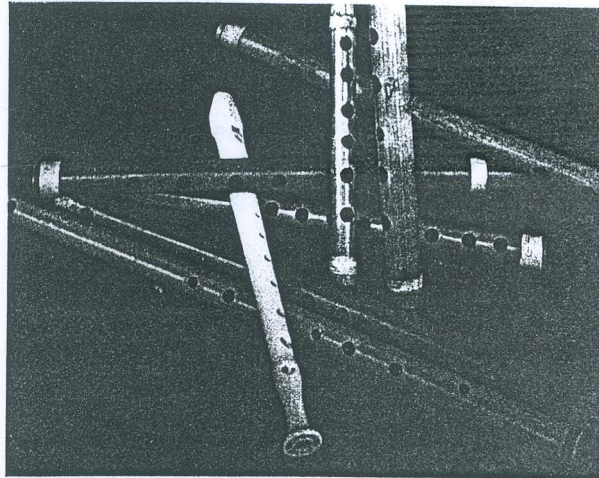
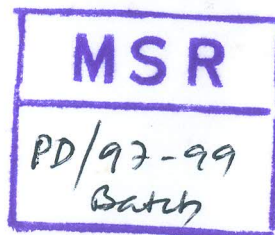


SPECIAL PROJECT:
STUDY OF MUSICAL INSTRUMENTS: FLUTE



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APPROVAL SHEET.

The special project titled "Study of Musical Instrument : Flute" by C.Himasunder Rao is approved in partial fulfillment of the requirement for the Masters Degree in Industrial Design at IIT Bombay.

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M Bhandari

Examiner

CHAPTER 1 INTRODUCTION

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CHAPTER 1

INTRODUCTION

We hear sounds of all kinds almost always. The pleasant sounds are called 'musical'. Composition of pleasant sounds makes music. Music has a tremendous influence on people's lives. Music is there for almost every occasion and every happening. Today music and musical instruments have become sophisticated and specialized that we rarely ponder to think of the roots of its existence. But if we do search, we would find the importance of the relation between music and cultural lifestyles of people.

Music is surely more evident from instruments. Right from Phantom's 'tom-tom' drums to mumbling of the bumblebees, we find the roots of music. Whistling of birds to drones of insects shows the idea of musical effects and origin of its creation. Though very versatile the simplest of all instruments is the flute. It is the wind instrument close to the human voice. It is an indoor as well as an outdoor instrument. It is very easy to carry and is most affordable. The punch of the flute is the ability to produce frequencies with continuity in tunes. These instruments use air directly or indirectly to produce sound. In most of the wind instruments, air is made to vibrate and is the cause of tones.

The flute belongs to the family of woodwind instruments. The flute is one of the world's oldest musical instruments, and it is also one of the simplest. It is essentially a hollow chamber equipped with a blow-hole for introducing acoustic energy. The flute is the only musical instrument which is purely acoustical, requiring no vibrating membranes, strings, reeds, or surfaces for the production of sound, and it has been developed to include a variety of wind instruments. Wind instruments from their very nature do not need recurring expenditure to maintain them. Amongst the musical instruments, it is the most universally found. It is considered as the common instruments of the humanity. This instrument occurs internationally, not limited by the geographical barriers.

This report concentrates essentially on the Indian aerophones; its growth and social influence. In the history of world music Indian flute may be said to be one of the first instrument wherein classical music was played. Among concert instruments flute enjoys same dignity and status as the veena. Folk music has a definite character and style of playing the flute. The flute enhances the charm of music and the theme of the occasion. The style is culturally well established by the distinct music evolved in region in course of time. For example, the music of the hills is distinctive from the kirtans of the south.

CHAPTER 2

THE MUSIC THEORY.

Music can be memorized and passed on from one person to another by direct sound transmission. Folk, religious and pop songs are examples of this form of dissemination of music. But the deeper aspect of music comes from understanding the factors relating to the effects of music and its creation.

In general, musical sounds are smooth, regular, pleasant and harmonious. Certain tones when sounded together or immediately following the other produce a pleasing effect, while other combinations of tones lead to an unpleasant sensation. Since musical instruments are capable of creating pleasing sounds, it would appear that these instruments form the basis for musical scales. In mathematics these are termed as harmonic series. It will be noted that the series is composed of the following frequency ratios: 2:1, 3:2, 4:3, 5:3, 5:4, 6:5, 8:5 etc. The interval of two frequencies having the ratios 2:1 is termed as an octave. An interval between two sounds is their spacing in pitch or frequency. This description has been found to produce a pleasant sensation for the octave. The holes of the flute are designed to produce the required frequency spacing to create pleasing sounds. The diameter and spacing gives the tone accuracy for the flute. A normal flute can cover upto two and half octaves.

The medium of transmission from flute player to the listener is in the form of sound waves. From the standpoint of music, sound waves may be defined in six physical variables, namely, frequency, intensity, waveform, duration, growth and decay, and vibrato. The flute can produce sounds that vary in the rendition to produce effects that suit the tune and purpose of the composition. Such effects are produced by modulation of breath, style of fingering, movement of the neck, pressure of the wind blown into it.

The flute has had a very significant role to play in the musical theory in India. The *venu* was one of the early instruments to define the musical scale. *Naradiya Siksha* (first century AD) gives us, perhaps for the first time, the relations of the Vedic (descending) scale and that of the flute (ascending). It says that it is "the *syara* (note) which is *prathama* (first) in the singing of *Samaveda* is the *madhyama* of the flute, *dviteeya* (second) is *gandhara*, *triteeya* (third) is *rishabha*, *chaturtha* (fourth) is *shadia*, *panchama* (fifth) is *dhaivata*, *atisvara* is *nishada* and *krustha* is *panchama*."

Tabulating this we have.

Vedic scale	Profane (flute)	Modern scale (Hindustani)
Prathama	Madhyama	Ma
Dviteeya	Gandhara	Ga
Triteeya	Rishabha	Re
Chaturtha	shadja	Sa
panchama	Dhaivata	Dha
Atisvara	Nishada	Ni
Krustha	panchama	Pa

Early History

Stage I

How did the idea of the flute arise? It is a question that has puzzled many. His sojourning after the sweet musical notes of the currents of wind dancing and beelines in their holes on the sides of the hills, he produced the notes, not of a crude kind, but of a refined kind, and capable of being played in a variety of ways. Scandinavians are

CHAPTER 3

THE ORIGIN....

With the exception of the conch and crude time keeping instruments, musical pipes are the oldest musical. Stringed instruments appear at a somewhat later stage. The earlier stringed instruments were of the, bowstring type and had crude resonators. Chordophonic instruments with plain finger-boards came later. Fretted instruments appeared at a much later stage. Mention is made of different kinds of musical pipes in the literature of India. From early times, instruments of the flute species seem to have found favour with all classes of people. Even in countries wherein we come across only a few varieties of stringed instruments, there exists a great variety of instruments of the flute species. Another line one may suggest is the common habit of many people of speaking with the closed, hollowed palm in front of their mouths. This is a mark of respect towards the hearer. But it may also be a survival of the primitive custom of protecting one's word or voice from evil influences. Amongst one of the tribal peoples of New Guinea the king always held "a trumpet shell before his mouth when speaking to his people, so his voice had a hollow sound". There are some who "speak into a calabash on which they are able to reproduce five tones of their language". This method of hiding one's true voice might have given rise to ideas of not only resonance but also of globular flutes where air is blown across a hole in a hollow sphere of clay or other material. Almost every one of us has played this game of blowing over the mouth of a bottle to produce a whistle.

The flute has a noble history. In very remote times, flutes were made of bones. Slender bones of birds were made into whistles and some of them are still found amongst Red Indians. Clay whistles came next. Bone flutes have been found in excavations in Central Europe and in the cliff dwellings of Colorado and the ancient caves of California.

Early History

Stage 1

How did the idea of preparing musical pipes .of the flute type first strike man? It was in this wise. In his sojourning after the necessities of life, he came across bamboo forests from whence he heard sweet musical notes. Closer observations revealed to him that these sweet notes were the results of currents of wind dashing against the holes drilled on the sides of the bamboo stems by the chafers and beetles in their innocent quest for food. The idea of preparing musical pipes by artificially drilling holes on the sides of such bamboo stems or other suitable material and supplying his own air to produce the notes, naturally struck him. It is at this stage that we come across some musical pipes of a crude kind, made of wood, bamboo or reed with a mouth-hole and with or without a few finger-holes, and capable of producing only a few notes. The Alphorn of the Swiss and the Lure of the Scandinavians are instances of this class. With such instruments primitive men were able to play the

few tunes they know. It should be borne in mind that the musical compass of primitive songs and tunes was very small.

Stage 2

With the increase in musical knowledge, we find attempts being made to increase the number of finger-holes to seven, to enable the sapta svaras to be played with facility and ease. The seven notes were played in *their arohana krama*, by closing all the finger-holes and opening them in succession from the right end towards the left, i.e., in the direction of the mouth-hole and *vice versa* for playing the notes in the *avarohana krama*.

Stage 3

With the perception of subtler shruti and the recognition of distinct scales, attempts were made to pierce finger-holes at such points that the different scales (modes) known to them, were played with the same system of fingering, in a mechanical way. As a consequence, distinct and separate flutes graduated to different scales came into existence. This stage corresponds to the method of playing, the different semi-tones of the octave by the system of partial closing and opening of the finger-holes was not yet known.

Stage 4

It was very soon found inconvenient to change the flute for each mode. With the same flute, attempts were made to produce the different semitones of the octave by the partial closing and opening of the finger-holes. The advantage of an eighth finger-hole in helping to product an additional lower octave note was also recognised and all subsequent flutes came to have eight finger-holes. At the same time, the system of fingering was gradually modified to enable notes ranging over two and a half octaves to be played with ease.

CHAPTER 4

THE CLASSIFICATION...

The classification of these various aerophones can be as follows:

1. free aerophones

2. air as vibrator

A. *Air Reed*

- (i) Without beak
 - a. without special blow hole
 - b. with special blow hole
- (ii) With beak

B. *Lip Reeds*

- (i) End blown (ii) Side blown

C. *Mechanical Reed*

- (i) Beating Reed
 - a. single b. double

3. air as an exciter

- (i) Free reed

Mouth blown instruments are of three kinds:

1. Where the wind is blown through an orifice (mouth-hole or embouchure) in the wall of the instrument itself, as in the flute and the piccolo.
2. Where the wind is blown through vibrating reeds or tongues or mouth-pieces, as in the nagasvaram, mukhavina, oboe, and the clarinet.
3. Where the column of air is set in the vibration by blowing obliquely across the open end of the pipe, as in Shakuhachi of Japan and the panpipe or syrinx.

All these three types of mouth-blown instruments are represented in the flute species. From the position in which the instrument is held, these three types of flutes are respectively called as traverse flute, direct flutes and the vertical flutes.

Wind instruments or aerophones may further be classified as follows:

1. a) manually blown as flute and shanai
b) wind supplied through a mechanical medium as in harmonium or organ.
2. a) with finger-holes
b) without finger-holes
4. a) woodwind as nagasvaram
b) brasswind as gaurikalam
c) stonewind as stone nagasvaram
5. a) used as a primary instrument
b) used as an accompaniment
6. a) Shruti vadya(ottu and donai)
b) tala vadya (counch)
c) sangita vadya (flute)
7. a) for classical music (nagasvaram)
b) for folk music (nedunkuzhal)
8. a) with drone coupling (magudi)
b) without drone (shanai)
9. a) stationery (organ)
b) portable (trumpet)
10. shape of the resonator
a) cylindrical (flute)
b) conical (nagasvaram)
c) crescent shaped (piraikkombu)
d) s-shaped (konakkombu)
e) spiral shaped (counch)
f) snake-shaped (nagapani)
g) bottle shaped (magudi)
h) rectangular (harmonium)
11. a) used outdoors (trumpets, horns: processions)
b) used in concert halls (flute)
c) used for temple rituals (bhuri)
d) in martial art (conch)
e) in dance music (clarinet)
f) in folk music (Ayarkuzhal)



CHAPTER 5 THE HISTORY...

The earliest wind instruments would have been made of hollow tubes readily available to man: horns, human and animal bones, and bamboo shoots. Even today trumpets of human thighbones are used in Laddakh and contiguous areas. The buffalo *horn-seengh* (Hindi, Marathi, etc.), *kombu* or *kommu* (Tamil, Kannada, Telugu) --are common throughout India. The metal curved trumpet still goes by the name of *seengh* or *kombu*, indicative of animal origins of the instrument as well as the name. Specimens of such very ancient aerophones in India have not come to light, though the Indus valley excavations have brought out few examples of birdshaped whistles. Also conch shells have been found, but it is difficult to say whether they were really used as musical instruments.

Free Reed

In the case of mechanical reeds, it is sometimes difficult to decide whether they act only as valves or are the main sound producers. The problem becomes significant as-on the basis of discussion here-it has been suggested that the harmonium had its beginnings in instruments like the *khung*.

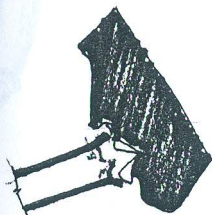
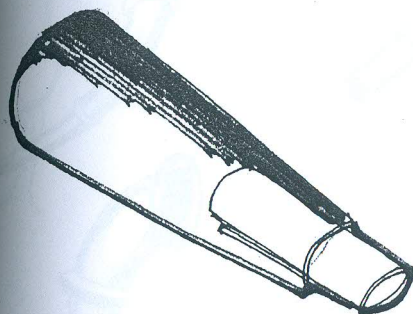
This division is based on the mechanism of the air: that is, the air may itself oscillate and be the cause of sound or it may excite a reed that becomes the source of the tone. In some cases, very rarely, the air may be outside the instrument.

Free Aerophones

In this class of instruments, the air is not confined in any tube or column but is external to it. Of this kind is what is known as the bull-roarer. This is just a flat piece of wood, a foot or two long, thin and fairly sharp at the edges. One end of it is tied to a long string which is held in one hand and rotated fast. As the wooden blade moves, the air round it is set into fast motion, producing a roar. Perhaps, there is no child who has not played this as a toy. Farmers, to frighten off birds often use it; but never has it been seen to be put to musical use.

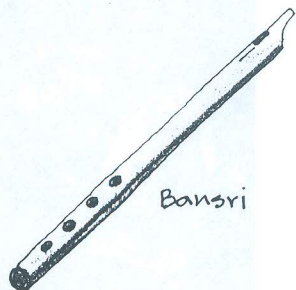
Air As Vibrator

In these aerophones air is blown into a column and the flow of air is controlled by some kind of exciter or valve. In the first case, which may be called, as air-reed there is no visible valve mechanism whereas in others the air current is made intermittent by a system of one or more valves.

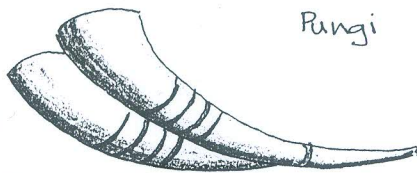




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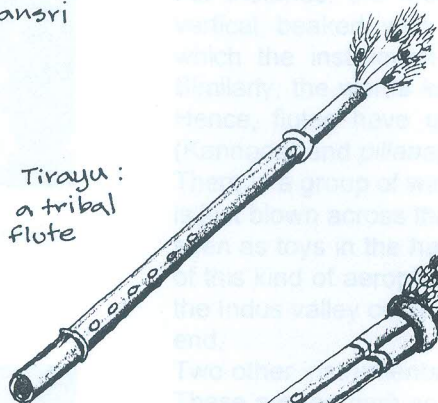
Bansri



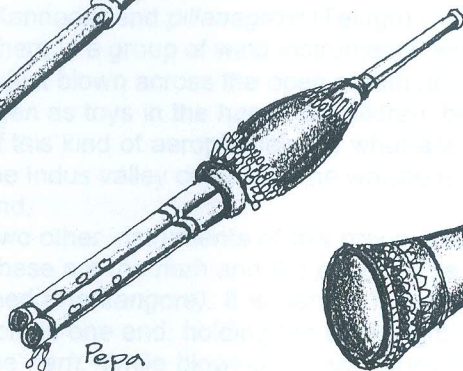
Pungi



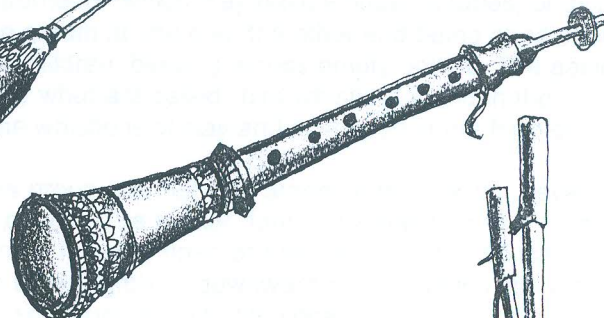
Folk
Shehnai



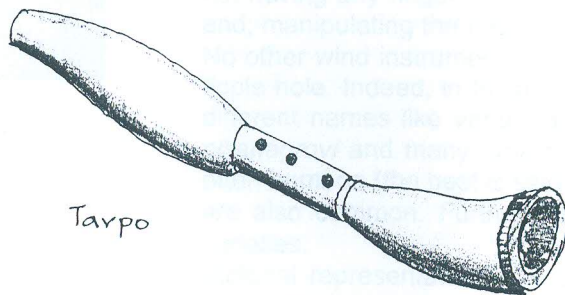
Tirayu :
a tribal
flute



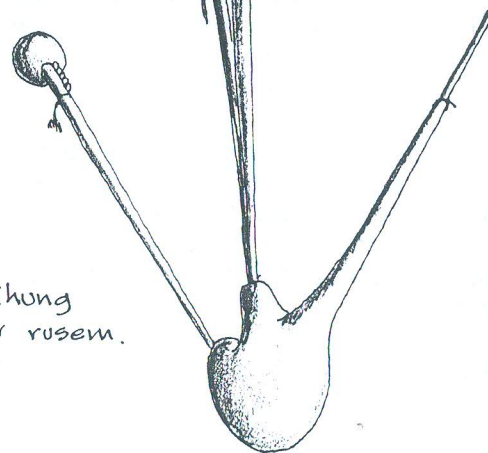
Рера



Tribal
Mohori



Tarpo



khung
or rosem.



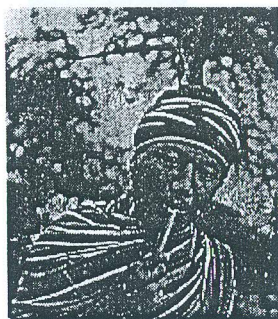
arsingha

CHAPTER 6

AIR REED FLUTES



KUZHAL, tamil nadu



PHEPLE, manipur

Here air is sent directly into a tube and impinges on some kind of an edge in the instrument, setting up vibrations in the air inside the tube. In the common concert flute there is no special edge to interrupt the wind current; but in beak-flutes like the algoza there is separate beak or mouthpiece. For instance, the Indo-Aryan words *venu*, *vamsi* and *bansuri* may indicate any kind: horizontal, vertical, beaked, with or without a fipple hole. Since these names are derived from the material of which the instrument is made-bamboo (*vamsi*?) This kind of generalisation is understandable. Similarly, the words *kolalu* (Kannada), *ktjzhal* (Tamil, Malayalam) in a literary sense mean 'a tube'. Hence, flutes have unspecified names such as *pillankuzhal* or *kuzhal* (Tamil), *kolalu* or *kolavi* (Kannada) and *pillanagrovi* (Telugu).

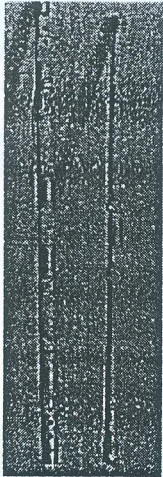
There is a group of wind instruments, which may have elongated tubes, or globular bodies, where air is just blown across the open mouth at one end, the other end being open or closed. These are often seen as toys in the hands of children, blowing across empty bottles. The earliest examples we have of this kind of aerophones are what are called "bird whistles" found in the remains of Charhudaro of the Indus valley complex. The whistle is of clay and is shaped in the form of a bird with a hole at one end.

Two other instruments of this group are met with amongst the folk but never used in concert music. These are the *narh* and the *pheple*. The former, found in Rajasthan, is a long tube made of a kind of reed (the *kangore*). It is narrow in bore, open at both ends and of 55 cm length. The player blows across one end, holding the tube slightly at downward angle manipulating four holes on the body of the *narh*. While blowing, he sort of hums with his vocal chords, which gives a kind of drone to the very simple melody. The *pheple* is an end blown whistle of the Mibar tribe of Manipur. It is a diminutive bamboo tube about 15 cm in length, open at both ends. It is even simpler than the *narh*, not having any finger- holes at all. In all these cases, changing the air pressure across the blowing end, manipulating the finger-holes gets pitch variations and very simple tunes.

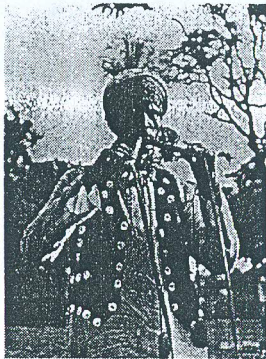
No other wind instrument is so ubiquitous, popular and well known as the side blown flute without a fipple hole. Indeed, in India, the word flute means, more often than not, this type. It is known under different names like *venu*, *vamsi*, *bansi*, *bansuri*, *paya*, *rnurali*, *kolalu*, *kolavi*, *kuzhal*, *pillankuzhal*, *pillanagrovi* and many others. The sizes are equally varied-anywhere from 15 cm to 60 cm. Most often bamboo (the best is said to be from Assam) is used for making it, though wood and metal ones are also common. Further, the number of holes may be from four to six, particularly in the folk varieties.

Pictorial representations are seen in Ajanta, Amaravati, Sikar, Khajuraho and innumerable other relief, paintings and sculptures. With the spread of the legend of Krishna, the Divine cowherd, there

is no corner of India without a description or visualisation of the horizontal flute. In use, it is, perhaps, one instrument which is almost the same, right from tribal life (it is said that the svaras invented the flute) to the concert platform.



JOD, gujrat



ALGOZA, punjab

While in the flutes discussed so far the sound was produced by the air striking the edge of the blow-hole but in the instruments to be described now there is a separate fipple hole, apart from the blow-hole. In this case wind is not blown against the edge of the embouchure but against the edge in a separate opening. While a concert instrument of this kind is hardly ever seen. There are two folk types, the *jode pavo* and the *nedunkuzhal*. *Jode pavo* (*pavo*, *veno*, *vanso*) belongs to Gujarat and is found among cowherds. It is essentially two 'beak' flutes connected by a single embouchure, though there is no regular beak as such. Each of the pair, made of bamboo or wood, consists of a flute at one end of which is a small opening. Through this hole air can pass on to the fipple, containing the edge. The two flutes are connected by these ends to a short metal tube, which bears the blow-hole. When the player blows into this opening, air passes through the small hole in each section and impinges on the edge in the fipple holes, producing sound. There are four holes in each part for playing the melody and the tuning is the name for the both; the instrument is held horizontally.

A very similar aerophone is the *nedunkuzhal* from Tamil Nadu, again a pastoral flute; *nedu* means long and *kuzhal* means a flute. Here there are no two separate flutes joined together, but one single tube serves the same purpose. The whole instrument comprises of one single tube of three internodes of bamboo. The central internode bears a hole into which is inserted a small reed tube for blowing. At each node a small piece is cut off producing a gap which connects across the node the two neighbouring internodes. This aperture is covered with a thin metal sheet. The entire contrivance is designed to create an edge at the node. As air passes along the flute, it strikes against this edge creating the sound. The instrument is held vertically, only the lower section with eight holes being the melody flute. The upper part is not played upon, but gives the tonic.

In a beak flute, the blowing is done into a special narrow aperture at one end. Since this is slightly 'pinched' in appearance, it is called a beak and such flutes are known as beak flutes or whistle flutes. The air from the beak strikes the edge in the fipple hole to give sound. The length may be anywhere from 20 to 65 cm and the number of holes may vary from four to eight.

Interesting varieties of this class are the *algoza* and *satara*. The former is found in Rajasthan, Punjab and in the south till Andhra. Both of them are similar in that they are flute-pairs. *Algoza* is a set of two flutes; both beaks are held in the mouth and played together the tune, being produced simultaneously in both. The *satara* is from Rajasthan and the name is there applied to a double beak flute played like the *algoza*. The difference here is that one of the two instruments serves only as a drone, giving the tonic; the other is employed to play the melody. The Pitch of the drone can be adjusted by fixing wax to one or more of the holes.



SHANKH, tamil nadu



KUMBU, south india

CHAPTER 7

LIP REED FLUTES

(i) Lip reed instruments are those that are blown directly into the lips acting as valves and functioning somewhat like the reed of a *shehnai*. To this group belong, the *shankh*, the *seengh* (horn), the *turahi*, the *kahata* and such others. Since it is very difficult to control the lips, accuracy of pitch is rarely possible and these aerophones have never found a place in our art music. But Western musicians have developed mechanical valves and sliding mechanisms in their trumpets and trombones to give more controlled pitch.

The earliest of such aerophones were the animal horn, the conch shell and the human bone. The conch, of course, is found naturally by cutting off one end, a hole is made which can be blown into. Animal horns and bones as well as bones of human beings have been employed, as they are strong yet hollow. Indeed, even today most of the metallic aerophones of folk music have the shape and the appellations of a horn (*seengh* in all Indo-Aryan languages and *kommu* or its variant *kombu* in the Dravidian); all these words mean horn.

The *khangling* is a trumpet in Tibet, Bhutan, Laddakh and contiguous areas. Made of human thighbone, it is a part of the paraphernalia of ceremonial dances. The femur of a woman is preferred, perhaps, because it is light and has a larger bore. The tube inside has a single blowing orifice at one end but bifurcates, giving two openings at the further end. While playing the player moves his fingers in these holes to produce various effects.

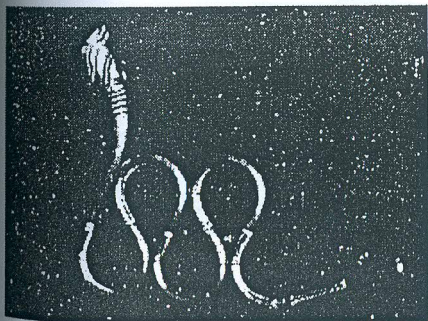
Animal horn as a trumpet has been known from ancient times and is also found extensively throughout the world. Horns of oxen and buffalo are common. With the inner marrow removed and the tapering end sawed off for blowing, a horn forms a very portable trumpet. Generally it is an end blown instrument, and its name in the local languages or dialects is just 'horn'- *seengh* (Hindi, Marathi, etc.), *sringa* (Sanskrit), *kombu* (Kannada, Tamil), *kommu* (Telugu). It was prominently a martial or hunting signal, calling men to arms, announcing victory or a successful catch.

Of the metallic trumpets one may recognise generally three, shapes: straight, semicircular, and 5-shaped. While these differ in shape and size, there is one feature, which is common to all; the blowing end is small in diameter (with or without a special mouth- piece) and the bore widens gradually ending in a flare. Again, the body may be made of one piece, or of three or more sections attached telescopically.

Of the straight trumpets, the *tiruchinnam* is of special interest, for it draws our attention to a possible link between south India and Egypt. It is very much like the trumpets of ancient Egypt and Assyria. The instrument is really a pair of conical brass tubes of thin bore and of about 75 cm length. Both the



THUCHEN, bhutan and ladakh



NAGPHANI, gujrat

trumpets are held at the mouth and blown simultaneously. These typical ritual instruments have travelled to Java where, for instance, they are shown in the Chandi Jawi relief of thirteenth century. Other aerophones of this kind are the *ekkalam* (Tamil Nadu), *bhenr* (Oraon tribe of Bihar), *kahala* and *turahi* of the northern areas of India. The *ekkalam* is made of brass or copper, having four telescopic sections. The *bhenr* is a thin copper tube of a very narrow flue. Its length of nearly 105 cm makes wielding the instrument difficult. It is therefore, supported by a long bamboo pole held by the player. The *kahata* is also a metal trumpet, mentioned as early in the *Rayapaseneeya* as *kahali*. Similarly the *turahi*, another metallic trumpet (brass, copper, silver), is also an ancient instrument. It is surmised that the *tureeya* found in some *Jalakas* referred to not only the *turahi* but also to instrumental ensemble (*kutapa*). Kautilya's *Arthasastra* also has the word *toorya*, meaning both 'to play' and 'a variety of musical instruments'-presumably a trumpet. Straight *turahis* of different lengths and conicality can be seen right from Ajanta and Devalana twelfth century AD). A fine specimen of a long *kahala* is seen sculptured in the Sun temple at Konark (thirteenth century). Today the *turahi* or its variants *turi*, *bhongal* (Rajasthani, Gujarati), *tuttari* (Marathi) *tuttoori* (Kannada), *karna* (Rajasthan), *karnal* (Himachal), *karnat* (Gujarat). The word *karna* (or its equivalent) is again of significance, as it is a pointer to the *quarna*, the Sumerian trumpet. If for nothing else but only for its impressive length of nearly two metres, the *thunchen* is of interest, though smaller ones of 160 cm are also known. The *thunchen*, made of copper and silver is a ceremonial instrument of Ladakh, Bhutan, and Tibet, used by the Lamas; usually a pair of them is played. The length and weight of the instrument are so great that boy assistants-or a special wooden stand-are employed to support it at one end, while the Lama blows at the other.

A typical C-shaped instrument is the *kombu* or *kommu* found in the rural areas of south India and is commonly seen in marriages and ceremonial processions. The S-shaped lip reed instrument is also very widely spread throughout the land. There is no corner in India where this is not found. The trumpet is made of brass, copper or silver and the length ranges from about 15 cm and above. The names of course vary from region to region; *narsingha* (Himachal), *vansingha* (Madhya Pradesh); *tutari* (Maharashtra-derivable from *turahi*?), *konakombu* (Tamil), *bargu* (Rajasthan) and many others. Indeed, it is even often referred to as *seengh* or *kombu*, once again pointing to its origin from nominal horn.

We may also note a further variation in shape; a wholly snakelike (even including the open mouth and the split tongue) brass instrument; the *nagphani*. Its very name shows its construction: *nag-snake*, *phani-hood*. It is common in Gujarat and Rajasthan where it is used in folk music.

The conch (*shankh*) is an ancient instrument, though not always used for musical purposes. As instances of the former, its use as an announcer of the battle) is well known. With the greater use of wood and metal, the conch was replaced by horns and bugles.

CHAPTER 8

MECHANICAL REED FLUTES.

There are large and important groups of aerophones, which have special mechanisms, the reeds, for controlling the entry of air into the instruments. None the less, the pitch of the instrument itself is dependent on the air column in the tube or instrument, and not on the reed valves. It is for this reason that air here has been considered as the vibrator and not the exciter.

The reeds are of two general kinds: the beating and the free. In the former, a piece of wood, bamboo, cane or metal covers an aperture through which the wind flows, in such a manner that it (reed) strikes the edges of the hole. In other words the reed is larger than the orifice and closes it periodically. This is the case, the *pungi*, the *tarpo* and so on. In the *shehnai* and for instance, in the *nagasvaram* there are two reeds, with a small gap between them, beating against each other. On the other hand the free reed has almost the same dimensions of the air-hole and hence vibrates within the shallot, without touching the edges; this happens, for instance, in the harmonium.

(a) The best known instrument in this group is the *pungi*, the snake charmer pipe. While it is extremely common, it goes under different names: *pungi*, *been*, *tumbi*, *nagasar*, *sapurer bansi* are the words used in northern areas; *nagasvaram*, *mahuili*, *pungi* and *pambatti kuzhal* are the words in the southern parts of the country. *Nagasvaram* refers also to the double reed wind instrument, a counterpart of the *shehnai* and the European oboe. Whatever be the differences in name, the construction is generally the same throughout the country. It consists of a small calabash, which serves as an air reservoir and to which are attached reed or bamboo pipes. At the top there is one tube inserted into the gourd. This is a simple open flue into which the snake-charmer blows. The air collects in the bottle gourd and passes out through two pipes fixed at its lower end. Each of these has a single beating reed and gives out the sound; but one of them acts only as a drone and the melody is played on the other. In recent specimens one may come across a long metallic tube, besides the two bamboo ones. This also functions as a drone.

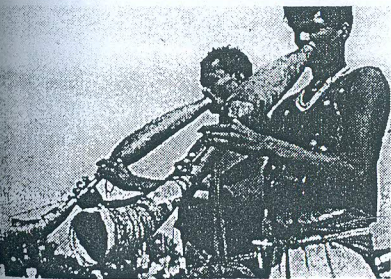
An instrument, which can be considered to be of the same family as, if not an improvement over, the *pungi* is the *tarpo* or *tarpu*, found in Gujarat and Maharashtra. Here, instead of a small gourd, a larger variety (*doodhia* bhopla-Marathi) is used as the air chamber.

The blowing is done in two ways: (a) from the end where the top of the gourd is cut out and blown into, (b) from the side, where a hole is made in the side of the air reservoir and blown into with a small tube often inserted in the aperture to act as a mouthpiece.

As in the *pungi* there are two single reed pipes having three to five holes inserted into the gourd at the lower end. Further the tubes have a common funnel of wound palmyra (tad) leaves, called *karna* in Marathi, which acts as a sound radiator. Incidentally, it may be suggested that the name of the



PUNGI, delhi



TARPO, gurat and maharashtra

instrument is itself derivable from *tad*, the leaves of which are used in making the funnel. There are two kinds of the *tarpo*: the medium size is known as *ghogha* (Marathi) and the larger one, sometimes of about two metres in length, as the *khomgada* (Marathi). In Gujarat, the smaller variety is often called the *Jobru*. While in Gujarat, it is found among the tribals of Balsar and Surat districts, in Maharastra, it is typical of the Vorli people. The months of *Bhadrapad* and *Asvin* (about september to October) when the rice is ready for reaping Vorli lads gather to dance to the accompaniment of the *tarpo* ensemble and competitions of *tarpo* playing are held.

Very much like the above ill construction is the *masak* of the North and the *tutti* or the *titti* of the south (*titti* in Telugu means a bag). This is the bagpipe of India. While in the *pungi* and the *tarpo*, the reservoir is of gourd in the, *masak* it is of leather. A small goat is slain and its full skin is used as the air bag. At one, end is a small Pipe into which the player puffs the air that passes out of two bamboo or cane tubes, each having a single beating reed. As with the *pungi*, one of the pipes is a melody pipe having about six holes, and the other is the drone.



NAGASVARAM south india

(b) In the single reed wind instruments one flap beats against an immovable part of the body of the tube, whereas in a double reed aerophone there are two reeds (made of palm, cane, reed and so on) called as *patti* (Hindi, Marathi), *aku* (Telugu), *seevali*. (Tamil), *peepi* (Kannada). The pair of reeds which acts as valves are fixed to a metal tube which is inserted into the funnel-shaped hollow body of the instrument. The length of the main pipe may be from about 25 cm, as in the *sundri* or the *naferi*, to nearly 90 cm, as in the *bari nagasvaram*, and there are usually seven playing holes. Besides these seven, four or five auxiliary ones may also be made, normally on the side opposite to the playing holes to adjust the pitch of the instrument. Closing one or more —of them with wax does this. As in the flute, these wind instruments do not hare keys for playing. Western aerophones of this class as well as the clarinet possess levered mechanisms that close or open the orifices. But such an arrangement is a handicap for Indian music where the fine distinctions of pitch (*shruti*) and graces (*gamaka*) are essential and only direct fingering can produce these *Aiukhapeena* (a *veena* played with the mouth- *mukha*) is mentioned by Somanatha of twelfth-thirteenth Century AD in his *Pandi-raaradhya Charitra* (Telugu) as also the Karnataka king Mummaadi Chikkabhoopala of the seventeenth century in *Abhinava Sangecia- sara*. It also occurs in some Telugu ballads attributed to a fourteenth century writer.

Naagasvara or *nagasara* is referred to in Sreenatha's *Kreeda- bhiramam* (Telugu, fourteenth century), Singiraja's, *Singiraja Puranam* (Kannada, fifteenth century). Of greater interest and significance is the *mohori* that is a tribal and folk oboe. It is also known as the *mori*. And here it is suggested that the word is related to *mahudi* and *magudi*, the snake charmer's single-reed pipe of south India and that the word has been Sanskrutized to *madhukari* and *madhukali*.

Mohori known in many areas, as a folk instrument, is somewhat similar to the *shehnai*. But the *mohori* found in Assam is very different. It is made of bamboo, in three sections which are detachable, the middle one having six holes. The Khasis of Assam have the *ka tangmuri*; the *muri* in this word is also significant.

Whether the instrument *shehnai* was imported into India from Central or West Asia is not certain; the word certainly was. Other instruments related to this one are the *sundri* and *naferi* which are small sized oboes. The former is found in Maharashtra and the latter in the Gangetic valley. Literary references to these occur in Hasan Nizami's *Taj-til-Masir* (twelfth-thirteenth century) and in the writings of Nizami Gaujavi of the twelfth century. Sreenatha, the Telugu poet (fourteenth century) in his *Palaati Yeeta Charitra* mentions *sannayi*; *naferi* finds a reference in the Telugu ballad, *Katama rajti katha* whose hero is dated AD 1170 though the written text of the ballad is of the seventeenth century. It is thus possible that the *shehnai* and *naferi* reached south India by some time before the twelfth century. The *shehnai* was known at the time of the Hindi poet, Krishnanand Dasa (sixteenth century) and Abobala in his *Sangeetaparijata* gives *sunadi* that may be the same as the *sundri*. *Shahnai*, may, perhaps, be the older name and the instrument itself is used in Central Asia and in the Slavic countries where it goes under the name *zurna*. Hasan Nizami and Nizami Ganjavi do give *naferi* and *zurna* (*surana*). *Shahnai*, *zurna*, *sundri*, *sunadi* and *shehnai* are closely similar not only in structure, but the linguistic relations are also evident. *Nai* means a tube and it has been suggested that *theyhellnai* is a compound of *shahnai*; this would mean that it is an instrument for the kings (compare *olaga*) or the 'king of instruments'. It is worth examining whether a derivation such as *sur+nai* is possible.

Notwithstanding so much textual evidence, a historically parallel evidence in sculpture and painting does not occur. There is a stray relief of the Gandbaran period (third century AD). The Veerabhadra temple in Asandi, Karnataka (early thirteenth century) and a temple car in south India (eighteenth century) show specimens of *nagasvaram*.

All the instruments of this family have the same basic structure and technique of playing. Their differences lie mainly in their sizes, and certain minor details. The basically functional parts are two:

3 **The reeds.** These are two small reeds held together, leaving a small gap between them. The reeds are fixed to the tube of the instrument, either directly or by means of a metallic staple.

2. **The tube:** This is the main body of the instrument and is the resonator. It is conical in shape, narrow near the blowing end and opening out gradually. Usually, there is metallic 'bell' at the farther end. The tube is usually of wood, but may be of metal also. *Nagasvarams* of silver, gold and even soap-stone are known.

There are seven holes along the tube. They are used for playing, closing or opening them by fingers. In the *nagasvaram*, there are five holes along the bottom. These are not used for playing, but for

adjusting the basic pitch of the instrument: one or more of these can be plugged with wax and thus raising or lowering the fundamental pitch of the instrument.

Like the flute, the *mukhaveena* species is found from the tribal to the sophisticated concert music. Essentially these are outdoor instruments of religious and secular ceremonies, and are also considered auspicious, particularly in south India where temples honour and maintain *nagasvaram* artistes. The *shehnai*, similarly, is employed by royal houses in upper India to announce and welcome the dawn and the dusk. Within the last two decades, however, these instruments have been brought to the concert platform and enjoy a high status.

CHAPTER 9

HOW TO MAKE A SIMPLE FLUTE.

There are a few important physical quantities one needs to keep in mind. First, let's define some measurements:

2a = bore diameter in the vicinity of the hole

2b = hole diameter

2s = hole spacing (e.g. from this hole to the next open hole)

t = physical length of hole, e.g. thickness of wood

te = effective acoustical length of open hole, approx. $te = t + 1.5b$

x1 = distance, in a conical bore, from the hole to the hypothetical apex of the cone.

These length corrections describe flattening effects which must be subtracted from each hole's idealized position (measuring from the mouthpiece end).

First, if only one hole is open, then define D as the distance from the center of this hole to the open end of the bore. The effective bore is not perfectly open at the hole, but appears to extend beyond the hole by a distance Cs ("s" for single hole)

$$Cs = \frac{te}{(2b/2a)^2 + te*(1/D + 1/x1)}$$

If the topmost open hole is followed by at least one more open hole, then the bore from the open hole downward can be usefully represented as a semi-infinite lattice constructed of similar holes and bore. The open-hole lattice correction, Co, is

$$Co = 2s * (0.5) * [(1 + 4(te/2s)(2a/2b)^2)^{0.5} - 1]$$

But, if there are any closed holes _north_ of the first open hole (i.e. in the main bore before the first open hole), they also provide a flattening effect. Each closed hole adds the correction Cc

$$Cc = (0.25) t (2b/2a)^2$$

Another very important physical quantity is the "cutoff frequency" fc. This marks the boundary between low frequencies, which are reflected by the tone holes back into the instrument to form strong resonances,

and high frequencies which leak freely out through the tone hole row. The cutoff frequency also marks the division between the low-frequency isotropic radiation pattern (energy radiates in all directions equally) and the high frequency directional radiation patterns.

Anyway, f_c can be estimated by

$$f_c = \frac{c}{2\pi a} \cdot \frac{2b}{2a} \cdot \frac{1}{(t_e \cdot 2s)^{0.5}}$$

If this expression is evaluated for all the tone holes and the numbers are consistent across the instrument, then this is a useful approximation. Virtually all reasonable musical instruments with tone holes share this feature.

So, if for example one were going to design an instrument from scratch, here's a sketch of the process:

1. Calculate the ideal lengths of the bore for each note, assuming no holes and the bore were going to be cut off clean (and no end effects)
2. Choose a cutoff frequency ($f_c=1500$ Hz is a good start for treble instruments; it scales pretty well with the base pitch of the instrument).
3. Choose tone hole sizes ($2b$) and spacings ($2s$) which are manageable by the hands of the player, consistent with f_c .
4. From the bottom of the instrument, working up, apply the corrections for each hole relative to the ideal lengths, starting with C_s for the first hole and then C_o after that.
5. Now you pretty much know the rough layout, so now calculate the closed hole corrections, adding up the effects for all the closed holes for each fingering.
6. Now repeat steps 4 and 5 until you don't get much change from one iteration to the next.

The frequencies produced by a flute depend (inversely) upon the physical dimensions of the instrument, particularly its length and the diameters of the bore and of the tone holes. The depth of the tone holes (the thickness of the body) also has noticeable effect, but not so much. Knowing this, and knowing the proportional relationships of the notes, one can apply the simple scaling factor to all of the flute's dimensions to affect a change in its overall key.

Since the interval of an octave is a doubling in frequency, then theoretically the dimensions of a flute would be halved to produce a flute in a key one octave higher. Expanding upon that with the knowledge that in an evenly tempered scale every half-step bears the same proportional relationship

to its neighbors as every other. Thus, if one would multiply the dimensions of a flute by some factor to get a flute in a key one half-step higher, it would repeat this multiplication twelve times to accomplish an entire octave. The factor for one half-step is then 0.943874, the twelfth root of one half.

Multiply [or divide] all length dimensions by this factor repeatedly for the number of half-steps up [or down] you wish to transpose. Thus you would first make a flute out of whatever tubing or pipe you have in mind, find out what key it turns out to be in, then scale the lengths and make another flute in the key you desire. There will almost certainly be some trial and error here but if you're not shifting too far you can compensate by adjusting the tone hole diameters.

MATERIALS

Every practical material, including silver, gold, platinum, wood, and even glass, has its proponents. Some say that material makes little or no contribution to the sound of a flute, since it is the vibrating air column in the flute that creates the sound. Others are sure that material does play an important part. Contributing to the disagreement is the difficulty of comparing instruments. Even two flutes of the same model can sound and "feel" different, so one can not be sure how much material affects the equation. At the border between objective and subjective tests, scientific measurements are not conclusive.

It is safe to say that workmanship is a critical factor in the quality of a flute. The cheaper flutes usually contain less silver (or none) and the workmanship is less. Solid silver flutes generally benefit from more careful manufacture. At the highest levels of craftsmanship, silver, gold, and platinum flutes all have their partisans

To the inexperienced a bamboo flute may not seem like much. Most of the flutes one sees around for sale in typical shops and markets etc. are just that and not much. They are mass produced items usually made from poor quality bamboo. The result is not really what one would call an instrument. More like a cheap toy. Play with it for a few days and then throw it away. Or if one actually keep them then the bamboo will probably split in a short time.

So from the outset when we talk about a bamboo flute we refer to a quality instrument, musically tuned that will last a very long time. Now anybody can cut a piece of bamboo somewhere, put a few holes in it, blow across the end and get some sounds. Not much talent is needed for that. But to make the type of quality flute we actually have an incredible science and art that has taken years to perfect.

Of those many years of flute making, it has been found that to be a good flute maker one needs to have three very important qualities:

1 Expert with Tools: This is the fundamental skill one must have. And to achieve the precision needed to make a good flute one really needs to be an expert in using tools. And use a combination of hand and power tools.

2 Musician: One also has to be a musician to make a flute. This is because one needs to be able to tune the flute so that it is in key and plays an actual musical scale. One should be able to hear when the flute is out of tune and then with the tools correct it so that it is in tune. With the best tool skills around but if a person is tone deaf he won't go very far with flute making.

3 Intuition: And thirdly one needs to have lots of intuition to make a bamboo flute. Bamboo is a natural material and does not happen to come in standard sizes such as a metal tube that we buy in hardware shop. Every single piece is different in size, shape and density. Therefore every piece will have different musical properties. Intuition plays a very big part in making a bamboo flute. One needs to be able to "feel" the bamboo to know how it is likely to behave. This intuition usually only comes with lots of experience. Lots of practice making many flutes. Lots of flutes in the rubbish bin.

CHAPTER 10 CONCLUSION....

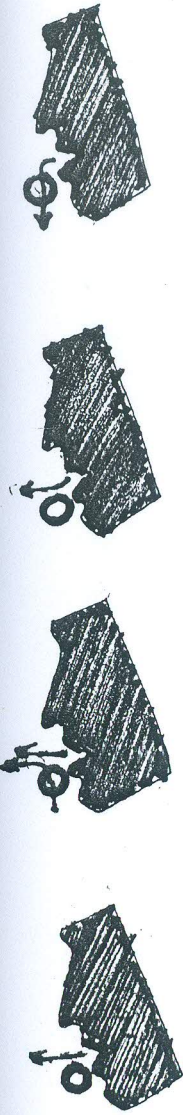
Flute is closely connected with mythology, taboos of people and much can be learnt from their history. The flute occupies a dignified place in Indian music. The potentiality of the instrument is the close link of music and the way people go about their activities everyday. Flute fits well into the music for any occasion with its capability of producing versatile sounds. The scales of the flute vary from the origin and usage. It is a fully portable instrument.

The ambience of flute is distinctively created a place in folk and classical flute. The folk category has exploited the flute more by creating music for many occasions. There is music for every occasion. Indian music is founded on emotions and moods. The lyrics of a compositions are based on a theme purposefully composed. The common feature throughout the country, as far as music is concerned, is that it is made for the responsive community. The songs made are blended with the history and culture of the locality. For example, the songs composed for a bride leaving her maternal home is mournful and the tune is derived for that. E.g., *kaheko byahe bides*. This is achieved through the lyrics and the composition is tuned for the 'mood of separation'. These tunes are enriched in a musical sense by the use of distinctive musical instruments. And the flute has its own charm and sweetness which make it wholly appropriate in Indian folk music.

The style of playing is specialized with respect to the cultural developments. For instance, the music for weddings is typical for the locality and the rendition of flute is cultured for that aspect. The physical development has been directly related to the aspiration of the people. The tunes for the hills from the *pipa* and the harvest tunes from the *tarpa* have their soothing musical effect. Film music has enriched its tunes with flute as an accompaniment instrument.

The other end of the potential flute is the classical side. The concert and solo compositions have found a dignified place in the musical scenario. The flutes for classical music has more refined format with 6 to 8 finger-holes that produce the essential ragas. The ragas from the flute are melodious and enchanting due to the capability of producing flowing continuous tones. The ability of flute to create modulations just as from the vocal system is the key to musical enrichment. The subtleties and variations of rendering notes with its sweetness of sound makes the simple flute a versatile source in classical music. The main characteristics that made flute take a strong stand in the classical music are:

1. melodic/ soothing sound.
2. continuity from note to note.

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3. Tone modulations.
 4. Blowing effects.
 5. Volume effects.
 6. Scale coverage: 2 ½ octaves.
 7. Smooth jump on notes.

These aspects of the flute are all associated to create music that forms an integral part of the artistic potential of the ever-lasting tradition. To conclude, the flute is the simplest and the most versatile of all instruments. And the music from it can easily put into words but almost impossible to understand and feel.

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