Chapter – Three

Acoustical Properties and Creativity of Tablā, Part (I)

STRUCTURAL PROPERTIES OF TABLĀ

INTRODUCTION

From the primeval forms of life there were traditions to use percussion instruments in India. There are several references to the percussion instruments we have got from the Vedas, great epics, Ramayana and Mahabharata. The Samhitas and the Brahmanas refer to the Bhūmi-dūndūbhi and Dūndūbhi several times, were used during religious ceremony. Bharat's Nātya Shāstra, also has been referred a large number of percussion instruments were used in that time[1]. It is also thought that perhaps drum is the first rhythm instrument in the world and bhūmidūndūbhi and dūndūbhi is the first for India.

There are so immeasurable variety – in quantity, quality and different shapes of musical instruments that it is almost impossible to list them all. There are also several types of instruments, like – classical instruments, folk instruments, tribal instruments,

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[1] यावंति चार्मनद्धानि ह्यतोद्धानी द्विजोत्तमाः।
तानि त्रिपुष्करादानि ह्यवनद्धामिति स्मृतम्।।२४।।
एतेषान्तु पुनर्भेदाः शतसंख्याःप्रकिर्तिता।
-Natya Shastra by Bharat, Translated by Babulal Shukla, Page no – 350.

etc. and each and every type are preserved a lot of sub-types with their different shapes. Dr. B C Deva also support this opinion and said, it is not possible to trace in all details the ethnic relation of music and musical instruments; for, enough data are not available[1]. Musical instruments are found generally with peculiar and extraordinary shape and name or nomenclature. It is also obsessed by individual nations or tribes. In this respect sir S. M. Tagore writes on his 'A Short Notice of Hindu Musical Instruments' that, 'thus a kind of harmonica of the Chinese represents the figure of crouching tiger. The Burmese possess a stringed instrument shaped like an alligator. Even more grotesque are the imitations of various beasts, adopted by the Japanese. The natives of Guinea possess a drum of singular structure, terminating in the head of a reptile. A wooden rattle, shaped like a bird, is a favorite instrument of the Indians of nootka sound. In short, not only in the inward construction of the instruments and their peculiar quality of sound, but also in their outward appearance, certain

[1] Musical Instruments of India, by B Chaitanya Deva, Page no – 16.

distinctive characteristics are discernible... There is indeed a remarkable variety in construction, form and size, of the different kinds of drums, found in almost every part of the world[1].'

At the time of beginnings of percussion instrument's initial journey, instruments were come across bared shaped, undeveloped, simple and used only to keep rhythm (laya) in music. But with the development of mankind's thinking instruments also developed day by day and immerged various kinds of membranophonic [2] musical instruments with other instruments.

From the very ancient time there were two types of instruments in use in India i.e. laya vadya – the rhythm instruments and swar vadya – the melody instruments. Laya-vadya are the instruments used for rhythm, are the most primitive musical instruments recognized to human history. Of

[1] Forwarded by Prajnanananda Swami on 'Musical Instruments of India', by B. C. Deva, Page – ix, x. Based on 'A Short Notice of Hindu Musical Instruments' by S. M. Tagore.

[2] As percussion instrument's head covered by membrane so, it is also known as membranophonic instrument.

among all laya vadyas Tablā finds an exceedingly respectable reveal and to keep laya with each and every style of music it makes a crucial remark.

There is a great contribution to Tablā for reaching Indian music today's gargantuan highly affluent position. The point of reference of Tablā in music is a significant fact and it can be said that, Tablā has been using in our folk music from year after year.

It is only in India where percussion instruments were very rich from the very beginning than other countries. In this respect Dr. Suneera Kasliwal says, 'nowhere in the world has drumming reached a higher degree of perfection than in India. Here is a country where the drum has been, and remains, the characteristic instrument associated with all kinds of events. The earliest reference to a drum that we get is as dūndūbhi in the Vedas. Excavations provide evidence of the use of simple percussion instruments resembling rattles, symbols and drums in 3000 BC. Drums are thus ascribed to the earliest known civilization in India. They are

represented in several forms on Indian temple relics at Bharhut (200 BC), which include an hourglass drum being played with two sticks by an ape[1].'

INSTRUMENT'S LOOKS IN ABORIGINAL PERIOD

We have got several uses for percussion instrument from the very ancient period. In ancient India bhūmi-dūndūbhi, and dhundubhi were in highest position for accompanying music of that period's. Instruments used in aboriginal period were undeveloped. If we execute an analytical study of ancient period of instruments, medieval period of instruments and modern period of instruments we come to know that the instruments of beginning periods were very simple. Day by day it makes critical and creates a new playing style.

Instruments by how we have got today to reach this position it had to go beyond a chained history. There was not enough gorgeousness to look at the

[1] Classical Musical Instruments, by Dr. Suneera Kasliwal, Page – 12.

aboriginal instruments and also were so loud and high pitched. But with the development of primitive people's of thinking they were varying to their making materials, making processes and also their playing styles gradually. The emotions of aboriginal men were undeveloped which is cured day by day and made changes also to their expressions. It is a matter of long work and correction to attain that current rich position for instruments.

POPERTIES OF TABLĀ

Tablā is a famous percussion instrument from

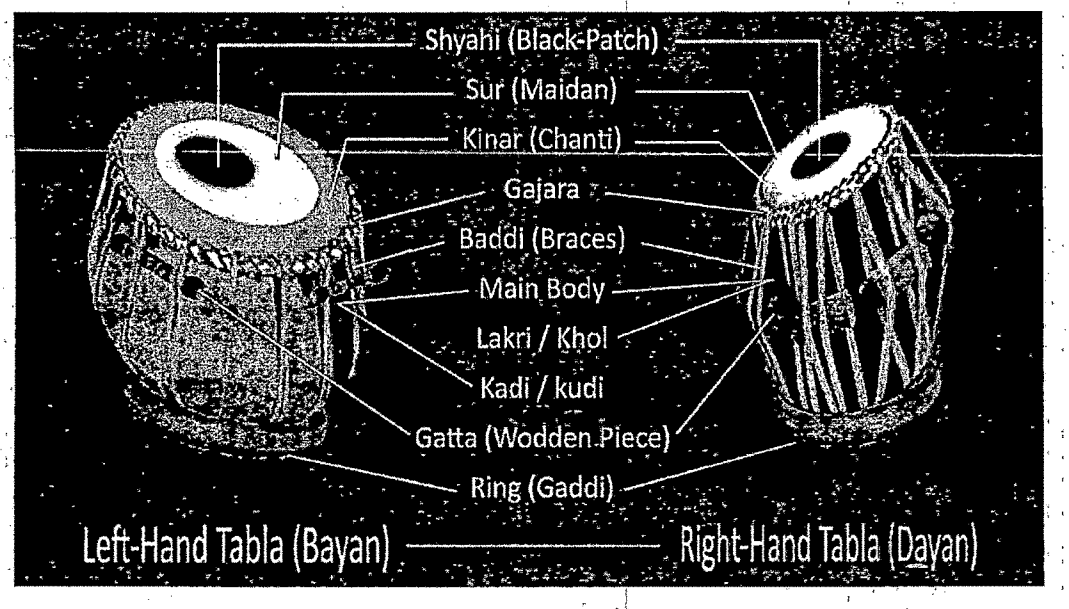

Fig. 3.1, Picture of a pair of Tablā with its out looking parts.

North India. There are so many properties in Tablā

instrument. First of all it is not a single piece of instrument as the Tablā comprises two tune drums which are placed in front of a drummer and played horizontally with the hands. One of these drum, which is literally played with right hand is called 'Dhahina'. It is also often referred to as 'Dayan' and often called itself the Tablā also.

The larger drum, played with the non dominant hand or left hand, is modified hemispherical kettle drum is called 'Bayan'. It is called variously 'Dagga', Dugga, 'Mada' also. For convenience sake it is used the term Tablā for both drums while the right hand drum and left hand drum is called 'Dayan' and 'Bayan' respectively.

The word Tablā is also commonly used to recognize to both drums as a pair. The dahina played with dominant hand and it is a smaller then other one. It is a slightly flared, closed cylindrical drum carved from a solid block of wood (Lakri or Kat). The Tablā is made from a conical piece of wood hollowed out to approximately half of its total depth.

TWO MAIN PROPERTIES OF TABLĀ

From the above discussion we have got that, there are two main properties of Tablā or Tablā is divided mainly in two divisions by their 'Structural acoustical properties. These are:

1. The Dahina Tablā and
2. The Bayan Tablā.

And both divisions are also divided individually by their several inner properties. A short description is given below:

PROPERTIES OF DAHINA TABLĀ

The Dahina Tablā which is also made by lots of different parts and, each and every parts of this dahina has its own demands for good acoustics.

The following parts are mainly consists for a Dahina Tablā:

⇒Lakri (Main body)
⇒Pūdi (Tablā's head)
⇒Gajra
⇒Chanti (Kinar)
⇒Shyāhi
⇒Sur (Maidan)

⇒Baddi (Braces) ⇒Gurri

⇒Gattā (Woden Piece) ⇒Gaddi (Ring)

A short description of different parts of a dahina Tablā is given below:

LAKRI (MAIN BODY)

The Dahina Tablā has an interesting construction. The drum shell, basic structure of a dahina Tablā is called Lakri'. Sometimes it is also called as 'Lakra'. It is also known as 'Kāt' or 'Kāth' or 'Kashtha' in Bengal region. The literally meaning of Lakri is wood as lakri is almost made of wood. Wood is a solid material and we can get it from woody plants, particularly trees but also shrubs.

Fig. 3.2, Lakri (Drum-Shell).

In this respect Dr. Ravi Sharma has written, 'in contemporary Hindi language a word 'Lakri' is commonly used for the wood. It is very surprising that the word 'Lakri' has gone so popular at present

that it is commonly used in most of the regional languages too by all the classes of society. So, the word 'Lakri' today also stands as a synonym of 'Daru' and 'Kashtha[1].

SHAPE OF LAKRI

The drum shell of right-hand Tablā or dayan Tablā, which is known as Lakri is straightly flared and is carved from a solid block of wood. The upper-end

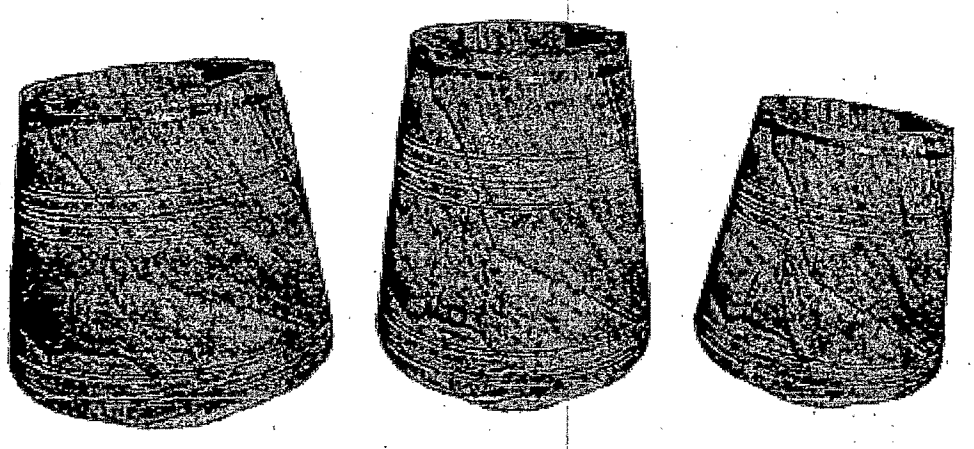

Fig. 3.3, Picture- different shapes of Lakri.

of Lakri which is also called the narrower-end made from a conical piece of wood is partly hollowed and is carved with a composite head with the help of a 'pūdi' made from goat skin mainly. It is frequently seven to nine inches in diameter at the bottom

[1] Sitar As I Know, by Ravi Sharma, Page – 60.

(opposite the narrower end) and the diameter at the top-end being about four inches to seven inches. And it is about ten to twelve inches in height and to make a hollow on its top end it is scooped out from the narrower end. The wood is hollowed out to approximately half of its total depth.

The height of lakri differs from place to place. In Bengal region it is preferred little more height then other places and we can see that the height of Tablā is about from eleven to fourteen inches. Except this areas where ever we go, found the height of Tablā are from ten to twelve inches. Actually it is depend on performer who will play this Tablā. Some performers are specially ordered for little height Lakri like nine inches in height for their short height also. But the slandered height is about eleven inches which is followed everywhere now-a-days. Dr. S Kasliwal also supports this and according to her the standared size of Tablā is ten-and-a-half inches[1].

[1] Classical Musical Instruments, by Dr. Suneera Kasliwal, Page no – 41.

It is also differed the diameter of top end of a lakri from place to place for making different tones. The top end is kept narrower and the wood (lakri) as a whole is smaller for getting higher pitch on Tablā. And its opposite the top end is kept wider and wood as a whole is bigger for getting lower pitch Tablā. In this respect Mr. Arvind Mulgaonkar has given a great list in his book 'Tablā' about the diameter of the top end of a Tablā and its related tone scale with frequency. The following chart has been given by him[1]:

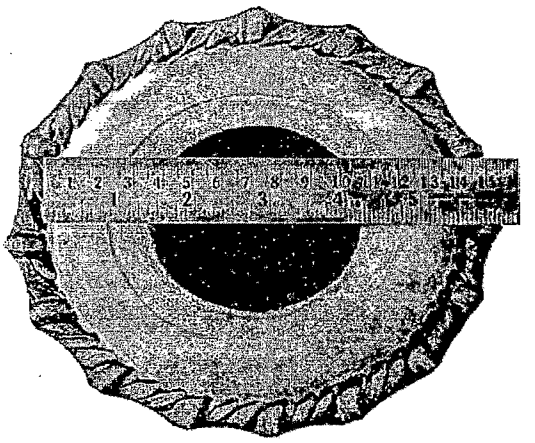

Fig. 3.4, Indicating the top-end diameter of a Tabl p di.

Middle Octave	Frequency	Diameter of the Top end of a Tablā (in inches)
Ċ #	276.6	7.25
D'#	310.4	6.50
F'	348.4	6.25
F'#	366.2	6.00
G'#	414.4	5.25

[1] Tablā, by Arvind Mulgaonkar, Page – 37.

A'#	464.1	5.75
Upper Octave	Frequency	Diameter of the Top end of a Tablā (in inches)
C'#	553.2	5.50
D'#	620.8	
F'#	732.4	
G'#	828.8	5.25
A'#	930.2	5.00

But when we go for practical analysis / experiments in our normal life we can see that, the tonal scale is not only depends by its top end's diameter. There are so many functions are created to maintain a tonal scale, like the thickness of a pūdi, the thickness of shyāhi, the tension of a pūdi, etc. For these reason so many times we see that the big diameter's top end Tablā is sounded largely also.

HOW A WHOLE IS MADE ON LAKRI

The hollow of a Tablā, either of dahina Tablā or bayan Tablā is an important fact for its acoustical performances. Sound varies by its depth of area. Generally, if the hollow's depth is made large then

it creates more base sound. On the other hand if the depth is made small then the sound created by Tablā is going for more sharper. According to

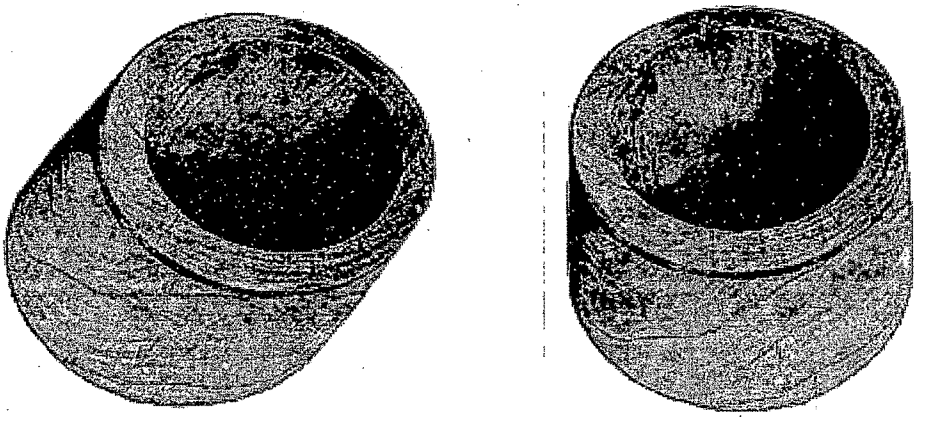

Fig. 3.5, Lakri, hollowed out by lade-machine.

Sudish Banerjee, 'For higher pitched Tablā, the top end is kept wider and the wood (lakri) as a whole is smaller. For lower pitched Tablā, the top end is kept wider and the wood as a whole is bigger[1].' At the primary stage performers would like to use more base sound but the modern trend is to use sharper sound.

Generally, a dahina Tablā is about ten to twelve inches in height and to make a hollow on its top end it is hollowed out from the narrower end. The

[1] Tablā & the World of Indian Rhythms, by Sudish Chandra Banerjee, Page no – 55.

wood is hollowed out to approximately half of its total depth. Three ways are used to hollow a Tablā. In modern days most of the Tablā maker hollowed out lakri by lade machine where it makes more perfect and smooth hollow. But, even today where modern technology is unavailable and also in some cases to save the scooping expenses, it is made by manually on hand. Mantu Chandra Das, who is a busy instrument maker made hollow on a Tablā lakri with his hand as well as lade machine also. He is a busy instrument maker now a day, so, he is unable to do this always, but, sometimes in off season when work is less then other times then he does it by his hand also, said on an interview[1].

QUALITY OF WOOD

Wood is unwavering by its cells, nature of the cell walls and structural arrangement of the cells. Wood's appropriateness for the different functions is determined on the basis of its qualities. The wood which are heavy and strong by its fiber are

[1] Mantu Chandra Das (a Bangladeshi busy instrument maker) on private interview.

considered ideal, as it tends to give better resonance, stability and sound quality to the Tablā. According to 'A Text Book of Botany', 'properties of wood are determined by the kind and disposition of its cells, nature of the cell walls and structural configuration of the cells. Suitability of the wood for various purposes is determined on the basic of its qualities[1].'

Wood is relatively cheaper, light weight and can be modified easily with various tools. Wood is tough, elastic, and poor conductor of heat, electricity and moisture. These qualities increase its utility in making various musical instruments. Besides, it is also an important source of many other useful products.

STRUCTURE OF WOOD

Wood is commonly classified as either softwood or hardwood. On the other way there are mainly two types of wood: porous wood and non-porous

[1] A Text Book of Botany, by Dr. V. Singh, Dr. P. C. Pande, and Dr. D. K. Jain. Page – 193.

wood. Technically, porous and non-porous woods are known as hard wood and soft wood respectively. The wood from conifers, including the pine, fir, spruce, and other cone-bearing trees and shrubs, and also the yews and their allies that bear drupe-like seeds is called softwood, and the wood from broad-leaved trees, including the iron-wood, segun, mehgani, aam-wood, neem, etc., is called hardwood.

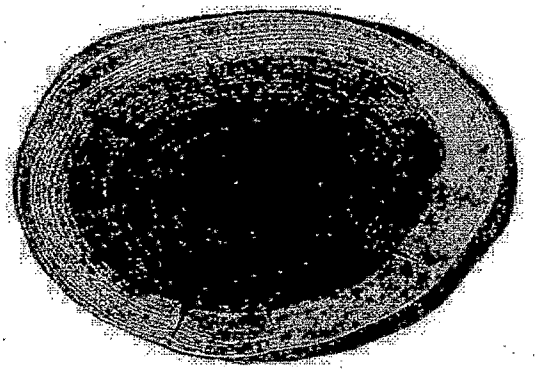

Fig. 3.6, Block of wood from which lakri is made.

Generally, porous wood which is very hard and essential for making musical instrument where as non- porous wood is not used to make a musical instruments it is very soft by its grain.

According to Dr. V Singh, 'Wood is a secondary tissue formed in a stems of gymnosperms and dicotyledonous plants by the activity of vascular cambium forms secondary phase of growth, the

vascular cambium forms secondary phloem on the outer side and secondary xylem on the inner side. The secondary xylem is formed in much larger quantity in comparison to the secondary phloem. The xylem of conifers is simpler than that of the xylem of most dicotyledonous. In dicotyledonous wood, vessels are usually present, and appear as small porous in transaction. Such wood is known as porous wood. On the other hand wood of gymnosperms which is devoid of vessels is known as non-porous wood[1].

There are differences also as hardwoods are not necessarily hard, and softwoods are not necessarily soft in every times. For example, a hard wood named balsa is actually softer than any commercial softwood. On the other hand 'yew' which is known as a softwoods but harder than most hardwoods.

A wood named 'Babla' is used to make dahina Tablā hugely in every where which is also not so

[1] A Text Book of Botany, by Dr. V. Singh, Dr. P. C. Pande, and Dr. D. K. Jain. Page – 192.

hard or so soft. Light grayish color timber sized easily by manufacturer. But it is cheaper and available almost every where.

WOOD USED TO MAKE DAHINA TABLĀ

Wood is a unique material for musical instruments. It is the solid under the bark of a tree, used for many years for making the musical instruments, because wood is a very resonant material and gives us pleasant sound waves. In Natya Shastra, Barat muni also has referred wood for making musical instrument. In the chapter thirty-three Bharat has written that,

भूयश्चान्यापि तथा काष्ठायस-कृतान्यथ ।
झल्लरीपटहादीनि चार्मनिष्ठानि तानि तु[1] ।।१३ ।।

And in thirtieth chapter of Natya Shastra we have got that,

आतोद्यं सुषिरं नाम ज्ञेयं वंशकृतं बुधैः[2] ।

[1] Natya Shastra by Bharat Muni, Chapter – 33, Verse no – 13.
[2] Natya Shastra by Bharat Muni, Chapter – 30, Verse no – 1 (first half).

Here Bharat muni referred bamboo for making musical instrument (flute). It is a matter of remark that bamboo is also a species of wood. Bamboo has a fabulous excellence to resonance musical sound.

Wood is found all over the world, and made so many products out of it because of its structure, chemical composition and properties. The base of a Dahina Tablā is also made by wood. The woods from Khair, Shisham, Neem, Kanthal, Mango tree are considered ideal wood for manufacturing the Dahina. It is also depended by the availability of wood; as all type of tree do not grow in every place. The cost of wood is also making a great factor to use it for making instruments.

A short description is given as under for the ideal wood which is used for making a Dahina Tablā:

SHISHAM WOOD:-

The shisham's timber is one of the most valuable in musical instruments. The wood is strong, very hard,

close grained, purple black in color but heavy, which is very essential to make a Lakri, for Dahina Tablā.

There are two types of shisham species are found, one is Bombay Rosewood, and another one Bombay Blackwood. Bombay Rosewood is also known as Delhi shisham is a little bit radishes in color. It takes a beautiful polish and excellent furniture can be made. It is said that the finest wood for Dahina Tablā is shisham. It has been also used for other percussion musical instruments like, Pakhawaj, Dholak, Dhol, etc. from ancient time.

SHISHAMS FAMILY, TRADE AND VERNACULAR NAMES

Shisham comes under the family of Dalborgia two species of this family are found. One is Latifolia and another is Sisoo. The generic name Dalborgia commemorates N. Dalberg, a Swedish botanist of the late 18th and early 19th centuries[1].

[1] Common Trees, by Dr. H. Santapau, Page no – 32.

It has many trade and vernacular names. As early said, in English it is called Bombay Rosewood and Bombay Black wood, which is known well almost every person in music field. In Bengal it is called Sitral, Shisu. Mantu Chandra Das also referred Shisu-wood as the finest wood for making Tablā[1]. In Kannada shisham is known as Biti; Marathi- Shisham, Hindi- Shisham; Tamil- Iti, Eriwadi; Telugu- Nalla virugudu cheva[2].

The shisham's tree is available almost everywhere in India and Bangladesh and in other countries. Bombay rosewood which is also known as delhi-shisham is more available then Bombay black wood. But black wood is stronger then red wood and more suitable to make dahina Tablā. According to R. A. Raju, 'rose wood is a native of India and distributed from the Himalayan foothills to Peninsular India. In mountain tracts it is found to grow upto an elevation of 1500m. The tree is small and crooked in dry deciduous forests of central and

[1] Mantu Chandra Das, a great instrument maker on private interview.
[2] The Sprit of Beautiful Trees, by R. A. Raju, Page no – 37.

western India and reaches upto 10 m. only. In moist peninsular India where rainfall is abundant, large trees of over 35m. high also can be seen in Southern reaches of Western Ghats. It does well in Well-drained moist soils[1].

PROPERTY OF THE WOOD

The wood distinctly differentiated into sap wood and heart wood. The sap wood is pale yellowish or grayish-white and the heart wood is golden brown to deep brown with darker streaks. The wood is medium coarse textured with fairly straight to somewhat interlocked grains. The average weight is 780 kg/m^3 at 12% moisture content[2].

The wood is defused porous with a tendency to semi-ring porous. The annual rings are indistinct to fairly distinct. The pores are moderately large, visible to the naked eye, mostly solitary or in short redial multiples. They are often field with dark gummy deposits. The modularly rays are very fine,

[1] The Sprit of Beautiful Trees, by R. A. Raju, Page no - 37
[2] A Text Book of Botany, by Dr. V. Singh, Page – 199.

numerous and closely spaced. Ripple marks are distinct and they are more prominent in the sap wood[1].

KHAIR (IRON WOOD):-

Khair which is known as Iron wood in English[2] is very hard, heavy and suitable for so many percussion instruments like Tablā, Pakhawaj, Nal, Dholok, Dhol, etc. For its strongness, heaviness it is very useful to make a lakri for dahina Tablā.

Of all Indian hardest and strongest timbers Khair is one of them. As it is so hard by its timber so it is very difficult to saw even in green conditions. The wood is so hard as well as very weighty. To make a lakri for dahina Tablā khair is a perfect wood as hardness, strongness and weighty wood demands for good acoustics. A lakri made from a weighty wood is also set on a ring (gaddi) firmly and does not move much on its playing moment.

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[1] A Text Book of Botany, by Dr. V. Singh, Page – 199.
[2] Common Trees, by Dr. H. Santapau, Page no – 66.

Khair is one of the hardest and strongest of Indian timbers and about its durability R. Raju said that, 'The wood is used for railway sleepers, bridges and posts, beams, electric poles, carrier's cutting blocks, boat building, crushers, bearing tool handles, golf club heads and walking stick. As it is highly durable it is also used as bridges, camel locks where strongness is needed. It is also used for making axles, felloes, spokes and stocks of country carts[1].'

IRON WOOD'S FAMILY TRADE AND VERNACULLAR NAMES

Iron wood tree comes from a family of 'Clusiacea. It has a trade named Mesua, and so many vernacular names. In Andaman it is called Gangane; in Assamme- Nahor; Gujarati and Marathi- Khair, Nagchampa; Hindi and Bengali- Nagakesar nagesar; Kannada-Nagakesara, Malayalam- Nanga; Sanskrit- Nagakeshara; Tamil- Nangu, Ngachambagam; Telugu- Nagakesara[2].

[1] The Sprit of Beautiful Trees by R. A. Raju, Page no – 42-43.
[2] The Sprit of Beautiful Trees, by R. A. Raju, Page no – 41.

There are several species of the genus Memecylon in Bomnay, and they all go under the local name Anjan[1]. Anjan is a testy and costly fruit name which comes from this tree in winter season. Fruit is egg-shaped and contains 1-4 seeds. Khair wood tree is not common tree and it is also not available along avenues or roads. So, the cost of a lakri made from Khair wood is very high. For this unavailability, shisham is more used on the place of iron wood, which is also very hard and strong.

Iron wood tree found in Southern and Northern tropical wet evergreen forest of Assam, Meghalaya, Nagaland, Arunachal Pradesh, West Bengal, Kerala, Karnataka, Bihar and Andman. It is usually grows in the warm, moist and equatorial habitat where the rainfall ranging from 2000-5000 mm. Mesua prefers deep, fertile – and well drained deep Sandy loams but come up on moderate heavy tools. The tree regenerates profusely in its natural habitat because of its abundant seed production[2].

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[1] Common Trees, by Dr. H. Santapao, Page no. – 66.
[2] The Sprit of Beautiful Trees, by R. A. Raju, Page no. – 41.

NEEM WOOD:-

We all are some what feminine with the neem tree as it is found here and there in India, Bangladesh or sub-continent of India. Indian people, especially Hindu religious are used its leaves for several works. It is used at the time of worship, at the time of cooking for digestive purpose and its juice as a medicinal purpose. It is believed that the rosaries usually made with these seeds are able to drive away the evil sprits, which are worn by Muslim Fakirs and Sadhus also.

The timber of neem is very hard and termite proof[1]. Neem's timber is lighter weight then Shisham and Khair. Even then it preserved a good quality to make a lakri. In Bangladesh it is very much available in every place and for this reason most of the lakri is made by this timber then. There is only one problem if Tablā made by its immature timber then it started to make crack in every places which looks very odd. But it's mature timber which looks like

[1] The Sprit of Beautiful Trees, by R. A. Raju, Page no. – 34.

dark yellow colour have no problem for cracks and after polishing looks very well. The neem wood is also used for making different furniture and as well as other instruments, like Dhol, Dholak, Pakhawaj, etc.

NEEM'S FAMILY, TRADE AND VERNACULAR NAMES

Neem is a family from meliaceae[1] and there are two types of neem tree we have found. One is originated from India and another from Persia. According to R. Raju, 'There is no doubt about the origin of neem from India as its botanical name itself indicating Azadirchta indica. The word indica means Indian origin. Some people confuse between Indian neem (A. indica) and Melia azadirachta L. as the morphological features are the same. The only difference lies in the colour of inflorescence. The flowers are white in case of Indian neem and lilac in Persian neem. The plant is well distributed throughout the Indian subcontinent in dry and

[1] A Text Book of Botany, by Dr. V. Singh, Page no – 165.

Semi-dry regions. It is sensitive to frost and waterlogging[1].'

It has another popular name 'Margosa' and so many vernacular names:
Bengali it is called Neem, Nim; Hindi it is also called nim, neem; Gujarati- timba; Kannada- buru; Malayalam-Vepe; Marathi- Nimbay, Limba; Punjabi- Neem; Tamil- Vepa; Telugu- Yepa,vempu[2].

AAM WOOD:-

It will be very hard to found a man in Indian sub-continent who does not have any idea of mango tree. However, it is not found as an avenue tree in our cities and towns but, it is hugely found as a road side tree here and there.

Mango trees are also cultivated commercially for its sweet and highly testy fruits. According to Santapau, any book on Indian trees would not be

[1] The Sprit of Beautiful Trees, by R. A. Raju, Page no – 33.
[2] The Sprit of Beautiful Trees, by R. A. Raju, Page no – 33.

complete if the mango tree was excluded[1]. Mango is a tropical fruit available from March to August. By the following sentences it will be clear to think how popular it is, 'mango (Mangifera indica), the king of fruits, is grown in India for over 400 years. More than 1,000 varieties exist today. It is grown in almost all the states. India shares about 56% of total mango production in the world[2].'

For its availability, the wood got from mango tree is very chip. It is also preserved enough hardness and strongness quality to make a lakri for dahina Tablā. It is very easy to saw even in dry conditions. The wood is enough hard but low weighty. As we know acoustics of Tablā is not depended by only one thing. There are several permutations like the thickness of pūdi, tension of pūdi, materials used to make pūdi, etc. etc. So, there is no problem to make a lakri by aam's timber and it is also sounded very well if other necessary materials are used perfectly.

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[1] Common Trees, by Dr. H. Santapau, Page no – 59.
[2] Hnnd Book of Horti Culture, by , Page no – 239.

VERNACULAR NAMES

Linne in the 18th century named the tree mangifera indica, meaning 'the Indian mango-bearing tree'. In english and other Eutopean languages the tree is known as the mango tree, the name apparently being derived through the Portuguese from the Malayan Mangga or the Tamil Manga. In Sanskrit literature the tree has been known under many names, among them Amra, Chuta Rasala, etc. In many of the North Indian languages, the tree goes under the names of Am, Amb, Amba, etc[1].

WOOD FROM JACK-TREE:-

The Jack fruit tree is also a very common one in our streets and gardens and Indian subcontinent. It has a delicious big sized fruit which is very testy and sweet. About jack-fruit-tree Santapau has written, it has been known in parts of India from the beginning of historical times; the Greek historian Theophrastus writing about 300 B.C. says: "There is also another tree which is very large and has

[1] Common Trees, by Dr. H. Santapau, Page no – 59.

wonderfully sweet and large fruit: it is used for food by the sages of India[1]..."

The timber of jack-tree is bright yellow at the time of fresh cutting but it changing dark with age. It is also a hard and middle weighty wood. Even it is found every where in Indian sub-continent but it is not use hugely as lakri for dahina Tablā. The timber of jack tree has a great demand to make furniture. The tree is commonly propagated through seeds and the seeds also may be eaten by cooking.

JACK-FRUIT TREE'S FAMILY TRADE AND VERNACULLAR NAMES

The Jack fruit tree is a family from Moraceae and it has several vernacular names[2]:

Bengal: Kanthal; Hindi: Kathal; Kannada: Halasu; Malayalam: Chakka; Marathi: Phanas; Sanskrit & Telugu: Panasa; Tamil: Pilapalam.

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[1] Common Trees, by Dr. H. Santapau, Page no – 11.
[2] The Sprit of Beautiful Trees, by R. A. Raju, Page no – 27.

PŪDI (TABLĀ'S HEAD)

The heads of percussion instruments are covered with a leather skin or parchment which is stretched on its head and tightened up with leather strip or rope over the opening of either frame or a hollow body in different shape. The percussion instrument is sounded by striking on its head with bare hand or by stick or other materials. In ancient period it was also sounded by the tale of a cow or buffalo.

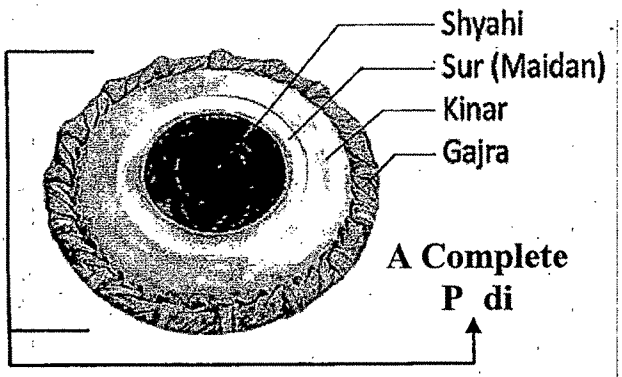

Fig. 3. 7, The outer looking of a Tabla p di.

The entire part of a Tablā which is made by leather, placed on a lakri and on which the Tablā is played called pūdi. The Pūdi (Tablā's head) of Tablā is firmly attached with its main body by interlaced

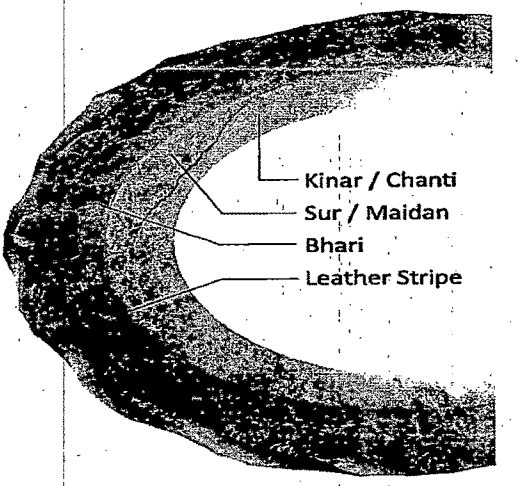

Fig. 3.8, The inner looking of a Tabla pudi.

thongs of leather. At equal intervals sixteen hoops are made over the ends of the pūdi to maintain the equal tension to its each and every portion of a pūdi.

The pūdi is devided by four parts mainly:

i. Gajra, ii. Kinar (Chanti),
iii. Sur (maidan) and iv. Shyāhi (Black patch).

A short description of different parts of a dahina pūdi is given below:

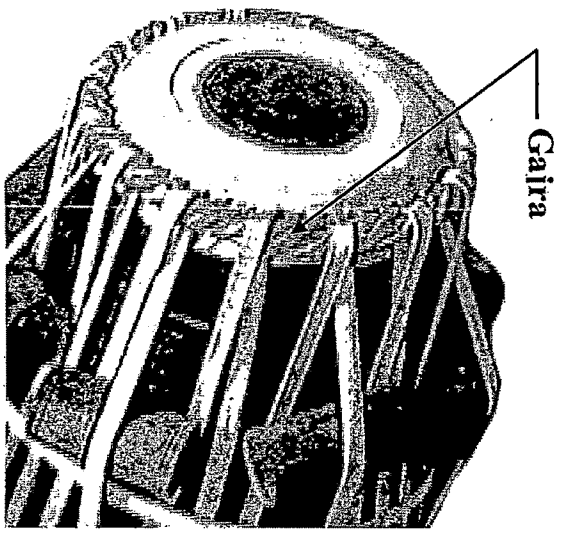

Fig. 3. 9, Indicating gajra on dahina Tablā.

GAJRA

The outer part of a pūdi is known as gajra. The gajra has sixteen hoops (Known also as hole or ghar) through which baddi are made pass so that the entire pūdi is tightened up equally on a lakri of

a dahina Tablā and on a kudi of a bayan Tablā. It is a very important part of a pūdi by which and with the help of baddi and gurri the total pūdi tightened up with equal tension and equal distance. In Tablā two types of gajra are used: i). Special gajra, and ii). Non-special or Commercial gajra. To make a special gajra a special care is given and good quality of leather is used, wherever leather used to make a commercial gajra, its quality is low. Gajra is made by joining four or five leather stripes either of made it by cow skin or goat skin.

CHANTI OR KINAR

The fraction in-between Gajra and maidan is known as Kinar or Chanti. It is the corner part of a pūdi where Tablā is played, so, it is named kinar (as in Hindi corner is called kinar). The kinar is trimmed

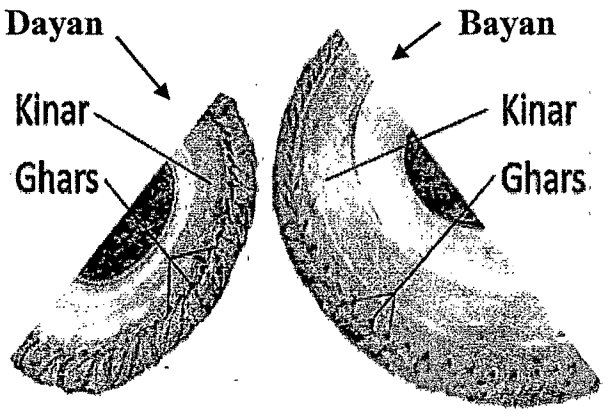

Fig. 3. 10, Indicating Kinar and Ghars of a dayan and bayan Tabla.

away to form a rim about half an inch to one inch wide. The thickness of kinar's skin is greater then maidan. Generally, there are 48 to 64 ghars on kinar and maidan's skin through which the leather stripe of gajra is attached with a dahina pūdi. On the other hand on a bayan pūdi it is fixed for 64 ghars. A lot of alphabets are played on kinar of a dahna Tablā and sounds produced from kinar are razor-sharp. The kinar of a bayan Tablā, which is also known as 'gott' and generally, no alphabets were played on the kinar of a bayan Tablā except 'ki' produced by the nail of left hand's index finger.

SUR OR MAIDAN

The fraction in-between kinar and shyāhi is known as Sur or Maidan. The sur or maidan is also known as Lav, which has several important functions. It is the main vibrating membrane on which

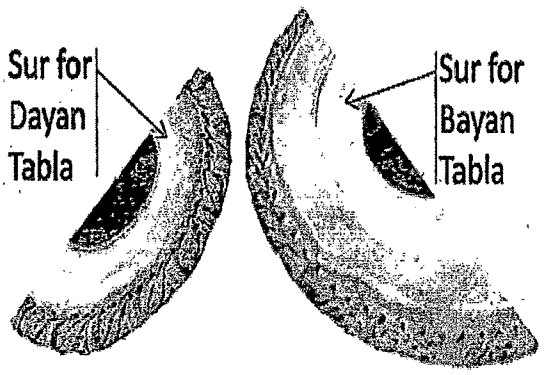

Fig. 3. 11, Indicating Sur or Maidan for Dayan and Bayan Tablā.

shyāhi is set-up. Maidan is fixed with gajra tightly and when gajra is tightened up with the help of baddi or gatta then the tension of maidan also rose up.

SHYĀHI (BLACK PATCH)

The shyāhi (black-patch) is perfect circle loaded on both the Dahina and the Bayan pūdi. It is which provides the Tablā indispensable pitch and

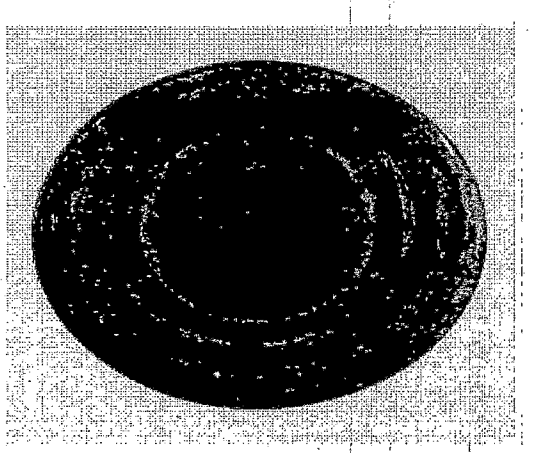

Fig. 3.12, Shyāhi of a Tablā pudi.

resonance is placed centrally on the Dahina Tablā and eccentrically on the Bayan Tablā. Shyāhi is set on a pūdi permanently with the semi-permanent pest.

It was the only in India where the tradition to use

black-patch first. By which, Indian percussion instruments were able to make a remarkable differentiation among all countries percussion instruments. In Natya Shastra, there are so many references to use black-patch on Tripuskara. In ancient time black-patch was called as Mārjanā (a layer made by mud). Bharat has given a full description about to use Mārjanā in his book Natya Shastra. Bharat said that[1],

'The Mārjanā of the Vamaka and the Urdhvaka should be done through the use of clay. Listen to salient features of the clay used for this purpose. The clay shall contain no gravel, sand, grass of husk of grains. It should not stick. It shall not be while, alkaline, pungent yellow, black, sour or letter. This clay is to be used for the purpose of plastering. The blackish clay from a river bank, renders fine and

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[1]मार्जना मृत्कृता कार्या वामकोर्ध्वकयोः सदा ।
लक्षणं मृत्तिकायास्तु गदतो मे निबोधत ।।१११.।।
निश्शर्करा निरिस्कता निस्तृणा विस्तुषा तथा ।
न विच्छिन्ना न विशदा न क्षारा कटुका न चा ।।११२।।
नावदात न कृष्णा चा नाम्ला नैव चा तिक्तिका ।
मृत्तिका लेपने शस्ता तया कार्या तु मार्जना ।।११३।।
नदीकूलप्रदेशस्ता श्यामा या मृत्तिका भवेत् ।
तोयापसरणश्लक्षणाः तयाकार्यातुमाजना ।।११४।।
बाहुव्यायामवाता चा कृष्णा गुर्वी न चा स्थिरा ।
सतृषा न स्वानकरी श्यामा यात्र चा दृश्यते ।।११५।।
तत्र गोधुमचूर्ण वा यवचूर्णेचा दापयेत् ।
यवगोधुमचूर्णन्तु कदाचिदुपयुज्यते ।।११६।।
-Natya Shastra by Bharat Muni, Chapter – 33, Verse no. – 111 to 116.

drained of water should be used for Mārjanā. One should use wheat flour or barley flour or a mixture of both, if the clay available spreads very much; it is heavy or unstable, white or black and full of husks or if it does not produce desirable notes. One defect of the mixture of the two flours is that it creates a monotonous around. Thus it is blackish clay applied for the Mārjanā that will produce proper notes[1].'

THE EFFECT OF SHYĀHI

Acoustically the most important and significant fraction of a pūdi is called shyāhi or black-patch. The literally meaning of shyāhi is ink and generally when we discuss about ink the indication is marked black ink only. Shyāhi also looks black, so, it is named as shyāhi. It is also known as khiran, gub, black-spot, etc. Generally, in Bengal region it is called khiran or gub frequently. With the help of shyāhi Tablā can produce the proper pitch and resonance.

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[1] The Natya Shastra of Bharat-Muni, Translated by A Board of Scholar, Page no – 495.

The great physicist C V Raman also emphasis this point and said that, 'a remarkable type of musical drum which has been in use in India right up to the present time is of special interest to acoustics. In this instrument the drum head is stretched over the open end of a heavy metal or wooden cylinder and carries a symmetric load distributed in five layers over a part of its surface whose superficial density decreases from the centre outwards. The load consists of a pliable and sticky mixture which contains finely powdered iron. This produces an increase in the surface density of the membrane which is proportional to the thickness of the layer applied[1].

Bhaarat muni also remarked this thing, and at the time of him there were hundred of percussion instruments existed but none of them were ready to produce proper sound except tripūshkara. There were no multiplicities of functions as in others. No production of distinct notes and no regulated

[1] Musical Instruments And Their Tones, by C V Raman, From, HANDBUCH DER PHYSIK, Page no – 555.

strokes. No distinct syllables are available and Mārjanā is not required[1]. But in tripūshkara where shyāhi (marjana) was set and able to produce different syllables, said Bharat muni in other places. He also suggested using shyāhi and in this respect Bharat writes,

वामके चोर्ध्वके कार्या आहार्यलेपनाः स्वराः ।
शैथिल्यादायतत्वाच्च तथा त्वलिंगयाकांगिके ।।१०१।।
-Natyashastra by Bharat muni, Chapter – 33, Verse no. – 101.

So, it is the black-patch by which Indian Tablā differentiated from other countries Tablā. It is also remarkable that, now-a-days Indian Tablā has acquired in such a position where other countries Tablā failed to go there. As even, the other percussion instruments either those are from India or from any other countries, failed to reach that

[1] यावंति चार्मनद्धानि ह्यतोद्यानी द्विजोत्तमाः ।
तानि त्रिपुष्करादीनि ह्यवनद्धानिति स्मृतम् ।।२४।।
ह्यतोद्यान्तु पुनर्भेदाः शतसंख्याःप्रकिर्तिता ।
किन्तु त्रिपुष्करस्यास्य लक्षणं प्रोच्यते मया ।।२५।।
शेषाणां कर्मबाहुल्यं यस्मादस्मिन्न दृश्यते ।
न स्वरा न प्रहाराश्च नाक्षराणि न मार्जना ।।२६।।
भेरीपटहजा ह्याभिस्तथा दंदुभिडिण्डिमैः ।
शैथिल्यादायतत्वाच्च स्वरे गाम्भिर्यमिष्यते ।।२७।।
- Natya Shastra written by Bharat Muni, Chapter – 33, Verse No. – 24 to 27.

such permutation. And it has possible mainly because of black-patch, which is used on both parts of a Tablā.

There are several items to make a shyāhi mixture, like, iron filings, boiled rice paste, glue and charcoal powder. Items are differed from person to person. Some instrument makers prefer wheat flour paste on the place of boiled rice paste. Mantu Chandra Das prefers boiled rice paste[1] where Jitu bhai another instrument maker prefers wheat flour paste[2]. Hasmukh bhai also prefers for wheat flour but according to him a powder which is made by grinding stone found at Sinhore in Bhavnagar is better then irons fillings and is used by him[3]. But most of the Tablā maker is preferred for iron fillings.

All the above items are mixed first appropriately. Normally, for this work a plate made by rubber is used. As it is band easily, so, it is very helpful to mix

[1] Mantu Chandra Das, instrument maker, on private interview, in Bangladesh.
[2] Jitendra Dabhoiwala, instrument maker, on private interview, in India.
[3] Hasmukh Bhai, instrument maker, on private interview, in India.

the items. Sometimes chisel or fingers also use to make a fine mixture. After making a complete

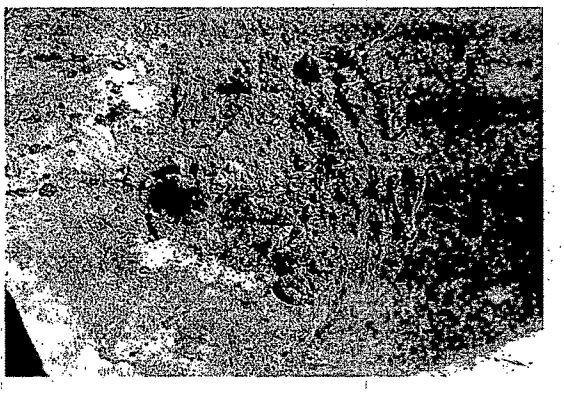

Fig. 3.13, Shyʌhi mxture is making.

mixture, at first the membrane of a pūdi on which shyāhi will be affixed is rubbed finely with the help of chisel. And then only glue which is made by wheat flour or rice paste is affixed and cleared roughly by chisel. And then first layer is made with

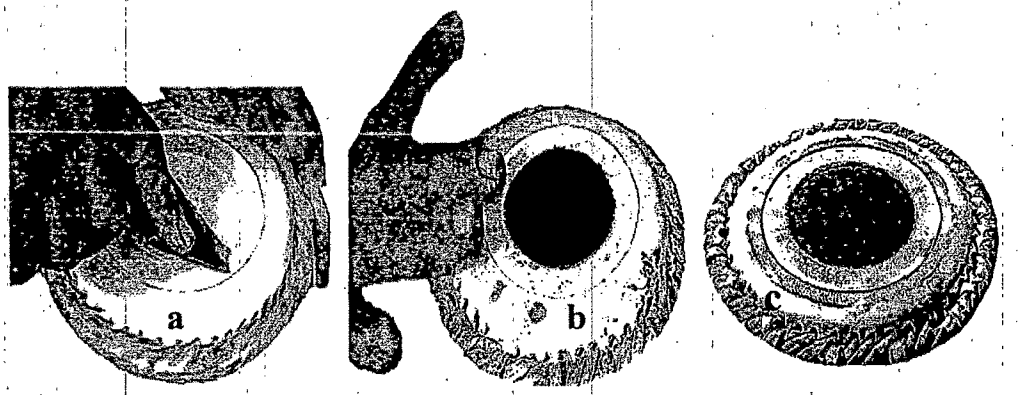

Fig. 3.14, a). Glue fixing before affixing shyʌhi mixture, b). First layer is affixing by shyʌhi paste, and c). 2nd layer is affixing by shyʌhi paste.

shyāhi mixture. After little bit drying it is polished properly with a smooth stone and before this layer

dries out the second layer is affixed. By this way, these works will continue until the proper thickness

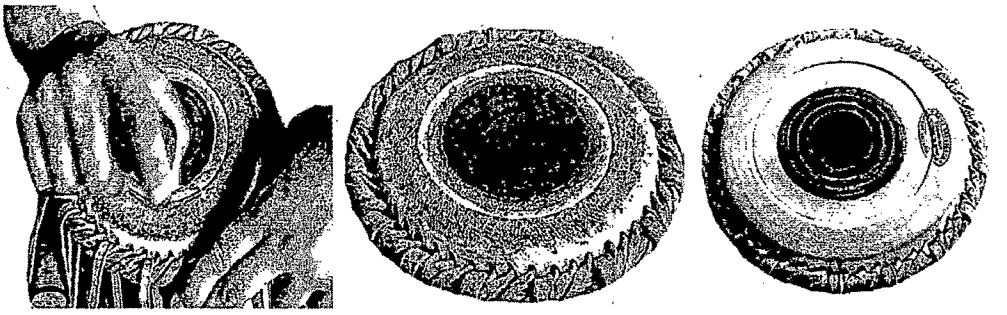

Fig. 3.15, a). Shyāhi is polishing by a smooth stone, b). Again shy hi paste is affixing and c). A complete shy hi is made-up.

is set on. It is really a very hard job to judge the proper thickness of shyāhi which is achieved only by experience and this work is done by highly expert Tablā makers only.

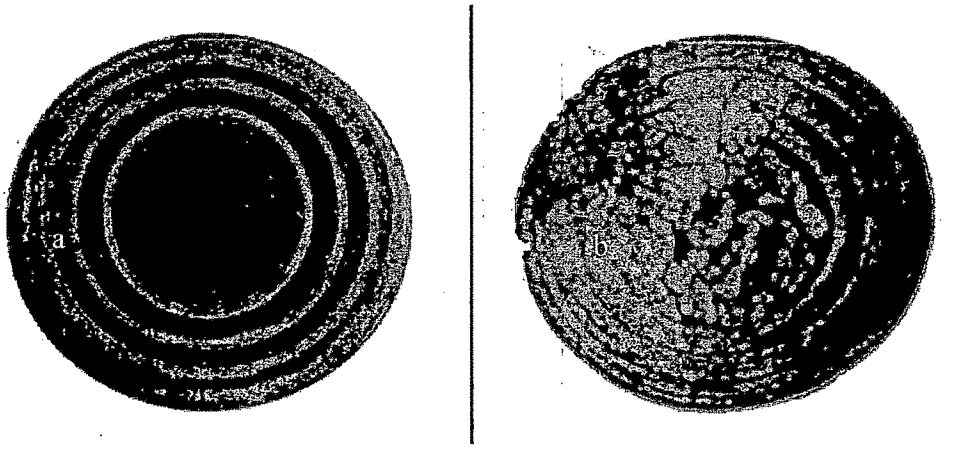

Fig. 3.16, a). A good shyāhi of a Tablā and b). A bad shyāhi of a Tablā.

MAKING OF TABLĀ PŪDI

However, the making of Tablā pūdi admits of continual improvement. It is a highly specialized craft to make a Tablā pūdi. And, it demands high dexterity to make a pūdi. Generally, this craftsmanship is passed down from father to son traditionally. The apprenticeship habitually initiates in childhood and is accomplished only when the craftsman reaches full maturity. According to Mantu Chandra Das, it takes at least four to five years to learn this craftsmanship[1].

In this respect B. C. Deva wrote on his book that, 'Indian drum making and playing have evolved certain techniques which are not only peculiar to this land but perhaps, unique in this craft and art[2].' Quality, which is also known as timbre is an important character for Tablā instrument. It is the reason of quality, which enables us to differentiate one musical instrument to others, even the same note of the same pitch and intensity produced from

[1] Mantu Chandra Das on private interview.
[2] Musical Instruments of India, by B. C. Deva, Page – 100.

other instruments. Usually, the quality of a Tablā sounds is already determined by the instrument maker at the time of its making.

As stated earlier that the pūdi is devided mainly in following four parts, Gajra, Kinar, Sur and Shyāhi. And it is also discussed earlier about the above four parts and its making also. Now we will see a short process of pūdi making.

Pūdi making for both drums is about same and it starts by taking the rawhide and soaking it in water.

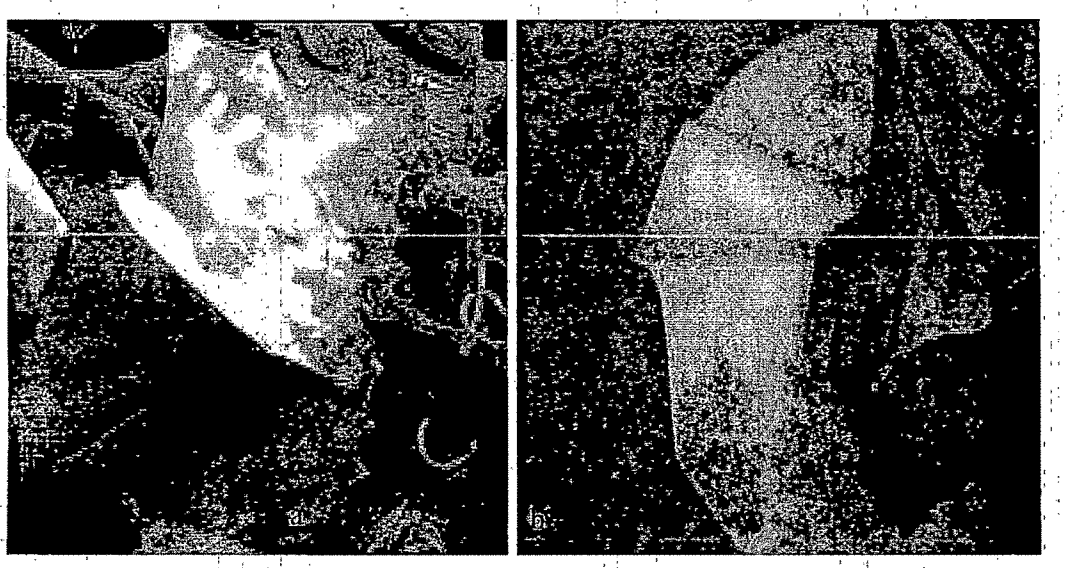

Fig. 3.17, a).Rawhide is cutting for soaking to make a Tablā p di and b). Excess hair and tissue is removing from a soaked rawhide.

After soaking rawhide for one to three hours, excess hair and tissue is removed and whole is

allowed to dry. Now a circle is made according to demanding diameters and cut three layers of it and attached it with gajra. Now the lower layer which is

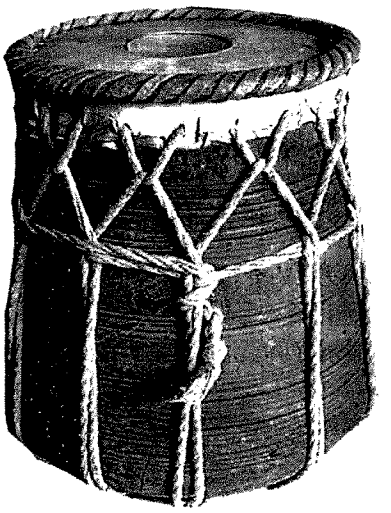

Fig. 3.18, Pudi is preparing for setting shyahi on it.

invisible of an out looking pūdi is cut off for making bhari (See fig. 3.8) and also cut the upper layer for making chanti and is placed on lakri to dry perfectly with the help of rope as it is shown on fig. 3.18.

When it is dried perfectly the pūdi is removed from lakri and cut off the excess portion finally and set it again on a lakri with the help of baddi (braces). Now the time to set shyahi on middle layer of the skin of a pūdi which is discussed earlier on shyahi title evidently.

GURRI

At the bottom of a dayan Tablā or bayan Tablā there is a little ring made of leather lace is called gurri. For making equal tension of pūdi it is tightened up by baddi through gajra and gurri. It is a very small ring made by buffalo skin or cow skin or of goat skin.

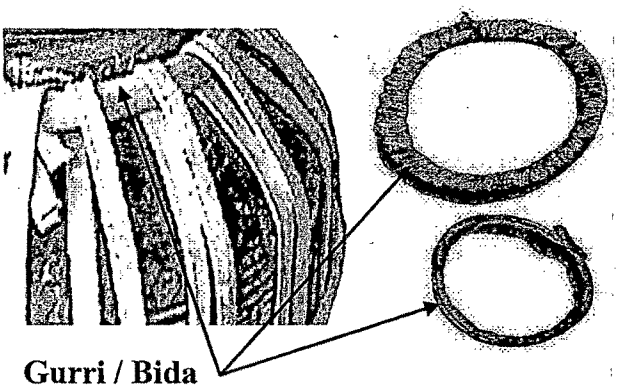

Fig. 3. 19, Gurri for dahina and bayan Tablā.

BADDI (BRACES)

Baddi is a long leather strip by which the pūdi is tightened up with the help of gajra and gurri. It is also a very important part of a pūdi to tight up perfectly with equal tension each and every portion. The physicist C V Raman also has made an important

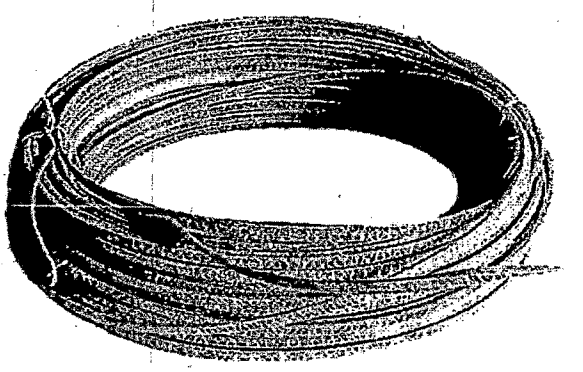

Fig. 3.20 , Baddi for dahina and bayan Tablā.

look on this matter and said that, 'A system of 16 tightening cords permit the drum head to be stretched in all directions. This is very important for the correct adjustment of the pitch[1].'

Generally baddi is made by buffalo skin, cow skin, and goat skin. As per strongness the finest baddi is made by buffalo skin. It is also depends on hide which is used for making pūdi. If the skin of a pūdi is made by heavy skin then it demands strong baddi like buffalo skin, otherwise it can be made by cow skin or goat skin. Generally, it can be seen that at Delhi, Gujarat, Bombay, Punjub, Benaras, where pūdi is made by heavy skin and buffalo skin is used to make baddi, on the other hand at West Bengal and Bangladesh where pūdi is made by little bit thin skin and baddi used which is made by cow or goat skin. Sometimes rope is also used on the place of baddi. But with the rope it can be created some problems for tensioning the pūdi. So, baddi is the best to tight-up a pūdi. Before using baddi on Tablā

[1] Musical Instruments And Their Tones, by C V Raman, From – HANDBUCH DER PHYSIK, Page no – 555.

it is soaked in water and then lightly covered with oil or ghee to grow-up its smoothness and elasticity.

GATTA (WOODEN PIECE)

The wooden pieces which are used to increase or decrease the tension of dahina and bayan Tablā is known as Gatta. It is also known as gulli about one inch in diameter and about two to three inches in length for dahina Tablā. Where as on bayan quarter inch in diameter and two to three and half inches in length gatta's are used. Tablā has eight gattas in its every part which are attached through braces and Tablā's main body. At the time of tuning a Tablā, the gattas are hammered down or up with the help of a hammer. At first each gatta is

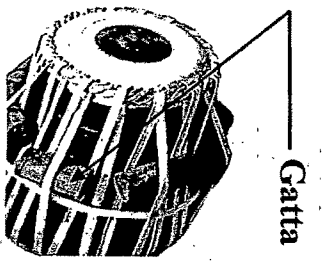

Fig. 3.21 , Indicating gatta on dahina Tablā.

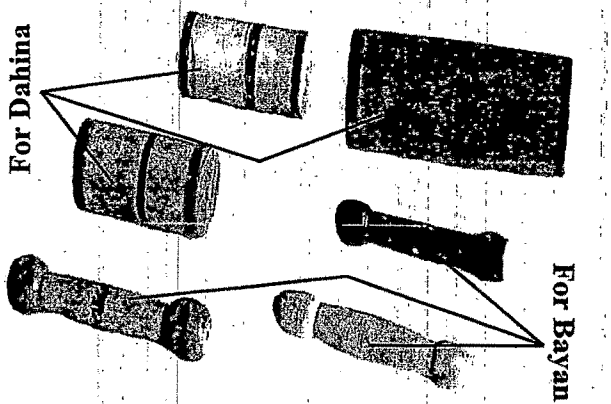

Fig. 3.22 , Gattas for dayan and bayan Tablā.

attached by only one baddi but with the demand of more tensions two, three or four baddis are used to attach a gatta. And finaly each gatta can support up to a maximum of four baddis for increasing the tension of a pūdi. The gattas are cylindrical components which made by different woods like Shisham, Neem, Aam, Babla, etc.

On bayan sometimes small rings which are made off by copper, brass or iron are used on the place of Gattas.

GADDI (RING)

Gaddi is a part of Tablā on which the dahina and bayan Tablā are set up. It has enough importance to set up Tablā on gaddi for playing it with relaxes. Or not Tablā will move here and there. It has more importance for bayan Tablā. As we know the bottom part of dahina Tablā is solid block of wood,

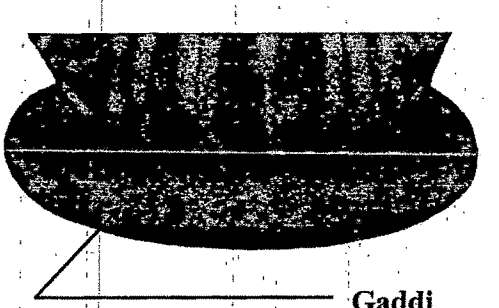

Fig. 3. 23, Gaddi of a dahina Tablā.

so, it is sounded well even its bottom touched with ground. But in bayan there is no any solid block friction like dayan Tablā. As a result if the bottom part is touched with ground the bayan will not be sounded well. So, the bayan is set on gaddi in such a way that its bottom does not touch with the ground.

Generally, gaddi is made by straw and cloths. At first with straw a strong ring is made and then it decorated by cloths. A sometimes cloth is also used to make a gaddi on the place of straw.

PROPERTIES OF BAYAN TABLĀ

The left part of a Tablā which is also known as bass drum and played by left hand or non-dominant hand is called bayan. It has several names like 'mada', 'dagga', 'dugga', etc. The bayan which is about ten to eleven inches high and its playing surface is about ten inches in diameter and the bottom where gurri is affixed is about two and half to three inches in diameter.

There are several properties of bayan Tablā like dayan Tablā. The bayan Tablā which is also made by lots of different parts and each and every parts of these bayan has great demands for good acoustics.

The following parts are mainly consists for a bayan Tablā:

⇒Kudi (Main body)
⇒Pūdi (bayan's head)
⇒Gajra
⇒Chanti (Kinar)
⇒Shyāhi
⇒Sur (Maidan)
⇒Baddi (Braces)
⇒Gattā (Woden Piece)
⇒Gurri
⇒Gaddi (Ring)

KUDI

The drum shell of bayan Tablā is made by different materials. Generally it is made out by clay. And after making a kudi by clay it is burnt for creating hardness. Even it is burnt by fire which made it hard but yet it is breakable. And that is why one needs very careful handling of it. For this reason it is also made by brass or copper which gives more

rigidity to the bayan. For decoration it is also plated by nickel and chromium which gives it a nice

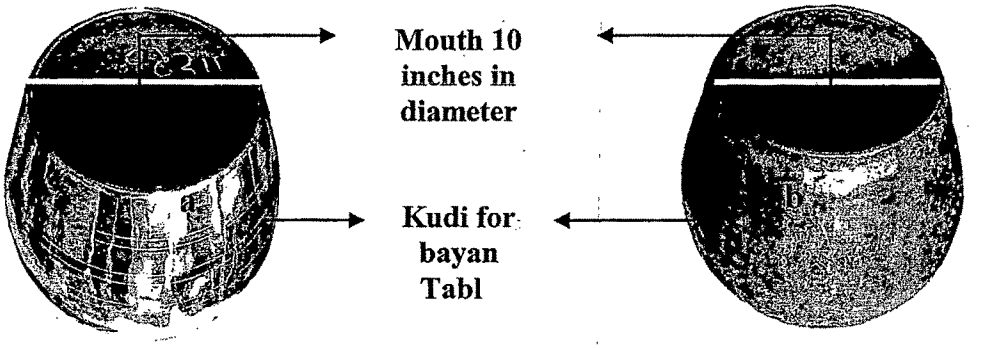

Fig. 3. 24, a). Chromium plated Kudi, and b). Unplated copper p di.

look. A good quality of metallic kudi weights between two and half to four kilograms. To make it stable on gaddi sometimes additional weight also is attached by adding extra coating of lead in the inner bottom of the kudi.

PŪDI

The pūdi of a bayan Tablā and dayan Tablā is almost same, only the kinar is little more wide then dayan and entire pūdi is bigger then dayan where

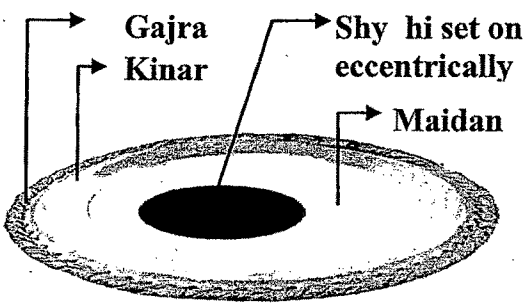

Fig. 3.25, P di of a bayan Tabl .

shyāhi is set-up by eccentrically. For this reason different types of sounds can be produced from a bayan Tablā.

The other properties of bayan Tablā and dahina Tablā is almost same, so the similar description is not repeated again.

MATERIAL USED TO MAKE BAYAN TABLĀ

Various kinds of skin are used in the making of a bayan's pūdi and various kinds of metals or clay are used in the making of a bayan Tablā's kudi or shell. The skin of cow, claf, goat, buffalo, are used in the making of bayan pūdi. But the goat skin is used more then others in every place. Leather braces of buffalo skin are used in most of the drums. The shells of bayan Tablā are made of mainly by copper, brass, Tamba, tin, and clay. Sometimes kudi is also made by wood also. The kudi made by wood or clay is not so hard. Specially, when it is made out by brunt clay, one need very much careful handling as it is very brittle. For this reason it is often made of

brass or copper. Besides offering more rigidity and decorative cosmetic value it is also plated by nickel and chromium.

IMPORTANCE OF CIRCLE

Painting is three dimensional where depth is misleading impression of reality or illusionary, sculpture is also three dimensional but depth is real, whereas music is multi-dimensional and each and every dimension is illusionary. On the other hand we can also say that, in paintings or any pictures or even in a sculpture the total shape is approximately measurable, but in music there is no any measurable depth or limitation by this point of view.

But when we discuss the instrument like Tablā and more perfectly the pūdi of a Tablā which enables to create music there is a real geometric shape, the circle, the regular two dimensional geometric shapes. The circle has had a special significance for artists still the Neolithic era. In the Roman period,

the circle was divine shape and thus most suitable for temples. Even today, the most of the temples, masque, and church are also planed by circle shape or some part of circle shape on its top.

It is possible easily to tighten up a Tablā pūdi the entire round equally and stay with equal tension always for its regular two dimensional circle shape. Which gives a pūdi more durability, otherwise it has chanced to crack the pūdi very often also. May be for this above reason the entire Indian and western percussion instruments has been made by circle shape.

Since there are a few exceptions in western percussion instruments, for instance, Tuning-fork, Triangle[1], but these instruments are not come in percussion categories by the Indian point of view. The circle shape is also a symbol for something endless. As we know the Tablā also has the quality

[1] Tuning-fork and Triangle are counted as percussion instruments in western countries. We can also see it in 'Musical Instruments', by Harry F. Olson, Page no – 109.

to create endless compositions and sweetening moments.

A number of scholars have opined their opinion about the importance of circle. It is said that, all 'Yagna Kunda' get perfection by circle and the nature is also a circle shape and others are the alternate pattern of that. In this respect Shridharsharmana has written[1],

प्रकृतिःक्षेत्रं वृत्तं । अन्यात्सर्वा विकृतिरिति ।
योऽस्तु चात्रस्त्रादिप्रकृतित्वेन स्वीकृतं
तात्स्वीयबुद्धिकौशल्यमेव प्रदर्शितं ।

The learned scholar has also proved all yagna-kundas of four angel, three angel, etc, by circle and narrates them by the affect of circle in his book 'Kundarkam'[2].

The shape of circle has also a great value in our every day life. Any thing even not in circle shape but when it moves in such or so forth way then it

[1] Kundarkam, by Shridharsharmana, Page – 24.
[2] Kundarkam, by Shridharsharmana, Page – 65 to70.

becomes circle shape. For example, the earth, the sun, fans, etc. Normally a fan is a triangle shape but when it starts to move round it becomes a circle or round shape.

Even mathematically it has been proved that a circular shape gives maximum area for a given length of periphery[1]. In this respect a Farmer-King story is also famous. There is a saying that, a King was pleased by a farmer's work and gave him a rope to measure a land. But, there was a condition that how much area he measured by that rope only will be his owned. Then the farmer made a circle by that rope and got highest area by this way.

The comparison of a circle of a Tablā pūdi with different circle shapes may seems exaggeration but it is definite, there is a great connection with circle.

[1] Gyanprakash Joshi (Engineering Consultant) on private interview on the date 13-06-08.