STUDIES ON INDIAN MUSICAL SCALES

Part II : On the Degree of Relatedness of Ragas and application to 72 Melas

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1. Introduction

In Part I of this series the results of computer analysis of the 72-melakartha scales of Venkatamakhi, particularly in relation to murchana or modal shift operations were considered. In that context a parameter Δ was introduced which, for a given scale, is a measure, in cyclical cents, of the mean of the deviations (from 171.4) of the intervals occurring in that scale. The value of 171.4 arises from the fact that it is the mean value of the seven intervals into which the full span of an octave of 1200 cents is divided by the eight notes of an idealised scale. Some of most common ragas which are capable of high elaboration and easy rendering etc., and most of the samvadi melas turn out to have systematically low values of Δ while most of the vivadi melas tend to have high values of Δ. Thus, this parameter was suggested for use as a convenient index for a proper assessment of these attributes of a scale.

In this paper we extend the concept developed in Part I to answer a question such as the following. Given two ragas A & B can one quantify the degree of relatedness (or conversely the degree of difference) between them? We shall first consider in this paper only the melakartha ragas, although the concept introduced can be extended *mutatis mutandis* to any two scales not necessarily of the sampurna melakartha types.

It is true that scales are not the same as ragas but only provide the 'skeleton' or 'frame' for the latter. However in any scientific study an important aspect is to be able to quantify the analysis. The scales with their associated sruthi values and intervals provide us (in the absence of any other frame work) with this possibility. At this stage it is useful to introduce some notions on the similarity of ragas, based on orders of differences. Thus we may consider differences based on only sruthi values (or sruthi intervals alone) as first order differences. It is well known that there are so many other factors which go to make up even simple ragas such as types of Gamaka, minute differences[2] —in the emphasis on the notes, sancharas, frequency of occurrence of notes etc. Differences based on these factors may be referred to as second order differences. It looks that one may even have to invoke 'third order' differences in other complex ragas such as vakra types, bashanga and similar ones. The discussions and methods of this part as well as the last one concern themselves with first order differences only.

2. Table of Deviations and Correlation Parameters

If we wish to construct first order differences only, based on sruthis two simple methods become possible. One is to take as a measure the sum (δ_1) of differences (in magnitude only) of *sruthi values* of corresponding notes in the pair of scales A & B and the other is to take the sum (δ_2) of the differences of *sruthi intervals*. Both calculations are presented in this paper, and would be valid more or less equally for purposes of discussions. However, strictly speaking, it is the latter that would seem more appropriate for the following simple reasons. In melodic music it is not the sruthi values that are of primary importance but the sruthi intervals. Thus, it is the relative frequencies of notes (and hence intervals in the logarithmic scale) that are of importance.

A corrollary to this is the fact that given a scale A a change of a single note to produce a new scale B (keeping the rest constant) produces changes in *two intervals* and hence the effect, from the point of view of change in melody, is doubled. In the author's opinion this is a point not sufficiently stressed (if not mentioned explicitly) in Indian musical theory.

The table of sruthi values used in the present calculations is the same as Table 1 of part I. Sruthi intervals are also readily computed and are given in Table 1 in this paper. It may be noted that in the sum δ_1, because of the constancy of S, P & Ṡ the summation is always over the differences of five notes only (namely R, G, M, D & N), the differences over S, P, Ṡ being zero always. On the other hand the sum δ_2, in general, sums over differences over seven intervals all of which can be finite.

In order to be able to see the relation between the two consider the case when there is change in one note only between A & B; say B is the prathi madyama equivalent of A. It may be readily verified that the sum δ_1 will be 90 which is just the difference between suddha M and prathi M whereas δ_2 will be 180 which is twice the value of δ_1. This occurs for the reason mentioned already namely the change in one note affects *two intervals* by a shift of 90 cents each.

TABLE 1

Sruthi Intervals for the 72-Melas

	S-R	R-G	G-M	M-P	P-D	D-N	N-S
	112	92	294	204	112	92	294
	112	92	294	204	112	204	182
	112	92	294	204	112	274	112
	112	92	294	204	204	112	182
	112	92	294	204	204	182	112
6	112	92	294	204	316	70	112
	112	204	182	204	112	92	294
	112	204	182	204	112	204	182
	112	204	182	204	112	274	112
	112	204	182	204	204	112	182
	112	204	182	204	204	182	112
12	112	204	182	204	316	70	112
	112	274	112	204	112	92	294
	112	274	112	204	112	204	182
	112	274	112	204	112	274	112
	112	274	112	204	204	112	182
	112	274	112	204	204	182	112
18	112	274	112	204	316	70	112
	204	112	182	204	112	92	294
	204	112	182	204	112	204	182
	204	112	182	204	112	274	112
	204	112	182	204	204	112	182
	204	112	182	204	204	182	112
24	204	112	182	204	316	70	112
	204	182	112	204	112	92	294
	204	182	112	204	112	204	182
	204	182	112	204	112	274	112
	204	182	112	204	204	112	182
	204	182	112	204	204	182	112
30	204	182	112	204	316	70	112
	316	70	112	204	112	92	294
	316	70	112	204	112	204	182
	316	70	112	204	112	274	112
	316	70	112	204	204	112	182
	316	70	112	204	204	182	112
36	316	70	112	204	316	70	112
	112	92	384	114	112	92	294
	112	92	384	114	112	204	182
	112	92	384	114	112	274	112
	112	92	384	114	204	112	182
	112	92	384	114	204	182	112

(Table 1 Contd.)

	S-R	R-G	G-M	M-P	P-D	D-N	N-S
42	112	92	384	114	316	70	112
	112	204	272	114	112	92	294
	112	204	272	114	112	204	182
	112	204	272	114	112	274	112
	112	204	272	114	204	112	182
	112	204	272	114	204	182	112
48	112	204	272	114	316	70	112
	112	274	202	114	112	92	294
	112	274	202	114	112	204	182
	112	274	202	114	112	274	112
	112	274	202	114	204	112	182
	112	274	202	114	204	182	112
54	112	274	202	114	316	70	112
	204	112	272	114	112	92	294
	204	112	272	114	112	204	182
	204	112	272	114	112	274	112
	204	112	272	114	204	112	182
	204	112	272	114	204	182	112
60	204	112	272	114	316	70	112
	204	182	202	114	112	92	294
	204	182	202	114	112	204	182
	204	182	202	114	112	274	112
	204	182	202	114	204	112	182
	204	182	202	114	204	182	112
66	204	182	202	114	316	70	112
	316	70	202	114	112	92	294
	316	70	202	114	112	204	182
	316	70	202	114	112	274	112
	316	70	202	114	204	112	182
	316	70	202	114	204	182	112
72	316	70	202	114	316	70	112

When A & B differ by change in more than one note this relation is not so simple although δ_2 is in general larger than δ_1.

Figure 2 and Table 2 give the value of δ_1 and δ_2 as a square matrix of 72 x 72. (See Figure 1 for key) Any entry in the table relates two scales specified by the corresponding values of the x and y axes. It is obvious that since only summation over magnitudes is involved the matrix of values has a diagonal symmetry for both δ_1 and δ_2 and it is enough we consider one major triangle shown in Fig. 2 and Table 2. In addition, this major triangle

0	22	36	22	36	40	22	44	58	44	58	63	36	58	72	58	72	77	22	44	58	44	58	63	36	58	72	58	72	77	40	63	77	63	77	81
	0	14	18	18	40	44	22	36	40	40	63	58	36	50	54	54	77	44	22	36	40	40	63	58	36	50	54	54	77	63	40	54	59	59	81
		0	32	18	40	58	36	22	54	40	63	72	50	36	68	54	77	58	36	22	54	40	63	72	50	36	68	54	77	77	54	40	73	59	81
			0	14	22	44	40	54	22	36	44	58	54	68	36	50	58	44	40	54	22	36	44	58	54	68	36	50	58	63	69	73	40	54	63
				0	22	58	40	40	36	22	44	72	54	54	50	36	58	58	40	40	36	22	44	72	54	54	50	36	58	77	59	59	54	40	63
					0	63	63	63	44	44	22	77	77	77	58	58	36	63	63	63	44	44	22	77	77	77	58	58	36	81	81	81	63	63	40
						0	22	36	22	36	40	14	36	50	36	50	54	18	40	54	40	54	59	18	40	54	40	54	59	40	63	77	63	77	81
							0	14	18	18	40	36	14	28	32	32	54	40	18	32	36	36	59	40	18	32	36	36	59	63	40	54	59	59	81
								0	32	18	40	50	28	14	46	32	54	54	32	18	50	36	59	54	32	18	50	36	59	77	54	40	73	59	81
									0	14	22	36	32	46	14	28	36	40	36	50	18	32	40	40	36	50	18	32	40	63	59	73	40	54	63
										0	22	50	32	32	28	14	36	54	36	36	32	18	40	54	36	36	32	18	40	77	59	59	54	40	63
											0	54	54	54	36	36	14	59	59	59	40	40	18	59	59	59	40	40	18	81	81	81	63	63	40
												0	22	36	22	36	40	32	54	68	54	68	73	18	40	54	40	54	59	40	63	77	63	77	81
													0	14	18	18	40	54	32	46	50	50	73	40	18	32	36	36	59	63	40	54	59	59	81
														0	32	18	40	68	46	32	64	50	73	54	32	18	50	36	59	77	54	40	73	59	81
															0	14	22	54	50	64	32	46	54	40	36	50	18	32	40	63	59	73	40	54	63
																0	22	68	50	50	46	31	54	54	36	36	32	18	40	77	59	59	54	40	63
																	0	73	73	73	54	54	32	59	59	59	40	40	18	81	81	81	63	63	40
																		0	22	36	22	36	40	14	36	50	36	50	54	22	44	58	44	58	63
																			0	14	18	18	40	36	14	28	32	32	54	44	22	36	40	40	63
																				0	32	18	40	50	28	14	46	32	54	58	36	22	54	40	63
																					0	14	22	36	32	46	14	28	36	44	40	54	22	36	44
																						0	22	50	32	32	28	14	36	58	40	40	36	22	44
																							0	54	54	54	36	36	14	63	63	63	44	44	22
																								0	22	36	22	36	40	22	44	58	44	58	63
																									0	14	18	18	40	44	22	36	40	40	63
																										0	32	18	40	58	36	22	54	40	63
																											0	14	22	44	40	54	22	36	44
																												0	22	58	40	40	36	22	44
																													0	63	63	63	44	44	22
																														0	22	36	22	36	40
																															0	14	18	18	40
																																0	32	18	40
																																	0	14	22
																																		0	22
																																			0

Table-2 (a)$^-$: Correlation parameter δ_2. Values are one tenth of actuals. Triangle corresponds to sector A_1 A_2 of Fig. 1. Sector A_3 A_4 is identical with A_1 A_2.

18	40	54	40	54	58	22	44	38	44	58	63	36	58	72	58	72	77	22	44	58	44	58	63	36	58	72	58	72	77	40	63	77	63	77	81
40	18	32	36	36	58	44	22	35	40	40	63	58	36	50	54	54	77	44	22	36	40	40	63	58	36	50	54	54	77	63	40	54	59	59	81
54	32	18	50	36	58	58	36	22	54	40	63	72	50	36	68	54	77	58	36	22	54	40	63	72	50	36	68	54	77	77	54	40	73	59	81
40	36	50	18	32	40	44	40	54	22	36	44	58	54	68	36	50	58	44	40	54	12	36	44	58	54	68	36	50	58	63	59	73	40	54	63
54	36	36	32	18	40	58	40	40	36	22	44	72	54	54	50	36	58	58	40	40	36	22	44	72	54	54	50	36	58	77	59	59	54	40	63
58	58	58	40	40	18	63	63	63	44	44	22	77	77	77	58	58	36	63	63	63	44	44	22	77	77	77	58	58	36	81	81	81	63	63	40
40	62	76	62	76	81	18	40	54	40	54	58	18	40	54	40	54	58	36	58	72	58	72	77	22	44	58	44	58	63	44	67	81	67	81	85
62	40	54	58	58	81	40	18	32	36	36	58	40	18	32	36	36	58	58	36	50	54	54	77	44	22	36	40	40	63	67	44	58	63	63	85
76	54	40	72	58	81	54	32	18	50	36	58	54	32	18	50	36	58	72	50	36	68	54	77	58	36	22	54	40	63	81	58	44	77	63	85
62	58	72	40	54	62	40	36	50	18	32	40	40	36	50	18	32	40	58	54	68	36	50	58	44	40	54	22	36	44	67	63	77	44	58	67
76	58	58	54	40	62	54	36	36	32	18	40	54	36	36	32	18	40	72	54	54	50	36	58	58	40	40	36	22	44	81	63	63	58	44	67
81	81	81	62	62	40	58	58	58	40	40	18	58	58	58	40	40	18	77	77	77	58	58	36	63	63	63	44	44	22	85	85	85	67	67	44
54	76	90	76	90	95	32	54	68	54	68	72	18	40	54	40	54	58	50	72	86	72	86	91	36	58	72	58	72	77	58	81	95	81	95	99
76	54	68	72	72	95	54	32	46	50	50	72	40	18	32	36	36	58	72	50	64	68	68	91	58	36	50	54	54	77	81	58	72	77	77	99
90	68	54	86	72	95	68	46	32	64	50	72	54	32	18	50	36	58	86	64	50	82	68	91	72	50	36	68	54	77	95	72	56	91	77	99
76	72	86	54	68	76	54	50	64	32	46	54	40	36	50	18	32	40	72	68	82	50	64	72	58	54	68	36	50	58	81	77	91	58	72	81
90	72	72	68	54	76	68	50	50	46	32	54	54	36	36	32	18	40	86	68	68	64	50	72	72	54	54	50	36	58	95	77	77	72	58	81
95	95	95	76	76	54	72	72	72	54	54	32	58	58	58	40	40	28	91	91	91	72	72	50	77	77	77	58	58	36	99	99	99	81	81	58
40	62	76	62	76	81	36	58	72	58	72	77	36	58	72	58	72	77	18	40	54	40	54	58	18	40	54	40	54	58	26	48	62	48	62	67
62	40	54	58	58	81	58	36	50	54	54	77	58	36	50	54	54	77	40	18	32	36	36	58	40	18	32	36	36	58	48	26	40	44	44	67
76	54	40	72	58	81	72	50	36	68	54	77	72	50	36	68	54	77	54	32	18	50	36	58	54	32	18	50	36	58	62	40	26	58	44	67
62	58	72	40	54	62	58	54	68	36	50	58	58	54	68	36	50	58	40	36	50	18	32	40	40	36	50	18	32	40	48	44	58	26	40	48
76	58	58	54	40	62	72	54	54	50	36	58	72	54	54	50	36	58	54	36	36	32	18	40	54	36	36	32	18	40	62	44	44	40	26	48
81	81	81	62	62	40	77	77	77	58	58	36	77	77	77	58	58	36	58	58	58	40	40	18	58	58	58	40	40	18	67	67	67	48	48	26
54	76	90	76	90	95	36	58	72	58	72	77	36	58	72	58	72	77	32	54	68	54	68	72	18	40	54	40	54	58	40	62	76	62	76	81
76	54	68	72	72	95	58	36	50	54	54	77	58	36	50	54	54	77	54	32	46	50	50	72	40	18	32	36	36	58	62	40	54	58	58	81
90	68	54	86	72	95	72	50	36	68	54	77	72	50	36	68	54	77	68	46	32	64	50	72	54	32	18	50	36	58	76	54	40	72	58	81
76	72	86	54	68	76	58	54	68	36	50	58	58	54	68	36	50	58	54	50	64	32	46	54	40	36	50	18	32	40	62	58	72	40	54	62
90	72	72	68	54	76	72	54	54	50	36	58	72	54	54	50	36	58	68	50	50	46	32	54	54	36	36	32	18	40	76	58	58	54	40	62
95	95	95	76	76	54	77	77	77	58	58	36	77	77	77	58	58	36	72	72	72	54	54	32	58	58	58	40	40	18	81	81	81	62	62	40
58	81	95	81	95	99	58	81	95	81	95	99	58	81	95	81	95	99	40	62	76	62	76	81	40	62	76	62	76	81	18	40	54	40	54	58
81	58	72	77	77	99	81	58	72	77	77	99	81	58	72	77	77	99	62	40	54	58	58	81	62	40	54	58	58	81	40	18	32	36	36	58
95	72	58	91	77	99	95	72	58	91	77	99	95	72	58	91	77	99	76	54	40	72	58	81	76	54	40	72	58	81	54	32	18	50	36	58
81	77	91	58	72	81	81	77	91	58	72	81	81	77	91	58	72	81	62	58	72	40	54	62	62	58	72	40	54	62	40	36	50	18	32	40
95	77	77	72	58	81	95	77	77	72	58	81	95	77	77	72	58	81	76	58	58	54	40	62	76	58	58	54	40	62	54	36	36	32	18	40
99	99	99	81	81	58	99	99	99	81	81	58	99	99	99	81	81	58	81	81	81	62	62	40	81	81	81	62	62	40	58	58	58	40	40	28

Table - 2(b): Correlation parameter δ_2. This square corresponds to sector B_1 to B_4 of Fig.1

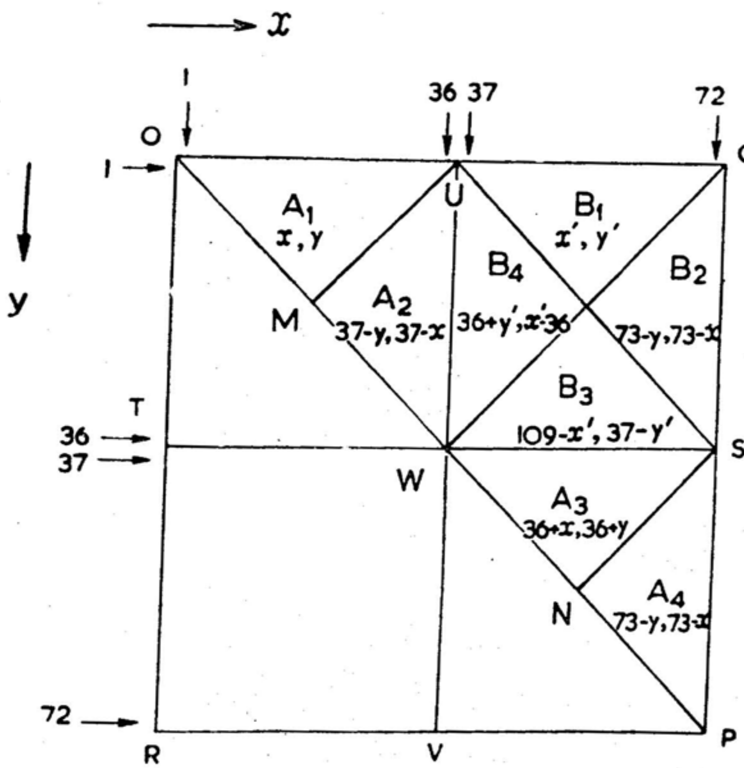

FIG. 1. Key to correlation tables.

The entire table of δ_1 values has mirror symmetry about the major diagonal OP. In addition within a major triangle OQP mirror symmetries exist along QW, UM and SN and also US. Consequently the minor triangles A_1 & B_1 are adequate to generate the entire table. The symmetry relations leading to the values in the minor triangles A_2 to A_4 and B_2 to B_4 are given, where x, y and x', y' denote the coordinate for any point on A_1 and B_1 respectively. For the δ_2 table, values of the entire triangle OUW and the square UWSQ are required to generate the rest. The mirror at OP exists and leads to values in the other major triangle ORP.

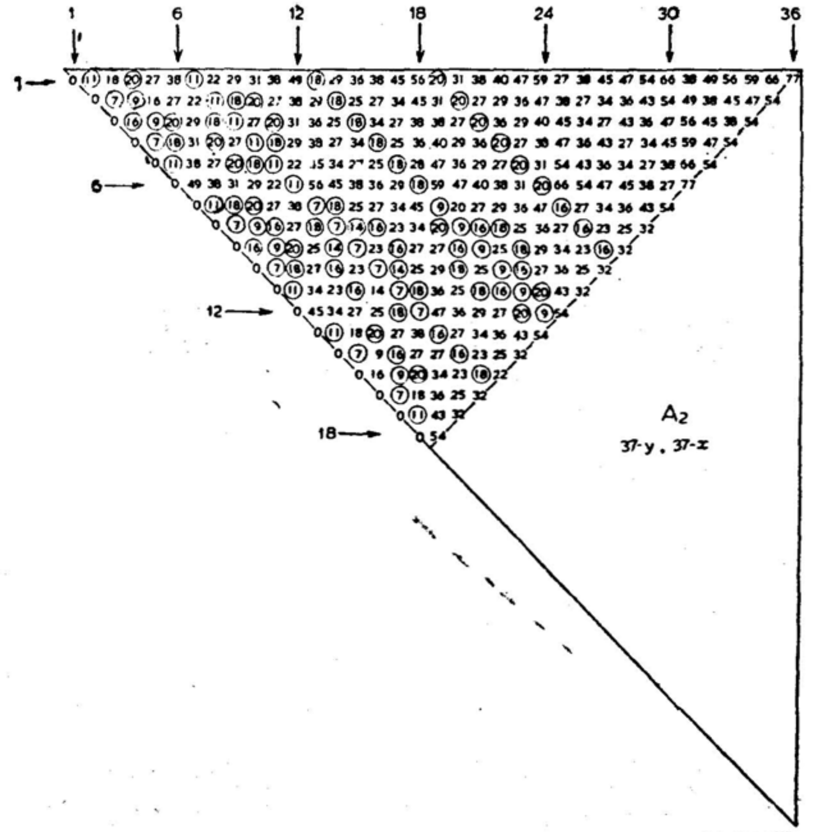

Figure 2(a) : Table of δ_1 values. See Fig. 1 for key to construct the full 72 × 72 matrix. The asymmetric portions given are (a) sector A_1 and (b) sector B_1.

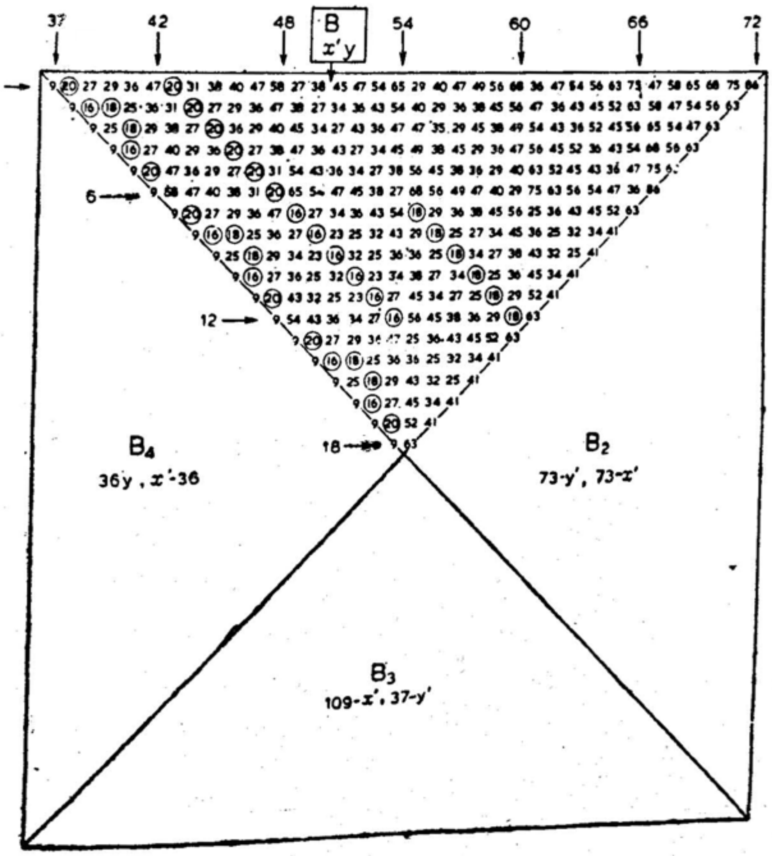

Figure 2 (b)

in the case of δ_1 also has additional symmetries the relations of which are indicated. It turns out that the values shown in the two minor triangles are adequate to generate the values for the entire major triangle.

Interestingly even the values of the two minor triangles have a close relation for δ_1. Thus the values for sector B_1 are systematically 90 cents larger than the corresponding values in sector A_1. However for δ_2 the symmetry is less as indicated.

Discussion

The above tables (Fig. 2 and Table 2) may be referred to as tables of 'Correlation' or 'Affinity' parameters, since the values give us an idea of the degree of relatedness or otherwise of a pair of scales. Although table of values measure deviations it would seem preferable to call them correlation provided we remember that larger the values of δ_1, or δ_2 for a given pair A and B the less their relatedness. It may be noted that all the 36 prathimadhyama melas occur on the diagonal line joining the points $x = 37$, $y = 37$ both for δ_1 and δ_2. This is clear since the values of δ_1 (and δ_2) is contributed by only change in one note namely suddha to prathi madhyama.

It may also be noted that scales which differ only in the nishada (from kaisiki to kakali) all have low values (70 cents on δ_1 and 140 on δ_2) and occur close to the major diagonals. A perusal of the table of values shows that two scales which differ say in their nishada (kaisiki to kakali) are more closely related than the two which differ only in Madhyama. There are also a number of other examples of this type which can be picked from the tables.

Table 3 lists pairs of scales with maximum relatedness, i.e. those with minimum values (140 cents) of δ_2. It turns out that we are led to the same set of 48 pairs if we take those with the minimum values (70 cent) of δ_1. However pairs of scales with maximal difference differ depending on whether we use δ_1 or δ_2. If we use the former only four pairs have the maximum values of 860. They are 1,72; 6,67; 31,42 and 36,37. δ_2 value lead to the following 24 pairs with maximum (990 cents) differences: 13,72; 14,72; 15,72; 18,67; 18,68; 18,69; 31,42; 31,48; 31,54; 32,42; 32,48; 32,54; 33,42; 33,48; 33,54; 36,37; 36,38; 36,39; 36,43; 36,44; 36,45; 36,49; 36,50; and 36,51.

We have not listed separately other pairs with differences of 180 in δ_2 or 90 in δ_1. The suddha and prati madhyama pairs will be found in this list. Correlation Tables (Fig. 2 and Table 2) will be useful in locating them.

Finally the possibility of extending these ideas to other ragas may be indicated, while detailed considerations are reserved for a later part of this series. When we step out of the sampoorna melas, one has to consider several varieties of ragas of increasing complexities, such as shadava, oudava, varja

TABLE 3

Pairs of Scales with Minimum (140) *Values of* δ_2
(The same set of pairs results from δ_1-values also)

Those with Minimum Differences:

2, 3	Ratnangi	Ganamurti
4, 5	Vasanpati	Manavati
7, 13	Senavati	Gayakapriya
8, 9	Hanumatodi	Dhenuka
8, 14	Hanumatodi	Vakulabaranam
9, 15	Dhenuka	Mayamalavagaula
10, 11	Natakapria	Kokulapriya
10, 16	Natakapria	Chakravakam
11, 17	Kokulapria	Hatakambari
12, 18	Rupavati	Hatakambari
14, 15	Vakulabaraman	Mayamalavagaula
16, 17	Chakravakam	Suryakantam
19, 25	Jankaradvani	Mararanjani
20, 21	Natabhairavi	Kiravani
20, 26	Natabhairavi	Charukesi
21, 27	Kiravani	Sarasangi
22, 23	Kharaharapriya	Gaurimanohari
22, 28	Kharaharapriya	Harikamboji
23, 29	Gaurimanohari	Sankarabharanam
24, 30	Varunapriya	Naganandini
26, 27	Charukesi	Sarasangi
28, 29	Harikamboji	Sankarabharanam
32, 33	Ragavardhini	Gangeyabhushani
34, 35	Vagadisvari	Sulini
38, 39	Jalarnavam	Jalavarali
40, 41	Navaneetam	Pavani
43, 49	Gavambodhi	Dhavalambari
44, 45	Bhavapria	Subhapantuvarali
44, 50	Bhavapria	Namanarayani
45, 51	Subhapantuvarali	Kamavardhini
46, 47	Shadvidhamargini	Suvarnangi
46, 52	Shadvidhamargini	Ramapriya
47, 53	Suvarnangi	Gamansramam
48, 54	Divyamani	Visvambari
50, 51	Namanarayani	Kamavardhini
52, 53	Ramapriya	Gamanasramam
55, 61	Syamalangi	Kantamani
56, 57	Shanmugapria	Simhendramaryaman
56, 62	Shanmugapria	Rishabhapriya
57, 63	Simhendramadhyaman	Latangi
58, 59	Hemavati	Dharmavati
58, 64	Hemavati	Vachaspati
59, 65	Dharmavati	Mechakalyani
60, 66	Nitimati	Chitrambari
62, 63	Rishabhapriya	Latangi
64, 65	Vachaspati	Mechakalyani
69, 69	Jyothiswarupini	Dhatuvardhini
70, 71	Nasikabhushani	Kosalam

and vakra varieties. The extensions to non-vakra varieties, when both arohana and avarohana contain the same number of notes and therefore the same number of intervals is fairly straight forwarded. Both Δ parameter of part I and the δ_1 and δ_2 parameters of this paper can be readily redefined for such a situation. The differences are to be taken over the available number of sruthi values or intervals as the case may be. One could thus construct all the tables for shadava shadava, oudava-oudava types.

An interesting question, however, is whether one could extend the concept to compare say a shadava-shadava scale with an oudava-oudava type. Consider typically Sriranjani and Abohi both derivatives of Kharaharapriya. The notes are identical excepting for the presence of N as extra note in Sriranjani. If we wish to construct the δ_2 type of parameter the contribution will be zero over the intervals (S-R), (R-G), (G-M), (M-D), for both and only one interval (D-S) for Abohi remains to be considered against two intervals remaining in Sriranjani namely (D-N) and (N-S). As mentioned in the introduction, for melody music it is the interval that is more important and accordingly the differences we perceive of Abohi and Sriranjani is to be attributed to the difference between interval D-S (=294) in Abohi and the intervals (D-N) (=112) and (N-S) (=182) of Sriranjani. That is to say we may take the average of the differences (D-S) — (D-N) and (D-S) — (N-S) which works out to $\frac{294-112}{2} + \frac{294-182}{2} = \frac{294}{2} = 147$. Thus, as per our correlation Table 2, the degree of relatedness of Abohi and Sriranjani could be of the same order as two scales differing by Kakali and Kaisiki Nishada, which seems to be reasonable.

Further analyses and extensions will be considered in later part.

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REFERENCES

1. The first part is on "Studies on Indian musical scales; Part I: Computer analysis of 72 melakartha scales" by R. Srinivasan, Sangeet Natak 49 (1978).
2. Several examples may be cited. A common one is the passages which may readily be distinguished as Sankarabharanam and Kalyani without touching M: Sankarabharanam; Sa Ri Ni Sa Da Ni Sa Pa Da Ni Sa Da Pa...... and Kalyani Sa Ri..Ni Sa Ni Da Ni....Sa Ni Da Pa....

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