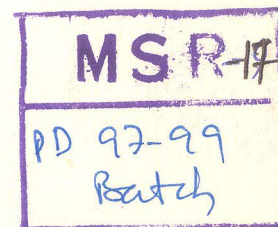


# Whistles in terracotta



By  
**Anand P. Rajhans.**

Guide  
**Prof. Vanmala Jain**

## Approval sheet

Special project entitled **Whistles in Terracotta** by **Anand P. Rajhans** is approved in partial fulfillment for Master's Degree in Industrial Design.

**GUIDE:** *Vannala Jain*

**CHAIRMAN:**

**INTERNAL EXAMINER:**

**EXTERNAL EXAMINER:**

## **Acknowledgement**

Constant encouragement of my guide **Prof. Vanmala Jain** could keep my interest up to completion of this project.

**I am very much thankful to her.**

Secondly it is worth mentioning one more name **Prof. Jyotsna Bhat**- head of pottery department, M. S. University, Baroda also took interest in my project and helped me by all means.

**I am also grateful to her.**

Last but not least **Mr. Patil** from ceramic studio helped me from time to time. I give **my special thanks to him also.**

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## **Aim of project**

This project mainly focuses on how to make whistles by terracotta method. Some **objectives** were before me to perceive this as a special project. They were\_

1. **Documentation** of terracotta whistles,
2. Why and **how whistles make sound**,
3. **Finding the methods** by which terracotta whistles are made,
4. Suggest **suitable method** for potters to make these on a large scale,
5. Make a **manual** explaining the suggested method so that anybody can make whistle by this method.

I have tried my best to achieve these.

Rest of the report explains the way how I went about whistle making.

## Introduction

### Why terracotta whistles?

Whistle making in terracotta is a dying art. Only **few potters from Patan** are making these whistles for selling. To make whistle in terracotta is a **difficult thing**, from potter's point of view. Potters do not have a particular method to make them. Many people do it by experience and skill.

Recently there was an article published in a Russian book ("Russian folk style figuring" by Genndi Blinov). That article threw light on the present situation of potters in Russia.

It says\_

### Will Folk Craft Survive?

"This is a question that arises quite often. Comparing the old Filimonovo, Kargopol or Dymkovo toys with the modern counterparts one can buy in craft stores, one cannot but notice that the new toys are usually at quite a disadvantage. Not so long ago, craftsmen managed to create a brilliant effect using just two or three colours. The simple designs on Vyatka toys, derived from the clothing of the period or ancient pagan symbols, were eminently suitable for clay. They were executed with light mastery and always

bore the individual mark of their creator. Recently made folk toys are often painted garishly in colours that fail to combine harmoniously. This does not mean, of course, that the young artists have produced nothing valuable, but as a rule, modern ware from Vyatka, Kargopol or Filimonovo is inferior to its predecessors. One is compelled to conclude that the craft is declining. Art critic Vladimir Stasov expressed similar fears nearly a century ago. He wrote sadly that the objects made by folk craftsmen for everyday use were rapidly disappearing to make way for new wares, which, although more serviceable and convenient, had inherited none of the originality and loneliness of their older counterparts. Stasov pointed out that it was time to start collecting, describing and reproducing those objects, for in his opinion it was a matter of decades or even years before they would disappear without a trace. The time of folk craftsmen is indeed passing. Young people do not show much interest in crafts. They prefer to become drivers, doctors, airline hostesses, Psychologists, or actors. But even if a young person takes up a craft and proves talented, he or she is still our contemporary, with a modern mentality

and perception of the world. He or she may master specific techniques and, at best, grasp the mood of the old craftsman embodied in his work. But that is all. Under modern conditions the imagery typical of folklore, that kernel of genuine folk art is bound to be lost. The Soviet State does a great deal to preserve the folk crafts and give a new impetus to the development of old art centers. Nearly 200 crafts have already been revived, such as toy making in Kargopol, Dymkovo, Filimonovo, Bogorod Skoye, Semyonov, and Abashevo. In the villages of Polkhovsky Maidan and Krutets, toy making began to develop very recently, a fact that obliges one to be cautious when making prognostications concerning the destiny of folk art. The old crafts may also assume new significance if they manage to transcend the production of souvenirs. Art critics note that even now, objects made by folk artists, like potter, baskets and lace, can find a use in everyday life. Folk art as a reflection of a certain perception of the world may be coming to an end, but some of its branches continue to exist and will most probably exist as long as poetic perception itself, which drafts on the life-style in the countryside, agricultural

labour, old traditions and proximity to nature, all of which is still a part of rural life. There is no reason to suppose that this will suddenly cease to be reflected in objets d'art. A heartening sign is a revival of interest in folk crafts not only in, town but among country people, who until recently tended to attach importance to urban culture only, treating the work of their fellow-villagers with ironic neglect. This welcome change has been brought about by the higher cultural level of the rural population, the efforts to popularize folk art by arranging exhibitions on all levels, and by the encouragement of folk artists, many of who have even been awarded State Prizes. The revival of interest in traditional folk-art, especially in the place of its origin, and appreciation of its value are certain to bear fruit. One should like to believe that the folk crafts will not confine themselves to the production of souvenirs, that it will develop, even if in non-traditional forms, and that the work of folk artists will become part of our daily life, testifying to the developed aesthetic taste of the people. We hope that the objects shown at international exhibitions and reproduced in part on the illustrations to this book will

promote understanding among nations. The language of art needs no interpreter. For a student of the history of a nation, nothing can be as revealing as folk art. And better knowledge of each other is that we all need in an epoch which has made it imperative that relations between the peoples of the earth be based on mutual trust and respect."

The situation of folk craft in India is similar. New generation of potters is not interested in playing with clay as their means of livelihood.

In order to **revive this dying art** of whistle making it is an amble attempt towards it.

## Chapter one

### CLAY

Potters know how to prepare the clay, how to 'form' it. They make many things in clay like pots, toys, matakas, etc. Then they bake them. Thus the basic information of baking they have by experience. But it is good to know about clay. i.e. about its formation\_

#### How clay was formed

Basically all clays are decomposed rock. The rock concerned is called feldspar. These rocks were formed and decomposition began millions of years ago at a time when the climate and physical forces at work were very different from those, which exist today. Hot gases and steam belched from the earth and frequent volcanic activity threw up molten masses, which cooled slowly and were often subjected to extreme variations in pressure and temperature. The decomposed feldspathic rock which remains where it was formed is very pure but rather large particled clay known as primary clay (such as the white-firing china clays of the West Country). However, most clays, over a long period of time, have been weathered by wind, rain, frost and sun and then

carried away by small streams into rivers, lakes, estuaries and oceans. This action performed a sorting and grading process. The larger and heavier clay particles were deposited on the stream and river beds; only the very smallest particles were carried on to the lakes and oceans where the water current slackened and the clay particles eventually settled into beds of fine secondary clays. These clays will have lost much of their soluble ingredients to the water by which they were transported but can be expected to have gained all manner of other impurities during their journey. Iron is a very common impurity and can be identified by the yellow, orange and red hues which it gives the clay. Sometimes the iron colouration may be disguised by decayed plants and other organic matter in the clay which will often cause it to turn to shades of grey, blue and black. Since the face of the earth has been frequently resculptured, the clays on today's hilltops may well have been raised from the lakebeds of a million years ago as the earth's crust folded and buckled in times past. Also, the world's first and most powerful bulldozers, the ice caps, did some mighty earth moving during the ice ages. Thus it is apparent that

although all clays have a common origin they can be expected to vary considerably. There will be differences of colour which can be seen and differences of texture which we can feel, but there are other differences which will only become evident when the clay is fired. These variations are due to the loss of clay solubles during weathering and to the impurities which are deposited with the secondary clays. They affect the meltability (fusibility) of clay when it is heated. All clays will eventually melt to a glassy state if they are heated to sufficiently high temperatures; the hardening and vitrifying of fired clays are the first signs of melting and are in some measure essential to the fired strength of clay. Suppliers of clay for pottery select and blend their clays so that they will have the desired characteristics. For low-temperature firing you will need an earthenware clay which will develop sufficient fired strength, but you will have to pay for the cost of clay preparation and transport too. Small quantities of clay may be sufficiently expensive to day to provide a strong incentive for you to gather your own. In anycase, I think this is very much part of the fun and good earthenware clays

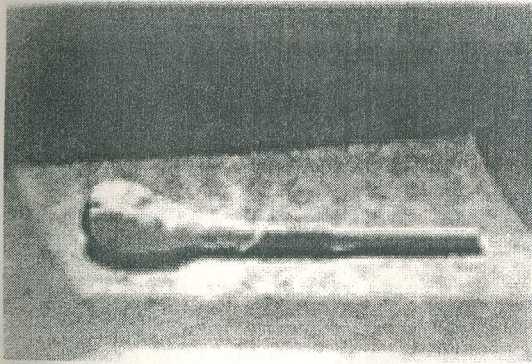
are very readily available. It is much less likely that you will find very refractory(not very meltable) clays. If your pots are still very soft after firing and have no ring to them you may assume either that they have not been fired to a high enough temperature or that the clay you are using is a refractory clay. If you have the facilities for making a good bonfire then you can recapture experiences of prehistoric potters.

(This is the article from the book Imaginative pottery by David Harvey.)

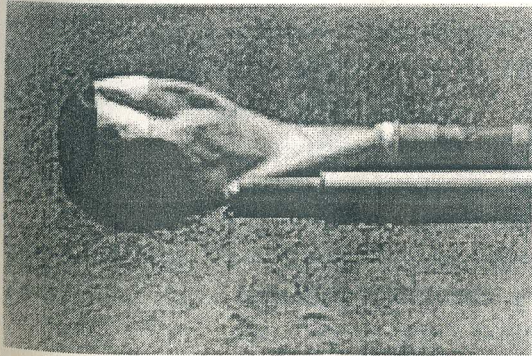
## Chapter two WHISTLE

After a long introduction now the actual project starts from here.

We all have played plenty of whistles in our childhood. Here some of the whistles are explained.



*Balloon whistle.*

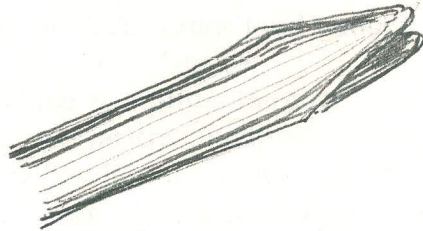


*From inside.*

**Balloon whistle-** In local fairs we get a typical whistle with **balloon attached to one of its ends**. The balloon gets filled with air when we blow air in the whistle. While filling it does not make sound. But when it is taken out of mouth loud sound is generated. This happens because **the air escaping from the balloon vibrates the flexible leaf inside the sound chamber**. The picture shown here describes how this whistle is.

**Straw whistle.**

This is again a simple type of whistle which children make.

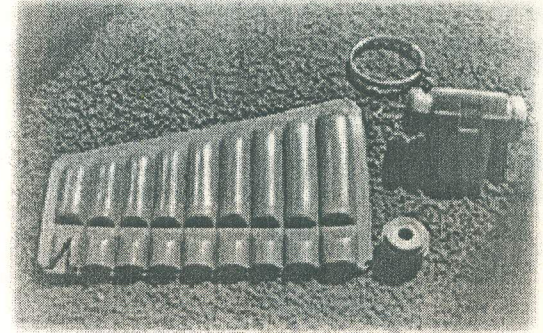


*Straw whistle.*

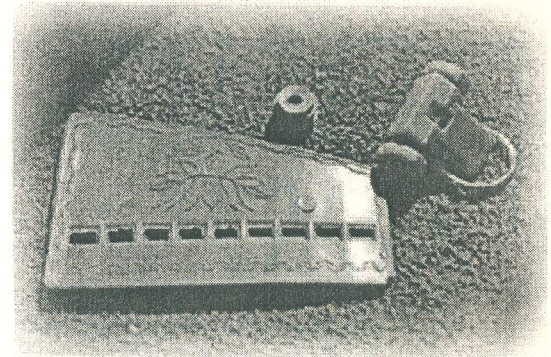
The diagram will clarify how is that. In this case when the air is blown **the two flexible leaves vibrate and make sound**. One important fact is that **-the shorter the straw in length, higher is the pitch of sound it makes**.

There are some other whistles also-

There are three whistles shown in the picture.



*Three plastic whistles.*



**Blue whistle(whistle strip)-** It is a stack of whistles. In this case the dimensions of wind pipe and sound hole are equal but the **length of vibrating column is different**

for each of these. It results into the production of **sound notes of different frequency**.

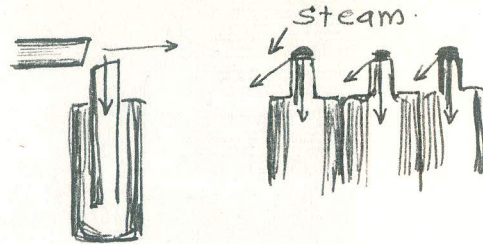
**Yellow whistle-** The yellow one has a fan inside. When it is blown fan rotates cuts the air stream passing and generates the sound. Beauty of this whistle is that as the air velocity in the chamber increases pitch also increases. In this way **sweep controlling the airflow can create frequency or siren effect**. One more thing about this whistle is it is **bi-directional** whistle.

**Orange and green whistle (keychain whistle)-** It is a modified kind of a police whistle. It has a windpipe, sound hole, a leaf and vibrating chamber with two holes. By **closing and opening these holes three different sound notes** and their combinations.

One must not forget two more industrially important whistles. Those are **Galton whistle** and **Steam engine whistle**.

**"Putting pen cap perpendicular to the air flow from mouth generates a shrill sound"**, this is the working principle of Galton whistle and Steam Engine whistle. In case of Galton adjusting the vibrating air column can also generate whistle

frequencies in the range of **ultrasonic sound spectrum**. In case of steam whistle



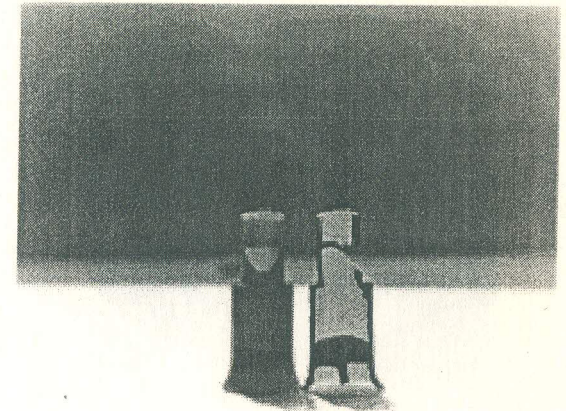
#### *Galton and steam whistles*

normally the frequency is fixed and pressurized steam is used in stead of airflow. One more notable point in this case is that **multiple whistles** are stacked to produce **sound loud enough** to hear it from a long distance.

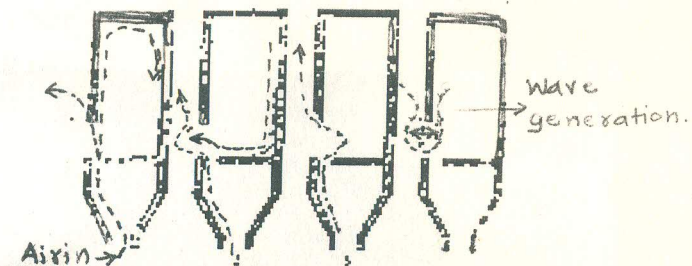
**Which technique-**Because of **constraints of terracotta medium** rotating fan or flexible leaves or any kind of movable parts cannot be made. Hence **passive type of mechanism** for sound producing has to be used. It is to be adopted for terracotta medium. The typical cheap whistle available in the local market is shown in picture alongwith its cross-section.

Again the question rises- how to produce the sound out of the whistle?

The principle is explained as follows-



*Cross-section of whistle.*



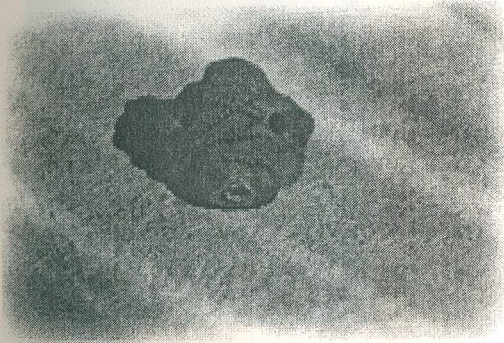
#### *Working principle of whistle*

The air stream passing gets deflected by striking the leaf. Within the enclosed volume compression and hence crest is produced. The reflected compression pushes out the air stream, creating a rarefaction which travels the same path. This process gets repeated.

## Chapter three

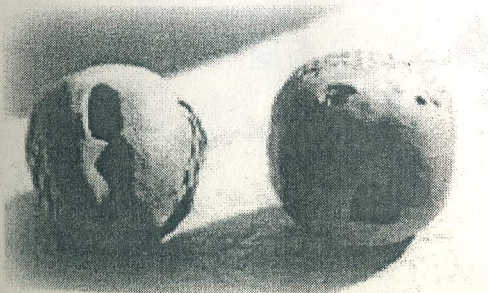
# WHISTLES IN CLAY

It is already mentioned that potters do not normally make the clay whistles. Only a small group of potters in Patan is making terracotta whistles.



Potter's whistle.

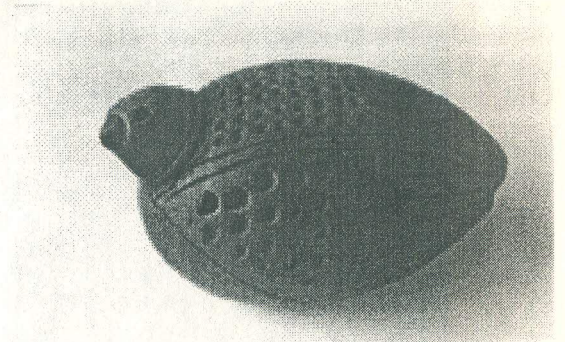
But abroad many people make those and one can see wide variety of whistles made there.(ref : Russian folk style figuring by Gennadi Blinov). Here is the documentation of work of Indian potters as well as some foreign potters.



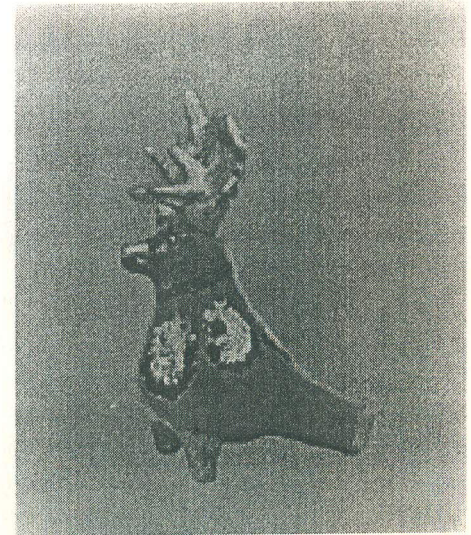
A parrot.



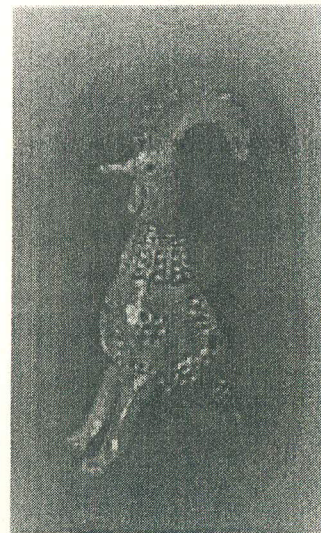
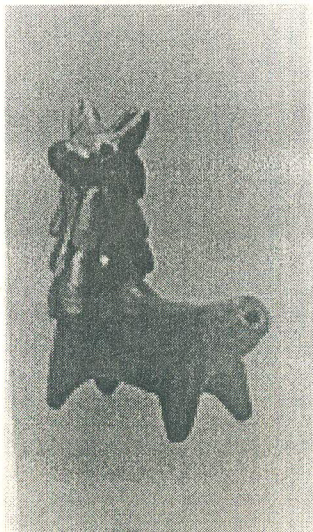
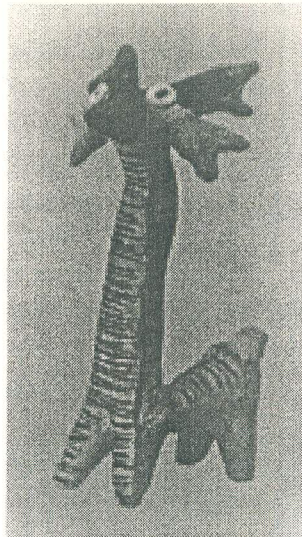
A sparrow.



A bird



A doll



These whistles are beautiful toys made for children. To make these understanding the theory behind these functional products is essential as sound adds point of interest in the toy.

TERRACOTT

Clay is and until the first... is known, it is... making whistles. This... may produce one whistle...

Material and Dimensions

Material- Clay is the... make the whistle. Before... clay must be kneaded... dries and cracks... drying. Knowledge... characteristics is given...

Dimensions-

whistle is a vital part... dimensions of... produce... vibrating volume... produce any sound... aspects of whistle... forthcoming chapters.

## Chapter four

# DIFFICULTIES IN WHISTLE MAKING IN TERRACOTTA

Unless and until the Physics behind whistle is known , it is very hard to go about making whistles. Trial and error method may produce one whistle per day's work.

Two mentionable points in this context are, **Material and Dimensions.**

**Material-** Clay is the basic material to make the whistle. Hence the **properties of clay** must be known. It **shrinks** when it dries and **cracks** get developed upon fast drying. Knowledge of these two characteristics is good enough to start.

**Dimensions-** Overall dimensions of whistle is a vital part. Selecting arbit dimensions of vibrating volume may produce unsatisfactory results. If the **vibrating volume is too large** it won't produce any sound at all. The dimensional aspects of whistle are discussed in detail in forthcoming chapters.

### Ways of making whistles in clay

There is a **hollow vibrating chamber** and a **sound producing mechanism**. These two important parts of any whistle. The sound producing mechanism has to be created manually. But the hollow chamber can be made by two ways. One is **handworking** and the another one is **wheelworking**.

**Handworking-** A slab of clay is prepared normally by rolling pin. Then a rectangular piece out of it is cut.



*Handworking*

A cylindrical shape is then created. This cylinder is then cut to desired length. Both ends of this cylinder is then closed by lump of clay. After that the sound producing mechanism is made manually at one of the ends. Then some small holes at appropriate places are made to take out different notes. This method is illustrated in the picture shown.

**Wheelworking-** A cylinder of desired diameter is made by rotation then small pieces of desired length are cut.



*Wheelworking.*

Then the openings of this are closed by clay. After this sound producing mechanism is made at one of the ends. These are couple of ways by which terracotta whistles are made.

### Methods of making sound producing mechanisms

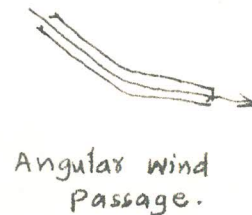
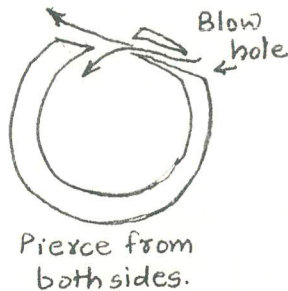
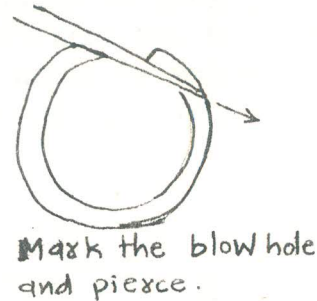
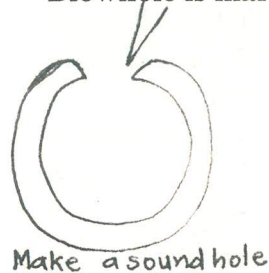
The hollow volume i.e. either a cylindrical or spherical shape is created. After this sound producing mechanism is to be made. One has to be precise in this stage. Five different methods of making sound producing mechanism are documented here including the new proposed method.

1. **Trial and error method-** All beginners start with this method as they do not have an idea how to go about whistle making. It tells- take a hollow volume. Cut a sound hole. Then pierce a straw or small strip to create a windpipe which opens in the sound hole. The clay is soft enough to be formed so by varying the position of windpipe try to take out the sound by blowing the whistle.

**Remarks :** the success rate is low. Whistle making started by this way and

after eight hours of struggling only two or three **feeble sounding whistles** could come out out of many unsuccessful attempt.

2. **Second method-** This method is used by professor Jyotsna Bhat. In this method a raw form is made first. **Blowhole** is marked on the other side.

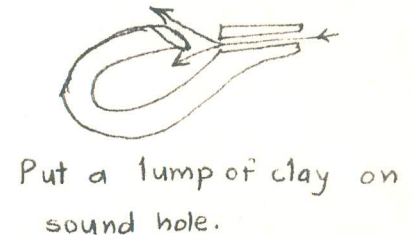
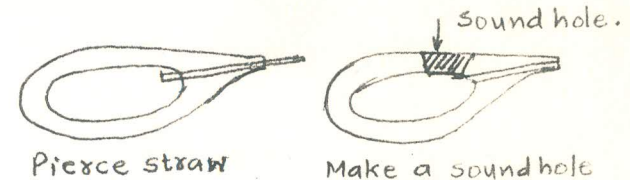


Straw is pierced from the sound hole and also from blowhole. By digging from both ends sound pipe is made. There is a reason why this method is used. Many times that blowhole opening has **aesthetic meaning**.

That means it can be a mouth or a tail of a particular animal form in which the maker is interested.

**Remark :** The **windpipe** made by this method is **angular**. This lessens the sound output.

3. **Potter's method-** This method is generally used by potters in Patan. The raw hollow forms are made first.



Then wind piercing the wooden stick in it makes pipe then at the end of windpipe sound hole is made. After this a small lump

of clay is put on the sound hole in order to make a leaf.

**Remark :** To make whistles by this method requires **experience and skill**. Even if the potter is skilled good amount of **rejection is there**.

4. **Water filled whistle-** Make two halves of clay. Join them. Make a clay section for blowing. Pierce it and make a wind pipe. 'form' the whistle.



Two halves and sound pipe.



Make air Passage.



Open it up.

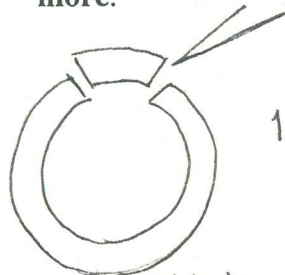


Create form.

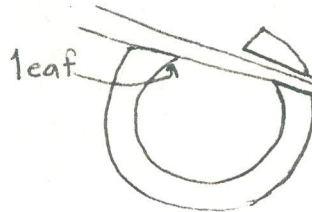
In figure a bird is made out of the remaining clay. Fill water in the whistle and blow it.

**Remark :** This is a **complicated** method. It **consumes lot of time** and hence unsuitable for potters.

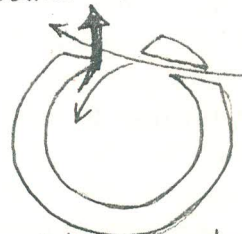
5. **Proposed method- or scientific method-** A hollow volume i.e. either spherical or cylindrical is **made first**. In case of **spherical shapes** the **wall thickness** should be comparatively **more**.



cut sound hole



Make a windpipe



Adjust the leaf.

The **sound hole** is made into that volume. Then a **stick** is **pierced** from one end of

that hole in the wall of that whistle without bothering from where it will come out. In this way **sound pipe** is made. Air is blown into it. Low amplitude **sound results**. After this the **leaf is pushed slightly upwards** to tune the whistle.

**Remark :** Anybody can make **clay whistle quickly** by this method. In this case **rejection is almost zero**. It has an advantage of **saving man-hours**.

## Chapter five

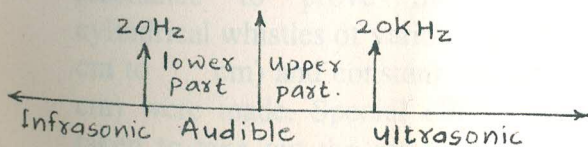
# THE SCIENTIFIC EXPLORATIONS

Taking out sound from lump of clay was a difficult task. To find out which are the **parameters that govern the sound production and qualities** of sound some experiments were done.

The working principle of whistle is already described, the question was **'how to make it working in clay?'** Before find out answer to this question **to know basics** of sound is important.

Sound is in form of **pressure waves**. They are generated by **pressure differences**. Sound can be defined by certain parameters. They are as follows-

- **Frequency or pitch-** figure shows the sound frequency spectrum. Human beings can hear sound between **20Hz and 20kHz** only.



Frequencies **less than 20Hz** are called **infrasonic** waves. Frequencies **more than**

**20kHz** are called **ultrasonic** waves. In short the **whistle** being made **should generate sound in the audible frequency range**. Musical instruments and their sounds are well known to us. **Hindustani tabla, drums, base guitar, double bass** resides in the **lower part of audible sound**. While **violin cellos, clarinet, flute and whistles** reside in the **upper side of audio spectrum**.

- **Loudness or amplitude-** This is second important parameter of sound. Our ears can easily feel this loudness. It is measured in decibels. When resonance takes place the amplitude suddenly rises to a very high value.
- **Harmonics-** It deals with **richness of sound**. Because of harmonic contents we can differentiate between the sounds made by two different sources like two different musical instruments. Sound note generated is always along with the frequencies which are **multiples of natural frequencies**. As the amplitude of these frequencies increases the sound note becomes **richer in harmonics**.

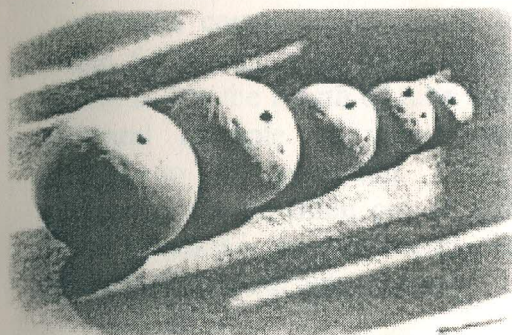
The above description about sound explains the basics required for this task.

Keeping these things in mind relevant experiments were made. Much of the time went in exploring **how to take out the sound from a hollow clay form**. After doing many experiments the technique of producing sound was discovered and then **thought was given to the manufacturing process**, keeping a village potter in mind.

## Chapter six

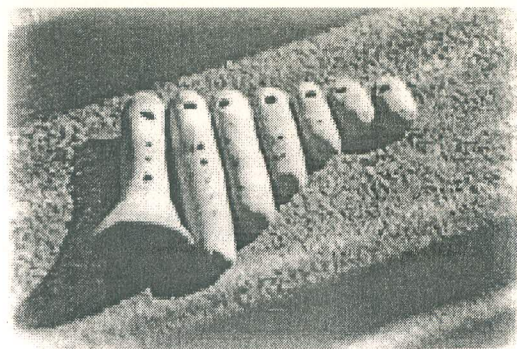
### THE EXPERIMENTS

1. To prove the fact that the frequency varies inversely with volume. Several spherical whistles of varying volume were made. The biggest whistle has a volume of      cubic cm and the smallest one has a volume of      cubic cm.



*Several spherical whistles*

2. Second important principle was resonance to prove this several cylindrical whistles of various lengths (cm to      cm) and constant diameter (cm) were made. Special efforts were taken to take out the same soundnote out of each one.



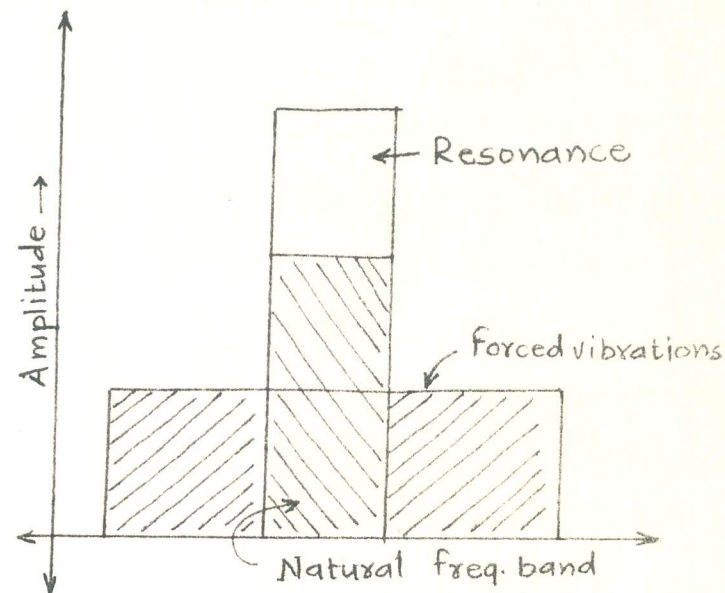
*Cylindrical whistles*

3. Keeping the volume constant wall thickness was varied.
4. Open-ended volumes like flute were experimented with. Long cylindrical tube and cone shapes were also tried.

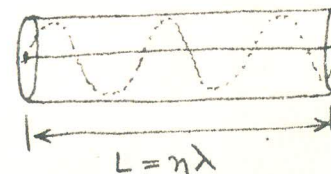
#### Observations

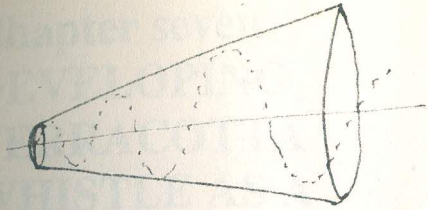
1. Frequency output varies inversely with the volume. The biggest spherical whistle was feeble sounding near 100Hz. The smallest whistle was vibrating near 1kHz. As frequency decreases the airflow to create a sound also reduces. As a result of this the amplitude of resulting sound decreases.
2. The lengths of whistles were different but the same frequency output tried from all. The smallest one of      cm

3. length produced loudmost sound as the natural frequency and forced vibrations were equal. Thus because of resonance the sound output got doubled.



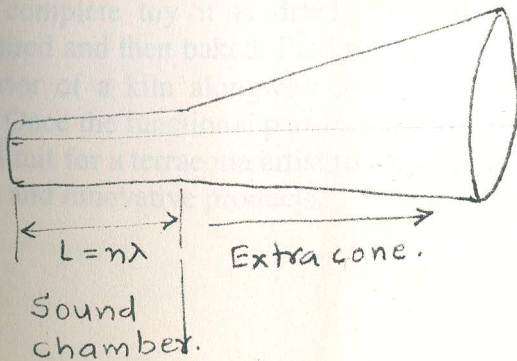
4. Wall thickness does not affect the frequency output but walls which are unnecessary thick consume material and extra efforts.





No sound can be generated from conical form.

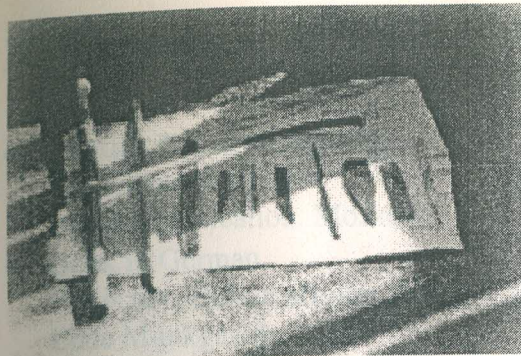
5. The position of leaf or tuning the open-ended flute is very critical and consumes comparatively much larger time for tuning. One more important point is that the length of tube must be integral multiple of wavelength of sound to be generated. Otherwise sound cannot be taken out of whistle. That means it is not possible to create a whistle from cone type of shape.



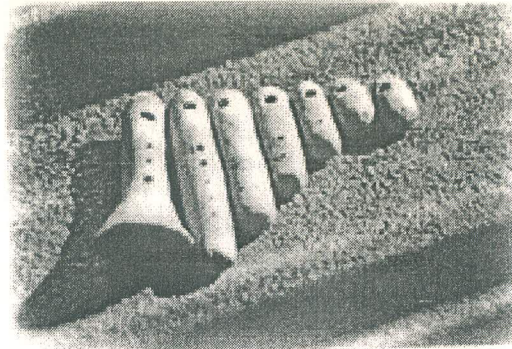
## Chapter seven DEVELOPING TERRACOTTA WHISTLE AS A PRODUCT

Terracotta whistle is a functional product. Unless and until that lump of clay is making sound it cannot be called a whistle. Thus as explained before one should always make a volume ( cylindrical, spherical or any closed shape ) which can make sound. Over this volume one can add material to make the desired form.

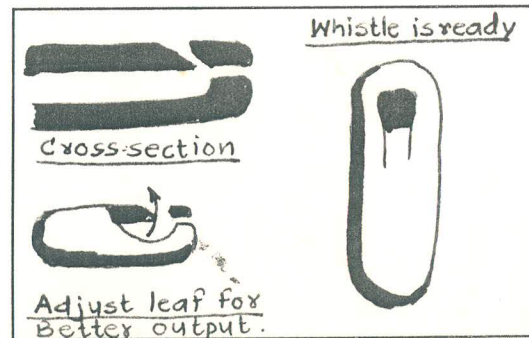
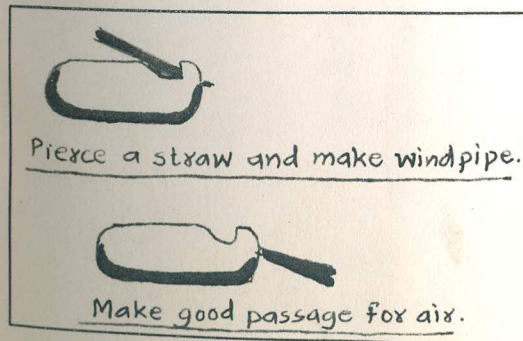
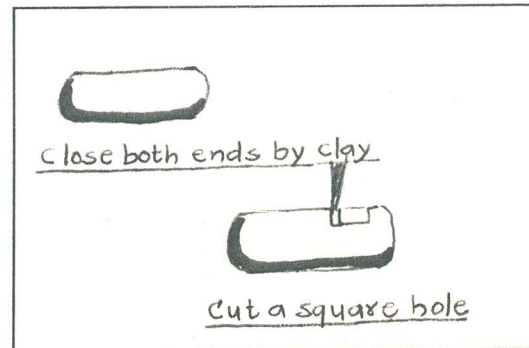
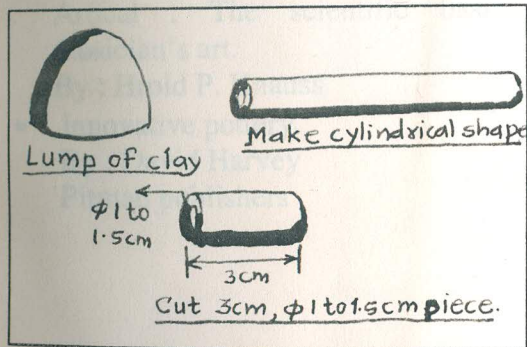
One should never try to make form first and then try to take out sound from that. This method seldom works. After making the complete toy it is dried, finished if required and then baked. Picture shows the interior of a kiln alongwith how it looks like. Once the functional part is ready sky is the limit for a terracotta artist to create new toys and innovative products.



*The tools required.*



*Your whistle will look like this*



## Potter's manual MAKE YOUR OWN WHISTLE

1. Take a lump of clay.
2. Make a **cylindrical hollow shape** of wall thickness **3mm to 6mm**.
3. Carefully cut it to **3cm**.
4. **Close it** from both ends by clay.
5. Let it **dry** for quite sometime. i.e. **couple of hours**.
6. Make a **square sound hole** of **4mm to 6mm** near to one end.
7. Make a **wind pipe** by piercing a tool through the sound hole. Do not worry about from where it will come out.
8. Once you know the position of blowhole, by same tool **create a uniform passage for air**. This is called **windpipe**.
9. Blow the whistle, **feeble sound** will be heard.
10. **Tune the whistle** for good sound by **adjusting the leaf** upwards.
11. Create a **form, shape, texture** you like on this volume by adding clay on it.
12. Let it **dry for a day or two**.
13. **Finish** it if required.
14. **Fire** it in a simple kiln.

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Special project

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