Chapter - 6

Thatas

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Thatas

It has been remarked earlier that seven note scales are ideal as generators of melodies because it is desirable to avoid notes too close to each other. If the notes of a seven note scale are produced in a ascending or descending order, the effect is pleasant and melodious.

In ancient times, Grams were considered as the fundamental seven note scales from which Murchhanas were derived. A gram, as we have been in Chapter III, is a seven note scale in which consecutive note intervals appear in the same cyclic order.

Shadaj Gram, for example, was seen to be

Sa	Re	Ga	Ma	Pa	Dha	Ni	Sa
1	10/9	32/27	4/3	3/2	5/3	16/9	2

in which the order of the successive notes frequencies is 10/9, 16/15,9/8,9/8,5/3, 16/15, 9/8....***(1).***

Now consider the following seven note scale

Sa	Re	Ga	Ma	Pa	Dha	Ni	Sa
1	9/8	5/4	4/3	3/2	27/16	15/8	2

in which the order is 9/8, 10/9, 16/15,9/8,9/8,10/9,16/15...***(2).***

Thus, the cyclic order the successive note frequencies, determines a Gram. The second scale, though a different scale of notes, is the same Gram because the cyclic order of successive note frequencies is the same in *(1)* and *(2)*.

A Gram gives rise to various Murchhanas. A Murchhanas starting with a particular note was considered to be a sequence of seven notes in which the particular note was taken to be tonic. A Gram did not specify the tonic. It was simply a collection of seven notes in a particular cyclic order as explained above. Each Murchhanas could be derived from a given Gram by regarding one of the seven notes as tonic. Hence, each Gram had seven Murchhanas.

Nishad Murchhana of the Shadaj Gram was as follows :

Ni	Sa	Re	Ga	Ma	Pa	Dha	Ni	*(3)*
	9/8	10/9	16/15	9/8	9/8	10/9	16/15	

with Ni as the tonic. The Shadaj Murchhana is

Sa	Re	Ga	Ma	Pa	Dha	Ni	Sa	*(4)*
	10/9	16/15	9/8	9/8	10/9	16/15	9/8	

with Sa as the tonic.

The concept of ancient Murchhanas is identical with the concept of modes in Western Music. With the change of tonic, the effect of each note on the ears undergoes a radical change although the absolute frequency remains the same. The is so because the ears recognize the ratios of frequencies and not their absolute values. If the ears are familiar with the scale 4 and after that the scale 3 is played, owing to the fact the tonic in scale 3 is Ni instead of Sa, the ears designate the Ni as Sa in scale 3, Sa as Re, Re as Ga and so on. The effect on the ears, of the scale (3) will be as if the following scale were being played.

Sa	Re	Ga	Ma	Pa	Dha	Ni	Sa	*(5)*
	9/8	10/9	16/15	9/8	10/9	9/8	16/15	

Where simply he name of notes are different in (5), otherwise the notes are the same as in *(3)*. That is why it is said that in a Murchhanas, the original appearance of a note gets concealed *(Murchhit)*.

As an example of this, everybody knows how different
the notes of Raga Bhairavi appear as compared to Raga Kalyan.

The notes of Raga Bhairavi are :

Sa	Re	Ga	Ma	Pa	Dha	Ni	Sa
	9/8	10/9	16/15	9/8	10/9	9/8	16/15

The notes of Raga Kalyan are :

Sa	Re	Ga	Ma *	Pa	Dha	Ni	Sa
	10/9	16/15	9/8	9/8	10/9	16/15	9/8

But it may surprise many that both the above scales come from the same Gram. If, in the scale of Bhairavi, Re' is regarded as tonic *(instead of Sa in Bhairavi)* the same notes will now appear belonging to Kalyan.

The scale obtained by regarding Re' in Bhairavi as tonic is

Re'	Ga '	Ma	Pa	Dha'	Ni '	Sa	Re
	9/8	10/9	9/8	16/15	9/8	10/9	16/15

This in relative terms, is the same scale as in Kalyan except the notes have different names. Hence, when the notes of Bhairavi are played regarding Sa as tonic, the effect is of Bhairavi Raga, but if Re' is regarded as tonic, the same notes will now produce the effect of Kalyan Raga. All that is necessary to pass on from Bhairavi to Kalyan is to change the setting of Tamboora *(which emphasizes the tonic throughout the recital)* from Sa to Re' by raising it by ratio 16/15.

In ancient times the modal music in which different notes are regarded as tonic to produce the effect of different scales, must have been in vogue. It must have been the practice to tune the Veena in a particular Gram and then pass on to different Murchhanas by a change of tonic and adjusting the Tamboora only without there being any necessity of adjusting the notes on the Veena.

Now-a-days, such a system is not in vogue and the modal music has disappeared from Indian classical music. The Thatas have replaced Murchhanas. In the modern system, the Sa is always kept the tonic or we can say that the tonic is always called Sa. The absolute pitch is chosen according to the convenience of the singer or player. To pass on from Bhairavi to Kalyan in the modern system, the setting of the Tamboora will be kept undisturbed and the absolute pitch of all the notes will be adjusted rather. This is not as difficult as it might appear because most of the instruments already contain sufficient notes to choose from and only marginal adjustments are required. The advantage in the modern system is that while singing a limited range is sufficient. To be able to sing on all the seven Murchhanas of a Gram keeping the notes in fact requires a very wide range.

We can now define a Thata formally as any seven-note scale which is useful for general of melodies. Thus Thatas are isolated Murchhans belonging to the same Gram or not is no longer relevant.

Thus the scales of Bhairavi and Kalyan mentioned above are called different Thatas, namely Bhairavi and Kalyan. To construct Kalyan Thata from Bhairav Thata, we have first to regard Re' as tonic and construct the following scale.

Re' Ga' Ma' Pa Dha' Ni' Sa Re'

and then lower all the notes of the above scale
by a ratio 16/15 *(that between Re' and Sa)* and rename the notes as

Sa Re Ga Ma* Pa Dha Ni' Sa

The first part of the process *(changing the tonic)* is inherent in constituting Murchhanas, but the second part lowering all the notes by the same ratio until the new tonic coincides with the original Sa and remaining the notes) is peculiar to the modern concept of Thata.

But the above process of transition from one Thata to another was mentioned only to underline the difference between Murchhanas and Thatas. In actual practice. Thatas are not derived from Grams or Murchhanas but are constructed from a note scale.

In the following discussion, by *"the twelve note system"* we shall mean the *"Standard notes"* of the diatonic scale. When there are variations, they will be pointed out.

If a Thata is defined as many seven-note scale chosen at random from the twelve-notes, the number of possible Thatas is the possible ways in which seven notes can be chosen out of twelve notes. This number can be calculated in much the same way as the number of possible Grams was calculated from 22 Shrutis in Chapter III and comes to

$$\frac{12}{1} \times \frac{11}{2} \times \frac{10}{3} \times \frac{9}{4} \times \frac{8}{5} \times \frac{7}{6} \times \frac{6}{7} \times = 792$$

But, we cannot accept all these Thatas. Some of the above Thatas leave the tonic Sa out.

Some are of the type

Sa Re' Re Ga' Ga Ma Ma*

in which all the seven-notes are hopelessly close to each other *(which is exactly what one wishes to avoid in a seven-note scale)* and than there is a wide gap between Ma* and Sa. Obviously such a Thata is totally unacceptable.

To ensure that only sensible Thatas are included,
Pandit Bhatkhande prescribes the following rules :

1). Sa and Pa must be included in all the Thatas

2). One of the two Madhyams *(Ma and Ma*)* must be included

3). The first four notes must be chosen from the notes Sa, Re*, Re, Ga' Ga, Ma, Ma*

4). The last three notes must be selected from Pa, Dha', Dha, Ni' and Ni.

Following these rules, we proceed to choose first four notes of a Thata from the notes

Sa, Re', Re, Ga', Ga, Ma, Ma*

Since Sa must be included, it remains to pick up three more notes. One note has to be picked from Ma and Ma' which can be done in 2 ways. The remaining 2 notes have to be picked up from 4 notes *(Re', Re, Ga' and Ga)* which can be done in $\frac{4 \times 3}{1 \times 2} = 6$ $6 \times 2 = 12$ ways.

Proceeding to pick up the last three notes from Pa, Dha', Dha, Ni' and Ni, Pa must be chosen. Hence, it remains to pick up two more notes from four notes *(Dha', Dha, Ni' and Ni)* which can be done in 4 x 3/1x2 = 6 ways.

Combining these with the 12 ways for the choice of first notes, we get 12 x 6 = 72 Thatas. All these Thatas are used in Karnataka system of music but in North Indian system, a much less number is in vogue.

It may be recalled that if we do away with the sanctity of the twelve note system and deduce our Thatas from the possible Grams, we get 105 Murchhanas *(which are Thatas for our purpose)* if we admit only 9/8, 10/9 and 16/15 as consecutive note ratios *(please see Chapter III)* and the number jumps to 210 if we admit ratios 27/25 and 75/64 also. Thus deriving from the Grams this way we get 210 Thatas. Even Thatas which are rich in musical relationships according to the yardstick adopted in page 50 number 154 *(arising from 22 Grams)*.

We shall now proceed to describe the Thatas which are recognized in the North Indian system.

These are as follows :

1) Bilawal Sa Re Ga Ma Pa Dha Ni
2) Kalyan Sa Re Ga Ma* Pa Dha Ni
~~3)~~ Khamaj Sa Re Ga Ma Pa Dha Ni'
~~4)~~ Khamaj Sa Re Ga Ma Pa Dha Ni'
5) Kafi Sa Re Ga' Ma Pa Dha' Ni'
6) Bhairavi Sa Re' Ga' Ma Pa Dha' Ni'
7) Purbi Sa Re' Ga Ma* Pa Dha' Ni
8) Marva Sa Re' Ga Ma* Pa Dha' Ni
9) Todi Sa Re' Ga' Ma* Pa Dha' Ni
10) Bhairav Sa Re' Ga Ma Pa Dha' Ni

To this list, the following Thatas have also been added by Pandit V.D. Paluskar

11) Sa Re Ga' Ma* Pa Dha' Ni
12) Sa Re Ga' Ma* Pa Dha' Ni

The frequency of the notes mentioned above is that of the standard notes, but there are variations at some places. If we discuss the above Thatas from the point of view of Grams, Bilawal, Kalyan and Bhairavi belong to the same Grams, viz., the Madhyam Gram of Bharat *(provided that the Dha of Kalyan is taken to be 27/16 instead of 5/3)*. Khamaj belongs to the Shadaj Gram of Bharat *(provided that Ni' is taken to be 16/9 instead of 9/5). The remaining are new Grams. If Dha (5/3)* is used in Kalyan Thata, its Gram becomes identical with that of Asawari Thata. The Thata Kafi *(using Dha 27/16)* , Bhairav and Asawari are the richest in terms of musical relationships. Now, we shall discuss the ten popular Thatas in slightly more detail.

Bilawal Thata has all the Shuddha notes as in the diatonic scales.
These notes are given below :

Sa	Re	Ga	Ma	Pa	Dha	Ni	*(1)*
1	9/8	5/8	4/3	3/2	5/3	15/8	

These notes are generated by the Nishad Murchhana of Madhyam Gram which is as follows :

Ni		Sa		Re		Ga	Ma		Pa		Dha		Ni	*(successive ratios)*
	9/8		10/9		16/15		9/8		10/9		9/8		16/15	

It can be seen easily that if Ni is regarding as Sa and other notes are remained accordingly, the scale becomes identical with the Bilawal Thata given above. The Thata is as musical as any Thata can be, for six out of seven pairs exhibit one of the Shadaj-Gandhar relationships and five out of seven pairs exhibit Shadaj Pancham relationships as has been seen in Chapter III. Only Re-Dha and Ma-Ni fail to exhibit Shadaj-Pancham Bhav while only Re-Ma fails to exhibit Shadaj Gandhar Bhav.

About Dha, there is some controversy which has been mentioned in the earlier Chapter.
Pandit Bhatkhande recommends Dha (27/16) in Bilawal That.
If this Dha is used, the Thata becomes :

Sa	Re	Ga	Ma	Pa	Dha	Ni	*(2)*
1	9/8	5/4	4/3	3/2	27/26	15/8	

Which is generated by Nishad Murchhana of Shadaj Gram. This Murchhana is

Ni		Sa		Re		Ga	Ma		Pa		Dha		Ni
	9/8		10/9		16/15		9/8		9/8		10/9		16/15

which, after renaming the notes appropriately becomes identical with Pandit Bhatkhande's version of Bilawal Thata. Regarding its musical properties, the pairs exhibiting Shadaj Pancham Bhav remaining the same with the only difference that now Dha-Ga fails to exhibit Shadaj-Pancham Bhav but Re-Dha becomes so related. However, the umber of pairs exhibiting Shadaj-Gandhar relationships drop to four since Ma-Dha and Dha-Sa fail to exhibit Shadaj Shuddha Gandhar and Shadaj Komal Gandhar Bhav respectively. Thus, the scale with Dha *(27/16)* can certainly not be discarded since it is as musical as the Shadaj Gram but it is inferior to the scale with Dha *(5/3)* in terms of musical relationships. However , when Re and Dha are required to be related *(at the cost of Ga-Dha, Ma-Dha and Dha-Sa relationships, of course)* Dha *(27/16)* may be used.

Re *(10/9)* also can be used in Bilawal Thata if the relationship Re with Dha *(5/3)* and Ma is important. However, this is at the cost of the relationships Pa-Re and Ni-Re relationships which now are no longer musical. The total number of pairs exhibiting Shadaj-Pancham Bhav and Shadaj-Gandhar Bhav remains the same.

Broadly speaking, when the relation Re-Ma is more important, Re*(10/9)* is used.
Both Re-Ma and Re-Pa can never be musical.

Another variation can be obtained by using Re *(10/9)*, Pa *(40/27)* and Dha *(5/3)* which is as musical as Shadaj Gram.

Kalyan Thata has all the Shuddha notes except Ma* which is Teevra.

Coming to exact frequencies, two versions of Kalyan Thata come into serious consideration.

Sa	Re	Ga	Ma*	Pa	Dha	Ni	Sa	
1	9/8	5/4	45/52	3/2	27/16	15/8	2	*(1)*

Sa	Re	Ga	Ma	Pa	Dha	Ni	Sa	
1	9/8	5/4	45/32	3/2	5/3	15/8	2	*(2)*

which differ in the frequency of Dhaivat only. The scale *(1)* is generated by Gandhar Murchhana of Madhyam Gram or Madhyam Murchhana of Madhyam Gram or Madhyam Murchhana of Bilawal Thata (it can be verified easily by the reader) and is therefore., as musical as Madhyam Gram or Bilawal Thata. Except the pairs Ma*-Sa and Dha-Ga *(failing to exhibit Shadaj-Komal Gandhar Bhav)* all other corresponding pairs are musically related.

The scale *(2)* is also just as musical as the scale *(1)*. Only now Dha-Ga has Shadaj Pancham Bhav at the cost of Re-Dha relationship similarly, relation Dha-Sa is established at the cost of Ma*-Dha relationship similarly, relation Dha-Sa is established at the cost of Ma*-Dha relationship. As a matter of fact the scale *(2)* is generated by the Madhyam Murchhana of Bilawal Thata with Re *(10/9)*.

Hence, both the versions of Kalyan Thata are equally musical. Broadly speaking when Dha-Sa are required to be related and the relation Ma*-Dha is not so important, Dha*(5/3)* is used. On the contrary when the relation Ma*-Dha is not so important, Dha*(5/3)* is used. The occasions to use Dha *(27/16)* appear to be more than those to use Dha*(5/3)*.

Some times, Ma**(25/18)* which is lower than the usual Ma**(45/32)* by a ratio 81/80 is also used along with Dha *(5/3)* when both the relations Ma*-Dha and Dha-Sa are important. It can be seen easily that Ma* *(25/18)* - Dha *(5/30)* = 6/5. and, of course Dha *(5/3)* - Sa*(2)* = 6/5.

However, in this scale, the relationship Re-Ma* is spoiled which is no longer Shadaj-Shuddha Gandhar Bhav. Also, Ma*-Ni no longer exhibit Shadaj-Madhyam Bhav. This scale is slightly poorer in musical relationships than *(1)* or *(2)* since the number of pairs exhibiting Shadaj Pancham Bhav drop to 4 while the number of pairs related by one of the Shadaj-Gandhar Bhavs remains the same.

Other variations would be found by using :
Ga (81/64) in *(1) and*
Re *(10/9)* in *(2)*
which are as musical as Shadaj Gram.

Bhairavi Thata - has all the notes Komal except Ma which is Shuddha. It can be verified that this Thata is generated by the Rishabha Murchhana of Madhyam Gram, Gandhar Murchhana of Bilawal Thata or Nishad Murchhana of Kalyan Thata using Dha*(27/16)*. Hence, it is as musical as any of the Thata mentioned earlier. The pairs Pa-Re', Ni'-ma*(failing to exhibit Shadaj-Pancham Bhav)* and Ni'-Re' *(failing to exhibit Shadaj Komal Gandhar Bhav)* are the ones not musically related.

The notes of the Bhairavi Thata are :

Sa	Re'	Ga'	Ma	Pa	Dha'	Ni
	16/15	6/5	4/3	3/2	8/5	9/5

Another version of this Thata can be obtained by using Ni' *(16/9)* instead of Ni' *(9/5)*. This amounts to depressing Ni' by a ratio 81/80. The scale remains as musical as before except that the Shadaj-Komal Gandhar relationship Ni'-Ma is gained at the cost of Ga'-Ni' and the Shadaj-komal Gandhar relationship Ni'-Re' is gained at the cost Pa-Ni'. Hence, both the versions of Ni' are equally musical and one or the other is used according to which relations are more important. It can also be verified that the version of Bhairavi Thata with Ni *(16/9) is generated by Nishad Murchhana of Kalyan Thata given in scale (2)* (which used Dha *(27/16)*.Also, it comes from the same Gram as Bilawal Thata using Re*(10/9)*.

Ga' *(32/27)* can also be used along with Ni' *(16/9)* so that the relationship of Ga'-Ni' is preserved. But the relationship Dha'-Ga no longer holds. On the other hand, both the Shadaj -Gandhar relationships Sa-Ga' and Ga'-Pa are lost. This scale is certainly inferior in musical relationships but may be used when both ma-Ni' and Ga'-Ni are important pairs. This is as musical as Shadaj Gram.

Similarly ma*(27/20)* is also usable in Bhairavi. Thata (With Ga'*(6/5)* and Ni' (9/5) (which is generated by Re-Murchhana of Shadaj-Gram) When both the relationships Ma-Ni' and Pa-Ni' are important as Shadaj-Madhyam and Shadaj-Komal Gandhar Bhavs respectively. But scale also is distinctly inferior to the original scale but may be used when the pairs Ma-Ni' and Pa-Ni' are equally important.

Khamaj Thata uses all Shuddha notes except Ni' which is Komal.
The exact frequencies are as follows :

Sa	Re	Ga	Ma	Pa	Dha	Ni
1	9/8	5/4	9/3	3/2	5/3	16/9

This can be easily seen to be generated by Madhyam-Murchhana of Shadaj-Gram or by Pancham Murchhana of Bhatkhande's version of Bilawal Thata with Dha*(27/16)*.

The following pairs fail to exhibit Shadaj-Pancham Bhav

Re-Dha

Ga-Ni'

While the following pairs fail to exhibit one of the Shadaj-Gandhar relationships

Re-Ma *(6/5)*

Pa-Ni' *(6/5)*

Ni'-Re *(5/4)*

Coming to its variations, Re *(10/9)* instead of Re *(9/8)* is used very often. This improves the scale in terms of musical relationships because the number of pairs related by Shadaj-Pancham Bhav remains the same *(the relationship Re-Dha is gained at the cost of Pa-Re)* but two more pairs become related by Shadaj-Gandhar Bhavs since

Re-Ma = 4/3-109 = 6/5

Ni'-Re = 10/9-1/2, 16/9 = 5/4

This version of Khamaj that is actually generated by the Madhyam Murchhana of Madhyam Gram. Hence it is at par with the Thatas Bilawal, Kalyan and Bhairavi. This version is used when Ni'-Re and Re-Ma are important pairs. For example, in raga Jai Jai Vanti Re*(10/9)* is used because Ni' and re-Ma are very important combinations.

If Pa is depressed by a ratio 81/80 and Re *(10/9)* is used, the scale remains as musical as the one with Re *(10/9)* and Pa *(3/2)*.This version of Thata belongs to the same gram as Bhairavi with Ni' *(10/9)*.The advantage is that both the relations Re-Ma and Re-Pa are taken care of at the same time and the Shadaj-Gandhar relationship between Pa-Ni also is established. But, Pa-Sa is no longer musical and the musical relationship Ga-Pa also is lost. The notes Re *(10/9)* and Pa *(40/27)* are used particularly when the relationships re-Ma and Re-Pa are both important at the same time.

There is another variation of Khamaj Thata using Dha *(27/16)* and Ni' *(9/5)* which becomes less musical than the original version using Dha *(5/3)* and Ni' *(16/9)* , because one more pair fails to exhibit Shadaj-Pancham Bhav. still Dha *(27/16)* and Ni' *(9/5)* may be used when pa-Ni' and Re-Dha are important combinations. However, if Ga *(81/64)* is used in this version, the scale remains as musical as Shadaj Gram.

***Kafi Thata** used all Shuddha notes except Ga' and Ni' which are Komal.*
The exact frequencies in the original version are :

Sa	Re	Ga'	Ma	Pa	Dha	Ni'	
1	9/8	6/5	4/3	3/2	27/16	9/5	***(1)***

This Thata is as musical as Madhyam Gram but comes from a different Gram *(please see the Gram(2) in Chapter III)*. The pairs Dha-Ga' Ni-Ma *(failing to exhibit Shadaj Pancham Bhav)* and re-Ma, Ma-Dha and Dha-Sa *(failing to exhibit any of the Gandhar Bhavs)* are the ones not related musically.

Regarding its variations, Shadaj Gram and Madhyam Gram of Bharat are two versions of this Thata.
The notes of these two scales are reproduced below :

Sa	Re	Ga	Ma	Pa	Dha	Ni	
1	10/9	32/27	4/3	3/2	5/3	16/9	*(Shadaj Gram)* ***(2)***
Sa	Re	Ga	Ma	Pa	Dha	Ni	
1	10/9	32/27	4/3	40/27	5/3	16/9	*(Madhyam Gram)* ***(3)***

The properties of the above two scales have been already discussed in great detail.

Another musically rich version of Kafi Thata is the following :

Sa	Re	Ga	Ma	Pa	Dha	Ni	
1	9/8	6/5	27/20	3/2	27/16	9/5	***(4)***

Which can be obtained from Madhyam Gram by depressing Sa by a ratio 81/80 and refixing the frequency-ratios of all the notes relative to the new Shadaj. It can be easily seen that depressing Shadaj by a ratio 81/80 is equivalent to elevating all other notes by the same ratio. Doing this for Re, Ga, Ma, Dha and Ni in Madhyam gram *(3)*, We get the scale *(4)*.

This scale *(4)* belongs to the same gram as the Bilawal Thata with re *(10/9)* and Dha *(5/3)*. To be precise, it is generated by the Murchhana of this version of Bilawal Thata starting with Rishabha. This scale is as musical as the Madhyam Gram, the only difference is that :

In Madhyam Gram, the pairs not related musically are :

Sa-Pa;
Ga-Ni *(failing to exhibit Shadaj Pancham Bhav);*
Sa-Ga *(failing to exhibit Shadaj Pancham Bhav);*
Dha-Sa *(failing to exhibit any of the two Shadaj Pancham Bhav) and*
Dha-Sa *(failing to exhibit any of the two Shadaj Gandhar Bhavs).*

Whenever the note Madhyam is predominant in a melody, the versions of Kafi Thata identical with Shadaj or Madhyam grams are used, while the versions *(1)* and *(4)* are used whenever the note Pancham is more important than Madhyam. Theoretically the versions *(3)* and *(4)* are most musical and one can choose from the accordingly as Madhyam or Pancham is the predominant note.

***Asawari Thata** uses all Shuddha notes except Ga, Dha and Ni which are Komal.*
The obvious version of this Thata is :

Sa	Re	Ga	Ma	Pa	Dha'	Ni'	
1	9/8	6/5	4/3	3/2	8/5	9/5	***(10)***

Checking up for musical relationships, one finds that all pairs except Re-Dha' and Ni-Ma exhibit Shadaj Pancham Bhav while all pairs except Re-Ma exhibit Shadaj Gandhar Bhav *(5/4 or 6/5)*. This version of Asawari Thata is easily seen to have been generated by Bilawal Thata with Re *(10/9)* and Dha *(5/5)* by taking Murchhana starting with Dhaivat.

Clearly the scale is as rich in musical relations as the Madhyam Gram.

Another version of Asawari Thata can be obtained
by simply raising Ma by a ratio 81/80 so that new scale is :

Sa	Re	Ga'	Ma	Pa	Dha'	Ni'	
1	9/8	6/5	27/20	3/2	8/5	9/5	***(2)***

This scale belongs to Madhyam Gram being generated by its Pancham Murchhana. The scale *(2)* is as rich as the scale *(1)* with the only difference that in scale *(2) the relationships of the pairs Ma-Sa and ma-Dha' are spoiled but the gain is of the relationships Ni'- Ma and Re-Ma.*

Yet another version can be obtained from (2) by elevating Sa by a ratio 81/80 or,
what is the same as depressing all the notes other than Sa by the same ratio.
The scale becomes :

Sa	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	
1	*10/9*	*32/27*	*4/3*	*40/27*	*128/81*	*16/9*	**(3)**

which belongs to the Shadaj gram being generated by its Murchhana starting with Pa. Its properties are similar to those of the Shadaj gram except the nomenclature of notes.

If Ni (16/9) is used in the scale (1) instead of Ni' (9/5),
we get another version of Asawari Thata which is as musical as Shadaj gram.
This scale is :

Sa	Re	Ga	Ma	Pa	Dha '	Ni'	
1	9/8	6/5	4/3	3/2	8/5	16/9	***(5)***

By using Ni' *(16/9)* the relationship Ni-Ma is gained at the expense of Ga'-Ni' while the relationships Pa-Ni' and Ni'-Re break down without any gain. Hence the total number of non musical pairs are 5 as in Shadaj Gram.

before proceeding further with the remaining four Thatas, we shall comment on the discussion of the six Thatas mentioned above from the point of view of their relationship with grams. It will be observed that the following four grams play a very important part as far as the notes of the six Thatas are concerned :

a.	Sa	Re	Ga	Ma	Pa	Dha	Ni
	1	10/9	32/27	4/3	3/2	5/3	16/9
				[Shadaj Gram]			
b.	Sa	Re	Ga	Ma	Pa	Dha	Ni
	1	10/9	32/27	4/3	40/27	5/3	16/9
				[Madhyam Gram]			
c.	Sa	Re	Ga	Ma	Pa	Dha	Ni
	1	9/8	6/5	27/20	3/2	27/16	9/5
				[Re-Murchhana of Gram (3)]			
d.	Sa	Re	Ga	Ma	Pa	Dha	Ni
	1	9/8	6/5	4/3	3/2	27/16	9/5
				[Gram(2)]			

(a) and *(b)* are Shadaj gram and Madhyam gram of Bharat respectively;
(c) generates version *(1)* of Asawari by its Pancham Murchhana Thata *and*
(d) is the version *(1)* of Kafi Thata.

In terms of musical relationships
(c) is as rich as Madhyam gram *and (d)* is as rich as Shadaj Gram.

Each of the four grams generate some version or the other
of each of the six Thatas described above. this will be clear as follows :

Nishad Murchhanas of each of the four Grams *(a), (b), (c)* and *(d)*
generate four versions of Bilawal Thata already mentioned.

Similarly Rishabha Murchhanas of the above Grams generate different versions of Bhairavi Thata;
Gandhar Murchhanas generate different versions of Kalyan Thata;
Madhyam Murchhanas generate variations of Khamaj Thata;
Pancham Murchhanas generate Asawari Thata.

Starting note of the Murchhanas of the four Grams *(a), (b), (c), and (d).*	**Thata generated** *(each of the different versions generated are already mentioned)*
Nishad	Bilawal
Shadaj *(Original Gram)*	Kafi
Rishabha	Bhairavi
Gandhar	Kalyan
Madhyam	Khamaj
Pancham	Asawari

The Grams can be obtained one from the other as follows starting from the Shadaj Gram
Shadaj-Gram ---------- Madhyam Gram----------

(a) Depress Pa by 81/80 *(b)* Depress Sa by 81/80 by 81/80 *(or raise other notes by the same ratio)* *(c)* Depress Ma by 81/80 *(d)*

It should be noted that there is no Thata corresponding to the Dhaivat Murchhanas of the above Grams. This is just because these scales have not come to be popular. There is nothing in the Dhaivat Murchhanas of the above Grams which would make them unsuitable to get the status of a Thata which could generate melodies.

The four Dhaivat Murchhanas are given below.

	Sa	**Re**	**Ga**	**ma**	**Pa**	**Dha**	**Ni**
1)	1	16/15	6/5	4/3	64/45	8/5	9/5 from *(a)*
2)	1	16/15	6/5	4/3	64/45	8/5	16/9 from*(b)*
3)	1	16/15	32/27	4/3	64/45	8/5	16/9 from*(c)*
4)	1	16/15	32/27	4/3	64/45	128/81	16/90 from*(d)*

It must be remembered that the note named Pancham in the above scales is actually far away from the traditional Pancham *(3/2)* being 135/128 times lower than it. In fact this note comes closer to ma *(45/32)* than to Pa *(3/2)*. Hence it may be more appropriate to name it Ma*.

Perhaps the reason why these Thatas have not been explored is that they use both Ma and Ma*. Otherwise they are as rich in musical relations as any of the Thatas described so far. The six Thatas mentioned so far involve the ratios 9/8, 10/9 and 16/15 between these consecutive notes. The four Thatas that we are going to describe now employ the ratios 75/64 also and as we shall see, some times employ frequency ratios smaller than 16/15 between these consecutive notes. The four Thatas that we are going to describe now employ the ratios 75/64 also and as we shall see, some times employ frequency ratios smaller than 16/15 viz. 135/128, 25/24 etc. This explains why the effect of the melodies derived from these Thatas is some what strange to a beginner.

Now we describe these Thatas individually.

Bhairav uses Re' and Dha' Komal and all the other notes Shuddha.
In terms of the notes of diatonic scale the exact frequencies are :

Sa	Re'	Ga	Ma	Pa	Dha'	Ni	*(1)*
1	16/15	5/4	4/3	3/2	8/5	15/8	

Checking up this scale for musical relationships we find that all corresponding pairs except Pa-Re, Dha'-Ga and also Ni-ma are related by Shadaj Pancham Bhav while all pairs except Ni-Re are related by one of the Shadaj Gandhar Bhavs. Hence, while the scale is not so rich in Shadaj pancham relationships as the Thatas discussed earlier, it is very rich in Shadaj-Gandhar relationships. This version of Bhairav Thata is used widely *(e.g. in Raga Bhairav)* whenever Re' is required to be related to Ma and Dha' to Sa.

There is one more version of this Thata which can be admitted on merits and it is the following

Sa	Re'	Ga	Ma	Pa	Dha'	Ni	
1	25/24	5/4	4/3	3/2	25/16	15/8	*(2)*

The variation in the frequencies of Re' and /Dha' does not affect Shadaj Pancham relationships at all; the same pairs remain related by Shadaj Pancham Bhav but now Re'-Ma and Dha'-Sa no longer remained related by the Shadaj Shuddha Gandhar Bhav *(5/4)*.

However, Re'-Ga and Dha'-Ni now became related by Shadaj-Komal Gandhar relationship because :

Re'-Ga = 5/4 / 25/24 = 6/5

Dha'-Ni = 15/8 / 25/16 = 6/5

In addition, now the Ni-Re' is *(25/24) /(15/16)* = 10/9 which is not one of the relationships 3/2, 4/3,5/4 and 6/5 but is nevertheless musically acceptable. We can say that in scale *(2)* the relationship Ni-Re' is improved as compared to that in scale *(1)*.

The reader may object that the notes Sa-Re' and Pa-Dha' in scale *(2)* are too close, being separated by a ratio as small as 25/24 which infringes the rule that in a seven note scale the ratio between consecutive notes should not be less than 16/15. But, in any case, this rule is going to be violated by the Thatas which follow. We shall come back to this point later.

Purbi - This Thata employs Re' and Dha' Komal, Ma* Teevra and other notes Shuddha.

Using the notes of the diatonic scale, the Thata is

Sa	*Re'*	*Ga*	*Ma**	*Pa*	*Dha*	*Ni*	
1	*16/15*	*5/4*	*45/32*	*3/2*	*8/5*	*15/8*	***(1)***

All the pairs except ma* -Sa, Pa-Re' and Dha'-Ga exhibit Shadaj Pancham Bhav and all pairs except Re'-Ma*, Ma-Dha' and Ni'-Re' exhibit one of the Shadaj Gandhar Bhavs. Thus the number of pairs not musically related are six. The scale is rather poor in musical relationships.

Another version of Purbi Thata is the following which used in some of its melodies

Sa	*Re*	*Ga*	*Ma**	*Pa*	*Dha'*	*Ni*	
1	*135/128*	*81/64*	*45/32*	*3/2*	*405/256*	*243/128*	***(2)***

The reader may wonder where we brought these ghastly fractions from. In fact, the idea is to relate Re'-ma* by Shadaj-Madhyam Bhav and at the same time relate Re'-Ga and Dha'-Ni by Shadaj Komal Gandhar Bhav. Ga and Ni are elevated by a ratio 81/80 as compared to their counterparts in diatonic scale. Re' is chosen such that Re'-Ma* = 4/3. Dha' is chosen such that Dha'-Ni = 6/5.

The scale is rather poor in Shadaj-Pancham relations.

Four pairs Sa-Pa, Re'-Dha, Ga-Ni and Ma*-Re' and related by Shadaj Pancham Bhav, but look at the following relations :

Re'-Ga	=	6/5
Ma*-Dha'	=	9/8
Dha'-Ni	=	6/5
Ni-Re'	=	10/9

The pairs Sa-Ga, Ga-Pa, Pa-Ni and Dha'-Sa are not related musically.

Yet another version of the Thata can be mentioned as follows :

Sa	Re'	Ga	Ma*	Pa	Dha'	Ni	
1	25/24	5/4	45/32	3/2	25/16	15/8	***(3)***

All pairs except ma-Sa, Pa-Re' and Dha'-Ga exhibit Shadaj Pancham Bhav while the following pairs exhibit Shadaj Gandhar Bhavs.*

Sa - Ga = 5/4		
Re' - Ga = 6/5	Dha'-Ni 6/5	
Ga - Pa = 6/5	*in addition* Ni - Re'	= 10/9
Pa - Ni = 5/4	Ma* - Dha'	= 10/9

The pairs musically unrelated are only Re'-Ma and Dha'-Sa.*

This version of the Thata is quite musical - as musical as the Shadaj Gram at least. In addition the pairs Ni-Re' and Ma*-Dha' have the agreeable relationship 10/9 if not one of the samvadas *(3/2,4/3,5/9 or 4/3)*.

In practice, the version *(1)* is hardly ever used. The version *(3)* is used far often than the version *(2)*. Where ever the combination Re'-Ma* is important, however re' *(135/128)* of version *(2)* is used. For example, in Raga Puriya Dhanashri the sequence Ma*-Re'-Ga is typical and therefore re' *(135/128)* and Ga *(81/64)* are used at least when this particular sequence is used.

Marva Thata uses Re' Komal, Ma* Teevra and all other notes Shuddha.

Using the notes of the diatonic scale alone the Thata is

Sa	Re	Ga	Ma*	Pa	Dha	Ni	
1	16/15	5/4	45/32	3/2	5/3	15/8	***(1)***

In which the three pairs Re'-Dha, Ma*-Sa and Pa-Re' fail to exhibit Shadaj pancham Bhav while the pairs Re'-Ma* Ni-Re' and Ma*-Dha fail to exhibit any of the Shadaj Gandhar Bhavs. The scale is thus less musical than the Shadaj gram.

If Dha *(27/16)* is used instead of Dha *(5/3)* ma*-Dha exhibits Shadaj-Komal Gandhar relationship at the cost of Dha-Sa relationship. But , the scale becomes still less musical since the Shadaj Pancham relationship Dha-Ga is broken for no gain.

If Re' (135/128) is used instead of Re (16/15),
the Thata improves in terms of musical relationships and becomes

Sa	Re	Ga	Ma*	Pa	Dha	Ni	
1	135/128	81/64	45/32	3/2	27/16	15/8	***(2)***

In this, Ga and Dha have been raised by a ratio 81/80
so that Re'-Ga = 6/5
and Dha-Ga = 3/2.

In this version of the Thata the pair re'-Dha, Pa-re and Ga-Ni fail to exhibit Shadaj Pancham Bhava *(the pair Ma* - Re' exhibits this relationship if not ma* - Sa)* while the following pairs exhibit one of the Shadaj Gandhar Bhavs.

Re' - Ga = 6/5
Ma*- Dha = 6/5
Pa - Ni' = 5/4

In addition, Ni-Re' = 9/8 which is an agreeable relationship.
Counting this also as a musical relationship, the Thata becomes as musical as Shadaj Gram.

The use of Ni *(243/128)* instead of Ni *(15/8)* achieves no purpose for the relationship Ga-Ni is gained at the cost of Ni-Ma* while the relationship Pa-Ni is spoiled without any compensation. However ,in Ragas which do not use Pa at all, this version of Thata *(with No = 243/128)* may be preferable. With No *(243/128)*, the relation Ni- Re becomes 10/9 instead of 9/8.

Another version of the Thata can be obtained by using Re' (25/24) along with Ga (5/4)

Sa	Re'	Ga	Ma*	Pa	Dha	Ni	
1	25/24	5/4	45/32	3/2	27/16	15/8	*(3)*

The pairs Re'-Dha, Ma* Sa, Pa-Re' and Dha-Ga fail to exhibit Shadaj-Pancham Bhav *(The Pair Ma*-Re' also to exhibit this relationship but since only one out of ma*-Sa and Ma*-Re' is expected to exhibit this relationship, Ma*-Re has not been enumerated)*. A poor performance.

The following pairs exhibit the Shadaj - Gandhar Bhavs

Sa - Ga = 5/4
Re' - Ga = 6/5 In addition
Ga - Pa = 6/5 Ni - Re' = 10/9
Ma* - Dha = 6/5
Pa - Ni = 5/4

Thus the Thata is rich in Shadaj-Gandhar relationships.

Dha (5/3) can also be used in the above scale to get the following form :

Sa	Re'	Ga	Ma*	Pa	Dha	Ni	
1	25/24	5/4	45/32	3/2	5/3	15/8	*(4)*

Which improves the Thata since the following relationships are gained :

Dha - Ga = 3/2
Dha - Sa = 6/5

While only one viz. Ma - Dha is lost.*

If Ma is depressed in scale (4), the Thata becomes very musical.*
The notes now become :

Sa	Re'	Ga	Ma*	Pa	Dha	Ni
1	25/24	5/4	25/18	3/2	5/3	15/8

The total number of pairs exhibiting Shadaj-Pancham relationship remain the same as in the scale *(4) (the number being 4)* but the relationship Ma* - Dha is gained at no cost.

The following pairs now exhibit one of the Shadaj-Gandhar Bhavs :

Sa - Ga = 5/4
Re' - Ga = 6/5
Ga - Pa = 6/5
Ma* - Dha = 6/5
Pa - Ni = 5/4
Dha - Sa = 6/5

Also Ni-Re = 10/9 which is an agreeable relationship.

The performance of this version of Marwa Thata can be said to be the best so far by any seven note scale as far Shadaj Gandhar relationships are concerned. This version of Marva Thata is used in Raga Sohani *(of course, there is no Pancham in this Raga).*

***Todi Thata** uses Re', Ga and Dha' Komal, Ma* Teevra and other notes Shuddha.*
In terms of the notes of the diatonic scale the Thata is

Sa	Re'	Ga'	Ma*	Pa	Dha'	Ni	
1	16/15	6/5	45/32	3/2	8/5	15/8	*(1)*

Checking it up for musical relationships, the pairs Ga'-Ni, Ma* Sa and Pa-Re' fail to exhibit Shadaj-Pancham Bhav while the pairs Re'-Ma, Ma*-Dha', and Ni-Re' are not musically related. The scale is rather poor in musical relationships.

Another version of the Thata uses the following notes :

Sa	Re'	Ga'	Ma*	Pa	Dha'	Ni	
1	16/15	32/27	64/45	3/2	8/5	48/25	*(2)*

The Ga of this scale is 81/80 times lower than its counterpart in scale *(1)*,
Ma* is 2048/2025 times higher, and
Ni is 128/125 times higher than their respective counterparts in scales *(1)*.

The pairs exhibiting Shadaj-Pancham relationships are only :

Sa - Pa
Re' - Dha'
Ma* - Re'

While the pairs exhibiting Shadaj Gandhar relationships are :

Ga' - Ma* = 6/5
Dha - Sa = 5/4
Dha - Ni = 6/5

While Re - Ga' = 10/9
Ma* - Dha' = 9/8
Ni* - Re' = 10/9

The pairs Sa-Ga', Ga'-Pa and Pa-Ni are unmusical.

The scale is not rich in musical relations
but it is used in Raga Todi in which Pancham is used very sparingly.
In Raga Gandhar Todi Pancham is completely forbidden.

If Pancham is completely omitted, the scale becomes :

Sa	Re'	Ga'	Ma*	Dha'	Ni	Sa
1	16/15	32/27	64/45	8/5	48/25	2

It can be verified that this sequence is equivalent to the following one :

Ni	Sa	Re	Ma	Pa	Ni'	Ni
15/16	1	10/9	4/3	3/2	9/5	15/8

Another version of Thata Todi is the following :

Sa	Re'	Ga'	Ma*	Pa	Dha'	Ni	
1	16/15	6/5	36/25	3/2	25/16	15/8	*(3)*

This is not rich in musical relationships but can be used in Ragas like Multani
in which Sa-Ga', Ga'-Pa, Pa-Ni and Ni-Dha' are to be emphasized.
The scale is not bad in Shadaj Gandhar relationships.

The following pairs exhibit it :

Sa - Ga'	=	6/5
Ga' - Pa	=	6/4
Pa - Ni	=	5/4
Dha' - Ni	=	6/5
Ga' - Ma *	=	6/5

But Shadaj Pancham relationship is exhibited by the pair Sa-Pa only.

This completes a discussion of the ten traditional Thatas. It has been evident that the first six Thatas described viz. Bilawal, Kalyan, Khamaj, Kafi, Asawari and Bhairavi employ only the ratios 9/8, 10/9 and 16/15 and none other between their consecutive notes. Although these Thatas umber only six when we confine ourselves to the notes of Diatonic scale only, but when other musical variants are also included, each Thatas splits into atleast four distinct scales derived from each of the four Grams described above. Hence the six Thatas multiply into 24 scales.

The remaining four Thatas are a bit unorthodox. They employ ratios other than 9/8, 10/9,16/15 also for their consecutive notes. Sometimes the consecutive note ratio goes as high as 6/5, sometimes it is a small as 25/24. The ratio 135/128 is also used in atleast some variants of these Thatas. What is particularly noteworthy, even the golden rule of a seven scale note is violated - the consecutive note ratio is vary often less than 16/15 *(of course it is not violated when we confine ourselves to notes of diatonic scale, but certainly there are Ragas in which the variations using notes other than belonging to the diatonic scale are used, and in many of these variations, the consecutive note ratios are smaller than 16/15).* This is why these four Thatas Bhairav, Purvi, Marwa and Todi sound different from the foregoing Thatas and beginners have to develop a taste for the Ragas derived from these Thatas. The acceptance of the unconventional ratios 25/24, and 135/128 for consecutive notes in a seven note scale *(which would not have found approval from Bharat)* marks an evolutionary process in the aesthetic values of classical music.

But there can be many Thatas even involving no more than 9/8,10/9 and 16/15 as consecutive note ratios which have not been explored in our system. If we drop the restriction that both Ma and Ma* cannot be included in a Thata and choose the frequency of Ma* such that Ma*(4/3)* - Ma* = 16/15, we get four Thatas generated by Dhaivat Murchhanas of the four basic Grams mentioned earlier, These Thatas are as musical as the six Thatas. Bilawal, Kalyan, Kafi, Khamaj, Asawari and Bhairavi and employ only the ratios 10/9, 9/8 and 16/15 for consecutive notes. Yet, these Thatas are not in use. A vast field of melodies remain unexplored generated by these Thatas.

Moreover, 22 grams have been listed as musical according to the yardstick specified earlier. In the constructions of the Thatas described above, only four Grams have been fully utilized *(viz. Shadaj Gram, Madhyam Gram No.2 and No.3.*

These Grams, when represented by all their Murchhanas *(except the Dhaivat Murchhana)* generate the six Thatas Bilawal, Kalyan, Kafi, Khamaj, Asawari and Bhairavi. A fifth Gram viz. III (p.) is the same as Bhairava Thata (the diatonic version) but this is only the Shadaj Murchhana of the Gram III.

Still there are six more Murchhanas of the Gram which can generate new Thatas. These Thatas are given below

Sa	Re	Ga	Ma	Pa	Dha	Ni	Shadaj Murchhanas of
1	16/15	5/4	4/3	3/2	8/5	15/8	Gram III *or* Bhairava That.
Sa	Re	Ga	Ma	Pa	Dha	Ni	*(Generated by **Re** Murchhana*
1	75/64	5/4	45/32	3/2	225/128	15/8	*of the above Gram).*
Sa	Re	Ga	Ma	Pa	Dha	Ni	*(Generated by **Ga** Murchhana)*
1	16/15	8/5	96/75	3/2	8/5	128/75	
Sa	Re	Ga	Ma	Pa	Dha	Ni	*(Generated by **Ma** Murchhana)*
1	9/8	6/5	45/32	3/2	8/5	15/8	
Sa	Re	Ga	Ma	Pa	Dha	Ni	*(Generated by **Pa** Murchhana)*
1	16/15	5/4	4/3	64/45	5/3	16/9	
Sa	Re	Ga	Ma	Pa	Dha	Ni	*(Generated by **Dha** Murchhana)*
1	75/64	5/4	4/3	25/16	5/3	15/8	
Sa	Re	Ga	Ma	Pa	Dha	Ni	*(Generated by **Ni** Murchhana)*
1	16/15	256/225	4/3	64/45	8/5	15/8	

It is interesting to note that the Thata generated by Madhyam Murchhana contains the familiar notes of diatonic scale only and therefore con be adopted in the world of music without any difficulty. It has been mentioned by Pandit V.D. Paluskar as a Thata *(and hence been mentioned earlier as the Thata No. 11).*

Besides, there are 17 more Grams *(Chapter IV)* which are rich in musical relations but have not been explored at all for the construction of Thatas. Since each Gram can give rise to seven Murchhanas and each Murchhana generates a Thata, these 17 Grams would yield us 119 new Thatas. All these Thatas are as musical atleast as the Shadaj Gram and worth including in our list of Thatas.

Particularly noteworthy is the Gandhar Gram. This Gram is reproduced below :

Sa	Re	Ga	Ma	Pa	Dha	Ni
1	10/9	6/5	4/3	36/25	8/5	9/5

It Murchhanas starting with Re, Ga, Ma, Pa, Dha and Ni respectively generate the following Thatas :

Sa	Re	Ga	Ma	Pa	Dha	Ni	
1	27/25	6/5	162/125	36/25	81/50	9/5	***(Re-Murchhana)***
Sa	Re	Ga	Ma	Pa	Dha	Ni	
1	10/9	6/5	4/3	3/2	5/3	50/27	***(Ga-Murchhana)***
Sa	Re	Ga	Ma	Pa	Dha	Ni	
1	27/25	6/5	27/20	3/2	5/3	9/5	***(Ma-Murchhana)***
Sa	Re	Ga	Ma	Pa	Dha	Ni	
1	10/9	5/4	25/19	125/81	5/3	50/27	***(Pa-Murchhana)***
Sa	Re	Ga	Ma	Pa	Dha	Ni	
1	9/8	5/4	25/18	3/2	5/3	9/5	***(Dha-Murchhana)***
Sa	Re	Ga	Ma	Pa	Dha	Ni	
1	10/9	100/81	4/3	40/27	8/5	16/9	***(Ni-Murchhana)***

All these Thatas, inspite of involving cumbersome fractions are as musical as the Gandhar Gram. Particularly, the Thata generated by the Dhaivat Murchhana uses all the well familiar notes except Ma* *(25/18)*.

The note Ma* *(25/18)* is not so unfamiliar. We have encountered it in one of the variations of Marva Thata and it is 10/9 times higher than Ga (5/4) and has a Shadaj Komal Gandhar Bhav with Dha *(5/3)*. This Thata can be the most familiar and convenient link with the ancient Gandhar Gram.

We have seen that admitting 9/8, 10/9, 16/15, 75/64 and 27/25
as the frequency-ratios between consecutive notes,
the following new Thatas, coming from musical Grams, can be added to our system :

1). 4 Thatas of the Dhaivat Murchhanas of the 4 Grams
which generate Bilawal, Kalyan etc. six Thatas.

2). 6 Thatas arising out of the six unexplored Murchhanas of the Gram III.
(Bhairava Thata is its Shadaj Murchhana).

3). 119 Thatas of the remaining 17 Grams giving a total number of 129 new Thatas
which can be included in our system.

Let us say a few words about the unusual Thatas also. If we include 25/24 and 135/128 etc. *(ratios less than 16/15)* as possible frequencies between consecutive notes also, as we have done in the four Thatas - Purbi, Marwa, Bhairav *(non-diatonic variations)* and Todi, how many more Thatas would be added to the system ?

We observe that the scales using the consecutive ratios 25/24, 135/128 etc.
can be broadly divided into the following categories :

I. The scales involving two consecutive note ratios equal to 25/24,
two ratios equal to 16/15,
two equal to 16/15,
two equal to 6/5
and one equal to 9/8,
when the octave is broken up as

$$(25/24 \times 25/24) \times (16/15 \times 16/15) \times (6/5 \times 6/5) \times 9/8 = 2$$

II. Scales involving two ratios equal to 135/128,
two equal to 6/5
one ratio equal to 10/9,
one equal to 16/15
and one equal to 256/243.

Thus, $(135/128 \times 135/128) \times 16/15 \times (6/5 \times 6/5) \times 10/9 \times 256/243 = 2$

III. Scales involving two ratios 6/5, two ratios 16/15, one $\frac{135}{128}$, one $\frac{25}{24}$ and one $\frac{10}{9}$.

Thus, $135/128 \times 25/24 \times (6/5 \times 6/5) \times (16/15 \times 16/15) \times 10/9 = 2$

All the variations of Marva, Purbi and Todi Thatas described above and those Bhairava Thata except the version using the notes of diatonic scale are included in one or the other categories out of the above.

The method of finding the number of all possible scales constructed by different arrangements of the ratios in any one of the categories is already familiar to us.

Thus we have, for the number of possible Thata.

$$\frac{7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1}{(1 \times 2) \times (1 \times 2) \times (1 \times 2)} = 630 \qquad \textit{for category I.}$$

$$\frac{7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1}{(1 \times 2) \times (1 \times 2)} = 1260 \qquad \textit{for category II.}$$

IV. Scales involving one ratio 135/128,
two ratios 16/15
one ratio 6/5,
two ratios 10/9 and
one ratio 9/8

i.e. 6/5 x (16/15 x 16/15) x (10/9 x 10/9) x 135/128 x 9/8 = 2

V. Scales involving one ratio 25/24,
two ratios 10/9,
one ratio 6/5 and ratio 10/9,
one ratio 9/8 and
one ratio 27/25.

Thus, 16/15 x 27/25 x 25/24 x (10/9 x 10/9) x 6/5 x 9/8 = 2

VI. Scales involving one ratio 25/24,
two ratios 16/15,
one ratio 6/5,
two ratios 9/8,
one ratio 10/9.

Thus, 25/24 x (16/15 x 16/15) x 6/5 x (9/8 x 9/8) x 10/9 = 2

$$\frac{7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1}{2 \times 2} = 1260 \quad \textit{for category IV.}$$

$$\frac{7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1}{1 \times 2} = 2520 \quad \textit{for category V.}$$

$$\frac{7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1}{1 \times 2 \times 1 \times 2} = 1260 \quad \textit{for category VI.}$$

Thus, all possible different arrangement of the consecutive ratios give us 8190 Thatas. But, most of these Thatas are not rich in musical relationships.

To discover Thatas rich in musical relationships, we proceed as follows :

Category - I

Let us put the ratio 6/5 in the beginning.
The next ratio must be 25/24 because this combines best with 6/5 (6/5 x 25/24 = 5/4).
Thus the first two notes are

Sa		Ga'		Ga
	6/5		25/24	

The next ratio must be again 6/5 for precisely the same reason.
This is Pa such that Ga -Pa = 6/5.
Now we can put another ratio 6/5 and then ratio 25/24.
The scale looks like :

Sa	Ga'	Ga	Pa	Ni	Ni
1	6/5	5/4	3/2	9/5	15/8

Now we can insert Ma or Ma to get the following two Grams :*

Sa	Ga'	Ga	Ma	Pa	Ni'	Ni	
1	6/5	5/4	4/3	3/2	9/5	15/8	***(A)***
Sa	Ga'	Ga	Ma*	Pa	Ni'	Ni	
1	6/5	5/4	45/32	3/2	9/5	15/8	***(B)***

The arrangement of the consecutive ratios in the above Gram is follows :

6/5 x 25/24 x 16/15 x 9/8 x 6/5 x 25/24 x 16/15 ***(A)***

6/5 x 25/24 x 9/8 x 16/15 x 6/5 x 25/24 x 16/15 ***(B)***

These two Grams are reasonably rich in musical relationships.

In A, the following are the Shadaj Gandhar relationships

Sa - Ga' = 6/5
Sa - Ga = 5/4
Ga - Pa = 6/5, Ga' - Pa - 5/4
Pa - Ni = 6/5
Pa - Ni = 5/4 *and*
Sa - Pa = Ma - Sa = Ga' - Ni' = Ga - Ni

In B the number of musical relationships is the same.
The only difference is that instead of Ma-Sa, Ni-Ma* is related by Shadaj Pancham Bhav.

If we put up a note Dha' instead of Ni' such that Pa-Dha' = 25/24
we would get the following two Grams

Sa	Ga'	Ga	Ma	Pa	Dha'	Ni	
1	6/5	5/9	4/3	3/2	25/16	15/8	***(C)***
Sa	Ga'	Ga	Ma*	Pa	Dha'	Ni	
1	6/5	5/4	45/32	3/2	25/16	15/8	***(D)***

Ga-Dha' = 5/4 but the relationship Pa-Ni = 6/5 is lost.
Also, the relationship Ga' Ni = 3/2 has been lost for no gain.

Another scheme could be, to start with the ratio 25/24.
The following tow Grams then come into consideration :

Sa	Re'	Ga	Ma	Pa	Dha'	Ni	
1	25/24	5/4	4/3	3/2	25/16	15/8	***(E)***
Sa	Re'	Ga	Ma	Pa	Dha'	Ni	
1	25/24	5/4	45/32	3/2	25/16	15/8	***(F)***

The musical pairs in (E) are the following :

Ga - Dha'	=	5/4
Sa - Ga	=	5/4
Re' - Ga	=	6/5
Ga - Pa	=	6/5
Pa - Ni	=	5/4
Dha' - Ni	=	6/5
Ni - Re'	=	10/9
Sa - Pa	=	3/2
Ma - Sa	=	3/2
Re' - Dha	=	3/2
Ga - Ni	=	3/2

In *(F)* Ma* - Dha' = 10/9 holds in addition
while Ni-Ma* has Shadaj Pancham Bhav instead of Ma-Sa.
The Grams E and F are fairly rich in musical relationship.

Lastly, we could put the ratio 9/8 right in the beginning and put the ratio 16/15 next.
This could give the following Grams :

Sa	Re	Ga'	Ga	Pa	Dha'	Ni	
1	9/8	6/5	5/4	3/2	25/16	15/8	***(G)***
Sa	**Re**	**Ga'**	**Ga**	**Pa**	**Ni'**	**Ni**	
1	9/8	6/5	5/4	3/2	9/5	15/8	***(H)***

The musical pairs in (G) are :

Sa - Ga	=	6/5
Ga'- Pa	=	5/4
Ga - Pa	=	6/5
Ga - Dha'	=	5/4
Pa - Ni	=	5/4
Dha' - Ni	=	6/5
Sa - Re	=	9/8
Ni - Re	=	6/5
Sa - Pa	=	3/2
Pa - Re	=	3/2
Ga - Ni	=	3/2

While in *(H)*, there is no pair corresponding to Ga-Dha' = 5/4
and Pa-Ni' = 6/5 replace the pair Dha'-Ni = 6/5.

The 8 Grams discussed above
give rise to 8 x 7 = 56 Murchhanas which generated as many Thatas.

Category II

We start with the ratio 135/128 and follow it with 6/5,
then we put 10/9, 16/15, 135/128, and 6/5 to get the following Gram :

Sa	Re	Ga'	Ga	Pa	Ni'	Ni	
1	9/8	6/5	5/4	3/2	9/5	15/8	***(H)***

This is nothing but the variation *(2)* of Purbi Thata already discussed.
Of course, we can get seven Thatas out of this generated by its seven Murchhanas.

Category III

To start with, we mention the following Gram :

Sa	Re'	Ga	Ma*	Pa	Dha'	Ni	
1	135/128	81/64	45/32	3/2	25/16	15/8	***(J)***

which is the variation (3) of Purbi Thata discussed earlier.

Another Gram can be obtained
by simply rearranging the ratios 10/9 and 16/15 in the following way

Sa	Re'	Ga'	Ma*	Pa	Dha'	Ni	
1	16/15	32/27	64/45	3/2	8/5	5/3	***(K)***

in which the consecutive note ratios are
16/15, 10/9, 6/5, 135/128, 16/15, 6/5, 25/24

while the order of consecutive ratios in Gram (J) were
135/128, 6/5, 109, 16/5, 25/24, 6/5, 16/15

The Gram K is the variation *(2)* of Thata Todi.
The seven Murchhanas of the Grams (J) and (K) give 14 Thatas.

Category IV

The following arrangement is the variation (2) of Marwa Thata discussed earlier.

Sa	Re'	Ga	Ma*	Pa	Dha	Ni	
1	135/128	81/64	45/32	3/2	27/16	15/8	*(L)*

This generates seven Thatas out of its Murchhanas.

Category V

The following Gram comes into consideration :

Sa	Re'	Ga	Ma*	Pa	Dha	Ni	
1	25/24	5/4	25/18	3/2	5/3	15/8	*(M)*

Being variation (5) of Marwa Thata above. Its Murchhanas generate seven Thatas.

Another Gram can be constructed out of the same successive ratios by a rearrangement as given below :

Sa	Re'	Ga	Ma	Pa	Dha	Ni	
1	25/24	5/4	4/3	40/27	5/3	50/27	*(N)*

It has the following Shadaj Pancham relationships :

Ma - $\overline{\text{Sa}}$ = 3/2

Dha - $\overline{\text{Ga}}$ = 3/2

and the following Shadaj Gandhar relationship

Sa - Ga	=	5/4
Re' - Ga	=	6/5
Ma - Dha	=	5/4
Pa - Ni	=	5/4
Dha - Sa	=	6/5 *and*
Ni - Re'	=	9/8

The Gram (N) also generates 7 Thatas. Using Pa = 3/2 in the above Gram we get :

Sa	Re'	Ga	Ma	Pa	Dha	Ni	
1	25/24	5/4	4/3	3/2	5/3	50/27	*(O)*

Regarding the musical relationships, the relationship Sa - Pa = 3/2 and Ga - Pa = 6/5 are gained while the relationship Pa - Ni = 5/4 is lost. We get 7 more Thatas.

Category VI

The first Gram to be mentioned is the variation (3) of Marwa Thata mentioned earlier viz :

Sa	Re'	Ga	Ma*	Pa	Dha	Ni	
1	25/24	5/4	45/32	3/2	27/16	15/8	*(P)*

By a slight rearrangement of ratios we get :

Sa	Re'	Ga	Ma	Pa	Dha	Ni	
1	25/24	5/4	4/3	3/2	5/3	15/8	*(Q)*

in which the following pairs have musical relationships :

Sa - Pa	=	3/2
Ga - Ni	=	3/2
Ma - Sa	=	3/2
Dha - Ga	=	3/2
Sa - Ga	=	5/4
Re' - Ga	=	6/5
Ga - Pa	=	6/5
Ma - Dha	=	5/4
Pa - Ni	=	5/4
Dha - Sa	=	6/5 *and*
Ni - Re'	=	10/9

The Grams *(P)* and *(Q)* together generate 14 Thatas.
Hence we get the following musically rich Thatas from each of the categories

Catagory I	-	56
Catagory II	-	7
Catagory III	-	14
Catagory IV	-	7
Catagory V	-	21
Catagory VI	-	14/119

Thus there are 119 musically rich Thatas using the peculiar ratios 25/24, 135/128 etc. of the type Purbi, Bhairav Marwa and Todi. Out of these some are included in the different versions of Bhairava, Purbi, Marwa and Todi Thatas already described. The remaining are yet unexplored by the musicians.

To sum up discussion on Thatas so far, Thatas are seven-note scales which form the basis for the construction of Ragas or melodies. They are the building blocks of Ragas. One way of defining Thatas is to select seven notes out of a standard twelve note scale which can be taken to be the diatonic scale. Some restrictions on this choice are considered necessary to ensure that too many notes do not get crowded in one portion of the octave leaving a wide gap at the other end. These restrictions have been specified by Pandit Bhatkhande and have been described earlier. These restrictions have been specified by Pandit Bhatkhande and have been described earlier. This way, 72 Thatas can be constructed from the 12 notes of the diatonic scale and all these Thatas are recognized in Karnataka style of classical music. However, in North Indian style, it is customary to select Sa, Pa and one each out of two Rishabhas, Gandhar, Madhyams, Dhaivata, and Nishadas. This way one gets 12 Thatas. Out of these, 10 Thatas are in use namely Bilawal, Kalyan, Khamaj, Kafi, Asawari, Bhairava, Bhairavi, Purbi, Marwa and Todi.

However, when we consider the Thatas as having arisen out of various Grams and their Murchhanas, many subtle variations of these Thatas come to light. As we have seen, the traditional 10 Thatas split up into 37 subtle variations, these variations arise from the fact that many musically rich Grams employ notes other than those included in the diatonic scale, and therefore, we can get more Thatas if the restriction of choosing the notes from the 12 note diatonic scale is removed. It has been shown that four Grams including the ancient Shadaj and Madhyam Grams generate all the variations of the modern Thatas Bilawal, Kalyan, Khamaj, Kafi, Asawari and Bhairavi. Besides, there can be 129 more Thatas originating from other musically rich Grams employing the consecutive note ratios 9/8, 10/916/15,27/25 and 75/64.

But there are some unusual Thatas also in use like Purbi, Marwa, Todi and the variations of Bhairava using notes other than those belonging to diatonic scale. In these Thatas, ratios like 135/128, 25/24,6/5 and 256/243 are also used in addition to the ones mentioned above between consecutive notes. We have discussed 119 such Thatas including the variations of the four modern Thatas, Bhairava, Purbi, Marwa and Todi mentioned above.

In constructing the above Thatas from Grams known to be rich in musical pairs, sometimes we do not hesitate to dispense with the restrictions imposed upon the selection of seven notes from 12 note scale. The purpose of imposing the restrictions was to avoid odd frequency ratios and thereby assure the musical quality of the Thatas and objective is amply achieved by deriving the Thatas from Grams assured of musical properties. In fact, this way we are on surer grounds, regarding the richness of musical relationships. For example, we improved the musical quality of Khamaj Thata by using Re *(10/9)* instead of Re (9/8) for the reason that the former was derived from Shadaj Gram while the latter one is derived from Madhyam Gram.

However, some Thatas are in use even though they are not rich in musical relations. This defect is made up while constructing Ragas out of it by omitting one or two notes which in some cases, improves the musical quality. For instance, in the variation *(2)* of Thata Todi, if Pa is omitted, the musical qualities are considerably improved. This is done in Raga Gujari Todi which is constructed from this Thata.

In the following chapter, we shall discuss Ragas which are constructed out of the Thatas.