUESTIONS

1. Explain the Ragalakshanas with sancharas for the following ragas
  - a. Darbar
  - b. Todi
  - c. Kambhoji
  - c. Begada
2. Write the short notes on Raga lakshanas
  - a) Sankarabharanam
  - b) Madhyamavati
  - c) Purvikalyani
  - d) Lathangi

## 5.10 REFERENCE BOOKS

1. South Indian Music by Prof. P Sambamurthy. (Book - I to VI)
2. Ragalakshanas by Nookala Chinna Satyanarayana.

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